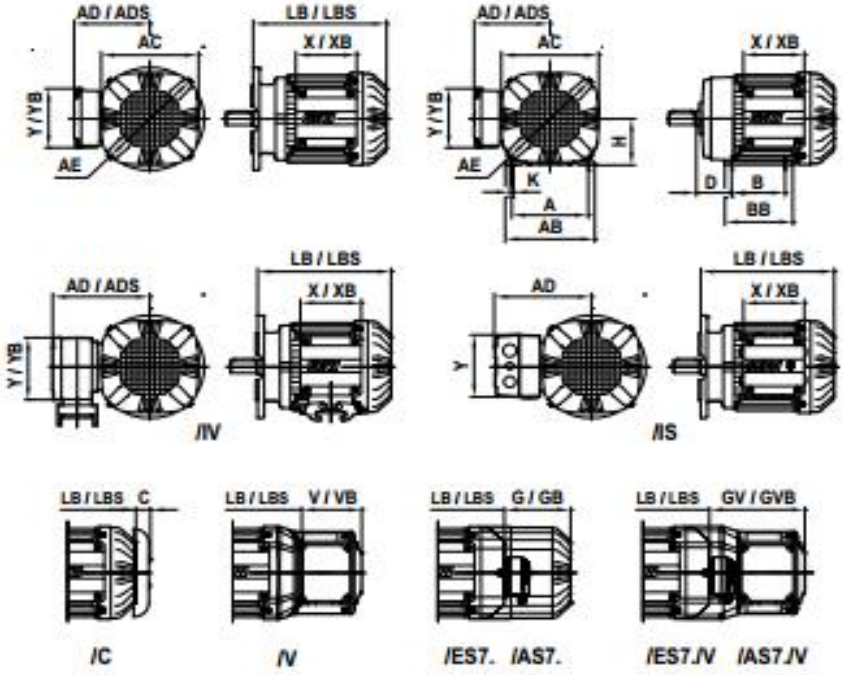
6.1 ANEXO A – HOJAS DE DATOS

1) Moto-reductor SA67 DRS132M4

3.24 D(F)V132M4 ↔ DRS132M4, 7.5 kW, 50 Hz



3.24.1 Technical Data

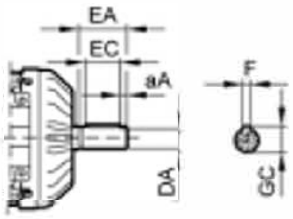
7.5 kW / 50 Hz	DV132M4	DRS132M4	
M_N [Nm]	50.1	49.5	-1.2%
n_N [rpm]	1430	1445	1.0%
M_A/M_N	2.1	2.4	14.3%
M_H/M_N	2	1.9	-5.0%
I_N [A]	15.5	14.4	-7.1%
I_A/I_N	6.2	6.6	6.5%
cos φ	0.85	0.85	0%
η 75% A [%]	89.5	89.1	-0.4%
η 100% A [%]	87.5	87.1	-0.5%
η 75% B [%]	89.5	90	0.6%
η 100% B [%]	87.5	88.5	1.1%
J_{Mot} [10^{-4} kgm²]	280	255	-8.9%
J_{BMot} [10^{-4} kgm²]	330	265	-19.7%
J_{2BMot} [10^{-4} kgm²]	-	-	-
J_{Mot+J2} [10^{-4} kgm²]	780	555	-28.8%
m_{Mot} [kg]	66	60	-9.1%
m_{BMot} [kg]	90	75	-16.7%
m_{2BMot} [kg]	-	-	-
Z_{DBG} [1/h]	-	-	-
Z_{DBGE} [1/h]	1700	2000	17.6%
Z_{DBGE_2} [1/h]	-	-	-
S1 temp. [K]	70	75	7.1%

3.24.2 Dimensioning [mm]

7.5 kW / 50 Hz	DV132M4	DRS132M4	
AC	275	221	–54
AD	230	170	–60
ADS	230	171.5	–58.5
AE[1)]	–	246	–
X	182	112	–70
Y	152	115	–37
XB	182	145	–37
YB	152	115	–37
LB	402	424	+22
LB B9	–	–	–
LB LIA120	–	–	–
LB LIA160	424	440	+16
LB LIA200	412	429	+17
LB LIA250	407	424	+17
LB LIA300	402	419	+17
LB LIA350	396	413	+17
LB L08400	389	406	+17
LB L08450	–	398	–
LB L08550	–	–	–
Delta LBS	112	112	0
LB FF	402	437	+35
IEC D	38	38	0
IEC L	80	80	0
RZ D	22	22	0
H	132	132	0
A	216	216	0
B	178	178	0
D	89	89	0
K	13	12	–1
AB	259	246	–13
BB	218	208	–10
C	37	31	–6
V	112	107	–5
VB	123	106	–17
AD /IS	–	190.5	–
X /IS	–	117	–
Y /IS	–	117	–
AD /IV	232	179	–53
X /IV	191	112	–79
Y /IV	161	115	–46
ADS /IV	232	180.5	–51.5
XB /IV	191	145	–46
YB /IV	161	115	–46
G /E	239	125	–114
GB /E	127	120.5	–6.5
GV /E+/V	339	183.5	–155.5
GVB /E+/V	227	183.5	–43.5

1) The AE dimension can be comapered with to the AC dimension of the DT/DV motor

4 2nd Shaft End /2W – Dimensions



4.1 Dimensioning [mm]

DT/DV	DR	DT/DV						DR					
Size		DA	EA	EC	aA	GC	F	DA	EA	EC	aA	GC	F
71D	71S	11	23	20	1	12.5	4	11	23	16	3.5	12.5	4
80K	71M	11	23	22	4	16	5	11	23	16	3.5	12.5	4
80N	80S	14	30	22	4	16	5	14	30	22	4	16	5
90S	80M	19	40	32	4	21.5	6	14	30	22	4	16	5
90L	90M	19	40	32	4	21.5	6	14	30	22	4	16	5
100M	90L	19	40	32	4	21.5	6	14	30	22	4	16	5
100L	100M	19	40	32	4	21.5	6	14	30	22	4	16	5
112M	100LC	24	50	40	5	27	8	14	30	22	4	16	5
	112M							19	40	32	4	21.5	6
132S	132S	28	60	50	5	31	8	19	40	32	4	21.5	6
132M	132M	38	80	70	5	41	10	19	40	32	4	21.5	6
132ML	132MC	38	80	70	5	41	10	19	40	32	4	21.5	6
	160S							28	60	50	5	31	8
160M	160M	38	80	70	5	41	10	28	60	50	5	31	8
160L	160MC	42	110	70	10	45	12	28	60	50	5	31	8
	180S							38	80	70	5	41	10
180M	180M	48	110	80	10	51.5	14	38	80	70	5	41	10
180L	180L	48	110	80	10	51.5	14	38	80	70	5	41	10
200L	180LC	55	110	90	10	59	16	38	80	70	5	41	10
225S	225S	55	110	90	10	59	16	48	110	100	5	51.5	14
225M	225M	55	110	90	10	59	16	48	110	100	5	51.5	14
250M	225MC	55	110	90	10	59	16	48	110	100	5	51.5	14
280S	-	55	110	90	10	59	16	-	-	-	-	-	-
280M	-	55	110	90	10	59	16	-	-	-	-	-	-
-	315K	-	-	-	-	-	-	70	140	125	7.5	74.5	20
-	315S	-	-	-	-	-	-	70	140	125	7.5	74.5	20
-	315M	-	-	-	-	-	-	70	140	125	7.5	74.5	20
-	315L	-	-	-	-	-	-	70	140	125	7.5	74.5	20

PowerFlex 520-Series AC Drive Advanced Features

Control Performance

- **Variety of motor control options, including:**
  - Volts per hertz (V/Hz)
  - Sensorless Vector Control (SVC)
  - Closed loop velocity vector control (PowerFlex 525 drives only)
- **Variety of Positioning Control, including:**
  - PointStop™ stops motor load in a consistent position without encoder feedback
  - Closed loop feedback with an optional encoder card (PowerFlex 525 drives only)
  - Point-to-point positioning mode (PowerFlex 525 drives only)
- **Integral PID** functionality enhances application flexibility (PowerFlex 523 drives have one PID loop, PowerFlex 525 drives have two PID loops)

I/O Wiring

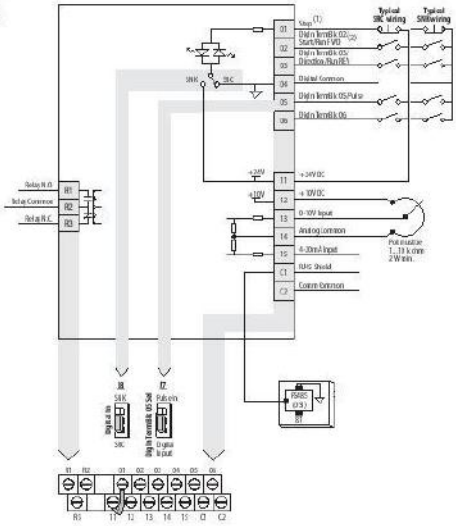
PowerFlex 523

- **Two (2) Analog Inputs** (two unipolar) are independently isolated from the rest of the drive I/O.
- **Five (5) Digital Inputs** (four programmable) provide application versatility.
- **One (1) Relay Output** (form C) can be used to indicate various drive, motor or logic conditions.

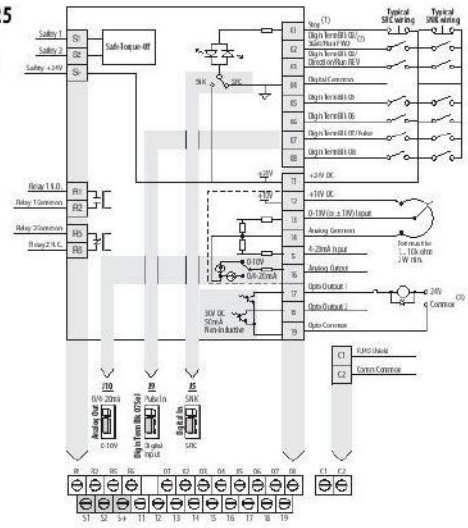
PowerFlex 525

- **Two (2) Analog Inputs** (one unipolar and one bipolar) are independently isolated from the rest of the drive I/O. These inputs can be toggled via a digital input.
- **Seven (7) Digital Inputs** (six programmable) provide application versatility.
- **One (1) Analog Output** is jumper selectable between either 0-10V or 0-20 mA. This scalable, 10-bit output is suitable for metering or as a speed reference for another drive.
- **Two (2) Opto Outputs and two (2) Relay Outputs** (one form A and one form B) can be used to indicate various drive, motor or logic conditions.

PowerFlex 523 Control I/O Wiring Block Diagram



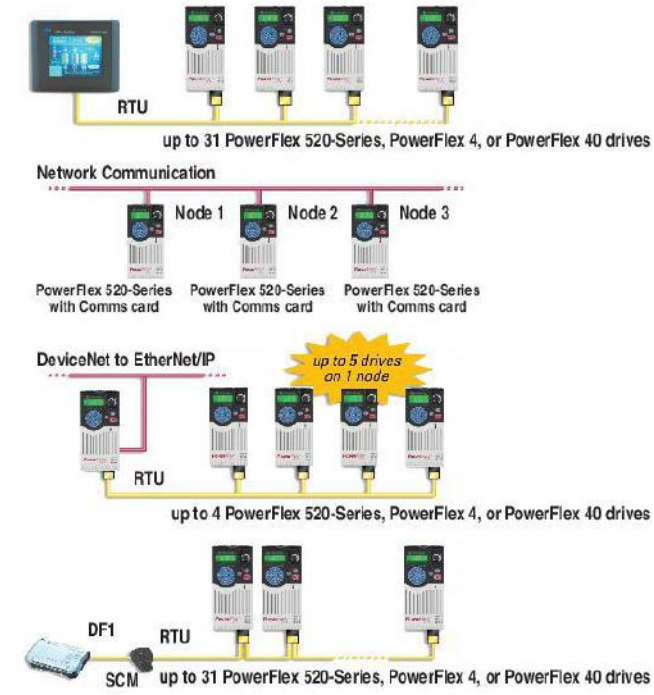
PowerFlex 525 Control I/O Wiring Block Diagram



Communications and Software

Versatile Programming and Network Solutions

- PowerFlex 520-Series drives are compatible with any device that acts as a **RTU Master** and supports standard 03 and 06 RTU commands.
- A network can be configured using PowerFlex 520-Series drives for **high performance and flexible configuration** capabilities.
  - Embedded port for EtherNet/IP (PowerFlex 525 drives only)
  - EtherNet/IP dual-port option card
  - DeviceNet option card
  - PROFIBUS DP option card
- A **multi-drive solution** can be reached using a single PowerFlex 520-Series drive, with the ability for up to five (5) drives to reside on one (1) node.
- **Integral RS485** communications enable the drives to be used in a multi-drop network configuration. A serial converter module (SCM) provides connectivity to any controller with a DF1 port. The SCM can be eliminated if the controller acts as a RTU Master.



PC Programming Software

Connected Components Workbench™

- Supports plug-and-play connectivity through a standard USB connection.
- AppView™ tool provides parameter groups for several of the most common applications.
- Create and save custom parameter groups using the CustomView™ tool.
- Supports PowerFlex drives, Micro800™ controllers and PanelView™ component graphic terminals.

Studio 5000™ Logix Designer

- Add-on profiles (AOPs) for PowerFlex 520-seriers AC drives provide seamless integration into the Logix environment.
- Configuration files from Studio 5000 Logix Designer(1) can be transferred directly to the PowerFlex 520-Series drive over EtherNet/IP.
- Automatic Device Configuration (ADC) uploads configuration parameters to a replaced drive, minimizing the need for a manual reconfiguration.

(1) The Logix Designer application is the rebranding of RSLogix 5000 software. You can also use RSLogix 5000 version 17 or greater.

Dimensions and Weights

Frame/Rating Cross-Reference

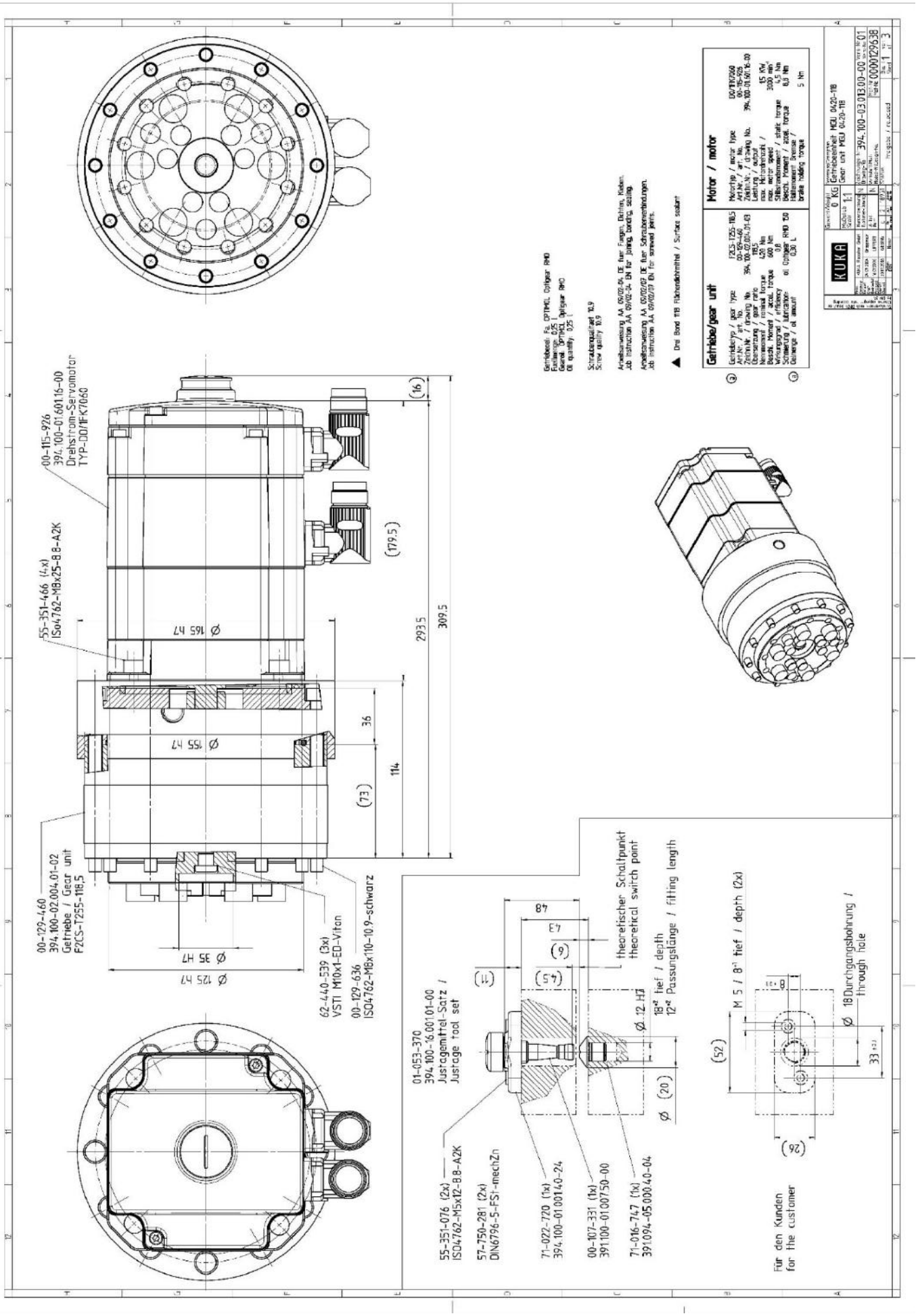
Catalog Number Description

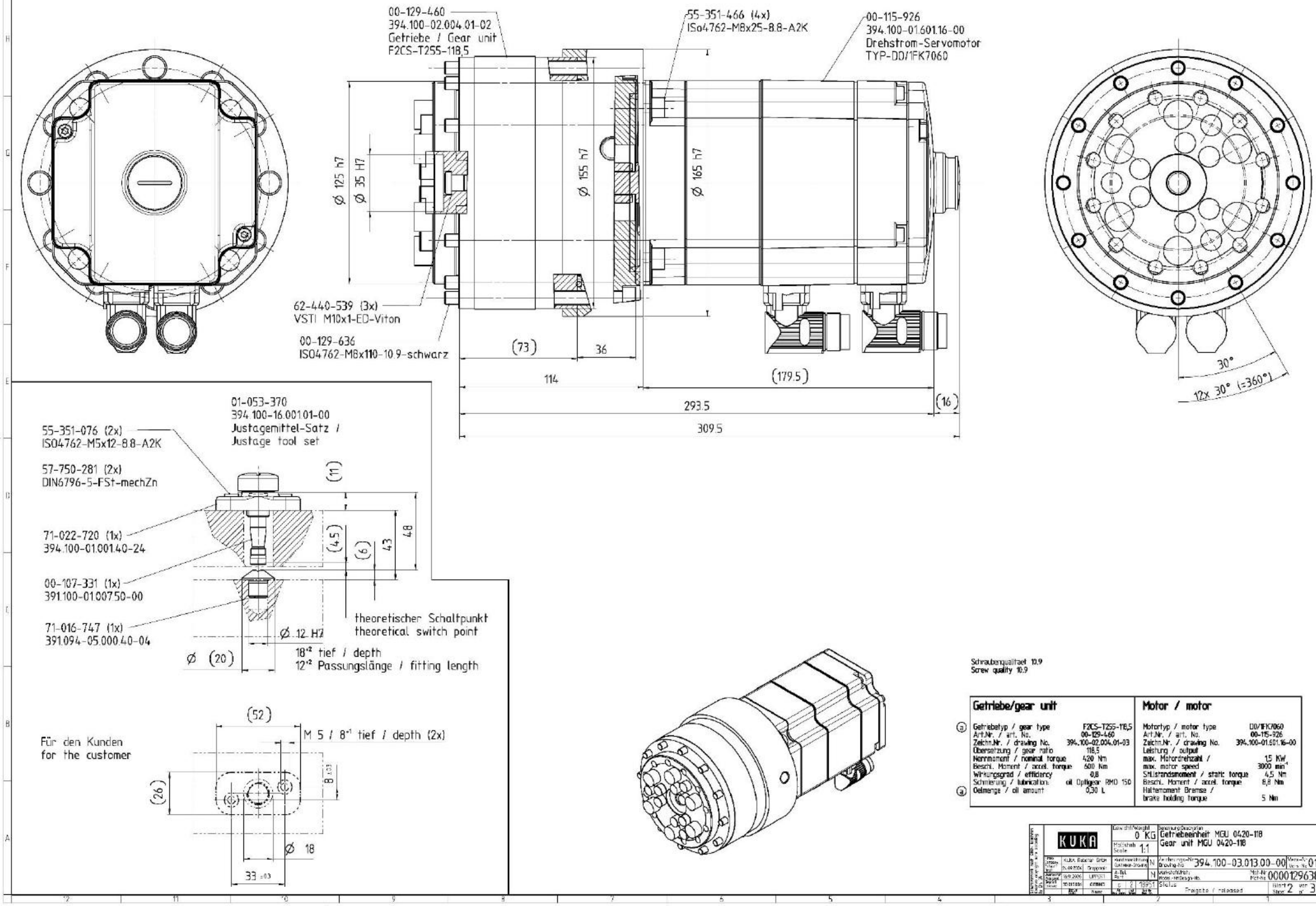
25B	-	V	2P5	N	1	0	4
Drive		Voltage Rating	Rating	Enclosure	HIM	Emission Class	Version

PowerFlex 520-Series Drive Ratings

PowerFlex 523	PowerFlex 525	Output Ratings					Input		
		Normal Duty		Heavy Duty		Output			
Catalog No.	Catalog No.	HP	kW	HP	kW	Current (A)	Voltage Range	Total Watts Loss	Frame Size
100...120V AC (-15%, +10%) – 1-Phase Input, 0...230V 3-Phase Output									
25A-V1P6N104	–	0.25	0.2	0.25	0.2	1.6	85...132	20.0	A
25A-V2P5N104	25B-V2P5N104	0.5	0.4	0.5	0.4	2.5	85...132	27.0	A
25A-V4P8N104	25B-V4P8N104	1.0	0.75	1.0	0.75	4.8	85...132	53.0	B
25A-V6P0N104	25B-V6P0N104	1.5	1.1	1.5	1.1	6.0	85...132	67.0	B
200...240V AC (-15%, +10%) – 1-Phase Input, 0...230V 3-Phase Output									
25A-A1P6N104	–	0.25	0.2	0.25	0.2	1.6	85...132	20.0	A
25A-A2P5N104	25B-A2P5N104	0.5	0.4	0.5	0.4	2.5	170...264	29.0	A
25A-A4P8N104	25B-A4P8N104	1.0	0.75	1.0	0.75	4.8	170...264	50.0	A
25A-A8P0N104	25B-A8P0N104	2.0	1.5	2.0	1.5	8.0	170...264	81.0	B
25A-A011N104	25B-A011N104	3.0	2.2	3.0	2.2	11.0	170...264	111.0	B
200...240V AC (-15%, +10%) – 1-Phase Input with EMC Filter, 0...230V 3-Phase Output									
25A-A1P6N114	–	0.25	0.2	0.25	0.2	1.6	85...132	20.0	A
25A-A2P5N114	25B-A2P5N114	0.5	0.4	0.5	0.4	2.5	170...264	29.0	A
25A-A4P8N114	25B-A4P8N114	1.0	0.75	1.0	0.75	4.8	170...264	53.0	A
25A-A8P0N114	25B-A8P0N114	2.0	1.5	2.0	1.5	8.0	170...264	84.0	B
25A-A011N114	25B-A011N114	3.0	2.2	3.0	2.2	11.0	170...264	116.0	B
200...240V AC (-15%, +10%) – 3-Phase Input, 0...230V 3-Phase Output									
25A-B1P6N104	–	0.25	0.2	0.25	0.2	1.6	85...132	20.0	A
25A-B2P5N104	25B-B2P5N104	0.5	0.4	0.5	0.4	2.5	170...264	29.0	A
25A-B5P0N104	25B-B5P0N104	1.0	0.75	1.0	0.75	5.0	170...264	50.0	A
25A-B8P0N104	25B-B8P0N104	2.0	1.5	2.0	1.5	8.0	170...264	79.0	A
25A-B011N104	25B-B011N104	3.0	2.2	3.0	2.2	11.0	170...264	107.0	A
25A-B017N104	25B-B017N104	5.0	4.0	5.0	4.0	17.5	170...264	148.0	B
25A-B024N104	25B-B024N104	7.5	5.5	7.5	5.5	24.0	170...264	259.0	C
25A-B032N104	25B-B032N104	10.0	7.5	10.0	7.5	32.2	170...264	323.0	D
25A-B048N104	25B-B048N104	15.0	11.0	10.0	7.5	48.3	170...264	584.0	E
25A-B062N104	25B-B062N104	20.0	15.0	15.0	11.0	62.1	170...264	708.0	E
380...480V AC (-15%, +10%) – 3-Phase Input, 0...460V 3-Phase Output[1]									
25A-D1P4N104	25B-D1P4N104	0.5	0.4	0.5	0.4	1.4	323...528	27.0	A
25A-D2P3N104	25B-D2P3N104	1.0	0.75	1.0	0.75	2.3	323...528	37.0	A
25A-D4P0N104	25B-D4P0N104	2.0	1.5	2.0	1.5	4.0	323...528	80.0	A
25A-D6P0N104	25B-D6P0N104	3.0	2.2	3.0	2.2	6.0	323...528	86.0	A
25A-D010N104	25B-D010N104	5.0	4.0	5.0	4.0	10.5	323...528	129.0	B
25A-D013N104	25B-D013N104	7.5	5.5	7.5	5.5	13.0	323...528	170.0	C
25A-D017N104	25B-D017N104	10.0	7.5	10.0	7.5	17.0	323...528	221.0	C
25A-D024N104	25B-D024N104	15.0	11.0	15.0	11.0	24.0	323...528	303.0	D
25A-D030N104	25B-D030N104	20.0	15.0	15.0	11.0	30.0	323...528	387.0	D

3) Servo-reductor MGU 0420 - 118





Schraubenqualitaet 10.9
Screw quality 10.9

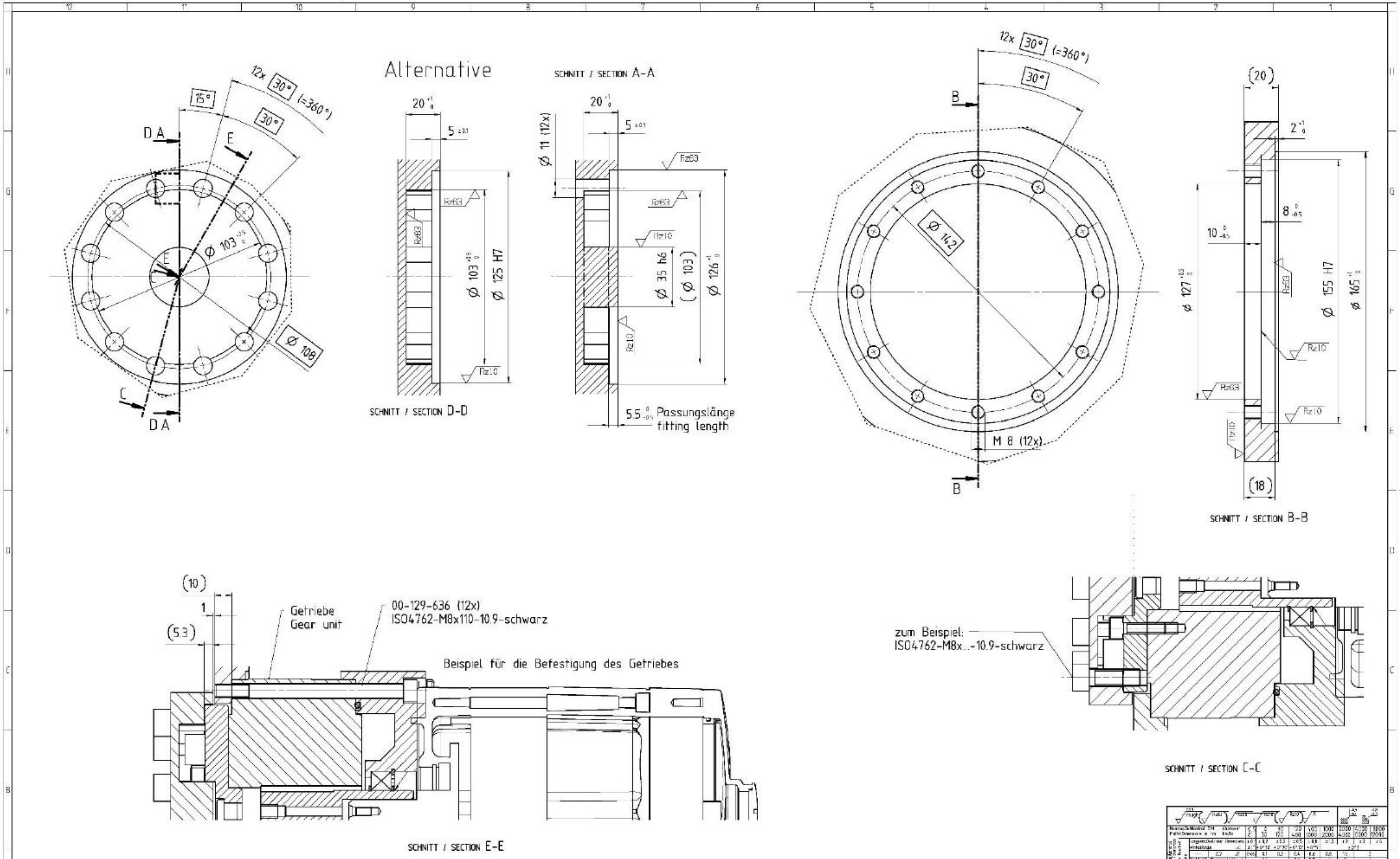
Getriebe/gear unit		Motor / motor	
ⓐ Getriebetyp / gear type	F2CS-T255-118,5	Motortyp / motor type	DD/1FK7060
Art.Nr. / art. No.	00-129-460	Art.Nr. / art. No.	00-115-926
Zeichn.Nr. / drawing No.	394.100-02.004.01-03	Zeichn.Nr. / drawing No.	394.100-01.601.16-00
Übersetzung / gear ratio	118,5	Leistung / output	1,5 KW
Nennmoment / nominal torque	420 Nm	max. Motordrehzahl / max. motor speed	3000 min⁻¹
Beschl. Moment / accel. torque	600 Nm	Stillstandsmoment / static torque	4,5 Nm
Wirkungsgrad / efficiency	0,8	Beschl. Moment / accel. torque	8,8 Nm
Schmierung / lubrication	oil Optigear RMO 150	Haltemoment Bremse / brake holding torque	5 Nm
ⓐ Oelmenge / oil amount	0,30 L		

KUKA

Gewicht/Weight: 0 KG
Maßstab/Scale: 1:1

Benennung/Description: Getriebeeinheit MGU 0420-118
Gear unit MGU 0420-118

Zeichnungs-Nr./Drawing-No. 394.100-03.013.00-00 Mengen-Nr. 01
Mat-Nr. 0000129638
Status: Freigabe / released
Blatt/Sheet 2 von/of 3


Alternative
12x 30° (=360°)
30°
15°
D A
E
C
Ø 103 +0.5 0
Ø 108
SCHNITT / SECTION D-D
20 +1 0
5 ±0.1
Ø 103 +0.5 0
Ø 125 H7
Rz63
Rz10
SCHNITT / SECTION A-A
Ø 11 (12x)
Ø 35 h6
(Ø 103)
Ø 126 +1 0
5.5 0 -0.5 Passungslänge
fitting length
Ø 142
M 8 (12x)
B
(20)
2 +1 0
8 0 -0.5
10 0 -0.5
Ø 127 +0.5 0
Ø 155 H7
Ø 165 +1 0
(18)
SCHNITT / SECTION B-B
(10)
1
(5.3)
Getriebe
Gear unit
00-129-636 (12x)
ISO4762-M8x110-10.9-schwarz
Beispiel für die Befestigung des Getriebes
SCHNITT / SECTION E-E
zum Beispiel:
ISO4762-M8x...-10.9-schwarz
SCHNITT / SECTION C-C
KUKA
0 KG
Maßstab Scale 1:1
Getriebeeinheit MGU 0420-118
Gear unit MGU 0420-118
394.100-03.013.00-00
01
0000129638
Freigabe / released
Blatt 3 von 3

4) Sensor Ultrasónico MB 7360

General Characteristics

- Low cost ultrasonic rangefinder
- Detection out to 5-meters or 10-meters
- Resolution of 1-mm
- Distance sensor from 30-cm to 5-meters or 50-cm to 10-meters based on model
- Excellent [2] Mean Time Between Failure (MTBF)
- Triggered operation yields real-time range data
- Free run operation with superior noise rejection [3]
- Operating temperature range from -40°C to +65°C
- Operating voltage from 2.7V to 5.5V
- Nominal current draw of 2.3mA at 3.3V, and 3.1mA at 5V
- IP67 Rated

Range Outputs

- Pulse width, 1uS/mm resolution
- Analog Voltage, 5-mm resolution (5-meter sensors)
- Analog Voltage, 10-mm resolution (10-meter sensors)
- Serial, 1-mm resolution
- Available in RS232 (MB7360 series) or TTL (MB7380 series)

HRXL-MaxSonar-WR Pin Out

Pin 1- Temperature Sensor Connection: Leave this pin unconnected if an external temperature sensor is not used. For best accuracy, this pin is optionally connected to the HR-MaxTemp temperature sensor. Some additional information for the temperature sensor can be found on page 7 of the datasheet.

Pin 2- Pulse Width Output: This pin outputs a pulse width representation of the distance with a scale factor of 1uS per mm. The pulse width output is sent with a value within 0.5% of the serial output.

Pin 3- Analog Voltage Output: This pin outputs a single ended analog voltage scaled representation of the distance. This output is referenced to the sensor ground and Vcc. After the ~50mS power up initialization, the voltage on this pin is set to a low voltage. Once the sensor has completed a range reading the voltage on this pin is set to the voltage corresponding to the latest measured distance.

The 5-meter sensors (MB7360, MB7364, MB7369, MB7380, MB7384, and MB7389) use a scale factor of (Vcc/5120) per 1-mm. The distance is output with a 5-mm resolution. The analog voltage output is typically within ±5-mm of the serial output.

The 10-meter sensors (MB7363, MB7366, MB7383, and MB7386) use a scale factor of (Vcc/10240) per 1-mm. The distance is output with a 10-mm resolution. The analog voltage output is typically within ±10-mm of the serial output.

Using a 10-bit analog to digital converter with the 5-meter sensors, one can read the analog voltage counts (i.e. 0 to 1023) directly and just multiply the number of counts in the value by 5 to yield the range in mm. For example, a converted value of 60 corresponds to 300-mm (where 60 x 5 = 300), and 1000 counts corresponds to 5,000-mm (where 1000 x 5 = 5,000-mm).

Using a 10-bit analog to digital converter with the 10-meter sensors, one can read the analog voltage counts (i.e. 0 to 1023) directly and just multiply the number of counts in the value by 10 to yield the range in mm. For example, 30 counts corresponds to 300-mm (where 30 x 10 = 300), and 1000 counts corresponds to 10,000-mm (where 1000 x 10 = 10,000-mm).

Pin 4- Ranging Start/Stop: This pin is internally pulled high. If this pin is left unconnected or held high, the sensor will continually measure and output the range data. If held low, the HRXL-MaxSonar-WR will stop ranging. Bring high for 20uS or longer to command a range reading.

Filtered Range Data: When pin 4 is left high on the sensors, the sensors will continue to range. The data that is output includes a filter for increased accuracy. The sensors will output the range based on recent range information. The filter does not affect the speed at which data is made available to the user but instead allows for more consistent range information to be presented. For sensor specific timing and filter information refer to pages 8 and 9.

Real-time Range Data: When pin 4 is low and then brought high, the sensor will operate in real time and the first reading output will be the range measured from this first commanded range reading. When the sensor tracks that the RX pin is low after each range reading, and then the RX pin is brought high, unfiltered real time range information can be obtained. For timing information please refer to pages 8 and 9.

Pin 5-Serial Output: The MB736X sensors have an RS232 data format (with 0V to Vcc levels) and the MB738X sensors have a TTL outputs. The output is an ASCII capital "R", followed by four ASCII character digits representing the range in millimeters, followed by a carriage return (ASCII 13). The maximum range reported is 4999 mm (5-meter models) or 9998 mm (10-meter models). A range value of 5000 or 9999 corresponds to no target being detected in the field of view.

The serial data format is 9600 baud, 8 data bits, no parity, with one stop bit (9600-8-N-1).

Because the data is presented in a binary data format, the serial output is most accurate .

V+ Pin 6 - Positive Power, Vcc: The sensor operates on voltages from 2.7V - 5.5V DC. For best operation, the sensor requires that the DC power be free from electrical noise. (For installations with known dirty electrical power, a 100uF capacitor placed at the sensor pins between V+ and GND will typically correct the electrical noise.)

GND Pin 7 – Sensor ground pin: DC return, and circuit common ground.

Sensor minimum distance - No sensor dead zone

(MB7360, MB7369, MB7380, and MB7389)

The 5 meter sensors have a minimum reported distance of 30-cm (11.8 inches). However, the HRXL-MaxSonar-WR will report targets up to the sensor face (for the WR sensors)[1] and to within 1-mm of the front sensor face (for the WRC sensors)[1]. For the 5 meter HRXL-MaxSonar-WR sensors, targets closer than 300-mm will typically range as 300-mm.

Notes: [1] refers to section that compares WR to Alternative Packages on page 4

Sensor minimum distance - No sensor dead zone

(MB7363, MB7366, MB7383, and MB7386)

The 10 meter sensors have a minimum reported distance of 50-cm (19.7 inches). However, the HRXL-MaxSonar-WRL will report targets up to the sensor face. For the 10 meter HRXL-MaxSonar-WRL sensors, targets closer than 500-mm will typically range as 500-mm.

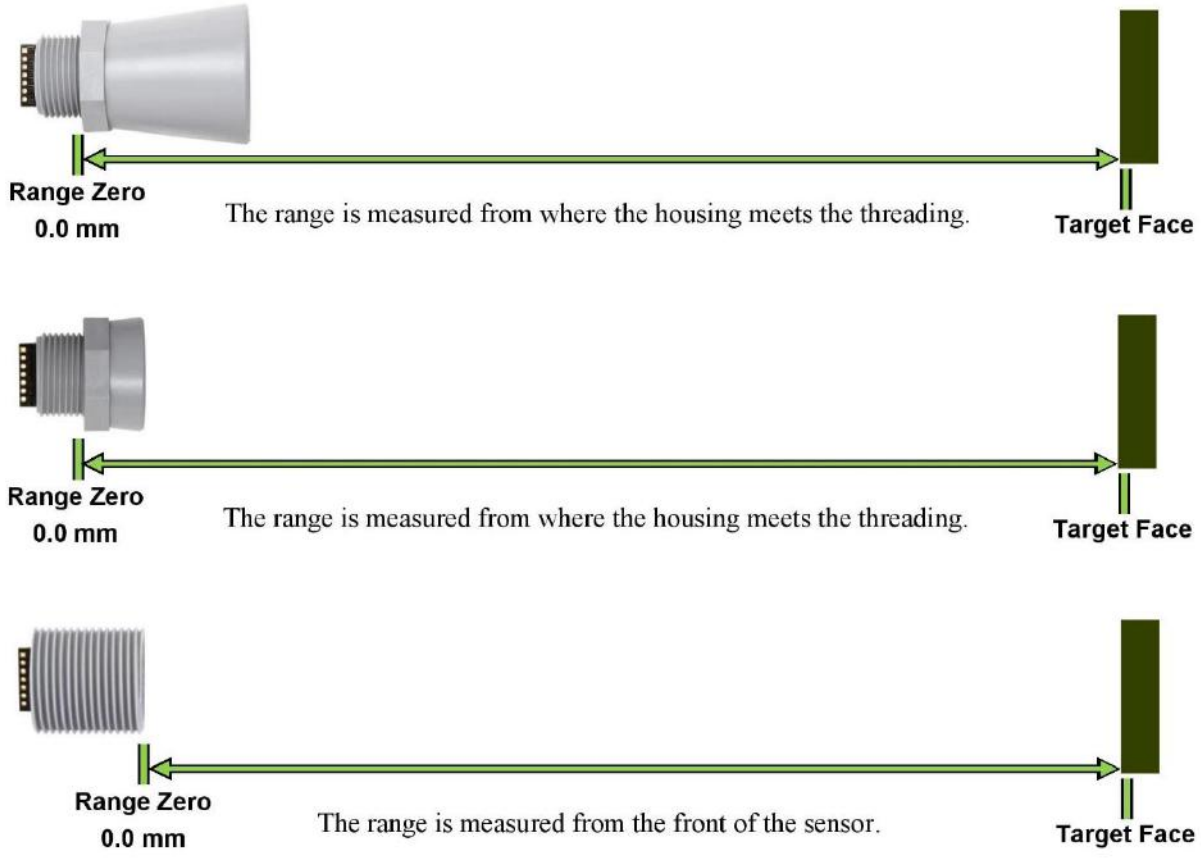
Sensor operation from 30-cm to 50-cm

Because of acoustic effects in the near field, objects between 30-cm and 50-cm may experience acoustic phase cancellation of the returning wave, resulting in inaccuracies of up to 5-mm. These effects become less prevalent as the target distance increases, and have not been observed past 50-cm. For this reason, users that require the highest accuracy are encouraged to mount the HRXL-MaxSonar-WR farther than 50-cm away from objects.

Range "0" location

The HRXL-MaxSonar-WR reports the range to distant targets from where the threading and nut meet on the sensor housing as shown in the diagram below.

In general, the HRXL-MaxSonar-WR will report the range to the leading edge of the closest detectable object. Target detection has been characterized in the sensor beam patterns.



MB7360-MB7380 HRXL-MaxSonar®-WR™ Beam Pattern and Uses

The HRXL-MaxSonar-WR product line has a narrow sensor beam and provides reliable long range detection zones.

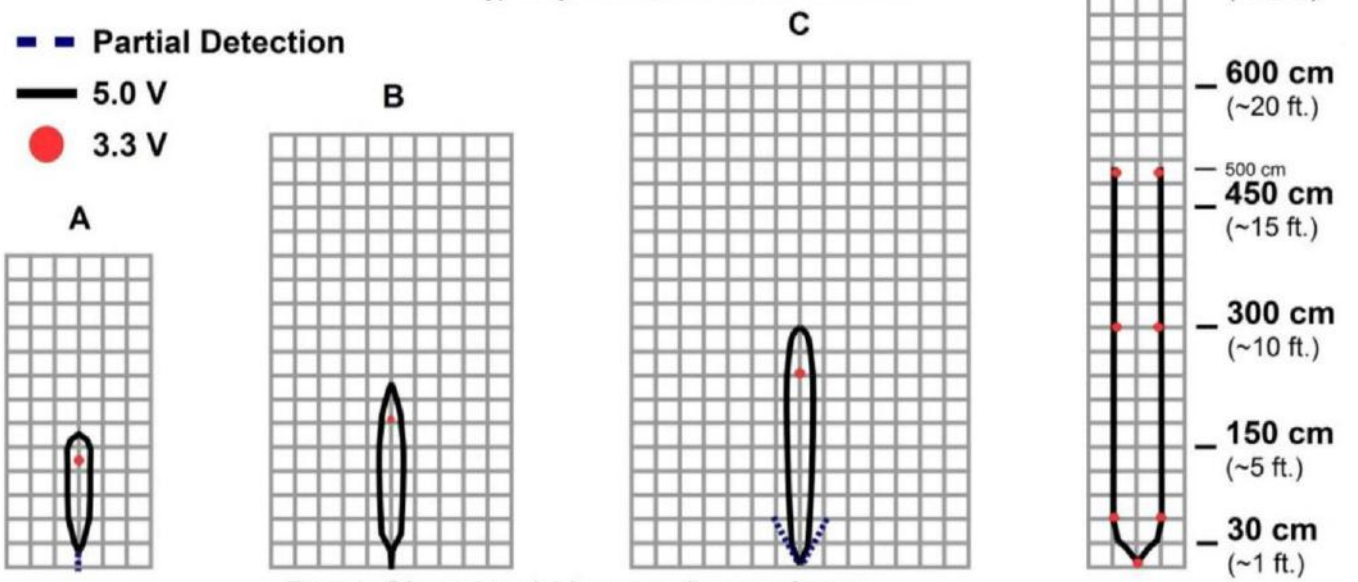
MB7360-MB7380

HRXL-MaxSonar® -WR/WRT™ Beam Pattern

Sample results for measured beam pattern are shown on a 30-cm grid. The detection pattern is shown for dowels of varying diameters that are placed in front of the sensor.

A 6.1-mm (0.25-inch) diameter dowel
B 2.54-cm (1-inch) diameter dowel
C 8.89-cm (3.5-inch) diameter dowel
D 11-inch wide board moved left to right with the board parallel to the front sensor face. This shows the sensor's range capability.

Note: For people detection the pattern typically falls between charts A and B.



Beam Characteristics are Approximate

Beam Pattern drawn to a 1:95 scale for easy comparison to our other products.

MB7360-MB7380
Features and Benefits

- Factory calibrated beam width
- Low operating voltages from 2.7V to 5.5V
- All range outputs are active simultaneously
- High acoustic sensitivity

MB7360-MB7380
Applications and Uses

- Autonomous Navigation
- Robot Ranging Sensor
- Bin Level Measurement
- Tank Level Measurement

5) Sensor Inductivo PR12-2DN

PR Series

●DC 3-wire type

Model	PR08-1.5DN PR08-1.5DP PR08-1.5DN2 PR08-1.5DP2 PRL08-1.5DN PRL08-1.5DP PRL08-1.5DN2 PRL08-1.5DP2	PR08-2DN PR08-2DP PR08-2DN2 PR08-2DP2 PRL08-2DN PRL08-2DP PRL08-2DN2 PRL08-2DP2	PR12-2DN PR12-2DP PR12-2DN2 PR12-2DP2 PRS12-2DN PRS12-2DP PRS12-2DN2	PR12-4DN PR12-4DP PR12-4DN2 PR12-4DP2 PRS12-4DN PRS12-4DP PRS12-4DN2 PRL12-4DN PRL12-4DP	PR18-5DN PR18-5DP PR18-5DN2 PR18-5DP2 PRL18-5DN PRL18-5DP PRL18-5DN2 PRL18-5DP2	PR18-8DN PR18-8DP PR18-8DN2 PR18-8DP2 PRL18-8DN PRL18-8DP PRL18-8DN2 PRL18-8DP2	PR30-10DN PR30-10DP PR30-10DN2 PR30-10DP2 PRL30-10DN PRL30-10DP PRL30-10DN2 PRL30-10DP2	PR30-15DN PR30-15DP PR30-15DN2 PR30-15DP2 PRL30-15DN PRL30-15DP PRL30-15DN2 PRL30-15DP2
Sensing distance	1.5mm ±10%	2mm ±10%	2mm ±10%	4mm ±10%	5mm ±10%	8mm ±10%	10mm ±10%	15mm ±10%
Hysteresis	Max. 10% of sensing distance							
Standard sensing target	8×8×1mm(Iron)		12×12×1mm(Iron)		18×18×1mm (Iron)	25×25×1mm (Iron)	30×30×1mm (Iron)	45×45×1mm (Iron)
Setting distance	0 ~ 1.05mm	0 ~ 1.4mm	0 ~ 1.4mm	0 ~ 2.8mm	0 ~ 3.5mm	0 ~ 5.6mm	0 ~ 7mm	0 ~ 10.5mm
Power supply (Operation voltage)	12-24VDC (10-30VDC)							
Leakage current	Max. 10mA							
Response frequency(※1)	1.5kHz	1kHz	1.5kHz	500Hz		350Hz	400Hz	200Hz
Residual voltage	Max. 1.5V							
Affection by Temp.	±10% Max. for sensing distance at +20℃ within temperature range of -25 ~ +70℃, PR08 Series:Max. ±20%							
Control output	200mA							
Insulation resistance	Min. 50MΩ (at 500VDC mega)							
Dielectric strength	1500VAC 50/60Hz for 1minute							
Vibration	1mm amplitude at frequency of 10 ~ 55Hz in each of X, Y, Z directions for 2 hours							
Shock	500m/s² (50G) in X, Y, Z direction for 3 times							
Indicator	Operation indicator(Red LED)							
Ambient temperature	-25 ~ +70℃ (at non-freezing status)							
Storage temperature	-30 ~ +80℃ (at non-freezing status)							
Ambient humidity	35 ~ 95%RH							
Protection circuit	Surge, Reverse power polarity, Overcurrent protection circuit							
Protection	IP67 (IEC standard)							
Cable spec.	φ3.5×3P, 2m		φ4×3P, 2m		φ5×3P, 2m			
Approval	CE							
Unit weight	Approx. 36g	Approx. 36g	PR:Approx. 70g PRS:Approx. 68g	PR:Approx. 70g PRS:Approx. 68g	PR:Approx. 119g PRL:Approx. 150g	PR:Approx. 118g PRL:Approx. 150g	PR:Approx. 184g PRL:Approx. 222g	PR:Approx. 181g PRL:Approx. 227g

※(•1) The response frequency is the average value. The standard sensing target is used and the width is set as 2 times of the standard sensing target, 1/2 of the sensing distance for the distance.

●AC 2-wire type

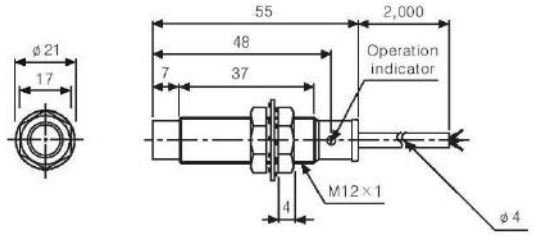
Model	PR12-2AO PR12-2AC	PR12-4AO PR12-4AC	PR18-5AO PR18-5AC PRL18-5AO PRL18-5AC	PR18-8AO PR18-8AC PRL18-8AO PRL18-8AC	PR30-10AO PR30-10AC PRL30-10AO PRL30-10AC	PR30-15AO PR30-15AC PRL30-15AO PRL30-15AC
Sensing distance	2mm ±10%	4mm ±10%	5mm ±10%	8mm ±10%	10mm ±10%	15mm ±10%
Hysteresis	Max. 10% of sensing distance					
Standard sensing target	12×12×1mm(Iron)		18×18×1mm(Iron)	25×25×1mm(Iron)	30×30×1mm(Iron)	45×45×1mm(Iron)
Setting distance	0 ~ 1.4mm	0 ~ 2.8mm	0 ~ 3.5mm	0 ~ 5.6mm	0 ~ 7mm	0 ~ 10.5mm
Power supply (Operation voltage)	100-240VAC (85-264VAC)					
Leakage current	Max. 2.5mA					
Response frequency(※1)	20Hz					
Residual voltage	Max. 10V					
Affection by Temp.	±10% Max. for sensing distance at +20℃ within temperature range of -25 ~ +70℃					
Control output	5 ~ 150mA		5 ~ 200mA			
Insulation resistance	Min. 50MΩ (at 500VDC mega)					
Dielectric strength	2500VAC 50/60Hz for 1minute					
Vibration	1mm amplitude at frequency of 10 ~ 55Hz in each of X, Y, Z directions for 2 hours					
Shock	500m/s² (50G) in X, Y, Z direction for 3 times					
Indicator	Operation indicator(Red LED)					
Ambient temperature	-25 ~ +70℃ (at non-freezing status)					
Storage temperature	-30 ~ +80℃ (at non-freezing status)					
Ambient humidity	35 ~ 95%RH					
Protection circuit	Surge protection circuit					
Protection	IP67 (IEC standard)					
Cable spec.	φ4×2P, 2m		φ5×2P, 2m			
Approval	CE					
Unit weight	Approx. 66g	Approx. 66g	PR : Appox. 130g PRL : Appox. 150g	PR : Appox. 130g PRL : Appox. 150g	PR : Appox. 185g PRL : Appox. 224g	PR : Appox. 117g PRL : Appox. 222g

※(•1) The response frequency is the average value. The standard sensing target is used and the width is set as 2 times of the standard sensing target, 1/2 of the sensing distance for the distance.

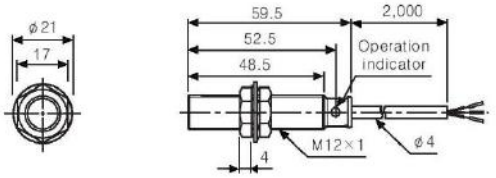
▣Dimensions

(Unit:mm)

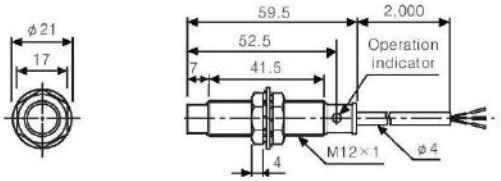
●PRL12-4D□



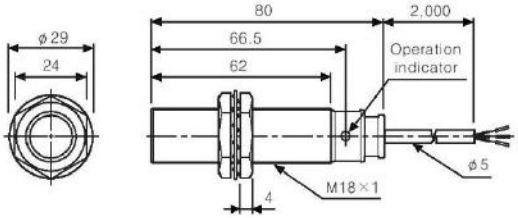
●PR12-2A□



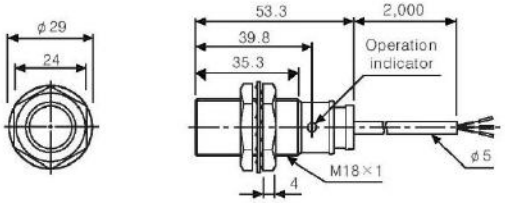
●PR12-4A□



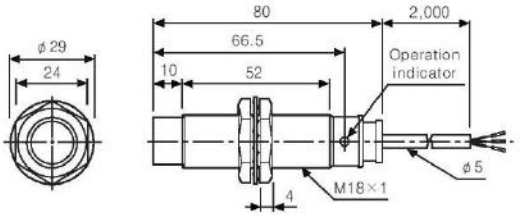
●PRL18-5D□ ●PRL18-5A□



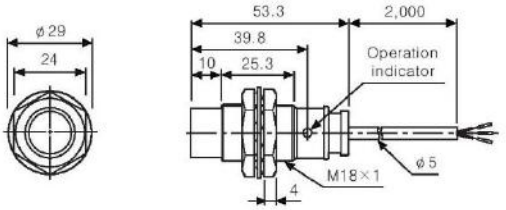
●PR18-5A□



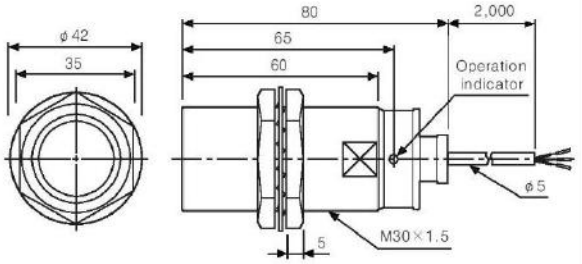
●PRL18-8D□ ●PRL18-8A□



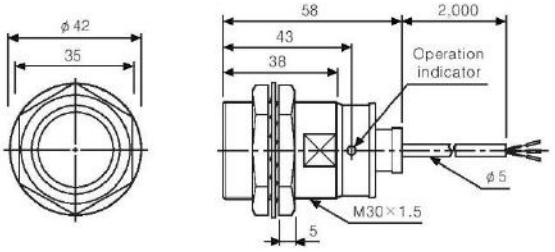
●PR18-8A□



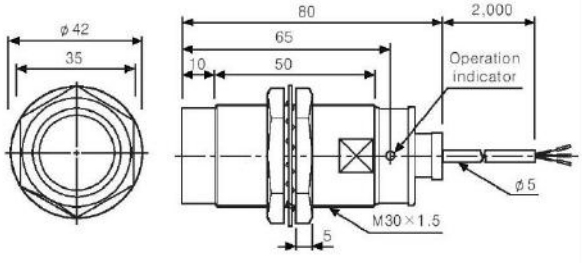
●PRL30-10D□ ●PRL30-10A□



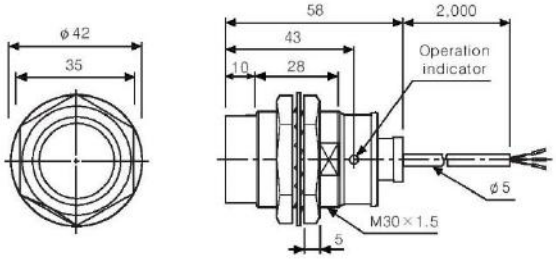
●PR30-10A□



●PRL30-15D□ ●PRL30-15A□

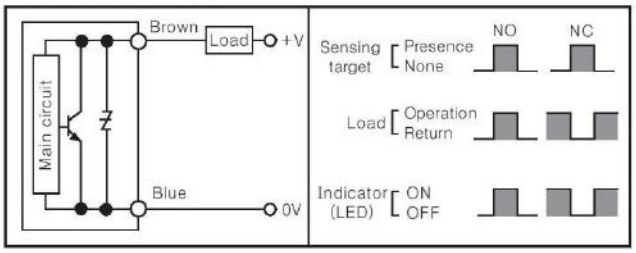


●PR30-15A□

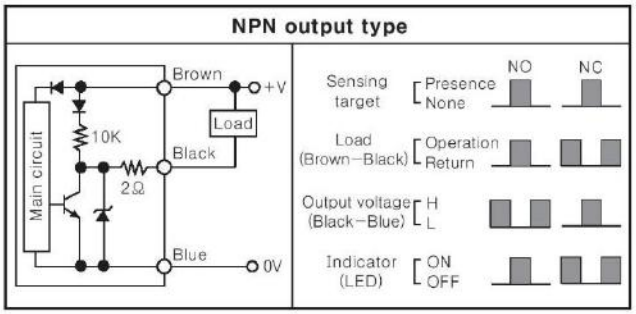


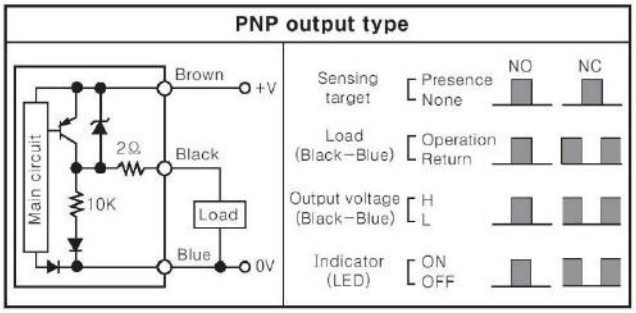
▣Control output diagram

◎DC 2-wire type

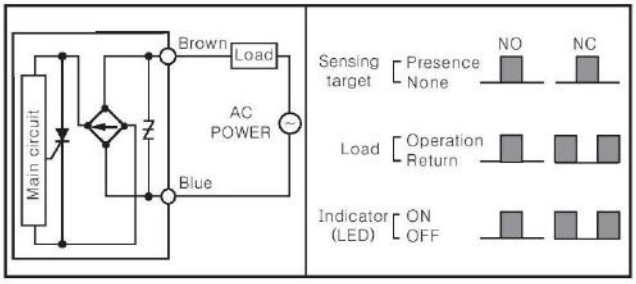


◎DC 3-wire type



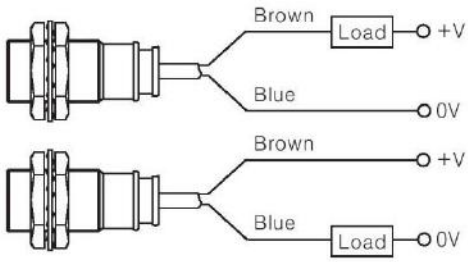


◎AC 2-wire type



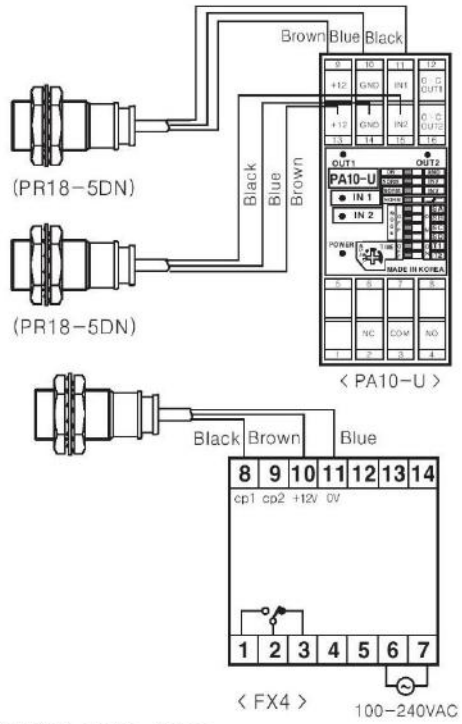
▣Connections

◎DC 2-wire type

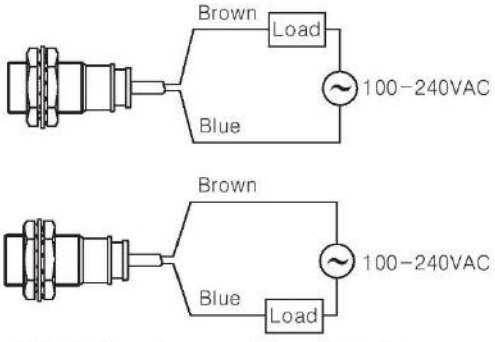


※The load can be connected to either wire.

◎DC 3-wire type



◎AC 2-wire type



※The load can be connected to either wire.

6) Interruptor de acción rápida Z-15GQ22-B7-K

OMRON

GENERAL PURPOSE

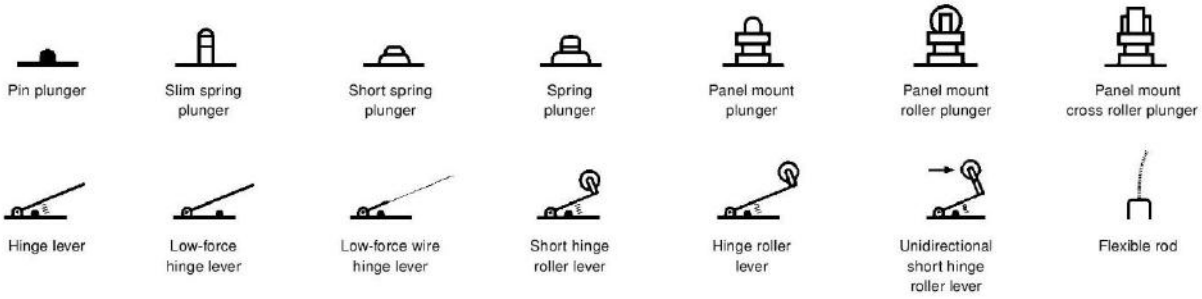
Basic Switch

Z

General Purpose Basic Switch

- High precision basic switch in a variety of styles
- Wide margins of operating conditions increase the operating speed range
- Available in general purpose and drip-proof types

Ordering Information



GENERAL PURPOSE TYPE

Standard

Actuator	Operating Characteristics	Rated Current	Part Number Solder Terminal	Part Number Screw Terminal
Pin plunger		15 A	**Z-15G**	**Z-15G-B**
Slim spring plunger		15 A	**Z-15GS**	**Z-15GS-B**
Short spring plunger	Low OP	15 A	**Z-15GD**	**Z-15GD-B**
Panel mount plunger	Middle OP	15 A	**Z-15GQ**	**Z-15GQ-B**
Panel mount roller plunger		15 A	**Z-15GQ22**	**Z-15GQ22-B**
Panel mount cross roller plunger		15 A	**Z-15GQ21**	**Z-15GQ21-B**
Hinge lever	Low OF	15 A	**Z-15GW**	**Z-15GW-B**
Low-force hinge lever		15 A	**Z-15GW4**	**Z-15GW4-B**
Short hinge roller lever		15 A	**Z-15GW22**	**Z-15GW22-B**
Hinge roller lever	Parallel	15 A	**Z-15GW2**	**Z-15GW2-B**
Unidirectional short hinge roller lever	Low OF	15 A	**Z-15GW2277**	**Z-15GW2277-B**

GENERAL PURPOSE TYPE

High-sensitivity

Actuator	Operating Characteristics	Rated Current	Part Number	
			Solder Terminal	Screw Terminal
Pin plunger		15 A	—	**Z-15H-B**
Low-force hinge lever		15 A	—	**Z-15HW24-B**
Low-force, wire hinge lever	Low OF	15 A	**Z-15HW78**	**Z-15HW78-B**
Short hinge roller lever		15 A	—	**Z-15HW22-B**

DRIP-PROOF TYPE

Standard

Actuator	Operating Characteristics	Rated Current	Contact Gap	Part Number	
				Solder Terminal	Screw Terminal
Slim spring plunger		15 A	0.5 mm	**Z-15GS55**	**Z-15GS55-B**
Short spring plunger		15 A	0.5 mm	**Z-15GD55**	**Z-15GD55-B**
Spring plunger	Middle OP	15 A	0.5 mm	**Z-15GK55**	**Z-15GK55-B**
	High OP	15 A	0.5 mm	**Z-15GK355**	**Z-15GK355-B**
Panel mount plunger	Middle OP	15 A	0.5 mm	**Z-15GQ55**	**Z-15GQ55-B**
Panel mount roller plunger		15 A	0.5 mm	—	**Z-15GQ2255-B**
Panel mount cross roller plunger		15 A	0.5 mm	—	**Z-15GQ2155-B**
Hinge lever	Low OF	15 A	0.5 mm	**Z-15GW55**	**Z-15GW55-B**
Short hinge roller lever		15 A	0.5 mm	**Z-15GW2255**	**Z-15GW2255-B**
Hinge roller lever	Parallel	15 A	0.5 mm	**Z-15GW255**	**Z-15GW255-B**
Flexible rod	High OF	15 A	0.5 mm	**Z-15GNJ55**	**Z-15GNJ55-B**

DRIP-PROOF TYPE

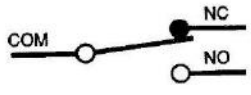
High-sensitivity

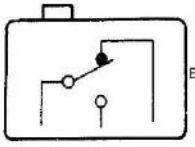
Actuator	Operating Characteristics	Rated Current	Contact Gap	Part Number	
				Solder Terminal	Screw Terminal
Panel mount plunger	Middle OP	15 A	0.25 mm	—	**Z-15HQ55-B**
Flexible rod	High OF	15 A	0.25 mm	—	**Z-15HNJS55-B**

Note: For smaller mounting hole types, please consult OMRON.

■ BASIC CONTACT FORM

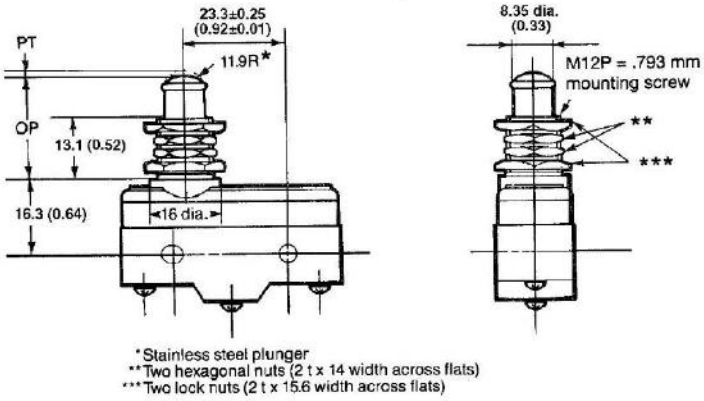
Type	Contact gap	Features
General purpose	H: 0.25 mm (high sensitivity)	Pin plunger and lever types available. Drip-proof and flexible rod types are also available.
	G: 0.5 mm (standard)	
Drip-proof	H: 0.25 mm (high sensitivity)	The pin plunger is sealed from the other switch mechanisms by a resilient rubber, and the case and cover are sealed by adhesive so that the switch is resistant to humidity, oil and dust. The degree of protection conforms to IEC IP63.
	G: 0.5 mm (standard)	





Basic Contact form

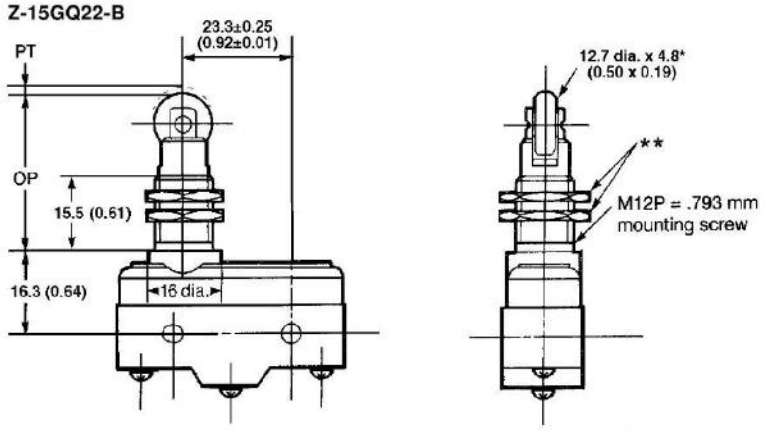
Z-15GQ-B



*Stainless steel plunger
**Two hexagonal nuts (2 t x 14 width across flats)
***Two lock nuts (2 t x 15.6 width across flats)

Operating characteristics	Z-15GQ-B
OF	250 to 350 g
RF min.	114 g
PT max.	0.4 mm (0.02)
OT min.	5.5 mm (0.22)
MD max.	0.05 mm (0.002)
OP	21.8 ± 0.8 mm (0.86 ± 0.03)

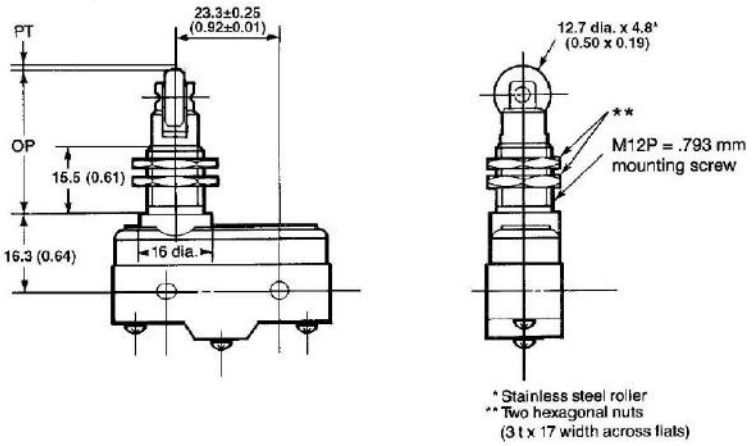
Z-15GQ22-B



*Stainless steel roller
**Two hexagonal nuts
(3 t x 17 width across flats)

Operating characteristics	Z-15GQ22-B
OF	250 to 350 g
RF min.	114 g
PT max.	0.4 mm (0.02)
OT min.	3.58 mm (0.14)
MD max.	0.05 mm (0.002)
OP	33.4 ± 1.2 mm (1.31 ± 0.05)

Z-15GQ21-B



*Stainless steel roller
**Two hexagonal nuts
(3 t x 17 width across flats)

Operating characteristics	Z-15GQ21-B
OF	250 to 350 g
RF min.	114 g
PT max.	0.4 mm (0.02)
OT min.	3.58 mm (0.14)
MD max.	0.05 mm (0.002)
OP	33.4 ± 1.2 mm (1.31 ± 0.05)

Note: 1. Unless otherwise specified, a tolerance of ± 0.4 mm applies to all dimensions.
2. For smaller diameter mounting holes, please consult OMRON.
3. All drawings show the switches with screw terminals. For solder terminals, remove the "-B" from the end of the part number.

7) Pulsador Schneider 9001SKR1UH13

Product data sheet
Characteristics

9001SKR1UH13
7 colors choice pushbutton Ø 30 - flush spring return - 1OC

Main

Range of product	Harmony 9001SK
Product or component type	Complete pushbutton
Device short name	9001SK
Type of operator	Spring return
Operator profile	Flush, 7 colors choice marking: unmarked

Complementary

Bezel material	Plastic
Mounting diameter	30 mm
Shape of signaling unit head	Octagonal
Connections - terminals	Screw clamp terminals 1 x 0.22...2 x 1.5 mm² conforming to EN/IEC 60947-1
Tightening torque	0.8 N.m conforming to EN/IEC 60947-1
Shape of screw head	Cross slotted
Mechanical durability	5000000 cycles
Operating position	Any position
[Ie] rated operational current	0.55 A at 125 V DC-13, A600-Q600 3 A at 240 V AC-15, A600-Q600
[Ui] rated insulation voltage	250 V, degree of pollution: 3 conforming to EN/IEC 60947-1
[Uimp] rated impulse withstand voltage	2.5 kV conforming to EN/IEC 60947-1
Contacts material	Silver alloy contacts
Positive opening	Without
Short circuit protection	10 A cartridge fuse conforming to EN/IEC 60947-5-1
[Ith] conventional free air thermal current	10 A
[Icm] rated short-circuit making capacity	<= 60 kA at 120 V AC-15, 7200 VA <= 30 kA at 240 V AC-15, 7200 VA <= 15 kA at 480 V AC-15, 7200 VA <= 12 kA at 600 V AC-15, 7200 VA
Rated breaking capacity	<= 1.5 kA at 480 V AC-15, 720 VA <= 1.2 kA at 600 V AC-15, 720 VA <= 0.55 kA at 125 V DC-13 <= 0.27 kA at 250 V DC-13 <= 0.1 kA at 600 V DC-13 <= 6 kA at 120 V AC-15, 720 VA <= 3 kA at 240 V AC-15, 720 VA
Product weight	0.086 kg

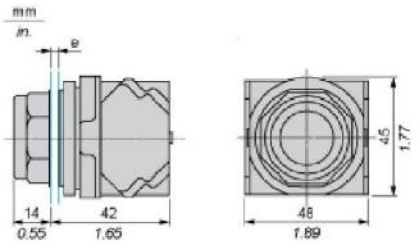
Environment

Standards	CSA C22-2 No 14 EN/IEC 60947-1 EN/IEC 60947-5-1 EN/IEC 60947-5-4 JIS C 4520 JIS C 852 UL 508
Product certifications	NEMA UL 508
Protective treatment	TC
Ambient air temperature for storage	-40...70 °C
Ambient air temperature for operation	-25...70 °C
Vibration resistance	7 gn (f = 2...500 Hz) conforming to IEC 60068-2-6
Shock resistance	50 gn conforming to IEC 60068-2-27
Class of protection against electric shock	Class II conforming to IEC 61140
IP degree of protection	IP66 conforming to IEC 60529
NEMA degree of protection	NEMA 4X NEMA 4 NEMA 3R NEMA 3 NEMA 2 NEMA 13 NEMA 12 NEMA 1

Offer Sustainability

Sustainable offer status	Not Green Premium product
RoHS	Compliant - since 0921 - Schneider Electric declaration of conformity download declaration of conformity

Dimensions



e panel thickness: 1 to 6 mm / 0.04 to 0.24 in.

8) Interruptor de emergencia ZB5AS54:

Product data sheet
Characteristics

ZB5AS54
red Ø40 Emergency switching off pushbutton head Ø22 latching turn release

Main

Range of product	Harmony XB5
Product or component type	Head for emergency switching off pushbutton
Device short name	ZB5
Bezel material	Plastic
Mounting diameter	22 mm
Sale per indivisible quantity	1
Shape of signaling unit head	Round
Type of operator	Mechanical latching
Reset	Turn to release
Operator profile	Red mushroom Ø 40 mm unmarked

Complementary

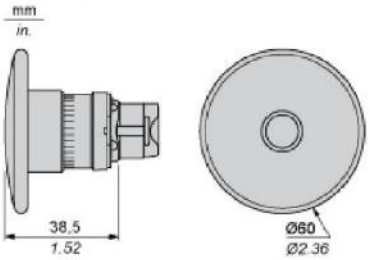
CAD overall width	30 mm
CAD overall height	30 mm
CAD overall depth	57 mm
Product weight	0.044 kg
Resistance to high pressure washer	7000000 Pa at 55 °C,distance: 0.1 m
Mechanical durability	300000 cycles
Main group	Switching off
Group of product	Emerg. swit. off turn to rel.
Maximum of contact NO or NC	4
Station name	XALD 1 cut-out XALK 1 cut-out
Cap/Operator or lens colour	Red
Marking	Unmarked

Environment

Protective treatment	TH
Ambient air temperature for storage	-40...70 °C
Ambient air temperature for operation	-25...70 °C
Class of protection against electric shock	Class II conforming to IEC 60536
IP degree of protection	IP66 conforming to IEC 60529
NEMA degree of protection	NEMA 13 NEMA 4X
IK degree of protection	IK03 conforming to IEC 50102
Standards	CSA C22-2 No 14 EN/IEC 60947-1 EN/IEC 60947-5-1 EN/IEC 60947-5-4 EN/IEC 60947-5-5 IEC 60364-5-53 JIS C 4520 UL 508 GB 14048.5

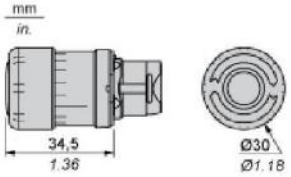
Product certifications	BV CSA DNV GL LROS (Lloyds register of shipping) RINA UL listed
Vibration resistance	5 gn (f = 2...500 Hz) conforming to IEC 60068-2-6
Shock resistance	30 gn for 18 ms half sine wave acceleration conforming to IEC 60068-2-27 50 gn for 11 ms half sine wave acceleration conforming to IEC 60068-2-27
RoHS EUR status	Compliant
RoHS EUR conformity date	0810

ZB5 AX2, ZB5 AX4

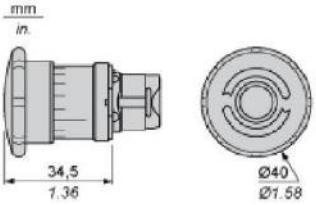


Turn to Release

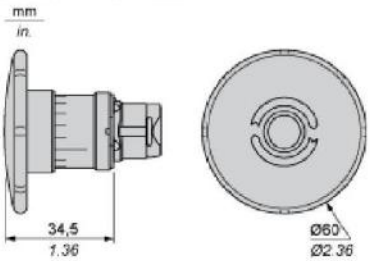
ZB5 AS42, ZB5 AS44



ZB5 AS52, ZB5 AS54, ZB5 AS55



ZB5 AS62, ZB5 AS64



9) Controlador PLC MICRO820 CONTROLLER:

Micro820™ Programmable Logic Controller

Allen-Bradley

Bulletin 2080 Product Profile

Features and Benefits

- Features optimized for small standalone machines and remote automation projects
- EtherNet/IP™ for Connected Components Workbench™ programming, RTU applications and HMI connectivity
- Built-in Real Time Clock (RTC) with no battery required
- microSD™ slot for program transfer, datalog and recipe
- Selected models available with removable terminal blocks for easier wiring and installation
- 5 KHz PWM Output for controlling solenoids and valves

The new Allen-Bradley Micro820 20pt controller is specifically designed for small standalone machines and remote automation projects with embedded Ethernet and Serial ports. It can function as a RTU (remote terminal unit) for remote machines with support for Modbus RTU and TCP. It has embedded support for 4 thermistor temperature inputs for use as a DDC (direct digital controller) for Building Management Systems.

The Micro820 supports an embedded microSD slot that can be used for storing large amounts of data that normally cannot fit into memory for applications that require datalog and recipe. All files are stored in CSV text format for easy viewing and editing. The microSD card is also used for backing up and restoring the program, which can be used for duplicating the program in several machines.

The Allen-Bradley Micro800 Remote LCD Display connects to the controller's embedded RS232 port and works as an essential accessory for the Micro820 controller. With 4 or 8 lines of ASCII text and a tactile keypad, it can be used as a simple HMI. Its system menu is available in multiple languages for direct viewing and editing of controller variables. Controller's Ethernet address can also be easily set from the menu. Supports front panel mounting as well as DIN rail mounting next to the controller.

Micro800 Remote LCD Display

- *USB port for program download to controller*
- *IP65 for front panel mount*
- *Configurable start-up screen*

*Readings on LCD Display are for illustration purposes only, not actual readings.

LISTEN. THINK. SOLVE.®

Allen-Bradley • Rockwell Software

Rockwell Automation

Bulletin 2080

Catalog Number	Inputs			Outputs		
	120V AC	24V DC/ V AC	Analog 0-10V (shared with 24V DC)	Relay	24V DC SRC	Analog 0-10V
2080-LC20-20QWB(R)	-	12	4	7	-	1
2080-LC20-20QBB(R)	-	12	4	-	7	1
2080-LC20-20AWB(R)	8	4	4	7	-	1

Removable terminal blocks are available on modules with catalog numbers that end in R. Catalog numbers that do not end in R have fixed terminal blocks.

Micro820	20-pt QWB(R)	20-pt QBB(R)	20-pt AWB(R)
Base Unit			
Power Supply	Base Unit has embedded 24V DC Power Supply. Optional External 120/240V AC via Cat. No. 2080-PS120-240VAC		
Base Programming Port	Embedded Ethernet Port		
Base EtherNet/IP™ port	EtherNet/IP Class 3, Modbus TCP		
Base Serial Port	RS232/485 non-isolated, CIP Serial, Modbus RTU, ASCII		
Plug-in Slots	2		
10V Output for Thermistors	1 Output Reference (supports up to four 10k thermistors)		
PWM Output	5 KHz		
microSD Card Slot	1		
Supported microSD Card Formats	FAT32/16		
microSD Card Size, Max	32GB		
microSD Card Class Speed	Class 6 and 10 SDSC and SDHC		
I/O			
Digital I/O (In/Out)	12/7 (4 Inputs shared with Analog Inputs)		
Analog I/O Channels	4/1		
Progamming			
Software	Connected Components Workbench		
Program Steps (or instructions)	10Ksteps		
Data (bytes)	20Kbytes (up to 400bytes non-volatile)		
IEC 61131-3 Languages	Ladder Diagram, Function Block, Structured Text		
User Defined Function Blocks	Yes		
Motion Instructions	No PTO motion supported		
Floating Point Math	32-bit and 64-bit		
PID Loop Control	Yes		
Environments			
Certifications	c-UL-us CL1DIV2, CE, C-Tick, KC		
Temperature Range (Controller)	-20°...65°C		
Dimensions (HxWxD, mm)	90x100x80		

LCD Display	
Communications	
Embedded Serial Port	RS232 (connects to Controller's Embedded RS232 port)
Embedded USB Port	Controller programming port (USB to Serial pass-through)
Environmentals	
Temperature Range (LCD Display)	0°...50°C
Dimensions (HxWxD, mm)	97x130x36

Catalog Number	Plug-in Modules
2080-IQ4	4-pt Digital Input, 12/24VDC, Sink/Source, Type3
2080-OB4	4-pt Digital Output, 12/24VDC, Source
2080-OV4	4-pt Digital Output, 12/24VDC, Sink
2080-OW4I	4-pt Relay Output, Individually Isolated, 2A
2080-IQ4OB4	8-pt Combo: 4-pt Digital Input, 12/24VDC, Sink/Source, Type3, and 4-pt Digital Output, 12/24VDC, Source
2080-IQ4OV4	8-pt Combo: 4-pt Digital Input, 12/24VDC, Sink/Source, Type3, and 4-pt Digital Output, 12/24VDC, Sink
2080-IF2, 2080-IF4	2/4-ch Analog Input, 0-20 mA, 0-10V, non-isolated 12-bit
2080-OF2	2-ch Analog Output 0-20 mA, 0-10V, non-isolated 12-bit
2080-SERIALISOL	RS232/485 isolated serial port
2080-TRIMPOT6	6-ch Trimpot Analog Input
2080-RTD2	2-ch RTD, non-isolated, ±1.0 °C
2080-TC2	2-ch TC, non-isolated, ±1.0 °C
2080-MOT-HSC	High Speed Counter, 250kHz, Differential Line Receiver, 1 Digital Output
2080-DNET20	DeviceNet Scanner, 20 Nodes
Catalog Number	**Accessories**
2080-PS120-240VAC	External 120/240V AC power supply
2080-REMLCD	Remote 3.5 in. LCD Display, 24V DC Power, 4 or 8 lines ASCII text

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication 2080-PP004A-EN-P – December 2013

6.2 ANEXO B – Planos de Piezas y Ensambles

6.3 ANEXO C - Sistema de Control Secundario

User Manual

Allen-Bradley

Micro820 Programmable Controllers

Catalog Numbers 2080-LC20-20QWB, 2080-LC20-20QBB, 2080-LC20-20AWB, 2080-LC20-20QWBR, 2080-LC20-20QBBR, 2080-LC20-20AWBR

Allen-Bradley • Rockwell Software

Rockwell Automation

Important User Information

Solid-state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://www.rockwellautomation.com/literature/) describes some important differences between solid-state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid-state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

Reproduction of the contents of this manual, in whole or in part, without written permission of Rockwell Automation, Inc., is prohibited.

Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

	**WARNING:** Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
	**ATTENTION:** Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence
	**SHOCK HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
	**BURN HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

Read this preface to familiarize yourself with the rest of the manual. It provides information concerning:

- who should use this manual
- the purpose of this manual
- related documentation
- supporting information for Micro800™

Who Should Use this Manual

Use this manual if you are responsible for designing, installing, programming, or troubleshooting control systems that use Micro800 controllers.

You should have a basic understanding of electrical circuitry and familiarity with relay logic. If you do not, obtain the proper training before using this product.

Purpose of this Manual

This manual is a reference guide for Micro820 controllers. It describes the procedures you use to install, wire, and troubleshoot your controller. This manual:

- explains how to install and wire your controllers
- gives you an overview of the Micro800 controller system

Refer to the Online Help provided with Connected Components Workbench™ software for more information on programming your Micro800 controller.

Additional Resources

These documents contain additional information concerning related Rockwell Automation products.

Resource	Description
Micro800 Plug-in Modules 2080-UM004	Information on features, configuration, installation, wiring, and specifications for the Micro800 plug-in modules.
Micro800 Programmable Controller External AC Power Supply Installation Instructions 2080-IN001	Information on mounting and wiring the optional external power supply.
Micro820 Programmable Controllers Installation Instructions, 2080-IN009	Information on installing, mounting, and wiring the Micro820 controller.
Micro800 Remote LCD Installation Instructions, 2080-IN010	Information on installing, mounting, and wiring the Micro800 Remote LCD module.
Micro800 RS232/485 Isolated Serial Port Plug-in Module Wiring Diagrams 2080-WD002	Information on mounting and wiring the Micro800 RS232/485 Isolated Serial Port Plug-in Module.
Micro800 Non-isolated Unipolar Analog Input Plug-in Module Wiring Diagrams 2080-WD003	Information on mounting and wiring the Micro800 Non-isolated Unipolar Analog Input Plug-in Module.
Micro800 Non-isolated Unipolar Analog Output Plug-in Module Wiring Diagrams 2080-WD004	Information on mounting and wiring the Micro800 Non-isolated Unipolar Analog Output Plug-in Module.
Micro800 Non-isolated RTD Plug-in Module Wiring Diagrams 2080-WD005	Information on mounting and wiring the Micro800 Non-isolated RTD Plug-in Module.

Resource	Description
Micro800 Non-isolated Thermocouple Plug-in Module Wiring Diagrams 2080-WD006	Information on mounting and wiring the Micro800 Non-isolated Thermocouple Plug-in Module.
Micro800 Memory Backup and High Accuracy RTC Plug-In Module Wiring Diagrams 2080-WD007	Information on mounting and wiring the Micro800 Memory Backup and High Accuracy RTC Plug-In Module.
Micro800 6-Channel Trimpot Analog Input Plug-In Module Wiring Diagrams 2080-WD008	Information on mounting and wiring the Micro800 6-Channel Trimpot Analog Input Plug-In Module.
Micro800 Digital Relay Output Plug-in Module Wiring Diagrams 2080-WD010	Information on mounting and wiring the Micro800 Digital Relay Output Plug-in Module.
Micro800 Digital Input, Output, and Combination Plug-in Modules Wiring Diagrams 2080-WD011	Information on mounting and wiring the Micro800 Digital Input, Output, and Combination Plug-in Modules.
Micro800 High Speed Counter Plug-in Module, 2080-WD012	Information on mounting and wiring the High Speed Counter Plug-in module.
Micro800 DeviceNet Plug-in Module, 2080-WD013	Information on mounting and wiring the Micro800 DeviceNet plug-in module.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, http://www.rockwellautomation.com/products/certification/	Provides declarations of conformity, certificates, and other certification details.
Application Considerations for Solid-State Controls SGI-1.1	A description of important differences between solid-state programmable controller products and hard-wired electromechanical devices.
National Electrical Code - Published by the National Fire Protection Association of Boston, MA.	An article on wire sizes and types for grounding electrical equipment.
Allen-Bradley Industrial Automation Glossary AG-7.1	A glossary of industrial automation terms and abbreviations.

You can view or download publications at http://www.rockwellautomation.com/literature/. To order paper copies of technical documentation, contact your local Rockwell Automation distributor or sales representative.

You can download the latest version of Connected Components Workbench for your Micro800 at the URL below.

http://ab.rockwellautomation.com/Programmable-Controllers/Connected-Components-Workbench-Software.

Table of Contents

Preface

Who Should Use this Manual iii
Purpose of this Manual iii
Additional Resources iii

Chapter 1

Hardware Overview

Hardware Features 1

Chapter 2

About Your Controller

Programming Software for Micro800 Controllers 7
Using Run Mode Change 7
Agency Certifications 12
Compliance to European Union Directives 12
Installation Considerations 13
Safety Considerations 15
Power Considerations 17
Preventing Excessive Heat 18
Master Control Relay 18

Chapter 3

Install Your Controller

Controller Mounting Dimensions 23
Connect the Controller to an EtherNet/IP Network 25
Install the microSD Card 26
Install the 2080-REMLCD Module 27

Chapter 4

Wire Your Controller

Wiring Requirements and Recommendation 29
Use Surge Suppressors 30
Grounding the Controller 33
Wiring Diagrams 33
Controller I/O Wiring 40
Wiring Analog Channels 43

Chapter 5

Communication Connections

Overview 47
Supported Communication Protocols 47
CIP Communications Pass-thru 50
Use Modems with Micro800 Controllers 51
Configure Serial Port 52
Configure Ethernet Settings 59
OPC Support Using RSLinx Enterprise 60

Chapter 6

Program Execution in Micro800

Overview of Program Execution 61
Controller Load and Performance Considerations 62
Power Up and First Scan 63
Memory Allocation 64
Guidelines and Limitations for Advanced Users 64

Chapter 7

Controller Security

Exclusive Access 67
Password Protection 67
Compatibility 67
Work with a Locked Controller 68
Configure Controller Password 70
Recover from a Lost Password 71

Chapter 8

Using the Micro800 Remote LCD

Overview 73
USB Mode 74
Text Display Mode 75
Backup and Restore 81
Hardware Features, Installation, and Specifications 81

Chapter 9

Using microSD Cards

Overview 83
Project Backup and Restore 84
Datalog 89
Recipe 94
Quickstart Projects for Datalog and Recipe Function Blocks 98

Appendix A

Specifications

General Specifications 113
Environmental Specifications 121
Certifications 122

Appendix B

Troubleshooting

Status Indicators on the Controller 123
Error Conditions 124
Error Codes 125
Controller Error Recovery Model 130
Calling Rockwell Automation for Assistance 131

Quickstarts

Appendix C

Flash Upgrade Your Micro800 Firmware. 133
Establish Communications between RSLinx and a Micro820 Controller through USB Port on 2080-REMLCD 140
Configure Controller Password 144
Forcing I/Os. 148
Using Run Mode Change 150

IPID Function Block

Appendix D

How to Autotune 159
Troubleshooting an Autotune Process 161
PID Application Example. 162

Modbus Mapping for Micro800

Appendix E

Modbus Mapping 165

Index

Notes:

Hardware Overview

This chapter provides an overview of the Micro820 hardware features. It has the following topics:

Topic	Page
Hardware Features	1
Embedded microSD (Micro Secure Digital) Card Slot	3
Embedded RS232/RS485 Serial Port Combo	3
Embedded Ethernet Support	4

Hardware Features

Micro820 controllers are 20-point economical brick style controllers with embedded inputs and outputs. These controllers can accommodate up to two plug-in modules and can connect to a remote LCD (2080-REMLCD) for configuring. The Micro820 controller also has a microSD™ card slot for project backup and restore, and datalog and recipe.

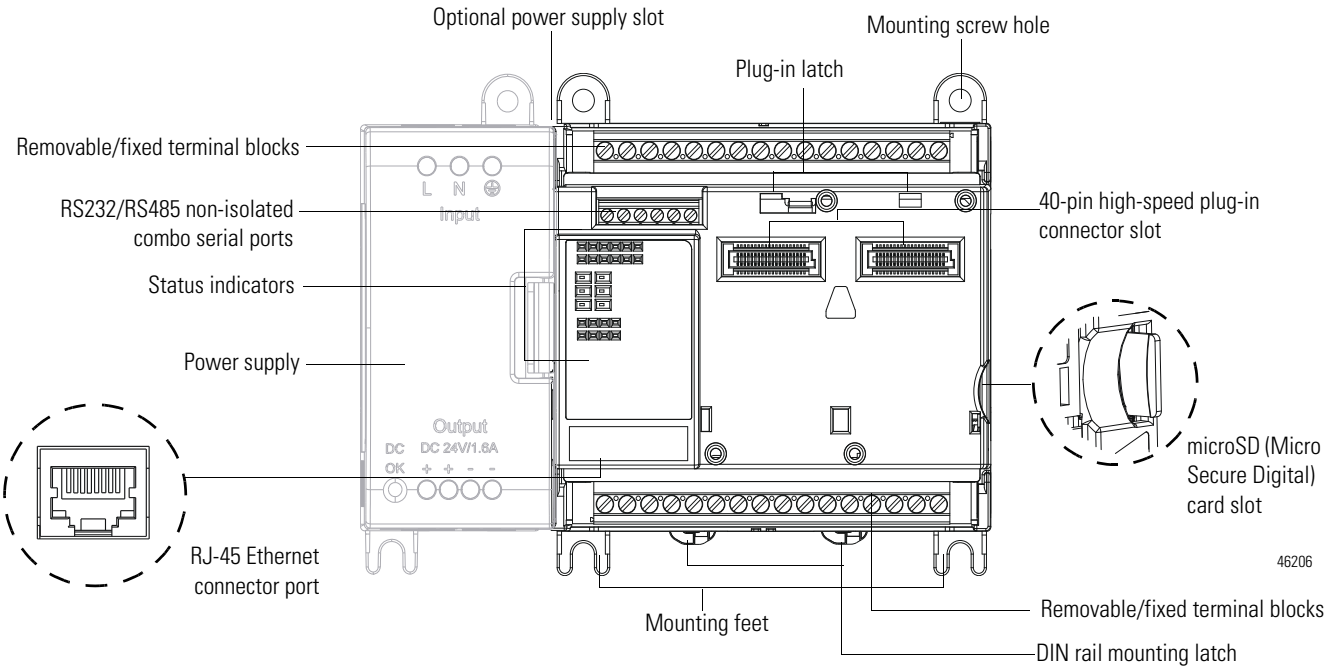
IMPORTANT The Micro820 controller supports all Micro800 plug-in modules, except for the 2080-MEMBAK-RTC.

For more information, see Micro800 Plug-in Modules User, publication 2080-UM004.

For information on the REMLCD module, see Using the Micro800 Remote LCD on page 73.

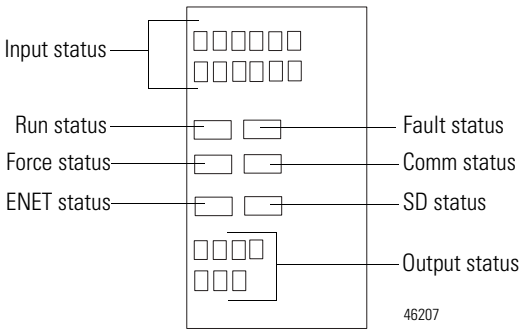
The controller also accommodates any class 2 rated 24V DC output power supply that meets minimum specifications such as the optional Micro800 power supply.

Micro820 Controllers



ATTENTION: Removable terminal blocks are available on catalog numbers that end in R (for example, 2080-LC20-20QBBR). Fixed terminal blocks are available on catalog numbers that do not end in R (for example, 2080-LC20-20QBB).

Status Indicators



See Troubleshooting on page 123 for descriptions of status indicator operation.

Inputs and Outputs

Number and Types of Inputs/Outputs for Micro820 Controllers

Controller Family	Catalogs	Inputs			Outputs			Analog Out 0…10V DC	Analog In 0…10V (shared with DC In)	PWM Support
		120V AC	120 / 240V AC	24V DC	Relay	24V DC Source	24V DC Sink			
Micro820	2080-LC20-20QBB	–	–	12		7	–	1	4	1
	2080-LC20-20QWB	–	–	12	7	–	–	1	4	–
	2080-LC20-20AWB	8	–	4	7	–	–	1	4	–
	2080-LC20-20QBBR	–	–	12	–	7	–	1	4	1
	2080-LC20-20QWBR	–	–	12	7	–	–	1	4	–
	2080-LC20-20AWBR	8	–	4	7		–	1	4	–

Embedded microSD (Micro Secure Digital) Card Slot

Micro820 controllers support microSD cards through an embedded microSD card slot. It supports Class 6 and 10 SDSC and SDHC microSD cards, with FAT32/16 formats, 32 GB maximum size. Industrial grade cards such as Swissbit S-200u/S300u are recommended. The microSD file system supports only one file partition. Class 4 cards are **not** supported.

The microSD card is primarily used for project backup and restore, as well as datalog and recipe functions. It can also be used to configure powerup settings (such as controller mode, IP address, and so on) through an optional ConfigMeFirst.txt file.

For more information, see Using microSD Cards on page 83.

To help you troubleshoot microSD card-related errors, see Troubleshooting on page 123.

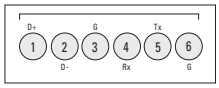
Embedded RS232/RS485 Serial Port Combo

The Micro820 controller supports an embedded non-isolated RS232/RS485 combo communications port. Only one port (RS232 or RS485) can work at any given time. The baud rate of this port supports up to 38.4 K.

The communication port uses a 6-pin 3.5 mm terminal block with pin definition shown in the following table.

IMPORTANT Serial port cables should not exceed 3 m length.

RS232/RS485 Serial Port Pin Definition



Pin	Definition	RS485 Example	RS232 Example
1	RS485+	RS485+	(not used)
2	RS485-	RS485-	(not used)
3	GND	GND	GND
4	RS232 input (receiver)	(not used)	RxD
5	RS232 output (driver)	(not used)	TxD
6	GND	GND	GND

The communication port (both RS232 and RS485) are non-isolated. The signal ground of the port is not isolated to the logic ground of the controller.

The RS232 port supports connection to the Micro800 Remote LCD module (2080-REMLCD).

REMLCD to Micro820 Serial Port Terminal Block Wiring

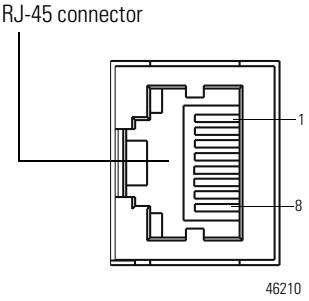
REMLCD Serial Port Terminal Block			Micro820 Serial Port Terminal Block	
Signal	**Pin number**		**Pin number**	**Signal**
RS232 TX	1	<-------->	4	RX RS232
RS232 RX	2	<-------->	5	TX RS232
RS232 G	3	<-------->	6	G RS232

Embedded Ethernet Support

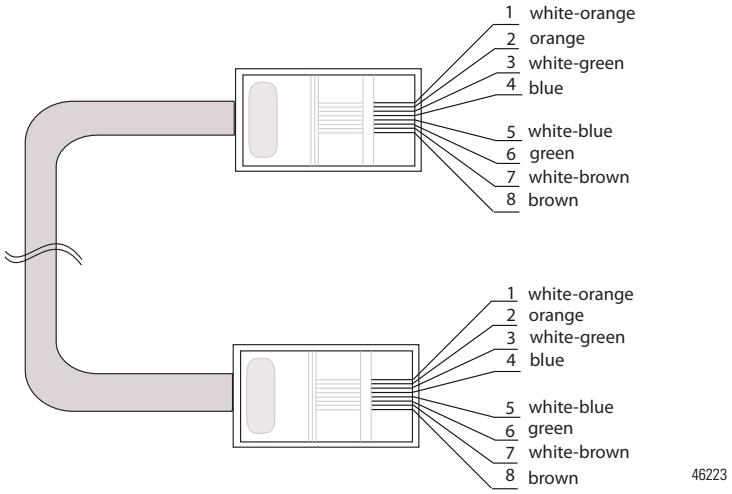
A 10/100 Base-T Port is available for connection to an Ethernet network through any standard RJ-45 Ethernet cable.

RJ-45 Ethernet Port Pin Mapping

Contact Number	Signal	Direction	Primary Function
1	TX+	OUT	Transmit data +
2	TX-	OUT	Transmit data -
3	RX+	IN	Receive data +
4	–	–	–
5	–	–	–
6	RX-	IN	Receive data -
7	–	–	–
8	–	–	–



Ethernet port pin-to-pin connection



See Troubleshooting on page 123 for descriptions of ENET status indicator.

Notes:

About Your Controller

Programming Software for Micro800 Controllers

Connected Components Workbench is a set of collaborative tools supporting Micro800 controllers. It is based on Rockwell Automation and Microsoft Visual Studio technology and offers controller programming, device configuration and integration with HMI editor. Use this software to program your controllers, configure your devices and design your operator interface applications.

Connected Components Workbench provides a choice of IEC 61131-3 programming languages (ladder diagram, function block diagram, structured text) with user defined function block support that optimizes machine control.

Obtain Connected Components Workbench

A free download is available at:

http://ab.rockwellautomation.com/Programmable-Controllers/Connected-Components-Workbench-Software

Use Connected Components Workbench

To help you program your controller through the Connected Components Workbench software, you can refer to the Connected Components Workbench Online Help (it comes with the software).

Using Run Mode Change

Run Mode Change (RMC) is a productivity enhancement feature introduced in Release 8 for Micro820/Mico830/Micro850 controllers. It saves the user time by allowing logic modifications to a running project without going to remote program mode and without disconnecting from the controller. It requires the Connected Components Workbench Developer Edition release 8 software to use this feature.

IMPORTANT	Micro820/Micro830/Micro850 controller firmware revision 8.0 or higher is also required to use Run Mode Change.

RMC is useful when the user is developing a project by incrementally adding small changes to the logic and immediately wants to see the effects of the changes on the machine. With RMC, since the controller stays in remote run mode, the controller logic and machine actuators will not have to constantly reinitialize, which can occur if the controller is switched to remote program mode (for example, first scan bit is checked in program logic to clear outputs).

When user is editing, building, and downloading a project without using RMC, a full build of the entire controller project is performed and also a full download of the project is performed. During RMC an incremental build is performed and only incremental changes are downloaded to the controller.

RMC is performed incrementally at the end of every program scan in order to prevent a large delay in the program scan. This adds up to an additional 12 ms to the scan time. For example, if the program scan is normally 10 ms, it may increase to 22 ms during RMC until the update is finished. Similarly user interrupts may be delayed.

Example of the Benefits of Using RMC – 20% Reduction in Download Time

Number of Changes	Time to Perform Conventional Download (seconds)	Time to Test Logic and Accept Changes (seconds)
1	103	80
5	241	191
10	376	308
Memory size of project used for comparison: Data = 16704 bytes; Program = 2052 bytes		

ATTENTION: Use extreme caution when you use Run Mode Change. Mistakes can injure personnel and damage equipment. Before using Run Mode Change:

- assess how machinery will respond to the changes.
- notify all personnel about the changes.

A new global variable SYSVA_PROJ_INCOMPLETE has been added to indicate when Run Mode Changes are being made. This can be used to notify personnel on the HMI that there are uncommitted changes in the controller.

Value of Global Variable – SYSVA_PROJ_INCOMPLETE

Value	Description
0 (Default)	No uncommitted changes
1	Uncommitted changes present
2	Error occurred during Test Logic Change (for example, communications loss during Test Logic)

When you perform a Test Logic Change, the value of the variable is changed from zero to one. After you choose to accept or undo the changes, the value of the variable is reset to zero.

IMPORTANT When a Test Logic is performed, or undoing changes after the Test Logic is completed, any active communication instructions will be aborted while the changes are downloaded to the controller.

Uncommitted Changes

Uncommitted changes are changes made in RMC that have not been accepted or undone after a Test Logic Change has been performed.

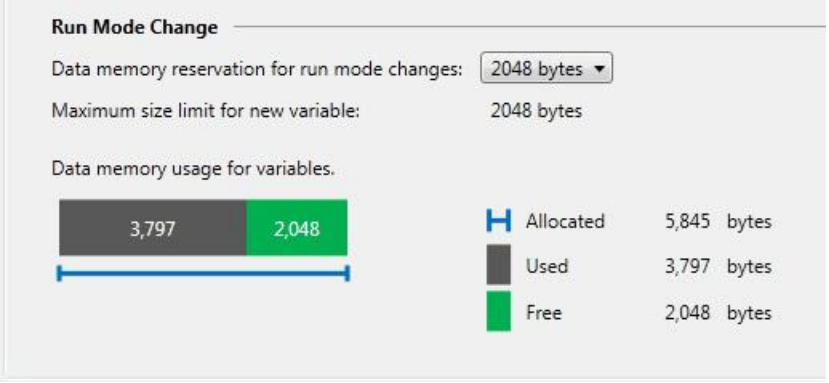
If the controller power loses power while there are uncommitted changes, you will not be able to re-enter RMC upon reconnection. You can choose to re-download the project to keep the changes, or upload if the uncommitted changes are not wanted.

If you choose to upload a project with uncommitted changes from the controller, you cannot enter RMC until you have done a full download.

RMC Memory

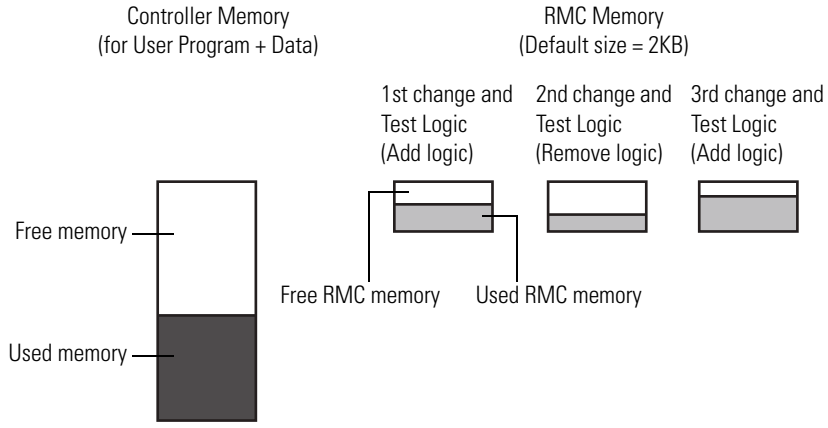
Run Mode Change (RMC) memory is used to store both the logic and user variable changes made during RMC. The default amount of memory allocated is 2KB and can be increased up to 8KB. However there is still a limit of 2KB for logic and user variables changes per Test Logic. To adjust the amount of RMC memory, the controller must be offline. After you have adjusted the amount, you must build the project and download it to the controller.

Controller Memory Diagnostics Page in Connected Components Workbench



During RMC an incremental build is performed and only incremental changes are downloaded to the controller until the RMC memory has been filled.

RMC Memory Usage Example

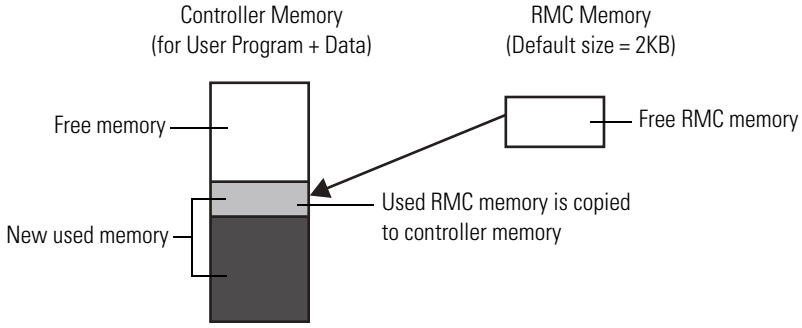


If not enough RMC memory is available to make more changes (for example, a "not enough memory" error message appears during RMC build or Test Logic), then a full download must be performed to transfer the incremental changes from the RMC memory to standard user program and data memory.

Transferring Contents in RMC Memory to Controller Memory

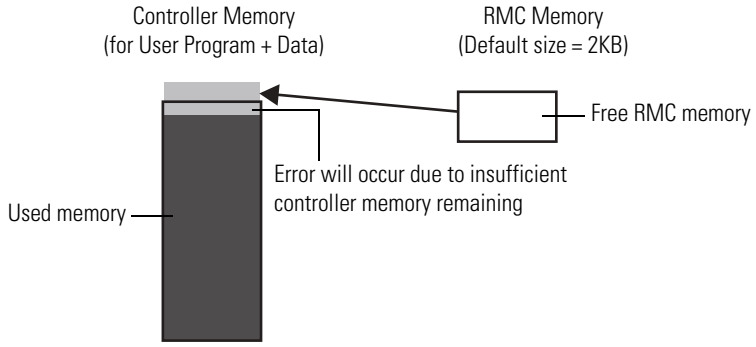
The changes that you have made during RMC are stored in RMC memory and will remain there until you perform a full download (while the controller is disconnected).

RMC Memory Usage When Performing Full Download Example



However if the controller memory does not have enough space remaining to copy the contents of the RMC memory as shown below, the operation will fail and a "not enough memory" error message will appear. Do not use RMC if you are near the limits of your controller memory.

Insufficient Controller Memory Example



Limitations of RMC

Take note of the following limitations when using the Run Mode Change (RMC) feature:

- Configuration changes cannot be made (for example, change filter times).
- Up to 2KB of logic (approximately 150 boolean instructions) and user variables and can be added for each Test Logic.
- Total memory allocated for RMC (cumulative of all Test Logic Changes) can be increased from 2KB to 8KB, but the 2KB limit for logic and user variables per Test Logic remains.
- A total of 20 POU (Program Organizational Units) can be added for each RMC (for example, if you currently have 5 POU, you can add 20 more for a total of 25 POU).
- If a User Defined Function Block is modified that changes the local variables, the local variables will be reinitialized or reset to zero and a warning message will be shown during the build. If you want to reapply the initial value, right-click on the UDFB and select Refactor -> Reset Initial Values of Instances.
- Exchange files cannot be imported when in RMC because it is considered a configuration change.
- Global variables cannot be deleted or modified in RMC, but can be added. To delete or modify a global variable, the workbench must be disconnected from the controller.
- If you create a global variable in RMC, it will not be shown in the LCD display.

WARNING: If you delete the output rung when in Run Mode Change and accept the changes, the output on the controller will remain ON.

See Using Run Mode Change on page 150 for an example on how to use this feature.

Agency Certifications

- UL Listed Industrial Control Equipment, certified for US and Canada. UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada.
- CE marked for all applicable directives
- C-Tick marked for all applicable acts
- KC - Korean Registration of Broadcasting and Communications Equipment, compliant with: Article 58-2 of Radio Waves Act, Clause 3.

Compliance to European Union Directives

This product has the CE mark and is approved for installation within the European Union and EEA regions. It has been designed and tested to meet the following directives.

EMC Directive

This product is tested to meet Council Directive 2004/108/EC Electromagnetic Compatibility (EMC) and the following standards, in whole or in part, documented in a technical construction file:

- EN 61131-2; Programmable Controllers (Clause 8, Zone A & B)
- EN 61131-2; Programmable Controllers (Clause 11)
- EN 61000-6-4
  EMC - Part 6-4: Generic Standards - Emission Standard for Industrial Environments
- EN 61000-6-2
  EMC - Part 6-2: Generic Standards - Immunity for Industrial Environments

This product is intended for use in an industrial environment.

Low Voltage Directive

This product is tested to meet Council Directive 2006/95/ECLow Voltage, by applying the safety requirements of EN 61131-2 Programmable Controllers, Part 2 - Equipment Requirements and Tests.

For specific information required by EN 61131-2, see the appropriate sections in this publication, as well as the following Allen-Bradley publications:

- *Industrial Automation Wiring and Grounding Guidelines for Noise Immunity*, publication 1770-4.1.
- *Guidelines for Handling Lithium Batteries*, publication AG-5.4
- *Automation Systems Catalog*, publication B115

Installation Considerations

Most applications require installation in an industrial enclosure (Pollution Degree 2[1]) to reduce the effects of electrical interference (Over Voltage Category II[2]) and environmental exposure.

Locate your controller as far as possible from power lines, load lines, and other sources of electrical noise such as hard-contact switches, relays, and AC motor drives. For more information on proper grounding guidelines, see the *Industrial Automation Wiring and Grounding Guidelines* publication 1770-4.1.

WARNING: When used in a Class I, Division 2, hazardous location, this equipment must be mounted in a suitable enclosure with proper wiring method that complies with the governing electrical codes.

WARNING: If you connect or disconnect the serial cable with power applied to this module or the serial device on the other end of the cable, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

WARNING: The local programming terminal port is intended for temporary use only and must not be connected or disconnected unless the area is assured to be nonhazardous.

WARNING: Exposure to some chemicals may degrade the sealing properties of materials used in the Relays. It is recommended that the User periodically inspect these devices for any degradation of properties and replace the module if degradation is found.

WARNING: If you insert or remove the plug-in module while backplane power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

WARNING: When you connect or disconnect the Removable Terminal Block (RTB) with field side power applied, an electrical arc can occur. This could cause an explosion in hazardous location installations.

WARNING: Be sure that power is removed or the area is nonhazardous before proceeding.

ATTENTION: To comply with the CE Low Voltage Directive (LVD), this equipment must be powered from a source compliant with the following: Safety Extra Low Voltage (SELV) or Protected Extra Low Voltage (PELV).

ATTENTION: To comply with UL restrictions, this equipment must be powered from a Class 2 source.

ATTENTION: Be careful when stripping wires. Wire fragments that fall into the controller could cause damage. Once wiring is complete, make sure the controller is free of all metal fragments.

ATTENTION: Electrostatic discharge can damage semiconductor devices inside the module. Do not touch the connector pins or other sensitive areas.

ATTENTION: The serial cables are not to exceed 3.0 m (9.84 ft).

ATTENTION: Do not wire more than 2 conductors on any single terminal.

ATTENTION: Do not remove the Removable Terminal Block (RTB) until power is removed.

(1) Pollution Degree 2 is an environment where normally only non-conductive pollution occurs except that occassionally temporary conductivity caused by condensation shall be expected.

(2) Overvoltage Category II is the load level section of the electrical distribution system. At this level, transient voltages are controlled and do not exceed the impulse voltage capability of the products insulation.

Environment and Enclosure

This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in IEC 60664-1), at altitudes up to 2000 m (6562 ft) without derating.

This equipment is considered Group 1, Class A industrial equipment according to IEC/CISPR 11. Without appropriate precautions, there may be difficulties with electromagnetic compatibility in residential and other environments due to conducted and radiated disturbances.

This equipment is supplied as open-type equipment. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that will be present and appropriately designed to prevent personal injury resulting from accessibility to live parts. The enclosure must have suitable flame-retardant properties to prevent or minimize the spread of flame, complying with a flame spread rating of 5VA, V2, V1, V0 (or equivalent) if non-metallic. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication may contain additional information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

In addition to this publication, see:

- Industrial Automation Wiring and Grounding Guidelines, Rockwell Automation publication 1770-4.1, for additional installation requirements.
- NEMA Standard 250 and IEC 60529, as applicable, for explanations of the degrees of protection provided by different types of enclosure.

Preventing Electrostatic Discharge

This equipment is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Follow these guidelines when you handle this equipment:

- Touch a grounded object to discharge potential static.
- Wear an approved grounding wriststrap.
- Do not touch connectors or pins on component boards.
- Do not touch circuit components inside the equipment.
- Use a static-safe workstation, if available.
- Store the equipment in appropriate static-safe packaging when not in use.

Safety Considerations

Safety considerations are an important element of proper system installation. Actively thinking about the safety of yourself and others, as well as the condition of your equipment, is of primary importance. We recommend reviewing the following safety considerations.

North American Hazardous Location Approval

The following information applies when operating this equipment in hazardous locations:	**Informations sur l'utilisation de cet équipement en environnements dangereux:**
Products marked "CL I, DIV 2, GP A, B, C, D" are suitable for use in Class I Division 2 Groups A, B, C, D, Hazardous Locations and nonhazardous locations only. Each product is supplied with markings on the rating nameplate indicating the hazardous location temperature code. When combining products within a system, the most adverse temperature code (lowest "T" number) may be used to help determine the overall temperature code of the system. Combinations of equipment in your system are subject to investigation by the local Authority Having Jurisdiction at the time of installation.	Les produits marqués "CL I, DIV 2, GP A, B, C, D" ne conviennent qu'à une utilisation en environnements de Classe I Division 2 Groupes A, B, C, D dangereux et non dangereux. Chaque produit est livré avec des marquages sur sa plaque d'identification qui indiquent le code de température pour les environnements dangereux. Lorsque plusieurs produits sont combinés dans un système, le code de température le plus défavorable (code de température le plus faible) peut être utilisé pour déterminer le code de température global du système. Les combinaisons d'équipements dans le système sont sujettes à inspection par les autorités locales qualifiées au moment de l'installation.
EXPLOSION HAZARD • Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous. • Do not disconnect connections to this equipment unless power has been removed or the area is known to be nonhazardous. Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product. • Substitution of any component may impair suitability for Class I, Division 2. • If this product contains batteries, they must only be changed in an area known to be nonhazardous.	**RISQUE D'EXPLOSION** • Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher l'équipement. • Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher les connecteurs. Fixer tous les connecteurs externes reliés à cet équipement à l'aide de vis, loquets coulissants, connecteurs filetés ou autres moyens fournis avec ce produit. • La substitution de tout composant peut rendre cet équipement inadapté à une utilisation en environnement de Classe I, Division 2. • S'assurer que l'environnement est classé non dangereux avant de changer les piles.

Disconnecting Main Power

WARNING: Explosion Hazard
Do not replace components, connect equipment, or disconnect equipment unless power has been switched off.

The main power disconnect switch should be located where operators and maintenance personnel have quick and easy access to it. In addition to disconnecting electrical power, all other sources of power (pneumatic and hydraulic) should be de-energized before working on a machine or process controlled by a controller.

Safety Circuits

WARNING: Explosion Hazard
Do not connect or disconnect connectors while circuit is live.

Circuits installed on the machine for safety reasons, like overtravel limit switches, stop push buttons, and interlocks, should always be hard-wired directly to the master control relay. These devices must be wired in series so that when any one device opens, the master control relay is de-energized, thereby removing power to the machine. Never alter these circuits to defeat their function. Serious injury or machine damage could result.

Power Distribution

There are some points about power distribution that you should know:

- The master control relay must be able to inhibit all machine motion by removing power to the machine I/O devices when the relay is de-energized. It is recommended that the controller remain powered even when the master control relay is de-energized.
- If you are using a DC power supply, interrupt the load side rather than the AC line power. This avoids the additional delay of power supply turn-off. The DC power supply should be powered directly from the fused secondary of the transformer. Power to the DC input and output circuits should be connected through a set of master control relay contacts.

Periodic Tests of Master Control Relay Circuit

Any part can fail, including the switches in a master control relay circuit. The failure of one of these switches would most likely cause an open circuit, which would be a safe power-off failure. However, if one of these switches shorts out, it no longer provides any safety protection. These switches should be tested periodically to assure they will stop machine motion when needed.

Power Considerations

The following explains power considerations for the micro controllers.

Isolation Transformers

You may want to use an isolation transformer in the AC line to the controller. This type of transformer provides isolation from your power distribution system to reduce the electrical noise that enters the controller and is often used as a step-down transformer to reduce line voltage. Any transformer used with the controller must have a sufficient power rating for its load. The power rating is expressed in volt-amperes (VA).

Power Supply Inrush

During power-up, the Micro800 power supply allows a brief inrush current to charge internal capacitors. Many power lines and control transformers can supply inrush current for a brief time. If the power source cannot supply this inrush current, the source voltage may sag momentarily.

The only effect of limited inrush current and voltage sag on the Micro800 is that the power supply capacitors charge more slowly. However, the effect of a voltage sag on other equipment should be considered. For example, a deep voltage sag may reset a computer connected to the same power source. The following considerations determine whether the power source must be required to supply high inrush current:

- The power-up sequence of devices in a system.
- The amount of the power source voltage sag if the inrush current cannot be supplied.
- The effect of voltage sag on other equipment in the system.

If the entire system is powered-up at the same time, a brief sag in the power source voltage typically will not affect any equipment.

Loss of Power Source

The optional Micro800 AC power supply is designed to withstand brief power losses without affecting the operation of the system. The time the system is operational during power loss is called program scan hold-up time after loss of power. The duration of the power supply hold-up time depends on power consumption of controller system, but is typically between 10 milliseconds and 3 seconds.

Input States on Power Down

The power supply hold-up time as described above is generally longer than the turn-on and turn-off times of the inputs. Because of this, the input state change from "On" to "Off" that occurs when power is removed may be recorded by the processor before the power supply shuts down the system. Understanding this concept is important. The user program should be written to take this effect into account.

Other Types of Line Conditions

Occasionally the power source to the system can be temporarily interrupted. It is also possible that the voltage level may drop substantially below the normal line voltage range for a period of time. Both of these conditions are considered to be a loss of power for the system.

Preventing Excessive Heat

For most applications, normal convective cooling keeps the controller within the specified operating range. Ensure that the specified temperature range is maintained. Proper spacing of components within an enclosure is usually sufficient for heat dissipation.

In some applications, a substantial amount of heat is produced by other equipment inside or outside the enclosure. In this case, place blower fans inside the enclosure to assist in air circulation and to reduce "hot spots" near the controller.

Additional cooling provisions might be necessary when high ambient temperatures are encountered.

TIP Do not bring in unfiltered outside air. Place the controller in an enclosure to protect it from a corrosive atmosphere. Harmful contaminants or dirt could cause improper operation or damage to components. In extreme cases, you may need to use air conditioning to protect against heat build-up within the enclosure.

Master Control Relay

A hard-wired master control relay (MCR) provides a reliable means for emergency machine shutdown. Since the master control relay allows the placement of several emergency-stop switches in different locations, its installation is important from a safety standpoint. Overtravel limit switches or mushroom-head push buttons are wired in series so that when any of them opens, the master control relay is de-energized. This removes power to input and output device circuits. Refer to the figures on pages 21 and 22.

WARNING: Never alter these circuits to defeat their function since serious injury and/or machine damage could result.

TIP If you are using an external DC power supply, interrupt the DC output side rather than the AC line side of the supply to avoid the additional delay of power supply turn-off.

The AC line of the DC output power supply should be fused.

Connect a set of master control relays in series with the DC power supplying the input and output circuits.

Place the main power disconnect switch where operators and maintenance personnel have quick and easy access to it. If you mount a disconnect switch inside the controller enclosure, place the switch operating handle on the outside of the enclosure, so that you can disconnect power without opening the enclosure.

Whenever any of the emergency-stop switches are opened, power to input and output devices should be removed.

When you use the master control relay to remove power from the external I/O circuits, power continues to be provided to the controller's power supply so that diagnostic indicators on the processor can still be observed.

The master control relay is not a substitute for a disconnect to the controller. It is intended for any situation where the operator must quickly de-energize I/O devices only. When inspecting or installing terminal connections, replacing output fuses, or working on equipment within the enclosure, use the disconnect to shut off power to the rest of the system.

TIP Do not control the master control relay with the controller. Provide the operator with the safety of a direct connection between an emergency-stop switch and the master control relay.

Using Emergency-Stop Switches

When using emergency-stop switches, adhere to the following points:

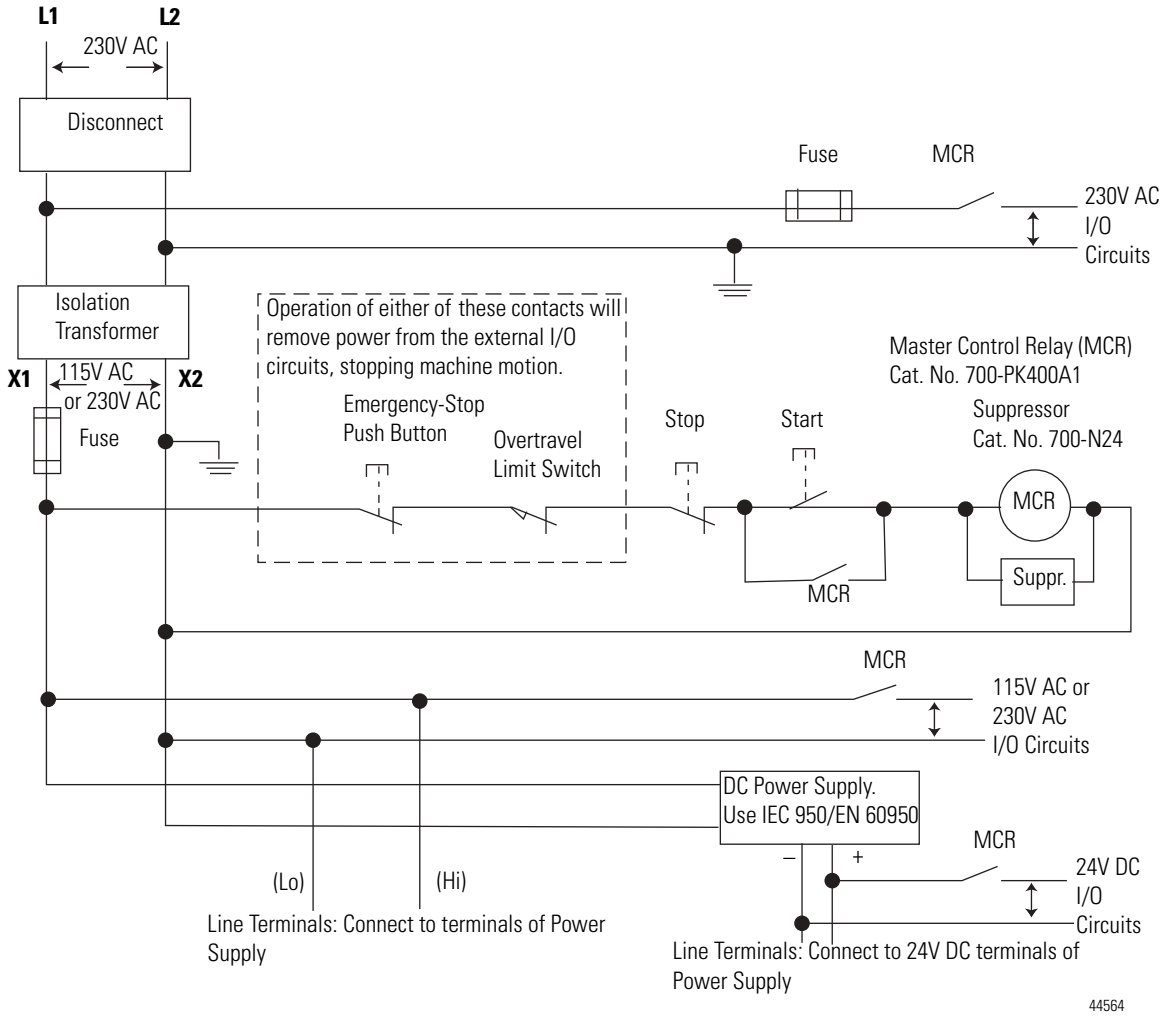
- Do not program emergency-stop switches in the controller program. Any emergency-stop switch should turn off all machine power by turning off the master control relay.
- Observe all applicable local codes concerning the placement and labeling of emergency-stop switches.

- Install emergency-stop switches and the master control relay in your system. Make certain that relay contacts have a sufficient rating for your application. Emergency-stop switches must be easy to reach.
- In the following illustration, input and output circuits are shown with MCR protection. However, in most applications, only output circuits require MCR protection.

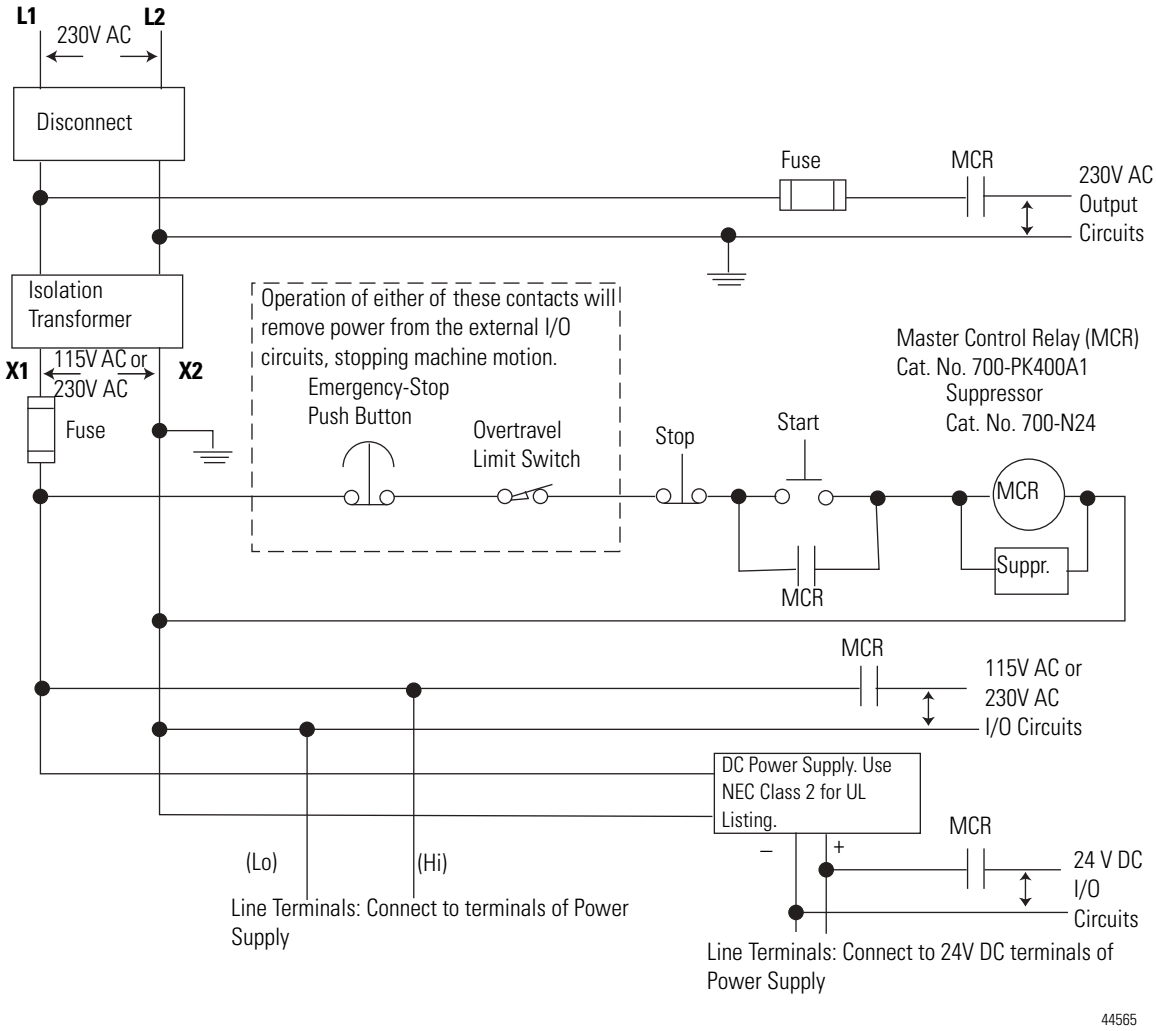
The following illustrations show the Master Control Relay wired in a grounded system.

TIP In most applications input circuits do not require MCR protection; however, if you need to remove power from all field devices, you must include MCR contacts in series with input power wiring.

Schematic (Using IEC Symbols)



Schematic (Using ANSI/CSA Symbols)



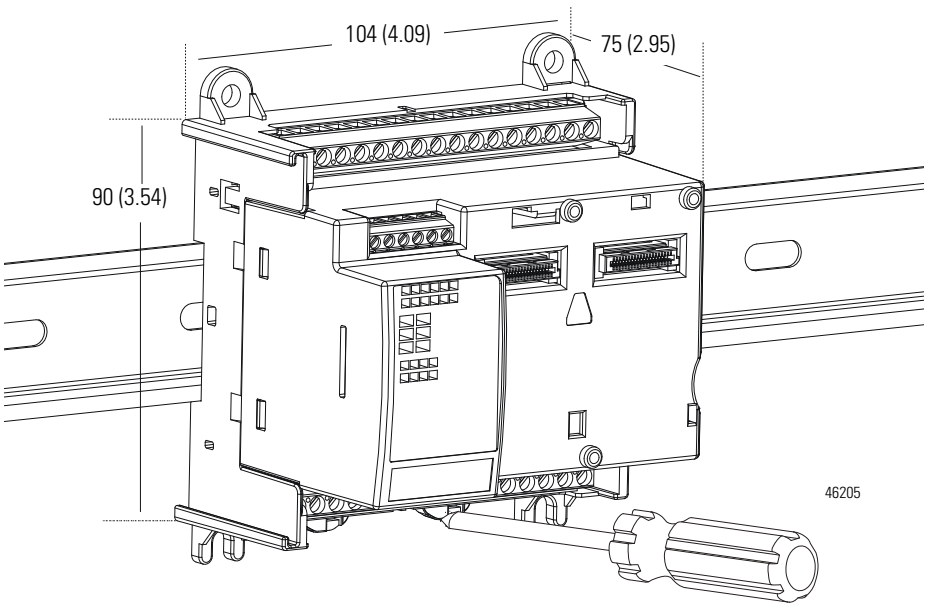
Install Your Controller

This chapter serves to guide the user on installing the controller. It includes the following topics.

Topic	Page
Controller Mounting Dimensions	23
Connect the Controller to an EtherNet/IP Network	25
Module Spacing	24
DIN Rail Mounting	24
Panel Mounting	24
Panel Mounting Dimensions	25
Install the microSD Card	26
Install the 2080-REMLCD Module	27

Controller Mounting Dimensions

Mounting dimensions do not include mounting feet or DIN rail latches.



Measurements in millimeters (inches)

Module Spacing

Maintain spacing from enclosure walls, wireways, and adjacent equipment. Allow 50.8 mm (2 in.) of space on all sides. This provides ventilation and electrical isolation. If optional accessories/modules are attached to the controller, such as the power supply 2080-PS120-240VAC or expansion I/O modules, make sure that there is 50.8 mm (2 in.) of space on all sides after attaching the optional parts.

DIN Rail Mounting

The module can be mounted using the following DIN rails: 35 x 7.5 x 1 mm and 35 x 15 mm (EN 50 022 - 35 x 7.5 and EN 50 022 - 35 x 15).

TIP For environments with greater vibration and shock concerns, use the panel mounting method, instead of DIN rail mounting.

Before mounting the module on a DIN rail, use a flat-blade screwdriver in the DIN rail latch and pry it downwards until it is in the unlatched position.

1. Hook the top of the DIN rail mounting area of the controller onto the DIN rail, and then press the bottom until the controller snaps onto the DIN rail.
2. Push the DIN rail latch back into the latched position.
   Use DIN rail end anchors (Allen-Bradley part number 1492-EAJ35 or 1492-EAHJ35) for vibration or shock environments.

To remove your controller from the DIN rail, pry the DIN rail latch downwards until it is in the unlatched position.

Panel Mounting

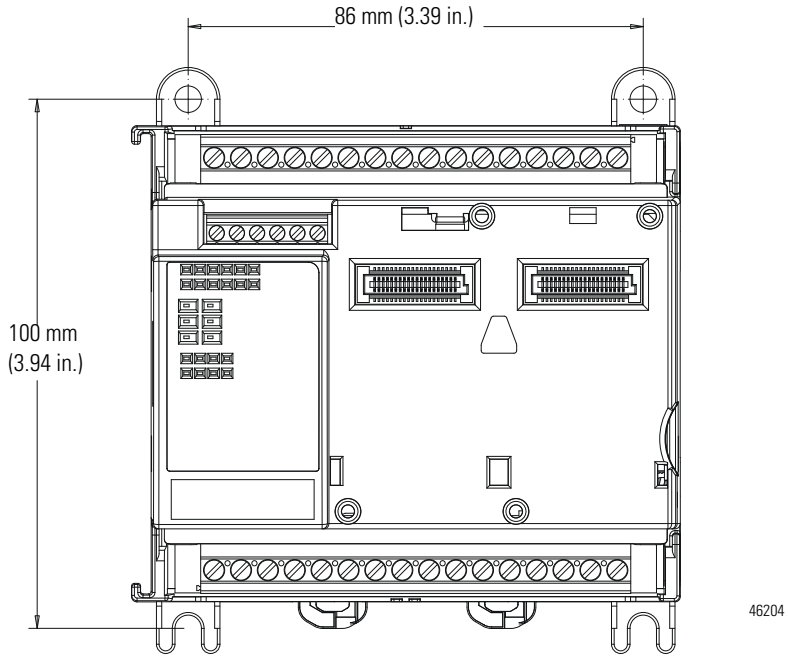
The preferred mounting method is to use four M4 (#8) screws per module. Hole spacing tolerance: ±0.4 mm (0.016 in.).

Follow these steps to install your controller using mounting screws.

1. Place the controller against the panel where you are mounting it. Make sure the controller is spaced properly.
2. Mark drilling holes through the mounting screw holes and mounting feet then remove the controller.
3. Drill the holes at the markings, then replace the controller and mount it. Leave the protective debris strip in place until you are finished wiring the controller and any other devices.

Panel Mounting Dimensions

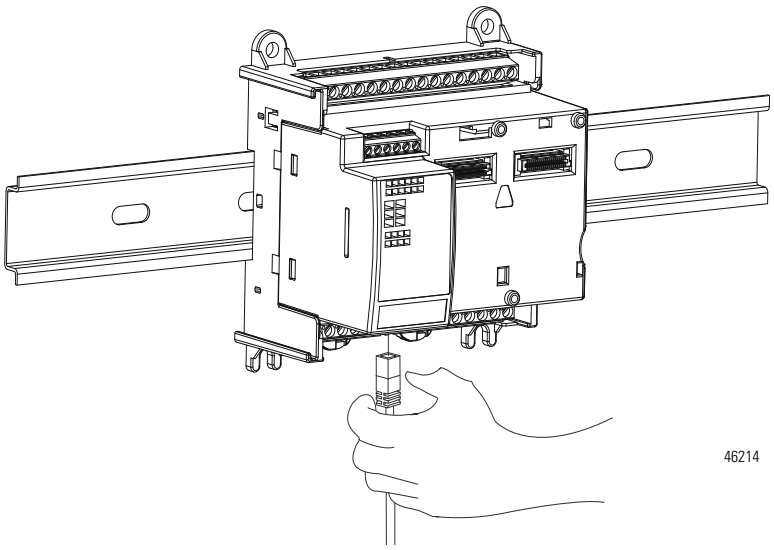
Micro820 20-point controllers
2080-LC20-20AWB, 2080-LC20-20QWB, 2080-LC20-20QBB
2080-LC20-20AWBR, 2080-LC20-20QWBR, 2080-LC20-20QBBR



Connect the Controller to an EtherNet/IP Network

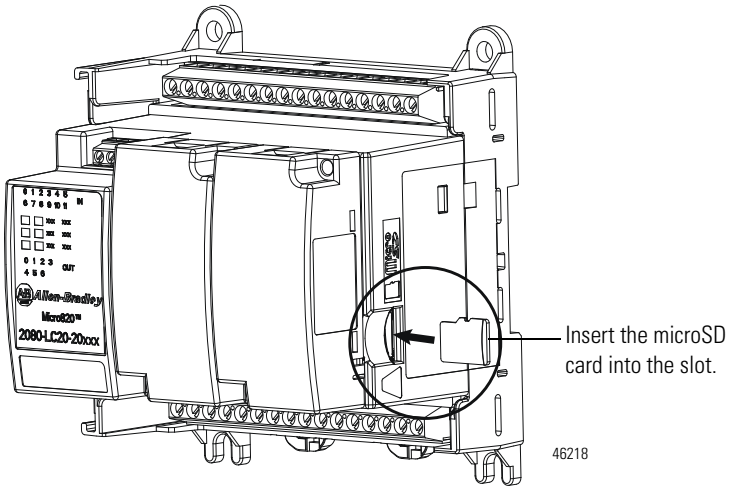
WARNING: If you connect or disconnect the communications cable with power applied to this module or any device on the network, an electrical arc can occur. This could cause an explosion in hazardous location installations.
Be sure that power is removed or the area is nonhazardous before proceeding.

Connect the RJ-45 connector of the Ethernet cable to the Ethernet port on the controller. The port is on the bottom of the controller.

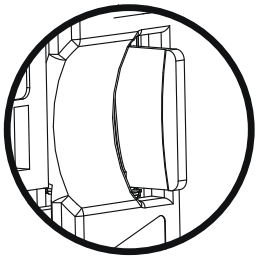


Install the microSD Card

1. Insert the microSD card into the card slot.
   You can install the microSD card in one orientation only. The beveled corner should be at the bottom. If you feel resistance when inserting the microSD card, pull it out and change the orientation.



2. Gently press the card until it clicks into place.



3. To remove the microSD card from the slot, gently press the card until it clicks back and releases itself from the slot.

Install the 2080-REMLCD Module

The Micro820 controller supports the 2080-REMLCD module, a simple text display interface for configuring settings such as IP address. It can be mounted through a front panel or on the same DIN rail as the controller.

For information on how the Remote LCD interfaces with the Micro820 controller, see Using the Micro800 Remote LCD on page 73.

To learn about installation, hardware features, and specifications of the 2080-REMLCD module, refer to the Installation Instructions, publication 2080-IN010 in the Literature Library.

Notes:

Wire Your Controller

This chapter provides information on the Micro820 controller wiring requirements. It includes the following sections:

Topic	Page
Wiring Requirements and Recommendation	29
Use Surge Suppressors	30
Recommended Surge Suppressors	32
Grounding the Controller	33
Wiring Diagrams	33
Controller I/O Wiring	40
Minimize Electrical Noise	40
Analog Channel Wiring Guidelines	40
Minimize Electrical Noise on Analog Channels	41
Grounding Your Analog Cable	41
Wiring Examples	42

Wiring Requirements and Recommendation

WARNING: Before you install and wire any device, disconnect power to the controller system.

WARNING: Calculate the maximum possible current in each power and common wire. Observe all electrical codes dictating the maximum current allowable for each wire size. Current above the maximum ratings may cause wiring to overheat, which can cause damage.
United States Only: If the controller is installed within a potentially hazardous environment, all wiring must comply with the requirements stated in the National Electrical Code 501-10 (b).

- Allow for at least 50 mm (2 in.) between I/O wiring ducts or terminal strips and the controller.
- Route incoming power to the controller by a path separate from the device wiring. Where paths must cross, their intersection should be perpendicular.

TIP Do not run signal or communications wiring and power wiring in the same conduit. Wires with different signal characteristics should be routed by separate paths.

- Separate wiring by signal type. Bundle wiring with similar electrical characteristics together.
- Separate input wiring from output wiring.
- Label wiring to all devices in the system. Use tape, shrink-tubing, or other dependable means for labeling purposes. In addition to labeling, use colored insulation to identify wiring based on signal characteristics. For example, you may use blue for DC wiring and red for AC wiring.

Wire Requirements

Wire Requirements for fixed terminal blocks

	Min	Max	
Solid	0.14 mm^2 (26 AWG)	2.5 mm^2 (14 AWG)	rated @ 90 °C (194 °F) insulation max
Stranded	0.14 mm^2 (26 AWG)	1.5 mm^2 (16 AWG)	

Wire requirements for removable terminal blocks

	Min	Max	
Solid and Stranded	0.2 mm^2 (24 AWG)	2.5 mm^2 (14 AWG)	rated @ 90 °C (194 °F) insulation max

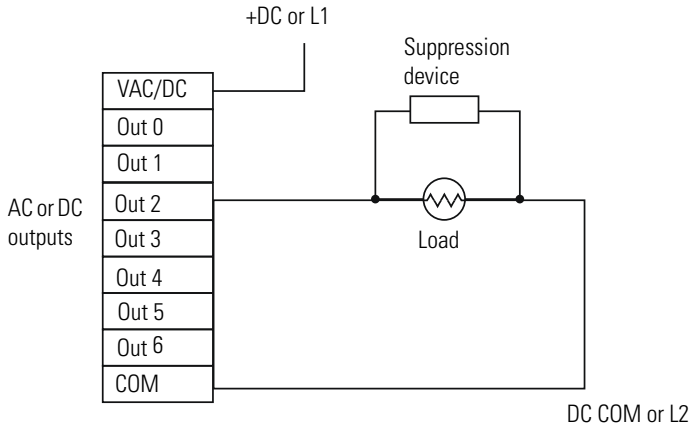
Wire requirements for RS232/RS485 serial port terminal block

	Min	Max	
Solid	0.14 mm^2 (26 AWG)	1.5 mm^2 (16 AWG)	rated @ 90 °C (194 °F) insulation max
Stranded	0.14 mm^2 (26 AWG)	1.0 mm^2 (18 AWG)	

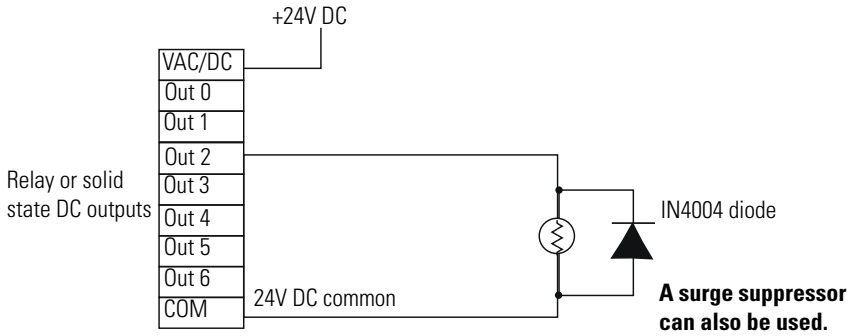
Use Surge Suppressors

Because of the potentially high current surges that occur when switching inductive load devices, such as motor starters and solenoids, the use of some type of surge suppression to protect and extend the operating life of the controllers output contacts is required. Switching inductive loads without surge suppression can *significantly* reduce the life expectancy of relay contacts. By adding a suppression device directly across the coil of an inductive device, you prolong the life of the output or relay contacts. You also reduce the effects of voltage transients and electrical noise from radiating into adjacent systems.

The following diagram shows an output with a suppression device. We recommend that you locate the suppression device as close as possible to the load device.



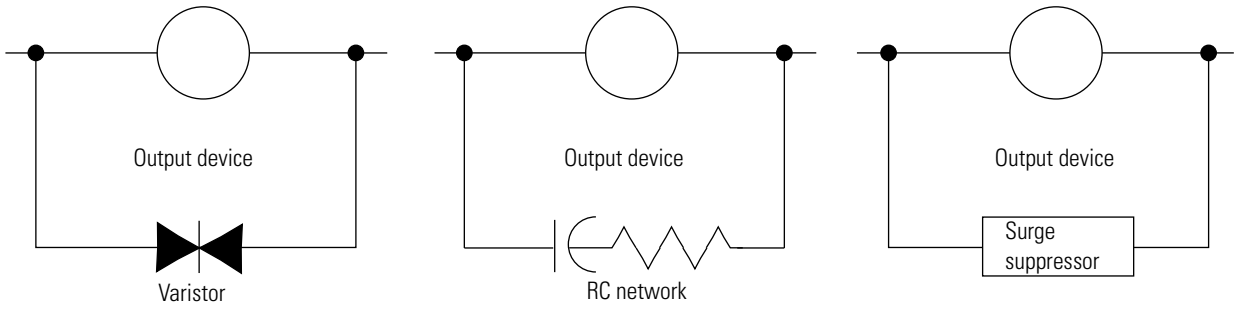
If the outputs are DC, we recommend that you use an 1N4004 diode for surge suppression, as shown below. For inductive DC load devices, a diode is suitable. A 1N4004 diode is acceptable for most applications. A surge suppressor can also be used. See Recommended Surge Suppressors on page 32. As shown below, these surge suppression circuits connect directly across the load device.



Suitable surge suppression methods for inductive AC load devices include a varistor, an RC network, or an Allen-Bradley surge suppressor, all shown below. These components must be appropriately rated to suppress the switching

transient characteristic of the particular inductive device. See Recommended Surge Suppressors on page 32 for recommended suppressors.

Surge Suppression for Inductive AC Load Devices



Recommended Surge Suppressors

Use the Allen-Bradley surge suppressors in the following table for use with relays, contactors, and starters.

Recommended Surge Suppressors

Device	Coil Voltage	Suppressor Catalog Number	Type[4]
Bulletin 100/104K 700K	24…48V AC	100-KFSC50	RC
	110…280V AC	100-KFSC280	
	380…480V AC	100-KFSC480	
	12…55 V AC, 12…77V DC	100-KFSV55	MOV
	56…136 VAC, 78…180V DC	100-KFSV136	
	137…277V AC, 181…250 V DC	100-KFSV277	
	12…250V DC	100-KFSD250	Diode
Bulletin 100C, (C09 - C97)	24…48V AC	100-FSC48[1]	RC
	110…280V AC	100-FSC280[1]	
	380…480V AC	100-FSC480[1]	
	12…55V AC, 12…77V DC	100-FSV55[1]	MOV
	56…136V AC, 78…180V DC	100-FSV136[1]	
	137…277V AC, 181…250V DC	100-FSV277[1]	
	278…575V AC	100-FSV575[1]	
	12…250V DC	100-FSD250[1]	Diode
Bulletin 509 Motor Starter Size 0 - 5	12…120V AC	599-K04	MOV
	240…264V AC	599-KA04	

Recommended Surge Suppressors

Device	Coil Voltage	Suppressor Catalog Number	Type[4]
Bulletin 509 Motor Starter Size 6	12…120V AC	199-FSMA1[2]	RC
	12…120V AC	199-GSMA1[3]	MOV
Bulletin 700 R/RM Relay	AC coil	Not Required	
	24…48V DC	199-FSMA9	MOV
	50…120V DC	199-FSMA10	
	130…250V DC	199-FSMA11	
Bulletin 700 Type N, P, PK or PH Relay	6…150V AC/DC	700-N24	RC
	24…48V AC/DC	199-FSMA9	MOV
	50…120V AC/DC	199-FSMA10	
	130…250V AC/DC	199-FSMA11	
	6…300V DC	199-FSMZ-1	Diode
Miscellaneous electromagnetic devices limited to 35 sealed VA	6…150V AC/DC	700-N24	RC

(1) Catalog numbers for screwless terminals include the string 'CR' after '100-'. For example: Cat. No. 100-FSC48 becomes Cat. No. 100-**CR**FSC48; Cat. No. 100-FSV55 becomes 100-**CR**FSV55; and so on.

(2) For use on the interposing relay.

(3) For use on the contactor or starter.

(4) RC Type not to be used with Triac outputs. Varistor is not recommended for use on the relay outputs.

Grounding the Controller

WARNING: All devices connected to the RS232/RS485 communication port must be referenced to controller ground, or be floating (not referenced to a potential other than ground). Failure to follow this procedure may result in property damage or personal injury.

This product is intended to be mounted to a well grounded mounting surface such as a metal panel. Refer to the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1, for additional information.

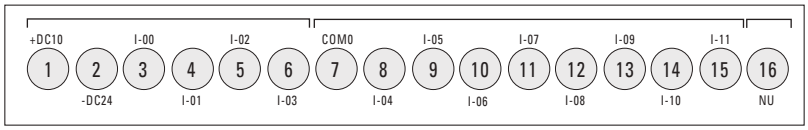
Wiring Diagrams

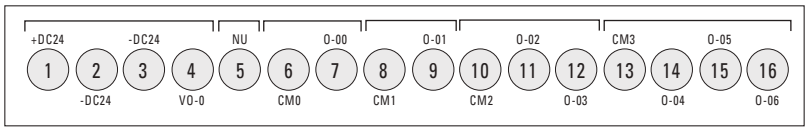
The following illustrations show the wiring diagrams for the Micro800 controllers. Controllers with DC inputs can be wired as either sinking or sourcing inputs. Sinking and sourcing does not apply to AC inputs.

High-speed inputs and outputs are indicated by ○.

2080-LC20-20AWB, 2080-LC20-20QWB,
2080-LC20-20AWBR, 2080-LC20- 20QWBR

Input Terminal Block





46212

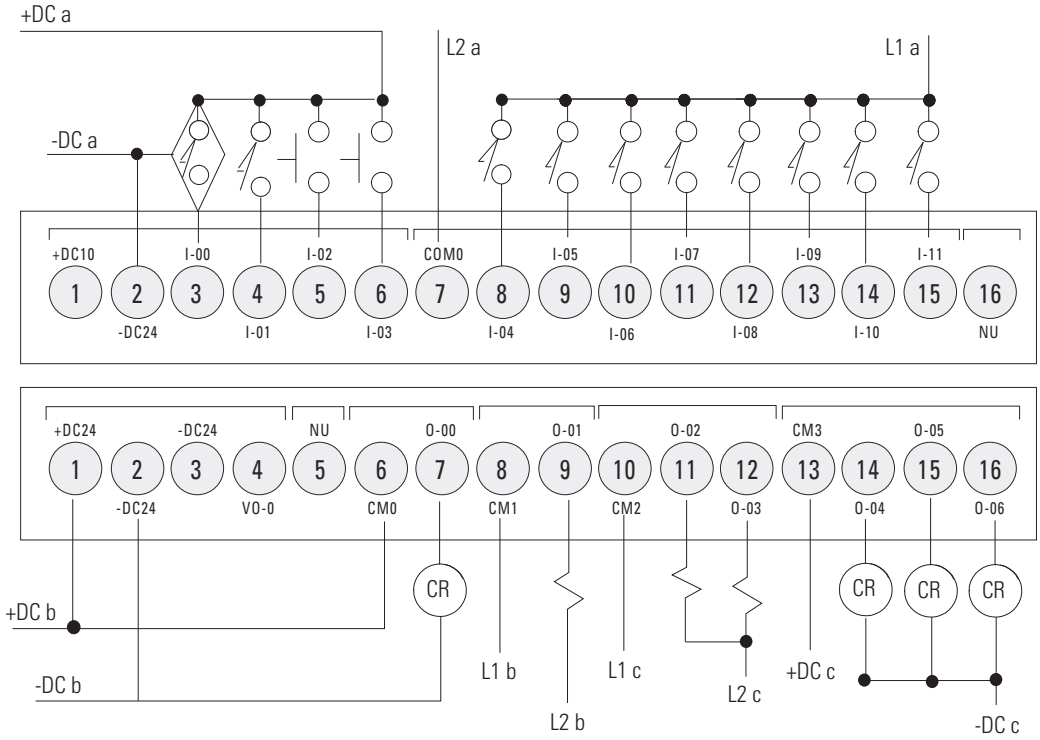
Output Terminal Block

IMPORTANT Note the following:

- The "-DC24" terminals on the Input (terminal 2) and Output (terminals 2 and 3) Terminal Blocks are internally shorted.
- "NU" means that the terminal is not used / no connection.
- Inputs I-00, I-01, I-02, and I-03 are shared between digital and analog inputs.
- Inputs I-00, I-01, I-02, and I-03 can only be used in sinking input configuration.

2080-LC20-20AWB, 2080-LC20-20AWBR

Sinking Input Configuration



ATTENTION: For 2080-LC20-20AWB/R catalogs, inputs 00…03 are limited to 24V DC. All other inputs (04…11) are limited to 120V AC.

Digital Input

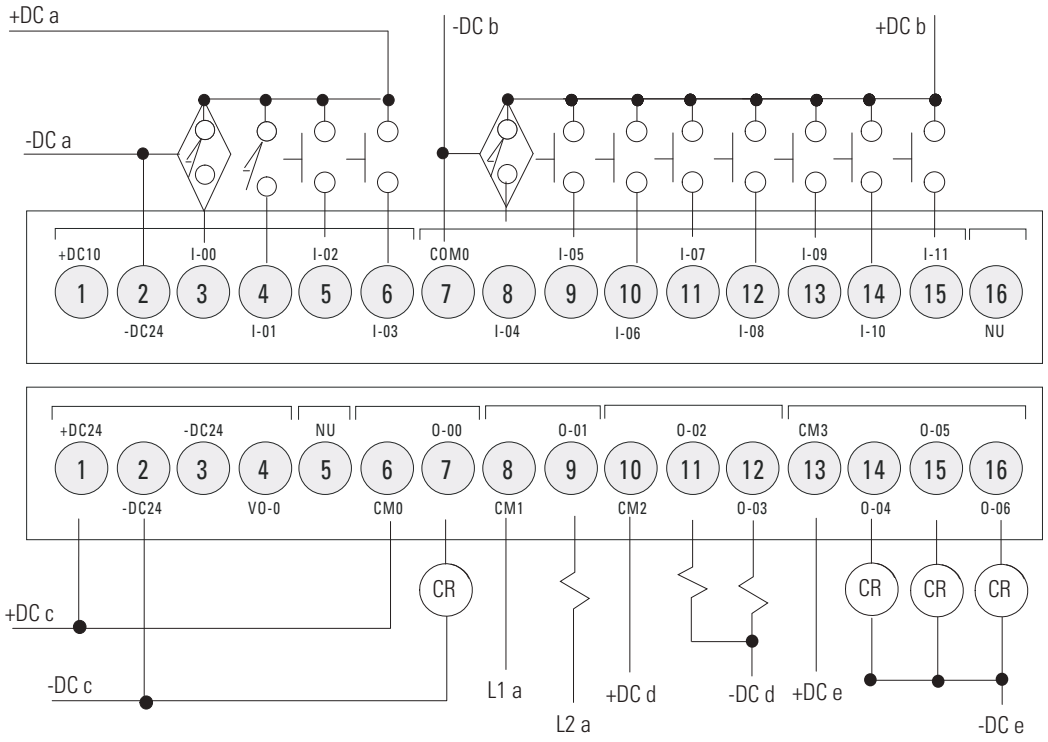
Controller	Terminal Number	Input Common Terminal Label	Terminal Number	Input Terminal Label
2080-LC20-20AWB, 2080-LC20-20AWBR	2	"-DC24" (24V DC sink only)	3	I-00
			4	I-01
			5	I-02
			6	I-03
	7	CM0 (120V AC)	8	I-04
			9	I-05
			10	I-06
			11	I-07
			12	I-08
			13	I-09
			14	I-10
			15	I-11

Digital Output

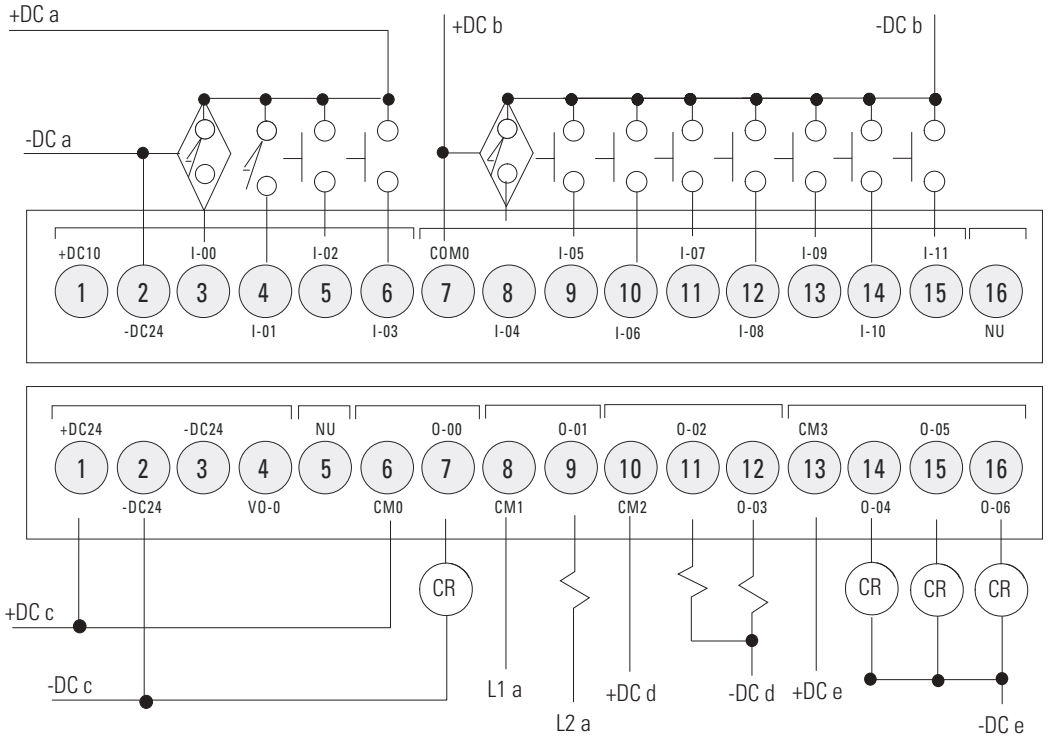
Controller	Terminal Number	Input Common Terminal Label	Terminal Number	Input Terminal Label
2080-LC20-20AWB, 2080-LC20-20AWBR	6	CM0 (VAC/DC)	7	O-00
	8	CM1 (VAC/DC)	9	O-01
	10	CM2 (VAC/DC)	11, 12	O-02, O-03
	13	CM3 (VAC/DC)	14, 15, 16	O-04, O-05, O-06

2080-LC20-20QWB, 2080-LC20-20QWBR

DC Sinking Input Configuration – Inputs 00...11



DC Sourcing Input Configuration – Inputs 4...11



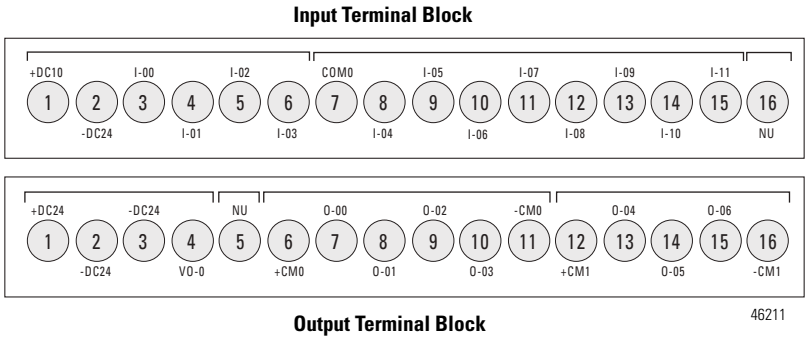
Digital Input

Controller	Terminal Number	Input Common Terminal Label	Terminal Number	Input Terminal Label
2080-LC20-20QWB, 2080-LC20-20QWBR	2	"-DC24" (24V DC sink only)	3	I-00
			4	I-01
			5	I-02
			6	I-03
	7	CM0 (24V DC sink/source)	8	I-04
			9	I-05
			10	I-06
			11	I-07
			12	I-08
			13	I-09
			14	I-10
			15	I-11

Digital Output

Controller	Terminal Number	Input Common Terminal Label	Terminal Number	Input Terminal Label
2080-LC20-20QWB, 2080-LC20-20QWBR	6	CM0 (VAC/DC)	7	O-00
	8	CM1 (VAC/DC)	9	O-01
	10	CM2 (VAC/DC)	11, 12	O-02, O-03
	13	CM3 (VAC/DC)	14, 15, 16	O-04, O-05, O-06

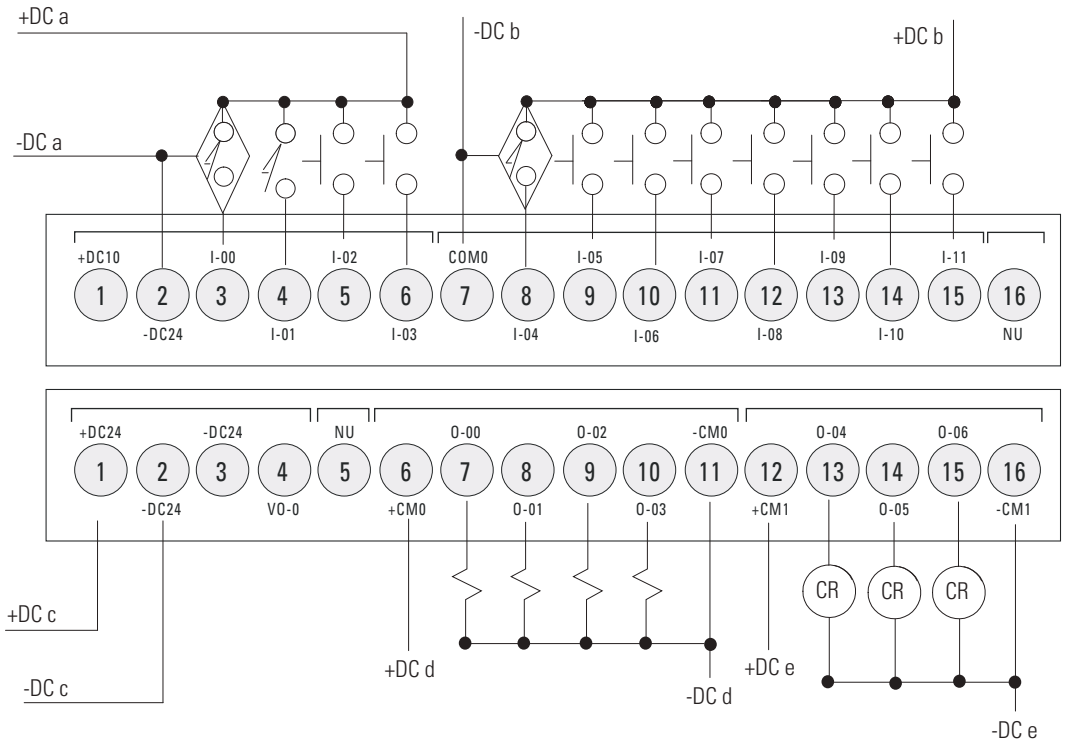
2080-LC20-20QBB / 2080-LC20-20QBBR



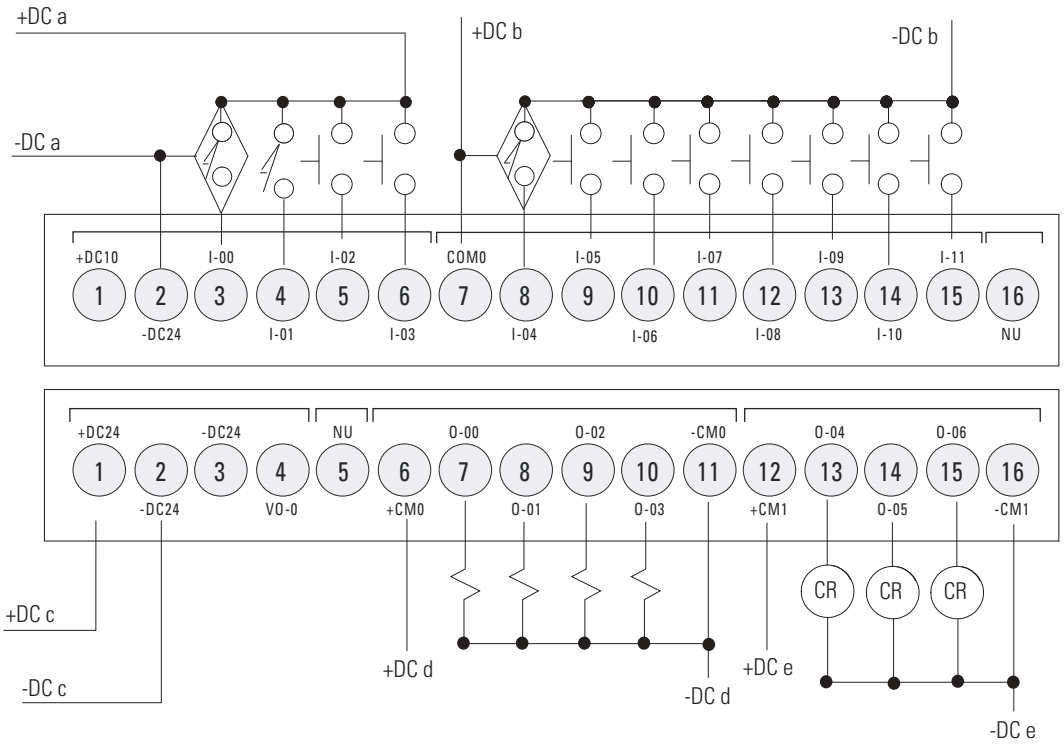
IMPORTANT Note the following:

- The "-DC24" terminals on the Input (terminal 2) and Output (terminals 2 and 3) Terminal Blocks are internally shorted.
- "NU" means that the terminal is not used / no connection.
- Inputs I-00, I-01, I-02, and I-03 are shared between digital and analog inputs.
- Inputs I-00, I-01, I-02, and I-03 can only be used in sinking input configuration.

DC Sinking Input Configuration – Inputs 00...11



DC Sourcing Input Configuration – Inputs 4...11



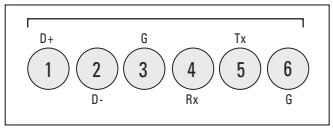
Digital Input

Controller	Terminal Number	Input Common Terminal Label	Terminal Number	Input Terminal Label
2080-LC20-20QBB, 2080-LC20-20QBBR	2	"-DC24" (24V DC sink only)	3	I-00
			4	I-01
			5	I-02
			6	I-03
	7	CM0 (24V DC sink/source)	8	I-04
			9	I-05
			10	I-06
			11	I-07
			12	I-08
			13	I-09
			14	I-10
			15	I-11

Digital Output

Controller	Terminal Number	Input Common Terminal Label	Terminal Number	Input Terminal Label
2080-LC20-20QBB, 2080-LC20-20QBBR	6	+CM0 (VDC source)	7, 8, 9, 10	O-00, O-01, O-02, O-03
	11	-CM0		
	12	+CM1 (VDC source)	13, 14, 15	O-04, O-05, O-06
	16	-CM1		

Serial Port Terminal Block



(View into terminal block)

Pin 1	RS485	Data +
Pin 2	RS485	Data -
Pin3	RS485	Ground(1)
Pin 4	RS232	Receive
Pin 5	RS232	Transmit
Pin 6	RS232	Ground(1)

(1) Non-isolated.

Controller I/O Wiring

This section contains some relevant information about minimizing electrical noise and also includes some wiring examples.

Minimize Electrical Noise

Because of the variety of applications and environments where controllers are installed and operating, it is impossible to ensure that all environmental noise will be removed by input filters. To help reduce the effects of environmental noise, install the Micro800 system in a properly rated (for example, NEMA) enclosure. Make sure that the Micro800 system is properly grounded.

A system may malfunction due to a change in the operating environment after a period of time. We recommend periodically checking system operation, particularly when new machinery or other noise sources are installed near the Micro800 system.

Analog Channel Wiring Guidelines

Consider the following when wiring your analog channels:

- The analog common (-DC24) is not electrically isolated from the system, and is connected to the power supply common.
- Analog channels are not isolated from each other.
- Use Belden cable #8761, or equivalent, shielded wire.
- Under normal conditions, the drain wire (shield) should be connected to the metal mounting panel (earth ground). Keep the shield connection to earth ground as short as possible.
- To ensure optimum accuracy for voltage type inputs, limit overall cable impedance by keeping all analog cables as short as possible. Locate the I/O system as close to your voltage type sensors or actuators as possible.

Minimize Electrical Noise on Analog Channels

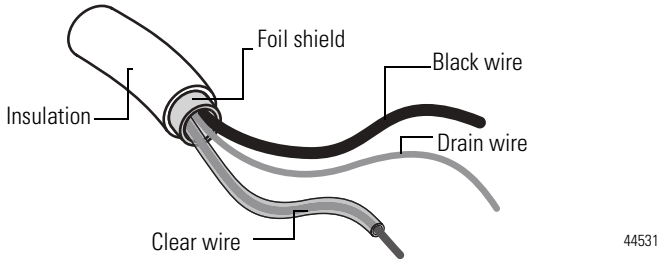
Inputs on analog channels employ digital high-frequency filters that significantly reduce the effects of electrical noise on input signals. However, because of the variety of applications and environments where analog controllers are installed and operated, it is impossible to ensure that all environmental noise will be removed by the input filters.

Several specific steps can be taken to help reduce the effects of environmental noise on analog signals:

- install the Micro800 system in a properly rated enclosure, for example, NEMA/IP. Make sure that the shield is properly grounded.
- use Belden cable #8761 for wiring the analog channels, making sure that the drain wire and foil shield are properly earth grounded.
- route the Belden cable separately from any AC wiring. Additional noise immunity can be obtained by routing the cables in grounded conduit.

Grounding Your Analog Cable

Use shielded communication cable (Belden #8761). The Belden cable has two signal wires (black and clear), one drain wire, and a foil shield. The drain wire and foil shield must be grounded at one end of the cable.

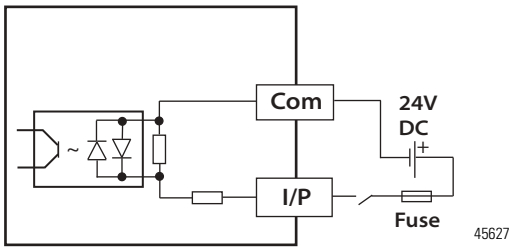


IMPORTANT Do not ground the drain wire and foil shield at both ends of the cable.

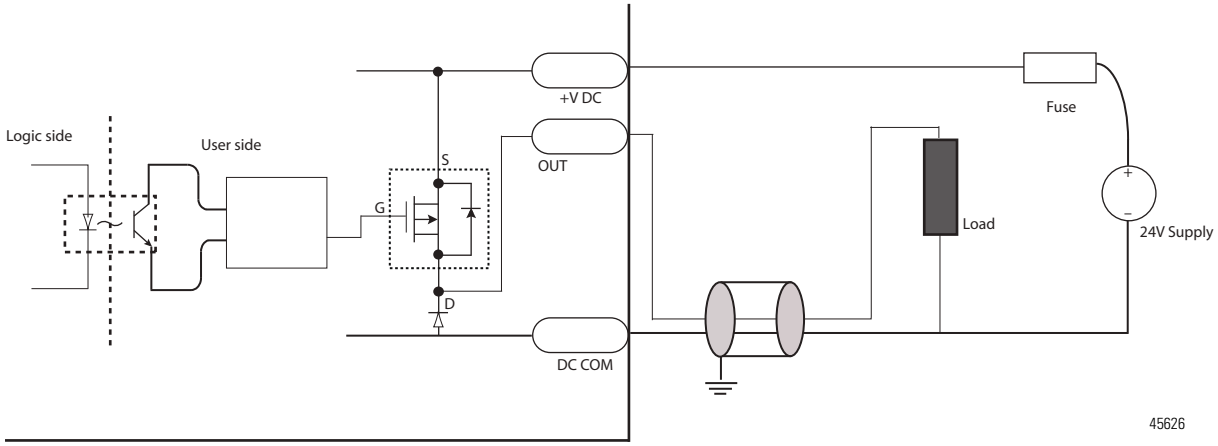
Wiring Examples

Examples of sink/source, input/output wiring are shown below.

Sink Input Wiring Example

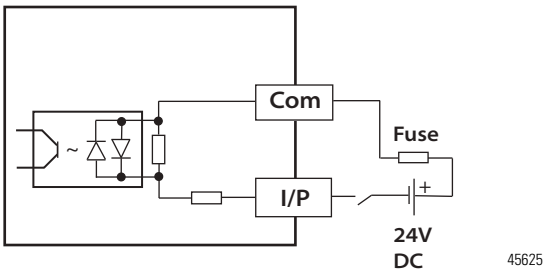


Source Output Wiring Example



IMPORTANT For 2080-LC20-20QBB(R) discrete output 06, shielded cable is required if the output is used as PWM. Otherwise, unshielded cable can be used.

Source Input Wiring Example

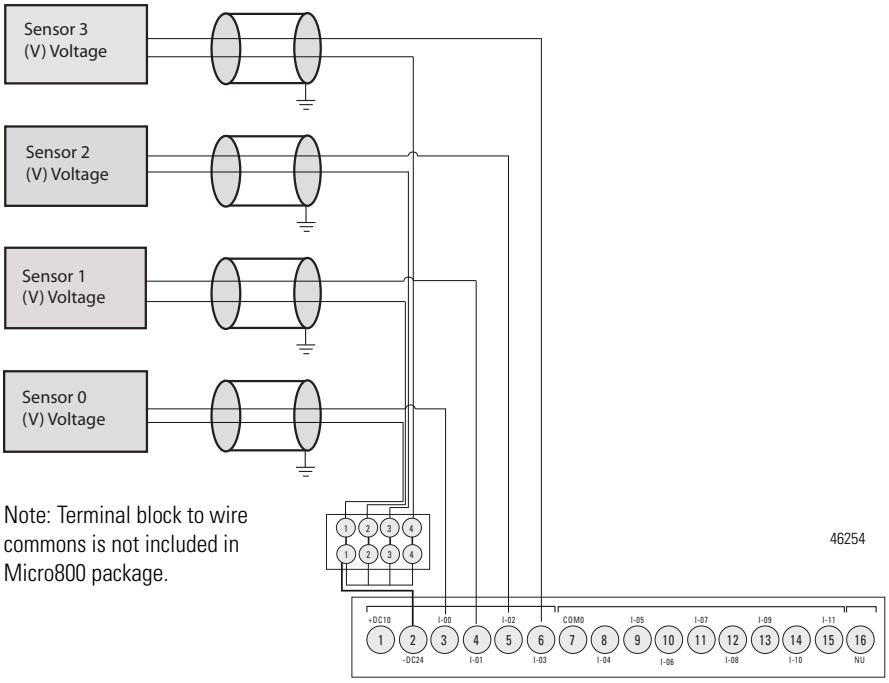


Wiring Analog Channels

Analog input circuits can monitor voltage signals and convert them to serial digital data as shown in the following illustration.

ATTENTION: Analog inputs and outputs are not isolated.

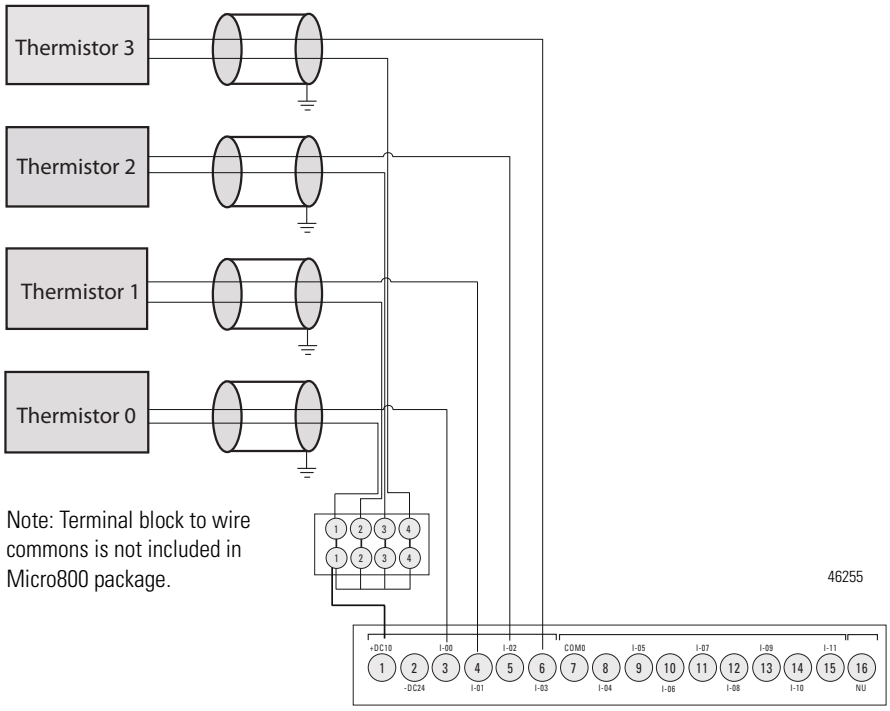
Analog input to sensors



Note: Terminal block to wire commons is not included in Micro800 package.

The "-DC24" terminal is the analog ground connection for analog inputs (I-00 to I-03).

Analog input to thermistors



The "+DC10" terminal supplies 10V DC power source to the Thermistor inputs (I-00 to I-03).

Calculate for Thermistor Resistance

While connecting Analog input to thermistor as shown in previous diagram, calculate input voltage using the following equation:

$$Vi = \frac{Ri}{Ri + Rt} * Vref$$

Where:
Vi = Voltage input (±5% without calibration; ±2% with calibration)
Ri = Resistance input (14.14 KΩ ±2%)
Rt = Thermistor resistance (10 KΩ Thermistor is recommended)
Vref = 10V ±0.5V

To calculate for thermistor resistance, use the following equation.

$$Rt = \frac{Vi\ Vref - Vi\ Ri}{Vi}$$

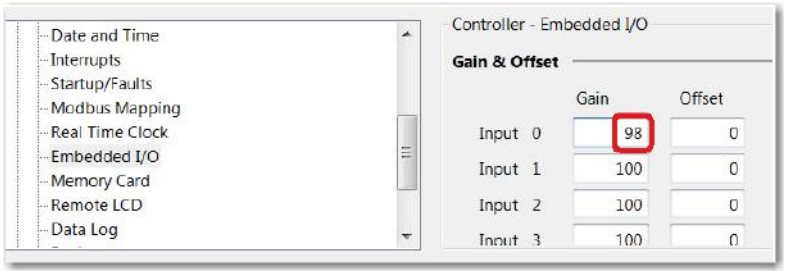
IMPORTANT Micro820 controllers support 10 KΩ type thermistors.
In order to get the best results, the system must be calibrated.

Calibrate Thermistor

1. Connect a resistor (10 KΩ is recommended) across Vref and Analog Input 00 of your Micro820 controller following the diagram, Analog input to thermistors on page 44. The resistor is measured as Ri using a precision multimeter.
2. Calculate the ideal counts (C1) for resistor (Ri) following this equation:
   C1 = 14.14 KΩ / (14.14 KΩ + Ri) * 4095
3. Read the actual counts (C2) of Analog Input 00 from Connected Components Workbench.
4. Calculate for calibration Gain.
   Gain = C1/C2

   For example:
   If Ri is measured as 10.00 KΩ, then
   C1 = 14.14 / (14.14 + 10.00) * 4095 = 2399 counts;
   C2 is read from Connected Components Workbench as 2440; so
   Gain = 2399/2440 = 98% .

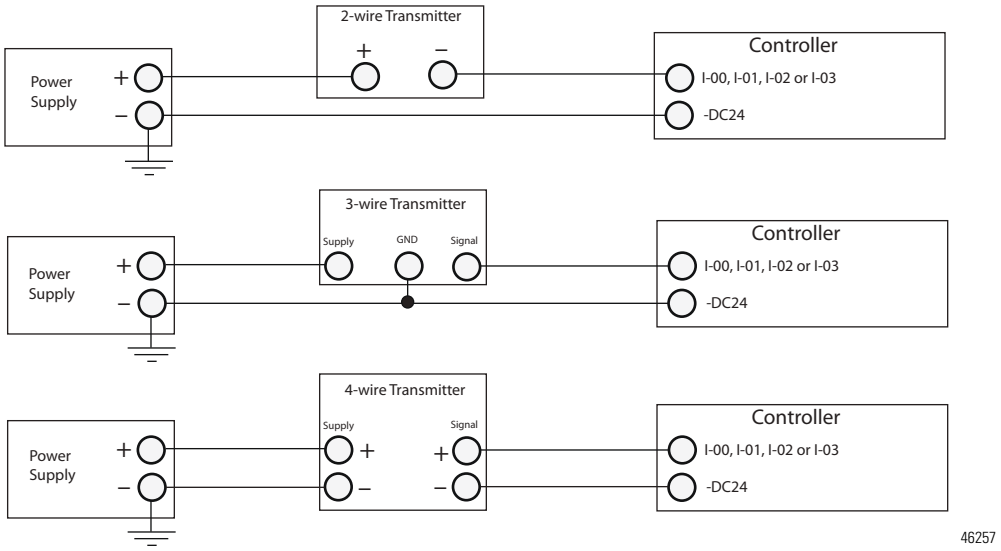
5. In Connected Components Workbench, go to Embedded I/O configuration page. Change the Gain parameter value for Input 00 to 98.



   No changes are required to the Offset parameter value.

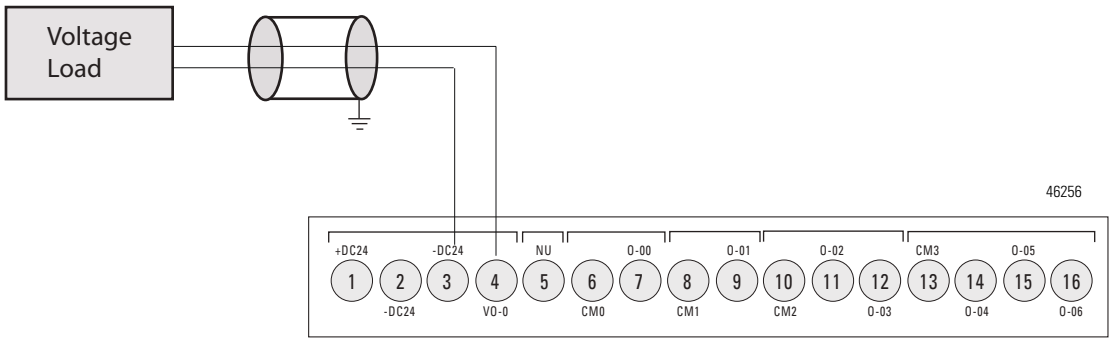
6. Repeat the same steps to calibrate all the other analog input channels.

Analog Input to Transmitters



Analog Output

The analog output can support voltage function as shown in the following illustration.



The "-DC24" terminal is the analog ground connection for analog output (VO-0).

Communication Connections

Overview

This chapter describes how to communicate with your control system and configure communication settings. The method you use and cabling required to connect your controller depends on what type of system you are employing. This chapter also describes how the controller establishes communication with the appropriate network. Topics include:

Topic	Page
Supported Communication Protocols	47
Use Modems with Micro800 Controllers	51
Configure Serial Port	52
Configure Ethernet Settings	59
OPC Support Using RSLinx Enterprise	60

The Micro820 controllers have the following embedded communication channels:

- a non-isolated RS232/RS485 combo port
- RJ45 Ethernet port

Supported Communication Protocols

Micro820 controllers support the following communication protocols through the embedded RS232/RS485 serial port as well as any installed serial port plug-in modules:

- Modbus RTU Master and Slave
- CIP Serial Client/Server (RS232 only)
- ASCII

In addition, the embedded Ethernet communication channel allows your Micro820 controller to be connected to a local area network for various devices providing 10 Mbps/100 Mbps transfer rate. Micro820 controllers support the following Ethernet protocols:

- EtherNet/IP Client/Server
- Modbus/TCP Client/Server
- DHCP Client

IMPORTANT If all client/server connections are fully loaded, performance may be affected, such as data loss and intermittent delays during communication.

Modbus RTU

Modbus is a half-duplex, master-slave communications protocol. The Modbus network master reads and writes bits and registers. Modbus protocol allows a single master to communicate with a maximum of 247 slave devices. Micro800 controllers support Modbus RTU Master and Modbus RTU Slave protocol. For more information on configuring your Micro800 controller for Modbus protocol, refer to the Connected Components Workbench Online Help. For more information about the Modbus protocol, refer to the Modbus Protocol Specifications (available from http://www.modbus.org).

See Modbus Mapping for Micro800 on page 165 for information on Modbus mapping. To configure the Serial port as Modbus RTU, see Configure Modbus RTU on page 56.

TIP Use MSG_MODBUS instruction to send Modbus messages over serial port.

Modbus/TCP Client/Server

The Modbus/TCP Client/Server communication protocol uses the same Modbus mapping features as Modbus RTU, but instead of the Serial port, it is supported over Ethernet. Modbus/TCP Server takes on Modbus Slave features on Ethernet.

The Micro820 controller supports up to 16 simultaneous Modbus TCP Client connections and 16 simultaneous Modbus TCP Server connections.

No protocol configuration is required other than configuring the Modbus mapping table. For information on Modbus mapping, see Modbus Mapping for Micro800 on page 165.

TIP Use MSG_MODBUS2 instruction to send Modbus TCP message over Ethernet port.

CIP Symbolic Client/Server

CIP Symbolic is supported by any CIP compliant interface including Ethernet (EtherNet/IP) and Serial Port (CIP Serial). This protocol allows HMIs to easily connect to the Micro820 controller.

CIP Serial, supported on the Micro820 controller, makes use of DF1 Full Duplex protocol, which provides point-to-point connection between two devices.

The Micro800 controllers support the protocol through RS232 connection to external devices, such as computers running RSLinx Classic software, PanelView Component terminals (firmware revisions 1.70 and above), or other controllers

that support CIP Serial over DF1 Full-Duplex, such as ControlLogix and CompactLogix controllers that have embedded serial ports.

EtherNet/IP, supported on the Micro820 controller, makes use of the standard Ethernet TCP/IP protocol. The Micro820 controller supports up to 16 simultaneous EtherNet/IP Client connections and 16 simultaneous EtherNet/IP Server connections.

To configure CIP Serial, see Configure CIP Serial Driver on page 54.

To configure for EtherNet/IP, see Configure Ethernet Settings on page 59.

CIP Symbolic Addressing

Users may access any global variable through CIP Symbolic addressing except for system and reserved variables.

One- or two-dimension arrays for simple data types are supported (for example, ARRAY OF INT[1..10, 1..10]) are supported but arrays of arrays (for example, ARRAY OF ARRAY) are not supported. Array of strings are also supported.

Supported Data Types in CIP Symbolic

Data Type[1]	Description
BOOL	Logical Boolean with values TRUE and FALSE
SINT	Signed 8-bit integer value
INT	Signed 16-bit integer value
DINT	Signed 32-bit integer value
LINT[2]	Signed 64-bit integer value
USINT	Unsigned 8-bit integer value
UINT	Unsigned 16-bit integer value
UDINT	Unsigned 32-bit integer value
ULINT[2]	Unsigned 64-bit integer value
REAL	32-bit floating point value
LREAL[2]	64-bit floating point value
STRING	character string (1 byte per character)

(1) Logix MSG instruction can read/write SINT, INT, DINT, LINT and REAL datatypes using "CIP Data Table Read" and "CIP Data Table Write" message types.
BOOL, USINT, UINT, UDINT, ULINT, LREAL, STRING and SHORT_STRING datatypes are not accessible with the Logix MSG instruction.

(2) Not supported in PanelView Component.

CIP Client Messaging

CIP Generic and CIP Symbolic messages are supported on Micro800 controllers through the Ethernet and serial ports. These client messaging features are enabled by the MSG_CIPSYMBOLIC and MSG_CIPGENERIC function blocks.

See Micro800 Programmable Controllers: Getting Started with CIP Client Messaging, publication 2080-QS002, for more information and sample quickstart projects to help you use the CIP Client Messaging feature.

ASCII

ASCII provides connection to other ASCII devices, such as bar code readers, weigh scales, serial printers, and other intelligent devices. You can use ASCII by configuring the embedded or any plug-in serial RS232 or RS485 port for the ASCII driver. Refer to the Connected Components Workbench Online Help for more information.

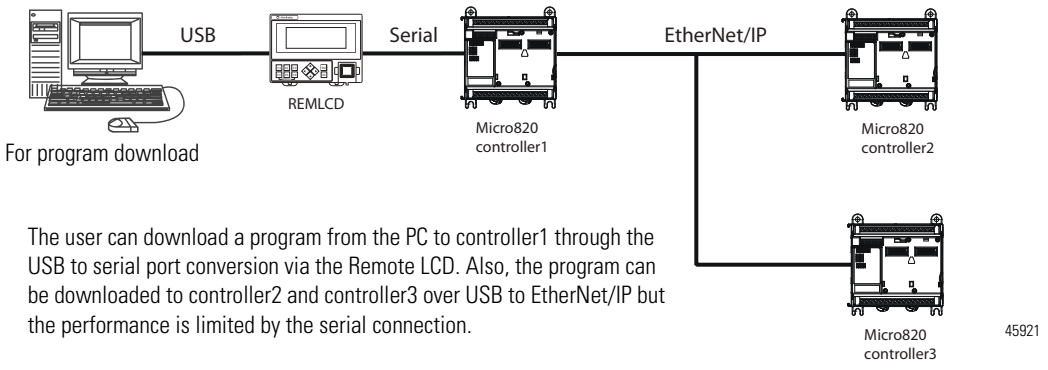
To configure the serial port for ASCII, see Configure ASCII on page 57.

CIP Communications Pass-thru

The Micro820 controllers support pass-thru on any communications port that supports Common Industrial Protocol (CIP) for applications such as program download. It does not support applications that require dedicated connections such as HMI. The maximum number of supported hops is **one**. A hop is defined to be an intermediate connection or communications link between two devices – in Micro800, this is through EtherNet/IP or CIP Serial.

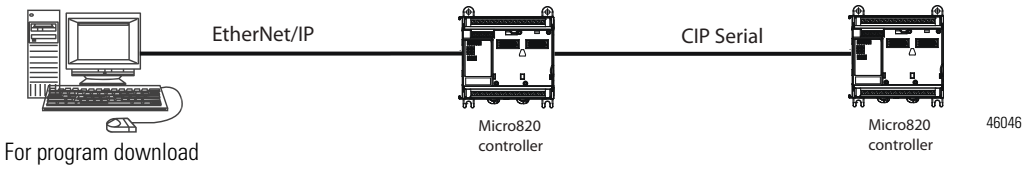
Examples of Supported Architectures

CIP Serial to EtherNet/IP

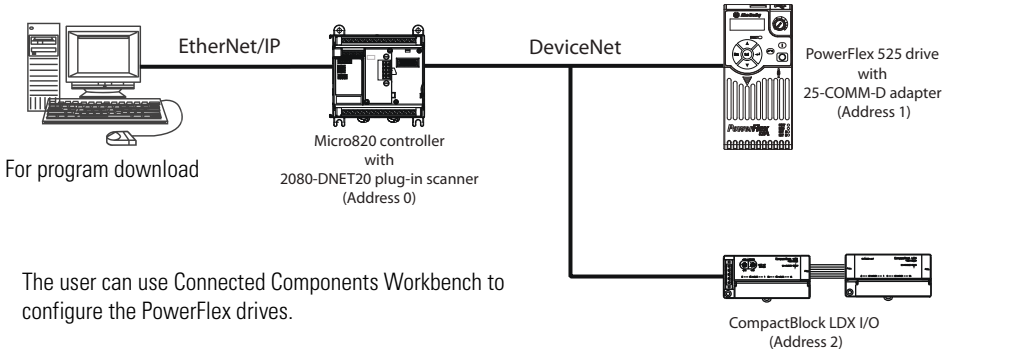


The user can download a program from the PC to controller1 through the USB to serial port conversion via the Remote LCD. Also, the program can be downloaded to controller2 and controller3 over USB to EtherNet/IP but the performance is limited by the serial connection.

EtherNet/IP to CIP Serial



EtherNet/IP to DeviceNet



The user can use Connected Components Workbench to configure the PowerFlex drives.

IMPORTANT Micro800 controllers do not support more than one hop (for example, from EtherNet/IP → CIP Serial → EtherNet/IP).

Use Modems with Micro800 Controllers

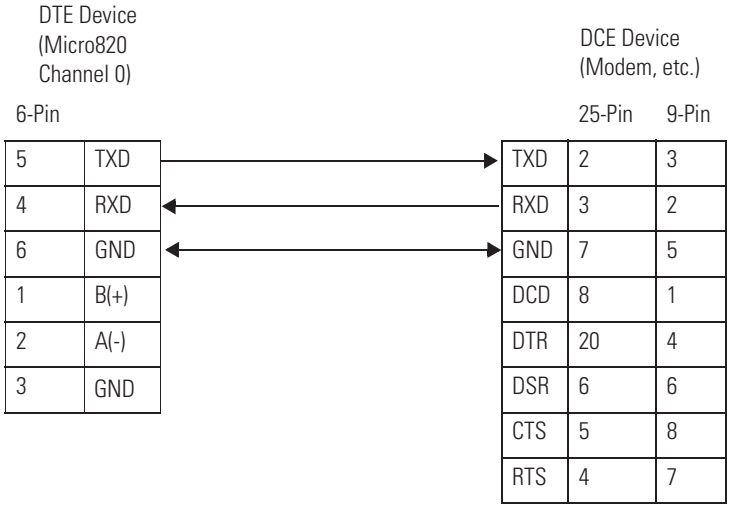
Serial modems can be used with the Micro820 controllers.

Making a DF1 Point-to-Point Connection

You can connect the Micro820 programmable controller to your serial modem. The recommended protocol for this is Modbus RTU.

Construct Your Own Modem Cable

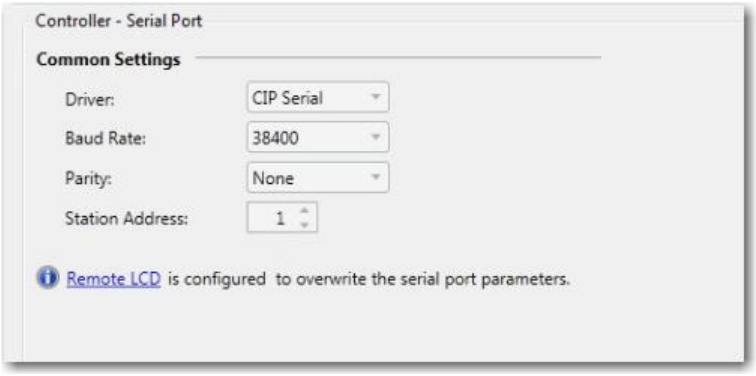
If you construct your own modem cable, the maximum cable length is 3 m (10 ft) with a 25-pin or 9-pin connector. Refer to the following typical pinout for constructing a straight-through cable:



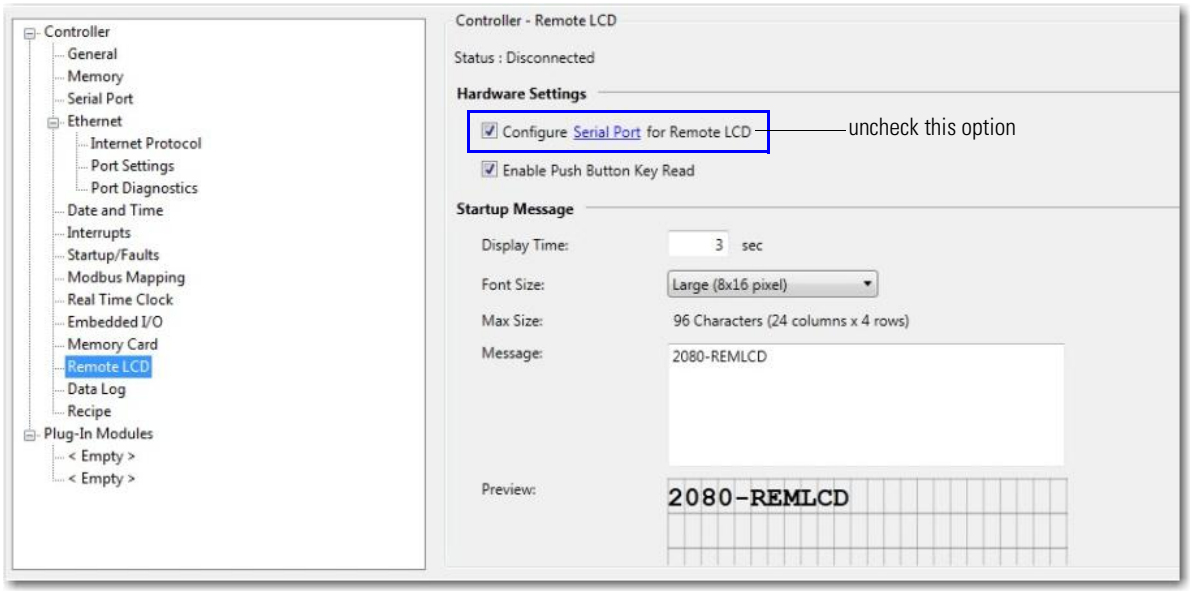
Configure Serial Port

You can configure the Serial Port driver as CIP Serial, Modbus RTU, ASCII or choose Shutdown through the Controller Configuration tree in Connected Components Workbench software.

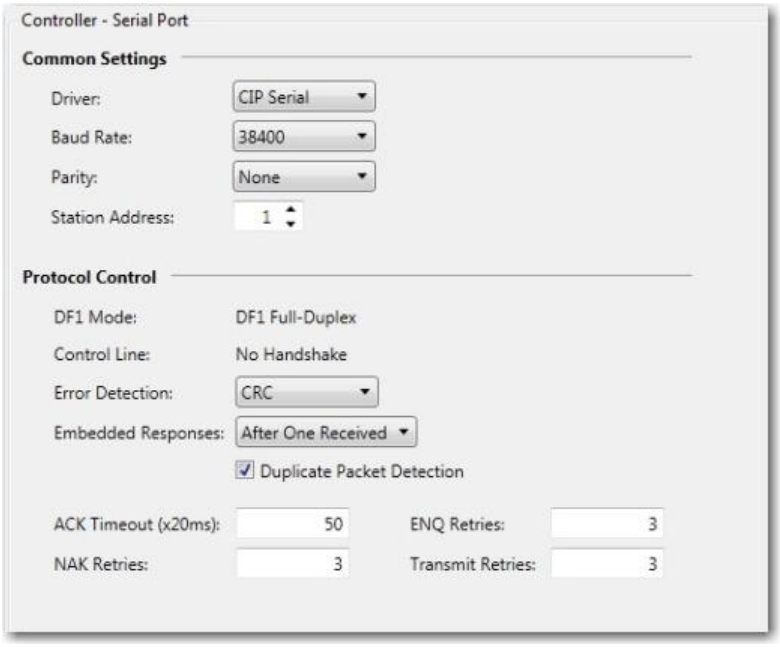
By default, when a Micro820 controller is added to the Project Organizer in Connected Components Workbench, Remote LCD parameters are configured to overwrite serial port settings.



To edit serial port settings, go to the Remote LCD configuration page and uncheck the Configure Serial Port for Remote LCD option button.



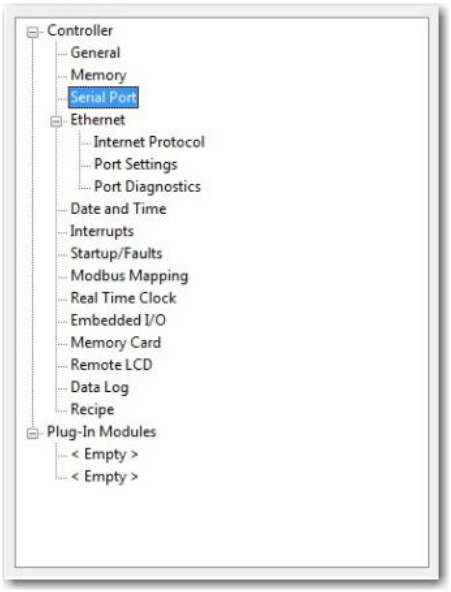
When the Remote LCD configuration is unchecked, the serial port values are visible and can be edited.



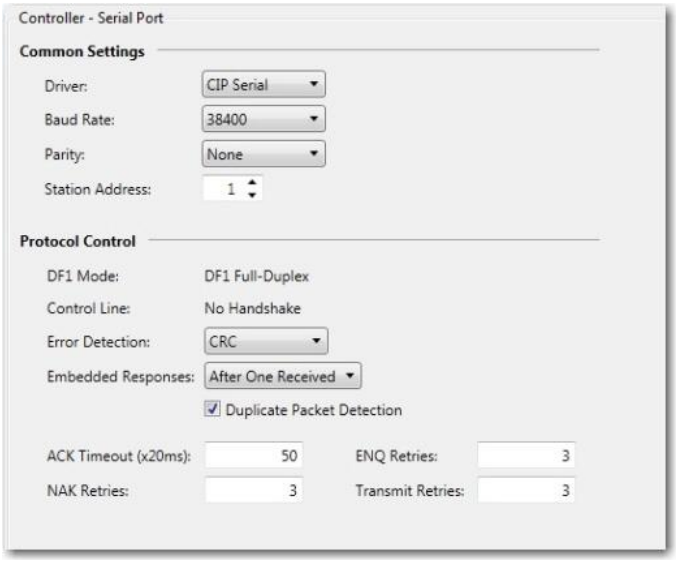
IMPORTANT After changing the serial port settings on the controller, power cycle the Remote LCD.

Configure CIP Serial Driver

1. Open your Connected Components Workbench project. On the device configuration tree, go to the Controller properties. Click Serial Port.



2. Select CIP Serial from the Driver field.



3. Specify a baud rate. Select a communication rate that all devices in your system support. Configure all devices in the system for the same communication rate. Default baud rate is set @ 38400 bps.
4. In most cases, parity and station address should be left at default settings.

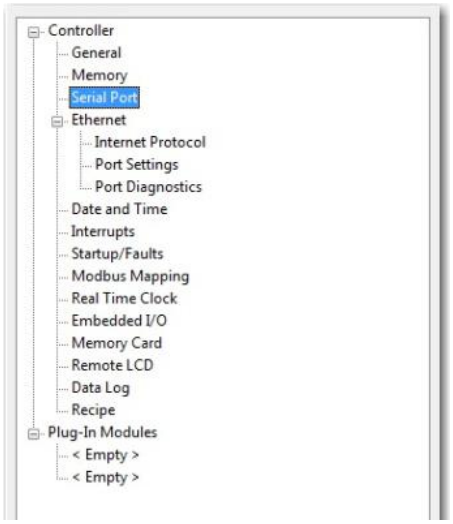
5. Click Advanced Settings and set Advanced parameters. Refer to the table CIP Serial Driver Parameters on page 55 for a description of the CIP Serial parameters.

CIP Serial Driver Parameters

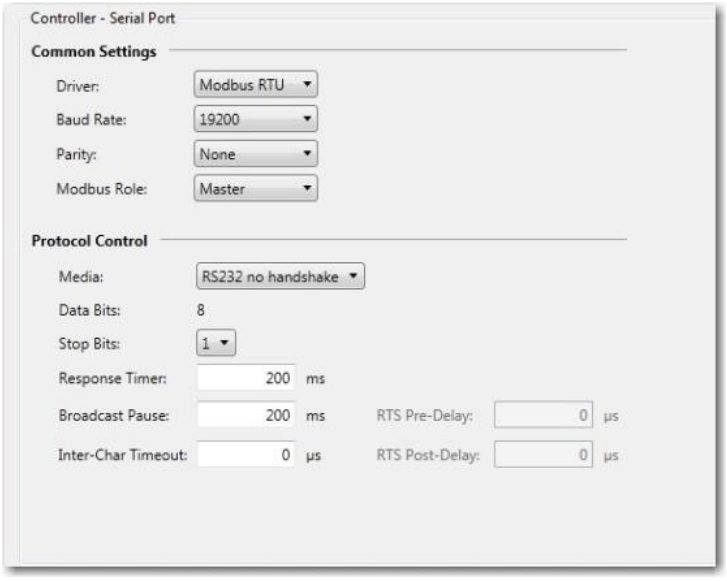
Parameter	Options	Default
Baud rate	Toggles between the communication rate of 1200, 2400, 4800, 9600, 19200, and 38400.	38400
Parity	Specifies the parity setting for the serial port. Parity provides additional message-packet error detection. Select Even, Odd, or None.	None
Station Address	The station address for the serial port on the DF1 master. The only valid address is 0…254.	1
DF1 Mode	DF1 Full Duplex (read only)	Configured as full-duplex by default.
Control Line	No Handshake (read only)	Configured as no handshake by default.
Duplicate Packet Detection	Detects and eliminates duplicate responses to a message. Duplicate packets may be sent under noisy communication conditions when the sender's retries are not set to 0. Toggles between Enabled and Disabled.	Enabled
Error Detection	Toggles between CRC and BCC.	CRC
Embedded Responses	To use embedded responses, choose Enabled Unconditionally. If you want the controller to use embedded responses only when it detects embedded responses from another device, choose After One Received. If you are communicating with another Allen-Bradley device, choose Enabled Unconditionally. Embedded responses increase network traffic efficiency.	After One Received
NAK Retries	The number of times the controller will resend a message packet because the processor received a NAK response to the previous message packet transmission.	3
ENQ Retries	The number of enquiries (ENQs) that you want the controller to send after an ACK timeout occurs.	3
Transmit Retries	Specifies the number of times a message is retried after the first attempt before being declared undeliverable. Enter a value from 0…127.	3
ACK Timeout (x20 ms)	Specifies the amount of time after a packet is transmitted that an ACK is expected.	50

Configure Modbus RTU

1. Open your Connected Components Workbench project. On the device configuration tree, go to the Controller properties. Click Serial Port.



2. Select Modbus RTU on the Driver field.



3. Specify the following parameters:
   - Baud rate
   - Parity
   - Unit address
   - Modbus Role (Master, Slave, Auto)

Modbus RTU Parameters

Parameter	Options	Default
Baud Rate	1200, 2400, 4800, 9600, 19200, 38400	19200
Parity	None, Odd, Even	None
Modbus Role	Master, Slave, Auto	Master

4. Click Advanced Settings to set advanced parameters.
   Refer to the table for available options and default configuration for advanced parameters.

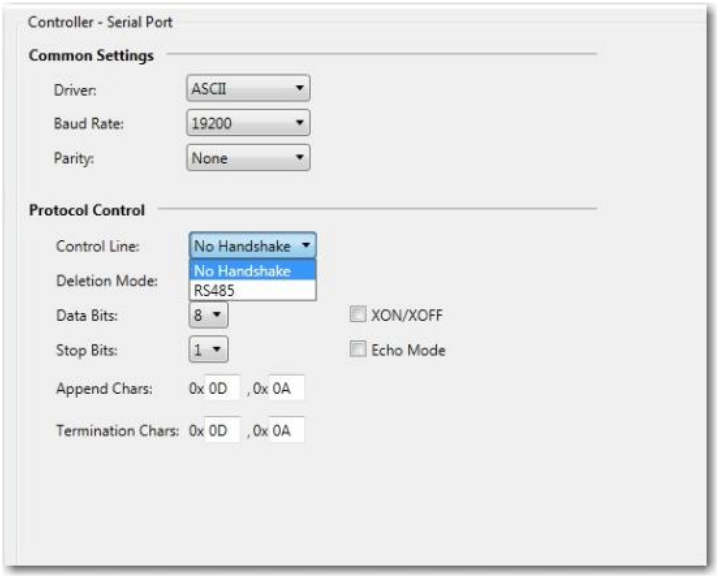
Modbus RTU Advanced Parameters

Parameter	Options	Default
Media	RS-232, RS-232 RTS/CTS, RS-485	RS-232
Data bits	Always 8	8
Stop bits	1, 2	1
Response timer	0…999,999,999 milliseconds	200
Broadcast Pause	0…999,999,999 milliseconds	200
Inter-char timeout	0…999,999,999 microseconds	0
RTS Pre-delay	0…999,999,999 microseconds	0
RTS Post-delay	0…999,999,999 microseconds	0

Configure ASCII

1. Open your Connected Components Workbench project. On the device configuration tree, go to Controller properties. Click Serial Port.

2. Select ASCII on the Driver field.



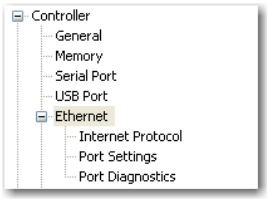
3. Specify baud rate and parity.

ASCII Parameters

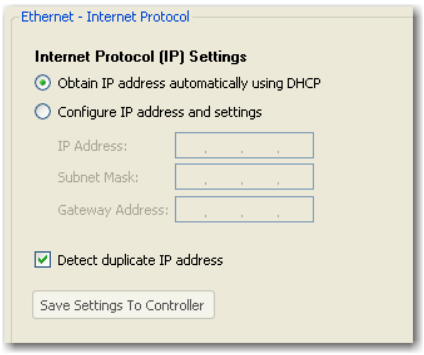
Parameter	Options	Default
Baud Rate	1200, 2400, 4800, 9600, 19200, 38400	19200
Parity	None, Odd, Even	None
Control Line	RS485 No Handshake	No Handshake
Deletion Mode	CRT Ignore Printer	Ignore
Data Bits	7, 8	8
XON/XOFF	Enabled or Disabled	Disabled
Stop Bits	1, 2	1
Echo Mode	Enabled or Disabled	Disabled
Append Chars	0x0D,0x0A or user-specified value	0x0D,0x0A
Termination Chars	0x0D,0x0A or user-specified value	0x0D,0x0A

Configure Ethernet Settings

1. Open your Connected Components Workbench project (for example, Micro820). On the device configuration tree, go to Controller properties. Click Ethernet.



2. Under Ethernet, click Internet Protocol.
   Configure Internet Protocol (IP) settings. Specify whether to obtain the IP address automatically using DHCP or manually configure IP address, subnet mask, and gateway address.



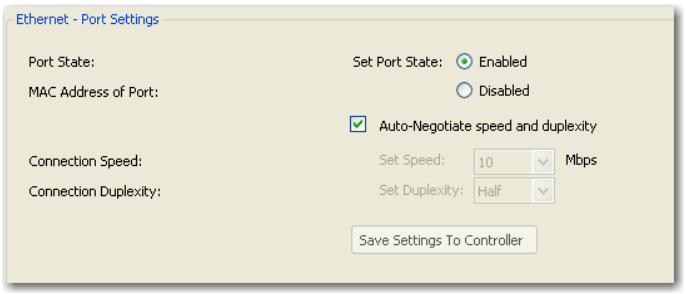
TIP The Ethernet port defaults to the following out-of-the box settings:

- DHCP (dynamic IP address)
- Address Duplicate Detection: On

IMPORTANT When a DHCP server fails, the Micro800 controller allocates IP addresses in the private range 169.254.0.1 to 169.254.255.254. The Micro800 controller verifies its address is unique on the network using ARP. When the DHCP server is again able to service requests, the Micro800 controller updates its address automatically.

3. Click the checkbox Detect duplicate IP address to enable detection of duplicate address.

4. Under Ethernet, click Port Settings.



5. Set Port State as Enabled or Disabled.
6. To manually set connection speed and duplexity, uncheck the option box Auto-Negotiate speed and duplexity. Then, set Speed (10 or 100 Mbps) and Duplexity (Half or Full) values.
7. Click Save Settings to Controller if you would like to save the settings to your controller.
8. On the device configuration tree, under Ethernet, click Port Diagnostics to monitor Interface and Media counters. The counters are available and updated when the controller is in Debug mode.

Ethernet Host Name

Micro800 controllers implement unique host names for each controller, to be used to identify the controller on the network. The default host name is comprised of two parts: product type and MAC address, separated by a hyphen. For example: 2080LC20-xxxxxxxxxxxx, where xxxxxxxxxxxx is the MAC address.

The user can change the host name using the CIP Service Set Attribute Single when the controller is in Program/Remote Program mode.

OPC Support Using RSLinx Enterprise

Support for Open Platform Communications (OPC) using CIP symbolic has been added from firmware release 7.0 onwards. This can be used in place of Modbus addressing.

RSLinx Enterprise version 5.70 (CPR9 SR7) or later and FactoryTalk Gateway version 3.70 (CPR9 SPR7) or later are required.

Program Execution in Micro800

This section provides a brief overview of running or executing programs with a Micro800 controller.

IMPORTANT This section generally describes program execution in Micro800 controllers. Certain elements may not be applicable or true in certain models (for example, Micro820 does not support PTO motion control).

Overview of Program Execution

A Micro800 cycle or scan consists of reading inputs, executing programs in sequential order, updating outputs and performing housekeeping (datalog, recipe, communications).

Program names must begin with a letter or underscore, followed by up to 127 letters, digits or single underscores. Use programming languages such as ladder logic, function block diagrams and structured text.

Up to 256 programs may be included in a project, depending on available controller memory. By default, the programs are cyclic (executed once per cycle or scan). As each new program is added to a project, it is assigned the next consecutive order number. When you start up the Project Organizer in Connected Components Workbench, it displays the program icons based on this order. You can view and modify an order number for a program from the program's properties. However, the Project Organizer does not show the new order until the next time the project is opened.

The Micro800 controller supports jumps within a program. Call a subroutine of code within a program by encapsulating that code as a User Defined Function Block (UDFB). Although a UDFB can be executed within another UDFB, a maximum nesting depth of five is supported. A compilation error occurs if this is exceeded.

Alternatively, you can assign a program to an available interrupt and have it executed only when the interrupt is triggered. A program assigned to the User Fault Routine runs once just prior to the controller going into Fault mode.

In addition to the User Fault Routine, Micro800 controllers also support two Selectable Timed Interrupts (STI). STIs execute assigned programs once every set point interval (1...65535 ms).

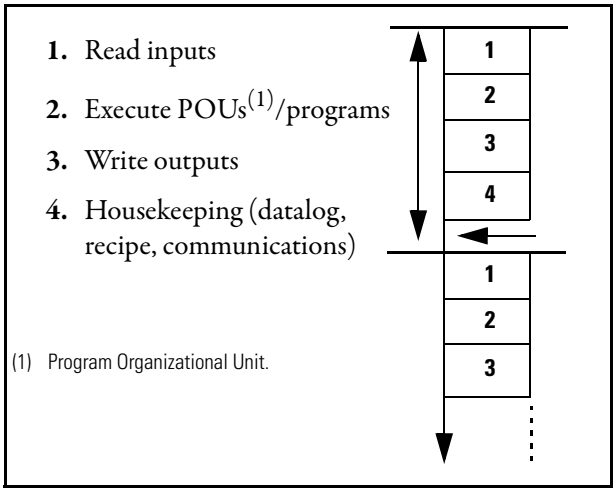
The Global System Variables associated with cycles/scans are:

- __SYSVA_CYCLECNT – Cycle counter

- __SYSVA_TCYCURRENT – Current cycle time
- __SYSVA_TCYMAXIMUM – Maximum cycle time since last start.

Execution Rules

This section illustrates the execution of a program. The execution follows four main steps within a loop. The loop duration is a cycle time for a program.



When a cycle time is specified, a resource waits until this time has elapsed before starting the execution of a new cycle. The POUs execution time varies depending on the number of active instructions. When a cycle exceeds the specified time, the loop continues to execute the cycle but sets an overrun flag. In such a case, the application no longer runs in real time.

When a cycle time is not specified, a resource performs all steps in the loop then restarts a new cycle without waiting.

Controller Load and Performance Considerations

Within one program scan cycle, the execution of the main steps (as indicated in the Execution Rules diagram) could be interrupted by other controller activities which have higher priority than the main steps. Such activities include,

1. User Interrupt events, including STI, EII, and HSC interrupts (when applicable);
2. Communication data packet receiving and transmitting;
3. PTO Motion engine periodical execution (if supported by the controller).

When one or several of these activities occupy a significant percentage of the Micro800 controller execution time, the program scan cycle time will be prolonged. The Watchdog timeout fault (0xD011) could be reported if the impact of these activities is underestimated, and the Watchdog timeout is set

marginally. The Watchdog setting defaults to 2 s and generally never needs to be changed.

Periodic Execution of Programs

For applications where periodic execution of programs with precise timing is required, such as for PID, it is recommended that STI (Selectable Timed Interrupt) be used to execute the program. STI provides precise time intervals.

It is not recommended that the system variable __SYSVA_TCYCYCTIME be used to periodically execute all programs as this also causes all communication to execute at this rate.

WARNING: Communication timeouts may occur if programmed cycle time is set too slow (for example, 200 ms) to maintain communications.

System Variable for Programmed Cycle Time

Variable	Type	Description
__SYSVA_TCYCYCTIME	TIME	Programmed cycle time. **Note**: Programmed cycle time only accepts values in multiples of 10 ms. If the entered value is not a multiple of 10, it will be rounded up to the next multiple of 10.

Power Up and First Scan

On firmware revision 2 and later, all digital output variables driven by the I/O scan gets cleared on powerup and during transition to RUN mode.

Two system variables are also available from revision 2 and later.

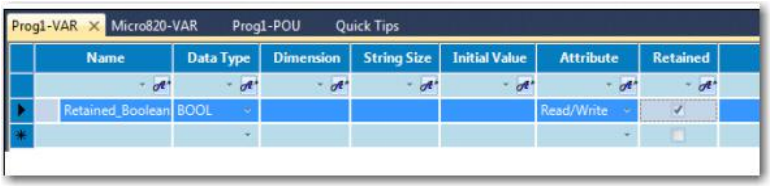
System Variables for Scan and Powerup on Firmware Release 2 and later

Variable	Type	Description
_SYSVA_FIRST_SCAN	BOOL	First scan bit. Can be used to initialize or reset variables immediately after every transition from Program to Run mode. **Note**: True only on first scan. After that, it is false.
_SYSVA_POWER_UP_BIT	BOOL	Powerup bit. Can be used to initialize or reset variables immediately after download from Connected Components Workbench or immediately after being loaded from memory backup module (for example, microSD card). **Note**:True only on the first scan after a powerup, or running a new ladder for the first time.

Variable Retention

Micro830 and Micro850 controllers retain all user-created variables after a power cycle, but the variables inside instances of instructions are cleared. For example: A user created variable called My_Timer of Time data type will be retained after a power cycle but the elapsed time (ET) within a user created timer TON instruction will be cleared.

Unlike Micro830/Micro850 controllers, Micro810 and Micro820 controllers can only retain a maximum of 400 bytes of user-created variable values. This means that after a power cycle, global variables are cleared or set to initial value, and only 400 bytes of user-created variable values are retained. Retained variables can be checked at the global variable page.



Memory Allocation

Depending on base size, available memory on Micro800 controllers are shown in the table below.

Memory Allocation for Micro800 Controllers

Attribute	10/16-point	20-point	24- and 48-points
Program steps(1)	4 K	10 K	10 K
Data bytes	8 KB	20 KB	20 KB

(1) Estimated Program and Data size are "typical" – program steps and variables are created dynamically. 1 Program Step = 12 data bytes.

These specifications for instruction and data size are typical numbers. When a project is created for Micro800, memory is dynamically allocated as either program or data memory at build time. This means that program size can exceed the published specifications if data size is sacrificed and vice versa. This flexibility allows maximum usage of execution memory. In addition to the user defined variables, data memory also includes any constants and temporary variables generated by the compiler at build time.

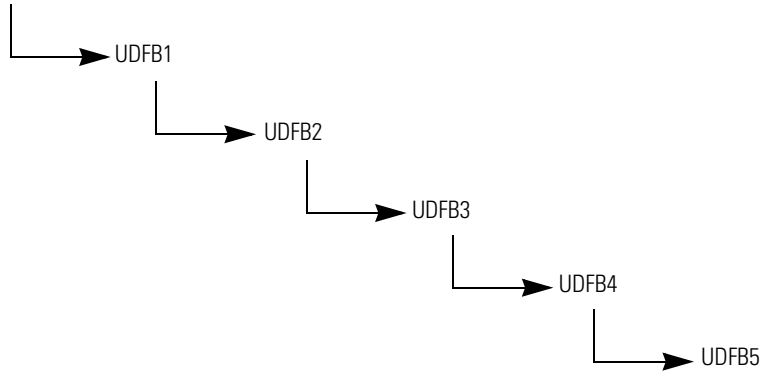
The Micro800 controllers also have project memory, which stores a copy of the entire downloaded project (including comments), as well as configuration memory for storing plug-in setup information, and so on.

Guidelines and Limitations for Advanced Users

Here are some guidelines and limitations to consider when programming a Micro800 controller using Connected Components Workbench software:

- Each program/POU can use up to 64 Kb of internal address space. It is recommended that you split large programs into smaller programs to improve code readability, simplify debugging and maintenance tasks.
- A User Defined Function Block (UDFB) can be executed within another UDFB, with a limit of five nested UDFBs. Avoid creating UDFBs with references to other UDFBs, as executing these UDFBs too many times may result in a compile error.

Example of Five Nested UDFBs



- Structured Text (ST) is much more efficient and easier to use than Ladder Logic, when used for equations. if you are used to using the RSLogix 500 CPT Compute instruction, ST combined with UDFB is a great alternative.
  As an example, for an Astronomical Clock Calculation, Structured Text uses 40% less Instructions.

  Display_Output LD:
  Memory Usage (Code) : 3148 steps
  Memory Usage (Data) : 3456 bytes

  Display_Output ST:
  Memory Usage (Code) : 1824 steps
  Memory Usage (Data) : 3456 bytes
- You may encounter an Insufficient Reserved Memory error while downloading and compiling a program over a certain size. One workaround is to use arrays, especially if there are many variables.

Notes:

Controller Security

Micro800 security generally has two components:

- **Exclusive Access** which prevents simultaneous configuration of the controller by two users
- **Controller Password Protection** which secures the Intellectual Property contained within the controller and prevents unauthorized access

Exclusive Access

Exclusive access is enforced on the Micro800 controller regardless of whether the controller is password-protected or not. This means that only one Connected Components Workbench session is authorized at one time and only an authorized client has exclusive access to the controller application. This ensures that only one software session has exclusive access to the Micro800 application-specific configuration.

Exclusive access is enforced on Micro800 firmware. When a Connected Components Workbench user connects to a Micro800 controller, the controller is given exclusive access to that controller.

Password Protection

By setting a password on the controller, a user effectively restricts access to the programming software connection of the controller to software sessions that can supply the correct password. Essentially, Connected Components Workbench operations such as upload and download are prevented if the controller is secured with a password and the correct password is not provided.

Micro800 controllers are shipped with no password but a password can be set through the Connected Components Workbench software (using firmware revision 2 or later).

The controller password is also backed up to the memory backup module (that is, 2080-MEMBAK-RTC for Micro830 and Micro850; 2080-LCD for Micro810; and microSD card for Micro820).

TIP For instructions on how to set, change, and clear controller passwords, see Configure Controller Password on page 144.

Compatibility

The Controller Password feature is supported on:

- Connected Components Workbench **revision 2** and later

- Micro800 controllers with at least **revision 2** firmware

For users with earlier versions of the software and/or hardware, refer to the compatibility scenarios below.

Connected Components Workbench revision 1 with Micro800 controller firmware revision 2 and later

Connection to a Micro800 controller with firmware revision 2 using an earlier version of the Connected Components Workbench software (revision 1) is possible and connections will be successful. However, the software will not be able to determine whether the controller is locked or not.

If the controller is not locked, access to the user application will be allowed, provided the controller is not busy with another session. If the controller is locked, access to the user application will fail. Users will need to upgrade to revision 2 of the Connected Components Workbench software.

Connected Components Workbench revision 2 and later with Micro800 controller firmware revision 1

Connected Components Workbench revision 2 is capable of "discovering" and connecting to Micro800 controllers with firmware revision earlier than revision 2 (that is, not supporting the Controller Password feature). However, the Controller Password feature will not be available to these controllers. The user will not be able see interfaces associated with the Controller Password feature in the Connected Components Workbench session.

Users are advised to upgrade the firmware. See Flash Upgrade Your Micro800 Firmware on page 133 for instructions.

Work with a Locked Controller

The following workflows are supported on compatible Micro800 controllers (firmware revision 2) and Connected Components Workbench software revision 2.

Upload from a Password-Protected Controller

1. Launch the Connected Components Workbench software.
2. On the Device Toolbox, expand Catalog by clicking the + sign.
3. Select the target controller.
4. Select Upload.
5. When requested, provide the controller password.

Debug a Password-Protected Controller

To debug a locked controller, you have to connect to the controller through the Connected Components Workbench software and provide the password before you can proceed to debug.

1. Launch the Connected Components Workbench software.
2. On the Device Toolbox, expand Catalog by clicking the + sign.
3. Select the catalog number of your controller.
4. When requested, provide the controller password.
5. Build and save your project.
6. Debug.

Download to a Password-Protected Controller

1. Launch the Connected Components Workbench software.
2. Click Connect.
3. Select the target controller.
4. When requested, provide the controller password.
5. Build and save the project, if needed.
6. Click Download.
7. Click Disconnect.

Transfer Controller Program and Lock Receiving Controller

In this scenario, the user needs to transfer user application from controller1 (locked) to another Micro800 controller with the same catalog number. The transfer of the user application is done through the Connected Components Workbench software by uploading from controller1, then changing the target controller in the Micro800 project, and then downloading to controller2. Finally, controller2 will be locked.

1. On the Device Toolbox, open Discover and click Browse Connections.
2. Select target controller1.
3. When requested, enter the controller password for controller1.
4. Build and save the project.
5. Click Disconnect.
6. Power down controller1.

7. Swap controller1 hardware with controller2 hardware.
8. Power up controller2.
9. Click Connect.
10. Select target controller2.
11. Click Download.
12. Lock controller2. See Configure Controller Password on page 144 .

Back Up a Password-Protected Controller

In this workflow, user application will be backed up from a Micro800 controller that is locked to a memory plug-in device.

1. On the Device Toolbox, open Discover. Click Browse Connections.
2. Select the target controller.
3. When requested, enter the controller password.
4. Back up controller contents from the memory module.

Configure Controller Password

To set, change, and clear controller password, see the quickstart instructions Configure Controller Password on page 144.

Recover from a Lost Password

If the controller is secured with a password and the password has been lost, then it is impossible to access the controller using the Connected Components Workbench software.

To recover, the controller must be set to Program Mode using the keyswitch for Micro830 and Micro850 controllers, the 2080-LCD for Micro810 controllers, or the 2080-REMLCD for the Micro820. Then, ControlFlash can be used to update the controller firmware, which also clears the controller memory.

ATTENTION: The project in the controller will be lost but a new project can be downloaded.

Notes:

Using the Micro800 Remote LCD

This chapter provides a description of how you can use the Micro800 Remote LCD with the Micro820 controller. It has the following sections.

Topic	Page
Overview	73
Text Display Mode	75
USB Mode	74
Backup and Restore	81
Hardware Features, Installation, and Specifications	81

Overview

The 2080-REMLCD module serves as a simple IP65 text display that allows the configuration of such controller settings as IP address. It connects to the Micro820 controller through the RS232 port. The Remote LCD module has a dot matrix LCD with backlight and supports multilingual characters. The display size is 3.5 inches with 192 x 64 pixel resolution.

It also has:

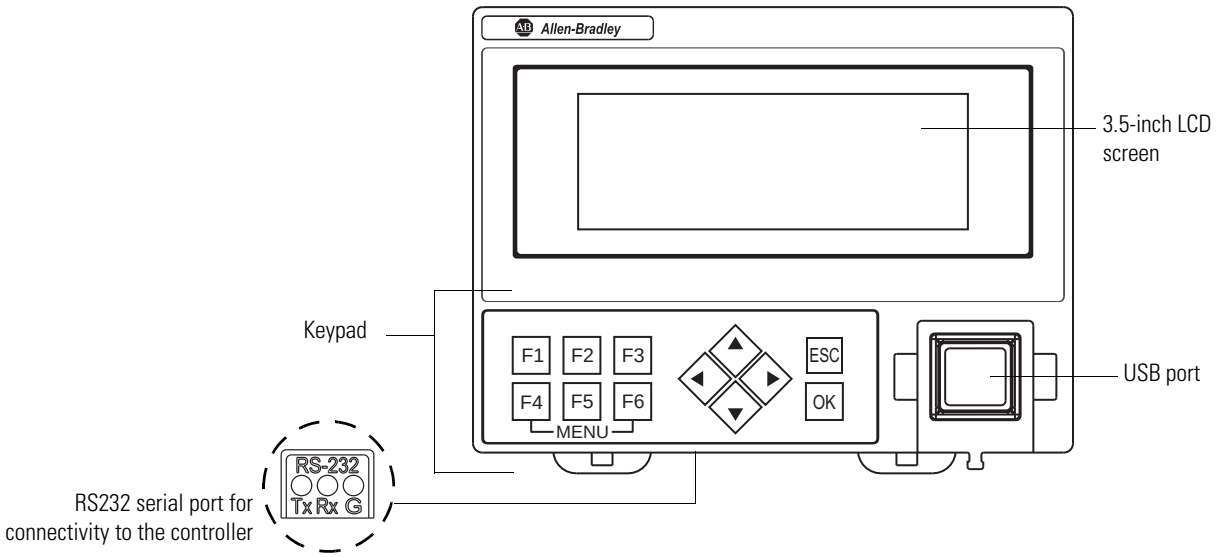
- Four arrow keys
- Six function keys
- ESC key
- OK key
- USB port for Connected Components Workbench connectivity

It supports:

- Small character set: 24 characters by 8 lines
- Large character set: 24 characters by 4 lines
- Extra large character set: displays 12 characters by 4 lines

The Remote LCD module supports English, French, Spanish, Italian and Simplified Chinese languages for the Main Menu.

Micro800 Remote LCD



The 2080-REMLCD module is IP65-rated and can be mounted through the front panel or on the same DIN rail as the Micro820 controller.

It has two modes of operation:

- USB Mode
- Text Display Mode
  - I/O Status and Main Menu operations (for example, change to RUN mode)
  - Optional user-defined screens (using the LCD_REM instructions)

USB Mode

In USB mode, the Remote LCD module acts as a USB pass-through for Connected Components Workbench. The Remote LCD module automatically enters USB mode when traffic is detected.

For example:

1. Remote LCD is in text display mode showing the I/O Status screen by default.
2. The user connects a USB cable between the PC and the Remote LCD.
3. Remote LCD is automatically detected by the PC as a USB device and the Remote LCD automatically goes to USB mode.
4. I/O Status screen is no longer shown. The user is now able to download program over USB using Connected Components Workbench.
5. When the USB cable is disconnected and no traffic is detected for 30 seconds, the Remote LCD automatically goes back to text display mode showing the I/O Status screen.

IMPORTANT Using the USB port is convenient when accessing the controller from the front of the cabinet without opening the door and when the IP address is unknown. For larger programs, it is recommended to use USB port through the Remote LCD to set the IP address and then use Ethernet to download. Ethernet is faster due to limitations of the USB to serial conversion.

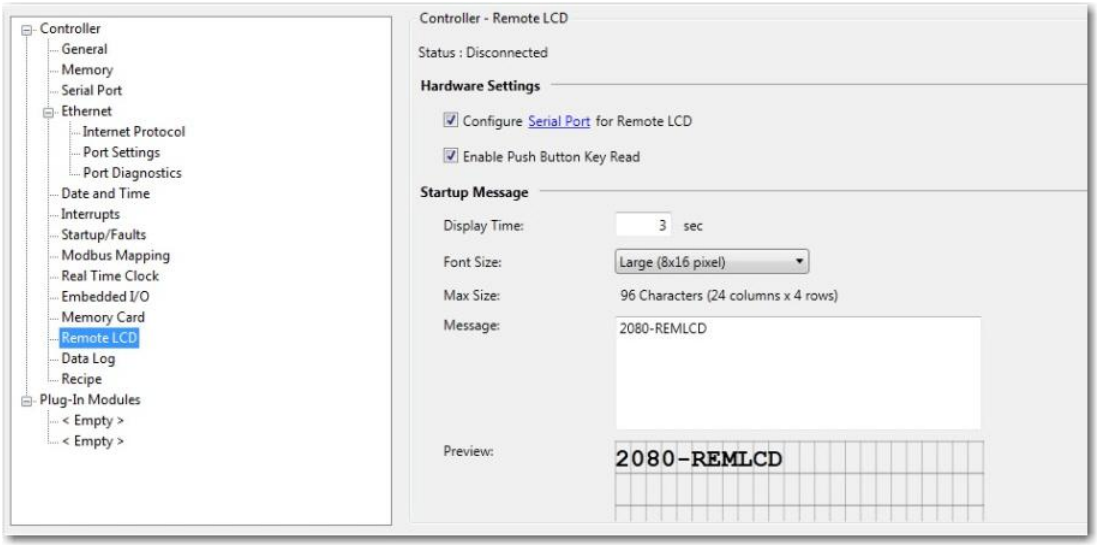
Text Display Mode

In text display mode, you are either in I/O Status, Main Menu, or executing Remote LCD instructions.

Startup Screen

On powerup, the Remote LCD module powers up with a splash screen that displays "Initializing". Then, it displays "Connecting to Controller" until the connection is established. The controller then displays the startup screen for 3 seconds by default or user-defined duration after the connection is established.

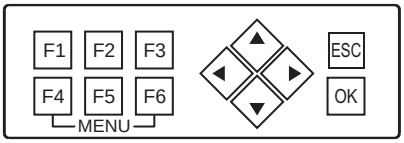
The user can customize this startup screen through Connected Components Workbench. The controller displays the default startup screen at powerup when the customized startup screen is blank.



After showing the startup message, the Remote LCD will show the I/O Status screen, assuming that no LCD_REM instructions are executing.

Navigate the Remote LCD

In text display mode, you can make use of available navigation keys (function keys, arrow keys, ESC and OK) to navigate through the menus.



The module has twelve keys with the following operations.

Function Keys Operation

Button	Function
Arrow keys (cursor buttons)	Move cursor
	Select menu item
	Increment/Decrement Number
	Choose numbers, values, times, and so on
OK	Next menu level, store your entry
Esc	Previous menu level, cancel your entry.
F1	Variable (Shortcut)
F2	ENET Cfg (Shortcut)
F3	Mode Switch (Shortcut)
F4	Fault Mode (Shortcut)
F5	Security (Shortcut)
F6	Backlight (Shortcut)

Shortcut keys jump from the I/O Status screen to the specific main menu operation.

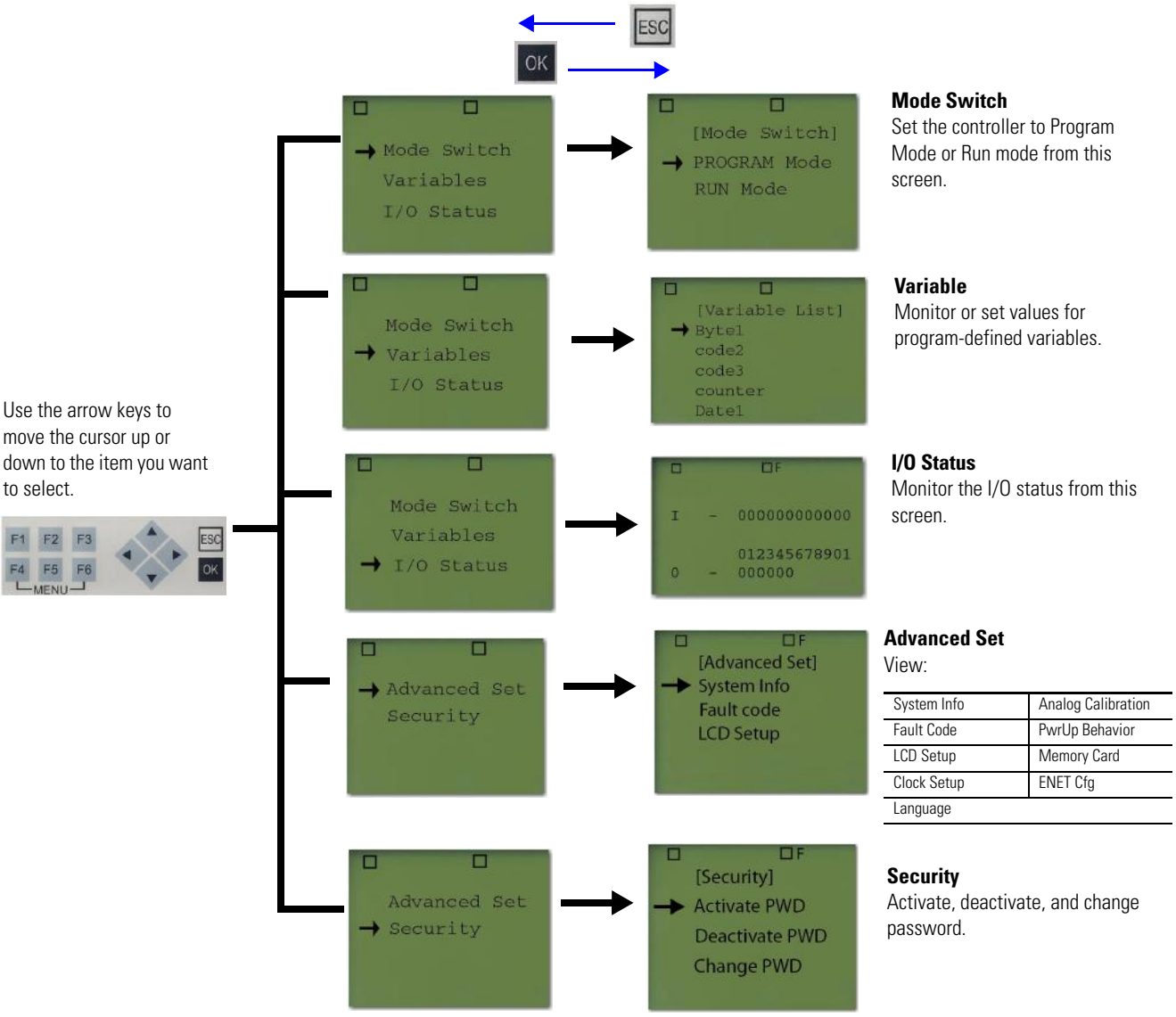
Main Menu

To access the Main Menu and available submenus, press F4 and F6 simultaneously. To exit the Main Menu, press ESC.

The Main Menu shows the following screen:

The following structure tree takes you through the different menus available in the Remote LCD module and their general description.

2080-REMLCD Menu Structure Tree



Mode Switch
Set the controller to Program Mode or Run mode from this screen.

Variable
Monitor or set values for program-defined variables.

I/O Status
Monitor the I/O status from this screen.

Advanced Set
View:

System Info	Analog Calibration
Fault Code	PwrUp Behavior
LCD Setup	Memory Card
Clock Setup	ENET Cfg
Language	

Security
Activate, deactivate, and change password.

Main Menu Items

Menu Item	Description	
I/O Status	Shows the status of the local I/O.	
Mode switch	Change the mode switch selection.	
Variables	View and change the data value of a variable. Using Connected Components Workbench software, you can specify which variables in the program can be viewed and edited through the 2080-REMLCD module. See View and Edit Variable Values through the Remote LCD on page 78.	
Security	Activate, deactivate and change password protection.	
Advanced Set	System Info	View system information such as operating systems series and firmware revision.
	Fault Code	View controller fault code information.
	LCD Setup	Adjust LCD contrast, backlight color and push button.
	Clock Setup	The real-time clock and daylight saving time.
	Language	Change menu language to French, Italian, Spanish, and Chinese.
	Analog Calibration	Configure calibration parameter of embedded analog inputs.
	PwrUp Behavior	Configure controller mode on powerup.
	Memory Card	Access the microSD card.
	ENET Cfg	View and change the Ethernet port configuration.

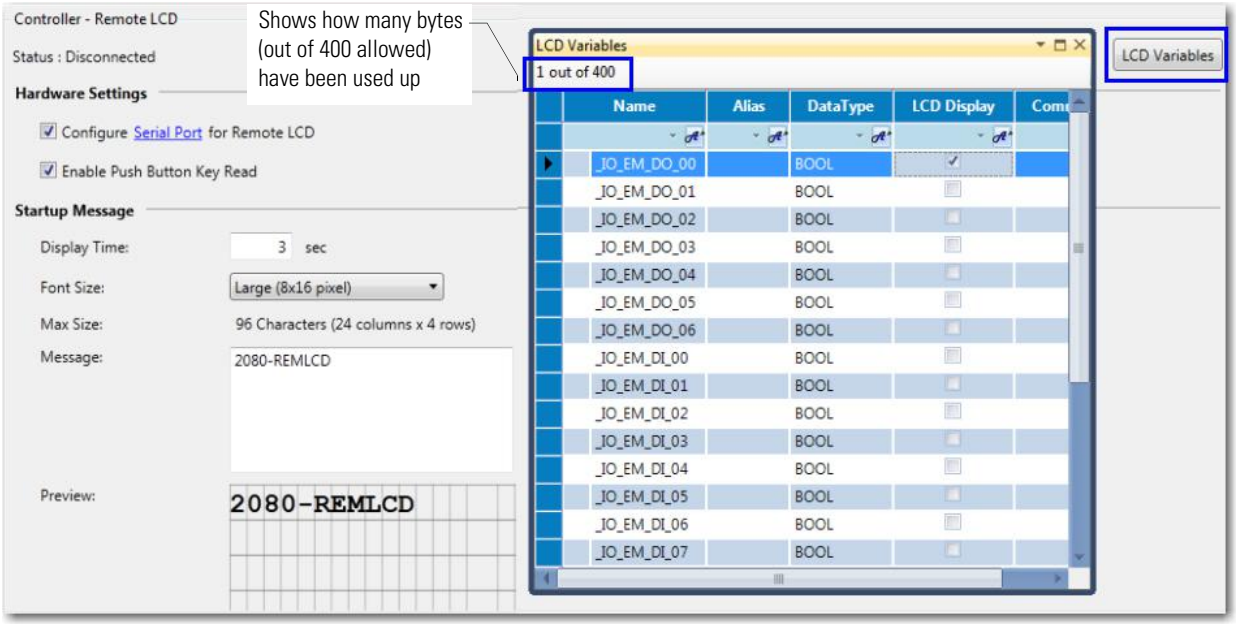
The controller limits certain operations according to controller mode, as shown in the following table.

Operational Limit on 2080-REMLCD

Operation	PROG Mode	RUN Mode
Variable Edit	NO	YES
Analog Calibration	YES	NO
Controller → Memory Card	YES	NO
Memory Card → Controller	YES	NO
Others	YES	YES

View and Edit Variable Values through the Remote LCD

Go to the 2080-REMLCD configuration window in Connected Components Workbench. Click LCD Variables and select which variables you would like to edit through the Remote LCD.



User-defined Screens

To create user-defined screens through Connected Components Workbench, you can program the Remote LCD module using the following function blocks.

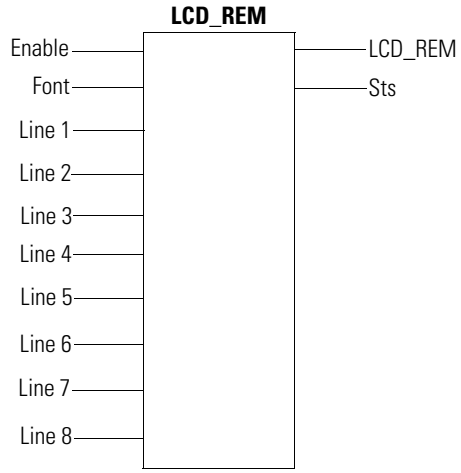
2080-REMLCD Function Blocks

Function Block Name	Description
LCD_REM	Used to display string or numbers on the Remote LCD.
KEY_READ_REM	Used to read keypad input on the Remote LCD.
LCD_BKLT_REM	Used to change the backlight color and mode of the Remote LCD screen.

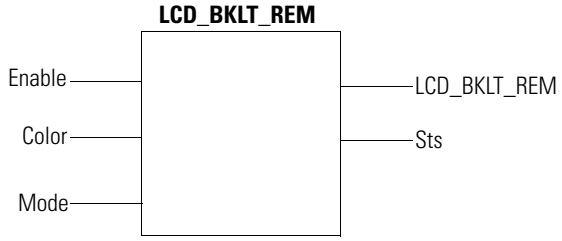
When the instructions are executing, the user-defined screen is shown, but when in the Main Menu, the Remote LCD instructions are disabled. For example, the KEY_READ_REM instruction will no longer read keypad input.

LCD_REM

The LCD_REM function block is used to display user strings on the REMLCD module when REMLCD is present and connected.



LCD_BKLT_REM



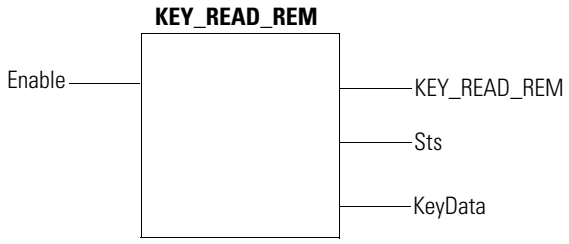
This function block is used to configure backlight parameters on the Remote LCD module.

Execution of the LCD_BKLT_REM takes precedence over current backlight settings in the Main Menu. When Enable input goes False and the instructions stop executing, the last Main Menu setting of the backlight takes effect.

The LCD_BKLT_REM instruction is only effective when displaying user-defined screen or default I/O Status screen. While in the Main Menu, backlight settings configured through the Main Menu take effect.

IMPORTANT When in the Main Menu, the LCD_BKLT_REM instruction will be disabled or ineffective.

KEY_READ_REM



This function block can be used to read key status on the Remote LCD module when the user-defined screen is active. When user-defined screen is not active, KEY_READ_REM instruction flags an error.

Note that the KEY_READ_REM instruction will always show key status as False if Push Button Key Read is disabled in Connected Components Workbench or the Remote LCD.

Backup and Restore

To initiate backup and restore through the REMLCD module, access the memory card by going to the Main Menu → Advanced Set → Memory Card.

See Using microSD Cards on page 83 for information about project backup and restore on the microSD card.

Hardware Features, Installation, and Specifications

To learn about installation, hardware features, and specifications of the Micro800 Remote LCD, refer to the installation instructions, publication 2080-IN010, in the Literature Library.

Notes:

Using microSD Cards

This chapter provides a description of microSD card support on Micro820 controllers.

Topic	Page
Overview	83
Project Backup and Restore	84
Backup and Restore Directory Structure	85
Powerup Settings in ConfigMeFirst.txt	86
General Configuration Rules in ConfigMeFirst.txt	88
ConfigMeFirst.txt Errors	88
Datalog	89
Recipe	94
Quickstart Projects for Datalog and Recipe Function Blocks	98

The last section provides quickstart projects for the datalog and recipe functions.

Overview

Micro820 controllers support microSD cards for the following purposes:

- Project backup and restore
- Datalog and Recipe

IMPORTANT For optimum performance, the microSD card should not be more than 90% full. Regularly check available space on your microSD card and ensure that the card is exclusively used for the Micro800 controller and no unnecessary files are present. Regularly delete old datalog files and directories.

IMPORTANT Do not remove the microSD card or power down while operations such as upload, download, delete, search, backup and restore are ongoing to prevent data loss. A blinking SD status LED indicates that these operations are ongoing.

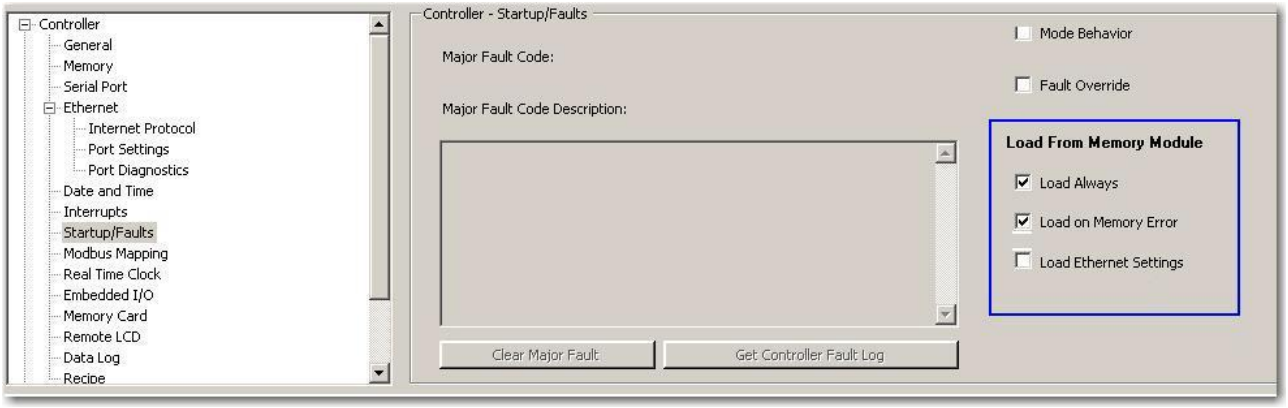
The SD status LED will not blink when flash upgrading the firmware from the microSD card.

IMPORTANT To prevent data loss, recipe and datalog function blocks must indicate Idle status before microSD card is removed.

Project Backup and Restore

Project backup and restore on Micro820 controllers are mainly supported through the microSD card. Both backup and restore can be initiated or manually triggered and configured through the Connected Components Workbench, the 2080-REMLCD module, and the ConfigMeFirst.txt file in the microSD card.

Backup and restore can only occur when the controller is in PROGRAM mode. On controller powerup, restore automatically occurs if the Load Always or Load on Memory Error option has been configured in Connected Components Workbench.



IMPORTANT To learn about restore and backup using the 2080-REMLCD module, see Using the Micro800 Remote LCD on page 73.

To learn about restore and backup using the Connected Components Workbench, refer to the software Online Help.

IMPORTANT For Micro800 controllers that support microSD cards, IP protection of user project can only be achieved through the POU password protection mechanism in Connected Components Workbench (Developer Edition) and NOT via Controller Lock feature.

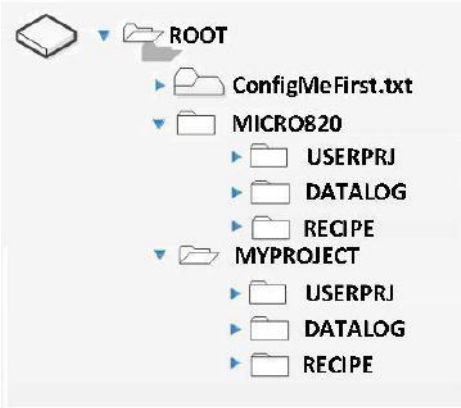
IMPORTANT If the Load Always setting is enabled and power is lost when restoring a project from the micoSD card, the controller will attempt to load the project using the default project name and directory after power is restored. If your project is not using the default name and directory, the operation will fail and a fault occurs.

The microSD card stores the controller password in encrypted format. When the password is mismatched, the contents of the microSD card is not restored on the controller.

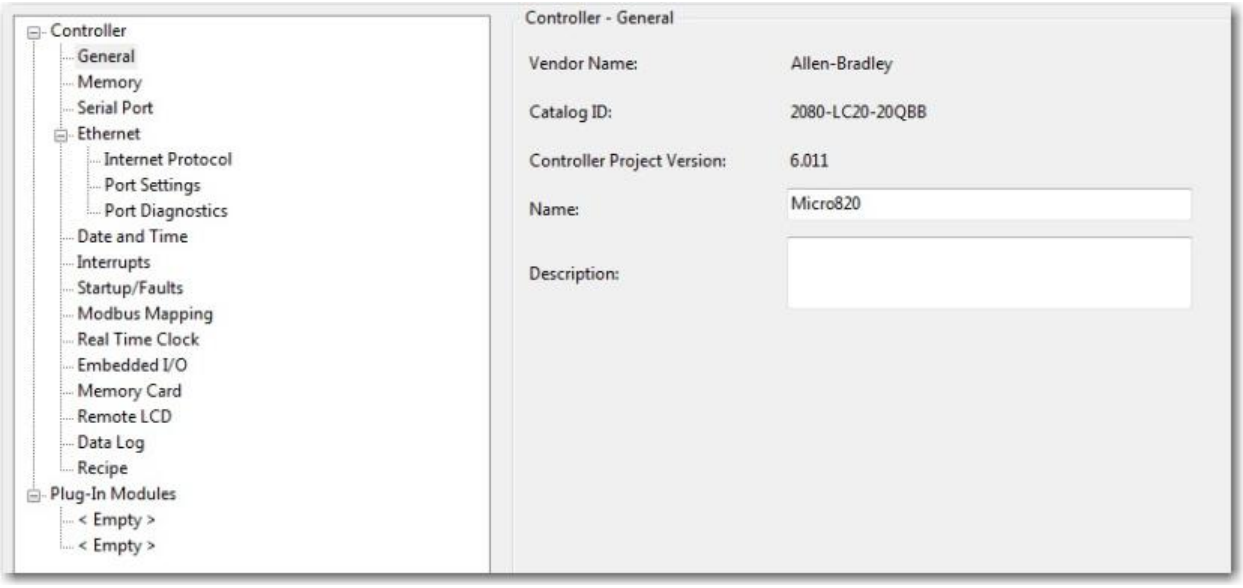
Backup and restore can be configured to trigger through the following ways:

Method	Backup	Restore
Online with Connected Components Workbench	Yes	Yes
2080-REMLCD	Yes	Yes
Project configuration on memory card at powerup	No	Load Always and/or Load on Memory Error options
ConfigMeFirst.txt at powerup	Yes (Through the [BKD] command)	Yes (Through the [RSD] command)

Backup and Restore Directory Structure



When a user project is backed up, a subdirectory named Micro820/USERPRJ is created on the microSD card. The folder name takes the name of the project specified in the General Page in Connected Components Workbench, which is Micro820 by default. However, if the ConfigMeFirst.txt file specifies a different subdirectory (example: MyProject), the project is backed up to that directory. See General Configuration Rules in ConfigMeFirst.txt on page 88.



Project restore is done from the subdirectory specified in ConfigMeFirst.txt file or the Micro820/USERPRJ default folder, if none is specified in the ConfigMeFirst.txt file. The user needs to ensure that the directory is populated with correct contents before restoring.

The ConfigMeFirst.txt file is a configuration file stored on the microSD card that the user can optionally create to customize backup, restore, recipe and datalog directories. The following sections include information on how to configure the ConfigMeFirst.txt properly.

IMPORTANT The Micro800 controller reports a major fault when project backup does not succeed because the memory card size is exceeded.

Powerup Settings in ConfigMeFirst.txt

On powerup, the Micro820 controller reads and carries out configuration settings described in the ConfigMeFirst.txt file, as shown in the following table.

ConfigMeFirst.txt Configuration Settings

Setting	Description
[FLASHFILE]	File path location of the firmware revision on the microSD card. The default location is in the following format: firmware\<catalog number>\<filename of firmware>
[FWBUS]	This setting is reserved and may be omitted.
[FWSLOT]	This setting is reserved and may be omitted.
[FWDOWN]	Sets whether to upgrade or downgrade the controller firmware from the current revision. 0 = Upgrade firmware; 1 = Downgrade firmware
[PM]	Power up and switch to PROGRAM mode.
[CF]	Power up and attempt to clear fault.
[BKD = My Proj 1]	Power up and save the controller project into backup directory, My Proj 1\USERPRJ. Require extra power cycle to clear existing fault first using [CF] setting or other means.
[RSD = MyProj2]	Power up and read the project from restore directory MyProj2\USERPRJ into controller. Require extra power cycle to clear existing fault first using [CF] setting or other means. This setting overwrites UPD (or its default) load always or load on error restore function.
[UPD = My Proj]	For normal usage of backup and restore (that is, through Connected Components Workbench, 2080-REMLCD, Load Always, or Load on Memory Error settings), set the user project directory name. For example, My Proj, during powerup or when the microSD card is inserted. This directory is also used by data logging and recipe function.
[ESFD]	Embedded Serial Factory Defaults. Power up and revert embedded serial comms to factory defaults.
[IPA = xxx.xxx.xxx.xxx]	Power up and set IP address to xxx (must be numbers only).

ConfigMeFirst.txt Configuration Settings

Setting	Description
[SNM = xxx.xxx.xxx.xxx]	Power up and set subnet mask to xxx (must be numbers only).
[GWA = xxx.xxx.xxx.xxx]	Power up and set gateway address to xxx (must be numbers only).
[END]	End of setting. This setting is **always** required even when the ConfigMeFirst.txt file does not contain any other setting. The SD LED goes off when this setting is not present.

IMPORTANT **Flash Upgrade Settings**

With Connected Components Workbench release 8.0 onwards, you can flash upgrade your Micro820 controller from the microSD card in addition to using ControlFLASH. See Flash Upgrade From MicroSD Card on page 137 for instructions.

- [FWFILE], [FWBUS], [FWSLOT], and [FWDOWN] settings must be placed at the beginning of the file.

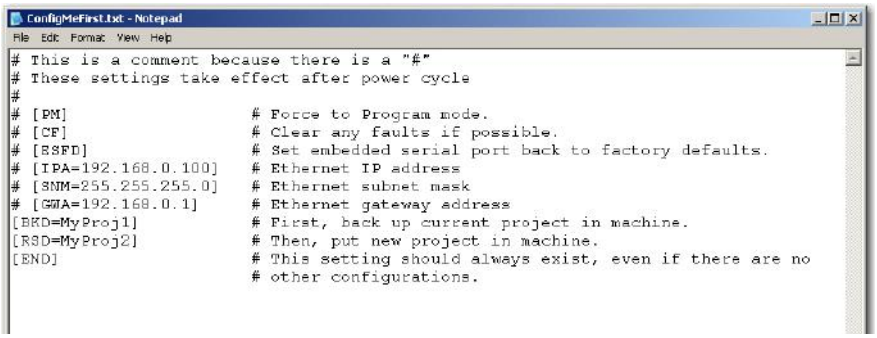
IMPORTANT **Directory Settings**

- If no directory has been specified in the ConfigMeFirst.txt file, then backup and restore will occur in the controller name directory (Micro820/USERPRJ, by default).
- If [UPD] is configured in the ConfigMeFirst.txt file, then backup and restore will occur in the [UPD] directory specified.
- [BKD] setting is implemented even when the controller is locked or password protected.
- [BKD] directory is automatically created if it does not yet exist.

IMPORTANT **Powerup Network Parameter Settings**

- [IPA], [SNM] and [GWA] follow the general IP configuration rules.
- [IPA], when set in ConfigMeFirst.txt, should always be configured with a valid [SNM] and vice versa.
- When optional [GWA] setting is used, make sure that [IPA] and [SNM] settings are also present in ConfigMeFirst.txt.
- The [ESFD], [IPA], [SNM], and [GWA] settings overwrite the respective communication settings from project restore due to [RSD], Load Always or Load on Memory Error.

Sample ConfigMeFirst.txt File



General Configuration Rules in ConfigMeFirst.txt

- All settings must be in upper case and enclosed in brackets [ ].
- Each line must contain only one setting.
- Settings must always appear first in a line.
- Comments are started with the # symbol.
- No action related to the setting will be carried out when the setting does not exist, or a # symbol appears before the setting (example, #[PM]).

ConfigMeFirst.txt Errors

The SD status LED goes off when the microSD card is inserted during PROGRAM or RUN mode (or on powerup) and the ConfigMeFirst.txt file is either unreadable or invalid. The ConfigMeFirst.txt file will be invalid when it has the following errors:

- unrecognized setting (that is, the first three configuration rules have not been followed),
- the setting parameters after the = symbol is invalid, does not exist, or out of range,
- the same setting exists twice or more,
- one or more non-setting characters exist within the same bracket,
- space in between setting characters (example, [P M]), or
- space in between IP address, subnet mask, and gateway address (for example, xxx. x xx.xxx.xxx)
- only one of the network parameter settings ([IPA], [SNM], or [GWA]) is assigned
- [END] setting does not exist (even if there are no other settings in the configuration file).

The microSD card becomes unusable until the ConfigMeFirst.txt file becomes readable or the errors are corrected.

Datalog

The datalogging feature allows you to capture global and local variables with timestamp from the Micro800 controller into the microSD card. You can retrieve the recorded datasets on the microSD card by reading the contents of the microSD card through a card reader or by doing an upload through the Connected Components Workbench software.

A maximum number of 10 datasets is supported for a Micro820 program. Each dataset can contain up to 128 variables, with a maximum of four (4) data string variables per dataset. String variables can have a maximum of 252 characters. All datasets are written to the same file. For more information on how datalogs are stored on the microSD card, see the Datalog Directory Structure on page 90.

Micro820 controllers typically support 10 MB of datalog per day.

You can retrieve datalog files from the microSD card using a card reader or by uploading the datalogs through Connected Components Workbench.

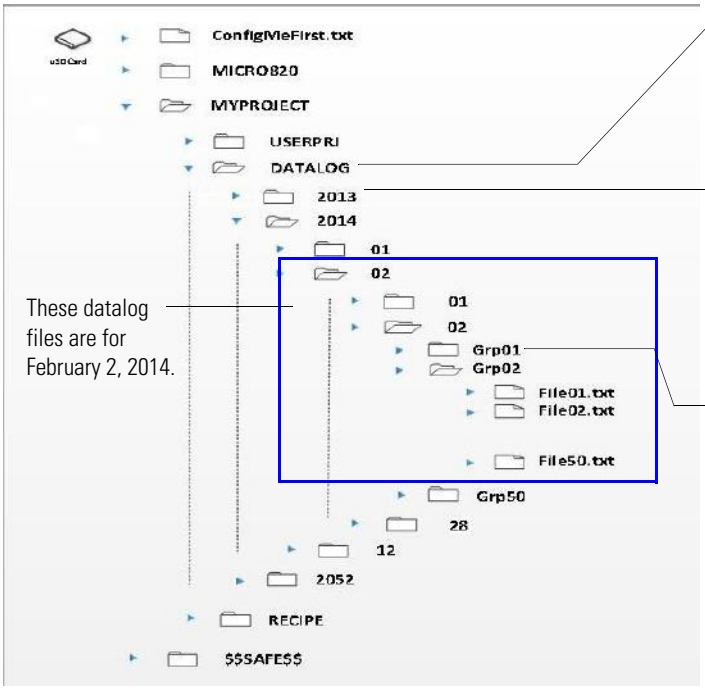
IMPORTANT	Uploading datalog files in PROGRAM mode is recommended for optimum performance and to prevent file access conflict. For example, if the datalog instruction is executing, Connected Components Workbench will not upload the last datalog file.

See the sample quickstart project to get you started on the Datalog feature, Use the Datalog Feature on page 99.

IMPORTANT	Datalog execution time depends on the user application and its complexity. Users are advised to datalog once a minute for typical applications. Note that housekeeping takes at least 5 ms per program scan. See Program Execution in Micro800 on page 61 for more information on program scan and execution rules and sequence. See also Datalog – Data Payload vs. Performance Time on page 120.

IMPORTANT	Note that in cases where there are simultaneous RCP and DLG function block execution or uploads/downloads/searches, the activities are queued up and handled one by one by the program scan. Users will notice a slowdown in performance in these cases.

Datalog Directory Structure



The DATALOG folder is created under the current project directory in the microSD card. In this example, the current project directory is MYPROJECT. By default, the current project directory name is taken from the downloaded project's controller name or from the ConfigMeFirst.txt. See ConfigMeFirst.txt Configuration Settings on page 86.

Subdirectories are also created following the controller RTC timestamp. This means that if RTC date at the time of function block execution is February 02, 2013, the subfolder 2013 is created under DATALOG. Under the 2013 folder, the subfolder 02 (which stands for the month of February) is created. Under 02, another subfolder 02 is created, corresponding to the current date.

Under the current working folder, the subfolder Grp01 is created. A maximum of 50 Grpxxx folders can be generated on the microSD card per day.

Under the current Grpxxx working folder, the datalog file File01.txt is created. Once this file reaches more than 4 KB, another file, File02.txt, is automatically created to store data. The file size is kept small in order to minimize data loss in case the card is removed or when there is unexpected power off.
Each Grpxx folder can accommodate up to 50 files. This means that, for example, when the Grp01 folder already stores 50 files, a new folder Grp02 is automatically created to store the next datalog files for that day. This automatic folder and file generation goes on until the Grpxx folder reaches 50 for that day.
When a microSD card is inserted, the DLG function block looks for the last Grpxx folder and filexx.txt file, and proceeds to do the datalogging based on that information.

The following table summarizes datalogging performance onMicro820 controllers.

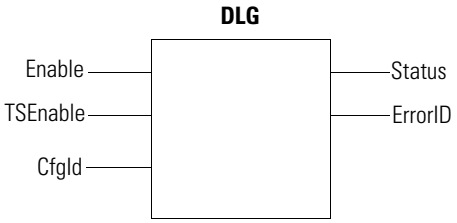
Datalog Specifications

Attribute	Value	
Maximum datasets	10	All datasets are stored in the same file.
Maximum variables per dataset	128	Configured in Connected Components Workbench software.
Minimum size per file	4 KB	
Maximum files per Grpxx folder(1)	50	When directory is full, a new directory is automatically created in RUN mode.
Maximum files (Filexx.txt) per day	50	When file reaches maximum size, a new file is automatically created in RUN mode.
Typical data per day	10 MB	

(1) Once the datalog limits is reached (that is, 50 Grpxx folders per day, then an error (ErrorID 3: DLG_ERR_DATAFILE_ACCESS) is returned.

Datalog Function (DLG) Block

The datalogging function block lets a user program to write run-time global values into the datalogging file in microSD card.



DLG Input and Output Parameters

Parameter	Parameter Type	Data Type	Description
Enable	INPUT	BOOL	Datalogging write function enable. On rising edge (that is, Enable value is triggered from low to high), the function block executes. The precondition for execution is that the last operation has completed.
TSEnable	INPUT	BOOL	Date and timestamp logging enable flag.
CfgId	INPUT	USINT	Configured dataset (DSET) number (1…10).
Status	OUTPUT	USINT	Datalogging function block current status.
ErrorID	OUTPUT	UDINT	Error ID if DLG Write fails.

DLG Function Block Status

Status Code	Description
0	Datalogging IDLE status.
1	Datalogging BUSY status.
2	Datalogging COMPLETE SUCCEED status.
3	Datalogging COMPLETE ERROR status.

DLG Function Block Errors

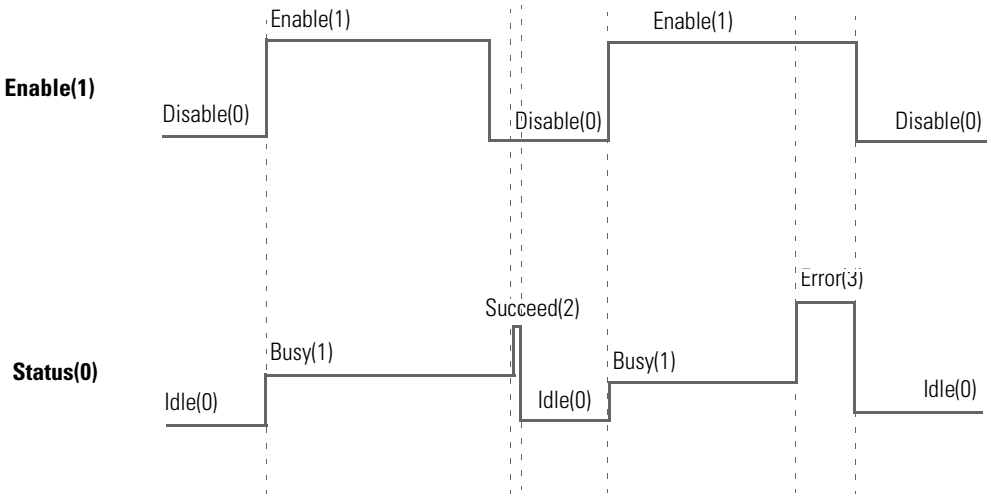
Status Code	Name	Description
0	DLG_ERR_NONE	No error.
1	DLG_ERR_NO_SDCARD	microSD card is missing.
2	DLG_ERR_RESERVED	Reserved.
3	DLG_ERR_DATAFILE_ACCESS	Error accessing datalog file in microSD card.
4	DLG_ERR_CFG_ABSENT	Datalog configuration file is absent.
5	DLG_ERR_CFG_ID	Configuration ID is missing in datalog configuration file.
6	DLG_ERR_RESOURCE_BUSY	Same Configuration ID is used with other datalog function block call at the same time

DLG Function Block Errors

Status Code	Name	Description
7	DLG_ERR_CFG_FORMAT	Datalog configuration file format is wrong.
8	DLG_ERR_RTC	Real time clock is invalid.
9	DLG_ERR_UNKNOWN	Unspecified error has occurred.

IMPORTANT File access error will be returned during DLG function block execution when card is full.

Datalog Function Block Timing Diagram



IMPORTANT **Datalog Function Block Execution**

- There are three possible states for the Datalog function block: Idle, Busy and Complete (which includes Complete with Succeed and Complete with Error).
- For one Datalog function block execution, the typical status starts from Idle, then Busy and finishes with Complete. To trigger another function block execution, the status needs to go back to Idle first.
- Idle status changes to Busy status only when Enable input signal is in rising edge. Complete status enters Idle status when Enable input signal is Disable status only.
- TSEnable and CfgId input parameters are only sampled at Enable input parameter's rising edge when a new function block execution starts. During function block execution, the input parameters of TSEnable and CfgId are locked and any changes are ignored.
- When execution completes, the status changes from Busy to Complete. At this stage, if input Enable is False, status changes to Idle after indicating Complete for exactly one scan time. Otherwise function block status is kept as Complete until input Enable changes to False.
- The datalog file can only be created by the DLG instruction block. Connected Components Workbench can only upload and delete the datalog file.
- There are separators in between every data variable in the data file which is defined during configuration in Connected Components Workbench.
  See Supported Data Types for Datalog and Recipe Function Blocks on page 93.
- Data variable values are sampled when datalogging function block is in Busy state. However, datalogging file is only created when datalogging function block is in Complete state.

Supported Data Types for Datalog and Recipe Function Blocks

Data Type	Description	Example format in output datalog file
BOOL[1]	Logical Boolean with values TRUE and FALSE	0: FALSE 1: TRUE)
SINT	Signed 8-bit integer value	-128, 127
INT	Signed 16-bit integer value	-32768, 32767
DINT	Signed 32-bit integer value	-2147483648, 2147483647
LINT	Signed 64-bit integer value	-9223372036854775808, 9223372036854775807
USINT(BYTE)	Unsigned 8-bit integer value	0, 255
UINT(WORD)	Unsigned 16-bit integer value	0, 65535
UDINT(DWORD)	Unsigned 32-bit integer value	0, 4294967295
ULINT(LWORD)	Unsigned 64-bit integer value	0, 18446744073709551615

Supported Data Types for Datalog and Recipe Function Blocks

Data Type	Description	Example format in output datalog file
REAL	32-bit floating point value	-3.40282347E+38, +3.40282347E+38
LREAL	64-bit floating point value	-1.7976931348623157E+308, +1.7976931348623157E+308
STRING(2)	character string (1 byte per character)	'"Rotation Speed"
DATE(1)	Unsigned 32-bit integer value	1234567 (Date variables are stored as 32-bit words, a positive number of seconds beginning at 1970-01-01 at midnight GMT.)
TIME(1)	Unsigned 32-bit integer value	1234567 (Time variables are stored as 32-bit words, positive number of milliseconds.)

(1) BOOL, DATE, TIME data variables are presented in decimal digital format in the microSD Card. Users have the option to convert this format to a more friendly format. For example, use ANY_TO_STRING function block to convert BOOL data type (0, 1) to FALSE or TRUE. You can similarly do the same for DATE and TIME data types. DATE data type is presented in differential decimal digital value between system baseline time (1970/01/01,00:00:00) and current date value. Unit is millisecond.
Time should be absolute time value. Unit is second.

(2) String data variables are enclosed in double quotation marks in the datalog file.
The example below shows DSET1 using string variables and DSET2 using integers.

```
DSET1,"Temperature", "Humidity", "Pressure"
DSET2, 30, 50, 125
```

Recipe

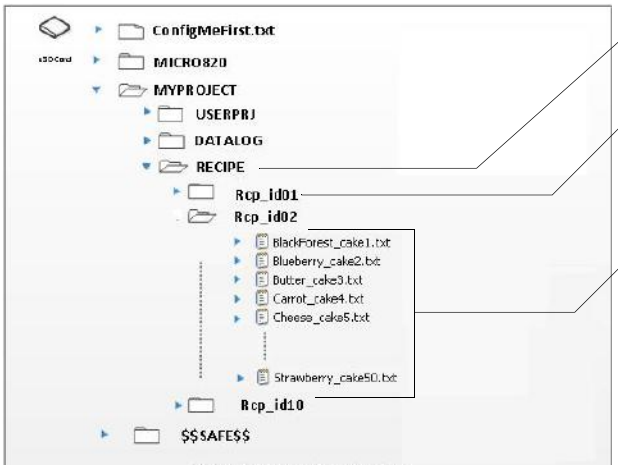
Micro820 controllers support the Recipe feature and allows users to store and load a list of data to and/or from recipe data files using the RCP instruction. It also allows users to download, upload, and delete Recipe data on the microSD card through Connected Components Workbench.

A maximum number of 10 recipe sets is supported for a Micro820 program. Each recipe can contain up to 128 variables, with a maximum of four (4) data string variables per recipe. String variables can have a maximum of 252 characters. Variations of the recipe are stored in separate files with unique file names. For more information on how recipes are stored on the microSD card, see the Recipe Directory Structure on page 95.

Recipe Specifications

Attribute	Value	
Maximum number of recipe sets	10	Recipe sets are stored in 10 directories (Rcp_Id01...Rcp_Id10) with a maximum number of 50 recipe files in each directory.
Maximum number of recipes in each set	50	
Maximum number of variables per recipe	128	Configured in Connected Components Workbench software.
Maximum bytes per recipe file	4 KB	

Recipe Directory Structure



On first execution of RCP, it creates the RECIPE folder under the current project directory on the microSD card.

It also creates 10 subdirectories for each recipe set with a name following the CfgID input value (1…10) . If the CfgID value is 1, then the subfolder Rcp_Id01 is created.

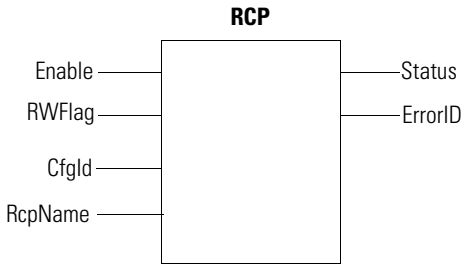
Recipe files are then created/written into the folder, with file names that correspond to the input value of RcpName parameter for the RCP function block, as configured in Connected Components Workbench. Each Recipe set can contain up to 50 recipe files or variations. Filenames for recipe files should not exceed 30 characters.

Recipe Configuration and Retrieval

You can retrieve recipe files from the microSD card using a card reader or by uploading and downloading the recipe sets through Connected Components Workbench.

Recipe Function (RCP) Block

The RCP function block allows a user program to read variable values from an existing recipe data file which is in the recipe folder of the microSD card and update run-time global or local variable values in the controller. The RCP function block also allows the user program to write run-time global or local variable values from smaller controller into the recipe data file in the microSD card.



RCP Input and Output Parameters

Parameter	Parameter Type	Data Type	Description
Enable	INPUT	BOOL	Recipe read/write function enable. If Rising Edge (Enable is triggered from "low" to "high"), starts recipe function block and the precondition is that last operation is completed.
RWFlag	INPUT	BOOL	TRUE: Recipe write data variables to recipe files into the microSD card. FALSE: Recipe reads saved data variables from the microSD card and update these variables accordingly.
CfgId	INPUT	USINT	Recipe set number (1…10).
RcpName	INPUT	STRING	Recipe data filename (maximum 30 characters).
Status	OUTPUT	USINT	Current state of Recipe function block.
ErrorID	OUTPUT	UDINT	Detailed error ID information if RCP read/write fails.

RCP Function Block Status

Status Code	Description
0	Recipe Idle status.
1	Recipe Busy status.
2	Recipe Complete Succeed status.
3	Recipe Complete Error status.

RCP Function Block Errors

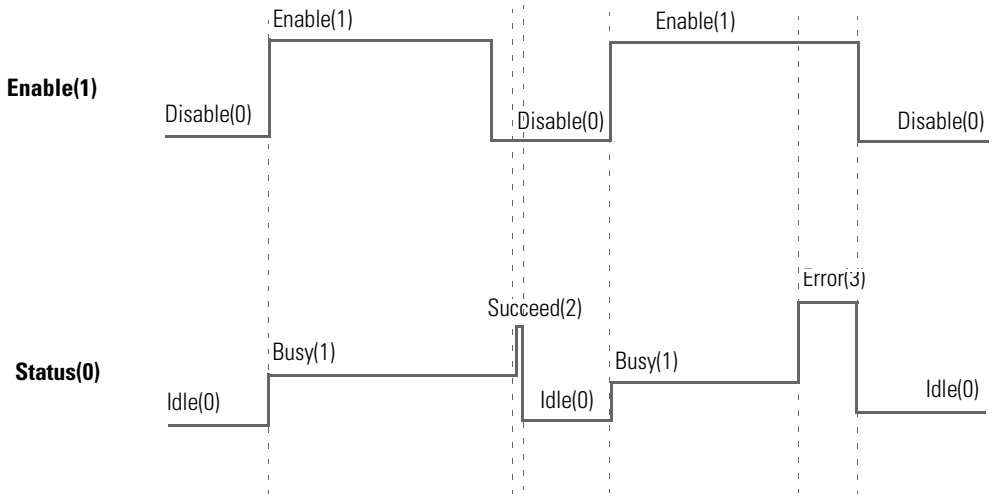
Error ID	Error name	Description
0	RCP_ERR_NONE	No error.
1	RCP_ERR_NO_SDCARD	microSD card is absent.
2	RCP_ERR_DATAFILE_FULL	Recipe files exceed maximum number of files per recipe set folder.
3	RCP_ERR_DATAFILE_ACCESS	Error to access recipe data file in microSD card.
4	RCP_ERR_CFG_ABSENT	Recipe configuration file is absent.
5	RCP_ERR_CFG_ID	Configure ID is absent in recipe configuration file.
6	RCP_ERR_RESOURCE_BUSY	The Recipe operation resource linked to this Recipe ID is used by another function block operation.
7	RCP_ERR_CFG_FORMAT	Recipe configuration file format is invalid.
8	RCP_ERR_RESERVED	Reserved.
9	RCP_ERR_UNKNOWN	Unspecified error has occurred.
10	RCP_ERR_DATAFILE_NAME	Recipe data file name is invalid.
11	RCP_ERR_DATAFOLDER_INVALID	Recipe dataset folder is invalid.

RCP Function Block Errors

Error ID	Error name	Description
12	RCP_ERR_DATAFILE_ABSENT	Recipe data file is absent.
13	RCP_ERR_DATAFILE_FORMAT	Recipe data file contents are wrong.
14	RCP_ERR_DATAFILE_SIZE	Recipe data file size is too big (>4K).

IMPORTANT File access error will be returned during RCP function block execution when card is full.

Recipe Function Block Timing Diagram



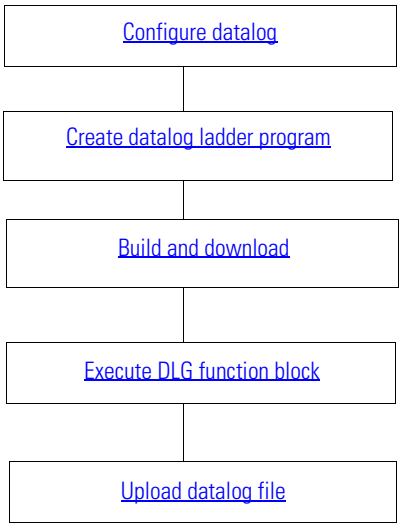
IMPORTANT **RCP Function Block Execution**

- There are three possible states for Recipe function block: Idle, Busy, Complete (Complete with Succeed and Complete with Error)
- For one Recipe function block execution, the typical status starts from Idle then Busy and finishes with Complete. To trigger another function block execution, the status needs to go back to Idle first.
- Idle status changes to Busy status only when Enable input signal is in rising edge. Complete status enters Idle status when Enable input signal is on Disable status.
- RWFlag, CfgId and RcpName input parameters are only sampled at Enable input parameter's rising edge when a new function block execution starts. During function block execution, input parameters of RWFlag, CfgId and RcpName are locked and any changes are ignored.
- When the function block execution finishes, the function block status changes from Busy to Complete. At this stage, if input Enable is False, function block status changes to Idle after staying as Complete for exactly one scan time. Otherwise, function block status remains Complete until input Enable changes to False.
- Recipe function block file name supports a maximum of 30 bytes in length, and only supports upper and lower case letters Aa…Zz, numbers 0…9 and underscore (_).
- The RcpName input parameter does not allow file extension (for example, .txt) to be added to its value. The recipe data file is written to the microSD card with the .txt extension.
- There are separators in between every data variable in the recipe data file which is defined during configuration in Connected Components Workbench. Redundant tab, space, carriage return and line feed characters are strictly not allowed.
  See Supported Data Types for Datalog and Recipe Function Blocks on page 93.
- Double quotes are not allowed within a string in a recipe file.

Quickstart Projects for Datalog and Recipe Function Blocks

The following sample quickstart projects provide step-by-step instructions on how to use the Datalog and Recipe function blocks in Connected Components Workbench to generate and manage your recipe files and datalogs.

Use the Datalog Feature

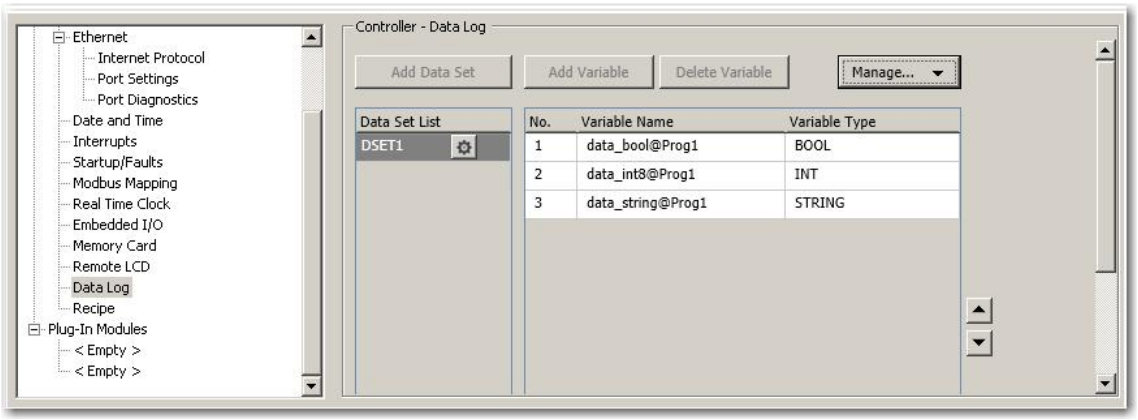


Configure datalog

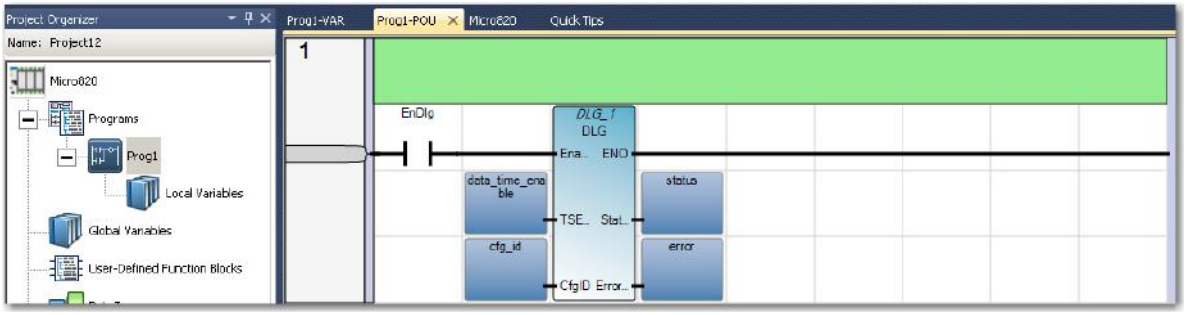
1. In Connected Components Workbench, go to the Properties pane to configure your datalog.
2. Select Datalog. Click Add Dataset to add a dataset. Note that each dataset will be stored in the same file. You can add up to 10 datasets per configuration.
3. Click Add Variable to add variables to the dataset. You can add up to 128 variables to each dataset.
   For this quickstart sample project, add the following variables that you have previously created to Dataset 1.

Local Variables

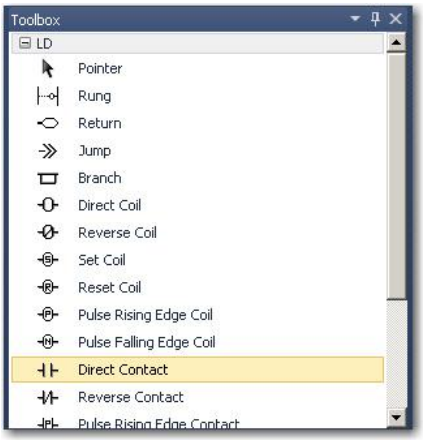
Variable Name	Data Type
data_bool	BOOL
data_int8	INT
data_string	STRING



Create datalog ladder program

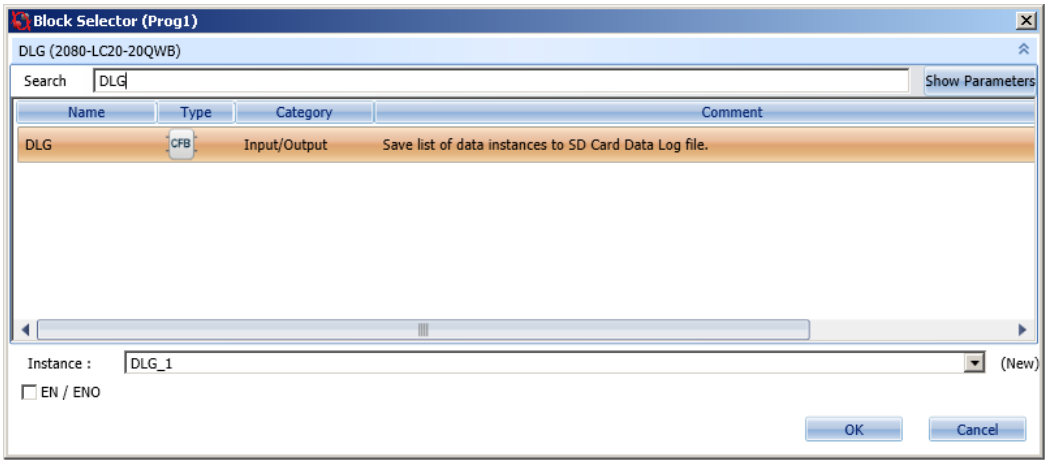


1. Launch Connected Components Workbench. Create a user program for your Micro820 controller.
2. Right-click Programs. Select Add New LD: Ladder Diagram. Name the Program (for example, Prog1).
3. From the Toolbox, double-click Direct Contact to add it to the rung.

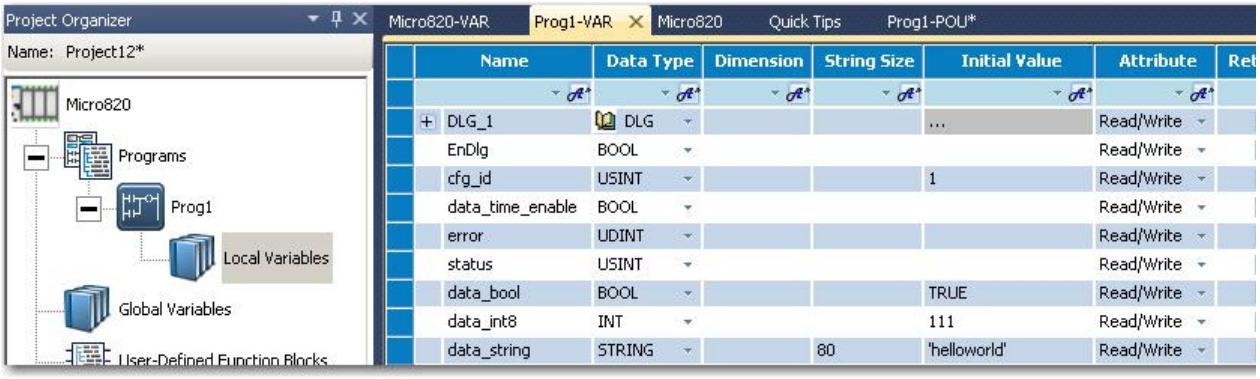


4. From the Toolbox, double-click Block to add it to the rung.

5. On the Block Selector window that appears, type DLG to filter the DLG function block from the list of available function blocks. Click OK.



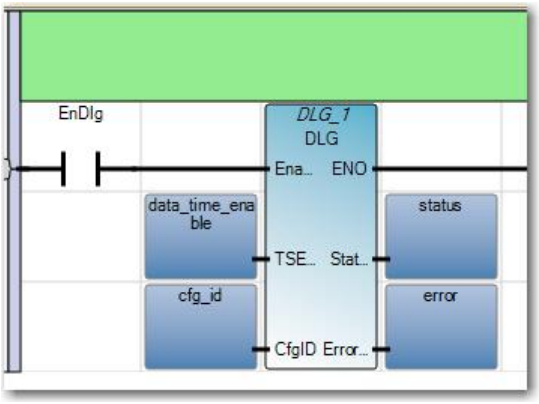
6. Create the following local variables for your project.



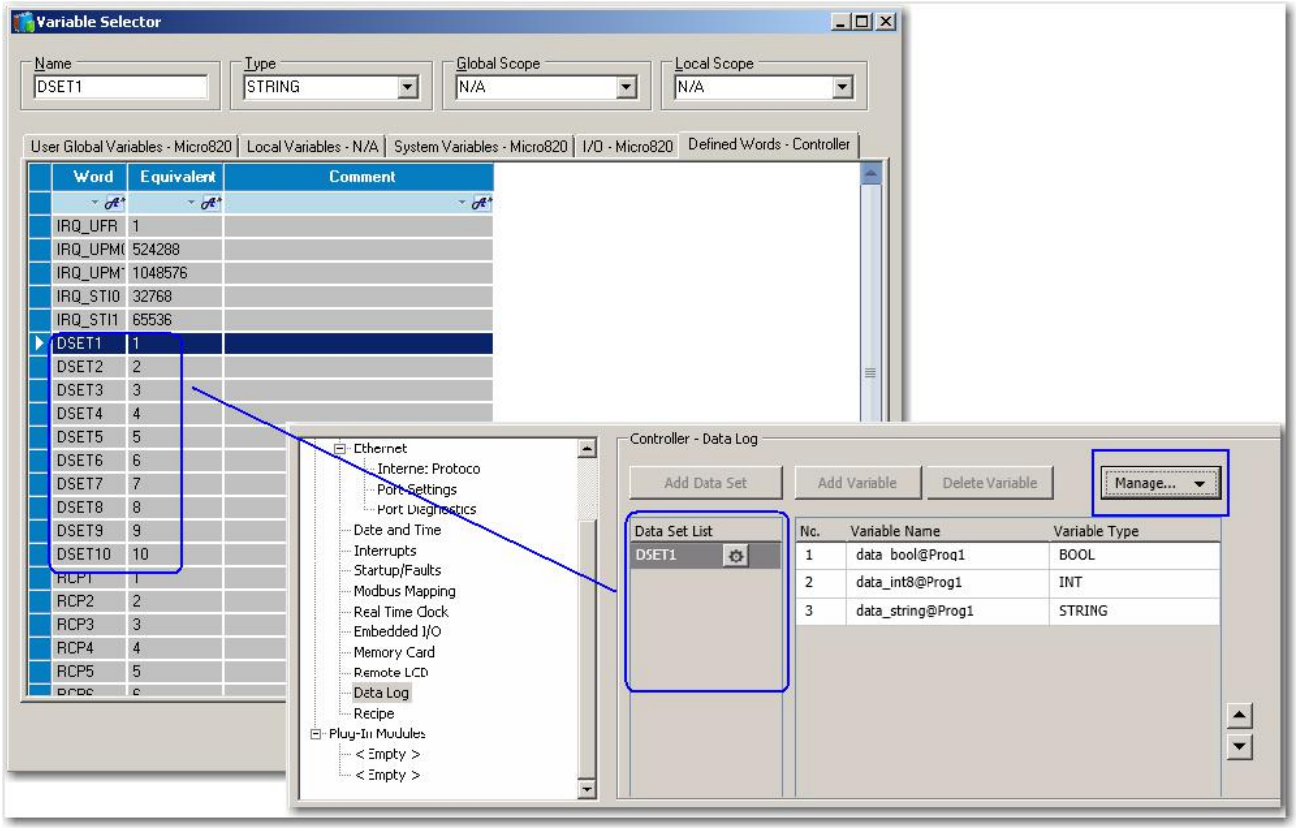
Local Variables

Variable Name	Data Type
EnDlg	BOOL
cfg_id	USINT
data_time_enable	BOOL
error	UDINT
status	USINT
data_bool	BOOL
data_int8	INT
data_string	STRING

7. Assign the variables to the DLG input and output parameters as follows:



Note: For CfgID input parameter, you can choose a predefined variable by choosing from the Defined Words in Connected Components Workbench. To do so, click the CfgID input box. From the Variable Selector window that appears, click the Defined Words tab and choose from the list of defined words (for example, DSET1 which corresponds to DSET1 in your recipe configuration). See the following screenshot.



Build and download

After configuring datalog properties, build the program and download to the controller.

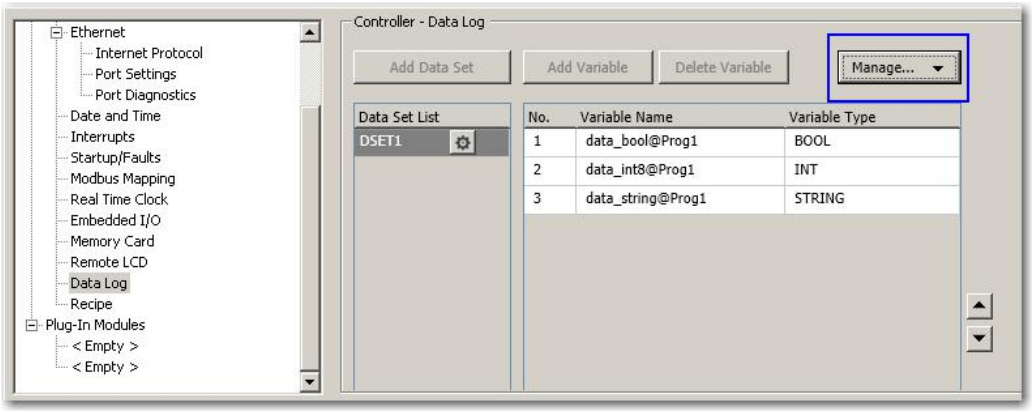
Execute DLG function block

Execute the DLG function block. Notice the Status output go from 0 (Idle) to 1 (Enable), and 2 (Succeed).

Upload datalog file

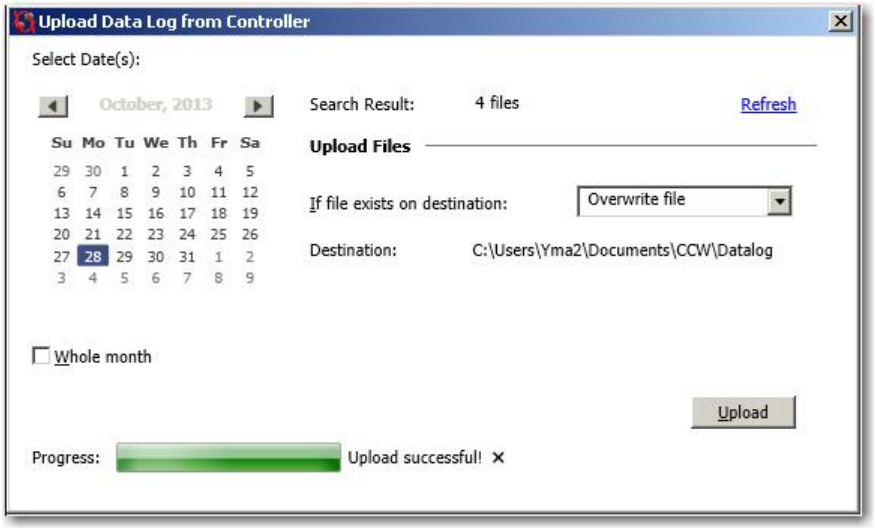
You can retrieve datalog files from the microSD card using a card reader or by uploading the datalogs through Connected Components Workbench.

1. To use the Upload feature, go to the Properties section of your project in Connected Components Workbench.
2. Select Data Log. Click Manage and then choose Upload.



IMPORTANT The Manage button is not available in DEBUG mode. You need to stop DEBUG mode to use the Manage button to upload datalog files. Uploading datalog files in PROGRAM mode is recommended for performance and file locking reasons.

3. From the Upload window that appears, select the date of the datalog files that you would like to upload. You can upload datalogs for the entire month by clicking Whole Month option button.

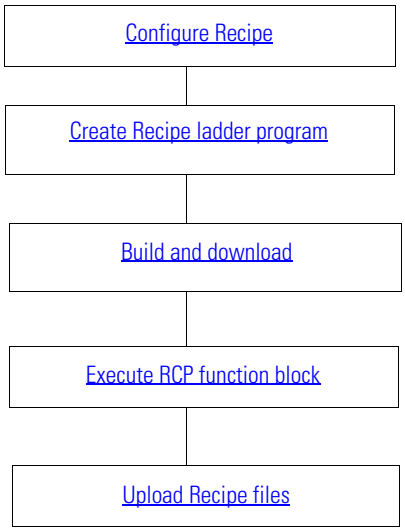


4. If the file already exists in your destination folder, select whether you would like to Overwrite file, Skip file, or Preserve both files.
5. Click Upload. The progress bar should tell you whether the upload is successful or not.

IMPORTANT Do not take out the microSD card from the slot while data is being written or retrieved from the card. Ongoing write and retrieval operations are indicated by a flashing SD status LED.

IMPORTANT For better datalog file management, you can use a third-party tool or DOS CMD to merge all your datalog files into a single file and import as a CSV file in Excel.

Use the Recipe Feature

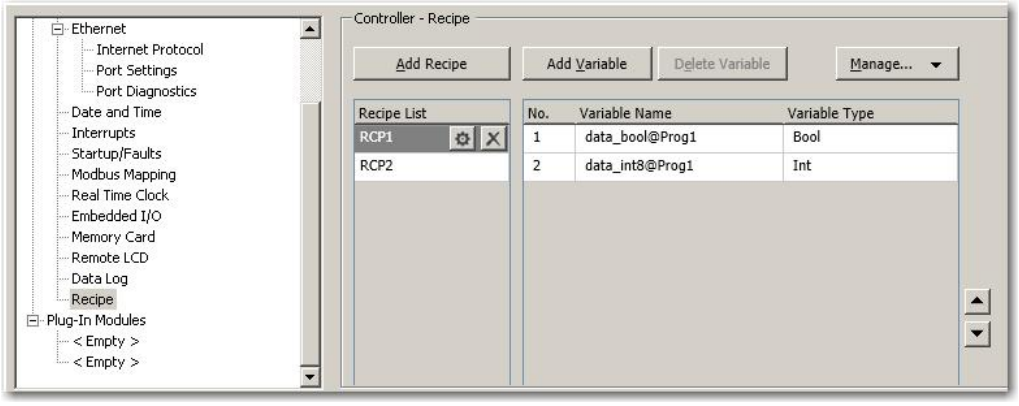


Configure Recipe

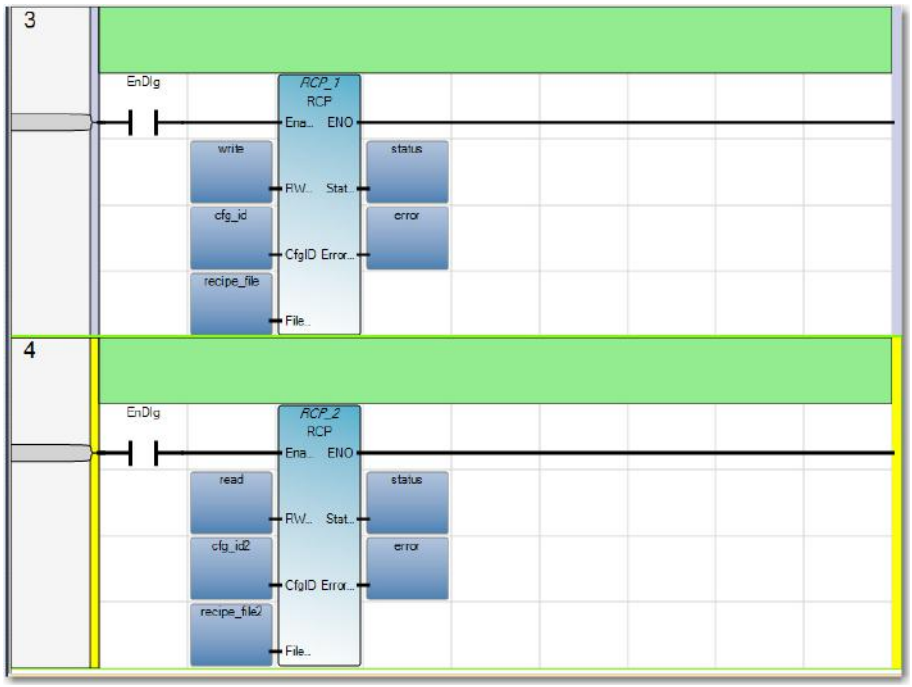
1. In Connected Components Workbench, go to the Properties pane to configure Recipe.
2. Select Recipe. Click Add Recipe to add a recipe. Note that each recipe will be stored in separate files. You can add up to 10 recipes per configuration.
3. Click Add Variable button to add variables to the recipe. You can add up to 128 variables to each recipe.
   For this quickstart sample project, add the following variables that you have previously created to RCP 1:

Local Variables

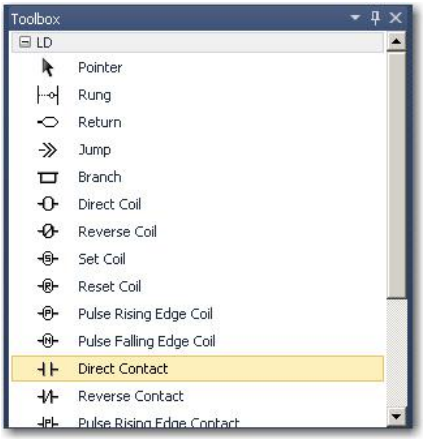
Variable Name	Data Type
data_bool	BOOL
data_int8	INT



Create Recipe ladder program

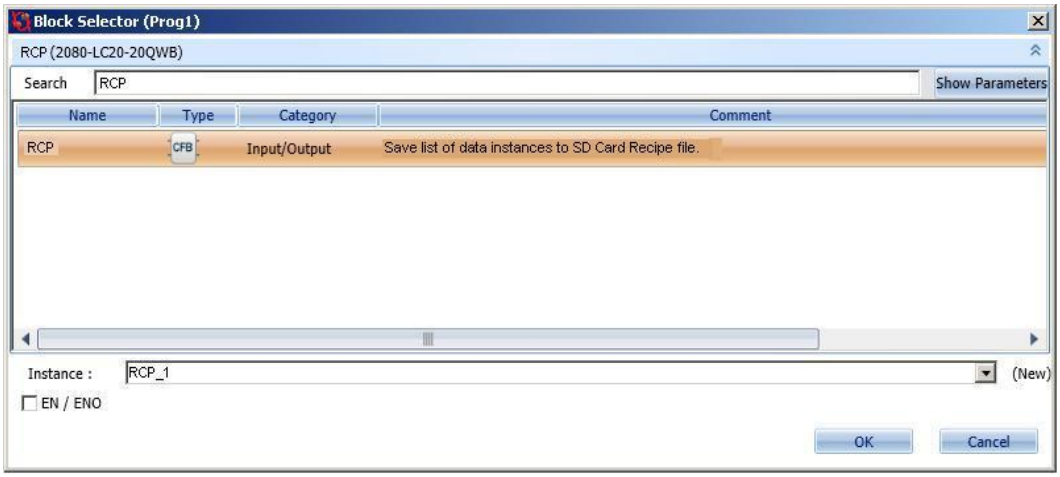


1. Launch Connected Components Workbench. Create a user program for your Micro820 controller.
2. Right-click Programs. Select Add New LD: Ladder Diagram. Name the Program (for example, Prog2).
3. From the Toolbox, double-click Direct Contact to add it to the first rung.

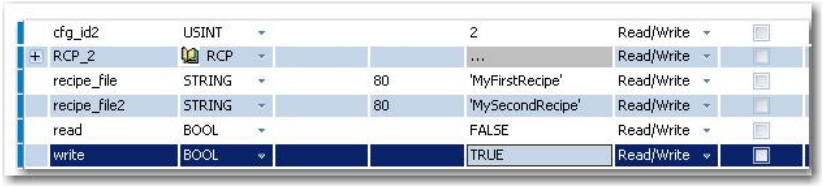


4. From the Toolbox, double-click Block to add it to the rung.

5. On the Block Selector window that appears, type RCP to filter the Recipe function block from the list of available function blocks. Click OK.



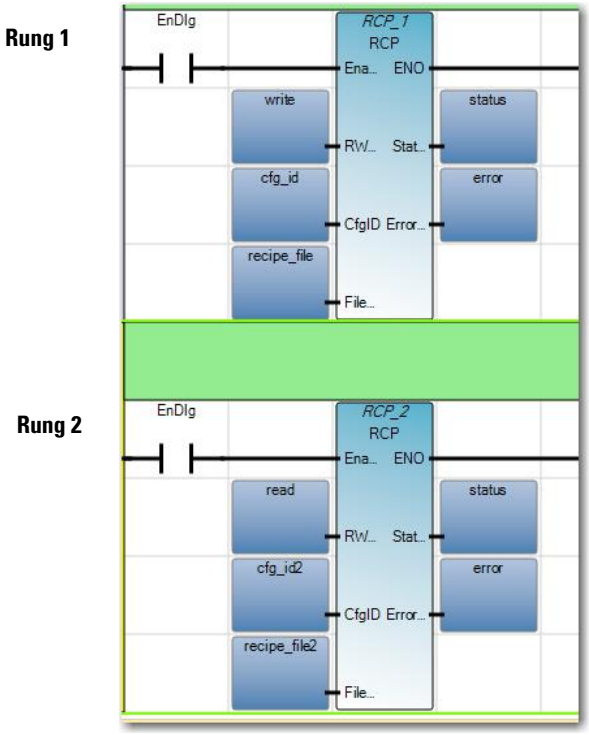
6. From the Toolbox, double-click rung to add another rung.
7. Add a Direct Contact and RCP function block to this second rung by following steps 3...5.
8. Create the following local variables for your program, in addition to the ones that you have already created for datalog.



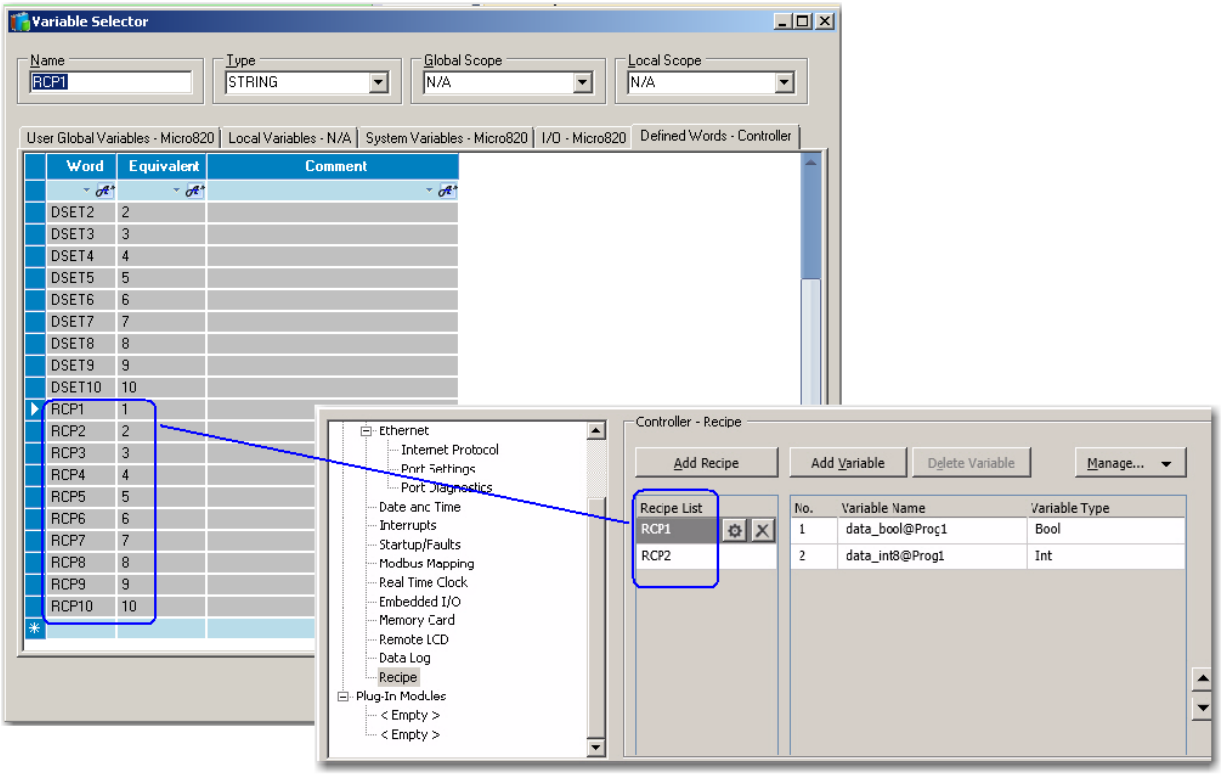
Local Variables

Variable Name	Data Type
recipe_file	STRING
recipe_file2	STRING
cfg_id2	USINT
read	BOOL
write	BOOL

9. Assign the variables to the RCP input and output parameters as follows:



Note: For CfgID input parameter, you can choose a predefined variable by choosing from the Defined Words in Connected Components Workbench. To do so, click the CfgID input box. From the Variable Selector window that appears, click the Defined Words tab and choose from the list of defined words (for example, RCP1 which corresponds to RCP1 in your recipe configuration). See the following screenshot.



Build and download

After configuring Recipe, build the program and download to the controller.

Execute RCP function block

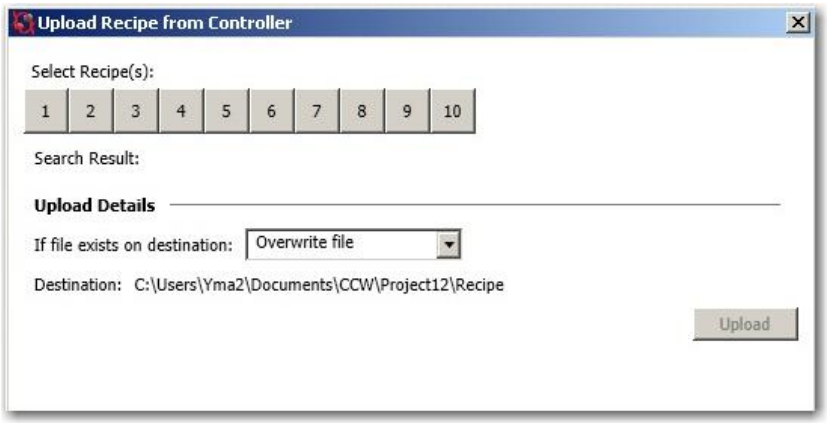
Execute the RCP function block. Notice the Status output go from 0 (Idle) to 1 (Enable), and 2 (Succeed).

Upload Recipe files

You can retrieve recipe files from the microSD card using a card reader or by uploading the recipe files through Connected Components Workbench.

1. To use the Upload feature, go to the Properties section of your project in Connected Components Workbench.
2. Select Recipe. Click Manage and then choose Upload.
   Through the Manage button, you can also choose to Download and Delete recipe files.

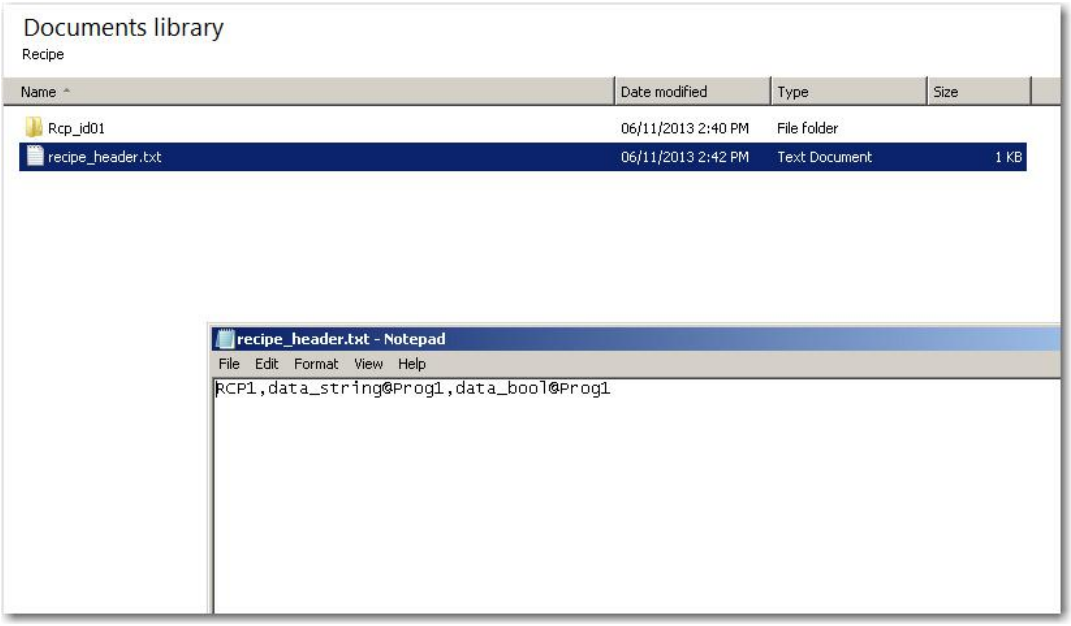
3. From the Upload window that appears, select the batch of recipe files that you would like to upload.



4. If the file already exists in your destination folder, select whether you would like to Overwrite file, Skip file, or Preserve both Files.
5. Click Upload. The progress bar should tell you whether the upload is successful or not.

IMPORTANT Do not take out the microSD card from the slot while data is being written or retrieved from the card. Ongoing write and retrieval operations are indicated by a flashing SD status LED.

A recipe header file will be saved with the uploaded recipes.



Notes:

Specifications

General Specifications

The Micro820 controllers have the following specifications and certifications.

General Specifications

Attribute	2080-LC20-20AWB(R)	2080-LC20-20QBB(R)	2080-LC20-20QWB(R)
Number of I/O	12 inputs, 8 outputs		
Dimensions HxWxD	90 x 104 x 75 mm (3.54 x 4.09 x 2.95 in.)		
Shipping weight, approx.	0.38 kg (0.83 lb)		
Wire size	**For fixed terminal blocks:**		

For fixed terminal blocks:

	Min	Max	
Solid	0.14 mm^2 (26 AWG)	2.5 mm^2 (14 AWG)	rated @ 90 °C (194 °F) insulation max
Stranded	0.14 mm^2 (26 AWG)	1.5 mm^2 (16 AWG)	

For removable terminal blocks:

	Min	Max	
Solid and Stranded	0.2 mm^2 (24 AWG)	2.5 mm^2 (14 AWG)	rated @ 90 °C (194 °F) insulation max

For RS232/RS485 serial port:

	Min	Max	
Solid	0.14 mm^2 (26 AWG)	1.5 mm^2 (16 AWG)	rated @ 90 °C (194 °F) insulation max
Stranded	0.14 mm^2 (26 AWG)	1.0 mm^2 (18 AWG)	

Wiring category[1]	2 – on signal ports 2 – on power ports 2 – on communication ports		
Wire type	Use copper conductors or shielded cables		
Terminal screw torque	**For removable and fixed terminal blocks:** 0.5…0.6 Nm (4.4…5.3 lb-in.) using a 0.6 x 3.5 mm flat-blade screwdriver. **Note:** Use a handheld screwdriver to hold down the screws at the side. **For RS232/RS485 serial port:** 0.22…0.25 Nm (1.95…2.21 lb-in.) using 0.4 x 2.5 x 80 mm 2-component grip with non-slip grip screwdriver.		
Input circuit type	24V DC sink/source (standard) – for 2080-LC20-20QWB(R), 2080-LC20-20QBB(R) 120V AC – for 2080-LC20-20AWB(R) for inputs 4…11 only		
Output circuit type	Relay	24V DC source (standard and high-speed)	Relay
Power input	24V DC		
Power consumption	5.62 W (without plug-ins, max)…8.5 W (with plug-ins, max)		

General Specifications

Attribute	2080-LC20-20AWB(R)	2080-LC20-20QBB(R)	2080-LC20-20QWB(R)
Power dissipation	6 W		
Power supply voltage range	20.4…26.4 V DC, Class 2		
Auxiliary power supply output for thermistor	10V		
I/O rating	Input: 120V AC 16 mA Output: 2 A, 240 V AC 2A, 24V DC	Input: 24V DC, 8.8 mA Output: 24V DC, 1 A per point (Surrounding air temperature 30°C) 24 V DC, 0.3 A per point (Surrounding air temperature 65 °C)	Input: 24V DC, 8.8 mA Output: 2 A, 240 V AC, 2A, 24V DC
Isolation voltage	250V (continuous), Reinforced Insulation Type, Output to Aux and Network, Inputs to Outputs. 150V (continuous), Reinforced Insulation Type, Input to Aux and Network. Type tested for 60 s @ 3250 V DC Output to Aux and Network, Inputs to Outputs. Type tested for 60 s @ 1950 V DC Input to Aux and Network.	50V (continuous), Reinforced Insulation Type, I/O to Aux and Network, Inputs to Outputs. Type tested for 60 s @ 720 V DC, I/O to Aux and Network, Inputs to Outputs.	250V (continuous), Reinforced Insulation Type, Output to Aux and Network, Inputs to Outputs. 50V (continuous), Reinforced Insulation Type, Input to Aux and Network. Type tested for 60 s @ 720 V DC, Inputs to Aux and Network, 3250 V DC Outputs to Aux and Network, Inputs to Outputs.
Pilot duty rating	C300, R150	–	C300, R150
Insulation stripping length	7 mm for the removable and fixed terminal blocks 5 mm for the RS232/RS485 serial port		
Enclosure type rating	Meets IP20		
North American temp code	T4		

(1) Use this Conductor Category information for planning conductor routing. Refer to Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Analog Input Specifications for I-00…I-03

Attribute	Value
Number of inputs	4
Type	Voltage (single-ended)
Data range	0...4095
Input voltage range	0…10V DC
Maximum input	26.4V DC
Input impedance	14.14 kΩ
Resolution	12-bit, 2.5 mV/count
Smoothing	None
Input time constant, typical	0.44 ms
Isolation	None
Accuracy (25…55 °C)	5% of full-scale (2% with calibration)

AC Input Specifications for I-04…I-11 for 2080-LC20-20AWB(R)

Attribute	Value
Number of inputs	8
On-state voltage	120V AC, nom 79V AC, min 125V AC, max
On-state current	5 mA, min 16 mA, max
Input frequency	50/60 Hz, nom 47 Hz, min 63 Hz, max
Off-state voltage, max	20V AC
Off-state current, max	2.5 mA
Inrush current, max	250 mA @ 125V AC
Inrush decay time constant, max	22 ms

DC Input Filter Settings for I-04…I-11 for 2080-LC20-20QWB(R), 2080-LC20-20QBB(R)

Nominal Filter Setting (ms) Inputs 4 and higher	Minimum ON Delay (ms)	Maximum ON Delay (ms)	Minimum OFF Delay (ms)	Maximum OFF Delay (ms)
0	0	0.1	0	0.1
8	5	8	5	8
16	10	16	10	16
32	20	32	20	32

DC Input Specifications

Attribute	Non-isolated, shared with analog inputs (Inputs 00…03)	Isolated inputs (Inputs 04…11) – for 2080-LC20-20QWB(R), 2080-LC20-20QBB(R) only
Voltage category	24V DC Sink	24V DC Sink/Source
On-state voltage, nom	12/24V DC	24V DC
On-state voltage range	9.8…26.4V DC	24V DC, nom 10…26.4V DC @ 65 °C (149 °F) 10…30V DC @ 30 °C (86 °F)
Off-state voltage, max	5V DC	
Off-state current. max	0.5 mA	1.5 mA
On-state current, min	0.75 mA @ 10.8V DC 1.0 mA @ 15V DC	1.8 mA @ 10.8V DC 2.7 mA @ 15V DC
On-state current, nom	2.1 mA @ 24V DC	8.5 mA @24V DC
On-state current, max	2.6 mA @ 26.4V	12.0 mA @ 30V DC
Nominal impedance	14.1 kΩ (non-isolated)	3.74 kΩ (isolated)
IEC input compatibility	Type 1	Type 3

Relay Output Specifications for O-00...06 for 2080-LC20-20QWB(R), 2080-LC20-20AWB(R)

Attribute	Value
Voltage, min	5 V, AC 5 V, DC
Voltage, max	250 V, AC
Maximum switching time	10 ms, turn on 10 ms, turn off
Life	10,000,000 cycles (mechanical) 100,000 cycles (Electrical with UL test load)

Relay Contact Ratings

Maximum Volts	Amperes		Amperes Continuous	Volt-Amperes	
	Make	Break		Make	Break
120 V AC	15 A	1.5 A	2 A	1800	180
240 V AC	7.5 A	0.75 A			
24 V DC	1.0 A		1 A	28	
125 V DC	0.22 A				

Analog Output Specifications

Attribute	Value
Output count range	0...4008
Output type	Voltage
Output Voltage Range	0…10V
Voltage Output Maximum Load (Resistive)	>1000 Ohms
Accuracy	2% of full scale for voltage
Resolution	12-bit, 2.5 mV/count
Output update rate (with no output capacitance), max	20 ms
Channel-to-bus isolation	No isolation
Channel-to-channel isolation	No isolation

DC Output Specifications for 2080-LC20-20QBB(R)

Attribute	Standard Outputs (Outputs O-00…O-05)	High Speed Output [1] (Output O-06)
User supply voltage	10V DC, min 26.4V DC, max	10V DC, min 26.4V DC, max
Load current, min	10 mA	
On state voltage drop	1V @ max load current 2.5V @ max surge current	1.5V @ max load current

DC Output Specifications for 2080-LC20-20QBB(R)

Attribute	Standard Outputs (Outputs O-00…O-05)	High Speed Output (1) (Output O-06)
Current ratings per point	0.3 A @ 65 °C, max 1.0 A @ 30 °C, max 1.0 mA, max leakage	100 mA (high speed operation) 1.0 A @ 30 °C 0.3 A @ 65 °C (standard operation) 1.0 mA, max leakage
Surge current per point peak current max surge duration max rate of repetition @ 30 °C max rate of repetition @ 65 °C	 4.0 A 10 ms once each second once every two seconds	
Controller current, max total	3 A	–
Turn-on time, max	0.1 ms	0.2 µs
Turn-off time, max	1.0 ms	2.5 µs
Response time, max	10 ms	
Frequency rate	NA	2%

(1) High speed output operation is greater than 5 Khz.

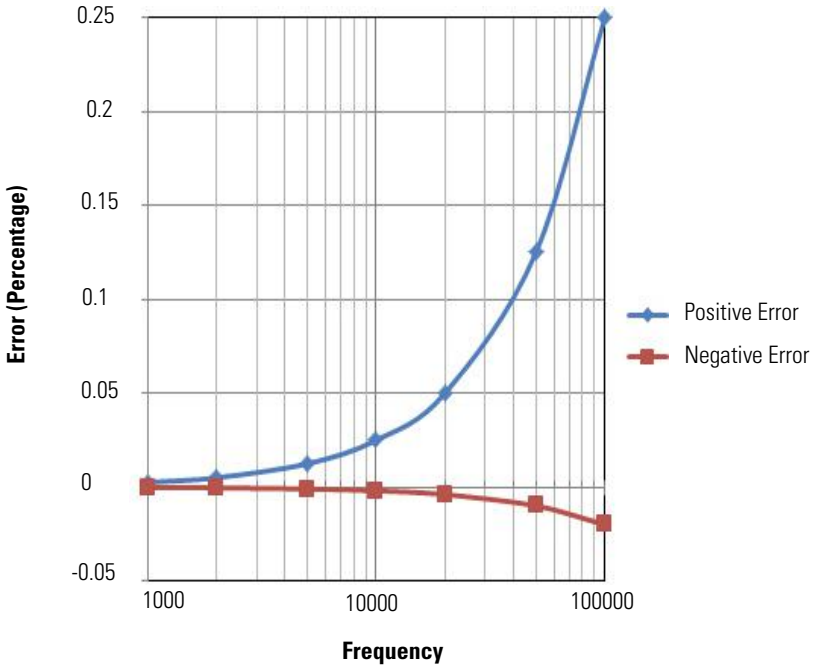
PWM Output Duty Cycle Error

Turn On/Off time for the Micro820 controllers for the PWM output port is 0.2 µs and 2.5 µs max, respectively. Duty cycle error is:
Positive error = 2.5 µs * F
Negative error = -0.2 µs * F

The plot below shows duty cycle error vs. frequency.

To get the duty cycle error at a certain frequency, for example, the user sets frequency to 20 KHz, and sets duty cycle to 30% in Connected Components Workbench, then actual duty cycle is

$30\%\ ^{+5\%}_{-0.4\%}$.



Auxiliary Power Supply for Thermistor Applications

Attribute	Value
Output voltage	9.5V, min 10.04V, typical 10.5V, max
Output current	10 mA, typical 20 mA, max

Embedded RTC

Attribute	Value
Resolution	1 sec
Accuracy, typical	± 60 sec/month @ 25 °C
Supercap life, typical	5 years @ 40 °C, 14.5 years @ 25 °C

PWM Typical Readings

PWM Typical Readings

		Expected Duty Cycle		Typical Duty Cycle (1.27 KΩ load)
Frequency (Khz)	**%Duty Cycle**	**Minimum**	**Maximum**	**%Duty Cycle**
5	5%	4.90%	6.25%	5.48
5	10%	9.90%	11.25%	10.5
5	20%	19.90%	21.25%	20.5
5	40%	39.90%	41.25%	40.5
5	55%	54.90%	56.25%	55.5
5	75%	74.90%	76.25%	75.5
5	95%	94.90%	96.25%	95.5
5	65%	64.90%	66.25%	65.5
10	5%	4.80%	7.50%	5.9
10	10%	9.80%	12.50%	11
10	20%	19.80%	22.50%	21
10	40%	39.80%	42.50%	40.9
10	55%	54.80%	57.50%	55.9
10	65.00%	64.80%	67.50%	65.9
10	85.00%	84.80%	87.50%	85.9
10	95.00%	94.80%	97.50%	95.9
25	5.00%	4.50%	11.25%	7.25
25	10.00%	9.50%	16.25%	12.3
25	20.00%	19.50%	26.25%	22.4
25	40.00%	39.50%	46.25%	42.3
25	55.00%	54.50%	61.25%	57.3
25	65.00%	64.50%	71.25%	67.3
25	85.00%	84.50%	91.25%	87.3
25	95.00%	94.50%	100%	97
50	5%	4%	17.50%	9.7
50	10%	9%	22.50%	14.8
50	20%	19%	32.50%	24.7
50	40%	39%	52.50%	44.7
50	55%	54%	67.50%	59.6
50	65%	64%	77.50%	69.6
50	85%	84%	97.50%	89.5
50	95%	94%	100%	98.1
100	5%	3.00%	30.00%	14.7
100	10%	8.00%	35.00%	19.5
100	20%	18.00%	45.00%	29.6

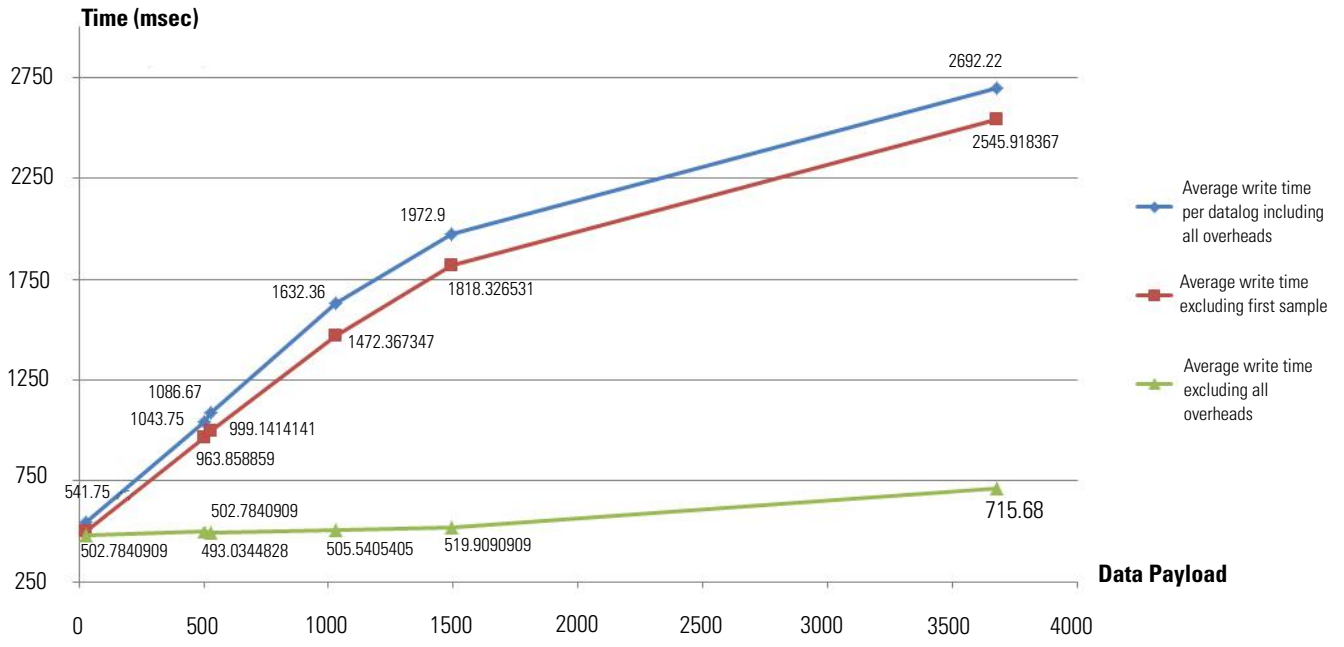
PWM Typical Readings

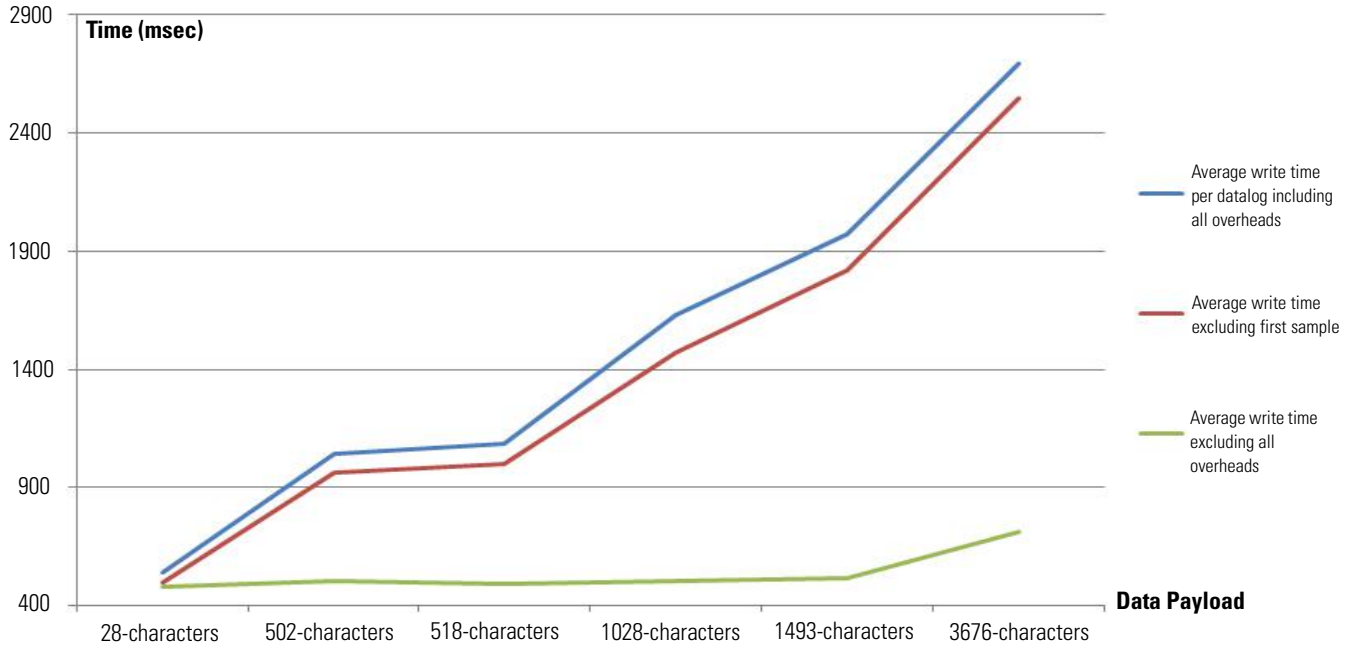
		Expected Duty Cycle		Typical Duty Cycle (1.27 KΩ load)
Frequency (Khz)	**%Duty Cycle**	**Minimum**	**Maximum**	**%Duty Cycle**
100	40%	38.00%	65.00%	49.3
100	55%	53.00%	80.00%	64
100	65%	63.00%	90.00%	73.8
100	85%	83.00%	100.00%	92.4
100	95%	93.00%	100.00%	98

Datalog Performance

Datalog – Data Payload vs. Performance Time

Parameter	Number of Characters					
	28	**502**	**518**	**1028**	**1493**	**3676**
Average write time per datalog file including all overheads	541.77 ms	1043.75 ms	1086.67 ms	1632.36 ms	1972.9 ms	2696.22 ms
Average write time excluding first sample	500.40 ms	963.86 ms	999.14 ms	1472.36 ms	1818.33 ms	2545.92 ms
Average write time excluding all overheads	479.10 ms	502.78 ms	493.03 ms	505.54 ms	519.91 ms	715.68 ms





Environmental Specifications

Environmental Specifications

Attribute	Value
Temperature, operating	IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock): -20…65 °C (-4…149 °F)
Temperature, surrounding air, max	65 °C (149 °F)
Temperature, nonoperating	IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock): -40…85 °C (-40…185 °F)
Relative humidity	IEC 60068-2-30 (Test Db, Unpackaged Damp Heat): 5…95% non-condensing
Vibration	IEC 60068-2-6 (Test Fc, Operating): 2 g @ 10…500 Hz
Shock, operating	IEC 60068-2-27 (Test Ea, Unpackaged Shock): 25 g
Shock, non-operating	IEC 60068-2-27 (Test Ea, Unpackaged Shock): DIN mount: 25 g PANEL mount: 45 g
Emissions	CISPR 11 Group 1, Class A
ESD immunity	IEC 61000-4-2: 6 kV contact discharges 8 kV air discharges

Environmental Specifications

Attribute	Value
Radiated RF immunity	IEC 61000-4-3: 10V/m with 1 kHz sine-wave 80% AM from 80…2000 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 900 MHz 10V/m with 200 Hz 50% Pulse 100% AM @ 1890 MHz 10V/m with 1 kHz sine-wave 80% AM from 2000…2700 MHz
EFT/B immunity	IEC 61000-4-4: ±2 kV @ 5 kHz on power ports ±2 kV @ 5 kHz on signal ports ±1 kV @ 5 kHz on communication ports
Surge transient immunity	IEC 61000-4-5: ±1 kV line-line(DM) and ±2 kV line-earth(CM) on power ports ±1 kV line-line(DM) and ±2 kV line-earth(CM) on signal ports ±1 kV line-earth(CM) on communication ports
Conducted RF immunity	IEC 61000-4-6: 10V rms with 1 kHz sine-wave 80% AM from 150 kHz…80 MHz

Certifications

Certifications

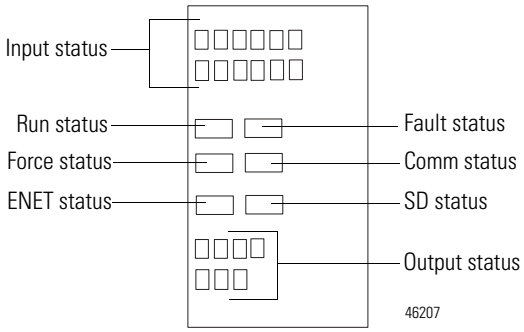
Certification (when product is marked)(1)	Value
c-UL-us	UL Listed Industrial Control Equipment, certified for US and Canada. See UL File E322657. UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada. See UL File E334470.
CE	European Union 2004/108/EC EMC Directive, compliant with: EN 61326-1; Meas./Control/Lab., Industrial Requirements EN 61000-6-2; Industrial Immunity EN 61000-6-4; Industrial Emissions EN 61131-2; Programmable Controllers (Clause 8, Zone A & B) European Union 2006/95/EC LVD, compliant with: EN 61131-2; Programmable Controllers (Clause 11)
C-Tick	Australian Radiocommunications Act, compliant with: AS/NZS CISPR 11; Industrial Emissions
EtherNet/IP	ODVA conformance tested to EtherNet/IP specifications
KC	Korean Registration of Broadcasting and Communications Equipment, compliant with: Article 58-2 of Radio Waves Act, Clause 3

(1) See the Product Certification link at http://www.rockwellautomation.com/products/certification for Declaration of Conformity, Certificates, and other certification details.

Troubleshooting

Status Indicators on the Controller

Status indication on the Micro820 controller is as follows.



Status Indicator Description

	Description	State	Indicates
1	Input status	Off	Input is low.
		On	Input is energized (terminal status).
2	Fault status	Off	No fault detected.
		Red	Controller hard fault.
		Flashing red	Major fault detected.
3	Run status	Green	Executing the user program in run mode.
		Flashing Green (1 Hz)	The controller is in program mode.
4	Serial communications status	Off	No traffic for RS232/RS485.
		Green	Traffic through RS232/RS485.
5	Force status	Off	No force conditions are active.
		Amber	Force conditions are active.

Status Indicator Description

	Description	State	Indicates
5	SD status	Off Uninitialized State	• microSD card is not inserted. • microSD card is inserted but medium is bad. • microSD card is inserted but file system is bad.
		Off Error State	• microSD card read/write failure. • Failure to read Configmefirst.txt in the root directory. • Errors are detected in ConfigMeFirst.txt. See ConfigMeFirst.txt Errors on page 88 for list of errors.
		On Idle State	• microSD card is initialized completely without read/write on SD card. • microSD card read/write is complete.
		Blinking Operating State	microSD card is being read/written.
6	ENET status	Steady Off	Not powered, no connection. The device is powered off, or is powered on but no Ethernet link established.
		Flashing Green	No IP address. The device is powered on with Ethernet link established but no IP address is assigned yet. Duplicate IP. The device has detected that its IP address as being used by another device in the network. This status is applicable only if the device's duplicate IP address detection (ACD) feature is enabled.
		Steady Green	Operational. Ethernet ink is active and the device has valid IP address.
7	Output status	Off	Output is not energized.
		On	Output is energized (logic status).

Normal Operation

The RUN indicator is on or flashing. If a force condition is active, the FORCE indicator turns on and remains on until all forces are removed.

Error Conditions

If an error exists within the controller, the controller indicators operate as described in the following table.

Indicator Behavior	Probable Error	Probable Cause	Recommended Action
All indicators off	No input power or power supply error	No line power	Verify proper line voltage and connections to the controller.
		Power supply overloaded	This problem can occur intermittently if power supply is overloaded when output loading and temperature varies.
Power and FAULT indicators on solid	Hardware faulted	Processor hardware error	Cycle power. Contact your local Allen-Bradley representative if the error persists.
		Loose wiring	Verify connections to the controller.
Power on with solid indicator and FAULT indicator flashing	Application fault	Hardware/software major fault detected	For error codes and status information, refer to the Connected Components Workbench online Help
Power on with solid indicator and FAULT indicator flashing	Operating system fault	Firmware upgrade unsuccessful	See Flash Upgrade Your Micro800 Firmware on page 133.

Error Codes

This section lists possible error codes for your controller, as well as recommended actions for recovery.

If an error persists after performing the recommended action, contact your local Rockwell Automation technical support representative. For contact information, go to http://support.rockwellautomation.com/MySupport.asp

List of Error Codes for Micro800 Controllers

Error Code	Description	Recommended Action
0xF000	The controller was unexpectedly reset due to a noisy environment or an internal hardware failure. • A **Micro800 controller revision 2 and later** attempts to save the program and clear the user data. If the system variable _SYSVA_USER_DATA_LOST is set, the controller is able to recover the user program but the user data is cleared. If not, the Micro800 controller program is cleared. • A **Micro800 controller revision 1.xx** clears the program. Note that the system variable _SYSVA_USER_DATA_LOST is not available on Micro800 controllers revision 1.xx.	Perform one of the following: • Download the program through Connected Components Workbench. • Refer to Wiring Requirements and Recommendation on page 29. If the fault persists, contact your local Rockwell Automation technical support representative. For contact information, see: http://support.rockwellautomation.com/MySupport.asp.
0xF001	The controller program has been cleared. This happened because: • a power-down occurred during program download or data transfer from the memory module. • the cable was removed from the controller during program download. • the RAM integrity test failed.	Perform one of the following: • Download the program using Connected Components Workbench software. • Transfer the program using the memory module restore utility or the microSD card. If the fault persists, contact your local Rockwell Automation technical support representative. For contact information, see: http://support.rockwellautomation.com/MySupport.asp.
0xF002	The controller hardware watchdog was activated. • A **Micro800 controller revision 2 and later** attempts to save the program and clear the user data. If the system variable _SYSVA_USER_DATA_LOST is set, the controller is able to recover the user program but the user data is cleared. If not, the Micro800 controller program is cleared. • A **Micro800 controller revision 1.xx** clears the program. Note that the system variable _SYSVA_USER_DATA_LOST is not available on Micro800 controllers revision 1.xx.	Perform the following: 1. Establish a connection to the Micro800 controller. 2. Download the program using Connected Components Workbench. If the fault persists, contact your local Rockwell Automation technical support representative. For contact information, see: http://support.rockwellautomation.com/MySupport.asp.
0xD00F	A particular hardware type (for example, embedded I/O) was selected in the user program configuration, but did not match the actual hardware base.	Perform one of the following: • Connect to the hardware that is specified in the user program. • Reconfigure the program to match the target hardware type.
0xF003	One of the following occurred: • The memory module hardware faulted. • The memory module connection faulted. • The memory module was incompatible with the Micro800 controller's firmware revision.	Perform one of the following: • Remove the memory module and plug it in again. • Obtain a new memory module. • Upgrade the Micro800 controller's firmware revision to be compatible with the memory module. For more information on firmware revision compatibility, go to http://www.rockwellautomation.com/support/firmware.html
0xF004	One of the following occurred: • The memory module is not present (for firmware revision 8.0 or higher, see fault 0xF303) • The password is mismatched (for firmware revision 8.0 or higher, see fault 0xF302) • The memory module's project is not compatible with the controller (for firmware revision 8.0 or higher, see fault 0xF301) • Data transfer error • Embedded RTC data error	For Memory Module failure, retry data transfer. If the error persists, replace the memory module. For embedded RTC failure, cycle power the controller. If the error persists, contact your local Rockwell Automation technical support representative. For contact information, see: http://support.rockwellautomation.com/MySupport.asp.

List of Error Codes for Micro800 Controllers

Error Code	Description	Recommended Action
0xF005	The user program failed an integrity check while the Micro800 controller was in Run mode.	Perform one of the following: • Cycle power on your Micro800 controller. Then, download your program using Connected Components Workbench and start up your system. • Refer to Wiring Requirements and Recommendation on page 29.
0xF006	The user program is incompatible with the Micro800 controller's firmware revision.	Perform one of the following: • Upgrade the Micro800 controller's firmware revision using ControlFlash. • Contact your local Rockwell Automation technical support representative for more information about firmware revisions for your Micro800 controller. For more information on firmware revision compatibility, go to http://www.rockwellautomation.com/support/firmware.html
0xF010	The user program contains a function/function block that is not supported by the Micro800 controller.	Perform the following: 1. Modify the program so that all functions/function blocks are supported by the Micro800 controller. 2. Build and download the program using Connected Components Workbench. 3. Put the Micro800 controller into Run mode.
0xF014	A memory module memory error occurred.	Reprogram the memory module. If the error persists, replace the memory module.
0xF015	An unexpected software error occurred.	Perform the following: 1. Cycle power on your Micro800 controller. 2. Build and download your program using Connected Components Workbench, and then reinitialize any necessary data. 3. Start up your system. Refer to Wire Your Controller on page 29.
0xF016	An unexpected hardware error occurred.	Perform the following: 1. Cycle power on your Micro800 controller. 2. Build and download your program using Connected Components Workbench, and then reinitialize any necessary data. 3. Start up your system. Refer to Wire Your Controller on page 29.
0xF017	An unexpected software error occurred due to unexpected hardware interrupt. If the system variable __SYSVA_USER_DATA_LOST has been set, the controller will be able to recover the user program, but the user data will be cleared. If not, the Micro800 controller program will be cleared.	Perform one of the following: • Download the program using Connected Components Workbench software. • Transfer the program using the memory module restore utility or the microSD card. If the fault persists, contact your local Rockwell Automation technical support representative. For contact information, see: http://support.rockwellautomation.com/MySupport.asp.
0xF018	An unexpected software error occurred due to SPI communication failure. If the system variable __SYSVA_USER_DATA_LOST has been set, the controller will be able to recover the user program but the user data will be cleared. If not, the Micro800 controller program will be cleared.	Perform one of the following: • Download the program using Connected Components Workbench software.what • Transfer the program using the memory module restore utility or the microSD card. If the fault persists, contact your local Rockwell Automation technical support representative. For contact information, see: http://support.rockwellautomation.com/MySupport.asp.
0xF019	An unexpected software error occurred due to memory or other controller resource issue.	Perform one of the following: • Download the program using Connected Components Workbench software. • Transfer the program using the memory module restore utility or the microSD card. If the fault persists, contact your local Rockwell Automation technical support representative. For contact information, see: http://support.rockwellautomation.com/MySupport.asp.

List of Error Codes for Micro800 Controllers

Error Code	Description	Recommended Action
0xF020	The base hardware faulted or is incompatible with the Micro800 controller's firmware revision.	Perform one of the following: • Upgrade the Micro800 controller's firmware revision using ControlFlash. • Replace the Micro800 controller. • Contact your local Rockwell Automation technical support representative for more information about firmware revisions for your Micro800 controller. For more information on firmware revision compatibility, go to http://www.rockwellautomation.com/support/firmware.html
0xF021	The I/O configuration in the user program is invalid or does not exist in the Micro800 controller.	Perform the following: 1. Verify that you have selected the correct Micro800 controller from the Device Toolbox. 2. Correct the plug-in I/O module configuration in the user program to match that of the actual hardware configuration. 3. Recompile and reload the program. 4. Put the Micro800 controller into Run mode. If the error persists, be sure to use Connected Components Workbench programming software to develop and download the program.
0xF022	The user program in the memory module is incompatible with the Micro800 controller's firmware revision.	Perform one of the following: • Upgrade the Micro800 controller's firmware revision using ControlFlash to be compatible with the memory module. • Replace the memory module. • Contact your local Rockwell Automation technical support representative for more information about firmware revisions for your Micro800 controller. For more information on firmware revision compatibility, go to http://www.rockwellautomation.com/support/firmware.html
0xF023	The controller program has been cleared. This happened because: • a power down occurred during program download or transfer from the memory module. • the Flash Integrity Test failed (Micro810 only).	Perform one of the following: • Download the program. If the fault persists, contact your local Rockwell Automation technical support representative. For contact information, see: http://support.rockwellautomation.com/MySupport.asp.
0xF030/0xF031/0xF032/0xF033	Power down information in persistent memory may not be written properly due to a noisy environment or an internal hardware failure. This fault may also occur if the controller has previously restored a corrupted project from the microSD card and the controller has been power cycled. If the system variable __SYSVA_USER_DATA_LOST has been set, the controller will be able to recover the user program but the user data will be cleared. If not, the Micro800 controller program will be cleared.	Perform one of the following: • Download the program. If the fault persists, contact your local Rockwell Automation technical support representative. For contact information, see: http://support.rockwellautomation.com/MySupport.asp.
0xF050	The embedded I/O configuration in the user program is invalid.	Perform the following: 1. Correct the embedded I/O configuration in the user program to match that of the actual hardware configuration. 2. Build and download the program using Connected Components Workbench. 3. Put the Micro800 controller into Run mode. If the error persists, be sure to use Connected Components Workbench programming software to develop and download the program.
0xF300	The memory module is empty.	Perform one of the following: • Check to make sure there is a valid project in the memory module. • Download a user program and use the backup function to the memory module.

List of Error Codes for Micro800 Controllers

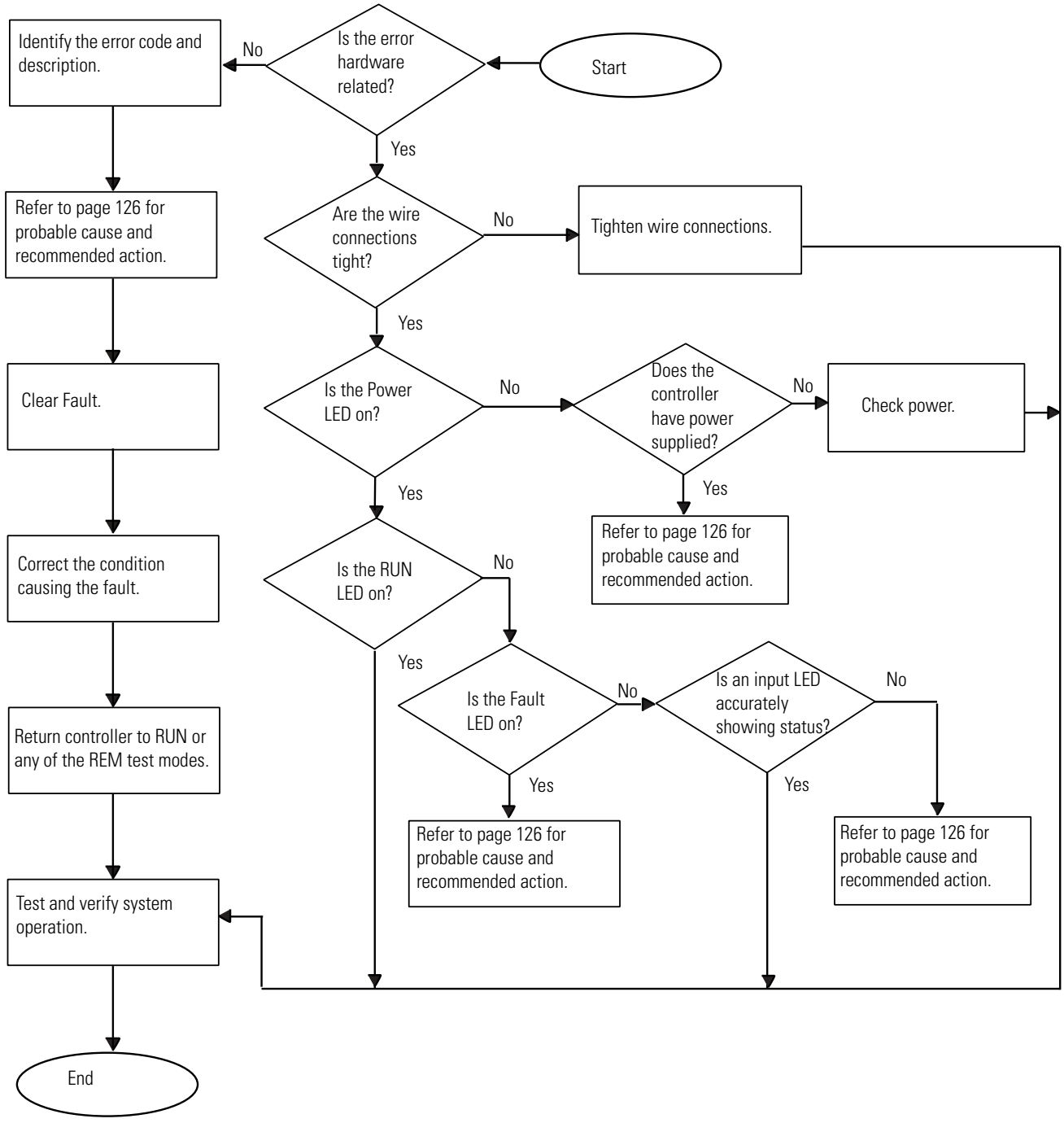
Error Code	Description	Recommended Action
0xF301	The memory module's project is not compatible with the controller.	Perform one of the following: • Check to make sure there is a user program with a controller that has the correct controller catalog configured. • Download a user program and use the backup function to the memory module.
0xF302	The password is mismatched.	Perform one of the following: • Check to make sure that the user program in the memory module has the correct password. • Download a user program with a password and use the backup function to the memory module. • Use Connected Components Workbench to enter the correct password into the controller and perform the restore operation again.
0xF303	The memory module is not present.	Check to make sure the memory module is present.
For the following four error codes, z is the slot number of the plug-in module. If z = 0, then the slot number cannot be identified		
0xF0Az	The plug-in I/O module experienced an error during operation.	Perform one of the following: • Check the condition and operation of the plug-in I/O module. • Cycle power to the Micro800 controller. If the error persists, see the Micro800 Plug-in Modules User Manual, publication 2080-UM004.
0xF0Bz	The plug-in I/O module configuration does not match the actual I/O configuration detected.	Perform one of the following: • Correct the plug-in I/O module configuration in the user program to match that of the actual hardware configuration. • Check the condition and operation of the plug-in I/O module. • Cycle power to the Micro800 controller. • Replace the plug-in I/O module. If the error persists, see the Micro800 Plug-in Modules User Manual, publication 2080-UM004.
0xF0Dz	When power was applied to the plug-in I/O module or the plug-in I/O module was removed, a hardware error occurred.	Perform the following: 1. Correct the plug-in I/O module configuration in the user program. 2. Build and download the program using Connected Components Workbench. 3. Put the Micro800 controller into Run mode.
0xF0Ez	The plug-in I/O module configuration does not match the actual I/O configuration detected.	Perform the following: 1. Correct the plug-in I/O module configuration in the user program. 2. Build and download the program using Connected Components Workbench. 3. Put the Micro800 controller into Run mode.
0xD011	The program scan time exceeded the watchdog timeout value.	Perform one of the following: • Determine if the program is caught in a loop and correct the problem. • In the user program, increase the watchdog timeout value that is set in the system variable _SYSVA_TCYWDG and then build and download the program using Connected Components Workbench.
0xF850	An error occurred in the STI configuration.	Review and change the STI configuration in the Micro800 controller properties.
0xF860	A data overflow occurred. A data overflow error is generated when the ladder, structured text or function block diagram execution encounters a divide-by-zero.	Perform the following: 1. Correct the program to ensure that there is no data overflow. 2. Build and download the program using Connected Components Workbench. 3. Put the Micro800 controller into Run mode.

List of Error Codes for Micro800 Controllers

Error Code	Description	Recommended Action
0xF870	An index address was out of data space.	Perform the following: 1. Correct the program to ensure that there is no index address out of data space. 2. Build and download the program using Connected Components Workbench. 3. Put the Micro800 controller into Run mode.
0xF880	A data conversion error occurred.	Perform the following: 1. Correct the program to ensure that there is no data conversion error. 2. Build and download the program using Connected Components Workbench. 3. Put the Micro800 controller into Run mode.
0xF888	The call stack of the controller cannot support the sequence of calls to function blocks in the current project. Too many blocks are within another block.	Change the project to reduce the quantity of blocks being called within a block.
0xF898	An error occurred in the user interrupt configuration for the plug-in I/O module.	Correct the user interrupt configuration for plug-in I/O module in the user program to match that of the actual hardware configuration.
0xF8A0	The TOW parameters are invalid.	Perform the following: 1. Correct the program to ensure that there are no invalid parameters. 2. Build and download the program using Connected Components Workbench. 3. Put the Micro800 controller into Run mode.
0xF8A1	The DOY parameters are invalid.	Perform the following: 1. Correct the program to ensure that there are no invalid parameters. 2. Build and download the program using Connected Components Workbench. 3. Put the Micro800 controller into Run mode.
0xFFzz (Note: zz indicates the last byte of the program number. Only program numbers up to 0xFF can be displayed. For program numbers 01x00 to 0xFFFF, only the last byte is displayed.)	A user-created fault from Connected Components Workbench has occurred.	If the fault persists, contact your local Rockwell Automation technical support representative. For contact information, see: http://support.rockwellautomation.com/MySupport.asp.

Controller Error Recovery Model

Use the following error recovery model to help you diagnose software and hardware problems in the micro controller. The model provides common questions you might ask to help troubleshoot your system. Refer to the recommended pages within the model for further help.



Calling Rockwell Automation for Assistance

If you need to contact Rockwell Automation or local distributor for assistance, it is helpful to obtain the following (prior to calling):

- controller type, series letter, revision letter, and firmware (FRN) number of the controller
- controller indicator status

Notes:

Quickstarts

This chapter covers some common tasks and quickstart instructions that are aimed to make you familiar with the in Connected Component Workbench. The following quickstarts are included:

Topic	Page
Flash Upgrade Your Micro800 Firmware	133
Establish Communications between RSLinx and a Micro820 Controller through USB Port on 2080-REMLCD	140
Configure Controller Password	144
Forcing I/Os	148
Using Run Mode Change	150

Flash Upgrade Your Micro800 Firmware

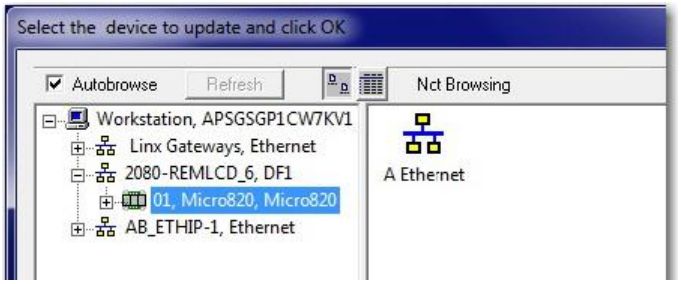
This quick start will show you how to flash update the firmware in a Micro800 controller using ControlFLASH. ControlFLASH is installed or updated with the latest Micro800 firmware when Connected Components Workbench software is installed on your computer.

ATTENTION: All Ethernet settings are reverted to factory default after a ControlFlash firmware upgrade. For users who need to use the same static IP address as previously set, for example, use the Memory Module to store project settings prior to a flash upgrade so that you can have the option to restore your original Ethernet settings.

On Micro820 controllers, users can use flash upgrade their controllers through the Ethernet port, in addition to the USB port of the 2080-REMLCD.

IMPORTANT To successfully flash update your controller over USB when using the ControlFLASH software, connect only one controller to your computer, and do not run ControlFLASH in a virtual machine such as VMware.

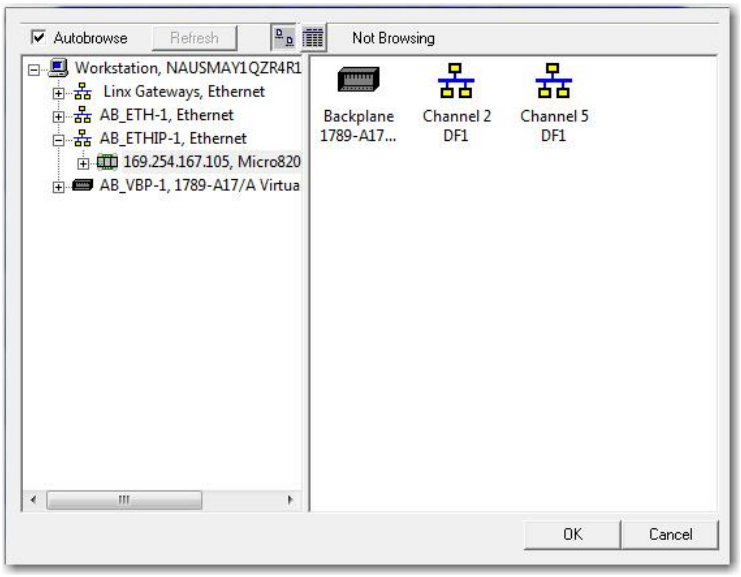
1. **Through USB**: Verify successful RSLinx Classic communications with your Micro800 controller by USB using RSWho. Micro820 controller uses the 2080_REMLCD_xxxx driver.



2. Start ControlFLASH and click Next.

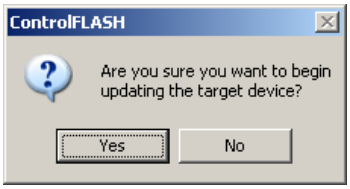
3. Select the catalog number of the Micro800 controller that you are updating and click Next.

4. Select the controller in the browse window and click OK.

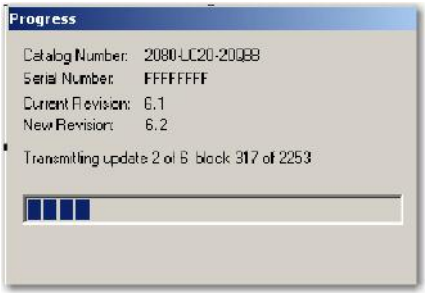


5. Click Next to continue, and verify the revision. Click Finish.

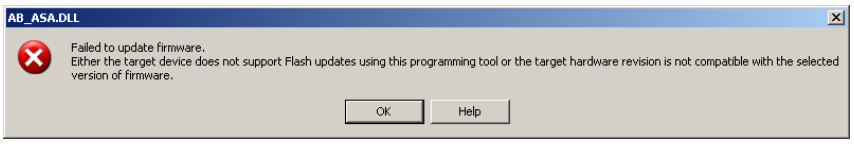
6. Click Yes to initiate the update.



A screen showing the download progress appears.



If you see the following error message instead, check to see if the controller is faulted or in Run mode. If so, clear the fault or switch to Program mode, click OK and try again.



7. When the flash update is complete, you will see a status screen. Click OK to complete the update.

IMPORTANT After control flashing the controller, some microSD cards may not be detected. Remove and insert the microSD card, or power cycle the controller if this issue is encountered.

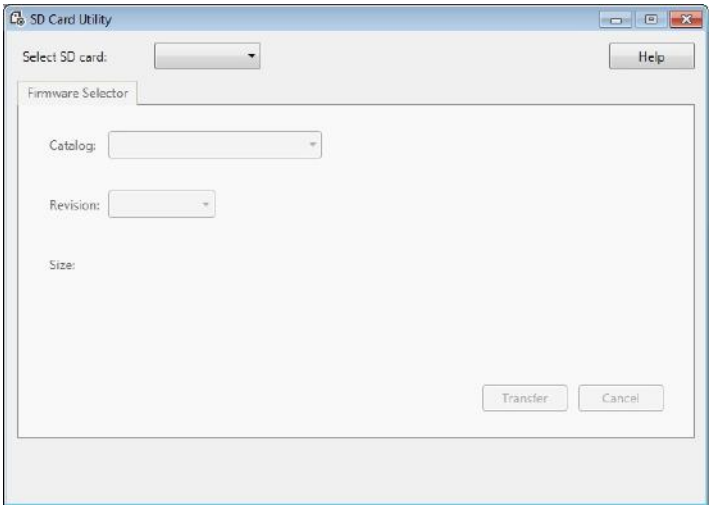
Flash Upgrade From MicroSD Card

With Connected Components Workbench release 8.0 onwards, you can flash upgrade your Micro820 controller from the microSD card in addition to using ControlFLASH. This is two-step process – first you have to transfer the firmware to the micoSD card using the SD Card Utility, then you need to edit the ConfigMeFirst.txt file to initiate the flash upgrade process. See the following instructions for performing the flash upgrade from the microSD card.

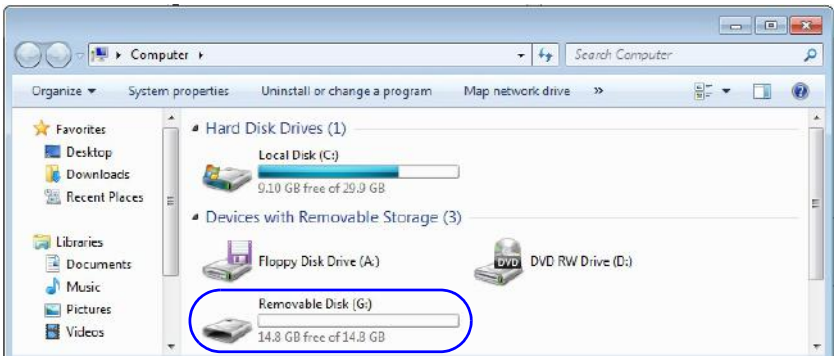
Step 1 – Transfer the Firmware to the MicroSD Card

1. Launch Connected Components Workbench.
2. Click Tools -> SD Card Utility.

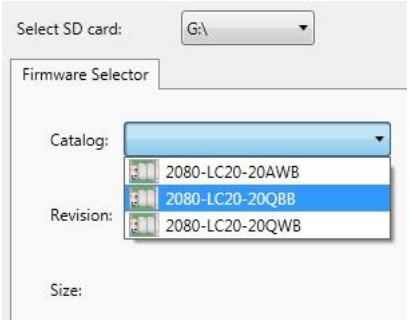
The SD Card Utility window appears.



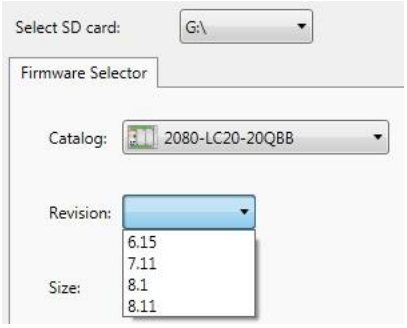
3. Select the drive letter that points to the microSD card on your computer from the pull-down list.
   You can check the drive letter by looking in Windows Explorer. For this example, the microSD card is using the drive letter "G".



4. Select the catalog number of your Micro820 controller.

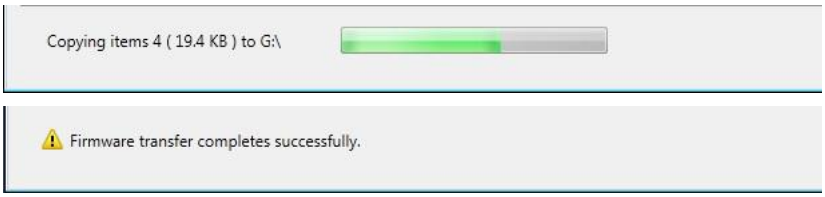


5. Select the firmware revision you want to flash your Micro820 controller with.



   The list of firmware revisions are installed together with Connected Components Workbench. If you require a revision that is not listed, download the firmware from the Product Compatibility and Download Center (PCDC) at
   http://www.rockwellautomation.com/rockwellautomation/support/pcdc.page
   and install the included ControlFLASH kit. Close and relaunch Connected Components Workbench, then open the SD Card Utility again. The revision should now appear in the list.

6. Click Transfer.
   The file is copied to the microSD card.



7. Close the SD Card Utility and proceed to the next step to edit the ConfigMeFirst.txt file.

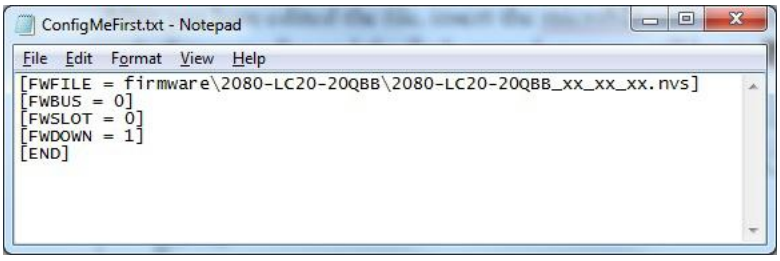
Step 2 – Edit the ConfigMeFirst.txt File

To flash upgrade the controller with the firmware that you have transferred to the microSD card, you need to edit the ConfigMeFirst.txt file with the settings listed below. These settings must be added at the beginning of the file.

New ConfigMeFirst.txt Configuration Settings for Flash Upgrade

Setting	Description
[FLASHFILE]	File path location of the firmware revision on the microSD card. The default location is in the following format: firmware\<catalog number>\<filename of firmware>
[FWBUS]	This setting is reserved and may be omitted.
[FWSLOT]	This setting is reserved and may be omitted.
[FWDOWN]	Sets whether to upgrade or downgrade the controller firmware from the current revision. 0 = Upgrade firmware; 1 = Downgrade firmware

Example of ConfigMeFirst.txt File for Flash Upgrade



After you have edited the file, insert the microSD card into the controller. Power cycle the controller and the flash upgrade process will begin. Note that the SD status LED will not blink when flash upgrading the firmware from the microSD card is in progress.

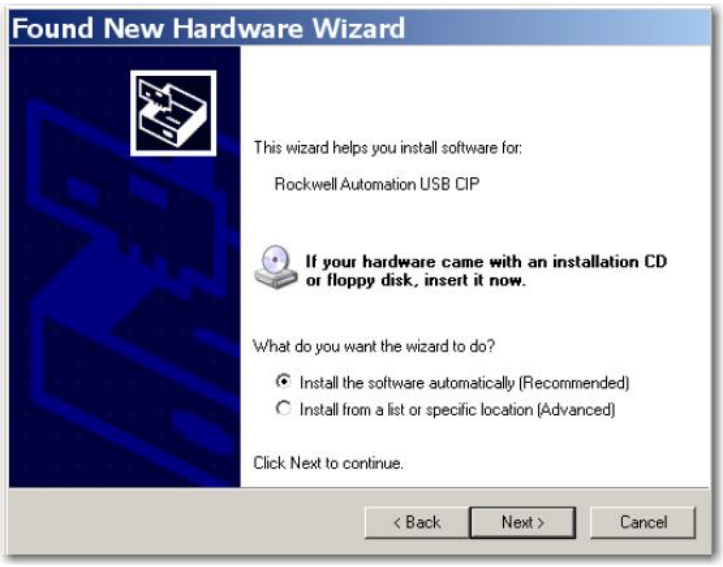
Establish Communications between RSLinx and a Micro820 Controller through USB Port on 2080-REMLCD

This quick start shows you how to get RSLinx RSWho to communicate with a Micro820 controller through a USB.

RSLinx Classic is installed as part of the Connected Components Workbench software installation process. The minimum version of RSLinx Classic with full Micro820 controller support is 3.60.01 (released on December 2013).

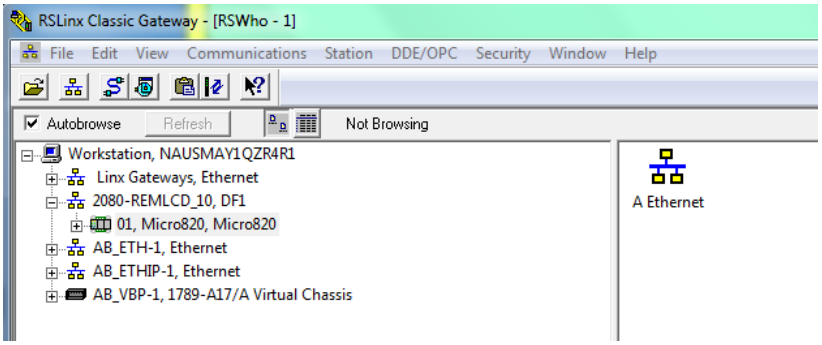
1. Power up the Micro820 controller.
2. Plug USB A/B cable directly between your PC and the USB port on the 2080-REMLCD.
3. Windows should discover the new hardware. Click No, not this time and then click Next.

4. Click Install the software automatically (Recommended), and then click Next.

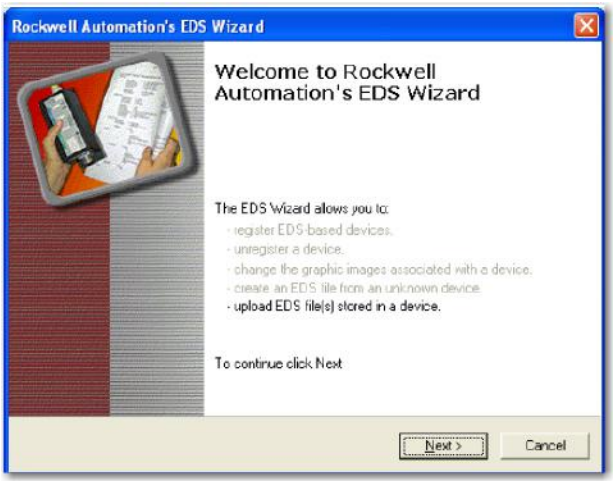


The Wizard searches for new hardware.

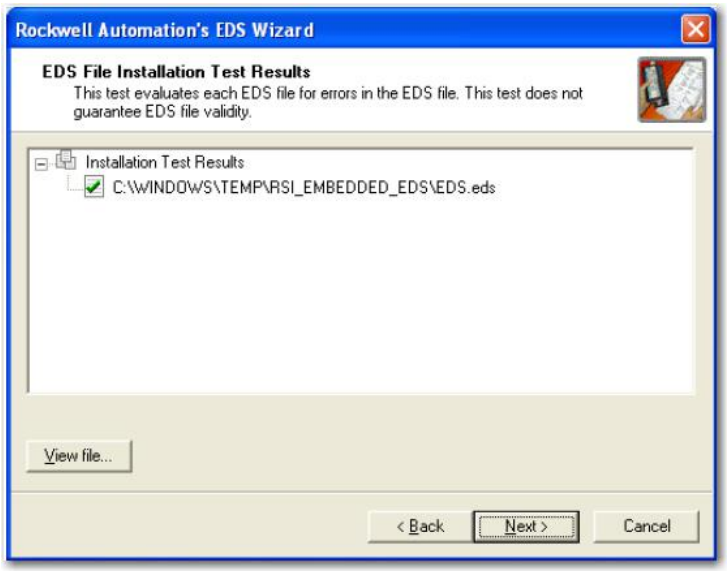
5. Open RSLinx Classic and run RSWho by clicking the  icon.



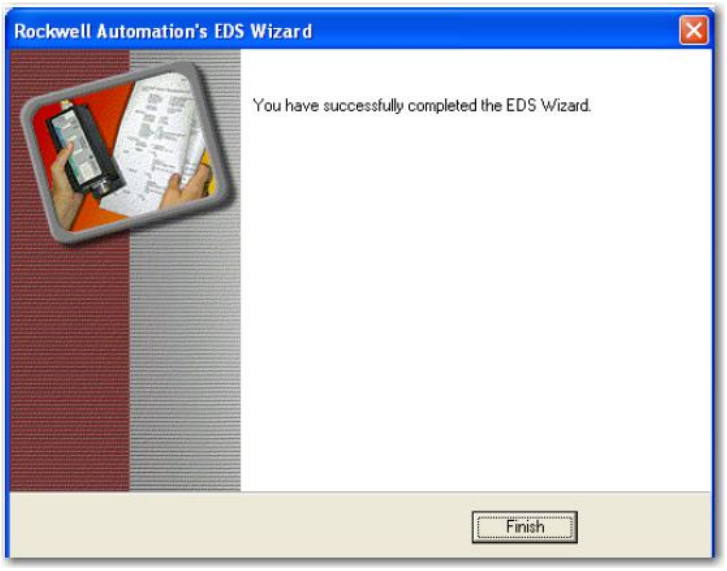
6. On the EDS Wizard that appears, click Next to continue.



7. Follow the prompts to upload and install the EDS file.


Rockwell Automation's EDS Wizard
EDS File Installation Test Results
This test evaluates each EDS file for errors in the EDS file. This test does not guarantee EDS file validity.
Installation Test Results
C:\WINDOWS\TEMP\RSI_EMBEDDED_EDS\EDS.eds
View file...
< Back
Next >
Cancel


Rockwell Automation's EDS Wizard
Change Graphic Image
You can change the graphic image that is associated with a device.
Product Types
Change icon...
Programmable Logic Controller
Micro820
< Back
Next >
Cancel



8. Click Finish to complete.

Configure Controller Password

Set, change, and clear the password on a target controller through the Connected Components Workbench software.

IMPORTANT The following instructions are supported on Connected Components Workbench revision 2 and Micro800 controllers with firmware revision 2.

For more information about the controller password feature on Micro800 controllers, see Controller Security on page 67.

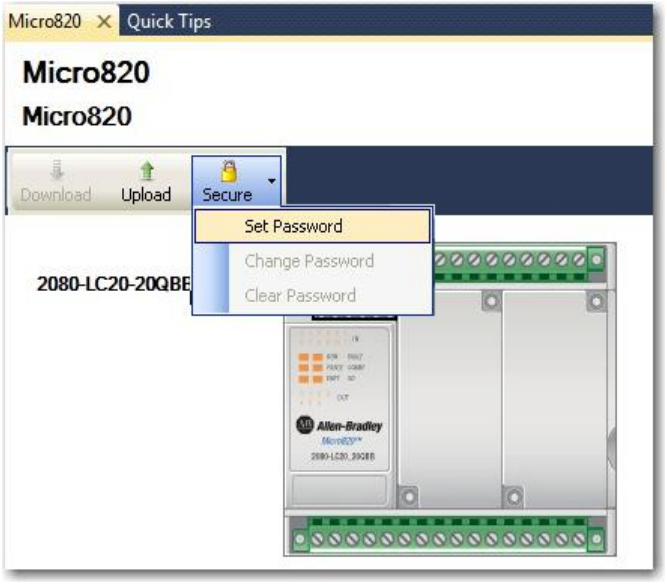
Set Controller Password

IMPORTANT After creating or changing the controller password, you need to power down the controller in order for the password to be saved.

In the following instructions, the Connected Components Workbench software is connected to the Micro800 controller.

1. On the Connected Components Workbench software, open the project for the target controller.
2. Click Connect to connect to the target controller.
   On the Device Details toolbar, roll over the Secure button. The tooltip message "Set, Change, or Clear Micro800 Controller Password Protection" is displayed.

3. Click Secure button. Select Set Password.



4. The Set Controller Password dialog appears. Provide password. Confirm the password by providing it again in the Confirm field.

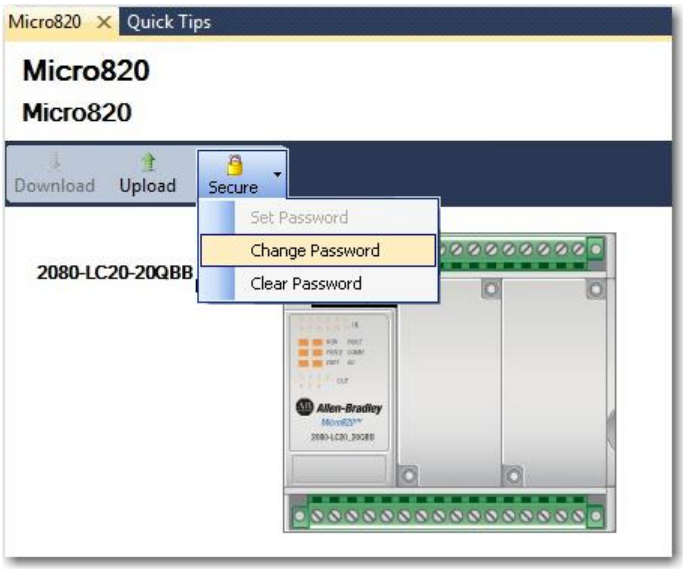
TIP Passwords must have at least eight characters to be valid.

5. Click OK.
   Once a password is created, any new sessions that try to connect to the controller will have to supply the password to gain exclusive access to the target controller.

Change Password

With an authorized session, you can change the password on a target controller through the Connected Components Workbench software. The target controller must be in Connected status.

1. On the Device Details toolbar, click Secure button. Select Change Password.



2. The Change Controller Password dialog appears. Enter Old Password, New Password and confirm the new password.

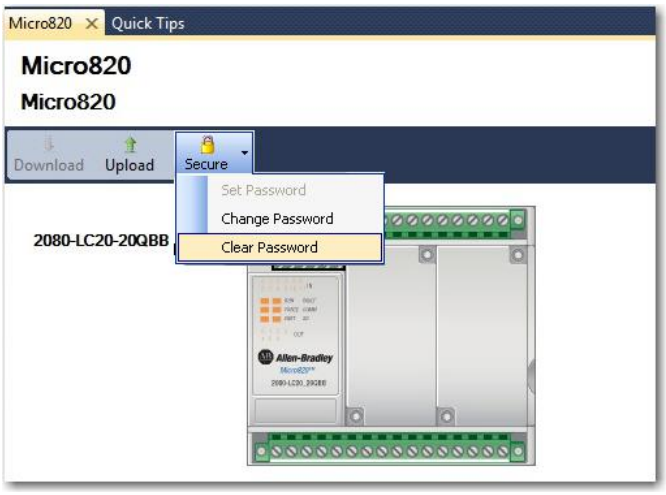
3. Click OK.

The controller requires the new password to grant access to any new session.

Clear Password

With an authorized session, you can clear the password on a target controller through the Connected Components Workbench software.

1. On the Device Details toolbar, click Secure button. Select Clear Password.



2. The Clear Password dialog appears. Enter Password.
3. Click OK to clear the password.

The controller will require no password on any new session.

Forcing I/Os

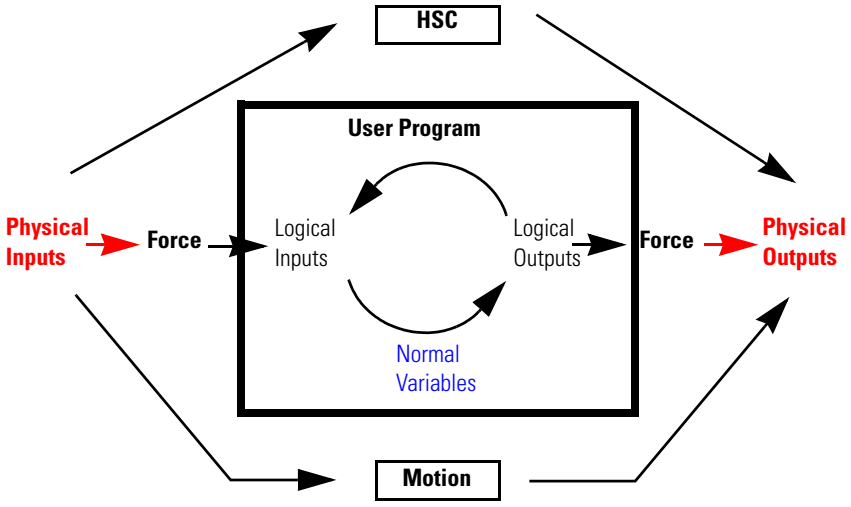
IMPORTANT This section generally talks about forcing I/O in Micro800 controllers. Some elements may not apply to certain models (for example, Micro810 and Micro820 controllers do not support PTO motion).

Inputs are logically forced. LED status indicators do not show forced values, but the inputs in the user program are forced.

Forcing is only possible with I/O and does not apply to user defined variables and non-I/O variables, and special functions such as HSC which execute independently from the User Program scan. For example, for motion, Drive Ready input cannot be forced.

Unlike inputs, outputs are physically forced. LED status indicators do show forced values and the user program does not use forced values.

The following diagram illustrates forcing behavior.



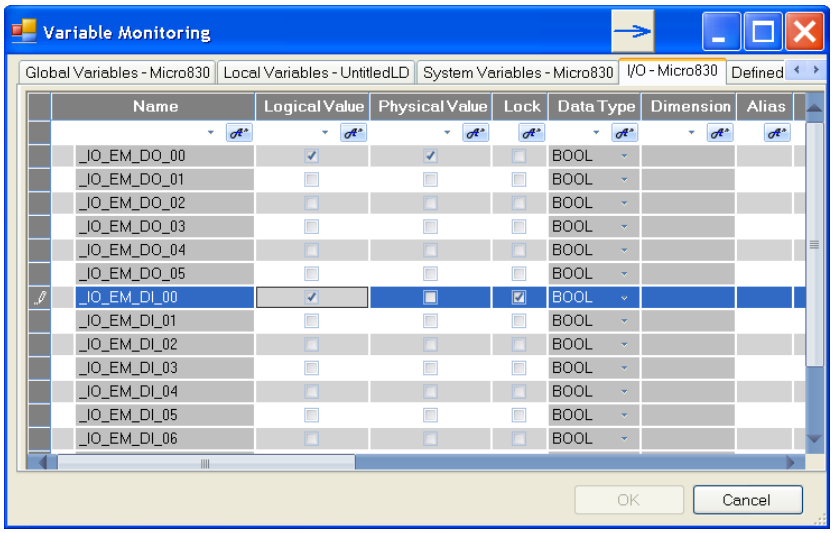
- LED status indicators always match the physical value of I/O
- Normal, non-physical internal variables cannot be forced
- Special functions such as HSC and Motion cannot be forced

ATTENTION: Forcing variable can result in sudden machine movement, possibly injuring personnel or equipment. Use extreme caution when forcing variables.

Checking if Forces (locks) are Enabled

If Connected Components Workbench is available, check the Variable Monitor while debugging online. Forcing is performed by first locking an I/O variable and then setting the Logical Value for Inputs and Physical Value for Outputs.

Remember you cannot force a Physical Input and cannot force a Logical Output.



In many cases, the front of the controller is not visible to the operator and Connected Components Workbench is not online with the controller. If you want the force status to be visible to the operator, then the User Program must read the force status using the SYS_INFO function block and then display the force status on something that the operator can see, such as the human machine interface (HMI), or stack light. The following is an example program in Structured Text.

```
(* Read System Information including Force Enable bit *)
SYS_INFO_1(TRUE);

(* Turn on Warning Light if Forces are Enabled *)
If SYS_INFO_1.Sts.ForcesInstall = TRUE THEN
    _IO_EM_DO_05 := TRUE;
ELSE
    _IO_EM_DO_05 := FALSE;
END_IF;
```

If the front of the controller is visible, and not blocked by the cabinet enclosure, Micro830 and Micro850 controllers have a Force LED indicator.

I/O Forces After a Power Cycle

After a controller is power cycled, all I/O forces are cleared from memory.

Using Run Mode Change

Run Mode Change allows the user to make small changes to the logic of a running project and immediately testing it out on the controller, without having to go into Program mode or disconnecting from the controller.

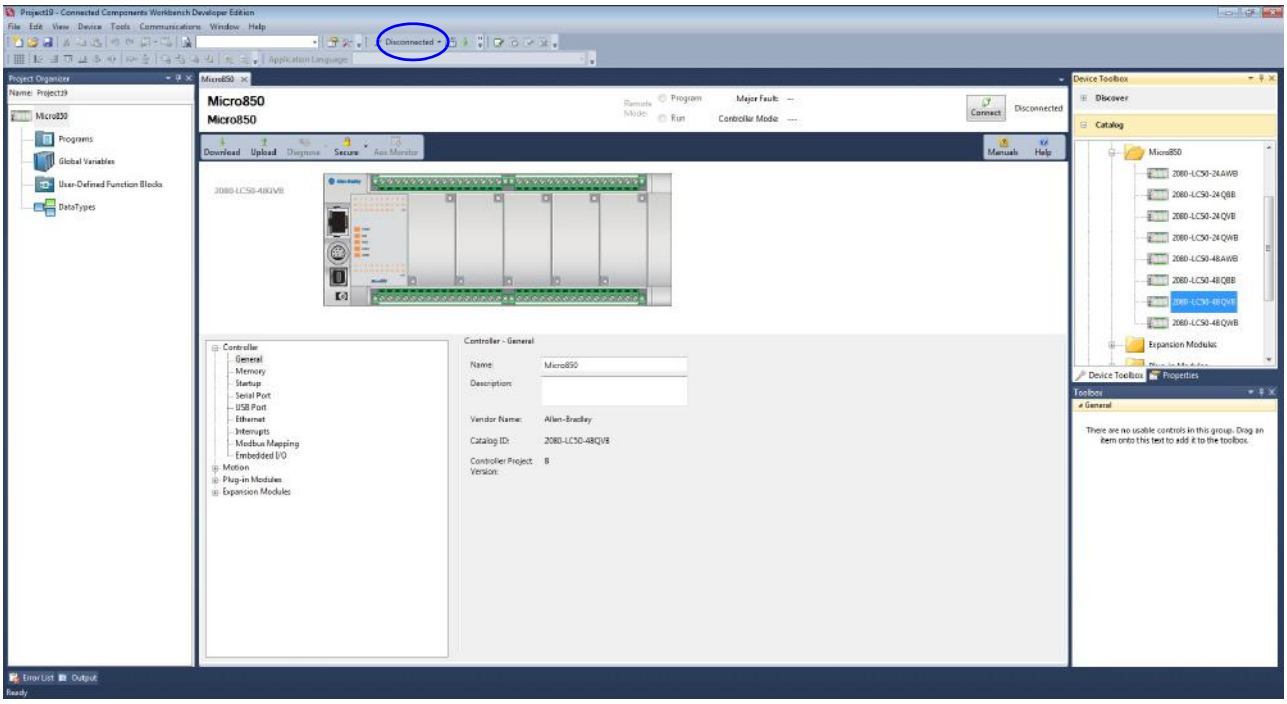
IMPORTANT The following requirements must be met to use Run Mode Change:

- Micro820/Micro830/Micro850 controller firmware revision 8.0 or higher, and
- Connected Components Workbench Developer Edition software, version 8.0 or higher.

The following sample project guides you through the creation of a simple application for a Micro850 controller without any plug-in modules, and how to use the Run Mode Change feature.

Create the Project

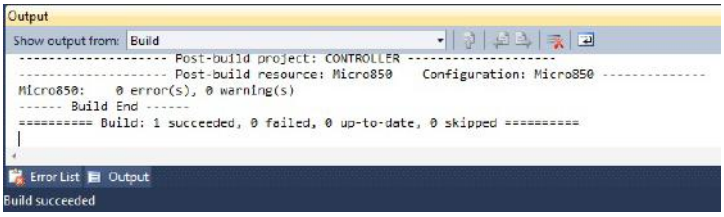
1. Create a new project for a Micro830/Micro850 controller without any plug-ins.
   Observe that the controller is disconnected.



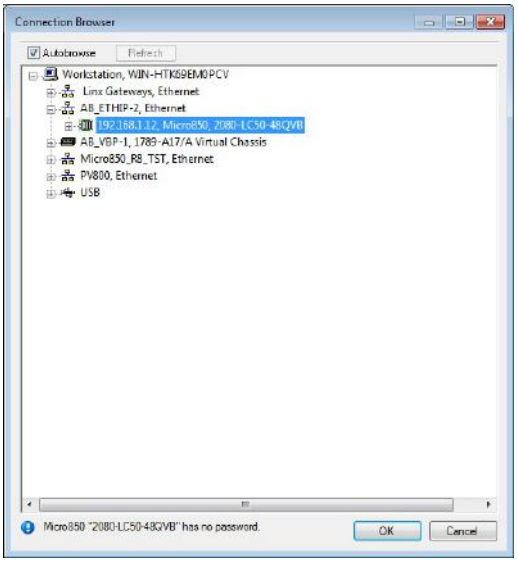
2. Right-click Programs and select Add -> New LD: Ladder Diagram.
3. From the Toolbox, double-click Direct Coil to add it to the rung, or drag and drop Direct Coil onto the rung.

4. Double -click the newly added Direct Coil to bring up the Variable Selector dialog and select "_IO_EM_DO_00".

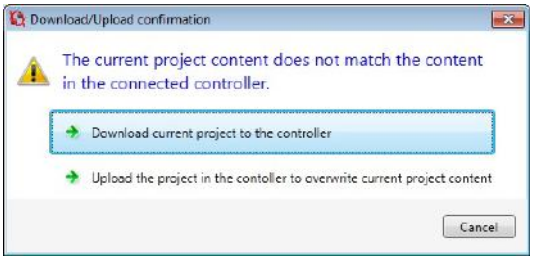
5. Build the project.



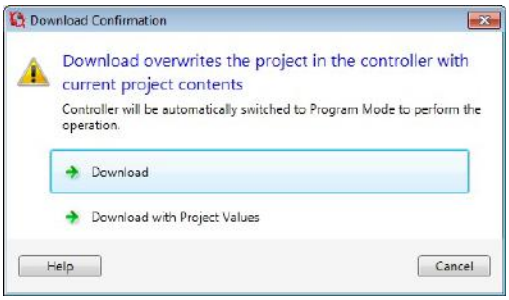
6. Download the project to the controller.
   In the Connection Browser dialog, select the Micro850 controller.



7. Select Download current project to the controller.



8. Select Download to confirm.



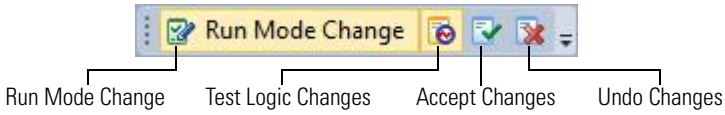
9. When the project has been downloaded to the controller, a prompt asking to change the controller to Remote Run mode appears. Click Yes.

10. Observe that the controller is now in Debug mode.

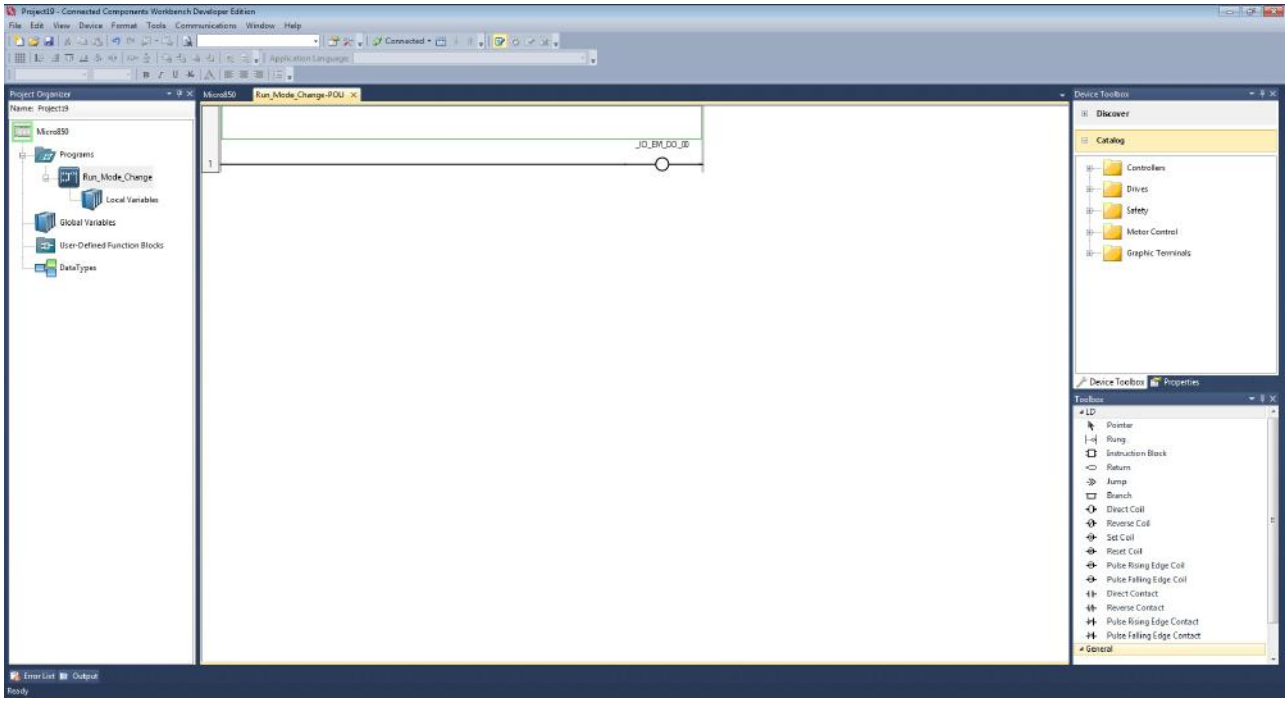
IMPORTANT From Connected Components Workbench version 8.0 onwards, selecting "Yes" to change the controller to Remote Run mode after a downloading a project automatically switches it to Debug mode.

Edit the Project Using Run Mode Change

Run Mode Change Toolbar



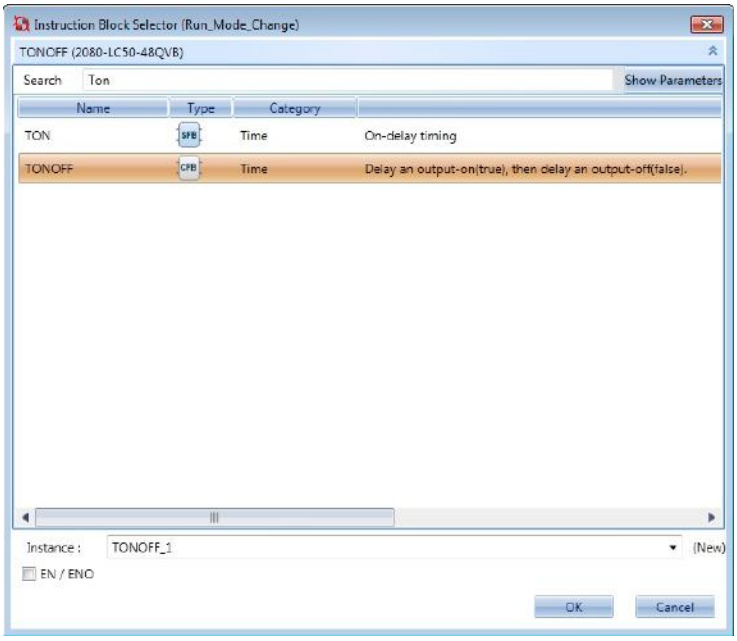
1. Click the Run Mode Change icon.
   Observe that the controller goes into Edit mode and is still connected.



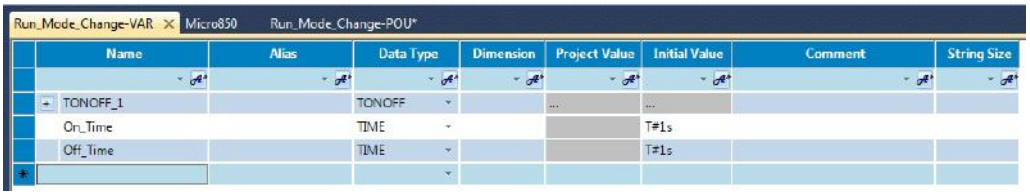
   If you add a new variable during RMC, external data access and changing the access type (default is Read/Write) of this new variable is not available until you have chosen to Accept or Undo the Test Logic changes.

2. From the Toolbox, double-click Instruction Block to add it to the rung, or drag and drop Instruction Block onto the rung.

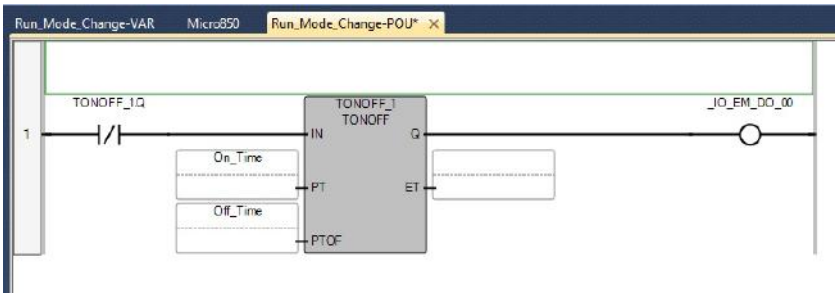
3. Double-click the newly added Instruction Block and select "Timer On/Off "(TONOFF).



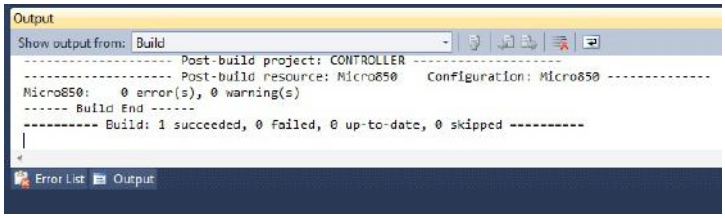
Configure the Instruction Block to trigger every one second.



4. From the Toolbox, double-click Reverse Contact to add it to the rung, or drag and drop Reverse Contact onto the run. Place it to left of the recently added Instruction Block.

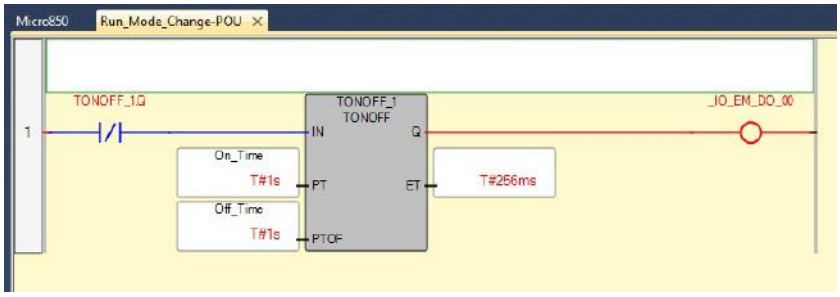


5. Click the Test Logic Changes icon to build the project and download it to the controller.



IMPORTANT When a Test Logic is performed, or undoing changes after the Test Logic is completed, any active communication instructions will be aborted while the changes are downloaded to the controller.

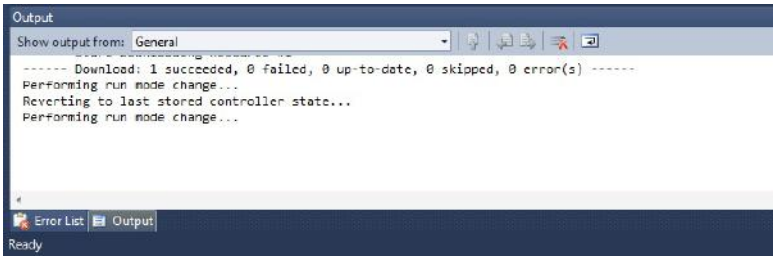
6. The controller will automatically go into Debug mode and display the updated project.



7. You can now choose to either Undo or Accept the changes to the project.

To Undo the Changes

1. Click the Undo Changes icon.
2. The changes will be discarded and the original project will be restored to the controller.



IMPORTANT When a Test Logic is performed, or undoing changes after the Test Logic is completed, any active communication instructions will be aborted while the changes are downloaded to the controller.

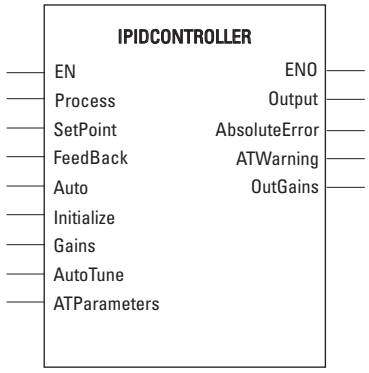
Observe that original project is shown and the controller is in Debug mode.

To Accept the Changes

1. Click the Accept Changes  icon.
2. Observe that only the Run Mode Change icon is now enabled and the controller remains in Debug mode.

IPID Function Block

This function block diagram shows the arguments in the IPIDCONTROLLER function block.



The following table explains the arguments used in this function block.

IPIDCONTROLLER Arguments

Parameter	Parameter Type	Data Type	Description
EN	Input	BOOL	Function block enable When EN = TRUE, execute function. When EN = FALSE, do not execute function. Only applicable to LD, EN is not required in FBD programming.
Process	Input	REAL	Process value, measured from the output of controlled process.
SetPoint	Input	REAL	Set point value for desired process
Feedback	Input	REAL	Feedback signal, measured from control input to a process.
Auto	Input	BOOL	Operating modes of PID controller: • TRUE —controller runs in normal mode • FALSE — controller out value equals to feedback value
Initialize	Input	BOOL	A change in value (True to False or FALSE to TRUE) causes the controller to eliminate any proportional gain during that cycle. It Also initializes AutoTune sequences.
Gains	Input	GAIN_PID	Gains for IPIDCONTROLLER See GAIN_PID Data type
AutoTune	Input	BOOL	Start AutoTune sequence

IPIDCONTROLLER Arguments

Parameter	Parameter Type	Data Type	Description
ATParameters	Input	AT_Param	Autotune parameters See AT_Param Data Type
Output	Output	Real	Output value from the controller
AbsoluteError	Output	Real	AbsoluteError is the difference between Process value and set point value
ATWarnings	Output	DINT	Warning for the Auto Tune sequence. Possible value are: • 0 – No auto tune done • 1 – Auto tuning in progress • 2 – Auto tuning done • -1 – Error 1: Controller input "Auto" is TRUE, please set it to False • -2 – Error 2: Auto tune error, the ATDynaSet time expired
OutGains	Output	GAIN_PID	Gains calculated from AutoTune Sequences. See GAIN PID Data type
ENO	Output	BOOL	Enable out. Only applicable to LD, "ENO" is not required in FBD programming.

GAIN_PID Data Type

Parameter	Type	Description
DirectActing	BOOL	Types of acting: • TRUE – Direct acting • FALSE – Reverse acting
ProportionalGain	REAL	Proportional gain for PID (>= 0.0001)
TimeIntegral	REAL	Time integral value for PID (>= 0.0001)
TimeDerivative	REAL	Time derivative value for PID (>= 0.0)
DerivativeGain	REAL	Derivative gain for PID (>= 0.0)

AT_Param Data Type

Parameter	Type	Description
Load	REAL	Initial controller value for autotuning process.
Deviation	REAL	Deviation for auto tuning. This is the standard deviation used to evaluate the noise band needed for AutoTune (noise band = 3* Deviation)[(1)]

AT_Param Data Type

Parameter	Type	Description
Step	REAL	Step value for AutoTune. Must be greater than noise band and less than ½ load.
ATDynamSet	REAL	Auto Tune time. Set the time to wait for stabilization after the step test (in seconds). Auto Tune process will be stopped when ATDynamSet time expires.
ATReset	BOOL	Determines whether the output value is reset to zero after an AutoTune sequence: • True – Reset IPIDCONTROLLER output to zero after Auto tune process. • False – leaves output at load value

(1) The application engineer can estimate the value of ATParams.Deviation by observing the value of Proces input. For example, in a project that involves the control of temperature, if the temperature stabilizes around 22 °C, and a fluctuation of 21.7…22.5 °C is observed, the value of ATParams.Deviation will be (22.5-21.7)/2=0.4.

How to Autotune

Before you autotune, you need to:

- Verify that your system is constant when there is no control. For example, for temperature control, process value should remain at room temperature when there is no control output.
- Configure the set point to 0.
- Set Auto Input to False.
- Set the Gain parameter as follows:

GAIN Parameter Values

GAIN Parameter	Value
DirectActing	According to operation: TRUE (for example, Cooling), or FALSE (for example, Heating)
DerivativeGain	Typically set to 0.1 or 0.0
ProportionalGain	0.0001
TimeIntegral	0.0001
TimeDerivative	0.0

- Set the AT_Parameter as follows:

AT_Parameter Values

AT Parameter	Recommendation
Load	Every 'Load' provides a saturated process value over a period of time. Adjust the load to the value for the saturated process value you want. **IMPORTANT**: If a load of 40 gives you a process value of 30 °C over a period of time, and you want to tune your system to 30 °C, you should set the load to 40.
Deviation	This parameter plays a significant role in the autotune process. The method of deriving this value is explained later in this section. It is not necessary to set this parameter prior to autotuning. However, if you already know the deviation, it is fine to set it first.
Step	Step value should be between 3*Deviation and ½ load. The step provides an offset for the load during autotuning. It should be set to a value high enough to create a significant change in process value.
ATDynamSet	Set this value to a reasonably long time for the autotune process. Every system is different, so allow more time to a system with a process value that takes longer to react to change.
ATReset	Set this parameter to TRUE to reset the output to zero after the autotune process completes. Set this parameter to FALSE to leave the output at load value after the autotune process completes.

To autotune, perform the following steps:

1. Set the Initialize input to TRUE.
2. Set the AutoTune input to TRUE.
3. Wait for the Process input to stabilize or reach a steady state.
4. Note the temperature fluctuation of the process value.
5. Calculate deviation value with reference to the fluctuation. For example, if the temperature stabilizes around 22 °C (72 °F) with a fluctuation of 21.7...22.5 °C (71...72.5 °F), the value of 'ATParams.Deviation' is:

$$\text{For °C: } \frac{22.5 - 21.7}{2} = 0.4 \qquad \text{For °F: } \frac{72.5 - 71}{2} = 0.75$$

6. Set the deviation value, if you have not set it yet.
7. Change the initialize input to FALSE.
8. Wait until the 'AT_Warning' shows 2. The autotune process is successful.
9. Get the tuned value from the 'OutGains'.

How Autotune Works

The auto tune process begins when the 'Initialize' is set to FALSE (Step 7.) At this moment, the control output increases by the amount of 'Step' and the process waits for the process value to reach or exceeds 'first peak'.

First peak is defined as:

For Direct Operation: First peak = PV1 - (12 x Deviation)
For Reverse Operation: First peak = PV1 + (12 x Deviation)
Where PV1 is the process value when Initialize is set to FALSE.

Once the process value reaches first peak, the control output reduces by the amount of Step and waits for the process value to drop to the second peak.

Second peak is defined as:

For Direct Operation: Second peak = PV1 - (3 x Deviation)
For Reverse Operation: Second peak = PV1 + (3 x Deviation)
Once the process value reaches or falls below second peak, calculations commence and a set of gain will be generated to parameter OutGains.

Troubleshooting an Autotune Process

You can tell what is going on behind the autotune process from the sequences of control output. Here are some known sequences of control output and what it means if autotune fails. For the ease of illustrating the sequence of control output, we define:

Load: 50
Step: 20

Output Sequence 1: 50 -> 70 -> 30

Sequence Condition	Autotune Result	Action for Autotune Fail
Process value reached 'first peak' and 'second' peak in time	Likely successful	NA

Output Sequence 2: 50 -> 70 -> 50

Sequence Condition	Autotune Result	Action for Autotune Fail
Process value not able to reach 'first peak'	Likely unsuccessful	Reduce Deviation or Increase Step

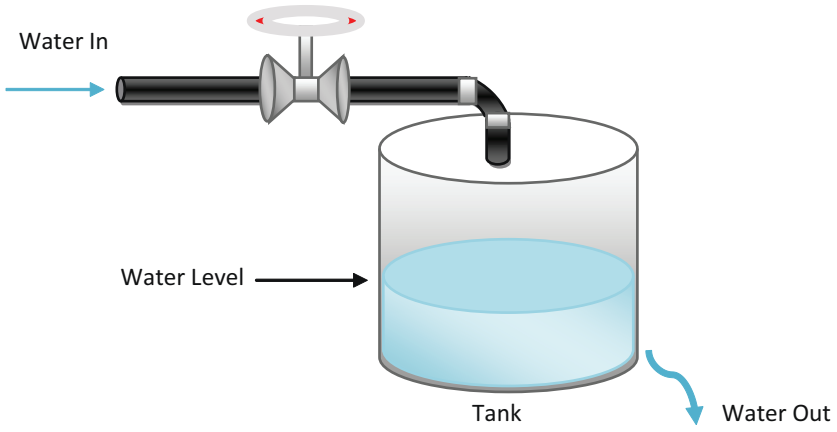
Output Sequence 3: 50 -> 70 -> 30 -> 50

Sequence Condition	Autotune Result	Action for Autotune Fail
Process value not able to reach second peak	Likely unsuccessful	Increase Deviation or increase Step

Output Sequence 4: 50 -> 70

Sequence Condition	Autotune Result	Action for Autotune Fail
Process value not able to reach First peak in time	Likely unsuccessful	Increase ATDynamSet

PID Application Example



The illustration above shows a basic water level control system, to maintain a preset water level in the tank. A solenoid valve is used to control incoming water, filling the tank at a preset rate. Similarly, outflowing water is controlled at a measureable rate.

IPID Autotuning for First and Second Order Systems

Autotune of IPID can only work on first and second order systems.

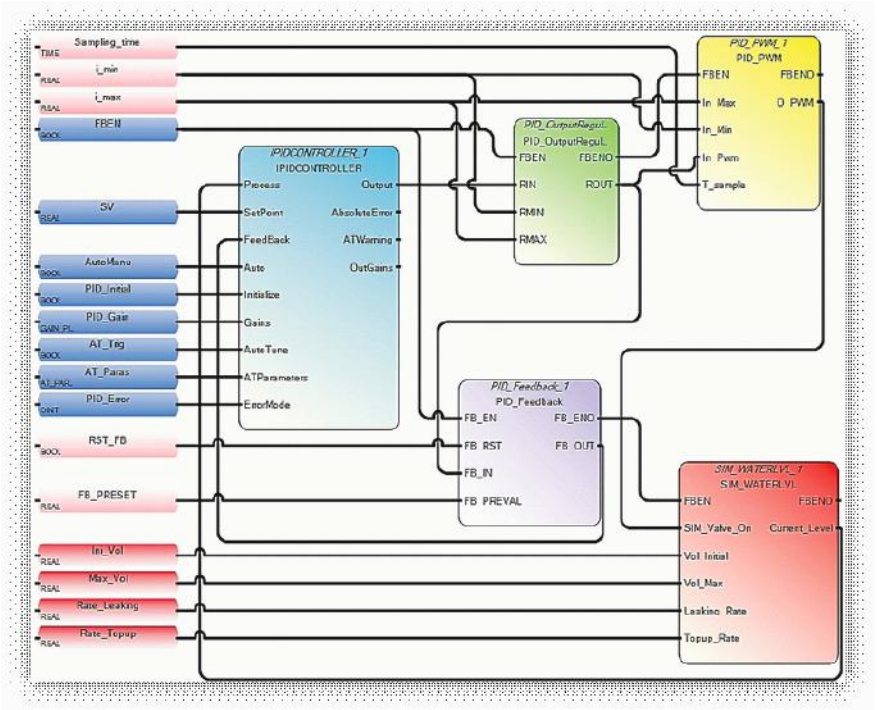
A first order system can be described by a single independent energy storage element. Examples of first order systems are the cooling of a fluid tank, the flow of fluid from a tank, a motor with constant torque driving a disk flywheel or an electric RC lead network. The energy storage element for these systems are heat energy, potential energy, rotational kinetic energy and capacitive storage energy, respectively.

This may be written in a standard form such as $f(t) = \tau dy/dt + y(t)$, where τ is the system time constant, f is the forcing function and y is the system state variable.

In the cooling of a fluid tank example, it can be modeled by the thermal capacitance C of the fluid and thermal resistance R of the walls of the tank. The system time constant will be RC, the forcing function will be the ambient temperature and the system state variable will be the fluid temperature.

A second order system can be described by two independent energy storage elements which exchange stored energy. Examples of second order systems are a motor driving a disk flywheel with the motor coupled to the flywheel via a shaft with torsional stiffness or an electric circuit composed of a current source driving a series LR (inductor and resistor) with a shunt C (capacitor). The energy storage elements for these systems are the rotational kinetic energy and torsion spring energy for the former and the inductive and capacitive storage energy for the latter. Motor drive systems and heating systems can be typically modeled by the LR and C electric circuit.

PID Code Sample



The illustration above shows sample code for controlling the PID application example shown before. Developed using Function Block Diagrams, it consists of a pre-defined function block, IPIDCONTROLLER, and four user-defined function blocks. These four are:

- PID_OutputRegulator
  This user-defined function block regulates the output of IPIDCONTROLLER within a safe range to ensure that there is no damage to the hardware used in the process.

  IF RMIN ≤ RIN ≤ RMAX, then ROUT = RIN,
  IF RIN < RMIN, then ROUT = RMIN,
  IF RIN > RMAX, then ROUT = RMAX.

- PID_Feedback
  This user defined function block acts as a multiplexer.

  IF "FB_RST" is false, FB_OUT=FB_IN;
  If "FB_RST" is true, then FB_OUT=FB_PREVAL.

- PID_PWM
  This user defined function block provides a PWM function, converting a real value to a time related ON/OFF output.
- SIM_WATERLVL
  This user defined function block simulates the process depicted in the application example shown before.

IMPORTANT **User Program Scan Time is Important**

The autotuning method needs to cause the output of the control loop to oscillate. In order to identify the oscillation period, the IPID must be called frequently enough to be able to sample the oscillation adequately. The scan time of the user program must be less than half the oscillation period. In essence the Shannon, or Nyquist-Shannon, or the sampling theorem must be adhered to.

In addition, it is important that the function block is executed at a relatively constant time interval.

Modbus Mapping for Micro800

Modbus Mapping

All Micro800 controllers (except the Micro810 12-point models) support Modbus RTU over a serial port through the embedded, non-isolated serial port. The 2080-SERIALISOL isolated serial port plug-in module also supports Modbus RTU. Both Modbus RTU master and slave are supported. Although performance may be affected by the program scan time, the 48-point controllers can support up to six serial ports (one embedded and five plug-ins), and so consequently, six separate Modbus networks.

Endian Configuration

Modbus protocol is big-endian in that the most significant byte of a 16-bit word is transmitted first. Micro800 is also big-endian, so byte ordering does not have to be reversed. For Micro800 data types larger than 16-bits (for example, DINT, LINT, REAL, LREAL), multiple Modbus addresses may be required but the most significant byte is always first.

Mapping Address Space and supported Data Types

Since Micro800 uses symbolic variable names instead of physical memory addresses, a mapping from symbolic Variable name to physical Modbus addressing is supported in Connected Components Workbench software, for example, InputSensorA is mapped to Modbus address 100001.

By default Micro800 follows the six-digit addressing specified in the latest Modbus specification. For convenience, conceptually the Modbus address is mapped with the following address ranges. The Connected Components Workbench mapping screen follows this convention.

Variable Data Type	0 - Coils 000001 to 065536		1 - Discrete Inputs 100001 to 165536		3 - Input Registers 300001 to 365536		4 - Holding Registers 400001 to 465536	
	Supported	Modbus Address Used	Supported	Modbus Address Used	Supported	Modbus Address Used	Supported	Modbus Address Used
BOOL	Y	1	Y	1				
SINT	Y	8	Y	8				
BYTE	Y	8	Y	8				
USINT	Y	8	Y	8				
INT	Y	16	Y	16	Y	1	Y	1
UINT	Y	16	Y	16	Y	1	Y	1

Variable Data Type	0 - Coils 000001 to 065536		1 - Discrete Inputs 100001 to 165536		3 - Input Registers 300001 to 365536		4 - Holding Registers 400001 to 465536	
	Supported	Modbus Address Used	Supported	Modbus Address Used	Supported	Modbus Address Used	Supported	Modbus Address Used
WORD	Y	16	Y	16	Y	1	Y	1
REAL	Y	32	Y	32	Y	2	Y	2
DINT	Y	32	Y	32	Y	2	Y	2
UDINT	Y	32	Y	32	Y	2	Y	2
DWORD	Y	32	Y	32	Y	2	Y	2
LWORD	Y	64	Y	64	Y	4	Y	4
ULINT	Y	64	Y	64	Y	4	Y	4
LINT	Y	64	Y	64	Y	4	Y	4
LREAL	Y	64	Y	64	Y	4	Y	4

NOTE: Strings are not supported.

In order to make it easier to map variables to five-digit Modbus addresses, the Connected Components Workbench mapping tool checks the number of characters entered for the Modbus Address. If only five-digits are entered, the address is treated as a five-digit Modbus address. This means that the Discrete Inputs are mapped from 00001...09999, Coils are mapped from 10001...19999, Input Registers are mapped from 30001...39999, and Holding Registers are mapping from 40001...49999.

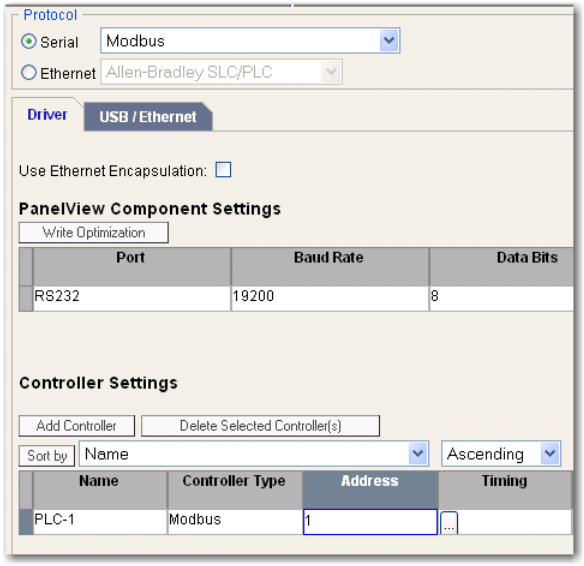
Example 1, PanelView Component HMI (Master) to Micro800 (Slave)

The embedded serial port is targeted for use with HMIs using Modbus RTU. The maximum recommended cable distance is 3 meters. Use the 2080-SERIALISOL serial port plug-in module if longer distances or more noise immunity is needed.

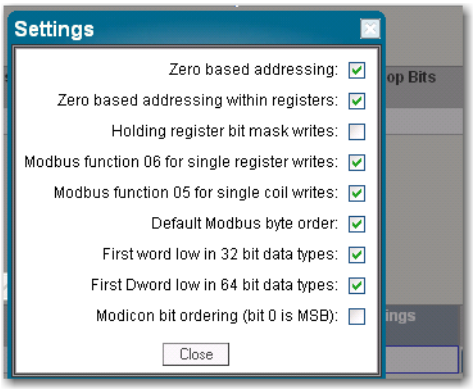
The HMI is typically configured for Master and the Micro800 embedded serial port is configured for Slave.

From the default Communications Settings for a PanelView Component HMI (PVC), there are three items that must be checked or modified in order to set up communications from PVC to Micro800.

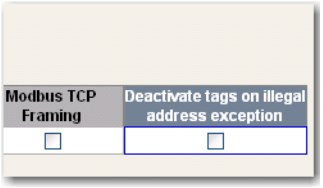
1. Change from DF1 to Modbus protocol.



2. Set the Address of Micro800 slave to match the serial port configuration for the controller.



3. Deactivate Tags on Error. This is to prevent the requirement of power cycling PVC when new Modbus Mappings are downloaded from Connected Components Workbench to Micro800 controller.



Example 2, Micro800 (Master) to PowerFlex 4M Drive (Slave)

The following is the overview of the steps to be taken for configuring a PowerFlex 4M drive.

Parameter numbers listed in this section are for a PowerFlex 4M and will be different if you are using another PowerFlex 4-Class drive.

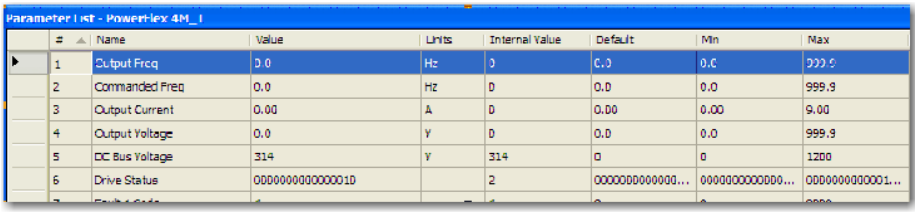
Parameter Name	Parameter Number						
	4M	4	40	40P	400	400N	400P
Start Source	P106	P36					
Speed Reference	P108	P38					
Comm Data Rate	C302	A103			C103		
Comm Node Addr	C303	A104			C104		
Comm Loss Action	C304	A105			C105		
Comm Loss Time	C305	A106			C106		
Comm Format	C306	A107			C102		

- Connect the 1203-USB to the PowerFlex Drive and to the Computer.
- Launch Connected Components Workbench, Connect to the Drive and set parameters.

To configure PowerFlex 4M, perform the following steps:

1. Double-click the PowerFlex 4M if it is not already open in Connected Components Workbench.
2. Click Connect.
3. In the Connection Browser, expand the AB_DF1 DH+ Driver. Select the AB DSI (PF4 Port) and click OK.
4. Once the Drive has connected and been read in, select the Start up wizard and change the following items. Select Finish to save the changes to the drive.
   - Select the Comm Port as the Speed Reference. Set P108 [Speed Reference] to 5 (Comm Port).
   - Set Start Source to Comm Port. Set P106 [Start Source] to 5 (Comm Port).
   - Defaults for the remaining Inputs
   - Accept Defaults for the remainder and click Finish.
5. Select Parameters from the Connected Components Workbench window.

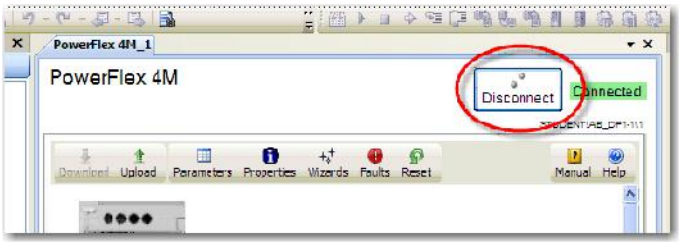
6. The Parameter window opens. Resize it to view the parameters. From this window, you can view and set data values of Parameters.



7. From the Parameter window, change the following Parameters to set the communications for Modbus RTU so that the PowerFlex 4M Drive will communicate with Micro830/850 via Modbus RTU communication.

Parameter	Description	Setting
C302	Comm. Data Rate (Baud Rate) 4 = 19200 bps	4
C303	Communication Node Address (address range is 1…127)	2
C304	Comm. Loss Action (Action taken when loss communication) 0 = Fault with coast stop	0
C305	Comm. Loss Time (Time remain in communication before taking action set in C304) 5 sec (Max. 60)	5
C306	Comm. Format (Data/Parity/Stop) RTU:8 Data Bit, Parity None, 1 Stop bit	0

8. Disconnect the Communications and save your project.



9. Turn off the power to the drive until the PowerFlex 4M display blanks out completely, then restore power to the PowerFlex 4M.
The drive is now ready to be controlled by Modbus RTU communication commands initiated from the Micro830/850 controller.

Modbus devices can be 0-based (registers are numbered starting at 0), or 1-based (registers are numbered starting at 1). When PowerFlex 4-Class drives are used with Micro800 family controllers, the register addresses listed in the PowerFlex User Manuals need to be offset by n+1.

For example, the Logic Command word is located at address 8192, but your Micro800 program needs to use 8193 (8192+1) to access it.

Modbus Address (n+1 value shown)
8193 Logic Command word (Stop, Start, Jog, etc.)

8194	Speed Reference word xxx.x format for 4/4M/40, where "123" = 12.3 Hz xxx.xx format for 40P/400/400N/400P, where "123" = 1.23 Hz
8449	Logic Status word (Read, Active, Fault, and so on.)
8452	Speed Feedback word (uses same format as Speed Reference)
8450	Error Code word
(n+1)	To access Parameter 'n'

TIP

- If the respective PowerFlex drive supports Modbus Function Code 16 Preset (Write) Multiple Registers, use a single write message with a length of "2" to write the Logic Command (8193) and Speed reference (8194) at the same time.
- Use a single Function Code 03 Read Holding Registers with a length of "4" to read the Logic status (8449), Error Code (8450), and Speed Feedback (8452) at the same time.

Refer to the respective PowerFlex 4-Class drive User Manual for additional information about Modbus addressing. (See Appendix E – Modbus RTU Protocol, on publication 22C-UM001G).

Performance

The performance of MSG_MODBUS (Micro800 is master) is affected by the Program Scan because messages are serviced when the message instruction is executed in a program. For example, if the program scan is 100 ms and six serial ports are used, then the theoretical maximum for serial ports is 60 messages/second total. This theoretical maximum may not be possible since MSG_MODBUS is a master/slave request/response protocol, so performance is affected by several variables such as message size, baud rate, and slave response time.

The performance of Micro800 when receiving Modbus request messages (Micro800 is slave) is also affected by the Program Scan. Each serial port is serviced only once per program scan.

Symbols

__SYSVA_CYCLECNT 61
__SYSVA_TCYCURRENT 62
__SYSVA_TCYMAXIMUM 62

Numerics

2080-LCD 67
2080-MEMBAK-RTC 1, 67
2080-PS120-240VAC 24
2080-REMLCD 1, 27, 71, 73
advanced set 77
analog calibration 78
backlight parameters 80
customization 75
edit variables 78
function blocks 79
I/O Status 77
main menu 76
memory card 78
mode switch 77
modes of operation 74
operational limit 78
rating 74
resolution 73
security 77
startup screen 75
text display mode 74
USB Mode 74
user-defined screens 79
variable 77
variable edit 78

A

About Your Controller 7
Additional Resources iii
analog cable grounding 41
analog channel wiring guidelines 40
analog input
to transmitters 46
analog inputs
analog channel wiring guidelines 40
analog output 46
array of strings 49
arrays 49
ASCII 47, 50, 52
configuration 57
ASCII devices 50
AutoTune 159

B

backup 1, 3
baud rate 3, 55
before calling for assistance 131
BOOL 49

C

calibration 44
calling for assistance 131
CE mark 12
certifications 12
Checking if Forces (locks) are Enabled 148
CIP Client Messaging 50
CIP communications pass-thru 50
CIP Generic 50
CIP Serial 48, 49, 52
Parameters 55
CIP Serial Driver
configure 54
parameters 55
CIP Serial Server 47
CIP Symbolic 48, 49, 50
supported data types 49
CIP Symbolic Addressing 49
CIP Symbolic Server 48
communication connections 47
communication protocols 47
communications
ports 47
CompactLogix 49
Compliance to European Union Directive
EMC Directive 12
Low Voltage Directive 12
Compliance to European Union Directives 12
ConfigMeFirst.txt 3
errors 88
Connected Components Workbench iv, 7, 59, 61, 64, 67, 68, 71, 74, 79, 89, 94
Connected Components Workbench Online 48
Connected Components Workbench. 75
control line 55
ControlFlash 71
controller
grounding 33
I/O wiring 40
minimizing electrical noise 40
preventing excessive heat 18
Controller Error Recovery Model 130
controller load 62
controller lock 68
controller password 67
ControlLogix 49

D

data types 49
datalog 1, 89
  data types 93
  directory structure 90
  execution rules 93
  specifications 90
  timing diagram 92
datasets 89, 90
DF1 mode 55
DF1 point-to-point connection 51
DHCP Client 47
DIN rail mounting 24
DINT 49
disconnecting main power 15
discover 68
DLG
  function block status 91
  function error ID list 91
  input and output parameters 91
DLG_ERR_DATAFILE_ACCESS 90
duplicate packet detection 55

E

embedded responses 55
Embedded Serial Port Cables 4
EMC Directive 12
Endian Configuration 165
ENET status 2
ENQ retries 55
error codes 125, 126
Error Conditions 124
error conditions 124
error detection 55
error recovery model 130
Ethernet 48, 75
  configuration settings 59
  transfer rate 47
Ethernet support 4
EtherNet/IP 48, 49
EtherNet/IP Client 49
EtherNet/IP Server 47, 49
European Union Directive compliance 12
  EMC Directive 12
exclusive access 67
Execution Rules 62
execution rules 89

F

Fault status 2
Force status 2
force status 123
Forcing I/Os 148

G

general considerations 13
grounding the controller 33
Guidelines and Limitations for Advanced Users 64

H

hardware
  features 1
Hardware Features 1
Hardware Overview 1
heat protection 18
housekeeping 61, 89

I

I/O Status 74, 76
input states on power down 18
inputs
  embedded 1
installation
  DIN rail mounting 24
  Micro820 controller 23
  module spacing 24
  mounting dimensions 23
  panel mounting 24
    dimensions 25
Installation Considerations 13
Installing Your Controller 23
INT 49
IP65 73
IPID Function Block 157
IPIDCONTROLLER 157
  parameters 157
isolation transformers
  power considerations 17

K

KEY_READ_REM 79, 81
keyswitch 71

L

LCD_BKLT_REM 79, 80
LCD_REM 79, 80

LINT 49
Literature Library 27
LREAL 49

M

Mapping Address Space and supported Data Types 165
master control relay 18
  emergency-stop switches 19
  using ANSI/CSA symbols schematic 22
  using IEC symbols schematic 21
master control relay circuit
  periodic tests 16
Micro800 cycle or scan 61
Micro800 Remote LCD 73
Micro830 Controllers 2
microSD 2, 3, 67
  card slot 3
  Class 4 3
  Class 6 and 10 SDSC and SDHC 3
microSD card 90
  installation 26
minimizing electrical noise 40
minimizing electrical noise on analog channels 41
Modbus 48
Modbus Mapping 165
Modbus Mapping for Micro800 165
Modbus RTU 47, 48, 52
  advanced parameters 57
  configuration 56
  parameters 57
Modbus TCP Client 48
Modbus/TCP Server 47, 48
Modbus/TCP server 48
module spacing 24
motor starters (bulletin 509)
  surge suppressors 32
MSG_CIPGENERIC 50
MSG_CIPSYMBOLIC 50
MSG_MODBUS 48
MSG_MODBUS2 48

N

NAK retries 55
Normal Operation 124
North American Hazardous Location Approval 15

O

outputs
  embedded 1
Overview of Program Execution 61

P

panel mounting 24
PanelView Component 48
parity 55
password 67
password recovery 71
Performance, MSG_MODBUS 170
PID Application Example 162
PID Code Sample 163
POU (Program Organizational Unit) 62
power considerations
  input states on power down 18
  isolation transformers 17
  loss of power source 17
  other line conditions 18
  overview 17
  power supply inrush 17
power distribution 16
power source
  loss of 17
power supply 2
  requirement 2
power supply inrush
  power considerations 17
powerup settings 3
preventing excessive heat 18
program mode 89
program scan 89
program scan cycle 62

Q

Quickstarts 133

R

REAL 49
recipe 1, 94
  data types 93
  directory structure 95
  function block errors 96
  function block parameters 95
  function block status 96
  specifications 94
recipe sets 94
Remote LCD
  configuration 53
resistance input 44
restore 1, 3

RJ-45 connector
location 26
RJ-45 Ethernet cable 4
RJ-45 Ethernet connector 2
RJ45 Ethernet port 47
RJ-45 ethernet port 4
RS232 3
RS-232/485 combo port 47
RS-232/485 serial port 47
RS232/RS485 2, 3, 4, 33
pin definition 4
RS232/RS485 serial port 4
RSLinx 48
Run Mode Change (RMC) 7
benefits 8
limitations 11
RMC memory 9
Uncommitted changes 9
using 150
run status 2

S

safety circuits 16
Safety Considerations 15
safety considerations 15
disconnecting main power 15
hazardous location 15
master control relay circuit
periodic tests 16
periodic tests of master control relay circuit 16
power distribution 16
safety circuits 16
security 67
serial communications status 123
serial port
configure 52
serial port cables 3
Shutdown 52
SINT 49
station address 55
status indicator 2
Comm 2
fault status 123
input status 2, 123
network status 124
output 2
run status 123
SD 2
serial communications 123
status indicators 2
Status Indicators on the Controller 123
STRING 49
surge suppression 30
surge suppressors
for motor starters 32
recommended 32
using 30

T

terminal blocks 2
thermistor resistance 44
transmit retries 55
troubleshooting 123

U

UDINT 49
UINT 49
ULINT 49
USB mode 74
USB port 74, 75
User Defined Function Block (UDFB) 61, 65
using emergency-stop switches 19
USINT 49

V

variable retainment 64
voltage input 44

W

wiring 29
fixed terminal blocks 30
removable terminal blocks 30
RS232/RS485 terminal block 30
wiring diagrams 33
Wiring Examples 42
wiring recommendation 29
Wiring Your Controller 29

Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products.
At http://www.rockwellautomation.com/support/, you can find technical manuals, a knowledge base of FAQs, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools.

For an additional level of technical phone support for installation, configuration, and troubleshooting, we offer TechConnect support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.rockwellautomation.com/support/.

Installation Assistance

If you experience a problem within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

United States or Canada	1.440.646.3434
Outside United States or Canada	Use the Worldwide Locator at http://www.rockwellautomation.com/support/americas/phone_en.html, or contact your local Rockwell Automation representative.

New Product Satisfaction Return

Rockwell Automation tests all of its products to ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for the return procedure.

Documentation Feedback

Your comments will help us serve your documentation needs better. If you have any suggestions on how to improve this document, complete this form, publication RA-DU002, available at http://www.rockwellautomation.com/literature/.

Rockwell Otomasyon Ticaret A.Ş., Kar Plaza İş Merkezi E Blok Kat:6 34752 İçerenköy, İstanbul, Tel: +90 (216) 5698400

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Rockwell Automation Publication 2080-UM005B-EN-E - March 2015
Supersedes Publication 2080-UM005A-EN-E - December 2013

6.4 ANEXO D – PROFORMAS

6.4.1 Proforma Moto-reductor SA67 DRS132M4:

SEW EURODRIVE DEL PERU S.A.C.
RUC: 20471133770
Calle los Calderos 122 - Ate - Lima - Perú
Telefono: + 511 - 2086700 Fax: + 511 - 3493002
e-mail: ventas@sew-eurodrive.com.pe

Cotización

Nuestra Ref.:2516134
Fecha : 14. Abril 2015
Pág.: 1 de 2

PONTIFICIA UNIVERSIDAD CATOLICA DEL (41000748)
Atención : Orson Lazo Pazce
Teléfono: 6262000
Teléfono Móvil: 968415249
Correo: orson.lazo@pucp.pe

Ref. de cliente:
Vendedor: Oficina
Teléfono: 2086700
Correo: ventas@sew-eurodrive.com.pe
Cotizador: WT

Item	Material	Cant.	Descripción	Mon.	Precio Unit.	Total
01	SEW	1	**Motorreductor_SA67 DRS132M4**	S/.	5.973,64	5.973,64

Número de Serie	41.0251613401.0001.15
Denominación de catálogo	SA67 DRS132M4
Potencia motor A [kW]	7,500
Vel. salida calculada A [rpm]	231
Par de salida [Nm]	285
Factor de servicio A FB	0,85
Índice reducción total [i]	7,56
Posición de montaje / IM	M1A
Eje hueco	40 mm
Eje de salida	22 mm Piñón del eje
Brida de Motor	0
Brida de Reductor	FG130 D160ARZ
Caracteristicas access. genera	0
Tipo de servicio S1-S10	S1
Tensión del motor [V]	440
Frecuencia del motor [Hz]	60,0
Tipo de conexión	Triángulo
Tipo de protección [IP]	55
TIEMPO DE ENTREGA	5 dias útiles,salvo venta prev

cont.

6.4.2 Proforma Variador de Velocidad POWERFLEX 525:

precisión

Nº Oportunidad	OP-141823/2015
Nº de cotización	00092972
Asunto	PONTIFICIA UNIVERSIDAD CATOLICA DEL PERU - VARIADOR DE VELOCIDAD 7.5KW
Fecha de creación	22/06/2015

Información del Cliente

Razón Social: PONTIFICIA UNIVERSIDAD CATOLICA DEL PERU

Oferta Comercial

Descripción Estandar	Nº de Parte	Proveedor	Precio de venta	Precio Unitario	Cantidad	Precio total	Tiempo de Entrega
POWERFLEX 525, 480 VAC, 3 PHASE, 17 AMPS, FRAME C,	25BD017N104	ROCKWELL AUTOMATION DE PERU S.A.	USD 1.390,00	USD 1.390,00	1,00	USD 1.390,00	2 Días

Divisa de la oportunidad: USD — Total Cotizacion: USD 1.390,00

Condición y Forma de Pago

Condición de Venta: C54 - CONTADO

Comentarios y Condiciones Especiales de la Cotización

Lugar de Entrega: BODEGAS LIMA
Impuesto: No Incluye
Validez de Oferta Comercial: 15 días
Tiempo Garantía: 12 meses

Emisión y Envio de Orden de Compra
EMITIR ORDEN DE COMPRA A PRECISION PERU S.A.
RUC: 20293331066

Para Consultar Contactar a

Vendedor Interno: STEIN NUÑURE GONZALES
Correo Vendedor Interno: stein.nunure@precisionperu.com
Vendedor Externo Perú: FIORELLA PHUN MEDINA
Correo Vendedor Externo: fiorella.phun@precisionperu.com

6.4.3 Proforma Controlador PLC MICRO820 CONTROLLER:

precisión

Nº Oportunidad	OP-141686/2015
Nº de cotización	00092868
Asunto	PONTIFICIA UNIVERSIDAD CATOLICA DEL PERU - 2080-LC20-20QWBR
Fecha de creación	19/06/2015

Información del Cliente

Razón Social: PONTIFICIA UNIVERSIDAD CATOLICA DEL PERU

Oferta Comercial

Descripción Estandar	Nº de Parte	Proveedor	Precio de venta	Precio Unitario	Cantidad	Precio total	Tiempo de Entrega
MICRO820 CONTROLLER, 12 24VDC INPUTS, 4 CONFIGURAB	2080LC2020QWBR	ROCKWELL AUTOMATION DE PERU S.A.	USD 279,00	USD 279,00	1,00	USD 279,00	2 Días

Divisa de la oportunidad: USD — Total Cotizacion: USD 279,00

Condición y Forma de Pago

Condición de Venta: C54 - CONTADO

Comentarios y Condiciones Especiales de la Cotización

Lugar de Entrega: BODEGAS LIMA
Impuesto: No Incluye
Validez de Oferta Comercial: 15 días
Tiempo Garantía: 12 meses

Emisión y Envio de Orden de Compra
EMITIR ORDEN DE COMPRA A PRECISION PERU S.A.
RUC: 20293331066

Para Consultar Contactar a

Vendedor Interno: STEIN NUÑURE GONZALES
Correo Vendedor Interno: stein.nunure@precisionperu.com
Vendedor Externo Perú: FIORELLA PHUN MEDINA
Correo Vendedor Externo: fiorella.phun@precisionperu.com

6.4.4 Proforma Servo-reductor MGU 0420 – 118, Brazo Robot KUKA KR16-2, Fronius TPS 4000 CrNi:

KUKA OFFICIAL SYSTEM PARTNER

MECANOS AUTOMATION
Robótica Industrial, Automatización, Instrumentación y Servicios Generales

PONTIFICIA UNIVERSIDAD CATÒLICA DEL PERÙ

Fecha: 29/04/2015

Ref: Celda Robótica de Soldadura - BASIC 4000

Cotización Nro: 2015-RPC009-V4

Descripción técnica

La siguiente propuesta contiene DOS alternativas Y ADICIONALES para vuestra consideración, así mismo en la parte final esta una descripción de los elementos principales para mayor detalle.

Alternativa 1:

Ítem	Cant	Descripción	P.Unit
1	1	Robot Antropomórfico Kuka KR16, Incluye: • Interface de comunicación a PLCs KUKA.Ethernet IP • 16 entradas, 16 salidas Y Maleta KIT de calibración de Ejes EMD • Conexión de 02 ejes externos matemáticos en fuente KUKA • Software: ArcTech Basic, Kuka.SeamTech Tracking y Kuka.SeamTech Finding 2.0	Incl.
2	1	Sistema de Soldadura FRONIUS TransPuls Synergic 4000 CrNi completo, incluye estación limpieza antorcha automático	Incl.
3	1	Servo-Reductor KUKA - Modelo MGU 3100 (3.2KW - 3100 Nm - 30 RPM), incluye cables de poder y realimentación de 7 mt.	Incl.
4	1	Frame Mecánico para soporte de Robot (pedestal para robot KUKA KR16)	Incl.
5	1	Instalación, Programación y puesta en marcha de instalación	Incl.
		TOTAL USD	100,000.00

Alternativa 2:

Ítem	Cant	Descripción	P.Unit
1	1	Robot Antropomórfico Kuka KR16, Incluye: • Interface de comunicación a PLCs KUKA.Ethernet IP • 16 entradas, 16 salidas Y Maleta KIT de calibración de Ejes EMD • Conexión de 02 ejes externos matemáticos en fuente KUKA • Software: ArcTech Basic, Kuka.SeamTech Tracking y Kuka.SeamTech Finding 2.0	Incl.
2	1	Sistema de Soldadura FRONIUS TransPuls Synergic 4000 CrNi completo, incluye estación limpieza antorcha automático	Incl.
3	2	Servo-Reductores KUKA - Modelo MGU 0420 - 118 (1.5KW - 420 Nm - 300RPM), incluye cables de poder y realimentación de 7 mt.	Incl.
4	1	Frame Mecánico para soporte de Robot (pedestal para robot KUKA KR16)	Incl.
5	1	Instalación, Programación y puesta en marcha de instalación	Incl.
		TOTAL USD	100,000.00

ADICIONALES, cada ítem incluye Servomotor acoplado a caja reductora con cables POWER y FEEDBACK:

Ítem	Cant	Descripción	P.Unit USD
1	1	Servo-Reductor KUKA - Modelo MGU 3100-118.5 (3.2KW - 3100 Nm – 33 RPM) Máximo modelo en KRC4 con fuente para dos ejes	10,000.00
2	1	Servo-Reductores KUKA - Modelo MGU 0420 - 118 (1.5KW - 420 Nm – 25 RPM)	6,000.00
3	1	Servo-Reductores KUKA - Modelo MGU 0800 - 118 (2.5KW - 800 Nm – 33 RPM)	7,000.00

6.4.5 Proforma:

COTIZACIÓN N° 2015-1285

Lima, 05 DE AGOSTO de 2015.

Señores: Pontificia Universidad Católica del Perú
Atención Orson Lazo Pazce

Dirección:

CANTIDAD	DESCRIPCION	P UNT	P TOTAL
8	ARANDELA PLANA FE M-12	S/. 0.12	S/. 0.94
24	ARANDELA PLANA FE M-16	S/. 0.20	S/. 4.70
24	PERNO FLAT ALLEN M-12 X 40	S/. 1.74	S/. 41.68
1	PERNO FLAT ALLEN M-12 X 80	S/. 2.87	S/. 2.87
8	PERNO HEX NC-5.8 M-12 X 80	S/. 0.78	S/. 6.22
8	PERNO HEX NC-5.8 M-24 X 70	S/. 6.60	S/. 52.78
12	PERNO SOCKET ALLEN M-10 X 40	S/. 0.73	S/. 8.76
54	PERNO SOCKET ALLEN M-12 X 40	S/. 1.05	S/. 56.67
4	PERNO SOCKET ALLEN M-12 X 70	S/. 2.83	S/. 11.34
28	PERNO SOCKET ALLEN M-16 X 110	S/. 5.09	S/. 142.42
6	PERNO SOCKET ALLEN M-16 X 140	S/. 6.88	S/. 41.27
8	PERNO SOCKET ALLEN M-16 X 150	S/. 7.28	S/. 58.28
6	PERNO SOCKET ALLEN M-16 X 40	S/. 2.61	S/. 15.64
4	PERNO SOCKET ALLEN M-16 X 55	S/. 5.46	S/. 21.82
4	PERNO SOCKET ALLEN M-20 X 150	S/. 21.57	S/. 86.29
2	PERNO SOCKET ALLEN M-5 X 12	S/. 0.20	S/. 0.40
4	PERNO SOCKET ALLEN M-5 X 30	S/. 0.27	S/. 1.10
4	PERNO SOCKET ALLEN M-5 X 40	S/. 0.39	S/. 1.58
8	PERNO SOCKET ALLEN M-6 X 35	S/. 0.22	S/. 1.72
4	PERNO SOCKET ALLEN M-6 X 60	S/. 0.40	S/. 1.60
12	PERNO SOCKET ALLEN M-8 X 110	S/. 1.80	S/. 21.57
12	TUERCA HEX NC-5.8 M-10	S/. 0.10	S/. 1.23
78	TUERCA HEX NC-5.8 M-12	S/. 0.15	S/. 11.68
8	TUERCA HEX NC-5.8 M-12	S/. 0.15	S/. 1.20
28	TUERCA HEX NC-5.8 M-16	S/. 0.31	S/. 8.61
8	TUERCA HEX NC-5.8 M-24	S/. 0.94	S/. 7.54
8	ARANDELA PLANA FE M-5	S/. 0.03	S/. 0.27
12	TUERCA HEX NC-5.8 M-6	S/. 0.02	S/. 0.27
		SUB TOTAL	S/. 610.46
		IGV	S/. 109.88
		TOTAL	S/. 720.34

SERMAR IMPORT & EXPORT S.A.C. TELF.: 955 411 102
Email: mgcsermar@gmail.com Web. **www.sermarperu.com**

AWS D16.3M/D16.3:2001
An American National Standard

Risk Assessment Guide for Robotic Arc Welding

American Welding Society

Approved American National Standard
ANSI

Key Words—Risk assessment, robot safety, safeguarding, automation, robot workcell

AWS D16.3M/D16.3:2001
An American National Standard

Approved by
American National Standards Institute
February 21, 2001

Risk Assessment Guide for Robotic Arc Welding

Prepared by
AWS D16 Committee on Robotic and Automatic Welding

Under the Direction of
AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

AWS D16.3M/D16.3:2001, *Risk Assessment Guide for Robotic Arc Welding*, provides recommendations and guidelines for the safe application of robotic arc welding. Emphasis is placed on conformance of this process with prevailing industry standards for hazard analysis and proper safeguarding.

American Welding Society
550 N.W. LeJeune Road, Miami, Florida 33126

Table of Contents

Page No.

Personnel iii
Foreword v
List of Figures viii

1. Scope 1
   1.1 Exclusions 1
   1.2 Units 1

2. Reference Documents 1

3. Definitions 1

4. General Considerations 5
   4.1 Risk Assessment Description 5
   4.2 Performance 5

5. Elements of the Risk Assessment 5
   5.1 Application Description 5
   5.2 Robot Operating Characteristics 5
   5.3 Robot Classification 5
   5.4 Category of Hazards Schedule 5
   5.5 Risk Analysis 6

6. Documentation 6
   6.1 Classification Summary 6
   6.2 Work Cell (Workspace) Description 6
   6.3 Summary of Potential Hazards 7
   6.4 Method of Safeguarding 7

7. Training 7
   7.1 Risk Assessment Training Program 7
   7.2 Other Safety Training Program 7

Annexes—Mandatory Information
Annex I—Operating Subclassification (Robot Arc Welding Applications) 9
Annex II—Application Classifications (Robot Arc Welding Applications) 11
Annex III—Classification Summary (Robot Arc Welding Applications) 13
Annex IV—Minimum Safeguarding Protocols (Robot Arc Welding Applications) 15
Annex V—Safeguarding Devices 17

Annexes—Nonmandatory Information
Annex A—Guidelines for Preparation of Technical Inquiries for AWS Technical Committees 19

AWS List of Documents on Robotics and Automatic Welding 21

List of Figures

Figure **Page No.**

1 Example of a Robot Arc Welding Workcell.....6

Risk Assessment Guide for Robotic Arc Welding

1. Scope

The purpose of D16.3M/D16.3:2001, *Risk Assessment Guide for Robotic Arc Welding*, is to identify and evaluate potential safety hazards associated with robotic arc welding. It is not intended to be a guideline for other robotic applications. This guide is intended to be used by the persons performing risk assessment.

1.1 Exclusions. This standard applies to arc welding robots and robot arc welding systems. This list includes the following items:

(1) Automatic guided vehicle systems,
(2) Undersea and space robots,
(3) Automatic conveyor and shuttle systems,
(4) Teleoperators,
(5) Mobile robots.

The above list is not all inclusive.

1.2 Units. This standard makes use of both the International System of Units (SI) and U.S. Customary Units. The measurements may not be exact equivalents; therefore, each system must be used independently of the other without combining in any way. The standard with the designation D16.3M:2001 uses SI Units. The standard designation D16.3:2001 uses U.S. Customary Units. The latter are shown within brackets [ ].

2. Reference Documents

The following standards contain provisions which, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

(1) AWS/NEMA D16.2, *Standard for Components of Robotic and Automatic Welding Installations*

(2) AWS D16.4, *Specification for the Qualification of Robotic Arc Welding Personnel*

(3) AWS *Arc Welding With Robots: Do's and Don'ts*

(4) AWS *Safety and Health Fact Sheets*

(5) ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes* (published by the American Welding Society)

(6) AWS A3.0, *Standard Welding Terms and Definitions*

(7) ANSI B11.1, *Machine Tools—Mechanical Power Presses—Safety Requirements for Construction, Care and Use*

(8) ANSI B15.1, *Safety Standard for Mechanical Power Transmission Apparatus* (with ASME)[1]

(9) ANSI Z136.1, *Safe Use of Lasers*

(10) NFPA 79, *Electrical Standard for Industrial Machinery*[2]

(11) RIA 15.06, *American National Standard for Industrial Robots and Robot Systems—Safety Requirements*[3]

(12) UL 1740, *Safety Standard for Industrial Robots and Robotic Equipment*[4]

3. Definitions

The following definitions either do not appear in AWS A3.0, *Standard Welding Terms and Definitions*, or they are used in a different manner:

analog input. A variable dc (0–10 V or 4–20 mA) signal from the welding equipment to the robot controller.

1. American Society of Mechanical Engineers, 3 Park Avenue, New York, NY 10016.
2. National Fire Protection Association, One Batterymarch Park, Quincy, MA, 02269-9101.
3. Robotics Industries Association, 900 Victors Way, P.O. Box 3724, Ann Arbor, MI 48106.
4. Underwriters Laboratory, 333 Pfingsten Road, Northbrook, IL 60062.

APPLIED SAFETY AND ERGONOMICS, INC.

Update on ANSI Z535.6:

A New Standard for Safety Information in Product Manuals, Instructions, and Other Collateral Materials

Steven M. Hall, J. Paul Frantz, Stephen L. Young, Timothy P. Rhoades, Judith J. Isaacson, and Charles G. Burhans
Applied Safety and Ergonomics, Inc.

www.appliedsafety.com

A new standard, ANSI Z535.6, *Product Safety Information in Product Manuals, Instructions, and Other Collateral Materials,* has been added to the ANSI Z535 series. To date, the ANSI Z535 Accredited Standards Committee has published five American National Standards:

- ANSI Z535.1: *Safety color code*
- ANSI Z535.2: *Environmental and facility safety signs*
- ANSI Z535.3: *Criteria for safety symbols*
- ANSI Z535.4: *Product safety signs and labels*
- ANSI Z535.5: *Safety tags and barricade tapes (for temporary hazards)*

The Need for the New Standard

The five existing Z535 standards contain recommendations regarding the formats, colors, and symbols for safety signs used in environmental and facility applications, product applications, and accident prevention tags/tape, but do not address safety messages in product manuals, instructions, and other collateral materials. The absence of standardized formatting systems, combined with the increased awareness and use of ANSI Z535.4, has led to attempts to apply various aspects of ANSI Z535.4 to safety information in collateral materials. However, ANSI Z535.4 was not intended for and is not well suited to this purpose. Therefore, one purpose of ANSI Z535.6 is to address the applicability of elements of other ANSI Z535 standards to collateral materials.

Different standards are needed for product signs and labels and collateral materials due to the differences between these two types of media. For example, collateral materials typically contain more information than a sign or label, address multiple hazards and contain multiple safety messages, provide longer and more detailed safety messages, contain multiple pages of information that cannot be viewed simultaneously, and can provide information that would be impractical on product safety signs, such as definitions of the safety alert symbol, signal words, and safety symbols. Also, unlike safety signs and labels, safety information in collateral materials must often be integrated with surrounding, non-safety information. Collateral materials are typically not attached to the product, so issues related to reading conditions, distinctiveness, placement, expected life, and maintenance are different. In addition, the concept of a safe viewing distance is not generally applicable.

The New Standard – ANSI Z535.6

To respond to this need, the new standard provides a hazard communication system developed specifically for product safety information in collateral materials. It provides a common design direction intended to provide product safety information in an orderly and visually consistent manner. Certain graphical elements used in the other Z535 standards are included in Z535.6:

- signal words (i.e., DANGER, WARNING, CAUTION, NOTICE)
- the safety alert symbol
- safety colors (i.e., red, orange, yellow)

However, in order to adapt these graphical elements for use in collateral materials, the standard includes some unique features, such as different safety message formats depending on the relationship between the safety message and other information in the document, and provisions for presenting safety messages without safety colors.

The following summarizes, in general terms, the contents of the new standard.

Scope

The standard sets forth requirements for the design and placement of safety messages in collateral materials. Like existing ANSI Z535 standards, such as Z535.2 and Z535.4, this standard is intended to apply to a broad range of products.

Collateral materials include a variety of documents, such as owner's manuals, instructions, user's guides, maintenance or service manuals, assembly instructions, and safety manuals. Collateral materials may take the form of a single sheet of paper, a multi-page document, instructions on a package or container, or a printable electronic document.

Signal Words

Many of the safety message formats in the standard use signal words to call attention to the safety message. Signal words are often used with the safety alert symbol to form a signal word panel (Figure 1).

Figure 1: Signal word panels (with optional color)

The standard includes signal words that are used in other ANSI Z535 standards: DANGER, WARNING, CAUTION, and NOTICE. As with other Z535 standards, signal words are selected based on degree or level of hazard seriousness, specifically, the probability and severity of harm associated with not following the safety message.

The signal word definitions in all of the ANSI Z535 standards' 2006 editions have been updated. The definitions of "DANGER," "WARNING," and "CAUTION," when used with the safety alert symbol, have been edited for clarity, but the intended meaning has not changed. The definition of "NOTICE" has been updated in all standards, and the signal word has been added to Z535.4 and Z535.6. This signal word replaces "CAUTION" without the safety alert symbol for use with messages not related to personal injury, such as messages related to property damage only.

In addition to the updated definitions, a detailed annex regarding risk assessment and signal word selection has been added to ANSI Z535 standards including Z535.6.

The Safety Alert Symbol

The proposed standard includes formats that use the safety alert symbol (Figure 2).

Figure 2: Example of the safety alert symbol

The safety alert symbol indicates a potential personal injury hazard; it is not used for messages related to property damage only. The safety alert symbol may be used alone or in conjunction with a signal word in a signal word panel.

When presented as a black triangle with yellow fill, a black exclamation mark and, optionally, a yellow border (Figure 3), the safety alert symbol is identical to the general warning sign defined in ISO 7010 – 2003, *Graphical symbols — Safety colours and safety signs — Safety signs used in workplaces and public areas*.

Figure 3: Examples of the safety alert symbol when formatted like the ISO general warning sign

This optional form of the safety alert symbol is being added to the ANSI Z535 standards' 2006 editions to allow greater harmonization with ISO standards. For example, ANSI Z535.4 - 2006 will allow the use of this optional yellow and black safety alert symbol in signal word panels. Such a signal word panel is essentially identical to the optional hazard severity panel defined in ISO 3864-2 - 2004, *Graphical symbols - Safety colours and safety signs - Part 2: Design principles for product safety labels*.

While there is no ISO standard that is directly comparable with ANSI Z535.6, inclusion of this optional safety alert symbol allows safety messages in collateral materials to be visually similar to signs, labels, and tags that are

formatted according to other ANSI Z535 standards and also to ISO standards.

Safety Colors

The use of color is not mandatory. However, if color is used with signal words, the same safety colors that are specified in the other Z535 standards are recommended. ANSI Z535.1 provides specifications for safety colors.

Types of Safety Messages

Unlike safety messages provided on signs or labels, safety messages in collateral materials can be classified based on their relationship to other information in the document. The standard defines four types of safety messages: supplemental directives, grouped safety messages, section safety messages, and embedded safety messages.

Supplemental Directives

Supplemental directives are messages that refer to other safety messages. They can be used to:

- direct users to new, unique, unusual, or particularly important safety information
- direct users to product safety information in the document, in another document, or in some other source (e.g., product safety signs and labels)
- make users aware of the safety-related nature and importance of an entire document or section within a document (e.g., a section of grouped safety messages)
- reduce the need to repeat consequence information, especially generic consequences (e.g., "severe injury or death"), that may be associated with failure to read the document or refer to other sources of safety information.

Some typical supplemental directives include messages like:

- "read all instructions before use to avoid injury"
- "to avoid serious injury or death, follow the safety information in this document"
- "keep this manual"
- "read all product safety labels"
- "refer to local building codes for installation requirements"

Recommended formats for supplemental directives use the safety alert symbol (Figure 4) and, in cases where hazards and consequences can be determined with enough specificity to assign them, signal words.

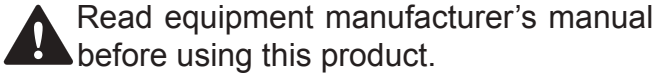


Figure 4: Example of a supplemental directive with the safety alert symbol

Grouped Safety Messages

Grouped safety messages are presented in their own separate section or document, for example an "Important Safety Information" chapter in a document or a separate "Safety Manual." When provided in a section within a document, these messages are typically placed at the beginning of a document, before any procedural information to which they apply. A separate section or document of grouped safety messages must have a title or heading indicating that the information is safety-related. Signal words and the safety alert symbol are often not used with grouped safety messages, since there is no need to distinguish safety messages from other information in an all-safety section or document.

Section Safety Messages

Section safety messages apply to an entire section of a document. These messages can be used to:

- provide safety information that applies throughout a procedure
- provide safety information that pertains to the topic of a particular section but that is not related to any particular procedural step or message in the section
- avoid unnecessary repetition of information about the hazards, consequences, or avoidance that applies to an entire section, paragraph, procedure, group of procedures, or other unit of text within the body of a document
- allow users to access procedural and other product-use information more easily and efficiently by reducing the extent to which a safety message interrupts or interferes with the access or flow of information

Section safety messages are typically located at the beginning of a section, before the information to which they apply. A signal word panel (Figure 5) or a safety alert symbol (Figure 6) typically precedes these messages.

Section heading

⚠ WARNING

This is a section safety message. This is a section safety message.

General text, general text, general text, general text.

Figure 5: Example of a section safety message with a signal word panel

Section heading

⚠ This is a section safety message. This is a section safety message.

General text, general text, general text, general text.

Figure 6: Example of a section safety message with a safety alert symbol only

Embedded Safety Messages

Embedded safety messages are integrated into procedures or into other non-safety information. Integrating safety messages into procedures can be particularly helpful, as the safety message can be placed at the step in the procedure when it should be followed. A variety of formats are permitted for embedded safety messages in order to allow them to be better integrated with the surrounding information in a particular situation. Formats include use of signal words (Figure 7), the safety alert symbol, consistently applied text treatments (e.g., bold, italics), or, when the content and context of the message make it clear that it has to do with safety, no special formatting.

General text, general text, general text, general text. **WARNING!** This is an embedded safety message. This is an embedded safety message.

Figure 7: Example of an embedded safety message with signal word

Conclusion

Because ANSI Z535.6 provides a completely new scheme for classifying different types of safety messages and a variety of options for formatting safety messages, applying the standard to collateral materials will initially be more complicated than applying ANSI Z535.4 to product safety labels. However, the additional effort required to initially apply the standard can provide valuable benefits. The process of identifying and classifying safety messages provides an opportunity to reevaluate the content and location of safety messages, and to develop a consistent approach regarding when and where warnings are provided, both in collateral materials and via other media. The relative flexibility in formatting safety messages provides an opportunity to develop a custom style that is appropriate for the particular documents and that also is consistent with the new standard. Once this style has been established, developing future collateral materials should be significantly easier.

As many different industries apply the standard to a wide variety of collateral materials over the next few years, areas of the standard in need of modification or refinement will likely be exposed. Users of the standard are encouraged to provide feedback to the Z535 committee and propose changes to improve the next edition of the standard.

Dr. Frantz is chairperson, Mr. Hall is vice-chairperson, and Dr. Young, Dr. Rhoades, Ms. Isaacson and Mr .Burhans are members of the ANSI Z535.6 subcommittee. Applied Safety and Ergonomics, Inc., is a consulting firm whose services include assisting clients in the development and evaluation of product warnings and manuals, training clients regarding warnings and product safety, and providing technical support in complex litigation involving hazard communication issues. For more information about ANSI Z535.6 or related product safety information issues, contact Mr. Burhans at cburhans@appliedsafety.com or 734-994-9400.

"Decenio de las Personas con Discapacidad en el Perú"
"Año de la Promoción de la Industria Responsable y del Compromiso Climático"

PERÚ | Ministerio de Trabajo y Promoción del Empleo | Viceministerio de Promoción del Empleo y Capacitación Laboral

Trabajo
Ministerio de Trabajo y Promoción del Empleo

RESOLUCIÓN DIRECTORAL N° 037-2014-MTPE/3/19

Lima, 23 de junio de 2014.

VISTOS: El Oficio N° 384-2014-MTPE/3/19.2 de fecha 02 de junio de 2014 expedido por la Dirección de Normalización y Certificación de Competencias Laborales, así como el Informe N° 001-2014-MTPE/3/19.2/MVRV/MAAA de fecha 24 de febrero de 2014, el Informe N° 011-2014-MTPE/3/19.2/RIM de fecha 18 de marzo de 2014 y el Informe N° 014-2014-MTPE/3/19.2/MAAA de fecha 02 de mayo de 2014, expedidos por Especialistas de la Dirección de Normalización y Certificación de Competencias Laborales, en relación al **Perfil Ocupacional de Soldadura Básica, así como los instrumentos del indicado perfil;**

CONSIDERANDO:

Que, mediante Ley N° 29381 - Ley de Organización y Funciones del Ministerio de Trabajo y Promoción del Empleo, se establece como una de las áreas programáticas del sector, la de normalización y certificación de competencias laborales[1], ejerciendo competencia exclusiva y excluyente, respecto de otros niveles de gobierno en todo el territorio nacional[2], así como función rectora formulando, planificando, dirigiendo, coordinando, ejecutando, supervisando y evaluando las políticas nacionales y sectoriales[3];

Que, conforme al Decreto Supremo N° 004-2014-TR, que aprueba el Reglamento de Organización y Funciones del Ministerio de Trabajo y Promoción del Empleo, la Dirección General de Formación Profesional y Capacitación Laboral como órgano de línea, es responsable de formular, planear, dirigir, coordinar, ejecutar, evaluar y supervisar las políticas públicas[4] y tiene como función específica emitir y aprobar lineamientos, directivas, mecanismos y procedimientos en el ámbito nacional y sectorial[5], en normalización y certificación de competencias laborales;

Que, de acuerdo al citado Decreto Supremo, constituye función específica de la Dirección de Normalización y Certificación de Competencias Laborales: proponer, validar, actualizar y promover la elaboración de perfiles ocupacionales en base a competencias laborales[6];

Que, mediante Resolución Ministerial N° 026-2010-TR, son aprobados los Criterios del Proceso de Certificación de Competencias Laborales, estableciendo el marco procedimental y contenido mínimo de un Perfil Ocupacional, siendo instancias competentes para proponerlo la Dirección de Normalización y Certificación de Competencias Laborales, así como las Direcciones o Gerencias Regionales de Trabajo y Promoción del Empleo;

[1] *Literal h) del Artículo 4°.*
[2] *Numeral 5.1. del Artículo 5°.*
[3] *Literal a), numeral 3.1., artículo 3° del Decreto Supremo N° 004-2014-TR.*
[4] *Artículo 72° del Decreto Supremo N° 004-2014-TR.*
[5] *Literal c) del artículo 73° del Decreto Supremo N° 004-2014-TR.*
[6] *Literal b) del artículo 76° del Decreto Supremo N° 004-2014-TR.*

Que, mediante Resolución Directoral N° 014-2013-MTPE/3.19, de fecha 24 de abril de 2013, se aprobó el **Perfil Ocupacional de Auxiliar de Soldadura,** vigente por un período de tres años;

Que, de conformidad al sustento técnico realizado en el Informe Nº 001-2014-MTPE/3/19.2/MVRV/MAAA de fecha 24 de febrero de 2014, se indica, entre otros, la mejora de los procesos productivos del sector y como resultado de ello, se propone modificar la denominación del indicado perfil por la del Perfil Ocupacional de Soldadura Básica, en vista que permite una mejor comprensión por parte de los actores involucrados en la normalización y certificación de competencias laborales;

Que, la actualización propuesta cuenta con el control de calidad efectuado según Informe N° 011-2014-MTPE/3/19.2/RIM de fecha 18 de marzo de 2014 e Informe N° 014-2014-MTPE/3/19.2/MAAA de fecha 02 de mayo de 2014, en base a la "Matriz de control de calidad del diseño de un Perfil Ocupacional" aplicada para tal efecto;

Que, la Dirección de Normalización y Certificación de Competencias Laborales, luego de la revisión y análisis correspondiente al perfil ocupacional aprobado, mediante oficio e informes de vistos propone modificar el contenido y la denominación del referido perfil ocupacional;

Que, asimismo, respecto a los instrumentos de evaluación del **Perfil Ocupacional de Soldadura Básica**, revisados estos, se advierte que contiene información de acuerdo a los estándares de calidad exigidos en el referido Perfil Ocupacional, recogiendo la información necesaria sobre el desempeño del trabajador(a), para ser aplicados en los procesos de evaluación y certificación de competencias laborales respectivos, asimismo, se aprecia que, dichos instrumentos pueden ser aplicados tanto en situación real como en situación simulada de trabajo; por lo que, corresponde aprobar los mencionados instrumentos, conforme al sustento desarrollado en el Informe N° 001-2014-MTPE/3/19.2/MVRV/MAAA y control de calidad efectuado según el Informe N° 011-2014-MTPE/3/19.2/RIM e Informe N° 014-2014-MTPE/3/19.2/MAAA;

Que, debe tenerse en cuenta que, para efectos de garantizar la objetividad y transparencia en las evaluaciones de competencias laborales y con la finalidad de no hacer públicos los instrumentos de evaluación por la utilización de estos en diferentes evaluaciones por distintos Centros de Certificación, deben tener el carácter de reservado; quedando dichos instrumentos a disposición de la Dirección de Normalización y Certificación de Competencias Laborales para que de acuerdo a su competencia disponga de ellos cuando el o los casos lo ameriten;

Que, estando a las facultades y atribuciones de la Dirección General de Formación Profesional y Capacitación Laboral y en el ejercicio de sus funciones específicas asignadas por el Reglamento de Organización y Funciones del Ministerio de Trabajo y Promoción del Empleo;

SE RESUELVE:

Artículo 1°.- Aprobación.

Aprobar la modificación del **Perfil Ocupacional de Soldadura Básica,** cuya denominación anterior fue Perfil Ocupacional de Auxiliar de Soldadura, propuesta por la Dirección de Normalización y Certificación de Competencias Laborales, la misma que forma parte integrante de la presente resolución.

Artículo 2°.- Aprobación de los instrumentos de evaluación.

Aprobar los instrumentos de evaluación de las unidades de competencias 1, 2 y 3 correspondientes al **Perfil Ocupacional de Soldadura Básica**, consistentes en pruebas de conocimiento (escritas) y pruebas de desempeño, de aplicación en situación real y simulada de trabajo.

Artículo 3°.- Disposición de aplicación y custodia de los instrumentos de evaluación.

Disponer que los instrumentos de evaluación aprobados, sean aplicados de manera reservada y cautelosa por los Centros de Certificación de Competencias Laborales autorizados, así como que dichos instrumentos se encuentren a cargo de la Dirección de Normalización y Certificación de Competencias Laborales, dependencia facultada para facilitarlos a los Centros de Certificación de Competencias Laborales cuando lo soliciten para el desarrollo de procesos de evaluación que ejecuten.

Artículo 4°.- Propuestas de instrumentos de evaluación de los Centros de Certificación de Competencias Laborales.

Los Centros de Certificación de Competencias Laborales pueden elaborar y proponer instrumentos de evaluación; sin embargo, su aplicación se encuentra sujeta a validación y aprobación por parte de las instancias competentes del Ministerio de Trabajo y Promoción del Empleo.

Artículo 5°.- Publicación.

Dispóngase la publicación de la presente Resolución Directoral en la separata de Normas Legales del Diario Oficial El Peruano, así como en el portal web institucional del Ministerio de Trabajo y Promoción del Empleo (*www.trabajo.gob.pe*) donde se adicionarán el Mapa Funcional, Perfil Ocupacional y Anexo de puestos vinculados a sus unidades de competencia.

Regístrese, comuníquese y publíquese.-

Mba Eco. Astrid Aimee Sánchez Falero
Directora General de Formación Profesional y Capacitación Laboral

MAPA FUNCIONAL DEL PERFIL OCUPACIONAL DE LA SOLDADURA BÁSICA

Ejecutar actividades básicas de soldadura de metales ferrosos y no ferrosos, teniendo en cuenta las indicaciones del jefe inmediato y los procedimientos de soldadura, normas de seguridad y salud en el trabajo y cuidado del medio ambiente.

Unidad de Competencia 1: Habilitar el área de trabajo y cortar el material base, teniendo en cuenta los procedimientos de soldadura, normas de seguridad y salud en el trabajo y cuidado del medio ambiente.

- Organizar el área de trabajo (equipos, materiales e insumos), teniendo en cuenta las indicaciones del jefe inmediato y de acuerdo a los procedimientos de soldadura.
- Realizar la medición, trazado y corte de los materiales, según la orden de trabajo o indicaciones del jefe inmediato y de acuerdo a los procedimientos de soldadura.

Unidad de Competencia 2: Preparar las juntas[1], teniendo en cuenta los procedimientos de soldadura, las normas de seguridad y salud en el trabajo y cuidado del medio ambiente.

- Establecer requerimientos de equipos, materiales e insumos de acuerdo a la orden de trabajo o las indicaciones del jefe inmediato, teniendo en cuenta los procedimientos de soldadura.
- Cortar las piezas de metal para la unión por soldadura, teniendo en cuenta las especificaciones técnicas de la orden de trabajo e indicaciones del jefe inmediato y los procedimientos de soldadura.

Unidad de Competencia 3: Apuntalar las juntas[1] a ser soldadas y brindar asistencia al jefe inmediato durante todo el proceso de soldadura, de acuerdo a los procedimientos de soldadura, normas de seguridad y salud en el trabajo y cuidado del medio ambiente.

- Realizar el apuntalado de las juntas, mediante la fijación de las piezas bajo la supervisión del jefe inmediato y considerando los procedimientos de soldadura.
- Realizar el pre y post calentamiento de la operación de soldeo y asistir durante el proceso de soldadura al jefe inmediato, considerando los procedimientos de soldadura.

[1] *Una junta es la unión de las partes, o los extremos de las mismas, que van a ser unidos o que han sido unidos.*

PERFIL OCUPACIONALDE LA DE LA SOLDADURA BÁSICA

SECTOR: MANUFACTURA	SUBSECTOR: Tratamiento y revestimiento de metales	CÓDIGO DE LA OCUPACIÓN: 785037	NIVEL DE COMPETENCIA: 2	VIGENCIA: 3 años

COMPETENCIA GENERAL	Ejecutar actividades básicas de soldadura de metales ferrosos y no ferrosos, teniendo en cuenta las indicaciones del jefe inmediato y los procedimientos de soldadura, normas de seguridad y salud en el trabajo y cuidado del medio ambiente.

Unidad de Competencia 1: Habilitar el área de trabajo y cortar el material base, teniendo en cuenta los procedimientos de soldadura, normas de seguridad y salud en el trabajo y cuidado del medio ambiente.

ELEMENTOS DE COMPETENCIA	CRITERIOS DE DESEMPEÑO
Organizar el área de trabajo (equipos, materiales e insumos), teniendo en cuenta las indicaciones del jefe inmediato y de acuerdo a los procedimientos de soldadura.	1. Viste el uniforme de trabajo y usa el equipo de protección personal necesario, según la normatividad correspondiente. 2. Verifica que el área de trabajo se encuentre limpia, durante su turno de trabajo, según los procedimientos de soldadura y normas de seguridad y salud en el trabajo, además del cuidado del medio ambiente. 3. Verifica el estado de los equipos, su instalación y funcionamiento, según las especificaciones del fabricante o las indicaciones del jefe inmediato. 4. Mantiene limpios y ordenados el área de trabajo, equipos, herramientas, instrumentos e insumos durante su turno de trabajo, teniendo en cuenta los procedimientos de soldadura, normas de seguridad y salud en el trabajo y cuidado del medio ambiente. 5. Solicita al área de provisión (o almacén) equipos de soldadura, herramientas, instrumentos, materiales e insumos, verificando que cumplan con las especificaciones técnicas establecidas en las órdenes de trabajo e indicaciones del jefe inmediato. 6. Traslada los materiales a la zona de trabajo, cumpliendo las normas técnicas y de seguridad y salud en el trabajo. 7. Dispone los materiales, insumos, instrumentos y herramientas, de acuerdo a su clasificación, características, usos y normas de seguridad, teniendo en cuenta las indicaciones del jefe inmediato.

ELEMENTOS DE COMPETENCIA	CRITERIOS DE DESEMPEÑO
Realizar la medición, trazado y corte de los materiales, según la orden de trabajo o indicaciones del jefe inmediato y de acuerdo a los procedimientos de soldadura.	1. Viste el uniforme de trabajo y usa el equipo de protección personal necesario, según la normatividad correspondiente. 2. Realiza la medición de los materiales metálicos, sean ferroso o no ferroso (planchas, platinas, ángulos, etc.), utilizando los instrumentos correspondientes, según la orden de trabajo y las indicaciones del jefe inmediato. 3. Traza los materiales metálicos, según las mediciones efectuadas, utilizando el elemento de trazado (tizas de calderero, rayador, etc.) según corresponda, teniendo en cuenta los procedimientos de soldadura. 4. Realiza el corte del material, de acuerdo a la orden de trabajo, considerando las normas técnicas y las indicaciones del jefe inmediato, teniendo en cuenta los procedimientos de soldadura. 5. Retorna los equipos, accesorios y materiales al área de provisión (o almacén), cuando el caso lo requiera, teniendo en cuenta las normas de seguridad y salud en el trabajo. 6. Limpia el área de trabajo y recoge los materiales sobrantes (metales) depositándolos en su respectivo tacho, teniendo en cuenta las normas de seguridad y salud en el trabajo y cuidado del medio ambiente. 7. En caso de existir alguna ocurrencia y/o deficiencia que afecte el desarrollo del proceso, se comunica al jefe inmediato.

	Evidencia de desempeño/producto	Evidencia de conocimientos	Evidencia de desempeño/producto	Evidencia de conocimientos
	1. Uniforme de trabajo y equipo personal correctamente colocado. 2. Área de trabajo, equipos, herramientas e insumos adecuadamente limpios durante el turno. 3. Equipos, herramientas, accesorios e insumos, correctamente organizados. 4. Equipos, insumos y materiales, en buen estado, ubicados e instalados de manera segura en el lugar correcto. 5. Provisión de materiales según la orden de servicio, entregados de manera segura y oportuna.	1. Conocimientos de normas técnicas sobre protección personal en procesos de soldadura. 2. Conocimientos básicos de los procesos y normas técnicas de soldadura. 3. Nociones básicas de electricidad. 4. Conocimiento de la norma de seguridad y salud en el trabajo. 5. Conocimiento de la norma del cuidado del medio ambiente.	1. Uniforme de trabajo y equipo personal correctamente colocados. 2. Piezas de material metálico (ferroso o no ferroso) con las medidas de acuerdo a las indicaciones del jefe inmediato 3. Material metálico debidamente trazado. 4. Piezas de material metálico (ferroso o no ferroso) cortadas de acuerdo a las indicaciones del jefe inmediato. 5. Equipos adecuadamente ubicados y disponibles para su utilización. 6. Área de trabajo limpia y ordenada y en condición operativa. 7. Comunica asertivamente las ocurrencias y/o deficiencias que afectan el normal desarrollo del proceso.	1. Conocimientos de normas técnicas sobre protección personal. 2. Conocimientos básicos de medición, trazado y corte de materiales para procesos de soldadura. 3. Conocimientos básicos de los procesos y normas técnicas de soldadura. 4. Conocimiento e identificación de las señales de seguridad. 5. Nociones básicas de electricidad. 6. Conocimiento de la norma de seguridad y salud en el trabajo. 7. Conocimiento de la norma del cuidado del medio ambiente.

CONTEXTO DEL DESEMPEÑO LABORAL

Instalaciones	Equipamiento	Equipo personal	Insumos /materiales	Información / Formatos
• ***Taller de soldadura*** de dimensiones mínimas de 10m. x 10m. x 6 m. de altura (o mínimo de 3 m. con instalación o utilización de extractor de humo). • ***Taller mecánico*** con equipamiento de dimensiones mínimas de 10 m. x 10 m. • ***Cabinas:*** de metal (acero): Altura: 2.20 m, ancho: 1.60 m, fondo: 1.25 m. Mesa de trabajo (metal con posicionador), banco y/o silla para sentarse (de ser necesario, según el espacio), cortinas (con filtro para rayos UV, permite la reducción de	• Herramientas manuales: - Arco de sierra. - Martillo. - Rayador. • Instrumentos: - Escuadra de tope. - Wincha metálica. - Regla de acero. • Banco de trabajo. • Tornillo de banco. • Yunque. • Comba. • Equipo de limpieza. • Equipos contra incendios. • Depósitos de residuos de acuerdo a estándares. • Amoladora. • Cincel. • Pirómetro.	• Zapatos de seguridad. • Mandil de cuero. • Lentes de seguridad. • Guantes de cuero. • Tapones de oído. • Escarpines. • Mascarillas o filtros. • Casco de protección. • Careta facial.	• Hojas de sierra. • Planchas. • Perfiles. • Platinas de acero. • Discos de corte. • Tiza de calderero. • Trapo industrial o waype. • Disco de desbaste. • Escobilla de metal. • Materiales de aporte de soldadura.	• Listado de los equipos de soldadura. • Formatos estandarizados (con especificaciones). • Guía de procedimientos de soldadura. • Formato 5 puntos de seguridad (opcional). • Formatos IPERC (identificación de peligros, evaluación y control de riesgos). • Orden de producción/Orden de servicio.

la luminosidad del arco eléctrico). • Instalaciones con iluminación y ventilación adecuadas, señalizadas y con salidas de emergencia.	• Hornos de almacenamiento (electrodos). • Termos. • Equipo de arco eléctrico. • Equipo oxiacetilénico de corte y soldadura. • Equipo de corte por plasma. • Cizalla o guillotina.			

Unidad de Competencia 2: Preparar las juntas, teniendo en cuenta los procedimientos de soldadura, las normas de seguridad y salud en el trabajo y cuidado del medio ambiente.	**ELEMENTOS DE COMPETENCIA**	**ELEMENTOS DE COMPETENCIA**
	Establecer requerimientos de equipos, materiales e insumos de acuerdo a la orden de trabajo o las indicaciones del jefe inmediato, teniendo en cuenta los procedimientos de soldadura.	Cortar las piezas de metal para la unión por soldadura, teniendo en cuenta las especificaciones técnicas de la orden de trabajo e indicaciones del jefe inmediato y los procedimientos de soldadura.
	CRITERIOS DE DESEMPEÑO	**CRITERIOS DE DESEMPEÑO**
	1. Viste el uniforme de trabajo y usa el equipo de protección personal necesario, según la normatividad correspondiente. 2. Interpreta la información del documento técnico (símbolos y dimensiones de los planos y lo señalado en la orden de trabajo), teniendo en cuenta lo siguiente: • Identifica los tipos de uniones y cortes, tipos de materiales, espesor y forma. • Identifica y descifra los materiales necesarios para la ejecución de la orden de trabajo, diferenciándolos por su composición y características principales. 3. Realiza el cálculo de los requerimientos de equipos, materiales e insumos necesarios, según la información consignada en la documentación técnica. 4. Elabora el listado de equipos, materiales e insumos detallando las cantidades y las características técnicas de los materiales e insumos requeridos. 5. Entrega al responsable del área de provisión, el listado de requerimiento de materiales, para su aprovisionamiento al taller o área de trabajo, según el caso.	1. Viste el uniforme de trabajo y usa el equipo de protección personal necesario, según la normatividad correspondiente. 2. Verifica que las herramientas y accesorios son las que se necesitan para realizar el acabado superficial del corte, teniendo en cuenta las especificaciones técnicas y las normas técnicas de soldadura. 3. Prepara los equipos de corte térmico y mecánico, según el tipo de material, espesor y las especificaciones técnicas de la orden de trabajo/orden de servicio. 4. Identifica las operaciones necesarias para dar el acabado y la forma superficial, según el tipo de unión especificado en la orden de trabajo/orden de servicio (limado, biselado, preparación de talones, etc.), teniendo en cuenta los procedimientos de soldadura. 5. Traza las piezas utilizando los implementos de acuerdo al tipo de material y características técnicas de la orden de trabajo/orden de servicio (como tizas de calderero, rayadores, etc.), teniendo en cuenta los procedimientos de soldadura. 6. Corta las piezas de acuerdo al material y especificaciones técnicas de la orden de trabajo/orden de servicio, teniendo en cuenta los procedimientos de soldadura, normas de seguridad y salud en el trabajo y del cuidado del medio ambiente. El corte de piezas, puede ser: **Corte manual:** • Utilizando arco de sierra.

		• Utilizando lima manual. **Corte con equipos:** • Con equipo de oxicorte. • Con amoladora. • Con plasma. • Utilizando cizalla. • Con arco eléctrico, carbón y aire. 7. Verifica que las juntas (piezas) estén según lo especificado en el documento técnico, a fin de que sean apuntalados.

Evidencia de desempeño/producto	Evidencia de conocimientos	Evidencia de desempeño/producto	Evidencia de conocimiento
1. Equipos de protección personal para el proceso de soldadura correctamente utilizados. 2. Interpreta los símbolos de los planos u orden de trabajo. 3. Listado de requerimientos con las características técnicas de los materiales e insumos y cantidades requeridas, de acuerdo al plano o a la orden de trabajo.	1. Conocimiento de normas técnicas sobre protección personal en procesos de soldadura. 2. Conocimiento básico de normas técnicas sobre estándares y simbología de soldadura. 3. Conocimiento básico de lectura e interpretación de planos para trabajos de soldadura. 4. Elaboración de croquis y bosquejos de dibujo técnico.	1. Equipos de protección personal para el proceso de soldadura correctamente utilizados. 2. Materiales medidos, trazados y cortados según especificaciones técnicas de la orden de servicio y plano. 3. Superficies (juntas) preparadas y verificadas de acuerdo al documento técnico (plano u orden de trabajo).	1. Conocimiento de normas técnicas sobre protección personal en procesos de soldadura. 2. Conocimiento de normas de materiales para procesos de soldadura. 3. Conocimiento de procesos de corte de materiales metálicos. 4. Conocimiento de control de calidad sobre ajustes y tolerancias.

CONTEXTO DEL DESEMPEÑO LABORAL				
Instalaciones	**Equipamiento/**	**Equipo personal**	**Insumos /materiales**	**Información / Formatos**
• ***Taller de soldadura*** de dimensiones mínimas de 10m. x 10m. x 6 m. de altura (o mínimo de 3 m. con instalación o utilización de extractor de humo). • ***Taller mecánico*** con equipamiento de dimensiones mínimas de 10 m. x 10 m. • ***Cabinas:*** de metal (acero), Altura: 2.20 m, ancho: 1.60 m, fondo: 1.25 m. Mesa de trabajo (metal con posicionador), banco y/o silla para sentarse (de ser	• Herramientas manuales: - Arco de sierra. - Martillo. - Rayador. • Instrumentos: - Escuadra de tope. - Wincha metálica. - Regla de acero. • Banco de trabajo. • Tornillo de banco. • Yunque. • Comba. • Equipo de limpieza. • Equipos contra incendios.	• Zapatos de seguridad. • Mandil de cuero. • Lentes de seguridad. • Guantes de cuero. • Tapones de oído. • Escarpines. • Mascarillas o filtros. • Casco de protección. • Careta facial.	• Hojas de sierra. • Planchas y perfiles de acero. • Discos de corte. • Tiza de calderero. • Trapo industrial o waype. • Disco de desbaste. • Escobilla de metal. • Materiales de aporte de soldadura. • Lijas de fierro. • Gases para corte y soldadura.	• Listado de los equipos de soldadura. • Formatos estandarizados (con especificaciones). • Guía de procedimientos de soldadura. • Formato 5 puntos de seguridad (opcional). • Formatos IPERC (identificación de peligros, evaluación y control de riesgos). • Orden de trabajo/Orden de servicio.

necesario, según el espacio), cortinas (con filtro para rayos UV, permite la reducción de la luminosidad del arco eléctrico). • Instalaciones con iluminación y ventilación adecuadas, señalizadas y con salidas de emergencia.	• Depósitos de residuos de acuerdo a estándares. • Amoladora. • Cincel. • Pirómetro. • Hornos de almacenamiento (electrodos). • Termos. • Equipo de arco eléctrico. • Equipo oxiacetilénico de corte y soldadura. • Equipo de corte por plasma. • Biombo de lona plastificado (1.5 m. ancho x 2 m de alto).			

Unidad de Competencia 3: Apuntalar las juntas a ser soldadas y brindar asistencia al jefe inmediato durante todo el proceso de soldadura, de acuerdo a los procedimientos de soldadura y normas de seguridad y salud en el trabajo y cuidado del medio ambiente.	**ELEMENTOS DE COMPETENCIA**	**ELEMENTOS DE COMPETENCIA**
	Realizar el apuntalado de las juntas, mediante la fijación de las piezas bajo la supervisión del jefe inmediato y considerando los procedimientos de soldadura.	Realizar el pre y post calentamiento de la operación de soldeo y asistir durante el proceso de soldadura al jefe inmediato, considerando los procedimientos de soldadura.
	CRITERIOS DE DESEMPEÑO	**CRITERIOS DE DESEMPEÑO**
	1. Viste el uniforme de trabajo y usa el equipo de protección personal necesario, según la normatividad correspondiente. 2. Verifica que las juntas estén limpias y con lo señalado en el documento técnico, considerando los procedimientos de soldadura, las normas de seguridad y salud en el trabajo. 3. Prepara los elementos de fijación para las uniones soldadas, de acuerdo a las especificaciones técnicas y lo indicado por el jefe inmediato, considerando los procedimientos de soldadura, las normas de seguridad y salud en el trabajo y cuidado del medio ambiente. 4. Verifica que las herramientas y materiales se encuentren disponibles a fin de realizar el apuntalamiento de las juntas, teniendo en cuenta las normas de seguridad y salud en el trabajo y cuidado del medio ambiente. 5. Verifica que el equipo este correctamente conectado y regula los parámetros, según los procedimientos establecidos por el fabricante, considerando las normas de seguridad y salud en trabajo y cuidado del medio ambiente. 6. Coloca, alinea y fija a fin de posicionar las piezas de acuerdo al documento técnico, considerando los procedimientos de soldadura, norma de seguridad y salud en el trabajo y cuidado del medio ambiente.	1. Viste el uniforme de trabajo y usa el equipo de protección personal necesario, según la normatividad correspondiente. 2. Proporciona al soldador, los materiales e insumos requeridos por éste, de acuerdo al trabajo de soldeo en ejecución, teniendo en cuenta las normas técnicas de soldadura. 3. Verifica que los equipos, herramientas e instrumentos necesarios para las operaciones de soldadura se encuentren operativos a fin de proveer al soldador, de acuerdo a las normas técnicas de soldadura y teniendo en cuenta las normas de seguridad y salud en el trabajo y cuidado del medio ambiente. 4. Regula el funcionamiento de los equipos e instrumentos utilizados en los procesos de soldadura, de acuerdo a las indicaciones del soldador y los requerimientos del soldeo en proceso de acuerdo a los procedimientos de soldadura, norma de seguridad y salud en el trabajo y cuidado del medio ambiente. 5. Realiza la limpieza de la escoria (material sólido, no metálico, atrapado en el metal de soldadura o entre el metal de soldadura y el metal base) según los procedimientos de soldadura, de acuerdo a las normas técnicas de soldadura, norma de seguridad y salud en el trabajo y cuidado del medio ambiente.

7. Realiza el apuntalado, según lo establecido en el documento técnico, indicaciones del jefe inmediato, norma de seguridad y salud en trabajo y cuidado del medio ambiente. 8. Verifica el alineamiento de las juntas a soldar y realiza las rectificaciones, según sea el caso, considerando los procedimientos de soldadura, las normas de seguridad y salud en el trabajo y cuidado del medio ambiente.		6. De ser caso, realiza el precalentamiento (aplicación de calor al metal base inmediatamente antes de la operación de soldeo, proyección térmica o corte, para conseguir la temperatura óptima de trabajo) de acuerdo a las indicaciones del soldador, procedimientos de soldadura, norma de seguridad y salud en el trabajo y cuidado del medio ambiente. 7. De ser caso, realiza el post calentamiento (aplicación de calor después de la operación de soldeo, proyección térmica o corte, con finalidad de eliminar tensiones o variar las estructuras metalográficas) de las piezas a soldar, siguiendo las indicaciones de acuerdo a los procedimientos de soldadura y teniendo en cuenta la norma de seguridad y salud en el trabajo y cuidado del medio ambiente.	
Evidencia de desempeño/producto	**Evidencia de conocimientos**	**Evidencia de desempeño/producto**	**Evidencia de conocimientos**
1. Equipos de protección personal para el proceso de soldadura correctamente utilizados. 2. Elementos de fijación preparados para las uniones (piezas) a soldar de acuerdo a la orden de trabajo. 3. Piezas apuntaladas de acuerdo a las especificaciones técnicas de la orden de trabajo. 4. Piezas a soldar, de acuerdo a las especificaciones técnicas de la orden de trabajo.	1. Normas técnicas sobre protección personal para trabajos de soldadura. 2. Conocimiento de elementos de fijación. 3. Técnicas de preparación y fijación en planchas, perfiles de acero, etc. 4. Conocimiento de materiales de soldadura 5. Conocimientos básicos de electricidad. 6. Conocimientos básicos de soldadura.	1. Viste correctamente los equipos de protección personal para el proceso de soldadura. 2. Instrumentos entregados al soldador oportunamente durante el proceso de soldadura. 3. Equipos regulados y operativos durante el proceso, que facilitan la labor del soldador. 4. Material en el proceso de soldadura limpio, libre de escoria y de elementos extraños. 5. Temperatura adecuada en las etapas de pre y post calentamiento para los procesos de soldadura.	1. Normas técnicas sobre protección personal para trabajos de soldadura. 2. Conocimientos de normas técnicas de soldadura. 3. Conocimientos básicos de electricidad. 4. Tipos de fuentes de energía. 5. Conocimientos de materiales (base y de aporte) y procesos de soldadura. 6. Conocimientos de conservación y secado de los materiales de aporte. 7. Conocimientos de elementos de fijación. 8. Conocimientos de procesos de pre y post calentamiento.

CONTEXTO DEL DESEMPEÑO LABORAL

Instalaciones	Equipamiento/	Equipo personal	Insumos /materiales	Información / Formatos
• ***Taller de soldadura*** de dimensiones mínimas de 10m. x 10m. x 6 m. de altura (o mínimo de 3 m. con instalación o utilización de extractor de humo). • ***Taller mecánico*** con equipamiento de dimensiones mínimas de 10 m. x 10 m. • ***Cabinas:*** de metal (acero), Altura: 2.20 m,	• Herramientas manuales: - Arco de sierra. - Martillo. - Rayador. • Instrumentos: - Escuadra de tope. - Wincha metálica. - Regla de acero. • Banco de trabajo. • Tornillo de banco. • Yunque. • Comba. • Equipo de limpieza.	• Zapatos de seguridad. • Mandil de cuero. • Lentes de seguridad. • Lentes de corte. • Guantes de cuero. • Tapones de oído. • Escarpines. • Mascarillas o filtros. • Casco de protección. • Careta facial. • Careta de soldador. • Capota.	• Hojas de sierra. • Planchas y perfiles de acero. • Discos de corte. • Tiza de calderero. • Trapo industrial o waype. • Disco de desbaste. • Escobilla de metal. • Materiales de aporte de soldadura. • Lijas de fierro. • Gases para corte y soldadura.	• Listado de los equipos de soldadura. • Formatos estandarizados (con especificaciones). • Guía de procedimientos de soldadura. • Formato 5 puntos de seguridad (opcional). • Formatos IPERC (identificación de peligros, evaluación y control de riesgos). • Orden de producción / Orden de servicio.

ancho: 1.60 m, fondo: 1.25 m. Mesa de trabajo (metal con posicionador), banco y/o silla para sentarse (de ser necesario, según el espacio), cortinas (con filtro para rayos UV, permite la reducción de la luminosidad del arco eléctrico). • Instalaciones con iluminación y ventilación adecuadas, señalizadas y con salidas de emergencia.	• Equipos contra incendios. • Depósitos de residuos de acuerdo a estándares. • Amoladora. • Cincel. • Pirómetro. • Hornos de almacenamiento (electrodos). • Termos. • Equipo de arco eléctrico. • Equipo oxiacetilénico de corte y soldadura. • Equipo de corte por plasma. • Biombo de lona plastificado (1.5 m. ancho x 2 m de alto).			

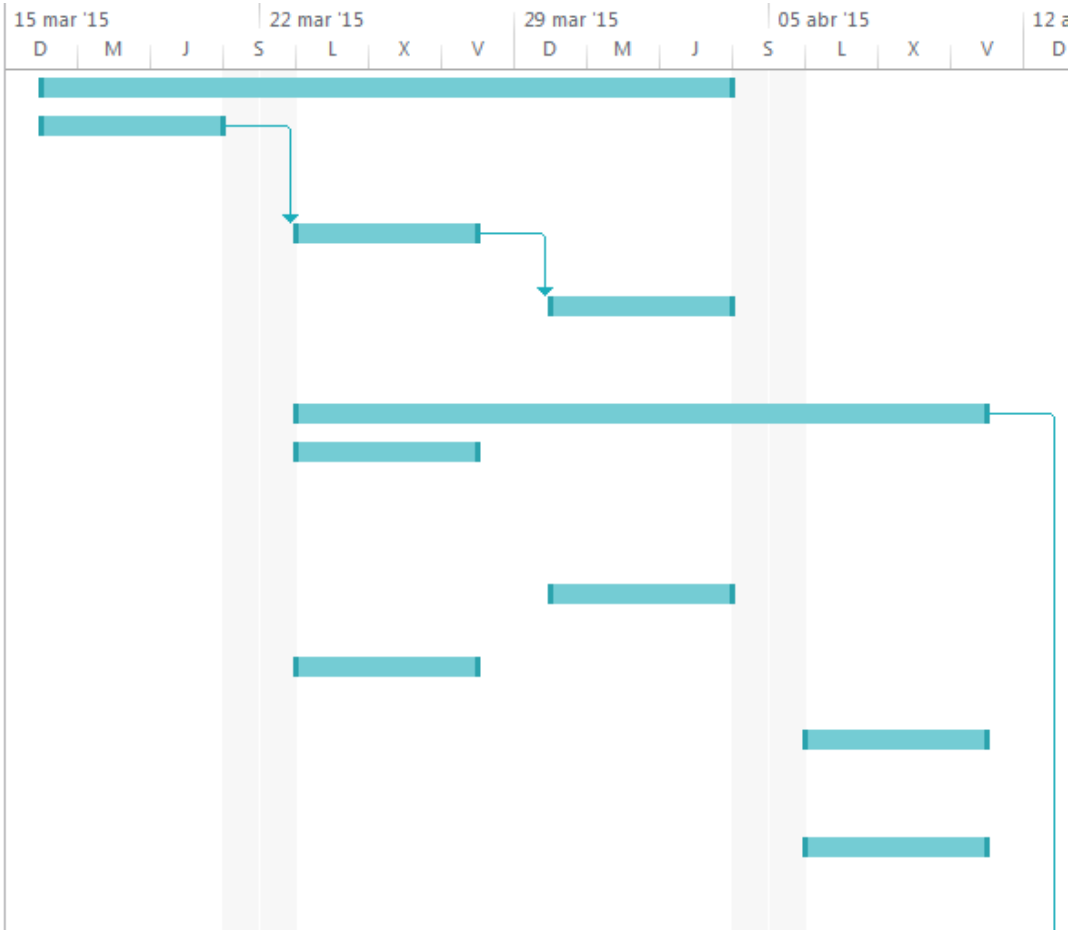
Competencias Básicas
Habilidades Básicas: Lecto escritura. Facilidad numérica para realizar cálculos menores. **Aptitudes analíticas:** Solucionar problemas cotidianos. Atención – concentración. Coordinación visomotora. Organización.

Competencias Genéricas
Relaciones Interpersonales: Capacidad para interrelacionarse. Trabajo en equipo. Adaptación al cambio. Puntualidad. Responsabilidad. Trabajo bajo presión. Tolerancia. **Gestión de Recursos:** Organización del tiempo. Organización de los materiales. **Gestión de la Información** Comprender órdenes e instrucciones. Organizar la información. Manejar la información de seguridad y salud en el trabajo y del cuidado del medio ambiente. Procedimientos de soldadura.

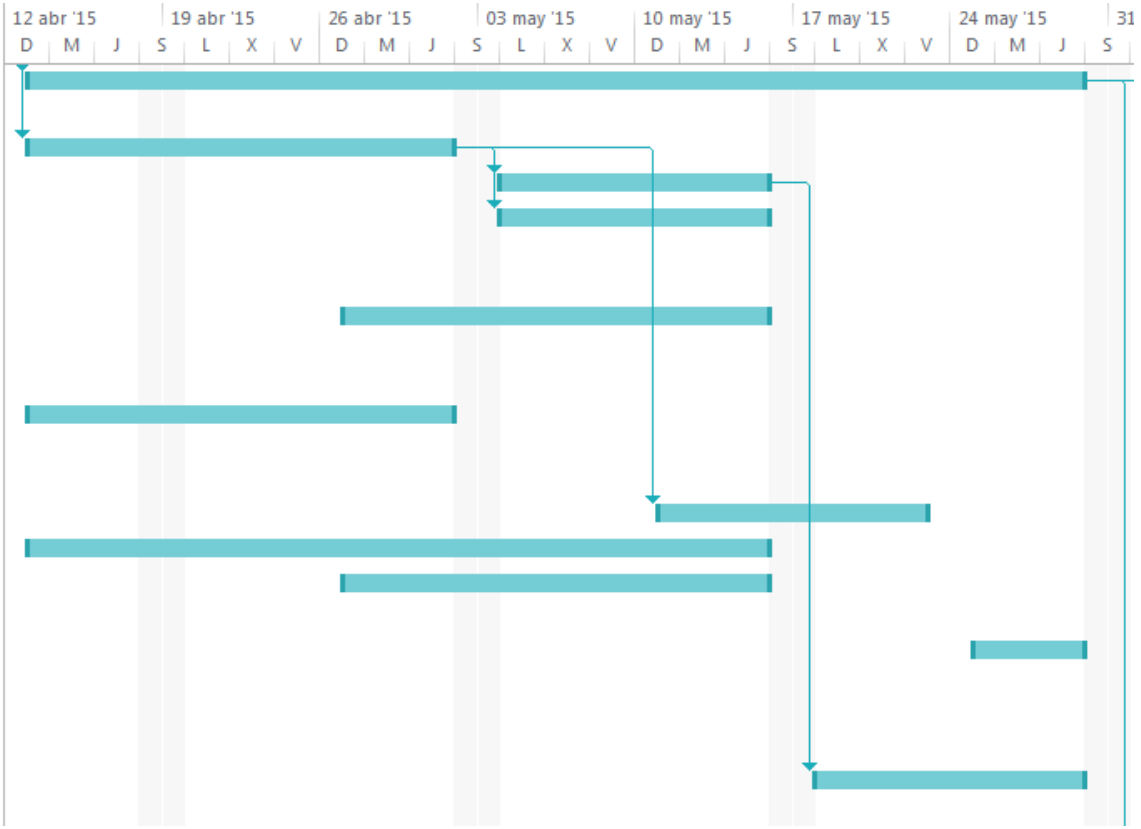
Fecha de refrendo:

6.8 ANEXO H - FLUJOGRAMA DE ACTIVIDADES

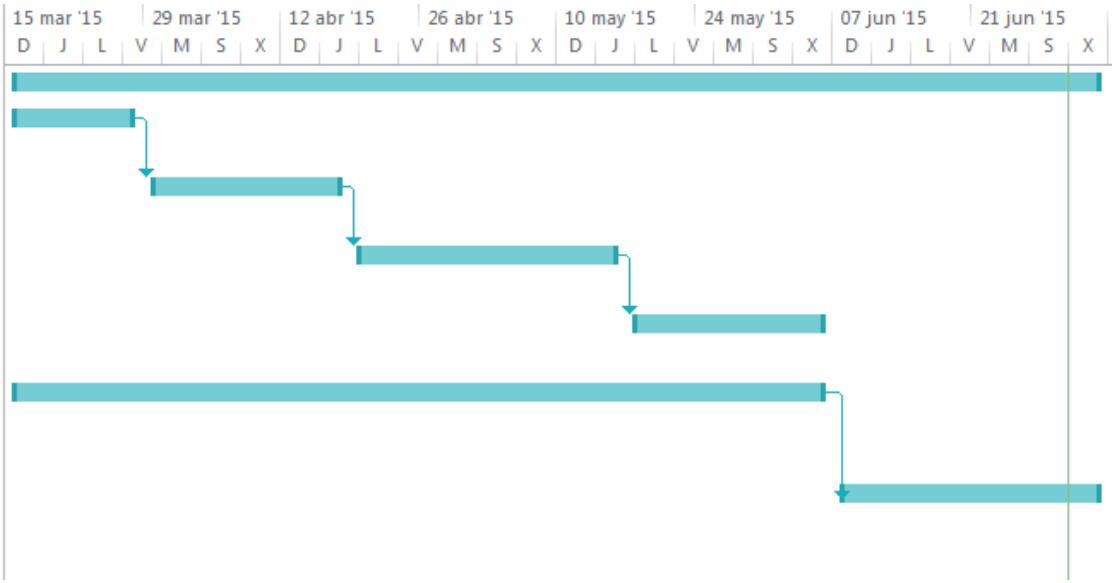
Nombre de tarea	Duración	Comienzo	Fin	Prede
Estado del arte	15 días	lun 16/03/15	vie 03/04/15	
Definición de objetivos y alcances del tema de tesis	5 días	lun 16/03/15	vie 20/03/15	
Revisión de literatura científica y tecnológica	5 días	lun 23/03/15	vie 27/03/15	2
Recopilación de información del uso de la tecnología	5 días	lun 30/03/15	vie 03/04/15	3
Selección de tecnología	15 días	lun 23/03/15	vie 10/04/15	
Selección del brazo robot y controlador de soldadura con los que se trabajará	5 días	lun 23/03/15	vie 27/03/15	
Se define distribución en la celda de trabajo.	5 días	lun 30/03/15	vie 03/04/15	
Metodología de Soldadura	5 días	lun 23/03/15	vie 27/03/15	
Averiguar del entorno de programación del brazo robot	5 días	lun 06/04/15	vie 10/04/15	
Averiguar del software para simulación KUKA SIM Pro	5 días	lun 06/04/15	vie 10/04/15	



Nombre de tarea	Duración	Comienzo	Fin	Prede
Diseño Mecánico/Electrónico	35 días	lun 13/04/15	vie 29/05/15	5
Diseño de tornamesa	15 días	lun 13/04/15	vie 01/05/15	5
Diseño de Celda	10 días	lun 04/05/15	vie 15/05/15	12
Selección de mecanismos de locomoción	10 días	lun 04/05/15	vie 15/05/15	12
Selección de componentes electrónicos	15 días	lun 27/04/15	vie 15/05/15	
Selección de materiales para fabricación de componentes	15 días	lun 13/04/15	vie 01/05/15	
Selección de Control	10 días	lun 11/05/15	vie 22/05/15	12
Selección de Sensores	25 días	lun 13/04/15	vie 15/05/15	
Selección de Sistemas de Comunicación	15 días	lun 27/04/15	vie 15/05/15	
Informe sobre lista de materiales para el sistema mecatrónico (cantidad/costos)	5 días	lun 25/05/15	vie 29/05/15	
Planos Mecánicos/Electrónicos	10 días	lun 18/05/15	vie 29/05/15	13



Nombre de tarea	Duración	Comienzo	Fin	Predec
Documentación	80 días	lun 16/03/15	vie 03/07/15	
Desarrollo de entregables parciales 1	10 días	lun 16/03/15	vie 27/03/15	
Desarrollo de entregables parciales 2	15 días	lun 30/03/15	vie 17/04/15	28
Desarrollo de entregables parciales 3	20 días	lun 20/04/15	vie 15/05/15	29
Desarrollo de entregables parciales 4	15 días	lun 18/05/15	vie 05/06/15	30
Recopilación y documentación del desarrollo	60 días	lun 16/03/15	vie 05/06/15	
Preparación del documento final de Tesis	20 días	lun 08/06/15	vie 03/07/15	32

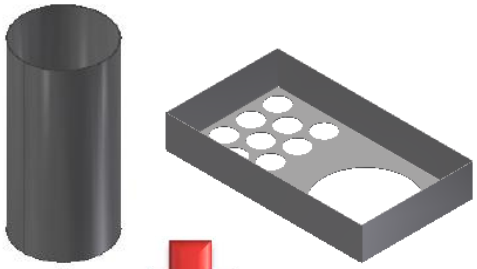


6.9 ANEXO I – DIAGRAMA DE FUNCIONAMIENTO

1) Área de Ingeniería:
Programación, simulación y prueba de funcionamiento del tornamesa y brazo robot en base a las etapas de fabricación.

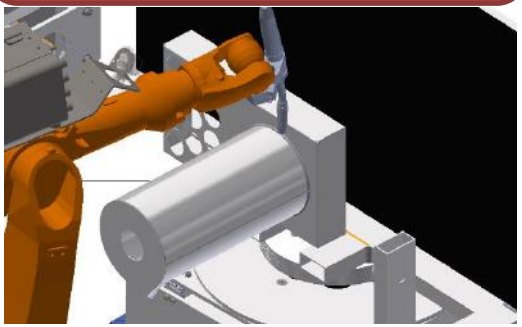
2) Área de corte y chapa:
Preparación y habilitación de materiales para la fabricación del Intercambiador del Horno Max 1000. En este proceso se garantiza la calidad en las tolerancias longitudinales.

3) Área de Soldadura: Estación 1
Operario realiza armado de las piezas de la Fase 01, mediante el uso de utillaje que fija las piezas en el tornamesa.

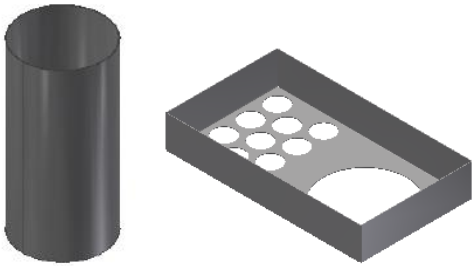


4) Área de Soldadura: Eje Vertical
Gira el tornamesa para llevar las piezas armadas de la Fase 01 al área de trabajo del brazo robot.

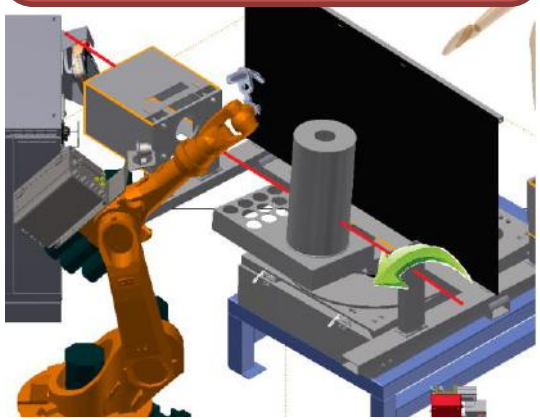
5a) Área de Soldadura: Estación 2
El Brazo robot inicia el proceso de soldadura según programación pre-ingresada para unir las piezas de la Fase 01.



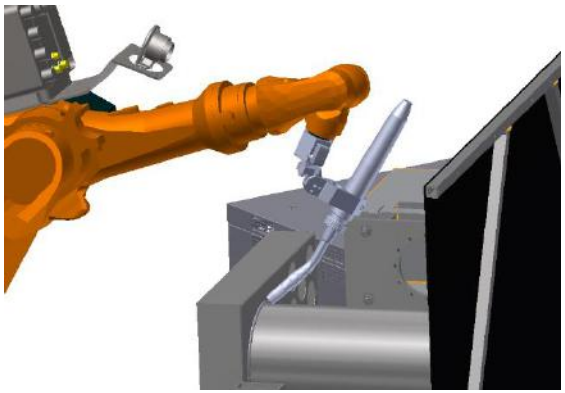
5b) Área de Soldadura: Estación 1
Operario realiza armado de las piezas de la Fase 01, mediante el uso de utillaje que fija las piezas en el tornamesa.



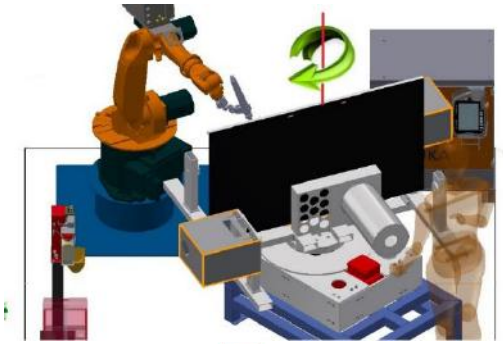
6) Área de Soldadura: Eje Horizontal
El eje tipo torno gira las piezas unidas 180º, para que el brazo robot termine el proceso de soldadura.



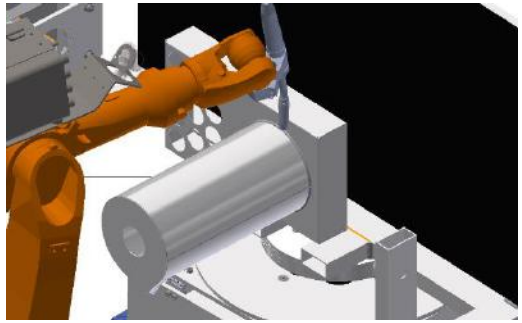
7) Área de Soldadura: Estación 2
El Brazo robot continúa el proceso de soldadura según programación pre-ingresada.



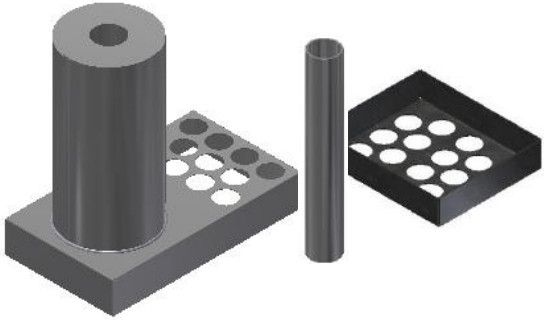
8) Área de Soldadura: Eje Vertical
Gira el tornamesa para llevar las piezas armadas de la Fase 01 al área de trabajo del brazo robot (Igual a 4).



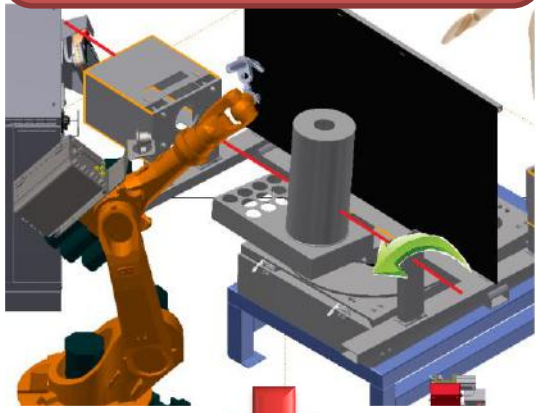
9a) Área de Soldadura: Estación 2
El Brazo robot inicia el proceso de soldadura según programación pre-ingresada para unir las piezas de la Fase 01.



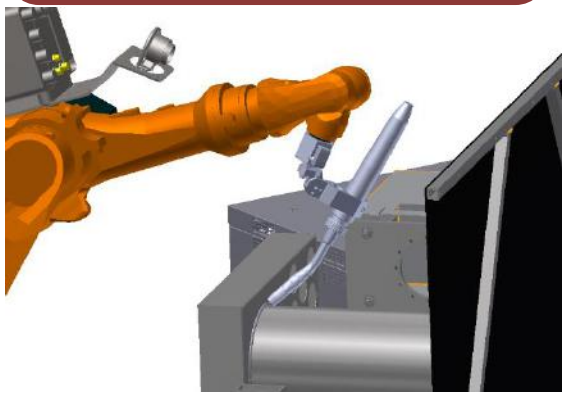
9b) Área de Soldadura: Estación 1
Operario realiza armado de las piezas de la Fase 02, mediante el uso de utillaje que fija las piezas en el tornamesa.



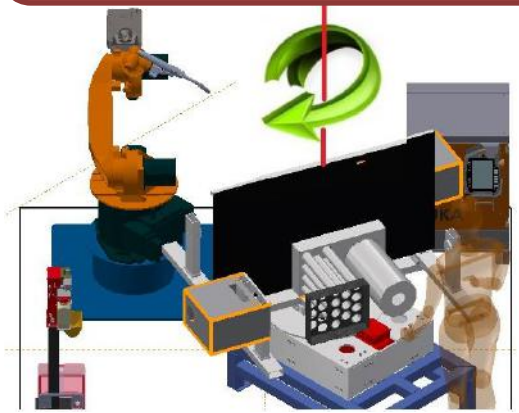
10) Área de Soldadura: Eje Horizontal
El eje tipo torno gira las piezas unidas 180º, para que el brazo robot termine el proceso de soldadura (igual a 6).



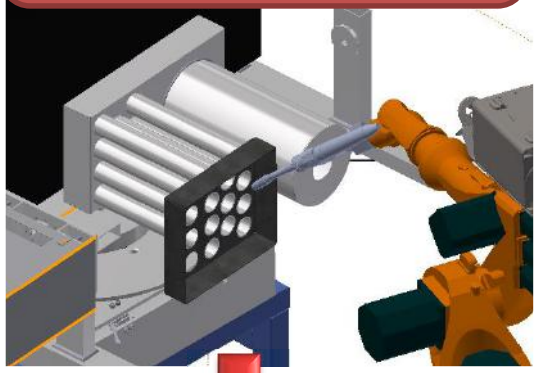
11) Área de Soldadura: Estación 2
El Brazo robot continúa el proceso de soldadura según programación pre-ingresada, culminando la Fase 01.



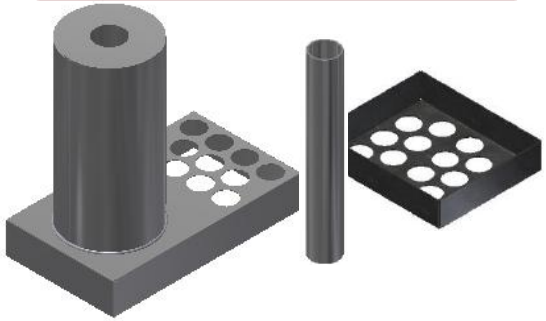
12) Área de Soldadura: Eje Vertical
Gira el tornamesa para llevar las piezas armadas de la Fase 02 al área de trabajo del brazo robot.



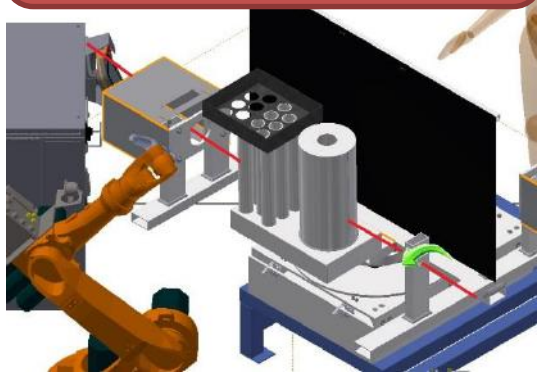
13a) Área de Soldadura: Estación 2
El Brazo robot inicia el proceso de soldadura según programación pre-ingresada para unir las piezas de la Fase 02



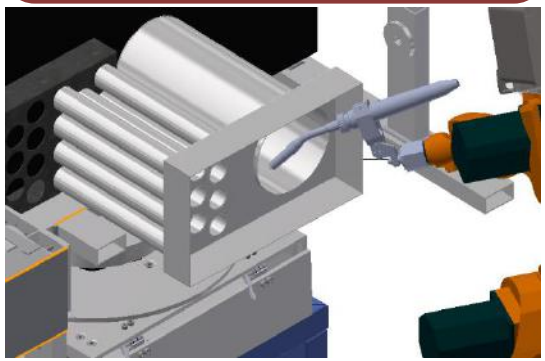
13b) Área de Soldadura: Estación 1
Operario realiza armado de las piezas de la Fase 02, mediante el uso de utillaje que fija las piezas en el tornamesa.



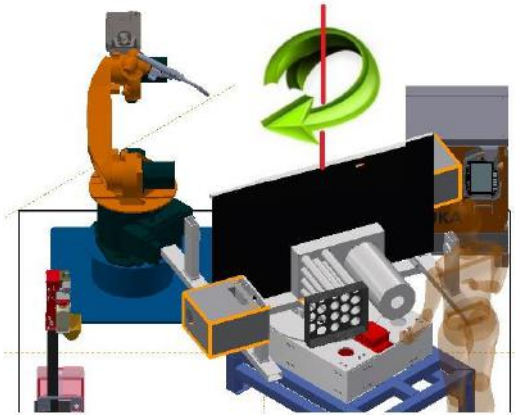
14) Área de Soldadura: Eje Horizontal
El eje tipo torno gira las piezas unidas 180º, para que el brazo robot termine el proceso de soldadura.



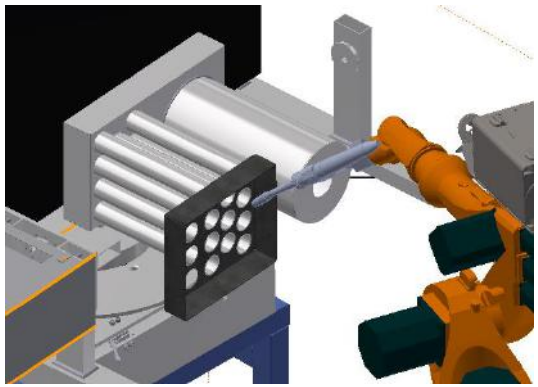
15) Área de Soldadura: Estación 2
El Brazo robot continúa el proceso de soldadura según programación pre-ingresada.



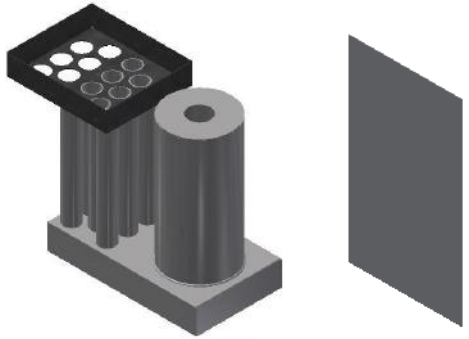
16) Área de Soldadura: Eje Vertical
Gira el tornamesa para llevar las piezas armadas de la Fase 02 al área de trabajo del brazo robot (igual a 12).



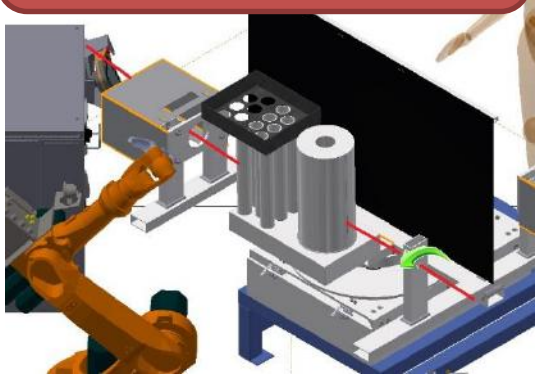
17a) Área de Soldadura: Estación 2
El Brazo robot inicia el proceso de soldadura según programación pre-ingresada para unir las piezas de la Fase 02



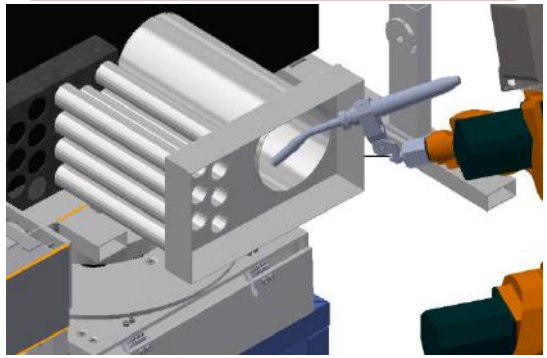
17b) Área de Soldadura: Estación 1
Operario realiza armado de las piezas de la Fase 03, mediante el uso de utillaje que fija las piezas en el tornamesa.



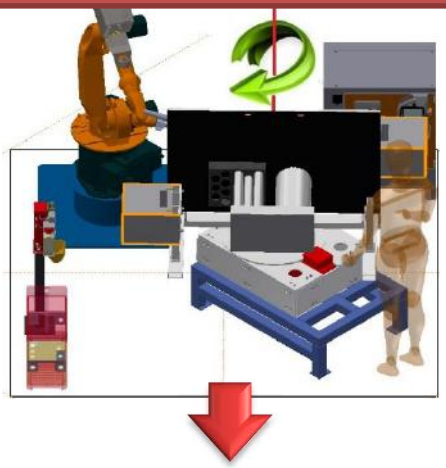
18) Área de Soldadura: Eje Horizontal
El eje tipo torno gira las piezas unidas 180º, para que el brazo robot termine el proceso de soldadura.



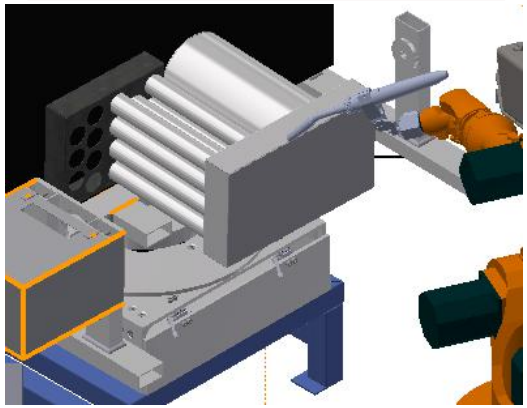
19) Área de Soldadura: Estación 2
El Brazo robot continúa el proceso de soldadura según programación pre-ingresada, culminando la Fase 02.



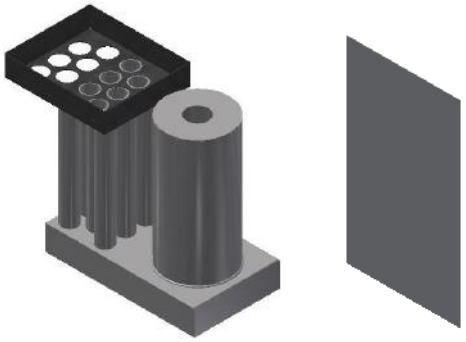
20) Área de Soldadura: Eje Vertical
Gira el tornamesa para llevar las piezas armadas de la Fase 03 al área de trabajo del brazo robot.



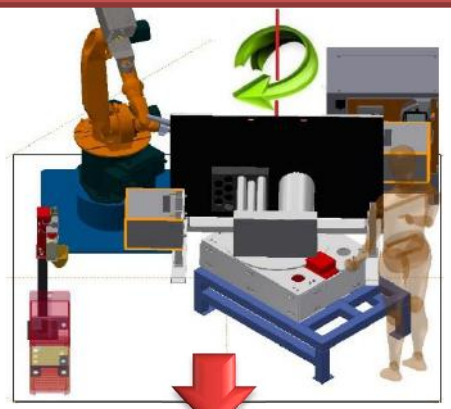
21a) Área de Soldadura: Estación 2
El Brazo robot inicia el proceso de soldadura según programación pre-ingresada para unir las piezas de la Fase 03.



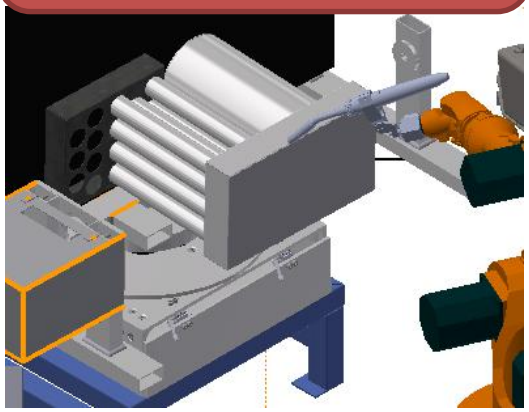
21b) Área de Soldadura: Estación 1
Operario realiza armado de las piezas de la Fase 03, mediante el uso de utillaje que fija las piezas en el tornamesa.



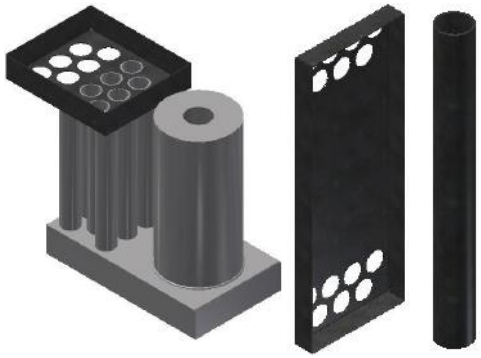
22) Área de Soldadura: Eje Vertical
Gira el tornamesa para llevar las piezas armadas de la Fase 03 al área de trabajo del brazo robot.



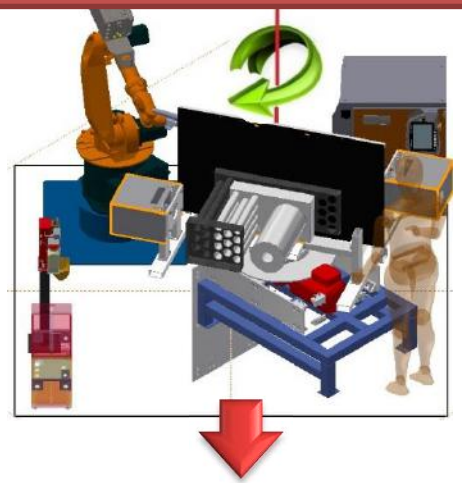
23a) Área de Soldadura: Estación 2
El Brazo robot inicia el proceso de soldadura según programación pre-ingresada para unir las piezas y culminando la Fase 03.



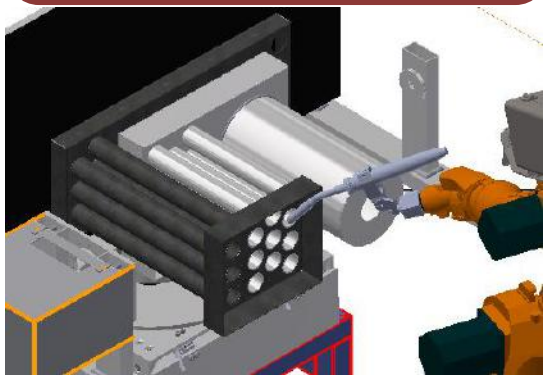
23b) Área de Soldadura: Estación 1
Operario realiza armado de las piezas de la Fase 04, mediante el uso de utillaje que fija las piezas en el tornamesa.



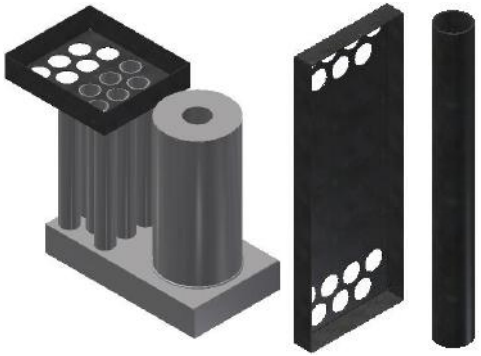
24) Área de Soldadura: Eje Vertical
Gira el tornamesa para llevar las piezas armadas de la Fase 04 al área de trabajo del brazo robot.



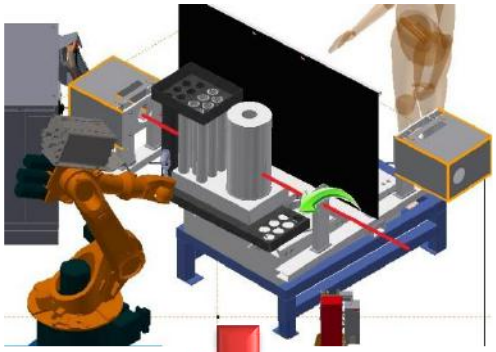
25a) Área de Soldadura: Estación 2
El Brazo robot inicia el proceso de soldadura según programación pre-ingresada para unir las piezas de la Fase 04.



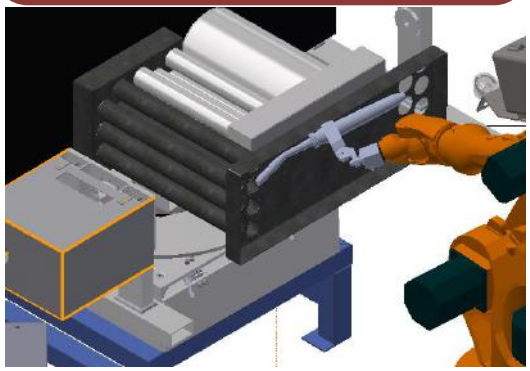
25b) Área de Soldadura: Estación 1
Operario realiza armado de las piezas de la Fase 04, mediante el uso de utillaje que fija las piezas en el tornamesa.



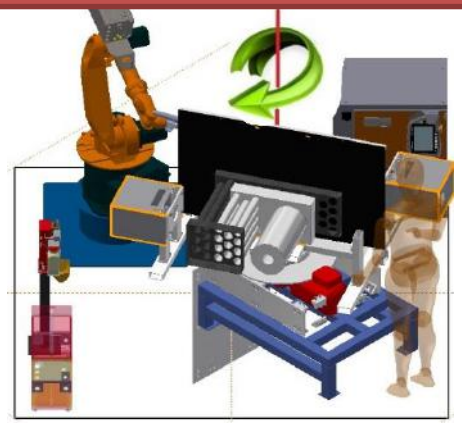
26) Área de Soldadura: Eje Horizontal
El eje tipo torno gira las piezas unidas 180º, para que el brazo robot termine el proceso de soldadura.



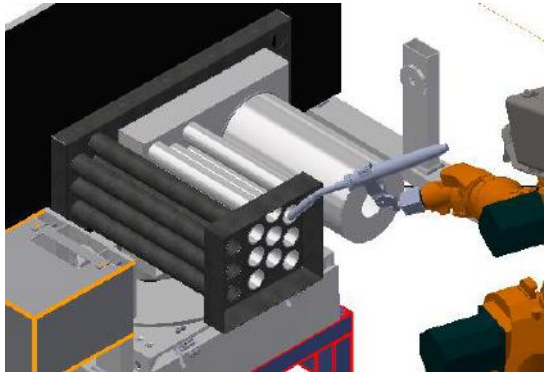
27) Área de Soldadura: Estación 2
El Brazo robot continúa el proceso de soldadura según programación pre-ingresada.



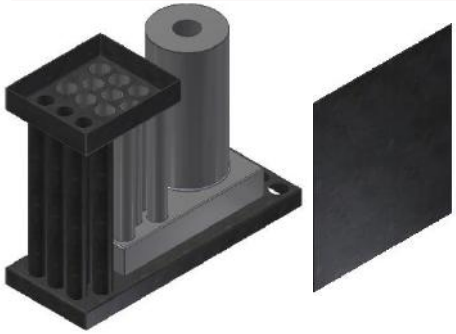
28) Área de Soldadura: Eje Vertical
Gira el tornamesa para llevar las piezas armadas de la Fase 04 al área de trabajo del brazo robot.



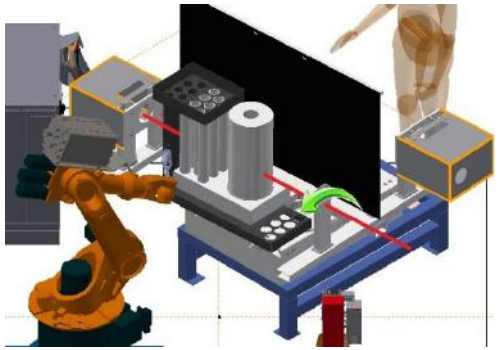
29a) Área de Soldadura: Estación 2
El Brazo robot inicia el proceso de soldadura según programación pre-ingresada para unir las piezas de la Fase 04.



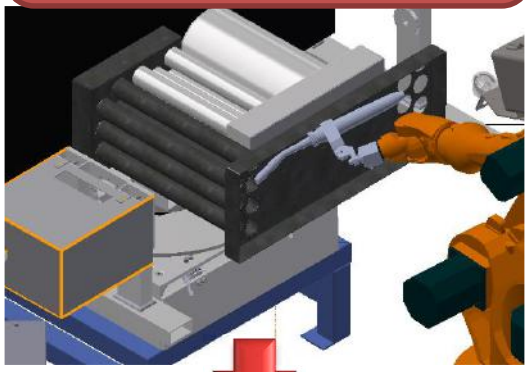
29b) Área de Soldadura: Estación 1
Operario realiza armado de las piezas de la Fase 05, mediante el uso de utillaje que fija las piezas en el tornamesa.



30) Área de Soldadura: Eje Horizontal
El eje tipo torno gira las piezas unidas 180º, para que el brazo robot termine el proceso de soldadura.

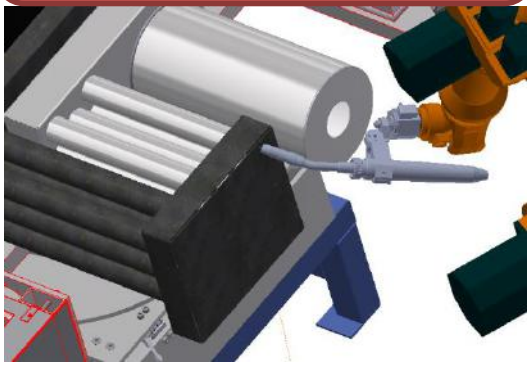


31) Área de Soldadura: Estación 2
El Brazo robot continúa el proceso de soldadura según programación pre-ingresada y culminando la Fase 04.

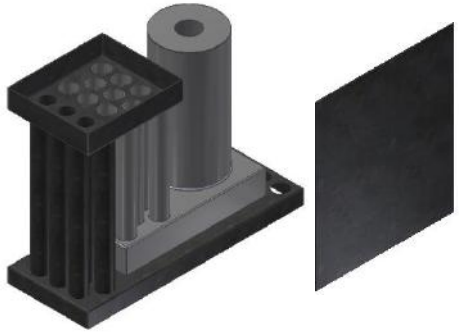


32) Área de Soldadura: Eje Vertical
Gira el tornamesa para llevar las piezas armadas de la Fase 05 al área de trabajo del brazo robot.

33a) Área de Soldadura: Estación 2
El Brazo robot inicia el proceso de soldadura según programación pre-ingresada para unir las piezas de la Fase 05.

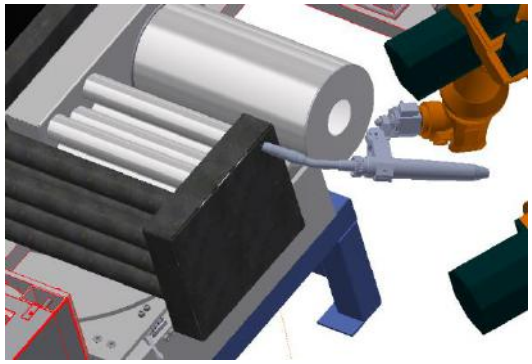


33b) Área de Soldadura: Estación 1
Operario realiza armado de las piezas de la Fase 05, mediante el uso de utillaje que fija las piezas en el tornamesa.

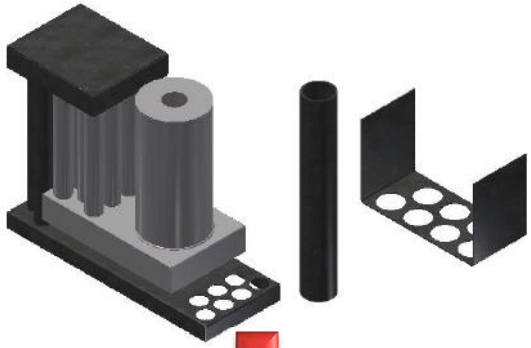


34) Área de Soldadura: Eje Vertical
Gira el tornamesa para llevar las piezas armadas de la Fase 05 al área de trabajo del brazo robot.

35a) Área de Soldadura: Estación 2
El Brazo robot inicia el proceso de soldadura según programación pre-ingresada para unir las piezas y culminar la Fase 05.

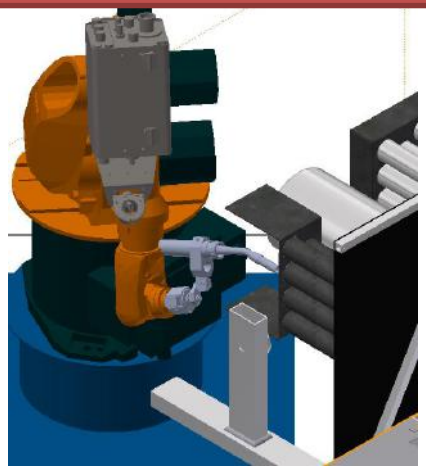


35b) Área de Soldadura: Estación 1
Operario realiza armado de las piezas de la Fase 06, mediante el uso de utillaje que fija las piezas en el tornamesa.

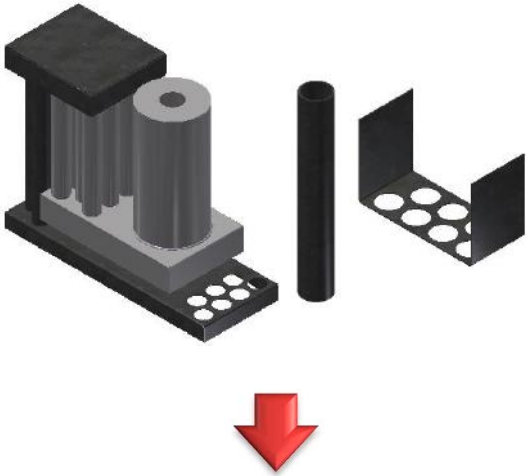


36) Área de Soldadura: Eje Vertical
Gira el tornamesa para llevar las piezas armadas de la Fase 06 al área de trabajo del brazo robot.

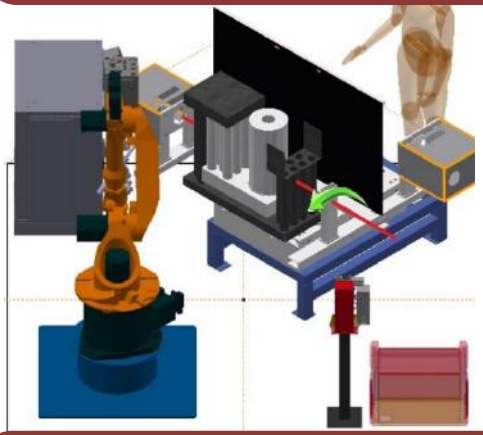
37a) Área de Soldadura: Estación 2
El Brazo robot inicia el proceso de soldadura según programación pre-ingresada para unir las piezas de la Fase 06.



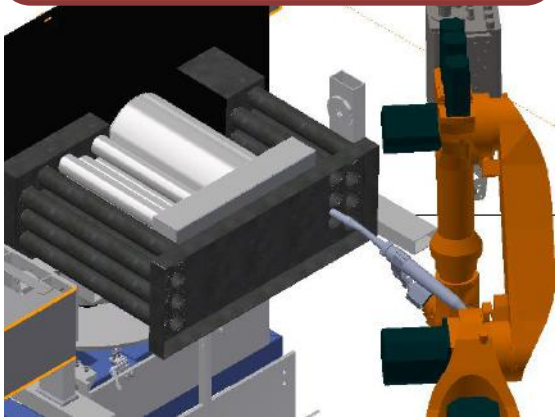
37b) Área de Soldadura: Estación 1
Operario realiza armado de las piezas de la Fase 06, mediante el uso de utillaje que fija las piezas en el tornamesa.



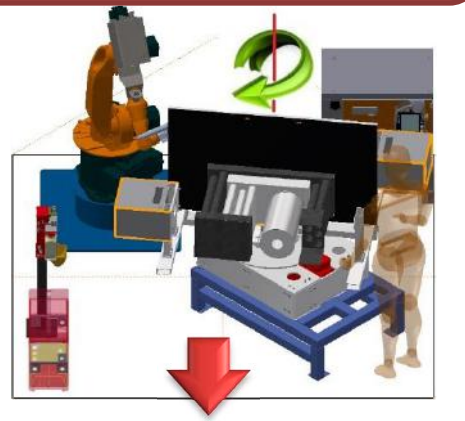
38) Área de Soldadura: Eje Horizontal
El eje tipo torno gira las piezas unidas 180º, para que el brazo robot termine el proceso de soldadura.



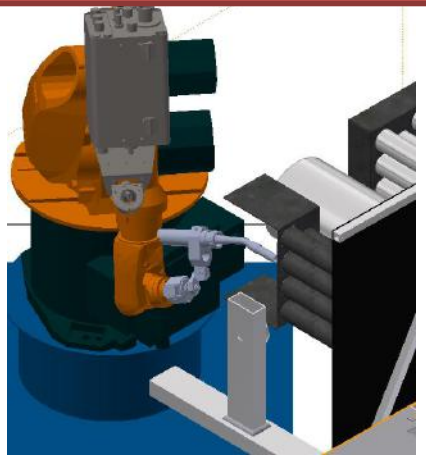
39) Área de Soldadura: Estación 2
El Brazo robot continúa el proceso de soldadura según programación pre-ingresada para la Fase 06.



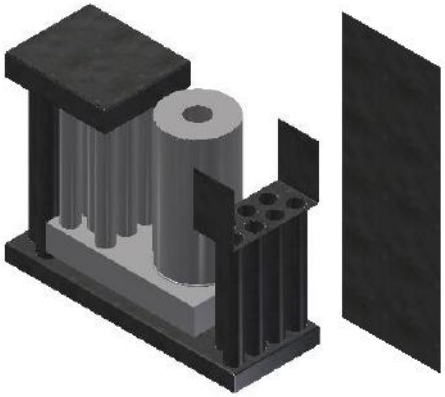
40) Área de Soldadura: Eje Vertical
Gira el tornamesa para llevar las piezas armadas de la Fase 06 al área de trabajo del brazo robot.



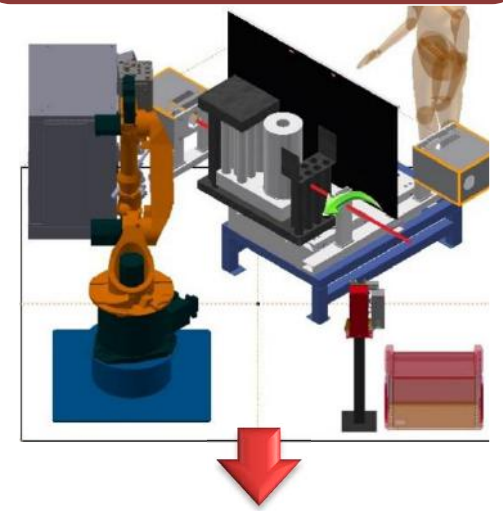
41a) Área de Soldadura: Estación 2
El Brazo robot inicia el proceso de soldadura según programación pre-ingresada para unir las piezas de la Fase 06.



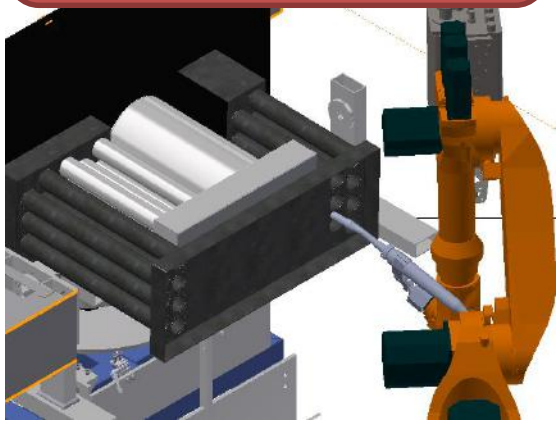
41b) Área de Soldadura: Estación 1
Operario realiza armado de las piezas de la Fase 07, mediante el uso de utillaje que fija las piezas en el tornamesa.



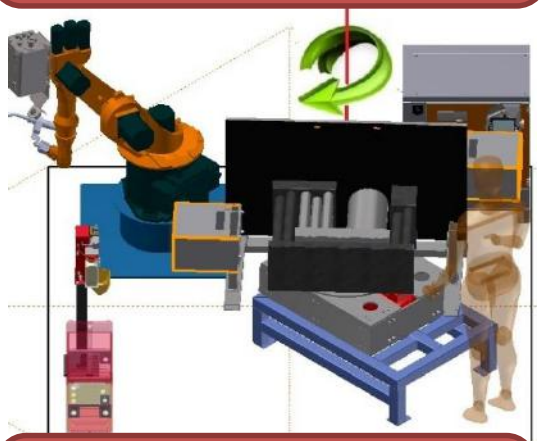
42) Área de Soldadura: Eje Horizontal
El eje tipo torno gira las piezas unidas 180º, para que el brazo robot termine el proceso de soldadura.



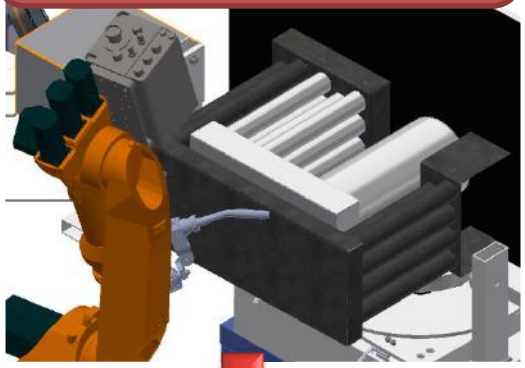
43) Área de Soldadura: Estación 2
El Brazo robot continúa el proceso de soldadura según programación pre-ingresada y culmina la Fase 06.



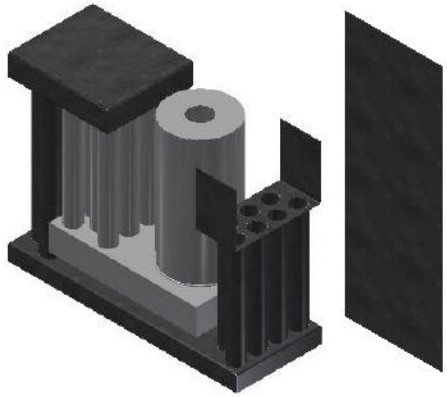
44) Área de Soldadura: Eje Vertical
Gira el tornamesa para llevar las piezas armadas de la Fase 07 al área de trabajo del brazo robot.



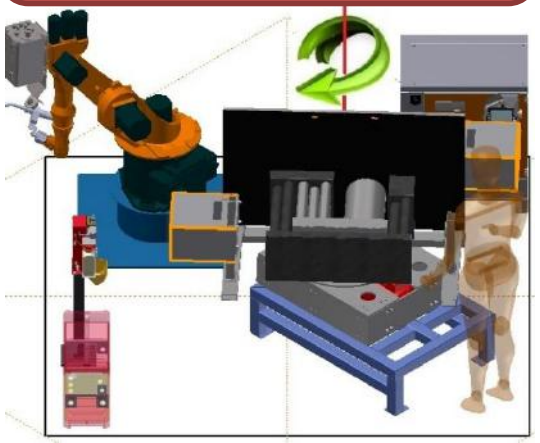
45a) Área de Soldadura: Estación 2
El Brazo robot inicia el proceso de soldadura según programación pre-ingresada para unir las piezas de la Fase 07.



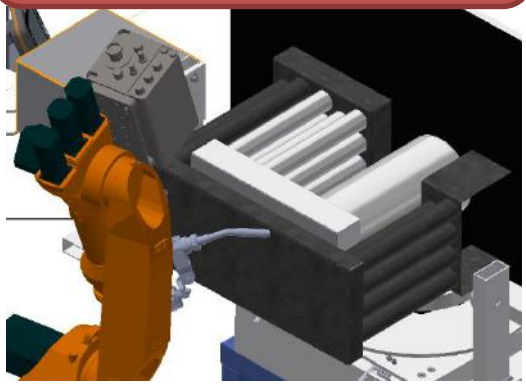
45b) Área de Soldadura: Estación 1
Operario realiza armado de las piezas de la Fase 07, mediante el uso de utillaje que fija las piezas en el tornamesa.



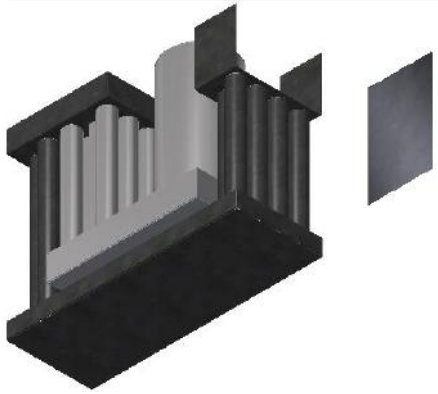
46) Área de Soldadura: Eje Vertical
Gira el tornamesa para llevar las piezas armadas de la Fase 07 al área de trabajo del brazo robot.



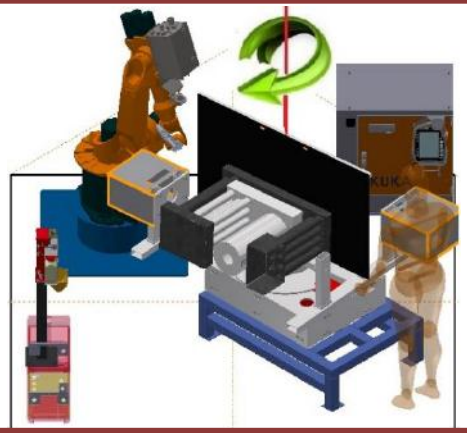
47a) Área de Soldadura: Estación 2
El Brazo robot inicia el proceso de soldadura según programación pre-ingresada para unir las piezas y culminar la Fase 07



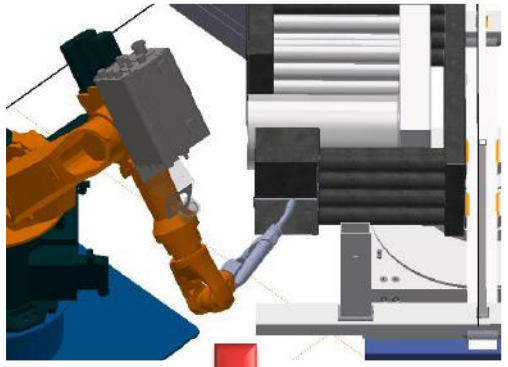
47b) Área de Soldadura: Estación 1
Operario realiza armado de las piezas de la Fase 08, mediante el uso de utillaje que fija las piezas en el tornamesa.



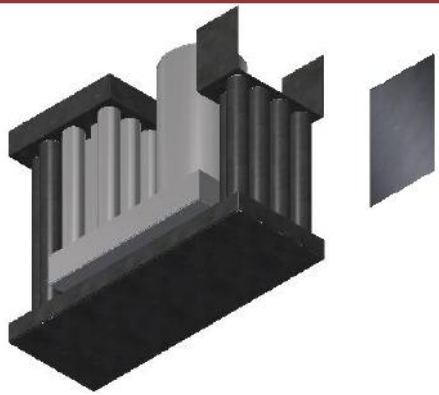
48) Área de Soldadura: Eje Vertical
Gira el tornamesa para llevar las piezas armadas de la Fase 08 al área de trabajo del brazo robot.



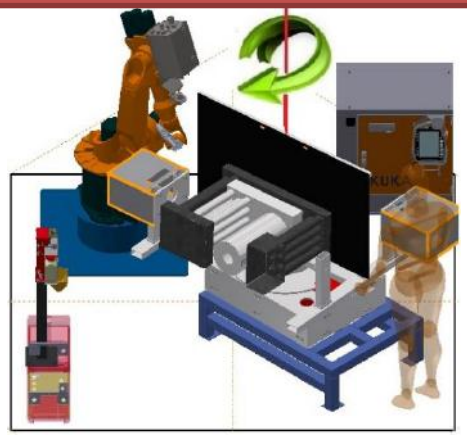
49a) Área de Soldadura: Estación 2
El Brazo robot inicia el proceso de soldadura según programación pre-ingresada para unir las piezas de la Fase 08.



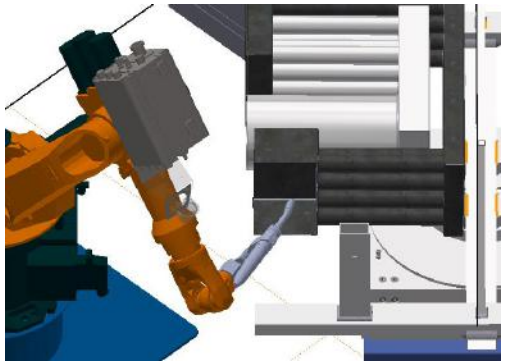
49b) Área de Soldadura: Estación 1
Operario realiza armado de las piezas de la Fase 08, mediante el uso de utillaje que fija las piezas en el tornamesa.



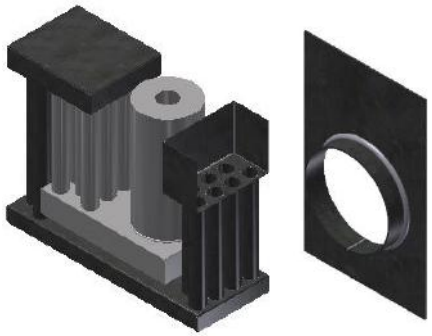
50) Área de Soldadura: Eje Vertical
Gira el tornamesa para llevar las piezas armadas de la Fase 08 al área de trabajo del brazo robot.



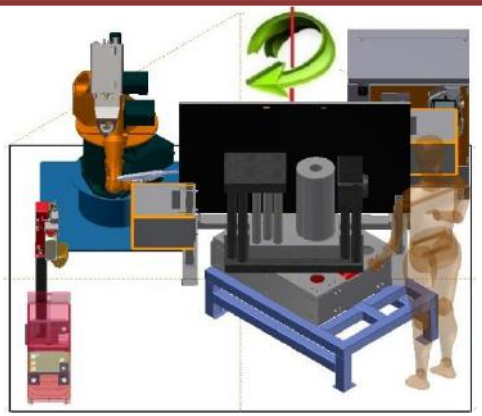
51a) Área de Soldadura: Estación 2
El Brazo robot inicia el proceso de soldadura según programación pre-ingresada para unir las piezas y culminar la Fase 08.



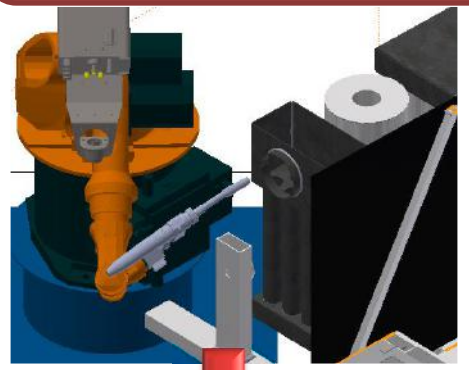
51b) Área de Soldadura: Estación 1
Operario realiza armado de las piezas de la Fase 09, mediante el uso de utillaje que fija las piezas en el tornamesa.



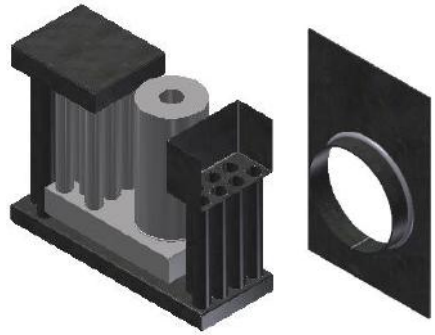
52) Área de Soldadura: Eje Vertical
Gira el tornamesa para llevar las piezas armadas de la Fase 09 al área de trabajo del brazo robot.



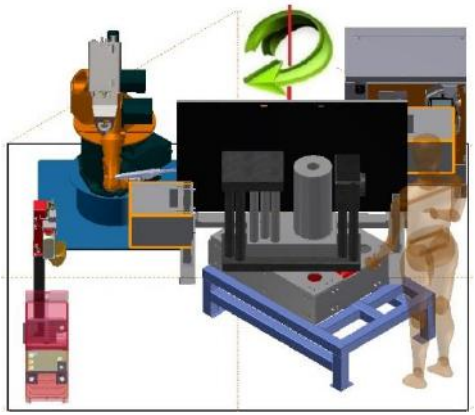
53a) Área de Soldadura: Estación 2
El Brazo robot inicia el proceso de soldadura según programación pre-ingresada para unir las piezas de la Fase 09.



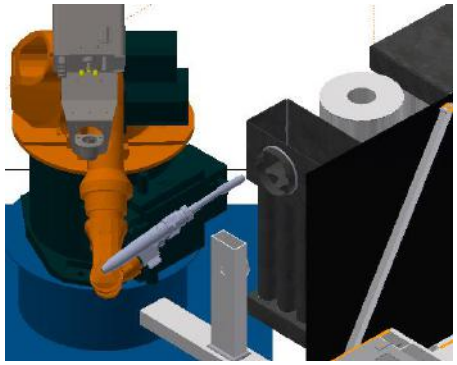
53b) Área de Soldadura: Estación 1
Operario realiza armado de las piezas de la Fase 09, mediante el uso de utillaje que fija las piezas en el tornamesa.



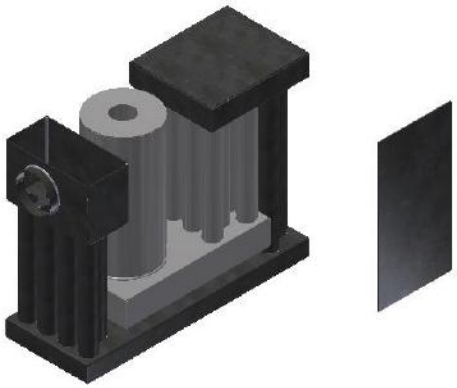
54) Área de Soldadura: Eje Vertical
Gira el tornamesa para llevar las piezas armadas de la Fase 09 al área de trabajo del brazo robot.



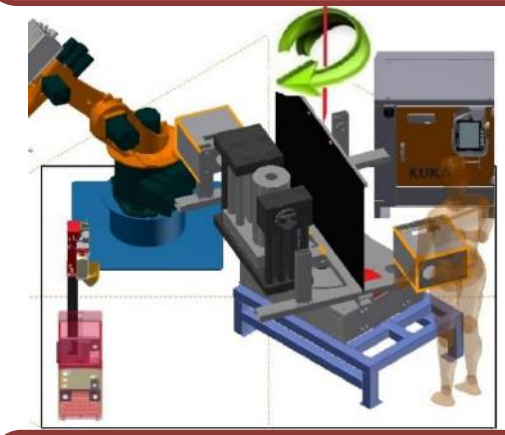
55a) Área de Soldadura: Estación 2
El Brazo robot inicia el proceso de soldadura según programación pre-ingresada para unir las piezas y culminar la Fase 09.



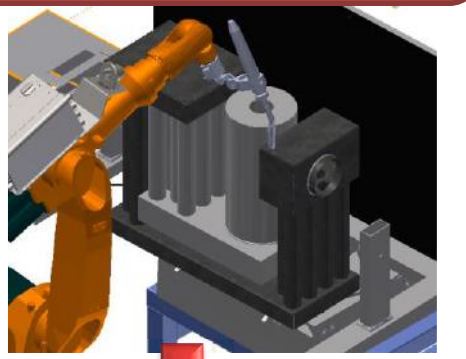
55b) Área de Soldadura: Estación 1
Operario realiza armado de las piezas de la Fase 10, mediante el uso de utillaje que fija las piezas en el tornamesa.



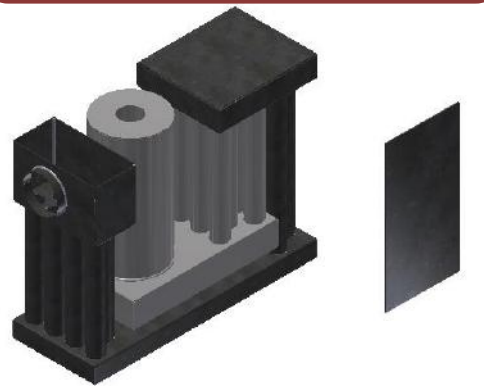
56) Área de Soldadura: Eje Vertical
Gira el tornamesa para llevar las piezas armadas de la Fase 10 al área de trabajo del brazo robot.



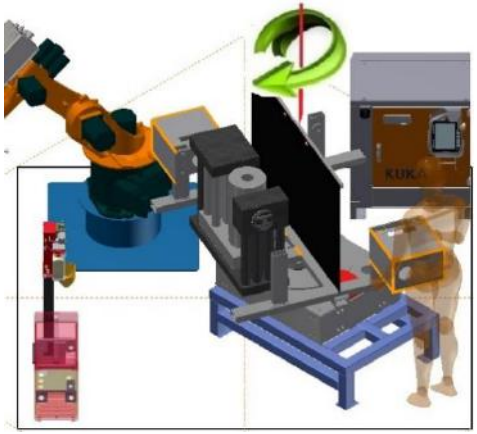
57a) Área de Soldadura: Estación 2
El Brazo robot inicia el proceso de soldadura según programación pre-ingresada para unir las piezas de la Fase 10.



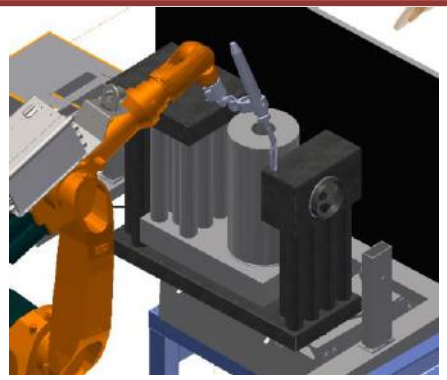
57b) Área de Soldadura: Estación 1
Operario realiza armado de las piezas de la Fase 10, mediante el uso de utillaje que fija las piezas en el tornamesa.



58) Área de Soldadura: Eje Vertical
Gira el tornamesa para llevar las piezas armadas de la Fase 10 al área de trabajo del brazo robot.



59a) Área de Soldadura: Estación 2
El Brazo robot inicia el proceso de soldadura según programación pre-ingresada para unir las piezas y culminar la Fase 10.



59b) Área de Soldadura: Estación 1
Operario realiza el desmontaje del Intercambiador de calor.

60) Área de Soldadura: Línea de Producción
Se Repite desde el Paso 01 para lograr la fabricación de grandes lotes. En caso se termine el lote, se salta al Paso 61.

61) Área de Soldadura: Eje Vertical
Gira el tornamesa para que el operario desmonte el Intercambiador de calor.

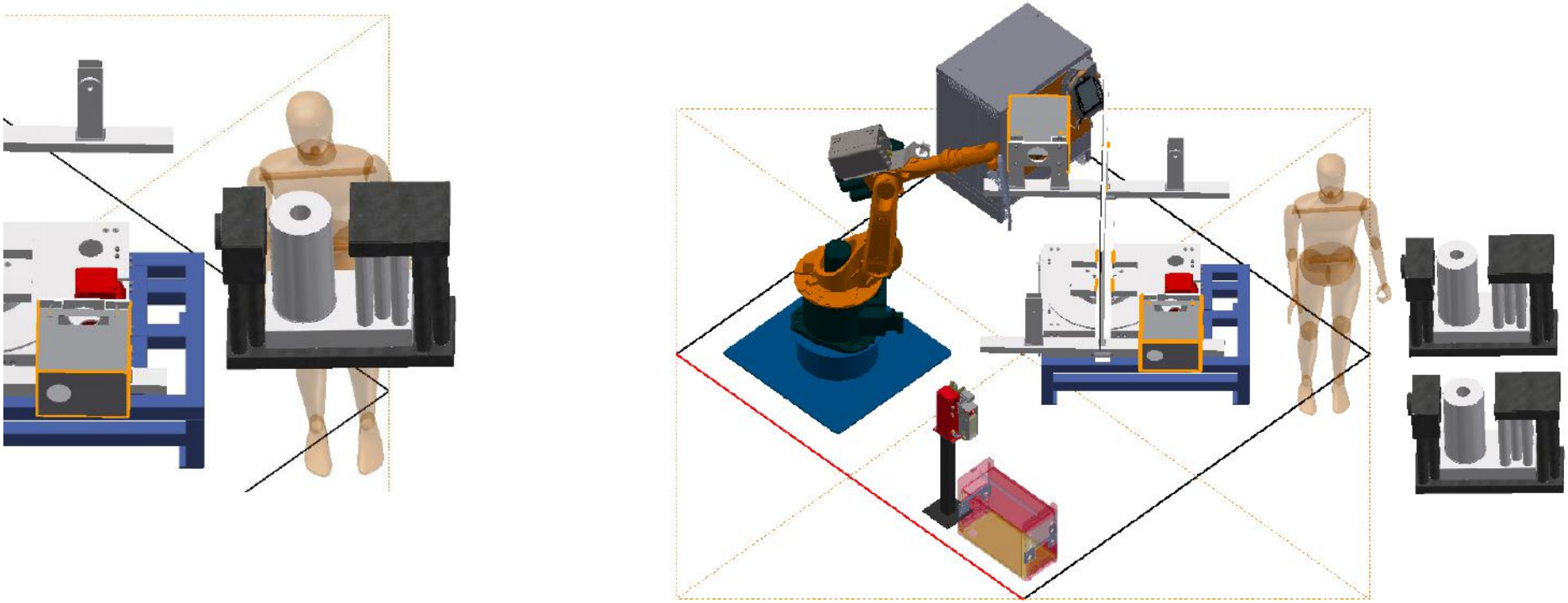


Diagrama de Funcionamiento Sistema Mecatrónico. Fuente: Propia

TÄYDELLISTÄ HITSAUSTA

6.10 Anexo J - Especificaciones y Operaciòn - FRONIUS TPS 4000 CrNi

CMT 4000 ADVANCED
TIME 5000 DIGITAL
TRANSPULS SYNERGIC 2700/3200/4000/5000

/ Operating Instructions
/ Spare Parts List

v.01/2012 ENG

Dear reader,

EN

Introduction

Thank you for the trust you have placed in our company and congratulations on buying this high-quality Fronius product. These instructions will help you familiarise yourself with the product. Reading the instructions carefully will enable you to learn about the many different features it has to offer. This will allow you to make full use of its advantages.

Please also note the safety rules to ensure greater safety when using the product. Careful handling of the product will repay you with years of safe and reliable operation. These are essential prerequisites for excellent results.

Contents

Safety rules ... 9
Explanation of safety symbols ... 9
General ... 9
Intended purpose ... 10
Environmental conditions ... 10
Obligations of the operator ... 10
Obligations of personnel ... 11
Mains connection ... 11
Protecting yourself and others ... 11
Noise emission values ... 12
Danger from toxic gases and vapours ... 12
Danger from flying sparks ... 13
Risks from mains current and welding current ... 13
Meandering welding currents ... 15
EMC device classifications ... 15
EMC measures ... 15
EMF measures ... 16
Specific hazards ... 16
Danger from shielding gas cylinders ... 18
Safety measures at the installation location and during transport ... 18
Safety measures in normal operation ... 19
Maintenance and repair ... 20
Safety inspection ... 20
Disposal ... 20
Safety symbols ... 20
Data protection ... 21
Copyright ... 21

General information **23**

General ... 25
Device concept ... 25
Functional principle ... 25
Application areas ... 25
Warning notices on the device ... 25
Special versions ... 27
General ... 27
Alu edition ... 27
CrNi edition ... 27
CMT Variants ... 27
CMT 4000 Advanced ... 27
TIME 5000 Digital ... 28
Yard edition ... 28
Steel-Edition ... 28
System components ... 29
General ... 29
Overview ... 29

Control elements and connections **31**

Description of the control panels ... 33
General ... 33
Safety ... 33
Übersicht ... 33
Standard control panel ... 34
General ... 34
Standard control panel ... 34
Key combinations - special functions ... 36
Displaying the feeder inching speed ... 36
Displaying the gas pre-flow and gas post-flow time ... 36

Displaying the software version 36
Comfort / CrNi / Steel control panel 38
Unterscheidung Bedienpanel Comfort, CrNi und Steel 38
Comfort control panel 38
Key combinations - special functions 41
Displaying the feeder inching speed 41
Displaying the gas pre-flow and gas post-flow time 42
Displaying the software version 42
US control panel 43
US control panel 43
Key combinations - special functions 46
Displaying the feeder inching speed 46
Displaying the gas pre-flow and gas post-flow time 46
Displaying the software version 46
TIME 5000 Digital control panel 48
TIME 5000 Digital control panel 48
Key combinations - special functions 51
Displaying the feeder inching speed 51
Displaying the gas pre-flow and gas post-flow time 52
Displaying the software version 52
CMT control panel 53
CMT control panel 53
Key combinations - special functions 56
Displaying the feeder inching speed 56
Displaying the gas pre-flow and gas post-flow time 56
Displaying the software version 56
Yard control panel 58
Yard control panel 58
Key combinations - special functions 61
Displaying the feeder inching speed 61
Displaying the gas pre-flow and gas post-flow time 61
Displaying the software version 61
“Remote” control panel 63
General 63
Remote control panel 63
CMT Remote control panel 64
General 64
CMT Remote and CMT Advanced control panel 64
Connections, switches and mechanical components 65
TPS 2700 power source 65
TPS 2700 CMT power source 66
TS 4000 / 5000, TPS 3200 / 4000 / 5000, TIME 5000 Digital power sources 67
CMT 4000 Advanced power source 68

Installation and commissioning **71**

Minimum equipment needed for welding task 73
General 73
MIG/MAG gas-cooled welding 73
MIG/MAG water-cooled welding 73
MIG/MAG automated welding 73
CMT manual welding 73
CMT automated welding 74
CMT Advanced welding 74
TIG DC welding 74
Manual metal arc welding 74
Before installation and commissioning 75
Safety 75
Proper use 75
Setup regulations 75
Mains connection 75
Connecting up the mains cable on US power sources 76
General 76
Stipulated mains cables and strain-relief devices 76

Safety ... 76
Connecting the mains cable ... 76
Replacing the strain-relief device ... 77
Start-up ... 79
Safety ... 79
Remarks on the cooling unit ... 79
Information on system components ... 79
Overview ... 79
Commissioning the TPS 2700 ... 80
General ... 80
Recommendation for water-cooled applications ... 80
Connecting the gas cylinder ... 80
Establishing a ground (earth) connection ... 81
Connecting the welding torch ... 81
Inserting/replacing feed rollers ... 81
Inserting the wirespool ... 82
Inserting the basket-type spool ... 82
Feeding in the wire electrode ... 83
Setting the contact pressure ... 84
Adjusting the brake ... 84
Design of the brake ... 85
Commissioning the TS 4000 / 5000, TPS 3200 / 4000 / 5000, TIME 5000 Digital ... 86
General ... 86
Fitting the system components (overview) ... 86
Fixing the strain-relief device in place ... 87
Connecting the interconnecting hosepack ... 87
Connecting the gas cylinder ... 88
Establishing a ground (earth) connection ... 89
Connecting the welding torch ... 89
Other tasks ... 89
Commissioning the CMT4000 Advanced ... 90
Fitting the system components (overview) ... 90
Connecting the interconnecting hosepack, CMT welding torch and wire buffer ... 90
Other tasks ... 90
Preparing the wire-feed unit ... 91

Welding **93**

MIG/MAG modes ... 95
General ... 95
Symbols and their explanations ... 95
2-step mode ... 96
4-step mode ... 96
Special 4-step mode ... 97
Spot welding ... 97
MIG/MAG welding ... 98
Safety ... 98
General tasks before MIG/MAG welding ... 98
Overview ... 98
MIG/MAG synergic welding ... 99
General ... 99
MIG/MAG synergic welding ... 99
Corrections during welding ... 100
Adjusting parameters for correction ... 100
Remarks on the Standard control panel ... 100
MIG/MAG standard manual welding ... 101
General ... 101
Available parameters ... 101
MIG/MAG standard manual welding ... 101
Corrections during welding ... 102
Adjusting parameters for correction ... 102
CMT welding ... 103
General ... 103
CMT welding ... 103

Corrections during welding ... 104
Adjusting parameters for correction ... 106
Special functions and options ... 107
Arc break watchdog function ... 107
Ignition time-out function ... 107
Spatter-free ignition option ... 107
SynchroPulse option ... 108
Robot welding ... 110
Prerequisite ... 110
General ... 110
Special 2-step mode for robot interface ... 110
Wire-stick control function ... 111
Changing the welding process during CMT Advanced welding ... 111
TIG welding ... 112
Safety ... 112
Prerequisite ... 112
Preparation ... 112
TIG welding ... 112
Igniting the arc ... 113
Finishing welding ... 114
TIG Comfort Stop option ... 114
TIG welding with TIG Comfort Stop ... 116
MMA welding ... 117
Safety ... 117
Prerequisite ... 117
Preparation ... 117
Manual metal arc welding ... 117
Corrections during welding ... 118
Adjusting parameters for correction ... 118
HotStart function ... 118
SoftStart function ... 119
Anti-stick function ... 119
Job mode ... 120
General ... 120
Prerequisites ... 120
Restrictions ... 120
Job mode displays on the left-hand digital display ... 120
Selecting job mode as the process ... 120
Creating a job ... 120
Retrieving a job ... 121
Copying/overwriting a job ... 122
Deleting a job ... 123

Setup settings **125**

Job correction ... 127
General ... 127
Opening the Job correction menu ... 127
Changing welding parameters ... 127
Exiting the Job correction menu ... 127
Parameters in the job correction menu ... 128
Permanently settable parameters ... 128
Parameters that can be corrected at a later time ... 130
Shielding gas setup menu ... 133
General ... 133
Protective gas shield setup menu for the standard control panel ... 133
Protective gas shield setup menu for the Comfort, US, TIME 5000 Digital and CMT control panels ... 133
Welding parameters in the Protective gas shield setup menu ... 133
Setup menu for the standard control panel ... 135
General ... 135
Setup menu for the standard control panel ... 135
Parameters in the Setup menu for the Standard control panel ... 135
Process setup menu ... 138
General ... 138

Process setup menu for the Comfort, US, TIME 5000 Digital and CMT control panels 138
Parameters for MIG/MAG welding in the Process setup menu 138
Parameters for TIG welding in the Process setup menu 141
Parameters for MMA welding in the Process setup menu 141
Mode setup menu 142
General 142
Mode setup menu for the Comfort, US, TIME 5000 Digital and CMT control panels 142
Welding parameters for "Special 2-step mode" in the Mode setup menu 142
Welding parameters for "Special 4-step mode" in the Mode setup menu 143
Parameters for spot welding in the Mode setup menu 143
Setup menu - Level 2 144
General 144
Setup menulevel 2 for the Standard control panel 144
Setup menu level 2 for the Comfort, US, TIME 5000 Digital and CMT control panels 145
Welding parameters for MIG/MAG welding in the Setup menu level 2 145
Parameters for operating power sources in parallel in the Setup menu level2 148
Parameters for TimeTwin Digital in the Setup menu level2 148
Parameters for TIG welding in the Setup menu level2 148
Parameters for rod electrode (MMA) welding in the Setup menu level 2 149
Notes on the use of the FAC parameter 152
Calibrating push-pull unit 153
General 153
Calibrating the push-pull unit - overview 153
Calibrating the push-pull unit 153
Service codes for push-pull calibration 157
Safety 157
Service codes when the drive units are disengaged ("open-circuit" calibration) 157
Service codes when the drive units are engaged ("engaged" calibration) 158
Measuring welding circuit resistance r 160
General 160
Measuring welding circuit resistance r 160
Displaying welding circuit inductivity L 162
General 162
Displaying welding circuit inductivity L 162
Arranging the interconnecting hosepack correctly 162

Troubleshooting and maintenance **163**

Troubleshooting 165
General 165
Safety 165
Displayed service codes 165
Power source - troubleshooting 173
Care, maintenance and disposal 177
General 177
Safety 177
At every start-up 177
Every 2 months 177
Every 6 months 177
Disposal 177

Appendix **179**

Technical data 181
Special voltages 181
TPS 2700 181
TPS 2700 MV 182
TPS 3200 183
TPS 3200 MV 184
TPS 3200 460VAC 185
TS/TPS 4000 186
TS/TPS 4000 MV 187
TS/TPS 5000 187
TS/TPS 5000 MV 188

Technical data - US devices 189
Technical data - Alu edition, CrNi edition, Yard edition and CMT variants 189
TIME 5000 Digital 189
CMT 4000 Advanced 190
CMT 4000 Advanced MV 191
Welding program databases 193
Explanation of symbols 193
Setting up a welding program database - example 193
Terms and abbreviations used 194
General 194
Terms and abbreviations A - C 194
Terms and abbreviations D - F 194
Terms and abbreviations G - I 195
Terms and abbreviations J - R 195
Terms and abbreviations S 196
Terms and abbreviations T - 2nd 196

Spare parts list **199**

Spare parts list: TransPuls Synergic 2700 200
Spare parts list: TS/TPS 3200/4000/5000, TIME 5000 203
Spare parts list: CMT 4000 Advanced 206

Safety rules

Explanation of safety symbols

DANGER! indicates immediate and real danger. If it is not avoided, death or serious injury will result.

WARNING! indicates a potentially dangerous situation. Death or serious injury may result if appropriate precautions are not taken.

CAUTION! indicates a situation where damage or injury could occur. If it is not avoided, minor injury and/or damage to property may result.

NOTE! indicates a risk of flawed results and possible damage to the equipment.

IMPORTANT! indicates tips for correct operation and other particularly useful information. It does not indicate a potentially damaging or dangerous situation.

If you see any of the symbols depicted in the "Safety rules", special care is required.

General

The device is manufactured using state-of-the-art technology and according to recognised safety standards. If used incorrectly or misused, however, it can cause

- injury or death to the operator or a third party,
- damage to the device and other material assets belonging to the operating company,
- inefficient operation of the device.

All persons involved in commissioning, operating, maintaining and servicing the device must:

- be suitably qualified,
- have sufficient knowledge of welding
- read and follow these operating instructions carefully.

The operating instructions must always be at hand wherever the device is being used. In addition to the operating instructions, attention must also be paid to any generally applicable and local regulations regarding accident prevention and environmental protection.

All safety and danger notices on the device

- must be kept in a legible state
- must not be damaged/marked
- must not be removed
- must not be covered, pasted or painted over.

For the location of the safety and danger notices on the device, refer to the section headed "General remarks" in the operating instructions for the device. Before switching on the device, remove any faults that could compromise safety.
Your personal safety is at stake!

Intended purpose

The device is to be used exclusively for its intended purpose.

The device is intended for the welding process described on the rating plate only.
Any use above and beyond this purpose is deemed improper. The manufacturer shall not be liable for any damage resulting from such improper use.

Utilisation in accordance with the "intended purpose" also comprises
- reading carefully and following all operating instructions to the letter
- studying and obeying all safety and danger notices carefully
- performing all stipulated inspection and servicing work.

Never use the device for the following purposes:
- Thawing out pipes
- Charging batteries/accumulators
- Starting engines

The device is designed for use in industry and the workshop. The manufacturer accepts no responsibility for any damage caused through use in a domestic setting.

The manufacturer likewise accepts no liability for unexpected or incorrect results.

Environmental conditions

Operation or storage of the device outside the stipulated area will be deemed as "not in accordance with the intended purpose". The manufacturer shall not be liable for any damage resulting from such improper use.

Ambient temperature:
- during operation: -10 °C to + 40 °C (14 °F to 104 °F)
- during transport and storage: -25 °C to +55 °C (-13 °F to 131 °F)

Relative humidity:
- up to 50 % at 40 °C (104 °F)
- up to 90 % at 20 °C (68 °F)

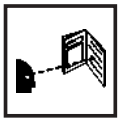
Ambient air: free from dust, acids, corrosive gases and substances, etc.
For use at altitudes above sea level: up to 2000 m (6500 ft)

Obligations of the operator

The operator undertakes only to allow persons to work with the device who:
- are familiar with the fundamental instructions regarding safety and accident prevention, and have been instructed how to use the device
- have read and understood these operating instructions, especially the section “safety rules”, and have confirmed as much with their signatures
- are trained to produce the required results.

Checks must be carried out at regular intervals to ensure that operators are working in a safety-conscious manner.

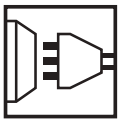
Obligations of personnel



Before using the device, all persons instructed to do so undertake:
- to observe the basic instructions regarding safety at work and accident prevention
- to read these operating instructions, especially the "Safety rules" section and sign to confirm that they have understood them and will follow them.

Before leaving the work area, ensure that people or property cannot come to any harm in your absence.

Mains connection



Devices with a higher rating may affect the energy quality of the mains due to their current input.

This may affect a number of types of device in terms of:
- connection restrictions
- criteria with regard to maximum permissible mains impedance *)
- criteria with regard to minimum short-circuit power requirement *)

*)at the interface with the public mains network

see Technical Data

In this case, the plant operator or the person using the device should check whether the device may be connected, where appropriate by discussing the matter with the power supply company.

Protecting yourself and others

Persons involved with welding expose themselves to numerous risks, e.g.:
- flying sparks and hot pieces of metal
- arc radiation, which can damage eyes and skin

- hazardous electromagnetic fields, which can endanger the lives of those using cardiac pacemakers

- risk of electrocution from mains current and welding current

- greater noise pollution

- harmful welding fumes and gases

Anyone working on the workpiece while welding is in progress must wear suitable protective clothing with the following properties:
- flame-resistant
- insulating and dry
- covers the whole body, is undamaged and in good condition
- safety helmet
- trousers with no turn-ups

Protective clothing refers to a variety of different items. Operators should:

- protect eyes and face from UV rays, heat and sparks using a protective visor and regulation filter.
- wear regulation protective goggles with side protection behind the safety visor.
- wear stout footwear that provides insulation even in wet conditions.
- protect the hands with suitable gloves (electrically insulated and providing protection against heat).
- wear ear protection to reduce the harmful effects of noise and to prevent injury.

Keep all persons, especially children, out of the working area while any devices are in operation or welding is in progress. If, however, there are people in the vicinity,

- make them aware of all the dangers (risk of dazzling by the arc, injury from flying sparks, harmful welding fumes, noise, possible danger from mains or welding current, etc.),
- provide suitable protective equipment or
- erect suitable safety screens/curtains.

Noise emission values

The device generates a maximum sound power level of <80 dB(A) (ref. 1pW) when idling and in the cooling phase following operation at the maximum permissible operating point under maximum rated load conditions according to EN 60974-1.

It is not possible to provide a workplace-related emission value during welding (or cutting) as this is influenced by both the process and the environment. All manner of different welding parameters come into play, including the welding process (MIG/MAG, TIG welding), the type of power selected (DC or AC), the power range, the type of weld metal, the resonance characteristics of the workpiece, the workplace environment, etc.

Danger from toxic gases and vapours

The fumes produced during welding contain harmful gases and vapours.

Welding fumes contain substances that may, under certain circumstances, cause birth defects or cancer.

Keep your face away from welding fumes and gases.

Fumes and hazardous gases,

- must not be breathed in
- must be extracted from the working area using appropriate methods.

Ensure an adequate supply of fresh air.

If this cannot be provided, a protective mask with an air supply must be worn.

Close the shielding gas cylinder valve or central gas supply if no welding is taking place.

If there is any doubt about whether the extraction system is powerful enough, then the measured toxic emission values should be compared with the permissible limit values.

The following components are responsible, amongst other things, for the degree of toxicity of welding fumes:
- Metals used for the workpiece
- Electrodes
- Coatings
- Cleaners, degreasers, etc.

The relevant material safety data sheets and manufacturer's specifications for the listed components should therefore be studied carefully.

Flammable vapours (e.g. solvent fumes) should be kept away from the arc's radiation area.

Danger from flying sparks

Flying sparks may cause fires or explosions.

Never weld close to flammable materials.

Flammable materials must be at least 11 metres (35 ft) away from the arc, or alternatively covered with an approved cover.

A suitable, tested fire extinguisher must be available and ready for use.

Sparks and pieces of hot metal may also get into adjacent areas through small gaps or openings. Take appropriate precautions to prevent any danger of injury or fire.

Welding must not be performed in areas that are subject to fire or explosion or near sealed tanks, vessels or pipes unless these have been prepared in accordance with the relevant national and international standards.

Do not carry out welding on containers that are being or have been used to store gases, propellants, mineral oils or similar products. Residues pose an explosive hazard.

Risks from mains current and welding current

An electric shock is life threatening and can be fatal.

Do not touch live parts either inside or outside the device.

During MIG/MAG or TIG welding, the welding wire, the wirespool, the drive rollers and all metal parts that are in contact with the welding wire are live.

Always set the wire-feed unit up on a sufficiently insulated surface or use a suitable, insulated wire-feed unit mount.

Make sure that you and others are protected with an adequately insulated, dry temporary backing or cover for the earth or ground potential. This temporary backing or cover must extend over the entire area between the body and the earth or ground potential.

All cables and leads must be complete, undamaged, insulated and adequately dimensioned. Loose connections, scorched, damaged or inadequately dimensioned cables and leads must be repaired/replaced immediately.

Do not sling cables or leads around either the body or parts of the body.

The electrode (rod electrode, tungsten electrode, welding wire, etc) must
- never be immersed in liquid for cooling
- never be touched when current is flowing.

Double the open circuit voltage of a welding machine can occur between the welding electrodes of two welding machines. Touching the potentials of both electrodes at the same time may under certain circumstances be fatal.

Arrange for the mains and device supply to be checked regularly by a qualified electrician to ensure the PE conductor is functioning properly.

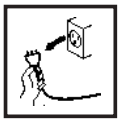
The device must only be operated on a mains supply with a PE conductor and a socket with an earth contact.

If the device is operated on a mains without a PE conductor and in a socket without an earth contact, this will be deemed gross negligence. The manufacturer shall not be liable for any damage resulting from such improper use.

If necessary, provide an adequate earth connection for the workpiece.

Switch off unused devices.

Wear a safety harness if working at height.



Before working on the device, switch it off and pull out the mains plug.

Attach a clearly legible and easy-to-understand warning sign to the device to prevent anyone from reconnecting it to the mains and switching it on again.

After opening the device:
- discharge all components holding an electric charge
- ensure that all components in the device are de-energised.

If work on live parts cannot be avoided, appoint a second person to switch off the main switch at the right moment.

Meandering welding currents

If the following instructions are ignored, meandering welding currents can develop with the following consequences:
- Fire hazard
- Overheating of parts connected to the workpiece
- Irreparable damage to PE conductors
- Damage to device and other electrical equipment

Ensure that the workpiece is held securely by the workpiece clamp.

Attach the workpiece clamp as close as possible to the area that is to be welded.

If the floor is electrically conductive, the device must be set up with sufficient insulating material to insulate it from the floor.

If distribution boards, twin-head mounts, etc., are being used, note the following: The electrode of the welding torch / electrode holder that is not used is also live. Make sure that the welding torch / electrode holder that is not used is kept sufficiently insulated.

In the case of automated MIG/MAG applications, ensure that only an insulated wire electrode is routed from the welding wire drum, large wirefeeder spool or wirespool to the wire-feed unit.

EMC device classifications

Devices with emission class A:
- are only designed for use in an industrial setting
- can cause conducted and emitted interference in other areas.

Devices with emission class B:
- satisfy the emissions criteria for residential and industrial areas. This also applies to residential areas in which power is supplied from the public low-voltage grid.

EMC device classification according to the rating plate or the technical data.

EMC measures

In certain cases, even though a device complies with the standard limit values for emissions, it may affect the application area for which it was designed (e.g. when there is sensitive equipment at the same location, or if the site where the device is installed is close to either radio or television receivers).
If this is the case, then the operator is obliged to take appropriate action to rectify the situation.

Check for possible problems, and check and evaluate neighbouring devices' resistance to interference according to national and international requirements:

- Safety features
- power, signal and data transfer lines
- IT and telecommunications devices
- measuring and calibrating devices

Supporting measures for avoidance of EMC problems:

a) Mains supply
   - if electromagnetic interference arises despite correct mains connection, additional measures are necessary (e.g. use a suitable line filter).
b) Welding leads
   - must be kept as short as possible
   - must run close together (to avoid EMF problems)
   - must be kept well apart from other leads
c) Equipotential bonding
d) Earthing the workpiece
   - if necessary, establish an earth connection using suitable capacitors.
e) Shielding, if necessary
   - shield off other nearby devices
   - shield off entire welding installation

EMF measures

Electromagnetic fields may pose as yet unknown risks to health:

- effects on the health of others in the vicinity, e.g. wearers of pacemakers and hearing aids
- wearers of pacemakers must seek advice from their doctor before approaching the device or any welding that is in progress
- for safety reasons, keep distances between the welding cables and the welder's head/torso as large as possible
- do not carry welding cables and hosepacks over the shoulders or wind them around any part of the body

---

Specific hazards

Keep hands, hair, clothing and tools away from moving parts. For example:

- Fans
- Cogs
- Rollers
- Shafts
- Wirespools and welding wires

Do not reach into the rotating cogs of the wire drive or into rotating drive components.

Covers and side panels may only be opened/removed while maintenance or repair work is being carried out.

During operation

- ensure that all covers are closed and all side panels are fitted properly.
- keep all covers and side panels closed.

The welding wire emerging from the welding torch poses a high risk of injury (piercing of the hand, injuries to the face and eyes, etc.).

Always keep the welding torch away from the body (devices with wire-feed unit) and wear suitable protective goggles.

Never touch the workpiece during or after welding - risk of burns.

Slag can jump off cooling workpieces. The specified protective equipment must therefore also be worn when reworking workpieces, and steps must be taken to ensure that other people are also adequately protected.

Welding torches and other parts with a high operating temperature must be allowed to cool down before handling.

Special provisions apply in areas at risk of fire or explosion - observe relevant national and international regulations.

Power sources that are to be used in areas with increased electric risk (e.g. near boilers) must carry the "Safety" sign. However, the power source must not be located in such areas.

Risk of scalding from escaping coolant. Switch off cooling unit before disconnecting coolant flow or return lines.

Use only suitable load-carrying equipment supplied by the manufacturer when transporting devices by crane.

- Hook chains and/or ropes onto the suspension points provided on the load-carrying equipment.
- Chains/ropes must be at the smallest angle possible to the vertical.
- Remove gas cylinder and wire-feed unit (MIG/MAG and TIG devices).

If the wire-feed unit is attached to a crane holder during welding, always use a suitable, insulated wire-feed unit holder (MIG/MAG and TIG devices).

If the device has a carrying strap or handle, this is intended solely for carrying by hand. The carrying strap is not to be used if transporting with a crane, forklift truck or other mechanical hoist.

Odourless and colourless shielding gas may escape unnoticed if an adapter is used for the shielding gas connection. Prior to assembly, seal the device-side thread of the adapter for the shielding gas connection using suitable Teflon tape.

Danger from shielding gas cylinders

Shielding gas cylinders contain gas under pressure and can explode if damaged. As the shielding gas cylinders are part of the welding equipment, they must be handled with the greatest of care.

Protect shielding gas cylinders containing compressed gas from excessive heat, mechanical impact, slag, naked flames, sparks and arcs.

Mount the shielding gas cylinders vertically and secure according to instructions to prevent them falling over.

Keep the shielding gas cylinders well away from any welding or other electrical circuits.

Never hang a welding torch on a shielding gas cylinder.

Never touch a shielding gas cylinder with an electrode.

Risk of explosion - never attempt to weld a pressurised shielding gas cylinder.

Only use shielding gas cylinders suitable for the application in hand, along with the correct and appropriate accessories (regulator, hoses and fittings). Only use shielding gas cylinders and accessories that are in good condition.

Turn your face to one side when opening the valve of a shielding gas cylinder.

Close the shielding gas cylinder valve if no welding is taking place.

If the shielding gas cylinder is not connected, leave the valve cap in place on the cylinder.

The manufacturer's instructions must be observed as well as applicable national and international regulations for shielding gas cylinders and accessories.

Safety measures at the installation location and during transport

A device that topples over can easily kill someone. Place the device on a solid, level surface in such a way that it remains stable

- The maximum permissible slope is 10°.

Special regulations apply in rooms at risk of fire or explosion

- observe relevant national and international requirements.

Use internal directives and checks to ensure that the workplace environment is always clean and clearly laid out.

Only set up and operate the device in accordance with the degree of protection shown on the rating plate.

When setting up the device, ensure there is a gap of 0.5 m (1 ft. 7.69 in.) all round so that cooling air can enter and exit unhindered.

When transporting the device, observe the relevant national and local guidelines and accident prevention regulations. This applies especially to guidelines regarding the risks arising during transportation.

Before transporting the device, allow coolant to drain completely and detach the following components:
- Wire-feed unit
- Wirespool
- Shielding gas cylinder

After transporting the device, and before commissioning, you MUST carry out a visual inspection to check whether it has been damaged in any way. Any damage must be repaired by trained service technicians before commissioning takes place.

Safety measures in normal operation

Only operate the device when all protection devices are fully functional. If the protection devices are not fully functional, there is a risk of
- injury or death to the operator or a third party,
- damage to the device and other material assets belonging to the operator,
- inefficient operation of the device.

Any safety devices that are not functioning properly must be repaired before switching on the device.

Never bypass or disable protection devices.

Before switching on the device, ensure that no one is likely to be endangered.

- Check the device at least once a week for obvious damage and proper functioning of safety devices.
- Always fasten the shielding gas cylinder securely and remove it beforehand if the device is to be transported by crane.
- Only the manufacturer's original coolant is suitable for use with our devices due to its properties (electrical conductivity, frost protection, material compatibility, flammability, etc.)
- Only use suitable original coolant from the manufacturer.
- Do not mix the manufacturer's original coolant with other coolants.
- If damage results from using a different coolant, the manufacturer accepts no liability. In addition, no warranty claims will be entertained.
- The coolant can ignite under certain conditions. Transport the coolant only in its original, sealed containers and keep well away from any sources of ignition
- Used coolant must be disposed of properly in accordance with the relevant national and international regulations. A safety data sheet may be obtained from your service centre or downloaded from the manufacturer's website.
- Check the coolant level before you start to weld while the system is still cool.

Maintenance and repair

It is impossible to guarantee that bought-in parts are designed and manufactured to meet the demands made on them, or that they satisfy safety requirements. Use only original replacement and wearing parts (also applies to standard parts).
Do not carry out any modifications, alterations, etc. to the device without the manufacturer's consent.
Components that are not in perfect condition must be changed immediately.
When ordering, please give the exact designation and part number as shown in the spare parts list, as well as the serial number of your device.

Safety inspection

The manufacturer recommends that a safety inspection of the device is performed at least once every 12 months.

The manufacturer recommends that the power source be calibrated during the same 12-month period.

A safety inspection should be carried out by a qualified electrician
- after any changes are made
- after any additional parts are installed, or after any conversions
- after repair, care and maintenance has been carried out
- at least every twelve months.

For safety inspections, follow the appropriate national and international standards and directives.

Further details on safety inspection and calibration can be obtained from your service centre. They will provide you on request with any documents you may require.

Disposal

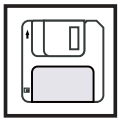
Do not dispose of this device with normal domestic waste! To comply with the European Directive 2002/96/EC on Waste Electrical and Electronic Equipment and its implementation as national law, electrical equipment that has reached the end of its life must be collected separately and returned to an approved recycling facility. Any device that you no longer require must either be returned to your dealer or given to one of the approved collection and recycling facilities in your area. Ignoring this European Directive may have potentially adverse affects on the environment and your health!

Safety symbols

Devices with the CE marking satisfy the essential requirements of the low-voltage and electromagnetic compatibility directive (e.g. relevant product norms from the EN 60 974 series).

Devices with the CSA test mark satisfy the requirements of the relevant standards in Canada and the USA.

Data protection



The user is responsible for the safekeeping of any changes made to the factory settings. The manufacturer accepts no liability for any deleted personal settings.

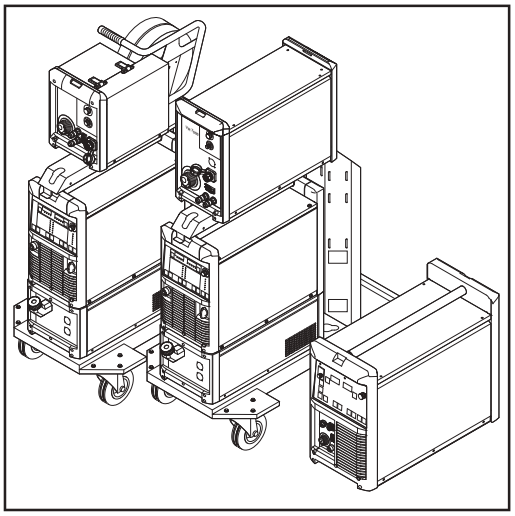
Copyright

The text and illustrations are all technically correct at the time of printing. We reserve the right to make changes. The contents of the operating instructions shall not provide the basis for any claims whatsoever on the part of the purchaser. If you have any suggestions for improvement, or can point out any mistakes that you have found in the instructions, we will be most grateful for your comments.

General information

General

Device concept



TS 4000 / 5000, TPS 3200 / 4000 / 5000 and TPS 2700 welding plants

The TransSynergic (TS) 4000 and TS 5000 and TransPulsSynergic (TPS) 2700, TPS 3200, TPS 4000 and TPS 5000 power sources are fully digitised microprocessor-controlled inverter power sources.

The modular design and potential for system add-ons ensure a high degree of flexibility. The devices can be adapted to any specific situation.

The TransPuls Synergic 2700 features an integral 4-roller drive. There is no longer an interconnecting hosepack between the power source and wire-feed unit. Its compact design makes the TPS 2700 particularly suitable for mobile applications.

All models except the TS 4000/5000 are multiprocess devices:
- MIG/MAG welding
- TIG welding with touchdown ignition (excluding CMT power sources)
- Manual metal arc welding

Functional principle

The central control and regulation unit of the power sources is coupled with a digital signal processor. The central control and regulation unit and the signal processor control the entire welding process.
During the welding process, the actual data is measured continuously and the device responds immediately to any changes. Control algorithms ensure that the desired target state is maintained.

This results in:
- a precise welding process
- exact reproducibility of all results
- excellent weld properties.

Application areas

The devices are used in workshops and industry for manual and automated applications with classical steel, galvanised sheets, chrome/nickel and aluminium.

The integral 4-roller drive, high performance and light weight of the TPS 2700 power source make it the ideal choice for portable applications on building sites or in repair workshops.

The TS 4000/5000 and TPS 3200/4000/5000 power sources are designed for:
- Automobile and component supply industry
- Machinery and rail vehicle construction
- Chemical plant construction
- Equipment construction
- Shipyards, etc.

Warning notices on the device

US power sources come with extra warning notices affixed to the unit. The warning notices must NOT be removed or painted over.

WARNING

Do not Remove, Destroy, Or Cover This Label

ARC WELDING can be hazardous.
- Read and follow all labels and the Owner´s Manual carefully
- Only qualified persons are to install, operate, or service this unit according to all applicable codes and safety practices.
- Keep children away. • Pacemaker wearers keep away.
- Welding wire and drive parts may be at welding voltage.

ELECTRIC SHOCK can kill.
- Always wear dry insulating gloves.
- Insulate yourself from work and ground.
- Do not touch live electrical parts.
- Disconnect input power before servicing.
- Keep all panels and covers securely in place.

FUMES AND GASES can be hazardous.
- Keep your head out of the fumes.
- Ventilate area, or use breathing device.
- Read Material Safety Data Sheets (MSDSs) and manufacturer´s instructions for materials used.

WELDING can cause fire or explosion.
- Do not weld near flammable material.
- Watch for fire: keep extinguisher nearby.
- Do not locate unit over combustible surfaces.
- Do not weld on closed containers.

ARC RAYS can burn eyes and skin; NOISE can damage hearing.
- Wear welding helmet with correct filter.
- Wear correct eye, ear and body protection.

EXPLODING PARTS can injure.
- Failed parts can explode or cause other parts to explode when power is applied.
- Always wear a face shield and long sleeves when servicing.

ELECTRIC SHOCK can kill; SIGNIFICANT DC VOLTAGE exists after removal of input power
- Always wait 60 seconds after power is turned off before working on unit.
- Check input capacitor voltage, and be sure it is near 0 before touching parts.

AVERTISSEMENT

UN CHOC ELECTRIQUE peut etre mortel.
- Installation et raccordement de cette machine doivent etre conformes a tous les pertinents.

SOUDAGE A L´ARC peut etre hasardeux.
- Lire le manuel d´instructions avant utillsation.
- Ne pas installer sur une surface combustible.
- Les fils de soudage et pieces conductrices peuvent etre a la tension de soudage.

Read American National Standard Z49.1, "Safety In Welding and Cutting" From American Welding Society, 550 N.W. LeJeune Rd., Miami, Fl 33126; OSHA Safety and Health Standards, 29 CFR 1910, from U.S. Government Printing Office, Washington, DC 20402. CSA, W117-2 M87 Code for Safety in Welding and Cutting.

Nur vorhanden bei Stromquelle „TPS 2700“ und auf Drahtvorschüben

Special versions

General

Professional processing of specific materials requires welding programs that are specially matched to the different materials in question. The special versions of the digital power sources are perfectly matched to these requirements. As a result the most important welding programs can be called up directly from the operating panel. Furthermore, the power sources are characterised by standard functions that assist the user when welding these materials.

NOTE! The technical data of the special versions is identical to that of the standard power sources.

Alu edition

The Alu edition power sources were developed for perfect and careful processing of aluminium. Special aluminium welding programs assist in the professional processing of aluminium.
The Alu edition power sources are equipped as standard with the following options:
- Special aluminium welding programs
- SynchroPulse option

CrNi edition

The CrNi edition power sources were developed for perfect and careful processing of CrNi. Special CrNi welding programs assist in the professional processing of high-grade steels.
The CrNi edition power sources are equipped as standard with the following options:
- Special CrNi welding programs
- SynchroPulse option
- TIG Comfort Stop option
- TIG welding torch connection
- Gas solenoid valve

NOTE! It is not possible to install the “Uni Box” system add-on on the CrNi edition (e.g. for the field bus connection of a robot control).
However, the CrNi edition supports a robot connection via ROB 4000 / 5000 robot interfaces.

CMT Variants

In addition to conventional welding processes, the CMT variants also support the CMT process. CMT (Cold Metal Transfer) is a special MIG short-arc process. Its special features include low heat input and a controlled, low-current material transfer.
CMT is suitable for:
- Virtually spatter-free MIG brazing
- Welding on light-gauge sheet with minimal distortion
- Joining steel and aluminium (weld brazing)

CMT 4000 Advanced

In addition to the conventional MIG/MAG welding processes, MMA welding and the CMT process, the CMT 4000 Advanced power source supports the improved CMT Advanced process.
The functional principle of the CMT Advanced process is based on a combination arc with negatively polarised CMT cycles and positively polarised CMT cycles or positively polar-

ised pulse cycles. Special features are targeted heat input, a higher deposition rate, better gap bridging properties, precise droplet detachment and an extremely stable arc.
CMT Advanced is suitable for:
- joining thin sheets with outstanding gap bridging properties
- High-strength steels with low heat input
- Spots: precisely defined drop volumes and defined heat input
- Root passes with no pool support
- Brazing high-strength and ultra high-strength steels

TIME 5000 Digital

Concept
As a universal power source, the TIME 5000 Digital is particularly suited for manual applications. In addition to conventional welding processes, the TIME 5000 Digital also supports the TIME high-performance welding process.

Functional principle
Compared with conventional MIG/MAG processes, the following features bring about faster welding speeds, with an increase in deposition rate of up to 30%:
- Power module with high voltage reserves
- High performance welding programs
- Specially selected shielding gases
- High-performance wire-feed unit with water-cooled disc armature motor for wire feed speeds of up to 30 m/min
- TIME welding torch with dual circuit cooling system

Application
Anywhere where long weld seams, large seam cross-sections and controlled heat input are required, e.g.:
- Mechanical engineering
- Steel engineering
- Crane construction
- Shipbuilding
- Boiler manufacture

The new TIME 5000 Digital power source can also be used in automated applications.

Material types
The high-performance welding process is especially suitable for
- unalloyed steels
- low-alloy steels EN 10027
- fine-grained structural steels up to 890 N/mm²
- steels resistant to low temperatures

Yard edition

Yard edition power sources are designed especially for use in shipyards and offshore applications. The welding programs are designed primarily for steel and CrNi applications with solid and flux cored wires.

Steel edition

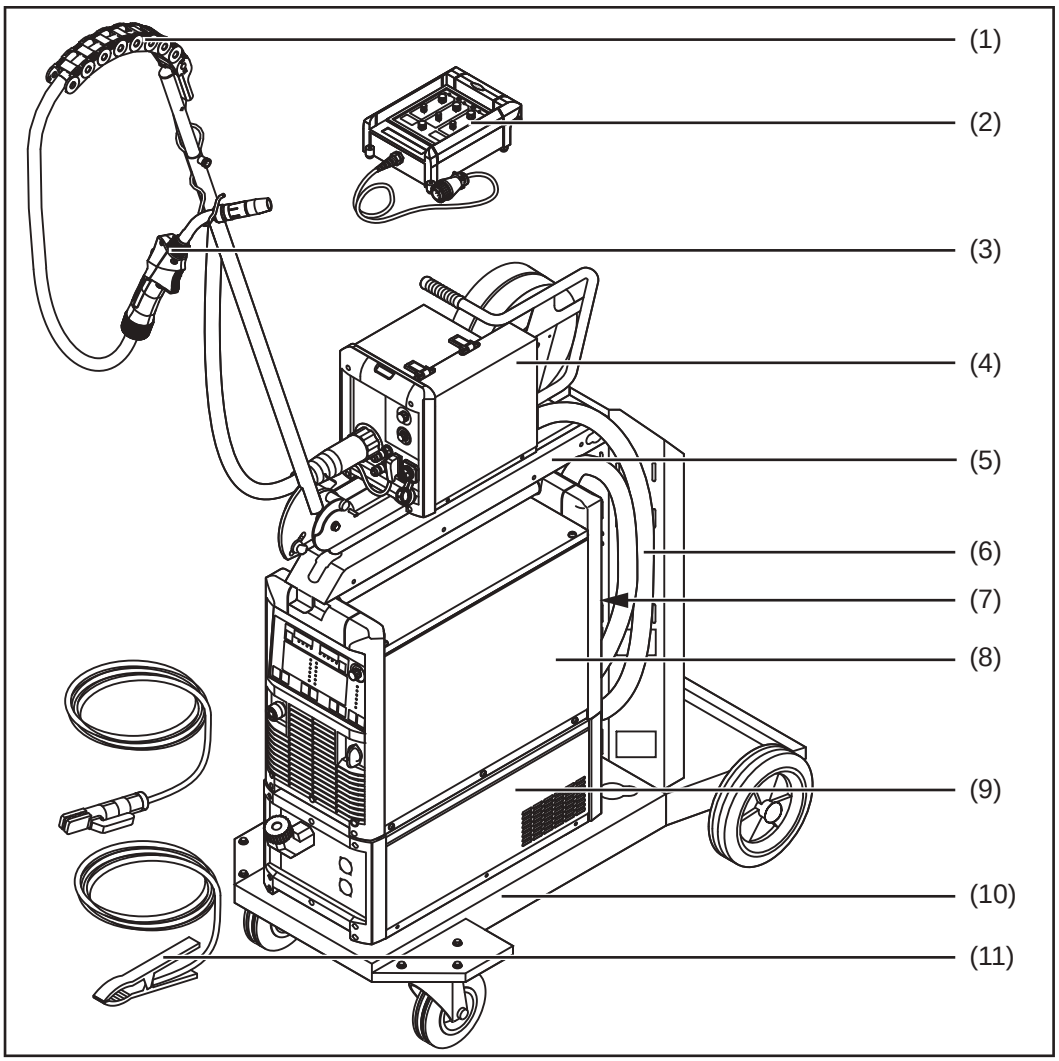
Steel edition power sources are designed specifically for use in the steel sector. The special characteristics can be set on the control panel - both for standard and pulsed arcs.

System components

General

Digital power sources can be run with various system components and options. This makes it possible to optimise procedures and to simplify machine handling and operation, as necessitated by the particular field of application in which the power source is to be used.

Overview



Overview of system components

Legend:

(1) “Human” hosepack boom
(2) Remote controls
(3) Welding torches
(4) Wire-feed units
(5) Wire-feed unit mount
(6) Interconnecting hosepacks
(7) Robot accessories
(8) Power sources
(9) Cooling units
(10) Trolleys and gas cylinder holders
(11) Grounding (earthing) cable and electrode cable

Control elements and connections

Description of the control panels

General

The functions on the control panels are all arranged in a logical way. The various welding parameters can easily be selected using buttons and can just as easily be
- altered using buttons or the adjusting dial
- displayed on the digital display during welding

The synergic function ensures that all other welding parameters are adjusted when an individual parameter has been changed.

NOTE! As a result of software updates, you may find that your device has certain functions that are not described in these operating instructions, or vice versa. Certain illustrations may also differ slightly from the actual control elements on your device, but these controls function in exactly the same way.

Safety

WARNING! Operating the equipment incorrectly can cause serious injury and damage. Do not use the functions described until you have thoroughly read and understood the following documents:
- these operating instructions
- all the operating instructions for the system components, especially the safety rules

Overview

"Description of the control panels" is composed of the following sections:
- Standard control panel
- Comfort control panel
- US control panel
- TIME 5000 Digital control panel
- CMT control panel
- Yard control panel
- Remote control panel
- CMT Remote control panel
- CrNi control panel
- Steel control panel

Standard control panel

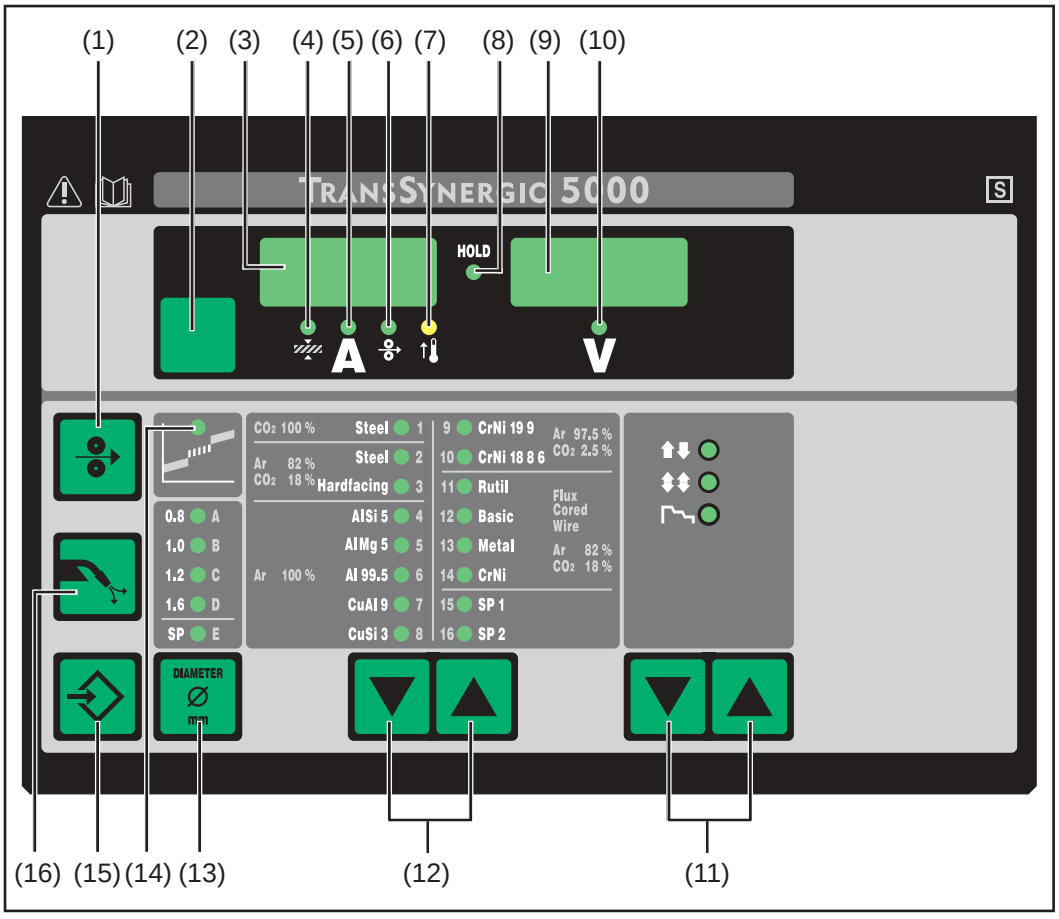
General

NOTE! On the Standard control panel, only the MIG/MAG standard synergic welding process is available. The following processes and functions are not available and cannot be retrofitted:

- MIG/MAG pulse synergic welding
- Job mode
- TIG welding
- Manual metal arc welding
- Spot welding

Any changes to the “Welding current” and “Arc-length correction” parameters have to be made on the wire-feed unit.

Standard control panel



No.	Function
(1)	**Feeder inching button** for feeding the wire electrode into the torch-hosepack without any flow of gas or current For information on the various wire feed sequences that are possible when the welder presses and holds the "Feeder inching" button, see the Fdi parameter in the Setup menu.

No.	Function
(2)	**Parameter selection button** for selecting the following parameters: **Sheet thickness** Sheet thickness in mm or in. **Welding current** Welding current in A Before the start of welding, the machine automatically displays a standard value based on the programmed parameters. During welding, the actual value is displayed. **Wire feed speed** Wire feed speed in m/min or ipm. **Welding voltage** Welding voltage in V Before the start of welding, the machine automatically displays a standard value based on the programmed parameters. During welding, the actual value is displayed. If one parameter is selected, then the synergic function means that all other parameters are automatically set as well.
(3)	**Left digital display**
(4)	**Sheet thickness LED** lights up when the sheet thickness parameter is selected
(5)	**Welding current LED** lights up when the welding current parameter is selected
(6)	**Wire feed speed LED** lights up when the wire feed speed parameter is selected
(7)	**Overtemperature indicator** lights up if the power source overheats (e.g. because the duty cycle has been exceeded). For more information on this, see the "Troubleshooting" section.
(8)	**HOLD indicator** every time a welding operation finishes, the actual values for welding current and welding voltage are stored, and the HOLD indicator lights up.
(9)	**Right digital display**
(10)	**Welding voltage LED** lights up when the welding voltage parameter is selected
(11)	**Mode button** for selecting the mode 2-step mode 4-step mode Special 4-step mode (aluminium welding start-up) When a mode is selected, the LED behind the relevant symbol lights up.
(12)	**Material button** for selecting the filler metal and shielding gas to be used. Parameters SP1 and SP2 are reserved for additional materials. When a material is selected, the LED behind the relevant filler metal lights up.
(13)	**Wire diameter button** for selecting the diameter of the wire to be used. Parameter SP is reserved for additional wire diameters. When a wire diameter is selected, the LED behind the relevant wire diameter lights up.

No.	Function
(14)	**Intermediate arc indicator** a spatter-prone intermediate arc occurs between the short arc and the spray arc. The intermediate arc indicator lights up to alert you to this critical area
(15)	**Store button** for opening the Setup menu
(16)	**Gas test button** for setting the required gas flow rate on the pressure regulator. Gas will flow out for 30 s after pressing the gas test button. Press the button again to stop the gas test flow before the end of this period.

Key combinations - special functions

The following special functions can be called by pressing buttons simultaneously or repeatedly.

Displaying the feeder inching speed

The set feeder inching speed is shown (e.g.: Fdi | 10 m/min or Fdi | 393.70 ipm).

Alter the feeder inching speed using the Material buttons (12)

Press the Store button to exit.

Displaying the gas pre-flow and gas post-flow time

The set gas pre-flow time is displayed (e.g. GPr | 0.1 s).

Alter the gas pre-flow time using the Material buttons (12)

Then press the Process button (11) to display the gas post-flow time setting (e.g. GPo | 0.5 s)

Alter the gas post-flow time using the Material buttons (12)

Press the Store button to exit.

Displaying the software version

In addition to the software version, these special functions can also be used to display the version number of the welding database, the wire-feed unit number, the software version of the wire-feed unit and the arc burning time.

The software version is displayed

Press the Material button (12) to display the version number of the welding database
(e.g.: 0 | 029 = M0029).

Press the Material button (12) again to display the number of the wire-feed unit (A or B in the case of twin-head mounts) and the software version of the wire-feed unit
(e.g.: A 1.5 | 0.23).

Press the Material button (12) a third time to display the actual arc burning time since starting for the first time (e.g. "654 | 32.1" = 65,432.1 h = 65,432 h, 6 min)

NOTE! The arc burning time indicator is not suitable as a basis for calculating hiring fees, guarantee, etc.

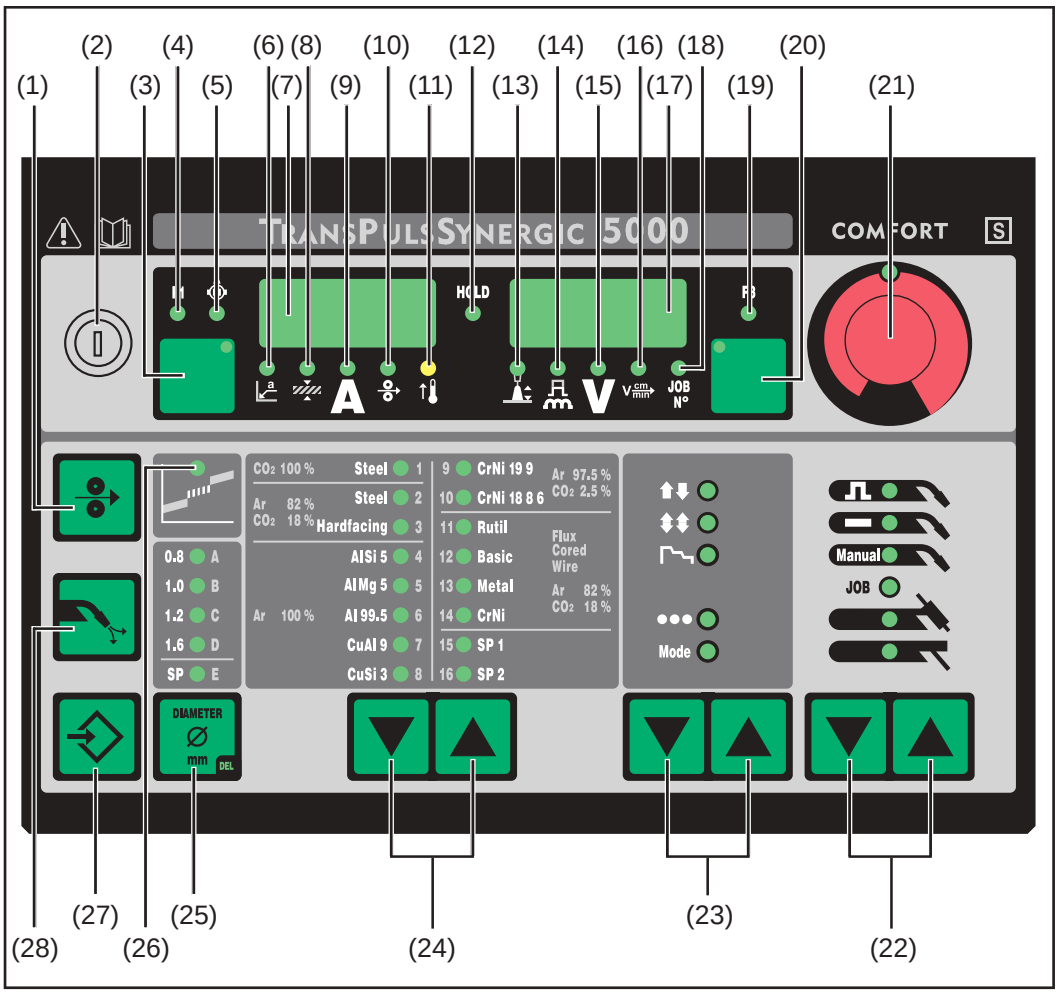
Press the Store button to exit.

Comfort / CrNi / Steel control panel

Difference between Comfort, CrNi and Steel control panels

The Comfort, CrNi and Steel control panels are identical except for the type of material used in their construction. The following section deals specifically with the Comfort control panel, but all the functions descriped apply equally to the CrNi and Steel control panels.

Comfort control panel



No.	Function
(1)	**Feeder inching button** for feeding the wire electrode into the torch-hosepack without any flow of gas or current For information on the various wire feed sequences that are possible when the welder presses and holds the "Feeder inching" button, see the Fdi parameter in the Setup menu.
(2)	**Keylock switch (optional)** When the key is in the horizontal position, the following functions are disabled: - Selecting the welding process using the Process button(s) (22) - Selecting the mode using the Mode button(s) (23) - Selecting the filler metal using the Material button(s) (24) - Opening the Setup menu using the Store button (27) - Opening the job correction menu (see “Job mode”)

No.	Function
	NOTE! The functions available on the control panel of system components are restricted in the same way as those of the control panel on the power source.
(3)	**Parameter selection button** for selecting the following parameters: **a-dimension**[1)] depending on the set welding speed **Sheet thickness**[1)] Sheet thickness in mm or in. **Welding current**[1)] Welding current in A Before the start of welding, the machine automatically displays a standard value based on the programmed parameters. During welding, the actual value is displayed. **Wire feed speed**[1)] Wire feed speed in m/min or ipm. **F1 indicator** indicates that the PushPull drive is switched on **Wire-feed unit drive current-input indicator** indicates that the wire-feed unit drive is switched on If the indicators are lit up on the parameter selection button (3) and on the adjusting dial (21), then the indicated / selected parameter can be altered using the adjusting dial (21). [1)] The synergic function means that if one of these parameters is selected during MIG/MAG pulse synergic welding or MIG/MAG standard synergic welding, then all other parameters including the welding voltage parameter are automatically set as well.
(4)	**F1 indicator LED** lights up when the F1 indicator parameter is selected
(5)	**Wire-feed unit drive current-input indicator LED** lights up when the wire-feed unit drive current-input indicator parameter is selected
(6)	**a-dimension LED** lights up when the a-dimension parameter is selected
(7)	**Left digital display**
(8)	**Sheet thickness LED** lights up when the sheet thickness parameter is selected
(9)	**Welding current LED** lights up when the welding current parameter is selected
(10)	**Wire feed speed LED** lights up when the wire feed speed parameter is selected
(11)	**Overtemperature indicator** lights up if the power source overheats (e.g. because the duty cycle has been exceeded). For more information on this, see the "Troubleshooting" section.
(12)	**HOLD indicator** every time a welding operation finishes, the actual values for welding current and welding voltage are stored, and the HOLD indicator lights up.
(13)	**Arc length correction LED** lights up when the arc length correction parameter is selected

No.	Function
(14)	**Droplet detachment correction/arc force dynamic correction/arc force dynamic LED** lights up when the Droplet detachment correction/arc force dynamic correction/ arc force dynamic parameter is selected
(15)	**Welding voltage LED** lights up when the welding voltage parameter is selected
(16)	**Welding speed LED** lights up when the welding speed parameter is selected
(17)	**Right digital display**
(18)	**Job no. LED** lights up when the job number parameter is selected
(19)	**F3 indicator LED** lights up when the F3 indicator parameter is selected
(20)	**Parameter selection button** for selecting the following parameters:  **Arc length correction** for correcting the arc length  **Droplet detachment correction/arc force dynamic correction/arc force dynamic** has a different function assigned to it, depending on the process being used. A description of the various functions can be found in the Welding chapter under the corresponding process.  **Welding voltage** Welding voltage in V Before the start of welding, the machine automatically displays a standard value based on the programmed parameters. During welding, the actual value is displayed.  **Welding speed** Welding speed in cm/min or ipm (necessary for the a-dimension parameter)  **Job N°** In the job mode process for retrieving parameter records stored under job numbers  **F3 indicator** for displaying the coolant flow rate with an FK 4000 Rob cooling unit If the indicators are lit up on the parameter selection button (20) and on the adjusting dial (21), then the indicated / selected parameter can be altered using the adjusting dial (21).
(21)	**Adjusting dial** for altering welding parameters. If the indicator on the adjusting dial is lit up, then the selected parameter is one that can be altered.
(22)	**Process button(s)** for selecting the welding process  MIG/MAG pulse synergic welding  MIG/MAG standard synergic welding  MIG/MAG standard manual welding  Job mode  TIG welding with touchdown ignition  Manual metal arc welding When a process is selected, the LED on the relevant symbol lights up.

No.	Function
(23)	**Mode button** for selecting the mode  2-step mode  4-step mode  Special 4-step mode (aluminium welding start-up)  Spot welding mode  Operating mode When a mode is selected, the LED behind the relevant symbol lights up.
(24)	**Material button** for selecting the filler metal and shielding gas to be used. Parameters SP1 and SP2 are reserved for additional materials. When a material is selected, the LED behind the relevant filler metal lights up.
(25)	**Wire diameter button** for selecting the diameter of the wire to be used. Parameter SP is reserved for additional wire diameters. When a wire diameter is selected, the LED behind the relevant wire diameter lights up.
(26)	**Intermediate arc indicator** a spatter-prone intermediate arc occurs between the short arc and the spray arc. The intermediate arc indicator lights up to alert you to this critical area
(27)	**Store button** for opening the Setup menu
(28)	**Gas test button** for setting the required gas flow rate on the pressure regulator. Gas will flow out for 30 s after pressing the gas test button. Press the button again to stop the gas test flow before the end of this period.

Key combinations - special functions

The following special functions can be called by pressing buttons simultaneously or repeatedly.

Displaying the feeder inching speed

The set feeder inching speed is shown
(e.g.: Fdi | 10 m/min or Fdi | 393.70 ipm).

Use the adjusting dial to change the feeder inching speed

Press the Store button to exit.

Displaying the gas pre-flow and gas post-flow time

The set gas pre-flow time is displayed (e.g. GPr | 0.1 s)

Use the adjusting dial to change the gas pre-flow time

Then press the Process button (22) to display the gas post-flow time setting (e.g. GPo | 0.5 s)

Use the adjusting dial to change the gas post-flow time

Press the Store button to exit.

Displaying the software version

In addition to the software version, these special functions can also be used to display the version number of the welding database, the wire-feed unit number, the software version of the wire-feed unit and the arc burning time.

The software version is displayed

Press the Material button (24) to display the version number of the welding database
(e.g.: 0 | 029 = M0029).

Press the Material button (24) again to display the number of the wire-feed unit (A or B in the case of twin-head mounts) and the software version of the wire-feed unit
(e.g.: A 1.5 | 0.23).

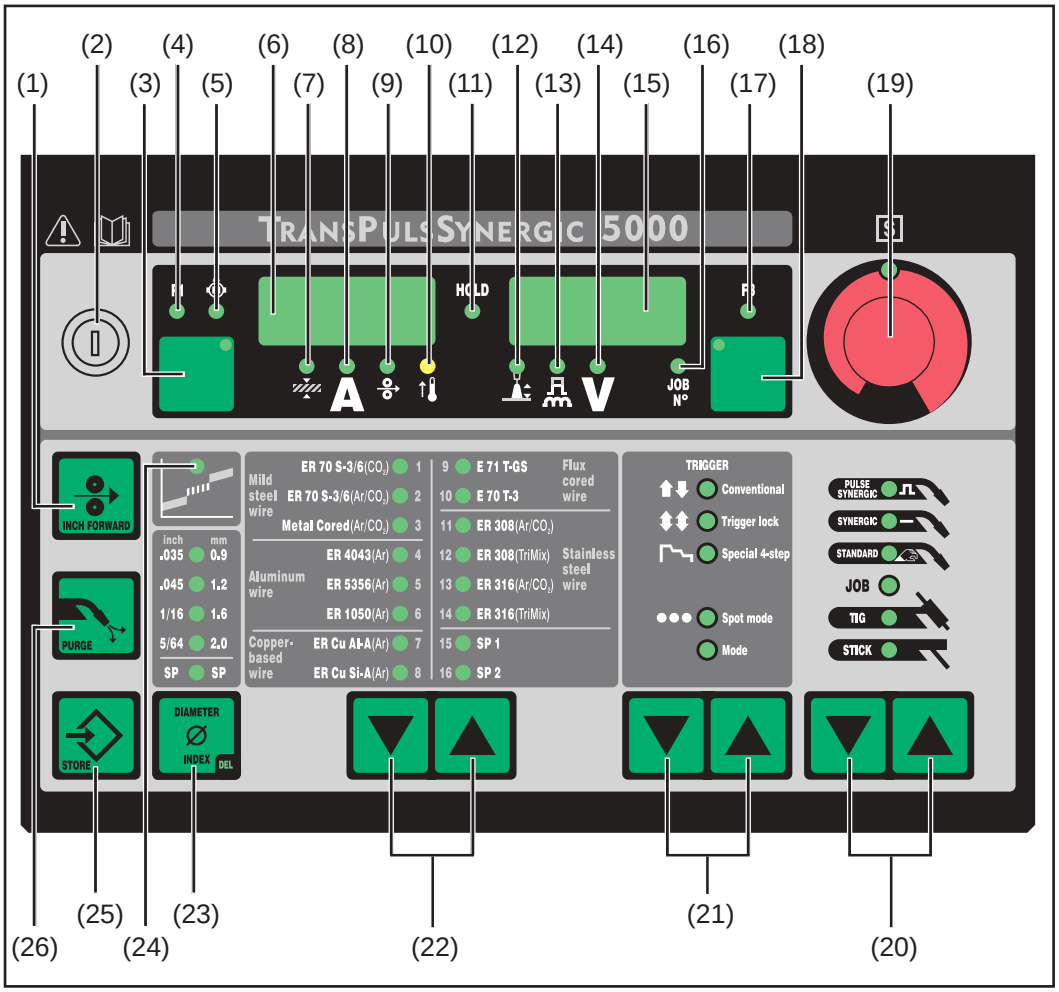
Press the Material button (24) a third time to display the actual arc burning time since starting for the first time (e.g. "654 | 32.1" = 65,432.1 h = 65,432 h, 6 min)

NOTE! The arc burning time indicator is not suitable as a basis for calculating hiring fees, guarantee, etc.

Press the Store button to exit.

US control panel

US control panel



No.	Function
(1)	**Inch Forward (feeder inching) button** for feeding the wire electrode into the torch-hosepack with no accompanying flow of gas or current For information on the various wire feed sequences that are possible when the welder presses and holds the "Feeder inching" button, see the Fdi parameter in the Setup menu.
(2)	**Keylock switch (optional)** When the key is in the horizontal position, the following functions are disabled: - Selecting the welding process using the Process button(s) (20) - Selecting the mode using the Mode button(s) (21) - Selecting the filler metal using the Material button(s) (22) - Opening the Setup menu using the Store button (25) - Opening the job correction menu (see “Job mode”) **NOTE!** The functions available on the control panel of system components are restricted in the same way as those of the control panel on the power source.

No.	Function
(3)	**Parameter selection button** for selecting the following parameters: **Sheet thickness**[1)] Sheet thickness in mm or in. **Welding current**[1)] Welding current in A Before the start of welding, the machine automatically displays a standard value based on the programmed parameters. During welding, the actual value is displayed. **Wire feed speed**[1)] Wire feed speed in m/min or ipm. **F1 indicator** indicates that the PushPull drive is switched on **Wire-feed unit drive current-input indicator** indicates that the wire-feed unit drive is switched on If the indicators are lit up on the parameter selection button (3) and on the adjusting dial (19), then the indicated / selected parameter can be altered using the adjusting dial (19). 1) The synergic function means that if one of these parameters is selected during MIG/MAG pulse synergic welding or MIG/MAG standard synergic welding, then all other parameters including the welding voltage parameter are automatically set as well.
(4)	**F1 indicator LED** lights up when the F1 indicator parameter is selected
(5)	**Wire-feed unit drive current-input indicator LED** lights up when the wire-feed unit drive current-input indicator parameter is selected
(6)	**Left digital display**
(7)	**Sheet thickness LED** lights up when the sheet thickness parameter is selected
(8)	**Welding current LED** lights up when the welding current parameter is selected
(9)	**Wire feed speed LED** lights up when the wire feed speed parameter is selected
(10)	**Overtemperature indicator** lights up if the power source overheats (e.g. because the duty cycle has been exceeded). For more information on this, see the "Troubleshooting" section.
(11)	**HOLD indicator** every time a welding operation finishes, the actual values for welding current and welding voltage are stored, and the HOLD indicator lights up.
(12)	**Arc length correction LED** lights up when the arc length correction parameter is selected
(13)	**Droplet detachment correction/arc force dynamic correction/arc force dynamic LED** lights up when the Droplet detachment correction/arc force dynamic correction/ arc force dynamic parameter is selected
(14)	**Welding voltage LED** lights up when the welding voltage parameter is selected
(15)	**Right digital display**
(16)	**Job no. LED** lights up when the job number parameter is selected

No.	Function
(17)	**F3 indicator LED** lights up when the F3 indicator parameter is selected
(18)	**Parameter selection button** for selecting the following parameters:  **Arc length correction** for correcting the arc length  **Droplet detachment correction/arc force dynamic correction/arc force dynamic** has a different function assigned to it, depending on the process being used. A description of the various functions can be found in the Welding chapter under the corresponding process.  **Welding voltage** Welding voltage in V Before the start of welding, the machine automatically displays a standard value based on the programmed parameters. During welding, the actual value is displayed.  **Job N°** In the job mode process for retrieving parameter records stored under job numbers  **F3 indicator** for displaying the coolant flow rate with an FK 4000 Rob cooling unit If the indicators are lit up on the parameter selection button (18) and on the adjusting dial (19), then the indicated / selected parameter can be altered using the adjusting dial (19).
(19)	**Adjusting dial** for altering welding parameters. If the indicator on the adjusting dial is lit up, then the selected parameter is one that can be altered.
(20)	**Process button(s)** for selecting the welding process  MIG/MAG pulse synergic welding  MIG/MAG standard synergic welding  MIG/MAG standard manual welding  Job mode  TIG welding with touchdown ignition  Manual metal arc welding When a process is selected, the LED on the relevant symbol lights up.
(21)	**Mode button** for selecting the mode  2-step mode  4-step mode  Special 4-step mode (aluminium welding start-up)  Spot welding mode  Operating mode When a mode is selected, the LED behind the relevant symbol lights up.
(22)	**Material button** for selecting the filler metal and shielding gas to be used. Parameters SP1 and SP2 are reserved for additional materials. When a material is selected, the LED behind the relevant filler metal lights up.

No.	Function
(23)	**Diameter / Index (wire diameter) button** for selecting the diameter of the wire to be used. Parameter SP is reserved for additional wire diameters. When a wire diameter is selected, the LED behind the relevant wire diameter lights up.
(24)	**Intermediate arc indicator** a spatter-prone intermediate arc occurs between the short arc and the spray arc. The intermediate arc indicator lights up to alert you to this critical area
(25)	**Store button** for opening the Setup menu
(26)	**Purge (Gas test) button** for setting the required gas flow rate on the pressure regulator. Gas will flow out for 30 s after pressing the gas test button. Press the button again to stop the gas test flow before the end of this period.

Key combinations - special functions

The following special functions can be called by pressing buttons simultaneously or repeatedly.

Displaying the feeder inching speed

The set feeder inching speed is shown (e.g.: Fdi | 10 m/min or Fdi | 393.70 ipm).

Use the adjusting dial to change the feeder inching speed

Press the Store button to exit.

Displaying the gas pre-flow and gas post-flow time

The set gas pre-flow time is displayed (e.g. GPr | 0.1 s)

Use the adjusting dial to change the gas pre-flow time

Then press the Process button (20) to display the gas post-flow time setting (e.g. GPo | 0.5 s)

Use the adjusting dial to change the gas post-flow time

Press the Store button to exit.

Displaying the software version

In addition to the software version, these special functions can also be used to display the version number of the welding database, the wire-feed unit number, the software version of the wire-feed unit and the arc burning time.

The software version is displayed

Press the Material button (22) to display the version number of the welding database
(e.g.: 0 | 029 = M0029).

Press the Material button (22) again to display the number of the wire-feed unit (A or B in the case of twin-head mounts) and the software version of the wire-feed unit
(e.g.: A 1.5 | 0.23).

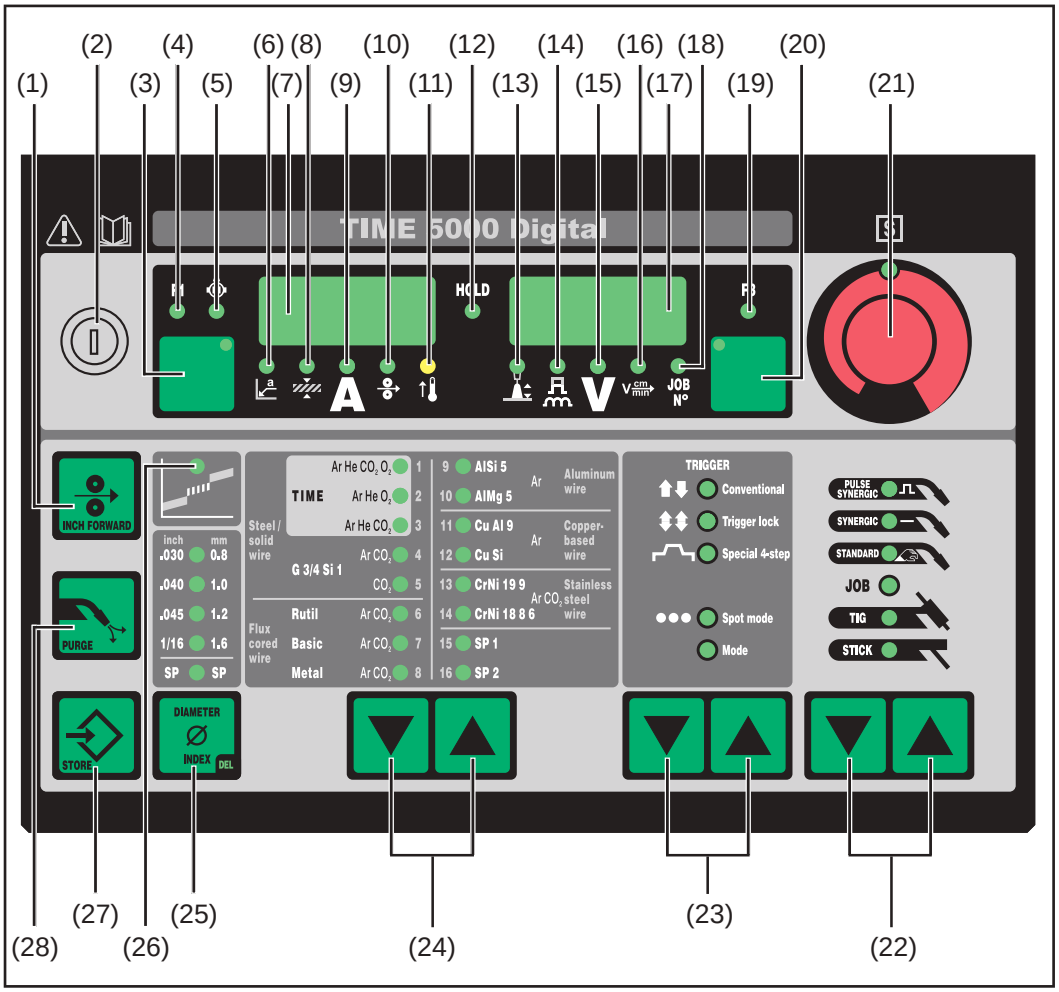
Press the Material button (22) a third time to display the actual arc burning time since starting for the first time (e.g. "654 | 32.1" = 65,432.1 h = 65,432 h, 6 min)

NOTE! The arc burning time indicator is not suitable as a basis for calculating hiring fees, guarantee, etc.

Press the Store button to exit.

TIME 5000 Digital control panel

TIME 5000 Digital control panel



No.	Function
(1)	**Inch Forward (feeder inching) button** for feeding the wire electrode into the torch-hosepack with no accompanying flow of gas or current For information on the various wire feed sequences that are possible when the welder presses and holds the "Feeder inching" button, see the Fdi parameter in the Setup menu.
(2)	**Keylock switch (optional)** When the key is in the horizontal position, the following functions are disabled: - Selecting the welding process using the Process button(s) (20) - Selecting the mode using the Mode button(s) (21) - Selecting the filler metal using the Material button(s) (22) - Opening the Setup menu using the Store button (25) - Opening the job correction menu (see “Job mode”) **NOTE!** The functions available on the control panel of system components are restricted in the same way as those of the control panel on the power source.

No.	Function
(3)	**Parameter selection button** for selecting the following parameters:  **a-dimension**[1)] depending on the set welding speed  **Sheet thickness**[1)] Sheet thickness in mm or in.  **Welding current**[1)] Welding current in A Before the start of welding, the machine automatically displays a standard value based on the programmed parameters. During welding, the actual value is displayed.  **Wire feed speed**[1)] Wire feed speed in m/min or ipm.  **F1 indicator** indicates that the PushPull drive is switched on  **Wire-feed unit drive current-input indicator** indicates that the wire-feed unit drive is switched on If the indicators are lit up on the parameter selection button (3) and on the adjusting dial (19), then the indicated / selected parameter can be altered using the adjusting dial (19). [1)] The synergic function means that if one of these parameters is selected during MIG/MAG pulse synergic welding or MIG/MAG standard synergic welding, then all other parameters including the welding voltage parameter are automatically set as well.
(4)	**F1 indicator LED** lights up when the F1 indicator parameter is selected
(5)	**Wire-feed unit drive current-input indicator LED** lights up when the wire-feed unit drive current-input indicator parameter is selected
(6)	**a-dimension LED** lights up when the a-dimension parameter is selected
(7)	**Left digital display**
(8)	**Sheet thickness LED** lights up when the sheet thickness parameter is selected
(9)	**Welding current LED** lights up when the welding current parameter is selected
(10)	**Wire feed speed LED** lights up when the wire feed speed parameter is selected
(11)	**Overtemperature indicator** lights up if the power source overheats (e.g. because the duty cycle has been exceeded). For more information on this, see the "Troubleshooting" section.
(12)	**HOLD indicator** every time a welding operation finishes, the actual values for welding current and welding voltage are stored, and the HOLD indicator lights up.
(13)	**Arc length correction LED** lights up when the arc length correction parameter is selected
(14)	**Droplet detachment correction/arc force dynamic correction/arc force dynamic LED** lights up when the Droplet detachment correction/arc force dynamic correction/ arc force dynamic parameter is selected

No.	Function
(15)	**Welding voltage LED** lights up when the welding voltage parameter is selected
(16)	**Welding speed LED** lights up when the welding speed parameter is selected
(17)	**Right digital display**
(18)	**Job no. LED** lights up when the job number parameter is selected
(19)	**F3 indicator LED** lights up when the F3 indicator parameter is selected
(20)	**Parameter selection button** for selecting the following parameters:  **Arc length correction** for correcting the arc length  **Droplet detachment correction/arc force dynamic correction/arc force dynamic** has a different function assigned to it, depending on the process being used. A description of the various functions can be found in the Welding chapter under the corresponding process.  **Welding voltage** Welding voltage in V Before the start of welding, the machine automatically displays a standard value based on the programmed parameters. During welding, the actual value is displayed.  **Welding speed** Welding speed in cm/min or ipm (necessary for the a-dimension parameter)  **Job N^{o}** In the job mode process for retrieving parameter records stored under job numbers  **F3 indicator** for displaying the coolant flow rate with an FK 4000 Rob cooling unit If the indicators are lit up on the parameter selection button (20) and on the adjusting dial (21), then the indicated / selected parameter can be altered using the adjusting dial (21).
(21)	**Adjusting dial** for altering welding parameters. If the indicator on the adjusting dial is lit up, then the selected parameter is one that can be altered.
(22)	**Process button(s)** for selecting the welding process  MIG/MAG pulse synergic welding  MIG/MAG standard synergic welding  MIG/MAG standard manual welding  Job mode  TIG welding with touchdown ignition  Manual metal arc welding When a process is selected, the LED on the relevant symbol lights up.

No.	Function
(23)	**Mode button** for selecting the mode  2-step mode  4-step mode  Special 4-step mode (aluminium welding start-up)  Spot welding mode  Operating mode When a mode is selected, the LED behind the relevant symbol lights up.
(24)	**Material button** for selecting the filler metal and shielding gas to be used. Parameters SP1 and SP2 are reserved for additional materials. When a material is selected, the LED behind the relevant filler metal lights up.
(25)	**Diameter / Index (wire diameter) button** for selecting the diameter of the wire to be used. Parameter SP is reserved for additional wire diameters. When a wire diameter is selected, the LED behind the relevant wire diameter lights up.
(26)	**Intermediate arc indicator** a spatter-prone intermediate arc occurs between the short arc and the spray arc. The intermediate arc indicator lights up to alert you to this critical area
(27)	**Store button** for opening the Setup menu
(28)	**Purge (Gas test) button** for setting the required gas flow rate on the pressure regulator. Gas will flow out for 30 s after pressing the gas test button. Press the button again to stop the gas test flow before the end of this period.

Key combinations - special functions

The following special functions can be called by pressing buttons simultaneously or repeatedly.

Displaying the feeder inching speed

 The set feeder inching speed is shown (e.g.: Fdi | 10 m/min or Fdi | 393.70 ipm).

 Use the adjusting dial to change the feeder inching speed

 Press the Store button to exit.

Displaying the gas pre-flow and gas post-flow time

The set gas pre-flow time is displayed (e.g. GPr | 0.1 s)

Use the adjusting dial to change the gas pre-flow time

Then press the Process button (20) to display the gas post-flow time setting (e.g. GPo | 0.5 s)

Use the adjusting dial to change the gas post-flow time

Press the Store button to exit.

Displaying the software version

In addition to the software version, these special functions can also be used to display the version number of the welding database, the wire-feed unit number, the software version of the wire-feed unit and the arc burning time.

The software version is displayed

Press the Material button (24) to display the version number of the welding database
(e.g.: 0 | 029 = M0029).

Press the Material button (24) again to display the number of the wire-feed unit (A or B in the case of twin-head mounts) and the software version of the wire-feed unit
(e.g.: A 1.5 | 0.23).

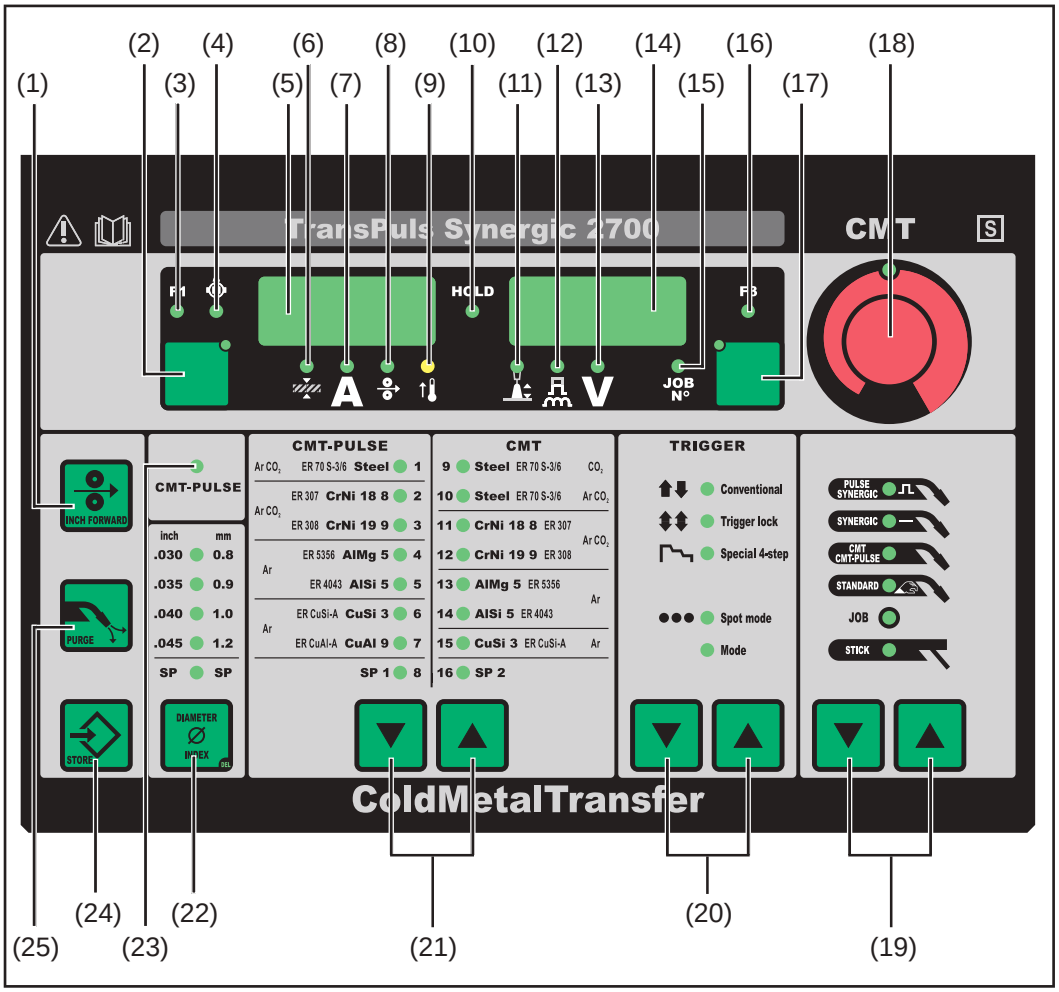
Press the Material button (24) a third time to display the actual arc burning time since starting for the first time (e.g. "654 | 32.1" = 65,432.1 h = 65,432 h, 6 min)

NOTE! The arc burning time indicator is not suitable as a basis for calculating hiring fees, guarantee, etc.

Press the Store button to exit.

CMT control panel

CMT control panel



No.	Function
(1)	**Inch Forward (feeder inching) button** for feeding the wire electrode into the torch-hosepack with no accompanying flow of gas or current For information on the various wire feed sequences that are possible when the welder presses and holds the "Feeder inching" button, see the Fdi parameter in the Setup menu.
(2)	**Parameter selection button** for selecting the following parameters: **Sheet thickness**[1)] Sheet thickness in mm or in. **Welding current**[1)] Welding current in A Before the start of welding, the machine automatically displays a standard value based on the programmed parameters. During welding, the actual value is displayed. **Wire feed speed**[1)] Wire feed speed in m/min or ipm. **F1 indicator** indicates that the PushPull drive is switched on

No.	Function
	Wire-feed unit drive current-input indicator indicates that the wire-feed unit drive is switched on If the indicators are lit up on the parameter selection button (3) and on the adjusting dial (19), then the indicated / selected parameter can be altered using the adjusting dial (19). 1) The synergic function means that if one of these parameters is selected during MIG/MAG pulse synergic welding or MIG/MAG standard synergic welding, then all other parameters including the welding voltage parameter are automatically set as well.
(3)	**F1 indicator LED** lights up when the F1 indicator parameter is selected
(4)	**Wire-feed unit drive current-input indicator LED** lights up when the wire-feed unit drive current-input indicator parameter is selected
(5)	**Left digital display**
(6)	**Sheet thickness LED** lights up when the sheet thickness parameter is selected
(7)	**Welding current LED** lights up when the welding current parameter is selected
(8)	**Wire feed speed LED** lights up when the wire feed speed parameter is selected
(9)	**Overtemperature indicator** lights up if the power source overheats (e.g. because the duty cycle has been exceeded). For more information on this, see the "Troubleshooting" section.
(10)	**HOLD indicator** every time a welding operation finishes, the actual values for welding current and welding voltage are stored, and the HOLD indicator lights up.
(11)	**Arc length correction LED** lights up when the arc length correction parameter is selected
(12)	**Droplet detachment correction/arc force dynamic correction/arc force dynamic LED** lights up when the Droplet detachment correction/arc force dynamic correction/ arc force dynamic parameter is selected
(13)	**Welding voltage LED** lights up when the welding voltage parameter is selected
(14)	**Right digital display**
(15)	**Job no. LED** lights up when the job number parameter is selected
(16)	**F3 indicator LED** lights up when the F3 indicator parameter is selected

No.	Function
(17)	**Parameter selection button** for selecting the following parameters:  **Arc length correction** for correcting the arc length  **Droplet detachment correction/arc force dynamic correction/arc force dynamic** has a different function assigned to it, depending on the process being used. A description of the various functions can be found in the Welding chapter under the corresponding process.  **Welding voltage** Welding voltage in V Before the start of welding, the machine automatically displays a standard value based on the programmed parameters. During welding, the actual value is displayed.  **Job N°** In the job mode process for retrieving parameter records stored under job numbers  **F3 indicator** for displaying the coolant flow rate with an FK 4000 Rob cooling unit If the indicators are lit up on the parameter selection button (17) and on the adjusting dial (18), then the indicated / selected parameter can be altered using the adjusting dial (18).
(18)	**Adjusting dial** for altering welding parameters. If the indicator on the adjusting dial is lit up, then the selected parameter is one that can be altered.
(19)	**Process button(s)** for selecting the welding process  MIG/MAG pulse synergic welding  MIG/MAG standard synergic welding  CMT, CMT pulse  MIG/MAG standard manual welding  Job mode  Manual metal arc welding When a process is selected, the LED on the relevant symbol lights up.
(20)	**Mode button** for selecting the mode  2-step mode  4-step mode  Special 4-step mode (aluminium welding start-up)  Spot welding mode  Operating mode When a mode is selected, the LED behind the relevant symbol lights up.
(21)	**Material button** for selecting the filler metal and shielding gas to be used. Parameters SP1 and SP2 are reserved for additional materials. When a material is selected, the LED behind the relevant filler metal lights up.

No.	Function
(22)	**Diameter / Index (wire diameter) button** for selecting the diameter of the wire to be used. Parameter SP is reserved for additional wire diameters. When a wire diameter is selected, the LED behind the relevant wire diameter lights up.
(23)	**CMT Pulse indicator** lights up when a CMT/pulse characteristic is selected
(24)	**Store button** for opening the Setup menu
(25)	**Purge (Gas test) button** for setting the required gas flow rate on the pressure regulator. Gas will flow out for 30 s after pressing the gas test button. Press the button again to stop the gas test flow before the end of this period.

Key combinations - special functions

The following special functions can be called by pressing buttons simultaneously or repeatedly.

Displaying the feeder inching speed

The set feeder inching speed is shown (e.g.: Fdi | 10 m/min or Fdi | 393.70 ipm).

Use the adjusting dial to change the feeder inching speed

Press the Store button to exit.

Displaying the gas pre-flow and gas post-flow time

The set gas pre-flow time is displayed (e.g. GPr | 0.1 s)

Use the adjusting dial to change the gas pre-flow time

Then press the Process button (20) to display the gas post-flow time setting (e.g. GPo | 0.5 s)

Use the adjusting dial to change the gas post-flow time

Press the Store button to exit.

Displaying the software version

In addition to the software version, these special functions can also be used to display the version number of the welding database, the wire-feed unit number, the software version of the wire-feed unit and the arc burning time.

The software version is displayed

Press the Material button (24) to display the version number of the welding database
(e.g.: 0 | 029 = M0029).

Press the Material button (24) again to display the number of the wire-feed unit (A or B in the case of twin-head mounts) and the software version of the wire-feed unit
(e.g.: A 1.5 | 0.23).

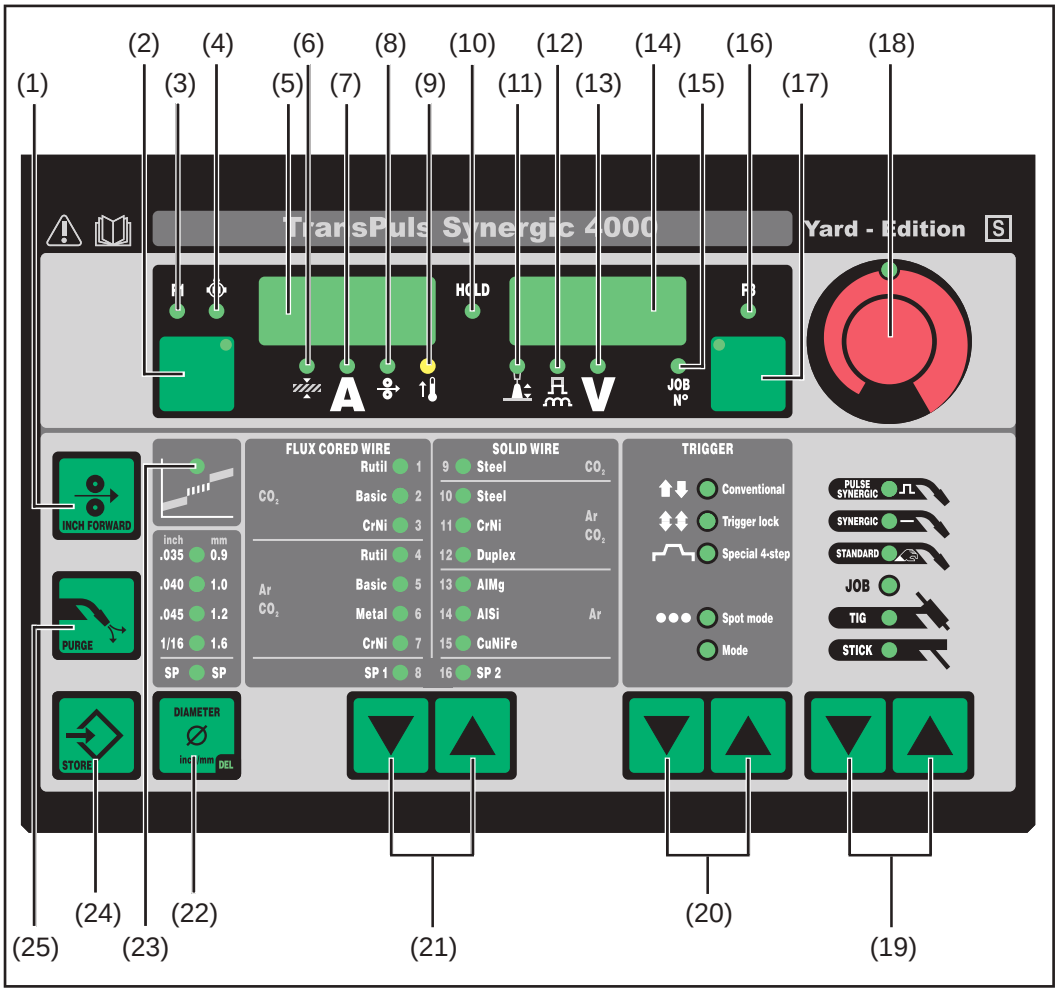
Press the Material button (24) a third time to display the actual arc burning time since starting for the first time (e.g. "654 | 32.1" = 65,432.1 h = 65,432 h, 6 min)

NOTE! The arc burning time indicator is not suitable as a basis for calculating hiring fees, guarantee, etc.

Press the Store button to exit.

Yard control panel

Yard control panel



No.	Function
(1)	**Inch Forward (feeder inching) button** for feeding the wire electrode into the torch-hosepack with no accompanying flow of gas or current For information on the various wire feed sequences that are possible when the welder presses and holds the "Feeder inching" button, see the Fdi parameter in the Setup menu.

No.	Function
(2)	**Parameter selection button** for selecting the following parameters: **Sheet thickness**[1)] Sheet thickness in mm or in. **Welding current**[1)] Welding current in A Before the start of welding, the machine automatically displays a standard value based on the programmed parameters. During welding, the actual value is displayed. **Wire feed speed**[1)] Wire feed speed in m/min or ipm. **F1 indicator** indicates that the PushPull drive is switched on **Wire-feed unit drive current-input indicator** indicates that the wire-feed unit drive is switched on If the indicators are lit up on the parameter selection button (2) and on the adjusting dial (18), then the indicated / selected parameter can be altered using the adjusting dial (18). 1) The synergic function means that if one of these parameters is selected during MIG/MAG pulse synergic welding or MIG/MAG standard synergic welding, then all other parameters including the welding voltage parameter are automatically set as well.
(3)	**F1 indicator LED** lights up when the F1 indicator parameter is selected
(4)	**Wire-feed unit drive current-input indicator LED** lights up when the wire-feed unit drive current-input indicator parameter is selected
(5)	**Left digital display**
(6)	**Sheet thickness LED** lights up when the sheet thickness parameter is selected
(7)	**Welding current LED** lights up when the welding current parameter is selected
(8)	**Wire feed speed LED** lights up when the wire feed speed parameter is selected
(9)	**Overtemperature indicator** lights up if the power source overheats (e.g. because the duty cycle has been exceeded). For more information on this, see the "Troubleshooting" section.
(10)	**HOLD indicator** every time a welding operation finishes, the actual values for welding current and welding voltage are stored, and the HOLD indicator lights up.
(11)	**Arc length correction LED** lights up when the arc length correction parameter is selected
(12)	**Droplet detachment correction/arc force dynamic correction/arc force dynamic LED** lights up when the Droplet detachment correction/arc force dynamic correction/ arc force dynamic parameter is selected
(13)	**Welding voltage LED** lights up when the welding voltage parameter is selected
(14)	**Right digital display**
(15)	**Job no. LED** lights up when the job number parameter is selected

No.	Function
(16)	**F3 indicator LED** lights up when the F3 indicator parameter is selected
(17)	**Parameter selection button** for selecting the following parameters:  **Arc length correction** for correcting the arc length  **Droplet detachment correction/arc force dynamic correction/arc force dynamic** has a different function assigned to it, depending on the process being used. A description of the various functions can be found in the Welding chapter under the corresponding process.  **Welding voltage** Welding voltage in V Before the start of welding, the machine automatically displays a standard value based on the programmed parameters. During welding, the actual value is displayed.  **Job N°** In the job mode process for retrieving parameter records stored under job numbers  **F3 indicator** for displaying the coolant flow rate with an FK 4000 Rob cooling unit If the indicators are lit up on the parameter selection button (17) and on the adjusting dial (18), then the indicated / selected parameter can be altered using the adjusting dial (18).
(18)	**Adjusting dial** for altering welding parameters. If the indicator on the adjusting dial is lit up, then the selected parameter is one that can be altered.
(19)	**Process button(s)** for selecting the welding process  MIG/MAG pulse synergic welding  MIG/MAG standard synergic welding  MIG/MAG standard manual welding  Job mode  TIG welding with touchdown ignition  Manual metal arc welding When a process is selected, the LED on the relevant symbol lights up.
(20)	**Mode button** for selecting the mode  2-step mode  4-step mode  Special 4-step mode (aluminium welding start-up)  Spot welding mode  Operating mode When a mode is selected, the LED behind the relevant symbol lights up.
(21)	**Material button** for selecting the filler metal and shielding gas to be used. Parameters SP1 and SP2 are reserved for additional materials. When a material is selected, the LED behind the relevant filler metal lights up.

No.	Function
(22)	**Diameter / Index (wire diameter) button** for selecting the diameter of the wire to be used. Parameter SP is reserved for additional wire diameters. When a wire diameter is selected, the LED behind the relevant wire diameter lights up.
(23)	**Intermediate arc indicator** a spatter-prone intermediate arc occurs between the short arc and the spray arc. The intermediate arc indicator lights up to alert you to this critical area
(24)	**Store button** for opening the Setup menu
(25)	**Purge (Gas test) button** for setting the required gas flow rate on the pressure regulator. Gas will flow out for 30 s after pressing the gas test button. Press the button again to stop the gas test flow before the end of this period.

Key combinations - special functions

The following special functions can be called by pressing buttons simultaneously or repeatedly.

Displaying the feeder inching speed

The set feeder inching speed is shown (e.g.: Fdi | 10 m/min or Fdi | 393.70 ipm).

Use the adjusting dial to change the feeder inching speed

Press the Store button to exit.

Displaying the gas pre-flow and gas post-flow time

The set gas pre-flow time is displayed (e.g. GPr | 0.1 s)

Use the adjusting dial to change the gas pre-flow time

Then press the Process button (20) to display the gas post-flow time setting (e.g. GPo | 0.5 s)

Use the adjusting dial to change the gas post-flow time

Press the Store button to exit.

Displaying the software version

In addition to the software version, these special functions can also be used to display the version number of the welding database, the wire-feed unit number, the software version of the wire-feed unit and the arc burning time.

The software version is displayed

Press the Material button (24) to display the version number of the welding database
(e.g.: 0 | 029 = M0029).

Press the Material button (24) again to display the number of the wire-feed unit (A or B in the case of twin-head mounts) and the software version of the wire-feed unit
(e.g.: A 1.5 | 0.23).

Press the Material button (24) a third time to display the actual arc burning time since starting for the first time (e.g. "654 | 32.1" = 65,432.1 h = 65,432 h, 6 min)

NOTE! The arc burning time indicator is not suitable as a basis for calculating hiring fees, guarantee, etc.

Press the Store button to exit.

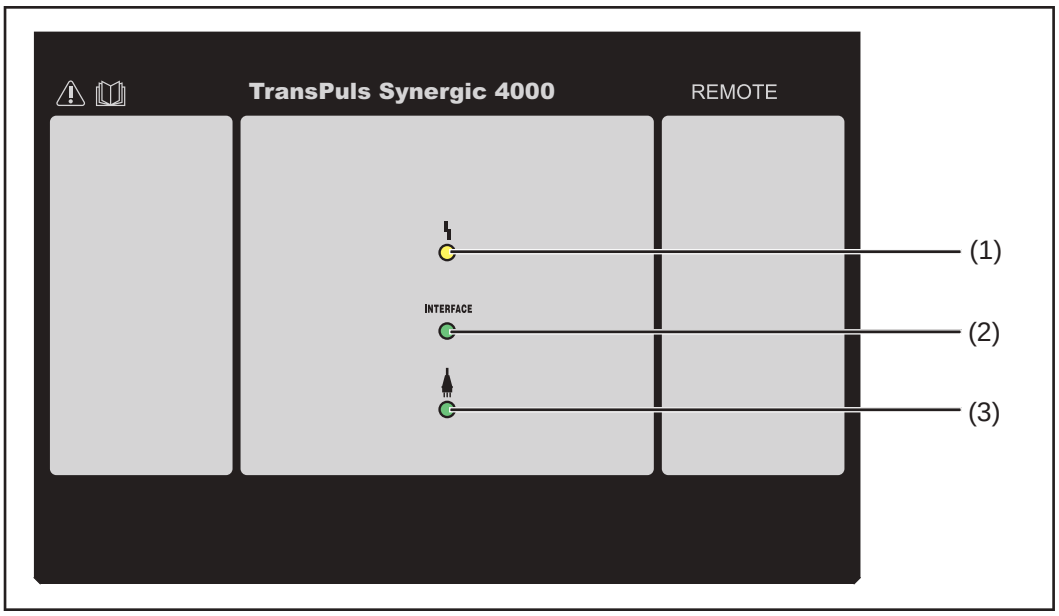
“Remote” control panel

General

The Remote operating panel is fitted to the Remote power source. The Remote power source is designed for automated and robot applications and is controlled exclusively via the LocalNet.

The Remote power source can be operated via the following system add-ons:
- Remote controls
- Robot interfaces
- Field bus systems

Remote control panel



No.	Function
(1)	**Error indicator** lights up if an error has occurred. The corresponding error message is displayed on all devices connected to the LocalNet that have a digital display. The error messages displayed are described in the section headed “Trouble-shooting”.
(2)	**Robot interface indicator** lights up when the power source is switched on and a robot interface or field bus system is connected to the LocalNet
(3)	**Power source ON indicator** lights up for as long as the mains cable is plugged in and the mains switch is in the “I” position

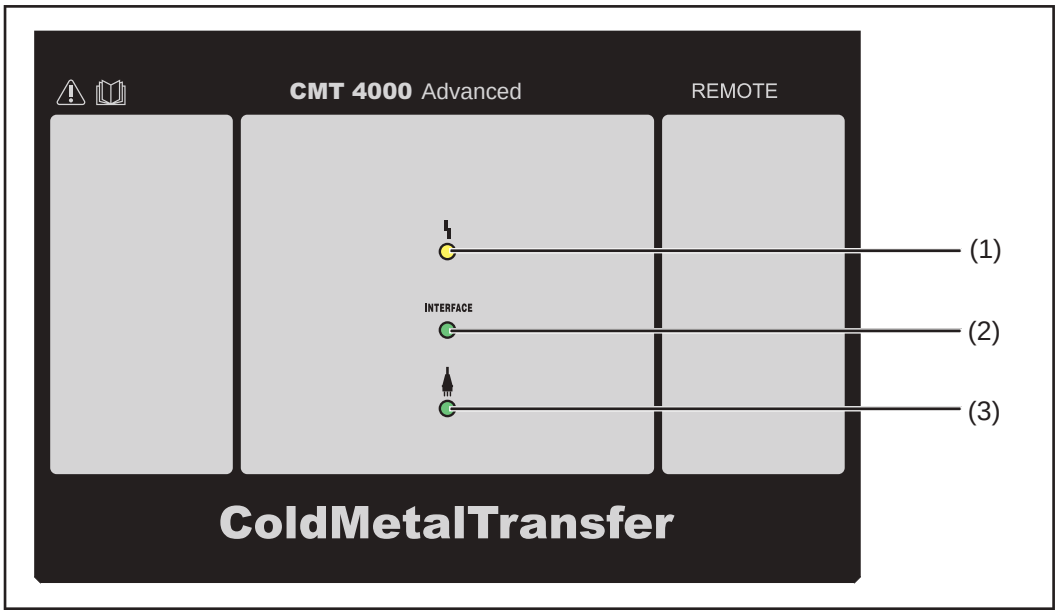
CMT Remote control panel

General

The CMT Remote control panel is fitted to the CMT Remote power source and CMT Advanced power source. The CMT Remote power source and CMT Advanced power source are designed for automated and robot applications and are controlled exclusively via the LocalNet.

The CMT Remote power source and CMT Advanced power source can be operated via the following system add-ons:
- RCU 5000i remote control
- ROB 5000 robot interface
- Field bus systems

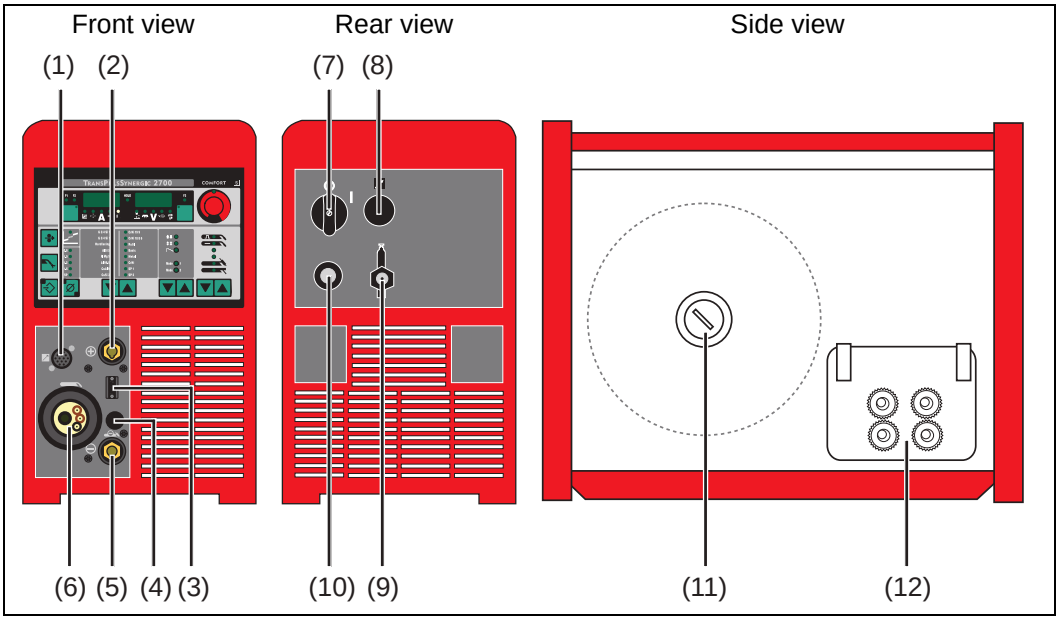
CMT Remote and CMT Advanced control panel



No.	Function
(1)	**Error indicator** lights up if an error has occurred. The corresponding error message is displayed on all devices connected to the LocalNet that have a digital display. The error messages displayed are described in the section headed “Trouble-shooting”.
(2)	**Robot interface indicator** lights up when the power source is switched on and a robot interface or field bus system is connected to the LocalNet
(3)	**Power source ON indicator** lights up for as long as the mains cable is plugged in and the mains switch is in the “I” position

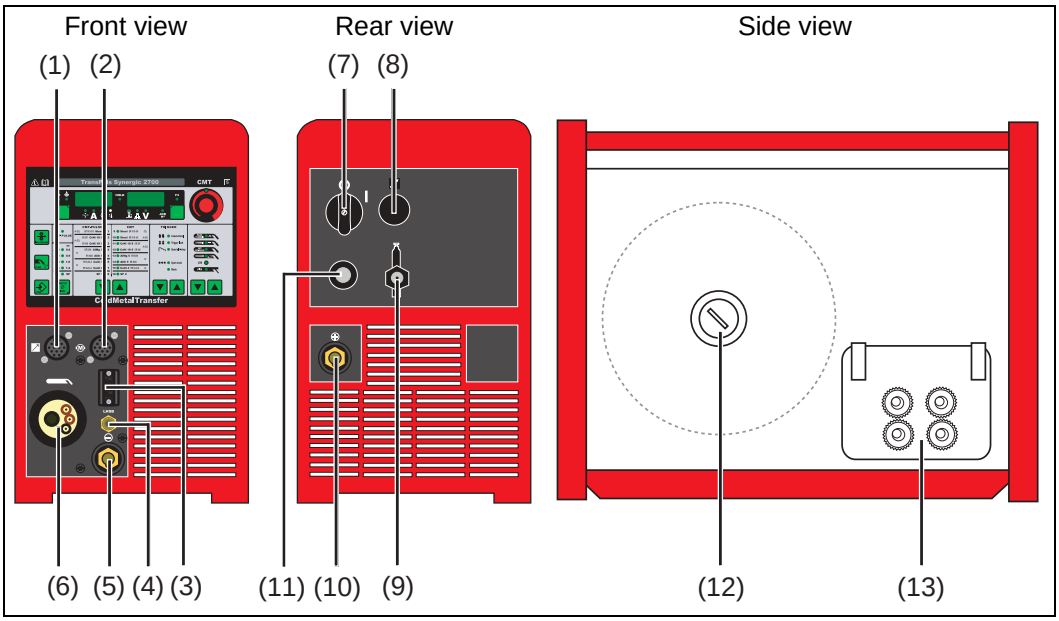
Connections, switches and mechanical components

TPS 2700 power source



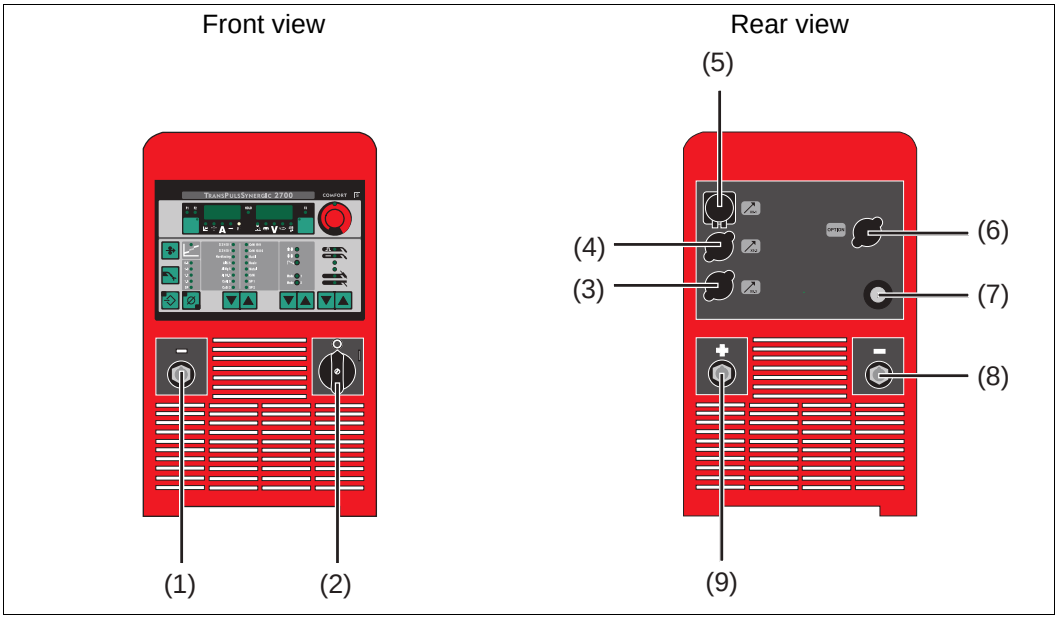
No.	Function
(1)	**LocalNet connection** Standardised connection socket for system add-ons (e.g. remote control, Job-Master torch, etc.)
(2)	**(+) - Current socket with bayonet latch** for: - connecting the grounding (earthing) cable during TIG welding - connecting the electrode cable or grounding (earthing) cable during MMA welding (depending on the type of electrode used)
(3)	**Welding torch control connection** for the welding torch control plug
(4)	**Blanking cover**
(5)	**(-) - Current socket with bayonet latch** for: - connecting the grounding (earthing) cable during MIG/MAG welding - the current connection for the TIG welding torch - connecting the electrode cable or grounding (earthing) cable during MMA welding (depending on the type of electrode used)
(6)	**Welding torch connection** for connecting the welding torch
(7)	**Mains switch** for switching the power source on and off
(8)	**Blanking cover** reserved for a LocalNet connection
(9)	**Shielding gas connection**
(10)	**Mains cable with strain relief device**
(11)	**Wirespool holder with brake** for holding standard wirespools weighing up to 16 kg (35.27 lbs) and with a max. diameter of 300 mm (11.81 in)
(12)	**4 roller drive**

TPS 2700 CMT power source



No.	Function
(1)	**LocalNet connection** Standardised connection socket for system add-ons (e.g. remote control, Job-Master torch, etc.)
(2)	**Motor control connection** for connecting the control line from the CMT drive unit
(3)	**Welding torch control connection** for the welding torch control plug
(4)	**LHSB connection** for connecting the LHSB cable from the CMT drive unit (LHSB = LocalNet High-Speed Bus)
(5)	**(-) - Current socket with bayonet latch** for: - connecting the grounding (earthing) cable during MIG/MAG welding - the current connection for the TIG welding torch - connecting the electrode cable or grounding (earthing) cable during MMA welding (depending on the type of electrode used)
(6)	**Welding torch connection** for connecting the welding torch
(7)	**Mains switch** for switching the power source on and off
(8)	**Blanking cover** reserved for a LocalNet connection
(9)	**Shielding gas connection**
(10)	**(+) - Current socket with bayonet latch** for: - connecting the grounding (earthing) cable during TIG welding - connecting the electrode cable or grounding (earthing) cable during MMA welding (depending on the type of electrode used)
(11)	**Mains cable with strain relief device**
(12)	**Wirespool holder with brake** for holding standard wirespools weighing up to 16 kg (35.27 lbs) and with a max. diameter of 300 mm (11.81 in)
(13)	**4 roller drive**

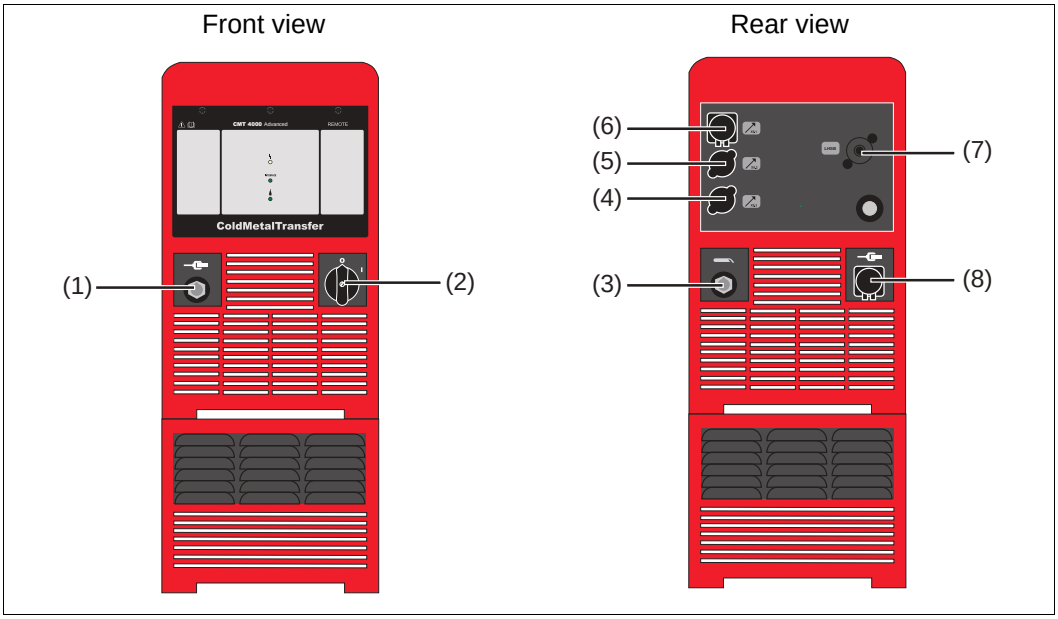
TS 4000 / 5000, TPS 3200 / 4000 / 5000, TIME 5000 Digital power sources



No.	Function
(1)	**(-) - Current socket with bayonet latch** for: - connecting the grounding (earthing) cable during MIG/MAG welding - the current connection for the TIG welding torch - connecting the electrode cable or grounding (earthing) cable during MMA welding (depending on the type of electrode used)
(2)	**Mains switch** for switching the power source on and off
(3)	**Blanking cover** Reserved for LocalNet or LHSB (LocalNet High-Speed Bus) connection
(4)	**Blanking cover** Reserved for LocalNet or LHSB (LocalNet High-Speed Bus) connection
(5)	**LocalNet connection** for interconnecting hosepack
(6)	**Blanking cover** Reserved for LHSB (LocalNet High-Speed Bus) connection The LHSB connection is provided as standard with CMT power sources.
(7)	**Mains cable with strain relief device**

No.	Function
(8)	**Second (-) - Current socket with bayonet latch (optional)** for: - connecting the interconnecting hosepack in MIG/MAG welding for polarity reversal (e.g. for innershield and flux core wire welding) - specially for automated and robot applications where the interconnecting hosepack and grounding (earthing) cable are to be connected to one side of the power source (e.g. in a switch cabinet) **Second (+) - Current socket with bayonet latch (optional)** for connecting a second current cable **Blanking cover** If the second (-) current socket with bayonet latch or second (+) current socket with bayonet latch options are not present on the power source.
(9)	**(+) - Current socket with bayonet latch** for: - connecting the current cable from the interconnecting hosepack during MIG/MAG welding - connecting the grounding (earthing) cable during TIG welding - connecting the electrode cable or grounding (earthing) cable during MMA welding (depending on the type of electrode used)

CMT 4000 Advanced power source



No.	Function
(1)	**Grounding (earthing) cable connection** for: - connecting the grounding (earthing) cable in MIG/MAG welding, CMT welding and CMT Advanced welding - connecting the electrode cable or grounding (earthing) cable during MMA welding (depending on the type of electrode used)
(2)	**Mains switch** for switching the power source on and off
(3)	**Current socket with bayonet latch** for: - connecting the current cable of the interconnecting hosepack in MIG/MAG welding, CMT welding and CMT Advanced welding - connecting the electrode cable or grounding (earthing) cable during MMA welding (depending on the type of electrode used)

No.	Function
(4)	**Blanking cover** Reserved for LocalNet connection
(5)	**Blanking cover** Reserved for LocalNet connection
(6)	**LocalNet connection** for interconnecting hosepack
(7)	**LHSB (LocalNet High-Speed Bus) connection**
(8)	**Mains cable with strain relief device**

Installation and commissioning

Minimum equipment needed for welding task

General

Depending on which welding process you intend to use, a certain minimum equipment level will be needed in order to work with the power source.
The welding processes and the minimum equipment levels required for the welding task are then described.

MIG/MAG gas-cooled welding

- Power source
- Grounding (earthing) cable
- MIG/MAG welding torch, gas-cooled
- Gas connection (shielding gas supply)
- Wire-feed unit (TS 4000 / 5000, TPS 3200 / 4000 / 5000 only)
- Interconnecting hosepack (TS 4000/5000, TPS 3200/4000/5000 only)
- Wire electrode

MIG/MAG water-cooled welding

- Power source
- Cooling unit
- Grounding (earthing) cable
- MIG/MAG welding torch, water-cooled
- Gas connection (shielding gas supply)
- Wire-feed unit (TS 4000 / 5000, TPS 3200 / 4000 / 5000 only)
- Interconnecting hosepack (TS 4000/5000, TPS 3200/4000/5000 only)
- Wire electrode

MIG/MAG automated welding

- Power source (TS 4000 / 5000, TPS 3200 / 4000 / 5000)
- Robot interface or field bus connection
- Grounding (earthing) cable
- MIG/MAG robot welding torch or MIG/MAG machine welding torch (a cooling unit is also required with water-cooled robot or machine welding torches)
- Gas connection (shielding gas supply)
- Wire-feed unit
- Interconnecting hosepack
- Wire electrode

CMT manual welding

- CMT power source
- Grounding (earthing) cable
- CMT welding torch with CMT drive unit and CMT wire buffer (a cooling unit is also required for water-cooled CMT applications)
- CMT wire-feed unit (TPS 3200 / 4000 / 5000 only)
- CMT interconnecting hosepack (TPS 3200 / 4000 / 5000 only)
- Wire electrode
- Gas connection (shielding gas supply)

CMT automated welding	- CMT power source: TPS 3200 / 4000 / 5000 (or CMT remote power source with RCU 5000i remote control) - Robot interface or field bus connection - Grounding (earthing) cable - CMT welding torch incl. CMT drive unit - Cooling unit - CMT wire-feed unit - CMT interconnecting hosepack - CMT wire buffer - Wire electrode - Gas connection (shielding gas supply)
CMT Advanced welding	- CMT 4000 Advanced power source - RCU 5000i remote control - Robot interface or field bus connection - Grounding (earthing) cable - CMT welding torch incl. CMT drive unit - Cooling unit - CMT wire-feed unit - CMT interconnecting hosepack - CMT wire buffer - Wire electrode - Gas connection (shielding gas supply)
TIG DC welding	- Power source - Grounding (earthing) cable - TIG gas valve welding torch - Gas connection (shielding gas supply) - Filler metal (depending on the application)
Manual metal arc welding	- Power source - Grounding (earthing) cable - Electrode holder - Rod electrodes

Before installation and commissioning

Safety

WARNING! Operating the equipment incorrectly can cause serious injury and damage. Do not use the functions described until you have thoroughly read and understood the following documents:
- these operating instructions
- all the operating instructions for the system components, especially the safety rules

Proper use

The power source may only be used for MIG/MAG, MMA and TIG welding. Any use above and beyond this purpose is deemed improper. The manufacturer shall not be held liable for any damage arising from such usage.

Proper use also includes:
- following all the information in the operating instructions
- carrying out all the specified inspection and servicing work

Setup regulations

The device is tested to IP 23 protection, meaning:
- protection against penetration by solid foreign bodies with diameters > 12.5 mm (0.49 in.)
- protection against direct sprays of water at any angle up to 60° from the vertical

The device can be set up and operated outdoors in accordance with IP23. Avoid direct wetting (e.g. from rain).

WARNING! If one of these devices topples over or falls it could cause serious or even fatal injury. Place devices, upright consoles and trolleys on a solid, level surface in such a way that they remain stable.

The venting duct is a very important safety feature. When choosing the installation location, ensure that the cooling air can enter and exit unhindered through the air ducts on the front and back of the device. Any electroconductive metallic dust (e.g. from grinding work) must not be allowed to get sucked into the device.

Mains connection

The devices are designed to run at the mains voltage specified on the rating plate. If your version of the device does not come with mains cables and plugs ready-fitted, these must be fitted in accordance with national regulations and standards. For details of fuse protection of the mains lead, please see the Technical Data.

NOTE! Inadequately dimensioned electrical installations can cause serious damage. The mains lead and its fuse must be dimensioned to suit the local power supply. The technical data shown on the rating plate applies.

Applies to TIME 5000 Digital power source:
The standard mains plug allows the user to operate with a mains voltage of up to 400 V. For mains voltages up to 460 V, fit an approved mains plug or install the mains supply directly.

Connecting up the mains cable on US power sources

General

The US power sources are supplied without a mains cable. A mains cable appropriate for the connection voltage must be fitted prior to commissioning.
A strain-relief device for a cable cross-section AWG 10 is installed on the power source. Strain-relief devices for larger cable cross-sections must be designed accordingly.

Stipulated mains cables and strain-relief devices

Power source	Mains voltage	Cable cross-section
TS 4000 / 5000, TPS 4000 / 5000, CMT 4000 Advanced	3 x 460 V 3 x 230 V	AWG 10 AWG 6
TPS 3200	3 x 460 V 3 x 230 V	AWG 10 AWG 8

AWG ... **A**merican **W**ire **G**auge

Safety

WARNING! Work that is carried out incorrectly can cause serious injury and damage. The following activities must only be carried out by trained and qualified personnel. Pay particular attention to the "Safety rules" sections in the power source and system component operating instructions.

Connecting the mains cable

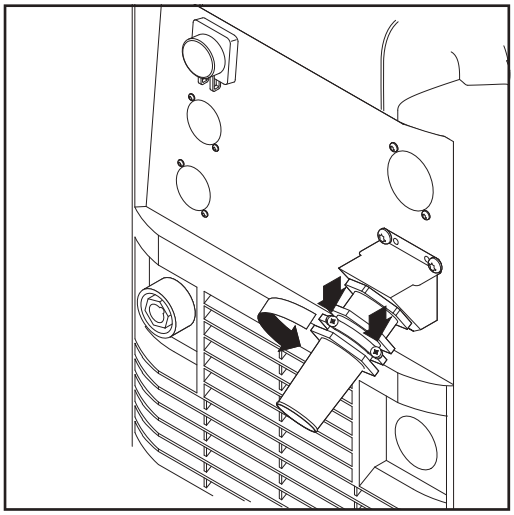
1 Remove the left side panel of the power source

2 Strip about 100 mm (4 in.) of insulation from the end of the mains cable

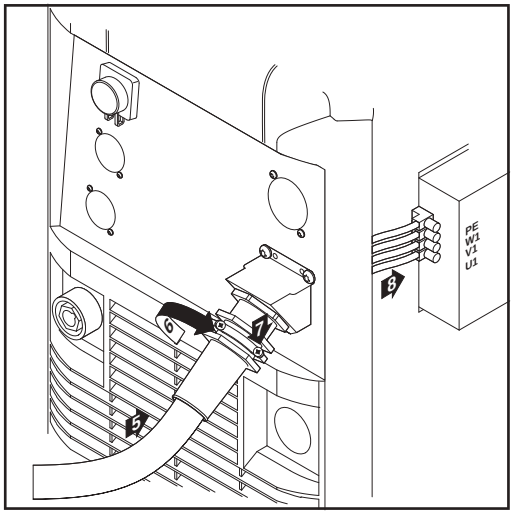
NOTE! The PE conductor (green, or green with yellow stripes) should be approx. 10 - 15 mm (0.4 - 0.6 in.) longer than the phase conductors.

3 Fit ferrules to phase conductors and the PE conductor of the mains cable; crimp ferrules with pliers

NOTE! If ferrules are not used, there is a risk of short circuits between the phase conductors or between phase conductors and the PE conductor. Fit ferrules to all phase conductors and the PE conductor of the stripped mains cable.



4 Undo the screws (2 x) and clamping nut (size 30) on the strain-relief device



5 Insert the mains cable into the strain-relief device

NOTE! Push the mains cable in far enough to make it possible to connect the PE conductor and the phase conductors to the block terminal properly.

6 Tighten the clamping nut (size 30 mm)

7 Tighten the screws (2 x)

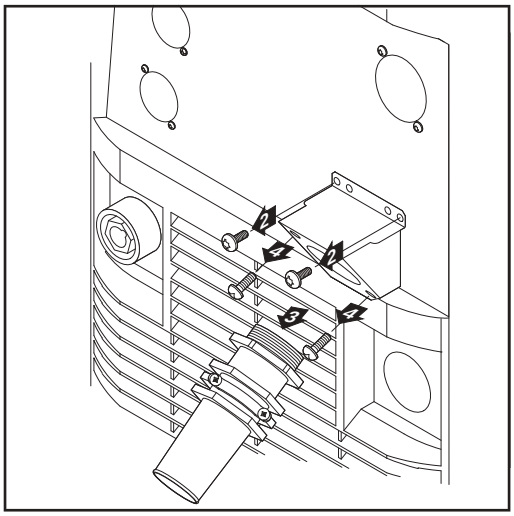
8 Connect the mains cable to the block terminal correctly:

– PE conductor (green, or green with yellow stripes) to the PE connection

– Phase conductors to connections L1 - L3

9 Replace the left side panel of the power source

Replacing the strain-relief device

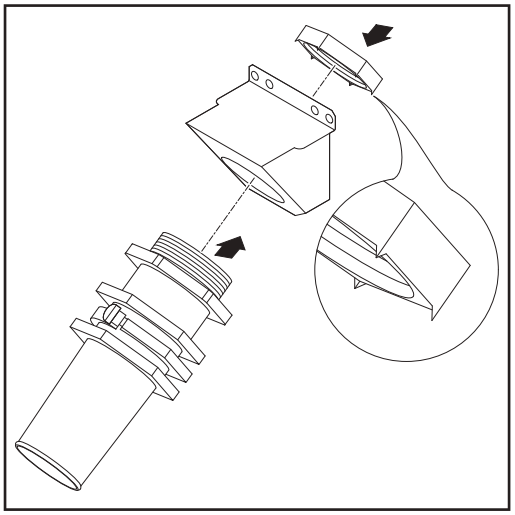


1 Remove the left side panel of the power source

2 Remove the screws (2 x) from the old strain-relief device

3 Pull the old strain-relief device forwards to detach it

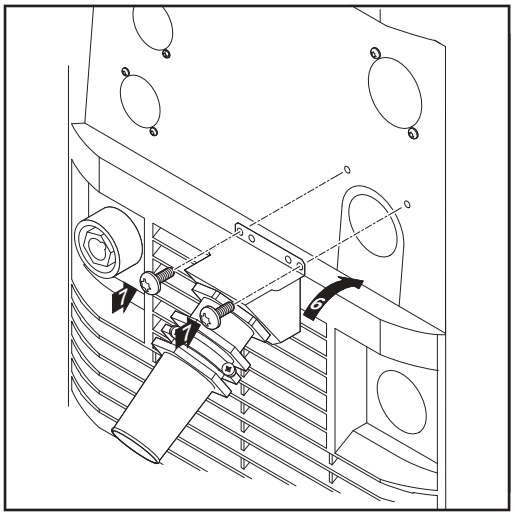
4 Remove the screws for the adapter plate, and remove the adapter plate



5 Insert the hexagon nut (size 50 mm) into the holding plate

NOTE! The points of the hexagon nut must point towards the holding plate for a reliable ground (earth) connection to the power source housing.

6 Screw the front of the large strain-relief device into the hexagon nut (size 50 mm). The hexagon nut (size 50 mm) now bites into the holding plate.



7 Slot the large strain-relief device into the housing and fasten it with 2 screws

8 Connecting the mains cable

9 Replace the left side panel of the power source

Start-up

Safety

WARNING! An electric shock can be fatal. If the power source is connected to the mains electricity supply during installation, there is a high risk of very serious injury and damage. Before carrying out any work on the device make sure that:
- the power source mains switch is in the "O" position
- the power source is unplugged from the mains

Remarks on the cooling unit

We recommend using an FK 4000 R cooling unit for the following applications and situations:
- TS 4000 / 5000, TPS 3200 / 4000 / 5000 power sources
- JobMaster welding torch
- Push-pull welding torch
- Robot welding
- Hosepacks over 5 m long
- MIG/MAG pulse synergic welding
- In general, where welding is performed in higher power ranges

The cooling unit is powered from the power source. The cooling unit is ready for operation when the mains switch of the power source is in the - I - position.

More information on the cooling unit can be found in the operating instructions for the cooling unit.

Information on system components

The steps and activities described below include references to various system components, including:
- Trolleys
- Cooling units
- Wire-feed unit holders
- Wire-feed units
- Interconnecting hosepacks
- Welding torches
- etc.

For more detailed information about installing and connecting the system components, please refer to the appropriate operating instructions.

Overview

"Commissioning" is composed of the following sections:
- Commissioning the TPS 2700
- Commissioning the TS 4000/5000, TPS 3200/4000/5000
- Commissioning the CMT 4000 Advanced

Commissioning the TPS 2700

General

Commissioning the TPS 2700 power source is described by reference to a manual gas-cooled MIG/MAG application.

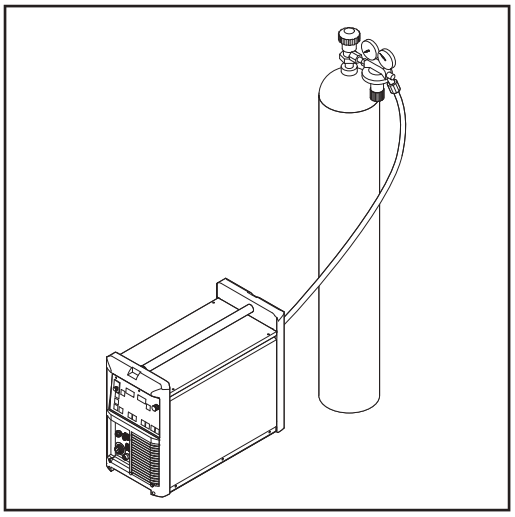
Recommendation for water-cooled applications

- Use the PickUp trolley
- Fit the cooling unit to the PickUp trolley
- Fit the TPS 2700 power supply to the cooling unit
- Only use water-cooled welding torches with an external water connection
- Connect the water connections on the welding torch directly to the cooling unit

Connecting the gas cylinder

WARNING! If gas cylinders topple over, there is a risk of very serious injury and damage. Place gas cylinders on a solid, level surface so that they remain stable. Secure gas cylinders to prevent them from falling over.

Observe the safety rules of the gas cylinder manufacturer.

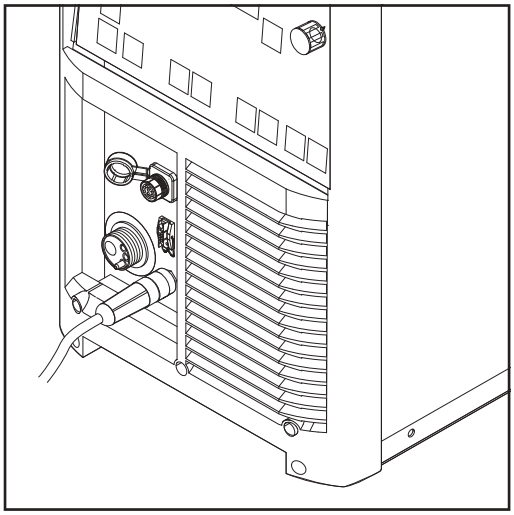


Connecting the gas hose to the TPS 2700

1. Place the gas cylinder on a solid, level surface in such a way that it remains stable
2. Secure the gas cylinder to prevent it from toppling over (but not around the neck of the cylinder)
3. Take the protective cap off the gas cylinder
4. Briefly open the gas cylinder valve to blow off any dust or dirt
5. Check the seal on the pressure regulator
6. Screw the pressure regulator onto the gas cylinder and tighten it
7. Connect the pressure regulator to the shielding gas connection on the power source using the gas hose

NOTE! US devices are supplied with an adapter for the gas hose:
- Glue in or seal the adapter
- Test the adapter to ensure that it is gas tight.

Establishing a ground (earth) connection

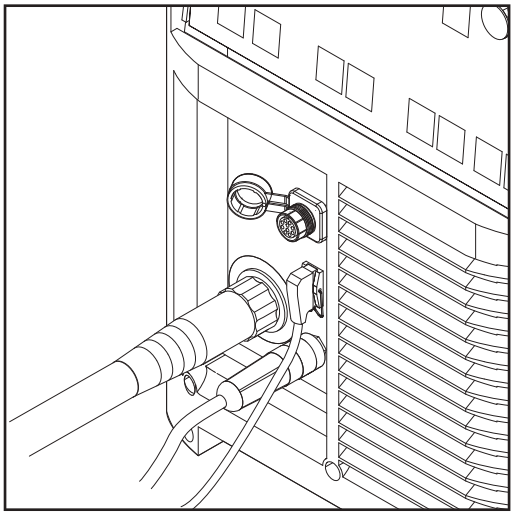


Connecting the grounding (earthing) cable to the TPS 2700

1 Plug the grounding (earthing) cable into the (-) current socket and twist to fasten it

2 Use the other end of the grounding (earthing) cable to establish a connection to the workpiece

Connecting the welding torch



Connecting the welding torch to the TPS 2700

1 Check that the torch is correctly and completely tooled up. Insert it - infeed tube first - into the torch connection

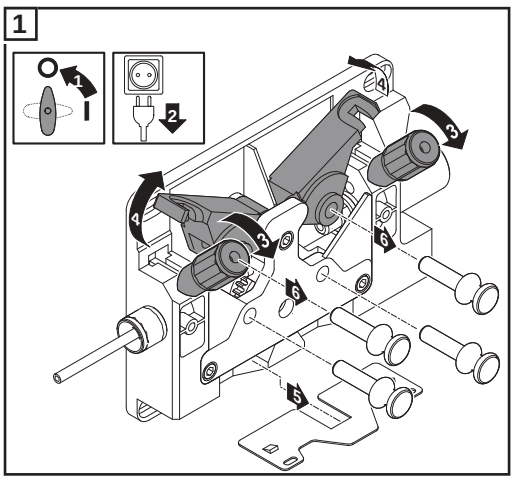
2 Tighten the union nut by hand to fix the torch in place

3 Plug the control plug of the welding torch into the torch control connection and latch it in place

NOTE! When altering the length and/or cross-section of the welding torch hosepack, measure the welding circuit resistance r and the welding circuit inductivity L (see "Further settings").

Inserting/replacing feed rollers

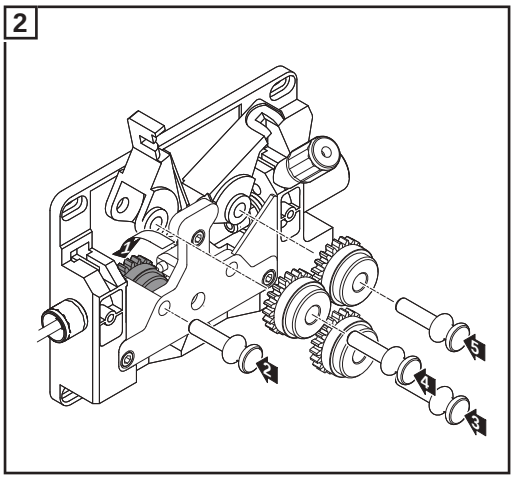
In order to achieve optimum wire electrode feed, the feed rollers must be suitable for the diameter and alloy of the wire being welded.

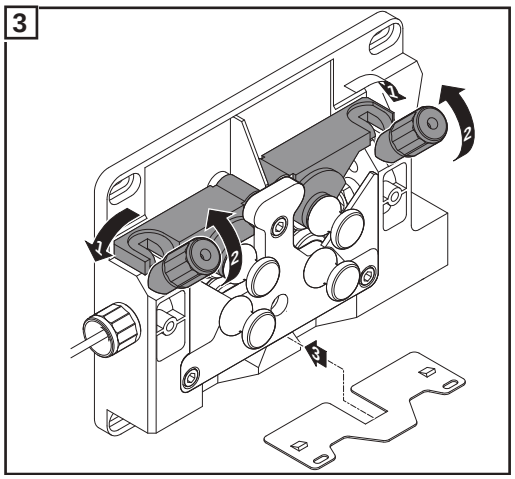


NOTE! Only use feed rollers that match the wire electrode.

An overview of the feed rollers available and their possible areas of use can be found in the spare parts lists.

US devices are supplied without feed rollers. After inserting the wirespool, insert the feed rollers.

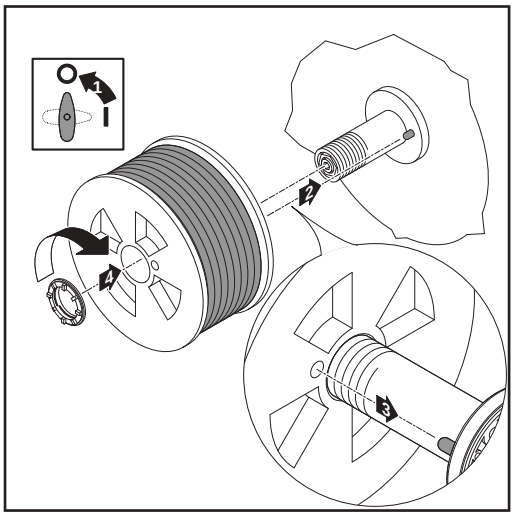




Inserting the wire-spool

CAUTION! Risk of injury from springiness of spooled wire electrode. While inserting the wirespool, hold the end of the wire electrode firmly to avoid injuries caused by the wire springing back.

CAUTION! Risk of injury from falling wirespool. Make sure the wirespool sits securely on the spool holder.



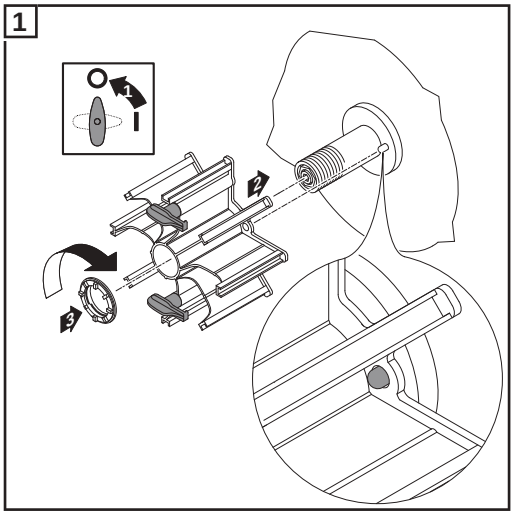
Inserting the basket-type spool

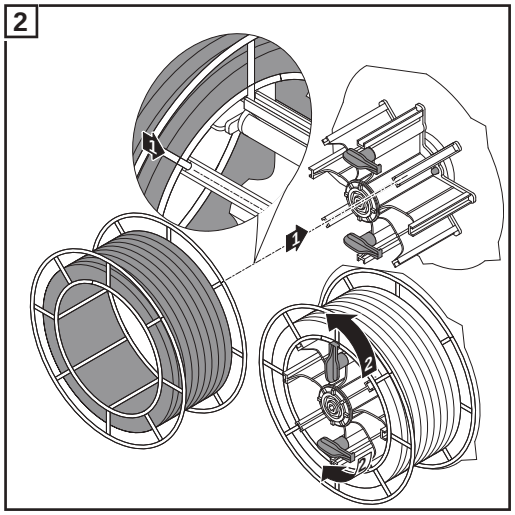
CAUTION! Risk of injury from springiness of spooled wire electrode. While inserting the wirespool, hold the end of the wire electrode firmly to avoid injuries caused by the wire springing back.

CAUTION! Risk of injury from falling wirespool. Make sure the wirespool sits securely on the spool holder.

NOTE! When working with basket-type spools, only use the basket-type spool adapter supplied with the device.

CAUTION! Risk of injury from falling basket-type spool. Place the basket-type spool on the adapter provided in such a way that the bars on the spool are inside the adapter guideways.

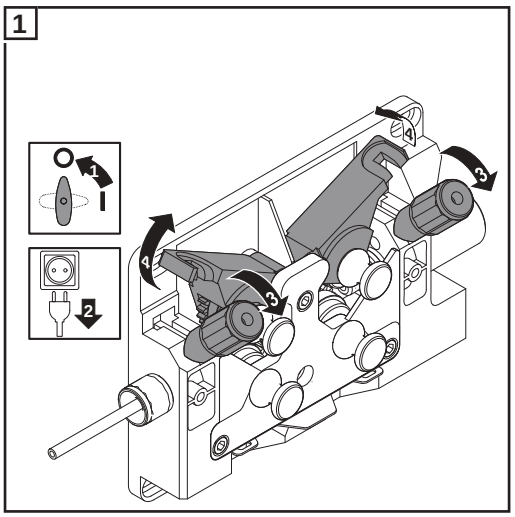


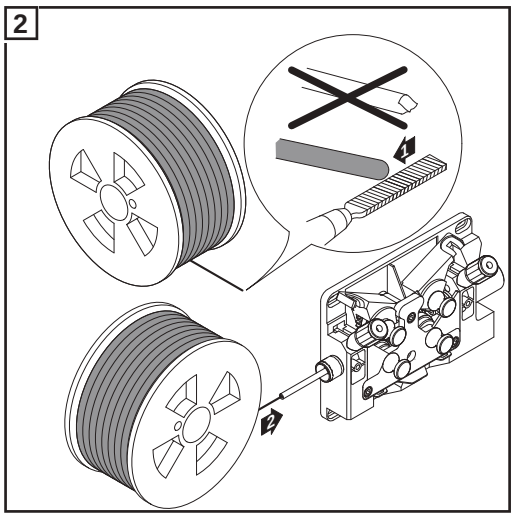


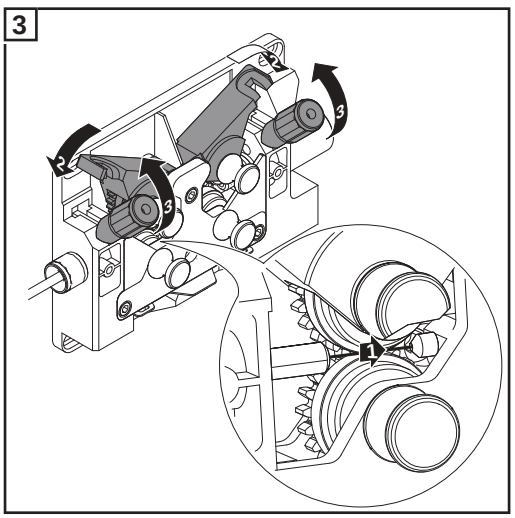
Feeding in the wire electrode

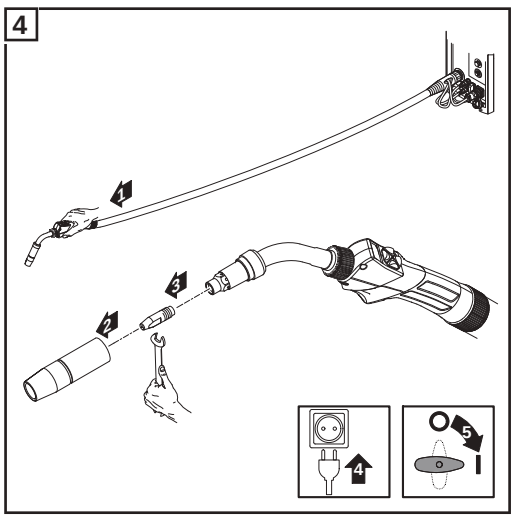
CAUTION! Risk of injury from springiness of spooled wire electrode. When inserting the wire electrode into the 4-roller drive, hold the end of the wire electrode firmly to avoid injuries caused by the wire springing back.

CAUTION! Risk of damage to the welding torch from sharp end of wire electrode. Deburr the end of the wire electrode well before feeding in.

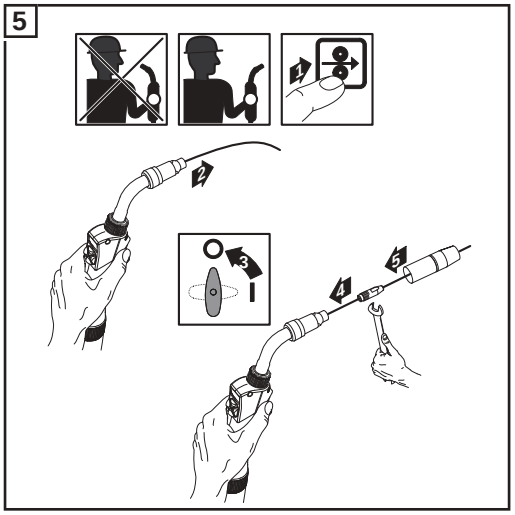


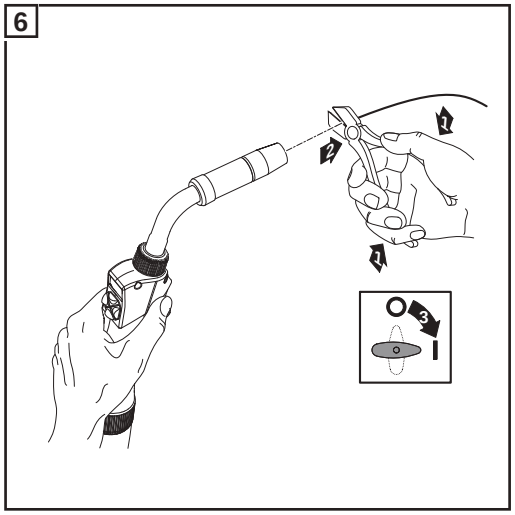




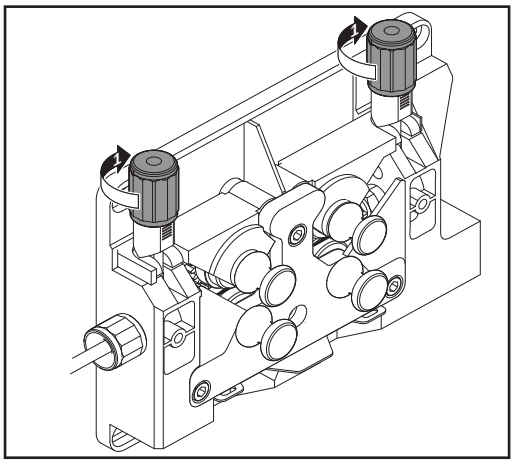


CAUTION! Risk of injury from wire electrode emerging at speed. Keep the welding torch away from face and body when pressing the feeder inching / inch forward button.





Setting the contact pressure

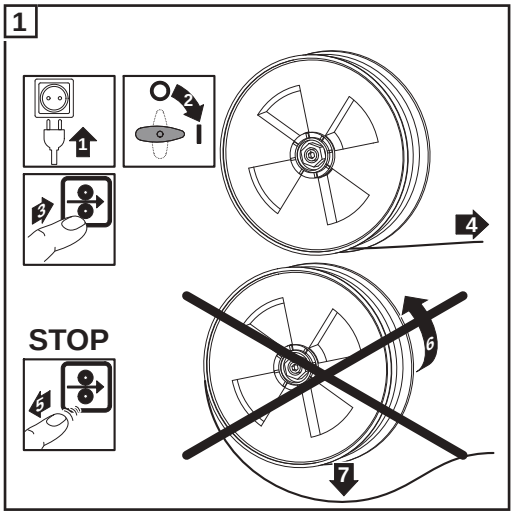


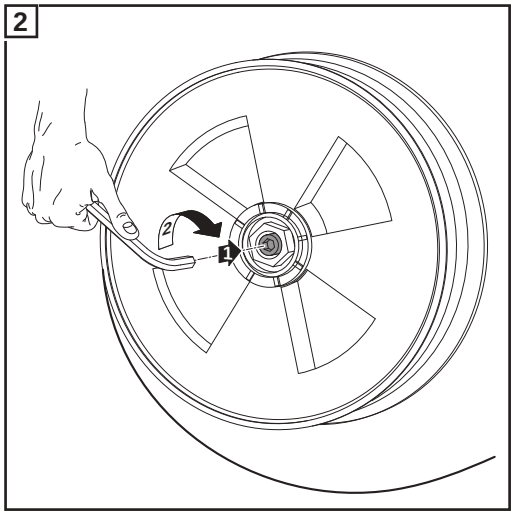
NOTE! Set the contact pressure in such a way that the wire electrode is not deformed but nevertheless ensures that the wire is transported properly.

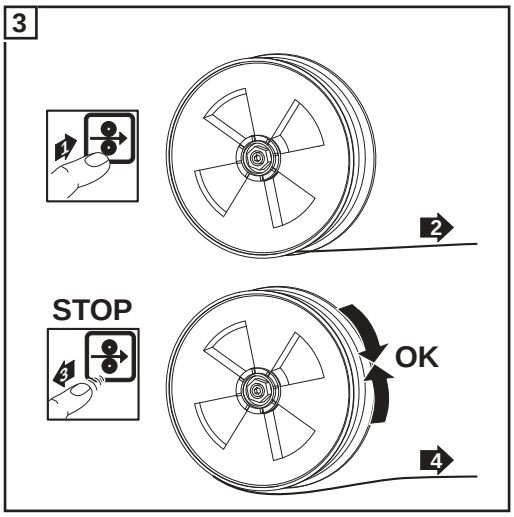
Contact pressure standard values	Semi-cylindrical rolls	Trapeze rolls	Plastic rolls
Aluminium	1.5	-	3.5 - 4.5
Steel	3 - 4	1.5	-
CrNi	3 - 4	1.5	-

Adjusting the brake

NOTE! After releasing the torch trigger the wirespool should stop unreeling. Adjust brake if necessary.

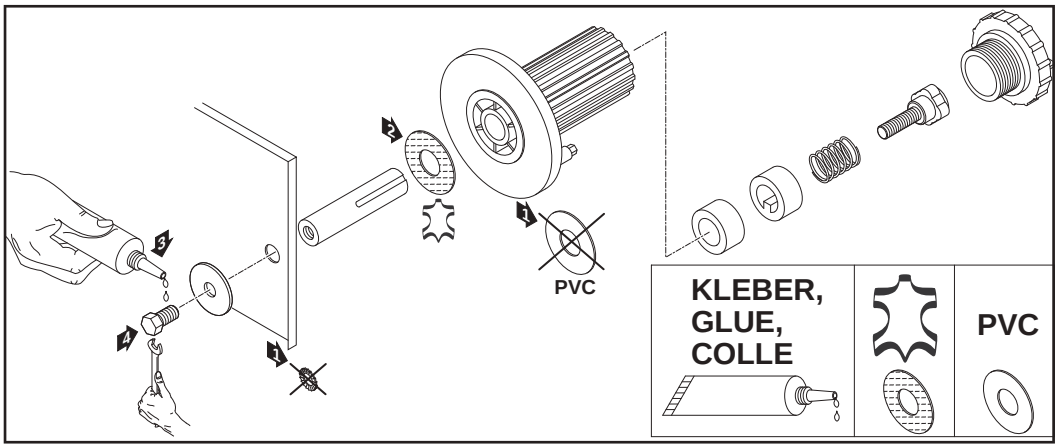






Design of the brake

CAUTION! Risk of injury and damage from falling wirespool. To ensure that the wirespool is properly in place and that the brake works properly, fit the brake according to the following diagram.



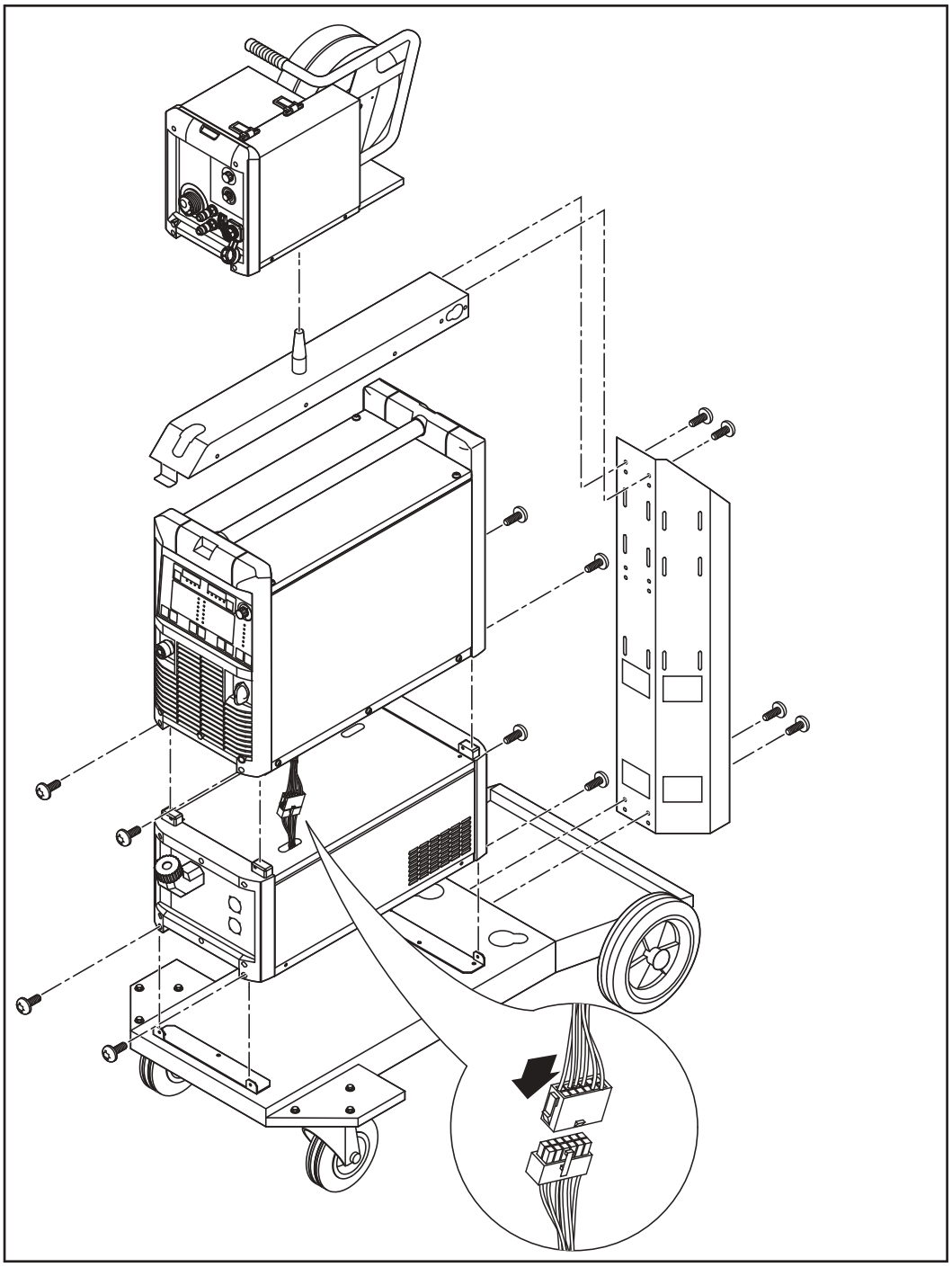
Commissioning the TS 4000 / 5000, TPS 3200 / 4000 / 5000, TIME 5000 Digital

General

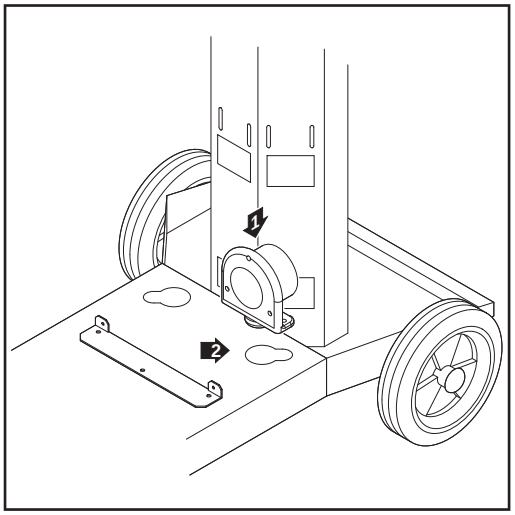
Commissioning the TS 4000 / 5000 and TPS 3200 / 4000 / 5000 power sources is described by reference to a manual water-cooled MIG/MAG application.

Fitting the system components (overview)

The diagram below is intended to show you how to fit the individual system components. For detailed information about the individual steps, please refer to the operating instructions for the system components.



Fixing the strain-relief device in place

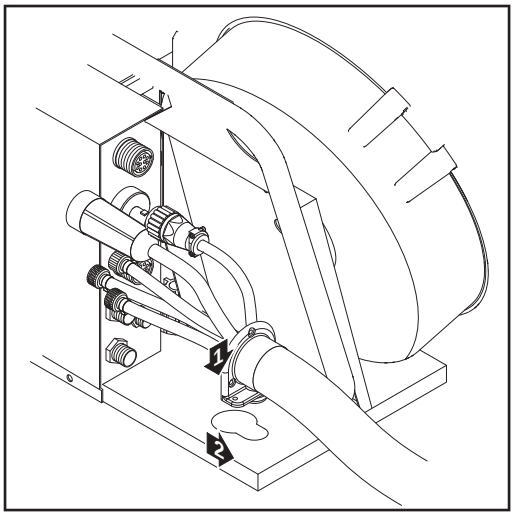


Fixing the strain-relief device to the trolley

1 Introduce the pin on the power source strain-relief device for the interconnecting-hosepack into the opening provided in the base of the trolley.

2 Use two screws supplied with the interconnecting hosepack to fasten the strain-relief device to the base of the trolley.

A strain-relief device is not provided in the case of 1.2 m (4 ft.) interconnecting hosepacks.



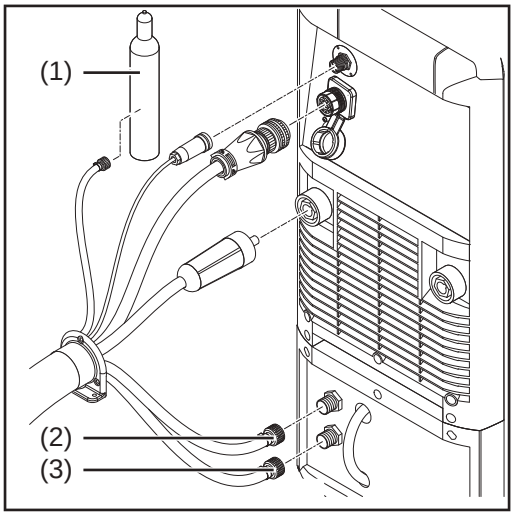
Fitting the strain-relief device to the wire-feed unit

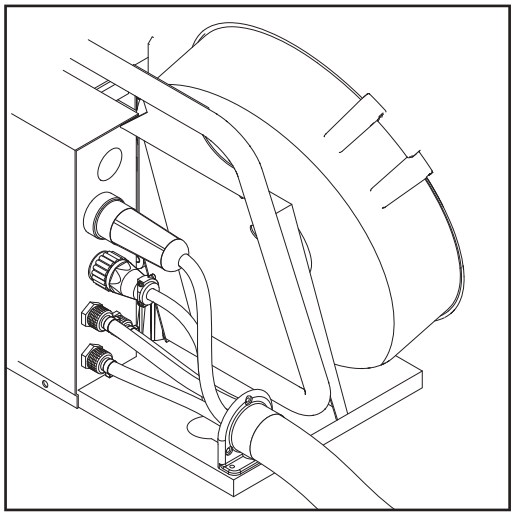
3 Introduce the pin on the wire-feed unit strain-relief device for the interconnecting hosepack into the opening provided in the wire-feed unit.

4 Use two screws supplied with the interconnecting hosepack to fasten the strain-relief device to the wire-feed unit.

Connecting the interconnecting hosepack

NOTE! There is no cooling unit present in the case of gas-cooled systems. There is no need to attach the water connections in the case of gas-cooled systems.





1 Plug the welding potential bayonet plug on the interconnecting hosepack into the (+) socket and twist to fasten it

2 Plug the LocalNet plug on the interconnecting hosepack into the LocalNet connection and secure with a union nut

3 CMT power sources only:
Connect the LHSB plug to the LHSB connection

4 Connect the water feed hose (blue) (3) to the cooling unit

5 Connect the water return hose (red) (2) to the cooling unit

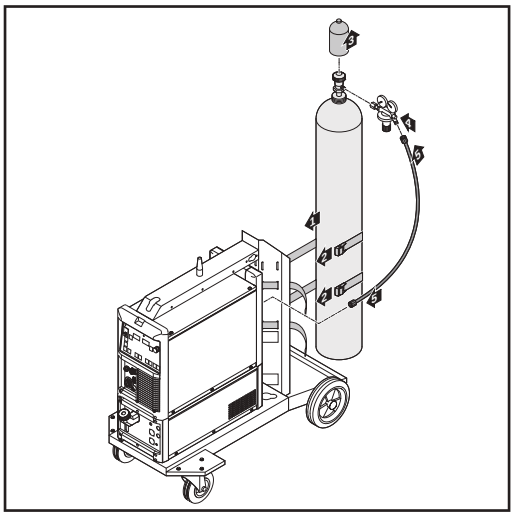
6 Connect the protective gas shield hose to the pressure regulator on the gas cylinder (1)

7 Connect the interconnecting hosepack to the wire-feed unit

Connecting the gas cylinder

WARNING! If gas cylinders topple over, there is a risk of very serious injury and damage. Place gas cylinders on a solid, level surface so that they remain stable. Secure gas cylinders to prevent them from falling over.

Observe the safety rules of the gas cylinder manufacturer.



Fixing the gas cylinder on the trolley

1 Place the gas cylinder on the base of the trolley

2 Secure the gas cylinder by fixing the cylinder strap around the upper part of the cylinder (but not around the neck) to prevent it from toppling over

3 Take the protective cap off the gas cylinder

4 Briefly open the gas cylinder valve to blow off any dust or dirt

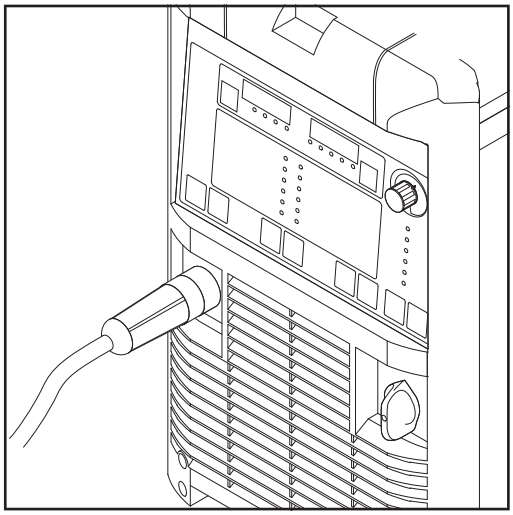
5 Check the seal on the pressure regulator

6 Screw the pressure regulator onto the gas cylinder and tighten it

7 Connect the protective gas shield hose of the interconnecting hose pack to the pressure regulator using the gas hose

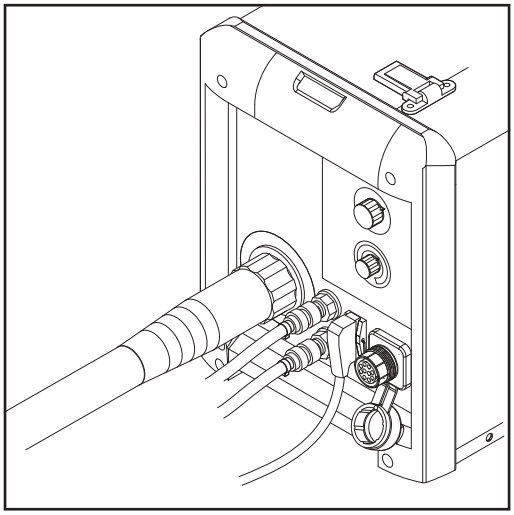
NOTE! US devices are supplied with an adapter for the gas hose:
- Glue in or seal the adapter
- Test the adapter to ensure that it is gas tight.

Establishing a ground (earth) connection



1. Plug the grounding (earthing) cable into the (-) current socket and twist to fasten it
2. Use the other end of the grounding (earthing) cable to establish a connection to the workpiece

Connecting the welding torch



Welding torch and torch control connections on the VR 4000

1. Check that the torch is correctly and completely tooled up. Insert it - infeed tube first - into the torch connection on the wire-feed unit
2. Tighten the union nut by hand to fix the torch in place
3. Plug the control plug of the welding torch into the torch control connection and latch it in place

NOTE! When altering the length and/or cross-section of the welding torch hosepack, measure the welding circuit resistance r and the welding circuit inductivity L (see "Further settings").

Other tasks

Carry out the following steps in accordance with the wire-feed unit operating instructions:

1. Insert the feed rollers in the wire-feed unit
2. Insert the wirespool or basket-type spool with adapter in the wire-feed unit
3. Feed in the wire electrode
4. Set the contact pressure
5. Adjust the brake

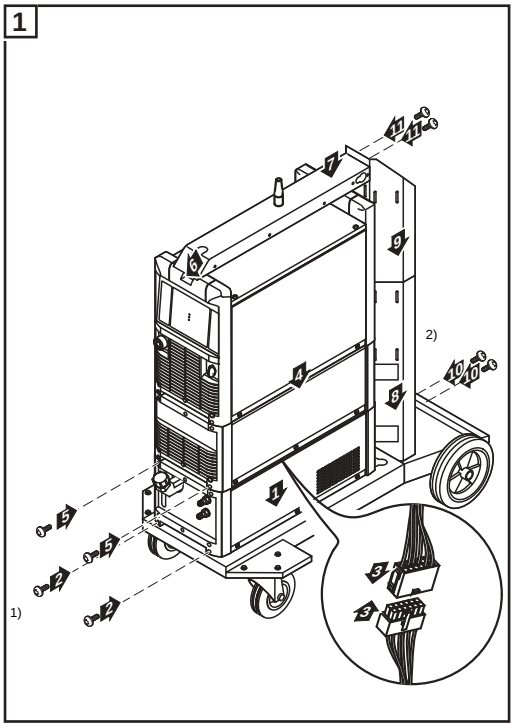
Commissioning the CMT4000 Advanced

Fitting the system components (overview)

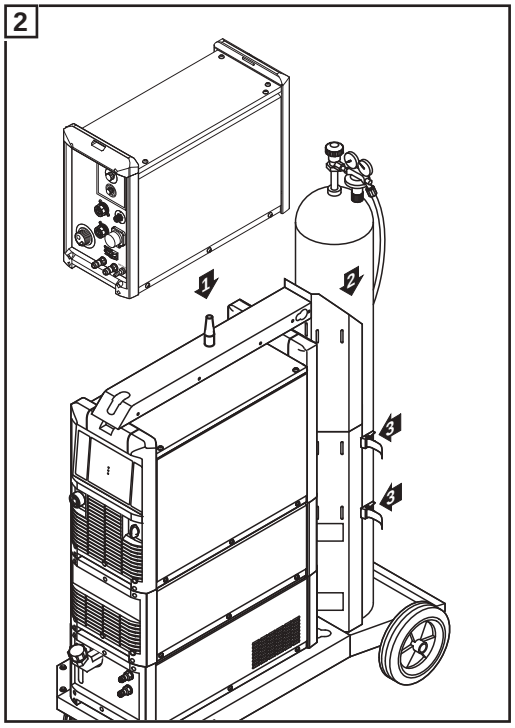
The diagram below is intended to show you how to fit the individual system components. For detailed information about the individual steps, please refer to the operating instructions for the system components.

WARNING! If gas cylinders topple over, there is a risk of very serious injury and damage. Place gas cylinders on a solid, level surface so that they remain stable. Secure gas cylinders to prevent them from falling over.

Observe the safety rules of the gas cylinder manufacturer.



Fitting the system components



Installing the wire-feed unit and setting up the gas cylinder

1) Fasten the cooling unit and power source to the back of the machine as well using 2 screws in each case
2) Cylinder holder extension

Connecting the interconnecting hosepack, CMT welding torch and wire buffer

For detailed information about the individual steps, please refer to the relevant operating instructions for the system components.

1 Fasten the strain-relief devices of the CMT interconnecting hosepack to the trolley and the wire-feed unit

2 Connect the CMT interconnecting hosepack to the power source and wire-feed unit

3 Connect the CMT hosepack to the CMT drive unit

4 Connect the wire buffer

5 Connect the CMT welding torch to the wire-feed unit

Other tasks

1 Connect the wirefeeding hose

2 Establish a ground (earth) connection between the workpiece and power source
3 Connect the gas cylinder
4 Connect the RCU 5000i remote control
5 Make the connection to the robot control

Preparing the wire-feed unit

Carry out the following steps in accordance with the wire-feed unit operating instructions:

1 Insert the feed rollers in the wire-feed unit
2 Insert the wirespool or basket-type spool with adapter in the wire-feed unit
3 Feed in the wire electrode
4 Set the contact pressure
5 Adjust the brake

Welding

MIG/MAG modes

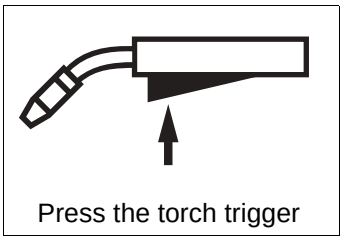
General

WARNING! Operating the equipment incorrectly can cause serious injury and damage. Do not use the functions described until you have thoroughly read and understood the following documents:

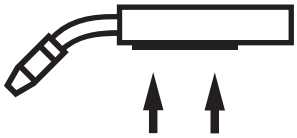
- these operating instructions
- all the operating instructions for the system components, especially the safety rules

See the Setup menu for information on settings, setting range and units of measurement for the available parameters.

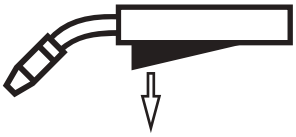
Symbols and their explanations



Press the torch trigger



Hold the torch trigger



Release the torch trigger

GPr
Gas pre-flow time

I-S
Starting-current phase: the base material is heated up rapidly, despite the high thermal dissipation that occurs at the start of welding

SL
Slope: the starting current is continuously lowered as far as the welding current and the welding current as far as the final current

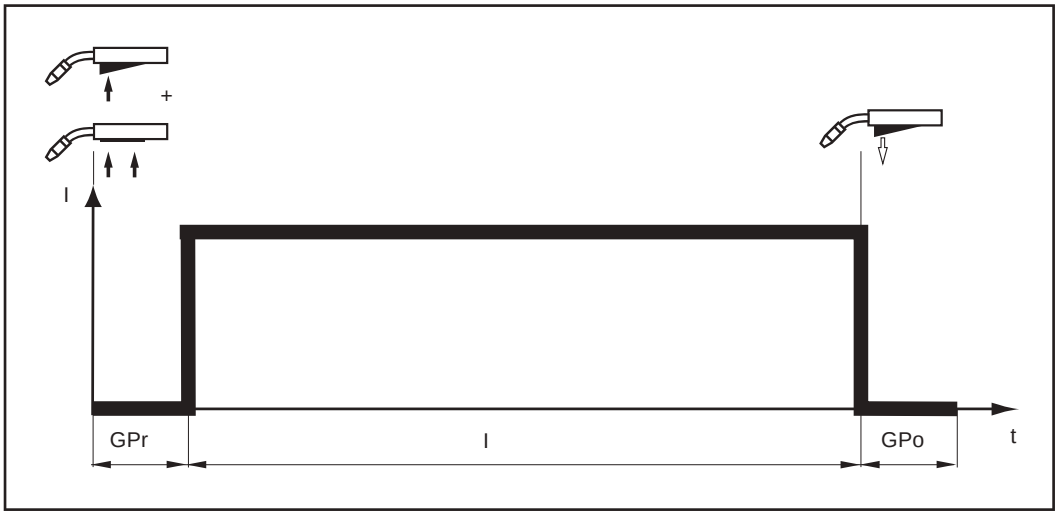
I
Welding-current phase: uniform thermal input into the base material, whose temperature is raised by the advancing heat

I-E
Crater-fill phase: to prevent any local overheating of the base material due to heat build-up towards the end of welding. This eliminates any risk of weld seam drop-through.

GPo
Gas post-flow time

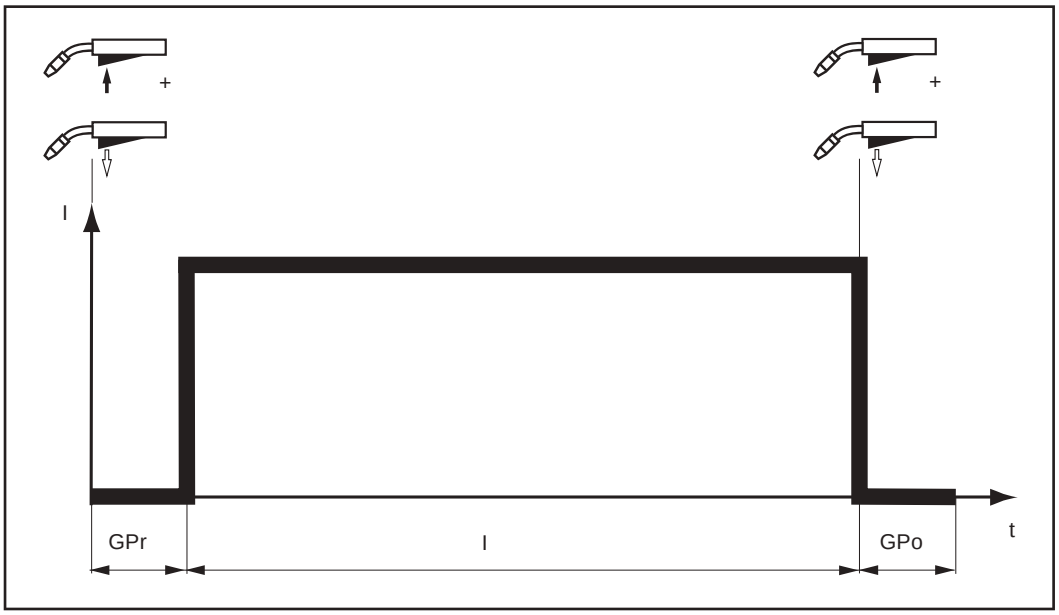
2-step mode

“2-step mode“ is suitable for
- Tacking work
- Short weld seams
- Automated and robot welding



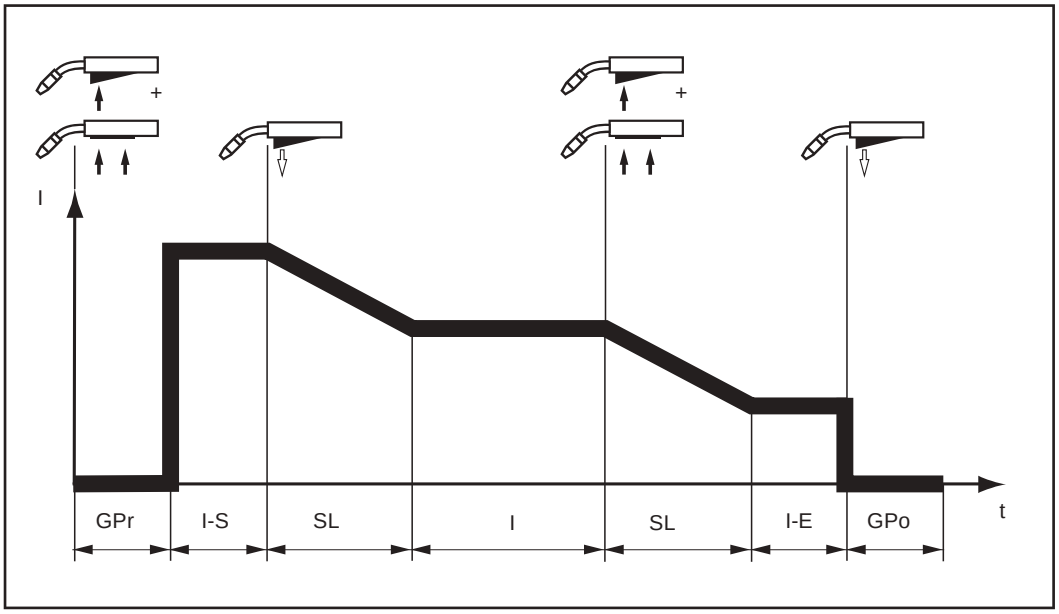
4-step mode

"4-step mode" is suitable for longer weld seams.



Special 4-step mode

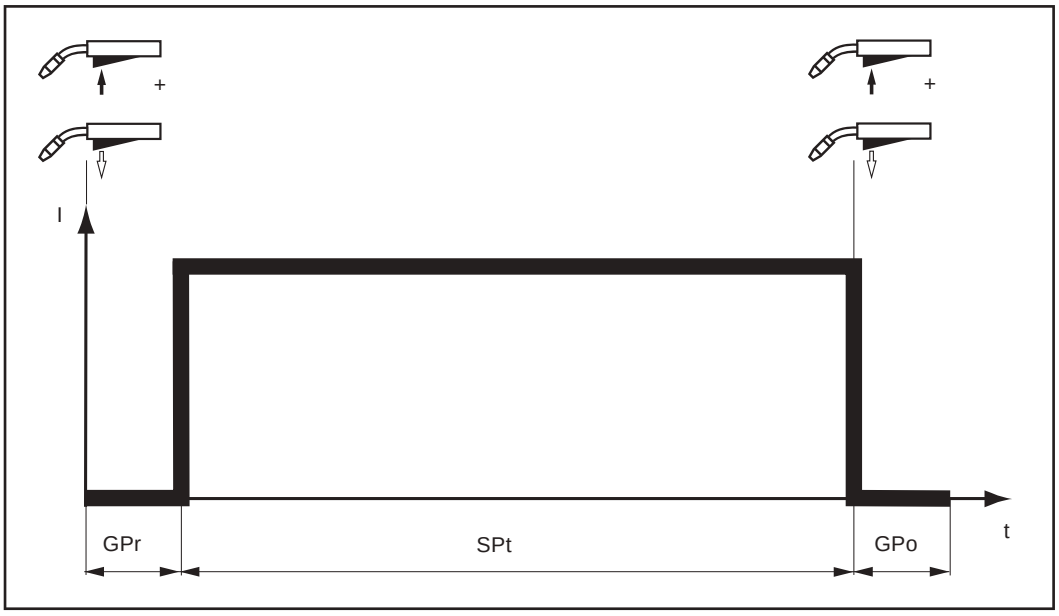
“Special 4-step mode ” is particularly suitable for welding aluminium materials. The special pattern of the welding current curve takes account of the high thermal conductivity of aluminium.



Spot welding

The “Spot welding” mode is suitable for welding joins on overlapped sheets.
Procedure for spot welding:

1. Hold welding torch in the vertical
2. Press and release the torch trigger
3. Keep the torch in the same position
4. Wait until the end of the gas post-flow time
5. Lift the torch off the workpiece



The welding operation can be aborted by pressing the torch trigger a second time.

MIG/MAG welding

Safety

WARNING! Operating the equipment incorrectly can cause serious injury and damage. Do not use the functions described until you have thoroughly read and understood the following documents:
- these operating instructions
- all the operating instructions for the system components, especially the safety rules

WARNING! An electric shock can be fatal. If the power source is connected to the mains electricity supply during installation, there is a high risk of very serious injury and damage. Before carrying out any work on the device make sure that:
- the power source mains switch is in the "O" position
- the power source is unplugged from the mains

General tasks before MIG/MAG welding

1 Only where a cooling unit and water-cooled welding torch are used:
- TPS 2700 with water cooling:
  Plug the water hoses of the welding torch to the correct connection sockets on the cooling unit
- TS 4000 / 5000, TPS 3200 / 4000 / 5000 with water cooling:
  Connect the water hoses of the welding torch to the correct connection sockets on the wire-feed unit

2 Plug in the mains plug

3 Move the mains switch to the "I" position:
- all the indicators on the control panel light up briefly
- where applicable, the cooling unit starts to run

NOTE! Follow the safety rules and note the operating conditions in the cooling unit operating instructions.

Overview

MIG/MAG welding is composed of the following sections:
- MIG/MAG synergic welding
- MIG/MAG standard manual welding
- CMT welding
- Special functions and options
- Robot welding

MIG/MAG synergic welding

General

The inputs required for MIG/MAG synergic welding (pulse/standard) are described by reference to the Comfort control panel.

MIG/MAG synergic welding

1 Press the Process button to select the desired welding process:
MIG/MAG pulse synergic welding
MIG/MAG standard synergic welding

2 Press the Material button to select the filler metal and shielding gas used

The assignment of SP1 and SP2 depends on the welding database used for the power source.

3 Press the Wire diameter button to select the diameter of the wire electrode

The assignment of SP depends on the welding database used for the power source.

4 Press the Mode button to select the desired MIG/MAG mode:

2-step mode
4-step mode
Special 4-step mode (aluminium welding start-up)
Spot welding

See the Setup menu for details of how to set the parameters for Special 4-step and Spot welding modes.

NOTE! Parameters that have been set on a system component control panel (e.g. wire feed unit or remote control) might not be able to be changed on the power source control panel.

5 Press the Parameter selection button to select the welding parameters to be used to specify the welding power:

a-dimension
Sheet thickness
Welding current
Wire feed speed

NOTE! Before selecting the a-dimension parameter, the welding speed parameter must be set (recommended welding speed for manual welding:- approx. 35 cm/min or 13.78 ipm).

6 Use the adjusting dial to set the selected parameter to the desired value. The parameter value is displayed in the digital display located above it.

The a-dimension, sheet thickness, welding current, wire feed speed and welding voltage parameters are directly interlinked. It is only necessary to alter one of the parameters, as the other parameters are immediately adjusted to match.

All welding parameter set values that have been set using the adjusting dial or buttons on the welding torch remain stored until the next time they are changed. This applies even if the power source is switched off and on again in the meantime.

7 Open the gas cylinder valve

8 Set the shielding gas flow rate:

Press the Gas test button
- Turn the adjusting screw on the underside of the pressure regulator until the pressure gauge shows the required gas flow rate

CAUTION! Risk of injury and damage from electric shock and from the wire electrode emerging from the torch. When pressing the torch trigger:

- keep the torch away from your face and body
- do not point the welding torch at people
- make sure that the wire electrode does not touch any electrically conducting or earthed (grounded) parts, such as the housing, etc.

9 Press the torch trigger and start welding

Corrections during welding

In order to obtain the best possible welding results, the following parameters can be corrected in certain circumstances:

Arc length correction
for correcting the arc length

- \- shorter arc length
- 0 neutral arc length
- \+ longer arc length

Droplet detachment correction/arc force dynamic correction/arc force dynamic

MIG/MAG pulse synergic welding:
for continuous correction of the droplet detachment energy

- \- lower droplet detachment force
- 0 neutral droplet detachment force
- \+ higher droplet detachment force

MIG/MAG standard synergic welding:
for influencing the short-circuiting dynamic at the instant of droplet transfer

- \- harder, more stable arc
- 0 neutral arc
- \+ soft, low-spatter arc

Gas pre-flow time

Gas post-flow time

Feeder creep speed

The settings for the background parameters gas pre-flow time, gas post-flow time and feeder creep speed are described in the Setup menu.

Adjusting parameters for correction

1 Press the Parameter selection button to select the parameter you wish to correct

2 Use the adjusting dial to set the selected parameter to the desired value. The parameter value is displayed in the digital display located above it.

Remarks on the Standard control panel

It is not possible to correct the arc length on the Standard control panel.

However, you can set the arc force correction as a background parameter in the Setup menu.

MIG/MAG standard manual welding

General

The MIG/MAG standard manual welding process is a MIG/MAG welding process with no Synergic function.
Changing one parameter does not result in any automatic adjustments to the other parameters. All of the variable parameters must therefore be adjusted individually, as dictated by the welding process in question.

The inputs required for MIG/MAG standard manual welding are described by reference to the "Comfort" control panel.

Available parameters

In MIG/MAG standard manual welding, the following parameters are available:

	Wire feed speed 0.5 m/min (19.69 ipm) - maximum wire feed speed e.g. 22.0 m/min (866.14 ipm)
V	**Welding voltage** TPS 3200 / 4000 / 5000: 10.0 - 40.0 V TPS 2700: 10.0 - 34.0 V
	Dynamic correction for influencing the short-circuiting dynamic at the instant of droplet transfer
A	**Welding current** only the actual value is displayed

MIG/MAG standard manual welding

1. Press the Process button to select the MIG/MAG standard manual welding process
2. Press the Material button to select the filler metal and shielding gas used

   The assignment of SP1 and SP2 depends on the welding database used for the power source.
3. Press the Wire diameter button to select the diameter of the wire electrode

   The assignment of SP depends on the welding database used for the power source.
4. Press the Mode button to select the desired MIG/MAG mode:

    2-step mode
    4-step mode
    Special 4-step mode (aluminium welding start-up)
    Spot welding

   In MIG/MAG standard manual welding, special 4-step mode corresponds to conventional 4-step mode.

   The settings for the parameters for Spot welding mode are described in the Setup menu.

   NOTE! Parameters that have been set on a system component control panel (e.g. wire feed unit or remote control) might not be able to be changed on the power source control panel.
5. Press the Parameter selection button and select the wire feed speed parameter
6. Use the adjusting dial to set the desired value for the wire feed speed
7. Press the Parameter selection button and select the welding voltage parameter
8. Use the adjusting dial to set the desired value for the welding voltage

   The parameter value is displayed in the digital display located above it.

All welding parameter set values that have been set using the adjusting dial or buttons on the welding torch remain stored until the next time they are changed. This is true even if the power source is switched off and on again in the meantime

To display the actual welding current during welding:
- press the Parameter selection button and select the welding current parameter
- the actual welding current is displayed on the digital display during welding

9 Open the gas cylinder valve

10 Set the shielding gas flow rate:

Press the Gas test button
- Turn the adjusting screw on the underside of the pressure regulator until the pressure gauge shows the required gas flow rate

CAUTION! Risk of injury and damage from electric shock and from the wire electrode emerging from the torch. When pressing the torch trigger:
- keep the torch away from your face and body
- do not point the welding torch at people
- make sure that the wire electrode does not touch any electrically conducting or earthed (grounded) parts, such as the housing, etc.

11 Press the torch trigger and start welding

Corrections during welding

In order to obtain the best possible welding results, the following parameters can be corrected in certain circumstances:

Dynamic correction
for influencing the short-circuiting dynamic at the instant of droplet transfer

0 harder, more stable arc

10 soft, low-spatter arc

Gas pre-flow time

Gas post-flow time

Feeder creep speed

The settings for the background parameters gas pre-flow time, gas post-flow time and feeder creep speed are described in the Setup menu.

Adjusting parameters for correction

1 Press the Parameter selection button to select the parameter you wish to correct

2 Use the adjusting dial to set the selected parameter to the desired value. The parameter value is displayed in the digital display located above it.

CMT welding

General

The inputs required for CMT welding are described by reference to the CMT control panel. Settings for CMT applications with the CMT remote power source and the RCU 5000i remote control can be found in the operating instructions for the RCU 5000i remote control.

CMT welding

1 Press the Process button to select the CMT/CMT pulse process:

2 Press the Material button to select the filler metal and shielding gas used

Filler metals for CMT welding:

1	ER 70 S-3/6	Steel
3	ER 308	CrNi 19 9
5	ER 4043	AlSi 5
6	ER CuSi-A	CuSi 3
8	SP 1	1)
10	Steel	ER 70 S-3/6
12	CrNi 19 9	ER 308
14	AlSi 5	ER 4043
15	CuSi 3	ER CuSi-A
16	SP 2	1)

To weld the other filler metals, select one of the following processes:
MIG/MAG pulse synergic welding
MIG/MAG standard synergic welding
MIG/MAG standard manual welding

1) The assignment of SP1 and SP2 depends on the welding database used for the power source.

3 Press the Wire diameter button to select the diameter of the wire electrode

The assignment of SP depends on the welding database used for the power source.

4 Press the Mode button to select the desired MIG/MAG mode:

2-step mode
4-step mode
Special 4-step mode (aluminium welding start-up)
Spot welding

See the Setup menu for details of how to set the parameters for Special 4-step and Spot welding modes.

NOTE! Parameters that have been set on a system component control panel (e.g. wire feed unit or remote control) might not be able to be changed on the power source control panel.

5 Press the Parameter selection button to select the welding parameters to be used to specify the welding power:

Sheet thickness
Welding current
Wire feed speed

6 Use the adjusting dial to set the selected parameter to the desired value. The parameter value is displayed in the digital display located above it.

The sheet thickness, welding current, wire feed speed and welding voltage parameters are directly interlinked. It is only necessary to alter one of the parameters, as the other parameters are immediately adjusted to match.

All welding parameter set values that have been set using the adjusting dial or buttons on the welding torch remain stored until the next time they are changed. This applies even if the power source is switched off and on again in the meantime.

7 Open the gas cylinder valve

8 Set the shielding gas flow rate:

Press the Purge (Gas test) button

- Turn the adjusting screw on the underside of the pressure regulator until the pressure gauge shows the required gas flow rate

CAUTION! Risk of injury and damage from electric shock and from the wire electrode emerging from the torch. When pressing the torch trigger:

- keep the torch away from your face and body
- do not point the welding torch at people
- make sure that the wire electrode does not touch any electrically conducting or earthed (grounded) parts, such as the housing, etc.

9 Press the torch trigger and start welding

Corrections during welding

In order to obtain the best possible welding results, the following parameters can be corrected in certain circumstances:

Arc length correction
for correcting the arc length

- \- shorter arc length
- 0 neutral arc length
- \+ longer arc length

Droplet detachment correction/arc force dynamic correction/arc force dynamic
depending on the selected filler metal and wire electrode diameter, different settings are corrected with this parameter:

Boost correction
sets the boost current for controlling the heat input to the base material

- -5 maximum boost current
- 0 neutral boost current
- +5 maximum boost current

The boost current can be corrected for the following filler metals:

- CrNi 19 9 / Ar + 2.5 % CO2 / 1.2 mm
- CuSi 3 / 100 % Ar / 0.8 mm
- CuSi 3 / 100 % Ar / 1.0 mm
- CuSi 3 / 100 % Ar / 1.2 mm

Dynamic correction
for influencing the short-circuiting dynamic at the instant of droplet transfer

- -5 harder, more stable arc
- 0 neutral arc

+5 soft, low-spatter arc

The arc force dynamic can be corrected with the following filler metals:
- G3Si 1 / Ar + 18 % CO2 / 1.0 mm
- G3Si 1 / Ar + 18 % CO2 / 1.2 mm

HotStart pulse cycles
for setting the HotStart pulse cycles

-5 0 pulses

+5 100 pulses

The HotStart pulse cycles can be corrected with the following filler metals:
- AlMg 4.5 Mn / 100 % Ar / 1.2 mm (CMT 0875)

HotStart time
for setting the HotStart time

-5 HotStart time = 0

+5 HotStart time = 200 ms

The HotStart pulse cycles can be corrected with the following filler metals:
- AlMg 4.5 Mn / 100 % Ar / 1.2 mm (CMT 0874)[1)]
- AlSi 5 / 100% Ar / 1.2 mm
- CrNi 19 9 / Ar + 2.5 % CO2 / 0.8 mm
- CrNi 19 9 / Ar + 2.5 % CO2 / 1.0 mm
- CuAl 5 Ni 2 / 100 % Ar / 1.0 mm

Pulse correction
for continuous correction of the droplet detachment energy

-5 lower droplet detachment force

0 neutral droplet detachment force

+5 higher droplet detachment force

The pulse can be corrected with the following filler metals:
- AlMg 4.5 Mn / 100% Ar / 1.2 mm [2)]
- AlSi 5 / 100 % Ar / 1.2 mm (CMT 0880) [2) 3)]
- AlSi 5 / 100 % Ar / 1.2 mm (CMT 0881) [2) 4)]
- CrNi 19 9 / Ar + 2.5 % CO2 / 0.8 mm [2)]
- CrNi 19 9 / Ar + 2.5 % CO2 / 1.0 mm [2)]
- CrNi 19 9 / Ar + 2.5 % CO2 / 1.2 mm [2)]
- CuAl 8 / 100 % Ar / 1.0 mm [2)]
- CuSi 3 / 100 % Ar / 1.0 mm [2)]

Notes
[1)] Different ignition process from the CMT 0875 characteristic
[2)] Combination of CMT characteristic and pulse characteristic
[3)] CMT/pulse characteristic with more pulse cycles than CMT cycles
[4)] CMT/pulse characteristic with fewer pulse cycles than CMT cycles

Gas pre-flow time

Gas post-flow time

Feeder creep speed

The settings for the background parameters gas pre-flow time, gas post-flow time and feeder creep speed are described in the Setup menu.

Adjusting parameters for correction

1. Press the Parameter selection button to select the parameter you wish to correct
2. Use the adjusting dial to set the selected parameter to the desired value. The parameter value is displayed in the digital display located above it.

Special functions and options

Arc break watchdog function

If the arc breaks and no current starts to flow again within a time defined in the Setup menu, the system cuts out automatically. The service code "no | Arc" appears on the control panel.

NOTE! At maximum welding current and very low arc length it is possible that the arc will break without the service code “no | Arc” appearing. If the arc is reduced significantly, the welding current would have to be increased to more than the maximum current in order to be able to maintain the requested welding power. As this is not acceptable, the power source switches off for safety reasons.

To start welding again, press the torch trigger again.

In the factory settings, the arc break watchdog function (Arc) is set to OFF.

The settings for the arc break watchdog parameter (Arc) are described in "Setup menu - level 2".

Ignition time-out function

The power source has the Ignition time-out function. This function is not factory-activated as standard.

Once the torch trigger is pressed, gas pre-flow begins immediately. Wire feeding then begins, followed by ignition. If no current starts flowing before the length of wire specified in the Setup menu has been fed, the power source cuts out automatically. The service code "no | IGn" appears on the control panel.

“E55” is displayed on the JobMaster torch and on the field bus module.

To make another attempt to achieve ignition, press the torch trigger again.

The settings for the Ignition time-out parameter (ito) are described in the "Setup-menu-level 2" section.

Spatter-free ignition option

The spatter free ignition option (SFi) makes it possible to ignite the arc with practically no spatter. At the beginning of welding, the wire is slowly fed as far as the surface of the workpiece and then stopped as soon as it touches it. Next, the welding current is activated and the wire is pulled back. Once the correct arc length has been reached, the wire starts being fed at the speed specified for this welding process.

NOTE! The optimum function of the spatter-free ignition option can only be guaranteed in aluminium applications in conjunction with Fronius push-pull wire-feed unit systems.

System requirements:
- Firmware version on the power source: OFFICIAL UST V2.60.1
- Firmware version on the wire-feed unit: OFFICIAL SR41 V1.40.15

NOTE! External enabling of the spatter-free ignition option is possible from firmware version OFFICIAL UST V2.70.1 (power source) upwards. At present, this option only supports aluminium wires of diameters:
- 0.8 mm / 1.0 mm / 1.2 mm / 1.6 mm
- USA: 0.9 mm (0.035 in.) / 1.2 mm (0.045 in) / 1.6 mm (1/16 in.)

NOTE! Not all of the stored welding programs support the SFI function. SFI is automatically deactivated on changing to a welding program that does not support the SFI function.
SFI must be re-activated on changing back to a program that supports the SFI function.

More information about whether a welding program supports SFI can be found on the sticker with the program chart on the power source.

The SFI function is set in the Process setup menu (Fdc parameter).

SynchroPulse option

The SynchroPulse option is recommended for welding aluminium alloys where you want to give the weld seams a rippled appearance. This effect is achieved by having the welding power alternate between two operating points.

The two operating points result from the welding output being changed - positively and negatively - by an adjustable dFd value that can be set in the Setup menu (welding power offset: 0.0 - 2.0 m/min or 0.0 - 78.74 ipm).

Additional parameters for SynchroPulse:
- Frequency F for alternating between operating points (set in the Setup menu)
- Arc length correction for the lower operating point (set using the arc length correction parameter on the control panel)
- Arc length correction for the higher operating point (set in the Setup menu, parameter Al.2)

In order to activate SynchroPulse, you must (as a minimum) change the value of the parameter F (frequency) in the Process setup menu from OFF to between 0.5 and 5 Hz.

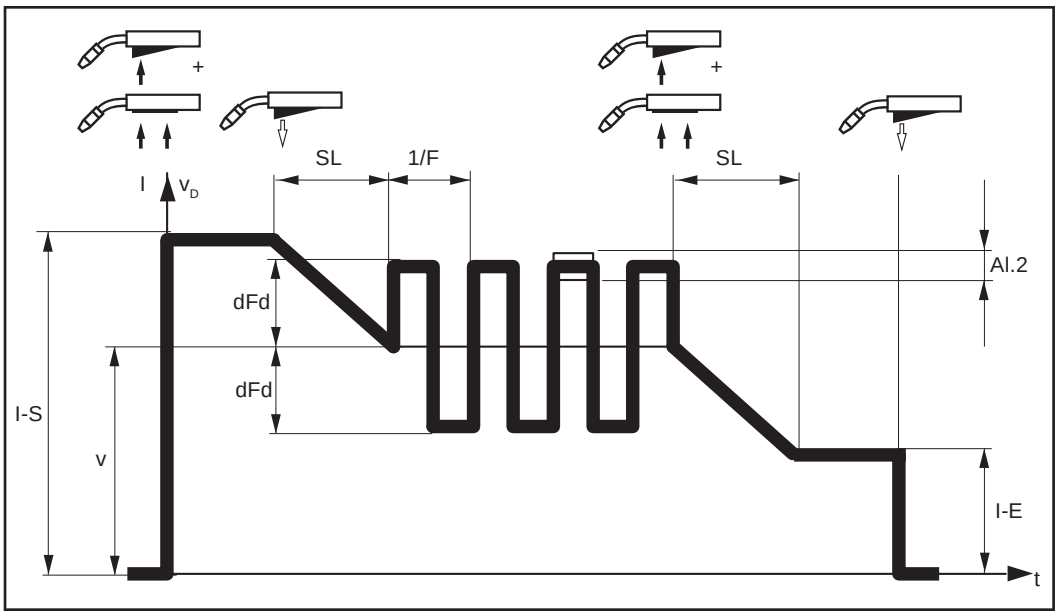
System requirements:
- Firmware version on the power source: OFFICIAL UST V2.60.4
- Firmware version on the wire-feed unit: OFFICIAL SR 1 V1.40.15

NOTE! External enabling of the SynchroPulse option is possible from firmware version OFFICIAL UST V2.70.1 (power source) upwards. Only Fronius push-pull wire-feed unit systems are supported.

NOTE! As long as the Standard manual welding process is selected, the SynchroPulse option is not supported.

Function of SynchroPulse in "Special 4-step" mode

I-S = Starting current phase SL = Slope
I-E = End-crater phase v = Wire feed speed



SynchroPulse function

Robot welding

Prerequisite

A robot interface or field bus system is needed in order to be able to control the power source from a robot control unit.

General

2-step mode is selected automatically if a ROB 4000 / 5000 robot interface or field bus system is connected. The mode can only be changed using the Mode button when the robot interface or field bus has been disconnected from the LocalNet.

If a ROB 3000 robot interface is connected, any mode (2-step mode, 4-step mode, special 4-step mode, etc.) can be selected.

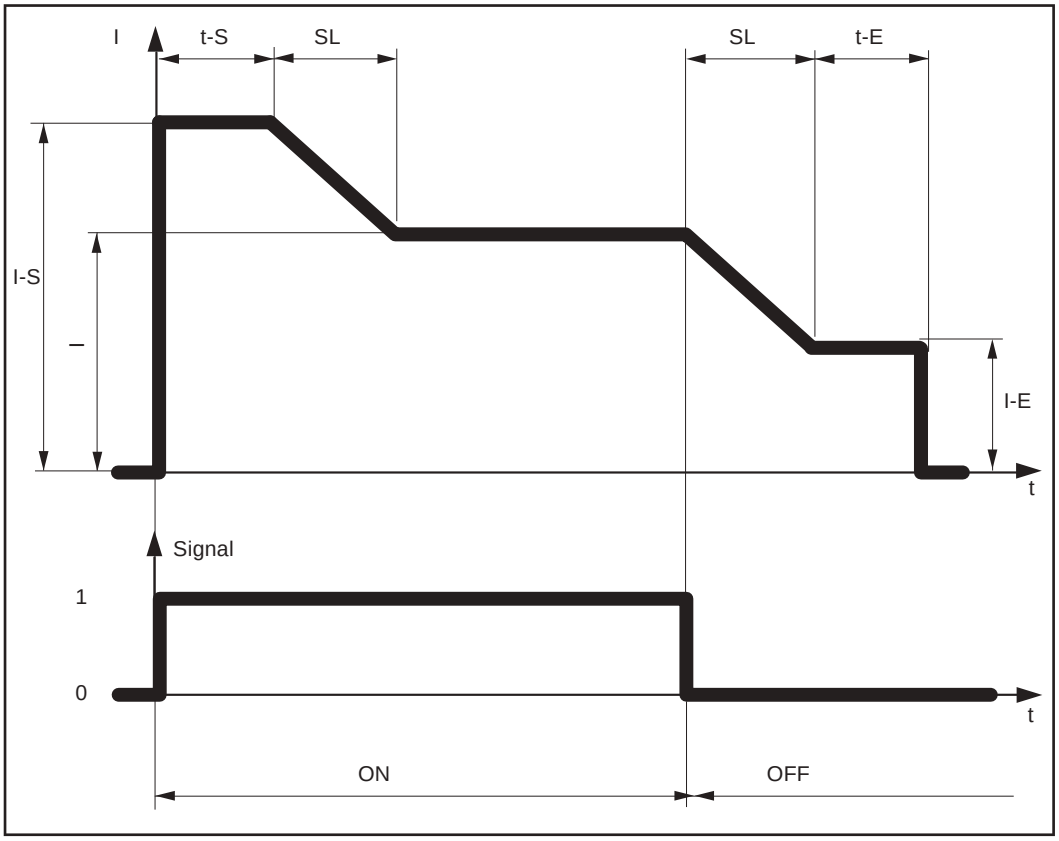
More information about robot welding can be found in the operating instructions for the robot interface or field bus systems and in the "Robot-interface" leaflet (42,0410,0616).

Special 2-step mode for robot interface

The special 2-step mode function is available if a robot interface or field bus system is connected to the LocalNet.

Function of special 2-step mode for robot interface

I-S = Starting current phase	SL = Slope	I-E = End-crater phase
t-S = Starting current dura-	t-E = Final current duration	Signal = Robot signal
ON = Welding start	OFF = Welding stop	



Function of special 2-step mode

Wire-stick control function

The wire-stick control function is available if a robot interface or field bus system is connected to the LocalNet.

After the end of welding, the wire-stick control function detects any “sticking” of the wire electrode in the solidifying weld pool. If a sticking wire electrode is detected within 750 ms after the end of welding, the error message “Err | 054” will be output.

Procedure in the event of a sticking wire electrode:

WARNING! A welding process that starts automatically can pose a risk to life. The “Arc on” signal must not be set while the error is being rectified, otherwise welding will start as soon as the error is rectified.

1 Cut off the end of the wire electrode that is sticking

NOTE! The error message “Err | 054” does not need to be acknowledged.

The power source is now ready for operation.

NOTE! The standard factory setting is that the wire-stick control function is not activated. If required, activate the wire-stick control function in the "Setup menu - level 2" (“Stc | ON”).

Changing the welding process during CMT Advanced welding

NOTE! Neither the welding process nor the currently selected characteristic can be changed during CMT Advanced welding.

To change the welding process or characteristic:

1 first, end the CMT Advanced process

2 wait 300 - 600 ms
Another welding process or characteristic can be selected during this time.

3 Resume the welding process with another welding process or characteristic

TIG welding

Safety

WARNING! Operating the equipment incorrectly can cause serious injury and damage. Do not use the functions described until you have thoroughly read and understood the following documents:
- these operating instructions
- all the operating instructions for the system components, especially the safety rules

WARNING! An electric shock can be fatal. If the power source is connected to the mains electricity supply during installation, there is a high risk of very serious injury and damage. Before carrying out any work on the device make sure that:
- the power source mains switch is in the "O" position
- the power source is unplugged from the mains

Prerequisite

The TIG welding process is only possible
- with the Comfort, US and TIME 5000 Digital control panels
- with a TIG gas valve torch

The inputs required for TIG welding are described by reference to the Comfort control panel.

Preparation

1. Move the mains switch to the "O" position
2. Disconnect the mains plug
3. Remove the MIG/MAG welding torch
4. Disconnect the grounding (earthing) cable from the (-) current socket
5. Plug the grounding (earthing) cable into the (+) current socket and latch it in place
6. Use the other end of the grounding (earthing) cable to establish a connection to the workpiece
7. Plug the bayonet current plug on the TIG gas valve torch into the (-) current socket and twist it clockwise to fasten it
8. Screw the pressure regulator onto the (argon) gas cylinder and tighten it
9. Connect the gas hose of the TIG gas valve torch to the pressure regulator
10. Plug in the mains plug

TIG welding

CAUTION! Risk of injury and damage from electric shock. As soon as the mains switch is in the "I" position, the tungsten electrode of the welding torch is LIVE. Make sure that the tungsten electrode does not touch any persons or electrically conducting or earthed parts (e.g. housing, etc.)

1. Move the mains switch to the "I" position: all the indicators on the control panel light up briefly
2. Press the Process button to select the TIG welding process:

   The welding voltage is connected to the welding socket with a 3-second time lag.

NOTE! Parameters that have been set on a system component control panel (e.g. wire feed unit or remote control) might not be able to be changed on the power source control panel.

3 Press the Parameter selection button. The LED indicator on the button must light up.

4 Use the adjusting dial to set the desired amperage.
The amperage value is shown in the left-hand digital display.

All welding parameter set values that have been set using the adjusting dial remain stored until the next time they are changed. This applies even if the power source is switched off and on again in the meantime.

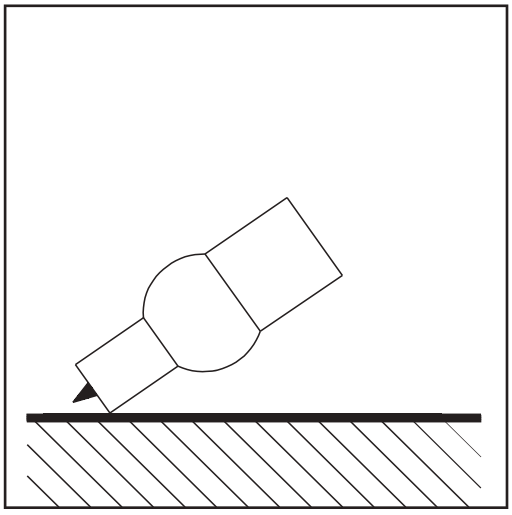
5 Open the gas stop valve on the TIG gas valve torch

6 Set the desired shielding gas flow rate on the pressure regulator

7 Start welding (ignite the arc)

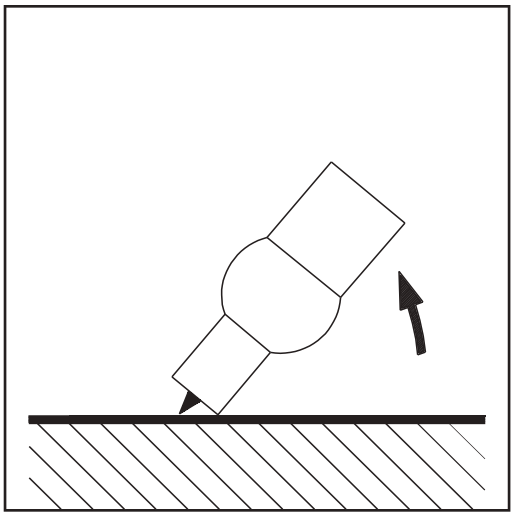
Igniting the arc

The welding arc is ignited by touching the workpiece with the tungsten electrode.



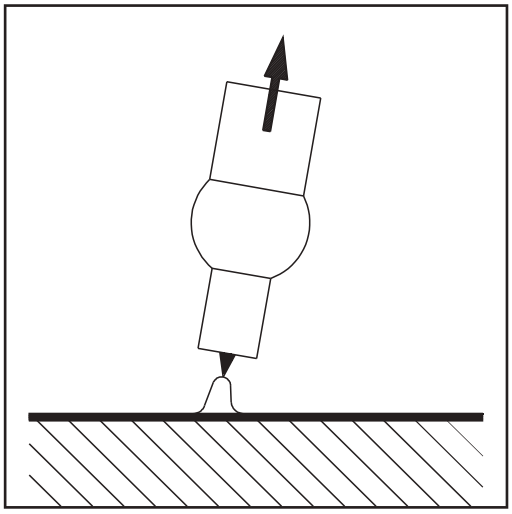
Placing the gas nozzle down

1 Place the gas nozzle on the ignition location so that there is a gap of 2-3 mm (0.08 - 0.12 in.) between the tip of the tungsten electrode and the workpiece.



Arc ignites when electrode is touched down on workpiece

2 Gradually tilt the welding torch up until the tungsten electrode touches the workpiece



Arc ignited - welding commences

3 Raise the torch and pivot it into the normal position - the arc ignites

4 Carry out welding

Finishing welding

NOTE! When the welding action is finished, the gas post-flow time required to protect the tungsten electrode and the weld seam depends on the welding current.

Welding current	Gas post-flow time
50 A	6 s
100 A	7 s
150 A	8 s
200 A	9 s
250 A	12 s
300 A	13 s
350 A	14 s
400 A	16 s
450 A	17 s
500 A	18 s

1 Lift the TIG gas-valve torch away from the workpiece until the arc goes out.

2 When the welding action is finished, wait for the gas post-flow time according to the standard values in the table.

3 Close the gas stop valve on the TIG gas valve torch

TIG Comfort Stop option

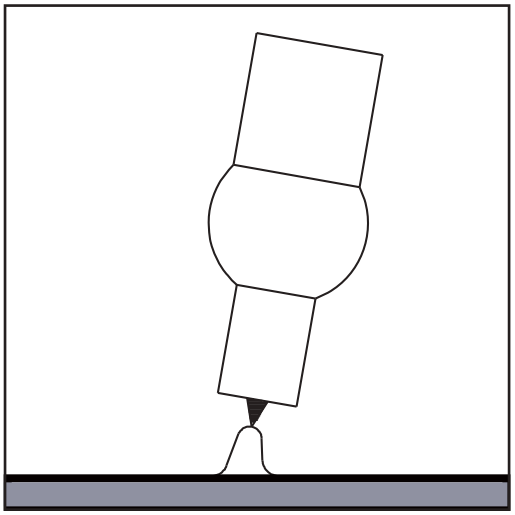
If desired, the power source can also be fitted with the optional “TIG Comfort Stop”.

At the end of the welding operation, the welding current is switched off automatically if the length of the arc increases by more than a defined amount. This prevents the arc being unnecessarily elongated when the TIG gas-valve torch is lifted off the workpiece.

System requirement:
Firmware version OFFICIAL UST V3.00.2 on the power source

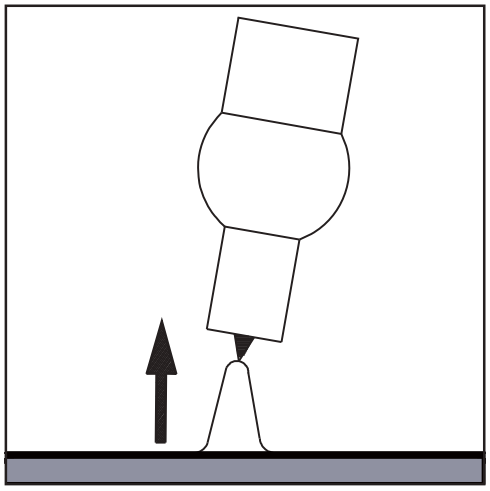
The standard factory setting is that the optional “TIG Comfort Stop” function of the power source is deactivated.

The “TIG Comfort Stop” function is activated and set by means of the CSS parameter. The CSS parameter is described in the "Setup menu - level 2", “TIG welding”.



Welding

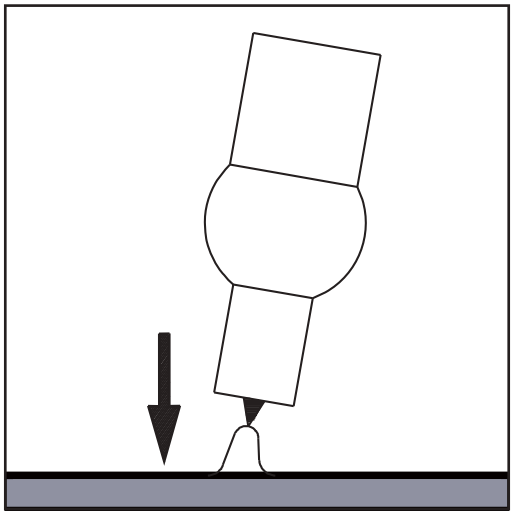
1 Welding



Raising the torch

2 At the end of the welding action, briefly raise the torch

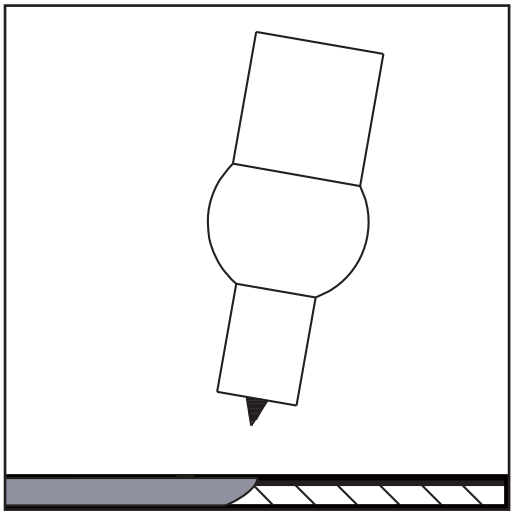
The arc length is increased significantly.



Lowering the torch

3 Lower the welding torch

- The arc length is reduced significantly
- The optional TIG Comfort Stop function is triggered



Keeping the torch at the same height and then removing it

4 Keep the torch in the same position
- The welding current is continuously decreased (downslope)
- The arc goes out

NOTE! The downslope is preset and cannot be adjusted.

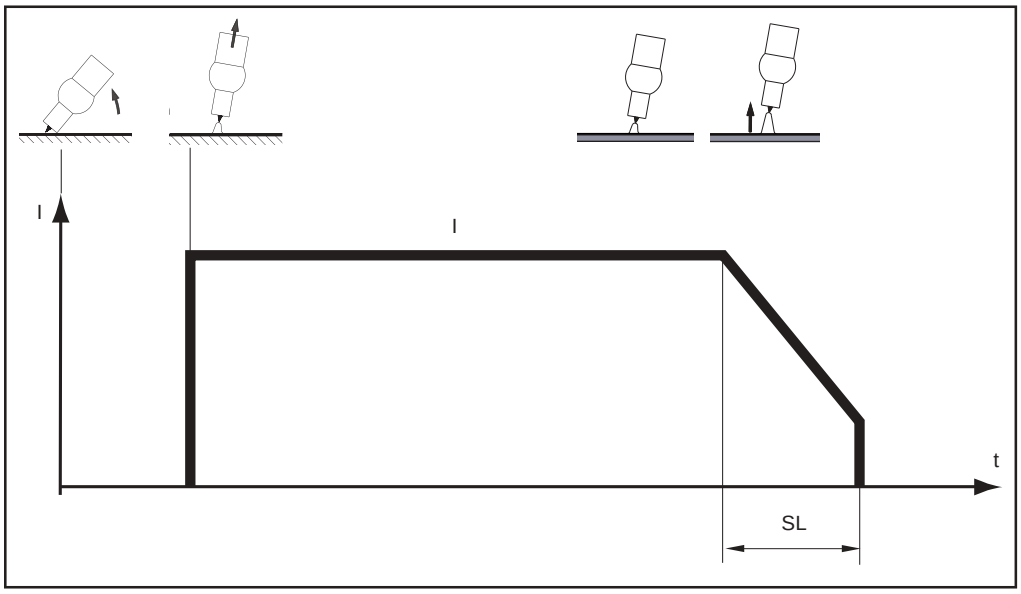
5 Raise the torch from the workpiece.

TIG welding with TIG Comfort Stop

Welding current curve with the TIG Comfort Stop option activated:

I .....Preset welding current

SL ..... Downslope



TIG welding process with the optional TIG Comfort Stop function activated

MMA welding

Safety

WARNING! Operating the equipment incorrectly can cause serious injury and damage. Do not use the functions described until you have thoroughly read and understood the following documents:
- these operating instructions
- all the operating instructions for the system components, especially the safety rules

WARNING! An electric shock can be fatal. If the power source is connected to the mains electricity supply during installation, there is a high risk of very serious injury and damage. Before carrying out any work on the device make sure that:
- the power source mains switch is in the "O" position
- the power source is unplugged from the mains

Prerequisite

Manual metal arc (MMA) welding is only possible in conjunction with the Comfort, US, TIME 5000 Digital and CMT control panels.

The inputs required for MMA welding are described by reference to the Comfort control panel.

Preparation

1 Move the mains switch to the "O" position

2 Disconnect the mains plug

3 Remove the MIG/MAG welding torch

NOTE! Check the rod electrode packaging to determine whether the rod electrodes are for (+) or (-) welding.

4 Plug the grounding (earthing) cable into either the (-) or the (+) current socket, depending on the type of electrode, and latch it in firmly

5 Use the other end of the grounding (earthing) cable to establish a connection to the workpiece

6 Plug the bayonet current plug of the electrode holder cable into the free current socket with the opposite polarity, according to the type of electrode, and twist it clockwise to latch it in place

7 Plug in the mains plug

Manual metal arc welding

CAUTION! Risk of injury and damage from electric shock. As soon as the mains switch is in the "I" position, the rod electrode in the electrode holder is LIVE. Make sure that the rod electrode does not touch any persons or electrically conducting or earthed parts (e.g. the housing etc.).

1 Move the mains switch to the "I" position: all the indicators on the control panel light up briefly

2 Press the Process button to select the MMA welding process:

The welding voltage is connected to the welding socket with a 3-second time lag.

If the MMA welding process is selected, any cooling unit present is automatically deactivated. It is not possible to switch it on.

NOTE! Parameters that have been set on a system component control panel (e.g. wire feed unit or remote control) might not be able to be changed on the power source control panel.

3 Press the Parameter selection button. The LED indicator on the button must light up.

4 Use the adjusting dial to set the desired amperage.
The amperage value is shown in the left-hand digital display.

All welding parameter set values that have been set using the adjusting dial remain stored until the next time they are changed. This applies even if the power source is switched off and on again in the meantime.

5 Start welding

NOTE! The power source has a pulsating open circuit voltage. When the MMA welding process is selected, the right hand digital display shows an average welding voltage value of 40 V before welding begins (open circuit). The following maximum welding voltages are available for the welding start and the welding process to ensure optimum ignition properties:
- TPS 2700 ... 50 V
- TS 4000 / 5000, TPS 3200 / 4000 / 5000 ... 70 V

Corrections during welding

In order to obtain the best possible welding results, the following parameter can be corrected in certain circumstances:

Arc-force dynamic
to influence the short-circuiting dynamic at the instant of droplet transfer

0	soft, low-spatter arc
100	harder, more stable arc

Adjusting parameters for correction

1 Press the Parameter selection button to select the parameter you wish to correct

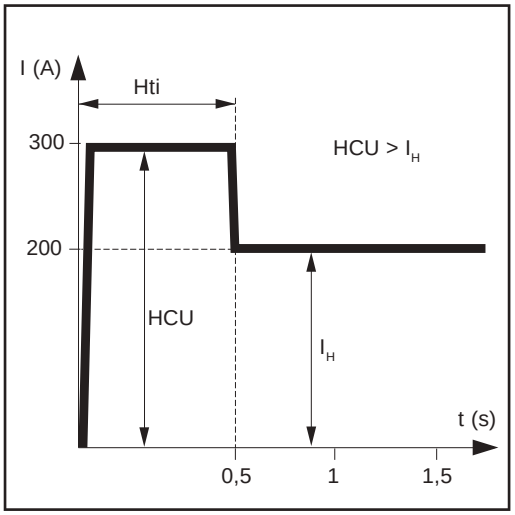
2 Use the adjusting dial to set the selected parameter to the desired value. The parameter value is displayed in the digital display located above it.

HotStart function

To obtain optimum welding results, it will sometimes be necessary to adjust the HotStart function.

Benefits
- Improved ignition, even when using electrodes with poor ignition properties
- Better fusion of the base material during start-up phase, meaning fewer cold-shut defects
- Largely prevents slag inclusions

See the "Setup menu: level 2" section for details on setting the available welding parameters.



Example of "Hotstart" function

Legend

Hti ..... Hot-current time, 0 - 2 s, factory setting: 0.5 s

HCU ... Hot-start current, 0 - 200%, factory setting 150 %

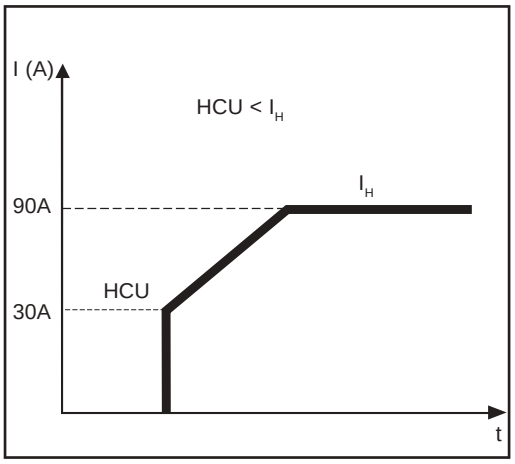
I_H ..... Main current = set welding current

Function:

during the specified hot-current time (Hti), the welding current is increased to a certain value. This value (HCU) is higher than the selected welding current (I_H).

SoftStart function

The SoftStart function is intended for basic electrodes. Ignition takes place at a low welding current. Once the arc is stable, the welding current continues to rise until it reaches the welding current command value.



Example of "SoftStart" function

Benefits

- Improved ignition properties for electrodes that ignite at low welding currents
- Largely prevents slag inclusions
- Reduces welding spatter

Legend

HCU ... Hot-start current, 0 - 200%, factory setting 150 %

I_H ..... Main current = set welding current

Anti-stick function

As the arc becomes shorter, the welding voltage may drop so far that the rod electrode will tend to stick. This may also cause the rod electrode to burn out.

Electrode burn-out is prevented by activating the anti-stick function. If the rod electrode begins to stick, the power source immediately switches the welding current off. After the rod electrode has been detached from the workpiece, the welding process can be continued without any problems.

The anti-stick function can be activated and deactivated in the "Setup menu: level 2" section.

Job mode

General

Job mode enhances the quality of welding engineering fabrication, both in manual and automated welding.

Up to 100 common jobs (operating points) can be reproduced in job mode, avoiding the need to document parameters by hand.

Prerequisites

Job mode is only available on power sources with the following control panels:
- Comfort control panel
- US control panel
- TIME 5000 Digital control panel
- CMT control panel

Restrictions

Job mode is not available with the TR 2100 TIME remote control and the VR 4000-30 TIME wire-feed unit. Once the remote control or wire-feed unit is connected, the MIG/MAG pulse synergic welding process is automatically selected. No other process can be selected on the power source.

Job mode displays on the left-hand digital display

The following job mode displays are used on the left-hand digital display:

- - - ..... No job in this program location (only when you try to retrieve a job from this location, otherwise nPG)

nPG ....No job in this program location

PrG .... There is a job in this program location

Pro ..... Job is being created / copied in this program location

dEL .... Job is being deleted from this program location

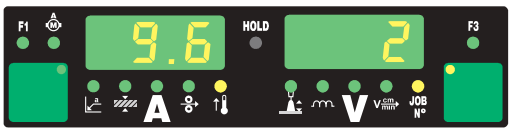
Selecting job mode as the process

1 Press the Process button to select Job mode as the process:

JOB

The following activities have to be carried out in Job mode:
- Retrieve a job
- Copy/overwrite a job

The display shows the last job to be used.

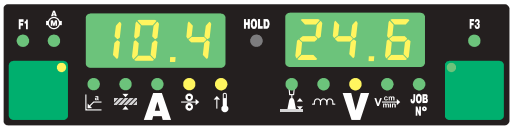


Creating a job

NOTE! Jobs are not created in the Job mode process. Jobs can be created in the MIG/MAG pulse synergic welding, MIG/MAG standard synergic welding, MIG/MAG standard manual welding, TIG welding and MMA welding processes.

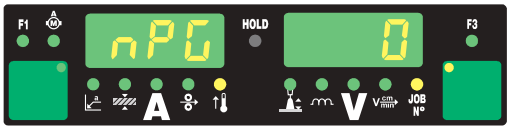
The device comes with no jobs pre-programmed. To create a job, proceed as follows:

1 Set the desired welding parameters that you want to store as a "Job".

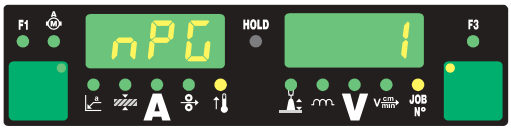


2 Briefly press the Store button to change to the job menu

The first vacant program location for the job is indicated.



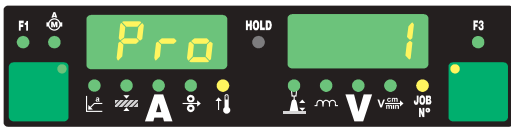
3 Select the desired program location with the adjusting dial, or else leave the suggested program location unchanged



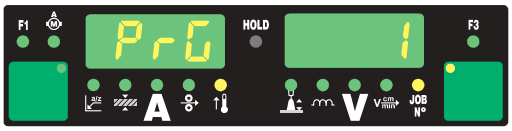
4 Press and hold the Store button

NOTE! If the selected program location already has a job stored in it, then this existing job will be overwritten with the new job. This action cannot be undone.

The left-hand digital display reads “Pro” - the job is stored in the program location you have just selected.



"PrG" appears on the left-hand digital display to indicate that the job is now stored.



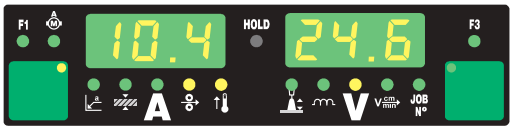
NOTE! The parameters from the Setup menu are also stored for each job with the exception of the following functions:

- Push-pull unit
- Cooling unit switch-off
- Measuring the welding circuit resistance
- Measuring the welding circuit inductivity

5 Release the Store button

6 Briefly press the Store button to exit from the Job menu

The power source switches to the setting selected before the job was stored.

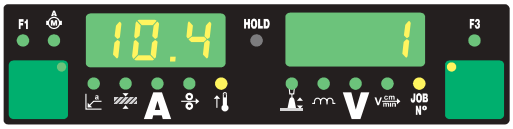


Retrieving a job

NOTE! Before retrieving a job, make sure that the welding system has been installed and set up for the job.

Jobs are retrieved in the job mode process.

1 Use the adjusting dial to select the desired job



MIG/MAG jobs can also be selected via the JobMaster or Up/Down welding torches.

When you retrieve a job directly from the power source, you can also select vacant program locations (symbolised by “- - -”). Only pre-programmed program locations can be selected via the JobMaster or Up/Down torches, however.

To view the settings for the selected job, use the "Parameter selection" buttons. The settings cannot be modified. The process and operating mode of the stored job are also displayed.

2 Start welding
Welding takes place with the welding parameters stored in the job.

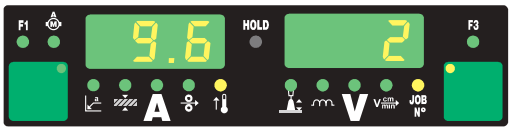
During welding you can switch to another job without stopping (e.g. in robot operation).

When you change to another process, Job mode is ended.

Copying/overwriting a job

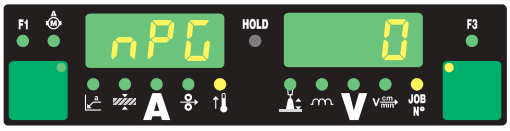
In Job mode you can copy a job that has already been saved to one program location to any other program location. To copy a job, proceed as follows:

1 Use the adjusting dial (1) to select which job you want to copy

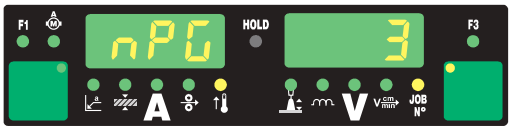


2 Briefly press the Store button to change to the job menu

The first vacant program location for the job to be copied is indicated.



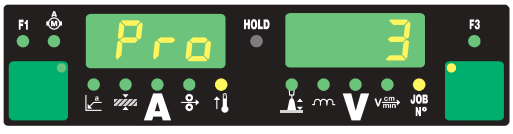
3 Select the desired program location with the adjusting dial, or else leave the suggested program location unchanged.



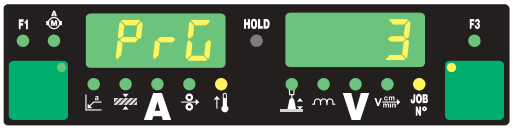
4 Press and hold the Store button

NOTE! If the selected program location already has a job stored in it, then this existing job will be overwritten with the new job. This action cannot be undone.

The left-hand digital display reads "Pro" - the job is copied to the program location you have just selected.



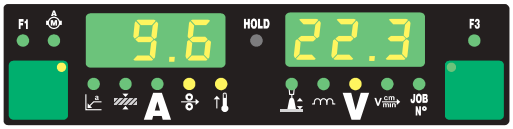
"PrG" appears on the left-hand digital display to indicate that the job has been copied.



5 Release the Store button.

6 Briefly press the Store button to exit from the Job menu

The power source switches to the setting selected before the job was copied.



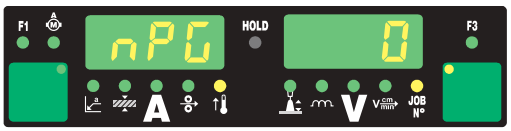
Deleting a job

NOTE! Jobs are deleted in the Job menu, not in the job mode process.

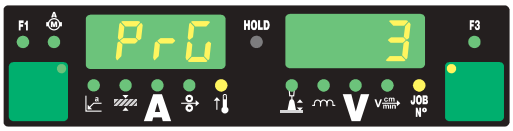
Stored jobs can also be deleted again. To delete a job, proceed as follows:

1 Briefly press the Store button to change to the job menu

The first vacant program location is shown.

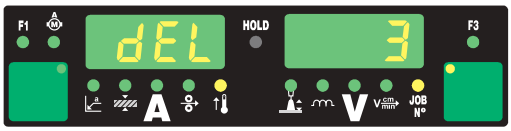


2 Using the adjusting dial, select the job to be deleted (the DEL symbol lights up on the wire diameter button). DEL

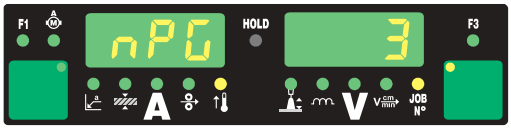


3 Press and hold the wire diameter button “DEL”.

The left-hand display reads "dEL" - the job is deleted.



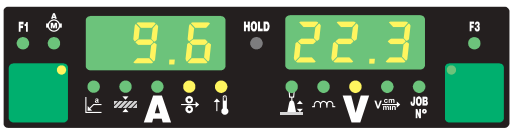
"PrG" appears on the left-hand digital display to indicate that the job has been deleted.



4 Release the wire diameter button “DEL”.

5 Briefly press the Store button to exit from the Job menu

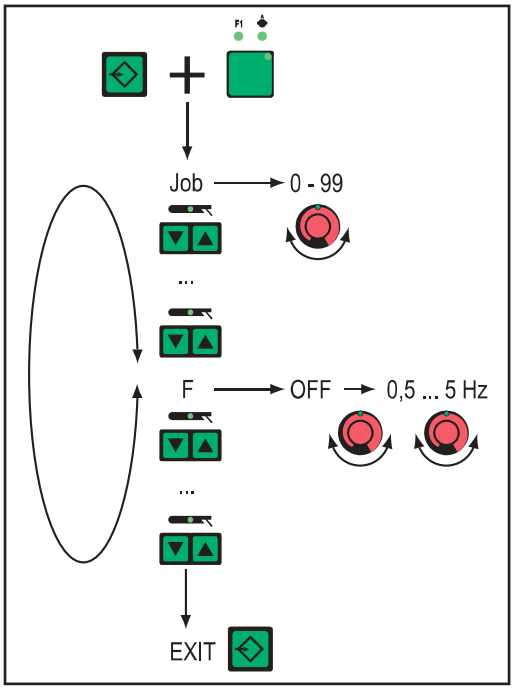
The power source switches to the setting selected before the job was deleted.



Setup settings

Job correction

General



Job correction menu: Overview

In the Job correction menu, setup parameters can be adapted to the specific requirements of individual jobs.

Opening the Job correction menu

1 Press and hold the Store button

2 Press the parameter selection button (left)

3 Release the Store button

The power source is now in the Job correction menu. The first parameter, "Job", is shown. The "Job" parameter is used to select the job for which the parameters are to be adjusted.

The job correction menu can also be opened using the following:
- RCU 4000 remote control
- Win RCU (JobExplorer software)
- ROB 4000/5000 robot interface
- Field bus systems

Changing welding parameters

1 Use the Process button to select the desired parameter

2 Use the adjusting dial to change the parameter value

Exiting the Job correction menu

1 Press the Store button

NOTE! Any alterations are saved by exiting from the Job correction menu.

Parameters in the job correction menu

There are two types of parameter in the job correction menu:

permanently settable parameters:
- cannot be altered apart from in the job correction menu.
- can only be corrected in the job correction menu.

parameters that can be corrected at a later time:
- with boundary values for which an adjusting range can be defined
- within this adjusting range, these parameters can be corrected from the following control elements:
  - Control panel (Comfort, US, TIME 5000 Digital, CMT)
  - JobMaster welding torch
  - RCU 4000 remote control
  - Win RCU (JobExplorer software)

Permanently settable parameters

"Minimum" and "maximum" are used for setting ranges that differ according to power source, wire-feed unit, welding program, etc.

Job
Job whose parameters are to be adjusted

Unit	-
Setting range	0 - 99 = numbers of the programmed jobs n = memory location vacant
Factory setting	-

P
Power correction - correction of the welding power as defined by the wire feed speed

Unit	m/min	ipm
Setting range	e.g.: 5 - 22	e.g.: 0.2 - 866.14
	The setting range depends upon which job has been selected.	
Factory setting	-	

AL.1
Arc length correction 1 - general arc length correction

Unit	% (of welding voltage)
Setting range	± 30%
Factory setting	-

NOTE! When the SynchroPulse option is enabled, AL.1 is the arc length correction for the lower operating point of the pulsed welding power. The arc length correction for the upper operating point is made using parameter AL.2.

dYn
dynamic - arc force dynamic correction for standard arcs or pulse correction for pulsed arcs.
The function of the "dyn" parameter corresponds to the droplet detachment correction/arc force dynamic correction/arc force dynamic parameter on the control panel, described under "Welding".

Unit	1
Setting range	± 5
Factory setting	-

GPr
Gas pre-flow time

Unit	s	
Setting range	0 - 9.9	
Factory setting	0.1	

GPo
Gas post-flow time

Unit	s	
Setting range	0 - 9.9	
Factory setting	0.5	

FDc
Feeder creep - wire feeder creep speed

Unit	m/min	ipm
Setting range	AUT, OFF or 0.5 - max.	AUT, OFF or 19.69 - max.
	Additional possible setting with SFi option: SFi	
Factory setting	AUT	AUT

NOTE! If Fdc is set to AUT, the value from the welding program database will be used. If Fdc values are set manually and these values are faster than the wire feed speed that was set for the welding operation then the feeder creep speed is equal to the wire feed speed set for the welding operation.

Fdi
Feeder inching

Unit	m/min	ipm
Setting range	1 - max.	39.37 - max.
Factory setting	10	393.7

bbc
Burn-back time correction

Unit	s
Setting range	± 0.20
Factory setting	0

I-S
I (current) - Starting current

Unit	% (of starting current)
Setting range	0 - 200
Factory setting	135

SL
Slope

Unit	s
Setting range	0.1 - 9.9
Factory setting	1.0

I-E
I (current) - End - Final current

Unit	% (of starting current)
Setting range	0 - 200
Factory setting	50

t-S
time - Starting current - Starting current duration

Unit	s
Setting range	OFF or 0.1 - 9.9

Factory setting	OFF	

t-E
time - End current - Final current duration

Unit	s	
Setting range	OFF or 0.1 - 9.9	
Factory setting	OFF	

SPt
Spot welding time

Unit	s	
Setting range	0.1 - 5.0	
Factory setting	1.0	

F
Frequency - for SynchroPulse option

Unit	Hz	
Setting range	OFF or 0.5 - 5	
Factory setting	OFF	

dFd
delta Feeder - Welding power offset for the SynchroPulse option (defined by the wire feed speed)

Unit	m/min	ipm
Setting range	0.0 - 2.0	0.0 - 78.74
Factory setting	2,0	78.74

AL.2
Arc length correction 2 (for the upper operating point of the pulsed welding power with the SynchroPulse option)

Unit	% (of welding voltage)
Setting range	± 30
Factory setting	0

NOTE! The arc length correction for the lower operating point is made using parameter AL.1.

tri
Trigger - subsequent correction of the mode: 2-step, 4-step, special 2-step, special 4-step, spot welding

Unit	-
Setting range	2-step, 4-step, special 4-step, spot welding
Factory setting	2-step

Parameters that can be corrected at a later time

NOTE! During welding, the welding power (defined by the wire feed speed) or arc length can only be corrected as follows:

- via the control panel (Comfort, US, TIME 5000 Digital, CMT)
- via the JobMaster welding torch
- via the RCU 4000 remote control
- via Win RCU (JobExplorer software)
- within the defined boundaries (listed below for the parameters PcH, PcL and AL.c)

As long as the power source is switched on, the corrected parameter values remain saved. After the power source has been switched on again, the parameters are reset to the permanently settable values.

"Minimum" and "maximum" are used for setting ranges that differ according to power source, wire-feed unit, welding program, etc.

PcH

Power correction High - Correction boundary (high) for the welding power

Unit	% (of permanently settable parameter P - power correction)
Setting range	0 - 20
Factory setting	0

NOTE! The maximum amount by which parameter P can be increased is the value set for PcL.

PcL

Power correction Low - Correction boundary (low) for the welding power

Unit	% (of permanently settable parameter P - power correction)
Setting range	0 - 20
Factory setting	0

NOTE! The maximum amount by which parameter P can be decreased is the value set for PcL.

AL.c

Arc length correction (up or down)

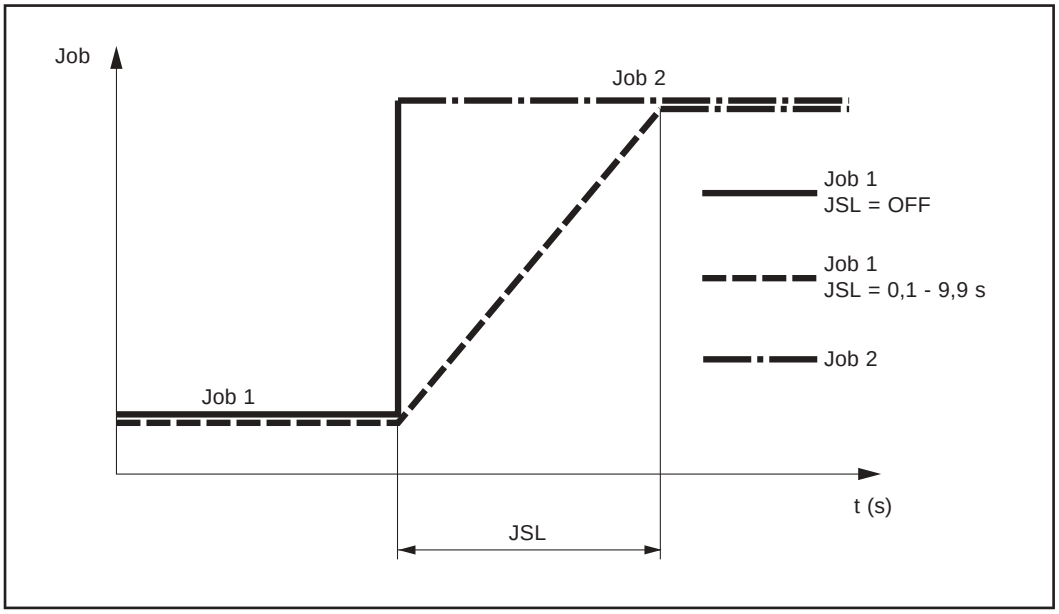
Unit	% (of permanently settable parameter AL.1)
Setting range	0 - 30
Factory setting	0

NOTE! The maximum amount by which parameter AL.1 can be increased or decreased is the value specified for AL.c.

JSL

Job Slope - defines the time between the job that is currently selected and the next job

Unit	s
Setting range	OFF or 0.1 - 9.9
Factory setting	OFF



Job Slope

The value that has been set for Job Slope is stored along with the Job currently selected.

Shielding gas setup menu

General

The Protective gas shield setup menu provides easy access to the protective gas shield settings.

Protective gas shield setup menu for the standard control panel

Opening the Protective gas shield setup menu

1 Press and hold the Store button

2 Press the Gas test button

3 Release the Store button

Changing welding parameters

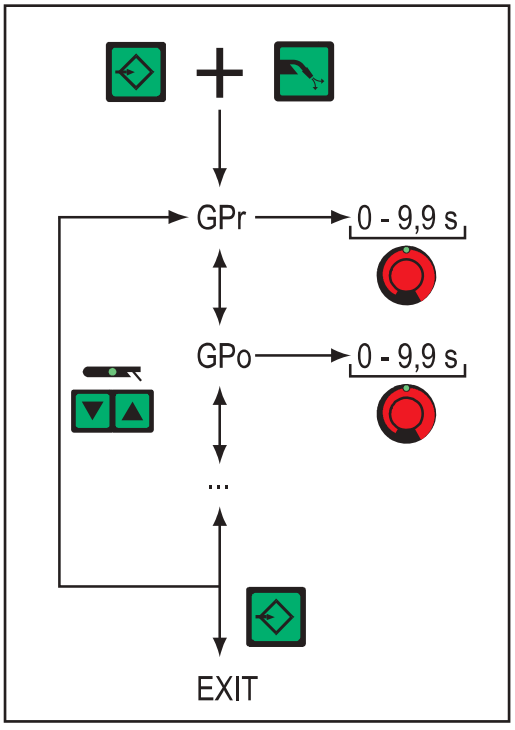
4 Use the Material button to select the desired parameter

5 Alter the parameter value using the Mode button

Exiting the Setup menu

6 Press the Store button

Protective gas shield setup menu for the Comfort, US, TIME 5000 Digital and CMT control panels



Protective gas shield setup menu: Overview

Opening the Protective gas shield setup menu

1 Press and hold the Store button

2 Press the Gas test button

3 Release the Store button

The power source is now in the Protective gas shield setup menu - the last parameter that was selected is displayed.

Changing welding parameters

4 Use the Process button to select the desired parameter

5 Use the adjusting dial to change the parameter value

Exiting the Setup menu

6 Press the Store button

Welding parameters in the Protective gas shield setup menu

"Minimum" and "maximum" are used for setting ranges that differ according to power source, wire-feed unit, welding program, etc.

GPr	
Gas pre-flow time	
Unit	s
Setting range	0 - 9.9
Factory setting	0.1

GPo	
Gas post-flow time	
Unit	s
Setting range	0 - 9.9
Factory setting	0.5

GPU	
Gas purger	
Unit	min
Setting range	OFF or 0.1 - 10.0
Factory setting	OFF

Purging of the shielding gas begins as soon as GPU is allocated a value.

For safety reasons, purging of the shielding gas cannot be restarted until a new GPU value is entered.

NOTE! Purging the shielding gas is necessary if condensation forms when the device is left unused in a cold environment for a prolonged period. Long hosepacks are most affected.

GAS		
Gasflow - set value for shielding gas flow (digital gas control option)		
Unit	l/min	cfh
Setting range	OFF or 0.5 - max.	OFF or 10.71 - max.
Factory setting	15.0	32.14

NOTE! Please refer to the “Digital Gas Control” operating instructions for more detailed explanations of the “GAS” parameter.

Setup menu for the standard control panel

General

The Setup menu provides easy access to expert knowledge in the power source and to additional functions. The Setup menu can be used to make simple adjustments of the welding parameters to suit the various job settings.

Setup menu for the standard control panel

Opening the Protective gas shield setup menu

1 Press and hold the Store button

2 Press the Gas test button

3 Release the Store button

Changing welding parameters

4 Use the Material button to select the desired parameter

5 Alter the parameter value using the Mode button

Exiting the Setup menu

6 Press the Store button

Parameters in the Setup menu for the Standard control panel

NOTE! The number of parameters available for the Standard control panel, and the order in which they are arranged, is not the same as in the extended setup menu structure found on the Comfort, US, TIME 5000 Digital and CMT control panels.

"Minimum" and "maximum" are used for setting ranges that differ according to power source, wire-feed unit, welding program, etc.

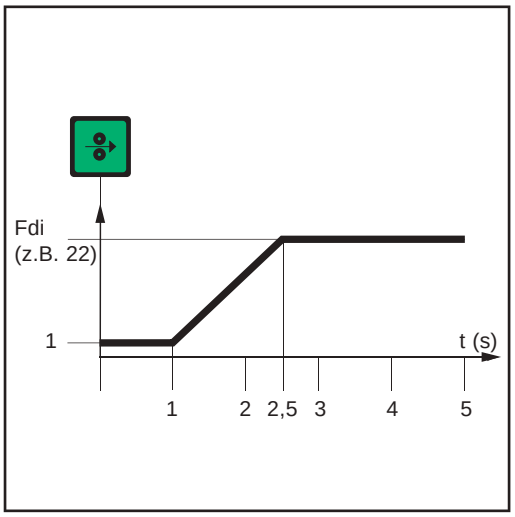
GPr Gas pre-flow time		
Unit	s	
Setting range	0 - 9.9	
Factory setting	0.1	
GPo Gas post-flow time		
Unit	s	
Setting range	0 - 9.9	
Factory setting	0.5	
Fdc Feeder creep - wire feeder creep speed (only available when a push-pull unit is connected and the SFI option has been enabled)		
Unit	m/min	ipm
Setting range	AUT, OFF or 0.5 - max.	AUT, OFF or 19.69 - max.
Factory setting	AUT	AUT

NOTE! If Fdc is set to AUT, the value from the welding program database will be used. If Fdc values are set manually and these values are faster than the wire feed speed that was set for the welding operation then the feeder creep speed is equal to the wire feed speed set for the welding operation.

Fdi
Feeder inching

Unit	m/min	ipm
Setting range	1 - max.	39.37 - max.
Factory setting	10	393.7

NOTE! To facilitate the exact positioning of the wire electrode, the following sequences are possible when the welder presses and holds the Feeder inching button down:



Passage over time of the wire feed speed when the feeder inching button is pressed and held down

- Hold down the button for up to **one second** ... Irrespective of the value that has been set, the wire feed speed remains at
  1 m/min or 39.37 ipm for the first second.
- Hold the button for up to **2.5 seconds** ... After one second, the wire feed speed increases at a uniform rate over the next 1.5 seconds.
- Hold the button for **longer than 2.5 seconds** ... After a total of 2.5 seconds, the wire is fed at a constant rate equal to the wire feed speed set for the Fdi welding parameter.

If the Feeder inching button is released and pressed again before one second has elapsed, the sequence starts again from the beginning. This makes it possible to position the wire continuously at the low wire feed speed of 1 m/min or 39.37 ipm when necessary.

bbc
Burn-back time correction

Unit	s
Setting range	± 0.20
Factory setting	0

dYn
dynamic - Arc force dynamic correction

Unit	1
Setting range	± 5
Factory setting	-

I-S
I (current) - Starting current

Unit	% (of starting current)
Setting range	0 - 200
Factory setting	135

SL
Slope

Unit	s
Setting range	0.1 - 9.9
Factory setting	1.0

I-E
I (current) - End - Final current

Unit	% (of starting current)
Setting range	0 - 200
Factory setting	50

FAC
Reset power source to factory setting
Press and hold down the Store button for 2 s to restore the factory settings
when "PrG" appears on the digital display, the power source has been reset

NOTE! When the power source is reset, all the customised settings in the Setup menu are lost.

When the power source is reset, jobs are not deleted but are retained in the memory. The functions in the second level of the Setup menu (2nd) are also not deleted. Exception: Ignition time-out welding parameter (ito).

2nd
Second level of the Setup menu (see “Setup menu - level 2”)

t-S
time - Starting current - Starting current duration

Unit	s
Setting range	OFF or 0.1 - 9.9
Factory setting	OFF

t-E
time - End current - Final current duration

Unit	s
Setting range	OFF or 0.1 - 9.9
Factory setting	OFF

Process setup menu

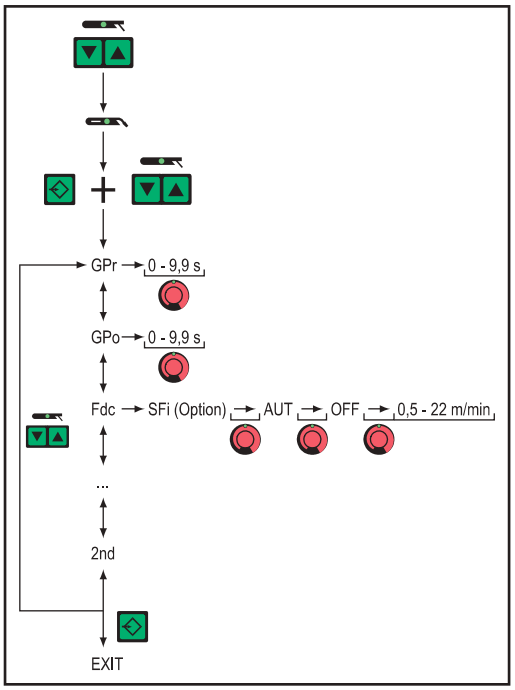
General

The Process setup menu provides simple access to expert knowledge in the power source and to additional functions. The Process setup menu can be used to make simple adjustments of the parameters to the various job settings.

The Process setup menu can be accessed using the Comfort, US, TIME 5000 Digital and CMT control panels.

Process setup menu for the Comfort, US, TIME 5000 Digital and CMT control panels

Setting process parameters is described here with reference to the MIG/MAG standard synergic welding process. The procedure for changing other process parameters is identical.



Process setup menu: Overview

Opening the Process setup menu

1. Use the Process button to select the "MIG/MAG Standard Synergic" welding process
2. Press and hold the Store button
3. Press the Process button
4. Release the Store button

   The power source is now in the setup menu for the MIG/MAG standard synergic welding process - the last parameter that was selected is displayed.

Changing welding parameters

5. Use the Process button to select the desired parameter
6. Use the adjusting dial to change the parameter value

Exiting the Setup menu

7. Press the Store button

Parameters for MIG/MAG welding in the Process setup menu

The parameters available in the Process setup menu are described below for the following MIG/MAG welding processes:

- MIG/MAG pulse synergic welding
- MIG/MAG standard synergic welding
- MIG/MAG standard manual welding
- CMT welding
- TIME welding

"Minimum" and "maximum" are used for setting ranges that differ according to power source, wire-feed unit, welding program, etc.

GPr	
Gas pre-flow time	
Unit	s
Setting range	0 - 9.9
Factory setting	0.1

GPo
Gas post-flow time

Unit	s
Setting range	0 - 9.9
Factory setting	0.5

Fdc
Feeder creep - Wire feeder creep speed used with the SFi option

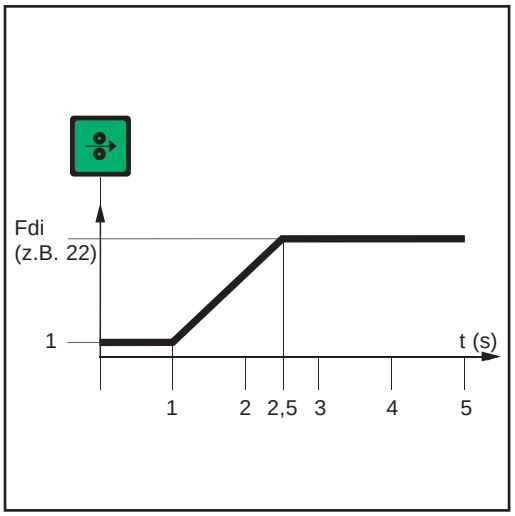
Unit	m/min	ipm
Setting range	AUT, OFF or 0.5 - max.	AUT, OFF or 19.69 - max.
Factory setting	AUT	AUT

NOTE! If Fdc is set to AUT, the value from the welding program database will be used. If Fdc values are set manually and these values are faster than the wire feed speed that was set for the welding operation then the feeder creep speed is equal to the wire feed speed set for the welding operation.

Fdi
Feeder inching

Unit	m/min	ipm
Setting range	1 - max.	39.37 - max.
Factory setting	10	393.7

NOTE! To facilitate the exact positioning of the wire electrode, the following sequences are possible when the welder presses and holds the Feeder inching button down:



Passage over time of the wire feed speed when the feeder inching button is pressed and held down

- Hold down the button for up to **one second** ... Irrespective of the value that has been set, the wire feed speed remains at
1 m/min or 39.37 ipm for the first second.
- Hold the button for up to **2.5 seconds** ... After one second, the wire feed speed increases at a uniform rate over the next 1.5 seconds.
- Hold the button for **longer than 2.5 seconds** ... After a total of 2.5 seconds, the wire is fed at a constant rate equal to the wire feed speed set for the Fdi welding parameter.

If the Feeder inching button is released and pressed again before one second has elapsed, the sequence starts again from the beginning. This makes it possible to position the wire continuously at the low wire feed speed of 1 m/min or 39.37 ipm when necessary.

bbc
Burn-back time correction

Unit	s
Setting range	± 0.20
Factory setting	0

F

Frequency - for SynchroPulse option

Unit	Hz
Setting range	OFF or 0.5 - 5
Factory setting	OFF

NOTE! In order to activate SynchroPulse, you must (as a minimum) change the value of the parameter F (frequency) from OFF to a value of between 0.5 Hz and 5 Hz.

The parameters and the function of SynchroPulse are explained in more detail in the MIG/MAG welding section.

dFd

delta Feeder - Welding power offset for the SynchroPulse option (defined by the wire feed speed)

Unit	m/min	ipm
Setting range	0.0 - 2.0	0.0 - 78.74
Factory setting	2.0	78.74

AL.2

Arc length correction 2 (for the upper operating point of the pulsed welding power with the SynchroPulse option)

Unit	% (of welding voltage)
Setting range	± 30
Factory setting	0

NOTE! The arc length correction for the lower operating point is made using parameter AL.1.

ALS

Arc length start - Increased welding voltage as striking voltage at welding startup, for MIG/MAG standard synergic welding. In conjunction with the Alt parameter explained below, ALS makes an optimised ignition sequence possible.

Unit	% (of welding voltage)
Setting range	0 - 100
Factory setting	0

Example

- ALS = 100 %
- Welding voltage currently set: 13 V
- Striking voltage: 13 V + 100 % = 26 V

ALt

Arc length time - Time for increased arc length via ALS. During time ALt there is a continuous decrease in the arc length to the currently set value.

Unit	s
Setting range	0 - 5
Factory setting	0

FAC

Reset power source to factory setting

Press and hold down the Store button for 2 s to restore the factory settings; when "PrG" appears on the digital display, the power source has been reset

NOTE! When the power source is reset, all the customised settings in the Setup menu are lost.

When the power source is reset, jobs are not deleted but are retained in the memory. The functions in the second level of the Setup menu (2nd) are also not deleted. Exception: Ignition time-out welding parameter (ito).

2nd
Second level of the Setup menu (see “Setup menu - level 2”)

Parameters for TIG welding in the Process setup menu

2nd
Second level of the Setup menu (see “Setup menu - level 2”)

Parameters for MMA welding in the Process setup menu

NOTE! If you reset the power source using the Factory parameter FAC, the hot-current time (Hti) and hot-start current (HCU) parameters are also reset.

Hti
Hot-current time

Unit	s
Setting range	0 - 2.0
Factory setting	0.5

HCU
Hot-start current

Unit	%
Setting range	0 - 200
Factory setting	150

2nd
Second level of the Setup menu (see “Setup menu - level 2”)

Mode setup menu

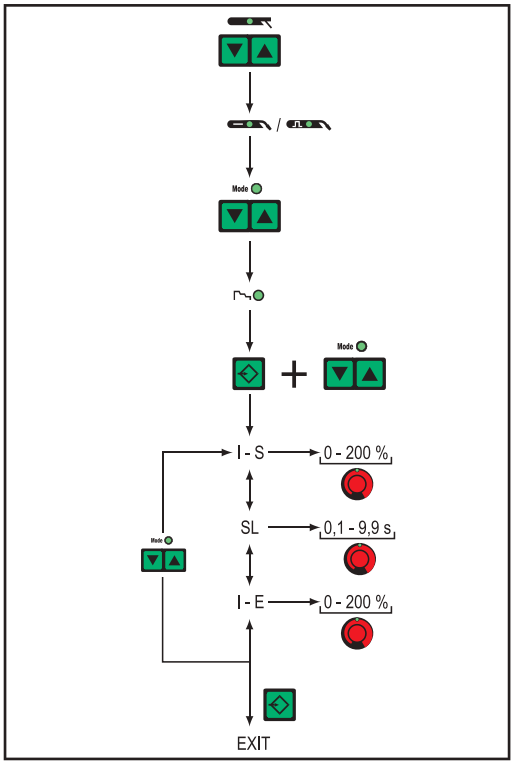
General

The Mode setup menu provides simple access to expert knowledge in the power source and to additional functions. The Mode setup menu can be used to make simple adjustments of the parameters to the various job settings.

The Process setup menu can be accessed using the Comfort, US, TIME 5000 Digital and CMT control panels.

Mode setup menu for the Comfort, US, TIME 5000 Digital and CMT control panels

Setting the Mode parameters is described by reference to "Special 4-step" mode. The procedure for changing other Mode parameters is identical.



Mode setup menu: Overview

Enter the Mode setup menu

1. Use the Process button to select MIG/MAG standard synergic welding or MIG/MAG pulse synergic welding
2. Use the Mode button to select “Special 4-step” mode
3. Press and hold the Store button
4. Press the Mode button
5. Release the Store button

   The power source is now in the setup menu for “Special 4-step" mode - the last parameter that was called is displayed.

Changing welding parameters

4. Use the Mode button to select the desired parameter
5. Use the adjusting dial to change the parameter value

Exiting the Setup menu

6. Press the Store button

Welding parameters for "Special 2-step mode" in the Mode setup menu

"Minimum" and "maximum" are used for setting ranges that differ according to power source, wire-feed unit, welding program, etc.

I-S	
I (current) - Starting current	
Unit	% (of starting current)
Setting range	0 - 200
Factory setting	135
SL	
Slope	
Unit	s
Setting range	0.1 - 9.9
Factory setting	1.0

I-E	
I (current) - End - Final current	
Unit	% (of starting current)
Setting range	0 - 200
Factory setting	50
t-S	
time - Starting current - Starting current duration	
Unit	s
Setting range	OFF or 0.1 - 9.9
Factory setting	OFF
t-E	
time - End current - Final current duration	
Unit	s
Setting range	OFF or 0.1 - 9.9
Factory setting	OFF

In the MIG/MAG welding section, the parameters for "Special 2-step mode for robot interface" are illustrated by means of a diagram.

Welding parameters for "Special 4-step mode" in the Mode setup menu

I-S	
I (current) - Starting current	
Unit	% (of starting current)
Setting range	0 - 200
Factory setting	135
SL	
Slope	
Unit	s
Setting range	0.1 - 9.9
Factory setting	1.0
I-E	
I (current) - End - Final current	
Unit	% (of starting current)
Setting range	0 - 200
Factory setting	50

Parameters for spot welding in the Mode setup menu

SPt	
Spot welding time	
Unit	s
Setting range	0.1 - 5.0
Factory setting	1.0

Setup menu - Level 2

General

The following functions are located in a second menu level:

- PPU (push-pull unit)
- C-C (cooling unit cut-out)
- Stc (wire-stick - only where there is a robot interface)
- Ito (ignition time-out)
- Arc (arc break watchdog)
- S4t (gun trigger option)
- Gun (option for changing between modes with the JobMaster torch)
- r (welding circuit resistance measurement)
- L (welding circuit inductivity display)
- Eln (characteristic selection - not on Standard control panel)
- ASt (Anti-stick - not on Standard control panel)
- COr (gas correction for digital gas control option)

Setup menu level 2 for the Standard control panel

Changing to the second menu level (2nd)

1 Access the Setup menu for the Standard control panel

2 Select "2nd" welding parameter

3 Press and hold the Store button

4 Press the Mode button

5 Release the Store button

The power source is now in the second menu level (2nd) of the Setup menu. The function “PPU” (push-pull unit) is displayed.

Selecting the function

6 Use the Material button to select the desired function

7 Make the settings for this function with the Mode button

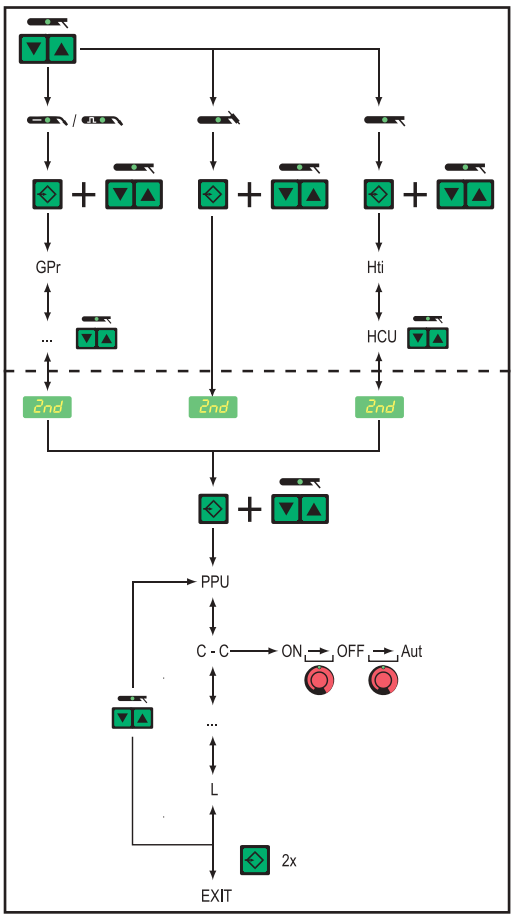
Exiting from the second menu level (2nd)

8 Press the Store button

The power source is now in the Setup menu for the Standard control panel.

9 To exit from the Setup menu for the Standard control panel press the Store button again

Setup menu level 2 for the Comfort, US, TIME 5000 Digital and CMT control panels



Setup menu: level 2: Overview (with reference to MIG/MAG standard synergic welding)

Changing to the second menu level (2nd)

1. Open the Process setup menu
2. Select "2nd" welding parameter
3. Press and hold the Store button
4. Press the Process button
5. Release the Store button

   The power source is now in the second menu level (2nd) of the Setup menu. The function “PPU” (push-pull unit) is displayed.

Selecting the function

6. Use the Process button to select the desired function
7. Set the function with the adjusting dial

Exiting from the second menu level (2nd)

8. Press the Store button

   The power source is now in the Process setup menu.
9. To exit from the Process setup menu, press the Store button again

Welding parameters for MIG/MAG welding in the Setup menu level 2

PPU	
Push-pull unit (see "Calibrating the push-pull unit")	
Unit	s
Setting range	0.1 - 5.0
Factory setting	1.0
C-C	
Cooling unit control	
Unit	-
Setting range	AUT, ON, OFF
Factory setting	AUT

AUT: The cooling unit cuts out after a 2-minute welding off-time

NOTE! If the “FK 4000 thermostat” option has been installed in the cooling unit, the cooling unit cuts out as soon as the return temperature has dropped below 50°C, but no sooner than after a 2-minute welding off-time.

ON: The cooling unit is permanently ON

OFF: The cooling unit is permanently OFF

If an FK 9000 cooling unit is used, the only possible settings are ON and OFF.

NOTE! Parameter C-C can be set differently for MIG/MAG welding and TIG welding.

Example:
- MIG/MAG welding process ... e.g. use of a water-cooled welding torch: C-C = AUT
- TIG welding process ... e.g. use of a gas-cooled welding torch: C-C = OFF

C-t
Cooling time - Time from when the rate-of-flow watchdog is triggered until the "no | H2O" service code is output. For example, if there are air bubbles in the cooling system, the cooling unit will not cut out until the end of this pre-set time.

Unit	s
Setting range	5 - 25
Factory setting	10

NOTE! Every time the power source is switched on, the cooling unit will do a 180-second test run.

Stc
Wire-stick control

Unit	-
Setting range	OFF, ON
Factory setting	OFF

The parameters for the wire-stick function (Stc) are available when a robot interface or field bus coupler for robot control is connected to the LocalNet.

The wire-stick control function (Stc) is described in the "Robot welding" section.

Ito
Ignition time-out - Length of wire that is fed before the safety cut-out is triggered

Unit	mm	in.
Setting range	OFF or 5 - 100	OFF or 0.20 - 3.94
Factory setting	OFF	

NOTE! The "Ignition time-out" function (ito) is a safety function. The length of wire that is fed before the safety cut-out trips may differ from the pre-set wire length, particularly when the wire is being fed at fast wire feed speeds.

The “Ignition time-out” function (ito) is explained in the “Special functions and options” section.

Arc
Arc - Arc break watchdog

Unit	s
Setting range	OFF (arc break watchdog is deactivated); 0.01 - 2 (arc break watchdog is activated)
Factory setting	OFF

The “Arc break watchdog” function (Arc) is explained in the “Special functions and options” section.

FCO
Feeder control - Wire-feed unit cut-out (wire-end sensor option)

Unit	-
Setting range	OFF / ON / noE
Factory setting	OFF

OFF: The power source halts wire feed when the wire-end sensor is triggered. "Err|056“ appears on the display.

ON: The power sources halts wire feed after completion of the current weld seam when the wire-end sensor is triggered. "Err|056" appears on the display.

Acknowledge Err | 056
Insert a new wirespool and feed the wire electrode into the hosepack

noE: The power source does not halt wire feed when the wire-end sensor is triggered. The wire-end alarm is not displayed and is only transmitted to the robot control via the field bus.

NOTE! The "noE" setting only functions in conjunction with the field bus applications. Robot interfaces ROB 4000/5000 do not support this function.

SEt
Setting - Country-specific setting (Standard / USA) ... Std / US

Unit	-
Setting range	Std, US (Standard / USA)
Factory setting	Standard version: Std (measurements in cm/mm) USA version: US (measurements in inches)

S4t
Special 4-step - Gun trigger (option)
Switch between jobs using torch trigger

Unit	-
Setting range	0, 1 (Off, On)
Factory setting	1

Gun
Gun (welding torch) - Changing between modes with the JobMaster torch (optional)

Unit	-
Setting range	0, 1 (Off, On)
Factory setting	1

NOTE! The “Gun Trigger” (S4t) and “Changing between modes with the JobMaster torch” (Gun) options are explained in more detail in the “GunTrigger” operating instructions.

S2t
Special 2-step (US control panel only) - for selecting jobs and groups by pressing the torch trigger

Press once (< 0.5 s)...	next job in a group is selected
Press twice (< 0.5 s)...	next group is selected

r
r (resistance) - Welding circuit resistance (in mΩ)
see "Measuring welding circuit resistance r"

L
L (inductivity) - Welding circuit inductivity (in microhenry)
see "Displaying welding circuit inductivity L"

COr
Correction - Gas correction ("Digital gas control" option)

Unit	-
Setting range	AUT / 1.0 - 10.0
Factory setting	AUT

NOTE! Please refer to "Digital Gas Control" operating instructions for more detailed explanations of the "COr" parameter.

Parameters for operating power sources in parallel in the Setup menu level 2

P-C
Power **C**ontrol - for defining the Master or Slave power sources when two power sources are operated in parallel

Unit	-
Setting range	On (Master power source), OFF (Slave power source)
Factory setting	OFF

NOTE! The P-C parameter is only available when two power sources are connected via an LHSB (LocalNet High-Speed Bus).

Parameters for TimeTwin Digital in the Setup menu level 2

T-C
Twin Control - for defining the leading or trailing power sources in the TimeTwin Digital process

Unit	-
Setting range	On (Leading power source), OFF (Trailing power source)
Factory setting	-

The T-C parameter is only available when two power sources are connected via an LHSB (LocalNet High-Speed Bus) and the “TimeTwin Digital” option has been enabled.

NOTE! When a robot interface is connected to the power source, the T-C parameter can only be adjusted via the robot interface.

Parameters for TIG welding in the Setup menu level 2

C-C
Cooling unit control

Unit	-
Setting range	AUT, ON, OFF
Factory setting	AUT

AUT: The cooling unit cuts out after a 2-minute welding off-time

NOTE! If the “FK 4000 thermostat” option has been installed in the cooling unit, the cooling unit cuts out as soon as the return temperature has dropped below 50°C, but no sooner than after a 2-minute welding off-time.

ON: The cooling unit is permanently ON

OFF: The cooling unit is permanently OFF

If an FK 9000 cooling unit is used, the only possible settings are ON and OFF.

NOTE! Parameter C-C can be set differently for MIG/MAG welding and TIG welding.

Example:
- MIG/MAG welding process ... e.g. use of a water-cooled welding torch: C-C = AUT
- TIG welding process ... e.g. use of a gas-cooled welding torch: C-C = OFF

CSS
Comfort stop sensitivity - Sensitivity of the response characteristic of the TIG comfort stop function

Unit	-
Setting range	0.5 - 5.0 or OFF
Factory setting	OFF

NOTE! A standard value setting of 2.0 is recommended for the CSS parameter. However, if the welding process is frequently stopped unintentionally, increase the value for the CSS parameter.

Depending on the value of the CSS parameter, it may be necessary to lengthen the arc to trigger the TIG comfort stop function:
- when CSS = 0.5 - 2.0 ..... small increase in the size of the arc
- when CSS = 2.0 - 3.5 ..... medium increase in the size of the arc
- when CSS = 3.5 - 5.0 ..... large increase in the size of the arc

r
r (resistance) - Welding circuit resistance (in mΩ)
see "Measuring welding circuit resistance r"

L
L (inductivity) - Welding circuit inductivity (in microhenry)
see "Displaying welding circuit inductivity L"

COr
Correction - Gas correction ("Digital gas control" option)

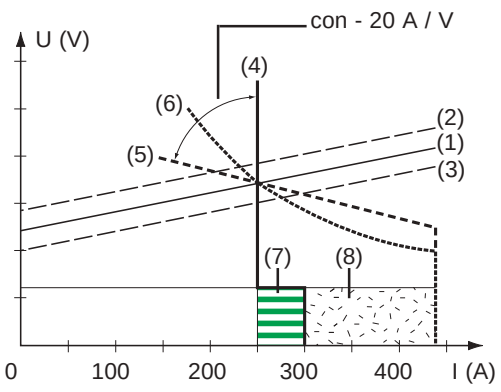
Unit	-
Setting range	AUT / 1.0 - 10.0
Factory setting	AUT

NOTE! Please refer to "Digital Gas Control" operating instructions for more detailed explanations of the "COr" parameter.

Parameters for rod electrode (MMA) welding in the Setup menu level 2

Eln
Electrode line - characteristic selection

Unit	1
Setting range	CON or 0.1 - 20 or P
Factory setting	CON



Characteristics that can be selected using the Eln function

(1) Load line for rod electrode

(2) Load line for rod electrode where arc length is increased

(3) Load line for rod electrode where arc length is reduced

(4) Characteristic where "CON" parameter is selected (constant welding current)

(5) Characteristic where "0.1 -20" parameter is selected (falling characteristic with adjustable slope)

(6) Characteristic where "P" parameter is selected (constant welding power)

(7) Example of pre-set arc-force dynamic where characteristic (4) is selected

(8) Example of pre-set arc-force dynamic where characteristic (5) or (6) is selected

“con” parameter (constant welding current)

- If the “con” parameter is set, the welding current will be kept constant, irrespective of the welding voltage. This results in a vertical characteristic (4).
- The “con” parameter is especially suitable for rutile electrodes and basic electrodes, as well as for gouging.
- For arc air gouging, set the arc-force dynamic to "100".

Parameter “0.1 - 20” (falling characteristic with adjustable slope)

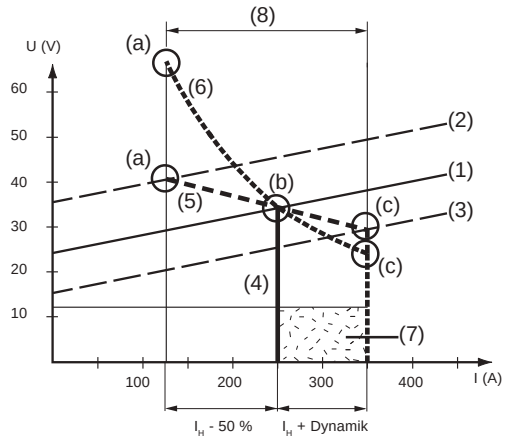
- Parameter “0.1 - 20” is used to set a falling characteristic (5). The setting range extends from 0.1 A / V (very steep) to 20 A / V (very flat).
- Setting a flat characteristic (5) is only advisable for cellulose electrodes.

NOTE! When setting a flat characteristic (5), set the arc-force dynamic to a higher value.

“P” parameter (constant welding power)

- If the “P” parameter is set, the welding power is kept constant, irrespective of the welding voltage and welding current. This results in a hyperbolic characteristic (6).
- The “P” parameter is particularly suitable for cellulose electrodes.

NOTE! If there are problems with a rod electrode tending to "stick", set the arc-force dynamic to a higher value.



Settings example: IH = 250 A, arc-force dynamic = 50

(1) Load line for rod electrode

(2) Load line for rod electrode where arc length is increased

(3) Load line for rod electrode where arc length is reduced

(4) Characteristic where "CON" parameter is selected (constant welding current)

(5) Characteristic where "0.1 -20" parameter is selected (falling characteristic with adjustable slope)

(6) Characteristic where "P" parameter is selected (constant welding power)

(7) Example of pre-set arc-force dynamic where characteristic (5) or (6) is selected

(8) Possible change in the current where characteristic (5) or (6) is selected, as a function of the welding voltage (arc length)

(a) Operating point where arc length is long

(b) Operating point when welding current IH is set

(c) Operating point where arc length is short

The characteristics (4), (5) and (6) shown here apply when using a rod electrode whose characteristic corresponds - at a given arc length - to the load line (1).

Depending on what welding current (I) has been set, the point of intersection (operating point) of characteristics (4), (5) and (6) will be displaced along the load line (1). The operating point provides information on the actual welding voltage and the actual welding current.

Where the welding current (IH) is permanently set, the operating point may migrate along the characteristics (4), (5) and (6) according to the welding voltage at a given moment. The welding voltage U is dependent upon the length of the arc.

If the arc length changes (e.g. in accordance with the load line (2)) the resulting operating point will be the point where the corresponding characteristic (4), (5) or (6) intersects with the load line (2).

Applies to characteristics (5) and (6): Depending upon the welding voltage (arc length), the welding current (I) will also become either smaller or larger, even though the value set for I_H remains the same.

r

r (resistance) - Welding circuit resistance (in mΩ)
see "Measuring welding circuit resistance r"

L

L (inductivity) - Welding circuit inductivity (in microhenry)
see "Displaying welding circuit inductivity L"

ASt

Anti-stick

Unit	-
Setting range	ON, OFF
Factory setting	OFF

Uco

U (Voltage) cut-off - Welding voltage limitation:

Unit	V
Setting range	OFF or 5 - 95
Factory setting	OFF

NOTE! The arc length depends on the welding voltage. To end the welding process, it is usually necessary to significantly lift the rod electrode away from the workpiece. With the “Uco” parameter, the welding voltage can be limited to a value that makes it possible to end the welding operation simply by slightly lifting the rod electrode.

If the welding process is stopped unintentionally during the welding, increase the value for the Uco parameter.

Notes on the use of the FAC parameter

The following parameters in Setup menu level 2 are not reset to the factory setting when the FAC parameter is used:

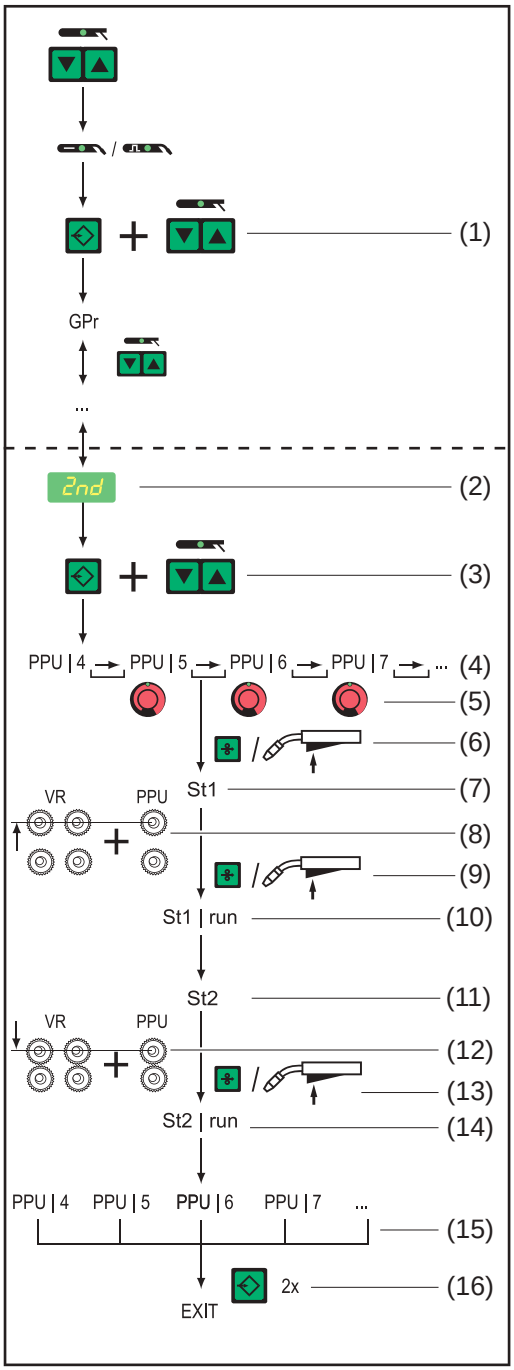
- PPU
- C-C
- Stc
- Arc
- S4t
- Gun

Calibrating push-pull unit

General

The push-pull unit must be calibrated before it is started up for the first time and whenever the wirefeed software is updated. If the push-pull unit is not calibrated, standard parameters will be used - which may lead to an unsatisfactory welding result.

Calibrating the push-pull unit - overview



Calibrating the push-pull unit using the Comfort control panel: Overview

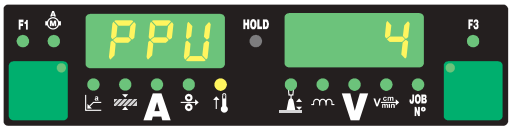
(1) Access Setup menu: Level 1
(2) Select “Parameter 2nd”
(3) Press and hold the Store button
Press the Process button
Release the Store button
(4) Select the “PPU” function
(5) Use the adjusting dial to select the corresponding push-pull unit
(6) Press the Feeder inching button or the torch trigger ...
(7) ... “St1” is shown on the display
(8) Disengage the drive units
(9) Press the Feeder inching button or the torch trigger ...
(10) ... “St1 | run” is shown on the display
(11) ... “St2” is shown on the display
(12) Engage the drive units
(13) Press the Feeder inching button or the torch trigger ...
(14) ... “St2 | run” is shown on the display
(15) The calibration operation on the push-pull unit is finished
(16) Press the Store button

Calibrating the push-pull unit

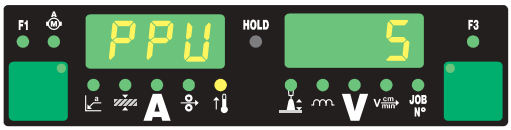
For an overview of the error messages that may occur during calibration of the push-pull unit, please refer to "Service codes for push-pull calibration".

1 Open the Set-up menu level 2 (2nd)

2 Select parameter PPU



3 Select the corresponding push-pull unit from the list:
- using the adjusting dial
- using the Mode button on the Standard control panel



NOTE! The types of push-pull unit that can be selected depend upon the control board fitted in the wire-feed unit. The control board designation can be found in the spare parts list for the wire-feed unit.

No.	Push-pull unit	PC board SR41	PC board SR43
0	Fronius unreeling device "VR 1530-22“ 22 m/min / 865 ipm [1)]	x	
1	Fronius unreeling device “VR 1530-30” 30 m/min / 1180 ipm (value displayed on the digital display: 1.18) [1)]	x	
2	Fronius robot push-pull "KD Drive“ 10 m/min / 393.70 ipm [1)]	x	x
3	Fronius robot push-pull “Robacta Drive” (Master control) [1)] Use with long torch hosepacks of 3.5 - 8 m (11 ft. 5.80 in. - 26 ft. 2.96 in.) in conjunction with a short lead from the wirespool, welding wire drum or large wire-feed unit spool to the wire-feed unit of 1.5 - 3 m (4 ft. 11.06 in. - 9 ft. 10.11 in.) Recommended feed rollers: 4 x half-round slot	x	x
4	Fronius robot push-pull “Robacta Drive” (slave control) Application: - with short torch hosepacks of 1.5 - 3.5 m (4ft. 11.06 in. - 9 ft. 10.11 in.) in conjunction with a long lead from the wire-spool, welding wire drum or large wire-feed unit spool to wire-feed unit of 3 - 10 m (9 ft. 10.11 in. - 32 ft. 9.70 in.) - in SynchroPulse mode	x	x
5	Fronius manual push-pull “PullMig” with power potentiometer	x	
6	Fronius manual push-pull “PullMig” without power potentiometer	x	
7	Binzel manual push-pull 42 V with power potentiometer [2)]	x	
8	Binzel manual push-pull 42 V without power potentiometer [2)]	x	
9	Binzel robot push-pull 42 V [2)]	x	
10	Binzel robot push-pull 24 V [2)]	x	
11	Dinse robot push-pull 42 V [2)]	x	
12	Hulftegger manual push-pull 24 V [2)]	x	
13	Fronius “VR 143-2“ intermediate drive	x	
14	Fronius unreeling device “MS” 22 m/min / 865 ipm [1)]	x	
16	“Cobra Gold” manual push-pull 24 V [2)]	x	
20	Fronius unreeling device "VR 1530-12“ 12 m/min / 470 ipm [1)]	x	

No.	Push-pull unit	PC board SR41	PC board SR43
23	Binzel robot push-pull 32 V [2]	x	
24	Dinse new robot push-pull 42V [2]	x	
27	Robacta Drive CMT		x
28	PullMig CMT with up/down button (CMT manual)		x
29	PullMig CMT without up/down button (CMT manual)		x
32	Robacta Powerdrive, 22 m/min	x	x
33	Elvi, 25 m/min, 500 mA, slave	x	x
34	Elvi, 25 m/min, 900 mA, slave	x	x
35	Robacta Powerdrive, 10 m/min	x	x
50	Fronius manual push-pull “PT Drive” (d=0.8 mm / 0.030 in.; material: aluminium) [3]	x	
51	Fronius manual push-pull “PT Drive” (d=1.0 mm / 0.040 in.; material: aluminium) [3]	x	
52	Fronius manual push-pull “PT Drive” (d=1.2 mm / 0.045 in.; material: aluminium) [3]	x	
53	Fronius manual push-pull “PT Drive” (d=1.6 mm / 1/16 in; material: aluminium) [3]	x	
54	Binzel robot push-pull “Master Feeder BG II” [1] [2] [3]	x	
55	Fronius “VR 1530 PD” unreeling device (d = 1.0 mm / 0.040 in.; material: steel) [3]	x	
56	Fronius “VR 1530 PD” unreeling device (d = 1.2 mm / 0.045 in.; material: steel) [3]	x	
57	Fronius “VR 1530 PD” unreeling device (d = 1.6 mm / 1/16 in.; material: steel) [3]	x	
59	Fronius manual push-pull “PT Drive” (d=1.0 mm / 0.040 in.; materials: steel, CrNi, CuSi3) [3]	x	
60	Fronius manual push-pull “PT Drive” (d=1.2 mm / 0.045 in.; materials: steel, CrNi) [3]	x	
61	Fronius manual push-pull “PT Drive” (d=0.8 mm / 0.030 in.; materials: steel, CrNi) [3]	x	
62	Binzel robot push-pull 32V with IWG [1] [2] [3]	x	

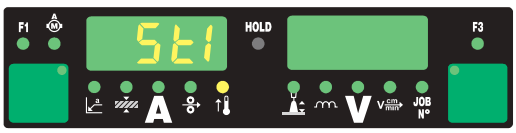
[1] No calibration under load (St2) is required

[2] Motor and gear tolerances may cause functional anomalies. Calibration may have to be carried out by Fronius.

[3] Software enabling required

4 Press the “Feeder inching” button or the torch trigger

"St1" is displayed on the left-hand digital display

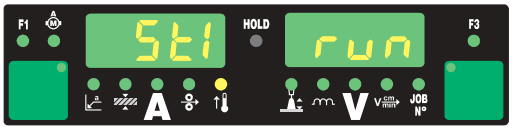


5 Disengage the drive units of both wire-feed unit motors (e.g. welding torch and wire-feed unit) - the wire-feed unit motors must not be under load (push-pull calibration - open circuit)

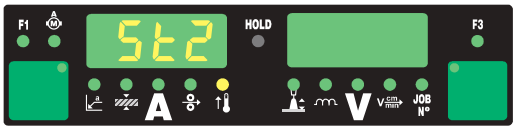
CAUTION! Risk of injury from rotating cogs and drive parts. Keep hands away from rotating cogs and the wire drive.

6 Press the “Feeder inching” button or the torch trigger

The wire-feed unit motors are calibrated while not under load. During the calibration process "run" is displayed on the right-hand digital display



Once the calibration - in the unloaded state - has been completed, the digital display will read "St2".

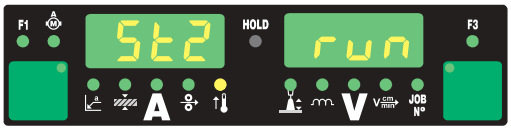


7 Engage the drive units of both wire-feed unit motors (e.g. welding torch and wire-feed unit) once again - the wire-feed unit motors must be under load (push-pull calibration - engaged)

CAUTION! Risk of injury from wire electrode emerging at speed and from rotating cogs and drive parts. Hold the welding torch so that it points away from your face and body. Keep hands away from rotating cogs and the wire drive.

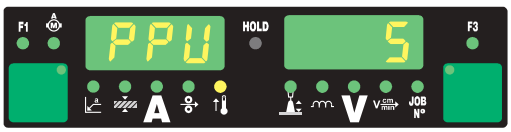
8 Press the “Feeder inching” button or the torch trigger

The wire-feed unit motors are calibrated while under load. During the calibration process "run" is displayed on the right-hand digital display.



If the push-pull unit does not need to be calibrated while under load (St2), the previously set values (e.g. "PPU" and "5") will appear on the digital display when you press the Feeder inching button or torch trigger.

Calibration of the push-pull unit is complete when the previously set values - e.g. "PPU" and "5" - reappear on the digital display.



9 Press the Store button twice to exit from the set-up menu

Service codes for push-pull calibration

Safety

WARNING! An electric shock can be fatal. Before opening the device
- Turn the mains switch to the "O" position
- Unplug the machine from the mains
- Prevent it from being switched on again
- Using a suitable measuring instrument, check to make sure that electrically charged components (e.g. capacitors) have discharged

Service codes when the drive units are disengaged ("open-circuit" calibration)

Err | Eto

Cause: Incorrect measurement during push-pull calibration

Remedy: Repeat push-pull calibration

St1 | E 1

Cause: At minimum wire feed speed, the wire-feed unit motor does not deliver any actual rotational speed value.

Remedy: Repeat the push-pull calibration. If the error message re-appears: Contact After-Sales Service.

St1 | E 2

Cause: At maximum wire feed speed, the wire-feed motor does not deliver any actual rotational speed value.

Remedy: Repeat the push-pull calibration. If the error message re-appears: Contact After-Sales Service.

St1 | E 3

Cause: At minimum wire feed speed, the wire-feed unit motor does not deliver any actual rotational speed value.

Remedy: Repeat the push-pull calibration. If the error message re-appears: Contact After-Sales Service.

St1 | E 4

Cause: At minimum wire feed speed, the wire-feed unit motor does not deliver any actual rotational speed value.

Remedy: Repeat the push-pull calibration. If the error message re-appears: Contact After-Sales Service.

St1 | E 5

Cause: At maximum wire feed speed, the wire-feed motor does not deliver any actual rotational speed value.

Remedy: Repeat the push-pull calibration. If the error message re-appears: Contact After-Sales Service.

St1 | E 6

Cause: At maximum wire feed speed, the wire-feed motor does not deliver any actual rotational speed value.

Remedy: Repeat the push-pull calibration. If the error message re-appears: Contact After-Sales Service.

Service codes when the drive units are engaged ("engaged" calibration)

St1 | E 16

Cause: Push-pull calibration was interrupted: Quick-stop was activated by pressing the torch trigger.

Remedy: Repeat push-pull calibration

St2 | E 7

Cause: "Push-pull calibration - open-circuit" has not been carried out

Remedy: Carry out "push-pull calibration - open-circuit"

St2 | E 8

Cause: At minimum wire feed speed, the wire-feed unit motor does not deliver any actual rotational speed value.

Remedy: Repeat the push-pull calibration. If the error message re-appears: Contact After-Sales Service.

St2 | E 9

Cause: At minimum wire feed speed, the motor of the push-pull unit does not deliver any actual rotational speed value.

Remedy: Repeat the push-pull calibration. If the error message re-appears: Contact After-Sales Service.

St2 | E 10

Cause: At minimum wire feed speed, the motor current of the wire-feed unit motor is outside the permitted range. Possible reasons are disengaged wire-feed unit motors or wire feed problems.

Remedy: Engage the drive units of both wire-feed unit motors, arrange the hosepack in as straight a line as possible; check the inner liner for kinks or soiling; check the contact pressure on the 2-roller or 4-roller drive of the push-pull unit. Repeat the push-pull calibration. If the error message re-appears: Contact After-Sales Service.

St2 | E 11

Cause: At minimum wire feed speed, the motor current of the push-pull unit is outside the permitted range. Possible reasons are disengaged wire-feed unit motors or wire feed problems.

Remedy: Engage the drive units of both wire-feed unit motors, arrange the hosepack in as straight a line as possible; check the inner liner for kinks or soiling; check the contact pressure on the 2-roller or 4-roller drive of the push-pull unit. Repeat the push-pull calibration. If the error message re-appears: Contact After-Sales Service.

St2 | E 12

Cause: At maximum wire feed speed, the wire-feed motor does not deliver any actual rotational speed value.

Remedy: Repeat the push-pull calibration. If the error message re-appears: Contact After-Sales Service.

St2 | E 13

Cause: At maximum wire feed speed, the motor of the push-pull unit does not deliver any actual rotational speed value.

Remedy: Repeat the push-pull calibration. If the error message re-appears: Contact After-Sales Service (faulty actual-value pick-up)

St2 | E 14

Cause: At maximum wire feed speed, the motor current of the wire-feed unit motor is outside the permitted range. Possible reasons are disengaged wire-feed unit motors or wire feed problems.

Remedy: Engage the drive units of both wire-feed unit motors, arrange the hosepack in as straight a line as possible; check the inner liner for kinks or soiling; check the contact pressure on the 2-roller or 4-roller drive of the push-pull unit. Repeat the push-pull calibration. If the error message re-appears: Contact After-Sales Service

---

St2 | E 15

Cause: At maximum wire feed speed, the motor current of the push-pull unit is outside the permitted range. Possible reasons are disengaged wire-feed unit motors or wire feed problems.

Remedy: Engage the drive units of both wire-feed unit motors, arrange the hosepack in as straight a line as possible; check the inner liner for kinks or soiling; check the contact pressure on the 2-roller or 4-roller drive of the push-pull unit. Repeat the push-pull calibration. If the error message re-appears: Contact After-Sales Service.

St2 | E 16

Cause: Push-pull calibration was interrupted: Quick-stop was activated by pressing the torch trigger.

Remedy: Repeat push-pull calibration

Measuring welding circuit resistance r

General

Measuring the welding circuit resistance “r” makes it possible to have a constant welding result at all times, even with hosepacks of different lengths. The welding voltage at the arc is then always precisely regulated, regardless of the length and cross-sectional area of the hosepack. Adjustment using the arc length correction parameter is no longer necessary.

The calculated welding circuit resistance is displayed on the right-hand digital display.

r ... Welding circuit resistance (in mΩ)

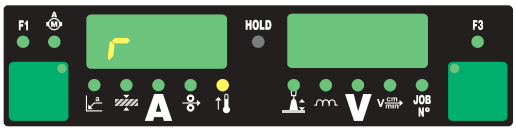
If the welding circuit resistance r has been measured correctly, the welding voltage will correspond exactly to the welding voltage at the arc. If you manually measure the voltage on the output jacks of the power source, this voltage will be higher than the welding voltage at the arc - that is, higher by the same amount as the voltage drop of the hosepack.

NOTE! The welding circuit resistance r depends on the hosepack used:
- if the hosepack length or cross-sectional area is changed, measure the welding circuit resistance r again
- measure the welding circuit resistance for each welding process separately with the appropriate welding leads

Measuring welding circuit resistance r

NOTE! In order to obtain good welding results, it is essential to measure the welding circuit resistance correctly. Make sure that the contact between the earthing clamp and the workpiece is on a cleaned workpiece surface.

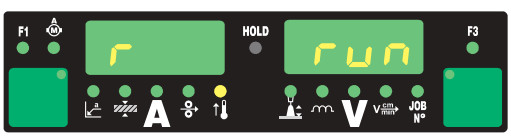
1. Make a ground (earth) connection to the workpiece
2. Open the Setup menu - level 2 (2nd)
3. Select parameter “r”



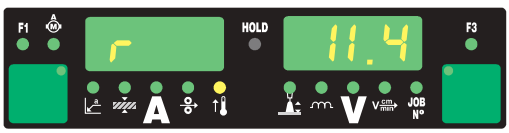
4. Remove the gas nozzle from the welding torch
5. Screw on the contact tube

NOTE! Make sure that the contact between the contact tube and the workpiece is on a cleaned workpiece surface. While the measurement is being performed, the wire-feed unit and the cooling unit are deactivated.

6. Place the contact tube down firmly on the surface of the workpiece
7. Briefly press the torch trigger or the Feeder inching button
The welding circuit resistance is calculated. During the measurement "run" is displayed on the right-hand digital display.



The measurement is finished when the welding circuit resistance is shown on the right-hand digital display (e.g. 11.4 mΩ)



8 Fit the gas nozzle back onto the welding torch

Displaying welding circuit inductivity L

General

The way that the interconnecting hosepack is arranged has a very significant effect on the weld properties. In MIG/MAG pulse synergic welding in particular, high welding circuit inductivity may occur, depending on the length of the interconnecting hosepack and the way it is arranged. The current rise during droplet transfer is limited.

NOTE! Wherever possible, compensation for the welding circuit inductivity is performed automatically. Where very high welding circuit inductivity occurs, it is also possible to attempt to influence the welding results with the droplet detachment correction parameter. If this does not produce the desired result, you must rearrange the interconnecting hosepack.

Displaying welding circuit inductivity L

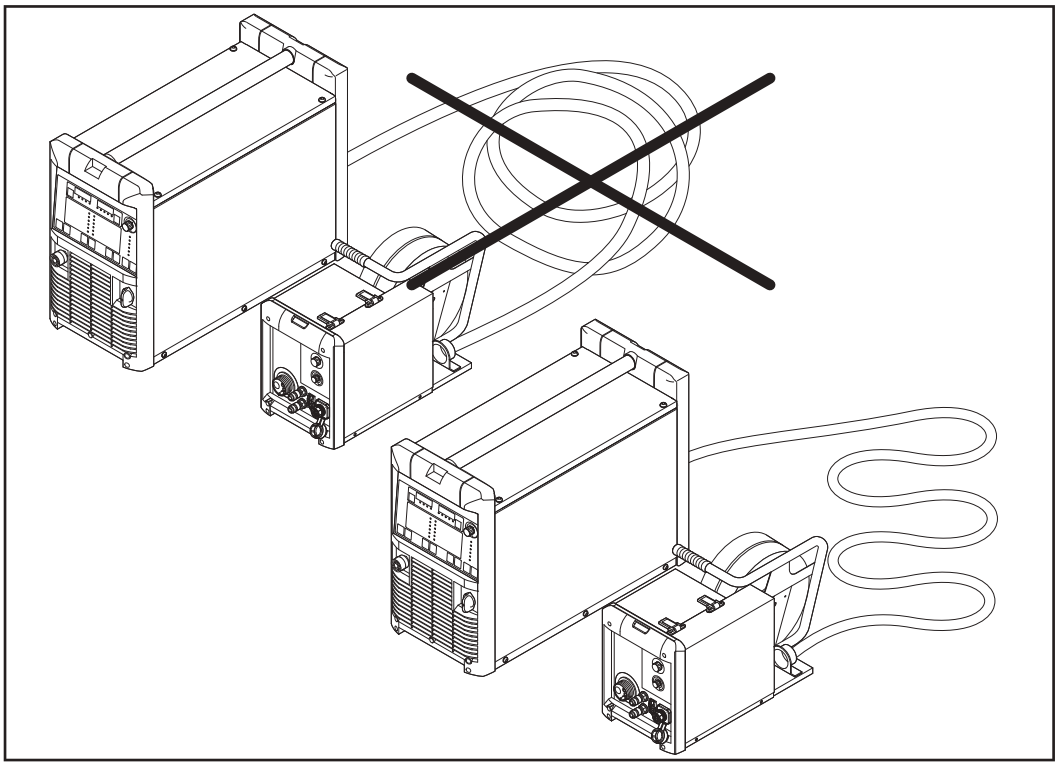
1 Open the Setup menu level 2 (2nd)

2 Select parameter “L”

The welding circuit inductivity L calculated during the welding process is displayed on the right-hand digital display.

L ... Welding circuit inductivity (in microhenrys)

Arranging the interconnecting hosepack correctly



Arranging the interconnecting hosepack correctly

Troubleshooting and maintenance

Troubleshooting

General

The digital power sources are equipped with an intelligent safety system. This means that apart from the fuse for the coolant pump, it has been possible to dispense with melting-type fuses entirely. After a possible malfunction or error has been remedied, the power source can be put back into normal operation again without any fuses having to be replaced.

Safety

WARNING! An electric shock can be fatal. Before opening the device
- Turn the mains switch to the "O" position
- Unplug the machine from the mains
- Prevent it from being switched on again
- Using a suitable measuring instrument, check to make sure that electrically charged components (e.g. capacitors) have discharged

CAUTION! Inadequate PE conductor connections can cause serious injury and damage. The housing screws provide a suitable PE conductor connection for earthing (grounding) the housing and must NOT be replaced by any other screws which do not provide a reliable PE conductor connection.

Displayed service codes

If any error message that is not described here appears on the displays, then the fault can only be fixed by a service technician. Make a note of the error message shown in the display and of the serial number and configuration of the power source, and contact our After-Sales Service team with a detailed description of the error.

-St | oP-

Where the power source is being operated with a robot interface or a field bus

Cause: Robot not ready

Remedy: Initialise "Robot ready" signal, initialise "Source error reset" signal ("Source error reset" only available in conjunction with ROB 5000 and field bus coupler for robot control)

dsP | A21

Can only occur when power sources are being operated in parallel or in Twin mode

Cause: The power source is configured for either parallel operation (setup parameter P-C is set to “ON”) or for TimeTwin Digital (setup parameter T-C is set to “ON”). However, the LHSB link has been disconnected or has become faulty while the power source was switched on.

Remedy: Reset the service code: Switch the power source off and back on again. If necessary, restore or repair the LHSB link.

dSP | Axx

Cause: Fault in the central control and regulation unit

Remedy: Contact After-Sales Service

dSP | Cxx

Cause: Fault in the central control and regulation unit

Remedy: Contact After-Sales Service

dSP | Exx

Cause: Fault in the central control and regulation unit

Remedy: Contact After-Sales Service

---

dSP | Sy

Cause: Fault in the central control and regulation unit

Remedy: Contact After-Sales Service

---

dSP | nSy

Cause: Fault in the central control and regulation unit

Remedy: Contact After-Sales Service

E-S | toP

only with the External stop and External stop - inching enabled options

Cause: The External stop or External stop - inching enabled option has tripped

Remedy: Acknowledge the service code via the robot control unit and re-apply the 24 V SELV safety voltage

---

EFd | xx.x

Cause: Fault in the wire feed system (overcurrent in wire-feed unit drive)

Remedy: Arrange the hosepack in as straight a line as possible; check that there are no kinks or dirt in the inner liner; check the contact pressure on the 2-roller (or 4-roller) drive

Cause: Wire-feed unit motor is sticking or defective

Remedy: Check or replace the wire-feed unit motor

EFd | 8.1

Cause: Fault in the wire feed system (overcurrent in wire-feed unit drive)

Remedy: Arrange the hosepack in as straight a line as possible; check that there are no kinks or dirt in the inner liner; check the contact pressure on the 2-roller (or 4-roller) drive

Cause: Wire-feed unit motor is sticking or defective

Remedy: Check or replace the wire-feed unit motor

EFd | 8.2

Cause: Fault in the wire feed system (overcurrent in wire-feed unit drive)

Remedy: Arrange the hosepack in as straight a line as possible; check that there are no kinks or dirt in the inner liner; check the contact pressure on the 2-roller (or 4-roller) drive

---

EFd | 9.1

Cause: The external supply voltage has dropped below the tolerance range

Remedy: Check the external supply voltage

Cause: Wire-feed unit motor is sticking or defective

Remedy: Check or replace the wire-feed unit motor

EFd | 9.2

Cause: The external supply voltage has exceeded the upper limit of the tolerance range

Remedy: Check the external supply voltage

EFd | 12.1

Cause: No actual rotational speed value from the wire-feed unit motor

Remedy: Check the actual-value pick-up and the cable connections to and from it, and replace if necessary

---

EFd | 12.2

Cause: No actual value rotational speed from the push-pull unit motor

Remedy: Check the actual-value pick-up and the cable connections to and from it, and replace if necessary

---

EFd | 15.1

Wire buffer empty

Cause: Counter lever on main wire-feed unit open

Remedy: Close counter lever on main wire-feed unit
Acknowledge service code using Feeder inching button

Cause: Main wire-feed unit slipping

Remedy: Check wearing parts on wire-feed unit
Use suitable feed rollers
Decrease wire braking force
Increase contact pressure on main wire-feed unit
Acknowledge service code using Feeder inching button

Cause: End of wire reached

Remedy: Check whether sufficient wire is available
Acknowledge service code using Feeder inching button

EFd | 15.2

Wire buffer full

Cause: Counter lever on push-pull unit open

Remedy: Close counter lever on push-pull unit
Acknowledge service code using Feeder inching button

Cause: Push-pull unit slipping

Remedy: Check wearing parts for wire feeding
Use suitable feed rollers
Increase contact pressure on the push-pull unit
Acknowledge service code using the Feeder inching button"

Cause: Arc not igniting due to inadequate ground (earth) connection

Remedy: Check the ground (earth) connection
Acknowledge service code using the Feeder inching button

Cause: Arc not igniting due to the wrong welding program setting

Remedy: Select wire diameter and material type in accordance with the material used (select a suitable welding program). Acknowledge service code using the Feeder inching button

---

EFd | 15.3

No wire buffer available

Cause: Connection to wire buffer missing

Remedy: Check connection to wire buffer, check wire buffer control line

---

EFd | 30.1

Cause: LHSB connection to power source missing

Remedy: Check LHSB connection to power source

EFd | 30.3

Cause: LHSB connection to CMT drive unit missing

Remedy: Check LHSB connection to CMT drive unit

EFd | 31.1

Cause: Rotor calibration on the CMT drive unit failed

Remedy: Switch power source off and on again; if the service code "EFd | 31.1" remains, switch off power source, disengage CMT drive unit and switch power source back on again; if still unsuccessful, contact After-Sales Service

---

EFd | 31.2

Cause: Rotor calibration on the CMT drive unit is running

Remedy: Wait for rotor calibration to finish

EiF XX.Y

Values XX and Y are taken from the operating instructions for the robot interface.

Cause: Interface error

Remedy: See the operating instructions for the robot interface

---

Err | 049

Cause: Phase failure

Remedy: Check the mains fuse, the mains lead and the mains plug

---

Err | 050

Cause: Intermediate circuit-balance error

Remedy: Contact After-Sales Service

Err | 051

Cause: Mains undervoltage: The mains voltage has fallen below the tolerance range

Remedy: Check the mains voltage

Err | 052

Cause: Mains overvoltage: The mains voltage has risen above the tolerance range

Remedy: Check the mains voltage

Err | 054

Cause: “Sticking” of the wire in the solidifying weld pool

Remedy: Cut off the sticking wire end;
there is no need to acknowledge this error message

Err | 056

Cause: The "Wire-end check" option has detected the end of the wire electrode

Remedy: Insert a new wirespool and feed the wire electrode into the hosepack;
acknowledge Err | 056 by pressing the Store button

Cause: Additional fan filter of the VR 1500 - 11 / 12 / 30 is contaminated
air supply for the additional fan is no longer sufficient to cool the power electronics
the power electronics temperature switch has tripped

Remedy: Clean filter or replace;
acknowledge Err | 056 by pressing the Store button

Cause: Excessive ambient temperature on the VR 1500 - 11 / 12 / 30

Remedy: Reduce ambient temperature
if necessary position and operate welding machine at a cooler location;
acknowledge Err | 056 by pressing the Store button

Cause: Excessive motor current on the VR 1500 - 11 / 12 / 30, e.g. due to wire feed problems or an adequately dimensioned wire-feed unit

Remedy: Check wire feed conditions, rectify errors;
acknowledge Err | 056 by pressing the Store button

Cause: VR 1530 wire-feed unit cover open or interlock release handles not snapped into place

Remedy: Close VR 1530 wire-feed unit cover properly
acknowledge Err | 056 by pressing the Store button

Err | 062

"E62“ is displayed on the TP 08 remote control at the same time

Cause: Overheating of TP 08 remote control

Remedy: Allow TP 08 remote control to cool down

Err | 069

Cause: Illegal mode change during welding (e.g. changing from a MIG/MAG job to a TIG job)

Remedy: Re-start welding action

Err |70.X

Cause: Fault in digital gas sensor
Err 70.1 ... Gas sensor not found
Err 70.2 ... No gas
Err 70.3 ... Calibration error
Err 70.4 ... Solenoid valve faulty
Err 70.5 ... Solenoid valve not found

Remedy: Check gas supply

Err |71.X

Set limits have been exceeded or have not been reached.

Cause: Err 71.1 ... Current limit exceeded
Err 71.2 ... Current limit not reached
Err 71.3 ... Voltage limit exceeded
Err 71.4 ... Voltage limit not reached

Remedy: Check quality of weld seam

Err |77.X

The current limit set for a wire-feed unit motor has been exceeded

Cause: Err 77.7 ... Wire-feed unit motor current exceeded
Err 77.8 ... PPU motor current exceeded

Remedy: Check the wire-feed unit components (e.g. feed rollers, inner liner, inlet/outlet nozzles, etc.); check quality of weld seam

---

Err | bPS

Cause: Fault in power module

Remedy: Contact After-Sales Service

Err | Cfg

Can only occur when power sources are being operated in parallel or in Twin mode

Cause: Power source is configured for parallel operation (setup parameter P-C is set to “ON”) or TimeTwin Digital (setup parameter T-C is set to “ON”). However, after being switched on, the power source was unable to establish an LHSB link (LHSB link was previously detached or faulty).

Remedy: Reset the service code: Switch the power source off and back on again. If necessary, restore or repair the LHSB connection.

Err | IP

Cause: Primary overcurrent

Remedy: Contact After-Sales Service

Err | PE

Cause: The earth current watchdog has triggered the safety cut-out of the power source.

Remedy: Switch off the power source, wait for 10 seconds and then switch it on again. If you have tried this several times and the error keeps recurring, contact After-Sales Service.

Err | tJo

Cause: JobMaster torch temperature sensor faulty

Remedy: Contact After-Sales Service

---

hot | H2O

Cause: Thermostat on cooling unit has tripped

Remedy: Wait until the end of the cooling phase, i.e. until "Hot | H2O" is no longer displayed.
ROB 5000 or field bus coupler for robot control: Before resuming welding, initialise the "Source error reset" signal.

---

no | Arc

Cause: Arc break

Remedy: Shorten the wire stick-out; press the torch trigger repeatedly;
clean the surface of the workpiece

---

no | GAS

Cause: The “Gas watchdog” option has detected that there is no gas pressure

Remedy: Connect a new gas cylinder and open the gas cylinder valve/pressure regulator;
Acknowledge no | GAS by pressing the Store button

---

no | IGn

Cause: Ignition time-out function is active: No current started flowing before the length of wire specified in the Setup menu had been fed. The safety cut-out of the power source has been triggered.

Remedy: Shorten the wire stick-out; press the torch trigger repeatedly; clean the surface of the workpiece; if necessary, increase the setting in “Setup menu: Level 2” for the length of wire that is fed before the safety cut-out is triggered.

---

no | H2O

Cause: Cooling unit flow watchdog has been triggered

Remedy: Check the cooling unit; top up with coolant or bleed the water flow if necessary (see cooling unit operating instructions). Then acknowledge the error by pressing the Store button

---

no | Prg

Cause: No preconfigured program has been selected

Remedy: Select a configured program

---

r | E30

Cause: r-calibration: There is no contact with the workpiece.

Remedy: Connect the grounding (earthing) cable; ensure a tight connection between the contact pipe and the workpiece

---

r | E31

Cause: r-calibration: Procedure has been interrupted by repeated pressing of the torch trigger.

Remedy: Ensure a tight connection between the contact tube and the workpiece press the torch trigger once only

---

r | E32

Cause: r-calibration: Grounding (earthing) cable, current cable or hosepack defective (value is below 0.5 mOhm or exceeds 30 mOhm)

Remedy: Check grounding (earthing) cable, current cable or hosepack and replace if necessary

---

r | E33

Cause: r-calibration: Poor contact between the contact tube and the workpiece.

Remedy: Clean the point of contact, tighten the contact tube, check the grounding (earthing) connection

---

r | E34

Cause: r-calibration: Poor contact between the contact tube and the workpiece.

Remedy: Clean the point of contact, tighten the contact tube, check the grounding (earthing) connection

---

tJO | xxx

At the same time, “E66” is displayed on the JobMaster
Note: xxx is a temperature value

Cause: Overheating in JobMaster welding torch

Remedy: Allow the torch to cool, then acknowledge the error by pressing the Store button

---

tP1 | xxx

Note: xxx is a temperature value

Cause: Overtemperature in the primary circuit of the power source

Remedy: Allow power source to cool down

---

tP2 | xxx

Note: xxx is a temperature value

Cause: Overtemperature in the primary circuit of the power source

Remedy: Allow power source to cool down

---

tP3 | xxx

Note: xxx is a temperature value

Cause: Overtemperature in the primary circuit of the power source

Remedy: Allow power source to cool down

---

tP4 | xxx

Note: xxx is a temperature value

Cause: Overtemperature in the primary circuit of the power source

Remedy: Allow power source to cool down

---

tP5 | xxx

Note: xxx is a temperature value

Cause: Overtemperature in the primary circuit of the power source

Remedy: Allow power source to cool down

---

tP6 | xxx

Note: xxx is a temperature value

Cause: Overtemperature in the primary circuit of the power source

Remedy: Allow power source to cool down

---

tS1 | xxx

Note: xxx is a temperature value

Cause: Overtemperature in the secondary circuit of the power source

Remedy: Allow power source to cool down

---

tS2 | xxx

Note: xxx is a temperature value

Cause: Overtemperature in the secondary circuit of the power source

Remedy: Allow power source to cool down

---

tS3 | xxx

Note: xxx is a temperature value

Cause: Overtemperature in the secondary circuit of the power source

Remedy: Allow power source to cool down

Power source - troubleshooting

tSt | xxx

Note: xxx is a temperature value

Cause: Overtemperature in the control circuit

Remedy: Allow power source to cool down

Power source has no function

Mains switch is on, but indicators are not lit up

Cause: There is a break in the mains lead; the mains plug is not plugged in

Remedy: Check the mains lead, ensure that the mains plug is plugged in

Cause: Mains socket or mains plug faulty

Remedy: Replace faulty parts

Cause: Mains fuse protection

Remedy: Change the mains fuse protection

No welding current

Mains switch is on, one of the overtemperature service codes "to" is displayed. Detailed information on the service codes "to0" to "to6" can be found in the section "Displayed service codes".

Cause: Overload

Remedy: Take the duty cycle into account

Cause: Thermostatic safety cut-out has tripped

Remedy: Wait until the power source automatically comes back on after the end of the cooling phase

Cause: Limited supply of cooling air

Remedy: Remove air filter on the rear of the housing from the side and clean. Ensure that the cooling air ducts are accessible.

Cause: The fan in the power source is faulty

Remedy: Contact After-Sales Service

No welding current

Mains switch is on and indicators are lit up

Cause: Grounding (earthing) connection is incorrect

Remedy: Check the grounding (earthing) connection and terminal for correct polarity

Cause: There is a break in the current cable in the welding torch

Remedy: Change the welding torch

Nothing happens when the torch trigger is pressed

Mains switch is on and indicators are lit up

Cause: The control plug is not plugged in

Remedy: Plug in the control plug

Cause: Welding torch or welding torch control line is faulty

Remedy: Change the welding torch

Cause: The interconnecting hosepack is defective or not connected properly (not for TPS 2700)

Remedy: Check interconnecting hosepack

No protective gas shield

All other functions are OK

Cause: The gas cylinder is empty

Remedy: Change the gas cylinder

Cause: The gas pressure regulator is faulty

Remedy: Replace the gas pressure regulator

Cause: The gas hose is not connected, damaged or kinked

Remedy: Connect/replace the gas hose, or straighten out kinks

Cause: The welding torch is faulty

Remedy: Replace welding torch

Cause: Gas solenoid valve is faulty

Remedy: Replace gas solenoid valve

Poor-quality weld properties

Cause: Incorrect welding parameters
Remedy: Check settings

Cause: Poor grounding connection
Remedy: Establish good contact with workpiece

Cause: Too little or no shielding gas
Remedy: Check pressure regulator, gas hose, gas solenoid valve, welding torch gas connection, etc.

Cause: Welding torch leaks
Remedy: Change welding torch

Cause: Incorrect or heavily worn contact tip
Remedy: Change contact tip

Cause: Incorrect wire alloy or incorrect wire diameter
Remedy: Check wire electrode in use

Cause: Incorrect wire alloy or incorrect wire diameter
Remedy: Check weldability of the base material

Cause: Shielding gas not suitable for wire alloy
Remedy: Use correct shielding gas

Irregular wire feed speed

Cause: Braking force has been set too high
Remedy: Loosen the brake

Cause: Hole in the contact tube is too narrow
Remedy: Use a suitable contact tube

Cause: Faulty inner liner in welding torch
Remedy: Check the inner liner for kinks, dirt, etc.

Cause: The feed rollers are not suitable for the wire electrode being used
Remedy: Use suitable feed rollers

Cause: Feed rollers have the wrong contact pressure
Remedy: Optimise the contact pressure

Wirefeed problems

when using long hosepacks

Cause: Incorrect arrangement of hosepack
Remedy: Arrange the hosepack in as straight a line as possible, avoid tight bends

---

The welding torch becomes very hot

Cause: The dimensions of the welding torch are inadequate

Remedy: Observe the duty cycle and loading limits

Cause: Only on water-cooled machines: Inadequate coolant flow

Remedy: Check coolant fill level, coolant flow, for coolant contamination, etc.

Care, maintenance and disposal

General

Under normal operating conditions, the power source requires only a minimum of care and maintenance. However, it is vital to observe some important points to ensure the welding system remains in a usable condition for many years.

Safety

WARNING! An electric shock can be fatal. Before opening the device
- Turn the mains switch to the "O" position
- Unplug the machine from the mains
- Prevent it from being switched on again
- Using a suitable measuring instrument, check to make sure that electrically charged components (e.g. capacitors) have discharged

At every start-up

- Check mains plug, mains cable, welding torch, interconnecting hosepack and grounding (earthing) connection for damage
- Check whether the all-round clearance of 0.5 m (1 ft. 8 in.) is kept to ensure that the cooling air can easily flow and escape.

NOTE! Air inlets and outlets must never be covered, not even partially.

Every 2 months

- If present: clean air filter

Every 6 months

NOTE! Risk of damage to electronic components. Do not bring air nozzle too close to electronic components.

- open the device
- clean out the device interior using dry compressed air at reduced pressure
- if a lot of dust has accumulated, clean the cooling air ducts.

Disposal

Dispose of in accordance with the applicable national and local regulations.

Appendix

Technical data

Special voltages

For devices designed for special voltages, the technical data on the rating plate applies.

For all machines with a permitted mains voltage of up to 460 V: The standard mains plug allows the user to operate with a mains voltage of up to 400 V. For mains voltages up to 460 V fit a mains plug permitted for such use or install the mains supply directly.

TPS 2700

Mains voltage			3 x 400 V
Mains voltage tolerance			+/- 15 %
Mains frequency			50 / 60 Hz
Mains fuse protection			16 A slow-blow
Mains connection [1]			Z_{max} at PCC [2] = 95 mOhm
Primary continuous current		100% d.c. [3]	6.6 A
Primary continuous power			4.5 - 8.7 kVA
Cos phi			0.99
Efficiency			87 %
Welding current range			
	MIG/MAG		3 - 270 A
	Rod electrode		10 - 270 A
	TIG		3 - 270 A
Welding current at			
	10 min / 40 °C (104 °F)	40 % d.c. [3]	270 A
		60 % d.c. [3]	270 A
		100% d.c. [3]	170 A
Welding voltage range according to standard characteristic			
	MIG/MAG		14.2 - 27.5 V
	Rod electrode		20.4 - 30.8 V
	TIG		10.1 - 20.8 V
Max. welding voltage			34.6 V
Open circuit voltage			50 V
Degree of protection			IP 23
Type of cooling			AF
Insulation class			B
EMC emission class			A
Marks of conformity			CE, CSA
Safety symbol			S
Dimensions l x w x h			641.5 x 297.4 x 476.5 mm 25.26 x 11.71 x 18.76 in.
Weight			27 kg 59.5 lb.
Supply voltage in wire-feed unit			55 V DC
Nominal current in wire-feed unit			4 A
Wire feed speed			0.5 - 22 m/min 19.69 - 866.14 ipm

Wirespool types	all standardised wirespools
Max. permitted wirespool weight	16 kg 35.27 lb
Wirespool diameter	300 mm 11.81 in.
Wire diameter	0.8 - 1.6 mm 0.03 - 0.06 in.
Drive	4 roller drive
Maximum shielding gas pressure	7 bar 101 psi.

The wire-feed unit for the TPS 2700 is integrated in the power source.

[1] connected to public grid at 230/400 V and 50 Hz
[2] PCC = Interface to the public grid
[3] d.c. = Duty cycle

TPS 2700 MV

Mains voltage			3 x 200-240 V 3 x 380-460 V
Mains voltage tolerance			+/- 10 %
Mains frequency			50 / 60 Hz
Mains fuse protection			25/16 A slow-blow
Mains connection [1]			Z_{max} at PCC [2] = 95 mOhm
Primary continuous current		100% d.c. [3]	6.4 - 14.2 A
Primary continuous power			4.6 - 10.7 kVA
Cos phi			0.99
Efficiency			88 - 91 %
Welding current range			
	MIG/MAG		3 - 270 A
	Rod electrode		10 - 270 A
	TIG		3 - 270 A
Welding current at			
	10 min / 40 °C (104 °F)	40 % d.c. [3]	270 A
		60 % d.c. [3]	270 A
		100% d.c. [3]	170 A
Welding voltage range according to standard characteristic			
	MIG/MAG		14.2 - 27.5 V
	Rod electrode		20.4 - 30.8 V
	TIG		10.1 - 20.8 V
Max. welding voltage			34.6 V
Open circuit voltage			50 V
Degree of protection			IP 23
Type of cooling			AF
Insulation class			B
EMC emission class			A
Marks of conformity			CE, CSA
Safety symbol			S

Dimensions l x w x h	641.5 x 297.4 x 476.5 mm 25.26 x 11.71 x 18.76 in.
Weight	27 kg 59.5 lb.
Supply voltage in wire-feed unit	55 V DC
Nominal current in wire-feed unit	4 A
Wire feed speed	0.5 - 22 m/min 19.69 - 866.14 ipm
Wirespool types	all standardised wirespools
Max. permitted wirespool weight	16 kg 35.27 lb
Wirespool diameter	300 mm 11.81 in.
Wire diameter	0.8 - 1.6 mm 0.03 - 0.06 in.
Drive	4 roller drive
Maximum shielding gas pressure	7 bar 101 psi.

The wire-feed unit for the TPS 2700 is integrated in the power source.

[1] connected to public grid at 230/400 V and 50 Hz
[2] PCC = Interface to the public grid
[3] d.c. = Duty cycle

TPS 3200

Mains voltage			3 x 400 V
Mains voltage tolerance			+/- 15 %
Mains frequency			50 / 60 Hz
Mains fuse protection			35 A slow-blow
Mains connection [1]			Restrictions possible
Primary continuous current		100% d.c. [2]	12.6 - 16.7 A
Primary continuous power			8.7 - 11.5 kVA
Cos phi			0.99
Efficiency			91 %
Welding current range			
	MIG/MAG		3 - 320 A
	Rod electrode		10 - 320 A
	TIG		3 - 320 A
Welding current at			
	10 min / 40 °C (104 °F)	40 % d.c. [2]	320 A
		60 % d.c. [2]	260 A
		100% d.c. [2]	220 A
Welding voltage range according to standard characteristic			
	MIG/MAG		14.2 - 30.0 V
	Rod electrode		20.4 - 32.8 V
	TIG		10.1 - 22.8 V
Max. welding voltage (320 A)			52.1 V

Open circuit voltage	65 V
Degree of protection	IP 23
Type of cooling	AF
Insulation class	F
EMC emission class	A
Marks of conformity	CE
Safety symbol	S
Dimensions l x w x h	626 x 287 x 477 mm 24.65 x 11.30 x 18.78 in.
Weight	34.6 kg 76.3 lb.

[1] connected to public grid at 230/400 V and 50 Hz
[2] d.c. = Duty cycle

TPS 3200 MV

Mains voltage			3 x 200-240 V 3 x 380-460 V
Mains voltage tolerance			+/- 10 %
Mains frequency			50 / 60 Hz
Mains fuse protection			35 A slow-blow
Mains connection [1]			Restrictions possible
Primary continuous current		100% d.c. [2]	10.6 - 31.2 A
Primary continuous power			8.7 - 11.5 kVA
Cos phi			0.99
Efficiency			90 - 91 %
Welding current range			
	MIG/MAG		3 - 320 A
	Rod electrode		10 - 320 A
	TIG		3 - 320 A
Welding current at			
	10 min / 40 °C (104 °F)	40 % d.c. [2]	320 A
		60 % d.c. [2]	260 A
		100% d.c. [2]	220 A
Welding voltage range according to standard characteristic			
	MIG/MAG		14.2 - 30.0 V
	Rod electrode		20.4 - 32.8 V
	TIG		10.1 - 22.8 V
Max. welding voltage (320 A)			49.1 - 63.1 V
Open circuit voltage			64 - 67 V
Degree of protection			IP 23
Type of cooling			AF
Insulation class			F
EMC emission class			A
Marks of conformity			CE, CSA
Safety symbol			S

Dimensions l x w x h	626 x 287 x 477 mm 24.65 x 11.30 x 18.78 in.
Weight	34.6 kg 76.3 lb.

[1] connected to public grid at 230/400 V and 50 Hz
[2] d.c. = Duty cycle

TPS 3200
460 V AC

Mains voltage			3 x 380-460 V
Mains voltage tolerance			+/- 10 %
Mains frequency			50 / 60 Hz
Mains fuse protection			according to rating plate
Mains connection [1]			Restrictions possible
Primary continuous current			
		40 % d.c. [2]	13.4 A
		60 % d.c. [2]	12.7 A
		100% d.c. [2]	13.0 A
Max. primary current			
		40 % d.c. [2]	21.3 A
		60 % d.c. [2]	16.4 A
		100% d.c. [2]	13.0 A
Primary continuous power			
		40 % d.c. [2]	17.0 kVA
		60 % d.c. [2]	13.1 kVA
		100% d.c. [2]	10.4 kVA
Cos phi			0.99
Efficiency			90 - 91 %
Welding current range			
	MIG/MAG		3 - 320 A
	Rod electrode		10 - 320 A
	TIG		3 - 320 A
Welding current at			
	10 min / 40 °C (104 °F)	40 % d.c. [2]	320 A
		60 % d.c. [2]	260 A
		100% d.c. [2]	220 A
Welding voltage range according to standard characteristic			
	MIG/MAG		14.2 - 30.0 V
	Rod electrode		20.4 - 32.8 V
	TIG		10.1 - 22.8 V
Max. welding voltage (320 A)			49.1 - 63.1 V
Open circuit voltage			64 - 67 V
Degree of protection			IP 23
Type of cooling			AF
Insulation class			F
EMC emission class			A
Marks of conformity			CE, CSA

Safety symbol			S
Dimensions l x w x h			626 x 287 x 477 mm 24.65 x 11.30 x 18.78 in.
Weight			34.6 kg 76.3 lb.

[1] connected to public grid at 230/400 V and 50 Hz
[2] d.c. = Duty cycle

TS/TPS 4000

Mains voltage			3 x 400 V
Mains voltage tolerance			+/- 15 %
Mains frequency			50 / 60 Hz
Mains fuse protection			35 A slow-blow
Mains connection [1]			Restrictions possible
Primary continuous current		100% d.c. [2]	26 A
Primary continuous power			12.2 kVA
Cos phi			0.99
Efficiency			88 %
Welding current range			
	MIG/MAG		3 - 400 A
	Rod electrode		10 - 400 A
	TIG		3 - 400 A
Welding current at			
	10 min / 40 °C (104 °F)	50 % d.c. [2]	400 A
		60 % d.c. [2]	365 A
		100% d.c. [2]	320 A
Welding voltage range according to standard characteristic			
	MIG/MAG		14.2 - 34.0 V
	Rod electrode		20.4 - 36.0 V
	TIG		10.1 - 26.0 V
Max. welding voltage			48 V
Open circuit voltage			70 V
Degree of protection			IP 23
Type of cooling			AF
Insulation class			F
EMC emission class			A
Marks of conformity			CE, CSA
Safety symbol			S
Dimensions l x w x h			626 x 287 x 477 mm 24.65 x 11.30 x 18.78 in.
Weight			35.2 kg 77.6 lb.

[1] connected to public grid at 230/400 V and 50 Hz
[2] d.c. = Duty cycle

TS/TPS 4000 MV

Mains voltage			3 x 200-240 V 3 x 380-460 V
Mains voltage tolerance			+/- 10 %
Mains frequency			50 / 60 Hz
Mains fuse protection			63/35 A slow-blow
Mains connection [1]			Restrictions possible
Primary continuous current		100% d.c. [2]	15.3 - 34.4 A
Primary continuous power			10.6 - 12.4 kVA
Cos phi			0.99
Efficiency			88 - 91 %
Welding current range			
	MIG/MAG		3 - 400 A
	Rod electrode		10 - 400 A
	TIG		3 - 400 A
Welding current at			
	10 min / 40 °C (104 °F)	50 % d.c. [2]	400 A
		60 % d.c. [2]	365 A
		100% d.c. [2]	280 - 320 A
Welding voltage range according to standard characteristic			
	MIG/MAG		14.2 - 34.0 V
	Rod electrode		20.4 - 36.0 V
	TIG		10.1 - 26.0 V
Max. welding voltage			48 V
Open circuit voltage			68 - 78 V
Degree of protection			IP 23
Type of cooling			AF
Insulation class			F
EMC emission class			A
Marks of conformity			CE, CSA
Safety symbol			S
Dimensions l x w x h			626 x 287 x 477 mm 24.65 x 11.30 x 18.78 in.
Weight			35.2 kg 77.6 lb.

[1] connected to public grid at 230/400 V and 50 Hz
[2] d.c. = Duty cycle

TS/TPS 5000

Mains voltage			3 x 400 V
Mains voltage tolerance			+/- 15 %
Mains frequency			50 / 60 Hz
Mains fuse protection			35 A slow-blow
Mains connection [1]			Restrictions possible
Primary continuous current		100% d.c. [2]	18 - 29.5 A
Primary continuous power			13.1 kVA

Cos phi			0.99
Efficiency			90 %
Welding current range			
	MIG/MAG		3 - 500 A
	Rod electrode		10 - 500 A
	TIG		3 - 500 A
Welding current at			
	10 min / 40 °C (104 °F)	40 % d.c. [2]	500 A
		60 % d.c. [2]	450 A
		100% d.c. [2]	360 A
Welding voltage range according to standard characteristic			
	MIG/MAG		14.2 - 39.0 V
	Rod electrode		20.4 - 40.0 V
	TIG		10.1 - 30.0 V
Max. welding voltage			49.2 V
Open circuit voltage			70 V
Degree of protection			IP 23
Type of cooling			AF
Insulation class			F
EMC emission class			A
Marks of conformity			CE, CSA
Safety symbol			S
Dimensions l x w x h			626 x 287 x 477 mm 24.65 x 11.30 x 18.78 in.
Weight			35.6 kg 78.5 lb.

[1] connected to public grid at 230/400 V and 50 Hz
[2] d.c. = Duty cycle

TS/TPS 5000 MV

Mains voltage			3 x 200-240 V 3 x 380-460 V
Mains voltage tolerance			+/- 10 %
Mains frequency			50 / 60 Hz
Mains fuse protection			63/35 A slow-blow
Mains connection [1]			Restrictions possible
Primary continuous current		100% d.c. [2]	10.1 - 36.1 A
Primary continuous power			12.4 - 13.9 kVA
Cos phi			0.99
Efficiency			88 - 91 %
Welding current range			
	MIG/MAG		3 - 500 A
	Rod electrode		10 - 500 A
	TIG		3 - 500 A
Welding current at			
	10 min / 40 °C (104 °F)	40 % d.c. [2]	500 A

	60 % d.c. [2]	450 A
	100% d.c. [2]	320 - 340 A
Welding voltage range according to standard characteristic		
	MIG/MAG	14.2 - 39.0 V
	Rod electrode	20.4 - 40.0 V
	TIG	10.1 - 30.0 V
Max. welding voltage		49.2 V
Open circuit voltage		68 - 78 V
Degree of protection		IP 23
Type of cooling		AF
Insulation class		F
EMC emission class		A
Marks of conformity		CE, CSA
Safety symbol		S
Dimensions l x w x h		626 x 287 x 477 mm 24.65 x 11.30 x 18.78 in.
Weight		35.6 kg 78.5 lb.

[1] connected to public grid at 230/400 V and 50 Hz
[2] d.c. = Duty cycle

Technical data - US devices

See TPS 2700 MV / 3200 MV and TS / TPS 4000 MV / 5000 MV

Technical data - Alu edition, CrNi edition, Yard edition and CMT variants

The technical data of the Alu edition, CrNi edition, Yard edition and CMT is identical to that of the standard power sources.

TIME 5000 Digital

Mains voltage		3 x 380 - 460 V
Mains voltage tolerance		+/- 10 %
Mains frequency		50 / 60 Hz
Mains fuse protection		35 A slow-blow
Mains connection [1]		Z_{max} at PCC [2] = 50 mOhm
Primary continuous current	450 A, 60% d.c.[3]	32.5 A
Primary continuous power		21.4 kVA
Cos phi		0.99
Efficiency		91 %
Welding current range		
	TIME	3 - 500 A
	MIG/MAG	3 - 500 A
	Rod electrode	10 - 500 A

	TIG		3 - 500 A
Welding current at			
	10 min / 40 °C (104 °F)	40 % d.c. [3]	500 A
		60 % d.c. [3]	450 A
		100% d.c. [3]	360 A
Welding voltage range according to standard characteristic			
	TIME		28.0 - 48.0 V
	MIG/MAG		14.2 - 39.0 V
	Rod electrode		20.4 - 40.0 V
	TIG		10.1 - 30.0 V
Max. welding voltage			48 V
Open circuit voltage			70 V
Degree of protection			IP 23
Type of cooling			AF
Insulation class			F
EMC emission class			A
Marks of conformity			CE
Safety symbol			S
Dimensions l x w x h			626 x 287 x 477 mm 24.65 x 11.30 x 18.78 in.
Weight			37.4 kg 82.45 lb.

[1] connected to public grid at 230/400 V and 50 Hz
[2] PCC = Interface to the public grid
[3] d.c. = Duty cycle

CMT 4000 Advanced

Mains voltage			3 x 400 V
Mains voltage tolerance			+/- 15 %
Mains frequency			50 / 60 Hz
Mains fuse protection			35 A slow-blow
Mains connection [1]			Restrictions possible
Primary continuous current		100% d.c. [2]	-
Primary continuous power			15 kVA
Cos phi			0.99
Efficiency			-
Welding current range			
	MIG/MAG		3 - 400 A
	Rod electrode		10 - 400 A
Welding current at			
	10 min / 40 °C (104 °F)	40 % d.c. [2]	400 A
		60 % d.c. [2]	360 A
		100% d.c. [2]	300 A
Welding voltage range according to standard characteristic			
	MIG/MAG		14.2 - 34.0 V
	Rod electrode		20.4 - 36.0 V

Max. welding voltage	-
Open circuit voltage	90 V
Degree of protection	IP 23
Type of cooling	AF
Insulation class	F
EMC emission class	A
Marks of conformity	CE
Safety symbol	S
Dimensions l x w x h	625 x 290 x 705 mm 24.61 x 11.42 x 27.76 in.
Weight	54.2 kg 119.49 lb.

[1] connected to public grid at 230/400 V and 50 Hz
[2] d.c. = Duty cycle

CMT 4000 Advanced MV

Mains voltage			3 x 200-240 V 3 x 380-460 V
Mains voltage tolerance			+/- 10 %
Mains frequency			50 / 60 Hz
Mains fuse protection			63/35 A slow-blow
Mains connection [1]			Restrictions possible
Primary continuous current		100% d.c. [2]	-
Primary continuous power			13.0 - 16.0 kVA
Cos phi			0.99
Efficiency			-
Welding current range			
	MIG/MAG		3 - 400 A
	Rod electrode		10 - 400 A
Welding current at			
	10 min / 40 °C (104 °F)	40 % d.c. [2]	400 A
		60 % d.c. [2]	350 A
		100% d.c. [2]	290 A
Welding voltage range according to standard characteristic			
	MIG/MAG		14.2 - 34.0 V
	Rod electrode		20.4 - 36.0 V
Max. welding voltage			-
Open circuit voltage			90 V
Degree of protection			IP 23
Type of cooling			AF
Insulation class			F
EMC emission class			A
Marks of conformity			CE, CSA
Safety symbol			S

Dimensions l x w x h	625 x 290 x 705 mm 24.61 x 11.42 x 27.76 in.
Weight	56.0 kg 123.46 lb.

[1] connected to public grid at 230/400 V and 50 Hz
[2] d.c. = Duty cycle

Welding program databases

Explanation of symbols

The key symbols for the welding program databases are explained below. The databases contain the welding programs depending on the following settings on the control panel:

- Mode:
  P = Pulse synergic welding
  S = Standard synergic welding
  CMT = Cold Metal Transfer
  C-P = CMT/pulse characteristic
- Welding programs that support the SFi (spatter free ignition) option have a grey background.

Setting up a welding program database - example

Welding Programs	TS/TPS 3200/4000/5000 CMT				
(2) M09-0005 12.9.2006 (3)	0.8	0.9	1.0	1.2	SP (4)
G3 Si1 / ER 70 (ArCO2)	P 0074 S 0008		P 0346 S 1084	P 0378 S 0375	
CrNi 18 8 / ER307 (Ar 97.5%/CO2 2.5%)	P 0148 S 0149		P 0421 S 0102	P 0345 S 0033	
CrNi 19 9 / ER308 (Ar 97.5%/CO2 2.5%)	P 0076 S 0009 C-P 0959		P 0414 S 0101 C-P 0882	P 0415 S 0011 C-P 0929	
AlMg 5 / ER5356 (Ar 100%)	P 0137 S 0138		P 0408 S 0014 C-P 1070	P 0191 S 0015 C-P 0879	
AlSi 5 / ER4043 (Ar 100%)	P 0141 S 0142		P 0131 S 0132 C-P 1076	P 0116 S 0016 C-P 0881	
CuSi 3 / ER CuSi-A (Ar 100%)			P 0405 S 0104 C-P 0884	P 0342 S 0153	
CuAl 9 / ER CuAl-A (Ar 100%)	P 0071 S 0018		P 0143 S 0103 C-P 0883	P 0113 S 0020	
SP1					
(1) G3 Si1 / ER 70-S-3/6 (CO2 100%)	S 0736	S 0519	S 0737 CMT 1055	S 0687 CMT 0986	
G3 Si1 / ER 70-S-3/6 (Ar 82%/CO2 18%)	P 0735 S 0602	S 0808	P 0891 S 0603 CMT 1053	P 0271 S 0783 CMT 0963	
CrNi 18 8 / ER307 (Ar 97.5%/CO2 2.5%)					
CrNi 19 9 / ER308 (Ar 97.5%/CO2 2.5%)	P 0766 S 0765 CMT 0960	P 0525 S 0524	P 0799 S 0767 CMT 0877	P 0539 S 0538 CMT 0928	
AlMg 5 / ER5356 (Ar 100%)			CMT 1069	CMT 0875	
AlSi 5 / ER4043 (Ar 100%)			CMT 1075	CMT 0876	
CuSi 3 / ER CuSi-A (Ar 100%)	P 0219 S 0220 CMT 0920	P 0530 S 0531	P 0057 S 0638 CMT 0878	CMT 0918	
SP2					

S....Standardprogram P....Pulsprogram CMT....Cold Metal Transfer C-P....CMT Puls SFI

Example of a welding program database

(1) Material type
(2) Number of welding program database
(3) Date of last revision
(4) Wire diameter

Terms and abbreviations used

General

The terms and abbreviations listed here are used in connection with functions that are either included in the standard scope of supply or that are available as optional extras.

Terms and abbreviations A - C

AL.c
Arc length correction
Up and down correction limits for the arc length (job correction)

AL.1
Arc length correction 1
General arc length correction (job correction)

AL.2
Arc length correction 2
Arc length correction for the upper operating point of the pulsed welding power (SynchroPulse)

Arc
Arc
Arc break watchdog

ASt
Anti-stick
For reducing the effect of a “sticking” rod electrode (MMA welding)

bbc
Burn-back time correction

C-C
Cooling unit cut-out
In position “Aut”, the cut-out is automatic depending on the coolant temperature. In position “On” / “Off”, the cooling unit remains permanently switched on/switched off. Separate adjustment for the MIG/MAG and TIG processes is supported.

COr
Correction
Gas correction ("Digital gas control" option)

CSS
Comfort stop sensitivity
Sensitivity of the response characteristic of the TIG comfort stop function The TIG Comfort Stop function supports the TIG welding process without torch trigger. A downslope is triggered by briefly lifting or lowering the welding torch (ramp decrease of the welding current).

C-t
Cooling time
Time from when the flow watchdog is triggered until the "no | H2O" service code is output.

Terms and abbreviations D - F

dFd
delta Feeder
Welding power offset for the SynchroPulse option (defined by the wire feed speed)

dYn
dynamic
Arc force dynamic correction for standard arcs, pulse correction for pulsed arcs or correction of various parameters in CMT (job correction or arc force dynamic and pulse correction settings in the Setup menu for the Standard control panel)

EIn
Electrode line
Characteristic selection (MMA welding)

F
Frequency
Frequency for SynchroPulse option

FAC
Factory
Reset welding system

FCO
Feeder control
Wire-feed unit cut-out (wire-end sensor option)

Fdc
Feeder creep
Feeder creep speed

Fdi
Feeder inching
Feeder inching speed

Terms and abbreviations G - I

GAS
Gasflow
Set value for shielding gas flow ("Digital gas control" option)

GPo
Gas post-flow time

GPR
Gas pre-flow time

Gun
Gun (welding torch)
Changing between modes with the JobMaster torch (optional) ... 0 / 1

HCU
Hot-start current

Hti
Hot-current time
(MMA welding)

I-E
I (current) - End
Final current

I-S
I (current) - Starting
Starting current

Ito
Ignition time-out

Terms and abbreviations J - R

Job
Job whose parameters are to be adjusted (job correction)

JSL
Job Slope
Defines the time between the job that is currently selected and the next job

L
L (inductivity)
Displays welding circuit inductivity

P
Power-correction
Welding power correction (defined by the wire feed speed, job correction function)

P-C
Power-Control
For defining the Master or Slave power sources when two power sources are operated in parallel

PcH
Power correction High
Correction boundary (high) for the welding power (job correction)

PcL
Power correction Low
Correction boundary (low) for the welding power (job correction)

PPU
Push-pull unit

r
r (resistance)
Determine welding circuit resistance

Terms and abbreviations S

SEt
Setting
Country-specific setting (Standard / USA)

SL
Slope

SPt
Spot welding time

Stc
Wire-Stick-Control
Detection of a sticking wire end

S2t
Special 2-step (US control panel only)
For selecting jobs and groups by pressing the torch trigger

S4t
Special 4-step (Gun-Trigger option)
Switch between jobs using torch trigger while "Special 4-step" mode symbol is displayed on JobMaster torch

Terms and abbreviations T - 2nd

t-C
Twin Control
For defining the leading or trailing power sources in the TimeTwin Digital process

t-E
time - End current
Final current duration

t-S
time - Starting current
Starting current duration

tri
Trigger
Subsequent correction of the mode

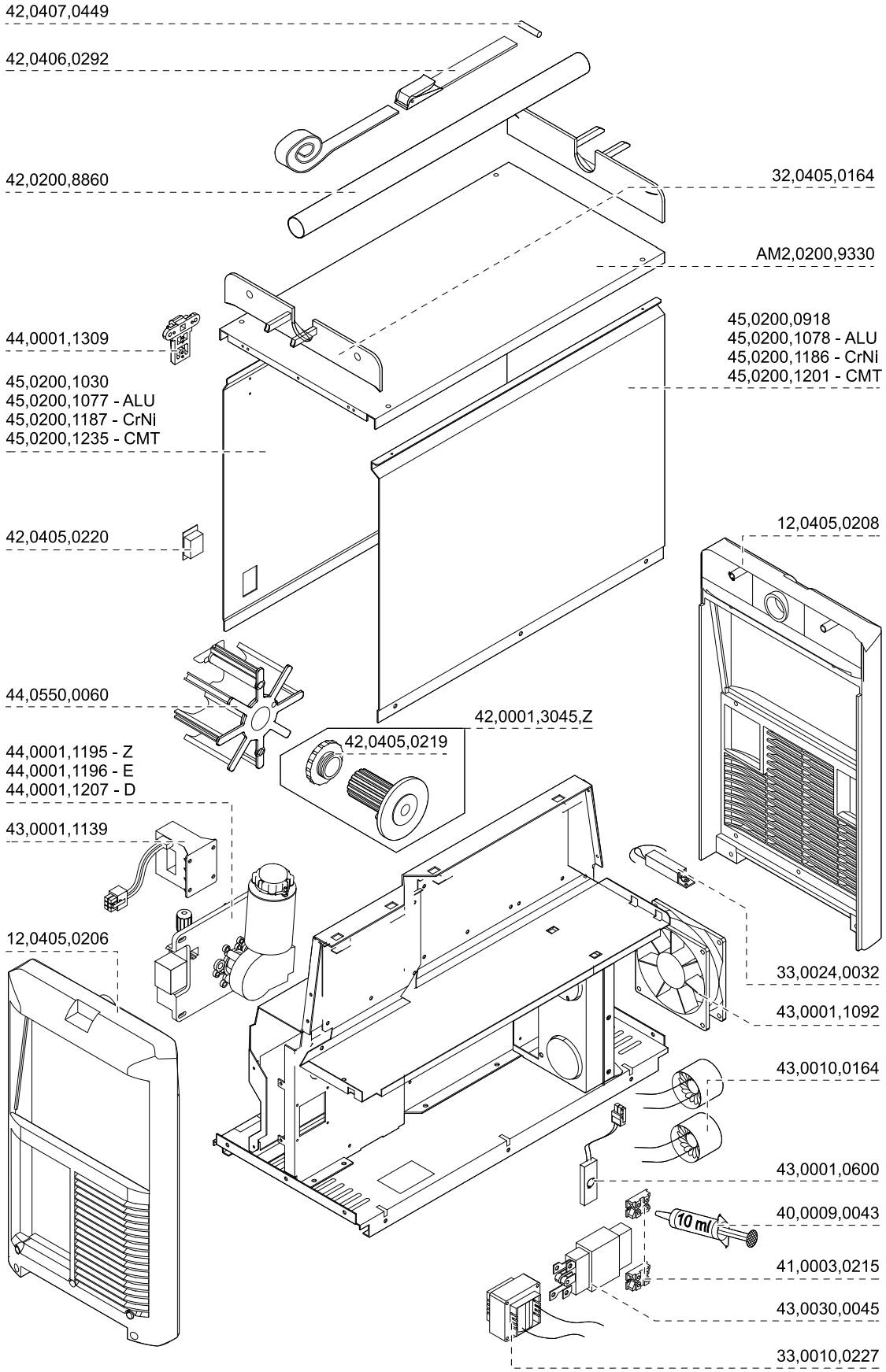
Uco
U (Voltage) cut-off
Welding voltage limitation during MMA welding Makes it possible to stop the welding process by slightly raising the rod electrode.

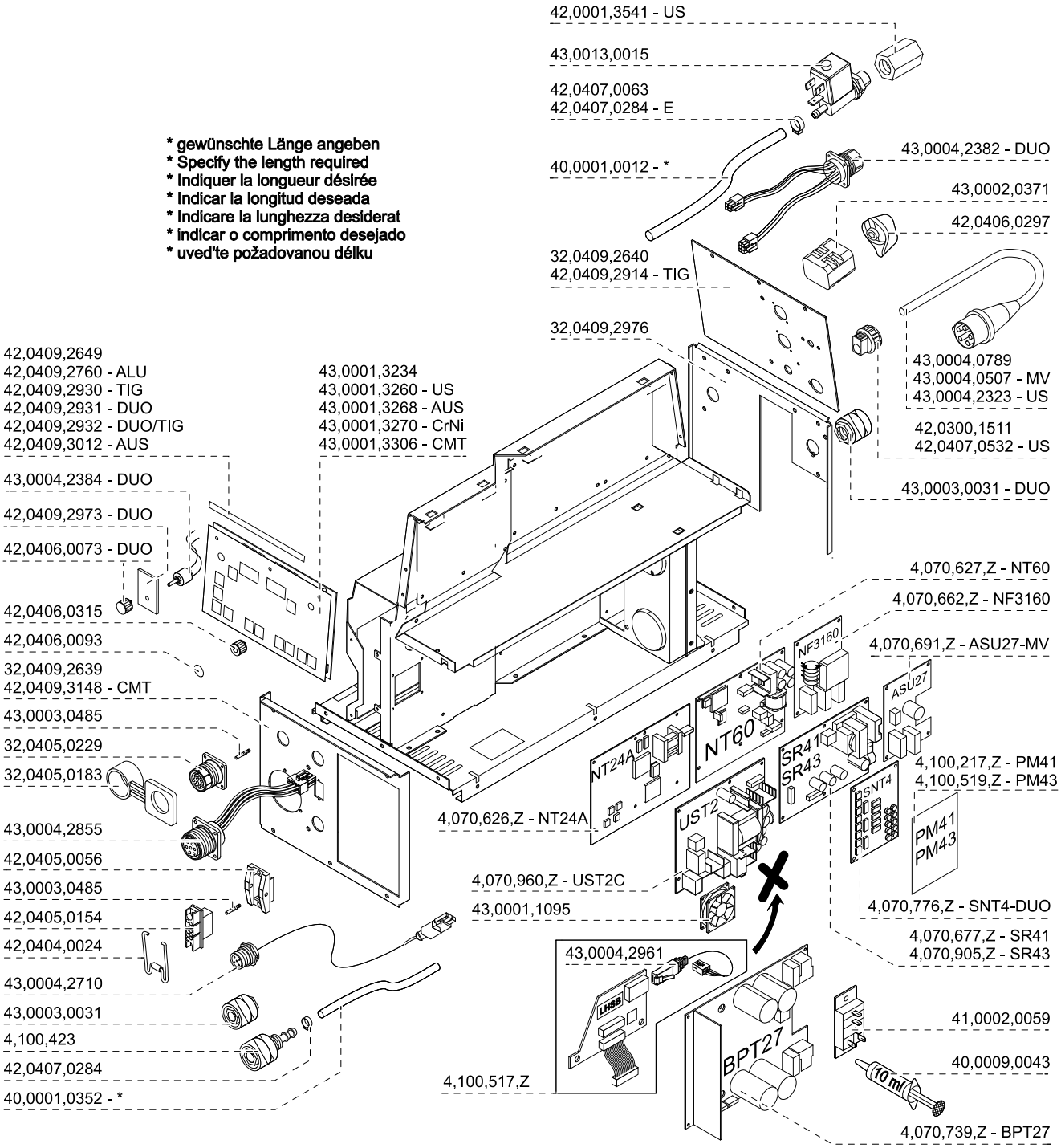
2nd
Second level of Setup menu

Spare parts list

Spare parts list: TransPuls Synergic 2700

TransPulsSyn. 2700 4R/Z	**4,075,095**
TransPulsSyn. 2700 4R/E	**4,075,095,001**
TransPulsSyn. 2700 4R/D	**4,075,095,002**
MV	
TransPulsSyn. 2700 MV/4R/Z	**4,075,095,630**
TransPulsSyn. 2700 MV/4R/E	**4,075,095,631**
ALU - Edition	
TransPulsSyn. 2700 4R/Z/ALU	**4,075,095,633**
TransPulsSyn. 2700 4R/E/ALU	**4,075,095,634**
MV / ALU - Edition	
TransPulsSyn. 2700 MV/4R/Z/ALU	**4,075,095,635**
TransPulsSyn. 2700 MV/4R/E/ALU	**4,075,095,636**
CrNi	
TransPulsSynerg.2700 4R/Z CrNi	**4,075,095,856**
TransPulsSynerg.2700 4R/E CrNi	**4,075,095,857**
MV / CrNi	
TransPulsSynerg.2700 MV/4R/Z CrNi	**4,075,095,858**
TransPulsSynerg.2700 MV/4R/E CrNi	**4,075,095,859**
DUO / TIG	
TransPulsSyn. 2700 4R/Z TIG	**4,075,095,850**
TransPulsSyn. 2700 4R/Z DUO	**4,075,095,851**
TransPulsSyn. 2700 4R/Z DUO/TIG	**4,075,095,852**
TransPulsSyn. 2700 4R/E TIG	**4,075,095,853**
TransPulsSyn. 2700 4R/E DUO	**4,075,095,854**
TransPulsSyn. 2700 4R/E DUO/TIG	**4,075,095,855**
US	
TransPulsSyn. 2700 MV/4R/Z US	**4,075,095,800**
TransPulsSyn. 2700 MV/4R/E US	**4,075,095,801**
AUS	
TransPulsSyn. 2700 4R/E AUS	**4,075,095,638**
CMT	
TransPulsSyn. 2700 4R/Z CMT	**4,075,136**
TransPulsSyn. 2700 MV/4R/Z CMT	**4,075,136,630**
TransPulsSyn. 2700 MV/4R/Z CMT US	**4,075,136,800**


42,0407,0449
42,0406,0292
42,0200,8860
32,0405,0164
AM2,0200,9330
44,0001,1309
45,0200,0918
45,0200,1078 - ALU
45,0200,1186 - CrNi
45,0200,1201 - CMT
45,0200,1030
45,0200,1077 - ALU
45,0200,1187 - CrNi
45,0200,1235 - CMT
42,0405,0220
12,0405,0208
44,0550,0060
42,0001,3045,Z
42,0405,0219
44,0001,1195 - Z
44,0001,1196 - E
44,0001,1207 - D
43,0001,1139
12,0405,0206
33,0024,0032
43,0001,1092
43,0010,0164
43,0001,0600
10 ml
40,0009,0043
41,0003,0215
43,0030,0045
33,0010,0227


* gewünschte Länge angeben
* Specify the length required
* Indiquer la longueur désirée
* Indicar la longitud deseada
* Indicare la lunghezza desiderat
* indicar o comprimento desejado
* uved'te požadovanou délku
42,0001,3541 - US
43,0013,0015
42,0407,0063
42,0407,0284 - E
40,0001,0012 - *
43,0004,2382 - DUO
43,0002,0371
42,0406,0297
32,0409,2640
42,0409,2914 - TIG
32,0409,2976
43,0004,0789
43,0004,0507 - MV
43,0004,2323 - US
42,0300,1511
42,0407,0532 - US
43,0003,0031 - DUO
42,0409,2649
42,0409,2760 - ALU
42,0409,2930 - TIG
42,0409,2931 - DUO
42,0409,2932 - DUO/TIG
42,0409,3012 - AUS
43,0001,3234
43,0001,3260 - US
43,0001,3268 - AUS
43,0001,3270 - CrNi
43,0001,3306 - CMT
43,0004,2384 - DUO
42,0409,2973 - DUO
42,0406,0073 - DUO
42,0406,0315
42,0406,0093
32,0409,2639
42,0409,3148 - CMT
43,0003,0485
32,0405,0229
32,0405,0183
43,0004,2855
42,0405,0056
43,0003,0485
42,0405,0154
42,0404,0024
43,0004,2710
43,0003,0031
4,100,423
42,0407,0284
40,0001,0352 - *
4,070,627,Z - NT60
4,070,662,Z - NF3160
4,070,691,Z - ASU27-MV
NF3160
ASU27
NT24A
NT60
SR41
SR43
SNT4
UST2
PM41
PM43
4,100,217,Z - PM41
4,100,519,Z - PM43
4,070,626,Z - NT24A
4,070,960,Z - UST2C
43,0001,1095
4,070,776,Z - SNT4-DUO
4,070,677,Z - SR41
4,070,905,Z - SR43
43,0004,2961
LH95
BPT27
41,0002,0059
40,0009,0043
10 m/
4,100,517,Z
4,070,739,Z - BPT27

Spare parts list: TS/TPS 3200/4000/5000, TIME 5000

TransPuls Synergic 3200	4,075,124
TransSynergic 4000 C	4,075,097
TransSynergic 5000 C	4,075,098
TransSynergic 4000	4,075,099
TransSynergic 5000	4,075,101
TransPuls Synergic 4000	4,075,100
TransPuls Synergic 5000	4,075,102

MV

TransPuls Synergic 3200 MV	4,075,124,630
TransSynergic 4000 C MV	4,075,097,630
TransSynergic 5000 C MV	4,075,098,630
TransSynergic 4000 MV	4,075,099,630
TransSynergic 5000 MV	4,075,101,630
TransPuls Synergic 4000 MV	4,075,100,630
TransPuls Synergic 5000 MV	4,075,102,630

RC

TransPuls Synergic 3200 R	4,075,124,R
TransSynergic 4000 R	4,075,097,R
TransSynergic 5000 R	4,075,098,R
TransPuls Synergic 4000 R	4,075,100,R
TransPuls Synergic 5000 R	4,075,102,R

MV/RC

TransPuls Synergic 3200 MV R	4,075,124,630,R
TransSynergic 4000 MV R	4,075,097,630,R
TransSynergic 5000 MV R	4,075,098,630,R
TransPulsSynergic 4000 MV R	4,075,100,630,R
TransPulsSynergic 5000 MV R	4,075,102,630,R

AUS

TransPuls Synergic 3200	4,075,124,638
TransPuls Synergic 4000	4,075,100,638
TransPuls Synergic 5000	4,075,102,638

CMT

TransPuls Synergic 3200 CMT	4,075,137
TransPuls Synergic 4000 CMT	4,075,138
TransPuls Synergic 5000 CMT	4,075,139
TransPuls Synergic 3200 CMT MV	4,075,137,630
TransPuls Synergic 4000 CMT MV	4,075,138,630
TransPuls Synergic 5000 CMT MV	4,075,139,630
TransPuls Synerg.3200 CMT MV US	4,075,137,800
TransPuls Synerg.4000 CMT MV US	4,075,138,800
TransPuls Synerg.5000 CMT MV US	4,075,139,800
TransPuls Synerg.3200 CMT 460 V	4,075,137,801
TransPuls Synerg.4000 CMT 460 V	4,075,138,801
TransPuls Synerg.5000 CMT 460 V	4,075,139,801

CMT/RC

TransPuls Synergic 3200 CMT R	4,075,137,R
TransPuls Synergic 4000 CMT R	4,075,138,R
TransPuls Synergic 5000 CMT R	4,075,139,R
TransPuls Synergic 3200 CMT MV R	4,075,137,630,R
TransPuls Synergic 4000 CMT MV R	4,075,138,630,R
TransPuls Synergic 5000 CMT MV R	4,075,139,630,R
TransPulsSynerg.3200 CMT MV US R	4,075,137,800,R
TransPulsSynerg.4000 CMT MV US R	4,075,138,800,R
TransPulsSynerg.5000 CMT MV US R	4,075,139,800,R

US

TransPuls Synergic 3200 MV	4,075,124,800
TransSynergic 4000 C MV	4,075,097,800
TransSynergic 5000 C MV	4,075,098,800
TransPuls Synergic 4000 MV	4,075,100,800
TransPuls Synergic 5000 MV	4,075,102,800
TransPuls Syn. 4000 MV Pipe	4,075,100,810

US/RC

TransPuls Synergic 3200 MV R	4,075,124,800,R
TransSynergic 4000 MV R	4,075,097,800,R
TransSynergic 5000 MV R	4,075,098,800,R
TransPulsSynergic 4000 MV R	4,075,100,800,R
TransPulsSynergic 5000 MV R	4,075,102,800,R

460V

TransPuls Synergic 3200 460V	4,075,124,801
TransPuls Syn. 3200 Pipe Single	4,075,124,808
TransPuls Syn. 3200 Pipe Tandem	4,075,124,809
TransPuls Syn. 3200 Pipe HE	4,075,124,810
TransPuls Syn. 3200 Pipe BA	4,075,124,811
TransSynergic 4000 C 460V	4,075,097,801
TransSynergic 4000 C 460V	4,075,097,930
TransSynergic 4000 460V	4,075,099,930
TransSynergic 5000 C 460V	4,075,098,801
TransSynergic 5000 C 460V	4,075,098,930
TransSynergic 5000 460V	4,075,101,930
TransPuls Synergic 4000 460V	4,075,100,801
TransPuls Synergic 4000 460V	4,075,100,930
TransPuls Synergic 5000 460V	4,075,102,801
TransPuls Synergic 5000 460V	4,075,102,930

460V/RC

TransSynergic 4000 460V R	4,075,097,930,R
TransSynergic 5000 460V R	4,075,098,930,R
TransPulsSynergic4000 460V R	4,075,100,930,R
TransPulsSynergic5000 460V R	4,075,102,930,R

CrNi

TransPuls Synergic 3200 CrNi	4,075,124,631
TransPuls Synergic 3200 MV CrNi	4,075,124,632
TransPuls Synergic 4000 CrNi	4,075,100,631
TransPuls Synergic 4000 MV CrNi	4,075,100,632
TransPuls Synergic 5000 CrNi	4,075,102,631
TransPuls Synergic 5000 CrNi 460V	4,075,102,632

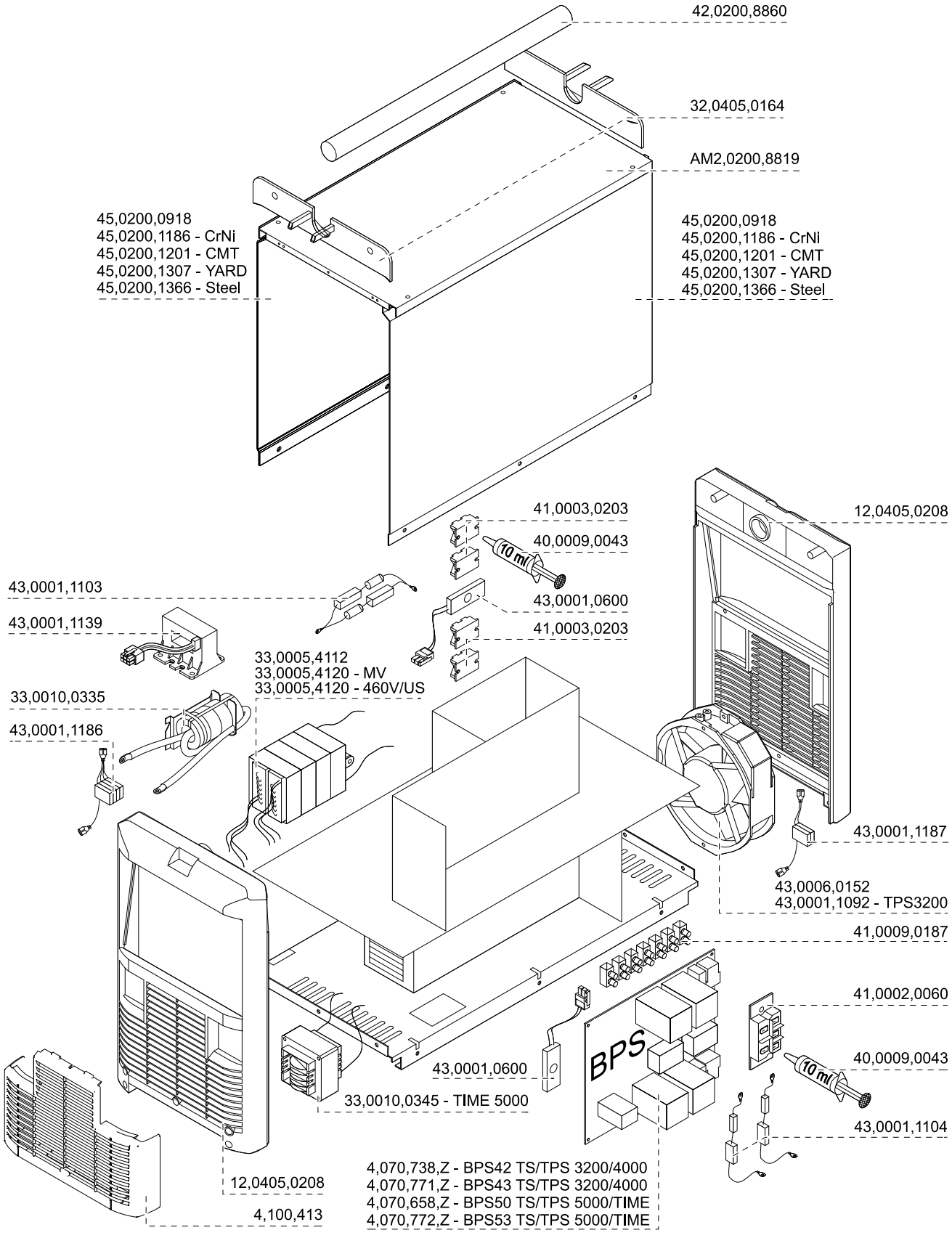
TIME 5000 Digital	4,075,140,93

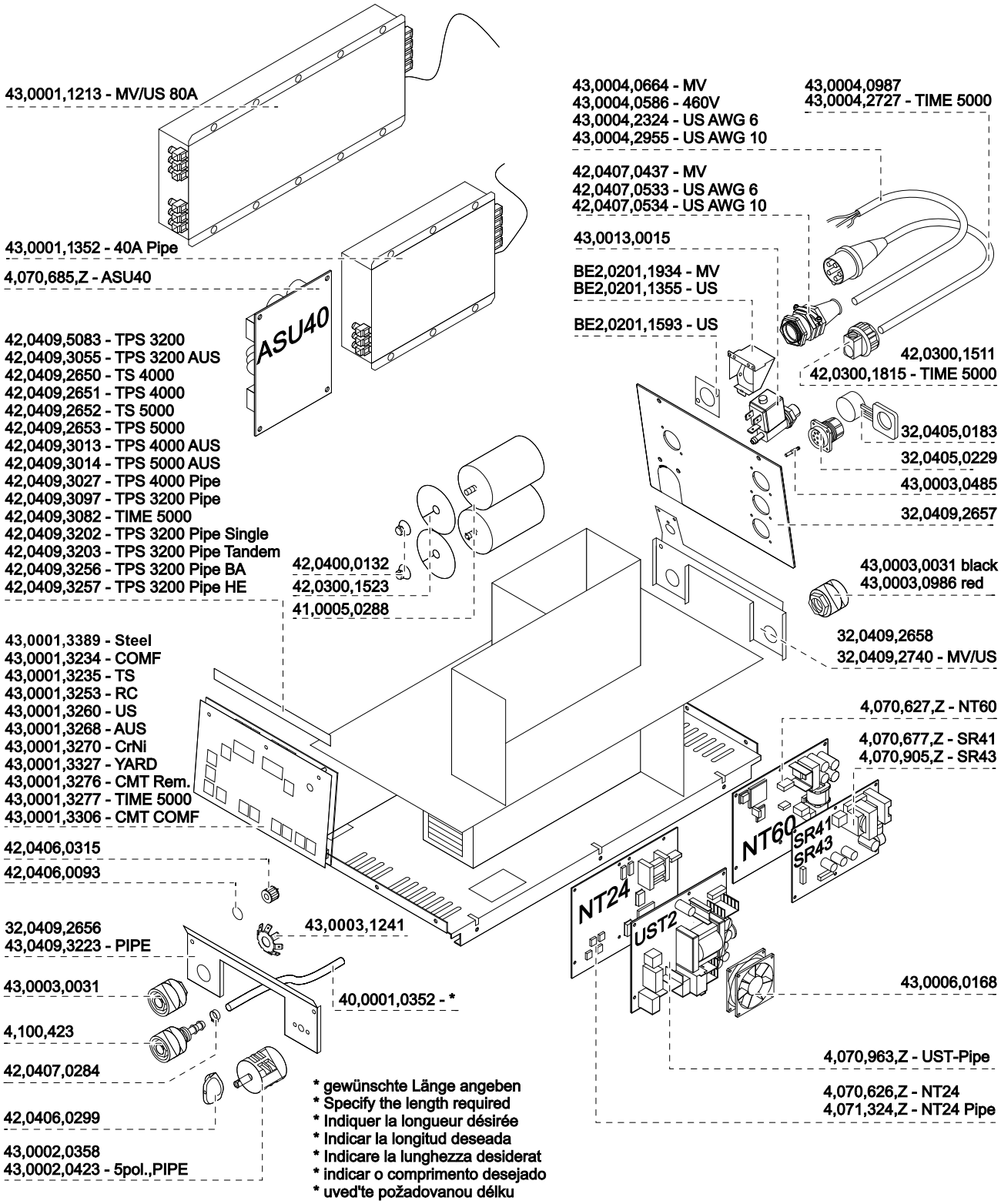
YARD

TransPulsSynergic 4000 Yard	4,075,100,634
TransPulsSynergic 4000 MV Yard	4,075,100,635
TransPulsSynergic 4000 460V Yard	4,075,100,802
TransPulsSynergic 4000 MV Yard	4,075,100,803
TransPulsSynergic 5000 Yard	4,075,102,634
TransPulsSynergic 5000 MV Yard	4,075,102,635
TransPulsSynergic 5000 460V Yard	4,075,100,802
TransPulsSynergic 5000 MV Yard	4,075,100,803

Steel

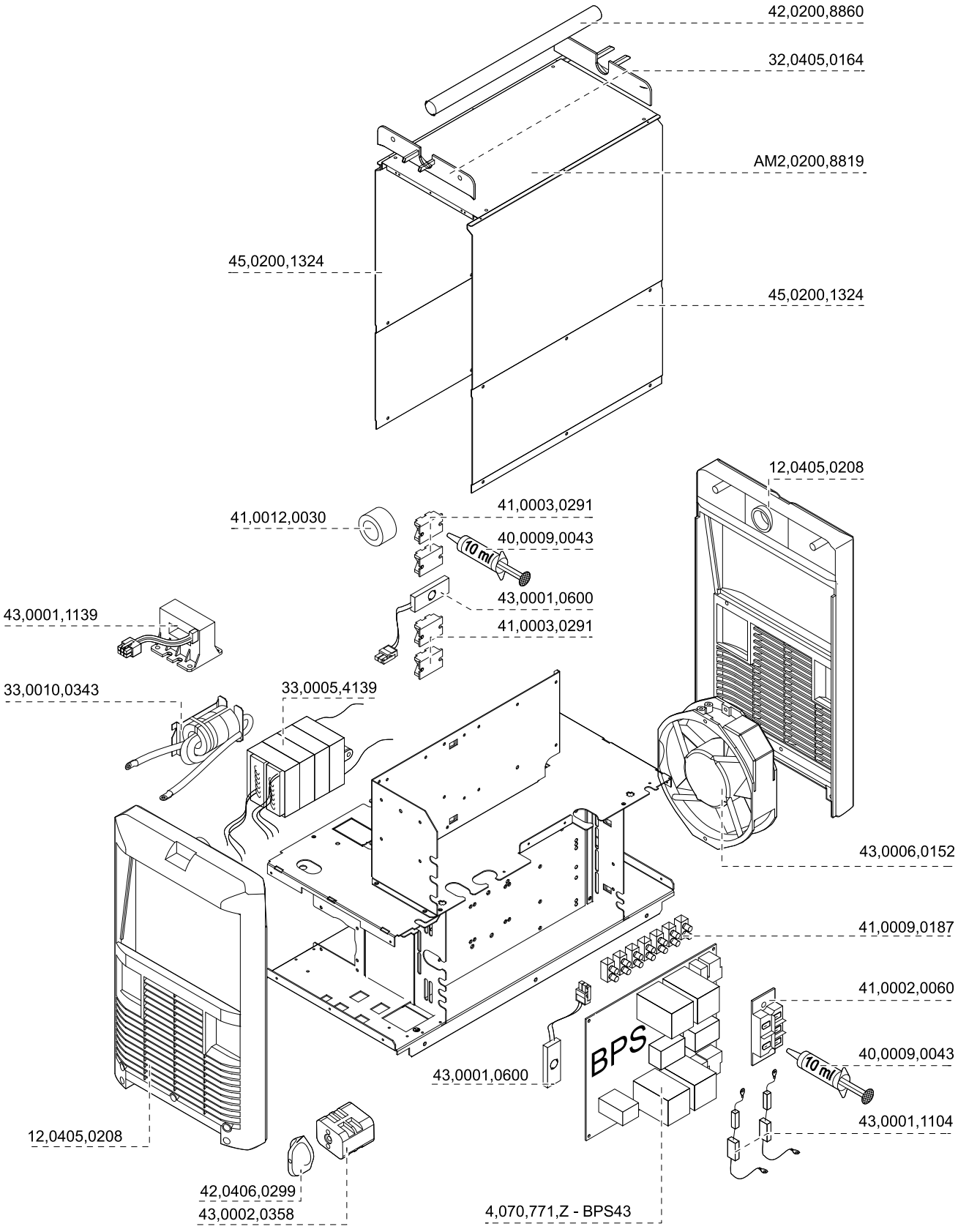
TransPulsSynergic 3200 Steel	4,075,124,850
TransPulsSynergic 4000 Steel	4,075,100,850
TransPulsSynergic 5000 Steel	4,075,102,850

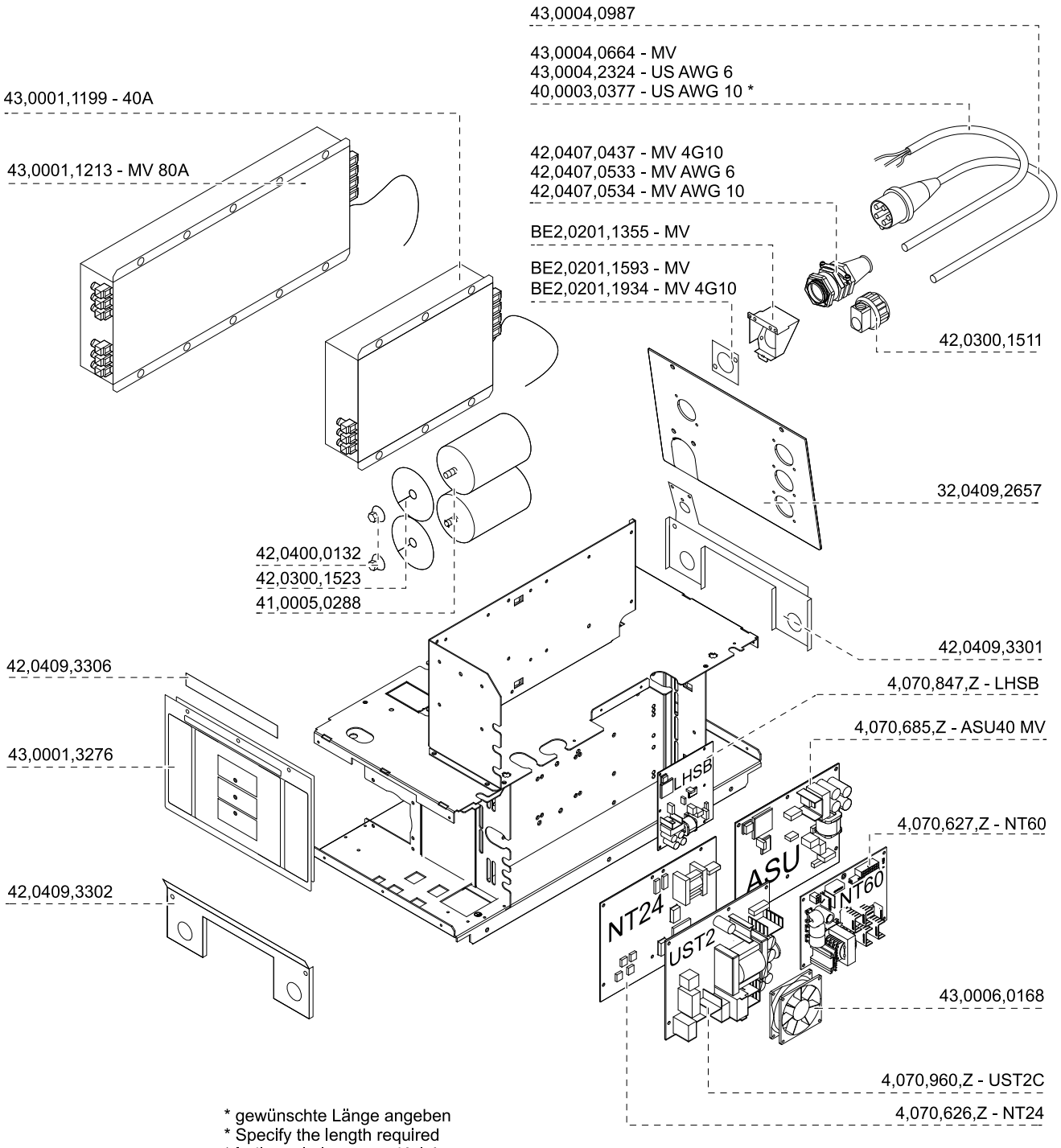

42,0200,8860
32,0405,0164
AM2,0200,8819
45,0200,0918
45,0200,1186 - CrNi
45,0200,1201 - CMT
45,0200,1307 - YARD
45,0200,1366 - Steel
45,0200,0918
45,0200,1186 - CrNi
45,0200,1201 - CMT
45,0200,1307 - YARD
45,0200,1366 - Steel
41,0003,0203
40,0009,0043
10 ml
43,0001,1103
43,0001,1139
43,0001,0600
41,0003,0203
12,0405,0208
33,0005,4112
33,0005,4120 - MV
33,0005,4120 - 460V/US
33,0010,0335
43,0001,1186
43,0001,1187
43,0006,0152
43,0001,1092 - TPS3200
41,0009,0187
41,0002,0060
40,0009,0043
10 ml
BPS
43,0001,0600
33,0010,0345 - TIME 5000
43,0001,1104
12,0405,0208
4,100,413
4,070,738,Z - BPS42 TS/TPS 3200/4000
4,070,771,Z - BPS43 TS/TPS 3200/4000
4,070,658,Z - BPS50 TS/TPS 5000/TIME
4,070,772,Z - BPS53 TS/TPS 5000/TIME


43,0001,1213 - MV/US 80A
43,0001,1352 - 40A Pipe
4,070,685,Z - ASU40
ASU40
42,0409,5083 - TPS 3200
42,0409,3055 - TPS 3200 AUS
42,0409,2650 - TS 4000
42,0409,2651 - TPS 4000
42,0409,2652 - TS 5000
42,0409,2653 - TPS 5000
42,0409,3013 - TPS 4000 AUS
42,0409,3014 - TPS 5000 AUS
42,0409,3027 - TPS 4000 Pipe
42,0409,3097 - TPS 3200 Pipe
42,0409,3082 - TIME 5000
42,0409,3202 - TPS 3200 Pipe Single
42,0409,3203 - TPS 3200 Pipe Tandem
42,0409,3256 - TPS 3200 Pipe BA
42,0409,3257 - TPS 3200 Pipe HE
43,0001,3389 - Steel
43,0001,3234 - COMF
43,0001,3235 - TS
43,0001,3253 - RC
43,0001,3260 - US
43,0001,3268 - AUS
43,0001,3270 - CrNi
43,0001,3327 - YARD
43,0001,3276 - CMT Rem.
43,0001,3277 - TIME 5000
43,0001,3306 - CMT COMF
42,0406,0315
42,0406,0093
32,0409,2656
43,0409,3223 - PIPE
43,0003,0031
4,100,423
42,0407,0284
42,0406,0299
43,0002,0358
43,0002,0423 - 5pol.,PIPE
42,0400,0132
42,0300,1523
41,0005,0288
43,0003,1241
40,0001,0352 - *
* gewünschte Länge angeben
* Specify the length required
* Indiquer la longueur désirée
* Indicar la longitud deseada
* Indicare la lunghezza desiderat
* indicar o comprimento desejado
* uved'te požadovanou délku
43,0004,0664 - MV
43,0004,0586 - 460V
43,0004,2324 - US AWG 6
43,0004,2955 - US AWG 10
43,0004,0987
43,0004,2727 - TIME 5000
42,0407,0437 - MV
42,0407,0533 - US AWG 6
42,0407,0534 - US AWG 10
43,0013,0015
BE2,0201,1934 - MV
BE2,0201,1355 - US
BE2,0201,1593 - US
42,0300,1511
42,0300,1815 - TIME 5000
32,0405,0183
32,0405,0229
43,0003,0485
32,0409,2657
43,0003,0031 black
43,0003,0986 red
32,0409,2658
32,0409,2740 - MV/US
4,070,627,Z - NT60
4,070,677,Z - SR41
4,070,905,Z - SR43
NT60
SR41
SR43
NT24
UST2
43,0006,0168
4,070,963,Z - UST-Pipe
4,070,626,Z - NT24
4,071,324,Z - NT24 Pipe

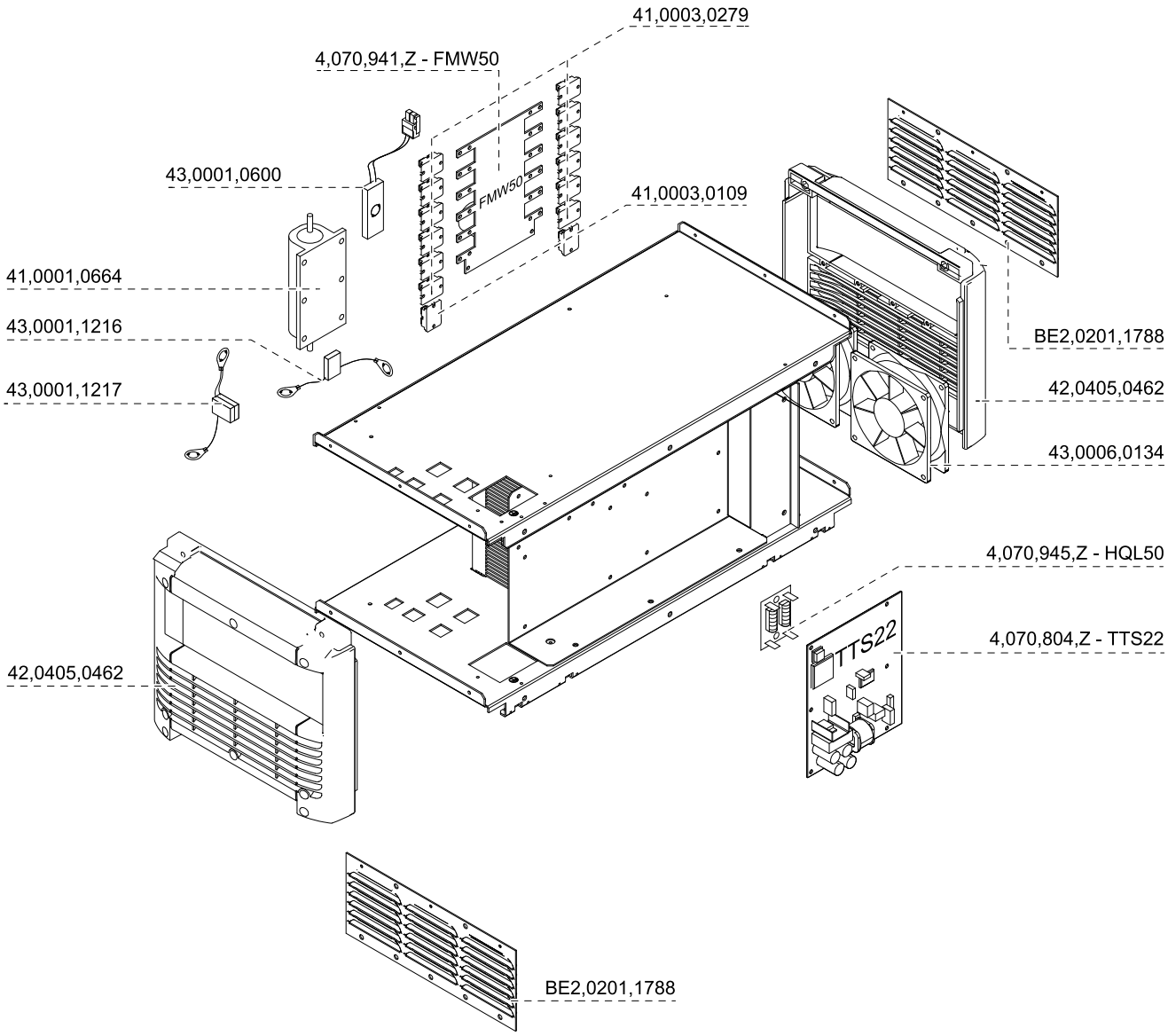
Spare parts list: CMT 4000 Advanced

CMT Advanced 4000 R	**4,075,162,R**
CMT Advanced 4000 MV R	**4,075,162,630,R**
CMT Advanced 4000 MV R	**4,075,162,800,R**





* gewünschte Länge angeben
* Specify the length required
* Indiquer la longueur désirée
* Indicar la longitud deseada
* Indicare la lunghezza desiderat
* indicar o comprimento desejado
* uved'te požadovanou délku


41,0003,0279
4,070,941,Z - FMW50
43,0001,0600
FMW50
41,0003,0109
41,0001,0664
43,0001,1216
43,0001,1217
BE2,0201,1788
42,0405,0462
43,0006,0134
4,070,945,Z - HQL50
TTS22
4,070,804,Z - TTS22
42,0405,0462
BE2,0201,1788

Maahantuonti ja myynti:

PRONIUS

Pronius Oy

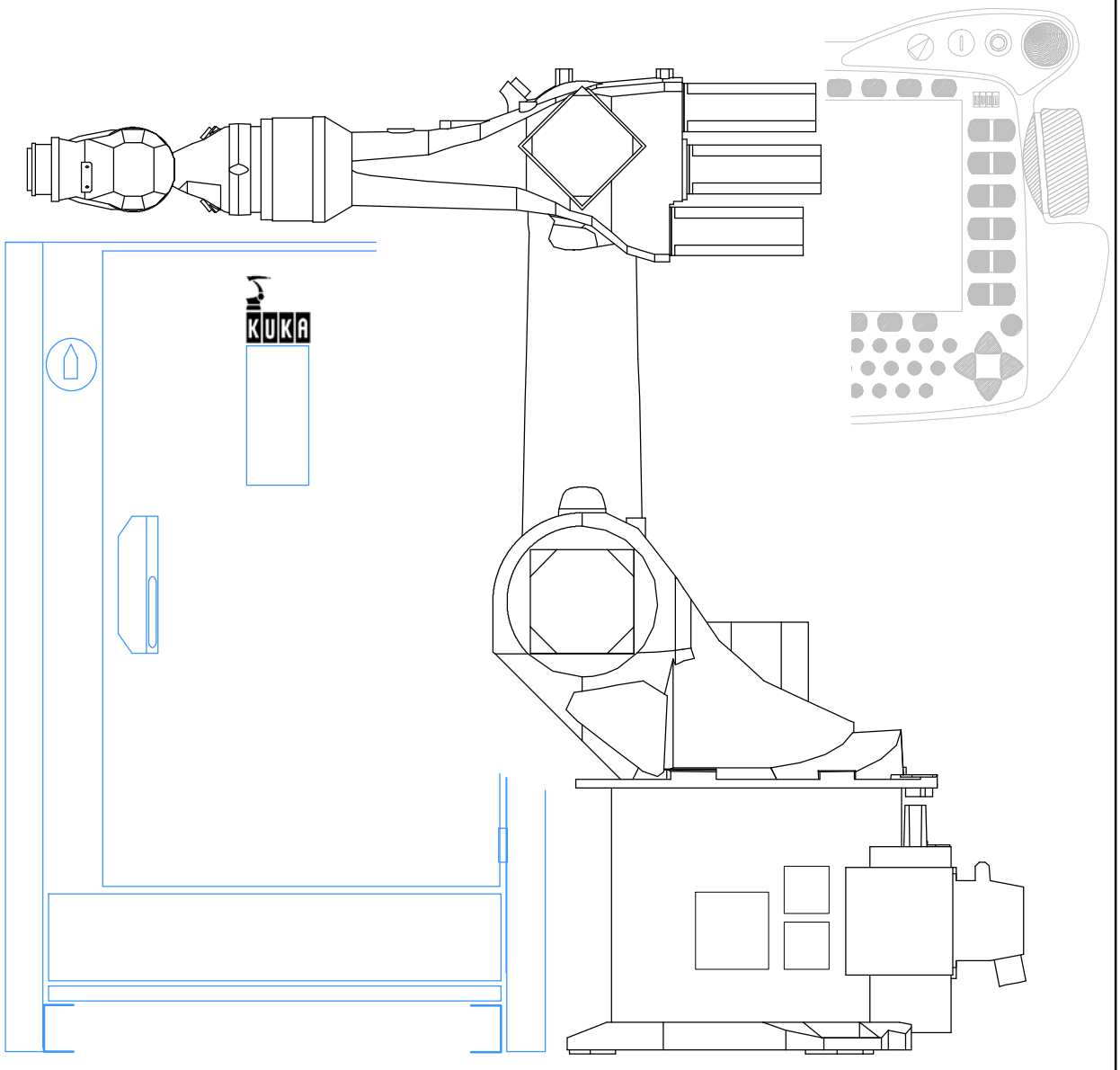
Keisarinviitta 20 B
33960 Pirkkala

+358 (0)44 200 9060
info@pronius.fi
www.pronius.fi

Spezifikation
Specification
Spécification

Roboter
Robots

KR 6
KR 16
KR 16 L6
KR 16 S



Deutsch Seite 3
English page 11
Français page 19

Inhaltsverzeichnis

1 Systembeschreibung 3
1.1 Allgemeines 3
1.2 Robotermechanik 4
1.3 Aufstellung 4
1.4 Austausch 5
1.5 Transport 5
2 Zubehör (Auswahl) 6
2.1 Roboterbefestigung 6
2.2 Zusätzliche Linearachse 6
2.3 Integrierte Energiezuführung für Achse 1 bis Achse 3 6
2.4 Arbeitsbereichsüberwachung 6
2.5 Arbeitsbereichsbegrenzung 6
2.6 KTL-Justage-Set 6
2.7 Zahnriemenspannungs-Messgerät für Zentralhand 6
2.8 Freidrehvorrichtung für Roboterachsen 6
3 Technische Daten 7
3.1 Einsatzbedingungen für KR 16 EX 10
Abbildungen 27-46

1 SYSTEMBESCHREIBUNG

1.1 Allgemeines

Die Roboter KR 6, KR 16, KR 16 L6 und KR 16 S sind sechsachsige Industrieroboter mit Gelenkkinematik (Bild 1-1) für alle Punkt- und Bahnsteuerungsaufgaben.

Die Haupteinsatzgebiete von KR 6, KR 16 und KR 16 L6 sind:
- Handhaben
- Montieren
- Auftragen von Kleb-, Dicht- und Konservierungsstoffen
- Bearbeiten

Die Haupteinsatzgebiete von KR 16 S sind:
- Handhaben
- Montieren
- Auftragen von Kleb-, Dicht- und Konservierungsstoffen
- Bearbeiten
- MIG/MAG-Schweißen
- YAG-Laserstrahlschweißen

Darüber hinaus gibt es folgende Varianten:
- KR 16 F für den Einsatz bei hoher thermischer und mechanischer Belastung.
- KR 16 EX für den Einsatz in explosionsgefährdeter Umgebung.
- KR 16 CR für den Einsatz in Clean-Room-Umgebung.

Der Roboter KR 16 CR wird am Boden eingebaut.

Der Roboter KR 16 S wird am Boden oder an der Decke eingebaut.

Alle anderen beschriebenen Roboter können am Boden, an der Wand und an der Decke eingebaut werden.

Nenn-Traglasten und Zusatzlasten können auch bei maximaler Armausladung mit maximaler Geschwindigkeit bewegt werden (siehe Abschnitt 3 “Technische Daten”).

Alle Grundkörper der beweglichen Hauptbaugruppen bestehen aus Leichtmetallguss. Dieses Auslegungskonzept wurde im Hinblick auf wirtschaftlichen Leichtbau und hohe Torsions- und Biegefestigkeit CAD- und FEM-optimiert. Hieraus resultiert eine hohe Eigenfrequenz des Roboters, der dadurch ein gutes dynamisches Verhalten mit hoher Schwingungssteifigkeit aufweist.

Gelenke und Getriebe bewegen sich weitgehend spielfrei, alle bewegten Teile sind abgedeckt. Alle Antriebsmotoren sind steckbare, bürstenlose AC-Servomotoren - wartungsfrei und sicher gegen Überlastung geschützt.

Die Grundachsen sind dauergeschmiert, d.h. ein Ölwechsel ist frühestens nach 20.000 Betriebsstunden erforderlich.

Alle Roboterkomponenten sind bewusst einfach und übersichtlich gestaltet, in ihrer Anzahl minimiert und durchweg leicht zugänglich. Der Roboter kann auch als komplette Einheit schnell und ohne wesentliche Programmkorrektur ausgetauscht werden. Überkopfbewegungen sind möglich.

Durch diese und zahlreiche weitere Konstruktionsdetails sind die Roboter schnell und betriebssicher, wartungsfreundlich und wartungsarm. Sie benötigen nur wenig Stellfläche und können aufgrund der besonderen Aufbaugeometrie sehr nahe am Werkstück stehen. Die durchschnittliche Lebensdauer liegt, wie bei allen KUKA-Robotern, bei 10 bis 15 Jahren.

Jeder Roboter wird mit einer Steuerung ausgerüstet, deren Steuer- und Leistungselektronik in einen gemeinsamen Steuerschrank integriert sind

(siehe gesonderte Spezifikation). Sie ist platzsparend, anwender- und servicefreundlich. Der Sicherheitsstandard entspricht der EU-Maschinenrichtlinie und den einschlägigen Normen (u.a. DIN EN 775).

Die Verbindungsleitungen zwischen Roboter und Steuerschrank enthalten alle hierfür notwendigen Versorgungs- und Signalleitungen. Sie sind am Roboter steckbar, auch die Energie- und Medienleitungen für den Betrieb von Werkzeugen (Zubehör "Integrierte Energiezuführung für Achse 1 bis Achse 3"). Diese Leitungen sind im Bereich der Grundachse 1 fest im Inneren des Roboters installiert und können bei Bedarf mit Hilfe von Systemschnittstellen an den nachgeordneten Achsen entlang bis zum Werkzeug geführt werden.

1.2 Robotermechanik

Die Roboter bestehen aus einem feststehenden Grundgestell, auf dem sich um eine senkrechte Achse das Karussell mit Schwinge, Arm und Hand dreht (Bild 1-1).

Die Hand (Bild 1-5) dient mit ihrem Anbauflansch der Aufnahme von Werkzeugen (z.B. Greifer, Schweißgerät).

Die Bewegungsmöglichkeiten der Roboterachsen gehen aus Bild 1-2 hervor.

Die Wegmessung für die Grund- und Handachsen (A 1 bis A 3, A 4 bis A 6) erfolgt über ein zyklisch absolutes Wegmesssystem mit einem Resolver für jede Achse.

Der Antrieb erfolgt durch transistorgesteuerte, trägheitsarme AC-Servomotoren. In die Motoreinheiten sind Bremse und Resolver raumsparend integriert.

Der Arbeitsbereich des Roboters wird in allen Achsen über Software-Endschalter begrenzt. Mechanisch werden die Arbeitsbereiche der Achsen 1, 2, 3 und 5 über Endanschläge mit Pufferfunktion begrenzt.

Als Zubehör "Arbeitsbereichsbegrenzung" sind für die Achsen 1 bis 3 mechanische Anschläge für eine aufgabenbedingte Begrenzung des jeweiligen Arbeitsbereichs lieferbar.

Für besondere Einsatzfälle stehen spezielle Robotervarianten mit angepasster Zentralhand zur Verfügung:

- KR 16 F mit ZH 16 F für den Einsatz bei hoher thermischer und mechanischer Belastung.
- KR 16 EX mit ZH 16 F für den Einsatz in explosionsgefährdeter Umgebung.
- KR 16 CR mit ZH 16 CR für den Einsatz in Clean-Room-Umgebung.

Die Zentralhand "F" (ZH 16 F) ist umfangreicher abgedichtet und mit korrosionsbeständigeren Bauteilen ausgestattet. Zum Erhalt der Belastbarkeit sind kürzere Wartungsintervalle einzuhalten.

Bei Robotern der "F"- und "EX"-Variante ist der Arm druckbeaufschlagt. Er wird mit einem Innendruck von 0,1 bar betrieben.

Bei Robotern der "CR-Variante" wird keine Druckluft benötigt.

In Clean-Room-Umgebung kommt die Variante KR 16 CR zum Einsatz. Durch umfangreiche Modifikationen ist die Partikelemission gegenüber der Standardversion deutlich reduziert. Außerdem ist die "CR"-Variante mit korrosionsbeständigen Bauteilen ausgestattet.

1.3 Aufstellung

Für die Aufstellung des Roboters gibt es folgende Möglichkeiten:

- **Variante 1 (nur Bodenroboter)**

  Diese Variante ist mit Fundamentplatten und Sechskantschrauben mit Sicherungsscheiben als Zubehör "Fundamentbefestigung mit Zentrierung" lieferbar.
  Drei Fundamentplatten werden mit je einer Sechskantschraube am Roboter befestigt (Bild 1-3). Der Roboter wird auf den vorbereiteten Hallenboden gesetzt und horizontal ausgerichtet. Seine Einbauposition wird durch sechs Dübelbohrungen bestimmt, in die je eine Mörtelpatrone und eine Gewindestange gesetzt werden. Dadurch wird die wiederholbare Austauschbarkeit des Roboters ermöglicht.
  Anschließend wird der Roboter mit Sechskantschrauben festgeschraubt.

Soll der Roboter am Boden, und zwar auf Beton aufgestellt werden, müssen zur Vorbereitung des Betonfundaments die einschlägigen Bauvorschriften hinsichtlich Betongüte (≥ B25 nach DIN 1045:1988 oder C20/25 nach DIN EN 206-1:2001/DIN 1045-2:2001) und Tragfähigkeit des Untergrunds beachtet werden. Bei der Anfertigung ist auf eine ebene und ausreichend glatte Oberfläche zu achten.

Das Einbringen der Klebedübel muss sehr sorgfältig erfolgen, damit die während des Betriebs auftretenden Kräfte (Bild 1-7) sicher in den Boden geleitet werden. Diese Bilder können auch für weitergehende statische Untersuchungen herangezogen werden.

- **Variante 2**

  Diese Variante ist mit Auflagebolzen und Schrauben als Zubehör “Maschinengestellbefestigungssatz” lieferbar.
  Der Roboter wird auf eine vorbereitete Stahlkonstruktion gesetzt und mit drei Sechskantschrauben festgeschraubt (Bild 1-4). Seine Einbauposition wird durch zwei Aufnahmebolzen bestimmt, was seine wiederholbare Austauschbarkeit ermöglicht.

1.4 Austausch

Bei Produktionsanlagen mit einer größeren Anzahl von Robotern ist die problemlose Austauschbarkeit der Roboter untereinander von Bedeutung.

Sie wird gewährleistet

- durch die Reproduzierbarkeit der werkseitig markierten Synchronisationsstellungen aller Achsen, der sogenannten mechanischen Null-Stellungen, und
- durch die rechnerunterstützte Nullpunktjustage,

und sie wird zusätzlich begünstigt

- durch eine fernab vom Roboter und vorweg durchführbare Offline-Programmierung sowie
- durch die reproduzierbare Aufstellung des Roboters.

Service- und Wartungsarbeiten (u. a. die Hand und die Motoren betreffend) erfordern abschließend die Herbeiführung der elektrischen und der mechanischen Null-Stellung (Kalibrierung) des Roboters. Zu diesem Zweck sind werkseitig Messpatronen an jeder Roboterachse angebracht.

Das Einstellen der Messpatronen ist Teil der Vermessungsarbeiten vor Auslieferung des Roboters. Dadurch, dass an jeder Achse immer mit derselben Patrone gemessen wird, erreicht man ein Höchstmaß an Genauigkeit beim erstmaligen Vermessen und beim späteren Wiederaufsuchen der mechanischen Null-Stellung.

Für das Sichtbarmachen der Stellung des in der Messpatrone liegenden Tasters wird als Zubehör ein elektronischer Messtaster (KTL-Justage-Set) auf die Messpatrone geschraubt. Beim Überfahren der Messkerbe während des Einstellvorgangs wird das Wegmesssystem automatisch auf elektrisch Null gesetzt.

Nach vollzogener Nullpunkt-Einstellung für alle Achsen kann der Roboter wieder in Betrieb genommen werden.

Die geschilderten Vorgänge ermöglichen es, dass die einmal festgelegten Programme jederzeit auf jeden anderen Roboter desselben Typs übertragen werden können.

1.5 Transport

Die Roboter können auf zweierlei Weise transportiert werden (Bild 1-9):

Mit Transportgeschirr und Kran

- Die Roboter lassen sich mit einem Transportgeschirr, das in drei Ringschrauben am Karussell eingehängt wird, an den Kranhaken hängen und so transportieren.
- **Für den Transport eines Roboters mittels Kran dürfen nur zugelassene Last- und Hebegeschirre mit ausreichender Traglast verwendet werden. Die Seile oder Bänder sind so zu führen, dass das Kippen des Roboters zur Seite sicher vermieden wird und Installationen bzw. Stecker nicht beschädigt werden.**

Mit Gabelstapler

- Für den Transport mit dem Gabelstapler müssen zwei Gabelstaplertaschen (Zubehör) an das Karussell angebaut werden.
- Für die Befestigung an der Decke wird der Roboter in einem speziellen Transportgestell hängend geliefert. Aus diesem kann er mit dem Gabelstapler bereits in richtiger Einbaulage entnommen und weitertransportiert werden.
- Für den Transport eines Wandroboters steht eine gesonderte Gabelstaplertasche zur Verfügung.
- **Für den Transport des Roboters mittels Gabelstapler dürfen keine Last- oder Hebegeschirre verwendet werden.**

Vor jedem Transport muss der Roboter in **Transportstellung** gebracht werden. Mit Hilfe des KCP werden alle Roboterachsen in definierte Positionen gebracht (Bild 1-10, 1-11, 1-12).

Maße für die Verpackung der Roboter im Container (mit Gabelstaplertaschen):

Robotertyp	L (mm)	B (mm)	H (mm)
KR 6	1115	1030	1075
KR 16	1184	1030	1078
KR 16 L6	1416	1030	1075
KR 16 S	1184	1030	1078

2 ZUBEHÖR (Auswahl)

Der Roboter KR 16 EX darf nur mit von KUKA angebotenem und zugelassenem Zubehör eingesetzt werden. Siehe Einsatzbedingungen im Abschnitt 3.1.

2.1 Roboterbefestigung

Die Befestigung des Roboters kann in zwei Varianten erfolgen:

- mit Fundamentbefestigungssatz (Bild 1-3)
- mit Maschinengestellbefestigungssatz (Bild 1-4)

Beschreibung siehe Abschnitt 1.3.

2.2 Zusätzliche Linearachse

Mit Hilfe einer Lineareinheit als zusätzliche Fahrachse auf der Basis der Baureihe KL 250/2 (Bild 2-1) kann der Roboter translatorisch und frei programmierbar verfahren werden.

2.3 Integrierte Energiezuführung für Achse 1 bis Achse 3

Es stehen verschiedene Energiezuführungen zur Verfügung, z. B. für die Applikation “Handhaben”. Die entsprechenden Leitungen verlaufen vom Steckerfeld innerhalb des Grundgestells und dann außen an Karussell und Schwinge bis zu einer Schnittstelle am Arm (Bild 2-2).

Von dort können zusätzliche Leitungen außen am Arm entlang bis zu einer entsprechenden Schnittstelle am Werkzeug geführt werden. Damit entfällt der raumaufwendige Versorgungsgalgen.

2.4 Arbeitsbereichsüberwachung

Die Achsen 1 und 2 können mit Positionsschaltern und Nutenringen, auf denen verstellbare Nocken befestigt sind, ausgerüstet werden. Das ermöglicht die ständige Überwachung der Roboterstellung.

Bei Robotern der “EX”-Variante ist keine Arbeitsbereichsüberwachung zulässig.

2.5 Arbeitsbereichsbegrenzung

Die Bewegungsbereiche der Achsen 1 bis 3 können mit zusätzlichen mechanischen Anschlägen aufgabenbedingt in 22,5°-Schritten begrenzt werden.

2.6 KTL-Justage-Set

Um eine für alle Achsen notwendige Nullpunkt-Einstellung durchzuführen, kann der zu einem KTL-Justage-Set gehörende elektronische Messtaster (Bild 3-5, 3-7) verwendet werden. Der Messtaster erlaubt ein besonders schnelles, einfaches Messen sowie eine automatische, rechnergestützte Justage und sollte bei der Roboterbestellung mitbestellt werden.

2.7 Zahnriemenspannungs-Messgerät für Zentralhand

Das vollelektronische, mit einem Microcontroller ausgestattete Messgerät ermöglicht das einfache und schnelle Messen von Zahnriemenspannungen durch Frequenzmessung (Bild 2-4).

2.8 Freidrehvorrichtung für Roboterachsen

Mit dieser Vorrichtung kann der Roboter nach einem Störfall mechanisch über die Grundachs-Antriebsmotoren bewegt werden. Sie darf nur in Notfällen (z.B. Befreiung von Personen) verwendet werden.

3 TECHNISCHE DATEN

Bautypen: KR 6, KR 16, KR 16 L6, KR 16 S

Varianten: KR 16 F, KR 16 CR, KR 16 EX

Anzahl der Achsen: 6 (Bild 1-2)

Lastgrenzen

Robotertyp	KR 6	KR 16 KR 16 S	KR 16 L6
Zentralhand	ZH 6	ZH 16	ZH 6
Nenn-Traglast [kg]	6	16	6
Zusatzlast Arm [kg]	10	10	10
Zusatzlast Schwinge [kg]	variabel	variabel	variabel
Zusatzlast Karussell [kg]	20	20	20
Max. Gesamtlast [kg]	36	46	36

siehe auch Bild 3-1

Die Abhängigkeit von Traglast und Lage des Traglastschwerpunkts geht aus Bild 3-2 und 3-3 hervor.

Achsdaten

Die Darstellung der Achsen und ihrer Bewegungsmöglichkeiten geht aus Bild 1-2 hervor. Grundachsen sind die Achsen 1 bis 3, Handachsen die Achsen 4 bis 6.

Alle Angaben in der Spalte “Bewegungsbereich” beziehen sich auf die elektrische Nullstellung und die Anzeige am Display des KCP für die jeweilige Roboterachse.

KR 6 mit ZH 6

Achse	Bewegungsbereich softwarebegrenzt	Geschwindigkeit
1	±185°	156°/s
2	+35° bis -155°	156°/s
3	+154° bis -130°	156°/s
4	±350°	343°/s
5	±130°	362°/s
6	±350°	659°/s

KR 16 mit ZH 16, ZH 16 F, ZH 16 CR

Achse	Bewegungsbereich softwarebegrenzt	Geschwindigkeit
1	±185°	156°/s
2	+35° bis -155°	156°/s
3	+154° bis -130°	156°/s
4	±350°	330°/s
5	±130°	330°/s
6	±350°	615°/s

KR 16 L6 mit ZH 6

Achse	Bewegungsbereich softwarebegrenzt	Geschwindigkeit
1	±185°	156°/s
2	+35° bis -155°	156°/s
3	+154° bis -130°	156°/s
4	±350°	335°/s
5	±130°	355°/s
6	±350°	647°/s

KR 16 EX mit ZH 16 F

Achse	Bewegungsbereich softwarebegrenzt	Geschwindigkeit
1	±145°	156°/s
2	+35° bis -155°	156°/s
3	+154° bis -130°	156°/s
4	±350°	330°/s
5	±130°	330°/s
6	±350°	615°/s

KR 16 S mit ZH 16

Achse	Bewegungsbereich softwarebegrenzt	Geschwindigkeit
1	±185°	192°/s
2	+35° bis -155°	173°/s
3	+154° bis -130°	192°/s
4	±350°	329°/s
5	±130°	332°/s
6	±350°	789°/s

Wiederholgenauigkeit

±0,05 mm

Einbaulage

KR 16 S Boden oder Decke

KR 16 CR Boden

Alle anderen Typen: Boden, Wand oder Decke (zulässiger Winkel A 1 siehe Bild 1−6)

Umgebungstemperatur

- bei Betrieb:
  278 K bis 328 K (+5 °C bis +55 °C)
  im Temperaturbereich zwischen 278 K (+5 °C) bis 283 K (+10 °C) ist ein Warmfahren des Roboters erforderlich.
  Achtung: Besondere Einsatzbedingungen bei KR 16 EX (siehe Abschnitt 3.1).
- bei Betrieb mit SafeRDW:
  278 K bis 323 K (+5 °C bis +50 °C)
- bei Lagerung und Transport:
  233 K bis 333 K (-40 °C bis +60 °C)

Andere Temperaturgrenzen auf Anfrage.

Hauptabmessungen und Arbeitsbereich

siehe Bild 3-8, 3-9, 3-10

Gewicht

KR 6	ca. 235 kg
KR 16	ca. 235 kg
KR 16 L6	ca. 240 kg
KR 16 S	ca. 235 kg

Arbeitsraumvolumen

Bezugspunkt ist hierbei der Schnittpunkt der Achsen 4 und 5.

KR 6	14,5 m^3
KR 16	14,5 m^3
KR 16 L6	24,0 m^3
KR 16 S	14,5 m^3

Traglastschwerpunkt P

Robotertyp	Hor. Abstand Lz (mm)	Vert. Abstand Lxy (mm)
KR 6	120	100
KR 16	150	120
KR 16 L6	120	100
KR 16 S	150	120

Diese Angaben gelten für alle Nennlasten (Bild 3-2, 3-3).

Dynamische Hauptbelastungen

siehe Bild 1-7 und 1-8.

Anbauflansch an Achse 6

Die Roboter sind mit einem Anbauflansch in DIN/ISO-Ausführung ausgestattet (Bild 3-4, 3-6):

KR 6	DIN/ISO 9409-1-A40
KR 16	DIN/ISO 9409-1-A50
KR 16 L6	DIN/ISO 9409-1-A40
KR 16 S	DIN/ISO 9409-1-A50

Schraubenqualität für Werkzeuganbau 10.9
Klemmlänge min. 1,5 x d
Einschraubtiefe min. 6 mm
max. 9 mm

HINWEIS: Das dargestellte Flanschbild entspricht der Null-Stellung des Roboters in allen Achsen, besonders auch in Achse 6 (Symbol ⧫ zeigt dabei die Lage des Pass-Elements).

Nullpunkt-Einstellung

Für die Nullpunkt-Einstellung mit dem elektronischen Messtaster (Zubehör) bei angebautem Werkzeug muss dieses so gestaltet sein, dass genügend Platz für Ein- und Ausbau des Messtasters bleibt (Bild 3-5, 3-7).

Antriebssystem

Elektromechanisch, mit transistorgesteuerten AC-Servomotoren.

Installierte Motorleistung 8,8 kW

Schutzart des Roboters

IP65 (nach EN 60529), betriebsbereit, mit angeschlossenen Verbindungsleitungen

Schutzart der Zentralhand "Standard", "CR"

IP65 (nach EN 60529)

Schutzart der Zentralhand "F"

IP67 (nach EN 60529)

Belastbarkeit Zentralhand "F"

Temperaturbelastung 10 s/min bei 453 K (180 °C)
Oberflächentemperatur 373 K (100 °C)
Beständig gegen:
- hohe Staubbelastung
- Schmier- und Kühlmittel
- Wasserdampf

Sonderausstattung bei "F"- und "EX"- Variante

Druckbeaufschlagter Arm

Überdruck im Arm:	0,1 bar
Druckluft:	öl- und wasserfrei
Druckluftbedarf:	ca. 0,1 m^3/h
Anschlussgewinde:	M5
Druckminderer:	0,1 - 0,7 bar
Manometer:	0 - 1 bar
Filter:	25 - 30 μm

Standardlackierung

KR 6, KR 16, KR 16 L6, KR 16 S:
Roboter und Hand orange (RAL 2003)
Abdeckung A 1 schwarz (RAL 9005)

Sonderlackierungen

KR 16 F mit ZH 16 F:
Roboter orange (RAL 2003)
Hand silber (hitzebeständige, wärmereflektierende Sonderlackierung)
Abdeckung A 1 schwarz (RAL 9005)

KR 16 EX mit ZH 16 F:
Roboter orange (RAL 2003)
Hand orange (RAL 2003)
Abdeckung A 1 Edelstahl blank

KR 16 CR mit ZH 16 CR:
Roboter weiss (RAL 9016)
Hand weiss (RAL 9016)
zusätzliche Sonderlackierung auf Wunsch
Abdeckung A 1 Edelstahl blank

Schallpegel

< 75 dB (A) außerhalb des Arbeitsbereichs

3.1 Einsatzbedingungen für KR 16 EX

Der Roboter KR 16 EX erreicht die EX-Schutzklasse: CE Ex II 3G EEx c,nA IIB T3 X

Bedeutung dieser Kennzeichnung:

CE-Zeichen: Bezieht sich hier ausschließlich auf die Einhaltung der ATEX-Richtlinie.

EX-Symbol: Kennzeichen zur Verhütung von Explosionen nach 94/4/EG.

II: Gerätegruppe II gibt an, dass das Gerät für alle Bereiche (außer unter Tage) eingesetzt werden kann.

3: ATEX-Kategorie: In der Kategorie 3 sind explosionsfähige Gase nur selten oder kurzzeitig vorhanden (<10h/Jahr). Geräte der Kategorie 3 werden für den Einsatz in der EX-Schutz-Zone 2 benötigt.

G: Der EX-Schutz bezieht sich auf explosive Gase und Dämpfe, nicht auf Stäube.

EEx: Das Gerät ist ein explosionsgeschütztes Betriebsmittel und entspricht gültigen EN-Normen.

c,nA: Gibt die Schutzkonzepte / die Zündschutzarten an, mit denen die EX-Kriterien erfüllt werden.

IIB: Explosionsgruppe, gibt an, wie hoch die Zündgefahr der Gase sein darf.

T3: Temperaturklasse, die Oberflächentemperatur liegt unter 200˚C.

X: Für den Einsatz des Geräts sind spezielle Bedingungen zu beachten.

Die Entscheidung darüber, ob explosionsgefährdete Umgebung für den Betrieb des Roboters vorliegt, muss der Anlagenbauer oder Anlagenbetreiber der Anlage treffen.

Bei Planung und Einsatz des Roboters in explosionsgefährdeter Umgebung müssen für diese Schutzklasse folgende Punkte beachtet werden:

- Maximale Umgebungstemperatur: 40 ˚C.
- Minimale Länge der Verbindungsleitungen: 7,00 m.
- Druckbelüftung des Armes muss bei Betrieb des Roboters aktiv sein.
- Alle offenen Steckverbindungen müssen dicht verschlossen werden.
- EX-Schutzklasse bezieht sich nur auf die Robotermechanik, nicht auf Steuerschrank oder KCP.
- Software-Endschalter müssen so programmiert werden, dass der Roboter zum Stillstand kommt, bevor er die mechanischen Anschläge (Standard- und Zusatzanschläge) berührt.
- Ausrüstungsteile, wie z.B. Energiezuführungen, müssen von KUKA zugelassen sein oder eine entsprechende Konformitätserklärung haben.
- Für die EX-Tauglichkeit der am Roboter angebauten Werkzeuge ist der Anlagenbauer oder Anlagenbetreiber verantwortlich.
- Der Roboter darf unter explosionsgefährdeter Umgebung nur im Normalbetrieb betrieben werden. Normalbetrieb ist nicht:
  - Wartungs- und Instandsetzungsbetrieb
  - EMT-Justage
  - Programmierung und Testbetrieb
  - NOT-AUS-Fahrt
  - Bedienerschutz
- I^2T-Überwachung und Maschinendaten dürfen nicht verändert werden.
- Der Roboter unterliegt kürzeren Wartungsintervallen.

3.2 Einsatzbedingungen für KR 16 CR

Einstufung bis 40% der Maximalgeschwindigkeit: DIN EN ISO 14644-1, Klasse 4
(entspricht etwa US Fed. Std. 209E, class 10)

Einstufung bis 100% der Maximalgeschwindigkeit: DIN EN ISO 14644-1, Klasse 5
(entspricht etwa US Fed. Std. 209E, class 100)

Deutsch Seite 3
English page 11
Français page 19

Contents

1 System description 11
1.1 General 11
1.2 Robot design 12
1.3 Installation 12
1.4 Exchange 13
1.5 Transportation 13

2 Accessories (selection) 14
2.1 Robot installation 14
2.2 Additional linear axis 14
2.3 Integrated energy supply for axis 1 to axis 3 14
2.4 Working range monitoring 14
2.5 Working range limitation 14
2.6 KTL mastering set 14
2.7 Belt tension measuring device for in-line wrist 14
2.8 Release device for robot axes 14

3 Technical data 15
3.1 Operating conditions for KR 16 EX 18

Figures 27-46

1 SYSTEM DESCRIPTION

1.1 General

The robots KR 6, KR 16, KR 16 L6 and KR 16 S are six-axis industrial robots with jointed-arm kinematics (Fig. 1-1) for all point-to-point and continuous-path controlled tasks.

The main areas of application of the KR 6, KR 16 and KR 16 L6 are:
- Handling
- Assembly
- Application of adhesives, sealants and preservatives
- Machining

The main areas of application of the KR 16 S are:
- Handling
- Assembly
- Application of adhesives, sealants and preservatives
- Machining
- MIG/MAG welding
- YAG laser beam welding

There are also the following variants:
- The KR 16 F for use in environments with high thermal and mechanical stress.
- The KR 16 EX for use in potentially explosive environments
- The KR 16 CR for use in cleanroom environments

The robot KR 16 CR is installed on the floor.

The robot KR 16 S is installed on the floor or ceiling.

All other robots described here can be installed on the floor, the wall or the ceiling.

The rated payloads and supplementary loads can be moved at maximum speed even with the arm fully extended (see Section 3 “Technical Data”).

All the main bodies of the principal moving assemblies are made of cast light alloy. This design concept has been optimized by means of CAD and FEM with regard to cost-effective lightweight construction and high torsional and flexural rigidity. As a result, the robot has a high natural frequency and is thus characterized by good dynamic performance with high resistance to vibration.

The joints and gears are virtually free from backlash; all moving parts are covered. All the axes are powered by brushless AC servomotors of plug-in design, which require no maintenance and offer reliable protection against overload.

The main axes are lifetime-lubricated, i.e. an oil change is necessary after 20,000 operating hours at the earliest.

All the robot components are of intentionally simple and straightforward configuration; their number has been minimized and they are all readily accessible. The robot can also be quickly replaced as a complete unit without any major program corrections being required. Overhead motion is possible.

These and numerous other design details make the robots fast, reliable and easy to maintain, with minimal maintenance requirements. They occupy very little floor space and can be located very close to the workpiece on account of the special structural geometry. Like all KUKA robots, they have an average service life of 10 to 15 years.

Each robot is equipped with a controller, whose control and power electronics are integrated in a common cabinet (see separate specification). The controller is compact, user-friendly and easy to service. It conforms to the safety requirements specified in the EU machinery directive and the relevant standards (including DIN EN 775).

The connecting cables between the robot and the control cabinet contain all of the relevant energy supply and signal lines. The cable connections on the robot are of the plug-in type, as too are the energy and fluid supply lines for the operation of end effectors ("Integrated energy supply for axis 1 to axis 3" accessory). These lines are permanently installed inside main axis 1 of the robot and can be routed along the downstream axes to the end effector with the aid of system interfaces if required.

1.2 Robot design

The robots consist of a fixed base frame, on which the rotating column turns about a vertical axis together with the link arm, arm and wrist (Fig. 1-1).

The wrist (Fig. 1-5) is provided with a mounting flange for attachment of end effectors (e.g. grippers, welding tools).

The possible movements of the robot axes are depicted in Fig. 1-2.

The positions of the main and wrist axes (A 1 to A 3 and A 4 to A 6) are sensed by means of a cyclically absolute position sensing system featuring a resolver for each axis.

Each axis is driven by a transistor-controlled, low-inertia AC servomotor. The brake and resolver are space-efficiently integrated into the motor unit.

The working range of the robot is limited by means of software limit switches on all axes. The working ranges of axes 1, 2, 3, and 5 are mechanically limited by end stops with a buffer function.

Mechanical stops for task-related limitation of the respective working range for axes 1 to 3 can be supplied as the "Working range limitation" accessory.

For certain applications, special robot types with an adapted in-line wrist are available:

- KR 16 F with IW 16 F for high thermal and mechanical stress.
- KR 16 EX with IW 16 F for use in potentially explosive environments.
- KR 16 CR with IW 16 CR for use in cleanroom environments.

The in-line wrist "F" (IW 16 F) is more extensively sealed and is fitted with corrosion-resistant components. Shorter maintenance intervals are required to maintain the higher stress rating.

With "F" and "EX" variant robots, the arm is pressurized. It is operated with an internal pressure of 0.1 bar.

With "CR-variant" robots no compressed air is required.

In cleanroom environments, the variant KR 16 CR is used. This variant has been extensively modified to achieve a substantially reduced level of particle emission compared with the standard version. The robot is additionally fitted with corrosion-resistant components.

1.3 Installation

The following methods are available for installing the robot:

- **Variant 1 (floor-mounted robots only)**

  This variant is available with bedplates and hexagon bolts with lock washers as the "Mounting base with centering" accessory.
  Three bedplates are fastened to the robot, each with a hexagon bolt (Fig. 1-3). The robot is placed onto the prepared shop floor and aligned horizontally. Its installation position is determined by six anchor holes, into each of which a resin capsule and a threaded rod are inserted. This allows the robot to be exchanged in a repeatable manner.
  The robot is then fastened by means of hexagon bolts.

If the robot is to be installed on the floor, being mounted on a concrete base, all pertinent construction specifications must be observed concerning the grade of concrete (≥ B25 according to DIN 1045:1988 or C20/25 according to DIN EN 206-1:2001/DIN 1045-2:2001) and the load-bearing capacity of the ground when preparing the concrete foundation. It must be ensured that the surface of the foundation is level and sufficiently smooth.

The chemical anchors must be inserted with great care to ensure that the forces occurring during the operation of the robot (Fig. 1-7) are transmitted safely to the ground. The specifications can also be used as a basis for more extensive static investigations.

- **Variant 2**

  This variant is available with locating pins and bolts as the “Machine frame mounting kit” accessory.
  The robot is placed on a prepared steel construction and fastened with three hexagon bolts (Fig. 1-4). Its installation position is fixed by means of two locating pins, enabling it to be exchanged in a repeatable manner.

1.4 Exchange

In manufacturing systems with a large number of robots, it is important for the robots to be interchangeable.

This is ensured by

- the reproducibility of the synchronization positions marked by the manufacturer on all axes, the so-called mechanical zero positions, and
- the computer-aided zero adjustment procedure,

and is additionally supported by

- off-line programming, which can be carried out in advance and remotely from the robot, and
- the reproducible installation of the robot.

After service and maintenance work (on the wrist and motors, for example), it is necessary to establish coincidence between the electrical and mechanical zero positions (calibration) of the robot. A gauge cartridge is mounted by the manufacturer on each robot axis for this purpose.

These gauge cartridges are set by the manufacturer when the robot is calibrated prior to shipment. The fact that measurements on each axis are always made using the same cartridge means that maximum accuracy is achieved both when first calibrating the mechanical zero position and when subsequently relocating it.

The position of the mechanical probe fitted in the gage cartridge can be displayed by screwing an electronic probe (KTL mastering set), available as an accessory, onto the cartridge. The position sensing system is automatically set to electrical zero when the probe passes the reference notch during the adjustment procedure.

The robot can resume operation once the zero adjustment has been carried out on all axes.

The procedures described make it possible for the programs, once defined, to be transferred at any time to any other robot of the same type.

1.5 Transportation

There are two methods of transporting the robots (Fig. 1-9):

With lifting tackle and crane

- The robots can be suspended from the hook of a crane by means of lifting tackle attached to three eyebolts on the rotating column.
- **Only approved lifting tackle with an adequate carrying capacity may be used for transporting a robot by crane. The ropes or belts of the lifting tackle must be positioned so that there is no possibility of the robot tilting to the side and of cabling or connectors being damaged.**

With fork lift truck

- For transport by fork lift truck, two fork slots (accessory) must be installed on the rotating column.
- For installation on the ceiling, the robot is delivered inverted in a special transport frame. Already in the correct orientation, it can be taken out of this frame by fork lift truck and transported to the site of installation.
- A special fork slot accessory is available for transporting wall-mounted robots.
- **No lifting tackle may be used when transporting the robot in conjunction with a fork lift truck.**

The robot must be moved into its **transport position** each time it is transported. All of the robot’s axes are moved to defined positions using the KCP (Fig. 1-10, 1-11, 1-12).

Dimensions for packing the robots in a container (with fork slots):

Robot type	L (mm)	W (mm)	H (mm)
KR 6	1115	1030	1075
KR 16	1184	1030	1078
KR 16 L6	1416	1030	1075
KR 16 S	1184	1030	1078

2 ACCESSORIES (selection)

The robot KR 16 EX may only be used with the appropriate accessories offered and approved by KUKA for this purpose. See Section 3.1 for operation conditions.

2.1 Robot installation

There are two variants available for installing the robot:

- with mounting base kit (Fig. 1-3)
- with machine frame mounting kit (Fig. 1-4)

See Section 1.3 for a description.

2.2 Additional linear axis

With the aid of a linear unit as an additional traversing axis, based on the KL 250/2 series (Fig. 2-1), the robot can be moved translationally. The axis is freely programmable.

2.3 Integrated energy supply for axis 1 to axis 3

Various energy supply systems are available, e.g. for the application “handling”. From the connector panel, the necessary supply lines run inside the base frame and then externally along the rotating column and link arm to an interface on the arm (Fig. 2-2).

From here, additional supply lines can be routed externally along the arm to an appropriate interface on the end effector. This eliminates the need for a space-consuming supply boom.

2.4 Working range monitoring

Axes 1 and 2 can be equipped with position switches and slotted rings to which adjustable cams are attached. This allows the position of the robot to be continuously monitored.

With “EX” variant robots, the use of working range monitoring is not permitted.

2.5 Working range limitation

The movement ranges of axes 1 to 3 can be limited by means of additional mechanical stops as required by the application, adjustable in 22.5° steps.

2.6 KTL mastering set

The zero adjustment operation, which is necessary for all axes, can be performed with the aid of the electronic probe which comes as part of a KTL mastering set (Fig. 3-5, 3-7). This probe provides a particularly fast and simple means of measurement and allows automatic, computer-aided mastering. It should be ordered along with the robot.

2.7 Belt tension measuring device for in-line wrist

Equipped with a microcontroller, the fully electronic measuring device enables the pretension set in the toothed belt to be easily and reliably measured by means of frequency measurement (Fig. 2-4).

2.8 Release device for robot axes

This device can be used to move the axes of the robot mechanically via the main axis drive motors after a malfunction. It is only for use in emergencies (e.g. for freeing personnel).

3 TECHNICAL DATA

Types: KR 6, KR 16, KR 16 L6, KR 16 S

Variants: KR 16 F, KR 16 CR, KR 16 EX

Number of axes: 6 (Fig. 1-2)

Load limits

Robot type	KR 6	KR 16 KR 16 S	KR 16 L6
In-line wrist	IW 6	IW 16	IW 6
Rated payload [kg]	6	16	6
Suppl. load, arm [kg]	10	10	10
Suppl. load, link arm [kg]	variable	variable	variable
Suppl. load, rotating column [kg]	20	20	20
Max. total distributed load [kg]	36	46	36

see also Fig. 3-1

The relationship between the payload and its center of gravity may be noted from Figures 3-2 and 3-3.

Axis data

The axes and their possible motions are depicted in Fig. 1-2. Axes 1 to 3 are the main axes, axes 4 to 6 the wrist axes.

All specifications in the “Range of motion” column refer to the electrical zero position and to the display on the KCP for the robot axis concerned.

KR 6 with IW 6

Axis	Range of motion software-limited	Speed
1	±185°	156°/s
2	+35° to -155°	156°/s
3	+154° to -130°	156°/s
4	±350°	343°/s
5	±130°	362°/s
6	±350°	659°/s

KR 16 with IW 16, IW 16 F, IW 16 CR

Axis	Range of motion software-limited	Speed
1	±185°	156°/s
2	+35° to -155°	156°/s
3	+154° to -130°	156°/s
4	±350°	330°/s
5	±130°	330°/s
6	±350°	615°/s

KR 16 L6 with IW 6

Axis	Range of motion software-limited	Speed
1	±185°	156°/s
2	+35° to -155°	156°/s
3	+154° to -130°	156°/s
4	±350°	335°/s
5	±130°	355°/s
6	±350°	647°/s

KR 16 EX with IW 16 F

Axis	Range of motion software-limited	Speed
1	±145°	156°/s
2	+35° to -155°	156°/s
3	+154° to -130°	156°/s
4	±350°	330°/s
5	±130°	330°/s
6	±350°	615°/s

KR 16 S with IW 16

Axis	Range of motion software-limited	Speed
1	±185°	192°/s
2	+35° to -155°	173°/s
3	+154° to -130°	192°/s
4	±350°	329°/s
5	±130°	332°/s
6	±350°	789°/s

Repeatability

±0.05 mm

Mounting position

KR 16 S: Floor or ceiling

KR 16 CR Floor
All other types: Floor, wall or ceiling
(permissible angle of A 1 see Fig. 1–6)

Ambient temperature

- During operation:
  278 K to 328 K (+5 °C to +55 °C)
  In the temperature range from 278 K (+5 °C) to 283 K (+10 °C), the robot must be warmed up before normal operation.
  Caution: special operating conditions apply to KR 16 EX (see Section 3.1).
- During operation with SafeRDC:
  278 K bis 323 K (+5 °C bis +50 °C)
- During storage and transportation:
  233 K to 333 K (–40 °C to +60 °C)

Other temperature limits available on request.

Principal dimensions and working envelope

see Fig. 3-8, 3-9, 3-10

Weight

KR 6	approx. 235 kg
KR 16	approx. 235 kg
KR 16 L6	approx. 240 kg
KR 16 S	approx. 235 kg

Volume of working envelope

The reference point is the intersection of axes 4 and 5.

KR 6	14.5 m^3
KR 16	14.5 m^3
KR 16 L6	24.0 m^3
KR 16 S	14.5 m^3

Load center of gravity P

Robot type	Horizontal distance Lz (mm)	Vertical distance Lxy (mm)
KR 6	120	100
KR 16	150	120
KR 16 L6	120	100
KR 16 S	150	120

These values are valid for all rated payloads (Fig. 3-2, 3-3).

Principal dynamic loads

see Fig. 1-7 and Fig. 1-8

Mounting flange on axis 6

The robots are fitted with a DIN/ISO mounting flange (Fig. 3-4, 3-6):

KR 6	DIN/ISO 9409-1-A40
KR 16	DIN/ISO 9409-1-A50
KR 16 L6	DIN/ISO 9409-1-A40
KR 16 S	DIN/ISO 9409-1-A50

Screw grade for attaching end effector 10.9
Grip length min. 1.5 x d
Depth of engagement min. 6 mm
max. 9 mm

NOTE: The flange is depicted with all axes of the robot, particularly axis 6, in the zero position (the symbol ⧫ indicates the position of the locating element).

Zero adjustment

For zero adjustment with the electronic probe (accessory) when the tool is mounted, the latter must be designed to allow sufficient space for installation and removal of the probe (Fig. 3-5, 3-7).

Drive system

Electromechanical, with transistor-controlled AC servomotors.

Installed motor capacity 8.8 kW

Protection classification of the robot

IP65 (according to EN 60529), ready for operation, with connecting cables plugged in

Protection classification of the in-line wrists "Standard" and "CR"

IP65 (according to EN 60529)

Protection classification of in-line wrist "F"

IP67 (according to EN 60529)

Loading of in-line wrist "F"

Thermal loading 10 s/min. at 453 K (180 °C)
Surface temperature 373 K (100 °C)
Resistant to:
- high ambient dust content
- lubricants and coolants
- steam

Special features for the "F" and "EX" variants

Pressurized arm

Overpressure in arm:	0.1 bar
Compressed air:	free of oil and water
Air consumption:	approx. 0.1 m^3/h
Threaded union:	M5
Pressure reducer:	0.1 - 0.7 bar
Pressure gauge:	0 - 1 bar
Filter:	25 - 30 μm

Standard paint finish

KR 6, KR 16, KR 16 L6, KR 16 S:

Robot and wrist	orange (RAL 2003)
Cover A 1	black (RAL 9005)

Special paint finishes

KR 16 F with IW 16 F:

Robot	orange (RAL 2003)
Wrist	silver (heat-resistant, heat-reflecting special paint finish)
Cover A 1	black (RAL 9005)

KR 16 EX with IW 16 F:

Robot	orange (RAL 2003)
Wrist	orange (RAL 2003)
Cover A 1	uncoated stainless steel

KR 16 CR with IW 16 CR:

Robot	white (RAL 9016)
Wrist	white (RAL 9016)

Additional special paint finish on request

Cover A 1	uncoated stainless steel

Sound level

<75 dB (A) outside the working envelope

3.1 Operating conditions for KR 16 EX

The robot KR 16 EX conforms to the explosion protection classification: CE Ex II 3G EEx c,nA IIB T3 X

Meaning of this designation:

CE mark: Refers here exclusively to compliance with the ATEX guidelines.

EX mark: Symbol for prevention of explosions according to 94/4/EC.

II: Device group II specifies that the device can be used for all areas (except underground).

3: ATEX category: in category 3, potentially explosive gases are present only occasionally or for short times (<10h/year). Devices of category 3 are required for operation in explosion protection zone 2.

G: The explosion protection applies to explosive gases and vapors, not to dust.

EEx: The device is explosion-proof equipment corresponding to valid EN norms.

c,nA: Specifies the safety concepts / types of protection used to fulfill the explosion protection criteria.

IIB: Explosion class, specifies how high the ignition hazard of the gases may be.

T3: Temperature class; the surface temperature is under 200°C.

X: Special conditions must be observed for operation of the device.

The decision as to whether a given environment for the operation of the robot is to be classified as potentially explosive must be made by the system integrator or system user.

During planning and operation of the robot in a potentially explosive environment, the following points must be observed for this protection classification:

- Maximum ambient temperature: 40 °C.
- Minimum length of connecting cables: 7.00 m.
- The arm must be pressurized during robot operation.
- All unplugged connectors must be sealed.
- The explosion protection classification covers only the robot arm, not the control cabinet or KCP.
- Software limit switches must be programmed so that the robot comes to a standstill before it hits the mechanical stops (standard and supplementary stops).
- Equipment and accessories, such as energy supply systems, must be approved by KUKA or have a corresponding declaration of conformity.
- The explosion protection suitability of the tool mounted on the robot is the responsibility of the system integrator or system user.
- The robot may be used under potentially explosive conditions for normal operation only. Normal operation is not:
  - Maintenance and repair
  - EMT mastering
  - Programming and testing
  - EMERGENCY STOP runs
  - Operator safety
- I^2T monitoring and the machine data must not be altered.
- Shorter maintenance intervals apply to the robot.

3.2 Operation conditions for KR 16 CR

Rated for up to 40% of maximum speed:
DIN EN ISO 14644-1, Class 4
(approximately corresponding to US Fed. Std. 209E, class 10)

Rated for up to 100% of maximum speed:
DIN EN ISO 14644-1, Class 5
(approximately corresponding to US Fed. Std. 209E, class 100)

Deutsch Seite 3
English page 11
Français page 19

Table des matières

1 Description du système 19
1.1 Généralités 19
1.2 Ensemble mécanique du robot . . 20
1.3 Mise en place 20
1.4 Echange 21
1.5 Transport 21

2 Accessoires (sélection) 22
2.1 Fixation du robot 22
2.2 Axe linéaire supplémentaire 22
2.3 Alimentation en énergie intégrée pour les axes 1 à 3 22
2.4 Surveillance de l'enveloppe d'évolution 22
2.5 Limitation de l'enveloppe d'évolution 22
2.6 Set de réglage KTL 22
2.7 Dispositif de mesure de la courroie crantée pour poignet en ligne 22
2.8 Dispositif de libération des axes de robot 22

3 Caractéristiques techniques . . . 23
3.1 Conditions d'exploitation pour KR 16 EX 26

Figures 27-46

1 DESCRIPTION DU SYSTÈME

1.1 Généralités

Les robots KR 6, KR 16, KR 16 L6 et KR 16 S sont des robots industriels à six axes à cinématique articulée (Figure 1-1), pouvant être mis en œuvre pour toutes les tâches avec positionnement point par point et en continu (contournage).

Les principaux domaines de mise en œuvre des robots KR 6, KR 16 et KR 16 L6 sont:
- la manutention
- le montage
- l'application de colles, de produits d'étanchéification et de produits de conservation
- l'usinage

Les principaux domaines de mise en œuvre du robot KR 16 S sont:
- la manutention
- le montage
- l'application de colles, de produits d'étanchéification et de produits de conservation
- l'usinage
- le soudage MIG/MAG
- le soudage au rayon laser YAG

Il existe en outre d'autres variantes:
- KR 16 F pour l'utilisation avec des sollicitations thermiques ou mécaniques importantes.
- KR 16 EX pour l'utilisation dans un environnement soumis à des risques d'explosion.
- KR 16 CR pour l'utilisation dans un environnement de salle blanche.

Le robot KR 16 CR est monté sur le sol.

Le robot KR 16 S est monté sur le sol ou au plafond.

Tous les autres robots décrits peuvent être montés au sol, au mur ou au plafond.
Les charges nominales et les charges supplémentaires peuvent également être déplacées à la vitesse maxi et avec la portée maxi du bras (voir paragraphe 3 "Caractéristiques techniques").
Tous les carters des sous-ensembles principaux mobiles sont en fonte d'alliage léger. Ce concept a encore été optimisé avec la CFAO et la méthode des éléments finis quant aux critères suivants: construction rentable légère et résistance importante à la torsion ainsi qu'à la flexion. Il en résulte donc une fréquence propre très importante du robot caractérisé ainsi par un excellent comportement dynamique avec une haute résistance aux vibrations.
Les articulations, les joints et les mécanismes de transmission sont caractérisés par un mouvement pratiquement sans jeu. Toutes les pièces mobiles sont recouvertes. Tous les moteurs d'entraînement sont des servomoteurs AC sans balais enfichables ne nécessitant aucune maintenance et protégés d'une manière fiable contre la surcharge.
Les axes majeurs sont lubrifiés à vie, c.à.d. qu'une vidange d'huile est nécessaire après 20.000 heures de service au plus tôt.
Tous les composants du robot ont été conçus sciemment d'une manière simple et claire. Leur nombre a été minimisé. Tous les composants sont aisément accessibles. Le robot pourra également être échangé rapidement en tant qu'unité complète sans que ceci suppose une correction importante du programme. Des basculements sont également possibles.

Ce point ainsi que de nombreux autres détails constructifs confèrent au robot une fiabilité et une rapidité très importantes ainsi qu'une très grande facilité de maintenance. L'encombrement nécessité est très faible. Vue la géométrie

particulière des superstructures, les robots peuvent être montés à proximité de la pièce. A l'instar des robots industriels éprouvés des autres séries KUKA, la durée de vie moyenne s'élève à 10–15 ans.

Chaque robot est doté d'une commande. Les électroniques de commande et de puissance sont intégrées dans une armoire de commande commune (voir spécification spéciale). Cette commande a un encombrement réduit, présente une grande simplicité de maintenance et autorise une conduite aisée du système. Le niveau de sécurité répond à la Directive Machines CE et aux normes en vigueur (entre autres DIN EN 775).

Les câbles de liaison entre le robot et l'armoire de commande contiennent toutes les lignes d'alimentation et de signaux nécessaires à cet effet. Elles sont enfichables sur le robot. Ceci s'applique également aux câbles d'énergie et des fluides pour l'exploitation des outils (accessoire "Alimentation en énergie intégrée pour les axes 1 à 3"). Dans la zone de l'axe majeur 1 , ces câbles et ces flexibles sont fixés et posés à l'intérieur du robot. En cas de besoin, ces câbles et ces flexibles peuvent être posés jusqu'à l'outil le long des axes secondaires en travaillant avec des interfaces système.

1.2 Ensemble mécanique du robot

Les robot sont formés d'une embase fixe sur laquelle tourne autour d'un axe vertical le bâti de rotation qui supporte l'épaule, le bras et le poignet (fig. 1-1).

La bride de fixation du poignet (fig. 1-5) permet de monter les outils (par exemple préhenseurs, appareils de soudage).

La figure 1-2 représente les mouvements possibles des axes du robot.

La mesure de la distance pour les axes majeurs et les axes du poignet (A 1 à A 3, A 4 à A 6) se fera par un système de mesure cycliquement absolu de la distance avec un résolveur pour chaque axe.

L'entraînement se fera par des servomoteurs AC commandés par transistors et à faible inertie. Le frein et le résolveur sont intégrés d'une façon peu encombrante dans les unités actionneurs.

L'enveloppe d'évolution du robot est limitée dans tous les axes par des fins de course logiciels. L'enveloppe d'évolution des axes 1, 2, 3 et 5 est limitée mécaniquement par des butées avec fonction tampon.

Des butées mécaniques pour une limitation de l'enveloppe d'évolution en fonction du cas d'application sont disponibles comme accessoire "Limitation de l'enveloppe d'évolution" pour les axes 1 à 3.

Pour des applications particulières, on dispose de variantes spéciales de robot avec un poignet en ligne adapté:

- KR 16 F avec PL 16 F en cas de sollicitations thermiques et mécaniques importantes.
- KR 16 EX avec PL 16 F pour l'utilisation dans un environnement soumis à des risques d'explosion.
- KR 16 CR avec PL 16 CR pour l'utilisation dans un environnement de chambre stérile.

Le poignet en ligne "F" (PL 16 F) est caractérisé par une meilleure étanchéité et des pièces plus résistantes à la corrosion. Pour conserver la fiabilité, il faut par contre respecter les intervalles de maintenance plus courts.

Dans le cas des robots du type "F" et "EX", le bras est sous pression. Il fonctionne avec une pression interne de 0,1 bar.

Dans le cas des robots de la "variante CR", l'air comprimé n'est pas nécessaire.

Dans un environnement de salle blanche, on travaille avec le variante KR 16 CR. D'importantes modifications ont permis de réduire sensiblement l'émission de particules par rapport à la version standard. En outre, le robot est équipé de pièces résistant à la corrosion.

1.3 Mise en place

Il existe plusieurs possibilités pour la mise en place du robot:

- **Variante 1 (seulement pour robots montés au sol)**

  Cette variante est fournie avec des plaques de fondation, des vis à tête hexagonale avec des rondelles-frein comme accessoire "Fixation aux fondations avec centrage".
  Trois plaques de fondation sont fixées au robot avec respectivement une vis à tête hexagonale (fig. 1-3). Le robot est posé de manière horizontale sur le sol de la halle préalablement préparé. Sa position de montage est définie par six trous de chevilles dans lesquels se trouvent respectivement une cartouche de mortier et une barre filetée. Ceci permet une répétabilité de l'échange du robot. Le robot est ensuite fixé avec des vis à tête hexagonale.

Si le robot doit être monté sur le sol, et ce directement sur le béton, la préparation des fondations en béton doit s'effectuer en respectant les directives de construction en vigueur en ce qui concerne la qualité du béton (≥ B25 selon DIN 1045:1988 ou C20/25 selon DIN EN 206-1:2001/DIN 1045-2:2001) et en

observant la capacité du sol. Lors de l'exécution des fondations, veiller à obtenir une surface de niveau suffisamment plane et lisse.
La fixation des chevilles collantes doit se faire avec une minutie extrême pour que les forces engendrées lors de l'exploitation du robot (fig. 1-7) soient fiablement introduites dans le sol. Ces figures peuvent également être exploitées pour des études statiques plus poussées.

- **Variante 2**

  Cette variante avec des boulons d'appui de et des vis est fournie comme accessoire "Kit de fixation à l'embase de machine".
  Le robot est posé sur une construction en acier préparée pour être vissé avec trois vis à tête hexagonale (fig. 1-4). Sa position de montage est définie par deux pieds de centrage pour permettre ainsi une répétabilité de l'échange.

1.4 Echange

Dans le cas des installations de production comprenant un certain nombre de robots, il faut garantir que l'échange des robots entre eux ne pose aucun problème.

Ceci est obtenu de la manière suivante:

- reproductibilité des positions de synchronisation repérées à l'usine pour tous les axes, c.à.d. de la position zéro mécanique, et
- calibration du point zéro assistée par ordinateur.

L'échange est en outre favorisé par:

- une programmation autonome ou offline pouvant non seulement se faire auparavant mais encore à distance du robot, et
- la mise en place reproductible du robot.

Les travaux de maintenance et de service après vente (entre autres poignet et moteurs) nécessitent que l'on obtienne la position zéro tant mécanique qu'électrique (calibration) du robot. A cette fin, les cartouches de mesure sont prévues départ usine pour chaque axe du robot.

Le réglage des cartouches de mesure fait partie des opérations de mesure qui précèdent la livraison du robot. Comme on mesure toujours avec la même cartouche à chaque axe, on obtient une précision maximale non seulement lors de la première mesure mais encore lors des recherches ultérieures de la position zéro mécanique.

Pour signaler la position du palpeur dans la cartouche, on visse comme accessoire un palpeur de mesure électronique (set de réglage KTL) sur la cartouche. Lorsqu'on passe ainsi par l'encoche de référence lors du réglage, le système de mesure est automatiquement réglé sur une position électrique zéro.

Le robot peut être remis en service après avoir réglé le point zéro pour tous les axes.

Grâce à ces opérations, les programmes déterminés ainsi peuvent à tout moment être transférés à n'importe quel autre robot du même type.

1.5 Transport

Les robots peuvent être transportés de deux manières (fig. 1-9):

Avec un dispositif de transport et une grue

- Les robots sont transportés avec le dispositif de transport accroché au crochet de la grue et aux trois vis à anneau du bâti de rotation.
- **Pour le transport du robot avec une grue, on ne peut travailler qu'avec des dispositifs de levage et de charge autorisés pour une charge suffisante. Les câbles ou bandes doivent être positionnés de façon à éviter de façon sûre un basculement du robot sur le côté et un endommagement des équipements ou des connecteurs.**

Avec chariot élévateur à fourches

- Pour le transport avec le chariot élévateur à fourches, il faudra monter sur le bâti de rotation deux poches (option) destinées à recevoir les fouches du chariot.
- Pour la fixation au plafond, le robot est livré accroché dans un dispositif de transport spécial. Il peut être retiré de ce dispositif avec un chariot élévateur à fourches déjà en position de montage correcte et transporté.
- Pour le transport d'un robot pour le montage au mur, une poche spéciale est à disposition.
- **Pour le transport du robot avec un chariot élévateur, il est interdit de travailler avec un dispositif de levage ou de charge.**

Avant chaque transport, le robot doit être amené en **position de transport**. A l'aide du KCP, tous les axes du robots sont amenés dans des positions définies (fig. 1-10, 1-11, 1-12).

Cotes pour l'emballage des robots dans le conteneur (avec poches pour fourches de chariot élévateur):

Type de robot	Lo. (mm)	La. (mm)	Ha. (mm)
KR 6	1115	1030	1075
KR 16	1184	1030	1078
KR 16 L6	1416	1030	1075
KR 16 S	1184	1030	1078

2 ACCESSOIRES (sélection)

Le robot KR 16 EX ne peut être utilisé qu'avec des accessoires proposés et homologués par KUKA. Voir les conditions d'exploitation dans le paragraphe 3.1.

2.1 Fixation du robot

La fixation du robot peut se faire selon deux variantes:

- avec kit de fixation aux fondations (fig. 1-3)
- avec kit de fixation à l'embase de machine (fig. 1-4)

Description voir paragraphe 1.3.

2.2 Axe linéaire supplémentaire

A l'aide d'une unité linéaire comme axe de déplacement supplémentaire sur la base de la série KL 250/2 (fig. 2-1), le robot peut faire l'objet d'une translation et être librement programmable.

2.3 Alimentation en énergie intégrée pour les axes 1 à 3

Diverses alimentations en énergie sont disponibles, entre autres pour l'application "Manutention". Les câbles et les flexibles correspondants sont posés dans l'embase et à l'extérieur sur le bâti de rotation et l'épaule, du panneau de raccordement jusqu'à une interface au bras (fig. 2-2).

Des câbles et flexibles supplémentaires peuvent être ensuite posés à l'extérieur sur le bras jusqu'à une interface correspondante de l'outil. La potence d'alimentation très encombrante est donc inutile.

2.4 Surveillance de l'enveloppe d'évolution

Les axes 1 à 2 peuvent être équipés de commutateurs de positionnement et d'anneaux à encoches sur lesquels des cames réglables sont fixées. Ceci permet la surveillance permanente de la position du robot.

Dans le cas des robots du type "EX", aucune surveillance de l'enveloppe d'évolution n'est autorisée.

2.5 Limitation de l'enveloppe d'évolution

Les plages de déplacement des axes 1 à 3 peuvent être limitées en fonction du cas d'application avec des butées mécaniques supplémentaires, réglables par pas de 22,5°.

2.6 Set de réglage KTL

Afin de réaliser un réglage du point zéro nécessaire pour tous les axes, on peut utiliser un palpeur de mesure électronique (fig. 3-5, 3-7) qui fait partie du set de réglage KTL. Le palpeur de mesure électronique autorise un mesurage particulièrement simple et rapide ainsi qu'un réglage automatique assisté par ordinateur. Il devrait être commandé avec le robot.

2.7 Dispositif de mesure de la courroie crantée pour poignet en ligne

Le dispositif de mesure entièrement électronique doté d'un microcontrôleur permet la mesure simple et rapide des tensions de la courroie crantée par une mesure de la fréquence (fig. 2-4).

2.8 Dispositif de libération des axes du robot

Ce dispositif permet, après une panne, de déplacer mécaniquement le robot via les moteurs d'entrainement des axes majeurs. Ce dispositif ne peut être utilisé qu'en cas d'urgence (par ex. pour dégager des personnes).

3 CARACTÉRISTIQUES TECHNIQUES

Types de construction: KR 6, KR 16, KR 16 L6, KR 16 S

Variantes: KR 16 F, KR 16 CR, KR 16 EX

Nombre d'axes 6 (fig. 1-2)

Charges admissibles

Type de robot	KR 6	KR 16 KR 16 S	KR 16 L6
Poignet en ligne	PL 6	PL 16	PL 6
Charge nominale admissible [kg]	6	16	6
Charge suppl. bras [kg]	10	10	10
Charge suppl. épaule [kg]	variable	variable	variable
Charge suppl. bâti de rotation [kg]	20	20	20
Charge totale max. [kg]	36	46	36

voir également fig. 3-1

Les figures 3-2 et 3-3 fournissent la relation entre la charge admissible et le centre de gravité de la charge.

Caractéristiques des axes

La figure 1-2 fournit une représentation des axes ainsi que des mouvements que ceux-ci sont en mesure d'effectuer. Les axes majeurs sont les axes 1 à 3 et les axes du poignet sont les axes mineurs 4 à 6.

Toutes les informations de la colonne "Plage de mouvements" se rapportent à la position zéro électrique et à l'affichage au KCP de l'axe en question du robot.

KR 6 avec PL 6

Axe	Plage de mouvements limitation logicielle	Vitesse
1	±185°	156°/s
2	+35° à -155°	156°/s
3	+154° à -130°	156°/s
4	±350°	343°/s
5	±130°	362°/s
6	±350°	659°/s

KR 16 avec PL 16, PL 16 F, PL 16 CR

Axe	Plage de mouvements limitation logicielle	Vitesse
1	±185°	156°/s
2	+35° à -155°	156°/s
3	+154° à -130°	156°/s
4	±350°	330°/s
5	±130°	330°/s
6	±350°	615°/s

KR 16 L6 avec PL 6

Axe	Plage de mouvements limitation logicielle	Vitesse
1	±185°	156°/s
2	+35° à -155°	156°/s
3	+154° à -130°	156°/s
4	±350°	335°/s
5	±130°	355°/s
6	±350°	647°/s

KR 16 EX avec PL 16 F

Axe	Plage de mouvements limitation logicielle	Vitesse
1	±145°	156°/s
2	+35° à -155°	156°/s
3	+154° à -130°	156°/s
4	±350°	330°/s
5	±130°	330°/s
6	±350°	615°/s

KR 16 S avec PL 16

Axe	Plage de mouvements limitation logicielle	Vitesse
1	±185°	192°/s
2	+35° à -155°	173°/s
3	+154° à -130°	192°/s
4	±350°	329°/s
5	±130°	332°/s
6	±350°	789°/s

Répétabilité

±0,05 mm

Position de montage

KR 16 S: Sol ou plafond

KR 16 CR Sol
Tous les autres types: Sol, mur ou plafond
(Angle d'inclinaison autorisé A 1 voir fig. 1–6)

Température ambiante

- En service:
  278 K à 328 K (+5 °C à +55 °C)
  dans la plage de température entre 278 K (+5 °C) et 283 K (+10 °C), il est indispensable de réchauffer le robot en le faisant marcher.
  Attention:
  Conditions d'exploitation particulières pour KR 16 EX (voir paragraphe 3.1).
- En service avec SafeRDW:
  278 K bis 323 K (+5 °C bis +50 °C)
- Pour stockage et transport:
  233 K à 333 K (–40 °C à +60 °C)

Autres limites de température sur demande.

Dimensions principales et enveloppe d'évolution

voir fig. 3–8, 3–9, 3–10

Poids

KR 6	env. 235 kg
KR 16	env. 235 kg
KR 16 L6	env. 240 kg
KR 16 S	env. 235 kg

Volume de travail

Le point de référence est ce faisant le point d'intersection des axes 4 et 5.

KR 6	14,5 m^3
KR 16	14,5 m^3
KR 16 L6	24,0 m^3
KR 16 S	14,5 m^3

Centre de gravité charge P

Type de robot	Ecart horizontal Lz (mm)	Ecart vertical Lxy (mm)
KR 6	120	100
KR 16	150	120
KR 16 L6	120	100
KR 16 S	150	120

Ces indications sont valables pour toutes les charges nominales (fig. 3–2, 3–3)

Sollicitations dynamiques principales

voir fig. 1–7 et 1–8

Bride de fixation à l'axe 6

Les robots sont dotés d'une bride de fixation de type DIN/ISO (fig. 3-4, 3-6)

KR 6	DIN/ISO 9409-1-A40
KR 16	DIN/ISO 9409-1-A50
KR 16 L6	DIN/ISO 9409-1-A40
KR 16 S	DIN/ISO 9409-1-A50

Qualité des vis pour le montage des outils 10.9
Longueur de serrage min. 1,5 x d
Longueur vissée min. 6 mm
max. 9 mm

REMARQUE: La figure de la bride correspond à la position zéro du robot sur tous les axes et notamment sur l'axe 6 (le symbole ⧫ montre la position de l'élément d'adaptation).

Réglage du point zéro

Pour le réglage de point zéro avec le palpeur de mesure électronique (accessoire) quand l'outil est monté, celui-ci doit être configuré de façon à laisser suffisamment de place pour le montage et le démontage du palpeur de mesure (fig. 3-5, 3-7).

Système d'entraînement

électromécanique avec servomoteurs AC commandés par transistors

Puissance moteur installée 8,8 kW

Mode de protection du robot

IP65 (selon EN 60529), opérationnel, avec câbles de liaison connectés

Mode de protection du poignet en ligne "Standard", "CR"

IP65 (selon EN 60529)

Mode de protection du poignet en ligne "F"

IP67 (selon EN 60529)

Capacité de charge poignet en ligne "F"

Sollicitation en température 10 s/min à 453 K (180 °C)
Température superficielle 373 (100 °C)

Résistance contre:
- poussières importantes
- lubrifiants et réfrigérants
- vapeur d'eau

Equipement spécial pour types "F" et "EX"

Bras sous pression
Surpression dans le bras: 0,1 bar
Air comprimé: sans teneur en huile et eau
Consommation air comprimé: env. 0,1 m^3/h
Filet raccord: M5
Détendeur: 0,1 - 0,7 bar
Manomètre: 0 - 1 bar
Filtre: 25 - 30 μm

Laque standard

KR 6, KR 16, KR 16 L6, KR 16 S:
Robot et poignet orange (RAL 2003)
Recouvrement A 1 noir (RAL 9005)

Laque spéciale

KR 16 F avec PL 16 F:
Robot orange (RAL 2003)
Poignet argent (peinture spéciale argent résistant aux températures et reflétant la chaleur)
Recouvrement A 1 noir (RAL 9005)

KR 16 EX avec PL 16 F:
Robot orange (RAL 2003)
Poignet orange (RAL 2003)
Recouvrement A 1 acier spécial nu

KR 16 CR avec PL 16 CR:
Robot blanc (RAL 9016)
Poignet blanc (RAL 9016)
Peinture spéciale à la demande du client
Recouvrement A 1 acier spécial nu

Niveau sonore

< 75 dB (A) à l'extérieur du volume de travail

3.1 Conditions d'exploitation pour KR 16 EX

Le robot KR 16 EX a la classe de protection EX:

CE Ex II 3G EEx c,nA IB T3 X

Signification de cette identification:

Symbole CE: Se rapporte dans ce cas exclusivement au respect de la directive ATEX.

Symbole EX: Symbole pour la prévention des explosions conformément à 94/4/CE.

II: Groupe d'appareils II: précise que cet appareil peut être utilisé pour tous les domaines (sauf dans les mines).

3: Catégorie ATEX: les gaz pouvant donner lieu à une explosion ne sont que rarement ou brièvement présents dans cette catégorie 3. (<10h/an). Les appareils de la catégorie 3 sont nécessaires pour une application dans les zones antidéflagrantes 2.

G: La protection anti-déflagrante se rapporte à des gaz et vapeurs pouvant exploser et non pas à des poussières.

EEx: Cet appareil est un moyen d'exploitation antidéflagrant répondant aux normes européennes en vigueur.

c,nA: Précise les concepts / modes de protection permettant de remplir les critères de protection contre les explosions.

IIB: Groupe d'explosion: précise le risque d'allumage ou d'inflammation autorisé pour les gaz.

T3: Classe de température, la température superficielle est de moins de 200˚C.

X: Il faut observer des conditions d'exploitation spéciales pour l'utilisation de l'appareil.

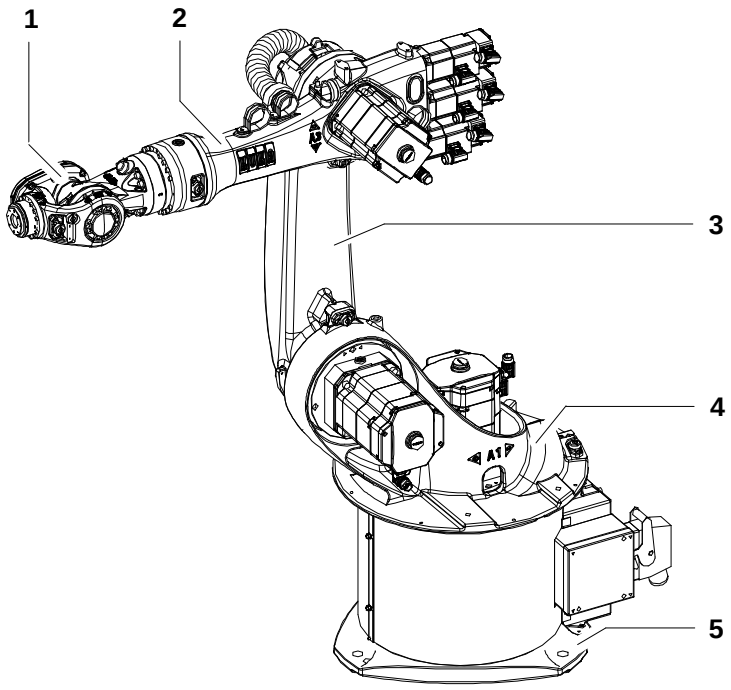
Le fabricant ou l'exploitant de l'installation est tenu – en premier lieu – de prendre la décision si l'environnement prévu pour l'exploitation du robot est soumis à un risque d'explosion ou non.

Les points suivants doivent être respectés pour cette classe de protection dans le cadre de l'étude et de l'application du robot dans un environnement soumis à un risque d'explosion:

- Température ambiante maximum: 40 ˚C.
- Longueur minimum des câbles de liaison: 7,00 m.
- La pressurisation du bras doit être activée lorsque le robot est en service.
- Tous les connecteurs mâles-femelles ouverts doivent être fermés de manière étanche.
- La classe de protection EX se rapporte uniquement à l'ensemble mécanique du robot, pas à l'armoire de commande ou au KCP.
- Les fins de courses logiciels doivent être programmés de manière à ce que le robot s'arrête avant de toucher les butées mécaniques (butées standard et butées supplémentaires).
- Les pièces supplémentaires comme par ex. l'alimentation en énergie doivent être autorisées par KUKA ou être accompagnées d'une déclaration de conformité adéquate.
- Le fabricant ou l'exploitant de l'installation est responsable de la protection antidéflagrante des outils montés sur le robot.
- Dans un environnement soumis à des risques d'explosion, le robot ne peut être exploité qu'en service normal. Le service normal n'est pas:
  - Les modes de maintenance et de réparation
  - La calibration PAL
  - Les modes de programmation et de test
  - La course d' ARRÊT D'URGENCE
  - La protection opérateur
- Interdiction de modifier les paramètres machines et la surveillance I^2T.
- Le robot a des intervalles de maintenances relativement courts.

3.2 Conditions d'exploitation pour KR 16 CR

Gradation jusqu'à 40% de la vitesse maximum :
DIN EN ISO 14644-1, classe 4
(correspond à peu près à US Fed. Std. 209E, classe 10)
Gradation jusqu'à 100% de la vitesse maximum :
DIN EN ISO 14644-1, classe 5
(correspond à peu près à US Fed. Std. 209E, classe 100)

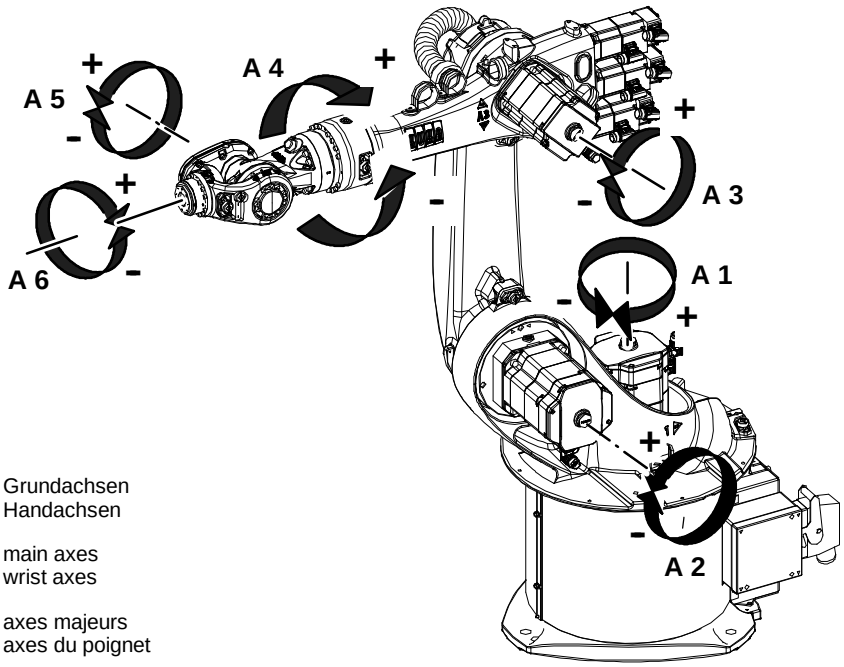


1 Hand
2 Arm
3 Schwinge
4 Karussell
5 Grundgestell

1 Wrist
2 Arm
3 Link arm
4 Rotating column
5 Base frame

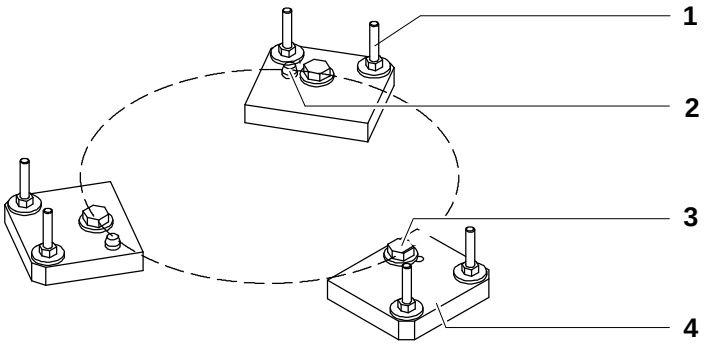
1 Poignet
2 Bras
3 Epaule
4 Bâti de rotation
5 Embase

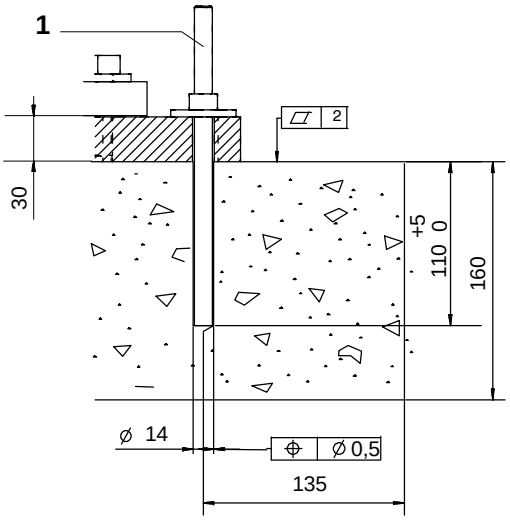
1-1 Hauptbestandteile des Roboters (alle beschriebenen Typen)
Principal components of the robot (all types described)
Sous-ensembles principaux du robot (tous les types décrits)

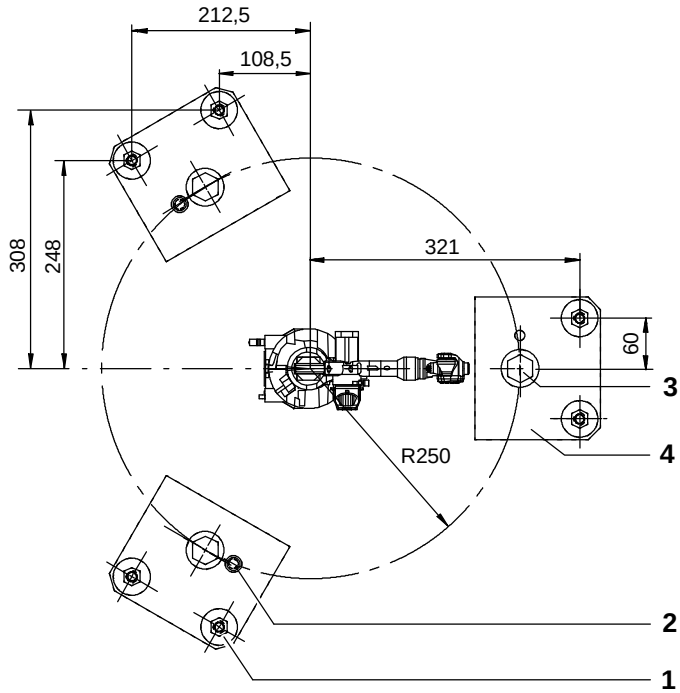


Achsen 1 bis 3	Grundachsen
Achsen 4 bis 6	Handachsen
Axes 1 to 3	main axes
Axes 4 to 6	wrist axes
Axes 1 à 3	axes majeurs
Axes 4 à 6	axes du poignet

1-2 Drehachsen und Drehsinn beim Verfahren des Roboters (alle beschriebenen Typen)
Rotational axes and directions of rotation in motion of the robot (all types described)
Axes de rotation et sens de rotation lors du déplacement du robot (tous les types décrits)

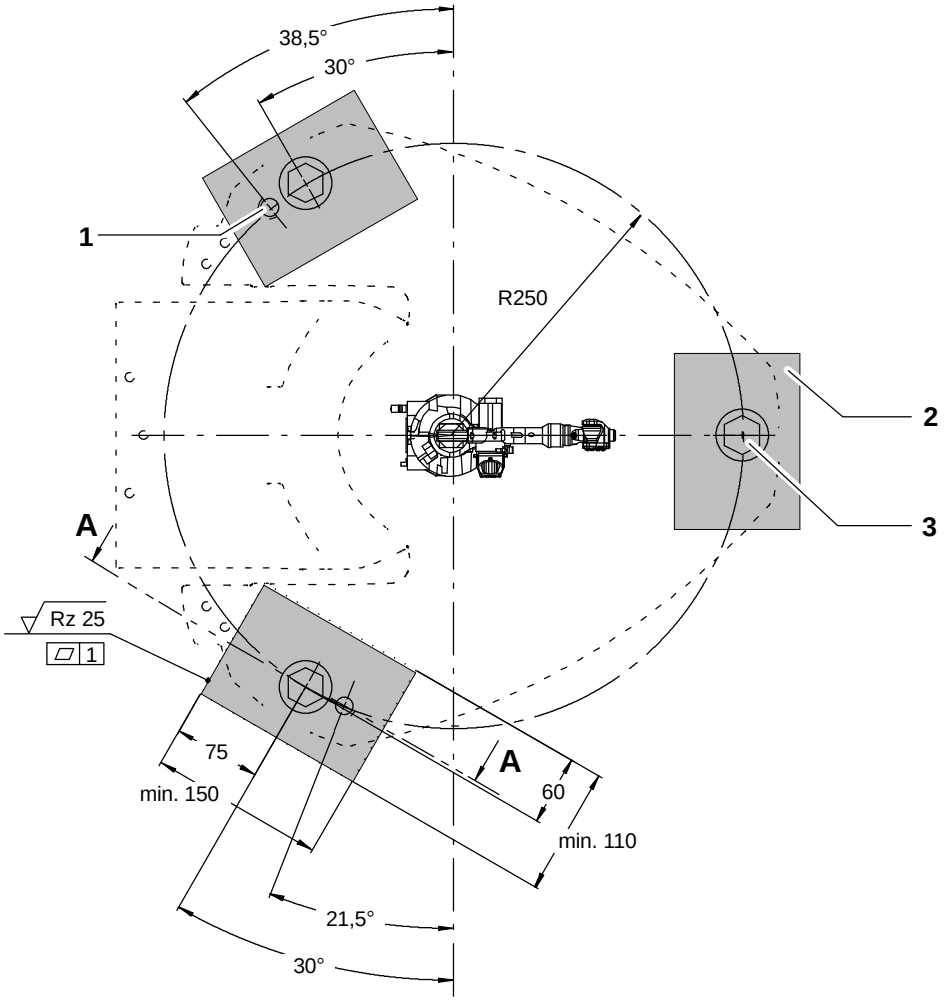




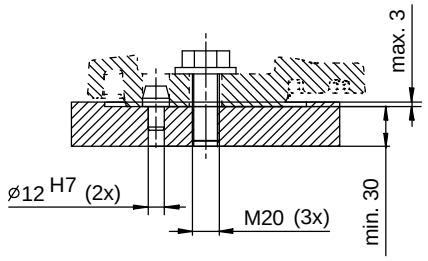


1 Gewindestange	1 Threaded rod	1 Barre filetée
2 Auflagebolzen 2x	2 Locating pin 2x	2 Pied de centrage 2x
3 Sechskantschraube 3x ISO 4017 M20 x 55-8.8	3 Hexagon bolt 3x ISO 4017 M20 x 55-8.8	3 Vis à tête hexagonale 3x ISO 4017 M20 x 55-8.8
4 Fundamentplatte	4 Bedplate	4 Plaque de fondations

1-3 Roboterbefestigung, Variante 1 (Fundamentbefestigung mit Zentrierung) - nur Bodenroboter
Installation of the robot, variant 1 (mounting base with centering) - floor-mounted robots only
Fixation du robot, variante 1 (fixation aux fondations avec centrage) - seulement montage au sol

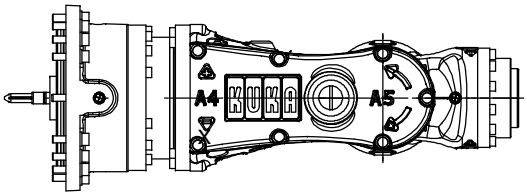


Schnitt A-A
Section A-A
Coupe A-A

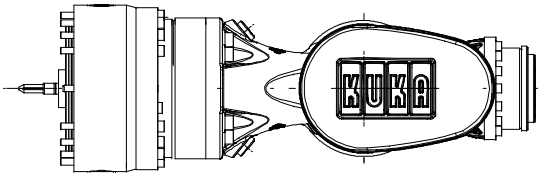


1 Auflagebolzen 2x	1 Locating pin 2x	1 Pied de centrage 2x
2 Auflagefläche	2 Mounting surface	2 Surface de montage
3 Sechskantschraube 3x ISO 4017 M20 x 55-8.8	3 Hexagon bolt 3x ISO 4017 M20 x 55-8.8	3 Vis à tête hexagonale 3x ISO 4017 M20 x 55-8.8

1-4 Roboterbefestigung, Variante 2 (Maschinengestellbefestigungssatz)
Installation of the robot, variant 2 (machine frame mounting kit)
Fixation du robot, variante 2 (kit de fixation à l'embase de machine)



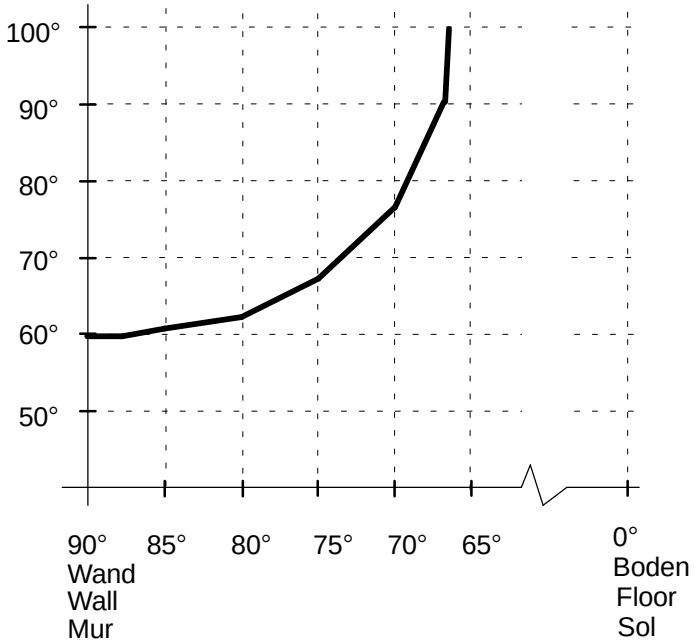
6 kg



16 kg

1-5 Zentralhand (ZH)
In-line wrist (IW)
Poignet en ligne (PL)

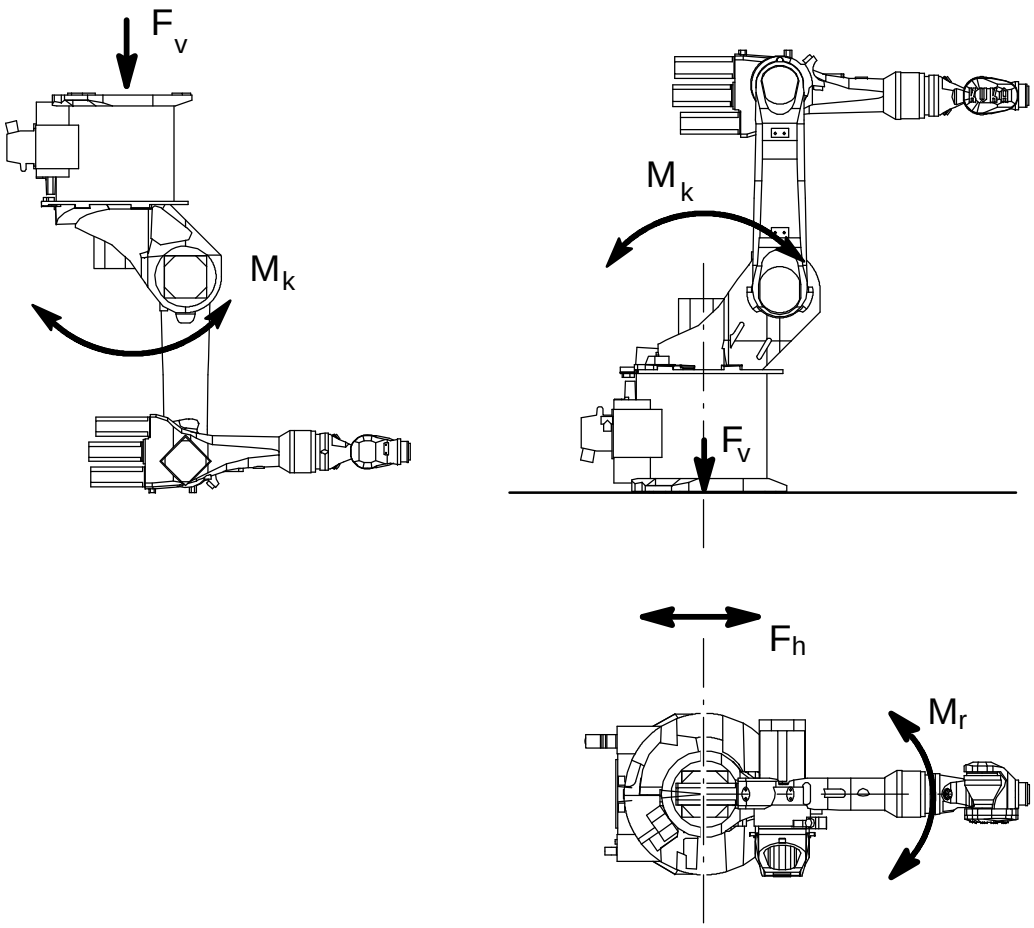
zulässiger Winkel Achse 1
permissible angle of axis 1
angle admissible axe 1



1-6 Einschränkung des Bewegungsbereichs Achse 1 in Abhängigkeit vom Aufstellwinkel (KR 6, KR 16, KR 16 L6, KR 16 S, KR 16 F, KR 16 EX)

Limitation of the range of motion of axis 1 as a function of the mounting angle (KR 6, KR 16, KR 16 L6, KR 16 S, KR 16 F, KR 16 EX)

Limitation de la plage de déplacement de l'axe 1 en fonction de l'angle de montage (KR 6, KR 16, KR 16 L6, KR 16 S, KR 16 F, KR 16 EX)



		KR 6 KR 16 KR 16 L6	KR 16 S
Vertikale Kraft / vertical force / force verticale	F_v	4 600 N	5 200 N
Horizontale Kraft / horizontal force / force horizontale	F_h	5 000 N	5 000 N
Kippmoment / tilting moment / moment de basculement	M_k	5 200 Nm	5 900 Nm
Drehmoment um Achse 1 / tilting moment about axis 1 moment de rotation autour de l'axe 1	M_r	4 200 Nm	4 800 Nm

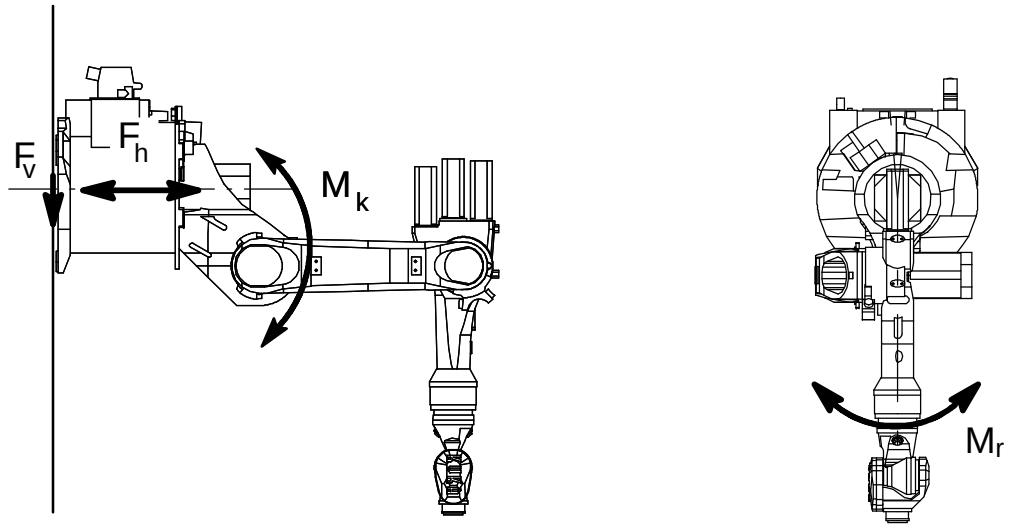
	KR 6	KR 16	KR 16 L6	KR 16 S
Masse Roboter / robot mass / masse robot	235 kg	235 kg	235 kg	235 kg
Gesamtlast / total load / charge totale	36 kg	46 kg	46 kg	46 kg
Gesamtmasse / total mass / masse totale	271 kg	281 kg	281 kg	281 kg

(Maximalwerte / maximum values / valeurs maximales)

1-7 Hauptbelastungen des Fundaments durch Roboter und Gesamtlast bei Boden- und Deckenrobotern

Principal loads acting on mounting base due to robot and total load for floor-mounted and ceiling-mounted robots

Sollicitations principales de la fondation par le robot et la charge totale pour robots de montage au sol et au plafond



Vertikale Kraft / vertical force / force verticale	F_v	4 600 N
Horizontale Kraft / horizontal force / force horizontale	F_h	3 600 N
Kippmoment / tilting moment / moment de basculement	M_k	4 700 Nm
Drehmoment um Achse 1 / tilting moment about axis 1 moment de rotation autour de l'axe 1	M_r	4 200 Nm

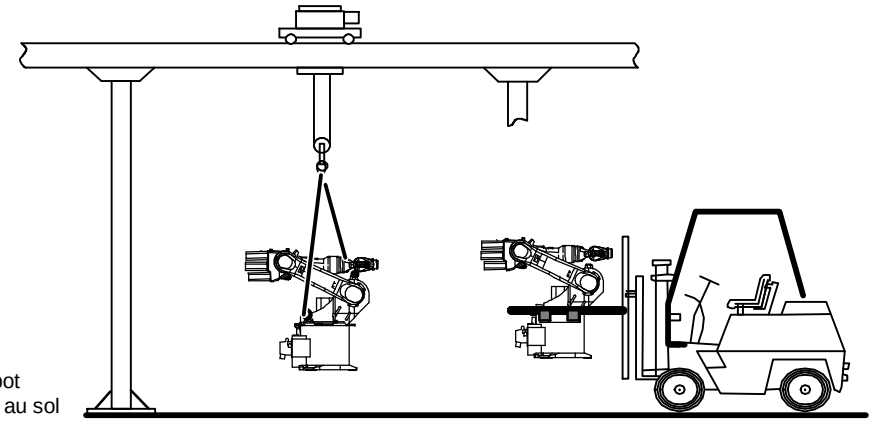
	KR 6	KR 16	KR 16 L6
Masse Roboter / robot mass / masse robot	235 kg	235 kg	240 kg
Gesamtlast / total load / charge totale	36 kg	46 kg	36 kg
Gesamtmasse / total mass / masse totale	271 kg	281 kg	276 kg

(Maximalwerte / maximum values / valeurs maximales)

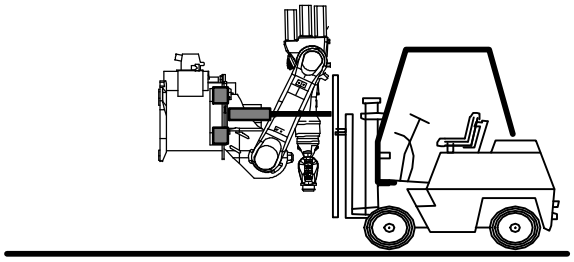
1-8 Hauptbelastungen des Fundaments durch Roboter und Gesamtlast bei Wandrobotern

Principal loads acting on mounting base due to robot and total load for wall-mounted robots

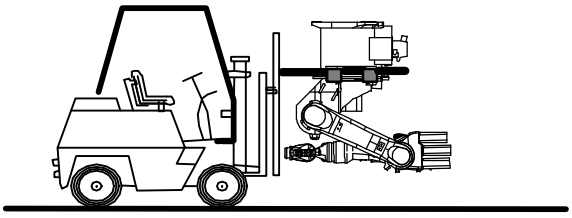
Sollicitations principales de la fondation par le robot et la charge totale pour robots de montage au mur



Bodenroboter
Floor-mounted robot
Robot de montage au sol

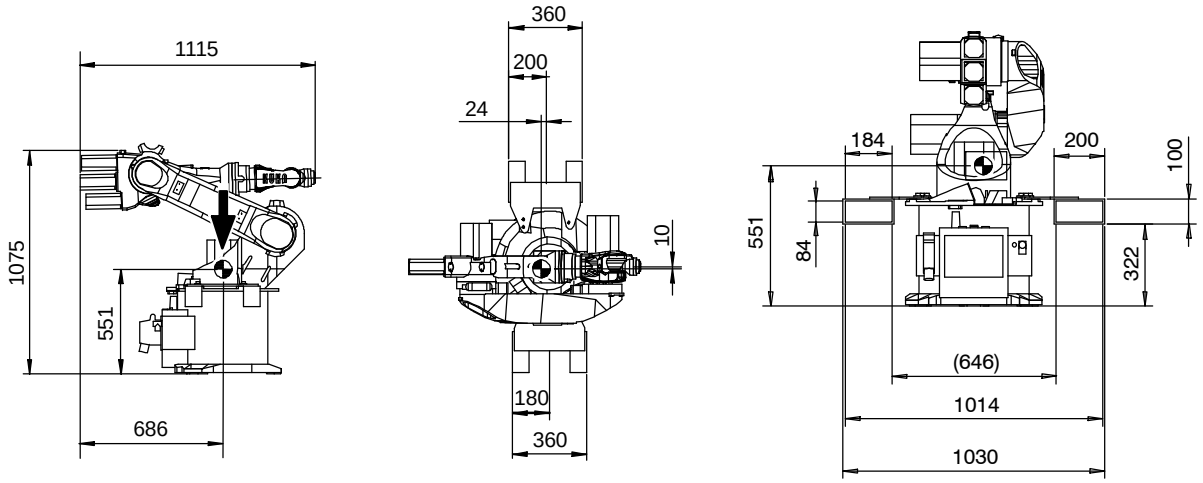


Wandroboter
Wall-mounted robot
Robot de montage au mur



Deckenroboter
Ceiling-mounted robot
Robot de montage au plafond

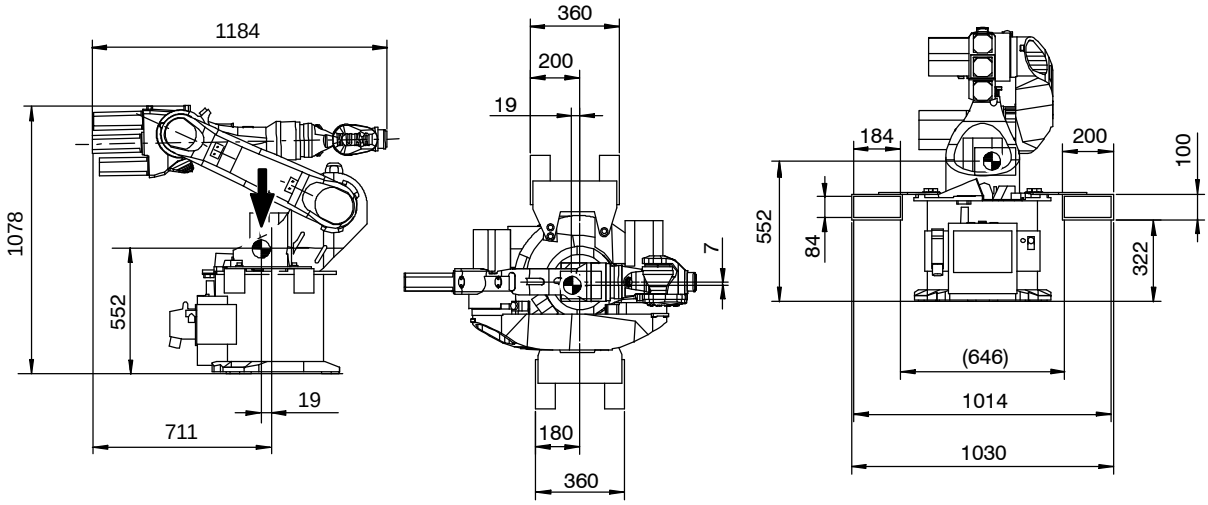
1-9 Transport des Roboters
Transporting the robot
Transport du robot



A 1	A 2	A 3	A 4	A 5	A 6
0°	-155°	+154°	0°	0°	0

Alle Winkelangaben beziehen sich auf die Anzeige am KCP
All angles refer to the display on the KCP
Tous les angles se rapportent à l'affichage au KCP

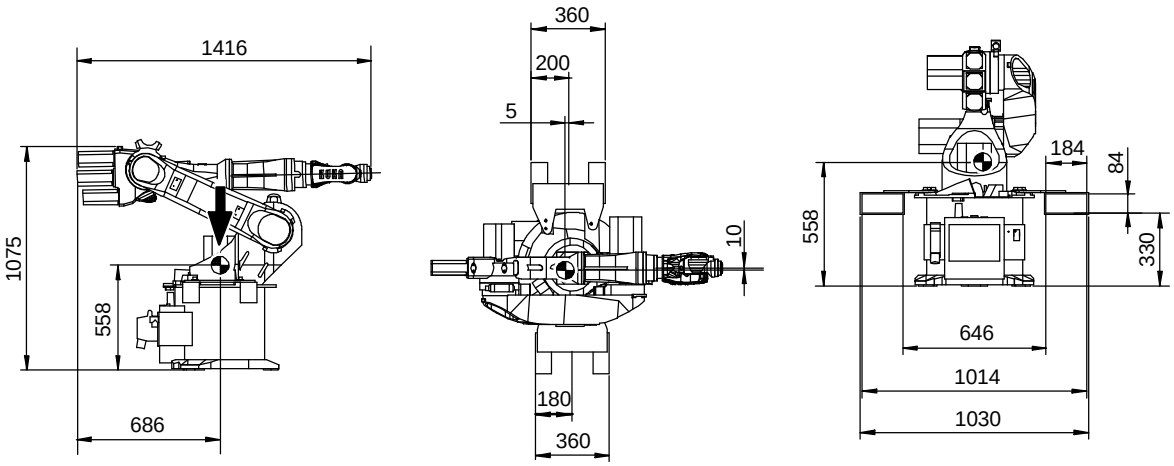
1-10 Abmessungen des Roboters KR 6 in Transportstellung
Dimensions of the robot KR 6 in transport position
Dimensions du robot KR 6 en position de transport



A 1	A 2	A 3	A 4	A 5	A 6
0°	-155°	+154°	0°	0°	0

Alle Winkelangaben beziehen sich auf die Anzeige am KCP
All angles refer to the display on the KCP
Tous les angles se rapportent à l'affichage au KCP

1-11 Abmessungen des Roboters KR 16 / KR 16 S in Transportstellung
Dimensions of the robot KR 16 / KR 16 S in transport position
Dimensions du robot KR 16 / KR 16 S en position de transport

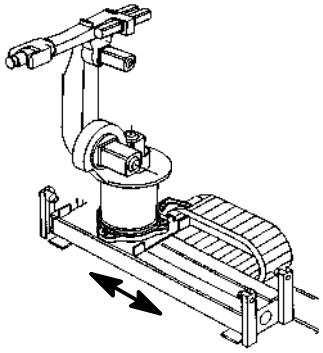


A 1	A 2	A 3	A 4	A 5	A 6
0°	-155°	+154°	0°	0°	0

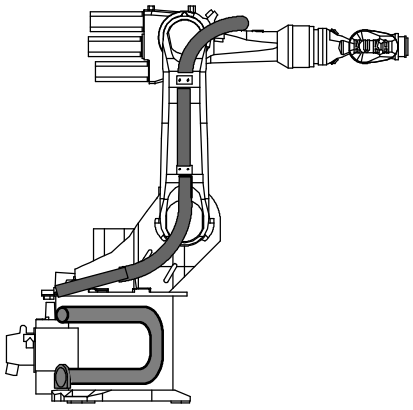
Alle Winkelangaben beziehen sich auf die Anzeige am KCP
All angles refer to the display on the KCP
Tous les angles se rapportent à l'affichage au KCP

1-12 Abmessungen des Roboters KR 16 L6 in Transportstellung
Dimensions of the robot KR 16 L6 in transport position
Dimensions du robot KR 16 L6 en position de transport

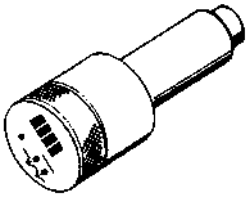
2-1 **Zusätzliche Linearachse**
Additional linear axis
Axe linéaire supplémentaire



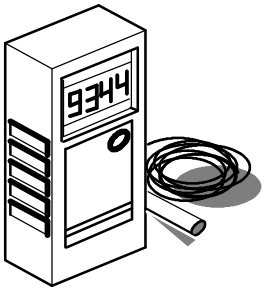
2-2 **Energiezuführung A1 - A 3, Handhaben**
Energy supply system A 1 to A 3, handling
Alimentation en énergie A 1 à A 3, manutention

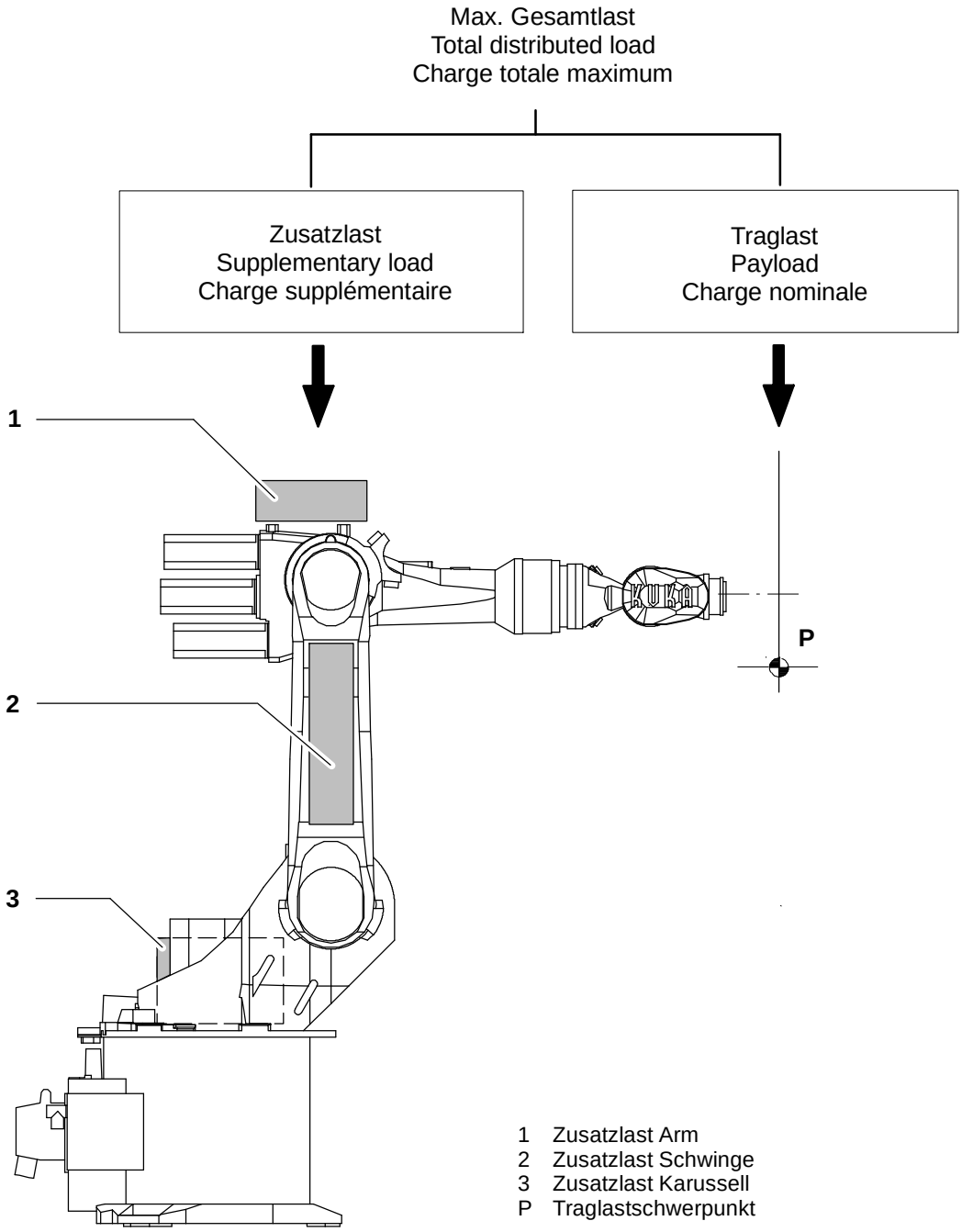


2-3 **Elektronischer Messtaster für KTL-Justage-Set**
Electronic probe for KTL mastering set
Palpeur de mesure électronique pour set de réglage KTL



2-4 **Zahnriemenspannungs-Messgerät für Zentralhand**
Belt tension measuring device for in-line wrist
Dispositif de mesure de la courroie crantée pour poignet en ligne





1 Zusatzlast Arm
2 Zusatzlast Schwinge
3 Zusatzlast Karussell
P Traglastschwerpunkt

1 Supplementary load on arm
2 Supplementary load on link arm
3 Supplementary load on rotating column
P Load center of gravity

1 Charge supplémentaire bras
2 Charge supplémentaire épaule
3 Charge supplémentaire bâti de rotation
P Centre de gravité de la charge

3-1 **Lastverteilung**
Distribution of the total load
Distribution de la charge

ACHTUNG: **Diese Belastungskurven und die Tabellenwerte entsprechen der äußersten Belastbarkeit! Ein Überschreiten geht in die Lebensdauer des Geräts ein, überlastet im allgemeinen Motoren und Getriebe und bedarf auf alle Fälle der Rücksprache mit KUKA.**

IMPORTANT: **These loading curves and the values in the table correspond to the maximum load capacity. Exceeding this capacity will reduce the service life of the robot and generally overload the motors and gears; in any such case KUKA must be consulted.**

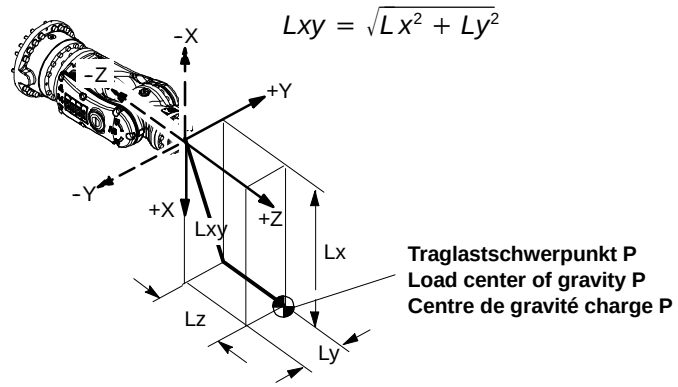
ATTENTION: **Les courbes de charge et les valeurs du tableau représentent la capacité de charge maximum! Un dépassement de cette capacité réduit la durée de vie du robot et, en règle générale, surcharge les moteurs ainsi que les engrenages et transmissions. Il faudra en tous cas consulter KUKA auparavant.**

HINWEIS: Die hier ermittelten Werte sind für die Robotereinsatzplanung notwendig. Für die Inbetriebnahme des Roboters sind gemäß KUKA-Softwaredokumentation zusätzliche Eingabedaten erforderlich.

NOTE: The values determined here are necessary for planning the robot application. For commissioning the robot, additional input data are required in accordance with the KUKA software documentation.

REMARQUE: Les valeurs ainsi déterminées sont indispensables pour définir le champ d'application du robot. Des données supplémentaires sont nécessaires pour la mise en service du robot conformément à la documentation du logiciel KUKA.

Roboterflansch-Koordinatensystem
Robot flange coordinate system
Système de coordonnées bride du robot



Traglastschwerpunkt P
Load center of gravity P
Centre de gravité charge P

Zulässige Massenträgheit im Auslegungspunkt (Lxy = 100 mm, Lz = 120 mm) 0,18 kgm^2.

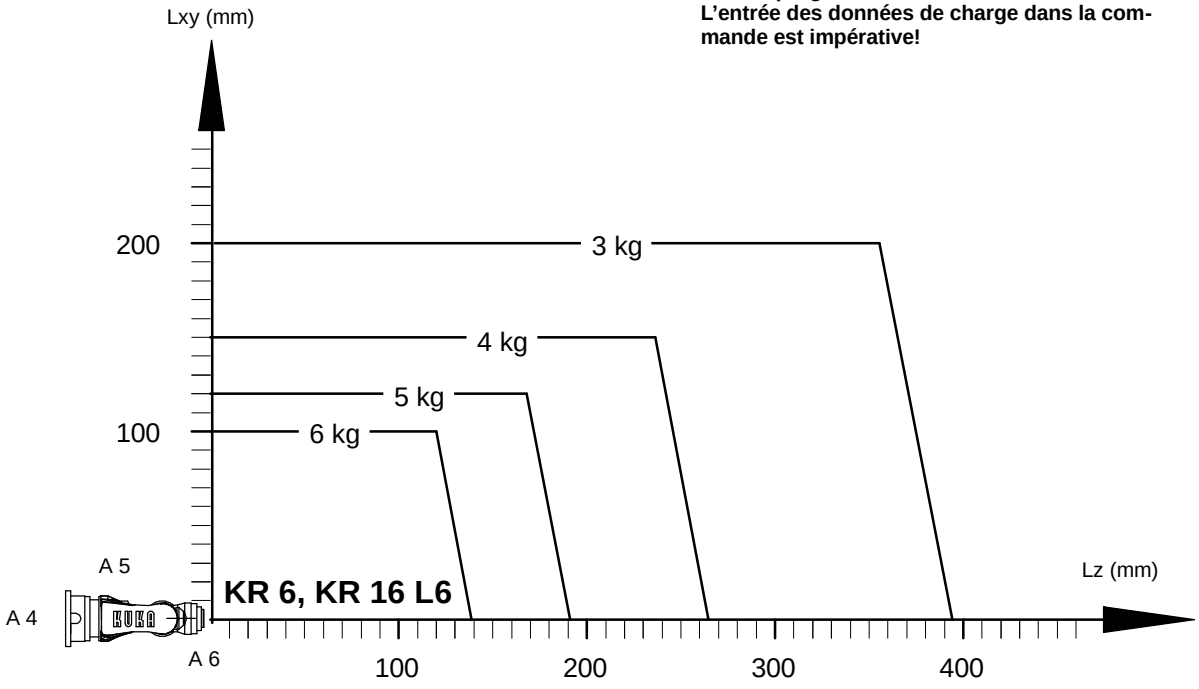
ACHTUNG: Die Massenträgheiten müssen mit dem Berechnungsprogramm KUKA Load überprüft werden. Die Eingabe der Lastdaten in die Steuerung ist unbedingt erforderlich!

Permissible mass inertia at the design point (Lxy = 100 mm, Lz = 120 mm) 0.18 kgm^2.

IMPORTANT: The mass inertia must be checked using the calculation program KUKA Load. It is imperative for the load data to be entered in the controller!

Inertie de masse autorisée au point de conception (Lxy = 100 mm, Lz = 120 mm) 0,18 kgm^2.

ATTENTION: Les inerties de masse sont à vérifier avec le programme de calculation KUKA Load. L'entrée des données de charge dans la commande est impérative!



3-2 **Traglastschwerpunkt P und Belastungskurven für KR 6 / KR 16 L6**
Load center of gravity P and loading curves for KR 6 / KR 16 L6
Centre de gravité de la charge P et courbes de charge pour KR 6 / KR 16 L6

ACHTUNG: **Diese Belastungskurven und die Tabellenwerte entsprechen der äußersten Belastbarkeit! Ein Überschreiten geht in die Lebensdauer des Geräts ein, überlastet im allgemeinen Motoren und Getriebe und bedarf auf alle Fälle der Rücksprache mit KUKA.**

IMPORTANT: **These loading curves and the values in the table correspond to the maximum load capacity. Exceeding this capacity will reduce the service life of the robot and generally overload the motors and gears; in any such case KUKA must be consulted.**

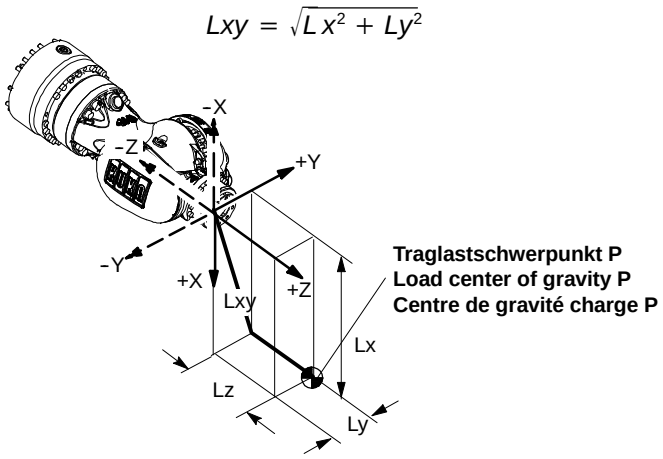
ATTENTION: **Les courbes de charge et les valeurs du tableau représentent la capacité de charge maximum! Un dépassement de cette capacité réduit la durée de vie du robot et, en règle générale, surcharge les moteurs ainsi que les engrenages et transmissions. Il faudra en tous cas consulter KUKA auparavant.**

HINWEIS: Die hier ermittelten Werte sind für die Robotereinsatzplanung notwendig. Für die Inbetriebnahme des Roboters sind gemäß KUKA-Softwaredokumentation zusätzliche Eingabedaten erforderlich.

NOTE: The values determined here are necessary for planning the robot application. For commissioning the robot, additional input data are required in accordance with the KUKA software documentation.

REMARQUE: Les valeurs ainsi déterminées sont indispensables pour définir le champ d'application du robot. Des données supplémentaires sont nécessaires pour la mise en service du robot conformément à la documentation du logiciel KUKA.

Roboterflansch-Koordinatensystem
Robot flange coordinate system
Système de coordonnées bride du robot



Traglastschwerpunkt P
Load center of gravity P
Centre de gravité charge P

Zulässige Massenträgheit im Auslegungspunkt (Lxy = 120 mm, Lz = 150 mm) 0,36 kgm^2.

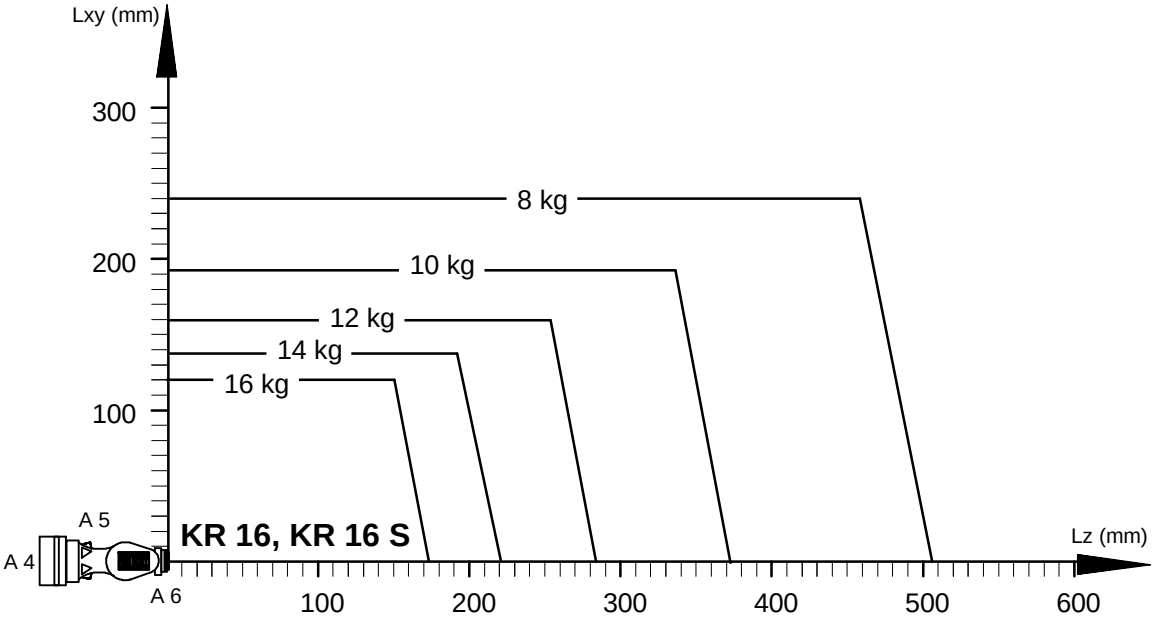
ACHTUNG: Die Massenträgheiten müssen mit dem Berechnungsprogramm KUKA Load überprüft werden. Die Eingabe der Lastdaten in die Steuerung ist unbedingt erforderlich!

Permissible mass inertia at the design point (Lxy = 120 mm, Lz = 150 mm) 0.36 kgm^2.

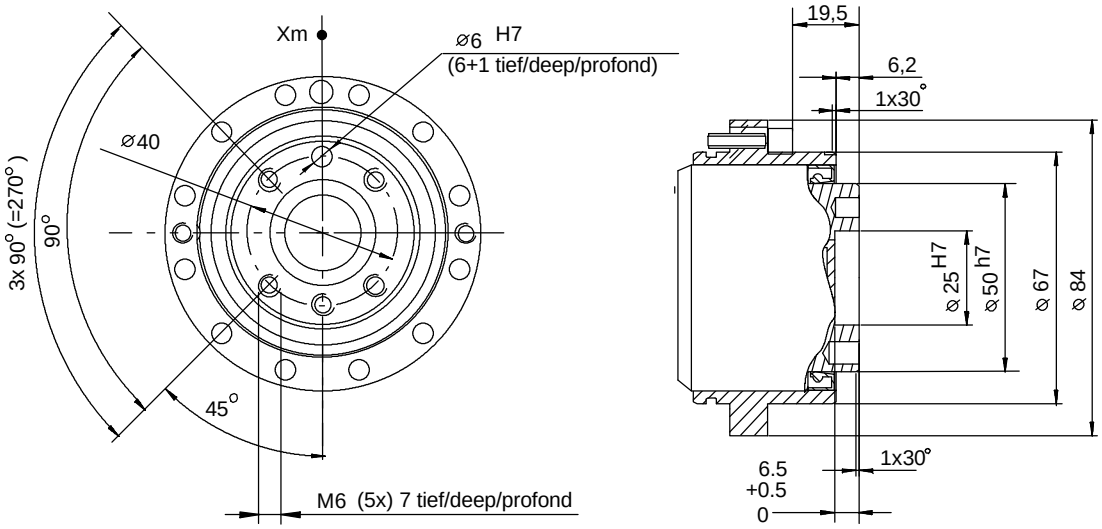
IMPORTANT: The mass inertia must be checked using the calculation program KUKA Load. It is imperative for the load data to be entered in the controller!

Inertie de masse autorisée au point de conception (Lxy = 120 mm, Lz = 150 mm) 0,36 kgm^2.

ATTENTION: Les inerties de masse sont à vérifier avec le programme de calculation KUKA Load. L'entrée des données de charge dans la commande est impérative!



3-3 Traglastschwerpunkt P und Belastungskurven für KR 16 / KR 16 S
Load center of gravity P and loading curves for KR 16 / KR 16 S
Centre de gravité de la charge P et courbes de charge pour KR 16 / KR 16 S

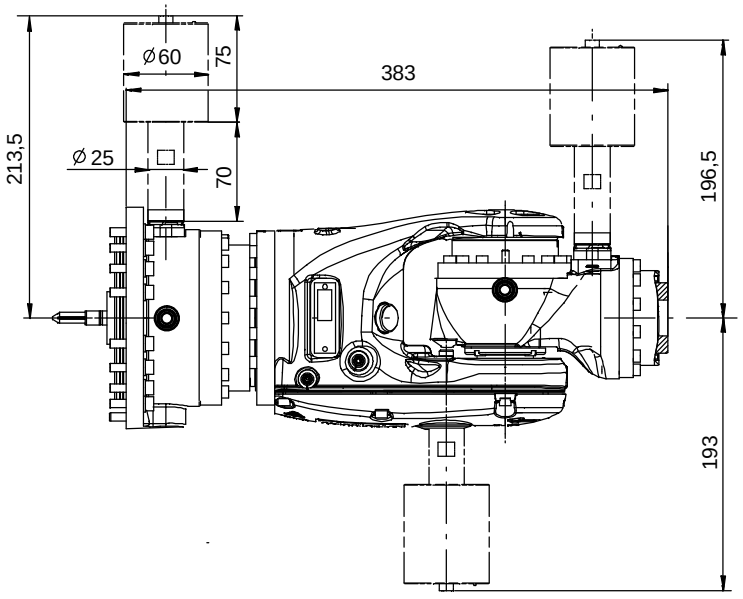


Befestigungsschrauben M6, Qualität 10.9
Einschraubtiefe: min. 6 mm, max. 9 mm

Fastening screws M6, quality 10.9
Depth of engagement: min. 6 mm, max. 9 mm

Vis de fixation M6, qualité 10.9
Longueur vissée: min. 6 mm, max. 9 mm

3-4 DIN/ISO-Anbauflansch für ZH 6 kg
DIN/ISO mounting flange for IW 6 kg
Bride de fixation DIN/ISO pour PL 6 kg



Für die Nullpunkt-Einstellung mit dem elektronischen Messtaster (siehe Abschnitt 2.6) **bei angebautem Werkzeug** muss dieses so gestaltet sein, dass genügend Platz für Ein- und Ausbau des Messtasters bleibt.

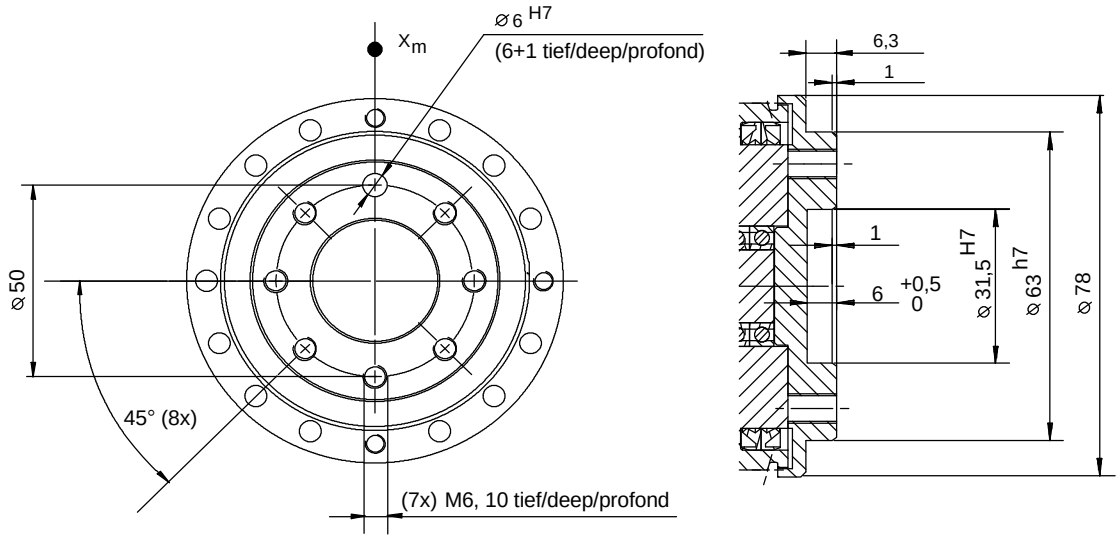
For zero adjustment with the electronic probe (see Section 2.6) **when the tool is mounted**, the latter must be designed to allow sufficient space for installation and removal of the probe.

Pour le réglage du point zéro avec le palpeur de mesure électronique (voir par. 2.6) **lorsque l'outil est monté,** il faut qu'il soit tel qu'on ait encore de la place suffisante pour le montage et le démontage du palpeur.

3-5 Elektronischer Messtaster, Anbau an A 4, A 5 und A 6 des KR 6 / KR 16 L6, bei mechanischer Null-Stellung der A 4 bis A 6

Electronic probe, installation on A 4, A 5 and A 6 of the KR 6 / KR 16 L6, in mechanical zero position of A 4 to A 6

Palpeur de mesure électronique, montage sur A 4, A 5 et A 6 du KR 6 / KR 16 L6, en position zéro mécanique de A 4 à A 6

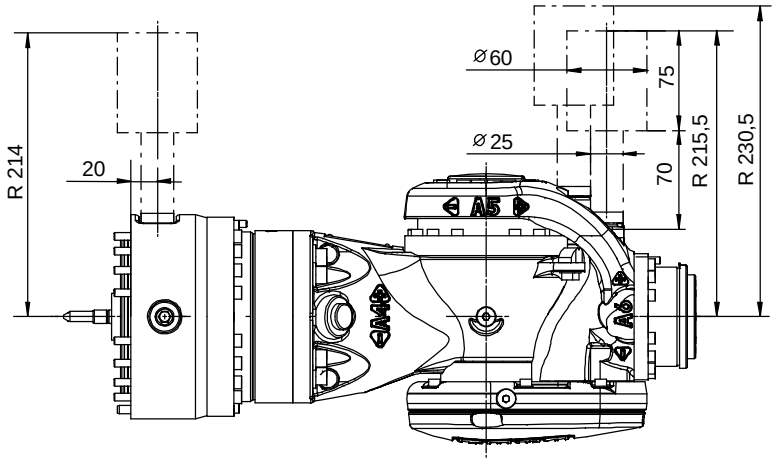


Befestigungsschrauben M6, Qualität 10.9
Einschraubtiefe: min. 6 mm, max. 9 mm

Fastening screws M6, quality 10.9
Depth of engagement: min. 6 mm, max. 9 mm

Vis de fixation M6, qualité 10.9
Longueur vissée: min. 6 mm, max. 9 mm

3-6 DIN/ISO-Anbauflansch für ZH 16 kg
DIN/ISO mounting flange for IW 16 kg
Bride de fixation DIN/ISO pour PL 16 kg



Für die Nullpunkt-Einstellung mit dem elektronischen Messtaster (siehe Abschnitt 2.6) **bei angebautem Werkzeug** muss dieses so gestaltet sein, dass genügend Platz für Ein- und Ausbau des Messtasters bleibt.

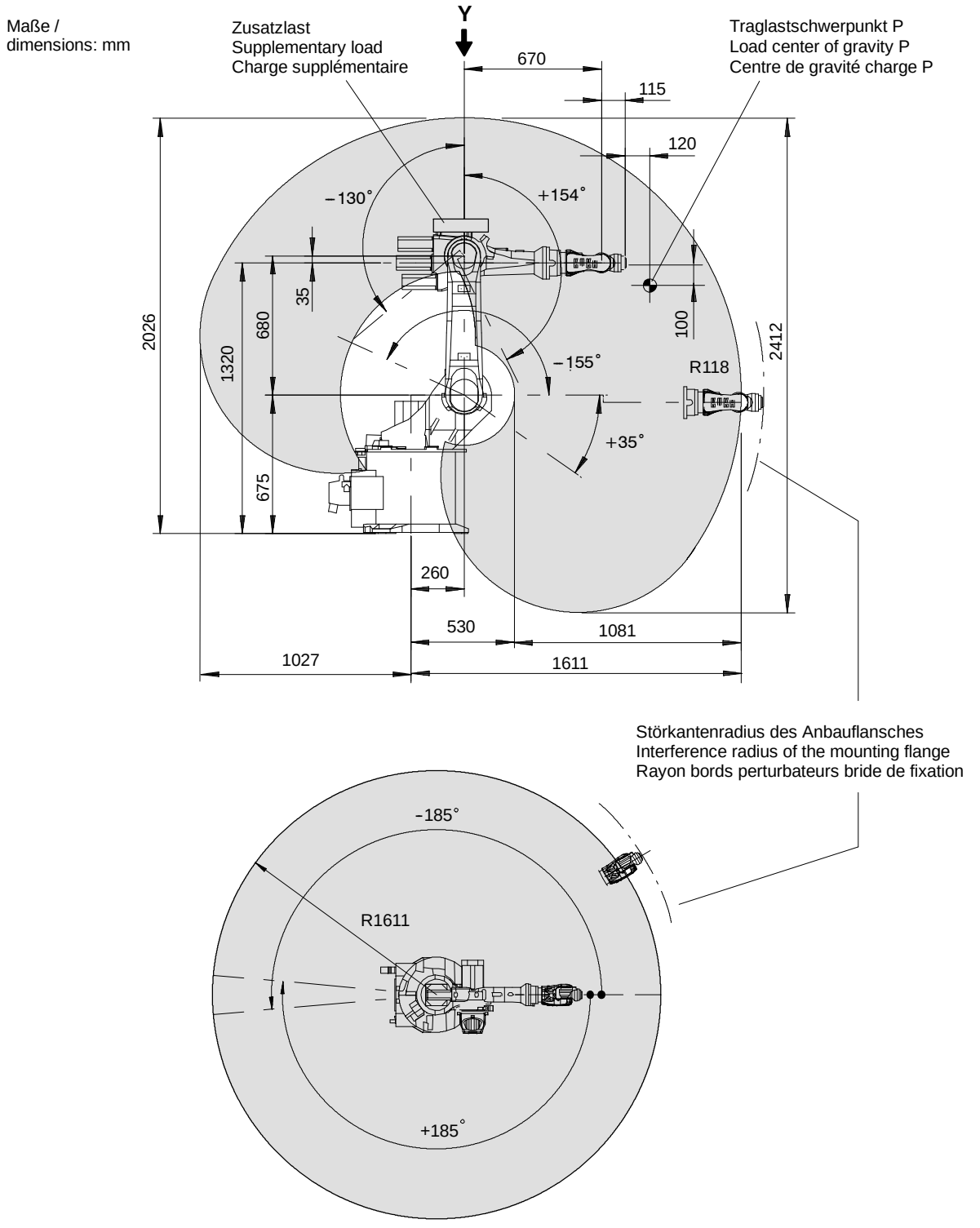
For zero adjustment with the electronic probe (see Section 2.6) **when the tool is mounted**, the latter must be designed to allow sufficient space for installation and removal of the probe.

Pour le réglage du point zéro avec le palpeur de mesure électronique (voir par. 2.6) **lorsque l'outil est monté,** il faut qu'il soit tel qu'on ait encore de la place suffisante pour le montage et le démontage du palpeur.

3-7 Elektronischer Messtaster, Anbau an A 4, A 5 und A 6 des KR 16 / KR 16 S bei mechanischer Null-Stellung der A 4 bis A 6

Electronic probe, installation on A 4, A 5 and A 6 of the KR 16 / KR 16 S in mechanical zero position of A 4 to A 6

Palpeur de mesure électronique, montage sur A 4, A 5 et A 6 du KR 16 / KR 16 S en position zéro mécanique de A 4 à A 6

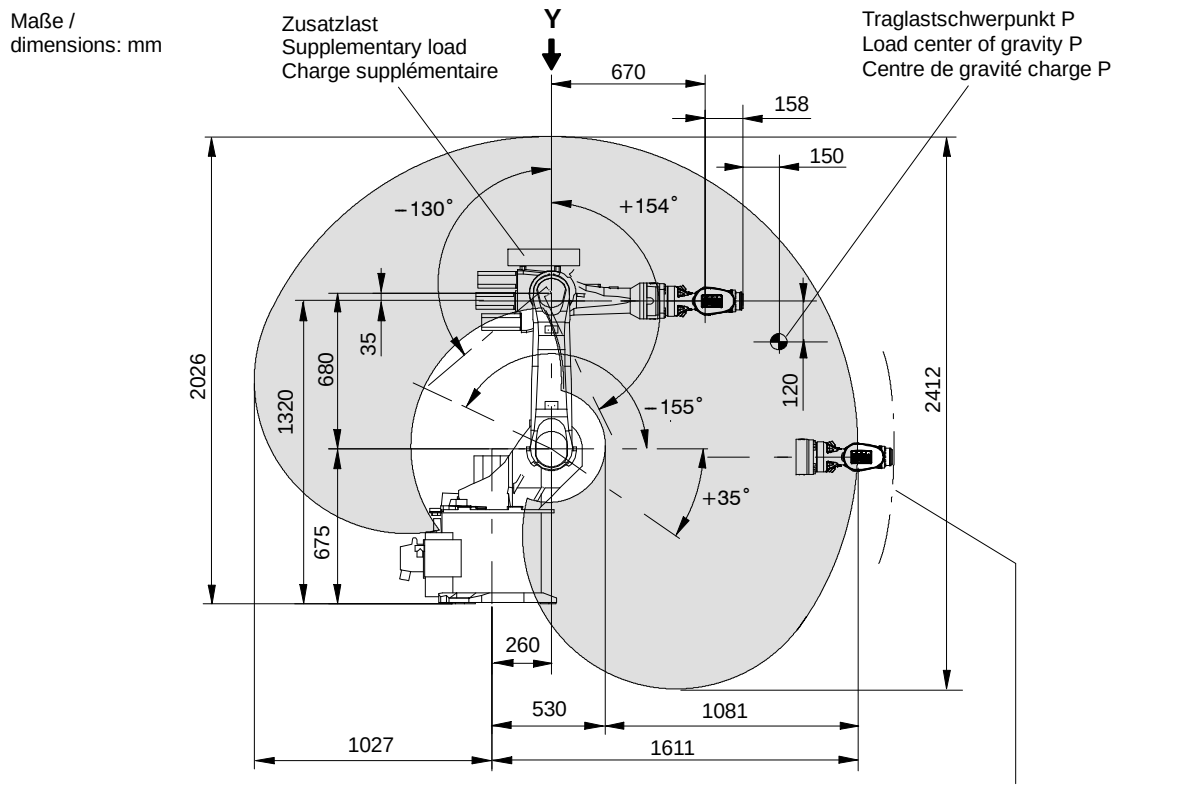


HINWEIS: Der Zusatzlast-Schwerpunkt muss so nahe wie möglich an der Drehachse 3 und an der Linie a in Bild 3-12 liegen. Bezugspunkt für den Arbeitsbereich ist der Schnittpunkt der Drehachsen 4 und 5. Ansicht Y siehe Bild 3-12.

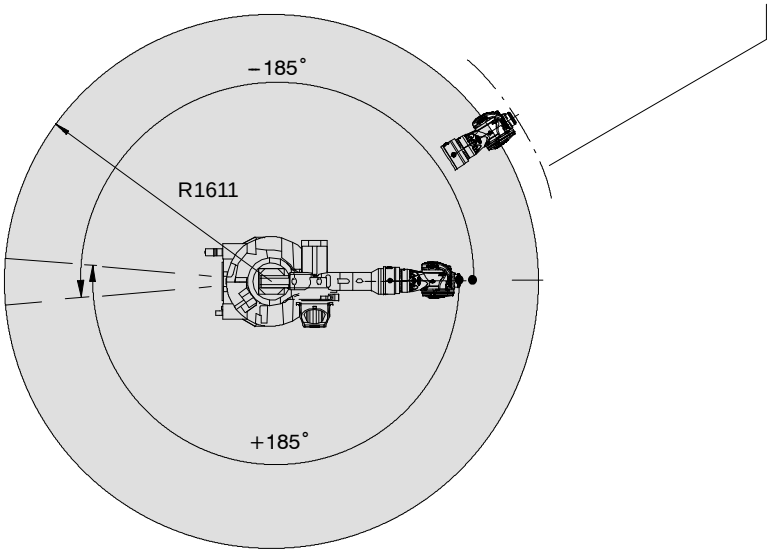
NOTE: The center of gravity of the supplementary load must be located as close as possible to rotational axis 3 and to line “a” in Figure 3-12. The reference point for the working envelope is the intersection of rotational axes 4 and 5. View Y see Figure 3-12.

REMARQUE: Le centre de gravité de la charge utile supplémentaire doit être aussi proche que possible de l’axe de rotation 3 et de la ligne a de la figure 3-12. Le point de référence de l’enveloppe d’évolution est le point d’intersection des axes de rotation 4 et 5. Vue Y voir figure 3-12.

3-8 Hauptabmessungen und Arbeitsbereich (softwarebezogen) des KR 6
Principal dimensions and working envelope (software values) of the KR 6
Dimensions principales et enveloppe d’évolution (se rapportant au logiciel) du KR 6



Störkantenradius des Anbauflansches
Interference radius of the mounting flange
Rayon bords perturbateurs bride de fixation

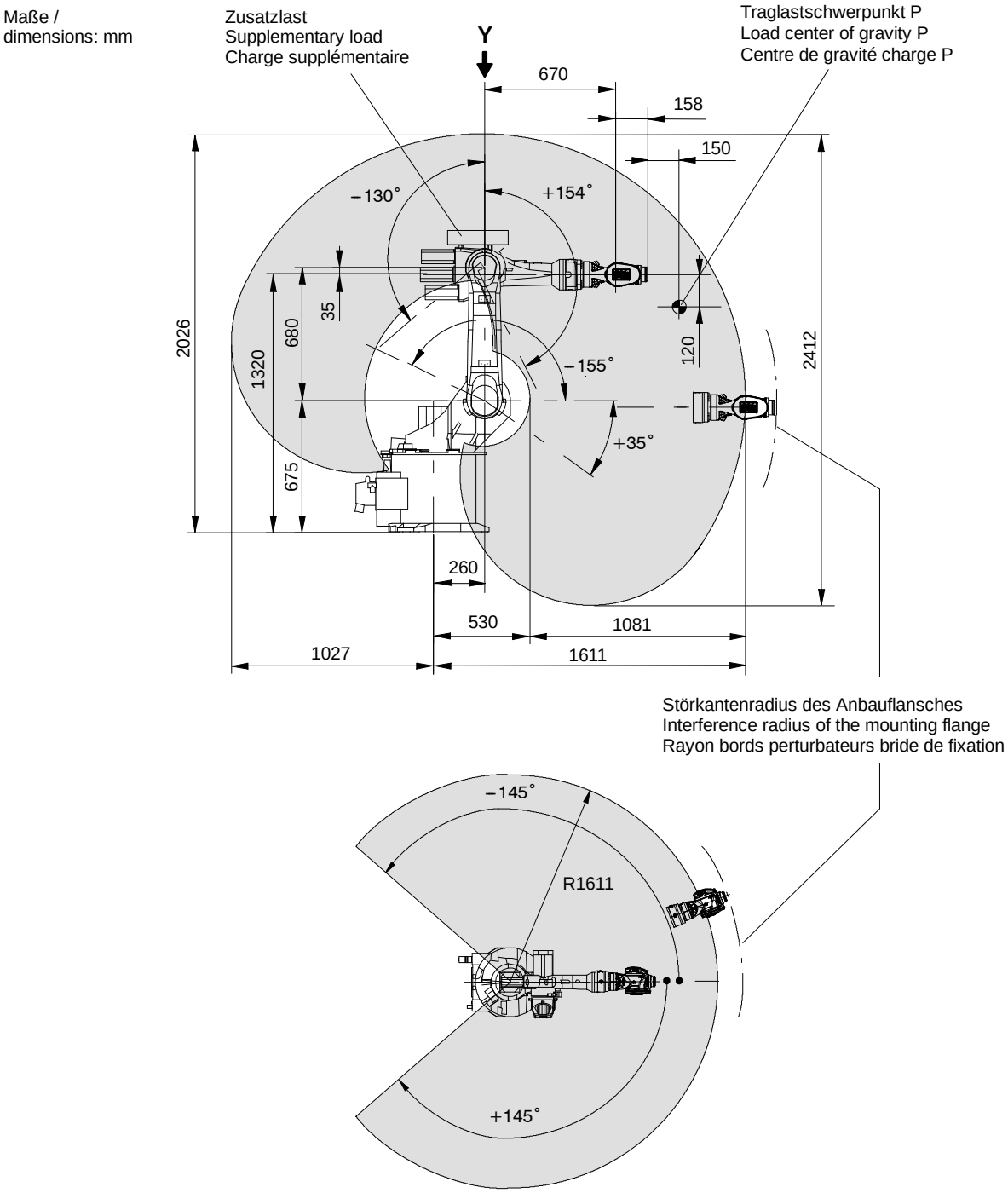


HINWEIS: Der Zusatzlast-Schwerpunkt muss so nahe wie möglich an der Drehachse 3 und an der Linie a in Bild 3-12 liegen. Bezugspunkt für den Arbeitsbereich ist der Schnittpunkt der Drehachsen 4 und 5. Ansicht Y siehe Bild 3-12.

NOTE: The center of gravity of the supplementary load must be located as close as possible to rotational axis 3 and to line “a” in Figure 3-12. The reference point for the working envelope is the intersection of rotational axes 4 and 5. View Y see Figure 3-12.

REMARQUE: Le centre de gravité de la charge utile supplémentaire doit être aussi proche que possible de l’axe de rotation 3 et de la ligne a de la figure 3-12. Le point de référence de l’enveloppe d’évolution est le point d’intersection des axes de rotation 4 et 5. Vue Y voir figure 3-12.

3-9 Hauptabmessungen und Arbeitsbereich (softwarebezogen) des KR 16, KR 16 S, KR 16 F, KR 16 CR
Principal dimensions and working envelope (software values) of the KR 16, KR 16 S, KR 16 F, KR 16 CR
Dimensions principales et enveloppe d’évolution (se rapportant au logiciel) du KR 16, KR 16 S, KR 16 F, KR 16 CR

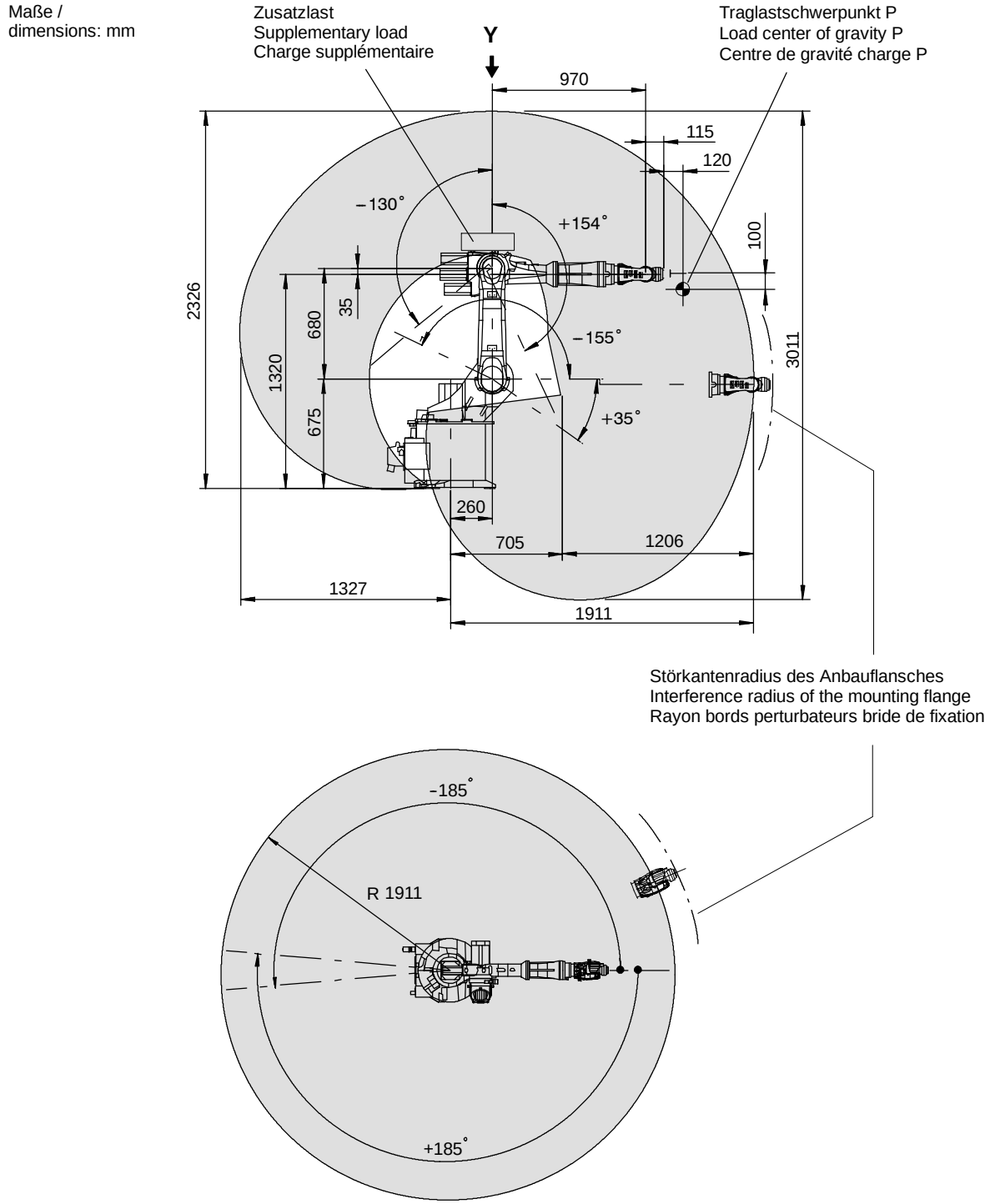


HINWEIS: Der Zusatzlast-Schwerpunkt muss so nahe wie möglich an der Drehachse 3 und an der Linie a in Bild 3-12 liegen. Bezugspunkt für den Arbeitsbereich ist der Schnittpunkt der Drehachsen 4 und 5. Ansicht Y siehe Bild 3-12.

NOTE: The center of gravity of the supplementary load must be located as close as possible to rotational axis 3 and to line “a” in Figure 3-12. The reference point for the working envelope is the intersection of rotational axes 4 and 5. View Y see Figure 3-12.

REMARQUE: Le centre de gravité de la charge utile supplémentaire doit être aussi proche que possible de l’axe de rotation 3 et de la ligne a de la figure 3-12. Le point de référence de l’enveloppe d’évolution est le point d’intersection des axes de rotation 4 et 5. Vue Y voir figure 3-12.

3-10 Hauptabmessungen und Arbeitsbereich (softwarebezogen) des KR 16 EX
Principal dimensions and working envelope (software values) of the KR 16 EX
Dimensions principales et enveloppe d’évolution (se rapportant au logiciel) du KR 16 EX



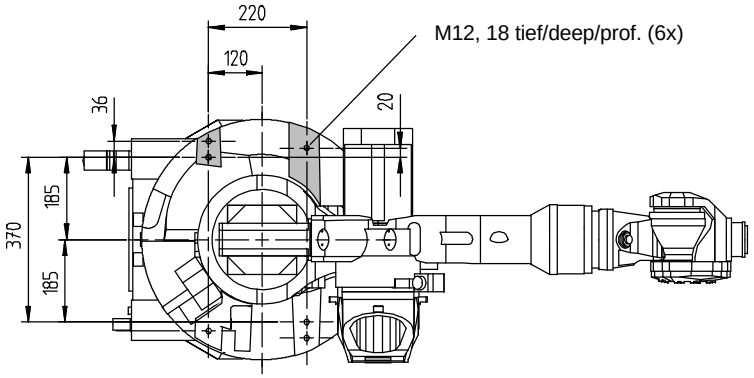
HINWEIS: Der Zusatzlast-Schwerpunkt muss so nahe wie möglich an der Drehachse 3 und an der Linie a in Bild 3-12 liegen. Bezugspunkt für den Arbeitsbereich ist der Schnittpunkt der Drehachsen 4 und 5. Ansicht Y siehe Bild 3-12.

NOTE: The center of gravity of the supplementary load must be located as close as possible to rotational axis 3 and to line “a” in Figure 3-12. The reference point for the working envelope is the intersection of rotational axes 4 and 5. View Y see Figure 3-12.

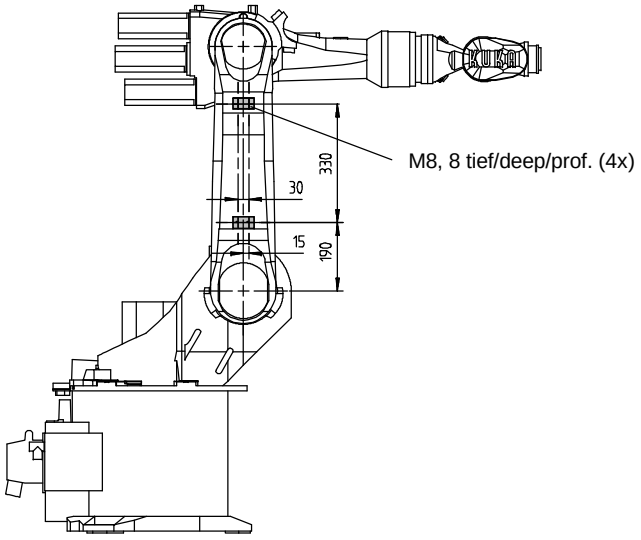
REMARQUE: Le centre de gravité de la charge utile supplémentaire doit être aussi proche que possible de l’axe de rotation 3 et de la ligne a de la figure 3-12. Le point de référence de l’enveloppe d’évolution est le point d’intersection des axes de rotation 4 et 5. Vue Y voir figure 3-12.

3-11 Hauptabmessungen und Arbeitsbereich (softwarebezogen) des KR 16 L6
Principal dimensions and working envelope (software values) of the KR 16 L6
Dimensions principales et enveloppe d’évolution (se rapportant au logiciel) du KR 16 L6

Karussell (Achse 1)
Rotating column (axis 1)
Bâti de rotation (axe 1)

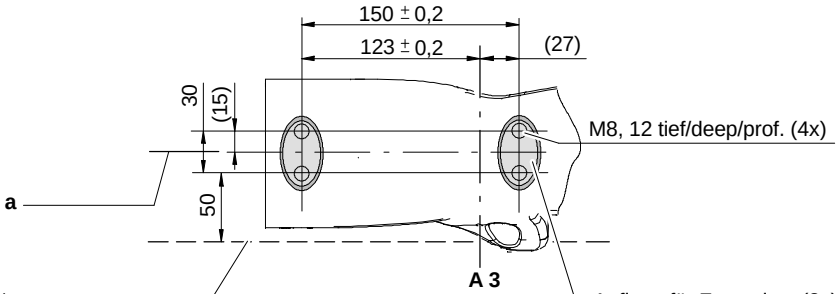


Schwinge (Achse 2)
Link arm (axis 2)
Epaule (axe 2)



Arm (Achse 3)
Arm (axis 3)
Bras (axe 3)

Ansicht Y	siehe Bild 3-8 bis 3-11
View Y	see Figures 3-8 to 3-11
Vue Y	voir figures 3-8 à 3-11



Störkante Zusatzlast
Interference contour, supplementary load
Bord perturbateur, charge supplémentaire

Auflage für Zusatzlast (2x)
Support brackets for supplementary load
Support pour la charge supplémentaire

3-12 Befestigungsbohrungen für Zusatzlast
Attachment holes for supplementary load
Trous de fixation des charges supplémentaires

KUKA Roboter GmbH

Produktprogramm Industrieroboter

- Gelenkroboter für Traglasten von 3 bis 1000 kg
- Lineareinheiten
- Steuerungen
- Softwareentwicklung
- Schulung, Service

Product range Industrial robots

- Jointed-arm robots for payloads from 3 kg to 500 kg
- Linear units
- Controllers
- Software development
- Training, service

Gamme de produits Robots industriels

- Robots polyarticulés pour des charges comprises entre 3 kg et 500 kg
- Unités linéaires
- Baies de commande
- Développement de logiciels
- Formation, service clients

Anschriften - Addresses - Adresses

D

KUKA Roboter GmbH
Global Sales Center
Hery-Park 3000
D-86368 Gersthofen
Tel.: +49 821 4533-0
Fax: +49 821 4533-1616
E-Mail: info@kuka-roboter.de
Internet: http://www.kuka-roboter.de

KUKA Roboter GmbH
Niederlassung West
Dortmunder Straße 15
D-57234 Wilnsdorf
Tel.: +49 2739 4779-0
Fax: +49 2739 4779-29
E-Mail: nl-west@kuka-roboter.de

KUKA Roboter GmbH
Niederlassung Nord
VW-Werk, Halle 4,
Eingang 22,
Berliner Ring
D-38436 Wolfsburg
Tel.: +49 5361 848481-0
Fax: +49 5361 848481-26

A

KUKA Roboter GmbH
Vertriebsbüro Österreich
Regensburger Strasse 9/1
A-4020 Linz
Tel.: +43 732 784752
E-Mail: office@kuka-roboter.at

B

KUKA Automatisering
+ Robots N.V.
Centrum Zuid 1031
B-3530 Houthalen
Tel.: +32 11 516160
E-Mail: info@kuka.be

BR

KUKA Roboter do Brasil Ltda.
Rua Dom Feliciano N° 63
Cidade Satélite, Guarulhos
CEP 07224 240
São Paulo, SP, Brasil
Tel.: +55 11 6413-4900
E-Mail: info@kuka-roboter.com.br

CH

KUKA Roboter Schweiz AG
Riedstrasse 7
CH-8953 Dietikon
Tel.: +41 17 449090
E-Mail: info@kuka-roboter.ch

E

KUKA Sistemas de Automatización, S.A.
Pol. Industrial Torrent de la Pastera
Carrer del Bages s/n
E-08800 Vilanova i la Geltrú
Tel.: +34 93 8142353
E-Mail: comercial@kuka-e.com

F

KUKA Automatisme
+ Robotique SAS
Techvallée, 6 Avenue du Parc
F-91140 Villebon S/Yvette
Tel.: +33 1 69316600
E-Mail: commercial@kuka.fr

H

KUKA Robotics Hungária Kft.
2335 Taksony, Fö út 140
Hungária
Tel.: +36 24 501609
E-Mail: info@kuka-robotics.hu

I

KUKA Roboter Italia S.p.A.
Via Pavia 9/a - int.6
I-10098 Rivoli (TO)
Tel.: +39 011 9595013
E-Mail: kuka@kuka.it

MAL

KUKA Robot Automation
Sdn Bhd South East Asia
Regional Office
No. 24, Jalan TPP 1/10
Taman Industri Puchong
47100 Puchong, Selangor, Malaysia
Tel.: +60 3 8061-0613
E-Mail: info@kuka.com.my

MEX

KUKA de México S. de R.L. de C.V.
Rio San Joaquin # 339, Local 5
Col. Pensil Sur
C.P. México D.F. 11490
Tel.: +52 55 52038407
E-Mail: info@kuka.com.mx

N

KUKA Svetsanläggningar
+ Robotar AB Avd. Norway
Hadelandsveien 2, Postbox 17
NO-2801 Gjövik, Norway
Tel.: +47 61 133422
E-Mail: geir.ulsrud@kuka.no

P

KUKA Sistemas de Automatización S.A.
Urb. do Vale do Alecrim, Lote 115-B
P-2950 Palmela
Tel.: +3 51 21 2388083
E-Mail: kuka@mail.telepac.pt

PRC

KUKA Automation Equipment (Shanghai) Co., Ltd.
Part B, Ground Floor, No. 211
Fu te Road (North)
Waigaoqiao Free Trade Zone
Shanghai 200 131, China
Tel.: +86 21 58665139
E-Mail: franz.poeckl@kuka-sha.com.cn

ROK

KUKA Robot Automation
Korea Co. Ltd.
4 Ba 806 Sihwa Ind. Complex,
Sung-Gok Dong, Ansan City,
Kyunggi Do, 425-110 Korea
Tel.: +82 31 4969937
E-Mail: info@kukakorea.com

S

KUKA Svetsanläggningar
+ Robotar AB
A. Odhners gata 15
S-42130 Västra Frölunda
Tel.: +46 31 7266200
E-Mail: info@kuka.se

THA

KUKA Robot Automation (M)
Sdn Bhd Thailand Office
c/o Maccall System Co. Ltd.
49/9-10 Soi Kingkaew 30,
Kingkaew Road
T. Rachatheva, A. Bangpli
Samutprakarn, 10540 Thailand
Tel.: +66 2 7502737
E-Mail: atika@ji-net.com

TWN

KUKA Robot Automation
Taiwan Co. Ltd.
136, Section 2,
Huanjung East Road
Jungli City, Taoyuan, Taiwan 320
Tel.: +886 3 4371902
E-Mail: info@kuka.com.tw

UK

KUKA Welding Systems
+ Robot Ltd.
Hereward Rise Halesowen
UK-West Midlands B62 8AN GB
Tel.: +44 121 5850800
E-Mail: sales@kuka.co.uk

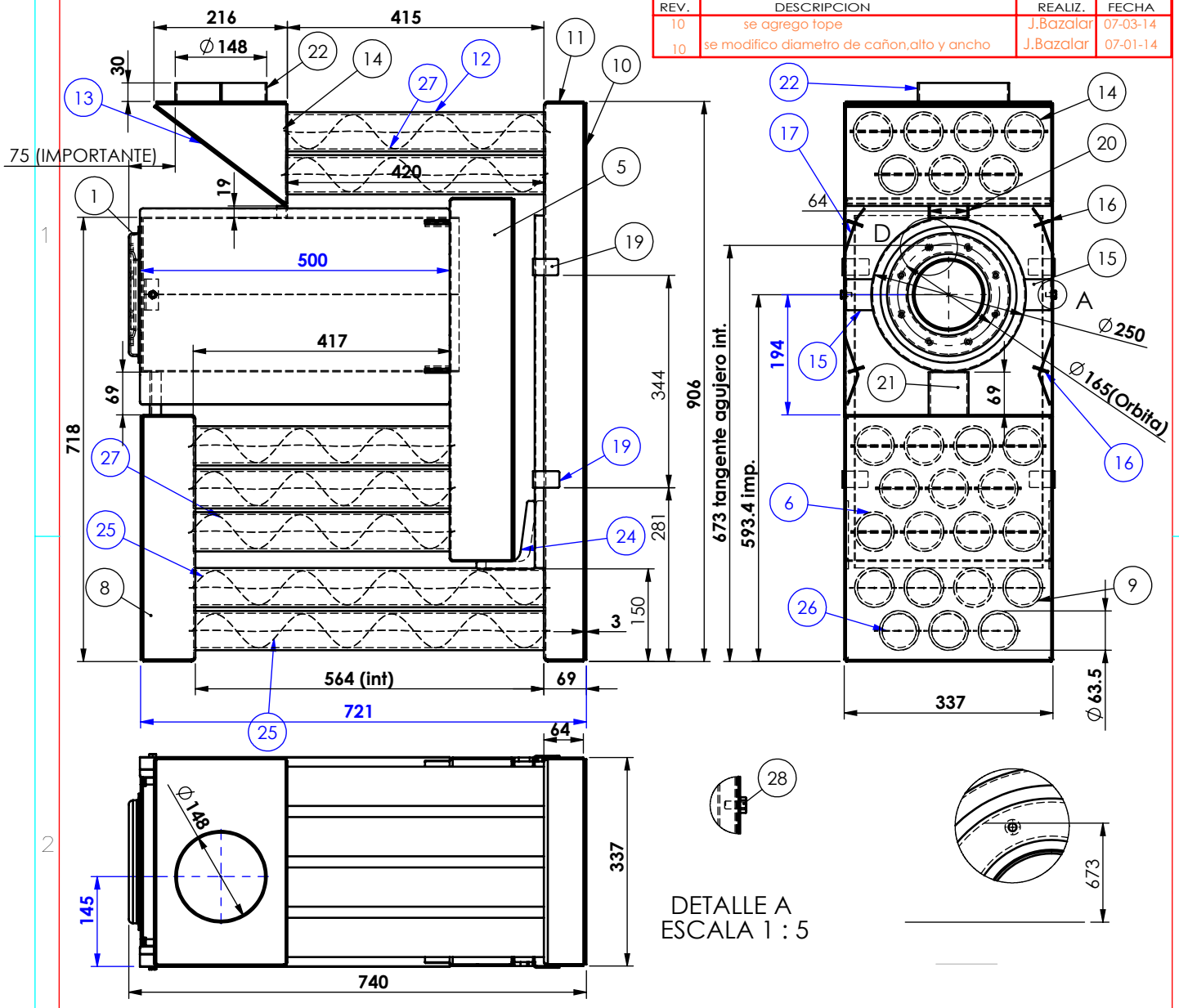
USA

KUKA Robotics Corp.
22500 Key Drive
Clinton Township
Michigan 48036 USA
Tel.: +1 866 873-5852
E-Mail: info@kukarobotics.com

Überreicht durch
Handed over by
Remis par

02/07

REV.	DESCRIPCION	REALIZ.	FECHA
10	se agrego tope	J.Bazalar	07-03-14
10	se modifico diametro de cañon,alto y ancho	J.Bazalar	07-01-14



CODIGO	MATERIAL	ITEM	DESCRIPCION	DIMENSIONES	CANT	PESO
2610604101	Zincado	28	P E 1/4"NC X 1/2"	1/4"NC x 1/2"	2	0.01
2130012056	AISI 430.2B	26	TRAVEZAÑO DE ESPIRAL - INTERCAMBIADOR	PL.1.2 x 5 x 75	25	0.00
2130011325	Fe-Ne	27	ESPIRAL 2 PARA TUBO INOX - FE.NE -INTERCAMBIADOR	Pl.0.6 x 55 x421	18	0.04
2130012246	Fe-Ne	25	ESPIRAL 1 PARA TUBO FE.NE - INTERCAMBIADOR	Pl.0.6 x 55 x 573	7	0.07
2130000412-3	Fe.Ne.	22	ANILLO DE CHIMENEA- INTERCAMBIADOR	PL.2.8mm x 456 x 30	1	0.30
2130012079	Fe.Ne.	21	SEPARADOR 2 - INTERCAMBIADOR	Pl.2.8mm x 64 x69	1	0.14
2130000574-4	AISI 310S	20	SEPARADOR 1-INTERCAMBIADOR	Pl. 2 x64 x17 x19	1	0.03
2130004288-2	Fe.Ne.	19	SUJETADOR-INTERCAMBIADOR	Pl 2.8 mmx 42.8 x 41 x 26.5	4	0.05
2130006957-4	Fe.Ne.	17	DEFLECTOR - INTERCAMBIADOR	Pl 1.5 x 501 x 330	2	1.95
2130005174-1	Fe-Ne	16	SUJETADOR DEFLECTOR - INTERCAMBIADOR	Pl. 3 x 25 x 40	4	0.02
2130009483-1	Fe-Ne	15	AMARRE DE DEFLECTOR - INTERCAMBIADOR	Pl 2.8mm x 45 x 23 x 50	2	0.07
2130000586-5	Fe-Ne	12	TUBO 3-INTERCAMBIADOR	Ø 63.5 x420	7	2.47
2130000579-3	Fe-Ne	9	TUBO 2-INTERCAMBIADOR	Ø64 x 569	7	3.34
2130000572-4	AISI 309 S	6	TUBO 1- INTERCAMBIADOR	Ø63.5 x 417	11	2.45
2130000585-4	Fe-Ne	23	TAPA SUPERIOR DE CAJA 4 - INTERCAMBIADOR	Pl 2.8mm x209 x332	1	1.16
2130009474-3	Fe-Ne	13	TAPA INCLINADA DE CAJA 4 - INTERCAMBIADOR	Pl 2.8 x 332 x 265	1	1.93
2130000583-4	Fe-Ne	14	CAJA 4 - INTERCAMBIADOR	Pl 2.8 x 160 x 212 x337.5	1	1.41
2130009790-4	Fe.Ne.	18	PROTECTOR DE CAJA 3 - INTERCAMBIADOR	Pl.1.5 x 15 x 305 x 570	1	2.22
2130000581-5	Fe.Ne.	10	TAPA POSTERIOR DE CAJA 3 - INTERCAMBIADOR	Pl 2.8 x 332 x900.5	1	6.57
2130009787-2	Fe.Ne.	11	CAJA 3 - INTERCAMBIADOR	Pl. 2.8 x337 x906 x 64	1	9.07
2130000576-4	Fe-Ne	7	TAPA LATERAL DE CAJA 2 - INTERCAMBIADOR	Pl. 3 X 332 X 394	1	2.87
2130009785-2	Fe.Ne.	8	CAJA 2 - INTERCAMBIADOR	Pl. 2.8 x 84 x399 x84	1	4.26
2130000050-1	AISI 304	1	BRIDA DE TAPA DE CAÑON-INTERCAMBIADOR	Pl.3mm x ø 220 x 19	1	0.89
2130000565-4	AISI 310 S	3	TAPA DE CAÑON - INTERCAMBIADOR	Pl. 2 x Ø250 x18	1	0.71
2130000566-6	AISI 310S	2	CAÑON - INTERCAMBIADOR	Pl. 2 xØ250 x511	1	
2130012046-1	Fe-Ne	24	SOPORTE DE CAJA 1 - INTERCAMBIADOR	PL.1/4" x 94 x110	2	0.15
2130009784 - 3	AISI 310S	4	TAPA POSTERIOR DE CAJA 1 - INTERCAMBIADOR	Pl 2 x333 x584	1	3.11
2130009782-3	AISI 310S	5	CAJA 1 - INTERCAMBIADOR	Pl. 2 x588 x 337 x 100	1	4.64

Diseñado: R. Melchor | Aprobado: J.Hinojosa | TOLERANCIAS GENERALES: H13 Agujero - h13 Eje; J14 Dimensiones lineales; ± 0º-30' Valores Angulares | Fecha: 16/01/2015 | Escala: 1:10 | Hoja Nº: 1

Denominación: Horno Max 1000
ENSAMBLE DE INTERCAMBIADOR

CODIGO: 2130000011-11 | REV.: 11

FECHA: 28/02/2013
FILE: D:\NOVA\2015\NOVA - Semana 1\INTERC MAX 1000\

KUKA

The Power of Control.

KR C4. The control system with security of investment.

KUKA

KUKA – YOUR STRONG PARTNER.

Quality made German robots built with the utmost commitment to our customer's needs. KUKA has been the basis for decades of exceptional technology helping companies to achieve process optimization. We were the pioneers in the world of robotics, and now are global leader in innovation. Our passion is finding future-oriented solutions to make even complex automation tasks simple. Whatever your application no matter the difficulty you can implement it with KUKA. Thanks to experienced KUKA system partners we are able to provide robotic solutions industry-wide. We strive to turn your ideas into reality. Use our experience to drive your success.

Versatility

One for for all.
The all-rounder KR C4.
4

Energy efficiency

Resource-conserving robotics.
Does more with less.
24

Flexibility

A global communicator.
KR C4 for compatibility worldwide.
6

Hardware

Superior in each and every form.
The KR C4 variants.
8

Safety

Helps and protects.
Safety with the KR C4.
22

Control panel

Simply more freedom.
The intelligent KUKA smartPAD.
10

Sustainability

Leading today and tomorrow.
Thanks to proven industrial standards.
20

Programming

Quickly on target.
KR C4 makes programming easy.
12

Applications

Makes the generalist a specialist.
Application and additional software.
18

Software

Work more efficiently.
The KUKA.WorkVisual engineering suite.
14

Integration

One interface for all.
KUKA.PLC mxA.
16

1 for all.

The all-rounder KR C4.

The KR C4 controller is a pioneer for the automation of today and tomorrow. It reduces your costs in integration, maintenance and servicing. At the same time, the long-term efficiency and flexibility of the systems are increased – thanks to common, open industry standards.

The KR C4 software architeture integrates Robot Control, PLC Control, Motion Control (e.g. KUKA.CNC) and Safety Control. All controllers share a database and infrastructure. This makes automation simpler and more powerful. Both now and in the future.

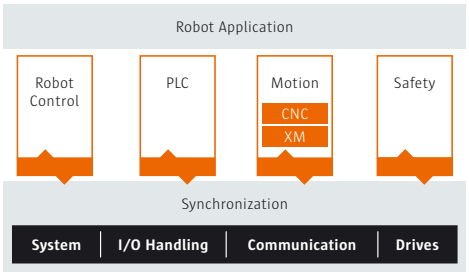
e– energy-saving

KR C4: one for all

- Robot, PLC, Motion and Safety Control seamlessly and interactively integrated
- Uses a shared database and infrastructure
- Maximum performance, scalability and flexibility
- Effortless control of entire systems
- Understands KRL and the PLC control language, G-code

4 control processes in one control system. And always safe.

The KR C4 concept is revolutionary. For the first time, Robot and Motion Control are seamlessly and interactively integrated with control processes for PLC, CNC and Safety. With simple and flexible robot programming via inline forms and new Spline motion programming, KR C4-based automation solutions are superior in every way. Furthermore, the KR C4 features intelligent, flexible and scalable application potential.



On the basis of the new hardware and software architecture of the KR C4, all dedicated control processes communicate directly. Without interface limitations. In real-time.

High-end PLC support.

The high-end SoftPLC option allows full access to the entire controller I/O system and has a high runtime performance. It allows the I/O handling of the robot, a complete robot cell or line of robots. In addition, variables such as axis positions or velocities can be read and processed via function blocks.

More performance in CNC machining.

The KUKA.CNC control option enables direct programming and operation of KUKA robots via G-code. It can process even the most complex programs from CAD/CAM systems and provides utmost accuracy due to CNC path planning. This hugely simplifies the integration of robots into an existing CNC environment. Thanks to the increasing number of robot-specific functions in upstream CAD/CAM systems, the robot can play a direct role in machining processes.

Fully integrated safety controller.

The KR C4 seamlessly integrates the complete safety controller into the control system without proprietary hardware. Safety functions and safety-oriented communication are implemented via Ethernet-based protocols. The safety concept uses multi-core technology and enables the dual-channel operation required for safety applications.

Direct execution of all standard G and M commands for tool handling and HSC (High-Speed Cutting).

A global communicator.
KR C4 for compatibility worldwide.

No matter where in the world high-performance control systems are required, KR C4 is the answer. It works reliably with different mains voltages and types. In extreme cold, heat or humidity. It speaks 25 languages – including the major Asian ones – and meets all globally relevant ISO and US standards.

ISO

Conforms to all relevant standards.

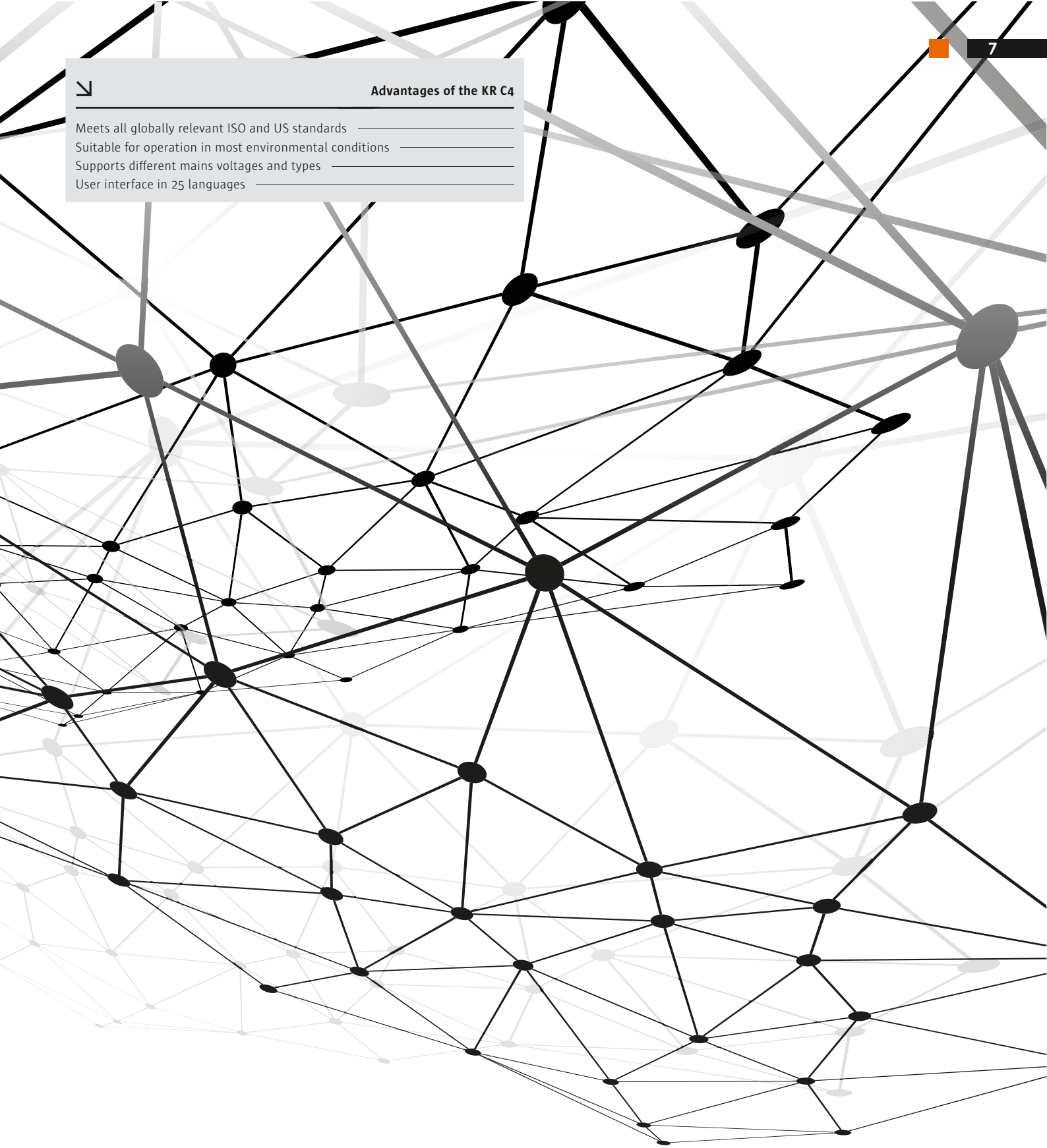
The KR C4 meets all relevant ISO standards as well as the UL1740/ CSA434-3/ANSI RIA 15.06 standards required in the USA and Canada.

Fully functional in every climate.

Can be used at ambient temperatures between +5 °C and +45 °C and optionally as high as +55 °C.

Advantages of the KR C4

- Meets all globally relevant ISO and US standards
- Suitable for operation in most environmental conditions
- Supports different mains voltages and types
- User interface in 25 languages



For different mains voltages and types.

Using transformers, the KR C4 works flexibly with rated supply voltages of 208 – 575 V (with 380/400/440/480 V also without an additional transformer).

Can be operated in 25 languages.

In addition to all official EU languages, the KR C4 also supports the major Asian languages.

Superior in each and every form.

The KR C4 variants.

With five variants, the KR C4 can be optimally integrated into your automation environment. Requirements for stackability, protection against dust, humidity and other influences can thus be taken into account.

KR C4 compact

Dimensions (HxWxD)	271 x 483 x 460 mm
Processor	Multi-core technology
Hard drive	SDD
Interface	USB3, Gb EtherNet, DVI-I
Number of axes (max.)	6 + 2 (with add. axis box)
Mains frequency	50/60 Hz ± 1 Hz
Rated supply voltage	AC 200 V to 240 V
Protection rating	IP20
Ambient temperature	+5 °C to +45 °C
Weight	33 kg

The 19" KR C4 compact controller is ideal for space-saving installation in customer enclosures or in small protective housings. Designed for up to 6 robot axes in the low payload category. Optionally expandable by up to 2 external axes with a motor capacity of up to approx. 2 kW.

KR C4 smallsize

Dimensions (HxWxD)	551 x 550 x 454 mm
Processor	Multi-core technology
Hard drive	SDD
Interface	USB3, Gb EtherNet, DVI-I
Number of axes (max.)	6 + 6 (with add. axis box)
Mains frequency	50/60 Hz ± 1 Hz
Rated supply voltage	AC 200 V to 240 V
Protection rating	IP54
Ambient temperature	+5 °C to +45 °C
Weight	50 kg

The universal KR C4 smallsize controller with protection rating IP54 is designed for industrial operation of up to 6 robot axes in the low payload category.

KR C4 – the versatile concept

Available in five cabinet variants designed for different areas of application
Control cabinets with protection rating IP54, rack version KR C4 compact with protection rating IP20
For control of up to 16 axes

The heat exchange system, with separate air circulation in the inner and outer zones of the controller, allows low-maintenance operation even in dusty environments. Entirely without filter mats.

KR C4

Dimensions (HxWxD)	960 x 792 x 558 mm
Processor	Multi-core technology
Hard drive	SDD
Interface	USB3, Gb EtherNet, DVI-I
Number of axes (max.)	8
Mains frequency	49 to 61 Hz
Rated supply voltage	AC 3 x 208 V to 3 x 575 V
w/o transformer	AC 3 x 380/400/440/480 V
Protection rating	IP54
Ambient temperature	+5 °C to +45 °C
Weight	150 kg

The universal KR C4 controller with protection rating IP54 is designed for industrial operation of up to 8 robot axes in the high payload category.

KR C4 midsize

Dimensions (HxWxD)	1,160 x 792 x 558 mm
Processor	MultiCore technology
Hard drive	SDD
Interface	USB3, Gb-EtherNet, DVI-I
Number of axes (max.)	8
Mains frequency	49 to 61 Hz
Rated supply voltage	AC 3 x 208 V bis 3 x 575 V
w/o transformer	AC 3 x 380/400/440/480 V
Protection rating	IP54
Ambient temperature	+5 °C to +45 °C
Weight	160 kg

The universal KR C4 midsize controller with protection rating IP54 is designed for industrial operation of up to 8 robot axes in the high payload category. Expanded with additional installation space and a side connector panel for integration of customer options.

KR C4 extended

Dimensions (HxWxD)	1,600 x 842 x 562 mm
Processor	MultiCore technology
Hard drive	SDD
Interface	USB3, Gb-EtherNet, DVI-I
Number of axes (max.)	16
Mains frequency	49 to 61 Hz
Rated supply voltage	AC 3 x 208 V to 3 x 575 V
w/o transformer	AC 3 x 380/400 V
Protection rating	IP54
Ambient temperature	+5 °C to +45 °C
Weight	240 kg

The universal KR C4 extended controller with protection rating IP54 is designed for industrial operation of up to 12 robot axes and 4 external axes in the heavy-duty category. Expanded with an additional side connector panel for integration of customer options.

Simply more freedom.
The intelligent KUKA smartPAD.

Master even complex operating tasks easily – that's what the KUKA smartPAD is designed for. The context-sensitive interface only displays the options relevant at the moment of operation. Thanks to the intuitive operator guidance, less experienced and expert users alike can work quickly and efficiently with a minimum of training.

ERGONOMIC DESIGN. Reduced weight and anatomically designed for efficient, comfortable operation.

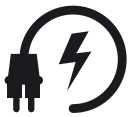
UNIVERSALLY APPLICABLE. Operate all KUKA robots and KR C4 controllers with the KUKA smartPAD.

ANTIREFLECTION TOUCH DISPLAY. Antireflection touch display.

6D-MOUSE. Intuitive, Cartesian movement and reorientation of the robot in 3 or all 6 degrees of freedom.

EIGHT JOG KEYS. Separate jog keys for direct control of up to 8 axes or external axes without switching.

MULTILINGUAL. The user interface for operation and programming is suitable for international use due to the wide range of languages available by simple selection. Systematic further development of the tried-and-tested KUKA operator control and programming concept.



Hot-pluggable.

The KUKA smartPAD can be simply connected to and disconnected from a KR C4 controller at any time – making it ideal for use with other KUKA robots or for avoidance of inadvertent operator errors.

Integrated USB connection.

USB port for direct saving and loading of application programs.

KUKA smartPAD: operation with all the advantages

Universally applicable for all KUKA robots and KR C4 controllers
Can be connected and disconnected at any time, integrated USB port
Suitable for international use
Intuitive operator control via the well-lit 8.4" touch display
8 jog keys for direct control of 8 axes/external axes

Control panel: KUKA smartPAD

Type	KUKA smartPAD
Display	scratch-resistant industrial touch display
Display size	8.4"
Dimensions (H x W x D)	240 x 290 x 50 mm
Weight	1,100 g

1 Simple, intuitive operator control via touch screen.

2 USB port for direct saving and loading of application programs.

3 Ergonomic 6D mouse.

1

2

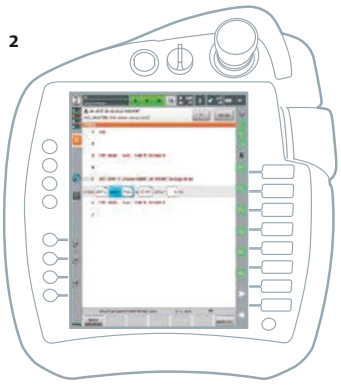
3

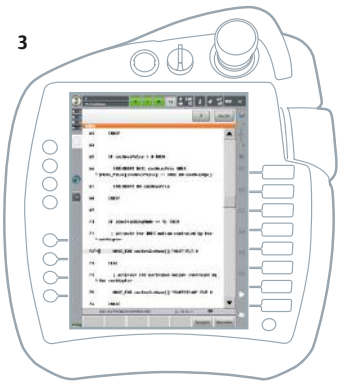
Quickly on target.

KR C4 makes programming easy.

Whether you're a novice or programming expert, the KUKA smartPAD will quickly take you to your goal. Because it offers the suitable programming options for every requirement. A single control panel to reliably perform the most varied of tasks.

KUKA smartPAD options





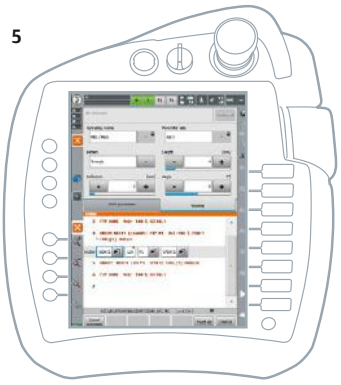
1–3 Simple programming with KUKA inline forms

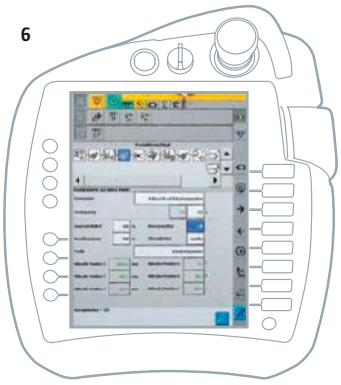
4 KUKA.CNC application

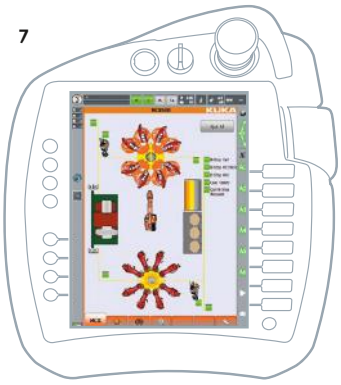
5 Application in the arc welding sector

6 Application in the plastics sector

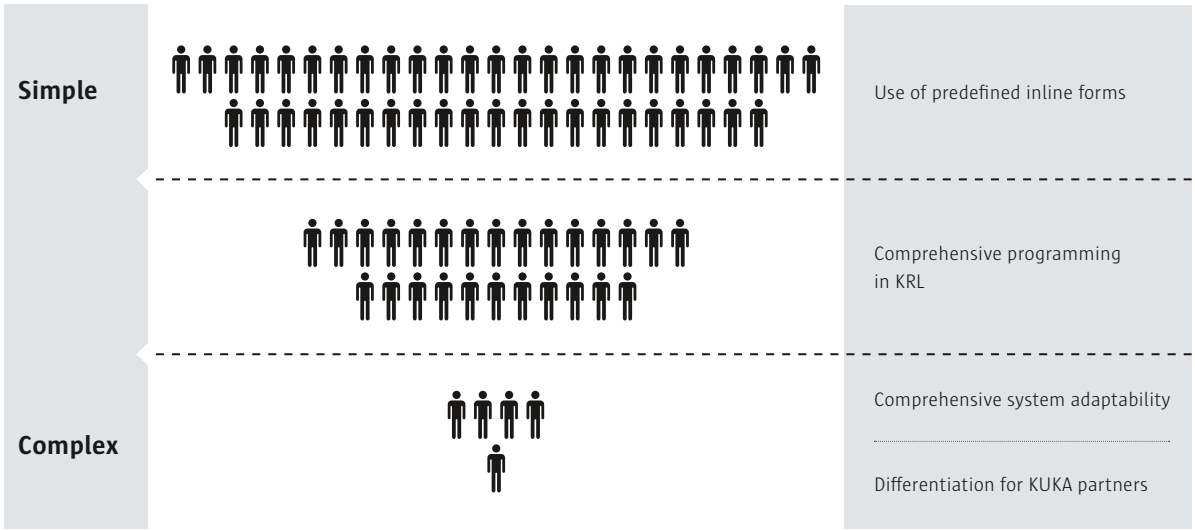
7 KUKA HMI.zenon application







Complexity classes of programming



KR C4 offers the right programming option for every group of operators: from simple template programming for non-specialists to highly differentiated expert programming.

KUKA.KRL – the programming language of advanced robotics.

"KUKA Robot Language" is a standard programming language across the globe. It is easy to learn and is perfectly suited to the wide-ranging options provided by KUKA robotics. The intuitive KUKA smartPAD can be used to create complex and customized programs for robot motion steps and tasks in a broad range of applications – both online and offline.

Simple and efficient: programming with inline forms.

The KR C4 provides inline forms for the fast, error-free programming of tasks and motion steps. They can be called via menus and are available as standard. This simplifies the programming of RoboTeams with up to four synchronized robots.

Customer-defined program modules.

KUKA integrators can expand the library of available KUKA inline forms according to customer requirements. This leads to the creation of special applications which can be easily programmed for recurring tasks. A competitive advantage for system integrators: specially developed inline forms allow for unique solutions, optimally tailored to the companies which use them.

Work more efficiently.
The KUKA.WorkVisual engineering suite.

Configuration, programming, start-up and diagnosis.

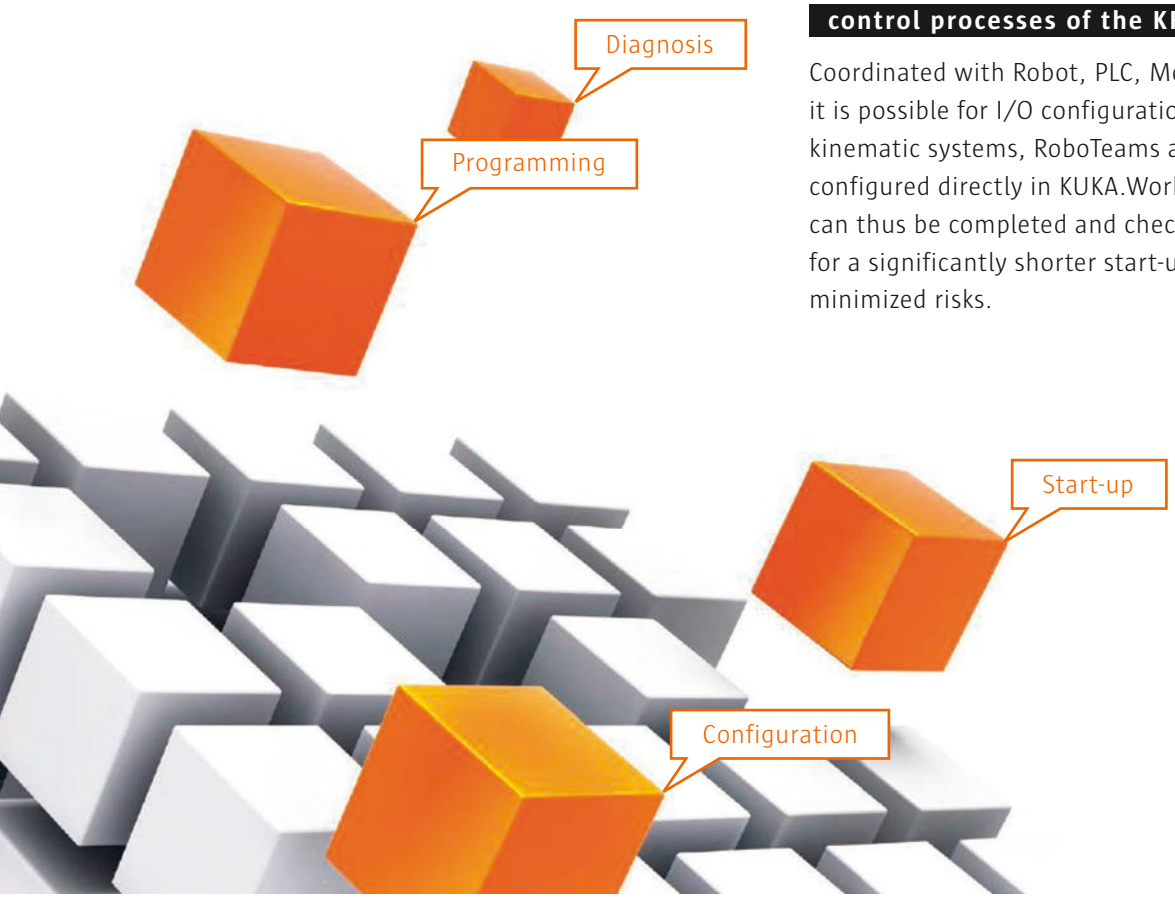
KUKA.WorkVisual provides a homogenous offline development, online diagnosis and maintenance environment. Program-neutral catalogs and project data ensure consistency and seamless integration.

Tools with a uniform interface and menu system.

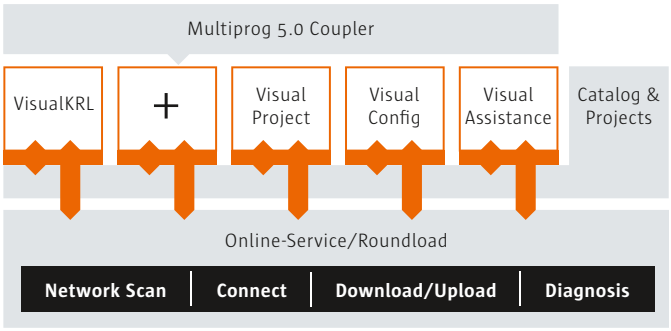
The program code is already checked for logic in the background while programming steps are being carried out. This means that errors are nipped in the bud, and projects can be implemented more efficiently and consistently. Interactions are made visible by visual tools – making them more intuitive and easier to operate.

Perfectly coordinated with the dedicated control processes of the KR C4.

Coordinated with Robot, PLC, Motion and Safety Control, it is possible for I/O configuration, mapping, non-KUKA kinematic systems, RoboTeams and SafeRobot 3.0 to be configured directly in KUKA.WorkVisual. The configuration can thus be completed and checked offline. This makes for a significantly shorter start-up time combined with minimized risks.



Program life cycle in the KUKA.WorkVisual engineering suite.



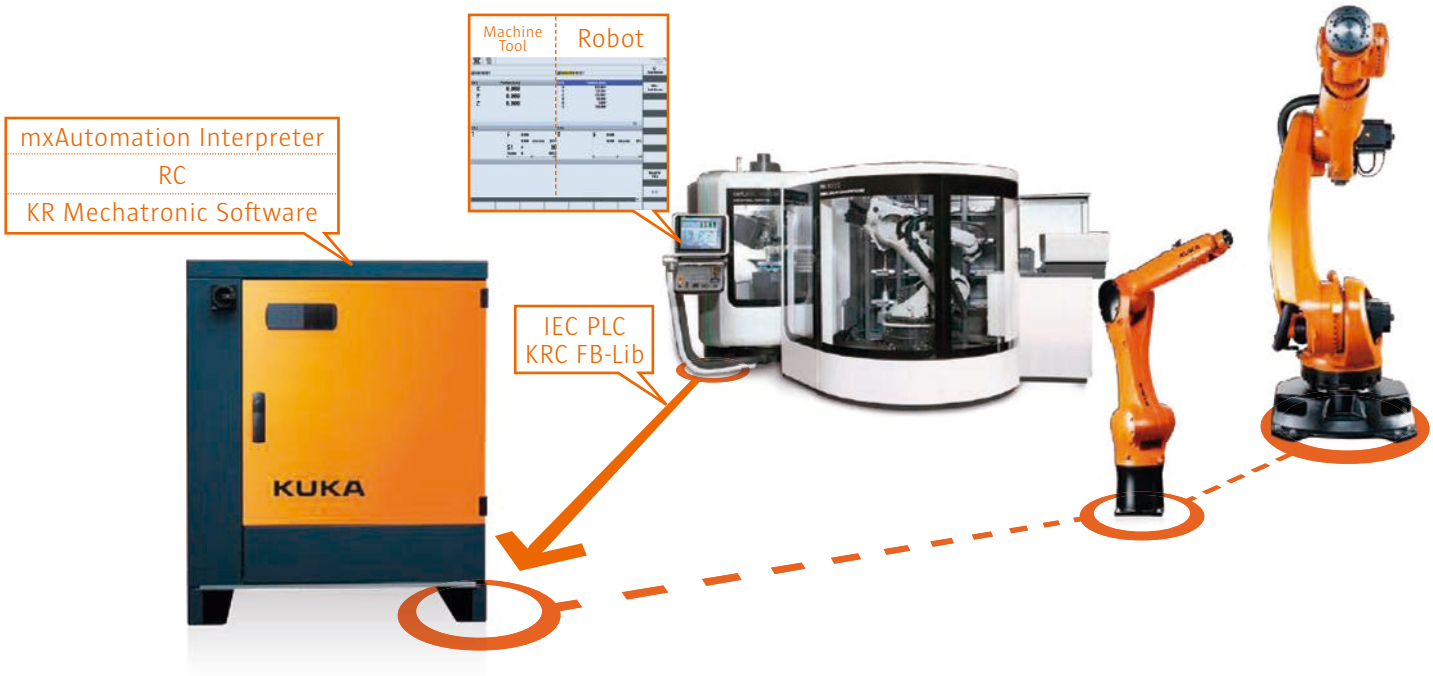
More efficiency, more consistency – throughout the entire software life cycle.

The KUKA.WorkVisual engineering suite can be used for cell configuration, as a universal programming environment and as a shop floor unit. It covers all areas in the life cycle of a program – and establishes perfect consistency between the online and offline worlds with WorkVisual Roundload. Editors and infrastructure components systematically access central services, such as project database, catalogs and online services, in the modular software architecture of KUKA.WorkVisual. In addition to the basic tools – VisualProject, VisualConfig, VisualKRL and VisualAssistance – the platform offers slots for further modules – Multiprog and others.

KUKA.WorkVisual

- Uniform, standards-oriented user interface
- Consistent project data storage facility, avoidance of error-prone multiple entry of the same data
- Network administration of all KR C4 controllers
- Comprehensive diagnostic options
- Integrated, uniform field bus I/O configuration, mapping and diagnosis on the robot controller and between Robot Control and SoftPLC
- Supported field buses: PROFINET, PROFIBUS, INTERBUS, EtherCAT, Ethernet/IP, DeviceNet and VARANBUS
- Drag & drop configuration and menu-guided parameterization for RoboTeam, ProfiSafe, CID/Safety and FSoE
- Editors for textual programming of cell components

1 interface for all. KUKA.PLC mxA.



Robots and systems combine to form a process-oriented integrated system operated from one terminal.

Native programming interfaces make for simple programming and integration of KUKA robots into your machine environment. The mxAutomation function package, KUKA.PLC mxA, makes it possible for external controllers with an embedded PLC to command KUKA robots on the basis of elementary motion instructions. This provides an easy route to implementing a central operator control concept for robot-automated production machines that is highly convenient for end customers. The outstanding kinematic and safety-relevant functions of the KUKA KR C4 controller remain fully available since the mxAutomation command interpreter of the KR C4 communicates the PLC commands to the path planning module, which sets the robot in motion with the accustomed precision and reliability.

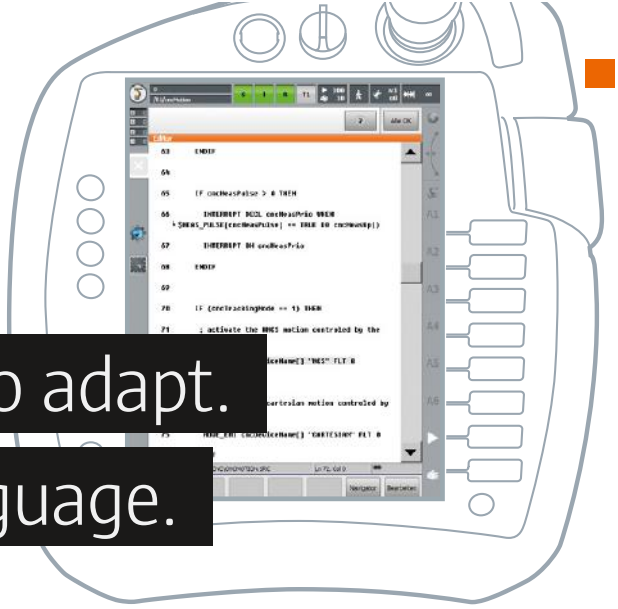
INTEGRATED BY KUKA
mxAutomation

KUKA.PLC mxA

- Can be programmed without knowledge of robot programming
- Direct commanding of the robot with PLC function blocks
- Supports control systems SIMATIC S7® via Profinet and Rockwell Logix Controller® via EtherNet/IP
- Internal SoftSPS KUKA PLC ProConOS
- Service-proven KUKA programming language KUKA.KRL

0% need to adapt.

KUKA speaks your language.



Besides the internal SoftPLC (KUKA.PLC ProConOS), KUKA.PLC mxA supports the external control systems SIMATIC S7® via Profinet and Rockwell Logix Controller® via EtherNet/IP and is thus prepared for use in Europe, Asia and America. The CODESYS-based control platforms are also supported with KUKA.PLC mxAutomation 2.0. Profinet, EtherNet I/P and EtherCAT are thus taken into account in the reference application. Special interface requirements for mxAutomation can be taken into account within our partner program.

Simple programming.

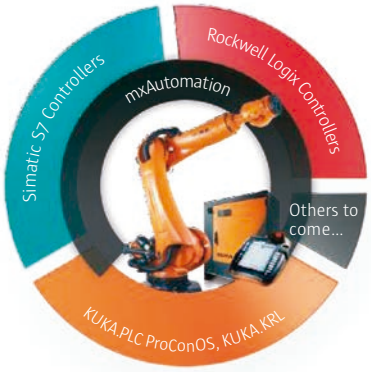
With KUKA.PLC mxA, the user requires minimal knowledge of robot programming. The mxAutomation function blocks allow the KUKA robot to be commanded within the familiar PLC programming environment.

High flexibility.

If the requirements in production are changed, the appropriate modifications or expansions can be implemented at any time with mxA-based operator control. The flexibility made possible by using robots with regard to processing new series of parts or performing additional tasks is made available for the operator in his customary environment.

Single point of operation.

Thanks to the combination of robot and machine control, KUKA robots can be effortlessly integrated into existing operator control concepts. The robot can therefore also be controlled via the customary human-machine interface. Teach pendants for the machine can be used for teaching the robot as well, provided appropriate safety precautions are implemented. A good integration example in this context is the incorporation of KUKA robots into the Sinumerik world on the basis of mxAutomation for S7, as offered by Siemens®.



Engineering Suite: KUKA.WorkVisual

For compact and cost-effective configuration of the control system, the user can remain entirely in the KUKA world of the multi-functional KR C4 and its engineering suite KUKA.WorkVisual.
Sophisticated, dovetailed control options such as Robot Control, SoftPLC, Motion Control, etc. are available here – together with the relevant programming language. Furthermore, with the new KUKA.CNC control option, robots can be programmed in G-code either directly or indirectly via upstream CAD/CAM process chains. This turns the KUKA robot into a machine tool.

Makes the generalist a specialist. Application and additional software.

KUKA provides a wide range of predefined application and additional software for the KR C4 for virtually all common robot applications. This makes it possible to program sequences quickly so that the system is operational in a short time, for example for adhesive bonding and arc welding applications. In addition, function and technology packages can compensate for deviations in the shape or position of workpieces, automatically transform the CNC data generated with a CAM system into a robot program and carry out further industry-specific tasks.

Special applications with the KR C4

Application and additional software for virtually every robotic application
Quickly customized and made ready for operation
Tried and tested in all sectors relevant to robotics

KUKA function and technology packages

KUKA.Gripper & SpotTech	Programming of grippers and weld guns via easy-to-use inline forms for many industrial applications.
KUKA.ArcTech	For rapid start-up, simple programming and automatic power source control of arc welding applications.
KUKA.ArcSense	Option for KUKA.ArcTech – with through-the-arc sensors for seam tracking.
KUKA.TouchSense	Software technology package for tactile component/seam finding before a joining process.
KUKA.SeamTech	Options for both component/seam finding before a joining process and for edge/seam tracking during a joining process using an intelligent triangulation laser sensor.
KUKA.TRACC TCP	With this option, the robot can automatically check and if necessary recalibrate its TCP with the desired regularity during production operation.
KUKA.LaserTech	A modular, time-saving and easy-to-operate programming support package for laser cutting and laser welding. Both applications can be executed using the same robot – giving maximum flexibility as the workpiece needs to be clamped only once.
KUKA.ServoGun	Enables the operation of electric motor-driven spot weld guns with the KUKA robot controller. Various additional software options allow e.g. the elimination of mechanical gun compensation and other functions.
KUKA.GlueTech	Enables user-friendly programming of dispensing applications such as bonding, seam sealing or application of support seams using inline forms on the KUKA robot controller.
KUKA.VisionTech	KUKA.VisionTech makes it possible to pick up unsorted parts and remove non-aligned parts, e.g. for Pick & Place applications in a single plane or in space.
KUKA.ConveyorTech	KUKA.ConveyorTech makes it possible to synchronize program execution of the robot with an externally controlled conveyor. The robot can be synchronized with both linear and circular conveyor systems.
KUKA.ForceTorque Control	Robots typically move along programmed paths solely under position control, without consideration of the forces and torques acting on the tool or workpiece. In many cases, however, the setting or maintaining of precisely defined process forces has a decisive influence on the quality and process reliability of an application (e.g. assembly, polishing, grinding, bending). In such cases, the process forces and torques must be taken into consideration during the programming of robot motions. This is possible with KUKA.ForceTorqueControl.
KUKA.RoboTeam	Coordinates and enables the high-precision interaction of a team of robots for handling a shared load or for working together on a moving workpiece.
KUKA.EtherNet KRL	Makes it possible to exchange data with external computers via the Ethernet interface. The robot can function here both as a client and as a server.
KUKA.OPC-Server	Basic technology for standardized data exchange between robots and external controllers for non-real-time information streams. Ideal for interfacing with external visualization and MES systems.
KUKA.HMI zenon	Increases usability with the simple creation of user-defined interfaces or plugins by means of drag & drop. 2D/3D graphics can be quickly displayed to facilitate operation or diagnosis of the automation system for the user.
KUKA.PLC Multiprog	Programming environment for an extremely fast SoftPLC conforming to the IEC61131 standard. Expands the functionality of the KR C4 and offers virtually unlimited openness in the programming of automation cells and applications.
KUKA.PLC ProConOS	Runtime system of the KUKA.PLC Multiprog SoftPLC. PLC programs created with KUKA.Multiprog are run directly on the KR C4, with full access to the entire I/O system of the robot. Reading and processing of variables such as axis positions and velocity via function blocks.
KUKA.PLC Multiprog MCFB	Complex application requirements can be flexibly implemented by using axes/motors which are external to the robot.
KUKA.PLC mxA	Allows direct commanding and positioning of the robot by external controllers (Siemens®, Rockwell®, etc.). The user thus requires no knowledge of robot programming in the KUKA-specific robot language KRL.
KUKA.CNC	Complete software-based CNC implementation for execution of machine tool code (G-code) directly on the robot controller. This turns the robot, with its accuracy and stiffness, into a machining center for path-supported processes.
KUKA.Sim	The simulation programs of KUKA.Sim allow robotic cells to be planned with true-to-life accuracy.

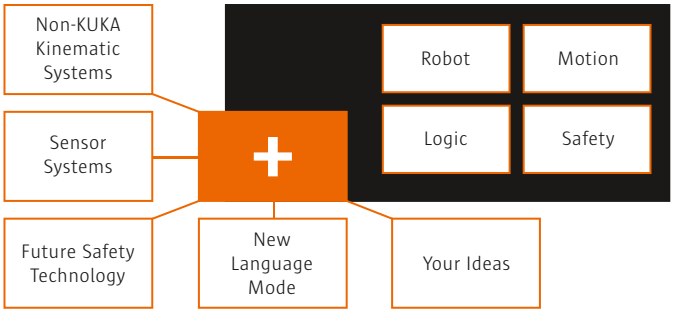
Interior of the KR C4: systematic reduction of hardware.

Leading today and tomorrow.

Thanks to proven industrial standards.

Today, mainstream technologies such as multi-core architecture and Gigabit Ethernet enable industry-standard performance. The KR C4 uses these technologies, allowing for the comprehensive expandability of software-based interfaces. It can be used to realize new safety concepts in automation, for example in human-robot cooperation tasks. Sensors which require numerous inputs and outputs can be easily connected to the KR C4.

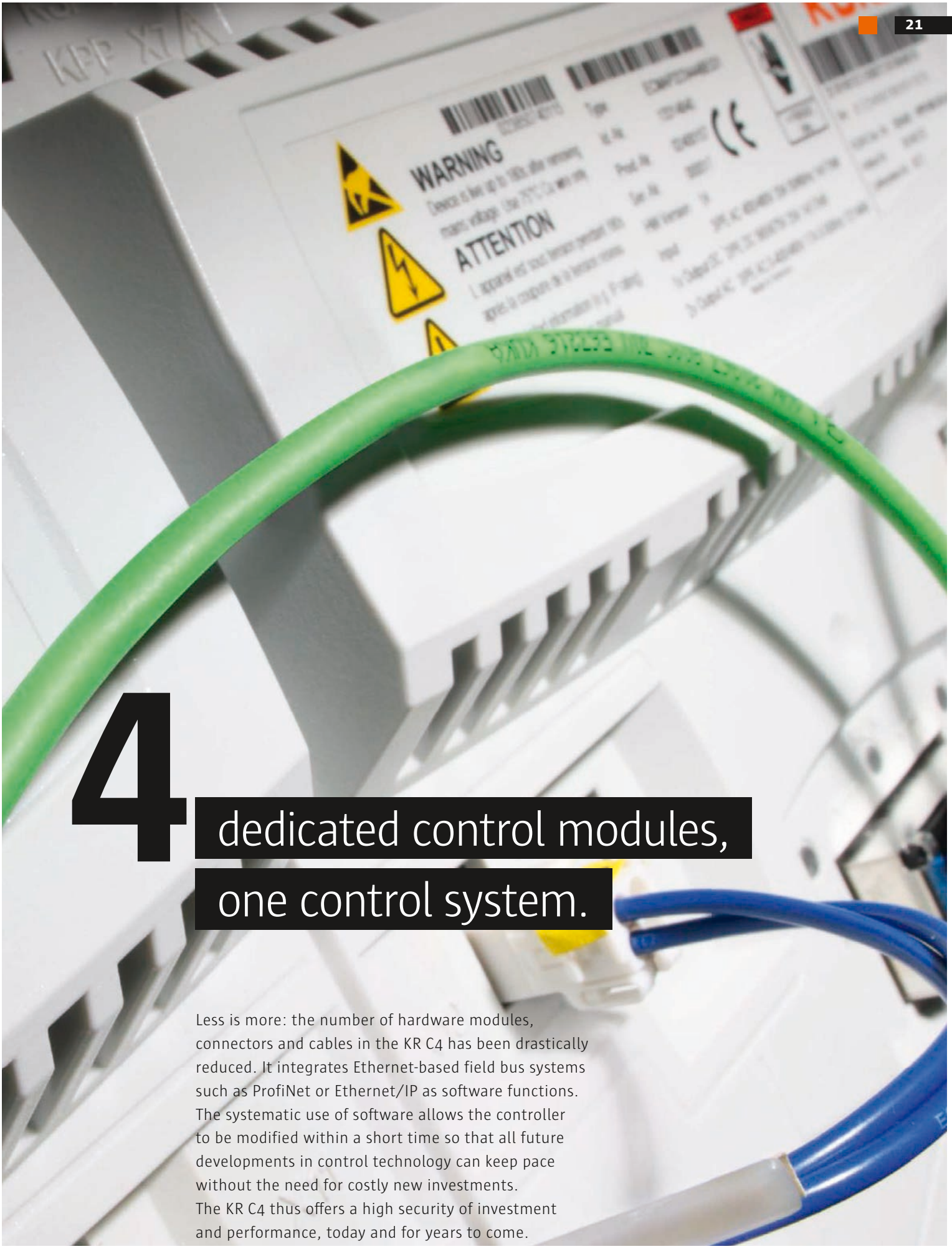
Robot, motion, sequence, process and safety control: all in one system. The KR C4 unites all the control tasks for the efficient use of robots in a single, smart system.



KR C4 – the future-proof choice

No proprietary hardware, open industry standards such as multi-core and Ethernet

Integrates Ethernet-based field bus systems, such as Profinet or Ethernet/IP as software functions



4 dedicated control modules, one control system.

Less is more: the number of hardware modules, connectors and cables in the KR C4 has been drastically reduced. It integrates Ethernet-based field bus systems such as ProfiNet or Ethernet/IP as software functions. The systematic use of software allows the controller to be modified within a short time so that all future developments in control technology can keep pace without the need for costly new investments. The KR C4 thus offers a high security of investment and performance, today and for years to come.

Pioneering human-robot cooperation: KUKA robotics with the KR C4 controller.

Robot source: KraussMaffei

Helps and protects. Safety with the KR C4.

The KR C4 integrates complete robot, motion, sequence, process and safety control. It also seamlessly incorporates the complete safety controller into the control system. Its multi-core technology enables the dual-channel operation required for safety applications. Safety functions and safety-oriented communication are implemented on the basis of Ethernet-based protocols.

This means that software-based safety interfaces have a virtually limitless capacity for expansion. New safety concepts in automation can be realized, for example for advanced human-robot cooperation tasks. The keyword “Safe Robot” becomes a reality with the KR C4. It saves production space, simplifies manual loading stations without the need for additional safety equipment and allows direct human-robot collaboration.

Safety and sensitivity are in demand.

Numerous KUKA Safe Robots in the medical sector attest to the performance of the KR C4. Just one of the many impressive examples is the medical application for robot-supported angiography developed by KUKA. Controlled by a KR C4, a robot examines the patient.

Advanced safety concept

Verification by an independent certification unit
All functions correspond to the latest ISO 10218-1:2011
Continuous performance level D / category 3: implementation of all safety functions in accordance with ISO 13849-1
Simple upgrade to future KUKA safety functions
Various interfaces to higher-level safety controllers (discrete 2-channel wiring, ProfiSafe, CIP Safety)

System integration

Safe inputs: operator safety (safety fence)
Safe standstill monitoring of all axes (robot & external axes)
Emergency Stop
Safe outputs
Safe disconnection of 24 V load voltage of peripheral components
Safe monitoring of max. 250 mm/s in T1 mode

Extended safety functions

Additional monitoring of the safety fence
Monitoring of axis ranges: robot & external axes, configurable axis group such as multiple positioners
Safe operational stop and restart monitoring for robots & external axes
Configurable axis group, such as multiple positioners
Offline configuration via WorkVisual or directly on the KUKA smartPAD
Assurance of the safety configuration by means of checksum methods and password-protected data entry menu
Protection against unintentional change
Graphical representation of monitoring ranges in simulation and in real time on the KUKA smartPAD
Proof of reliability based on applications with higher safety requirements (entertainment, medical)

Safety for the machine – motion with foresight.

Protection against overheating with temperature monitoring: for a maximum value or interval-based (I2T monitoring).

Collision avoidance with collision detection technology. If a collision is anticipated based on the real and pre-calculated robot motion, the robot is braked.

Following error monitoring and error message if limit value is exceeded and configurable online load data monitoring.

Safety for humans – in contact with machines.

Safe operational stop and restart monitoring for the safe proximity of humans and robots.

Safe Robot Technology monitors the robot in safe technology in its predefined working envelope and reduces reaction times.

The KR C4 safety advantage

Integrated safety controller, multi-core technology for the required dual-channel operation
Safety functions and safety communication via Ethernet-based protocols
Software-based interfaces for pioneering human-robot cooperation

Resource-conserving robotics.

Does more with less.

The energy efficiency of the KR C4 sustainably conserves resources and minimizes the cost risks inherent in rising energy prices.

The KR C4's integrated energy management offers various standby modes and an Eco mode. These reduce energy consumption and can mean savings of up to 95 % for individual operating states. The energy consumption can be simulated and calculated even in the engineering phase. During operation, the energy consumption can be displayed and verified on the control panel. KR C4 means efficiency with transparent energy consumption. This forms the basis for energy saving certification with tax advantages (ISO 50001).

Standby modes: up to 95 % less energy consumption.

Three different standby modes allow for energy savings by switching off the drives or the drives and controller. The KR C4's energy management thus drastically reduces power consumption in production-free times. Energy savings in standby mode: up to 95 %.

Transparent energy balance: energy and tax savings.

In simulation, the KR C4 optimizes energy consumption. Consumption during operation is continuously displayed. This paves the way for energy saving certification, which provides tax advantages.

Intelligent brake management: stops high costs.

The KR C4's programmable brake management reduces the strain on motors and keeps robots exactly in position with less power consumption.

weiskind.com

Contact KUKA at:

www.contact.kuka-robotics.com

www.facebook.com/**KUKA.Robotics**

www.youtube.com/**kukarobotgroup**

PB0008/E/1/0514