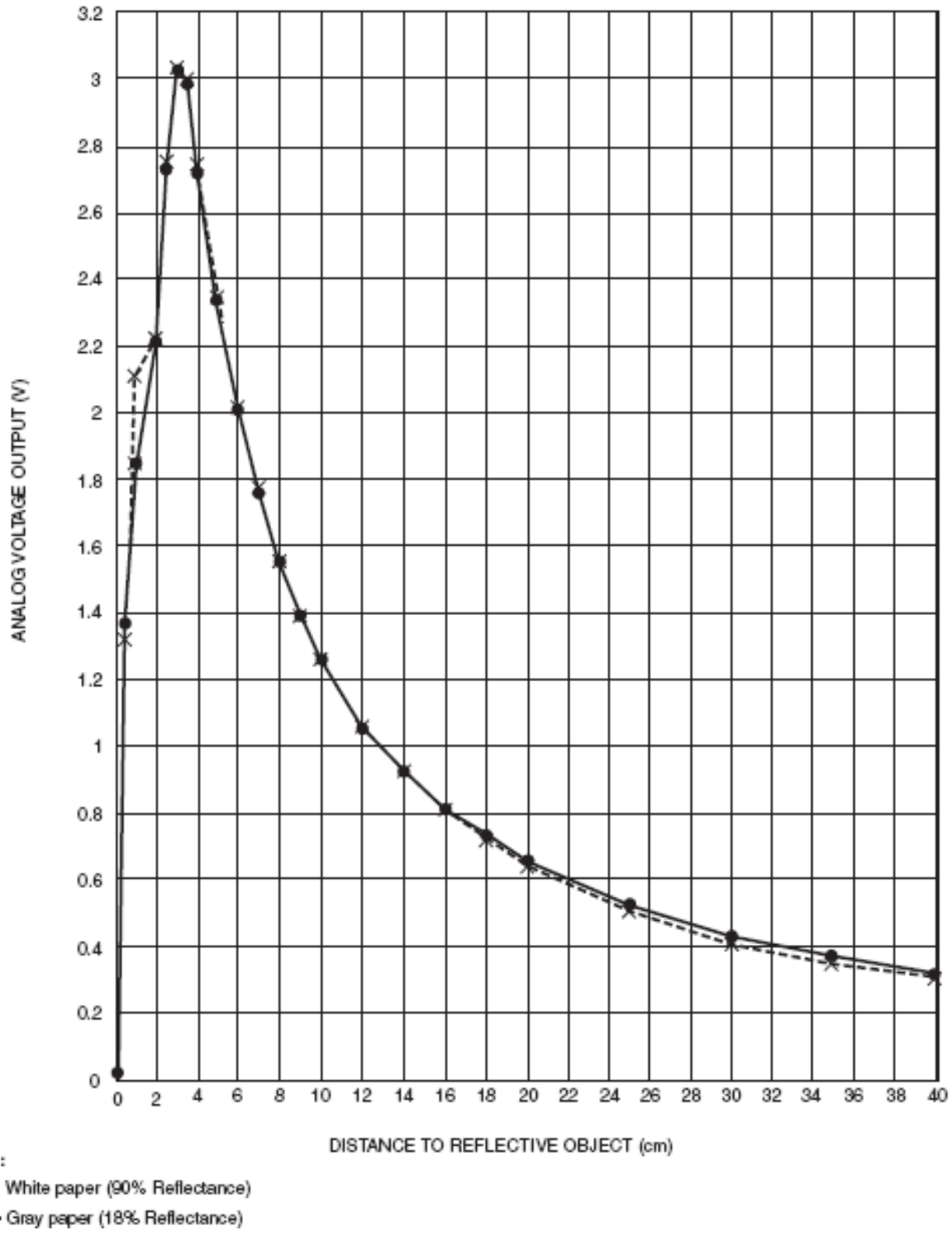
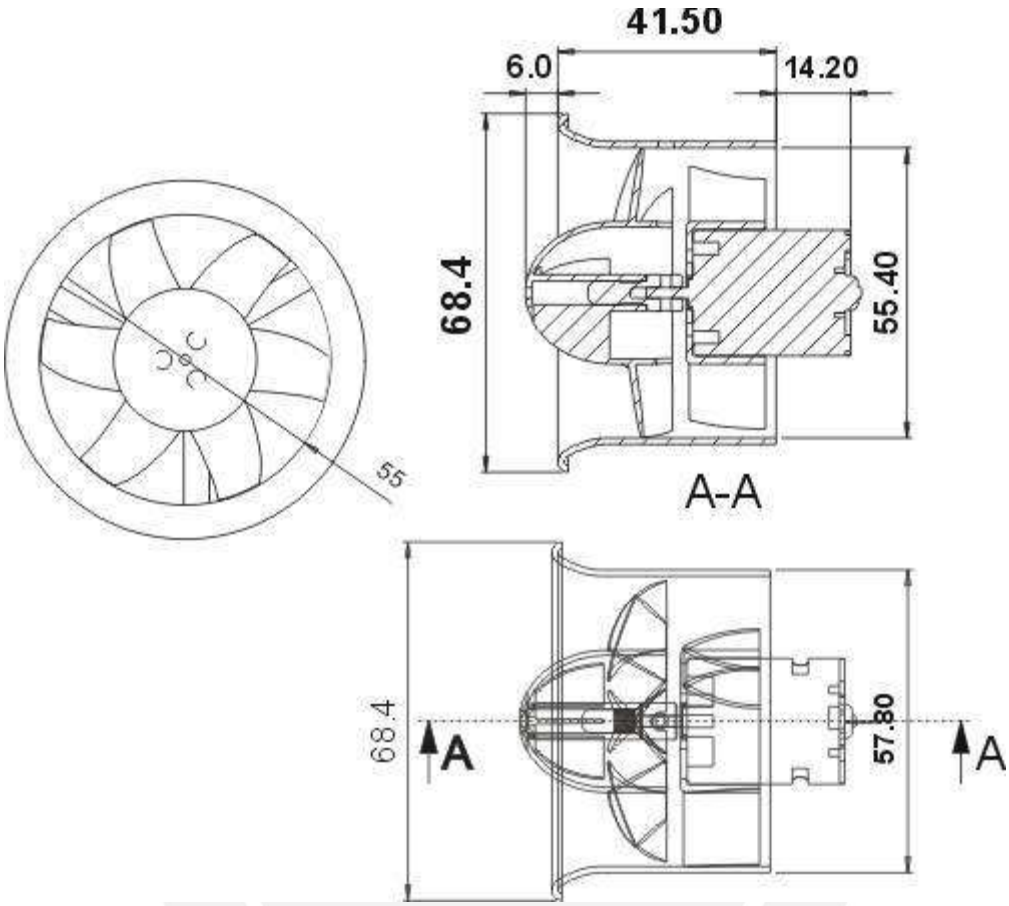
Ane o 1 Gra ica Distancia VS Volta e del sensor de ultrasonido.



Tesis publicada con autorización del autor
No olvide citar esta tesis

TESIS PUCP

Ane o 2 Plano del EDF55



Tesis publicada con autorización del autor
No olvide citar esta tesis

Ane o 3 ater a de pol mero de litio Turni y nano-tec A-SPEC G2 2200ma 3S 65 130C Lipo Pack

Especificaciones:
Capacidad: 2200mAh (mili amperio hora)
Voltaje: 3S1P / 3 Celdas / 11.1V
Descarga: 65C Constante / 130C Golpe
Máximo ratio de carga: **8C**
Peso: 192g (incluye cables, conector y carcaza)
Dimensiones: 103x34x26mm
Conector de inspección: JST-XH
Conector de descarga: XT60 Connector

Tesis publicada con autorización del autor
No olvide citar esta tesis

Ane o 4 Pro ramador de ESC TURNIGY ESC Pro rammin Card

Facilita la pro ramaci n de la ESC con una serie de indicadores LED. Posee otones para la nave aci n de las opciones, seleccionar la caracter stica deseada y cam iarla. Simple y m s cil ue escuc ar los sonidos emitidos por los ESC para la pro ramaci n.

Tesis publicada con autorización del autor
No olvide citar esta tesis

TESIS PUCP

Ane o 5 Electronic Speed Controler (ESC) Q rain 4 25A rus less Quadcopter ESC 2-4S 3A S EC

Inte ra 4 ESC en un solo inte rado, cada uno controlado por su propia se al de control. A orra espacio y peso en la aplicaci n.

Caracter sticas

- Conveniente todo-en-uno dise o de ESC
- Salida de 4 25 amperios.
- Protecci n de a o volta e re ula le.
- Completamente pro rama le.

Especi icaciones

Volta e de entrada 7.4 14.8V (2 4S lipoly)
Corriente 25 A 4 (constante)
Corriente de olpe 30 A 4 por 10 se undos
Tipo de EC conmutaci n
Salida de EC 5.25 V 3 A
Lon itud de ca le de motor 250mm
Dimensiones 69 62 11 mm
Peso 112 ramos

Este ESC es compati le con la tar eta de pro ramaci n Turni y ESC Pro rammin Card.

Nota El circuito de eliminaci n de ater a (EC, por sus si las en in l s) es un circuito electr nico dise ado para entre ar ener a el ctrica a otro circuito sin necesidad de una ater a.

Tesis publicada con autorización del autor
No olvide citar esta tesis

TESIS PUCP

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

Ane o 6 Car ador de ater a IMA 6-AC C ar er/Disc ar er 1-6 Cells (GENUINE)

Features:
•AC 100~240v or 12V DC input
•Microprocessor controlled
•Delta-peak sensitivity
•Individual cell balancing
•Li-ion, LiPo and LiFe capable
•Ni-Cd and NiMH capable
•Large range of charge currents
•Store function, allows safe storage current
•Time limit function
•Input voltage monitoring. (Protects car batteries at the field)
•Data storage (Store up to 5 packs in memory)
•Battery break in and cycling.

ESPECIFICACIONES:

Volta e de operaci n: ……De 11 a 18 Voltios, Corriente Continua.
AC 125 240 voltios 50H .
Potencia: ……Máxima en Carga: 50 Vatios.
M ima en Descar a 5 Vatios.
Corriente de carga: ……...0.1 a 5 Amperios.
Corriente de descarga: ……0.1 a 1 Amperio.
Corriente drenaje para equilibrar baterías LiPos: …300 mAh/célula.
Número de células de baterías de NiCd/NiMH: ……1 a 15 células.
N mero de c lulas de Li-íon/Polímero: ……1 a 6 en serie.
Voltaje para baterías de Plomo: ……..2 a 20 Voltios.
Peso: ……220 gramos.
Dimensiones: ……133 x 87 x 33 mm.

Tesis publicada con autorización del autor
No olvide citar esta tesis

TESIS PUCP

Ane o 7 Control remoto Futa a 14SG 14-C annel 2.4GH Computer Radio System 2.4GH FASSTest

Fetures:

• Channels: 12 proportional, 2 switched
• Compatible with FASSTest, FASST and S-FHSS protocols
• FASSTest telemetry – compati le wit Futa a telemetry sensors (sold separately)
• Free user-updata le so tware
• 30-model memory
• 10-c aracter user namin
• 10-c aracter model namin
• Airplane, helicopter and lider pro rammin
• Large, 1.75” x 3” backlit LCD screen with 128 x 64 resolution
• SensorTouch™ programming
• Compatible with secure digital memory cards for external storage of model setups and software • updates (32MB-2G or HC (Hi -Capacity) 4G -32G)
• Left and right assignable slider switches
• Two assignable rotary knobs
• Six assignable three-position switc es
• One assignable momentary two-position switc
• One assignable two-position switc
• Comfortable rubber grips on the sides and ack
• Wide top switch spacing
• Adjustable stick tension
• Dual ball bearing gimbals
• 4 vibration warning types

Tesis publicada con autorización del autor
No olvide citar esta tesis

TESIS PUCP

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

- Home/Exit; User Menu/Servo Monitor buttons
- Audio earphone jack (for telemetry alarms)
- 6V 1800mAh NiMH battery pack
- User stick cali ration
- Trainer system
- Servo speed adjust
- 5 programmable mixes
- V-tail, Ailvator, win let, motor mi in
- Trim mix
- Logic switch (condition switch only)
- Internal programmer for S.Bus servos
- User menu
- Servo monitor (neutral and moving tests)
- 2 count up/countdown timers
- Integral timer
- Model timer
- Quick model select

Tesis publicada con autorización del autor
No olvide citar esta tesis

TESIS PUCP

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

Ane o 8 Receptor RF R7008S FASSTest Telemetry Receiver

Dimensiones 24.9 47.3 14.3 mm

Peso 10.9 ramos

Frecuencia 2.4 GH

Canales 8

Volta e de alimentaci n 3.7 – 7.4 voltios

Tesis publicada con autorización del autor
No olvide citar esta tesis

Anexo 9: Tabla de coeficientes cinéticos y estáticos

Superficies en contacto	μ_s	μ_k
Cobre sobre acero	0.53	0.36
Acero sobre acero	0.74	0.57
Aluminio sobre acero	0.61	0.47
Caucho sobre concreto	1.0	0.8
Madera sobre madera	0.25-0.5	0.2
Madera encerada sobre nieve húmeda	0.14	0.1
Teflón sobre teflón	0.04	0.04
Articulaciones sinoviales en humanos	0.01	0.003

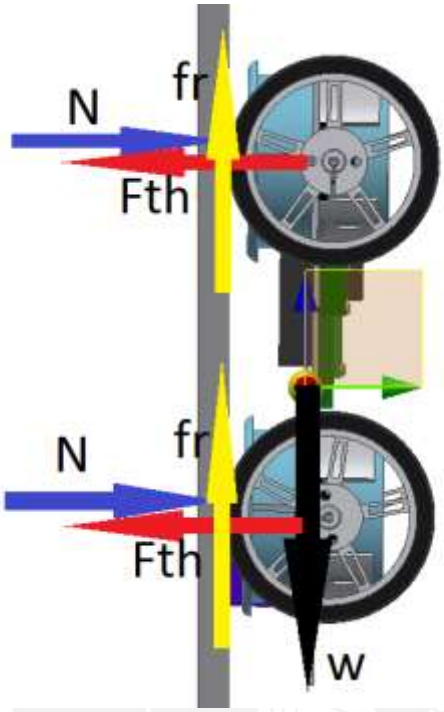
Fuente: Serway R. A.. *Física*. Editorial McGraw-Hill. (1992)

Tesis publicada con autorización del autor
No olvide citar esta tesis

TESIS PUCP

Anexo 10: Cálculos de la fuerza de agarre

1) Cuando el móvil se encuentra en una pared



$$fr = \mu * N,$$

$$4N = Fth,$$

$$N = \frac{Fth}{4},$$

$$4 * fr - w = m * a,$$

$$4 * (\mu * N) - m * g = m * a,$$

$$4 * \left(\mu * \frac{Fth}{4}\right) - m * g = m * a,$$

$$Fth = \frac{m * a}{\mu} + \frac{m * g}{\mu},$$

$$Fth = \frac{m}{\mu} * (a + g).$$

Reemplazando los valores:

m = masa del móvil = 0.750 kg,

μ = coeficiente de fricción cinética entre caucho y concreto = 0.8,

Tesis publicada con autorización del autor
No olvide citar esta tesis

a = aceleración del móvil = 0.164 m/s2,

g = aceleración de la gravedad = 9.81 m/s2,

$$Fth = \frac{0.750}{0.8} * (0.164 + 9.81) = 9.35\ N.$$

La fuerza que de la que se dispone es:

$$Freal = 4 * 0.490 * 9.81 = 19.23\ N.$$

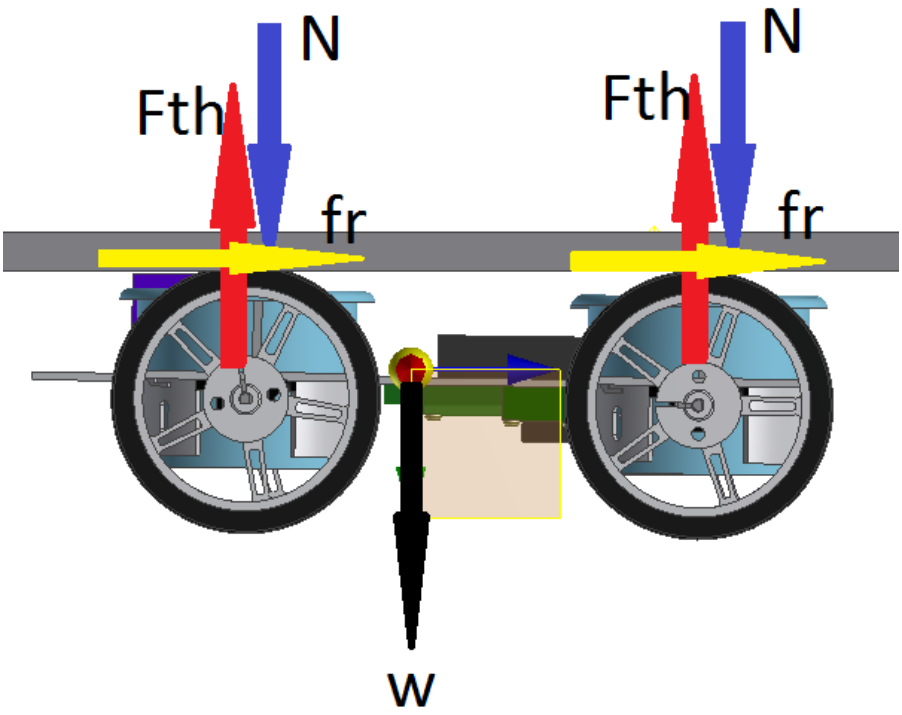
Como Freal > Fth, el agarre del móvil a la pared es posible.

Si la masa fuera m = 1kg (0.250 kg adicionales):

$$Fth = \frac{1}{0.8} * (0.164 + 9.81) = 12.47\ N.$$

La nueva fuerza Fth necesaria para adherir el móvil a la pared sigue siendo menor a la suministrada, por ende, adicionarle un sensor de 0.250 kg es posible.

2) Cuando el móvil se encuentra en un techo



Tesis publicada con autorización del autor
No olvide citar esta tesis

$$w + 4 * N = Fth,$$

$$fr = \mu * N,$$

$$4 * fr = m * a,$$

$$\mu * (Fth - mg) = ma,$$

$$\mu * Fth = m * (a + \mu * g),$$

$$Fth = \frac{m}{\mu} * (a + \mu * g).$$

Reemplazando los valores:

Reemplazando los valores:

m = masa del móvil = 0.750 kg,

μ = coeficiente de fricción entre caucho y concreto = 0.8,

a = aceleración del móvil = 0.164 m/s2,

g = aceleración de la gravedad = 9.81 m/s2,

$$Fth = \frac{0.750}{0.8} * (0.164 + 0.8 * 9.81) = 7.51\ N.$$

La fuerza que de la que se dispone es;

$$Freal = 4 * 0.490 * 9.81 = 19.23\ N,$$

Como Freal > Fth, el agarre del móvil a la pared es posible.

Si la masa fuera m = 1kg (0.250 kg adicionales)

$$Fth = \frac{1}{0.8} * (0.164 + 0.8 * 9.81) = 10.01\ N.$$

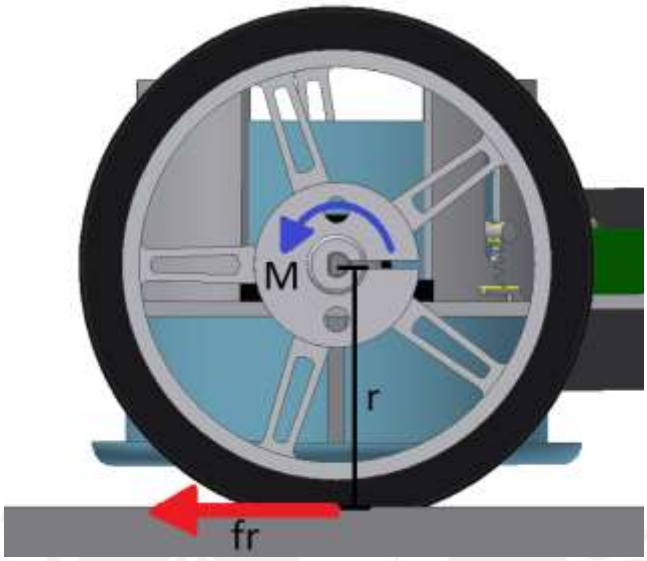
La nueva fuerza Fth necesaria para adherir el móvil a la pared sigue siendo menor a la suministrada, por ende, adicionarle un sensor de 0.250 kg es posible.

Como se puede observar de los resultados, el caso más crítico se presenta cuando el móvil se encuentra en una superficie vertical, pues depende de la fuerza de fricción para su movimiento y su agarre.

Tesis publicada con autorización del autor
No olvide citar esta tesis

Anexo 11: Calculo de torque para movimiento de las ruedas

Se quiere hallar el torque que el micro motor DC necesita entregar para hacer girar la rueda, y así que el móvil escalador pueda desplazarse.



$$M = fr * r = \mu * Fth * r.$$

M = torque del motor DC,

fr = friccion de la rueda con el concreto,

μ = coeficiente de fricción estático del caucho con concreto = 1 (Ver Anexo 9)

Fth = Fuerza del EDF = 0.490 kgf,

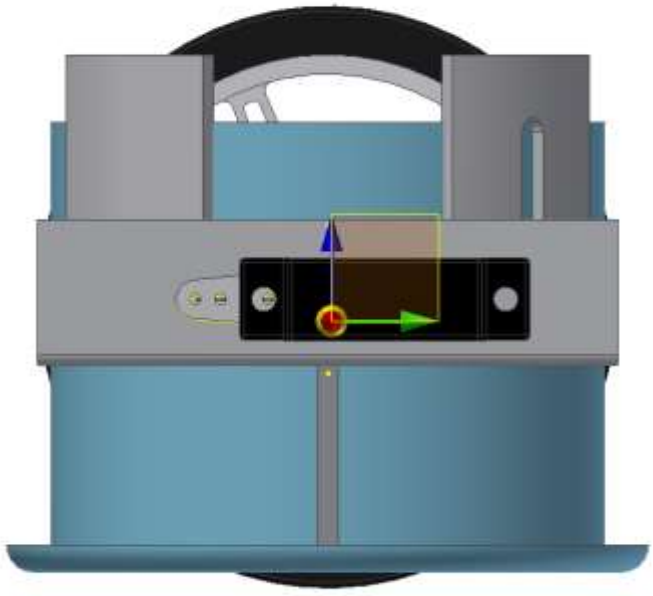
r = radio de la rueda = 3.5 cm.

$$M = (0.490 * 1) * 3.5 = 1.715\ kgf * cm.$$

Por lo tanto, el torque necesario para girar la rueda a una velocidad constante es 1.7 kgf.cm. Con este dato, se escoje el 298:1 Micro Gearmotor HP, especificado en el documento.

Tesis publicada con autorización del autor
No olvide citar esta tesis

Anexo 12: Calculo del torque del servomotor para movimiento de las extremidades



Dado que la extremidad se moverá a una velocidad constante, es necesario calcular el torque necesario para cambiar su estado inercial del reposo a imponerle una velocidad.

$$T = Tc + J\alpha + f\omega.$$

T = toque deseado,

Tc = torque de la carga (= 0 N*m),

J = momento de inercia respecto al eje de giro (Ixx = 0.402 kg*cm^2, dato calculado desde el modelo en Autodesk Inventor 2014),

α = aceleración angular,

f = coeficiente de rozamiento,

ω = velocidad angular.

Para la aceleración angular, se requiere que el servomotor gire π/4 radianes en 1 segundo, y que pase del reposo a dicha velocidad angular en 0.09 segundos. Por ende, se tiene que:

$$\alpha = \frac{\omega}{t} = \frac{0.25\pi \frac{rad}{s}}{0.09\ s} = 8.73 \frac{rad}{s^2}.$$

Tesis publicada con autorización del autor
No olvide citar esta tesis

Despreciando el valor de la fricción, se calcula:

$$T = (0.404\ kg * cm^2) * \left(8.73 \frac{rad}{s^2}\right) = 3.53\ \frac{kg * cm^2}{s^2} = 3.53x10^{-3}\ kgf * cm\ .$$

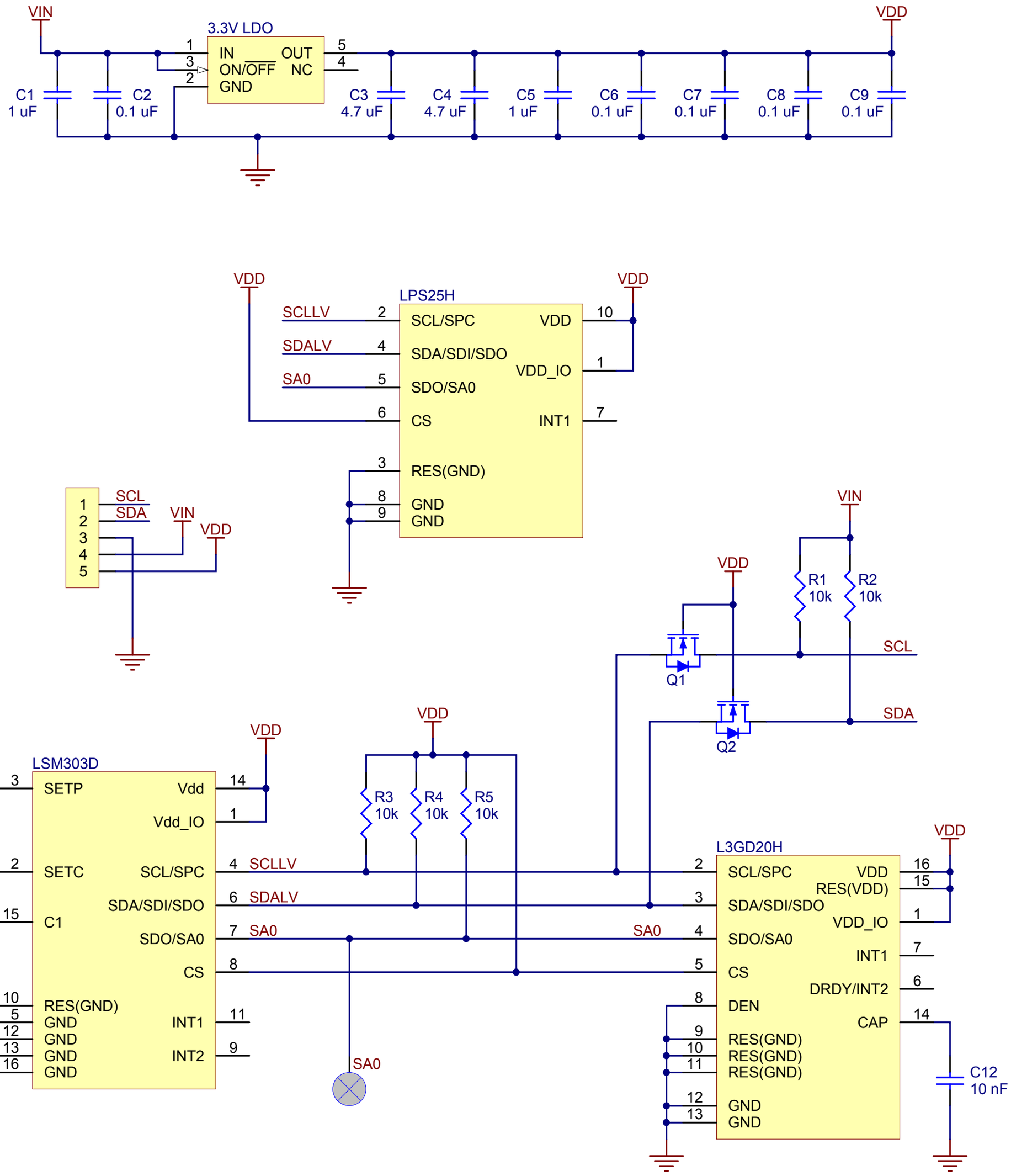
Con este dato, se comprueba que el servomotor elegido (Power HD High-Speed Digital Micro Servo DSM44) brinda el torque necesario (1.2 kgf*cm) para girar la extremidad.

Tesis publicada con autorización del autor
No olvide citar esta tesis

Pololu AltIMU-10 v4
Gyro, Accelerometer, Compass, and Altimeter
(L3GD20H, LSM303D, and LPS25H Carrier)

©2014 Pololu Corporation

www.pololu.com



Traducción: Tecnocarp

INTRODUCION:

Gracias por comprar el Cargador Balanceador iMAX B6 LiPro. Este producto es un cargador rápido, con un microprocesador de alto rendimiento, y un software especializado de operación. Por favor lea este manual de instrucciones, completamente y con atención, antes de usar este producto, describe una amplia gama de información, sobre el funcionamiento y de seguridad. O por favor haga uso de este producto, con un conocedor de este Cargador.

ESPECIFICACIONES:

Voltaje de operación: ……De 11 a 18 Voltios, Corriente Continua.
AC 125 240 voltios 50H .
Potencia: ……Máxima en Carga: 50 Vatios.
Máxima en Descarga: 5 Vatios.
Corriente de carga: ……..0.1 a 5 Amperios.
Corriente de descarga: ……0.1 a 1 Amperio.
Corriente drenaje para equilibrar baterías LiPos: …300 mAh/célula.
Número de células de baterías de NiCd/NiMH: ……1 a 15 células.
Número de células de Li-íon/Polímero: ……1 a 6 en serie.
Voltaje para baterías de Plomo: ……..2 a 20 Voltios.
Peso: ……220 gramos.
Dimensiones: ……133 x 87 x 33 mm.

Tesis publicada con autorización del autor
No olvide citar esta tesis

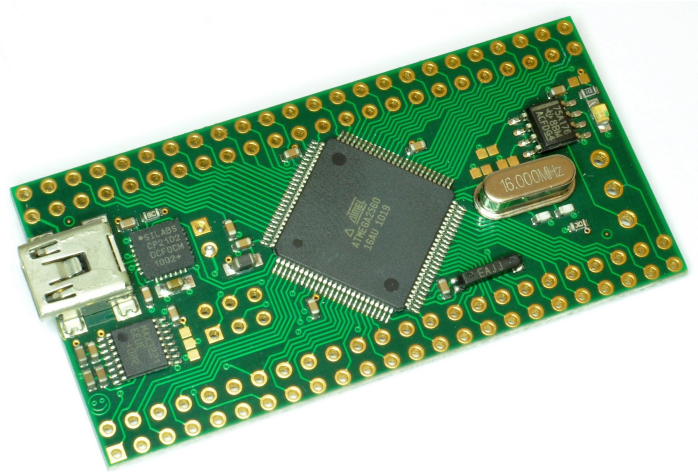
Arduino-compatible OEM module with ATmega2560 controller and CP2102 USB UART converter.

AVAILABLE OPTIONS

Module	Processor	RAM	EEPROM	Flash	Peripherals
Crumbuino-Mega	ATmega2560	8kB SRAM	4kB EEPROM	256kB Flash	- CP2102 USB-UART converter - MAX3221 RS232 transceiver - SN75ALS176 RS485 transceiver - mini USB B 5pin connector - status LED and tiny reset button

ARDUINO BOOTLOADER

The Crumbuino-Mega module comes preloaded with the Arduino ATmega2560 bootloader. Also actived is the auto-reset function, providing a seamless integration to the Arduino IDE for uploading of a program without the need to reset the module in advance.



AUTO RESET FEATURE

Jumper J7 (on the bottom of the module) is closed by default, thus enabling the automatic reset of the ATmega2560 by the Arduino IDE before connecting the bootloader and upload a program.

USB INTERFACE

A USB UART converter CP2102 by Silabs is connected to the MCU's USART0 RXD/PE0 and TXD/PE1. A standard 5pin mini USB B connector is available onboard and allows for easy connection to a host PC. The CP2102 is always powered from USB bus.

FEATURES

High Performance
- 16MHz operating frequency
- single 5V power supply

Familiar Integrated AVR Peripherals
- up to 83 IO pins available
- two 8 bit, four 16 bit timer/counter
- 4 PWM channels (8 bit resolution)
- 12 PWM channels (2 to 16 bit resolution)
- input capture and output compare functions
- real time clock counter
- four programmable UARTs
- master/slave SPI interface
- two wire interface (I²C comp.)
- analog comparator
- 16 channel 10 bit ADC
- watchdog timer
- ISP and JTAG interface

Enhanced Onboard Peripherals
- CP2102 USB to UART converter at USART0 (PE0, PE1)
- MAX3221 RS232 transceiver at USART2 (PH0, PH1)
- SN75ALS176 RS485 transceiver at USART3 (PJ0, PJ1, PJ2)
- 16MHz XTAL crystal
- 32768Hz clock crystal preinstalled
- standard 6 pin Atmel AVR ISP connector
- status LED (connected to PJ7)

Expansion Headers
- standard 2.54mm headers with all controller signals and signals from onboard peripherals
- auxiliary 3pin screw terminal (connected to RS485 signals for direct cable connection, RS485 signals are also available at pin headers, see below pinout)

SCOPE OF DELIVERY

This module is being shipped with preloaded Arduino bootloader, mounted 16MHz crystal and a set of headers/receptacles (each 2x 48 pin + ISP header) added to the module separately (not mounted).

Tesis pu
No olvide citar esta tesis

BUS INTERFACES

USB INTERFACE

A USB UART converter CP2102 by Silabs is connected to the MCU's USART0. A standard 5pin mini USB B connector is available onboard and allows for easy connection to a host PC. The CP2102 is always powered from USB bus. The USB driver for the CP2102 is available at http://www.silabs.com/products/interface/usbtouart.

RS232 INTERFACE

USART2 is connected to an industry standard RS232 transceiver MAX3221. When you want to use the RS232 port, you have to enable it by setting solder jumper J2 to 1-2. If not used, the jumper should be set to 2-3 to fully disable the transceiver. RS232 can be used not only with 5V supply, but with 3.3V supply, too.

RS485 INTERFACE

USART3 is connected to an industry standard RS485 transceiver SN75ALS176. By closing all four jumpers J3 to J6, the RS485 transceiver is connected to the MCU and to VCC. If not used, all four jumper should be left open. The RS485 is available with 5V supply only.

STATUS LED

A green low-current status LED is connected low-active to the MCU's signal PJ7, i.e. Arduino Digital Pin 83. Setting this pin to output and low will turn on the LED.

ISP CONNECTOR

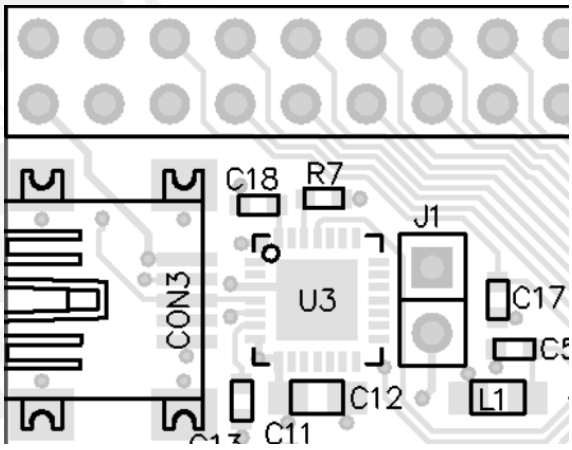
An ISP header with Atmel's standard 6-pin pinout is available on the module, see pictures below for location and pinout.

POWER SUPPLY OPTIONS

The module can be power either externally (VCC pin on the expansion headers) or from USB bus 5V.

J1 selects between these options:

- open: external power supply (1.8V – 5.5V)
- close: USB bus powered (approx. 5V)



ARDUINO PIN MAPPING

The Crumbuino-Mega can be used in the Arduino software environment (Arduino IDE) either as Arduino-MEGA 2560 or as Crumbuino-Mega.

The next section and picture shows the mapping of the Arduino signal names (Digital Pin xx, Analog Pin yy, etc.) to the Crumbuino-Mega module pins, when used as dedicated Crumbuino-Mega device. If you want to use the module as Crumbuino-Mega in the Arduino IDE, make sure to download the latest Arduino software extension from our homepage (http://download.chip45.com/chip45-arduino-extension.zip) and unzip it into your original Arduino installation.

If you want to use the module as Arduino-Mega 2560, you don't have to install anything. The signal / pin mapping is shown in a separate section below. As Arduino-Mega 2560 not all ATmega2560 signals are available as Arduino pin names, since not all of them have been used on the original Arduino-Mega 2560. If you run out of IOs or want a more intuitive pin mapping on the module, you should consider using it as Crumbuino-Mega, see above.

Tesis pu
No olvide citar esta tesis

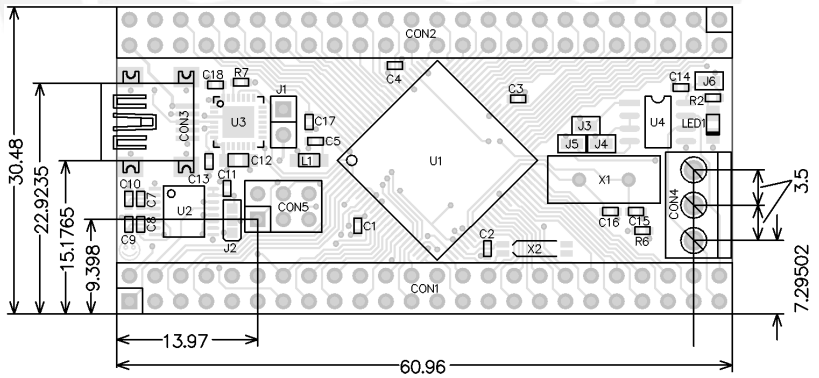
CRUMBUINO-MEGA PIN MAPPING

The following table shows the mapping of the Arduino pin names on the Crumbuino-Mega module pins.

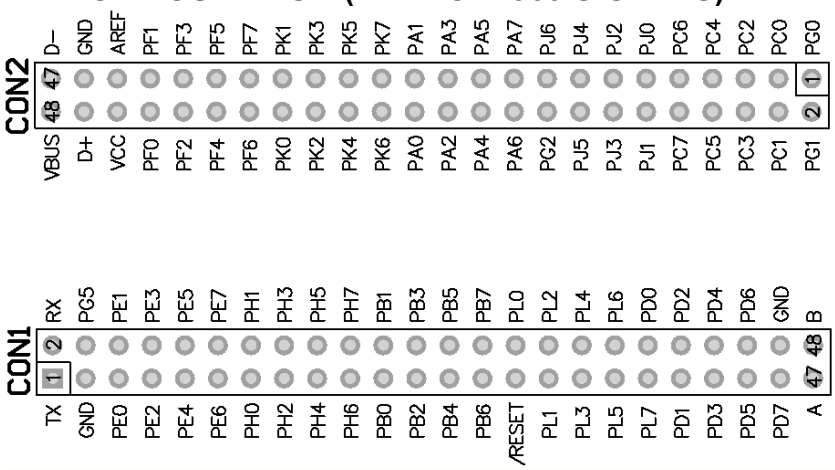
RS232 TX	RS232 RX	VBUS	D-
GND	Digital Pin 82	D+	GND
(USART0_RX) Digital Pin 0	Digital Pin 1 (USART0_TX)	VCC	AREF
Digital Pin 2	Digital Pin 3 (PWM)	Analog Input 0	Analog Input 1
(PWM) Digital Pin 4	Digital Pin 5 (PWM)	Analog Input 2	Analog Input 3
Digital Pin 6	Digital Pin 7	Analog Input 4	Analog Input 5
(USART2_RX) Digital Pin 8	Digital Pin 9 (USART2_TX)	Analog Input 6	Analog Input 7
Digital Pin 10	Digital Pin 11 (PWM)	Analog Input 8	Analog Input 9
(PWM) Digital Pin 12	Digital Pin 13 (PWM)	Analog Input 10	Analog Input 11
(PWM) Digital Pin 14	Digital Pin 15	Analog Input 12	Analog Input 13
(SPI_CS) Digital Pin 16	Digital Pin 17 (SPI_SCK)	Analog Input 14	Analog Input 15
(SPI_MOSI) Digital Pin 18	Digital Pin 19 (SPI_MISO)	Digital Pin 65	Digital Pin 64
(PWM) Digital Pin 20	Digital Pin 21 (PWM)	Digital Pin 63	Digital Pin 62
(PWM) Digital Pin 22	Digital Pin 23 (PWM)	Digital Pin 61	Digital Pin 60
/RESET	Digital Pin 24	Digital Pin 59	Digital Pin 58
Digital Pin 25	Digital Pin 26	Digital Pin 57	Digital Pin 56
(PWM) Digital Pin 27	Digital Pin 28 (PWM)	Digital Pin 55	Digital Pin 54
(PWM) Digital Pin 29	Digital Pin 30	Digital Pin 53	Digital Pin 52
Digital Pin 31	Digital Pin 32 (I2C_SCL)	(USART3_TX) Digital Pin 51	Digital Pin 50 (USART_RX)
(I2C_SDA) Digital Pin 33	Digital Pin 34 (USART1_TX)	Digital Pin 49	Digital Pin 48
(USART1_RX) Digital Pin 35	Digital Pin 36	Digital Pin 47	Digital Pin 46
Digital Pin 37	Digital Pin 38	Digital Pin 45	Digital Pin 44
Digital Pin 39	GND	Digital Pin 43	Digital Pin 42
RS485 A	RS485 B	Digital Pin 41	Digital Pin 40

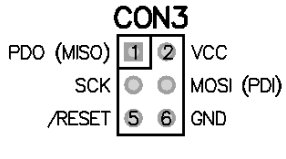
PHYSICAL DIMENSIONS

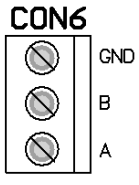
Values are [mm] unless otherwise noted.



PIN CONFIGURATION (ATMEGA2560 SIGNALS)







auxiliary screw terminal with RS485 bus signals

ATMEGA2560/Crumb2560 ↔ ARDUINO MEGA 2560 PIN MAPPING

The following table shows the mapping of the original ATmega2560 pin names from the Atmel data sheet to the pin names of the Arduino development environt when used as Arduino-Mega 2560. For pin location on the module, also check the picture “pin configuration” above.

Atmega2560 Pin Name	Arduino Pin Name	Atmega2560 Pin Name	Arduino Pin Name
PA7 (AD7)	Digital Pin 29	PF7 (ADC7/PCINT15)	Analog Pin 7
PA6 (AD6)	Digital Pin 28	PF6 (ADC6/PCINT14)	Analog Pin 6
PA5 (AD5)	Digital Pin 27	PF5 (ADC5/TMS)	Analog Pin 5
PA4 (AD4)	Digital Pin 26	PF4 (ADC4/TMK)	Analog Pin 4
PA3 (AD3)	Digital Pin 25	PF3 (ADC3)	Analog Pin 3
PA2 (AD2)	Digital Pin 24	PF2 (ADC2)	Analog Pin 2
PA1 (AD1)	Digital Pin 23	PF1 (ADC1)	Analog Pin 1
PA0 (AD0)	Digital Pin 22	PF0 (ADC0)	Analog Pin 0
PB0 (SS/PCINT0)	Digital Pin 53 (PWM)(RX1)	PG0 (WR)	Digital Pin 41
PB1 (SCK/PCINT1)	Digital Pin 52 (PWM)(SDA)	PG1 (RD)	Digital Pin 40
PB2 (MOSI/PCINT2)	Digital Pin 51 (PWM)(SCL)	PG2 (ALE)	Digital Pin 39
PB3 (MISO/PCINT3)	Digital Pin 50	PH0 (RXD2)	Digital Pin 17 (PWM)
PB4 (OC2A/PCINT4)	Digital Pin 10 (PWM)	PH1 (TXD2)	Digital Pin 16 (PWM)
PB5 (OC1A/PCINT5)	Digital Pin 11 (PWM)	PH2 (XCK2)	(TX3)
PB6 (OC1B/PCINT6)	Digital Pin 12 (PWM)	PH3 (OC4A)	Digital Pin 6 (PWM)(RX3)
PB7 (OC0A/OC1C/PCINT7)	Digital Pin 13 (PWM)	PH4 (OC4B)	Digital Pin 7 (PWM)(TX2)
PC0 (A8)	Digital Pin 37	PH5 (OC4C)	Digital Pin 8 (PWM)(RX2)
PC1 (A9)	Digital Pin 36	PH6 (OC2B)	Digital Pin 9 (PWM)(TX1)
PC2 (A10)	Digital Pin 35	PH7 (T4)	
PC3 (A11)	Digital Pin 34	PJ0 (RXD3/PCINT9)	Digital Pin 15
PC4 (A12)	Digital Pin 33	PJ1 (TXD3/PCINT10)	Digital Pin 14
PC5 (A13)	Digital Pin 32	PJ2 (XCK3/PCINT11)	
PC6 (A14)	Digital Pin 31	PJ3 (PCINT12)	
PC7 (A15)	Digital Pin 30	PJ4 (PCINT13)	
PD0 (SCL/INT0)	Digital Pin 21 (SCL)	PJ5 (PCINT14)	
PD1 (SDA/INT1)	Digital Pin 20 (SDA)	PJ6 (PCINT 15)	
PD2 (RXDI/INT2)	Digital Pin 19	PK7 (ADC15/PCINT23)	Analog Pin 15
PD3 (TXD1/INT3)	Digital Pin 18	PK6 (ADC14/PCINT22)	Analog Pin 14
PD4 (ICP1)		PK5 (ADC13/PCINT21)	Analog Pin 13
PD5 (XCK1)		PK4 (ADC12/PCINT20)	Analog Pin 12
PD6 (T1)		PK3 (ADC11/PCINT19)	Analog Pin 11
PD7 (T0)	Digital Pin 38	PK2 (ADC10/PCINT18)	Analog Pin 10
PE0 (RXD0/PCINT8)	Digital Pin 0 (PWM) (RX0)	PK1 (ADC9/PCINT17)	Analog Pin 9
PE1 (TXD0)	Digital Pin 1 (PWM) (TX0)	PK0 (ADC8/PCINT16)	Analog Pin 8
PE2 (XCK0/AIN0)			
PE3 (OC3A/AIN1)	Digital Pin 5 (PWM)	AREF	Analog Reference
PE4 (OC3B/INT4)	Digital Pin 2 (PWM)	GND	GND
PE5 (OC3C/INT5)	Digital Pin 3 (PWM)	AVCC	VCC
PE6 (T3/INT6)		RESET	RESET
PE7 (CLKO/ICP3/INT7)			

Tesis pu
No olvide citar esta tesis

OPERATING CHARACTERISTICS

Symbol	Parameter	Condition	Min	Typ	Max	Units
Vcc	Supply Voltage	16 MHz	4.5		5.5	V
Icc	Power Supply Current *(Icc strongly depends on CPU activity, like frequency, power saving modes, etc. as well as external circuitry, io pin input and output current, etc. The values denoted here are for reference only and can differ from final application vallues.)*	Active 16MHz Vcc = 5V		22		mA
		USB bus active *(power is drawn from USB bus)*		+26		mA
T	Operating Temperature *(industrial temperature range on request)*		-20		+70	°C

DESIGN AND HANDLING GUIDELINES

This module – just like any other semiconductor devices – is susceptible to damage by ESD. Suitable precautions should be taken when handling and transporting devices. The possible damage to devices depends on the circumstances of the handling and transporting, and the nature of the device. The extent of damage can vary from immediate functional or parametric malfunction to degradation of function or performance in use over time. Devices suspected of being affected should be replaced.

DEVELOPMENT TOOLS

As an Arduino-compatible module, the Crumbuino-Mega is indendet to be used with the Arduino IDE as development environment.

- Arduino Homepage: http://arduino.cc/en/
- Getting Started Page: http://arduino.cc/en/Guide/HomePage
- Arduino Software Page: http://arduino.cc/en/Main/Software

- chip45 Arduino Extensions: http://download.chip45.com/chip45-arduino-extension.zip

- Crumbuino-Mega LED blink example sketch: http://download.chip45.com/Blink_Crumbuino-Mega.zip

WHAT ELSE DO YOU NEED?

The only thing you really need, is a USB cable to connect the Crumbuino-Mega to a PC or Mac:

- Cable mini-USB-B to USB-A: http://go.chip45.com/KAB-USB-A-miniB-1.5

Tesis pu
No olvide citar esta tesis

Declaration of Electro Magnetic Conformity of the CHIP45 „Crumbuino-2560“

CE

CHIP45 embedded microcontroller modules (henceforce products) are designed for installation in electrical appliances or as dedicated evaluation boards (i.e.: for use as a test and prototype platform for hardware/software development) in laboratory environments.

Caution:

CHIP45 products lacking protective enclosures are subject to damage by ESD and, hence, may only be unpacked, handled or operated in environments in which sufficient precautionary measures have been taken in respect to ESD-dangers. It is also necessary that only appropriately trained personnel (such as electricians, technicians and engineers) handle and/or operate these products. Moreover, CHIP45 products should not be operated without protection circuitry if connections to the product's pin header rows are longer than 3m.

CHIP45 products fulfill the norms of European Union's Directive for Electro Magnetic Conformity only in accordance to the descriptions and rules of usage indicated in this document (particularly in respect to the pin header row connectors, power connector and serial interface to a host-PC).

Implementation of CHIP45 products into target devices, as well as user modifications and extensions of CHIP45 products, is subject to renewed establishment of conformity to, and certification of, Electro Magnetic Directives. Users should ensure conformance following any modifications to the products as well as implementation of the products into target systems

DISCLAIMER

In this manual are descriptions for copyrighted products that are not explicitly indicated as such. The absence of the trademark (™) and copyright (©) symbols does not imply that a product is not protected. Additionally, registered patents and trademarks are similarly not expressly indicated in this manual.

The information in this document has been carefully checked and is believed to be entirely reliable. However, chip45 GmbH & Co. KG assumes no responsibility for any inaccuracies. chip45 GmbH & Co. KG neither gives any guarantee nor accepts any liability whatsoever for consequential damages resulting from the use of this manual or its associated product. chip45 GmbH & Co. KG reserves the right to alter the information contained herein without prior notification and accepts no responsibility for any damages which might result.

Additionally, chip45 GmbH & Co. KG offers no guarantee nor accepts any liability for damages arising from the improper usage or improper installation of the hardware or software. chip45 GmbH & Co. KG further reserves the right to alter the layout and/or design of the hardware without prior notification and accepts no liability for doing so.

© Copyright 2011 chip45 GmbH & Co. KG, D-35440 Linden.
Rights - including those of translation, reprint, broadcast, photomechanical or similar reproduction and storage or processing in computer systems, in whole or in part - are reserved. No reproduction may occur without the express written consent from chip45 GmbH & Co. KG.

CONTACT INFORMATION

Address:	chip45 GmbH & Co. KG Am Pfad 8 D-35440 Linden Germany
Ordering Information:	+49 (6403) 9299-406 info@chip45.com
Technical Support:	+49 (6403) 9299-406 support@chip45.com
Fax:	+49 (6403) 9253-50
Web Site:	http://www.chip45.com

Tesis publicada en
No olvide citar esta tesis

TESIS PUCP

1. 使 用 環 境 條 件

Apply Environmental Condition :

No.	項目 item	規格 standard
1-1	保存溫度 Storage Temperature Range	-20℃ ~ 60℃
1-2	操作溫度 Operating Temperature Range	-10℃ ~ 50℃
1-3	操作電壓 Operating Voltage Range	4.8V~6.0V

2. 測 試 環 境

Standard Test Environment :

2-1	測試環境 Standard Test Environment	每一个检查必须是正常的温度和湿度进行测量，温度 25 ± 5℃，相对湿度 65 ± 10%,在按照本规范的标准测试条件下判断特征。 Every characteristic of the inspect must be normal temperature and humidity carry out the test , temperature 25±5□ and relative humidity 65±10% of judgment made in accordance with this specification standard testing conditions.

3. 外 觀 檢 查

Appearance Inspection :

No.	項目 item	規格 standard
3-1	外觀尺寸 Outline Drawing	尺寸见附件 Dimension see the attachment
3-2	外觀 Appearance	无损坏，不允许影响功能 No damage which affects functions allowed

Tesis publicada con autorización del autor
No olvide citar esta tesis

TESIS PUCP

4. 電 氣 特 性

Electrical Specification (Function of the Performance) :

No.	項目 item	4.8V	6.0V
4-1	空載轉速 Operating speed (at no load)	0.09 sec/60°	0.07 sec/60°
4□2	空載電流 Running current (at no load)	<100 mA	<100 mA
4-3	停止扭力 Stall torque (at locked)	1.2 kg-cm	1.6 kg-cm
4-4	停止電流 Stall current (at locked)	600 mA	700 mA
4-5	待機電流 Idle current (at stopped)	<50 mA	<50 mA

注：项目 4-2 定义平均值时，伺服器无负荷运行

Note: Item 4-2 definition is average value when the servo running with no load

5. 機 械 特 性

Mechanical Specification :

No.	項目 item	規格 standard
5-1	外觀尺寸 Overall Dimensions	见附件 See the drawing
5-2	機構極限角度 Limit angle	180° ± 10°
5-3	重量 Weight	5.8 ± 0.2 (grams without servo horn)
5-4	導線規格 Connector wire gauge	OD0.8mm/16 x 0.08mm 3p x 160mm "J" type
5-5	導線長度 Connector wire length	160 ± 5 mm
5-6	舵片規格 Horn gear spline	25T/ψ5.77
5-7	舵片種類 Horn type	十字，圆盘，条型 Cross , Disk, Double Flat
5-8	減速比 Reduction ratio	1/400

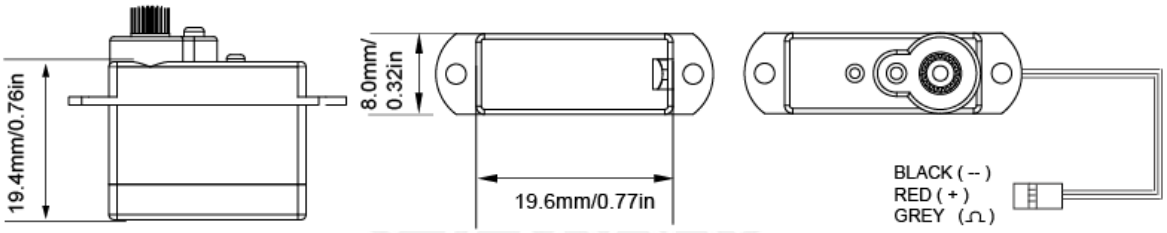
Tesis publicada con autorización del autor
No olvide citar esta tesis

TESIS PUCP

6. 控 制 特 性

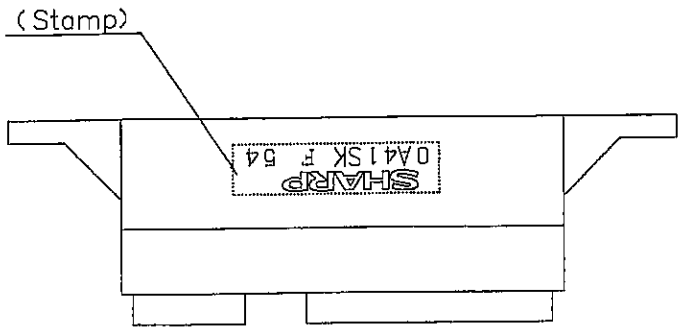
Control Specification :

No.	项目	規格
6-1	控制系統 Control system	改变脉冲宽度 Pulse Width Modification
6-2	放大器種類 Amplifier type	数字控制器 Digital Controller
6-3	操作角度 Operating travel	90° (在 1000→2000 μsec)
6-4	中立位置 Neutral position	1500 μsec
6-5	脈波訊號虛位 Dead band width	4 μsec
6-6	旋轉方向 Rotating direction	顺时针 (在 1500→2000 μsec) Counterclockwise (when1500→2000 μsec)
6-7	脈波寬度範圍 Pulse width range	900→2100 μsec
6-8	可作動角度範圍 Maximum travel	大约 125°(when900→2100 μsec) Approx 125°(when900→2100 μsec)



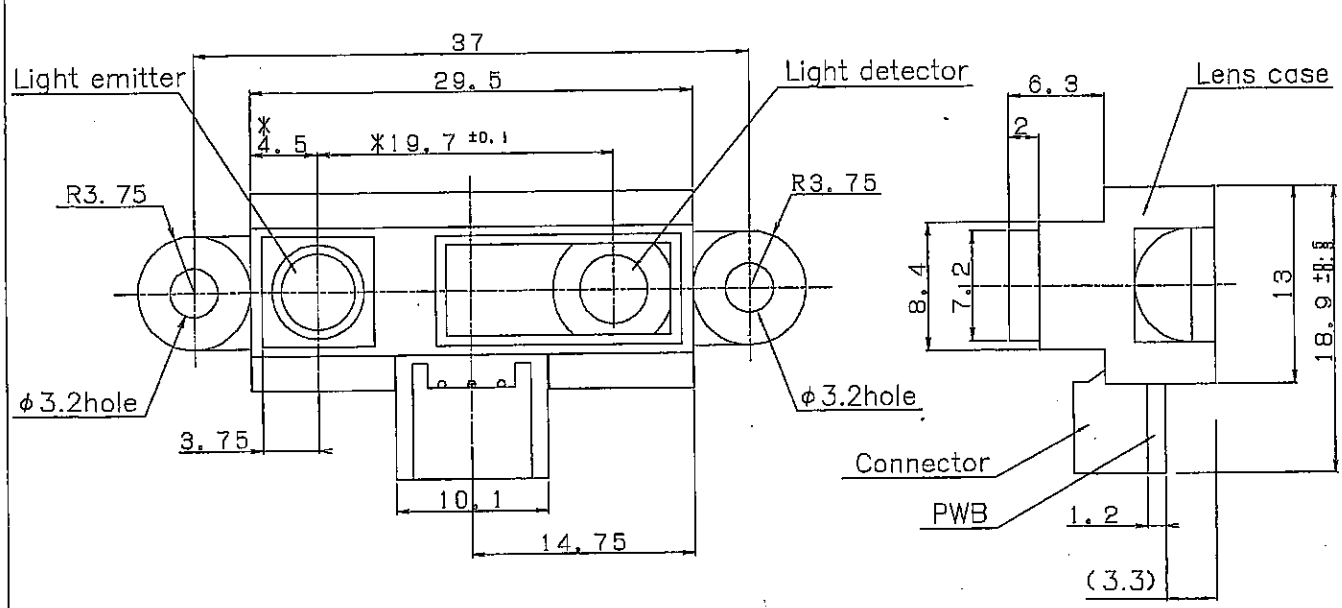
Tesis publicada con autorización del autor
No olvide citar esta tesis

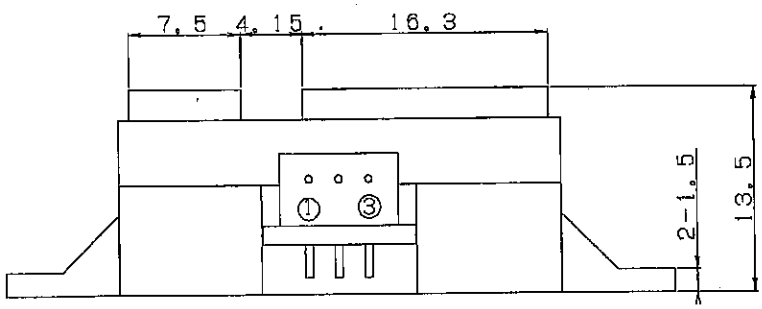
2. Outline



Stamp (Example)

SHARP
0A41SK F 5 4
Model name
Month (1 to 9, X, Y, Z)
Year (2005:5)





Connector signal

	Signal name
①	Vo
②	GND
③	Vcc

Connector :
J.S.T.TRADING COMPANY,LTD.
S3B-PH

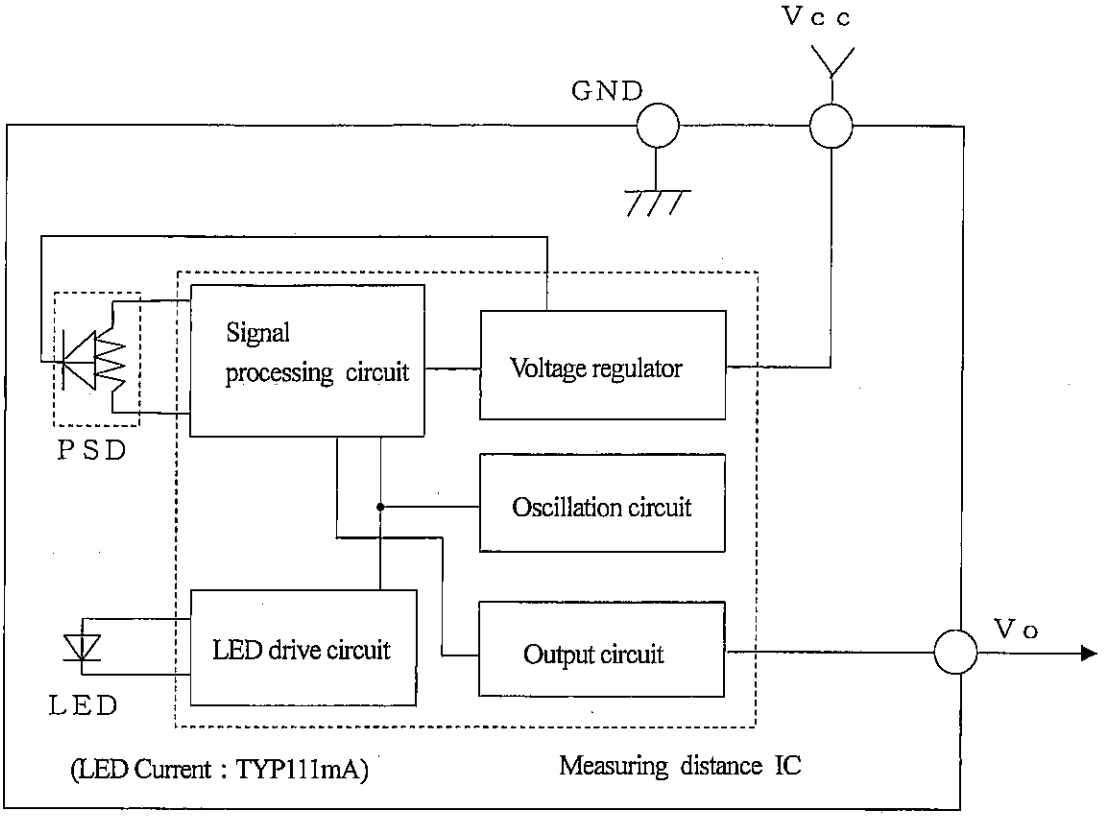
Materials
Lens: Acrylic acid resin
(Visible light cut-off resin)
Case: Carbonic ABS
(Conducttive resin)
PCB: Paper phenol

Unit: mm Scale: 2/1

Note 1: The dimensions marked * are described the dimensions of lens center position.
Note 2: Unspecified tolerance shall be ±0.3mm.
Note 3: The dimensions in parenthesis are shown for reference.

Name	GP2Y0A41SK0F Outline Dimensions
Drawing No.	CY13036j02

3-1 Schematic



3-2 Absolute maximum ratings (Ta=25℃, Vcc=5V)

Parameter	Symbol	Ratings	Unit	Remark
Supply voltage	Vcc	-0.3 to +7	V	-
Output terminal voltage	Vo	-0.3 to Vcc+0.3	V	-
Operating temperature	Topr	-10 to +60	℃	-
Storage temperature	Tstg	-40 to +70	℃	-

Operating supply voltage

Symbol	Rating	Unit	Remark
Vcc	4.5 to 5.5	V	-

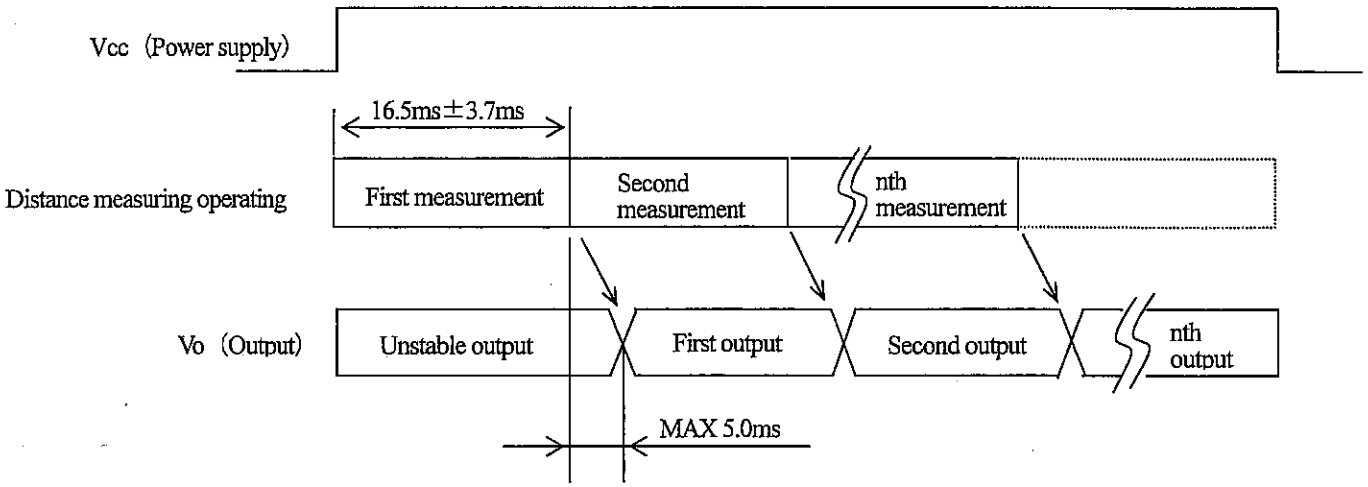
3-3 Electro-optical Characteristics

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Measuring distance range	ΔL	(Note 1)	4	-	30	cm
Output terminal voltage	Vo	L=30cm (Note 1)	0.25	0.4	0.55	V
Output voltage difference	ΔVo	Output change at L change (30cm → 4cm) (Note 1)	1.95	2.25	2.55	V
Average supply current	Icc	L=30cm (Note 1)	-	12	22	mA

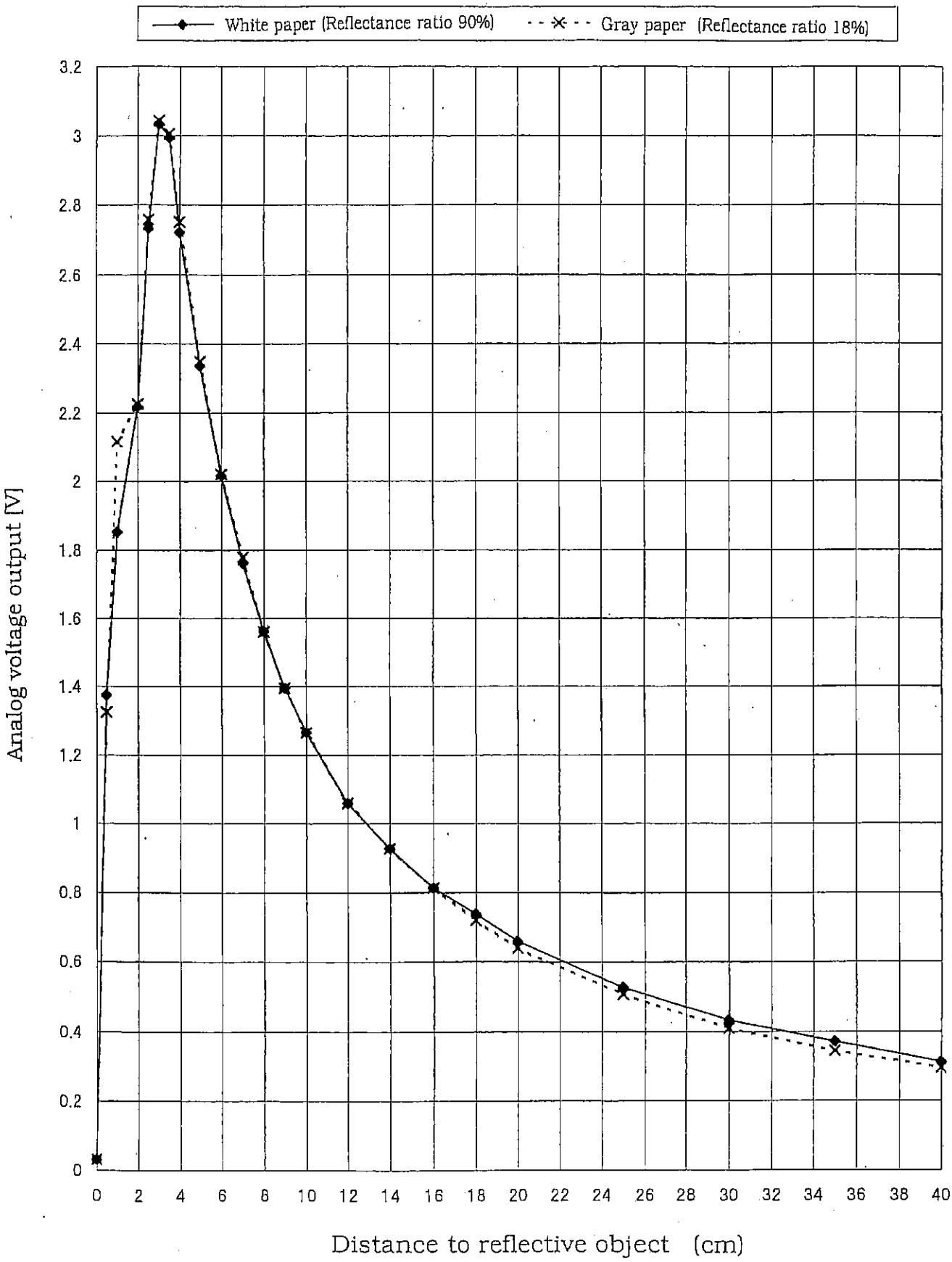
※ L: Distance to reflective object

(Note 1) Using reflective object : White paper (Made by Kodak Co., Ltd. gray cards R-27・white face, reflective ratio ; 90%)

3-4 Timing chart



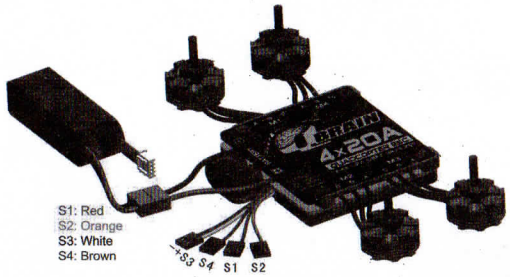
6-1 GP2Y0A41SK0F Example of output distance characteristics

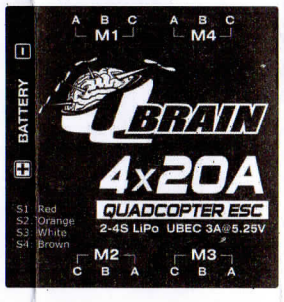


Thanks for purchasing our Electronic Speed Controller (ESC). High power system for RC model is very dangerous, please read this manual carefully. In that we have no control over the correct use, installation, application, or maintenance of our products, no liability shall be assumed nor accepted for any damages, losses or costs resulting from the use of the product. Any claims arising from the operating, failure or malfunctioning etc. will be denied. We assume no liability for personal injury, property damage or consequential damages resulting from our product or our workmanship. As far as is legally permitted, the obligation to compensation is limited to the invoice amount of the affected product.

Features

1. 4 speed controllers in1board, only 1 pair of battery wire is needed.
2. Powerful switch mode built-in BEC (the BEC voltage outputs from the S3 connector).
3. Multiple protection features: Low voltage cut-off protection / over-heat protection / throttle signal loss protection.
4. The throttle range of each ESC can be calibrated to be suitable for different multi-rotor flying control systems / transmitters.
5. Maximum speed: 210000 RPM (2 poles motor), 70000 RPM (6 poles motor), 35000 RPM (12 poles motor).





Specification

Model	Cont. Current	Burst Current (>10s)	BEC Mode	BEC Output	BEC Output Capability			Battery Cell		Weight	Size
					2S Lipo	3S Lipo	4S Lipo	Lipo	NiMH		L*W*H
QBrain 4*20A Quadcopter ESC	20A*4	25A*4	Switch mode	5V@3A	5 servos	5 servos	4 servos	2-4S	5-12 cells	112g	70*62*11
QBrain 4*25A Quadcopter ESC	25A*4	30A*4	Switch mode	5V@3A	5 servos	5 servos	4 servos	2-4S	5-12 cells	112g	70*62*11

Programmable Items (The option written in bold font is the default setting)

1. Brake：**Disabled** / Enabled
2. Battery Type：Lipo / **NiMH**
3. Low Voltage Protection Mode (Cut-Off Mode)：**Soft Cut-Off (Gradually reduce the output)** /Cut-Off (Immediately stop the output)
4. Low Voltage Protection Threshold (Cut-Off Threshold)：**Low** / Medium / High
   a) For lithium battery, the battery cell amount is calculated automatically. Low / medium / high cutoff voltage for each cell is: 2.85V/3.15V/3.3V. For example: For a 3S Lipo battery, when "Medium" cutoff threshold is set, the cut-off voltage will be: 3.15*3=9.45V
   b) For NiMH battery, low / medium / high cutoff voltages are 0% / 50% / 65% of the startup voltage (i.e. the initial voltage of battery pack), and 0% means the low voltage cut-off function is disabled. For example: For a 6 cells NiMH battery, fully charged voltage is 1.44*6=8.64V, when "Medium" cut-off threshold is set, the cut-off voltage will be 8.64*50%=4.32V。

   Warning! In order to protect the expensive multi-rotor, the default settings (i.e. **Battery Type** = "NiMH" and **Cut-Off Threshold** = "Low") don't take any protection even if the Lipo battery is over discharged. If you do need to activate the battery protection function please change the default settings.
5. Startup Mode：**Normal** /Soft /Super-Soft (300ms / 1.5s / 3s)
   The initial acceleration of the Soft and Super-Soft modes are slower than the Normal mode, it takes 1.5 second for Soft startup or 3 seconds for Super-Soft startup from initial throttle advance to full throttle. If the throttle is completely closed (throttle stick moved to bottom position) and opened again (throttle stick moved to top position) within 3 seconds after the first startup, the re-startup will be temporarily changed to normal mode to get rid of the chance of a crash caused by slow throttle response. This special design is suitable for aerobatic flight when quick throttle response is needed.
6. Timing：Low / **Medium** / High,(3.75°/ 15°/ 26.25°)
   Usually, the default timing is suitable for most motors. To get higher speed, High timing can be chosen.

Begin To Use Your New ESC

Because different transmitters / flying control systems have different throttle ranges, please calibrate the throttle range for each speed controller before flying.
The Throttle Signal HUB is recommended for calibrating the throttle ranges for 4 speed controllers simultaneously instead of one by one.

Throttle range setting:
Note: The throttle range of each speed controller in the Quattro should be set separately. When the Quattro is installed in a multi-rotor, you should set the throttle range of each ESC via the flying control system.

Switch on the transmitter, move throttle stick to the top position	Connect battery pack to the ESC, and wait for about 2 seconds	The "Beep-Beep-" tone should be emitted, means the top point of throttle range has been confirmed	Move throttle stick to the bottom position, several "beep-" tones should be emitted to present the amount of battery cells	A long "Beep-" tone should be emitted, means the lowest point of throttle range has been correctly confirmed

Normal startup procedure:

Move throttle stick to bottom position and then switch on transmitter.	Connect battery pack to ESC, special tone like " ♪ 123" means power supply is OK	Several "beep-" tones should be emitted to present the amount of lithium battery cells	When self-test is finished, a long "beep-----" tone should be emitted	Move throttle stick upwards to go flying

Protection Function

1. Start up failure protection: If the motor failed to start within 2 seconds of throttle application, the ESC would cut-off the output power. In such a case, the throttle stick **MUST** be moved to the bottom position again to restart the motor. (Such a situation happens in the following cases: The connection between ESC and motor is not reliable, the propeller or the motor is blocked, etc.)
2. Over-heat protection: When the temperature of the ESC is higher than 110 Celsius degrees, the ESC will reduce the output power.
3. Throttle signal loss protection: The ESC will reduce the output power if the throttle signal is lost for 1 second, further loss for 2 seconds will cause the output to be cut-off completely.

【Accessory: Throttle Hub】

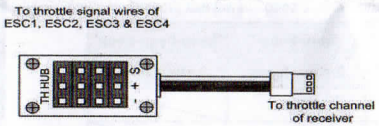
Applications

1. Use this throttle Hub to calibrate the throttle range for the Quattro ESC (The Quattro is an equipment in quadcopter, usually it has 4 ESCs in 1 board);
2. Use this throttle Hub as throttle signal distributor for several speed controllers (1 ESC to 4 ESCs).

Operations

1. To calibrate the throttle range for the Quattro ESC;
   a) Plug the throttle signal wires of 4 ESCs (S1 to S4) into Port #1 to Port #4 of the throttle Hub.
      Attention! In the following picture, the pins at the symbol "S" line are the paths of throttle signals transmission.
   b) Plug the lead at right side into the throttle channel of receiver or fly-control system.
   c) Connect battery to the Quattro ESC.
   d) Calibrate throttle range of the 4 ESCs in the Quattro simultaneously.

2. To distribute throttle signal to several ESCs
   a) Generally, in case of throttle signal distribution, only one ESC has its built-in BEC enabled (or reserved), the BECs in other ESCs must be disabled (That is, cut the red wires in the Rx cables)
   b) Plug the throttle signal wires of 4 ESCs into Port #1 to Port #4 of the throttle Hub.
      Attention! In the following picture, the pins at the symbol "S" line are the paths of throttle signals transmission.
   c) Plug the lead at right side into the throttle channel of receiver.



Trouble Shooting

Trouble	Possible Reason	Action
After power on, motor doesn't work, no sound is emitted	The connection between battery pack and ESC is not correct	Check the power connection. Replace the connector.
After power on, motor doesn't work, such an alert tone is emitted: "beep-beep-, beep-beep-,beep-beep-" (Every "beep-beep-" has a time interval of about 1 second)	Input voltage is abnormal, too high or too low.	Check the voltage of battery pack
After power on, motor doesn't work, such an alert tone is emitted: "beep-, beep-, beep- "(Every "beep-" has a time interval of about 2 seconds)	Throttle signal is abnormal.	Check the receiver / transmitter / flying controller Check the cable of throttle channel
After power on, motor doesn't work, such an alert tone is emitted: "beep-, beep-, beep-" (Every "beep-" has a time interval of about 0.25 second)	The throttle stick is not in the bottom (lowest) position	Move the throttle stick to bottom position
After power on, motor doesn't work, a special tone " ♪ 56712" is emitted after 2 beep tone (beep-beep-)	The Direction of throttle channel is reversed, so the ESC enters the program mode	Set the direction of throttle channel correctly
The motor runs in the opposite direction	The connection between ESC and the motor need to be changed.	Swap any two wire connections between ESC and motor

TESIS PUCP
TEXAS INSTRUMENTS
PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

DUAL H-BRIDGE MOTOR DRIVER

Check for Samples: DRV8833

FEATURES

- **Dual-H-Bridge Current-Control Motor Driver**
  - **Capable of Driving Two DC Motors or One Stepper Motor**
  - **Low MOSFET On-Resistance: HS + LS 360 mΩ**
- **Output Current (at V_M = 5 V, 25°C)**
  - **1.5-A RMS, 2-A Peak per H-Bridge in PWP and RTY Package Options**
  - **500-mA RMS, 2-A Peak per H-Bridge in PW Package Option**
- **Outputs Can Be Paralleled for**
  - **3-A RMS, 4-A Peak (PWP and RTY)**
  - **1-A RMS, 4-A Peak (PW)**
- **Wide Power Supply Voltage Range: 2.7 V – 10.8 V**
- **PWM Winding Current Regulation/Limiting**
- **Thermally Enhanced Surface Mount Packages (PWP and RTY)**

APPLICATIONS

- **Battery-Powered Toys**
- **POS Printers**
- **Video Security Cameras**
- **Office Automation Machines**
- **Gaming Machines**
- **Robotics**

DESCRIPTION

The DRV8833 provides a dual bridge motor driver solution for toys, printers, and other mechatronic applications.

The device has two H-bridge drivers, and can drive two DC brush motors, a bipolar stepper motor, solenoids, or other inductive loads.

The output driver block of each H-bridge consists of N-channel power MOSFET's configured as an H-bridge to drive the motor windings. Each H-bridge includes circuitry to regulate or limit the winding current.

Internal shutdown functions with a fault output pin are provided for over current protection, short circuit protection, under voltage lockout and overtemperature. A low-power sleep mode is also provided.

The DRV8833 is packaged in a 16-pin HTSSOP or QFN package with PowerPAD™ (Eco-friendly: RoHS & no Sb/Br) as well as a 16-pin TSSOP package.

ORDERING INFORMATION(1)

PACKAGE(2)		ORDERABLE PART NUMBER	TOP-SIDE MARKING
PowerPAD™ (HTSSOP) - PWP	Reel of 2000	DRV8833PWPR	DRV8833
	Tube of 90	DRV8833PWP	
(TSSOP) - PW	Reel of 2000	DRV8833PWR	8833PW
	Tube of 90	DRV8833PW	
PowerPAD™ (QFN) - RTY	Reel of 3000	DRV8833RTYR	DRV8833
	Reel of 250	DRV8833RTYT	

(1) For the most current packaging and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.
(2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.

Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.
PowerPAD is a trademark of Texas Instruments.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of the Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

Copyright © 2011–2013, Texas Instruments Incorporated

Tesis publicada con autorización del autor
No olvide citar esta tesis

Table 1. TERMINAL FUNCTIONS

NAME	PIN (PWP or PW)	PIN (RTY)	I/O(1)	DESCRIPTION	EXTERNAL COMPONENTS OR CONNECTIONS
POWER AND GROUND					
GND	13 PPAD (PWP only)	11 PPAD	-	Device ground	Both the GND pin and device PowerPAD must be connected to ground
VM	12	10	-	Device power supply	Connect to motor supply. A 10-µF (minimum) ceramic bypass capacitor to GND is recommended.
VINT	14	12	-	Internal supply bypass	Bypass to GND with 2.2-µF, 6.3-V capacitor
VCP	11	9	IO	High-side gate drive voltage	Connect a 0.01-µF, 16-V (minimum) X7R ceramic capacitor to VM
CONTROL					
AIN1	16	14	I	Bridge A input 1	Logic input controls state of AOUT1. Internal pulldown.
AIN2	15	13	I	Bridge A input 2	Logic input controls state of AOUT2. Internal pulldown.
BIN1	9	7	I	Bridge B input 1	Logic input controls state of BOUT1. Internal pulldown.
BIN2	10	8	I	Bridge B input 2	Logic input controls state of BOUT2. Internal pulldown.
nSLEEP	1	15	I	Sleep mode input	Logic high to enable device, logic low to enter low-power sleep mode and reset all internal logic. Internal pulldown.
STATUS					
nFAULT	8	6	OD	Fault output	Logic low when in fault condition (overtemp, overcurrent)
OUTPUT					
AISEN	3	1	IO	Bridge A ground / Isense	Connect to current sense resistor for bridge A, or GND if current control not needed
BISEN	6	4	IO	Bridge B ground / Isense	Connect to current sense resistor for bridge B, or GND if current control not needed
AOUT1	2	16	O	Bridge A output 1	Connect to motor winding A
AOUT2	4	2	O	Bridge A output 2	
BOUT1	7	5	O	Bridge B output 1	Connect to motor winding B
BOUT2	5	3	O	Bridge B output 2	

(1) Directions: I = input, O = output, OZ = tri-state output, OD = open-drain output, IO = input/output

Copyright © 2011–2013, Texas Instruments Incorporated

Tesis publicada con autorización del autor
No olvide citar esta tesis

ELECTRICAL CHARACTERISTICS

T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
POWER SUPPLY						
I_{VM}	VM operating supply current	V_M = 5 V, xIN1 = 0 V, xIN2 = 0 V		1.7	3	mA
I_{VMQ}	VM sleep mode supply current	V_M = 5 V		1.6	2.5	µA
V_{UVLO}	VM undervoltage lockout voltage	V_M falling			2.6	V
V_{HYS}	VM undervoltage lockout hysteresis			90		mV
LOGIC-LEVEL INPUTS						
V_{IL}	Input low voltage	nSLEEP			0.5	V
		All other pins			0.7	
V_{IH}	Input high voltage	nSLEEP	2.5			V
		All other pins	2			
V_{HYS}	Input hysteresis			0.4		V
R_{PD}	Input pull-down resistance	nSLEEP		500		kΩ
		All except nSLEEP		150		
I_{IL}	Input low current	VIN = 0			1	µA
I_{IH}	Input high current	VIN = 3.3 V, nSLEEP		6.6	13	µA
		VIN = 3.3 V, all except nSLEEP		16.5	33	
t_{DEG}	Input deglitch time			450		ns
nFAULT OUTPUT (OPEN-DRAIN OUTPUT)						
V_{OL}	Output low voltage	I_O = 5 mA			0.5	V
I_{OH}	Output high leakage current	V_O = 3.3 V			1	µA
H-BRIDGE FETS						
$R_{DS(ON)}$	HS FET on resistance	V_M = 5 V, I_O = 500 mA, T_J = 25°C		200		mΩ
		V_M = 5 V, I_O = 500 mA, T_J = 85°C			325	
		V_M = 2.7 V, I_O = 500 mA, T_J = 25°C		250		
		V_M = 2.7 V, I_O = 500 mA, T_J = 85°C			350	
	LS FET on resistance	V_M = 5 V, I_O = 500 mA, T_J = 25°C		160		
		V_M = 5 V, I_O = 500 mA, T_J = 85°C			275	
		V_M = 2.7 V, I_O = 500 mA, T_J = 25°C		200		
		V_M = 2.7 V, I_O = 500 mA, T_J = 85°C			300	
I_{OFF}	Off-state leakage current	V_M = 5 V, T_J = 25°C, V_{OUT} = 0 V	–1		1	µA
MOTOR DRIVER						
f_{PWM}	Current control PWM frequency	Internal PWM frequency		50		kHz
t_R	Rise time	V_M = 5 V, 16 Ω to GND, 10% to 90% V_M		180		ns
t_F	Fall time	V_M = 5 V, 16 Ω to GND, 10% to 90% V_M		160		ns
t_{PROP}	Propagation delay INx to OUTx	V_M = 5 V		1.1		µs
t_{DEAD}	Dead time (1)	V_M = 5 V		450		ns
PROTECTION CIRCUITS						
I_{OCP}	Overcurrent protection trip level		2	3.3		A
t_{DEG}	OCP Deglitch time			2.25		µs
t_{OCP}	Overcurrent protection period			1.35		ms
t_{TSD}	Thermal shutdown temperature	Die temperature	150	160	180	°C

(1) Internal dead time. External implementation is not necessary.

Copyright © 2011–2013, Texas Instruments Incorporated

Tesis publicada con autorización del autor
No olvide citar esta tesis

TESIS PUCP

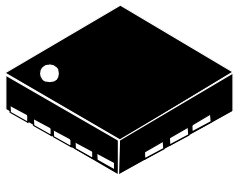
PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

life.augmented

L3GD20H

MEMS motion sensor: three-axis digital output gyroscope

Datasheet - production data



LGA-16 (3x3x1 mm)

Features

- Wide supply voltage, 2.2 V to 3.6 V
- Wide extended operating temperature range (from -40 °C to 85 °C)
- Low voltage compatible IOs, 1.8 V
- Low power consumption
- Embedded power-down
- Sleep mode
- Fast turn-on and wake-up
- Three selectable full scales up to 2000 dps
- 16 bit rate value data output
- 8 bit temperature data output
- I^2C/SPI digital output interface
- 2 dedicated lines (1 interrupt, 1 data ready)
- User enable integrated high-pass filters
- Embedded temperature sensor
- Embedded 32 levels of 16 bit data output FIFO
- High shock survivability
- ECOPACK® RoHS and “Green” compliant

Applications

- Gaming and virtual reality input devices
- Motion control with MMI (man-machine interface)
- GPS navigation systems
- Appliances and robotics

Description

The L3GD20H is a low-power three-axis angular rate sensor.

It includes a sensing element and an IC interface able to provide the measured angular rate to the external world through digital interface (I^2C/SPI).

The sensing element is manufactured using a dedicated micromachining process developed by ST to produce inertial sensors and actuators on silicon wafers.

The IC interface is manufactured using a CMOS process that allows a high level of integration to design a dedicated circuit which is trimmed to better match the sensing element characteristics.

The L3GD20H has a full scale of ±245/±500/±2000 dps and is capable of measuring rates with a user selectable bandwidth.

The L3GD20H is available in a plastic land grid array (LGA) package and can operate within a temperature range from -40 °C to +85 °C.

Table 1. Device summary

Order code	Temperature range (°C)	Package	Packing
L3GD20H	-40 to +85	LGA-16 (3x3x1)	Tray
L3GD20HTR	-40 to +85	LGA-16 (3x3x1)	Tape and reel

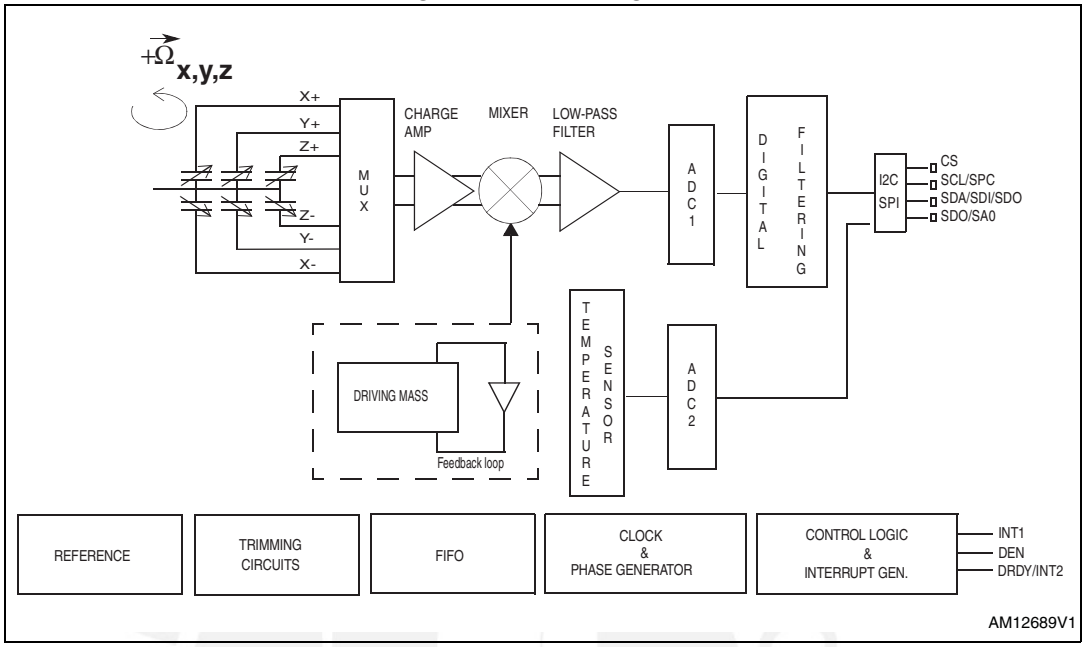
This is information on a product in full production. www.st.com

Tesis publicada con autorización del autor
No olvide citar esta tesis

TESIS PUCP

1 Block diagram and pin description

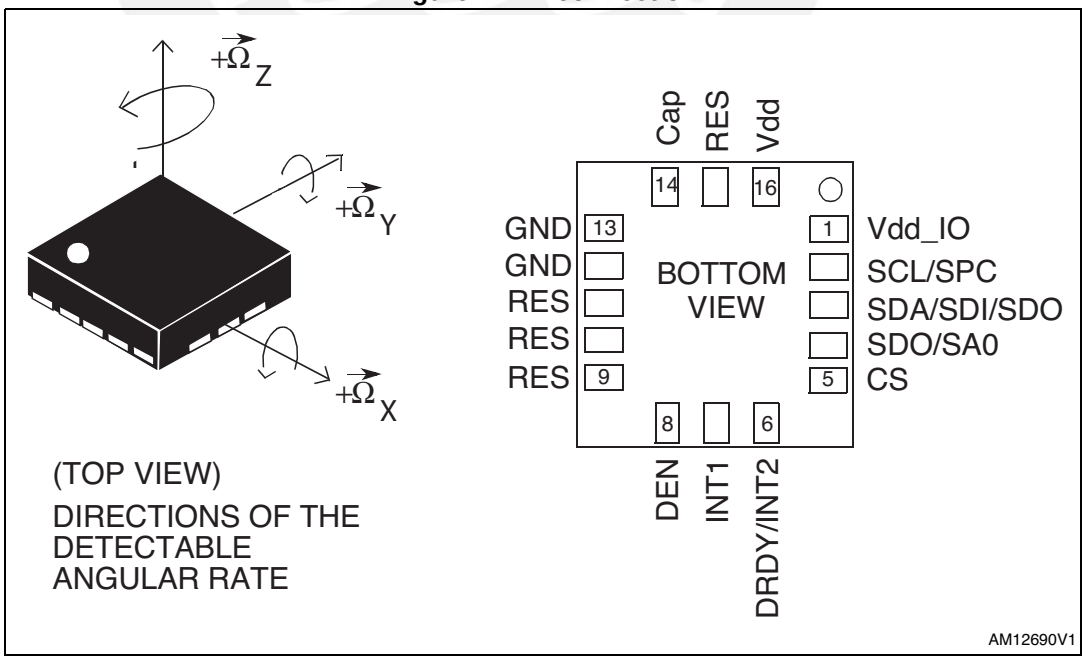
Figure 1. Block diagram



The vibration of the structure is maintained by a drive circuitry in a feedback loop. The sensing signal is filtered and appears as digital signal at the output.

1.1 Pin description

Figure 2. Pin connection



Tesis publicada con autorización del autor
No olvide citar esta tesis

TESIS PUCP

2.2 Electrical characteristics

@ Vdd =3.0 V, T=25 °C unless otherwise noted[b].

Table 4. Electrical characteristics

Symbol	Parameter	Test condition	Min.	Typ.[1]	Max.	Unit
Vdd	Supply voltage		2.2	3.0	3.6	V
Vdd_IO	I/O pins supply voltage[2]		1.71		Vdd+0.1	V
Idd	Supply current			5.0		mA
IddSL	Supply current in sleep mode[3]	Selectable by digital interface		2.5		mA
IddPdn	Supply current in power-down mode	Selectable by digital interface		1		µA
VIH	Digital high level input voltage		0.8*Vdd_IO			V
VIL	Digital low level input voltage				0.2*Vdd_IO	V
Ton	Turn-on time[4]	LPF2 disabled ODR = 190 Hz		50		ms
Top	Operating temperature range		-40		+85	°C

1. Typical specifications are not guaranteed.
2. It is possible to remove Vdd maintaining Vdd_IO without blocking the communication busses, in this condition the measurement chain is powered off.
3. Sleep mode introduces a faster turn-on time related to power down mode.
4. Time to obtain stable sensitivity (within ±5% of final value) after exiting power-down mode. It is guaranteed by design.

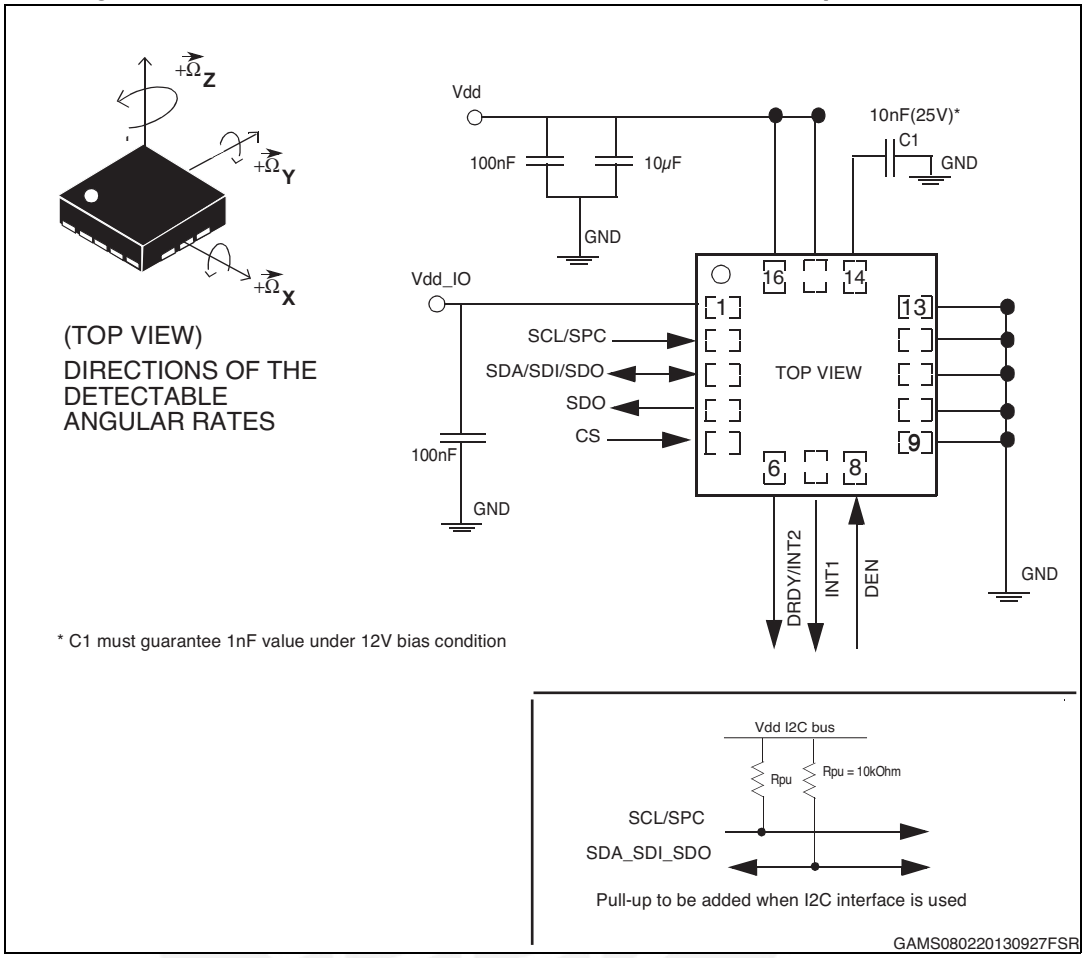
b. The product is factory calibrated at 3.0 V.

Tesis publicada con autorización del autor
No olvide citar esta tesis

TESIS PUCP

3 Application hints

Figure 5. L3GD20H electrical connections and external components values



Power supply decoupling capacitors (100 nF + 10 μF) should be placed as near as possible to the device (common design practice).

If Vdd and Vdd_IO are not connected together, 100 nF and 10 μF decoupling capacitors must be placed between Vdd and common ground while 100 nF between Vdd_IO and common ground. Capacitors should be placed as near as possible to the device (common design practice).

Tesis publicada con autorización del autor
No olvide citar esta tesis

TESIS PUCP

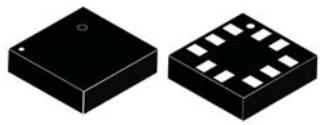
PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

life.augmented

LPS25H

MEMS pressure sensor: 260-1260 hPa absolute digital output barometer

Datasheet - production data



HCLGA-10L
(2.5 x 2.5 x 1.0 mm)

Features

- 260 to 1260 hPa absolute pressure range
- High-resolution mode: 1 Pa RMS
- Low power consumption:
  - Low resolution mode: 4 µA
  - High resolution mode: 25 µA
- High overpressure capability: 20x full scale
- Embedded temperature compensation
- Embedded 24-bit ADC
- Selectable ODR from 1 Hz to 25 Hz
- SPI and I²C interfaces
- Embedded FIFO
- Supply voltage: 1.7 to 3.6 V
- High shock survivability: 10,000 *g*
- Small and thin package
- ECOPACK® lead-free compliant

Applications

- Altimeter and barometer for portable devices
- GPS applications
- Weather Station Equipment
- Sport Watches

Description

The LPS25H is an ultra compact absolute piezoresistive pressure sensor. It includes a monolithic sensing element and an IC interface able to take the information from the sensing element and to provide a digital signal to the external world.

The sensing element consists of a suspended membrane realized inside a single mono-silicon substrate. It is capable to detect the absolute pressure and is manufactured with a dedicated process developed by ST.

The membrane is very small compared to the traditionally built silicon micromachined membranes. Membrane breakage is prevented by an intrinsic mechanical stopper.

The IC interface is manufactured using a standard CMOS process that allows a high level of integration to design a dedicated circuit which is trimmed to better match the sensing element characteristics.

The LPS25H is available in a cavity holed LGA package (HCLGA). It is guaranteed to operate over a temperature range extending from -30 °C to +105 °C. The package is holed to allow external pressure to reach the sensing element.

Table 1. Device summary

Order codes	Temperature range [°C]	Package	Packing
LPS25HTR	-30 to +105	HCLGA-10L	Tape and reel
LPS25H		HCLGA-10L	Tray

This is information on a product in full production. www.st.com

Tesis publicada con autorización del autor
No olvide citar esta tesis

TESIS PUCP

2 Mechanical and electrical specifications

2.1 Mechanical characteristics

V_{DD} = 2.5 V, T = 25 °C, unless otherwise noted.

Table 3. Mechanical characteristics

Symbol	Parameter	Test condition	Min.	Typ.(1)	Max.	Unit
Top	Operating temperature range		-30		105	°C
Tfull	Full accuracy temperature range		0		80	°C
Pop	Operating pressure range		260		1260	hPa
Pbits	Pressure output data			24		bits
Psens	Pressure sensitivity			4096		LSB/ hPa
Paccrel	Relative accuracy over pressure(2)	P = 800 to 1100 hPa T = 25°C		± 0.1		hPa
PaccT	Absolute accuracy pressure over temperature(3)	P = 260 to 1260 hPa T = 20 ~ +60 °C		± 0.2		hPa
		P = 260 to 1260 hPa T = 0 ~ +80 °C		± 1		
Pnoise	Pressure noise(4)	without embedded filtering		0.03		hPa RMS
		with embedded filtering		0.01		
Tbits	Temperature output data			16		bits
Tsens	Temperature sensitivity			480		LSB/°C
Tacc	Absolute accuracy temperature	T= 0 ~ +65 °C		± 2		°C

1. Typical specifications are not guaranteed.
2. Characterization data. Parameter not tested at final test
3. Embedded quadratic compensation.
4. Pressure noise RMS evalueted in a controlled environment,based on the average standard deviation of 32 measurements at highest ODR.

Tesis publicada con autorización del autor
No olvide citar esta tesis

TESIS PUCP

2.2 Electrical characteristics

VDD = 2.5 V, T = 25 °C, unless otherwise noted.

Table 4. Electrical characteristics

Symbol	Parameter	Test condition	Min.	Typ.(1)	Max.	Unit
VDD	Supply voltage		1.7		3.6	V
VDD_IO	IO supply voltage		1.7		3.6	V
Idd	Supply current @ ODR 1 Hz, highest resolution			25		µA
IddPdn	Supply current in power-down mode T = 25 °C			0.5		µA

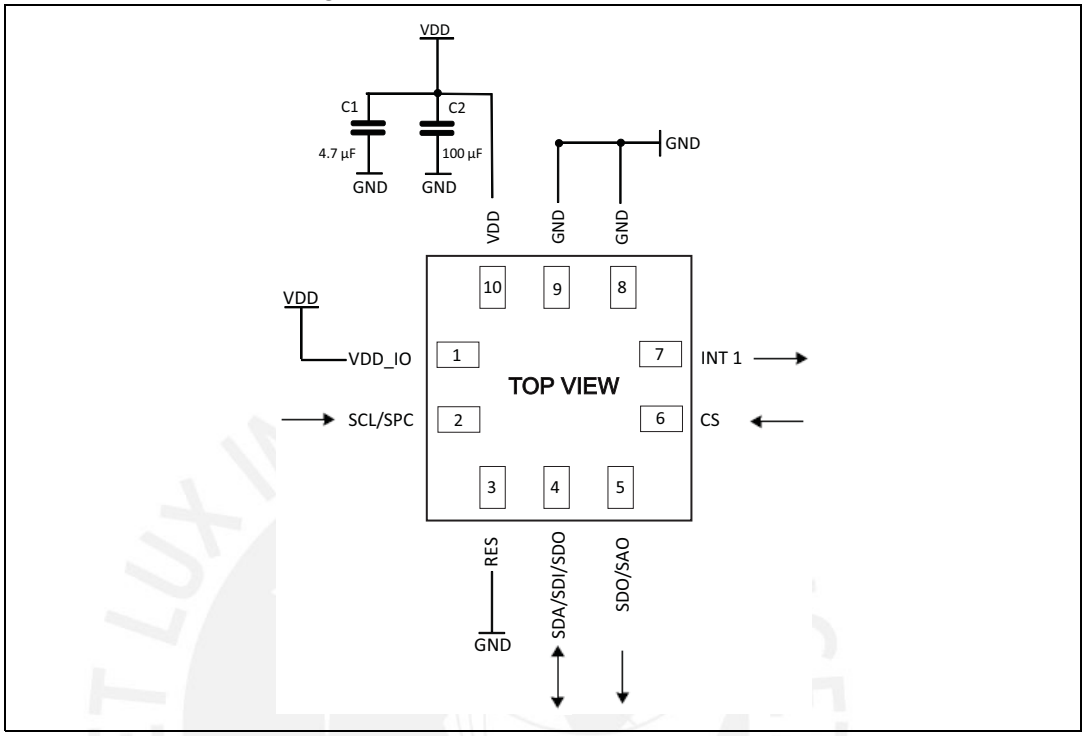
1. Typical specifications are not guaranteed.

Tesis publicada con autorización del autor
No olvide citar esta tesis

TESIS PUCP

4 Application hints

Figure 5. LPS25H electrical connection



The device core is supplied through the VDD line. Power supply decoupling capacitors (100 nF, 4.7 µF) should be placed as near as possible to the supply pad of the device (common design practice).

The functionality of the device and the measured data outputs are selectable and accessible through the I²C/SPI interface. When using the I²C, CS must be tied high (i.e. connected to VDD_IO).

4.1 Soldering information

The HCLGA package is compliant with the ECOPACK® standard and it is qualified for soldering heat resistance according to JEDEC J-STD-020.

Tesis publicada con autorización del autor
No olvide citar esta tesis

TESIS PUCP

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

LSM303D

Ultra compact high performance e-Compass 3D accelerometer and 3D magnetometer module

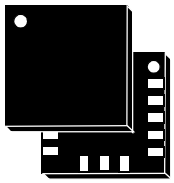
Datasheet — preliminary data

Features

- 3 magnetic field channels and 3 acceleration channels
- ±2/±4/±8/±12 gauss dynamically selectable magnetic full-scale
- ±2/±4/±6/±8/±16 g dynamically selectable linear acceleration full-scale
- 16-bit data output
- SPI / I^2C serial interfaces
- Analog supply voltage 2.16 V to 3.6 V
- Power-down mode / low-power mode
- Programmable interrupt generators for free-fall, motion detection and magnetic field detection
- Embedded temperature sensor
- Embedded FIFO
- ECOPACK®, RoHS and “Green” compliant

Applications

- Tilt compensated compass
- Map rotation
- Position detection
- Motion activated functions
- Free-fall detection
- Click/double click recognition
- Pedometer
- Intelligent power saving for handheld devices
- Display orientation
- Gaming and virtual reality input devices
- Impact recognition and logging
- Vibration monitoring and compensation



LGA-16 (3x3x1 mm)

Description

The LSM303D is a system-in-package featuring a 3D digital linear acceleration sensor and a 3D digital magnetic sensor.

The LSM303D has linear acceleration full-scales of ±2*g* / ±4*g* / ±6*g* / ±8*g* / ±16*g* and a magnetic field full-scale of ±2 / ±4 / ±8 / ±12 gauss. All full-scales available are fully selectable by the user.

The LSM303D includes an I^2C serial bus interface that supports standard and fast mode 100 kHz and 400 kHz and SPI serial standard interface.

The system can be configured to generate an interrupt signal for free-fall, motion detection and magnetic field detection. Thresholds and timing of interrupt generators are programmable by the end user on the fly.

Magnetic and accelerometer parts can be enabled or put into power-down mode separately.

The LSM303D is available in plastic land grid array package (LGA) and is guaranteed to operate over an extended temperature range from -40 °C to +85 °C.

Table 1. Device summary

Part number	Temperature range [°C]	Package	Packaging
LSM303D	-40 to +85	LGA-16	Tray
LSM303DTR	-40 to +85	LGA-16	Tape and reel

This is preliminary information on a new product now in development or undergoing evaluation. Details are subject to change without notice.

www.st.com

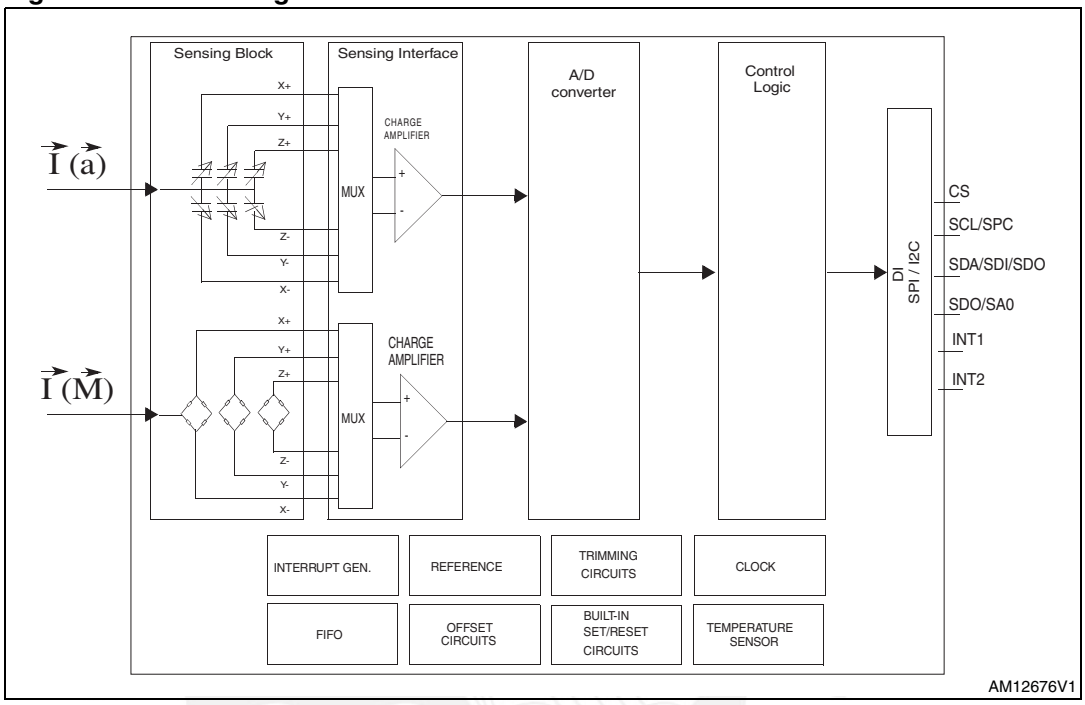
Tesis publicada con autorización del autor
No olvide citar esta tesis

TESIS PUCP

1 Block diagram and pin description

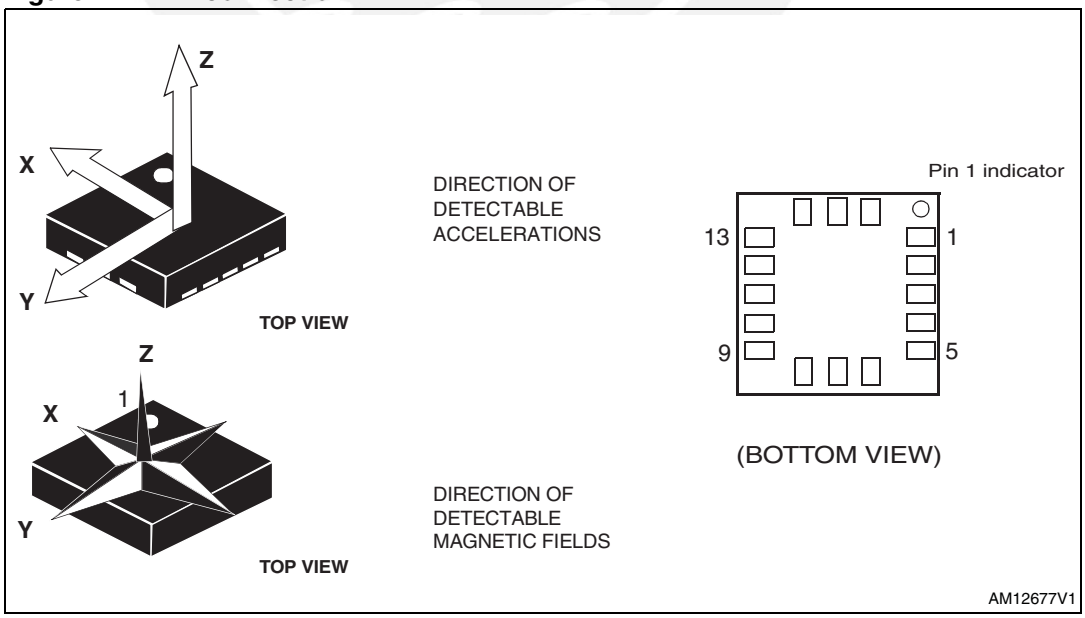
1.1 Block diagram

Figure 1. Block diagram



1.2 Pin description

Figure 2. Pin connection



Tesis publicada con autorización del autor
No olvide citar esta tesis

TESIS PUCP

2.3 Electrical characteristics

@ Vdd = 2.5 V, T = 25 °C unless otherwise noted.

Table 5. Electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.(1)	Max.	Unit
Vdd	Supply voltage		2.16		3.6	V
Vdd_IO	Module power supply for I/O		1.71	1.8	Vdd+0.1	
Idd	eCompass(2) current consumption in normal mode(3)	LR setting CTRL5 (M_RES [1,0]) = 00b, see *Table 45*		300		µA
IddSL	Current consumption in power-down(4)			1		µA
Top	Operating temperature range		-40		+85	°C

1. Typical specifications are not guaranteed.
2. eCompass: accelerometer - magnetic sensor.
3. Magnetic sensor setting ODR =6.25 Hz, accelerometer sensor ODR = 50 Hz and magnetic high resolution setting.
4. Linear accelerometer and magnetic sensor in power-down mode.

Tesis publicada con autorización del autor
No olvide citar esta tesis

TESIS PUCP

2.5 Absolute maximum ratings

Stresses above those listed as “absolute maximum ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device under these conditions is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

Table 8. Absolute maximum ratings

Symbol	Ratings	Maximum value	Unit
Vdd	Supply voltage	-0.3 to 4.8	V
Vdd_IO	I/O pins supply voltage	-0.3 to 4.8	V
Vin	Input voltage on any control pin (SCL/SPC, SDA/SDI/SDO, SDO/SA0, CS)	-0.3 to Vdd_IO +0.3	V
A_{POW}	Acceleration (any axis, powered, Vdd = 2.5 V)	3,000 for 0.5 ms	*g*
		10,000 for 0.1 ms	*g*
A_{UNP}	Acceleration (any axis, unpowered)	3,000 for 0.5 ms	*g*
		10,000 for 0.1 ms	*g*
T_{OP}	Operating temperature range	-40 to +85	°C
T_{STG}	Storage temperature range	-40 to +125	°C

Note: Supply voltage on any pin should never exceed 4.8 V.

This is a mechanical shock sensitive device, improper handling can cause permanent damage to the part

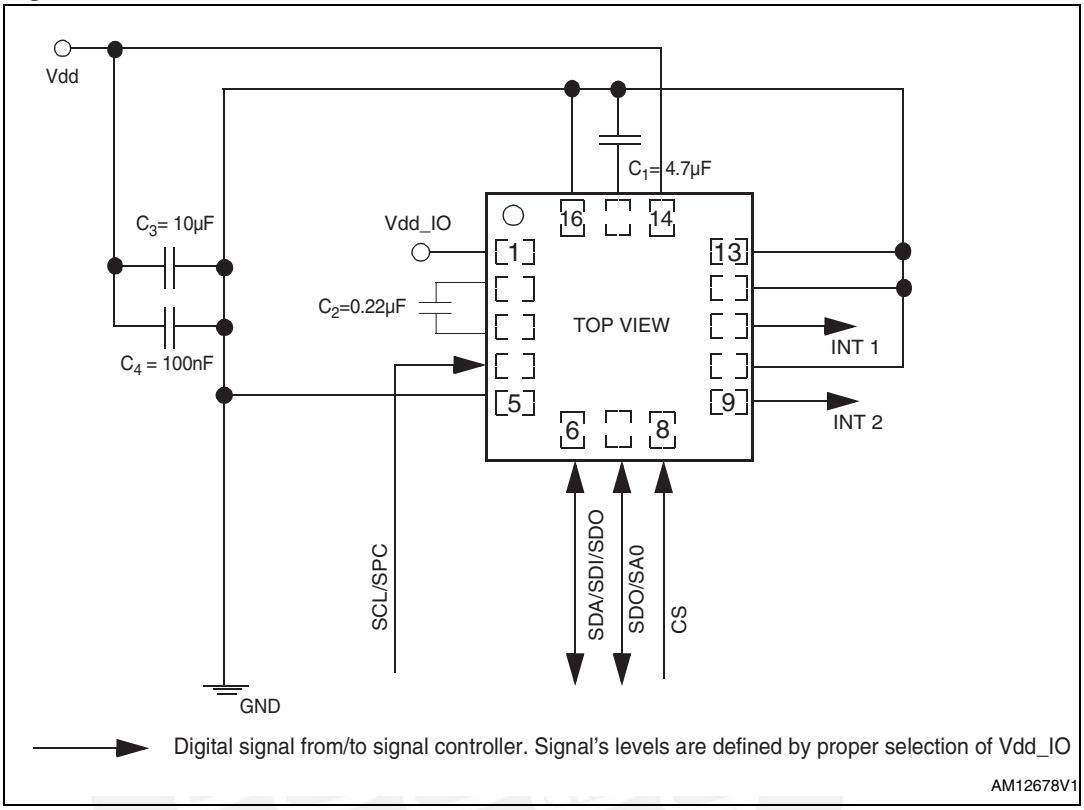
This is an ESD sensitive device, improper handling can cause permanent damage to the part

Tesis publicada con autorización del autor
No olvide citar esta tesis

TESIS PUCP

5 Application hints

Figure 5. LSM303D electrical connection



5.1 External capacitors

The C1 and C2 external capacitors should be low SR value ceramic type construction (typ. suggested value 200 mΩ). Reservoir capacitor C1 is nominally 4.7 µF in capacitance, with the set/reset capacitor C2 nominally 0.22 µF in capacitance.

The device core is supplied through the Vdd line. Power supply decoupling capacitors (C4=100 nF ceramic, C3=10 µF Al) should be placed as near as possible to the supply pin of the device (common design practice). All the voltage and ground supplies must be present at the same time to have proper behavior of the IC (refer to *Figure 5*).

The functionality of the device and the measured acceleration/magnetic field data is selectable and accessible through the I^2C/SPI interfaces.

The functions, the threshold and the timing of the two interrupt pins (INT1 and INT2) can be completely programmed by the user through the I^2C/SPI interfaces.

5.2 Pull-up resistors

If an I^2C interface is used, pull-up resistors (suggested value 10 kΩ) must be placed on the two I^2C bus lines.

Tesis publicada con autorización del autor
No olvide citar esta tesis

Lima 31 de Octu re de 2014

SOLICITUD DE COTI ACI N

Estimado
ose Alvarado

Re . Impresi n 3d de pie as en pl stico
A S
Lima.-

NOMBRE / EMPRESA	PIEZA	TOTAL	MATERIAL / IMPRESORA
Jose Alvarado	Cuerpo frontal	S/. 76.1	MAKER/ABS
	Cuerpo trasero	S/. 43.51	MAKER/ABS
	Extremidad	S/. 32	MAKER/ABS
	Pin	S/. 2	MAKER/ABS
	Pin EDF	S/. 0.50	MAKER/ABS

Montos e presados en nuevos soles (PEN), no incluye IGV.

Forma de pa o
- Adelantado
- Tesorer a de la Ponti icia Universidad Cat lica del Per

Atentamente,

enni er on Po i
Responsa le del rea de impresi n 3D
Ponti icia Universidad Cat lica del Per

Tesis publicada con autorización del autor
No olvide citar esta tesis