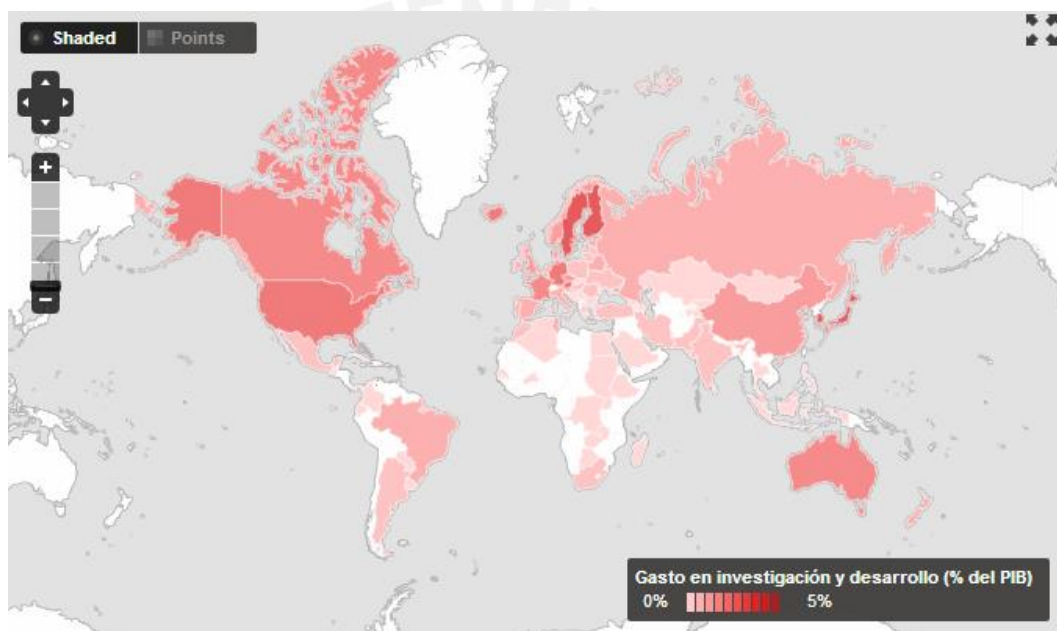


## Anexo 1: Gastos en Ciencia y Tecnología

Cuando se trata de investigación en tecnología, los países invierten cada año una mayor gran cantidad de dinero. En Estados Unidos [19], el país que más invierte en este tipo de investigaciones, gastó en el año 2011 cerca de \$78.9 billones, mientras que en el 2012 invirtió \$41.7 billones debido a la crisis mundial que los afecta. Asimismo, la gigante asiática, China [20] invirtió \$36.1 billones en gastos de tecnología posicionándose en el 2do lugar de inversión en el mundo en el 2012.

Por otro lado, según el Banco Interamericano de Desarrollo (BID), Perú [21] duplicó su inversión en tecnología en 2012, ya que pasó de invertir 220 millones en 2011 a 460 millones de dólares en 2012. Esto nos indica que se realiza un esfuerzo significativo de inversión en materia tecnológica, impulsado por el sector público.



Gastos en Ciencia y Tecnología en el mundo [22]

## Anexo 2: Inversión en Investigación y Tecnología de la Pontificia Universidad Católica del Perú

La inversión en Investigación de proyectos multidisciplinarios y en Tecnología de la Pontificia Universidad Católica del Perú es el 2% de su inversión total (S/. 609, 269 millones), es decir, cerca de S/. 12 millones. Esta información está basada en las cifras de presupuestos operativos del año 2012 del Vicerrectorado Administrativo.

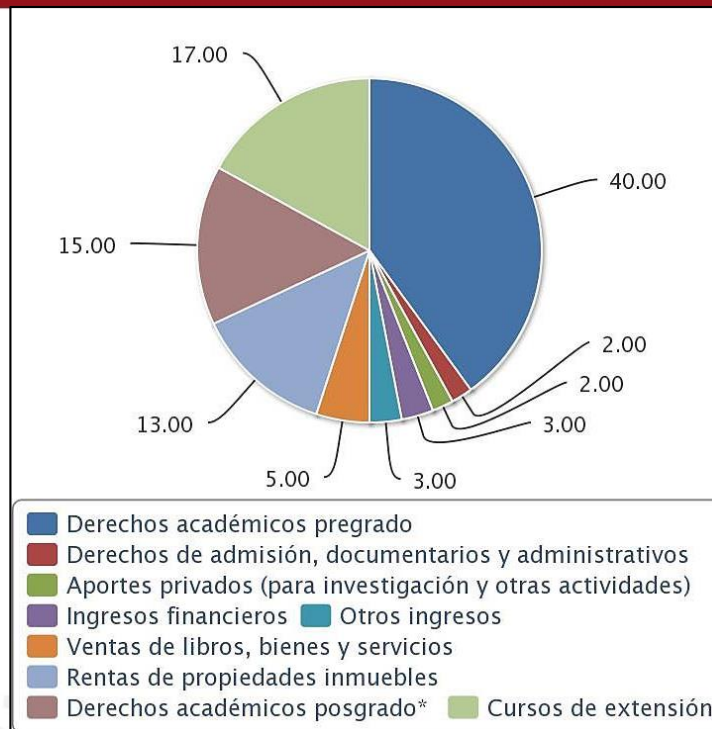


Diagrama del porcentaje de las inversiones en la PUCP [23]

### Anexo 3: Código de colores para cableado de circuitos electrónicos

COLOR	DESCRIPCIÓN
Amarillo	Voltaje: 12 V
Rojo	Voltaje: 5 V
Naranja	Voltaje: 3.3V
Negro	Tierra
Azul	Entrada analógica
Celeste	Salida analógica
Marrón	Entrada digital
Verde	Salida digital

## Anexo 4: Estado del arte – Robots anfitriones

- **BIRON [1]:** (Bielefeld Robot Companion) es un robot anfitrión y de compañía de origen Alemán que fue desarrollado en el 2005 en la Facultad de Tecnología de la Universidad de Bielefeld. Su principal función es la de interactuar y mantener una conversación con personas por medio de un parlante incorporado y dos micrófonos estéreo. Además, cuenta con dos cámaras: Una para detección de objetos y obstáculos, y la otra usada para el reconocimiento de gestos en los rostros de las personas. Finalmente, posee una pantalla táctil en donde puedes navegar por internet y buscar información del robot.



- **NAO [4]:** NAO fue fabricado por la empresa francesa Aldebaran Robotics en el año 2006. Estos hombres mecánicos que miden 58 cm de alto y pesan 4,3 Kg, presentan dos cámaras y cuatro micrófonos integrados, así como varios sensores infrarrojos y la posibilidad de conectarse al WiFi. Dado que permite una programación personalizada puede realizar múltiples actividades como caminar, bailar, hablar, tomar objetos, etc. Debido a esto, en el año 2010 fue el anfitrión de la XVII edición de la Feria de Ciencia y Tecnología realizada en México, en donde saludó y recibió a la mayoría de asistentes a la Feria.



- **Robot PR2 [7]:** Personal Robot 2 (PR2) es robot rodante con dos brazos articulados del tamaño de una persona. Fue una creación del laboratorio de investigación robótica Willow Garage, la cual se dedica a la creación de software de código abierto para las aplicaciones de robots personales. Una de las funciones, para lo cual ha sido modificado por sus creadores, es la de servir diferentes tipos de cerveza; esto incluye abrir el refrigerador, buscarlas en la nevera, analizar los tipos de botella y llevarlas a su destino. Por si fuese poco, posee un software de reconocimiento facial que determina si una persona esta sedienta o no.



- **FURO ROBOT [9]:** Este robot fue diseñado en Corea del Sur en 2011 por la compañía Future Robot. FURO es capaz de guiar a las personas y tomar órdenes gracias a la tecnología HRI (Human Robot Interacción). Posee una pantalla LCD como rostro en la que puede mostrar emociones como alegría, cuando una persona se le acerca, o tristeza, cuando se alejan. Además, sus creadores agregaron una pantalla táctil de 25" para que pueda usarse tanto como menú de restaurantes o como robot anfitrión de museos o eventos de gran acogida. En esta pantalla se puede encontrar información del lugar de operación del robot.



- **AEDI, The Robot [11]:** AEDI es un robot anfitrión y guía del Mind Museum en Manila, Filipinas. Entre sus funciones están la de saludar a todos los visitantes, presentar a los guías turísticos y dar facilidades ante cualquier consulta que tenga acerca del museo. Para realizar todo lo mencionado, posee un software de reconocimiento de voz para poder entender las preguntas de los visitantes y, de acuerdo a una base de datos de respuestas, puede mantener la conversación con ellos.



- **AR (Robot Asistente) [12]:** El Instituto de Investigación y Robótica de la Universidad de Tokio (Tokyo University's IRR) ha desarrollado un robot que puede ayudarnos tanto para actividades domésticas como para ser el anfitrión de una fiesta. El robot mide 155 cm, pesa 120 Kg y tiene 32 grados de libertad. Tiene un total de 5 cámaras en su cabeza usadas para la detección de rostros y múltiples sensores laser e infrarrojos para detectar y evitar obstáculos en su camino. Aunque ya está completamente diseñado, se espera que la producción en masa de este robot se empiece en unos 10 o 15 años y, según sus creadores, costaría \$10,000 U.S.



## Anexo 5: Estado del arte – Robots guías

- **ENON [16]:** Su nombre proviene del acrónimo Exciting Nova On Network. ENON es un robot asistente personal que fue desarrollado por la compañía japonesa Fujitsu en el año 2006. Su principal función es la de movilizarse autónomamente a la entrada de los museos para recibir a los visitantes y guiarlos a lo largo de las exposiciones usando gestos con sus brazos y mostrando videos en su pantalla LCD que tiene incorporada. Además, tiene módulos de reconocimiento de voz que permiten que los visitantes puedan entablar conversación o realizar preguntas al robot.



- **UAIBOT-C2 [5]:** Este es el nombre de un robot desarrollado en Argentina por la Universidad Abierta Interamericana. Ha participado en el 6º Edición del Congreso Internacional en Innovación Tecnología Informática (CIITI) en donde interactuó con los asistentes e incluso contó chistes. Tiene la capacidad de movilizarse autónomamente, reconociendo obstáculos a su alrededor mediante dos cámaras y diversos sensores infrarrojos que posee en su estructura. Para su desplazamiento usa un ruedas orugas, lo cual lo hace un poco ruidoso.



- **WEVER-R2 [10]:** Es un robot desarrollado por el Instituto de Investigación de Telecomunicaciones y Electrónica (ETRI, por sus siglas en Inglés) en Corea del Sur. Su principal función es la de servir como guía de museos o como robot anfitrión. Puede responder interrogantes de los visitantes ya que cuenta con un módulo de reconocimiento de voz, el cual añade conocimiento y nuevas palabras a la base de datos que tiene pregrabada. Adicionalmente, posee una cámara para el reconocimiento facial y puede ser usado como guardia de seguridad en los museos cuando este se encuentre cerrado al público.



**UBIKO [15]:** Este simpático robot humanoide fue desarrollado en 2009 por las compañías japonesas Ubix y Tmsuk. Sus creadores pretenden que reemplace a los humanos en tareas repetitivas como darles la bienvenida a clientes, promocionar productos en mercados o centros comerciales, guiar a los pacientes y visitantes al interior de los hospitales. El robot es completamente autónomo y responde a comandos de voz específicos. Asimismo, cuenta con una cámara con la que registra todo lo que ve y reconoce a visitantes frecuentes.

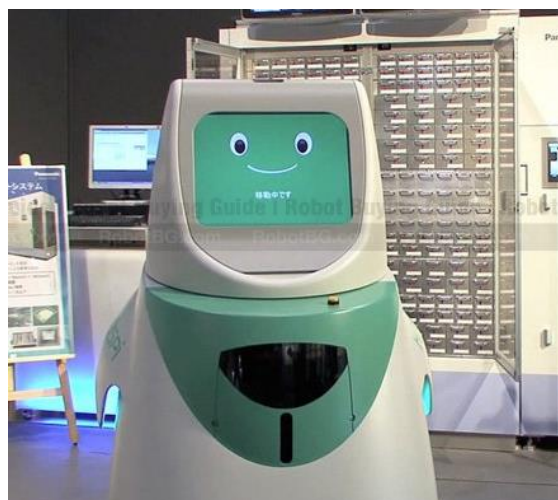


## Anexo 6: Estado del arte – Robots asistentes

- **JULIA, The Household Entertainment Robot [2]:** El Laboratorio de Control Avanzado de la Universidad Nacional de Taiwán creó el robot de entretenimiento y asistente familiar llamado JULIA. Este robot está programado para cantar y bailar con fines de entretenimiento. Entre sus funciones destacan que posee un sistema de reconocimiento de voz y una pantalla táctil para interactuar con las personas a su alrededor. Asimismo, sirve como sistema de alarma para proteger la casa mientras los dueños estén fuera.

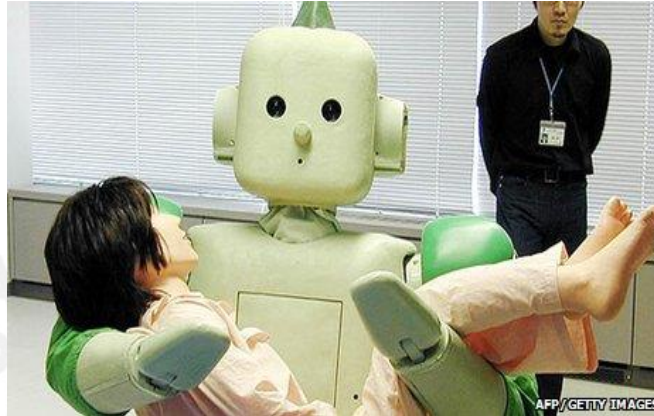


- **HOSPI [3]:** HOSPI es un robot asistente que fue creado por la empresa japonesa Panasonic en el 2011 y fue el ganador de un premio en la cuarta edición del Robot Awards. El robot, que viene adornado con los colores de los uniformes de las enfermeras y doctoras, consta de dos partes: Un gabinete fijo por donde se reparten las ampollas frágiles y un gabinete móvil por donde recoge o entrega los medicamentos a las enfermeras. El objetivo para la creación de este robot es la de ayudar en hospitales que poseen un escaso número de enfermeras. Cabe recalcar que este robot es completamente autónomo y se desplaza usando sensores ultrasónicos para evitar los obstáculos. Las primeras pruebas del robot se realizaron en el Matsushita Memorial Hospital en diciembre del 2012.





- **RI-MAN [8]:** Es un robot desarrollado en Nagoya, Japón por el centro de investigación Bio-Mimetic en el año 2008. Una peculiar característica es que tiene la piel suave y blanda al tacto. Mide 158 cm, pesa 100 Kg y tiene el cuerpo cubierto por 5 mm de silicona, así como 320 sensores que controlan la presión ejercida sobre la piel para ajustar la delicadeza con que carga a los pacientes. Además, RI-MAN está equipado con 19 motores, controlados por un “sistema nervioso” que le provee de la autonomía necesaria para responder rápidamente a cualquier cambio que se produzca en el entorno. Su principal función es la de ayudar a movilizar pacientes de una cama a otra (distancias cortas), pero también puede hablar e interactuar con las personas para hacerlas sentir mejor.

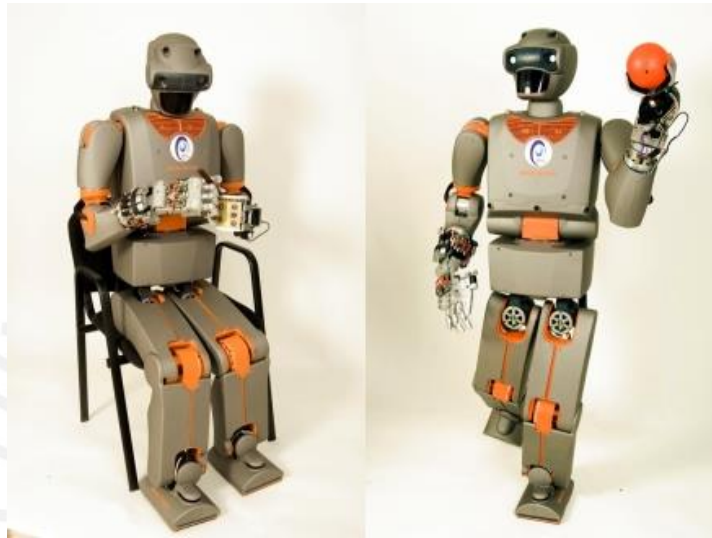


## Anexo 7: Estado del arte – Robots humanoides

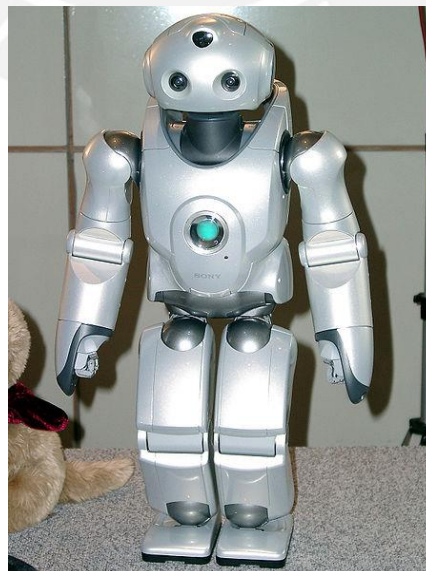
- **Albert Hubo [6]:** Es un robot hecho en Corea del Sur que posee la cara del científico Albert Einstein. Su primera aparición fue en la Cumbre de la APEC en el año 2005. Entre las funciones del robot se encuentran la capacidad de articular palabras, expresar frases hechas e, incluso, de mantener conversaciones en diferentes idiomas. Una particularidad es que sólo la cara de Einstein tiene 31 motores, usados para simular diversas expresiones faciales, como parpadear y sonreír.



- **REEM [13]:** Es el último prototipo robótico desarrollado en España por PAL Robotics. El robot autómatas REEM mide 1.7 m de alto, pesa 90 Kg y se desplaza a una velocidad máxima de 4 a 5 Km/h. Consta de un torso con una pantalla táctil, dos brazos y una cabeza, ambos motorizados. Además, posee una cámara y dos micrófonos usados para el reconocimiento de rostros y voces. Contiene una gran variedad de sensores para evitar obstáculos a través de un sistema simultáneo de localización y mapeo (SLAM). REEM puede ser usado como robot guía, punto dinámico de información, asistente personal y plataforma robótica para investigación.



- **QRIO [14]:** Quest Curiosity (QRIO) es un robot humanoide bípedo desarrollado por Sony en el año 2007. El robot, que mide 60 cm y pesa 7.3 Kg, tiene por slogan “Makes life fun, makes you happy”. QRIO es capaz de reconocer voces y rostros, haciéndolo ideal para recordar a las personas y sus gustos o disgustos. Un dato curioso es que posee el Record Mundial Guinness por ser el primer robot capaz de correr.



- **ROBOVIE R3 [17]:** Este robot humanoide ha sido desarrollado por ART en el año 2011. Fue diseñado principalmente para ayudar a personas de la tercera edad en actividades rutinarias como salir de compras o salir a caminar en las inmediaciones. Posee 2 cámaras USB (una en cada ojo) para detectar el rostro de las personas, 2 micrófonos para reproducir sonido y más de 10 sensores alrededor de su cuerpo para regular la fuerza que ejerce sobre las personas.



## Anexo 8: Set de rostros de la Universidad de Yale [24]

Nombre:	The Yale Face Database
Imagen a color:	No
Tamaño de imagen:	320 x 243
Número de personas únicas:	15
Número de imágenes por persona:	11
Diferentes condiciones:	Luz central, luz derecha, luz izquierda, con lentes, sin lentes, feliz, triste, con bostezo, sorpresa, amargo, serio.



Imagen de rostro de una persona extraído del set de entrenamiento de Yale

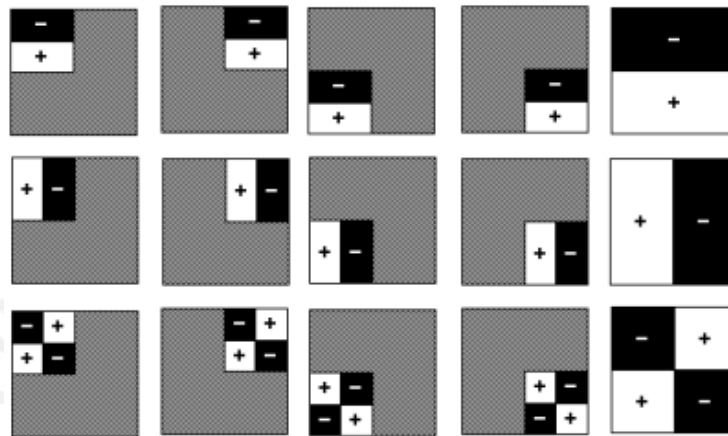
## Anexo 9: Cómo funciona el algoritmo de detección y reconocimiento de rostros [25], [26] y [27]

El algoritmo de detección de rostros usado en este trabajo de tesis está basado en el Método de Viola – Jones. Se escogió este método ya que posee una tasa muy alta de precisión en comparación a otros métodos [28], [29] y, a su vez, es relativamente sencillo de implementar.

El algoritmo implementado no trata de analizar la imagen directamente, en cambio, analiza las características rectangulares de la imagen. La metodología se divide en tres etapas: la generación de la imagen integral, la extracción de características, y por último, la clasificación (rostro o no rostro).

En la primera etapa, se le quita el color a la imagen y se obtiene una imagen en escala de grises. Finalmente, la imagen integral en la posición (x, y) se define como la suma de todos los píxeles por encima y a la izquierda de esa posición.

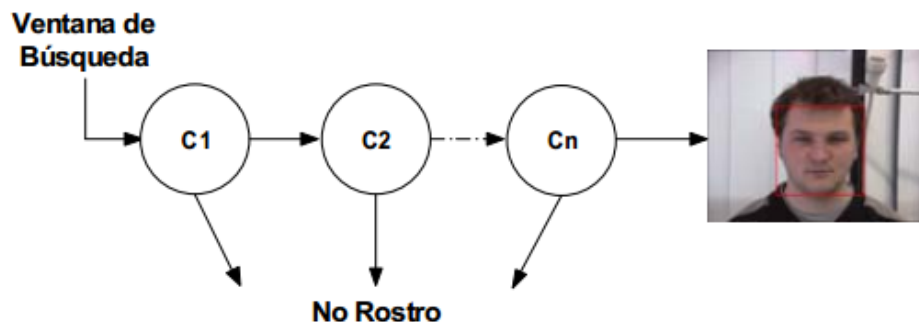
Luego, en la segunda etapa se hace uso de la imagen integral y de los filtros de Haar. La extracción de características es realizada aplicando, a la imagen integral, filtros de Haar. Estos filtros realizan un cálculo de diferencia de intensidades en la imagen, generando características de contornos, puntos y líneas mediante la captura de contraste entre regiones. A continuación se muestran algunos de los filtros usados para la extracción de características:



Filtros de Haar rotados y escalados [26]

Finalmente, para la clasificación se hace uso de cada una de las características extraídas en la etapa anterior. Para ello, el método de Viola – Jones utiliza un sistema llamado AdaBoost, el cual combina características débiles en un clasificador más fuerte. A cada característica dentro de un clasificador se le asigna una ponderación que define que tan preciso es el clasificador.

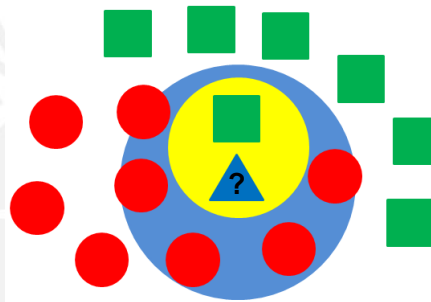
Cuando se desea conocer si una imagen es un rostro o no, se prueba cada subventana de la imagen original contra el primer clasificador. Si pasa ese clasificador, se prueba contra el segundo, y así sucesivamente. Si se rechaza la subventana en algún clasificador, la imagen se considera una “no cara”. Caso contrario, la imagen se clasifica como una cara



Clasificador en cascada [26]

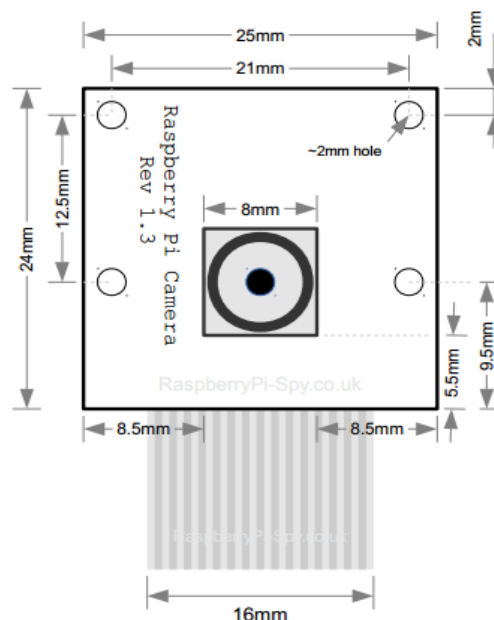
Una vez realizada la detección de rostros, se procede a realizar el reconocimiento de rostros. El objetivo de un sistema de reconocimiento facial es: Dada una imagen de una cara “desconocida” (imagen de test), encontrar una imagen de la misma cara en un conjunto de imágenes “conocidas” (imágenes de entrenamiento). El algoritmo usado en esta etapa es el de vecinos cercanos [27], el cual consiste en usar los vectores de características de la base de datos (imágenes pregrabadas de los rostros a reconocer), compararlos con el vector de características de la imagen de entrada y seleccionar los “K” vecinos más cercanos a esta imagen.

Como se observa en el siguiente dibujo, se tienen dos tipos de instancias: círculos y cuadrados. El clasificador decidirá si una instancia “?” es un círculo o cuadrado. Si se escogiera el primer vecino más cercano (círculo amarillo), entonces se clasificaría a la instancia “?” como cuadrado. Sin embargo, si se tomarán los 6 vecinos más cercanos, se clasificaría al elemento “?” como círculo.



De esta manera, se puede conocer y determinar a qué persona pertenece el rostro de la imagen capturada por la cámara del robot. En caso que no se encuentre una similitud entre el rostro de entrada, este algoritmo nos indicará que es un rostro desconocido.

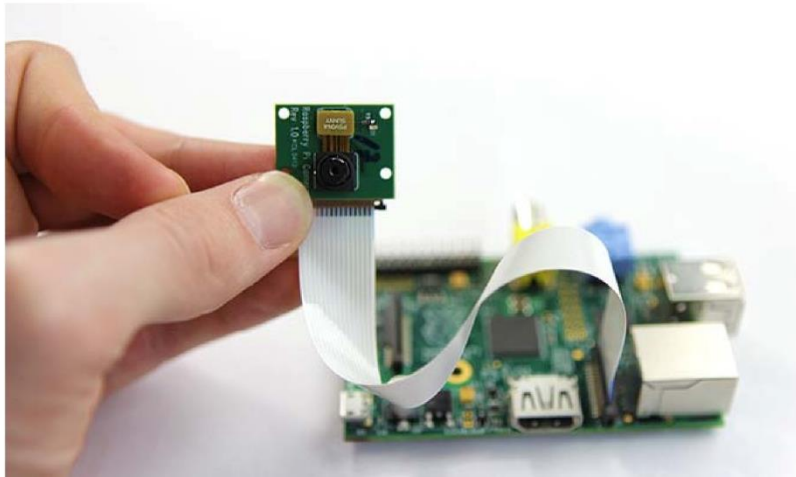
## Anexo 10: Documentación de la cámara Raspberry Pi [30], [31]



Andy Laing is a committed Raspberry Pi *pi-oneer* at element14 and these notes are intended to help users get the Raspberry Pi camera working on any Model A or Model B Raspberry Pi computer.

First, please download the latest Raspbian image (2013-02-09-wheezy-raspbian.img) and install it onto your SD card. Please ensure that your SD card is at least 4 GB in size.

Then, connect the Camera module to the CSI port on the Raspberry Pi computer.



### Using the camera software

Once your Raspberry Pi computer has rebooted, you can login again and run the camera software to take photographs or record video.

1. Online help (gives you all of the command-line options available)  
pi@raspberrypi ~ \$ `/opt/vc/bin/raspicam`
2. Taking a simple photograph  
pi@raspberrypi ~ \$ `/opt/vc/bin/raspicam -o file.jpg`
3. Recording a simple video  
pi@raspberrypi ~ \$ `/opt/vc/bin/raspivid -o file.h264`

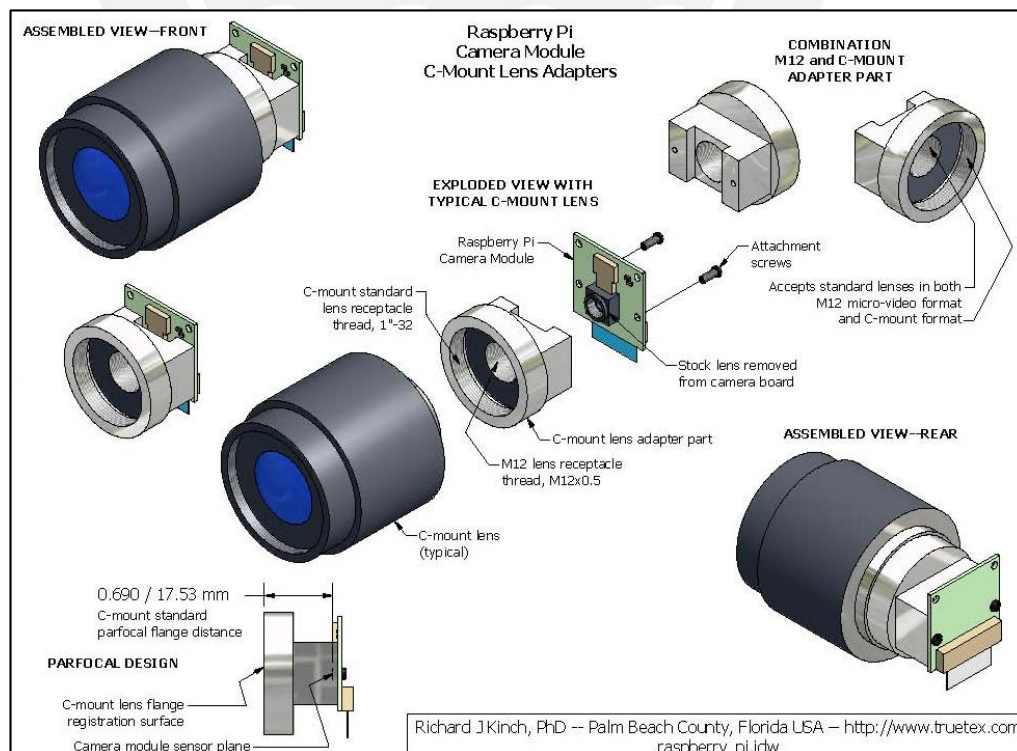
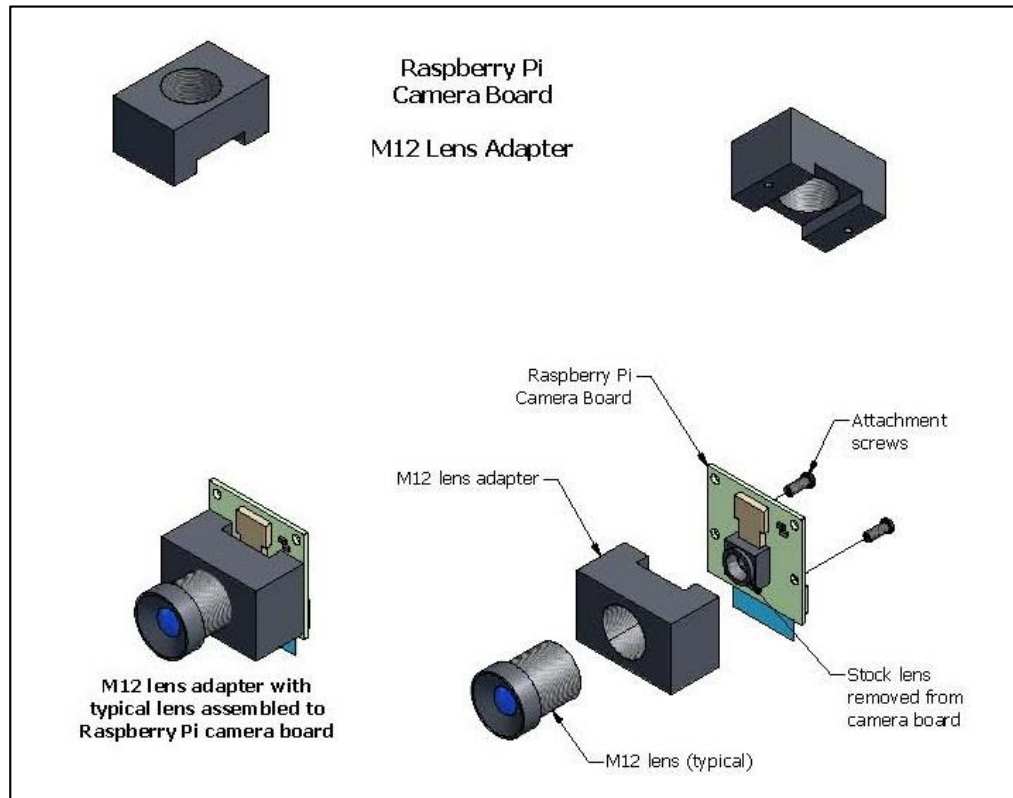
**Please note that when recording video the camera module will not record any sound – this unit will only capture HD video images only.**

4. Taking some time lapsed images (in this case the images are 30ms apart)  
pi@raspberrypi ~ \$ `/opt/vc/bin/raspicam -tl 30 -o file%d.jpg`  
Note the filename – the %d will be replaced with an integer (creating file1.jpg, file2.jpg etc).  
This software will continue taking images until you press 'CTRL-C' to terminate the program.
5. Using the image effects when taking photographs or capturing video  
This command will take a picture in 'negative'  
pi@raspberrypi ~ \$ `/opt/vc/bin/raspicam -ifx negative -o negative_image.jpg`

For a full list of image effects when taking photographs type:  
pi@raspberrypi ~ \$ `/opt/vc/bin/raspicam`  
To read the help screen and all available command line options.

For a full list of image effects when recording video type:  
pi@raspberrypi ~ \$ `/opt/vc/bin/raspivid`  
To read the help screen and all available command line options.

## Anexo 11: Uso de lentes intercambiables en cámara Raspberry Pi [32]





# Anexo 12: Hoja técnica del motor de la cabeza



SPG30 Series

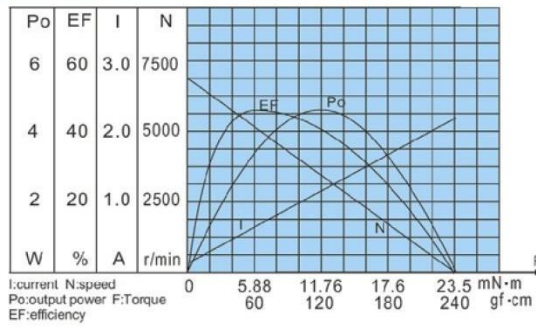


Output Power: 1.1W

Weight: ~160g

**Typical applications:** Labal printers, auto shutter, welding machines, water meter IC card, grill, oven, cleaning machine, garbage disposers, household appliances, slot machines, money detector, automatic actuator, coffee machine, towel disposal, lighting, coin refund devices, peristaltic pump.

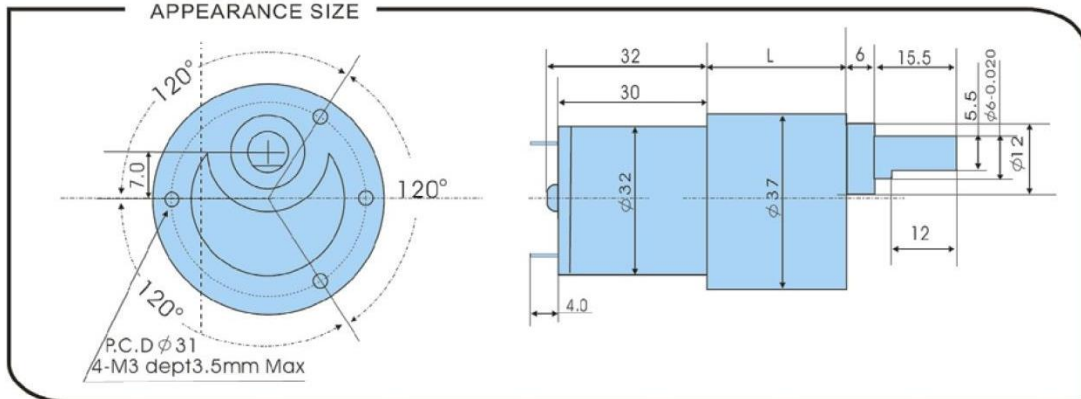
**MOTOR CHARACTERISTICS**



**MOTOR TORQUE/SPEED/CURRENT**

Rated voltage	12VDC
No load speed	7000r/min
No load current	70mA
Rated torque	60gf · cm 5.88mN · m
Rated current	410mA
Rated speed	5200r/min
Stall torque	240gf · cm 23.5mN · m
Stall current	1.8A

**APPEARANCE SIZE**



Order Code	Input Voltage	Rated		Weight (g)	Power (w)	Diameter (mm)	L (mm)
		Speed (RPM)	Torque (mN.m)				
SPG10-30K	6	440	29.4	10	-	12	24
SPG10-150K	6	85	107.9	10	-	12	24
SPG10-298K	6	45	176.5	10	-	12	24
SPG20-50K	12	130	58.8	60	0.6	27.2	-
SPG30-20K	12	185	78.4	160	1.1	37	22
SPG30-30K	12	103	127.4	160	1.1	37	22
SPG30-60K	12	58	254.8	160	1.1	37	25
SPG30-150K	12	26	588	160	1.1	37	27
SPG30-200K	12	17	784	160	1.1	37	27
SPG30-300K	12	12	1176	160	1.1	37	27
SPG50-20K	12	170	196	300	3.4	37	23
SPG50-60K	12	56	588	300	3.4	37	26
SPG50-100K	12	34	980	300	3.4	37	26
SPG50-180K	12	17	1960	300	3.4	37	28

# Anexo 13: Hoja técnica del encoder del motor de la cabeza



ROBOT . HEAD to TOE  
Product User's Manual – MO-SPG-30E-XXXX

## 1. Introduction and Overview



Figure 1.0 DC geared motor with encoder and its removable cover

This document explains the general method to use the encoder for MO-SPG-30E-XXXX. “XXX” is referring to the gear ratio of Cytron’s SPG-30 Geared Motor series which is either 20, 30, 60, 150, 200 or 300. This DC Geared Motor with Encoder is formed by a quadrature hall effect encoder board which is designed to fit on the rear shaft of Cytron’s SPG-30 Geared Motor series. Two hall effect sensor are placed 90 degree apart to sense and produce two output A and B which is 90 degree out of phase and allowing the direction of rotation to be determined. This encoder provides 3 counts per revolution of the rear shaft. Please note that the encoder is mounted at the rear shaft, the minimum resolution is depends on the motor’s gear ratio.

- Resolution : 3 pulses per rear shaft revolution, single channel output.
  - 60 counts per main shaft revolution for 1:20 geared motor

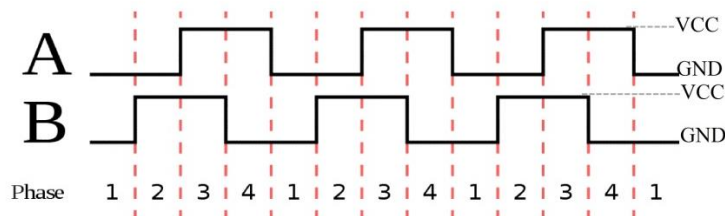
Clockwise Rotation

Phase	A	B
1	0	0
2	0	1
3	1	1
4	1	0

Counter Clockwise Rotation

Phase	A	B
1	1	0
2	1	1
3	0	1
4	0	0

Square quadrature waveform for Channel A and B (Clockwise)





## 2. Pin Descriptions

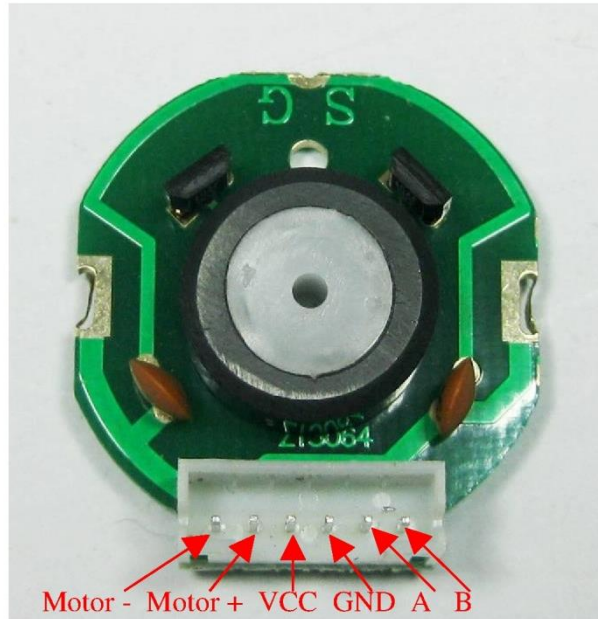


Figure 2.0 2020-06 connector pin descriptions

Pin	Name	Description
1	Motor -	Output of motor driver
2	Motor +	Output of motor driver
3	Hall effect sensor VCC	Supply voltage for sensor circuit (4.5V-5.5V)
4	Hall effect sensor GND	Ground
5	Channel A	Output of the encoder
6	Channel B	Output of the encoder

## Anexo 14: Hoja técnica del acople del motor de la cabeza

### POLOLU UNIVERSAL ALUMINUM MOUNTING HUB FOR 6MM SHAFT PAIR, 4-40 HOLES

The Pololu universal aluminum mounting hub allows you to mount custom wheels and mechanisms to **6 mm** motor shafts. The hubs are sold in **pairs**, and each hub includes two 4-40 set screws for securing a motor shaft to the hub. The set includes one [Allen wrench](#) and two 4-40 set screws for securing the hubs to motor shafts. Each hub has four mounting holes for [4-40 screws](#) (not included).



These universal mounting hubs are designed to work with most [6 mm shafts](#), including round shafts and "D" shafts. Each hub has six mounting holes for [4-40 screws](#) (not included), letting you mount custom wheels or mechanisms to your motors. 4-40 hex set screws (two included for each hub) allow secure coupling of shaft to hub. A [0.05" hex wrench](#) (often the smallest size in SAE Allen wrench sets) is included for use with the set screws.

## Anexo 15: Hoja técnica del controlador del motor de la cabeza

### Ardumoto - Motor Driver Shield DEV-09815

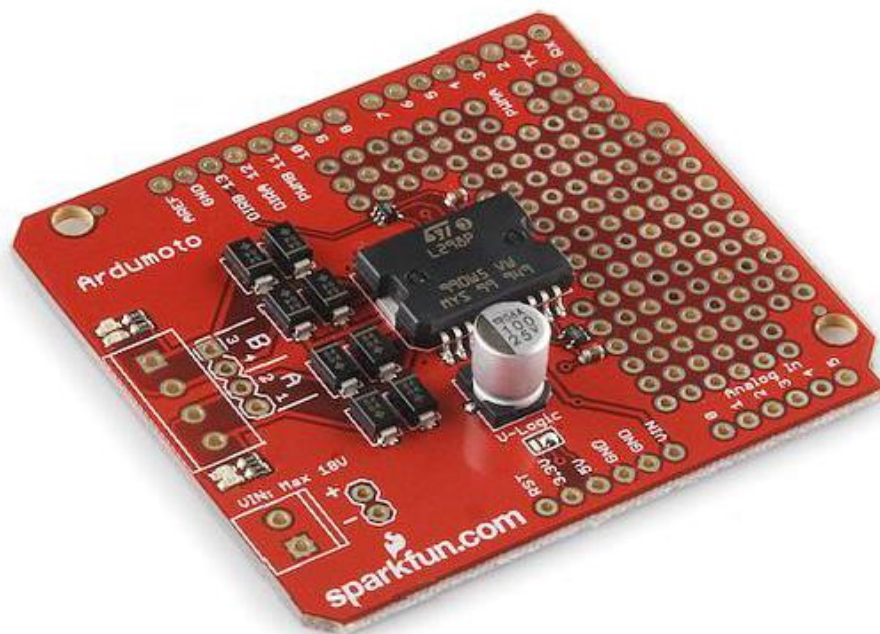
**Description:** The new version of this shield allows for either 3.3 or 5v logic, a separate and more robust VIN connection, and the PWM input has moved to pin 3.

This is a motor shield for Arduino that will control two DC motors. Based on the L298 H-bridge, the Ardumoto can drive up to 2 amps per channel. The board takes its power from the same Vin line as the Arduino board, includes blue and yellow LEDs to indicate active direction, and all driver lines are diode protected from back EMF.

Control for motor attached to OUT1/2 is connected to digital line 12 (direction A) and digital line 3 (PWM A).

Control for motor attached to OUT3/4 is connected to digital line 13 (direction B) and digital line 11 (PWM B).

Compatible screw terminals and connectors are listed below. They are not included in this SKU. You will need to add them to your cart separately.



## Anexo 16: Hoja técnica del integrado usado por la tarjeta controladora de motores



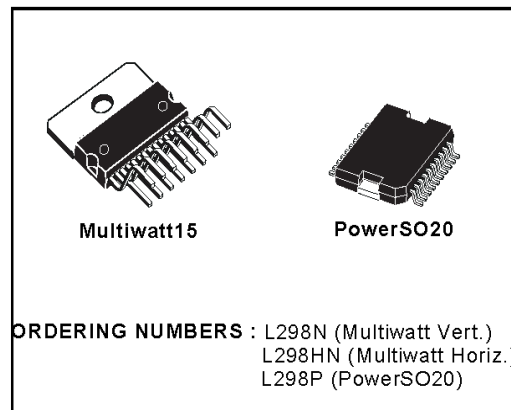
**L298**

### DUAL FULL-BRIDGE DRIVER

- OPERATING SUPPLY VOLTAGE UP TO 46 V
- TOTAL DC CURRENT UP TO 4 A
- LOW SATURATION VOLTAGE
- OVERTEMPERATURE PROTECTION
- LOGICAL "0" INPUT VOLTAGE UP TO 1.5 V (HIGH NOISE IMMUNITY)

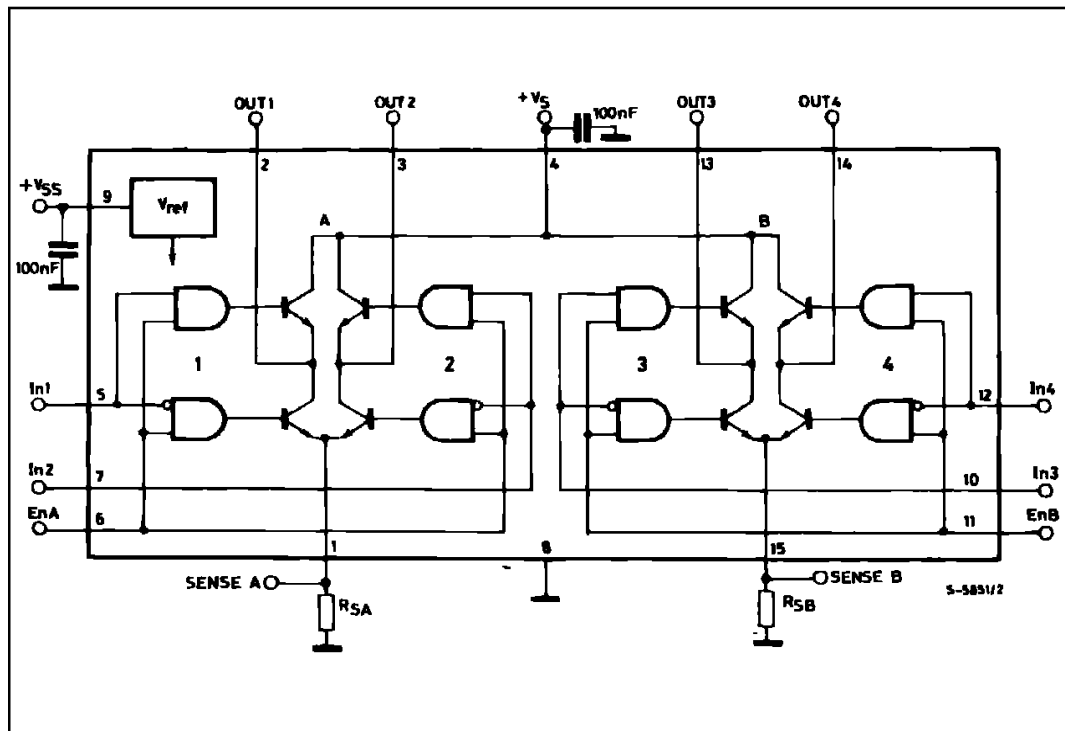
#### DESCRIPTION

The L298 is an integrated monolithic circuit in a 15-lead Multiwatt and PowerSO20 packages. It is a high voltage, high current dual full-bridge driver designed to accept standard TTL logic levels and drive inductive loads such as relays, solenoids, DC and stepping motors. Two enable inputs are provided to enable or disable the device independently of the input signals. The emitters of the lower transistors of each bridge are connected together and the corresponding external terminal can be used for the con-



nection of an external sensing resistor. An additional supply input is provided so that the logic works at a lower voltage.

#### BLOCK DIAGRAM



January 2000

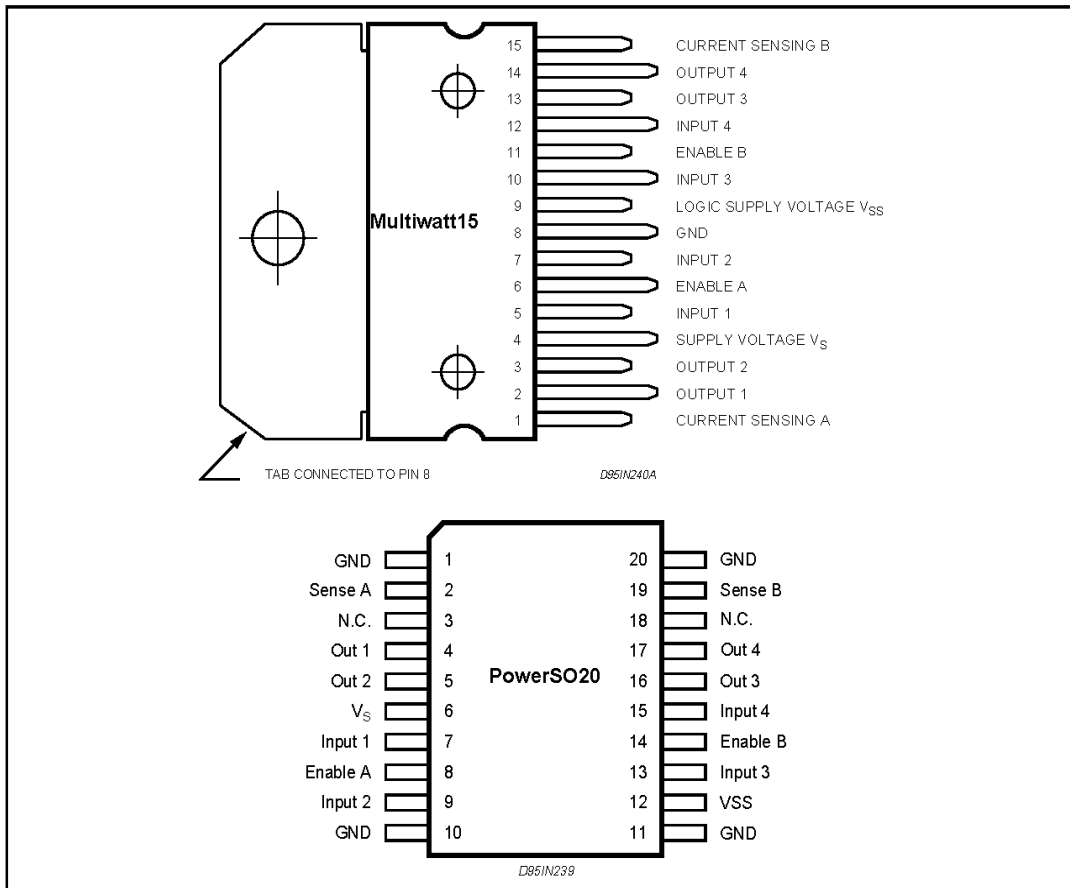
1/13

**L298**

**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
$V_S$	Power Supply	50	V
$V_{SS}$	Logic Supply Voltage	7	V
$V_i, V_{en}$	Input and Enable Voltage	-0.3 to 7	V
$I_O$	Peak Output Current (each Channel)		
	- Non Repetitive ( $t = 100\mu s$ )	3	A
	- Repetitive (80% on -20% off, $t_{on} = 10ms$ )	2.5	A
	-DC Operation	2	A
$V_{sens}$	Sensing Voltage	-1 to 2.3	V
$P_{tot}$	Total Power Dissipation ( $T_{case} = 75^\circ C$ )	25	W
$T_{op}$	Junction Operating Temperature	-25 to 130	$^\circ C$
$T_{stg}, T_j$	Storage and Junction Temperature	-40 to 150	$^\circ C$

**PIN CONNECTIONS (top view)**



**THERMAL DATA**

Symbol	Parameter	PowerSO20	Multiwatt15	Unit
$R_{th-j-case}$	Thermal Resistance Junction-case	Max.	3	$^\circ C/W$
$R_{th-j-amb}$	Thermal Resistance Junction-ambient	Max.	13 (*)	$^\circ C/W$

(\*) Mounted on aluminum substrate

**PIN FUNCTIONS** (refer to the block diagram)

MW.15	PowerSO	Name	Function
1;15	2;19	Sense A; Sense B	Between this pin and ground is connected the sense resistor to control the current of the load.
2;3	4;5	Out 1; Out 2	Outputs of the Bridge A; the current that flows through the load connected between these two pins is monitored at pin 1.
4	6	V <sub>S</sub>	Supply Voltage for the Power Output Stages. A non-inductive 100nF capacitor must be connected between this pin and ground.
5;7	7;9	Input 1; Input 2	TTL Compatible Inputs of the Bridge A.
6;11	8;14	Enable A; Enable B	TTL Compatible Enable Input: the L state disables the bridge A (enable A) and/or the bridge B (enable B).
8	1,10,11,20	GND	Ground.
9	12	V <sub>SS</sub>	Supply Voltage for the Logic Blocks. A 100nF capacitor must be connected between this pin and ground.
10; 12	13;15	Input 3; Input 4	TTL Compatible Inputs of the Bridge B.
13; 14	16;17	Out 3; Out 4	Outputs of the Bridge B. The current that flows through the load connected between these two pins is monitored at pin 15.
-	3;18	N.C.	Not Connected

**ELECTRICAL CHARACTERISTICS** (V<sub>S</sub> = 42V; V<sub>SS</sub> = 5V, T<sub>j</sub> = 25°C; unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V <sub>S</sub>	Supply Voltage (pin 4)	Operative Condition	V <sub>IH</sub> +2.5		46	V
V <sub>SS</sub>	Logic Supply Voltage (pin 9)		4.5	5	7	V
I <sub>S</sub>	Quiescent Supply Current (pin 4)	V <sub>en</sub> = H; I <sub>L</sub> = 0 V <sub>i</sub> = L V <sub>i</sub> = H		13 50	22 70	mA mA
		V <sub>en</sub> = L V <sub>i</sub> = X			4	mA
I <sub>SS</sub>	Quiescent Current from V <sub>SS</sub> (pin 9)	V <sub>en</sub> = H; I <sub>L</sub> = 0 V <sub>i</sub> = L V <sub>i</sub> = H		24 7	36 12	mA mA
		V <sub>en</sub> = L V <sub>i</sub> = X			6	mA
V <sub>IL</sub>	Input Low Voltage (pins 5, 7, 10, 12)		-0.3		1.5	V
V <sub>IH</sub>	Input High Voltage (pins 5, 7, 10, 12)		2.3		V <sub>SS</sub>	V
I <sub>IL</sub>	Low Voltage Input Current (pins 5, 7, 10, 12)	V <sub>i</sub> = L			-10	μA
I <sub>IH</sub>	High Voltage Input Current (pins 5, 7, 10, 12)	V <sub>i</sub> = H ≤ V <sub>SS</sub> -0.6V		30	100	μA
V <sub>en</sub> = L	Enable Low Voltage (pins 6, 11)		-0.3		1.5	V
V <sub>en</sub> = H	Enable High Voltage (pins 6, 11)		2.3		V <sub>SS</sub>	V
I <sub>en</sub> = L	Low Voltage Enable Current (pins 6, 11)	V <sub>en</sub> = L			-10	μA
I <sub>en</sub> = H	High Voltage Enable Current (pins 6, 11)	V <sub>en</sub> = H ≤ V <sub>SS</sub> -0.6V		30	100	μA
V <sub>CEsat (H)</sub>	Source Saturation Voltage	I <sub>L</sub> = 1A I <sub>L</sub> = 2A	0.95	1.35 2	1.7 2.7	V V
V <sub>CEsat (L)</sub>	Sink Saturation Voltage	I <sub>L</sub> = 1A (5) I <sub>L</sub> = 2A (5)	0.85	1.2 1.7	1.6 2.3	V V
V <sub>CEsat</sub>	Total Drop	I <sub>L</sub> = 1A (5) I <sub>L</sub> = 2A (5)	1.80		3.2 4.9	V V
V <sub>sens</sub>	Sensing Voltage (pins 1, 15)		-1 (1)		2	V


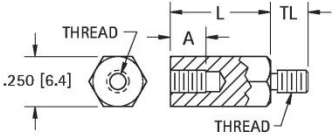




## Anexo 17: Hoja técnica de los bastones separadores del controlador del motor

HEX MALE/FEMALE STANDOFFS

### MALE/FEMALE THREADED STANDOFFS

THREAD SIZE	TL EXTERNAL	A INTERNAL
4-40	.187 (4.7)	.250 (6.4)
6-32	.250 (6.4)	.375 (9.5)
8-32	.375 (9.5)	.375 (9.5)

**Application Note:**  
For PC/104 applications use length .600 (15.3) 4-40 Thread

**CHOICE OF:**

Stainless: ASTM A581/A582	Brass: ASTM-B16 Plating: Nickel (QQ-N-290)	Aluminum: RoHS Compliant Plating: Clear Iridite (Mil-C-5541)
---------------------------	---	---

4-40 THREAD			
L LENGTH	STAINLESS STEEL CAT NO.	BRASS CAT NO.	ALUMINUM CAT NO.
.250 (6.4)***	8712	8713	8714
.375 (9.5)	2087	7200	8400
.500 (12.7)	2088	1944	8401
.600 (15.2)*	5799	8799	6799
.625 (15.9)	2089	1945	8402
.750 (19.1)	2090	1946	8403
.875 (22.2)	2091	7201	8404
1.000 (25.4)	2092	1947	8405
1.125 (28.6)	2093	7202	8406
1.250 (31.8)	2094	1948	8407
1.375 (34.9)	2095	1949	8408
1.500 (38.1)	2096	1950	8409
1.625 (41.3)	2097	7203	8410
1.750 (44.5)	2098	7205	8411
2.000 (50.8)	2099	1951	8412

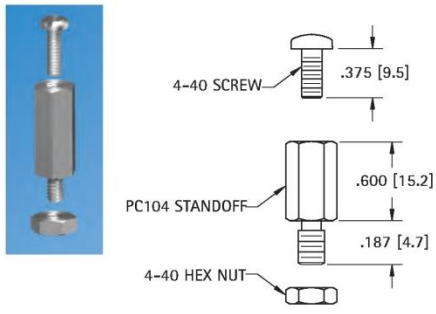
6-32 THREAD			
L LENGTH	STAINLESS STEEL CAT NO.	BRASS CAT NO.	ALUMINUM CAT NO.
.250 (6.4)***	8715	8716	8717
.375 (9.5)**	2119	7210	8413
.500 (12.7)	2120	1952	8414
.625 (15.9)	2121	1953	8415
.750 (19.1)	2122	1954	8416
.875 (22.2)	2123	7211	8417
1.000 (25.4)	2124	1644	8418
1.125 (28.6)	2125	7212	8419
1.250 (31.8)	2126	1955	8420
1.375 (34.9)	2127	1956	8421
1.500 (38.1)	2128	1645	8422
1.625 (41.3)	2129	7214	8423
1.750 (44.5)	2130	7215	8424
2.000 (50.8)	2131	1646	8425

8-32 THREAD			
L LENGTH	STAINLESS STEEL CAT NO.	BRASS CAT NO.	ALUMINUM CAT NO.
.250 (6.4)***	8731	8732	8733
.375 (9.5)**	2149	7220	8426
.500 (12.7)	2150	1957	8427
.625 (15.9)	2151	1958	8428
.750 (19.1)	2152	1959	8429
.875 (22.2)	2153	7221	8430
1.000 (25.4)	2154	1960	8431
1.125 (28.6)	2155	7222	8432
1.250 (31.8)	2156	1961	8433
1.375 (34.9)	2157	1962	8434
1.500 (38.1)	2158	1963	8435
1.625 (41.3)	2159	7224	8436
1.750 (44.5)	2160	7225	8437
2.000 (50.8)	2161	1964	8438
2.500 (63.5)	2180	1965	8439
3.000 (76.2)	2181	1966	8440

\*PC/104 Standard Length  
 \*\*Internal Thread .130 (3.3)/.150 (3.8) Deep  
 \*\*\* Internal Thread .250 (6.4) Deep  
 \*\*\*\* Internal Thread .130 (3.3)/.150 (3.8) Deep

### PC 104 MOUNTING KITS

- Designed to ease the assembly of new modules and multi-board stacks.
- Each kit includes all the hardware that is required to mount a single-board.

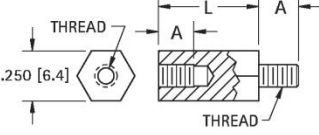



Complete Kit CAT. NO.	Kit Description	Includes Four (4) each:		
		Standoff	Screw	Nut
4799-4	Nylon	4799	9328	9605
5799-4	Stainless Steel	5799	9901	7248-3
6799-4	Aluminum	6799	9301*	9600*
8799-4	Brass	8799	9301*	9600*

\* Aluminum and brass kits supplied with steel hardware.

### NYLON STANDOFFS

MATERIAL: Nylon 6/6

L LENGTH	THREAD SIZE		
	4-40 CAT. NO.	6-32 CAT. NO.	8-32 CAT. NO.
.250 (6.4)***	4800	4814	4828
.375 (9.5)	4801	4815	4829**
.500 (12.7)	4802	4816	4830
.600 (15.2)*	4799	-	-
.625 (15.9)	4803	4817	4831
.750 (19.1)	4804	4818	4832
.875 (22.2)	4805	4819	4833
1.000 (25.4)	4806	4820	4834
1.125 (28.6)	4807	4821	4835
1.250 (31.8)	4808	4822	4836
1.375 (34.9)	4809	4823	4837
1.500 (38.1)	4810	4824	4838
1.625 (41.3)	4811	4825	4839
1.750 (44.5)	4812	4826	4840
2.000 (50.8)	4813	4827	4841

\* PC/104 Standard Length  
 \*\* Internal Thread .250 (6.4) Deep  
 \*\*\* Internal Thread .130 (3.3)/.150 (3.8) Deep

**Application Note:**  
For PC/104 applications use CAT. NO. 4799

THREAD SIZE	A
4-40	.187 (4.7)
6-32	.250 (6.4)
8-32	.375 (9.5)

## Anexo 18: Hoja técnica del sensor de movimiento (PIR)

Web Site: [www.parallax.com](http://www.parallax.com)  
Forums: [forums.parallax.com](http://forums.parallax.com)  
Sales: [sales@parallax.com](mailto:sales@parallax.com)  
Technical: [support@parallax.com](mailto:support@parallax.com)

Office: (916) 624-8333  
Fax: (916) 624-8003  
Sales: (888) 512-1024  
Tech Support: (888) 997-8267

### PIR Sensor (#555-28027)

The PIR (Passive Infra-Red) Sensor is a pyroelectric device that detects motion by sensing changes in the infrared (radiant heat) levels emitted by surrounding objects. This motion can be detected by checking for a sudden change in the surrounding IR pattern. When motion is detected the PIR sensor outputs a high signal on its output pin. This logic signal can be read by a microcontroller or used to drive an external load; see the source current limits in the features list below.

**NOTE:** Revision B of this sensor provides many updates and improvements from Revision A. If your PIR Sensor's PCB does not read "Rev B," please use the information found in the Revision History section on page 5.

#### Features

- Detect a person up to approximately 30 ft away, or up to 15 ft away in reduced sensitivity mode
- Jumper selects normal operation or reduced sensitivity
- Source current up to 12 mA @ 3 V, 23 mA @ 5 V
- Onboard LEDs light up the lens for fast visual feedback when movement is detected
- Mounting holes for #2 sized screws
- 3-pin SIP header ready for breadboard or through-hole projects
- Small size makes it easy to conceal
- Easy interface to any microcontroller

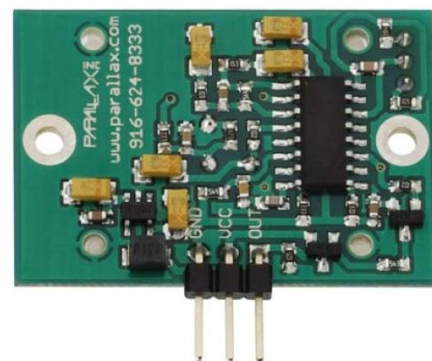


#### Key Specifications

- Power Requirements: 3 to 6 VDC; 130  $\mu$ A idle, 3 mA active (no load)
- Communication: Single bit high/low output
- Operating temperature: 32 to 122 °F (0 to 50 °C)
- Dimensions: 1.41 x 1.0 x 0.8 in (35.8 x 25.4 x 20.3 cm)

#### Application Ideas

- Motion-activated nightlight
- Alarm systems
- Holiday animated props



## Theory of Operation

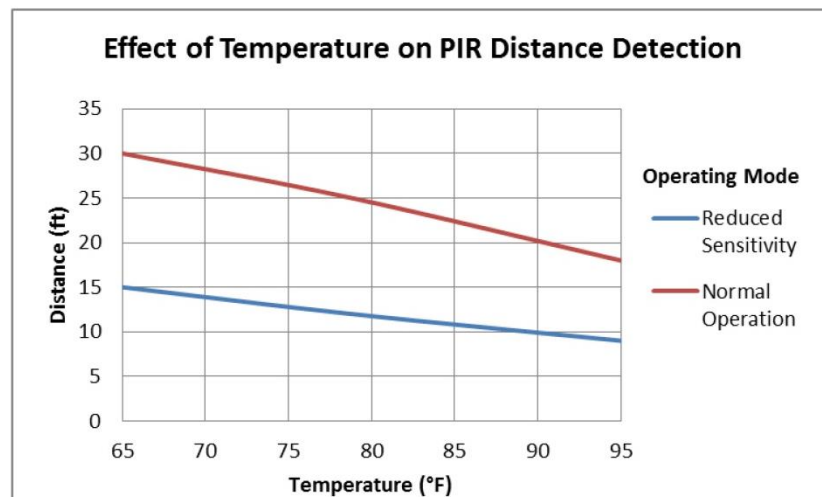
Pyroelectric devices, such as the PIR sensor, have elements made of a crystalline material that generates an electric charge when exposed to infrared energy. The changes in the amount of infrared energy striking the element change the voltages generated, which are measured by an on-board amplifier. The device contains a Fresnel lens, which focuses the infrared signals onto the element. As the ambient infrared signals change rapidly, the on-board amplifier trips the output to indicate motion.

## Range

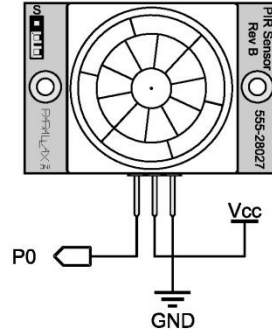
The PIR Sensor's range is affected by:

- The sensitivity jumper setting
- The size and thermal properties of nearby objects
- Environmental conditions including ambient temperature and light sources

The graph below depicts the approximate effects of known temperatures on the PIR Sensor's detection range of an adult. *Note: This device is designed for indoor use. Operation outside or in extreme temperatures may negatively affect stability. Direct exposure to sunlight or other forms of radiant heating may cause undesired operation.*



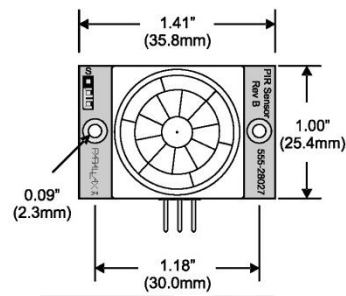
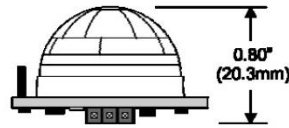
**Quick-Start Circuit**



**Calibration**

The PIR Sensor requires a warm-up time in order to function properly. This is due to the settling time involved in “learning” its environment. This could be up to 40 seconds. During this time, the LEDs under the lens will be on and there should be as little motion as possible in the sensors field of view.

**Module Dimensions**



**Anexo 19: Hoja técnica del sensor de localización Hagisonic**





B. Specification of StarGazer™

Hardware Interface	UART(TTL 3.3V), 115,200bps
Size	50×50×28mm
Communication Protocol	User protocol based on ASCII code
Measurement Time	20 times/sec
Localization Rang (per a Landmark)	2.5~5 m in diameter (for ceiling height 2~6 m)
Repetitive Precision	2 cm
Heading Angle Resolution	1.0degree
Landmark Types (Classification for height range)	<i>Type 1: 0.3 ≤ height ≤ 1.1 m</i> <i>Type 2: 1.1 ≤ height ≤ 2.9 m</i> <i>Type 3: 2.9 ≤ height ≤ 4.5 m</i> <i>Type 4: 4.5 ≤ height ≤ 6.5 m</i> <i>Type 5: 6.5 ≤ height ≤ 15 m</i>
Landmark Types (Classification for total ID numbers)	HL1: 31 ea (for a normal space) HL2: 4,095 ea (for a larger space)
Power Consumption	5 V: 300 mA, 12 V: 70 mA

C. Features and Performance

- It analyzes the image of the infrared ray which is reflected from a passive landmark with a unique ID.
- It is composed of an IR Projector part and an image processing unit.
- High resolution and high speed localization of position and heading angle.
- Landmark is used by being attached on ceiling.
- No need for any synchronization or communication between a robot and a landmark.
- The area that StarGazer covers is extended by only adding landmarks to ceiling.
- Each room can be distinguished easily each other by using landmarks with different IDs.
- Automatic measurement and calibration of distance between landmarks and ceiling height.
- No battery or power supply for landmark is needed.
- A little extra cost consumes when landmarks are attached additionally.
- Nearly not affected in environment such as lamp and sunlight
- It works excellent localization function at night as well as in the day.



- World's best in resolution, convenience and cost-efficiency

#### 4. Connector Configuration

① Connector configuration for DSP Module

Cable Line Color	White	Black	White	Black	White	Red	Red
Function	Reserved	GND	SDIN	GND	SDOUT	VCC(5V)	VCC(5V)

② Connector configuration for IRED Module

Cable Color	Black	White	Yellow
Function	GND	Reserved	VCC(12V)

#### 5. UART Configuration

The StarGazer supports UART communication as shown in Table 1.

Table. 1. UART configuration

I/O Level	TTL 3.3V Output, 3.3V~5V Input
Baudrate	115200 bps
Data Bit	8bit
Stop Bit	1bit
Paraty Bit	None
Flow Control	None

#### 6. Communication Protocol

StarGazer calculates coordinates and heading angle using parameters in flash memory. The protocols, shown in Table 2 and Table 3, can be used to read or update the parameters.

##### A. Communication Protocol, Parameters, Commands

Table. 2. Communication Protocols

Read	STX	@	Command	ETX	
Write	STX	#	Command	Data	ETX
Return Value	STX	\$	Command	Data	ETX
ACK	STX	!	Command	Data	ETX

※ Notice: STX: '~', ETX: '~'

Table. 3. Parameters and commands

Parameters and Command	ThrAlg	Threshold Algorithm(Auto/Manual)
	ThrVal	Threshold Value(0-255)
	MarkType	Mark Type(Home/Office)
	MapMode	Map Building Mode(Start/Stop)
	MarkMode	Landmark Mode(Alone/Map)
	MarkDim	Landmark Deimension(HLDn-m)
	MarkHeight	Height of Landmark(mm)
	HeightCalc <sup>*</sup>	Calculate Height of Landmark
	IDNum	Number of ID(1-31, 1-4095)
	RefID	Reference ID(2-626, 2-28662)
	Version	Firmware Version
	CalcStart <sup>*</sup>	Calculation Start
	CalcStop <sup>*</sup>	Calculation Stop
	SetEnd <sup>*</sup>	Parameter Setting End
Reset	Reset All Parameter	

B. Basic Command and Protocol

~: to mean the start of command sentence; STX(start of text) character.

`: to mean the end of command sentence; ETX(end of text) character.

@: to mean command to read a following parameter; READ command

!: to follow automatically when READ or WRITE command completely executed; ACK(acknowledge) character. Response symbol sent from a StarGazer.

\$: Response symbol to mean that data follow after the following parameter as response of READ command.

|: Symbol to distinguish a command from data

Or to distinguish Parameter from data

C. About Parameters

(1) Parameters for data

Parameters: ThrVal, MarkHeight, IDNum, RefID, Version

ThrVal: Threshold level to reject external turbulence shown in image; depend on surroundings. Default number is 210. Recommended value is ranging from 210 to 240.

MarkHeight: Distance from a StarGazer to a landmark; used when wanting to input manually the height; Default value: 2400 mm

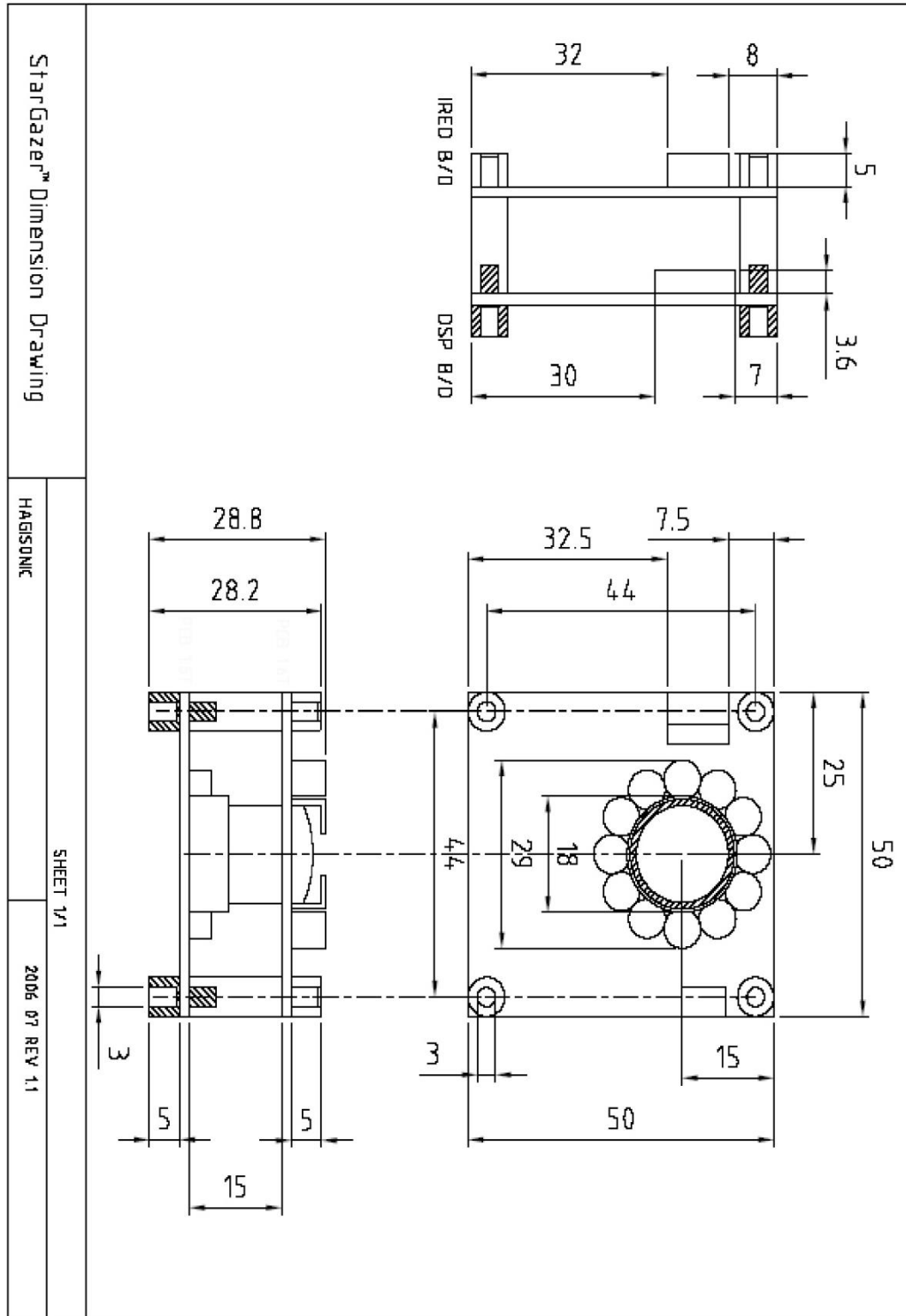
IDNum: A total number of landmarks to be assigned under Map Mode. Default value: 4

RefID: The number of reference ID under Map Mode; Default value: 2

Version: Version of Firmware.



**A. Dimension of StarGazer™**





## Anexo 20: Hoja técnica de la referencia pasiva Hagisonic



### 4.2.2 Landmarks setting

The landmarks should be placed at maximum of  $x$  m interval on the ceiling for the height of about  $h$  m in order that any dead zone may not occur (figure 4-2 b), with a relation of:

$$\text{Equation 4.1: } x = 0.8 \cdot h$$

Example:  $h=2.5$  m  $\Rightarrow$   $x = \max$  2m

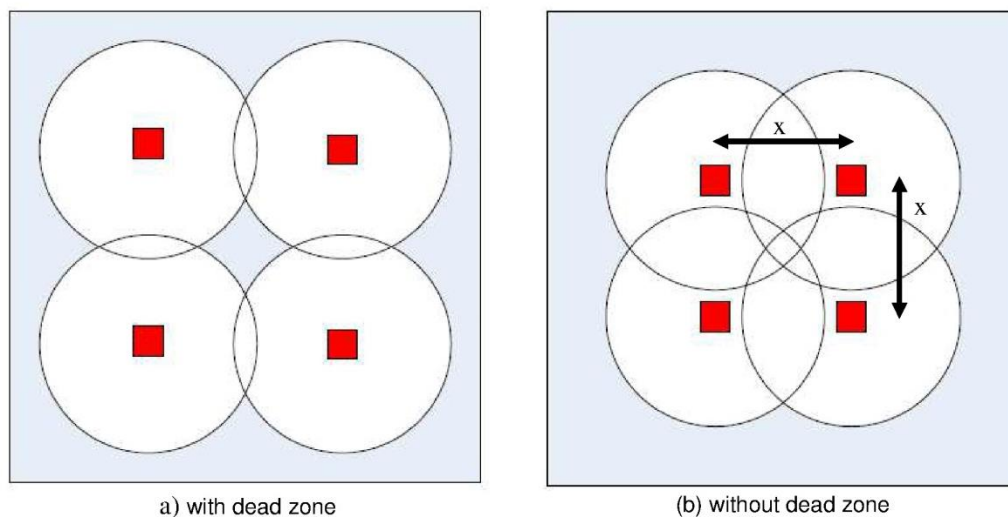


Figure 4-2: The placement of landmarks

You don't need to install all the 4 landmarks if your area is smaller. And they don't need to be placed in square shape because during the map building process, the relative position of the landmarks are computed.

### E. Types of landmarks and how to generate the number of ID

- (1) HLD1 landmarks are composed of the 3 X 3 combination of small circles. The total number is 31. The landmarks are used for general application such as at home.
- (2) HLD2 landmarks are composed of the 4 X 4 combination of small circles. The total number is 4095. The landmarks are used for the application to very large area with several offices.
- (3) Each line corresponds to an identified hexadecimal value.

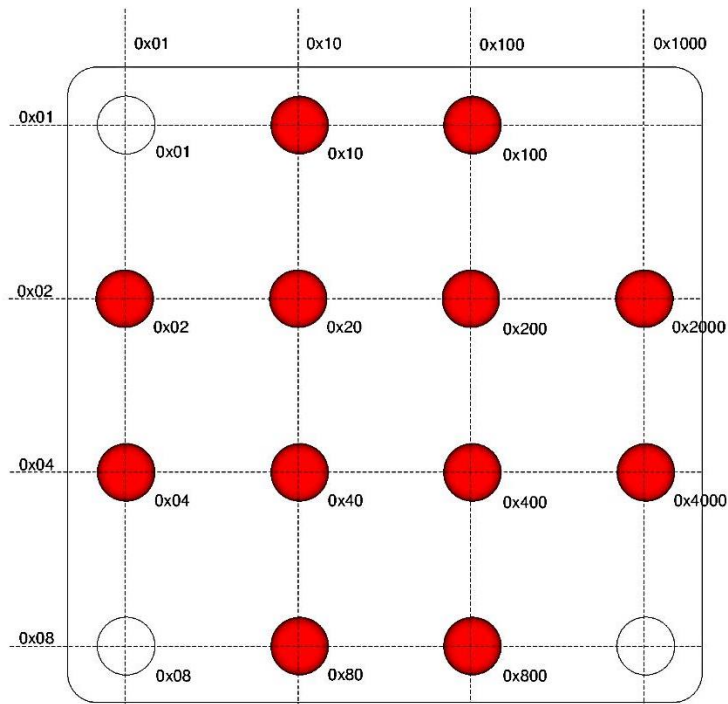
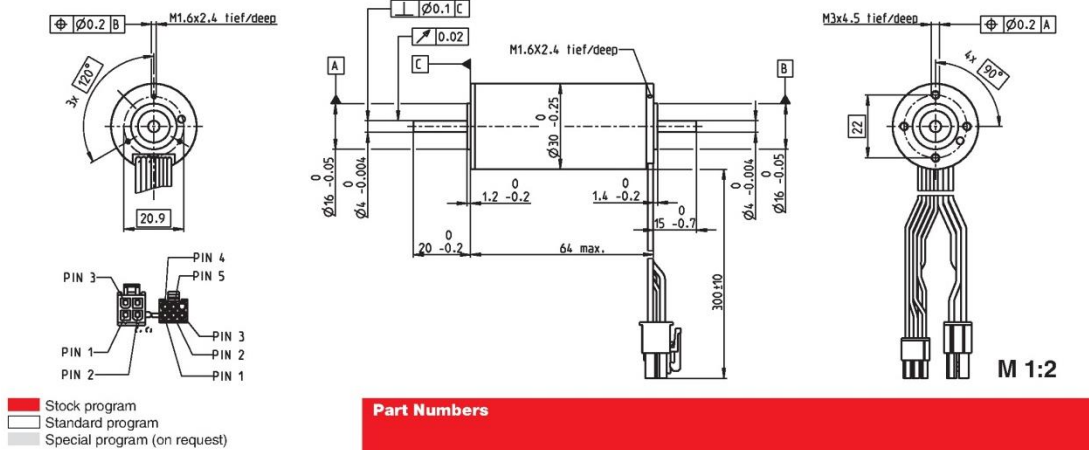


Fig.16-C-2. HL2 landmark with hexadecimal values corresponding to each line.

번호	HEX	DEC
1	0x002	2
2	0x010	16
3	0x012	18
4	0x020	32
5	0x022	34
6	0x030	48
7	0x032	50
8	0x040	64
9	0x042	68
10	0x050	80
11	0x052	82
12	0x060	96
13	0x062	98
14	0x070	112
15	0x072	114
16	0x200	512
17	0x202	514
18	0x210	528
19	0x212	530
20	0x220	544
21	0x222	546
22	0x230	560
23	0x232	562
24	0x240	576
25	0x242	578
26	0x250	592
27	0x252	594
28	0x260	608
29	0x262	610
30	0x270	624
31	0x272	626

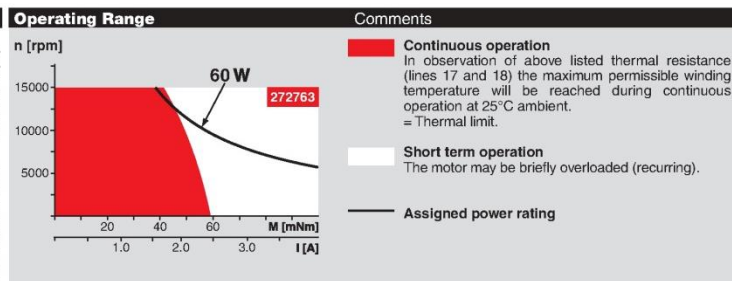
# Anexo 21: Hoja técnica del motor de la base

## EC-max 30 Ø30 mm, brushless, 60 Watt



Motor Data	Part Numbers				
	272762	272763	272764	272765	
<b>Values at nominal voltage</b>					
1 Nominal voltage	V	12	24	36	48
2 No load speed	rpm	7980	9340	9490	9350
3 No load current	mA	302	191	130	95.4
4 Nominal speed	rpm	6590	8040	8270	8130
5 Nominal torque (max. continuous torque)	mNm	63.6	60.7	63.7	64.1
6 Nominal current (max. continuous current)	A	4.72	2.66	1.88	1.4
7 Stall torque	mNm	381	458	522	519
8 Starting current	A	26.8	18.8	14.5	10.7
9 Max. efficiency	%	80	81	82	82
<b>Characteristics</b>					
10 Terminal resistance phase to phase	Ω	0.447	1.27	2.48	4.49
11 Terminal inductance phase to phase	mH	0.049	0.143	0.312	0.573
12 Torque constant	mNm/A	14.2	24.3	35.9	48.6
13 Speed constant	rpm/V	672	393	266	197
14 Speed/torque gradient	rpm/mNm	21.2	20.6	18.4	18.2
15 Mechanical time constant	ms	4.86	4.73	4.21	4.17
16 Rotor inertia	gcm <sup>2</sup>	21.9	21.9	21.9	21.9

Specifications		
<b>Thermal data</b>		
17 Thermal resistance housing-ambient	7.4 K/W	
18 Thermal resistance winding-housing	0.5 K/W	
19 Thermal time constant winding	2.76 s	
20 Thermal time constant motor	1000 s	
21 Ambient temperature	-40...+100°C	
22 Max. permissible winding temperature	+155°C	
<b>Mechanical data (preloaded ball bearings)</b>		
23 Max. permissible speed	15000 rpm	
24 Axial play at axial load < 6.0 N	0 mm	
	> 6.0 N	0.14 mm
25 Radial play	preloaded	
26 Max. axial load (dynamic)	5 N	
27 Max. force for press fits (static) (static, shaft supported)	98 N	
	1300 N	
28 Max. radial loading, 5 mm from flange	25 N	
<b>Other specifications</b>		
29 Number of pole pairs	1	
30 Number of phases	3	
31 Weight of motor	305 g	



Values listed in the table are nominal.

Connection motor (Cable AWG 20)			
red	Motor winding 1	Pin 1	
black	Motor winding 2	Pin 2	
white	Motor winding 3	Pin 3	
	N.C.	Pin 4	

Connector	Part number
Molex	39-01-2040

Connection Sensors (Cable AWG 26)			
yellow	Hall sensor 1	Pin 1	
brown	Hall sensor 2	Pin 2	
grey	Hall sensor 3	Pin 3	
blue	GND	Pin 4	
green	V <sub>bat</sub> 3...24 VDC	Pin 5	
	N.C.	Pin 6	

Connector	Part number
Molex	430-25-0600

Wiring diagram for Hall sensors see p. 35

**maxon Modular System**

Planetary Gearhead Ø32 mm 8.0 Nm Page 266		Encoder MR 500/1000 CPT, 3 channels Page 302
Koaxdrive Ø32 mm 1.0 - 4.5 Nm Page 268		Encoder HEDL 5540 500 CPT, 3 channels Page 308
Planetary Gearhead Ø42 mm 3 - 15 Nm Page 271		Brake AB 20 24 VDC 0.1 Nm Page 346

**Recommended Electronics:**

ESCON 36/3 EC	Page 320
ESCON 50/5, Module 50/5	321
ESCON 70/10	321
DECS 50/5	324
DEC Module 24/2	325
DEC Module 50/5	325
EPOS2 24/5, 50/5	331
EPOS2 P 24/5	334
EPOS3 70/10 EtherCAT	337

Notes 24

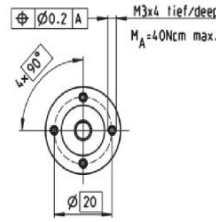
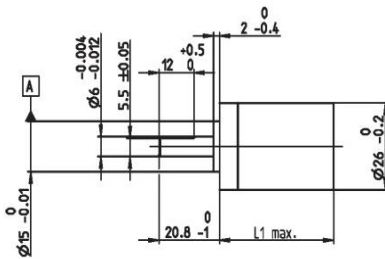
Overview on page 20 - 25

maxon EC motor 193

June 2013 edition / subject to change

## Anexo 22: Hoja técnica del reductor planetario de la base

### Planetary Gearhead GP 26 A Ø26 mm, 0.75–4.5 Nm



#### Technical Data

Planetary Gearhead	straight teeth
Output shaft	stainless steel, hardened
Bearing at output	preloaded ball bearings
Radial play, 5 mm from flange	max. 0.1 mm
Axial play at axial load	< 6 N 0 mm
	> 6 N max. 0.4 mm
Max. permissible axial load	120 N
Max. permissible force for press fits	120 N
Sense of rotation, drive to output	=
Recommended input speed	< 8000 rpm
Recommended temperature range	-40...+100°C
Number of stages	1 2 3
Max. radial load, 12 mm from flange	70 N 110 N 140 N

M 1:2

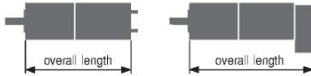
- Stock program
- Standard program
- Special program (on request)

#### Part Numbers

406757	406762	406764	406767	406128	406769	406770	406771	406092
--------	--------	--------	--------	--------	--------	--------	--------	--------

#### Gearhead Data (provisional)

	57/11	3581/187	3245/121	1535/44	226233/3178	204687/2057	185183/1331	87723/484	41553/176
2 Reduction absolute	1	2	2	2	3	3	3	3	3
4 Number of stages	1	2	2	2	3	3	3	3	3
5 Max. continuous torque Nm	0.75	2.25	2.25	2.25	4.5	4.5	4.5	4.5	4.5
6 Intermittently permissible torque at gear output Nm	1.1	3.2	3.2	3.2	6.2	6.2	6.2	6.2	6.2
7 Max. efficiency %	90	80	80	80	70	70	70	70	70
8 Weight g	53	77	77	77	93	93	93	93	93
9 Average backlash no load °	0.5	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8
10 Mass inertia gcm <sup>2</sup>	0.96	0.54	0.54	0.54	0.31	0.31	0.31	0.31	0.31
11 Gearhead length L1 mm	23.4	32.9	32.9	32.9	39.5	39.5	39.5	39.5	39.5
13 Max. transmittable continuous power W	60	35	35	35	20	20	20	20	20
14 Max. transmittable intermittent power W	90	50	50	50	30	30	30	30	30



#### maxon Modular System

+ Motor	Page	+ Sensor/Brake	Page	Overall length [mm] = Motor length + gearhead length + (sensor/brake) + assembly parts									
RE 25	99/101			78.0	87.5	87.5	87.5	94.1	94.1	94.1	94.1	94.1	94.1
RE 25	99/101	MR	302	89.0	98.5	98.5	98.5	105.1	105.1	105.1	105.1	105.1	105.1
RE 25	99/101	Enc 22	304	92.1	101.6	101.6	101.6	108.2	108.2	108.2	108.2	108.2	108.2
RE 25	99/101	HED_5540	305/307	98.8	108.3	108.3	108.3	114.9	114.9	114.9	114.9	114.9	114.9
RE 25	99/101	DCT22	315	100.3	109.8	109.8	109.8	116.4	116.4	116.4	116.4	116.4	116.4
RE 25, 20 W	100			66.5	76.0	76.0	76.0	82.6	82.6	82.6	82.6	82.6	82.6
RE 25, 20 W	100	MR	302	77.5	87.0	87.0	87.0	93.6	93.6	93.6	93.6	93.6	93.6
RE 25, 20 W	100	HED_5540	306	87.3	96.8	96.8	96.8	103.4	103.4	103.4	103.4	103.4	103.4
RE 25, 20 W	100	DCT 22	315	88.8	98.3	98.3	98.3	104.9	104.9	104.9	104.9	104.9	104.9
RE 25, 20 W	100	AB 28	348	100.6	110.1	110.1	110.1	116.7	116.7	116.7	116.7	116.7	116.7
RE 25, 20 W	100	HED_5540/AB 28	306/348	117.8	127.3	127.3	127.3	133.9	133.9	133.9	133.9	133.9	133.9
RE 25, 20 W	101	AB 28	348	112.1	121.6	121.6	121.6	128.2	128.2	128.2	128.2	128.2	128.2
RE 25, 20 W	101	HED_5540/AB 28	307/348	129.3	138.8	138.8	138.8	145.4	145.4	145.4	145.4	145.4	145.4
A-max 26	125-132			68.2	77.7	77.7	77.7	84.3	84.3	84.3	84.3	84.3	84.3
A-max 26	125-132	MEnc 13	314	75.3	84.8	84.8	84.8	91.4	91.4	91.4	91.4	91.4	91.4
A-max 26	125-132	MR	302	77.0	86.5	86.5	86.5	93.1	93.1	93.1	93.1	93.1	93.1
A-max 26	125-132	Enc 22	304	82.6	92.1	92.1	92.1	98.7	98.7	98.7	98.7	98.7	98.7
A-max 26	125-132	HED_5540	306/307	86.6	96.1	96.1	96.1	102.7	102.7	102.7	102.7	102.7	102.7

## Anexo 23: Hoja técnica del controlador del motor de la base

**maxon motor**

**maxon motor control**

**1-Q-EC Amplifier DEC Module 50/5**

**Order number 380200**

**Operating Instructions**

**Edition April 2011**

The DEC Module 50/5 (**D**igital **E**C **C**ontroller) is a small 1-quadrant digital controller for the control of brushless DC motors (**E**lectronic **C**ommutated motors) up to 250 W. The used EC motor must be equipped with digital Hall sensors.



Features:

- Digital speed control operates as «closed loop» or as «open loop» speed controller
- Maximum speed 80 000 rpm (motor with 1 pole pair)
- Set value input through external analogue voltage (0 ... +5 V)
- 3 different speed ranges selectable
- Direction of rotation preset by a digital signal
- The output stage can be enabled or disabled
- Maximum output current limit adjustable up to 10 A
- Motor speed can be monitored with the «Monitor n» output
- Status indication via «Ready» output
- Blockage protection (current limit for blocked motor)
- Protective functions: undervoltage, overvoltage and thermal overload
- Standardized connector strip, pitch 2.54 mm

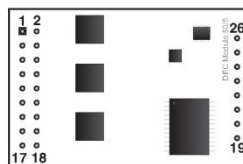
Thanks to the wide input power supply range of 6...50 VDC (optional 5 VDC operation possible), the DEC Module 50/5 is very versatile and can be used with various power supplies.

A sturdy PI speed controller design is an ideal premise for immediate operation.

The well-priced and miniaturized OEM module seamlessly integrates into applications. Now the customer can fully focus on developing his/hers own device - while being able to make use of maxon motor's vast drive know-how. For start-up maxon motor offers a comprehensive Evaluation Board.

### 3 Pin assignment DEC Module 50/5

Top view



Pin	Signal	Description	Pin	Signal	Description
1	W1	Motor winding 1	14	Gnd	Ground
2	W1	Motor winding 1	15	H2	Hall sensor 2
3	W2	Motor winding 2	16	Gnd	Ground
4	W2	Motor winding 2	17	H3	Hall sensor 3
5	W3	Motor winding 3	18	Monitor n	Speed monitor output
6	W3	Motor winding 3	19	Ready	Status indication output
7	+V <sub>CC</sub>	Supply voltage 6...50 VDC	20	DigIN1	Digital input 1
8	+V <sub>CC</sub>	Supply voltage 6...50 VDC	21	DigIN2	Digital input 2
9	Gnd	Ground	22	Enable	Enable input
10	Gnd	Ground	23	Direction	Direction input
11	V <sub>CC</sub> Hall	+5 VDC output voltage	24	Gnd	Ground
12	n.c.	do not connect	25	Set current limit	Set current limit input
13	H1	Hall sensor 1	26	Set value speed	Set value speed input

## 1-Q-EC Amplifier Data



**DEC Module 24/2** 1-Q-EC Amplifier  
1-quadrant amplifier for controlling EC motors with Hall sensors with a maximum output of 48 watts.



**DEC Module 50/5** 1-Q-EC Amplifier  
1-quadrant amplifier for controlling EC motors with Hall sensors with a maximum output of 250 watts.

Operating modes		
	Speed controller, open loop speed controller	Speed controller, open loop speed controller
<b>Electrical Data</b>		
Operating voltage $V_{CC}$	8 - 24 VDC (optional 5.0 VDC)	6 - 50 VDC (optional 5.0 VDC)
Max. output voltage	$V_{CC}$	$0.95 \times V_{CC}$
Max. output current $I_{max}$	3 A	10 A
Continuous output current $I_{cont}$	2 A	5 A
Switching frequency of power stage	46.8 kHz	46.8 kHz
Band width current controller		
Max. speed (1 pole pair)	80 000 rpm	80 000 rpm
Built-in motor choke per phase		
<b>Input</b>		
Set value	"Speed" 0...+5 V (1024 steps)	"Speed" 0...+5 V (1024 steps)
Current limit	"Current Limit" external resistor against GND	"Current Limit" external resistor against GND
Enable	"Enable" +2.4...24 V	"Enable" +2.4...50 V
Direction	"Direction" +2.4...24 V	"Direction" +2.4...50 V
Stop / Brake		
Configurable		
<b>Output</b>		
Monitor		"Monitor n", digital, (5 V)
Status reading "Ready"	"Ready", digital, (5 V)	"Ready", digital, (5 V)
<b>Voltage outputs</b>		
Hall sensors supply voltage $V_{CC}$ Hall	+5 VDC, max. 35 mA	+5 VDC, max. 35 mA
Auxiliary voltages		
Possible adjustments	Input "Mode 0" and "Mode 1"	Input "Mode 0" and "Mode 1"
<b>Trim potentiometer</b>		
<b>Indicator</b>		
<b>Protective functions</b>		
Blockage protection	Motor current limitation if motor shaft is blocked for longer than 1.5 s	Motor current limitation if motor shaft is blocked for longer than 1.5 s
Heat monitoring of power stage	$T > 95^{\circ}\text{C}$	$T > 100^{\circ}\text{C}$
Dynamic current limit		
Under- / Overvoltage protection	Switches off when $V_{CC} < 6.5 \text{ V}$ or $V_{CC} > 30 \text{ V}$	Switches off when $V_{CC} < 6 \text{ V}$ or $V_{CC} > 56 \text{ V}$
<b>Ambient temperature and humidity range</b>		
Operation	-10...+45°C	-10...+45°C
Storage	-40...+85°C	-40...+85°C
No condensation	20...80%	20...80%
<b>Mechanical Data</b>		
Weight	Approx. 4 g	Approx. 9 g
Dimensions (L x W x H)	24.2 x 20.38 x 12.7 mm (see page 326)	43.18 x 27.94 x 12.7 mm (see page 326)
Mounting threads	mountable on socket terminal strips pitch 2.54 mm	mountable on socket terminal strips pitch 2.54 mm
Connections	See page 326	See page 326
<b>Part Numbers</b>		
	<b>367661</b> DEC Module 24/2 1-Q-EC Amplifier	<b>380200</b> DEC Module 50/5 1-Q-EC Amplifier
<b>Accessories</b>		
	<b>370652</b> DEC Module Eva-Board	<b>370652</b> DEC Module Eva-Board

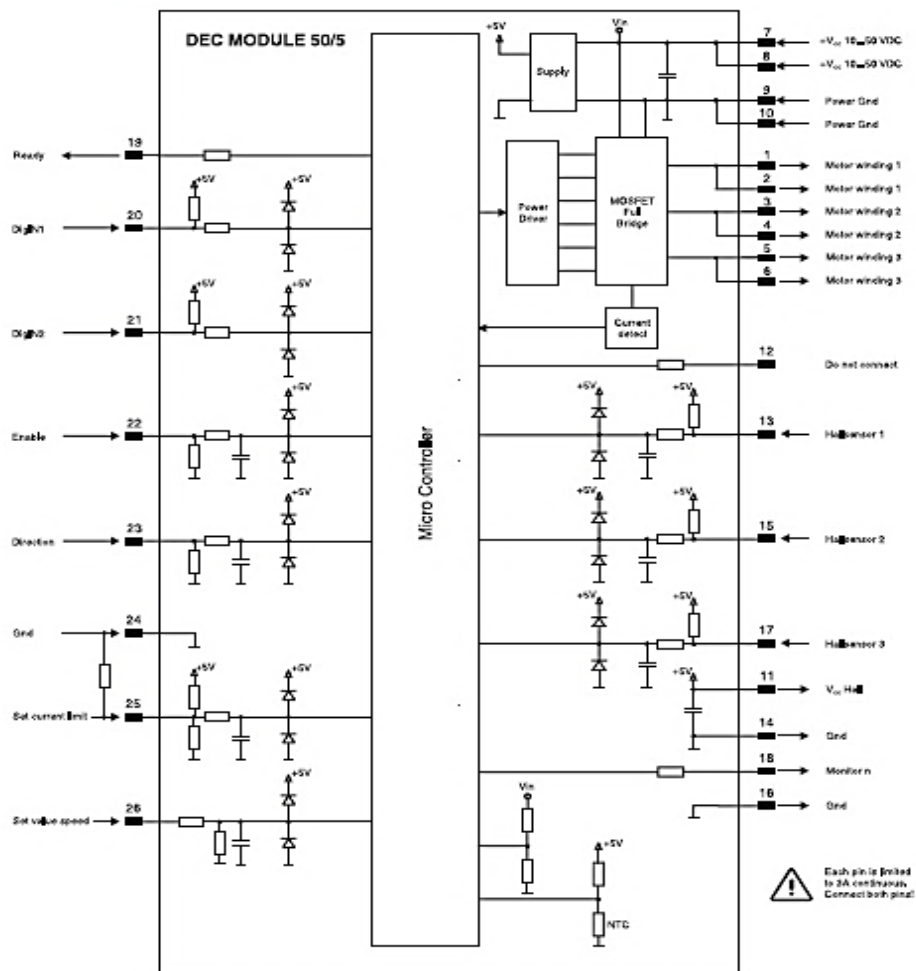


Diagrama de bloques de la tarjeta que controla el motor de la base. Extraídos de: [https://downloads.maxonmotor.com/Katalog\\_neu/eshop/Downloads/maxon\\_motor\\_control/1-Q-EC-Verstaerker/DEC\\_Module/Operating\\_Instruction\\_E.pdf](https://downloads.maxonmotor.com/Katalog_neu/eshop/Downloads/maxon_motor_control/1-Q-EC-Verstaerker/DEC_Module/Operating_Instruction_E.pdf)

## Anexo 24: Hoja técnica de la rueda motriz del robot

### Robot Drive Wheel - 6 inch Solid Core Tire



#### **Description:**

This is a robot drive wheel we had made specifically for us. It does not have a bearing. It is 6 inches in diameter and 2 inches wide. It's a solid foam core with rubber treads and outer layer. The steel rim is painted black with a 4 bolt pattern so you can easily mount it to a flanged hub.

#### **Features and Specifications:**

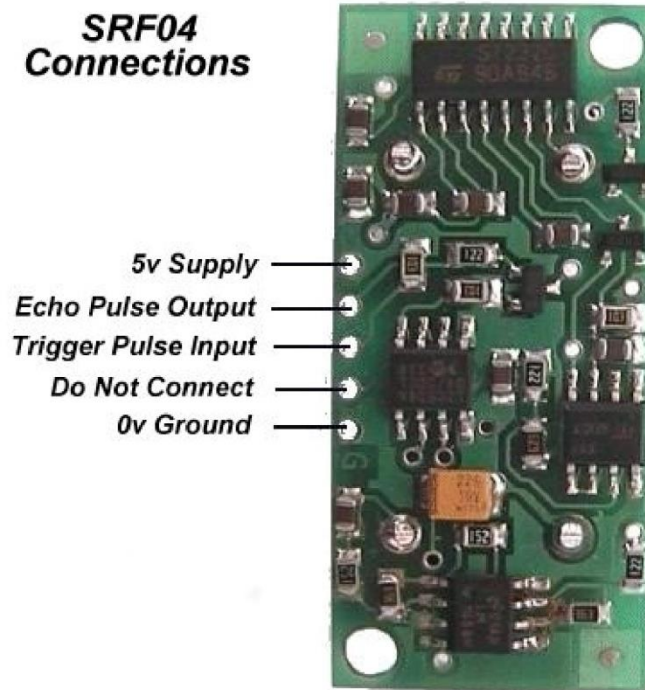
- Foam Filled Robot Drive Wheel - 6 X 2 NOT FOR HIGHWAY USE.
- The tire does not have a load rating. It's a foam core, so it can be loaded up. We have put 125lbs on a 4WD robot using these wheels with no issue.
- Black Rims, Black Rubber Tire.
- 2 section rim with 4 Bolt Pattern. 2.125 inch diameter bolt circle, 0.24" bolt hole. Nuts and bolts included.
- 1.22 center hole in rim.
- 6 inch diameter (measured). 1.9 inches wide (measured).
- Weight 0.83lbs.
- Not for Highway Use



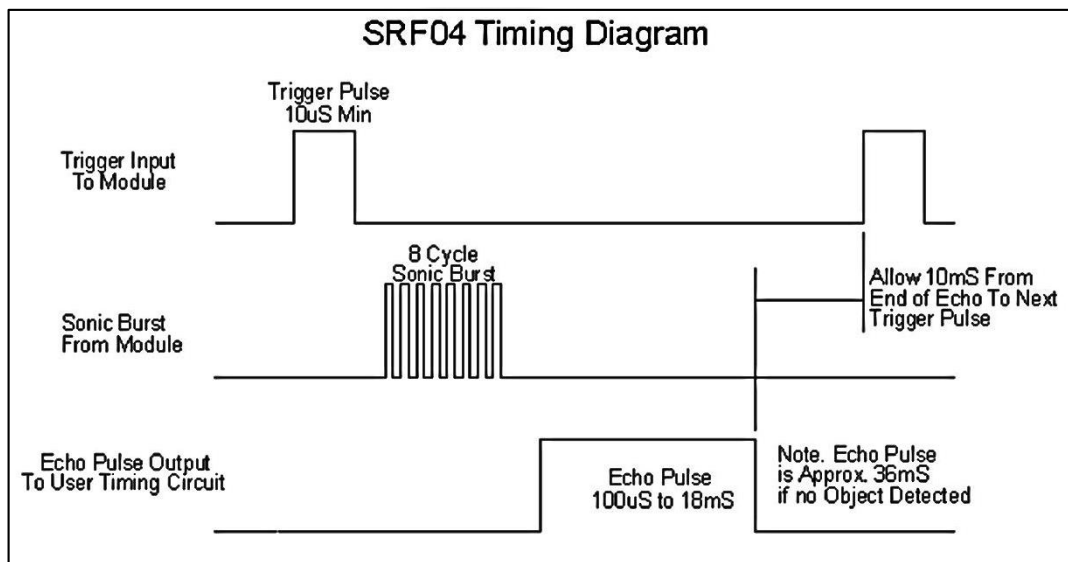
## Anexo 25: Hoja técnica del sensor ultrasónico

### SRF04 - Ultra-Sonic Ranger Technical Specification

#### SRF04 Connections



The SRF04 Timing diagram is shown below. You only need to supply a short 10uS pulse to the trigger input to start the ranging. The SRF04 will send out an 8 cycle burst of ultrasound at 40kHz and raise its echo line high. It then listens for an echo, and as soon as it detects one it lowers the echo line again. The echo line is therefore a pulse whose width is proportional to the distance to the object. By timing the pulse it is possible to calculate the range in inches/centimeters or anything else. If nothing is detected then the SRF04 will lower its echo line anyway after about 36mS.



Maximum range is a little over 3m. As an example of the sensitivity of this design, it will detect a 1inch thick plastic broom handle at 2.4m.  
Average current consumption is reasonable at less than 50mA and typically about 30mA.

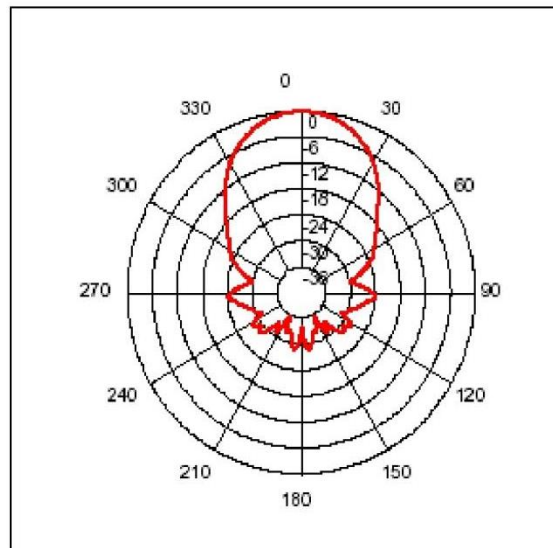
Download the source code and a ready assembled hex file.

### Calculating the Distance

The SRF04 provides an echo pulse proportional to distance. If the width of the pulse is measured in uS, then dividing by 58 will give you the distance in cm, or dividing by 148 will give the distance in inches.  $\mu\text{S}/58=\text{cm}$  or  $\mu\text{S}/148=\text{inches}$ .

### Changing beam pattern and beam width

You can't! This is a question which crops up regularly, however there is no easy way to reduce or change the beam width that I'm aware of. The beam pattern of the SRF04 is conical with the width of the beam being a function of the surface area of the transducers and is fixed. The beam pattern of the transducers used on the SRF04, taken from the manufacturers data sheet, is shown below.



There is more information in the sonar faq.

### Update - May 2003

Since the original design of the SRF04 was published, there have been incremental improvements to improve performance and manufacturing reliability. The op-amp is now an LMC6032 and the comparator is an LP311. The 10uF capacitor is now 22uF and a few resistor values have been tweaked. These changes have happened over a period of time.

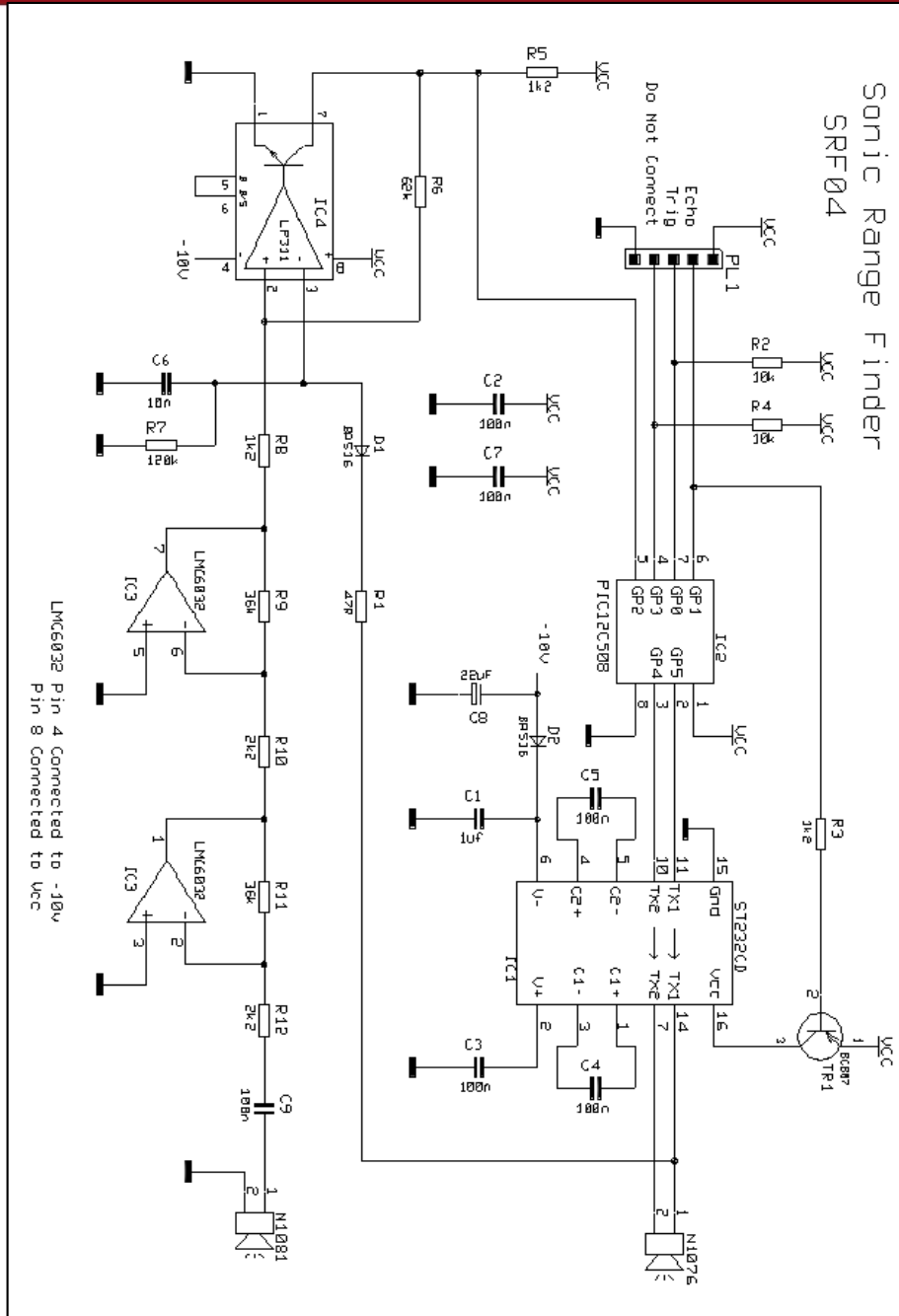


Diagrama Específico: Esquemático del sensor ultrasónico SRF04. Extraído de: <http://www.robotshop.com/media/files/pdf/devantech-ultrasonic-range-finder-specifications.pdf>

## Anexo 26: Hoja técnica del sensor infrarrojo

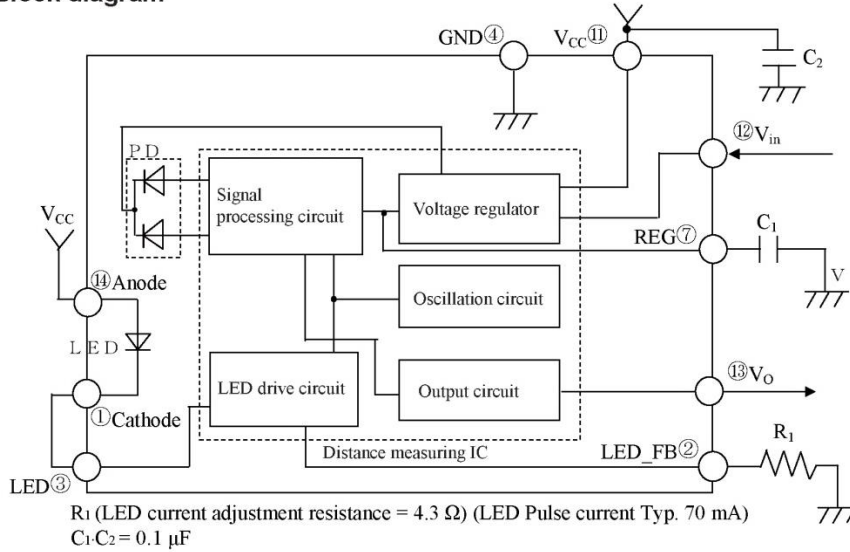
SHARP

GP2Y0D805Z0F

# GP2Y0D805Z0F

Distance Measuring Sensor Unit  
Digital output (50 mm) type

## Block diagram



## Outline Dimensions

(Unit : mm)

Symbol	Symbol
①	Cathode
②	LED_FB
③	LED
④	GND
⑤	—
⑥	—
⑦	REG
⑧	—
⑨	—
⑩	—
⑪	V <sub>CC</sub>
⑫	V <sub>in</sub>
⑬	V <sub>O</sub>
⑭	Anode
—	No contact

Material	A	B	C	D
Case	PC (Color:Black)			
Lens		PC (Visible light cut type)		
Device coating			PPS (Color:Black)	
Lead pin				42ALLOY (Pd-Au plating)

year	Mark
2006	U
2007	V
2008	W
2009	X
...	...
2025	T
2026	U

(Note1) Unspecified tolerances shall be ± 0.3 mm.  
(Note2) ( ) : Reference value

Product mass : approx. 0.7g

**■ Absolute Maximum Ratings**

Parameter	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	-0.3 to +7	V
Output terminal voltage	$V_O$	-0.3 to $V_{CC}+0.3$	V
Input terminal voltage	$V_{in}$	-0.3 to $V_{CC}+0.3$	V
Operating temperature	$T_{opr}$	-10 to +60	°C
Storage temperature	$T_{stg}$	-20 to +70	°C
* Soldering temperature	$T_{sol}$	260	°C

\* 5s or less/time up 2times  
 $t = 1.0$  mm One side board mounting

**■ Electro-optical Characteristics**

( $T_a=25^\circ\text{C}, V_{CC}=5\text{V}$ )

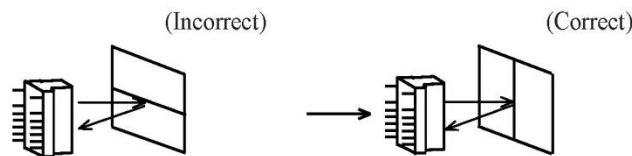
Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Average supply current	$I_{CC1}$	$V_{CC}=5\text{V}, V_{in}=5\text{V}, R_1=4.3\Omega$ (*1)	—	5	6.5	mA
Average supply current	$I_{CC2}$	$V_{CC}=5\text{V}, V_{in}=5\text{V}, R_1=4.3\Omega$ (*1)	—	9	10.5	mA
Stand-by supply current	$I_{CC3}$	$V_{CC}=5\text{V}, V_{in}=0\text{V}$	—	5	8	$\mu\text{A}$
Output voltage	$V_{OH}$	Output voltage at high level	$V_{CC}-0.6$	—	—	V
	$V_{OL}$	Output voltage at low level	—	—	0.6	V
Detecting distance	L	(*2)(*3)	40	50	60	mm

- (\*1)  $I_{CC1}$  : (LED Emitting time : Typ.  $20 \mu\text{s} \times 8$  times),  $I_{CC2}$  : (Emitting time : Typ.  $20 \mu\text{s} \times 15$  times),  
 LED Pulse Current : Typ. 70 mA
- (\*2) Using reflective object : White paper (Made by Kodak Co., Ltd. gray cards R-27-white face, reflectance ; 90%)
- (\*3) Output voltage switch has a hysteresis width. The distance specified by L should be the distance which the output turns from L to H in case an object moves to the sensor.

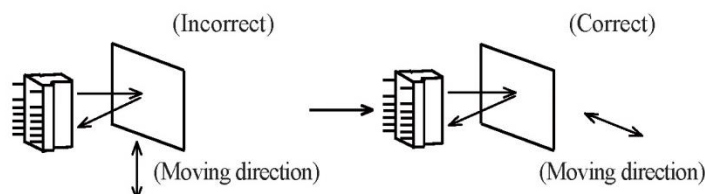
**■ Recommended operating conditions**

Parameter	Symbol	Conditions	Rating	Unit
Supply voltage	$V_{CC}$		2.7 to 6.2	V
High level input voltage	$V_{inH}$	CMOS level signal. Operating	MIN $V_{CC}-0.2$	V
Low level input voltage	$V_{inL}$	CMOS level signal. Standby state	MAX 0.2	V

- In case that reflective object has boundary line which material or color etc. are excessively different, in order to decrease deviation of measuring distance, it shall be recommended to set the sensor that the direction of boundary line and the line between emitter center and detector center are in parallel.



- In order to decrease deviation of measuring distance by moving direction of the reflective object, it shall be recommended to set the sensor that the moving direction of the object and the line between emitter center and detector center are vertical.



## Anexo 27: Hoja técnica de las matrices de LEDs



深圳市昱申科技有限公司  
CHINA YOUNG SUN LED TECHNOLOGY CO., LTD.

TEL: (86) 755-28079401 28079402 28079403 28079404 28079405  
FAX: (86) 755-28079407 E-mail: info@100LED.com Web: www.100LED.com

Model No.: YSM-2088CR3G2C  
8mm Pitch RED/GREEN Double Color Dot Matrix

Applications:

- Moving Message Display
- Full Color Display
- Banking Board
- Score Boards
- Digital Display

LED Chip Absolute Maximum Ratings: (Ta=25°C)

Parameter	Symbol	Red	Green	Unit
Forward current	I <sub>F</sub>	20	20	mA
Peak forward current (Duty Cycle=1/10, 10KHz)	I <sub>PF</sub>	30	30	mA
Reverse voltage (V <sub>R</sub> =5V)	I <sub>R</sub>	10	10	μ A
Operating temp	T <sub>OPR</sub>	-25 - 85	-25 - 85	°C
Storage temp	T <sub>STG</sub>	-30-85	-30-85	°C
Peak Emission Wavelength	λ <sub>PH</sub>	20	30	nm

\* Soldering Bath: not more than 5 seconds @260 °C. The bottom ends of the plastic reflector should be at least 2mm above the solder surface  
Soldering Iron: not more than 3 seconds @300 °C under 30W

LED Chip Typical Electrical & Optical Characteristics: (Ta=25°C)

ITEMS	Color	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Voltage	Red	V <sub>F</sub>	I <sub>F</sub> =20mA	1.9	2.0	2.2	V
	Green			3.2	3.3	3.5	
Luminous Intensity	Red	I <sub>v</sub>	I <sub>F</sub> =20mA	200	210	220	mcd
	Green			280	300	330	
Wavelength	Red	Δ λ	I <sub>F</sub> =20mA	620	---	625	nm
	Green			515	---	517.5	
Light Degradation after 1000 hours	Red	-4.68% ~ -8.27%					
	Green	-11.37% ~ -15.30%					

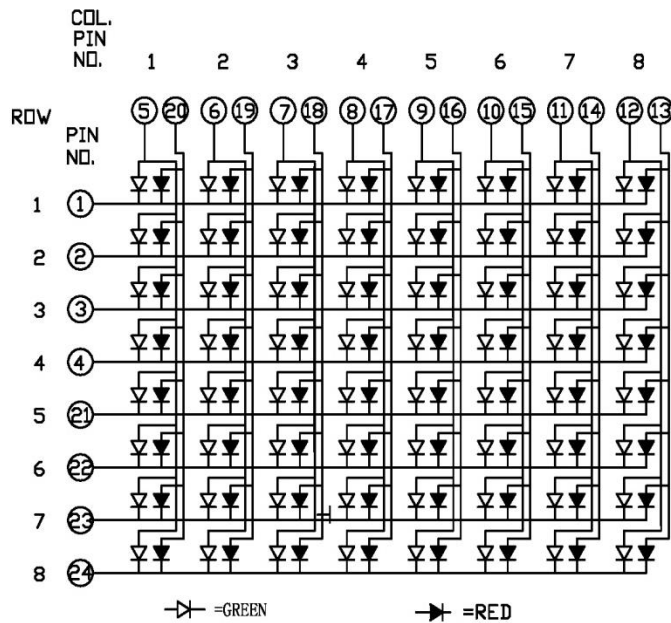
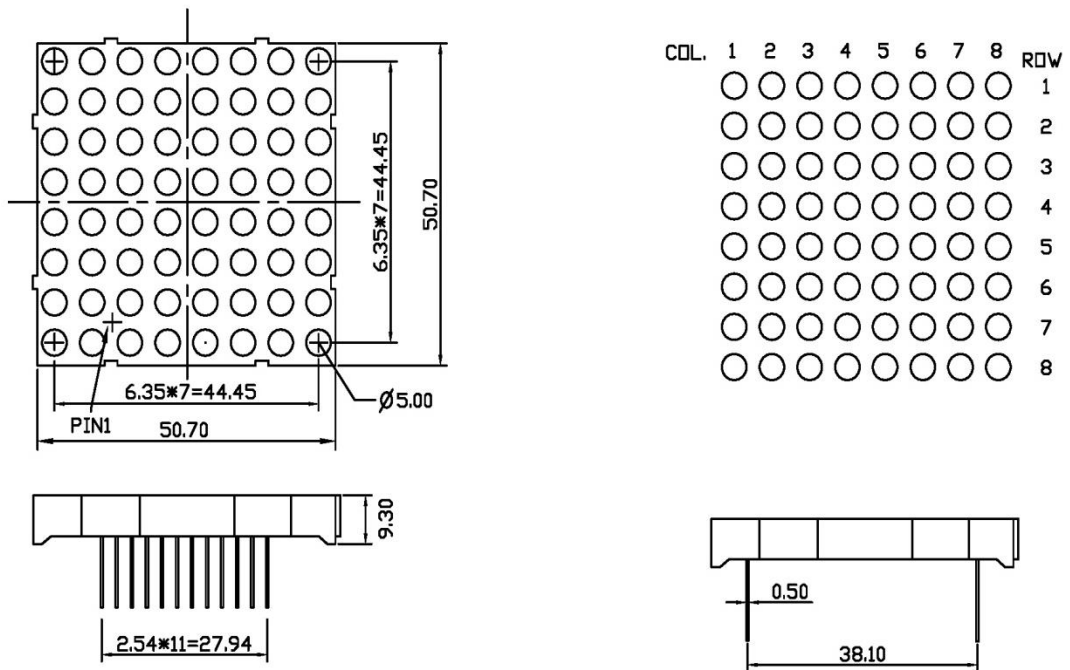


深圳市显申科技有限公司  
CHINA YOUNG SUN LED TECHNOLOGY CO., LTD.

TEL: (86) 755-28079401 28079402 28079403 28079404 28079405  
FAX: (86) 755-28079407 E-mail: info@100LED.com Web: www.100LED.com

**Mechanical Dimensions:**

- All dimension are in mm, tolerance is  $\pm 0.2\text{mm}$  unless otherwise noted
- An epoxy meniscus may extend about 1.5mm down the leads.



Unit:

## Anexo 28: Hoja técnica del controlador de las matrices de LEDs



### RG Matrix – Serial Backpack User Guide 2009.04.20

#### Overview

The new RG Matrix – Serial Backpack controller from SparkFun offers an easy way to control the tri-color common cathode 8x8 LED matrices. The entire controller fits behind the LED matrix so that even larger arrays of matrices may be created; external connectors are oriented to allow daisy-chaining of multiple controller boards. The boards accept a special software command to be re-configured for daisy-chained systems. Each backpack is based around an AVR microcontroller and contains all the necessary circuitry to drive the LED matrix.

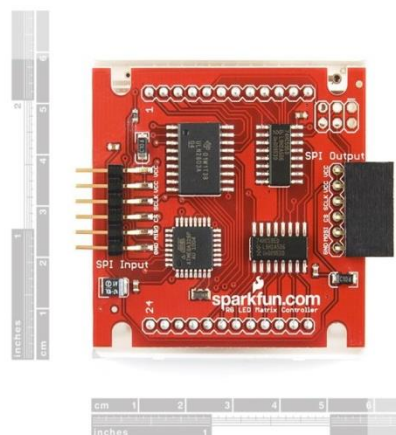
By default the controller runs a simple frame buffer program that listens for image data and displays in constantly on the LEDs. Data is sent to the backpack using an SPI interface. The microcontroller may also be reprogrammed to give the LED matrix more individual intelligence.

Figure 2

Parameter	Min.	Recommended	Max	Unit
Voltage	4.50	5.00	5.25	V
Current	-	120(typical)	275	mA

\*Current Rating is for a single board. Ratings for multiple boards will be linear (i.e. If 'N' boards are connected in the system, the maximum current draw will be N\*Max Current mA.). If your power supply is not capable of providing enough power for the required load, the boards may malfunction.

Figure 3







WEBSITE: sparkfun.com | [303] 284.0979 [GENERAL] P  
6175 LONGBOW DRIVE, SUITE 200 ZIP CODE: 80301 USA 443.0048 P

**RG Matrix – Serial Backpack User Guide**

2009.04.20

Figure 4

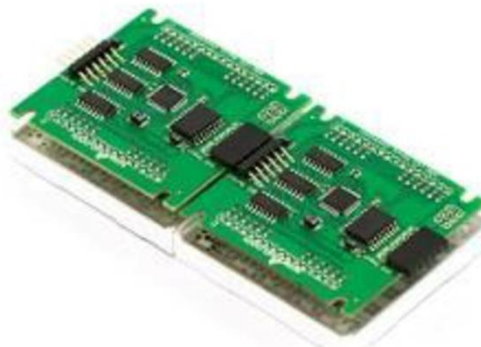
Buffer Byte Representing and LED Color Value					
Red			Green		
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2

Figure 5

<u>Color(Brightest Setting)</u>	<u>Byte Value</u>
Black	0x00
Red	0xE0
Green	0x1C
Orange	0xFC
White	0xFF

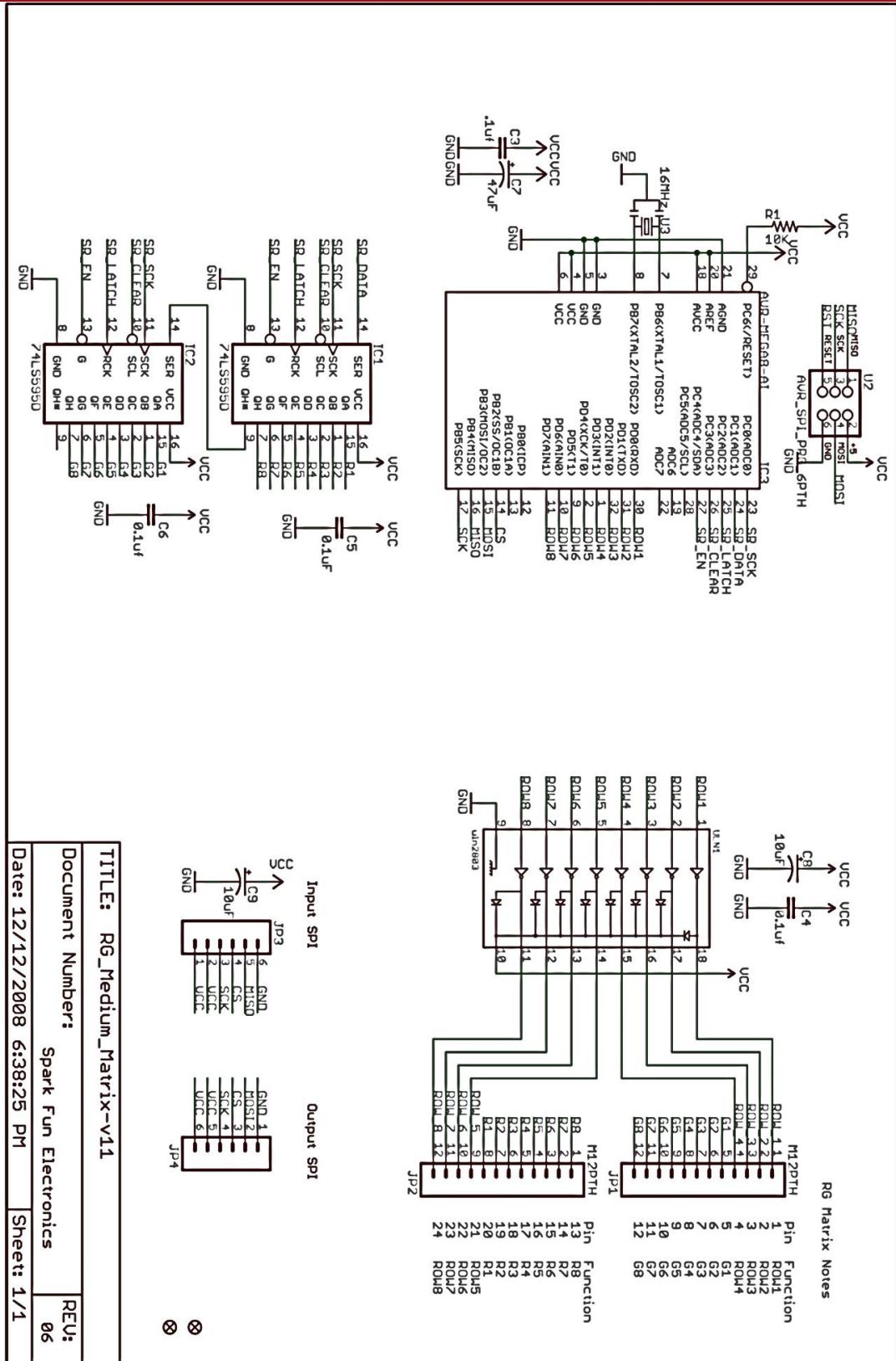
**Daisy-chaining RG Matrix Controllers**

The newest version of the RG matrix controller has a new layout and a new version of firmware that allow the user to more easily daisy-chain multiple RG matrix controllers. Daisy-chaining is when multiple controllers are connected together, and the data is passed from the first controller in the "chain" to the next connected controller; data is passed along until the data reaches the end of the chain.



In order to daisy-chain the controllers each controller must be reconfigured for the size of the desired chain. By default the controllers come configured to operate in standalone mode, or a 1 controller chain. If there are two controllers to be daisy-chained together, each of them must be reconfigured for a 2 controller chain. To reconfigure the boards a special two byte command sequence must be sent via the SPI interface: the character '%' followed by the decimal number of the desired chain length. The controllers must be reconfigured individually (so they can't already be connected in the chain). The commands should be sent using the normal SPI protocol. Be sure to assert CS (low) before sending the two command bytes, and then de-assert CS (high) when you are finished. Do not start sending the color values to the chain before de-asserting the CS pin. Also, it is recommended to limit the daisy-chain lengths to 8 boards.

When you are connecting the boards, make sure to connect the output of the 1st board in the system to the input of the 2nd board in the system. The connections from your Host system should be plugged into the Input connector of the first controller in the system. Power will be passed through the connectors to all the boards in the system. However, be sure that the power supply can provide enough current for the entire system.



Esquemático de tarjeta serial para las matrices de LEDs. Extraído de: [https://www.sparkfun.com/datasheets/Components/RG\\_Medium\\_Matrix-v11.pdf](https://www.sparkfun.com/datasheets/Components/RG_Medium_Matrix-v11.pdf)

TITLE: RG\_Medium\_Matrix-v11  
 Document Number: Spark Fun Electronics  
 Date: 12/12/2008 6:38:25 PM  
 Sheet: 1/1

REV: 06

## Anexo 29: Hoja técnica del circuito de reconocimiento de voz

www.veear.eu



### Recommended Operating Conditions

Symbol	Parameter	Min	Typ	Max	Unit
VCC	Voltage DC Input	3.3	5.0	5.5	V
Ta	Ambient Operating Temperature Range	0	25	70	°C
ERX	Serial Port Receive Data	0	-	VCC	V
ETX	Serial Port Transmit Data	0	-	VCC	V

### Electrical Characteristics

These are applicable to J4 pins only, including IO1-3, /XM and /RST.

Symbol	Parameter	Min	Typ	Max	Unit
V <sub>IH</sub>	Input High Voltage	2.4	3.0	3.3	V
V <sub>IL</sub>	Input Low Voltage	-0.1	0.0	0.75	V
I <sub>IL</sub>	Input Leakage Current (0 < V <sub>IO</sub> < 3V, Hi-Z Input)		<1	10	µA
R <sub>PU</sub>	Pull-up Resistance	Strong	10		kΩ
		Weak	200		kΩ
V <sub>OH</sub>	Output High Voltage (I <sub>OH</sub> = -5 mA)	2.4			V
V <sub>OL</sub>	Output Low Voltage (I <sub>OL</sub> = 8 mA)			0.6	V

### Power Supply Requirements

Symbol	Parameter	Min	Typ	Max	Unit
I <sub>Sleep</sub>	Sleep current		< 1		mA
I <sub>Oper</sub>	Operating current		12		mA
I <sub>Speaker</sub>	Audio playback current (with 8Ω speaker)	180			mA (RMS)

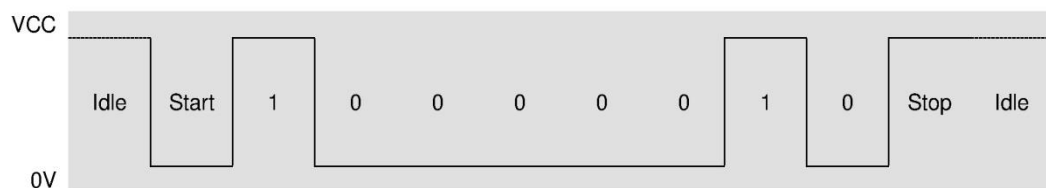
### Serial Interface

The EasyVR is a “slave” module communicating via an asynchronous serial interface (commonly known as UART interface), with the following features:

- Baud Rate: **9600** (default), 19200, 38700, 57600, 115200
- Frame: **8** Data bits, **No** parity, **1** Stop bit

The receiver input data line is ERX, while the transmitter output data line is ETX. No handshake lines are used.

Example of a serial data frame representing character “A” (decimal 65 or hexadecimal 41):



See also chapter [Communication Protocol](#) later on this manual for communication details.

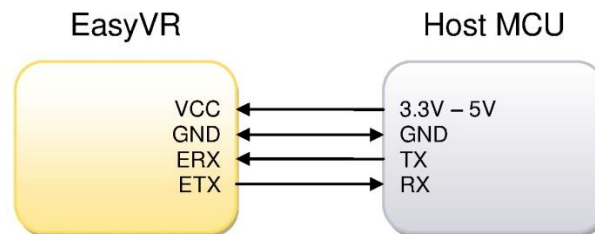
## EasyVR Programming

### Communication Protocol

#### Introduction

Communication with the EasyVR module uses a standard UART interface compatible with 3.3-5V TTL/CMOS logical levels, according to the powering voltage VCC.

A typical connection to an MCU-based host:



The initial configuration at power on is 9600 baud, 8 bit data, No parity, 1 bit stop. The baud rate can be changed later to operate in the range 9600 - 115200 baud.

The communication protocol only uses printable ASCII characters, which can be divided in two main groups:

- Command and status characters, respectively on the TX and RX lines, chosen among lower-case letters.
- Command arguments or status details, again on the TX and RX lines, spanning the range of capital letters.

Each command sent on the TX line, with zero or more additional argument bytes, receives an answer on the RX line in the form of a status byte followed by zero or more arguments.

There is a minimum delay before each byte sent out from the EasyVR module to the RX line, that is initially set to 20 ms and can be selected later in the ranges 0 - 9 ms, 10 - 90 ms, and 100 ms - 1 s. That accounts for slower or faster host systems and therefore suitable also for software-based serial communication (bit-banging).

Since the EasyVR serial interface also is software-based, a very short delay might be needed before transmitting a character to the module, especially if the host is very fast, to allow the EasyVR to get back listening to a new character.

The communication is host-driven and each byte of the reply to a command has to be acknowledged by the host to receive additional status data, using the *space* character. The reply is aborted if any other character is received and so there is no need to read all the bytes of a reply if not required.

Invalid combinations of commands or arguments are signaled by a specific status byte, that the host should be prepared to receive if the communication fails. Also a reasonable timeout should be used to recover from unexpected failures.

If the host does not send all the required arguments of a command, the command is ignored by the module, without further notification, and the host can start sending another command.

The module automatically goes to lowest power sleep mode after power on. To initiate communication, send any character to wake-up the module.

### Built-in Command Sets

In the tables below a list of all built-in commands for each supported language, along with group index (trigger or word set), command index and language identifier to use with the communication protocol.

Trigger Word set	Command Index	Language						
		0	1	2	3	4	5	
		English (US)	Italian	Japanese (Rōmaji)	German	Spanish	French	
0	0	robot	robot	ロボット <i>robotto</i>	roboter	robot	robot	
	1	0	action	azione	アクション <i>acution</i>	aktion	acción	action
		1	move	vai	進め <i>susu-me</i>	gehe	muévete	bouge
		2	turn	gira	曲がれ <i>magare</i>	wende	gira	tourne
		3	run	corri	走れ <i>hashire</i>	lauf	corre	cours
		4	look	guarda	見ろ <i>miro</i>	schau	mira	regarde
		5	attack	attacca	攻撃 <i>kougeki</i>	attacke	ataca	attaque
		6	stop	fermo	止まれ <i>tomare</i>	halt	para	arrête
7	hello	ciao	こんにちは <i>konnichiwa</i>	hallo	hola	salut		
2	0	left	a sinistra	左 <i>hidari</i>	nach links	a la izquierda	à gauche	
	1	right	a destra	右 <i>migi</i>	nach rechts	a la derecha	à droite	
	2	up	in alto	上 <i>ue</i>	hinauf	arriba	vers le haut	
	3	down	in basso	下 <i>shita</i>	hinunter	abajo	vers le bas	
	4	forward	avanti	前 <i>mae</i>	vorwärts	adelante	en avant	
	5	backward	indietro	後ろ <i>ushiro</i>	rückwärts	atrás	en arrière	
3	0	zero	zero	ゼロ <i>zero</i>	null	cero	zéro	
	1	one	uno	一 <i>ichi</i>	eins	uno	un	
	2	two	due	二 <i>ni</i>	zwei	dos	deux	
	3	three	tre	三 <i>san</i>	drei	tres	trois	
	4	four	quattro	四 <i>yon</i>	vier	cuatro	quatre	
	5	five	cinque	五 <i>go</i>	fünf	cinco	cinq	
	6	six	sei	六 <i>roku</i>	sechs	seis	six	
	7	seven	sette	七 <i>nana</i>	sieben	siete	sept	
	8	eight	otto	八 <i>hachi</i>	acht	ocho	huit	
	9	nine	nove	九 <i>kyu</i>	neun	nueve	neuf	
	10	ten	dieci	十 <i>jyuu</i>	zehn	diez	dix	

# Anexo 30: Hoja técnica del micrófono omnidireccional

**HORN** 深圳市豪恩实业有限公司  
SHENZHEN HORN INDUSTRIAL CO., LTD.

SPEC. SHEET NO: 00011239

Address:  
BLOCK 1, DEHUINA INDUSTRIAL DISTRICT,  
MINGZHI RD LONGHUA, SHENZHEN,  
GUANGDONG, CHINA 518131

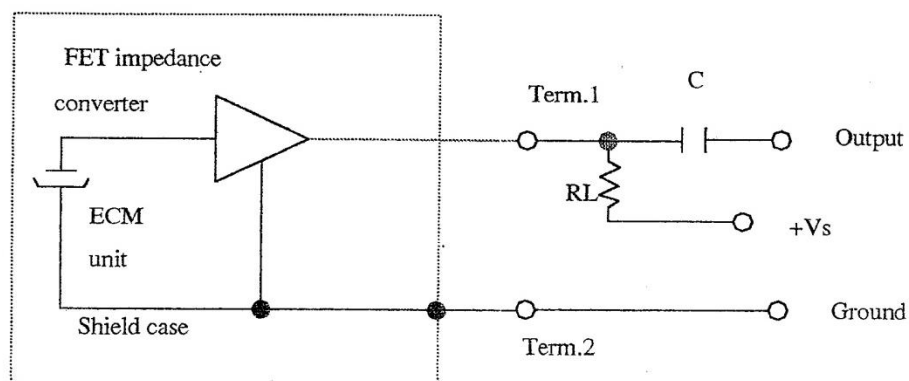
TEL: (86) 755-8192552 8190943  
FAX: (86) 755-8192557  
E-mail: szwwiner@public.szptt.net.cn  
HOME PAGE: www.globalsources.com/hornmic.co

## SPECIFICATION

Item	Symbol	Test conditions	Min	Standard	Max	Unit
Sensitivity	S	f=1KHz. Pin=1pa	-46	-44	-42	dB odB=1V/pa
Directivity	Omnidirectional					
Impedance	Zout				2.2	K Ω
Current consumption	I	f=1KHz. Pin=1pa			450	uA
Sensitivity reduction	ΔS	f=1KHz. Pin=1pa. Vs=4.5→1.5V			-3	dB
S/N ratio	S/N(A)	f=1KHz. Pin=1pa. A=curve	60			dB

### Measurement Circuit (Test Condition $V_S=4.5V$ $R_L=2.2K\Omega$ )

$T_a=20^\circ C$  R.H=65%)



# HORN 深圳市豪恩实业有限公司

SHENZHEN HORN INDUSTRIAL CO., LTD.

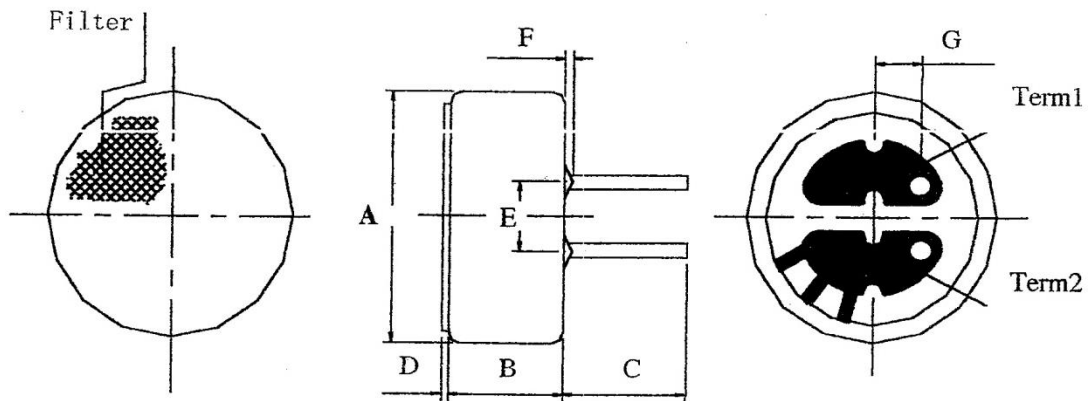
SPEC. SHEET NO: 00011239

Address:  
BLOCK 1, DEHUINA INDUSTRIAL DISTRICT,  
MINGZHI RD LONGHUA, SHENZHEN,  
GUANGDONG, CHINA 518131

TEL: (86) 755-8192552 8190943  
FAX: (86) 755-8192557  
E-mail: szwwiner@public.szptt.net.cn  
HOME PAGE: www.globalsources.com/hornmic.co

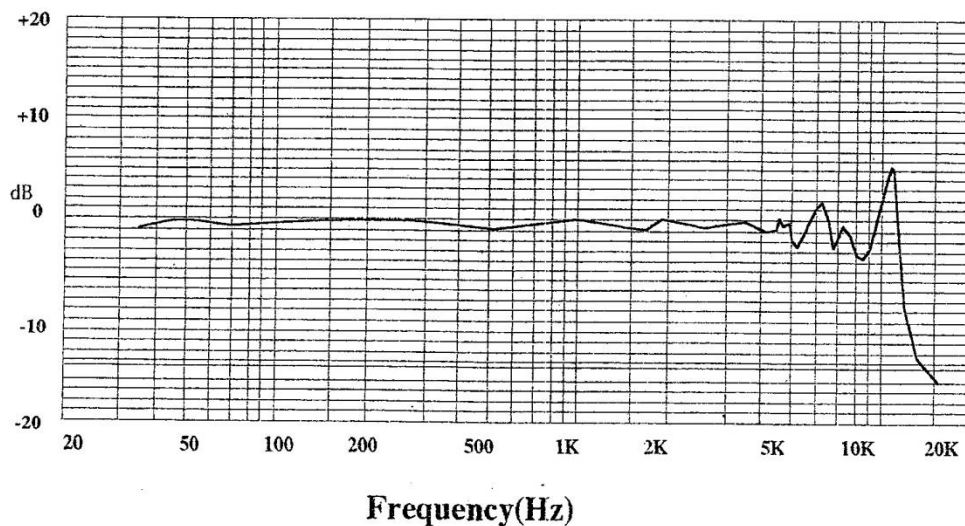
## Dimensional Drawing

unit: mm



PART	MIN	TYPE	MAX	REMARK
A	Ø9.6	Ø9.7	Ø9.8	
B	4.3	4.5	4.7	
C	4	5	6	
D	-	-	0.2	
E	-	2.54	-	
F			0.6	
G	1.9	2	2.1	

## Typical Frequency Response Curve

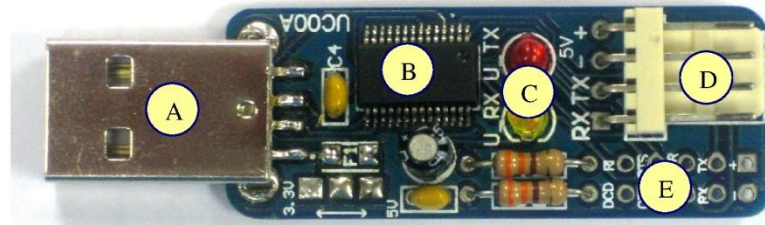


## Anexo 31: Hoja técnica del conversor UART a USB



ROBOT . HEAD to TOE  
Product User's Manual – UC00A

### 4. BOARD LAYOUT



Label	Function
A	USB A type (male).
B	USB to UART chip.
C	Two LED indicators for USB's transmitter and receiver status.
D	4 ways header pin for interface to microcontroller.
E	2 x5 extension pad for extra COM Port Feature.





## 5. PRODUCT SPECIFICATION

UC00A is designed to ease communication between microcontroller and PC. The specifications are as listed below:

### 5.1 4 ways 2510 header pin

Pin	Label	Definition	Function
1	+	5V Power output from UC00A	5V supply from USB, optional for user to power external device, maximum current 200mA.
2	-	Ground or negative	Ground of power and signal. This pin should be connected to device's GND pin.
3	TX	UC00A UART Transmit pin	This is UC00A's transmitter pin (5V TTL). It should be connected to device's receiver pin.
4	RX	UC00A UART Receive pin	This is UC00A's receiver pin (5V TTL). It should be connected to device's transmitter pin.

### Absolute Maximum Rating

Symbol	Parameter	Min	Max	Unit
+	Power output pin	5.0	5.0	V
-	Operating voltage	0	0	V
TX	Transmitter pin of UC00A	0	5.5	V
RX	Receiver pin of UC00A	0	5.5	V

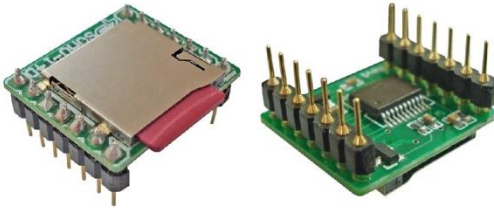
## Anexo 32: Hoja técnica del circuito de reproducción de audio



## SOMO-14D Embedded Audio Module

### Data Sheet

#### Description



The **SOMO-14D** is a tiny Audio-Sound module that can play back pre-stored audio files such as voice and music from a micro-SD memory card. The module supports 4-bit ADPCM audio files with sample rates from 6Khz up to 32Khz. By using the freely available software tool, any WAVE(.wav) or MP3(.mp3) file can be easily converted to the ADPCM(.ad4) format which can then be saved to a micro-SD memory card. The compact 14pin drop-in-module takes up very minimal board space and is ideal for any application that requires embedded audio.

The module offers two modes of operation, SERIAL-MODE and the KEY-MODE.

The SERIAL-MODE provides a simple 2-wire interface to any micro-controller via its DATA and CLK lines. Audio operations such as PLAY, PAUSE, STOP and VOLUME control functions are all available to the host micro via simple serial commands.

The KEY-MODE provides a stand alone operation where a host micro is not required. With only 3 push buttons, a 3V battery and a speaker, an extremely compact and low component count MP3-Player like system can be implemented.

In short, the SOMO offers a very flexible, compact and low cost embedded audio solution for many applications.

#### Features

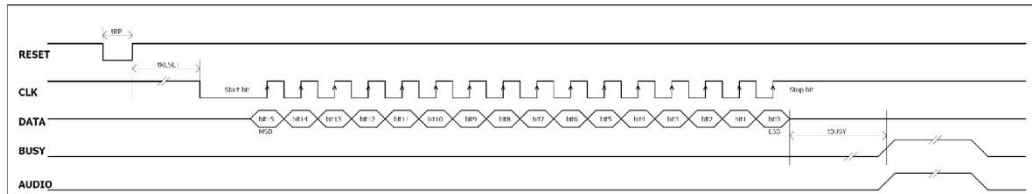
- Low-cost module for all embedded Audio-Sound applications.
- Supports 4-bit ADPCM (.ad4) file formats with sampling rates from 6Khz to 32Khz.
- SERIAL MODE: Supports a 2-Wire (Data, Clock) interface to any micro-controller.
- KEY-MODE: Supports a simple stand alone operation without a host micro.
- Differential 2 line PWM output for direct speaker drive (8/16/32 Ohm/0.25W).
- Dedicated 16-bit DAC/PWM audio output to use with an external amplifier.
- On-board micro-SD memory card adaptor for storing of audio, voice and music files (up to 512 files).
- Supports up to 2Gig micro-SD memory cards (FAT/FAT16 format).
- Compact size measuring only 18.3 x 20.8 mm.
- 2.7V to 3.6V DC voltage range (single supply).
- RoHS Compliant.

#### Applications

- General purpose embedded audio and sound applications.
- All voice annunciator systems.
- Automotive, Parking radar, GPS navigation systems.
- Elevator, Security, Access-Control and Warning devices.
- Intelligent home automation and domestic appliances.
- Robotics and Industrial control.
- Traffic facilities: Toll gates, parking lots.
- Toys, learning tools, talking books and all gaming sound effects.
- MP3 player like simple devices.

## 7. Timing Diagrams

### 7.1 Serial Data Timing and Waveforms



Item	Symbol	Min.	Typ.	Max.	Unit
Reset Pulse Width	tRP	5	-	-	ms
Reset Idle to Start Bit	tRESET	300	-	-	ms
Start Bit Low level pulse width	tSTART	2	-	-	ms
Stop Bit High level pulse width	tSTOP	2	-	-	ms
Clock High level pulse width	tCH	100	-	-	μs
Clock Low level pulse width	tCL	100	-	-	μs
Clock Cycle Total Period	tCT	200	-	-	μs
Write Data Setup	tDS	1	-	-	μs
Write Data Hold	tDH	50	-	-	μs
Busy Active High from last data bit latch	tBUSY	20	-	-	ms



## 8. Specifications and Ratings

### Absolute Maximum Ratings

Operating ambient temperature .....	-20°C to +75°C
Storage temperature .....	-40°C +80°C
Voltage on any digital input pin with respect to GND .....	-0.3V to 6.0V
Voltage on SWITCH pin with respect to GND .....	-0.3V to 6.0V
Voltage on VCC with respect to GND .....	-0.3V to 6.0V
Total power dissipation .....	1.0W

**NOTE:** Stresses above those listed here may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the recommended operation listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

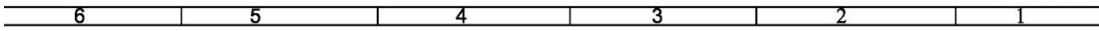
### Recommended Operating Conditions

Parameter	Conditions	Min	Typ	Max	Units
Supply Voltage (VCC)		2.7	3.3	3.6	V
Operating Temperature		-10	--	+70	°C
Input Low Voltage	All pins	GND	--	0.8	V
Input High Voltage	All pins	2.0	--	VCC	V
Reset Pulse (tRP)	External Open Collector	5.0	--	--	ms

### Global Characteristics based on Operating Conditions

Parameter	Conditions	Min	Typ	Max	Units
Supply Current (ICC)	VCC = 3.3V, Audio playing	36	41	45	mA
Supply Current (ICQ)	VCC = 3.3V, Idle	8.0	10	15	μA
Output Low Voltage (VOL)	All pins, IOL = 3.4mA	--	--	0.4	V
Output High Voltage (VOH)	All pins, IOL = -2.0mA	2.4	--	3.3	V

## Anexo 33: Hoja técnica del parlante del robot



## FE23100PCW-03 LF

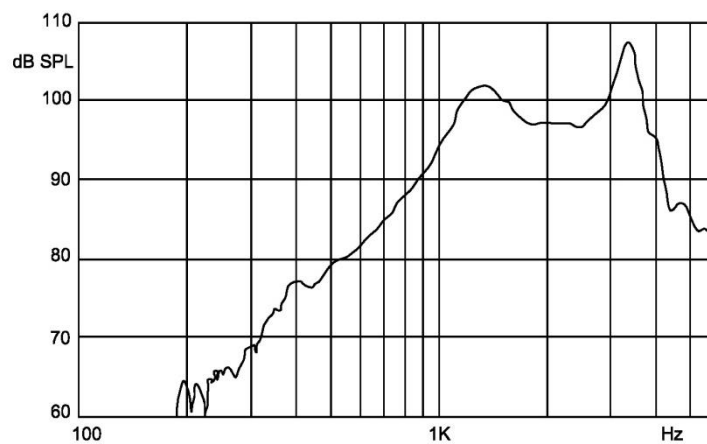


### 1. Characteristics

#### 1.1 Electrical and Mechanical Characteristics

No.	Item	Specifications
1-1)	Impedance (1V,*2kHz)	100 ± 10 % Ω
1-2)	Rated input power	0.15W
1-3)	Max Input	0.3W
1-4)	Frequency response	1000...4000Hz
1-5)	Sound pressure level	≥90dB( at 0.25W/10cm/1000Hz square wave)
		≥95dB( at0.25W/10cm/2000Hz square wave)
1-6)	Buzzes and Rattles	Must be normal
		sine wave 3.87V
1-7)	Operating temperature	-40...+85°C
1-8)	Weight	9g

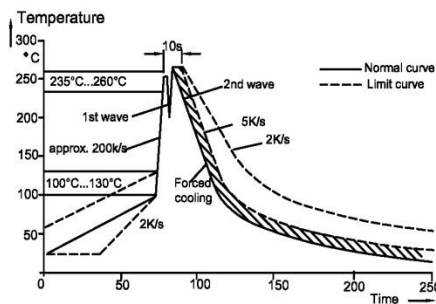
#### 1.2 Frequency response curve



# FE23100PCW-03 LF


## 5. Reliability test

1. Endurance test
  - Duration 240hrs
  - at square wave, duty cycle:50% asymmetric,  $U_n=8.9V_{p-p}$   $f=2048Hz$
  - Temperature cycle  $-40...+85^{\circ}C$  with cycle duration 4h; 10s on/off
2. High temperature durability acc. to IEC 60068 part2-2
  - Temperature  $+85^{\circ}C$
  - Duration 1000h
3. Low temperature durability acc. to IEC 60068 part 2-1
  - Temperature  $-40^{\circ}C$
  - Duration 500h
4. Humidity durability acc.to IEC 60068 part2-3
  - Temperature  $40^{\circ}C$
  - Rel.humidity 93%RH
  - Duration 56days
5. Temperature cycle durability acc.to IEC60068 part2-14
  - Low Temperature  $-40^{\circ}C$
  - Upper Temperature  $+85^{\circ}C$
  - each duration 30minutes
  - Transfer time from lower to upper temperature  $<10s$
  - Number of cycles 100cycles
6. Shock test acc. to IEC 60068 part2-27
  - 100g for each free mutually perpendicular directions to each of 3times by sine-wave
7. Vibration test acc. to IEC 60068 part 2 -6
  - sine-wave excitation; 8...300Hz,2g,1 octave/min; test time 16h each axis
  - Additional requirements:
  - Test of solderability and resistance to soldering heat acc. to VDON4.3643.001
  - X-ray solderpoint inspection according to VDON 4.4814.001
  - Washability: not washable
  - Cadmium prohibited as per DIN 5.5000.1
8. Wave soldering



				Date:	07/01/23	FE23100PCW-03 LF
B	07/01/23	莫丽丽		Drawn by:	莫丽丽	
A	05/01/15	王善梅		Checked by:	邵凯	Speaker
Rev.	Date	Drawn	Note	Approved by:	程久生	
BESTAR ELECTRONICS INDUSTRY CO.,LTD						
				www.be-star.com wu@be-star.com		DRG NO: BS/TES01.486B   Pa

## Anexo 34: Hoja técnica del integrado usado en el convertidor bidireccional de voltaje



October 2005

### BSS138

#### N-Channel Logic Level Enhancement Mode Field Effect Transistor

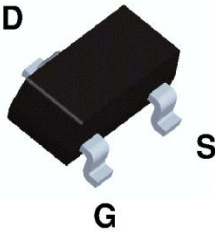
#### General Description

These N-Channel enhancement mode field effect transistors are produced using Fairchild's proprietary, high cell density, DMOS technology. These products have been designed to minimize on-state resistance while provide rugged, reliable, and fast switching performance. These products are particularly suited for low voltage, low current applications such as small servo motor control, power MOSFET gate drivers, and other switching applications.

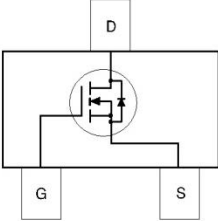
#### Features

- 0.22 A, 50 V.  $R_{DS(ON)} = 3.5\Omega @ V_{GS} = 10\text{ V}$   
 $R_{DS(ON)} = 6.0\Omega @ V_{GS} = 4.5\text{ V}$
- High density cell design for extremely low  $R_{DS(ON)}$
- Rugged and Reliable
- Compact industry standard SOT-23 surface mount package

---



SOT-23



#### Absolute Maximum Ratings

$T_A = 25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Ratings	Units
$V_{DSS}$	Drain-Source Voltage	50	V
$V_{GSS}$	Gate-Source Voltage	$\pm 20$	V
$I_D$	Drain Current – Continuous (Note 1)	0.22	A
	– Pulsed	0.88	
$P_D$	Maximum Power Dissipation (Note 1)	0.36	W
	Derate Above $25^\circ\text{C}$	2.8	mW/ $^\circ\text{C}$
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	$-55$ to $+150$	$^\circ\text{C}$
$T_L$	Maximum Lead Temperature for Soldering Purposes, 1/16" from Case for 10 Seconds	300	$^\circ\text{C}$

#### Thermal Characteristics

$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (Note 1)	350	$^\circ\text{C}/\text{W}$
-----------------	--	-----	---------------------------

#### Package Marking and Ordering Information

Device Marking	Device	Reel Size	Tape width	Quantity
SS	BSS138	7"	8mm	3000 units

### Electrical Characteristics

$T_A = 25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
<b>Off Characteristics</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	50			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$		72		$\text{mV}/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 50\text{ V}, V_{GS} = 0\text{ V}$			0.5	$\mu\text{A}$
		$V_{DS} = 50\text{ V}, V_{GS} = 0\text{ V}, T_J = 125^\circ\text{C}$			5	$\mu\text{A}$
		$V_{DS} = 30\text{ V}, V_{GS} = 0\text{ V}$			100	nA
$I_{GSS}$	Gate-Body Leakage	$V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$			$\pm 100$	nA
<b>On Characteristics (Note 2)</b>						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 1\text{ mA}$	0.8	1.3	1.5	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	$I_D = 1\text{ mA}$ , Referenced to $25^\circ\text{C}$		-2		$\text{mV}/^\circ\text{C}$
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}, I_D = 0.22\text{ A}$		0.7	3.5	$\Omega$
		$V_{GS} = 4.5\text{ V}, I_D = 0.22\text{ A}$		1.0	6.0	
		$V_{GS} = 10\text{ V}, I_D = 0.22\text{ A}, T_J = 125^\circ\text{C}$		1.1	5.8	
$I_{D(on)}$	On-State Drain Current	$V_{GS} = 10\text{ V}, V_{DS} = 5\text{ V}$	0.2			A
$g_{FS}$	Forward Transconductance	$V_{DS} = 10\text{ V}, I_D = 0.22\text{ A}$	0.12	0.5		S
<b>Dynamic Characteristics</b>						
$C_{iss}$	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}$		27		pF
$C_{oss}$	Output Capacitance			13		pF
$C_{rss}$	Reverse Transfer Capacitance			6		pF
$R_G$	Gate Resistance	$V_{GS} = 15\text{ mV}, f = 1.0\text{ MHz}$		9		$\Omega$
<b>Switching Characteristics (Note 2)</b>						
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 30\text{ V}, I_D = 0.29\text{ A}, V_{GS} = 10\text{ V}, R_{GEN} = 6\ \Omega$		2.5	5	ns
$t_r$	Turn-On Rise Time			9	18	ns
$t_{d(off)}$	Turn-Off Delay Time			20	36	ns
$t_f$	Turn-Off Fall Time			7	14	ns
$Q_g$	Total Gate Charge	$V_{DS} = 25\text{ V}, I_D = 0.22\text{ A}, V_{GS} = 10\text{ V}$		1.7	2.4	nC
$Q_{gs}$	Gate-Source Charge			0.1		nC
$Q_{gd}$	Gate-Drain Charge			0.4		nC
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
$I_S$	Maximum Continuous Drain-Source Diode Forward Current				0.22	A
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 0.44\text{ A}$ (Note 2)		0.8	1.4	V

**Notes:**

- $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins.  $R_{\theta IC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.



a)  $350^\circ\text{C}/\text{W}$  when mounted on a minimum pad..

Scale 1 : 1 on letter size paper

- Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$



## Anexo 35: Hoja técnica de la batería del robot



AA Portable Power Corp  
[www.batteryspace.com](http://www.batteryspace.com), Email: [Sales@batteryspace.com](mailto:Sales@batteryspace.com)

### Battery Data Sheet

<b>Packing</b>	<ul style="list-style-type: none"> <li>• Customize 14.8 V 20Ah pack is made by 8 pcs of <a href="#">Polymer Li-ion Battery, 3.7V 10000mAh cells (PL-9059156)</a> in 4S2P connection.</li> <li>• Battery is placed in <a href="#">ABS Fire Retardant / water-proof Enclosure(10-22)</a> to protect battery from wet weather, drop impact and fire accident with separate charge and discharge terminals.</li> <li>• On/Off switch for 12V output.</li> <li>• Built in Low battery alert function. If battery voltage drops below 11V, a tone sounds for 10 seconds to remind you to recharge the battery.</li> </ul>
<b>Voltage</b>	Voltage without regulation: 14.8V (working), 16.8V (peak) and 11.0V (cut-off).
<b>Capacity</b>	20 Ah. (296 Wh).
<b>Protection</b>	<ul style="list-style-type: none"> <li>• Two <a href="#">PCBs</a> (10A) are installed with the battery pack to protect the battery from:             <ul style="list-style-type: none"> <li>○ Over charge (&gt; 16.8V).</li> <li>○ Over discharge (&lt; 11.0 V).</li> <li>○ Over drain (&gt; 20 Amp).</li> <li>○ Short circuits.</li> </ul> </li> <li>• Two <a href="#">7.0 Amp polyswitch</a> installed to limit max. discharging current at 14.0A and to protect wrong polarity.</li> <li>• Two 4.0A DC to DC regulators to gives you 12V or 13.2V at 8.0A.</li> </ul>
<b>Prewired</b>	Discharge terminal: <a href="#">4.0' coil cord with Female Trailtech connector</a> Charge terminal: <a href="#">4.0" Male Tamiya connector</a> .
<b>Max. Discharging Rate</b>	8 Amp limited by regulator, up to 12A for less than 5 minutes.
<b>Dimension (LxWxH)</b>	200mm x 120mm x 75mm (7.87" x 4.72" x 2.95").



AA Portable Power Corp  
[www.batteryspace.com](http://www.batteryspace.com), Email: [Sales@batteryspace.com](mailto:Sales@batteryspace.com)

<b>Weight</b>	2150g (4.0 lbs = 12.0 Oz).
<b>Smart Tips</b>	<ul style="list-style-type: none"> <li>• Use <a href="#">14.8V (6A) Smart Li-Ion battery charger</a> to recharge this battery pack.</li> <li>• The charging time with this charger is about 3 hours.</li> <li>• Must plug the charger to charge terminal to recharge battery.</li> </ul>
<b>Applications</b>	<ul style="list-style-type: none"> <li>• Burn time = 296 Wh / Wattage of device.</li> <li>• Designed for running 12V HID light up to 96W.</li> <li>• Used for video light battery pack.</li> <li>• Used as external 12V battery pack to run DC devices at a max 8A draw (other than 12V or 13.2V) via <a href="#">DC-DC converter</a>.</li> </ul>
<b>Warning</b>	<ul style="list-style-type: none"> <li>• Li-Ion battery may exploded if misusing. We are not responsible for any damages or losses caused by misusing (included but not limited to: mis-charging, mis-discharging, any changes of this battery pack, mis-assembling battery packs).</li> <li>• Please check battery polarity before plug battery into light.</li> </ul>

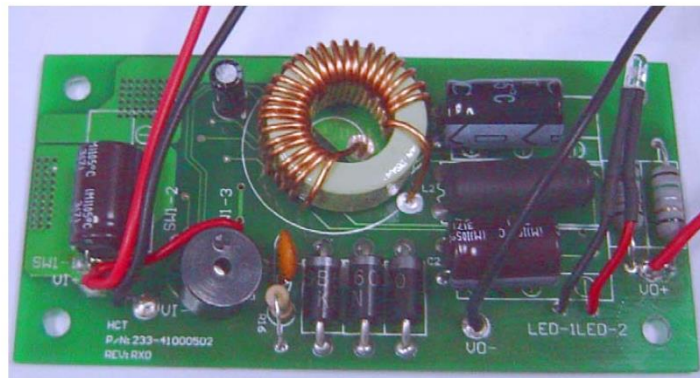


## Anexo 36: Hoja técnica del regulador de voltaje de la batería

AA Portable Power Corp.

### SPECIFICATION

**DC-DC regulator; 12V-16.8VDC to 12V-13.2VDC**



MCMXVII

## 1.0 INPUT

### 1.1 Voltage

Minimum	Normal	Maximum	Unit
12.0	14.8	16.8	Vdc

### 1.2 Low voltage alarm

The buzzer will alarm when the input voltage is less than 12.6V.

### 1.3 Efficiency

88%(min.) at full load,

## 2.0 OUTPUT

Output voltage1:12.0V



Connect SW1-1 to SW1-2, output voltage is 12.0V

**AA Portable Power Corp.**

If SW1-2 and SW1-3 float, output voltage is 0V, dissipation current  $I_s$  is less than 50 $\mu$ A.

Voltage	+12.0V	+13.2V
Max. load	4.0A	4.0A
Min load	0A	0A
Regulation	+/-5%	+/-5%
Ripple & Noise	200mVp-p	200mVp-p

**NOTE:**

- . A 0.1 $\mu$ F ceramic and 10 $\mu$ F tantalum capacitors should be put across output terminals during ripple & noise test. The oscilloscope bandwidth is set at 20MHz and co-axial probe will be used to measure it. The test condition is max. load and normally line.

**2.1 Load transient response (Step load)**

Step load changes of 40% to 80% of full load. The load wave form shall be a square wave with the slope of the rise and fall at 0.1A/ $\mu$ S. the DC output voltages will stay within regulation. Recovery time 500 $\mu$ s max. during the step load changes.

### 3.0 PROTECTION

**3.1 Over voltage protection**

Output over voltage protection with zener diode.

**3.2 Short circuit protection**

The output short to ground, it will auto-recovery without damage.

### 4.0 ENVIRONMENT:

**4.1 Ambient operation temperature**

0°C to +40°C

**4.2 Ambient operation relative humidity**

20% to 85%

**4.3 Ambient storage temperature**

-40°C to +70°C

**4.4 Ambient storage relative humidity**

10% to 95%

## Anexo 37: Hoja técnica del polyswitch limitador de corriente de la batería

REV: #0567

**PolySwitch®**  
**PTC Devices**  
Overcurrent Protection Device

**PRODUCT: LR4-730**

DOCUMENT: SCD 23898  
PCN: D37401  
REV LETTER: D  
REV DATE: APRIL 12, 2005  
PAGE NO.: 1 OF 1

**Specification Status: Released**

**Electrical Rating**  
Voltage: 20Vdc MAX  
Current: 100A MAX

Leads:  
Nickel: 0.13mm nom.

Tape:  
Polyester

Marking:  
 Manufacturer's Mark  
 Part Identification  
 Lot Identification

**TABLE I. DIMENSIONS:**

	A		B		C		D		E		F		G	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
mm:	27.1	29.1	13.9	14.5	0.6	1.0	4.1	5.5	4.1	5.5	5.9	6.1	--	--
in*:	(1.06)	(1.15)	(0.54)	(0.57)	(0.02)	(0.04)	(0.16)	(0.22)	(0.16)	(0.22)	(0.23)	(0.24)	--	--

\*Rounded off approximation

**TABLE II. PERFORMANCE RATINGS: As measured in Mueller Kelvin Clips model BU-75K**

I HOLD	CURRENT TRIP LIMITS								TIME TO TRIP	REFERENCE RESISTANCE		ONE-HOUR POST-TRIP RESISTANCE		TRIPPED-STATE POWER DISSIPATION
	AMPS 20°C HOLD	AMPS AT 0°C HOLD	AMPS AT 20°C AT 20°C TRIP	AMPS AT 60°C AT 60°C HOLD	AMPS AT 80°C AT 80°C TRIP	SECONDS AT 20°C, 30.0 A TYP	SECONDS AT 20°C, 30.0 A MAX	OHMS AT 20°C MIN		OHMS AT 20°C MAX	OHMS AT 20°C MIN	OHMS AT 20°C MAX	WATTS AT 20°C, 20V MAX	
7.3	8.6	16.6	7.3	14.1	5.4	10.5	--	--	5	0.006	0.012	0.006	0.015	3.3

Reference Documents: PS300  
Precedence: This specification takes precedence over documents referenced herein.  
Effectivity: Reference documents shall be the issue in effect on the date of invitation for bid.  
CAUTION: Operation beyond the rated voltage or current may result in rupture, electrical arcing or flame.  
Materials Information:

**ELV Compliant**

Directive 2000/53/EC Compliant


## Anexo 38: Hoja técnica del cargador de la batería del robot



AA Portable Power Corp  
[www.batteryspace.com](http://www.batteryspace.com), Email: Sales@batteryspace.com

## Charger Data sheet

No.	Items	Specification	Notes
<b>Input Characteristics</b>			
1	Input Voltage	AC 100~240V, 50-60Hz	
	Max. Input Current	6A	
<b>Output Characteristics</b>			
2	Max Output Voltage	DC 16.8 V	
	Max Output Current	6 A	
	Battery Capacity	6000 mAh	
	Power Indication	LED=Green: No Battery Connected/ Battery Fully charged LED=Red : AC Connected/ In charging	
<b>Charging Supervision and Protection Mechanism</b>			
3	Over Voltage Protection	Yes (cut off at 16.8 V)	
	Output Reverse Protection	Yes	
	CCCV	Yes	
<b>Environment</b>			
4	Operation Temperature	-10 ~+40 F	
	Operation Humidity	< 90%	
<b>Mechanical</b>			
5	Dimensions	154mm(6.0") x 95mm(3.7") x 55mm(2.2")	
	US AC cable	1 Pcs	
	Weight	33.2 Oz (425g)	
	Output cable	4-Pin Female Cannon Plug --- For CH-L1486 154mm(6.0") x95mm(3.7")x55mm(2.2") Andersen Connector --- For PR-CU-R218	
	Connector/Adaptor	Connector/Adaptor: From 4 Pin male Cannon plug to Clips --- For CH-L1486 Only	



| **Charge Instruction** | | | |
| 1. Make sure your AC supply source is 100-240V and your battery pack match with the battery requirement. 2. Connect the charger to the AC outlet. LED=Green: it means power on or no battery connected. 3. Connect DC output to battery pack terminals. LED turn into red. It means in charging. 4. When LED turns Green, the battery pack is fully charged. You can charge next battery pack or switch off the power. | | | |

# Anexo 39: Hoja técnica de los sensores de contacto de la caja del cargador

OMRON

## Miniature Basic Switch D3V

### Reliable Basic Switch with External Lever

- Available by 0.1 A, 6 A, 11 A, 16 A and 21 A models, all with self-cleaning contacts. 0.1 A utilizes gold alloy crossbar contacts for high reliability at low loads.
- Available with internally or externally fitted levers, and 2 fixing positions for external levers.
- Conforms to EN61058-1 UL1054.
- High Temperature models rated up to 200°C (D3V-6, D3V-01) and 155°C (D3V-11) are available.
- RoHS Compliant.



## Specifications

### ■ Ratings

Type	Rated voltage	Non-inductive load				Inductive load			
		Resistive load		Lamp load		Inductive load		Motor load	
		NC	NO	NC	NO	NC	NO	NC	NO
D3V-21	250 VAC	21 A		3 A		12 A		4 A	
	8 VDC	21 A		5 A		12 A		7 A	
	30 VDC	14 A		5 A		12 A		5 A	
	125 VDC	0.6 A		0.1 A		0.6 A		0.1 A	
	250 VDC	0.3 A		0.05 A		0.3 A		0.05 A	
D3V-16	250 VAC	16 A		2 A		10 A		3 A	
	8 VDC	16 A		4 A		10 A		6 A	
	30 VDC	10 A		4 A		10 A		4 A	
	125 VDC	0.6 A		0.1 A		0.6 A		0.1 A	
	250 VDC	0.3 A		0.05 A		0.3 A		0.05 A	
D3V-11	250 VAC	11 A		1.5 A		6 A		2 A	
	8 VDC	11 A		3 A		6 A		3 A	
	30 VDC	6 A		3 A		6 A		3 A	
	125 VDC	0.6 A		0.1 A		0.6 A		0.1 A	
	250 VDC	0.3 A		0.05 A		0.3 A		0.05 A	
D3V-6	250 VAC	6 A		3 A		4 A		---	
	8 VDC	6 A		3 A		4 A		---	
	30 VDC	6 A		3 A		4 A		---	
	125 VDC	0.4 A		0.1 A		0.4 A		---	
	250 VDC	0.3 A		0.05 A		0.2 A		---	
D3V-01	125 VAC	0.1 A		---		---		---	
	8 VDC	0.1 A		---		---		---	
	30 VDC	0.1 A		---		---		---	

- Note:**
1. The above current values are the normal current values of models with a contact gap of 1 mm (gap F), which vary with the normal current values of models with a contact gap of 0.5 mm (gap G).
  2. Inductive load has a power factor of 0.4 min. (AC) and a time constant of 7 ms max. (DC).
  3. Lamp load has an inrush current of 10 times the steady-state current.
  4. Motor load has an inrush current of 6 times the steady-state current.
  5. The ratings values apply under the following test conditions: Ambient temperature: 20±2°C, Ambient humidity: 65±5%, Operating frequency: 30 operations/min



## ■ Characteristics

<b>Operating speed</b>	0.1 mm to 1 m/s (plunger models)
<b>Operating frequency</b>	Mechanical: 600 operations/min Electrical: 60 operations/min
<b>Insulation resistance</b>	100 MΩ min. (at 500 VDC)
<b>Contact resistance</b>	D3V-21: 50 mΩ max. D3V-16, D3V-11, D3V-6: 30 mΩ max. D3V-01, 50 gf versions: 50 mΩ max. 25 gf versions: 100 mΩ max.
<b>Dielectric strength (see note 2)</b>	1,000 VAC, 50/60 Hz for 1 min between terminals of the same polarity 2,000 VAC, 50/60 Hz for 1 min between current-carrying metal parts and ground, and between each terminal and non-current-carrying metal parts
<b>Vibration resistance (see note 3)</b>	Malfunction: 10 to 55 Hz, 1.5-mm double amplitude
<b>Shock resistance (see note 3)</b>	Destruction: 400 m/s <sup>2</sup> (approx. 40G) max. Malfunction: 100 m/s <sup>2</sup> (approx. 10G) max.
<b>Life expectancy</b>	Mechanical: 10,000,000 operations min. Electrical: D3V-21: 50,000 operations min. D3V-16: 100,000 operations min. D3V-11: 200,000 operations min. D3V-6, D3V-01: 500,000 operations min.
<b>Degree of protection</b>	IEC IP40
<b>Degree of protection against electric shock</b>	Class I
<b>Proof tracking index (PTI)</b>	250 (High Temperature type with suffix "-T": 175)
<b>Ambient operating temperature</b>	D3V-21: -25°C to 85°C with no icing D3V-16: -25°C to 105°C (High Temperature type "H": -25°C to 125°C) with no icing D3V-11: -25°C to 105°C (High Temperature types "H": -25°C to 125°C, "T": -25°C to 155°C) with no icing D3V-6: -25°C to 105°C (High Temperature types "H": -25°C to 125°C, "T": -25°C to 200°C) with no icing D3V-01: -25°C to 85°C (High Temperature type "T": -25°C to 200°C) with no icing
<b>Ambient operating humidity</b>	85% max. (for 5°C to 35°C)
<b>Weight</b>	Approx. 6.2 g (plunger models)

**Note:** 1. Data shown are of initial value.

2. The dielectric strength values shown in the table are for models with a Separator.

3. For plunger models, the above values apply for use at both the free position and total travel position. For lever models, they apply at the total travel position.

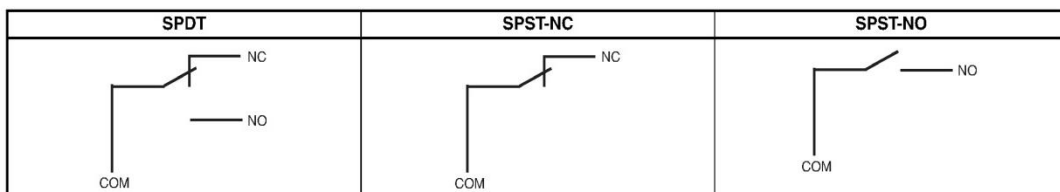
4. For testing conditions, contact your OMRON sales representative.

## ■ Contact Specifications

Item		D3V-21	D3V-16	D3V-11	D3V-6	D3V-01
Contact	Specification	Rivet				Crossbar
	Material	Silver alloy				Gold alloy
	Gap (standard value)	0.5 mm	1 mm (F gap type) or 0.5 mm (G gap type)			1.0 mm
Inrush current	NC	50 A max.	40 A max.	24 A max.	15 A max.	---
	NO					
Minimum applicable load		160 mA at 5 VDC				1 mA at 5 VDC

**Note:** Minimum applicable loads are indicated by N standard reference values. This value represents the failure rate at a 60% ( $\lambda_{60}$ ) reliability level (JIS C5003). The equation  $\lambda_{60}=0.5 \times 10^{-6}$  / operations indicates that a failure rate of 1/2,000,000 operations can be expected at a reliability level of 60%

## ■ Contact Form



# Anexo 40: Hoja técnica del integrado usado para la detección de batería baja



TPS3700

www.ti.com

SBVS187C—FEBRUARY 2012—REVISED MAY 2013

## Window Comparator for Over- and Undervoltage Detection

Check for Samples: [TPS3700](#)

### FEATURES

- Wide Supply Voltage Range: 1.8 V to 18 V
- Adjustable Threshold: Down to 400 mV
- Open-Drain Outputs for Over- and Undervoltage Detection
- Low Quiescent Current: 5.5  $\mu\text{A}$  (typ)
- High Threshold Accuracy:
  - 1.0% Over Temperature
  - 0.25% (typ)
- Internal Hysteresis: 5.5 mV (typ)
- Temperature Range:  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$
- Packages:
  - ThinSOT23-6
  - 1,5-mm  $\times$  1,5-mm SON-6

### APPLICATIONS

- Industrial Control Systems
- Automotive Systems
- Embedded Computing Modules
- DSP, Microcontroller, or Microprocessor Applications
- Notebook and Desktop Computers
- Portable- and Battery-Powered Products
- FPGA and ASIC Applications

### DESCRIPTION

The TPS3700 wide-supply voltage window comparator operates over a 1.8-V to 18-V range. The device has two high-accuracy comparators with an internal 400-mV reference and two open-drain outputs rated to 18 V for over- and undervoltage detection. The TPS3700 can be used as a window comparator or as two independent voltage monitors; the monitored voltage can be set with the use of external resistors.

OUTA is driven low when the voltage at INA+ drops below  $(V_{ITP} - V_{HYS})$ , and goes high when the voltage returns above the respective threshold  $(V_{ITP})$ . OUTB is driven low when the voltage at INB- rises above  $V_{ITP}$ , and goes high when the voltage drops below the respective threshold  $(V_{ITP} - V_{HYS})$ . Both comparators in the TPS3700 include built-in hysteresis for filtering to reject brief glitches, thereby ensuring stable output operation without false triggering.

The TPS3700 is available in a ThinSOT23-6 and a 1,5-mm  $\times$  1,5-mm SON-6 package and is specified over the junction temperature range of  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ .

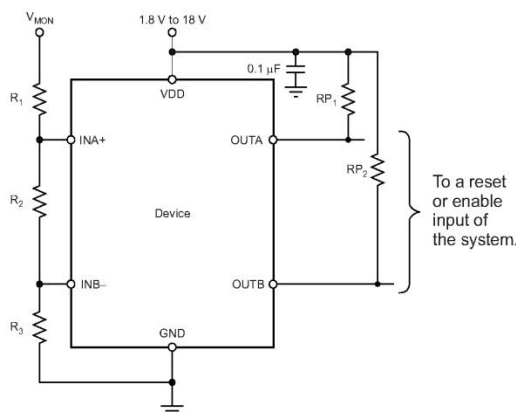
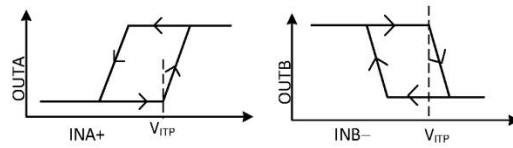
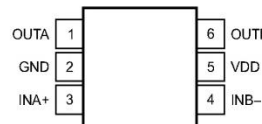


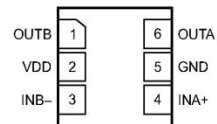
Figure 1. TPS3700 Typical Application




DDC PACKAGE  
ThinSOT23-6  
(TOP VIEW)



DSE PACKAGE  
SON-6  
(TOP VIEW)



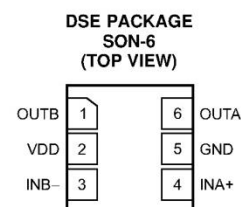
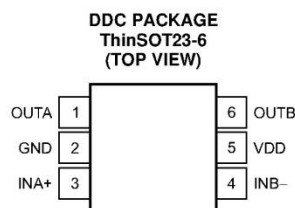
 Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet. All trademarks are the property of their respective owners.

### ELECTRICAL CHARACTERISTICS

Over the operating temperature range of  $T_J = -40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ , and  $1.8\text{ V} < V_{DD} < 18\text{ V}$ , unless otherwise noted. Typical values are at  $T_J = +25^{\circ}\text{C}$  and  $V_{DD} = 5\text{ V}$ .

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_{DD}$ Supply voltage range		1.8		18	V
$V_{(POR)}$ Power-on reset voltage <sup>(1)</sup>	$V_{OL}(\text{max}) = 0.2\text{ V}$ , $I_{(OUT)} = 15\ \mu\text{A}$			0.8	V
$V_{ITP}$ Positive-going input threshold voltage	$V_{DD} = 1.8\text{ V}$	396	400	404	mV
	$V_{DD} = 18\text{ V}$	396	400	404	mV
$V_{ITN}$ Negative-going input threshold voltage	$V_{DD} = 1.8\text{ V}$	387	394.5	400	mV
	$V_{DD} = 18\text{ V}$	387	394.5	400	mV
$V_{HYS}$ Hysteresis voltage ( $HYS = V_{ITP} - V_{ITN}$ )			5.5	12	mV
$I_{IN}$ Input current (at IN pin)	$V_{DD} = 1.8\text{ V}$ and $18\text{ V}$ , $V_{IN} = 6.5\text{ V}$	-25	1	25	nA
	$V_{DD} = 1.8\text{ V}$ and $18\text{ V}$ , $V_{IN} = 0.1\text{ V}$	-15	1	15	nA
$V_{OL}$ Low-level output voltage	$V_{DD} = 1.3\text{ V}$ , $I_{OUT} = 0.4\text{ mA}$			250	mV
	$V_{DD} = 1.8\text{ V}$ , $I_{OUT} = 3\text{ mA}$			250	mV
	$V_{DD} = 5\text{ V}$ , $I_{OUT} = 5\text{ mA}$			250	mV
$I_{kg(OD)}$ Open-drain output leakage current	$V_{DD} = 1.8\text{ V}$ and $18\text{ V}$ , $V_{OUT} = V_{DD}$			300	nA
	$V_{DD} = 1.8\text{ V}$ , $V_{OUT} = 18\text{ V}$			300	nA
$t_{pd(HL)}$ High-to-low propagation delay <sup>(2)</sup>	$V_{DD} = 5\text{ V}$ , 10-mV input overdrive, $R_L = 10\text{ k}\Omega$ , $V_{OH} = 0.9 \times V_{DD}$ , $V_{OL} = 400\text{ mV}$		18		$\mu\text{s}$
$t_{pd(LH)}$ Low-to-high propagation delay <sup>(2)</sup>	$V_{DD} = 5\text{ V}$ , 10-mV input overdrive, $R_L = 10\text{ k}\Omega$ , $V_{OH} = 0.9 \times V_{DD}$ , $V_{OL} = 400\text{ mV}$		29		$\mu\text{s}$
$t_R$ Output rise time	$V_{DD} = 5\text{ V}$ , 10-mV input overdrive, $R_L = 10\text{ k}\Omega$ , $V_O = (0.1\text{ to }0.9) \times V_{DD}$		2.2		$\mu\text{s}$
$t_F$ Output fall time	$V_{DD} = 5\text{ V}$ , 10-mV input overdrive, $R_L = 10\text{ k}\Omega$ , $V_O = (0.1\text{ to }0.9) \times V_{DD}$		0.22		$\mu\text{s}$
$I_{DD}$ Supply current	$V_{DD} = 1.8\text{ V}$ , no load		5.5	11	$\mu\text{A}$
	$V_{DD} = 5\text{ V}$		6	13	$\mu\text{A}$
	$V_{DD} = 12\text{ V}$		6	13	$\mu\text{A}$
	$V_{DD} = 18\text{ V}$		7	13	$\mu\text{A}$
Startup delay <sup>(3)</sup>			150		$\mu\text{s}$
UVLO Undervoltage lockout <sup>(4)</sup>	$V_{DD}$ falling	1.3		1.7	V

### PIN CONFIGURATIONS



### PIN ASSIGNMENTS

PIN NAME	PIN NO.		DESCRIPTION
	DDC	DSE	
GND	2	5	Ground
INA+	3	4	This pin is connected to the voltage to be monitored with the use of an external resistor divider. When the voltage at this terminal drops below the threshold voltage ( $V_{ITP} - V_{HYS}$ ), OUTA is driven low.
INB-	4	3	This pin is connected to the voltage to be monitored with the use of an external resistor divider. When the voltage at this terminal exceeds the threshold voltage ( $V_{ITP}$ ), OUTB is driven low.
OUTA	1	6	INA+ comparator open-drain output. OUTA is driven low when the voltage at this comparator is below ( $V_{ITP} - V_{HYS}$ ). The output goes high when the sense voltage returns above the respective threshold ( $V_{ITP}$ ).
OUTB	6	1	INB- comparator open-drain output. OUTB is driven low when the voltage at this comparator exceeds $V_{ITP}$ . The output goes high when the sense voltage returns below the respective threshold ( $V_{ITP} - V_{HYS}$ ).
VDD	5	2	Supply voltage input. Connect a 1.8-V to 18-V supply to VDD to power the device. It is good analog design practice to place a 0.1- $\mu\text{F}$ ceramic capacitor close to this pin.

## Anexo 41: Cálculo de las resistencias usadas en el circuito detector de batería baja

TPS3700



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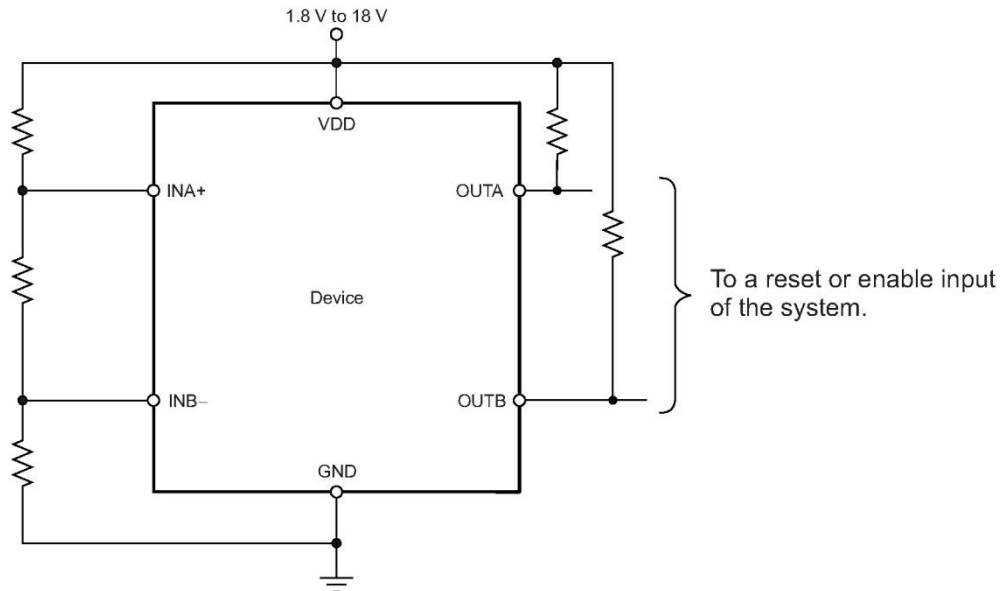


Figure 20. Monitoring the Same Voltage as  $V_{DD}$

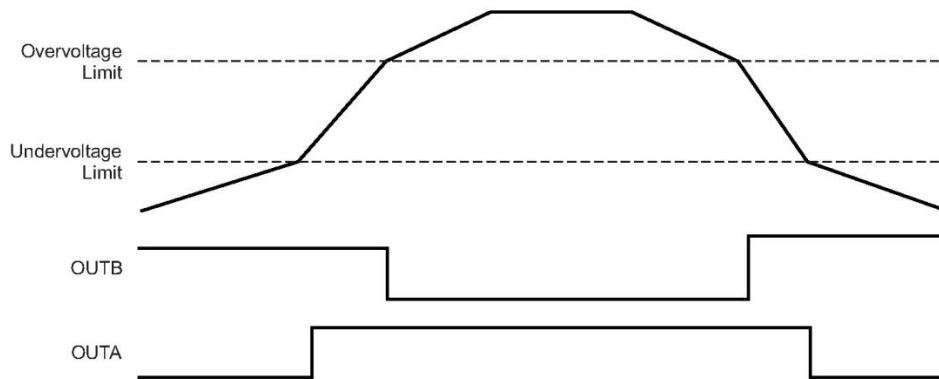


Figure 18. Window Comparator Timing Diagram



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The resistor divider values and target threshold voltage can be calculated by using [Equation 1](#) through [Equation 4](#):

$$R_{\text{TOTAL}} = R_1 + R_2 + R_3 \quad (1)$$

Choose  $R_{\text{TOTAL}}$  such that current through the divider is approximately 100x higher than the input current at the INA+ and INB– pins. The resistors can have high values to minimize current consumption as a result of low input bias current without adding significant error to the resistive divider. Refer to application note [Optimizing Resistor Dividers at a Comparator Input \(SLVA450\)](#) for details on sizing input resistors.

$R_3$  is determined by [Equation 2](#):

$$R_3 = \frac{R_{\text{TOTAL}}}{V_{\text{MON(OV)}}} \times V_{\text{ITP}}$$

where:

$V_{\text{MON(OV)}}$  is the target voltage at which an overvoltage condition is detected (2)

$R_2$  is determined by either [Equation 3](#) or [Equation 4](#):

$$R_2 = \left[ \frac{R_{\text{TOTAL}}}{V_{\text{MON(no UV)}}} \times V_{\text{ITP}} \right] - R_3$$

where:

$V_{\text{MON(no UV)}}$  is the target voltage at which an undervoltage condition is removed as  $V_{\text{MON}}$  rises (3)

$$R_2 = \left[ \frac{R_{\text{TOTAL}}}{V_{\text{MON(UV)}}} \times (V_{\text{ITP}} - V_{\text{HYS}}) \right] - R_3$$

where:

$V_{\text{MON(UV)}}$  is the target voltage at which an undervoltage condition is detected (4)

**FALTA REALIZAR LOS CALCULOS PARA LAS RESISTENCIAS**

# Anexo 42: Hoja técnica del convertidor Buck (reductor) de voltaje



## CLL Series Mid Power DC-DC Converter

Datasheet

### Non-isolated DC-DC Converter

Compact Size, Full-load Efficiency > 90%

Die Cast Housing & Epoxy Resin Sealing, Waterproof

Low Cost & Long Life Circuit Design

Customize Solution Available

CLL is a low cost series designed for common usage in low voltage range (3~56VDC). It is a cost effective solution for pumps, LED lights, small motor etc.

Small case (66x59x24 mm)

Big case (74x72x28 mm)

Customize solution available with CLL Series:  
input and output voltage between 5VDC ~ 56VDC  
Output power < 200W



Small Case



Big Case



### Input Characteristic

Default Input Voltage Range\* :

Step-up Converter:

12V = 10~15VDC

24V = 20~30VDC

Step-down Converter:

12V = 10~30VDC

24V = 18~36VDC

36V = 30~44VDC

48V = 40~56VDC

Input Reverse Protection: NOT implemented by default

### Output Characteristic

Full-load Efficiency: 90~94%\*\*\*  
Ripple p-p: 1%of output voltage (MAX)  
Load Regulation: 1.5%  
Max Non-load Consumption: 0.5%of full-load power  
Over-load Protection: +10%of rated output current  
Short-circuit Protection: yes

### Other info

Allowed Case Temperature: -10°C ~ 75°C  
Storage Temperature: -20°C ~ 80°C  
Storage Humidity: 20~90%  
Weight:  
Small Case: 170~190g  
Big Case: 240~280g

\* Input range can be customized, the range listed is for standard types. Input range is not always the same for different models

\*\* Can implement in customize products

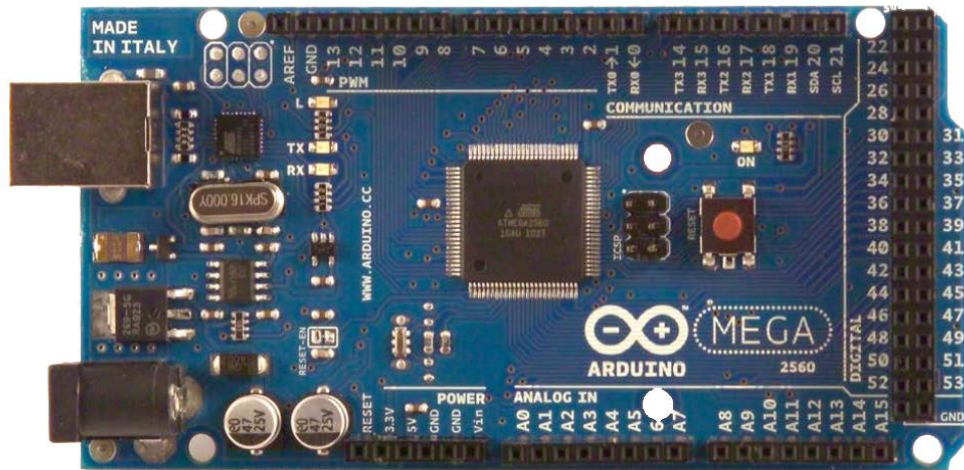
\*\*\* Not every model can achieve 94% efficiency.

[www.current-logic.com](http://www.current-logic.com)

Contact: [sales@current-logic.com](mailto:sales@current-logic.com)

## Anexo 43: Hoja técnica del controlador Arduino Mega 2560

### Arduino MEGA 2560



#### Product Overview

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560 ([datasheet](#)). It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Mega is compatible with most shields designed for the Arduino Duemilanove or Diecimila.

#### Index

<b>Technical Specifications</b>	Page 2
<b>How to use Arduino</b> Programming Enviroment, Basic Tutorials	Page 6
<b>Terms &amp; Conditions</b>	Page 7
<b>Enviromental Policies</b> half sqm of green via Impatto Zero®	Page 7

# Technical Specification

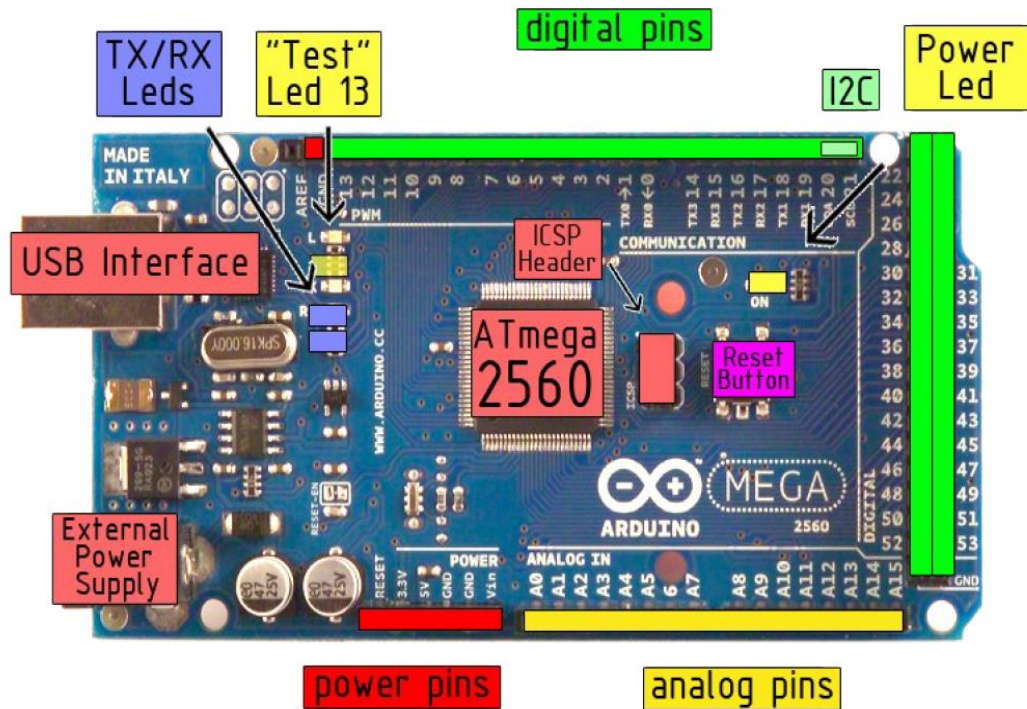


EAGLE files: [arduino-mega2560-reference-design.zip](#) Schematic: [arduino-mega2560-schematic.pdf](#)

## Summary

Microcontroller	ATmega2560
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	54 (of which 14 provide PWM output)
Analog Input Pins	16
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	256 KB of which 8 KB used by bootloader
SRAM	8 KB
EEPROM	4 KB
Clock Speed	16 MHz

## the board



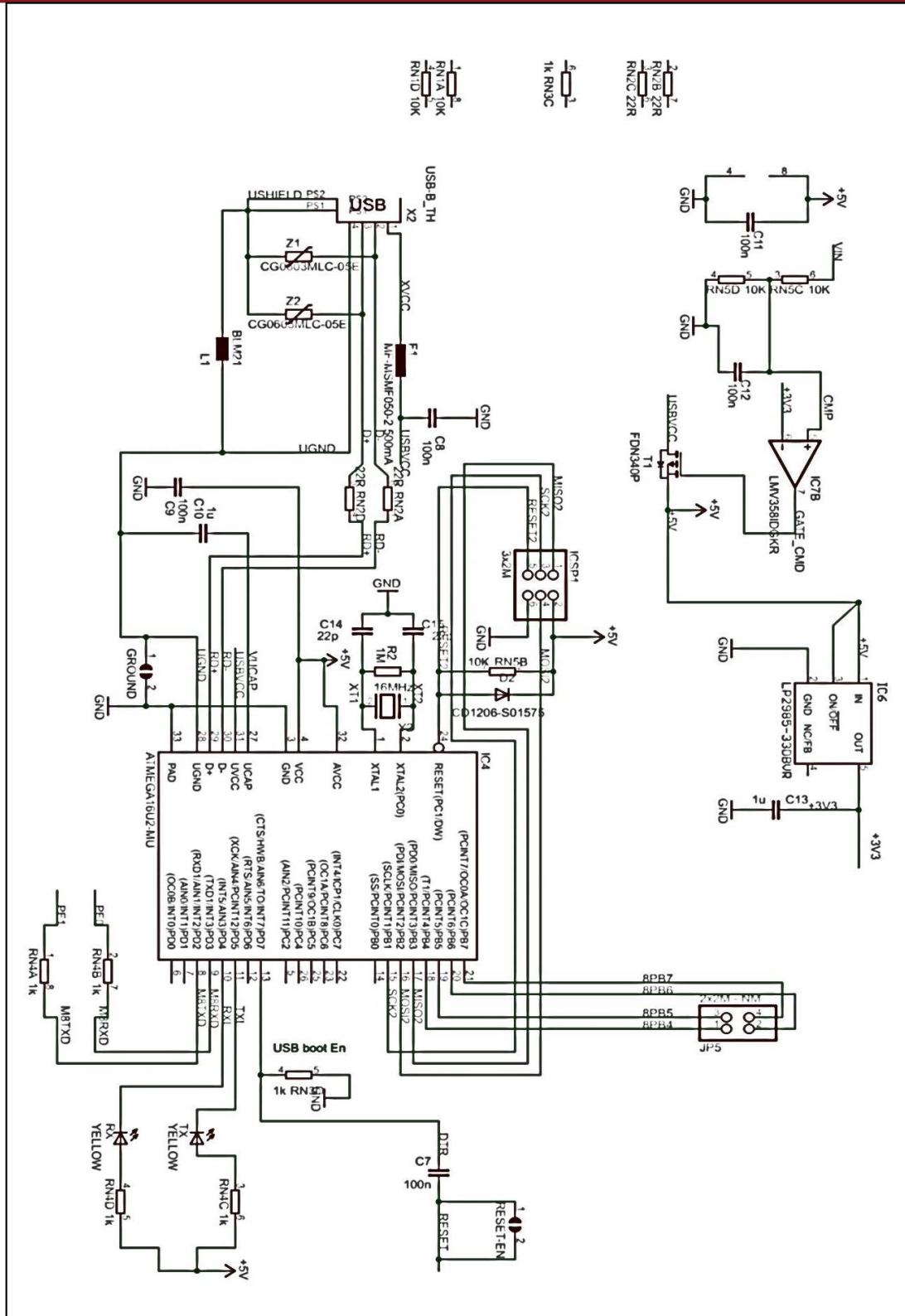
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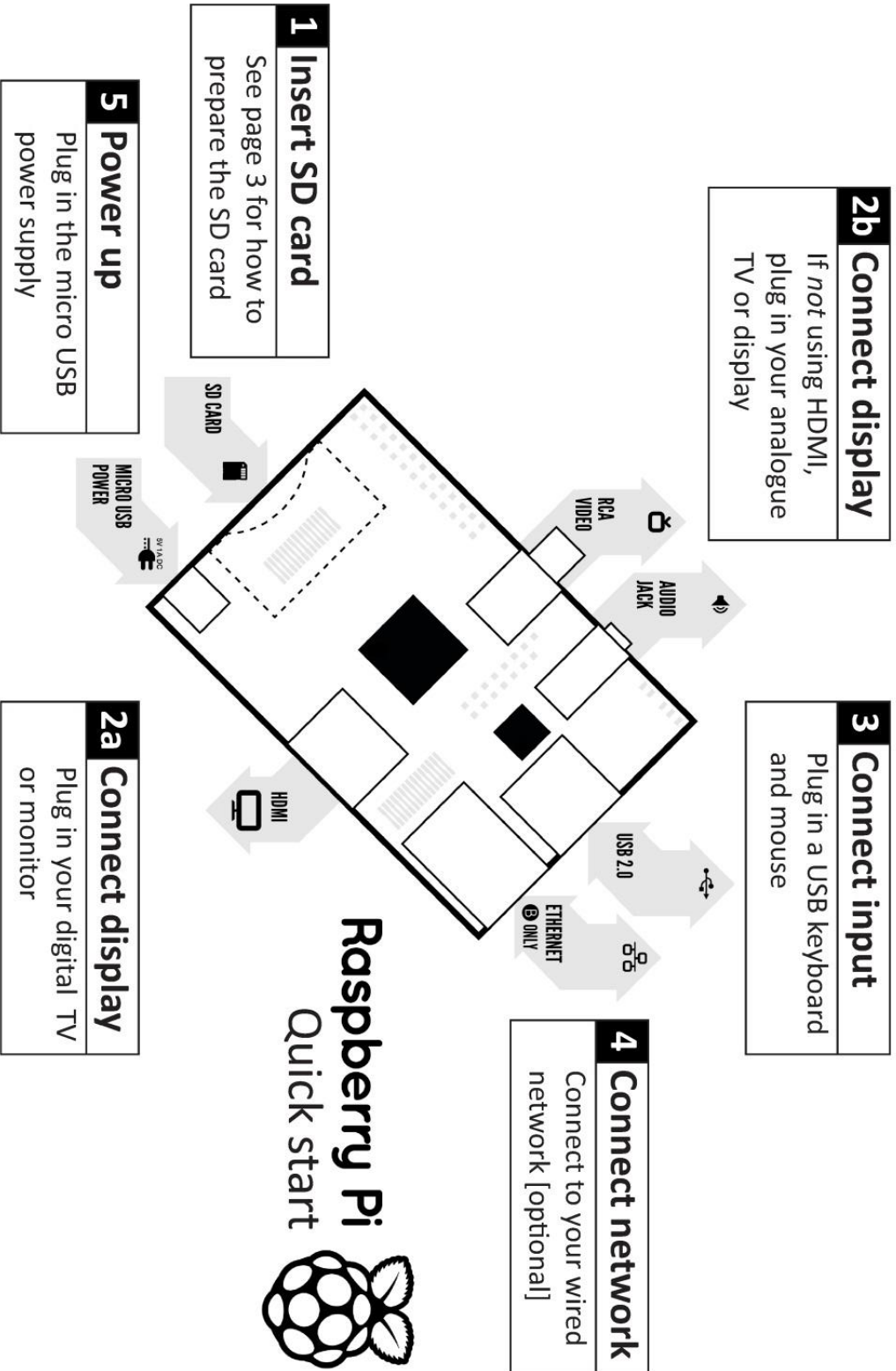
Esquemático del controlador Arduino Mega 2560. Extraído de: [http://arduino.cc/en/uploads/Main/arduino-mega2560\\_R3-sch.pdf](http://arduino.cc/en/uploads/Main/arduino-mega2560_R3-sch.pdf)

## Anexo 44: Validación de la selección del controlador Arduino Mega 2560

DEL ARDUINO DESDE/HACIA:	SALIDAS			ENTRADAS		
Sensores ultrasónicos					8	Digital
Sensores infrarrojos					6	Digital
Sensor de localización StarGazer	Rx/Tx	1	Tx	Rx/Tx	1	Rx
Módulo EasyVR					6	Digital
Raspberry Pi					5	Digital
Módulo de reproducción de audio	CLK	1	Digital			
	Data	1	Digital			
	Reset	1	Digital			
Controlador de los motores de la base	DigN1	2	Digital			
	DigN2	2	Digital			
	Enable	2	Digital			
	Direction	2	Digital			
	Brake	2	Digital			
					Monitor	2

Se requiere en total 42 entradas/salidas digitales, una entrada de recepción de dato RX y una salida de transmisión de datos TX. El controlador Arduino Mega 2560 posee 54 entradas/salidas digitales por lo que cumple con los requerimientos.

## Anexo 45: Manual de usuario de la placa reducida Raspberry Pi



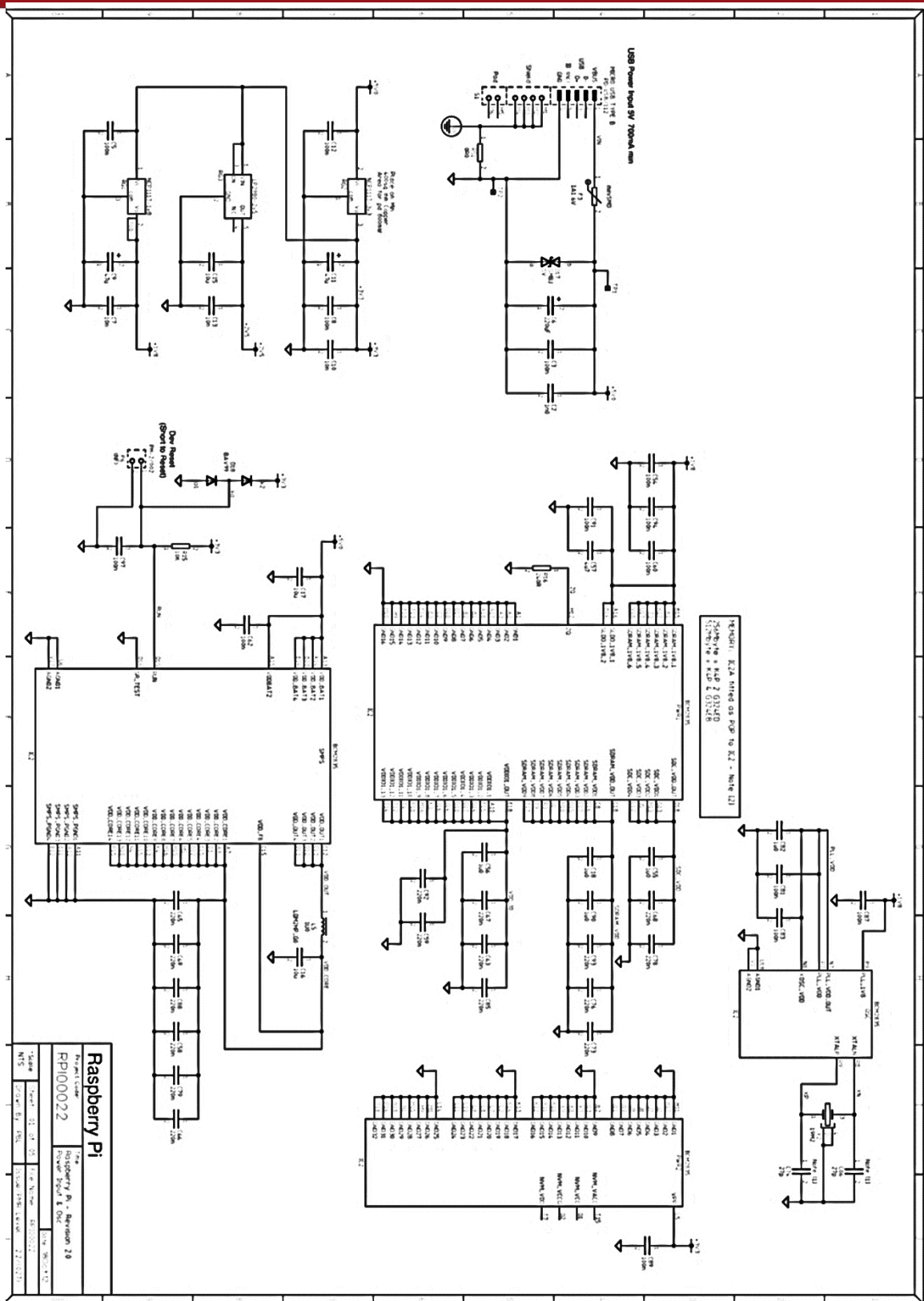
## Two models:

The Raspberry Pi is available in two models, Model A and Model B, which cost respectively 20 and 28 euro. The main difference between the two is that model B has an onboard rj45 Ethernet connector, 256MiB instead of the 128MiB which comes with model A. For other differences, see the specification-table below.

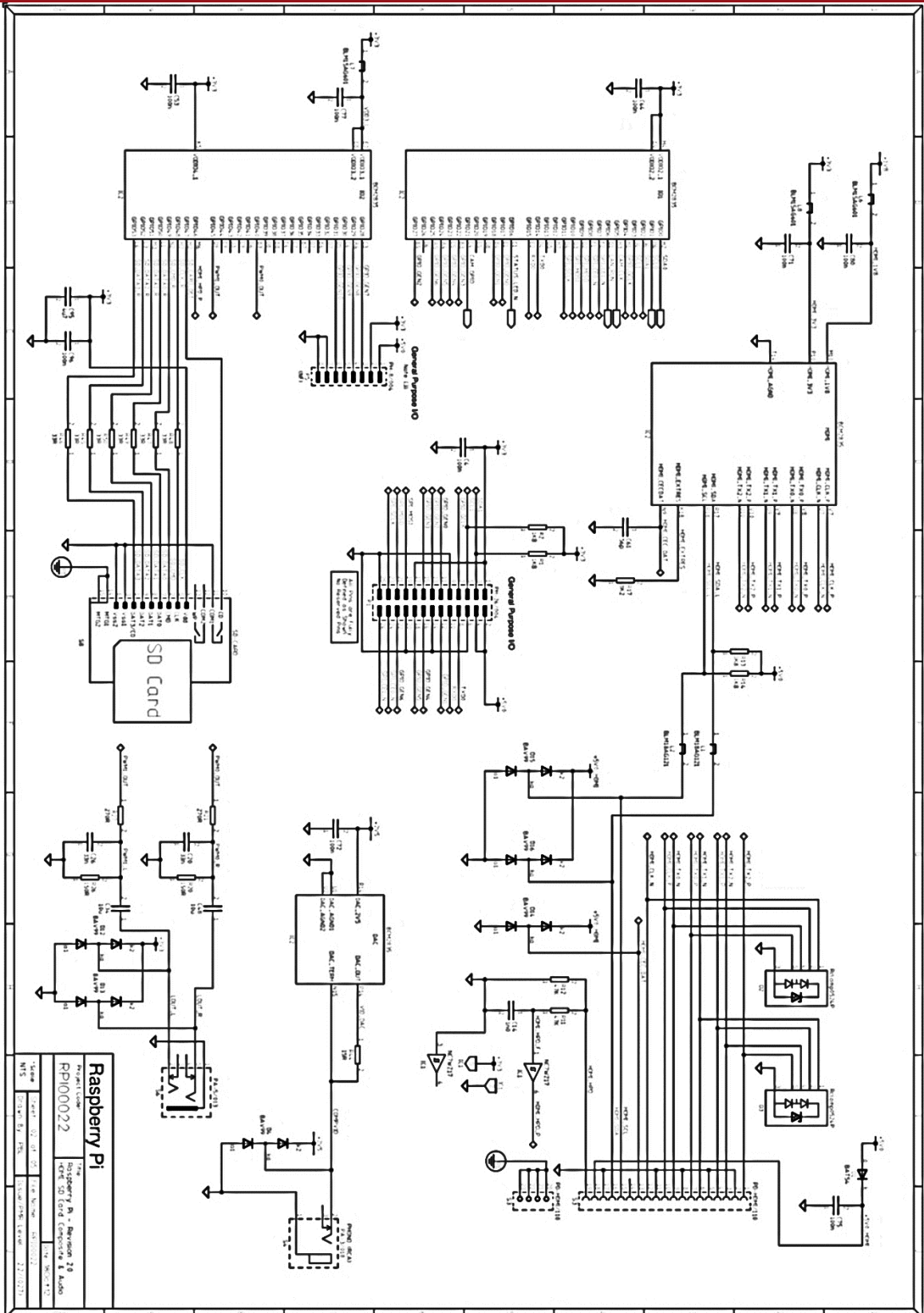
	Model A	Model B
Target Price	20,00 €	28,00 €
SoC	Broadcom BCM2835 (CPU + GPU + DSP + SDRAM)	
CPU	700 Mhz ARM1176JZF-S core	
GPU	VideoCore IV, OpenGL ES 2,0, 1080p30 Full HD HP H.264	
Memory	128 MiB SDRAM	256 MiB SDRAM
USB 2.0 ports	1	2 (via integrated USB hub)
Video outputs	Composite RCA, HDMI	
Audio outputs	3.5 mm jack, HDMI	
Onboard storage	SD / MMC / SDIO card slot	
Low-level peripherals	GPIO pins, SPI, I <sup>2</sup> C, UART	
Onboard network	none	10/100 wired Ethernet (RJ45)
Real-time clock	No clock or battery	
Power ratings	500 mA (2.5 Watt)	700 mA (3.5 Watt)
Power source	5 Volt via MicroUSB or GPIO header	
Size	85.60mm x 53.98mm	
Supported OS'es	Debian GNU/Linux, Fedora, Arch Linux	

## To set up your Raspberry Pi you will need:

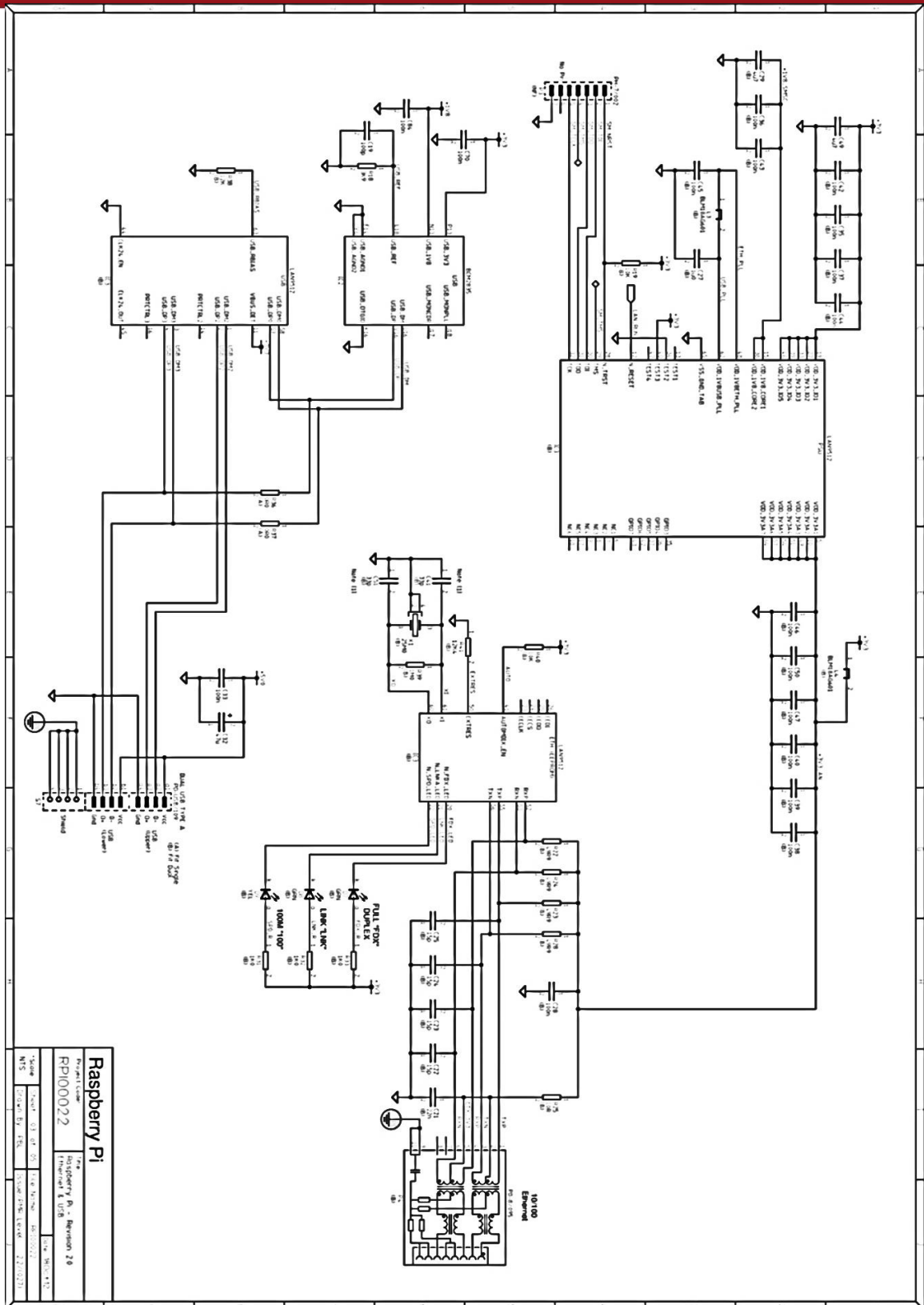
	Item	Minimum recommended specification & notes
1	SD card	<ul style="list-style-type: none"> <li>Minimum size 4Gb; class 4 (the <i>class</i> indicates how fast the card is).</li> <li>We recommend using branded SD cards as they are more reliable.</li> </ul>
2a	HDMI to HDMI / DVI lead	<ul style="list-style-type: none"> <li>HDMI to HDMI lead (for HD TVs and monitors with HDMI input).</li> <li><b>OR</b></li> <li>HDMI to DVI lead (for monitors with DVI input).</li> <li>Leads and adapters are available for few pounds -- there is no need to buy expensive ones!</li> </ul>
2b	RCA video lead	<ul style="list-style-type: none"> <li>A standard RCA composite video lead to connect to your analogue display if you are not using the HDMI output.</li> </ul>
3	Keyboard and mouse	<ul style="list-style-type: none"> <li>Any standard USB keyboard and mouse should work.</li> <li>Keyboards or mice that take a lot of power from the USB ports, however, may need a powered USB hub. This may include some wireless devices.</li> </ul>
4	Ethernet (network) cable [optional]	<ul style="list-style-type: none"> <li>Networking is optional, although it makes updating and getting new software for your Raspberry Pi much easier.</li> </ul>
5	Power adapter	<ul style="list-style-type: none"> <li>A good quality, micro USB power supply that can provide at least <b>700mA at 5V</b> is essential.</li> <li>Many mobile phone chargers are suitable—check the label on the plug.</li> <li>If your supply provides less than 5V then your Raspberry Pi may not work at all, or it may behave erratically. Be wary of very cheap chargers: some are not what they claim to be.</li> <li>It does not matter if your supply is rated at <i>more</i> than 700mA.</li> </ul>
6	Audio lead [optional]	<ul style="list-style-type: none"> <li>If you are using HDMI then you will get digital audio via this.</li> <li>If you are using the analogue RCA connection, stereo audio is available from the 3.5mm jack next to the RCA connector.</li> </ul>



Esquemático de la placa reducida Raspberry Pi Model B. Extraído de:  
<http://www.adafruit.com/datasheets/pi2schem.pdf>



Esquemático de la placa reducida Raspberry Pi Model B. Extraído de:  
<http://www.adafruit.com/datasheets/pi2schem.pdf>



Esquemático de la placa reducida Raspberry Pi Model B. Extraído de: <http://www.adafruit.com/datasheets/pi2schem.pdf>





## Anexo 46: Cálculo de potencia – Batería del robot

Elemento	Cantidad	Voltaje (V)	Corriente Min (A)	Corriente Max (A)	Potencia Min (W)	Potencia Max (W)
Sensor StarGazer	1	12	0.070		0.84	
Sensor ultrasónico	8	5	0.240		1.20	
Sensor infrarrojo	6	5	0.030		0.15	
Sensor PIR	1	5	0.010		0.05	
Circuito EasyVR	1	5	0.012	0.150	0.06	0.75
Circuito de reproducción de audio	1	5	0.050		0.25	
Matrices de Leds	6	5	0.720	1.650	3.60	8.25
Motor de la cabeza	1	12	0.070	0.410	0.84	4.92
Motor de la base	2	12	0.396	2.450	8.50	67.28
Placas controladoras	2	5	0.500		2.5	
<b>TOTAL</b>			1.163	4.920	19.064	88.26

La fuente del robot anfitrión es capaz de entregar 12V y una corriente máxima de 8A. Por tanto, se tiene que:

$$\begin{aligned}
 P_{fuente} &= V * I \\
 P_{fuente} &= 12 * 8 \\
 P_{fuente} &= 96 \text{ W}
 \end{aligned}$$

$$\begin{aligned}
 P_{robot} &= V * I \\
 P_{fuente} &= 88.26 \text{ W}
 \end{aligned}$$

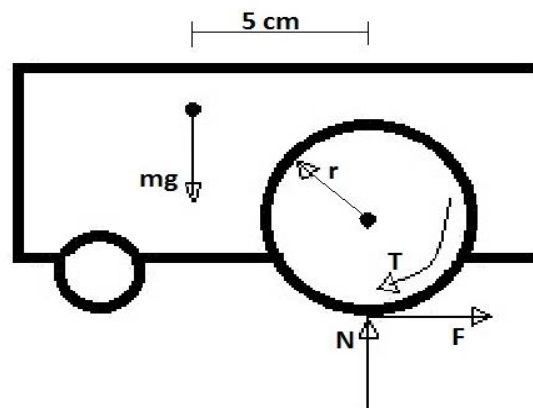
Por tanto, se observa que **la fuente es capaz de entregar la potencia necesaria al robot en el caso más crítico** de su funcionamiento (todos los dispositivos trabajando a la vez). Asimismo, el tiempo mínimo de duración de la batería estará determinado por el máximo consumo de corriente:

$$\begin{aligned}
 t_{descarga} &= \frac{\text{Carga eléctrica}}{\text{Consumo eléctrico}} \\
 t_{descarga} &= \frac{20 \text{ Ah}}{4.920 \text{ A}} = 4.06 \text{ horas}
 \end{aligned}$$

## Anexo 47: Cálculo de motores de la base

Antes de empezar con los cálculos, definamos los parámetros ya conocidos y deseados para el robot anfitrión:

- Peso total del robot: 35 Kg
- Coeficiente de fricción entre rueda y cerámica: 0.12
- Radio de las ruedas motrices: 3 pulg = 7.62 cm
- Número de ruedas: 2 motrices y 2 conducidas
- Velocidad deseada: 1.10 m/s



Los parámetros más importantes de un motor son la velocidad, el torque y la eficiencia. El torque se define como la fuerza que hay que hacer para mover un peso a una determinada distancia. Considerando un factor de seguridad (FS) igual a 3 para el cálculo del torque:

$$\text{Torque } (T) = FS * \text{Fuerza } (F) * \text{Distancia } (d)$$

$$T = FS * \left( \frac{m * g * \mu}{2} \right) * r = 2 * \left( \frac{35 * 9.81 * 0.12}{2} \right) * 0.0762$$

$$T = 1.495 \text{ N.m}$$

Las unidades del Torque (T) pueden ser Newtons por metro (N-m) u Onzas por pulgada (Oz-in). Por otro lado, si se desea que nuestro robot se mueva a 0,85 m/s (velocidad promedio de una persona caminando) [18], y conociendo que las ruedas tienen 7.62 cm de radio, entonces la velocidad angular del motor deberá ser:

$$\text{Velocidad } (V) = \text{Velocidad angular } (\omega) * \frac{2\pi}{60} * \text{Radio } (r)$$

$$\omega = \left( \frac{0.85}{2\pi * 0.0762} \right) * 60 = 106.52 \text{ RPM}$$

Dado que el torque necesario en cada motor es de 1.495 N.m, entonces escogemos un reductor planetario que pueda entregarnos este par (Anexo 22). Una vez escogido el reductor planetario, vamos a la figura 1 y escogemos el radio de reducción 246:1 que posee una eficiencia máxima de 0.60.

		Part Numbers				
		406757	406762	406764	406767	406128
■ Stock program □ Standard program ■ Special program (on request)						
Gearhead Data (provisional)						
2	Reduction absolute	57/11	3591/187	3249/121	1539/44	226233/3179
4	Number of stages	1	2	2	3	3
5	Max. continuous torque	Nm 0.75	2.25	2.25	2.25	4.5
6	Intermittently permissible torque at gear output	Nm 1.1	3.2	3.2	3.2	6.2
7	Max. efficiency	% 33	33	33	80	70
8	Weight	g 53	77	77	77	93
9	Average backlash no load	° 0.5	0.7	0.7	0.7	0.8
10	Mass inertia	gcm <sup>2</sup> 0.96	0.54	0.54	0.54	0.31
11	Gearhead length L1	mm 23.4	32.9	32.9	32.9	39.5
13	Max. transmittable continuous power	W 60	35	35	35	20
14	Max. transmittable intermittent power	W 90	50	50	50	30

Figura 1: Datos técnicos del reductor

Las rpm necesarias del motor se calculan multiplicando la velocidad requerida por el radio de reducción (35:1):

$$RPM\ Motor (\omega m) \geq RPM (\omega) * Reduccion$$

$$\omega m \geq 106.52 * 35 = 3728.24\ RPM$$

El torque necesario del motor puede calcularse dividiendo el torque requerido entre el producto del radio de reducción y la eficiencia del planetario:

$$Torque\ Motor (Tm) \geq \frac{Torque (T)}{Reduccion * Eficiencia}$$

$$Tm \geq \frac{1.495}{35 * 0.8} = 53.39\ mNm$$

Dado los requerimientos de torque y velocidad angular del motor, se eligió un motor que nos pueda entregar estos valores (Anexo 21). Según lo visto en la figura 2, el torque continuo máximo capaz de otorgar el motor es 63.3 mNm, el cual es mayor al requerido 53.39 mNm. Asimismo, la velocidad requerida (3628.24 rpm) es mucho menor a la velocidad nominal que otorga el motor (6590 rpm).

Luego, tenemos que encontrar la constante de torque y la constante de velocidad que se muestra en el datasheet para calcular la corriente necesaria para arrancar el motor. Dado que el voltaje de operación del motor es de 12V y que la constante de torque es 24.2 mNm/A, por tanto:

$$Im = \frac{53.39}{24.2} = 2.21\ A$$

La máxima corriente continua que soporta el motor es 4.72 A, la cual es mayor a la corriente que se requiere  $I_m$ .

		272762	272763	272764	272765
<b>Motor Data</b>					
<b>Values at nominal voltage</b>					
1	Nominal voltage	V → 12	24	36	48
2	No load speed	rpm 7980	9340	9490	9350
3	No load current	mA 302	191	130	95.4
4	Nominal speed	rpm → 6590	8040	8270	8130
5	Nominal torque (max. continuous torque)	mNm → 63.6	60.7	63.7	64.1
6	Nominal current (max. continuous current)	A → 4.72	2.66	1.88	1.4
7	Stall torque	mNm 381	458	522	519
8	Starting current	A 26.8	18.8	14.5	10.7
9	Max. efficiency	% → 80	81	82	82
<b>Characteristics</b>					
10	Terminal resistance phase to phase	Ω 0.447	1.27	2.48	4.49
11	Terminal inductance phase to phase	mH 0.049	0.143	0.312	0.573
12	Torque constant	mNm/A → 24.2	24.3	35.9	48.6
13	Speed constant	rpm/V 672	393	266	197
14	Speed/torque gradient	rpm/mNm 21.2	20.6	18.4	18.2
15	Mechanical time constant	ms 4.86	4.73	4.21	4.17
16	Rotor inertia	gcm <sup>2</sup> 21.9	21.9	21.9	21.9

**Figura 1: Datos técnicos del motor**

Finalmente, se valida que la potencia requerida por el motor es menor a la potencia suministrada:


$$Pr = T * w \leq Ps = Im * Vm$$

$$1.495 * 106.52 * \frac{2\pi}{60} \leq 2.21 * 12$$

$$16.68 W \leq 26.52 W$$





## Anexo 48: Proformas

### AA PORTABLE POWER CORP: Batería, cargador y conectores especiales



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Quality Controlled in USA*

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<input type="checkbox"/> Item	Price	Quantity	Total	
 <p><a href="#">Connector/Adaptor: Standard Male Tamiya Connector with 14 AWG Silicon Wires (8" long) --- RoHS Compliant</a> Part Number: CN-TMML</p>	\$1.50	<input type="text" value="1"/>	\$1.50	<input type="button" value="Update"/> <input type="button" value="X Remove"/>
 <p><a href="#">Connector/Adaptor: Trail-Tech Coaxis Female Lockable Connector with 4' Coil Cord</a> Part Number: CN-TTFML</p>	\$5.95	<input type="text" value="1"/>	\$5.95	<input type="button" value="Update"/> <input type="button" value="X Remove"/>
 <p><a href="#">Custom Polymer Li-Ion Box Battery: Regulated 12V 20Ah (296 Wh 8A rate) (24.0)</a> Part Number: CU-J369</p>	\$322.95	<input type="text" value="1"/>	\$322.95	<input type="button" value="Update"/> <input type="button" value="X Remove"/>
 <p><a href="#">Smart Charger (6.0A) for 14.8V Li-ion/Polymer Rechargeable Battery Pack --- CE listed</a> Part Number: PR-CU-R218 Terminals: Andersen Connector <a href="#">Edit this product</a></p>	\$79.95	<input type="text" value="1"/>	\$79.95	<input type="button" value="Update"/> <input type="button" value="X Remove"/>

Estimate Shipping & Tax

Zip/Postal Code:



FedEx Ground® (\$17.53)

Subtotal: \$410.35

Shipping & Handling: \$17.53

Estimated Tax: \$0.00







**Total: \$427.88**

## ADAFRUIT: Tarjetas y accesorios



### Your Shopping Cart Contents

Total Items: 7 Weight: 0.97lbs Amount: \$108.65

Qty.		Item Name	Unit	Total	
<input type="text" value="1"/> <a href="#">UPDATE CART</a>		Raspberry Pi Camera Board (PID: 1367)	\$29.95	\$29.95	<a href="#">DELETE</a>
<input type="text" value="1"/> <a href="#">UPDATE CART</a>		Adjustable Pi Camera Mount (PID: 1434)	\$4.95	\$4.95	<a href="#">DELETE</a>
<input type="text" value="1"/> <a href="#">UPDATE CART</a>		Raspberry Pi Model B 512MB RAM (PID: 998)	\$39.95	\$39.95	<a href="#">DELETE</a>
<input type="text" value="2"/> <a href="#">UPDATE CART</a>		SD/MicroSD Memory Card (4 GB SDHC) (PID: 102)	\$7.95	\$15.90	<a href="#">DELETE</a>
<input type="text" value="1"/> <a href="#">UPDATE CART</a>		Adafruit Pi Box - Enclosure for Raspberry Pi Model A or B (PID: 859)	\$14.95	\$14.95	<a href="#">DELETE</a>
<input type="text" value="1"/> <a href="#">UPDATE CART</a>		GPIO Ribbon Cable for Raspberry Pi (PID: 862)	\$2.95	\$2.95	<a href="#">DELETE</a>
				<b>Sub-Total: \$108.65</b>	



Order \$241.35 more to get a free Raspberry Pi.

[EMPTY CART](#) [UPDATE CART](#) [CONTINUE SHOPPING](#) [CHECKOUT](#)

### Estimate Shipping Costs

Total Items: 7 Weight: 0.97lbs Amount: \$108.65

Country:


State/Province:

Post/Zip Code:

[UPDATE](#)

#### Available Shipping Methods

Rates

	United Parcel Service (1 pkg x 0.97 lbs total) (UPS Worldwide Expedited (recommended))	\$32.99
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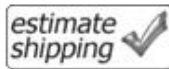
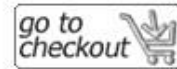
## CURRENT - LOGIC: Regulador de voltaje

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Please NOTE: Flat Rate Mail will take 2-3 weeks to deliver and **cannot track**. Please chose DHL if you need to track your parcel.

Total Items: 1 Weight: 0.16kg Amount: \$17.50

Qty.	Item Name	Unit	Total
1	 12V / 24V to 5V, Step-down, 10A, 50W	\$17.50	\$17.50
<b>Sub-Total: \$17.50</b>			



### Estimate Shipping Costs

Total Items: 1 Weight: 0.16kg Amount: \$17.50

Shipping quotes are based on the address information you selected:	
Available Shipping Methods	Rates
DHL Rates (3~5 Business days from China to CN (1 x 0.18kg))	\$27.78

## SUPERDROID ROBOTS: Neumáticos del robot



Robots | Electrical/Controls | Mechanical | Ph: 1-919-557-9162 | Toll Free: 866-SDRobot

### Shopping Cart

Item Name/Item #	Quantity	Price	Extended
Robot Drive Wheel - 6 inch Solid Core Tire TD-110-006	1	\$6.95	\$6.95



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Free domestic ground shipping for orders over 150.00 USD. You are 143.05 USD away from qualifying.

Sub Total: \$6.95  
Total Items: 1

### Domestic Shipping Estimator

\*\* Shipping rates to are based on items in your cart \*\*

Carrier Name	Shipping Charge
Use My Shipping Account	\$0.00
USPS Priority Mail Domestic	\$6.00






## MAXON MOTOR: Motor, reductor planetario y tarjeta controladora

### Carrito de la compra

Iniciar pedido

#### COMBINACIONES

##### 1. Combinación

Unidad motriz	Datos técnicos	Precio por unidad	Cantidad / duración de envío	Precio total
 <p><b>REDUCTOR</b> Reductor planetario GP 26 A Ø26 mm, 0.75–4.5 Nm</p> <p>N° de artículo:: 406767</p>	<p>Diámetro exterior: 26 mm Relación de reducción: 35 : 1 Máx. par en continuo: 2.25 Nm</p>	\$ 145.65	2	\$ 291.30
 <p><b>MOTOR</b> EC-max 30 Ø30 mm, Conmutación electrónica (Brushless), 60 Vatios, con sensores Hall</p> <p>N° de artículo:: 272762</p>	<p>Diámetro exterior: 30 mm Tipo de potencia: 60 W Tensión nominal: 12 V Velocidad en vacío: 7980 rpm Par nominal (máx. par en continuo): 63.6 mNm</p>	\$ 264.63	2	\$ 529.26
 <p><b>CONTROLADORA</b> DEC Module 50/5, Amplificador digital 1-Q-EC 50 V/5 A, control de velocidad</p>				

**Importe de carrito de la compra \$ 971.08**

Costes de embalaje \$ 5.00

Costes de envío previstos \$ 51.25

IVA (8%)

**Importe total \$ 1027.33**

**ROBOTSHOP: Motor de la cabeza, sensor Hagisonic, rueda giratorio y tarjetas electrónicas**





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Del	Product Name	Qty	Unit Price	Status	Subtotal
	 <a href="#">12V 103RPM 30:1 Gear Motor w / Encoder</a> Product Code : RB-Cyt-82	<input type="text" value="1"/>	x USD \$22.58	 In stock	USD \$22.58
	 <a href="#">Hagisonic StarGazer RS Robot Localization System (US)</a> Product Code : RB-Hag-06 <small>* This product is not available in the requested quantity. 1 of the items will be backordered.</small>	<input type="text" value="1"/>	x USD \$1,280.00	 In stock	USD \$1,280.00
	 <a href="#">Hagisonic StarGazer Landmark HLD1-S 3x3 Grid (1-2.9m Ceiling)</a> Product Code : RB-Hag-02 <small>* This product is not available in the requested quantity. 6 of the items will be backordered.</small>	<input type="text" value="6"/>	x USD \$1.65	 In stock	USD \$9.90
	 <a href="#">Arduino Mega 2560 Microcontroller Rev3</a> Product Code : RB-Ard-33	<input type="text" value="1"/>	x USD \$54.95	 In stock	USD \$54.95
	 <a href="#">1.5" Omni-Directional Caster Wheel w/ Brake</a> Product Code : RB-All-66	<input type="text" value="1"/>	x USD \$8.74	 In stock	USD \$8.74
	 <a href="#">Devantech SRF04 Ultrasonic Range Finder</a> Product Code : RB-Dev-01 <small>* This product is not available in the requested quantity. 8 of the items will be backordered.</small>	<input type="text" value="8"/>	x USD \$29.17	 In stock	USD \$233.36
	 <a href="#">EasyVR Speech Recognition Module</a> Product Code : RB-Tig-01 <small>* This product is not available in the requested quantity. 1 of the items will be backordered.</small>	<input type="text" value="1"/>	x USD \$49.95	 In stock	USD \$49.95
	 <a href="#">Cytron USB to UART Converter</a> Product Code : RB-Cyt-43	<input type="text" value="1"/>	x USD \$14.68	 In stock	USD \$14.68
	 <a href="#">4D Systems Embedded Audio-Sound Module</a> Product Code : RB-Fds-14	<input type="text" value="1"/>	x USD \$24.19	 In stock	USD \$24.19

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Enter your gift card code

[Check Gift Card balance](#)

Subtotal **USD \$1,698.35**  
 Shipping & Handling (Canada Post - Parcel Surface) **USD \$48.47**  
 Grand Total Excl. Tax **USD \$1,746.82**  
**Grand Total USD \$1,746.82**

Check out with  **PayPal**  
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## POLOLU: Acoples y bastones separadores

Product	Quantity	Back Order	Price	Total Price
#1999 Pololu Universal Aluminum Mounting Hub for 6mm Shaft, M3 Holes (2-Pack)	<input type="text" value="1"/>	1	\$7.95	\$7.95
#1942 Aluminum Standoff: 1/2" Length, 2-56 Thread, M-F (4-Pack)	<input type="text" value="5"/>	0	\$1.29	\$6.45
#1941 Aluminum Standoff: 3/8" Length, 2-56 Thread, M-F (4-Pack)	<input type="text" value="1"/>	0	\$1.29	\$1.29
#1132 Pololu Carrier with Sharp GP2Y0D805Z0F Digital Distance Sensor 5cm	<input type="text" value="6"/>	0	\$6.95	\$41.70
#1944 Aluminum Standoff: 1" Length, 2-56 Thread, M-F (4-Pack)	<input type="text" value="1"/>	0	\$1.59	\$1.59
#1261 30mm Speaker: 100 Ohm, 0.15 W	<input type="text" value="1"/>	0	\$1.99	\$1.99
<b>Subtotal</b>				<b>\$60.97</b>

**Shipping Estimate**

For shipping the 15 items in your cart to a Peru address, postal code 051:

Shipping service	Price (USD)
USPS First Class Mail International (airmail)	17.95
FedEx International Priority	26.95
FedEx International Economy	34.95
USPS Priority Mail International	41.95
USPS Express Mail International (EMS)	50.95

Update your shipping information for a new estimate:

Country    
 Zip/Postal code

## SPARKFUN: Matrices de LEDs y tarjetas electrónicas

Product	Quantity	Subtotal
<p>COM-00682 LED Matrix - Dual Color - Medium RoHS ✓</p>	<input type="text" value="6"/> <span>update</span> <span>remove</span> in stock / Move to Wish List	\$41.70 (\$6.95 ea.)
<p>COM-00759 LED Matrix - Serial Interface - Red/Green</p>	<input type="text" value="6"/> <span>update</span> <span>remove</span> in stock / Move to Wish List	\$209.70 (\$34.95 ea.)
<p>DEV-09815 Ardumoto - Motor Driver Shield RoHS ✓</p>	<input type="text" value="1"/> <span>update</span> <span>remove</span> in stock / Move to Wish List	\$24.95
<p>SEN-08630 PIR Motion Sensor RoHS ✓</p>	<input type="text" value="1"/> <span>update</span> <span>remove</span> in stock / Move to Wish List	\$9.95
<span>Calculate Shipping</span>		<b>Subtotal: \$ 285.40</b>
International Economy <b>FREE</b>		
Shipping to: Lima Lima, Lima 051		

## CUERPO DEL ROBOT ANFITRION:



### INDUSTRIAS SERVICIOS GENERALES E.I.R.L.

#### COTIZACION N° 652-13

Lima, 31 de Octubre del 2013

Señores  
**Pontificia Universidad Católica del Perú**  
 Av. Universitaria 1801, Lima

Atte.: **Sr. Kenji Azula**

Atendiendo a su solicitud de cotización tenemos el agrado de cotizarle lo siguiente:

1. **Suministro de carcasa hecha de fibra de vidrio** según las dimensiones del plano y especificaciones del cliente. El espesor de la carcasa será de 2mm.
2. **Acabado superficial fino:** Se pulirá y pintará la carcasa con latex de color plateado brillante.
3. Se agregarán soportes de aluminio en la parte inferior y en puntos críticos.

Item	Cantidad	Material
1	1	Fibra de vidrio

**VALOR DE VENTA TOTAL: \$ 150.00**

Tipo de cambio: 2.80

Tiempo de entrega: 3 días después de recibida la orden de compra.

Forma de pago: factura a 30 días.

Validez de la oferta: 15 días.

Sin otro particular nos despedimos de Ud.

Atentamente

-----  
 Ing. Víctor Huamán Ludeña  
 Titular – Gerente

PD: Para cualquier consulta comunicarse con el Sr. Carlos Champac. Teléfono: 451-2125  
 anexo 103, correo: [cch.produccion@insege.net](mailto:cch.produccion@insege.net)

Av. Materiales N° 2819 – Cercado Lima – Perú E-mail: [insege@infonegocio.net.pe](mailto:insege@infonegocio.net.pe)

Telefax: 451-4406 / 452-7016  
 Teléfono: 451-2125

## PIEZAS METÁLICAS - VARIAS:



PROYECTOS METALICOS Y ELECTRICOS S.A.C

**COTIZACION: 842-13**

Lima 10 de Noviembre del 2013

Señores:  
Pontificia Universidad Católica del Perú.  
Atte.: Kenji Azula

En esta oportunidad nos es grato saludarlos y a la vez presentarle nuestra cotización por lo siguiente:

**BASE METALICA:**

Fabricación de base metálica hecho de acero inoxidable (AISI 304) según planos de diseño. Acabado superficial medio. Perforaciones de todos los agujeros de la base metálica.

**PRECIO DE VENTA TOTAL: \$65.70**

**CUBIERTA METALICA:**

Fabricación de la cubierta inferior de la base (Material: acero inoxidable AISI 304) según planos de diseño. Acabado superficial medio. Perforaciones de todos los agujeros de la cubierta. Se pintará la cubierta con pintura acrílica de látex color plateado brillante.

**PRECIO DE VENTA TOTAL: \$65.70**

**CAJA METALICA:**

Fabricación de caja (Material: acero inoxidable AISI 304) según planos de diseño. Acabado superficial medio. Perforaciones de todos los agujeros de la cubierta. Se pintará la cubierta con pintura acrílica de látex color negro brillante.

**PRECIO DE VENTA TOTAL: \$62.50**

**SOPORTES VARIOS**

Fabricación de soportes (Material: acero inoxidable AISI 304) según planos de diseño. Incluye suministro de pernos y roscas necesarios para el montaje. Soportes sensores: 8 unidades. Soporte motores base: 2 unidades.

**PRECIO DE VENTA TOTAL: \$110.70**

**Validez de la oferta:** 15 días a partir de la fecha.  
**Plazo de entrega:** 05 días después de recibida su orden de compra.  
**Forma de pago:** 30 días entregada la factura.

Agradeciendo su atención y a la espera de sus gratas ordenes quedamos ante ustedes.

-----  
**Jorge Chapoñan S.**

Psje. Los Materiales N° 623 4to piso - Lima Telf. 719-8367 Nextel: 108\*7921 – 420\*1483 – 835\*9375  
Email: [proimelsac@proimelsac.com](mailto:proimelsac@proimelsac.com) Web: [www.proimelsac.com](http://www.proimelsac.com)