

Treball de Fi de Màster

Màster Universitari en Enginyeria Industrial

Disseny i implementació d'un vehicle elèctric

Annex I

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Convocatòria: Setembre 2018



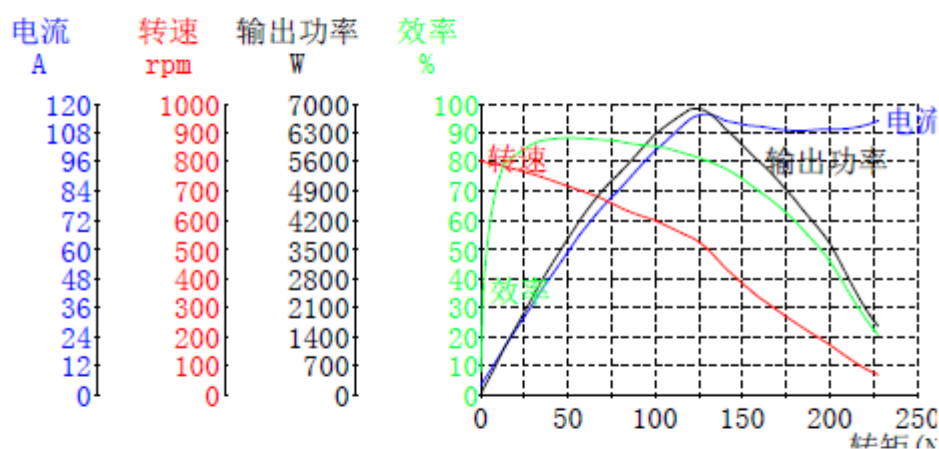
Escola Tècnica Superior
d'Enginyeria Industrial de Barcelona



1 Informació Motor Hub

电机测试报告

客户名称(Customer): 额定电压(Voltage): 72V
 档案名称(FileName): 额定功率(Power rated): 4000W
 电机型号(Type): 13 寸 测试人员(Tester): 01
 电机编号(Number): 测试日期(Test Date): 2016.05.05



特征点	电压 V	电流 A	输入功率 W	转矩 N.m	转速 rpm	输出功率 W	效率 %
不加载点(No_Load)	72.43	4.346	314.8	0.3	805	25.29	8.0
最高效率点(Eff_max)	72.35	58.47	4231	49.7	718	3736	88.3
最大输出功率点(Pout_max)	73.20	117.1	8574	127.0	524	6968	81.3
最大转矩点(Torque_max)	71.58	113.0	8089	227.9	70	1670	20.6
结束点(End)	71.58	113.0	8089	227.9	70	1670	20.6

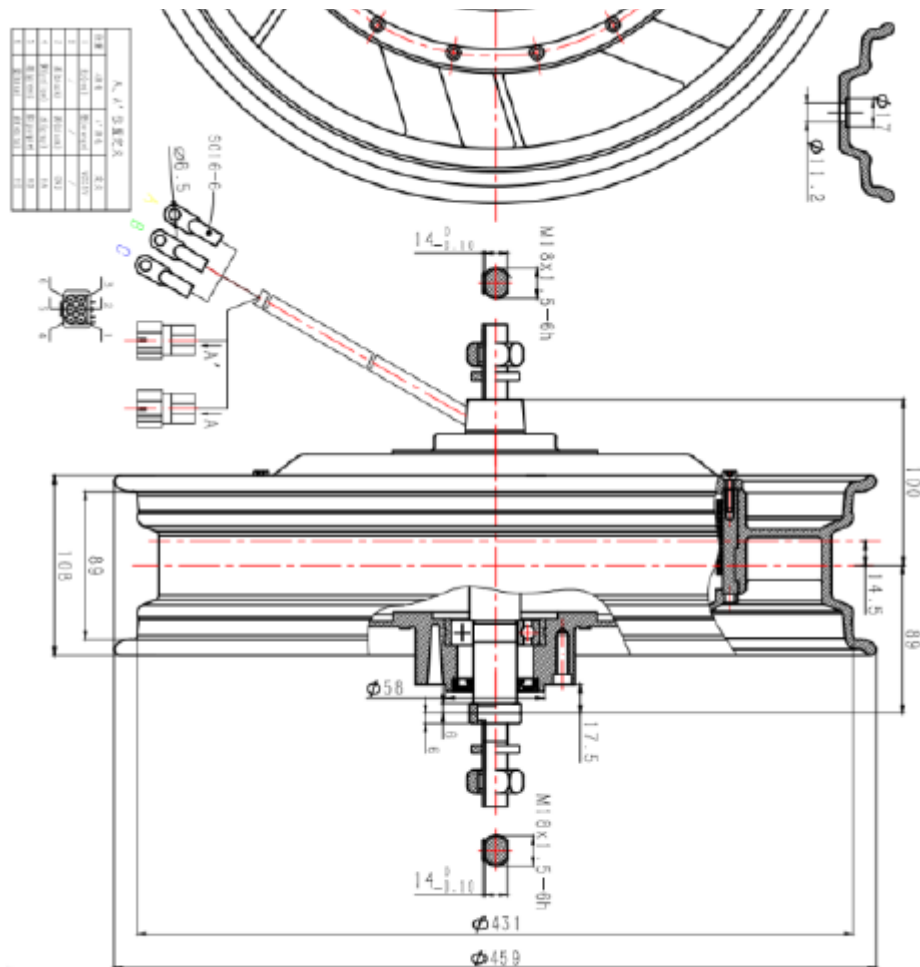
序号	电压	电流	输入功率	转矩	转速	输出功率	效率
	V	A	W	N.m	rpm	W	%
1	72.43	4.346	314.8	0.3	805	25.29	8.0
2	72.43	4.264	308.8	0.4	805	33.71	10.9
3	72.43	4.375	316.9	0.7	804	58.93	18.6
4	72.44	5.862	424.7	1.8	802	151.1	35.6
5	72.52	8.845	641.4	4.7	797	392.2	61.1
6	72.71	13.25	963.6	8.3	792	688.3	71.4
7	72.96	19.37	1413	13.6	786	1119	79.2
8	73.05	26.14	1910	19.2	776	1560	81.7
9	72.96	34.48	2516	27.2	762	2170	86.3
10	72.73	43.30	3150	35.1	747	2745	87.2
11	72.56	51.28	3721	42.7	732	3273	88.0
12	72.35	58.47	4231	49.7	718	3736	88.3
13	72.31	65.49	4735	56.6	704	4172	88.1
14	72.42	72.15	5225	63.6	690	4595	87.9
15	72.55	78.49	5694	70.5	674	4975	87.4
16	72.61	83.28	6047	77.7	648	5272	87.2
17	72.59	88.93	6456	84.6	628	5563	86.2
18	72.77	94.74	6894	91.6	616	5908	85.7
19	72.92	100.3	7314	99.3	601	6248	85.4
20	73.07	104.1	7606	106.4	581	6472	85.1
21	73.08	109.2	7981	112.8	564	6661	83.5
22	73.22	113.3	8296	119.9	545	6842	82.5
23	73.20	117.1	8574	127.0	524	6968	81.3
24	73.03	115.7	8452	133.4	481	6718	79.5
25	72.87	113.0	8234	140.1	436	6395	77.7
26	72.79	112.2	8169	146.7	401	6159	75.4
27	72.54	110.7	8029	153.0	365	5848	72.8
28	72.60	110.6	8031	159.6	336	5615	69.9
29	72.70	109.9	7987	166.9	306	5347	66.9
30	72.55	108.7	7888	173.5	275	4996	63.3

31	72.07	108.9	7850	180.0	248	4674	59.5
32	71.83	108.6	7797	186.6	220	4298	55.1
33	71.90	110.0	7906	193.3	200	4048	51.2
34	72.34	109.1	7895	199.9	174	3642	46.1
35	72.29	109.4	7908	207.7	143	3110	39.3
36	71.09	109.9	7811	217.3	94	2139	27.4
37	71.58	113.0	8089	227.9	70	1670	20.6

17inch Hub Motor specially designed for electric motorcycle, the rated power can be made 2kw,3kw,4kw,5kw,6kw,7kw or 8kw. Max speed can be customized from 30-120KMPH.

Motor Specification:

1. Motor Type: BLDC Hub Motor with Permanent Magnets
2. Motor design: Double axle out with 17inch Aluminium rim
3. Rim size: 3.5x17
4. Matching Tire: 120/70-17
5. Magnet Height: 40MM
6. No. of Pole Pairs: 16 pairs
7. Rated Power: 4000W
8. Max Power: 5760W(Peak 8000W)
9. Rated Voltage: 72V(48-96V Can be optional)
10. Speed: 90km/h (45-100km/h can be customized)
11. Max No-load RPM: 1000RPM
12. Max Torque: 190N.M
13. Max Efficiency: 90%
14. Continuous current: 67A
15. Max current: 80A Peak 140A
16. Brake type: Disc brake
17. Rear Fock width for installation: 200mm
18. Winding Core material: Aluminium
19. Cross Section of Phase wire: 16 mm²
20. Hall sensor phasing angle: 120 degree
21. Temperature Sensor: Optional
22. Max. Working Temperature: 70 degree, Peak 120 degree
23. Waterproof Grade: IP54
24. N.W/ G.W. : 21kgs / 22kgs
25. Package Size: 58*58*40CM



2 Informació de les bateries

Battery Information

GBS is a high-tech manufacturer who specializes in developing and manufacturing of LiFeMnPO₄ power battery packs. GBS owns a patented environmentally friendly solvent binder (which replaces “PVDF”) and creates a unique scalable battery cell design. GBS has developed more than 10 battery products with single cell capacities ranging from 20AH to 400AH. They are the ideal energy sources not only for electric bikes, scooters, hybrid electric vehicles (HEVs) and electric vehicles (EVs), but also for energy storage devices used in solar and wind electricity generation applications and other multi-power systems, as well as military use.

GBS Features

- 10% higher energy density by weight and by volume than Thundersky batteries.
- Superior safety performance due to patented new safety valve and pressure cap designs.
- Safer chemistry minimizes risks of explosion and fire when batteries are shorted or punctured resulting in internal shorts.
- Robust connection due to new electrode terminal design using four rivets or four screws per terminal. This helps prevent loose connections caused by vibration.
- Reduced impedance due to improved electrode terminal design.
- Improved cycle life.
- New cell structure better facilitates BMS integration and battery pack formation, and improves air

circulation.

Specifications

- Nominal Voltage: 12.8V (4X 3.2 V)
- Nominal Capacity: 100 Ah
- LiFeMnPO₄ chemistry
- Operation Voltage Range: 11.2 to 14.4V
- Weight: 14.5 kg or 31.96 lbs
- Dimension: 140X272X243 mm or 5.51X10.7X9.56 in
- Max Charging Current: 3C
- Max Discharge Current: 3C (continuous) / 10C (pulsed)
- Cycle Life : >1500 (80%DOD)
- Operating Temperature: -20 to 65 C or -4 to 149 F
- Self Discharge Rate: <3% monthly
- Accessories included: jumpers, bolts or rivets, washers, split washers and cell covers

BMS Information

Recent development of rechargeable battery technology allowed wider use of electric propulsion in electric vehicles, electric motorcycles, boats etc. Most popular high performance batteries are based on Lithium chemistries. Such batteries require systems to keep them in the specified usage range while being used. The Battery Management System (BMS) is required for batteries that are sensitive to their usage conditions such as current, voltage and temperature. Emus BMS is the product intended for use with Lilon, LiPO, LiFePO₄ and other chemistries prismatic battery cells which operating voltages range is from 2V to 5V. Emus BMS is a distributed type of digital BMS with central Control Unit. It does the balancing of the cells by dissipating the excess energy of cells as heat which is often referred to as passive balancing.

Included

- BMS control unit
- BMS cell modules
- Dual range current sensor

Optional Accessories (sold separately)

- Bluetooth Adapter
- Solid State Relay
- Display (tablet or phone with Android OS or Windows Mobile OS)
- Spare BMS cell modules

Elektromotus (EMUS) BMS Features

- Support of various charging algorithms by flexible software upgrades
- Voltage and current control of battery charger via CAN bus
- Supported CAN charger: currently Elcon PFC series, other models implemented by software upgrade
- Observation of every battery cell voltage and temperature
- Control of battery cell equal charge applying shunting current
- Gradual control of shunting current from 0 to maximum
- Possibility to limit shunting current to specified maximum which reduces dissipated heat

- Peak dissipated power per cell: 5W
- Easy battery connection via one wire going between adjacent cells
- Easy expansion of number of controlled cells
- Maximum number of controlled cells: 255
- Single cell voltage range: 2-5V - the best fit for Lilon, LiPo, LiFePO4 chemistries.

Specifications

BMS Type	Distributed with central control unit
Cells count	2÷255
Cell type	Any in 2÷5 V range (LiIon, LiPO, LiFePO4, ...) prismatic cells, other custom shapes cell modules available upon request
Battery pack voltage	From 4 to 1300 V
Balancing type	Dissipative
Control Unit supply voltage range	7 – 20 V
Control Unit consumption	40 mA average
Control Unit outputs maximum drive current	0,5 A
Control Unit RS232 speed	57600 bits/s 8N1
Control Unit CAN speed	up to 1 Mbps
Control Unit USB speed	standard Full Speed
Control Unit dimensions	95 x 50 x 30 mm
Cell Module voltage range	2÷5 V
Cell Module consumption	0,5 mA average, 8 mA peaks
Cell module shunt resistor	2,7 Ohm 5W
Cell Module maximum balancing current	1.5 A
Cell Module voltage measurement accuracy	+/- 0,01V
Cell Module temperature measurement accuracy	+/- 5°C
Cell Module communication speed	~2,3 ms per cell, allows to receive 45 cells parameters information in approx. 0,1 second
Cell Module dimensions	50 x 30 x 17 mm

Features and Functionality

Weather protection	Control Unit is hermetically sealed to meet IP55 requirements. Internal electronics protected with conformal silicone coating. Cell Module's electronic parts coated with silicone conformal coating protecting circuits from moisture and dust.
Suitable for different cell sizes	Small size of the cell modules and variable length „+“ terminal wire allows installation on the prismatic cells of different sizes
Tool-less installation	Cell modules can be installed without tools (only a bolt wrench is needed for cell terminals) as cell modules have spring-loaded terminals that allow reliable connection of wires by hand. Pre-cut inter-connection wires are supplied in the shipped package for quicker installation. When connected to Control Unit blinking green LEDs on Cell Modules indicate live

	communication and allow quick identification of problematic cell connection.
Configurable	BMS has various parameters that are configurable by using convenient Emus BMS Control Panel PC software over USB connection: pre-charge, pre-heat, timeouts, cell voltages (min and max allowed, early balancing threshold, allowed disbalance, etc), currents (maximum balancing current, charge modes), cell parameter read interval, etc...
Configurable balancing current range	Linear zero to max, configurable maximum balancing current – useful to define maximum balancing current and amount of heat dissipated by modules during balancing.
Cell voltage measurement	Real-time bar graph on LCD or PC – useful to detect faulty cells and track battery health, or as general visualisation for advanced users.
Cell temperature measurement	Real-time value on LCD and bar graph on PC – useful for controlling charger and load in high temperatures, for setting charging mode and control of battery heater in cold weather (lithium batteries can't be charged below freezing point). Many other BMS systems are not suitable for use in cold environment.
Early cell balancing	Balancing is done while charging, battery pack is in balance when charged – takes no additional time. Many other BMS systems start the balancing only when at least one cell is fully charged and overall charging time is drastically increased (in terms of hours).
Digital one-wire interface between cells	Allows neat and robust installation with lowest count of wires that could break
Forward Error Correction algorithm	Increases data transfer robustness and drastically reduces possibility of faulty data – data is corrected by Control Unit, even if it arrives with errors caused by high EMI levels.
USB interface	USB 2.0 compatible, with free, intuitive and easy to use, good quality Emus BMS Control Panel windows application.
RS-232 interface	Periodically sending the working status and parameters which can be received by LCD display or other device. Parameters output format specification is available upon request.
CAN interface	Used for controlling CAN-capable charger and broadcasting working status and parameters to other devices that could be connected on CAN bus. Broadcasted parameters specification is available upon request. Other peripherals support is possible after firmware upgrade.
CAN-equipped charger control	Precise charging process control by setting required charging voltage and current and monitoring actual values. Currently chargers produced by www.hztiecheng.com are supported. Additional charger models can be added by software upgrade.
Simple charger control	Ordinary charger may be conveniently used as BMS detects charger's plug connection to AC mains outlet via optional isolated charger sensing solid state relay. Charger switched on and off via same solid state relay.
Bluetooth adapter (Optional)	Bluetooth adapter for EMUS BMS (allows Tablet PC and smartphones (running on Windows Mobile or Android OS) to be used as Display unit for EMUS BMS, range - up to 10 meters)

Charger Information

You have the ability to choose from multiple charging options. Specifications will vary.

3 Informació del controlador

APT Programmable Sine Wave FOC AE96600 72V 96V 8kW PM Motor Driver Controller electric car controller

SPACE VECTOR & DIRECT TORQUE CONTROL PM MOTOR DRIVER

AE1405 Series, the latest product by Shanghai APT, specially designed for EV or Scooters use the PM motors for its main drive power. By the method of space vector and direct torque control, based on the 32bit ARM processor, and embedded the APT private algorithm, the product's features mostly presented are large torque and high speed, as well as high reliability. The pc software can set most of the drive parameter and can take the intelligent & individuation scheme to the rider.

Specification

1. Programable, with Reverse function, support regenerative braking
 2. Configurable battery voltage range, B+. Max operating range: 42V to 120V.
 3. Peak Phase Current: 600A.
 2. Product Size: 346mm*148mm*76mm Net Weight: 5.9kg
 4. Testing way: Hall sensor
 5. Not including CAN Bus for this link, but it's optional for sample (cost will increase according to communication protocol)
 6. Package Including: 1pc controller + 1pc GX16-10 to RS232 cable + 1pc Function harness + 1pc USB to RS232 Converter Cable (programming cable).
- P.S.: The controller extremely suit for electric trycycle, mini e-car, in spide of the size.
For Software & Manual, please contact with us freely.

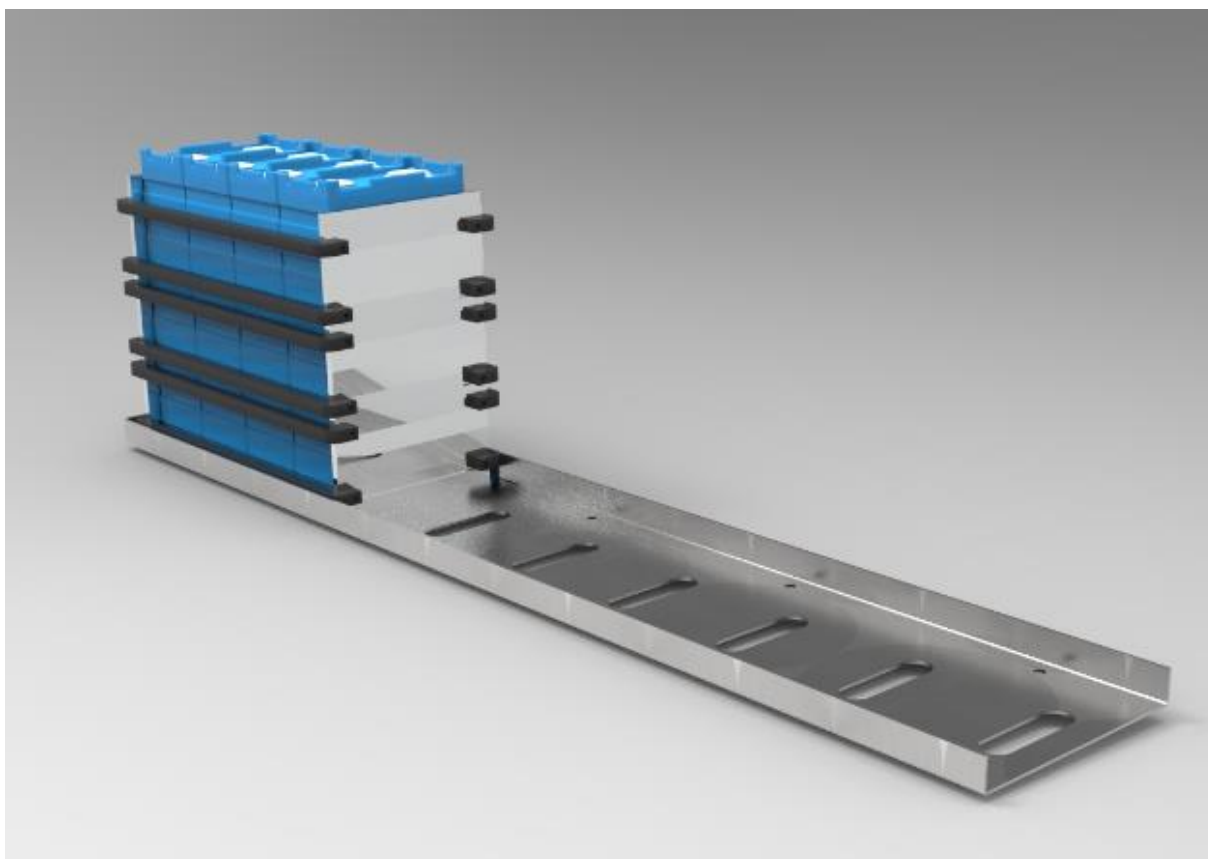
Suitable Motor

QS BLDC Hub Motor, 273 50H 8000W Motors
http://qsmotor.en.alibaba.com/product/60272780151-801685249/QS_8000W_273_50H_E_car_Extra_V3_Type_Hub_Motor.html

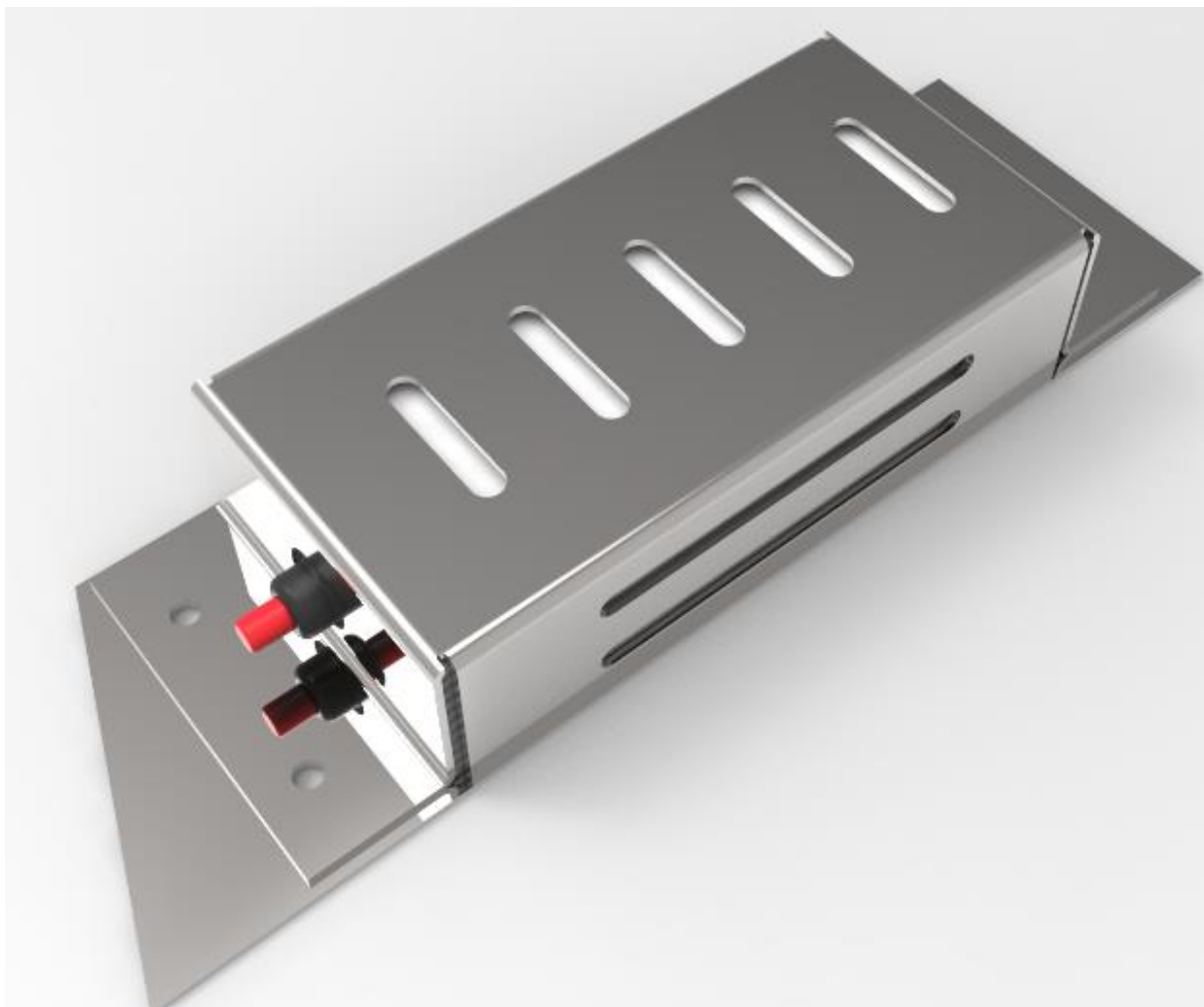
Product Info.

Water Proof : Fully embed in glue
Work Surroundings: -15°C~50°C
Humidity: Completely Waterproof
Assemble advise: Air Flow, No blanket
Body material: A6061

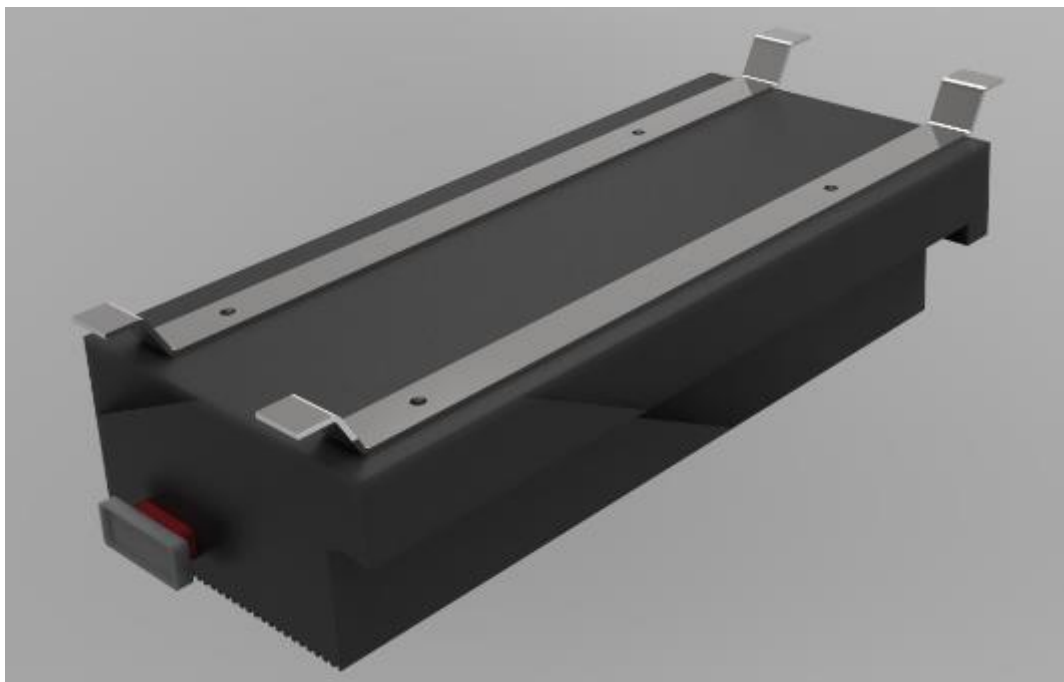
4 Suport bateries



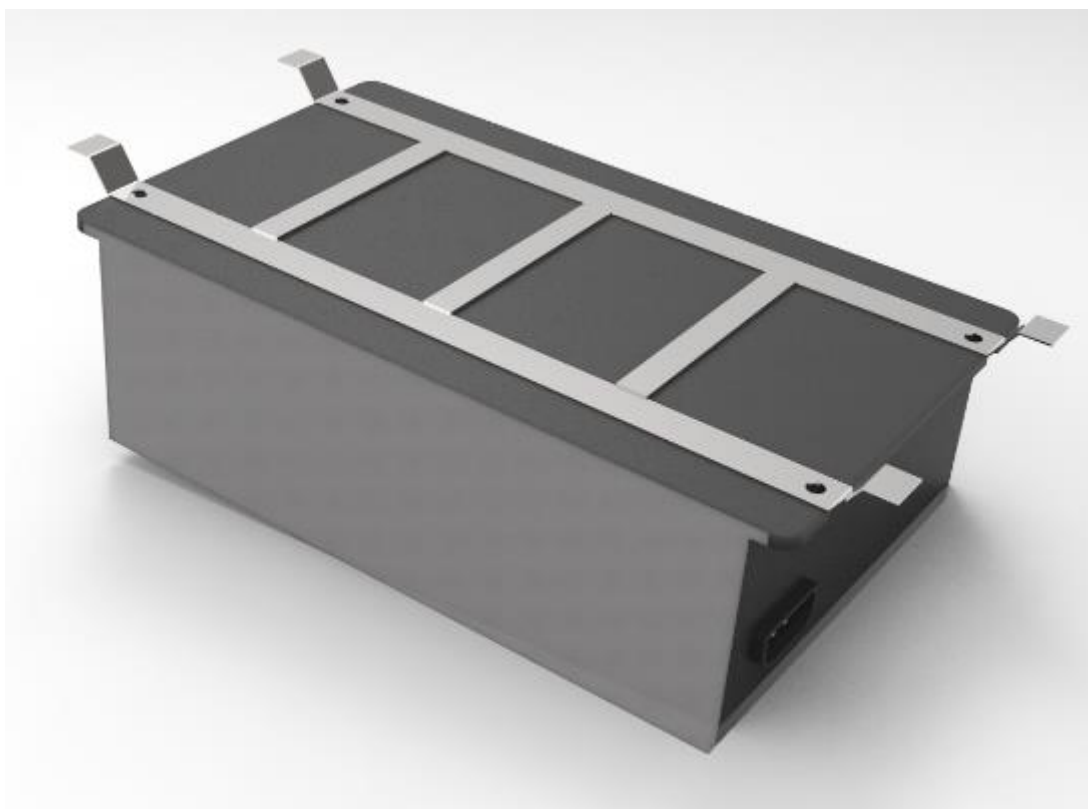
5 Suport BMS



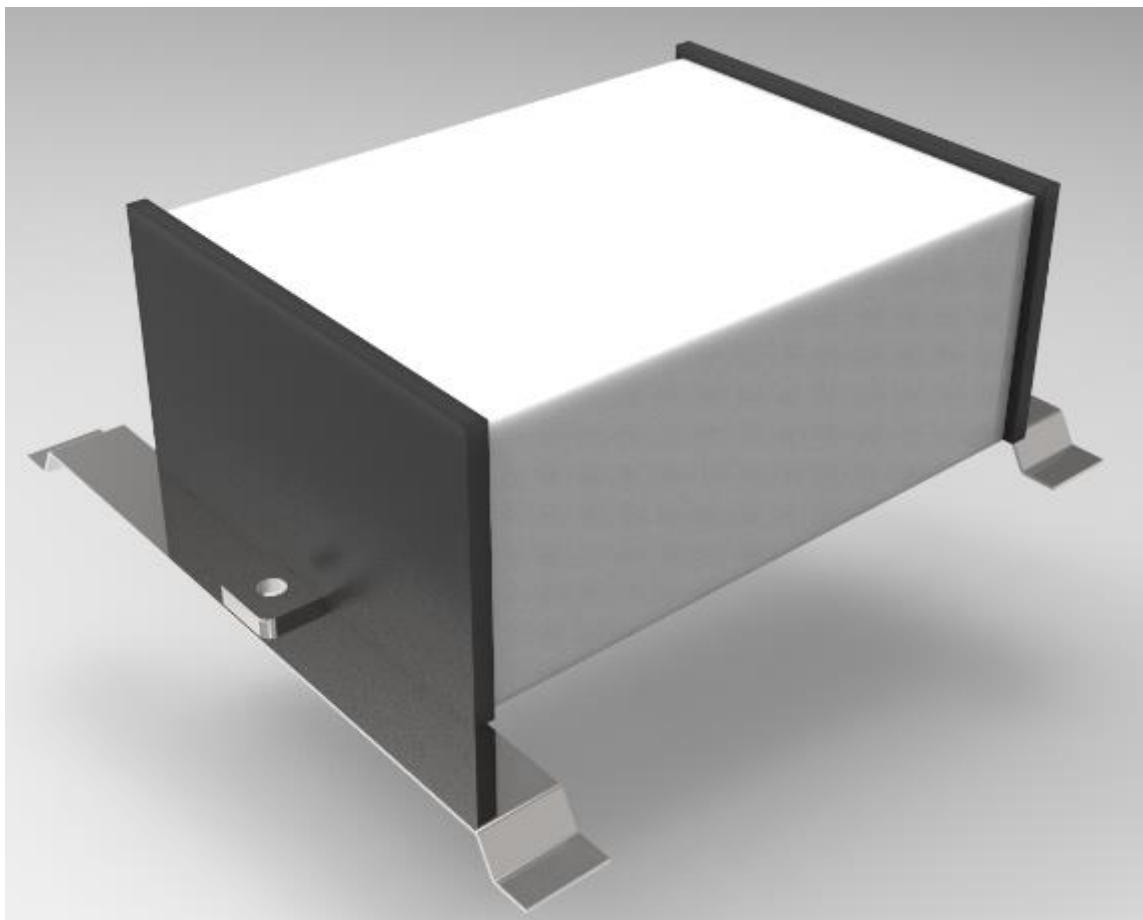
6 Suport controlador



7 Suport carregador

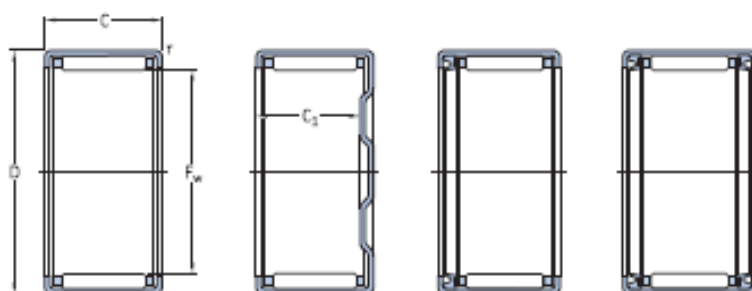


8 Suport convertidor



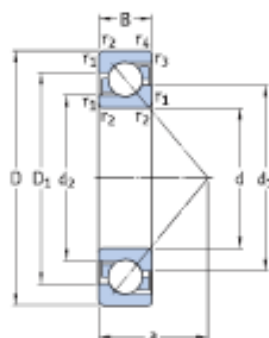
9 Especificacions rodaments

6.2 Casquillos de agujas F_w 15-18 mm



Dimensiones principales			Capacidad de carga básica		Carga límite de fatiga	Velocidades nominales		Masa	Designación
F _w	D	C	C _d	C ₀	P _e	Velocidad de referencia	Velocidad límite	g	—
mm			kN		kN	r.p.m.			
15	21	12	7,65	9,5	1,08	15 000	16 000	11	HK 1512
	21	12	7,65	9,5	1,08	15 000	16 000	13	BK 1512
	21	14	7,48	10	1,14	—	9 500	12	HK 1514 RS
	21	14	7,48	10	1,14	—	9 500	14	BK 1514 RS
	21	16	10,1	14,6	1,7	15 000	16 000	15	HK 1516
	21	16	7,48	10	1,14	—	9 500	15	HK 1516.2RS
	21	16	14,5	26	3,25	12 000	15 000	14	HN 1516
	21	16	10,1	14,6	1,7	15 000	16 000	17	BK 1516
	21	18	10,1	14,6	1,7	—	9 500	16	HK 1518 RS
	21	20	10,1	14,6	1,7	—	9 500	18	HK 1520.2RS
	21	22	13	20	2,28	15 000	16 000	20	HK 1522
16	22	12	7,37	9,8	1,12	14 000	16 000	12	HK 1612
	22	12	11,2	20,4	2,32	12 000	15 000	13	HN 1612
	22	12	7,37	9,8	1,12	14 000	16 000	14	BK 1612
	22	14	7,37	9,8	1,12	—	9 000	13	HK 1614 RS
	22	14	7,37	9,8	1,12	—	9 000	15	BK 1614 RS
	22	16	10,5	15,6	1,8	14 000	16 000	16	HK 1616
	22	16	7,37	9,8	1,12	—	9 000	14	HK 1616.2RS
	22	16	10,5	15,6	1,8	14 000	16 000	18	BK 1616
	22	20	10,5	15,6	1,8	—	9 000	18	HK 1620.2RS
	22	22	12,8	19,6	2,24	14 000	16 000	24	HK 1622 ¹⁾
	22	22	12,8	19,6	2,24	14 000	16 000	24	BK 1622 ²⁾
17	23	12	7,65	10,6	1,2	14 000	15 000	12	HK 1712
18	24	12	7,92	11,2	1,27	13 000	15 000	13	HK 1812
	24	12	7,92	11,2	1,27	13 000	15 000	15	BK 1812
	24	14	7,92	11,2	1,27	—	8 500	14	HK 1814 RS
	24	16	11,2	17,6	2,04	13 000	15 000	18	HK 1816
	24	16	7,92	11,2	1,27	—	8 500	15	HK 1816.2RS
	24	16	16,1	33,5	3,8	11 000	14 000	20	HN 1816
	24	16	11,2	17,6	2,04	13 000	15 000	20	BK 1816

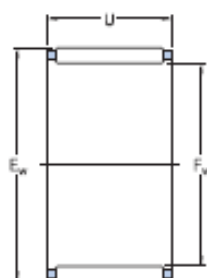
3.1 Rodamientos de una hilera de bolas de contacto angular d 10–25 mm



Dimensiones principales			Capacidad de carga básica		Carga límite de fatiga	Velocidades nominales		Masa	Designaciones	Rodamiento de diseño básico
d	D	B	C	C ₀	P ₀	Velocidad de referencia	Velocidad límite	kg	Rodamiento de emparejamiento universal	
mm			kN		kN	r. p. m.			–	
10	30	9	7,02	3,35	0,14	30 000	30 000	0,03	7200 BECBP	7200 BEP
12	32	10	7,61	3,8	0,16	26 000	26 000	0,036	7201 BECBP	7201 BEP
	37	12	10,6	5	0,208	24 000	24 000	0,06	7301 BECBP	7301 BEP
15	35	11	8,8	4,65	0,196	26 000	26 000	0,045	7202 BECBP	–
	35	11	8,32	4,4	0,183	24 000	24 000	0,045	–	7202 BEP
	42	13	13	6,7	0,28	20 000	20 000	0,08	7302 BECBP	7302 BEP
17	40	12	11	5,85	0,25	22 000	22 000	0,065	7203 BECBM	–
	40	12	11	5,85	0,25	22 000	22 000	0,065	7203 BECBP	–
	40	12	10,4	5,5	0,234	20 000	20 000	0,065	–	7203 BEP
	40	12	11,1	6,1	0,26	20 000	20 000	0,065	–	7203 BEY
	47	14	15,9	8,3	0,355	19 000	19 000	0,11	7303 BECBP	7303 BEP
20	47	14	14,3	8,15	0,345	19 000	19 000	0,11	7204 BECBM	–
	47	14	14,3	8,15	0,345	19 000	19 000	0,11	7204 BECBP	–
	47	14	14	8,3	0,355	18 000	18 000	0,11	7204 BECBY	–
	47	14	13,3	7,65	0,325	18 000	18 000	0,11	–	7204 BEP
	47	14	14,3	8,15	0,345	19 000	19 000	0,11	7204 BECBPH	–
	52	15	19	10	0,425	18 000	18 000	0,14	7304 BECBPH	–
	52	15	19	10	0,425	18 000	18 000	0,14	7304 BECBM	–
	52	15	19	10	0,425	18 000	18 000	0,14	7304 BECBP	–
	52	15	19	10,4	0,44	16 000	16 000	0,14	7304 BECBY	–
	52	15	17,4	9,5	0,4	16 000	16 000	0,14	–	7304 BEP
25	52	15	15,6	10	0,43	17 000	17 000	0,13	7205 BECBPH	–
	52	15	15,6	10	0,43	17 000	17 000	0,13	7205 BECBM	–
	52	15	15,6	10	0,43	17 000	17 000	0,13	7205 BECBP	–
	52	15	15,6	10,2	0,43	15 000	15 000	0,13	7205 BECBY	7205 BEY
	52	15	14,8	9,3	0,4	15 000	15 000	0,13	–	7205 BEP
	62	17	26,5	15,3	0,655	15 000	15 000	0,23	7305 BECBPH	–
	62	17	26,5	15,3	0,655	15 000	15 000	0,23	7305 BECBM	–
	62	17	26,5	15,3	0,655	15 000	15 000	0,23	7305 BECBP	–
	62	17	26	15,4	0,655	14 000	14 000	0,23	7305 BECBY	7305 BEY
	62	17	24,2	14	0,6	14 000	14 000	0,23	–	7305 BEP

6.1 Coronas de agujas

F_w 3-22 mm

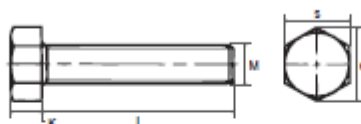


Dimensiones principales			Capacidad de carga básica		Carga límite de fatiga	Velocidades nominales		Masa	Designación	Sello adecuado ¹⁾
F_w	E_w	U	C	C_0	P_0	Velocidad de referencia	Velocidad Emite			Designación
mm			kN		kN	r.p.m.		g	—	—
3	5	7	1,51	1,34	0,134	40 000	45 000	0,3	K 3x5x7 TN	—
	5	9	1,68	1,53	0,153	40 000	45 000	0,4	K 3x5x9 TN	—
	6	7	1,42	1,02	0,104	38 000	43 000	0,4	K 3x6x7 TN	—
4	7	7	1,72	1,32	0,137	36 000	43 000	0,5	K 4x7x7 TN	—
	7	10	2,29	1,9	0,204	36 000	43 000	0,7	K 4x7x10 TN	—
5	8	8	2,29	2	0,212	36 000	40 000	0,7	K 5x8x8 TN	—
	8	10	2,92	2,7	0,29	36 000	40 000	0,9	K 5x8x10 TN	—
6	9	8	2,55	2,36	0,25	34 000	38 000	0,8	K 6x9x8 TN	—
	9	10	3,3	3,2	0,345	34 000	38 000	1,1	K 6x9x10 TN	—
	10	13	3,69	3,15	0,36	34 000	38 000	1,9	K 6x10x13 TN	G 6x10x2,5
7	9	7	1,68	1,81	0,19	34 000	38 000	0,6	K 7x9x7 TN	—
	10	8	2,81	2,75	0,29	32 000	36 000	0,9	K 7x10x8 TN	—
	10	10	3,58	3,75	0,415	32 000	36 000	1	K 7x10x10 TN	—
8	11	8	3,03	3,1	0,335	32 000	36 000	1	K 8x11x8 TN	—
	11	10	3,8	4,25	0,445	32 000	36 000	1,2	K 8x11x10 TN	—
	11	13	5,01	5,85	0,67	32 000	36 000	1,7	K 8x11x13 TN	—
	12	10	4,84	4,75	0,54	30 000	34 000	2	K 8x12x10 TN	G 8x12x3
9	12	10	4,4	5,2	0,57	30 000	34 000	1,5	K 9x12x10 TN	—
	12	13	5,72	7,2	0,815	30 000	34 000	2,1	K 9x12x13 TN	—
10	13	10	4,57	5,7	0,63	28 000	32 000	1,6	K 10x13x10 TN	—
	13	13	5,94	8	0,9	28 000	32 000	2,3	K 10x13x13 TN	—
	13	16	6,82	9,5	1,08	28 000	32 000	2,9	K 10x13x16 TN	—
	14	10	5,61	6,1	0,695	28 000	32 000	2,5	K 10x14x10 TN	G 10x14x3
	14	13	7,21	8,5	0,98	28 000	32 000	4,6	K 10x14x13 TN	G 10x14x3
	16	12	7,65	7,2	0,85	28 000	32 000	5,5	K 10x16x12 TN	—
12	15	10	4,73	6,2	0,695	26 000	30 000	2,9	K 12x15x10 TN	—
	15	13	6,16	8,65	0,98	26 000	30 000	2,3	K 12x15x13 TN	—
	16	13	7,65	9,5	1,1	26 000	30 000	3,6	K 12x16x13 TN	G 12x16x3
	17	13	9,13	10,4	1,22	26 000	30 000	4,9	K 12x17x13 TN	—
	18	12	9,52	10	1,18	26 000	30 000	6	K 12x18x12 TN	G/SO 12x18x3

10 Especificacions cargoleria

DIN 933

TORNILLO CABEZA HEXAGONAL. ROSCA FONDO

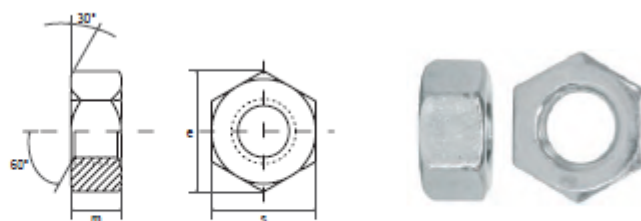


d	M4	M5	M6	M8	M10	M12	M14	M16	M18	M20	M22	M24
s	7	8	10	13	17	19	22	24	27	30	32	36
k	2,8	3,5	4	5,3	6,4	7,5	8,8	10	11,5	12,5	14	15
Paso	0,7	0,8	1	1,25	1,50	1,75	2	2	2,5	2,5	2,5	3
e	7,66	8,79	11,05	14,38	18,90	21,10	24,49	26,75	30,14	33,53	35,72	39,98

Calidad 5.8 Ref. Catálogo	Calidad 8.8 Ref. Catálogo	Calidad Inox. Ref. Catálogo	Medidas d x L	Calidad 5.8 Ref. Catálogo	Calidad 8.8 Ref. Catálogo	Calidad Inox. Ref. Catálogo	Medidas d x L	Calidad 5.8 Ref. Catálogo	Calidad 8.8 Ref. Catálogo	Calidad Inox. Ref. Catálogo	Medidas d x L
13010001	13010162	13010323	M4x8	13010037	13010198	13010359	M6x25	13010073	13010234	13010395	M10x80
13010002	13010163	13010324	M4x10	13010038	13010199	13010360	M6x30	13010074	13010235	13010396	M10x70
13010003	13010164	13010325	M4x12	13010039	13010200	13010361	M6x35	13010075	13010236	13010397	M10x80
13010004	13010165	13010326	M4x14	13010040	13010201	13010362	M6x40	13010076	13010237	13010398	M10x90
13010005	13010166	13010327	M4x16	13010041	13010202	13010363	M6x45	13010077	13010238	13010399	M10x100
13010006	13010167	13010328	M4x18	13010042	13010203	13010364	M6x50	13010078	13010239	13010400	M12x16
13010007	13010168	13010329	M4x20	13010043	13010204	13010365	M6x60	13010079	13010240	13010401	M12x20
13010008	13010169	13010330	M4x22	13010044	13010205	13010366	M8x10	13010080	13010241	13010402	M12x25
13010009	13010170	13010331	M4x25	13010045	13010206	13010367	M8x12	13010081	13010242	13010403	M12x30
13010010	13010171	13010332	M4x30	13010046	13010207	13010368	M8x14	13010082	13010243	13010404	M12x35
13010011	13010172	13010333	M4x35	13010047	13010208	13010369	M8x16	13010083	13010244	13010405	M12x40
13010012	13010173	13010334	M4x40	13010048	13010209	13010370	M8x18	13010084	13010245	13010406	M12x45
13010013	13010174	13010335	M4x45	13010049	13010210	13010371	M8x20	13010085	13010246	13010407	M12x50
13010014	13010175	13010336	M4x50	13010050	13010211	13010372	M8x22	13010086	13010247	13010408	M12x55
13010015	13010176	13010337	M5x8	13010051	13010212	13010373	M8x25	13010087	13010248	13010409	M12x60
13010016	13010177	13010338	M5x10	13010052	13010213	13010374	M8x30	13010088	13010249	13010410	M12x70
13010017	13010178	13010339	M5x12	13010053	13010214	13010375	M8x35	13010089	13010250	13010411	M12x80
13010018	13010179	13010340	M5x14	13010054	13010215	13010376	M8x40	13010090	13010251	13010412	M12x90
13010019	13010180	13010341	M5x16	13010055	13010216	13010377	M8x45	13010091	13010252	13010413	M12x100
13010020	13010181	13010342	M5x18	13010056	13010217	13010378	M8x50	13010092	13010253	13010414	M14x20
13010021	13010182	13010343	M5x20	13010057	13010218	13010379	M8x55	13010093	13010254	13010415	M14x25
13010022	13010183	13010344	M5x22	13010058	13010219	13010380	M8x60	13010094	13010255	13010416	M14x30
13010023	13010184	13010345	M5x25	13010059	13010220	13010381	M8x70	13010095	13010256	13010417	M14x35
13010024	13010185	13010346	M5x30	13010060	13010221	13010382	M8x80	13010096	13010257	13010418	M14x40
13010025	13010186	13010347	M5x35	13010061	13010222	13010383	M8x90	13010097	13010258	13010419	M14x45
13010026	13010187	13010348	M5x40	13010062	13010223	13010384	M8x100	13010098	13010259	13010420	M14x50

DIN 934

TUERCA HEXAGONAL



d1	M3	M4	M5	M6	M7	M8	M10	M12	M14	M16	M18	M20	M22	M24	M27	M30	M33	M36	M39	M42	M48
e	6,01	7,66	8,79	11,05	12,12	14,38	18,9	21,10	24,49	26,75	29,56	32,95	35,03	39,55	45,2	50,85	55,37	60,79	66,44	72,09	82,6
s	5,5	7	8	10	11	13	17	19	22	24	27	30	32	36	41	46	50	55	60	65	70
m	2,4	3,2	4	5	5,5	6,5	8	10	11	13	15	16	18	19	22	24	26	29	31	34	38

Calidad 8.8 Ref. catálogo	Calidad 10.9 Ref. catálogo	Calidad Zincado Ref. catálogo	Calidad Inox Ref. catálogo	Medidas sistema métrico	Calidad 8.8 Ref. catálogo	Calidad 10.9 Ref. catálogo	Calidad Zincado Ref. catálogo	Calidad Inox Ref. catálogo	Medidas sistema métrico
13020001	13020019	13020037	13020055	M3	13020011	13020029	13020047	13020065	M20
13020002	13020020	13020038	13020056	M4	13020012	13020030	13020048	13020066	M22
13020003	13020021	13020039	13020057	M5	13020013	13020031	13020049	13020067	M24
13020004	13020022	13020040	13020058	M6	13020014	13020032	13020050	13020068	M27
13020005	13020023	13020041	13020059	M8	13020015	13020033	13020051	13020069	M30
13020006	13020024	13020042	13020060	M10	13020016	13020034	13020052	13020070	M33
13020007	13020025	13020043	13020061	M12	13020017	13020035	13020053	13020071	M36
13020008	13020026	13020044	13020062	M14	13020018	13020036	13020054	13020072	M48
13020009	13020027	13020045	13020063	M16					
13020010	13020028	13020046	13020064	M18					

Consultar para otras medidas

DIN 125-A

ARANDELA PLANA SIN BISEL

M	M3	M4	M5	M6	M8	M10	M12	M14	M16	M18	M20	M22	M24	M27	M30
d	3,2	4,3	5,3	6,4	8,4	10,5	13	15	17	19	21	23	25	28	31
D	7	9	10	12	16	20	24	28	30	34	37	39	44	50	56
s	0,5	0,8	1	1,6	1,6	2	2,5	2,5	3	3	3	3	4	4	4



Pavonado Ref. catálogo	Zincado Ref. catálogo	Inox. Ref. catálogo	Medidas (para Ø de rosca)	Pavonado Ref. catálogo	Zincado Ref. catálogo	Inox. Ref. catálogo	Medidas (para Ø de rosca)
13030001	13030016	13030031	M3	13030009	13030024	13030039	M16
13030002	13030017	13030032	M4	13030010	13030025	13030040	M18
13030003	13030018	13030033	M5	13030011	13030026	13030041	M20
13030004	13030019	13030034	M6	13030012	13030027	13030042	M22
13030005	13030020	13030035	M8	13030013	13030028	13030043	M24
13030006	13030021	13030036	M10	13030014	13030029	13030044	M27
13030007	13030022	13030037	M12	13030015	13030030	13030045	M30
13030008	13030023	13030038	M14				

