

# TECHNICAL CATALOGUE



## ELECTRIC MOTORS

STANDARD **IEC**



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Motovario® corporate philosophy aims to promote the company's brand and products at an international level with determination and transparency, while constantly striving to offer innovative solutions for satisfying and anticipating the demand of the market. Motovario® provides technologically advanced solutions in the transmission components field for industrial and civil applications worldwide.

### The company

At Formigine, the heart of Modena's industrial district, Motovario® boasts a production plant spanning 50,000 m<sup>2</sup> that employs 500 people.

1965 Foundation of Motovario

1998 Acquisition of Spaggiari Trasmissioni, an important brand in the mechanical technology sector.

2006 Motovario acquisition by a private investment fund managed by Synergo SGR, in order to guarantee its development and support its expansion throughout the world.

2014 Acquisition of Pujol.

2015 Acquisition by TECO.

At the core of Motovario® lies an evolved production process based on technological solutions that convert power into movement. Motovario® is at the heart of the production processes that drive industries worldwide. Quality and reliability are the company's fundamental assets. Motovario® is present throughout the world with branches in France, Spain, Germany, England, China, the United States and India. The sales network and customer service guarantee immediate and high-quality support to all customers. In addition, the company boasts a worldwide network of MAC (Motovario Assembly Centre). Qualified assembly centres are present, in Italy, Australia, Benelux, Bulgaria, China, Finland, France, India, Ireland, Israel, Malaysia, Poland, Portugal, South Korea, Spain, Sweden, Turkey, United Kingdom, Ukraine and USA. The company is able to offer a wide range of products: speed variators, right-angle, helical-bevel, shaft-mounted, worm gear reducers and gearmotors, electric motors, inverter and inverter drives. Maximum quality and precision are ensured by the cutting-edge technologies implemented in the production process. 170 numerical control machines, served by LGV lines for storage in automatic warehouses, ensure a high standard of efficiency for the Motovario® production department.

The highly automated assembly lines are supported by a specific computerised system. The process statistical control system manages the production process to avoid rejects, by enabling the operator to monitor all the processing phases. The annealing, tempering, hardening and carburizing treatments are carried out inside the plant. The plant operates on a 24-hour basis, including holidays. Reliability, resilience and versatility are the distinctive features of Motovario® products, the most qualified solution to any power transmission requirement.

### Main fields OF APPLICATIONS

- Mechanical-electromechanical industry (car washing, pumps, barriers & automatic doors, circuit breakers)
- Ceramic industry (ovens, press feeding systems)
- Food, farming, oenology industry
- Wood, marble, glass industry
- Packaging & bottling industry
- Textile, shoes, leather industry
- Transport, logistic industry
- Construction industry
- Milling, animal husbandry, flower industry
- Machine tools & steel industry
- Mining, quarry, cement industry
- Energy industry (solar, nuclear, biomass, wind)
- Amusement industry (theatres, leisure parks, kiddy rides)
- Chemical & pharmaceuticals industry
- Paper & printing industry
- Plastic & rubber industry
- Telecommunications industry (satellite orientation systems, military radar)
- Engineering and consultant companies

### Certifications

Our products can be manufactured to conform with the ATEX Directive 2014/34/UE. In addition, the safety and quality of our motors, geared motors and motovariators is guaranteed by the EAC (EurAsian Conformity) certification, an essential requirement for products exported to the Russian Federation. Our motors are UL certified, which guarantees their safety and quality requirements for the North American market.

### Quality CONCEPT

Motovario® has obtained the quality certification renewal of its production system in conformity to the UNI EN ISO 9001:2008 standard. This internationally recognised certification acknowledges the company's commitment and drive geared towards constantly improving products, projects and services offered. Moreover, the company has obtained the OHSAS 18001:1999 (Occupational Health and Safety Assessment Series) certification, which defines the requirements of the workplace safety and health management system.

### Research & DEVELOPMENT

Technological innovation: a crucial factor for competing in the market. In the company's 50-year history, research and change have been the pivotal factors in guaranteeing competitiveness at a global level, thanks to increasingly advanced products in terms of performance and reliability. Each year the company invests an increasing amount of its turnover in research and development, geared towards promoting the constant study and analysis of products, control processes and performance certification. In order to ensure that customers receive products that comply with the requested performance levels, the company carries out simulations on all new products, including NVH (Noise, Vibration, Harshness) tests effected in the advanced semi-anechoic chamber.

### Customer CARE

Innovative instruments and software applications supporting the technical and logistic requirements of our partners worldwide guarantee a timely and customised service. The experience acquired by Motovario® has led to the creation of the new online portal MyMotovario 4.0, which allows for selecting products and exporting their 3D file. As a result, designers and engineering departments can download the three-dimensional model of the requested product and implement it directly in their own layout. In order to maximise customer service and quality, Motovario® offers all its customers the following online services: Order Tracking, which allows for monitoring the progress of an order in real time, and the Stock Availability service, through which users may check the availability (stock) of our products, both in the Italian plant and in the various branches.

### Motovario chooses technological evolution.

Motovario® has chosen technological evolution and actively collaborates with the Faculty of Engineering of the University of Modena and Reggio Emilia and of the University of Bologna.



**Reliability, sturdiness, versatility**

These are the distinctive traits of Motovario products. A broad range of transmission products that provide a competent, innovative solution to each and every power application need. Cutting-edge tools, unrelenting research efforts and ongoing commitment to upgrading manufacturing equipment to the latest state-of-the-art enable us to offer high quality and performance standards to cater to industry requirements and the broadest variety of applications. Motovario ranks among the leading, well-reputed companies in Italy engaged in the design, manufacture and sales of transmission products for industrial and civil applications. The entire manufacturing process takes place in Formigine and Ubersetto plants, in Modena area, with an overall surface area of over 50.000 sq m. and a workforce of about 500 people. 170 numerically controlled machines and cutting-edge handling, storage and assembly automated systems ensure that all products meet high quality standards. The network includes more than 40 Motovario-certified assembly centres, with the capability to supply products in a broad range of versions, including customised versions, high service capacity and fast response. As a result, our product offering can cater to the needs of all plant engineering sectors, in all industries and for different applications, and includes: speed variators, helical, bevel-helical, parallel helical, worm gear reducers and gearmotors, electric motors and motor-inverters. All of the products we manufacture share such common features as reliability, sturdiness and versatility, topped with a high innovation content. At the heart of a company's technological innovation is the ability to develop integrated tools for computer-aided calculation simulation and management of different processes as part of product development. When simulating operating, setup and process conditions, it is also necessary to analyse and optimize the overall functional design of a product using a synergistic approach. This is achieved by implementing an exhaustive experimental plan, without using interpolation or approximation, as they frequently allow criticalities or any oversizing which is not conducive to maximising quality/cost ratio to go unnoticed.

**High-efficiency method for calculation according to standards**

A set of specific functions have been developed to this end. A few significant examples include functions to:

- Optimise individual reduction ratios and the combinations of the different reduction stages based on parametrisable target normal series;
- Calculate torque values and maximum permissible external forces for gear reducer units, using iterative numeric algorithms to confirm target life/safety values of components;
- Create databases for loading a FEM structural analysis model by automatically writing all reaction components of bearings under all load conditions to a specific file, with automatic selection of critical cases that need to be verified.

Another goal of the method is to create synergy between calculation according to standards and FEM structural calculation and the implementation of FEM model loading procedures, so as to simplify input data, meshing and constraint criteria

**Competitiveness and operational benefits of the new method**

This method offers many practical advantages over traditional calculation procedures within the company, namely:

- Iterative optimisation of project since setup stage;
- Accurate assessment of the various service factors and reliability levels for the entire gear reducer unit and for all operating conditions as per catalogue rating or customer specific requirements;
- Faster support to customers in analysing tailored product configurations;
- Integrated corporate databases that can be updated in real-time;

**Range extension and ongoing evolution**

The steady, significant growth of Motovario Group is achieved thanks to an ongoing search for new calculation and design tools, as well as to customer service. The new tools identified have led to innovation, improved product reliability as well as positive developments in market management. The following software products are used for design, calculation and management:

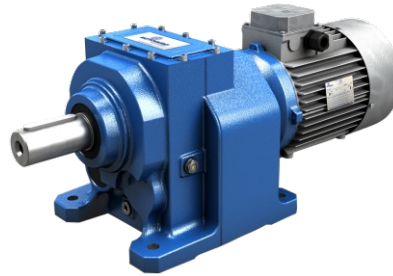
- Solidworks;
- Kisoft;
- Kissys;
- Ansys;
- FEM modelling analysis software;
- Circuit design and simulation software;
- Specific spreadsheets;
- SAP.

In MyMotovario 4.0 portal, PRODUCT SELECTION includes a section named APPLICATIONS where customers can enter application data and find out which gear reducer suits them best in a matter of minutes.

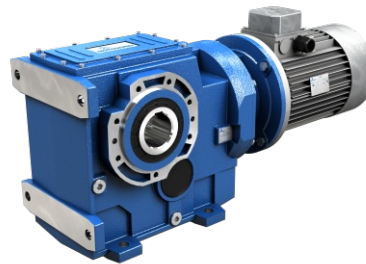
## MOTOVARIO Products

**HELICAL GEAR REDUCERS**

Cast iron or aluminum casing  
 Output shaft up to 90 mm  
 Mn<sub>2</sub> up to 8.600 Nm  
 Reduction stages 1, 2, 3  
 Ratios up to 354  
 Atex units

**HELICAL BEVEL GEAR REDUCERS**

Cast iron or aluminum casing  
 Output shaft up to 110 mm  
 Mn<sub>2</sub> up to 14.000 Nm  
 Reduction stages 2, 3  
 Ratios up to 443  
 Atex units

**SHAFT MOUNTED GEAR REDUCERS**

Cast iron  
 Output shaft up to 90 mm  
 Mn<sub>2</sub> up to 10.250 Nm  
 Reduction stages 2, 3  
 Ratios up to 395  
 Atex units

**WORM GEAR REDUCERS**

Cast iron or aluminum casing  
 Output shaft up to 50 mm  
 Mn<sub>2</sub> up to 2.700 Nm  
 Ratios up to 1083  
 Atex units

**PLANETARY GEARED UNITS**

Cast iron  
 Output shaft up to 80 mm  
 Mn<sub>2</sub> up to 10000 Nm  
 Reduction stages 1, 2, 3, 4  
 Ratios up to 2700



<p><b>PARALLEL HELICAL AND BEVEL HELICAL GEAR REDUCERS FOR MIDDLE HEAVY INDUSTRY</b></p> <p>Cast iron casing                  Output shaft up to 180 mm                  Mn<sub>2</sub> up to 110.000 Nm                  Reduction stages 2, 3, 4                  Ratios up to 431                  Atex units</p>	
<p><b>MOTOVARIATORS AND MOTOVARIATOR-GEAR REDUCERS</b></p> <p>Cast iron or aluminum casing                  Mn<sub>2</sub> up to 5.000 Nm                  Atex units</p>	
<p><b>ELECTRIC MOTORS</b></p> <p>Power ratings up to 90 kW                  Poles 2, 4, 6                  Three-phase and single-phase, built-in brake, dual polarity                  Protection class up to IP66</p>	
<p><b>SELF POWER® SELF-STARTING SYNCHRONOUS ELECTRIC MOTORS</b></p> <p>Power ratings up to 7,5 kW                  Poles 4                  Three-phase, built-in brake                  Protection class up to IP66</p>	
<p><b>DRIVES</b></p> <p><b>DRIVON - motoinverter</b></p> <p>Three phase and single phase power supply                  High dynamics sensorless vectorial control                  Power ratings up to 5,5 kW                  Standard integrated STO                  Integrated field bus                  Optional field bus</p>	

Three-phase and single-phase asynchronous electric motors, totally enclosed, with external fan ventilation, cage rotor in die-cast aluminium alloy or aluminium, insulation class F, protection degree IP55, standardised height to centre and dimensions from 56 to 132, standardised powers from 0.09 to 11 kW.

Standard production	Series
Three-phase, single polarity, standard efficiency	TS
Three-phase, single polarity, high efficiency	TH
Three-phase, single polarity, premium efficiency	TP
Three-phase, double polarity	D
Single-phase	SH
Single-phase, high starting torque, electronic cutout	HSH
Three-phase, single polarity, self-braking motor, standard efficiency	TBS
Three-phase, single polarity, self-braking motor, high efficiency	TBH
Three-phase, single polarity, self-braking motor, high efficiency	TBP
Three-phase, double polarity, self-braking motor	DB

### 2.2.1 Conformity with standards

The standard electric motors conform with the following Italian, European and international standards for rotating electrical machines:

TITLE	CEI / EN	IEC
General prescriptions for rotating electrical machines	CEI EN 60034-1	IEC 60034-1
Normalised methods for the determination, by testing, of the loss and efficiency of rotating electrical machines (excluding traction vehicle motors)	CEI EN 60034-2-1	IEC 60034-2-1
Classification of the protection ratings of rotating electrical machines	CEI EN 60034-5	IEC 60034-5
Cooling systems for electrical machines	CEI EN 60034-6	IEC 60034-6
Mounting position and installation type codes	CEI EN 60034-7	IEC 60034-7
Marking terminals and direction of rotation for rotating electrical machines	CEI 2-8	IEC 60034-8
Noise limits	CEI EN 60034-9	IEC 60034-9
Vibration levels for electrical machines	CEI EN 60034-14	IEC 60034-14
Efficiency classes for alternate current motors powered by mains (IE Code)	CEI EN 60034-30-1	IEC 60034-30-1
Dimensions and nominal powers of rotating electrical machines	EN 50347	IEC 60072-1
Nominal voltage for low voltage public power grids	CEI 8-6	IEC 60038

### 2.2.2 Conformity with Community Directives - CE Marking

Standard execution electric motors carry the CE marking on the plate because they comply with the following European Union Directives:

- Low Voltage Directive 2014/35/UE;
- Directive EMC 2014/30/UE regarding intrinsic characteristics in relation to emissions and levels of immunity;
- Directive RoHS 2015/863/UE relating to the prohibition or limitation of use of noxious substances in electrical and electronic equipment;
- ErP Directive 2009/125/EC on ecodesign and its implementing regulation no. 640/2009, replaced by no. 1781/2029 as of 01/07/2021.

The manufacturer of the machine is exclusively responsible for the conformity with the Machinery Directive and EMC Directive of a complete installation. Electric motors may not be commissioned until the machines to which they are coupled have themselves been declared conforming with the Machinery Directive (Certificate of Incorporation - Directive 2006/42/CE Annex II 1B).

### 2.2.3 Compliance with UK directives (Statutory Instruments) - UKCA Marking

Standard execution electric motors carry the UKCA marking on the plate because they comply with the following United Kingdom Statutory Instruments (UKSI):

- The Electrical Equipment (Safety) Regulations 2016.;
- Electromagnetic Compatibility Regulations 2016;
- The Ecodesign for Energy-Related Products and Energy Information (Amendment) (EU Exit) Regulations 2019;
- The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012.

### 2.2.4 Conformity with UL/CSA standards

On request, TS, TH, TP, TBS, TBH, TBP and D series electric motors can be manufactured in conformity with the following standards:

- UL1004 “Electric motors”
- CSA C22.2 No.100-04 “Motors and Generators” for the USA and CANADA markets respectively.

### 2.2.5 Conformity with EAC standards (former GOST)

TS, TH, TBS, TBH, TP, TBP, D, DB, SH, HSH, TSP-SL, TBSP-SL series electric motors are manufactured in conformity with the following standards:

- EAC

for Russian, Belarussian and Kazakh market.

### 2.2.6 Conformity with European Directive 2014/34/UE (ATEX)

On request, TS, TH, TP, D and SH series electric motors can be manufactured in conformity with the following standards:

- IEC-CEI-EN 60079-0 - Explosive Atmospheres - Equipment - General Requirements;
- IEC-CEI-EN 60079-15 - Explosive Atmospheres - Equipment Protection by Type of Protection 'n';
- IEC-CEI-EN 60079-31 - Explosive Atmospheres - Equipment Dust Ignition Protection by Enclosure “t”;

and hence meet the requirements of European Directive 2014/34/UE (ATEX).

In particular, MOTOVARIO electric motors may be constructed for Group II, category 3, atmosphere G with temperature class T3 (200°C) and protection mode “nA” or atmosphere D with temperature class T135°C and Type of Protection “tc”, and hence bear the double marking:

- **II 3G Ex nA IIB T3 Gc / II 3D Ex tc IIIB T135 °C Dc.**

For further information, consult the respective documentation.

### 2.2.7 Conformity with CCC standards

On request, TS, TH, TP series electric motors can be manufactured in conformity with the following standards:

- CCC

for the Chinese market, limited to the following sizes:

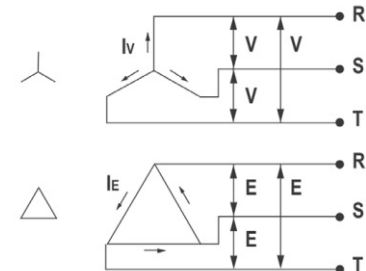
- 2-pole from size 63A2 0.18 kW to size 90L2 2.2 kW
- 4-pole from size 63A4 0.12 kW to size 90S4 1.1 kW
- 6-pole from size 63A6 0.09 kW to size 90S6 0.75 kW

## 2.3.1 Physical measurements and conversion factors

Physical measurement	Unit of measurement		Conversion from	
	SI units	Imperial units	SI units to Imperial units	Imperial units to SI units
<b>length</b>	m = metre	ft = foot	1 ft = 0.3048 m	1 m = 3.2808 ft
		in = inch	1 in = 25.4 mm	1 mm = 0.03937 in
<b>speed</b>	m/s	ft/s	1 ft/s = 0.3048 m/s	1 m/s = 3.2808 ft/s
		in/s	1 in/s = 25.4 mm/s	1 mm/s = 0.03937 in/s
<b>weight</b>	kg = kilogram	lb = pound	1 lb = 0.4536 kg	1 kg = 2.205 lb
<b>density</b>	kg/m <sup>3</sup>	lb/ft <sup>3</sup>	1 lb/ft <sup>3</sup> = 16.0185 kg/m <sup>3</sup>	1 kg/m <sup>3</sup> = 0.0624 lb/ft <sup>3</sup>
		lb/in <sup>3</sup>	1 lb/in <sup>3</sup> = 27.6799 g/cm <sup>3</sup>	1 g/cm <sup>3</sup> = 0.0361 lb/in <sup>3</sup>
<b>moment of inertia</b>	kg·m <sup>2</sup>	lb·ft <sup>2</sup>	1 lb·ft <sup>2</sup> = 0.4214 kg·m <sup>2</sup>	1 kg·m <sup>2</sup> = 23.3 lb·ft <sup>2</sup>
		lb·in <sup>2</sup>	1 lb·in <sup>2</sup> = 2.264 kg·cm <sup>2</sup>	1 kg·cm <sup>2</sup> = 0.417 lb·in <sup>2</sup>
<b>force</b>	N = newton	lbf = pound-force	1 lbf = 4.44822 N	1 N = 0.2248 lbf
	kgf* = kilogram-force		1 lbf = 0.4536 kgf	1 kgf = 2.2045 lbf (1 N = 0.102 kgf 1 kgf = 9.8 N)
<b>mechanical moment</b>	[Nm]	lbf·ft	1 lbf·ft = 0.138 kgf·m	1 kgf·m = 7.23 lbf·ft
	kgf·m*		1 lbf·ft = 1.36 N·m	1 N·m = 0.738 lbf·ft
<b>energy</b>	J = Joule (=Nm)	lbf·ft	1 lbf·ft = 1.36 J	1 J = 0.738 lbf·ft
	kWh = kilowatt hour		1 lbf·ft = 3.7·10 <sup>-7</sup> kWh	1 kWh = 2.6·10 <sup>6</sup> lbf·ft
<b>pressure</b>	Pa = Pascal (=N/m <sup>2</sup> )	psi (=lbf/ in <sup>2</sup> )	1 psi = 6.895·10 <sup>3</sup> Pa (N/m <sup>2</sup> )	1 Pa = 1.45·10 <sup>-4</sup> psi
	atm* = atmosphere		1 psi = 0.068 atm	1 atm = 14.7 psi
	bar*		1 psi = 0.0689 bar	(1Pa=9.87·10 <sup>-6</sup> atm=10 <sup>-5</sup> bar)
<b>power</b>	W = Watt	hp = horse power	1 hp = 745.7 W	1 W = 0.00134 hp
		lbf·ft/s	1 lbf·ft/s = 1.356 W	1 W = 0.738 ft·lbf/s

(\*) unit of measurement not included in SI system

## 2.3.2 Formulas

MEASUREMENT	SYMBOLS AND UNITS OF MEASUREMENT	DESCRIPTION	RELATIONSHIPS
phase voltage and current	$E$ [V] $I_E$ [A]	voltage and current measured between phase and neutral	
voltage and current concatenated	$V$ [V] $I_V$ [A]	voltage and current measured between phase and phase (threephase systems)	<p>three-phase system</p>  <p><math>V = \sqrt{3}E \quad I_V = I_E/\sqrt{3}</math></p>
speed of rotation	$n$ [min <sup>-1</sup> ] $\omega$ [rad/s]	motor shaft speed	$n = (60/2p) \times \omega = 9,55 \times \omega$
force weight force	$F$ [N] $P$ [N]	product of mass x acceleration product of mass x gravitational acceleration	$F = m_{[kg]} \times a_{[m/s^2]}$ $P = m_{[kg]} \times 9,8_{[m/s^2]}$
moment	$M$ [Nm]	product of force x distance r of point of application from axis	$M = F_{[N]} \times r_{[m]}$
linear power	$P$ [W]	product of force x linear speed	$P = F_{[N]} \times V_{[m/s]}$
angular power	$P$ [W]	product of torque x rotational speed	$P = M_{[Nm]} \times \omega_{[rad/s]}$
energy	$W$ [J]	power delivery over time	$W = P_{[W]} \times t_{[s]}$



## 2.3.3 Nominal characteristics

Nominal characteristics: total of numerical electrical and mechanical values (power voltage, frequency, current, speed, power delivery,...) together with their duration and sequence in time, attributed to the machine and indicated on the nameplate, in conformity with the specified conditions. In particular, the following values in relation to the operation of the motor; the same symbols are used in the performance tables.

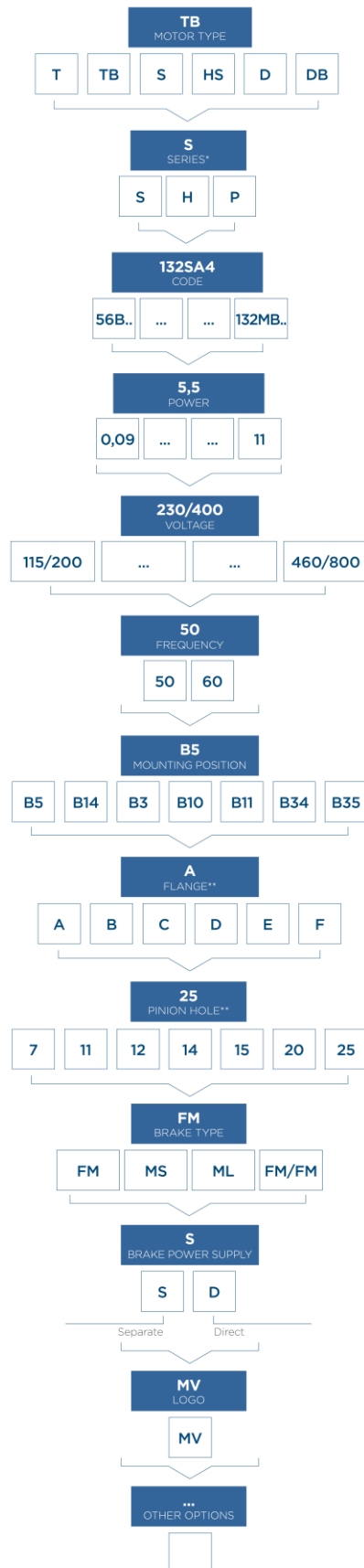
MEASUREMENT	SYMBOLS AND UNITS OF MEASUREMENT	DESCRIPTION															
nominal voltage	$V_n$ [V]	concatenated voltage at the machine's terminals at nominal power															
nominal current	$I_n$ [A]	current absorbed by the motor at nominal power															
starting current	$I_s$ [A]	line current absorbed by the motor at nominal starting voltage and frequency															
nominal torque	$M_n$ [Nm]	torque delivered by motor shaft at nominal conditions															
starting torque	$M_s$ [Nm]	torque delivered by the motor shaft at starting															
sag torque	$M_i$ [Nm]	minimum asynchronous torque under normal running conditions developed by the motor at speeds from zero to maximum torque speed; this definition does not apply to asynchronous motors whose torque decreases continuously as speed increases															
maximum torque	$M_{max}$ [Nm]	<p>maximum torque under normal running conditions developed by the motor without a sudden drop in speed; this definition does not apply to asynchronous motors whose torque decreases continuously as speed increases</p>															
synchronous speed	$\omega_s$ [rad/s] $n_s$ [min <sup>-1</sup> ]	<p>synchronous motor shaft speed under no load; the following relations apply:  <math>n_s = 120 \times f_n / p</math> [rpm]    <math>\omega_s = 4p \times f_n / p</math> [rad/s]    <math>\omega_s = n_s / 9,55</math> [rad/s]                      where: <math>f_n</math> = nominal power supply frequency [Hz]  <math>p</math> = number of motor poles                      it follows that:</p> <table border="1"> <thead> <tr> <th>poles</th> <th>rpm at 50Hz</th> <th>rpm at 60Hz</th> </tr> </thead> <tbody> <tr> <td>2</td> <td>3000</td> <td>3600</td> </tr> <tr> <td>4</td> <td>1500</td> <td>1800</td> </tr> <tr> <td>6</td> <td>1000</td> <td>1200</td> </tr> <tr> <td>8</td> <td>750</td> <td>900</td> </tr> </tbody> </table>	poles	rpm at 50Hz	rpm at 60Hz	2	3000	3600	4	1500	1800	6	1000	1200	8	750	900
poles	rpm at 50Hz	rpm at 60Hz															
2	3000	3600															
4	1500	1800															
6	1000	1200															
8	750	900															
nominal speed	$n_n$ [rpm] $\omega_n$ [rad/s]	motor shaft speed in nominal conditions at nominal power															

<p><b>creep</b> <b>nominal creep</b></p>	<p>s s<sub>n</sub></p>	<p>ratio between the deviation of the shaft speed relative to the synchronous speed and the synchronous speed itself; normally declared as a percentage:  <math>s = (\omega_s - \omega) / \omega_s \times 100</math>  <math>s_n = (\omega_s - \omega_n) / \omega_s \times 100</math></p>
<p><b>mechanical power delivery</b></p>	<p>P [W]</p>	<p>numerical value of mechanical power delivered to the shaft; the relation between power, torque and speed is:  <math>P [W] = T [Nm] \times \omega [rad/s]</math></p>
<p><b>nominal power delivery</b></p>	<p>P<sub>n</sub> [W]</p>	<p>numerical value of the mechanical power delivered to the shaft at nominal conditions  <math>P_n (W) = T_n [Nm] \times \omega_n [rad/s]</math></p>
<p><b>power factor</b> <b>nominal power factor</b></p>	<p>cosφ cosφ<sub>n</sub></p>	<p>cosine of the phase angle between the voltage and current, a function of the load characteristics</p>
<p><b>active absorbed electrical power</b></p>	<p>P<sub>a</sub> [W]</p>	<p>numerical value of the active electrical power absorbed from the mains; the following relations apply:                      three-phase system <math>P_a [W] = \sqrt{3} V_{[V]} I_{[A]} \cos\phi</math>                      single-phase system <math>P_a [W] = V_{[V]} I_{[A]} \cos\phi</math></p>
<p><b>reactive electrical power absorbed</b></p>	<p>Q<sub>a</sub> [VAr]</p>	<p>numerical value of the reactive electrical power absorbed from the mains; the following relations apply:                      three-phase system <math>Q_a [W] = \sqrt{3} V_{[V]} I_{[A]} \sin\phi</math>                      single-phase system <math>Q_a [W] = V_{[V]} I_{[A]} \sin\phi</math></p>
<p><b>reactive power furnished by an array of capacitors</b></p>	<p>Q<sub>c</sub> [VAr]</p>	<p>numerical value of the reactive electrical power furnished by an array of capacitors of capacity C [μF], for three-phase systems:  <math>Q_c = \sqrt{3} V^2 [V] C_{[m\mu F]} 2\pi f_n [Hz]</math></p>
<p><b>efficiency</b></p>	<p>η</p>	<p>ratio between mechanical power delivery and electrical power absorption  <math>\eta = P / P_a</math>  <math>\eta\% = P / P_a \times 100</math>                      once we know the efficiency, the power delivered to the shaft can be calculated as follows:                      asynchronous three-phase motor <math>P [W] = \sqrt{3} V_{[V]} I_{[A]} \eta \cos\phi</math>                      asynchronous single-phase motor <math>P [W] = E_{[V]} I_{[A]} \eta \cos\phi</math></p>
<p><b>moment of inertia</b></p>	<p>J [kg×m<sup>2</sup>]</p>	<p>Product of rotating mass m [kg] and the square of the equivalent radius of rotation r [m]:  <math>J = m r^2</math>                      In practice one uses PD<sup>2</sup>, the product of the weight [kgp] and the square of the equivalent diameter of rotation D [m]; it follows that:  <math>PD^2_{[kgp \times m^2]} = 4J_{[kg \times m^2]}</math>                      Note that the weight in the practical system corresponds (numerically) to the mass in the SI system</p>
<p><b>acceleration time</b> <b>braking time</b></p>	<p>t<sub>a</sub> [s] t<sub>f</sub> [s]</p>	<p>In evaluating the acceleration and braking times we must sum the motor's moment of inertia J<sub>m</sub> to that of the load J<sub>ext</sub>, to obtain the total moment of inertia:  <math>J_t = J_m + J_{ext}</math>                      and analogously:  <math>PD^2_t = PD^2_m + PD^2_{txt}</math>                      Furthermore, to the torque delivered by the motor M<sub>m</sub>, which may be accelerating or braking, we must subtract or add the resisting torque M<sub>r</sub>, to obtain, as a first approximation:                      during acceleration, the accelerating torque: <math>M_a = M_m - M_r</math>                      during braking, the braking torque: <math>M_f = M_m + M_r</math>                      As a first approximation we can use for M<sub>m</sub> the value of the starting torque as given in the catalogue; a more precise calculation, given the load curve, can be obtained by integrating from 0 to the nominal speed. The acceleration time, for a speed variation of Δω (or Δn), is:                      in the SI system <math>t_a = [J_t / M_a] \times \Delta\omega [kg \times m^2]</math>                      in the practical system <math>t_a = [2.67 PD^2_t / M_a] \times \Delta n \times 10^{-3} [kgp \times m^2]</math>                      The same formulas apply to the braking time, with M<sub>a</sub> replaced by M<sub>f</sub> and bearing in mind that M<sub>a</sub> and Δn are negative.                      If the external loads are connected by gear reducers or speed multipliers, the respective moments of inertia must be referred to the motor axis by multiplying them by the square of the ratio between the load speed n<sub>c</sub> and the motor speed n<sub>m</sub>:  <math>J_{ext} (n_c / n_m)^2</math>                      and analogously for PD<sup>2</sup>.                      To refer the inertia to a load of mass M drive in a linear motion by the motor to the motor's shaft, we must know the ratio between the linear speed v and the corresponding speed n (or ω) of the motor; the corresponding moment of inertia will be:                      in the SI system <math>J_{ext} = M_{[kg]} (v_{[m/s]} / \omega_{[rad/s]})^2</math>                      in the practical system <math>PD^2 = 365 P_{[kgp]} (v_{[m/s]} / n_{[rpm]})^2</math>                      where P is the weight of the moving part.</p>

## 2.3.4 Tolerances

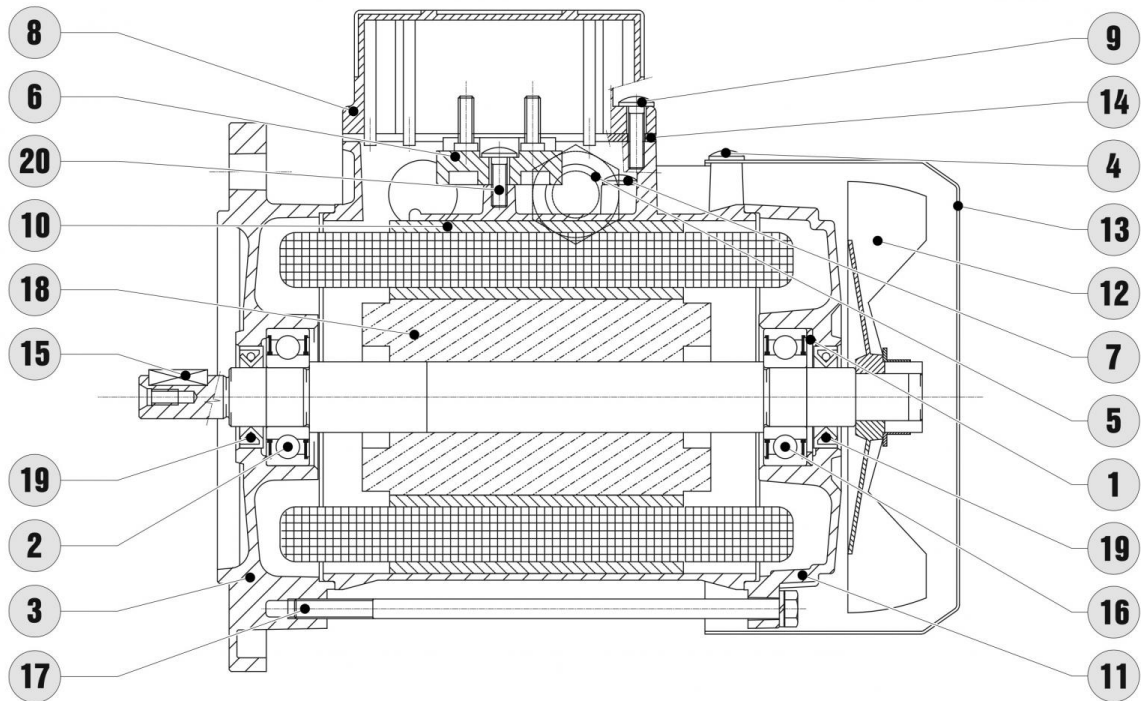
	TOLERANCES
Efficiency (ratio between measured power delivery and absorption)	-15% di (1-h)
Power factor	-1/6 di (1-cosj) 0.02 min 0.07 max
Creep at full load and at operating temperature - Power delivery $\geq$ 1kW - Power delivery < 1kW	$\pm$ 20% $\pm$ 30%
Current with rotor locked with any specific starting device	20%
Torque with rotor locked	-15% +25%
Sag torque	-15%
Maximum torque	-10%
Moment of inertia	$\pm$ 10%
Sound pressure level	+3dBA
Height of axis	-0.5mm.
Flange centring diameter	J6
Outer diameter of shaft on delivery end D - Up to 28mm - Over 28mm	j6 k6
Key dimensions F x GD	h9
Keyway width F	N9

## 2.4.1 Designation




\*D/DB motors excluded  
 \*\*Mounting positions B10/B11 only

## 2.4.2 Design features



1. Preloaded spring
2. Bearing on driving side
3. Flange/Shield driving side
4. Fan cover fastening screws
5. Cable gland
6. Terminal box
7. Ground screw
8. Terminal board cover
9. Terminal box fastening screws
10. Casing complete with winding
11. Shield opposite to driving side
12. Fan
13. Fan cover
14. Terminal box cover gasket F
15. Key
16. Bearing opposite to driving side
17. Stud
18. Rotor with shaft
19. Oil seal
20. Fastening screw for terminal box

**Casing**

- in die-cast aluminium alloy, chosen for its high tensile strength and corrosion resistance from size 56 to size 132;
- finned; not painted from size 56 to size 132 (painting optional);
- fitted with lifting rings starting from size 100;
- fitted for mounting feet opposite the terminal block from size 56 to size 63; fitted for mounting feet opposite the terminal block and in the two side positions from size 71 to size 132;
- fitted with clamp for grounding inside the terminal block; option of external GND connection on the motor casing. The terminal is marked with the symbol .

**Shaft**

In C40 steel or similar; dimensions, standardised output shaft and key, according to IEC60072-1; end of shaft with threaded hole on driving side. Optional double-ended shaft from size 63 to size 132.

**Rotor**

The rotor is the squirrel-cage type in die-cast aluminium or aluminium alloy. The aluminium alloy (silumin) is used on single-phase motors to increase their starting torque. The angle, number of slots and geometrical shape of the rotors have been designed in relation to the number of stator slots and the polarity of the motor to ensure the most regular operation even in variable speed applications, decreasing the phenomenon of torque pulses, detrimental to the motor's correct operation and a cause of running noise. Rotor balancing, from frame size 90, is performed dynamically with the half-key method in accordance with ISO 2373 standard rating G6.3 for normal vibration. On request it is possible to have increased balancing (rating G2.3).

**Stator and Winding**

- Laminations with controlled magnetic properties. All TS motors are constructed with low loss magnetic laminations. All TH, TP, SH and HSH motors are constructed with very low loss isolated magnetic laminations.
- Appropriate number of slots and geometrical shape in relation to the motor's polarity so as to enable the most regular operation;
- Winding made with glazing copper G2 degree in H class, capable of providing considerable mechanical strength and ensuring an adequate thermal reserve such as to slow down the ageing of the motor;
- Class F insulation system;
- 100% testing of all electrical parameters at line end.

**Flange / Shield**

In die-cast aluminium alloy, excluding the oversized B5 flange for size 132 (cast iron); the rear shield is in cast iron or aluminium, depending on the size, in the versions with FM or MS type electromagnetic brake and non-return device.

**Terminal block cover**

In die-cast aluminium alloy with Motovario logo. All terminal box covers have a pre-defined thinner section to be easily broken, which is suitable for the fitting of a cable gland (M20 on size 63-71-80, M25 on size 90-100-112, M32 on size 132) and allowing the insertion of power cable on fan or flange sides.

**Fan**

Centrifugal fan with radial blades to enable cooling in both directions of rotation, keyed externally onto the non-drive-end shaft. Made of loaded thermoplastic, suitable for normal motor operating temperatures. Optionally in aluminium for very high/low ambient temperatures, or for EU ATEX versions.

**Fan cover**

Made of galvanised stamped plate, suitably shaped to avoid phenomena of resonance and to improve the flow of air over the motor casing. The air feed grill has holes of a size, in relation to the distance from the accessible rotating parts, in conformity with the safety requirements of the UNI EN 294 standard.

**Cable glands and plugs**

Cable glands and plugs are in compliance with metric standardization.

STANDARD MOTOR (TS, TH, TP, D, SH, HSH)						
Size	Fitted for cable gland	Cable gland included	Plugs included	Cable entry point Ø min - max [mm]	Power terminal clamps	Tightening torque max [Nm]
56	2 x M16 x 1,5 (2 for side)	1 x M16 x 1,5	-	5 - 10	M4	2
63	4 x M16 x 1,5 (2 for side)	1 x M16 x 1,5 (1)	-	5 - 10	M4	2
71 - 80	2 x M16 x 1,5 2 x M20 x 1,5 (1 + 1 for side)	1 x M20 x 1,5 (1)	-	6 - 12	M4	2
90	2 x M25 x 1,5 (1 for side)	1 x M25 x 1,5	1 x M25 x 1,5	9 - 17	M5	3
100	2 x M25 x 1,5 (1 for side)	1 x M25 x 1,5	1 x M25 x 1,5	9 - 17	M5	3
112	2 x M25 x 1,5 (1 for side)	1 x M25 x 1,5	1 x M25 x 1,5	9 - 17	M5	3
132	2 x M32 x 1,5 (1 for side)	1 x M32 x 1,5	1 x M32 x 1,5	11 - 21	M6	4

BRAKE MOTOR (TBS, TBH, TBP, DB)						
Size	Cable routing	Cable glands	Plugs	Cable entry point Ø min - max [mm]	Power terminal clamps	Tightening torque max [Nm]
63	4 x M16 x 1,5 (2 for side)	2 x M16 x 1,5 (2)	2 o 3 x M20 x1,5 (2)	5 - 10	M4	2
71 - 80	4 x M20 x 1,5 (2 for side)	1 x M20 x 1,5 1 x M16 x 1,5 (2)	2 o 3 x M20 x1,5 (2)	6 - 12	M4	2
90	2 x M25 x 1,5 2 x M20 x 1,5	1 x M25 x 1,5 1 x M20 x 1,5 (3)	1 x M25 x 1,5 1 o 2 x M20 x 1,5 (3)	9 - 17	M5	3
100	2 x M25 x 1,5 2 x M20 x 1,5	1 x M25 x 1,5 1 x M20 x 1,5 (3)	1 x M25 x 1,5 1 o 2 x M20 x 1,5 (3)	9 - 17	M5	3
112	2 x M25 x 1,5 2 x M20 x 1,5	1 x M25 x 1,5 1 x M20 x 1,5 (3)	1 x M25 x 1,5 1 o 2 x M20 x 1,5 (3)	9 - 17	M5	3
132	2x M32 x 1,5	1 x M32 x 1,5 1 x M20 x 1,5 (4)	none or 1 x M32 x 1,5	11 - 21	M6	4

**Notes:**

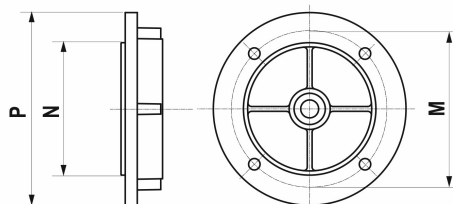
- (1) For motor sizes 63-71-80 in the standard version, cable glands are not installed but are included with the motor. The cable glands may be mounted in the desired positions by breaking on of the caps on the terminal block box.
- (2) a) Direct power: 3 plugs installed, 1 M16 cable gland included, the other cable gland is already installed;  
b) Separate power: 2 plugs installed, both cable glands installed.
- (3) a) Direct power: 3 plugs installed, 1 M20 cable gland included, the other cable gland is already installed  
b) Separate power: 2 plugs installed, both cable glands installed.
- (4) a) Direct power: 1 plug installed, 1 M20 cable gland included, the other cable gland is already installed;  
b) Separate power: plugs not included, both cable glands installed.

For all motor sizes cable glands and nameplates may also be located opposite the standard side (respectively right and left viewed from the coupling side).

For all motor sizes mounting position B3 is mounted on feet with terminal block on the opposite side. As an option and excluding size 63, feet can be mounted also on the side with respect to the terminal block.

On request for motor sizes it is possible to have the cable gland fan side; in this case call our Technical Service for technical feasibility and dimensions.

## 2.4.3 Flange B5



		P [mm]	M [mm]	N [mm]	F [mm]	Mat.
56	A	120	100	80	7	EN AC 46100
63	A	140	115	95	9,5	EN AC 46100
71	B	140	115	95	9,5	EN AC 46100
	A	160	130	110	9,5	EN AC 46100
80/90	B	160	130	110	9,5	EN AC 46100
	A	200	165	130	11,5	EN AC 46100
100/112	B	200	165	130	11,5	EN AC 46100
	A	250	215	180	11,5	EN AC 46100
132	B	250	215	180	11,5	EN AC 46100
	A	300	265	230	14,5	EN AC 46100

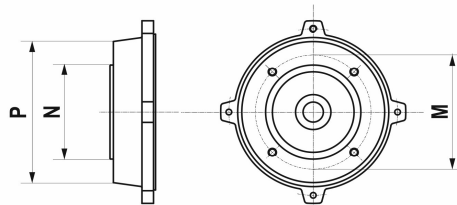
F - Through holes

A - Standard

B - Reduced

Note: contact our technical service for solutions with reduced or oversize flanges

## 2.4.4 Flange B14



		P [mm]	M [mm]	N [mm]	F [mm]	Mat.
56	A	80	65	50	M5	EN AC 46100
63	B	80	65	50	M5	EN AC 46100
	A	90	75	60	M5	EN AC 46100
71	B	90	75	60	M5	EN AC 46100
	A	105	85	70	M6	EN AC 46100
80	B	105	85	70	M6	EN AC 46100
	A	120	100	80	M6	EN AC 46100
90	B	120	100	80	M6	EN AC 46100
	A	140	115	95	M8	EN AC 46100
100 / 112	B	140	115	95	M8	EN AC 46100
	A	160	130	110	M8	EN AC 46100
132	A	200	165	130	M10	EN AC 46100

F - Threaded holes

A - Standard

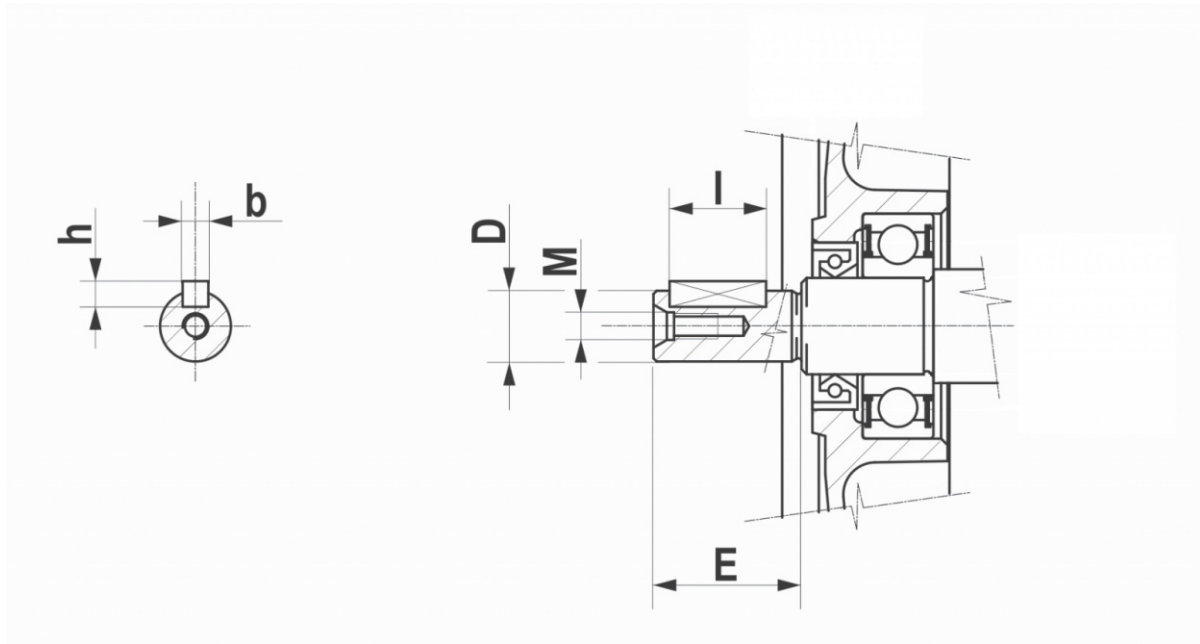
B - Reduced

Note: contact our technical service for solutions with reduced or oversize flanges



## 2.4.5 Motor shaft

Motor shaft end - drive side



		D x E [mm]	M	b x h x l [mm]
56	A	9 x 20	M4	3 x 3 x 12
63	B	9 x 20	M4	3 x 3 x 12
	A	11 x 23	M4	4 x 4 x 15
71	B	11 x 23	M4	4 x 4 x 15
	A	14 x 30	M5	5 x 5 x 20
80	B	14 x 30	M5	5 x 5 x 20
	A	19 x 40	M6	6 x 6 x 30
90	B	19 x 40	M6	6 x 6 x 30
	A	24 x 50	M8	8 x 7 x 35
100-112	B	24 x 50	M8	8 x 7 x 35
	A	28 x 60	M10	8 x 7 x 45
132	B	28 x 60	M10	8 x 7 x 45
	A	38 x 80	M12	10 x 8 x 60

A - Standard

B - Reduced

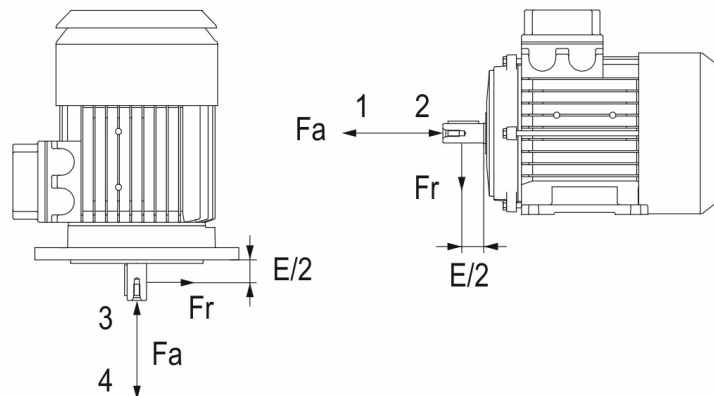
Note: contact our technical service for solutions with reduced or oversize flanges

### 2.4.6 Bearings

Radial, single race ball bearings are used, with normal play, lubricated for life, drive side shielding 2Z, non-drive side shielding 2Z or 2RS in the standard or brake versions respectively. The rear bearings are pre-loaded with a compensation ring that acts on the external ring of bearings to decrease operating noise and to enable axial movement by thermal action.

Motor size	Drive side bearing (DE)	Non-drive side bearing (NDE)	Static load coefficient $C_0$ [N]
56	6201 2Z	6201 2Z/2RS	n.d.
63	6202 2Z	6202 2Z/2RS	3750
71	6202 2Z	6202 2Z/2RS	3750
80	6204 2Z	6204 2Z/2RS	6550
90S/L	6205 2Z	6205 2Z/2RS	7800
100	6206 2Z	6206 2Z/2RS	11200
112	6306 2Z	6306 2Z/2RS	16000
132S/M	6308 2Z	6308 2Z/2RS	24000

## 2.4.7 Radial load



Maximum overhung load  $F_r$  [N] at 50Hz with  $F_a/F_r < 0.2$

	2 (p)	4 (p)	6 (p)	8 (p)
<b>63</b>	80	360	410	450
<b>71</b>	270	350	400	440
<b>80</b>	440	560	650	720
<b>90S</b>	480	610	700	770
<b>90L</b>	490	620	710	790
<b>100</b>	680	870	1000	1100
<b>112</b>	990	1260	1450	1600
<b>132S</b>	1350	1720	1980	2190
<b>132M</b>	1430	1830	2100	2320

(p) Pole

The following table was obtained by taking into account a radial load  $F_R$  applied on shaft output end centre line and a negligible axial load  $F_A$  ( $F_A/F_R < 0,2$ ), with bearing reliability rate of 98% and lifetime of 20000 operating hours.

In the case of belt/pulley coupling, the motor shaft is subject to an overhung load  $F_R$  which can be evaluated as follows:

$$F_R = \frac{19100 \cdot P_n \cdot K}{n \cdot D_p} \pm P_P \text{ [N]}$$

where:

$P_n$  = Nominal motor power [kW];

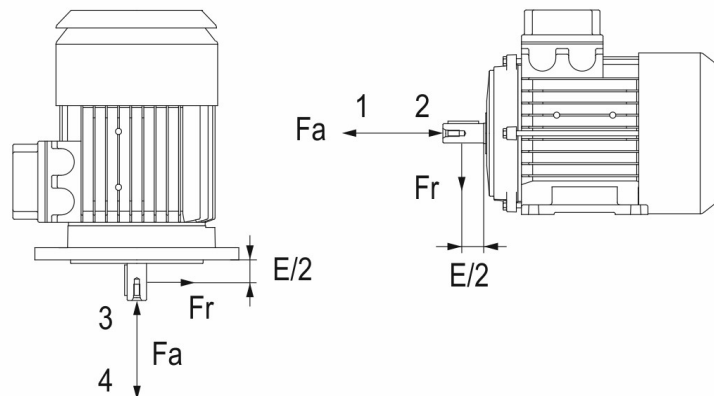
$P_P$  = pulley weight; the sign in the equation accounts for whether the weight is acting with or against the belt tension [N];

$n$  = speed [rpm];

$D_p$  = primitive diameter of pulley [m];

$K$  = coefficient, generally between 2 and 3, depending on type of belt/pulley transmission (refer to transmission documentation).

## 2.4.8 Axial load



Maximum axial load  $F_a$  [N] at 50Hz with no overhung load  $F_r$

	2 (p)				4 (p)				6 (p)				8 (p)			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
<b>63</b>	225	105	115	215	280	160	170	270	325	205	215	315	355	235	245	345
<b>71</b>	225	105	120	210	280	160	175	265	325	205	220	310	355	235	250	340
<b>80</b>	365	225	245	345	460	320	340	440	525	385	405	505	580	440	460	560
<b>90S</b>	390	210	235	365	495	315	340	470	565	385	410	540	620	440	465	595
<b>90L</b>	390	210	240	360	495	315	345	465	565	385	415	535	620	440	470	590
<b>100</b>	550	360	400	500	690	500	545	645	790	600	645	745	870	680	725	825
<b>112</b>	795	575	625	745	1000	780	830	950	1150	930	980	1100	1260	1040	1090	1210
<b>132S</b>	1145	765	845	1065	1445	1065	1145	1365	1650	1270	1350	1570	1820	1440	1520	1740
<b>132M</b>	1145	765	865	1045	1445	1065	1165	1345	1650	1270	1370	1550	1820	1440	1540	1720

(p) Pole

IMPORTANT: In case of vertical installation with the shaft end uppermost, values 3 and 4 must be inverted.

No axial loads above  $0,25C_0$  are allowed. The following table was obtained with no axial load, based on the type of installation and of the force application direction; the calculation made includes any possible unfavourable effect of the rotor weight and of the preload spring force.

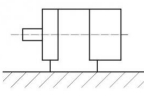
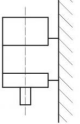
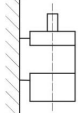
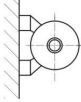
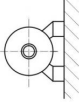

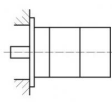
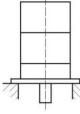
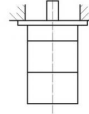
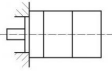
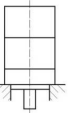
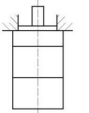
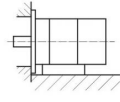
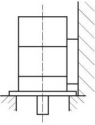
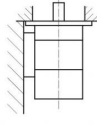
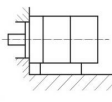
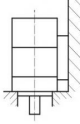
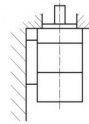
For 60Hz operation, a reduction of approximately 7% of the values specified in the table must be considered.

**Mounting position:** specific construction in relation to the mounting equipment, type of bearings and shaft end.

**Installation type:** positioning of the motor in relation to the axis line (horizontal or vertical) and mounting equipment.

The table lists the most common installation methods in relation to the mounting position.

With reference to standard IEC 60034-7, the electric motor's nameplate must be marked with the mounting position (IMB3, IMB5, IMB14, IMB34, IMB35) independently of the installation type.

IMB3	     
IMB5	  
IMB14	  
IMB35	  
IMB34	  

Mounting position:

- IMB3 with feet
- IMB5 with drive side flange, through holes
- IMB14 with drive side flange, threaded holes
- IMB35 with feet and drive side flange, through holes
- IMB34 with feet and drive side flange, threaded holes

Besides being available in the above-indicated standardised mounting positions, motors are available also in compact versions; this applies to both aluminium CHA and CBA gear reducers (B10 mounting position) and to cast iron CH, CB and CS gear reducers (B11 mounting position). These mounting positions require special flanges integral with the gear reducer and cable output shaft where pinion is fitted before the reduction stage. The resulting gearmotor has reduced axial size. For further details, including dimensional drawings, refer to the specific catalogues of the gear reducers.

Definition and applicability (IEC 60034-5):

The protection rating gives the protection provided by the enclosure in relation to:

- protection of persons against approaching or contact with live components;
- protection against ingress of solid foreign matter;
- protection against damage by water.

It does not account for protection against mechanical damage or special conditions, including humidity (for example, as caused by condensation), corrosive vapours, mould, insects or explosive atmospheres.

The code indicating the protection rating is composed of the letters IP followed by two characteristic digits which indicate conformity with the conditions indicated in the table.

The Motovario electric motors in standard operation have an IP55 degree of protection; optionals include executions with IP56, IP65 and IP66 degrees of protection .

The Motovario self-braking electric motors have an IP54 degree of protection; optionals include executions with IP55, IP56, IP65 and IP66 degrees of protection.

Motors with superior degree of protection of IP66 cannot be supplied.

Protection degree of the motors is guaranteed and certified by tests carried out in qualified testing room.

The first digit indicates the degree of protection against ingress of solid matter and approach to or contact with live components	
0	no protection
1	protection against ingress of solid bodies of diameter greater than 50mm. (e.g. involuntary contact with the hands)
2	protection against ingress of solid bodies of diameter greater than 12mm. (e.g. finger)
3	protection against ingress of solid bodies of diameter greater than 2.5mm
4	protection against ingress of solid bodies of diameter greater than 1mm
5	protection against ingress of dust; penetration by dust is not completely eliminated, but it may not enter in amounts sufficient to compromise the operation of the motor
6	total protection against ingress of dust

The second digit indicates the degree of protection against ingress of water	
0	no protection
1	drops of water falling vertically may not cause damage (e.g. condensation)
2	drops of water falling vertically may not cause damage when the machine is inclined at any angle up to 15° from its normal position
3	water falling at an angle to the vertical of up to 60° may not cause damage
4	water sprayed onto the machine from any direction may not cause damage
5	water sprayed onto the machine with a nozzle from any direction may not cause damage
6	waves or jets of water may not penetrate into the machine in amounts sufficient to cause damage
7	water may not penetrate into the machine in amounts sufficient to cause damage when it is submerged in given conditions of pressure and duration
8	the motor may remain submerged permanently in water in the conditions indicated by the manufacturer

### 2.7.1 Insulation classes

The thermal insulation system is classified by a single letter (IEC60085).

Depending on the thermal class, the winding overtemperature, which is the difference between their temperature and ambient temperature, has the maximum limit given in the table; the resistance variation method is used to measure the overtemperature.

To obtain the maximum absolute temperature admitted for the insulation system, a maximum ambient temperature of 40°C is used.

Standard electric motors are made with a winding insulation system in conformity with thermal classification F, in accordance with publication IEC60034-1; the thermal reserve, for standardised powers, is such that the overtemperatures of the windings do not exceed the limits set for class B; this ensures less strain on the insulation from a thermal point of view, therefore a longer service life for the motor.

Given the ambient installation conditions, constructions to class H are optionally available, for which the respective overtemperature is permitted.

### 2.7.2 Thermal class

MOT.	Thermal class			
		B	F	H
$P_n < 600W$	$\frac{\Delta T}{T_M}$	85 130	110 155	130 180
$P_n \geq 600W$	$\frac{\Delta T}{T_M}$	80 130	105 155	125 180
IC410 / IEC 60034-7	$\frac{\Delta T}{T_M}$	85 130	110 155	130 180

$P_n$  = Nominal power

IC410 / IEC 60034-7 = Motors without ventilation (IC410 for IEC60034-7)

$\Delta T$  = Winding overtemperature in [K] measured with the resistance variation method

$T_M$  = Maximum operating temperature of windings in [°C] at ambient temperature of 40°C

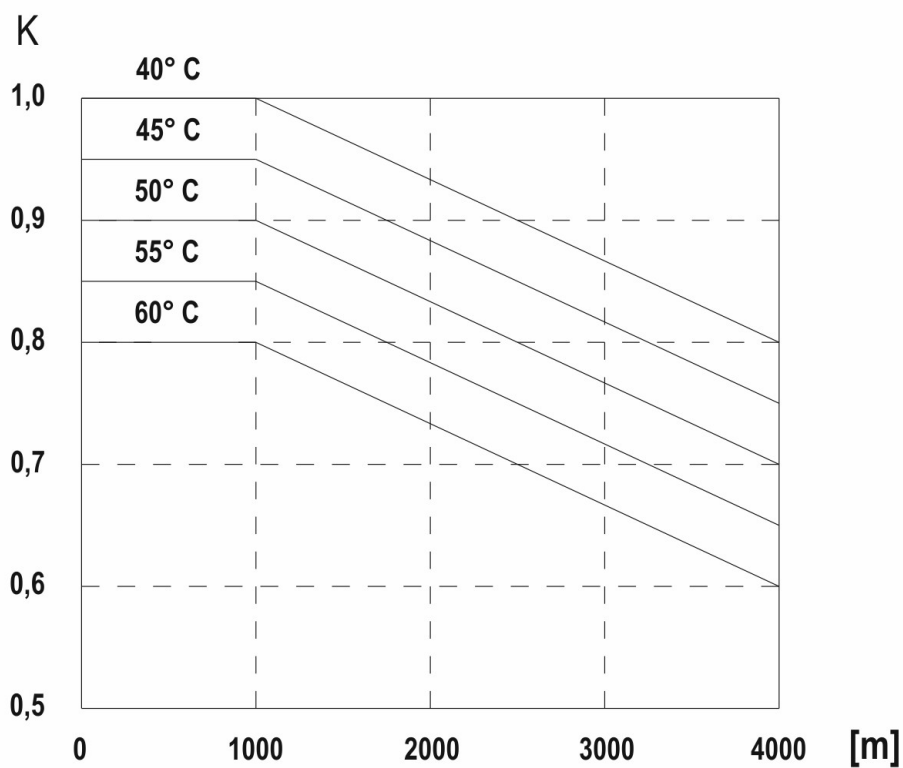
### 3.1.1 STD ambient conditions - Derating for non-standard conditions

Standard electric motors are designed for the following operating conditions on-site:

- **Altitude:** no greater than 1000 m above sea level.
- **Ambient temperature:** minimum -15°C, maximum +40°C.

If the motors are destined to operate at places at a height of between 1000 and 4000m a.s.l., or if the ambient temperature is between +40 and +60°C, it is necessary to **apply** a corrective coefficient (see graph) to the motor power to allow the motor to maintain its thermal reserve (maximum temperature reached by the windings in normal operating conditions). **Alternatively, to select the right motor size it is recommended to account for such ambient conditions by dividing the application's power requirement by the same corrective coefficient.**

In some cases, power corrective coefficient cannot be applied, this mainly applies to high-efficiency motors (TH, TP, SH, HSH); however it must be borne in mind that this reduces the motor's thermal reserve. In any case, the maximum winding temperature must be within the range given for the thermal class in question. For further details, contact our Technical Service.





### 3.1.2 Options for particularly humid environments

The paint and the standard impregnation method adopted for insulation of the motor windings is also suitable in cases where there is a high humidity environment (tropical climates). In such case no additional treatment is required.

In the case of particular ambient conditions that may lead to the formation of condensation inside the motor, the following options are available:

1. Condensation drain holes. Holes for draining out condensation, normally closed with plastic plugs to provide the protection rating declared on the nameplate; periodically open the plugs to drain out the moisture and then close them again.
2. Condensation heater. Condensation heaters are electrical heating elements installed directly on the heads of the motor windings and, due to the particular nature of the impregnation process, connected to the latter. This prevents condensation forming even in extreme climatic conditions. The power cables are routed into the motor's terminal block enclosure and hooked up to a mammut type terminal block. The heaters should not be powered while the motor is running.

Condensation heater technical data:

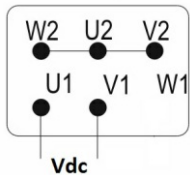
- insulation class: 180°C
- temperature range: -50 to +180°C
- dielectric rigidity: 2kV
- heating power:
  1. 12.5W (30W for UL/CSA homologated construction) for motor sizes 63 to 112
  2. 25W (50W for UL/CSA homologated construction) for motor sizes 132
- operating voltage: 110V or 230V

Custom voltages and powers are available on request.

Condensation drain holes and condensation heaters can also be ordered as individual options.

With reference to the condensation heaters, with a DC power source, the same effect can be obtained by powering two phases of the motor with the motor off; the power voltage must be such as to provide the same heating effect as the condensation heater itself, as follows:

$$V_{dc} = \sqrt{(P \cdot R)}$$



where:

P = heating power [W]

R = resistance between two phases measured across terminals U1 - V1

Options 1) and 2) are not available in conjunction with servo-ventilation and on the self-braking motors with ML brake; on self-braking motors with brake, FM and MS are only available with IP55 degree of protection.

### 3.1.3 Low temperature construction (-40°C / -15°C)

In case of applications with ambient temperature included between -40°C and -15°C, the electric motor is equipped with special components:

- Bearings with special lubrication (LHT) and higher backlash (C3) suitable for low running temperatures;
- Silicone oil seal;
- Aluminium fan;
- Metal cable glands and plugs.

In these conditions, if condensation formation is a risk, we recommend employing, or at least order the condensation drain holes and/or heaters. The low temperature construction is not available in combination with forced ventilation or for brake motors with ML or MS brake; brake motors with FM brakes have this option only with IP55 protection rating.

### 3.1.4 High temperature construction (+60°C / +90°C)

In case of applications with ambient temperature included between +60°C and +90°C, the electric motor is equipped with special components:

- Class H winding insulation
- Bearings with special lubrication (LHT) and higher backlash (C3) suitable for high running temperatures;
- Viton/FKM seal rings;
- Aluminium fan;
- Metal cable glands and plugs.

Furthermore, when selecting the product it is advisable to adopt power derating for +60°C ambient temperature (see "Standard ambient conditions - Derating for non-standard ambient temperature/ altitude"). The high temperature construction is not available in combination with forced ventilation or on brake motors.

### 3.2.1 Standard high efficiency (TS), high (TH, SH, HSH) and premium (TP) motors

Motovario, three-phase, single polarity motors are available in three different versions (IE1-IE2-IE3) in compliance with standard 60034-30-1. The efficiency value is calculated according to the method set forth in standard IEC 60034-2-1.

1. IE1: TS series (standard efficiency) for nominal power less than 0.12 kW.;
2. IE2: TH series (high efficiency) for nominal power greater than or equal to 0.12 kW and less than 0.75 kW;
3. IE3: TP series (premium efficiency) (\*) 4 poles for nominal power greater than or equal to 0.12 kW, 2 and 6 poles for nominal power greater than or equal to 0.75 kW.

Motovario single-phase, single-polarity motors are available in IE2 efficiency class according to IEC 60034-30-1 for nominal power ratings higher than or equal to 0.12 kW and lower than or equal to 2.2 kW. The efficiency value is calculated according to the method set forth in standard IEC 60034-2-1.

Table of Motovario commercial availability

NOMINAL POWER [kW]	EFFICIENCY LEVEL		
	IE1	IE2	IE3
$P_n < 0,12$	TS-TBS	-	-
$0,12 \leq P_n < 0,75$	-	TH-TBH SH-HSH	TP-TBP (**)
$P_n \geq 0,75$	-	SH-HSH	TP-TBP

(\*) Motor TP100LA4 2,2 kW and all TP 6 poles motors are available at 60Hz only upon request. As a consequence, these motors are in IE3 efficiency level at 50 Hz and IE2 at 60 Hz in case of bifrequency electrical design (standard 230/400-265/460V 50-60Hz and optional 200/346-220/380V 50-60Hz, 290/500-330/575V 50-60Hz and 400/690-460/800V 50-60Hz, see chapter on input voltage and frequency).

(\*\*) Only 4 poles.

### 3.2.2 EU Regulation No.°1781/2019

The EC Regulation 1781/2019 (EU MEPS – Minimum Energy Performance Standard) implements Directive 2009/125/EC with regard to ecodesign requirements, to improve energy saving. It applies on the European Union territory to the three-phase asynchronous electric motors having the following features:

- 2, 4, 6 or 8 poles
- Nominal power between 0.12 kW and 1000 kW, thresholds included
- Nominal voltage between 50V and 1000 V, thresholds included
- Designed to operate in continuous duty S1
- Designed to operate in environments with ambient temperature -30°C to +60°C and altitude below 4000m asl

These motors can be placed on the Community market for the first time according to the 2 following deadlines:

1. 01/07/2021
  - a. The efficiency class of three-phase motors with a nominal power greater than or equal to 0.12 kW and less than 0.75 kW with 2, 4, 6, 8 poles (excluding ATEX Ex eb increased safety motors) must be at least IE2.
  - b. The efficiency class of three-phase motors with a nominal power greater than or equal to 0.75 kW and less than or equal to 1000 kW with 2, 4, 6 or 8 poles (excluding ATEX Ex eb increased safety motors) must be at least IE3.
2. 01/07/2023
  - a. The efficiency class of ATEX increased safety Ex eb motors with nominal power between 0.12 kW and 1000 kW (thresholds included) with 2, 4, 6 or 8 poles and single phase motors with nominal power greater than or equal to 0.12 kW must be at least IE2.
  - b. The efficiency class of three-phase motors (excluding ATEX motors and brake motors) with a power rating greater than or equal to 75 kW and less than or equal to 200 kW with 2, 4 or 6 poles must be at least IE4.

This regulation explicitly excludes the following types of motors that, as a consequence, do not need to comply with any special efficiency requirement:

- motors designed for intermittent (S3) or limited duration (S2) duty
- fully enclosed non-ventilated motors (IC410 according to IEC or TENV according to NEMA)
- double polarity motors
- motors in wireless or battery-powered equipment
- motors specifically designed for electrically driven vehicles
- motors in portable equipment whose weight is supported by hand during operation
- motors equipped with mechanical switches.

The energy performance, and hence efficiency, of Motovario compact motors (incorporated with the gear reducer) can be tested independent of the gear reducer; in compliance with Regulation No. 1781/2019, they are thus not an exception to motors with coupling according to the IEC standard.

We remind you that in other parts of the world (i.e. USA, Australia, South Korea, etc.) other energy regulations, with other provisions, apply. It is a good practice to collect detailed information about these regulations before placing an electric motor on these markets.

### 3.3.1 Standard construction motor voltage and frequency

In the standard construction (Euro Voltage) the power voltages and frequencies permitted for motors are as follows:

1. For single polarity three-phase motors 230/400V 50Hz with 10% voltage tolerance;
2. For double polarity three-phase motors 400V 50Hz with 10% voltage tolerance;
3. For single-phase motors 230V 50Hz with 5% voltage tolerance.

Within the permitted voltage tolerance range the nominal motor ratings may differ slightly by an amount which generally depends on the motor size; no generally valid rules are available. As a first approximation, the data given in the table applies, where the values represent corrective coefficients for the catalogue and nameplate data.

	$V_n -10\%$	$V_n -5\%$	$V_n$	$V_n +5\%$	$V_n +10\%$
$n$	0,97	0,99	1	1,01	1,02
$M_n$	1,03	1,01	1	0,99	0,98
$I_n$	1,05	1,03	1	1,03	1,05
$\cos\phi_n$	1,08	1,05	1	0,95	0,9
$M_s/M_n$	0,81	0,9	1	1,1	1,21

Normally, single polarity three-phase motors in the standard (Euro Voltage) construction have nameplate ratings of 230/400V 50Hz and 265/460V 60Hz. The nominal power for 60 Hz voltages is greater by 15-20% in TS series motors; and is equal to the nominal power at 50 Hz in TH and TP series motors. A tolerance of 10% is guaranteed for all four voltage/frequency values.

### 3.3.2 Standard electrical construction motors with ST2 option

A single polarity three-phase motor in the standard (Euro Voltage) construction may also be used with 60Hz grid power. In particular, if powered at 460V 60Hz it can deliver 15% to 20% more than the nominal power at 50 Hz (over-rated power) while maintaining the other catalogue ratings (to an approximation). In further detail, with 60 Hz power the nominal operational ratings vary in relation to the power voltage compared to their values at 50 Hz (catalogue ratings) by approximately the factors given in the following table.

V 50 Hz	V 60Hz	$M_n$	$P_n$	$n_n$	$M_s$	$M_s/M_n$
220/380 230/400 240/415	255/440 265/460 280/480	1,00	1,15-1,20	1,20	1,00	1,00
	220/380 230/400 240/415	0,83	1,00	1,20	0,70	0,83

Consequently, single polarity three-phase standard efficiency motors (TS series) for voltages 220/380V, 230/400V or 240/415V, frequency 60Hz and standard nominal power (second row in table above) are constructed with standard (Euro Voltage) winding; note however that some ratings will decrease (in particular, starting torque). If the performance is considered insufficient for the application, the said motors can be ordered with over-rated power which, since they are constructed with a custom winding, will guarantee the catalogue ratings (see next paragraph). For single polarity three-phase motors the voltages 220/380V $\pm$ 5% 50Hz and 240/415V $\pm$ 5% 50Hz are included in the interval 230/400V $\pm$ 10% 50Hz and are thus constructed with standard windings. These voltage/frequency ratings are declared on the nameplate if the motors are explicitly requested with such power supply specifications in the order. On request, motors can be supplied for which even these voltages have a declared tolerance of  $\pm$ 10%.

Single-phase standard (Euro Voltage) motors cannot generally be used on 60Hz power, but require a custom electrical design (modified winding and capacitor).

## 3.3.3 Motors with non-standard electrical construction (SP1 - optional)

As an option, single polarity three-phase motors can be provided for the optional voltages/frequencies indicated in the following table; in this case the winding is always non-standard. "S" indicates the nominal power at 50Hz, i.e. the catalogue rating (technical data table), while "M" indicates the overrated nominal power (15-20%) at 60Hz. TH and TP motors are not available at 60 Hz with over-rated power.

[Hz]	[V]	TS	TH/TP
50-60	200/346-220/380	S-M	S
	290/500-330/575	S-M	S
	400/690-460/800	S-M	S
50	115/200	S	S
	133/230	S	S
	208/360	S	S
	255/440	S	S
	380/660	S	S
	415/720	S	S
60	120/208	S, M	S
	200/346	S, M	S
	208/360	S, M	S
	230/400	M <sup>(1)</sup>	S
	240/415	M <sup>(1)</sup>	S
	330/575 <sup>(2)</sup>	S	S
	346/600	S, M	S
	380/660	S, M	S
	400/690	S, M	S
415/720	S, M	S	

**Notes:**

The voltage pair 220/380 60Hz can be selected with over-rated power by selecting 4 voltages 200/346-220/380V, 50-60 Hz; the standard power selection is available with standard winding and option ST2 for the TS series, or optional winding for the TH and TP series.

TP series 6-pole motors are available at 60 Hz only upon request. When the voltage values are present on nameplate, usually at 60 Hz, these motors (TP with 6 poles) have a IE2 efficiency class.

- Standard power at 50 Hz with standard winding and option ST2.
- By selecting 4 voltages 290/500-330/575V 50-60Hz the over-rated power is available for TS series, and standard power for TH series and TP series.

The following table gives the detailed values of "S" and "M" for all nominal voltages listed in the catalogue.

	[kW]													
(S)	0,09	0,12	0,18	0,25	0,37	0,55	0,75	1,1	1,5	2,2	3	4	5,5	7,5
(M)	0,11	0,14	0,21	0,29	0,45	0,65	0,9	1,3	1,8	2,6	3,6	4,7	6,5	9

High efficiency motors (TH series) and premium efficiency motors (TP series) for voltages 220/380V, 230/400V or 240/415V at 60 Hz are always made with a custom winding and are not available with over-rated power. Single-phase motors (SH and HSH series) are available on request with the following supply voltages: 230V 60Hz, 115V 60Hz, 230V 50Hz with balanced winding (see page 102). More voltages are available upon request. Normally, all single polarity three-phase motors are fitted with a 6 terminal winding hooked up to a 6 clamp terminal block and are suited for D/Y connection. For the USA market, single polarity three-phase motors with UL/CSA homologation can be ordered for the voltage 230/460V 60Hz with 9 terminal winding hooked up to a 9 clamp terminal block for YY/Y connection. On request, motors suited for different power voltages than those indicated above are available. UL/CSA homologated motors do not declare voltages above 600V on their nameplates.

### 3.3.4 Inverter power supply

Standard asynchronous three-phase motors can be used in variable speed applications if powered by inverters, in observance of the general prescriptions for rotating electrical machines given in IEC 60034-1. This is possible thanks to the generous electromagnetic specification and effective insulation system, with an ample thermal and dielectric margin, such as to enable good response even in case of overloads and limited frequency applications. All three-phase motors are also equipped with phase separators to ensure resistance of the insulation to the voltage peaks generated by inverter power supply. Applications with an extremely high or low speed may require the use of forced ventilation, on the one hand to improve cooling as it is insufficient, on the other hand to eliminate the noise caused by self-ventilation and to decrease the load caused by the flow rate of the air produced by the fan, that becomes quite considerable at high speeds. Of course, the operating limits of the servo-fan are strictly connected with the conditions of load (duration and quantity); for S1 duty, please refer to the indications given in the operation diagram below. Applications at speeds above 3600rpm must be discussed with our technical service. Note that Motovario also produces the DRIVON vectorial inverter drive. For further information, consult the respective catalogue. In use, asynchronous electric motors with inverter power supply have two operating ranges:

#### Constant torque (magnetic flux) range: constant V/f ratio.

(400/50 for motor with 230/400V 50Hz star winding connection or 400/690V 50Hz  $\Delta$  winding connection and three-phase inverter, 230/50 for 230/400V 50Hz  $\Delta$  winding connection and single- or three-phase inverter). This range allows the motor to run at nominal torque down to a lower limit (approximately 30 Hz for self-ventilated motors in S1 continuous duty and 2 Hz for S3 intermittent or S2 limited duration duty, or with forced ventilation motor in S1 continuous duty), below which the torque is derated as shown in the graph; the low frequency torque curve is nonetheless dependent on the inverter settings (e.g. voltage boost function); in the case of a vectorial inverter (e.g. the DRIVON), the motor's nominal torque can be guaranteed down a few Hz, and even in S1 duty if the motor is of the forced ventilation type. Under these conditions, the best performance can be achieved through the integrated autotuning function, allowing inverter automatic setting by adapting it to the parameters of the equivalent circuit of the electric motor, thus optimizing its performance. In the case of a 230/400V 50Hz winding motor powered by a three-phase inverter, the motor can also be connected in  $\Delta$ ; in these conditions the magnetic flux in the motor remains almost constant up to 87Hz, and the constant torque range can thus be extended up to that frequency, obviously if the inverter can deliver the current required by the  $\Delta$  winding motor. Operation at constant V/f but at torques greater than nominal, even overloading the motor, are admitted, so far as they are compatible with the inverter's current limit and the duty time.

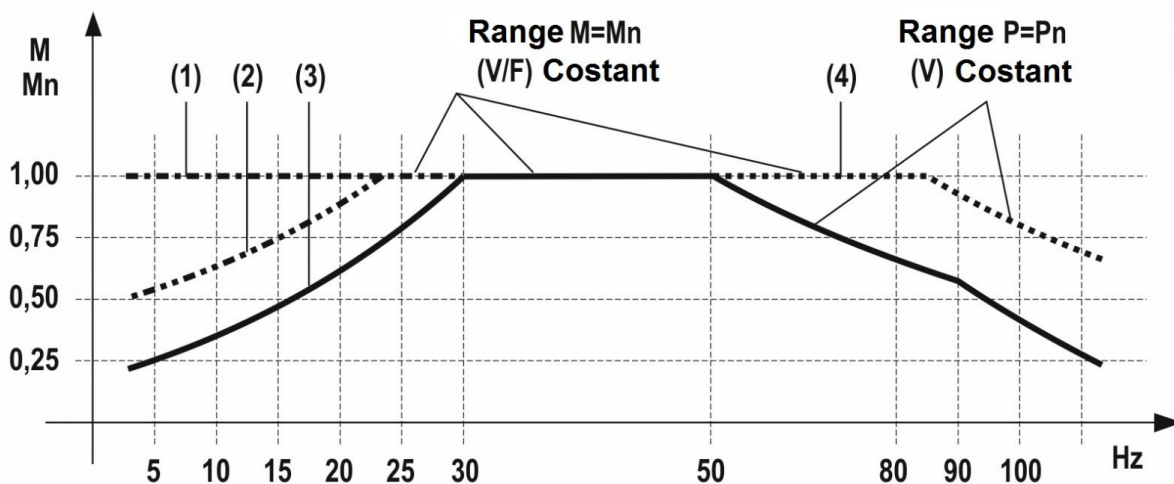
N.B.: On request, motors can be supplied with special windings to adapt the constant torque speed range to the client's actual application.

#### Constant voltage operating range (value set by power mains).

In this range, where the voltage reaches the maximum possible value (mains voltage), an increase in the speed and hence frequency decreases the V/f ratio and hence the magnetic flux (defluxing operation); there is also a drop off in torque with constant power delivery up to around 80-90Hz; beyond this limit (the "limit frequency") torque and power both fall off as the frequency rises. For motor operation with constant torque up to 87Hz, the line of the power remains constant for values above 100Hz. The limit frequency  $f_L$  can be determined as follows:

$$f_L = f_n M_{max}/M_n$$

where  $f_n$  and  $M_n$  are the nominal frequency (e.g. 50Hz) and nominal torque respectively, and  $M_{max}$  is the maximum torque. The value of  $M_{max}/M_n$  is given on the performance data page.



(1) Torque limit with vectorial inverter (e.g. DRIVON) in S1 duty and forced ventilation motor (IC416), or S2 or S3 duty with forced ventilation

self-ventilated motor (IC411).

(2) Torque limit with scalar V/f inverter in S1 duty and forced ventilation motor (IC416), or S2 or S3 duty with self-ventilated motor (IC411).

(3) Torque limit with vectorial inverter (e.g. DRIVON) in S1 duty and self-ventilated motor (IC411).

(4) Extension of torque limit with three-phase inverter (e.g. DRIVON and delta winding connection).



## 3.4 SOUND PRESSURE LEVEL

The table gives the normal mean sound pressure level  $L_{pA}$  [dB(A)] for three-phase motors running under no load, power frequency 50Hz, with measurement per ISO R 1680; tolerance +3dB(A). At 60Hz the values are increased by around 2dB(A). The values are measured in a semi-anechoic chamber at 1 m from the housing of the motor located in a free field and on a reflecting plane. The measurements were made with standard motors in closed constructions with external surface ventilation (method IC411 per IEC 60034-6).

	$L_{pA}$ [dB(A)]			
	2 (*)	4 (*)	6 (*)	8 (*)
<b>63</b>	56	46	47	44
<b>71</b>	61	48	47	45
<b>80</b>	64	54	52	50
<b>90</b>	65	55	53	51
<b>100</b>	69	57	56	53
<b>112</b>	70	58	56	53
<b>132</b>	76	60	58	56

(\*) Poles

“Duty” is defined as being the load condition the machine is subject to, including (if applicable) the periods of starting, electrical braking, operating with no load, and rest, as well as their duration and sequence in time. Duty can be described as one of the following standard types, in line with IEC 60034-1, or by another type identified by the user with a graph to show the sequence over time of the variable duty parameters; if the sequence is not defined, a nominal sequence must be selected which is no less severe than the actual sequence, conforming to one of the predefined duty types; if the duty is not specified, S1 is deemed applicable. The values given in the catalogue tables refer to electric motors, totally enclosed, with fan-cooled external surface ventilation, for which in nominal operating conditions, taking account of the insulation class, the S1 duty is applied. The type of duty is given on the motor name plate. In case of non-continuous duty three-phase standard construction motors (duty S1) may be overloaded as indicated in the table.

Duty		Power over-rating factor
S2	60min.	1,1
	30min.	1,2
	10min.	1,4
S3	60%	1,1
	40%	1,15
	25%	1,25
	15%	1,35
Other	-	Contact our technical service

#### S1 continuous duty

Operation at constant load of sufficient duration to achieve thermal equilibrium; for it to be applicable the user must precisely specify the load and nominal operating conditions in which the machine is to run for an unlimited period.

#### S2 limited duration duty

Constant load operation for a limited period of time, less than that required to achieve thermal equilibrium, followed by a period of standby sufficient to cool the machine down to the coolant fluid temperature, with a tolerance of 2°C. This duty is abbreviated as S2 followed by an indication of the running time; the user must precisely specify the load, running time and nominal operating conditions in which the machine, started at ambient temperature, may operate for a limited period. If the load is not specified, nominal load is assumed.

Sample designation: S2 30 min.

#### S3 periodic intermittent duty

Sequence of identical cycles, each including a period of operation at constant load and a period of standby; in this duty the cycle is such that the starting current does not significantly affect the overtemperature. The duty is designated S3 followed by the intermittency ratio; the cycle duration used to calculate the intermittency ratio is 10 minutes. The user must precisely specify the load and nominal operating conditions in which the machine is to run for a periodic cycle.

Sample designation: S3 25%.

#### S4 periodic intermittent duty with starting

Sequence of identical cycles, each including a non-negligible starting phase, period of operation at constant load and period of standby. The duty is designated S4 followed by the intermittency ratio, the motor moment of inertia  $J_T$  and load moment of inertia  $J_L$ , referred to the motor shaft. The user must precisely specify the load and nominal operating conditions in which the machine is to run for a periodic cycle.

Sample designation: S4 25%  $J_T=0.15\text{kgm}^2$   $J_L=0.7\text{kgm}^2$

#### S5 periodic intermittent duty with electric braking

Sequence of identical cycles, each including a starting phase, period of operation at constant load, period of rapid electric braking and period of standby. The duty is designated S5 followed by the intermittency ratio, the motor moment of inertia  $J_T$  and load moment of inertia  $J_L$ , referred to the motor shaft. The user must precisely specify the load and nominal operating conditions in which the machine is to run for a periodic cycle.

Sample designation: S5 25%  $J_T=0.15\text{kgm}^2$   $J_L=0.7\text{kgm}^2$

#### S6 periodic uninterrupted duty with intermittent load

Sequence of identical cycles, each including a period of operation at constant load and period of operation under no load; there is no period of standby. The duty is designated S6 followed by the intermittency ratio; the cycle duration used to calculate the intermittency ratio is 10 minutes. The user must precisely specify the load and nominal operating conditions in which the machine is to run for a periodic cycle.

Sample designation: S6 40%

#### S7 periodic uninterrupted duty with electric braking

Sequence of identical cycles, each including a starting phase, period of operation at constant load and period of electric braking; there is no period of standby. The duty is designated S7 followed by the motor moment of inertia  $J_T$  and load moment of inertia  $J_L$ , referred to the motor shaft. The user must precisely specify the load and nominal operating conditions in which the machine is to run for a periodic cycle.

Sample designation: S7  $J_T=0.15\text{kgm}^2$   $J_L=0.7\text{kgm}^2$

#### **S8 periodic uninterrupted duty with correlated variations of load and speed**

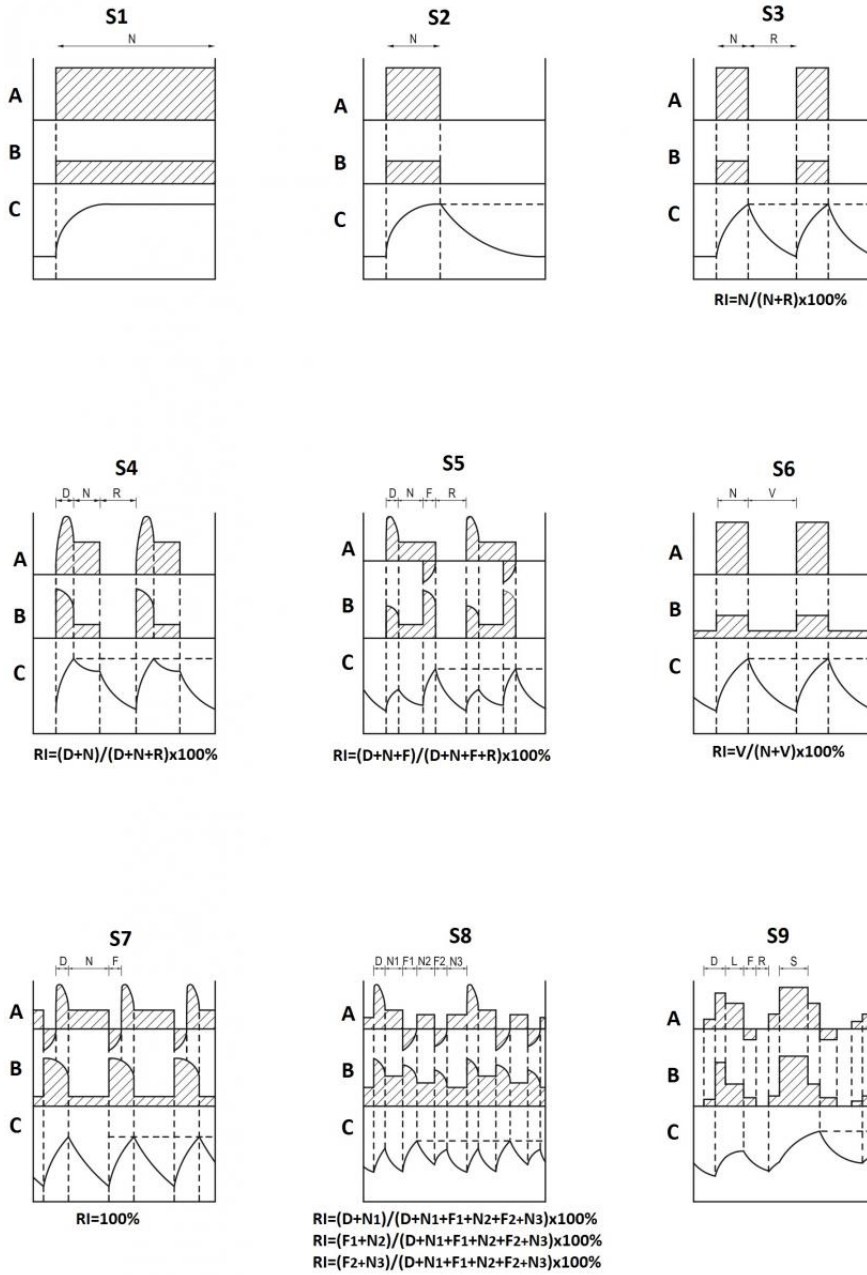
Sequence of identical cycles, each including a period of operation at constant load at a preset constant speed, followed by one or more periods of operation at other constant loads at other speeds (done by changing the number of poles, for instance); no standby period exists. The duty is abbreviated as S8 followed by the motor moment of inertia  $J_T$  and load moment of inertia  $J_L$ , referred to the engine shaft, the loads, speeds and intermittency ratios for each period of operation at a given speed. The user must precisely specify the load and nominal operating conditions in which the machine is to run for a periodic cycle. Sample designation:

S8  $J_T=0.15\text{kgm}^2$   $J_L=0.7\text{kgm}^2$  (5KW-740rpm-30%) (2kW-1460rpm-30%) (1KW-980rpm-40%).

#### **S9 duty with non-periodic variations of load and speed**

Duty in which the load and speed generally vary in a non-periodic manner within the allowable range; this duty includes frequent overloads which may largely exceed the full load values; for this type of duty one must consider suitable full load values as a reference for the overloads. The duty is designated S9; the user must give precise details of the loads, speed and other conditions, including overloads, in which the machine is to operate non-periodically.

# 3.5 DUTY



<b>A</b>	Load
<b>B</b>	Electrical losses
<b>C</b>	Temperature
<b>D</b>	Starting or acceleration time
<b>N</b>	Constant load running time
<b>F</b>	Electric braking time
<b>R</b>	Standby time
<b>RI</b>	Intermittency ratio
<b>V</b>	No load running time
<b>θ<sub>max</sub></b>	Maximum temperature reached during cycle

## 3.6.1 Bimetal thermal cutouts

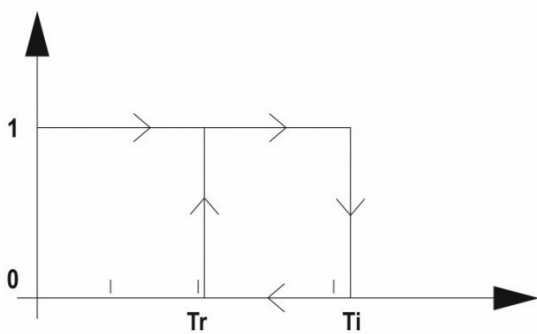
A bimetal thermal cutout is simply an NC bimetal contact which, at its trip temperature, switches from closed to open. It is normally used as a sensor to control a contactor which shuts off power. In this way the cutout guarantees quick circuit breaking without the maximum allowed winding temperature being exceeded, in relation to the motor insulation class per IEC60034-1. Thermal cutouts are normally positioned in close contact with the conductors inside the winding heads, before they are formed and impregnated. Normally in the three-phase motors three thermoprotectors in series are used (one for each phase). In single-phase motors there is only one thermoprotector. The terminals of the thermal protectors are free inside the terminal box; their wiring to special pins of motor terminal board or to a mammut terminal is available upon request. Upon request it is possible to provide thermoprotectors that are normally open (NO), with the principle of operation inverse to that described.

Technical characteristics of standard bimetal thermal cutouts:

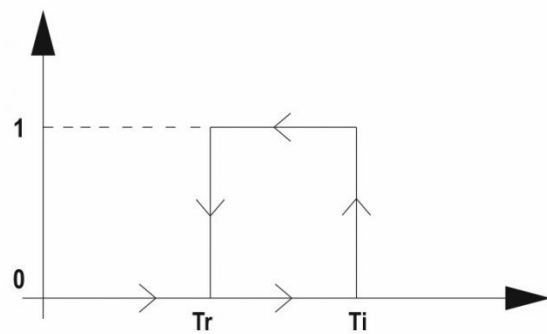
- Type NC;
- Trip temperature 130°C for class F insulation motors, 140°C for class F insulation motors homologated to the UL/CSA standards, 150°C for class H motors. Trip temperature tolerance  $\pm 5^\circ\text{C}$ ;
- Insulation dielectrical rigidity 2KV;
- Conformity with standard IEC60034-11.

Different trip temperatures are available on request, from 70 to 180°C.

Operation with NC contact



Operation with NO contact

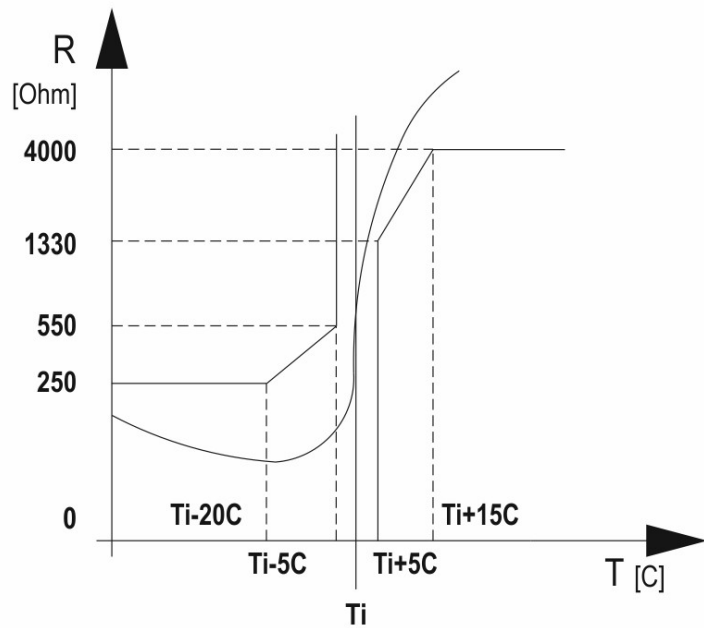


$T_i$	Trip temperature
$T_r = T_i - 30^\circ\text{C}$	Rearm temperature

### 3.6.2 Thermistors (PTC)

Thermistors are temperature sensors with high temperature sensitivity. Thermistors with positive temperature coefficient (PTC) are generally used, whose resistance rises drastically in the vicinity of the trip temperature. Their use is similar to that of bimetallic thermal fuses, the resistance value can thus be used by a release device (not supplied by Motovario) protecting the motor. Thermistor terminals are free inside the terminal block box; their wiring to special pins of motor terminal board is available upon request.

TEMPERATURE - RESISTANCE DIAGRAM



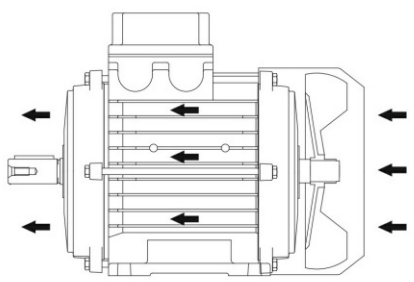
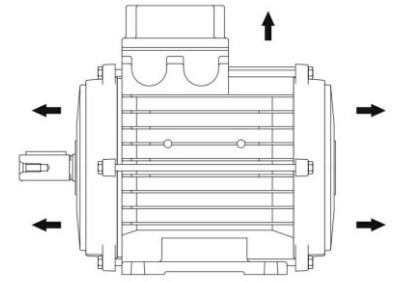
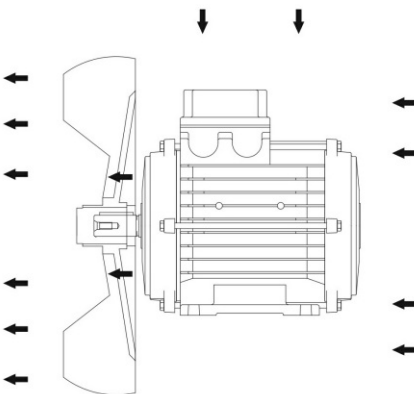
Technical characteristics of standard thermistors:

- Trip temperature 130°C for class F motors, also valid for UL/CSA homologation; 150°C for class H motors;
- Insulation dielectrical rigidity 2.5kV.

Different trip temperatures are available on request, from 60 to 180°C.

## 3.7.1 Cooling systems

Standard construction electric motors are closed and self-ventilated with a fan mounted to the motor shaft which operates in both directions of rotation. This cooling system, per IEC 60034-6, is designated IC411. Standard construction electric motors are constructed so that with IC411 cooling, duty is S1; this duty is guaranteed if the fan cover intake grille is not blocked by dirt deposited during operation or due to the installation itself (for example, inside the frame of a machine); such situations of poor ventilation must be carefully analysed to avoid compromising the motor's performance. If the cooling system is IC418 (e.g. motor driving a fan and cooled by the resulting current of air), standard motors can be used in non-ventilated construction and S1 duty; naturally the speed and flow of air must be at least equivalent to that of the IC411 system. In case of total lack of external surface ventilation (IC410) standard motors may be used only for limited duration or very periodic duty. In such conditions the standard duty is S2 10 min or S3 10%. On request, motors can be provided without ventilation for S1 duty; the power, for a given motor size, is reduced to around 1/3 of the power available in S1 duty for IC411 motors. Contact our technical service for further information.

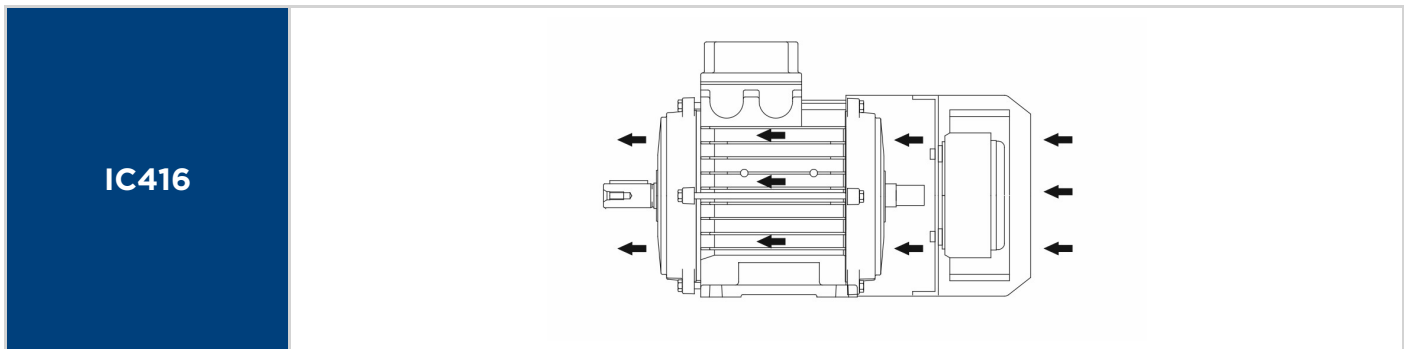
<p><b>IC411</b></p>	
<p><b>IC410</b></p>	
<p><b>IC418</b></p>	

## 3.7.2 Forced ventilation

In the case of applications of the variable speed motor, it may be necessary to resort to forced ventilation (cooling method IC416), obtained by means of an axial flow servo-fan whose air flow rate is independent of the speed of rotation of the drive shaft. The supply, independent from the electric motor, is given by means of a connector applied directly on fan cover (single phase version 230V 50-60Hz, sizes 63-90), or by means of a separate terminal box cover applied on fan cover (single-phase 230V 50-60Hz sizes 100-132 and three-phase 380/420-380/480V 50-60Hz sizes 100-132). On request, we can analyse different solutions, or for special power voltages. Use of the servo-fan is recommended for motor speeds much lower than the nominal speed, when the air flow rate of the standard fan would be insufficient for correct cooling, and for much higher speeds than the nominal speed, when the losses due to ventilation of the standard fan would no longer be negligible compared to the nominal load and also the noise of ventilation would be annoying. Forced ventilation could be necessary in case of frequent starting torques, as this condition entails a high heating and a low heat dissipation by the fan fitted on motor shaft. The speed limit which determines the need for forced ventilation depends on the load conditions to which the electric motor is subjected, in relation to the speed and duty type. Forced ventilation has been designed as a kit; therefore it is possible to modify a standard selfventilated electric motor (IC411) into a motor with forced ventilation (IC416) by following these simple instructions:

- disassemble the standard fan cover, unscrewing the fastening screws from the motor casing;
- remove the fastening bush of the plastic fan and remove the fan with the help of a tool;
- assemble the forced ventilation kit by tightening to the motor casing with the fastening screws of the fan cover just disassembled.

On request it is possible to supply forced ventilated motors with forced ventilation supply directly from the terminal box of the motor; in this case the forced ventilated unit cannot be supplied as a kit, but it should be ordered together with the complete motor. The application of the forced ventilation kit determines a length variation of the motor (see dimensional tables). Forced ventilation is not available for protection ratings higher than IP55 or in combination with high or low temperature.

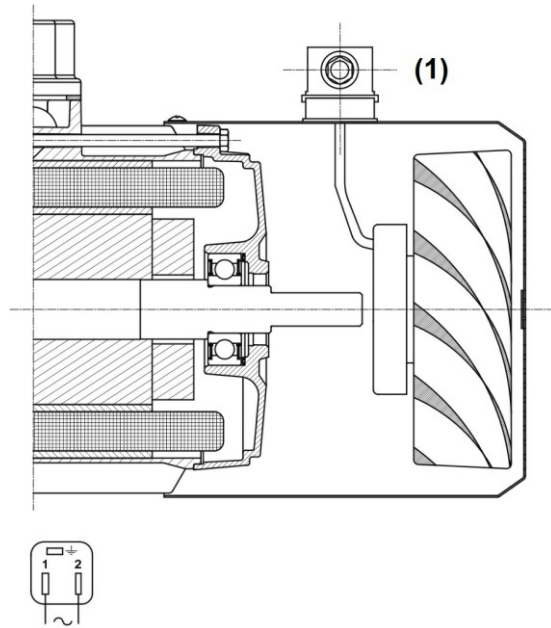


	[V] / [Hz]	[W]	[A]
<b>63</b>	230V/50-60Hz	14-16	0,09-0,11
<b>71</b>	230V/50-60Hz	14-16	0,09-0,11
<b>80</b>	230V/50-60Hz	33-36	0,20-0,24
<b>90</b>	230V/50-60Hz	33-36	0,20-0,24
<b>100</b>	230V/50-60Hz	33-36	0,20-0,24
<b>112</b>	230V/50-60Hz	76-90	0,35-0,40
<b>132</b>	230V/50-60Hz	76-90	0,35-0,40
<b>100</b>	380-420V/50Hz 380-480V/60Hz	55-60	0,21-0,20
<b>112</b>	380-420V/50Hz 380-480V/60Hz	55-60	0,21-0,20
<b>132</b>	380-420V/50Hz 380-480V/60Hz	55-60	0,21-0,20

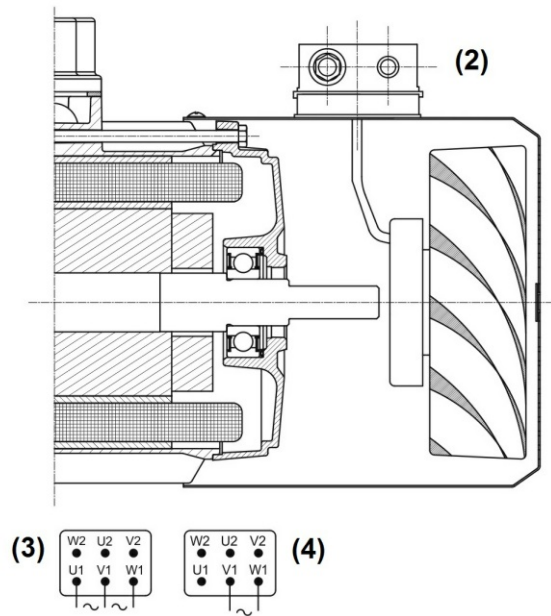


# 3.7 COOLING SYSTEMS

Single-phase power  
sizes 63-71-80-90



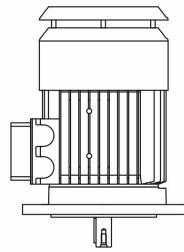
Single- and three-phase power  
sizes 100-112-132



1. Connector mPm B202000N2 DIN 43650-A/ISO 4400
2. Cable gland M16x1.5 – Cable entry diameter 5-10 mm
3. Three-phase power 400V
4. Single-phase power 230V

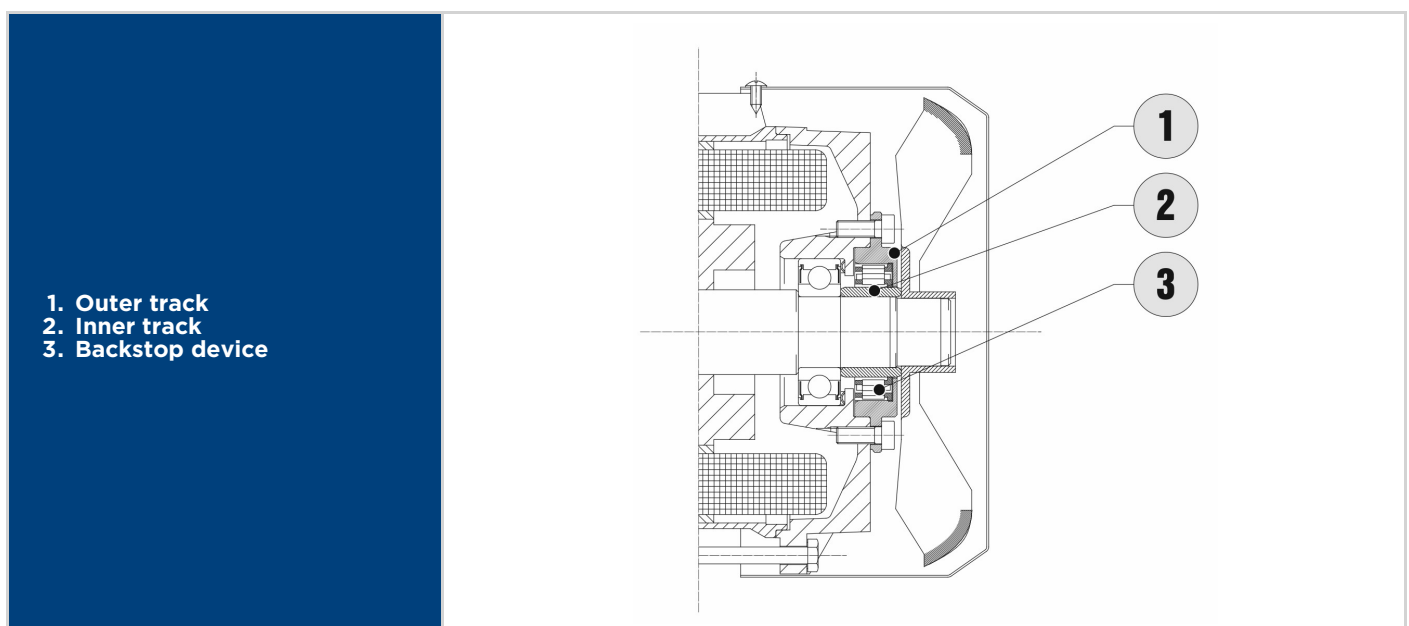
### 3.8.1 Version with roof

In the case of positioning the motor vertically in outdoor applications, with the end of the shaft on the driving side facing downwards, it is recommended to use a fan guard with a roof to shelter it from the rain. This version is generally recommended in all cases where entry of water or solid bodies is such as to jeopardise the correct operation of the motor, due to infiltration of water, partial blockage of the air grille, or an obstruction preventing the fan and the shaft from turning correctly. The roof not only protects against rain, but may be supplied for use in the textile industry; in this case the fan cover has the same roof as the rain cover, but without grille, to prevent blocking by textile processing fragments. The cover does not significantly alter the winding overtemperature. The application of the cover determines a height variation of the motor (see dimensional specifications). The presence of the roof is incompatible with the double extension shaft and/or with the recessed rear hexagon.



### 3.8.2 Backstop device

In applications where reverse motor rotation must be prevented, caused by the dragging action of the load, it is possible to have a backstop device applied directly on the motor on the fan side. This device is composed of eccentric cams with single spring guided by an inner and outer cage, themselves incorporated into two cylindrical tracks. When the inner track rotates with the motor shaft, the cams lift off the track due to the centrifugal force, thus allowing the shaft to rotate freely in the direction of rotation of the motor; when the shaft is rotated in the opposite direction, the cams lock down and prevent the shaft rotating. In consideration of the high speed of rotation, it is not recommended to use this device on 2 pole motors. For correct assembly of the backstop device, the direction of rotation of the motor must be specified in the order; a sticker on the fan cover shows the allowed direction of rotation. The backstop device, sized so as to be able to withstand the maximum torque transmitted by the motor and to work at the nominal speed of rotation of the motor without excessive wear, is lubricated for life with specific grease. The device's construction is such as not to increase the axial length of standard motors. The backstop device is not available for sizes 63 and 71.

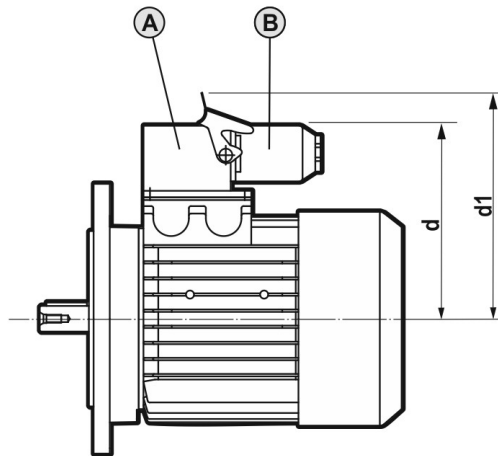


## 3.8.3 Rapid connection power supply

It is possible to supply motors with incorporated connector, for quick and safe power cable hookup. The connector has a modular structure, therefore it is possible to adapt the voltage values and the current capacities according to the motor type where the connector is applied. The motor is connected with fixed part (A) incorporated into the terminal block box and connections cabled directly to the connector and a piggyback part (B) supplied hooked on to the fixed part. As far as the application is concerned following solutions are suggested:

- 10 pole connector for three-phase motor in standard version (TS, TH, TP and D versions) or brake versions (series TBS, TBH, TBP and DB) with or without thermal cutout, excluding AC brake and separate supply. For the three-phase motors it is possible to prearrange the detachable part with double connection in order to do the star-delta connection;
- 10 pole connector for single-phase motor in standard version (SH series) or self-braking version (SBH series, upon request) with or without thermal protector;
- 5 pole connector for single-phase motor (series SH) with or without thermal cutout. With thermal cutout version it is necessary to know the direction of rotation beforehand.

Rapid connection power supply is available for motors up to nominal power 4 kW and sizes 112 inclusive. Brake motors (TBS, TBH, TBP and DB series) with Hartling connection are only available with a protection level IP54. Higher protection levels can be confirmed on request.



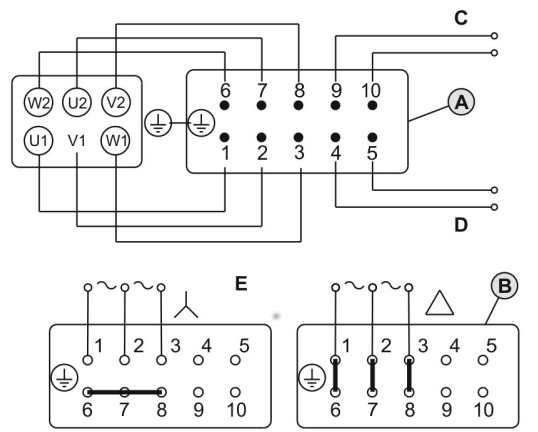
	5 (*)		10 (**)	
	d [mm]	d1 [mm]	d [mm]	d1 [mm]
<b>63</b>	96	120	122	160
<b>71</b>	108	132	134	172
<b>80</b>	119	143	145	183
<b>90</b>	127	151	157	195
<b>100</b>	136	160	166	204
<b>112</b>	-	-	181	219

(\*) 5 pole connector

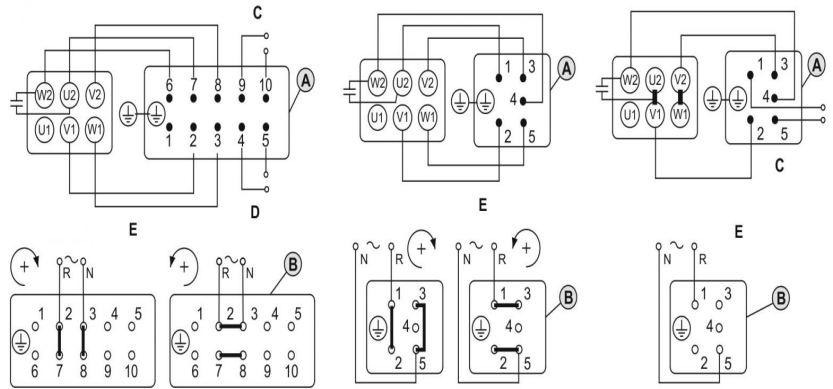
(\*\*) 10 pole connector

# 3.8 OTHER OPTIONAL CONSTRUCTIONS

**Series TS-TH-TP-D-TBS-TBH-TBP-DB (except for separate power AC brake)**



**Series SH (SBH On request)**



- C - Temperature sensor
- D - Separate power DC brake
- E - Motor power supply

### 3.8.4 Incremental encoder

Incremental encoders are used when the motor speed must be known with precision, for example when used as a feedback signal for an inverter or indirect angular position signal or speed signal for a component of the machine to which the motor is coupled. Motovario supplies two distinct incremental encoder solutions.

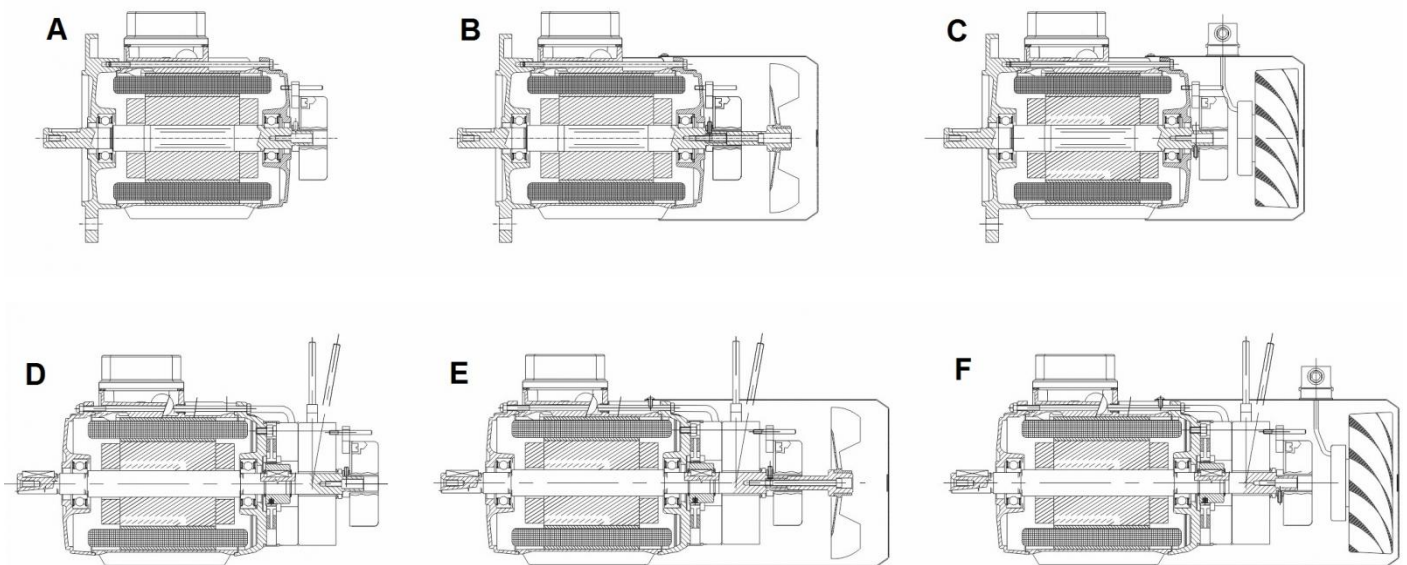
#### 1. Standard incremental encoder

The encoder, available in the version with hollow through shaft, is mounted by locking the rotor directly onto the motor shaft, while its fixed part (stator) is held in place by locking pawl secured to the motor shield or directly to the brake; the pawl is then fitted into a slot in the encoder's reaction arm which has a certain axial elasticity to compensate for play and dampen vibrations. It can be supplied in the following versions:

- Three-phase motor (TS, TH and D series) and three-phase brake motor (TBS, TBH and DB series) with FM and MS brakes;
- Non-ventilated (IC410), self-ventilated (IC411), forced ventilation (IC416).

We give below the various constructions with standard incremental encoder without connector in the case of motor:

- Fig.A - three-phase (TS, TH, TP and D) without ventilation (IC410);
- Fig.B - three-phase (TS, TH, TP and D) self-ventilated (IC411);
- Fig.C - three-phase (TS, TH, TP and D) forced ventilation (IC416);
- Fig.D - three-phase brake (TBS, TBH, TBP and DB - MS and FM brake) without ventilation (IC410);
- Fig.E - three-phase brake (TBS, TBH, TBP and DB - MS and FM brake) self-ventilated (IC411);
- Fig.F - three-phase brake (TBS, TBH, TBP and DB - MS and FM brake) forced ventilation (IC416).



Mounting the standard incremental encoder changes the overall external dimensions of the motor (see dimensional tables).

#### Technical characteristics:

- standard resolution: 1024 pulse/cycle;
- Push-Pull (HTL) with 10-32 V power or Line Driver (TTL) with 5 V power;
- version without connector (free cable 0.5 m);
- version (optional) with male connector M23 12 pin cabled at the end of the wire 0.5 m; female connector supplied
- protection rating equal to that of the motor up to IP65;
- maximum speed: 9000 rpm;
- operating temperature: -30°C / +100°C;
- maximum current absorption under load: 30 mA;
- maximum current absorption under no load: 40 mA;
- maximum operating frequency: 300kHz.

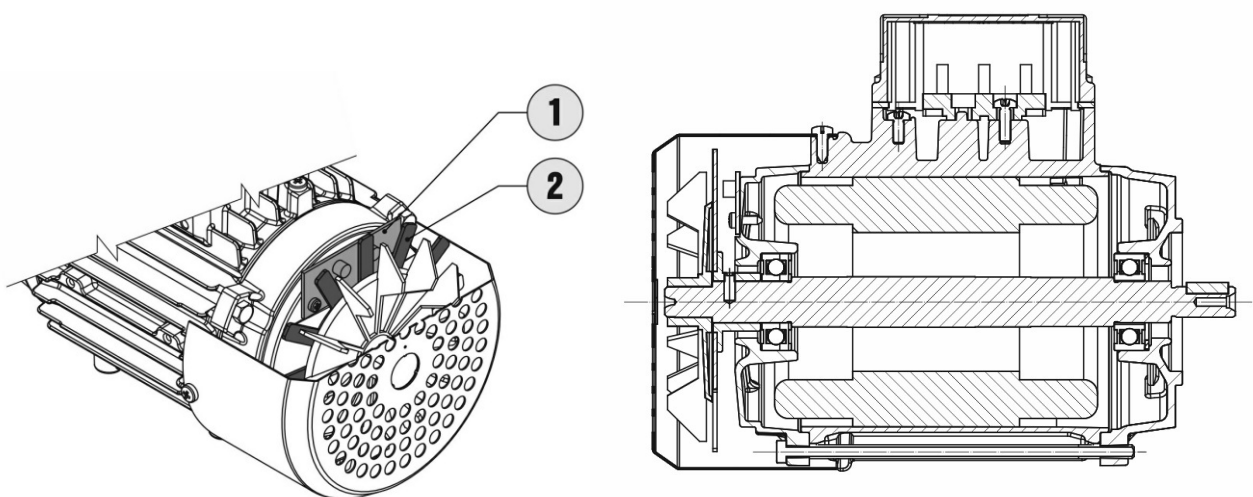
On request, incremental encoders can be provided with any logic (HTL or TTL) and pulse/cycle resolution (1 to 65536) desired.

## 2. Low resolution incremental encoder

Motovario low resolution incremental encoders are available on three-phase motors in the sizes 63-71-80-90, in brake and brakeless versions. On request, they can also be mounted to three-phase motors in the sizes 100-112-132. They are composed of an encoder board to read the speed and a magnetic stainless steel phonic wheel. The board uses two Hall effect sensors to read the fins of the phonic wheel mounted to the motor shaft (see diagram). The 2 output signals are dephased by 90° to determine the direction of rotation. The logic is of the NPN type. Mounting a low resolution incremental encoder does not affect the overall external dimensions of the motor.

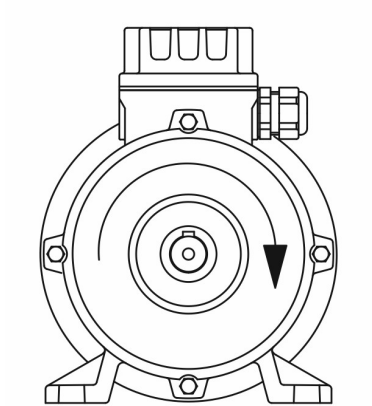
*Technical characteristics:*

- standard resolution: 13 pulses/cycle for size 63, 15 pulses/cycle for sizes 71-80-90;
- NPN version with 10-30 V power; PNP and Push-Pull versions available on request;
- version without connector (free cable 1.2 m);
- protection rating equal to that of the motor up to IP65;
- operating temperature: -40°C / +90°C;
- maximum current absorption under load: 25 mA;
- maximum operating frequency: 12.6 kHz.



1. Encoder board
2. Phonic wheel

### 3.9.1 Direction of rotation - Hookup



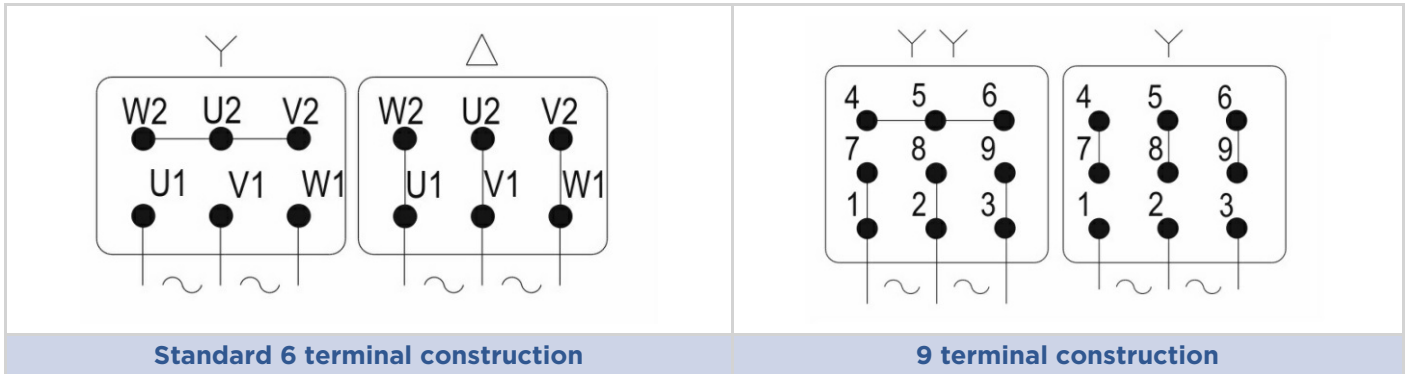
The connections on the terminal board and the direction of rotation are made in conformity with the requirements of the standard IEC60034-8. The direction of rotation, by definition, is the direction when viewing the motor from the coupling side (see figure). All standard motors are suitable for operation in both directions of rotation; clockwise is the default direction. The tables with the connections on the terminal board are inside the terminal board cover. If the motor needs to operate anticlockwise, ie. the opposite direction to the standard supply, it is necessary to proceed as follows:

- In the case of three-phase motors, by swapping over two supply phases;
- In the case of single-phase motors, by changing the connections on the terminal board as shown on the wiring diagrams.

In both cases it is prohibited to alter the internal connections of the motor to its terminals on the terminal board, they must remain unchanged. If the motor needs to be fitted for just one direction of rotation (e.g. with backstop device), this direction is shown with an arrow on the fan cover or in another clearly visible position.

## 3.9.2 TS-TH and TP series

The technical data given in the tables in the catalogue refer to standard three-phase asynchronous motors insulated in class F and in continuous duty S1, supplied at the nominal voltage of 400V and nominal frequency 50Hz. The connection types are marked inside the terminal block cover. The conventional direction of rotation (clockwise) is obtained by powering the unit with the direct three phases L1 L2 L3 connected to the terminals U1-V1- W1 respectively (standard 6 terminal construction) or terminals 1-2-3 (9 terminal construction for North American market).

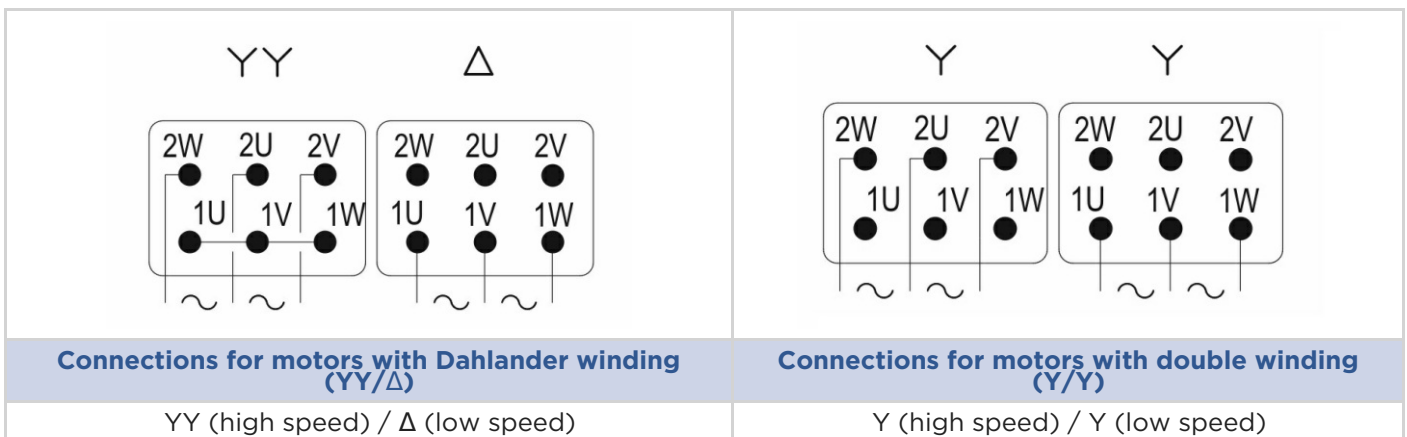


## 3.9.3 D series

The double polarity motors in the series D are used in applications requiring two fixed speeds, obtained by swapping over the poles of the motor. They comprise:

1. Motors with polarity ratio of 2 (2/4 pole, 4/8 pole) with single winding and pole number switching via modification of the internal connections; the standard version is with Dahlander YY-D connection and power with single voltage 400V/50Hz;
2. Motors with polarity ratio other than 2 (2/8 poles) for which there are two distinct windings and the possibility of supply with one voltage with a Y or D connection. Motors in standard execution are set only with the Y-Y connection and single voltage 400V/50Hz.

The conventional clockwise direction of rotation for D series motors is obtained by supplying the terminals U-V-W respectively with the direct triple voltage of the supply network L1-L2-L3.



In applications of double polarity motors it is necessary to pay special attention to the phases of switching over from one polarity to the other. We recommend low speed starting with switching to high speed after completion of the starting phase. When passing over from the low polarity (high speed) to the high polarity (low speed) it is necessary to consider the braking torque that is applied during switchover; because when the synchronous speed is exceeded, the torque becomes negative; therefore when passing over the high and low speed, the load torque is sharply compounded with the braking torque, which applies its action until the motor stabilizes at the new point of operation at low speed; the stress created during switchover must not be neglected when sizing the transmission.

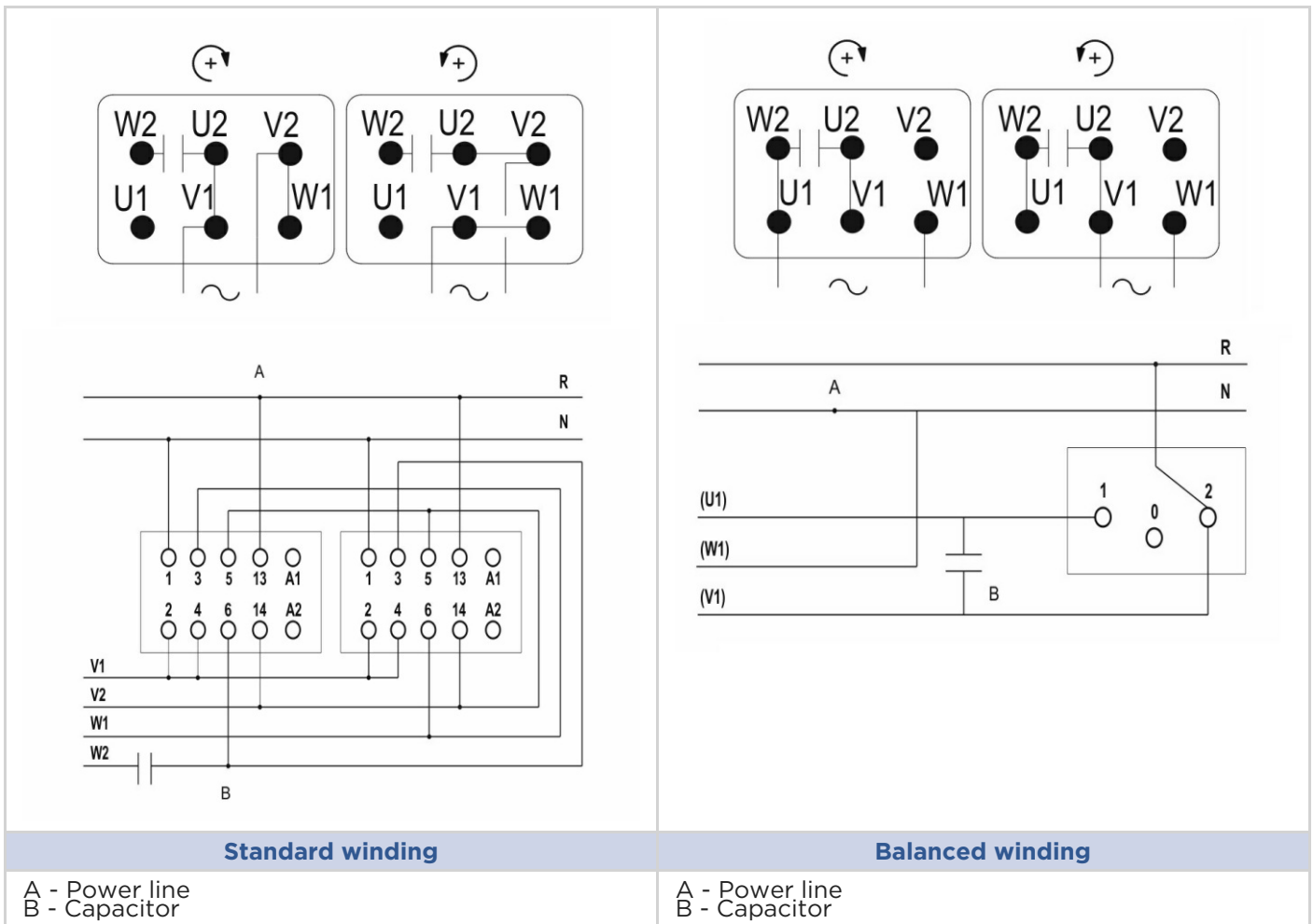


## 3.9.4 SH series

The technical data given in the tables in the catalogue refer to standard single-phase asynchronous motors with running capacitor permanently activated, insulated in class F and in continuous duty S1, supplied at the nominal voltage of 230V and nominal frequency 50Hz. The allowed voltage tolerance is  $\pm 5\%$ . Standard motors cannot generally be used at 60Hz; on demand, motors with an supply voltage of 230V 60Hz or 115V 60Hz can be supplied; other supply voltage values are available upon request.

Single-phase motors (SH series) have two separate windings: one running winding distributed on 2/3 of the stator slots and an auxiliary winding distributed on 1/3 of the slots. The type of winding makes it possible to reverse the direction of rotation by modifying two connections on the terminal board, or externally with two contactors.

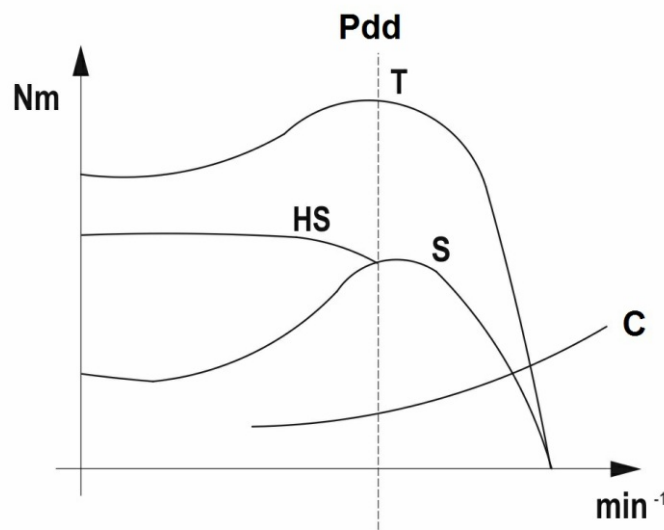
As an alternative, on demand, in case of 230V 50Hz supply voltage, single-phase motors with balanced winding - with one run and one auxiliary winding - can be supplied, composed of two identical windings each distributed over 1/2 of the stator slots. In this case the motor's performance in terms of torque is generally lower. This winding is only used for low-powered motors (size 63/71/80) and it has the great advantage of being able to swap over the direction of rotation from the outside without using the two contactors, by simply using a switch (with positions 0-1-2). On request, this option is also available for 230V 60Hz and 115V 60Hz power supply.



### 3.9.5 HSH series

#### HSH SERIES (single-phase, high starting torque, high efficiency with electronic circuit breaker)

Standard single-phase asynchronous series motors (SH series), due to their design and in contrast with three-phase motors, generally have starting torques lower than the nominal torque. In applications where the required starting torque is high, it is possible to use series motors which, along with a permanently activated running capacitor, are equipped with an auxiliary capacitor that is only activated in the motor start-up phase and is disconnected once full rate has been reached. The auxiliary capacitor makes it possible to obtain starting torques comparable to a three-phase motor of the same power (see graph).



**Pdd - Cutout detachment point    C - Load**

#### Characteristics

To disconnect the auxiliary capacitor there is a triac device (electronic cutout) sensitive to the capacitor starting voltage which, unlike current relay and timer solutions, can be used in many types of motors (compressors, centrifugal pumps, etc.) also with inertia during switching off and reversing the direction of rotation. The cutout allows for safe starting under load since, as it is sensitive to the voltage at the starting capacitor terminals, which is itself proportional to the motor speed, the starting capacitor is only disengaged when a certain voltage is reached, corresponding to around 70% of nominal speed and thus only when the motor is effectively started (as happens with centrifugal cutouts). It also has a much shorter re-insertion time than other electronic solutions, since the motor can be restarted after a stop in 1 second; Note also the flexibility and simplicity of the construction (in practice a high starting torque HSH motor can be obtained simply by adding the cutout and starting capacitor to a normal SH series motor). The HSH version is thus very competitive in comparison to centrifugal cutout solutions since it requires no special parts (motor shield, shaft, fan cover, etc.); it also maintains - except for the presence of the capacitors - the same overall dimensions as a standard motor (an advantage in cases in which an increased shaft length due to the application of a centrifugal cutout would not be tolerable). The device is designed for use also on balanced winding motors. The construction without centrifugal cutout mounted at the back of the motor, means brake motor versions are also available (HSBH series, on request).

#### Protection equipment

The cutout is an internal protection device which trips when starting takes longer than 3 seconds (after which it is evident that either the application is not correctly sized or the motor is blocked by some external factor). Furthermore, there is a voltage discharge resistance to safeguard the correct operation of the capacitors (after the motor stops the capacitors are still charged, so any subsequent starting can generate hazardous overvoltages if the charge is not discharged).

#### Caution

For the correct use of HSH series single-phase motors, the following points must be considered:

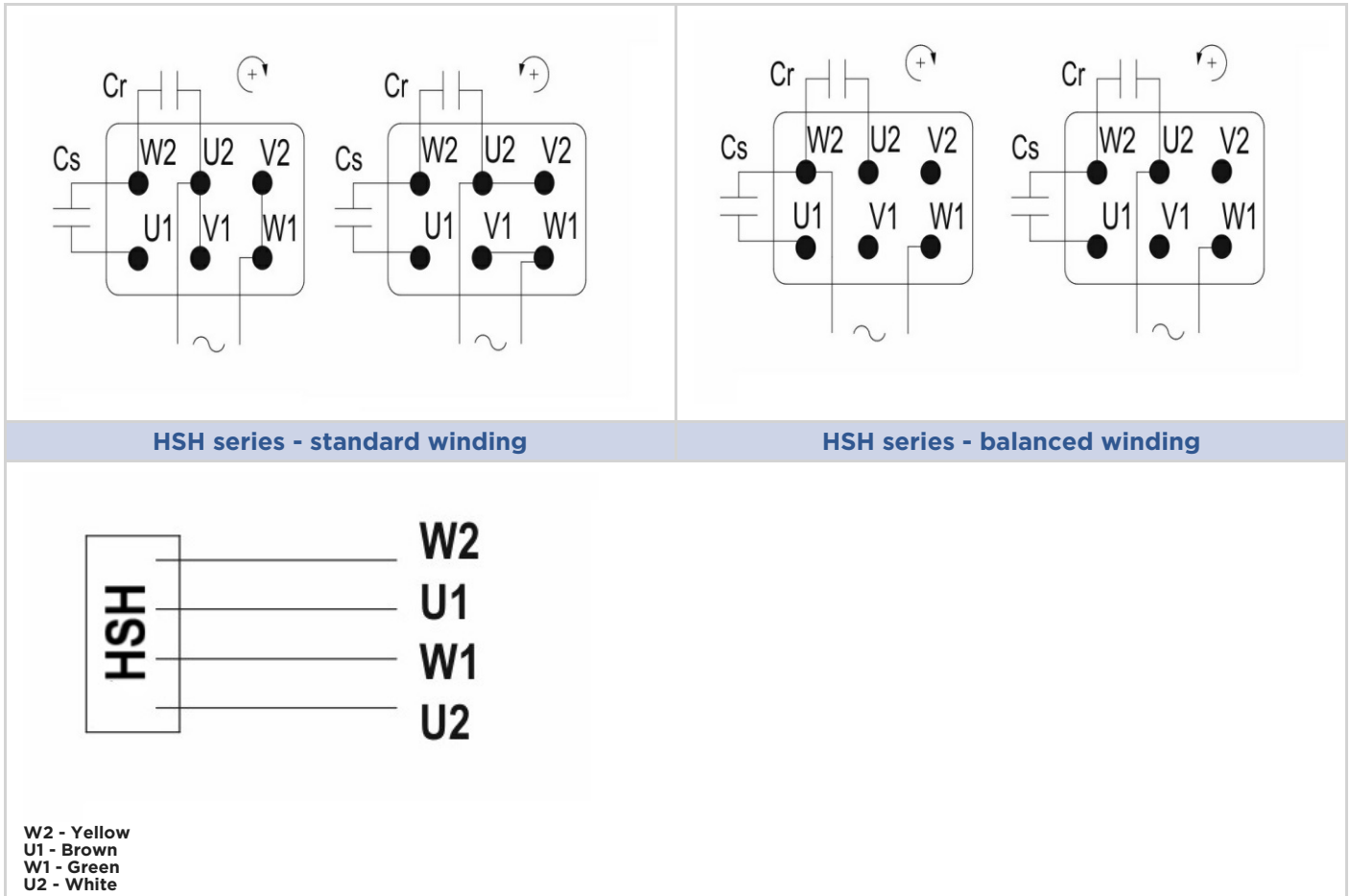
- The device's insertion time is around 1 second; this means that the device does not work if there are multiple starts in a period of less than one second;
- once the motor has started, the device disengages and can be restored only by shutting down and restarting the

### 3.9 SERIES AND HOOKUP

motor; under heavy, lengthy overloads which drastically reduce motor speed, the device does not act and the motor will tend to come to a stop; it is thus best that the motor is always coordinated with protection equipment in the electrical cabinet (thermal cutouts) to prevent the motor stalling or jamming. Upon request, to overcome this limit of the standard electronic cutout, a special electronic cutout can be requested: in case of temporary overload with strong speed reduction, it allows starting capacitor activation also when motor is already started.

**Warning for all the single phase motors (SH and HSH series)**

Unlike the three phase motors, all the single phase motors have higher losses at no-load than full load: therefore you should not work at no-load for a long time to avoid overheating.



### 3.10.1 Brake motors

Standard motors (TS, TH, TP, D) can be constructed as brake motors (TBS, TBH, TBP, DB) when the driven machine must be stopped quickly and safely. This is done without modifying the motor's electrical or mechanical assemblies, except for the non-drive side where the brake is applied. The brake is electromagnetic in various versions for the range of possible applications.

Brake: FM

Power supply: DC

Action: Negative (1)

Applications: Ideal for applications which require smooth, silent and gradual operation (both in starting and braking thanks to the slower response of DC brakes), accompanied by rapid release and braking.

Typical applications: gearmotors, transfer machines, electric trucks.

Brake: MS

Power supply: AC

Action: Negative (1)

Applications: Ideal for applications requiring rapid and precise braking and high braking loads.

Typical applications: automation with a high number of actions, lifting and handling equipment, packaging and packing machines.

Brake: ML

Power supply: DC

Action: Negative (1)

Applications: Ideal for applications requiring smooth gradual braking and high loads per braking cycle (thanks to the steel or cast iron disk mounted to the motor shaft, which can dissipate high braking energies); also designed for reduced size and low cost.

Typical applications: cutting machines (e.g. wood working), safety stops (parking brakes).

(1) negative action: the brake acts without power supply.

**If not otherwise specified, Motovario supplies brake motors with FM type DC brakes.**

### 3.10.2 FM brake

#### Operation

The FM brake is a DC electromagnetic brake and acts with no power supply through the pressure of the springs. When the brake magnet (1) is powered, the moving coil (2) is attracted against the brake body and overcomes the spring force (7) thus leaving the shaft to which the brake disk (3) is mounted axially free on the toothed hub (4), to rotate freely. Once power is shut off, the springs press the moving coil and hence the disk mounted to the hub, against the motor shield (14) to brake the motor. Brake motors with FM brakes in the standard version have a standard protection rating of IP54.

#### Characteristics:

- power supply 230V±10% 50/60Hz or 400V±10% 50/60Hz; other voltages available as options. The brake's power voltage must always be specified if the brake is ordered with separate power supply (see below, "Hookup for DC brakes").
- service S1, insulation class F;
- silent friction surfaces, with no asbestos, with double braking surface;
- steel disk brake, sliding on splined drive hub; vibration damping O-ring;
- fixed braking moment selected in relation to nominal motor torque (value given in motor technical data table). Optionally, disks can be supplied with other braking moments; see column Mb in the table "Brake characteristic values". On request, brakes can be supplied with adjustable braking moment.

#### Options

- manual release lever with automatic return, hand lever can be removed; it is useful for manual operations in case of power outage or during installation; the lever is parallel to the terminal box cover; on request we can evaluate the possibility to supply the lever a different position; in case of gearmotors, the different positions available for the lever are always referred to the terminal block box position. As an option we can supply a release lever which can be locked in the released position, by screwing it in until it engages with a lug in the brake body.
- Anti-seizing stainless steel washer. This is a stainless steel washer mounted between the motor shield and brake disk to prevent the ferode from seizing to the shield, for example, during long periods of disuse.
- Brake motor with protection rating IP55. Including: a) protective boot to prevent foreign matter entering the brake (e.g.: textile flock); b) stainless steel washer between motor shield and brake disk; c) stainless steel hub and disk;
- Self-braking motor with IP65 degree of protection, in which, in addition to components for IP55 degree of protection are added: a) plastic caps to close the holes for the passage of the tie-beams of the release lever; b) brake fixing screws sealed with O-ring
- Self-braking motor with IP56 degree of protection, in which, in addition to components for IP55 degree of protection are added: a) hardware and brake fixing nuts in stainless steel; b) stainless steel springs.
- Self-braking motor with IP66 degree of protection which combines the characteristics for IP65 and for IP56.
- Motor with double FM brake. For applications in which, for instance, a redundant brake is required (e.g.: theatres) motors can be supplied with two FM brakes, each with its own rectifier. The motors are normally supplied with both brakes with separate power supply and, given the application, without ventilation, hence in duty S2 10 min or S3 10%.
- Silent brake. To ensure a lower noise level inside special environments. This is achieved by adding an O-ring between moving coil and electromagnet. This option is also available with dual brake and is therefore recommended for theatre applications.
- Hexagonal recess on non-drive side shaft end for manual rotation with straight hex key (6 mm key for ≤ size 90, 8 mm for sizes 100-112, 10 mm for size 132);
- Microswitch to signal brake locking/releasing and brake ferode wear;
- Flywheel for gradual starting and braking. Brake motors with FM brake can be equipped with a steel hub, placed between the brake and fan, acting as a flywheel to increase the moment of inertia of the system. This is done to obtain starting and braking that are less sharp and more progressive to make the action smoother. Gradual starting and stopping is accomplished thanks to the increased moment of inertia, which extends the time of action for a given accelerating and braking torque. The overall length dimensions of the motor for application of the flywheel are unchanged with respect to the standard brake version.

#### Power supply

The brake is powered with direct current through a rectifier bridge, by rectifying the single-phase AC input:

- for three-phase TBS, TBH and TBP motors, the standard input voltage is 230V AC, rectified with a half-wave rectifier to obtain an output of 103V DC; the brake's power supply may be direct (drawn from the motor's power supply) or separate, from an external source (separate power option);
- for 2 pole three-phase DB motors, the standard input voltage is 400V AC, rectified with a half-wave rectifier to obtain an output of 178V DC; in this case the brake power supply is always separate.

Optionally, brakes are available for the following power voltages: 115V AC, 133V AC, 200V AC, 208V AC, 230V AC, 255V AC, 265V AC, 280V AC, 290V AC, 330V AC, 346V AC, 380V AC, 400V AC, 415V AC, 12V DC, 24V DC, 103V DC, 178V DC (if a voltage is requested directly in DC, it is understood that the brake motor will be supplied without rectifier). Possible rectifiers are listed below:

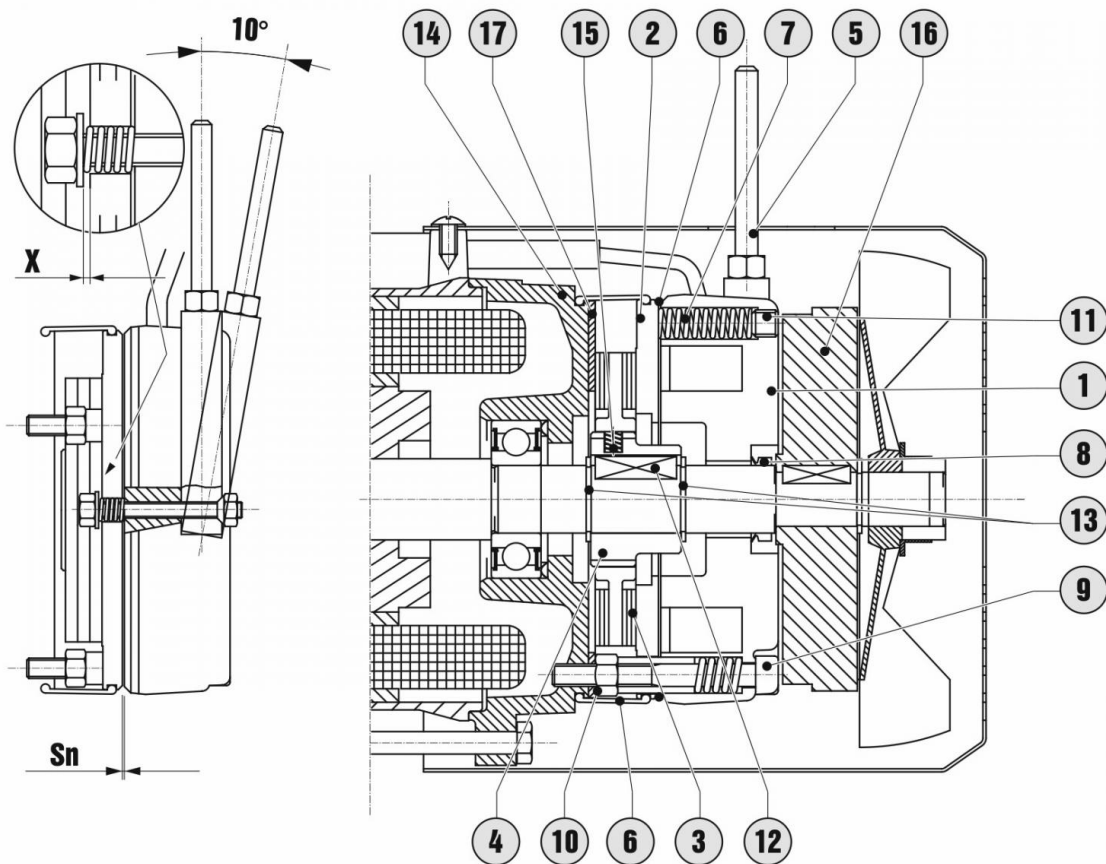
- half-wave rectifier with NBR filter (standard from size 63 to size 100); in special cases, to adapt the requested AC voltage to the brake winding's DC voltage, a full-wave DBR rectifier is supplied instead of an NBR rectifier (e.g. 115V

AC-103V DC). DBR rectifiers have comparable braking and release response times to NBR rectifiers.

- b. half-wave quick detachment rectifier SBR (standard for sizes 112 and 132; optional for sizes 63-100), thanks to which the brake, when release starts, is powered with full-wave rather than half-wave voltage; this results in shorter release times than standard (see “Brake characteristic values” and “Hookup for FM and ML brakes”); it is thus ideal for applications with frequent multiple braking cycles (e.g. lifting).
- c. half-wave rapid braking rectifier RSD (optional for size 63 to size 100), which reduces the brake de-excitation period, thus giving braking times comparable to those obtainable by opening the DC side (see “Brake characteristic values” and “Hookup for FM and ML brakes”). This rectifier does not have a rapid braking contact (see “Hookup for FM and ML brakes”) and is only available for brake voltages 230V AC - 103V DC and 400V AC - 178V DC.
- d. half-wave rectifier for quick detachment and braking RRSD (as an option on all sizes), combines type b) and c) functionality. This rectifier does not have a rapid braking contact (see “Hookup for FM and ML brakes”) and is only available for brake voltages 230V AC - 103V DC and 400V AC - 178V DC.

All rectifiers except for RRSD are also available in versions homologated to the UL/CSA standards. All rectifiers are compliant with the Low Voltage Directive 2014/35/EU; in relation to the EMC Directive 2014/30/EU, the rectifier/coil assembly is conforming due to the use of a filter on the rectifier (NBR); for DC brakes with rapid half-wave rectifier (SBR, RSD and RRSD) the filter is implemented by connecting a capacitor (440V AC 0.22 $\mu$ F class X2 per EN132400) in parallel with the AC power supply (default configuration for this type of rectifier).

FM



1. Brake magnet
2. Moving coil
3. Brake disk
4. Drive hub
5. Release lever (optional)
6. Boot (in combination with IP 55)
7. Thrust springs
8. V-ring (in combination with IP 55)
9. Mounting bolt
10. Locknuts
11. Braking torque adjuster screw (on request)
12. Key
13. Circlip
14. Cast iron shield
15. Vibration damping O-ring
16. Flywheel (optional)
17. Anti-seizing stainless steel washer (optional)

## Brake characteristic values

	T	S <sub>n</sub>	S <sub>max</sub>	X	J <sub>B</sub>	W	W <sub>1</sub>	t <sub>1</sub>	t <sub>11</sub>	t <sub>2</sub>	t <sub>22</sub>	m <sub>B</sub>	P <sub>a</sub>	M <sub>B</sub>	m <sub>F</sub>	J <sub>F</sub>
<b>63</b>	..2	0,2	0,5	0,6	0,6	260	15,6	30	20	100	10	1,5	16	1,8-3,5	0,7	6,1
<b>71</b>	..3	0,2	0,5	0,8	1,1	370	22,4	60	25	120	10	2,2	20	2,5-5-7,5-10	1,1	13
<b>80</b>	..4	0,3	0,6	1	1,6	500	30	100	40	150	10	3,1	30	5-10-15-20	1,7	28
<b>90S-L</b>	..5	0,3	0,6	1	3,5	750	45	120	50	220	15	4,9	40	13-26-40-55	2,3	54
<b>100</b>	..5	0,3	0,6	1	3,5	750	45	120	50	220	15	4,9	40	13-26-40-55	3,1	98
<b>112</b>	..6S	0,35	0,7	1,2	8,8	1000	70	-	80	300	30	8,3	50	20-40-60	4,5	145
<b>132S</b>	..6	0,35	0,7	1,2	10,3	1100	77	-	80	200	20	9,5	65	37-50-75-100	4,8	200
<b>132M</b>	..7	0,4	0,8	1,2	22,5	1650	132	-	100	200	20	12,3	65	50-100-150	6,9	350

T = Type

S<sub>n</sub> = nominal airgap [mm]

S<sub>max</sub> = maximum airgap [mm]

X = release lever play [mm]

J<sub>B</sub> = brake disk moment of inertia [kgcm<sup>2</sup>]

W = maximum energy which can be dissipated by brake [MJ]

W<sub>1</sub> = energy which can be dissipated between two successive adjustments of airgap from S<sub>n</sub> to S<sub>max</sub> [MJ]

t<sub>1</sub>(\*) = brake release time with normal detachment rectifier (NBR, RSD) [ms]

t<sub>11</sub>(\*) = brake release time with rapid detachment rectifier (SBR, RRSD) [ms]

t<sub>2</sub>(\*) = brake response time - AC side opening [ms]

t<sub>22</sub>(\*) = brake response time - DC side opening [ms]

m<sub>B</sub> = weight [kg]

P<sub>a</sub> = power absorption [W]

M<sub>B</sub> = brake moments available [Nm]

m<sub>F</sub> = flywheel weight [kg]

J<sub>F</sub> = flywheel moment of inertia [kgcm<sup>2</sup>]

(\*) NOTE: the effective values may deviate slightly in relation to the ambient temperature and humidity, the brake temperature and wear of the friction surfaces; t<sub>1</sub>, t<sub>11</sub>, t<sub>2</sub> and t<sub>22</sub> refer to a brake calibrated with medium airgap, nominal voltage and separate power; as regards the braking moment, one must allow for running in to allow the ferode to adapt to the braking surface of the motor shield, for a period which depends on the actual braking loads; once running in is completed, in nominal operating conditions one can expect a deviation from the declared value of ±15%.



### 3.10.3 ML brake

#### Operation

The ML brake is a DC electromagnetic brake and acts with no power supply through the pressure of the springs. When the brake magnet (1) is powered, the moving coil (2) is attracted and overcomes the spring force (4) thus leaving the shaft, to which the brake disk + fan (9) are locked, to rotate freely. When power is shut off, the springs push the moving coil against the disk, thus braking the shaft. Brake motors with ML brakes in the standard version have a standard protection rating of IP54. High protection ratings are not available.

#### Characteristics:

- power voltage 230V±10% 50/60Hz or 400V±10% 50/60Hz;
- duty S1, insulation class F;
- silent, asbestos free friction surface;
- steel or cast iron braking flywheel;
- axial dimensions less than FM brake;
- airgap adjustable with one nut or collar;
- braking moment set for motor size (see value  $M_B$  in "Brake characteristic values");
- O-ring gasket protects airgap from dust and other external agents.

#### Options

- Manual release lever with automatic return, hand lever can be removed; it is useful for manual operations in case of power outage or during installation; the lever is parallel to the terminal box cover; on request we can evaluate the possibility to supply the lever a different position; in case of gearmotors, the different positions available for the lever are always referred to the terminal block box position.
- Microswitch to signal brake locking/releasing and brake ferode wear.

#### Braking moment

For each motor size, independently of the torque delivery, the braking moment is given by the value  $M_B$  in the table; the braking moment is NOT adjustable.

#### Power supply

The brake is powered with direct current through a rectifier bridge, by rectifying the single-phase AC input:

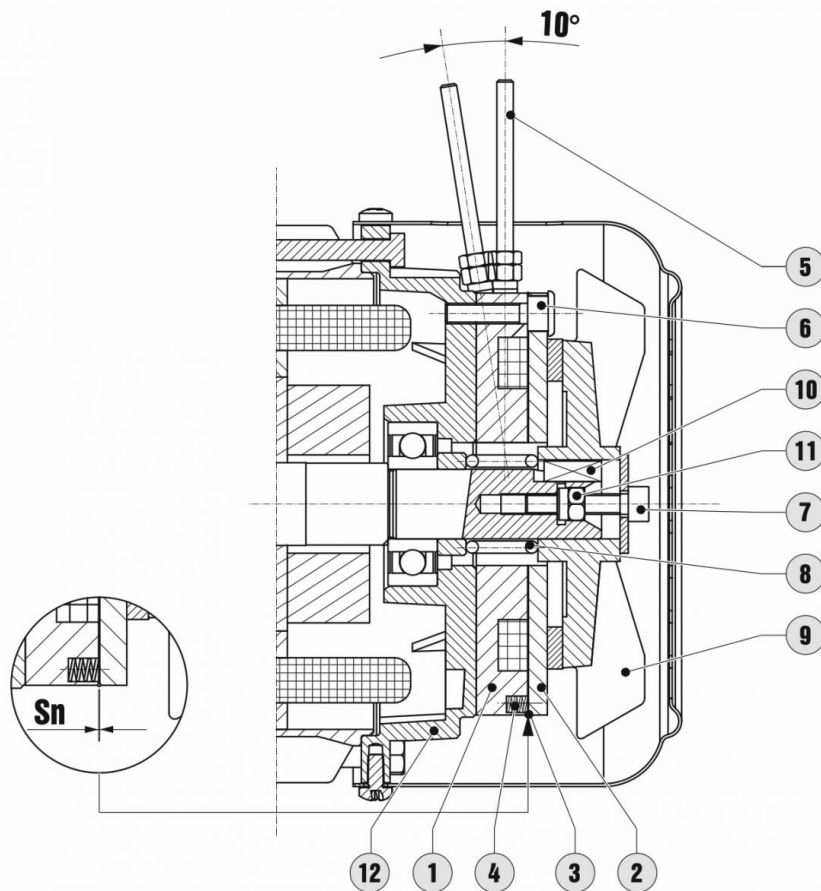
- for three-phase TBS, TBH and TBP motors, the standard input voltage is 230V AC, rectified with a half-wave rectifier to obtain an output of 103V DC; the brake's power supply may be direct (drawn from the motor's power supply) or separate, from an external source (separate power option);
- for 2 pole three-phase DB motors, the standard input voltage is 400V AC, rectified with a halfwave rectifier to obtain an output of 178V DC; in this case the brake power supply is always separate.

Optionally, brakes can be supplied for the following voltages; 115V AC, 133V AC, 200V AC, 208V AC, 230V AC, 255V AC, 290V AC, 330V AC, 346V AC, 380V AC, 400V AC, 415V AC, 12V DC, 24V DC, 103V DC, 178V DC. If a voltage is requested directly in DC, then the brake motor will be supplied without rectifier. Possible rectifiers are listed below:

- half-wave rectifier with NBR filter (standard from size 63 to size 100); in special cases, to adapt the requested AC voltage to the brake winding's DC voltage, a full-wave DBR rectifier is supplied instead of an NBR rectifier (e.g. 115V AC-103V DC). DBR rectifiers have comparable braking and release response times to NBR rectifiers.
- half-wave quick detachment rectifier SBR (standard for sizes 112 and 132; optional for sizes 63-100), thanks to which the brake, when release starts, is powered with full-wave rather than half-wave voltage; this results in shorter release times than standard (see "Brake characteristic values"); it is thus ideal for applications with frequent multiple braking cycles (e.g. lifting).
- half-wave rapid braking rectifier RSD (optional for size 63 to size 100), which reduces the brake de-excitation period, thus giving braking times comparable to those obtainable by opening the DC side (see "Brake characteristic values"). This rectifier is only available for brake voltages 230V AC - 103V DC and 400V AC - 178V DC.
- half-wave rectifier for quick detachment and braking RRSD (optionally available for all sizes), combines type b) and c) functionality. This rectifier is only available for brake voltages 230V AC - 103V DC and 400V AC - 178V DC.

All rectifiers except for RRSD are also available in versions homologated to the UL/CSA standards All rectifiers are compliant with the Low Voltage Directive 2014/35/EU; in relation to the EMC Directive 2014/30/EU, the rectifier/coil assembly is conforming due to the use of a filter on the rectifier (NBR); for DC brakes with rapid half-wave rectifier (SBR, RSD and RRSD) the filter is implemented by connecting a capacitor (440V AC 0.22mF class X2 per EN132400) in parallel with the AC power supply (default configuration for this type of rectifier).

ML



1. Brake magnet
2. Moving coil
3. O-ring
4. Thrust springs
5. Release lever (optional)
6. Mounting bolt
7. Airgap adjuster screw
8. Return spring
9. Steel/cast iron disk + fan
10. Key
11. Self-locking nut
12. Motor shield

## Brake characteristic values

	T	S <sub>n</sub>	S <sub>max</sub>	J <sub>B</sub>	W	W <sub>1</sub>	t <sub>1</sub>	t <sub>2</sub>	t <sub>22</sub>	m <sub>B</sub>	P <sub>a</sub>	M <sub>B</sub>
63	3	0,2	0,5	3	250	30	30	80	8	1,1	18	3
71	4	0,2	0,6	5	250	40	40	100	10	1,3	18	4
80	7	0,2	0,6	10	375	60	60	150	15	2,1	25	7
90S-L	7	0,2	0,6	11	375	60	60	150	15	2,1	25	7
100	13	0,25	0,65	30	500	80	100	250	15	3,6	35	13
112	13	0,25	0,65	34	500	80	100	250	25	4	35	13
132S-M	30	0,3	0,7	50	1650	132	150	400	40	7,4	60	30

T = Type

S<sub>n</sub> = nominal airgap [mm]

S<sub>max</sub> = maximum airgap [mm]

J<sub>B</sub> = brake disk moment of inertia [kgcm<sup>2</sup>]

W = maximum energy which can be dissipated by brake [MJ]

W<sub>1</sub> = energy which can be dissipated between two successive adjustments of airgap from S<sub>n</sub> to S<sub>max</sub> [MJ]

t<sub>1</sub>(\*) = brake release time [ms]

t<sub>2</sub>(\*) = brake response time - AC side opening [ms]

t<sub>22</sub>(\*) = brake response time - DC side opening [ms]

m<sub>B</sub> = weight [kg]

P<sub>a</sub> = power absorption [W]

M<sub>B</sub> = brake moments available [Nm]

(\*) NOTE: the effective values may deviate slightly in relation to the ambient temperature and humidity, the brake temperature and wear of the friction surfaces; t<sub>1</sub>, t<sub>2</sub> and t<sub>22</sub> refer to a brake calibrated with medium airgap, nominal voltage and separate power; as regards the braking moment, one must allow for running in to allow the ferode to adapt to the braking surface of the motor shield, for a period which depends on the actual braking loads; once running in is completed, in nominal operating conditions one can expect a deviation from the declared value of ±10%.

### 3.10.4 Hookup for FM and ML brakes

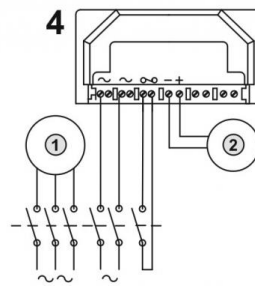
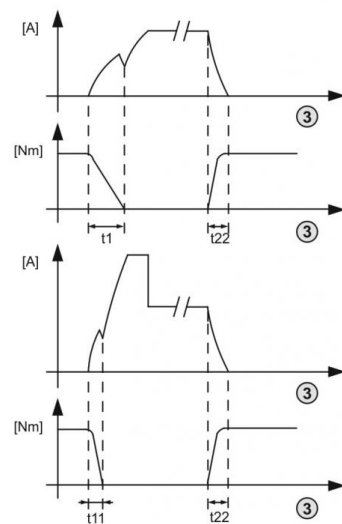
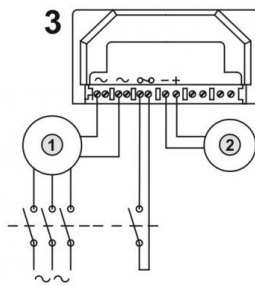
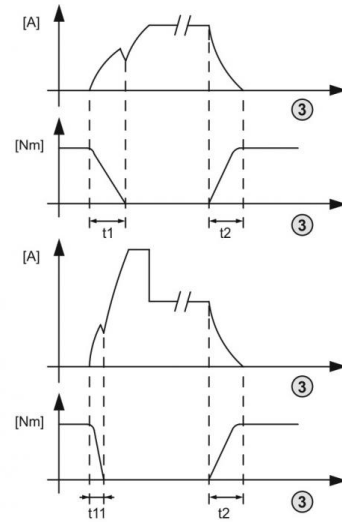
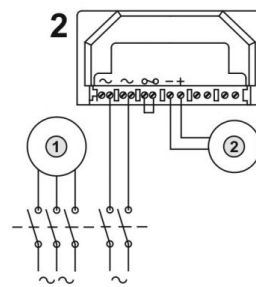
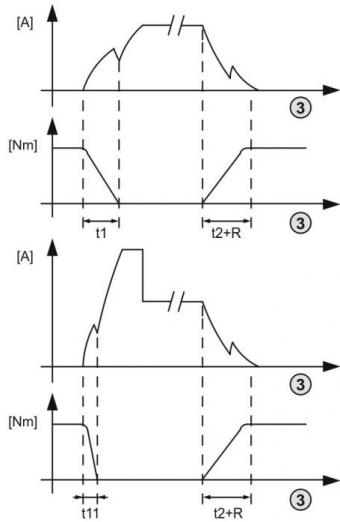
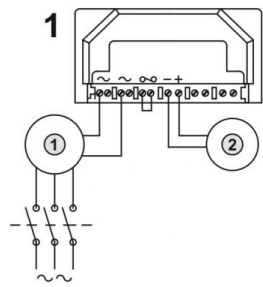
If the brake power is derived directly from the motor or is independent, one speaks of direct and separate brake power respectively. In detail, with reference to the figures given below:

1. Direct brake power: supply cables on the AC side of the rectifier are connected to the motor's power terminal board; when you power up the motor, the brake coil is automatically energised and the brake is released; when power to the motor is shut off, the brake automatically brakes the motor. During this phase, the brake response time  $t_2$  has to be added to the delay R generated by the inertia of the load and by the energy accumulated by the motor. R changes in every motor and – as it depends on the load – cannot be previously calculated.
2. Separate brake power, brake opens only from the AC side: the brake is powered, via the rectifier, off terminals separate from those of the motor. In this case stop time  $t_2$  does not depend on the characteristics of both the motor and load.
3. Direct brake power, DC side opens: connection possible on the basis of type 1, if one can cable the rectifier's rapid braking contact (DC side opening) as shown in figure 3. Despite the direct power supply (see point 1), the braking response time is independent of the characteristics of the motor and load, and is significantly shorter than that of case 2 ( $t_{22} < t_2$ ). This connection is thus an alternative to the use of rapid braking rectifiers (RSD and RRSD).
4. Separate brake power, AC and DC sides open: connection possible on the basis of type 2, if one can cable the rectifier's rapid braking contact (DC side opening) as shown in figure 4. Response time equal to that of type 3, hence this connection is an alternative to the use of rapid braking rectifiers (RSD and RRSD). The advantage over the previous case is that, during braking, the energy accumulated by the motor does not discharge into the rectifier, thus safeguarding its service life.

**Motovario supplies brakes connected as type 1 or 2** when ordered as “direct” or “separate” power supply respectively. Type 3 and 4 connections must be implemented by the client. If SBR rapid release rectifiers are used, the brake release time reduces from  $t_1$  to  $t_{11}$  (see graph below). In case of independent power supply of the brake through direct current, therefore without any rectifier (ex. 24Vdc), the supply cables of the brake are set inside the terminal box and connected in a fly terminal board mammuth type. In this case, not considering the external power supply, for the time of operations you can refer to case 4.

1. Motor
2. Brake
3. Time

# 3.10 BRAKE MOTORS



### 3.10.5 MS brake

#### Operation

MS brake is an a. c. electromagnetic brake and acts with no power supply through the pressure of the springs. When the brake magnet (1) is powered, the moving coil (2) is attracted against the brake body and overcomes the spring force (7) thus leaving the shaft to which the brake disk (3) is mounted axially free on the toothed hub (4), to rotate freely. Once power is shut off, the springs press the moving coil and hence the disk mounted to the hub, against the motor shield (14) to brake the motor.

#### Characteristics

- standard power supply voltage 230/400V±10% 50Hz 265/460V±10% 60Hz; other voltages available as options;
- duty S1, insulation class F;
- silent friction surfaces, with no asbestos, with double braking surface;
- steel brake disk sliding on the splined driving hub;
- fixed braking moment selected in relation to nominal motor torque (value given in motor technical data table). Optionally, disks can be supplied with other braking moments; see column  $M_D$  in the table "Brake characteristic values". On request, brakes can be supplied with adjustable braking moment.

#### Options

- Manual release lever with automatic return, hand lever can be removed; it is useful for manual operations in case of power outage or during installation; the lever is parallel to the terminal box cover; on request we can evaluate other lever positions; in case of gearmotors, the different positions available for the lever are always referred to the terminal block box position.
- Anti-seizing stainless steel washer. This is a stain- less steel washer mounted between the motor shield and brake disk to prevent the ferode from seizing to the cast iron shield, for example, during long periods of disuse.
- Brake motor with protection rating IP55 for applications in special conditions (e.g. installation outdoors) including: a) boot + O-ring to prevent foreign matter entering the brake (e.g.: textile flock); b) stainless steel washer between motor shield and brake disk; c) stainless steel hub and disk; d) V-ring on the motor shaft.
- Hexagonal recess on non-drive side shaft end for manual rotation with straight hex key (6 mm key for  $\leq$  size 90, 8 mm for sizes 100-112, 10 mm for size 132).

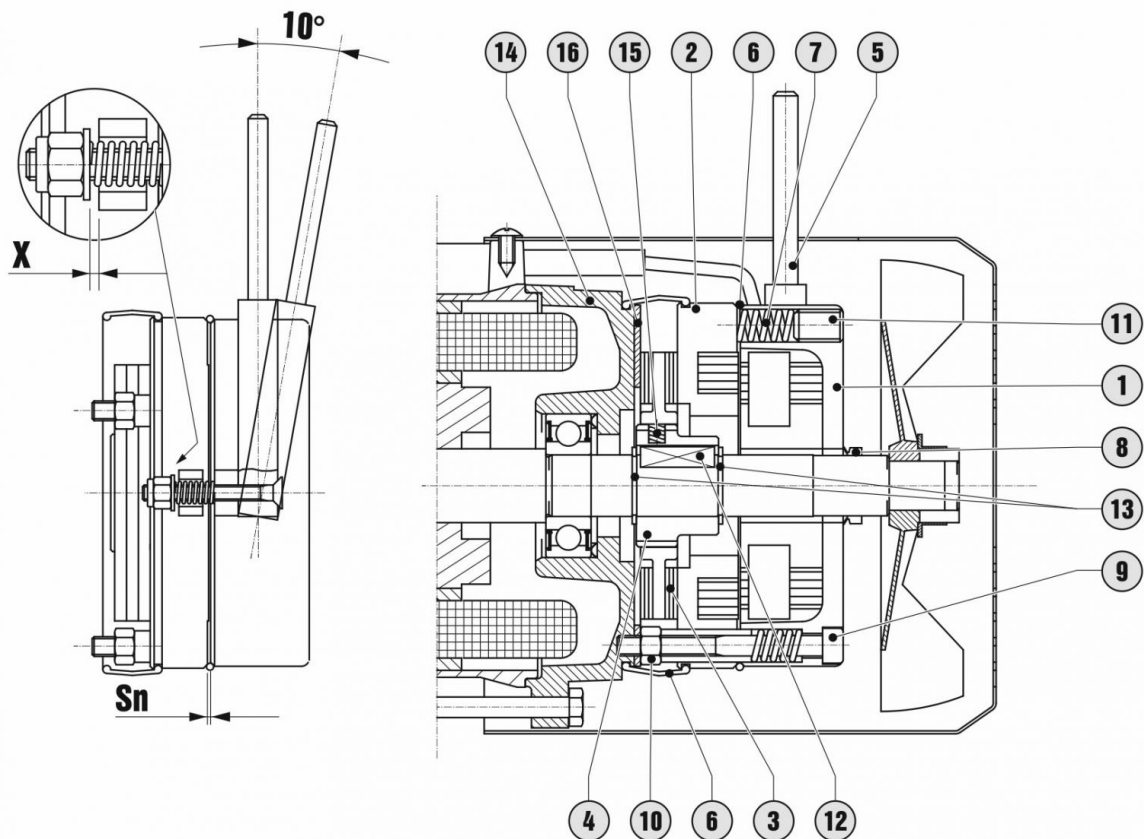
#### Power supply

The brake is powered AC 230/400V±10% 50Hz.

Optionally, brakes can be supplied for the following voltages: 115/200V 50Hz, 120/208V 60Hz, 133/230V 50Hz, 208/360V 50Hz, 208/360V 60Hz, 255/440V 50Hz, 200/346-220/380V 50-60Hz, 290/500-330/575V 50-60Hz, 400/690-460/800V 50-60Hz. In three-phase TBS, TBH and TBP motors, the brake is usually powered directly from the motor's power supply (direct power). Separate brake power is available as an option; in this case, a second terminal block is mounted in the terminal box to which are cabled the brake cables and an additional cable gland is provided to route the brake power cord into the terminal box; brake power is always separate for 2 pole three-phase DB motors.

## 3.10 BRAKE MOTORS

MS



1. Brake magnet
2. Moving coil
3. Brake disk
4. Drive hub
5. Release lever (optional)
6. Boot + O-ring (optional)
7. Thrust springs
8. V-ring (optional - in combination with protective boot + O-ring)
9. Mounting bolt
10. Locknuts
11. Braking torque adjuster screw (on request)
12. Key
13. Circlip
14. Cast iron shield
15. Vibration damping O-ring
16. Anti-seizing stainless steel washer (optional)

## Brake characteristic values

	T	S <sub>n</sub>	S <sub>max</sub>	X	J <sub>B</sub>	W	W <sub>1</sub>	t <sub>1</sub>	t <sub>2</sub>	m <sub>B</sub>	P <sub>a</sub>	M <sub>B</sub>
<b>63</b>	..2	0,2	0,5	0,6	0,6	260	15,6	4	20	1,3	60	1,8-3,5
<b>71</b>	..3	0,2	0,5	0,8	1,1	370	22,4	4	40	1,9	80	2,5-5-7,5-10
<b>80</b>	..4	0,3	0,6	1	1,6	500	30	6	60	3	110	5-10-15-20
<b>90S-90L-100</b>	..5	0,3	0,6	1	3,5	750	45	8	90	5,6	250	13-26-40
<b>112</b>	..6S	0,35	0,7	1,2	8,8	1000	70	16	120	9,7	470	40-60
<b>132S</b>	..6	0,35	0,7	1,2	10,3	1100	77	16	140	10,3	550	50-75-100
<b>132L-M</b>	..7	0,4	0,8	1,2	22,5	1650	132	16	180	14,7	600	50-100-150

T = Type

S<sub>n</sub> = nominal airgap [mm]

S<sub>max</sub> = maximum airgap [mm]

X = release lever play [mm]

J<sub>B</sub> = brake disk moment of inertia [kgcm<sup>2</sup>]

W = maximum energy which can be dissipated by brake [MJ]

W<sub>1</sub> = energy which can be dissipated between two successive adjustments of airgap from S<sub>n</sub> to S<sub>max</sub> [MJ]

t<sub>1</sub>(\*) = brake release time [ms]

t<sub>2</sub>(\*) = brake response time [ms]

m<sub>B</sub> = weight [kg]

P<sub>a</sub> = power absorption [VA]

M<sub>B</sub> = brake moments available [Nm]

(\*) NOTE: the effective values may deviate slightly in relation to the ambient temperature and humidity, the brake temperature and wear of the friction surfaces; t<sub>1</sub> and t<sub>2</sub> refer to a brake calibrated with medium airgap, nominal voltage and separate power; as regards the braking moment, one must allow for running in to allow the ferode to adapt to the braking surface of the motor shield, for a period which depends on the actual braking loads; once running in is completed, in nominal operating conditions one can expect a deviation from the declared value of ±10%.

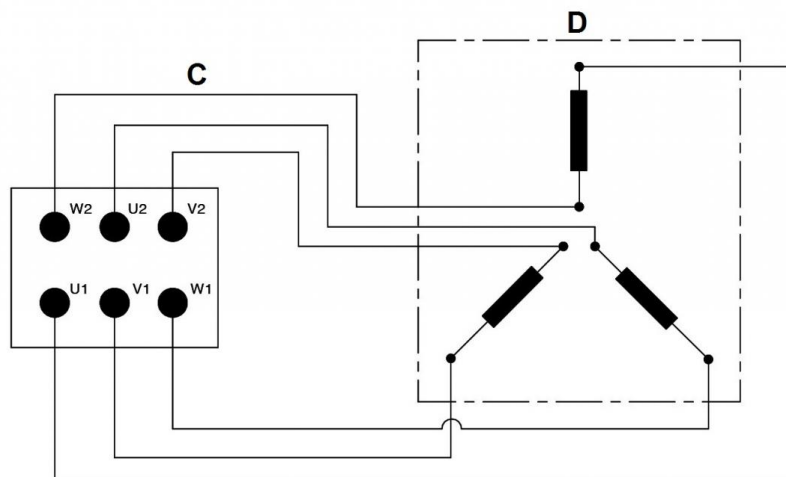
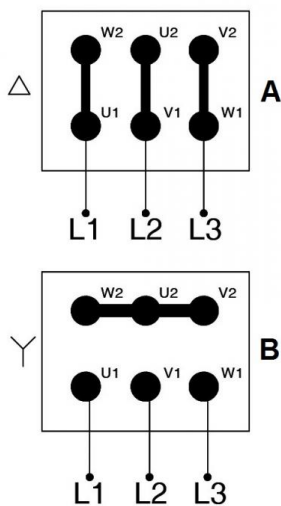
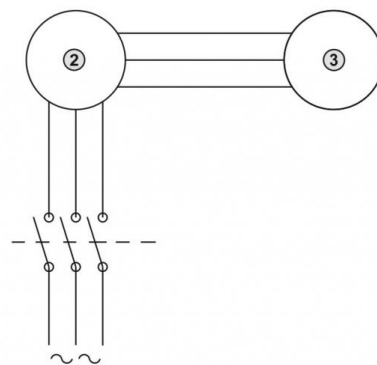
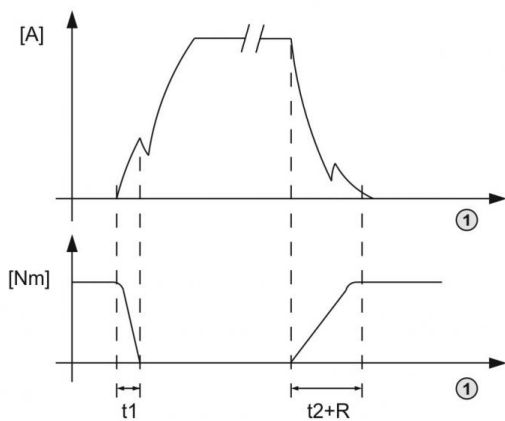


## 3.10.6 Hookup for MS brakes

1. Direct brake power: the brake is powered directly off the motor's terminal block; when the motor is powered up, the brake coil is automatically energised and the brake is released; when power to the motor is shut off, the brake coil is automatically de-energised and the brake, brakes the motor. During this phase, the braking response time  $t_2$  has to be added to delay R, generated by the inertia of the load and by the energy accumulated by the motor. R changes in every motor and - as it depends on the load - cannot be previously calculated.

- 1. Time
- 2. Motor
- 3. Brake

- A. Delta connection
- B. Star connection
- C. Motor terminal board
- D. Brake

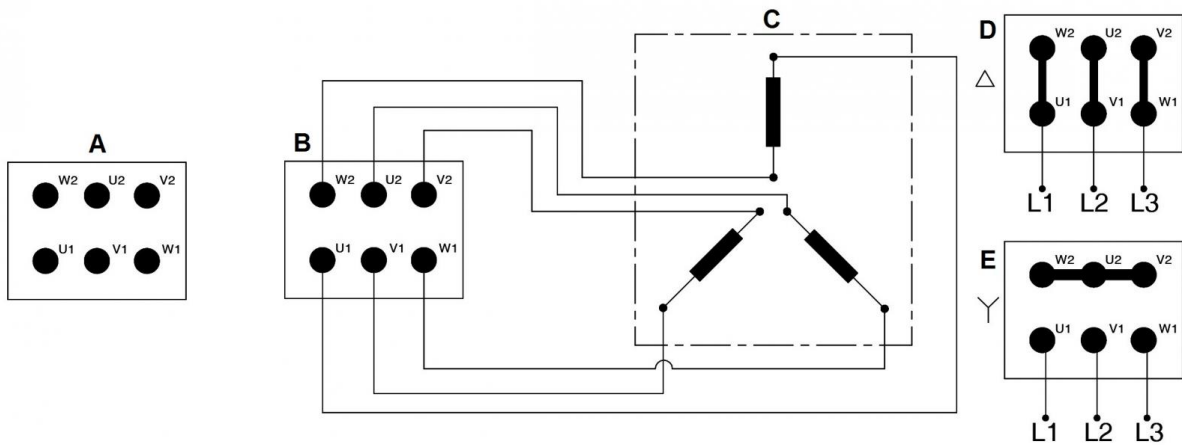
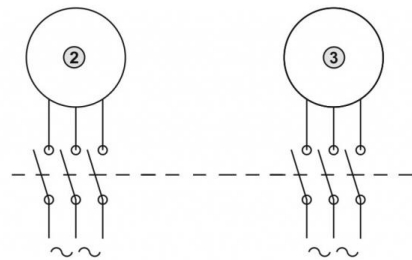
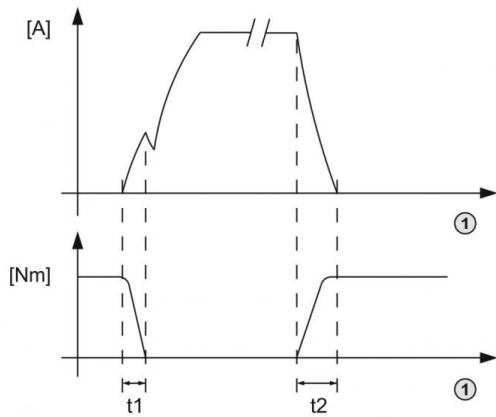


# 3.10 BRAKE MOTORS

2. Separate brake power: the brake is powered off a terminal block separate from the motor's block; in this case  $t_1$  and  $t_2$  depend only on the characteristics of the brake.

- 1. Time
- 2. Motor
- 3. Brake

- A. Motor terminal board
- B. Auxiliary terminal board
- C. Brake
- D. Delta connection
- E. Star connection



### 3.10.7 Notes and calculations

#### Calculating the braking moment

The rating of the brake depends largely on the moment of inertia it is to brake, the number of braking cycles per hour, the severity of the duty and the required stopping times; in particular, the following must be borne in mind:

- braking moment;
- wear of friction surfaces in relation to service intervals;
- thermal load (work which can be dissipated by the brake in relation to the load's moment of inertia and the number of cycles per hour);
- special ambient conditions for which guards or corrosion proofing are required.

The calculation of the braking moment  $M_B$  for a given application depends on the following design parameters:

$J_{tot}$  = total inertia of rotating parts reduced to motor shaft [kgm<sup>2</sup>]

$n_0$  = motor shaft speed [rpm]

$t_F$  = braking time [s]

$M_L$  = moment of load acting on system (e.g. load to be lifted, resisting moment, etc.)

The braking moment is calculated as follows:

$$M_B = K [(2\pi * n_0 / 60) * J_{tot} \pm M_L] / t_F$$

where:

- K = safety coefficient ( $\geq 2$ )
- $M_L$  takes the following sign:
  - "-" when lifting a weight or torque opposing the motor's direction of rotation;
  - "+" when lowering a weight or torque in the motor's direction of rotation.

#### Verification of heat which can be dissipated

In each cycle, the energy of the moving masses is transformed into heat by friction. The work done during braking is:

$$W_B = J_{tot} * [(2\pi * n_0 / 60)^2 / 2] * [M_B / M_B \pm M_L] \quad [J]$$

When we know the work done during a braking cycle  $W_B$ , the application's number of cycles per hour Z must be less than the maximum number of cycles per hour permitted for the type of brake selected as shown in the graph ( $W_{Bmax}$ -Z).

Instead, when we know the number of cycles per hour Z, the corresponding maximum work to be done  $W_{Bmax}$  must be greater than that of the actual application (calculation).

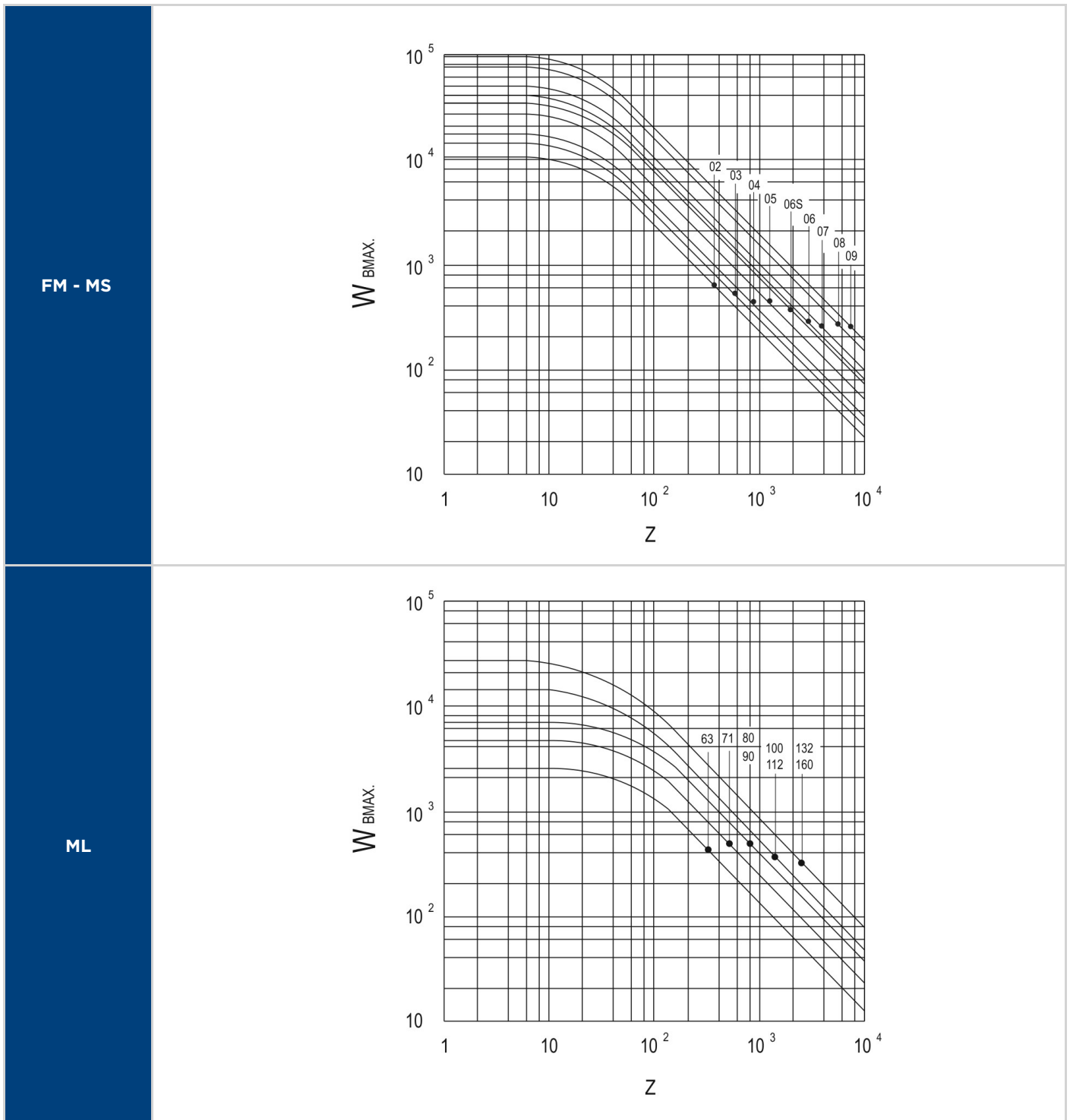
# 3.10 BRAKE MOTORS

### Braking work which can be dissipated between two adjustments

Given the moments of inertia of the moving masses reduced to the shaft to be braked, and once the work per cycle  $W_B$  has been calculated, the number of cycles per interval between two successive adjustments is:

$$N = W_1 / W_B$$

$W_1$  is given in the table for the type of brake in question.



**Starting frequency**

For a given application, the maximum starting frequency  $Z$  in relation to the load and the inertias can be determined as:

$$Z = K_J * K_M * Z_0 \quad [h^{-1}]$$

where:

$K_J$  = coefficient given in the table in relation to  $J/J_T$

$K_M$  = coefficient given in the table in relation to  $M_L/M_S$

$J_T$  = moment of inertia of the motor

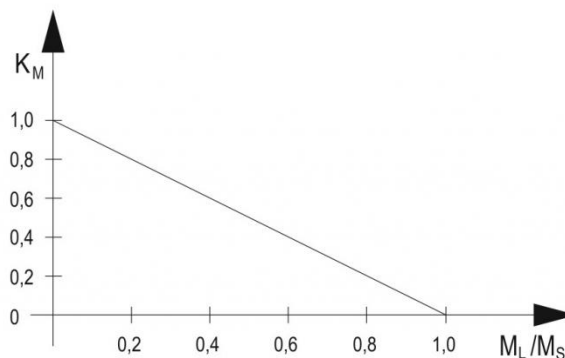
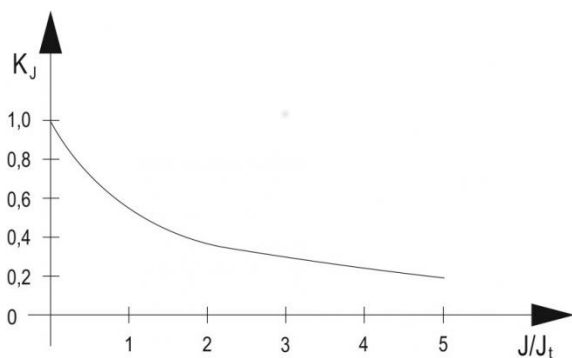
$J$  = moment of inertia of the load excluding that of the motor itself

$M_S$  = motor starting torque

$M_L$  = resisting moment

$Z_0$  = starting frequency under load and inertia except for that of the motor itself (value given in the performance data tables for each type of motor).

The resulting starting frequency  $Z$  must be less than the maximum number of cycles/hour permitted for the brake; if this condition is not met, the brake is unable to dissipate the heat generated by braking, so one must either reduce the starting frequency or oversize the brake (see brake ratings paragraph). If the value of  $Z$  is close to  $Z_0$ , it is advisable to keep the motor windings temperature under control with, for instance, a bimetal cutout.



# 3.11 ELECTRIC MOTOR IDENTIFICATION

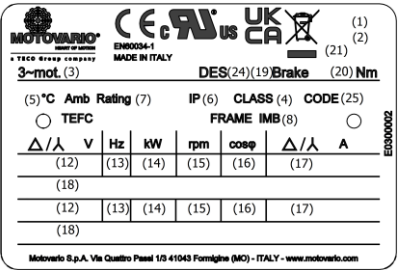
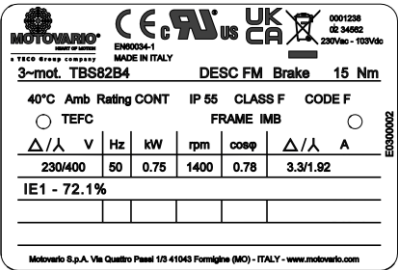
An electric motor can feature a metal silk-screen printed and/or punched nameplate or an adhesive label glued a metal support.

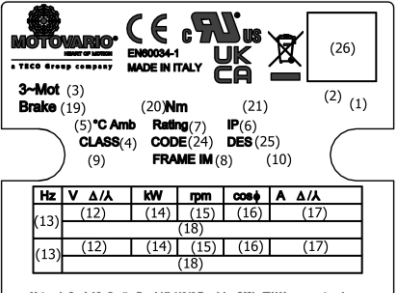
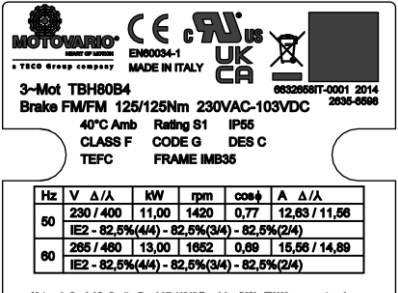
The nameplate must not be removed and must be kept intact and readable. In case you need a copy of it just contact MOTOVARIO TECHNICAL SERVICE.



THREE-PHASE MOTOR NAMEPLATE LAYOUT	THREE-PHASE MOTOR – FILLED-OUT EXAMPLE																																
<p> <b>MOTOVARIO</b>                      EN60034-1                      MADE IN ITALY                      3-mot.(3) Brake (19) Nm (20)                 </p> <p>                     I.C.I.(4) Tamb (5) C IP(6) S (7) IMB (8)                      IC41(9) kg(11)                 </p> <table border="1"> <tr> <th><math>\Delta/\lambda</math></th> <th>V</th> <th>Hz</th> <th>kW</th> <th>min 1</th> <th>cos<math>\phi</math></th> <th><math>\Delta/\lambda</math></th> <th>A</th> </tr> <tr> <td>(12)</td> <td>(13)</td> <td>(14)</td> <td>(15)</td> <td>(16)</td> <td>(17)</td> <td>(17)</td> <td>(17)</td> </tr> </table> <p>Motovario S.p.A. Via Quattro Piani 1/3 41043 Formigine (MO) - ITALY - www.motovario.com</p>	$\Delta/\lambda$	V	Hz	kW	min 1	cos $\phi$	$\Delta/\lambda$	A	(12)	(13)	(14)	(15)	(16)	(17)	(17)	(17)	<p> <b>MOTOVARIO</b>                      EN60034-1                      MADE IN ITALY                      3-mot. TH80B4 Brake Nm                 </p> <p>                     I.C.I.F Tamb 40°C IP 55 S1 IMB14                      IC411 kg                 </p> <table border="1"> <tr> <th><math>\Delta/\lambda</math></th> <th>V</th> <th>Hz</th> <th>kW</th> <th>min 1</th> <th>cos<math>\phi</math></th> <th><math>\Delta/\lambda</math></th> <th>A</th> </tr> <tr> <td>230/400</td> <td>50</td> <td>0.75</td> <td>1400</td> <td>0.77</td> <td>3.10/1.77</td> <td></td> <td></td> </tr> </table> <p>                     IE2 - 79.6% (4/4) - 79.7% (3/4) - 75.8% (2/4)                      265/480 80 0.75 1740 0.72 2.74/1.58                      IE2 - 82.5% (4/4) - 81.9% (3/4) - 79.7% (2/4)                 </p> <p>Motovario S.p.A. Via Quattro Piani 1/3 41043 Formigine (MO) - ITALY - www.motovario.com</p>	$\Delta/\lambda$	V	Hz	kW	min 1	cos $\phi$	$\Delta/\lambda$	A	230/400	50	0.75	1400	0.77	3.10/1.77		
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UL/CSA MOTOR NAMEPLATE	UL/CSA MOTOR – FILLED-OUT EXAMPLE																																								
 <p>MOTOVARIO EN60034-1 MADE IN ITALY</p> <p>3-mot. (3) DES(24)(19) Brake (20) Nm</p> <p>(5) °C Amb Rating (7) IP(6) CLASS (4) CODE (25)</p> <p>TEFC ○ FRAME IMB (8) ○</p> <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th>Δ/Λ</th> <th>V</th> <th>Hz</th> <th>kW</th> <th>rpm</th> <th>cosφ</th> <th>Δ/Λ</th> <th>A</th> </tr> <tr> <td>(12)</td> <td>(13)</td> <td>(14)</td> <td>(15)</td> <td>(16)</td> <td>(17)</td> <td>(18)</td> <td>(17)</td> </tr> <tr> <td>(12)</td> <td>(13)</td> <td>(14)</td> <td>(15)</td> <td>(16)</td> <td>(17)</td> <td>(18)</td> <td>(17)</td> </tr> </table> <p>Motovario S.p.A. Via Quattro Passi 1/3 41043 Formigine (MO) - ITALY - www.motovario.com</p>	Δ/Λ	V	Hz	kW	rpm	cosφ	Δ/Λ	A	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(17)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(17)	 <p>MOTOVARIO EN60034-1 MADE IN ITALY</p> <p>3-mot. TBS82B4 DESC FM Brake 15 Nm</p> <p>40°C Amb Rating CONT IP 55 CLASS F CODE F</p> <p>TEFC ○ FRAME IMB ○</p> <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th>Δ/Λ</th> <th>V</th> <th>Hz</th> <th>kW</th> <th>rpm</th> <th>cosφ</th> <th>Δ/Λ</th> <th>A</th> </tr> <tr> <td>230/400</td> <td>50</td> <td>0.75</td> <td>1400</td> <td>0.78</td> <td>3.3/1.92</td> <td></td> <td></td> </tr> </table> <p>IE1 - 72.1%</p> <p>Motovario S.p.A. Via Quattro Passi 1/3 41043 Formigine (MO) - ITALY - www.motovario.com</p>	Δ/Λ	V	Hz	kW	rpm	cosφ	Δ/Λ	A	230/400	50	0.75	1400	0.78	3.3/1.92		
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CCC MOTOR LABEL	CCC MOTOR – FILLED-OUT EXAMPLE																																																
 <p>MOTOVARIO EN60034-1 意大利制造 MADE IN ITALY</p> <p>3-Mot (3) (2) (1)</p> <p>(4) I.C.I. F Ta (5) C (6) IP55 (7) 安装方式 (8) 冷却方式 (9) 重量 (11) (10)</p> <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th>Hz</th> <th>V Δ/Λ</th> <th>kW</th> <th>rpm</th> <th>cosφ</th> <th>A Δ/Λ</th> </tr> <tr> <td>(13)</td> <td>(12)</td> <td>(14)</td> <td>(15)</td> <td>(16)</td> <td>(17)</td> </tr> <tr> <td>(13)</td> <td>(12)</td> <td>(14)</td> <td>(15)</td> <td>(16)</td> <td>(17)</td> </tr> </table> <p>Motovario S.p.A. Via Quattro Passi 1/3 41043 Formigine (MO) - ITALY - www.motovario.com</p>	Hz	V Δ/Λ	kW	rpm	cosφ	A Δ/Λ	(13)	(12)	(14)	(15)	(16)	(17)	(13)	(12)	(14)	(15)	(16)	(17)	 <p>MOTOVARIO EN60034-1 意大利制造 MADE IN ITALY</p> <p>三相异步电动机 3-Mot TS80A2</p> <p>绝缘等级 I.C.I. F 温度 Ta 40° C 防护等级 IP55 S2/60M 安装方式 IMB34 冷却方式 IC416 重量 50,3kg TR 3B H1 V</p> <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th>Hz</th> <th>V Δ/Λ</th> <th>kW</th> <th>rpm</th> <th>cosφ</th> <th>A Δ/Λ</th> </tr> <tr> <td>50</td> <td>230 / 400</td> <td>11,00</td> <td>1420</td> <td>0,77</td> <td>12,63 / 11,56</td> </tr> <tr> <td></td> <td colspan="5">IE2 - 82,5%(4/4) - 82,5%(3/4) - 82,5%(2/4)</td> </tr> <tr> <td>60</td> <td>265 / 480</td> <td>13,00</td> <td>1652</td> <td>0,89</td> <td>15,56 / 14,89</td> </tr> <tr> <td></td> <td colspan="5">IE2 - 82,5%(4/4) - 82,5%(3/4) - 82,5%(2/4)</td> </tr> </table> <p>Motovario S.p.A. Via Quattro Passi 1/3 41043 Formigine (MO) - ITALY - www.motovario.com</p>	Hz	V Δ/Λ	kW	rpm	cosφ	A Δ/Λ	50	230 / 400	11,00	1420	0,77	12,63 / 11,56		IE2 - 82,5%(4/4) - 82,5%(3/4) - 82,5%(2/4)					60	265 / 480	13,00	1652	0,89	15,56 / 14,89		IE2 - 82,5%(4/4) - 82,5%(3/4) - 82,5%(2/4)				
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1. Serial number
2. Year of manufacture - order number
3. Motor type code (series/size/n. poles)
4. Insulation class
5. Maximum ambient operating temperature
6. Protection rating
7. Duty
8. Mounting position
9. Cooling system (\*)
10. Additional options (see below)
  11. Motor weight (only for > 30 kg)
  12. Motor voltage (depending on connection)
  13. Power frequency [Hz]
  14. Nominal power delivery [kW]
  15. Nominal speed [rpm]
  16. Nominal power factor
  17. Nominal current (depending on connection) [A]
  18. Code IE1, IE2, IE3 or IE4 (depending on type of motor and whether applicable) followed by efficiency value at 4/4, 3/4 and 2/4 of nominal power.

Brake motors only

19. Brake type
20. Nominal braking moment [Nm]
21. Brake power supply

Single-phase version only

22. Running capacitor [ $\mu$ F]
23. Starting capacitor [ $\mu$ F]

UL/CSA version only

24. Current identification with rotor blocked (ANSI/NFPA 70-1996)
25. "NEMA Electrical Design Classification"
26. QR code

**ADDITIONAL OPTIONS (10)**

- H1 condensation heaters for voltage 110V
- H2 condensation heaters for voltage 230V
- LT low temperature construction
- HT high temperature construction
- 3B n. 3 bimetal cutouts
- 3P n. 3 thermistors (PTC)
- A backstop device (counterclockwise rotation permitted)
- B backstop device (clockwise rotation permitted)
- E encoder
- V flywheel
- HC rapid connection

(\*) For motors in UL/CSA versions, the cooling system is indicated with the following codes:

TEFC = (T)otally (E)nclosed (F)an (C)ooled - corresponds to IC411 (self-ventilation)

TENV = (T)otally (E)nclosed (N)ot (V)entilated - corresponds to IC410 (non-ventilated)

TEBC = (T)otally (E)nclosed (B)lower (C)ooled - corresponds to IC416 (forced ventilation)



Meaning of the symbols and abbreviations used in the performance tables.

SYMBOLS AND UNITS OF MEASUREMENT	DESCRIPTION
$P_n$ [W]	Nominal power [kW]
$n_n$ [rpm]	Nominal speed [rpm]
$I_n$ [A]	Nominal current [A]
$M_n$ [Nm]	Nominal torque [Nm]
$\eta\%$	Nominal efficiency in % (limit: minimum value required by the standard; 4/4, 3/4, 2/4: fraction of nominal power)
$\cos\phi_n$	Nominal power factor
$M_s / M_n$	Starting torque / Nominal torque ratio
$M_{max} / M_n$	Maximum torque / Nominal torque ratio
$I_s / I_n$	Starting current / Nominal current ratio
$J_t$ [kg×m <sup>2</sup> ]	Moment of inertia of motor [10 <sup>-4</sup> kg×m <sup>2</sup> ] 1) without brake 2) with brake (MS - FM)
$W_t$ [kg]	Motor weight (version B5) [kg] 1) without brake 2) with brake (MS - FM)
$Z_0$ [1/h]	Max. admitted nr. start-ups/hour with no load [1/h]
$M_B$ [Nm]	Braking torque [Nm]
$C_r$ [μF]	Operating capacitor [μF] (series SH, HSH)
$C_a$ [μF]	Starting capacitor [μF] (series HSH)

# 4.2 TH/TP TBH/TBP

2 Pole

400V 50Hz

P <sub>n</sub> [kW]	Series	Size	n <sub>n</sub> [rpm]	I <sub>n</sub> [A]	M <sub>n</sub> [Nm]	IE	η <sub>n</sub> % (4/4) limit	η <sub>n</sub> % (4/4)	η <sub>n</sub> % (3/4)	η <sub>n</sub> % (2/4)	cosφ <sub>n</sub>	M <sub>s</sub> M <sub>n</sub>	I <sub>s</sub> I <sub>n</sub>	M <sub>max</sub> M <sub>n</sub>	J <sub>T</sub>	J <sub>TB</sub>	W <sub>T</sub>	W <sub>TB</sub>	Z <sub>0</sub> 10 <sup>3</sup> ×1/h	M <sub>B</sub> [Nm]
															10 <sup>-4</sup> ×Kg <sub>m</sub> <sup>2</sup>	Kg				
0,12	TH	56B2	2640	0,40	0,43	IE2	53,6	56,5	57,1	54,1	0,76	3,3	3,5	2,5	1,2	0,0	3,3	0,0	0,0	0,0
0,18	TH-TBH	63A2	2830	0,59	0,61	IE2	60,4	63,7	58,7	53,5	0,69	2,8	4,0	3,3	2,0	2,6	3,7	5,2	4,7	1,8
0,25	TH-TBH	63B2	2820	0,72	0,85	IE2	64,8	70,9	69,0	63,6	0,71	3,0	4,6	3,0	2,2	2,8	4,1	5,6	4,7	1,8
0,37	TH-TBH	63C2	2790	1,03	1,27	IE2	69,5	70,1	69,6	65,8	0,74	2,8	4,4	2,7	2,5	3,1	4,5	6,0	4,0	3,5
0,37	TH-TBH	71A2	2820	1,14	1,25	IE2	69,5	70,1	68,7	62,1	0,67	3,0	4,0	2,9	4,0	4,7	5,4	7,6	4,0	5,0
0,55	TH-TBH	71B2	2830	1,51	1,86	IE2	74,1	74,1	72,3	65,8	0,71	3,4	4,9	2,9	4,4	5,5	6,0	8,2	4,0	5,0
0,75	TP-TBP	80A2	2860	1,58	2,50	IE3	80,7	81,8	82,3	80,9	0,84	3,2	6,1	3,3	13,5	15,1	10,0	13,5	3,0	10,0
1,10	TP-TBP	80B2	2860	2,31	3,70	IE3	82,7	84,0	85,0	84,3	0,82	3,4	7,0	3,2	14,4	16,0	11,4	14,9	3,0	15,0
1,50	TP-TBP	90S2	2860	3,30	5,00	IE3	84,2	84,8	84,2	82,0	0,78	4,7	6,5	4,0	16,8	18,4	15,3	18,8	2,5	13,0
2,20	TP-TBP	90L2	2880	4,80	7,30	IE3	85,9	86,2	85,9	83,6	0,77	4,7	7,2	4,3	22,8	26,3	18,3	23,9	2,5	26,0
3,00	TP-TBP	100L2	2900	6,10	9,90	IE3	87,1	87,2	86,7	83,9	0,82	4,3	8,9	4,6	43,2	46,7	23,9	29,5	1,5	40,0
4,00	TP-TBP	112M2	2930	8,20	13,00	IE3	88,1	88,8	88,7	86,8	0,79	4,0	9,2	4,6	79,1	87,9	32,9	42,7	1,5	40,0
5,50	TP-TBP	132S2	2950	10,60	17,80	IE3	89,2	90,2	90,0	88,0	0,83	4,3	9,5	4,8	178,0	188,0	49,0	59,3	1,2	75,0
7,50	TP-TBP	132M2	2950	14,20	24,00	IE3	90,1	91,0	90,9	89,1	0,84	3,7	8,2	3,9	216,0	239,0	56,3	71,0	1,0	100,0

2 Pole

460V 60Hz

P <sub>n</sub> [kW]	Series	Size	n <sub>n</sub> [rpm]	I <sub>n</sub> [A]	M <sub>n</sub> [Nm]	IE	η <sub>n</sub> % (4/4) limit	η <sub>n</sub> % (4/4)	η <sub>n</sub> % (3/4)	η <sub>n</sub> % (2/4)	cosφ <sub>n</sub>	M <sub>s</sub> M <sub>n</sub>	I <sub>s</sub> I <sub>n</sub>	M <sub>max</sub> M <sub>n</sub>	J <sub>T</sub>	J <sub>TB</sub>	W <sub>T</sub>	W <sub>TB</sub>	Z <sub>0</sub> 10 <sup>3</sup> ×1/h	M <sub>B</sub> [Nm]
															10 <sup>-4</sup> ×Kg <sub>m</sub> <sup>2</sup>	Kg				
0,12	TH	56B2	3310	0,34	0,35	IE2	59,5	59,8	57,2	50,1	0,74	4,2	4,1	3,2	1,2	0,0	3,3	0,0	0,0	0,0
0,18	TH-TBH	63A2	3470	0,54	0,50	IE2	64,0	65,1	60,2	53,8	0,64	3,6	5,1	3,8	2,0	2,6	3,7	5,2	4,7	1,8
0,25	TH-TBH	63B2	3460	0,63	0,69	IE2	68,0	72,8	70,5	63,1	0,68	3,4	5,5	3,8	2,2	2,8	4,1	5,6	4,7	1,8
0,37	TH-TBH	63C2	3440	0,90	1,03	IE2	72,0	72,8	71,0	64,6	0,71	3,8	6,0	3,5	2,5	3,1	4,5	6,0	4,0	3,5
0,37	TH-TBH	71A2	3450	1,01	1,02	IE2	72,0	72,1	70,4	63,1	0,64	3,9	5,3	3,5	4,0	4,7	5,4	7,6	4,0	5,0
0,55	TH-TBH	71B2	3470	1,38	1,51	IE2	74,0	74,8	73,3	67,0	0,67	4,0	5,7	3,7	4,4	5,5	6,0	8,2	4,0	5,0
0,75	TP-TBP	80A2	3490	1,41	2,10	IE3	77,0	81,6	81,7	78,9	0,82	3,8	7,8	3,7	13,5	15,1	10,0	13,5	3,0	10,0
1,10	TP-TBP	80B2	3490	2,04	3,00	IE3	84,0	84,7	84,6	83,3	0,80	4,3	8,4	4,0	14,4	16,0	11,4	14,9	3,0	15,0
1,50	TP-TBP	90S2	3490	2,90	4,10	IE3	85,5	85,5	84,8	81,9	0,76	5,8	8,4	4,8	16,8	18,4	15,3	18,8	2,5	13,0
2,20	TP-TBP	90L2	3510	4,10	6,00	IE3	86,5	86,5	85,4	82,6	0,77	6,2	9,3	5,1	22,8	26,3	18,3	23,9	2,5	26,0
3,00	TP-TBP	100L2	3520	5,30	8,10	IE3	88,5	88,5	87,2	84,8	0,80	4,9	10,3	5,8	43,2	46,7	23,9	29,5	1,5	40,0
4,00	TP-TBP	112M2	3550	7,20	10,80	IE3	88,5	88,8	88,1	85,3	0,79	5,3	10,8	6,0	79,1	87,9	32,9	42,7	1,5	40,0
5,50	TP-TBP	132S2	3550	9,40	14,80	IE3	89,5	89,6	88,5	85,4	0,82	5,5	11,1	5,9	178,0	188,0	49,0	59,3	1,2	75,0
7,50	TP-TBP	132M2	3530	12,40	20,00	IE3	90,2	90,6	88,6	86,2	0,84	4,3	11,5	5,6	216,0	239,0	56,3	71,0	1,1	75,0

# 4.3 TS/TH/TP TBH/TBP

4 Pole

400V 50Hz

P <sub>n</sub> [kW]	Series	Size	n <sub>n</sub> [rpm]	I <sub>n</sub> [A]	M <sub>n</sub> [Nm]	η <sub>n</sub> % (4/4) limit	η <sub>n</sub> % (4/4)	η <sub>n</sub> % (3/4)	η <sub>n</sub> % (2/4)	cosφ <sub>n</sub>	M <sub>s</sub> M <sub>n</sub>	I <sub>s</sub> I <sub>n</sub>	M <sub>max</sub> M <sub>n</sub>	J <sub>T</sub>	J <sub>TB</sub>	W <sub>T</sub>	W <sub>TB</sub>	Z <sub>0</sub> 10 <sup>-2</sup> ×1/h	M <sub>B</sub> [Nm]	
														10 <sup>-4</sup> ×Kgm <sup>2</sup>	Kg					
0,09	<b>TS</b>	<b>56B4</b>	1250	0,42	0,68	-	0,0	45,4	43,4	0,0	0,66	2,0	2,2	2,1	1,5	0,0	3,1	0,0	0,0	0,0
0,12	<b>TH-TBH</b>	<b>63A4</b>	1350	0,40	0,85	IE2	59,1	62,6	62,3	57,3	0,70	2,3	3,2	2,3	2,8	3,4	4,1	5,6	12,5	1,8
0,12	<b>TP-TBP</b>	<b>63A4</b>	1350	0,39	0,85	IE3	64,8	64,8	63,3	57,9	0,69	2,2	3,1	2,2	2,8	3,4	4,1	5,6	12,5	1,8
0,18	<b>TH-TBH</b>	<b>63B4</b>	1360	0,59	1,26	IE2	64,7	66,1	64,3	58,6	0,67	2,5	3,5	2,5	3,6	4,2	4,8	6,3	12,5	3,5
0,18	<b>TP-TBP</b>	<b>63B4</b>	1350	0,55	1,27	IE3	69,9	69,9	67,9	62,8	0,68	2,6	3,2	2,4	3,6	4,2	4,8	6,3	12,5	3,5
0,25	<b>TH-TBH</b>	<b>63D4</b>	1350	0,80	1,77	IE2	68,5	68,5	66,7	59,8	0,66	2,8	3,5	2,5	3,6	4,2	4,9	6,4	10,0	3,5
0,25	<b>TH-TBH</b>	<b>71A4</b>	1380	0,73	1,73	IE2	68,5	68,5	67,5	61,7	0,72	2,5	4,0	2,4	7,8	8,9	5,4	7,6	10,0	5,0
0,25	<b>TP-TBP</b>	<b>71A4</b>	1410	0,68	1,69	IE3	73,5	73,5	72,8	68,5	0,72	2,8	4,8	2,8	11,0	12,1	7,0	9,2	10,0	5,0
0,37	<b>TH-TBH</b>	<b>71B4</b>	1400	1,01	2,50	IE2	72,7	72,7	72,4	69,1	0,73	2,8	4,7	2,6	11,0	12,1	7,0	9,2	10,0	7,5
0,37	<b>TP-TBP</b>	<b>71B4</b>	1410	0,96	2,51	IE3	77,3	77,3	76,4	72,5	0,72	2,8	4,9	3,0	13,9	15,0	8,3	10,5	10,0	7,5
0,55	<b>TH-TBH</b>	<b>71C4</b>	1400	1,43	3,80	IE2	77,1	77,1	76,7	73,1	0,72	3,2	5,0	2,9	13,9	15,0	8,3	10,5	8,0	7,5
0,55	<b>TH-TBH</b>	<b>80A4</b>	1420	1,39	3,70	IE2	77,1	77,3	77,3	73,5	0,74	2,5	5,0	3,1	20,6	22,2	8,3	11,8	8,0	10,0
0,55	<b>TP-TBP</b>	<b>80A4</b>	1440	1,23	3,60	IE3	80,8	80,8	80,9	77,8	0,80	3,1	6,3	3,2	31,8	33,4	11,4	14,9	8,0	10,0
0,75	<b>TP-TBP</b>	<b>80B4</b>	1440	1,67	5,00	IE3	82,5	82,9	82,5	80,0	0,78	3,2	6,1	3,5	38,1	39,7	13,2	16,7	7,1	15,0
1,10	<b>TP-TBP</b>	<b>90S4</b>	1430	2,41	7,30	IE3	84,1	84,5	84,6	82,6	0,78	3,2	6,2	3,4	42,3	45,8	17,7	21,2	5,0	13,0
1,50	<b>TP-TBP</b>	<b>90L4</b>	1430	3,20	10,00	IE3	85,3	85,6	85,6	83,0	0,79	3,3	6,5	3,4	48,0	51,5	19,7	25,3	4,0	26,0
2,20	<b>TP-TBP</b>	<b>100LA4</b>	1440	4,60	14,60	IE3	86,7	86,9	86,9	85,2	0,80	3,3	7,5	3,7	88,9	92,7	24,0	31,0	3,2	40,0
2,20	<b>TP-TBP</b>	<b>112MR4</b>	1460	4,60	14,40	IE3	86,7	88,9	88,4	86,2	0,77	4,0	9,0	4,3	137,0	146,0	32,0	42,0	2,5	40,0
3,00	<b>TP-TBP</b>	<b>112MS4</b>	1450	6,20	20,00	IE3	87,7	87,8	88,0	86,7	0,80	3,5	7,9	3,5	137,0	146,0	33,0	43,0	2,5	40,0
4,00	<b>TP-TBP</b>	<b>112M4</b>	1450	8,30	26,00	IE3	88,6	88,7	88,7	87,2	0,78	3,4	7,7	3,7	155,0	164,0	35,0	45,0	2,5	60,0
5,50	<b>TP-TBP</b>	<b>132MS4</b>	1470	11,10	36,00	IE3	89,6	89,6	89,6	87,9	0,80	3,8	8,2	3,9	388,0	411,0	61,0	75,0	1,8	100,0
7,50	<b>TP-TBP</b>	<b>132M4</b>	1460	15,20	49,00	IE3	90,4	90,4	90,6	89,5	0,79	3,5	6,9	3,3	413,0	436,0	64,0	78,0	1,1	150,0

# 4.3 TS/TH/TP TBH/TBP

4 Pole

460V 60Hz

P <sub>n</sub> [kW]	Series	Size	n <sub>n</sub> [rpm]	I <sub>n</sub> [A]	M <sub>n</sub> [Nm]	η <sub>n</sub> % (4/4) limit	η <sub>n</sub> % (4/4)	η <sub>n</sub> % (3/4)	η <sub>n</sub> % (2/4)	cosφ <sub>n</sub>	M <sub>s</sub> M <sub>n</sub>	I <sub>s</sub> I <sub>n</sub>	M <sub>max</sub> M <sub>n</sub>	J <sub>T</sub>	J <sub>TB</sub>	W <sub>T</sub>	W <sub>TB</sub>	Z <sub>0</sub> 10 <sup>3</sup> ×1/h	M <sub>B</sub> [Nm]	
														10 <sup>-4</sup> ×Kgm <sup>2</sup>	Kg					
0,09	TS	56B4	1620	0,38	0,55	-	0,0	48,4	45,2	0,0	0,60	2,5	2,6	2,5	1,5	0,0	3,1	0,0	0,0	0,0
0,12	TH-TBH	63A4	1680	0,35	0,68	IE2	64,0	66,1	64,4	60,1	0,65	2,8	3,9	2,9	2,8	3,4	4,1	5,6	12,5	1,8
0,12	TP-TBP	63A4	1680	0,35	0,68	IE3	66,0	66,0	62,5	55,9	0,65	2,6	3,8	2,8	2,8	3,4	4,1	5,6	12,5	1,8
0,18	TH-TBH	63B4	1690	0,53	1,02	IE2	68,0	70,8	68,9	62,5	0,60	3,2	4,2	3,2	3,6	4,2	4,8	6,3	12,5	3,5
0,18	TP-TBP	63B4	1680	0,53	1,02	IE3	69,5	69,5	66,8	60,7	0,61	3,3	3,9	3,2	3,6	4,2	4,8	6,3	12,5	3,5
0,25	TH-TBH	63D4	1680	0,73	1,42	IE2	70,0	71,8	69,1	63,1	0,60	3,5	4,3	3,2	3,6	4,2	4,9	6,4	10,0	3,5
0,25	TH-TBH	71A4	1710	0,66	1,40	IE2	70,0	71,8	69,5	63,7	0,66	3,0	5,0	3,2	7,8	8,9	5,4	7,6	10,0	5,0
0,25	TP-TBP	71A4	1730	0,63	1,38	IE3	73,4	73,6	73,4	68,2	0,68	3,2	5,6	3,4	11,0	12,1	7,0	9,2	10,0	5,0
0,37	TH-TBH	71B4	1710	0,90	2,07	IE2	72,0	74,8	74,1	69,7	0,69	3,1	5,6	3,4	11,0	12,1	7,0	9,2	10,0	7,5
0,37	TP-TBP	71B4	1730	0,87	2,04	IE3	78,2	78,2	77,2	72,3	0,68	3,3	5,9	3,5	13,9	15,0	8,3	10,5	10,0	7,5
0,55	TH-TBH	71C4	1720	1,30	3,10	IE2	75,5	77,9	76,5	71,9	0,68	3,8	6,1	3,7	13,9	15,0	8,3	10,5	8,0	7,5
0,55	TH-TBH	80A4	1730	1,20	3,00	IE2	75,5	80,0	78,8	74,0	0,70	3,0	6,1	3,5	20,6	22,2	8,3	11,8	8,0	10,0
0,55	TP-TBP	80A4	1750	1,11	3,00	IE3	81,1	81,1	81,0	76,8	0,77	3,5	7,5	3,8	31,8	33,4	11,4	14,9	8,0	10,0
0,75	TP-TBP	80B4	1750	1,49	4,10	IE3	83,5	85,5	82,8	79,8	0,74	3,8	7,2	4,0	38,1	39,7	13,2	16,7	7,1	15,0
1,10	TP-TBP	90S4	1750	2,13	6,00	IE3	86,5	86,5	85,6	82,8	0,75	3,8	7,6	3,8	42,3	45,8	17,7	21,2	5,0	13,0
1,50	TP-TBP	90L4	1750	2,80	8,20	IE3	86,5	86,6	85,7	82,7	0,77	3,8	7,8	4,2	48,0	51,5	19,7	25,3	4,0	26,0
2,20	TP-TBP	112MR4	1770	4,10	11,90	IE3	89,5	89,5	88,6	85,9	0,75	5,0	10,9	5,6	137,0	146,0	32,0	42,0	2,5	40,0
3,00	TP-TBP	112MS4	1760	5,40	16,30	IE3	89,5	89,5	88,8	86,8	0,78	4,1	9,5	4,7	137,0	146,0	33,0	43,0	2,5	40,0
4,00	TP-TBP	112M4	1760	7,50	22,00	IE3	89,5	89,5	89,0	87,0	0,75	3,8	9,1	4,5	155,0	164,0	35,0	45,0	2,5	60,0
5,50	TP-TBP	132MS4	1770	9,70	30,00	IE3	91,7	91,7	90,2	88,3	0,78	4,2	9,7	4,6	388,0	411,0	61,0	75,0	1,8	100,0
7,50	TP-TBP	132M4	1760	13,30	41,00	IE3	91,7	91,7	91,0	89,4	0,77	3,9	7,9	3,9	413,0	436,0	64,0	78,0	1,1	150,0

# 4.4 TS/TH/TP TBS/TBH/TBP

6 Pole

400V 50Hz

P <sub>n</sub> [kW]	Series	Size	n <sub>n</sub> [rpm]	I <sub>n</sub> [A]	M <sub>n</sub> [Nm]	η <sub>n</sub> % (4/4) limit	η <sub>n</sub> % (4/4)	η <sub>n</sub> % (3/4)	η <sub>n</sub> % (2/4)	cosφ <sub>n</sub>	M <sub>s</sub> M <sub>n</sub>	I <sub>s</sub> I <sub>n</sub>	M <sub>max</sub> M <sub>n</sub>	J <sub>T</sub>	J <sub>TB</sub>	W <sub>T</sub>	W <sub>TB</sub>	Z <sub>0</sub> 10 <sup>3</sup> ×1/h	M <sub>B</sub> [Nm]	
														10 <sup>-4</sup> ×Kg <sup>m</sup> ²	Kg					
0,09	TS-TBS	63A6	860	0,49	1,00	-	0,0	42,1	39,3	0,0	0,63	2,1	2,0	2,1	3,6	4,2	5,0	6,5	12,5	3,5
0,12	TH-TBH	63B6	870	0,59	1,32	IE2	50,6	50,6	45,2	37,9	0,58	2,0	2,4	2,2	3,6	4,2	5,1	6,6	12,5	3,5
0,18	TH-TBH	71A6	900	0,60	1,91	IE2	56,6	56,8	55,8	49,2	0,76	1,8	3,0	1,9	9,3	10,4	5,2	7,4	11,2	5,0
0,25	TH-TBH	71B6	910	0,82	2,62	IE2	61,6	64,1	64,6	59,7	0,69	1,9	3,0	2,1	12,0	13,1	6,0	8,2	11,2	7,5
0,37	TH-TBH	71C6	900	1,08	3,90	IE2	67,6	67,8	70,1	66,9	0,73	1,7	3,2	2,0	15,6	17,0	7,5	9,7	10,0	7,5
0,37	TH-TBH	80A6	940	1,18	3,80	IE2	67,6	67,6	64,9	58,6	0,67	2,0	3,8	2,7	25,4	27,0	9,6	13,0	9,5	10,0
0,55	TH-TBH	80B6	940	1,65	5,60	IE2	73,1	73,1	71,7	65,6	0,66	2,2	4,3	2,6	29,9	31,5	11,1	14,6	9,0	15,0
0,75	TP-TBP	90S6	940	1,85	7,60	IE3	78,9	78,9	79,0	74,9	0,74	2,5	5,0	2,7	65,0	66,6	15,4	18,8	7,1	26,0
1,10	TP-TBP	100LR6	950	2,73	11,10	IE3	81,0	82,0	82,2	80,8	0,71	2,6	5,1	2,8	88,0	91,5	22,7	27,9	4,0	26,0
1,50	TP-TBP	100L6	940	3,70	15,20	IE3	82,5	82,6	83,2	81,0	0,71	2,7	4,9	2,9	91,6	95,1	24,8	30,0	3,6	40,0
2,20	TP-TBP	112M6	960	5,10	21,90	IE3	84,3	84,3	84,5	81,8	0,74	2,3	6,1	2,9	229,0	258,0	34,0	44,0	2,8	40,0
3,00	TP-TBP	132S6	970	6,70	30,00	IE3	85,6	86,2	87,2	86,5	0,75	2,5	6,1	2,7	384,0	394,0	46,0	57,0	2,3	75,0
4,00	TP-TBP	132MA6	970	8,90	39,00	IE3	86,8	87,2	88,0	88,2	0,74	2,5	6,6	2,9	456,0	479,0	54,0	68,0	1,5	75,0
5,50	TP-TBP	132MB6	970	12,10	54,00	IE3	88,0	88,3	88,6	87,7	0,74	2,7	6,4	2,9	562,0	585,0	62,0	76,0	1,3	100,0

6 Pole

460V 60Hz

P <sub>n</sub> [kW]	Series	Size	n <sub>n</sub> [rpm]	I <sub>n</sub> [A]	M <sub>n</sub> [Nm]	η <sub>n</sub> % (4/4) limit	η <sub>n</sub> % (4/4)	η <sub>n</sub> % (3/4)	η <sub>n</sub> % (2/4)	cosφ <sub>n</sub>	M <sub>s</sub> M <sub>n</sub>	I <sub>s</sub> I <sub>n</sub>	M <sub>max</sub> M <sub>n</sub>	J <sub>T</sub>	J <sub>TB</sub>	W <sub>T</sub>	W <sub>TB</sub>	Z <sub>0</sub> 10 <sup>3</sup> ×1/h	M <sub>B</sub> [Nm]	
														10 <sup>-4</sup> ×Kg <sup>m</sup> ²	Kg					
0,09	TS-TBS	63A6	1070	0,44	0,80	-	0,0	43,3	39,8	0,0	0,59	2,6	2,4	2,6	3,6	4,2	5,0	6,5	12,5	3,5
0,12	TH-TBH	63B6	1100	0,61	1,04	IE2	50,5	50,5	45,5	38,0	0,49	2,2	2,4	3,0	3,6	4,2	5,1	6,6	12,5	3,5
0,18	TH-TBH	71A6	1130	0,55	1,52	IE2	55,0	60,8	58,9	51,6	0,68	1,6	3,7	2,6	9,3	10,4	5,2	7,4	11,2	5,0
0,25	TH-TBH	71B6	1130	0,75	2,11	IE2	59,5	68,4	67,7	61,5	0,61	2,3	3,4	2,5	12,0	13,1	6,0	8,2	11,2	7,5
0,37	TH-TBH	71C6	1120	0,97	3,20	IE2	64,0	72,9	73,2	68,9	0,66	2,2	3,9	2,4	15,6	17,0	7,5	9,7	10,0	7,5
0,37	TH-TBH	80A6	1130	1,11	3,10	IE2	64,0	68,3	66,6	59,6	0,61	2,6	4,7	3,4	25,4	27,0	9,6	13,0	9,5	10,0
0,55	TH-TBH	80B6	1150	1,53	4,60	IE2	68,0	74,2	73,1	65,1	0,61	2,4	4,8	3,2	29,9	31,5	11,1	14,6	9,0	15,0

4 Pole

230V 50Hz

$P_n$ [kW]	Series	Size	$n_n$ [rpm]	$I_n$ [A]	$M_n$ [Nm]		$\eta_n\%$ (4/4) limit	$\eta_n\%$ (4/4)	$\eta_n\%$ (3/4)	$\eta_n\%$ (2/4)	$\cos\varphi_n$	$C_r$ [μF]	$\frac{M_s}{M_n}$	$\frac{I_s}{I_n}$	$\frac{M_{max}}{M_n}$	$J_T$ [10 <sup>-4</sup> × Kg m <sup>2</sup> ]	$W_T$ [Kg]
0,12	SH	63A4	1400	0,90	0,82	IE2	59,1	61,0	55,4	44,9	0,95	6,3	0,7	3,1	1,9	3,6	4,9
0,18	SH	63B4	1370	1,23	1,25	IE2	64,7	64,7	58,5	47,9	0,98	8,0	0,6	2,6	1,7	4,1	5,3
0,25	SH	71A4	1450	1,72	1,65	IE2	68,5	68,5	61,9	50,6	0,92	10,0	0,5	5,0	2,5	11,0	7,1
0,37	SH	71B4	1430	2,57	2,47	IE2	72,7	72,7	66,4	59,1	0,86	12,5	0,5	4,8	2,2	13,9	8,4
0,55	SH	80A4	1460	3,34	3,60	IE2	77,1	77,1	71,2	63,0	0,93	20,0	0,6	5,9	3,0	31,8	11,3
0,75	SH	80B4	1460	4,27	4,91	IE2	79,6	79,6	76,1	68,8	0,96	25,0	0,3	5,7	2,5	38,1	13,3
1,10	SH	90S4	1460	6,60	7,19	IE2	81,4	81,4	78,6	71,8	0,89	30,0	0,4	5,4	2,3	42,3	17,8
1,50	SH	90L4	1450	8,12	9,88	IE2	82,8	82,8	79,5	72,6	0,97	50,0	0,4	4,9	2,2	48,0	19,9
2,20	SH	100LA4	1440	11,94	14,59	IE2	84,3	84,3	82,8	77,9	0,95	80,0	0,3	4,8	2,0	88,9	24,8

## 4.6 HSH

4 Pole

230V 50Hz

$P_n$ [kW]	Series	Size	$n_n$ [rpm]	$I_n$ [A]	$M_n$ [Nm]		$\eta_n\%$ (4/4) limit	$\eta_n\%$ (4/4)	$\eta_n\%$ (3/4)	$\eta_n\%$ (2/4)	$\cos\phi_n$	$C_r / C_s$ [μF]	$\frac{M_s}{M_n}$	$\frac{I_s}{I_n}$	$\frac{M_{max}}{M_n}$	$J_T$ [10 <sup>-4</sup> × Kg m <sup>2</sup> ]	$W_T$ [Kg]
0,12	HSB	63A4	1400	0,90	0,82	IE2	59,1	61,0	55,4	44,9	0,95	6.3 - 12.5	2,5	3,9	1,9	3,6	5,4
0,18	HSB	63B4	1370	1,23	1,25	IE2	64,7	64,7	58,5	47,9	0,98	8 - 16	2,1	3,7	1,7	4,1	5,9
0,25	HSB	71A4	1450	1,72	1,65	IE2	68,5	68,5	61,9	50,6	0,92	10 - 20	1,9	5,3	2,5	11,0	7,5
0,37	HSB	71B4	1430	2,57	2,47	IE2	72,7	72,7	66,4	59,1	0,86	12.5 - 30	2,1	4,9	2,2	13,9	8,9
0,55	HSB	80A4	1460	3,34	3,60	IE2	77,1	77,1	71,2	63,0	0,93	20 - 40	1,9	6,1	3,0	31,8	11,8
0,75	HSB	80B4	1460	4,27	4,91	IE2	79,6	79,6	76,1	68,8	0,96	25 - 80	2,0	6,0	2,5	38,1	13,5
1,10	HSB	90S4	1460	6,60	7,19	IE2	81,4	81,4	78,6	71,8	0,89	30 - 100	2,1	5,4	2,3	42,3	18,2
1,50	HSB	90L4	1450	8,12	9,88	IE2	82,8	82,8	79,5	72,6	0,97	50 - 160	2,1	5,7	2,2	48,0	20,6
2,20	HSB	100LA4	1440	11,94	14,59	IE2	84,3	84,3	82,8	77,9	0,95	80 - 260	1,8	5,0	2,0	88,9	25,4

# 4.7 D-DB

## 2/4 Pole - Dahlander YY/Δ

400V 50Hz

P <sub>n</sub> [kW]	Series	Size	n <sub>n</sub> [rpm]	I <sub>n</sub> [A]	M <sub>n</sub> [Nm]	η <sub>n</sub> %	cosφ <sub>n</sub>	M <sub>s</sub> M <sub>n</sub>	I <sub>s</sub> I <sub>n</sub>	M <sub>max</sub> M <sub>n</sub>	J <sub>T</sub> D	J <sub>T</sub> DB	W <sub>T</sub> D	W <sub>T</sub> DB	Z <sub>0</sub> 10 <sup>3</sup> ×1/h	M <sub>B</sub> [Nm]
											10 <sup>-4</sup> ×Kg <sup>m</sup> ²		Kg			
0,18 / 0,12	D DB	63A2/4	2800 / 1370	0,55 / 0,55	0,62 / 0,83	60 / 50	0,77 / 0,65	1,5 / 1,4	3,4 / 2,5	1,7 / 1,7	2,8	3,4	4,2	5,7	4,0 / 6,3	1,0
0,20 / 0,15	D DB	63B2/4	2790 / 1370	0,64 / 0,66	0,70 / 1,05	62 / 51	0,80 / 0,64	3,0 / 2,7	4,0 / 2,6	3,1 / 2,8	2,8	3,4	4,2	5,7	3,4 / 5,8	3,0
0,25 / 0,18	D DB	63C2/4	2820 / 1380	0,70 / 0,70	0,85 / 1,25	63 / 54	0,82 / 0,70	2,4 / 2,3	3,5 / 2,6	2,5 / 2,4	3,5	4,1	4,8	6,5	2,8 / 5,3	3,0
0,25 / 0,18	D DB	71A2/4	2850 / 1420	0,70 / 0,60	0,84 / 1,23	64 / 62	0,80 / 0,70	2,0 / 1,9	4,2 / 3,6	2,1 / 2,0	7,2	8,3	5,3	7,5	2,8 / 5,3	5,0
0,37 / 0,25	D DB	71B2/4	2810 / 1420	0,98 / 0,78	1,25 / 1,70	66 / 64	0,86 / 0,75	2,2 / 2,1	4,7 / 4,0	2,3 / 2,2	8,6	9,7	5,9	8,1	2,8 / 5,3	5,0
0,55 / 0,37	D DB	71C2/4	2790 / 1390	1,3 / 1,1	1,88 / 2,55	69 / 67	0,88 / 0,78	2,0 / 1,9	4,5 / 3,7	2,1 / 2,0	10,8	11,9	6,7	8,9	2,3 / 4,2	5,0
0,60 / 0,45	D DB	80A2/4	2800 / 1410	1,75 / 1,25	2,1 / 3,1	58 / 64	0,87 / 0,82	1,7 / 1,7	3,6 / 4,1	1,8 / 2,0	19,0	20,6	8,7	12,2	2,3 / 4,2	5,0
0,80 / 0,60	D DB	80B2/4	2830 / 1410	1,95 / 1,5	2,7 / 4,0	68 / 70	0,89 / 0,84	1,8 / 1,8	4,6 / 4,6	1,9 / 1,9	25,0	26,6	10,1	13,6	2,0 / 3,5	10,0
1,10 / 0,75	D DB	80C2/4	2850 / 1420	2,7 / 1,9	3,7 / 5,1	68 / 70	0,90 / 0,86	1,7 / 1,9	4,3 / 5,0	1,9 / 2,0	31,0	32,6	11,3	14,8	1,6 / 2,8	10,0
1,4 / 1,1	D DB	90S2/4	2800 / 1390	3,7 / 2,9	4,8 / 7,6	69 / 72	0,79 / 0,78	2,5 / 2,3	4,4 / 4,8	2,6 / 2,4	29,0	30,6	13,5	17,0	1,2 / 2,0	13,0
1,7 / 1,3	D DB	90LA2/4	2830 / 1390	3,8 / 3,0	5,7 / 8,9	73 / 71	0,89 / 0,86	2,3 / 2,1	4,8 / 4,3	2,4 / 2,1	32,0	35,5	14,5	20,1	1,1 / 1,9	26,0
2,2 / 1,5	D DB	90LB2/4	2850 / 1420	5,0 / 3,5	7,4 / 10,3	72 / 74	0,84 / 0,80	2,3 / 2,6	4,8 / 5,3	2,4 / 2,6	39,0	42,5	16,5	22,1	1,0 / 1,7	26,0
2,3 / 1,8	D DB	100LA2/4	2870 / 1420	5,5 / 4,2	7,6 / 12,2	73 / 74	0,84 / 0,80	2,4 / 2,4	6,3 / 4,6	2,5 / 2,7	53,0	56,5	19,1	24,7	1,0 / 1,7	26,0
3,0 / 2,2	D DB	100LB2/4	2870 / 1420	6,9 / 5,2	10,0 / 14,7	74 / 75	0,85 / 0,80	2,1 / 2,2	5,4 / 5,1	2,6 / 2,4	64,0	67,5	21,2	26,8	0,8 / 1,3	40,0
3,3 / 2,6	D DB	100LC2/4	2860 / 1420	7,5 / 6,0	10,8 / 17,3	74 / 75	0,86 / 0,81	2,1 / 2,0	5,4 / 4,5	2,6 / 2,4	72,0	75,5	22,8	28,4	0,7 / 1,2	40,0
4,0 / 3,0	D DB	112MA2/4	2800 / 1420	9,0 / 6,6	13,7 / 20,2	74 / 78	0,85 / 0,84	2,5 / 2,5	5,2 / 5,8	2,6 / 2,6	90,0	98,8	25,0	34,7	0,7 / 1,2	60,0
4,8 / 3,6	D DB	112MB2/4	2870 / 1420	10,0 / 7,7	16,0 / 24,2	79 / 81	0,87 / 0,84	2,1 / 2,1	6,1 / 5,0	2,8 / 2,4	110,0	118,8	29,4	39,1	0,6 / 1,1	60,0
6,0 / 4,5	D DB	132SA2/4	2880 / 1440	12,5 / 10,0	20,0 / 29,9	80 / 82	0,88 / 0,81	2,0 / 2,0	6,2 / 4,7	2,4 / 2,4	240,0	250,3	42,3	52,6	0,5 / 0,8	75,0
7,5 / 5,8	D DB	132SB2/4	2890 / 1440	16,7 / 12,8	24,6 / 38,3	77 / 80	0,86 / 0,82	2,5 / 2,5	5,8 / 4,7	2,6 / 2,6	307,0	317,3	50,2	60,5	0,4 / 0,7	100,0
9,2 / 7,0	D DB	132MA2/4	2900 / 1440	18,8 / 14,8	29,9 / 45,9	81 / 83	0,86 / 0,82	2,5 / 2,6	7,6 / 5,2	2,6 / 2,7	350,0	373,0	54,8	69,5	0,4 / 0,7	100,0
11,0 / 8,5	D DB	132MB2/4	2920 / 1460	24,0 / 17,0	35,7 / 55,8	82 / 86	0,81 / 0,83	2,2 / 2,2	7,9 / 5,8	2,3 / 2,3	389,0	412,0	59,4	74,1	0,4 / 0,7	150,0

## 2/8 Pole - Separate windings Y/Y

400V 50Hz

P <sub>n</sub> [kW]	Series	Size	n <sub>n</sub> [rpm]	I <sub>n</sub> [A]	M <sub>n</sub> [Nm]	η <sub>n</sub> %	cosφ <sub>n</sub>	M <sub>s</sub> M <sub>n</sub>	I <sub>s</sub> I <sub>n</sub>	M <sub>max</sub> M <sub>n</sub>	J <sub>T</sub> D	J <sub>T</sub> DB	W <sub>T</sub> D	W <sub>T</sub> DB	Z <sub>0</sub> 10 <sup>3</sup> ×1/h	M <sub>B</sub> [Nm]
											10 <sup>-4</sup> ×Kg <sup>m</sup> ²		Kg			
0,18 / 0,045	D DB	71A2/8	2890 / 710	0,58 / 0,42	0,61 / 0,61	57 / 28	0,82 / 0,60	2,0 / 2,6	4,5 / 2,0	2,1 / 2,7	7,2	8,3	5,3	7,5	7,5 / 19	2,5
0,25 / 0,06	D DB	71B2/8	2890 / 700	0,75 / 0,50	0,85 / 0,84	65 / 35	0,80 / 0,53	2,0 / 2,4	4,8 / 2,0	2,1 / 2,5	8,6	9,7	5,9	8,1	7,1 / 17	2,5
0,37 / 0,09	D DB	71C2/8	2880 / 680	1,05 / 0,70	1,23 / 1,27	64 / 32	0,82 / 0,53	2,1 / 2,5	4,9 / 2,1	2,2 / 2,6	10,8	11,9	6,7	8,9	6,0 / 14	5,0
0,55 / 0,12	D DB	80B2/8	2900 / 720	1,60 / 0,78	1,83 / 1,63	64 / 37	0,81 / 0,63	2,1 / 2,0	5,0 / 2,4	2,2 / 2,2	25,0	26,6	10,1	13,6	2,7 / 11,2	5,0
0,75 / 0,18	D DB	80C2/8	2900 / 710	1,95 / 0,92	2,5 / 2,4	68 / 44	0,86 / 0,63	1,8 / 1,6	5,3 / 2,5	2,0 / 1,9	31,1	32,7	11,7	15,2	2,4 / 10	10,0
0,90 / 0,20	D DB	90S2/8	2840 / 680	2,30 / 0,95	3,0 / 2,8	68 / 44	0,86 / 0,68	1,6 / 1,3	4,4 / 2,1	2,1 / 1,6	25,0	26,6	12,0	15,5	1,9 / 9,0	10,0
1,1 / 0,25	D DB	90L2/8	2890 / 690	2,70 / 1,25	3,6 / 3,5	72 / 45	0,83 / 0,64	2,6 / 1,8	5,8 / 2,2	2,7 / 2,0	32,0	35,5	14,5	20,1	1,7 / 7,5	13,0
1,5 / 0,37	D DB	100LA2/8	2890 / 710	3,9 / 1,8	4,9 / 4,8	70 / 48	0,85 / 0,58	2,1 / 1,6	5,4 / 2,5	2,5 / 1,9	53,0	56,5	19,1	24,7	1,6 / 5,6	26,0
2,2 / 0,55	D DB	100LB2/8	2900 / 710	5,1 / 2,7	7,3 / 7,5	75 / 52	0,87 / 0,59	2,3 / 1,7	6,5 / 2,5	2,5 / 1,9	72,0	75,5	22,8	28,4	1,4 / 4,5	26,0
3,0 / 0,75	D DB	112M2/8	2920 / 710	6,5 / 3,4	10,0 / 10,1	78 / 59	0,87 / 0,52	2,4 / 1,8	7,0 / 2,6	2,2 / 2,7	120,0	128,8	30,5	40,2	1,3 / 4,0	40,0
4,0 / 1,1	D DB	132S2/8	2920 / 710	8,9 / 4,5	13,0 / 14,8	75 / 62	0,86 / 0,57	2,6 / 2,1	5,2 / 2,9	2,7 / 2,2	240,0	250,3	42,3	52,6	1,1 / 3,1	50,0
5,5 / 1,5	D DB	132M2/8	2940 / 720	11,5 / 5,7	18,0 / 20,1	83 / 69	0,87 / 0,56	2,8 / 2,3	5,6 / 2,7	2,9 / 2,5	330,0	352,5	52,5	67,2	0,8 / 2,5	50,0



## 4/8 Pole - Dahlander YY/Δ

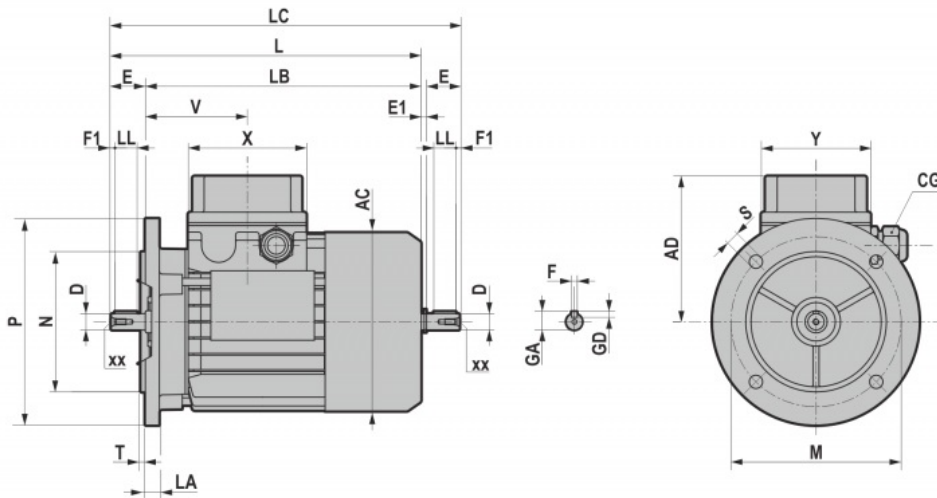
400V 50Hz

P <sub>n</sub> [kW]	Series	Size	n <sub>n</sub> [rpm]	I <sub>n</sub> [A]	M <sub>n</sub> [Nm]	η <sub>n</sub> %	cosφ <sub>n</sub>	$\frac{M_s}{M_n}$	$\frac{I_s}{I_n}$	$\frac{M_{max}}{M_n}$	J <sub>T D</sub>	J <sub>T DB</sub>	W <sub>T D</sub>	W <sub>T DB</sub>	Z <sub>0</sub> 10 <sup>3</sup> ×1/h	M <sub>B</sub> [Nm]
											10 <sup>-4</sup> ×Kg·m <sup>2</sup>		Kg			
0,18 / 0,11	D DB	71B4/8	1380 / 690	0,53 / 0,72	1,27 / 1,55	59 / 35	0,84 / 0,60	1,7 / 2,1	3,4 / 2,2	2,2 / 2,5	12,0	13,1	6,0	8,2	4,2 / 7,5	3,5
0,25 / 0,15	D DB	71C4/8	1370 / 670	0,72 / 0,89	1,76 / 2,10	60 / 38	0,78 / 0,57	1,7 / 1,9	3,4 / 2,1	2,1 / 2,4	14,8	15,9	6,8	9,0	4,0 / 6,7	5,0
0,30 / 0,18	D DB	80A4/8	1390 / 700	0,76 / 0,85	2,1 / 2,5	66 / 50	0,88 / 0,64	1,6 / 1,7	3,9 / 2,2	1,9 / 2,1	22,0	23,6	9,3	12,7	4,0 / 6,7	5,0
0,40 / 0,25	D DB	80B4/8	1390 / 690	1,05 / 1,15	2,8 / 3,5	68 / 50	0,85 / 0,61	1,6 / 1,5	3,6 / 1,9	1,8 / 1,8	28,0	29,6	10,9	14,4	3,8 / 6,5	10,0
0,55 / 0,30	D DB	80C4/8	1390 / 700	1,3 / 1,3	3,8 / 4,1	69 / 54	0,89 / 0,65	1,6 / 2,1	4,1 / 3,1	2,4 / 3,0	31,0	32,6	11,7	15,2	3,2 / 5,6	10,0
0,75 / 0,40	D DB	90S4/8	1400 / 700	1,70 / 1,75	5,1 / 5,5	75 / 58	0,86 / 0,56	1,5 / 2,1	4,6 / 2,9	2,5 / 2,5	45,0	46,5	13,1	16,6	3,1 / 5,3	13,0
1,0 / 0,55	D DB	90L4/8	1390 / 700	2,4 / 2,4	7,5 / 7,5	75 / 58	0,88 / 0,58	1,5 / 2,3	3,8 / 3,2	2,1 / 2,8	60,0	63,5	16,0	21,6	2,8 / 4,8	13,0
1,25 / 0,7	D DB	100LA4/8	1420 / 710	2,7 / 3,0	8,5 / 9,5	75 / 58	0,88 / 0,56	1,9 / 2,4	5,5 / 3,2	2,2 / 2,6	72,0	75,5	20,0	25,6	1,9 / 3,3	26,0
1,6 / 0,9	D DB	100LB4/8	1420 / 710	3,5 / 3,8	10,8 / 12,1	77 / 60	0,88 / 0,56	2,0 / 2,6	5,5 / 3,3	2,4 / 2,8	91,0	94,5	24,0	29,6	1,8 / 3,0	26,0
2,3 / 1,2	D DB	112MA4/8	1410 / 710	5,0 / 4,5	15,6 / 15,9	74 / 67	0,88 / 0,57	1,3 / 1,7	4,4 / 3,8	2,1 / 2,5	115,0	122,2	23,9	33,6	1,7 / 2,8	40,0
3,0 / 1,5	D DB	112MB4/8	1420 / 720	6,2 / 5,5	20,5 / 20,2	78 / 70	0,89 / 0,55	1,7 / 2,2	5,5 / 4,1	2,1 / 2,5	140,0	148,8	28,9	38,6	1,7 / 2,8	40,0
3,8 / 2,1	D DB	132SA4/8	1430 / 720	8,2 / 7,6	25,3 / 27,8	77 / 71	0,86 / 0,57	1,5 / 2,1	5,0 / 4,2	1,9 / 2,2	330,0	340,3	42,0	52,3	1,4 / 2,3	75,0
4,5 / 2,4	D DB	132SB4/8	1440 / 720	9,6 / 9,0	30,1 / 31,7	80 / 71	0,86 / 0,52	1,6 / 2,4	5,4 / 4,1	1,9 / 2,4	380,0	390,3	46,4	56,7	1,2 / 2,1	75,0
5,2 / 3,0	D DB	132MA4/8	1430 / 720	10,3 / 10,9	34,2 / 39,6	82 / 73	0,86 / 0,54	1,7 / 2,4	6,3 / 4,1	2,3 / 2,4	430,0	453,0	52,5	67,2	1,0 / 1,7	100,0
6,0 / 3,7	D DB	132MB4/8	1440 / 720	12,6 / 12,5	39,7 / 48,8	80 / 70	0,88 / 0,60	1,7 / 2,2	6,0 / 4,1	2,2 / 2,2	510,0	533,0	59,4	74,1	0,95 / 1,6	100,0

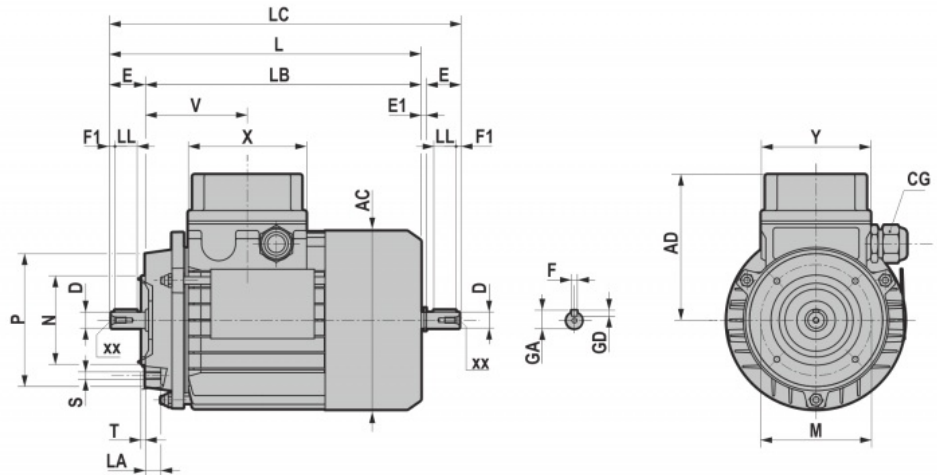
# 5.1 DIMENSIONS

## 5.1.1 General dimensions

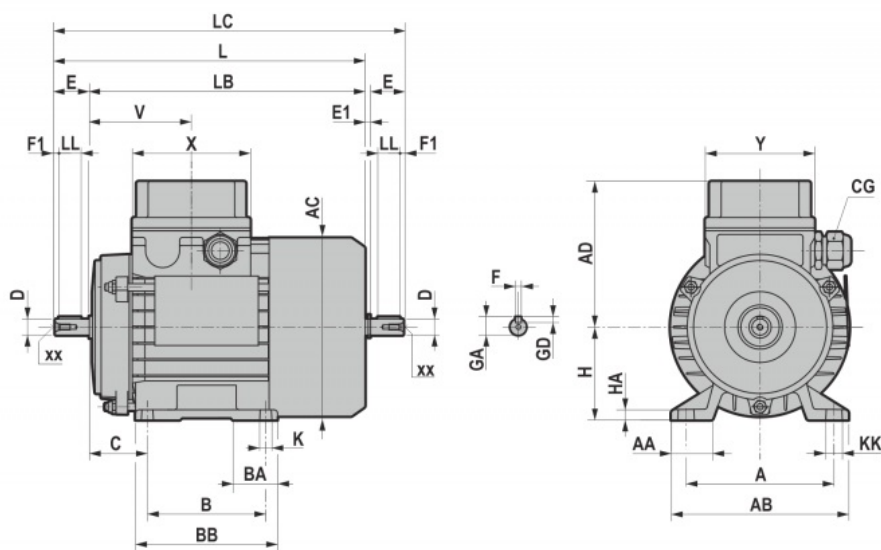
**B5**



**B14**



**B3**



## 5.1 DIMENSIONS

	AC	AD	L	LB	X	Y	V	LC
<b>56</b>	106	95	197	177	93	93	55	-
<b>63</b>	121	104	211	188	80	74	70	235,5
<b>71</b>	139	112	238,5	208,5	80	74	74,5	271
<b>80</b>	158	121,5	272,5 *295,5	232,5 *255,5	80	74	78	314 *337
<b>90S</b>	173	148	298 *331	248 *281	98	98	87	349,5 *380,5
<b>90L</b>	173	148	323 *356	273 *306	98	98	87	374,5 *407,5
<b>100</b>	191	156	368	308	98	98	97,5	431,5
<b>112</b>	210,5	171	383,5 *407,5	322,5 *347,5	98	98	100	447 *472
<b>132S</b>	248,5	195	453	372	118	118	115,5	536,5
<b>132M</b>	248,5	195	490	410	118	118	115,5	574,5

\*TP80B4, SH80B4, HSH80B4, TP90S4, SH90S4, HSH90S4, TP90L4, SH90L4, HSH90L4, TP90S6, TP112M4, TP112M6

	Shaft end						Key			Cable gland		
	D	E	E1	xx	F1	GA	F	GD	LL	CG	Ø hollow min	Ø hollow max
<b>56</b>	9	20	-	M4x12	3,5	10	3	3	14	M16x1,5	5	10
<b>63</b>	11 j6	23	1,5	M4x10	2,5	12,5	4	4	15	M16x1,5	5	10
<b>71</b>	14 j6	30	2,5	M5x12.5	3	16	5	5	20	M20x1,5	6	12
<b>80</b>	19 j6	40	1,5	M6x16	5	21,5	6	6	30	M20x1,5	6	12
<b>90S</b>	24 j6	50	1,5	M8x19	5	27	8	7	35	M25x1,5	13	18
<b>90L</b>	24 j6	50	1,5	M8x19	5	27	8	7	35	M25x1,5	13	18
<b>100</b>	28 j6	60	3,5	M10x22	7,5	31	8	7	45	M25x1,5	13	18
<b>112</b>	28 j6	60	3,5	M10x22	7,5	31	8	7	45	M25x1,5	13	18
<b>132S</b>	38 k6	80	4	M12x28	10	41	10	8	60	M32x1,5	18	25
<b>132M</b>	38 k6	80	4	M12x28	10	41	10	8	60	M32x1,5	18	25

B5	M	N	P	LA	S	T
<b>56</b>	100	80	120	9	7	3
<b>63</b>	115	95	140	10	9	3
<b>71</b>	130	110	160	10	9,5	3,5
<b>80</b>	165	130	200	12	11	3,5
<b>90</b>	165	130	200	12	11	3,5
<b>100</b>	215	180	250	15	14	4
<b>112</b>	215	180	250	14,5	14	4
<b>132</b>	265	230	300	20	14	3,5

B14	M	N	P	LA	S	T
<b>56</b>	65	50	80	9	M5	3
<b>63</b>	75	60	90	10	M5	2,5
<b>71</b>	85	70	105	10,5	M6	2,5
<b>80</b>	100	80	120	10,5	M6	3
<b>90</b>	115	95	140	11,5	M8	3
<b>100</b>	130	110	160	15	M8	3,5
<b>112</b>	130	110	160	11,5	M8	3,5
<b>132</b>	165	130	200	20,5	M10	3,5

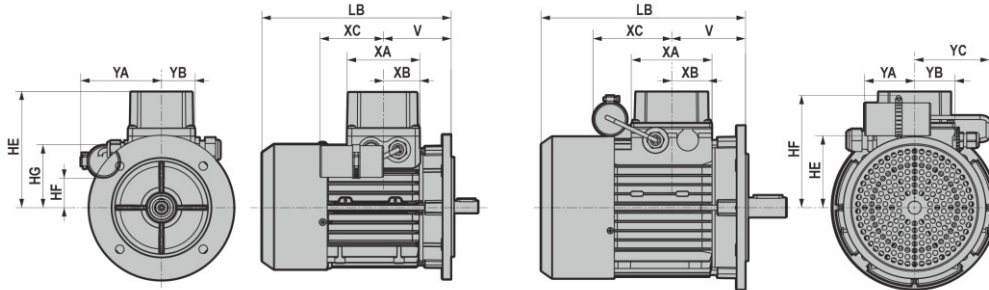
B3	A	AA	AB	KK	B	BB	BA	K	C	H	HA
<b>56</b>	91	25,5	111	10	71	90	18	7	37	56	10
<b>63</b>	100	44	120	12	80	108	25	7,5	40	63	9
<b>71</b>	112	44	132	12	90	108	25	7,5	44	71	9
<b>80</b>	125	56,5	156	19,5	100	122	26	9,5	49	80	11
<b>90S</b>	140	56	172	12	100	136	33	8,5	54	90	11
<b>90L</b>	140	57	172	12	125	155	33	8,5	54	90	13
<b>100</b>	160	64	192	20	140	170	37	8,5	62	100	14
<b>112</b>	190	76	221	21	140	175	40	8,5	69	112	14
<b>132S</b>	216	84	260	22	140	175	40	10,5	87	132	16
<b>132M</b>	216	85	260	22	180	210	40	10,5	87	132	16

# 5.1 DIMENSIONS

## 5.1.2 SH series

63 - 71 - 80

90 - 100

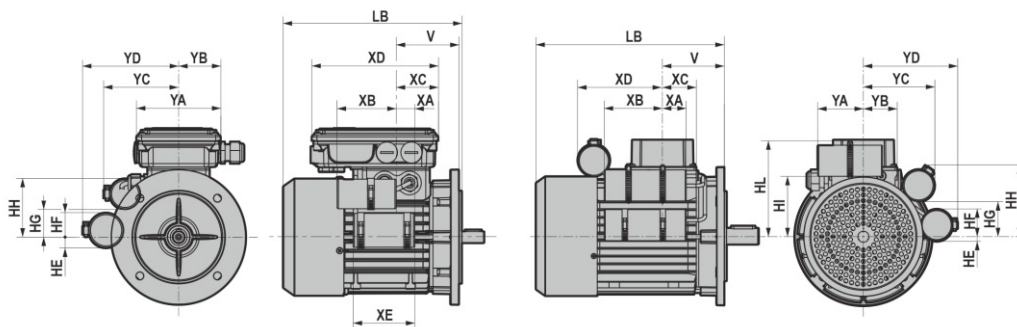


	V	YA	YB	YC	HE	HF	HG	XA	XB	XC
63A4	69	86	37	-	104	30,5	62,5	80	40	57
63B4	69	89	37	-	104	28	65	80	40	57
71A4	74,5	92	37	-	112	39,5	69,5	80	40	57
71B4	74,5	92	37	-	112	39,5	69,5	80	40	71,5
80A4	78	95	37	-	122	45	81	80	40	71,5
80B4	78	95	37	-	122	45	83,5	80	40	75
90S4	89,5	56	49	90	85,5	140,5	-	98	49	98
90L4	89,5	75	49	90	85,5	140,5	-	98	49	123
100LA4	97,5	81	49	90	94,5	159,5	-	98	49	138

## 5.1.3 HSH series

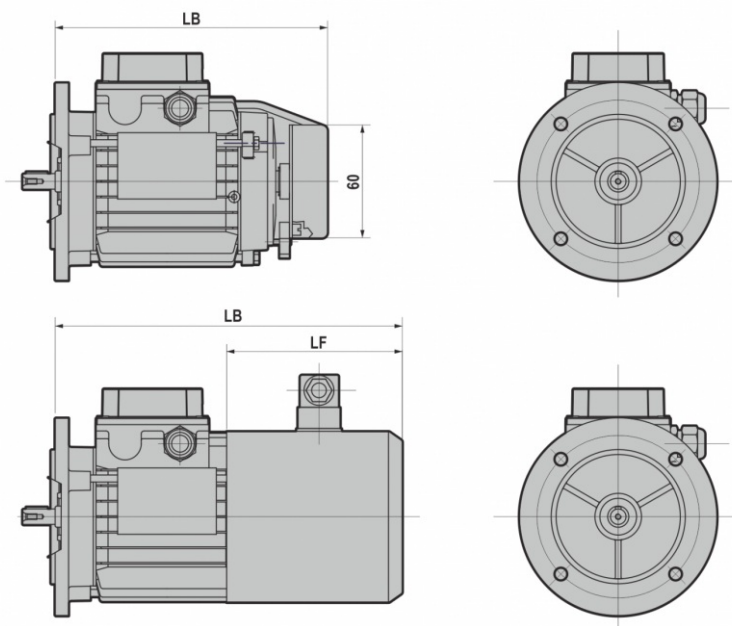
63 - 71 - 80

90 - 100



	V	YA	YB	YC	YD	HE	HF	HG	HH	HI	HL	XA	XB	XC	XD	XE
63A4	69	110	54	86	98	16	21	30,5	62,5	-	-	25	57	54	153	71,5
63B4	69	110	54	89	98	16	21	28	65	-	-	25	57	54	153	71,5
71A4	74,5	110	54	92	114	13	29	39,5	69,5	-	-	20,5	57	54	153	71,5
71B4	74,5	110	54	92	114	15,5	31,5	39,5	69,5	-	-	20,5	71,5	54	153	75
80A4	78	110	54	95	130	17	30	45	81	-	-	26,5	71,5	54	153	95
80B4	78	110	54	95	139	22	35	45	83,5	-	-	46	75	54	153	120
90S4	76,5	56	49	-	156	17	50,5	-	-	86,5	140,5	38	81	36	111	-
90L4	89	75	49	110	148	12	45,5	47,5	111	86,5	140,5	34	86	48,5	123,5	-
100LA4	100,5	81	49	108	156,5	9,5	47,5	53	118	94,5	159,5	34	86	52	143,5	-

## 5.1.4 Incremental standard encoder



		LB	LF
63	IC410	210	/
	IC411	247	124,5
	IC416	280	158
71	IC410	226	/
	IC411	254	118
	IC416	296	160
80	IC410	245 *268	/
	IC411	305 *328	152 *173,5
	IC416	338 *361	185 *208
90S	IC410	255 *288	/
	IC411	325 *358	166 *213
	IC416	341 *374	182 *215
90L	IC410	280 *313	/
	IC411	350 *383	166 *213
	IC416	366 *399	182 *215

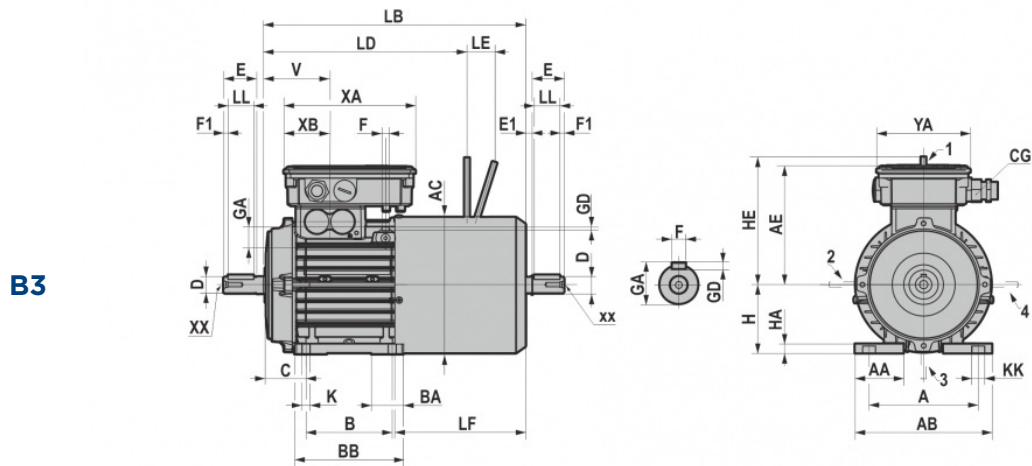
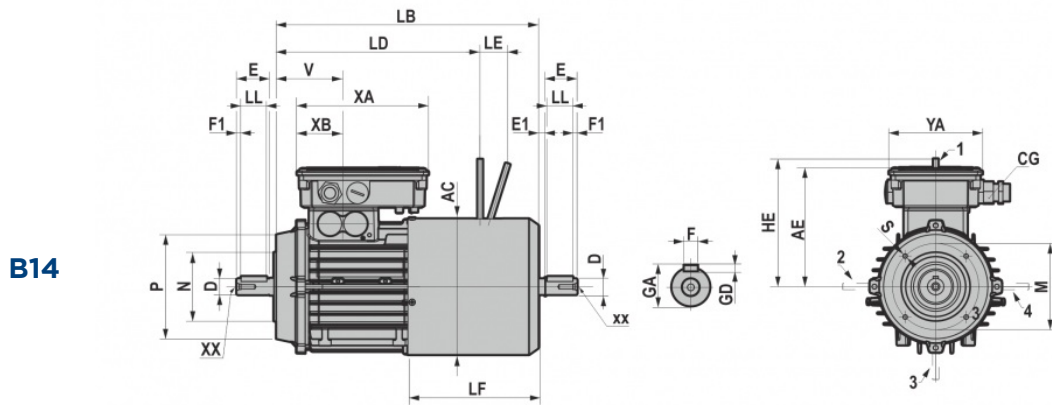
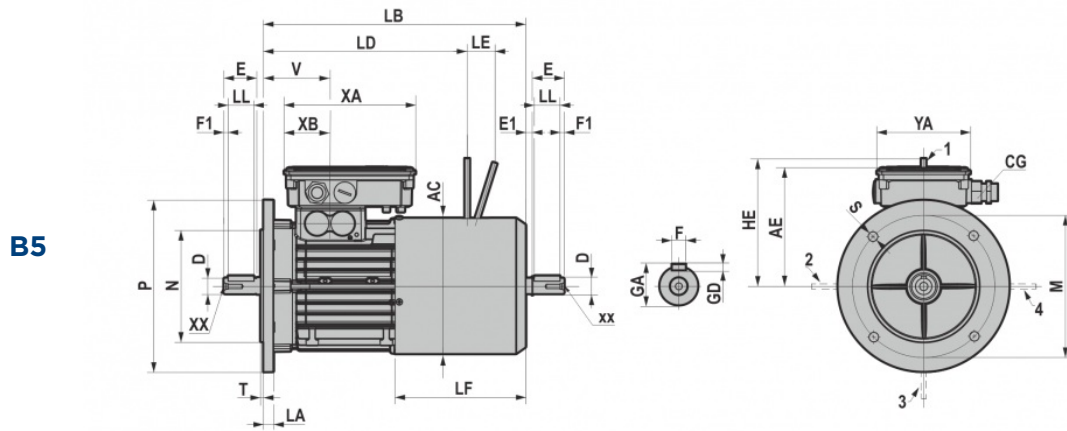
		LB	LF
100	IC410	308	/
	IC411	389,5	183
	IC416	437	230
112	IC410	321 *346	/
	IC411	420 *445	201 *227
	IC416	450 *475	230 *255
132S	IC410	360	/
	IC411	463	212
	IC416	490	240
132M	IC410	398	/
	IC411	501	212
	IC416	528	240

\* TP80B4, SH80B4, HSH80B4, TP90S4, SH90S4, HSH90S4, TP90L4, SH90L4, HSH90L4, TP90S6, TP112M4, TP112M6

IC410 = NON-VENTILATED  
 IC411 = SELF-VENTILATED  
 IC416 = FORCED VENTILATED

# 5.1 DIMENSIONS

## 5.1.5 Brake motors



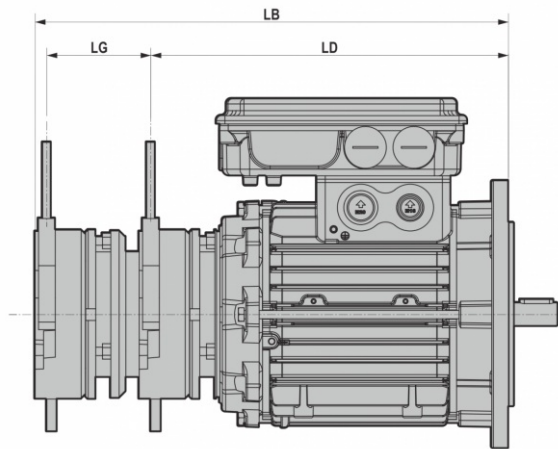
## 5.1 DIMENSIONS

	Brake Power supply	Cable gland			XA	XB	YA
		Pg	Ø hollow min	Ø hollow max			
63	AC / DC	M16x1.5	5	10	153	54	109
71							
80							
90	AC / DC	M20x1.5	6	12	206	66,5	132
100							
112							
132	AC / DC	M20x1.5	6	12	206	66,5	132
160							

		LD	LE	HE	LB	LF	AE	V
63	MS	192	21	116	249	124,5	118	69
	FM	192	17,5	96	249	124,5	118	69
	ML	-	-	-	203	72	118	69
71	MS	211,5	23	124	276	137	127	74,5
	FM	214	19	101,5	276	137	127	74,5
	ML	182	18	103	225	80	127	74,5
80	MS	238 *259	23	134	304 *326	152 *174	136	78
	FM	237 *258	22,5	129	304 *326	152 *174	136	78
	ML	203	22	128	248	84	136	78
90S	MS	252,5 *297	27,5	160	324,5 *372	166 *213	165	89,5
	FM	255 *300	28	159,5	324,5 *372	166 *213	165	89,5
	ML	212,5	22	128	261	90	165	89,5
90L	MS	279 *324	28	160	349,5 *396	166 *212	165	89,5
	FM	279 *324	27,5	159,5	349,5 *396	166 *212	165	89,5
	ML	237,5	22	128	285	90	165	89,5
100	MS	307	28	160	389,5	183	174	97,5
	FM	307	27,5	159,5	389,5	183	174	97,5
	ML	267	26	148	325	105	174	97,5
112	MS	330 *358	34,5	198	419 *446	201 *227	189	100
	FM	326 *353	35	199	419 *446	201 *227	189	100
	ML	281	26	148	325	95	189	100
132S	MS	364	34,5	200	461,5	212	225	113
	FM	359	35,5	204	461,5	212	225	113
	ML	317,5	30	172	395	133	225	113
132M	MS	404,5	37,5	217	513,5	212	225	113
	FM	403,5	39	226	513,5	212	225	113
	ML	355,5	30	172	434	133	225	113

\* TBP80B4, TBP90S4, TBP90L4, TBP90S6, TBP112M4, TBP112M6 (for versions TBP ML brake is not expected).

## 5.1.6 Double brake



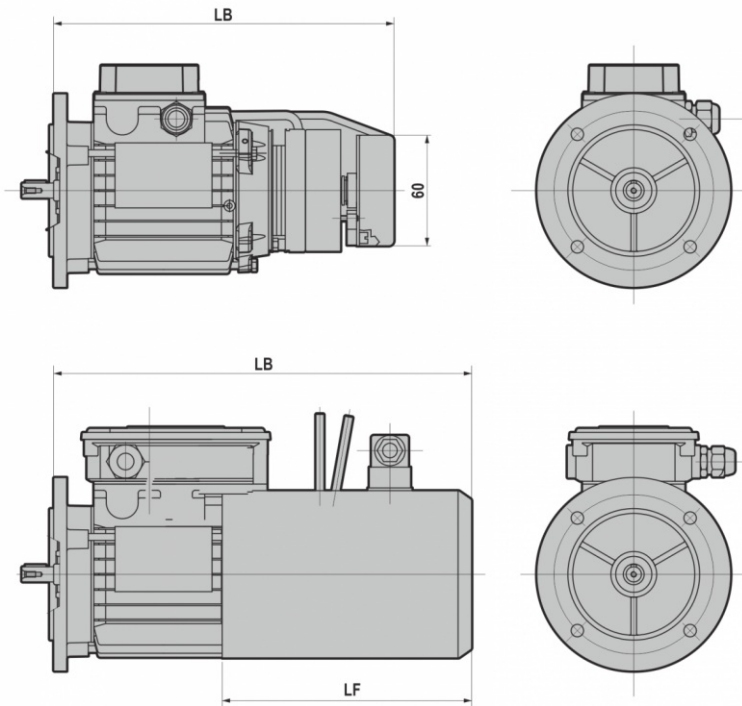
	LB	LD	LG
<b>63</b>	255,5	193,5	58
<b>71</b>	283	214	63
<b>80</b>	317,5 *341	235 *258,5	73
<b>090S</b>	343 *390	252 *299	81
<b>090L</b>	368 *415	277 *324	81
<b>100</b>	396	307	81
<b>112</b>	428 *456	325 *353	89
<b>132S</b>	463	359	89
<b>132M</b>	516	403,5	96

\*TBP80B4, TBP90S4, TBP90L4, TBP90S6, TBP112M4, TBP112M6

For other dimensions, refer to the dimensional charts for the brake motors.



## 5.1.7 Brake motors with incremental encoder



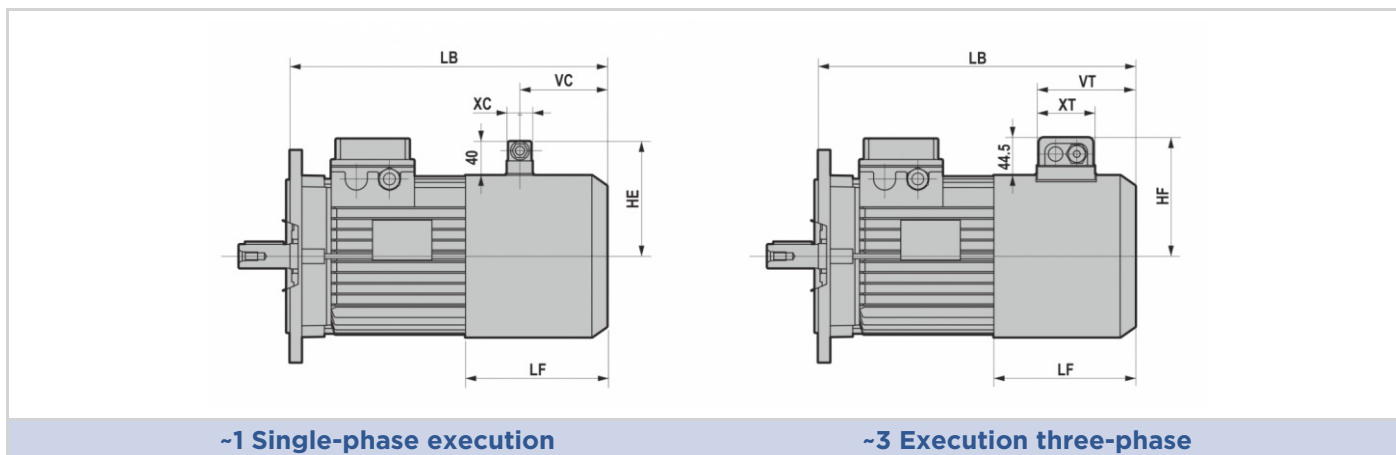
	LF	LB (IC411 - IC416)	LB (IC410 - IC418)
<b>63</b>	198	320	254
<b>71</b>	199	336	283
<b>80</b>	235 *257	388 *410	311 *334
<b>90S</b>	242 *293	401 *448,5	334 *381
<b>90L</b>	242 *293	426 *472,5	359 *406
<b>100</b>	293	505,5	380
<b>112</b>	288 *340	507 *559	410 *438,5
<b>132S</b>	294	545	448
<b>132L</b>	294	583	486

\*TBP80B4, TBP90S4, TBP90L4, TBP90S6, TBP112M4, TBP112M6

Note: Version with incremental encoder available only with MS and FM brakes.

# 5.1 DIMENSIONS

## 5.1.8 Forced ventilation



-1 Single-phase execution

-3 Execution three-phase

1 = standard (T-D-S series)    2 = brake motor (TB-DB-SB series)

		LB	LF
63	1	239	117
	2	311,5	190
71	1	254,5	118
	2	331	195
80	1	295,5 *318,5	143 *166
	2	382 *409	230 *257
90S	1	308 *341	149 *182
	2	398,5 *448	240 *293
90L	1	333 *366	149 *182
	2	423,5 *472	240 *293
100	1	407	200
	2	500	293
112	1	419 *448	201 *230
	2	532 *559	313 *340
132S	1	461	212
	2	568,5	319
132M	1	499	212
	2	620,5	319

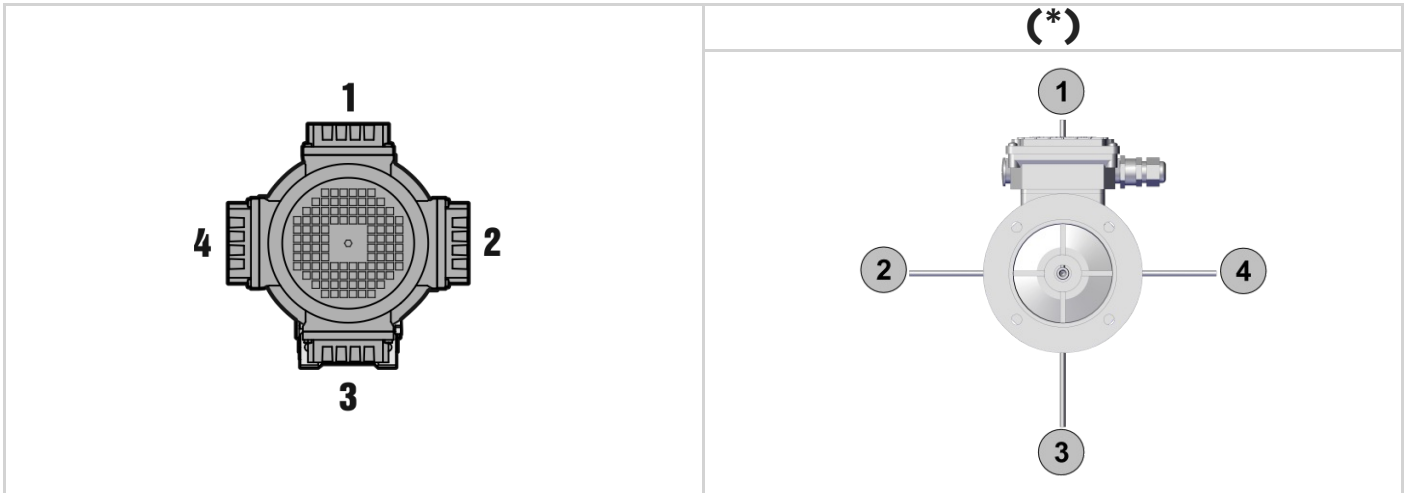
		HE	VC	XC	HF	VT	XT
-1	63	100,5	59	30	-	-	-
	71	109,5	64	30	-	-	-
	80	119	78	30	-	-	-
	90	126,5	87	30	-	-	-
	100	135,5	103	30	-	-	-
	112	145	95	30	-	-	-
	132	169	109	68	-	-	-
-3	100	-	-	-	140	158	75
	112	-	-	-	150	158	75
	132	-	-	-	159	158	75

\*TP/TBP80B4, TP/TBP90S4, TP/TBP90L4, TP/TBP90S6, TP/TBP112M4, TP/TBP112M6

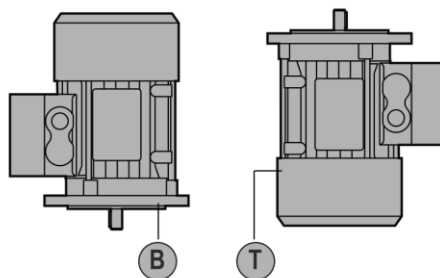
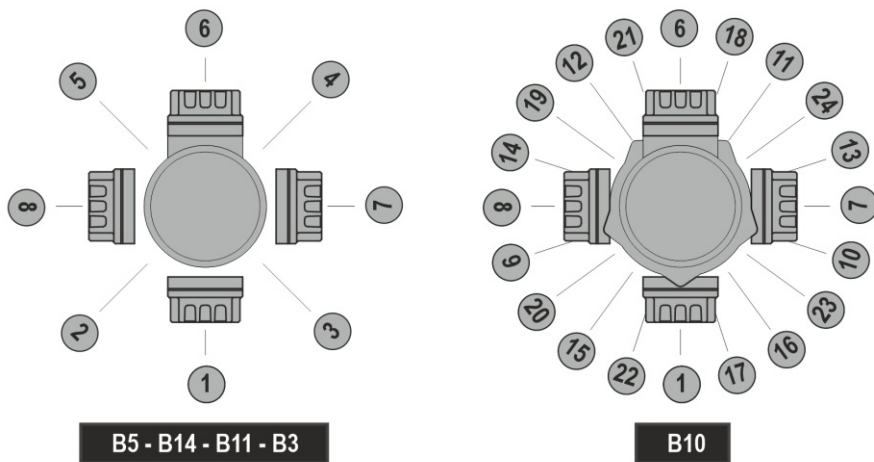
## 5.1.9 Position of terminal box-Release lever-Forced ventilation connector

Unless otherwise specified when ordering, the motor is supplied with terminal box/release lever/forced ventilation connector in position 1.

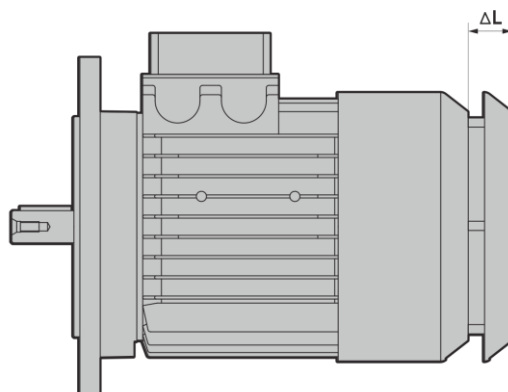
(\*) Position of the release lever with respect to position of terminal box.



## 5.1.10 Condensation drain holes position



## 5.1.11 Version with rain cover



	$\Delta L$ (T)	$\Delta L$ (P)
63	11	20
71	15	20
80	11	22
90	14	23
100	19	25
112	19	30
132	19	35

(T) = Textile canopy

(P) = Rain guard canopy

- B35 (B3+B5)
- B34 (B3+B14)
- Reduced B5 flange
- Reduced shaft end
- Second shaft end
- Rear hexagon
- Protection rating IP65, IP56, IP66
- Insulation class H
- Condensation drain holes
- Condensation heater (110V - 230V)
- Low temperature construction
- High temperature construction
- Bimetal cutout - NC contact (130°C for class F / 140°C for class F UL/CSA / 150°C for class H)
- PTC thermistors (130°C for class F / 150°C for class H)
- Single-phase motor, high starting torque with electronic cutout (HSH series motors)
- Rain canopy
- Textile canopy
- Backstop device (sizes 80/90/100/112/132)
- Rapid connection (HARTING)
- Motor without ventilation (IC410)
- Single-phase forced ventilation kit (up to size 132 inclusive)
- Three-phase forced ventilation kit (from size 100 inclusive)
- Incremental encoder without connector
- Incremental encoder with connector
- Low resolution incremental encoder (without connector)
- Single-phase forced ventilation kit (up to size 132 inclusive) for encoder version
- Three-phase forced ventilation kit (from size 100 inclusive) for encoder version
- Motor paint job
- Optional power voltages (see respective section)
- 9 terminal construction for 1 pole three-phase motors (230V/460V 60Hz)
- Motor construction to UL/CSA (TS, TH, TP, TBS, TBH, TBP and D series only)
- Motor constructions to ATEX II 3GD (TS, TH, TP, D and SH series only)
- Motor constructions to CCC (TS, TH series only)

**With FM brake:**

- Separate power
- Special brake coil voltage (\*)
- Manual release lever
- Hexagonal machining on non-drive shaft end
- Brake motor to IP55
- Brake motor to IP56
- Brake motor to IP65
- Brake motor to IP66
- Motor with double brake
- Anti-seizing stainless steel washer
- Microswitch
- Silent brake
- Inertial flywheel (gradual braking/starting)
- Double-ended shaft
- Half-wave fast detachment rectifier SBR (from sizes 63 to 100)
- Single-phase forced ventilation kit (up to size 132 inclusive)
- Three-phase forced ventilation kit (from size 100 inclusive)
- Incremental encoder without connector
- Incremental encoder with connector
- Low resolution incremental encoder (without connector, sizes 63-71-80-90)
- Single-phase forced ventilation kit (up to size 132 inclusive) for encoder version
- Three-phase forced ventilation kit (from size 100 inclusive) for encoder version
- Motor paint job

**With ML brake:**

- Separate power
- Special brake voltage (\*)
- Manual release lever
- Motor paint job

**With MS brake:**

- Separate power
- Special brake coil voltage (\*)
- Manual release lever
- Hexagonal machining on non-drive shaft end
- Brake motor to IP55
- Anti-seizing stainless steel washer
- Double-ended shaft
- Single-phase forced ventilation kit (up to size 132 inclusive)
- Three-phase forced ventilation kit (from size 100 inclusive)
- Incremental encoder without connector
- Incremental encoder with connector
- Low resolution incremental encoder (without connector, sizes 63-71-80-90)
- Single-phase forced ventilation kit (up to size 132 inclusive) for encoder version
- Three-phase forced ventilation kit (from size 100 inclusive) for encoder version
- Motor paint job

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(\*) Standard brake coil voltages

- FM - ML brakes: 103V DC for TBS and TBH / 178V DC for DB
- MS brake: 230/400V/50Hz

**ATTENTION!**

The revised data and information, shown in this technical catalogue, replaces the data of the previous editions. Old data is now obsolete. All technical data, dimensions, weights in this catalogue are subject to changes without warning. Illustrations are not binding. You can find the above mentioned data and information on our site [www.motovario.com](http://www.motovario.com); please periodically consult the technical documentation on the web site to be always updated about possible modifications of performances and characteristics of the product.

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