TECHNICAL CATALOGUE

M SERIES

SELF power

Synchronous Eco Line-start Friendly

ELECTRIC MOTORS

STANDARD IEC

CARE for EARTH

MOTOVARIO®
HEART OF MOTION
a TECO Group company

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1.1 PRODUCT DESCRIPTION

The Self Power® motor is an environmentally friendly hybrid electric motor that simultaneously combines the features of an asynchronous motor and a synchronous reluctance motor.
It is an innovative and highly efficient solution. Due to its ability to start up without the use of other external devices (e.g. inverters), it helps to reduce operating and maintenance costs.
The Self Power self-starting synchronous motor is particularly suitable for constant speed applications, i.e. those in which the motor must run continuously at a constant speed, ensuring greater precision and reliability in the application.
After a start-up phase, which is the same as for asynchronous motors, the motor synchronises with the working frequency and runs synchronously at constant speed (without encoder) regardless of the load.
The rotor has an advanced magnet-less geometry (patented technology) that optimizes performance and increases power density compared to a standard asynchronous motor. The innovative design of the rotor, the squirrel cage and the absence of magnets make this motor a unique product on the market.
The Self Power® motor is therefore the technological solution needed to achieve high efficiencies without the use of permanent magnets. The Self Power motor is designed to operate directly from the mains or powered by a simple V/f scalar inverter.
The TSP-SL series has the following features:

- IE4 efficiency;
- Sizes (80 to 132M);
- Powers: 0.55 to 1.5 kW (2.2 to 7.5 kW soon available);
- Operation with direct mains supply or with V/f scalar inverter.

In general, the Self Power self-starting synchronous motor is an excellent choice for constant speed applications where high energy efficiency, low operating temperature, reduced vibration and noise, and high speed stability are required. Thanks to its innovative features and advanced technology, the self-starting synchronous motor is set to become an increasingly popular solution for industrial and commercial applications where precision and reliability are paramount.
It is also the most cost-effective solution on the market today to achieve IE4 efficiency class.

1.2 SYNCHRONOUS OPERATION

The Self Power® motor is a self-starting synchronous motor that during its operation has the ability to maintain a constant speed (e.g. 50 Hz power supply, 1500 rpm synchronous speed) even if there is a change in load torque. Self Power is the ideal solution for all applications where constant speed is required (e.g. conveyor belts, lifters, pumps, fans, flow meters, etc.). With Self Power, there is no need to use an encoder to ensure constant speed.
Self Power has the following advantages:

- Self-starting (powered from the mains or by a simple V/f inverter);
- Super Premium IE4 efficiency;
- Perfectly constant operating speed at variable load (can maintain a constant speed regardless of load variations, ensuring greater accuracy and reliability in the application);
- Suitable for multi-motor applications (e.g. 1 inverter and 4 motors) where synchronism and constant speed is required between several motors powered directly from the mains or by a simple V/f inverter;
- Low operating temperatures (longer bearing life with increased reliability) and therefore a longer service life than a normal asynchronous motor.

1.3 EFFICIENCY

Self Power® is a self-starting synchronous motor that has no rotor losses during operation. This makes it possible to achieve IE4 efficiency class while maintaining the same overall dimensions as an asynchronous motor in IE2 efficiency class.

2.1 GENERAL FEATURES

Self-starting three-phase synchronous electric motors, enclosed design, external surface ventilation, rotor with patented hybrid technology, insulation class F, protection grade IP55, standardised dimensions and shaft heights from 80 to 132, standardised powers from 0.55 kW to 7.5 kW.

Standard production	Series
Three-phase self-starting synchronous reluctance super premium efficiency	TSP-SL
Three-phase self-starting synchronous reluctance and self-braking super premium efficiency	TBSP-SL

2.2 CONFORMITY AND DIRECTIVES

2.2.1 Conformity with standards

The electric motors Self Power (series TSP-SL, TBSP-SL) 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

The electric motors Self Power (series TSP-SL, TBSP-SL) 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. 1781/2019 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).

2.3 SYMBOLS AND FORMULAS

2.3.1 Physical measurements and conversion factors

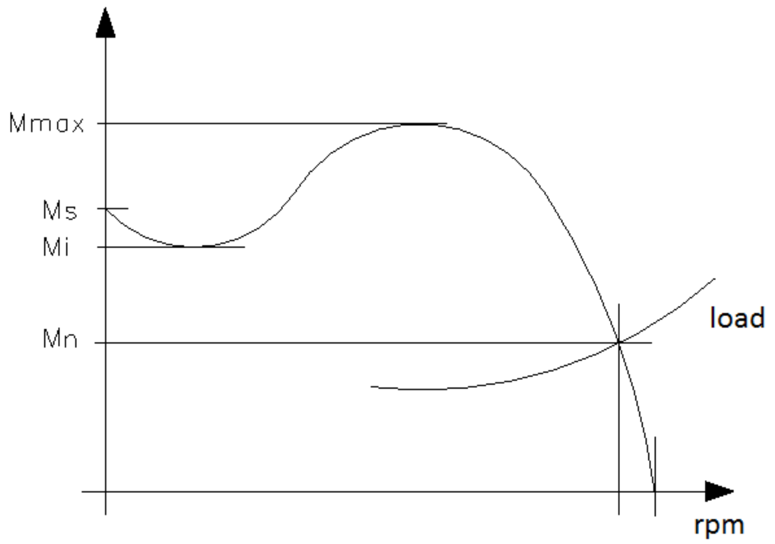
Physical measurement	Unit of measurement		Conversion from	
	SI units	Imperial units	SI units to Imperial units	Imperial units to SI units
length	m = metre	ft = foot	1 ft = 0.3048 m	1 m = 3.2808 ft
		in = inch	1 in = 25.4 mm	1 mm = 0.03937 in
speed	m/s	ft/s	1 ft/s = 0.3048 m/s	1 m/s = 3.2808 ft/s
		in/s	1 in/s = 25.4 mm/s	1 mm/s = 0.03937 in/s
weight	kg = kilogram	lb = pound	1 lb = 0.4536 kg	1 kg = 2.205 lb
density	kg/m^3	lb/ft^3	1 lb/ft^3 = 16.0185 kg/m^3	1 kg/m^3 = 0.0624 lb/ft^3
		lb/in^3	1 lb/in^3 = 27.6799 g/cm^3	1 g/cm^3 = 0.0361 lb/in^3
moment of inertia	$kg{\cdot}m^2$	$lb{\cdot}ft^2$	1 $lb{\cdot}ft^2$ = 0.4214 $kg{\cdot}m^2$	1 $kg{\cdot}m^2$ = 23.3 $lb{\cdot}ft^2$
		$lb{\cdot}in^2$	1 $lb{\cdot}in^2$ = 2.264 $kg{\cdot}cm^2$	1 $kg{\cdot}cm^2$ = 0.417 $lb{\cdot}in^2$
force	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)
mechanical moment	[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
energy	J = Joule (=Nm)	lbf·ft	1 lbf·ft = 1.36 J	1 J = 0.738 lbf·ft
	kWh = kilowatt hour		1 lbf·ft = $3.7{\cdot}10^{-7}$ kWh	1 kWh = $2.6{\cdot}10^{6}$ lbf·ft
pressure	Pa = Pascal (=N/m2)	psi (=lbf/ in^2)	1 psi = $6.895{\cdot}10^{3}$ Pa (N/m^2)	1 Pa = $1.45{\cdot}10^{-4}$ psi
	atm* = atmosphere		1 psi = 0.068 atm	1 atm = 14.7 psi
	bar*		1 psi = 0.0689 bar	(1Pa=$9.87{\cdot}10^{-6}$atm=10^{-5}bar)
power	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 SYMBOLS AND FORMULAS

2.3.2 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.

<table>
<tr><th>MEASUREMENT</th><th>SYMBOLS AND UNITS OF MEASUREMENT</th><th>DESCRIPTION</th></tr>
<tr><td>nominal voltage</td><td>V_n [V]</td><td>concatenated voltage at the machine's terminals at nominal power</td></tr>
<tr><td>nominal current</td><td>I_n [A]</td><td>current absorbed by the motor at nominal power</td></tr>
<tr><td>starting current</td><td>I_s [A]</td><td>line current absorbed by the motor at nominal starting voltage and frequency</td></tr>
<tr><td>nominal torque</td><td>M_n [Nm]</td><td>torque delivered by motor shaft at nominal conditions</td></tr>
<tr><td>starting torque</td><td>M_s [Nm]</td><td>torque delivered by the motor shaft at starting</td></tr>
<tr><td>sag torque</td><td>M_i [Nm]</td><td>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</td></tr>
<tr><td>maximum torque</td><td>M_{max} [Nm]</td><td>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

</td></tr>
<tr><td>synchronous speed</td><td>ω_s [rad/s]
n_s [min^{-1}]</td><td>synchronous motor shaft speed under no load; the following relations apply:
$n_s = 120 \times f_n / p$ [rpm] $\omega_s = 4p \times f_n / p$ [rad/s] $\omega_s = n_s / 9{,}55$ [rad/s]
where: fn = nominal power supply frequency [Hz]
p = number of motor poles
it follows that:
<table>
<tr><th>poles</th><th>rpm at 50Hz</th><th>rpm at 60Hz</th></tr>
<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>
</table></td></tr>
<tr><td>nominal speed</td><td>n_n [rpm]
ω_n [rad/s]</td><td>motor shaft speed in nominal conditions at nominal power</td></tr>
</table>

2.3 SYMBOLS AND FORMULAS

creep **nominal creep**	s s_n	ratio between the deviation of the shaft speed relative to the synchronous speed and the synchronous speed itself; normally declared as a percentage: $s = (\omega_s - \omega) / \omega_s \times 100$ $s_n = (\omega_s - \omega_n) / \omega_s \times 100$
mechanical power delivery	P [W]	numerical value of mechanical power delivered to the shaft; the relation between power, torque and speed is: $P_{[W]} = T_{[Nm]} \times \omega_{[rad/s]}$
nominal power delivery	P_n [W]	numerical value of the mechanical power delivered to the shaft at nominal conditions $P_{n\,(W)} = T_{n\,[Nm]} \times \omega_{n\,[rad/s]}$
power factor **nominal power factor**	cosφ $\cos\varphi_n$	cosine of the phase angle between the voltage and current, a function of the load characteristics
active absorbed electrical power	P_a [W]	numerical value of the active electrical power absorbed from the mains; the following relations apply: three-phase system $P_{a\,[W]} = \sqrt{3}V_{[V]}I_{[A]}\cos\varphi$ single-phase system $P_{a\,[W]} = V_{[V]}I_{[A]}\cos\varphi$
reactive electrical power absorbed	Q_a [VAr]	numerical value of the reactive electrical power absorbed from the mains; the following relations apply: three-phase system $Q_{a\,[W]} = \sqrt{3}V_{[V]}I_{[A]}\text{sen}\varphi$ single-phase system $Q_{a\,[W]} = V_{[V]}I_{[A]}\text{sen}\varphi$
reactive power furnished by an array of capacitors	Q_c [VAr]	numerical value of the reactive electrical power furnished by an array of capacitors of capacity C [µF], for three-phase systems: $Q_c=\sqrt{3}V^2_{[V]}C_{[m\mu F]}2\pi f_{n\,[Hz]}$
efficiency	η	ratio between mechanical power delivery and electrical power absorption $\eta = P / P_a$ $\eta\% = P / P_a \times 100$ once we know the efficiency, the power delivered to the shaft can be calculated as follows: asynchronous three-phase motor $P_{[W]} = \sqrt{3}V_{[V]}\, I_{V[A]}\eta\cos\varphi$ asynchronous single-phase motor $P_{[W]} = E_{[V]}\, I_{E[A]}\eta\cos\varphi$
moment of inertia	J [kg×m²]	Product of rotating mass m [kg] and the square of the equivalent radius of rotation r [m]: $J = mr^2$ In practice one uses PD2, the product of the weight [kgp] and the square of the equivalent diameter of rotation D [m]; it follows that: $PD^2_{[kgp\times m^2]} = 4J_{[kg\times m^2]}$ Note that the weight in the practical system corresponds (numerically) to the mass in the SI system
acceleration time **braking time**	t_a [s] t_f [s]	In evaluating the acceleration and braking times we must sum the motor's moment of inertia Jm to that of the load Jext, to obtain the total moment of inertia: $J_t = J_m + J_{ext}$ and analogously: $PD^2_t = PD^2_m + PD^2_{txt}$ Furthermore, to the torque delivered by the motor Mm, which may be accelerating or braking, we must subtract or add the resisting torque Mr, to obtain, as a first approximation: during acceleration, the accelerating torque: $M_a = M_m - M_r$ during braking, the braking torque: $M_f = M_m + M_r$ As a first approximation we can use for Mm 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 $t_a = [J_t / M_a]\times\Delta\omega$ [kg×m²] in the practical system $t_a = [2.67\, PD^2_t / M_a] \times\Delta n\times 10^{-3}$ [kgp×m²] The same formulas apply to the braking time, with Ma replaced by Mf and bearing in mind that Ma 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 nc and the motor speed nm: $J_{ext}\,(n_c / n_m)^2$ and analogously for PD^2. 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 $J_{ext} = M_{[kg]}\,(v_{[m/s]} / \omega_{m[rad/s]})^2$ in the practical system $PD^2 = 365\, P_{[kgp]}\,(v_{[m/s]} / n_{m[rpm]})^2$ where P is the weight of the moving part.

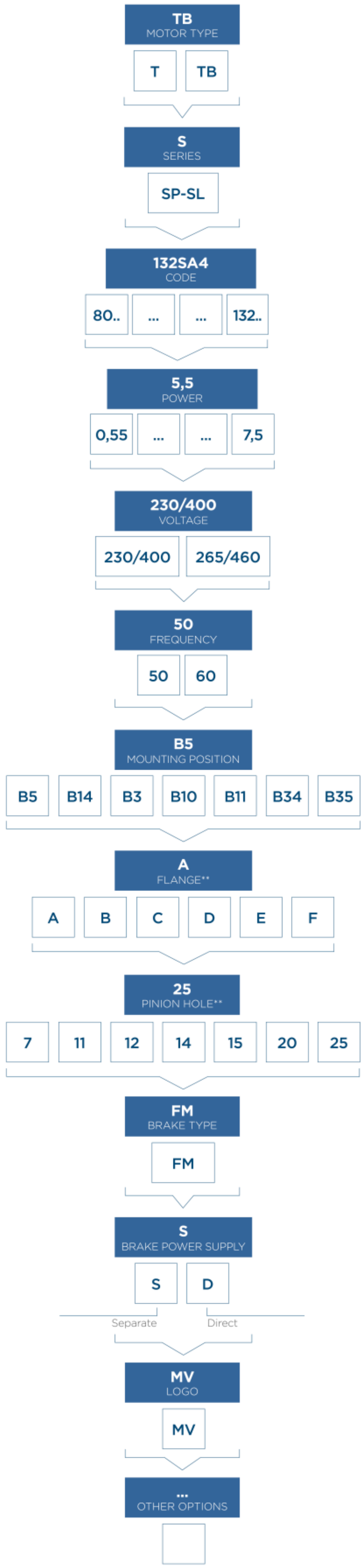
2.3 SYMBOLS AND FORMULAS

2.3.3 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 ≥ 1kW - Power delivery < 1kW	 ±20% ±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	±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 DESIGN FEATURES

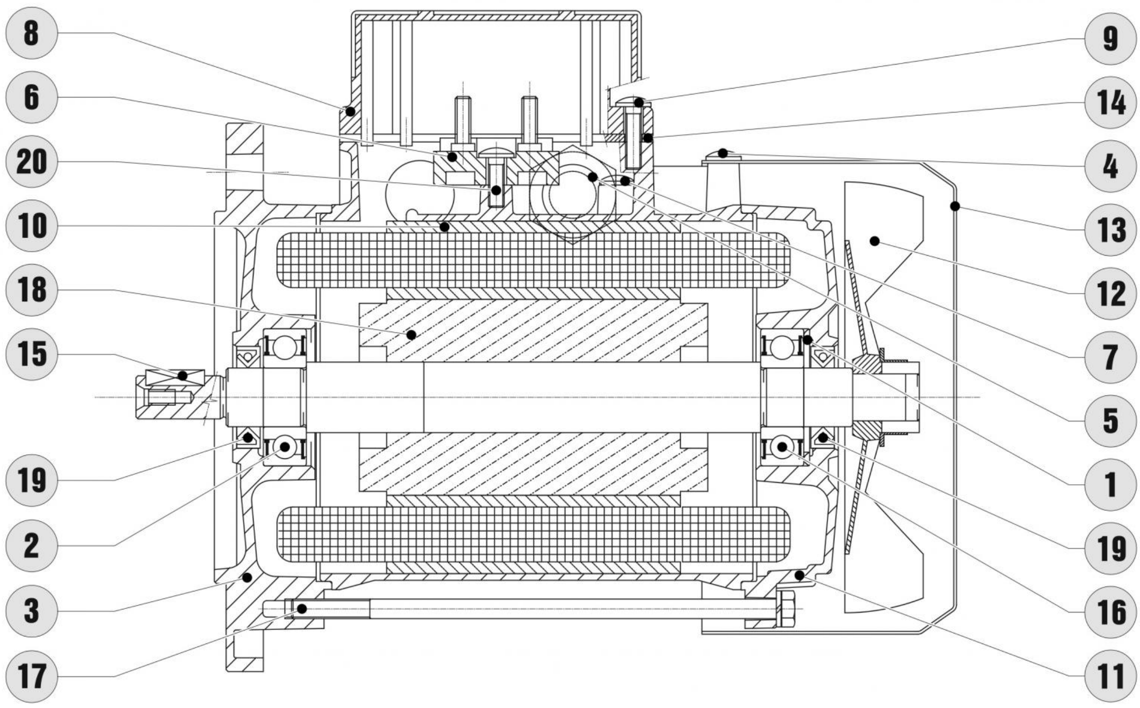
2.4.1 Designation



**Mounting positions B10/B11 only

2.4 DESIGN FEATURES

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

2.4 DESIGN FEATURES

Casing

- in die-cast aluminium alloy, chosen for its high tensile strength and corrosion resistance from size 80 to size 132;
- finned; not painted from size 80 to size 132 (painting optional);
- fitted with lifting rings starting from size 100;
- fitted for mounting feet opposite the terminal block and in the two side positions from size 80 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.

Rotor
In the TSP-SL and TBSP-SL series, the rotor consists of a low-loss magnetic lamination and has a die-cast aluminium cage. The geometry is patented.
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).

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.

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.

2.4 DESIGN FEATURES

Cable glands and plugs
Cable glands and plugs are in compliance with metric standardization.

STANDARD MOTOR (TSP-SL)						
Size	Fitted for cable gland	Cable gland included	Plugs included	Cable entry point Ø min - max [mm]	Power terminal clamps	Tightening torque max [Nm]
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	2x M25 x 1.5 (1 for side)	1 x M25 x 1.5	1 x M25 x 1.5	9 - 17	M5	3
100	2x M25 x 1.5 (1 for side)	1 x M25 x 1.5	1 x M25 x 1.5	9 - 17	M5	3
112	2x M25 x 1.5 (1 for side)	1 x M25 x 1.5	1 x M25 x 1.5	9 - 17	M5	3
132	2x 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 (TBSP-SL)						
Size	Cable routing	Cable glands	Plugs	Cable entry point Ø min - max [mm]	Power terminal clamps	Tightening torque max [Nm]
80	4 x M20 x 1.5 (2 for side)	1 x M20 x 1.5 1 x M16 x 1.5 (2)	2 or 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 or 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 or 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 or 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:

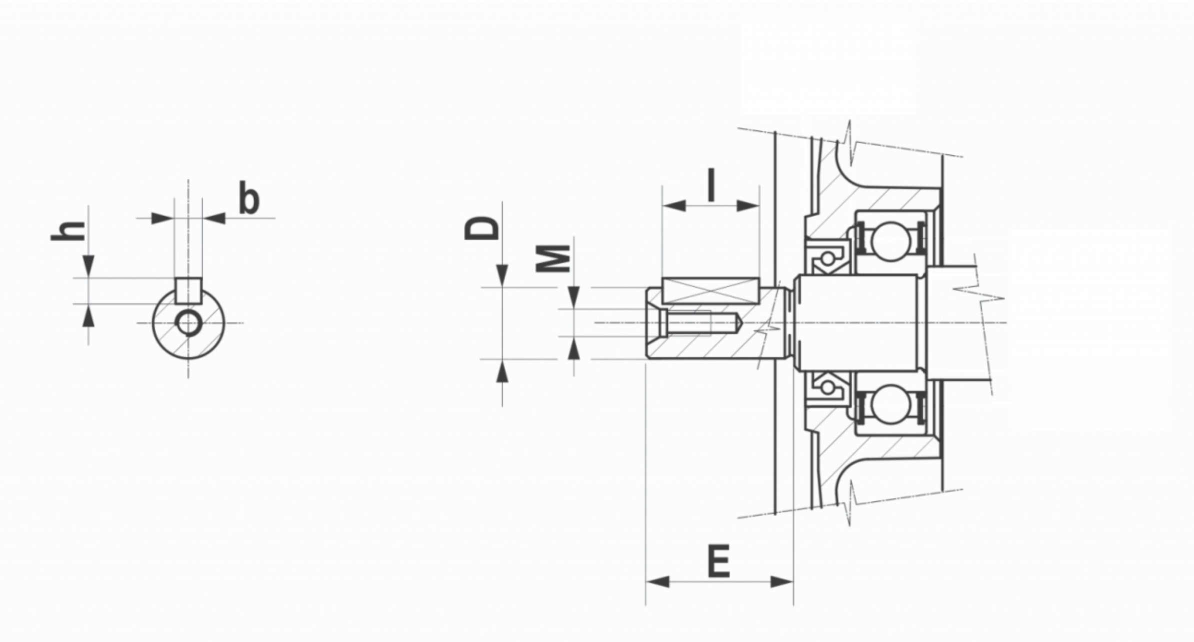
(1) For motor size 80 in the standard version, cable glands are not installed but are included with the motor. The cable glands may be mounted in the desired positions by breaking one of the caps on the terminal block box.
(2) a) Direct power: 3 plugs installed, 1 M16 cable gland included, the other 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, 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 on the fan side; in this case call our Technical Service for technical feasibility and dimensions.

2.4 DESIGN FEATURES

2.4.3 Motor shaft

Motor shaft end – drive side



		D x E [mm]	M	b x h x l [mm]
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 DESIGN FEATURES

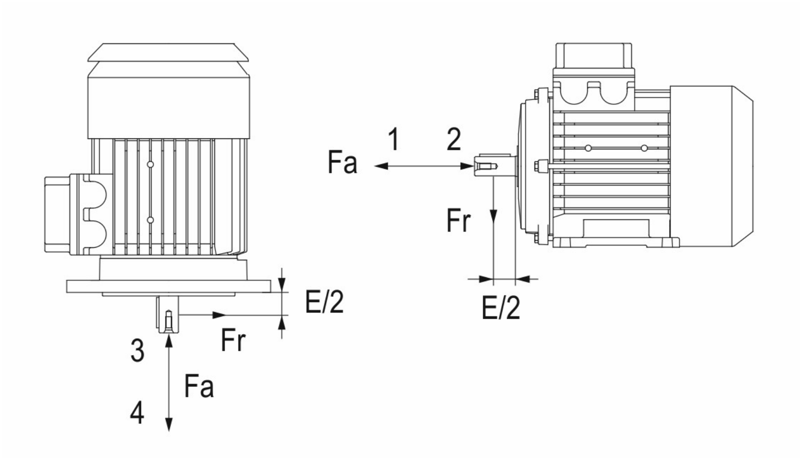
2.4.4 Bearings

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]
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 DESIGN FEATURES

2.4.5 Radial load



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

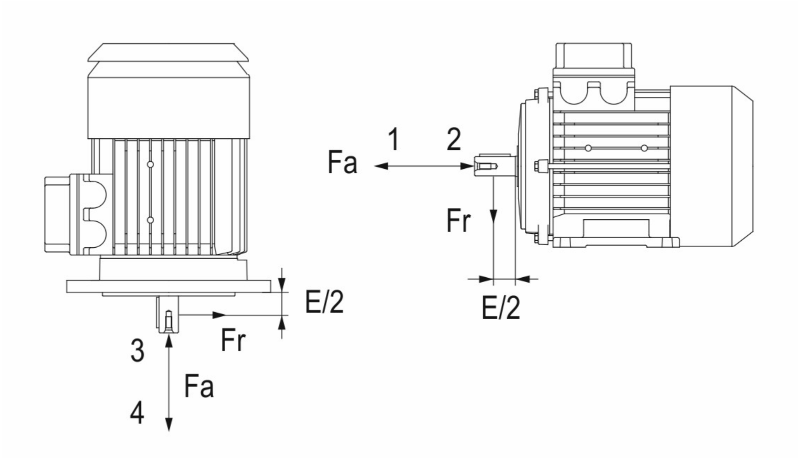
	4 (p)
80	560
90S	610
90L	620
100	870
112	1260
132S	1720
132M	1830

(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).

2.4.6 Axial load



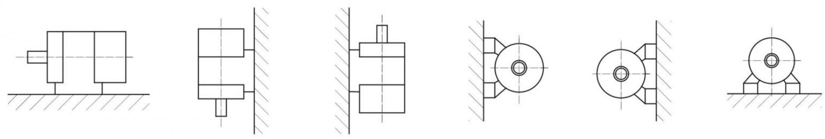
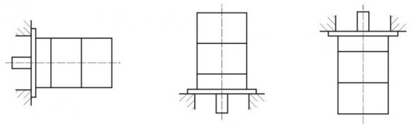
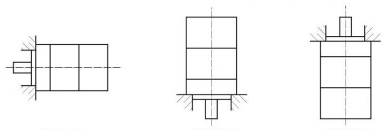
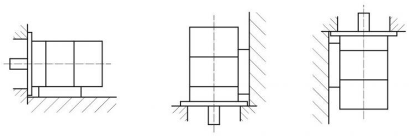
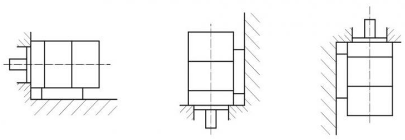
Maximum axial load F_a [N] at 50Hz with no overhung load F_r

	4 (p)			
	1	2	3	4
80	460	320	340	440
90S	495	315	340	470
90L	495	315	345	465
100	690	500	545	645
112	1000	780	830	950
132S	1445	1065	1145	1365
132M	1445	1065	1165	1345

(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.

2.5 MOUNTING POSITIONS

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	 IMB3 IMV5 IMV6 IMB6 IMB7 IMB8
IMB5	 IMB5 IMV1 IMV3
IMB14	 IMB14 IMV18 IMV19
IMB35	 IMB35 IMV15 IMV36
IMB34	 IMB34 IMV15 IMV36

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.

2.6 PROTECTION RATINGS

2.6.1 Protection rating

Definition and applicability (IEC 60034-5):
The Motovario electric motors TSP-SL in standard operation have an IP55 degree of protection; options include executions with IP56, IP65 and IP66 degrees of protection .
The Motovario self-braking electric motors TBSP-SL have an IP54 degree of protection; options 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 fall- ing 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 perma- nently in water in the conditions indicated by the manufacturer

2.7 THERMAL CLASSIFICATION

2.7.1 Insulation classes

TSP-SL, TBSP-SL 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 over-temperatures 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.

2.7.2 Thermal class

	Thermal class			
MOT.		**B**	**F**	**H**
P_n < 600W	ΔT T_M	85 130	110 155	130 180
Pn >= 600W	ΔT T_M	80 130	105 155	125 180
IC410 / IEC 60034-7	ΔT T_M	85 130	110 155	130 180

P_n = Nominal power
IC410 / IEC 60034-7 = Motors without ventilation (IC410 for IEC60034-7)
ΔT = 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 POWER CONDITIONS

3.1.1 Power voltage and frequency

TSP-SL, TBSP-SL motors in standard version (Eurovoltage) indicate the voltages-frequencies 230/400V 50Hz and 265/460V 60Hz on the plate.
Other electric versions are available on request only.

3.1.2 Mains power supply

In order for the Self Power motor to operate correctly according to its intended use, it must synchronise with the operating frequency after its asynchronous start and switch to synchronous operation. This phase is called **pull-in**.
Pull-in is only possible if the J_L/J_T inertia ratio at constant load torque (corresponding to the rated torque value) is less than or equal to the J_{Lmax}/J_T ratio (see table below).

TSP-SL - TBSP-SL 4 (p)							
P_n [kW]	Size	J_{lmax}/J_T at Mn		J_T [10^{-4}×Kgm²]		W_T [Kg]	
		1)	2)	1)	2)	1)	2)
0,55	80A4	4,3	4,1	24	25,6	9	12,5
0,75	80B4	4,5	4,3	30,7	32,3	11,3	14,8
1,1	90S4	5	4,5	32,3	35,8	14,4	17,9
1,5	90L4	6	5,5	39	42,5	16,4	22

(p) Poles
1) Without brake
2) With brake

P_n	Nominal power
M_n	Rated torque
J_L	Load moment of inertia
J_{Lmax}	Maximum load moment of inertia
J_T	Motor moment of inertia
W_T	Motor weight

Application example

Conveyor belt application: the application requires a motor that delivers a constant motor torque of 4.7 Nm coupled to a worm gear reducer with a reduction ratio of 20. The application has an overall inertia value of $70x10^{-4}$ Kgm^2. The motor selected, due to the torque required, is a TSP-SL80B4

VERIFICATION: $J_L = J'_L/i^2 = 70x10^{-4}/20^2 = 17.5x10^{-6}$ Kgm^2 (calculation of moment of inertia of the load transferred to the motor shaft)

$$J_L/J_t = 17.5x10^{-6}/30.7x10^{-4} = 0.0057 << J_{Lmax}/J_T = 4.5$$

This calculation therefore verified that the overall inertia ratio transferred to the motor (0.0057) is much lower than the value in the table above. As a result, the motor will synchronise without any problems. For each motor in the range, there is a maximum value of load inertia that can be started and brought to synchronism, which varies with the value of the load torque itself. The value indicated in the catalogue applies if the load torque is more or less constant throughout the starting and synchronisation phase and equal to the nominal value of the motor; if during starting the load develops a resistant torque less than the nominal value, the load that can be brought to synchronisation may have an inertia greater than the maximum value indicated in the catalogue; if during starting the load develops a resistant torque greater than the nominal value, the load that can be brought to synchronisation may have an inertia lower than the maximum value indicated in the catalogue.
However, it must be remembered that particular care was taken during the design phase: all Self Power motors are designed to operate most applications without any problems.

3.1 POWER CONDITIONS

3.1.3 Direct On Line motor selection

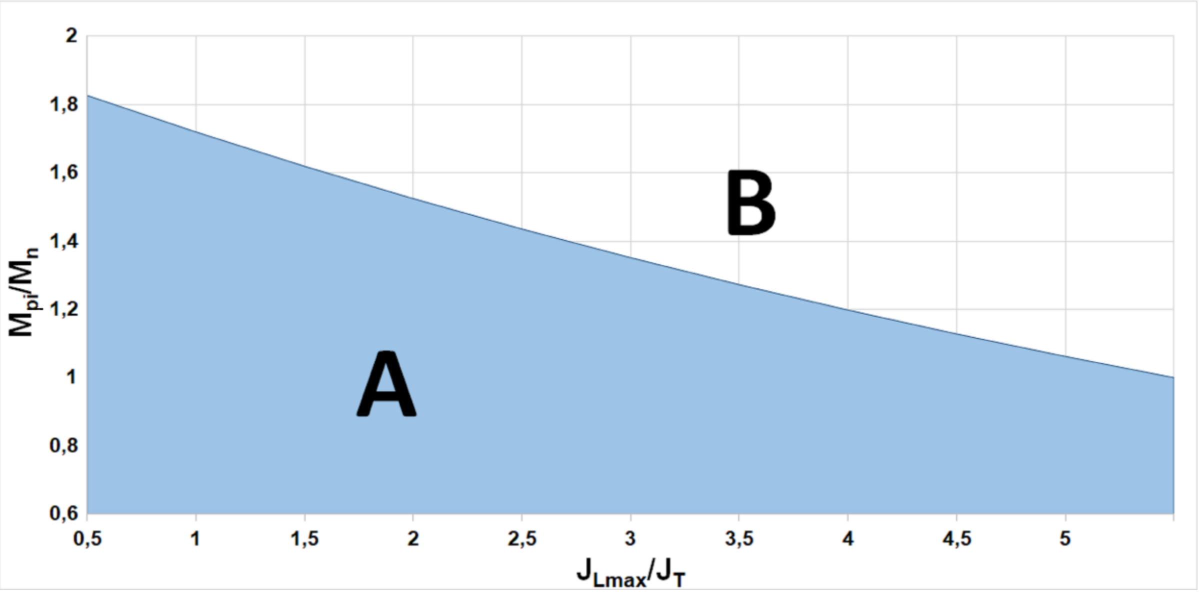
Self Power motors are available for 230/400 50 Hz and 265/460 60 Hz voltages (contact Motovario for special voltage requests).

3.1.4 Standard 50 and 60 Hz connection

Frequency [Hz]	Poles	Rated speed [rpm]	Connection
50	4	1500	Y/Δ
60		1800	

The diagram below shows the variation of Pull-In torque according to the inertia ratio. The curve in the diagram delimits two different regions of operation:

- **Synchronous operation region (region A)**
  operating region in which the motor works correctly in synchronous mode at a constant speed of 1500 rpm at 50 Hz or 1800 rpm at 60 Hz. The speed is constant even if there is a change in load during operation (see figure below).
- **Synchronisation region not possible (region B)**
  operating region in which the motor shows increased vibration, high current draw and speed fluctuations; operation under these conditions for more than a few seconds is strongly advised against (see figure below).



M_{pi}/M_n= pull-in torque / rated motor torque ratio
J_{Lmax}/J_T= maximum load inertia / motor inertia ratio

3.1 POWER CONDITIONS

3.1.5 Inverter power supply

The Self Power motor can be powered by the following inverters:

- TECO S510
- TECO L510s
- TECO E510
- TECO E510s
- TECO A510s
- TECO F510
- Drivon

Furthermore, it is possible to power Self Power with a generic V/f scalar inverter from another manufacturer.
The Self Power motor is also designed for frequency converter operation with the following settings:

- V/f scalar operating mode
- slip compensation: disabled
- additional voltage / boost enabled

To achieve maximum torque at very low speeds, a manual boost of the frequency converter output voltage must be set. Depending on the load and the desired acceleration, a boost of 10% to 30% of the rated motor voltage may be required.

The Self Power motor, with its patented hybrid technology and high efficiency, is able to deliver the rated torque up to near-zero speed without requiring forced ventilation (see figure below).

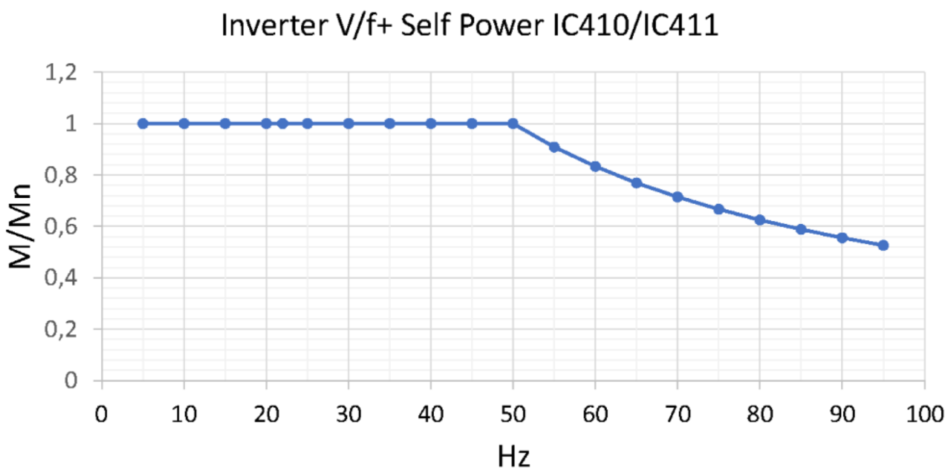


Figure 1 - Self Power torque limit, powered with V/f scalar control in S1 duty, self-ventilated (IC411) or not ventilated (IC410)

3.1 POWER CONDITIONS

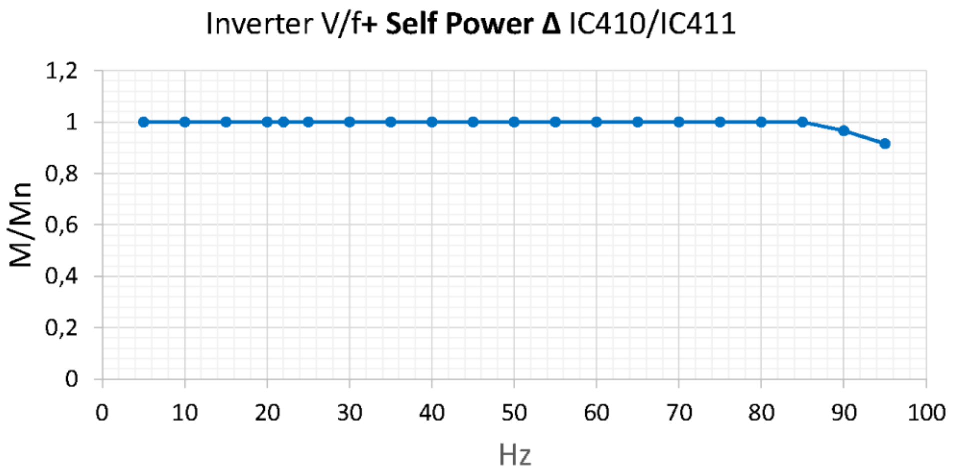


Figure 2 - Delta-connected Self Power torque limit, powered with V/f scalar control in S1 duty, self-ventilated (IC411) or not ventilated (IC410)

3.2 SOUND PRESSURE LEVEL

3.2.1 Sound pressure level LpA

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).

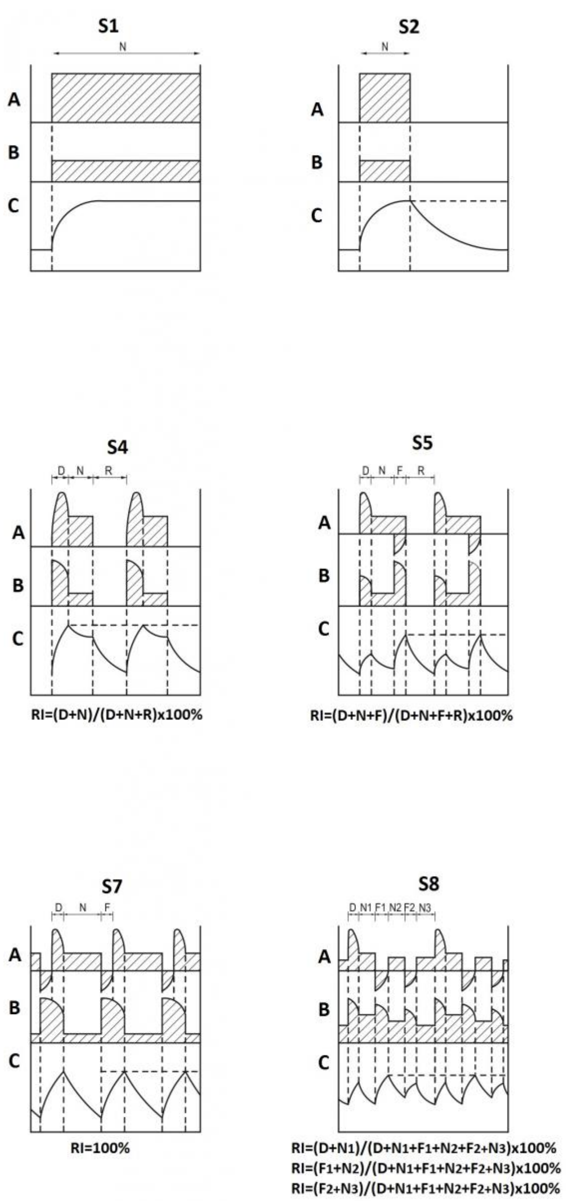
	L_{pA} [dB(A)]
	4 (*)
80	64
90	65
100	69
112	70
132	76

(*) Poles

3.3 DUTY

3.3.1 Duty

“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.



A	Load
B	Electrical losses
C	Temperature
D	Starting or acceleration time
N	Constant load running time

F	Electric braking time
R	Standby time
RI	Intermittency ratio
V	No load running time
Θ_{max}	Maximum temperature reached during cycle

3.4 OPTIONAL PROTECTION EQUIPMENT

Optionally, TSP-SL/ TBSP-SL motors can be supplied with the following thermal cutout protectors:

- Bimetallic
- PTC (Positive Temperature Coefficient)

- 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 winding temperature allowed being exceeded, in relation to the motor insulation class as per IEC60034-1. Thermal cutouts are normally positioned in close contact with the conductors inside the winding heads, before they are formed and impregnated.

Thermistors are temperature sensors with high temperature sensitivity. Thermistors with positive temperature coefficient (PTC) are generally used, so the 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 in the motor terminal board is available upon request.

Technical characteristics of standard thermistors:

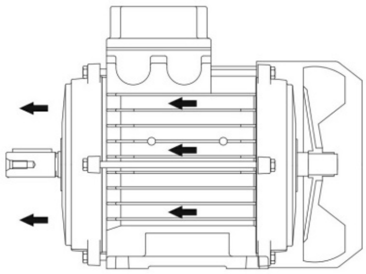
- Trip temperature 130°C for class F motors;
- Insulation dielectrical rigidity 2.5kV.

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

3.5 COOLING SYSTEMS

Standard construction electric motors TSP-SL, TBSP-SL are closed and self-ventilated with a fan mounted on the motor shaft which operates in both directions of rotation. This cooling system, as per IEC 60034-6, is designated IC411. Standard construction electric motors are constructed so that with IC411 cooling, duty is S1.

IC411



IMPORTANT!

The TSP-SL and TBSP-SL series motors do not require forced ventilation even for variable speed applications that are more thermally demanding (delivery of rated torque at very low speed). The motors are able to deliver the rated torque even at very low frequencies without the aid of servo fans even in continuous S1 duty.

3.6 OTHER OPTIONAL CONSTRUCTIONS

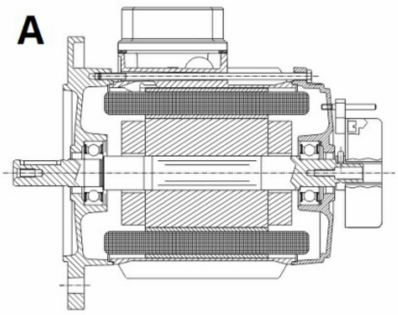
Incremental encoders are used when the motor speed must be known with precision, for example when used as a feedback signal for an inverter or indirect angular position signal or speed signal for a component of the machine to which the motor is coupled.

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.

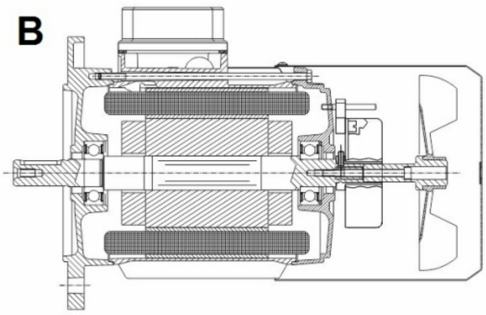
We give below the various constructions with standard incremental encoder without connector in the case of motor:

- Fig.A - TSP-SL without ventilation (IC410);
- Fig.B - TSP-SL self-ventilated (IC411);
- Fig.D - TBSP-SL (MS and FM brake) without ventilation (IC410);
- Fig.E - TBSP-SL (MS and FM brake) self-ventilated (IC411);

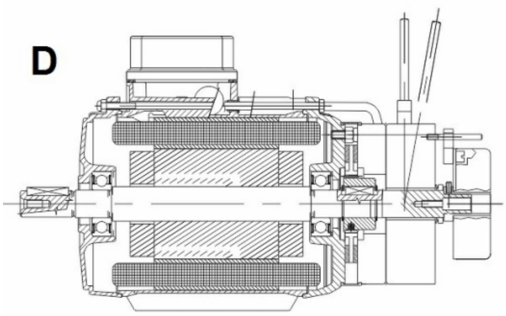
A



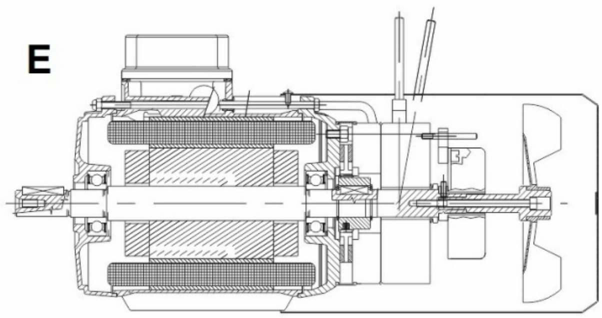
B



D



E



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.

3.7 BRAKE MOTORS

3.7.1 Brake motors

Standard motors TSP-SL can be constructed as brake motors (TBSP-SL) 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) (only upon request)
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.

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

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

3.7 BRAKE MOTORS

3.7.2 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.
- 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.

3.7 BRAKE MOTORS

Power supply

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

- for three-phase TBSP-SL 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).

Possible rectifiers are listed below:

a. half-wave rectifier with NBR filter (standard from size 80 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 80-100), 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 80 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 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 0.22μF class X2 per EN132400) in parallel with the AC power supply (default configuration for this type of rectifier).

3.7 BRAKE MOTORS

Brake characteristic values

	T	S_n	S_{max}	X	J_B	W	W_1	t_1	t_{11}	t_2	t_{22}	m_B	P_a	M_B	m_F	J_F
80	..4	0,3	0,6	1	1,6	500	30	100	40	150	10	3,1	30	5-10-15-20	1,7	28
90S-L	..5	0,3	0,6	1	3,5	750	45	120	50	220	15	4,9	40	13-26-40-55	2,3	54
100	..5	0,3	0,6	1	3,5	750	45	120	50	220	15	4,9	40	13-26-40-55	3,1	98
112	..6S	0,35	0,7	1,2	8,8	1000	70	-	80	300	30	8,3	50	20-40-60	4,5	145
132S	..6	0,35	0,7	1,2	10,3	1100	77	-	80	200	20	9,5	65	37-50-75-100	4,8	200
132M	..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_n = nominal airgap [mm]
S_{max} = maximum airgap [mm]
X = release lever play [mm]
J_B = brake disk moment of inertia [$kgcm^2$]
W = maximum energy which can be dissipated by brake [MJ]
W_1 = energy which can be dissipated between two successive adjustments of airgap from S_n to S_{max} [MJ]
t_1(*) = brake release time with normal detachment rectifier (NBR, RSD) [ms]
t_{11}(*) = brake release time with rapid detachment rectifier (SBR, RRSD) [ms]
t_2(*) = brake response time – AC side opening [ms]
t_{22}(*) = brake response time – DC side opening [ms]
m_B = weight [kg]
P_a = power absorption [W]
M_B = brake moments available [Nm]
m_F = flywheel weight [kg]
J_F = flywheel moment of inertia [$kgcm^2$]

(*) 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_1, t_{11}, t_2 and t_{22} refer to a bake 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%.

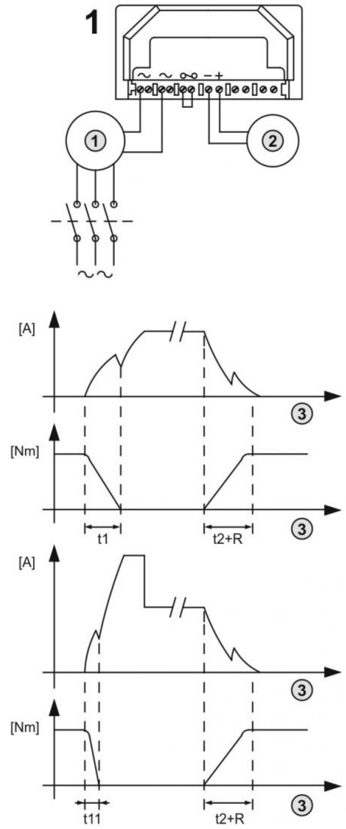
3.7 BRAKE MOTORS

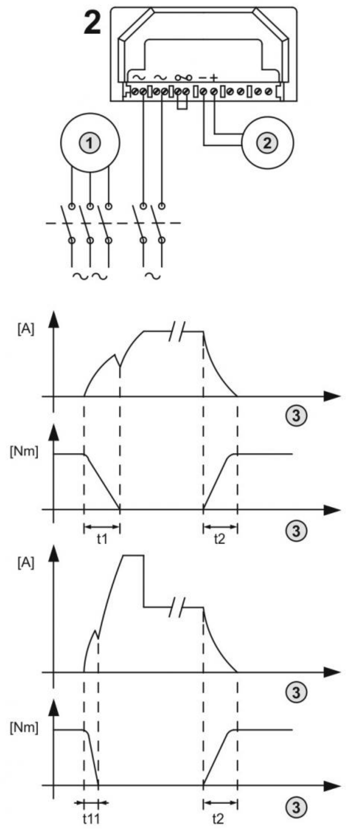
If the brake power is derived directly from the motor or is independent, one speaks of direct and separate brake power respectively. In detail, with reference to the figures given below:

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.

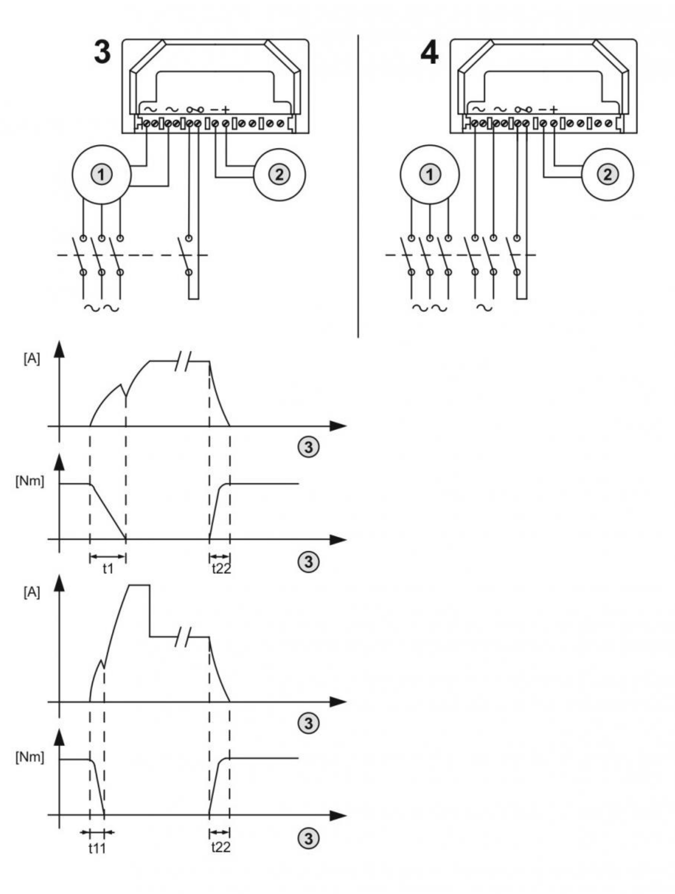
Motovario supplies brakes connected as type 1 or 2 when ordered as "direct" or "separate" power supply respectively. Type 3 and 4 connections must be implemented by the client. If SBR rapid release rectifiers are used, the brake release time reduces from t_1 to t_{11} (see graph below). In case of independent 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





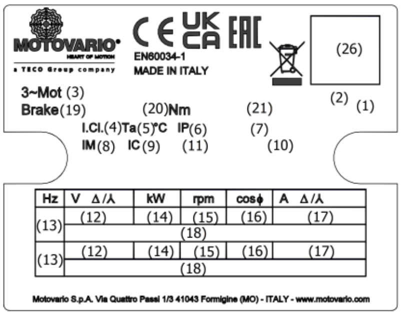
3.7 BRAKE MOTORS



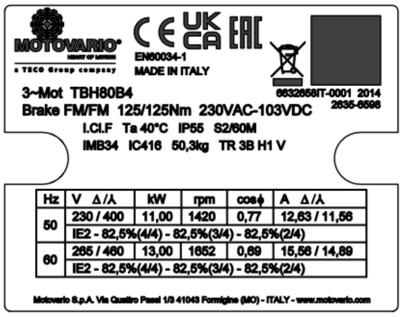
3.8 ELECTRIC MOTOR IDENTIFICATION

An electric motor features an adhesive label glued a metal support.
The label 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 LABEL



THREE-PHASE MOTOR – FILLED-OUT EXAMPLE



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 IE4 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

ADDITIONAL OPTIONS (10)

- 3B n. 3 bimetal cutouts
- 3P n. 3 thermistors (PTC)
- E encoder

4.1 MEANING OF THE SYMBOLS

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]
η%	Nominal efficiency in % (limit: minimum value required by the standard; 4/4, 3/4, 2/4: fraction of nominal power)
$\cos\varphi_n$	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(T-TB) [kgxm^2]	Moment of inertia of motor [10^{-4} kgxm^2] T - without brake TB - with brake (MS - FM)
W_T(T-TB) [kg]	Motor weight (version B5) [kg] T - without brake TB - with brake (MS - FM)
Z_0 [1/h]	Max. admitted nr. start-ups/hour with no load [1/h]
M_{po}/M_n	Pull-out torque / rated torque ratio
J_{Lmax}/J_T(T-TB) at M_n	Maximum load inertia/motor inertia ratio (maximum starting inertia at rated torque) T - without brake TB - with brake (MS - FM)
M_B [Nm]	Braking torque [Nm]

4.2 TSP-SL TBSP-SL

4 Pole

400V 50Hz

P_n [kW]	Size	n_n [min^{-1}]	I_n [A]	M_n [Nm]		η% (4/4) limit	η% (4/4)	η% (3/4)	η% (2/4)	$cos\varphi_n$	$\frac{M_s}{M_n}$	$\frac{I_s}{I_n}$	$\frac{M_{max}}{M_n}$	$\frac{M_{po}}{M_n}$	$\frac{J_{Lmax}}{J_T T}$	$\frac{J_{Lmax}}{J_T TB}$	$J_T T$	$J_T TB$	$W_T T$	$W_T TB$	Z_0 10^3x1/h	M_B [Nm]
															at M_n		10^{-4}xKgm²		Kg			
0,55	**80A4**	1500	1,39	3,50	**IE4**	**83,9**	83,9	82,5	79,9	0,68	2,4	5,6	2,6	1,8	4,3	4,1	24,0	25,6	9,0	12,5	8,0	10,0
0,75	**80B4**	1500	1,83	4,80	**IE4**	**85,7**	85,7	84,6	82,9	0,69	3,0	5,6	2,7	1,9	4,5	4,3	30,7	32,3	11,3	14,8	7,1	15,0
1,10	**90S4**	1500	2,60	7,00	**IE4**	**87,2**	87,2	86,4	83,9	0,70	2,6	5,9	3,0	2,0	5,0	4,5	32,3	35,8	14,4	17,9	5,0	13,0
1,50	**90L4**	1500	3,60	9,50	**IE4**	**88,2**	88,2	87,5	85,9	0,69	2,9	5,8	3,2	2,1	6,0	5,5	39,0	42,5	16,4	22,0	4,0	26,0

4 Pole

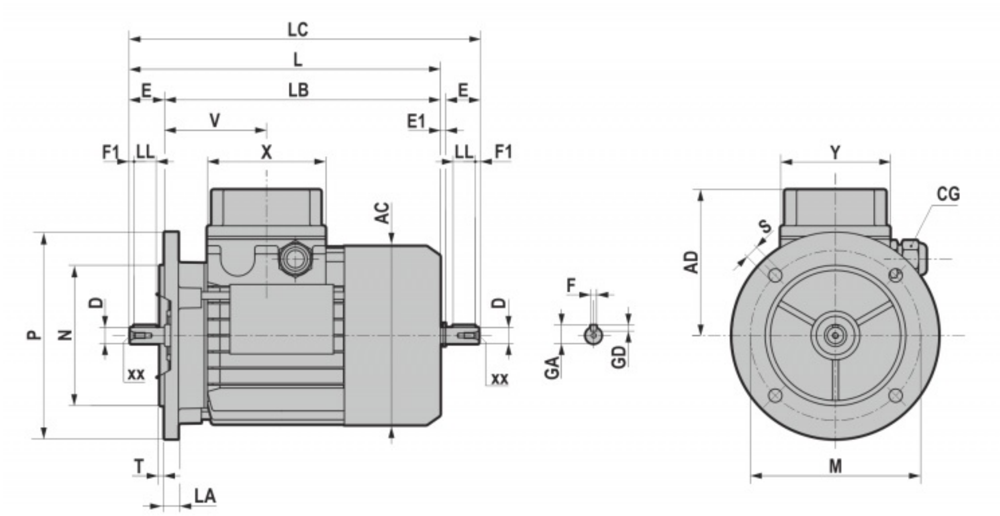
460V 60Hz

P_n [kW]	Size	n_n [min^{-1}]	I_n [A]	M_n [Nm]		η% (4/4) limit	η% (4/4)	η% (3/4)	η% (2/4)	$cos\varphi_n$	$\frac{M_s}{M_n}$	$\frac{I_s}{I_n}$	$\frac{M_{max}}{M_n}$	$\frac{M_{po}}{M_n}$	$\frac{J_{Lmax}}{J_T T}$	$\frac{J_{Lmax}}{J_T TB}$	$J_T T$	$J_T TB$	$W_T T$	$W_T TB$	Z_0 10^3x1/h	M_B [Nm]
															at M_n		10^{-4}xKgm²		Kg			
0,55	**80A4**	1800	1,25	2,90	**IE4**	**84,0**	84,0	82,8	78,6	0,66	2,6	6,6	3,0	2,0	4,3	4,1	24,0	25,6	9,0	12,5	8,0	10,0
0,75	**80B4**	1800	1,64	4,00	**IE4**	**85,5**	85,5	84,5	81,0	0,67	3,6	6,9	3,5	2,1	4,5	4,3	30,7	32,3	11,3	14,8	7,1	15,0
1,10	**90S4**	1800	2,32	5,80	**IE4**	**87,5**	87,5	86,4	83,5	0,68	3,0	7,2	3,6	2,3	5,0	4,5	32,3	35,8	14,4	17,9	5,0	13,0
1,50	**90L4**	1800	3,20	8,00	**IE4**	**88,5**	88,5	87,5	85,4	0,67	3,2	7,0	3,6	2,2	6,0	5,5	39,0	42,5	16,4	22,0	4,0	26,0

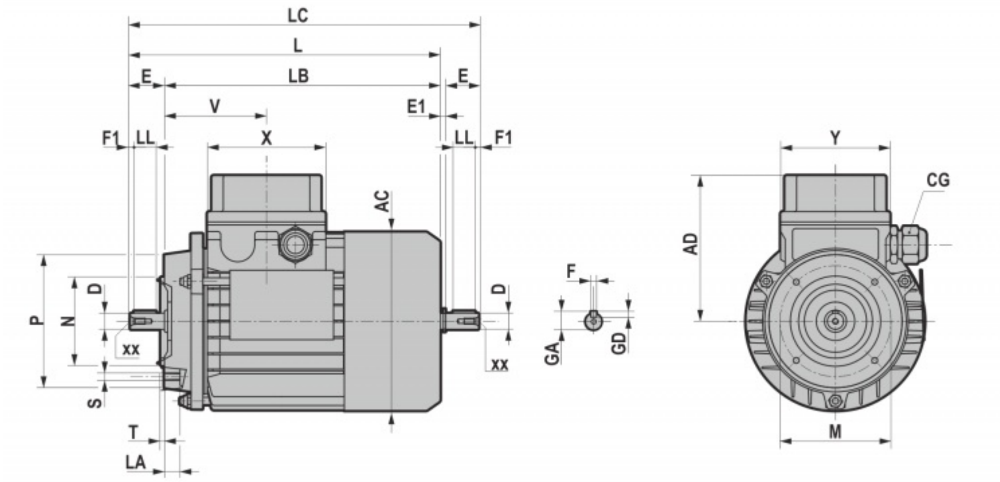
5.1 DIMENSIONS

5.1.1 General dimensions

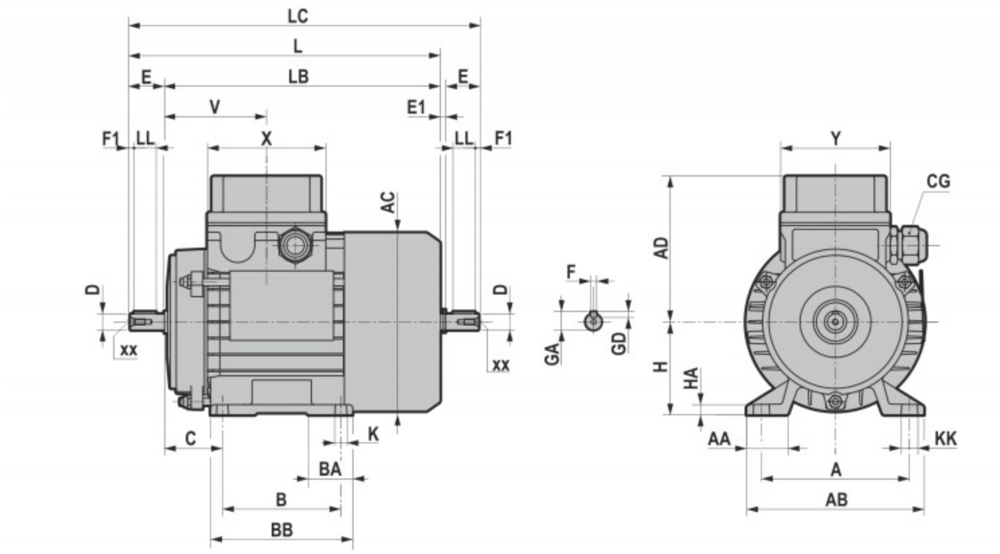
B5



B14



B3



5.1 DIMENSIONS

	AC	AD	L	LB	X	Y	V	LC
80	158	121,5	272,5	232,5	80	74	78	314
90S	173	148	298	248	98	98	87	349,5
90L	173	148	323	273	98	98	87	374,5

	Shaft end						Key			Cable gland		
	D	E	E1	xx	F1	GA	F	GD	LL	CG	Ø hollow min	Ø hollow max
80	19 j6	40	1,5	M6x16	5	21,5	6	6	30	M20x1.5	6	12
90S	24 j6	50	1,5	M8x19	5	27	8	7	35	M25x1.5	13	18
90L	24 j6	50	1,5	M8x19	5	27	8	7	35	M25x1.5	13	18

B5	M	N	P	LA	S	T
80	165	130	200	12	11	3,5
90	165	130	200	12	11	3,5

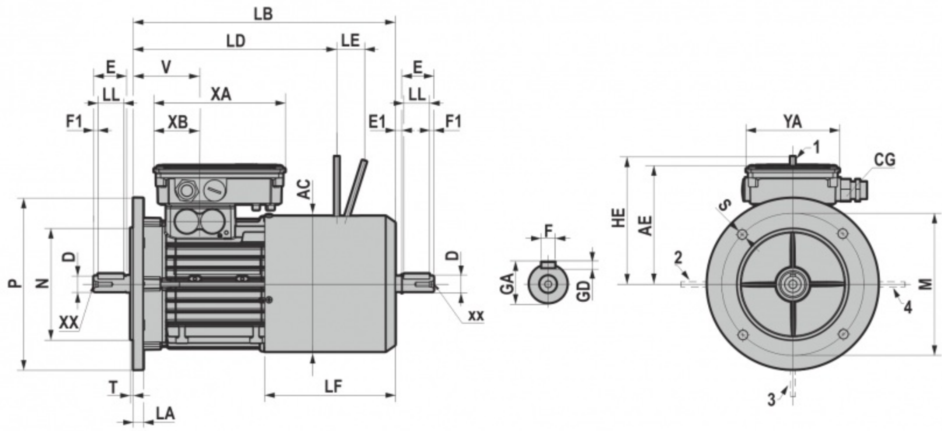
B14	M	N	P	LA	S	T
80	100	80	120	10,5	M6	3
90	115	95	140	11,5	M8	3

B3	A	AA	AB	KK	B	BB	BA	K	C	H	HA
80	125	56,5	156	19,5	100	122	26	9,5	49	80	11
90S	140	56	172	12	100	136	33	8,5	54	90	11
90L	140	57	172	12	125	155	33	8,5	54	90	13

5.1 DIMENSIONS

5.1.2 Brake motors

B5



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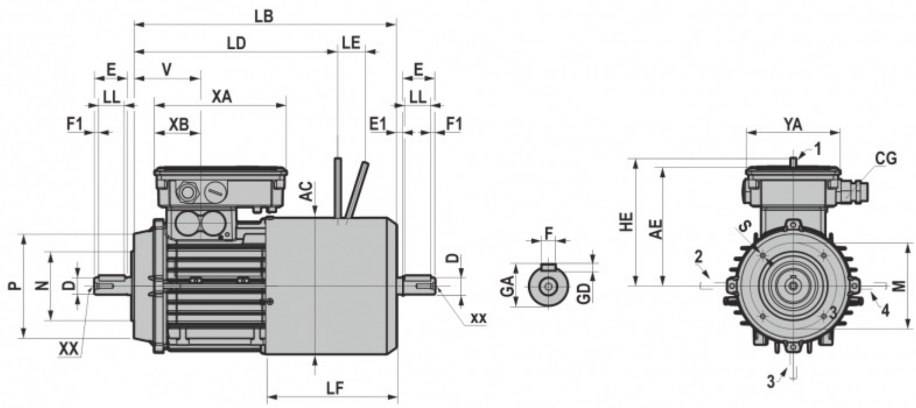
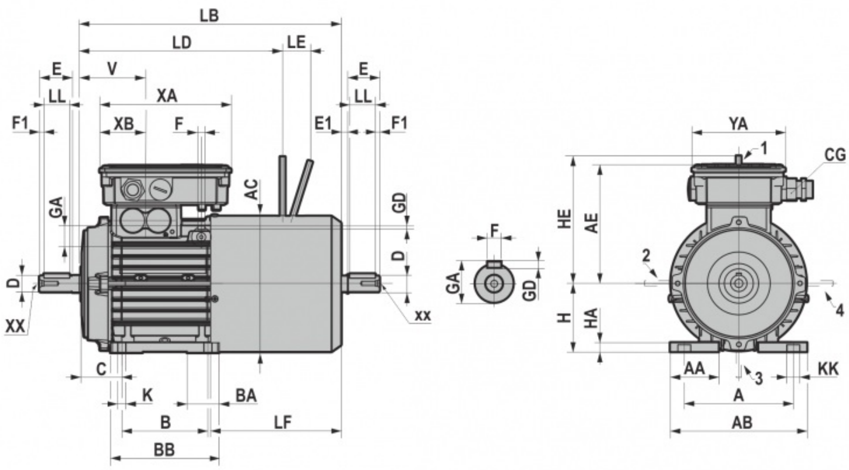


B3



5.1 DIMENSIONS

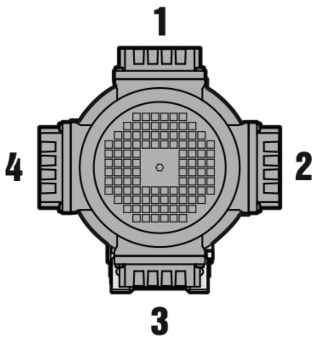
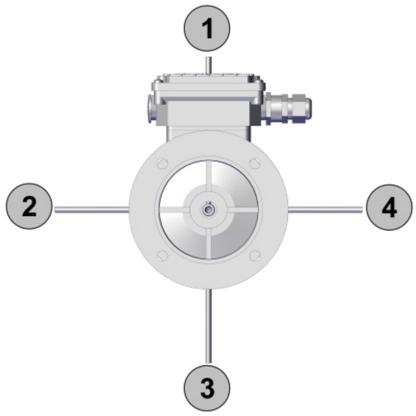
		Cable gland					
	Brake Power supply	Pg	Ø hollow min	Ø hollow max	XA	XB	YA
80	DC	M16x1.5	5	10	153	54	109
90	DC	M20x1.5	6	12	206	66,5	132

		LD	LE	HE	LB	LF	AE	V
80	FM	237	22,5	129	304	152	136	78
90S	FM	255	28	159,5	324,5	166	165	89,5
90L	FM	279	27,5	159,5	349,5	166	165	89,5

5.1 DIMENSIONS

5.1.3 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.

	(*)
	

6.1 OPTIONAL CONSTRUCTIONS - ACCESSORIES

6.1.1 Optional constructions - Accessories TSP-SL

	SIZE				
OPTIONS	80	90	100	112	132
			REGULATIONS		
ATEX 3GD	•	•	•	•	•
			PROTECTION		
IP55	○	○	○	○	○
IP56	•	•	•	•	•
IP65	•	•	•	•	•
IP66	•	•	•	•	•
			TEMPERATURE SENSORS		
BIMETALLIC THERMAL CUTOUT PROTECTORS	•	•	•	•	•
PTC THERMISTORS	•	•	•	•	•
			ENVIRONMENT		
LOW TEMPERATURE VERSION	-	-	-	-	-
HIGH TEMPERATURE VERSION	-	-	-	-	-
			POWER SUPPLY		
SPECIAL POWER SUPPLY VOLTAGES	-	-	-	-	-
			COOLING SYSTEM		
MOTOR WITHOUT VENTILATION IC410	•	•	•	•	•
FORCED VENTILATION KIT	-	-	-	-	-
			PAINT COATING		
MOTOR PAINT COATING	-	-	-	-	-
			INSULATION		
CLASS F	○	○	○	○	○
CLASS H	-	-	-	-	-
			ANTI-CONDENSATION		
CONDENSATION DRAIN HOLES	-	-	-	-	-
ANTI-CONDENSATION HEATER	-	-	-	-	-
			DESIGN FEATURES		
REDUCED B5 FLANGE	-	-	-	-	-
REDUCED B14 FLANGE	-	-	-	-	X
REDUCED SHAFT	-	-	-	-	-
			DEVICE		
INCREMENTAL ENCODER WITH CONNECTOR	•	•	•	•	•
INCREMENTAL ENCODER WITHOUT CONNECTOR	•	•	•	•	•

• Option
○ Standard
- On request
x Not feasible

* Standard motor version unpainted

6.1.2 Optional constructions - Accessories TBSP-SL

	SIZE				
OPTIONS	80	90	100	112	132
			PROTECTION		
IP54	○	○	○	○	○
IP55	•	•	•	•	•
IP56	•	•	•	•	•
IP65	•	•	•	•	•
IP66	•	•	•	•	•
			TEMPERATURE SENSORS		
BIMETALLIC THERMAL CUTOUT PROTECTORS	•	•	•	•	•
PTC THERMISTORS	•	•	•	•	•
			FM BRAKE		
MANUAL RELEASE LEVER	•	•	•	•	•
ANTI-LOCK STAINLESS STEEL RING	○	○	○	○	○
MICROSWITCH	-	-	-	-	-
SEPARATE POWER SUPPLY	•	•	•	•	•
SBR RECTIFIER (QUICK RELEASE HALF-WAVE)	•	•	•	X	X
RSD RECTIFIER (QUICK BRAKING HALF-WAVE)	•	•	•	X	X
RRSD RECTIFIER (BRAKING/QUICK RELEASE HALF-WAVE)	•	•	•	•	•
SILENT BRAKE	•	•	•	•	•
			ENVIRONMENT		
LOW TEMPERATURE VERSION	-	-	-	-	-
HIGH TEMPERATURE VERSION	-	-	-	-	-
			POWER SUPPLY		
SPECIAL POWER SUPPLY VOLTAGES	-	-	-	-	-
SPECIAL BRAKE REEL VOLTAGES	-	-	-	-	-
			COOLING SYSTEM		
MOTOR WITHOUT VENTILATION IC410	•	•	•	•	•
FORCED VENTILATION KIT	-	-	-	-	-
			PAINT COATING		
MOTOR PAINT COATING	-	-	-	-	-
			INSULATION		
CLASS F	○	○	○	○	○
CLASS H	-	-	-	-	-
			ANTI-CONDENSATION		
CONDENSATION DRAIN HOLES	-	-	-	-	-
ANTI-CONDENSATION HEATER	-	-	-	-	-
			DESIGN FEATURES		
REDUCED B5 FLANGE	-	-	-	-	-
REDUCED B14 FLANGE	-	-	-	-	X
REDUCED SHAFT	-	-	-	-	-
DOUBLE SHAFT	•	•	•	•	•
			DEVICE		
INCREMENTAL ENCODER WITH CONNECTOR	•	•	•	•	•
INCREMENTAL ENCODER WITHOUT CONNECTOR	•	•	•	•	•

• Option
○ Standard
- On request
x Not feasible

* Standard motor version unpainted

7.1 SALES CONDITIONS

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; 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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http://www.motovario.com/eng/corporate/sales-conditions

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