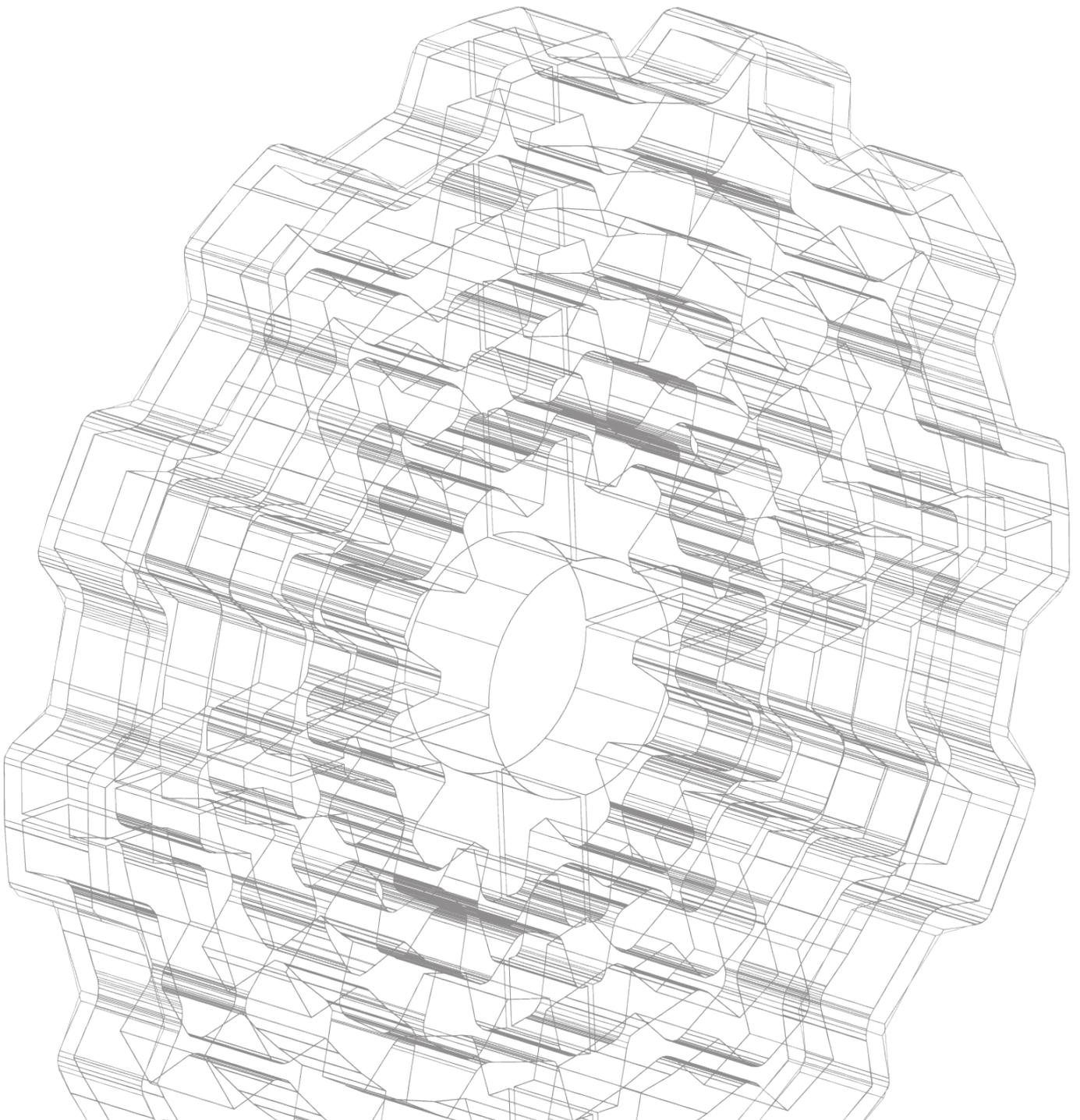


USE AND MAINTENANCE INSTRUCTIONS FOR ELECTRIC MOTORS



**ORIGINAL VERSION IN ITALIAN
ENGLISH VERSION - TRANSLATION**

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1. SCOPE

The instructions in this manual apply to the following series of asynchronous electric motors produced by MOTOVARIO S.p.A:

- **TS** (three-phase, single polarity, standard efficiency);
- **TH** (three-phase, single polarity, high efficiency);
- **TP** (three-phase, single polarity, premium efficiency);
- **TBS** (three-phase, self-braking, single polarity, standard efficiency);
- **TBH** (three-phase, self-braking, single polarity, high efficiency);
- **TBP** (three-phase, self-braking, single polarity, premium efficiency);
- **TSX** (three-phase, single polarity, standard efficiency for aggressive / corrosive / food environments);
- **THX** (three-phase, single polarity, high efficiency for aggressive / corrosive / food environments);
- **TPX** (three-phase, single polarity, premium efficiency for aggressive / corrosive / food environments);
- **TBSX** (three-phase, self-braking, single polarity, standard efficiency for aggressive / corrosive / food environments);
- **TBHX** (three-phase, self-braking, single polarity, high efficiency for aggressive / corrosive / food environments);
- **TBPX** (three-phase, self-braking, single polarity, premium efficiency for aggressive / corrosive / food environments);
- **D** (three-phase, double polarity);
- **DB** (three-phase, self-braking, double polarity);
- **S** (single-phase);
- **HSE** (high starting torque single-phase with electronic cutout).

Specialist products (i.e. different to those present in our catalogues and/or product offers) or specialist applications (e.g. power supply from inverters) require additional information to be provided.

2. GENERAL SAFETY WARNING

Electric motors are a source of electrical hazards and consequently their improper use may cause injury and/or damage to people, animals and objects.

Read the following instructions carefully before starting up the motor; all installation, commissioning, maintenance and protection of the electric motor must be done by qualified staff in full compliance with established legislation and technical regulations as well as the safety regulations governing the electrical equipment of machinery as declared by European standard EN60204-1.

Please note that the present literature supplements and does not replace any established legislation, technical regulations or safety regulations governing electric motors; it merely makes practical suggestions that qualified personnel can make use of. It is forbidden to use electric motors in potentially explosive atmospheres unless expressly foreseen and specified on the nameplate in compliance with European Directive 94/9/EC.

Motovario is exempt from any responsibility deriving from improper use or failure to follow current safety directives governing electric motors.

3. COMPLIANCE WITH EU DIRECTIVES – CE MARKING

Standard three-phase asynchronous electric motors (TS, TH, TP, TSX, THX, TPX, D series) and single-phase (S and HSE series) comply with the standardised construction regulation IEC 60034-1 and therefore meet the requirements of the Low Voltage Directive 2006/95/CE. The electric motor, considered as a component, is compliant with the following directives:

- Directive ROHS 2011/65/EU relating to the prohibition or the limitation of the use of noxious substances in electrical and electronic equipment.
- Directive ErP 2009/125/EC on ecological designing of energy-using devices and in particular EC Regulation no. 640/2009 (and subsequent UE modification no. 4/2014) on the ecological design of electric motors.
- Directive EMC 2004/108/CE relating to intrinsic characteristics in relation to emissions and levels of immunity.

All standard mounting position motors in continuous operation and powered from the mains are compliant with general standards EN50081 (emission limits for civil environments) and EN50082 (immunity for industrial environments); in the case of brake motors (TBS, TBH, TBP, TBSX, TBHX, TBPX, DB RRSD series) or full wave rectifier (DBR) the filter is implemented by connecting a 440Vac 0.22µF class X2 condenser in parallel to the AC power, as per EN132400; the half-wave rectifier type RV6 has no integral filter and is thus suited to installation with the filter upline of the machine (to be done by the client). Follow the instructions of the devices' manufacturers in case of intermittent malfunctions and interferences generated by the triggering devices, power supplies with inverters, systems with encoders, etc. All electric motors are intended to be integrated in equipment and complete systems and must never be started until the equipment they are installed in is compliant with Machinery Directive (Certificate of Integration - Directive 2006/42/EC Ann. II B). The compliance of a complete installation with the "Machinery Directive" and the EMC Directive is the responsibility of the machine's manufacturer.

According to EC Regulation no. 640/2009, starting from 01/01/2015 the motors of the TH series (IE2, high efficiency) with power greater than or equal to 7.5 kW can be started in the European Union only if supplied by an inverter. From 01/01/2017 this provision applies to the motors of the TH series with power greater than or equal to 0.75 kW.

4. ELECTRIC MOTOR IDENTIFICATION

All motors feature a nameplate containing all necessary identification details. The nameplate layout is described below.

Three-phase motor nameplate

EN60034-1		CE		(1)
MOTOVARIO		made in ITALY		(2)
3 ~ mot. (3)	(19)	brake (20)	Nm	(21)
I.Cl. (4)	T _{amb} (5) °C	IP (6)	S (7)	IM B (8)
○ IC41 (9)	(10)	kg (11)	○	AD90000
△/△ V	Hz	kW	min ⁻¹	cos φ
(12)	(13)	(14)	(15)	(16)
(18)				(17)
(12)	(13)	(14)	(15)	(16)
(18)				(17)
Via Quattro Passi 1/3 - 41043 - Formigine (MO) - ITALY				

Single-phase motor nameplate

EN60034-1		CE		(1)
MOTOVARIO		made in ITALY		(2)
1 ~ mot. (3)	(19)	brake (20)	Nm	(21)
I.Cl. (4)	T _{amb} (5) °C	IP (6)	S (7)	IM B (8)
○ IC41 (9)	(10)	kg (11)	○	CO90000
V	Hz	kW	min ⁻¹	cos φ
(12)	(13)	(14)	(15)	(16)
(12)	(13)	(14)	(15)	(16)
Cap.run. (22)		Cap.start (23)		
Via Quattro Passi 1/3 - 41043 - Formigine (MO) - ITALY				

UL/CSA motor nameplate

EN60034-1		CE		(1)
MOTOVARIO		made in ITALY		(2)
3 ~ mot. (3)	(19)	brake (20)	Nm	(21)
DES(24)(19)		CODE (25)		
(5) °C	Amb Rating (7)	IP (6)	CLASS (4)	CODE (25)
○ (9)	(10)	FRAME IMB (8) ○		
△/△ V	Hz	kW	rpm	cos φ
(12)	(13)	(14)	(15)	(16)
(12)	(13)	(14)	(15)	(16)
(18)				(17)
(12)	(13)	(14)	(15)	(16)
(18)				(17)
Via Quattro Passi 1/3 - 41043 - Formigine (MO) - ITALY				

Sample nameplate

EN60034-1		CE		14-6252567
MOTOVARIO		made in ITALY		0013
3 ~ mot. TH80B4		brake	Nm	
I.Cl. F	T _{amb} 40 °C	IP 55	S 1	IM B 14
○ IC41 1		kg	○	AD90000
△/△ V	Hz	kW	min ⁻¹	cos φ
230/400	50	0,75	1410	0,77
IE2-79,6% (4/4)-79,7% (3/4)-75,8% (2/4)				
265/460 60 0,75 1740 0,72 2,74/1,58				
IE2-82,5% (4/4)-81,9% (3/4)-79,7% (2/4)				
Via Quattro Passi 1/3 - 41043 - Formigine (MO) - ITALY				

Sample nameplate

EN60034-1		CE		14-5934335
MOTOVARIO		made in ITALY		0015
1 ~ mot. HSE80B4		brake	Nm	
I.Cl. F	T _{amb} 40 °C	IP 55	S 1	IM B 14
○ IC41 1		kg	○	CO90000
V	Hz	kW	min ⁻¹	cos φ
230	50	0,75	1430	0,93
Cap.run. 25μF		Cap.start 50μF		
Via Quattro Passi 1/3 - 41043 - Formigine (MO) - ITALY				

Sample nameplate

EN60034-1		CE		14-6365771
MOTOVARIO		made in ITALY		0021
3 ~ mot. TBS80B4		DES C FM	brake 15 Nm	230Vac-103Vdc
40 °C	Amb Rating	CONT IP 55	CLASS F	CODE F
○ TEFC		FRAME IMB 14 ○		
△/△ V	Hz	kW	rpm	cos φ
230/400	50	0,75	1400	0,78
IE1 - 72,1%				
Via Quattro Passi 1/3 - 41043 - Formigine (MO) - ITALY				

- | | |
|---|--|
| <p>(1) Year of manufacture – order number</p> <p>(2) Serial number</p> <p>(3) Motor type code
(series/size/no. poles)</p> <p>(4) Insulation class</p> <p>(5) Maximum ambient operating temperature</p> <p>(6) IP protection rating</p> <p>(7) Service</p> <p>(8) Construction type</p> <p>(9) Cooling method (*)</p> <p>(10) Additional options (see below)</p> <p>(11) Motor weight (only for > 30 kg)</p> <p>(12) Motor voltage (depending on connection)</p> <p>(13) Power frequency [Hz]</p> <p>(14) Nominal power delivery [kW]</p> <p>(15) Nominal speed [rpm]</p> <p>(16) Nominal power factor</p> <p>(17) Nominal current (depending on connection) [A]</p> <p>(18) Code IE1, IE2 or IE3 (depending on type of motor and whether applicable) followed by efficiency value at 4/4, 3/4 and 2/4 of nominal power.</p> <p>(19) Brake type</p> | <p>(20) Nominal braking moment [Nm]</p> <p>(21) Brake power supply
(single-phase version only)</p> <p>(22) running capacitor [μF]</p> <p>(23) starting capacitor [μF]
(UL/CSA version only)</p> <p>(24) "NEMA Electrical Design Classification"</p> <p>(25) locked rotor current identification code (ANSI NFPA 70-1996)</p> |
|---|--|

Additional options (10)

- H1 condensation heaters for voltage 110V
- H2 condensation heaters for voltage 230V
- TR humid environment construction
- LT low temperature construction
- HT high temperature construction
- 3B no. 3 bimetal thermal fuses
- 3P no. 3 thermistors (PTC)
- A backstop device (anti-clockwise rotation permitted)
- B backstop device (clockwise rotation permitted)
- E encoder
- V flywheel
- HC rapid connection

(*) For UL/CSA motors, 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)

5. MECHANICAL INSTALLATION

Before installation please check that:

- 1) the electric motor is not visibly damaged (whether damaged in transit or during storage).
 - 2) the information on the nameplate corresponds with the features of the electric motor and its intended use; the power supply voltage matches the mains voltage; the permitted voltage tolerance is $\pm 10\%$ for 230/400V 50Hz and 265/460V 60Hz, and $\pm 5\%$ for other voltages and/or single-phase motors.
 - 3) the ambient temperature is between -15°C and $+40^{\circ}\text{C}$ ($+50^{\circ}\text{C}$ 2- and 4-pole TS motors with nominal power ≥ 0.75 kW); in addition, the altitude must be $< 1000\text{m}$ above sea level; ambient temperatures outside this range and/or higher altitudes require the application of a corrective power factor (see product catalogue).
 - 4) If the environment features sudden temperature changes with possible consequent condensate formation, it is recommended to request the condensation heaters and/or the condensate discharge holes.
 - 5) The IP protection rating given on the nameplate is suited to the environment under the terms of IEC 60034-5.
 - 6) In outdoor installations, protect the motor from the direct sunlight and, if possible, from the atmospheric agents.
- Use the provided attachment points to lift the motor; the eyebolts on the motor are for lifting the motor only and not any other equipment coupled to it; ensure that the systems mounted to the motor match the electric motor's specifications.

Preliminary tasks:

- 1) remove any fastenings and protective material used for shipping (e.g. guards on the ends of the motor shaft) and check that the shaft turns freely (for TBS – TBH – TBP – TBSX - TBHX - TBPX – DB series brake motors, first release the manual release lever if present).
- 2) carefully clean the ends of the shaft with a normal solvent to remove any rust protection, contaminants and similar matter; take care that the solvent does not get into the bearings or comes into contact with the seal ring lips and damages them.
- 3) check, especially after lengthy storage, that the motor has not absorbed humidity, by measuring the insulation resistance which must be $< 10\text{M}\Omega$ at 20°C ; take the measurement by applying a direct current of 500V between the phases towards GND; the windings must be discharged immediately after the measurement has been taken. If the insulation resistance is insufficient the motor must be dried with hot air or using an isolation transformer, connecting the windings of each phase in series and applying an auxiliary AC current of 10-20% of the nominal current, until the resistance measurement is satisfactory.

Installing the motor:

- 1) take care to secure the motor adequately in relation to its weight, mounting type and position;
- 2) assemble the motor on a flat, rigid, vibration-free and deformation-resistant surface; align the motor carefully with the driven machine to avoid inadmissible stresses on the shaft and observe the overhung and axial loading specifications (see product catalogue); misalignments and forced locking can result in hazardous overheating;
- 3) if the motor construction type is IEC B14, the four retaining screws must be screwed in the flange even if they are not necessary. It is recommendable to apply sealant, such as Loctite 242 on the retaining screws thread. The maximum screwing depth in the bearing shield is $2 \times d$, where "d" is the threaded hole;
- 4) vertical installations must include measures to prevent foreign bodies falling into the ventilation slots; in such case, we recommend using a fan cover with awning (compulsory in case of self-braking motor);
- 5) during assembly, avoid damaging the bearings by using the shaft as a stop after removing the fan cover; do not knock the end of the shaft;
- 6) the motor shaft is dynamically balanced and complete with half key from size 90 upwards, with normal vibration; make sure that any parts to be locked to the motor shaft are balanced with half key; if using double-ended shaft motors, take care not to start the motor until the unused key has been secured.
- 7) the motor must be mounted in such a way that the nameplate data is legible, the terminal block box can be inspected, the motor compartment can be cleaned, there are no moving parts outside the guards (e.g. fan cover), the assembly is sufficiently ventilated without bottlenecks or machining residue, dust or fluids in the air supply, and that nothing is blocking normal dispersal of heat; finally, ensure that there is sufficient distance between the fan cover holes and any external protective devices which could potentially block the inflow of cooling air.
- 8) in particularly humid conditions: make sure, if possible, that the cables enter the terminal block box from below, and check for condensation; if there is a condensation drain hole, drain the condensation, then refit the plug to restore the box's IP rating. Do this only with the power supply visibly shut off (breaker open). If there are anti-condensation heaters, make sure the motor is not powered up or rotating before turning them on; also make sure the heaters' power supply is compliant with their ratings.

6. ELECTRICAL INSTALLATION AND START UP

- 1) Connect the motor to the mains as shown in the diagram inside the terminal block box (the wiring diagrams are also included at the end of this manual).
- 2) Do not connect up or start the motor if the wiring diagram is absent.
- 3) Do not start the motor with the key unengaged.
- 4) Before making the connections, check that the motor's wires are properly tightened down to the terminal block; to connect the cable, use the parts kit in the bag supplied with the motor and follow the installation instructions, paying particular attention to the correct component order and to the maximum tightening torques; the terminals used to hook up the cable must be isolated to ensure the minimum distances between the live parts and inactive metal parts; the cable grommet must be suited to the external diameter of the cable's sheathe; all unused cable entry points must be sealed to restore the box's IP rating.
- 5) As well as the main power terminals, the terminal block box may also contain the cable terminals for the thermal protective devices and/or condensation heaters and/or the brake (if the motor in question is a brake motor with separate power supply). The cable terminals in the terminal block for thermal protective devices and condensation heaters are usually free. For connecting up brakes with separate power supplies please refer to the relevant section.
Motors can also be fitted with incremental encoders and/or an external forced ventilation capacity (servo-ventilation). Please consult the relevant sections.
- 6) The power and GND cables must comply with established practice and standards, and be properly insulated and rated for the current draw; the connection cabling and cable cross sections must comply with EN60204-1.
- 7) All motors are equipped for grounding inside the terminal block box and outside on the motor casing; the GND clamp points are marked with the relevant symbol.
- 8) Secure the GND cable to prevent its slackening (use an elastic washer between the terminal and the bolt) and rotating (use only split cable terminals).
- 9) Before starting up the motor, check its direction of rotation; if it is required to run in the opposite direction from the default direction, for three-phase motors (series TS, TH, TP, TSX, THX, TPX, TBS, TBH, TBP, TBSX, TBHX, TBPX, D; DB) simply swap 2 phases; for single-phase motors (series S), refer to the wiring diagram. The direction of rotation is clockwise when seen from the drive side.
- 10) If a backstop device is present, do not start the motor in the stop direction; for inspection reasons, the backstop can only be operated once in the stop direction at a voltage less than half the power voltage.
- 11) After wiring the unit, refit the terminal block cover with its gasket.
- 12) For brake motors, check the operation of the brake and its braking torque before starting the motor.
- 13) For motors of the TSX, THX, TPX, TBSX, TBHX, TBPX series, smear sealant (like LOCTITE 5331) on the cable glands and the closing plugs and tighten them correctly; properly seal the cable inlet; thoroughly clean the sealing surface of the terminal block box; in case of installation in particularly aggressive environments, seals (to be replaced if damaged) must be stuck on the terminal block box cover with suitable sealant (like LOCTITE 3020); if present and if necessary, touch-up the anti-corrosion pain with kit that can be supplied upon request.
- 14) Do not touch the motor's housing while it is running as it can reach more than 50°C.

7. INCREMENTAL ENCODER

Motors can (optionally) be supplied with standard or low-resolution incremental encoders (for further information see product catalogue).

Safety information

- 1) Wiring must always be done by fully qualified specialist personnel.
- 2) Shut off the power to all equipment/machinery involved in the wiring process.
- 3) Do not connect or disconnect the encoder when powered up as this may irrevocably damage it.
- 4) A suitable ground connection must be in place for the encoder to work properly. The cable screen must be grounded at both ends to ensure the right shielding from EMC interference.
- 5) Do not bang or knock the encoder shaft in any way.
- 6) The standard incremental encoder either comes with or without connectors. Connectors are always supplied with the low-resolution incremental encoder. Please consult the following wiring diagrams:

Standard incremental encoder

The standard incremental encoder either comes with or without connectors. If connectors are included, the male connector should already be connected to the encoder, whereas the female connector is supplied separately and it is the responsibility of the customer to connect it.



Description of terminals

PIN, 12-pin M23 Connector	Colour of wires	Signal TTL, HTL	Explanation
6	Brown	\bar{A}	Signal line
5	White	A	Signal line
1	Black	\bar{B}	Signal line
8	Pink	B	Signal line
4	Yellow	\bar{Z}	Signal line
3	Lilac	Z	Signal line
10	Blue	GND	Ground connection of the encoder
12	Red	+U _s	Supply voltage ¹⁾
9	Screen	Screen	Screen ²⁾
2	-	N. C.	
11	-	N. C.	

¹⁾ Potential free to housing

²⁾ Screen on the encoder side connected to the housing. On the control side connected to earth.

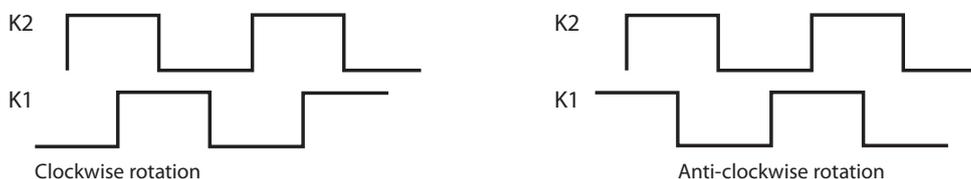
Please note: if the encoder is not supplied with a connector, refer to the colour code for the wiring.

Low-resolution incremental encoder

Connections:

BLUE	Power supply - negative (ground)
BROWN	Power supply - positive
BLACK	K1 output channel
WHITE	K2 output
SCREEN	Connect to negative (ground)

Output channels



8. FORCED VENTILATION

It may be necessary on all model sizes 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 power supply, independent from that of the electric motor, is provided via a connector applied directly on the fan cover (single phase version 230V 50-60Hz, sizes 63-90), or by means of a separate terminal block box mounted on the fan cover (single-phase 230V 50-60Hz sizes 100-132 and three-phase 400V 50-60Hz sizes 100-132).

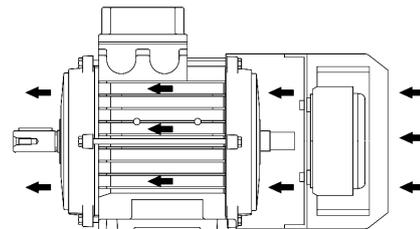
Forced ventilation has been designed as a kit; therefore it is possible to modify a standard self-ventilated electric motor (IC411) into a motor with forced ventilation (IC416) by following these simple instructions:

- 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.

The application of the forced ventilation kit will increase the length of the motor (see dimensional tables).

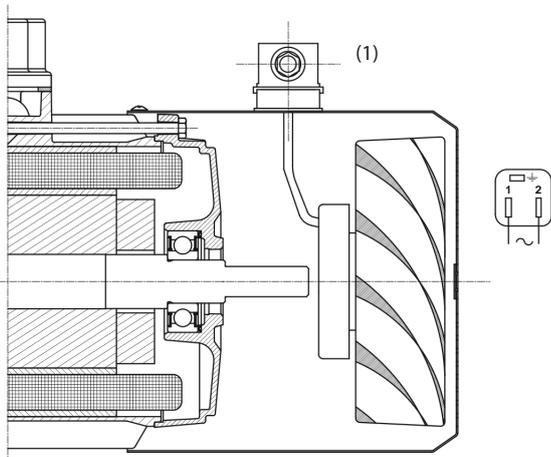
The technical specifications and power details are listed below.

motor	[V] / [Hz]	[W]	[A]
63	230V/50-60Hz	14-16	0.09-0.11
71	230V/50-60Hz	14-16	0.09-0.11
80	230V/50-60Hz	33-36	0.20-0.24
90	230V/50-60Hz	33-36	0.20-0.24
100	230V/50-60Hz	33-36	0.20-0.24
112	230V/50-60Hz	76-90	0.35-0.40
132-160	230V/50-60Hz	76-90	0.35-0.40
100	400V 50/60Hz	55/60	0.15/0.17
112	400V 50/60Hz	55/60	0.15/0.17
132-160	400V 50/60Hz	55/60	0.15/0.17

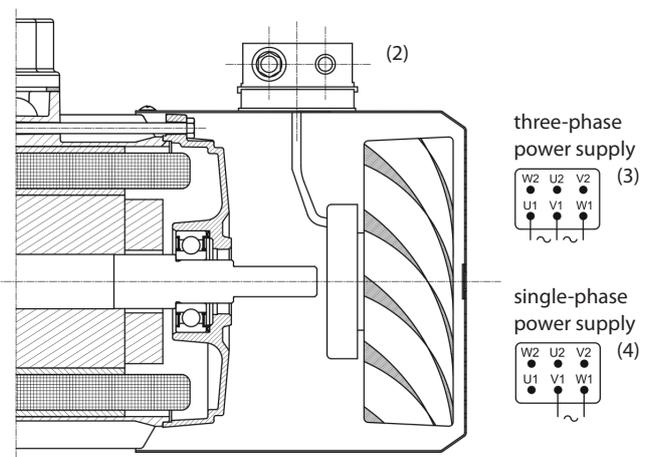


IC416

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



Single-phase and three-phase power size 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

9. ELECTRIC MOTOR PROTECTION

All electrical equipment must be protected against damage deriving from trouble or abnormal operation. The following phenomena must be taken into consideration:

- overcurrents deriving from short-circuiting;
- overload currents;
- break or dip in supply voltage;
- motor overspeed.

In addition, for the purposes of safety, there needs to be protection against direct contact with live parts and indirect contact with parts normally not live but which could become live in the event of insulation failure.

• **Overcurrents deriving from short-circuiting.** Protection can take the form of: fuses, overcurrent relays or thermal cutouts.

Fuses interrupt the electric current, while the over-current relays and thermal cutouts open the circuit via automatic switches or contactors. These protective devices must be installed upline from the conductors to be protected.

Overload and short circuit protection can take the form of: an automatic magnetothermic switch which must have sufficient interrupting capacity to interrupt the short circuit current, capable of protecting an electrical circuit from both overloads and short circuits; or switches which, although capable of protecting electrical circuits from overloads, require additional fuses to be installed further upline to prevent damage from short circuits. These must be time-delay fuses since motors draw larger than normal currents for up to several seconds while coming up to speed.

• **Overload currents.** Overload protection must feature in all motors with a power rating over 0.5kW which are normally in constant operation; however, it is recommended for all other motors as well. Protection normally takes the form of thermal cutouts installed on all live conductors except for neutral; in single-phase motors only one ungrounded live conductor is permitted.

The time constant of the protective device must be as close as possible to that of the motor; if this stringent requirement is not met, then the safety device may become inefficient or circuit interruption ill-timed. This is especially the case for intermittent motors or motors which are subjected to a high number of operational processes (start-up, stop, reversing); here it is advisable to use temperature sensors incorporated into the motor (PTC thermistors or bimetal thermal fuses) that can interrupt the current if the internal motor temperature exceeds a certain level. These devices are also recommended in reduced cooling circumstances and all other situations where the motor may overheat, but not necessarily because of an overload current.

Please bear in mind that such devices may not be sufficient to protect the motor if the rotor is locked; in this case it may be worthwhile to connect them to the thermal ones on the phases.

In general, equipment must be designed so that the motor does not automatically restart after the thermal protective device has been triggered. In certain production cycles, the sudden halting of a motor (especially if not coordinated with other motors in the cycle) may damage it; in this instance, the thermal protective devices can initially send a visual or audio warning signal to the operator, and then eventually shut down the motor if no action has been taken. The level of action to be taken and the relevant time delays must be set so as to avoid any kind of potential hazard. If the motor is powered via a converter (i.e. inverter), then it can also be protected by limiting the absorbed current; this limit is generally set at a value superior to the nominal current so that the motor can withstand predicted peak loads and have a sufficient starting torque. As a result, the motor must be connected to another device capable of intervening if overload conditions persist over a certain period of time.

• **Break or dip in supply voltage.** In situations where a dip or interruption in the supply voltage may result from faulty wiring, an undervoltage device must be in place that guarantees suitable protection (i.e. machine shut off) at a set voltage level. If machine operation can withstand a voltage interruption or dip for a short period, an undervoltage time delay device can be fitted. The operation of the undervoltage protective device must not interfere with any machine shutdown commands.

• **Motor overspeed.** Motor overspeed can occur if the converter used to power the motor is faulty, or if the brake action is insufficient or absent, causing the load to drag the shaft. Protection against this is vital in that overspeed can be hazardous. Preventive measures can be taken, such as motor speed sensors (centrifugal circuit breakers or voltage relays connected to tachymetric dynamos) which cut off the power supply to the motor, and braking devices, which are necessary where the interruption of the electric current is not enough to stop the driven load (e.g. lifting).

• **Protection against direct contact with live parts.** In order to minimise risk of direct contact with the live parts of the motor, these have been housed in the motor casing; furthermore, the terminal block box can only be opened using a special tool. The removal of the terminal block box cover for maintenance purposes must only be carried out by qualified personnel and the power supply must be visibly shut off, including auxiliary circuits (i.e. for condensation heaters), so that no accessible parts stay live.

In the case of live parts that remain energised after power has been shut off, e.g. capacitors in single-phase motors, then discharge these capacitors (with the power supply visibly shut off) before proceeding.

• **Protection against indirect contact with live parts.** Protection against indirect contact, i.e. contact due to insulation faults that bring external metal parts into contact with live parts, is mainly accomplished by connecting all the accessible parts to a protective ground conductor and by using protective devices that act by cutting off the power when, due to a fault in the winding, current flows towards earth.

The fundamental principle behind this kind of protection is, in the event of fault, to prevent a flow of voltage between an accessible part and earth or between two simultaneously accessible parts, that lasts long enough to cause serious bodily harm if such parts are touched. A distinction can be made between:

- a protective wiring system with a protective conductor grounded independently from the mains. This protection can be effected by means of an overcurrent current circuit breaker or a residual current circuit breaker;
- a protective wiring system with a neutral conductor grounded at origin and used as a protective conductor (in this case it is not possible to use the residual current protection and so overcurrent circuit breakers are necessary).

Please refer to the relevant regulations and standards.

The operation of protective devices must be both coordinated and allow for individual device selection so as to adequately protect lines and equipment. The automatic reset of protective devices after they have tripped is strictly forbidden as this can be hazardous. In addition, trained personnel must manually reset the system which the electric motor belongs to or is the main component of. When there is a neutral conductor, the installation of protective devices on the various conductors must take into account the type of connection (system) used.

10. MAINTENANCE / SPARE PARTS

When ordering spare parts, quote the type of motor, product code and serial number given on the nameplate.

Before working on the motors or in their vicinities, shut off the power supply and wait for all moving parts to come to a halt; ensure that the motor cannot restart as a result of moving parts dragging the shaft; finally, wait for the motor's surface temperature to drop below 50°C (burn hazard).

Periodic maintenance:

- inspect the motor at regular intervals;
- remove powder, dust, oil and dirt on the fan and fan cover; this helps air to circulate and keep the motor cool;
- check the condition of the seal rings and V-rings;
- check the electrical and mechanical connections and the tightening/anchor nuts and bolts.
- check the condition of the bearings, listening for strange noises or vibrations.

In the event that the motor needs to be disassembled and its internal components examined, then qualified personnel must be enlisted who use appropriate equipment and follow the relevant procedures; Motovario is in no way responsible for any damage or injury that results from the improper use of its parts by unauthorised personnel. Removing parts without the manufacturer's authorisation voids the warranty and the manufacturer is not liable for any claims resulting therefrom.

11. ASSEMBLY/DISASSEMBLY INSTRUCTIONS

1. Disassembly: free the motor from its couplings with the operating part. Take off the fan cover and fan, removing the relative fastenings. Remove the key. Unscrew and remove the screw tie bars holding the motor together. Take out the flange or front shield, extracting it from the casing and from the bearing. Extract the rotor from the support of the opposite shield, taking care not to damage the winding.

2. Replacing the bearings: extract the bearings with a special extractor. New bearings must be mounted using a press or buffer resting on the inside ring, or using the heat mounting method. Pre-lubricated shielded bearings that do not require greasing should be used for all kinds of motors.

3. Stator rewinding: to be done at qualified workshops only; this however will invalidate the Motovario guarantee.

4. Assembly: follow the disassembly instructions in reverse order. The only warning is to take care when mounting the seal rings, after cleaning their seats and turning the rings correctly with their concave surface facing outwards. On completion of maintenance and inspections, run functional and safety checks (thermal protection, brake, etc.).

12. DISPOSAL AND RECYCLING

The motor must be first of all disassembled following the indications in the previous paragraph. The packages materials can be recycled: oils, greases, detergents, solvents and paint residues must be disposed of in compliance with the prevailing laws and regulations. The materials remained after the motor disassembly (wrapped stator: copper, steel, aluminium; rotor: steel and aluminium; flanges, shields, feet and terminal block box cover: aluminium or cast iron; bearings and pinions: steel; seal rings and electronic waste: hazardous waste) must be separated and disposed of in compliance with the prevailing laws and regulations.

13. STORAGE

The motors must be stored in temperate, dry, clean conditions away from bad weather, vibrations and collisions. The shaft ends must be protected with rustproofing paint or grease (do not allow such products to come into contact with the seal rings, if present). Condensation heaters (where present) should ideally be kept energised.

14. CLAIMS

In the event of a breakdown, the entitlement to repair under warranty is granted depending on: warranty expiry date, correct handling and installation and the integrity of the manufacturer's assembly prior to the work done by authorised personnel.

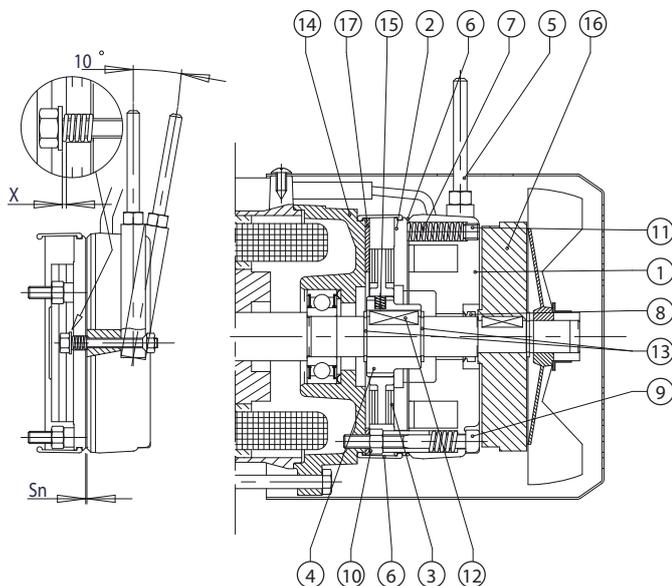
The customer is responsible for making sure that installation technicians and operators are familiar with these instructions. Please contact technical assistance for any problems or queries you may have.

15. ASSISTANCE

The warranty covers a period of 24 months from the date of purchase; such right is not granted in case of clear damages and wear, removal of non-authorised components and/or use of non-original spare parts. The customer is responsible for making sure that installation technicians and operators are familiar with these instructions.

Additional instructions valid only for brake motors (TBS, TBH, TBP, TBSX, TBHX, TBPX, DB) are detailed below.

16. "FM TYPE" DIRECT CURRENT BRAKE



1. Brake magnet
2. Moving coil
3. Brake disc
4. Driving hub
5. Manual release lever (option)
6. Protective boot + O-ring (option)
7. Thrust springs
8. V-Ring (option, combined with 6)
9. Mounting bolts
10. Locknuts
11. Braking torque adjuster screw (option)
12. Key
13. Circlip
14. Cast iron shield
15. Vibration-damping O-ring
16. Flywheel for gradual starting/braking (option)
17. Stainless steel washer (option)

Size	Type	S_n	S_{max}	X	J_B	W	W_1	t_1	t_{11}	t_2	t_{22}	m_B	P_a	Flywheel		
														M_B	m_f	J_f
63	..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
71	..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
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-90L 100	..5	0.3	0.6	1	3.5	750	45	120	50	220	15	4.9	40	13-26-40-55	2.3 3.1	54 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-160S	..7	0.4	0.8	1.2	22.5	1650	132	-	100	200	20	12.3	65	50-100-150	6.9	350

- S_n = nominal gap [mm]
- S_{max} = maximum airgap [mm]
- X = release lever play [mm]
- J_B = brake disc moment of inertia [kgcm²]
- W = maximum energy which can be dissipated by brake [MJ]
- W_1 = energy dissipated between two successive adjustments of the gap from S_n to S_{max} [MJ]
- t_1 = brake release time with rectifier with normal release (NBR, RSD) [ms]
- t_{11} = brake release time with rectifier with fast release (SBR, RRS) [ms]
- t_2 = brake response time with AC side opening [ms]
- t_{22} = brake response time with DC side opening [ms]
- m_B = weight [kg]
- P_a = power absorption [VA]
- M_B = available brake torques [Nm]
- m_f = flywheel weight [kg]
- J_f = flywheel moment of inertia [kgcm²]

Adjustment and maintenance

The braking moment is fixed and is indicated on the motor nameplate.

Adjusting the gap

For correct brake operation, the gap between the brake magnet and the moving coil must be in the range ($S_n - S_{max}$) shown in the table; it can be adjusted with the mounting bolts and the locknuts, with a feeler gauge to check the actual gap.

Release lever play adjustment (if present)

When there is a manual release lever, adjust the free travel value X of the lever (tightening/loosening the nuts) to a level equal to or greater than the one indicated in the table before releasing.

Maintenance

The scheduled maintenance interval will depend on actual braking duty and the work done by the brake between successive adjustments W_1 . When running maintenance, check that the thickness of the friction member is no less than 1 mm (in this case replace the brake disc), adjust the gap, check the braking torque, and check any play due to excessive wear during operation.

PLEASE NOTE: the effective values may be affected by the ambient temperature and humidity, the brake temperature and the wear of the friction members; the maintenance intervals refer to the brake adjusted to a medium gap setting, nominal voltage and separate power supply; as regards the braking torque, allow for a running in period in which the brake lining adapts to the engine shield braking surface, the duration of which (number of cycles) will depend on the actual braking load. Once the brake has been run in, in nominal operating conditions a deviation from the declared value of $\pm 10\%$ is always acceptable.

Connecting up the FM brake

If the brake is powered directly by the motor itself, this is called **direct** power supply, if it is powered separately, it is called **separate** power supply. What follows is a more detailed explanation, which makes reference to the diagrams at the foot of the page.

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, by 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.

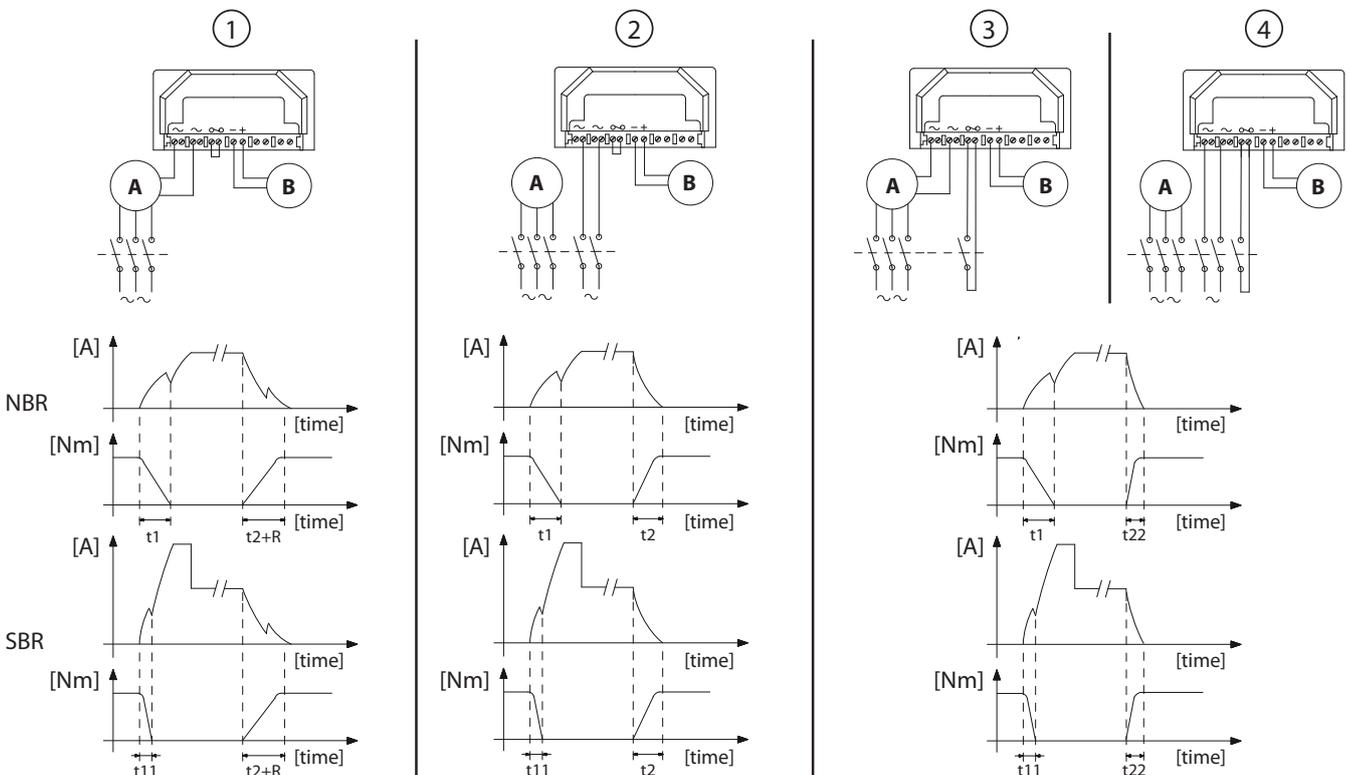
3. Direct brake power, DC side opens: connection possible on the basis of type 1, if one can cable the rectifier's rapid braking contact (DC side opening) as shown in figure 3. Despite the direct power supply (see point 1), the braking response time is independent of the characteristics of the motor 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 starting from type 2, if the rectifier's rapid braking contact (DC side power off) can be hooked up as shown in diagram 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 brake operation the energy stored by the motor does not have to be absorbed by the rectifier, thus giving it a longer service life.

Motovario supplies brakes hooked up as shown in types 1 and 2 specify as "direct or "separate" brake power respectively in the order. Type 3 and 4 connections must be implemented by the client.

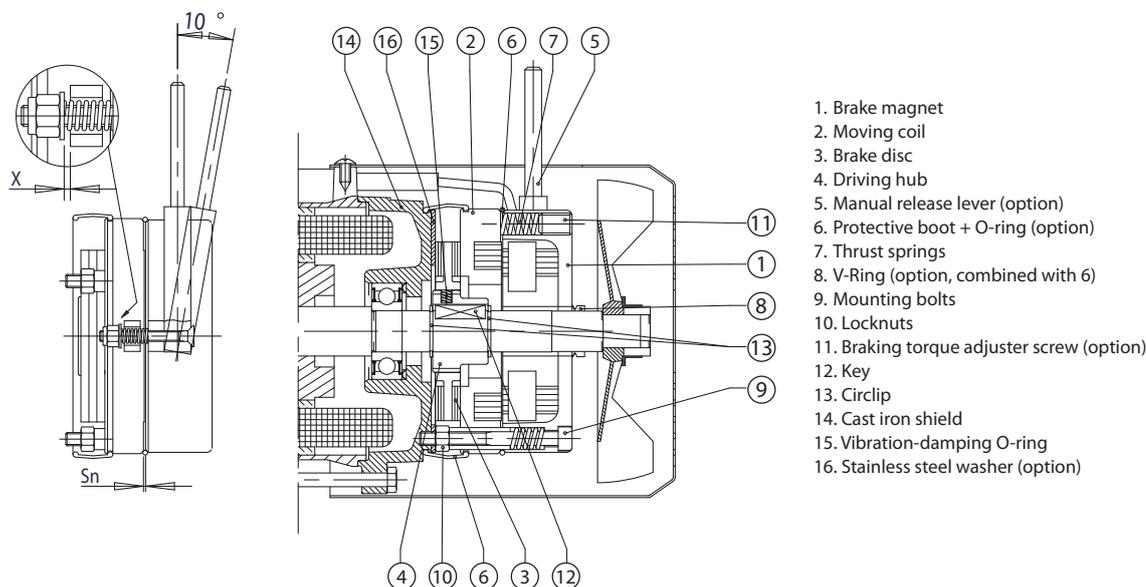
If SBR rapid release rectifiers are used, the brake release time reduces from t_1 to t_{11} (see graphs below).

In the event of independent power supply of the brake from a direct current power source, and thus minus rectifier (ex. 24Vdc), the supply cables of the brake are set inside the terminal block box and connected to a strip connector-type flying terminal block. In this instance, refer to case 4 for the response times (power source excluded).



A = Motor B = Brake

17. "MS TYPE" ALTERNATING CURRENT BRAKE



- 1. Brake magnet
- 2. Moving coil
- 3. Brake disc
- 4. Driving hub
- 5. Manual release lever (option)
- 6. Protective boot + O-ring (option)
- 7. Thrust springs
- 8. V-Ring (option, combined with 6)
- 9. Mounting bolts
- 10. Locknuts
- 11. Braking torque adjuster screw (option)
- 12. Key
- 13. Circlip
- 14. Cast iron shield
- 15. Vibration-damping O-ring
- 16. Stainless steel washer (option)

Size	Type	S_n	S_{max}	X	J_B	W	W_1	t_1	t_2	m_B	P_a	M_B
63	..2	0.2	0.5	0.6	0.6	260	15.6	4	20	1.3	60	1.8-3.5
71	..3	0.2	0.5	0.8	1.1	370	22.4	4	40	1.9	80	2.5-5-7.5-10
80	..4	0.3	0.6	1	1.6	500	30	6	60	3	110	5-10-15-20
90S-90L-100	..5	0.3	0.6	1	3.5	750	45	8	90	5.6	250	13-26-40
112	..6S	0.35	0.7	1.2	8.8	1000	70	16	120	9.7	470	40-60
132S	..6	0.35	0.7	1.2	10.3	1100	77	16	140	10.3	550	50-75-100
132M-160S	..7	0.4	0.8	1.2	22.5	1650	132	16	180	14.7	600	50-100-150

- S_n = nominal gap [mm]
- S_{max} = maximum airgap [mm]
- X = release lever play [mm]
- J_B = brake disc moment of inertia [kgcm²]
- W = maximum energy which can be dissipated by brake [MJ]
- W_1 = energy dissipated between two successive adjustments of the gap from S_n to S_{max} [MJ]
- t_1 = brake release time with rectifier with normal release (NBR, RSD) [ms]
- t_2 = brake response time with AC side opening [ms]
- m_B = weight [kg]
- P_a = power absorption [VA]
- M_B = available brake torques [Nm]

Adjustment and maintenance

The braking moment is fixed and is indicated on the motor nameplate.

Adjusting the gap

For correct brake operation, the gap between the brake magnet and the moving coil must be in the range ($S_n - S_{max}$) shown in the table; it can be adjusted with the mounting bolts and the locknuts, with a feeler gauge to check the actual gap.

Release lever play adjustment (if present)

When there is a manual release lever, adjust the free travel value X of the lever (tightening/loosening the nuts) to a level equal to or greater than the one indicated in the table before releasing.

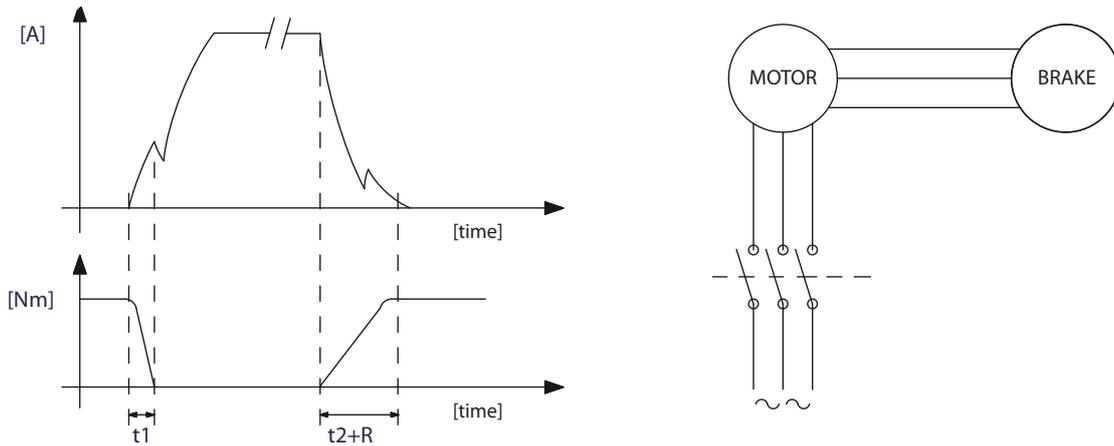
Maintenance

The scheduled maintenance interval will depend on actual braking duty and the work done by the brake between successive adjustments W_1 . When running maintenance, check that the thickness of the friction member is no less than 1 mm (in this case replace the brake disk), adjust the gap, check the braking torque, and check any play due to excessive wear during operation.

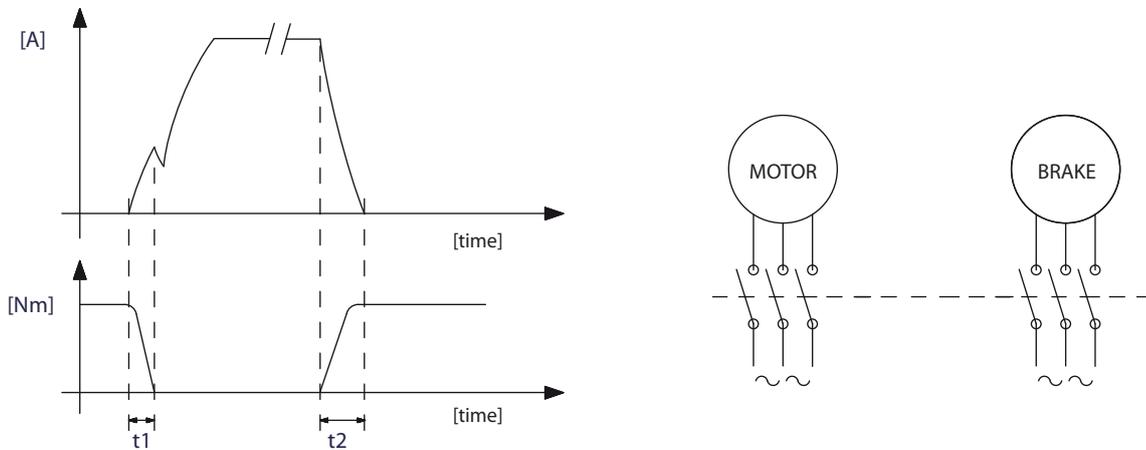
PLEASE NOTE: the effective values may be affected by the ambient temperature and humidity, the brake temperature and the wear of the friction members; the maintenance intervals refer to the brake adjusted to a medium gap setting, nominal voltage and separate power supply; as regards the braking torque, allow for a running in period in which the brake lining adapts to the engine shield braking surface, the duration of which (number of cycles) will depend on the actual braking load. Once the brake has been run in, in nominal operating conditions a deviation from the declared value of $\pm 10\%$ is always acceptable.

Connecting up the MS brake

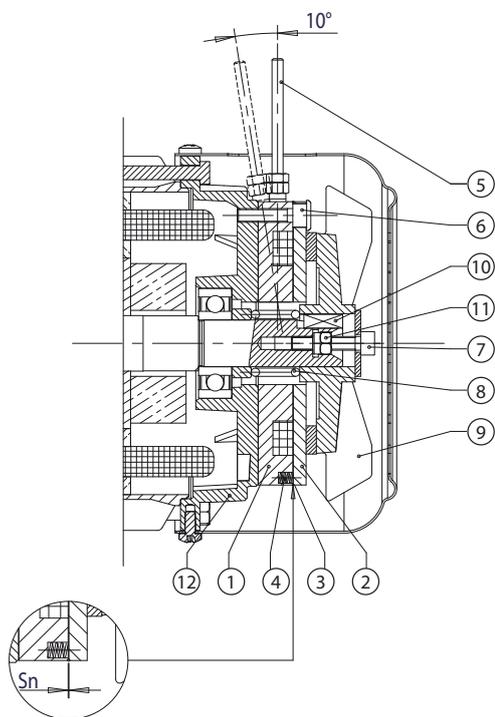
1. Direct brake power: the brake is powered directly off the motor's terminal block; when the motor is powered up, the brake coil is automatically energised and the brake is released; when power to the motor is shut off, the brake coil is automatically de-energised and the brake brakes the motor. During this phase, the 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: 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.



18. "ML TYPE" DIRECT CURRENT BRAKE



1. Brake magnet
2. Moving coil
3. O-Ring
4. Thrust springs
5. Manual release lever
6. Mounting bolts
7. Studbolt
8. Return spring
9. Cast iron fan
10. Key
11. Gap adjuster locknut
12. Motor shield

Size	Type	S_n	S_{max}	X	J_B	W	W_1	t_1	t_{11}	t_2	t_{22}	m_B	P_a	M_B
63	..2	0.2	0.5	0.6	0.6	260	15.6	30	20	100	10	1.5	16	1.8-3.5
71	..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
80	..4	0.3	0.6	1	1.6	500	30	100	40	150	10	3.1	30	5-10-15-20
90S-90L 100	..5	0.3	0.6	1	3.5	750	45	120	50	220	15	4.9	40	13-26-40-55
112	..6S	0.35	0.7	1.2	8.8	1000	70	-	80	300	30	8.3	50	20-40-60
132S	..6	0.35	0.7	1.2	10.3	1100	77	-	80	200	20	9.5	65	37-50-75-100
132M-160S	..7	0.4	0.8	1.2	22.5	1650	132	-	100	200	20	12.3	65	50-100-150

- S_n = nominal gap [mm]
- S_{max} = maximum airgap [mm]
- J_B = brake disc moment of inertia [kgcm²]
- 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 [ms]
- t_2 = brake response time with AC side power shutdown [ms]
- t_{22} = brake response time DC side [ms]
- m_B = weight [kg]
- P_a = power absorption [W]
- M_B = braking moment [Nm]

Adjustment and maintenance

The braking moment is given by the value M_B in the table and on the motor nameplate.

Adjusting the gap

For correct brake operation, the gap between the brake magnet and the moving coil must be in the range ($S_n - S_{max}$) shown in the table; it can be adjusted with the shaft head locknut, with a feeler gauge to check the actual gap.

Maintenance

The scheduled maintenance interval will depend on actual braking duty and the work done by the brake between successive adjustments W_1 . When running maintenance, check that the thickness of the friction member is no less than 1mm, adjust the gap, check the braking torque, and check any play due to excessive wear during operation (in particular the play between the fan hole and the motor shaft).

PLEASE NOTE: the effective values may be affected by the ambient temperature and humidity, the brake temperature and the wear of the friction members; the maintenance intervals refer to the brake adjusted to a medium gap setting, nominal voltage and separate power supply; as regards the braking torque, allow for a running in period in which the brake lining adapts to the engine shield braking surface, the duration of which (number of cycles) will depend on the actual braking load. Once the brake has been run in, in nominal operating conditions a deviation from the declared value of $\pm 10\%$ is always acceptable.

Connecting up the ML brake

If the brake is powered directly by the motor itself, this is called **direct** power supply, if it is powered separately, it is called **separate** power supply. What follows is a more detailed explanation, which makes reference to the diagrams at the foot of the page.

1. Direct power supply: the rectifier AC side power cables are connected to the motor terminal board; when the motor is powered up, the brake coil is automatically energised and the brake releases; when power to the motor is shut off, the brake coil automatically de-energises and the brake 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, by separate terminals from those of the motor. In this case stop time t_2 does not depend on the characteristics of both the motor and load.

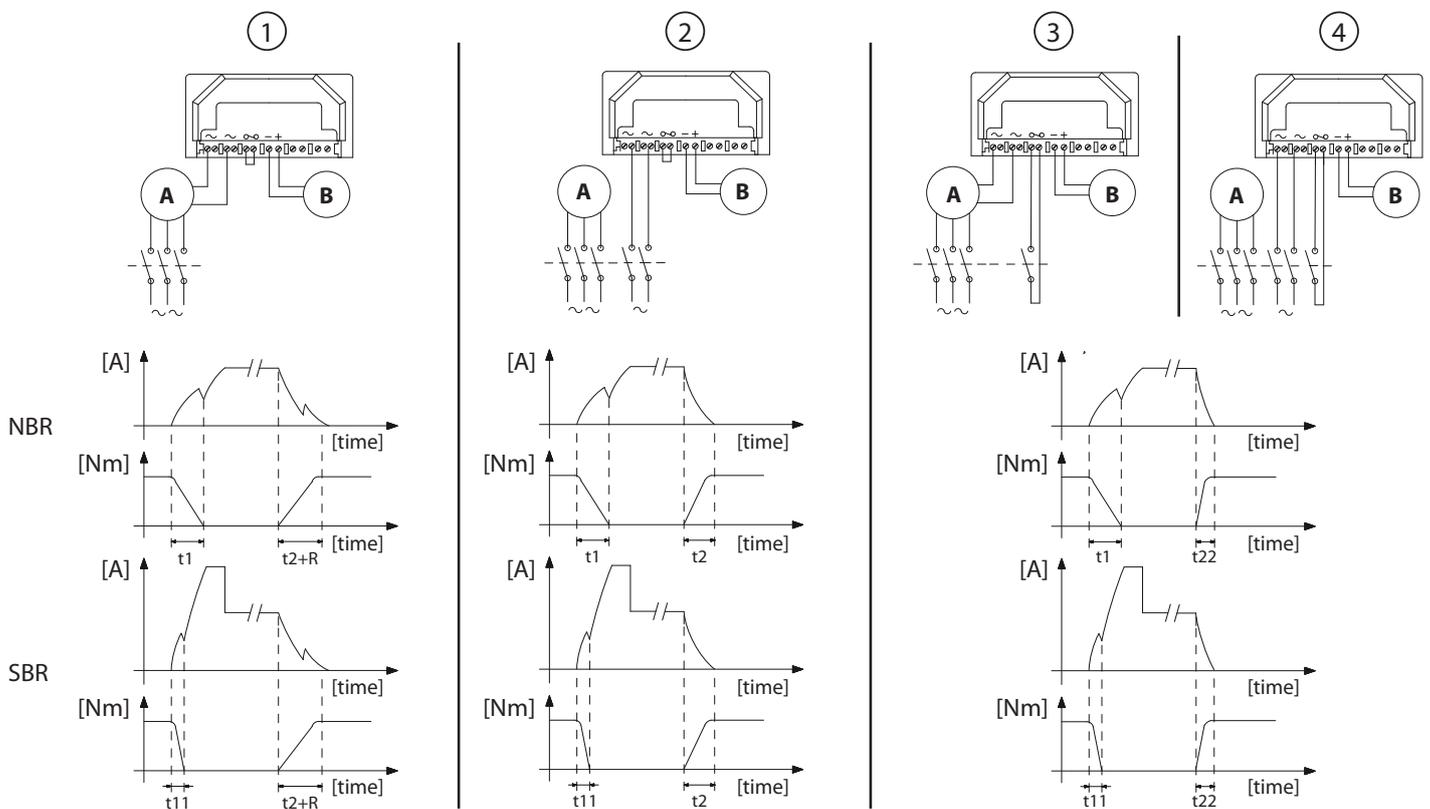
3. Direct brake power, DC side opens: connection possible on the basis of point 1, if one can cable the rectifier's rapid braking contact (DC side opening) as shown in figure 3. Despite the direct power supply (see point 1), the braking response time is independent of the characteristics of the motor 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 brake operation the energy stored by the motor does not have to be absorbed by the rectifier, thus giving it a longer service life.

Motovario supplies brakes hooked up as shown in types 1 and 2 specify as "direct or "separate" brake power respectively in the order. 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 graphs below).

In the event of independent power supply of the brake from a direct current power source, and thus minus rectifier (ex. 24Vdc), the supply cables of the brake are set inside the terminal block box and connected to a strip connector-type flying terminal block. In this instance, refer to case 4 for the response times (power source excluded).

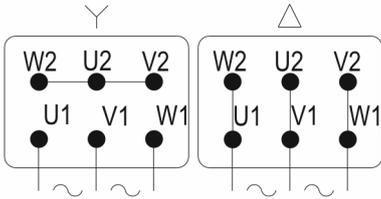


A = Motor B = Brake

19. MOTOR POWER SUPPLY WIRING DIAGRAM

TS-TH-TP-TSX-THX-TPX series with 6 terminals

MOTOR - TS/TH
Wiring diagram



max tightening torque

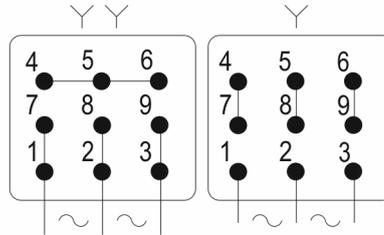
M4 = 2Nm
M5 = 3Nm
M6 = 4Nm

TO POWER

Cod. 07492T1

TS-TH-TP-TSX-THX-TPX series with 9 terminals

MOTOR - TS/TH
Wiring diagram



max tightening torque

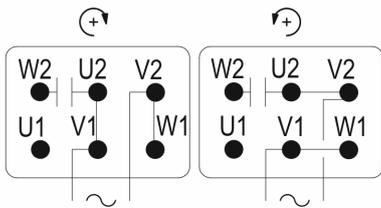
M4 = 2Nm
M5 = 3Nm
M6 = 4Nm

TO POWER

Cod. 07492T3

Standard S series

MOTOR - S
Wiring diagram



max tightening torque

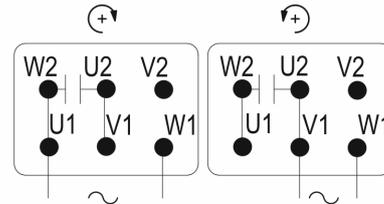
M4 = 2Nm
M5 = 3Nm
M6 = 4Nm

TO POWER

Cod. 07492S1

S series with balanced winding

MOTOR - S (balanced winding)
Wiring diagram



max tightening torque

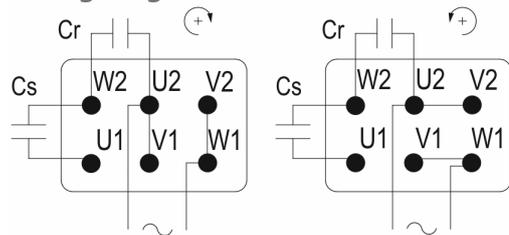
M4 = 2Nm
M5 = 3Nm
M6 = 4Nm

TO POWER

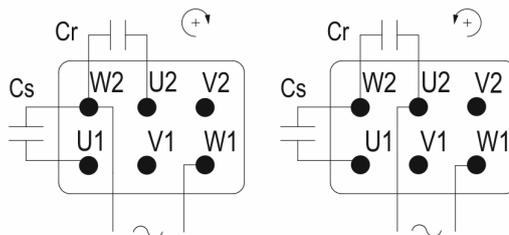
Cod. 07492S2

Standard HSE series

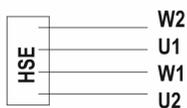
MOTOR - HSE
Wiring diagram



standard winding



balanced winding

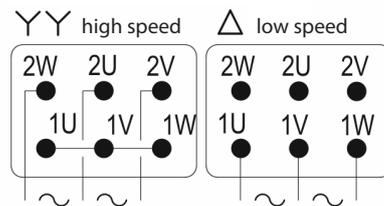


TO POWER

Cod. 2513041

D series (2/4 and 4/8 poles)

MOTOR - D
Wiring diagram



max tightening torque

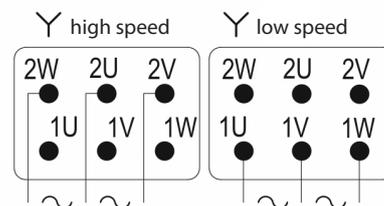
M4 = 2Nm
M5 = 3Nm
M6 = 4Nm

TO POWER

Cod. 07492D1

D series (2/8 poles)

MOTOR - D
Wiring diagram



max tightening torque

M4 = 2Nm
M5 = 3Nm
M6 = 4Nm

TO POWER

Cod. 07492D2

