MS4000

Model C

Submersible motors

50/60 Hz



GRUNDFOS

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1. Product description

The Grundfos MS4000 product range is a complete range of submersible motors available in 50 Hz and 60 Hz versions from 0.37 kW up to 7.5 kW.

The entire motor surface is made of stainless steel, so that all external components have a uniform corrosion resistance. Two material versions are available:

- a standard version made of stainless steel EN 1.4301 (AISI 304).
- an R-version made of stainless steel EN 1.4539 (AISI 904L) for aggressive liquids such as mine- and seawater.

The Grundfos MS4000 submersible motors are designed according to market standards. All Grundfos MS4000 motors are designed to fit pump ends manufactured according to NEMA standards, therefore, they can be fitted on all Grundfos SP pumps without adapters.

General characteristics of the MS4000 motor:

- 4" diameter (OD = 95 mm)
- 2-pole asynchronous motor
- hermetically sealed, canned motor with dry stator
- stator completely encapsulated in stainless steel
- cooled by pumped liquid
- hydrodynamic bearings lubricated by the motor liquid
- high efficiency
- operating media temperature up to 60 °C
- enclosure class IP68
- insulation class 150 °C (F)
- NEMA flange and shaft spline
- CE or cCSAus-approved options
- reliable cable plug system with robust and safe earth connection
- factory filled with Grundfos motor liquid SML-3, alternatively filled with demineralized water or high glycol content motor liquid (60 % HTF)
- built-in temperature transmitter (Tempcon) available on request for all motor variants
- motor temperature monitoring via a Pt1000 sensor is available as an option (used for frequency controlled installations).



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MS4000 motors without cable



TM087041

MS4000 motors with cable

Features and benefits

The Grundfos MS4000 submersible motor offers the following features and benefits:

- high motor efficiency
- sealing system
- high reliability
- super stainless steel versions
- worldwide usage
- highly reliable thrust bearing
- monitoring of motor temperature
- additional monitoring of motor temperature.

High motor efficiency

The complete motor range is characterized by high efficiency which contributes to improved economy of the entire pump system.

Sealing system

All motors are equipped with mechanical shaft seals.

High reliability

The shaft seal design and material choices offer wear resistance and long operating life.

Super stainless steel version

Super stainless steel version EN 1.4539 (AISI 904 L) with silicon carbide based (SiC/SiC) mechanical shaft sealing system and FKM elastomer parts are used for applications in seawater and slightly contaminated environment that might contain hydrocarbons.

Worldwide usage

With different voltage and frequency combinations, the product range covers markets worldwide.

Highly reliable thrust bearing

Fitted with a sturdy Michell/Kingsbury thrust bearing, the motors offer high and reliable operation.

Monitoring of motor temperature

To achieve maximum protection of the motor against burnout, the motors are also available with a built-in Tempcon temperature sensor with power line communication. In combination with motor protection (MP204), the Tempcon sensor offers optimal protection for the motor. Tempcon is not suitable for frequency converter operation.

Additional monitoring of motor temperature

The MS4000 motors also allow for installing a Pt1000 sensor to monitor the temperature.

This solution is suitable for frequency converter operation.

Applications

Grundfos submersible motors are designed for a wide range of applications, for example, the following:

- deep well water supply
- irrigation
- groundwater regulation
- pressure boosting
- industrial water transfer and similar applications
- fountains
- dewatering.

Application variants

The MS4000 asynchronous motor is available in a wide range of variants for different applications.

MS4000**AZBCW____**

It is for operation in water without any appreciative content of chloride: EN 1.4301 material, elastomers in NBR and HM/Ceramic shaft seal.

The motor contains NBR elastomers, therefore it is approved for drinking water.

MS4000**AZBSW____**

It is for operation in water with abrasive particles but without appreciable chloride content: EN 1.4301 material, elastomers in NBR and Sic/Sic shaft seal.

The motor contains NBR elastomers, therefore it is approved for drinking water.

MS4000**AZECW____**

It is for operation in neutral liquids with hydrocarbon content and dissolved gasses: EN 1.4301 material, elastomers in FKM and HM/Ceramic shaft seal.

MS4000**AZESW____**

It is for operation in neutral liquids with hydrocarbon content, dissolved gasses and abrasive particles: EN 1.4301 material, elastomers in FKM and Sic/Sic shaft seal.

MS4000**ARBSW____**

It is for operation in water with chloride content (salty water) and abrasive particles: EN 1.4539 material (R version), elastomers in NBR and Sic/Sic shaft seal.

MS4000**ARESW____**

It is for operation in aggressive liquids: EN 1.4539 material (R version), elastomers in FKM, and Sic/Sic shaft seal.

MS4000**____D___**

It is for applications that do not allow the risk of contamination with SML-3 motor liquid based on glycol (e.g. chip manufacturing or RO plants): factory-filled with demineralized water.

MS4000**_____J__,** MS4000**_____X__**

The variants can be ordered with (J) or without (X) the built-in temperature sensor (Tempcon).

MS4000**_____T4**

It is for operation in liquids up to 40 °C.

MS4000**_____T6**

It is for operation in liquids up to 60 °C.

2. Identification

Type key

The type key cannot be used for ordering as not all combinations are possible.

Example	MS4000 A	R	E	S	W	D	M	X	T4	3 × 380-415/50	7.5 kW
Pos.	1	2	3	4	5	6	7	8	9	10	11

Pos.	Description		
1	Motor type		
	MS4000A	=	MS4000 asynchronous motor
2	Material version		
	Z	=	EN 1.4301
	R	=	EN 1.4539
3	Elastomers		
	B	=	NBR
	E	=	FKM
4	Shaft seal		
	C	=	Hard metal/Ceramic
	S	=	SiC/SiC
5	Bearing system		
	W	=	Ceramic
6	Motor liquid		
	L	=	SML-3
	D	=	Demineralised water
	H	=	High glycol (60 % HTF)
7	Thread		
	U	=	UNF 5/16"
	M	=	M8
8	Tempcon		
	J	=	With
	X	=	Without
9	Temperature version (Max. pumped liquid temperature)		
	T4	=	40 °C at min. 0.15 m/s
	T6	=	60 °C at min. 1.0 m/s

	Key	Config. code	Key	Config. code	Key	Config. code	Key	Config. code	Key	Config. code
Available configurations	ZBCWLMXT4	25	ZBSWLMXT4	23	ZESWLMXT4	21	RBSWLMXT4	27	RESWLMXT4	29
	ZBCWLUXT4	25	ZBSWLUXT4	23	ZESWLUXT4	21	RBSWLUXT4	27	RESWLUXT4	29
	ZBCWLMJT4	35	ZBSWLMJT4	33	ZESWLMJT4	31	RBSWLMJT4	37	RESWLMJT4	39
	ZBCWLUJT4	35	ZBSWLUJT4	33	ZESWLUJT4	31	RBSWLUJT4	37	RESWLUJT4	39
	ZBCWLMXT6	45	ZBSWLMXT6	43	ZESWLMXT6	41	RBSWLMXT6	47	RESWLMXT6	49
	ZBCWLUXT6	45	ZBSWLUXT6	43	ZESWLUXT6	41	RBSWLUXT6	47	RESWLUXT6	49
	ZBCWLMJT6	55	ZBSWLMJT6	53	ZESWLMJT6	51	RBSWLMJT6	57	RESWLMJT6	59
	ZBCWLUJT6	55	ZBSWLUJT6	53	ZESWLUJT6	51	RBSWLUJT6	57	RESWLUJT6	59
	ZBCWDMXT4	65	ZBSWDMXT4	63	ZESWDMXT4	61	RBSWDMXT4	67	RESWDMXT4	69
	ZBCWDUXT4	65	ZBSWDUXT4	63	ZESWDUXT4	61	RBSWDUXT4	67	RESWDUXT4	69
	ZBCWDMJT4	75	ZBSWDMJT4	73	ZESWDMJT4	71	RBSWDMJT4	77	RESWDMJT4	79
	ZBCWDUJT4	75	ZBSWDUJT4	73	ZESWDUJT4	71	RBSWDUJT4	77	RESWDUJT4	79
	ZBCWDMJT6	85	ZBSWDMJT6	83	ZESWDMJT6	81	RBSWDMJT6	87	RESWDMJT6	89
	ZBCWDUJT6	85	ZBSWDUJT6	83	ZESWDUJT6	81	RBSWDUJT6	87	RESWDUJT6	89

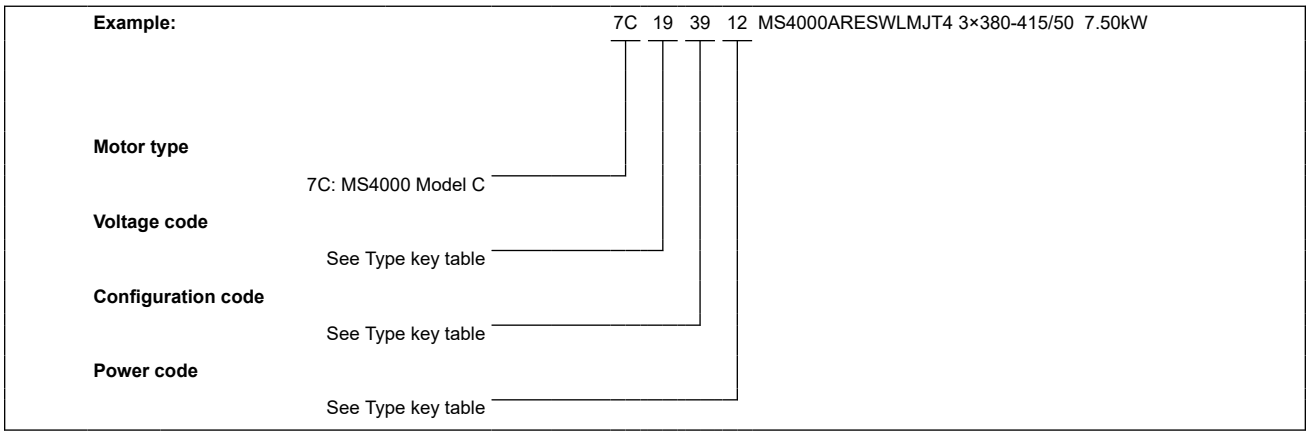
Pos.									
10	Voltage								
			50 Hz	60 Hz	Method of starting [1]	Thread	Region	Approval	Voltage code
	1×220/50 PSC	=	220-240	-	3-wire PSC	M8	Global	CE	75
	1×240/50 PSC	=	240	-	3-wire PSC	M8	Global	CE	25
	1×220-230/50 CSCR	=	220-230	-	3-wire CSCR	M8	Global	CE	21
	1×240/50 CSCR	=	240	-	3-wire CSCR	M8	Global	CE	24
	1×230/60 CSCR	=	-	230	3-wire CSCR	UNF 5/16	US	cCSAus	45
	3×220-230/50	=	220-230	-	DOL	M8	Global	CE	10
	3×380/50 440/60	=	340-360-380	440	DOL	M8	Global	CE	08
	3×380-415/50	=	380-400-415	440-460-480	DOL	M8	Global	CE	19
	3×440-460/50	=	440-460	-	DOL	M8	Global	CE	17
	3×500-525/50	=	500-525	-	DOL	M8	Global	CE	18
	3×208-230/60	=	-	208-220-230	DOL	M8	Global	CE	28
	3×380-415/60	=	-	380-400-415	DOL	M8	Global	CE	33
	3×208/60	=	-	208	DOL	UNF 5/16	US	cCSAus	32
	3×208-230/60	=	-	208-220-230	DOL	UNF 5/16	US	cCSAus	30
	3×230/60	=	-	230	DOL	UNF 5/16	US	cCSAus	31
	3×440-460/60	=	-	440-460	DOL	UNF 5/16	US	cCSAus	35
	3×575/60	=	-	575	DOL	UNF 5/16	US	cCSAus	39
	3×200/50 220/60	=	200	200-220	DOL	M8	Japan	CE	09
	3×400/50 440/60	=	400	400-440	DOL	M8	Japan	CE	65

11 Motor power				
kW	hp	Service factor (60 Hz)		Power code
		Global/US	Japan	
0.37	0.50	1.60	-	02
0.55	0.75	1.50	-	03
0.75	1.00	1.40	1.00	04
1.10	1.50	1.30	1.00	05
1.50	2.00	1.25	1.00	06
1.90	2.50	-	1.00	95
2.20	3.00	1.15	1.00	07
2.70	3.60	-	1.00	96
3.00	4.00	1.15	1.00	08
3.70	5.00	1.15	1.00	09
4.00	5.50	1.15	1.00	10
5.50	7.50	1.15	1.00	11
7.50	10.00	1.15	1.00	12

[1] Method of starting:

- DOL: Direct on line
- CSCR: Capacitor-Start Capacitor-Run induction motor, requires a Grundfos CSCR motor starter box
- PSC: Permanent Split Capacitor motor, requires a run capacitor.

Talkative part number



3. Installation and operating conditions

Pumped liquids

The MS4000 motors are produced with different materials to enable their use in various liquids.

- The standard material version (EN 1.4301/ss 316) is intended for use in freshwater without any appreciative chloride content. The R material version (EN 1.4539/ss 904L) is recommended for use in water with chloride content (for example, seawater) or in aggressive liquids (for example, mine applications).
- Elastomers made of NBR for drinking water applications, while FKM elastomers are intended for operation in neutral liquids with hydrocarbon content and dissolved gasses.
- Shaft seal with HM/ceramic faces is for use in water without abrasive particles. In water with abrasive particles, such as sand, or aggressive liquids, the Sic/Sic shaft seal is recommended.

The motors are designed for use in applications with a maximum permissible abrasive content of 200 ppm in the pumped liquid.

For special applications, make an analysis of the liquid and contact Grundfos.

Chloride containing water

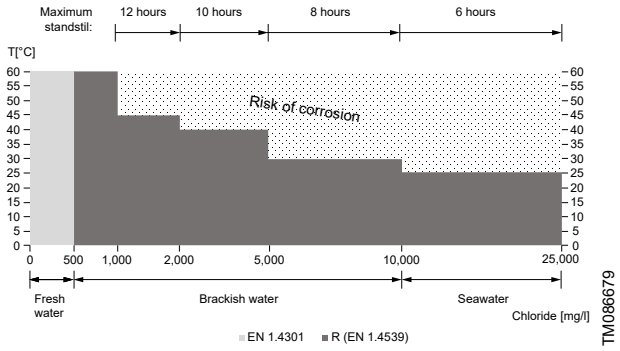
When immersed in chloride-containing water, stainless steel can be damaged by crevice or pitting corrosion.

The likelihood of corrosion depends on the following factors:

- material version (standard, R)
- chloride concentration in the water
- temperature
- oxygen concentration
- presence of biological activity
- velocity of the water around the motor
- pH value
- presence of disinfectant, such as chlorine, sulphuric acid (for example, in mining applications) and chemicals.

The increase in chloride concentration and/or temperature is unfavorable to stainless steel. Additionally, standstill time and biological activity increase the risk of corrosion. At chloride concentrations above 1000 mg/l, longer standstill periods must be avoided. All these factors must be considered when selecting the right material version and assessing the cathodic protection requirement.

The following diagram shows the allowable ranges of each material version for water with pH above 6.5.



Corrosion resistance diagram at pH above 6.5

Pos.	Description
T [°C]	Pumped water temperature in °C
Chloride [mg/l]	Chloride concentration in mg/l

Cathodic protection must be used when there is a risk of corrosion, that is, in standstill periods or temperatures higher than those allowed in the table above. Grundfos offers sacrificial zinc anodes to bring cathodic protection, see section Accessories. Cathodic protection is not recommended in liquids with a pH value lower than 6 or above 9.

If aggressive liquids are pumped, a flow sleeve may be required to ensure sufficient cooling (flow and temperature) around the motor since corrosion is doubled for every 10 °C rise in temperature.

To splice motor cables and drop cables, use the type KM cable termination kits in seawater applications.

Ambient pressure

The motor alone or assembled with EPR jacketed or XLPE single leads motor cables, maximum 60 bar ~ 6.0 MPa.

Motors assembled with PTFE jacketed motor cables, maximum 20 bar ~ 2.0 MPa.

It is not recommended to use the motor for operation in a vacuum.

Cooling

The cooling of the motor depends on the temperature and the flow velocity of the pumped liquid past the motor. It is important that the values for maximum temperature of the pumped liquid and its minimum velocity past the motor are fulfilled to ensure sufficient cooling of the motor. See the table below.

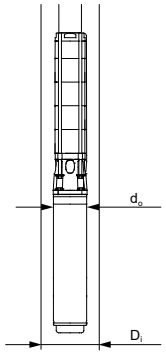
Motor	Pumped liquid past the motor	
	Minimum flow velocity	Maximum temperature
MS4000 (T4 versions)	0.15 m/s (0.5 ft/s)	40 °C (~ 104 °F)
MS4000 (T6 versions)	1.00 m/s (3.3 ft/s)	60 °C (~ 140 °F)

Calculation of the flow velocity

$$V = \frac{Q \times 353}{D_i^2 - d_o^2} \left[m/s \right]$$

Legends

v	=	flow velocity past the motor [m/s]
Q	=	pump rated flow [m^3/h]
D_i	=	internal borehole diameter [mm]
d_o	=	outer motor diameter [mm].



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Diameter of motor and borehole

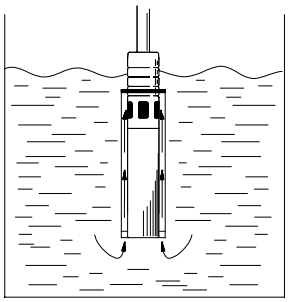
Flow sleeve

Flow sleeves are recommended for all applications in which motor cooling is insufficient. The flow sleeve is fitted to the submersible motor so that the liquid passes close by the motor on its way toward the pump suction interconnector, ensuring the optimum cooling of the motor. The result is a general extension of motor life.

Flow sleeves are necessary to ensure sufficient cooling in the following cases:

- The velocity of the flow passing the motor is not achieved due to the difference between the borehole and motor diameters.
- The pumped liquid does not flow through the entire motor length, for instance, when the pump is located under the well screens (top feeding).
- Sedimentation, deposits, or biological growth could occur around or on the motor.
- The submersible pump is exposed to high thermal load due to the high temperature of the pumped liquid or bad cooling conditions.
- The submersible pump is installed horizontally.

Grundfos offers a complete range of stainless steel flow sleeves for both vertical and horizontal operation. The selection depends on the combined SP pump and motor assembly. Review the *SP Accessories Data Booklet* available at the *Grundfos Product Center* for more information.



TM010509

Flow sleeve function

Related information

Motor cooling

Temperature monitoring

Monitoring the motor temperature to detect and correct changes over time, for example, due to improper cooling, prevents motor life reduction. Deviations from the temperature under normal operation conditions could indicate changes in operation conditions or motor abnormalities that must be addressed to avoid failures.

Temperature sensors

The MS4000 can be ordered with a built-in temperature transmitter (Tempcon) to enable monitoring of the motor temperature. The Tempcon transmits the motor temperature as a high-frequency signal through the motor power cables, and requires connection to an MP204 device for signal reading and monitoring. The Tempcon is not able to monitor the temperature with a frequency converter. The frequency converter signal will cause a fuse in the Tempcon to melt, and the fuse cannot be replaced.

Additionally, all MS4000 motors can be fitted with a Pt1000 temperature sensor. The Pt1000 can be connected to a PR 5714 relay, MP204 motor protector, frequency converter, or another device prepared for the Pt1000 reading and temperature monitoring.

Sensor cables

Grundfos offers the Pt1000 with sensor cable up to 100 meters. For longer cables, it is recommended to splice a 20 meter Pt1000 to the required drop sensor cable length. The maximum recommended total length is 350 m.

Temperature limits

To set the warning and alarm (trip) limits, add 5 °C and 10 °C to the stable temperature of the motor during normal operation at maximum load (highest current demand).

Related information

Protection

Frequency converter operation

Pt1000

Thrust

The thrust load capacity is related to the motor configuration and size.

Motor type		Motor power		
Phase	Temperature version	[kW (hp)]		Thrust
		Min.	Max.	
Single phase	T4	0.37 (0.50)	3.70 (5.00)	4400
Three phase	T4	0.75 (1.00)	1.50 (2.00)	2200
		1.90 (2.50)	7.50 (10.00)	4400
	T6	0.55 (0.75)	1.50 (2.00)	2200
		1.90 (2.50)	5.50 (7.50)	4400

Output power

The rated power (P2), service factor (SF), and SF current (Max. SF C.) are stamped on the nameplate for a respective supply (rated voltage and frequency). The SF power is the maximum power output, and equals the rated power times the SF.

The Grundfos submersible motors are designed to run continuously (S1 Duty) at SF current with SF power as long as the voltage quality and cooling requirements are met.

Frequency of starts and stops

The MS4000 is designed for continuous as well as intermittent operation.

The maximum number of starts in the following table applies only to the motor and may be limited by the pump design and the drive system.

If the motor is stored, the shaft must be rotated manually at least once a year.

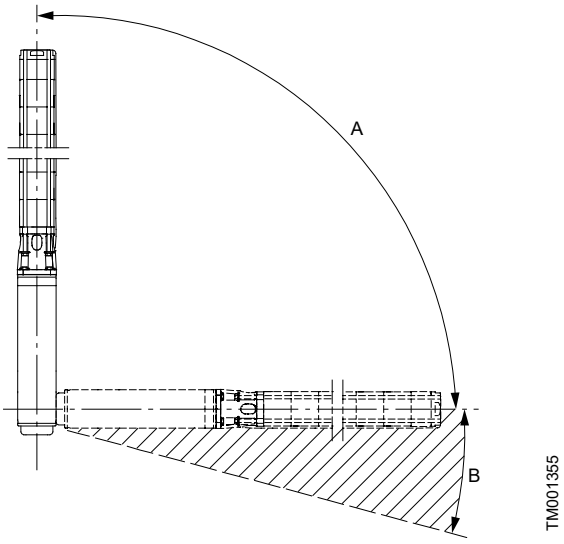
Minimum number of starts	1 per year
Maximum number of starts	100 per hour
	300 per day

Mechanical installation

The motor must be fully submerged in the pumped liquid during operation, ensuring sufficient cooling of the motor and lubrication of the shaft seal. It can be installed either horizontally or vertically.

The maximum installation depth allowed below water level is 600 m.

If the motor is installed horizontally, the shaft end must not fall below the horizontal level. The use of a flow sleeve is always recommended when the motor is installed horizontally.



Positional requirements

Pos.	Description
A	Allowed
B	Not allowed

Electrical supply requirements

The electrical installation must comply with local legislation.

Supply requirements

Measured at the motor terminals, the motor requires the following voltage quality in relation to the rated voltage stamped on the motor nameplate:

- Voltage range motors: +6 % / -10 %
- Fixed voltage motors: +10 % / -10 %.

The tolerance covers variations in the mains supply and losses in the cables.

There must be voltage symmetry in the supply network, that is, there must be the same voltage difference between the individual phases. When the motor is operating, there must be current symmetry, that is, the three phases must be evenly loaded.

The voltage and current unbalance between the phases must be within the limits below:

- maximum voltage unbalance: 2 %
- maximum current unbalance: 5 %.

Even a small voltage unbalance results in a large current unbalance, causing an uneven distribution of heat in the stator windings, leading to hot spots and local overheating. Possible current unbalance can be limited by rotating the phase sequence.

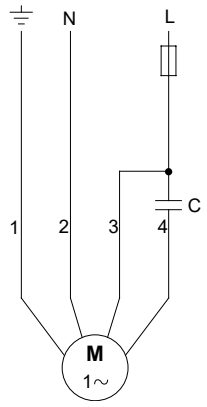
Connection of single-phase motors

The MS4000 3-wire single-phase motors are split-phase motors with built-in separate main and auxiliary winding. The main winding is connected directly to the power supply, whereas the connection of the auxiliary winding depends on the motor type.

Single-phase PSC motors: the auxiliary winding must be connected via a run capacitor permanently installed in the electrical panel.

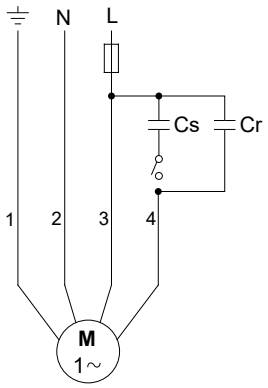
Single-phase CSCR motors: the auxiliary winding must be connected via two parallel branches, one with a permanently installed run capacitor and the other with a start capacitor, and a voltage relay in series. The relay must disconnect the start capacitor after the motor starts, leaving the auxiliary winding connected through the run capacitor for normal operation.

Grundfos offers run capacitors and CSCR motor starter boxes to connect the single-phase motors. The motor starter boxes include motor protection. For more details, see the accessories section.



TM001359

PSC motors



TM074265

CSCR motors

Related information

CSCR motor starters

PSC motor capacitors

Protection

The MS4000 motors do not have built-in motor protection.

Overload and short-circuit

The MS4000 motors must be protected by a thermal relay placed on the electrical panel, starting device, or drive. A thermal relay protects against overload and short-circuit of the motor, as well as against mains failure. The thermal relay must cut out in maximum 10 seconds in case it exceeds 5 times the maximum SF current (rated current on the nameplate), IEC trip class 10.

Surge protection

Surge (overvoltage) protection must be installed as close to the motor or the motor starter as possible. It protects the motors against surges introduced by electronics, switch contactors, and similar factors.

The overvoltage protector does not protect against direct lightning strikes into the installation, but it protects against transients caused by lightning strikes in the vicinity of the installation.

Overtemperature monitoring

The thermal relay does not protect against insufficient cooling caused by, for instance, low flow past the motor, high pumped liquid temperature, top feeding, deposits on the motor, or similar factors. Direct measurement and monitoring of the motor temperature are required to avoid operating under insufficient cooling conditions.

The MS4000 motors are available with Tempcon as an option to monitor temperature via the MP 204. Additionally, all MS4000 can be fit with a Pt1000 sensor. See the section on temperature monitoring.

Dry-running

If the pump stops pumping water, the motor must be cut out immediately. Dry-running protection can be implemented by combining level switches, pressure/flow measurements, and CosPhi/power readings.

In addition, protection devices may be required to ensure the following:

- the supply requirements and voltage limits are not exceeded during operation.
- the phase sequence for three-phase motors is kept.

Using an MP 204 with temperature monitoring via Tempcon or Pt1000 offers complete protection of the motor, including monitoring the insulation resistance. See the section on accessories for further information.

In frequency converter applications, a sine-wave filter may be required to ensure the motor voltage limits are not exceeded, see section Frequency converter operation.

Related information

Temperature monitoring

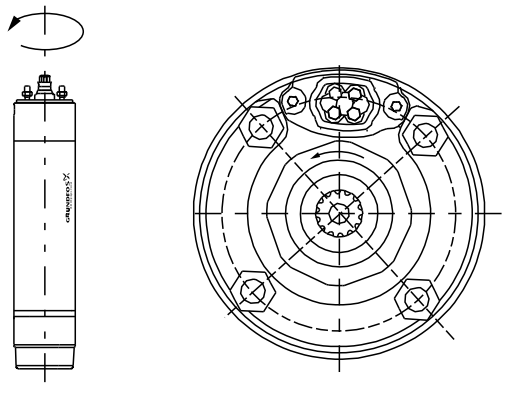
Frequency converter operation

Direction of rotation

Single-phase MS4000 motors rotate counterclockwise. Three-phase MS4000 motors are bidirectional, and rotate clockwise or counterclockwise, depending on the phase rotation of the electrical supply.

If the motor is fitted to a Grundfos SP or SPA submersible pump, the correct direction of rotation is counterclockwise as seen from the shaft end.

If the motor is started without being connected to a pump, the rotating shaft end must be shielded.



TM087656

Counterclockwise direction of rotation

Cables

In submersible pump applications, motor cables and drop cables can be used in combination.

Motor cables, if not otherwise indicated, are dimensioned for submerged operation. When a submersible motor cable is extended with a larger drop cable, the splice must always be as close to the pump outlet as possible, a maximum of 0.5 meters above the pump outlet, to ensure the motor cable is submerged.

Long motor cables that will not work completely submerged in water must be sized to work in the air.

Drop cables must be sized to work in the air without exceeding the allowed voltage drop. Review the cable sizing section. Grundfos offers submersible drop cables for all types of applications. The choice of submersible drop cable depends on the application and type of installation.

A cable termination kit (splice) joins the motor and the drop cable. Optionally, for an easy connection, motor cables are available with an additional plug (2-plugs motor cable) to be used in combination with a submersible drop cable with plug.

See the section on accessories for more information about motor cables, drop cables, and cable termination kits.

Related information

Model C motor cables

Submersible drop cable

Submersible drop cables with plug

Female plug kit for drop cable

Cable termination kit, type KM

Cable termination kit, types M0 to M4

Cable clips

Frequency converter operation

Cables and other system components must be properly rated for frequency converter applications.

Output filter

The frequency converter introduces electromagnetic noise and voltage peaks to the voltage signal. The voltage peaks are amplified in the cable between the frequency converter and the motor, and can damage the insulation system of the motor. The voltage peak levels at motor terminals depend on many factors, such as:

- voltage supply to the frequency converter
- cable length
- switching frequency
- frequency converter type.

At motor terminals, the voltage peaks (Upeak) and voltage rise time (dU/dt) must not exceed the values shown in the table *Submersible motor limits*. To ensure this, an output filter between the frequency converter and the motor may be required. If the frequency converter has a voltage boost function, the use of an output filter is always needed.

Grundfos always recommends the use of sine-wave filters, which also reduce electromagnetic noise.

The technology of Grundfos CUE or RSI frequency converter allows their use without output filters for low voltage and short cable lengths. It also allows their use for cable length up to 500 m with a sine-wave filter. For more information, see the table *CUE/RSI Supply limits*.

Local and national requirements for safety, electromagnetic interference (EMI), etc., must always be followed and can demand filtering due to, for example, electromagnetic compatibility or noise suppression.

Submersible motor limits

	Voltage limits at motor terminals [2]	
Motor type	Max dU/dt	Max Upeak (Line-Line)
	[V/us]	[V]
MS4000	6000	850

2) To be ensured regardless of the frequency converter brand/model

CUE/RSI supply and cable length limits

	Operating with CUE/RSI					
	Without filter			With Sine-wave filter		
Motor [3] type	Max. supply to CUE/RSI		Max. unscreened cable length	Max. supply to CUE/RSI		Max. unscreened cable length
	[Vac [4]]	[Vdc [5]]	[m]	[Vac [4]]	[Vdc [5]]	[m]
MS4000	240	400	100	575/500 [6]	800	500

3) Motors operating within their temperature rating

4) Single-phase or three-phase AC supply (rms Voltage)

5) Renewable energy DC supply

6) 575 V for CUE and 500 V for RSI

Temperature monitoring

To enable monitoring of the motor temperature in applications with frequency converters, all MS4000 can be optionally fitted with a Pt1000 temperature sensor.

Frequency range

The rated frequency must not be exceeded.

The minimum operation frequency for the MS4000 asynchronous motor is 30 Hz.

In submersible pump installations, a reduction of the rated frequency often results in an increased generation of heat in the motor. Although the motor load is reduced with its frequency, the load reduction is very small as the major part of the power input is often consumed to overcome the static head. Moreover, the flow past the motor, that is, the motor cooling, is reduced. Therefore, it is important never to adjust the frequency to a very low level as there must still be a sufficient flow of pumped liquid past the motor.

The motor must still cut out immediately if the pump stops pumping water.

The permissible frequency ranges are:

- 30-50 Hz
- 30-60 Hz.

Ramp times

The start and stop ramp times to and from the minimum frequency must be fast enough to allow the formation and maintenance of the lubricant layer in the thrust bearing:

- start ramp from 0 to 30 Hz: maximum 3 seconds
- start ramp from 30 to 0 Hz: maximum 3 seconds.

For further details, contact your frequency converter supplier or Grundfos.

Overload protection

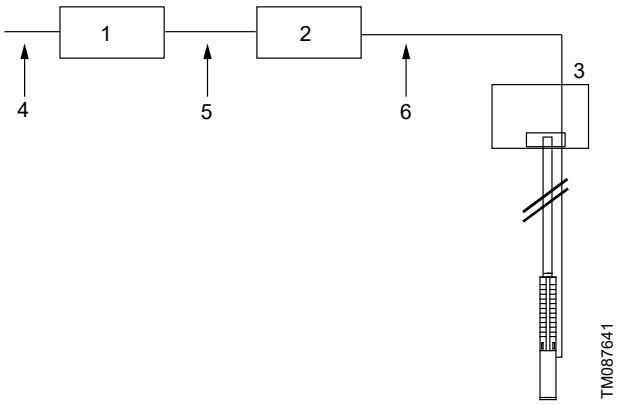
The motor must be protected against overload through setting of the output current limit of the frequency converter to the same value as the rated maximum current or the maximum actual current of the submersible motor. See section Protection in section Installation.

Cables configuration

When a frequency converter is installed in connection with SP pumps, there are two types of installation:

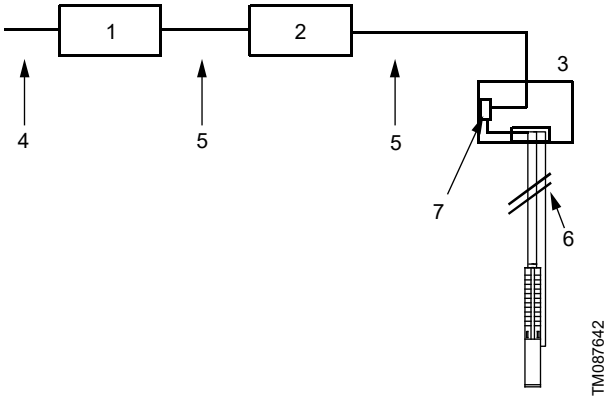
- installation in EMC-insensitive sites.
- installation in EMC-sensitive sites.

The two installation types differ in the use of screened cable. Screened cables are required in those parts of the installation where the surroundings must be protected against EMC. Drop cables inside the borehole are always unscreened. The screened cable between the frequency converter and the filter must be short.



Example of installation in EMC-insensitive sites

Pos.	Description
1	Frequency converter
2	Sine-wave filter
3	Borehole/well head
4	Mains cable, unscreened
5	Screened cable
6	Drop cable, unscreened



Example of installation in EMC-sensitive sites

Pos.	Description
1	Frequency converter
2	Sine-wave filter
3	Borehole/well head
4	Mains cable, unscreened
5	Screened cable
6	Drop cable, unscreened
7	Connection box

Related information

Temperature monitoring
Protection
Accessories

Soft starter operation

Grundfos only recommends soft starters that control the voltage on all three phases and are provided with a bypass contactor.

Soft starters with bypass contactor will only operate during ramp-up and ramp-down. This reduces both the load on the soft starter and the energy consumption in comparison with operation without bypass contactor.

The soft starter must not be used in connection with operation via a generator.

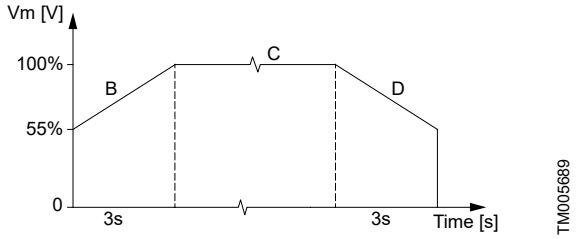
The starting voltage is minimum 55 % of the value stated on the motor nameplate.

If a high locked-rotor torque is required or if the electricity supply is not optimal, the starting voltage should be higher.

Ramp times:

- ramp-up time (until the voltage stated on the nameplate is reached): 3 seconds.
- ramp-down time: 3 seconds.

If the ramp-up and ramp-down times are followed, you will avoid unnecessary heating of the motor.



Soft starter

Pos.	Description
Vm [V]	Motor rated voltage in volts
B	Start ramp
C	Operation
D	Stop ramp
Time [s]	Time in seconds

For further details, contact your soft starter supplier or Grundfos.

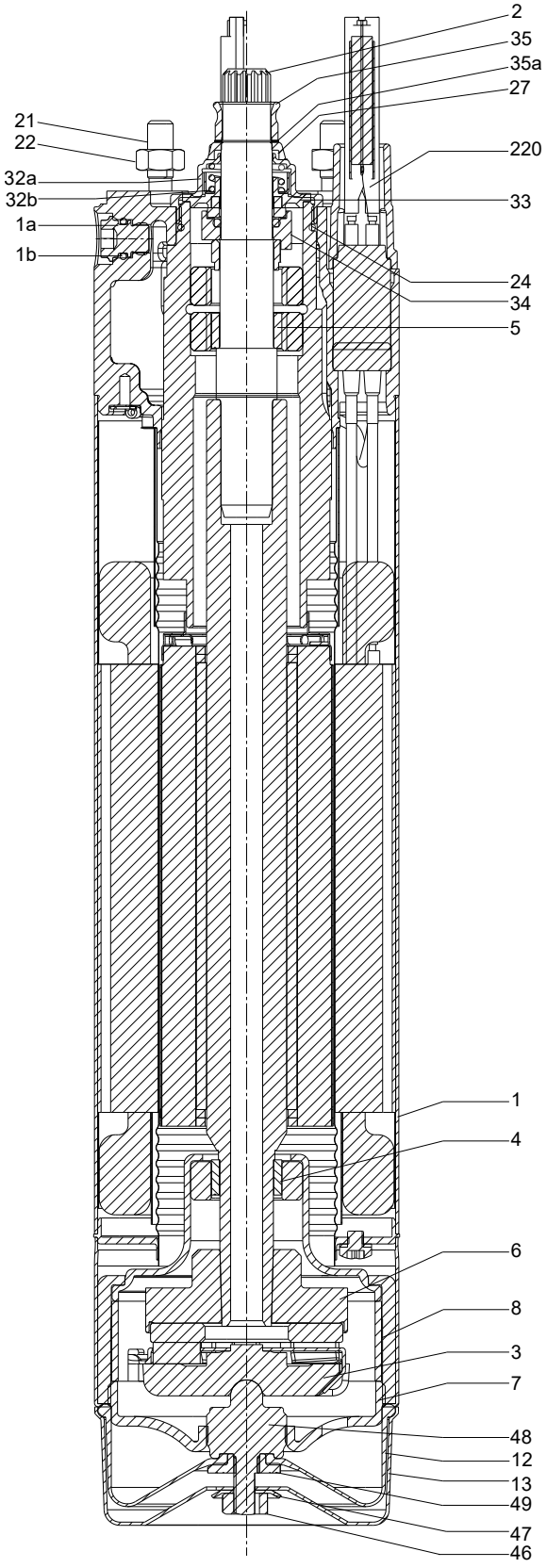
4. Construction

Material specification

Pos.	Description		Type key MS4000_				
			AZBCW_ _ _ __	AZBSW_ _ _ __	AZESW_ _ _ __	ARBSW_ _ _ __	ARESW_ _ _ __
35	Spline protector		NBR	NBR	FKM	NBR	FKM
35a	Supporting ring		EN 1.4401	EN 1.4401	EN 1.4401	EN 1.4539	EN 1.4539
27	Sand shield		NBR	NBR	FKM	NBR	FKM
32	Shaft seal housing		EN 1.4308	EN 1.4308	EN 1.4308	EN 1.4517	EN 1.4517
32b	Spring		EN 1.4462/1.4563	EN 1.4462/1.4563	EN 1.4462/1.4563	EN 1.4462/1.4563	EN 1.4462/1.4563
32a	Supporting ring		EN 1.4401	EN 1.4401	EN 1.4401	EN 1.4539	EN 1.4539
33	Shaft seal, stationary		Ceramic	Silicon Carbide	Silicon Carbide	Silicon Carbide	Silicon Carbide
			NBR	NBR	FKM	NBR	FKM
34	Shaft seal, rotating		Tungsten Carbide	Silicon Carbide	Silicon Carbide	Silicon Carbide	Silicon Carbide
			EN 1.4308	EN 1.4308	EN 1.4308	EN 1.4517	EN 1.4517
22	Nut		EN 1.4401	EN 1.4401	EN 1.4401	EN 1.4539	EN 1.4539
21	Staybolt		EN 1.4401	EN 1.4401	EN 1.4401	EN 1.4539	EN 1.4539
220a	Screw [7)]		EN 1.4401	EN 1.4401	EN 1.4401	EN 1.4462	EN 1.4462
220b	Retaining ring [7)]		Polyester	Polyester	Polyester	Polyester	Polyester
220	Motor cable [7)]						
1a	Filling plug		EN 1.4401	EN 1.4401	EN 1.4401	EN 1.4462	EN 1.4462
1b	O-ring		EPDM	EPDM	EPDM	EPDM	EPDM
1	Stator housing		EN 1.4301/1.4308	EN 1.4301/1.4308	EN 1.4301/1.4308	EN 1.4539	EN 1.4539
24	O-ring		NBR	NBR	FKM	NBR	FKM
5	Radial bearing DE	Holder	EN-GJL-150	EN-GJL-150	EN-GJL-150	EN-GJL-150	EN-GJL-150
		Stationary bush	Ceramic	Ceramic	Ceramic	Ceramic	Ceramic
2	Shaft with rotor	Shaft extension	EN 1.4057	EN 1.4057	EN 1.4057	EN 1.4462	EN 1.4462
		Bearing bush	Tungsten Carbide	Tungsten Carbide	Tungsten Carbide	Tungsten Carbide	Tungsten Carbide
4	Radial bearing NDE	Holder	EN 1.0338	EN 1.0338	EN 1.0338	EN 1.0338	EN 1.0338
		Stationary bush	Ceramic	Ceramic	Ceramic	Ceramic	Ceramic
6	Thrust bearing, rotating	Holder	EN-GJS-400-15	EN-GJS-400-15	EN-GJS-400-15	EN-GJS-400-15	EN-GJS-400-15
		Bearing disc	Ceramic	Ceramic	Ceramic	Ceramic	Ceramic
8	Clamping ring		EN 1.0330.3	EN 1.0330.3	EN 1.0330.3	EN 1.0330.3	EN 1.0330.3
3	Thrust bearing, stationary	Holder	EN-GJS-450-10	EN-GJS-450-10	EN-GJS-450-10	EN-GJS-450-10	EN-GJS-450-10
		Tilting pads	Carbon graphite	Carbon graphite	Carbon graphite	Carbon graphite	Carbon graphite
7	Bearing retainer		EN 1.0330.3	EN 1.0330.3	EN 1.0330.3	EN 1.0330.3	EN 1.0330.3
48	Adjusting screw		EN 1.4460	EN 1.4460	EN 1.4460	EN 1.4462	EN 1.4462
12	Diaphragm		NBR	NBR	FKM	NBR	FKM
49	Nut for rubber diaphragm		EN 1.4305	EN 1.4305	EN 1.4305	EN 1.4539	EN 1.4539
13	Bottom cover		EN 1.4301	EN 1.4301	EN 1.4301	EN 1.4539	EN 1.4539
47	Lock washer		EN 1.4401	EN 1.4401	EN 1.4401	EN 1.4539	EN 1.4539
46	Nut		EN 1.4401	EN 1.4401	EN 1.4401	EN 1.4539	EN 1.4539

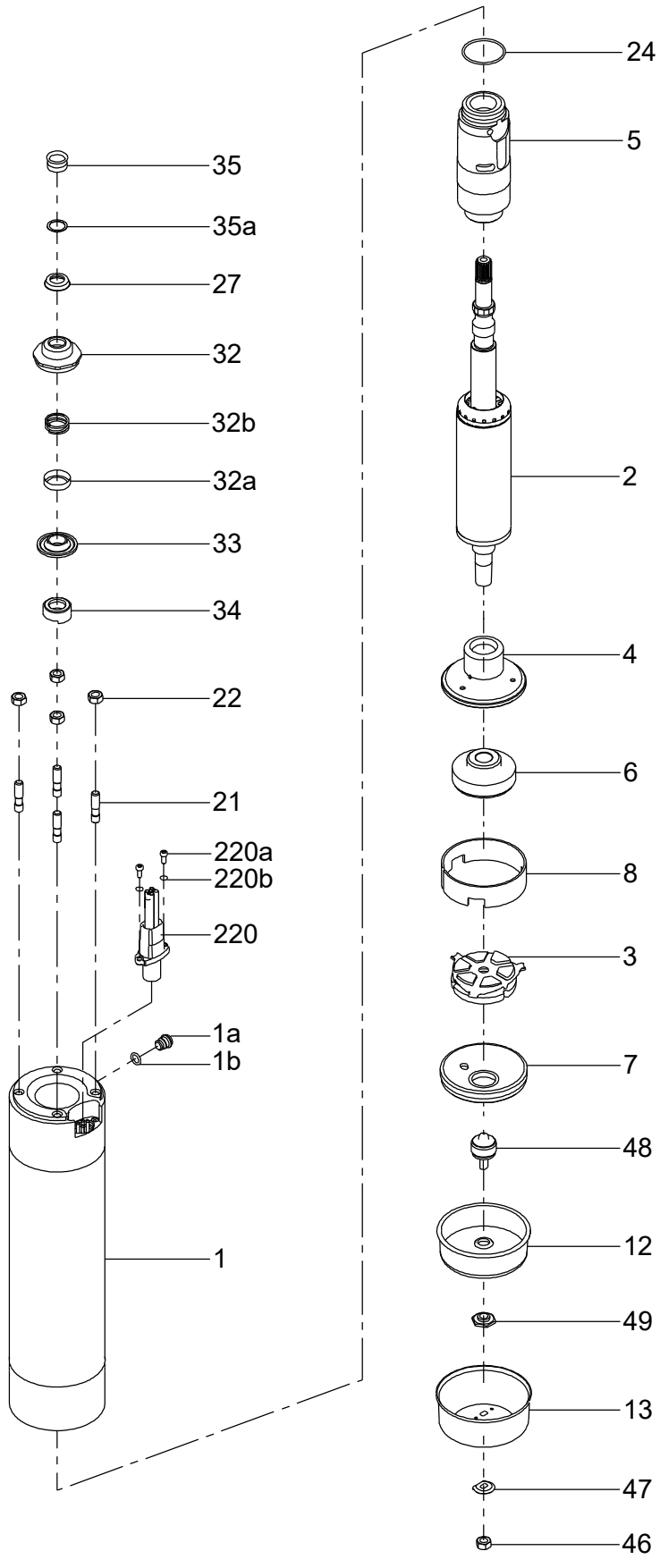
7) Motor cable components

Sectional drawing of MS4000



Sectional drawing of the MS4000 Model C motor

Exploded drawing of MS4000



Exploded drawing of the MS4000 Model C motor

Description of construction

The motor is a 2-pole, asynchronous squirrel-cage, dry stator (canned) submersible motor.

- Enclosure class: IP68 according to IEC 60034-5.
- Insulation class: 155 °C (F) according to IEC 60034-1.

The entire surface is stainless steel which means that all external components have uniform corrosion resistance.

Cable connection

The motor is connected to the drop cable via a special motor cable.

The motor cable cannot be fitted or removed when the motor and pump are assembled.

- CE-approved motors are equipped with a flat blue EPR jacketed motor cable with four cores of 1.5 mm^2. Motor cables with an additional plug connector to assembly the drop cable are available as option.
- cCSAus-approved motors are equipped with four single leads XLPE AWG14 motor cable.
- Round black PTFE motor cable with four cores of 2.5 mm2 is available.
- Motors for BM (booster) pumps are equipped with three single leads XLPE AWG14 motor cable.

The motor cable must work fully submerged in the pumped liquid unless specific.

Pump connection

The motor has standardized drive-end (DE) connection, according to the NEMA standard MG1-2021, with 4 studs and a spline shaft end for mounting of the pump.

- CE-approved motors are provided with M8 thread connection studs and nuts.
- cCSAus-approved motors are provided with 5/16"-24 UNF thread connection studs and nuts.

The stainless steel splined shaft end fulfils the ANSI B92.1, 1970, class 5.

Shaft seal

The motor is fitted with a mechanical shaft seal. A spring-loaded elastomer diaphragm is vulcanized on the stationary upper seat. The elastomer diaphragm functions as a safety valve for the motor opening at 0.5 to 1.0 bar excess pressure. The lapped stationary face seals against the rotating lower seal face.

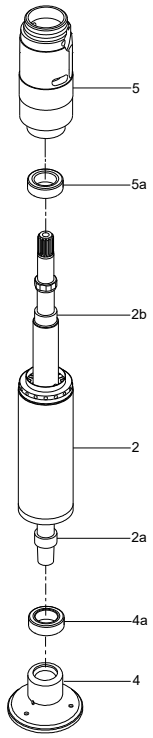
The shaft seal is available in three variants for different applications:

- hard metal (Tungsten carbide) against ceramic (Aluminium Oxide) faces with NBR elastomer, approved for drinking water
- hard metal (Tungsten carbide) against ceramic (Aluminium Oxide) faces with FKM elastomer, for operation in liquids without abrasive particles but with hydrocarbon content and dissolved gases
- silicon carbide against silicon carbide faces with NBR elastomer for operation in liquids with abrasive particles
- silicon carbide against silicon carbide faces with FKM elastomer for operation in liquids with abrasive particles, hydrocarbon content and dissolved gases.

Radial bearing

The motor have two hydrodynamic radial bearings lubricated by the motor liquid, they are placed at the DE (top) and NDE (bottom) of the motor. The rotating bushings, fixed on the shaft, are made of tungsten carbide. The replaceable stationary bushings are made of ceramic (Aluminium Oxide) and are mounted on a bearing holder. Depending on the motor size, each radial bearing can have one or two bushings, see the table below.

Motor type		Motor power [kW (hp)]		Radial bearing bushings
Phase	Temp. version	Min.	Max.	
Single-phase	T4	0.37 (0.50)	0.55 (0.75)	1 × D22
		0.75 (1.0)	3.70 (5.0)	2 × D22
Three-phase	T4	0.75 (1.0)	2.20 (3.0)	1 × D22
		2.70 (3.6)	5.50 (7.5)	2 × D22
		7.50 (10)		2 × D25
	T6	0.55 (0.75)	1.50 (2.0)	1 × D22
		1.90 (2.5)	4.00 (5.5)	2 × D22
		5.50 (7.5)		2 × D25



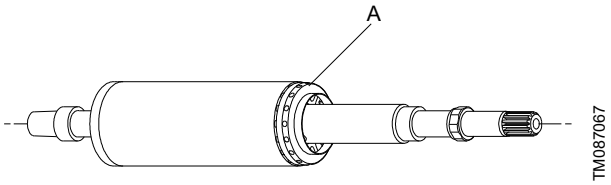
TM082540

DE and NDE radial bearings

Pos.	Description
5	Radial bearing holder - DE
5a	Stationary bush
2b	Rotating bush
2	Shaft with rotor
2a	Rotating bush
4a	Stationary bush
4	Radial bearing holder - NDE

Rotor

The squirrel cage rotor is mounted on the shaft. It has brass bars on single-phase motors and copper bars on three-phase motors. To provide optimum cooling, the rotor is equipped with an impeller and has an internal channel that ensures internal circulation of the motor liquid and cooling of the motor, see section Motor cooling.



Rotor with impeller

Pos.	Description
A	Rotor impeller

Related information

Motor cooling

Stator

The stator is hermetically encapsulated in stainless steel. Its windings are embedded in epoxy compound. This results in high mechanical stability, optimum cooling, and eliminates the risk of short circuits in the windings caused by condensing water.

Thrust bearing

The hydrodynamic thrust bearing is of Michell/Kingsbury type, a very simple but highly efficient bearing. It fulfils the requirements specified in the NEMA MG1-2021 standard.

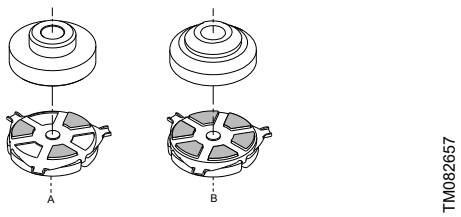
The thrust bearing consists of the following:

- a ceramic (Aluminium Oxide) rotating part with precision-ground and polished sliding surface for optimum surface finish
- a stationary part with tilting carbon pads (shoes) that have a special ground surface, ensuring optimum thrust capacity and lubrication.

The stationary part is fitted with a bearing retainer with a special adjusting screw for shaft height adjustment.

As the thrust bearing is made for bidirectional rotation, the motor can operate both clockwise and counterclockwise.

The thrust bearings are available in two sizes, rated for 2.2 and 4.4 kN thrust capacity. See the next figure.



Thrust bearings

Pos.	Description
A	2.2 kN
B	4.4 kN

The table below shows the default thrust bearing configuration. The motors can always be upgraded with a larger thrust bearing, but must not be downgraded with a smaller thrust bearing than those stated in the table.

Motor type by phase	Motor power [kW (hp)]		Size of thrust bearing
	Min.	Max.	[kN]
Single phase	0.37 (0.5)	3.7 (5)	4.4
Three phase	0.55 (0.75)	1.5 (2)	2.2
	1.9 (2.5)	7.5 (10)	4.4

Diaphragm

The rubber diaphragm, fitted between the stator and the bottom cover, is dimensioned to equalize volume variations caused by the temperature rise in connection with intermittent operation.

Motor liquid

The motor is factory-filled with the Grundfos SML-3 motor liquid. The SML-3 is based on mono-propylene glycol, contains anti-corrosive and lubricating additives, and is frost-proof down to -20 °C.

Motor liquid with a high glycol content (60 % HTF) is available for motors that are stored or operated at lower temperatures (up to -55 °C).

Mixtures with more than 60 % of glycol content are not recommended.

If the motor is entirely drained of SML-3 liquid, for instance, in connection with service, it must always be refilled with SML-3. When topping up with small amounts of liquid, demineralized or clean water may be used.

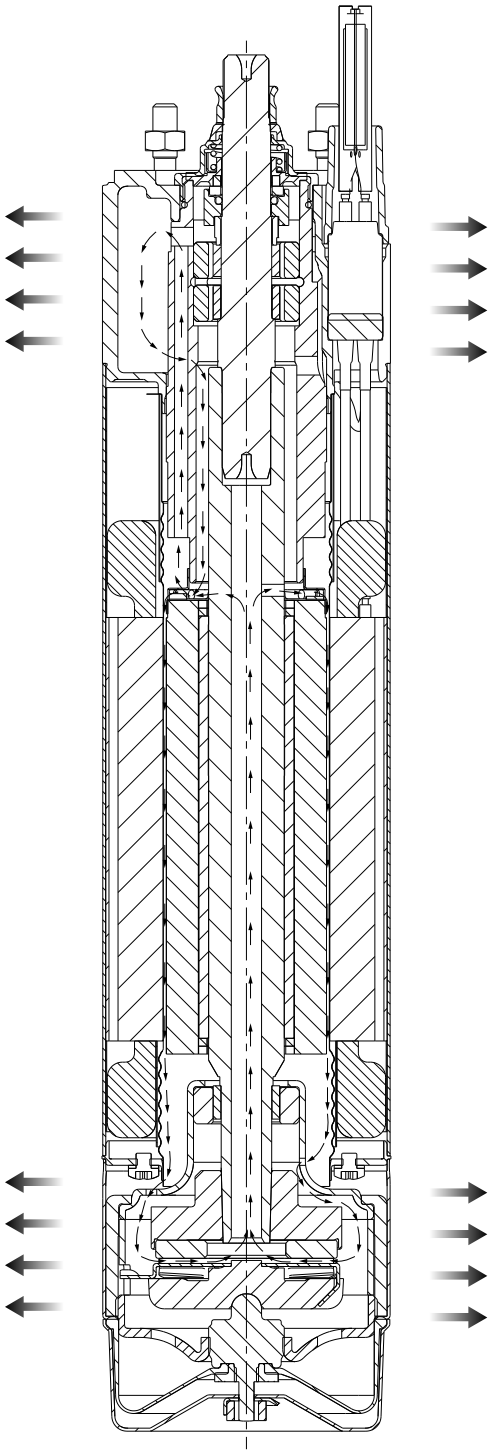
If motor liquid based on mono-propylene glycol is not allowed for special applications, the motor may be factory-filled with demineralized water upon request. A motor filled with demineralized water must be frost-protected when stored or transported in freezing temperatures.

	Glycol content in the motor liquid	Freezing point
SML-3	36.5 % volume	-20 °C
High glycol (60% HTF)	57.6 % volume	-55 °C

Motor cooling

The motor has cooling chambers at the top and bottom. An efficient internal circulation system transports the heat from the rotor, stator and bearings via the motor liquid to the cooling chambers. In the cooling chambers, the heat generated in the motor is carried away to the surrounding pumped liquid via the outer surface of the motor.

The temperature and flow velocity of the pumped liquid past the motor are of vital importance to the cooling process and to the life of the motor. See cooling requirements in the section Cooling.



TM082535

Internal circulation system for cooling

Related information

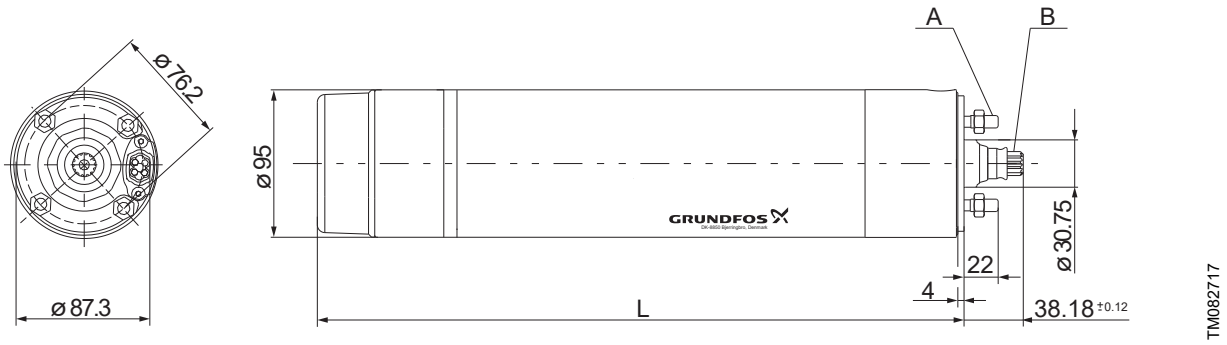
Cooling

Rotor

5. Technical data

Dimensions and weights

Dimensional drawing of MS4000



		CE	cCSAus
	A =	M8	5/16"-24UNF
	B =	Spline 14x24/48-30 (ANSI B92.1 class 5)	

Motor power, P_2		Single-phase CSCR			Single-phase PSC			Three-phase					
		T40			T40			T40			T60		
		L	Net weight	Shipping volume	L	Net weight	Shipping volume	L	Net weight	Shipping volume	L	Net weight	Shipping volume
[kW]	[hp]	[mm]	[kg]	[m^3]	[mm]	[kg]	[m^3]	[mm]	[kg]	[m^3]	[mm]	[kg]	[m^3]
0.37	0.50	-	-	-	402	13	0.019	-	-	-	-	-	-
0.55	0.75	-	-	-	457	16	0.025	-	-	-	402	13	0.019
0.75	1.00	-	-	-	497	17	0.025	402	13	0.019	417	14	0.025
1.10	1.50	-	-	-	577	21	0.025	417	14	0.025	417	14	0.025
1.50	2.00	497	17	0.025	677	26	0.032	417	14	0.025	457	16	0.025
1.90	2.50	-	-	-	-	-	-	457	16	0.025	497	17	0.025
2.20	3.00	577	21	0.025	677	26	0.032	457	16	0.025	497	17	0.025
2.70	3.60	-	-	-	-	-	-	497	17	0.025	577	21	0.025
3.00	4.00	-	-	-	-	-	-	497	17	0.025	577	21	0.025
3.70	5.00	677	26	0.032	-	-	-	577	21	0.025	677	26	0.032
4.00	5.50	-	-	-	-	-	-	577	21	0.025	677	26	0.032
5.50	7.50	-	-	-	-	-	-	677	26	0.032	777	31	0.032
7.50	10.00	-	-	-	-	-	-	777	31	0.032	-	-	-

Motor cables

The motors are available with four types of motor cables.
Motor cables for the model C are not interchangeable with previous models.

- Model C motor cables are available as accessories, see the section Accessories.
- Model B motor cables are available as service kits.

Cable type	Approval
4 G 1.5 mm^2 jacketed EPR flat cable	CE
4 × 1 × 14 AWG single leads XLPE	cCSAus
3 × 1 × 14 AWG single leads XLPE for BM (booster)	
4 G 2.5 mm^2 jacketed PTFE round cable	-

In submersible pump applications, motor cables and drop cables can be used in combination.
For more information about Model C motor cables, drop cables and cable termination kits, see the section Accessories.

Moment of inertia

Motor power, P_2		Single-phase CSCR	Single-phase PSC	Three-phase	
[kW]	[hp]	T40	T40	T40	T60
		[kg·m^2]	[kg·m^2]	[kg·m^2]	[kg·m^2]
0.37	0.50	-	0.0009	-	-
0.55	0.75	-	0.0014	-	0.0009
0.75	1.00	-	0.0017	0.0009	0.0010
1.10	1.50	-	0.0022	0.0010	0.0010
1.50	2.00	0.0017	0.0029	0.0010	0.0014
1.90	2.50	-	-	0.0014	0.0017
2.20	3.00	0.0022	0.0029	0.0014	0.0017
2.70	3.60	-	-	0.0017	0.0022
3.00	4.00	-	-	0.0017	0.0022
3.70	5.00	0.0029	-	0.0022	0.0029
4.00	5.50	-	-	0.0022	0.0029
5.50	7.50	-	-	0.0029	0.0036
7.50	10.00	-	-	0.0036	-

Related information

Model C motor cables

6. Electrical data

Overview of electrical data

Voltage code	Voltage description		Rated voltages		Approval	Region	Temperature version													Page
							kW	0.37	0.55	0.75	1.1	1.5	1.9	2.2	2.7	3.0	3.7	4.0	5.5	7.5	
			50 Hz	60 Hz			hp	0.50	0.75	1.00	1.5	2.0	2.5	3.0	3.6	4.0	5.0	5.5	7.5	10.0	
75	1×220/50 PSC	=	220-240	-	CE	Global		T4	T4	T4	T4	-	-	-	-	-	-	-	-	-	**24**
21	1×220-230/50 CSCR	=	220-230	-	CE	Global		-	-	-	-	-	-	T4	-	-	-	-	-	-	**24**
24	1×240/50 CSCR	=	240	-	CE	Global		-	-	-	-	-	-	T4	-	-	-	-	-	-	**24**
45	1×230/60 CSCR	=	-	230	cCSAus	US		-	-	-	-	T4	-	T4	-	-	T4	-	-	-	**24**
10	3×220-230/50	=	220-230	-	CE	Global		-	-	T4 T6	T4 T6	T4 T6	-	T4 T6	-	T4 T6	-	T4 T6	T4 T6	T4	**25**
08	3×380/50 440/60	=	340-360-380	440	CE	Global		-	-	T4	T4	T4	-	T4	-	T4	-	T4	T4	T4	**26**
19	3×380-415/50	=	380-400-415	440-460-480	CE	Global		-	T6	T4	T4	T4	-	T4 T6	-	T4 T6	-	T4 T6	T4 T6	T4	**27**
18	3×500-525/50	=	500-525	-	CE	Global		-	-	T4	T4	T4	-	T4 T6	-	T4 T6	-	T4 T6	T4 T6	T4	**30**
28	3×208-230/60	=	-	208-220-230	CE	Global		-	-	T4	T4	T4	-	T4	-	T4	-	T4	T4	T4	**31**
33	3×380-415/60	=	-	380-400-415	CE	Global		-	-	T4	T4	T4	-	T4	-	T4	-	T4	T4 T6	T4	**32**
30	3×208-230/60	=	-	208-220-230	cCSAus	US		-	-	-	-	-	-	T4	-	T4	T4	-	T4	T4	**33**
35	3×440-460/60	=	-	440-460	cCSAus	US		-	-	T4	T4	T4	-	T4 T6	-	T4 T6	T4 T6	-	T4 T6	T4	**34**
39	3×575/60	=	-	575	cCSAus	US		-	-	T4	T4	T4	-	T4 T6	-	T4 T6	T4 T6	-	T4 T6	T4	**35**
09	3×200/50 220/60	=	200	200-220	CE	Japan		-	-	T4	T4	T4 T6	T4 T6	T4 T6	T4 T6	T4 T6	T4 T6	T4 T6	T4 T6	-	**35**
65	3×400/50 440/60	=	400	400-440	CE	Japan		-	-	T4	T4	T4 T6	T4 T6	T4 T6	T4 T6	T4 T6	T4 T6	T4 T6	T4 T6	T4	**37**

Electrical data tables

The abbreviations used in the following tables are explained below.

Category	Abbr.	Explanation
Power	FL	Power at full load (rated load)
	SF	Power at service factor load
Current	FL	Current at full load (rated current at 50 Hz)
	SF	Current at service factor load (rated current at 60 Hz)
	FL Main	Current at full load in the main winding
	FL Aux	Current at full load in the auxiliary winding
	LR	Locked rotor current
Motor efficiency η	SF	Motor efficiency at service factor load
	FL	Motor efficiency at full load
	¾FL	Motor efficiency at 75 % of the full load
	½FL	Motor efficiency at 50 % of the full load
Cos φ	SF	Power factor at service factor load
	FL	Power factor at full load
	¾FL	Power factor at 75 % of the full load
	½FL	Power factor at 50 % of the full load
Torque	FL	Torque at full load
	LR	Locked rotor torque provided in % of FL torque
	BD	Break down torque provided in % of FL torque
Speed	SF	Rotation speed at service factor load
	FL	Rotation speed at full load

Voltage code 75

1 × 220 V PSC, 50 Hz, T40

Power	Current				Motor efficiency η			Cos φ			Torque			Speed
FL	FL	FL Main	FL Aux	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[A]	[A]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
0.37	3.3	2.1	1.8	12	57.7	51.6	41.4	0.99	0.98	0.95	1.3	70	220	2800
0.55	4.5	3.1	2.2	17	63.4	58.4	48.7	0.98	0.97	0.94	1.9	60	240	2790
0.75	5.8	3.7	3.3	22	66.1	60.9	51.1	0.99	0.98	0.97	2.6	70	230	2790
1.10	8.7	6.1	4.4	34	68.2	63.6	54.2	0.97	0.95	0.91	3.8	60	250	2790

1 × 240 V PSC, 50 Hz, T40

Power	Current				Motor efficiency η			Cos φ			Torque			Speed
FL	FL	FL Main	FL Aux	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[A]	[A]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
0.37	3.3	2.6	2.0	13	54.4	47.1	36.5	0.94	0.90	0.83	1.3	80	280	2830
0.55	4.4	3.5	2.5	19	61.1	54.7	44.0	0.93	0.89	0.82	1.9	70	280	2830
0.75	5.9	4.5	3.7	24	63.2	56.7	46.0	0.95	0.91	0.84	2.5	80	300	2830
1.10	9.1	7.4	4.9	37	65.2	58.8	48.2	0.90	0.84	0.75	3.8	70	300	2830

Voltage code 21

1 × 220 V CSCR, 50 Hz, T40

Power	Current				Motor efficiency η			Cos φ			Torque			Speed
FL	FL	FL Main	FL Aux	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[A]	[A]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
2.2	14.6	10.3	6.0	48	75	74.1	67.9	0.99	0.99	0.99	7.4	140	170	2850

1 × 230 V CSCR, 50 Hz, T40

Power	Current				Motor efficiency η			Cos φ			Torque			Speed
FL	FL	FL Main	FL Aux	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[A]	[A]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
2.2	14.0	9.6	6.3	50	75.5	73.4	66.1	0.99	0.99	0.99	7.3	150	190	2870

Voltage code 24

1 × 240 V CSCR, 50 Hz, T40

Power	Current				Motor efficiency η			Cos φ			Torque			Speed
FL	FL	FL Main	FL Aux	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[A]	[A]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
2.2	13.2	9.0	6.5	47	75.5	73.4	66.2	0.99	0.99	0.99	7.3	150	190	2860

Voltage code 45

1 × 230 V CSCR, 60 Hz, T40

Power			Current							Motor efficiency η				Cos φ				Torque			Speed of rotation	
FL	FL	SF	SF	SF Main	SF Aux	FL	FL Main	FL Aux	LR	SF	FL	¾FL	½FL	SF	FL	¾FL	½FL	FL	LR	BD	SF	FL
[kW]	[hp]	[kW]	[A]	[A]	[A]	[A]	[A]	[A]	[A]	[%]	[%]	[%]	[%]	[-]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]	[rpm]
1.50	2.00	1.88	13.2	11.0	2.5	10.6	9.0	2.6	40	74.5	73.6	70.1	62.4	0.92	0.90	0.86	0.78	4.1	80	250	3470	3500
2.20	3.00	2.53	17.0	13.3	4.5	14.4	11.4	4.6	55	75.1	74.9	72.3	65.4	0.96	0.96	0.96	0.94	6.0	160	220	3460	3480
3.70	5.00	4.26	27.5	16.0	12.2	24.1	13.2	12.4	86	73.8	72.4	67.6	58.3	0.99	0.99	0.98	0.97	10.1	160	230	3460	3480

Voltage code 10

3 × 220 V, 50 Hz, T40

Power	Current		Motor efficiency η			Cos φ			Torque			Speed
FL	FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
0.75	3.4	16	73.7	72.7	69.1	0.84	0.79	0.70	2.5	160	240	2870
1.10	5.0	24	74.9	74.0	70.3	0.81	0.74	0.62	3.7	160	250	2870
1.50	7.2	30	73.6	72.9	68.3	0.78	0.68	0.54	5.0	150	230	2860
2.20	11.2	49	74.3	73.1	67.6	0.74	0.63	0.49	7.3	180	260	2860
3.00	14.2	62	75.1	74.8	70.8	0.77	0.67	0.52	10.0	170	240	2860
4.00	17.4	88	77.9	79.0	76.6	0.80	0.71	0.57	13.4	190	250	2860
5.50	23.6	117	79.5	80.5	78.3	0.81	0.72	0.57	18.4	180	240	2860
7.50	32.8	160	76.7	77.4	74.8	0.84	0.77	0.63	25.3	200	250	2830

3 × 230 V, 50 Hz, T40

Power	Current		Motor efficiency η			Cos φ			Torque			Speed
FL	FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
0.75	3.4	17	72.9	71.1	66.8	0.82	0.76	0.66	2.5	170	260	2880
1.10	5.0	25	75.0	73.2	69.1	0.78	0.70	0.57	3.7	180	270	2880
1.50	7.4	32	70.1	67.5	60.6	0.76	0.66	0.53	5.0	170	250	2860
2.20	11.6	52	69.1	65.2	56.9	0.69	0.58	0.45	7.3	200	290	2870
3.00	14.6	65	74.4	72.8	67.3	0.77	0.67	0.53	10.0	190	260	2870
4.00	17.6	99	76.4	74.8	69.6	0.77	0.67	0.53	13.3	210	280	2870
5.50	24.2	123	77.7	76.8	72.6	0.81	0.72	0.58	18.3	200	270	2880
7.50	33.1	168	76.8	76.5	72.5	0.80	0.71	0.56	25.2	220	280	2850

3 × 220 V, 50 Hz, T60

Power	Current		Motor efficiency η			Cos φ			Torque			Speed
FL	FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
0.75	3.6	19	69.0	66.4	59.9	0.82	0.77	0.67	2.5	190	280	2880
1.10	5.1	24	71.0	69.6	64.1	0.83	0.76	0.65	3.7	160	250	2860
1.50	7.4	39	72.3	69.7	63.2	0.77	0.69	0.56	5.0	200	300	2880
2.20	9.5	45	74.5	74.6	71.0	0.85	0.80	0.70	7.3	160	240	2850
3.00	12.7	66	76.2	75.9	72.3	0.85	0.80	0.70	10.0	180	250	2860
4.00	16.6	89	77.5	77.4	74.2	0.86	0.81	0.71	13.1	190	260	2870
5.50	22.0	130	78.0	78.1	75.0	0.84	0.78	0.67	18.4	210	280	2850

3 × 230 V, 50 Hz, T60

Power	Current		Motor efficiency η			Cos φ			Torque			Speed
FL	FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
0.75	3.6	20	69.1	65.8	58.7	0.79	0.73	0.63	2.5	210	320	2890
1.10	5.1	25	71.0	68.7	62.4	0.79	0.71	0.59	3.7	180	270	2870
1.50	7.7	41	71.3	67.8	60.3	0.72	0.62	0.50	5.0	220	330	2890
2.20	9.3	48	75.1	74.3	69.9	0.83	0.76	0.65	7.3	180	270	2870
3.00	12.5	69	76.6	75.6	71.2	0.83	0.76	0.64	10.0	200	280	2880
4.00	15.1	94	78.0	77.2	73.2	0.83	0.77	0.66	13.3	210	280	2890
5.50	21.8	137	78.2	77.5	73.5	0.81	0.73	0.60	18.3	240	310	2870

Voltage code 08

3 × 340 V, 50 Hz, T40

Power	Current		Motor efficiency η			Cos φ			Torque			Speed
FL	FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
0.75	2.4	9	67.5	68.0	64.2	0.86	0.83	0.76	2.5	140	190	2810
1.10	3.4	13	69.7	70.1	66.2	0.86	0.82	0.74	3.7	140	210	2820
1.50	4.6	17	70.6	71.4	67.8	0.86	0.80	0.69	5.0	130	200	2810
2.20	6.7	26	71.9	72.4	68.6	0.85	0.78	0.66	7.5	140	200	2820
3.00	8.5	35	74.1	75.5	73.1	0.87	0.81	0.70	10.2	140	200	2820
4.00	11.3	44	74.3	76.7	75.4	0.88	0.85	0.76	13.6	130	190	2800
5.50	15.0	65	76.4	78.1	76.5	0.88	0.83	0.73	18.5	150	210	2830
7.50	20.9	97	74.9	77.7	77.1	0.88	0.84	0.74	25.8	160	210	2780

3 × 360 V, 50 Hz, T40

Power	Current		Motor efficiency η			Cos φ			Torque			Speed
FL	FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
0.75	2.2	9.5	69.3	68.5	63.7	0.85	0.81	0.72	2.5	150	230	2840
1.10	3.1	14	71.0	70.1	65.0	0.84	0.78	0.68	3.7	150	230	2850
1.50	4.5	18	71.5	70.6	65.4	0.82	0.74	0.61	5.0	150	230	2840
2.20	6.6	27	72.2	70.9	65.4	0.80	0.71	0.57	7.4	160	230	2850
3.00	8.3	37	75.0	74.8	70.8	0.83	0.75	0.61	10.1	160	230	2850
4.00	10.6	47	76.1	76.9	74.4	0.86	0.81	0.70	13.5	160	220	2840
5.50	14.5	70	77.6	77.9	75.0	0.85	0.78	0.66	18.4	180	240	2860
7.50	19.8	94	76.6	77.8	75.6	0.86	0.79	0.66	25.4	190	240	2820

3 × 380 V, 50 Hz, T40

Power	Current		Motor efficiency η			Cos φ			Torque			Speed
FL	FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
0.75	2.0	10	72.8	71.9	68.1	0.84	0.79	0.69	2.5	170	250	2870
1.10	3.0	15	74.9	74.0	70.3	0.82	0.74	0.62	3.7	170	260	2870
1.50	4.3	19	73.6	72.7	68.3	0.78	0.68	0.54	5.0	170	250	2860
2.20	7.0	29	74.3	73.1	67.6	0.74	0.63	0.49	7.3	180	260	2870
3.00	8.8	40	75.1	74.8	70.8	0.77	0.67	0.52	10.0	190	260	2860
4.00	10.8	50	77.9	79.0	76.6	0.80	0.71	0.57	13.4	180	250	2860
5.50	14.6	75	79.5	80.5	78.3	0.81	0.72	0.57	18.3	200	270	2870
7.50	20.4	100	77.5	78.7	76.8	0.84	0.73	0.56	25.5	210	270	2850

3 × 440 V, 60 Hz, T40

Power			Current			Motor efficiency η				Cos φ				Torque			Speed	
FL		SF	FL	SF	LR	SF	FL	¾FL	½FL	SF	FL	¾FL	½FL	FL	LR	BD	SF	FL
[kW]	[hp]	[kW]	[A]	[A]	[A]	[%]	[%]	[%]	[%]	[-]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]	[rpm]
0.75	1.00	1.05	1.8	2.3	11	71.1	71.1	68.3	61.6	0.87	0.83	0.78	0.69	2.1	190	300	3420	3480
1.10	1.50	1.43	2.6	3.3	15	74.8	74.8	72.5	66.7	0.84	0.80	0.73	0.62	3.0	200	320	3440	3480
1.50	2.00	1.88	3.8	4.4	20	75.1	75.3	73.0	66.8	0.82	0.75	0.66	0.54	4.1	190	310	3440	3480
2.20	3.00	2.53	5.8	6.1	31	76.5	76.1	73.9	68.2	0.75	0.71	0.61	0.48	6.0	210	320	3460	3480
3.00	4.00	3.45	7.3	7.8	42	75.2	74.5	71.6	65.0	0.78	0.74	0.65	0.52	8.2	220	320	3460	3480
4.00	5.50	4.60	9.1	9.9	53	79.7	80.1	79.5	76.0	0.82	0.78	0.70	0.57	11.0	210	300	3460	3480
5.50	7.50	6.33	12.2	13.2	79	81.0	81.4	81.0	77.8	0.82	0.79	0.70	0.57	15.0	240	330	3460	3480
7.50	10.00	8.63	16.6	19.2	106	79.9	80.2	79.7	76.3	0.84	0.78	0.70	0.57	20.7	250	330	3440	3470

Voltage code 19

3 × 380 V, 50 Hz, T40

Power	Current		Motor efficiency η			Cos φ			Torque			Speed
FL	FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
0.75	2.1	8.5	71.7	71.6	68.2	0.86	0.82	0.74	2.5	140	200	2850
1.10	2.8	13	74.5	74.6	71.8	0.85	0.79	0.69	3.7	140	220	2850
1.50	4.0	16	73.0	73.8	70.6	0.83	0.75	0.62	5.0	140	210	2840
2.20	6.0	25	75.5	75.8	72.2	0.80	0.70	0.56	7.4	150	220	2850
3.00	7.7	33	75.0	75.9	73.8	0.86	0.79	0.66	10.1	150	220	2830
4.00	9.8	43	77.6	80.3	78.6	0.85	0.78	0.65	13.5	150	210	2830
5.50	13.0	61	79.4	81.6	80.3	0.85	0.78	0.65	18.5	160	220	2840
7.50	18.4	86	78.0	80.1	78.5	0.83	0.74	0.59	25.5	180	230	2830

3 × 400 V, 50 Hz, T40

Power	Current		Motor efficiency η			Cos φ			Torque			Speed
FL	FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
0.75	2.0	9	72.8	71.9	68.1	0.84	0.79	0.69	2.5	180	280	2870
1.10	2.8	13	74.9	74.0	70.3	0.81	0.74	0.62	3.7	160	240	2870
1.50	4.0	17	73.6	72.9	68.3	0.78	0.68	0.54	5.0	150	230	2860
2.20	6.0	26	74.3	73.1	67.6	0.74	0.63	0.49	7.4	170	250	2860
3.00	7.9	35	75.5	74.9	70.9	0.81	0.73	0.58	10.0	170	250	2850
4.00	9.6	46	77.9	79.0	76.6	0.80	0.71	0.57	13.4	170	240	2860
5.50	13.0	65	79.5	80.5	78.3	0.81	0.72	0.57	18.4	180	250	2860
7.50	19.3	92	77.9	78.4	75.2	0.77	0.67	0.52	25.3	200	260	2850

3 × 415 V, 50 Hz, T40

Power	Current		Motor efficiency η			Cos φ			Torque			Speed
FL	FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
0.75	1.9	9.5	72.9	71.4	66.8	0.82	0.76	0.66	2.5	170	260	2880
1.10	2.8	14	75.0	73.5	69.2	0.78	0.70	0.57	3.7	170	260	2880
1.50	4.1	18	72.4	70.2	63.9	0.74	0.64	0.50	5.0	170	260	2870
2.20	6.3	28	73.0	70.8	64.2	0.69	0.57	0.44	7.3	190	280	2880
3.00	8.1	37	75.1	73.5	68.3	0.77	0.67	0.52	10.0	190	270	2870
4.00	9.8	48	77.7	77.6	73.8	0.77	0.66	0.52	13.3	190	260	2870
5.50	13.4	68	79.7	79.2	76.0	0.76	0.66	0.51	18.3	200	270	2880
7.50	19.6	96	77.7	76.9	72.3	0.72	0.61	0.46	25.1	230	290	2860

3 × 440 V, 60 Hz, T40

Power			Current			Motor efficiency η				Cos φ				Torque			Speed	
FL		SF	FL	SF	LR	SF	FL	¾FL	½FL	SF	FL	¾FL	½FL	FL	LR	BD	SF	FL
[kW]	[hp]	[kW]	[A]	[A]	[A]	[%]	[%]	[%]	[%]	[-]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]	[rpm]
0.75	1.00	1.05	1.7	2.3	9	65.4	72.4	70.1	56.6	0.87	0.85	0.80	0.72	2.1	160	230	3460	3450
1.10	1.50	1.43	2.5	3.0	13	74.5	74.9	73.2	67.8	0.87	0.83	0.77	0.67	3.0	160	260	3420	3470
1.50	2.00	1.88	3.5	4.1	17	74.4	75.6	74.3	68.9	0.85	0.80	0.73	0.61	4.2	150	250	3420	3460
2.20	3.00	2.53	5.3	5.7	26	77.2	77.3	75.9	71.0	0.80	0.76	0.67	0.54	6.1	170	270	3440	3470
3.00	4.00	3.45	6.7	7.4	34	75.8	76.0	74.6	69.8	0.86	0.83	0.77	0.66	8.3	170	260	3430	3460
4.00	5.50	4.60	8.7	9.4	45	79.0	79.9	79.7	76.3	0.85	0.82	0.76	0.64	11.1	170	250	3440	3460
5.50	7.50	6.33	11.4	12.8	63	78.2	79.0	79.9	78.9	0.87	0.84	0.77	0.63	15.2	180	260	3440	3460
7.50	10.00	8.63	16.0	18.0	91	80.4	81.3	81.5	78.8	0.83	0.79	0.71	0.57	20.8	210	280	3430	3460

3 × 460 V, 60 Hz, T40

Power			Current			Motor efficiency η				Cos φ				Torque			Speed	
FL		SF	FL	SF	LR	SF	FL	¾FL	½FL	SF	FL	¾FL	½FL	FL	LR	BD	SF	FL
[kW]	[hp]	[kW]	[A]	[A]	[A]	[%]	[%]	[%]	[%]	[-]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]	[rpm]
0.75	1.00	1.05	1.8	2.2	9.5	71.1	71.3	68.3	61.6	0.86	0.83	0.78	0.69	2.1	170	270	3420	3470
1.10	1.50	1.43	2.5	3.0	14	74.8	74.8	72.5	66.7	0.80	0.80	0.73	0.62	3.0	180	290	3440	3480
1.50	2.00	1.88	3.6	4.1	18	75.1	75.3	73.0	66.8	0.82	0.75	0.66	0.54	4.1	180	280	3440	3480
2.20	3.00	2.53	5.5	5.8	28	73.5	72.7	69.6	62.6	0.78	0.74	0.64	0.52	6.0	190	300	3460	3480
3.00	4.00	3.45	6.6	7.5	36	76.2	75.9	73.8	68.1	0.83	0.80	0.72	0.59	8.2	200	290	3450	3470
4.00	5.50	4.60	8.7	9.4	47	79.7	80.2	79.6	75.9	0.82	0.78	0.70	0.57	11.0	190	280	3460	3480
5.50	7.50	6.33	11.7	12.6	67	81.0	81.4	81.0	77.8	0.82	0.79	0.70	0.57	15.1	210	290	3460	3480
7.50	10.00	8.63	16.9	18.6	97	80.3	81.0	80.6	76.7	0.78	0.74	0.64	0.51	20.7	230	310	3470	3450

3 × 480 V, 60 Hz, T40

Power			Current			Motor efficiency η				Cos φ				Torque			Speed	
FL		SF	FL	SF	LR	SF	FL	¾FL	½FL	SF	FL	¾FL	½FL	FL	LR	BD	SF	FL
[kW]	[hp]	[kW]	[A]	[A]	[A]	[%]	[%]	[%]	[%]	[-]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]	[rpm]
0.75	1.00	1.05	1.8	2.1	10	73.0	72.3	69.1	62.3	0.85	0.80	0.74	0.65	2.1	190	300	3440	3480
1.10	1.50	1.43	2.5	3.0	14	75.6	74.8	72.0	65.6	0.81	0.75	0.68	0.56	3.0	200	320	3460	3490
1.50	2.00	1.88	3.8	4.2	19	74.0	73.6	71.0	64.6	0.77	0.70	0.60	0.47	4.1	190	310	3450	3490
2.20	3.00	2.53	5.8	6.0	29	75.4	71.7	71.7	65.0	0.70	0.65	0.54	0.42	6.0	220	330	3470	3490
3.00	4.00	3.45	7.0	7.8	38	75.9	75.2	72.4	65.8	0.78	0.74	0.65	0.52	8.2	220	320	3470	3490
4.00	5.50	4.60	9.0	9.4	50	79.5	79.5	78.0	73.0	0.77	0.73	0.64	0.51	11.0	220	310	3470	3490
5.50	7.50	6.33	12.1	12.8	71	80.6	80.7	79.5	75.2	0.78	0.73	0.64	0.50	15.0	230	320	3470	3490
7.50	10.00	8.63	17.5	18.6	102	80.0	79.9	78.4	73.5	0.73	0.68	0.58	0.44	20.6	260	350	3460	3490

3 × 380 V, 50 Hz, T60

Power	Current		Motor efficiency η			Cos φ			Torque			Speed
FL	FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
0.55	1.5	6.5	65.0	64.2	59.3	0.85	0.82	0.75	1.8	150	210	2830
2.20	5.8	26	76.9	77.2	74.0	0.84	0.77	0.65	7.4	150	230	2870
3.00	7.8	37	79.1	79.5	76.8	0.83	0.77	0.65	10.0	170	240	2880
4.00	10.2	45	78.6	79.7	77.4	0.86	0.82	0.72	13.4	160	220	2860
5.50	14.2	66	79.7	80.9	78.7	0.83	0.75	0.62	18.6	180	240	2860

3 × 400 V, 50 Hz, T60

Power	Current		Motor efficiency η			Cos φ			Torque			Speed
FL	FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
0.55	1.4	7	66.4	64.7	59.0	0.84	0.80	0.73	1.8	170	230	2850
2.20	5.9	27	77.1	76.5	72.4	0.80	0.72	0.59	7.3	180	260	2880
3.00	7.8	39	79.5	79.0	75.1	0.79	0.71	0.58	10.0	200	280	2890
4.00	9.8	48	79.3	79.6	76.6	0.84	0.78	0.67	13.3	180	250	2880
5.50	14.4	71	79.9	79.8	76.8	0.78	0.69	0.55	18.4	210	270	2880

3 × 415 V, 50 Hz, T60

Power	Current		Motor efficiency η			Cos φ			Torque			Speed
FL	FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
0.55	1.4	7	67.1	64.9	58.8	0.83	0.79	0.70	1.8	180	260	2870
2.20	6.0	29	76.6	75.3	70.4	0.76	0.67	0.54	7.3	190	280	2890
3.00	7.8	41	78.9	77.6	73.4	0.76	0.67	0.54	10.0	210	300	2900
4.00	9.7	50	79.6	79.0	75.3	0.82	0.74	0.62	13.3	200	270	2890
5.50	14.6	74	79.1	79.1	74.8	0.74	0.64	0.50	18.4	230	290	2890

3 × 440 V, 60 Hz, T60

Power			Current			Motor efficiency η				Cos φ				Torque			Speed	
FL		SF	FL	SF	LR	SF	FL	¾FL	½FL	SF	FL	¾FL	½FL	FL	LR	BD	SF	FL
[kW]	[hp]	[kW]	[A]	[A]	[A]	[%]	[%]	[%]	[%]	[-]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]	[rpm]
0.55	0.75	0.83	1.5	2.1	6.7	61.2	61.9	58.6	51.3	0.86	0.84	0.81	0.75	1.5	170	240	3320	3440
2.20	3.00	2.53	5.0	5.8	27	73.6	73.5	71.6	66.1	0.86	0.84	0.79	0.70	6.1	180	270	3450	3470
3.00	4.00	3.45	6.7	7.6	38	75.7	75.4	73.4	67.9	0.86	0.84	0.79	0.71	8.2	200	290	3450	3480
4.00	5.50	4.60	8.4	9.9	47	75.9	76.2	75.1	70.7	0.88	0.86	0.83	0.76	11.0	180	260	3440	3460
5.50	7.50	6.33	11.6	13.8	70	76.8	77.1	76.2	71.9	0.87	0.86	0.81	0.72	15.2	210	290	3460	3480

3 × 460 V, 60 Hz, T60

Power			Current			Motor efficiency η				Cos φ				Torque			Speed	
FL		SF	FL	SF	LR	SF	FL	¾FL	½FL	SF	FL	¾FL	½FL	FL	LR	BD	SF	FL
[kW]	[hp]	[kW]	[A]	[A]	[A]	[%]	[%]	[%]	[%]	[-]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]	[rpm]
0.55	0.75	0.83	1.4	1.9	7	63.6	62.5	58.7	51.1	0.86	0.83	0.79	0.73	1.5	190	270	3369	3460
2.20	3.00	2.53	5.0	5.7	28	74.3	73.8	71.3	65.2	0.84	0.82	0.76	0.66	6.0	200	310	3460	3480
3.00	4.00	3.45	7.6	7.6	41	76.2	75.6	78.2	67.1	0.84	0.82	0.76	0.66	8.2	220	320	3470	3490
4.00	5.50	4.60	8.4	9.6	49	76.8	76.7	75.1	70.1	0.87	0.85	0.80	0.71	11.0	200	290	3460	3480
5.50	7.50	6.33	12.2	13.8	74	81.2	81.3	80.0	75.6	0.80	0.76	0.68	0.55	15.2	230	320	3470	3490

3 × 480 V, 60 Hz, T60

Power			Current			Motor efficiency η				Cos φ				Torque			Speed	
FL		SF	FL	SF	LR	SF	FL	¾FL	½FL	SF	FL	¾FL	½FL	FL	LR	BD	SF	FL
[kW]	[hp]	[kW]	[A]	[A]	[A]	[%]	[%]	[%]	[%]	[-]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]	[rpm]
0.55	0.75	0.83	1.4	1.8	7.3	65.3	62.9	58.7	50.7	0.86	0.82	0.78	0.71	1.5	200	290	3400	3480
2.20	3.00	2.53	5.0	5.7	30	74.4	73.6	70.6	63.9	0.82	0.79	0.72	0.60	6.0	220	340	3480	3500
3.00	4.00	3.45	6.6	7.6	43	76.4	75.5	72.5	66.0	0.82	0.79	0.72	0.61	8.2	250	360	3480	3500
4.00	5.50	4.60	8.2	9.5	52	77.4	77.0	74.9	69.4	0.85	0.83	0.77	0.68	10.9	220	320	3470	3490
5.50	7.50	6.33	12.9	14.2	78	80.9	80.6	78.7	73.6	0.75	0.71	0.62	0.49	15.1	260	360	3480	3500

Voltage code 18

3 × 500 V, 50 Hz, T40

Power	Current		Motor efficiency η			Cos φ			Torque			Speed
FL	FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
0.75	1.5	7	73.7	72.7	69.1	0.84	0.79	0.69	2.5	160	240	2870
1.10	2.2	11	74.9	74.0	75.0	0.81	0.74	0.62	3.7	160	240	2870
1.50	3.2	14	73.6	72.9	68.3	0.78	0.68	0.54	5.0	150	230	2860
2.20	4.5	21	72.3	70.5	64.7	0.74	0.63	0.49	7.4	160	240	2850
3.00	6.3	28	75.1	74.8	70.8	0.77	0.67	0.52	10.0	170	240	2860
4.00	7.7	37	78.0	79.0	76.6	0.80	0.71	0.57	13.4	170	240	2860
5.50	10.4	52	79.5	80.5	78.5	0.81	0.72	0.57	18.3	180	250	2860
7.50	15.0	73	77.9	78.4	75.2	0.77	0.67	0.52	25.3	200	260	2850

3 × 525 V, 50 Hz, T40

Power	Current		Motor efficiency η			Cos φ			Torque			Speed
FL	FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
0.75	1.5	7.5	72.9	71.4	66.8	0.82	0.76	0.66	2.5	180	260	2880
1.10	2.2	11	75.0	73.5	69.1	0.78	0.70	0.57	3.7	170	270	2880
1.50	3.3	14	72.9	71.4	66.0	0.73	0.64	0.51	5.0	170	260	2870
2.20	4.8	22	70.6	67.5	60.0	0.72	0.61	0.48	7.4	190	270	2870
3.00	6.4	29	74.5	72.9	67.1	0.72	0.61	0.47	10.0	190	270	2870
4.00	7.8	39	77.7	77.6	73.8	0.77	0.66	0.52	13.3	200	270	2870
5.50	10.6	56	79.2	79.2	76.0	0.76	0.66	0.51	18.2	210	280	2880
7.50	15.4	78	77.7	77.1	72.3	0.72	0.62	0.46	25.1	230	290	2870

3 × 500 V, 50 Hz, T60

Power	Current		Motor efficiency η			Cos φ			Torque			Speed
FL	FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
2.20	4.7	22	77.1	76.5	72.4	0.80	0.72	0.59	7.3	180	270	2880
3.00	6.2	30	79.5	79.0	75.1	0.79	0.71	0.58	10.0	180	260	2890
4.00	7.8	39	79.3	79.6	76.6	0.84	0.78	0.67	13.3	180	250	2880
5.50	11.6	54	79.9	79.8	76.8	0.78	0.69	0.55	18.5	200	260	2880

3 × 525 V, 50 Hz, T60

Power	Current		Motor efficiency η			Cos φ			Torque			Speed
FL	FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
2.20	4.7	24	76.6	75.3	70.4	0.76	0.67	0.54	7.3	210	300	2890
3.00	6.2	32	78.9	77.6	73.3	0.76	0.67	0.54	10.0	200	290	2900
4.00	7.7	41	79.6	79.0	75.3	0.82	0.74	0.62	13.2	210	280	2890
5.50	11.6	58	79.7	79.1	74.8	0.74	0.64	0.50	18.4	230	290	2890

Voltage code 28

3 × 208 V, 60 Hz, T40

Power			Current			Motor efficiency η				Cos φ				Torque			Speed	
FL		SF	FL	SF	LR	SF	FL	¾FL	½FL	SF	FL	¾FL	½FL	FL	LR	BD	SF	FL
[kW]	[hp]	[kW]	[A]	[A]	[A]	[%]	[%]	[%]	[%]	[-]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]	[rpm]
0.75	1.00	1.05	3.9	5.1	19	67.1	68.1	65.7	59.5	0.87	0.84	0.80	0.73	2.1	160	230	3370	3450
1.10	1.50	1.43	5.8	6.9	24	65.7	67.5	65.9	60.1	0.87	0.86	0.83	0.77	3.1	140	220	3340	3420
1.50	2.00	1.88	7.9	9.4	31	67.9	69.8	68.8	63.7	0.88	0.86	0.81	0.73	4.2	130	210	3350	3420
2.20	3.00	2.53	10.8	11.9	48	72.2	72.6	71.1	65.9	0.86	0.84	0.79	0.68	6.1	150	230	3410	3440
3.00	4.00	3.45	13.9	15.1	63	73.3	74.3	74.1	70.1	0.88	0.86	0.82	0.73	8.4	150	220	3400	3430
4.00	5.50	4.60	18.1	19.3	84	78.9	79.9	79.9	77.1	0.88	0.87	0.83	0.76	11.1	150	220	3400	3430
5.50	7.50	6.33	24.5	27.0	119	75.8	76.9	77.0	73.8	0.88	0.87	0.83	0.76	15.3	160	230	3420	3440
7.50	10.00	8.63	33.0	35.0	164	77.6	79.5	80.5	78.3	0.88	0.87	0.82	0.73	20.9	180	250	3370	3410

3 × 220 V, 60 Hz, T40

Power			Current			Motor efficiency η				Cos φ				Torque			Speed	
FL		SF	FL	SF	LR	SF	FL	¾FL	½FL	SF	FL	¾FL	½FL	FL	LR	BD	SF	FL
[kW]	[hp]	[kW]	[A]	[A]	[A]	[%]	[%]	[%]	[%]	[-]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]	[rpm]
0.75	1.00	1.05	3.6	4.7	20	72.0	72.4	70.1	64.0	0.87	0.85	0.80	0.72	2.1	180	290	3400	3470
1.10	1.50	1.43	5.0	6.3	25	74.5	74.9	73.2	67.8	0.86	0.82	0.77	0.67	3.1	150	250	3390	3470
1.50	2.00	1.88	7.5	7.5	32	74.4	75.6	74.3	68.9	0.85	0.80	0.73	0.60	4.2	150	240	3460	3420
2.20	3.00	2.53	10.6	11.4	52	72.9	72.5	70.0	63.7	0.83	0.80	0.72	0.60	6.1	170	270	3440	3460
3.00	4.00	3.45	13.0	14.0	68	78.2	79.0	78.7	74.8	0.82	0.79	0.70	0.57	8.3	170	260	3440	3460
4.00	5.50	4.60	16.8	18.1	90	79.0	79.9	79.3	71.1	0.85	0.82	0.76	0.64	11.1	170	250	3440	3460
5.50	7.50	6.33	23.4	24.5	128	78.2	79.0	79.9	78.9	0.87	0.84	0.77	0.64	15.2	180	260	3440	3470
7.50	10.00	8.63	31.4	33.0	177	79.4	80.4	80.3	77.2	0.86	0.84	0.78	0.66	20.8	200	280	3410	3450

3 × 230 V, 60 Hz, T40

Power			Current			Motor efficiency η				Cos φ				Torque			Speed	
FL		SF	FL	SF	LR	SF	FL	¾FL	½FL	SF	FL	¾FL	½FL	FL	LR	BD	SF	FL
[kW]	[hp]	[kW]	[A]	[A]	[A]	[%]	[%]	[%]	[%]	[-]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]	[rpm]
0.75	1.00	1.05	3.5	4.4	21	71.1	71.1	68.3	61.6	0.88	0.83	0.78	0.69	2.1	200	310	3430	3480
1.10	1.50	1.43	5.4	6.0	27	74.8	74.8	72.5	66.7	0.84	0.80	0.73	0.62	3.0	180	290	3420	3440
1.50	2.00	1.88	7.1	8.1	34	75.1	75.3	73.0	66.8	0.82	0.79	0.75	0.54	4.1	170	270	3440	3460
2.20	3.00	2.53	11.1	11.6	54	72.5	71.6	68.4	61.1	0.78	0.74	0.65	0.53	6.0	190	300	3460	3480
3.00	4.00	3.45	13.7	15.0	72	75.2	75.0	72.9	67.1	0.83	0.80	0.72	0.60	8.3	190	290	3450	3470
4.00	5.50	4.60	17.0	17.5	95	77.1	77.0	75.3	70.3	0.85	0.83	0.76	0.66	11.0	200	290	3450	3470
5.50	7.50	6.33	23.8	25.0	135	81.0	81.4	81.0	77.8	0.82	0.79	0.70	0.57	15.1	210	290	3460	3480
7.50	10.00	8.63	30.5	32.3	187	80.0	80.5	79.7	75.7	0.84	0.81	0.73	0.60	20.7	230	310	3740	3470

Voltage code 33

3 × 380V, 60 Hz, T40

Power			Current			Motor efficiency η				Cos φ				Torque			Speed	
FL		SF	FL	SF	LR	SF	FL	¾FL	½FL	SF	FL	¾FL	½FL	FL	LR	BD	SF	FL
[kW]	[hp]	[kW]	[A]	[A]	[A]	[%]	[%]	[%]	[%]	[-]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]	[rpm]
0.75	1.00	1.05	2.2	2.7	12	71.1	70.7	67.8	61.3	0.86	0.81	0.76	0.68	2.1	180	290	3420	3480
1.10	1.50	1.43	3.0	3.7	17	74.8	74.8	72.5	66.7	0.86	0.80	0.73	0.62	3.0	190	300	3480	3480
1.50	2.00	1.88	4.4	5.1	22	75.5	74.9	72.7	67.2	0.81	0.76	0.67	0.53	4.1	180	290	3440	3470
2.20	3.00	2.53	6.3	6.8	34	76.5	76.2	74.0	68.1	0.75	0.71	0.61	0.48	6.0	200	310	3460	3480
3.00	4.00	3.45	7.8	8.1	43	77.3	77.3	75.7	70.7	0.83	0.80	0.72	0.59	8.3	190	290	3450	3470
4.00	5.50	4.60	10.4	11.4	58	79.7	80.2	79.6	75.9	0.82	0.78	0.70	0.57	11.0	200	290	3450	3470
5.50	7.50	6.33	14.2	15.0	84	81.0	81.4	81.0	77.8	0.82	0.79	0.70	0.57	15.1	220	300	3460	3480
7.50	10.00	8.63	18.1	19.1	104	78.6	79.4	79.4	76.3	0.86	0.84	0.78	0.67	20.8	210	280	3410	3440

3 × 400 V, 60 Hz, T40

Power			Current			Motor efficiency η				Cos φ				Torque			Speed	
FL		SF	FL	SF	LR	SF	FL	¾FL	½FL	SF	FL	¾FL	½FL	FL	LR	BD	SF	FL
[kW]	[hp]	[kW]	[A]	[A]	[A]	[%]	[%]	[%]	[%]	[-]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]	[rpm]
0.75	1.00	1.05	2.1	2.7	12	72.3	70.7	67.3	60.1	0.84	0.80	0.73	0.63	2.1	200	320	3440	3490
1.10	1.50	1.43	3.1	3.7	18	73.4	71.7	68.1	60.7	0.81	0.75	0.67	0.56	3.0	210	340	3460	3500
1.50	2.00	1.88	4.6	5.2	23	73.2	71.6	67.9	60.2	0.77	0.70	0.60	0.48	4.1	200	320	3450	3490
2.20	3.00	2.53	7.0	7.3	36	72.1	70.6	66.0	57.6	0.69	0.64	0.54	0.43	6.0	230	350	3480	3490
3.00	4.00	3.45	8.3	9.0	46	77.0	76.5	73.9	67.7	0.78	0.73	0.64	0.51	8.2	220	330	3470	3490
4.00	5.50	4.60	10.4	11.4	62	78.6	78.2	76.1	70.6	0.81	0.77	0.68	0.55	11.0	220	320	3470	3490
5.50	7.50	6.33	14.8	15.2	90	76.9	76.1	73.4	67.0	0.80	0.76	0.68	0.55	15.0	250	340	3480	3500
7.50	10.00	8.63	17.7	18.6	111	79.3	79.6	78.6	74.6	0.84	0.80	0.72	0.59	20.7	240	320	3430	3460

3 × 415 V, 60 Hz, T40

Power			Current			Motor efficiency η				Cos φ				Torque			Speed	
FL		SF	FL	SF	LR	SF	FL	¾FL	½FL	SF	FL	¾FL	½FL	FL	LR	BD	SF	FL
[kW]	[hp]	[kW]	[A]	[A]	[A]	[%]	[%]	[%]	[%]	[-]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]	[rpm]
0.75	1.00	1.30	2.1	2.7	13	72.2	70.5	61.3	58.9	0.83	077	0.69	0.59	2.1	230	370	3460	3490
1.10	1.50	1.43	3.2	3.7	19	73.1	70.9	66.7	58.8	0.78	0.71	0.62	0.51	3.0	230	370	3470	3500
1.50	2.00	1.88	4.8	5.4	24	72.2	69.9	65.4	57.0	0.72	0.64	0.54	0.43	4.1	220	350	3460	3490
2.20	3.00	2.53	7.7	7.9	38	69.9	67.9	62.6	53.3	0.63	0.58	0.49	0.39	6.0	250	380	3490	3500
3.00	4.00	3.45	8.6	9.4	48	76.2	75.3	72.0	64.9	0.73	0.68	0.58	0.45	8.2	240	350	3480	3500
4.00	5.50	4.60	10.6	11.6	64	78.1	77.4	74.7	68.5	0.76	0.72	0.62	0.49	10.9	250	350	3480	3500
5.50	7.50	6.33	14.6	15.6	95	76.3	75.3	71.9	64.9	0.75	0.71	0.62	0.49	15.0	270	370	3490	3500
7.50	10.00	8.63	18.7	20.6	116	79.3	79.2	77.7	72.8	0.80	0.76	0.67	0.54	20.6	260	350	3450	3470

3 × 380 V, 60 Hz, T60

Power			Current			Motor efficiency η				Cos φ				Torque			Speed	
FL		SF	FL	SF	LR	SF	FL	¾FL	½FL	SF	FL	¾FL	½FL	FL	LR	BD	SF	FL
[kW]	[hp]	[kW]	[A]	[A]	[A]	[%]	[%]	[%]	[%]	[-]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]	[rpm]
5.50	7.50	6.33	13.3	14.2	75	77.4	78.1	77.8	74.5	0.88	0.87	0.83	0.74	15.3	190	270	3410	3440

3 × 400V, 60 Hz, T60

Power			Current			Motor efficiency η				Cos φ				Torque			Speed	
FL		SF	FL	SF	LR	SF	FL	¾FL	½FL	SF	FL	¾FL	½FL	FL	LR	BD	SF	FL
[kW]	[hp]	[kW]	[A]	[A]	[A]	[%]	[%]	[%]	[%]	[-]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]	[rpm]
5.50	7.50	6.33	12.9	13.7	80	78.5	78.8	77.8	73.8	0.87	0.85	0.80	0.70	15.2	220	300	3440	3460

3 × 415 V, 60 Hz, T60

Power			Current			Motor efficiency η				Cos φ				Torque			Speed	
FL		SF	FL	SF	LR	SF	FL	¾FL	½FL	SF	FL	¾FL	½FL	FL	LR	BD	SF	FL
[kW]	[hp]	[kW]	[A]	[A]	[A]	[%]	[%]	[%]	[%]	[-]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]	[rpm]
5.50	7.50	6.33	12.5	13.4	83.6	79.1	79.1	77.6	73.0	0.85	0.83	0.77	0.67	15.1	240	330	3450	3470

Voltage code 30

3 × 208 V, 60 Hz, T40

Power			Current			Motor efficiency η				Cos φ				Torque			Speed	
FL		SF	FL	SF	LR	SF	FL	¾FL	½FL	SF	FL	¾FL	½FL	FL	LR	BD	SF	FL
[kW]	[hp]	[kW]	[A]	[A]	[A]	[%]	[%]	[%]	[%]	[-]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]	[rpm]
2.20	3.00	2.53	10.8	11.9	48	72.2	72.6	71.1	65.9	0.86	0.84	0.79	0.68	6.1	150	230	3410	3440
3.00	4.00	3.45	13.9	15.1	63	73.3	74.3	74.1	70.1	0.88	0.86	0.82	0.73	8.4	150	220	3400	3430
3.70	5.00	4.26	17.0	18.6	84	75.4	76.0	75.2	71.1	0.88	0.86	0.82	0.74	10.3	160	240	3420	3450
5.50	7.50	6.33	24.5	27.0	119	75.8	76.9	77.0	73.8	0.88	0.87	0.83	0.76	15.3	160	230	3420	3440
7.50	10.00	8.63	32.8	35.0	164	77.6	79.5	80.5	78.3	0.88	0.87	0.82	0.73	20.9	170	240	3370	3420

3 × 220 V, 60 Hz, T40

Power			Current			Motor efficiency η				Cos φ				Torque			Speed	
FL		SF	FL	SF	LR	SF	FL	¾FL	½FL	SF	FL	¾FL	½FL	FL	LR	BD	SF	FL
[kW]	[hp]	[kW]	[A]	[A]	[A]	[%]	[%]	[%]	[%]	[-]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]	[rpm]
2.20	3.00	2.53	10.6	11.4	52	72.9	72.5	70.0	63.7	0.83	0.80	0.72	0.60	6.1	170	270	3440	3460
3.00	4.00	3.45	13.0	14.0	68	78.2	79.0	78.7	74.8	0.82	0.79	0.70	0.57	8.3	180	260	3440	3460
3.70	5.00	4.26	16.4	17.8	89	77.1	76.7	75.1	70.2	0.84	0.84	0.79	0.69	10.2	200	280	3440	3470
5.50	7.50	6.33	23.4	24.5	128	78.2	79.0	79.9	78.9	0.87	0.84	0.77	0.64	15.2	190	270	3440	3470
7.50	10.00	8.63	31.4	33.0	177	79.4	80.4	80.3	77.2	0.86	0.84	0.78	0.66	20.8	200	280	3410	3450

3 × 230 V, 60 Hz, T40

Power			Current			Motor efficiency η				Cos φ				Torque			Speed	
FL		SF	FL	SF	LR	SF	FL	¾FL	½FL	SF	FL	¾FL	½FL	FL	LR	BD	SF	FL
[kW]	[hp]	[kW]	[A]	[A]	[A]	[%]	[%]	[%]	[%]	[-]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]	[rpm]
2.20	3.00	2.53	11.1	11.6	54	72.5	71.6	68.4	61.1	0.78	0.74	0.65	0.53	6.0	190	300	3460	3480
3.00	4.00	3.45	13.7	15.0	72	75.2	75.0	72.9	67.1	0.83	0.80	0.72	0.60	8.3	190	290	3450	3470
3.70	5.00	4.26	16.1	17.4	95	81.5	81.6	80.4	76.0	0.79	0.76	0.67	0.54	10.2	210	310	3460	3480
5.50	7.50	6.33	23.8	25.0	135	81.0	81.4	81.0	77.8	0.82	0.79	0.70	0.57	15.1	210	290	3460	3480
7.50	10.00	8.63	30.5	32.3	187	80.0	80.5	79.7	75.7	0.84	0.81	0.73	0.60	20.7	230	310	3740	3470

Voltage code 35

3 × 440 V, 60 Hz, T40

Power			Current			Motor efficiency η				Cos φ				Torque			Speed	
FL		SF	FL	SF	LR	SF	FL	¾FL	½FL	SF	FL	¾FL	½FL	FL	LR	BD	SF	FL
[kW]	[hp]	[kW]	[A]	[A]	[A]	[%]	[%]	[%]	[%]	[-]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]	[rpm]
0.75	1.00	1.05	1.7	2.3	9	65.4	72.4	70.1	56.6	0.87	0.85	0.80	0.72	2.1	160	230	3360	3450
1.10	1.50	1.43	2.5	3.0	13	74.5	74.9	73.2	67.8	0.87	0.83	0.77	0.67	3.0	160	260	3420	3470
1.50	2.00	1.88	3.5	4.1	17	74.4	75.6	74.3	68.9	0.85	0.80	0.73	0.61	4.2	150	250	3420	3460
2.20	3.00	2.53	5.3	5.7	26	77.2	77.3	75.9	71.0	0.80	0.76	0.67	0.54	6.1	170	270	3440	3470
3.00	4.00	3.45	6.7	7.4	34	75.8	76.0	74.6	69.8	0.86	0.83	0.77	0.66	8.3	170	260	3430	3460
3.70	5.00	4.26	8.1	8.6	45	79.6	80.1	79.3	75.3	0.83	0.81	0.74	0.61	10.2	190	270	3450	3470
5.50	7.50	6.33	11.4	12.8	63	78.2	79.0	79.9	78.9	0.87	0.84	0.77	0.63	15.2	180	260	3440	3460
7.50	10.00	8.63	16.0	18.0	91	80.4	81.3	81.5	78.8	0.83	0.79	0.71	0.57	20.8	210	280	3430	3460

3 × 460 V, 60 Hz, T40

Power			Current			Motor efficiency η				Cos φ				Torque			Speed	
FL		SF	FL	SF	LR	SF	FL	¾FL	½FL	SF	FL	¾FL	½FL	FL	LR	BD	SF	FL
[kW]	[hp]	[kW]	[A]	[A]	[A]	[%]	[%]	[%]	[%]	[-]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]	[rpm]
0.75	1.00	1.05	1.8	2.2	10	71.1	71.3	68.3	61.6	0.86	0.83	0.78	0.69	2.1	170	270	3420	3470
1.10	1.50	1.43	2.5	3.0	14	74.8	74.8	72.5	66.7	0.80	0.80	0.73	0.62	3.0	180	290	3440	3480
1.50	2.00	1.88	3.6	4.1	18	75.1	75.3	73.0	66.8	0.82	0.75	0.66	0.54	4.1	180	280	3440	3480
2.20	3.00	2.53	5.5	5.8	28	73.5	72.7	69.6	62.6	0.78	0.74	0.64	0.52	6.0	190	300	3460	3480
3.00	4.00	3.45	6.6	7.5	36	76.2	75.9	73.8	68.1	0.83	0.80	0.72	0.59	8.2	200	290	3450	3470
3.70	5.00	4.26	8.1	8.6	47	80.0	80.2	79.1	74.9	0.80	0.76	0.67	0.54	10.2	210	300	3460	3480
5.50	7.50	6.33	11.7	12.6	67	81.0	81.4	81.0	77.8	0.82	0.79	0.70	0.57	15.1	210	290	3460	3480
7.50	10.00	8.63	16.9	18.6	97	80.3	81.0	80.6	76.7	0.78	0.74	0.64	0.51	20.7	230	310	3470	3450

3 × 440 V, 60 Hz, T60

Power			Current			Motor efficiency η				Cos φ				Torque			Speed	
FL		SF	FL	SF	LR	SF	FL	¾FL	½FL	SF	FL	¾FL	½FL	FL	LR	BD	SF	FL
[kW]	[hp]	[kW]	[A]	[A]	[A]	[%]	[%]	[%]	[%]	[-]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]	[rpm]
2.20	3.00	2.53	5.0	5.8	27	73.6	73.5	71.6	66.1	0.86	0.84	0.79	0.70	6.1	180	270	3450	3470
3.00	4.00	3.45	6.7	7.6	38	75.7	75.4	73.4	67.9	0.86	0.84	0.79	0.71	8.2	200	290	3450	3480
3.70	5.00	4.26	8.0	9.1	47	76.1	76.1	74.5	69.5	0.87	0.86	0.82	0.74	10.2	190	280	3460	3480
5.50	7.50	6.33	11.6	13.8	70	76.8	77.1	76.2	71.9	0.87	0.86	0.81	0.72	15.2	210	290	3460	3480

3 × 460 V, 60 Hz, T60

Power			Current			Motor efficiency η				Cos φ				Torque			Speed	
FL		SF	FL	SF	LR	SF	FL	¾FL	½FL	SF	FL	¾FL	½FL	FL	LR	BD	SF	FL
[kW]	[hp]	[kW]	[A]	[A]	[A]	[%]	[%]	[%]	[%]	[-]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]	[rpm]
2.20	3.00	2.53	5.0	5.7	28	74.3	73.8	71.3	65.2	0.84	0.82	0.76	0.66	6.0	200	310	3460	3480
3.00	4.00	3.45	7.6	7.6	41	76.2	75.6	78.2	67.1	0.84	0.82	0.76	0.66	8.2	220	320	3470	3490
3.70	5.00	4.26	9.1	9.1	49	76.8	76.5	74.4	68.8	0.86	0.84	0.79	0.70	10.1	220	320	3470	3490
5.50	7.50	6.33	12.2	13.8	74	81.2	81.3	80.0	75.6	0.80	0.76	0.68	0.55	15.2	230	320	3470	3490

Voltage code 39

3 × 575 V, 60 Hz, T40

Power			Current			Motor efficiency η				Cos φ				Torque			Speed	
FL		SF	FL	SF	LR	SF	FL	¾FL	½FL	SF	FL	¾FL	½FL	FL	LR	BD	SF	FL
[kW]	[hp]	[kW]	[A]	[A]	[A]	[%]	[%]	[%]	[%]	[-]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]	[rpm]
0.75	1.00	1.05	1.5	1.8	8	71.1	71.1	68.3	61.6	0.85	0.83	0.78	0.69	2.1	170	280	3470	3400
1.10	1.50	1.43	2.0	2.4	11	74.8	74.8	72.5	66.7	0.85	0.84	0.73	0.62	3.0	180	290	3440	3480
1.50	2.00	1.88	2.9	3.3	14	75.1	75.3	73.0	66.8	0.81	0.75	0.66	0.54	4.1	170	280	3480	3480
2.20	3.00	2.53	4.3	4.7	21	73.9	73.3	70.5	63.9	0.80	0.76	0.67	0.54	6.0	190	290	3450	3470
3.00	4.00	3.45	5.6	6.0	29	75.1	74.9	72.8	67.0	0.83	0.80	0.72	0.60	8.3	190	280	3450	3470
3.70	5.00	4.26	6.6	6.9	38	80.4	80.5	79.4	75.4	0.80	0.76	0.67	0.54	10.2	210	300	3470	3490
5.50	7.50	6.33	9.0	10.0	54	81.0	81.4	81.0	77.8	0.82	0.78	0.70	0.57	15.1	210	290	3460	3480
7.50	10.00	8.63	13.2	14.4	77	80.3	81.0	80.6	76.7	0.79	0.74	0.64	0.51	20.7	230	310	3450	3470

3 × 575 V, 60 Hz, T60

Power			Current			Motor efficiency η				Cos φ				Torque			Speed	
FL		SF	FL	SF	LR	SF	FL	¾FL	½FL	SF	FL	¾FL	½FL	FL	LR	BD	SF	FL
[kW]	[hp]	[kW]	[A]	[A]	[A]	[%]	[%]	[%]	[%]	[-]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]	[rpm]
2.20	3.00	2.53	4.0	4.6	23	74.7	74.2	71.6	65.4	0.84	0.82	0.75	0.65	6.0	210	320	3460	3480
3.00	4.00	3.45	5.2	6.1	31	75.6	75.2	72.9	67.2	0.83	0.83	0.78	0.68	8.2	200	300	3460	3480
3.70	5.00	4.26	6.3	7.2	40	77.0	76.6	74.5	68.9	0.86	0.84	0.78	0.69	10.1	220	320	3470	3490
5.50	7.50	6.33	9.1	10.3	57	77.4	77.6	76.3	71.7	0.86	0.85	0.80	0.70	15.2	230	310	3430	3460

Voltage code 09

3 × 200 V, 50 Hz, T40

Power	Current		Motor efficiency η			Cos φ			Torque			Speed
FL	FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
0.75	3.8	20	72.8	71.9	68.1	0.84	0.79	0.69	2.5	180	280	2870
1.10	5.5	26	74.9	74.0	70.3	0.82	0.74	0.62	3.7	160	240	2870
1.50	7.9	33	73.6	72.9	68.3	0.78	0.68	0.54	5.0	150	230	2860
1.90	10.2	44	72.3	70.7	65.1	0.80	0.72	0.58	6.3	170	250	2860
2.20	12.2	52	71.7	69.4	62.8	0.77	0.63	0.52	7.4	170	250	2860
2.70	13.6	64	74.9	74.3	69.8	0.82	0.74	0.61	9.0	170	250	2860
3.00	15.6	69	75.1	74.8	70.8	0.77	0.67	0.52	10.0	170	240	2860
3.70	18.1	90	76.8	76.3	72.3	0.83	0.75	0.62	12.3	190	260	2870
4.00	19.2	92	77.9	79.0	76.6	0.80	0.71	0.57	13.4	180	240	2860
5.50	24.3	130	77.4	77.5	74.1	0.84	0.77	0.64	18.3	180	250	2860

3 × 200 V, 60 Hz, T40

Power		Current		Motor efficiency η			Cos φ			Torque			Speed
FL		FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[hp]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
0.75	1.00	3.9	18	70.2	69.4	64.7	0.87	0.84	0.78	2.1	150	210	3430
1.10	1.50	5.3	23	72.8	72.3	68.2	0.86	0.83	0.76	3.1	130	180	3430
1.50	2.00	7.0	29	75.0	75.8	72.8	0.86	0.82	0.72	4.2	120	200	3430
1.90	2.50	9.5	39	71.6	71.5	67.5	0.87	0.84	0.76	5.3	130	210	3420
2.20	3.00	10.8	46	72.0	71.4	66.8	0.86	0.82	0.73	6.1	130	210	3440
2.70	3.60	13.1	55	73.2	73.5	69.9	0.88	0.84	0.77	7.5	130	210	3420
3.00	4.00	14.2	60	77.5	78.8	76.5	0.86	0.80	0.70	8.4	130	200	3430
3.70	5.00	17.6	79	74.9	74.9	71.3	0.87	0.84	0.77	10.3	140	220	3430
4.00	5.50	18.8	79	78.7	80.1	79.0	0.87	0.82	0.74	11.2	140	200	3430
5.50	7.50	26.1	113	75.8	76.7	74.1	0.88	0.85	0.78	15.3	140	210	3430

3 × 220 V, 60 Hz, T40

Power		Current		Motor efficiency η			Cos φ			Torque			Speed
FL		FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[hp]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
0.75	1.00	3.6	20	72.4	70.1	64.0	0.85	0.80	0.72	2.1	180	290	3470
1.10	1.50	5.0	25	74.9	73.2	67.8	0.82	0.77	0.67	3.1	150	250	3470
1.50	2.00	6.8	32	75.6	74.3	68.9	0.80	0.73	0.60	4.2	150	240	3460
1.90	2.50	9.0	44	73.0	71.0	65.3	0.82	0.76	0.65	5.2	170	260	3460
2.20	3.00	10.6	52	72.5	70.0	63.7	0.80	0.72	0.60	6.1	170	270	3460
2.70	3.60	12.2	62	75.0	73.5	68.4	0.84	0.78	0.68	7.4	170	260	3460
3.00	4.00	13.0	68	79.0	78.7	74.8	0.79	0.70	0.57	8.3	170	260	3460
3.70	5.00	16.2	89	76.5	75.0	70.0	0.84	0.79	0.69	10.2	190	270	3470
4.00	5.50	16.8	90	79.9	79.3	71.1	0.82	0.76	0.64	11.1	170	250	3460
5.50	7.50	23.4	128	79.0	79.9	78.9	0.84	0.77	0.64	15.2	180	260	3470

3 × 200 V, 50 Hz, T60

Power	Current		Motor efficiency η			Cos φ			Torque			Speed
FL	FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
1.50	7.4	36	71.6	69.8	66.2	0.85	0.79	0.67	5.0	170	260	2860
1.90	9.4	47	74.2	73.7	70.0	0.85	0.79	0.69	6.3	170	260	2860
2.20	10.4	55	73.2	71.6	68.2	0.85	0.79	0.67	7.3	180	270	2870
2.70	12.9	67	76.3	76.2	73.2	0.85	0.80	0.70	9.0	180	260	2870
3.00	13.3	76	76.7	76.3	72.5	0.84	0.78	0.66	10.0	190	270	2870
3.70	17.3	87	76.8	77.2	74.8	0.87	0.83	0.73	12.3	180	250	2860
4.00	18.0	95	75.3	74.2	71.6	0.88	0.84	0.74	13.3	180	250	2860
5.50	26.5	156	78.2	77.6	73.7	0.81	0.74	0.61	18.3	230	300	2870

3 × 200 V, 60 Hz, T60

Power		Current		Motor efficiency η			Cos φ			Torque			Speed
FL		FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[hp]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
1.50	2.00	7.6	32	68.8	67.8	62.7	0.87	0.84	0.79	4.2	140	210	3410
1.90	2.50	9.7	41	70.4	69.9	65.4	0.87	0.84	0.78	5.3	140	210	3420
2.20	3.00	10.6	48	72.4	71.8	67.5	0.87	0.84	0.78	6.1	140	220	3430
2.70	3.60	13.2	58	73.1	73.1	69.3	0.87	0.85	0.79	7.5	140	220	3430
3.00	4.00	13.2	66	74.3	74.1	70.4	0.87	0.84	0.78	8.3	150	230	3440
3.70	5.00	18.0	75	73.1	73.5	70.3	0.88	0.86	0.80	10.3	130	200	3420
4.00	5.50	18.8	82	73.8	74.3	71.2	0.88	0.86	0.80	11.2	140	210	3420
5.50	7.50	25.5	136	77.5	77.6	74.5	0.87	0.83	0.75	15.2	180	260	3440

3 × 220 V, 60 Hz, T60

Power		Current		Motor efficiency η			Cos φ			Torque			Speed
FL		FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[hp]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
1.50	2.00	7.0	36	70.7	68.1	61.8	0.84	0.80	0.73	4.1	170	270	3460
1.90	2.50	8.8	46	72.4	70.4	64.7	0.85	0.81	0.73	5.2	170	270	3460
2.20	3.00	10.0	54	74.0	72.0	66.4	0.84	0.79	0.70	6.1	180	280	3470
2.70	3.60	11.9	65	75.2	73.7	68.7	0.86	0.82	0.74	7.4	180	270	3470
3.00	4.00	12.1	75	75.9	74.3	69.3	0.84	0.79	0.70	8.2	190	290	3470
3.70	5.00	16.0	85	75.6	74.5	70.0	0.86	0.83	0.76	10.2	170	260	3460
4.00	5.50	16.6	93	76.2	75.1	70.7	0.86	0.83	0.76	11.0	180	260	3470
5.50	7.50	23.6	154	78.8	77.5	73.0	0.84	0.78	0.67	15.1	230	330	3470

Voltage code 65

3 × 400 V, 50 Hz, T40

Power	Current		Motor efficiency η			Cos φ			Torque			Speed
FL	FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
0.75	2.0	9	72.8	71.9	68.1	0.84	0.79	0.69	2.5	180	280	2870
1.10	2.8	13	74.9	74.0	70.3	0.81	0.74	0.62	3.7	160	240	2870
1.50	4.0	17	73.6	72.9	68.2	0.78	0.68	0.54	5.0	150	230	2860
1.90	5.1	22	72.3	70.7	65.1	0.80	0.72	0.58	6.3	170	250	2860
2.20	6.0	26	74.3	73.1	67.6	0.76	0.63	0.49	7.4	170	250	2860
2.70	6.8	32	74.9	74.3	69.8	0.82	0.74	0.61	9.0	170	250	2860
3.00	7.9	35	75.5	74.9	70.9	0.81	0.73	0.58	10.0	170	250	2850
3.70	9.1	45	76.8	76.3	72.3	0.83	0.75	0.62	12.3	190	260	2870
4.00	9.6	46	77.9	79.0	76.6	0.80	0.71	0.57	13.4	170	240	2860
5.50	13.0	65	79.5	80.5	78.3	0.81	0.72	0.57	18.4	180	250	2860
7.50	19.3	92	77.9	78.4	75.2	0.77	0.67	0.52	25.3	200	260	2850

3 × 400 V, 60 Hz, T40

Power		Current		Motor efficiency η			Cos φ			Torque			Speed
FL		FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[hp]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
0.75	1.00	1.9	8	70.2	69.4	64.7	0.87	0.84	0.78	2.1	130	190	3430
1.10	1.50	2.7	12	72.8	72.3	68.2	0.86	0.83	0.76	3.1	130	200	3430
1.50	2.00	3.5	15	75.0	75.8	72.8	0.86	0.81	0.72	4.2	120	200	3430
1.90	2.50	4.8	20	71.6	71.5	67.5	0.87	0.84	0.76	5.3	130	210	3420
2.20	3.00	5.4	23	73.1	72.8	68.7	0.86	0.81	0.72	6.1	130	210	3430
2.70	3.60	6.5	28	73.2	73.5	69.9	0.88	0.84	0.77	7.5	130	210	3420
3.00	4.00	7.1	30	74.4	74.8	71.5	0.87	0.84	0.77	8.4	130	210	3410
3.70	5.00	8.7	40	74.9	74.9	71.3	0.87	0.84	0.77	10.3	140	220	3430
4.00	5.50	9.4	40	78.6	80.4	78.8	0.87	0.83	0.75	11.2	130	200	3430
5.50	7.50	11.8	56	80.0	81.6	80.3	0.87	0.85	0.77	15.4	140	210	3440
7.50	10.00	16.4	81	79.9	82.6	82.3	0.86	0.80	0.69	21.1	160	230	3420

3 × 440 V, 60 Hz, T40

Power		Current		Motor efficiency η			Cos φ			Torque			Speed
FL		FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[hp]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
0.75	1.00	1.7	9	72.4	70.1	56.6	0.85	0.80	0.72	2.1	160	230	3470
1.10	1.50	2.5	13	74.9	73.2	67.8	0.83	0.77	0.67	3.0	160	260	3470
1.50	2.00	3.5	17	75.6	74.3	68.9	0.80	0.73	0.61	4.2	150	250	3460
1.90	2.50	4.5	22	73.0	71.0	65.3	0.82	0.76	0.65	5.2	170	260	3460
2.20	3.00	5.3	26	77.3	75.9	71.0	0.76	0.67	0.54	6.1	170	270	3470
2.70	3.60	6.1	31	75.0	73.5	68.4	0.84	0.78	0.68	7.4	170	260	3460
3.00	4.00	6.7	34	76.0	74.6	69.8	0.83	0.77	0.66	8.3	170	260	3460
3.70	5.00	8.1	45	80.1	79.3	75.3	0.81	0.74	0.61	10.2	190	270	3470
4.00	5.50	8.7	45	79.9	79.7	76.3	0.82	0.76	0.64	11.1	170	250	3460
5.50	7.50	11.4	63	79.0	79.9	78.9	0.84	0.77	0.63	15.2	180	260	3460
7.50	10.00	16.0	91	81.3	81.5	78.8	0.79	0.71	0.57	20.8	210	280	3460

3 × 400 V, 50 Hz, T60

Power	Current		Motor efficiency η			Cos φ			Torque			Speed
FL	FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
1.50	3.8	18	71.6	69.8	66.2	0.85	0.79	0.67	5.0	170	260	2860
1.90	4.7	24	74.3	73.8	70.0	0.85	0.79	0.68	6.3	170	260	2860
2.20	5.9	27	77.1	76.5	72.4	0.80	0.72	0.59	7.3	180	260	2880
2.70	6.5	33	76.3	76.2	73.2	0.85	0.80	0.70	9.0	180	260	2870
3.00	6.7	38	76.0	76.3	72.5	0.84	0.76	0.66	10.0	190	270	2870
3.70	8.6	44	76.8	77.2	74.8	0.87	0.83	0.73	12.3	180	250	2860
4.00	9.8	48	79.3	79.6	76.6	0.84	0.78	0.67	13.3	180	250	2880
5.50	14.4	71	79.9	79.8	76.8	0.78	0.69	0.55	18.4	210	270	2880

3 × 400 V, 60 Hz, T60

Power		Current		Motor efficiency η			Cos φ			Torque			Speed
FL		FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[hp]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
1.50	2.00	4.0	16	68.8	67.8	62.7	0.87	0.84	0.79	4.2	140	210	3410
1.90	2.50	4.8	21	70.4	69.9	65.4	0.87	0.84	0.78	5.3	140	210	3420
2.20	3.00	5.4	24	71.8	71.4	67.2	0.87	0.84	0.78	6.1	140	220	3420
2.70	3.60	6.6	29	73.1	73.1	69.3	0.87	0.85	0.79	7.5	140	220	3430
3.00	4.00	6.7	33	74.3	74.1	70.4	0.87	0.84	0.78	8.3	150	230	3440
3.70	5.00	9.0	38	73.1	73.5	70.3	0.88	0.86	0.8	10.3	130	200	3420
4.00	5.50	9.4	41	73.8	74.3	71.2	0.88	0.86	0.8	11.2	140	210	3420
5.50	7.50	12.8	62	75.1	75.7	72.8	0.88	0.85	0.79	15.4	160	230	3400

3 × 440 V, 60 Hz, T60

Power		Current		Motor efficiency η			Cos φ			Torque			Speed
FL		FL	LR	FL	¾FL	½FL	FL	¾FL	½FL	FL	LR	BD	FL
[kW]	[hp]	[A]	[A]	[%]	[%]	[%]	[-]	[-]	[-]	[Nm]	[%]	[%]	[rpm]
1.50	2.00	3.6	18	70.7	68.1	61.8	0.84	0.80	0.73	4.1	170	270	3460
1.90	2.60	4.4	23	72.4	70.4	64.7	0.85	0.81	0.73	5.2	170	270	3470
2.20	3.00	5.0	27	73.5	71.6	66.1	0.84	0.79	0.70	6.1	180	270	3470
2.70	3.60	6.0	33	75.2	73.7	68.7	0.86	0.82	0.74	7.4	180	270	3470
3.00	4.00	6.6	38	75.9	74.3	69.3	0.84	0.79	0.70	8.2	190	290	3470
3.70	5.00	8.0	43	75.6	74.5	70.0	0.86	0.83	0.76	10.2	170	260	3460
4.00	5.50	8.4	47	76.2	75.1	70.7	0.86	0.83	0.76	11.0	180	260	3460
5.50	7.50	11.6	70	77.1	76.2	71.9	0.86	0.81	0.72	15.2	210	290	3480

7. Accessories

CSCR motor starters

SA-SPM motor starters are required to connect the MS4000 200-240V single-phase 3-wire CSCR motors.

The motor starter boxes incorporate start/run capacitors for motor operation and start/run overload relays together with a surge arrestor for motor protection.



TM077903

CSCR motor starters	CS [µF]	CR [µF]	Product number		
			Standard	Delux [8]	Approval
2.20 kW/50 Hz	260	60	98582401	-	CE
2.00 hp/60 Hz	115	20	98315256	98315257	$_{c}UL_{us}$
3.00 hp/60 Hz	220	35	98315258	99053534	$_{c}UL_{us}$
5.00 hp/60 Hz	300	80	98315260	99053535	$_{c}UL_{us}$

8) Deluxe versions with on/off pressure switch relay for extra protection.

Related information

Connection of single-phase motors

PSC motor capacitors

The MS4000 220-240V single-phase 3-wire PSC motors must be connected to the mains through a run capacitor permanently connected in series with the auxiliary winding.

Product numbers

Motor	Size [µF] / Voltage [V]	Product number
0.27 kW/50 Hz	16/400	96279800
0.55 kW/50 Hz	20/400	96279732
0.75 kW/50 Hz	30/400	96279808
1.10 kW/50 Hz	40/400	96279810
1.50 kW/50 Hz	60/400	96279809
2.20 kW/50 Hz	100/400	96279810 + 96279809 [9]

9) 40 µF + 60 µF capacitors in parallel

Related information

Connection of single-phase motors

CUE frequency converter



TM077504

The CUE range

The Grundfos CUE is a series of external frequency converters designed for speed control of a wide range of Grundfos pumps.

The CUE offers quick and easy setup and commissioning compared to a standard frequency converter because of the startup guide. The startup guide takes the installer through all the necessary settings, requiring few inputs from which the CUE automatically sets all necessary parameters.

The CUE enables gentle pumping and thereby protects the water reservoir and the rest of the distribution system, as water hammer can be avoided by adjusting ramp times up and down.

When a CUE is installed, the motor requires no further overload protection. If needed, a Pt100 or Pt1000 together with the MCB 114 provides overheat protection of the motor windings.

If the motor has a built-in Tempcon sensor, this sensor is disconnected when it is exposed to the frequency converter drive. An internal fuse in the motor melts and it cannot be replaced. The motor will work without the sensor, but it is not possible to restore the functionality of the Tempcon sensor.

Overview of CUE range

Supply voltage [V]	Power range								
	[kW]	0.55	0.75	1.1	7.5	11	45	90	250
	[hp]	0.75	1.0	1.5	10	15	60	125	350
1 × 200-240				•	•				
3 × 200-240			•	•	•	•	•		
3 × 380-500		•	•	•	•	•	•	•	•
3 × 525-600			•	•	•	•	•	•	
3 × 525-690						•	•	•	•

CUE is available in two enclosure classes:

- IP20/21
- IP54/55.

RFI filters

To meet the EMC requirements, the CUE comes with the following types of built-in radio frequency interference filter (RFI).

Voltage [V]	Typical shaft power, P2 [kW (hp)]	RFI filter type	Application
1 × 200-240	1.1 - 7.5 (1.5 - 10)	C1	Domestic
3 × 200-240	0.75 - 45 (1.0 - 60)	C1	
3 × 380-500	0.55 - 90 (0.75 - 125)	C1	
	110 - 250 (150 - 350)	C3	Industry
3 × 525-600	0.75 - 90 (1.0 - 125)	C3	
3 × 525-690	11 - 250 (15 - 350)	C3	

Inputs and outputs

The CUE is equipped with a number of inputs and outputs:

- 1 RS-485 GENIbus connection
- 1 analog input, 0-10 V, 0/4-20 mA
  - external setpoint
- 1 analog input, 0-10 V, 0/4-20 mA
  - sensor input, feedback sensor
- 1 analog output, 0-20 mA
- 6 digital inputs
  - 2 inputs can be changed to digital outputs
  - all digital inputs and outputs are programmable
- 2 signal relays (C/NO/NC)
  - programmable.

Features

CUE has the following features:

- startup guide for easy setup of the CUE with Grundfos pumps. It is automatically launched the first time the CUE is connected to the power supply (and relaunched on request)
- checking of direction of rotation
- duty or standby operation
- dry-running protection
- ow-flow stop function
- pump-specific functions.

Functions

The CUE has a wide range of pump-specific functions, such as the following:

- constant pressure
- constant level
- constant flow rate
- constant temperature
- constant curve.

Accessories

Grundfos offers various accessories for the CUE.

MCB 114 sensor input module

The MCB 114 is required to connect a Pt100/Pt1000 sensor, and offers additional analog inputs for the CUE:

- one analog input, 0/4-20 mA
- two inputs for the Pt100/Pt1000 temperature sensors.

Sensors

The following sensors can be used in connection with the CUE:

- pressure sensors, up to 25 bar
- temperature sensors
- differential-pressure sensors
- differential-temperature sensors
- flowmeters
- potentiometer box for external setpoint setting.

For further information, see the *CUE frequency converter data booklet* at the *Grundfos Product Center*.

Output filters

Output filters protect the motor from voltage peaks and increased operating temperature due to the frequency converter driving supply. The filters also decrease acoustic noise from the frequency converter driven motor.

Always use sine-wave filters for a submersible motor installation.

See section *Frequency converter operation* for further information.

Related information

Frequency converter operation

RSI frequency converter

The Grundfos Renewable Solar Inverter (RSI) is an off-grid solar inverter converting the DC power output from the solar panel to AC power supply for the pump operation.

RSI can be used in both new and existing systems as long as the motor specifications are compatible and the motor is suitable for use with a variable frequency drive.



TM066678

Applications

The RSI is designed for continuous as well as intermittent operation, and it is suitable for various water supply systems, including irrigation.

The RSI can be used in existing systems with submersible pumps or dry-installed pumps, thus providing a very wide range of applications, allowing you to leverage renewable energy sources with the ability to back up the system with grid or generator power.

Features and benefits

Enclosure classes up to IP66

RSI is available in three enclosure classes:

- IP21: The RSI must be installed in a cabinet with sufficient ingress protection.
- IP54: The RSI can be installed without a cabinet, but must not be installed outdoors without additional protection against water and sun.
- IP66: The RSI can be installed without a cabinet. It can be installed outdoors, but should be shaded from direct sunlight.

Setup wizard with Grundfos product library

The RSI has a built-in Grundfos product library that allows a plug-and-pump experience. The motor library contains all related parameters, which simplifies the setup process to just a few clicks and a setup time of a few minutes.

Detachable operating panel

The operating panel is mounted on the RSI via a magnet and a communication plug. The inverter can operate without the operating panel, and operates with the last saved setup data.

AC/DC compatibility

The RSI is AC and DC compatible. The RSI can be connected to the grid or a generator as back-up power during solar panel disruptions.

The AC compatibility also allows the end user to connect the inverter to three-phase power in their workshop for off-site setup, which enables a fast and simple on-site installation.

Maximum power point tracking (MPPT)

The inverter has built-in electronics with four MPPT algorithms. The inverter continuously optimises the power output according to available solar irradiation as well as various environmental conditions.

Overvoltage and undervoltage protection

Overvoltage and undervoltage may occur in case of faulty installation. The inverter disconnects the power connection to the motor if the voltage falls outside the allowed voltage limits. The inverter stays in fault mode with the error code displayed until reset.

Overload protection

Overload may occur if the maximum allowed frequency is set too high or a wrong pump is used. The inverter disconnects the power connection to the motor if overload occurs. The inverter stays in fault mode with the error code displayed until reset.

Overcurrent protection

Overcurrent may occur if, for example, a wrong cable size is used. The inverter disconnects the power connection to the motor if the current falls outside the allowed current limits. The inverter stays in fault mode with the error code displayed until reset.

Note that for the overcurrent protection to function properly, the actual current value must be adjusted according to the maximum current attained at the maximum frequency shortly after the system started operation.

Overtemperature protection

The inverter may be overheated if appropriate ventilation is not available or the ambient temperature is too high. The inverter disconnects the power connection to the motor if overtemperature occurs in the inverter. The inverter stays in fault mode with the error code displayed until reset.

By installing the Pt100/Pt1000 option board, the motor temperature can be monitored via the Pt100/Pt1000, and the motor can be protected against overtemperature.

No-load protection

No-load situation of the inverter may occur if, for example, the cable to the motor is broken. The inverter disconnects the power connection to the motor if no-load occurs. The inverter stays in fault mode with the error code displayed until reset.

For the no-load protection to function properly, check the RSI installation and operating instructions carefully and follow them during operation.

Operating history

The inverter stores historical operating data. The data can be retrieved through the menu on the inverter.

Communication

Built-in:

- Serial communication (RS485/Modbus)
- Ethernet IP
- Profinet IO
- Modbus TCP
- Bacnet IP.

Via optional boards:

- CanOpen
- Profibus DP
- DeviceNet
- Lonworks
- AS-interface.

Product numbers

Low voltage range (3 × 208-240 V)

Power [kW (hp)]	Product number	Electrical data		Frame size	IP class
		Max. P2 [kW (hp)]	Rated output current [A]		
1.5 (2)	99090622	1.5 (2)	8	A	IP66
2.2 (3)	99090633	2.2 (3)	11	A	
3.0 (4)	99090634	3.0 (4)	12.5	A	
4.0 (5)	99090635	4.0 (5)	18	B	
5.5 (7.5)	99090636	5.5 (7.5)	24.2	B	
7.5 (10)	99090637	7.5 (10)	31	B	
11 (15)	99090638	11 (15)	48	C	
15 (20)	99090639	15 (20)	62	C	

High voltage range (3 × 380-440 V)

Power [kW (hp)]	Product number	Electrical data		Frame size	IP class
		Max. P2 [kW (hp)]	Rated output current [A]		
2.2 (3)	99044348	2.2 (3)	5.6	A	IP66
3.0 (4)	99044349	3.0 (4)	8	A	
4.0 (5)	99044350	4.0 (5)	9.6	A	
5.5 (7.5)	99044351	5.5 (7.5)	12	A	
7.5 (10)	99044352	7.5 (10)	16	B	
11 (15)	99044363	11 (15)	23	B	
15 (20)	99044364	15 (20)	31	B	
18.5 (25)	99044365	18.5 (25)	38	C	
22 (30)	99044366	22 (30)	46	C	
30 (40)	99044367	30 (40)	61	C	
37 (50)	99044368	37 (50)	72	C	
45 (60)	99648886	45 (60)	87	MR7	IP54
55 (75)	99648887	55 (75)	105	MR7	
110 (150)	99648888	110 (150)	205	MR8	
132 (200)	99648889	132 (200)	261	MR9	
160 (250)	99648890	160 (250)	310	MR9	
200 (300)	99648891	200 (300)	385	ED	
250 (350)	99648892	250 (350)	460	ED	

Option boards

Description	Product number
Digital	99295565
Analog	99295551
Pt100/Pt1000	99295525

For further information, see the *RSI documentation* available at the *Grundfos Product Center*.

MP 204



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MP 204 motor protector

The MP 204 is an electronic motor protector designed for the protection of an asynchronous motor.

The MP 204 cannot be used in installations where a frequency converter is installed.

The MP 204 operates with the following set of limits:

- warning limits
- trip limits.

If one or more of the warning limits are exceeded, the motor continues to run, but the warnings appear on the MP 204 display.

If one of the trip limits is exceeded, the trip relay stops the motor and an alarm appears on the MP204 display. At the same time, the signal relay is operating to indicate that the limit is exceeded.

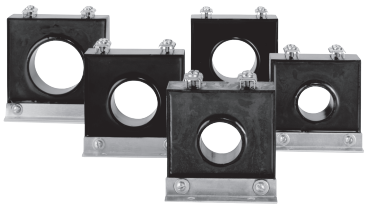
The details of warnings and alarms can be reviewed on the Grundfos GO remote app.

The MP 204 primarily protects the motor by measuring the motor current utilizing a true RMS measurement. The trip relay stops the motor if, for example, the current exceeds the preset value. Secondarily, the motor can be protected via temperature measuring by a Tempcon sensor, a Pt100/Pt1000 sensor, or a PTC sensor/thermal switch.

The MP 204 is designed for single- and three-phase motors. In single-phase motors, the starting and run capacitors are also measured. Cos ϕ is measured in both single- and three-phase systems.

The MP 204 directly measures motor currents up to 120A on the motor cables passing through the device. Five sizes of external single-turn transformers are available for motor currents higher than 120A and up to 999A.

Note: the monitoring of motor temperature via Tempcon is not possible when single-turn transformers are used.



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Single-turn transformers

Applications

Applications of the MP 204 are the following:

- stand-alone motor protector
- remote monitoring via a Grundfos GENIbus.

Benefits

The MP 204 offers the following benefits:

- suitability for both single-phase and three-phase motors
- dry-running protection
- overload protection
- very high accuracy
- made for submersible pumps
- insulation resistance measurement
- monitoring motor temperature throughout the motor cable in MS motors with a built-in Tempcon sensor (without the need for a control cable)
- direct measurement of motor currents up to 120A
- settings and status reading via the Grundfos GO remote app and GENIbus.

Monitoring options

The MP 204 monitors the following parameters:

- insulation resistance before startup
- temperature (Tempcon, Pt100/Pt1000 sensor and PTC/thermal switch)
- overload/underload
- overvoltage/undervoltage
- current unbalance
- phase sequence
- phase failure
- power factor
- power consumption
- harmonic distortion
- operating hours and number of starts.

Grundfos GO remote app

The Grundfos GO Remote app offers easy access to setting options, status information, control and fault finding of the MP 204 on your Android or iOS-based device.

The Grundfos MI 301 mobile interface is required to connect the MP 204 with your device via Bluetooth. It has a rechargeable Li-ion battery that must be charged separately. Currently, Grundfos supports Android devices using Android 5.0 and later, and Apple devices using iOS 6.1.2 and later, but cannot guarantee operation on all devices in the market.



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MI 301

Communication

The MP 204 is prepared for the following communication modules:

- Grundfos Connect cellular (CIU 900 + CIM 280)
- Grundfos Connect IP (CIU 900 + CIM 550)
- PROFIBUS DP (CIU 900 + CIM 150)
- Modbus RTU (CUI 900 + CIM 200)
- Modbus Cellular/SMS (CUI 900 + CIM 260)
- Modbus TCP/PROFINET IO (CIU 900 + CIM 500).

Related information

Communication

Product numbers, MP 204

Product numbers

Product	Product number
MP 204	96079927
Grundfos Go Remote interface	
Grundfos MI 301 (with charger)	98046408
Grundfos MI 301 (without charger)	98761178
Single-turn transformers	
Current transformer ratio: 200:5, $I_{max.}$ = 200 A	96095274
Current transformer ratio: 300:5, $I_{max.}$ = 300 A	96095275
Current transformer ratio: 500:5, $I_{max.}$ = 500 A	96095276
Current transformer ratio: 750:5, $I_{max.}$ = 750 A	96095277
Current transformer ratio: 1000:5, $I_{max.}$ = 1000 A	96095278

For further information about motor protection via the MP 204, see the *MP 204 documentation* available at the *Grundfos Product Center*.

Technical data, MP 204

Enclosure class	IP20
Ambient temperature	-20 °C to +60 °C
Relative humidity	5-95 %
Voltage range	100-480 VAC
Current range	3-999 A
Frequency	50 to 60 Hz
IEC trip class	1-45
Special Grundfos "P" trip class delay	0.1 to 30 s
Marking	CE, cUL, UKCA
Consumption	Max. 5 W
Plastic type	Black PC/ABS

Electrical data, MP 204

	Measuring range	Accuracy	Resolution
Current without external current transformers	3-120 A	± 1 %	0.1 A
Current with external current transformers	120-999 A	± 1 %	1 A
Phase-to-phase voltage	80-610 VAC	± 1 %	1 V
Frequency	47-63 Hz	± 1 %	0.5 Hz
Insulation resistance	10-1 MΩ	± 10 %	10 kΩ
Temperature via Pt100/ Pt1000	0-180 °C	± 1 °C	1 °C
Temperature via Tempcon	0-125 °C	± 3 °C	1 °C
Power consumption	0-16 MW	± 2 %	1 W
Power factor (cos φ)	0 - 0.99	± 2 %	0.01
Run capacitor (single-phase)	10-1000 µF	± 10 %	1 µF
Start capacitor (single-phase)	10-1000 µF	± 10 %	1 µF
Number of starts	0-65535	-	1
Energy consumption	0-4 × 10^9 kWh	± 5 %	1 kWh

Control MP 204



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The Control MP 204 cabinets are supplied with all necessary components to regulate the water supply by switching on and off a Grundfos SP pump when the installation reaches a certain water pressure or level. For this purpose, an external pressure switch or a flow switch must be connected to the control.

The integrated MP 204 device monitors and protects the motor of the pump. Additionally, the control cabinets have a built-in main switch and a thermal-magnetic circuit breaker. The MP 204 device is factory-set to an average current value, and must be adjusted during commissioning. Different models are available, depending on the motor size and the starting method.

Functions

- Demand-depend on/off control
- Protection against dry running
- Fault indication
- Motor monitoring and protection

Communication

See the section on MP 204 communication options.

Related information

Communication

Technical data

Number of pumps	1
Enclosure class	IPS4
Ambient temperature	0° C to 40 °C
Relative humidity	95 %
Supply frequency	50 Hz
Supply voltage	3 × 400
Rated power	3.0 - 132 kW
Rated current	DOL 3 - 290 A
	SD 3 - 290 A
Motor connection	DOL or SD
Motor protection device	MP 204
Marking	CE, UKCA

Product numbers

Motor rated characteristics				
Voltage / Hz	Power	Current	Connection	
[V/Hz]	[kW]	[A]	Direct on line (DOL)	Star-Delta (YD)
3 × 400 V / 50 Hz	3.0	3-8	99175449	99175463
	5.5	8-14.5	99175450	99175464
	9.2	14.5-23.5	99175451	99175465
	13.0	23.5-30.0	99175452	99175466
	15.0	30.0-36.5	99175453	99175467
	18.5	36.5-45	99175454	99175468
	26.0	45-61	99175455	99175469
	30.0	61-75	99175456	99175470
	37.0	75-85	99175457	99175471
	55.0	85-120	99175458	99175472
	75.0	120-156	99175459	99175473
	90.0	156-180	99175460	99175474
	110.0	180-235	99175461	99175475
	132.0	235-290	99175462	99175476

For further information, see the *Control MP 204 documentation* available at the *Grundfos Product Center*.

Communication Interface Units (CIU)



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Grundfos Communication Interface Unit (CIU)

A CIU is required for complete control of the pump system and the data communication between the main network and an SP pump with a CUE, RSI or MP 204. The CIU enables data communication via open and interoperable networks, such as the following:

- LON
- PROFIBUS DP
- PROFINET IO
- Modbus RTU
- Modbus TCP
- Ethernet/IP
- BACnet MS/TP
- BACnet IP
- Grundfos Connect.

Applications

The range of Grundfos CIUs offers ease of installation and commissioning as well as user-friendliness. All units are based on standard functional profiles for an easy integration into the network.

The CIU devices enable communication of operating data, such as measured values and setpoints, between the pump and the following:

- PLC
- SCADA system
- building management system
- Grundfos Connect.

Benefits

- Open communication standards
- complete process control
- one concept for the Grundfos products
- 24-240 VAC/DC power supply in CIU devices
- simple configuration and easy installation
- readiness for DIN rail or wall mounting.

Product numbers

To create the necessary control unit, a CIU must be ordered with the Communication Interface Module (CIM) required for the Fieldbus protocol. Use the table below for the selection.

Product numbers

Product	Product number
CIU 900	99448387
CIM 100	96824797
CIM 150	96824793
CIM 200	96824796
CIM 300	96893770
CIM 500	98301408
CIM 260-EU [10)]	99439302
CIM 260-US [10)]	99439306
CIM 280-EU [11)]	99895383
CIM 280-US [11)]	99895386
Antenna EU	99518079
Antenna US	98851149
Mounting bracket for Antenna-US	99606614
Grundfos Connect subscription - one year	92711156

10) 3G/4G SIM card required

11) eUICC SIM card included

Fieldbus support protocols

Products		MP 204	CUE	RSI
GENIbus		built-in	built-in	N/A
LON		N/A	CIU 900 + CIM 100	Optional
PROFIBUS DP		CIU 900 + CIM 150		Optional
PROFINET IO		CIU 900 + CIM 500		built-in
Modbus RTU		CIU 900 + CIM 200		built-in
Modbus TCP		CIU 900 + CIM 500		built-in
Modbus cellular [12) 13)]	EU	CIU 900 +CIM 260-EU + Antenna-EU + SIM card [14)]		N/A
	US	CIU 900 +CIM 260-US + Antenna-US + SIM card [14)] + Mounting bracket for Antenna-US		N/A
EtherNet/IP		N/A	CIU 900 + CIM 500	built-in
BACnet MS/TP		N/A	CIU 900 + CIM 300	N/A
BACnet IP		N/A	CIU 900 + CIM 500	built-in
Grundfos Connect IP [15) 16)]		CIU 900 + CIM 500		
Grundfos Connect cellular [12) 16)]	EU	CIU 900 + CIM 280-EU [17)] + Antenna-EU		
	US	CIU 900 + CIM 280-US [17)] + Antenna-US + Mounting bracket for Antenna-US		

12) Available in regional versions for EU and USA (consider needed 3G/4G frequency bands)

13) Cellular data connection for SCADA and SMS

14) 3G/4G SIM card required for the CIM 260

15) Wired internet connection required

16) One-year subscription required for the Grundfos Utility Connect service

17) eUICC SIM card included in the CIM 280

For further information about data communication via CIU units and fieldbus protocols, see the *CIM/CIU documentation* available at the *Grundfos Product Center*.

PR 5714

The PR 5714 is a programmable LED indicator with relay output. In combination with a Pt100/Pt1000 sensor, it offers the following features:

- continuous monitoring of the motor temperature
- protection against too high temperature.

The Pt100/Pt1000 sensor measures the temperature, and the PR 5714 monitors it, ensuring that the preset values are not exceeded. If the preset values are exceeded, the PR 5714 relay disconnects the contactor.

Monitoring and protection employing a Pt100/ Pt1000 require the following parts:

- Pt100 or Pt1000 sensor
- PR 5714 relay
- sensor cable.

The following temperature limits are preset on delivery:

- 60 °C warning limit
- 75 °C stop limit.

The temperature limits must be adjusted during the start-up based on the temperature at maximum load in normal operation. The following temperature limits are preset in the PR 5714 on delivery:

- 60 °C warning limit
- 75 °C stop limit.

Technical data

Enclosure class	IP65 (fitted in a control panel)
Ambient temperature	-20 °C to +60 °C
Relative air humidity	95 % (condensating)
Voltage variation	1 × 24-230 VAC ± 10 %, 50-60 Hz 24-250 VDC ± 20 %
Approvals	UL, DNV
Marking	CE

Product number

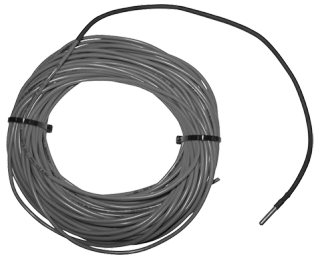
PR 5714 relay	Voltage	Product number
	24-230 VAC, 50/60 Hz / 24-250 VDC	96913234

Pt1000

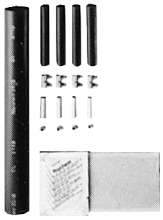
A Pt1000 temperature sensor can be installed to monitor the temperature of the MS4000 motors without Tempcon or fed by a frequency converter. To mount the Pt1000, one of the motor studs must be replaced by a staybolt for the Pt1000.

Temperature monitoring is done via the PR 5714, MP 204, CUE, RSI or another monitoring device prepared for reading the Pt1000 signal. The temperature limits for motor protection must be set on the monitoring device during start-up according to the normal operating conditions, see section Temperature monitoring.

If a sensor cable longer than 100 m is required, a 20 m sensor with cable can be spliced to the required drop sensor cable length. The recommended maximum total length is 350 m.

Pt1000 sensor, including cable	Cable length [m]	Product number
	20	96804042
	40	96804044
	60	96804064
	80	96804065
	100	96804067

Staybolt kits for Pt1000 in MS 402 and MS 4000	Description	Product number
	Staybolt kit for Pt1000 Material: EN 1.4401 / AISI 316	98090278
	Staybolt kit for Pt1000. Material: EN 1.4539 / AISI 904L	98090341

Extension kit for sensor cable for Pt100/Pt1000	Description	Product number
	Extension kit for Pt100/Pt1000 sensor cable [18] For watertight shrink-joining of the sensor cable	99039717

18) Extra sensor cable must be ordered separately

Drop sensor cable	Description	Product number
	Drop cable for extension: 4 × 1 mm^2 [19] Maximum recommended length: 350 m.	00RM5271

19) Mention length when ordering

Related information

Temperature monitoring

Model C motor cables

Motor type	Motor plug material	Length		Jacketed flat cable (for CE-approved motors)		Single leads (for cCSAus-approved motors)	Single leads (for booster applications)	PTFE jacketed cable
				EPR rubber		XLPE rubber		PTFE
		[m]	[ft]	4 G 1.5 mm^2	4 G 1.5 mm^2 2-plugs [20]	4 × 1 × 14 AWG	3 × 1 × 14 AWG BM	4G 2.5mm^2
MS4000 Model C [21]	EN 1.4401	1.7	5.6	99412628	99412615	-	-	-
		1.8	5.9	-	-	99412552	-	-
		2.5	8.2	99410241	99410222	99412580	-	-
		5	16.4	99410115	99410429	99412836	-	-
		10	33	99410245	99410147	-	-	-
		20	66	99410252	99410168	-	-	-
		25	82	-	-	99413964	-	-
		30	99	99410264	99410189	-	-	-
		40	131	99410266	99410194	-	-	-
		50	164	99410301	99410198	-	-	-
		60	197	99410303	99410214	-	-	-
		70	230	99410425	99410219	-	-	-
MS4000R Model C [21]	EN 1.4539	1.7	5.6	99412529	99411278	-	-	-
		1.8	5.9	-	-	99413021	-	-
		2.0	6.6	-	-		99412545	99414026
		2.5	8.2	99411201	99411260	99412872	-	-
		3.8	12.5	-	-	-	99414019	-
		4.0	13.1	-	-	-	-	99413950
		5.0	16.4	99413823	99411413	99412863	-	-
		8.0	26.3	-	-	99414037	-	-
		10	33	99412525	99411421	-	99414022	99410476
		20	66	99412497	99411434	-	-	99411153
		30	99	99412464	99411472	-	-	99411155
		40	131	99412383	99411488	99413967	-	99411156
		50	164	99411611	99411505	-	-	99411158
		60	197	99412782	99412700	-	-	99411160
		70	230	99412702	99412650	-	-	99411183
		80	263	-	-	-	-	99411188
		90	295	-	-	-	-	99411193
		100	328	-	-	-	-	99411196
		110	361	-	-	-	-	99413762
		120	394	-	-	-	-	99413722
		150	492	-	-	-	-	99414036
		200	656	-	-	-	-	99413755
		220	722	-	-	-	-	99413882
		400	1312	-	-	-	-	99413760

20) It is a motor cable with additional plug for drop cable. A submersible drop cable with plug is required for easy connection.

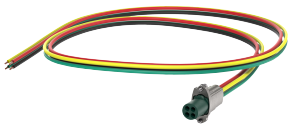
21) Model B motor cables are available as service kits.

Note: Long motor cables that will not work completely submerged in water must be sized to work in the air. Otherwise, motor cables must work submerged in water.

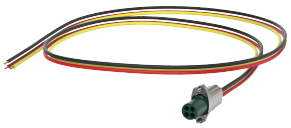
Jacketed flat cable
(for CE-approved motors)



Single leads
(for cCSAus-approved motors)



Single leads
(for booster applications)



PTFE jacketed cable



Jacketed flat cable 2-plugs
(for CE approved motors)



Related information

Cables

Moment of inertia

Submersible drop cable

Product	Description	Number of leads and nominal cross-section [mm²]	Outer cable diameter min./max. [mm]	Weight [kg/m]	Product number
	Suitable for the following applications: • continuous application in groundwater and potable water (approved for potable-water applications) • connection of electrical equipment (e.g., submersible motors) • installation depths up to 2000 m and average loads. Ozone-, water- and weather-resistant insulation and sheath of special EPR-based elastomer materials. Maximum permissible water temperature: 60 °C. Maximum permissible lead service temperature: 90 °C. Further cable sizes are available. For more information, see the *Grundfos Product Center*.	1 × 16	11.0 / 14.5	0.280	00ID4071
		1 × 25	12.5 / 16.5	0.365	00ID4072
		1 × 35	14.0 / 18.5	0.490	00ID4073
		1 × 50	16.5 / 21.0	0.690	00ID4074
		1 × 70	18.5 / 23.5	0.920	00ID4075
		1 × 95	21.0 / 26.5	1.210	00ID4076
		1 × 120	23.5 / 28.5	1.455	00ID4077
		1 × 150	26.0 / 31.5	1.825	00ID4078
		1 × 185	27.5 / 34.5	2.160	00ID4079
		4G1.5	10.5 / 13.5	0.165	00ID4063
		4G2.5	12.5 / 15.5	0.235	00ID4064
		4G4.0	14.5 / 18.0	0.335	00ID4065
		4G6.0	16.5 / 22.0	0.460	00ID4066
		4G10	22.5 / 24.5	0.800	00ID4067
		4G16	26.5 / 28.5	1.165	00ID4068
		4G25	32.0 / 34.0	1.650	00ID4069
		4G35	33.0 / 42.5	2.200	96432949
		4G50	38.0 / 48.5	3.260	96432950
		4G70	43.0 / 54.5	4.149	96432951

Related information

Cables

8. Cable sizing

Submersible drop cables with plug

It is used for an easy connection to the 2-plug motor cable of a MS402 or MS4000 motor.

Product	Cable length [m]	Product number
	4 × 1.5 mm^2	
	15	96737342
	20	96737343
	25	96737344
	30	96737345
	40	96737347
	50	96737349
	70	96737351
	100	96737354
	4 × 2.5 mm^2	
	15	0079H021
	20	0079H022
	25	0079H023
	30	0079H024
	40	0079H025
	50	0079H026
	70	0079H028
	100	0079H029
	4 × 4 mm^2	
	15	0079H041
	20	0079H042
	25	0079H043
	30	0079H044
	40	0079H045
	50	0079H046
	70	0079H048
	100	0079H049

Related information

Cables

8. Cable sizing

Female plug kit for drop cable

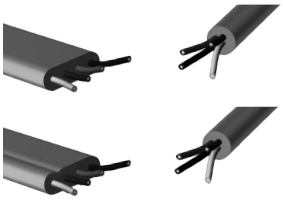
Product	Description	Version	Product number	
			N-version	R-version
 TM007883	It is a female plug for watertight joining of the MS402/ MS4000 with 2-plug motor cable and submersible drop cable in an acrylic tube filled with resin. It is used for both single- and multi-core cables during installation of submersible pumps. 24 hours of hardening is required.	For cables up to 4 × 2.5 mm^2	00799901	00799918
		For cables up to 4 × 6 mm^2	00799902	97937466

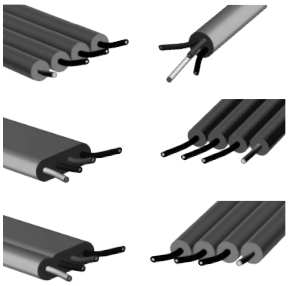
Related information

Cables

Cable termination kit, type KM

For instruction on how to make the cable termination between motor cable and drop cable, see the *KM quick guide* available at the *Grundfos Product Center*.

Possible cable termination		Content of kit	Motor cable [mm²]	Drop cable [mm²]	Number of leads	Product number
Motor cable	Drop cable					
			KM kits with pressed connections:			
			1.5 - 6	1.5 - 6	4	00116251
			6 - 16	6 - 16	4	00116252
			10 - 25	10 - 25	4	00116255
			KM kits with screw connectors:			
			6 - 35	6 - 35	4	96636867
			25 - 70	25 - 70	4	96636868

Possible cable termination		Content of kit	Motor cable [mm²]	Drop cable [mm²]	Number of leads	Product number
Motor cable	Drop cable					
			KM kits with pressed connections:			
			1.5 - 6	1.5 - 6	4	00116257
			6 - 16	6 - 16	4	00116258
			10 - 50	10 - 50	4	96637330
			16 - 70	16 - 70	4	96637332
			1.5 - 6	1.5 - 6	3	00116253
			10 - 25	10 - 25	3	00116254
			10 - 50	10 - 50	3	96637318
			16 - 70	16 - 70	3	96637331

Possible cable termination		Content of kit	Motor cable [mm²]	Drop cable [mm²]	Number of leads	Product number
Motor cable	Drop cable					
			KM kits with pressed connections:			
			10-70	10-70	1	96828296
			32-120	32-120	1	00116256
			KM kits with screw connectors:			
			70-240	70-240	1	96637279

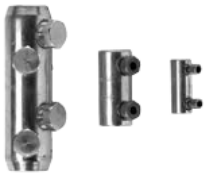
Note: A KM termination kit for single leads only consists of material for one connection. When ordering, keep in mind how many kits are needed for a complete cable termination.

Related information

Cables

Cable termination kit, types M0 to M4

Product	Description	Version			
		Type	Diameter of cable joint [mm]	Outer cable diameter [mm]	Product number
	This kit is for watertight joining of motor cable and submersible drop cable. The joint is encapsulated by the glue which is part of the kit. **Note:** When ordering this cable termination kit, the screw connectors are not included. For ordering suitable screw connectors, see the table below.	M0	Ø40	Ø6 - Ø15	00ID8903
		M1	Ø46	Ø9 - Ø23	00ID8904
		M2	Ø52	Ø17 - Ø31	00ID8905
		M3	Ø77	Ø26 - Ø44	00ID8906
		M4	Ø97	Ø29 - Ø55	91070700

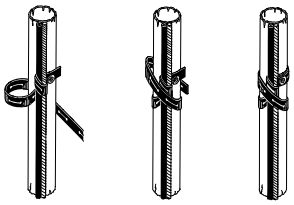
		Cross-section of leads [mm^2]	Number of connectors	Product number
	These are accessories for cable kits M0 to M4. These are the screw connectors only.	6-25	4	96626021
		16-95		96626022
		35-185		96626023
		70-240		96626028

In high pressure, high temperature or sea water applications, use the type KM cable termination kits.

Related information

Cables

Cable clips

Product	Description	Product number
	The clips are for fastening of the cable and straining wire to the riser pipe. They must be fitted every 3 meters. One set for approximately 45 m riser pipe: • 16 cable buttons. • 7.5 m rubber band.	00115016

Related information

Cables

Zinc anodes

Cathodic protection by zinc anodes protects submersible motors against corrosion in chloride-containing liquids, such as brackish water and seawater.

The sacrificial anodes are placed on the outside of the motor, increasing the motor diameter by a minimum of 40 mm. To ensure proper electric and metallic contact between the clamp and the motor surface, the motor surface must be cleaned thoroughly before a new anode string is fitted, and the anode strings must be fastened tightly. The distance between the anode strings must be identical.

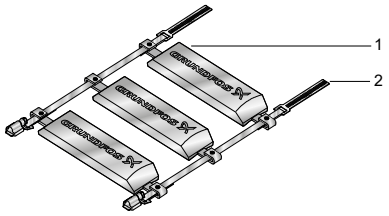
During operation, the material of the zinc anodes is reduced, and the anodes become gradually covered by corrosion products, which obstructs the direct metallic contact between the anode and the motor surface. To counteract this, the metallic contact must be ensured through the clamp, keeping tight contact with the motor by adjusting the clamp.

Inspection must be made at regular intervals to ensure the functioning of the galvanic cathodic protection system. The first inspection is recommended after six months, while the following subsequently approximately once a year.

The life of a zinc anode is 1 to 4 years, depending on the operation conditions.

The number of anodes required depends on the operation conditions, the pump, and the motor in question.

The following tables show the available kits and the number of anode strings recommended for each motor model. Contact Grundfos for further details.



TM078809

Anode string components

Pos.	Description	Part
1	1 pc. zinc anode cast around the clamp	PN 99722879
2	2 pcs. stainless steel clamps	PN 99812400

Anode string kits

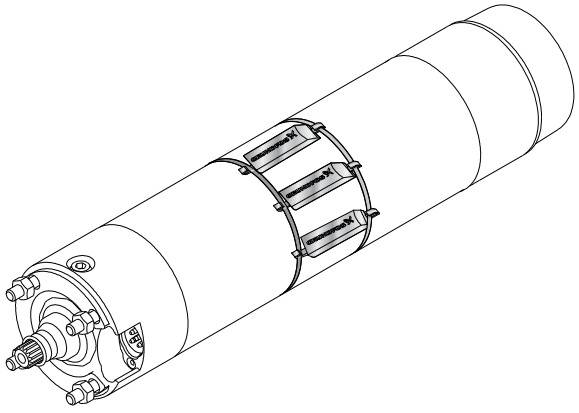
Kit no.	Kit contents
92836041	1 × 99812400, 2 × 99722879
92836043	1 × 99812400, 4 × 99722879
92621545	1 × 99812400, 6 × 99722879



TM083095

Anode string kit with 2 anodes

Zinc anodes for MS - MMS motors			
Motor	Length	Recommended number of anode strings	Ordering
			Product number
MS402	Up to 350 mm	1	92836041
MS4000	Up to 1000 mm	1	92836041
MS6000	Up to 1000 mm	1	92836043
MMS6	Up to 1000 mm	1	92836043
MMS6	1000 to 1400 mm	2	92836043
MMS8000	Up to 1000 mm	1	92836043
MMS8000	1000 to 2060 mm	2	92836043
MMS10000	Up to 2000 mm	2	92621545
MMS10000	2000 to 2500 mm	3	92621545
MMS12000	Up to 2000 mm	2	92621545
MMS12000	2000 to 2300 mm	3	92621545



TM086185

One anode string on the MS submersible motor

Flow sleeves

Grundfos offers a complete range of stainless steel flow sleeves for vertical and horizontal operation. The selection depends on the combined SP pump and motor assembly. For more information, review the *SP Accessories Data Booklet* available at the *Grundfos Product Center*.



TM078415

Flow sleeves

8. Cable sizing

Grundfos offers round single-core and multicore submersible drop cables. Drop cables for Grundfos 4" submersible motors are available without or with a plug for easy connection to the motor cable.

The submersible drop cable must be sized to work in air based on:

- the allowed voltage drop in its entire length (from the motor starter to the motor terminals)
- the current capacity of its cross-section at the maximum air temperature at which the cable will work.

The voltage supplied at the motor terminals must always be within the motor voltage tolerances. For this reason, the voltage drop in the cable and other systems between the voltage source and the motor terminals must be considered or limited.

Grundfos recommends allowing a maximum voltage drop of 1 % to 3 % in the drop cable.

Additionally, the energy losses in the cable are proportional to the voltage drop, thus limiting the voltage drop may save energy.

Local and national requirements regarding cable sizing and selection must always be followed and can demand the use of a bigger cross-section than the one computed by the following formulas and tables.

The cable properties used in the following formulas and tables correspond to Grundfos submersible drop cables. If other brands are used, contact your cable supplier for guidance.

Related information

Submersible drop cable

Submersible drop cables with plug

Calculation of the cross section

Use the following formula to calculate the minimum required cross-section of a cable as a function of the installation length for a three-phase submersible pump.

Single-phase motor

$$q = \frac{I \times 2 \times 100 \times L \times \rho \times \cos\varphi}{U \times \Delta U - (I \times 2 \times 100 \times L \times X_L \times \sin\varphi)}$$

Three-phase motor (DOL)

$$q = \frac{I \times 1.73 \times 100 \times L \times \rho \times \cos\varphi}{U \times \Delta U - (I \times 1.73 \times 100 \times L \times X_L \times \sin\varphi)}$$

Three-phase motor (Star-delta)

$$q = \frac{I \times 100 \times L \times \rho \times \cos\varphi}{U \times \Delta U - (I \times 100 \times L \times X_L \times \sin\varphi)}$$

Calculation of the maximum cable length

The maximum cable length for a given cable cross-section can be calculated by the following formulas.

Single-phase motor

$$L = \frac{U \times \Delta U}{I \times 2 \times 100 \times \left(\cos\varphi \times \frac{\rho}{q} + \sin\varphi \times X_L\right)} \quad [m]$$

Three-phase motor (DOL)

$$L = \frac{U \times \Delta U}{I \times 1.73 \times 100 \times \left(\cos\varphi \times \frac{\rho}{q} + \sin\varphi \times X_L\right)} \quad [m]$$

Three-phase motor (Star-delta)

$$L = \frac{U \times \Delta U}{I \times 100 \times \left(\cos\varphi \times \frac{\rho}{q} + \sin\varphi \times X_L\right)} \quad [m]$$

The maximum cable length may be based on the maximum operating current when it is lower than the rated current of the motor. For example, if the maximum operating current is 10 % lower than the rated current of the motor, the cable may be 10 % longer than the value computed with the formula or indicated in the tables.

Calculation of the energy loss

The cross-section of the cable determines the energy losses throughout its length. To minimize operating losses, the cable cross-section may be increased compared to what is calculated based on the maximum allowed voltage drop. This is only economical if the borehole provides the necessary space and if the operational time of the pump is long. The energy loss is computed by multiplying the power loss with the operating hours.

The following formula can be used to calculate the power loss in the cable of a three-phase system.

$$\Delta p = \frac{3 \times L \times \rho \times I^2}{q} \quad [W]$$

Formula designations		
ΔU	=	Allowed voltage drop in the cable: 1 to 3 [%]
U	=	Rated voltage [V]
I	=	Rated current [A]
cos φ	=	Rated power factor
q	=	Cable cross-section [mm^2]
ρ	=	Cable specific resistance: 0.025 [$\Omega.mm^2/m$]
X_L	=	Cable inductive resistance: 0.078×10^{-3}[Ω/m]
L	=	Cable length [m]
Δp	=	Power loss [W]
sin φ	=	$\sqrt{1 - \cos^2\varphi}$

Selection tables

For an easy selection, the tables below indicate the maximum length of Grundfos submersible drop cables for different cross-sections. The cable length is calculated based on a maximum voltage drop of 3 % and air temperature of 30 °C.

T4 motors at 3 × 400V, 50 Hz, DOL

Voltage drop 3 %

Maximum cable lengths [m]

P2	P2	Imax	Cos φ	Cable cross-section [mm²]								
kW	hp	[A]	-	1.5	2.5	4.0	6.0	10	16	25	35	50
0.75	1.00	2.0	0.84	247	411	655	979					
1.10	1.50	2.8	0.81	183	304	485	724					
1.50	2.00	4.0	0.78	133	221	352	526	868				
2.20	3.00	6.0	0.74	93	155	247	369	608	956			
3.00	4.00	7.9	0.81	65	108	172	257	424	670			
4.00	5.50	9.6	0.80	54	90	143	214	353	557	853		
5.50	7.50	13.0	0.81	39	66	104	156	258	407	624	855	
7.50	10.00	19.3	0.77	28	46	74	110	182	287	438	599	827
Cable current capacity in air at 30 °C [A]				23	30	41	53	74	99	131	162	202

For motors with star-delta starting, the cable length can be calculated by multiplying the relevant cable length from the above tables by $\sqrt{3}$.

T4 motors at 3 × 460V, 60 Hz, DOL

Voltage drop 3 %

Maximum cable lengths [m]

P2	P2	Imax	Cos φ	Cable cross-section [mm²]								
kW	hp	[A]	-	1.5	2.5	4.0	6.0	10	16	25	35	50
0.75	1.00	2.2	0.86	252	420	670						
1.10	1.50	3.0	0.80	199	330	527	787					
1.50	2.00	4.1	0.82	142	236	376	562	929				
2.20	3.00	5.8	0.78	105	175	279	417	688				
3.00	4.00	7.5	0.83	77	127	203	304	502	793			
3.70	5.00	8.6	0.80	69	115	184	274	453	715			
4.00	5.50	9.4	0.82	62	103	164	245	405	640	981		
5.50	7.50	12.6	0.82	46	77	122	183	302	477	732		
7.50	10.00	18.6	0.78	33	55	87	130	215	338	517	708	977
Cable current capacity in air at 30 °C [A]				23	30	41	53	74	99	131	162	202

For motors with star-delta starting, the cable length can be calculated by multiplying the relevant cable length from the above tables by $\sqrt{3}$.

Examples

Maximum cable length

Example		
Allowed voltage drop (ΔU)	=	3 %
Motor	=	5.5 kW, MS4000, T6
Connection method	=	Direct on line
Rated voltage (U)	=	3 × 400 V, 50 Hz
Rated current (I)	=	14.4 A
Rated power factor (cos φ)	=	0.78
Cable cross-section (q)	=	4 mm²
Cable specific resistance (ρ)	=	0.025 [Ω.mm²/m]
Cable inductive resistance (X_L)	=	0.078 × 10^{-3}[Ω/m]
sin φ	=	0.63

$$L = \frac{400 \times 3}{14.4 \times 1.73 \times 100 \times \left(0.78 \times \frac{0.025}{4} + 0.63 \times 10^{-3}\right)} \quad [m]$$

L = 98 m

Energy loss comparison

Example		
Motor	=	5.5 kW, MS4000, T6
Connection method	=	Direct on line
Rated voltage (U)	=	3 × 400 V, 50 Hz
Rated current (I)	=	14.4 A
Cable length (L)	=	80 m
Cable specific resistance (ρ)	=	0.025 [Ω.mm²/m]
Operating hours/year	=	4000 h
Cable cross-section (q) options		
Choice A:	=	4 mm²
Choice B:	=	6 mm²

Choice A

$$\Delta p_A = \frac{3 \times 80 \times 0.25 \times 14.4^2}{4}$$

$\Delta p_A = 311\,W$

$Energy\ loss_A$ = 311 W × 4000 h = 1444 kWh

Choice B

$$\Delta p_B = \frac{3 \times 80 \times 0.25 \times 14.4^2}{6}$$

$\Delta p_B = 207\,W$

$Energy\ loss_B$ = 207 W × 4000 h = 829 kWh

Savings

Annual savings	=	$Energy\ loss_A$ - $Energy\ loss_B$
	=	1244 kWh - 829 kWh
	=	415 kWh

By choosing the 6 mm^2 instead of the 4 mm^2 cable, an annual saving of 415 kWh can be achieved. Considering an evaluation time of 10 years, the total energy saving can be:

Saving energy after 10 years	=	415 × 10
	=	4150 kWh

The amount saved can be calculated in local currency by multiplying the saved energy by the local energy cost.

9. Further product documentation

MS - MMS Installation and operating instructions
MS - MMS Safety instructions and other important information
MS Service Kit Catalogue
MS4000 model C Service Instruction

10. Grundfos Product Center

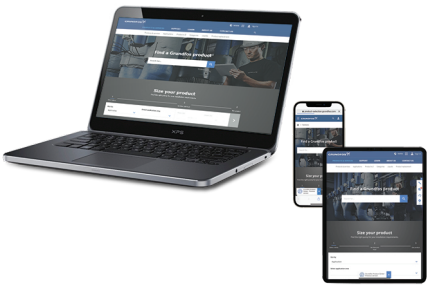
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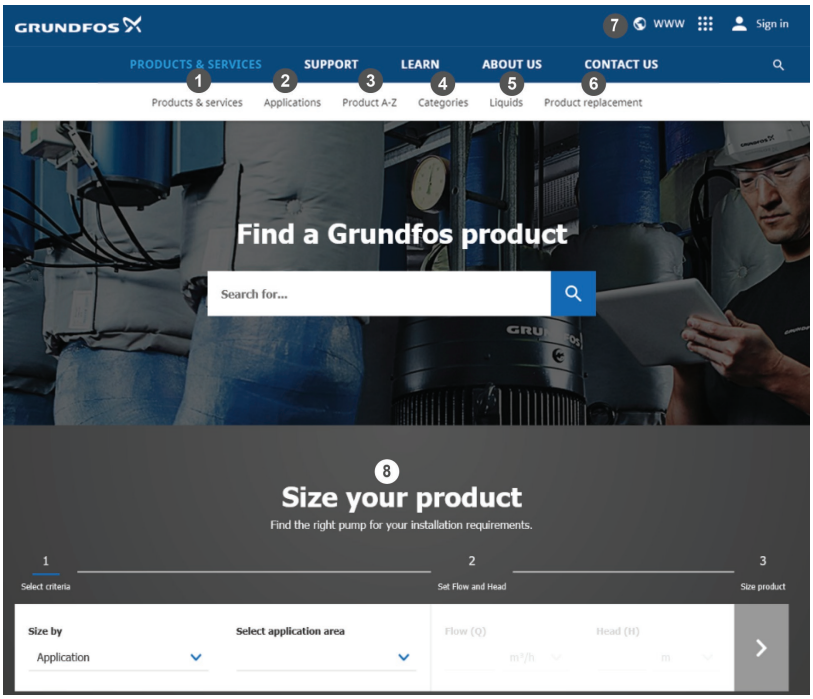
All the information you need in one place

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