EMERSON
Industrial Automation





LS2 HIGH-EFFICIENCY VARIABLE SPEED DRIVES
POWERDRIVE MD2S inverter
FLSES induction motors with cast iron frame

75 to 355 kW

Selection guide

4956 en - 2012.10 / b

POWERDRIVE MD2

MODULARITY

Each application is designed by combining standard, compact modules which are easy to handle: rectifiers, inverters, control, ventilation, filters, etc.

FLEXIBILITY & SIMPLICITY

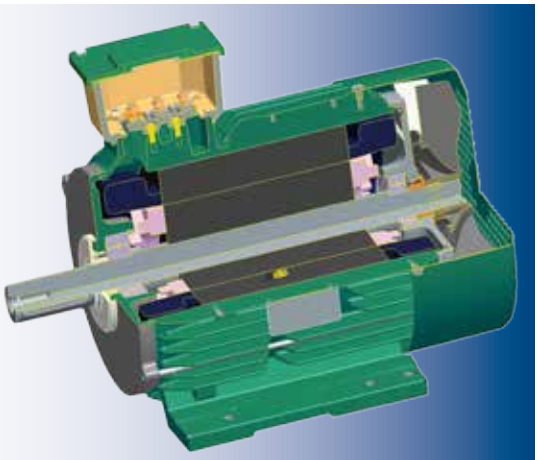
- Adaptation to the environment and the application
  - IP 00 to IP 55 or special cabinet
  - Electrical protection
  - Customized process interface systems
  - Safety devices
  - Dedicated functions, etc
- Easy, user-friendly commissioning: 8 parameters are enough in the majority of cases
  - MDX-Powerscreen: multilingual colour touch screen
  - MDX-Soft software: guided commissioning

SAVINGS DURING OPERATION

- High level of availability due to dedicated functions: management of mains interference, etc
- Longer service life of components: preventive self-test, protection devices, etc
- Maintenance reduced to the absolute minimum
  - Optimised stock and downtime
  - Diagnostic assistance
- Remote application management
- Savings on energy bills
  - Reduced power consumption
  - Power restored to the grid: POWERDRIVE REGEN

FLSES motors

CONSTRUCTION

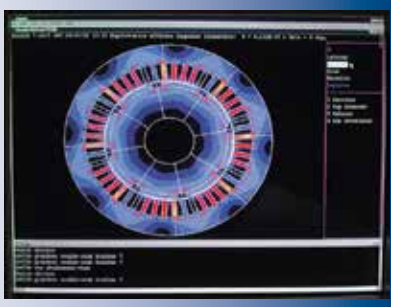


• Concentricity
- Geometric motor design (perpendicularity of flange surface in relation to the shaft axis and the feet fastenings)
- Level of vibration below grade A of IEC 60034-14
  - Improved equipment life
  - Operational quality of the driven machine
- Optimised supply and protection switchgear (reduced neutral current)

• Mechanism of rotation
- Cast iron DE and NDE shields:
  - No deformation of the bearing cage
  - Improved withstand to axial and radial forces
- Locked at the drive end:
  - Guaranteed performance of the driven machine without premature wear
- Generously dimensioned bearings:
  - Extended life time
  - Reliability for belt/pulley applications

• Easier installation and maintenance
- Enlarged terminal box: easy mains connection/increased safety
- Standard dimensions complying with IEC: total interchangeability

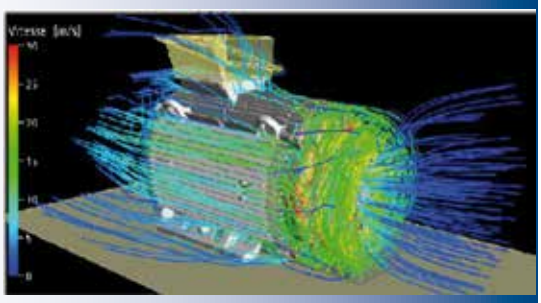
• For a Corrobloc finish
- Stainless steel screws
- Dielectric and anti-corrosion protection on the stator and rotor
- Corrosivity category in C4M



OPTIMISED DESIGN

• Optimised for centrifugal applications
- Optimised efficiency/motor speed of rotation resulting in energy savings

• No derating on inverter duty
- Lower temperature rise
- Anticipation of the ErP Directive (01/2015)



• Maximised lifetime

Considerable reduction in temperature rise:
- Increase in thermal reserve
- Doubled winding life time
- Extended speed range on inverter duty
- Permissible ambient temperature > 40°C
- Permissible continuous overload

EMERSON'S EXPERIENCE

- Motors designed for easy servicing and repair by a network of dedicated partners (Eco-Energy expert)
- Improved traceability: enlarged nameplate with more easily comprehensible information
- Access to more technical data (torque/current curves, efficiency/power factor, current/slip) to select the most suitable motor

ECO-DESIGN

- Publication of a Product Environmental Plan
- Reduction in CO2 emissions throughout the motor's life cycle
- 98% of the motor can be recycled

High-efficiency solutions

In its LS2 high-efficiency motors offer, EMERSON Industrial Automation has a range of FLSES motors with cast iron frame, a high-performance solution suited to all processes with a class F insulation system and winding temperature rise class B under normal operating conditions.

The POWERDRIVE MD2 range is suitable for all environments thanks to its modular system, its flexibility and its ease of integration in the application by offering solutions ranging from the drive that can be directly incorporated in the machine to the complete system. Add-ons or options for drives and motors can be included to satisfy particular demands.

Combined with POWERDRIVE MD2 inverter, FLSES motors offer solutions adapted to difficult environmental conditions, producing optimum electrical and mechanical performance that is ideal for saving energy and substantially cutting operating costs:

- Extended operating range at constant torque
- High efficiency
- Shock and vibration resistance
- Modular system
- Minimal derating at low speed

This guide has been produced based on EMERSON Industrial Automation's expertise in sizing variable speed drive systems, and international technical specifications (IEC 60034-17 and 60034-25) in order to guide you in your choice of solutions. This expertise is not a substitute for the rules and recommendations described in these technical manuals, but is complementary and based on EMERSON Industrial Automation's long experience.

Further information about the products described in this catalogue is available in the corresponding technical documentation.

The Configurator, available on www.leroy-somer.com, can be used to select the most suitable motors and drives and provides the technical specifications and corresponding drawings.

Contents

Modular offer

Operator interface programming

MDX-SOFT
www.leroy-somer.com

MDX-USB isolator
Connection cables

MDX-KEYPAD
Remote console

MDX-Powerscreen
Touchscreen interface

Environment

IP 54

Cabinet adapted to the environment: IP23 roof, double skin, stainless steel, filters, air conditioning, etc

MDX-Bus

Communication

ETHERNET
Modbus TCP
Ethernet IP

Modbus
RTU

CAN

PROFIBUS

Protection & safety devices

Contactor
Circuit-breaker
High-speed fuses
Switch
Thermal relay
Isolator, etc

Motor protection devices: PTC, PT100, KTY, etc

Emergency stop
Pushbuttons
LEDs: voltage reference, run, etc

Adaptation to the site configuration

400, 600, 800, 1000 or 1200 mm cells

Incoming supply line depending on input and motor output

100 or 200 mm baseplates

Auxiliaries

Line reactors, motor reactors and filters

RFI filter

Braking:
- internal transistor
- external resistor

Additional I/O

MDX-I/O

9 I/O
2 relay outputs
EtherNet/IP port
Datalogger

Speed/position feedback

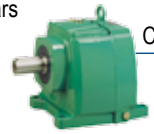
MDX-ENCODER
Incremental encoders with or without commutation channels

MDX-RESOLVER
Resolvers

Gearboxes

Axial output — Series

Helical gears



Cb 3000

Parallel output

Helical gears

Mub 3000

Right-angle output

Helical bevel gears

Ot 3000

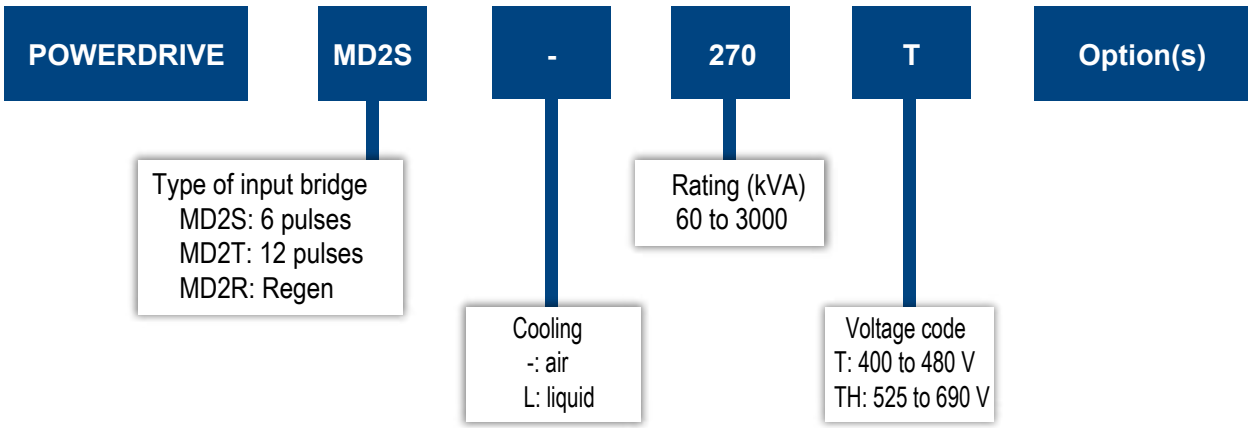
Motor options

Mechanical brakes
Speed/position feedback
Forced ventilation
Heat sensors
Reinforced insulation

The options characteristics are described in the technical documents for the relevant products.

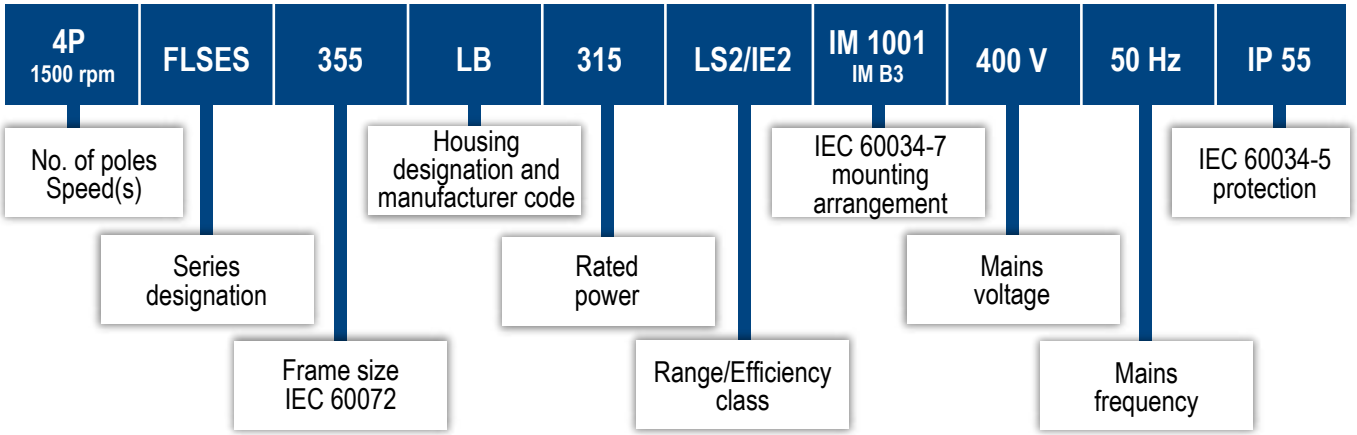
Variable speed drive designation

Drive



Motor

IP 55
Class F insulation
Class B temperature rise



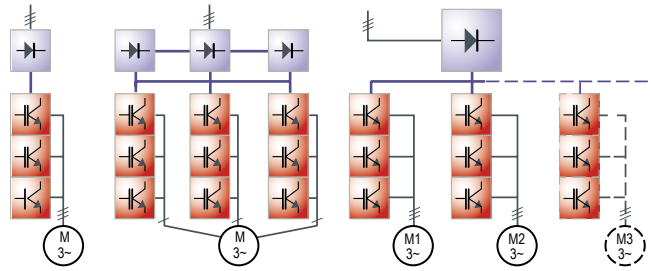
Drive POWERDRIVE MD2

POWERDRIVE MD2 is a modular electronic drive manufactured in an IP21 or IP54 switch cabinet, designed for supplying asynchronous or synchronous 3-phase motors such as FLSES.
Available in air or liquid (MD2xL) cooling versions, POWERDRIVE MD2 can be adapted to all FLSES motor control configurations, with or without encoder feedback.

Conformance

- Storage and transport temperature: -20°C to +60°C
- Operating temperature: -10°C to +40°C, up to +50°C with derating
- Altitude: 0 to 4000 m, with operating temperature derating of 0.6°C per 100 m between 1000 and 4000 m
- Relative humidity in accordance with IEC standard 60068-2-56: < 90% non condensing
- Degree of protection: EN 60529
- Vibrations: EN 60068-2-6
- Mechanical shocks: tested in compliance with IEC standard 60068-2-29
- Electromagnetic immunity complies with EN 61800-3 and EN 61000-6-2 standards
- Safe Torque Off inputs in accordance with EN ISO 13849-1 and EN IEC 62061, 2-channel locking with feedback (SIL3 - PLe)
- I/O: IEC 61131-2
- Emissions: EN 61800-3, category C2 with optional filter or category C3

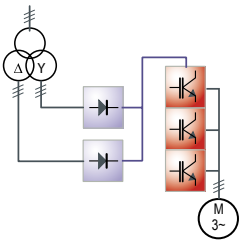
MD2S



6-pulse drive
Standard environment

Common DC bus

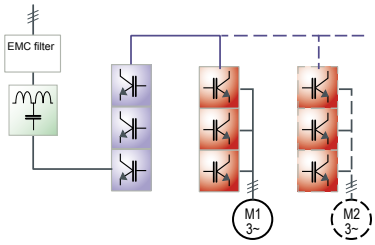
MD2T



12-pulse configuration

Reduced harmonic level (THDi < 12%)

MD2R



Drive or multiple drives with "Active Front End" (regenerative) synchronous rectifier. *Optimised energy bills and reduced harmonic level (THDi ≤ 5%)*

Rectifier Inverter Sine wave filter

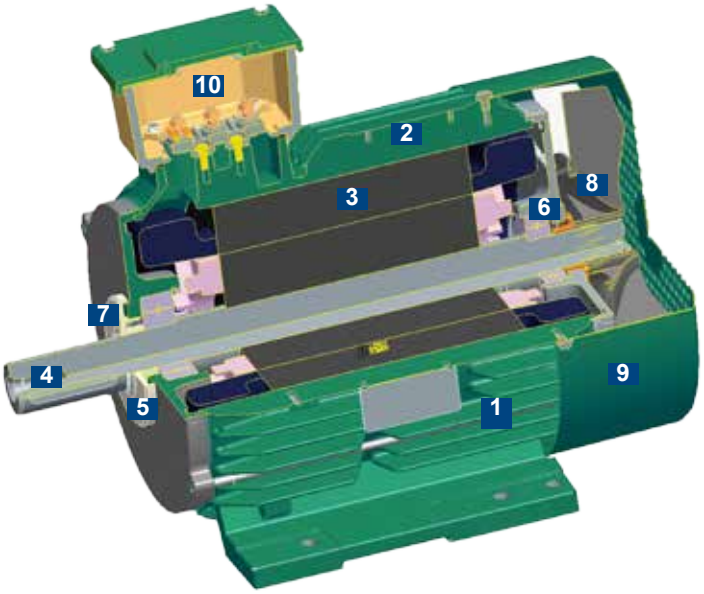
Output current(1)			MD2 rating	Dimensions(3) and Weight (not including options)			
continuous		maximum		MD2S		MD2SL	
Duty		for 60 s (A)		width (mm)		width (mm)	
heavy (A)	normal (A)			basic	Option(2)	basic	Option(2)
145	175	200	***100T***	400		600	
175	215	240	***120T***	400		600	
220	260	308	***150T***	400		600	
260	305	360	***180T***	400	600	600	1000
305	380	450	***220T***	400	600	600	1000
380	470	530	***270T***	400	600	600	1000
470	580	660	***340T***	600	1000	600	1000
570	630	760	***400T***	600	1000	600	1000
680	800	940	***470T***	600	1000	600	1000
820	990	1140	***600T***	1200	1800	600	1000
990	1220	1400	***750T***	1200	1800	1200	1800
1220	1430	1725	***900T***	1200	1800	1200	1800

(1) Values specified for a voltage of 400 V, a switching frequency of 3 kHz and an ambient temperature of 40°C.
(2) Standard options: RFI filter, line reactor, braking transistor, switch and high-speed fuses, emergency stop
(3) Height in IP21 version: MD2x = 2160 mm; MD2SL = 2086 mm - Depth for all ratings = 600 mm

Examples for basic drive with or without standard option(s). Customised configurations are made to customer specification.

FLSES motors

Description	Materials	Comments
1 **Housing with cooling fins**	Cast iron	- lifting rings - earth terminal with an optional jumper screw - stainless steel nameplate with indelible marking for Corrobloc finish - stainless steel fixing screws for Corrobloc finish
2 **Stator**	Insulated low-carbon magnetic steel laminations Electroplated copper	- low carbon content guarantees long-term lamination pack stability - welded laminations - semi-enclosed slots - class F insulation - dielectric and anti-corrosion protection of the stator (coil end turns) for Corrobloc finish
3 **Rotor**	Insulated low-carbon magnetic steel laminations Aluminium	- inclined cage bars - rotor cage pressure die-cast in aluminium (or alloy for special applications), or soldered in copper, or keyed for soldered rotors - shrink-fitted to shaft - rotor balanced dynamically, class A, 1/2 key - dielectric and anti-corrosion protection for Corrobloc finish
4 **Shaft**	Steel	- open keyway
5 **End shields**	Cast iron	- stainless steel fixing screws for Corrobloc finish
6 **Bearings and lubrication**	Steel	- regreasable ball bearings - bearings preloaded at NDE up to 315 S, preloaded at DE from size 315 M upwards
7 **Labyrinth seal** **Lipseals**	Plastic or steel Synthetic rubber	- decompression grooves
8 **Fan**	Composite up to size 280 inclusive Metal from 315 ST upwards	- 2 directions of rotation: straight blades
9 **Fan cover**	Pressed steel	- fitted, on request, with a drip cover for operation in vertical position, shaft end facing down - stainless steel fixing screws for Corrobloc finish
10 **Terminal box**	Cast iron body and cover for all frame sizes	- IP 55 - fitted with a block with 6 terminals - undrilled cable gland mounting plate (nozzle and cable gland as options) - 1 earth terminal in each terminal box - stainless steel fixing screws for Corrobloc finish



Definition

APPLICATIONS AND CHOICE OF SOLUTIONS

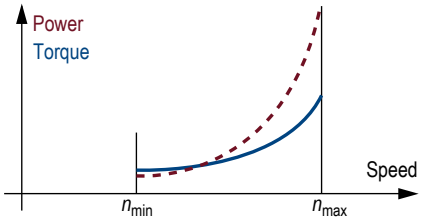
In principle, there are three typical types of load. It is essential to determine the speed range and the application torque (or power) in order to select the drive system:

► Centrifugal machines

The torque varies as the square of the speed (or cube of the power). The torque required for acceleration is low (about 20% of rated torque). The starting torque is low.

- Sizing: depends on the power or torque at maximum speed
- Drive selected for normal duty

Typical applications: ventilation, pumping, etc

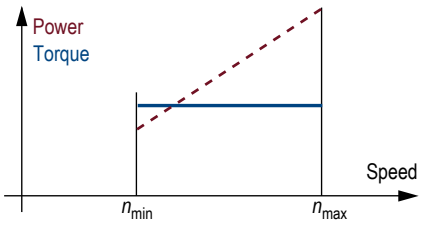


► Machines with constant torque

The torque remains constant throughout the speed range. The torque required for acceleration may be high, depending on the machine (higher than the rated torque).

- Sizing: depends on the torque required over the entire speed range
- Drive selected for heavy duty

Typical machines: extruding machines, grinders, overhead cranes, presses, etc

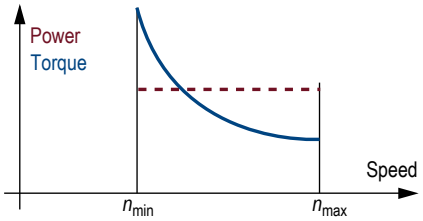


► Machines with constant power

The torque decreases as the speed increases. The torque required for acceleration is no more than the rated torque. The starting torque is at its maximum.

- Sizing: depends on the torque required at minimum speed and the range of operating speeds.
- Drive selected for heavy duty
- An encoder feedback is advised for improved regulation

Typical machines: winders, machine tool spindles, etc

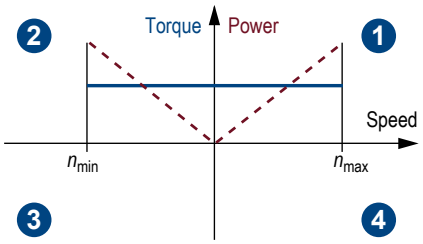


4-QUADRANT MACHINES

These applications have a torque/speed operating type as described above, but the load becomes a driving load in certain stages of the cycle.

- Sizing: see above depending on the load
- In the case of repetitive braking, install a reinforced insulation system (RIS)
- Drive selection: to dissipate the power from a driving load, it is possible to use a braking resistor, or to send power back to the grid. In the latter case, a regenerative or 4-quadrant drive should be used.

Typical machines: centrifuges, hoisting, presses, machine tool spindles, etc



REGULATION MODE

The speed and torque of an induction motor can be regulated in open loop (without encoder feedback) or closed loop mode to obtain optimum performance (with encoder feedback).

► Open loop regulation

This regulation mode limits the voltage drop at the motor terminals (≈375 V), which optimises the motor & drive selection. The torque and speed accuracy are limited, especially at low speed.

Typical applications: ventilation, pumping, compression

► Closed loop regulation

This regulation mode imposes a greater voltage drop at the motor terminals (≈360 V), which can have an impact on motor & drive selection. There is optimal torque and speed accuracy, enabling the rated torque to be held at zero speed.

Typical machines: extruding machines, overhead cranes, winders, centrifuges, machine tool spindles, etc

Definition

DRIVE SELECTION

Depending on the application, several variable speed drive combinations are suggested:

Selection for a centrifugal machine with an inertia ratio < 50.
Drive duty: normal

Selection for a machine with constant torque or constant power.
Drive duty: heavy

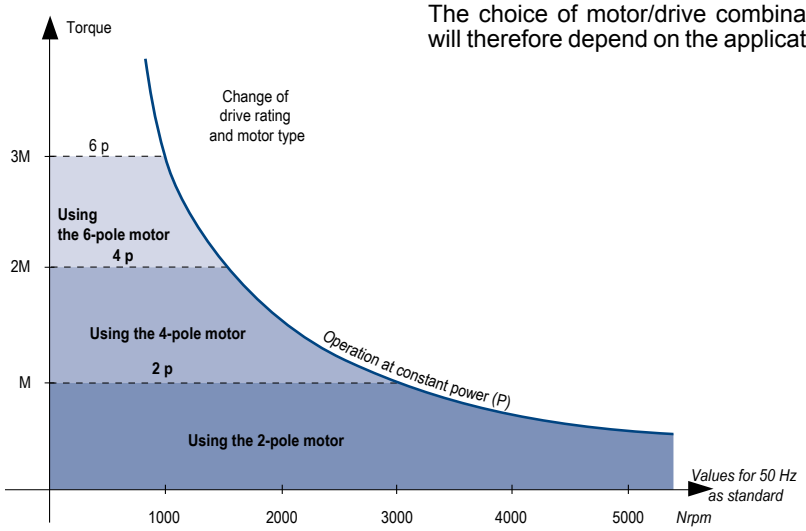
Selection for a machine with accelerating torque or resistive torque with a high number of starts.
Motor torque: maximum

CHOICE OF DRIVE/MOTOR TORQUE

The graph below expresses the output torque of a 50 Hz motor (2, 4 or 6 poles) supplied by a variable speed drive.
For a frequency inverter with power P_n operating at constant power P within a predefined range of speeds, it is possible to optimise the choice of motor and its number of poles to deliver a maximum amount of torque.

Example: The Powerdrive MD2S 120T drive can supply the following motors:
FLSES 280M - 2 p - 90 kW - 291 Nm
FLSES 280M - 4 p - 90 kW - 581 Nm
FLSES 315M - 6 p - 90 kW - 873 Nm

The choice of motor/drive combination will therefore depend on the application.



Example of how to select a variable speed drive assembly

A travelling crane requires power of 132 kW over a speed range from 510 to 1500 rpm in continuous duty.
The maximum required torque is 160%.

Step 1: Calculating the torque required over the speed range

The selection depends on the torque required over the speed range.
The overhead crane is a constant torque application.

$M = P/\omega = P^* 1000 * 60/2\pi n = P \times 9550/n$

M: torque in N.m
P: power in kW
n: speed in rpm

The required torque is 840 N.m from 17 to 50 Hz.
The maximum required torque is 840 N.m * 160% = 1344 N.m.

Step 2: Selecting the regulation mode

The drive can operate without encoder feedback (open loop) or with encoder feedback (closed loop).
In order to hold the load at zero speed and for safety reasons, our overhead crane application requires speed feedback information, hence closed loop regulation (with encoder feedback).

Step 3: Selecting the motor

Choice of number of poles:
The operating speed range extends from 510 to 1500 rpm.
On the basis of the above curve, a 4-pole motor should be selected.

Use the selection table below.
Since 840 N.m of torque cannot be obtained with the FLSES 315 M (791 N.m at 17 Hz), you should select the next motor up, ie. the **4-pole FLSES 315 LA 132 kW** IC411 (self-cooled).
NB: If you choose a motor with a forced ventilation unit, the motor will not need to be derated and the 4P FLSES 315 M 132 kW IC416 could be selected.

Step 4: Selecting the drive

The drive rating is selected according to the rated and maximum torque required by the application. Depending on which motor is selected, there are several drive rating options.

In our example, we need rated torque of 840 N.m and maximum torque of 1344 N.m.

MD2S	**220T**
Drive type	Drive rating

where M_n = 1031 N.m and M_{max}/M_n = 1.48

MOTOR		DRIVE	VARIABLE SPEED DRIVE											Motor moment of inertia
Type	Power on 400 V grid supply 50 Hz P_n kW	Type Powerdrive	Power on drive at 50 Hz kW	Torque in continuous duty 5 Hz 150 rpm N.m	10 Hz 300 rpm N.m	17 Hz 510 rpm N.m	25 Hz 750 rpm N.m	**50 Hz 1500 rpm N.m**	60 Hz 1800 rpm N.m	Maximum torque/ Rated torque M_{max}/M_n (2)	Current on drive at 50 Hz I_a (3) A	I_{max} drv A	Efficiency 4/4 %	Noise LP db(A)	J kg.m²
		MD2S 220T								1.74		378			
		MD2S 150T								1.19		308			
FLSES 315 M	132	MD2S 180T	**132**	596	723	791	851	**851**	700	1.39	260	360	94.0	77	2.64
		MD2S 220T								1.68		435			
		MD2S 180T								1.18		360			
FLSES 315 LA	160	MD2S 220T	**160**	722	876	959	1031	**1031**	849	1.48	305	450	94.5	77	2.26
		MD2S 340T								2.04		622			

2-poles FLSES - without encoder feedback

Power supply upstream of the drive 400 V ± 10% (in accordance with IEC 60034-1) - Open loop flux vector control 3 kHz switching frequency - Class F motor - F temperature rise - S1 Self-cooled
Drive & motor: Altitude 1000 m max - Ambient temperature 40°C max

Open loop regulation
This regulation mode limits the voltage drop at the motor terminals (≈-25 V(1)), which optimises the motor & drive selection. The torque and speed accuracy are limited, especially at low speed.

MOTOR		DRIVE	VARIABLE SPEED DRIVE											Motor moment of inertia
Type	Power on 400 V grid supply 50 Hz P_n kW	Type Powerdrive	Power on drive at 50 Hz kW	Torque in continuous duty 5 Hz 300 rpm N.m	10 Hz 600 rpm N.m	17 Hz 1020 rpm N.m	25 Hz 1500 rpm N.m	**50 Hz 3000 rpm N.m**	60 Hz 3600 rpm N.m	Maximum torque/ Rated torque M_{max}/M_n(2)	Current on drive at 50 Hz I_a(3) A	I_{max} drv A	Efficiency 4/4 %	Noise LP db(A)	J kg.m²
FLSES 280 S	75	MD2S 100T	**75**	169	206	225	242	**242**	199	1.48	135	200	93.4	81	0.43
		MD2S 150T								2.13		288			
FLSES 280 M	90	MD2S 100T	**90**	204	247	271	291	**291**	239	1.25	160	200	93.8	82	0.51
		MD2S 120T								1.50		240			
		MD2S 150T								1.82		292			
FLSES 315 S	110	MD2S 120T	**110**	248	301	329	354	**354**	292	1.20	200	240	94.0	85	1.3
		MD2S 150T								1.54		308			
		MD2S 220T								1.98		395			
FLSES 315 M	132	MD2S 150T	**132**	298	361	395	425	**425**	350	1.30	238	308	93.5	85	1.36
		MD2S 180T								1.52		360			
		MD2S 220T								1.74		413			
FLSES 315 LA	160	MD2S 180T	**160**	361	439	480	516	**516**	424	1.24	291	360	94.1	85	1.48
		MD2S 220T								1.54		450			
		MD2S 340T								2.06		599			
FLSES 315 LB	200	MD2S 220T	**200**	450	547	598	643	**643**	531	1.25	359	450	94.7	85	1.92
		MD2S 270T								1.48		530			
		MD2S 470T								2.37		852			
FLSES 355 LA	250	MD2S 270T	**250**	561	682	746	802	**802**	663	1.14	464	530	94.7	87	3.26
		MD2S 340T								1.42		660			
		MD2S 600T								2.45		1137			
FLSES 355 LB	315	MD2S 340T	**315**	706	858	938	1009	**1009**	836	1.19	555	660	94.7	87	3.68
		MD2S 400T								1.37		760			
		MD2S 900T								2.61		1449			
FLSES 355 LC	355	MD2S 400T	**348**	781	948	1038	1095	**1116**	924	1.21	630	760	94.7	86	3.71
		MD2S 470T	**355**	796	966	1057	1137	**1137**	942	1.46	642	940			
		MD2S 750T								2.22		1399			

(1) Voltage drop at the drive output, excluding motor reactance.
(2) M_{max}/M_n: 60 s every 600 s
(3) I_a: Current absorbed by motors supplied by a drive
For higher power ratings: please consult Emerson Industrial Automation.

If the motor has a forced ventilation unit, the rated torque is no longer derated between 0 and 50 Hz.

Each motor can be combined with different drives depending on the application (see page 10):

Drive selected for "normal duty"

Drive selected for "heavy duty"

Drive selected for the maximum torque available on the motor

2-poles FLSES - with encoder feedback

Power supply upstream of the drive 400 V ± 10% (in accordance with IEC 60034-1) - Closed loop flux vector control 3 kHz switching frequency - Class F motor - F temperature rise - S1 Self-cooled
Drive & motor: Altitude 1000 m max - Ambient temperature 40°C max

Closed loop regulation

This regulation mode imposes a greater voltage drop at the motor terminals (≈-40 V(1)), which can have an impact on motor & drive selection. There is optimal torque and speed accuracy, enabling the rated torque to be held at zero speed.

MOTOR		DRIVE	VARIABLE SPEED DRIVE												Motor moment of inertia
Type	Power on 400 V grid supply 50 Hz P_n kW	Type Powerdrive	Power on drive at 50 Hz kW	Torque in continuous duty 5 Hz 300 rpm N.m	10 Hz 600 rpm N.m	17 Hz 1020 rpm N.m	25 Hz 1500 rpm N.m	**50 Hz 3000 rpm N.m**	60 Hz 3600 rpm N.m	Maximum torque/ Rated torque M_{max}/M_n(2)	Current on drive at 50 Hz I_a(3) A	I_{max} drv A	Efficiency 4/4 %	Noise LP db(A)	J kg.m²
FLSES 280 S	75	MD2S 100T	**75**	169	206	225	242	**242**	199	1.42	141	200	93.4	81	0.43
		MD2S 150T								1.97		277			
FLSES 280 M	90	MD2S 100T	**90**	204	247	271	291	**291**	239	1.20	167	200	93.8	82	0.51
		MD2S 120T								1.44		240			
		MD2S 150T								1.68		280			
FLSES 315 S	110	MD2S 120T	**110**	248	301	329	354	**354**	292	1.15	208	240	94.0	85	1.3
		MD2S 150T								1.48		308			
		MD2S 220T								1.82		379			
FLSES 315 M	132	MD2S 150T	**132**	298	361	395	425	**425**	350	1.24	247	308	93.5	85	1.36
		MD2S 180T								1.46		360			
		MD2S 220T								1.60		397			
FLSES 315 LA	160	MD2S 180T	**160**	361	439	480	516	**516**	424	1.19	304	360	94.1	85	1.48
		MD2S 220T								1.48		450			
		MD2S 340T								1.90		575			
FLSES 315 LB	200	MD2S 220T	**200**	450	547	598	643	**643**	531	1.20	374	450	94.7	85	1.92
		MD2S 270T								1.42		530			
		MD2S 470T								2.19		818			
FLSES 355 LA	250	MD2S 270T	**243**	546	663	725	758	**780**	645	1.13	470	530	94.7	87	3.26
		MD2S 340T	**250**	561	682	746	802	**802**	663	1.33	483	660			
		MD2S 600T								2.26		1062			
FLSES 355 LB	315	MD2S 340T	**315**	706	858	938	1009	**1009**	836	1.14	578	660	94.7	87	3.68
		MD2S 470T								1.63		940			
		MD2S 750T								2.41		1391			
FLSES 355 LC	355	MD2S 470T	**355**	796	966	1057	1137	**1137**	942	1.41	669	940	94.7	86	3.71
		MD2S 750T								2.04		1365			

(1) Voltage drop at the drive output, excluding motor reactance.
(2) M_{max}/M_n: 60 s every 600 s
(3) I_a: Current absorbed by motors supplied by a drive
For higher power ratings: please consult Emerson Industrial Automation.

If the motor has a forced ventilation unit, the rated torque is no longer derated between 0 and 50 Hz.

Each motor can be combined with different drives depending on the application (see page 10):

- Drive selected for "normal duty"
- Drive selected for "heavy duty"
- Drive selected for the maximum torque available on the motor

For information about the encoder, see page 23

4-poles FLSES - without encoder feedback

Power supply upstream of the drive 400 V ± 10% (in accordance with IEC 60034-1) - Open loop flux vector control 3 kHz switching frequency - Class F motor - F temperature rise - S1 Self-cooled
Drive & motor: Altitude 1000 m max - Ambient temperature 40°C max

Open loop regulation
This regulation mode limits the voltage drop at the motor terminals (≈-25 V(1)), which optimises the motor & drive selection.
The torque and speed accuracy are limited, especially at low speed.

MOTOR		DRIVE	VARIABLE SPEED DRIVE											Motor moment of inertia
Type	Power on 400 V grid supply 50 Hz P_n kW	Type Powerdrive	Power on drive at 50 Hz kW	Torque in continuous duty 5 Hz 150 rpm N.m	10 Hz 300 rpm N.m	17 Hz 510 rpm N.m	25 Hz 750 rpm N.m	**50 Hz 1500 rpm N.m**	60 Hz 1800 rpm N.m	Maximum torque/ Rated torque M_{max}/M_n(2)	Current on drive at 50 Hz I_a(3) A	I_{max} drv A	Efficiency 4/4 %	Noise LP db(A)	J kg.m²
FLSES 280 S	75	MD2S 100T	**75**	339	411	450	484	**484**	398	1.39	144	200	92.8	77	0.8
		MD2S 180T								2.20		316			
FLSES 280 M	90	MD2S 100T	**90**	407	494	540	581	**581**	477	1.16	172	200	93.1	77	0.94
		MD2S 120T								1.40		240			
		MD2S 180T								2.09		360			
FLSES 315 S	110	MD2S 120T	**110**	496	602	658	708	**708**	584	1.15	209	240	93.6	78	2.24
		MD2S 150T								1.48		308			
		MD2S 220T								1.89		394			
FLSES 315 M	132	MD2S 150T	**132**	596	723	791	851	**851**	700	1.24	249	308	94.0	77	2.64
		MD2S 180T								1.44		360			
		MD2S 220T								1.80		449			
FLSES 315 LA	160	MD2S 180T	**160**	722	876	959	1031	**1031**	849	1.23	294	360	94.5	77	2.26
		MD2S 220T								1.53		450			
		MD2S 340T								2.21		650			
FLSES 315 LB	200	MD2S 220T	**200**	908	1102	1206	1297	**1297**	1061	1.24	363	450	95.0	77	2.75
		MD2S 270T								1.46		530			
		MD2S 470T								2.35		854			
FLSES 355 LA	250	MD2S 270T	**250**	1122	1363	1491	1603	**1603**	1326	1.16	456	530	95.0	83	5.16
		MD2S 340T								1.45		660			
		MD2S 750T								2.79		1273			
FLSES 355 LB	315	MD2S 340T	**315**	1414	1717	1879	2020	**2020**	1671	1.15	574	660	95.0	80	5.9
		MD2S 470T								1.64		940			
		MD2S 750T								2.14		1226			
FLSES 355 LC	355	MD2S 400T	**348**	1566	1902	2081	2196	**2237**	1848	1.21	630	760	95.0	83	6.6
		MD2S 470T	**355**	1596	1938	2120	2280	**2280**	1883	1.46	642	940			
		MD2S 900T								2.34		1473			

(1) Voltage drop at the drive output, excluding motor reactance.
(2) M_{max}/M_n: 60 s every 600 s
(3) I_a: Current absorbed by motors supplied by a drive
For higher power ratings: please consult Emerson Industrial Automation.

If the motor has a forced ventilation unit, the rated torque is no longer derated between 0 and 50 Hz.

Each motor can be combined with different drives depending on the application (see page 10):

Drive selected for "normal duty"

Drive selected for "heavy duty"

Drive selected for the maximum torque available on the motor

4-poles FLSES - with encoder feedback

Power supply upstream of the drive 400 V ± 10% (in accordance with IEC 60034-1) - Closed loop flux vector control 3 kHz switching frequency - Class F motor - F temperature rise - S1 Self-cooled
Drive & motor: Altitude 1000 m max - Ambient temperature 40°C max

Closed loop regulation

This regulation mode imposes a greater voltage drop at the motor terminals (≈-40 V(1)), which can have an impact on motor & drive selection. There is optimal torque and speed accuracy, enabling the rated torque to be held at zero speed.

MOTOR		DRIVE	VARIABLE SPEED DRIVE											Motor moment of inertia
Type	Power on 400 V grid supply 50 Hz P_n kW	Type Powerdrive	Power on drive at 50 Hz kW	Torque in continuous duty 5 Hz 150 rpm N.m	10 Hz 300 rpm N.m	17 Hz 510 rpm N.m	25 Hz 750 rpm N.m	**50 Hz 1500 rpm N.m**	60 Hz 1800 rpm N.m	Maximum torque/ Rated torque M_{max}/M_n(2)	Current on drive at 50 Hz I_a(3) A	I_{max} drv A	Efficiency 4/4 %	Noise LP db(A)	J kg.m²
FLSES 280 S	75	MD2S 120T	**75**	339	411	450	484	**484**	398	1.60	150	240	92.8	77	0.8
		MD2S 150T								2.03		303			
FLSES 280 M	90	MD2S 100T	**88**	397	482	527	554	**567**	466	1.14	175	200	93.1	77	0.94
		MD2S 120T	**90**	407	494	540	581	**581**	477	1.31	179	240			
		MD2S 180T								1.94		347			
FLSES 315 S	110	MD2S 120T	**109**	490	595	651	692	**700**	577	1.12	215	240	93.6	78	2.24
		MD2S 150T	**110**	496	602	658	708	**708**	584	1.42	217	308			
		MD2S 220T								1.74		378			
FLSES 315 M	132	MD2S 150T	**132**	596	723	791	851	**851**	700	1.19	260	308	94.0	77	2.64
		MD2S 180T								1.39		360			
		MD2S 220T								1.68		435			
FLSES 315 LA	160	MD2S 180T	**160**	722	876	959	1031	**1031**	849	1.18	305	360	94.5	77	2.26
		MD2S 220T								1.48		450			
		MD2S 340T								2.04		622			
FLSES 315 LB	200	MD2S 220T	**200**	908	1102	1206	1297	**1297**	1061	1.19	378	450	95.0	77	2.75
		MD2S 270T								1.40		530			
		MD2S 470T								2.17		820			
FLSES 355 LA	250	MD2S 270T	**247**	1111	1349	1476	1571	**1587**	1313	1.13	470	530	95.0	83	5.16
		MD2S 340T	**250**	1122	1363	1491	1603	**1603**	1326	1.38	475	660			
		MD2S 750T								2.57		1210			
FLSES 355 LB	315	MD2S 400T	**315**	1414	1717	1879	2020	**2020**	1671	1.27	598	760	95.0	80	5.9
		MD2S 470T								1.57		940			
		MD2S 600T								1.91		1140			
FLSES 355 LC	355	MD2S 470T	**355**	1596	1938	2120	2280	**2280**	1883	1.41	669	940	95.0	83	6.6
		MD2S 750T								2.09		1398			

(1) Voltage drop at the drive output, excluding motor reactance.
(2) M_{max}/M_n: 60 s every 600 s
(3) I_a: Current absorbed by motors supplied by a drive
For higher power ratings: please consult Emerson Industrial Automation.

If the motor has a forced ventilation unit, the rated torque is no longer derated between 0 and 50 Hz.

Each motor can be combined with different drives depending on the application (see page 10):

- Drive selected for "normal duty"
- Drive selected for "heavy duty"
- Drive selected for the maximum torque available on the motor

For information about the encoder, see page 23

6-poles FLSES - without encoder feedback

Power supply upstream of the drive 400 V ± 10% (in accordance with IEC 60034-1) - Open loop flux vector control 3 kHz switching frequency - Class F motor - F temperature rise - S1 Self-cooled
Drive & motor: Altitude 1000 m max - Ambient temperature 40°C max

Open loop regulation
This regulation mode limits the voltage drop at the motor terminals (≈-25 V(1)), which optimises the motor & drive selection. The torque and speed accuracy are limited, especially at low speed.

MOTOR		DRIVE	VARIABLE SPEED DRIVE												Motor moment of inertia
Type	Power on 400 V grid supply 50 Hz	Type	Power on drive at 50 Hz	Torque in continuous duty						Maximum torque/ Rated torque	Current on drive at 50 Hz		Efficiency	Noise	
				5 Hz	10 Hz	17 Hz	25 Hz	**50 Hz**	60 Hz						
	P_n	Powerdrive	**kW**	100 rpm N.m	200 rpm N.m	340 rpm N.m	500 rpm N.m	**1000 rpm N.m**	1200 rpm N.m	M_{max}/M_n(2)	I_a(3) A	I_{max} drv A	4/4 %	LP db(A)	J kg.m²
FLSES 315 S	75	MD2S 100T	**75**	508	617	675	726	**726**	597	1.36	148	200	92.9	75	2.6
		MD2S 120T								1.47		217			
FLSES 315 M	90	MD2S 100T	**89**	604	734	803	854	**864**	708	1.14	175	200	93.0	75	3
		MD2S 120T								1.37		240			
		MD2S 150T	**90**	611	742	812	873	**873**	716	1.50	177	263			
FLSES 315 LA	110	MD2S 120T	**110**	744	904	989	1063	**1063**	875	1.13	212	240	93.4	75	3.45
		MD2S 150T								1.45		308			
		MD2S 180T								1.66		352			
FLSES 315 LB	132	MD2S 150T	**132**	896	1088	1190	1280	**1280**	1050	1.21	254	308	93.5	75	3.95
		MD2S 180T								1.42		360			
		MD2S 270T								1.90		482			
FLSES 355 LA	160	MD2S 180T	**160**	1079	1311	1434	1542	**1542**	1273	1.19	302	360	93.9	79	6.8
		MD2S 220T								1.49		450			
		MD2S 400T								2.39		722			
FLSES 355 LB	200	MD2S 220T	**200**	1349	1638	1792	1927	**1927**	1592	1.21	373	450	94.1	79	7.7
		MD2S 270T								1.42		530			
		MD2S 470T								2.39		892			
FLSES 355 LC	250	MD2S 270T	**249**	1681	2041	2233	2388	**2401**	1979	1.13	470	530	94.5	79	9.3
		MD2S 400T	**250**	1690	2052	2245	2414	**2414**	1989	1.61	473	760			
		MD2S 600T								2.14		1004			

(1) Voltage drop at the drive output, excluding motor reactance.
(2) M_{max}/M_n: 60 s every 600 s
(3) I_a: Current absorbed by motors supplied by a drive
For higher power ratings: please consult Emerson Industrial Automation.

If the motor has a forced ventilation unit, the rated torque is no longer derated between 0 and 50 Hz.

Each motor can be combined with different drives depending on the application (see page 10):

- Drive selected for "normal duty"
- Drive selected for "heavy duty"
- Drive selected for the maximum torque available on the motor

6-poles FLSES - with encoder feedback

Power supply upstream of the drive 400 V ± 10% (in accordance with IEC 60034-1) - Closed loop flux vector control 3 kHz switching frequency - Class F motor - F temperature rise - S1 Self-cooled
Drive & motor: Altitude 1000 m max - Ambient temperature 40°C max

Closed loop regulation

This regulation mode imposes a greater voltage drop at the motor terminals (≈-40 V(1)), which can have an impact on motor & drive selection. There is optimal torque and speed accuracy, enabling the rated torque to be held at zero speed.

MOTOR		DRIVE	VARIABLE SPEED DRIVE												Motor moment of inertia
Type	Power on 400 V grid supply 50 Hz	Type	Power on drive at 50 Hz	Torque in continuous duty						Maximum torque/ Rated torque	Current on drive at 50 Hz		Efficiency	Noise	
				5 Hz	10 Hz	17 Hz	25 Hz	**50 Hz**	60 Hz						
	P_n	Powerdrive		100 rpm	200 rpm	340 rpm	500 rpm	**1000 rpm**	1200 rpm	M_{max}/M_n(2)	I_a(3)	I_{max} drv	4/4	LP	J
	kW		**kW**	N.m	N.m	N.m	N.m	**N.m**	N.m		A	A	%	db(A)	$kg.m^2$
FLSES 315 S	75	MD2S 100T	**75**	508	617	675	726	**726**	597	1.30	154	200	92.9	75	2.6
		MD2S 120T								1.36		208			
FLSES 315 M	90	MD2S 120T	**90**	611	742	812	873	**873**	716	1.30	184	240	93.0	75	3
		MD2S 150T								1.39		255			
FLSES 315 LA	110	MD2S 150T	**110**	744	904	989	1063	**1063**	875	1.40	221	308	93.4	75	3.45
		MD2S 180T								1.63		360			
		MD2S 180T								1.53		338			
FLSES 315 LB	132	MD2S 180T	**132**	896	1088	1190	1280	**1280**	1050	1.36	264	360	93.5	75	3.95
		MD2S 220T								1.70		450			
		MD2S 270T								1.75		462			
FLSES 355 LA	160	MD2S 180T	**155**	1046	1270	1389	1447	**1494**	1234	1.18	305	360	93.9	79	6.8
		MD2S 270T	**160**	1079	1311	1434	1542	**1542**	1273	1.68	315	530			
		MD2S 340T								2.16		659			
FLSES 355 LB	200	MD2S 270T	**200**	1349	1638	1792	1927	**1927**	1592	1.36	389	530	94.1	79	7.7
		MD2S 340T								1.70		660			
		MD2S 470T								2.20		857			
FLSES 355 LC	250	MD2S 340T	**250**	1690	2052	2245	2414	**2414**	1989	1.34	492	660	94.5	79	9.3
		MD2S 400T								1.54		760			
		MD2S 600T								1.97		969			

(1) Voltage drop at the drive output, excluding motor reactance.
(2) M_{max}/M_n: 60 s every 600 s
(3) I_a: Current absorbed by motors supplied by a drive
For higher power ratings: please consult Emerson Industrial Automation.

If the motor has a forced ventilation unit, the rated torque is no longer derated between 0 and 50 Hz.

Each motor can be combined with different drives depending on the application (see page 10):

- Drive selected for "normal duty"
- Drive selected for "heavy duty"
- Drive selected for the maximum torque available on the motor

For information about the encoder, see page 23

General information

INFLUENCE OF THE MAINS SUPPLY

Each industrial power supply has its own intrinsic characteristics (short-circuit capability, voltage value and fluctuation, phase imbalance, etc) and supplies equipment some of which can distort its voltage either permanently or temporarily (notches, voltage dips, overvoltage, etc). The quality of the mains supply has an impact on the performance and reliability of electronic equipment, especially variable speed drives.
POWERDRIVE MD2 drives are designed to operate with the mains supplies typically found on industrial sites throughout the world. However, for each installation, it is important to know the characteristics of the mains supply so that you can take corrective steps in the event of abnormal conditions.

TRANSIENT OVERVOLTAGES

There are numerous sources of overvoltages on an electrical installation:
• Connection/disconnection of banks of power factor correction capacitors
• High-power thyristor-controlled equipment (oven, DC drive, etc)
• Overhead power supply

Connection/disconnection of a bank of power correction capacitors

Connecting power factor correction capacitors in parallel on the drive power supply line when the drive is running can generate transient overvoltages that are likely to trip the drive safety devices, or even damage it in extreme cases.
If banks of power factor correction capacitors are used on the power supply line, make sure that:
• The threshold between steps is low enough to avoid causing overvoltage on the line
• The capacitors are not permanently connected

Presence of commutation notches on the line

When high-power thyristor-controlled equipment is connected on the same line as the drive, it is essential to ensure that the harmonics generated by the commutation notches do not excessively distort the mains voltage and do not create voltage peaks with amplitude higher than 1.6 x mains Vrms. If this is the case, it is essential to take corrective measures to guarantee the mains quality.

UNBALANCED POWER SUPPLY

In the same way as can be seen on an electric motor, the line phase voltage imbalance of a drive may have consequences on its operation. Please refer to the drive installation manual.

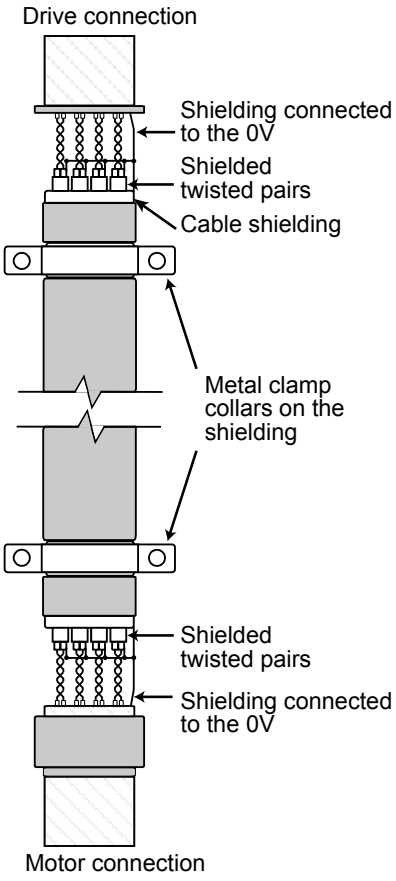
EQUIPOTENTIAL BONDING

The equipotential earth bonding of some industrial sites is sometimes neglected. This lack of equipotentiality leads to leakage currents which flow via the earth cables (green/yellow), the machine chassis, the pipework, etc and also via the electrical equipment. In some extreme cases, these currents can trip the drive.
It is essential that the earth network is designed and implemented by the installation supervisor so that its impedance is as low as possible, so as to distribute the fault currents and high-frequency currents without them passing through electrical equipment.
Metal grounds must be mechanically connected to each other with the largest possible electrical contact area. Under no circumstances can earth connections designed to protect people, by linking metal grounds to earth via a cable, serve as a substitute for ground connections (see IEC 61000-5-2).

The immunity and radio-frequency emission level are directly linked to the quality of the ground connections.

CONNECTION OF CONTROL CABLES AND ENCODER CABLES

WARNING: Strip back the shielding on the metal clamp collars in order to ensure 360° contact.



Installation

The following information is given for guidance only, and should never be used as a substitute for the current standards, nor does it relieve the installer of his responsibility.
Depending on the installation, more optional elements can be added to the installation:

Switch-fuse: a padlockable breaking device must be installed to isolate the installation should operator intervention be necessary. This device must provide protection against overheating and short-circuits. The fuse rating is stated in the drive documentation. The switch-fuse can be replaced with a circuit-breaker (with appropriate breaking capacity).

RFI filter: its role is to reduce the drive electromagnetic emissions, and thus comply with EMC standards. Emerson Industrial Automation drives are, as standard, equipped with an internal RFI filter. Some environments require the addition of an external filter. Please consult the drive documentation to find out the drive conformance levels, with and without an external RFI filter.

Drive power supply cables: these cables do not necessarily need shielding. Their cross-section is recommended in the drive documentation, however, it can be adapted according to the type of cable, installation method, cable length (voltage drop), etc. See below "Sizing power cables".

Line reactor: its role is to reduce the risk of damage to drives following phase imbalance or significant disturbance on the electrical mains supply. The line reactor can also reduce low-frequency harmonics.

Motor reactor: different types of reactor or filter are available. The motor reactor can, depending on the circumstances, reduce high-frequency earth leakage currents, residual currents between phases, dV/dt voltage peaks, etc. The choice of reactor depends on the distance between motor and drive.

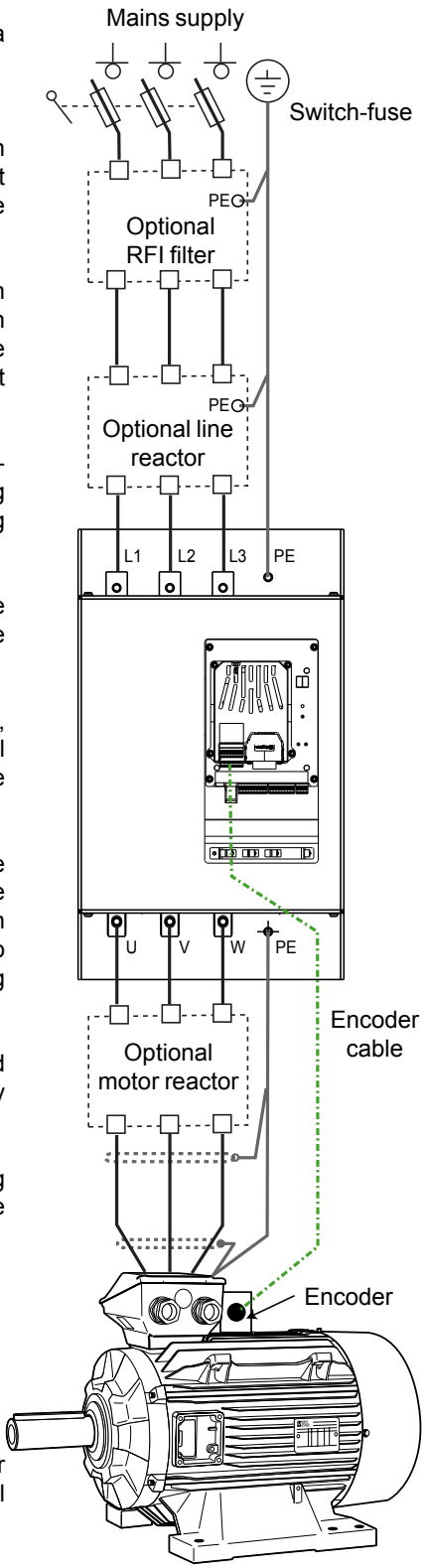
Motor power supply cables: these cables must be shielded to ensure EMC conformance of the installation. The cable shielding must be connected over 360° at both ends. At the motor end, special EMC cable glands are available as an option. The cable cross-section is recommended in the drive documentation, however, it can be adapted according to the type of cable, installation method, cable length (voltage drop), etc. See below "Sizing power cables".

Encoder cables: shielding the sensor cables is important due to the high voltages and currents present at the drive output. This cable must be laid at least 30 cm away from any power cables. See "Encoders" section.

Sizing power cables: the drive and motor power supply cables must be sized according to the applicable standard, and depending on the design current, stated in the drive documentation.
The different factors to be taken into account are:
- The installation method: in a conduit, a cable tray, suspended, etc
- The type of conductor: copper or aluminium
- The correction factors, according to the installation method:
- K1 correction factor, depending on the installation
- K2 correction factor, depending on the number of conductors
- K3 correction factor, depending on the ambient temperature and the cable insulation

Once the cable cross-section has been determined, check the voltage drop at the motor terminals. A significant voltage drop results in an increase in the current and additional losses in the motor (temperature rise).

A variable speed drive and transformer system which has been earthed in accordance with good practice will contribute significantly to reducing the voltage on the shaft and the motor casing, resulting in fewer high-frequency leakage currents. Premature breakage of bearings and auxiliary equipment, such as encoders, should also be avoided wherever possible.



Adapting the motor for use at variable speed

A motor is always characterised by the following parameters, which depend on the design:
• Temperature class
• Voltage range
• Frequency range
• Thermal reserve

CHANGES IN MOTOR PERFORMANCE

When power is supplied by a drive, changes are observed in the above parameters due to certain phenomena:
• Voltage drops in the drive components
• Current increase in proportion with the decrease in voltage
• Difference in motor power supply according to the type of control (flux vector or *U/F*)

The main consequence is an increase in the motor current resulting in increased copper losses and a higher temperature rise in the winding (even at 50 Hz).
Reducing the speed leads to a reduction in air flow and hence a reduction in cooling efficiency, and as a result the motor temperature rise will increase again. Conversely, in prolonged operation at high speed, the fan may make excessive noise. It is again advisable to install a forced ventilation system.

Above the synchronous speed, the iron losses increase and hence cause further temperature rise in the motor.

The type of control mode influences temperature rise in the motor:
• A *U/F* ratio gives the fundamental voltage maximum at 50 Hz but requires more current at low speed to obtain a high starting torque and therefore generates a temperature rise at low speed when the motor is poorly ventilated.
• Flux vector control requires less current at low speed while providing significant torque but regulates the voltage at 50 Hz and causes a voltage drop at the motor terminals, therefore requiring more current at the same power.

Consequences on the motor

Reminder: Emerson Industrial Automation recommends the use of PTC sensors, monitored by the drive, to protect the motor as much as possible.
The choice of class B tempertaure rise when supplied on grid means that LSES, FLSES or PLSES motors can be used on a drive without derating the power in centrifugal applications.
As far as constant torque applications are concerned, derating will depend on the speed range: please consult the tables on previous pages.
In constant torque applications which can operate below the rated frequency and to avoid derating the power, it may prove necessary to use a forced ventilation unit, depending on the operating cycle.
Note 1: The thermal reserve, a Emerson Industrial Automation special feature, should be used to keep the motor in its temperature class. However in certain cases, the temperature class will change from B to F, ie. between 80 k and 105 k.

CONSEQUENCES OF POWER SUPPLIED BY DRIVES

When power is supplied to the motor by a variable speed drive with diode rectifier, this causes a voltage drop (~5%).
Some PWM techniques can be used to limit this voltage drop (~2%), to the detriment of the machine temperature rise (injection of harmonics of orders 5 and 7).
As a manufacturer of drives and motors, Emerson Industrial Automation has opted for a better voltage form at the drive output in order to preserve machine life time without adversely affecting efficiency.
The non-sinusoidal signal (PWM) provided by the drive generates voltage peaks at the winding terminals due to the significant voltage variations relating to switching of the IGBTs (also called dV/dt). Repeated overvoltages can eventually damage the windings depending on their value and/or the motor design.

The value of the voltage peaks is proportional to the supply voltage. This value can exceed the minimum voltage for the windings which is related to the wire grade, the impregnation type and the insulation that may or may not be present in the slot bottoms or between phases.
Another option for attaining high voltage values is when regeneration phenomena occur in the case of a driving load, hence the need to prioritise coast stops or following the longest permissible ramp.

Recommendations concerning the motor winding depending on the supply voltage

Emerson Industrial Automation offers a range of motor solutions in order to minimise risks:
• "Star" connections whenever possible
• Serial winding whenever possible
• Deceleration following the longest possible ramp
• Ideally, do not use the motor at the limits of its insulation class
These solutions are preferable to filters at the drive output, which accentuate the voltage drop and thus increase the current in the motor.

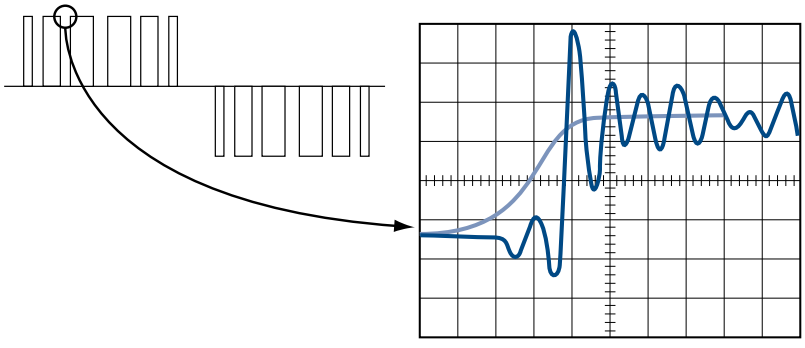


Figure 1

Adapting the motor for use at variable speed

The insulation system for Emerson Industrial Automation motors can be used on a drive without modification, regardless of the size of the machine or the application, at a supply voltage ≤ 480 V 50/60 Hz and can tolerate voltage peaks up to 1500 V and variations of 3500 V/µs. These values are guaranteed without using a filter at the motor terminals.

For a supply voltage > 480 V, other precautions should be taken to maximise motor life. Emerson Industrial Automation's reinforced insulation system (RIS) must be used unless otherwise agreed by Emerson Industrial Automation or a sine filter is used, taking account of the voltage drop at the motor terminals (only compatible with a U/F control mode).

Recommendations concerning the mechanism of rotation

The voltage wave form at the drive output (PWM) can generate high-frequency leakage currents which can, in certain situations, damage the motor bearings. This phenomenon is amplified with:
• High mains supply voltages
• Increased motor size
• Incorrectly earthed variable speed drive system
• Long cable length between the drive and the motor
• Motor incorrectly aligned with the driven machine

Emerson Industrial Automation machines which have been earthed in accordance with good practice need no special options except in the situations listed below:
• For voltage ≤ 480 V 50/60 Hz, and frame size ≥ 315 mm, we recommend using an insulated NDE bearing.
• For voltage > 480 V 50/60 Hz, and frame size ≥ 315 mm, it is advisable to fit the motor with two insulated bearings, especially if there is no filter at the drive output.
If there is one, only one insulated NDE bearing is recommended.

Good wiring practice

It is the responsibility of the user and/or the installer to connect the variable speed drive system in accordance with the current legislation and regulations in the country of use. This is particularly important as concerns cable size and connection of earths and grounds.

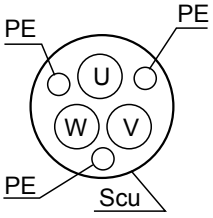
The following information is given for guidance only, and should never be used as a substitute for the current standards, nor does it relieve the installer of his responsibility. For more information, please refer to technical specification IEC 60034-31.

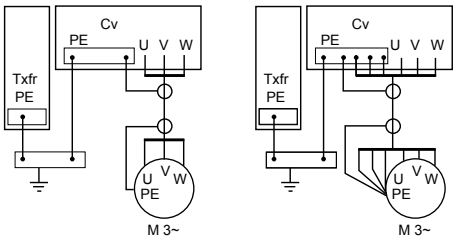
A variable speed drive and transformer system which have been earthed in accordance with good practice will contribute significantly to reducing the voltage on the shaft and the motor casing, resulting in fewer high-frequency leakage currents. Premature breakage of bearings and auxiliary equipment, such as encoders, should also be avoided wherever possible.

To ensure the safety of personnel, the size of the earthing cables should be determined individually in accordance with local regulations.

To ensure the safety of motors with frame size 315 mm or above, we recommend installing grounding strips between the terminal box and the feet and/or the motor and the driven machine.

For compliance with standard EN 61800-3, the power conductors between drive and motor must be shielded. Use a special variable speed cable: shielded with low stray capacity and with 3 PE conductors arranged at 120° (diagram below). There is no need to shield the drive power supply cables.





Example of cables recommended in IEC 60034-25:
SCu = Concentric copper or aluminium shielding
Txfr = Transformer
Cv = Drive

The variable speed drive wiring must be symmetrical (U,V,W at the motor end must correspond to U,V,W at the drive end) with the cable shielding earthed at both the drive end and motor end over 360°.

In the second industrial environment (if an HV/LV transformer belongs to the user), the shielded motor power supply cable can be replaced with a 3-core + earth cable placed in a fully-enclosed metal conduit (metal cable duct for example). This metal conduit should be mechanically connected to the electrical cabinet and the structure supporting the motor. If the conduit consists of several pieces, these should be interconnected by braids to ensure earth continuity. The cables must be fixed securely at the bottom of the conduit.

The motor earth terminal (PE) must be connected directly to the drive earth terminal. A separate PE protective conductor is mandatory if the conductivity of the cable shielding is less than 50% of the conductivity of the phase conductor.

Adapting the motor for use at variable speed

Summary of protection devices recommended for POWERDRIVE MD2 - FLSES assemblies

Mains voltage	Cable length (1)	Frame size	Winding protection	Insulated bearings
≤ 480 V	< 20 m	All frame sizes	Standard (2)	No
	< 250 m	< 315	Standard (2)	No
	> 20 m and < 250 m	≥ 315	RIS or drive filter (3)	NDE
> 480 V and ≤ 690 V	< 20 m	≤ 160	Standard (2)	No
	< 250 m		RIS or drive filter (3)	No
		> 160 and < 315		NDE
		≥ 315		NDE (or DE + NDE if no filter)

(1) Length of shielded cable, cumulative (length) per phase between motor and drive, for a drive with 3 kHz switching frequency.
(2) Standard insulation = 1500 V peak and 3500 V/µs.
(3) Drive filter: dV/dt reactor or sine wave filter. Please consult Emerson Industrial Automation.

Adjusting the switching frequency

The variable speed drive switching frequency has an impact on losses in the motor and the drive, on the acoustic noise and the torque ripple.
A low switching frequency has an adverse effect on temperature rise in motors.
For motors of frame size ≥ 315 mm, Emerson Industrial Automation recommends a drive switching frequency of 3 kHz minimum.
In addition, a high switching frequency optimises the acoustic noise and torque ripple level.

Position sensor

Incremental encoder

This pulse generator supplies a number of pulses on channels A,A/, B,B/, 0 marker, 0 marker/ proportional to the speed.

A 1024 lpr encoder is sufficient for most applications. However, where stability at very low speed (<10 rpm) is required, use of a higher-resolution encoder is recommended.

Powerdrive can supply encoders with +5 V DC or +15 V DC.

Encoder type Data interface	Incremental encoder
Supply voltage	5 - 30 V DC
Positions per revolution	1024 or 4096
Output stage	TTL or HTL
Max. current (no load)	150 mA
Max. mechanical speed in continuous operation	10,000 rpm
Shaft diameter	14 mm
Protection	IP65
Operating temperature	-40° +85°C
Certification	CE, CURus, UL/CSA
Type of cable to be used with it	SCBAC _ _ _
Motor end finish	M23 12 pins
Drive end finish	Marked ferrules

Encoder-drive connecting cable

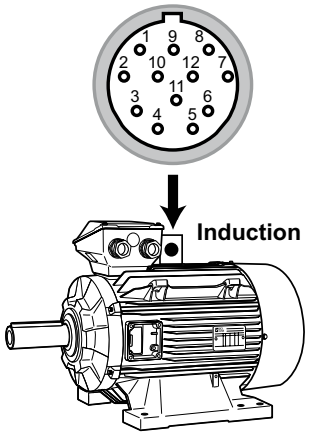
It may be possible to order a suitable cable, guaranteeing optimum performance of the drive connection. Please consult Emerson Industrial Automation.

Cable type	Insulation		Option		Finish			Length
					Motor		Drive	
Incremental SC	B	Class 6 PUR insulation	A	Without PTC	C	M23 12 or 17p	Marked ferrules	1 to 100 m

Example of cable name: SCBAC005

MDX-ENCODER wiring for an incremental encoder

-	Encoder power supply 0 V
+	5 V or 15 V power supply depending on encoder characteristics. Set **Mtr.12 (03.36).**
A	Encoder channel connection
A\	
B	
B\	
0	Not used
0\	



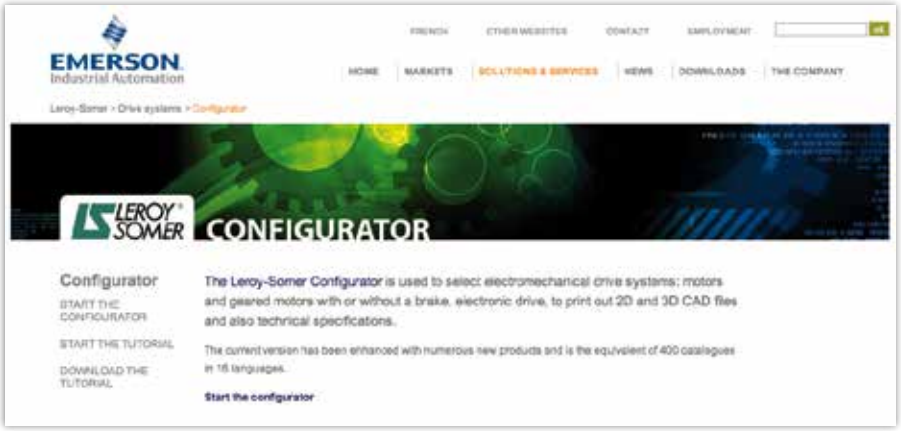
12-pin connector on encoder end (male plug)		MDX-Encoder terminals
No.	Name	Name
1	0V	-
2	+5V or +15V	+
3	A	A
4	B	B
5	0	x
6	A\	A\
7	B\	B\
8	0\	x
9	x	x
10	x	x
11	Shielding	Bracket
12	x	x

Configurator

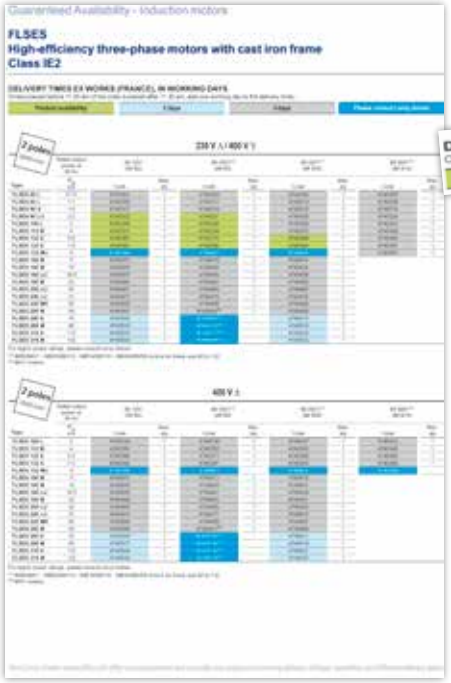
The configurator can be used to choose the most suitable motor and provides the technical specifications and corresponding drawings.

To register online: www.leroy-somer.com/en/solutions_and_services/drive_systems/configurator

- Help with product selection
- Print-outs of technical specifications
- Print-outs of 2D and 3D CAD files
- The equivalent of 300 catalogues in 10 languages



Availability of products



Being able both to respond to urgent requests and adhere to promised customer lead times calls for a powerful logistics system.

The availability of motors is ensured by the network of approved partners and Leroy-Somer central services all working together.

The selection data in the "Guaranteed Availability Drive systems" catalogue specify for each family in the form of a colour code and according to the quantities per order, the product delivery time.

Please consult Leroy-Somer.

Notes

Notes

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