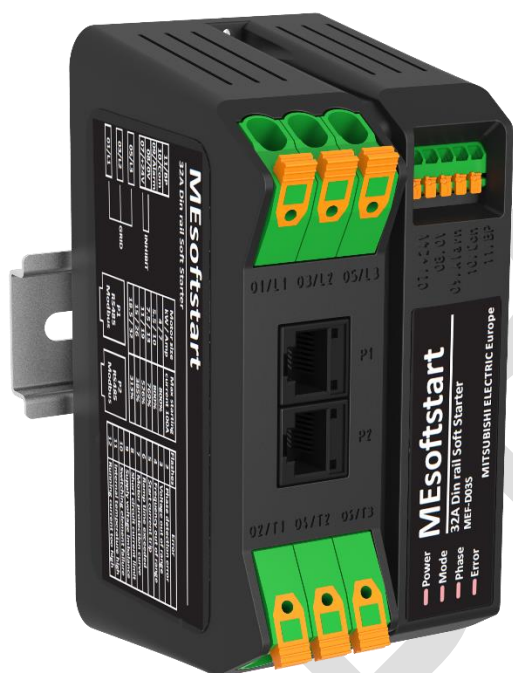


MEsoftstart DIN Rail or Panel mount LOW-VOLTAGE SOFT STARTER INSTALLATION AND INSTRUCTION MANUAL

MEsoftstart-D02	(32A DIN Rail Soft Starter – Two phase control)
MEsoftstart-D03	(32A DIN Rail Soft Starter – Three phase control)
MEsoftstart-D02S	(32A DIN Rail Soft Starter – Self powered, Two phase control)
MEsoftstart-D03S	(32A DIN Rail Soft Starter – Self powered, Three phase control)
MEsoftstart-D02L	(16A DIN Rail Soft Starter – Self powered, Two phase control)
MEsoftstart-D03L	(16A DIN Rail Soft Starter – Self powered, Three phase control)
MEsoftstart-D02LF	(16A DIN Rail Soft Starter – Factory configured, Two phase control)

Thank you for choosing this Mitsubishi soft starter. This Instruction Manual provides installation instructions and guidelines for advanced use of the MEsoft series soft starters. Before using the soft starter carefully read this Manual and ensure to follow all Safety Instructions



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October 2018	A015_070_INT_EN_002D	Updated for new MEdsoftstart model name
December 2018	A015_070_INT_EN_003	Updated for new MEdsoftstart label on photos and inhibit circuitry
February 2018	A015_070_INT_EN_003B	Updated for new Error LED pattern and troubleshooting

For Maximum Safety

- Mitsubishi Soft Starters are not designed or manufactured to be used in equipment or systems in situations that can affect or endanger human life
- When considering this product for operation in special applications such as machinery or systems in passenger transportation, medical, aerospace, atomic power or submarine applications, please contact your nearest Mitsubishi Electric sales representative
- Although this product was manufactured under conditions of strict control, you are strongly advised to install safety devices to prevent serious accidents when it is used in facilities where breakdowns of the product are likely to cause serious accident.
- Please check upon receiving your soft starter whether this instruction manual corresponds to the delivered Soft Starter. Compare the specifications on the label with the specifications given in this manual

DRAFT

Safety Instructions

Do not attempt to install, operate, maintain or inspect the product until you have read through this Instruction Manual and can use the equipment correctly. Do not use this product unless you have a full knowledge of the equipment, safety information and instructions and are qualified to do installations of this nature.

Installation, operation, maintenance and inspection must be performed by qualified personnel. Here, an expert means a person who meets all the conditions below:

- A person who has proper engineering training. Such training may be available at your local Mitsubishi Electric office. Contact your local sales office for schedules and locations.
- A person who can access the operating manuals.
- A person who has read and familiarized themselves with the manuals.

In this Instruction Manual, the safety instruction levels are classified into "Warning" and "Caution":

WARNING

Incorrect handling may cause hazardous conditions, resulting in death or severe injury.

CAUTION

Incorrect handling may cause hazardous conditions, resulting in medium or slight injury, or may cause only material damage.

Note that even the **CAUTION** level may lead to serious consequences under certain conditions. Please follow the instructions of both levels. They are important for personnel safety.

Electric Shock Prevention

WARNING

- Do not work on the soft starter wiring while there is power on the soft starter power terminals.
- Ensure that the power is OFF (MCCB open) before working on the motor or any load connected to the motor. Do not assume that the power at the motor is OFF while the power to the soft starter is still ON.
- Even if power is OFF, do not open the soft starter enclosure.
- Before wiring or inspection, the power must be switched OFF.
- Any person who is involved in wiring or inspection of this equipment shall be fully competent to do the work.
- The soft starter must be installed before wiring otherwise there is a risk of electric shock or injury.
- Ensure that cables are not damaged, under excessive stress or pinched anywhere otherwise there is a risk of causing a short circuit or even electric shock.
- Do not touch any part of the soft starter or handle the cables with wet hands- this increases the risk of electric shock.

Fire Prevention

CAUTION

- The soft starter must be installed against a non-flammable surface - mounting it in proximity of flammable material may result in a fire.
- If the soft starter has become faulty, the soft starter power must be switched OFF. A continuous flow of large current may cause a fire.
- Be sure to perform daily and periodic inspections as specified in the Instruction Manual. If a product is used without regular inspection, damage or even a fire may occur.

Injury Prevention

CAUTION

- The voltage applied to each terminal must be as specified in the Instruction Manual - otherwise damage will occur.
- The cables must be connected to the correct terminals - otherwise damage may occur.
- The connection order of the phases must be correct (from supply input to motor terminals).
- While power is ON or for some time after it was ON, do not touch the soft starter as it may be extremely hot and could inflict a burn injury.

Transportation and Installation

CAUTION

- Any person who is opening a package using a sharp object, such as a knife and cutter, must wear gloves to prevent injuries caused by the edge of the sharp object.
- The product must be transported in an appropriate method for the weight of the package. Failure to do so may lead to injuries.
- Do not stand or rest heavy objects on the product.
- During installation, caution must be taken not to drop the soft starter as doing so may cause injuries and damage to the product.
- The product must be installed either clipped onto a DIN Rail or panel mounted against a thermally conductive surface (ideal for heavy duty applications).
- Do not install the product on a hot surface.
- Do not install or operate the soft starter if it is damaged or has parts missing.
- Foreign conductive objects must be prevented from entering the soft starter. That includes screws and metal fragments or flammable substance such as oil.
- As the soft starter is a precision instrument, do not drop or subject it to impact.
- For the all ranges of the soft starter, the surrounding air temperature must comply with the temperature specification - Otherwise the soft starter may be damaged.
- The ambient humidity specification must be adhered to. Otherwise the soft starter may be damaged. (Refer to par 2.2.1.2 for details.)
- The storage temperature (applicable for a short time, e.g. during transit) specification must be adhered to. Otherwise the soft starter may be damaged.
- The soft starter must be used indoors (without corrosive gas, flammable gas, oil mist, dust and dirt etc.) Otherwise the soft starter may be damaged.
- The soft starter can be used as rated, at an altitude of 1400 m or less above sea level. Higher altitudes require de-rating.
- The soft starter should not be subjected to operational vibration. The soft starter is designed for transportation vibration only. (Refer to par. 2.2.1.7 for details.)
- If halogen-based materials (fluorine, chlorine, bromine, iodine, etc.) infiltrate into a Mitsubishi product, the product will be damaged. Halogen-based materials are often included in fumigant, which is used to sterilize or disinfest wooden packages. When packaging, prevent residual fumigant components from being infiltrated into Mitsubishi products, or use an alternative sterilization or disinfection method (heat disinfection, etc.) for packaging. Sterilization or disinfection of wooden package should also be performed before packaging the product.

Wiring

CAUTION

- The supply side terminals (terminals L1, L2 and L3) must be connected correctly. The soft starter will give a phase error indication if the supply phase is not connected in clockwise rotation.
- Ensure that the motor side terminals (T1, T2, T3) is connected correctly for the desired rotation direction.
- Never connect the motor side terminals (terminals T1, T2 and T3) to the grid power supply. Applying the grid power supply to motor terminals (T1, T2, T3) will damage the soft starter.
- For inside delta wiring ensure that the motor windings are wired between the phases as shown in the wiring diagram. Wiring the motor windings between different supply phases will result in a hard start.

Commissioning

CAUTION

- Before starting operation, each configuration parameter must be adjusted for the installation and motor size. A failure to do so may cause unexpected behaviour or damage to the motor.

Usage

CAUTION

- The soft starter's built-in temperature trip functions can only protect the motor from overheating if the motor temperature sensor is wired in and connected to the motor at an appropriate temperature sensing location.
- The effect of electromagnetic interference must be reduced by using a noise filter or by other means. Otherwise nearby electronic equipment may be affected.
- Before running a soft starter, which had been stored for a long period, inspection and test operation must be performed.
- Static electricity in your body must be discharged before you touch the product.
-

Emergency Stop and peripheral devices

CAUTION

- An independent hardware Emergency Stop must be provided as a safety measure to prevent hazardous conditions to the machine and equipment in case of soft starter failure (refer par.2.1.3).
- When the breaker on the soft starter input side trips, the wiring must be checked for fault (short circuit). The cause of the trip must be identified and removed before turning ON the power on the breaker.
- When a fuse on the soft starter input blows, the wiring and the soft starter needs to be checked for faults. The cause of the blown fuse must be identified and removed before replacing the fuse and turning on again.
- When a protective function activates, take appropriate corrective action, then reset the soft starter and resume the operation.
-

Maintenance, inspection and parts replacement

CAUTION

- Do not carry out a megger (insulation resistance) test on the soft starter when connected. It may cause damage.

Disposal

CAUTION

- When unserviceable, the soft starter should be treated as industrial waste.

List of Abbreviations

Abbreviation	Definition
AC	Alternating Current
AC3	Device category for squirrel cage motors
AM	Amplitude Modulation
BAUD	Bits per second (relating to the Modbus link)
CE	Conformité Européenne
COM	Communication
CTs	Current Transformers
DIN	Deutsches Institut für Normung (clip-on rail for installation)
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
FCs	Function Codes (Modbus)
GND	Ground / Earth
HMI	Human Machine Interface
I/O	Input / Output
IEC	International Electrotechnical Commission
L1	Supply Line Phase 1
L2	Supply Line Phase 2
L3	Supply Line Phase 3
MCCB	Moulded Case Circuit Breaker
ME	Mitsubishi Electric
MFLC	Maximum Full Load Current
MFS	Motor Frame Size (in kW)
MODBUS	Serial Communication Protocol
MOLC	Motor Overload Current
MSC	Maximum Starting Current
MULC	Motor Underload Current
OC	Open Circuit
PC	Personal Computer (running Windows 10)
PF	Power Factor
PLC	Programmable Logic Controller
RJ45	Connector standard (on MEsoftstart – used for Modbus)
RMS	Root Mean Square
RPM	Revolutions per Minute
RS485	Communication hardware specification (used for Modbus)
RTU	Remote Terminal Unit (on Modbus)
SC	Short Circuit
SCADA	Supervisory Control and Data Acquisition
SCR	Silicon Controlled Rectifier
SICD	Software Interface Control Document
USB	Universal Serial Bus
VL-L	Voltage Line to Line

1. INTRODUCTION

Mitsubishi Electric Europe's **MEsoftstart/din** microprocessor-based advanced digital soft starter range features internal bypass and full 3-phase control or 2-phase control. It incorporates both enhanced soft-start and soft-stop characteristics providing the best solution for a wide range of applications.

This manual contains the Installation and Operating instructions for the MEsoftstart-D02, MEsoftstart-D02S, MEsoftstart-D02L and MEsoftstart-D02SF Core variants and the MEsoftstart-D03, MEsoftstart-D03S, and MEsoftstart-D03L Pro variants of the MEsoftstart range of DIN rail soft starters.

Always read the instructions before using the equipment.



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1.1 Soft starter selection

The correct soft starter model needs to be selected according to the user's intended application and installation environment.

The selection of the soft starter model is dependent on the following characteristics of the user's installation:

- 1) **Motor size and connection type**— in general the soft starter current must be greater or equal to the motor full load current.
- 2) **Typical operating temperature** – the soft starter is rated at a nominal operational temperature of 50°C but may be operated from -20°C up to 60°C. Implement de-rating of the soft starter maximum current at temperatures above 50°C. The operating temperature is determined by the environmental factors as well as the soft starter workload.
 - ⚠ In a hot operating environment, the soft starter will need a long time to cool down after a start or stop ramp. In a hot environment, panel mounting the soft starter against a surface that can assist with the heat dissipation, will be beneficial.
- 3) **Soft starter workload** – The workload is what causes heat build-up in the soft starter, and what limits the performance capabilities of the soft starter. The workload comprises the installation, the typical starting time and the typical number of starts per hour.
 - a. **Installation**
MEsoftstart/din 32A models: A panel mounted installation where the panel can serve as additional heat sink for the soft starter, is preferable for installations where the running current is more than 20A or where frequent starts are required. A DIN rail installation where the only heat sink is the built-in heat sink, and especially where the MEsoftstart/din is installed next to other devices with limited airflow, should only be considered for low current small motors (20A or less) with infrequent short starting ramps.
 - b. **Typical starting time** – the shorter the starting time, the lower the thermal loading on the soft starter. A starting time of less than 5 seconds is considered normal duty. 5 second-starts and longer, are considered heavy duty and a panel mount installation is preferable.
 - c. **Typical number of starts per hour** – frequent starting increases temperature of the heat sink in the soft starter. Number of starts less than 6 per hour (or 10 minutes or longer between starts) are deemed normal duty. 6 or more starts per hour (or less than 10 minutes between starts) are considered heavy duty and a panel mount installation is preferable.
- 4) **Altitude above sea-level** – the MEsoftstart range of soft starters are designed and tested at 1400m above sea level and de-rating of the soft starter maximum current is needed for operation at higher altitude.

1.1.1 Motor size

The tables below serve as a guideline for selecting the correct model soft starter for the application according to the motor starting current and type of application. The tables show the starting current as a percentage of maximum normal running current at power factor of 0.85.

When using an inside delta connection, a Motor Protection Circuit Breaker must also be used to disconnect the motor and soft starter from the supply in the event of a trip. Inside delta connection:

- Simplifies replacement of star/delta starters because the existing wiring can be used.

- Has an impact on installation cost: Soft starter cost will be reduced but there are additional cabling and circuit breaker costs. The cost implication of installing inside delta must be evaluated for each installation.

MEsoftstart-D02L and MEsoftstart-D03L models are rated at 16A continuous current (when panel mounted) and can be used at 50A starting current. Bypass relays are built-in on all MEsoftstart/din models.

Table 1: MEsoftstart-D02L, -D02LF and -D03L 16 A models: guideline for motor sizes

Motor Size [kW]	MEsoftstart/din Normal 3-wire circuit	MEsoftstart/din 6-wire inside delta circuit
3	800%	
4	714%	
5.5	500%	800%
7.5	385%	625%
11	263%	455%
15		333%
18.5		263%
22		

MEsoftstart-D02, -D02S, -D03 and MEsoftstart-D03S models are rated at 32A continuous current (when panel mounted) and can be used at 100A starting current. Bypass relays are built-in on all MEsoftstart/din models.

Table 2: MEsoftstart-D02, D02S, D03 and D03S 32A models: guideline for motor sizes

Motor Size [kW]	MEsoftstart/din Normal 3-wire circuit	MEsoftstart/din 6-wire inside delta circuit
4	800%	
5.5	800%	
7.5	769%	
11	526%	800%
15	385%*	667%
18.5	313%*	526%
22		455%*
30		333%*

* : Panel mount recommended

1.1.2 Typical operating temperature

The operating temperature is determined by the typical ambient temperature in the immediate vicinity of the soft starter, air flow through the soft starter and cooling mechanisms that are used, as well as the soft starter workload. Refer par 2.2.2 for a description of how the cabinet design can also be used to best regulate operating temperature.

De-rate the soft starter starting capacity at 1.4% per °C for higher temperatures above 50°C.

1.1.3 Altitude of installation.

The MEsoftstart range of soft starters are designed and tested at 1400m above sea level. When planning to use the soft starter at altitudes higher than 1400m the soft starter the guideline is to de-rate at 0.67% per 100m for higher altitudes.

1.1.4 Selection example

1. The application is a motor in a 400V AC3 distribution, which does not require high starting torque. A normal 3-wire configuration 7.5kW motor is specified, with normal duty starting: Ramp-start of 5s duration, requiring no more than 250% of the motor's running current during start-up:

a) Calculations:

$$\begin{aligned} - \text{Normal full-load current} &= P(\text{kW}) / (\sqrt{3} \times PF \times VL-L) \times 1000 \\ &= 7.5 / (\sqrt{3} \times 0.85 \times 400) \times 1000 \\ &= 12.7A \end{aligned}$$

$$\begin{aligned} - \text{Starting current needed} &= 250\% \times 12.7A \\ &= 31.7A \end{aligned}$$

b) Conclusion: our starting current < 50A allowed for MEssoftstart-D03L

- **Use soft starter (MEssoftstart-D03L).**

2. The application is a motor in a 400V AC3 distribution, which requires high starting torque. A normal 3-wire configuration 7.5kW motor is specified, with normal duty starting: Ramp-start of 10s duration, requiring around than 350% of the motor's running current during start-up:

c) Calculations:

$$\begin{aligned} - \text{Normal full-load current} &= P(\text{kW}) / (\sqrt{3} \times PF \times VL-L) \times 1000 \\ &= 7.5 / (\sqrt{3} \times 0.85 \times 400) \times 1000 \\ &= 12.7A \end{aligned}$$

$$\begin{aligned} - \text{Starting current needed} &= 350\% \times 12.7A \\ &= 44.5A \end{aligned}$$

d) Conclusion: our starting current < 50A allowed for MEssoftstart-D03L

- **Use soft starter (MEssoftstart-D03L).**

3. The application is a motor in a 400V AC3 distribution, which does not require high starting torque. A normal 3-wire configuration 11kW motor is specified, with normal duty starting: Ramp-start of 5s duration, requiring no more than 300% of the motor's running current during start-up:

e) Calculations:

$$\begin{aligned} - \text{Normal full-load current} &= P(\text{kW}) / (\sqrt{3} \times PF \times VL-L) \times 1000 \\ &= 11 / (\sqrt{3} \times 0.85 \times 400) \times 1000 \\ &= 18.7A \end{aligned}$$

$$\begin{aligned} - \text{Starting current needed} &= 300\% \times 18.7A \\ &= 56.1A \end{aligned}$$

f) Conclusion: our starting current > 50A which is not allowed for MEssoftstart-D03L, but the MEssoftstart-D03 will allow up to 100A starting currents.

- **Use soft starter (MEssoftstart-D03).**

1.2 Product checking

Unpack the product and check the label on the soft starter to ensure that the model agrees with the order and that the product is intact. Figure 1 shows product labels for the MEssoftstart-D03 model.

From the label can be seen the rated continuous current of the MEssoftstart soft starter, as well as the maximum starting current for normal duty. The rated supply voltage is also visible on the label.

Recommended motor sizes are shown on the label. These motor sizes are applicable for normal 3-wire installation. Also refer to the tables in par. 1.1.1 for more information about the supported motor sizes.

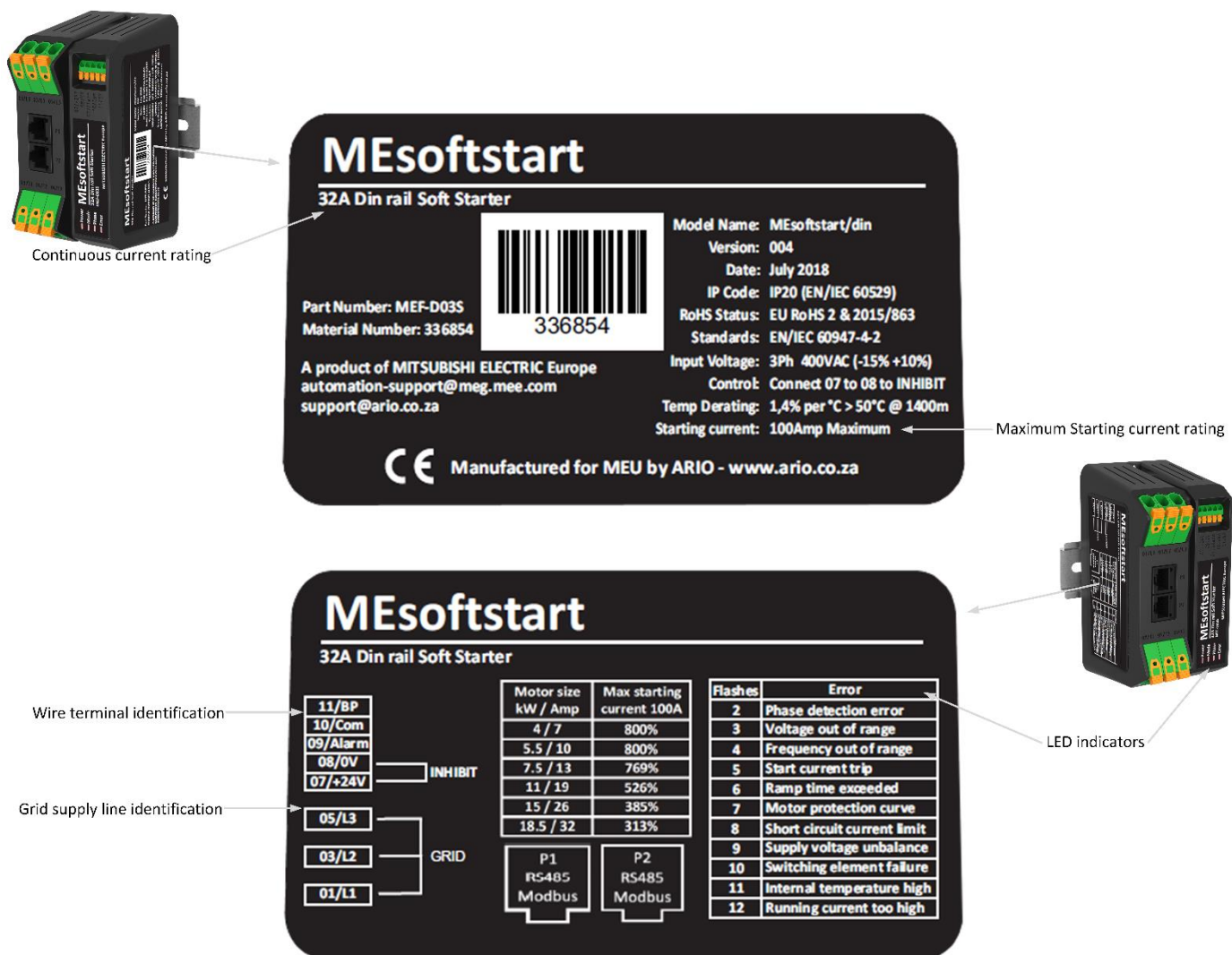


Figure 1 – Product marking

1.3 Component and Terminal identification

Component and terminals are identified in the photo below. Note that the photo shows the MEsoftstart-D03 model soft starter but the terminals are applicable to the other MEsoftstart models as well.

- 1 L1, L2, L3: Supply line connections
- 2 T1, T2, T3: Load connections
- 3 RS-485 Modbus RTU Interface on RJ45 connectors for daisy-chain*¹
- 4 LED indicators
- 5 BYPASS (Normally Open relay contactor)
COM (Common for both BYPASS and ALARM relays)
ALARM (Normally Open relay contactor)
0V – DC supply input*² / Inhibit*³
+24VDC - DC supply input*² / Inhibit*³

*¹ Not available on MSoftstart/D02LF

*² Optional for internally powered models

*³ Link 0V and 24V to INHIBIT the soft starter on internally powered models

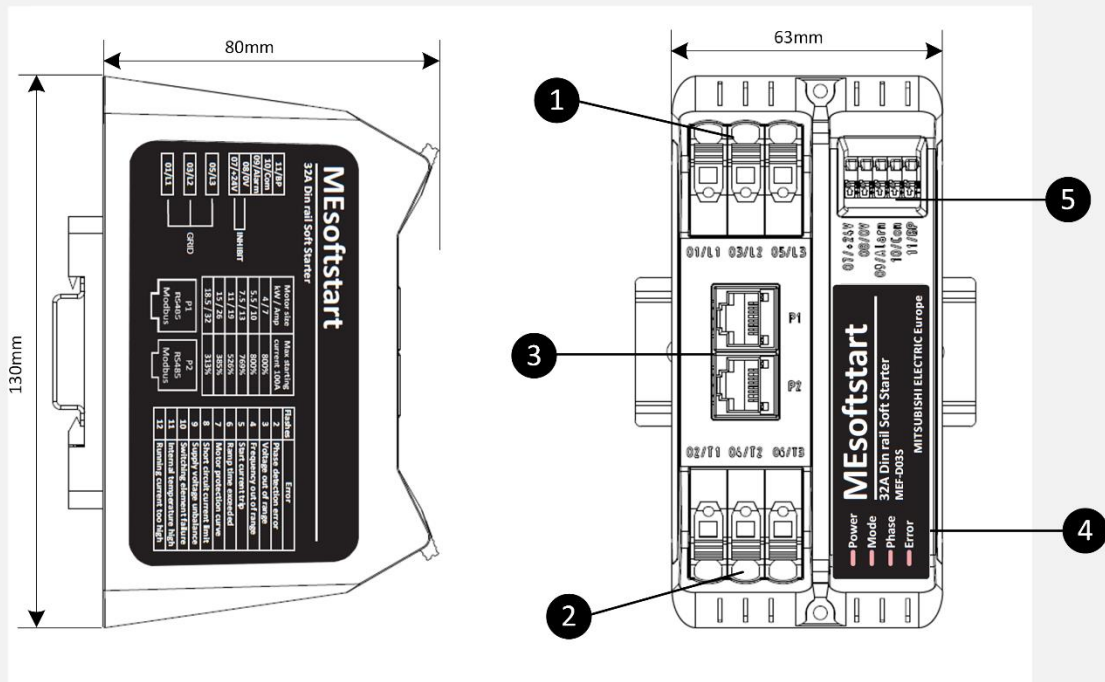


Figure 2 – Soft starter terminal and component identification

2. INSTALLATION INSTRUCTIONS

This chapter explains the installation of the MEssoftstart/din range of soft starters.

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2.1	Preparing for soft starter installation	14
2.2	MEssoftstart/din installation environment.....	17
2.3	Soft starter installation	20

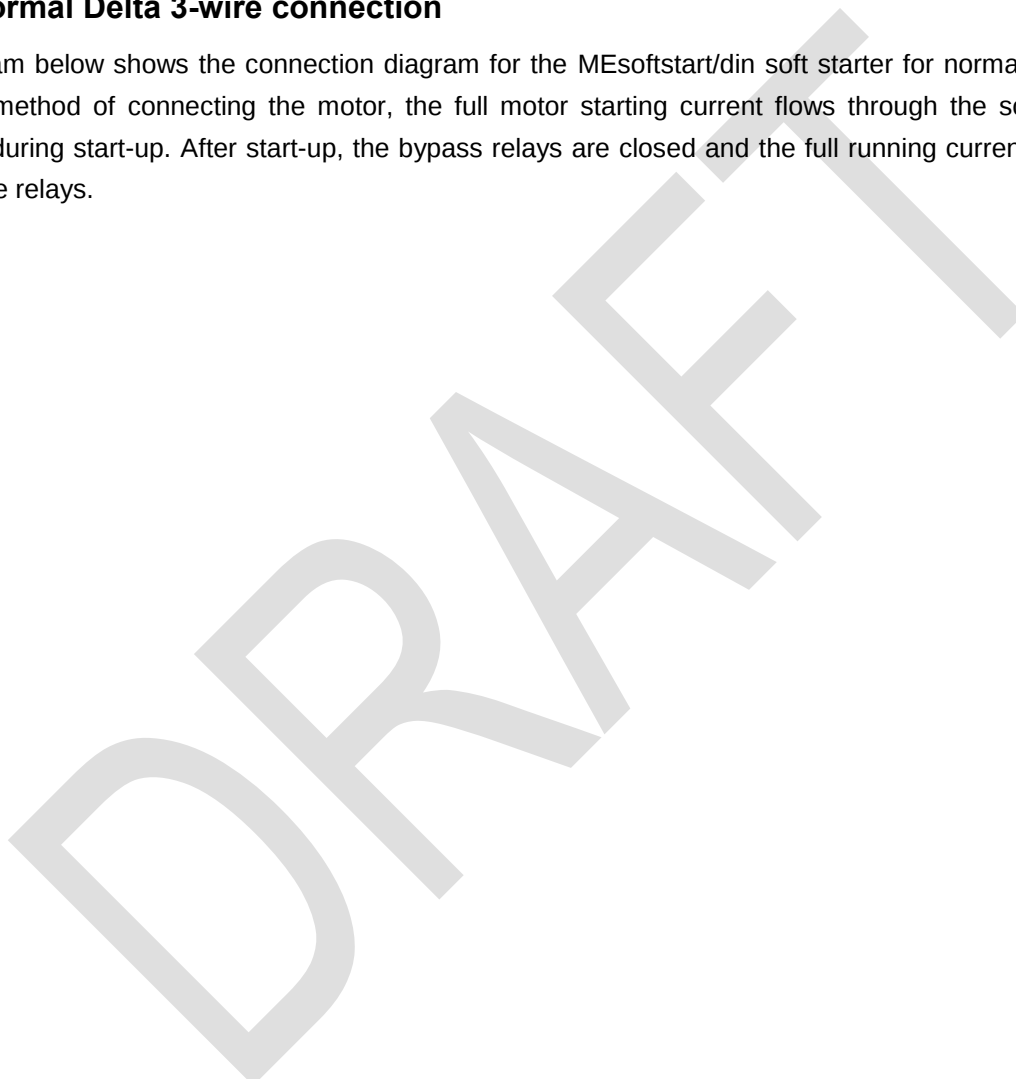
2.1 Preparing for soft starter installation

The peripheral devices that are needed around the soft starter needs to be specified before planning the installation of the soft starter.

All MEdsoftstart/din soft starters can be wired to start a normal 3-wire motor. The MEdsoftstart-D03 models (with 3-phase control) can also be wired to start an inside-delta six-wire motor. The installation and wiring of the soft starter is similar for the normal and the inside-delta connections, but there may be implications for the enclosure size and cable length and thickness, for the different ways of connecting the motor.

2.1.1 Normal Delta 3-wire connection

The diagram below shows the connection diagram for the MEdsoftstart/din soft starter for normal 3-wire connection. With this method of connecting the motor, the full motor starting current flows through the soft starter switching elements during start-up. After start-up, the bypass relays are closed and the full running current of the motor flows through the relays.



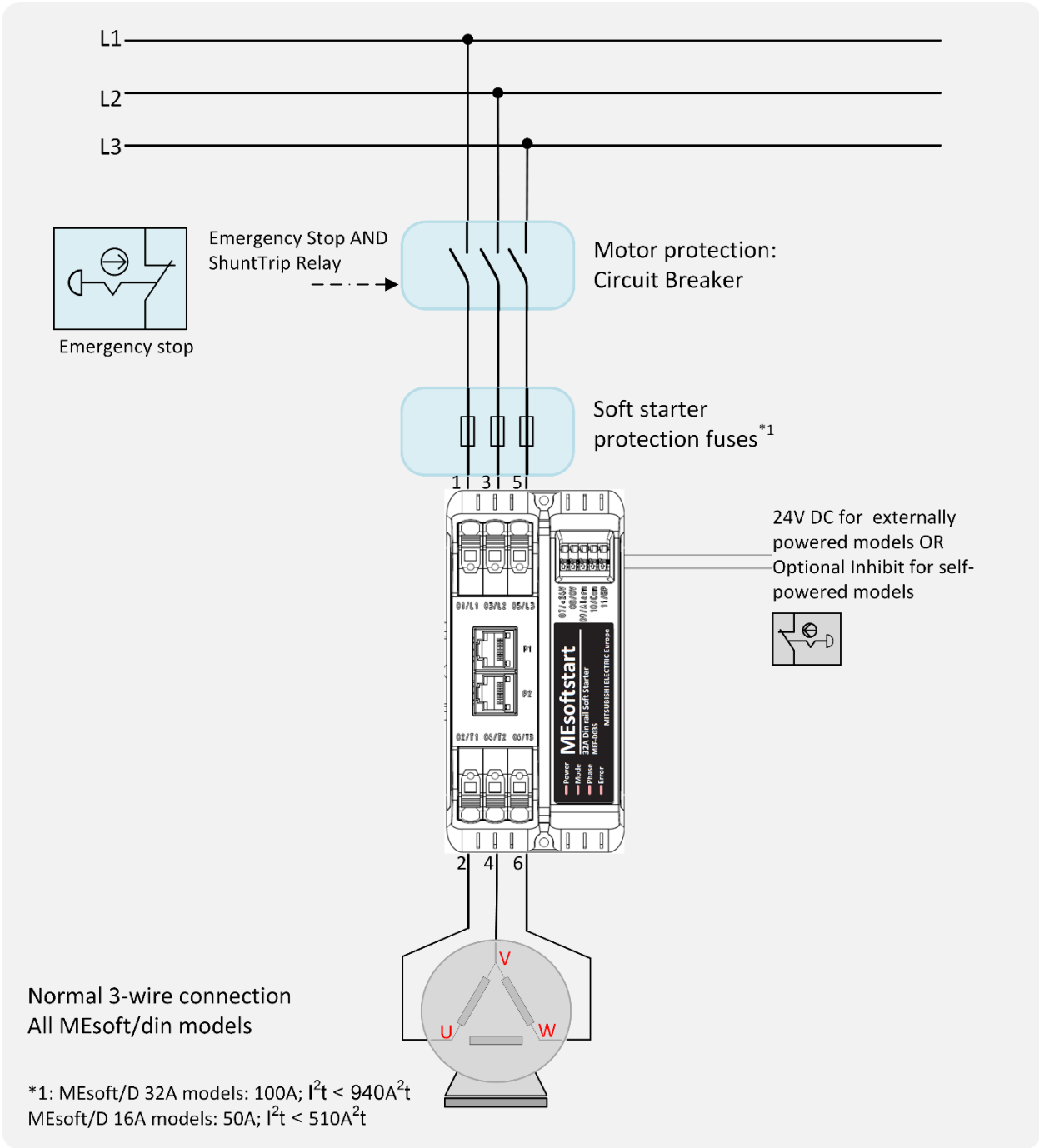


Figure 3 – Soft starter circuit diagram for 3-wire delta motor

With this method of installation, the bypass contactor must be scaled for the full running current of the motor. Only three cables are needed to run the distance to the motor.

2.1.2 Inside-delta 6-wire connection

The diagram below shows examples of connection diagrams for the soft starter for an inside-delta 6-wire connection. With this method of connecting the motor, 58% of the motor's starting current flows through the soft starter switching elements during the start-up ramp. After start-up 58% of the running current of the motor flows through the internal bypass relays.

- ⚠ Only MEsoftstart-D03 (three-phase control) soft starters may be used with inside delta wiring. MEsoftstart-D02 models are not suitable for inside delta wiring.

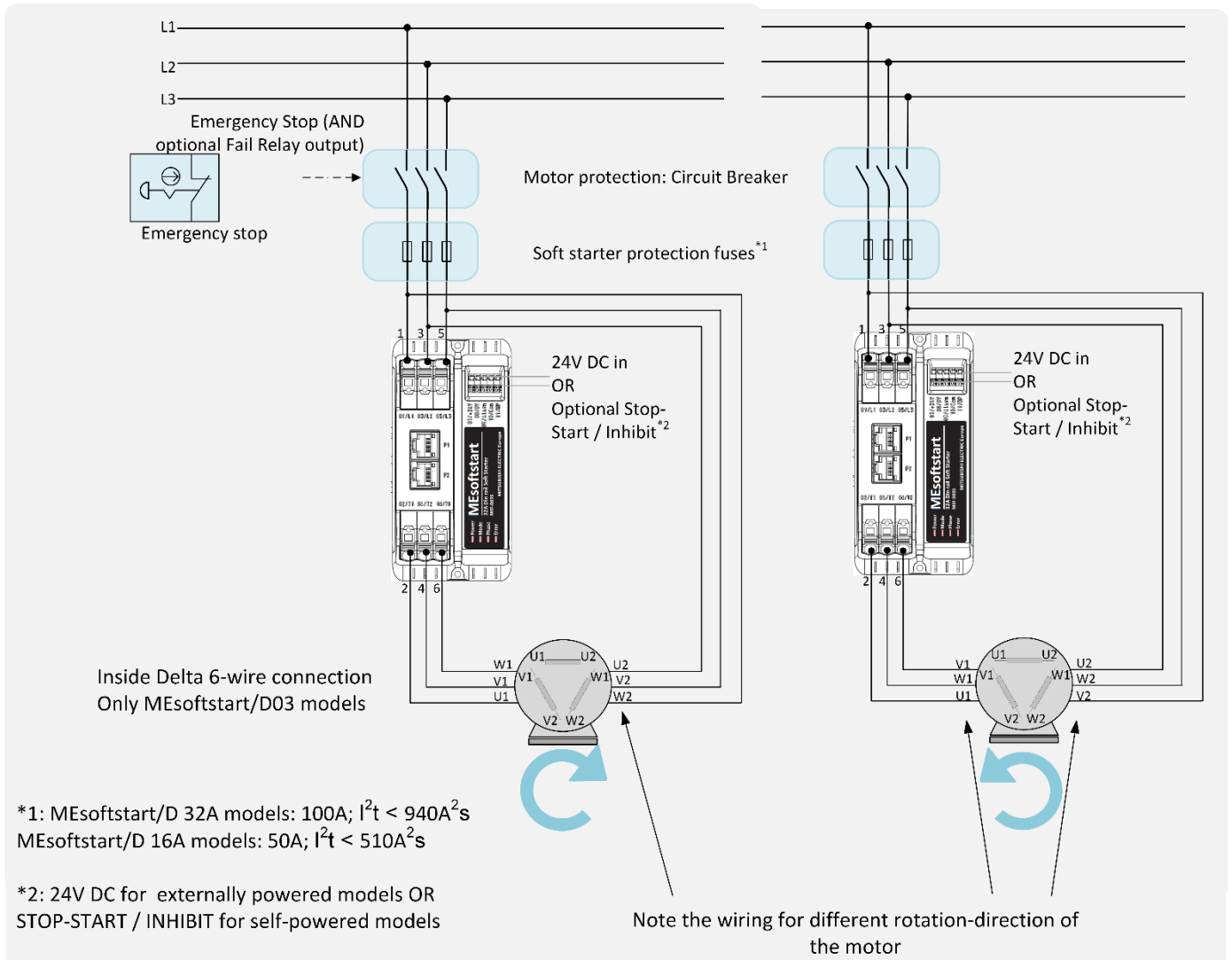


Figure 4 – Soft starter circuit diagrams for 6-wire inside-delta motor – only MEsoftstart-D03 models

- ⚠ In an inside delta installation, the motor protection circuit breaker and fuses are very important. If a failure occurs the soft starter is unable to remove the power from the motor and the Circuit Breaker or Fuses should disconnect the power from both the motor and the soft starter.
- ⚠ Ensure to connect the grid-side terminals of the inside-delta motor to the correct supply phase for successful soft start. An incorrect wiring on the motor terminals may result in a hard start and possible damage to the soft starter or motor.

2.1.3 Soft starter and Peripheral devices

The diagrams in Figure 3 and Figure 4 shows the MEsoftstart/din soft starter and the associated peripheral devices.

The items are further described in Table 3.

- ⚠ Always check the nameplate information on your motor before designing the peripheral devices

Table 3: Peripheral devices in the soft starter installation

Item	Name	Description	Refer												
1.	Soft starter (MEsoftstart-D03, MEsoftstart-D03L, MEsoftstart-D02L MEsoftstart-D02, MEsoftstart-D03S, MEsoftstart-D02S, MEsoftstart-D02LF)	The MEsoftstart soft starter connects to the supply voltage on the top side on terminals 01/L1, 03/L2 and 05/L3 and to the motor on the bottom side on terminals 02/T1, 04/T2 and 06/T3.	Figure 2												
2.	Moulded case circuit breaker (MCCB)	The circuit breaker must be selected according to the maximum current of the motor. The circuit breaker should ideally be controllable from an Emergency Stop button.	-												
3.	Fuses	<table><tr><td colspan="3">The fuses are required to protect the soft starter SCRs against excessive currents. The fuses should ideally be in line between the circuit breaker and the soft starter and outside the delta for 6-wire installations. The fuses should be selected as follows for the different MEsoftstart models:</td></tr><tr><td>Model</td><td>Minimum Fuse current</td><td>Max I²t rating</td></tr><tr><td>MEsoftstart-D02; MEsoftstart-D03; MEsoftstart-D02S; MEsoftstart-D03S</td><td>100A</td><td>940</td></tr><tr><td>MEsoftstart-D02L; MEsoftstart-D03L; MEsoftstart-D02LF</td><td>50A</td><td>510</td></tr></table>	The fuses are required to protect the soft starter SCRs against excessive currents. The fuses should ideally be in line between the circuit breaker and the soft starter and outside the delta for 6-wire installations. The fuses should be selected as follows for the different MEsoftstart models:			Model	Minimum Fuse current	Max I²t rating	MEsoftstart-D02; MEsoftstart-D03; MEsoftstart-D02S; MEsoftstart-D03S	100A	940	MEsoftstart-D02L; MEsoftstart-D03L; MEsoftstart-D02LF	50A	510	Figure 3 Figure 4
The fuses are required to protect the soft starter SCRs against excessive currents. The fuses should ideally be in line between the circuit breaker and the soft starter and outside the delta for 6-wire installations. The fuses should be selected as follows for the different MEsoftstart models:															
Model	Minimum Fuse current	Max I²t rating													
MEsoftstart-D02; MEsoftstart-D03; MEsoftstart-D02S; MEsoftstart-D03S	100A	940													
MEsoftstart-D02L; MEsoftstart-D03L; MEsoftstart-D02LF	50A	510													
4.	Inhibit knob	The activation of the INHIBIT button will cause the soft starter to stop the motor and when released, to start the motor again as follows: The soft starter will stop the motor (in the manner as configured for stop e.g. ramp-down or coasting). After the motor is completely stopped and the delay between motor starts has elapsed, the soft starter will check for the release of the inhibit button. If the inhibit button is released (and all other conditions are still in place to start the motor e.g. start signal present if in Remote control mode), the soft starter will again ramp-up the motor in the manner as configured. Refer Figure 9 for wiring configurations to use the INHIBIT inputs (24V and 0V inputs on the self-powered models)  The Inhibit knob should not be used in place of an emergency stop	-												
5.	Induction motor	Configured as a 3-wire motor for normal delta connection or 6-wire for inside delta wiring.	-												

2.1.4 Capacitors for power factor improvement

Capacitors for power factor improvement must not be connected on the output of the soft starter (between the soft starter and the motor). If power factor correction is required, add the capacitors on the grid-side of the soft starter.

2.2 MEsoftstart/din installation environment

A soft starter unit uses semiconductor devices. To ensure reliable operation and long service lifetime for the soft starter, it is important to operate the soft starter in the ambient environment that complies with the equipment specifications.

When selecting the soft starter installation location, the structure, size and device layout around the soft starter should be determined by considering issues such as:

- Safe and easy access for wiring;
- Safe and easy access to the LED HMI for monitoring;
- Heat generation and cooling of the soft starter;
- Peripheral devices that need to be in the cabinet and
- The operating environment.

This section gives general information pertaining to the placement and installation of the soft starter.

2.2.1 Soft starter operational environment

The following table lists the standard specifications of the soft starter installation environment.

Table 4: Soft starter environmental specification

Environmental parameter	Model	Specification	Notes
Surrounding Air temperature	MEsoftstart-D03, MEsoftstart-D03L, MEsoftstart-D02L, MEsoftstart-D02, MEsoftstart-D03S, MEsoftstart-D02S, MEsoftstart-D02LF	-20°C to +60°C	Measurement position 5 cm from the soft starter inside the closed cabinet De-rate above 50°C at 5% per °C
Relative humidity		< 85%	Ideally < 50% @ 50° to < 85% @20°C
Storage temperature		-30°C to +70°C	
Atmosphere		Indoors - free from corrosive gas, flammable gas, oil mist, dust and dirt	
Altitude		1400 m above sea level.	For the installation at an altitude above 1400m de-rate the rated current of the soft starter at 0.67% per 100 m
Vibration		0.02g ² /Hz from 10 to 50Hz, reducing linearly on a log-linear plot to 0.0001g ² /Hz at 500Hz. (directions of X, Y, Z axes)	Road transport vibration only

Using the soft starter in an environment that does not satisfy these conditions, deteriorates the performance, shortens the life and can lead to a failure. The following paragraphs contain suggested actions to take measures to ensure that the environment complies with the specification.

2.2.1.1 Temperature

For the MEsoftstart range of soft starters, the permissible surrounding air temperature of the soft starter is between -20°C and +60°C. Always operate the soft starter within this temperature range. Operation outside this range will considerably shorten the service lives of the semiconductors, parts, capacitors and other electronics. Take the following measures to keep the surrounding air temperature of the soft starter within the specified range.

(a) Measures against high temperature

- Use a forced ventilation system or similar cooling system. (Refer to par 2.2.2 on page 20.)
- Install the soft starter in an air-conditioned chamber.
- Block direct sunlight.
- Provide a shield or similar plate to avoid direct exposure to the radiated heat and wind of a heat source.
- Ventilate the area around the soft starter well.
- Remove the DIN rail clip and panel mount the soft starter flush on a cooler surface

(b) Measures against low temperature

- Provide a space heater near the soft starter.

(c) Sudden temperature changes

- Select an installation place where temperature does not change suddenly.
- Avoid installing the soft starter near the air outlet of an air conditioner.
- If temperature changes are caused by opening/closing of a door, install the soft starter away from the door.

2.2.1.2 Humidity

Operate the soft starter within the specified ambient air humidity. Too high humidity will pose problems of reduced insulation and metal corrosion. On the other hand, too low humidity is conducive to the build-up of static electricity and may cause dielectric breakdown in solid state devices.

(a) Measures against high humidity

- Seal the cabinet around the soft starter and provide it with a hygroscopic agent.
- Provide dry air into the cabinet where the soft starter is installed, from outside.
- Provide a space heater near the soft starter.

(b) Measures against low humidity

- Air with proper humidity can be blown into the cabinet where the soft starter is installed, from outside. Also, when installing or inspecting the unit, discharge your body (static electricity) beforehand.

(c) Measures against condensation

Condensation may occur if the temperature changes suddenly. Condensation causes faults such as reduced insulation and corrosion.

- Take the measures against high humidity in (a) above.

2.2.1.3 Dust, dirt, oil mist

Dust and dirt may cause such faults as poor contacts, reduced insulation and cooling effect due to the moisture-absorbed accumulated dust and dirt and in-cabinet temperature rise due to a clogged filter. In an atmosphere where conductive powder floats, dust and dirt may cause such faults as malfunction, deteriorated insulation and short circuit in a short time.

Since oil mist may cause similar conditions, it is necessary to take adequate measures.

Countermeasures:

- Place the soft starter in a totally enclosed cabinet.
- Take measures if the in-cabinet temperature rises. (Refer to par. 2.2.1.1)
- Purge air.
- Pump clean air from outside to make the in-cabinet air pressure higher than the outside air pressure.

2.2.1.4 Corrosive gas, salt damage

If the soft starter is exposed to corrosive gas or to salt (e.g. near the sea), the printed circuit board and components will corrode, the relays and switches can deteriorate resulting in unreliable contact.

When it is required to operate the soft starter in this environment, take the measures suggested in the paragraph 2.2.1.3.

2.2.1.5 Explosive, flammable gases

It is not recommended to install and use the soft starter in an environment where flammable gasses are present. The soft starter is not explosion proof and it will have to be contained in a certified explosion-proof cabinet. If possible, avoid installation in such environments and install the soft starter in a non-hazardous place.

2.2.1.6 High altitude

The soft starter may be used at its recommended current rating, at altitudes lower than 1400m above sea-level. For the installation at an altitude above 1400 m, de-rate the rated current of the soft starter at 0.67% per 100 m.

If it is used at a higher altitude than 2500m above sea level, thin air will reduce the cooling effect and low air pressure will deteriorate dielectric strength and a higher rated soft starter model should be selected.

2.2.1.7 Vibration, impact

The soft starter is not designed to withstand periods of high vibration or high impact. The vibration resistance of the soft starter vibration spectrum is tested at 0.02g²/Hz from 10 to 50Hz, reducing linearly on a log-linear plot to

0.0001g²/Hz at 500Hz for the directions of X, Y, Z axes. Applying vibration and impacts for a long time may loosen the structures and cause poor contacts of connectors, even if those vibration and impacts are within the specified values. (Refer to IEC 60068-2-6).

Especially when impacts are applied repeatedly, caution must be taken because such impacts may break the installation feet.

Countermeasures:

- Install the soft starter inside a cabinet that has rubber vibration isolators.
- Strengthen the structure to prevent the cabinet from resonance.
- Install the cabinet away from the sources of the vibration.

2.2.2 Cooling

The heat that the soft starter generates, as well as any incoming heat (such as direct sunlight) must be dissipated. This is especially so if the soft starter is installed inside a closed cabinet. The cabinet should allow for ventilation.

The MEdsoftstart/din soft starter may be din-rail mounted or panel mounted. Panel mounting against a surface that conducts the heat, will allow for improved cooling of the soft starter.

2.3 Soft starter installation

2.3.1 Soft starter placement

 Note the recommendation for panel mounting in par. 1.1.1.

Placement of the soft starter needs careful planning. The clearance below the soft starter is required for terminal access for wiring as well as air inlet and the clearance above the soft starter is required for heat dissipation as well as terminal access for wiring. Consider the following:

- a) Leave enough clearances and take measures to cool the device.
- b) Leave enough clearance to access terminals to wire the soft starter.
- c) Avoid places where the soft starter is subjected to direct sunlight, high temperature and high humidity (refer par. 2.2.1).
- d) When panel-mounting, install the soft starter on a non-flammable, preferably heat conducting surface. Thermal-conductive heat compound between the soft starter base and the heat conducting surface will further enhance cooling.
- e) For heat dissipation and maintenance, keep clearance between the soft starter and the other devices or cabinet surface.

2.3.2 Installation orientation of the soft starter

The MEdsoftstart/din models may be mounted at any orientation, but the recommended orientation is upright hooked onto a din-rail or panel mounted against a heat conducting surface. This allows for easy viewing of the HMI LEDs, access to the terminals and with natural air flow from bottom to top.

2.3.3 Drilling plan for panel-mount soft starter installation

When drilling mounting holes in a cabinet, take caution not to allow chips and other foreign matter to enter the soft starter. **Figure 5** below shows the drilling plan for mounting the MEdsoftstart soft starter in a cabinet or against a wall.

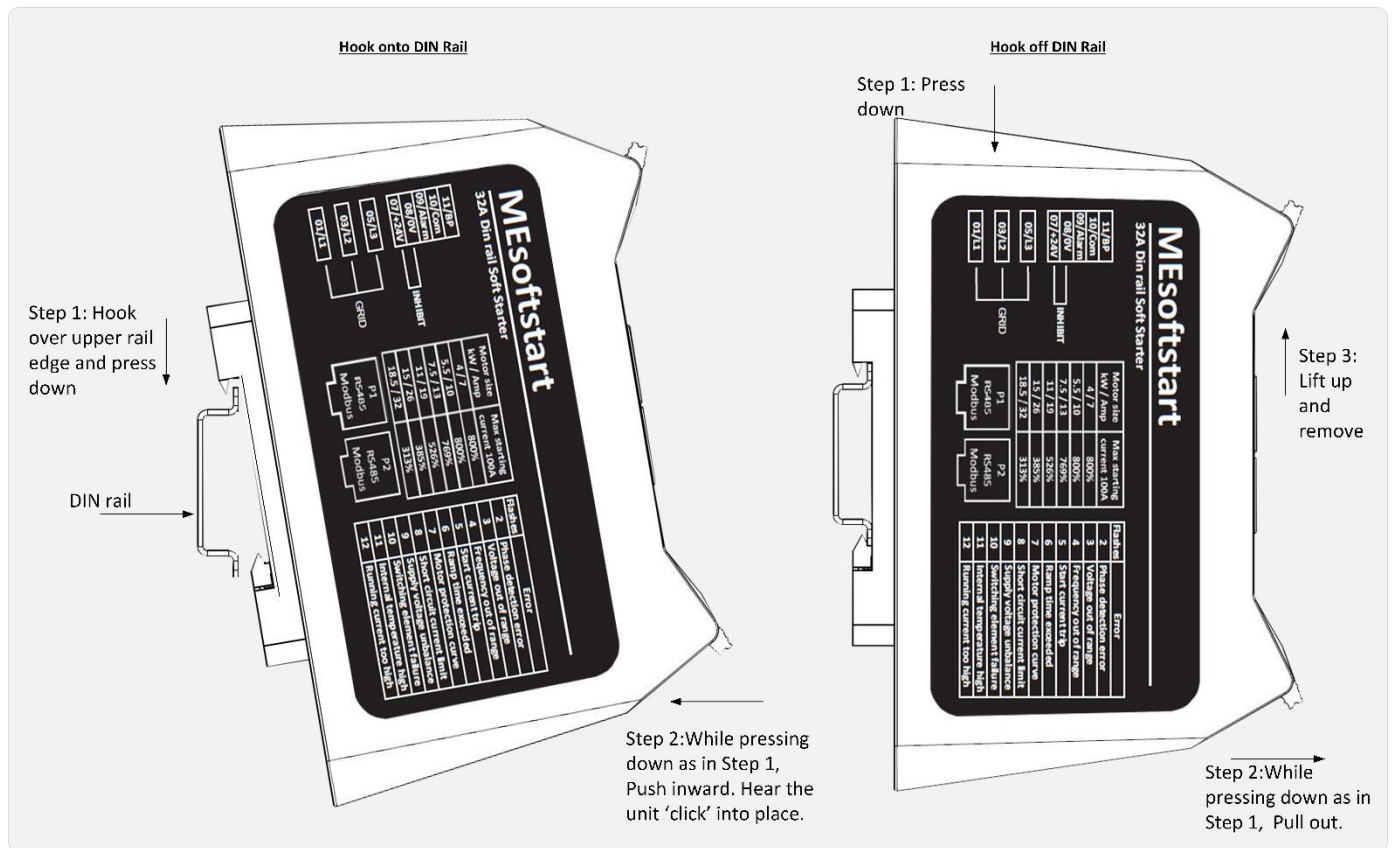


Figure 6 – Din-rail mounting

3. WIRING

This chapter identifies the terminals and explains the wiring of the MSoftstart/din model soft starter.

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3.1 Terminal identification

The soft starter has grid-side and motor-side power terminals and signal terminals on green wire terminals. Some variants have RJ45 Modbus RTU cable connectors. The terminals are clearly marked on all MEsoftstart/din models. (Refer Figure 2)

NOTES:

- To prevent a malfunction due to noise, route the signal cables 10 cm or more away from the power cables. Also, separate the main circuit cables at the input side from the main circuit cables at the output side.
- After wiring, wire offcuts must not be left in the cabinet. Always keep the soft starter cabinet clean. When drilling mounting holes in a cabinet etc., take caution not to allow chips and other foreign matter to enter the soft starter.

3.2 Wiring instructions

Wiring of the Main circuit of the soft starter and the motor is specified in Table 5 and Table 6 and shown in Figure 7.

Table 5: Power terminals wiring

Terminal symbol	Terminal name	Terminal function description
01 L1, 03 L2, 05 L3	3 phase AC power input.	Connect these terminals via fuses and MCCB to the three-phase supply lines. (Refer par. 2.1.1 and 2.1.2).
02 T1, 04 T2, 06 T3	Soft starter power output to motor	Connect these terminals straight to a three-phase squirrel cage motor. (No power factor correction capacitors should be fitted between the soft starter and the motor).

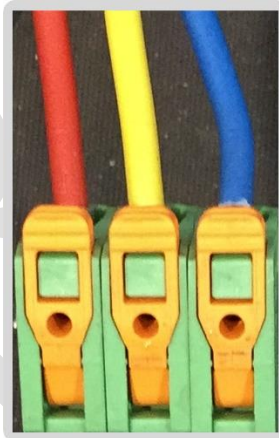


Figure 7 – Power wiring on the soft starter

The cable sizes and connection ferrules for the main 3-phase circuit and signal wires are specified in Table 6.

Table 6: Wiring specification

Inverter model	Bootlace ferrules size		Wire size
MEsoftstart/din models 3-phase wires		1.5 – 2.6mm pin diameter	0.2 - 6mm ² wire - Select the cable size according to the motor maximum starting current. Refer to local installation standards for the site.
MEsoftstart/din models signal wires		1mm pin diameter	0.25 – 0.5mm ² signal wire

The signal wires are connected as shown in Figure 8. Wire and ferrule sizes as shown in Table 6. Externally powered models need 24V supply and will start as soon as the 3-phase supply is present OR may be started and stopped from a Modbus controller (or the PC Application – refer par. 5.3).

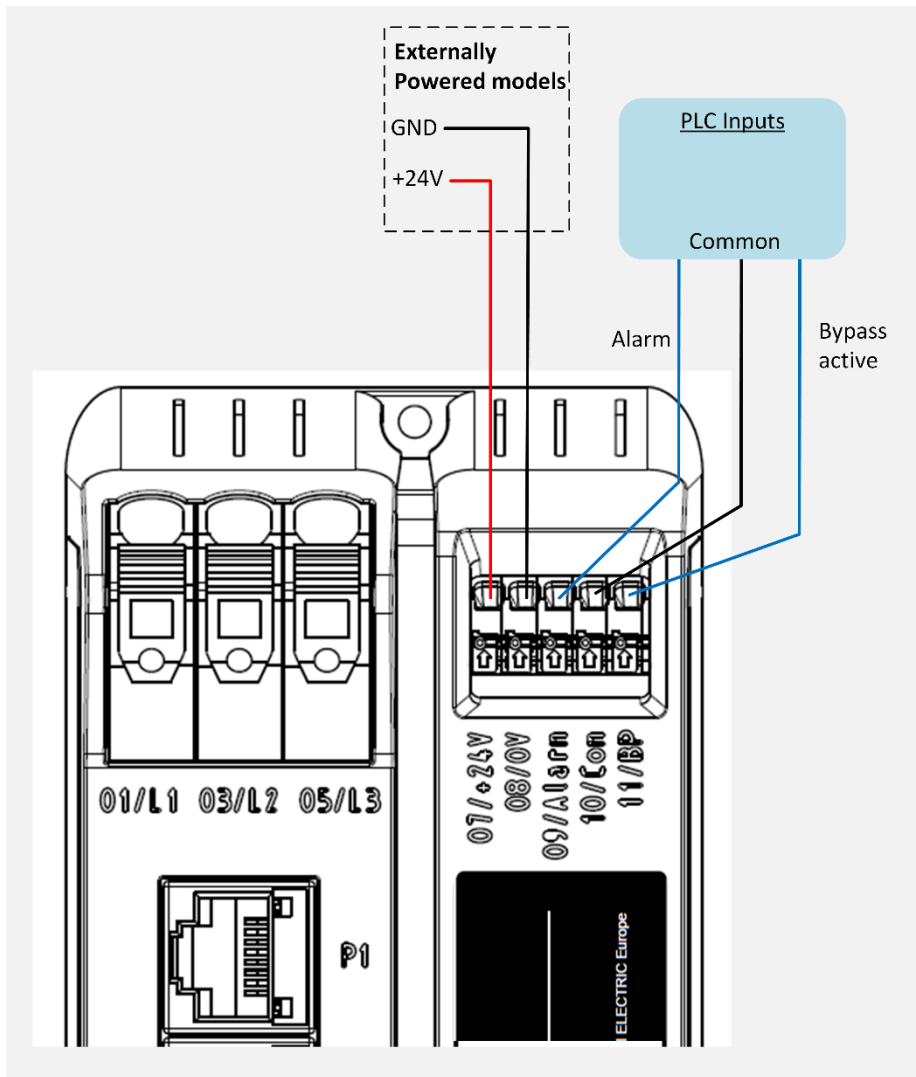


Figure 8 – MSoftstart/din externally powered models: Signal and control power wiring example

The self-powered models provide INHIBIT capability on the 24V and 0V inputs of the MSoftstart/Din as shown in Figure 9.

Self-powered models are factory-ready to auto-start when the 3-phase supply voltage is applied, or may be wired for external start-stop control either from a button or from a PLC, or may be controlled from a Modbus controller.

Note that all self-powered MSoftstart/din models may also be powered with an auxiliary power supply at 24Vdc. This is useful when e.g. configuring the MSoftstart/din soft starters before installation in the site where the three-phase power is present.

Refer Figure 9 for the wiring options for the self-powered model.

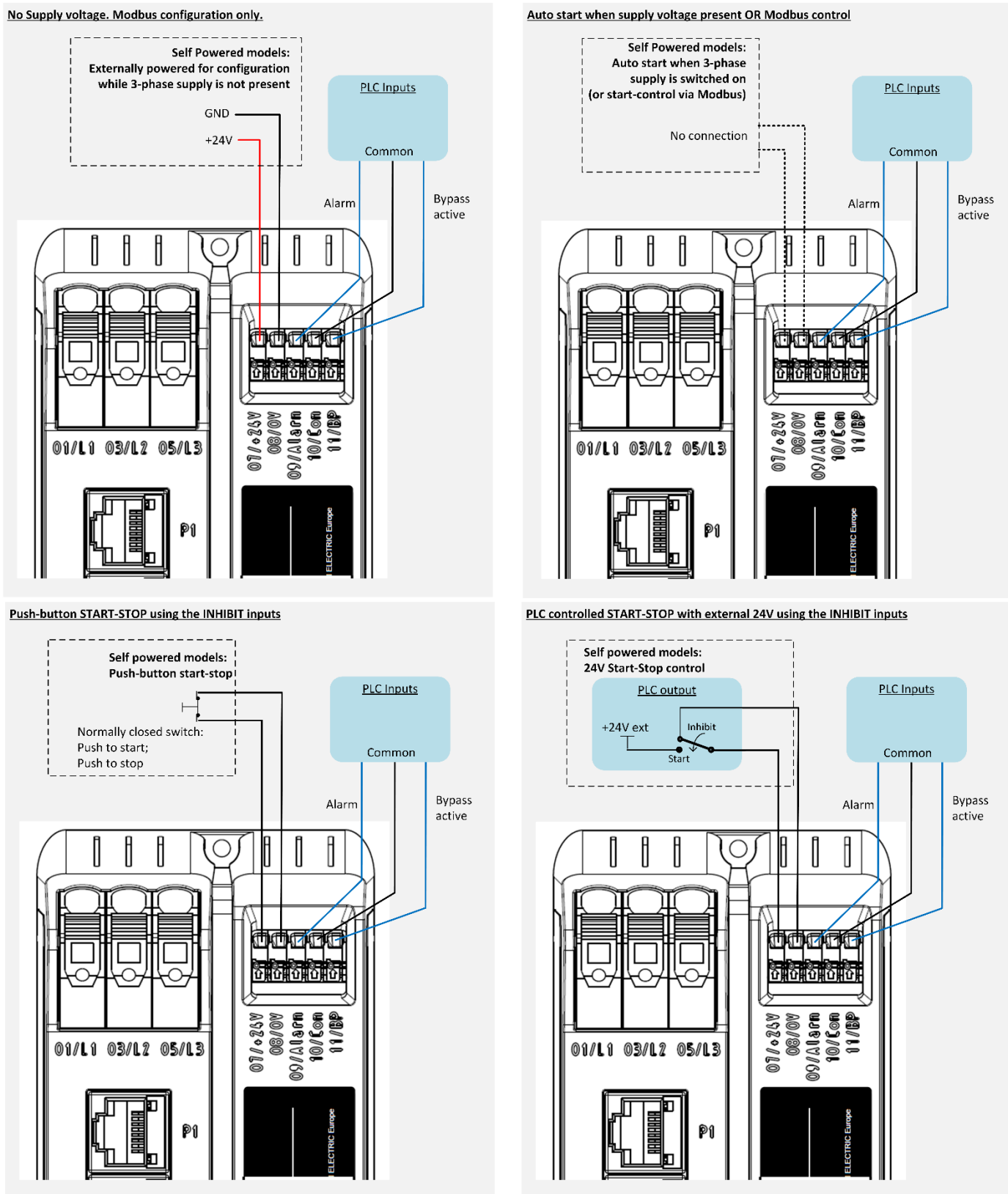


Figure 9 – MESoftstart/din start-stop signal wiring example

3.2.1 MESoftstart Modbus Interface

The MESoftstart soft starter supports Modbus RTU interface as a two-wire RS485 port on all the MESoftstart/din models except the MESoftstart-D02LF factory pre-configured model.

For the PC Application on the Modbus RTU it is recommended to use the dedicated RS485 to USB cable that is available with all MEssoftstart PC Interface application programs. This cable plugs in on the P1 or P2 RJ45 connectors on the soft starter (refer Figure 10) and connects to a USB port on the PC.

Note that drivers for the RS485 to USB converter may need to be installed. For the MEssoftstart dedicated cable, the drivers will be provided with the cable. Refer par 6.1 for instructions to install the drivers and the application.

The soft starters may be daisy-chained on the RS485 line to enable the PC to configure them one after the other without having to move the cable. To minimise reflections the RS485 lines need to be terminated with a 120Ω resistor at the far end.

If a cable needs to be made up for a Modbus master, the pin-outs on the RJ45 connectors is shown in Figure 10.

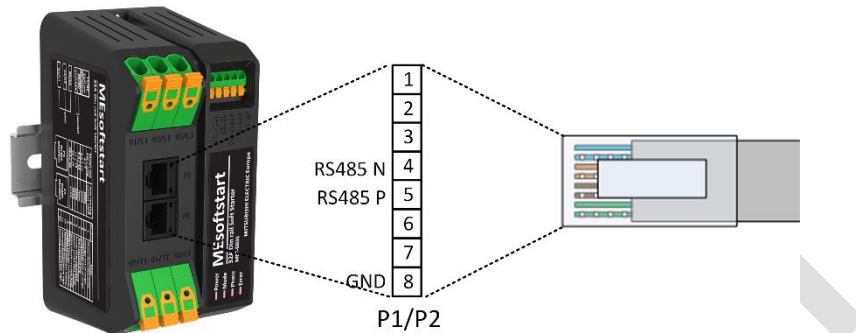


Figure 10 – MEssoftstart/din RJ45 Modbus RTU pinouts

4. PRECAUTIONS FOR USE OF THE SOFT STARTER

This chapter explains the precautions for use of this product. Always read the instructions before using the equipment.

4.	PRECAUTIONS FOR USE OF THE SOFT STARTER.....	28
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4.1 Checklist before applying power

The MSoftstart/din series soft starter is a highly reliable product, but an incorrect peripheral circuit may shorten the product life or damage the product. Before starting operation, always recheck the following points:

Checkpoint	Countermeasure	Refer	Checked
The soft starter model is appropriate for the motor that will be connected to it.	If the soft starter model is not appropriate for the motor that it is connected to, the starting current may not be enough and the motor can overheat. - Consider a larger model soft starter. - Consider connecting the soft starter inside delta to the motor. - Contact your local distributor for assistance to find the best solution.	Table 1	
The soft starter is configured for the application.	The default setting is for an 18.5kW motor wired on a Normal delta motor. Use the PC application to check or change the configuration for the application. Note that all MSoftstart/Din models (except the Factory Configured model) can be configured via the Modbus interface using the PC application.	Par. 6.1.3	
The mounting of the MSoftstart/Din is appropriate for the application	Din rail mounting may be used for applications for motor running currents up to 25A on the 32A model. For higher currents or high temperature operating environment, panel mounting against a heat conductive surface is recommended.	Par. 2.3	
There is adequate space for air-flow around the soft starter.	If the air-flow is restricted, the soft starter will overheat and trip.		
Terminals are insulated.	Use terminals with insulation sleeves to wire the power supply and the motor.	Figure 7	
The main circuit cable gauge is adequate.	Use an appropriate cable gauge to suppress the voltage drop to 2% or less. If the wiring distance is long between the soft starter and motor, the voltage drop in the main circuit will cause the motor torque to decrease.	Local standards	
The wiring is correct:	Direct application of power to the motor-side output terminals (T1, T2, T3) of the soft starter will damage the soft starter.	Table 3	
Wiring between the supply lines (L1, L2, L3), Circuit breaker, Fuses, soft starter and motor is correct.	- Confirm that the line voltage is within the soft starter's rated voltage range. - Confirm that the circuit breaker selected is adequate for the motor maximum starting current. - Confirm that the fuses that are installed are according to the specification in Table 3 for the selected soft starter model. - Confirm that the wiring is correct, especially when using inside delta wiring on the motor		
No wire offcuts or remnants from drilling are left in the enclosure.	Wire offcuts can cause failure or malfunction. Always keep the soft starter and enclosure clean. When drilling mounting holes in a cabinet etc., take caution not to allow chips and other foreign matter to enter the soft starter or to remain in the enclosure.	Par. 2.3.3	
Emergency stop is wired to the circuit breaker and is in a position where the operator has easy access.	The emergency stop should remove all power to the soft starter and the motor and should be hard wired to the main circuit breaker to ensure that the operator can reliably stop the motor in case of an emergency.  Do not rely on the INHIBIT input to do this. INHIBIT is detected and processed by the processor in the soft	Par. 2.1.3	

Checkpoint	Countermeasure	Refer	Checked
	starter and should not be used in place of a hard disconnect from the line voltage.		
Countermeasures are taken against EMI.	The input/output (main circuit) of the soft starter includes high frequency components, which may interfere with the communication devices (such as AM radios) used near the soft starter. In such case, install a noise filter.	-	
On the soft starter's output side, there should be no power factor correction capacitor, surge suppressor, or radio noise filter installed.	Such installation will cause the soft starter to trip or the capacitor and surge suppressor to be damaged. If any of the above devices are connected, remove it before power is applied.	Par. 2.1.4	
No short circuit or ground fault is present on the soft starter's output side.	• A short circuit or ground fault on the soft starter's output side may damage the soft starter. • Fully check the insulation resistance of the circuit prior to installing the soft starter. Repeated short circuits caused by peripheral circuits inadequacy or a ground fault caused by wiring insulation inadequacy or reduced motor insulation resistance may damage the soft starter module. • Fully check the phase-to-earth (ground) insulation and phase-to-phase insulation of the soft starter's output side before connecting the soft starter. • This is especially important for an installation with an existing or old motor or use in a hostile atmosphere to make sure to check the motor insulation resistance.	-	
The voltage applied to the soft starter I/O signal circuits is within the specifications.	Application of a voltage higher than the permissible voltage to the soft starter I/O signal circuits or opposite polarity may damage the I/O devices.	Par. 3.2	

5. BASIC OPERATION

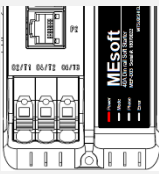
This chapter explains the configuration and the basic operation of the MSoftstart/din soft starter

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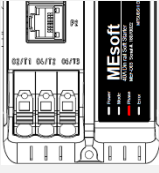


5.1 Power-up the soft starter

On power-up, the soft starter will be in IDLE mode. (Note that for the self-powered soft starter without the INHIBIT input, the IDLE mode will immediately transition to the RAMP mode – refer Figure 11). The user will be presented with HMI LEDs that indicates that the power is present and the supply phase is detected.

Power LED			
	When 24V power is present on the board this LED will flash at a frequency of 0.5 Hz. When Modbus RTU communication has been established and the board is under Modbus control this LED will flash at 1 Hz.		
	LED state	CPU state	Description
	LED off	No power	No power on the CPU card in the soft starter.
	0.5Hz Flashing	Power present; Modbus not detected	The power is present on the CPU card. CPU is not detecting any Modbus communication.
	1 Hz Flashing	Power present; Modbus in control	The power is present on the CPU card. Soft starter is under Modbus control. Use the Modbus commands to start and stop the motor.

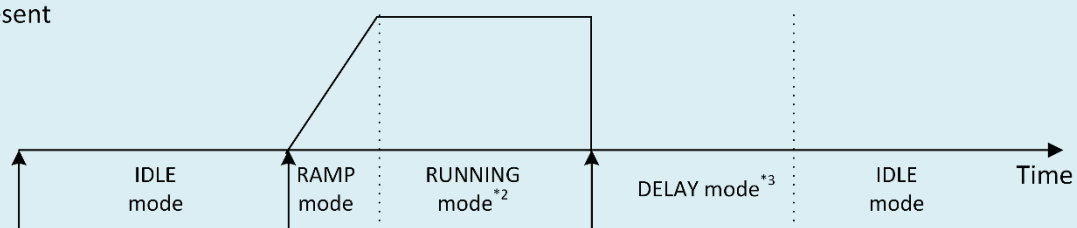
If the Phase LED is flashing the indication is that the phase rotation of the 3-phase grid connection to the soft starter is incorrect. Switch off the grid voltage and swap the incoming phases.

Phase LED			
	This LED indicates the detected phase of the applied 3-phase power. The configured phase orientation must be Clockwise. The interpretation of the Phase LED state is described in the table below.		
	LED state	Detected phase	Description
	LED off	Unknown phase	This occurs before AC power is applied and during phase synchronisation immediately after application of AC power.
	LED on	Correct phase	The phase rotation is correct.
	0.5 Hz flashing	Phase error	An incorrect phase rotation is detected.

The Mode LED should be off at this stage, indicating that the soft starter is in IDLE mode. The operational modes of the MEsoftstart/din soft starters are illustrated in the Figure 11 below. Note that the operational modes are the same for all the MEsoftstart/din models, but transition between them looks different to the user when the control power is externally provided, or when the Modbus control is being used, or when the INHIBIT feature is being used to control the soft starter.

Modes of the MSoftstart/Din soft starter

24V externally powered
No Modbus present

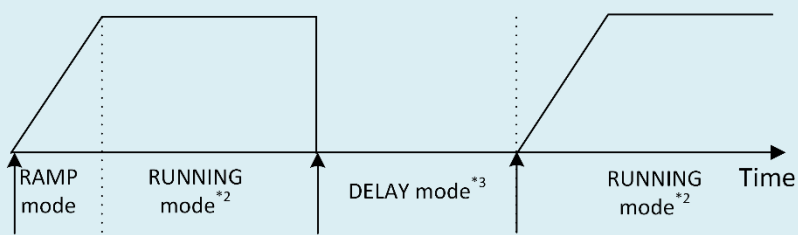


24V external power
ON

3-phase power
applied

3-phase power removed
OR 24V external power OFF

Self-powered
No Modbus present
INHIBIT not present

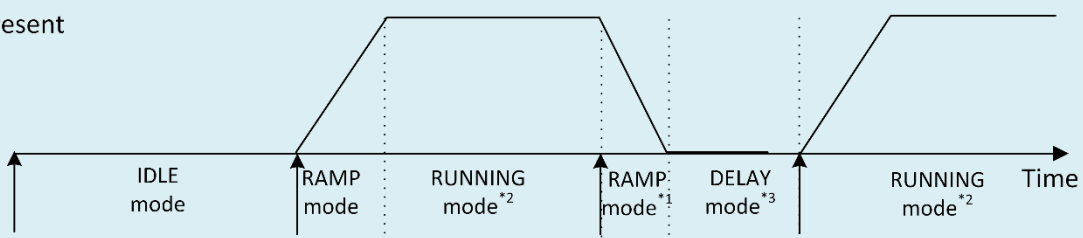


3-phase power
ON

3-phase power OFF

3-phase power ON

Self-powered
No Modbus present



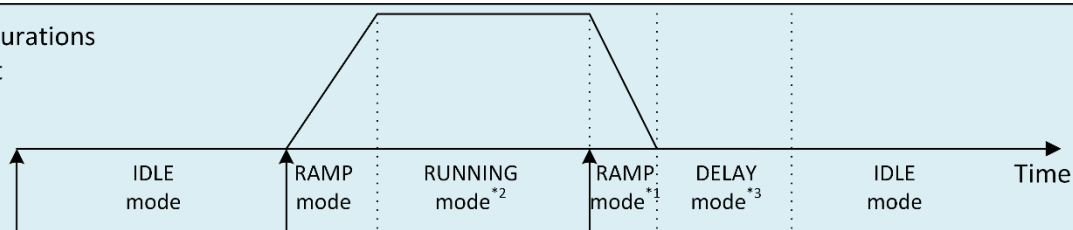
INHIBIT command
AND
3-phase power ON

INHIBIT removed
OR START signal

INHIBIT applied
OR STOP signal

INHIBIT removed OR
START signal

All power configurations
Modbus Present



3-phase and 24V present
(if externally powered)

NO INHIBIT and
Modbus START
command

Modbus STOP
Command OR
INHIBIT

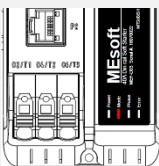
*1 - If configured for a soft stop

*2 - Bypass Active relay closed.

*3 - Delay time dependent on the configured number of starts per hour

Figure 11 – MSoftstart/din operational modes

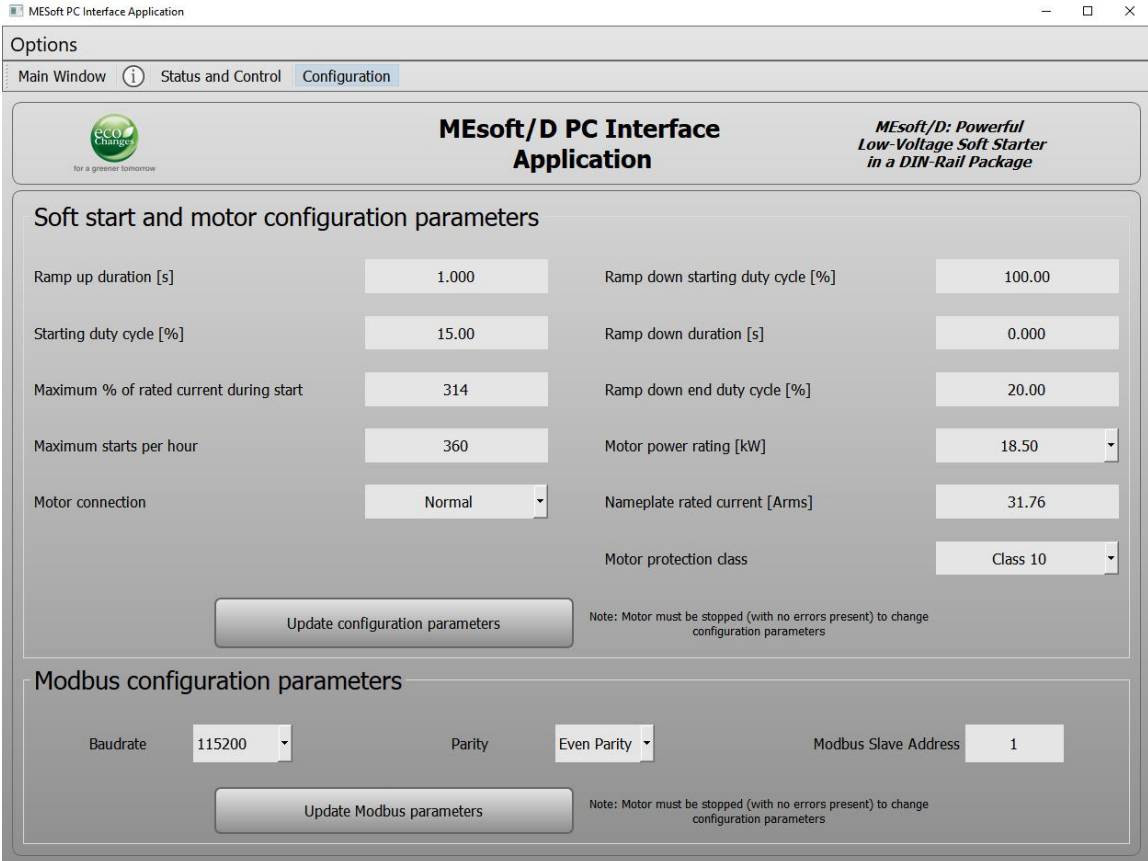
The Mode LED will indicate the operational mode of the soft starter as shown in the table below.

Mode LED		
	This LED provides feedback regarding the mode of the software. The Mode LED state can be interpreted whenever the Power LED is flashing. The interpretation of the Mode LED state is described in the table below.	
	LED state	Software mode
	LED off	Idle mode
	5 Hz Flashing	Ramp mode
	LED on	Bypassed mode
	1 Hz flashing	Delay mode
	0.5 Hz flashing	Error mode
		Mode description
		This is the state when 24 Vdc is present, but prior to application of the AC voltage, or if AC voltage is present but the soft starter is under Modbus control: prior to a START command.
		When AC voltage is applied and the ramp-up or ramp-down is in progress, the LED flashes.
		Ramp-up has been completed, and bypass relays have been engaged. The motor should be running. The bypass relays are closed.
		After a Modbus STOP command, or when operating from 24Vdc supply, after the AC voltage is removed: Soft starter is implementing the restart delay time. The soft starter will also start up in Delay mode after a power-cycle when the restart delay has not elapsed or the internal temperature of the soft starter is still too high. This is to protect the motor from repeated, too frequent starts.
		An error condition was detected. All switching elements are turned off awaiting further operator intervention. See error LED for more details.

In the case where the soft starter is in ERROR mode, the Error LED will help to troubleshoot the cause of the fault – refer par. 5.4.

5.2 Configure the soft starter for the application

The MEsoftstart/din soft starters are easy to configure, using the PC Application on the Modbus RTU interface. The configuration options are shown in Figure 12. The installation of the PC Application is described in par. 6.



MEsoft/D PC Interface Application

MEsoft/D: Powerful Low-Voltage Soft Starter in a DIN-Rail Package

Soft start and motor configuration parameters

Ramp up duration [s]	1.000	Ramp down starting duty cycle [%]	100.00
Starting duty cycle [%]	15.00	Ramp down duration [s]	0.000
Maximum % of rated current during start	314	Ramp down end duty cycle [%]	20.00
Maximum starts per hour	360	Motor power rating [kW]	18.50
Motor connection	Normal	Nameplate rated current [Arms]	31.76
		Motor protection class	Class 10

Update configuration parameters

Note: Motor must be stopped (with no errors present) to change configuration parameters

Modbus configuration parameters

Baudrate	115200	Parity	Even Parity	Modbus Slave Address	1
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Update Modbus parameters

Note: Motor must be stopped (with no errors present) to change configuration parameters

Figure 12 – MEsoftstart/din PC Application configuration options

The parameters that can be used to configure the soft starter are listed below:

Parameter	Usage
-----------	-------

Ramp up duration [seconds]	The duration of the start ramp can be adjusted from 1 seconds to 10 seconds. Factory Default: 1sec
Starting duty cycle [%]	The Start Ramp may be started between 15% and 40% depending on the load of the motor. Starting the ramp at too low a percentage will cause heat build-up in the motor without turning the motor. Factory Default: 15%
Maximum % of rated current during start [%]	The current can be limited between 150% and 600% of the full load current of the motor (within the limits of the soft starter). Refer Table 1. Example: For the MSoftstart-D03 which is a 32A soft starter with starting current of 100A, the starting current for a 15kW motor with full load current of 26A at power factor of 0.85, may be limited to a value between 100A (385%) and e.g. 52A (200%) Factory Default: 314%
Maximum starts per hour [times / hour]	This value determines the time that the soft starter will 'delay' before allowing to start the motor again. This is a safety mechanism to protect the motor and the soft starter against overuse. This can be adjusted between 1 and 30 starts per hour. Factory Default: 12
Motor connection	The soft starter allows for motor to be wired in normal 3-wire connection or, for the 3-phase controlled MSoftstart-D03 models, in 6-wire inside-delta connection. The inside-delta wiring allows for a lower current that flows through the soft starter and larger motors may be used with the same size soft starter. Refer Table 1 for Inside-Delta connection. Refer par. 2.1.1 and par. 2.1.2 to understand the difference between the wiring, to be able to make the correct selection.  It is important to have the Motor connection parameter correct. The motor and soft starter can be damaged if this parameter is wrong. Factory Default: Normal 3-wire
Ramp down starting duty cycle [%]	If enabled, the stop ramp may commence at between 100% and 60%. Factory Default: 100%
Ramp down duration [s]	The stop ramp may be disabled by setting this parameter to zero and the motor will coast to a stop. When a controlled soft-stop is required, the stop ramp duration may be set up to 10 seconds. Factory Default: 0s
Ramp down end duty cycle [%]	If enabled, the stop ramp may be stopped at between 40% and 15% after which the motor will coast to a stop if not stopped already. Factory Default: 20%
Motor Power rating [kW]	This parameter configures the size of the motor. The parameter may be set between [0.75kW .. 37kW]. Factory Default: 18.5kW (or maximum size motor for the MSoftstart/din model in normal 3-wire installation.
Nameplated rated current	This parameter is the running current of the motor as specified by the manufacturer. The running current is calculated from the motor power rating, but the user may override this calculated current with the specified current. This current is used to calculate the starting current and current limit settings.
Motor protection Class	This parameter sets the motor protection class. The parameter may be set between [Class2, Class5, Class 10]

5.3 Controlling the soft starter

The MEsoftstart/din soft starters are easy to use and may be controlled in a number of ways. Select the control method that is suitable for the application.

All models:

- Control using power-on / power-off from the supply circuit breaker

All models except MEsoftstart-D02LF:

- Control from a Modbus RTU master (such as the MEsoftstart/din PC Application) via the Modbus interface.

Self-powered models (MEsoftstart-D02S; MEsoftstart-D03S; MEsoftstart-D02L; MEsoftstart-D03L):

- Control from a remote start-stop button
- Control from a controller e.g a PLC using a 24V signal

Externally powered models (MEsoftstart-D02; MEsoftstart-D03):

- Control by switching the external 24V power on and off.

5.3.1 Control using power-on / power-off from the supply circuit breaker

The user may START and STOP the motor by switching the supply voltage on and off. Note that for self-powered models the wire terminals 07 and 08 (24VDC and 0V) should be left open. Switch the supply voltage on to start and off to stop the motor as shown in Figure 13.

- ⚠ The soft starter will implement a delay after switch-off as determined by the 'Maximum starts per hour' configuration parameter (refer par. 5.2), and the soft starter will also delay restart when the internal temperature of the soft starter is high.

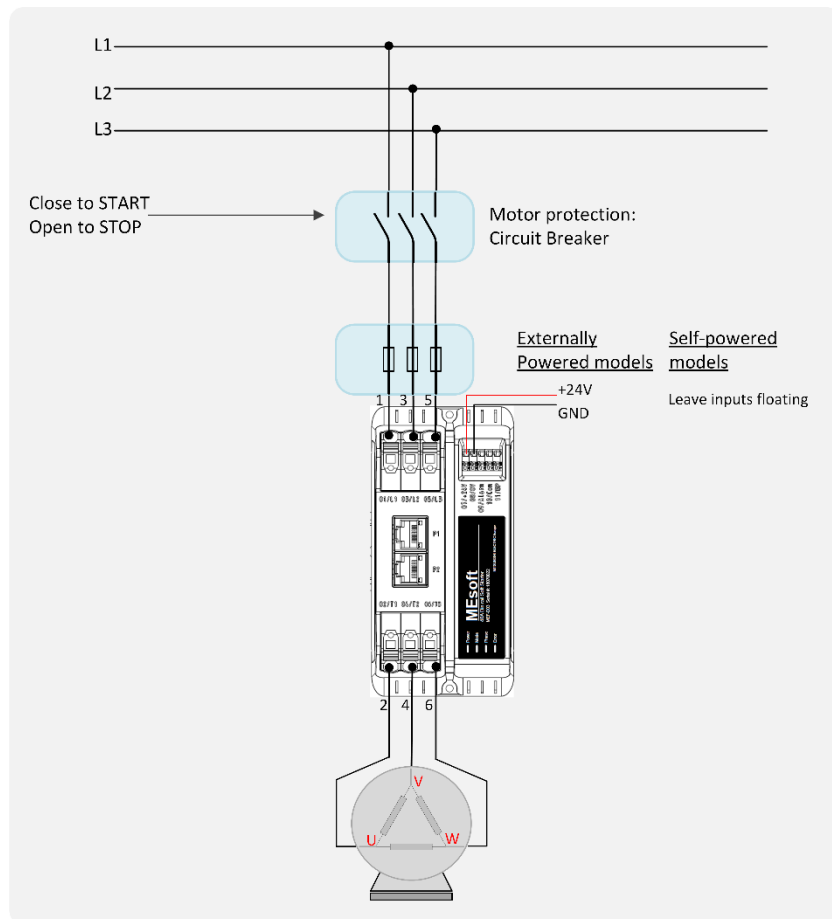


Figure 13 – MEsoftstart/din – Start, Stop using the 3-phase supply voltage

Note that the motor can be started from any of the inputs and stopped from any of the inputs. However, while the Modbus controller is present and active, the soft starter will wait for a START command from the Modbus controller.

Example: If the motor is started from the Modbus using the PC Application and then stopped by closing the INHIBIT switch on the green terminal, the motor will be stopped and can only be started again from the PC Application after the INHIBIT switch is opened.

⚠ If work needs to be done on the motor or the load, ensure that the Main supply is switched off to prevent inadvertent starting from a remote switch or Modbus Master.

If an error occurs the motor will be stopped and the ERROR LED will be flashing to indicate the cause of the fault - refer par. 5.4. After 5 minutes of no operator intervention, the fault will self-reset, and the soft starter will be ready to start again. If an error condition occurs three times with no operator intervention to recover, the soft starter will enter ERROR mode. Once the cause of the fault is understood and removed, the soft starter will have to be RESET before operation can continue. RESET can be done from the Modbus controller or by cycling power on the 24V supply, or for self-powered models, the 3-phase power supply.

5.4 Troubleshooting with the MEssoftstart/din soft starter

5.4.1 No LEDs on

For an externally powered model, the presence of the 24V DC supply should activate at least the Power LED. When connected to three phase power the Power LED should be on, and the Phase LED should be either ON or flashing. If neither of these two LEDs are on the following checks should be done:

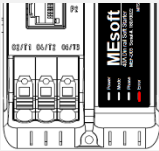
- Measure the incoming three phase supply power on the Grid-side terminals of the soft starter. If there is not supply power on all three terminals, check the Main Circuit Breaker and contact the installer to find the problem.
- For externally powered models, measure the 24V DC supply. If there is no 24Vdc control voltage, check the external power supply and the wiring to the green terminal connector.
- If the 24V DC supply is present on the externally powered model, or the 3-phase supply voltage is present on all three phases (measured on all three terminals) and the soft starter is not showing any LEDs, please contact your distributor for support.

5.4.2 Flashing Phase LED

- A flashing phase LED indicates that the phase rotation of the 3-phase supply is wrong. Switch off the main circuit breaker and swap the incoming lines so that Line 1, Line 2, Line 3 is connected to the Power terminals (L1/01, L2/03, L3/05) in that order.

5.4.3 Mode LED flashing at 0.5Hz

A Mode LED that is flashing at 0.5 Hz indicates that the soft starter is in Error Mode and the ERROR LED will show a flash pattern as described below. Use this table to determine the cause of the fault.

Error LED		
	The Error LED provides feedback on error conditions. When no error condition is detected, this LED will be off. When an error is detected the LED will repeat a sequence of flashes specific to the error condition. The sequence will consist of a number of 0.5s on and 0.5s off pulses, followed by an off-period of 1.5 s. The table below describes the number of flashes for each error condition.	
	Flashes	Error
	Description	
	2	Motor underload
	3	Supply voltage out of range
	4	Supply frequency out of range
	5	Over current during start
	6	Ramp time exceeded
	7	Motor overload
	8	Short circuit while running
	9	Supply voltage imbalance
	10	Switching element failure
	11	Internal temperature high

	12	Running current too high	The motor running current exceeds soft starter continuous rated current.
--	----	--------------------------	--

5.4.4 Two flashes: Motor Underload

- i. Switch the main supply off.
- ii. Check the motor and the load. This error can typically occur when e.g. a pump runs dry.
- iii. Use the PC application to check and ensure that the motor size and nameplate current is correct – the default motor size is 18.5kW.
- iv. Use the PC application to check and ensure that the 'Motor connection' is set correctly for Normal or Inside Delta.
- v. Re-try starting the motor.
- vi. If this error occurs repeatedly and all other checks are done, contact your distributor.

5.4.5 Three flashes: Supply voltage out of range

- i. Check the supply voltage levels. Measure all three phases and confirm that the supply voltages are within the limits of the supply voltage for the soft starter (refer Figure 3).
- ii. If supply voltage is within limits while the motor is not running, start the motor and monitor the supply voltage while the motor is running. Measure the supply voltage at the soft starter GRID terminals.
- iii. The error will also occur when a brown-out is detected. If the above checks are done and the problem persists, monitor the supply for brown-out voltage dips.
- iv. If this error occurs repeatedly and all other checks are done, contact your distributor.

5.4.6 Four flashes: Supply frequency out of range

- i. Check the supply frequency. Measure all three phases and confirm that the supply frequency is within the limits of the supply frequency for the soft starter (refer 8.1).
- ii. If supply frequency is within limits while the motor is not running, start the motor and monitor the supply frequency while the motor is running. Measure the supply frequency at the soft starter GRID terminals.
- iii. If this error occurs repeatedly and all other checks are done, contact your distributor.

5.4.7 Five flashes: Over current during start

This error occurs during the start ramp.

- i. Check the motor nameplate for the full load current specification of the motor and re-check the soft starter continuous current rating as well as the maximum starting current for the MEdsoftstart soft starter.
- ii. Confirm that the maximum starting current of the MEdsoftstart soft starter for the duty required by the installation, is at least three times the motor full load current (refer par. 1.1.1)
- iii. If possible, connect the PC Application to the Modbus RTU connector on the soft starter and read back the configuration (refer par 42). The PC Application display the configuration of the soft starter so that it is easy to see where the problem lies.
- iv. Confirm that the 'Rated Current%' parameter is set correctly for the size of the motor (refer par. 5.2). – If the motor size is wrong, the soft starter will apply an incorrect ramp during start-up.

- v. Check the setting of the 'Start current' parameter. Adjust this parameter to allow for a higher starting current. A typical start current is between 400% and 200% of the Motor Full Load current.
- vi. Confirm that the Normal / Inside Delta switch setting is correct for the installation.
- vii. Confirm that the Start Ramp starting% is not too high for the configured motor size. E.g. 60% may be too high for a small motor especially when wired as inside delta.
- viii. If changing the settings does not fix the problem contact your distributor for advice.

5.4.8 Six flashes: Ramp time exceeded

A trip on Ramp-Up time is an indication that the motor takes too long to start with the Soft starter configuration.

- i. Make the 'Start Ramp' shorter. This will result in a steeper increase in voltage during startup.
- ii. Make the 'Start Current' higher.
- iii. Make the 'Start%' higher.
- iv. If none of these actions resolve the problem, check the motor nameplate for the full load current specification of the motor and re-check the soft starter continuous current rating as well as the maximum starting current for the MEsoftstart soft starter and contact your distributor for advice.

5.4.9 Seven flashes: Motor overload

This error is related to the Motor protection class. The default protection class is 10. If this causes an error, confirm that the motor and wiring is correct and check with the motor manufacturer.

5.4.10 Eight flashes: Short circuit while running

- i. Check the wiring to the motor.
- ii. Check that the motor temperature is not too high.
- iii. Confirm that there is no locked rotor or overload on the motor.

5.4.11 Nine flashes: Supply voltage imbalance

- i. The default permitted supply voltage imbalance amongst phases is 20%. Measure the imbalance and if more than 20%, contact your plant electrician to check and try to balance phase loading for the plant.

5.4.12 Ten flashes: Switching element failure

- i. Check the wiring to the motor. Ensure that all three phases are connected from the soft starter to the motor and that good contact is made on both sides of the wires.
- ii. If the installation is correct, this error indicates a hardware fault inside the soft starter. Contact your distributor.

5.4.13 Eleven flashes: Internal temperature high

This error occurs when the temperature inside the soft starter is too high. The soft starter will trip and only allow a restart again when the soft starter has cooled down to room temperature. The error may occur because of long start ramp or a motor that is not suitable for the soft starter.

If there is no overuse or abnormal load or environmental conditions that may contribute to this issue and the soft starter repeatedly trips on this error, please contact your distributor for advice.

5.4.14 Twelve flashes: Running current too high

This error occurs when the motor and load connected to the soft starter require a current that exceeds the continuous current capability of the soft starter. Contact your distributor for advice on soft starter model selection

5.4.15 No communication on Modbus interface

If a Modbus Master device is connected to the RTU (RS485) Modbus port on the MEssoftstart/din soft starter, the soft starter should start communicating when polled for data. The Power LED should start flashing faster at 1Hz (refer par. 5.1), indicating that communication with the Modbus master has been established. The default settings for the RTU Modbus interface is as specified in par. 8.1, with a Modbus address of 1.

- i. Check the communication settings on the Modbus master and confirm that they are correct.
- ii. If the Modbus master is running on a PC, ensure that the correct drivers for the Modbus RTU (to USB) cable is installed on the PC.
- iii. If the Modbus Master is not the MEssoftstart PC application, test the communication first with the MEssoftstart/din PC application (refer par. 6.1).
- iv. Replace the cable with a supplied Modbus RTU cable. Install the provided drivers (refer par. 6.1) and test again with the MEssoftstart/din PC application
- v. If it is possible that the Modbus communication parameters were changed, contact your distributor for support.
- vi. If the interface still does not work, contact your distributor for support.

6. MESOFTSTART COMMUNICATION INTERFACE

This chapter introduces the MSoftstart PC Interface Application for the MSoftstart/din soft starters, and explains how to install and use the software.

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6.1 MSoftstart PC Interface Application

This section describes how to install the MSoftstart PC Interface Application on the user's computer and how to use the interface to configure, monitor and control the soft starter.

The MSoftstart PC Interface Application is tested to run on the Windows 10 operating system. The PC Application provides the following functionality:

- i. Configuration - The PC Application for the MSoftstart/din soft starters allows the user to view and change the configuration (refer par. 5.2).
- ii. Monitoring - The PC Application for the MSoftstart/din soft starters provides monitoring of the soft starter parameters and modes.
- iii. Control - The PC Application allows Start, Stop and Reset control (refer par.5.3)

To use the PC Application:

- i. Interface - The MSoftstart PC application for MSoftstart/din models is based on Modbus RTU and interfaces on the RS485 RJ45 connector on P1 or P2. All MSoftstart/din soft starters (except the MSoftstart-D02LF) with the P1 and P2 connectors support the Modbus interface. A special cable is needed that converts the RS485 on the soft starter to a USB interface on the laptop.
- ii. Software – MSoftstart/din PC Interface Application and Driver for Modbus interface

6.1.1 Installing the MSoftstart PC Interface Application on a PC or laptop

The installation instruction for installing and using the PC application, is provided in this section. Ensure to download the correct zip folder for the MSoftstart/din soft starters.

6.1.1.1 Copy the files to the PC or laptop

Copy the MSoftstart installation files from the Mitsubishi Electric Europe website (as can be obtained from your distributor) to the hard drive of the PC or laptop that will be used for the MSoftstart configuration and monitoring. A cable with RS485 to USB converter will be used. The drivers for the Modbus interface cable also need to be downloaded. Open the folder where the files are copied. The folder should look like Figure 14 :

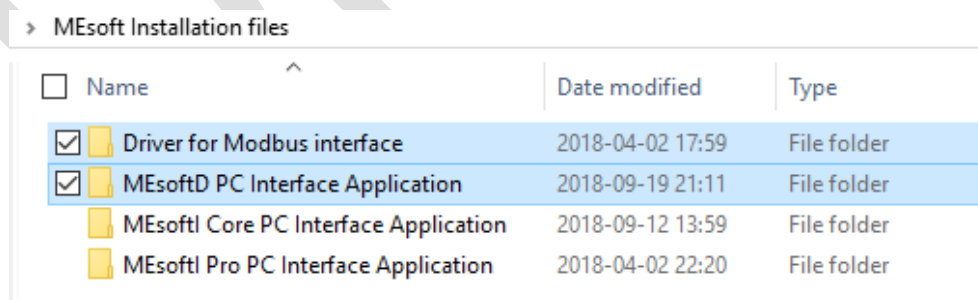


Figure 14 – MSoftstart Installation files on the user PC or Laptop

6.1.1.2 Run the PC application

Open the folder *MSoftstart/din PC Interface Application* and double click on the '.exe' file to run the program.

MEsoft Installation files > MEsoftD PC Interface Application

☐ Name	Date modified	Type	Size
platforms	2018-09-26 20:24	File folder	
libEGL.dll	2016-12-01 12:33	Application extens	22 KB
libgcc_s_dw2-1.dll	2015-12-29 00:25	Application extens	118 KB
libGLSv2.dll	2016-12-01 12:33	Application extens	2 736 KB
libstdc++-6.dll	2015-12-29 00:25	Application extens	1 505 KB
libwinpthread-1.dll	2015-12-29 00:25	Application extens	78 KB
☒ MEsoftD_PC_Interface_v2_00.exe	2018-09-20 10:47	Application	3 858 KB
Qt5Core.dll	2018-01-03 16:52	Application extens	5 275 KB
Qt5Gui.dll	2016-12-01 12:41	Application extens	5 159 KB
Qt5PrintSupport.dll	2016-12-01 12:51	Application extens	355 KB
Qt5SerialPort.dll	2016-12-01 15:04	Application extens	76 KB
Qt5Widgets.dll	2016-12-01 12:49	Application extens	6 219 KB

Figure 15 MEsoftstart/din PC Interface Application files on the user PC or Laptop

The MEsoftstart PC Interface application should run and the home screen should be visible (refer Figure 16).

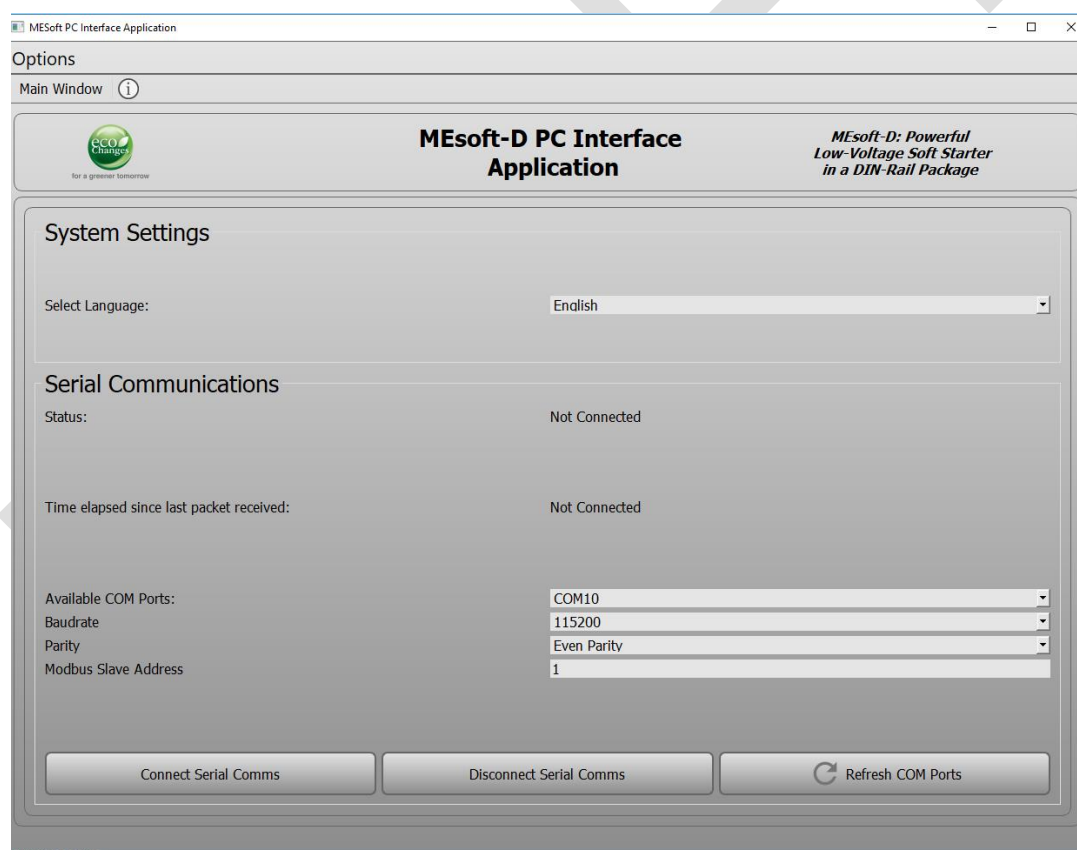


Figure 16 Home screen

Once the MEsoftstart PC Interface Application is running, the Information screen can be accessed by clicking the  icon. The Information screen shows the software version and the supported MEsoftstart models.

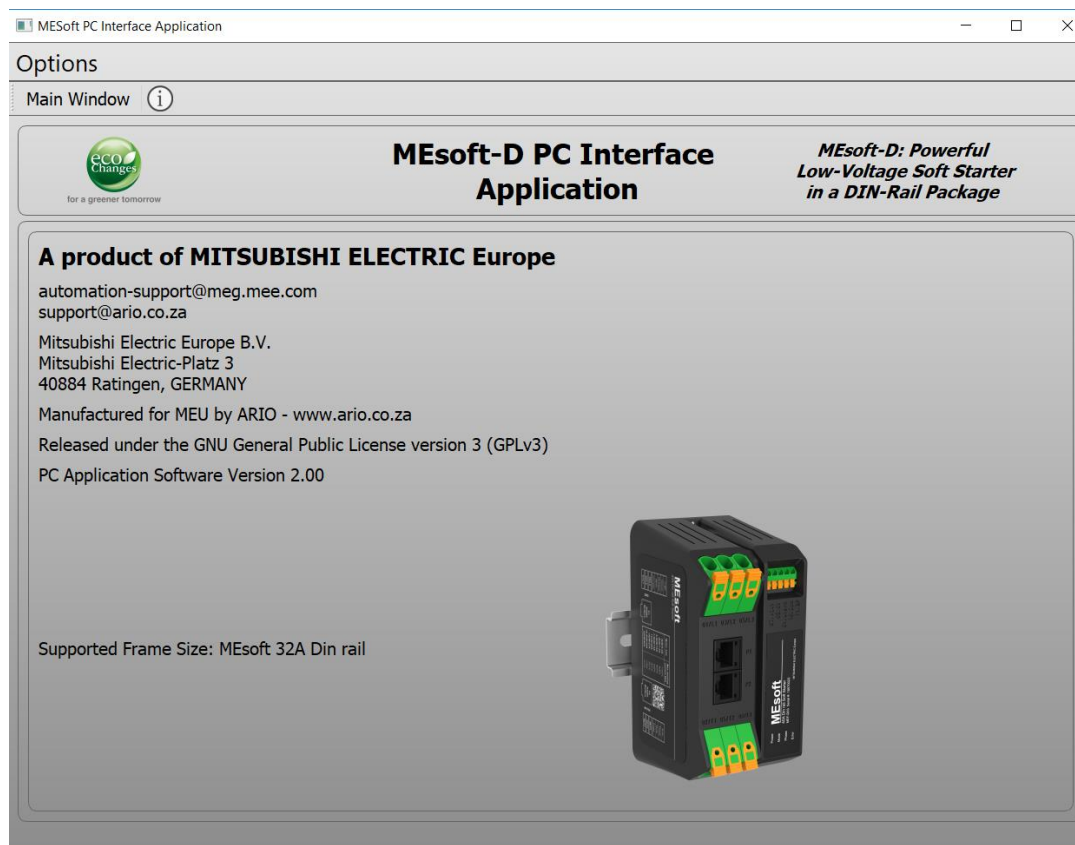


Figure 17 –Information screen

6.1.1.3 Modbus RTU- Test to see if a driver is required for the Modbus-USB cable

Before plugging the communication cable into the laptop or PC, click on the down arrow of the “Available COM Ports” drop-down box and make a note of all the COM ports listed.

Plug the cable in and connect the computer to the MEsoftstart/din soft starter.

If the wires are long or communication quality is a problem ensure to use a terminating resistor on the other connector on the last soft starter in line (if they are daisy-chained) – refer par. 3.2.1.

Note: If the computer is connected to the internet and offers to find a driver for the new hardware, wait for it to complete the procedure. You may also point the computer to the driver in the “MEsoftstart Installation files\Driver for Modbus interface” folder (refer Figure 14).

If nothing happens once the new driver installation is completed, click on the “Refresh COM ports” button and confirm that a new COM port was added to the drop-down list of “Available COM Ports”.

If the new COM port is not automatically detected, close the MEsoftstartD PC Interface Application, remove the Modbus-USB cable. Install the provided driver, reconnect the Modbus-USB cable and start the MEsoftstart PC Interface Application again.

6.1.2 Connecting to the soft starter

When the MEsoftstart din PC Interface Application is running and the Modbus-USB cable is connected to a MEsoftstart/din soft starter that is powered-up, the “Connect” button can be clicked, to connect the computer to the soft starter.

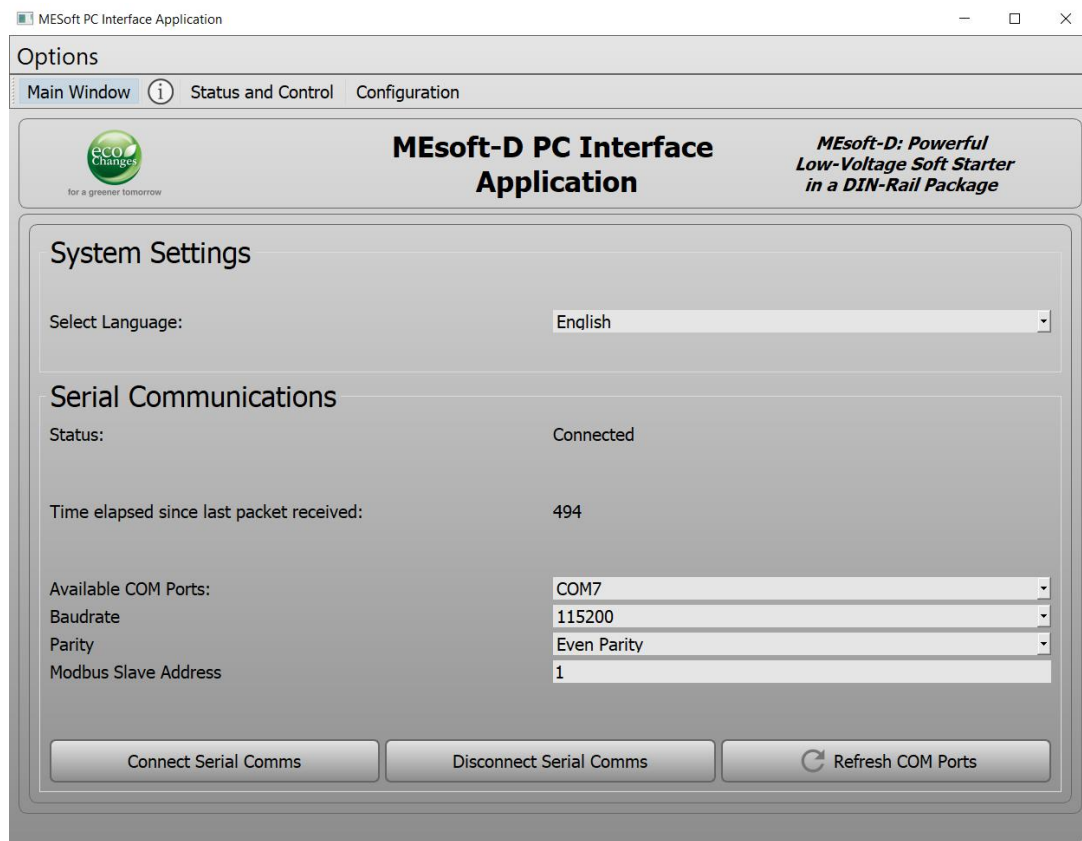


Figure 18 – MEssoftstart PC Interface Application on RTU modbus – connected to the soft starter

If the MEssoftstart PC Interface Application is not connecting to the soft starter, it may be that the Modbus communication parameters or the Modbus Slave Address of the soft starter have been modified on the soft starter. Contact your distributor for support.

Once the communication parameters and RTU address on the soft starter and the MEssoftstart PC Interface Application are the same, try connecting to the soft starter again.

When first connected to the soft starter, the Serial Communication 'Status' will be 'Connected' and the 'Status and Control' and 'Configuration' tabs will be shown (refer Figure 18)

6.1.3 Configuring start and stop behaviour using the MEssoftstart/din PC Interface Application

Configuration is done from the 'Configuration' screen (refer par. 5.2). Once the configuration is as required, use the 'Update configuration parameters' button to download the configuration to the soft starter. Note that this may only be done while the motor is stopped and the soft starter is in IDLE mode. If configuration is not possible the button will be unavailable as shown in Figure 19.

Note that from this screen the Modbus parameters may also be changed. Take care to change this only when needed and to keep track of the new Modbus parameters and address for each soft starter.

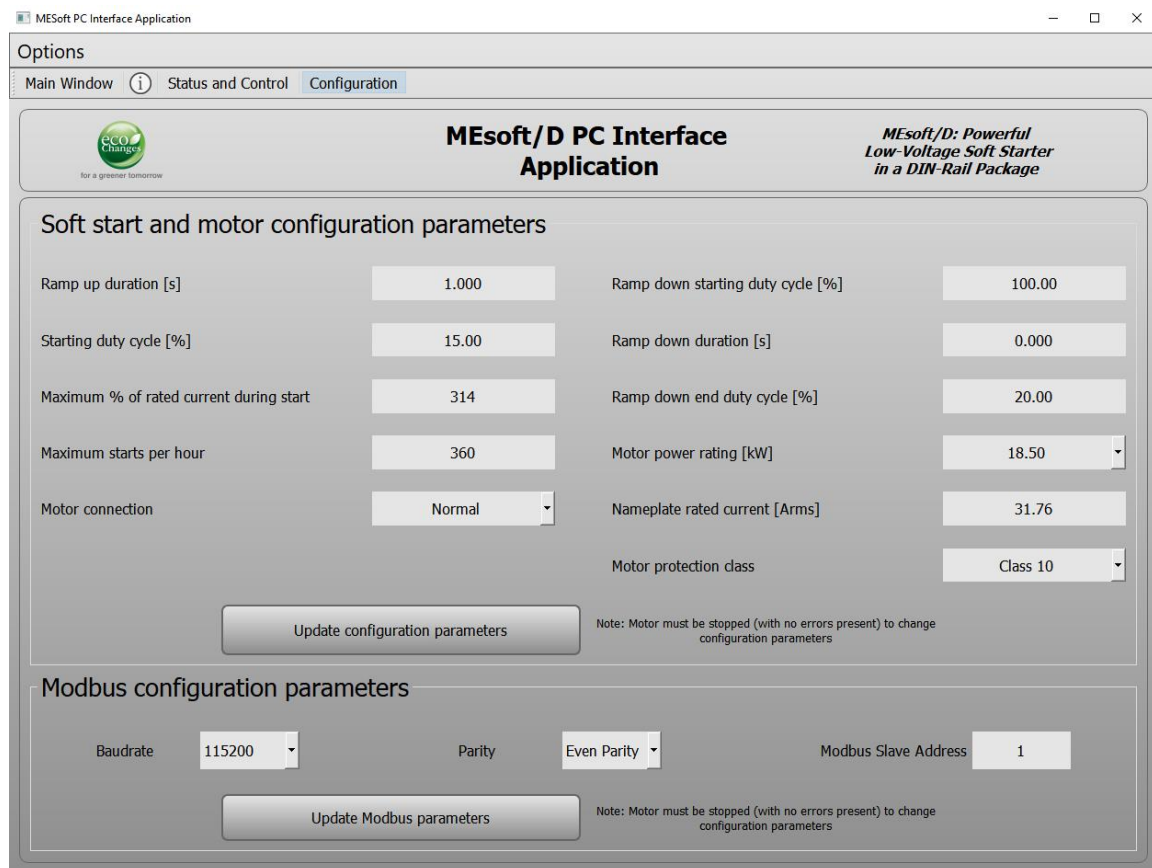


Figure 19 –PC Application - Configuration screen

6.1.4 Controlling the soft starter using the MEsoftstart PC Interface Application

Refer par 5.3 for information to control the motor via the PC Interface Application and to reset the soft starter in case of an error.

6.2 MEsoftstart Modbus interfaces

The MEsoftstart/din soft starters (except MEsoftstart-D02LF) supports Modbus RTU on RS485 connectors P1 and P2 (refer par. 3.2.1)

The MEsoftstart PC Interface Application and any SCADA system, both use the same MODBUS protocol and is the Modbus Master when connected to the soft starter. The SCADA uses a subset of the total register definition. Some of the registers will only be used by the PC Application and the register values will not be visible in the final SCADA SICD document.

Please request the Modbus Software Interface Control Document from your local distributor. The following general guidelines apply:

The PC Application and the SCADA system may not be simultaneously present on the Modbus RTU RS-485 data bus due to bus conflict issues.

The Modbus Master can to connect to the soft starter (via MODBUS messages) and request status updates as well as read the soft starter's present configuration.

The soft starter configuration may only be updated by the Modbus Master when the soft starter is in the IDLE mode. On receipt of a new configuration, the soft starter performs a validity check on the received parameters. If the parameters are valid the soft starter will acknowledge the request. If the parameters are invalid the soft starter will

respond with an 'Illegal Data Value' error code as per the Modbus Application Protocol Specification. A single configuration parameter compliance failure will result in the whole configuration being discarded.

The Modbus Master may send regular status request messages beginning when the soft starter is in IDLE mode. The Modbus Master will then be in control of the soft starter and will remain in control, provided that a continuous regular message is sent from the Master to the Soft starter. While the Modbus Master is in control of the soft starter the Power LED will indicate this (refer par. 5.1).

If the soft starter does not receive messages from the Modbus Master for a period longer than 20 seconds, the soft starter will continue operation in the mode that it was and revert to normal control as shown in Figure 13.

The soft starter is not able to distinguish when under Modbus control, whether it is the PC Application or a SCADA control system that is the Modbus Master.

The soft starter Modbus interface does not support Modbus Broadcast mode or Silent mode.

The RS-485 RTU Modbus communication interface is default set to 115200 BAUD, 1 Start, 1 Stop, Even Parity (with the possibility of No Parity and Odd Parity available).

At present the following Modbus function codes (FCs) are supported:

- 4 = Read Input Register. (Read Only Registers)
- 3 = Read Holding Registers. (Read/Write Registers)
- 6 = Write Single Holding Register.
- 16 = Write Multiple Holding Registers.

The soft starter RTU address can be configured from 1 to 247.

Any write action either to Configuration registers, or the Control Command register, that receives a positive response back from the soft starter, may be interpreted by the Modbus Master as confirmation that the configuration data is correct and will be saved in the soft starter, or that the command will be put into effect. An error response must be interpreted as the opposite.

Updates to individual configuration parameters should be done by sending the full complement of configuration parameters.

7. MAINTENANCE AND INSPECTION

This chapter explains the precautions for maintenance and inspection for this product. Always read the instructions before using the equipment.

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DRAFT

7.1 Inspection item

The soft starter is a static unit mainly consisting of semiconductor devices. Weekly inspection should be performed to prevent any fault from occurring due to the adverse effects of the operating environment, such as temperature, humidity, dust, dirt and vibration, changes in the parts with time, service life and other factors.

-  When accessing the soft starter for inspection, wait for at least 10 minutes after the power supply has been switched OFF before touching the soft starter.

7.1.1 Weekly inspection

Check the following during operation:

- Error LED indications.
- Improper installation environment.
- Cooling system fault.
- Abnormal vibration, abnormal noise, bearing noises in motor.
- Abnormal overheat and discoloration of terminals.

7.1.2 Periodic inspection

Check the following when the unit is not operational:

- Check that there is no voltage on the input terminals.
- Check all areas inaccessible during operation.
- Clean the air inlet and outlet grills (if applicable).
- Check that the power wires are firmly in place and that the green terminals are fully closed.
- Torque fastening screws (panel mounted soft starters) as they may become loose due to vibration and temperature variations.
- Check connections and insulating materials for corrosion and damage.

7.1.3 Weekly and periodic inspection checklist

Area of inspection	Inspection item	Description	Inspection interval		Corrective action at fault occurrence	Check
			Weekly	Periodic ¹		
General	Surrounding environment	Check the surrounding air temperature, humidity, dirt, corrosive gas, water, oil, etc.	☐		Improve the environment.	
	Overall unit	Check for unusual noise and vibration.	☐		Check fault location and re-torque.	
		Check for dirt, oil and other foreign material.	☐		Clean.	
	Power supply voltage	Check that the main circuit voltages and control voltages are within the operating range ² .	☐		Inspect the power supply.	
Main circuit	General	Check for loose screws		☐	Retighten.	
		Check for overheat traces on the parts.		☐	Contact the manufacturer.	
		Check for stain.		☐	Clean.	
	Conductors, cables	Check conductors for distortion.		☐	Contact the manufacturer.	
		Check cable sheaths for breakage and deterioration (crack, discoloration, etc.).		☐	Contact the manufacturer.	
	Terminal block	Check for damage.		☐	Stop the equipment and contact the manufacturer.	
	Relay/contactors	Check that the operation is normal and no chattering sound is heard.		☐	Contact the manufacturer.	
Control circuit Protective circuit	Operation check	Check that the output voltages across phases are balanced while operating the soft starter.		☐	Contact the manufacturer.	
	Overall	Check for unusual odor and discoloration.		☐	Stop the equipment and contact the manufacturer.	
		Check for serious rust development.		☐	Contact the manufacturer.	

7.1.4 Cleaning

Always run the soft starter in a clean condition.

When cleaning the soft starter, gently wipe dirty areas with a soft cloth damped with neutral detergent or ethanol.

- ⚠ Do not use solvent, such as acetone, benzene, toluene or alcohol, as these might damage the soft starter surface.
- ⚠ The display is vulnerable to detergent and alcohol. Only use a soft cloth damped with water.

¹ One to two years of periodic inspection cycle is recommended. However, it differs according to the installation environment.

² It is recommended to install a voltage recording device for monitoring the voltage of the power supplied to the soft starter.

8. SPECIFICATIONS

This chapter explains the specifications of this product. Always read the instructions before using the equipment.

MEsoftstart/din identifier	model	Range	Description
MEsoftstart-D02		Core	DIN rail or Panel mount; Externally powered; 2-phase control; 32A soft starter with Modbus RTU
MEsoftstart-D03		Pro	DIN rail or Panel mount; Externally powered; 3-phase control; 32A soft starter with Modbus RTU
MEsoftstart-D02L		Core	DIN rail or Panel mount; Self-powered; 2-phase control; 16A soft starter with Modbus RTU
MEsoftstart-D03L		Pro	DIN rail or Panel mount; Self-powered; 3-phase control; 16A soft starter with Modbus RTU
MEsoftstart-D03S		Pro	DIN rail or Panel mount; Self-powered; 3-phase control; 32A soft starter with Modbus RTU
MEsoftstart-D02S		Core	DIN rail or Panel mount; Self-powered; 2-phase control; 32A soft starter with Modbus RTU
MEsoftstart-D02LF		Core	DIN rail or Panel mount; Self-powered; 2-phase control; 16A soft starter; Factory pre-configured

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8.1 Soft starter specification

General		Status Feedback (LEDs)	
Starting method*1	Constant current ramp	Power	Indicates control power is present, LED flickers ON for 1 sec; OFF for 1 sec to show that the processor is running. If Modbus control is active the LED flickers ON for 0.5 sec and OFF for 0.5 sec
Ramp-up time*1	1 – 10sec	Mode	Operating Mode: LED flicker pattern to indicate IDLE, RAMP-UP or -DOWN, BYPASSED, DELAY (before restart) or ERROR state – refer to the LED flash patterns for details
Ramp-down time*1	0s – 10 sec (stop-ramp- only an option when under Modbus control)		
Initial Torque*1	Factory set via the maximum starting current, default value 200%	Phase	LED on indicates a correct phase rotation; LED flashing indicates incorrect phase rotation
Under-/Over-voltage protection:		Error	LED off indicates no error; LED flicker pattern to identify different errors – refer to the LED flash patterns for details
Recovery from under-voltage	320 Vac		
Recovery from over-voltage	480 Vac		
*1 – Configurable via Modbus on all except MEdsoftstart-D02L model			
Input Specifications		Output Specifications	
Control Voltage	24Vdc $\pm$ 10% (MEsoftstart-D02 and -D03) OR Internal supply (MEsoftstart-D02S; -D03S; -D02L; -D03L; -D02LF)	IEC rated operational current IEC60947-4-2 (AC-53b) @ 50°C	MEdsoftstart-D02S; -D03S; -D02 and -D03 20 A RMS for DIN Rail mounting 32 A RMS for panel mounting (on a temperature conductive surface) MEdsoftstart-D02L; -D03L; -D02LF 16 A RMS for DIN rail or Panel mounting
Rated ac frequency	50/60Hz $\pm$ 10%	IEC60947-4-2 (AC-53b) above 50°C	De-rate at 5% per °C above 50°C
Rated Insulation Voltage	500 Vac	Max. number starts/hour @ 50°C	Default is 60 (no more than once every minute) but adjustable between 12 and 120
Dielectric Strength:		Min. time between stop and start	1 sec.
Dielectric withstand voltage	2 kV RMS	Minimum time between starts	30 sec.
Rated Impulse Withstand Voltage	4 kV RMS	Minimum load current	0.1A RMS
Control Input Current	24Vdc: < 100 mA in idle state Self-powered: 30 mA ac	Communication	
Input to Output response time	< 100 ms	Modbus RTU on all except MEdsoftstart-D02LF (RS485, Baud rate: 9600- 115200 default=115200, 1 start, 1 stop, even parity. Default address 1)	
Environmental Specifications		Supply Specifications	
Operating Temperature	-20°C to +60°C	Operational Voltage L1 – L3	340 – 440 Vac RMS 50/60 Hz
Storage Temperature	-40°C to +80°C (-40°F to 176°F)	Supply Current at standby	<30 mAac
Relative Humidity	<95% non-condensing @ 40°C	Blocking voltage	1200 Vp
Pollution Degree	2	Rated ac frequency	50/60Hz $\pm$ 10%
Degree of Protection	IP20 (EN/IEC 60529)	Rated insulation voltage	500Vac
Installation Category	III	Dielectric withstand voltage:	
Installation Altitude	1400m, De-rate at 0.7% per 100m for altitudes >1400m	Supply to enclosure	2.5 kV RMS
Electromagnetic Compatibility			
Immunity	IEC/EN 60947-4-2	Conducted Radio Frequency	
Electrostatic discharge (ESD)		Immunity	IEC/EN 61000-4-6
Immunity	EC/EN 61000-4-2	10V/m, 0.15 - 80 MHz	Performance Criteria 1
Air discharge: 8kV	Performance Criteria 2	Emission	IEC/EN 60947-4-2
Contact: 4kV	Performance Criteria 2	Radio interference field emissions (radiated)	
Electrical Fast Transient(Burst)			CISPR 11 IEC/EN 55011, Class A (Industrial)
Immunity	IEC/EN 61000-4-4	Radio interference voltage emissions (conducted)	
Output: 2kV	Performance Criteria 2		CISPR 11 IEC/EN 55011, Class A (Industrial)
Input: 1kV	Performance Criteria 2	Voltage dips & interruptions	
Electrical surge immunity	IEC/EN61000-4-5	0% Ue & Uc, 5000 ms	Performance Criteria 2
Output, line to line, 1kV	Performance Criteria 2	40% Ue & Uc, 100/1000 ms	Performance Criteria 1/ Performance Criteria 2
Output, line to earth, 2kV	Performance Criteria 2	70% Ue & Uc, 10 ms	Performance Criteria 1
Input, line to line, 1kV	Performance Criteria 2	Harmonics	IEC/EN 61000-3-2
Input, line to earth, 2kV	Performance Criteria 2	Flicker	IEC/EN 61000-3-3
Rated radio frequency			
Immunity	IEC/EN 61000-4-3		
3V/m, 0.15 - 80 MHz	Performance Criteria 1		

8.2 Outline dimension drawings

8.2.1 MSoftstart/din - all models

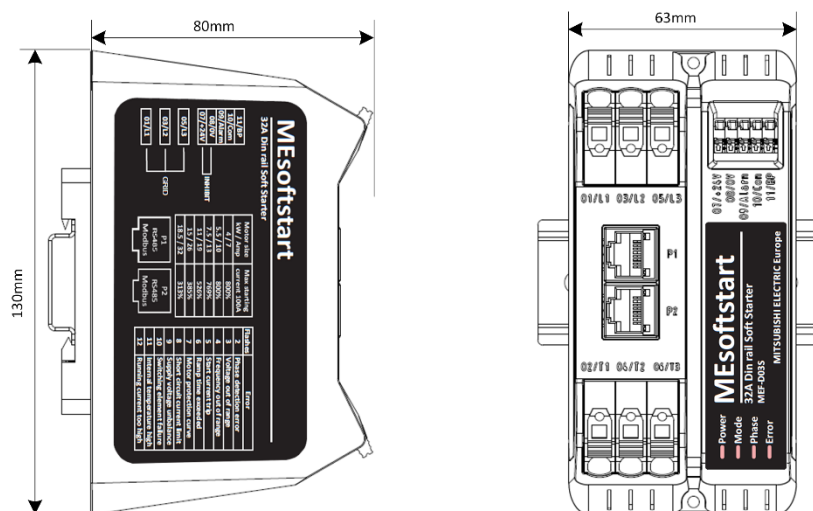


Figure 20: Soft starter with internal bypass relays



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