## Safety Precautions and Warnings

**Before installing and putting this equipment into operation, please read these safety precautions and warnings carefully and all the warning signs attached to the equipment. Make sure that the warning signs are kept in a legible condition and replace missing or damaged signs.**



### WARNING

This equipment contains hazardous voltages and controls hazardous rotating mechanical parts. Loss of life, severe personal injury or property damage can result if the instructions contained in this manual are not followed.

Only suitable qualified personnel should work on this equipment, and only after becoming familiar with all safety notices, installation, operation and maintenance procedures contained in this manual. The successful and safe operation of this equipment is dependent upon its proper handling, installation, operation and maintenance.

– The MICRO MASTER and MIDI MASTER operate at high voltages.

– The dc–link capacitor remains charged to dangerous voltages even when the power is removed. For this reason it is not permissible to open the equipment until five minutes after the power has been turned off. When handling the open equipment it should be noted that live parts are exposed. Do not touch these live parts.

– Machines with a three phase power supply must not be connected to a supply via an ELCB (Earth Leakage Circuit–Breaker – see DIN VDE 0160, section 6.5).

– The following terminals can carry dangerous voltages even if the inverter is inoperative:

  – the power supply terminals L/L2, N/L3 or L1, L/L2, N/L3.
  – the motor terminals W, V, U.
  – the braking resistor / braking unit terminals B+, B–.

– Only qualified personnel may connect, start the system up and repair faults. These personnel must be thoroughly acquainted with all the warnings and operating procedures contained in this manual.

– Certain parameter settings may cause the inverter to restart automatically after an input power failure.



### CAUTION

- Children and the general public must be prevented from accessing or approaching the equipment!

- This equipment may only be used for the purpose specified by the manufacturer. Unauthorised modifications and the use of spare parts and accessories that are not sold or recommended by the manufacturer of the equipment can cause fires, electric shocks and injuries.

- Keep these operating instructions within easy reach and give them to all users!

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# 1. OVERVIEW

## 1.1 Description and Features

The MICRO MASTER and MIDI MASTER are a range of inverters with a voltage dc–link circuit for variable speed AC drives *(see Figure 1)*. Various options are available, ranging from the compact 250 W MICRO MASTER up to the 37 kW MIDI MASTER *(see section 1.3 below)*.

Both types of inverter are microprocessor–controlled. A special pulse–width modulation method with selectable pulse frequency permits extremely quiet motor operation. Complete inverter and motor protection is provided by various protective functions.

**Features**

- Microprocessor–control for reliability and flexibility.
- Remote control capability via RS485 serial link using the USS protocol.
- Ability to control up to 31 inverters via the USS protocol.
- A comprehensive range of parameters is provided to enable the inverters to be configured for use in almost any application.
- Built–in non–volatile memory for storing parameter settings.
- Factory default parameter settings pre–programmed for European and North American requirements.
- Output frequency (and hence motor speed) can be controlled by one of five methods:

  (1) Digital frequency setpoint
  (2) Analogue setpoint (voltage or current input)
  (3) Motor potentiometer
  (4) Fixed frequency
  (5) Via remote data transmission

- Built–in dc injection brake.
- Built–in brake chopper for external resistor (MICRO MASTER), optional for MIDI MASTER.
- Automatic load compensation by flux current control.
- Built–in ramp generator for variable ramping times.
- Membrane–type front panel controls.
- Two relay outputs incorporated.
- Analogue output incorporated.
- External connection for optional enhanced operator panel or for use as external RS485 interface.

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## 1.2 Options

The following options are available for the MICRO MASTER and MIDI MASTER:

Braking resistor (MICRO MASTER)
Braking unit (MIDI MASTER)
RFI suppression filter
Enhanced operator panel

## 1.3 MICRO MASTER and MIDI MASTER Variants

This handbook covers all variants of the MICRO MASTER and MIDI MASTER inverters as listed below:

| MICRO MASTER | | | | MIDI MASTER | | | |
|---|---|---|---|---|---|---|---|
| Model | Input Voltage | Power Rating | Order No. | Model | Input Voltage | Power Rating | Order No. |
| MM25 | 230 V 1 AC | 250 W | 6SE3111–5BA40 | MD550/2 | 230 V 3 AC | 5.5 kW | *see Note below* |
| MM25/2 | 230 V 3 AC | | 6SE3111–5CA40 | MD750/2 | | 7.5 kW | |
| MM37 | 230 V 1 AC | 370 W | 6SE3112–1BA40 | MD1100/2 | | 11.0 kW | |
| MM37/2 | 230 V 3 AC | | 6SE3112–1CA40 | MD1500/2 | | 15.0 kW | |
| MM55 | 230 V 1 AC | 550 W | 6SE3112–8BA40 | MD1850/2 | | 18.5 kW | |
| MM55/2 | 230 V 3 AC | | 6SE3112–8CA40 | MD2200/2 | | 22.0 kW | |
| MM75 | 230 V 1 AC | 750 W | 6SE3113–6BA40 | MD750/3 | 400 – 500 V 3 AC | 7.5 kW | 6SE3121–7DG40 |
| MM75/2 | 230 V 3 AC | | 6SE3113–6CA40 | MD1100/3 | | 11.0 kW | 6SE3122–4DG40 |
| MM110 | 230 V 1 AC | 1.1 kW | 6SE3115–2BB40 | MD1500/3 | | 15.0 kW | 6SE3123–0DH40 |
| MM110/2 | 230 V 3 AC | | 6SE3115–2CB40 | MD1850/3 | | 18.5 kW | 6SE3123–5DH40 |
| MM150 | 230 V 1 AC | 1.5 kW | 6SE3116–8BB40 | MD2200/3 | | 22.0 kW | 6SE3124–2DJ40 |
| MM150/2 | 230 V 3 AC | | 6SE3116–8CB40 | MD3000/3 | | 30.0 kW | 6SE3125–5DJ40 |
| MM220 | 230 V 1 AC | 2.2 kW | 6SE3121–0BC40 | MD3700/3 | | 37.0 kW | 6SE3126–8DJ40 |
| MM220/2 | 230 V 3 AC | | 6SE3121–0CC40 | MD750/4 | 575 V 3 AC | 7.5 kW | *see Note below* |
| MM300/2 | 230 V 3 AC | 3.0 kW | 6SE3121–3CC40 | MD1100/4 | | 11.0 kW | |
| MM150/3 | 400 – 500 V 3 AC | 1.5 kW | 6SE3114–0DC40 | MD1500/4 | | 15.0 kW | |
| MM220/3 | | 2.2 kW | 6SE3115–8DC40 | MD1850/4 | | 18.5 kW | |
| MM300/3 | | 3.0 kW | 6SE3117–3DC40 | MD2200/4 | | 22.0 kW | |
| MM400/3 | | 4.0 kW | 6SE3121–0DC40 | MD3000/4 | | 30.0 kW | |
| MM550/3 | | 5.5 kW | 6SE3121–3DC40 | MD3700/4 | | 37.0 kW | |

**Note**
Please check with your Siemens dealer for availability of these variants.

Many aspects of operation are common to all variants. However, some differences do exist (particularly in installation procedures). These differences are described at the appropriate places in the text.

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# 2. INSTALLATION



## WARNING

To guarantee the safe operation of the equipment it must be installed and commissioned properly by qualified personnel in compliance with the warnings laid down in these operating instructions.

Take particular note of the general and regional installation and safety regulations regarding work on high voltage installations (e.g. VDE), as well as the relevant regulations regarding the correct use of tools and personal protective gear.

Make sure that the unobstructed clearance for each of the cooling inlets and outlets above and below the inverter is at least 100 mm.

Ensure that the temperature does not exceed the specified level when the inverter is installed in a cubicle.

Avoid excessive vibration and shaking of the equipment.

Inverter models MM25, MM37, MM55 and MM75 **must** be fixed securely to a flat surface before use to prevent access to the capacitors contained within the heatsink.

**Note:** Consider the possible use of options (e.g. RFI suppression filters) at the planning stage.

## 2.1 Wiring Guidelines to Minimise the Effects of EMI

The inverters are designed to operate in an industrial environment where a high level of Electro–Magnetic Interference (EMI) can be expected. Usually, good installation practices will ensure safe and trouble–free operation. However, if problems are encountered, the following guidelines may prove useful. In particular, grounding of the system 0V at the inverter, as described below, may prove effective.

(1) Ensure that all equipment in the cubicle is well earthed using short, thick earthing cable connected to a common star point or busbar. It is particularly important that any control equipment that is connected to the inverter (such as a PLC) is connected to the same earth or star point as the inverter via a short, thick link. Flat conductors (e.g. metal brackets) are preferred as they have lower impedance at high frequencies.

The return earth from motors controlled by the inverters should be connected directly to the earth connection (PE) on the associated inverter.

(2) Use saw–tooth washers when mounting the inverter and ensure that a good electrical connection is made between the heatsink and the panel, removing paint if necessary.

(3) Wherever possible, use screened leads for connections to the control circuitry. Terminate the ends of the cable neatly, ensuring that long strands of unscreened wire are not left visible.

(4) Separate the control cables from the power connections as much as possible, using separate trunking, etc. If control and power cables cross, arrange the cables so that they cross at 90$^{o}$ if possible.

(5) Ensure that contactors in the cubicle are suppressed, either with R–C suppressors for AC contactors or 'flywheel' diodes for DC contactors, **fitted to the coils**. Varistor suppressors are also effective. This is particularly important if the contactors are controlled from the relays on the inverter.

(6) Use screened or armoured cables for the power connections and ground the screen at both ends.

(7) If the drive is to be operated in a noise–sensitive environment, the RFI filter kit should be used to reduce the conducted and radiated interference from the inverter. In this case, the filter should be mounted as close to the inverter as possible and well grounded *(see (2) above)* and the supplied metallised cover should be fitted to the inverter.

(8) Select the lowest switching frequency possible. This will reduce the amount of EMI generated by the inverter.

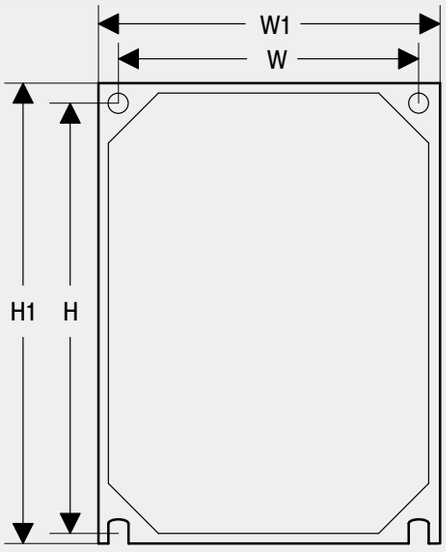
**On no account must safety regulations be compromised when installing inverters!**



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## 2.2 Mechanical Installation

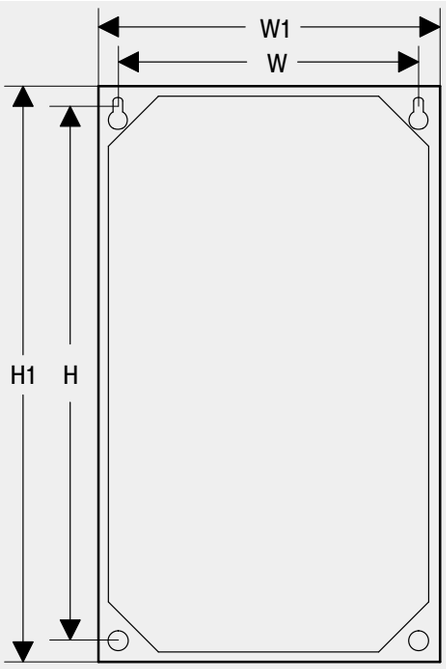
Mount the MICRO MASTER or MIDI MASTER in accordance with Figure 2 or Figure 3.




Clearances for cooling (all models):
Top & bottom: 100 mm

| | H | W | H1 | W1 | |
|---|---|---|---|---|---|
| MM25<br>MM25/2<br>MM37<br>MM37/2<br>MM55<br>MM55/2<br>MM75<br>MM75/2 | 173 mm | 103 mm | 182 mm | 112 mm | 4 bolts M4<br>4 nuts M4<br>4 washers M4<br>Mounting holes: Ø 4.5 mm |
| MM110<br>MM110/2<br>MM150<br>MM150/2 | 174 mm | 138 mm | 184 mm | 149 mm | 4 bolts M4<br>4 nuts M4<br>4 washers M4<br>Mounting holes: Ø 4.8 mm |
| MM220<br>MM220/2<br>MM300/2<br>MM150/3<br>MM220/3<br>MM300/3<br>MM400/3<br>MM550/3 | 204 mm | 174 mm | 215 mm | 185 mm | 4 bolts M5<br>4 nuts M5<br>4 washers M5<br>Mounting holes: Ø 5.6 mm |

*Figure 2:* **Mechanical Installation Diagram – MICRO MASTER**




Clearances for cooling (all models):
Top & bottom: 100 mm

| | H | W | H1 | W1 | |
|---|---|---|---|---|---|
| MD550/2<br>MD750/3<br>MD1100/3<br>MD750/4<br>MD1100/4 | 430 mm | 235 mm | 450 mm | 275 mm | 4 bolts M8<br>4 nuts M8<br>4 washers M8<br>Mounting holes: Ø 8.5 mm |
| MD750/2<br>MD1100/2<br>MD1500/3<br>MD1850/3<br>MD1500/4<br>MD1850/4 | 530 mm | 235 mm | 550 mm | 275 mm | |
| MD1500/2<br>MD1850/2<br>MD2200/2<br>MD2200/3<br>MD3000/3<br>MD3700/3<br>MD2200/4<br>MD3000/4<br>MD3700/4 | 630 mm | 235 mm | 650 mm | 275 mm | |

*Figure 3:* **Mechanical Installation Diagram – MIDI MASTER**

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The MIDI MASTER is suitable for use in a circuit capable of delivering not more than 5000 A symmetrical (rms), 550 V maximum, when protected by a time delay fuse, as listed below:

| | Mains Input | Model | Fuse Rating |
|---|---|---|---|
| 5000 A | 230 V, 3 AC | **MD550/2** | *Data not yet available* |
| | | **MD750/2** | |
| | | **MD1100/2** | |
| | | **MD1500/2** | |
| | | **MD1850/2** | |
| | | **MD2200/2** | |
| | 400 – 500 V, 3 AC | **MD750/3** | 32 A |
| | | **MD1100/3** | |
| | | **MD1500/3** | 50 A |
| | | **MD1850/3** | |
| | | **MD2200/3** | 80 A |
| | | **MD3000/3** | |
| | | **MD3700/3** | 100 A |
| | 575 V, 3 AC | **MD750/4** | *Data not yet available* |
| | | **MD1100/4** | |
| | | **MD1500/4** | |
| | | **MD1850/4** | |
| | | **MD2200/4** | |
| | | **MD3000/4** | |
| | | **MD3700/4** | |

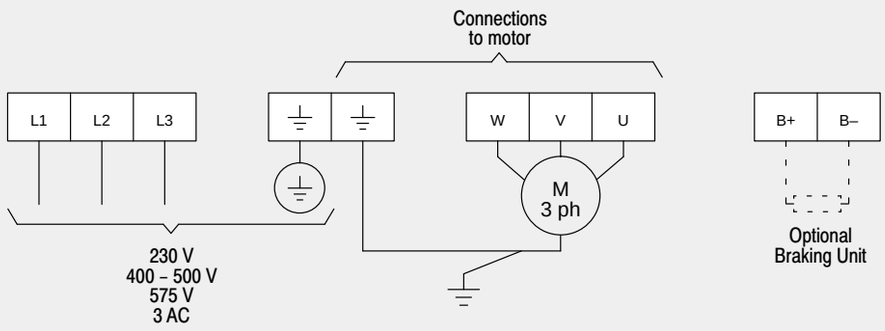
To tighten up the terminal screws use: **power terminals** – small or medium blade screwdriver 3 – 7 mm (depends on inverter variant)
**control terminals** –small blade screwdriver 2 – 2.5 mm

### 2.4.1 Power and Motor Connections

Make sure that the power source supplies the correct voltage and is designed for the necessary current *(see section 1.3)*. Ensure that the appropriate circuit–breakers with the specified current rating are connected between the power supply and inverter *(see section 7.1)*.

Connect the power input to the power terminals L1, L2, L3 and earth using a 4–core cable. For cross–section of each core see section 7.1.

Use a 4–core cable to connect the motor. As indicated in Figure 8, the cable is connected to the power terminals W/V/U and the separate earth.




**Note:**
The terminal arrangement for the 37 kW inverter is slightly different *(see Figure 7)*.

*Figure 8:* **Mains Input / Motor Terminal Connections – MIDI MASTER**

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# 3. FRONT PANEL CONTROLS

## WARNING

The equipment must not be switched on until after its plastic cover has been fitted.

After the power has been turned off, you must always wait five minutes so that the dc–link capacitors can discharge. Do not remove the cover until this time has elapsed.

As a precautionary measure, the digital frequency setpoint has been set at 0.0 Hz in the factory. This prevents inadvertent and uncontrolled running of the motor occurring at initial start–up.

Before the motor will run it is necessary to enter a frequency setpoint via parameter P000 with the △ button, or to set it with parameter P005.

All settings must only be entered by qualified personnel, paying particular attention to the safety precautions and warnings.

The parameter settings required can be entered using the three parameterisation buttons (**P**, △ and ▽) on the front panel of the inverter (Figure 11 contains a flowchart for the procedure for setting parameter values). The parameter numbers and values are indicated on the four digit LED display.

Switch SW1 selects between voltage (V) and current (I) analogue inputs. This switch can only be accessed while the cover is removed *(see Figure 4 (MICRO MASTER) or Figure 7 (MIDI MASTER) for location)*.

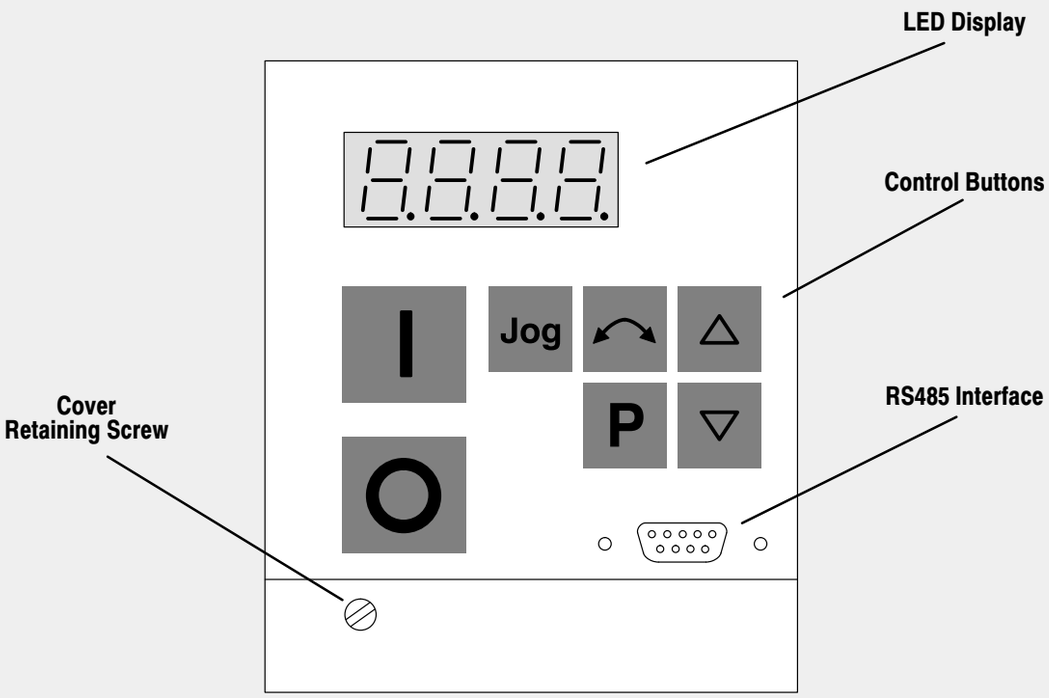



*Figure 10:* **Front Panel**

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# 4. OPERATING INFORMATION

Refer to the parameter list in section 5 for a full description of each parameter.

## 4.1 General

(1) The inverter does not have a main power switch and is therefore live when the mains supply is connected. It waits with the output disabled for the RUN button to be pressed or for an ON signal via terminal 8 (rotate right) or terminal 9 (rotate left) – *see parameters P051 – P055*.

(2) If output frequency (P001 = 0) is selected as the display, the corresponding setpoint is displayed approximately every 1.5 seconds while the inverter is stopped.

(3) The inverter is programmed at the factory for standard applications on Siemens four–pole standard motors. When using other motors it is necessary to enter the specifications from the motor's rating plate into parameters P081 to P085 *(see Figure 12)*. Note that access to these parameters is not possible unless P009 has been set to 002 or 003.

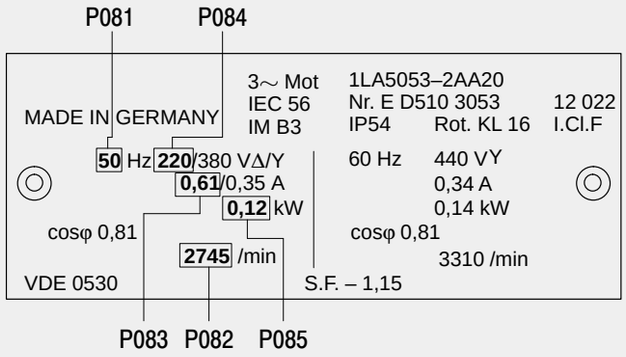



*Figure 12:* **Motor Rating Plate Example**

**Note:** Ensure that the motor is configured correctly, i.e. in the above example connection is for 220 V.

(4) When delivered, the inverter's frequency setpoint is set to 0.00 Hz, which means that the motor will not rotate! To make it start up, a setpoint must be entered using the △ button or entering a value in P005.

(5) When a parameter value has been set, it is stored automatically in the internal memory.

## 4.2 Basic Operation

The most basic method of setting up the inverter for use is described below. This method uses a digital frequency setpoint and requires only the minimum number of parameters to be changed from their default settings.

(1) Apply mains power to the inverter. Set parameter P009 to 002 or 003 to enable all parameters to be adjusted *(see Figure 11 for the procedure)*.

(2) Set parameter P005 to the desired frequency setpoint.

(3) Check parameters P081 to P085 and ensure that they match the requirements stated on the rating plate on the motor *(see Figure 12)*.

(4) Press the RUN button ( **I** ) on the inverter's front panel. The inverter will now drive the motor at the frequency set by P005.

If required, the motor's speed (i.e. frequency) can be varied directly by using the △ ▽ buttons. (Set P011 to 001 to enable the new frequency setting to be retained in memory during periods when the inverter is not running.)

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# 6. FAULT CODES

In the event of a failure, the inverter switches off and an error code appears on the display. The last error that occurred is stored in parameter P930. e.g. '0004' indicates that the last error was F004.

| Fault Code | Cause | Corrective Action |
|---|---|---|
| **F001** | Overvoltage | Check whether supply voltage is within the limits indicated on the rating plate.<br>Increase the ramp down time (P003) or apply braking resistor (option).<br>Check whether the required braking power is within the specified limits. |
| **F002** | Overcurrent | Check whether the motor power corresponds to the inverter power.<br>Check motor lead and motor for short–circuits and earth faults.<br>Check whether the motor parameters (P081 – P086) correspond with the motor being used.<br>Increase the ramp–up time (P002).<br>Reduce the boost set in P078 and P079.<br>Check whether the motor is obstructed or overloaded. |
| **F003** | Overload | Check whether the motor is overloaded.<br>Increase the maximum motor frequency if a motor with high slip is used. |
| **F004** | Overheating of motor (monitoring with PTC) | Check whether the motor is overloaded.<br>Check the connections to the PTC.<br>Check that P087 has not been set to '1' without a PTC being connected. |
| **F005** | Inverter overtemperature | Check that the ambient temperature is not too high.<br>Check that the air inlet and outlet are not obstructed. |
| **F006** | Mains phase missing (3–phase units only) | Check the mains supply and rectify. |
| **F008** | USS protocol timeout | Check the serial interface.<br>Check the settings of the bus master and P091 – P093.<br>Check whether the timeout interval is too short (P093). |
| **F009** | Undervoltage | Check the supply voltage. |
| **F010** | Initialisation fault | Check the entire parameter set. Set P009 to '0000' before power down. |
| **F011** | Internal interface fault | Switch off power and switch on again. |
| **F013** | Programme fault | Switch off power and switch on again. |
| **F106** | Parameter fault P006 | Parameterise fixed frequency(ies) and/or motor potentiometer on the digital inputs. |
| **F112** | Parameter fault P012 | Set parameter P012 < P013. |
| **F151 – F154** | Digital input parameter fault | Change the settings of digital inputs P052 to P055. |

When the fault has been corrected the inverter can be reset. To do this press button **P** twice (once to display P000 and the second time to reset the fault), or erase the fault via a binary input *(see parameters P051 – P055 in section 5)*.



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# 7. SPECIFICATIONS AND SUPPLEMENTARY INFORMATION

## 7.1 Specifications

| Single Phase MICRO MASTER Inverters | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Inverter model | | MM25 | MM37 | MM55 | MM75 | MM110 | MM150 | MM220 |
| Input voltage range | | 1 AC 230 V +/–15% | | | | | | |
| Motor output rating [1] | | 250 W | 370 W | 550 W | 750 W | 1.1 kW | 1.5 kW | 2.2 kW |
| Continuous output | | 660 VA | 880 VA | 1.14 kVA | 1.5 kVA | 2.1 kVA | 2.8 kVA | 4.0 kVA |
| Output current (nom.) | | 1.5 A | 2.0 A | 2.6 A | 3.4 A | 4.8 A | 6.4 A | 9.0 A |
| Output current (max. continuous) | | 1.6 A | 2.3 A | 3.3 A | 3.9 A | 5.5 A | 7.1 A | 10.4 A |
| Input current | | 3.0 A | 3.8 A | 5.5 A | 6.5 A | 14.0 A | 18.0 A | 20.0 A |
| Recommended mains fuse | | 10 A | | | 16 A | 20 A | | 25 A |
| Recommended lead cross-section (min.) | Input | 1.0 $mm^2$ | | | 1.5 $mm^2$ | 2.5 $mm^2$ | | |
| | Output | 1.0 $mm^2$ | | | | 1.5 $mm^2$ | | |
| Dimensions (mm) (w x h x d) | | 112 x 182 x 113 | | | | 149 x 184 x 157 | | 185 x 215 x 195 |
| Weight | | 1.9 kg | | | | 2.6 kg | | 5.0 kg |

| 230 V Three Phase MICRO MASTER Inverters | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Inverter model | | MM25/2 | MM37/2 | MM55/2 | MM75/2 | MM110/2 | MM150/2 | MM220/2 | MM300/2 |
| Input voltage range | | 3 AC 230 V +/–15% | | | | | | | |
| Motor output rating [1] | | 250 W | 370 W | 550 W | 750 W | 1.1 kW | 1.5 kW | 2.2 kW | 3.0 kW |
| Continuous output | | 660 VA | 880 VA | 1.14 kVA | 1.5 kVA | 2.1 kVA | 2.8 kVA | 4.0 kVA | 5.2 kVA |
| Output current (nom.) | | 1.5 A | 2.0 A | 2.6 A | 3.4 A | 4.8 A | 6.4 A | 9.0 A | 11.8 A |
| Output current (max. continuous) | | 1.6 A | 2.3 A | 3.3 A | 3.9 A | 5.5 A | 7.1 A | 10.4 A | 12.9 A |
| Input current | | 2.1 A | 3.0 A | 4.2 A | 5.0 A | 7.0 A | 9.5 A | 12.0 A | 14.5 A |
| Recommended mains fuse | | 10 A | | | | 16 A | | 20 A | |
| Recommended lead cross-section (min.) | Input | 1.0 $mm^2$ | | | | 1.5 $mm^2$ | | 2.5 $mm^2$ | |
| | Output | 1.0 $mm^2$ | | | | 1.5 $mm^2$ | | | 2.5 $mm^2$ |
| Dimensions (mm) (w x h x d) | | 112 x 182 x 113 | | | | 149 x 184 x 142 | | 185 x 215 x 162 | |
| Weight | | 1.8 kg | | | | 2.4 kg | | 4.5 kg | |

| 400 V – 500 V Three Phase MICRO MASTER Inverters | | | | | | |
|---|---|---|---|---|---|---|
| Inverter model | | MM150/3 | MM220/3 | MM300/3 | MM400/3 | MM550/3 |
| Input voltage range | | 3 AC 400 V – 500 V +/–10% | | | | |
| Motor output rating [1] | | 1.5 kW | 2.2 kW | 3.0 kW | 4.0 kW | 5.5 kW |
| Continuous output | | 2.8 kVA | 4.0 kVA | 5.2 kVA | 7.0 kVA | 9.0 kVA |
| Output current (nom.) | | 3.7 A | 5.2 A | 6.8 A | 9.2 A | 11.8 A |
| Output current (max. continuous) | | 4.0 A | 5.9 A | 7.7 A | 10.2 A | 13.2 A |
| Input current | | 5.5 A | 7.5 A | 10.0 A | 12.5 A | 16.0 A |
| Recommended mains fuse | | 10 A | 16 A | | 20 A | |
| Recommended lead cross-section (min.) | Input | 1.0 $mm^2$ | 1.5 $mm^2$ | | 2.5 $mm^2$ | |
| | Output | 1.0 $mm^2$ | | | | 1.5 $mm^2$ |
| Dimensions (mm) (w x h x d) | | 185 x 215 x 195 | | | | |
| Weight | | 5.0 kg | | | | |

[1] *Siemens 4 pole–motor, 1LA5 series or equivalent.*

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