SIEMENS

MICROMASTER

Operating Instructions

Contents

English

Contents

Safety Instructions

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

⚠️⚡ WARNING

This equipment contains dangerous voltages and controls dangerous 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.

- MICROMASTERS operate at high voltages.

- Only permanently-wired input power connections are allowed. This equipment must be grounded (IEC 536 Class 1, NEC and other applicable standards).

- If a Residual Current-operated protective Device (RCD) is to be used, it must be an RCD type B.

- Machines with a three phase power supply, fitted with EMC filters, 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/L1, N/L2, L3.
    - the motor terminals U, V, W.

- 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.

    This equipment is capable of providing internal motor overload protection in accordance with UL508C section 42. Refer to P074. Motor overload protection can also be provided by using an external PTC. This applies to units at software issue (P922) 3.06 or greater only .

    This equipment is suitable for use in a circuit capable of delivering not more than 100,000 symmetrical amperes (rms), for a maximum voltage of 230/460V* when protected by a time delay fuse* (*See Section 7).

- This equipment must not be used as an 'emergency stop mechanism' *(see EN 60204, 9.2.5.4)*

- If motor thermal protection is required, then an external PTC must be used. (*Refer to Section 2.2.5.*)

- Lowering the fan tray on Frame Size C MICROMASTER exposes rotating parts. Power must be isolated prior to this operation.

⚠️ 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!

CE

European Low Voltage Directive

The MICROMASTER product range complies with the requirements of the Low Voltage Directive 73/23/EEC as amended by Directive 98/68/EEC. The units are certified for compliance with the following standards:

EN 60146-1-1   Semiconductor converters - General requirements and line commutated converters

EN 60204-1   Safety of machinery - Electrical equipment of machines

European Machinery Directive

The MICROMASTER inverter series does not fall under the scope of the Machinery Directive. However, the products have been fully evaluated for compliance with the essential Health & Safety requirements of the directive when used in a typical machine application. A Declaration of Incorporation is available on request.

European EMC Directive

When installed according to the recommendations described in this manual, the MICROMASTER fulfils all requirements of the EMC Directive as defined by the EMC Product Standard for Power Drive Systems EN61800-3.

Underwriters Laboratories

UL c UL

UL and CUL listed power conversion equipment 5B33 for use in a pollution degree 2 environment

ISO 9001

Siemens plc operates a quality management system, which complies with the requirements of ISO 9001.

1. OVERVIEW

The MICROMASTERS are a range of frequency inverters for controlling the speed of three phase AC motors. Various models are available, ranging from the compact 120 W single phase input MICROMASTER up to the 7.5 kW three phase input MICROMASTER.

The inverters are microprocessor-controlled and use state of the art IGBT technology for reliability and flexibility. A special pulse-width modulation method with selectable ultrasonic pulse frequency permits extremely quiet motor operation. Inverter and motor protection is provided by comprehensive protective functions.

For additional product information such as application examples, part numbers, operation with long cables etc, please refer to catalog DA64 or http://www.con.siemens.co.uk

Features:

- Easy to install, program and commission.

- Closed loop control using a Proportional, Integral (PI) control loop function.

- High starting torque with automatic starting boost.

- Remote control capability via RS485 serial link using the USS protocol with the ability to control up to 31 inverters.

- A comprehensive range of parameters is provided to enable the inverters to be configured for use in almost any application.

- Membrane-type front panel controls for simple operation.

- 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) Frequency setpoint using the keypad.

  (2) High resolution analogue setpoint (voltage input).

  (3) External potentiometer to control motor speed.

  (4) Fixed frequencies via binary inputs.

  (5) Serial interface (US protocol, PROFIBUS, CANbus)

- Built-in DC injection brake with special COMPOUND BRAKING.

- Integral EMC filter on single phase input inverters (MM12 - MM300, and three phase input inverters MM220/3F to MM750/3F

- Acceleration/deceleration times with programmable smoothing.

- Fully programmable single relay output incorporated.

- External Options connector for optional multi-language Clear Text Display (OPM2) optional PROFIBUS or CANbus module.

- Automatic recognition of 2, 4, 6 or 8-pole motors by software.

- Integral software-controlled cooling fan.

- Fast Current Limit (FCL) for reliable trip-free operation.

- Compact design and the ability to mount inverters side by side provides greater space saving.

1.1   Installation - General notes

Environmental Requirements

Ideal Installation

| Hazard	Notes
Temperature	Min. Operating = 0°C Max. Operating = 50°C (MMV)
Altitude	If the Inverter is to be installed at an altitude >1000m, derating will be required. (Refer to DA64 Catalogue)
Shock	Do not drop the inverter or expose to sudden shock.
Vibration	Do not install the inverter in an area where it is likely to be exposed to constant vibration.
Electro-Magnetic Radiation	Do not install the inverter near sources of electro-magnetic radiation.
Atmospheric Pollution	Do not install the inverter in an environment, which contains atmospheric pollutants such as dust, corrosive gases, etc.
Water	Take care to site the inverter away from potential water hazards, e.g. do not install the inverter beneath pipes that are subject to condensation. Avoid installing the inverter where excessive humidity and condensation may occur.
Overheating	Mount the inverter vertically to ensure optimum cooling. Additional ventilation may be required for horizontal mounting. Ensure that the inverter's air vents are not obstructed, including the air vent at the front of the unit, which should be at least 15mm from any obstruction Make sure that there is an adequate air-flow through the cabinet, as follows: 1. Using the formula below, calculate the air-flow required: Air-flow (m^3 / hr) = (Dissipated Watts / ΔT) x 3.1 2. If necessary, install cabinet cooling fan(s). **Note**: Dissipation (Watts) = 3-5% of inverter rating. ΔT = Allowable temperature rise within cabinet in °C. 3.1 = Specific heat of air at sea level.
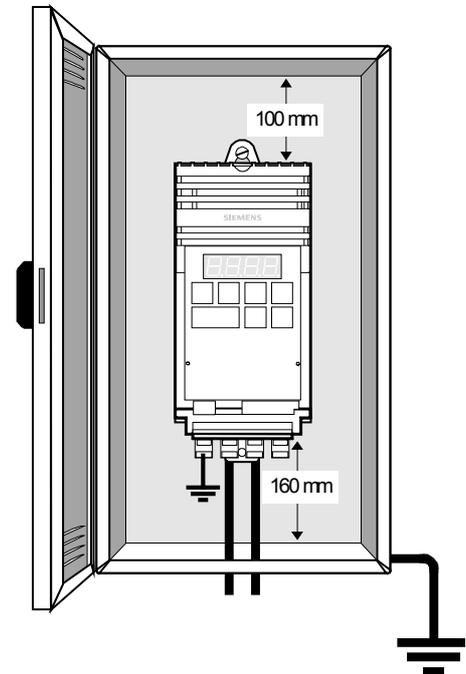
Figure 1.1

Note: The Plastic Material of the case can be degraded by oil or grease. Care should be taken to ensure that the mounting surface and fixings are thoroughly degreased before use.

1.2   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. *Figure 1.2.1- 3* illustrates how an RFI suppression filter should be installed.

(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. braids or 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)   Wherever possible, use screened leads for connections to the control circuitry. Terminate the ends of the cable neatly, ensuring that unscreened wires are as short as possible. Use cable glands whenever possible.

(3)   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° if possible.

(4)   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 relay on the inverter.

(5)   Use screened or armoured cables for the motor connections and ground the screen at both ends via the cable glands.

(6)   If the drive is to be operated in an Electromagnetically noisy environment, the RFI filter should be used to reduce the conducted and radiated interference from the inverter. For optimum performance, there should be a good conductive bond between filter and metal mounting plate.

(7)   For FSA units (*Fig 1.2.1*), the flat earth braid strap, supplied with the unit, should be fitted to minimise emissions .

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

CONTROL CABLE

MAINS POWER INPUT

FOOTPRINT FILTER

METAL BACK-PLATE

CONTROL CABLE

Fix motor and control cable screens securely to metal back plate using suitable clips.

30mm

EARTH BRAID

EARTH BRAID
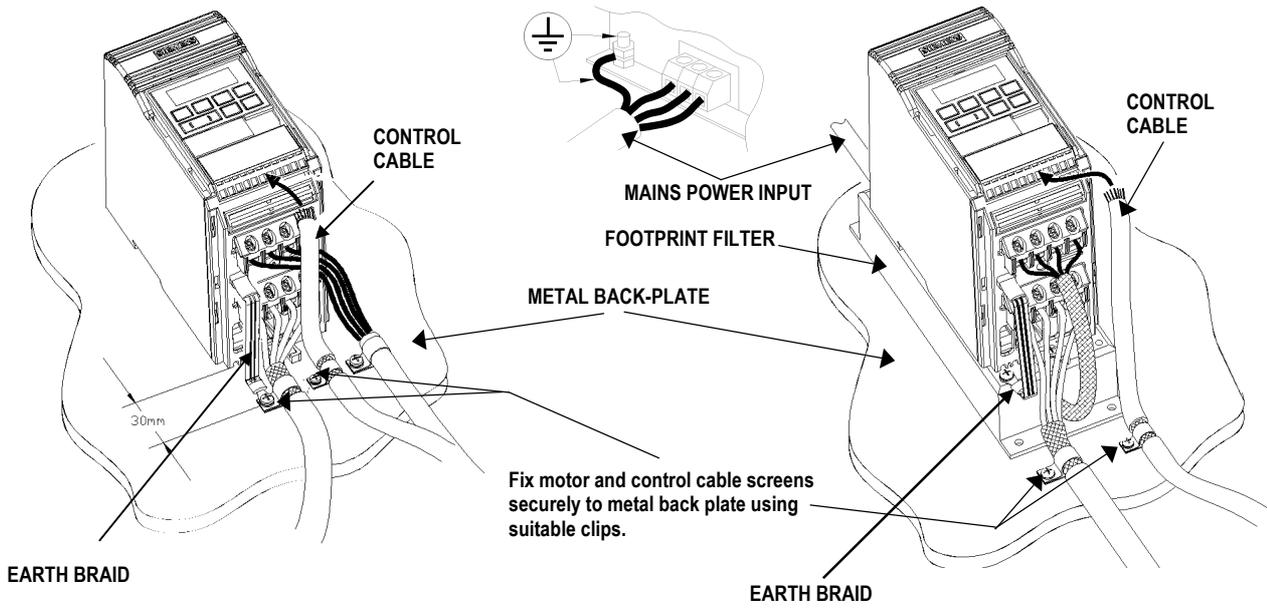
Figure 1.2.1: Wiring guidelines to minimise effects of EMI - MICROMASTER FSA

MAINS POWER INPUT

FOOTPRINT FILTER

METAL BACK-PLATE

CONTROL CABLE

Fix motor and control cable screen securely to metal back plate using suitable clips.
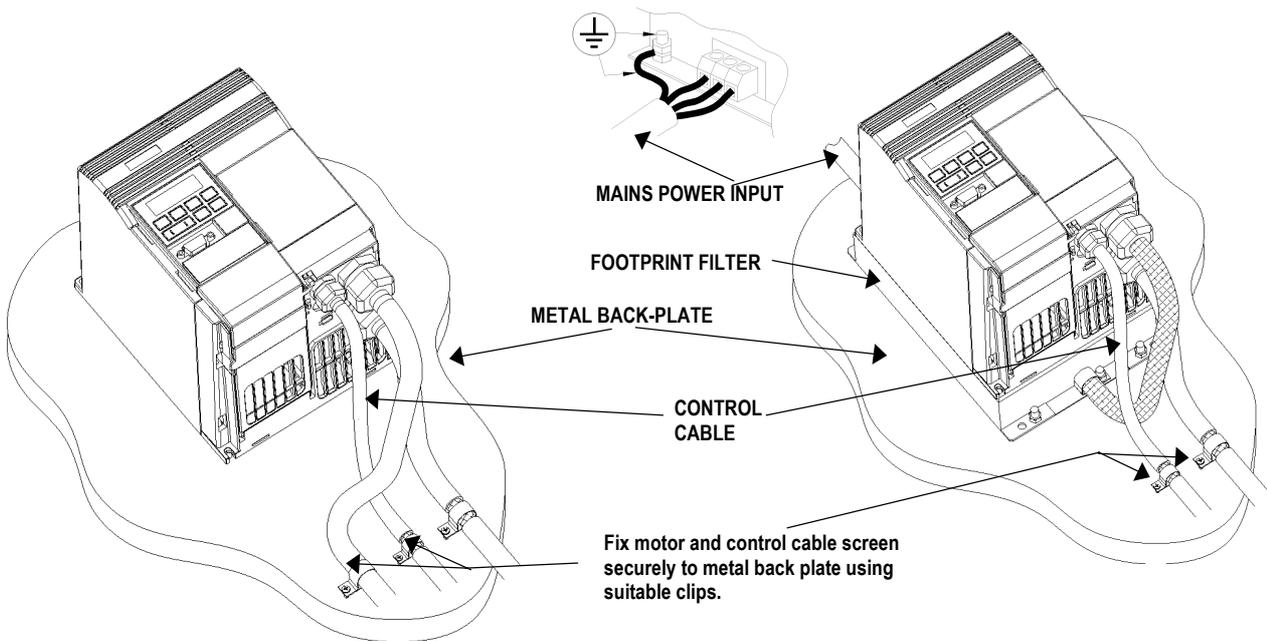
Figure 1.2.2: Wiring guidelines to minimise effects of EMI - MICROMASTER FSB

MAINS POWER INPUT

FOOTPRINT FILTER

METAL BACK-PLATE

Fix motor and control cable screen securely to metal back plate using suitable clips.

Figure 1.2.3: Wiring guidelines to minimise effects of EMI - MICROMASTER FSC

1.3 Electrical Installation - General Notes
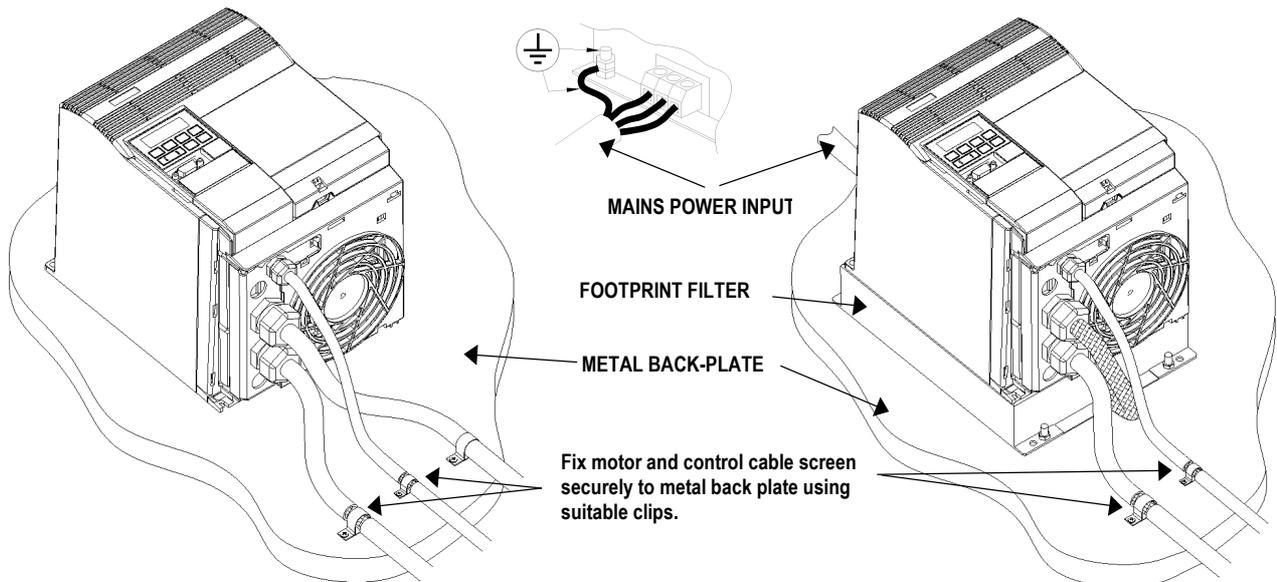
1.3.1 Operation with Unearthed (IT) Supplies

The MICROMASTER will operate from unearthed supplies and will continue to operate if an input phase is shorted to earth. If an output phase is shorted to earth, the MICROMASTER will trip and indicate F002.

1.3.2 Operation with Residual Current Device (RCD)

The MICROMASTER inverters will operate without nuisance tripping with an RCD (also called ELCBs or RCCBs) fitted to the input providing:

- A type B RCD is used.

- The trip limit of the RCD is 300mA.

- The neutral of the supply is earthed.

- Only one inverter is supplied from each RCD.

- The output cables are less than 50m (screened) or 100m (unscreened).

1.3.3 Installation after a Period of Storage

It is necessary to reform the capacitors in the inverter if the unit has been stored for a prolonged period.

- Period of storage 1 year old or less:

  No reforming is required.

- 1 - 2 years old:

  Apply power to the inverter one hour before giving the run command. (Preparation time 1 Hour)

- 2 - 3 years old:

  Use a variable AC supply. Apply 25% of input voltage for 30 minutes. Increase volts to 50% for a further 30 minutes. Increase volts to 75% for further 30 minutes. Increase volts to 100% for a further 30 minutes. Now ready for run signal. (Preparation Time 2 hours)

- 3 years and over:

  As with 2 - 3 years, but the steps should be 2 hours. (Preparation Time 8 Hours)

1.3.4 Operation with Long Cables

Motor cable lengths vary depending on type of cable, power rating and voltage rating - and in some cases can be as long as 200m without the need for additional chokes. Refer to DA64 catalogue for further details.

In any case, all inverters will operate at full specification with cable lengths up to 25m for screened cable or

50m for unscreened cables.

2. INSTALLATION

2.1 Mechanical Installation

⚠ **WARNING**

THIS EQUIPMENT MUST BE EARTHED.

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 dangerous voltage installations (e.g. VDE), as well as the relevant regulations regarding the correct use of tools and personal protective gear.

The mains input and motor terminals can carry dangerous voltages even if the inverter is inoperative. Use insulated screwdrivers only on these terminal blocks.

Tightening Torque
(with washers fitted)
2.5 Nm Frame size A and B
3.0 Nm Frame size C

∅ = 4.5 mm

2 bolts M4
2 nuts M4
2 washers M4

∅ = 4.8 mm (B)
∅ = 5.6 mm (C)

Frame size B:
4 bolts M4
4 nuts M4
4 washers M4

Frame size C:
4 bolts M5
4 nuts M5
4 washers M5

Frame Size A

Frame Sizes B and C
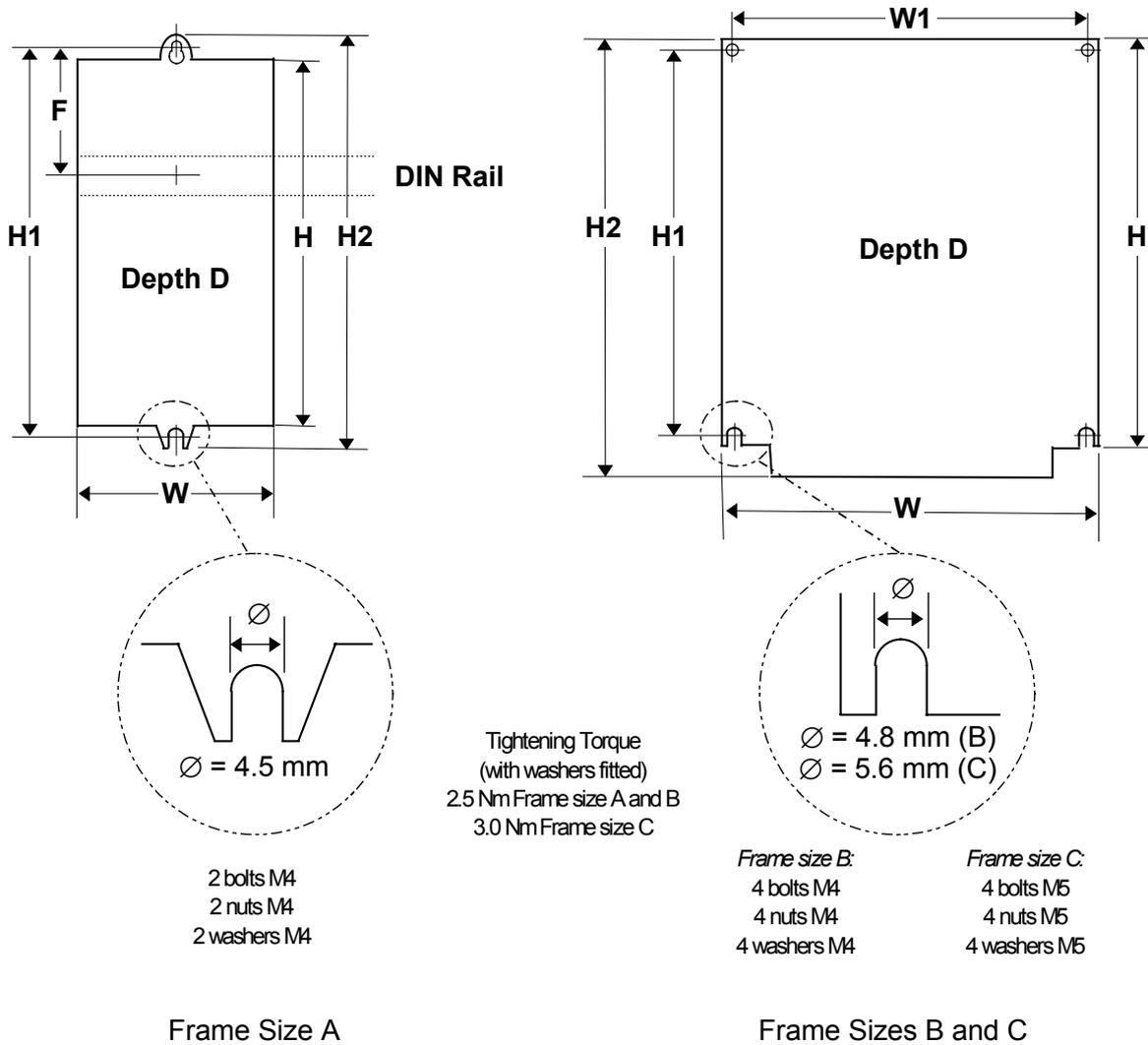
Model	MMxxx 1 AC 230 V Class A Filter	MMxxx/2 1/3 AC 230 V Without Filter	MMxxx/3 3 AC 380 - 500 V Without Filter	Frame Sizes (all measurements in mm)						
MM12	A	A	-							
MM25	A	A	-							
MM37	A	A	A		**H**	**W**	**D**	**H1**	**H2**	**W1**	**F**
MM55	A	A	A								
MM75	A	A	A	**A** =	147 x	73 x	141	160	175	-	55
MM110	B	B	A								
MM150	B	B	A	**B** =	184 x	149 x	172	174	184	138	-
MM220	C	C	B*								
MM300	C	C	B*	**C** =	215 x	185 x	195	204	232	174	-
MM400	-	C	C*								
MM550	-	-	C*								
MM750	-	-	C*								

* These units also available with built in filter e.g. MM220/3F

Figure 2.1.1: Mechanical Installation Diagram

2.2   Electrical Installation

Read the Wiring Guidelines given in section 1.2 before commencing installation.

The electrical connectors on the MICROMASTER are shown in Figure 2.2.1. Connect the cables to the power and control terminal blocks in accordance with the information supplied in sections 2.3.1 - 2.3.4. Ensure that the leads are connected correctly and the equipment is properly earthed as shown in Figure 2.2.1.

⚠️ # CAUTION

The control, power supply and motor leads <u>must</u> be laid separately. They must not be fed through the same cable conduit/trunking. High voltage insulation test equipment must not be used on cables connected to the inverter.

Use screened cable for the control lead. Use Class 1 60/75°C copper wire only (for UL compliance). Tightening torque for the power (mains input and motor) terminals is 1.1 Nm.
To tighten up the power/motor terminal screws use a 4 - 5 mm cross-tip screwdriver.

2.2.1   Power and Motor Connections - Frame Size A

Ensure that the power source supplies the correct voltage and is designed for the necessary current *(see section 7)*. Ensure that the appropriate circuit-breakers/fuses with the specified current rating are connected between the power supply and inverter *(see section 7)*.

Connect the power and motor connections as shown in Figure 2.2.1.

Fit the earth braid strap, supplied with the unit, between the PE faston connector and the mounting surface. Ensure there is a good electrical connection between the mounting surface and the earth strap.

⚠️ # WARNING

Isolate the mains electrical supply before making or changing connections to the unit.

Ensure that the motor is configured for the correct supply voltage. **Single/three phase 230 V MICROMASTERS must not be connected to a 400 V three phase supply.**

When synchronous machines are connected or when coupling several motors in parallel, the inverter must be operated with voltage/frequency control characteristic (P077= 0 or 2).

PE L/L1 N/L2 L3

PE U V W

Control Terminals

Mains Input Terminals

Motor Terminals

Asynchronous and synchronous motors can be connected to the MICROMASTER inverters either individually or in parallel.

Note: If a synchronous motor is connected to the inverter, the motor current may be two and a half to three times greater than that expected, so, the inverter must be de-rated accordingly.

L3
L2
L1
N

FUSE   CONTACTOR   FILTER (Class B only)   MICROMASTER   MOTOR

L   U   U
N   W   V
PE   W

SINGLE PHASE

L3
L2
L1

TYPICAL INSTALLATION

FUSES   CONTACTOR   FILTER   MICROMASTER   MOTOR
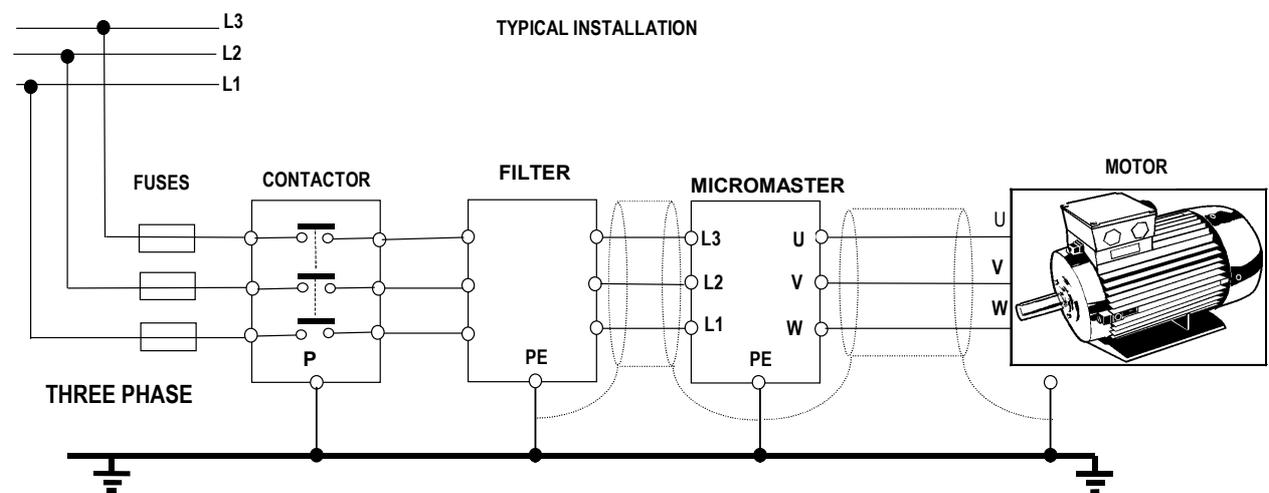
L3   U   U
L2   V   V
L1   W   W
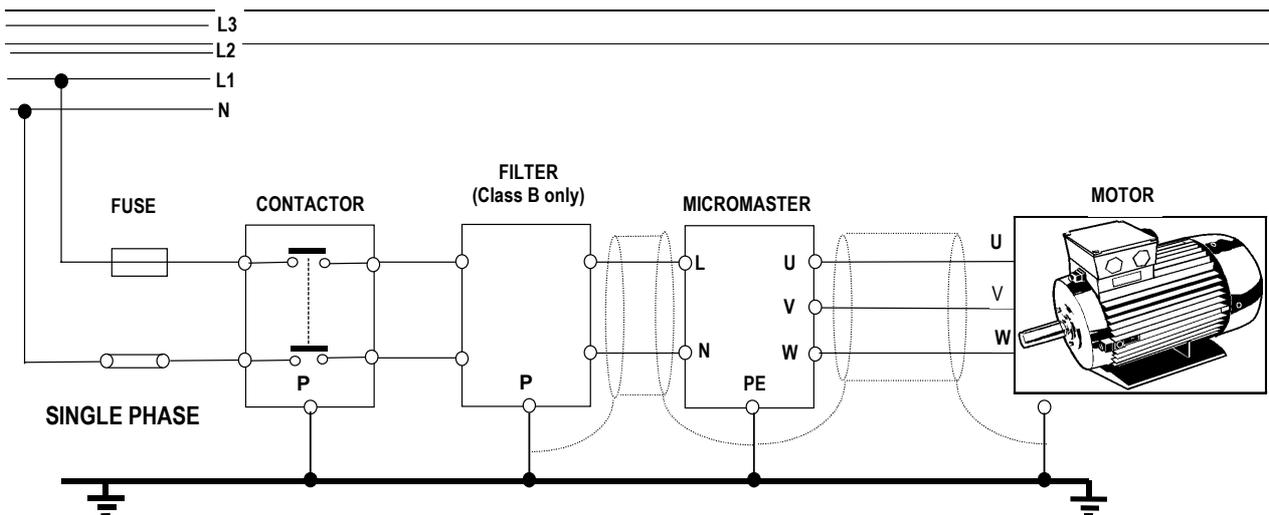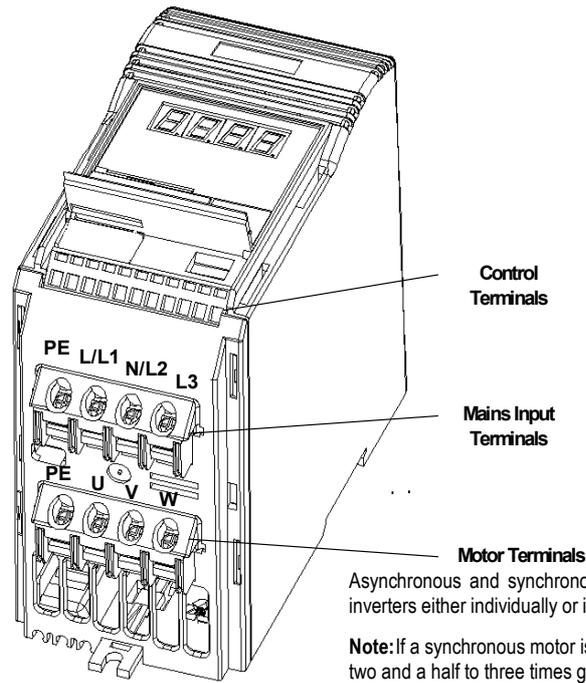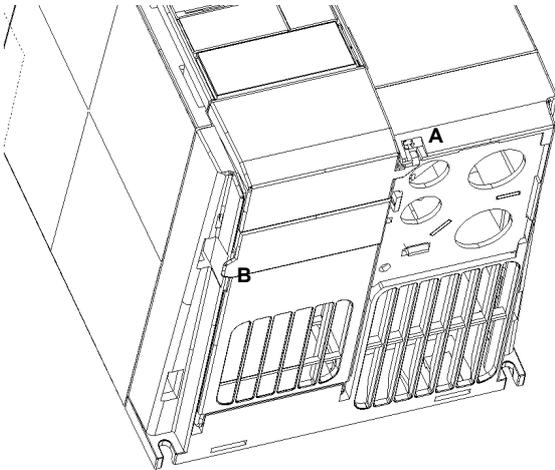PE   PE

THREE PHASE

Figure 2.2.1: Power Connections

### 2.2.2 Power and Motor Connections - Frame Size B

The terminal arrangement for frame size B is similar to frame size A *(see Figure 2.2.1)*.

Refer to Figure 2.2.2 and proceed as follows:

1. Insert the blade of a small screwdriver into slot A in the front of the inverter and press in the direction of the arrow. At the same time, press down on tab B at the side of the access panel.

Power Connections Access Diagram - Frame Size B
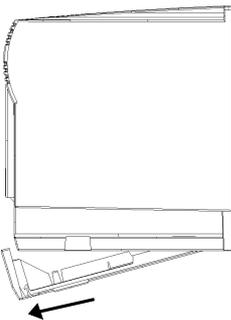
2. This will release the access panel, which will then swing down on its rear-mounted hinges.

    Note: The access panel can be removed from the inverter when at an angle of approximately 30° to the horizontal. If allowed to swing lower, the panel will remain attached to the inverter.

Removal of Terminal Cover- Frame Size B
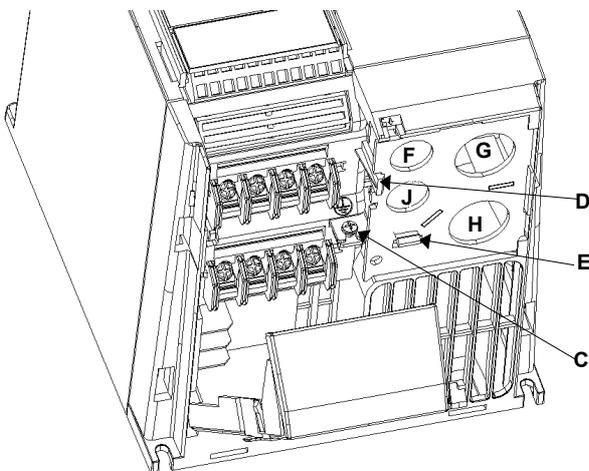
3. Remove the earthing screw C from the gland plate.
4. Press both release catches D and E to release the gland plate and then remove the metal gland plate from the inverter.

F: Control cable input
G: Mains cable input
H: Motor cable output
J: Braking resistor/ DC link cable input

Removal of Gland Plate- Frame Size B

Figure 2.2.2

5. Ensure that the power source supplies the correct voltage and is designed for the necessary current *(see section 7)*. Ensure that the appropriate circuit-breakers with the specified current rating are connected between the power supply and inverter *(see section 7)*.

6. For the power input, use a 3-core cable for single phase units or a 4-core cable for three phase units. For the cross-section of each core see section 7.

7. Use a 4-core screened cable to connect the motor.

8. Carefully measure and cut the cable leads for power connections, motor connections and braking resistor connections (if required) before feeding the screened cables through the glands in the metal gland plate provided (see Figure 2.2.2) and securing the glands.

9. Carefully measure and cut the cable leads for the control connections (if required). Feed the control cable through the correct gland (see Figure 2.2.2) and secure the gland to the metal gland-plate.

10. Carefully feed the power and control leads through the correct holes in the inverter housing.

11. Secure the metal gland plate to the underside of the inverter. Fit and tighten the earth securing screw.

12. Connect the power input leads to the power terminals L/L1 - N/L2 (1 phase) or L/L1, N/L2, L3 (3 phase), and earth (PE) *(shown in Figure 2.2.2)* and torque down the screws.

13. Connect the motor leads to the motor terminals U, V, W and the earth (PE) *(shown in Figure 2.2.2)* and torque down the screws.

    Note: For operation with cables longer than 25m see section 1.3.

14. If required, secure Faston connectors to the braking resistor leads and fit the connectors to the B+/DC+ and B- terminals under the inverter.

15. Connect the control leads as shown in Figures 2.2.4 and 2.2.6, Section 2.2.4 and 2.2.6.

2.2.3   *Power and Motor Connections - Frame Size C*

The terminal arrangement for frame size C is identical to frame size A *(see Figure 2.2.1)*. However, before the wires can be connected to the terminal blocks, you must lower the fan housing and secure the cables to the gland plate.

Refer to Figure 2.2.3 and proceed as follows:

1. While supporting the fan housing with one hand, insert the blade of a screwdriver into slot A on the underside of the inverter and press upwards to release the securing tab. Lower the fan housing, allowing it to swing out to the right on its side-mounted hinges.

2. Applying pressure to the gland plate release clips B and C in the direction of the arrows. Swing the plate out to the left on its side-mounted hinges,

3. Secure each cable to the correct hole in the gland plate, ensuring that the exposed wires are long enough to reach the terminal blocks.

4. Connect the wires to the terminal blocks as shown in Figure 2.2.1 (See section 2.2.4 for information about connecting the control wires.) IT IS MOST IMPORTANT THAT THE MOTOR AND CONTROL WIRES ARE KEPT APART.

5. Swing the gland plate back into the base of the inverter. Ensure that the release clips snap into position.

6. Swing the fan housing back into the base of the inverter.

A: Fan housing opening tab
B & C: Gland plate release tabs
D: Control cable input
E: Mains cable input
F: Motor cable input
G: Braking resistor/ DC link cable input

H: Fan connector
J: Fan Housing removal tab

To remove fan housing and fan disconnect fan connector 'H', release tab 'J' in direction shown and remove fan and housing in same direction.
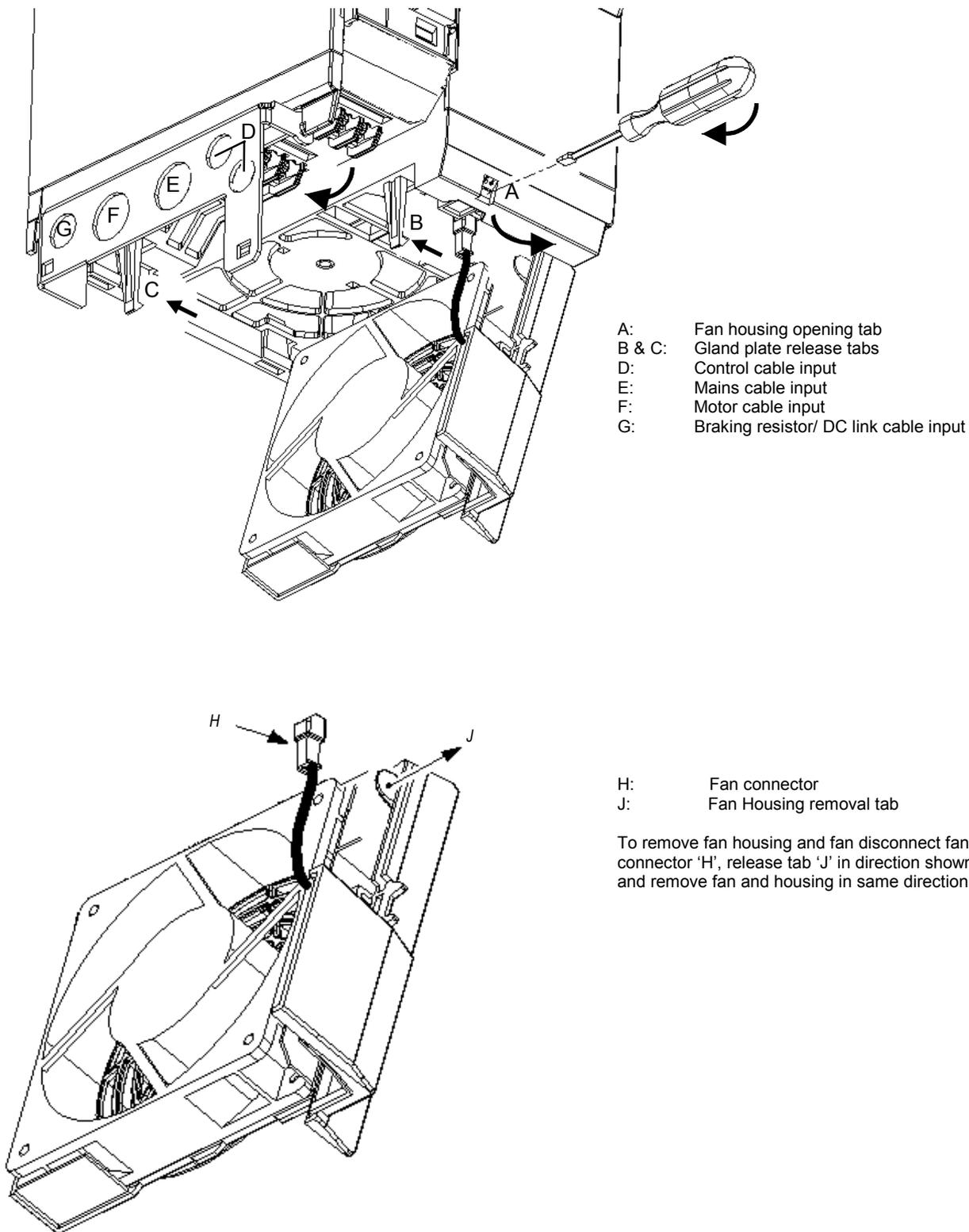
Figure 2.2.3: Power Connections Access Diagram - Frame Size C

2.2.4   *Control Connections*
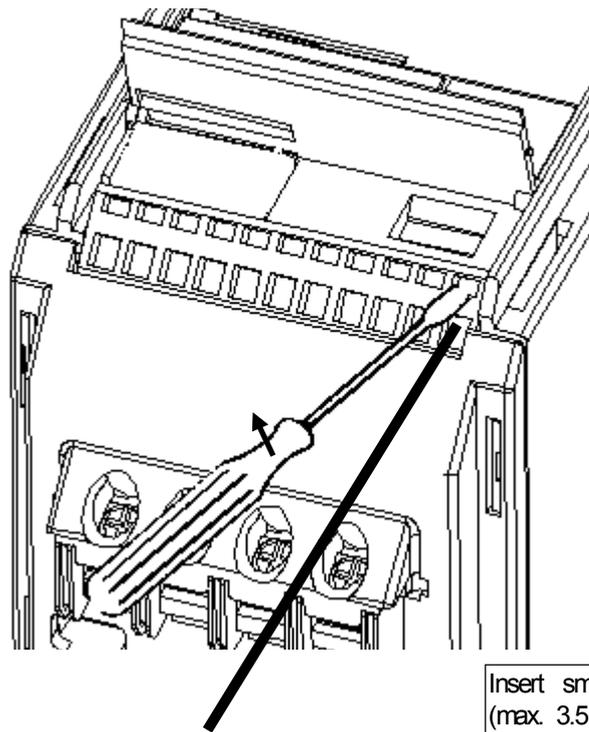
Insert small blade screwdriver (max. 3.5 mm) as shown while inserting control wire from below.

Output Relay
(normally open)
max. 0.4 A / 110 V AC
1 A / 30 V DC
(resistive rating)

P10+	0V	AIN+	AIN-	DIN1	DIN2	DIN3	P15+	0V		
1	2	3	4	5	6	7	8	9	10	11

RL1B   RL1C
(NO)   (COM)

Power Supply
(+10 V, max. 10 mA)

Analogue Input
(0/2 - 10 V)
(input impedance = 70 kΩ)

Digital Inputs
(7.5 - 33 V, max. 5 mA)

Power Supply
for
PI Feedback
Transducer or other
load
(+15 V, max. 50 mA)

Control Terminal Block

Front Panel
RS485 D-type

0V   P+
N-   5V
(max. 250 mA)

Figure 2.2.4: Control Connections

2.2.5.   External Motor Thermal Overload Protection

When operated below rated speed, the cooling effect of fans fitted to the motor shaft is reduced. Consequentially, most motors require de-rating for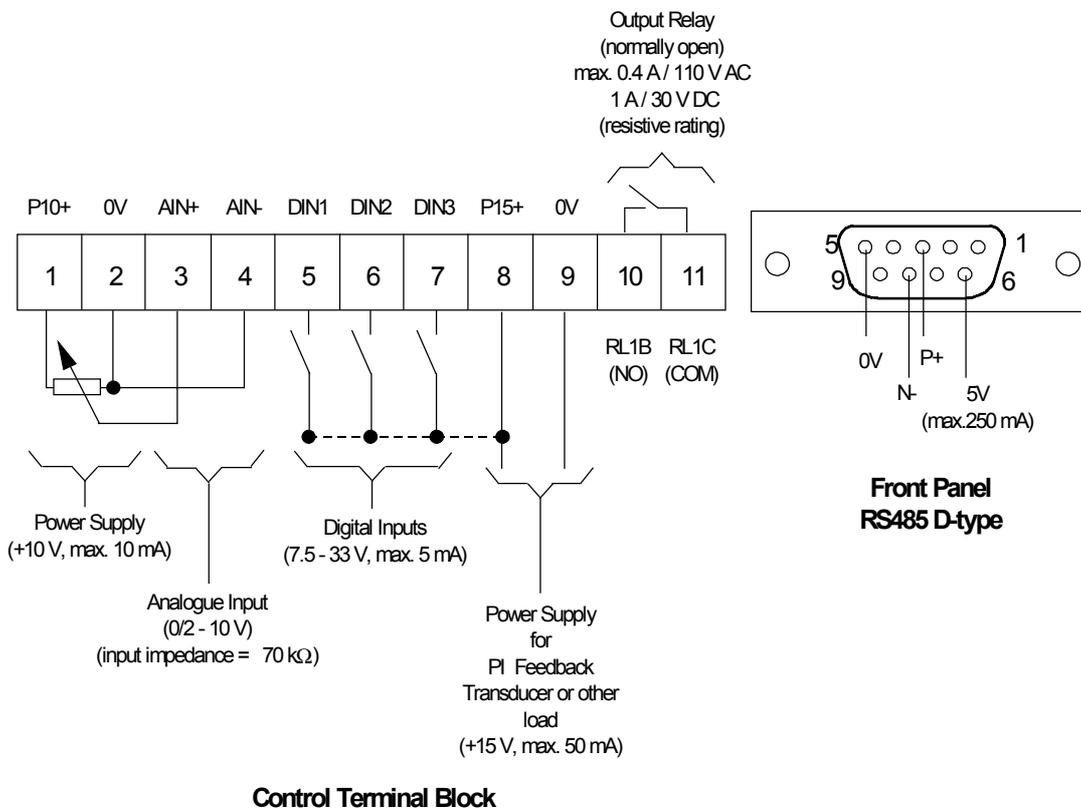 continuous operation at low frequencies. To ensure that motors are protected against overheating under these conditions, a PTC temperature sensor must be fitted to the motor and connected to the inverter control terminals as shown in Figure 2.2.5.

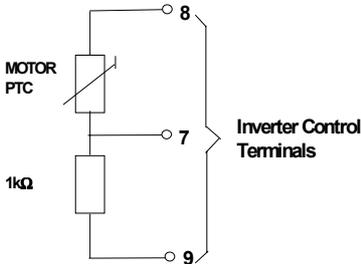**Note:**   To enable the trip function, set parameter P051, P052 or P053 =19.

Figure 2.2.5: Motor Overload PTC Connection
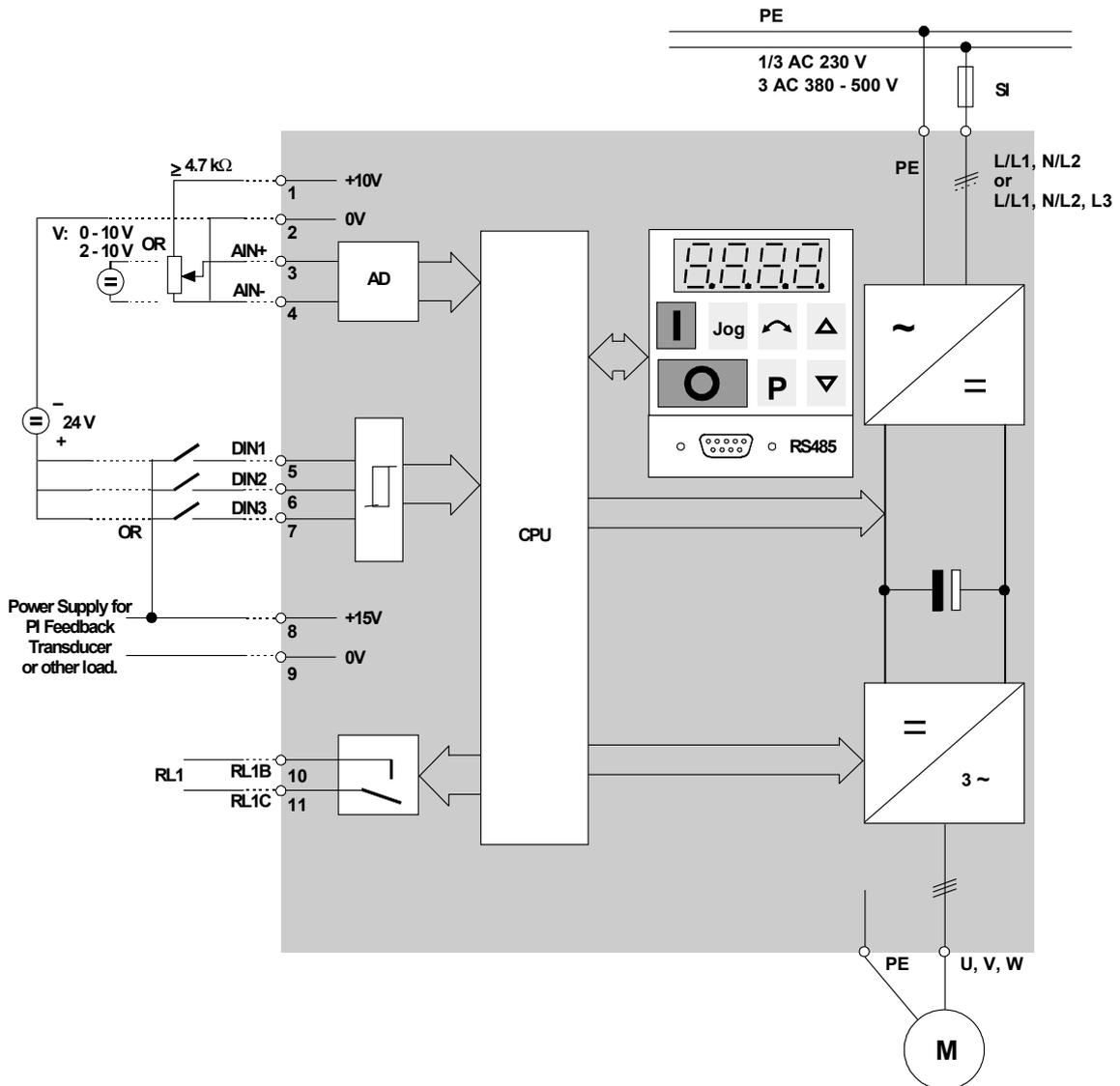
2.2.6   Block Diagram

Figure 2.2.6: Block Diagram

3. FRONT PANEL CONTROLS & BASIC OPERATION

3.1   Front Panel Controls

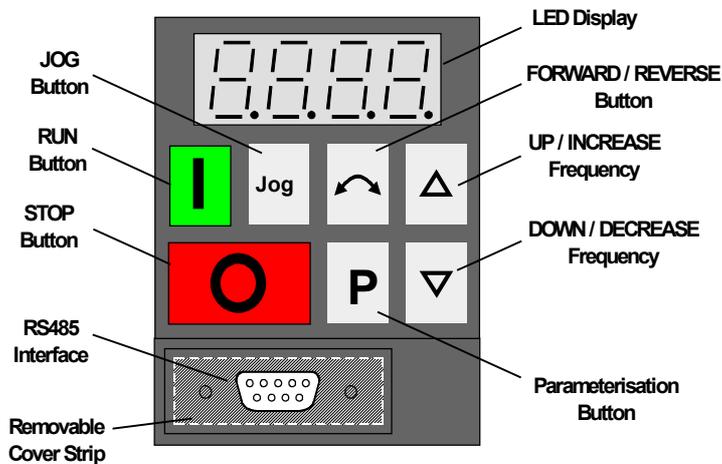| ⚠	# CAUTION
	The digital frequency setpoint has been set at 5.00 Hz in the factory. This means that, it is not necessary to enter a frequency setpoint via the Δ button or parameter P005 in order to test that the motor turns following a RUN command.
	All settings must only be entered by qualified personnel, paying particular attention to the safety precautions and warnings.

The parameter settings required can be entered using the three parameterisation buttons (**P**, Δ and ∇) on the front panel of the inverter. The parameter numbers and values are indicated on the four digit LED display.

Jog	Pressing this button while the inverter is stopped causes it to start and run at the preset jog frequency. The inverter stops as soon as the button is released. Pressing this button while the inverter is running has no effect. Disabled if P123 = 0.
I	Press to start the inverter. Disabled if P121 = 0.
O	Press to stop the inverter. Press once for an OFF1 (see section 4.3). Press twice (or hold down) for an OFF2 (see section 4.3) to immediately remove voltage from the motor allowing the motor to coast to a halt without ramp-down.
LED Display	Displays frequency (default), parameter numbers or parameter values (when P is pressed) or fault codes.
↷	Press to change the direction of rotation of the motor. REVERSE is indicated by a minus sign (values < 100) or a flashing decimal point (values > 100). Disabled if P122 = 0
Δ	Press to INCREASE frequency. Used to change parameter numbers or values to higher settings during the parameterisation procedure. Disabled if P124 = 0.
∇	Press to DECREASE frequency. Used to change parameter numbers or values to lower settings during the parameterisation procedure. Disabled if P124 = 0.
P	Press to access parameters. Disabled if P051 - P053 = 14 when using digital inputs. Press and hold to access higher resolution for some parameters. See section 5

Figure 3.1: Front Panel

3.2   Basic Operation

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

3.2.1   General

(1) The inverter does not have a main power switch and is live when the mains supply is connected. It waits, with the output disabled, until the RUN button is pressed or for the presence of a digital ON signal at terminal 5 (rotate right) or terminal 6 (rotate left) - *see parameters P051 - P053*.

(2) If output frequency is selected to be displayed (P001 = 0), 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 3.2.1)*. **Note: Access to these parameters is not possible unless P009 has been set to 002 or 003.**
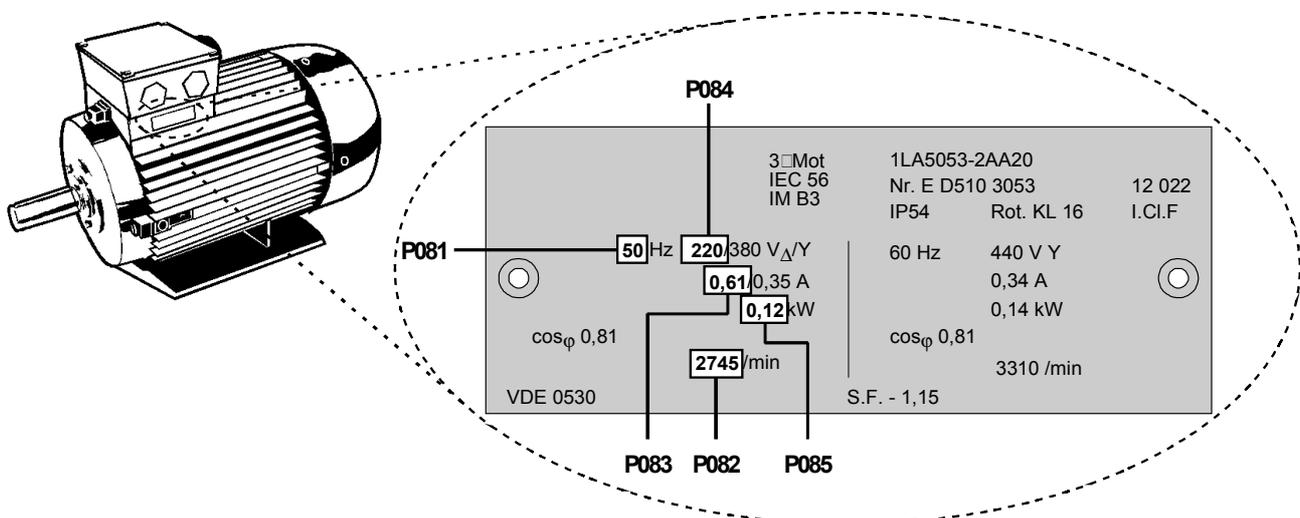
Figure 3.2.1: Typical Motor Rating Plate Example

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

3.2.2   Initial Testing

(1) Check that all cables have been connected correctly *(section 2)* and that all relevant product and plant/location safety precautions have been complied with.

(2) Apply mains power to the inverter.

(3) Ensure that it is safe to start the motor. Press the RUN button on the inverter. The display will change to **5.0** and the motor shaft will begin to turn. It will take one second for the inverter to ramp up to 5 Hz.

(4) Press the STOP button. The display will change to **0.0** and the motor slow to a complete stop within one second.

3.2.3   Basic Operation - 10 Step Guide

The 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. It assumes that a standard Siemens four-pole motor is connected to the inverter *(see section 3.2.1 if a different motor type is being used)*.

Step /Action	Button	Display
1. Apply mains power to the inverter. The display will alternate between the actual frequency (0.0 Hz) and the requested frequency setpoint (5.0 Hz default).		0.0 ↕ 5.0
2. Press the parameterisation button.	P	P000
3. Press the Δ button until parameter P005 is displayed.	Δ	P005
4. Press P to display the current frequency setpoint (5 Hz is the factory default setting).	P	005.0
5. Press the Δ button to set the desired frequency setpoint (e.g. 35 Hz).	Δ	035.0
6. Press P to lock the setting into memory.	P	P005
7, Press the ∇ button to return to P000.	∇	P000
8. Press P to exit the parameterisation procedure. The display will alternate between the current frequency and the requested frequency setpoint.	P	0.0 ↕ 35.0
9. Start the inverter by pressing the RUN button. The motor shaft will start to turn and the display will show that the inverter is ramping up to the setpoint of 35 Hz. **Note** The setpoint will be achieved after 7 seconds (35 Hz/50 Hz x 10 s *). If required, the motor speed (i.e. frequency) can be varied directly by using the Δ ∇ buttons. (Set P011 to 001 to enable the new frequency setting to be retained in memory during periods when the inverter is not running.)	I	0.0 ↓ 35.0
10. Switch the inverter off by pressing the STOP button. The motor will slow down and come to a controlled stop (takes 7 s **).	O	↓ 0.0

*   Default ramp-up time is 10 s to reach 50 Hz (defined by P002 and P013).
**   Default ramp-down time is 10 s from 50 Hz (defined by P003 and P013).

4. OPERATING MODES

4.1 Digital Control

For a basic startup configuration using digital control, proceed as follows:

(1) Connect control terminal 5 to terminal 8 via a simple on/off switch. This sets up the motor for clockwise rotation (default).

(2) Apply mains power to the inverter. Set parameter P009 to 002 or 003 to enable all parameters to be adjusted.

(3) Check that parameter P006 is set to 000 to specify digital setpoint.

(4) Set parameter P007 to 000 to specify digital input (i.e. DIN1 (terminal 5) in this case) and disable the front panel controls.

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

(6) Set parameters P081 to P085 in accordance with the rating plate on the motor *(see Figure 3.2.1)*.

Note: In many cases, when default factory parameters are used, the default stator resistance set in P089 will generally suit the default power rating set in P085. Should the inverter and motor ratings differ greatly, it is recommended that the stator resistance of the motor is measured and entered manually into P089. Continuous Boost (P078) and Starting Boost (P079) are dependent on the value of Stator Resistance - too high a value may cause overcurrent trips

(7) Set the external on/off switch to ON. The inverter will now drive the motor at the frequency set by P005.

4.2 Analogue Control

For a basic startup configuration using analogue voltage control, proceed as follows:

(1) Connect control terminal 5 to terminal 8 via a simple on/off switch. This sets up the motor for clockwise rotation (default).

(2) Connect a 4.7 kΩ potentiometer to the control terminals as shown in Figure 2.2.4 or connect pin 2 (0V) to pin 4 and a 0 - 10 V signal between pin 2 (0V) and pin 3 (AIN+).

(3) Apply mains power to the inverter. Set parameter P009 to 002 or 003 to enable all parameters to be adjusted.

(4) Set parameter P006 to 001 to specify analogue setpoint.

(5) Set parameter P007 to 000 to specify digital input (i.e. DIN1 (terminal 5) in this case) and disable the front panel controls.

(6) Set parameters P021 and P022 to specify the minimum and maximum output frequency settings.

(7) Set parameters P081 to P085 in accordance with the rating plate on the motor *(see Figure 3.2.1)*.

Note: In many cases, when default factory parameters are used, the default stator resistance set in P089 will generally suit the default power rating set in P085. Should the inverter and motor ratings differ greatly, it is recommended that the stator resistance of the motor is measured and entered manually into P089. Continuous Boost (P078) and Starting Boost (P079) are dependent on the value of Stator Resistance - too high a value may cause overcurrent trips

(8) Set the external on/off switch to ON. Turn the potentiometer (or adjust the analogue control voltage) until the desired frequency is displayed on the inverter.

4.3   Stopping the Motor

Stopping can be achieved in several ways:

- Cancelling the ON command or pressing the OFF button (**O**) on the front panel causes the inverter to ramp down at the selected ramp down rate *(see P003)*.
- OFF2 - operation causes the motor to coast to a standstill *(see parameters P051 to P053)*.
- OFF3 - operation causes rapid braking *(see parameters P051 to P053)*.
- DC injection braking up to 150% causes a rapid stop *(see P073)*.

4.4   If the Motor Does Not Start Up

If the display shows a fault code, refer to Section 6.

If the motor does not start up when the ON command has been given, check that the ON command is valid, check if a frequency setpoint has been entered in P005 and check that the motor specifications have been entered correctly under parameters P081 to P085.

If the inverter is configured for operation via the front panel (P007 = 001) and the motor does not start when the RUN button is pressed, check that P121 = 001 (RUN button enabled).

If the motor does not run after parameters have been changed accidentally, reset the inverter to the factory default parameter values by setting parameter **P944** to **001** and then pressing **P**.

4.5   Local and Remote Control

The inverter can be controlled either locally (default), or remotely via a USS data line connected to the RS485 D-type connector on the front panel. (Refer to parameter P910 in Section 5 for the available remote control options.)

When local control is used, the inverter can only be controlled via the front panel or the control terminals. Control commands, setpoints or parameter changes received via the RS485 interface have no effect.

When operating via remote control the inverter will not accept control commands from the terminals. *Exception: OFF2 or OFF3 can be activated via parameters P051 to P053 (refer to parameters P051 to P053 in Section 5).*

Several inverters can be connected to an external control unit at the same time. The inverters can be addressed individually.

For further information, refer to the following documents *(available from your local Siemens office)*:

E20125-B0001-S302-A1   Application of the USS Protocol in SIMOVERT Units 6SE21 and MICROMASTER (German)

E20125-B0001-S302-A1-7600   Application of the USS Protocol in SIMOVERT Units 6SE21 and MICROMASTER (English)

4.6 Closed Loop Control

4.6.1 General Description

The MICROMASTER provides a PI control function for closed loop control *(see Figure 4.6.1)*. PI control is ideal for temperature or pressure control, or other applications where the controlled variable changes slowly or where transient errors are not critical. This control loop is **not** suitable for use in systems where fast response times are required.

When closed loop PI control is enabled (P201 = 002), all setpoints are calibrated between zero and 100%, i.e. a setpoint of 50.0 = 50%. This allows general purpose control of any process variable that is actuated by motor speed and for which a suitable transducer is available.
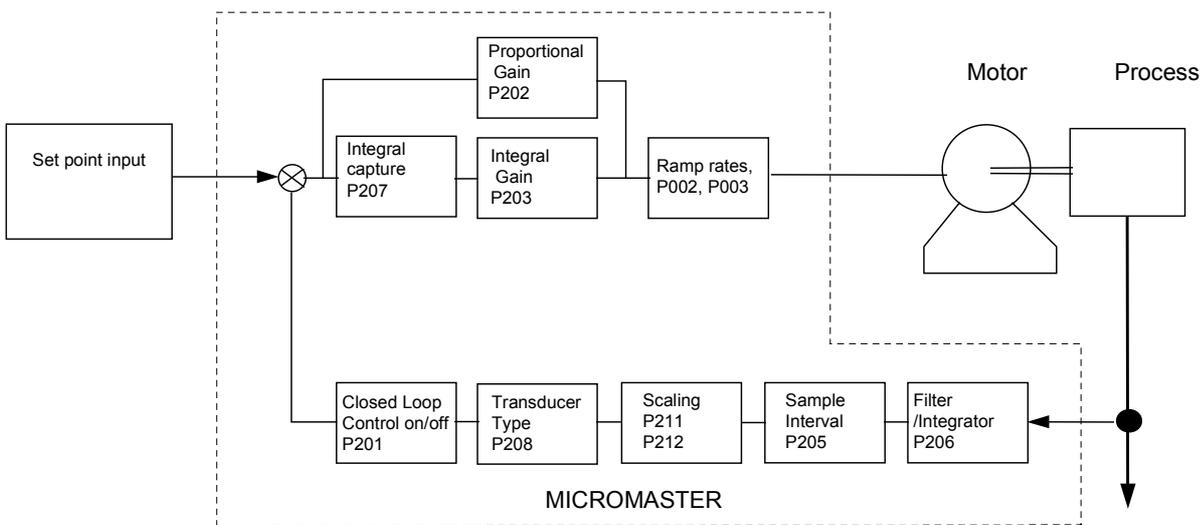
MICROMASTER Closed loop PI control - Block Diagram

Figure 4.6.1

4.6.2 Hardware Setup

Connect the outputs from the external feedback transducer to control terminals 3 and 4. This analogue input accepts a 0/2 - 10 V signal, has 10-bit resolution and permits a differential (floating) voltage. Ensure that the values of parameters P023 and P024 are set to 000 and that P006 is set to 000 or 002.

15 V dc/Max 50mA power for the feedback transducer can be supplied from terminals 8 and 9 on the control block.

4.6.3 Parameter Settings

Closed loop control cannot be used unless P201 is first set to 002. Most of the parameters associated with closed loop control are shown in Figure 4.6.1. Other parameters which are also associated with closed loop control are as follows:

P001 (value = 007)
P061 (value = 012 or 013)
P210
P220

Descriptions of all closed loop control parameters are provided in section 5. For further detailed information about PI operation refer to the application note "Closed Loop Control", which may be obtained from http://www.con.siemens.co.uk, or a Siemens sales office..

5. SYSTEM PARAMETERS

Parameters can be changed and set using the membrane-type buttons to adjust the desired properties of the inverter, such as ramp times, minimum and maximum frequencies etc. The parameter numbers selected and the setting of the parameter values are indicated in the four digit LED display.

Note: If you press the Δ or ∇ button momentarily, the values change step by step. If you keep the buttons pressed for a longer time, the values scroll through rapidly.

Access to parameters is determined by the value set in P009. Check that the key parameters necessary for your application have been programmed.

Note: In the following parameter table:

'•'   Indicates parameters that can be changed during operation.
'☆☆☆' Indicates that the value of this factory setting depends on the rating of the inverter.

Increased Parameter Resolution.

To increase the resolution to 0.01 when changing frequency parameters, instead of pressing P momentarily to return to the parameter display, keep the button pressed until the display changes to '- -.n0' (n = the current tenths value, e.g. if the parameter value = '055.8' then n = 8). Press Δ or ∇ to change the value (all values between .00 and .99 are valid) and then press P twice to return to the parameter display.

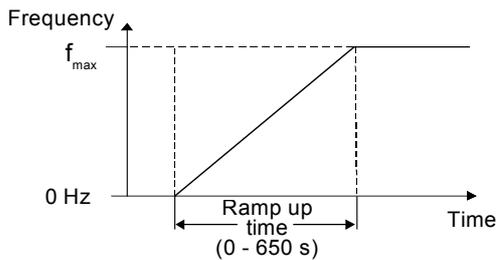**Resetting to Factory Defaults**

If parameters are changed accidentally, all parameters can be reset to their default values by setting parameter **P944** to **1** and then pressing **P**.

Parameter	Function	Range [Default]	Description / Notes
P000	Operating display	-	This displays the output selected in P001. In the event of a fault, the relevant fault code (Fxxx) is displayed *(see section 6)*. In the event of a warning the display flashes (See P931). If output frequency has been selected (P001 = 0) and the inverter is OFF, the display alternates between the setpoint frequency and zero.
P001 ●	Display mode	0 - 8 [0]	Display selection: **0** = Output frequency (Hz) **1** = Frequency setpoint (i.e. speed at which inverter is set to run) (Hz) **2** = Motor current (A) **3** = DC-link voltage (V) **4** = *Not used* **5** = Motor RPM **6** = USS status *(see section 8.2)* **7** = Closed loop control setpoint (% of full scale) **8** = Output voltage
P002 ●	Ramp up time (seconds)	0 - 650.0 [10.0]	This is the time taken for the motor to accelerate from standstill to the maximum frequency as set in P013. Setting the ramp up time too short can cause the inverter to trip (fault code F002 - overcurrent).
P003 ●	Ramp down time (seconds)	0 - 650.0 [10.0]	This is the time taken for the motor to decelerate from maximum frequency (P013) to standstill. Setting the ramp down time too short can cause the inverter to trip (fault code F001 - overvoltage). This is also the period for which DC injection braking is applied *(see P073)*

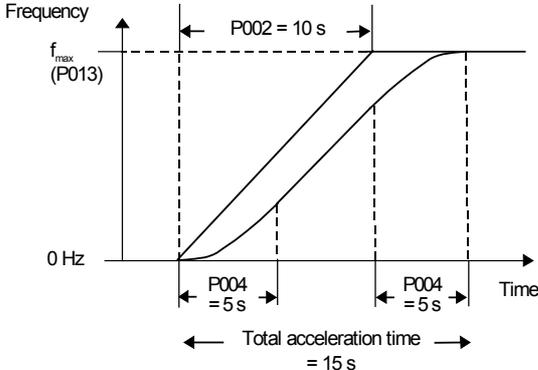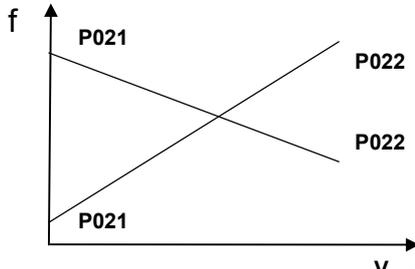| Parameter	Function	Range [Default]	Description / Notes
P004 ●	Smoothing Time (seconds)	0 - 40.0 [0.0]	Used to smooth the acceleration/deceleration of the motor (useful in applications where it is important to avoid 'jerking', e.g. conveyor systems, textiles, etc.). Smoothing is only effective if the ramp up/down time exceeds 0.3 s.

Note: The smoothing curve for deceleration is based on the ramp up gradient (P002) and is added to the ramp down time set by P003. Therefore, the ramp down time is affected by changes to P002.

Parameter	Function	Range [Default]	Description / Notes
P005 ●	Digital frequency setpoint (Hz)	0 - 400.00 [5.00]	Sets the frequency that the inverter will run at when operated in digital mode. Only effective if P006 set to '0'.
P006	Frequency setpoint source selection	0 - 2 [0]	Sets the control mode of the inverter. **0** = Digital. The inverter runs at the frequency set in P005. Alternatively, if P007 is set to zero, the frequency may be controlled by setting any two of binary inputs P051 - P053 to values of 11 and 12. **1** = Analogue. Control via analogue input signal. **2** = Fixed frequency or motor potentiometer. Fixed frequency is only selected if the value of at least one binary input (P051 - P053) = 6, 17 or 18. **Notes:** (1) If P006 = 1 and the inverter is set up for remote control operation, the analogue inputs remain active. (2) Motor potentiometer setpoints via digital inputs are stored when P011 = 1.
P007	Keypad control	0 - 1 [1]	**0** = Front panel buttons disabled (except STOP, Δ and ∇). Control is via digital inputs *(see parameters P051 - P053)*. Δ and ∇ may still be used to control frequency provided that P124 = 1 and a digital input has not been selected to perform this function. **1** = Front panel buttons enabled (can be individually disabled depending on the setting of parameters P121 - P124). **Note:** The digital inputs for RUN, REVERSE, JOG and increase/ decrease frequency are disabled.
P009 ●	Parameter protection setting	0 - 3 [0]	Determines which parameters can be adjusted: **0** = Only parameters from P001 to P009 can be read/set. **1** = Parameters from P001 to P009 can be set and all other parameters can only be read. **2** = All parameters can be read/set but P009 automatically resets to 0 when power is removed. **3** = All parameters can be read/set.

Parameter	Function	Range [Default]	Description / Notes
P011	Frequency setpoint memory	0 - 1 [0]	**0** = Disabled **1** = Enabled after switch-off. i.e. The setpoint alterations made with the Δ / ∇ buttons or digital inputs are stored even when power has been removed from the inverter.
P012 ●	Minimum motor frequency (Hz)	0 - 400.00 [0.00]	Sets the minimum motor frequency (must be less than the value of P013).
P013 ●	Maximum motor frequency (Hz)	0 - 400.00 [50.00]	Sets the maximum motor frequency.
P014 ●	Skip frequency 1 (Hz)	0 - 400.00 [0.00]	A skip frequency can be set with this parameter to avoid the effects of mechanical resonance. Frequencies within +/-(value of P019) of this setting are suppressed. Stationary operation is not possible within the suppressed frequency range - the range is just passed through.
P015 ●	Automatic restart after mains failure.	0 - 1 [0]	Setting this parameter to '1' enables the inverter to restart automatically after a mains break or 'brownout', provided the run/stop switch is still closed, P007 = 0 and P910 = 0, 2 or 4. **0** = Disabled **1** = Automatic restart
P016 ●	Start on the fly	0 - 2 [0]	Allows the inverter to start onto a spinning motor. Under normal circumstances the inverter runs the motor up from 0 Hz. However, if the motor is still spinning or is being driven by the load, it will undergo braking before running back up to the setpoint - this can cause an overcurrent trip. By using a flying restart, the inverter 'homes in' on the motor's speed and runs it up from that speed to the setpoint. **Note:** If the motor has stopped or is rotating slowly, some 'rocking' may occur as the inverter senses the direction of rotation prior to restarting. *(See also P020)* **0** = Normal restart **1** = Flying restart after power up, fault or OFF2 (if P018 = 1). **2** = Flying restart every time (useful in circumstances where the motor can be driven by the load).
P017 ●	Smoothing type	1 - 2 [1]	**1** = Continuous smoothing (as defined by P004). **2** = Discontinuous smoothing. This provides a fast unsmoothed response to STOP commands and requests to reduce frequency. **Note:** P004 must be set to a value > 0.0 for this parameter to have any effect.
P018 ●	Automatic restart after fault	0 - 1 [0]	Automatic restart after fault: **0** = Disabled **1** = The inverter will attempt to restart up to 5 times after a fault. If the fault is not cleared after the 5th attempt, the inverter will remain in the fault state until reset. **WARNING:** **While waiting to re-start, the display will flash. This means that a start is pending and may happen at any time. Fault codes can be observed in P930.**
P019 ●	Skip frequency bandwidth (Hz)	0 - 10.00 [2.00]	Frequencies set by P014, P027, P028 or P029 that are within +/- the value of P019 are suppressed.
P020	Flying start ramp time (seconds)	0.50 - 25.0 [5.0]	Used in conjunction with P016 (set longer times if persistent F002 trips occur).
P021 ●	Minimum analogue frequency (Hz)	0 - 400.00 [0.00]	Frequency corresponding to the lowest analogue input value, i.e. 0 V or 2 V. This can be set to a higher value than P022 to give an inverse relationship between analogue input and frequency output *(see diagram in P022).*

Parameter	Function	Range [Default]	Description / Notes
P022 ●	Maximum analogue frequency (Hz)	0 - 400.00 [50.00]	Frequency corresponding to the highest analogue input value, i.e. 10 V, determined by P023. This can be set to a lower value than P021 to give an inverse relationship between analogue input and frequency output. i.e. **Note:** The output frequency is limited by values entered for P012/P013.
P023 ●	Analogue input function	0 - 2 [0]	**0 =** 0 V to 10 V **1 =** 2 V to 10 V **2 =** 2 V* to 10 V * The inverter will come to a controlled stop if V < 1 V. **WARNING: With P023=2, the inverter will automatically start when V goes above 1 V. This equally applies to analogue and digital control (i.e. P006 = 0 or 1).**
P024 ●	Analogue setpoint addition	0 - 2 [0]	If the inverter is not in analogue mode (P006 = 0 or 2), setting this parameter to '1' causes the analogue input value to be added. **0 =** No addition. **1 =** Addition of the analogue setpoint (defined by P023) to the fixed frequency or the motor potentiometer frequency. **2 =** Scaling of digital/fixed setpoint by analogue input (P023) in the range 0 - 100%. **Note:** By selecting a combination of reversed negative fixed frequency settings and analogue setpoint addition, it is possible to configure the inverter for 'centre zero' operation with a +/-5 V supply or a 0 - 10 V potentiometer so that the output frequency can be 0 Hz at any position, including the centre position.
P027 ●	Skip frequency 2 (Hz)	0 - 400.00 [0.00]	*See P014.*
P028 ●	Skip frequency 3 (Hz)	0 - 400.00 [0.00]	*See P014.*
P029 ●	Skip frequency 4 (Hz)	0 - 400.00 [0.00]	*See P014.*
P031 ●	Jog frequency right (Hz)	0 - 400.00 [5.00]	Jogging is used to advance the motor by small amounts. It is controlled via the JOG button or with a non-latching switch on one of the digital inputs (P051 to P053). If jog right is enabled for one if these digital inputs (e.g. P051-53 = 7), or if the jog button is pressed, this parameter controls the frequency at which the inverter will run when the switch is closed. Unlike other setpoints, it can be set lower than the minimum frequency.
P032 ●	Jog frequency left (Hz)	0 - 400.00 [5.00]	If jog left is enabled (e.g. P051-53 = 8), this parameter controls the frequency at which the inverter will run when the switch is closed. Unlike other setpoints, it can be set lower than the minimum frequency.

Parameter	Function	Range [Default]	Description / Notes
P033 •	Jog Ramp-up time (seconds)	0 - 650.0 [10.0]	This is the time taken to accelerate from 0 Hz to maximum frequency (P013) for jog functions. It is **not** the time taken to accelerate from 0 Hz to the jog frequency.
			If one of the digital inputs is programmed to select jog ramp times (e.g. P051-53=16), the corresponding digital input can be used to select the ramp time set by this parameter instead of the normal Ramp-up time set by P002.
P034 •	Jog Ramp-down time (seconds)	0 - 650.0 [10.0]	This is the time taken to decelerate from maximum frequency (P013) to 0 Hz for jog functions. It is **not** the time taken to decelerate from the jog frequency to 0 Hz.
			If one of the digital inputs is programmed to select jog ramp times (e.g. P051-53, the corresponding digital input can be used to select the ramp time set by this parameter, instead of the normal Ramp-down time set by P003.
P041 •	Fixed frequency 1 (Hz)	0 - 400.00 [5.00]	Valid if P006 = 2 and P053 = 6 or 18, or P053-55=17
P042 •	Fixed frequency 2 (Hz)	0 - 400.00 [10.00]	Valid if P006 = 2 and P052 = 6 or 18, or P053-55=17
P043 •	Fixed frequency 3 (Hz)	0 - 400.00 [15.00]	Valid if P006 = 2 and P051 = 6 or 18, or P053-55=17
P044 •	Fixed frequency 4 (Hz)	0 - 400.00 [20.00]	Valid if P006 = 2 and P051 = P052 = P053 = 17.
P045	Inversion fixed setpoints for fixed frequencies 1 - 4	0 - 7 [0]	Sets the direction of rotation for the fixed frequency:

	FF 1	FF 2	FF 3	FF4
P045 = 0	⇒	⇒	⇒	⇒
P045 = 1	⇐	⇒	⇒	⇒
P045 = 2	⇒	⇐	⇒	⇒
P045 = 3	⇒	⇒	⇐	⇒
P045 = 4	⇒	⇒	⇒	⇐
P045 = 5	⇐	⇐	⇒	⇒
P045 = 6	⇐	⇐	⇐	⇒
P045 = 7	⇐	⇐	⇐	⇐

⇒ Fixed setpoints not inverted.
⇐ Fixed setpoints inverted.

Parameter	Function	Range [Default]	Description / Notes
P046 •	Fixed frequency 5 (Hz)	0 - 400.00 [25.00]	Valid if P006 = 2 and P051 = P052 = P053 = 17
P047 •	Fixed frequency 6 (Hz)	0 - 400.00 [30.00]	Valid if P006 = 2 and P051 = P052 = P053 = 17.
P048 •	Fixed frequency 7(Hz)	0 - 400.00 [35.00]	Valid if P006 = 2 and P051 = P052 = P053 = 17.
P050	Inversion fixed setpoints for fixed frequencies 5 - 7	0 - 7 [0]	Sets the direction of rotation for the fixed frequency:

	FF 5	FF 6	FF 7
P050 = 0	⇒	⇒	⇒
P050 = 1	⇐	⇒	⇒
P050 = 2	⇒	⇐	⇒
P050 = 3	⇒	⇒	⇐
P050 = 4	⇒	⇒	⇒
P050 = 5	⇐	⇐	⇒
P050 = 6 or 7	⇐	⇐	⇐

⇒ Fixed setpoints not inverted.
⇐ Fixed setpoints inverted.

Parameter	Function	Range [Default]	Description / Notes
P051	Selection control function, DIN1 (terminal 5), fixed frequency 3 or binary fixed frequency bit 0.	0 - 19 [1]	(see table below)
P052	Selection control function, DIN2 (terminal 6), fixed frequency 2. or binary fixed frequency bit 1.	0 - 19 [2]	
P053	Selection control function, DIN3 (terminal 7), fixed frequency 1 or binary fixed frequency bit 2.	0 - 19 [6]	

Value	Function of P051 to P053	Function, low state	Function, high state
0	Input disabled	-	-
1	ON right	Off	On right
2	ON left	Off	On left
3	Reverse	Normal	Reverse
4	OFF2 **	OFF2	On
5	OFF3 **	OFF3	On
6	Fixed frequencies 1 - 3	Off	On
7	Jog right	Off	Jog right
8	Jog left	Off	Jog left
9	Remote operation	Local	Remote
10	Fault code reset	Off	Reset on rising edge
11	Increase frequency *	Off	Increase
12	Decrease frequency *	Off	Decrease
13	Disable analogue input (setpoint is 0.0 Hz)	Analogue on	Analogue disabled
14	Disable the ability to change parameters	enabled	disabled
15	Enable dc brake	Off	Brake on
16	Use jog ramp times instead of normal ramp times	Normal	Jog ramp times
17	Binary fixed frequency control (fixed frequencies 1 - 7)	Off	On
18	As 6, but RUN signal not required *	Off	On
19	External trip/PTC	Yes (F012)	No

*   Only effective when P007 = 0.
**   *See section 4.3.*

Binary Coded Fixed Frequency Mapping
(P051, P052, P053 = 17)

	DIN3 (P053)	DIN2 (P052)	DIN1 (P051)
STOP	0	0	0
RUN to FF1 (P041)	0	0	1
RUN to FF2 (P042)	0	1	0
RUN to FF3 (P043)	0	1	1
RUN to FF4 (P044)	1	0	0
RUN to FF5 (P046)	1	0	1
RUN to FF6 (P047)	1	1	0
RUN to FF7 (P048)	1	1	1

Parameter	Function	Range [Default]	Description / Notes
P056	Digital input debounce time	0 - 2 [0]	**0** = 12.5 ms **1** = 7.5 ms **2** = 2.5 ms

Parameter	Function	Range [Default]	Description / Notes
P061	Selection relay output RL1	0 - 13 [6]	

Value	Relay function	Active [3]
0	No function assigned (relay not active)	Low
1	Inverter is running	High
2	Inverter frequency 0.0 Hz	Low
3	Motor run right has been selected	High
4	External brake on (see parameters P063/P064)	Low
5	Inverter greater than minimum frequency	High
6	Fault indication [1]	Low
7	Inverter frequency greater than or equal to setpoint	High
8	Warning active [2]	Low
9	Output current greater than or equal to P065	High
10	Motor current limit (warning) [2]	Low
11	Motor over temperature (warning) [2]	Low
12	Closed loop motor LOW speed limit	High
13	Closed loop motor HIGH speed limit	High

1 Inverter switches off *(see parameter P930 and section 6)*.
2 Inverter does not switch off *(see parameter P931)*.
3 'Active low' = relay OPEN. 'Active high' = relay CLOSED.

Note: If the external brake function is used (P061 or P062 = 4) and additional slip compensation is used (P071 $\neq$ 0), minimum frequency **must be less than 5 Hz** (P012 < 5.00), otherwise the inverter may not switch off.

Warning: **Relay operation is not defined during parameter changes and may change unpredictably. Ensure any equipment connected to the relays will remain safe if the relays change state during parameterisation.**

Parameter	Function	Range [Default]	Description / Notes
P062	Electro-mechanical brake option control	0 - 4 [0]	This operates in the same manner as the external brake control (described in P063/P064), except that the relay is not activated. 0 = Normal stop mode 1 - 3 = *Do not use* 4 = Combination stop mode
P063	External brake release delay (seconds)	0 - 20.0 [1.0]	Only effective if the relay output is set to control an external brake (P061 = 4). In this case when the inverter is switched on, it will run at the minimum frequency for the time set by this parameter before releasing the brake control relay and ramping *up (see illustration in P064)*.

Parameter	Function	Range [Default]	Description / Notes
P064	External brake stopping time (seconds)	0 - 20.0 [1.0]	As P063, only effective if the relay output is set to control an external brake. This defines the period for which the inverter continues to run at the minimum frequency after ramping down and while the external brake is applied.
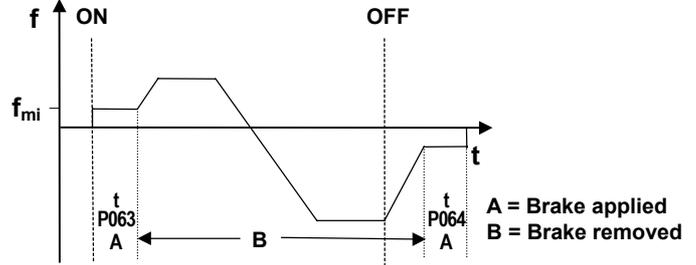
			Notes: (1) Settings for P063 and P064 should be slightly longer than the actual time taken for the external brake to apply and release respectively. (2) Setting P063 or P064 to too high a value, especially with P012 set to a high value, can cause an overcurrent warning or trip as the inverter attempts to move a locked motor shaft.
P065	Current threshold for relay (A)	0 - 99.9 [1.0]	This parameter is used when P061= 9. The relay switches on when the motor current is greater than the value of P065 and switches off when the current falls to 90% of the value of P065 (hysteresis).
P066	Compound braking	0 - 1 [1]	**0** = Off **1** = On. Permits faster ramp-down times and enhances stopping capability.
P073 ●	DC injection braking (%)	0 - 150 [0]	This stops the motor by applying a DC current. This causes heat to be generated in the motor rather than the inverter and holds the shaft stationary until the end of the braking period. Braking is effective for the period of time set by P003. The DC brake can be activated using DIN1 - DIN3 *(braking is active for as long as the DIN is high - see P051 - P053)*. **WARNING:** **Frequent use of long periods of dc injection braking can cause the motor to overheat.** **If DC injection braking is enabled via a digital input then DC current is applied for as long as the digital input is high. This causes heat in the motor.**

Parameter	Function	Range [Default]	Description / Notes
P074 ●	I^2t motor protection	0 - 7 [1]	Selects the most appropriate curve for the motor derating at low frequencies due to the reduced cooling effect of the shaft mounted cooling fan.

I_N = Nominal motor current (P083)
F_N = Nominal motor frequency (P081)
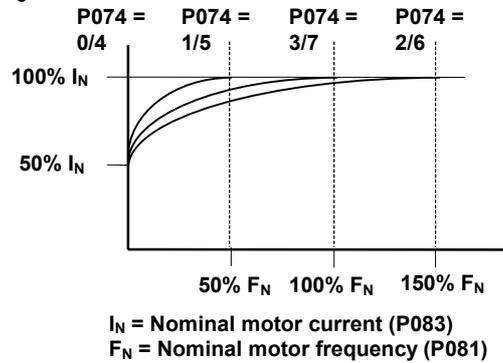
0 = No derating. Suitable for motors with separately powered cooling or no fan cooling which dissipate the same amount of heat regardless of speed.

1 = For 2 or 4-pole motors which generally have better cooling due to their higher speeds. The inverter assumes that the motor can dissipate full power at 50% nominal frequency.

2 = Suitable for special motors not continuously rated at nominal current at nominal frequency..

3 = For 6 or 8-pole motors. The inverter assumes that the motor can dissipate full power at 50% nominal frequency.

4 = As P074 = 0 but the inverter trips (F074) instead of reducing the motor torque / speed.

5 = As P074 = 1 but the inverter trips (F074) instead of reducing the motor torque / speed.

6 = As P074 = 2 but the inverter trips (F074) instead of reducing the motor torque / speed.

7 = As P074 = 3 but the inverter trips (F074) instead of reducing the motor torque / speed.

Note: I^2t motor protection is not recommended where the motor is less than half the power rating of the inverter.

WARNING: Where motor thermal protection is required, an external PTC must be used.

| **P076** ● | Pulse frequency | 0 - 7 [0 or 4] | Sets the pulse frequency (from 2 to 16 kHz) and the PWM mode. If silent operation is not absolutely necessary, the losses in the inverter as well as the RFI emissions can be reduced by selecting lower pulse frequencies. |

0/1 = 16 kHz (230 V default)
2/3 = 8 kHz
4/5 = 4 kHz (400 V default)
6/7 = 2 kHz

Note: When P076 = 0/1, the display of the current at frequencies below 10 Hz is less accurate.

400V inverters require the continuous current rating reduced for operation below 5Hz, when operating at switching frequencies greater than 4kHz and with boost values greater than 100% (P078 + P079). These are typically as follows:

Parameter	Function	Range [Default]	Description / Notes

Model	P076 =	
	0 or **1**	**2** or **3**
MM37/3- MM750/3	50%xP083	80%xP083
MM220/3F- MM750/3F	50%xP083	80%xP083

P077 — Control mode — 0 - 2 [1]

Controls the relationship between the speed of the motor and the voltage supplied by the inverter. One of two modes can be selected:

0/1 = Linear voltage/frequency
Use this curve for synchronous motors or motors connected in parallel.

2 = Quadratic voltage/frequency relationship
This is suitable for centrifugal pumps and fans.
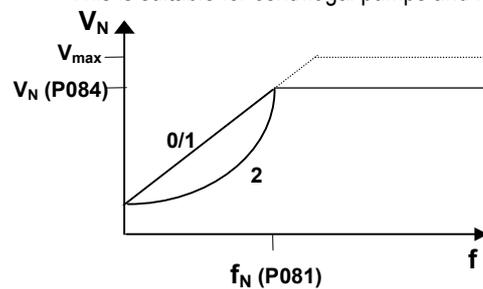
P078 ● — Continuous boost (%) — 0 - 250 [100]

Operates continuously over the whole frequency range.

For many applications it is necessary to increase low frequency torque. This parameter sets the start-up voltage at 0 Hz to adjust the available torque for low frequency operation. 100% setting will produce rated motor current at low frequencies.

WARNING: If P078 is set too high, overheating of the motor and/or an overcurrent trip (F002) can occur.

P079 ● — Starting boost (%) — 0 - 250 [0]

For drives which require a high initial starting torque, it is possible to set an additional current (added to the setting in P078) during ramping. This is only effective during initial start up and until the frequency setpoint is reached.

WARNING: This increase is in addition to P078, but the total is limited to 250%.

Parameter	Function	Range [Default]	Description / Notes
P081	Nominal frequency for motor (Hz)	0 - 400.00 [50.00]	
P082	Nominal speed for motor (RPM)	0 - 9999 [☆☆☆]	These parameters must be set for the motor used.
P083	Nominal current for motor (A)	0.1 - 99.9 [☆☆☆]	Read the specifications on the motor rating plate *(see section 3.2.1)*.
P084	Nominal voltage for motor (V)	0 - 1000 [☆☆☆]	**Note:** The inverter's default setting vary according to the power rating.
P085	Nominal power for motor (kW/hp)	0 - 100.0 [☆☆☆]	

Parameter	Function	Range [Default]	Description / Notes
P086 ●	Motor current limit (%)	0 - 250 [0]	Defines the motor overload current as a % of the Nominal motor current (P083) allowed for up to one minute. With this parameter the motor current can be limited and overheating of the motor prevented. If the value set in P083 is exceeded for one minute, (or longer if the overload is small) the output frequency is reduced until the current falls to that set in P083. The inverter display flashes as a warning indication but the inverter does not trip. The inverter can be made to trip using P074. **Note:** The maximum value that P086 can be set to is automatically limited by the rating of the inverter. **Note:** When P086 is set to 0, the current limit settings in P083 and P086 are inoperative, the inverter and motor are protected by a fixed internal limit . Additional overload protection is still offered by P074. **Note: If a value other than the default value of 0 is entered in P086, this must not be smaller than the sum of the values entered in parameters P078 and P079 (continuous and staring boost respectively). Any value lower than this sum will cause the inverter to go into current limitation.**
P089 ●	Stator resistance (Ω)	0.01- 100.00 [✫✫✫]	The stator resistance of the motor should be entered in this parameter. The value entered should be the resistance between any two phases with the motor connected. **The measurement should be made at the inverter output terminals with power off.** **Note:** If the value of P089 is too high then an overcurrent trip (F002) may occur.
P091 ●	Serial link slave address	0 - 30 [0]	Up to 31 inverters can be connected via the serial link and controlled by a computer or PLC using the USS protocol. This parameter sets a unique address for the inverter.
P092 ●	Serial link baud rate	3 - 7 [6]	Sets the baud rate of the RS485 serial interface (USS protocol): **3** = 1200 baud **4** = 2400 baud **5** = 4800 baud **6** = 9600 baud **7** = 19200 baud **Note:** Some RS232 to RS485 converters are not capable of baud rates higher than 4800.
P093 ●	Serial link timeout (seconds)	0 - 240 [0]	This is the maximum permissible period between two incoming data telegrams. This feature is used to turn off the inverter in the event of a communications failure. Timing starts after a valid data telegram has been received and if a further data telegram is not received within the specified time period, the inverter will trip and display fault code F008. Setting the value to zero switches off the control.
P094 ●	Serial link nominal system setpoint (Hz)	0 - 400.00 [50.00]	Setpoints are transmitted to the inverter via the serial link as percentages. The value entered in this parameter represents 100% (HSW = 4000H).
P095 ●	USS compatibility	0 - 2 [0]	**0** = Compatible with 0.1 Hz resolution **1** = Enable 0.01 Hz resolution **2** = HSW is not scaled but represents the actual frequency value to a resolution of 0.01 Hz (e.g. 5000 = 50 Hz).
P099 ●	Option module type	0 - 2 [0]	**0** = Option module not present **1** = PROFIBUS module (enables parameters relating to PROFIBUS) **2** = CANbus module (enables parameters relating to CANbus)

Parameter	Function	Range [Default]	Description / Notes
P101 ●	Operation for Europe or North America	0 - 1 [0]	This sets the inverter for European or North America supply and motor frequency: **0** = Europe (50 Hz) **1** = North America(60 Hz) **Note:** After setting P101 = 1 the inverter must be re-set to factory defaults. i.e. P944 = 1 to automatically set P013 = 60 Hz, P081 = 60 Hz, P082 = 1680 rpm and P085 will be displayed in hp.
P111	Inverter power rating (kW/hp)	0.0 - 50.00 [☆☆☆]	Read-only parameter that indicates the power rating of the inverter in kW. e.g. 0.55 = 550 W **Note:** If P101 = 1 then the rating is displayed in hp.
P112	Inverter type (model)	1 - 7 [☆☆☆]	Read-only parameter. **1** = MICROMASTER series 2 (MM2) **2** = COMBIMASTER **3** = MIDIMASTER **4** = MICROMASTER Junior (MMJ) **5** = MICROMASTER series 3 (MM3) **6** = MICROMASTER Vector (MMV) **7** = MIDIMASTER Vector (MDV) **8** = COMBIMASTER 2nd Generation.
P113	Inverter type (power rating)	0 - 29 [☆☆☆]	Read-only parameter. **0** = MM12 **10** = MM12/2 **20** = MM37/3 **1** = MM25 **11** = MM25/2 **21** = MM55/3 **2** = MM37 **12** = MM37/2 **22** = MM75/3 **3** = MM55 **13** = MM55/2 **23** = MM110/3 **4** = MM75 **14** = MM75/2 **24** = MM150/3 **5** = MM110 **15** = MM110/2 **25** = MM220/3 **6** = MM150 **16** = MM150/2 **26** = MM300/3 **7** = MM220 **17** = MM220/2 **27** = MM400/3 **8** = MM300 **18** = MM300/2 **28** = MM550/3 **19** = MM400/2 **29** = MM750/3
P121	Enable/disable RUN button	0 - 1 [1]	**0** = RUN button disabled. **1** = RUN button enabled (only possible if P007 = 1).
P122	Enable/disable FORWARD/REVERSE button	0 - 1 [1]	**0** = FORWARD/REVERSE button disabled. **1** = FORWARD/REVERSE button enabled (only possible if P007 = 1).
P123	Enable/disable JOG button	0 - 1 [1]	**0** = JOG button disabled. **1** = JOG button enabled (only possible if P007 = 1).
P124	Enable/disable Δ and ∇ buttons	0 - 1 [1]	**0** = Δ and ∇ buttons disabled. **1** = Δ and ∇ buttons enabled (only possible if P007 = 1). **Note:** This applies for frequency adjustment only. The buttons can still be used to change parameter values.
P125	Reverse direction inhibit	0 - 1 [1]	**0** = Reverse direction disabled. Inhibits reverse commands from ALL sources (reverse RUN commands result in forward rotation) **1** = Normal operation (FORWARD/REVERSE operation allowed)
P128	Fan switch-off delay time (seconds)	0 - 600 [120]	Time taken for the fan to switch off following an OFF command.
P131	Frequency setpoint (Hz)	0.00-400.00 [-]	
P132	Motor current (A)	0.0 - 99.9 [-]	
P134	DC link voltage (V)	0 - 1000 [-]	**Read-only parameters. These are copies of the values stored in P001 but can be accessed directly via the serial link.**
P135	Motor RPM	0 - 9999 [-]	
P137	Output voltage (V)	0 - 1000 [-]	

Parameter	Function	Range [Default]	Description / Notes
P139	Peak output current detect	0.0 - 99.9 [-]	Stores the peak current seen by the motor. Can be reset using Δ and ∇buttons.
P140	Most recent fault code	0 - 9999 [-]	Read only. The last recorded fault code (see section 6) is stored in this parameter. The stored value can be cleared by using the ∇ button . Or by resetting to factory defaults (P944) This is a copy of the code stored in P930.
P141	Most recent fault code -1	0 - 9999 [-]	This parameter stores the last recorded fault code prior to that stored in P140/P930.
P142	Most recent fault code -2	0 - 9999 [-]	This parameter stores the last recorded fault code prior to that stored in P141.
P143	Most recent fault code -3	0 - 9999 [-]	This parameter stores the last recorded fault code prior to that stored in P142.
P201	Closed loop mode	0 - 2 [0]	**0** = Normal operation (closed loop control disabled). **1** = *Not used.* **2** = Closed loop control using analogue input for transducer feedback input.
P202 ●	**P** gain (%)	0.0 - 999.9 [1.0]	Proportional gain.
P203 ●	**I** gain (%)	0.00 - 99.99 [0.00]	Integral gain. 0.01% corresponds to the longest integral action time.
P205 ●	Sample interval (x 25 ms)	1 - 2400 [1]	Sampling interval of feedback sensor. The integral response rate is slowed down by this factor
P206 ●	Transducer filtering	0 - 255 [0]	**0** = Filter off. **1 - 255** = Low pass filtering applied to sensor.
P207 ●	Integral capture range (%)	0 - 100 [100]	Percentage error above which integral term is reset to zero.
P208	Transducer type	0 - 1 [0]	**0** = An increase in motor speed causes an increase in sensor voltage/current output. **1** = An increase in motor speed causes a decrease in sensor voltage/current output.
P210	Transducer reading (%)	0.0 - 100.0 [-]	Read only. Value is a percentage of full scale of the selected input.
P211 ●	0% setpoint	0.00- 100.00 [0.00]	Value of P210 to be maintained for 0% setpoint.
P212 ●	100% setpoint	0.00- 100.00 [100.00]	Value of P210 to be maintained for 100% setpoint.
P220	PI frequency cut-off	0 - 1 [0]	**0 =** Normal operation **1 =** Switch off inverter output at or below minimum frequency. Note: Active in all modes.
P700			*Specific to PROFIBUS-DP. See PROFIBUS Handbook for further details. Access only possible with P099 = 1*
P701 ●			
P702			
P880			
P900 to P970	(Other than those listed below)		*Specific to PROFIBUS-DP and CANbus operation. See PROFIBUS or CANbus Handbook for further details. Access only possible with P099 = 1 or 2*

Parameter	Function	Range [Default]	Description / Notes
P910 ●	Local/Remote mode	0 - 4 [0]	Sets the inverter for local control or remote control over the serial link: **0** = Local control **1** = Remote control (and setting of parameter values) **2** = Local control (but remote control of frequency) **3** = Remote control (but local control of frequency) **4** = Local control (but remote read and write access to parameters and facility to reset trips) **Note:** When operating the inverter via remote control (P910 = 1 or 3), the analogue input remains active when P006 = 1 and is added to the setpoint.
P922	Software version	0.00 - 99.99 [-]	Contains the software version number and cannot be changed.
P923 ●	Equipment system number	0 - 255 [0]	You can use this parameter to allocate a unique reference number to the inverter. It has no operational effect.
P930	Most recent fault code	0 - 9999 [-]	The last recorded fault code *(see section 6)* is stored in this parameter. This parameter can be cleared using the Δ and ∇ buttons.
P931	Most recent warning type	0 - 9999 [-]	The last recorded warning is stored in this parameter until power is removed from the inverter: **002** = Current limit active **003** = Voltage limit active **005** = Inverter over-temperature (Internal PTC) **006** = Motor over-temperature **018** = Auto restart after fault **Warning:** inverter may start at any time!
P944	Reset to factory default settings	0 - 1 [0]	Set to '1' and then press **P** to reset all parameters except P101 to the factory default settings.
P971 ●	EEPROM storage control	0 - 1 [1]	**0** = Changes to parameter settings (including P971) are lost when power is removed. **1** = Changes to parameter settings are retained during periods when power is removed. **WARNING:** **When using the serial link to update the parameter set held in EEPROM, care must be taken not to exceed the maximum number of write cycles to this EEPROM - this is approximately 50,000 write cycles. Exceeding this number of write cycles would result in corruption of the stored data and subsequent data loss. The number of read cycles are unlimited.**

6. FAULT CODES

In the event of a failure, the inverter switches off and a fault code appears on the display. The last fault that occurred is stored in parameter P140, the preceding faults in P141-143.. e.g. '0003' indicates that the last error was F003.

Fault Code	Cause	Corrective Action
F001	Overvoltage	Check whether supply voltage is within the limits indicated on the rating plate. Increase the ramp down time (P003). Check whether the required braking power is within the specified limits.
F002	Overcurrent	Check whether the motor power corresponds to the inverter power. Check that the cable length limits have not been exceeded. Check motor lead and motor for short-circuits and earth faults. Check whether the motor parameters (P081 - P086) correspond with the motor being used. Check the stator resistance (P089). Increase the ramp-up time (P002). Reduce the boost set in P078 and P079. Check whether the motor is obstructed or overloaded.
F003	Overload	Check whether the motor is overloaded. Increase the maximum motor frequency if a motor with high slip is used.
F005	Inverter overtemperature (internal heatsink sensor)	Check that the ambient temperature is not too high. Check that the air inlet and outlet are not obstructed. Check that the integral fan is working.
F008	USS protocol timeout	Check the serial interface. Check the settings of the bus master and P091 - P093. Check whether the timeout interval is too short (P093).
F010	Initialisation fault / Parameter loss *	Check the entire parameter set. Set P009 to `0000' before power down.
F011	Internal interface fault *	Switch off power and switch on again.
F012	External trip (PTC)	Check if motor is overloaded.
F013	Programme fault *	Switch off power and switch on again.
F030	PROFIBUS link failure	Check the integrity of the link.
F031	Option module to link failure	Check the integrity of the link.
F033	PROFIBUS configuration error	Check the PROFIBUS configuration.
F036	PROFIBUS module watchdog trip	Replace PROFIBUS module
F074	Motor overtemperature by I^2t calculation	Trip occurs only if P074 = 4, 5, 6 or 7. Check that the motor current does not exceed the value set in P083 and P086.
F075	Over current during ramping down	Increase the ramp down time (P003).
F101	Internal interface fault *	Switch off power and switch on again.
F105	Inverter overtemperature (internal sensor)	Check that the ambient temperature is not too high. Check that the air inlet and outlet are not obstructed Check that the inverter's integral fan is working
F106	Parameter fault P006	Parameterise fixed frequency(ies) and/or motor potentiometer on the digital inputs.
F112	Parameter fault P012/P013	Set parameter P012 < P013.
F151 - F153	Digital input parameter fault	Check the settings of digital inputs P051 to P053.
F201	P006 = 1 while P201 = 2	Change parameter P006 and/or P201.
F212	Parameter fault P211/P212	Set parameter P211 < P212.
F231	Output current measurement imbalance	See F002
F255	Watchdog Trip	Remove prime power and re-apply

* Ensure that the wiring guidelines described in section 1.2 have been complied with.

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 - P053)* or via the serial interface.

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7. SPECIFICATIONS

230 V Single Phase MICROMASTER Inverters									
Order No. (6SE92 ..)	10-7BA40	11-5BA40	12-1BA40	12-8BA40	13-6BA40	15-2BB40	16-8BB40	21-0BC40	21-3BC40
Inverter model	MM12	MM25	MM37	MM55	MM75	MM110	MM150	MM220	MM300 [c]
Input voltage range	1 AC 208V - 240 V +/-10%								
Motor output rating [a] (kW / hp)	0.12 / $^1/_6$	0.25 / $^1/_3$	0.37 / $^1/_2$	0.55 / $^3/_4$	0.75 / 1	1.1 / $1^1/_2$	1.5 / 2	2.2 / 3	3.0 / 4
Continuous output	350 VA	660 VA	920 VA	1.14 kVA	1.5 kVA	2.1 kVA	2.8 kVA	4.0 kVA	5.2 kVA
Output current (nom.) [a]	0.75 A	1.5 A	2.1 A	2.6 A	3.5 A	4.8 A	6.6 A	9.0 A	11.8 A
Output current (max. continuous)	0.9 A	1.7 A	2.3 A	3.0 A	3.9 A	5.5 A	7.4 A	10.4 A	13.6 A
Input current (I rms)	1.8 A	3.2 A	4.6 A	6.2 A	8.2 A	11.0 A	14.4 A	20.2 A	28.3 A
Recommended mains fuse	10 A				16 A	20 A		25 A	32 A
Recommended lead cross-section (min.) Input	1.0 mm²			1.5 mm²		2.5 mm²			4.0 mm²
Output	1.0 mm²					1.5 mm²			2.5 mm²
Dimensions (mm) (w x h x d)	73 x 175 x 141					149 x 184 x 172		185 x 215 x 195	
Weight (kg / lb)	0.85 / 1.9					2.6 / 5.7		5.0 / 11.0	

All 1 AC 230 V MICROMASTERS include integrated Class A filters. Optional external Class B filters are available (see section 8.3).

230 V 3 Phase MICROMASTER Inverters										
Order No. (6SE92 ..)	10-7CA40	11-5CA40	12-1CA40	12-8CA40	13-6CA40	15-2CB40	16-8CB40	21-0CC40	21-3CC40	21-8CC13
Inverter model	MM12/2	MM25/2	MM37/2	MM55/2	MM75/2	MM110/2	MM150/2	MM220/2	MM300/2 [c]	MM400/2
Input voltage range	1 - 3 AC 208V - 240 V +/-10%									3 AC
Motor output rating [a] (kW / hp)	0.12 / $^1/_6$	0.25 / $^1/_3$	0.37 / $^1/_2$	0.55 / $^3/_4$	0.75 / 1	1.1 / $1^1/_2$	1.5 / 2	2.2 / 3	3.0 / 4	4.0 / 5
Continuous output	350 VA	660 VA	920 VA	1.14 kVA	1.5 kVA	2.1 kVA	2.8 kVA	4.0 kVA	5.2 kVA	7.0 kVA
Output current (nom.) [a]	0.75 A	1.5 A	2.1 A	2.6 A	3.5 A	4.8 A	6.6A	9.0 A	11.8 A	15.9 A
Output current (max. continuous)	0.9 A	1.7 A	2.3 A	3.0 A	3.9 A	5.5 A	7.4 A	10.4 A	13.6 A	17.5 A
Input current (I rms) (1 AC / 3 AC)	1.8 / 1.1 A	3.2 / 1.9 A	4.6 / 2.7 A	6.2 / 3.6 A	8.2 / 4.7 A	11.0 / 6.4 A	14.4 / 8.3 A	202 / 11.7A	28.3 / 16.3A	- / 21.1 A
Recommended mains fuse [b]	10 A					16 A		20 A		25 A
Recommended lead cross-section (min.) Input	1.0 mm²					1.5 mm²		2.5 mm²		4.0 mm²
Output	1.0 mm²					1.5 mm²		2.5 mm²		
Dimensions (mm) (w x h x d)	73 x 175 x 141					149 x 184 x 172		185 x 215 x 195		
Weight (kg / lb)	0.75 / 1.7					2.4 / 5.3		4.8 / 10.5		

All 1 AC and 3 AC 230 V MICROMASTERS (excluding MM400/2) are suitable for 208 V operation.
All 3 AC 230 V MICROMASTERS can operate on 1 AC 230 V (MM300/2 requires an external line choke, e.g. 4EM6100-3CB).

380 V - 500 V Three Phase MICROMASTER Inverters										
Order No. (6SE92 ..)	11-1DA40	11-4DA40	12-0DA40	12-7DA40	14-0DA40	15-8DB40	17-3DB40	21-0DC40	21-3DC40	21-5DC40
Inverter model	MM37/3	MM55/3	MM75/3	MM110/3	MM150/3	MM220/3	MM300/3	MM400/3	MM550/3	MM750/3
Input voltage range	3 AC 380 V - 500 V +/-10%									
Motor output rating [a] (kW / hp)	0.37 / $^1/_2$	0.55 / $^3/_4$	0.75 / 1	1.1 / $1^1/_2$	1.5 / 2	2.2 / 3	3.0 / 4	4.0 / 5	5.5 / $7^1/_2$	7.5 / 10
Continuous output	930 VA	1.18 kVA	1.5 kVA	2.1 kVA	2.8 kVA	4.0 kVA	5.2 kVA	7.0 kVA	9.0 kVA	12.0 kVA
Output current (nom.) (400 V / 500 V) [a]	1.05/0.95A	1.5 / 1.3 A	2.0 / 1.8 A	2.8 / 2.5 A	3.7 / 3.3 A	5.2 / 4.6 A	6.8 / 6.0 A	9.2 / 8.1 A	11.8 / 104A	15.8 / 13.9A
Output current (max. continuous)	1.2 / 1.06 A	1.6 /1.45 A	2.1 / 1.9 A	3.0 / 2.7 A	4.0 / 3.6 A	5.9 / 5.3 A	7.7 / 6.9 A	10.2 / 9.1A	132 / 11.8A	17.0 / 152A
Input current (I rms)	2.2 A	2.8 A	3.7 A	4.9 A	5.9 A	8.8 A	11.1 A	13.6 A	17.1 A	22.1 A
Recommended mains fuse	10 A					16 A		20 A		25 A
Recommended lead cross-section (min.) Input	1.0 mm²					1.5 mm²		2.5 mm²		4.0 mm²
Output	1.0 mm²					1.5 mm²		2.5 mm²		
Dimensions (mm) (w x h x d)	73 x 175 x 141					149 x 184 x 172		185 x 215 x 195		
Weight (kg / lb)	0.75 / 1.7					2.4 / 5.3		4.8 / 10.5		

Integrated Class A filters are also available (see below).

380 V - 480 V Three Phase MICROMASTER Inverters with built in filter									
Order No. (**6SE92** ..)						**15-8DB50**	**17-3DB50**	**21-0DC50**	**21-3DC50**	**21-5DC50**
Inverter model						MM220/3F	MM300/3F	MM400/3F	MM550/3F	MM750/3F
Input voltage range					3 AC 380 V - 480 V +/-10%				
Motor output rating [a] (kW / hp)						2.2 / 3	3.0 / 4	4.0 / 5	5.5 / 7$^1/_2$	7.5 / 10
Continuous output						4.0 kVA	5.2 kVA	7.0 kVA	9.0 kVA	12.0 kVA
Output current (nom.) (400 V / 480 V) [a]						5.2 / 4.6 A	6.8 / 6.0 A	9.2 / 8.1 A	11.8 / 10.4 A	15.8 / 13.9 A
Output current (max. continuous)						5.9 / 5.3 A	7.7 / 6.9 A	10.2 / 9.1 A	13.2 / 11.8 A	17.0 / 15.2 A
Input current (I rms)						8.8 A	11.1 A	13.6 A	17.1 A	22.1 A
Recommended mains fuse						16 A		20 A		25 A
Recommended lead cross-section (min.) Input						1.5 mm^2		2.5 mm^2		4.0 mm^2
Recommended lead cross-section (min.) Output						1.5 mm^2			2.5 mm^2	
Dimensions (mm) (w x h x d)						149 x 184 x 172		185 x 215 x 195		
Weight (kg / lb)						2.4 / 5.3		4.8 / 10.5		

Integrated Class B may be achieved by adding a Class B footprint filter to an unfiltered inverter

Notes

[a] Siemens 4 pole-motor, 1LA5 series or equivalent.

[b] Assumes 3-phase supply. If a single phase supply is used, the input current ratings, wire sizes and fuses for single phase MICROMASTERS will apply.

[c] MM300 and MM300/2 require an external choke (e.g. 4EM6100-3CB) and a 30 A mains fuse to operate on a single phase supply.

Input frequency:	47 Hz to 63 Hz
Power factor:	$\lambda \geq 0.7$
Output frequency range:	0 Hz to 400 Hz
Resolution:	0.01 Hz
Overload capability:	150% for 60 s, related to nominal current
Protection against:	Inverter overtemperature Motor overtemperature Overvoltage and undervoltage
Additional protection:	Against short-circuits and earth/ground faults pull-out protection. Protection against running with no load (open-circuit)
Operating mode:	4 quadrants possible
Regulation and control:	Voltage/frequency curve
Analogue setpoint / PI Input:	0 - 10 V/2 - 10 V (recommended potentiometer 5 kΩ)
Analogue setpoint resolution:	10-bit
Setpoint stability:	Analogue < 1% Digital < 0.02%
Motor temperature monitoring:	I^2t control
Ramp times:	0 - 650 s
Control outputs:	1 relay 110 V AC / 0.4 A; 30 V DC / 1 A **WARNING:** External inductive loads must be suppressed in an appropriate manner *(see section 1.2 (4))*.
Interface:	RS485
Inverter efficiency:	97% (typically)
Operating temperature:	0°C to +50°C
Storage/transport temperature:	-40°C to +70°C
Ventilation:	Fan-cooled (Software Controlled)
Humidity:	95% non-condensing
Installation height above sea level:	< 1000 m **Note:** If the Inverter is to be installed at an altitude >1000m, derating will be required.(Refer to DA 64 Catalogue)
Degree of protection:	Frame size A: IP20 (NEMA 1 using accessory kit - *see options*) Frame sizes B & C: IP20 (NEMA 1) (National Electrical Manufacturers' Association)
Protective separation of circuits:	Double insulation or protective screening
Electro-magnetic compatibility (EMC):	*See section 8.3*

Options / Accessories

Additional RFI suppression filter

Clear Text Display (OPM2)

PROFIBUS module (CB15)

CANbus Module (CB16)

SIMOVIS software for control via PC

Output chokes and line chokes

Output filters

IP20 (NEMA 1) Accessory Kit

(Only for Frame Size A)

Please contact your local Siemens sales office for further details

8. SUPPLEMENTARY INFORMATION

8.1 Application Example

Setup procedure for a simple application

Motor:	220 V 1.5 kW output power
Application requirements:	Setpoint adjustable via potentiometer 0 - 50 Hz Ramp up from 0 to 50 Hz in 15 seconds Ramp down from 50 to 0 Hz in 20 seconds
Inverter used:	MM150 (6SE9216-8BB40)
Settings:	P009 = 2 (all parameters can be altered) P081 - P085 = values given on motor rating plate P006 = 1 (analogue input) P002 = 15 (ramp up time) P003 = 20 (ramp down time)

This application is now to be modified as follows:

Operation of motor up to 75 Hz
(voltage/frequency curve is linear up to 50 Hz).
Motor potentiometer setpoint in addition to
analogue setpoint .
Use of analogue setpoint at maximum 10 Hz.
Ramp times to remain the same.
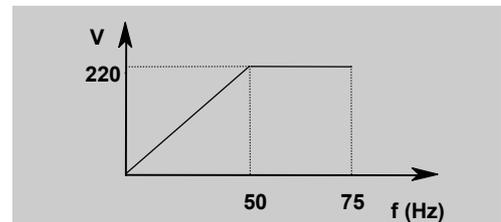
Parameter adjustments:	P009 = 2 (all parameters can be altered) P013 = 75 (maximum motor frequency in Hz) P006 = 2 (setpoint via motor potentiometer or fixed setpoint) P024 = 1 (analogue setpoint is added) P022 = 10 (maximum analogue setpoint at 10 V = 10 Hz)

8.2 USS Status Codes

The following list gives the meaning of status codes displayed on the front panel of the inverter when the serial link is in use and parameter P001 is set to 006:

001	Message OK
002	Slave address received
100	Invalid start character
101	Timeout
102	Checksum error
103	Incorrect message length
104	Parity fail

Notes

(1)   The display flashes whenever a byte is received, thus giving a basic indication that a serial link connection is established.

(2)   If '**100**' flashes on the display continuously, this usually indicates a bus termination fault.

8.3   Electro-Magnetic Compatibility (EMC)

All manufacturers / assemblers of electrical apparatus which performs a complete intrinsic function which is placed on the market as a single unit intended for the end user must comply with the EMC directive EEC/89/336 after January 1996. There are three routes by which the manufacturer/assembler can demonstrate compliance:

1.   *Self-Certification*

      This is a manufacturer's declaration that the European standards applicable to the electrical environment for which the apparatus is intended have been met. Only standards that have been officially published in the Official Journal of the European Community can be cited in the manufacturer's declaration.

2.   *Technical Construction File*

      A technical construction file can be prepared for the apparatus describing its EMC characteristics. This file must be approved by a 'Competent Body' appointed by the appropriate European government organisation. This approach allows the use of standards which are still in preparation.

3.   *EC Type-Examination Certificate*

      This approach is only applicable to radio communication transmitting apparatus.

The MICROMASTER units do not have an intrinsic function until connected with other components (e.g. a motor). Therefore, the basic units are not allowed to be CE marked for compliance with the EMC directive. However, full details are provided below of the EMC performance characteristics of the products when they are installed in accordance with the wiring recommendations in section 1.2

Three classes of EMC performance are available as detailed below. Note that these levels of performance are only achieved when using the default switching frequency (or less) and a maximum motor cable length of 25 m.

Class 1: General Industrial

Compliance with the EMC Product Standard for Power Drive Systems EN 68100-3 for use in **Second Environment (Industrial)** and **Restricted Distribution**.

EMC Phenomenon	Standard	Level
Emissions:		
Radiated Emissions	EN 55011	Level A1 *
Conducted Emissions	EN 68100-3	*
Immunity:		
Electrostatic Discharge	EN 61000-4-2	8 kV air discharge
Burst Interference	EN 61000-4-4	2 kV power cables, 1 kV control
Radio Frequency Electromagnetic Field	IEC 1000-4-3	26-1000 MHz, 10 V/m

* Limits not required inside a plant where no other consumers are connected to the same electricity supply transformer.

Class 2: Filtered Industrial

This level of performance will allow the manufacturer/assembler to self-certify their apparatus for compliance with the EMC directive for the industrial environment as regards the EMC performance characteristics of the power drive system. Performance limits are as specified in the Generic Industrial Emissions and Immunity standards EN 50081-2 and EN 50082-2.

EMC Phenomenon	Standard	Level
Emissions:		
Radiated Emissions	EN 55011	Level A1
Conducted Emissions	EN 55011	Level A1
Immunity:		
Supply Voltage Distortion	IEC 1000-2-4 (1993)	
Voltage Fluctuations, Dips, Unbalance, Frequency Variations	IEC 1000-2-1	
Magnetic Fields	EN 61000-4-8	50 Hz, 30 A/m
Electrostatic Discharge	EN 61000-4-2	8 kV air discharge
Burst Interference	EN 61000-4-4	2 kV power cables, 2 kV control
Radio Frequency Electromagnetic Field, amplitude modulated	ENV 50 140	80-1000 MHz, 10 V/m, 80% AM, power and signal lines
Radio-frequency Electromagnetic Field, pulse modulated	ENV 50 204	900 MHz, 10 V/m 50% duty cycle, 200 Hz repetition rate

Class 3: Filtered - for residential, commercial and light industry

This level of performance will allow the manufacturer / assembler to self-certify compliance of their apparatus with the EMC directive for the residential, commercial and light industrial environment as regards the EMC performance characteristics of the power drive system. Performance limits are as specified in the generic emission and immunity standards EN 50081-1 and EN 50082-1.

EMC Phenomenon	Standard	Level
Emissions:		
Radiated Emissions	EN 55022	Level B1
Conducted Emissions	EN 55022	Level B1
Immunity:		
Electrostatic Discharge	EN 61000-4-2	8 kV air discharge
Burst Interference	EN 61000-4-4	1 kV power cables, 0.5 kV control

Note:
The MICROMASTERS are intended **exclusively for professional applications**. Therefore, they do not fall within the scope of the harmonics emissions specification EN 61000-3-2.

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Compliance Table:

Model No.	EMC Class
MM12 - MM220	Class 2
MM12/2 - MM300/2	Class 1
MM12/2 - MM220/2 with external filter (see table) *1 phase input only*	Class 2*
MM220/3F - MM750/3F	Class 2*
MM150/3 - MM750/3	Class 1
MM150/3 - MM750/3 with external filter (see table)	Class 2*

* If the installation of the inverter reduces the radio frequency field emissions (e.g. by installation in a steel enclosure), Class 3 limits will typically be met.

External Filters:

Model No.	Filter Class	Filter Part No.	Standard
MM12 & MM25 MM12/2 & MM25/2	B	6SE3290-0BA87-0FB0*	EN 55011 / EN 55022
MM37 & MM75 MM37/2 - MM75/2	B	6SE3290-0BA87-0FB2*	EN 55011 / EN 55022
MM110 & MM150 MM110/2 & MM150/2	B	6SE3290-0BB87-0FB4*	EN 55011 / EN 55022
MM220 & MM300 MM220/2 & MM300/2	B	6SE3290-0BC87-0FB4*	EN 55011 / EN 55022
MM400/2	-	*Not available*	-
MM37/3 - MM150/3	A B	6SE3290-0DA87-0FA1 6SE3290-0DA87-0FB1	EN 55011 / EN 55022
MM220/3 & MM300/3	A B	6SE3290-0DB87-0FA3 6SE3290-0DB87-0FB3	EN 55011 / EN 55022
MM400/3 - MM750/3	A B	6SE3290-0DC87-0FA4 6SE3290-0DC87-0FB4	EN 55011 / EN 55022

*Class B filters are for use with 1/3 AC 230V unfiltered units.

Note: Maximum mains supply voltage when filters are fitted is 460V.

8.4   Environmental Aspects

Transport and Storage

Protect the inverter against physical shocks and vibration during transport and storage. The unit must also be protected against water (rainfall) and excessive temperatures *(see section 7)*.

The inverter's packaging is re-usable. Retain the packaging or return it to the manufacturer for future use.

Dismantling and Disposal

The unit can be broken-down to its component parts by means of easily-released screw and snap connectors.

The component parts can be re-cycled, disposed of in accordance with local requirements or returned to the manufacturer.

Documentation

This handbook is printed on chlorine-free paper which has been produced from managed sustainable forests. No solvents have been used in the printing or binding process.

8.5   User's Parameter Settings

Record your own parameter settings in the table below:

Parameter	Your setting	Default	Parameter	Your setting	Default	Parameter	Your setting	Default
P000		-	P064		1.0	P207		100
P001		0	P065		1.0	P208		0
P002		10.0	P066		1	P210		-
P003		10.0	P073		0	P211		0.0
P004		0.0	P074		1	P212		100.00
P005		5.00	P076		0/4	P220		0
P006		0	P077		1	P700		-
P007		1	P078		100	P701		0
P009		0	P079		0	P702		-
P011		0	P081		50.00	P880		-
P012		0.00	P082		☆☆☆	P910		0
P013		50.00	P083		☆☆☆	P918		-
P014		0.00	P084		☆☆☆	P922		-
P015		0	P085		☆☆☆	P923		0
P016		0	P089		☆☆☆	P927		0
P017		1	P091		0	P928		0
P018		0	P092		6	P930		-
P019		2.00	P093		0	P931		-
P020		5.0	P094		50.00	P944		0
P021		0.00	P095		0	P947		-
P022		50.00	P099		0	P958		-
P023		0	P101		0	P963		-
P024		0	P111		☆☆☆	P967		-
P027		0.00	P112		☆☆☆	P968		-
P028		0.00	P113		☆☆☆	P970		1
P029		0.00	P121		1	P971		1
P031		5.00	P122		1
P032		5.00	P123		1
P033		10.0	P124		1
P034		10.0	P125		1
P041		5.00	P128		120
P042		10.00	P129		-
P043		15.00	P131		-
P044		20.00	P132		-
P045		0	P134		-
P046		25.00	P135		-
P047		30.00	P137		-
P048		35.00	P140		-
P050		0	P141		-
P051		1	P142		-
P052		2	P143		-
P053		6	P201		0
P056		0	P202		1.0
P061		6	P203		0.00
P062		0	P205		1
P063		1.0	P206		0

☆☆☆ = *Value depends on the rating of the inverter*