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## 1. SAFETY AND COMPLIANCE

Before installing and putting this equipment into operation, read these safety instructions and warnings carefully. Also read and obey all the warning signs attached to the equipment. Make sure that the warning labels are kept in a legible condition and replace any 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 suitably 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.

- Use only permanently-wired input power connections. The equipment must be grounded (IEC 536 Class 1, NEC and other applicable standards)
- Use only Residual Current-operated protective Device (RCD) type B if an RCD is required
- Wait at least five minutes after the power has been turned off, before opening the equipment. The dc-link capacitor remains charged to dangerous voltages even when the power is removed. When working on equipment with covers removed, note that live parts are exposed and do not touch these parts
- Do not connect machines with a three-phase power supply, fitted with EMC filters, to a supply via an ELCB (Earth Leakage Circuit Breaker - see DIN VDE 0160, section 6.5)
- Note that certain parameter settings may cause the inverter to restart automatically once power is restored following an input supply failure.
- Do not use this equipment as an "emergency stop" mechanism (see EN 60204, 9.2.5.4)
- Obey all general and regional installation and safety regulations relating to work on high voltage installations, as well as regulations covering correct use of tools and personal protective equipment
- Note that the following terminals can carry dangerous voltages even when the inverter is inoperative:
  - Power supply terminals** L/L1, N/L2 and L3 MICROMASTER Eco. L1, L2 and L3 MIDIMASTER Eco
  - Motor terminals** U, V and W
  - DC link terminals**
- MICROMASTER Eco B+/DC+ and B-MIDIMASTER Eco DC+ and DC-
- This equipment is capable of providing internal motor thermal overload protection in accordance with section 42 of UL508C. Please refer to P074. An external PTC may also be used (refer to electrical installation).
- 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\*
  - \* As detailed in sections 9.1 and 10.7 respectively.
- Do not operate the motor with a higher nominal power than the inverter, or a nominal power less than half the inverter. Only operate the inverter when the nominal current in P083 exactly matches the motor rating plate nominal current
- Enter the motor data parameters (P080-P085) and do an auto-calibration (P088) before the motor is started. Unstable/unpredictable motor operation (e.g. Reverse rotation) may result if this is not done. If this instability occurs, the mains supply to the inverter must be disconnected.
- When using the analogue input, the DIP switches must be correctly set and the analogue input type selected (P023) before enabling the analogue input with P006. If this is not done the motor may start inadvertently.



### Caution

- Do not allow children or the general public to access or approach this equipment
- Do not install the inverter where it will be subject to shock, vibration, electro-magnetic radiation, water hazards, or atmospheric pollutants such as dust or corrosive gases.
- Keep operating instructions within easy reach and give them to all users
- Use this equipment only for the purpose specified by the manufacturer. Do not carry out any modifications, or fit any spare parts which are not sold or recommended by the manufacturer; this could cause fires, electric shock or other injuries.

## EUROPEAN LOW VOLTAGE DIRECTIVE

The MICROMASTER Eco and MIDIMASTER Eco product range complies with the requirements of the Low Voltage Directive 73/23/EEC as amended by Directive 93/68/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**

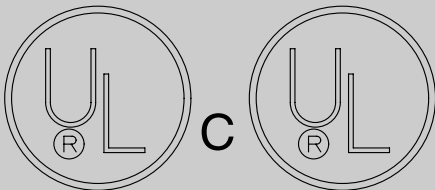
Safety of machinery -  
Electrical equipment  
of machines

## EUROPEAN MACHINERY DIRECTIVE

The MICROMASTER Eco and MIDIMASTER Eco product range do 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 Eco and MIDIMASTER Eco product range fulfil all requirements of the EMC Directive as defined by the EMC Product Standard for Power Drive Systems EN 61800-3



UL and cUL listed power conversion equipment type 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.



## 2. INTRODUCTION

### PRODUCT DESCRIPTION AND APPLICATIONS

The MICROMASTER Eco and MIDIMASTER Eco provides a range of variable frequency speed controllers (inverters) specifically developed for the Heating, Ventilation & Air Conditioning (HVAC) industry.

Key design features include:

- Automatic energy optimisation
- Motor thermal overload protection
- Automatic switching frequency optimisation for minimised acoustic noise generation
- Zero de-rating of motor
- Automatic motor tuning at switch-on
- Earth fault protection
- Short circuit protection
- Built-in chokes allow use of up to 150 metre motor cables

The ability to easily control the speed of pump or fan motors provides superior regulation and control of the process, enabling optimisation of room temperatures and personal comfort levels.

The Eco range combines ease of installation and commissioning with low maintenance and operating costs. In addition, the specific HVAC product functionality (compared with similar products aimed at "Hi-Tech" multiple applications) means that product costs can be minimised, and the user does not pay for features which are not required.

Day-to-day operating costs can be drastically reduced - up to 60% in some applications. Energy consumption and associated emissions are also reduced to the lowest possible levels.

### ECO OPERATING INSTRUCTION MANUAL

The Eco Operating Instructions booklet (which should be read in conjunction with this manual) provides basic information on equipment installation and programming, to control the functions of fans and pump motors. It is aimed at HVAC Installation Technicians and Electricians working and commissioning on-site, and is intended to provide a quick, straightforward guide to installing and simple operating of the Eco units.

### ECO REFERENCE MANUAL

This Manual - The Eco Reference Manual is intended for use by a wide range of HVAC professionals. For example, the Eco Reference Manual is to be used by Building Automation Engineers to plan their equipment and cabling schedules and estimate their material requirements. HVAC Consultants may also use it in order to compile the relevant portions of their tender specification.

The Eco Reference Manual should also be useful to electrical panel builders, building automation control engineers, quantity surveyors / estimators, electrical project managers, and maintenance contractors.



**3. PRINCIPLES OF INVERTER OPERATION**

**INTRODUCTION**

This section of the manual is intended to help first-time users of variable speed drives to understand basic principles of operation, and gain some insight into successful installation and application of the MICROMASTER Eco range of Variable Speed Drives.

**VARIABLE SPEED DRIVES**

A Variable Speed Drive (VSD) system consists of a Motor and some form of speed controller.

**History**

Early electric VSDs consisted of AC and DC motor combinations which were used as rotating AC to DC converters. The DC supply was used to drive the DC motor at variable speed by controlling the field current in the DC generator to vary the DC voltage to the DC motor.

The first electronic controllers used Thyristor (SCR) Rectifiers which controlled the voltage, and therefore the speed of DC motors. These DC

VSDs are still widely used and offer very sophisticated control capability. However, the DC motor is large, expensive and requires periodic brush maintenance.

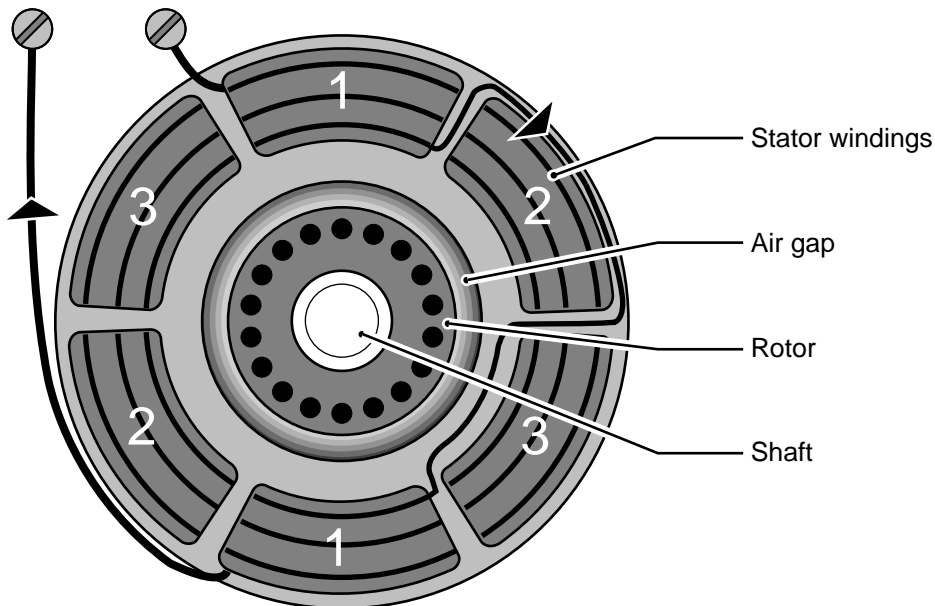
**Present day**

The AC induction motor is simple, low cost, reliable and widely used throughout the world. In order to control the speed of an AC induction motor a more complex controller, which varies the frequency as well as the voltage, usually called an inverter is required.

**Induction motor**

In order to understand how an inverter works, it is first necessary to understand how an induction motor works.

An asynchronous induction motor works like a transformer. When the stator (the fixed, outer winding) is connected to a three phase power source, a magnetic field which rotates at the frequency of the supply is set up.



*Simplified Induction Motor - Cross Section*

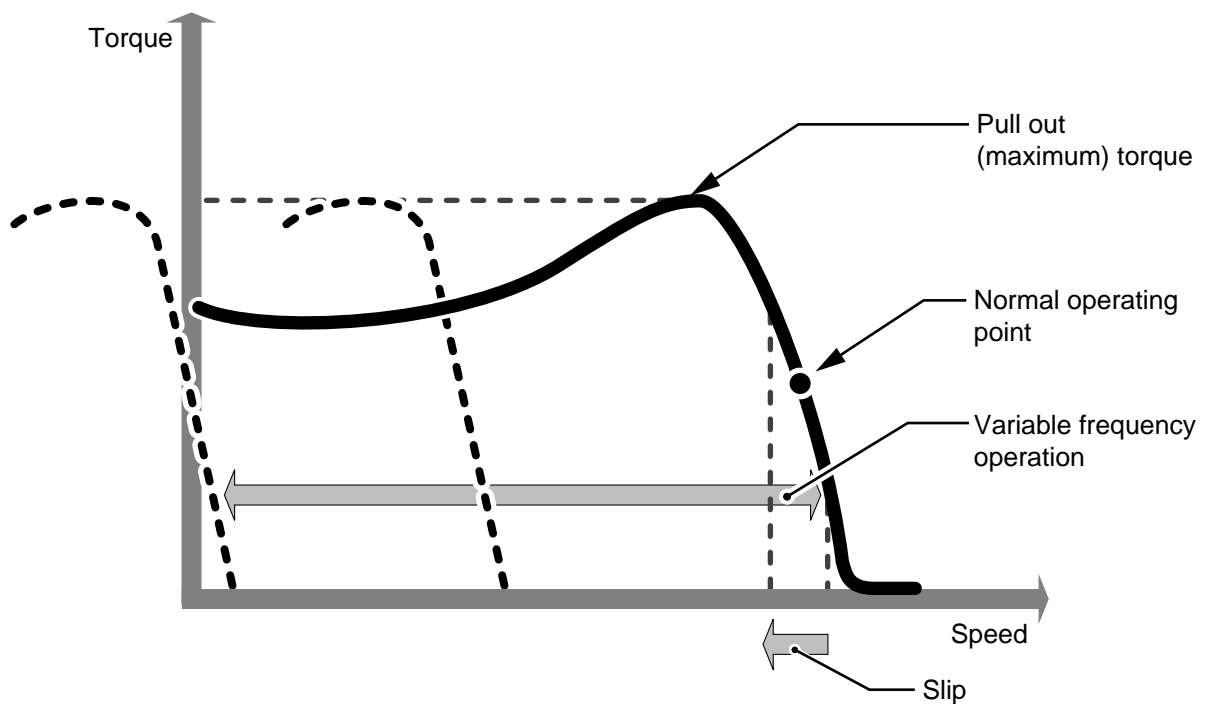


This field crosses the air gap between the stator and rotor and causes currents to flow in the rotor windings. This produces a force (torque) on the rotor as the current interacts with the changing magnetic field, and the rotor turns.

If the windings are arranged in several pairs (or poles), the frequency of the rotating field will be less than the applied frequency (e.g. two pole = 50/60Hz = 3000/3600 rpm, but four pole = 50/60Hz = 1500/1800 rpm).

However, if the rotor runs at the same speed as the rotating field, there will be no changing magnetic field, and therefore no torque.

Since rotor currents must be induced in order to create output torque, the rotor always runs a little slower than the rotating field. This difference in speed is known as slip and is generally about 3%.



*Torque Speed Characteristic of An Induction Motor*

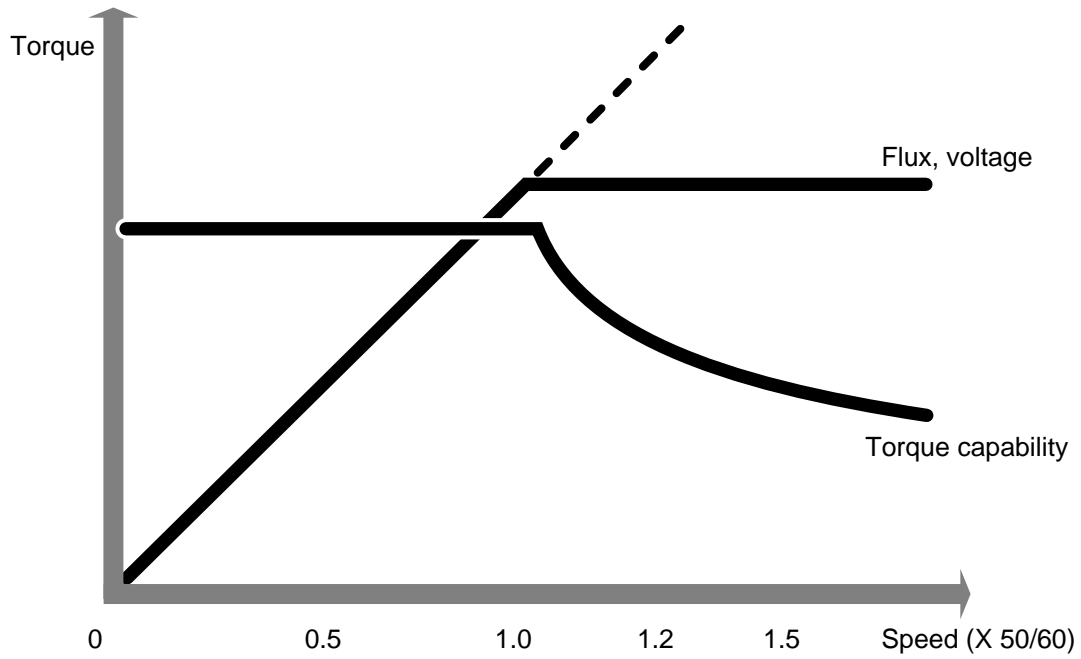
The speed of the motor depends on the applied frequency, as well as the winding arrangement, and to some extent on the load.

Therefore in order to control the motor speed it is necessary to control the frequency of the supply.

If the frequency is reduced, the voltage must be reduced, or the stator current and magnetic flux will be too high and the motor's magnetic field will saturate. Hence the voltage must be controlled as well.

If the frequency is increased above normal, more voltage would normally be needed to maintain maximum flux; this is not usually possible, so less torque is available at high speed, (i.e. speeds above the supply frequency).





*Torque Reduction above Base Speed*

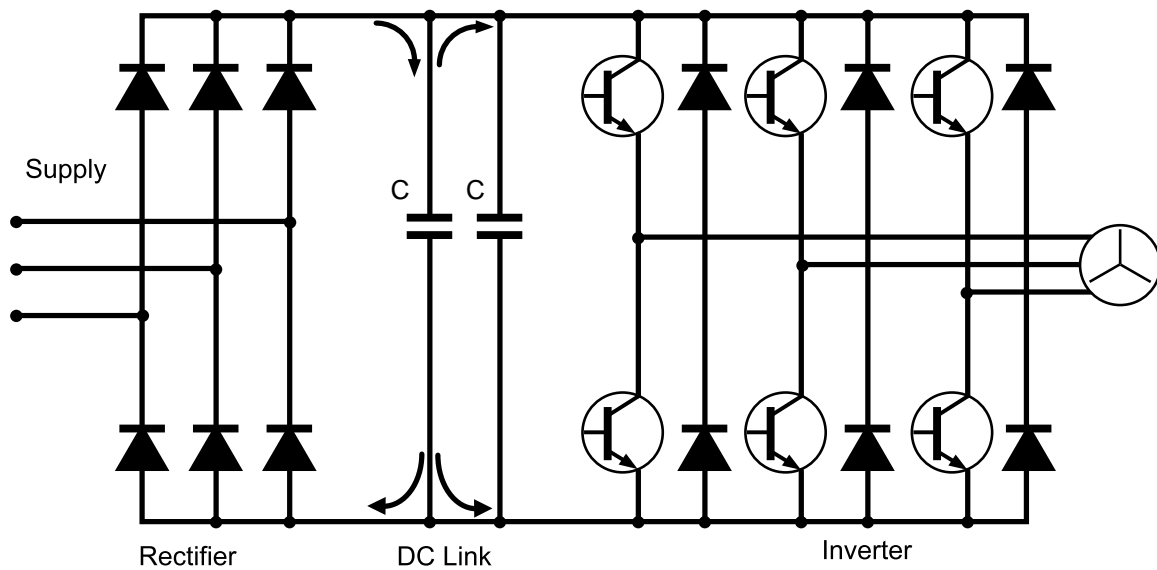
Therefore in order to control the speed of a standard AC motor, the applied frequency and voltage must be controlled.

The use of a standard induction motor together with a variable frequency speed controller allows a cost effective speed control system to be built.



## VARIABLE FREQUENCY INVERTER.

An electronic converter which converts Direct Current (DC) to Alternating Current (AC) is known as an inverter. Electronic speed controllers for AC motors usually convert the AC supply to DC using a rectifier, and then convert it back to a variable frequency, variable voltage AC supply using an inverter bridge. The connection between the rectifier and inverter is called the DC link. The block diagram of a speed controller (often called an inverter) is shown below:



*Inverter Block Diagram*

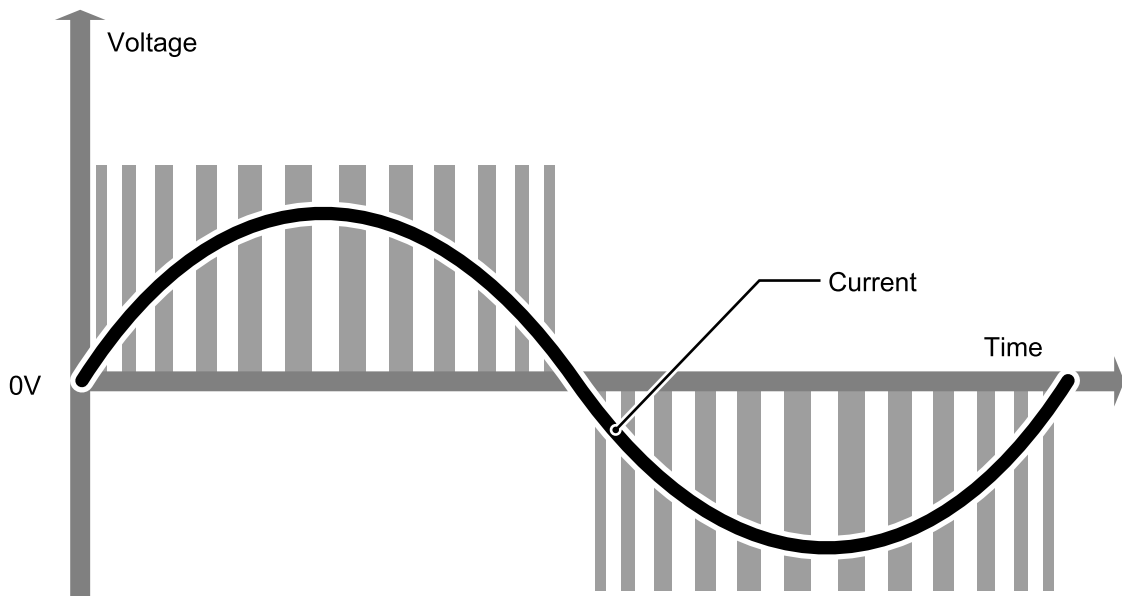


The three phase supply is fed into a full wave rectifier which supplies the DC link capacitors. The capacitors reduce the voltage ripple (especially on single phase supplies) and supply energy for short mains breaks. The voltage on the capacitors is uncontrolled and depends on the peak AC supply voltage.



MICROMASTER Eco & MIDIMASTER Eco inverters are available as three phase.

The DC voltage is converted back to AC using Pulse Width Modulation (PWM). The desired waveform is built up by switching the output transistors (Insulated Gate Bipolar Transistors; IGBTs) on and off at a fixed frequency (the switching frequency). By varying the on and off time of the IGBTs the desired current can be generated. The output voltage is still a series of square wave pulses and the inductance of the motor windings results in a sinusoidal motor current. Pulse Width Modulation is shown in the figure below.



*Pulse Width Modulation*

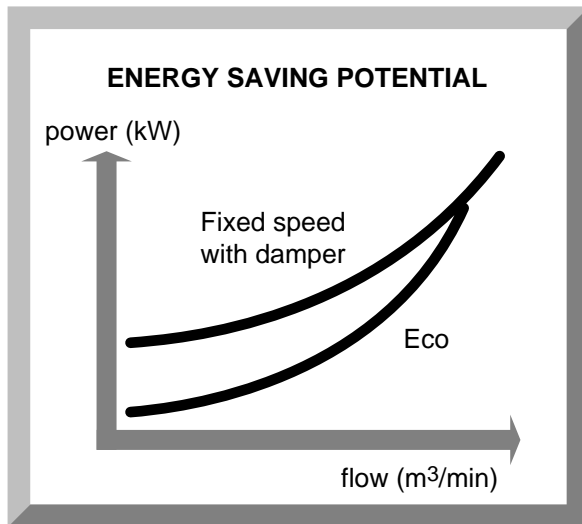


## 4. ADVANTAGES OF THE ECO

### ENERGY SAVINGS

The Eco range provides considerable potential for energy saving in the following areas:

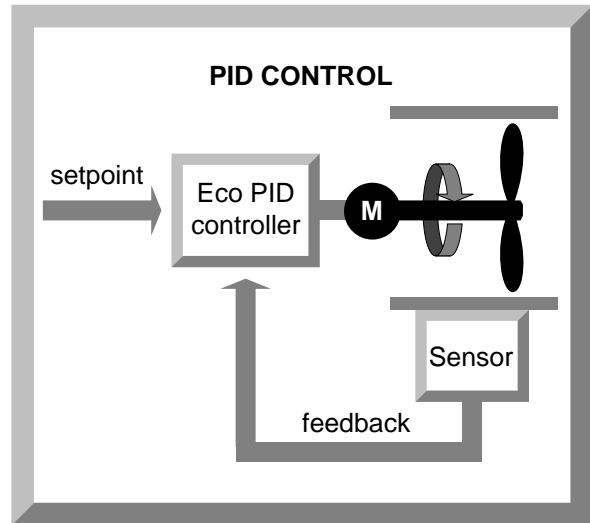
- Air flow requirements are matched precisely to demand.
- Optimum system regulation means less energy/power is required.
- The requirement for changing clean air filters is reduced.



### CONTROL & REGULATION

The Eco range enables the following improvements to system control and regulation.

- Finer control of system functions as the Eco accurately follows set points.
- Closed loop process control using a standard Proportional, Integral, Derivative (PID) control loop function.
- Reduced overshoot of pre-set parameters, provides optimised levels of comfort.
- Automatic compensation for system fluctuations - partially blocked filters.



### PID - INTERNAL

Closed loop process control using a standard Proportional, Integral, Derivative (PID) control loop function. 15 V, 50 mA supply provided for feedback transducer

### NOISE

Noise reductions can be achieved by reduction in:

- Motor and fan rpm.
- Air flow velocity
- Balance dampers are set in a more open position.
- Periodic on/off actions create a higher and more irritating noise level than continuous running



Advantages of the Eco

## WEAR & TEAR

Eco inverters can make possible greatly reduced maintenance and running costs:

- Fewer stop/start sequences means that mechanical stresses are reduced.
- Equipment life is extended, and a smaller number of components require reduced degree of maintenance
- Reduced airflow means reduced cleaning.
- Reduction in replacement of maintenance consumables such as fan belts, motor bearings and fan bearings.

## EQUIPMENT RATIONALISATION

Using Eco inverters can significantly reduce the number of system components and often enable valuable space to become available:

- Mechanical components which may be eliminated include dampers, actuators, (and outstations by using serial communication).
- Reductions in the use of electrical contactors, control and overload relays, terminals and PID modules can be achieved. Also, control panel complexity is reduced, as is wiring and labour costs.

## OUTSTATION CAPABILITY WITH RS485 SERIAL COMMUNICATION

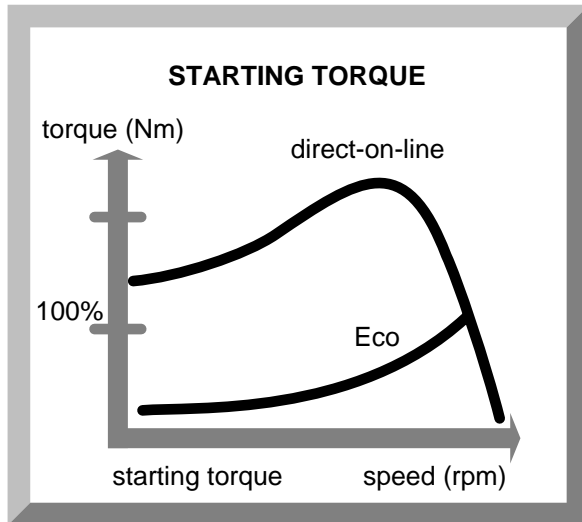
Remote control capability via RS485 serial link using the USS protocol with the ability to control up to 31 inverters via the USS protocol.

See further documentation-  
Universal Serial linterface  
Protocol specification

Order Codes:

English E20125-D0001-S302-A1-7600

German E20125-D0001-S302-A1





## 5. TECHNICAL OVERVIEW & PRODUCT RANGE TABLES

The MICROMASTER Eco and MIDIMASTER Eco inverters are intended for use anywhere in the world and therefore support a wide range of mains voltages:

3 phase	208 - 240V±10%
3 phase	380 – 460 / 480 / 500V ±10%
3 phase	525 - 575V±15% (MIDIMASTER Eco only)

### STANDARD FEATURES

- Easy to install program and commission.
- Fast Current Limit (FCL) for reliable trip-free operation.
- to 50°C temperature range (0 to 40°C for MIDIMASTER Eco).
- Factory default parameter settings pre-programmed for European, Asian, and North American requirements.
- Output frequency (and hence motor speed) can be controlled by:
  1. frequency setpoint using the keypad
  2. High resolution analogue setpoint (voltage or current input)
  3. External potentiometer to control motor speed
  4. 8 fixed frequencies via binary inputs
  5. Motorised potentiometer function (raise and lower speed pushbuttons)
  6. Serial RS485 interface
- Acceleration/deceleration times.
- Two fully-programmable relay outputs (13 functions).
- Fully-programmable analogue outputs (1 for MICROMASTER Eco, 2 for MIDIMASTER Eco).
- External options connector for optional multi-language Clear Text Display (OPe).
- Dual Motor-parameter sets available if Clear Text Display option (OPe) is fitted.
- Integral software controlled cooling fan.
- Side by side mounting without additional clearance. (IP20/21 models).
- Optional protection to IP56 (NEMA 4/2) for MIDIMASTER Eco inverters.
- Standard open loop quadratic V/F Control, ideal for simple applications such as pumps and fans.
- Range of drives benefits from the standard inclusion of a PID controller for closed loop system regulation.
- All products make use of the same, simple to use, standard user interface consisting of push buttons and LED display.
- User-friendly screwless terminals used for control connections. (MICROMASTER Eco only)
- RS485 serial interface is standard, allowing up to 31 drives to be networked to a PLC or Building Management System (BMS).
- Drive can be enabled via keypad, via digital inputs or via standard RS485 serial interface.
- Motor speed set-point can be selected, using a digital set-point, motorised potentiometer, fixed frequency, analogue input or via the RS485 serial link.
- Mixed mode control is also available, allowing drive control and setpoint input to be from different sources.
- Drives can be configured to start automatically following a mains break or after a fault.
- Parameter sets are fully compatible between different product types, reducing learning time.
- All drives are certified in accordance with VDE, UL and Canadian UL, and are manufactured to ISO9001.
- All drives conform to the requirements of the EC low voltage directive 73/23/EEC and have been awarded the CE mark.

## TECHNICAL FEATURES

Inverter	MICROMASTER Eco	MIDIMASTER Eco
Input Voltage	3 AC 208 - 240V±10% 3 AC 380 – 480 / 500V±10%	3 AC 208 - 240V±10% 3 AC 380V - 460 / 480 / 500V±10% 3 AC 525V - 575V±15%
Power Ranges 3 AC 208-240V 3 AC 380-500V 3 AC 525-575V	0.75kW - 4.0kW 1.1kW - 7.5kW -	5.5kW - 45kW (1.1kW - 45kW) IP56 11kW - 315kW (3kW - 90kW) IP56 4kW - 45kW (4kW - 45kW) IP56
Protection Level	IP20 / NEMA1	IP20 / IP21 / NEMA1 or IP56 / NEMA 4/12 or IP20 / NEMA1 with integrated Class A EMC filter
EMC conformance EN55011 Class A 3 AC 208-240V 3 AC 380-460V 3 AC 525-575V	Footprint Filter Integrated or Footprint Filter not available	Integrated or external Filter Integrated or external Filter not available
EMC conformance EN55011 Class B 3 AC 208-240V 3 AC 380-460V 3 AC 525-575V	Footprint Filter Footprint Filter not available	External Filter External Filter not available
Temperature Range	0 - 50°C	0 - 40°C See Section 14 for derating at higher temperatures
Control Method	Energy Control Optimisation (Eco) Mode or Multi-motor Mode.	
Protection Features	Undervoltage, Overvoltage, Overload, Short-Circuit, Earth Fault, Motor Pull-out, Motor Overtemperature, Drive Overtemperature	
Maximum Motor Cable Length	See section 14	See Section 14
Overload Capability	150% for 60 sec	110% for 60 sec
Digital Inputs	6 configurable	6 configurable
Fixed Frequencies	8	8
Relay Outputs	2 configurable (230V AC/1.0A)	2 configurable (230V AC/1.0A)
Analogue Inputs	2	2
Analogue Outputs	1 configurable	2 configurable
Serial Interface	RS485	
Dynamic Braking	Compound Braking /DC Injection Braking	Compound Braking /DC Injection Braking
Process Control	PID	PID

Technical Overview



MICROMASTER Eco 3ph 208-240V±10% IP20 / NEMA1							
Product	Motor Power	Rated Output Current		Input Current (I <sub>rms</sub> ) (A)	H x W x D	Weight	Order No.
	(kW)	(A)		3ph	(mm)	(kg)	
ECO1-75/2	0.75	3.9		4.7	147x73x141	0.95	6SE9513-8CA40
ECO1-110/2	1.1	5.5		6.4	184x149x172	1.9	6SE9515-5CB40
ECO1-150/2	1.5	7.4		8.3	184x149x172	1.9	6SE9517-4CB40
ECO1-220/2	2.2	10.4		11.7	215x185x195	3.8	6SE9521-0CC40
ECO1-300/2	3.0	13.6		16.3	215x185x195	3.8	6SE9521-4CC40
ECO1-400/2	4.0	17.5		21.1	215x185x195	3.8	6SE9521-8CC40

MICROMASTER Eco 3 ph 380-500 V±10% IP20 / NEMA1							
Product	Motor Power	Rated Output Current		Input Current	H x W x D	Weight	Order No.
	(kW)	400V (A)	500V (A)	(A)	(mm)	(kg)	
ECO1-110/3	1.1	3.0	2.6	4.9	147x73x141	0.95	6SE9513-0DA40
ECO1-150/3	1.5	4.0	3.6	5.9	147x73x141	0.95	6SE9514-0DA40
ECO1-220/3	2.2	5.9	5.3	8.8	184x149x172	1.6	6SE9516-0DB40
ECO1-300/3	3.0	7.7	6.9	11.1	184x149x172	1.6	6SE9517-7DB40
ECO1-400/3	4.0	10.2	9.1	13.6	215x185x195	3.6	6SE9521-0DC40
ECO1-550/3	5.5	13.2	11.8	17.1	215x185x195	3.6	6SE9521-3DC40
ECO1-750/3	7.5	17.0	15.2	22.1	215x185x195	3.6	6SE9521-7DC40

MICROMASTER Eco IP20 / NEMA1 with Integrated Class A EMC Filter 3 ph 380-480 V±10% IP20/NEMA1							
Product	Motor Power	Rated Output Current		Input Current	H x W x D	Weight	Order No.
	(kW)	400V (A)	480V (A)	(A)	(mm)	(kg)	
ECO1-220/3	2.2	5.9	5.3	8.8	184x149x172	2.4	6SE9516-0DB50
ECO1-300/3	3.0	7.7	6.9	11.1	184x149x172	2.4	6SE9517-7DB50
ECO1-400/3	4.0	10.2	9.1	13.6	215x185x195	4.8	6SE9521-0DC50
ECO1-550/3	5.5	13.2	11.8	17.1	215x185x195	4.8	6SE9521-3DC50
ECO1-750/3	7.5	17.0	15.2	22.1	215x185x195	4.8	6SE9521-7DC50





MIDIMASTER Eco - IP21 / NEMA1 Standard 3ph 208-240 V ±10%						
Product	Rated Inverter Output Current	Motor Rating		H x W x D	Weight	Order No.
		(A)	(kW)			
ECO1-550/2	23	5.5	7.5	450x275x210	11	6SE9522-3CG40
ECO1-750/2	28	7.5	10	450x275x210	11	6SE9522-8CG40
ECO1-1100/2	42	11	15	550x275x210	14.5	6SE9524-2CH40
ECO1-1500/2	54	15	20	650x275x285	26.5	6SE9525-4CH40
ECO1-1850/2	68	18.5	25	650x275x285	26.5	6SE9526-8CJ40
ECO1-2200/2	80	22	30	650x275x285	27	6SE9528-0CJ40
ECO1-3000/2	104	30	40	850x420x310	55	6SE9531-0CK40
ECO1-3700/2	130	37	50	850x420x310	55	6SE9531-3CK40
ECO1-4500/2	154	45	60	850x420x310	55.5	6SE9531-5CK40

MIDIMASTER Eco - IP21 (IP20) / NEMA1 Standard 3ph 380-(480) / 500 V ±10%						
Product	Rated Inverter Output Current	Motor Rating		H x W x D	Weight	Order No.
		400V [500V] (A)	(kW)			
ECO1-1100/3	23.5 [21]	11	15	450x275x210	11.5	6SE9522-4DG40
ECO1-1500/3	30 [27]	15	20	450x275x210	12.0	6SE9523-0DG40
ECO1-1850/3	37 [34]	18.5	25	550x275x210	16.0	6SE9523-7DH40
ECO1-2200/3	43.5 [40]	22	30	550x275x210	17.0	6SE9524-3DH40
ECO1-3000/3	58 [52]	30	40	650x275x285	27.5	6SE9525-8DJ40
ECO1-3700/3	71 [65]	37	50	650x275x285	28.0	6SE9527-1DJ40
ECO1-4500/3	84 [77]	45	60	650x275x285	28.5	6SE9528-4DJ40
ECO1-5500/3	102 [96]	55	75	850x420x310	57.0	6SE9531-0DK40
ECO1-7500/3	138 [124]	75	100	850x420x310	58.5	6SE9531-4DK40
ECO1-9000/3	168 [152]	90	125	850x420x310	60.0	6SE9531-7DK40
ECO1-110K/3*	210	110	150	1480x508x480	155	6SE9532-1EL40
ECO1-132K/3*	260	132	200	1480x508x480	155	6SE9532-6EL40
ECO1-160K/3*	315	160	250	1480x508x480	155	6SE9533-2EL40
ECO1-200K/3*	370	200	300	1480x508x480	155	6SE9533-7EL40
ECO1-250K/3*	510	250	350	2230x870x680	510	6SE9535-1EM40
ECO1-315K/3*	590	315	400	2230x870x680	510	6SE9536-0EM40

\* max voltage 480V, protection IP20



MIDIMASTER Eco IP21 / NEMA1 - Standard 3ph 525-575 V ±15%						
Product	Rated Inverter Output Current	Motor Rating		H x W x D	Weight	Order No.
		(A)	(kW)			
ECO1-400/4	6.1	4	5	450x275x210	11.0	6SE9516-1FG40
ECO1-550/4	9	5.5	7.5	450x275x210	11.5	6SE9521-0FG40
ECO1-750/4	11	7.5	10	450x275x210	11.5	6SE9521-1FG40
ECO1-1100/4	17	11	15	450x275x210	11.5	6SE9521-7FG40
ECO1-1500/4	22	15	20	450x275x210	12.0	6SE9522-2FG40
ECO1-1850/4	27	18.5	25	550x275x210	16.0	6SE9522-7FH40
ECO1-2200/4	32	22	30	550x275x210	17.0	6SE9523-2FH40
ECO1-3000/4	41	30	40	650x275x285	27.5	6SE9524-1FJ40
ECO1-3700/4	52	37	50	650x275x285	28.0	6SE9525-2FJ40
ECO1-4500/4	62	45	60	650x275x285	28.5	6SE9526-2FJ40

MIDIMASTER Eco - IP20/NEMA1 with Integral Class A Filter, 3ph 208-240 V ±10%						
Product	Rated Inverter Output Current	Motor Rating		H x W x D	Weight	Order No.
		(A)	(kW)			
ECO1-550/2	23	5.5	7.5	700x275x210	18	6SE9522-3CG50
ECO1-750/2	28	7.5	10	700x275x210	18	6SE9522-8CG50
ECO1-1100/2	42	11	15	800x275x210	21.5	6SE9524-2CH50
ECO1-1500/2	54	15	20	920x275x285	37	6SE9525-4CJ50
ECO1-1850/2	68	18.5	25	920x275x285	37.5	6SE9526-8CJ50
ECO1-2200/2	80	22	30	920x275x285	37.5	6SE9528-0CJ50
ECO1-3000/2	104	30	40	1150x420x310	85	6SE9531-0CK50
ECO1-3700/2	130	37	50	1150x420x310	85.5	6SE9531-3CK50
ECO1-4500/2	154	45	60	1150x420x310	85.5	6SE9531-5CK50



MIDIMASTER Eco - IP20 / NEMA1 with Integral Class A Filter, 3ph 380 - 460 V ±10%							
Product	Rated Inverter Output Current		Motor Rating		H x W x D	Weight	Order No.
	(A)	[ ]	(kW)	(HP)	(mm)	(kg)	
ECO1-1100/3	23.5	[21]	11	15	700x275x210	18.5	6SE9522-4DG50
ECO1-1500/3	30	[27]	15	20	700x275x210	19	6SE9523-0DG50
ECO1-1850/3	37	[34]	18.5	25	800x275x210	23	6SE9523-7DH50
ECO1-2200/3	43.5	[40]	22	30	800x275x210	24	6SE9524-3DH50
ECO1-3000/3	58	[52]	30	40	920x275x285	38	6SE9525-8DJ50
ECO1-3700/3	71	[65]	37	50	920x275x285	38.5	6SE9527-1DJ50
ECO1-4500/3	84	[77]	45	60	920x275x285	39	6SE9528-4DJ50
ECO1-5500/3	102	[96]	55	75	1150x420x310	87	6SE9531-0DK50
ECO1-7500/3	138	[124]	75	100	1150x420x310	88.5	6SE9531-4DK50
ECO1-9000/3	168	[152]	90	125	1150x420x310	90	6SE9531-7DK50

MIDIMASTER Eco - IP56 (NEMA4/12) 3ph 208- 240 V ±10%							
Product	Rated Inverter Output Current		Motor Rating		H x W x D	Weight	Order No.
	(A)	[ ]	(kW)	(HP)	(mm)	(kg)	
ECO1-110/2	5.5	[ ]	1.1	1.5	675x360x351	30	6SE9515-5CS45
ECO1-150/2	7.4	[ ]	1.5	2.0	675x360x351	30	6SE9517-4CS45
ECO1-220/2	10.4	[ ]	2.2	3.0	675x360x351	30	6SE9521-0CS45
ECO1-300/2	13.6	[ ]	3.0	4.0	675x360x351	30	6SE9521-4CS45
ECO1-400/2	17.5	[ ]	4.0	5.0	675x360x351	30	6SE9521-8CS45
ECO1-550/2	23	[ ]	5.5	7.5	675x360x351	30	6SE9522-3CS45
ECO1-750/2	28	[ ]	7.5	10	675x360x351	30	6SE9522-8CS45
ECO1-1100/2	42	[ ]	11	15	775x360x422	39	6SE9524-2CS45
ECO1-1500/2	54	[ ]	15	20	875x360x483	50	6SE9525-4CS45
ECO1-1850/2	68	[ ]	18.5	25	875x360x783	53.5	6SE9526-8CS45
ECO1-2200/2	80	[ ]	22	30	875x360x783	54	6SE9528-0CS45
ECO1-3000/2	104	[ ]	30	40	1150x500x570	95	6SE9531-0CS45
ECO1-3700/2	130	[ ]	37	50	1150x500x570	96	6SE9531-3CS45
ECO1-4500/2	154	[ ]	45	60	1150x500x570	97	6SE9531-5CS45



MIDIMASTER Eco - IP56 / NEMA4/12 / with Integral Class A Filter, 3ph 208- 240 V ±10%							
Product	Rated Inverter Output Current		Motor Rating		H x W x D	Weight	Order No.
	(A)		(kW)	(HP)	(mm)	(kg)	
ECO1-110/2	5.5		1.1	1.5	675x360x351	34	6SE9515-5CS55
ECO1-150/2	7.4		1.5	2.0	675x360x351	34	6SE9517-4CS55
ECO1-220/2	10.4		2.2	3.0	675x360x351	34	6SE9521-0CS55
ECO1-300/2	13.6		3.0	4.0	675x360x351	34	6SE9521-4CS55
ECO1-400/2	17.5		4.0	5.0	675x360x351	34	6SE9521-8CS55
ECO1-550/2	23		5.5	7.5	675x360x351	34	6SE9522-3CS55
ECO1-750/2	28		7.5	10	675x360x351	34	6SE9522-8CS55
ECO1-1100/2	42		11	15	775x360x422	43	6SE9524-2CS55
ECO1-1500/2	54		15	20	875x360x483	58	6SE9525-4CS55
ECO1-1850/2	68		18.5	25	875x360x783	61	6SE9526-8CS55
ECO1-2200/2	80		22	30	875x360x783	62	6SE9528-0CS55
ECO1-3000/2	104		30	40	1150x500x570	105	6SE9531-0CS55
ECO1-3700/2	130		37	50	1150x500x570	106	6SE9531-3CS55
ECO1-4500/2	154		45	60	1150x500x570	107	6SE9531-5CS55

MIDIMASTER Eco - IP56 (NEMA 4/12) 3ph 380 -500 V ±10%							
Product	Rated Inverter Output Current		Motor Rating		H x W x D	Weight	Order No.
	400V	[500V] (A)	(kW)	(HP)	(mm)	(kg)	
ECO1-300/3	7.7	[6.9]	3	4	675x360x351	29	6SE9517-7DS45
ECO1-400/3	10.2	[9.1]	4	5	675x360x351	29	6SE9521-0DS45
ECO1-550/3	13.2	[11.8]	5.5	7.5	675x360x351	29	6SE9521-3DS45
ECO1-750/3	17	[15.2]	7.5	10	675x360x351	29	6SE9521-7DS45
ECO1-1100/3	23.5	[21]	11	15	675x360x351	29	6SE9522-4DS45
ECO1-1500/3	30	[27]	15	20	675x360x351	30	6SE9523-0DS45
ECO1-1850/3	37	[34]	18.5	25	775x360x422	39	6SE9523-7DS45
ECO1-2200/3	43.5	[40]	22	30	775x360x422	40	6SE9524-3DS45
ECO1-3000/3	58	[52]	30	40	875x360x483	50	6SE9525-8DS45
ECO1-3700/3	71	[65]	37	50	875x360x483	52	6SE9527-1DS45
ECO1-4500/3	84	[77]	45	60	875x360x483	54	6SE9528-4DS45
ECO1-5500/3	102	[96]	55	75	1150x500x570	97	6SE9531-0DS45
ECO1-7500/3	138	[124]	75	100	1150x500x570	99	6SE9531-4DS45
ECO1-9000/3	168	[152]	90	125	1150x500x570	100	6SE9531-7DS45



MIDIMASTER Eco - IP56/NEMA4/12 with Integral Class A Filter, 3ph 380 -460 V ±10%							
Product	Rated Inverter Output Current		Motor Rating		H x W x D	Weight	Order No.
	(A)		(kW)	(HP)	(mm)	(kg)	
ECO1-300/3	7.7	[6.9]	3	4	675x360x351	33	6SE9517-7DS55
ECO1-400/3	10.2	[9.1]	4	5	675x360x351	33	6SE9521-0DS55
ECO1-550/3	13.2	[11.8]	5.5	7.5	675x360x351	33	6SE9521-3DS55
ECO1-750/3	17	[15.2]	7.5	10	675x360x351	33	6SE9521-7DS55
ECO1-1100/3	23.5	[21]	11	15	675x360x351	33	6SE9522-4DS55
ECO1-1500/3	30	[27]	15	20	675x360x351	34	6SE9523-0DS55
ECO1-1850/3	37	[34]	18.5	25	775x360x422	43	6SE9523-7DS55
ECO1-2200/3	43.5	[40]	22	30	775x360x422	44	6SE9524-3DS55
ECO1-3000/3	58	[52]	30	40	875x360x483	58	6SE9525-8DS55
ECO1-3700/3	71	[65]	37	50	875x360x483	60	6SE9527-1DS55
ECO1-4500/3	84	[77]	45	60	875x360x483	62	6SE9528-4DS55
ECO1-5500/3	102	[96]	55	75	1150x500x570	107	6SE9531-0DS55
ECO1-7500/3	138	[124]	75	100	1150x500x570	109	6SE9531-4DS55
ECO1-9000/3	168	[152]	90	125	1150x500x570	110	6SE9531-7DS55

MIDIMASTER Eco - IP56 (NEMA 4/12) 3ph 525 - 575 V ±10%							
Product	Rated Inverter Output Current		Motor Rating		H x W x D	Weight	Order No.
	(A)		(kW)	(HP)	(mm)	(kg)	
ECO1-400/4	6.1		4	5	675x360x351	28	6SE9516-1FS45
ECO1-550/4	9		5.5	7.5	675x360x351	29	6SE9521-0FS45
ECO1-750/4	11		7.5	10	675x360x351	29	6SE9521-1FS45
ECO1-1100/4	17		11	15	675x360x351	29	6SE9521-7FS45
ECO1-1500/4	22		15	20	675x360x351	30	6SE9522-2FS45
ECO1-1850/4	27		18.5	25	775x360x422	39	6SE9522-7FS45
ECO1-2200/4	32		22	30	775x360x422	40	6SE9523-2FS45
ECO1-3000/4	41		30	40	875x360x483	50	6SE9524-1FS45
ECO1-3700/4	52		37	50	875x360x483	52	6SE9525-2FS45
ECO1-4500/4	62		45	60	875x360x483	54	6SE9526-2FS45



## OPTIONS

You can use a range of specially designed options, from the following tables, to enhance the MICROMASTER Eco and MIDIMASTER Eco Inverters.

Options	Order no.	IP Rating	Inverter	
			MICROMASTER Eco	MIDIMASTER Eco
EMC Filter for EN55011A / EN61800-3	See Following Pages and Section 15	IP20	Footprint	Integrated or external
EMC Filter for EN55011 B	See Following Pages and Section 15	IP20	Footprint	External
Multilingual Clear Text Operator Panel (OPe)	6SE9590-0XX87-8BF0	IP54	Available	Available
Panel Mounting Cable Kit (3m) for Multilingual Clear Text Operator Panel (OPe)	6SE3290-0XX87-8PK0	IP20	Available - End March 1999	
SIMOVIS Version 5.2 Software database program – for commissioning and parameter set upread / download & storage.	6SE3290-0XX87-8SA2	n.a.	Available - End March 1999	
Interface Cable Kit for connecting a PC to the OPe RS232 communications port.	6SE3290-0XX87-8SK0	IP20	Available	
Mains input reactors	See Section 15.	IP00	Available	Available



## EMC-Filters for MICROMASTER Eco (IP20 only)

Inverter Type	Filter Type	Order no.	Filter Type
			Class
ECO1-75/2 - ECO1-110/3 - ECO1-150/3	Footprint	6SE3290-0DA87-0FA1	A
ECO1-110/2 - ECO1-150/2 - ECO1-220/3 - ECO1-300/3	Footprint	6SE3290-0DB87-0FA3	A
ECO1-220/2 - ECO1-300/2 - ECO1-400/2 - ECO1-400/3 - ECO1-550/3 - ECO1-750/3	Footprint	6SE3290-0DC87-0FA4	A
ECO1-110/3 - ECO1-150/3	Footprint	6SE3290-0DA87-0FB1	B
ECO1-110/2 - ECO1-150/2 - ECO1-220/3 - ECO1-300/3	Footprint	6SE3290-0DB87-0FB3	B
ECO1-220/2 - ECO1-300/2 - ECO1-400/2 - ECO1-400/3 - ECO1-550/3 - ECO1-750/3	Footprint	6SE3290-0DC87-0FB4	B

Note: Certain ratings of MICROMASTER Eco may be supplied with factory integrated Class A filters – consult tables in section 5.

## EMV-Filters for MIDIMASTER Eco (IP21 & IP56)

Inverter Type	Filter Type	Order no.	Filter Type
			Class
ECO1-110/2* - ECO1-150/2* - ECO1-300/3* - ECO1-220/2* - ECO1-300/2* - ECO1-400/2* - ECO1-400/3* - ECO1-550/3* - ECO1-750/3* - ECO1-550/2 - ECO1-750/2 - ECO1-1100/3 - ECO1-1500/3	External Filter	6SE3290-0DG87-0FA5	A
ECO1-1100/2 – ECO1-1850/3 – ECO1-2200/3	External Filter	6SE3290-0DH87-0FA5	A
ECO1-1500/2 – ECO1-1850/2 – ECO1-2200/2 - ECO1-3000/3 - ECO1-3700/3 - ECO1-4500/3	External Filter	6SE3290-0DJ87-0FA6	A
ECO1-3000/2 – ECO1-3700/2 – ECO1-4500/2 - ECO1-5500/3 - ECO1-7500/3 - ECO1-9000/3	External Filter	6SE3290-0DK87-0FA7	A
ECO1-110K/3, ECO1-132K/3, ECO1-160K/3	External Filter	6SE7033-2ES87-0FA1	A
ECO1-200K/3, ECO1-250K/3, ECO1-315K/3	External Filter	6SE7036-OES87-0FA1	A
ECO1-110/2* - ECO1-150/2* - ECO1-300/3* - ECO1-220/2* - ECO1-300/2* - ECO1-400/2* - ECO1-400/3* - ECO1-550/3* - ECO1-750/3* - ECO1-550/2 - ECO1-750/2 - ECO1-1100/2 - ECO1-1100/3 – ECO1-1500/3 - ECO1-1850/3 – ECO1-2200/3	External Filter	6SE2100-1FC20	B
ECO1-1500/2 – ECO1-1850/2 – ECO1-2200/2 - ECO1-3000/3 - ECO1-3700/3	External Filter	6SE2100-1FC21	B
ECO1-3000/2, ECO1-3700/2, ECO1-4500/2, ECO1-4500/3, ECO1-5500/3, ECO1-7500/3, ECO1-9000/3	External Filter	6SE3290-ODK87-OFB7	B

Notes: \* denotes IP56 protected MIDIMASTER Eco only  
 Class A MIDIMASTER Eco Filters may be installed within IP56 MIDIMASTER Eco units.  
 Class B MIDIMASTER Eco Filters are for external stand-alone installation only.  
 Certain ratings of MIDIMASTER Eco may be supplied with factory integrated Class A filters – consult tables in section 5.



## Mains Input Reactors for MIDIMASTER Eco

Inverter	Input Line Reactor (2%) 2% for low impedance supplies	Dimensions (HxWxD) mm	Weight (kg)
	<b>208 V – 240 V 50/60 Hz</b>		
ECO1-75/2	4EP3200-1US	108x88.5x57.5	0.7
ECO1-110/2	4EP3200-1US	108x88.5x57.5	0.7
ECO1-150/2	4EP3400-2US	122x124x73	1.4
ECO1-220/2	4EP3400-1US	122x124x73	1.4
ECO1-300/2	4EP3500-0US	139x148x68	1.9
ECO1-400/2	4EP3600-4US	139x148x78	2.5
ECO1-550/2	4EP3600-5US	139x148x78	2.8
ECO1-750/2	4EP3700-2US	159x178x73	3.3
ECO1-1100/2	4EP3800-2US	193x178x88	4
ECO1-1500/2	4EP3800-7US	153x178x88	5
ECO1-1850/2	4EP3900-2US	181x219x99	6.5
ECO1-2200/2	4EP3900-2US	181x219x99	6.5
ECO1-3000/2	4EP4000-2US	181x219x119	8.2
ECO1-3700/2	4EU2451-2UA00	220x206x105	12.0
ECO1-4500/2	4EU2551-4UA00	220x206x128	15.3
	<b>380V 50Hz- 500V 60Hz (500V 50Hz)</b>		
ECO1-110/3	4EP3200-1US [4EP3200-2US]	108x88.5x57.5	0.7
ECO1-150/3	4EP3200-1US [4EP3200-1US]	108x88.5x57.5	0.7
ECO1-220/3	4EP3400-2US [4EP3200-2US]	122x124x73 (108x88.5x57.5)	1.3
ECO1-300/3	4EP3400-1US [4EP3300-0US]	122x124x73 (122x124x64)	1.4
ECO1-400/3	4EP3400-1US [4EP3400-3US]	122x124x73	1.4
ECO1-550/3	4EP3500-0US [4EP3600-8US]	139x148x68 (139x148x78)	1.9
ECO1-750/3	4EP3600-4US [4EP3600-2US]	139x148x78	2.5
ECO1-1100/3	4EP3600-5US (4EP3600-3US)	139x148x78	2.8
ECO1-1500/3	4EP3700-2US (4EP3700-6US)	159x178x73	3.3
ECO1-1850/3	4EP3700-5US (4EP3700-1US)	159x178x73	3.8
ECO1-2200/3	4EP3800-2US (4EP3801-2US)	193x178x88	4
ECO1-3000/3	4EP3800-7US (4EP3900-1US)	153x178x88 (181x219x99)	5
ECO1-3700/3	4EP3900-2US (4EP4000-1US)	181x219x99 (181x219x119)	6.5
ECO1-4500/3	4EP4000-2US (4EP4000-8US)	181x219x119	8.2
ECO1-5500/3	4EP4000-6US (4EP4000-8US)	181x219x119	9.6
ECO1-7500/3	4EU2451-2UA00 (4EU2551-2UA00)	220x206x105 (220x206x128)	12
ECO1-9000/3	4EU2551-4UA00 (4EU2551-6UA00)	220x206x128	15.3





Inverter	Input Line Reactor (2%) 2% for low impedance supplies	Dimensions (HxWxD) mm	Weight (kg)
	<b>380V 50Hz- 480V 60Hz</b>		
ECO1-110K/3	4EU2551-8UA00	220x206x128	16.4
ECO1-132K/3	4EU2751-0UB00	250x235x146	22.8
ECO1-160K/3	4EU2751-7UA00	250x235x146	23
ECO1-200K/3	4EU2751-8UA00	250x235x146	26.8
ECO1-250K/3	4EU3051-5UA00	280x264x155	38.2
ECO1-315K/3	4EU3051-6UA00	280x264x155	40.3
	<b>525V- 575V 50/60Hz</b>		
ECO1-400/4	4EP3400-3US	122x124x73	1.3
ECO1-550/4	4EP3600-8US	139x148x78	2.3
ECO1-750/4	4EP3600-2US	139x148x78	2.5
ECO1-1100/4	4EP3600-3US	139x148x78	2.4
ECO1-1500/4	4EP3700-6US	159x178x73	3.4
ECO1-1850/4	4EP3700-1US	159x178x73	3.7
ECO1-2200/4	4EP3801-2US	193x178x88	4.2
ECO1-3000/4	4EP3800-1US	193x178x88	4.6
ECO1-3700/4	4EP3900-1US	181x219x99	6.4
ECO1-4500/4	4EP4000-7US	181x219x119	7.7



Inverter	Input Line Reactor (4%) 4% for reduction of harmonic currents (& low impedance supplies)	Dimensions (HxWxD) mm	Weight (kg)
	<b>208 V - 240 V 50/60 Hz</b>		
ECO1-75/2	4EP3200-1US	108x88.5x57.5	0.7
ECO1-110/2	4EP3200-1US	108x88.5x57.5	0.7
ECO1-150/2	4EP3400-1US	122x124x73	1.3
ECO1-220/2	4EP3400-1US	122x124x73	1.4
ECO1-300/2	4EP3500-0US	139x148x68	1.9
ECO1-400/2	4EP3600-4US	139x148x78	2.4
ECO1-550/2	4EP3600-5US	139x148x78	2.8
ECO1-750/2	4EP3700-2US	159x178x73	3.3
ECO1-1100/2	4EP3800-2US	193x178x88	4
ECO1-1500/2	4EP3800-7US	153x178x88	5
ECO1-1850/2	4EP3900-2US	181x219x99	6.5
ECO1-2200/2	4EP3900-2US	181x219x99	6.5
ECO1-3000/2	4EP4000-2US	181x219x119	8.2
ECO1-3700/2	4EU2451-2UA00	220x206x105	12.0
ECO1-4500/2	4EU2551-4UA00	220x206x128	15.3
ECO1-110/3	3x4EM4605-4CB	61x51x73 each	0.5
	<b>380V 50Hz- 500V 60Hz (500V 50Hz)</b>		
ECO1-150/3	3x4EM4605-6CB	61x51x73 each	0.5
ECO1-220/3	3x4EM4605-6CB	79x69x86 each	1.0
ECO1-300/3	3x4EM4807-4CB	79x69x86 each	1.0
ECO1-400/3	3x4EM4807-6CB	79x69x86 each	1.1
ECO1-550/3	4EP3700-7US [4EP3800-8US]	159x178x73 (159x178x88)	3.3
ECO1-750/3	4EP3801-0US [4EP3800-8US]	193x178x88	3.8
ECO1-1100/3	4EP3900-5US [4EP4001-0US]	181x219x99 (181x219x119)	6.1
ECO1-1500/3	4EP3900-5US [4EP4001-0US]	181x219x99 (181x219x119)	6.1
ECO1-1850/3	4EP4001-1US [4EP4001-2US]	220x219x119	7.6
ECO1-2200/3	4EU2451-4UA00 [4EU2451-5UA00]	220x206x104 (220x206x104)	4.6
ECO1-3000/3	4EU2451-4UA00 [4EU2551-1UB00]	220x206x104 (220x206x104)	11.1
ECO1-3700/3	4EU2551-2UB00 [4EU2551-3UB00]	220x206x128 (220x206x128)	15.5
ECO1-4500/3	4EU2751-1UB00 [4EU2551-3UB00]	250x235x146 (220x206x128)	16.7
ECO1-5500/3	4EU2751-1UB00 [4EU2751-3UB00]	250x235x146 (250x235x146)	23.4
ECO1-7500/3	4EU2751-1UB00 [4EU2751-6UB00]	250x235x146 (250x235x146)	22.8
ECO1-9000/3	4EU2751-2UB00 [4EU3051-0UB00]	250x235x146 (280x264x155)	24.2



Inverter	Input Line Reactor (4%) 4% for reduction of harmonic currents (& low impedance supplies)	Dimensions (HxWxD) mm	Weight (kg)
	<b>380V 50Hz- 480V 60Hz</b>		
ECO1-110K/3	4EU2751-5UB00	250x235x146	25.5
ECO1-132K/3	4EU3051-7UA00	280x264x155	37
ECO1-160K/3	4EU3051-3UB00	280x264x155	39
ECO1-200K/3	4EU3651-3UB00	335x314x169	47.1
ECO1-250K/3	4EU3651-4UB00	335x314x169	55.2
ECO1-315K/3	4EU3651-6UC00	335x314x169	58
	<b>525V- 575V 50/60Hz</b>		
ECO1-400/4	3x4EM4807-1CB	79x69x86 each	1.1
ECO1-550/4	3x4EM4911-7CB	85x85x91 each	1.8
ECO1-750/4	4EP3800-8US	193x178x88	5
ECO1-1100/4	4EP3800-8US	193x178x88	5
ECO1-1500/4	4EP4001-0US	181x219x119	8.8
ECO1-1850/4	4EP4001-0US	181x219x119	8.8
ECO1-2200/4	4EP4001-2US	181x219x119	8.3
ECO1-3000/4	4EP4001-2US	181x219x119	8.3
ECO1-3700/4	4EU2551-1UB00	220x206x128	15.5
ECO1-4500/4	4EU2551-1UB00	220x206x128	15.5

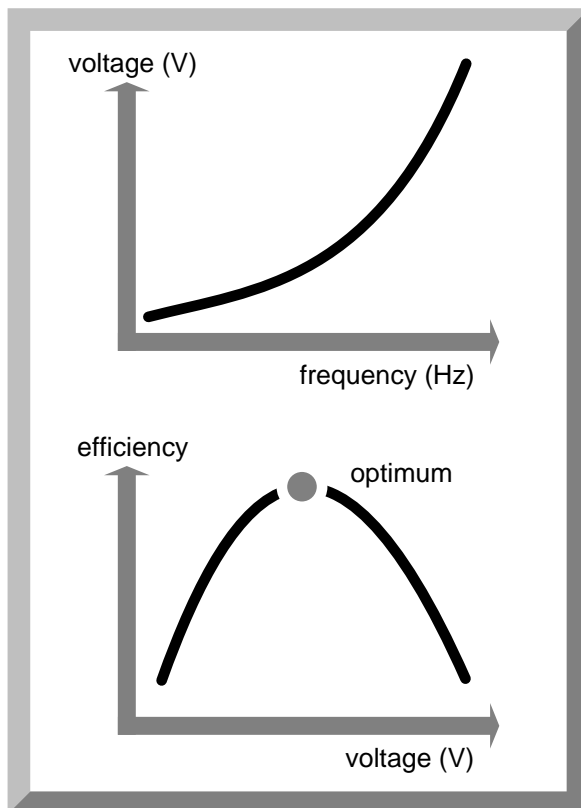


## 6. ENERGY SAVING PROGRAM

### ENERGY CONTROL OPTIMIZATION (P077)

This feature provides :

- “Energy Control Optimization” (Eco)
- Automatically increases and decreases motor voltage in order to search for the minimum power consumption
- Operates when the setpoint speed is reached
- Factory default setting



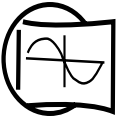
The Eco starts to analyse the power consumption of the motor as soon as the motor has reached setpoint speed (i.e. when acceleration is complete).

It then begins to search for the optimum efficiency (lowest power consumption) by slightly lowering or raising the output voltage to the motor.

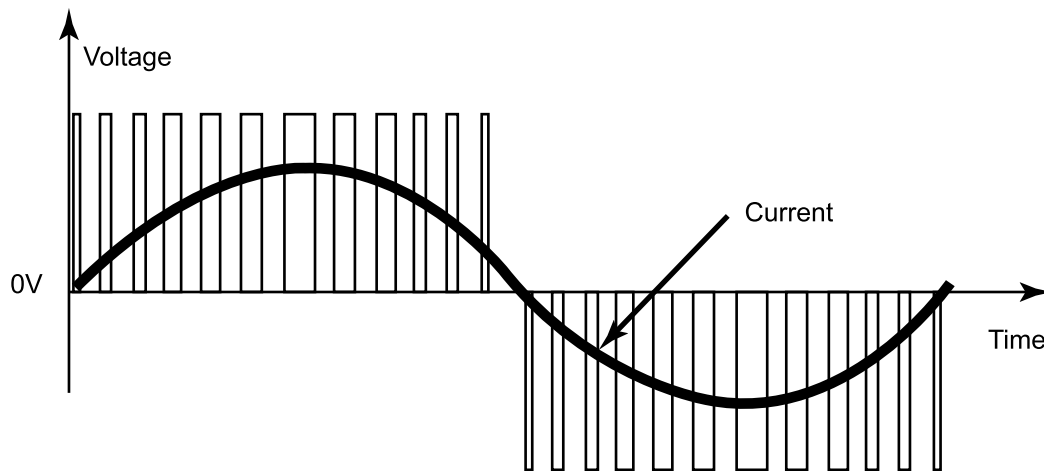
For example, if the Eco detects that the power consumption is increasing as it is increasing the voltage to the motor, then the control strategy will begin to decrease the output motor voltage in search of the lowest power consumption level. The converse of this will also apply, again to automatically determine the lowest power consumption level.

The Control Mode (P077=4) is set to Energy Control Optimisation as the factory default.

The amount of additional energy saved using this optimisation technique can vary considerably and is dependent on motor loading, motor type and duty cycle. Typical additional savings can be between 2% and 5%.



## 7. PULSE WIDTH MODULATION (PWM) OUTPUT METHOD



Pulse Width Modulation

### SWITCHING FREQUENCY FOR LOW MOTOR NOISE

- PWM (pulse width modulation) switching frequency adjustable from 2kHz to 16kHz
- 16kHz (Generally above audible frequency)
- The pulse width modulation (PWM) switching frequency used is proportional to the heating and energy losses within the inverter. The higher the switching frequency the greater is the amount of heat produced by the inverter output devices (IGBTs). An overtemperature trip can result if the inverter is operating close to its maximum rated temperature and is fully loaded.
- The Eco unit automatically optimizes switching frequency whenever possible for motor noise reduction
- Lowers switching frequency if heat sink temperature exceeds limits
- Once heat sink temperature returns to normal, switching frequency returns to setting

Larger MIDIMASTER Eco units may be restricted from operating above 4kHz. Refer to parameter P076 which shows output current restrictions associated with switching frequency.

## 8. Eco SELECTION CRITERIA - SIZE, TYPE ETC.

Generally, drive selection is straightforward, as the motor rating is already known and the speed range requirements are either pre-determined, or easily identified and accomplished. However, when a drive system is selected from first principles, careful consideration may avoid problems in installation and operation, and may also generate significant cost savings.

### OVERALL CONSIDERATIONS

- Make sure that the Current rating of the inverter is compatible with the name plate current rating of motor - power rating can be used as a rough guide.
- Check that you have selected the correct operating voltage and that the motor terminals are configured correctly.
- Make sure that the speed range you require is attainable. Operation above normal supply frequency (50 or 60Hz) is usually only possible at reduced power. Operation at low frequency and high torque (not normally a characteristic of fans and pumps) can cause the motor to overheat unless provision is made for additional cooling.
- Do you need to operate with cables longer than 100m, or screened or armoured cables longer than 50m ?. If so, it may be necessary to de-rate the inverter, or fit a choke to compensate for the cable capacitance. See section 14 for motor cable length details.
- The Eco is only intended for use with centrifugal pumps and fans see p 8-8 for further information.

### SUPPLY SIDE REQUIREMENTS

To achieve maximum reliability and optimum performance, the main power supply to the inverter system must be suited to the inverter. The following points should be considered:

### SUPPLY TOLERANCE

The inverters are designed to operate on a wide range of supply voltages as follows:

208 - 240 V +/- 10%

380 - 460/480/500 V +/- 10%

525 - 575 V +/- 15%

Inverters will operate over a supply frequency of 47 - 63 Hz.

Many supplies vary outside these levels. For example:

- Supply voltages at the end of long power lines in remote areas can rise excessively in the evening and weekends when large loads are no longer present.
- Industries with locally controlled and generated supplies can have poor voltage regulation and control.
- Power systems in certain parts of the world may not meet the inverter input voltage tolerances.

In all installations, check that the supply will remain within the voltage tolerances stated above. Operation outside of the stated supply levels may cause damage and give unreliable operation.



Selection Criteria

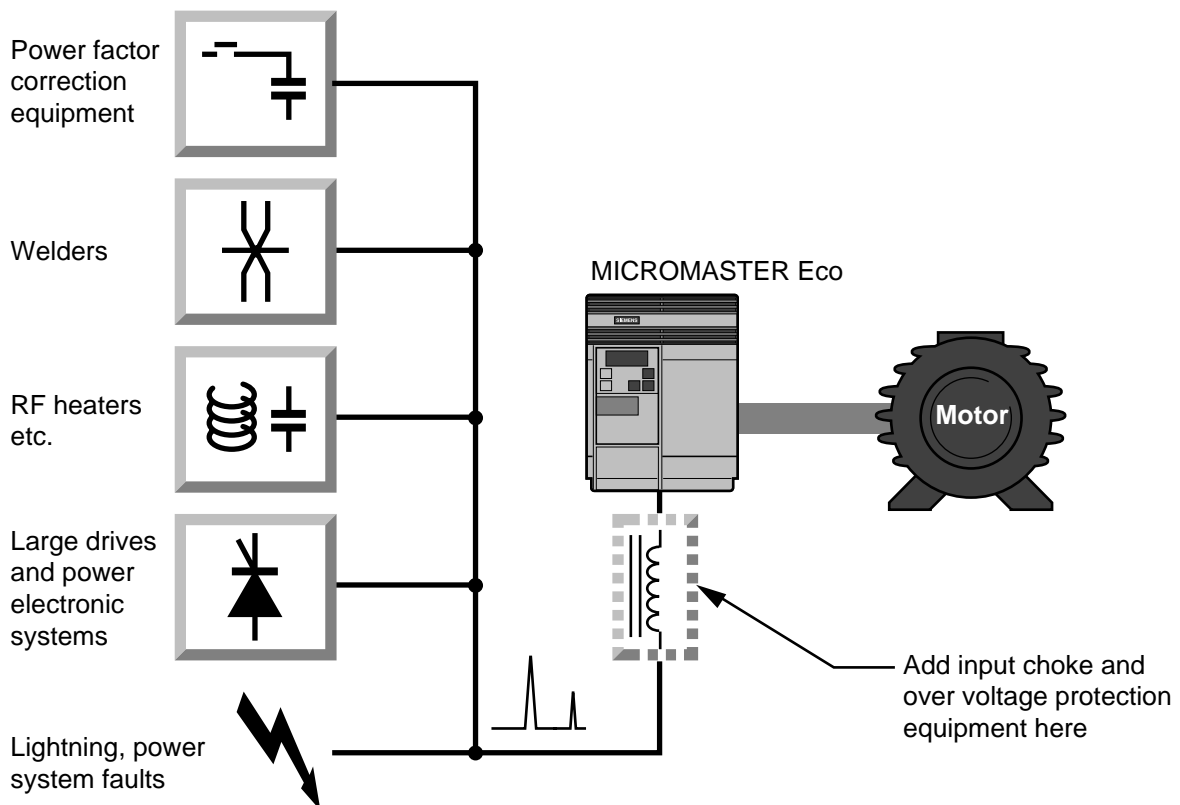
## SUPPLY DISTURBANCE

Many supplies are well controlled and remain in tolerance, but are affected by local disturbances. These can cause faulty operation and damage to inverters. In particular, check for:

- Power Factor Correction equipment. Unsuppressed switching of capacitor banks can produce very large voltage transients and is a common cause of inverter damage.
- High power welding equipment, especially resistance and RF welders.
- Other drives, semiconductor heater controllers etc.

*The inverter is designed to absorb a high level of supply disturbance - for instance, voltage spikes up to 2kV. However, the above equipment can cause power supply disturbances in excess of this. It will be necessary to suppress this interference - preferably at source - or at least by the installation of an input choke in the inverter supply. EMC filters do not suppress disturbances with this level of energy. Over-voltage protection products such as metal oxide varistors should also be considered in extreme cases.*

Damage can also be caused by local supply faults and the effects of electrical storms. In areas where these are expected, similar precautions are recommended.





## UNGROUNDING SUPPLIES

Certain installations need to operate with supplies that are isolated from the protective earth (IT supply). This permits equipment to continue to run following a line to earth fault. However, MICROMASTER Eco and MIDIMASTER Eco are designed to normally operate on grounded supplies and are fitted with interference suppression capacitors between the supply and ground. Preventative measures (see below) should be used on ungrounded supplies. Please consult Siemens for further clarification.

## LOW FREQUENCY HARMONICS

The inverter converts the AC supply to DC using an uncontrolled diode rectifier bridge. The DC link voltage is close to the peak AC supply voltage, so the diodes only conduct for a short time at the peak of the AC waveform.

The current waveform therefore has a relatively high RMS value as a high current flows from the supply for a short time.

For typical harmonic details, refer to Section 15 and page 8 - 5.

## MICROMASTER Eco

MICROMASTER can be used on unearthed supplies if connected through an isolating transformer.

Alternatively they may also be connected directly to the unearthed supply, but the inverter may then shut down (F002) if an output earth fault develops.

## MIDIMASTER Eco

The 380/500V models are suitable for use on unearthed supplies at a maximum switching frequency of 2kHz (P076 = 6 or 7). This is to prevent the input Y capacitors from overheating in the event of an earth fault on the Eco output.

The MIDIMASTER Eco will continue to operate normally under earth fault conditions at the MIDIMASTER Eco input.

Earth fault monitoring on the input supply, capable of detecting an earth fault on the motor output, is recommended.

## EMC FILTER RESTRICTIONS FOR ALL PRODUCTS

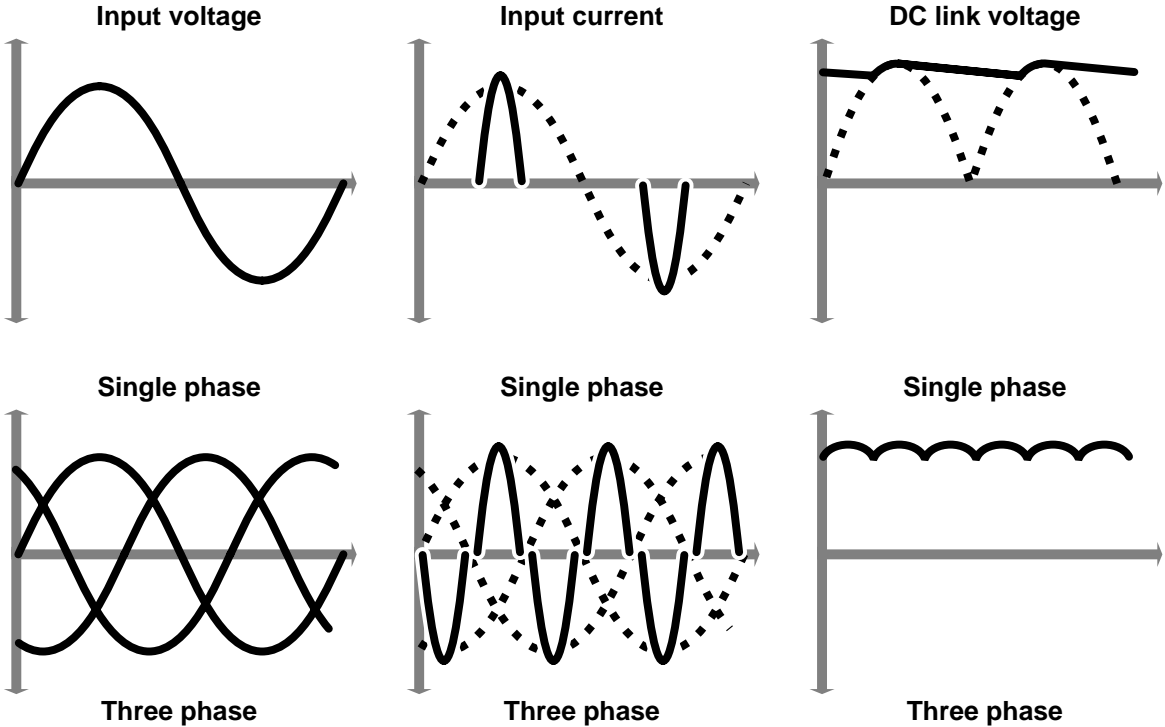
The input RFI suppression filters **cannot** be used on unearthed supplies since they are designed for earthed supplies only. Many unearthed supplies are only intended for industrial users (particularly 500V ones), and EN61800-3 does not impose any emissions limits in such applications. Therefore a filter may not be required in any case.

The EMC tests have been carried out according to EN61800-3 on earthed supplies. The test results will not be valid for unearthed supplies.





Selection Criteria



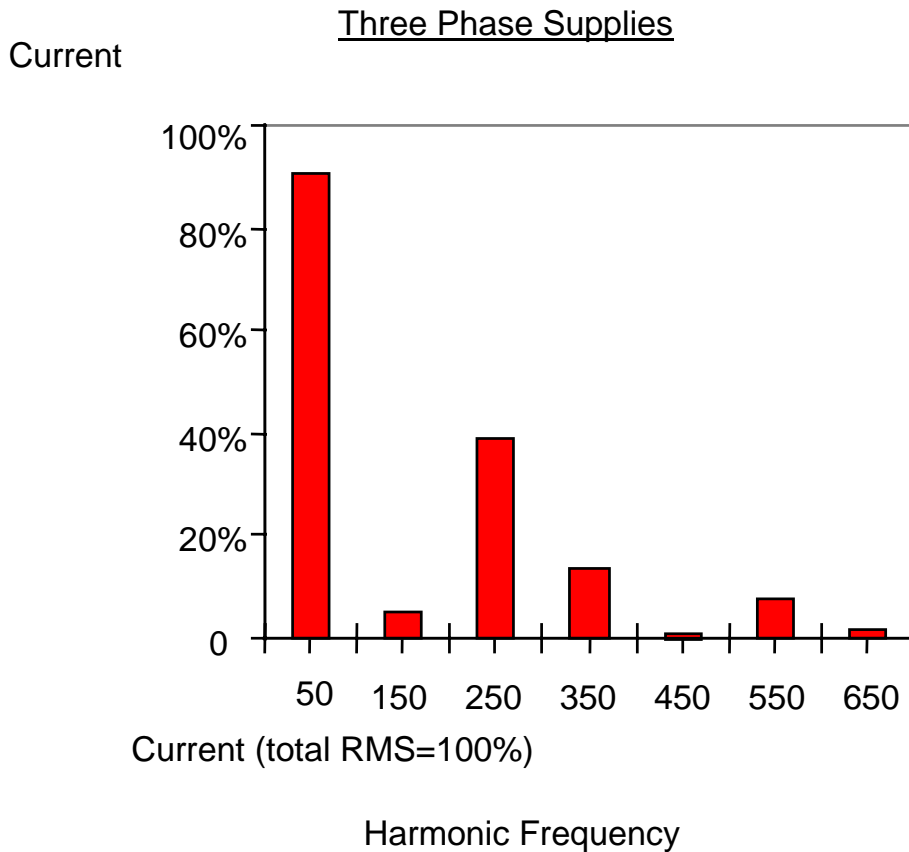


This means that the input current waveform consists of a series of low frequency harmonics, and this may in turn cause voltage harmonic distortion, depending on the supply impedance.

Sometimes these harmonics need to be assessed in order to ensure that certain levels are not exceeded. Excessive harmonic levels can cause high losses in transformers, and may interfere with other equipment. In any case, the rating and selection of cabling and protection equipment must take into account these high RMS levels. Some typical measured harmonic levels are shown below.

In order to calculate the harmonics in a particular supply system it is essential that the supply impedance is known. This is usually stated in terms of fault current levels, transformer size, and installed impedance such as line inductors etc. The addition of input line chokes reduces the level of harmonic currents and also reduces the overall RMS current as well as improving the overall power factor.

Where supplies have very low impedance (such as below 1%) an input inductor is recommended in any case to limit peak currents in the drive.



Typical Harmonic content - Measured Results (50Hz supply)



Selection Criteria

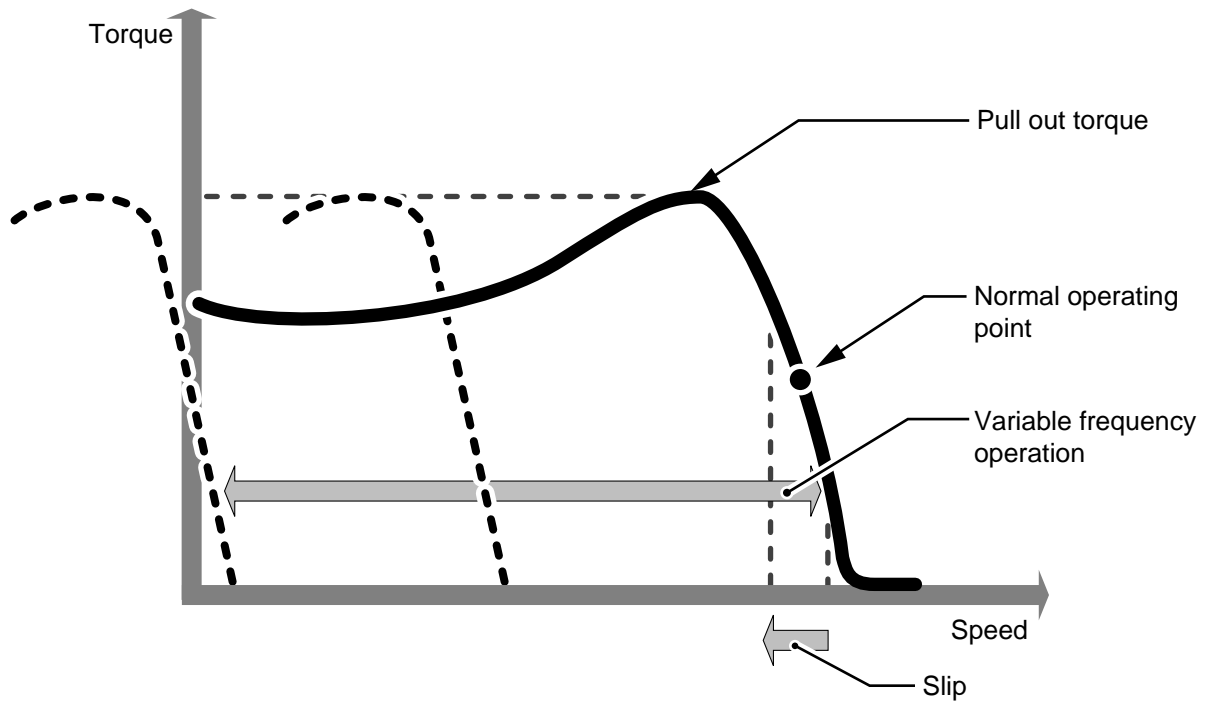
## MOTOR LIMITATIONS

The motor speed is determined mainly by the applied frequency. The motor slows down a little as the load increases and the slip increases. If the load is too great the motor will exceed the maximum torque and stall or 'pull out'.

The standard induction motor is cooled by a built in fan connected directly to the shaft that runs at motor speed. This is designed to cool the motor at full load and name plate rated speed. If a motor runs at a lower frequency and at full torque - that is high current not normally an operating condition of pumps and fans - motor cooling may

be inadequate. Motor manufacturers generally give the necessary de-rating information, but a typical de-rating curve would limit output torque at zero frequency rising to full output torque capability at 50% of nameplate rated speed (see diagram). Ensure that these limitations are not exceeded for long term operation.

*Use the  $I^2t$  function to help protect the motor (See P074 in parameter descriptions ) or consider using a motor with built in thermal protection such as a thermistor (PTC).*





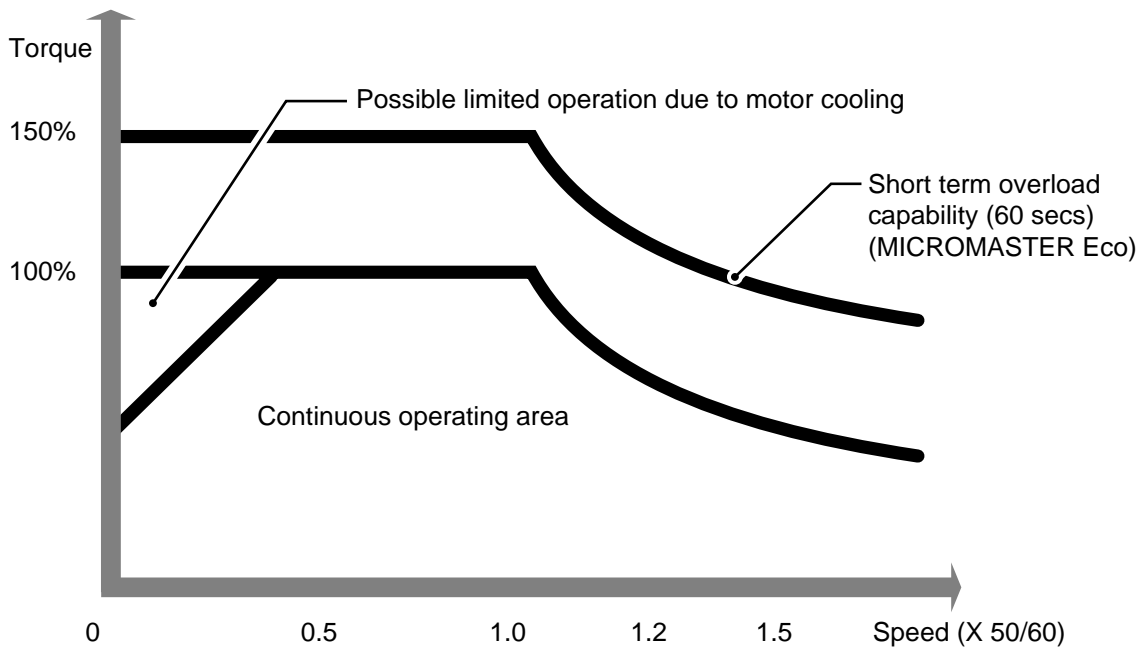
High speed operation of standard motors is usually limited to twice the normal operating speed (i.e. up to 6000 or 7200 rpm) of a two pole motor because of bearing limitations. However, because the motor magnetic flux level will reduce above base speed (because the output voltage is limited to approximately the input voltage) the maximum torque will also fall in inverse proportion to the speed above base speed.

It is not usually possible to operate a fan or pump motor over its base speed since the torque (current) requirement will increase proportionally to the square of the speed.

However, if a motor is connected as a low voltage motor (delta connected motor windings) and operated on a higher voltage inverter, full torque may be obtained up to 1.7 times base frequency if the inverter is correctly set up. Obtain the correct voltage/frequency curve by setting the motor parameters as follows:

P081= 87

P084= 400 Hz (or to suit supply)



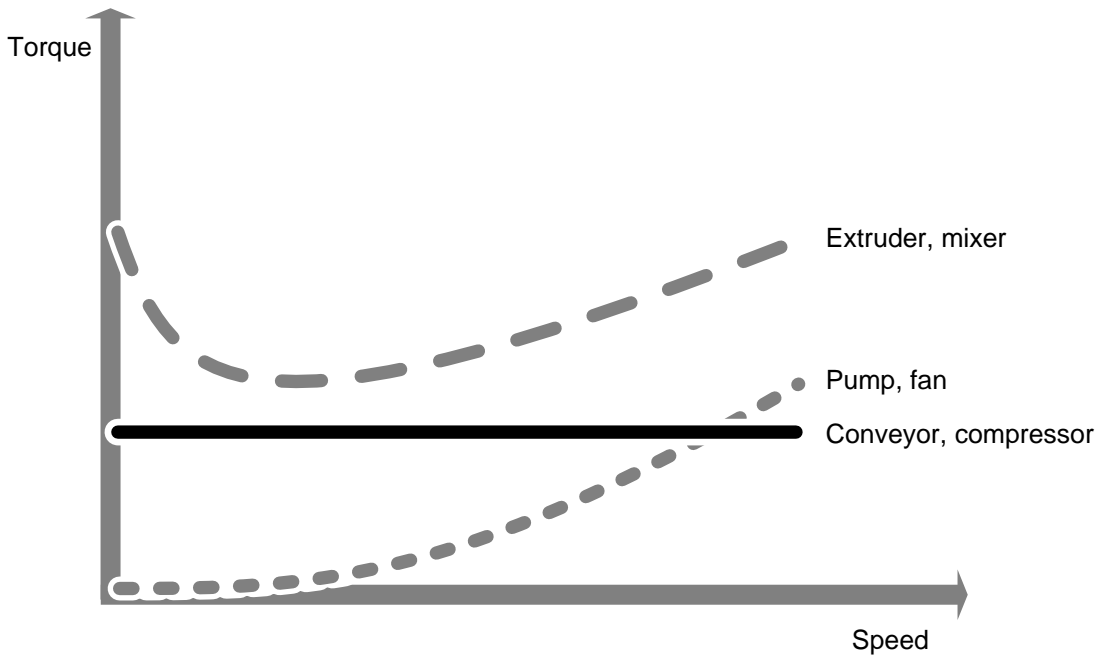


Selection Criteria

## LOAD CONSIDERATIONS

The inverter and motor requirements are determined by the speed range and torque requirements of the load. The relationship between speed and torque is different for different loads. Many loads can be considered to be constant torque loads. That is, the torque remains the same over the operating speed range. Typical constant torque loads are compressors, positive displacement pumps and conveyors.

These constant torque loads are generally not suited to the MICROMASTER Eco since it is rated only for variable torque loads such as pumps and fans.



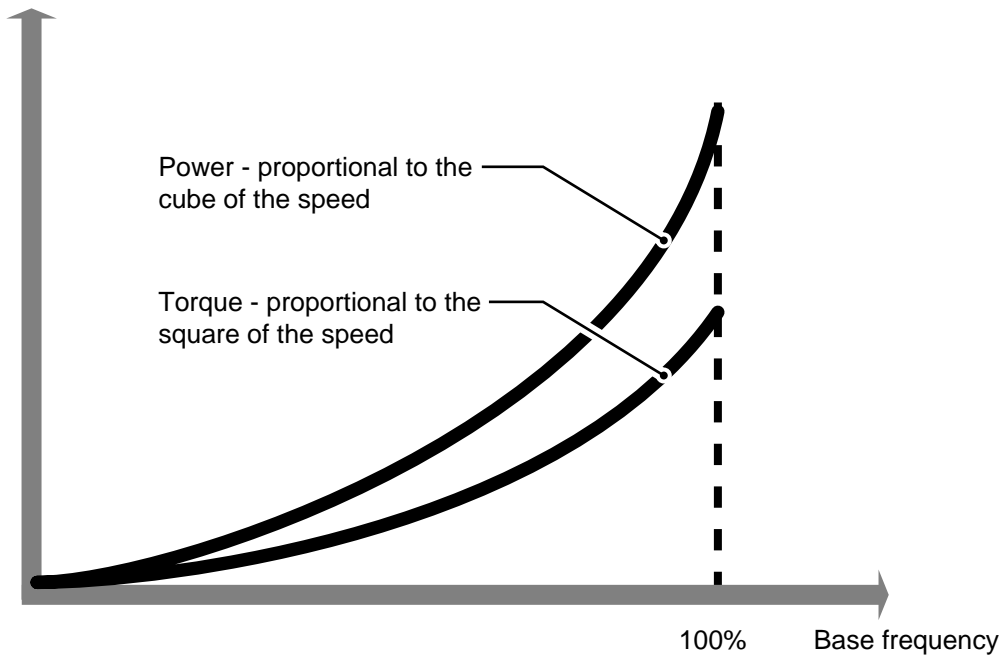
**VARIABLE TORQUE APPLICATIONS**

Some loads have a Variable Torque characteristic, that is, the torque increases with the speed. Typical variable torque loads are centrifugal pumps and fans. In these applications the load is proportional to the square of the speed, and therefore the power is proportional to the cube of the speed. This means that at reduced speeds there is a great reduction in power and therefore energy saving - a major advantage of variable speed drives applied to pumps and fans. For example, a 10% reduction in speed will give a theoretical 35% reduction on power!

Because the power is greatly reduced, the voltage applied to the motor can also be reduced and additional energy saving achieved. A 'quadratic' or 'pump and fan' voltage to frequency relationship is a factory default within the MICROMASTER Eco and MIDIMASTER Eco.

It is not generally useful to run pumps or fans above base speed as the power will rise excessively and the fan or pump may become inefficient or damaged.

MIDIMASTER Eco are therefore variable torque rated for pump and fan operation can give an additional capital cost saving in these applications.





Selection Criteria

## OTHER LOADS

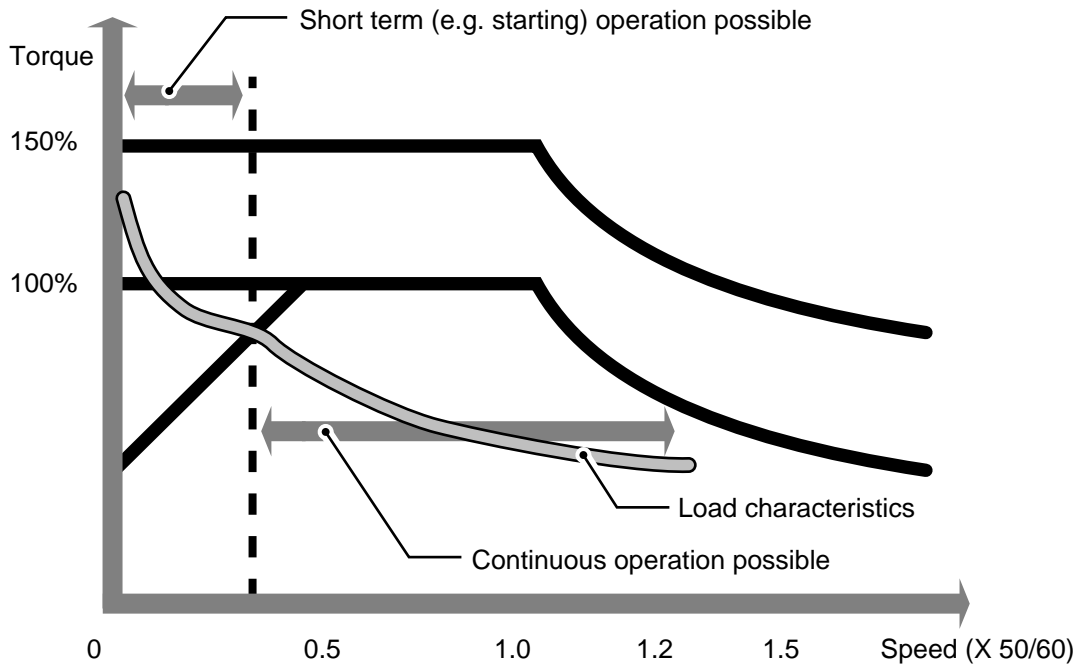
Many other loads have non linear or varying torque relationships. The torque requirement of the load should be understood before the inverter and motor is selected.

By comparing the load/speed requirement with the motor capability, the correct motor can be selected. Remember a different pole pair

arrangement (nameplate rated speed) may give a better match to the load needs.

Starting torque may need special consideration. If a high starting torque is required this must be considered during rating.

This type of starting duty is generally not characteristic of fan and pump applications.





**ENVIRONMENTAL CONSIDERATIONS**

The inverter is designed for operation in an HVAC environment. However there are certain limitations which must be considered; the following check list should help:

- Check that the airflow through the inverter will not be blocked by wiring etc. Ensure adequate clearance between cable trunking and the top and bottom ventilation ducts of the inverter.
- Make sure the temperature of the air does not exceed 50°C MICROMASTER Eco or 40°C MIDIMASTER Eco. Remember to allow for any temperature rise inside the enclosure or cubicle.
- The inverters are available with protection levels of IP20 (MICROMASTER Eco and filtered MIDIMASTER Eco), IP21 or IP56 (MIDIMASTER Eco).  
IP20 and IP21 units need additional protection against dust, dirt, and water.

(NEMA Equivalent: IP20 / IP21 = NEMA1, IP56 = NEMA 4/12.

- The inverter is designed for fixed installation and is not designed to withstand excessive shock and vibration.
- The inverter will be damaged by corrosive atmospheres.
- Protect the unit from dust; dust can build up inside the unit, damage the fans, and prevent proper cooling. Conductive dust, such as metal dust, will damage the unit.
- Give due consideration to Electromagnetic Compatibility (EMC), such as:
  1. The inverter should be protected from the effects of equipment such as Power Factor Correction equipment, Resistance Welding Equipment etc.
  2. The inverter must be well grounded.
  3. How will the inverter and any control equipment (contactors, PLCs, relays sensors etc.) interact? Contactor coils should be suppressed using an R-C module. BMS units actuators and sensors should be well earthed.

**IP Protection**

The IP number defines the level of Ingress Protection (IP) for the particular inverter.

First Number	Second Number	Third Number (not quoted)
<b>IP<del>X</del>XX</b>	<b>IPX<del>X</del>X</b>	<b>IPXX<del>X</del></b>
<b>0</b> No protection	<b>0</b> No protection	<b>0</b> No protection
<b>1</b> Protected against solid objects of 50mm or bigger	<b>1</b> Protected against water falling vertically	<b>1</b> Protected against 0.225J impact
<b>2</b> Protected against solid objects of 12mm or bigger	<b>2</b> Protected against direct sprays up to 15 deg. From vertical	<b>2</b> Protected against 0.375J impact
<b>3</b> Protected against solid objects of 2.5mm or bigger	<b>3</b> Protected against direct sprays up to 60 deg. From vertical	<b>3</b> Protected against 0.5J impact
<b>4</b> Protected against solid objects of 1mm or bigger	<b>4</b> Protected against sprays from all directions	<b>5</b> Protected against 2.0J impact
<b>5</b> Protected against dust (limited ingress)	<b>5</b> Protected against low pressure jets from all directions	<b>7</b> Protected against 6.0J impact
<b>6</b> Protected against dust (totally)	<b>6</b> Protected against high pressure jets from all directions	<b>9</b> Protected against 20.0J impact
	<b>7</b> Protected against immersion between 15cm and 1m	
	<b>8</b> Protected against immersion under pressure	





## 9. MECHANICAL INSTALLATION

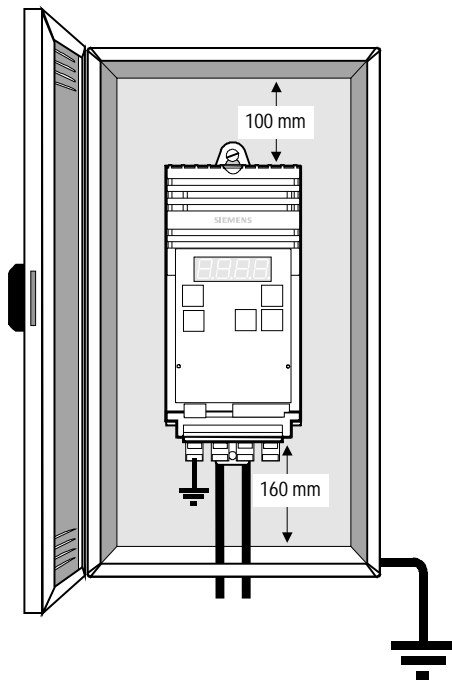
MICROMASTER Eco and MIDIMASTER Eco inverters are available in the following models, with corresponding frame sizes and power rating as indicated; Frame sizes A, B & C refer to the dimensions of the MICROMASTER Eco units and frame sizes 4 to 9 refer to the dimensions of the MIDIMASTER Eco units.

HVAC Inverter Model / type	Voltage rating	Frame Size	Motor ratings		
			P(kW)	P(Hp)	
ECO1-75/2	208-240V +/-10V	A	0.75	1	
ECO1-110/2		B	1.1	1.5	
ECO1-150/2		B	1.5	2	
ECO1-220/2		C	2.2	3	
ECO1-300/2		C	3	4	
ECO1-400/2		C	4	5	
ECO1-550/2	380-500V +/-10V	4	5.5	7.5	
ECO1-750/2		4	7.5	10	
ECO1-1100/2		5	11	15	
ECO1-1500/2		6	15	20	
ECO1-1850/2		6	18.5	25	
ECO1-2200/2		6	22	30	
ECO1-3000/2		7	30	40	
ECO1-3700/2		7	37	50	
ECO1-4500/2		7	45	60	
ECO1-110/3		380-500V +/-10V	A	1.1	1.5
ECO1-150/3			A	1.5	2
ECO1-220/3			B	2.2	3
ECO1-300/3			B	3	4
ECO1-400/3			C	4	5
ECO1-550/3			C	5.5	7.5
ECO1-750/3	C		7.5	10	
ECO1-1100/3	4		11	15	
ECO1-1500/3	4		15	20	
ECO1-1850/3	5		18.5	25	
ECO1-2200/3	5		22	30	
ECO1-3000/3	6		30	40	
ECO1-3700/3	6		37	50	
ECO1-4500/3	6		45	60	
ECO1-5500/3	7		55	75	
ECO1-7500/3	7	75	100		
ECO1-9000/3	7	90	125		
ECO1-110K/3	380-480V +/-10V	8	110	150	
ECO1-132K/3		8	132	200	
ECO1-160K/3		8	160	250	
ECO1-200K/3		8	200	300	
ECO1-250K/3		9	250	350	
ECO1-315K/3		9	315	400	
ECO1-400/4	525-575V +/-15V	4	4	5	
ECO1-550/4		4	5.5	7.5	
ECO1-750/4		4	7.5	10	
ECO1-1100/4		4	11	15	
ECO1-1500/4		4	15	20	
ECO1-1850/4		5	18.5	25	
ECO1-2200/4		5	22	30	
ECO1-3000/4		6	30	40	
ECO1-3700/4		6	37	50	
ECO1-4500/4		6	45	60	



The unit must be secured to a suitable, non-combustible, vertical surface (a load bearing wall for the heavier MIDIMASTER Eco range). Note that the frame size 9 MIDIMASTER Eco units are floor mounted. Depending on frame size, use nuts, bolts and washers as shown in the following table:

Frame size	A	B	C	4	5	6	7	8	9
Bolt size	M4	M4	M5	M8	M8	M8	M8	M8	M12
Quantity	2	4	4	4	4	4	6	6	up to 15
Torque (Nm)	2.5	2.5	3.0	-	-	-	-	-	-



Frame size A units can be DIN rail Mounted.

Frame size 7, 8 & 9 units should be lifted using lifting lugs provided.



## SAFETY INFORMATION AND ENVIRONMENTAL REQUIREMENTS

- This equipment must be earthed
- Do not energise the equipment with the cover removed
- The equipment must be installed and commissioned only by qualified personnel
- Obey all general and regional installation and safety regulations relating to work on high voltage installations, as well as regulations covering correct use of tools and personal protective equipment
- Make sure that the clearance for cooling inlets and outlets, above and below the inverter, is at least 150mm. If the unit is installed in a cabinet, it may be necessary to install cabinet cooling fans.
- Use insulated hand tools on mains input and motor terminals. Dangerous voltages can be present even when the inverter is not operating
- Do not exceed operating temperature range 0°C to 50°C for the MICROMASTER Eco, or 0°C to 40°C for the MIDIMASTER Eco range
- De-rate the inverter if operating at altitude above 1000m
- Do not install the inverter where it will be subject to shock, vibration, electro-magnetic radiation, water hazards, or atmospheric pollutants such as dust or corrosive gasses.

**Use the formula below to calculate the air-flow required: Air-flow (m<sup>3</sup> / hr) = (Dissipated Watts / ΔT) x 3.1**



Typical dissipation (Watts) = 3% of inverter rating.

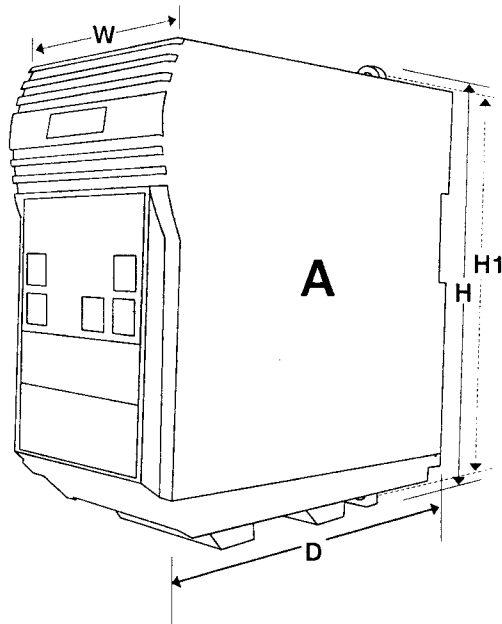
ΔT = Allowable temperature rise within cabinet in °C.

3.1 = Specific heat of air at sea level.

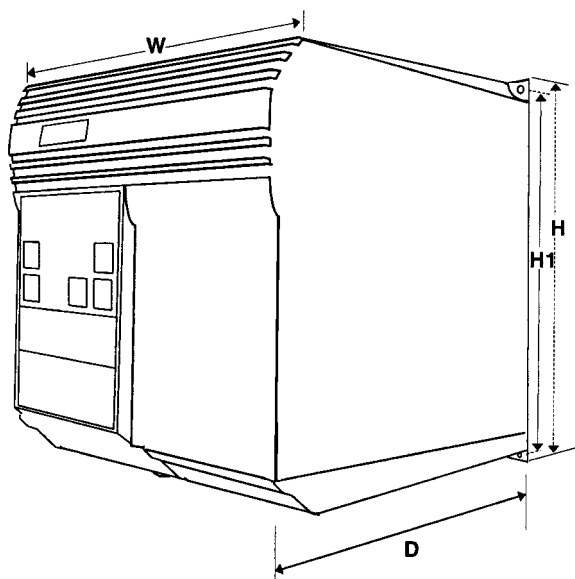


**CLEARANCES AND DIMENSIONS - MICROMASTER Eco**

Frame Size	H	W	D	H1	H2	W1	F
A	147	73	141	160	175	-	55
B	184	149	172	174	184	138	-
C	215	185	195	204	232	174	-



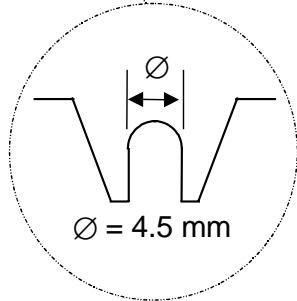
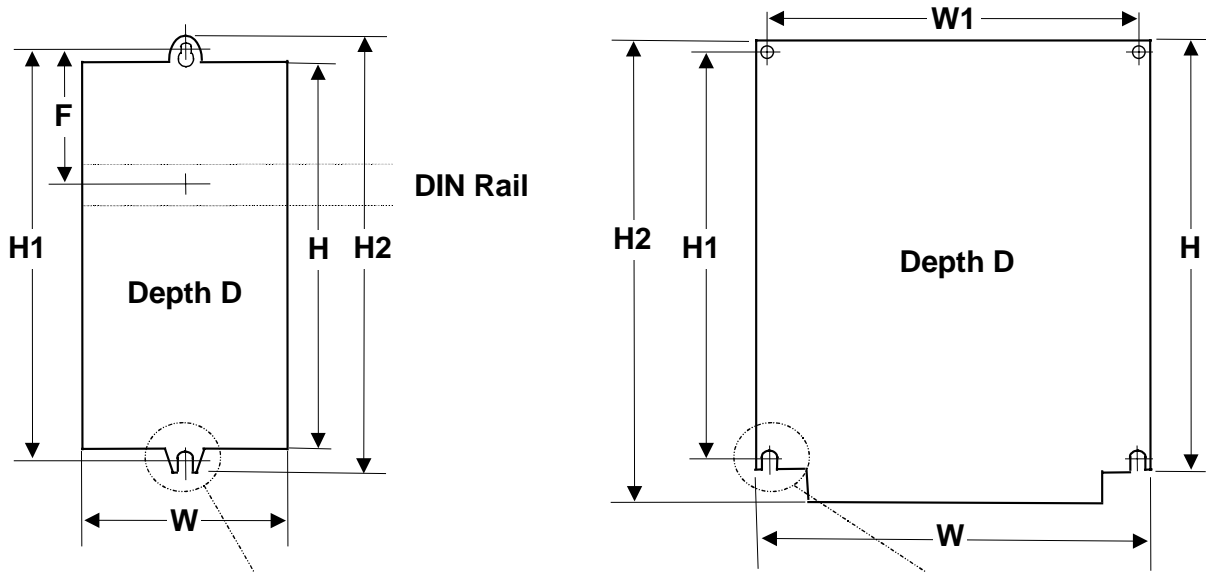
*MICROMASTER Eco Frame Size A*



*MICROMASTER Eco Frame Size B and C*



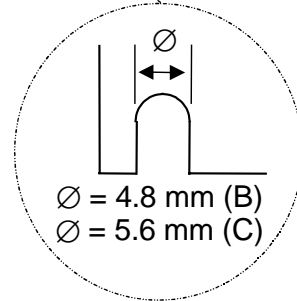
Mechanical Installation



- 2 bolts M4
- 2 nuts M4
- 2 washers M4

Frame Size A

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




- |                      |                      |
|----------------------|----------------------|
| <i>Frame size B:</i> | <i>Frame size C:</i> |
| 4 bolts M4           | 4 bolts M5           |
| 4 nuts M4            | 4 nuts M5            |
| 4 washers M4         | 4 washers M5         |


Frame Sizes B and C

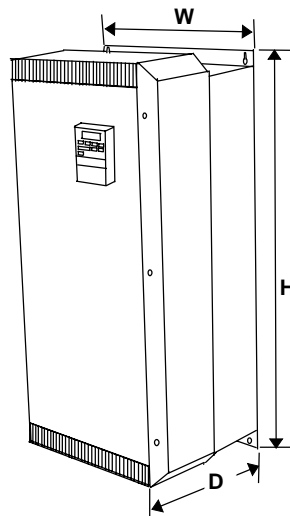


**CLEARANCES AND DIMENSIONS - MIDIMASTER Eco**

Mechanical Installation

IP21 / IP20 */ NEMA 1						
Frame Size	W	H	D	W1	H1	Weight Kg
4 =	275 x 450 x 210			235	430	11
5 =	275 x 550 x 210			235	530	15
6 =	275 x 650 x 285			235	630	27
7 =	420 x 850 x 310			374	830	56
8 =	508 x 1450 x 480			270	1375	155
*9 =	870 x 2230 x 680			-	-	510
	Dimension D includes the front control panel. If a Clear Text Display (OPe is to be included, an additional 30mm will be required.					

IP56 / NEMA 4/12						
Frame Size	W	H	D	W1	H1	Weight Kg
4 =	360 x 675 x 376			313	649	30
5 =	360 x 775 x 445			313	749	40
6 =	360 x 875 x 505			313	849	54
7 =	500 x 1150 x 595			451	1122	100
	Dimension D includes the front panel access door.					




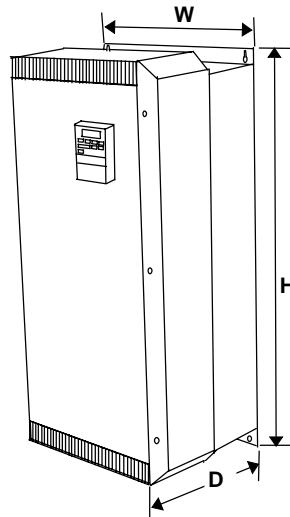
MIDIMASTER Eco (Typical)

## CLEARANCES AND DIMENSIONS - MIDIMASTER Eco

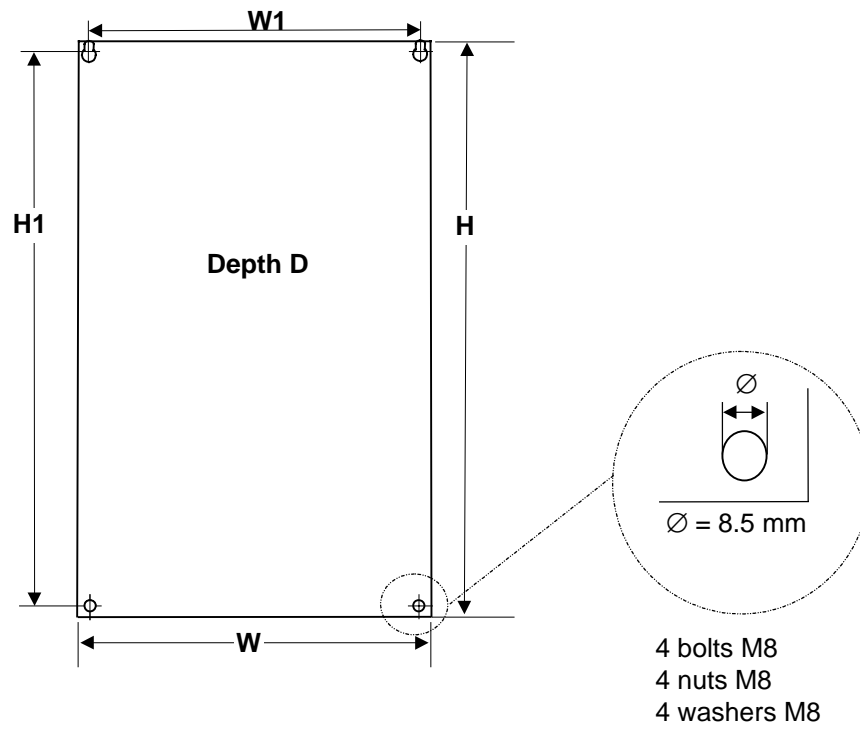


Mechanical Installation

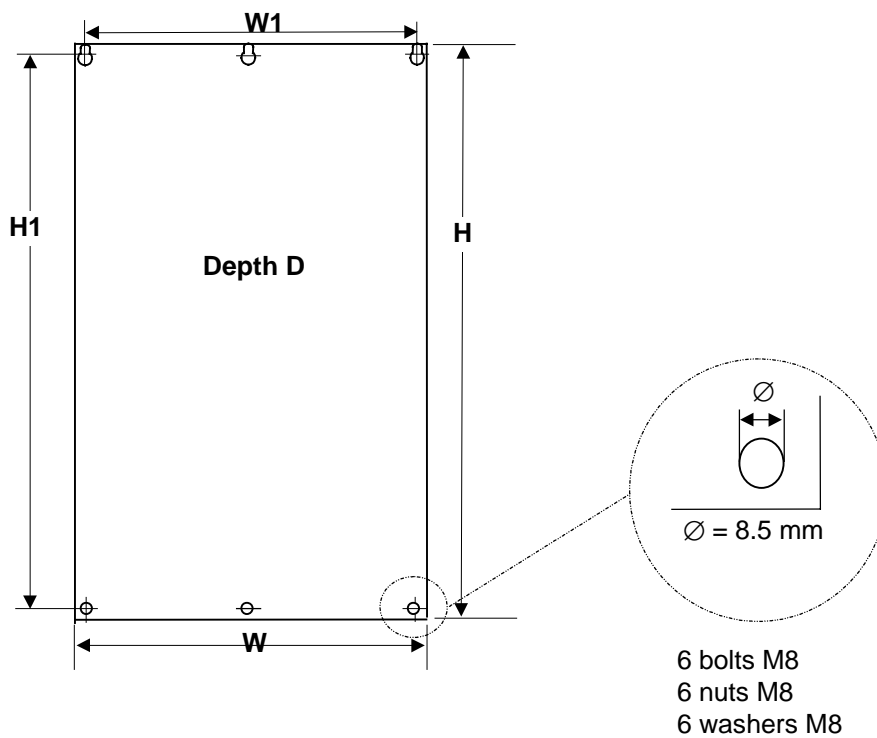
IP20 / NEMA 1 with Integrated Class A EMC Filter						
Frame Size	W	H	D	W1	H1	Weight Kg
4 =	275 x 700 x 210			235	680	19
5 =	275 x 800 x 210			235	780	24
6 =	275 x 920 x 285			235	900	39
7 =	420 x 1150 x 310			374	1130	90
	Dimension D includes the front control panel. If a Clear Text Display (OPe is to be included, an additional 30mm will be required.					



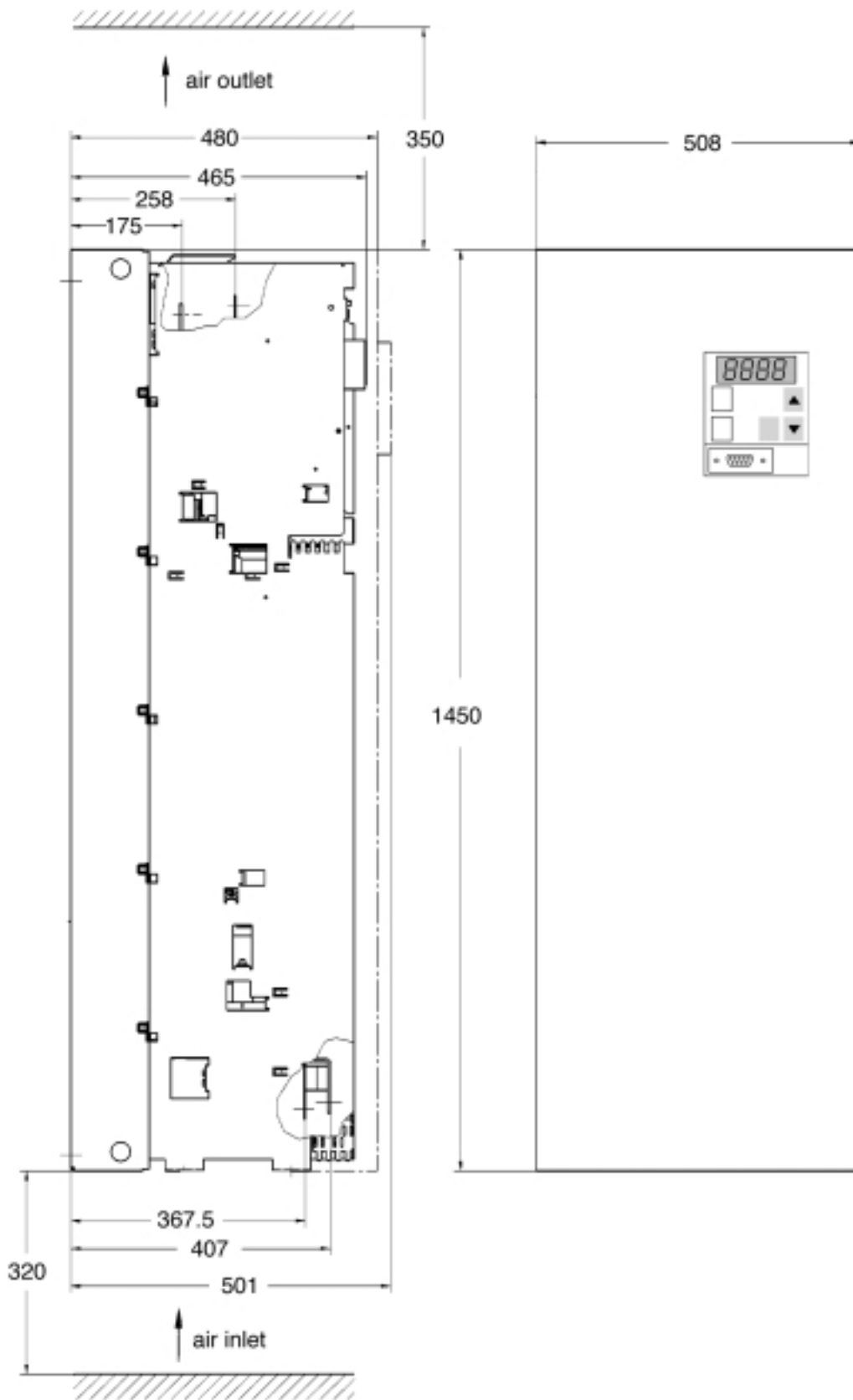
MIDIMASTER Eco (Typical)



**Frame Sizes 4, 5 and 6**

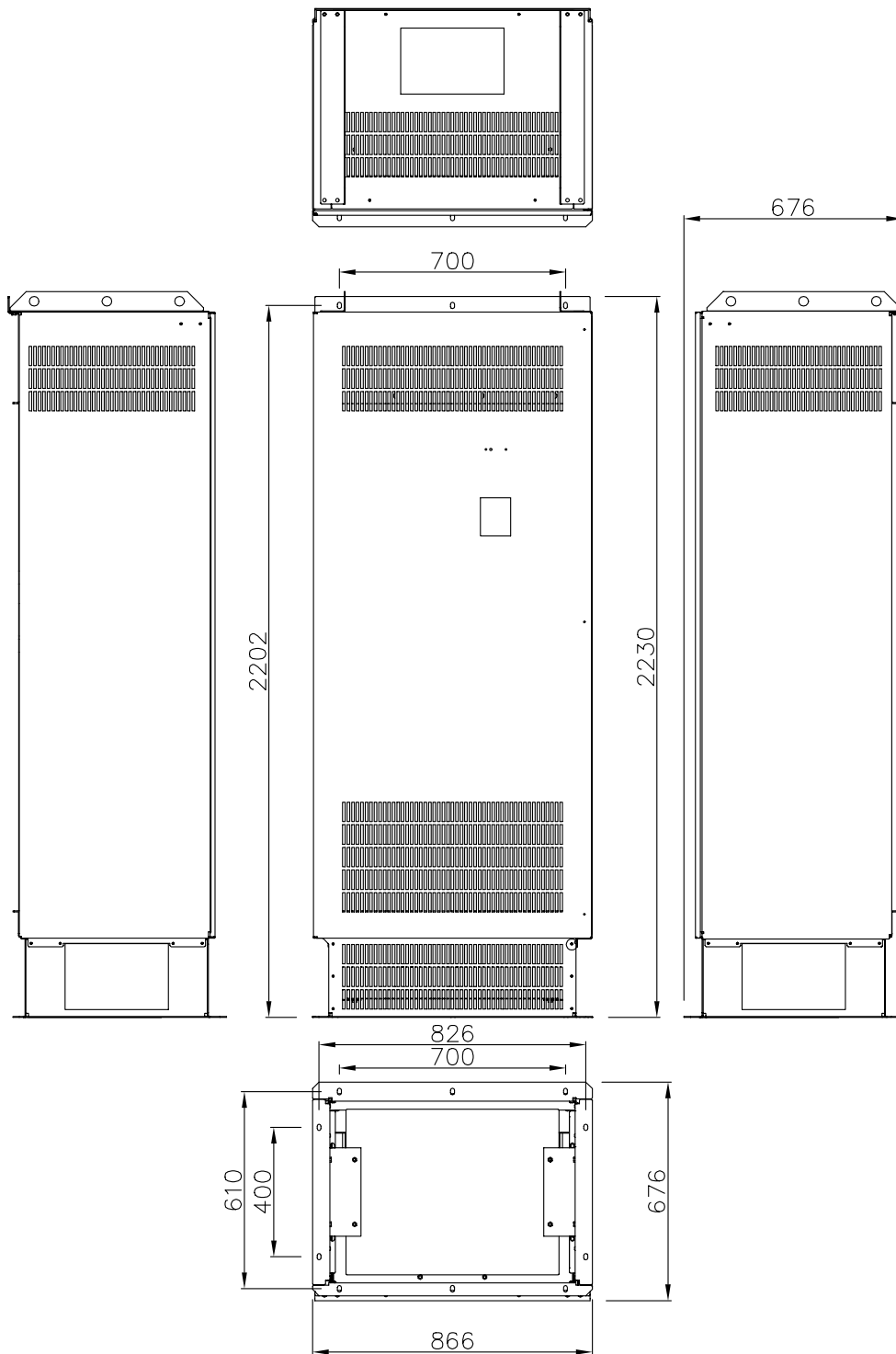


**Frame Sizes 7 and 8**



Frame Size 8





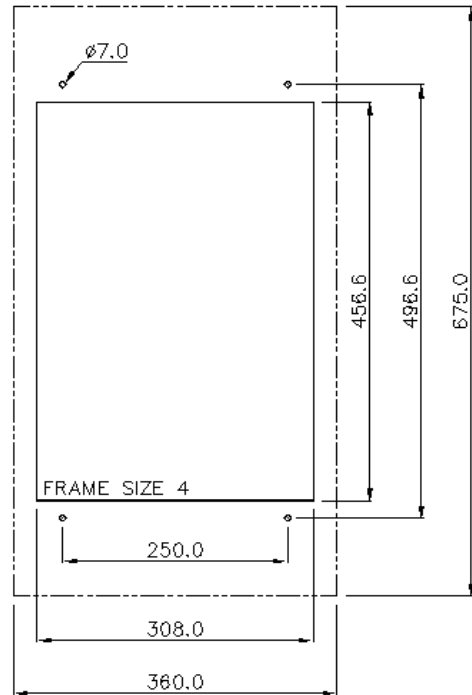
**Frame Size 9**



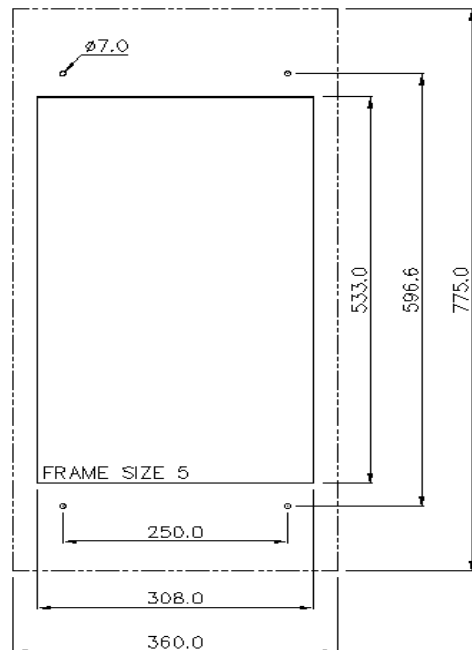
## IP56 / NEMA 4/12 Mounting Details for Panel Installation with Heatsink Protruding from Rear.

The IP56 protected unit can be mounted so that its heatsink protrudes from the rear of a larger enclosure.

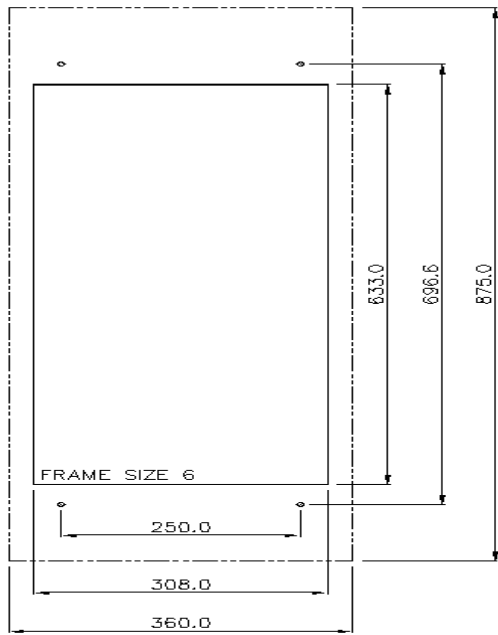
The cutout dimensions to take the IP56 flange are shown.



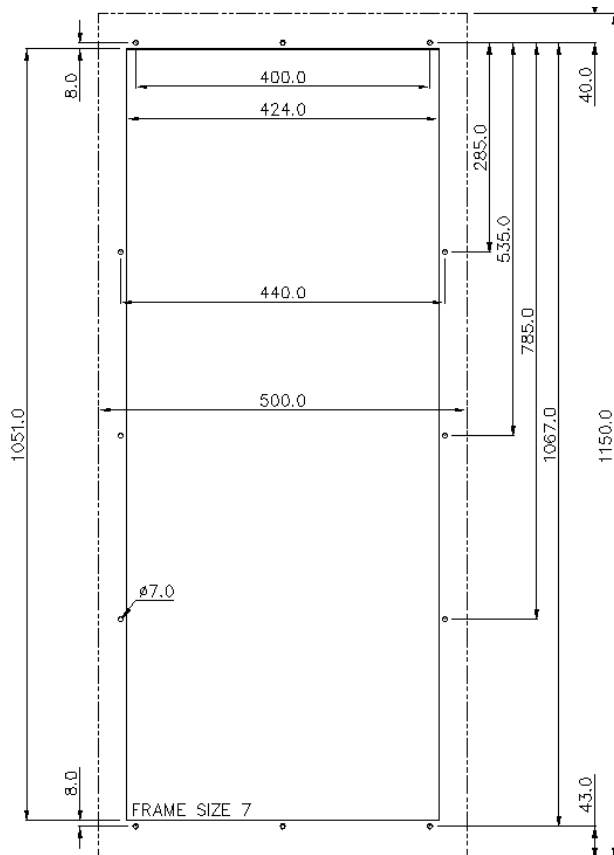
Frame Size 4



Frame Size 5



Frame Size 6

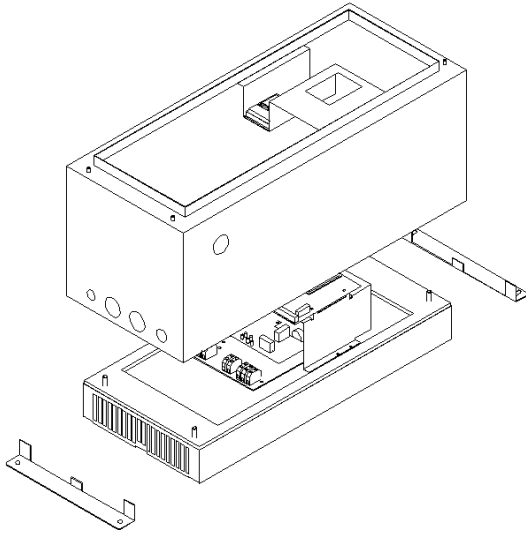


Frame Size 7

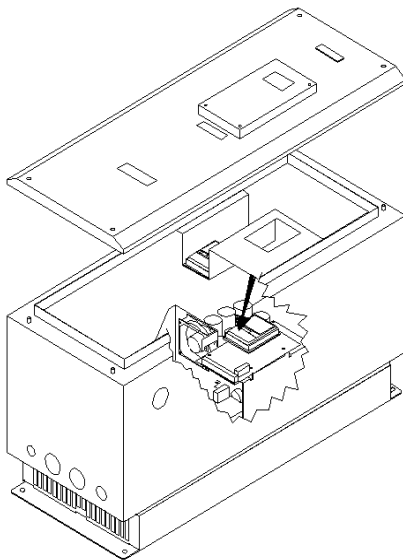
## To Panel Mount the IP56 Unit



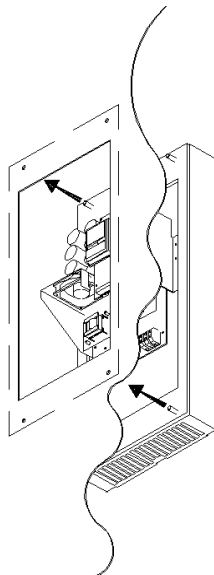
Mechanical Installation



1. Remove and discard the cover assembly. On FS4/5/6 the wall mounting brackets can also be removed and discarded.



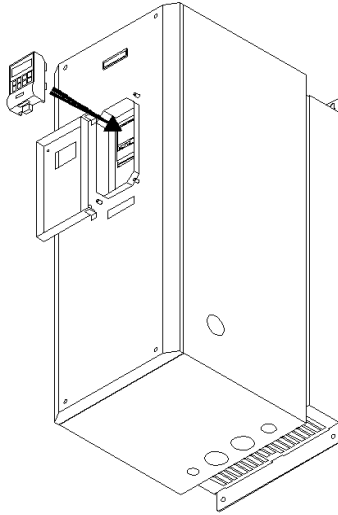
2. Move the keypad control panel from the top mounting position to the lower position.



3. Offer the unit from the outside of the cubicle fitting the original nuts and washers from the inside.



## Procedure for Installation of OPe (Clear Text Display Option)



1. Open the door and insert the option module into the 4 slots on the control panel.



10. ELECTRICAL INSTALLATION

SAFETY INFORMATION AND GENERAL GUIDELINES

- Make sure that the motor terminals are configured for the correct supply voltage
- Make sure that the input power supply is isolated before making or changing any connections
- The control power supply and motor leads must be laid separately. They must not be fed through the same cable conduit/trunking and should cross at 90° wherever this is unavoidable

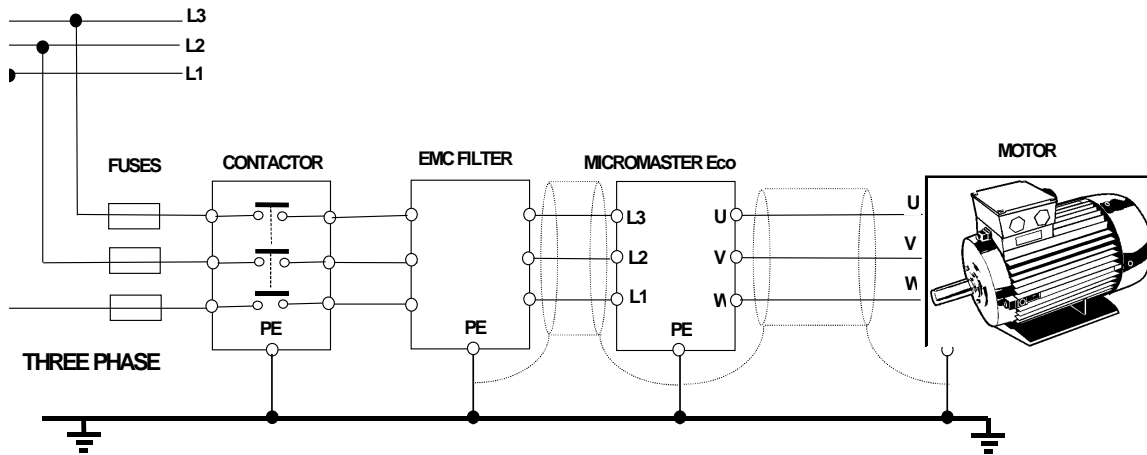
- High voltage insulation test equipment must not be used on any cables connected to the inverter



Motors can be connected to inverters either individually or in parallel. For parallel motor operation each motor should have an overload protection relay fitted. Set parameter P077 to 0 for multi-motor operation mode.



For wiring guidelines to minimise the effect of electro-magnetic interference (EMI), refer to section 12.





## POWER AND MOTOR CONNECTIONS - MIDIMASTER Eco RANGE

1. Gain access to power and motor terminals by removing the front cover from the inverter (lower-front cover only, for frame size 7).
2. Make sure that the power source supplies the correct voltage and has the necessary current supply capacity. Make sure that the appropriate circuit-breaker (or fuses) with the specified current rating are connected between the power supply and inverter (Refer to Table of recommended fuses and ratings on page 10-7).
3. Feed the cables through the correct glands in the base of the inverter. Secure the cable glands to the inverter and connect the leads to the power and motor terminals.
4. Connect the power input leads to the power terminals L1, L2, L3 (3 phase) and earth (PE) using a 4-core cable and lugs to suit the cable size.
5. Use a 4-core cable and suitable lugs to connect the motor leads to the motor terminals U, V, W and earth (PE).

6. Tighten all the power and motor terminals:

Frame size 4 and 5: Tighten up each of the power and motor terminal screws to 1.1 Nm.  
Frame size 6: tighten up each of the power and motor terminal Allen-screws to 3.0 Nm.  
Frame size 7: Tighten up each of the M12 power and motor terminal nuts to 30 Nm.

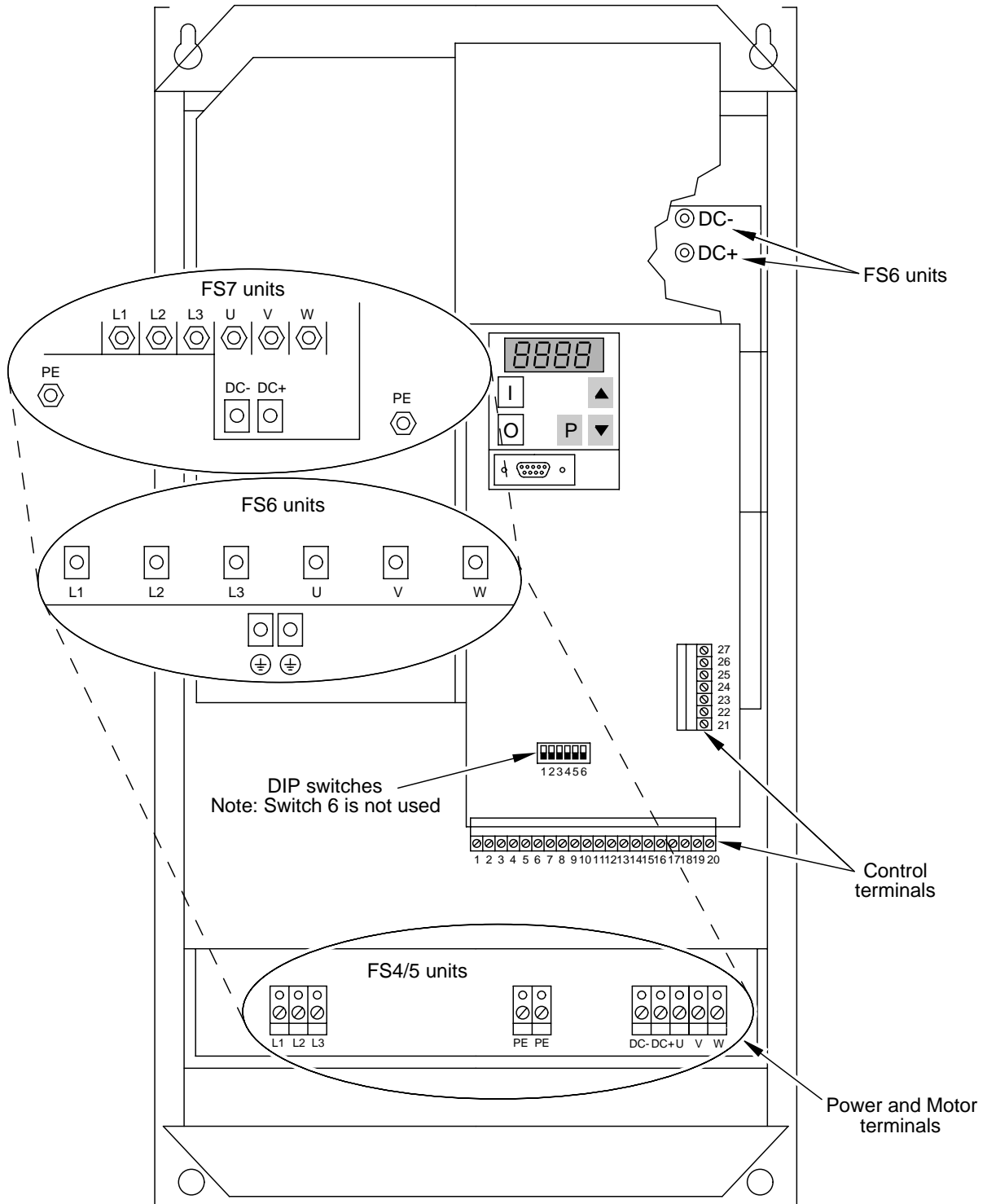


Make sure that all the leads are connected correctly and the equipment is properly earthed.



The total length of the motor cable(s) should generally not exceed 100m. If a screened motor cable is used or if the cable channel is well grounded, the maximum length should generally not exceed 50m. Cable lengths above 200m are possible by derating the inverter's output current or by using additional output reactors (chokes). Refer to table of maximum recommended motor cable lengths-Section 14 and output reactor selection-Section 15.

7. Secure the front cover to the inverter when all connections are complete and before energising.



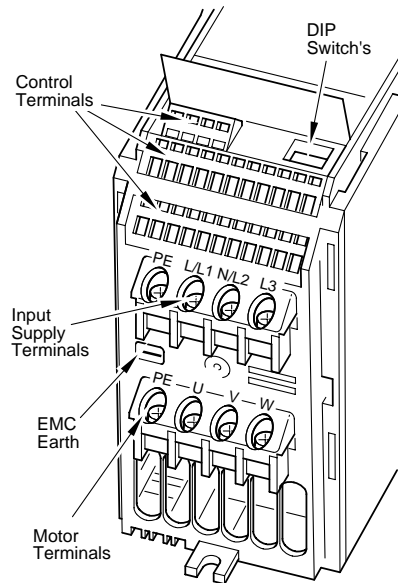
Location of Power and Control Terminals





Electrical Installation

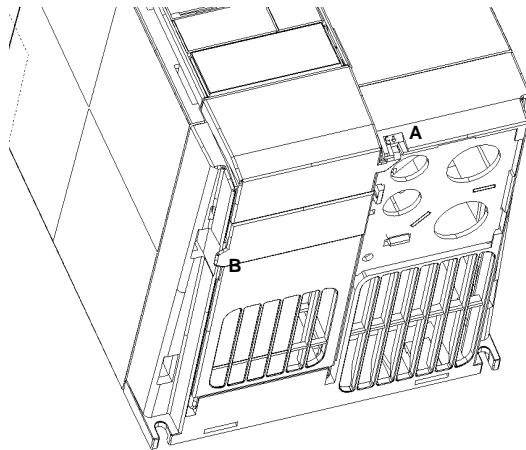
## POWER AND MOTOR CONNECTIONS - MICROMASTER Eco RANGE



### Gain Access to Terminals Frame Size A.

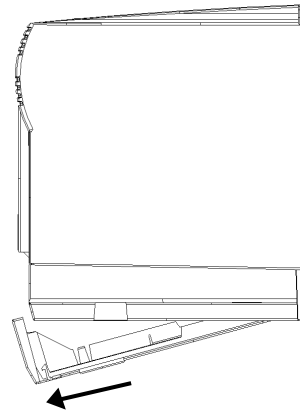
The power and motor terminals are directly accessible beneath the inverter.

### Gain Access to Terminals Frame Size B.



### Power Connection Access

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.

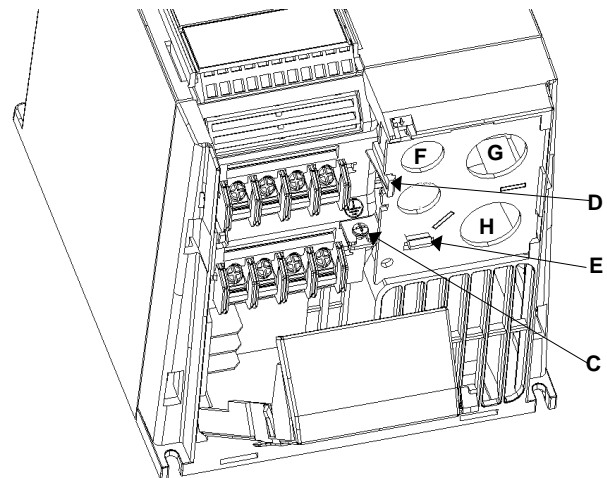


### Removal of Terminal Cover

This will release the access panel, which will then swing down on its rear-mounted hinges.



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.



- F: Control cable input
- G: Mains cable input
- H: Motor cable output

### Removal of Gland Plate

Remove the earthing screw C from the gland plate.

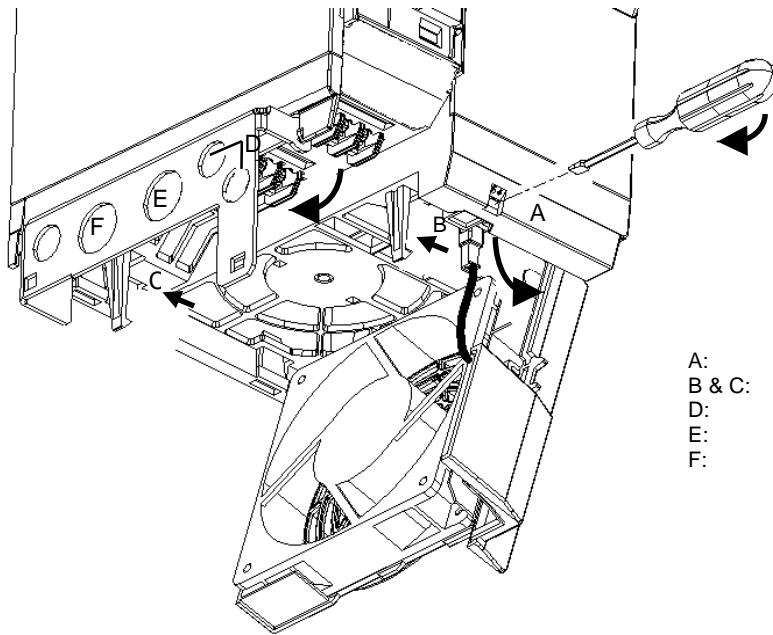
Press both release catches D and E to release the gland plate and then remove the metal gland plate from the inverter.



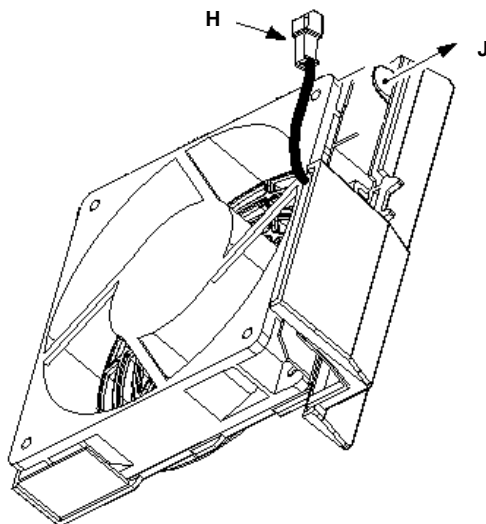
**Gain Access to Terminals Frame Size C**

While supporting the fan housing with one hand, insert the blade of a screwdriver into the slot 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.

Applying pressure to the gland plate, release 2 clips in the direction of the arrows. Swing the plate out



- A: Fan housing opening tab
- B & C: Gland plate release tabs
- D: Control cable input
- E: Mains cable input
- F: Motor 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.



## Connections

1. Make sure that the power source supplies the correct voltage and has the necessary supply current capacity. Make sure that the appropriate circuit-breaker or fuses with the specified current rating are connected between the power supply and inverter (Refer to the fuse recommendations on page 10-7).
2. Feed the cables through the correct glands in the base of the inverter. Secure the cable glands to the inverter and connect the leads to the power and motor terminals.
3. For the power input, use a 4-core cable for three phase units.
4. Connect the power input leads to the power terminals L/L1, N/L2, L3 (3 phase), and earth (PE).
5. Use a 4-core cable and suitable lugs to connect the motor leads to the motor terminals U, V, W and the earth (PE).
6. Tighten all the power and motor terminals



Make sure that the leads are connected correctly and the equipment is properly earthed.



The total length of the motor cable should not generally exceed 150 m. If a screened motor cable is used or if the cable channel is well grounded, the maximum length should be 100 m. Cable lengths up to 200 m are possible by using additional output chokes or de-rating the inverter's output current. See sections 14 and 15.



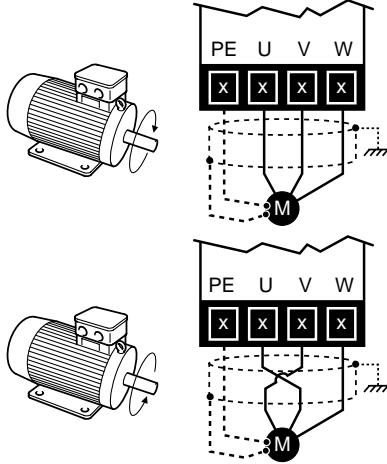
## RECOMMENDED FUSES AND RATINGS

HVAC Inverter Model / type	Recommended Fuse Rating	Recommended Fuse (Duty Class gL) Order Code
ECO1-75/2	10A	3NA3803
ECO1-110/2	16A	3NA3805
ECO1-150/2	20A	3NA3807
ECO1-220/2	25A	3NA3810
ECO1-300/2	35A	3NA3814
ECO1-400/2	25A	3NA3810
ECO1-550/2	50A	3NA3820
ECO1-750/2	63A	3NA3822
ECO1-1100/2	63A	3NA3822
ECO1-1500/2	63A	3NA3822
ECO1-1850/2	80A	3NA3824
ECO1-2200/2	100A	3NA3830
ECO1-3000/2	100A	3NA3830
ECO1-3700/2	160A	3NA3036
ECO1-4500/2	200A	3NA3140
ECO1-110/3	10A	3NA3803
ECO1-150/3	10A	3NA3803
ECO1-220/3	16A	3NA3805
ECO1-300/3	16A	3NA3805
ECO1-400/3	20A	3NA3807
ECO1-550/3	20A	3NA3807
ECO1-750/3	20A	3NA3807
ECO1-1100/3	35A	3NA3814
ECO1-1500/3	35A	3NA3814
ECO1-1850/3	50A	3NA3820
ECO1-2200/3	50A	3NA3820
ECO1-3000/3	80A	3NA3824
ECO1-3700/3	80A	3NA3824
ECO1-4500/3	100A	3NA3830
ECO1-5500/3	125A	3NA3032
ECO1-7500/3	160A	3NA3036
ECO1-9000/3	200A	3NA3140
ECO1-110K/3	315A	3NA3252
ECO1-132K/3	315A	3NA3252
ECO1-160K/3	400A	3NA3260
ECO1-200K/3	500A	3NA3365
ECO1-250K/3	630A	3NA3372
ECO1-315K/3	800A	3NA3375
ECO1-400/4	10A	3NA3803-6
ECO1-550/4	10A	3NA3803-6
ECO1-750/4	16A	3NA3805-6
ECO1-1100/4	25A	3NA3810-6
ECO1-1500/4	35A	3NA3814-6
ECO1-1850/4	35A	3NA3814-6
ECO1-2200/4	50A	3NA3820-6
ECO1-3000/4	50A	3NA3820-6
ECO1-3700/4	63A	3NA3822-6
ECO1-4500/4	80A	3NA3824-6



## DIRECTION OF ROTATION

The direction of rotation of the motor can be reversed during commissioning by changing over two of the output connections on the Eco.



ratio between the rated motor speeds will be consistent over the full range.

If motor sizes vary to any great extent, this could cause problems at start-up and at low rpm. This is because smaller motors need a higher voltage during start-up, as they have a higher resistance value in the stator.

Additional motor protection (e.g. thermistors in every motor or individual thermal overload relays) is essential in systems with parallel motor operation. This is because the inverter's internal thermal protection cannot be used, as output current must be programmed to match the overall motor current.

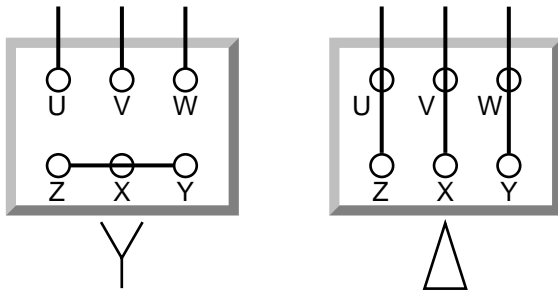
Total motor current consumption must not exceed maximum rated output current.

Parameter P077 should be set to multi motor mode.

## STAR OR DELTA MOTOR CONNECTION

The MICROMASTER Eco & MIDIMASTER Eco range can be used to control all types of three-phase asynchronous squirrel cage motors.

The voltage and connection method should be taken from the motor nameplate, but as a general rule, larger motors (380/660 volt) are delta-connected and smaller motors (220/380 volt) are star-connected.



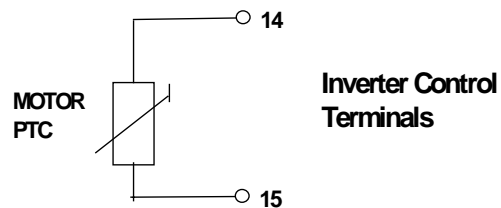
## MOTOR OVERLOAD PROTECTION

When operated below rated speed, the cooling effect of fans fitted to the motor shaft is reduced, so that most motors require de-rating for continuous operation at low frequencies. However, variable torque loads such as pumps and fans are generally not heavily loaded at low speeds. To provide motors with additional protection against overheating, a PTC (thermistor) temperature sensor may be fitted to the motor and connected to the inverter control terminals. Note: to enable the motor overload protection trip function, see parameter P087=1.

## MULTI-MOTOR CONNECTION

The MICROMASTER Eco & MIDIMASTER Eco range can be used to control several motors connected in parallel.

If the motors to be controlled are to run at different speeds from one another, then motors with different rated speeds must be used. Because motor speeds will change simultaneously, the





## CONTROL CONNECTIONS (ALL MODELS)

### GENERAL INFORMATION

Use screened cable for the control cable, Class 1 60/75 °C copper wire only (for UL compliance). Tightening torque for the field wiring terminals is 1.1 Nm.



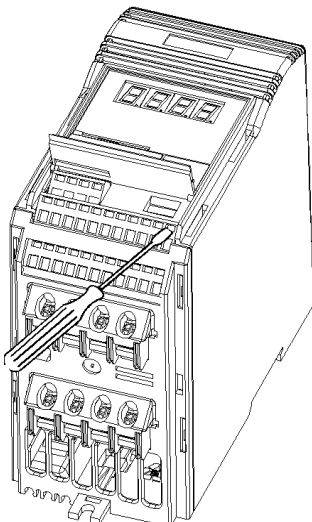
Do not use the internal RS485 connections (terminals 24 and 25) if you intend using the external RS485 D-type connection on the front panel (e.g. to connect a Clear Text Display/option (OPe).

DIP switches select between voltage (V) and current (I) analogue speed setting inputs. They also select between either a voltage or current PID feedback signal. These switches can only be accessed when:

- For Frame sizes 4, 5 and 6, the front cover is removed.
- For Frame size 7, the lower front cover is removed.
- For Frame sizes 8 and 9 the front door panel is opened.
- For Frame sizes A, B, C, the flap on the front cover is open.

### MICROMASTER Eco

Insert a small screwdriver in the slot above the terminal, whilst inserting control wire from below. Withdraw the screwdriver to secure the wire.

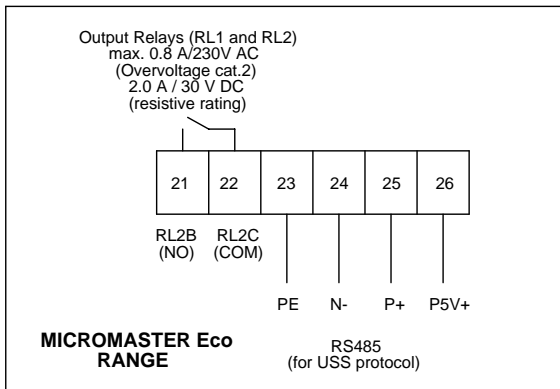
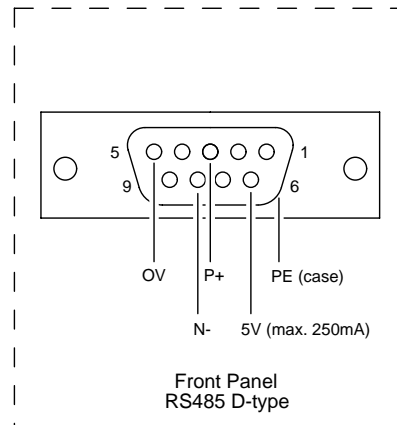
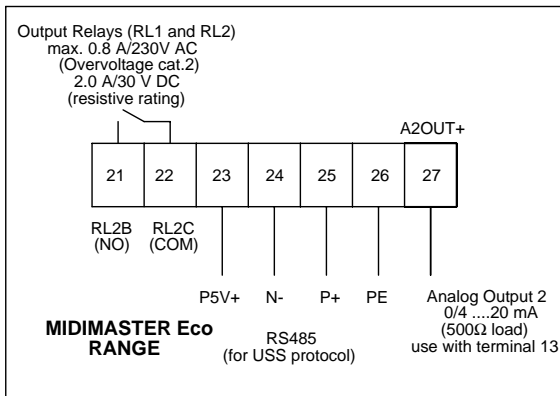
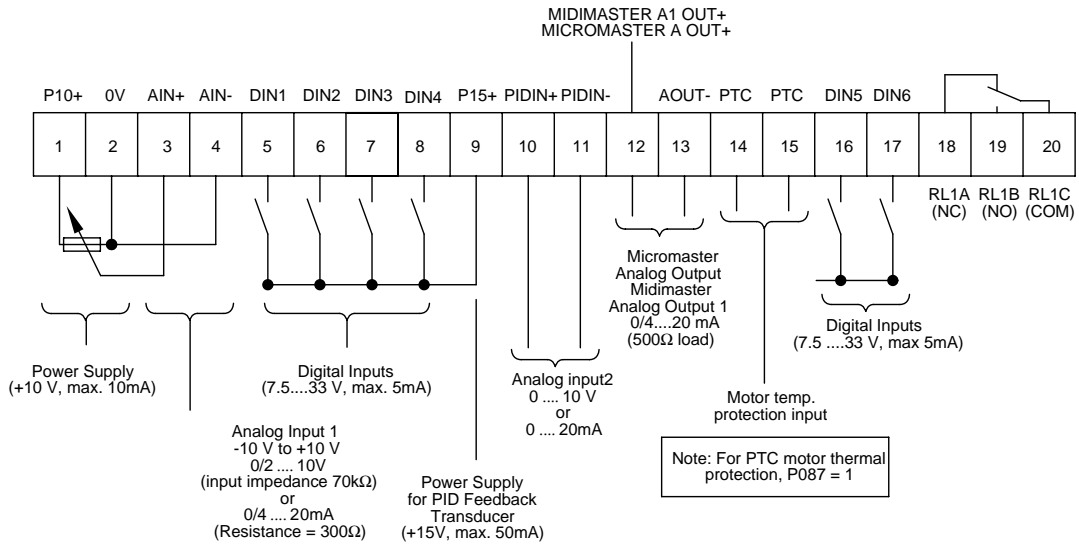


### MIDIMASTER Eco

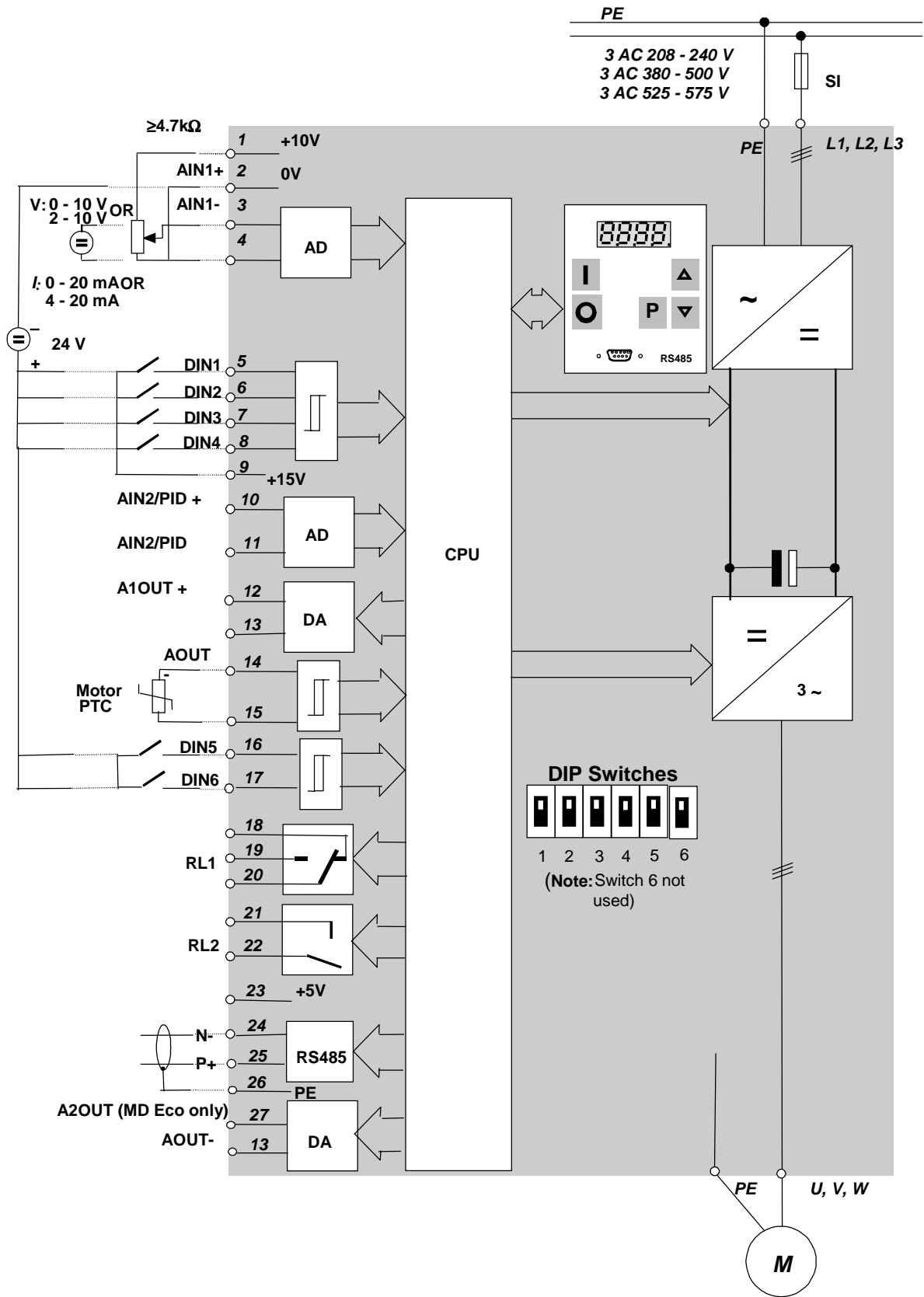
Control connections to the MIDIMASTER Eco are made via two terminal blocks located on the control panel. The terminal blocks are of a two-part design. The part containing the screw terminals can be unplugged from its housing before wires are connected. When all connections to the terminals have been secured, the terminal block must be plugged firmly back into its housing.



Electrical Installation



Control Connections



Block Diagram



**11. APPLICATION EXAMPLES**

The following examples are based on actual applications where Siemens Drives have been successfully applied:

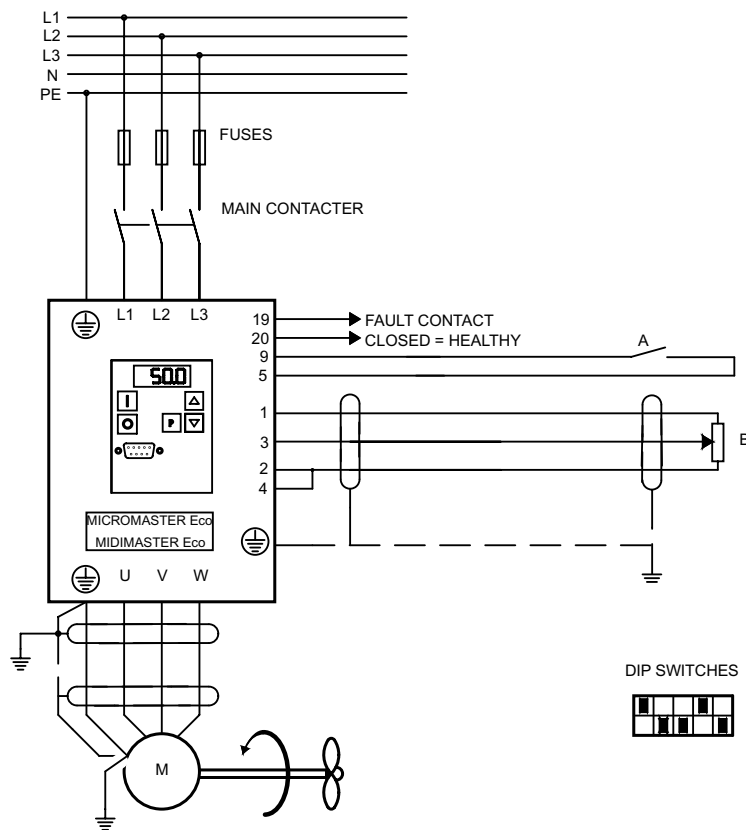
**EXAMPLE 1**

**POTENTIOMETER SETPOINT AND RUN/STOP VIA TERMINALS**

A fan is to be speed controlled using a potentiometer to provide the control signal

All settings based on factory settings with the following exceptions :

PARAMETER CHANGES FROM FACTORY DEFAULTS	
SETTING	DESCRIPTION
P006 = 1	SELECT ANALOG/POTENTIOMETER SET POINT
P007 = 0	SELECT RUN/STOP FROM TERMINALS



ITEM	DESCRIPTION
A	RUN/STOP SWITCH
B	SPEED SETTING POTENTIOMETER.



Examples

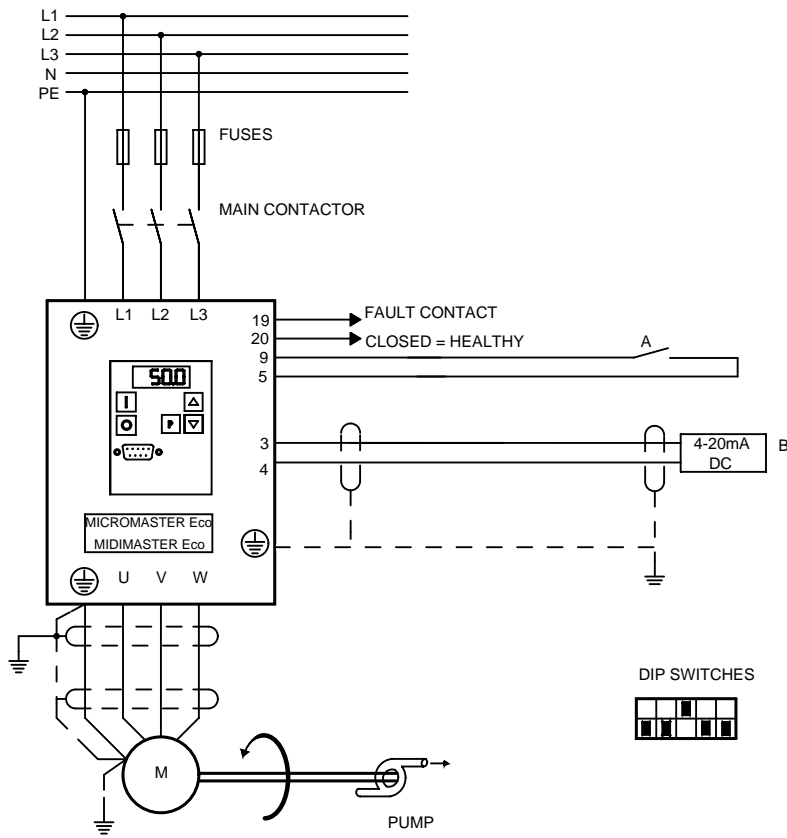
## EXAMPLE 2.

### ANALOG CURRENT SETPOINT AND RUN/STOP VIA TERMINALS

A pump is to be speed controlled using an external 4 - 20 mA current signal

All settings based on factory settings with the following exceptions :

PARAMETER CHANGES FROM FACTORY DEFAULTS	
SETTING	DESCRIPTION
P006 = 1	SELECT ANALOG SET POINT
P007 = 0	SELECT RUN/STOP FROM TERMINALS
P023 = 1	SELECT 4 - 20 mA RANGE



ITEM	DESCRIPTION
A	RUN/STOP SWITCH
B	4 - 20 mA SPEED SETTING SIGNAL

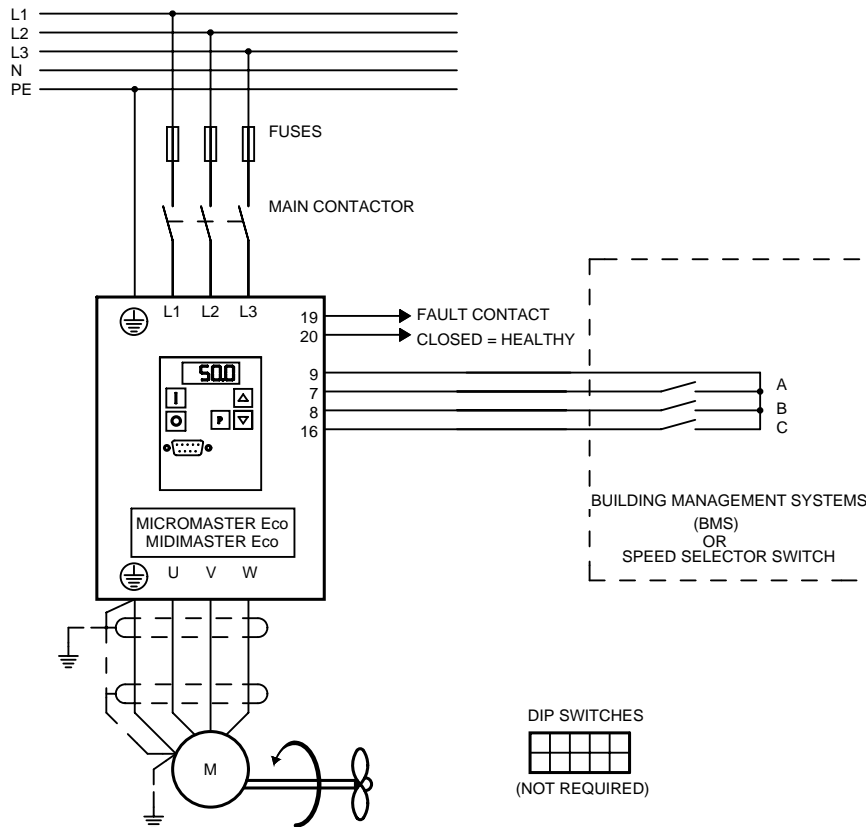
**EXAMPLE 3.**

**FIXED SPEEDS VIA TERMINAL RAIL**

A fan is to be run at 3 fixed speeds using digital inputs to control the speed setting

All settings based on factory settings with the following exceptions :

PARAMETER CHANGES FROM FACTORY DEFAULTS	
SETTING	DESCRIPTION
P006 = 2	SELECT FIXED FREQUENCIES FROM TERMINALS
P007 = 0	SELECT RUN/STOP FROM TERMINALS
P053 = 18	FIXED FREQUENCY 3 (P043) TERMINAL 7
P054 = 18	FIXED FREQUENCY 2 (P042) TERMINAL 8
P055 = 18	FIXED FREQUENCY 1 (P041) TERMINAL 16
P041 = 50	FIXED FREQUENCY 1 = 50 Hz
P042 = 40	FIXED FREQUENCY 2 = 40 Hz
P043 = 20	FIXED FREQUENCY 3 = 20 Hz



ITEM	DESCRIPTION
A	SWITCH - RUN AT 20Hz
B	SWITCH - RUN AT 40Hz
C	SWITCH - RUN AT 50Hz



Examples

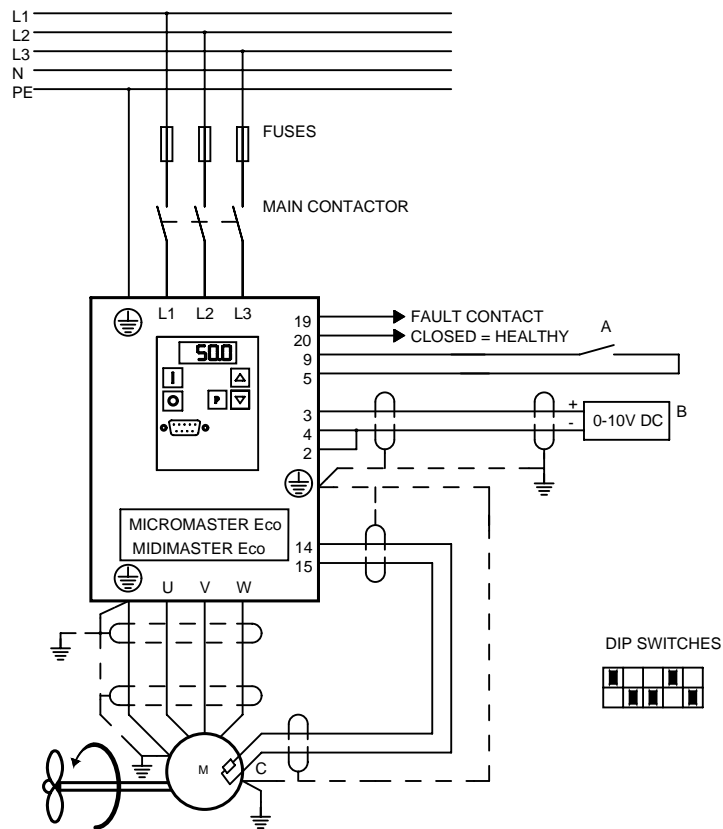
## EXAMPLE 4

### MOTOR THERMISTOR PROTECTION AND SPEED SETTING BY DC SIGNAL

A fan is to be speed controlled using an analog voltage to provide the control signal. A thermistor is installed in the fan motor to obtain optimum motor protection

All settings based on factory settings with the following exceptions :

PARAMETER CHANGES FROM FACTORY DEFAULTS	
SETTING	DESCRIPTION
P006 = 1	SELECT ANALOG SETPOINT
P007 = 0	P007 = SELECT RUN/STOP FROM TERMINALS
P087 = 1	SELECT MOTOR THERMISTOR PROTECTION



ITEM	DESCRIPTION
A	RUN/STOP SWITCH
B	0 - 10V DC SPEED SETTING SIGNAL
C	MOTOR THERMISTOR

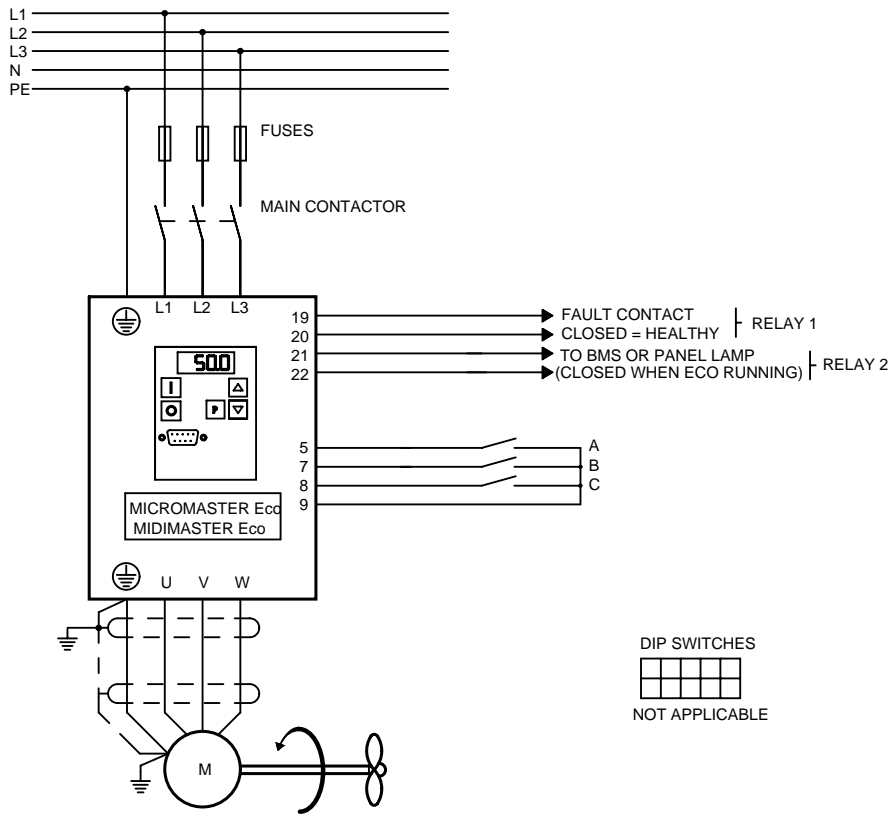
**EXAMPLE 5**

**MOTORISED POTENTIOMETER. OUTPUT RELAY CLOSING WHEN RUNNING**

A fan is to be speed controlled by push buttons or contacts which when operated will raise and lower the speed setpoint (The inverter energises a relay output to indicate it is running).

All settings based on factory settings with the following exceptions :

PARAMETER CHANGES FROM FACTORY DEFAULTS	
SETTING	DESCRIPTION
P007 = 0	SELECT RUN/STOP AND SPEED UP/DOWN CONTROL FROM DIGITAL INPUT TERMINALS
P053 = 11	INCREASE SPEED (DIGITAL INPUT 3) TERMINAL 7
P054 = 12	DECREASE SPEED (DIGITAL INPUT 4) TERMINAL 8
P062 = 11	INVERTER IS RUNNING (RELAY 2)



ITEM	DESCRIPTION
A	RUN/STOP SWITCH
B	INCREASE SPEED (PUSH BUTTON OR BMS)
C	DECREASE SPEED (PUSH BUTTON OR BMS)



Examples

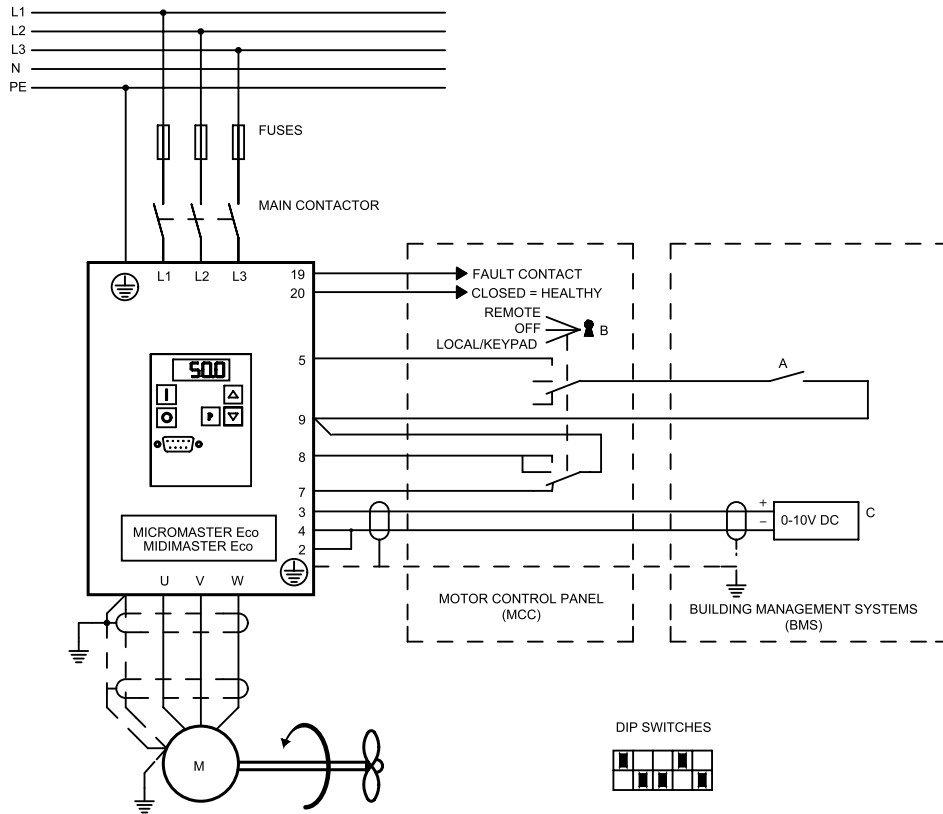
## EXAMPLE 6

### LOCAL (KEYPAD)/REMOTE (BMS) SELECTION

A fan is to be speed controlled using an analog signal from a BMS to provide the control. There is provision to switch between local (Keypad) control and remote control using the BMS.

All settings based on factory settings with the following exceptions :

PARAMETER CHANGES FROM FACTORY DEFAULTS	
SETTING	DESCRIPTION
P053 = 13 TERMINAL 7	SWITCH BETWEEN ANALOG SPEED SETTING AND Eco KEYPAD SPEED SETTING
P054 =9 TERMINAL 8	SWITCH BETWEEN LOCAL KEYPAD DISPLAY RUN/STOP AND REMOTE DIGITAL INPUT TERMINAL RUN/STOP



ITEM	DESCRIPTION
A	RUN/STOP COMMAND FROM BMS
B	THREE POSITION KEY SWITCH ON MCC PANEL FOR LOCAL/OFF/REMOTE SELECTION (SHOWN IN LOCAL KEYPAD MODE)
C	0 - 10V DC SPEED SETPOINT FROM BMS

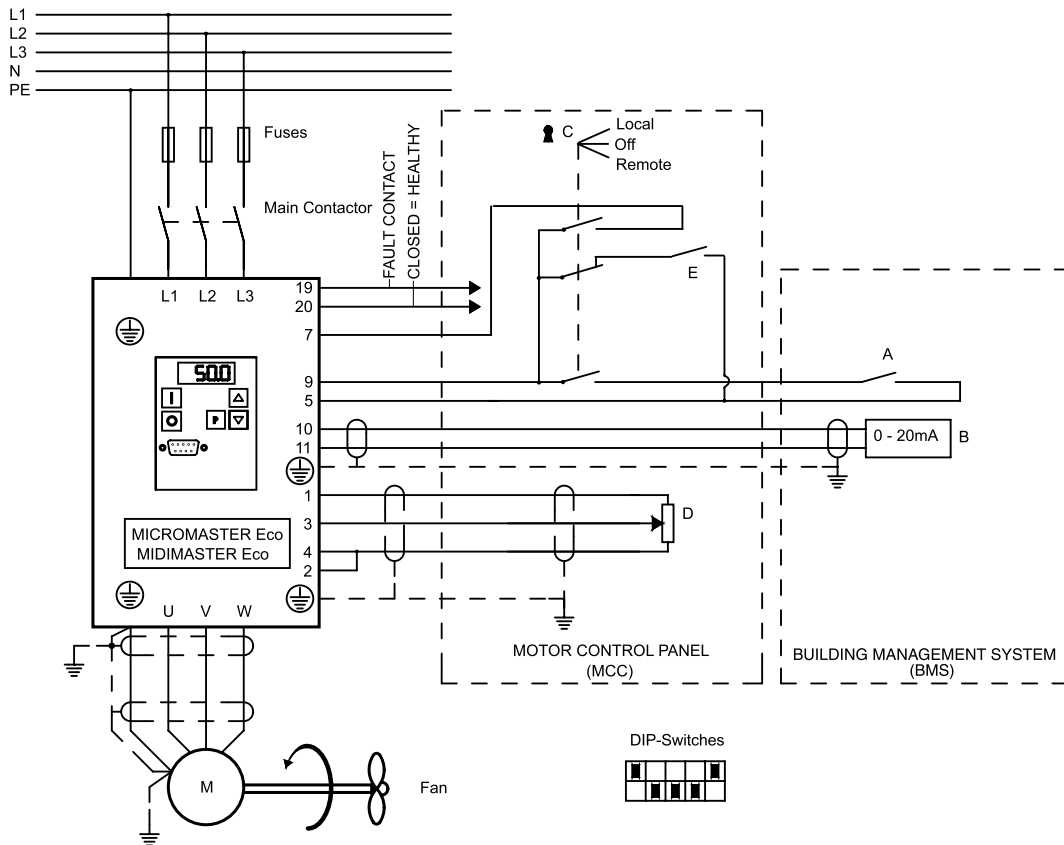
**EXAMPLE 7**

**LOCAL POTENTIOMETER/REMOTE BMS SELECTION FROM FRONT OF MCC PANEL**

A fan is to be speed controlled locally, using a potentiometer on the motor control panel to provide the control signal, or, remotely using an external 4 - 20 mA current signal. The local or remote control is set via a keyswitch on the motor control panel. An additional run/stop contact is provided within the motor control panel.

All settings based on factory settings with the following exceptions :

PARAMETER CHANGES FROM FACTORY DEFAULTS	
SETTING	DESCRIPTION
P006 = 1	SELECT ANALOG SET POINTS
P007 = 0	SELECT RUN/STOP VIA DIGITAL INPUT TERMINALS
P053 = 24	SWITCH BETWEEN ANALOG SPEED SETPOINT (LOCAL POTENTIOMETER) AND SETPOINT 2 (REMOTE BMS)



ITEM	DESCRIPTION
A	REMOTE RUN/STOP COMMAND FROM BMS
B	REMOTE 0 - 20 mA SPEED SETTING SIGNAL FROM BMS
C	KEYSWITCH ON MCC PANEL TO SELECT BETWEEN LOCAL, OFF AND REMOTE (SHOWN IN LOCAL)
D	LOCAL SPEED SETTING POTENTIOMETER ON MCC PANEL
E	LOCAL RUN/STOP CONTACTS WITHIN MCC PANEL



Examples

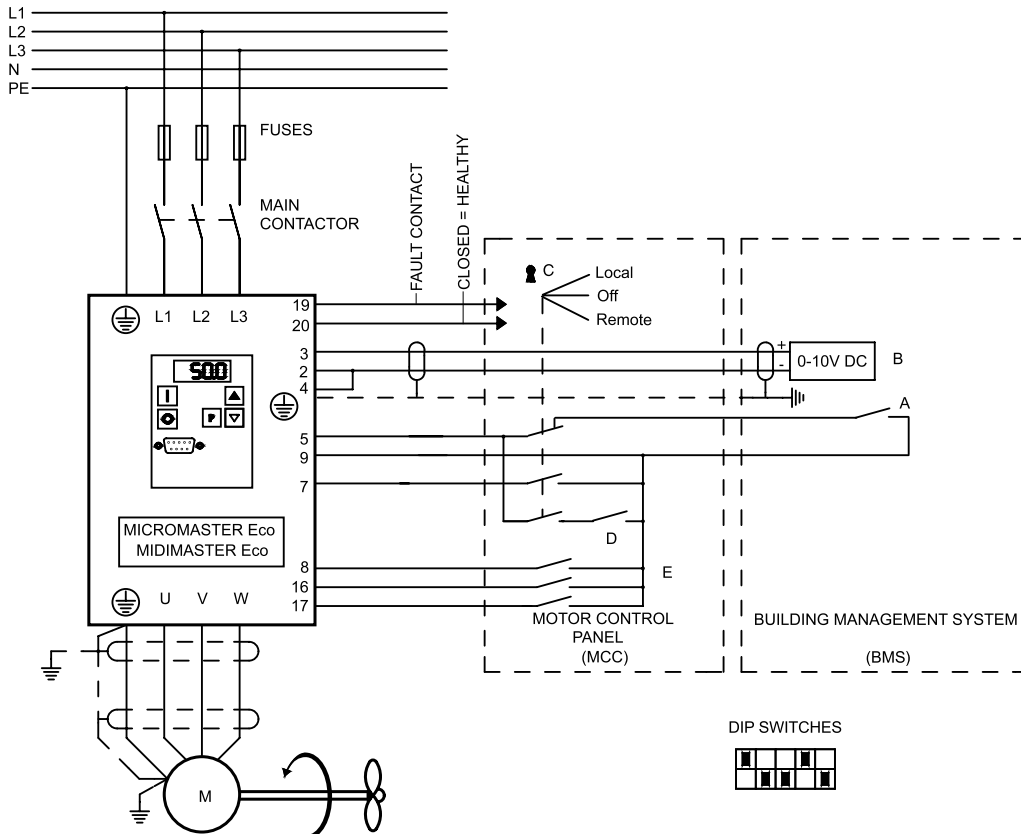
## EXAMPLE 8

### MCC PANEL FIXED FREQUENCIES/REMOTE ANALOG (BMS) SELECTION

A fan is to be speed controlled locally, using a fixed speed selector switch on the motor control panel to provide 3 fixed frequency output signals, or, remotely using an external 0 - 10V DC speed setting signal. The local or remote control is set via a keyswitch on the motor control panel. An additional run/stop contact is provided within the motor control panel.

All settings based on factory settings with the following exceptions :

PARAMETER CHANGES FROM FACTORY DEFAULTS	
SETTING	DESCRIPTION
P005 = 0	TUNE INTERNAL SETPOINT TO 0Hz
P006 = 2	SELECT FIXED FREQUENCIES
P007 = 0	SELECT RUN/STOP VIA DIGITAL INPUT TERMINALS
P041 = 10	FIXED FREQUENCY 1 = 10Hz
P042 = 30	FIXED FREQUENCY 2 = 30Hz
P047 = 50	FIXED FREQUENCY 6 = 50Hz
P053 = 13	SELECT BETWEEN ANALOG AND DIGITAL INPUTS
P054 = 6	FIXED FREQUENCY 2 (P042) TERMINAL 8
P055 = 6	FIXED FREQUENCY 1 (P041) TERMINAL 16
P356 = 6	FIXED FREQUENCY 6 (P047) TERMINAL 17



ITEM	DESCRIPTION
A	RUN/STOP COMMAND FROM BMS
B	0 -10V DC SPEED SETTING SIGNAL FROM BMS
C	KEYSWITCH LOCAL/BMS SELECTION (SHOWN IN REMOTE / BMS MODE)
D	LOCAL RUN/STOP CONTACTS WITHIN MCC
E	LOCAL FIXED SPEED SELECTOR SWITCHES



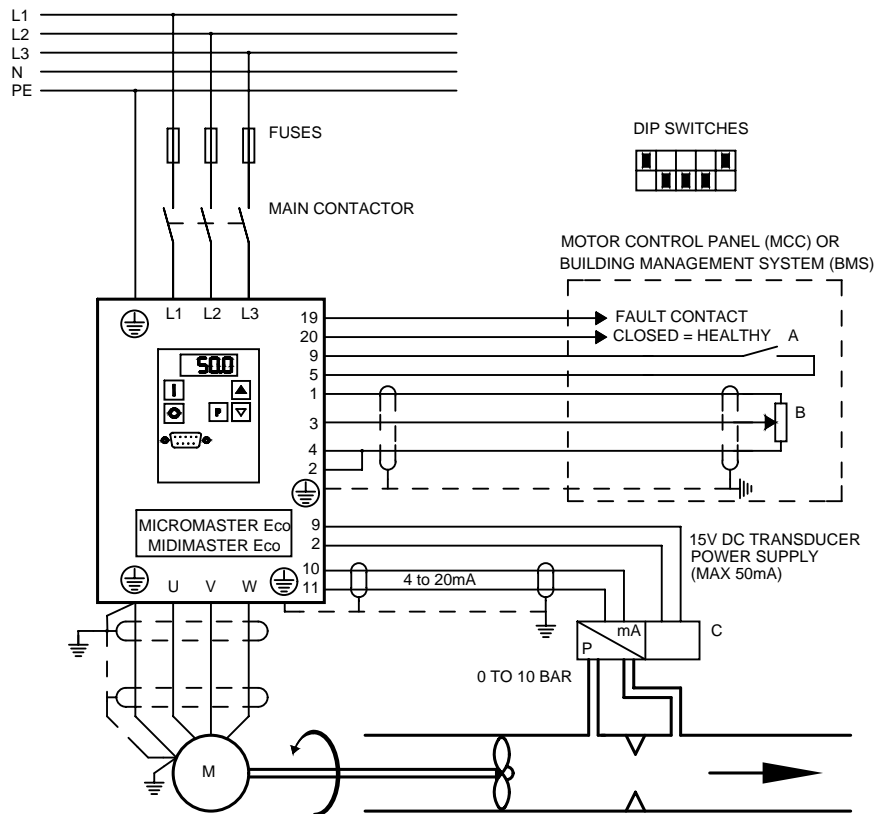
**EXAMPLE 9**

**PID CONTROL - PRESSURE SETPOINT**

In a ventilation system, the duct pressure differential is to be adjustable by means of a 0 - 10V potentiometer. Output signals from the pressure transducer are supplied to the Eco, the selected pressure differential must be kept constant, and the internal PID regulator is used to achieve this.

All settings based on factory settings with the following exceptions :

PARAMETER CHANGES FROM FACTORY DEFAULTS	
SETTING	DESCRIPTION
P006 = 1	SELECT ANALOG SETPOINT
P007 = 0	SELECT RUN/STOP VIA TERMINALS
P012 = 10	MINIMUM SPEED = 10Hz
P201 = 1	PID ENABLED
P202 = 1	PID PROPORTIONAL GAIN (MAY NEED TUNING)
P203 = 0 P205 = 10	PID INTEGRAL GAIN (MAY NEED TUNING)
P220 = 1	SWITCH OFF AT MINIMUM SPEED
P211 = 20 P212 = 100	SELECT ANALOG (PID) INPUT FOR 4 - 20mA

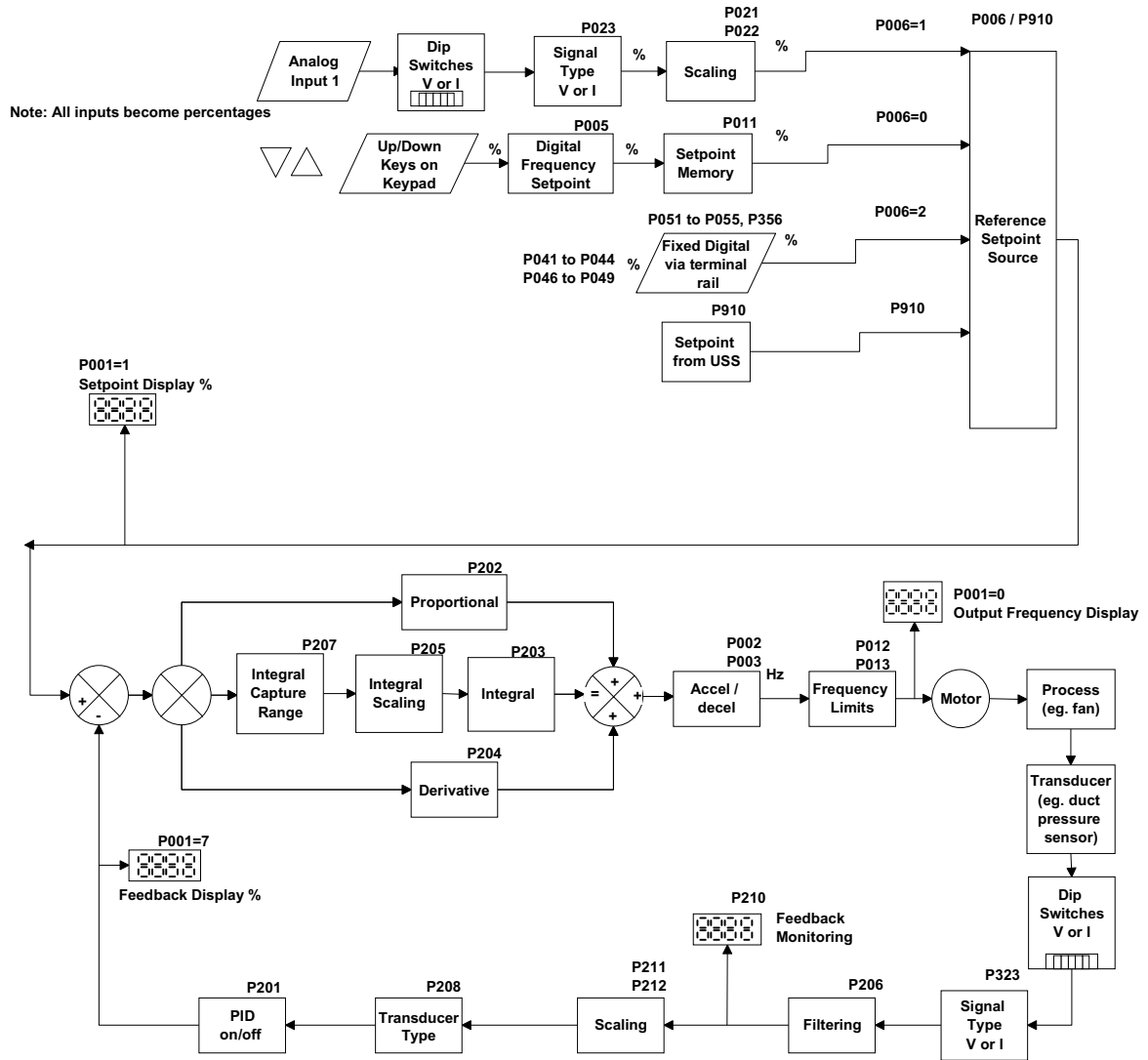


ITEM	DESCRIPTION
A	RUN/STOP COMMAND
B	PRESSURE SETPOINT POTENTIOMETER OR 0 - 10V DC SIGNAL
C	DIFFERENTIAL PRESSURE TRANSDUCER Note: Link terminals 2 and 10 if a 2 wire transducer is used.

## PID FLOW CHART



Examples



**EXAMPLE 10**

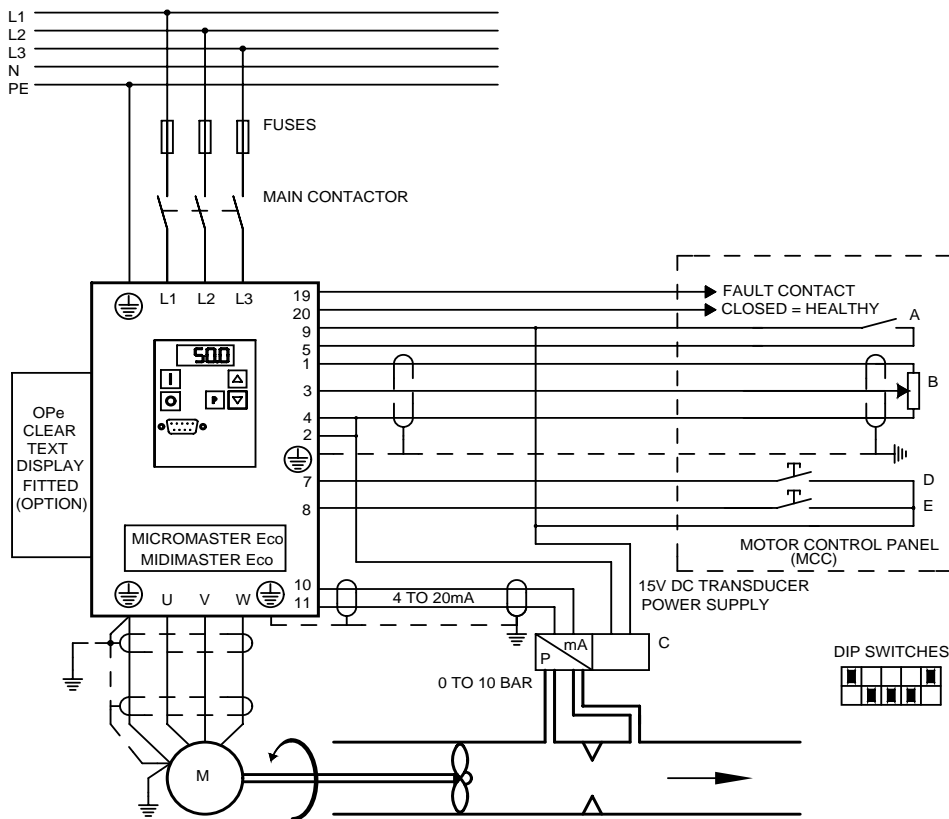
**SELECT BETWEEN POTENTIOMETER CONTROL AND PID REGULATION**

In a ventilation system, the duct pressure differential is to be adjustable by means of a potentiometer. Output signals from the pressure transducer are supplied to the Eco, the selected pressure differential must be kept constant, and the internal PID regulator is used to achieve this. Alternatively, selection can be made at the motor control panel for closed loop PID regulation.

The OPe clear text display is required to be fitted and remain fitted for this application.

All settings based on factory settings with the following exceptions:

PARAMETER CHANGES FROM FACTORY DEFAULTS	
SETTING	DESCRIPTION
P006 = 1	SELECT ANALOG SETPOINT
P007 = 0	SELECT RUN/STOP VIA TERMINALS
P012 = 10	MINIMUM SPEED = 10Hz
P053 = 22	DOWNLOAD OPe PARAMETER SET 0
P054 = 23	DOWNLOAD OPe PARAMETER SET 1
P201 = 1	PID ENABLED (SEE ABOVE OPe SETTINGS)
P202 = 1	PID PROPORTIONAL GAIN (MAY NEED TUNING)
P203 = 0.1 P205 = 10	PID INTEGRAL GAIN (MAY NEED TUNING)
P220 = 1	SWITCH OFF AT MINIMUM SPEED
P211 = 20 P212 = 100	SET ANALOG (PID) INPUT FOR 4 - 20 mA



ITEM	DESCRIPTION
A	RUN/STOP COMMAND FROM MCC PANEL
B	SETPOINT POTENTIOMETER
C	DIFFERENTIAL PRESSURE TRANSDUCER
D	SELECT LOCAL POTENTIOMETER PUSHBUTTON
E	SELECT PID CONTROL PUSHBUTTON



Examples

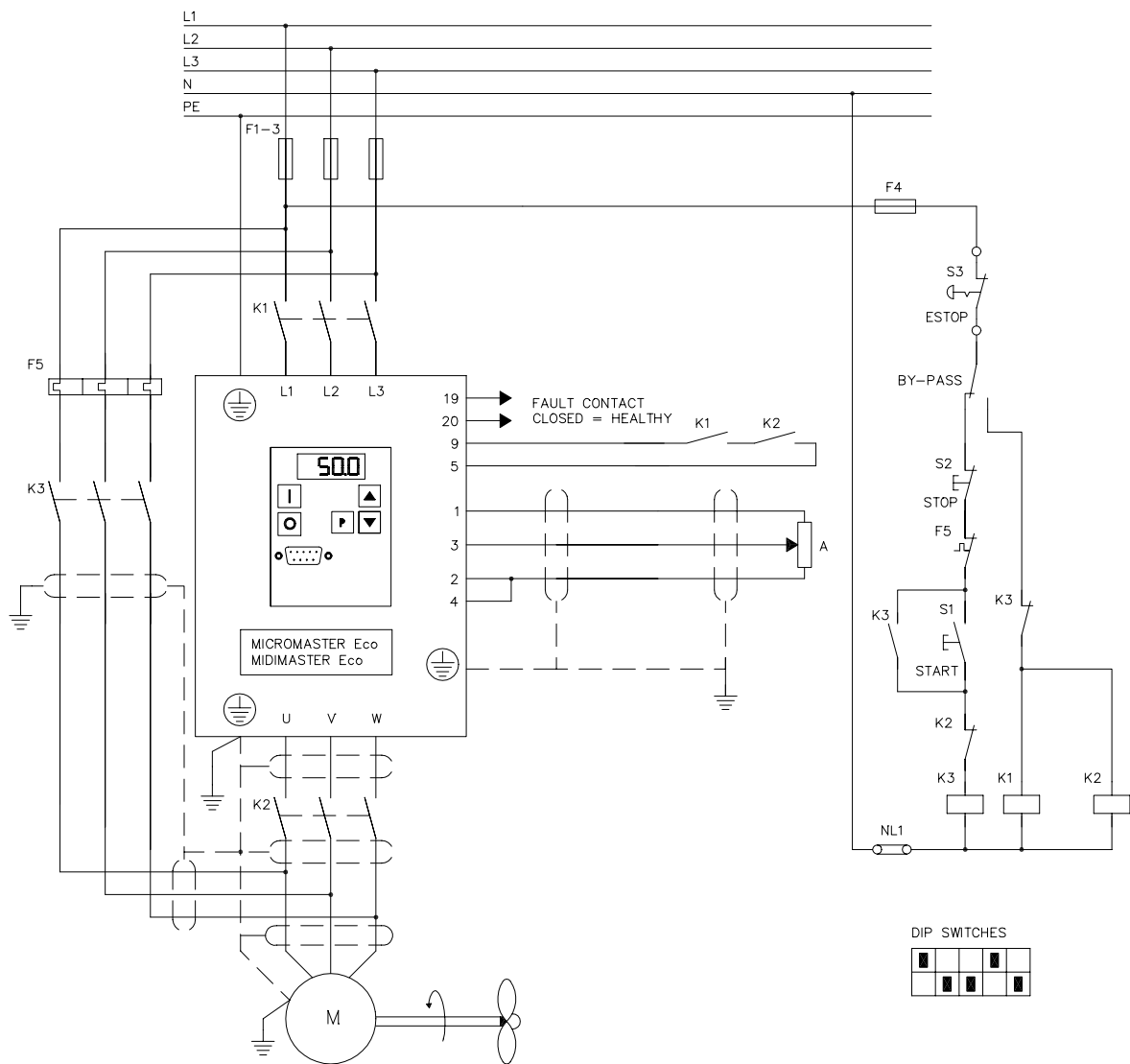
## EXAMPLE 11

### DIRECT-ON-LINE BYPASS

Switch between inverter control and direct-on-line starting.

All settings based on factory settings with the following exceptions:

PARAMETER CHANGES FROM FACTORY DEFAULTS	
SETTING	DESCRIPTION
P006 = 1	SELECT ANALOGUE/POTENTIOMETER SETPOINT
P007 = 0	SELECT RUN/STOP VIA TERMINALS
P016 = 1	FLYING RESTART



ITEM	DESCRIPTION
A	SPEED SETTING POTENTIOMETER.
K1	INVERTER CONTACTOR
K2	INVERTER CONTACTOR
K3	DIRECT-ON-LINE CONTACTOR
S1	START PUSHBUTTON
S2	STOP PUSHBUTTON
S3	EMERGENCY STOP PUSHBUTTON
F1-3	MAIN SUPPLY FUSES
F4	CONTROL FUSE
F5	THERMAL OVERLOAD RELAY

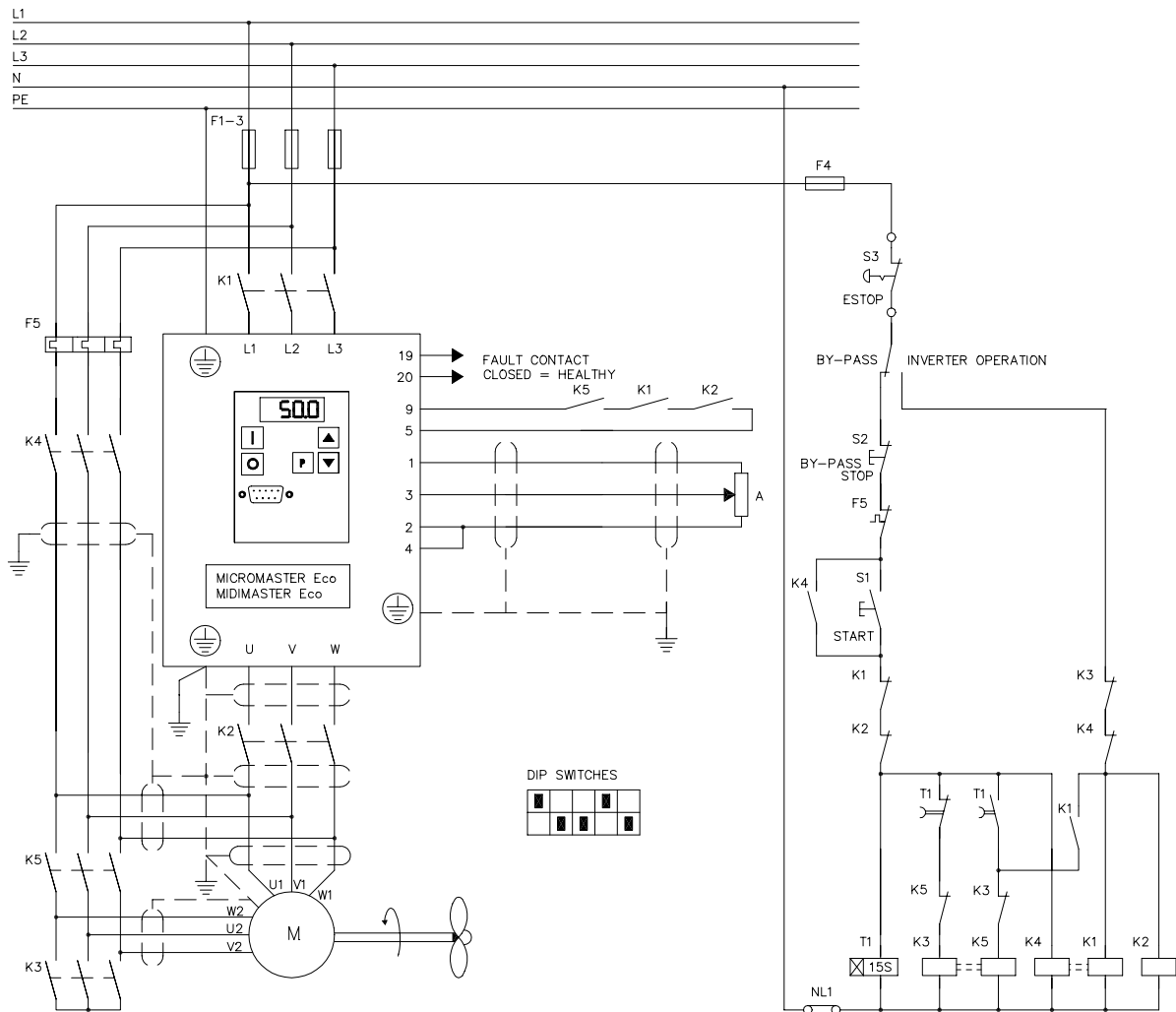
**EXAMPLE 12**

**STAR-DELTA BYPASS**

Switch between inverter control and star-delta starting.

All settings based on factory settings with the following exceptions:

PARAMETER CHANGES FROM FACTORY DEFAULTS	
SETTING	DESCRIPTION
P006 = 1	SELECT ANALOGUE/POTENTIOMETER SETPOINT
P007 = 0	SELECT RUN/STOP VIA TERMINALS
P016 = 1	FLYING RESTART



ITEM	DESCRIPTION
A	SPEED SETTING POTENTIOMETER.
K1, K2	INVERTER CONTACTORS
K3	STAR CONTACTOR
K4, K5	DIRECT-ON-LINE CONTACTORS
S1	START PUSHBUTTON
S2	STOP PUSHBUTTON
S3	EMERGENCY STOP PUSHBUTTON
F1-3	MAIN SUPPLY FUSES
F4	CONTROL FUSE
F5	THERMAL OVERLOAD RELAY



Examples

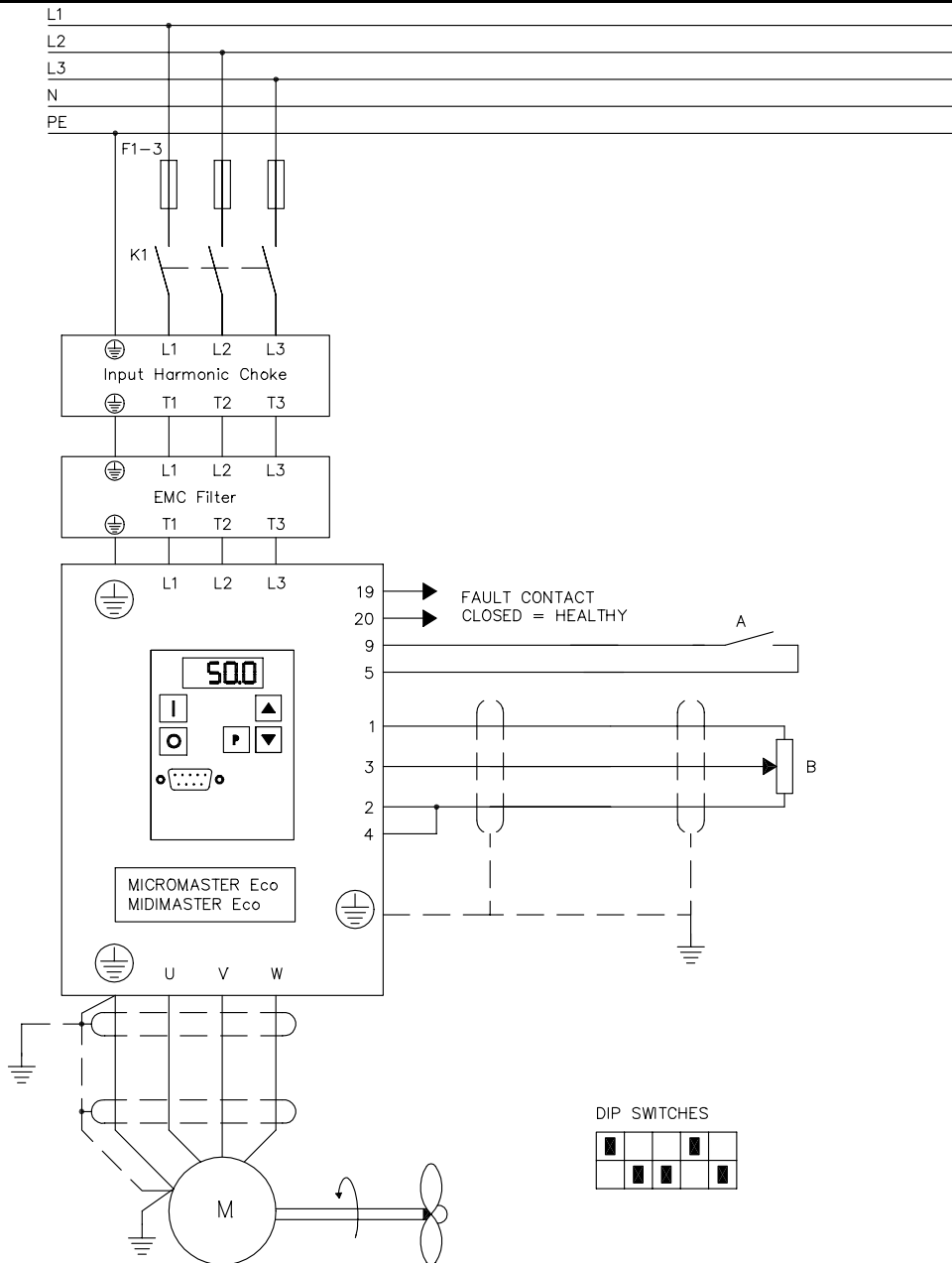
## EXAMPLE 13

### INPUT HARMONIC CHOKE & EMC FILTER FITTED

Input harmonic choke and EMC filter fitted.

All settings based on factory settings with the following exceptions:

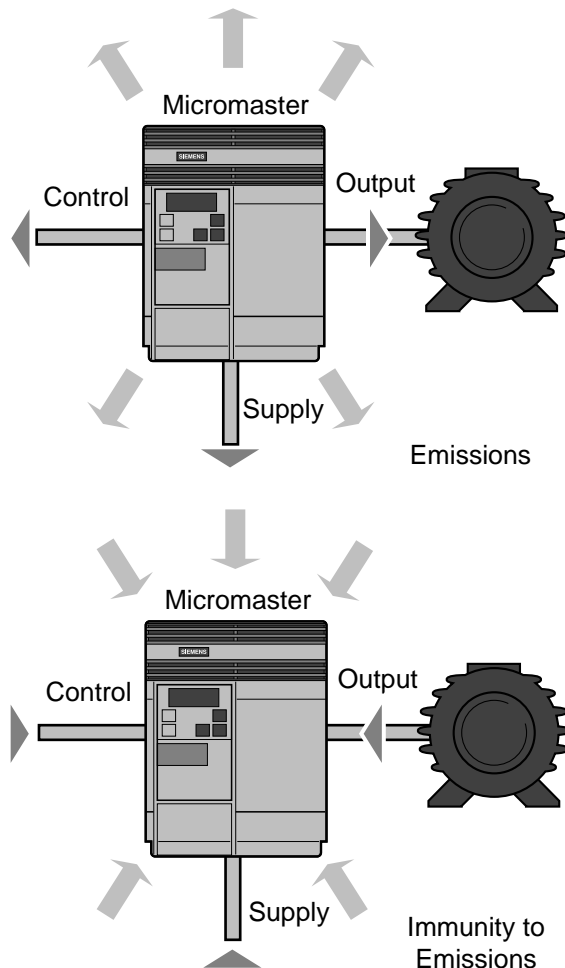
PARAMETER CHANGES FROM FACTORY DEFAULTS	
SETTING	DESCRIPTION
P006 = 1	SELECT ANALOGUE/POTENTIOMETER SETPOINT
P007 = 0	SELECT RUN/STOP VIA TERMINALS



ITEM	DESCRIPTION
A	RUN/STOP SWITCH
B	SPEED SETTING POTENTIOMETER.
F1-3	MAIN SUPPLY FUSES
K1	MAIN CONTACTOR

## 12. EMC GUIDELINES

All electronic and electrical equipment generate unwanted signals. These signals can be emitted from the product either via cables that are connected to the product (Input, output, control signals etc.) or via electromagnetic radiation 'radio transmission'. These signals can be received by other products (via the same routes) and can interfere with the correct operation of the product.



Any particular product gives out a certain level of emissions, and has a certain level of immunity to incoming signals from other products. If the immunity of all products is higher than their emissions, there is no problem. If the immunity is lower, severe problems can occur, causing quality problems, damage, or in extreme cases injury.

Electro-magnetic Compatibility (EMC) concerns how equipment works together; Electro-magnetic Interference (EMI) refers to the unwanted signals themselves.

EMI has become a more serious problem recently as more electronic systems (which may prove to have low immunity) are used in industrial applications, and as power electronic products such as drives, generate high frequency signals which can produce high levels of interference.

### ELECTRO-MAGNETIC COMPATIBILITY (EMC)

All manufacturers/assemblers of electrical apparatus which performs a complete intrinsic function which is placed on the European 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 ways by which the manufacturer/assembler can demonstrate compliance:

#### 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 which have been officially published in the Official Journal of the European Community can be cited in the manufacturer's declaration.

- **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.

- **EC Type-Examination Certificate**

This approach is only applicable to radio communication transmitting apparatus.

The MICROMASTER Eco and MIDIMASTER Eco 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 of the EMC performance characteristics of the products when they are installed in accordance with the wiring recommendations in the Wiring Guidelines at the end of this section.



**Compliance Table (MICROMASTER Eco IP20):**

Model No.	EMC Class
ECO1-75/2 - ECO1-400/2	Class 1
ECO1-75/2 - ECO1-400/2 with footprint filter (see table)	Class 2*
ECO1-110/3 - ECO1-750/3	Class 1
ECO1-110/3 - ECO1-750/3 with footprint class A filter (see table)	Class 2*
ECO1-220/3 - ECO1-750/3 with internal integrated class A filter (see table)	Class 2*
ECO1-110/3 - ECO1-750/3 with footprint class B filter (see table)	Class 3*

**Compliance Table (MIDIMASTER Eco IP20/21):**

Model No.	EMC Class
ECO1-550/2 - ECO1-4500/2	Class 1
ECO1-550/2 - ECO1-4500/2 with internal or external class A filter (see table)	Class 2*
ECO1-550/2 - ECO1-4500/2 with class B external filter (see table)	Class 3*
ECO1-1100/3 - ECO1-315K/3	Class 1
ECO1-1100/3 - ECO1-7500/3 with internal or external class A filter (see table)	Class 2*
ECO1-110K/3 - ECO1-315/3 with external class A filter (see table)	Class 2*
ECO1-1100/3 - ECO1-7500/3 with class B external filter (see table)	Class 3*
ECO1-400/4 - ECO1-4500/4	Class 1

**Compliance Table (MIDIMASTER Eco IP56):**

Model No.	EMC Class
ECO1-110/2 - ECO1-4500/2	Class 1
ECO1-110/2 - ECO1-4500/2 with internal or external class A filter (see table)	Class 2*
ECO1-110/2 - ECO1-4500/2 with class B external filter (see table)	Class 3*
ECO1-300/3 - ECO1-315K/3	Class 1
ECO1-300/3 - ECO1-7500/3 with internal or external class A filter (see table)	Class 2*
ECO1-110K/3 - ECO1-315/3 with external class A filter (see table)	Class 2*
ECO1-300/3 - ECO1-7500/3 with class B external filter (see table)	Class 3*
ECO1-400/4 - ECO1-4500/4	Class 1

\* If the installation of the Eco reduces RF emissions by installation in a steel enclosure, class 3 radiation-emission limits will typically be met.



## Filter Part Numbers:

Inverter Model No.	Class A Filter Part No.	Class B Filter Part No.	Standard
ECO1-75/2	6SE3290-0DA87- 0FA1	6SE3290-0DA87-0FB1	EN 55011 / EN 55022
ECO1-110/2 - ECO1-150/2 (IP20 only)	6SE3290-0DB87- 0FA3	6SE3290-0DB87-0FB3	EN 55011 / EN 55022
ECO1-220/2 - ECO1-400/2 (IP20 only)	6SE3290-0DC87- 0FA4	6SE3290-0DC87-0FB4	EN 55011 / EN 55022
ECO1-110/3 - ECO1-150/3	6SE3290-0DA87- 0FA1	6SE3290-0DA87-0FB1	EN 55011 / EN 55022
ECO1-220/3 - ECO1-300/3 (IP20 only)	6SE3290-0DB87- 0FA3	6SE3290-0DB87-0FB3	EN 55011 / EN 55022
ECO1-400/3 - ECO1-750/3 (IP20 only)	6SE3290-0DC87- 0FA4	6SE3290-0DC87-0FB4	EN 55011 / EN 55022
ECO1-110/2 - ECO1-400/2 (IP56 only)	6SE3290-0DG87- 0FA5	6SE2100-1FC20	EN 55011 / EN 55022
ECO1-550/2 - ECO1-750/2	6SE3290-0DG87- 0FA5	6SE2100-1FC20	EN 55011 / EN 55022
ECO1-1100/2	6SE3290-0DH87- 0FA5	6SE2100-1FC20	EN 55011 / EN 55022
ECO1-1500/2 - ECO1-2200/2	6SE3290-0DJ87- 0FA6	6SE2100-1FC21	EN 55011 / EN 55022
ECO1-3000/2 - ECO1-4500/2	6SE3290-0DK87- 0FA7	6SE3290-0DK87- 0FB7	EN 55011 / EN 55022
ECO1-300/3 - ECO1-1500/3 (IP56 only)	6SE3290-0DG87- 0FA5	6SE2100-1FC20	EN 55011 / EN 55022
ECO1- 1100/3 - ECO1-1500/3	6SE3290-0DG87- 0FA5	6SE2100-1FC20	EN 55011 / EN 55022
ECO1-1850/3 - ECO1-2200/3	6SE3290-0DH87- 0FA5	6SE2100-1FC20	EN 55011 / EN 55022
ECO1-3000/3 - ECO1-3700/3	6SE3290-0DJ87- 0FA6	6SE2100-1FC21	EN 55011 / EN 55022
ECO1-4500/3	6SE3290-0DJ87- 0FA6	6SE3290-0DK87- 0FB7	EN 55011 / EN 55022
ECO1-5500/3 - ECO1-9000/3	6SE3290-0DK87- 0FA7	6SE3290-0DK87- 0FB7	EN 55011 / EN 55022
ECO1-110K/3 - ECO1-160K/3	6SE7033-2ES87-0FA1	Not available	EN 55011 / EN 55022
ECO1-200K/3 – ECO1-315K/3	6SE7036-0ES87-0FA1	Not available	EN 55011 / EN 55022



Maximum mains supply voltage when filters are fitted is :

- 480V for MICROMASTER Eco.
- 460V for MIDIMASTER Eco.

Three classes of EMC performance are available.



These levels of performance are only achieved when using the default switching frequency (or less) and a maximum screened motor cable length of 25 m.

Compliance with the EMC Product Standard for Power Drive Systems EN 61800-3 for use in Second Environment (Industrial) and Restricted Distribution.



## Class 1: General Industrial

EMC Phenomenon	Standard	Level
<b>Emissions:</b>		
Radiated Emissions	EN 55011	Level A1 *
Conducted Emissions	EN 61800-3	*
<b>Immunity:</b>		
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

\* Emission limits not applicable 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
<b>Emissions:</b>		
Radiated Emissions	EN 55011	Level A1
Conducted Emissions	EN 55011	Level A1
<b>Immunity:</b>		
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
<b><i>Emissions:</i></b>		
Radiated Emissions	EN 55022	Level B1
Conducted Emissions	EN 55022	Level B1
<b><i>Immunity:</i></b>		
Electrostatic Discharge	EN 61000-4-2	8 kV air discharge
Burst Interference	EN 61000-4-4	1 kV power cables, 0.5 kV control



The MICROMASTER Eco and MIDIMASTER Eco units are intended exclusively for professional applications. Therefore, they do not fall within the scope of the harmonics emissions specification EN 61000-3-2.



## EMC LAW: FOR POWER DRIVE SYSTEMS EN61800-3

### UNRESTRICTED DISTRIBUTION

When the product is available to the general public, an EC declaration of conformity and CE mark are required. (This is not applicable to the MICROMASTER Eco range which is always supplied via restricted distribution channels).

### RESTRICTED DISTRIBUTION

When the product is not available to the general public (expert use only) EC declaration of conformity and CE mark are not required. However, components must be designed in such a way that they will not cause EMC disturbances when properly installed.

### Limits specified in EN 61800-3

Characteristic	First Environment (Domestic)		Second Environment (Industrial)	
	Unrestricted	Restricted	Unrestricted	Restricted
Radiated Emissions	Class B (10m)	Class A (30m)	No limits specified - EMC warning required	No limits specified - information required
Conducted Emissions	Class B	Class A	Class A	based on today's unfiltered drives
Harmonics	1EC 1000-3-2(4)	1EC 1000-3-2(4)	"reasonable economic approach"	"reasonable economic approach"

## ELECTRO-MAGNETIC INTERFERENCE (EMI)

The inverters are designed to operate in an environment where a high level of Electro-Magnetic Interference (EMI) can be expected. Usually, good installation practices will ensure safe and trouble-free operation. If there are any problems, the following guidelines may prove useful. In particular, grounding of the system at the inverter, as described below, may prove effective. The figures at the end of this section illustrate how filters should be installed and connected.

- 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 (such as a BMS), that is connected to the inverter is also 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.

Connect the return earth from motors controlled by the inverter directly to the earth connection (PE) on the associated inverter.

- On the MIDIMASTER Eco, use saw-tooth washers when mounting the inverter and ensure that a good electrical connection is made between the heatsink and the back panel, removing paint if necessary to expose bare metal.

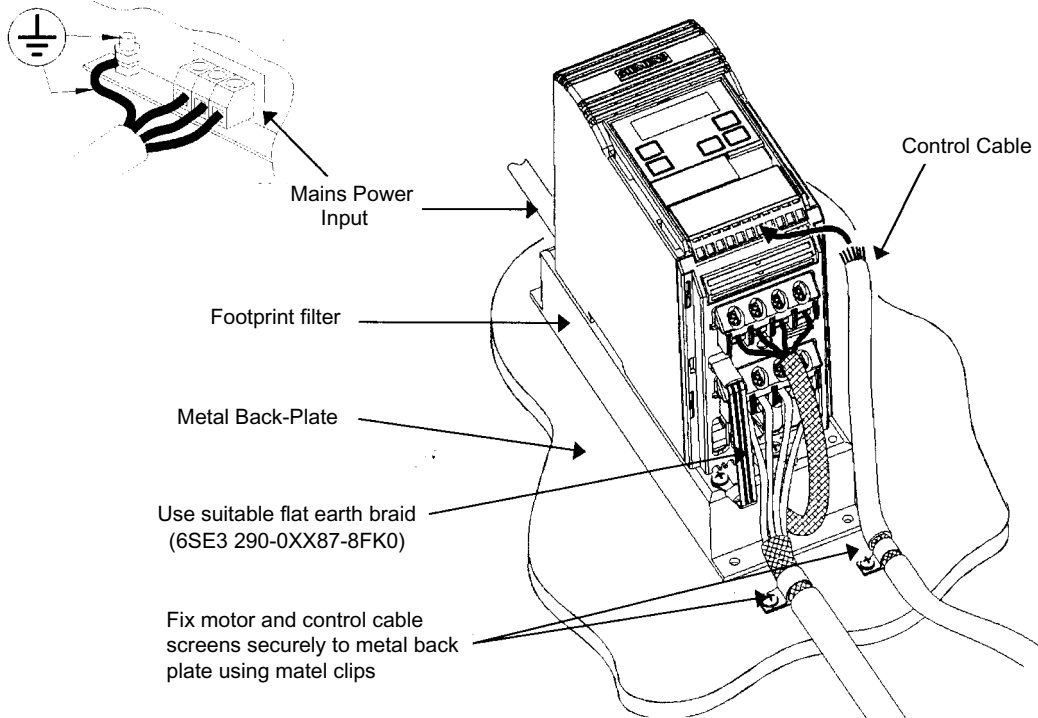
- Wherever possible, use screened leads for connections to the control circuitry. Terminate both the ends of the cable neatly, ensuring that unscreened wires are as short as possible. Use cable glands whenever possible and earth both ends of the screen on the control cable.
- Separate the control cables from the power connections as much as possible, using separate trunking, etc. If control and power cables need to cross, arrange the cables so that they cross at 90° if possible.
- 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 output relay on the inverter.
- Use screened or armoured cables for the motor connections and ground the screen at both ends via the cable glands.
- If the drive is to be operated in an Electro-magnetic noise-sensitive 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.

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

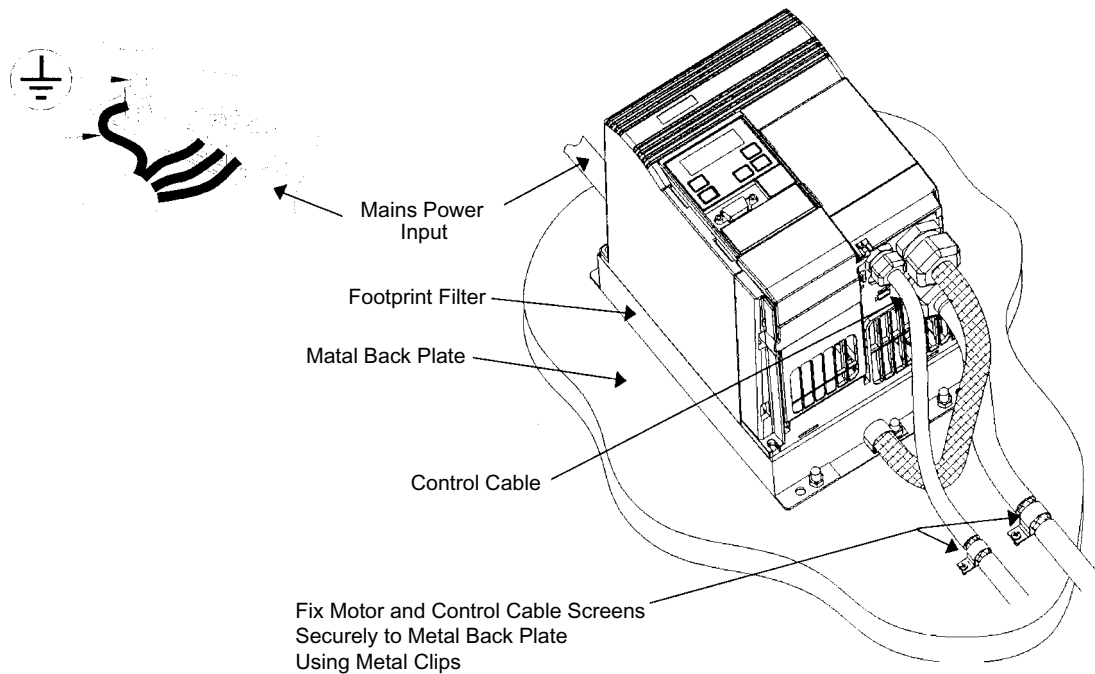


## WIRING GUIDELINES TO MINIMISE EFFECTS OF EMI

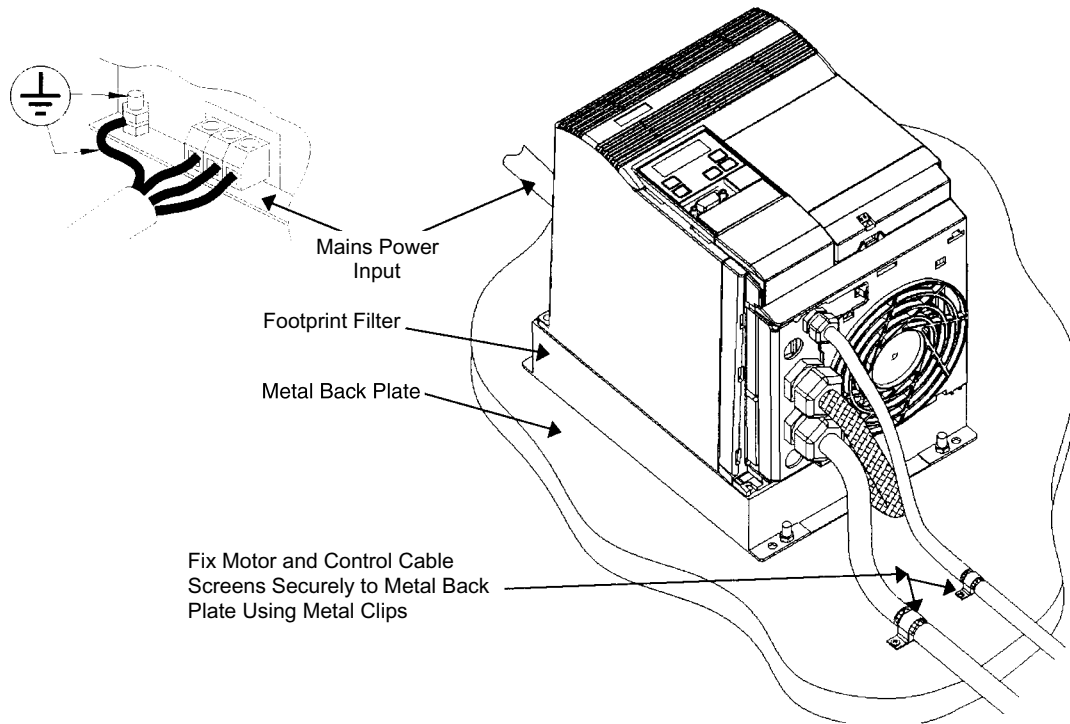
Frame Sizes A, B and C



Wiring guidelines to minimise effects of EMI MICROMASTER Eco (frame size A)



Wiring guidelines to minimise effects of EMI - MICROMASTER Eco (Frame Size B)



*Wiring guidelines to minimise effects of EMI - MICROMASTER Eco (Frame size C)*



Use metallic PG - Glands on the inverter glandplate as shown.

## Fitting a Class A Filter to a Standard Unfiltered IP56 Eco Unit (Frame Sizes 4 to 7)



Generally the IP56 Eco Units can be ordered with internal factory fitted class A EMC filters (see Section % for ordering details). However, if a filter needs to be fitted to the standard unfiltered IP56 Eco unit, then there are mounted studs provided within the IP56 enclosure for installing the recommended class A filter.

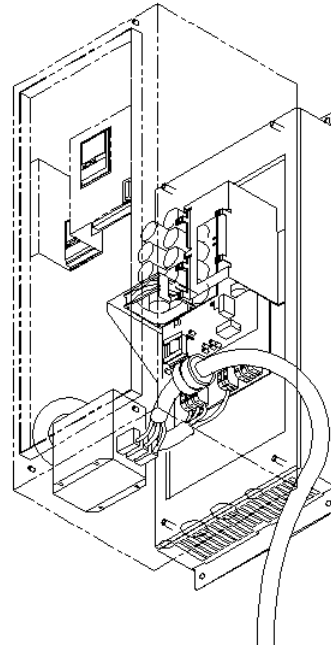
Class B EMC Filters cannot be installed within the IP56 Eco unit.

### Fitting of Accessory Filter (Frame Sizes 4, 5 and 6, IP56)

The installation procedure is as follows:-

1. Unpack the filter and prepare the connecting cable. Trim the screen back so that it will not obstruct the connection of the cables into the mains input terminals (L1, L2, L3 & E) of the inverter.
2. Cover the loose strands of the cable screen with either a short length of heat shrink sleeve or some insulation tape. This is to ensure that the screen is tidy and loose strands will not cause a nuisance.
3. Fit the filter to the studs provided in the IP56 case and bolt down.
4. Screw the three power cables and the earth connection into the supply input terminals (L1, L2, L3 and E) of the inverter.

The screen over the cable that leaves the filter is not used in this type of installation. It is only required if the filter is to be fitted to an IP21 rated inverter as an external filter.



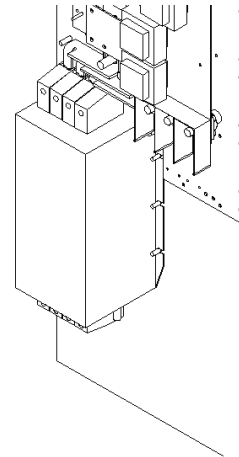
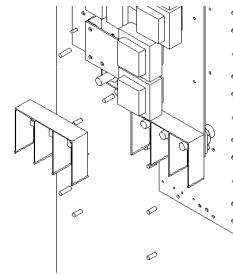
*Filter mounted within the IP56 MIDIMASTER Eco Frame size 4, 5 & 6*



**Fitting of Accessory Filter (Frame Size 7, IP56)**

The installation procedure is as follows:-

1. Remove and discard the inverter input terminal connector plate.
2. Remove the eight screws securing the input terminal divider to the printed circuit board.
3. Remove and discard the input terminal divider.
4. Refit the eight screws in the board.
5. Fit the filter to the mounting studs.
6. Connect the output of the filter to the input terminals of the inverter using the bus-bars supplied with the drive.



*Filter mounted within the Frame Size 7 IP56  
MIDIMASTER Eco*



### 13. PROGRAMMING

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

#### KEYPAD

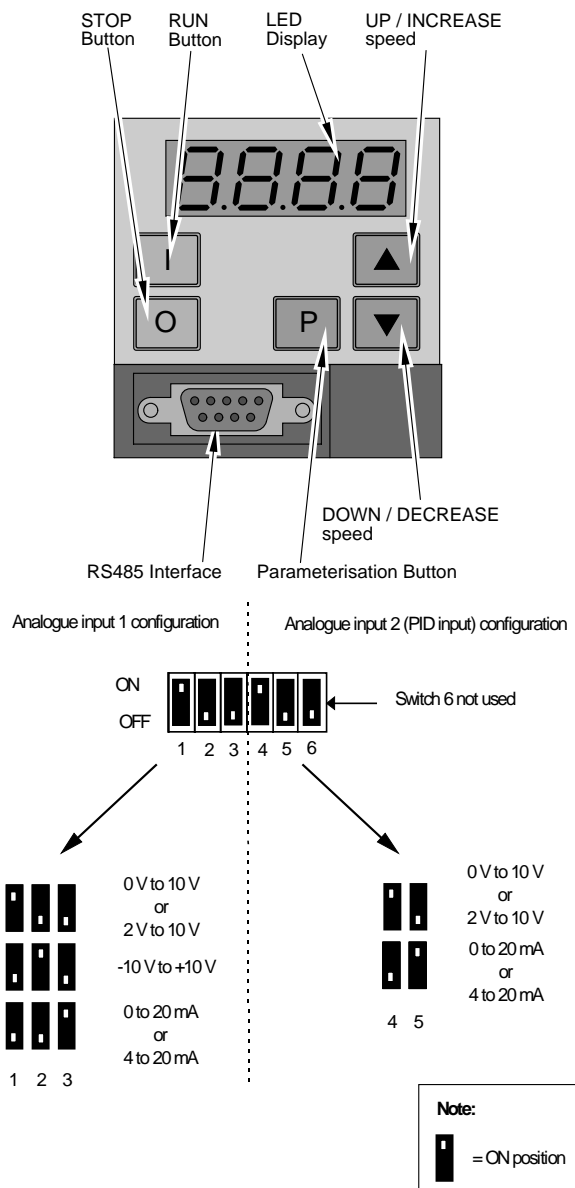
The keypad comprises membrane-type keys as well as an integral 4-digit 7-segment LED display. The keys are limited to [run], [stop], [up], [down] and [P]. All parameters can be accessed and changed using the keys.

#### DIP SELECTOR SWITCHES

DIP switches select between voltage (V) and current (I) analogue inputs. They also select either a voltage or current PID feedback signal. These switches can only be accessed when:

- the front cover is removed on the MICROMASTER Eco and MIDIMASTER Eco, Frame size 4, 5 and 6.
- the lower front cover is removed on the MIDIMASTER Eco, Frame size 7.
- Open the front door on the MIDIMASTER Eco, Frame sizes 8 & 9.

The five DIP selector switches have to be set in agreement with Parameters P023 or P323, according to the operation of the inverter. The figure opposite, shows the settings of the switches for the different modes of operation.



DIP Selector Switches



## PARAMETER TYPES

There are three types of parameters:

- **True value parameters.**  
For example, setting parameter P003 ramp-down time to 10 seconds tells the Eco to take 10 seconds to slow the motor from its normal operating speed to stopped.
- **Limited range parameters.**  
The values themselves are not relevant and only represent the function required. For example:
  1. Parameter P199 can only be set to 0 or 1.
  2. setting the value to 0 tells the Eco to give access to the basic parameters only.
  3. setting the value to 1 gives access to the expert parameters.
- **'Read only' parameters.**  
The values of these parameters are factory set and provide the user with information. For instance, parameter P111 is a read only parameter and indicates the inverter's variable torque power rating in kW.



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.**

## PARAMETER RANGES

The Eco has three ranges of parameters;

- Display mode
- Basic mode
- Expert mode.

One of the Basic mode parameters (P199) controls access to the Expert mode parameters



## ACCESSING PARAMETERS AND CHANGING VALUES

The and keys are used to change parameter values. The keys have two modes of operation:

- A single momentary press will change the value by a value of 1.

- Keeping the button pressed for longer initiates scrolling and allows values to be changed rapidly.

To access a parameter and change its value, follow the simple sequence described below:

Key	Action	Display
	Press <b>P</b> to enter parameter mode	
 	Use the [ <b>up</b> ] and [ <b>down</b> ] keys to select the required parameter number (eg ramp-up time)	
	Press <b>P</b> to confirm that you wish to enter a value for that parameter. The current value is displayed	
 	Use the [ <b>up</b> ] and [ <b>down</b> ] keys to change the required value	
	Press <b>P</b> to confirm that you have changed the value as required. The parameter number is re-displayed.	
 	Use the [ <b>up</b> ] and [ <b>down</b> ] keys to return the parameter number to the display default parameter.	
	Press <b>P</b> to return to default display. The display will alternate between the setpoint frequency and actual output frequency, which will be 0 Hz.	

## DISPLAY MODE PARAMETERS

Parameter	Function	Range	Default	Units
P000	Operating display	-	(output frequency)	Hz

Displays the output selected by P001 (an Expert mode parameter).

### Display selection via P001:

- |  |                              |
|--|------------------------------|
| 0 = Output frequency (Hz)  | 4 = Motor torque (% nominal) |
| 1 = Frequency setpoint (i.e. speed at which inverter is set to run) (Hz) | 5 = Motor speed (rpm)        |
| 2 = Motor current (A)  | 6 = USS serial bus status    |
| 3 = DC-link voltage (V)  | 7 = PID Feedback signal (%)  |
|  | 8 = Output voltage (V)       |

The default setting (0) displays the inverter output frequency. If the inverter is in stand-by mode, the flashing display will alternate between the setpoint frequency and actual output frequency, which will be 0 Hz when not being run.

In the event of a failure, the relevant fault code (Fnnn) is displayed.

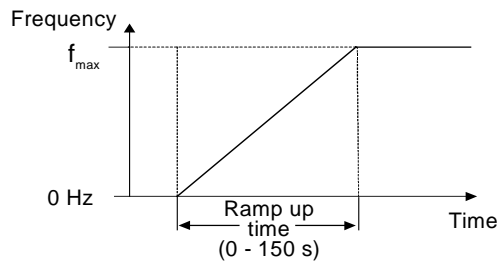




**BASIC MODE PARAMETERS**

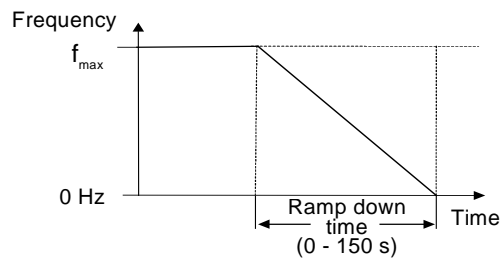
Parameter	Function	Range	Default	Units
P002	Ramp-up time	0 - 150.0	20	seconds

This is the time taken for the motor to accelerate from standstill to the maximum frequency. The maximum frequency is set by parameter P013. Setting the ramp-up time too short can cause the inverter to trip (Fault code F002 = overcurrent).



P003	Ramp-down time	0 - 150.0	20	seconds
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This is the time taken for the motor to decelerate from maximum frequency to standstill. The maximum frequency is set by parameter P013. Setting the ramp-down time too short can cause the inverter to trip (Fault code F001 = DC link overvoltage). This is also the period for which injection braking is applied, if selected (refer to parameter P073 in Expert mode).



P006	Frequency setpoint source selection	0 - 2	0	-
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The value of this parameter (0, 1 or 2) selects the mode of control of the inverter's frequency setpoint.

- 0 = Digital motorised potentiometer (keypad control potentiometer). The inverter runs at the frequency set in P005 (refer to Expert mode) and can be controlled with the **[up]** and **[down]** keys. If P007 (see below) is set to 0, the frequency can be increased or decreased by setting any two of the digital inputs (P051 to P055 or P356 - refer to Expert mode) to the values of 11 and 12.
- 1 = Analogue. the inverter output frequency is controlled by analogue input signals (0-10V, 0/4-20mA or potentiometer).
- 2 = Fixed frequency. Fixed frequency is only selected by setting the value of at least one of the digital inputs (P051 to P055 or P536 - refer to Expert mode) to the value of 6 or 18.



Parameter	Function	Range	Default	Units
P007	Keypad control	0 or 1	1	-

The value of this parameter (0 or 1) configures keypad control.

0 = Control is by digital inputs (P051 to P055 or P356 - refer to Expert mode)

1 = Front panel (keypad) control enabled. However, the level of control enabled from the keypad is determined by the values of P121 and P124 (refer to Expert mode).

P012	Minimum motor frequency	0.0 - 150.0	0.00	Hz
------	-------------------------	-------------	------	----

This value sets the minimum motor frequency and must logically be less than the value of P013 (see below)

P013	Maximum motor frequency	0.0 - 150.0	50.00 60.0 (North America)	Hz
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This value sets the maximum motor frequency. To maintain stable operation, this value should not generally exceed the nominal rating plate frequency when operating pumps and fans.

P016	Start on the fly	0 or 2	0	
------	------------------	--------	---	--

Flying restart

P016=0 Flying restart disabled

P016=2 Flying restart enabled

Allows the inverter to start onto a spinning motor.

Always enter the correct motor nameplate details when enabling this feature.

P081	Motor rating plate nominal frequency	0 - 150.0	50.00 60.0 (North America)	Hz
P082	Motor rating plate nominal speed	0 - 999	Depends on inverter rating	RPM
P083	Motor rating plate nominal current	0.1 – 590.0	Depends on inverter rating	A
P084	Motor rating plate nominal voltage	0 – 1000	Depends on inverter rating	V
P085	Motor rating plate nominal power	0.12 – 400.0	Depends on inverter rating	kW (hp - North America)



**\* Parameters P081 to P085**

- These parameters must be set for the particular motor being controlled by the inverter. You must use the data provided on the motor's rating plate.
- Perform an automatic calibration (P088 = 1 - refer to Expert mode) if any of the parameters P081 to P085 are changed from their factory default settings.
- When the inverter is set-up for North America operation (P101 = 1 - refer to Expert mode), P081 will default to 60 Hz and P085 will indicate in hp (range = 016 to 530).



Parameter	Function	Range	Default	Units
P199	Access to Expert mode	0 or 1	-	-

This value enables or disables access to Expert mode parameters.

0 = Normal mode parameter values only can be changed.

1 = Expert mode parameter values can be changed in addition to the Normal mode parameters.

It is possible to reset all parameter values to their factory default settings using expert parameter P944.





## EXPERT MODE PARAMETERS



The Display mode and Basic mode Parameters are also included in this Expert Mode Parameter listing

Parameter	Function	Range [default]	Description / Notes
P000	Operating display	-	<p>(output frequency) Hz Displays the output selected by P001 (an Expert mode parameter).</p> <p><b>Display selection via P001:</b></p> <ul style="list-style-type: none"> <li>0 = Output frequency (Hz)</li> <li>1 = Frequency setpoint (i.e. speed at which inverter is set to run) (Hz)</li> <li>2 = Motor current (A)</li> <li>3 = DC-link voltage (V)</li> <li>4 = Motor torque (% nominal)</li> <li>5 = Motor speed (rpm)</li> <li>6 = USS serial bus status</li> <li>7 = PID Feedback signal (%)</li> <li>8 = Output voltage (V)</li> </ul> <p>The default setting (0) displays the inverter output frequency. If the inverter is in stand-by mode, the flashing display will alternate between the setpoint frequency and actual output frequency, which will be 0 Hz when not being run.</p> <p>In the event of a failure, the relevant fault code (Fnnn) is displayed.</p>



Parameter	Function	Range [default]	Description / Notes
P001 ●	Display mode	0 - 8 [0]	<p>Display selection:</p> <ul style="list-style-type: none"> <li>0 = Output frequency (Hz)</li> <li>1 = Frequency setpoint (i.e. speed at which inverter is set to run) (Hz)</li> <li>2 = Motor current (A)</li> <li>3 = DC-link voltage (V)</li> <li>4 = Motor torque (% nominal)</li> <li>5 = Motor speed (rpm)</li> <li>6 = USS serial bus status (see section 9.2)</li> <li>7 = PID Feedback signal (%)</li> <li>8 = Output voltage (V)</li> </ul> <p>The display can be scaled via P010.</p>
P002 ●	Ramp-up time (Seconds)	0-150.0 [20]	<p>This is the time taken for the motor to accelerate from standstill to the maximum frequency. The maximum frequency is set by parameter P013. Setting the ramp-up time too short can cause the inverter to trip (Fault code F002 = overcurrent).</p> <div style="text-align: center;"> </div>



Parameter	Function	Range [default]	Description / Notes
P003 ●	Ramp-down time (Seconds)	0-150.0 [20.0]	<p>This is the time taken for the motor to decelerate from maximum frequency to standstill. The maximum frequency is set by parameter P013. Setting the ramp-down time too short can cause the inverter to trip (Fault code F001 = DC link overvoltage). This is also the period for which injection braking is applied, if selected (refer to parameter P073 in Expert mode).</p>
P005 ●	Digital frequency setpoint (Hz)	0 - 150.0 [50.0]  (60.0) North America	Sets the frequency that the inverter will run at when operated in digital mode. Only effective if P006 = 0 or 2.
P006	Frequency setpoint source selection	0-2 [0]	<p>The value of this parameter 0, 1 or 2) selects the mode of control of the inverter's frequency setpoint.</p> <p>0 = Digital motorised potentiometer (Keypad control potentiometer). The inverter runs at the frequency set in P005 (refer to Expert mode) and can be controlled with the <b>[up]</b> and <b>[down]</b> keys. If P007 (see below) is set to 0, the frequency can be increased or decreased by setting any two of the digital inputs (P051 to P055 or P356 - refer to Expert mode) to the values of 11 and 12.</p> <p>1 = Analogue. The inverter output frequency is controlled by analogue input signals (0-10V, 0/4-20mA or potentiometer).</p> <p>2 = Fixed frequency. Fixed frequency is only selected by setting the value of at least one of the digital inputs (P051 to P055 or P536 - refer to Expert mode) to the value of 6 or 18.</p>

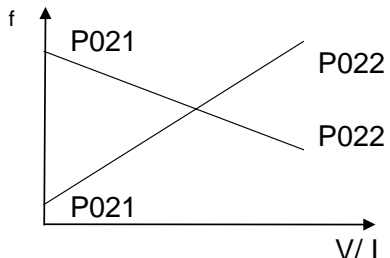



Parameter	Function	Range [default]	Description / Notes
P007	Keypad Control	0 or 1 [1]	The value of this parameter (0 or 1) configures keypad control.  0 = Control is by digital inputs (P051 to P055 or P356 - refer to Expert mode) 1 = Front panel (keypad) control enabled. However, the level of control enabled from the keypad is determined by the values of P121 and P124 (refer to Expert mode).
P010	Display scaling	0.01 - 500.0 [1.00]	Scale factor for display selected when P001 = 0, 1, 4, 5, 7 or 9.
P012	Minimum motor frequency	0.0–150.0 [0.0]	This value sets the minimum motor frequency and must logically be less than the value of P013 (see below)
P013	Maximum motor frequency	0.0-150.0 [50.0] (60.0) North America	This value sets the maximum motor frequency. To maintain stable operation, this value should not generally exceed the nominal rating plate motor nominal frequency when operating pumps and fans.
P014	Skip frequency 1 (Hz) (Not applicable in PID mode)	0 – 150.0 [0.0]	A skip frequency can be set with this parameter to avoid the effects of resonance of the inverter. Frequencies within +/- (the value of P019) of this setting are suppressed. Stationary operation is not possible within this suppressed frequency range - the range is just passed through. Setting P014=0 disables this function.
P015	Automatic re-start after mains break	0 – 1 [1]	0 = No re-start after mains break - run signal must be re-generated 1 = Automatic re-start after mains break if run signal is present
P016	Start on the fly	0 or 2 [0]	Flying restart  P016=0 Flying restart disabled  P016=2 Flying restart enabled  Allows the inverter to start onto a spinning motor.  Always enter the correct motor nameplate details when enabling this feature.



Parameter	Function	Range [default]	Description / Notes
P018 ●	Automatic restart after fault	0 - 1 [0]	<p>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.</p> <p><b>WARNING:</b>                      When this feature is enabled, the Inverter may start without warning.</p>
P019 ●	Skip frequency bandwidth (Hz)	0.0 - 10.0 [2.0]	Frequencies set by P014, P027, P028 and P029 that are within +/- the value of P019 of all skip frequencies are suppressed.



Parameter	Function	Range [default]	Description / Notes
P021 ●	Minimum analogue frequency (Hz)	0 - 150.0 [0.0]	Frequency corresponding to the lowest analogue input value, i.e.0 V/0 mA or 2 V/4 mA, determined by P023 and the settings of the DIP selector switches 1, 2 and 3 (see the <i>DIP Selector Switches figure in this section</i> ). This can be set to a higher value than P022 to give an inverse relationship between analogue input and frequency output (see <i>diagram in P022</i> ).
P022 ●	Maximum analogue frequency (Hz)	0 - 150.0 [50.0] (60)North America	Frequency corresponding to the highest analogue input value, i.e.10 V or 20 mA, determined by P023 and the setting of the DIP selector switches 1, 2 and 3 (see the <i>DIP Selector Switches figure in this section</i> ). This can be set to a lower value than P021 to give an inverse relationship between analogue input and frequency output. i.e.   <p>Note: The output frequency is limited by values entered for P012/P013.</p>
P023 ●	Analogue input 1 type	0 - 2 [0]	Sets analogue input type for analogue input 1, in conjunction with the settings of the DIP selector switches 1, 2 and 3 (See see the <i>DIP Selector Switches figure in this section</i> ) 0 = 0 V to 10 V/ 0 to 20 mA Unipolar input 1 = 2 V to 10 V/ 4 to 20 mA Unipolar input 2 = 2 V to 10 V/ 4 to 20 mA Unipolar input with controlled start/stop when using analogue input control.   <p><b>WARNING:</b> The inverter will automatically start when voltage goes above 1V. This equally applies to both analogue and digital control (i.e. P006 = 0 or 1)</p>



Parameter	Function	Range [default]	Description / Notes																																
P025 ●	Analogue output 1	0 - 105 [0]	<p>This provides a method of scaling the analogue output 1 in accordance with the following table:                      Use range 0 - 5 if minimum output value = 0 mA.                      Use range 100 - 105 if minimum output value = 4 mA</p> <table border="1"> <thead> <tr> <th>P025=</th> <th>Selection</th> <th colspan="2">Analogue Output Range Limits</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td>0/4 mA</td> <td>20 mA</td> </tr> <tr> <td>0/100</td> <td>Output frequency</td> <td>0 Hz</td> <td>Output frequency (P013)</td> </tr> <tr> <td>1/101</td> <td>Frequency setpoint</td> <td>0 Hz</td> <td>Frequency setpoint (P013)</td> </tr> <tr> <td>2/102</td> <td>Motor current</td> <td>0 A</td> <td>Max. overload current (P083 x P086/100)</td> </tr> <tr> <td>3/103</td> <td>DC-link voltage</td> <td>0 V</td> <td>1023 Vdc</td> </tr> <tr> <td>4/104</td> <td>Motor torque</td> <td>-250%</td> <td>+250% (100% = P085/P082 x 9.55Nm)</td> </tr> <tr> <td>5/105</td> <td>Motor RPM</td> <td>0</td> <td>Nominal motor RPM (P082)</td> </tr> </tbody> </table>	P025=	Selection	Analogue Output Range Limits				0/4 mA	20 mA	0/100	Output frequency	0 Hz	Output frequency (P013)	1/101	Frequency setpoint	0 Hz	Frequency setpoint (P013)	2/102	Motor current	0 A	Max. overload current (P083 x P086/100)	3/103	DC-link voltage	0 V	1023 Vdc	4/104	Motor torque	-250%	+250% (100% = P085/P082 x 9.55Nm)	5/105	Motor RPM	0	Nominal motor RPM (P082)
				P025=	Selection	Analogue Output Range Limits																													
						0/4 mA	20 mA																												
				0/100	Output frequency	0 Hz	Output frequency (P013)																												
				1/101	Frequency setpoint	0 Hz	Frequency setpoint (P013)																												
				2/102	Motor current	0 A	Max. overload current (P083 x P086/100)																												
				3/103	DC-link voltage	0 V	1023 Vdc																												
				4/104	Motor torque	-250%	+250% (100% = P085/P082 x 9.55Nm)																												
5/105	Motor RPM	0	Nominal motor RPM (P082)																																
P026 ●	Analogue output 2 (MIDIMASTER Eco only)	0 - 105 [2]	This provides a method of scaling the analogue output 2 in accordance with the table shown in P025.																																
P027 ●	Skip frequency 2 (Hz)	0 - 150.0 [0.0]	See P014.																																
P028 ●	Skip frequency 3 (Hz)	0 - 150.0 [0.0]	See P014.																																
P029 ●	Skip frequency 4 (Hz)	0 - 150.0 [0]	See P014.																																
P041 ●	Fixed frequency1 (Hz)	0 - 150.00 [5.00]	Valid if P006 = 2 and P055 = 6 or 18																																
P042 ●	Fixed frequency 2 (Hz)	0 - 150.00 [10.00]	Valid if P006 = 2 and P054 = 6 or 18																																
P043 ●	Fixed frequency 3 (Hz)	0 - 150.00 [15.00]	Valid if P006 = 2 and P053 = 6 or 18																																
P044 ●	Fixed frequency 4 (Hz)	0 - 150.00 [20.00]	Valid if P006 = 2 and P052 = 6 or 18.																																
P046 ●	Fixed frequency 5 (Hz)	0 - 150.00 [25.0]	Valid if P006 = 2 and P051 = 6 or 18..																																



Parameter	Function	Range [default]	Description / Notes
<b>P047</b> ●	Fixed frequency 6 (Hz)	0 - 150.00 [30.0]	Valid if P006 = 2 and P356 = 6 or 18.
<b>P051</b>	Selection control function, DIN1 (terminal 5), fixed frequency 5.	0 - 24 [1]	See table overleaf
<b>P052</b>	Selection control function, DIN2 (terminal 6), fixed frequency 4.	0 - 24 [10]	See table overleaf
<b>P053</b>	Selection control function, DIN3 (terminal 7), fixed frequency 3.	0 - 24 [6]	See table overleaf
<b>P054</b>	Selection control function, DIN4 (terminal 8), fixed frequency 2.	0 - 24 [6]	See table overleaf
<b>P055</b>	Selection control function, DIN5 (terminal 16), fixed frequency 1.	0 - 24 [6]	See table overleaf
<b>P356</b>	Selection control function, DIN6 (terminal 17), fixed frequency 6.	0 - 24 [6]	See table overleaf





Value	Function of P051 to P055 and P356	Function, low state (0V)	Function, high state (>10V)
0	Input disabled	-	-
1	On right	Off	On right
4	OFF2	OFF2	On
5	OFF3	OFF3	On
6	Fixed frequencies 1-6	Off	On
9	Start / Stop command selection from keypad or digital terminals (for USS communication operation P910 = 1 or 3)	Local Keypad Start / Stop	Digital Terminal Start / Stop (or USS communication control)
10	Fault reset	Off	Reset on rising edge
11	Increase frequency*	Off	Increase
12	Decrease frequency*	Off	Decrease
13	Switch between analogue input frequency setting and digital/keypad frequency setting	Analogue setpoint	Keypad / Digital setpoint
14	Disable the ability to change parameters	'P' enabled	'P' disabled
18	Fixed frequencies 1-6, but input high will also request RUN when P007 = 0	Off	On
19	External trip	Off	On
22	Download parameter set 0 from Ope***	Off	Download
23	Download parameter set 1 from OPe***	Off	Download
24	Switch analogue setpoint	Analogue input 1 active	Analogue input 2 active

\* Only effective when P007 = 0.

\*\*\* The motor must be stopped before downloading begins.

Downloading takes approx. 30 seconds.



Parameter	Function	Range [default]	Description / Notes
<b>P061</b>	Selection relay output RL1	0 - 13 [6]	Sets the relay function, output RL1 (terminals 18,19 and 20)

Value	Relay function	Active <sup>3</sup>
0	No function assigned (relay not active)	Low
1	Inverter is running	High
2	Inverter frequency 0.0 Hz	Low
5	Inverter frequency less than or equal to minimum frequency	Low
6	Fault indication <sup>1</sup>	Low
7	Inverter frequency greater than or equal to setpoint	High
9	Output current greater than or equal to P065	High
12	PID closed loop motor LOW speed limit	High
13	PID closed loop motor HIGH speed limit	High

<sup>1</sup> Inverter switches off (see parameter P930 and P140 to P143).

<sup>3</sup> 'Active low' = relay OFF/ de-energised or 'Active high' = relay ON/ energised

Parameter	Function	Range [default]	Description / Notes
<b>P062</b>	Selection relay output RL2.	0 - 13 [1]	Sets the relay function, output RL2 (terminals 21 and 22) (refer to the table in P061).
<b>P065</b>	Current threshold for relay (A)	0.0-300.0 [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).
<b>P066</b>	Compound braking	0 - 250 [0]	0 = Off 1 to 250 = Defines the level of DC superimposed on the AC waveform, expressed as a percentage of P083. Generally, increasing this value improves braking performance, however, with 400V inverters, a high value in this parameter could cause F001 trips.



Programming

Parameter	Function	Range [default]	Description / Notes
P073 ●	DC injection braking (%)	0 - 200 [0] Range is Variant dependent	<p>This rapidly stops the motor by applying a DC braking current and holds the shaft stationary until the end of the braking period. Additional heat is generated within the motor. Braking is effective for the period of time set by P003.</p> <p>The DC brake can be activated using DIN1 to DIN6 (see P051 to P055 and P356).</p> <p><b>WARNING:</b> Frequent use of long periods of DC injection braking can cause the motor to overheat.</p> <p>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 heating of the motor.</p>





Parameter	Function	Range [default]	Description / Notes
<p><b>P074</b> ●</p>	<p>The I<sup>2</sup>t Motor Overload Protection function protects the motor against overheating by monitoring the motor's current and its speed (heat is dissipated from the motor by the motor's internal cooling fan) and calculating an estimate of the motor's temperature.</p> <p>This I<sup>2</sup>t Motor Overload Protection (P074) function acts independently of the Current Limit (P086) function. The Current Limit function acts quickly to reduce the speed and voltage (in order to try to reduce the inverter load current) in the event of a current overload it will generally act much faster than the Motor I<sup>2</sup>t Protection.</p> <p>The Current Limit function (P086) may reduce the motor speed and current in an attempt to prevent inverter nuisance trips. This may therefore prevent or extend the time that it takes to trip the inverter on I<sup>2</sup>t Motor Overload Protection (even if P074=4, 5, 6 or 7).</p>	<p>0 - 7 [1]</p>	<p>Selects the most appropriate curve for the motor de-rating at low frequencies due to the reduced cooling effect of the shaft mounted cooling fan.</p> <p>CURRENT</p> <p>P074 = 0/4    P074 = 1/5    P074 = 3/7    P074 = 2/6</p> <p>I<sub>N</sub> = Nominal motor current (P083) F<sub>N</sub> = Nominal motor frequency (P081)</p> <p>I<sub>N</sub> = Nominal motor current (P083) F<sub>N</sub> = Nominal motor frequency (P081)</p> <p>0 = No de-rating. Suitable for motors with separately powered cooling or no fan cooling which dissipate the same amount of heat regardless of speed.</p> <p>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.</p> <p>2 = Suitable for special motors not continuously rated at nominal current at nominal frequency..</p> <p>3 = For 6 or 8-pole motors. The inverter assumes that the motor can dissipate full power at ≥ nominal frequency.</p> <p>4 = As P074 = 0 but the inverter trips (F074) instead of reducing the motor torque / speed.</p> <p>5 = As P074 = 1 but the inverter trips (F074) instead of reducing the motor torque / speed.</p> <p>6 = As P074 = 2 but the inverter trips (F074) instead of reducing the motor torque / speed.</p> <p>7 = As P074 = 3 but the inverter trips (F074) instead of reducing the motor torque / speed.</p>



Programming

Parameter	Function	Range [default]	Description / Notes
P076 ●	Pulse frequency	0 - 7 [rating dependent] [0]	<p>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.</p> <p>0/1 = 16 kHz (230 V default) 2/3 = 8 kHz 4/5 = 4 kHz (400 V default) 6/7 = 2 kHz</p> <p>Even numbers = normal modulation technique. Odd numbers = lower loss modulation technique used when operating mainly at speeds above 5 Hz. (Not generally for fan and pump applications)</p>

Due to higher switching losses at increased frequencies, certain inverters may have their maximum continuous current (100%) derated if the switching frequency is changed from the default value.

Model	% of full load de-rating	
	16 kHz	8 kHz
<b>MICROMASTER Eco</b>		
ECO1-75/3	100	100
ECO1-110/3	100	100
ECO1-150/3	100	100
ECO1-220/3	100	100
ECO1-300/3	100	100
ECO1-400/3	100	100
ECO1-550/3	100	100
ECO1-750/3	100	100

Model	% of full load de-rating		
	16 kHz	8 kHz	4 kHz
<b>MIDIMASTER Eco</b>			
ECO1-550/2	60	90	100
ECO1-750/2	55	90	100
ECO1-1100/2	64	90	100
ECO1-1500/2	60	100	100
ECO1-1850/2	47	80	100
ECO1-2200/2	43	79	100
ECO1-1100/3	57	90	100
ECO1-1500/3	50	83	100
ECO1-1850/3	64	90	100
ECO1-2200/3	55	75	100
ECO1-3000/3	50	90	100
ECO1-3700/3	47	88	100
ECO1-4500/3	40	75	100
ECO1-750/4	75	100	100
ECO1-1100/4	55	100	100
ECO1-1500/4	39	75	100
ECO1-1850/4	64	90	100
ECO1-2200/4	55	75	100



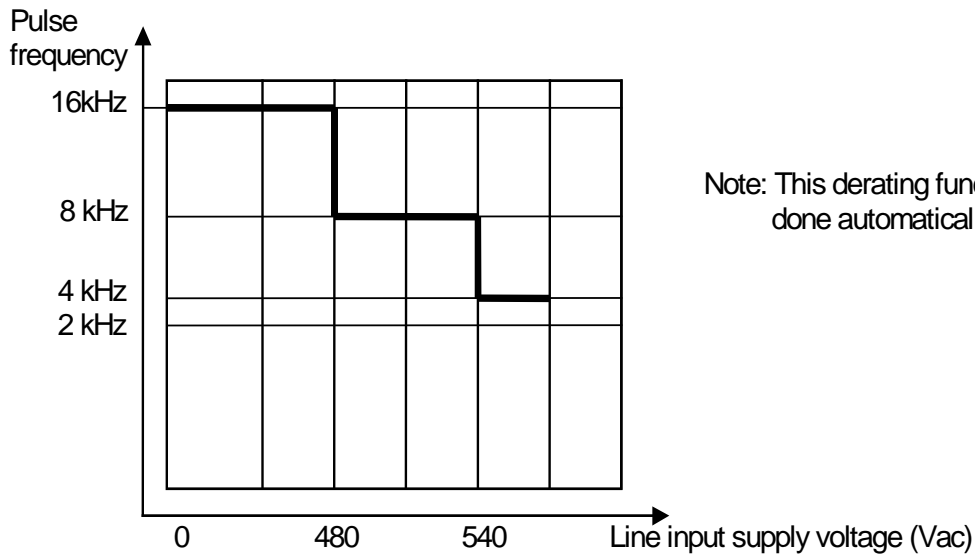
Model	% of full load de-rating	
	4 kHz	2 kHz
<b>MIDIMASTER</b>		
ECO1-110K/3	85	100
ECO1-132K/3	85	100
ECO1-160K/3	85	100
ECO1-200K/3	85	100
ECO1-250K/3	85	100
ECO1-315K/3	Not available	100



On all FS6 575V inverters and all FS7, FS8 & FS9 MIDIMASTER Eco inverters, the switching frequency can only be either 2kHz or 4kHz (with the exception of the 315kW unit where the switching frequency is fixed at 2 kHz).

The switching frequency will automatically be reduced if the inverter internal protection detects an excessive heat sink temperature. The switching frequency will automatically be returned to the setting once this temperature returns to normal.


MICROMASTER Eco switching frequency is automatically reduced at high supply voltage as shown in the diagram below. (Not applicable to MIDIMASTER Eco)



Note: This derating function is done automatically.

Parameter	Function	Range [default]	Description / Notes
P077	Control mode	0 or 4 [4]	0 = Multi-motor mode 4 = Energy saving mode see section 6
P079	Starting boost	0 -250 [50]	Sets additional current during ramping to ensure consistent starting and to overcome stiction effects





Parameter	Function	Range [default]	Description / Notes
P080	Nominal rating plate motor power factor (cosφ)	0.00-1.00 [☆☆☆]	If efficiency is shown on the motor rating plate, calculate the power factor as follows: $pf = \frac{hp \times 746}{1.732 \times \text{efficiency} \times \text{nom. volts} \times \text{nom. amps}}$ If neither power factor nor efficiency are shown on the motor rating plate - set P080 = 0.
P081	Motor rating plate nominal frequency (Hz)	0-150.0 [50.0] [60.0 N.America]	 <b>Parameters P081 to P085</b> - These parameters must be set for the particular motor being controlled by the inverter. You must use the data provided on the motor's rating plate. - Perform an automatic calibration (P088 = 1) if any of the parameters P081 to P085 are changed from their factory default settings. - When the inverter is set-up for North America operation (P101 = 1), P081 will default to 60 Hz and P085 will indicate in hp (range = 016 to 530).
P082	Motor rating plate nominal speed (RPM) ☆☆☆	0-999	
P083	Motor rating plate nominal current (A) ☆☆☆	0.1-590.0	
P084	Motor rating plate nominal voltage (V) ☆☆☆	0-1000	
P085	Motor rating plate nominal power (kW - hp N.America) ☆☆☆	0.12-400.0	
P086 ●	Motor current limit (%)	0 – 200 [100]	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 this set value is exceeded for one minute, the output frequency is reduced until the current falls to that set in P083. The inverter can be made to trip by using the relay in conjunction with P074. The maximum value that P086 can be set to is automatically limited by the rating of the inverter.
P087 ●	Motor PTC enable	0 - 1 0]	0 = disabled 1 = enabled (inverter will trip F004 if external PTC input goes high impedance)



Parameter	Function	Range [default]	Description / Notes
	Automatic calibration	0 - 1 [1]	<p>The motor stator resistance is used in the inverter's internal current monitoring calculations. When P088 is set to '1' and the RUN button is pressed, the inverter performs an automatic measurement of motor stator resistance; stores it in P089 and then resets P088 to '0'.</p> <p>If the measured resistance is too high for the size of inverter (e.g. motor not connected or unusually small motor connected), the inverter will trip (fault code F188) and will leave P088 set to '1'. If this happens, set P089 manually and then set P088 to '0'.</p>
●	Stator resistance (Ω)	0.01-199.99 [☆☆☆]	<p>Can be used instead of P088 to set the motor stator resistance manually. The value entered should be the resistance measured across any two motor phases.</p> <p><b>WARNING:</b></p> <p> The measurement should be made at the inverter terminals with power off.</p> <p> If the value of P089 is too high then an overcurrent trip (F002) may occur.</p>
●	Serial link slave address	0 - 30 [0]	<p>Up to 31 inverters can be connected via the serial link and controlled by a computer or PLC using the USS serial bus protocol. This parameter sets a unique address for the inverter.</p>
●	Serial link baud rate	3 - 7 [6]	<p>Sets the baud rate of the RS485 serial interface (USS protocol):</p> <ul style="list-style-type: none"> <li>3 = 1200 baud</li> <li>4 = 2400 baud</li> <li>5 = 4800 baud</li> <li>6 = 9600 baud</li> <li>7 = 19200 baud</li> </ul> <p> Some RS232 to RS485 converters are not capable of baud rates higher than 4800.</p>






Parameter	Function	Range [default]	Description / Notes
<b>P093</b> ●	Serial line time-out (seconds)	0 - 240 [0]	<p>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.</p> <p>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.</p> <p>Setting the value to zero switches off the control.</p>
<b>P094</b> ●	Serial link nominal system setpoint (Hz)	0 - 150.0 [50.0] (60.0) North America	<p>Setpoints are transmitted to the inverter via the serial link as percentages. The value entered in this parameter represents 100% (HSW = 4000H).</p>
<b>P095</b> ●	USS compatibility	0 - 2 [0]	<p>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).</p>
<b>P101</b>	<p>Operation for Europe or North America</p> <p>Factory Default 0 for 230V Eco 2 for 380V to 500V Eco 0 for 525V to 575V Eco</p>	0 - 2 [0 or 2]	<p>This sets the inverter for European or North America supply and nominal rating plate frequency for the motor to:</p> <p>0 = Europe (50 Hz and power ratings to kW) 1 = North America NEMA (60 Hz and power ratings to hp) 2 = Automatic Selection based on mains voltage     mains voltage &lt;450V goes to 0     mains voltage &gt;450V goes to 1</p> <p> After setting P101 = 0 or 1 the inverter must be re-set to factory defaults, i.e. P944 = 1 to automatically set P013 = 60Hz, P081 = 60Hz, P082 = 1680rpm and P085 will be displayed in hp.</p> <p>After setting P101 = 2 the inverter will automatically re-set to factory defaults, i.e. P944 = 1</p>
<b>P111</b>	Inverter power rating (kW/hp)	1.1 - 90.0 [☆☆☆]	<p>Read-only parameter that indicates the variable torque power rating of the inverter in kW. E.g. 7.5=7.5kW</p> <p> If P101 = 1 then the rating is displayed in hp.</p>



Parameter	Function	Range [default]	Description / Notes
P112	Inverter type	1 - 10 [☆☆☆]	Read-only parameter. 1 = MICROMASTER 2nd Generation (MM2) 2 = COMBI MASTER 3 = MIDIMASTER 4 = MICROMASTER Junior (MMJ) 5 = MICROMASTER 3rd Generation (MM3) 6 = MICROMASTER Vector (MMV) 7 = MIDIMASTER Vector (MDV) 8 = COMBIMASTER 2nd Generation 9 = MICROMASTER Eco 10 = MIDIMASTER Eco
P113	Drive model	0 - 47 [☆☆☆]	Read-only parameter; indicates the power rating according to the type range indicated by P112.

P113	P112 =9	P112=10	P113	P112=10
0		ECO1-110/2	26	ECO1-5500/3
1		ECO1-150/2	27	ECO1-7500/3
2		ECO1-220/2	28	ECO1-9000/3
3		ECO1-300/2	29	ECO1-110K/3
4	ECO1-75/2	ECO1-400/2	30	ECO1-132K/3
5	ECO1-110/2	ECO1-550/2	31	ECO1-160K/3
6	ECO1-150/2	ECO1-750/2	32	ECO1-200K/3
7	ECO1-220/2	ECO1-1100/2	33	ECO1-250K/3
8	ECO1-300/2	ECO1-1500/2	34	ECO1-315K/3
9	ECO1-400/2	ECO1-1850/2	35	
10		ECO1-2200/2	36	ECO1-220/4
11		ECO1-3000/2	37	ECO1-300/4
12		ECO1-3700/2	38	ECO1-400/4
13		ECO1-4500/2	39	ECO1-550/4
14	ECO1-110/3		40	ECO1-750/4
15	ECO1-150/3	ECO1-300/3	41	ECO1-1100/4
16	ECO1-220/3	ECO1-400/3	42	ECO1-1500/4
17	ECO1-300/3	ECO1-550/3	43	ECO1-1850/4
18	ECO1-400/3	ECO1-750/3	44	ECO1-2200/4
19	ECO1-550/3	ECO1-1100/3	45	ECO1-3000/4
20	ECO1-750/3	ECO1-1500/3	46	ECO1-3700/4
21		ECO1-1850/3	47	ECO1-4500/4
22		ECO1-2200/3		
23		ECO1-3000/3		
24		ECO1-3700/3		
25		ECO1-4500/3		




Parameter	Function	Range [default]	Description / Notes
P121	Enable/disable RUN button	0 - 1 [1]	0 = RUN button disabled 1 = RUN 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)  This applies for frequency adjustment only. The buttons can still be used to change parameter values.
P128	Fan switch-off delay time (seconds) (MMV only)	0 - 600 [120]	Time taken for the fan to switch off following an OFF command.
P131	Frequency setpoint (Hz)	0.0- 150.0[-]	
P132	Motor current (A)	0.0 - 300.0 [-]	Read-only parameters. These are copies of the values stored in P001 but can be accessed directly via the serial link.
P133	Motor torque (% nominal torque)	0 - 250 [-]	
P134	DC link voltage (V)	0 - 1000 [-]	
P135	Motor RPM	0 - 9999 [-]	
P136	Output voltage (V)	0 - 1000 [-]	
P140	Most recent fault code	0 - 255 [-]	Read only. The last recorded fault code (see 'Fault Codes') is stored in this parameter. It is cleared when the inverter is reset.  This is a copy of the code stored in P930.
P141	Most recent fault code -1	0 - 255 [-]	Read only. This parameter stores the last recorded fault code prior to that stored in P140/P930.
P142	Most recent fault code -2	0 - 255 [-]	Read only. This parameter stores the last recorded fault code prior to that stored in P141.
P143	Most recent fault code -3	0 - 255 [-]	Read only. This parameter stores the last recorded fault code prior to that stored in P142.



Parameter	Function	Range [default]	Description / Notes
P199 ●	Access to expert mode	0 or 1 [0]	This value enables or disables access to Expert mode parameters. 0 = Normal mode parameter values only can be changed. 1 = Expert mode parameter values can be changed in addition to the Normal mode parameters. It is possible to reset all parameter values to their factory default settings using expert parameter P944.
P201	PID closed loop mode	0 - 1 [0]	0 = Normal operation (closed loop process control disabled). 1 = Closed loop process control using analogue input 2 as feedback.
P202 ●	P gain	0.0-999.9 [1.0]	Proportional gain.
P203 ●	I gain	0.00-99.9 [0]	Integral gain.
P204 ●	D gain	0.0-999.9 [0]	Derivative gain.
P205 ●	Sample Interval (x25ms)	1 - 2400 [1]	The integral response rate is slowed down by this value
P206 ●	Transducer filtering	0 - 255 [0]	0 = Filter off. 1 - 255 = Low pass filtering applied to transducer.
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 transducer voltage/current output. 1 = A increase in motor speed causes an decrease in transducer voltage/current output.
P210	Transducer reading (%) (unscaled)	0.00- 100.00 [-]	Read-only. Value is a percentage of full scale of the selected signal input (i.e. 10 V or 20 mA).
P211 ●	0% setpoint	0.0 - 100.00 [0.0]	Value of P210 to be maintained for 0% setpoint.
P212 ●	100% setpoint	0.0 - 100.00 [100.00]	Value of P210 to be maintained for 100% setpoint.




Parameter	Function	Range [default]	Description / Notes
P220	PID frequency cut-off.	0 - 1 [0]	0 = Normal operation. 1 = Switch off inverter output at or below minimum frequency.  For correct operation of P220 ensure that P202 >0.
P321 ●	Minimum analogue frequency for analogue setpoint 2 (Hz)	0 - 150.0 [0.0]	Frequency corresponding to the lowest analogue input value, i.e. 0 V/0 mA or 2 V/4 mA, determined by P323 and the settings of the DIP selector switches 4 and 5 (see the <i>DIP Selector Switches</i> figure in this section). This can be set to a higher value than P322 to give an inverse relationship between analogue input and frequency output (see diagram in P322).
P322 ●	Maximum analogue frequency for analogue setpoint 2 (Hz)	0 - 150.0 [50.0] (60) North America	Frequency corresponding to the highest analogue input value, i.e. 10 V or 20 mA, determined by P323 and the setting of the DIP selector switches 4 and 5 (see the <i>DIP Selector Switches</i> figure in this section). This can be set to a lower value than P321 to give an inverse relationship between analogue input and frequency output. i.e.  



Parameter	Function	Range [default]	Description / Notes
<b>P323</b> ●	Analogue input 2 type	0 - 2 [0]	<p>Sets analogue input type for analogue input 2, in conjunction with the settings of the DIP selector switches 4 and 5 (see the <i>DIP Selector Switches</i> figure in this section):</p> <p>0 = 0 V to 10 V/ 0 to 20 mA Unipolar input            1 = 2 V to 10 V/ 4 to 20 mA Unipolar input            2 = 2 V to 10 V/ 4 to 20 mA Unipolar input with controlled start / stop when using analogue input control.</p> <p>Setting P323 = 2 will not work unless the inverter is under full local control (i.e. P910 = 0 or 4) and <math>V \geq 1</math> V or 2mA.</p> <p><b>WARNING:</b>            The inverter will automatically start when voltage goes above 1V. This equally applies to both analogue and digital control (i.e. P006 = 0 or 1)</p>
<b>P356</b>	Digital input 6 configuration	0 - 24 [6]	Control function selection, DIN 6 See P051 - P055 for description.
<b>P386</b>	Inertia compensation	0.1-20.0 [1.0]	To ensure reliable starting on the fly this term may need to be adjusted dependent on load inertia. For high inertia loads increase the setting until reliable re-start occurs following short mains breaks.
<b>P720</b> ●	Direct input/output functions	0 - 7 [0]	<p>Allows direct access to the relay outputs and the analogue output via the serial link (USS):</p> <p>0 = Normal operation            1 = Direct control of relay 1            2 = Direct control of relay 2            3 = Direct control of relay 1 and relay 2            4 = Direct control of analogue output 1 only            5 = Direct control of analogue output 1 and relay 1            6 = Direct control of analogue output 1 and relay 2            7 = Direct control of analogue output 1, relay 1 and relay 2</p>
<b>P721</b>	Analogue input 1 voltage (V)	0.0 - 10.0 [-]	Read only. Displays the analogue input 1 voltage (approximate).
<b>P722</b> ●	Analogue output 1 current (mA)	0.0 - 20.0 [0.0]	Allows direct control of the output current if P720 = 4, 5, 6 or 7.



Parameter	Function	Range [default]	Description / Notes
P723	State of digital inputs	0 - 3F [-]	Read-only. Provides a HEX representation of a 6-digit binary number of which the LSB = DIN1 and the MSB = DIN6 (1 = ON, 0 = OFF).  e.g. If P723 = B, this represents '001011' - DIN1, DIN2 and DIN4 = ON, DIN3, DIN5 and DIN6 = OFF.
P724 ●	Relay output control	0 - 3 [0]	Enables control of the output relays. Used in conjunction with P720, e.g. setting P724 = 1 (relay 1 = ON) has no effect unless P720 = 1, 3, 5, or 7.  0 = Both relays OFF / de-energised 1 = Relay 1 ON / energised 2 = Relay 2 ON / energised 3 = Both relays ON / energised
P725	Analogue input 2 voltage (V)	0.0-10.0 [-]	Read only. Displays the analogue input 2 voltage (approximate) only when analogue input 2 is active (P051 to P055 or P356 = 24 and the respective digital input is high).
P726	Analogue output 2 current (mA) Models above 7.5kW only	0.0-20.0 [0.0]	Allows direct control of the analogue output 2 current if P720 = 4, 5, 6 or 7.
P910 ●	Local/USS mode	0 - 4 [0]	Sets the inverter for local control or USS control over the serial link: 0 = Local control 1 = Remote control (and setting of parameter values) 2 = Local control (but USS control of frequency) 3 = USS control (but local control of frequency) 4 = Local control (but USS read and write access to parameters and facility to reset trips)   When operating the inverter via remote control (P910 = 1 or 2), 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.



Parameter	Function	Range [default]	Description / Notes
P930	Most recent fault code	0 - 255 [-]	Read only. The last recorded fault code (see 'Fault Codes') is stored in this parameter. It is cleared when the inverter is reset.(see P140)
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. Previously set parameters will be overwritten including the motor parameters P080 - P085





## FAULT CODES

Fault Code	Cause	Corrective Action
F001	Overvoltage	<p>Check whether supply voltage is within the limits indicated on the rating plate.</p> <p>Increase the Ramp-down time (P003) or apply braking resistor (option).</p> <p>Check whether the required braking power is within the specified limits.</p>
F002	Overcurrent	<p>Check whether the motor power corresponds to the inverter power.</p> <p>Check that the cable length limits have not been exceeded.</p> <p>Check motor cable and motor for short-circuits and earth faults.</p> <p>Check whether the motor parameters (P080 - P085) correspond with the motor being used.</p> <p>Check the stator resistance (P089).</p> <p>Increase the ramp-up time (P002).</p> <p>Reduce the boost set in P079.</p> <p>Check whether the motor is obstructed or overloaded.</p>
F003	Overload	<p>Check whether the motor is overloaded.</p> <p>Increase the maximum motor frequency if a motor with high slip is used.</p>
F004	Overheating of motor (monitoring with PTC)	<p>Check if motor is overloaded.</p> <p>Check the connections to the PTC.</p> <p>Check that P087 has not been set to 1 without a PTC being connected.</p>
F005	Inverter overtemperature (internal PTC)	<p>Check that the ambient temperature is not too high.</p> <p>Check that the air inlet and outlet are not obstructed.</p> <p>Check that the inverter's integral fan is working</p>
F008	USS protocol time-out	<p>Check the serial interface.</p> <p>Check the settings of the bus master and P091 - P093.</p> <p>Check whether the time-out interval is too short (P093).</p>
F010	Initialisation fault	<p>Check the entire parameter set. Set P009 to `0000` before power down.</p>
F011	Internal interface fault <sup>1</sup>	<p>Switch off power and switch on again.</p>
F012	External trip	<p>Source of trip is digital input (configured as an external trip input) going low - check the external source.</p>
F013	Programme fault <sup>1</sup>	<p>Switch off power and switch on again.</p>
F016	Flying Start Instability	<p>Disable flying restart</p> <p>Ensure that P080 to P085 correspond to the name plate motor details.</p> <p>Adjust P386. Note that flying restart will not operate correctly with multi-motors.</p>

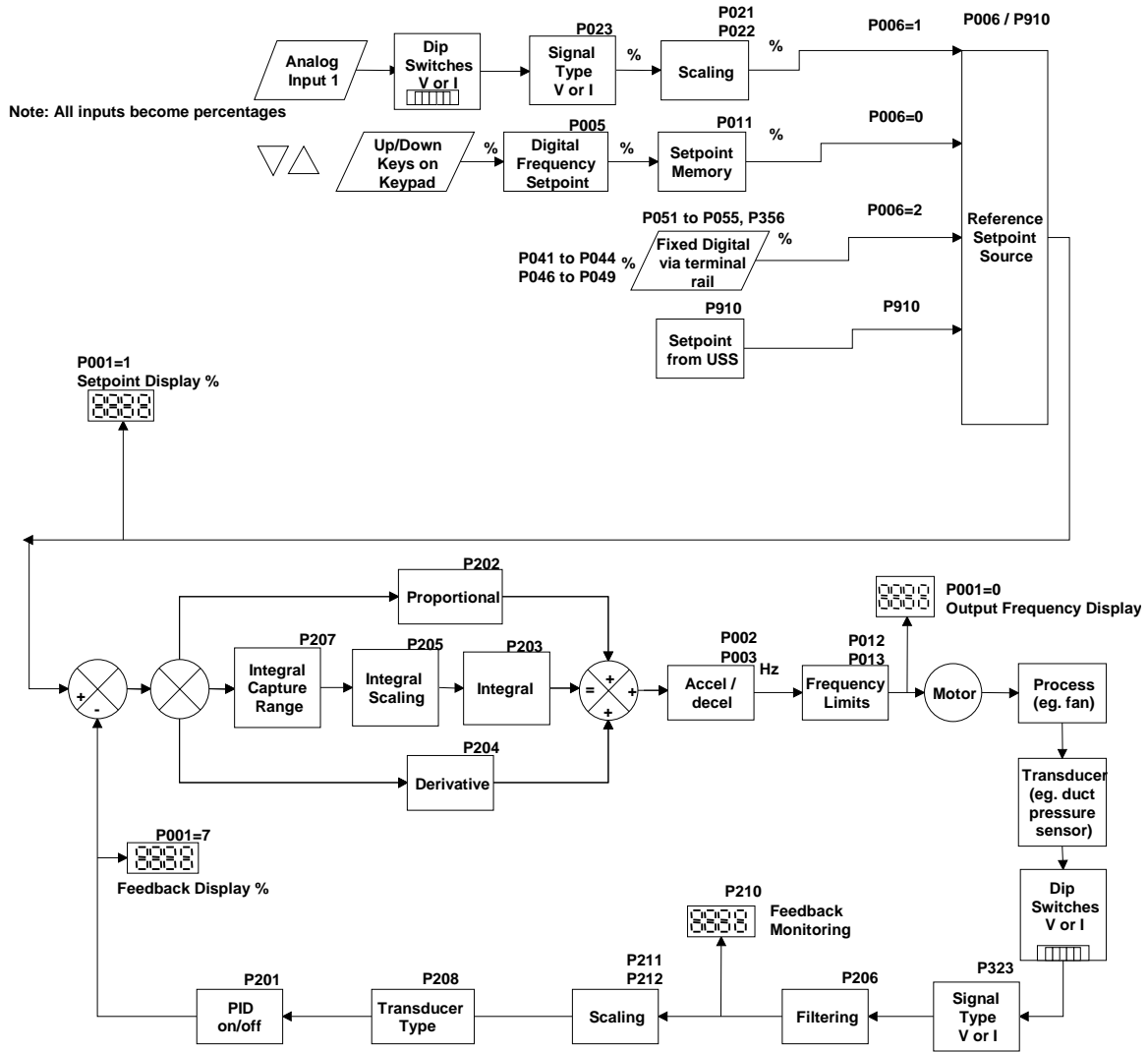


Fault Code	Cause	Corrective Action
F074	Motor overtemperature by I <sup>2</sup> t calculation	Trip occurs only if P074 = 4, 5, 6 or 7. Check that the motor current does not exceed the value set in P083 and P086.
F106	Parameter fault P006	Parameterise fixed frequency(ies) on the digital inputs.
F112	Parameter fault P012/P013	Set parameter P012 < P013.
F151 F156	Digital input parameter fault	Change the settings of digital inputs P051 to P055 and P356.
F188	Automatic calibration failure	Motor not connected to inverter - connect motor. If the fault persists, set P088 = 0 and then enter the measured stator resistance of the motor into P089 manually.
F212	Parameter fault P211/P212	Set parameter P211 < P212.
F231	Output current measurement imbalance	Check motor cable and motor for short-circuits and earth faults.

<sup>1</sup> Check wiring guidelines have been followed.

## PID PROCESS CONTROL

Together with open loop motor control, PID closed loop process control can be applied to any process which is a function of motor speed and for which a transducer is available to provide a suitable feedback signal (see *Figure below*). When closed loop process control is enabled (P201 = 001), all setpoints are calibrated between zero and 100%, i.e. a setpoint of 50.0 = 50%.



### Closed Loop Process Control

#### HARDWARE SET-UP

Make sure that the DIP selector switches 4 and 5 are correctly set (see the *DIP Selector Switches figure in this section*) and in agreement with P323 for unipolar voltage or current feedback signal inputs. Connect feedback transducer between control terminals 10 and 11 (analogue input 2). This analogue input accepts a 0/2 - 10 V or a 0/4 - 20 mA input signal (determined by the setting of the DIP selector switches 4 and 5 and P323) has 10-bit resolution and permits a differential (floating) input. Make sure that the value of parameter P006 is set to 000.

15 V dc power for the feedback transducer can be supplied from terminal 9 on the control terminal block.



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## PID PARAMETER SETTINGS

Closed loop process control cannot be used unless P201 is first set to 001. Most of the parameters associated with closed loop process control are shown in the Closed Loop Process Control figure. Other parameters which are also associated with closed loop process control are as follows:

- P010**      Scaling of display(only if P001 = 1, 4, 5, 7 or 9)
- P061**      Relay output to indicate when controller has reached output limits (value = 012 or 013)
- P220**      Auto switch off inverter output when control has reached minimum output level.

**14. DE-RATING INFORMATION**

**THERMAL PROTECTION AND AUTOMATIC DE-RATING**

Losses within the power module rise with increasing switching frequencies, leading to higher heatsink temperatures. If the inverter operates outside its recommended ambient operating temperature it would normally trip, with an over-temperature fault code. To avoid such nuisance tripping, the MICROMASTER Eco/MIDIMASTER Eco automatically reduces its switching frequency ( e.g. from 16kHz to 8kHz). This reduces the temperature of the heatsink, enabling the application to continue running - trip free. Should the load or ambient temperature then reduce, the inverter will first check to see if it is safe to increase the switching frequency again and then do so.

See parameter P076 for a list of de-ratings applicable to particular ratings.

**MAXIMUM MOTOR CABLE LENGTHS**

The tables shown below give an indication of the maximum motor cable allowed to be connected to the inverter without the use of additional output chokes.

$I$  is the motor current and  $I_N$  is the nominal motor current (P083).



Standard MICROMASTER Eco units have a maximum value of  $I/I_N = 1.5$  (i.e. 150% overload).

For cable lengths greater than those specified in the tables, an external output choke is required, see section 15.

**Maximum cable lengths and derating with respect to load current**

**208/240V MICROMASTER Eco:**

**Un-screened cable**

**$F_{max} = 16\text{kHz}$  (Switching Frequency)**

Current ( $I/I_N$ )	ECO1-75/2	ECO1-110/2	ECO1-150/2	ECO1-220/2	ECO1-300/2	ECO1-400/2
	<b>Cable length (m)</b>					
<b>1.5</b>	200	200	200	185	185	185
<b>1.4</b>	200	200	200	200	200	200
<b>1.3</b>	200	200	200	200	200	200
<b>1.2</b>	200	200	200	200	200	200
<b>1.1</b>	200	200	200	200	200	200
<b>1.0</b>	200	200	200	200	200	200



De-rating Information

**208/240V MICROMASTER Eco:**

**Screened cable**

**F<sub>max</sub> = 16kHz (Switching Frequency)**

Current (I/I <sub>N</sub> )	ECO1-75/2	ECO1-110/2	ECO1-150/2	ECO1-220/2	ECO1-300/2	ECO1-400/2
	<b>Cable length (m)</b>					
<b>1.5</b>	185	200	200	155	150	145
<b>1.4</b>	200	200	200	200	200	200
<b>1.3</b>	200	200	200	200	200	200
<b>1.2</b>	200	200	200	200	200	200
<b>1.1</b>	200	200	200	200	200	200
<b>1.0</b>	200	200	200	200	200	200

**380V/500V MICROMASTER Eco:**

**Un-screened cable**

**F<sub>max</sub> = 4kHz (Switching Frequency)**

Current (I/I <sub>N</sub> )	ECO1-110/3		ECO1-150/3		ECO1-220/3		ECO1-300/3		ECO1-400/3		ECO1-550/3		ECO1-750/3	
	<b>Cable Length (m)</b>													
	<b>440V</b>	<b>550V</b>	<b>440V</b>	<b>550V</b>	<b>440V</b>	<b>550V</b>	<b>440V</b>	<b>550V</b>	<b>440V</b>	<b>550V</b>	<b>440V</b>	<b>550V</b>	<b>440V</b>	<b>550V</b>
<b>1.5</b>	110	100	110	100	170	165	165	160	200	200	200	200	200	200
<b>1.4</b>	120	110	120	110	175	170	170	165	200	200	200	200	200	200
<b>1.3</b>	130	115	130	115	175	170	170	165	200	200	200	200	200	200
<b>1.2</b>	140	120	140	120	175	170	170	165	200	200	200	200	200	200
<b>1.1</b>	150	130	150	130	175	170	170	165	200	200	200	200	200	200
<b>1.0</b>	160	140	160	140	175	170	170	165	200	200	200	200	200	200

**380V/500V MICROMASTER Eco:**

**Screened cable**

**F<sub>max</sub> = 4kHz (Switching Frequency)**

Current (I/I <sub>N</sub> )	ECO1-110/3		ECO1-150/3		ECO1-220/3		ECO1-300/3		ECO1-400/3		ECO1-550/3		ECO1-750/3	
	<b>Cable Length (m)</b>													
	<b>440V</b>	<b>550V</b>	<b>440V</b>	<b>550V</b>	<b>440V</b>	<b>550V</b>	<b>440V</b>	<b>550V</b>	<b>440V</b>	<b>550V</b>	<b>440V</b>	<b>550V</b>	<b>440V</b>	<b>550V</b>
<b>1.5</b>	80	70	80	70	140	140	135	135	200	200	200	200	200	200
<b>1.4</b>	85	80	85	80	145	145	140	140	200	200	200	200	200	200
<b>1.3</b>	95	80	95	80	145	145	140	140	200	200	200	200	200	200
<b>1.2</b>	100	80	100	80	145	145	140	140	200	200	200	200	200	200
<b>1.1</b>	100	80	100	80	145	145	140	140	200	200	200	200	200	200
<b>1.0</b>	100	80	100	80	145	145	140	140	200	200	200	200	200	200



**MAXIMUM OUTPUT CURRENT AT ELEVATED TEMPERATURES - VARIABLE TORQUE APPLICATIONS**

Maximum Inverter Output Current With High Ambient Temperature - 25m of Screened Cable or 50m of Unscreened Cable Maximum, Variable Torque Applications (110% overload for 1 minute in every 5 minutes)

De-rating Information

Model Number	40 deg C				50 deg C				60 deg C				70 deg C			
	2kHz	4kHz	8kHz	16kHz	2kHz	4kHz	8kHz	16kHz	2kHz	4kHz	8kHz	16kHz	2kHz	4kHz	8kHz	16kHz
ECO1-550/2 @ 264V	22	22	16.5	8.8	22	22	16.5	8.6	22	22	16.5	8.6	20	17.3	16.5	8.6
ECO1-750/2 @ 264V	28.0	28.0	21	10.9	28	28	21	10.9	28	25.9	21	10.9	20	17.3	17.3	8.8
ECO1-1100/2 @ 264V	42.0	42.0	31.5	23.1	42	42	31.5	23.1	39.9	38.9	31.5	23.1	24.4	24.3	21.3	21.2
ECO1-1500/2 @ 264V	54	54	(a)	(a)	49.7	49.7	(a)	(a)	46.6	46.6	(a)	(a)	37.3	35.4	(a)	(a)
ECO1-1850/2 @ 264V	68.0	68.0	(a)	(a)	52.8	52.8	(a)	(a)	49.5	49.5	(a)	(a)	39.6	37.5	(a)	(a)
ECO1-2200/2 @ 264V	80.0	80.0	(a)	(a)	62.1	62.1	(a)	(a)	58.2	58.2	(a)	(a)	46.6	44.1	(a)	(a)
ECO1-3000/2 @ 264V	95.0	95.0	(a)	(a)	73.7	73.7	(a)	(a)	69.1	69.1	(a)	(a)	55.3	52.4	(a)	(a)
ECO1-3700/2 @ 264V	130.0	130.0	(a)	(a)	130.0	130.0	(a)	(a)	130.0	130.0	(a)	(a)	129.2	119.9	(a)	(a)
ECO1-4500/2 @ 264V	154.0	154.0	(a)	(a)	154	154	(a)	(a)	154	154	(a)	(a)	153	142	(a)	(a)
ECO1-1100/3 @ 460V	23.5	23.5	21.1	12.9	21.0	20.4	23.3	12.9	18.6	17.8	21.8	12.9	10.5	10.4	7.0	(b)
ECO1-1500/3 @ 460V	30.0	30.0	22.5	11.7	28.8	26	22.3	11.7	23.7	22.7	20.9	11.7	13.4	13.3	6.7	(b)
ECO1-1850/3 @ 460V	37.0	37.0	33.3	23.7	33.2	30.3	28.3	15.1	24.2	24.2	27.4	15.1	8.4	8.4	10.8	10.1
ECO1-2200/3 @ 460V	43.5	43.5	30	22	39	35.6	25.5	14	28.4	28.4	24.7	14	9.9	9.9	9.7	9.4
ECO1-3000/3 @ 460V	58.0	58.0	(a)	(a)	51.8	51.8	(a)	(a)	35.9	35.9	(a)	(a)	(b)	(b)	(a)	(a)
ECO1-3700/3 @ 460V	71.0	71.0	(a)	(a)	63.4	63.4	(a)	(a)	44.0	44.0	(a)	(a)	(b)	(b)	(a)	(a)
ECO1-4500/3 @ 460V	84.0	84.0	(a)	(a)	75	75	(a)	(a)	52	52	(a)	(a)	(b)	(b)	(a)	(a)
ECO1-5500/3 @ 460V	102.0	102.0	(a)	(a)	102.0	100.8	(a)	(a)	102.0	91.7	(a)	(a)	93.5	82.6	(a)	(a)
ECO1-7500/3 @ 460V	138.0	138.0	(a)	(a)	138.0	136.4	(a)	(a)	138.0	124.0	(a)	(a)	126.5	111.7	(a)	(a)
ECO1-9000/3 @ 460V	168.0	168.0	(a)	(a)	168	166	(a)	(a)	168	151	(a)	(a)	154	136	(a)	(a)
ECO1-110K/3 @ 460V	210	193	(a)	(a)	157	145	(a)	(a)	(b)	(b)	(a)	(a)	(b)	(b)	(a)	(a)
ECO1-132K/3 @ 460V	260	239	(a)	(a)	195	179	(a)	(a)	(b)	(b)	(a)	(a)	(b)	(b)	(a)	(a)
ECO1-160K/3 @ 460V	315	290	(a)	(a)	236	217	(a)	(a)	(b)	(b)	(a)	(a)	(b)	(b)	(a)	(a)
ECO1-200K/3 @ 460V	370	340	(a)	(a)	277	255	(a)	(a)	(b)	(b)	(a)	(a)	(b)	(b)	(a)	(a)
ECO1-250K/3 @ 460V	510	469	(a)	(a)	382	352	(a)	(a)	(b)	(b)	(a)	(a)	(b)	(b)	(a)	(a)
ECO1-315K/3 @ 460V	590	(a)	(a)	(a)	442	(a)	(a)	(a)	(b)	(a)	(a)	(a)	(b)	(a)	(a)	(a)
ECO1-1100/3 @ 550V	21.1	21.1	21.1	11.6	20.3	18.9	21.1	(b)	16.3	14.8	19.5	(b)	(b)	(b)	(b)	(b)
ECO1-1500/3 @ 550V	27.0	27.0	19.5	8.7	26	24.2	19.5		20.9	18.9	18	(b)	(b)	(b)	(b)	(b)
ECO1-1850/3 @ 550V	33.3	33.3	30	21.3	29.8	28.8	22.5	13.6	22.7	17.9	10.2	10.0	12.1	(b)	(b)	(b)
ECO1-2200/3 @ 550V	39.1	39.1	28.3	19.6	35	33.8	21.2	12.5	26.7	21	9.6	9.2	14.2	(b)	(b)	(b)
ECO1-3000/3 @ 550V	52.2	52.2	(a)	(a)	44.2	44.2	(a)	(a)	31.1	31.1	(a)	(a)	(b)	(b)	(a)	(a)
ECO1-3700/3 @ 550V	63.9	63.9	(a)	(a)	54.1	54.1	(a)	(a)	38.0	38.0	(a)	(a)	(b)	(b)	(a)	(a)
ECO1-4500/3 @ 550V	75.6	75.6	(a)	(a)	64	64	(a)	(a)	45	45	(a)	(a)	(b)	(b)	(a)	(a)
ECO1-5500/3 @ 550V	91.8	91.8	(a)	(a)	91.8	91.8	(a)	(a)	91.8	88.6	(a)	(a)	89.9	79.5	(a)	(a)
ECO1-7500/3 @ 550V	124.2	124.2	(a)	(a)	124.2	124.2	(a)	(a)	124.2	119.9	(a)	(a)	121.6	107.6	(a)	(a)
ECO1-9000/3 @ 550V	151.2	151.2	(a)	(a)	151.2	151.2	(a)	(a)	151.2	146	(a)	(a)	148	131	(a)	(a)
ECO1-400/4 @ 660V	6.1	6.1	6.1	6.1												
ECO1-550/4 @ 660V	9.0	9.0	9.0	8.2												
ECO1-750/4 @ 660V	11.0	11.0	11.0	8.2												
ECO1-1100/4 @ 660V	17.0	17.9	17.0	9.3												
ECO1-1500/4 @ 660V	22.0	22.0	16.5	8.6												
ECO1-1850/4 @ 660V	27.0	27.0	24.3	17.3												
ECO1-2200/4 @ 660V	32.0	32.0	24.0	17.6												
ECO1-3000/4 @ 660V	41.0	41.0	(a)	(a)	41.0	41.0	(a)	(a)	36.2	36.2	(a)	(a)	22.6	22.6	(a)	(a)
ECO1-3700/4 @ 660V	52.0	52.0	(a)	(a)	52.0	52.0	(a)	(a)	46.0	46.0	(a)	(a)	28.6	28.6	(a)	(a)
ECO1-4500/4 @ 660V	62.0	62.0	(a)	(a)	62	62	(a)	(a)	54.8	54.8	(a)	(a)	34.1	34.1	(a)	(a)

Notes: (a) Switching frequency not available  
(b) Not Possible.



De-rating Information

## MAXIMUM OUTPUT CURRENT WITH LONG UNSCREENED CABLES - VARIABLE TORQUE APPLICATIONS

Maximum Inverter Output Current With Long Unscreened Cable Lengths - 40°C Ambient Temperature Maximum, Variable Torque Applications (110% overload for 1 minute in every 5 minutes)

Model Number	up to 50m				up to 100m				up to 200m				up to 300m			
	2kHz	4kHz	8kHz	16kHz	2kHz	4kHz	8kHz	16kHz	2kHz	4kHz	8kHz	16kHz	2kHz	4kHz	8kHz	16kHz
ECO1-550/2 @ 264V	22.0	22.0	16.5	8.6	22.0	22.0	16.5	8.6	21.4	21.1	16.5	8.6	20.8	20.4	16.5	8.6
ECO1-750/2 @ 264V	28.0	28.0	21	10.9	28.0	28.0	21.0	10.9	28.0	27.9	21.0	10.9	27.9	27.9	21.0	10.9
ECO1-1100/2 @ 264V	42.0	42.0	37.8	26.9	42.0	42.0	37.8	26.9	42.0	42.0	37.8	26.9	42.0	41.9	37.8	26.9
ECO1-1500/2 @ 264V	54.0	54.0	(a)	(a)	54.0	54.0	(a)	(a)	54.0	54.0	(a)	(a)	54.0	54.0	(a)	(a)
ECO1-1850/2 @ 264V	68.0	68.0	(a)	(a)	57.3	57.3	(a)	(a)	57.3	57.3	(a)	(a)	57.3	57.3	(a)	(a)
ECO1-2200/2 @ 264V	80.0	80.0	(a)	(a)	67.4	67.4	(a)	(a)	67.4	67.4	(a)	(a)	67.4	67.4	(a)	(a)
ECO1-3000/2 @ 264V	104.0	104.0	(a)	(a)	104.0	104.0	(a)	(a)	104.0	104.0	(a)	(a)	104.0	104.0	(a)	(a)
ECO1-3700/2 @ 264V	130.0	130.0	(a)	(a)	130.0	130.0	(a)	(a)	130.0	130.0	(a)	(a)	130.0	130.0	(a)	(a)
ECO1-4500/2 @ 264V	154.0	154.0	(a)	(a)	154.0	154.0	(a)	(a)	154.0	154.0	(a)	(a)	154.0	154.0	(a)	(a)
ECO1-1100/3 @ 460V	23.5	23.5	23.5	12.9	21.9	20.8	23.2	12.9	21.5	20.1	23.0	(b)	21.2	19.5	20.1	(b)
ECO1-1500/3 @ 460V	30.0	30.0	22.5	11.7	28.0	26.6	22.2	11.7	27.5	25.7	22.0	(b)	27.1	24.9	19.2	(b)
ECO1-1850/3 @ 460V	37.0	37.0	33.3	23.7	34.0	33.1	28.2	14.9	33.9	32.1	28.0	14.0	33.3	31.1	27.8	13.1
ECO1-2200/3 @ 460V	43.5	43.5	30	22	40.0	38.9	25.4	13.8	39.9	37.7	25.2	13.0	39.2	36.6	25.0	12.2
ECO1-3000/3 @ 460V	58.0	58.0	(a)	(a)	55.2	55.2	(a)	(a)	55.2	55.2	(a)	(a)	(b)	(b)	(a)	(a)
ECO1-3700/3 @ 460V	71.0	71.0	(a)	(a)	67.6	67.6	(a)	(a)	67.6	67.5	(a)	(a)	(b)	(b)	(a)	(a)
ECO1-4500/3 @ 460V	84.0	84.0	(a)	(a)	80.0	80.0	(a)	(a)	80.0	79.9	(a)	(a)	79.9	79.9	(a)	(a)
ECO1-5500/3 @ 460V	102.0	102.0	(a)	(a)	102.0	102.0	(a)	(a)	102.0	102.0	(a)	(a)	102.0	102.0	(a)	(a)
ECO1-7500/3 @ 460V	138.0	138.0	(a)	(a)	138.0	138.0	(a)	(a)	138.0	138.0	(a)	(a)	138.0	138.0	(a)	(a)
ECO1-9000/3 @ 460V	168.0	168.0	(a)	(a)	168.0	168.0	(a)	(a)	168.0	168.0	(a)	(a)	168.0	168.0	(a)	(a)
ECO1-110K/3 @ 460V	210	210	(a)	(a)	210	210	(a)	(a)	210	210	(a)	(a)	210	210	(a)	(a)
ECO1-132K/3 @ 460V	260	260	(a)	(a)	260	260	(a)	(a)	260	260	(a)	(a)	260	260	(a)	(a)
ECO1-160K/3 @ 460V	315	315	(a)	(a)	315	315	(a)	(a)	315	315	(a)	(a)	315	315	(a)	(a)
ECO1-200K/3 @ 460V	370	370	(a)	(a)	370	370	(a)	(a)	370	370	(a)	(a)	370	370	(a)	(a)
ECO1-250K/3 @ 460V	510	510	(a)	(a)	510	510	(a)	(a)	510	510	(a)	(a)	510	510	(a)	(a)
ECO1-315K/3 @ 460V	590	(a)	(a)	(a)	590	(a)	(a)	(a)	590	(a)	(a)	(a)	590	(a)	(a)	(a)
ECO1-1100/3 @ 550V	21.1	21.1	21.1	11.6	20.2	19.5	21.1	(b)	20.2	18.1	(b)	(b)	(b)	(b)	(b)	(b)
ECO1-1500/3 @ 550V	27.0	27.0	19.5	8.7	25.9	24.9	19.5	(b)	25.9	23.2	(b)	(b)	25.8	21.7	(b)	(b)
ECO1-1850/3 @ 550V	33.3	33.3	30	21.3	32.4	31.3	26.9	14.7	32.3	29.9	26.6	8.9	31.5	(b)	(b)	(b)
ECO1-2200/3 @ 550V	39.1	39.1	28.3	19.6	38.0	36.8	25.4	13.5	37.9	35.1	25.1	8.2	37.0	33.5	22.9	(b)
ECO1-3000/3 @ 550V	52.2	52.2	(a)	(a)	52.2	52.2	(a)	(a)	52.2	52.2	(a)	(a)	(b)	(b)	(a)	(a)
ECO1-3700/3 @ 550V	63.9	63.9	(a)	(a)	63.9	63.9	(a)	(a)	63.9	63.9	(a)	(a)	(b)	(b)	(a)	(a)
ECO1-4500/3 @ 550V	75.6	75.6	(a)	(a)	75.6	75.6	(a)	(a)	75.6	75.6	(a)	(a)	75.6	75.6	(a)	(a)
ECO1-5500/3 @ 550V	91.8	91.8	(a)	(a)	91.8	91.8	(a)	(a)	91.8	91.8	(a)	(a)	91.8	91.8	(a)	(a)
ECO1-7500/3 @ 550V	124.2	124.2	(a)	(a)	124.2	124.2	(a)	(a)	124.2	124.2	(a)	(a)	124.2	124.2	(a)	(a)
ECO1-9000/3 @ 550V	151.2	151.2	(a)	(a)	151.2	151.2	(a)	(a)	151.2	151.2	(a)	(a)	151.2	151.2	(a)	(a)
ECO1-400/4 @ 660V	6.1	6.1	6.1	6.1												
ECO1-550/4 @ 660V	9.0	9.0	9.0	8.2												
ECO1-750/4 @ 660V	11.0	11.0	11.0	8.2												
ECO1-1100/4 @ 660V	17.0	17.0	17.0	9.3												
ECO1-1500/4 @ 660V	22.0	22.0	16.5	8.6												
ECO1-1850/4 @ 660V	27.0	27.0	24.3	17.3												
ECO1-2200/4 @ 660V	32.0	32.0	24.0	17.6												
ECO1-3000/4 @ 660V	41.0	41.0	(a)	(a)	41.0	40.9	(a)	(a)	40.9	40.9	(a)	(a)	40.9	40.8	(a)	(a)
ECO1-3700/4 @ 660V	52.0	52.0	(a)	(a)	52.0	51.9	(a)	(a)	51.9	51.8	(a)	(a)	51.9	51.7	(a)	(a)
ECO1-4500/4 @ 660V	62.0	62.0	(a)	(a)	62	61.9	(a)	(a)	61.9	61.8	(a)	(a)	61.9	61.7	(a)	(a)

Notes: (a) Switching frequency not available  
 (b) Not Possible.





**MAXIMUM OUTPUT CURRENT WITH LONG SCREENED CABLES - VARIABLE TORQUE APPLICATIONS**

**Maximum Inverter Output With Current Long Screened Cable Lengths - 40°C Ambient Temperature Maximum, Variable Torque Applications (110% overload for 1 minute in every 5 minutes)**

Model Number	up to 50m				up to 100m				up to 200m				up to 300m			
	2kHz	4kHz	8kHz	16kHz	2kHz	4kHz	8kHz	16kHz	2kHz	4kHz	8kHz	16kHz	2kHz	4kHz	8kHz	16kHz
ECO1-550/2 @ 264V	22.0	22.0	16.5	8.6	21.4	21.0	16.5	8.6	20.2	19.8	16.5	8.6	19.3	18.7	16.5	8.6
ECO1-750/2 @ 264V	28.0	28.0	21	10.9	28.0	28.0	21.0	10.9	28.0	27.9	21.0	10.9	27.9	27.9	21.0	10.9
ECO1-1100/2 @ 264V	42.0	42.0	37.8	26.9	42.0	42.0	37.8	26.9	42.0	41.7	37.8	26.9	41.3	40.8	37.8	26.9
ECO1-1500/2 @ 264V	54.0	54.0	(a)	(a)	54.0	54.0	(a)	(a)	54.0	54.0	(a)	(a)	54.0	54.0	(a)	(a)
ECO1-1850/2 @ 264V	68.0	68.0	(a)	(a)	57.3	57.3	(a)	(a)	57.3	57.3	(a)	(a)	57.3	57.3	(a)	(a)
ECO1-2200/2 @ 264V	80.0	80.0	(a)	(a)	67.4	67.4	(a)	(a)	67.4	67.4	(a)	(a)	67.4	67.4	(a)	(a)
ECO1-3000/2 @ 264V	104.0	104.0	(a)	(a)	104.0	104.0	(a)	(a)	104.0	104.0	(a)	(a)	104.0	104.0	(a)	(a)
ECO1-3700/2 @ 264V	130.0	130.0	(a)	(a)	130.0	130.0	(a)	(a)	130.0	130.0	(a)	(a)	130.0	130.0	(a)	(a)
ECO1-4500/2 @ 264V	154.0	154.0	(a)	(a)	154.0	154.0	(a)	(a)	154.0	154.0	(a)	(a)	154.0	154.0	(a)	(a)
ECO1-1100/3 @ 460V	23.5	23.5	23.5	12.9	21.6	20.5	20.4	(b)	21.2	19.6	20.2	(b)	20.8	18.6	(b)	(b)
ECO1-1500/3 @ 460V	30.0	30.0	22.5	11.7	27.6	26.2	19.5	(b)	27.1	25.0	19.3	(b)	26.6	23.8	(b)	(b)
ECO1-1850/3 @ 460V	37.0	37.0	33.3	23.7	34.0	32.4	28.1	14.5	33.3	31.0	27.8	13.1	32.4	29.8	27.4	11.6
ECO1-2200/3 @ 460V	43.5	43.5	30	22	40.0	38.1	25.3	13.5	39.1	36.5	25.0	12.2	38.1	35.0	24.7	10.8
ECO1-3000/3 @ 460V	58.0	58.0	(a)	(a)	55.2	55.2	(a)	(a)	55.2	55.2	(a)	(a)	(b)	(b)	(a)	(a)
ECO1-3700/3 @ 460V	71.0	71.0	(a)	(a)	67.6	67.6	(a)	(a)	67.6	67.5	(a)	(a)	(b)	(b)	(a)	(a)
ECO1-4500/3 @ 460V	84.0	84.0	(a)	(a)	80.0	80.0	(a)	(a)	80.0	79.9	(a)	(a)	79.9	79.8	(a)	(a)
ECO1-5500/3 @ 460V	102.0	102.0	(a)	(a)	102.0	102.0	(a)	(a)	102.0	102.0	(a)	(a)	102.0	101.9	(a)	(a)
ECO1-7500/3 @ 460V	138.0	138.0	(a)	(a)	138.0	138.0	(a)	(a)	138.0	138.0	(a)	(a)	138.0	137.9	(a)	(a)
ECO1-9000/3 @ 460V	168.0	168.0	(a)	(a)	168.0	168.0	(a)	(a)	168.0	168.0	(a)	(a)	168.0	167.9	(a)	(a)
ECO1-110K/3 @ 460V	210	210	(a)	(a)	210	210	(a)	(a)	210	210	(a)	(a)	210	200	(a)	(a)
ECO1-132K/3 @ 460V	260	260	(a)	(a)	260	260	(a)	(a)	260	260	(a)	(a)	260	247	(a)	(a)
ECO1-160K/3 @ 460V	315	315	(a)	(a)	315	315	(a)	(a)	315	315	(a)	(a)	315	300	(a)	(a)
ECO1-200K/3 @ 460V	370	370	(a)	(a)	370	370	(a)	(a)	370	370	(a)	(a)	370	352	(a)	(a)
ECO1-250K/3 @ 460V	510	510	(a)	(a)	510	510	(a)	(a)	510	510	(a)	(a)	510	485	(a)	(a)
ECO1-315K/3 @ 460V	590	(a)	(a)	(a)	590	(a)	(a)	(a)	590	(a)	(a)	(a)	590	(a)	(a)	(a)
ECO1-1100/3 @ 550V	21.1	21.1	21.1	11.6	20.2	18.8	18.7	(b)	20.2	17.0	(b)	(b)	(b)	(b)	(b)	(b)
ECO1-1500/3 @ 550V	27.0	27.0	19.5	8.7	25.9	24.1	17.3	(b)	25.8	21.7	(b)	(b)	25.3	19.0	(b)	(b)
ECO1-1850/3 @ 550V	33.3	33.3	30	21.3	32.3	30.4	26.7	14.1	31.4	28.3	23.4	(b)	30.3	(b)	(b)	(b)
ECO1-2200/3 @ 550V	39.1	39.1	28.3	19.6	37.9	35.7	25.2	13.0	36.9	33.2	22.1	(b)	35.6	30.9	13.8	(b)
ECO1-3000/3 @ 550V	52.2	52.2	(a)	(a)	52.2	52.2	(a)	(a)	52.2	52.2	(a)	(a)	(b)	(b)	(a)	(a)
ECO1-3700/3 @ 550V	63.9	63.9	(a)	(a)	63.9	63.9	(a)	(a)	63.9	63.9	(a)	(a)	(b)	(b)	(a)	(a)
ECO1-4500/3 @ 550V	75.6	75.6	(a)	(a)	75.6	75.6	(a)	(a)	75.6	75.6	(a)	(a)	75.6	75.6	(a)	(a)
ECO1-5500/3 @ 550V	91.8	91.8	(a)	(a)	91.8	91.8	(a)	(a)	91.8	91.8	(a)	(a)	91.8	91.8	(a)	(a)
ECO1-7500/3 @ 550V	124.2	124.2	(a)	(a)	124.2	124.2	(a)	(a)	124.2	124.2	(a)	(a)	124.2	124.2	(a)	(a)
ECO1-9000/3 @ 550V	151.2	151.2	(a)	(a)	151.2	151.2	(a)	(a)	151.2	151.2	(a)	(a)	151.2	151.2	(a)	(a)
ECO1-400/4 @ 660V	6.1	6.1	6.1	6.1												
ECO1-550/4 @ 660V	9.0	9.0	9.0	8.2												
ECO1-750/4 @ 660V	11.0	11.0	11.0	8.2												
ECO1-1100/4 @ 660V	17.0	17.0	17.0	9.3												
ECO1-1500/4 @ 660V	22.0	22.0	16.5	8.6												
ECO1-1850/4 @ 660V	27.0	27.0	24.3	17.3												
ECO1-2200/4 @ 660V	32.0	32.0	24.0	17.6												
ECO1-3000/4 @ 660V	41.0	41.0	(a)	(a)	40.9	40.9	(a)	(a)	40.9	40.8	(a)	(a)	40.9	40.7	(a)	(a)
ECO1-3700/4 @ 660V	52.0	52.0	(a)	(a)	51.9	51.9	(a)	(a)	51.9	51.7	(a)	(a)	51.8	51.7	(a)	(a)
ECO1-4500/4 @ 660V	62.0	62.0	(a)	(a)	61.9	61.9	(a)	(a)	61.9	61.7	(a)	(a)	61.8	61.6	(a)	(a)

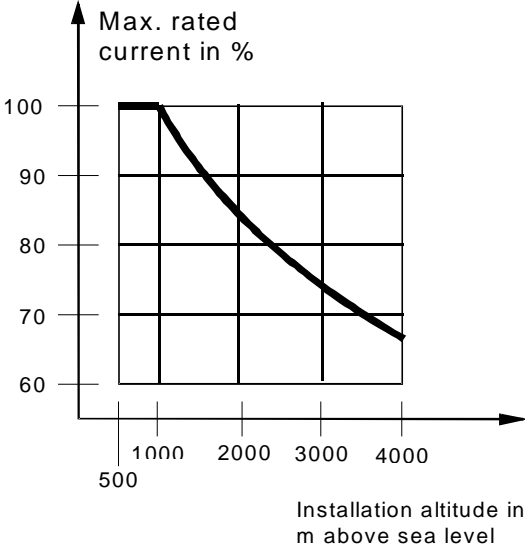
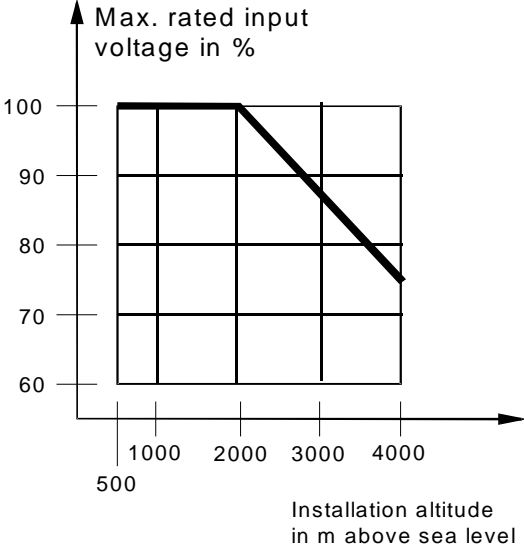
Notes: (a) Switching frequency not available  
 (b) Not Possible.

De-rating Information



De-rating Information

## VOLTAGE AND CURRENT DE-RATING WITH RESPECT TO ALTITUDE





## 15. OPTIONS

The MICROMASTER Eco and MIDIMASTER Eco can be enhanced by a range of specially designed options, with various IP ratings:

Accessory	Order No.	IP Rating	Availability	
			MICROMASTER Eco	MIDIMASTER Eco
Multilingual Clear Text Operator Panel OPe	6SE9590-0XX87-8BF0	IP54	Yes	Yes
EMC Filter for EN55011A / EN 61800-3 (filter options are available as integrated factory fitted or stand-alone external units)	-	IP20	Footprint or integrated	Integrated to 90kW or external only from 110kW to 315kW
EMC Filter for EN55011B	-	IP20	Footprint	External to 90kW
Motor Reactors (chokes) for long motor cables	-	IP00	Yes	Yes
Motor dV/dt filters	-	IP00	Yes	Yes
Mains input reactors	-	IP00	Yes	Yes
SIMOVIS Version 5.2 Software database program – for commissioning and parameter set upread / download & storage.	6SE3290-0XX87-8SA2	n.a.	Yes	Yes
Panel Mounting Cable Kit (3m) for Multilingual Clear Text Operator Panel (OPe)	6SE3290-0XX87-8PK0	IP20	Yes	Yes
Interface Cable Kit for connecting a PC to the OPe RS232 communications port.	6SE3290-0XX87-8SK0	IP20	Yes	Yes

These options are described separately below.



## CLEAR TEXT OPERATING PANEL OPe

The clear text operating panel consists of a control and display unit that fits directly on top of the MICROMASTER Eco or MIDIMASTER Eco Control panel. A D-Type socket connects directly onto the D-type connector on the front of the unit so that the OPe can take power from and communicate with the drive via the RS485 interface.

The OPe offers the following features:

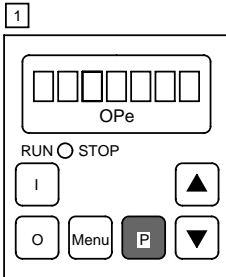
- Seven language ( English, German, French, Italian, Spanish, Dutch, Danish) text operation with explanation of parameters, faults etc.
- Diagnostics - help with fault finding.
- Upload/download up to 10 parameter sets from units to OPe and back. This allows fast, reliable programming and copying of parameter sets.
- OPe mounts directly on MICROMASTER Eco and MIDIMASTER Eco.
- Door mounting kit with IP54 protection included.
- Built in RS232 to RS485 Converter for simple connection to computer.
- External supply connector for remote operation and off line programming.
- The OPe has several practical uses; for example:
  - The OPe may be mounted directly onto the inverter and used to control the drive directly.
  - The OPe can be mounted on a separate panel (using an optional cable of up to 5m) to enable remote control and monitoring of the drive.
  - If an external power supply is connected to the OPe, remote control over distances greater than 5m is permissible
  - The built in RS232 to RS485 connector can be used to allow communication between a PC and the drive.
  - Parameter sets can be stored in the OPe and uploaded or downloaded as required. This is particularly useful where many inverters require programming in production.



- (D) OPe - GEBRAUCHSANWEISUNG
- (GB) OPe - OPERATING INSTRUCTIONS
- (F) OPe - MODE D'EMPLOI
- (I) OPe - ISTRUZIONI PER L'USO

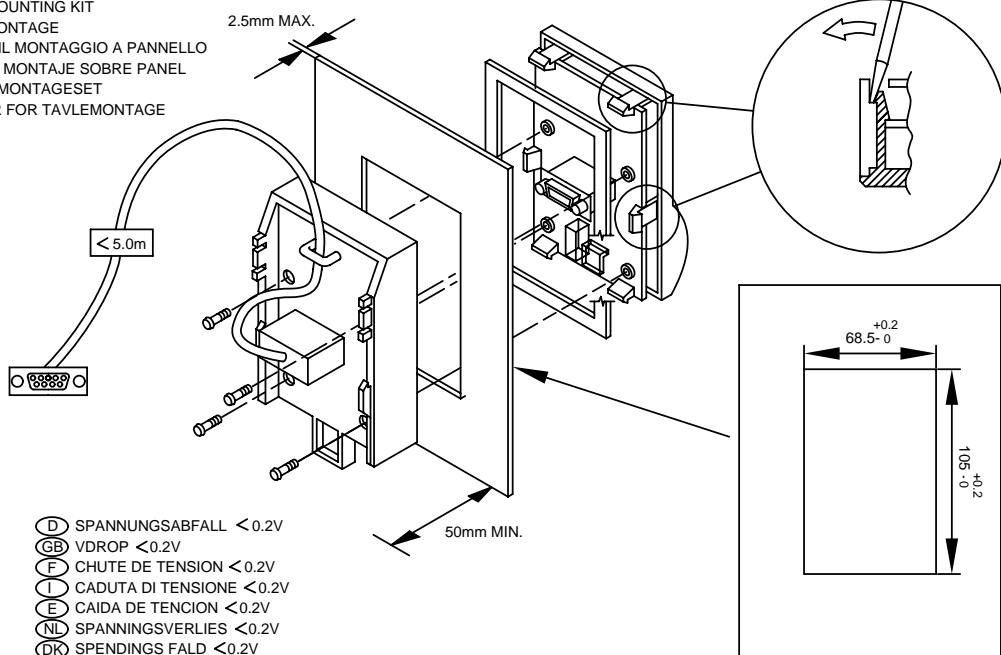
- (E) OPe - INSTRUCCIONES PARA EL USO
  - (NL) OPe - BEDININGSHANDLEIDING
  - (DK) OPe - BETJENINGSREJLEDNING
- 6SE9590-0XX87-8BFO

Iss	Desc.	Date	Iss	Desc.	Date
A1	PROD ISSUE	12.06.98			



- |                                      |                                  |
|--------------------------------------|----------------------------------|
| START (D)                            | (D) ERHOHUNG                     |
| START INVERTER (GB)                  | (GB) INCREASE VALUE/UP           |
| MISE EN MARCHÉ DE L'ENTRAÎNEMENT (F) | (F) AUGMENTER FREQUENCE/UP       |
| AVVIAMENTO DELL'INVERTITORE (I)      | (I) AUMENTO DEL VALORE/SU        |
| ARRANQUE DEL CONVERTIDOR (E)         | (E) INCREMENTAR VALOR/ARRIBA     |
| START OMVORMER (NL)                  | (NL) VERHOOG WAARDE/HOGER        |
| START (DK)                           | (DK) FORAG VARD/IOP              |
| STOP (D)                             | (D) REDUZIERUNG                  |
| STOP INVERTER (GB)                   | (GB) DECREASE VALUE/DOWN         |
| ARRET DE L'ENTRAÎNEMENT (F)          | (F) DIMINUER FREQUENCE/DOWN      |
| ARRESTO DELL'INVERTITORE (I)         | (I) DIMINUIZIONE DEL VALORE/GIU' |
| PARADA DEL CONVERTIDOR (E)           | (E) DECREMENTAR VALOR/ABAJO      |
| STOP OMVORMER (NL)                   | (NL) VERLAAG WAARDE/LAGER        |
| STOP (DK)                            | (DK) FORMINDSK VARD/NED          |
| HAUPT MENU (D)                       | (D) AUSWAHL                      |
| MAIN MENU (GB)                       | (GB) SELECT CHOICE/VALUE         |
| MENU PRINCIPAL (F)                   | (F) SELECTION CHOIX/VALEUR       |
| MENU PRINCIPALE (I)                  | (I) SCELTA OPZIONE/VALORE        |
| MENU PRICIPALE (E)                   | (E) SELECCIONAR/VALOR            |
| HOOFDMENU (NL)                       | (NL) SELECTEER KEUS/WAARDE       |
| HOVED MENU (DK)                      | (DK) VALG FUNKHON/VARDI          |
| (D) HILFE                            | (D) ZURUCK ZUM UNTER MENU        |
| (GB) GET HELP                        | (GB) RETURN TO SUB-MENU          |
| (F) AIDE                             | (F) RETOUR AU SOUS-MENU          |
| (I) AIUTO                            | (I) RITORNO AL SOTTO-MENU        |
| (E) AYUDO                            | (E) VOLVER AL SUB-MENU           |
| (NL) VRAAG HULP                      | (NL) TERUGKEREN NAAR SUB-MENU    |
| (DK) REKVINEN HJALP                  | (DK) TILBAGE TIL UNDERMENU       |

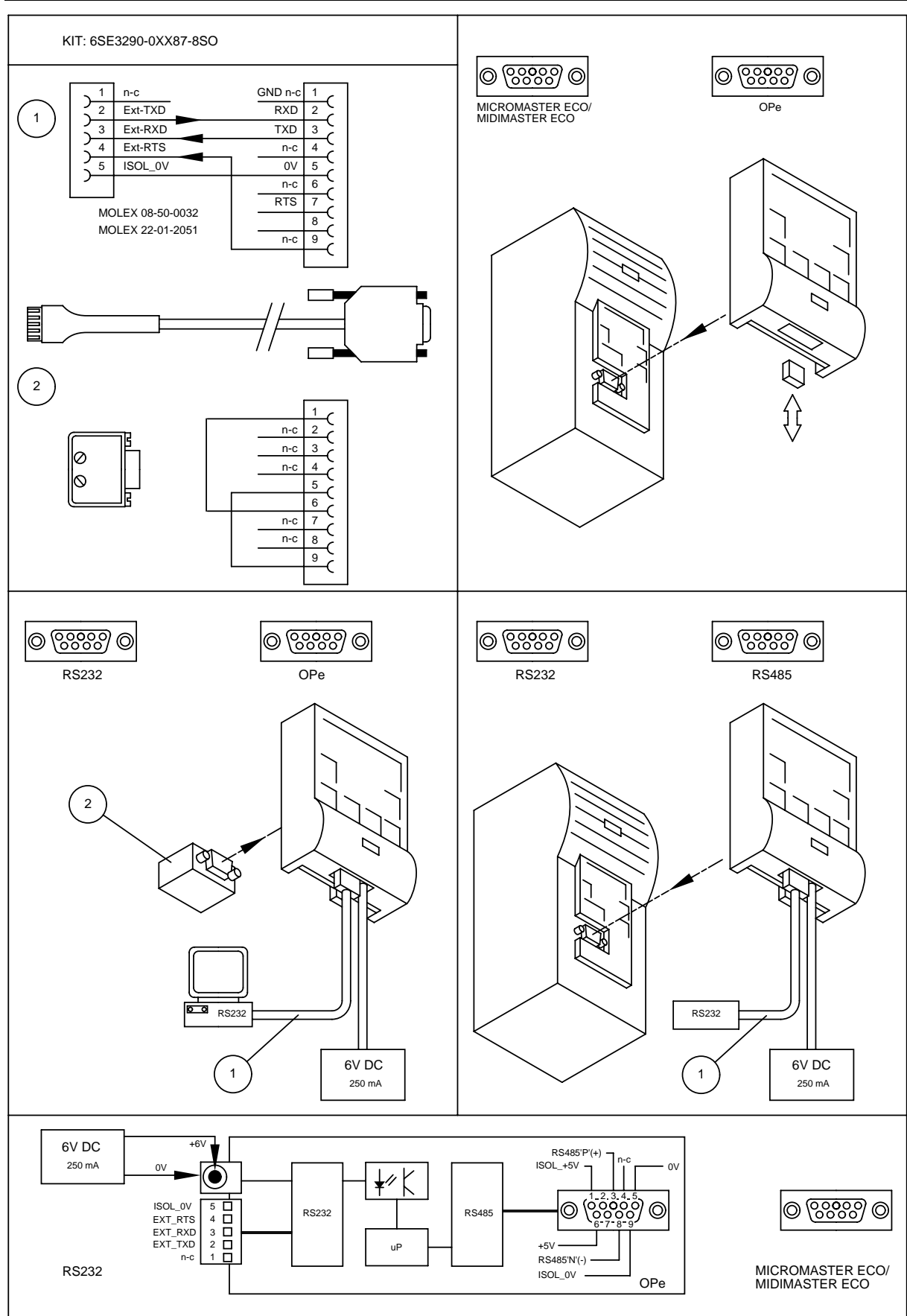
- (D) MONTAGE BAUSATZ
- (GB) PANEL MOUNTING KIT
- (F) KIT DE MONTAGE
- (I) KIT PER IL MONTAGGIO A PANNELLO
- (E) KIT PARA MONTAJE SOBRE PANEL
- (NL) INBOUW MONTAGESET
- (DK) ADAPTER FOR TAVLEMONTAGE



- (D) SPANNUNGSABFALL <math>< 0.2V</math>
- (GB) VDROPP <math>< 0.2V</math>
- (F) CHUTE DE TENSION <math>< 0.2V</math>
- (I) CADUTA DI TENSIONE <math>< 0.2V</math>
- (E) CAIDA DE TENCION <math>< 0.2V</math>
- (NL) SPANNINGSVERLIES <math>< 0.2V</math>
- (DK) SPENDINGS FALD <math>< 0.2V</math>



Options



RS232

OPe

**2**

RS232

**1**

6V DC  
250 mA

RS232

OPe

**1**

6V DC  
250 mA

RS232

OPe

MICROMASTER ECO/  
MIDIMASTER ECO

6V DC 250 mA

+6V

0V

ISOL\_0V

EXT\_RT5

EXT\_RXD

EXT\_TXD

n-c

RS232

uP

RS485

RS485P(+)

ISOL\_+5V

n-c

0V

+5V

RS485N(-)

ISOL\_0V

OPe

Note: When the Ope is connected to a PC a 6V DC Power supply is required. The connection dimensions are: Outer diameter 3,5mm and Inner diameter 1,35mm.



## EMC FILTERS

### RFI Suppression Filters.

MICROMASTER Eco and MIDIMASTER Eco inverters are designed to minimise conducted and radiated radio frequency interference. However, they are power electronic products and generate significant levels of interference over a wide electromagnetic spectrum.

In many applications it is possible to operate without filters or with the built-in filter.

However, in order to achieve higher levels of attenuation an external filter may be required. In particular, in order to meet residential, commercial and light industrial levels, an external filter will be needed.

The purpose of RFI filters is to reduce the conducted levels of interference from the inverter to the supply. It is not intended to reduce radiated interference or attenuate interference into the inverter. It should be fitted to the mains input to the inverter only and will be damaged if installed in the inverter output.

The filters are designed to mount underneath the MICROMASTER Eco to minimise space requirements. MICROMASTER Eco units are also available with built-in filters.

MIDIMASTER Eco inverters have external separate filters; MIDIMASTER Eco units are also available with built-in filters.

Full installation instructions and information concerning the appropriate filters are given below

:

### Input EMC Filter Order Numbers for IP20 /21 MICROMASTER ECO & MIDIMASTER ECO Units

Model/Type	Maximum Variable Torque Continuous Input Current (A)	Frame Size	EMC Input Filter Class A Order Code	EMC Input Filter Class B Order Code
<b>208-240V +/- 10% 3AC</b>	<b>3AC</b>		<b>208-240V +/-10% 3AC</b>	<b>208-240V +/-10% 3AC</b>
ECO1-75/2	4.7	A	6SE3290-ODA87-OFA1	6SE3290-ODA87-OFB1
ECO1-110/2	6.4	B	6SE3290-ODB87-OFA3	6SE3290-ODB87-OFB3
ECO1-150/2	8.3	B	6SE3290-ODB87-OFA3	6SE3290-ODB87-OFB3
ECO1-220/2	11.7	C	6SE3290-ODC87-OFA4	6SE3290-ODC87-OFB4
ECO1-300/2	16.3	C	6SE3290-ODC87-OFA4	6SE3290-ODC87-OFB4
ECO1-400/2	21.1	C	6SE3290-ODC87-OFA4	6SE3290-ODC87-OFB4
ECO1-550/2	28	4	6SE3290-ODG87-OFA5	6SE2100-1FC20
ECO1-750/2	32	4	6SE3290-ODG87-OFA5	6SE2100-1FC20
ECO1-1100/2	45	5	6SE3290-ODH87-OFA5	6SE2100-1FC20
ECO1-1500/2	61	6	6SE3290-ODJ87-OFA6	6SE2100-1FC21
ECO1-1850/2	75	6	6SE3290-ODJ87-OFA6	6SE2100-1FC21
ECO1-2200/2	87	6	6SE3290-ODJ87-OFA6	6SE2100-1FC21
ECO1-3000/2	105	7	6SE3290-ODK87-OFA7	6SE3290-ODK87-OFB7
ECO1-3700/2	113	7	6SE3290-ODK87-OFA7	6SE3290-ODK87-OFB7
ECO1-4500/2	152	7	6SE3290-ODK87-OFA7	6SE3290-ODK87-OFB7



Options

Model/Type	Maximum Variable Torque Continuous Input Current (A)	Frame Size	EMC Input Filter Class A Order Code	EMC Input Filter Class B Order Code
<b>380-500V +/- 10% 3AC</b>			<b>380-460V +/-10% 3AC</b>	<b>380-460V +/-10% 3AC</b>
ECO1-110/3	4.9	A	6SE3290-0DA87-0FA1	6SE3290-0DA87-0FB1
ECO1-150/3	5.9	A	6SE3290-0DA87-0FA1	6SE3290-0DA87-0FB1
ECO1-220/3	8.8	B	6SE3290-0DB87-0FA3	6SE3290-0DB87-0FB3
ECO1-300/3	11.1	B	6SE3290-0DB87-0FA3	6SE3290-0DB87-0FB3
ECO1-400/3	13.6	C	6SE3290-0DC87-0FA4	6SE3290-0DC87-0FB4
ECO1-550/3	17.1	C	6SE3290-0DC87-0FA4	6SE3290-0DC87-0FB4
ECO1-750/3	22.1	C	6SE3290-0DC87-0FA4	6SE3290-0DC87-0FB4
ECO1-1100/3	30	4	6SE3290-0DG87-0FA5	6SE2100-1FC20
ECO1-1500/3	32	4	6SE3290-0DG87-0FA5	6SE2100-1FC20
ECO1-1850/3	41	5	6SE3290-0DH87-0FA5	6SE2100-1FC20
ECO1-2200/3	49	5	6SE3290-0DH87-0FA5	6SE2100-1FC20
ECO1-3000/3	64	6	6SE3290-0DJ87-0FA6	6SE2100-1FC21
ECO1-3700/3	79	6	6SE3290-0DJ87-0FA6	6SE2100-1FC21
ECO1-4500/3	96	6	6SE3290-0DJ87-0FA6	6SE3290-0DK87-0FB7
ECO1-5500/3	113	7	6SE3290-0DK87-0FA7	6SE3290-0DK87-0FB7
ECO1-7500/3	152	7	6SE3290-0DK87-0FA7	6SE3290-0DK87-0FB7
ECO1-9000/3	185	7	6SE3290-0DK87-0FA7	6SE3290-0DK87-0FB7
ECO1-110K/3	210	8	6SE7033-2ES87-0FA1	not available
ECO1-132K/3	260	8	6SE7033-2ES87-0FA1	not available
ECO1-160K/3	315	8	6SE7033-2ES87-0FA1	not available
ECO1-200K/3	370	8	6SE7036-0ES87-0FA1	not available
ECO1-250K/3	510	9	6SE7036-0ES87-0FA1	not available
ECO1-315K/3	590	9	6SE7036-0ES87-0FA1	not available
<b>525-575V +/- 15% 3AC</b>				
ECO1-400/4	7	4	not available	not available
ECO1-550/4	10	4	not available	not available
ECO1-750/4	12	4	not available	not available
ECO1-1100/4	18	4	not available	not available
ECO1-1500/4	24	4	not available	not available
ECO1-1850/4	29	5	not available	not available
ECO1-2200/4	34	5	not available	not available
ECO1-3000/4	45	6	not available	not available
ECO1-3700/4	55	6	not available	not available
ECO1-4500/4	65	6	not available	not available





## Input EMC Filter Order Numbers for IP56 MIDIMASTER Eco Units

Model/Type	Maximum Variable Torque Continuous Input Current (A)	Frame Size	EMC Input Filter Class A Order Code	EMC Input Filter Class B Order Code
<b>208-240V +/- 10% 3AC</b>	<b>3AC</b>		<b>208-240V +/-10% 3AC</b>	<b>208-240V +/-10% 3AC</b>
ECO1-110/2	6.4	B	6SE3290-0DG87-0FA5	6SE2100-1FC20
ECO1-150/2	8.3	B	6SE3290-0DG87-0FA5	6SE2100-1FC20
ECO1-220/2	11.7	C	6SE3290-0DG87-0FA5	6SE2100-1FC20
ECO1-300/2	16.3	C	6SE3290-0DG87-0FA5	6SE2100-1FC20
ECO1-400/2	21.1	C	6SE3290-0DG87-0FA5	6SE2100-1FC20
ECO1-550/2	28	4	6SE3290-0DG87-0FA5	6SE2100-1FC20
ECO1-750/2	32	4	6SE3290-0DG87-0FA5	6SE2100-1FC20
ECO1-1100/2	45	5	6SE3290-0DH87-0FA5	6SE2100-1FC20
ECO1-1500/2	61	6	6SE3290-0DJ87-0FA6	6SE2100-1FC21
ECO1-1850/2	75	6	6SE3290-0DJ87-0FA6	6SE2100-1FC21
ECO1-2200/2	87	6	6SE3290-0DJ87-0FA6	6SE2100-1FC21
ECO1-3000/2	105	7	6SE3290-0DK87-0FA7	6SE3290-0DK87-0FB7
ECO1-3700/2	113	7	6SE3290-0DK87-0FA7	6SE3290-0DK87-0FB7
ECO1-4500/2	152	7	6SE3290-0DK87-0FA7	6SE3290-0DK87-0FB7
<b>380-500V +/- 10% 3AC</b>			<b>380-460V +/-10% 3AC</b>	<b>380-460V +/-10% 3AC</b>
ECO1-300/3	11.1	B	6SE3290-0DG87-0FA5	6SE2100-1FC20
ECO1-400/3	13.6	C	6SE3290-0DG87-0FA5	6SE2100-1FC20
ECO1-550/3	17.1	C	6SE3290-0DG87-0FA5	6SE2100-1FC20
ECO1-750/3	22.1	C	6SE3290-0DG87-0FA5	6SE2100-1FC20
ECO1-1100/3	30	4	6SE3290-0DG87-0FA5	6SE2100-1FC20
ECO1-1500/3	32	4	6SE3290-0DG87-0FA5	6SE2100-1FC20
ECO1-1850/3	41	5	6SE3290-0DH87-0FA5	6SE2100-1FC20
ECO1-2200/3	49	5	6SE3290-0DH87-0FA5	6SE2100-1FC20
ECO1-3000/3	64	6	6SE3290-0DJ87-0FA6	6SE2100-1FC21
ECO1-3700/3	79	6	6SE3290-0DJ87-0FA6	6SE2100-1FC21
ECO1-4500/3	96	6	6SE3290-0DJ87-0FA6	6SE3290-0DK87-0FB7
ECO1-5500/3	113	7	6SE3290-0DK87-0FA7	6SE3290-0DK87-0FB7
ECO1-7500/3	152	7	6SE3290-0DK87-0FA7	6SE3290-0DK87-0FB7
ECO1-9000/3	185	7	6SE3290-0DK87-0FA7	6SE3290-0DK87-0FB7



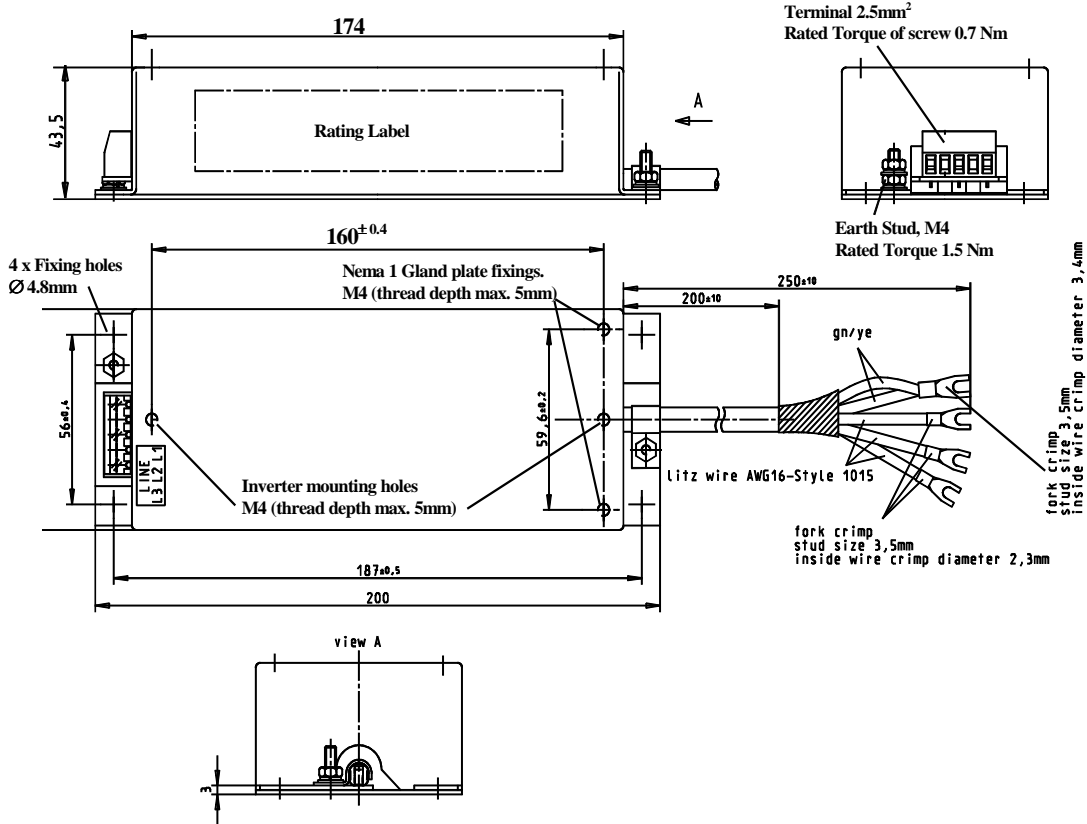
Options

Model/Type	Maximum Variable Torque Continuous Input Current (A)	Frame Size	EMC Input Filter Class A Order Code	EMC Input Filter Class B Order Code
<b>525-575V +/- 15% 3AC</b>				
ECO1-400/4	7	4	not available	not available
ECO1-550/4	10	4	not available	not available
ECO1-750/4	12	4	not available	not available
ECO1-1100/4	18	4	not available	not available
ECO1-1500/4	24	4	not available	not available
ECO1-1850/4	29	5	not available	not available
ECO1-2200/4	34	5	not available	not available
ECO1-3000/4	45	6	not available	not available
ECO1-3700/4	55	6	not available	not available
ECO1-4500/4	65	6	not available	not available

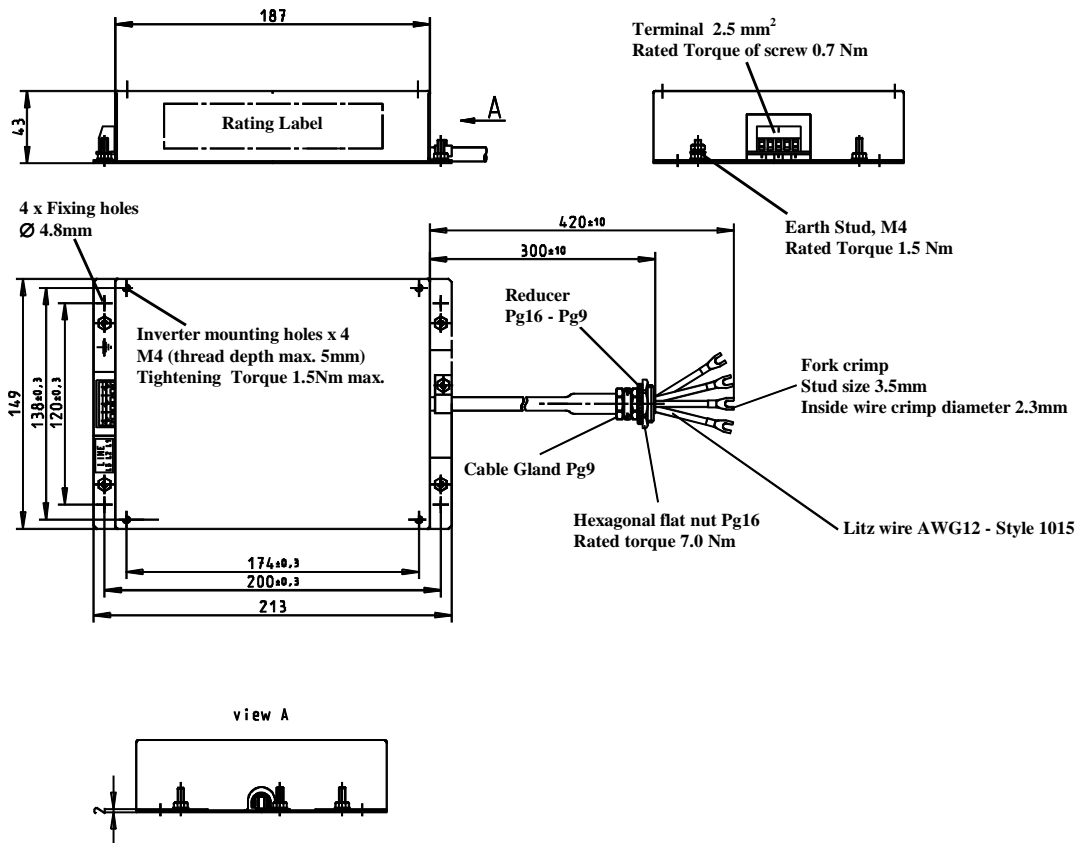


Installation of Filters

6SE3290-0DA87-0FA1, 6SE3290-0DA87-0FB1



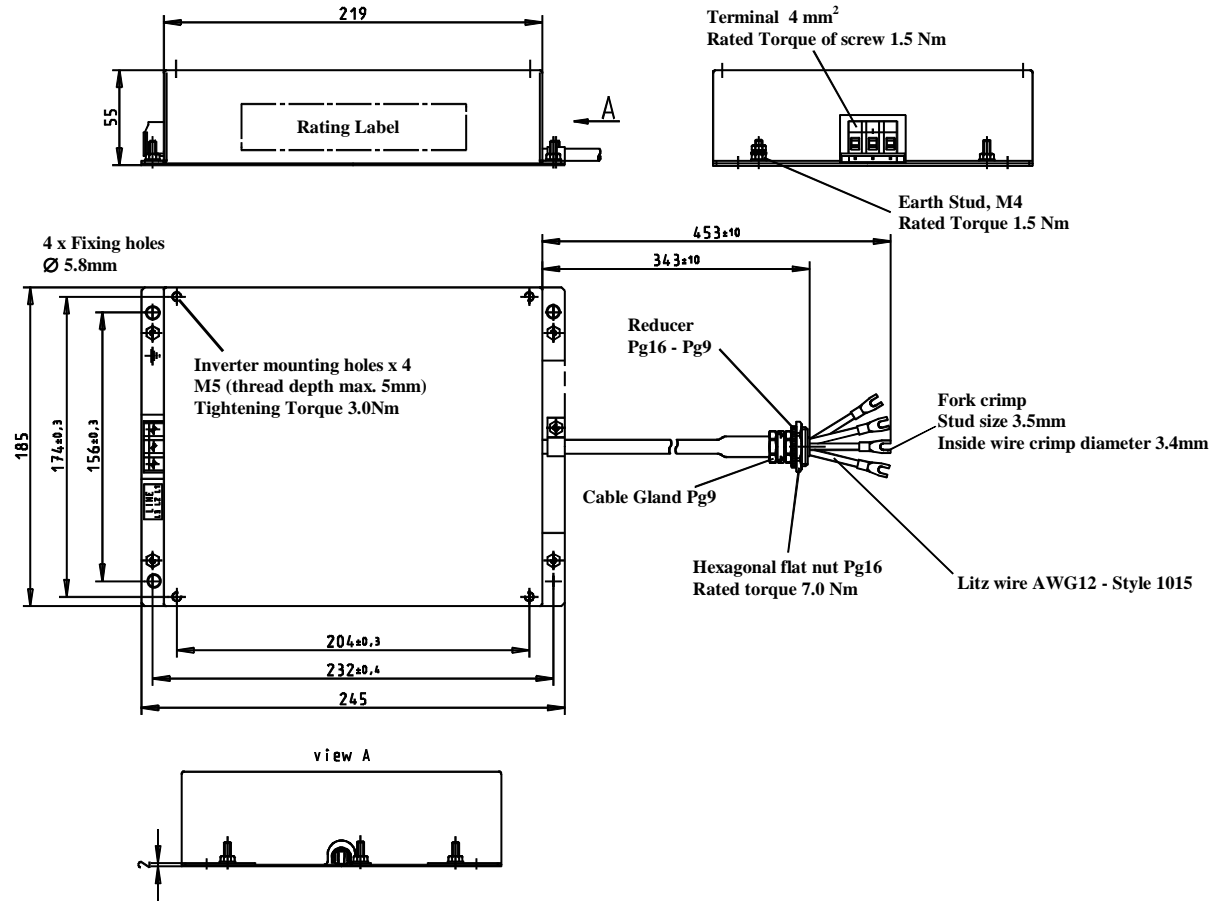
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6SE3290-0DC87-0FA4, 6SE3290-0DC87-0FB4

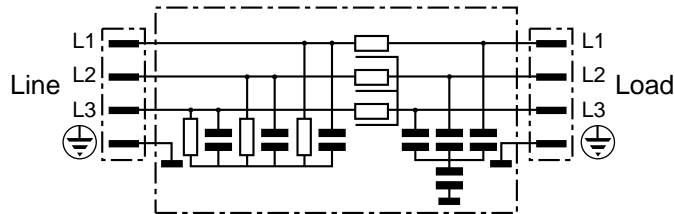
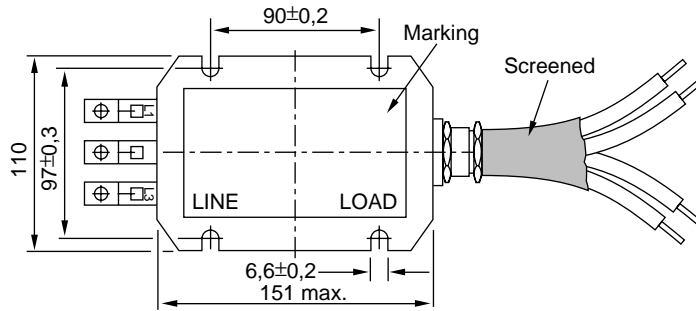
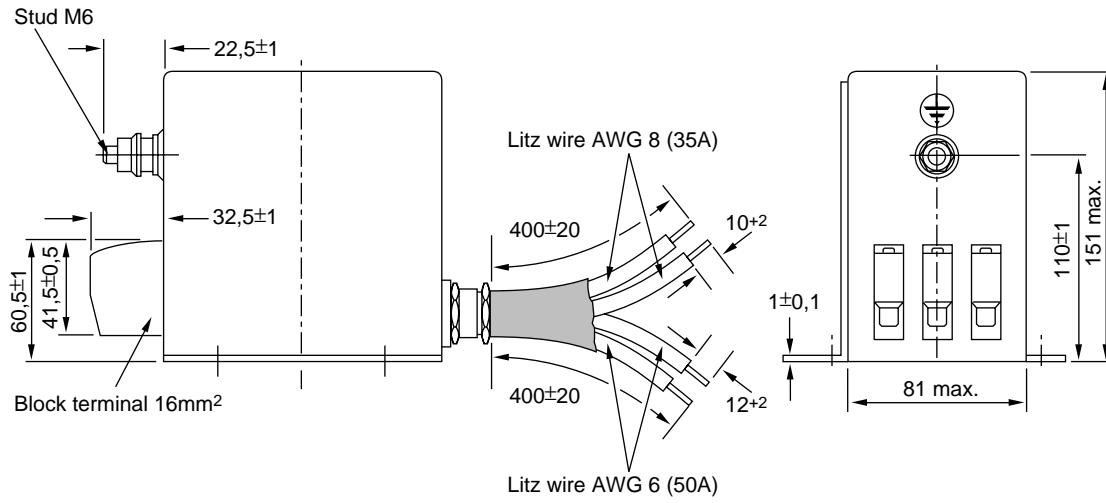


Options





6SE3290-ODG87-OFA5 Class A EMC Input Filter



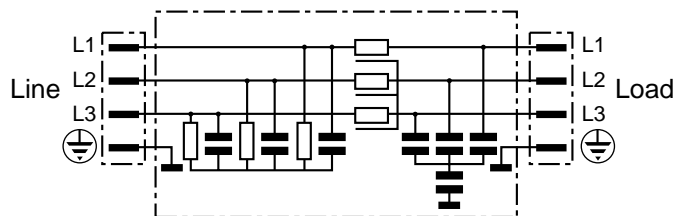
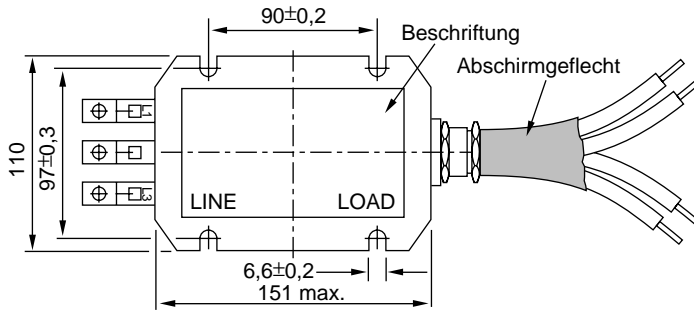
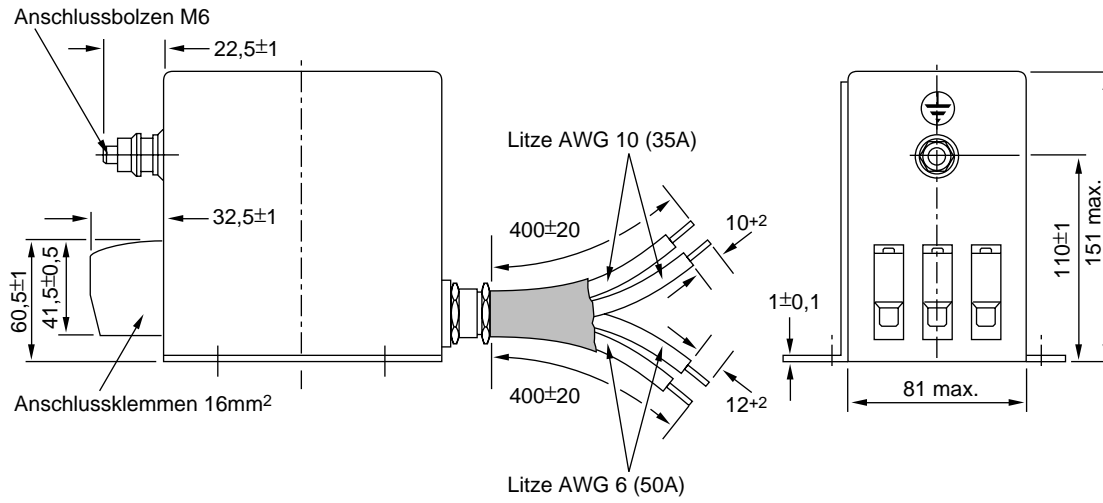
**Technical Data**

Rated Voltage	440/250V~50/60 Hz
Rated Current	35A Referred ambient 40°C
Test Voltage	1770 V-, 2s (line/line)
	2700 V-, 2s (line/case)
IEC Climatic Category	In accordance with IEC 68-1
Feeder Resistor	
Leakage Current	
Approx. Weight	

## 6SE3290-ODH87-OFA5 Class A EMC Input Filter



Options



### Technical Data

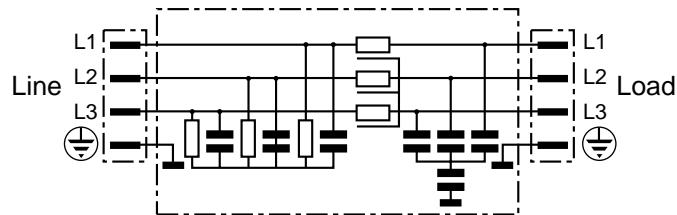
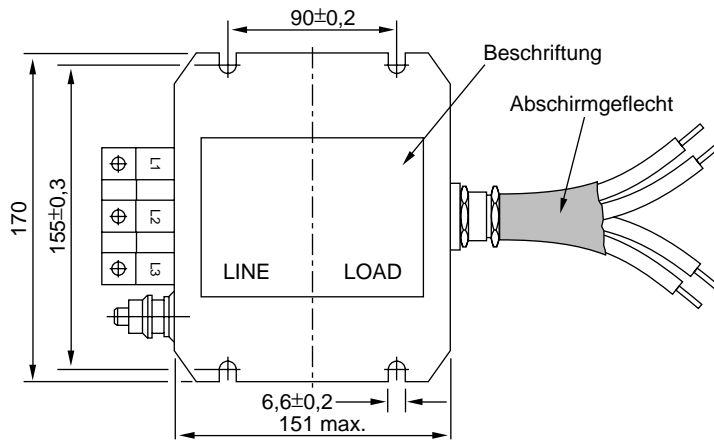
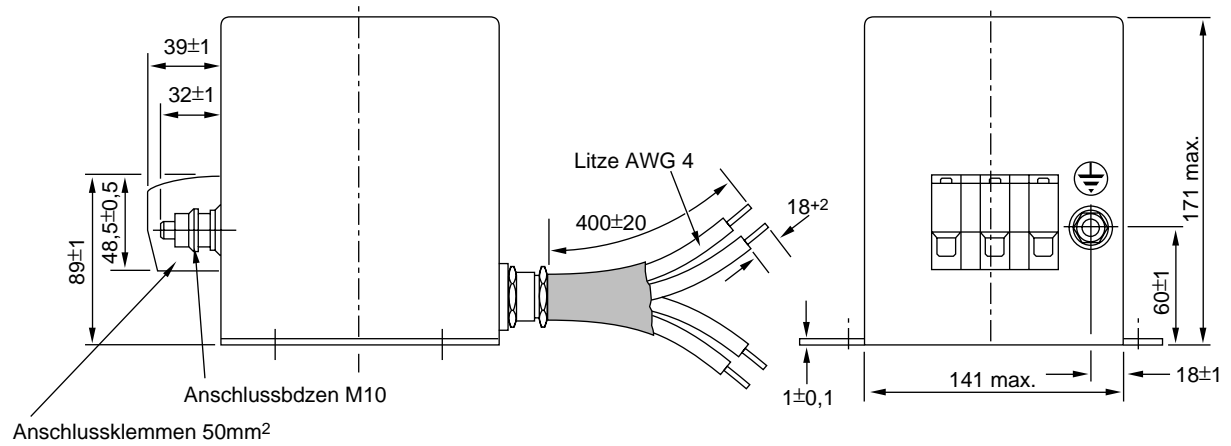
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 Rated Current 50A Referred ambient 40°C  
 Test Voltage 1770 V-, 2s (line/line)  
 2700 V-, 2s (line/case)

IEC Climatic Category In accordance with IEC 68-1

Feeder Resistor  
 Leakage Current  
 Approx. Weight



6SE3290-ODJ87-OFA6 Class A EMC Input Filter



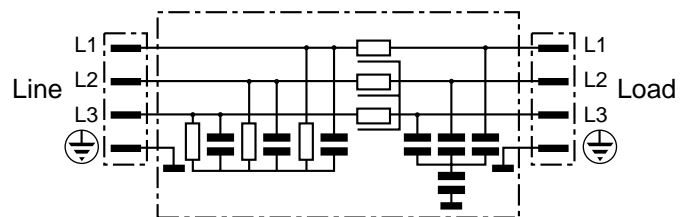
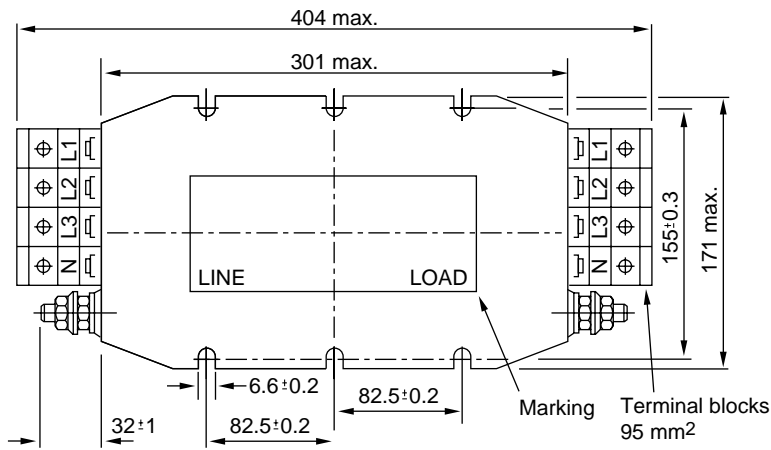
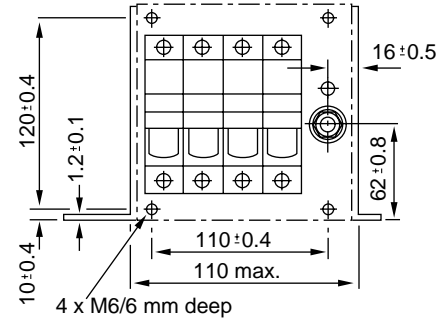
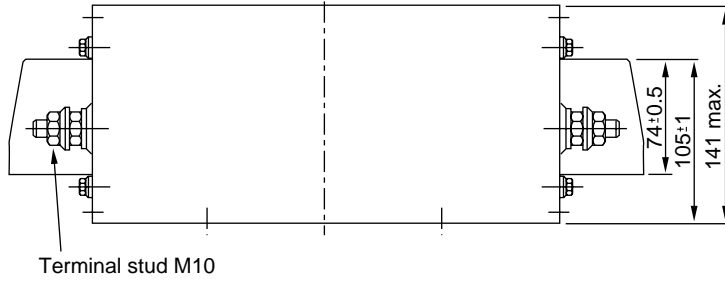
**Technical Data**

Rated Voltage	440/250V~50/60 Hz
Rated Current	96A Referred ambient 40°C
Test Voltage	1770 V-, 2s (line/line)
	2700 V-, 2s (line/case)
IEC Climatic Category	In accordance with IEC 68-1
Feeder Resistor	
Leakage Current	
Approx. Weight	



Options

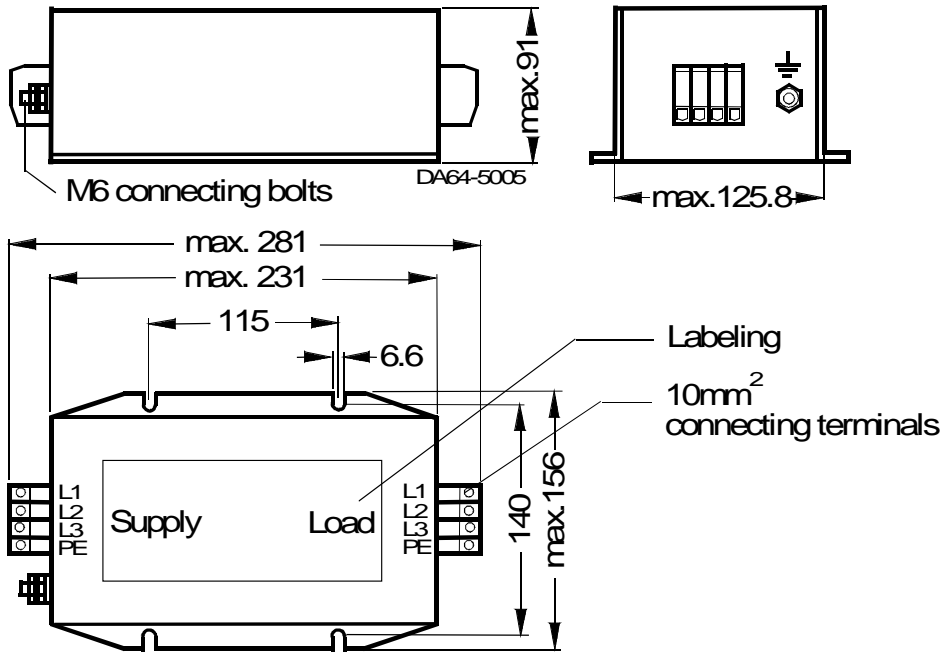
## 6SE3290-ODK87-OFA7 Class A EMC Input Filter







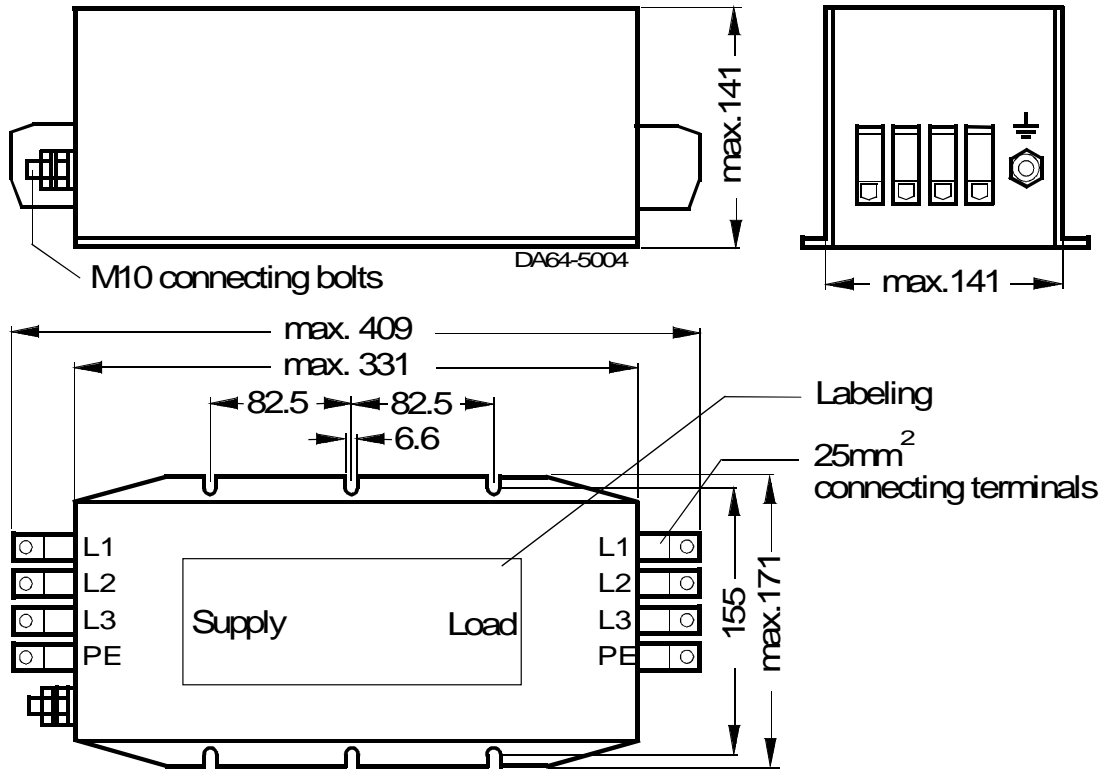
6SE2100-1FC20 Class B EMC Input Filter





Options

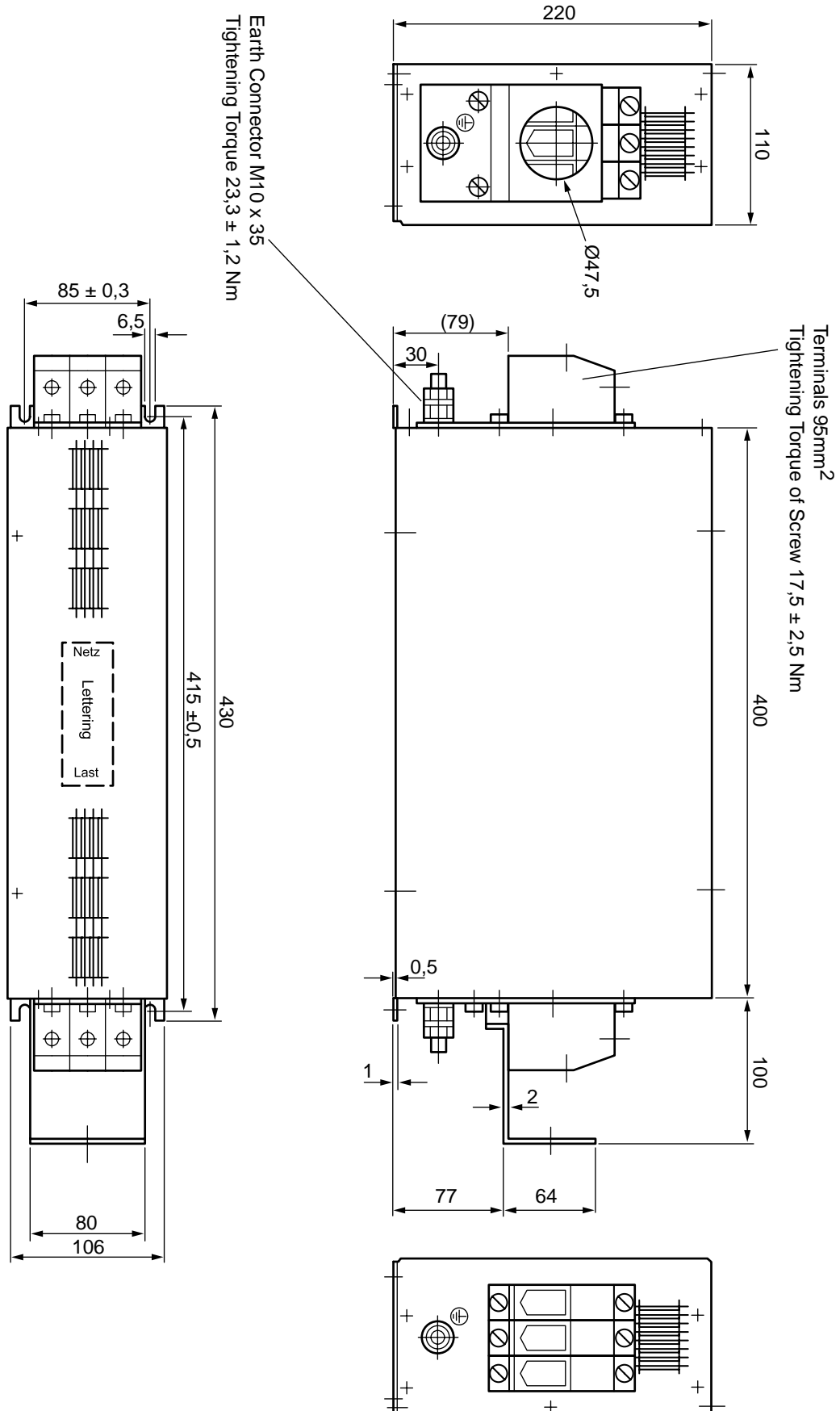
## 6SE2100-1FC21 Class B EMC Input Filter





Options

6SE3290-ODK87-OFB7 Class B EMC Input Filter





Options

## HARMONIC INPUT REACTORS (CHOKES)

### Mains Supply Harmonics

When the inverter is operating it draws a non-sinusoidal current from the mains supply. This is caused by the input rectifier stage of the inverter which converts the mains supply AC voltage and current to DC voltage and current. The input rectifier draws current from each of the three mains supply phases in turn. This drawn current is not sinusoidal, as a normal AC sine-wave would be, but is distorted by the rectifier switching between phases. This distorted mains supply current waveform is said to contain harmonics since the distorted waveform can be broken down into a set of sine-wave components which is known as its harmonic components.

Since the rectifier stage of the inverter is a full six-pulse bridge rectifier module and the mains supply is a balanced standard three phase supply only certain harmonic “numbers” are dominant. The dominant harmonic numbers, associated with all three phase supplied inverter units operating on a 50Hz supply, are the 1<sup>st</sup> (fundamental, 50Hz), 5<sup>th</sup> (250Hz), 7<sup>th</sup> (350Hz), 11<sup>th</sup> (550Hz), 13<sup>th</sup> (650Hz), and so on. If operating on a mains supply of 60Hz (North America) then the harmonic frequencies would be the 1<sup>st</sup> (fundamental, 60Hz), 5<sup>th</sup> (300Hz), 7<sup>th</sup> (420Hz), 11<sup>th</sup> (660Hz), 13<sup>th</sup> (780Hz), and so on. As the harmonic number gets larger the magnitude of the harmonic current reduces, therefore only the first few lower order harmonics tend to dominate and are important.

Harmonic voltages and currents can be detrimental to other electrical equipment connected to the same supply as the inverter since the additional currents flowing in supply transformers and cables can cause their overheating. The harmonic voltages can increase the peak voltage of the supply which increases stress on electrical insulation and can cause early-life failures to equipment such as power factor correction capacitor banks. It is therefore desirable to reduce the harmonics generated by inverters to an acceptable level.

### Mains Supply Line Reactors Selection

Line Reactors are used to reduce the harmonics produced by inverters and will assist the installation engineer to meet the relevant harmonic standards. They are also used to increase the mains supply impedance and help absorb mains supply line spikes and surges which can occur if operating from a standby generator or close to heavy industrial equipment.

2% impedance Line Reactors are typical sufficient to absorb mains supply spikes and will prevent nuisance tripping of inverters in most applications. They also protect the DC link capacitors internal to the inverter against overheating and early life failures by absorbing surges and increasing the mains supply impedance.

4% impedance Line Reactors are best for reducing the harmonic frequency currents produced by inverters and thereby reduce the Total Harmonic Voltage Distortion (THD) at the point of common supply coupling to other users.

Line reactors are connected in series between the mains supply and the inverter power input terminals. If an EMC filter is also used then the line reactor would be connected in series between the EMC filter and the mains supply.

### Supply Impedance

The impedance of the mains supply should not be less than 0.5% at the inverter terminals. This means that the supply voltage drop which occurs when the inverter is fully loaded should be greater than or equal to 0.5% of the nominal voltage. If the mains impedance is below this value the lifetime of the DC link electrolytic capacitors could be reduced. To overcome this effect, 2% input reactors should be fitted to increase the inverter supply impedance.

If a further reduction of harmonic currents is also required then 4% input reactors can be fitted which will increase the inverter supply impedance as well as reduce the inverter harmonic currents.



### Inverter Harmonics

The table below shows the approximate harmonic currents as a percentage of the fundamental current, based on a 1% typical mains supply impedance.

As indicated within the table the amplitude of the harmonic currents can be reduced by fitting 2% or 4% input line reactors.

Inverter Type & Supply Voltage	Harmonic Number	Typical Harmonic Current (% of fundamental current , i.e. 50 or 60Hz)		
		1% Mains Supply Impedance	1% Mains Supply Impedance with a 2% Line Reactor fitted	1% Mains Supply Impedance with a 4% Line Reactor fitted
208-240V 3ac Type ECO1-2200/2 and below	Fundamental	100%	100%	100%
	5 <sup>th</sup>	72.9	56.3	39.4
	7 <sup>th</sup>	48.4	31.3	14.7
	11 <sup>th</sup>	10.6	6.6	6.9
	13 <sup>th</sup>	5.5	6.6	3.4
208-240V 3ac Type ECO1-3000/2 and above	Fundamental	100%	100%	100%
	5 <sup>th</sup>	32	29.2	26.0
	7 <sup>th</sup>	9.6	7.9	6.9
	11 <sup>th</sup>	7.8	7.0	5.9
	13 <sup>th</sup>	3.7	3.6	3.4
380/500V 3ac Type ECO1-4500/3 and below	Fundamental	100%	100%	100%
	5 <sup>th</sup>	72.5	62.0	41.0
	7 <sup>th</sup>	52.6	36.7	16.5
	11 <sup>th</sup>	17.0	7.4	7.3
	13 <sup>th</sup>	7.2	6.2	3.2
380/500V 3ac Type ECO1-5500/3 to ECO1- 9000/3	Fundamental	100%	100%	100%
	5 <sup>th</sup>	42.7	37.8	32.6
	7 <sup>th</sup>	17.7	13.2	9.2
	11 <sup>th</sup>	6.7	7.1	6.9
	13 <sup>th</sup>	4.0	3.5	3.3



Options

## Harmonic Input Reactors (Chokes) for MICROMASTER Eco & MIDIMASTER Eco

The line reactor rating is generally given as a percentage of the mains supply voltage (e.g. 2% and 4% line reactors) since the line reactor's inductance causes a voltage drop of say 2% or 4% across the reactor when operating at nominal inverter rated input current.

For example, on a 400V, 50Hz mains supply a 4 % line reactor would have a voltage drop of 16V when operating at the inverter's rated input current.

The line reactors reduce the harmonic currents by "filtering out" the harmonic currents. At higher harmonic frequencies the inductance of the line reactor causes a larger impedance which attenuates the inverter harmonic currents.

The order codes of suitable line reactors providing an additional line impedance of 2% or 4% are shown within the tables below:

Inverter	Input Line Reactor (2%) for low impedance supplies	Dimensions H x W x D (mm)	Weight (kg)
<b>208 V - 240 V 50/60 Hz</b>			
ECO1-75/2	4EP3200-1US	108x88.5x57.5	0.7
ECO1-110/2	4EP3200-1US	108x88.5x57.5	0.7
ECO1-150/2	4EP3400-1US	122x124x73	1.4
ECO1-220/2	4EP3400-1US	122x124x73	1.4
ECO1-300/2	4EP3500-0US	139x148x68	1.9
ECO1-400/2	4EP3600-4US	139x148x78	2.5
ECO1-550/2	4EP3600-5US	139x148x78	2.8
ECO1-750/2	4EP3700-2US	159x178x73	3.3
ECO1-1100/2	4EP3800-2US	193x178x88	4
ECO1-1500/2	4EP3800-7US	153x178x88	5
ECO1-1850/2	4EP3900-2US	181x219x99	6.5
ECO1-2200/2	4EP3900-2US	181x219x99	6.5
ECO1-3000/2	4EP4000-2US	181x219x119	8.2
ECO1-3700/2	4EU2451-2UA00	220x206x105	12.0
ECO1-4500/2	4EU2551-4UA00	220x206x128	15.3
<b>380V 50Hz- 500V 60Hz (500V 50Hz)</b>			
ECO1-110/3	4EP3200-1US [4EP3200-2US]	108x88.5x57.5	0.7
ECO1-150/3	4EP3200-1US [4EP3200-1US]	108x88.5x57.5	0.7
ECO1-220/3	4EP3400-2US [4EP3200-2US]	122x124x73 (108x88.5x57.5)	1.3
ECO1-300/3	4EP3400-1US [4EP3300-0US]	122x124x73 (122x124x64)	1.4
ECO1-400/3	4EP3400-1US [4EP3400-3US]	122x124x73	1.4
ECO1-550/3	4EP3500-0US [4EP3600-8US]	139x148x68 (139x148x78)	1.9
ECO1-750/3	4EP3600-4US [4EP3600-2US]	139x148x78	2.5
ECO1-1100/3	4EP3600-5US (4EP3600-3US)	139x148x78	2.8



Inverter	Input Line Reactor (2%) for low impedance supplies	Dimensions H x W x D (mm)	Weight (kg)
ECO1-1500/3	4EP3700-2US (4EP3700-6US)	159x178x73	3.3
ECO1-1850/3	4EP3700-5US (4EP3700-1US)	159x178x73	3.8
ECO1-2200/3	4EP3800-2US (4EP3801-2US)	193x178x88	4
ECO1-3000/3	4EP3800-7US (4EP3900-1US)	153x178x88 (181x219x99)	5
ECO1-3700/3	4EP3900-2US (4EP4000-1US)	181x219x99 (181x219x119)	6.5
ECO1-4500/3	4EP4000-2US (4EP4000-8US)	181x219x119	8.2
ECO1-5500/3	4EP4000-6US (4EP4000-8US)	181x219x119	9.6
ECO1-7500/3	4EU2451-2UA00 (4EU2551-2UA00)	220x206x105 (220x206x128)	12
ECO1-9000/3	4EU2551-4UA00 (4EU2551-6UA00)	220x206x128	15.3
	<b>380V 50Hz- 480V 60Hz</b>		
ECO1-110K/3	4EU2551-8UA00	220x206x128	16.4
ECO1-132K/3	4EU2751-0UB00	250x235x146	22.8
ECO1-160K/3	4EU2751-7UA00	250x235x146	23
ECO1-200K/3	4EU2751-8UA00	250x235x146	26.8
ECO1-250K/3	4EU3051-5UA00	280x264x155	38.2
ECO1-315K/3	4EU3051-6UA00	280x264x155	40.3
	<b>525V- 575V 50/60Hz</b>		
ECO1-400/4	4EP3400-3US	122x124x73	1.3
ECO1-550/4	4EP3600-8US	139x148x78	2.3
ECO1-750/4	4EP3600-2US	139x148x78	2.5
ECO1-1100/4	4EP3600-3US	139x148x78	2.4
ECO1-1500/4	4EP3700-6US	159x178x73	3.4
ECO1-1850/4	4EP3700-1US	159x178x73	3.7
ECO1-2200/4	4EP3801-2US	193x178x88	4.2
ECO1-3000/4	4EP3800-1US	193x178x88	4.6
ECO1-3700/4	4EP3900-1US	181x219x99	6.4
ECO1-4500/4	4EP4000-7US	181x219x119	7.7



Options

Inverter	Input Line Reactor (4%) for reduction of harmonic currents (& low impedance supplies)	Dimensions H x W x D (mm)	weight (kg)
	<b>208 V - 240 V 50/60 Hz</b>		
ECO1-75/2	4EP3200-1US	108x88.5x57.5	0.7
ECO1-110/2	4EP3200-1US	108x88.5x57.5	0.7
ECO1-150/2	4EP3400-1US	122x124x73	1.3
ECO1-220/2	4EP3400-1US	122x124x73	1.4
ECO1-300/2	4EP3500-0US	139x148x68	1.9
ECO1-400/2	4EP3600-4US	139x148x78	2.4
ECO1-550/2	4EP3600-5US	139x148x78	2.8
ECO1-750/2	4EP3700-2US	159x178x73	3.3
ECO1-1100/2	4EP3800-2US	193x178x88	4
ECO1-1500/2	4EP3800-7US	153x178x88	5
ECO1-1850/2	4EP3900-2US	181x219x99	6.5
ECO1-2200/2	4EP3900-2US	181x219x99	6.5
ECO1-3000/2	4EP4000-2US	181x219x119	8.2
ECO1-3700/2	4EU2451-2UA00	220x206x105	12.0
ECO1-4500/2	4EU2551-4UA00	220x206x128	15.3
	<b>380V 50Hz- 500V 60Hz (500V 50Hz)</b>		
ECO1-110/3	3x4EM4605-4CB	61x51x73 each	0.5
ECO1-150/3	3x4EM4605-6CB	61x51x73 each	0.5
ECO1-220/3	3x4EM4605-6CB	61x51x73 each	0.5
ECO1-300/3	3x4EM4807-4CB	79x69x86 each	1.0
ECO1-400/3	3x4EM4807-6CB	79x69x86 each	1.1
ECO1-550/3	4EP3700-7US [4EP3800-8US]	159x178x73 (159x178x88)	3.3
ECO1-750/3	4EP3801-0US [4EP3800-8US]	193x178x88	3.8
ECO1-1100/3	4EP3900-5US [4EP4001-0US]	181x219x99 (181x219x119)	6.1
ECO1-1500/3	4EP3900-5US [4EP4001-0US]	181x219x99 (181x219x119)	6.1
ECO1-1850/3	4EP4001-1US [4EP4001-2US]	220x219x119	7.6
ECO1-2200/3	4EU2451-4UA00 [4EU2451-5UA00]	220x206x104 (220x206x104)	4.6
ECO1-3000/3	4EU2451-4UA00 [4EU2551-1UB00]	220x206x104 (220x206x104)	11.1
ECO1-3700/3	4EU2551-2UB00 [4EU2551-3UB00]	220x206x128 (220x206x128)	15.5
ECO1-4500/3	4EU2751-1UB00 [4EU2551-3UB00]	250x235x146 (220x206x128)	16.7
ECO1-5500/3	4EU2751-1UB00 [4EU2751-3UB00]	250x235x146 (250x235x146)	23.4
ECO1-7500/3	4EU2751-1UB00 [4EU2751-6UB00]	250x235x146 (250x235x146)	22.8
ECO1-9000/3	4EU2751-2UB00 [4EU3051-0UB00]	250x235x146 (280x264x155)	24.2





Inverter	Input Line Reactor (4%) for reduction of harmonic currents (& low impedance supplies)	Dimensions H x W x D (mm)	weight (kg)
	<b>380V 50Hz- 480V 60Hz</b>		
ECO1-110K/3	4EU2751-5UB00	250x235x146	25.5
ECO1-132K/3	4EU3051-7UA00	280x264x155	37
ECO1-160K/3	4EU3051-3UB00	280x264x155	39
ECO1-200K/3	4EU3651-3UB00	335x314x169	47.1
ECO1-250K/3	4EU3651-4UB00	335x314x169	55.2
ECO1-315K/3	4EU3651-6UC00	335x314x169	58
	<b>525V- 575V 50/60Hz</b>		
ECO1-400/4	3x4EM4807-1CB	79x69x86 each	1.1
ECO1-550/4	3x4EM4911-7CB	85x85x91 each	1.8
ECO1-750/4	4EP3800-8US	193x178x88	5
ECO1-1100/4	4EP3800-8US	193x178x88	5
ECO1-1500/4	4EP4001-0US	181x219x119	8.8
ECO1-1850/4	4EP4001-0US	181x219x119	8.8
ECO1-2200/4	4EP4001-2US	181x219x119	8.3
ECO1-3000/4	4EP4001-2US	181x219x119	8.3
ECO1-3700/4	4EU2551-1UB00	220x206x128	15.5
ECO1-4500/4	4EU2551-1UB00	220x206x128	15.5



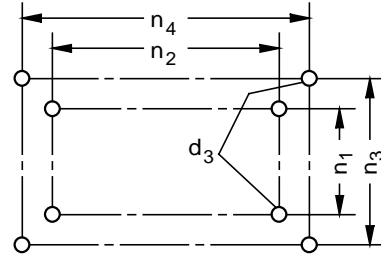
Options

## 4EP three-phase line reactors

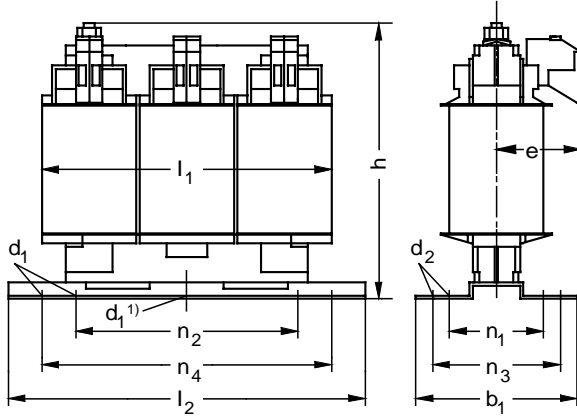
$I_{LN} \leq 35.5 \text{ A}$

Dimensions

With terminals, for any arrangement of the reactor



$n_3$  and  $n_4$  mounting holes acc. to EN 60852-4  
 $n_1$  and  $n_2$  mounting holes acc. to DIN 41308



Three-phase line reactor	$b_1$ max.	$d_1$ mm	$d_2$ mm	$d_3$ mm	$e$ max.	$h$ max.	$l_1$ max.	$l_2$ max.	$n_1$ $\pm IT12$ mm	$n_2$ $\pm IT12$ mm	$n_3$ $\pm IT12$ mm	$n_4$ $\pm IT12$ mm
Type	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
4EP32	57,5	4,8	9	M4	56	108	78	88,5	34	1)	42,5	79,5
4EP33	64	4,8	9	M4	55	122	96	124	33	1)	44	112
4EP34	73	4,8	9	M4	59	122	96	124	42	1)	53	112
4EP35	68	4,8	9	M4	57	139	120	148	39	90	48	136
4EP36	78	4,8	9	M4	62	139	120	148	49	90	58	136
4EP37	73	5,8	11	M5	60	159	150	178	49	113	53	166
4EP38	88	5,8	11	M5	67	159	150	178	64	113	68	166
4EP39	99	7	13	M6	62	181	182	219	56	136	69	201
4EP40	119	7	13	M6	72	181	182	219	76	136	89	201

1) Retaining slot at the center of the foot

Terminal 8WA9200 (for $I_{LN} \leq 15 \text{ A}$ )	Cross-sections:	Solid	0,5 mm <sup>2</sup> to 6,0 mm <sup>2</sup>
		Stranded	1,5 mm <sup>2</sup> to 4,0 mm <sup>2</sup>
Terminal RKW 110 or TRKSD 10 (for $I_{LN} 16 \text{ A to } 35.5 \text{ A}$ )	Cross-sections:	Solid	1.0 mm <sup>2</sup> to 16.0 mm <sup>2</sup>
		Stranded	1.0 mm <sup>2</sup> to 10.0 mm <sup>2</sup>
Grounding terminal, M6 x 12		Solid	2,5 mm <sup>2</sup> to 10,0 mm <sup>2</sup>
		Stranded	4,0 mm <sup>2</sup> to 10,0 mm <sup>2</sup>



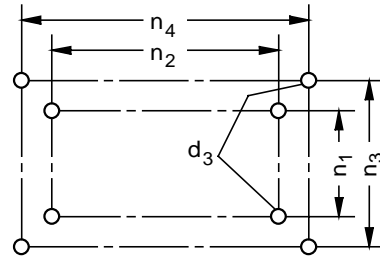
Options

**4EP three-phase line reactors**

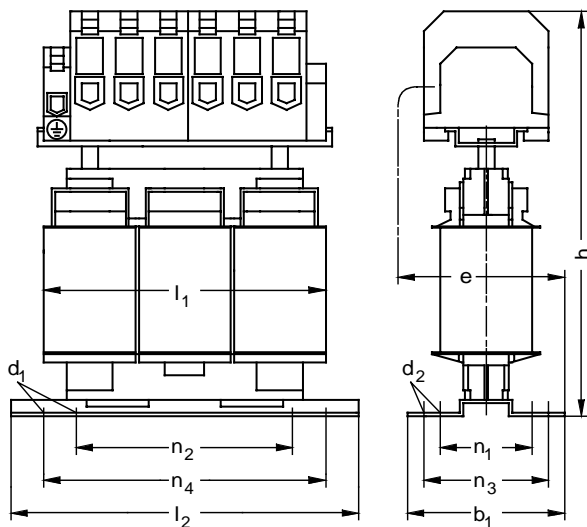
$I_{LN}$  36 A to 50 A

Dimensions

With terminals, for any arrangement of the reactor



$n_3$  and  $n_4$  mounting holes acc. to EN 60852-4  
 $n_1$  and  $n_2$  mounting holes acc. to DIN 41308



Three-phase line reactor	$b_1$ max.	$d_1$	$d_2$	$d_3$	$e$ max.	$h$ max.	$l_1$ max.	$l_2$ max.	$n_1$ $\pm IT12$	$n_2$ $\pm IT12$	$n_3$ $\pm IT12$	$n_4$ $\pm IT12$
Type	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
4EP38	88	5,8	11	M5	86	193	150	178	64	113	68	166
4EP39	99	7	13	M6	91,5	220	182	219	56	136	69	201
4EP40	119	7	13	M6	101,5	220	182	219	76	136	89	201

Terminal 8WA1304  
 (for  $I_{Ln}$  40 A to 50 A)

Cross-sections:

- Solid 1.0 mm<sup>2</sup> to 16.0 mm<sup>2</sup>
- Stranded 10.0 mm<sup>2</sup> to 25.0 mm<sup>2</sup>
- Stranded 2.5 mm<sup>2</sup> to 16.0 mm<sup>2</sup>

Associated grounding terminal, EK 16/35

- Solid 2,5 mm<sup>2</sup> to 16,0 mm<sup>2</sup>
- Stranded 4,0 mm<sup>2</sup> to 16,0 mm<sup>2</sup>



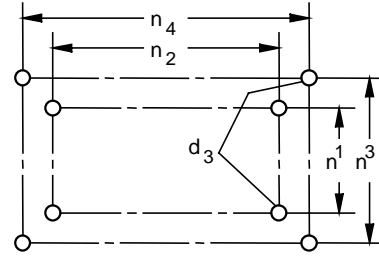
Options

## 4EP three-phase line reactors

$I_{LN} \geq 51$  A

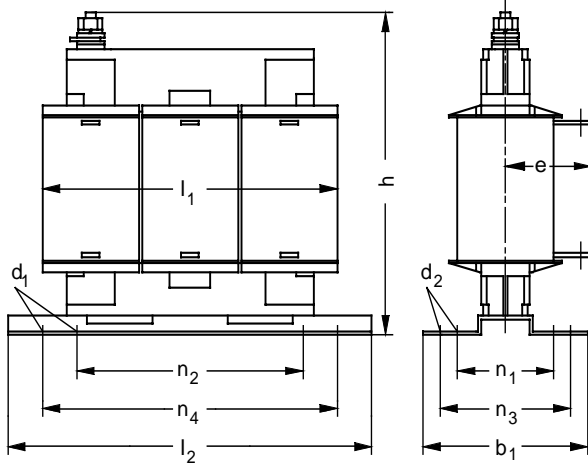
Dimensions

With terminals, for any arrangement of the reactor



$n_3$  and  $n_4$  mounting holes acc. to EN 60852-4

$n_1$  and  $n_2$  mounting holes acc. to DIN 41308



Three-phase line reactor Type	$b_1$ max. mm	$d_1$ mm	$d_2$ mm	$d_3$ mm	$e$ max. mm	$h$ max. mm	$l_1$ max. mm	$l_2$ max. mm	$n_1$ $\pm IT12$ mm	$n_2$ $\pm IT12$ mm	$n_3$ $\pm IT12$ mm	$n_4$ $\pm IT12$ mm
4EP38	88	5,8	11	M5	76	153	150	178	64	113	68	166
4EP39	99	7	13	M6	73	179	182	219	56	136	69	201
4EP40	119	7	13	M6	83	179	182	219	76	136	89	201

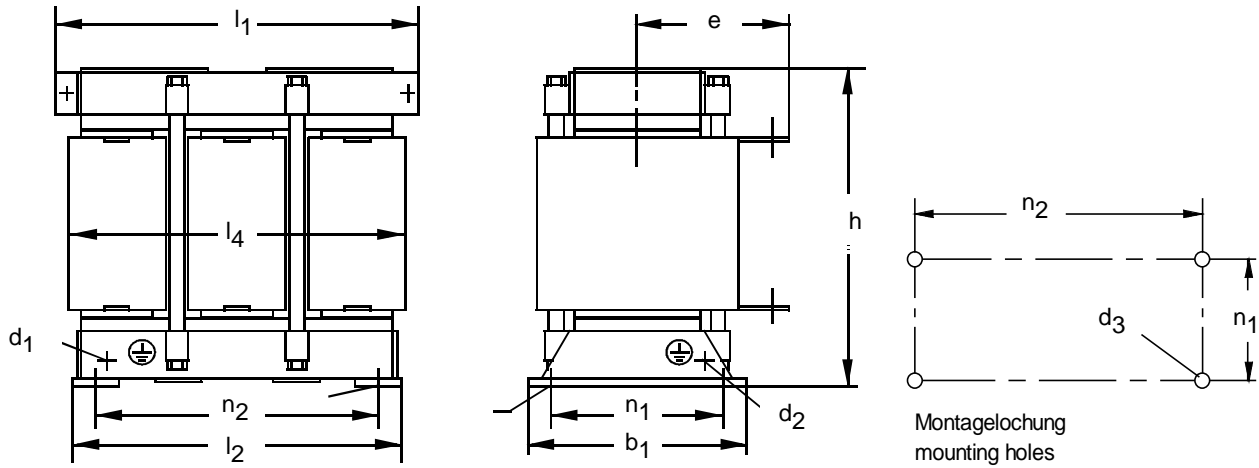
Flat Connector	Rated current $I_{Ln}$ A			$a_1$ mm	$a_2$ mm	$a_3$ mm	$a_4$ mm	$a_5$ mm
		51	to	80	30	20	3	10
81		to	200	35	25	5	12,5	11



### 4EU three-phase line reactors

#### Dimensions

With flat connectors,  
for mounting the reactor on horizontal surfaces



Three-phase line reactor	$b_1$	$d_1$	$d_2$	$d_3$	$e$	$h$	$l_1$	$l_2$	$l_4$	$n_1$	$n_2$	①
Type	max.	mm	mm	mm	mm	max.	max.	max.	max.	± IT12	± IT12	②
4EU24	104	7	13	M6	80	220	219	206	196	70	176	M6
4EU25	128	7	13	M6	97	220	219	206	196	94	176	M6
4EU27	146	10	18	M8	114	250	255	235	280	101	200	M6
4EU30	155	10	18	M8	116	280	285	264	310	118	224	M6
4EU36	169	10	18	M8	180	335	345	314	360	138	264	M6
4EU39	174	12	18	M10	197	385	405	366	410	141	316	M6
4EU43	194	15	22	M12	212	435	458	416	460	155	356	M6
4EU45	221	15	22	M12	211	435	458	416	460	182	356	M6
4EU47	251	15	22	M12	231	435	458	416	460	212	356	M6
4EU50	195	12,5	12,5	M10	220	565	533	470	518	158	410	M12
4EU52	220	12,5	12,5	M10	242	565	533	470	518	183	410	M12

Flat connector	Rated current $I_{Ln}$		$a_1$	$a_2$	$a_3$	$a_4$	$a_5$	$a_6$	$a_7$
	A		mm	mm	mm	mm	mm	mm	mm
	45	to 80	30	20	3	10	9	-	-
	81	to 200	35	25	5	12,5	11	-	-
	201	to 315	40	30	6	15	14	-	-
	316	to 800	50	40	6	20	14	-	-
	801	to 1000	50	40	8	20	14	-	-



Options

## OUTPUT REACTORS (CHOKES)

Output reactors are fitted to the output terminals (U, V & W) of the inverter to allow operation with long motor cables. The inductance of the output reactor compensates for the stray phase-to-phase and phase-to-earth capacitance of the motor cable.

As the motor cable length is increased the total stray capacitance of the motor cable also increases. This stray cable capacitance combined with the residual voltage spikes on the inverter output (caused by the Pulse Wide Modulation (PWM) switching of the inverter's IGBT output devices) has the effect of causing current spikes to flow back to the inverter. These current spikes may cause nuisance tripping of the inverter which can be prevented by the installation of an output reactor.

The recommended motor cable lengths for screened and unscreened cables when output reactors are fitted are shown within the table below:

<b>Maximum Cable Lengths (m)</b>						
<b>for MICROMASTER Eco &amp; MIDIMASTER Eco (380 – 500V ± 10%)</b>						
<b>Inverter Rating (kW)</b>	<b>Standard (no output reactor fitted)</b>		<b>Output Reactor Fitted</b>		<b>Output Reactor Fitted</b>	
	<b>Screened Cable</b>	<b>Unscreened Cable</b>	<b>Screened Cable</b>		<b>Unscreened Cable</b>	
			<b>One Reactor Fitted</b>	<b>Two Reactors Fitted in Series</b>	<b>One Reactor Fitted</b>	<b>Two Reactors Fitted in Series</b>
Up to 1.5kW	80	110	150	200	180	250
2.2 to 3	135	165	200	250	250	300
4	200	200	250	300	300	350
5.5	200	200	250	300	300	350
7.5	200	200	250	300	300	350
11*	50	50	100	150	150	200
15*	50	50	100	150	150	200
18.5*	50	50	100	150	150	200
22*	50	50	100	150	150	200
30*	50	50	100	150	150	200
37*	50	50	100	150	150	200
45*	50	50	100	150	150	200
55	300	300	300	400	400	500
75	300	300	300	400	400	500
90	200	300	300	400	400	500



<b>Maximum Cable Length (m) for MICROMASTER Eco &amp; MIDIMASTER Eco (380 – 500V ± 10%)</b>						
<b>Inverter Rating (kW)</b>	<b>Standard (no output reactor fitted)</b>		<b>Output Reactor Fitted</b>		<b>Output Reactor Fitted</b>	
	<b>Screened Cable</b>	<b>Unscreened Cable</b>	<b>Screened Cable</b>		<b>Unscreened Cable</b>	
			<b>One Reactor Fitted</b>	<b>Two Reactors Fitted in Series</b>	<b>One Reactor Fitted</b>	<b>Two Reactors Fitted in Series</b>
110	200	300	300	400	400	500
132	200	300	300	400	400	500
160	200	300	300	400	400	500
200	200	300	300	400	400	500
250	200	300	350	450	400	550
315	300	300	350	450	400	550



\*It is often a simpler and more economic connection solution to select an Eco inverter rating which is one kW rating larger rather than to fit an output reactor, see section 14 for de-rating information.

The maximum switching frequency must be limited to 2kHz for iron cored reactors and 4Hz for ferrite cored reactors.

For multi-motor connection to a single inverter the total motor cable length is the sum of the individual motor cable lengths.



Options

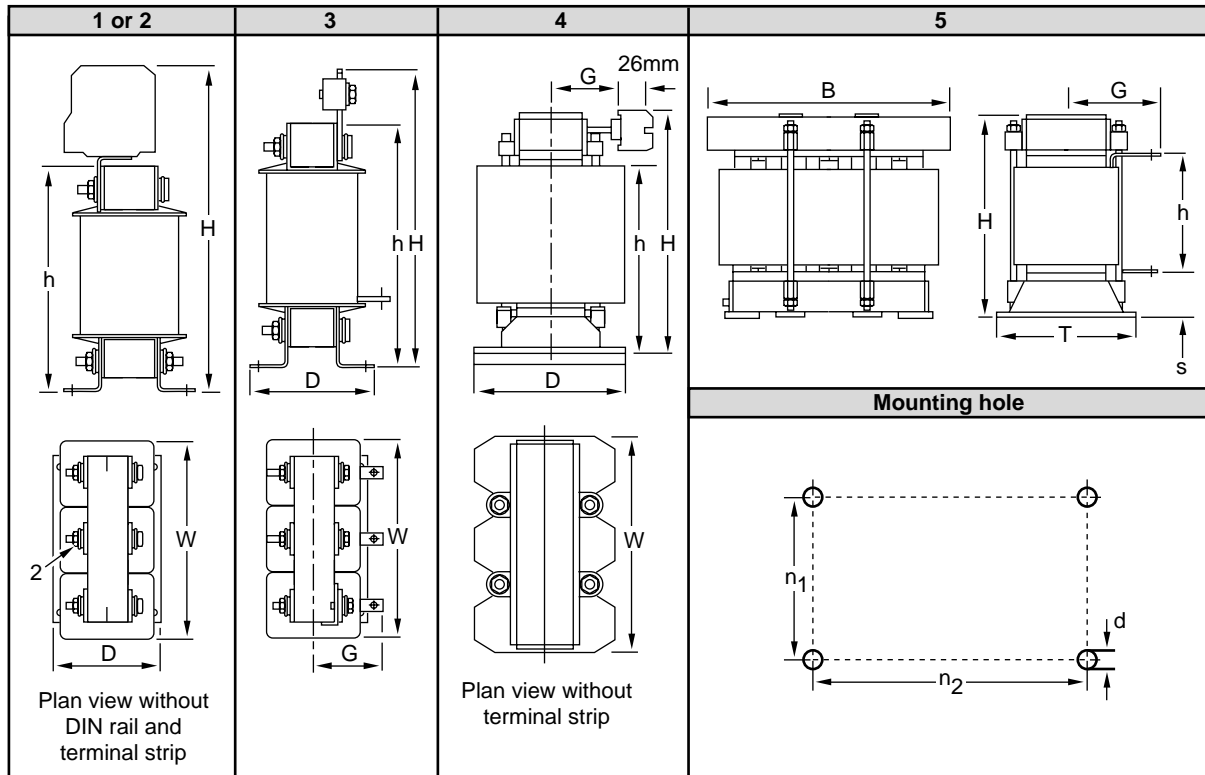
## Output Reactor Order Numbers

Inverter Power Rating (kW) (380 – 500V±10%)	Iron Cored Reactor Part Number	Ferrite Cored Reactor Part Number
ECO1-110/3 (1.1)	6SE7016-1ES87-1FE0	6SE7016-1ES87-1FF1
ECO1-150/3 (1.5)	6SE7016-1ES87-1FE0	6SE7016-1ES87-1FF1
ECO1-220/3 (2.2)	6SE7016-1ES87-1FE0	6SE7016-1ES87-1FF1
ECO1-300/3 (3.0)	6SE7021-8ES87-1FE0	6SE7021-8ES87-1FF1
ECO1-400/3 (4.0)	6SE7021-8ES87-1FE0	6SE7021-8ES87-1FF1
ECO1-555/3 (5.5)	6SE7021-8ES87-1FE0	6SE7021-8ES87-1FF1
ECO1-750/3 (7.5)	6SE7021-8ES87-1FE0	6SE7021-8ES87-1FF1
ECO1-1100/3 (11)	6SE7022-6ES87-1FE0	6SE7022-6ES87-1FF0
ECO1-1500/3 (15)	6SE7023-4ES87-1FE0	6SE7023-4ES87-1FF0
ECO1-1850/3 (18.5)	6SE7024-7ES87-1FE0	6SE7024-7ES87-1FF0
ECO1-2200/3 (22)	6SE7024-7ES87-1FE0	6SE7024-7ES87-1FF0
ECO1-3000/3 (30)	6SE7027-2ES87-1FE0	6SE7027-2ES87-1FF0
ECO1-3700/3 (37)	6SE7027-2ES87-1FE0	6SE7027-2ES87-1FF0
ECO1-4500/3 (45)	6SE7031-0ES87-1FE0	6SE7031-0ES87-1FF0
ECO1-5500/3 (55)	6SE7031-5ES87-1FE0	6SE7031-5ES87-1FF0
ECO1-7500/3 (75)	6SE7031-5ES87-1FE0	6SE7031-5ES87-1FF0
ECO1-9000/3 (90)	6SE7031-8ES87-1FE0	6SE7031-8ES87-1FF0
ECO1-110K/3 (110)	6SE7032-6ES87-1FE0	6SE7032-6ES87-1FF0
ECO1-132K/3 (132)	6SE7032-6ES87-1FE0	6SE7032-6ES87-1FF0
ECO1-160K/3 (160)	6SE7033-2ES87-1FE0	6SE7033-2ES87-1FF0
ECO1-200K/3 (200)	6SE7033-7ES87-1FE0	6SE7033-7ES87-1FF0
ECO1-250K/3 (250)	6SE7035-1ES87-1FE0	6SE7035-1ES87-1FF0
ECO1-315K/3 (315)	6SE7037-0ES87-1FE0	6SE7037-0ES87-1FF0





**Installation of Output Reactors**  
**Output Reactors (Iron core)**

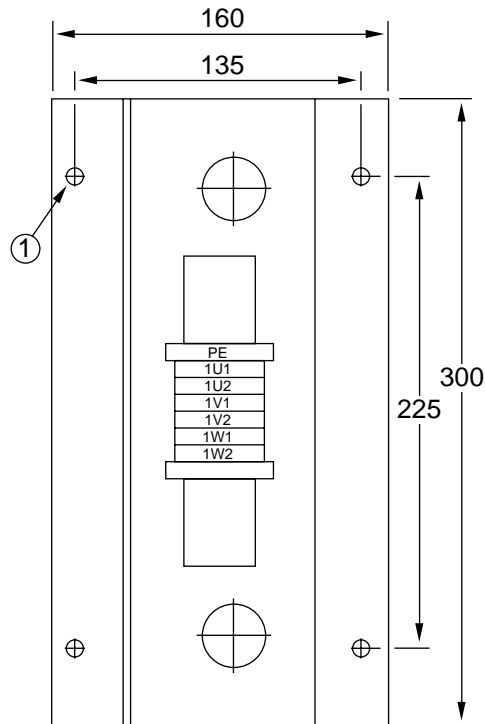
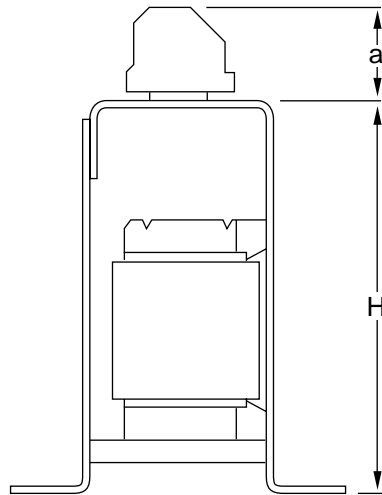


Type	Drawing	H (mm) max	h (mm) max	W (mm) max	D (mm) max	$c_1$ (mm) max	$n_1$ (mm) max	$n_2$ (mm) max	$c^2$ (mm) max	d	Weight (kg)
6SE7016-1ES87-1FE0	2	153	140	178	73	-	53	166	-	M5	4.4
6SE7021-8ES87-1FE0	2	180	165	219	99	-	69	201	-	M6	8.0
6SE7022-6ES87-1FE0	2	180	165	219	119	-	89	201	-	M6	9.2
6SE7023-4ES87-1FE0	2	265	206	267	107	-	77	249	-	M6	11
6SE7024-7ES87-1FE0	5	220	103	197	104	69	70	176	55	M6	20
6SE7027-2ES87-1FE0	3	221	206	267	107	77	77	249	-	M6	11
6SE7031-0ES87-1FE0	3	221	206	267	107	77	77	249	-	M6	17
6SE7031-5ES87-1FE0	5	220	100	197	128	81	94	176	59	M6	25
6SE7031-8ES87-1FE0	5	250	119	281	146	98	101	200	65	M8	30
6SE7032-6ES87-1FE0	5	250	121	281	146	111	101	200	64	M8	30
6SE7033-2ES87-1FE0	5	280	139	311	155	114	118	224	67	M8	45
6SE7033-7ES87-1FE0	5	280	-	264	155	101	118	224	-	M8	45
6SE7035-1ES87-1FE0	5	280	150	310	155	106	118	224	66	M8	45
6SE7037-0ES87-1FE0	5	335	180	360	169	114	138	264	76	M8	60



Options

## Output Reactors (Ferrite core)

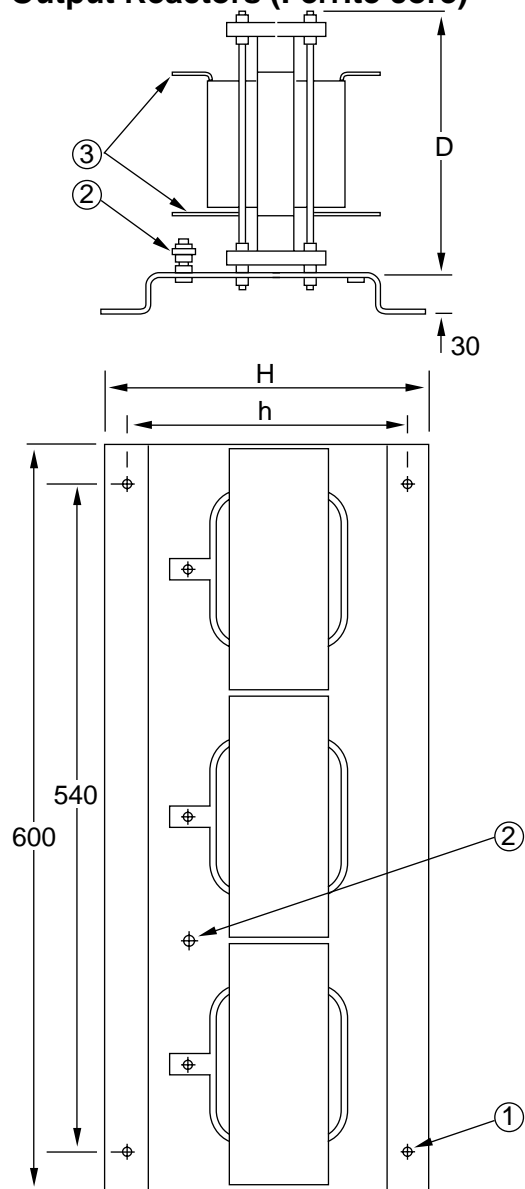


Type	H (mm)	a (mm)	Weight appr. (kg)
6SE7016-1ES87-1FF1	230	max. 50	8.5
6SE7021-8ES87-1FF1	230	max. 50	8.5
6SE7022-6ES87-1FF0	280	max. 50	9.5
6SE7023-4ES87-1FF0	280	max. 50	12.0
6SE7024-7ES87-1FF0	280	max. 60	16.4
6SE7027-2ES87-1FF0	280	max. 50	14.0
6SE7031-0ES87-1FF0	280	max. 60	16.7



Options

**Output Reactors (Ferrite core)**



- ① Hole 7.5 mm diameter for M6 bolt.
- ② M6x23 earthing bolts
- ③ Power connections for
  - M6 bolts (rated current up to 63 A)
  - M8 bolts (rated current from 63 A to 100 A)
  - M10 bolts (rated current from 100 A to 400 A)

Type	H (mm)	D (mm)	h (mm)	Weight appr. (kg)
6SE7031-5ES87-1FF0	255	max. 260	225	23
6SE7031-8ES87-1FF0	255	max. 260	225	31
6SE7032-6ES87-1FF0	295	max. 260	270	32
6SE7033-2ES87-1FF0	295	max. 260	270	41
6SE7033-7ES87-1FF0	295	max. 260	270	45
6SE7035-1ES87-1FE0	295	max. 280	270	52
6SE7037-0ES87-1FE0	295	max. 280	270	65



Options

## dV/dt OUTPUT FILTERS

dV/dt output filters are used to limit the voltage rate of rise to less than 500V/micro-second as well as the peak voltage at the motor connection terminals.

The dV/dt output filter limits the peak motor terminal voltage to 1000V for motor cable lengths up to 150m.

Standard Siemens motors, which are rated for a supply voltage up to 500V, generally do not require the installation of a dV/dt output filter.

Fitting a dV/dt output filter to the inverter output terminals is recommended when the mains supply voltage is (or exceeds) 575V or the insulation strength or condition of the motor is not known (e.g. retro-fitting inverters to older used motors).



For dV/dt filters the output switching frequency must be limited to 2kHz.

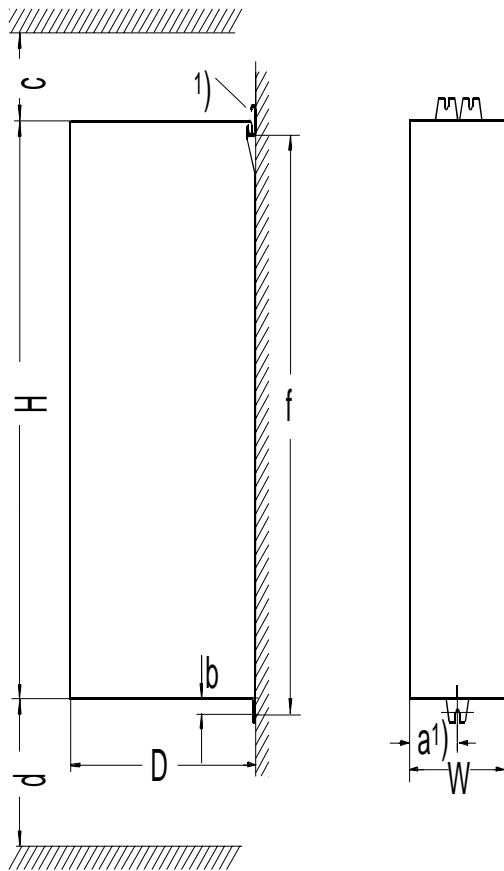
### dV/dt Filter Order Numbers

Inverter Power Rating (kw)	dV/dt Filter part Number	dV/dt Filter Size
ECO1-110/3 (1.1)	6SE7016-2FB87-1FD0	B
ECO1-150/3 (1.5)	6SE7016-2FB87-1FD0	B
ECO1-220/3 (2.2)	6SE7016-2FB87-1FD0	B
ECO1-300/3 (3.0)	6SE7021-5FB87-1FD0	B
ECO1-400/3 (4.0)	6SE7021-5FB87-1FD0	B
ECO1-555/3 (5.5)	6SE7021-5FB87-1FD0	B
ECO1-750/3 (7.5)	6SE7021-5FB87-1FD0	B
ECO1-1100/3 (11)	6SE7022-2FC87-1FD0	C
ECO1-1500/3 (15)	6SE7023-4FC87-1FD0	C
ECO1-1850/3 (18.5)	6SE7024-7FC87-1FD0	C
ECO1-2200/3 (22)	6SE7024-7FC87-1FD0	C
ECO1-3000/3 (30)	6SE7026-0HE87-1FD0	E
ECO1-3700/3 (37)	6SE7028-2HE87-1FD0	E
ECO1-4500/3 (45)	6SE7031-2HS87-1FD0	S
ECO1-5500/3 (55)	6SE7031-7HS87-1FD0	S
ECO1-7500/3 (75)	6SE7031-7HS87-1FD0	S
ECO1-9000/3 (90)	6SE7032-3HS87-1FD0	S
ECO1-110K/3 (110)	6SE7033-0HS87-1FD0	S
ECO1-132K/3 (132)	6SE7033-0HS87-1FD0	S
ECO1-160K/3 (160)	6SE7033-5HS87-1FD0	S
ECO1-200K/3 (200)	6SE7034-5HS87-1FD0	S
ECO1-250K/3 (250)	6SE7035-7HS87-1FD0	S
ECO1-315K/3 (315)	6SE7036-5HS87-1FD0	S



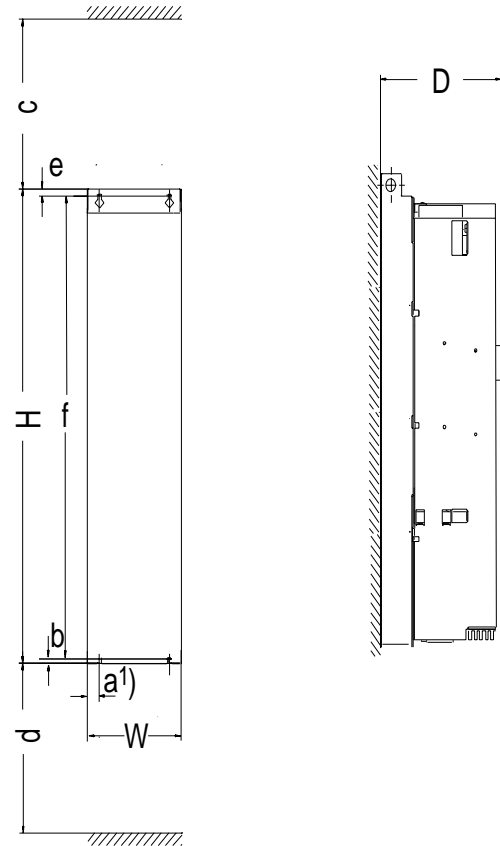
Options

Installation of dV/dt Output Filters



1) 2 lugs, left and right

dV/dt Output Filters Frame Sizes B - C



dV/dt Output Filters Frame Sizes E and S



Options

dv/dt Filter Size	B	C	E	S
H [mm]	425	600	1050	1450
W [mm]	135	180	250	270
D [mm]	350	350	350	450
a* [mm]	67.5	90	45	45
b [mm]	16	16	10	10
c [mm]	100	100	350	350
d [mm]	250	250	400	400
f [mm]	425	600	1025	1425
Weight approx. [kg]	20	27	55	95

\* Note: For sizes E and S: 2 lugs left and right



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# Technical Specification for VARIABLE SPEED DRIVES (VSD)

## Heating, Ventilation and Air Conditioning (HVAC)

### Scope

The document in this section is the recommended Technical Specification for Variable Speed Drives (VSD) when used within HVAC applications.

The specification covers the VSD design, operation, performance, testing and support requirements for the project.

The specification may be used in whole or in part by Building Services Consultants in order to assist with the preparation of tender documentation.



## Technical Tender Specification

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## 1. General

- The VSD shall be purposely designed and manufactured for HVAC (Heating Ventilation and Air Conditioning) applications. The VSD shall be suitable for all loads with variable torque characteristics, such as fans and pumps.
- The VSD shall be capable of starting and running high inertia loads such as centrifugal fan equipment.
- The VSD supplier shall carry a comprehensive range of spares which shall continue to be available for at least 5 years after the production of the particular VSD model has been discontinued.
- The VSD and motor shall preferably be manufactured by the same firm in order to ensure VSD and motor performance matching as well as optimum total system efficiency.
- The VSD shall also be compatible for use with the various asynchronous squirrel cage induction motors typically used by manufacturers of HVAC equipment.
- The VSD shall be of sufficient capacity and shall produce a quality low distortion output waveform so as to achieve full rated nameplate shaft power output of the motor. The VSD shall be capable of operating any standard squirrel cage induction motor of the specified VSD power rating without any modifications to the motor or the VSD.

## 2. Design

- The VSD shall be fully digitally controlled utilising PCB surface mounting technology and VLSI.
  - The VSD shall consist of the following major components:
    1. Full-wave bridge 6 pulse Rectifier.
    2. DC link capacitors.
    3. Inverter stage with Insulated Gate Bipolar Transistor (IGBT) power modules across the entire range (GTO or BJT devices shall not be acceptable).
    4. Control and display panel.
- The VSD shall have high efficiency and have low maintenance requirements. The VSD shall provide an adjustable output frequency and voltage utilising the principles of Pulse Width Modulation (PWM) design. This technique shall provide full nameplate motor voltage as well as distortion free sinusoidal currents at the terminals of the motor in order to obtain full motor rated torque at rated frequency. The PWM strategy shall be of the Space Vector Modulation type implemented through a microprocessor and ASIC in order to operate with optimum power and efficiency, minimise acoustic noise produced by the motor and reduce motor heating created by output harmonics. The operating characteristics shall not exceed those which are recommended by the motor manufacturer.
- The mechanical design of VSD shall adhere to the following guidelines;
  1. The internal layout of the VSD shall maintain separation between the control signals and the power conductors in order to minimise EMC noise related problems
  2. The VSD shall be assembled in such a way as to facilitate easy maintenance
  3. Control signal wiring installation shall be simplified through the use of screwless terminal design.
  4. The location of the nameplate or label of the VSD shall be easily accessible and contain all the necessary information in order to determine the VSD rating and to also assist with identification



- 
- 5. All incoming and outgoing cables shall enter and exit from the top and/or the bottom of the VSD. Gland plates shall be provided as standard for the correct fitting of cables with cable glands to ensure safety and reliable operation.
  - 6. The VSD shall be of compact design and have the ability to be mounted side-by-side without separation for greater space saving.
  - The VSD enclosure shall be protected to IP20 (NEMA1). An optional IP56 (NEMA4/12) VSD enclosure shall be available if further environmental protection is required
- 

### 3. Quality Assurance & Standards

- The VSD shall be supplied by a manufacturer who has considerable experience in the design and manufacturing of VSD of the ratings specified for a period of at least ten (10) years.
- The VSD shall be designed and constructed in accordance with the requirements of the IEEE and NEMA standards. (The VSD shall be rated for compatibility with NEMA design B premium efficiency motors.)
- The VSD shall be designed and manufactured to a quality management system in accordance with ISO 9001.
- The VSD shall be UL and CUL listed for power conversion equipment 5B33 for use in pollution degree 2 environments and labelled accordingly.
- The VSD shall comply with the requirements of the Low Voltage Directive 73/23/EEC as amended by Directive 98/68/EEC and shall be CE marked accordingly.
- The VSD units shall be 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

The VSD, when installed in accordance with the recommendations and guidelines of the VSD manufacturer, shall comply with the requirements of the EMC Directive as defined by the EMC Product Standard for Power Drive Systems EN61800-3.

- The VSD shall be routinely factory tested upon real asynchronous induction motors using a variety of user parameters. The factory tests shall simulate operation within actual VSD installations. The VSD supplier shall be able to provide copies of the Certificates of Type Test, upon request
- The VSD shall meet or exceed the following standards:
  1. Degree of protection to EN60 529 (DIN VDE 0470, Part 1) standard IP20/21 optional IP56
  2. Environmental class to BS2011, BS EN 60068-2-1
  3. Shock Protection to DIN 40046 Part 7, BS EN 6006-2



## 4. Performance Requirement

The VSD shall be designed to operate correctly when installed within the following service conditions:

- **Elevation:**  
Up to 1000 metre (3300 feet) altitude without derating.
- **Ambient Temperature:**  
0°C to 40°C above 7.5kW  
0°C to 50°C up to 7.5kW (380V and above)
- **Storage Temperature:**  
-40°C to 70°C BS EN 60068-2-3 Moisture and condensation not permissible.
- **Relative Humidity:**  
Up to 90% non-condensing.
- **Input Voltage:**  
204-240V +/-10%, 380-460/480/500 VAC +/-10%, 525V-575V +/-15%, 3AC
- **Input frequency tolerance:**  
47 to 63Hz (Europe and North America)
- **Output Voltage:**  
230V +/-15%, 380-500 VAC +/-10%, 525V-575V +/-15%, 3AC
- **Output voltage stability:**  
+/- 1%
- **Service factor:**  
1.0
- **Power unit rating:**  
100% rated continuous current.
- **Power factor:**  
At least 0.98 prime power factor or better.
- **Efficiency:**  
Minimum level at 97% at 100% load.
- **Digital stability:**  
< 1%
- **Analogue stability:**  
< 0.02%
- **Frequency stability:**  
+/- 0.05%
- **Overload capability:**  
110% for 60 seconds

## 5. Basic Parameter Settings

The VSD shall have at least the following adjustable settings easily accessible within the Basic Mode of set-up and operation;

- Maximum frequency                      0-150 Hz
- Minimum frequency                      0-150 Hz
- Acceleration time                      0-150 sec
- Deceleration time                      0-150 sec
- Start-on-the-fly enabling the VSD to synchronise on to a spinning motor (bi-directional)
- Output frequency setpoint selection (e.g. 0 -10V)
- Run/stop command selection
- Motor nameplate details (kW, V, rpm, A, Hz)



## 6. Expert / Advanced Parameter Settings

The VSD shall have at least the following adjustable settings easily accessible within the Expert Mode of set-up and operation;

- Motor current limit: 0-250%
- Starting voltage/torque boost: 0-200%
- Switching frequency for acoustic noise control: 2-16 kHz  
(higher kW rated VSD may have limited max. switching freq.)
- (4) Skip frequencies with adjustable band width to prevent mechanical resonance.
- Energy Control Optimisation or Multi-Motor mode selection.
- DC injection braking intensity.
- Compound braking.
- (6) programmable fixed frequencies.
- Direct serial communication monitoring of digital input status and direct control of digital relay outputs and analogue outputs.
- Adjustable display scaling factor for display of temperature and pressure.

## 7. Protection Functions and Features

The VSD shall include the following protective features in order to ensure the security and safe operation of the equipment:

- Line to line and line to ground instantaneous short circuit over-current
- Over-voltage
- Under-voltage
- VSD overload
- VSD over-current
- RAM/EPROM/EEPROM malfunction
- Serial communication time out
- Digital input external fault
- VSD power stage over-temperature
- Motor I<sup>2</sup>t overload protection
- Motor PTC input facility for motor winding temperature monitoring
- Memory register for storage of the last four fault codes
- Ability to disable panel buttons whilst in remote control mode
- Parameter protection with 2 levels of setting
- Automatic restart after a fault, etc.
- Expansion to serial communication network using RS485 and simple protocol (USS).
- Closed loop internal PID control for pressure and temperature regulation.  
Setpoint may be from an analogue, digital or serial input.  
Feedback may be either 0-10V or 0/4-20mA.  
A 15Vdc power supply shall be provided for a transducer.
- Ability to reset to factory default settings.
- Ability to have selection between MANUAL and AUTO through use of selector via VSD digital input terminals.
- Ability to provide optional AC line reactors for power factor improvement, harmonic control, prevention of zero voltage notching or surge protection from low impedance supplies.
- Factory default parameter settings. Automatic selection of either European or North American defaults.

The VSD shall have at least the following additional features:



**8. Control Signals**

The VSD shall have two (2) analogue inputs (0-10V or 0/4-20mA) and six (6) fully programmable digital inputs.

The VSD shall accept any of the following speed setting input signals from the Building Management System (BMS) or other controls;

- 0-10V DC
- 0-20 mA or 4-20 mA
- Motorised potentiometer using up/down digital inputs
- Fixed frequencies using digital inputs
- RS485
- Keypad display for local hand operation

The VSD shall have at least one analogue output signal (0/4-20mA) which can be programmed to:

- Output frequency.
- Output current (load).
- DC-link voltage.
- Motor torque.
- Motor rpm.
- Setpoint frequency.

The VSD shall incorporate two (2) volt-free relay outputs (240VAC, 1A) for remote indication of the following:

- Motor running.
- Setpoint speed reached.
- Fault indication (over-temperature, over-current, etc.).
- PID high and/or low speed limits reached.

**9. Communications**

The VSD shall have an RS485 interface as standard allowing the VSD to be used in conjunction with an external system within a multi-drop LAN configuration. The interface shall allow all the various parameter settings of the VSD to be programmed via BMS control. In addition, the VSD shall have the capability to retain these setting within the non-volatile EEPROM memory.

The VSD shall incorporate a clear and easy to operate user-interface panel. The preferred design is to have a 4 digit green LED display with a membrane keypad.

An optional multi-language back-lit LCD keypad display (at least 4 lines of 16 character alpha-numeric text) shall be available. It shall be able to be panel door mounted to a protection rating of IP54 or alternatively used as a portable module and be able to upload, download and store up to 10 different parameter sets.

The information to be displayed in the VSD display mode shall be:

- Output frequency (Hz)

- Speed of motor (RPM)
- Status of motor (Running, Stop, Fault, etc.)
- Motor current (A)
- Motor torque (Nm)
- Fault status (Code)
- PID feedback signal (%)
- DC-link voltage (Vdc)
- Setpoint frequency (Hz)
- Motor output voltage (V)
- Serial link status -



## 10. Harmonics on Mains Supply System

The VSD and their installation shall comply with the following reference standards:

- IEEE 519 - "Guide for Harmonic Control and Reactive Compensation of Static Power Converters."

- Engineering Recommendation G5/3 of the Electrical Council (UK).

## 11. Electromagnetic Compatibility (EMC)

When installed according to the recommendations of the manufacturer the VSD product range shall fulfil all requirements of the EMC Directive as defined by the EMC Product Standard for Power Drive Systems EN61800-3.

The VSD shall have a level of performance to allow the 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 Emission and Immunity standards EN50081-2 and EN50082-2.

### Emissions

- Radiated Emissions  
EN55011, Level A1
- Conducted Emissions  
EN55011, 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,  
50Hz, 30A/m
- Electrostatic Discharge  
EN 61000-4-2,  
8kV air discharge
- Burst Interference  
EN 61000-4-4, 2 kV power cables,  
2kV control
- Surge Immunity  
EN61000-4-5, 4kV common mode,  
2kV differential

Radio frequency electromagnetic field, amplitude modulated

ENV 50 140, 80-1'000Mhz, 10 V/m,  
80% AM, power and signal lines

Radio-frequency electromagnetic field, pulse modulated

ENV 50 204, 900 MHz, 10V/m 50%  
duty cycle, 200Hz repetition rate

Preference shall be given to VSD that utilise dedicated RFI filters and are integrated into the VSD design. The design of the EMC filters must minimise any additional space requirement and shall preferably be filters which fit to the footprint of the VSD

The VSD shall have the ability to be fitted with RFI filters to Class B1.

Where RFI filters are supplied from a separate supply source, documentation showing the test results of the RFI filter and VSD combination and its compliance to EN55011 (BS800) shall be supplied as evidence of conformity.

If external RFI filters are used, they shall have metal enclosures to a minimum protection rating of IP20 (NEMA 1), and located as close to the VSD input terminals as possible. Motor cables shall be segregated from the mains supply cables and the RFI filter by at least 30cm. Where motor cables cross the mains cables they must cross at right angles.



## 12. Output Chokes

The VSD should be capable of operating normally (without the need for an output choke or reactor) when connected to the motor with a screened / unscreened motor cable length of up to 50m

A range of output motor choke options shall be available for the VSD to enable operation with longer motor cable lengths.

## 13. Commissioning & Documentation

The keypad display should include only the pushbuttons required for setting up the VSD for standard fan and pump applications. The pushbuttons layout should include:

- a start and a stop pushbutton
- an up and a down pushbutton to control the speed
- a pushbutton to access the VSD program

Operating Instructions shall be enclosed and shipped with the VSD. Further documentation and literature shall be made available upon request.

The Operating Instructions shall be kept small and simple so that the commissioning and installation of standard fan and pump applications can be easily and quickly completed.

The information within the Operating Instructions shall be:

- safety and CE / UL compliance

- introduction
- mechanical installation
- electrical installation
- application examples
- keypad
- display parameters
- basis parameters for HVAC applications
- Important additional parameters for HVAC applications
- complete parameter listing
- fault codes
- empty table to document own parameter settings.

A Quick Set Up card shall be included so that commissioning and installation personnel can get an overview of all the most important HVAC parameters.

## 14. Preference

The VSDs shall be MICROMASTER Eco units manufactured by Siemens, or equivalent.



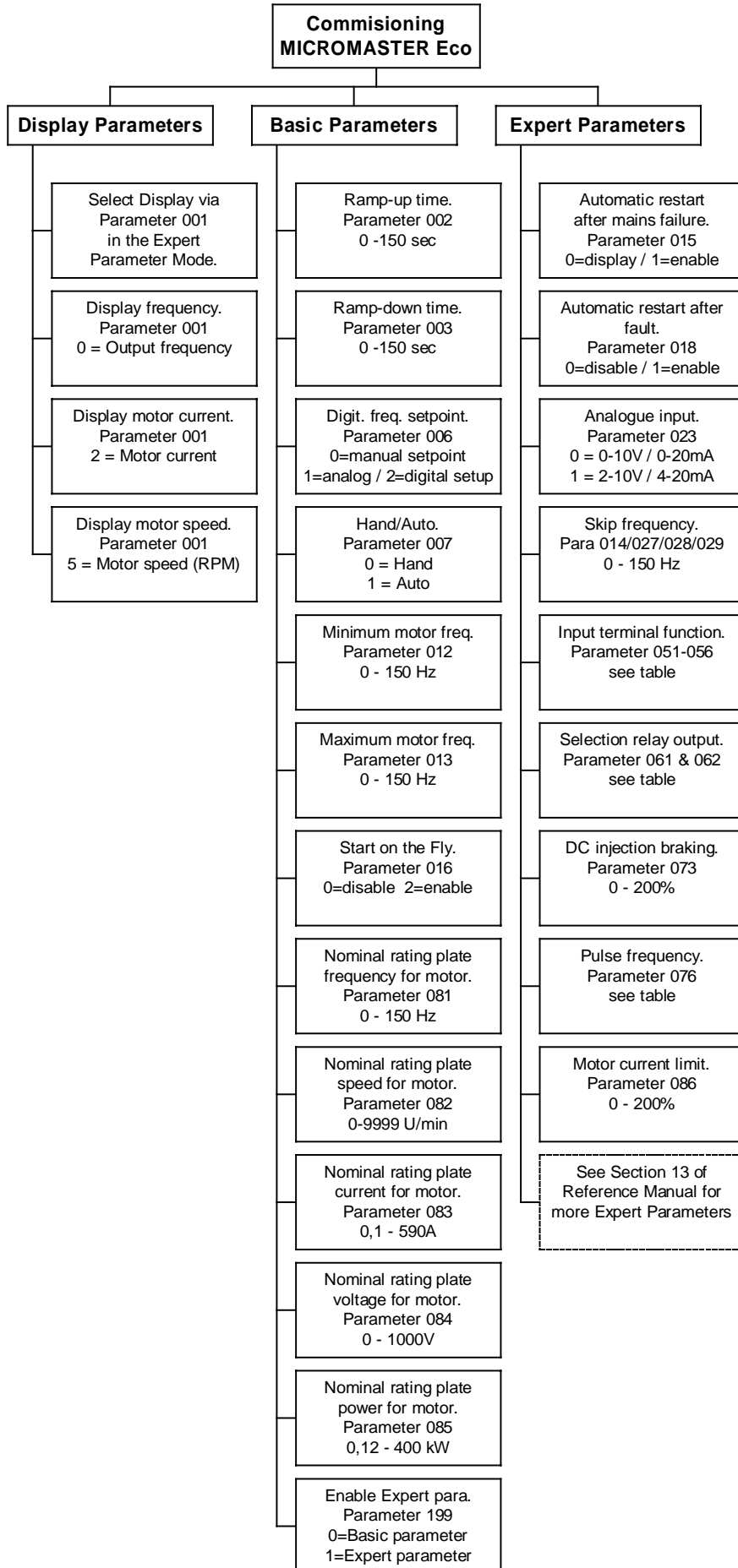
## 17. YOUR PARAMETER SETTINGS

Parameter	Default	Your setting
P000	-	
P001	0	
P002	20.0	
P003	20.0	
P005	50.0 (60.0 North America)	
P006	0	
P007	1	
P010	1.00	
P012	0.0	
P013	50.0 (60.0 North America)	
P014	0.0	
P015	1	
P016	0	
P018	0	
P019	2.0	
P021	0.0	
P022	50.0 (60.0 North America)	
P023	0	
P025	0	
P026	2	
P027	0.0	
P028	0.0	
P029	0.0	
P041	5.0	
P042	10.0	
P043	15.0	
P044	20.0	
P046	25.0	
P047	30.0	
P051	1	
P052	10	
P053	6	
P054	6	
P055	6	
P061	6	
P062	1	
P065	1.0	
P066	0	
P073	0	
P074	1	
P076	Variant Dependent	
P077	4	
P079	50.0	
P080	***	
P081	50.0 (60.0 North America)	
P082	***	
P083	***	
P084	***	
P085	***	
P086	100	
P087	0	
P088	1	

\*\*\* - Value depends on rating of the inverter

Parameter	Default	Your setting
P089	***	
P091	0	
P092	6	
P093	0	
P094	50.0 (60.0 North America)	
P095	0	
P101	2 Goes to either 0 or 1 after first energised	
P111	***	
P112	***	
P113	***	
P121	1	
P124	1	
P128	120	
P131	-	
P132	-	
P133	-	
P134	-	
P135	-	
P136	-	
P140	-	
P141	-	
P142	-	
P143	-	
P199	0	
P201	0	
P202	1.0	
P203	0	
P204	0	
P205	1	
P206	0	
P207	100	
P208	0	
P210	-	
P211	0.0	
P212	100.00	
P220	0	
P321	0.00	
P322	50.0 (60.0 North America)	
P323	0	
P356	6	
P386	1.0	
P720	0	
P721	-	
P722	0.0	
P723	-	
P724	0	
P725	-	
P726	0.0	
P910	0	
P922	-	
P923	0	
P930	-	
P944	0	





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