MSC-3

Instruction Manual

ZENER TECHNOLOGY AND QUALITY ASSURANCE

Since 1976 Zener Electric has supplied many thousands of drives to industry. These drives have been installed into numerous applications resulting in a wealth of in house experience. The Zener MSC-3 AC variable speed controller is the culmination of this experience, modern technology and industrial application requirements. The Zener Quality Assurance program ensures that every MSC-3 manufactured has proven to operate correctly in the production test bay before dispatch.

SAFETY

Your MSC-3 must be applied, installed and operated in a safe manner. It is the responsibility of the user to ensure compliance with all regulations and practices covering the installation and wiring of your MSC-3. The instruction manual should be completely read and understood before attempting to connect or operate the MSC-3. Only skilled personnel should install this equipment.

This equipment contains a number of components that are designated by their various manufacturers as “not for use in life support appliances, devices or systems where malfunction of the components can reasonably be expected to result in personal injury or death”. Customers using or selling Zener products for use in such applications do so at their own risk and agree to indemnify Zener for any damage resulting from improper use or sale.

THE CONTENTS OF THIS MANUAL ARE SUBJECT TO CHANGE WITHOUT NOTICE

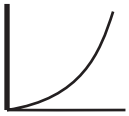
ZENER is a registered trademark of Zener Electric Pty Limited

A Zener Drive for Every Application

The ZENER MSC-3 series Variable Speed Drive is suitable for all types of loads, producing greater motor torque over the full speed range with ZENER's unique 'Flux Plus' control algorithm.

Variable Torque Loads

Typically Pumps and Fans

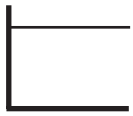


- Quiet Motor Operation (Audible frequency adjustable from 2 to 16kHz)
- 110% full overload capacity from 0-200Hz
- Controlled ramp from 0.1 sec to 1min
- Able to start into a high inertia load rotating at full speed without damage
- PID control for automatic process control
- Energy savings with speed reduction
- Soft Stop to reduce water hammer problems

Constant Torque Loads

Typically Conveyors,

Machines



- Flux plus for torque maximisation
- 150% - 175% full overload capacity from 0-200Hz
- Automatic Boost and slip compensation for fluctuating loads
- Dynamic Braking for rapid deceleration of high inertia loads (optional)
- Configurable Analog & Digital I/O

A Zener Drive for Different Environments

ZENER also offers a range of enclosure types to suit different environmental conditions, for improved life expectancy and reliability. Ratings at 40°C, 45°C and a 50°C rating are available.

IP30 ENCLOSED

Painted enclosure with IP30 rating for mounting within an enclosure or Switch Board.

Up to 170Amps

IP66 ENCLOSED

Painted enclosure with a dual compartment, self-contained, forced ventilated IP66 enclosure providing added protection against the ingress of dust and water without the use of air filters. All electronic components are housed in a totally enclosed compartment separate from the heatsink and ventilation fan compartment.

Up to 140Amps

IP66 STAINLESS STEEL

Stainless Steel 304 with a dual compartment, self-contained, forced ventilated IP66 enclosure providing added protection against the ingress of dust and water without the use of air filters. All electronic components are housed in a totally enclosed compartment separate from the heatsink and ventilation fan compartment.

Up to 109Amps

Zener MSC-3 Options

SUPPLY VOLTAGE

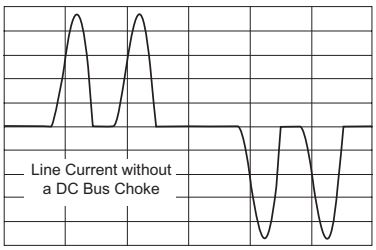
The ZENER MSC-3 is available to operate from the following types of power supplies;

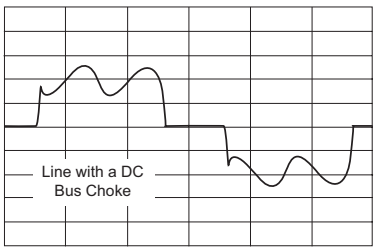
Supply Voltage	Supply Phase	Tolerance	Model
380 to 480Vac	3 Phase	-15, , +10%	MSC-3R
208 to 240Vac	3 Phase	-15, , +10%	MSC-3L
440 to 600Vac	3 Phase	-15, , +10%	MSC-3J
380 to 480Vac	1 Phase*	-15, , +10%	MSC-3R
208 to 240Vac	1 Phase*	-15, , +10%	MSC-3L

* Derating required for single phase operation. (See page 9)

DC BUS CHOKE

Provides a reduction of power line harmonics with the added benefit of reducing peak inrush currents, improved power factor and enhanced protection against AC line transients.





REMOTE DISPLAY PANEL

Remote Display Kit which allows remote access to programming menu and drive controls. An IP66 rating applies if fitted correctly.

Available in 2m, 5m or 10m kits. Cable lengths greater than 10m may required screened cable and/or additional power supply.

OPTION BOARDS

The ZENER MSC-3 provides 2 expansion slots located on the control board to accept up to 2 option boards.

AQ03000	24vdc 20mA Power Supply Card
AQ03001	Extended Features; PID controller, Analogue Output, 2nd Analogue Input, Thermistor input, Speed Reference Select, Additional Relay output
AQ03004	Communication; Modbus
AQ03005	Communication; Metasys
AQ03078	Communication; Lonworks

Check with your authorised Zener Distributor for other communications protocols.

All Communication Option Boards include; Run, kWh log, Trip log, battery backed real time clock.

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Explanation of symbols

	WARNING	Indicates a condition or practice that, if the warning is not strictly observed, could result in personal injury or death.
	CAUTION	Indicates a condition or practice, if the caution is not strictly observed, could lead to damage or destruction of equipment or a significant impairment of proper operation.
	WARNING	This symbol is used to highlight an electrical hazard. Failure to strictly observe the warning could result in electrocution.
		This symbol is used to highlight additional information on the product's capabilities or a common error in installation, commissioning or operation.

Warnings

Read all operating instructions before installing, wiring, operating, servicing or inspecting the MSC-3.

Ensure that the instruction manual is made available to the final user of the product as well as all personnel involved in any aspect of installation, adjustment or maintenance.

Your MSC-3 must be applied and installed by a suitably qualified and experienced electrical tradesperson in accordance with this manual, good engineering practice and all local rules and regulations

There are hazardous voltages inside the MSC-3 whenever it is connected to an electrical supply and for some time afterwards.

Before touching anything inside the MSC-3 enclosure or other equipment connected to the MSC-3 terminals, disconnect all sources of electrical power, wait at least 11 minutes for capacitors within the MSC-3 to discharge to less than 50VDC and then ensure, by measurement, that there is no hazardous AC or DC voltage present at any terminal.

The MSC-3 contains high energy circuits that may be hazardous. Do not operate the MSC-3 with the door open or any part of the enclosure removed.

Do not touch the terminals of the MSC-3 or any associated motor and wiring when it is energised, even if the MSC-3 and motor are stopped. Electric shock may result.

Do not modify this equipment electrically, mechanically or otherwise. Modification may create safety hazards as well as voiding the UL listing of models so listed.

The MSC-3 is designed to drive an appropriately rated and otherwise suitable 3 phase induction motor. It is not suitable for single phase motors or other types of motor or non-motor load. Use with inappropriate load types may create a safety hazard.

Where the MSC-3 is used as a component part of another product, it is the purchaser's responsibility to ensure that the final product meets all of the necessary safety, EMC, regulatory, operational and other requirements for that product. Requirements for the purchaser's final product may be substantially different to the requirements for stand-alone inverters.

The MSC-3 is intended for use only in fixed wiring applications. It is not intended for use on a flexible supply cable.

The MSC-3 contains a substantial EMC line filter and as a result it is unsuitable for use on earth leakage protected circuits.

Mount the MSC-3 on a vertical, incombustible surface such as metal or masonry. Do not place combustible or flammable material near the MSC-3. Failure to observe these precautions may create a fire hazard.

The MSC-3 is manufactured under strict quality control arrangements, however additional and independent safety equipment must be installed if the application is such that failure of the product may result in personal injury or property damage.

Ensure that electrical noise generated by the product and any associated equipment does not adversely affect the proper operation of other equipment or systems, particularly those that have a safety function.

Install emergency stop circuitry that removes power from the MSC-3 and does not depend on any feature of the product for proper and safe operation. Do not use the braking functions of the product for safety purposes.

The MSC-3 has features that may be used to cause an automatic restart in certain circumstances. The overall application (machine etc) must be designed such that automatic restart is not hazardous.

Do not install this equipment in locations where mechanical damage to the enclosure is possible. In particular, consider vehicles, vandalism and attack by insects or animals. Severe equipment damage and safety hazards may result.

Receiving

Inspect the MSC-3 for any shipping damage. If any damage is found, report it to the carrier immediately. Access the inside of the controller and visually check for any damage.

Do not attempt to operate the MSC-3 if any obvious damage exists.

After the initial inspection, the MSC-3 can be repacked and stored in a clean, dry location until it is required for use.

DO NOT store this equipment in an area where the ambient temperature will fall below -20ºC (-4ºF) or rise above 70ºC (158ºF). DO NOT store this equipment in areas that are subject to condensation or corrosive atmosphere. Proper storage is necessary to ensure satisfactory controller start up and performance.

Software

This manual applies to MSC-3 software revision 1.53. The software revision is displayed briefly at power up.

Installation

MSC-3 mounting location

In general, the MSC-3 should be mounted as close to the motor as practical, consistent with other requirements. This not an absolute requirement, but the following advantages may support such a choice:

- Generally, electrical cabling costs per metre are lower for the unscreened power cable used on the AC supply side than for the screened output cable required between the MSC-3 and the motor. Cabling costs can therefore be expected to be lower when less screened cable is needed.
- EMC performance can be expected to be mildly enhanced with a shorter motor cable because of reduced leakage from the cable
- In circumstances where an isolator switch is required near the motor, it may be possible to connect this in the AC supply to the MSC-3. This has the advantages of saving two screened cable terminations and allowing the use of a non-metallic isolator switch enclosure where allowed by local electrical codes. There are also safety advantages for service personnel in that the local isolator switch also isolates the MSC-3 from the electrical supply.

The choice is predominantly an economic one. There are many perfectly satisfactory installations where, for a variety of specific site reasons, the most effective solution results in the MSC-3 and the motor being a long distance apart.

CAUTION Installation Information

- The MSC-3 must be mounted on a vibration free vertical surface, away from heat radiating sources. Do not mount the MSC-3 in direct sunlight or on a hot surface.
- The MSC-3 must be mounted vertically. No other mounting orientation is acceptable.
- If the MSC-3 is mounted inside another enclosure, the total heat dissipation and resulting temperature rise in the enclosure must be allowed for.
- Attention is drawn to the potential for condensation in vulnerable environments. Additional precautions may be required for all enclosure types.
- The installation location and environment should provide for safe access and working conditions for service personnel. Do not mount the MSC-3 in “confined spaces” [1]
- Do not drill holes in the enclosure except in the gland plate.
- Remove the gland plate before drilling cable holes.
- Do not allow metal shavings or any other conductive material to enter the enclosure or damage may result.
- DC Bus choke is mandatory with MSC-3Jxx (600VAC) and some other models.
- The optional DC Bus choke is fitted inside the MSC-3 in all models except Chassis A, IP30. For these models, the DC Bus choke is located in an additional enclosure fitted to the rear face of the MSC-3. The wiring between the MSC-3 and the choke is internal.

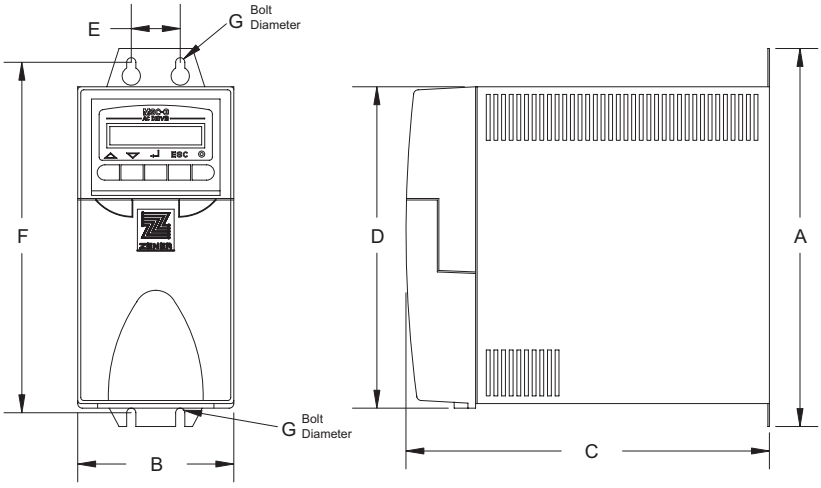
DC bus chokes

MSC-3 may be fitted with an optional DC bus choke. Fitting this option offers several benefits:

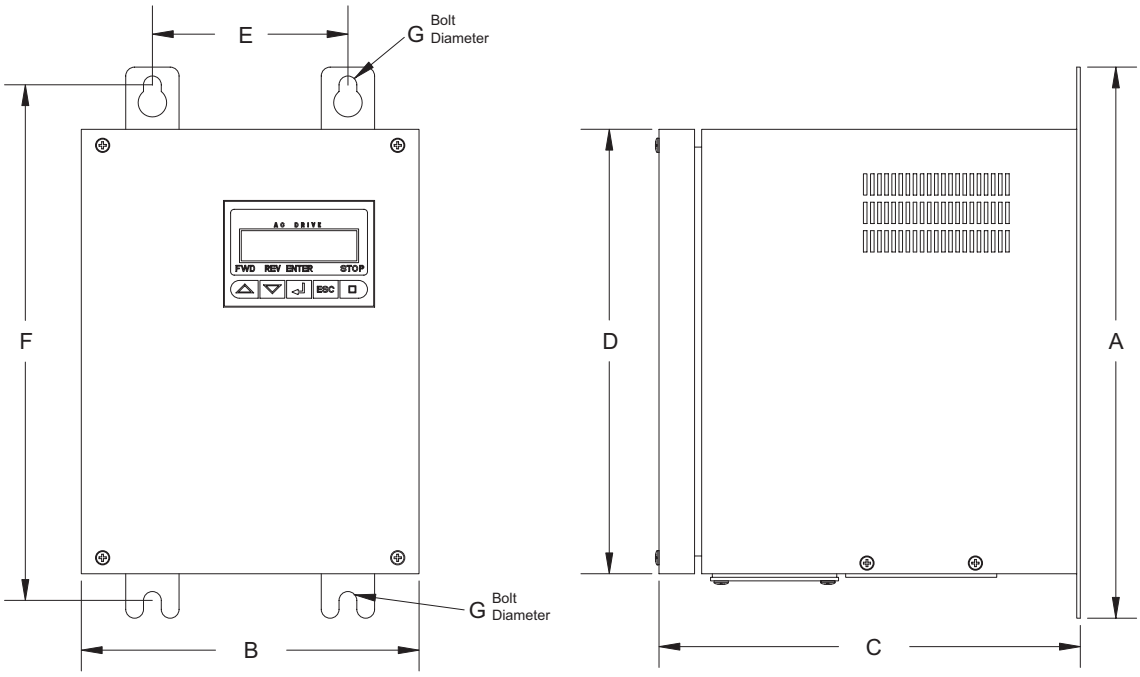
- Considerable reduction in harmonic and RMS currents in the AC line, particularly on low impedance (high fault level) electrical supplies. Values become relatively independent of AC line parameters, simplifying application design.
- Increased tolerance to phase imbalance in the 3 phase AC supply.
- Increased immunity to AC line transients.

[1] Confined spaces are generally defined in Occupational Health and Safety (OH&S) regulations to mean spaces where special precautions are necessary to ensure a safe breathing atmosphere, or there is limited access for escape/rescue in case of emergency.

MSC-3 Mechanical Installation Information



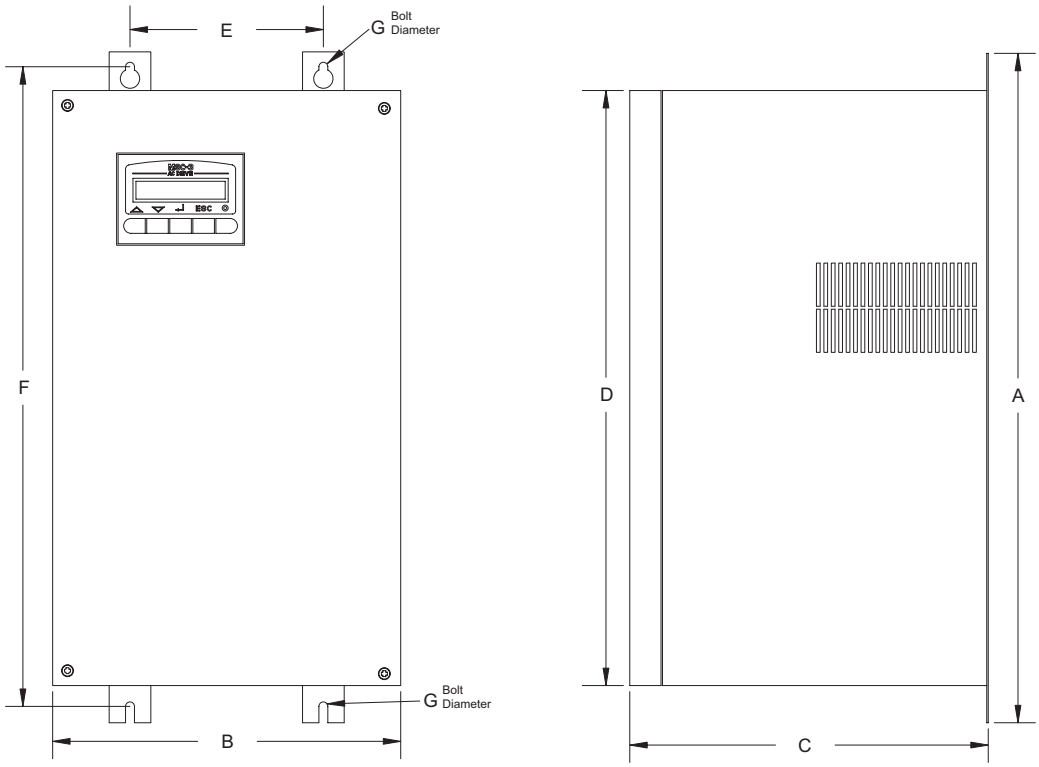
Chassis A IP30 / NEMA 1 (3 - 11 Amps)



Chassis A IP66 / NEMA 4 (3 - 11 Amps)

CAUTION

Allow 50 mm above, below and either side of the enclosure for ventilation.



Chassis B (15 - 40 Amps)

CAUTION

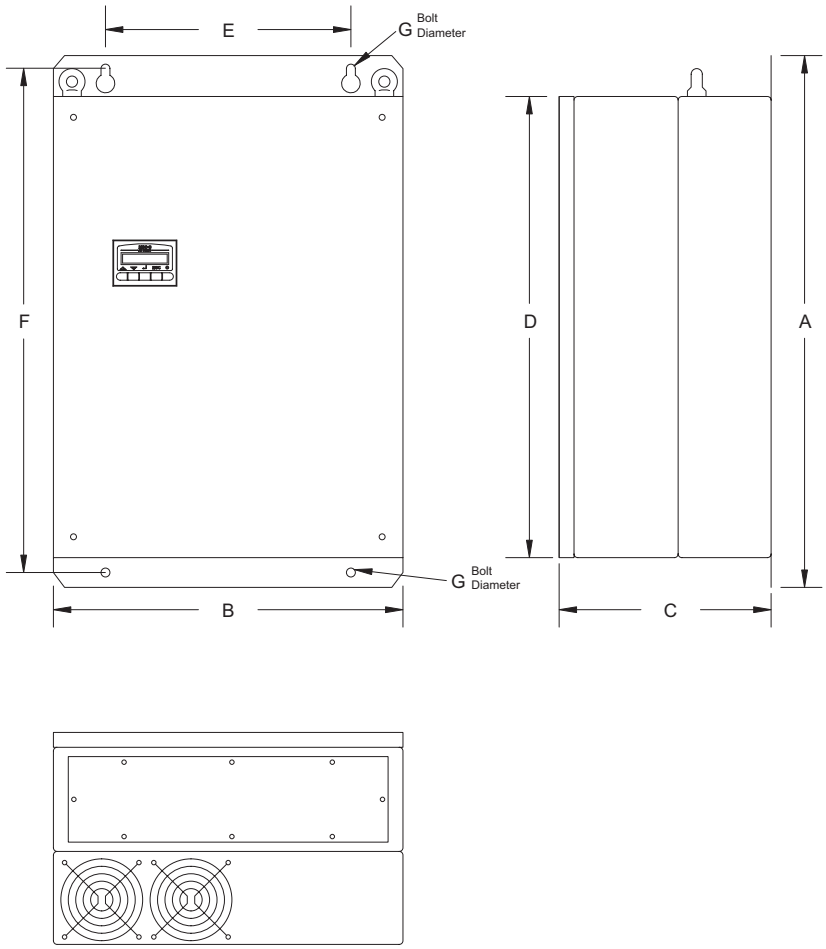
Allow 75 mm above, below and either side of the enclosure for ventilation.

Model	Enclosure type	Dimensions - tolerance +/- 1.0mm							Weight without choke	Weight with choke
		A	B	C	D	E	F	G		
MSC-3*3 MSC-3*5 MSC-3*7 MSC-3*11	Chassis A IP30 / NEMA 1 (No DC Choke)	248mm 9.8”	102mm 4”	237mm 9.3”	208mm 8.2”	32mm 1.3”	230mm 9.1”	6mm 0.25”	3.5Kg 8lbs	
MSC-3*3 MSC-3*5 MSC-3*7 MSC-3*11	Chassis A IP30 / NEMA 1 (With DC Choke)	248mm 9.8”	102mm 4”	309mm 12.2”	208mm 8.2”	32mm 1.3”	230mm 9.1”	6mm 0.25”		7.2Kg 16lbs
MSC-3*3 MSC-3*5 MSC-3*7 MSC-3*11	Chassis A IP66 / NEMA 4	310mm 12.2”	190mm 7.5”	236mm 9.3”	250mm 9.8”	108mm 4.3”	287mm 11.3”	6mm 0.25”	5.7Kg 13lbs	8.6Kg 19lbs
MSC-3*15 MSC-3*20 MSC-3*23 MSC-3*30	Chassis B All types	459mm 18.1”	234mm 9.2”	243mm 9.6”	400mm 15.8”	130mm 5.1”	436mm 17.1”	6mm 0.25”	17.7Kg 38lbs	22.9Kg 51lbs
MSC-3*40	Chassis B All types	459mm 18.1”	234mm 9.2”	243mm 9.6”	400mm 15.8”	130mm 5.1”	436mm 17.1”	6mm 0.25”		24.8Kg 55lbs

* L, R or J to specify supply voltage - see page 60 for details

CAUTION

All MSC-3Jxx (600VAC) models must be used with a DC bus choke.



Chassis C (55 - 170 Amps)

CAUTION

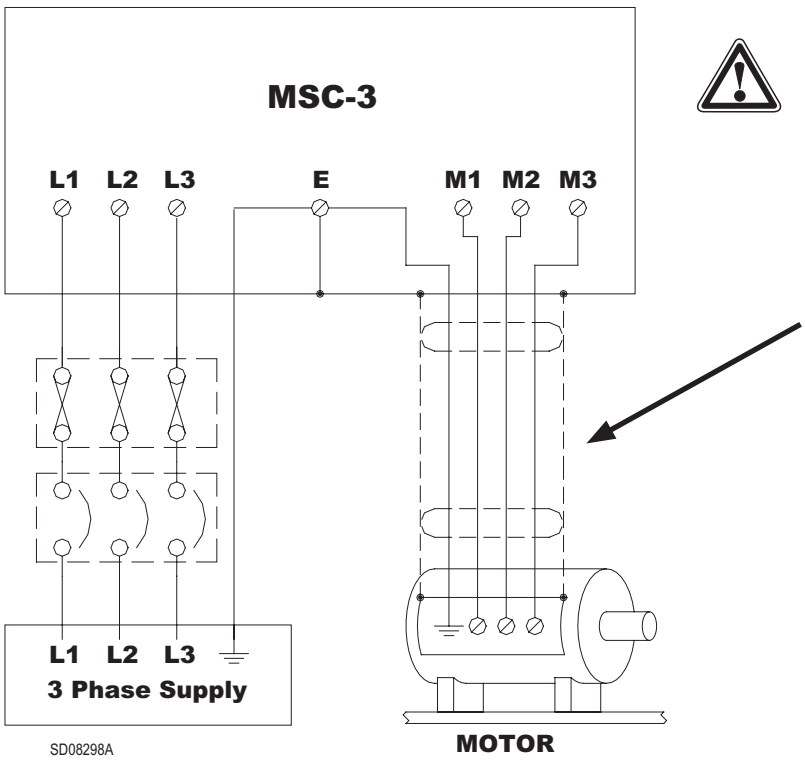
Allow 100 mm above, below and either side of the enclosure for ventilation.

Model	Enclosure type	Dimensions - tolerance +/- 1.0mm							Weight without choke	Weight with choke
		A	B	C	D	E	F	G		
MSC-3*55	Chassis C All types	715mm 28.1”	470mm 18.5”	290mm 11.4”	625mm 24.6”	330mm 13”	677mm 26.7”	12mm 0.47”	42Kg 92lbs	62Kg 136lbs
MSC-3*82	Chassis C All types	715mm 28.1”	470mm 18.5”	290mm 11.4”	625mm 24.6”	330mm 13”	677mm 26.7”	12mm 0.47”	44Kg 97lbs	64Kg 141lbs
MSC-3*109	Chassis C All types	715mm 28.1”	470mm 18.5”	290mm 11.4”	625mm 24.6”	330mm 13”	677mm 26.7”	12mm 0.47”	46Kg 101lbs	66Kg 145lbs
MSC-3*140	Chassis C All types	715mm 28.1”	470mm 18.5”	290mm 11.4”	625mm 24.6”	330mm 13”	677mm 26.7”	12mm 0.47”	50Kg 110lbs	70Kg 154lbs
MSC-3*170	Chassis C All types	715mm 28.1”	470mm 18.5”	290mm 11.4”	625mm 24.6”	330mm 13”	677mm 26.7”	12mm 0.47”		72Kg 158lbs

* L or R to specify supply voltage - see page 60 for details

MSC-3 Power wiring for 3 Phase supply

Basic power wiring diagram



CAUTION

Be sure to review the information on the following pages concerning electrical installation issues.

See installation practices for Electromagnetic compatibility (EMC) compliance on page 11 and specific information for the EMC compliant installation of each chassis size on pages 12 - 15 BEFORE selecting or installing motor cables and glands.

The screened motor cable should only contain the phase and earth (PE) conductors of one inverter and the associated motor. Do not include other conductors inside the screen.

Supply circuit protection and switchgear

Either fuses or a circuit breaker must be connected as shown. The protective elements used and any upstream switchgear (contactors, isolation switches etc) must be selected with due regard for the prospective short circuit currents of the electrical supply and the requirements of your local electrical code. The selection should provide for “type II” (no damage) coordination as per IEC 60947 or Australian Standard AS 3947.

Fuses or circuit breakers of the current limiting type are preferred in order to minimise the total energy let through in the unlikely, but possible, event of a major arcing fault in wiring or within MSC-3 enclosure.

Installations that are required to be UL compliant must use UL listed fuses of the amp rating and class detailed on page 8 of this manual.

Cable sizes

Cable sizes should be selected according to local wiring rules using the currents given in the table on page 8. Note that the power terminals of the MSC-3 are designed to accept normally stranded power cables with temperature rating of 70ºC or more. In the event that other cable types are to be used (particularly flexible cables with very fine stranding), the overall size of the conductor should be checked prior to final cable selection for proper fit in the power terminals. The combination of the cable and the supply circuit protection selected must be such that the supply cable is properly protected under all circumstances.

Electrical Isolation

A suitable means of isolating the MSC-3 from the electrical supply must be provided in accordance with your local electrical code. In the event that a second supply is connected to the relay contacts on the control terminal strip (or otherwise brought into the MSC-3 enclosure), suitable marking must be applied to the outside of the MSC-3 enclosure by the installer to indicate the dual supply arrangement in accordance with your local electrical code and other safety requirements. A means of isolating the second electrical supply source will also be required.

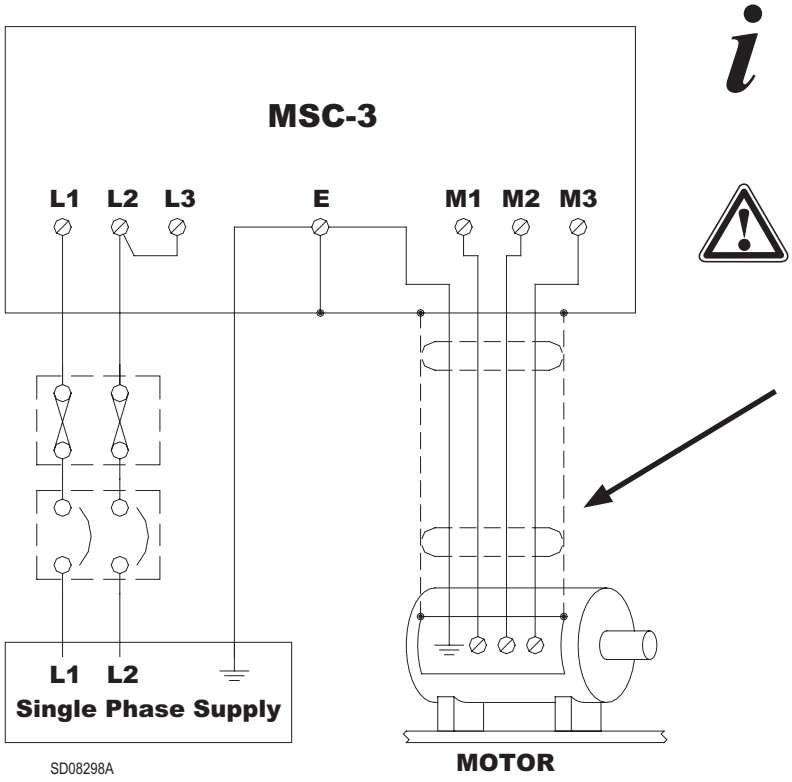
Fuse Circuit Breaker Ratings for All MSC-3 Models

Model Numbers	Chassis Size	Maximum RMS Input Current	Recommended Fuse or C/B Rating (A)	UL Class Fuse for UL compliant installation (A) †
MSC-3*3	A	4.1	10	10A, Class J
MSC-3*5	A	6.9	10	10A, Class J
MSC-3*7	A	9.6	16	15A, Class J
MSC-3*11	A	15.1	20	120A, Class J
MSC-3*15	B	22.5	32	30A, Class T
MSC-3*20	B	30.4	40	40A, Class T
MSC-3*23	B	33.0	40	40A, Class T
MSC-3*30	B	43.1	63	60A, Class T
MSC-3*40	B	55.0	63	60A, Class T
MSC-3*55	C	78.0	100	100A, Class T
MSC-3*82	C	108.0	125	125A, Class T
MSC-3*109	C	148.0	160	175A, Class T
MSC-3*140	C	179.0	200	200A, Class T
MSC-3*170	C	187.0	200	200A, Class T
* L, R or J for Chassis A and B, L or R for Chassis C to specify supply voltage - see page 60 for details				
† The fuse **class** referred to here is the American designation fuse required for a UL compliant installation. This should not be confused with the British **Type** T etc designation, which refers to an entirely different kind of fuse.				

Motor thermal protection

The MSC-3 provides an electronic type thermal overload function that relies on the measured motor current to estimate the thermal conditions of the motor. For complete motor thermal protection, microtherms or thermistors should be installed in the motor winding and wired to the appropriate trip relay. MSC-3 Extended Features Option provides a thermistor relay function and other features.

MSC-3 Power wiring for Single Phase Supply



The *D09 1 Phase Input Supply* feature on page 46 must be enabled for single phase supply operation

CAUTION

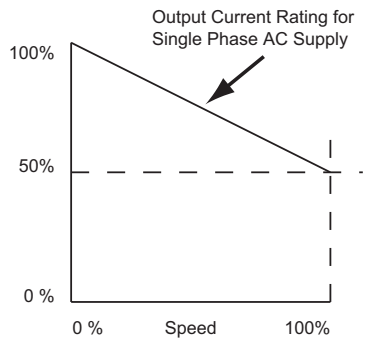
Be sure to review the information on the following pages concerning electrical installation issues.

See Installation practices for Electromagnetic compatibility (EMC) compliance on page 11 and specific information for the EMC compliant installation of each chassis size on pages 12 - 15 BEFORE selecting or installing motor cables and glands.

The screened motor cable should only contain the phase and earth (PE) conductors of one inverter and the associated motor. Do not include other conductors inside the screen.

Any model MSC-3 can be operated from a single phase AC supply. In addition to the electrical installation information on pages 7 and 8, the following additional constraints apply to operation on a single phase power supply:

- The single-phase supply voltage must be within the 3 phase supply voltage limits for the MSC-3 model to be used. For example, use an MSC-3Lxx model for a 240VAC single-phase supply or a MSC-3Rxx model for a 480VAC single phase supply.
- A standard 3-phase motor of a voltage rating appropriate to the MSC-3 model should be used. See the specifications section of this manual for output voltages.
- Fuses or circuit breakers for the AC supply should be according to the table on page 8.
- The MSC-3 is unsuitable for use with single-phase motors.
- The DC Bus Choke option is mandatory for operation from a single-phase supply.
- The continuous output current rating is reduced from the values stated for 3-phase supply operation according to the graph on the right.



- The maximum available output voltage will decrease to 95% of the RMS input voltage. This is a consequence operating from a single phase supply and means that the available motor torque at full speed will be reduced to approximately 90% of the motor rated torque. De-rating can be avoided if the single phase input voltage is at least 1.05 times the rated motor voltage.

MSC-3 with a DC Supply

Some models of MSC-3 may be used with a DC supply. There are a number of issues to be considered in properly applying MSC-3 in this situation, some of which involve the characteristics of the particular DC supply to be used.

Please consult the factory for proper application of MSC-3 on DC supply systems.

Installation practices for Electromagnetic Compatibility (EMC) compliance

Installation practices for EMC compliance

The EMC performance of the MSC-3 is installation dependent. For compliance with EMC standards, the use of a screened power cable between the MSC-3 and the motor is required. Other arrangements that provide a continuous metallic sheath enclosing only the motor phase conductors and the associated protective earth (PE) conductor may also be used.

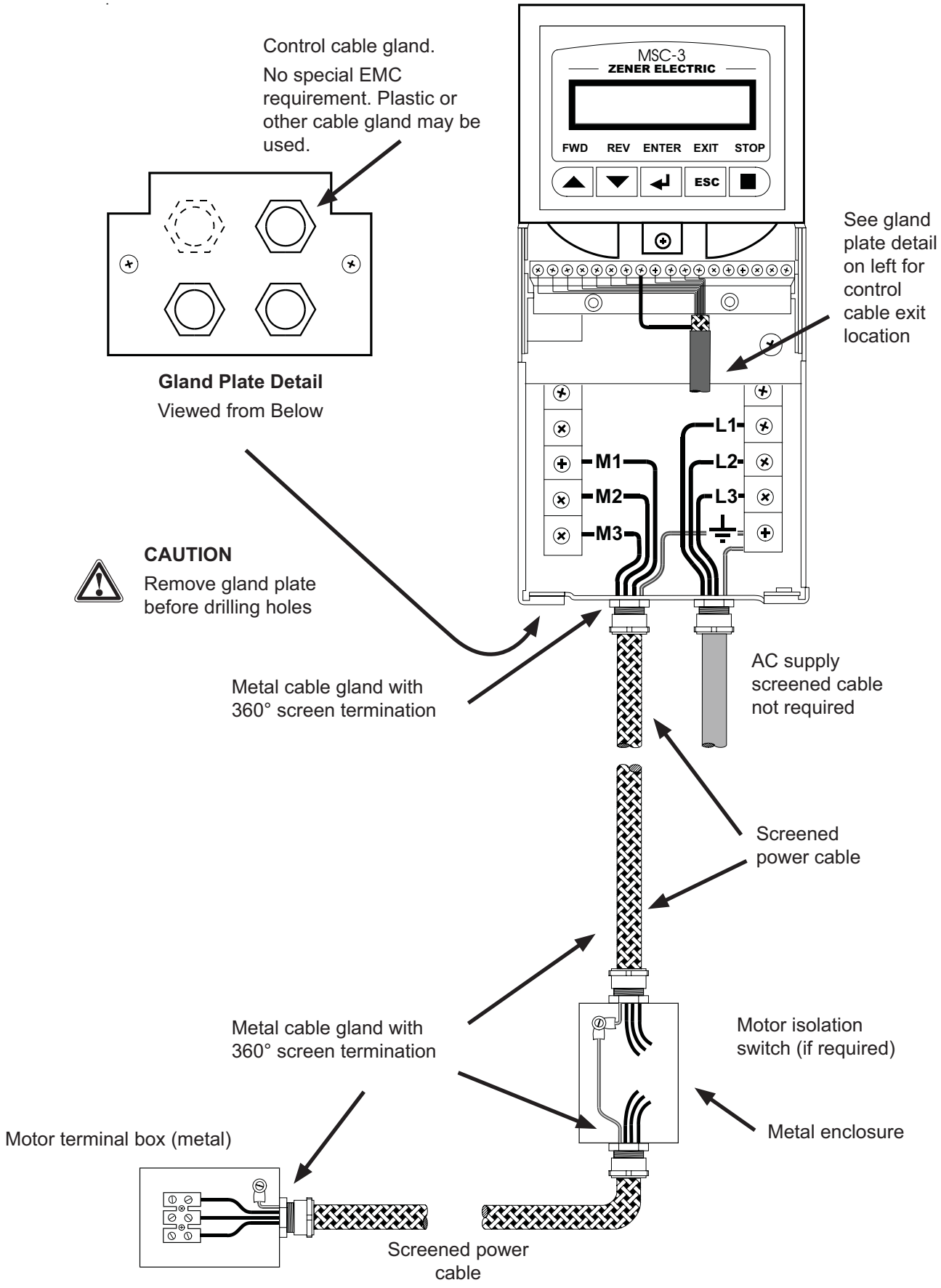
In order to achieve the required electrical performance at high frequencies, it is essential that the screen of the cable have a 360º connection to both the MSC-3 gland plate and the motor terminal box. The correct type of metal cable gland to suit the screened cable should be used. The protective earth (PE) conductor should be terminated in the usual way to meet the local wiring codes at the ground terminals provided in the MSC-3 and the motor. Isolation switches wired between the MSC-3 and the motor should be in a metallic enclosure with the power cable screen properly terminated on both sides. Failure to properly terminate the screened power cable (or alternative metal sheath) will result in a severe degradation of the screened cables performance at high frequencies and increase the possibility of EMC problems. The screened motor cable should only contain the phase and earth (PE) conductors of one inverter and the associated motor. Do not include other conductors inside the screen.

Specific information for the EMC compliant installation of each chassis size is provided on pages 12 - 15.

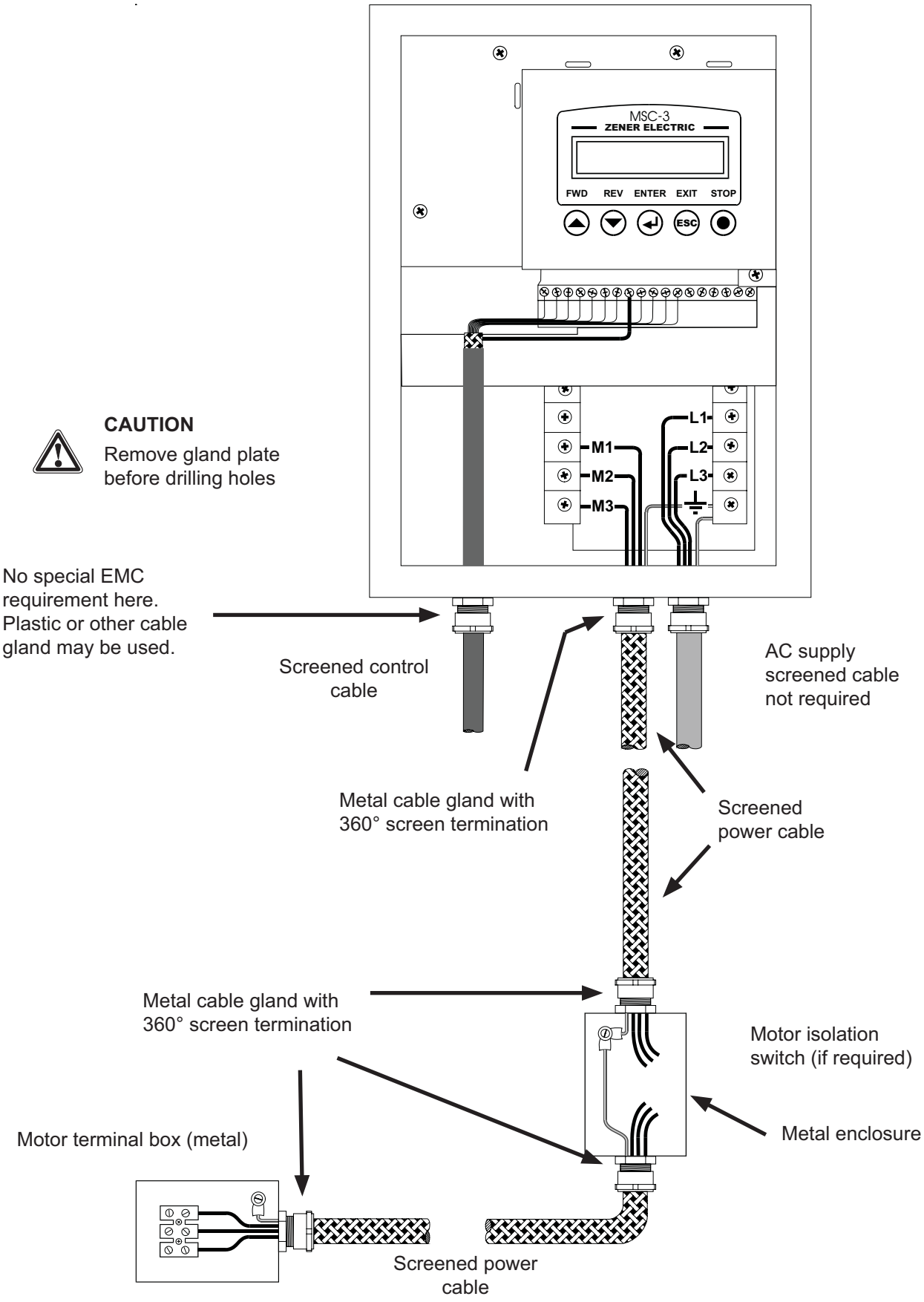
Wiring materials for EMC compliance

The EMC related properties of the shielded power cable used between the inverter and motor will have a significant impact on the overall EMC result achieved in any given installation. The EMC performance of an installation will usually be dominated by the lowest performance section of the inverter to motor cabling. For this reason it is imperative that appropriate material (including cable glands/terminators) is used in every part of this cabling. There is a wide range of materials available, and these may be generally categorised as follows:

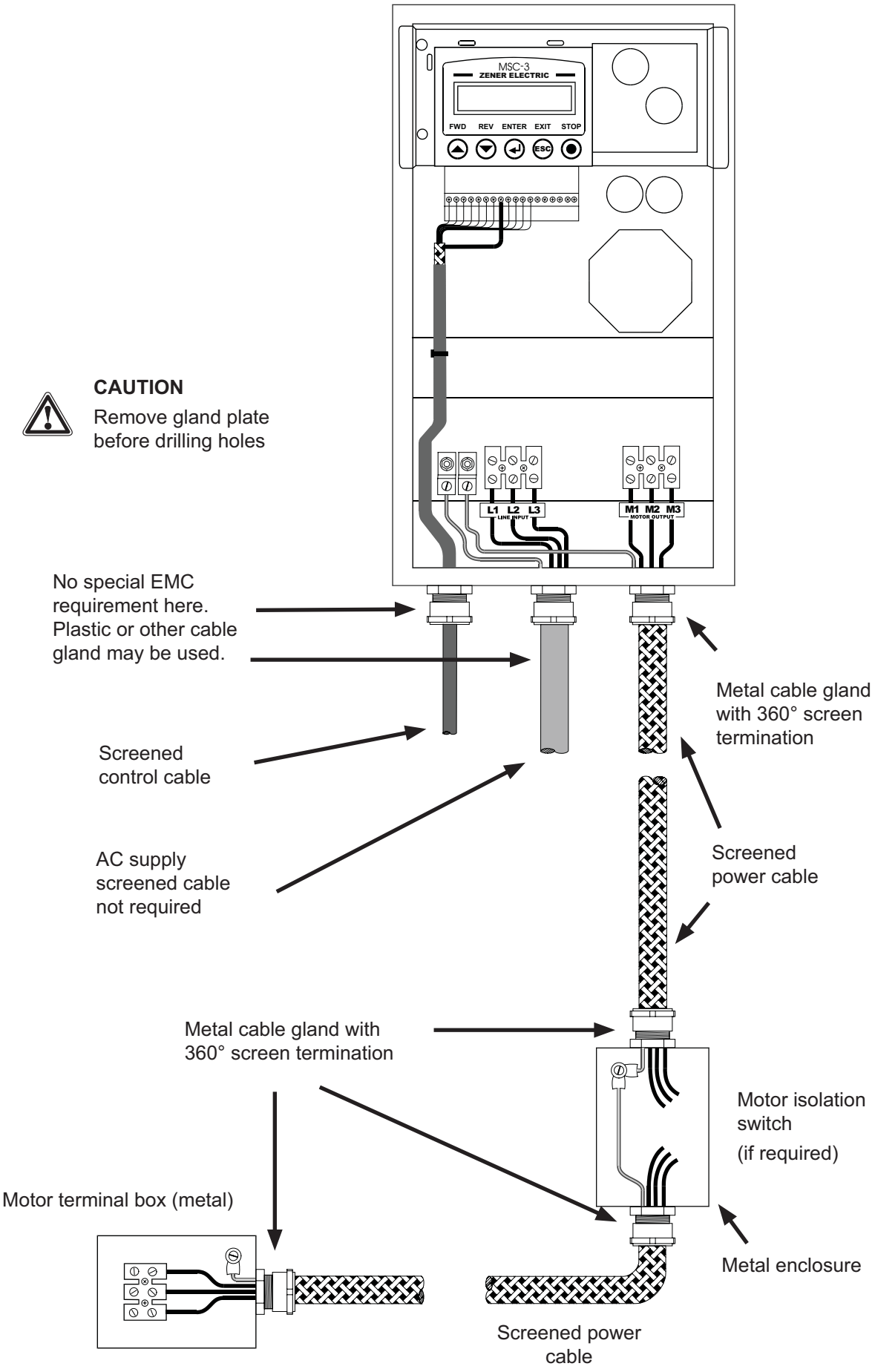
	Category	Technical Data	Comment	
1	Screened cable material from reputable manufacturers	Technical data will be available to allow assessment of the performance of the material against specific criteria	The manufacturer's claimed data can generally be relied on, provided that the proper installation and termination practices are strictly adhered to.	✓
2	Generic materials with well understood EMC properties. For example, screwed steel conduit and MIMS cable	The technical performance of these materials is well understood by analysis from basic principles. Specific data has been reported in reputable engineering research journals.	These materials generally offer very high performance, provided that the proper installation and termination practices are strictly adhered to.	✓
3	Material without specific EMC performance data. Armored cables and flexible conduit systems fall into this category when there is no EMC performance data provided. Note that there are high performance, fully EMC specified examples of these materials available which would make them part of category 1.	None. Assessment of the likely performance by visual inspection is difficult and unreliable.	These materials represent a high risk category because the EMC performance is simply unknown. Apparently similar materials may have widely differing EMC performance. In general, there is no control of the EMC properties during design or manufacture because this is not the intended application.	✗



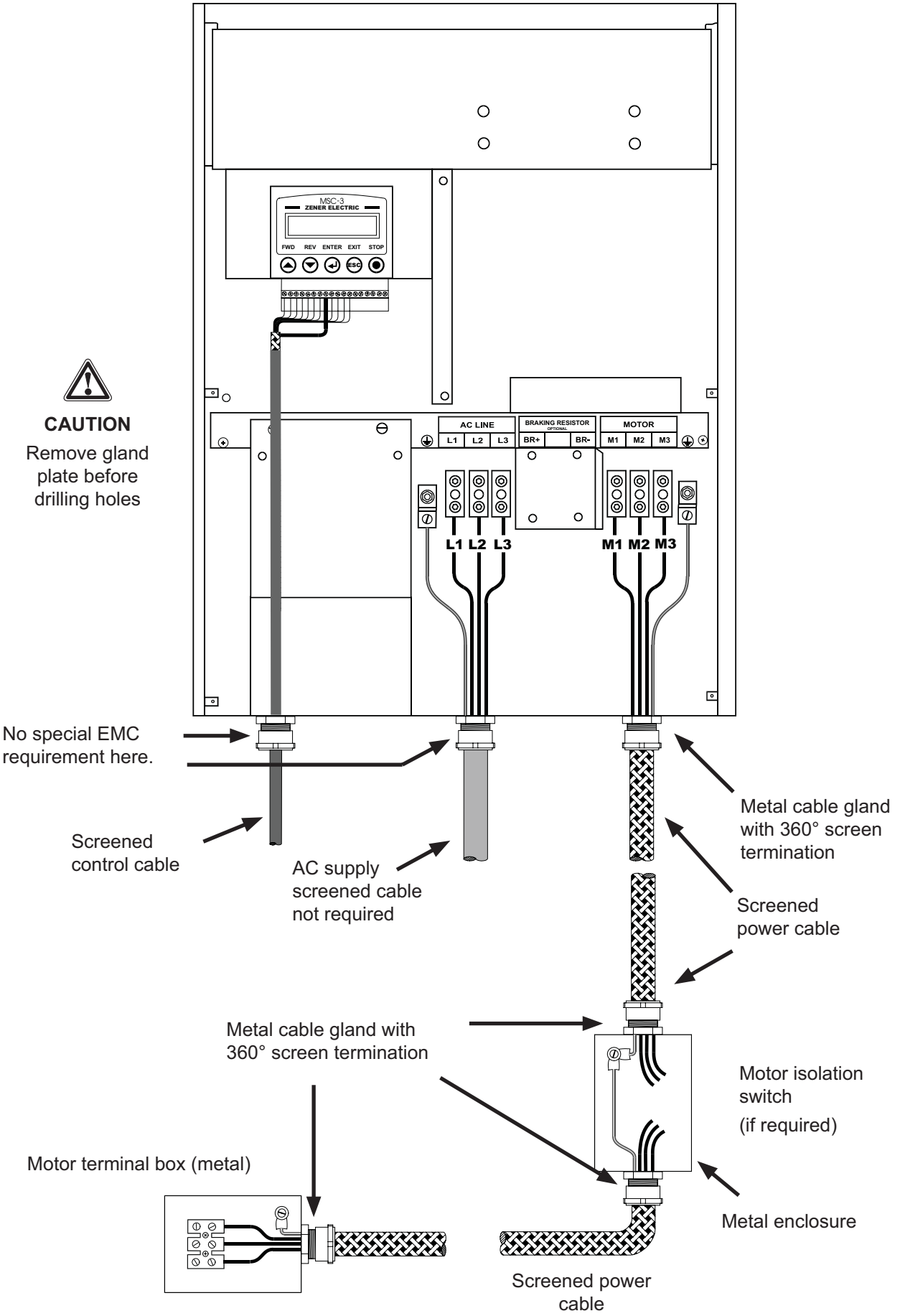
Chassis A (3 - 11Amp) IP30 EMC Installation



Chassis A (3 - 11Amp) IP66 EMC Installation



Chassis B (15 - 40Amp) EMC Installation



Chassis C (55 - 170Amp) EMC Installation

Control connections and configuration

General

The purpose of selecting particular control connections and setting various configuration parameters is to select the required logical and speed control functions for the particular application. The configurable items can be grouped as follows:

Category	Description
Display	Customisation of the display in terms of what variable (speed, frequency, load, current, voltage etc) is displayed. Customisation of the output frequency display to show user defined units. Some housekeeping functions.
Motor	Information from the motor nameplate.
Performance	Maximum and minimum speeds, acceleration rates, motor flux adjustment etc.
Protection	Current limit settings, I^2t (thermal overload) etc.
Stop / Start	Choices for stopping, automatic restart options etc.
References	Choice of speed signal source to be used in local and remote modes, jog speeds.
Input / Output	Assignment of particular control functions to terminals (inputs) and relays (status outputs). These can be selected individually or from one of 8 preset configurations.

The MSC-3 control terminals can be configured, on an individual terminal basis, to suit a wide variety of applications. This provides enormous flexibly.

Factory default settings

The factory default terminal configuration provides for single direction control from either the terminal strip or the front panel console, as selected by a local / remote input on the terminal strip. This is detailed as “Config 1”, starting on page 18.

There is a menu function to restore the terminal configuration and all parameters to the factory default state should you wish to do so. See A05 SET CTL DEFS on page 40.

Settings for your application

For convenience and to simplify the more common applications, there are 8 preset terminal configurations provided. These may be used “as is” or used as the basis for further user customisation. It is important to note that functionality of each control terminal (D1…. D4) is individually configurable. Full details begin on page 53 - G00 INPUT/OUTPUT.

Quick Setup

To assist with quick configuration of the most frequently encountered applications, there are a number of application specific setup guide pages in this manual. Terminal strip configuration and associated setup notes are provided on the pages listed below.

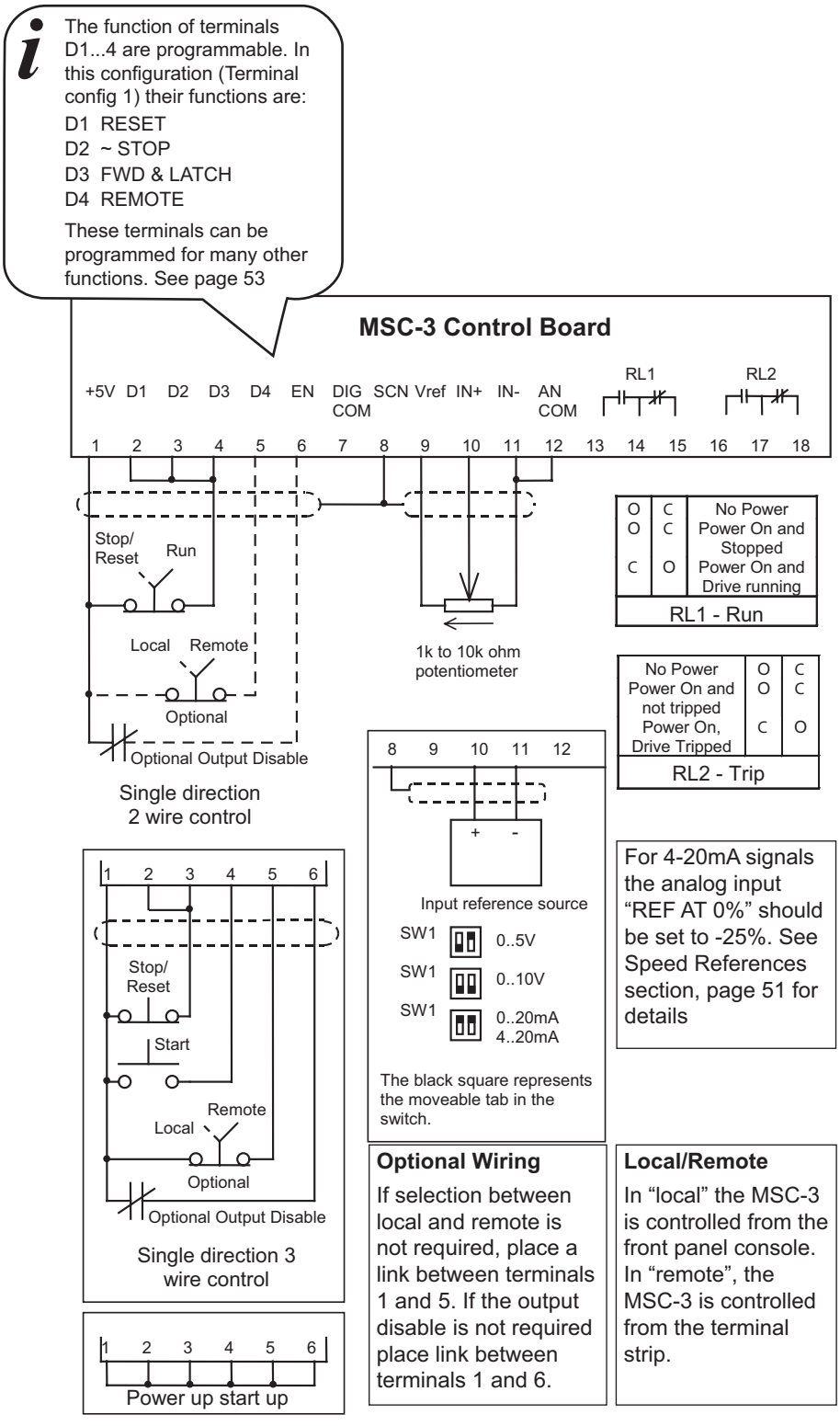
	Page
Typical industrial application	18
Typical industrial applications	
Water pumpimg with automatic pressure control	21
Machine drive with stop/start, jog forward/reverse	24
Typical HVAC application	26
Typical HVAC applications	
Supply air or smoke spill fan	29
Return air fan	30
Stair pressurisation fan with internal PID	31
Stair pressurisation fan with external PID	32
Cooling tower fan with reverse acting internal PID	33
Full details on customising terminal functions	53

Industrial Terminals Typical Connection Diagram – Terminal Config 1

General

This section shows the typical configurations applicable to a wide range of industrial applications.

The motor speed may be controlled from the local console on the MSC-3 or a remote signal source. Switching between local and remote operation is controlled by a contact closure. This terminal configuration is the factory default. Several alternative arrangements for starting and stopping are shown.



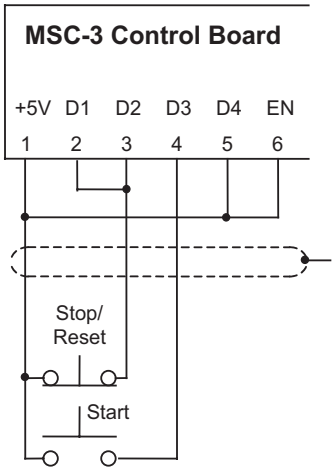
Quick Setup for Terminal Config 1.

Features	Single direction operation, Select between Local (console) and Remote (wiring to terminal strip) control

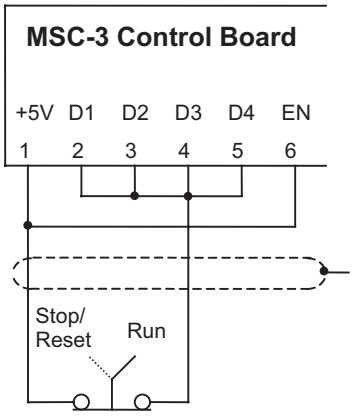
Procedure

STEP 1. Complete the power wiring according to the instructions on pages 7 to 15

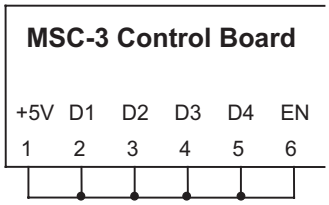
STEP 2. Choose your control method from one of the following. Connect your control wiring as shown.



Pushbutton control
(3 - wire control)



Switch or contact control
(2 - wire control)

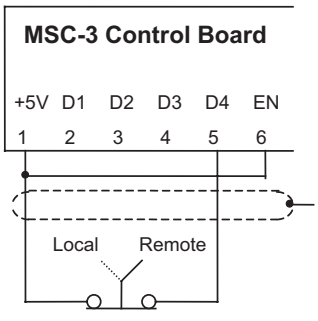


Power up start
MSC-3 will start as soon as power is applied

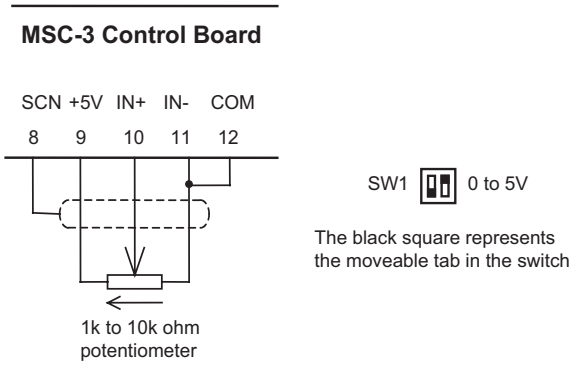
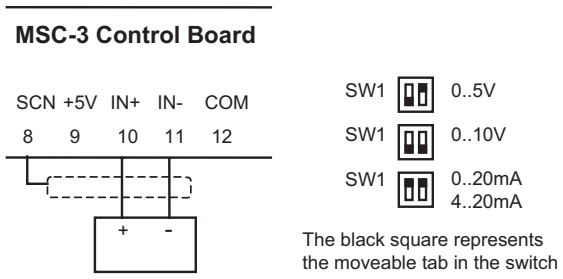
Local / Remote Selection

The Local/Remote Selection can be used in conjunction with any of the above circuits. Wire terminals 5 and 6 as shown.The Local/Remote selection can be overridden from the control console. See Remote Override Operation on page 40.

In “local” the MSC-3 is stopped and started from the front panel console. In “remote”, the MSC-3 stop / start is controlled from the terminal strip. The source of the speed reference in both modes may be independently configured to come from a wide variety of sources including the terminal strip, console up/down buttons, preset values and the output of optional features such as the PID controller and networked communications



STEP 3. Choose your speed reference and connect it as shown.

Speed control from an external potentiometer This is typically used for simple manual speed control. See also Console Reference below.	
Speed control from an external signal Set SW1 as shown. If a **4 to 20mA** reference is to be used, select REMOTE from the REFERENCES menu. AN1 should be displayed. Press Enter. Set the REF AT 0% to –25%. Press Enter.	
Preset speed This provides a single fixed speed.	Select REMOTE from the REFERENCES menu. Use the arrows to display the options. Press Enter when PRESET is displayed. Now set your desired preset speed. No speed reference wiring is necessary
Console reference This uses the Up and Down arrows on the front panel to control the speed.	Select REMOTE from the REFERENCES menu. Use the arrows to display the options. Press Enter when CONSOLE is displayed. No speed reference wiring is necessary.

STEP 4. Follow the instructions on page 34 for MSC-3 startup, setting the parameters according to the table below. Alternative values may be used to suit the application.

Menu	Item	Suggested Setting	Page for detailed information
Input/Output	Terminal strip configuration	G01 TERMINAL CFG = G02 CONFIG 1 (Default setting)	53
	Relay 1	G15 RELAY 1 = O00 RUN (Default setting)	59
	Relay 2	G16 RELAY 2 = O01 TRIP (Default setting)	
Motor	Motor Voltage	B01 MOTOR VOLTS = Motor nameplate voltage	41
	Motor Amps	B02 MOTOR AMPS = Motor nameplate amps	
	Motor Hz	B03 MOTOR Hz = Motor nameplate frequency	
	Motor RPM	B04 MOTOR RPM = Motor nameplate RPM	
Protection	Current Limit	D01 CURRENT LIMIT = Motor nameplate current +10%	45
	I^2t (thermal overload)	D02 I2t = Motor nameplate current	
Stop/Start	Auto Restart	E08 A/Rs ALLOWED = 5 starts	48
	Reset by PF	E10 RESET BY PF = H00 ENABLE	
References	References Remote	F01 REMOTE = AN1 or PRESET or CONSOLE as selected in Step 3.	49
Performance	Acceleration Time	C04 ACCEL TIME = 10 sec	43
	Deceleration Time	C05 DECEL TIME = 10 sec	

End of procedure

Application: Water pumping with automatic pressure control

This setup is for a typical centrifical pump application that requires water pressure control using a water pressure transducer and PID controller function provided by the MSC-3 extended features option board. Prior to commissioning, you will need to know the type of water pressure transducer signal that is to be used (0-10V,4-20mA etc).

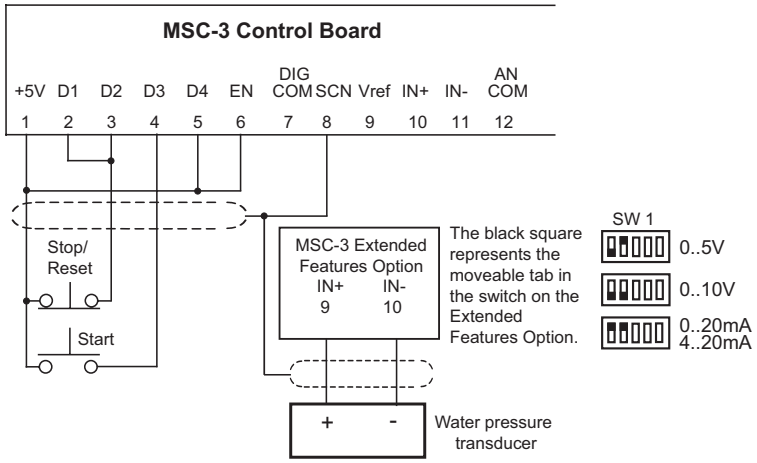
Procedure

STEP 1 Complete the power wiring according to the instructions on pages 7 to 15

STEP 2 Connect the control wiring as shown.

CAUTION

Do not connect the wire to terminal 6 yet. The terminal configuration cannot be changed while the MSC-3 is enabled.



STEP 3 Connect the signal wiring from the water pressure transducer as shown. Consult the pressure transducer manufacturer's literature for power supply requirements of the transducer. Set the switches on the extended features option board to suit the type of signal.

Set SW1 on the Extended Features Option as shown. If a **4 to 20mA** reference is to be used, select REMOTE from the REFERENCES menu. AN1 should be displayed. Press Enter. Press ▲ until you see P22 ANALOG INPT. Press Enter. Set the REF AT 0% to –25%. Press Enter.

STEP 4 Follow the instructions on page 34 for MSC-3 startup, setting the parameters according to the table below. Alternate values may be used to suit the application. See the Extended Features Option manual for information on tuning the PID performance.

Menu	Item	Suggested Setting	Page for detailed information
Input/Output	Terminal strip configuration	G01 TERMINAL CFG = G02 CONFIG 1 (Default setting)	53
	Relay 1	G15 RELAY 1 = O00 RUN (Default setting)	59
	Relay 2	G16 RELAY 2 = O01 TRIP (Default setting)	
Motor	Motor Voltage	B01 MOTOR VOLTS = Motor nameplate voltage	41
	Motor Amps	B02 MOTOR AMPS = Motor nameplate amps	
	Motor Hz	B03 MOTOR Hz = Motor nameplate frequency	
	Motor RPM	B04 MOTOR RPM = Motor nameplate RPM	
Protection	Current Limit	D01 CURRENT LIMIT = Motor nameplate current +10%	45
	I^2t (thermal overload)	D02 I2t = Motor nameplate current	
Stop/Start	Auto Restart	E08 A/Rs ALLOWED = 5 starts	48
	Reset by PF	E10 RESET BY PF = H00 ENABLE	
References	Remote	F01 REMOTE = P38.. PID OUTPUT	49
PID Control	PID set point value	P33 SV CHOICE = PRESET 1 Set to % of transducer full scale equivalent to required pressure.	Extended Features Option Manual
Performance	Acceleration Time	C04 ACCEL TIME = 1 sec	43
	Deceleration Time	C05 DECEL TIME = 1 sec	

STEP 5 Now connect the wire to terminal 6

End of Procedure

Quick Setup for Terminal Config 4.

Features	Forward and reverse operation controlled from pushbuttons. Selection between Local and Remote modes by a switch or contact closure.

Procedure

STEP 1. Complete the power wiring according to the instructions on pages 7 to 15

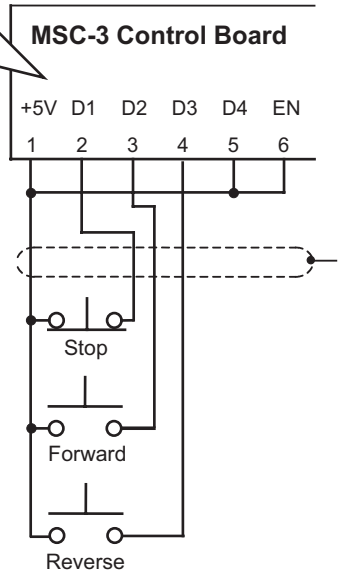
STEP 2. Connect your control wiring as shown

.

CAUTION

Do not connect the wire to terminal 6 yet. The terminal configuration cannot be changed while the MSC-3 is enabled.

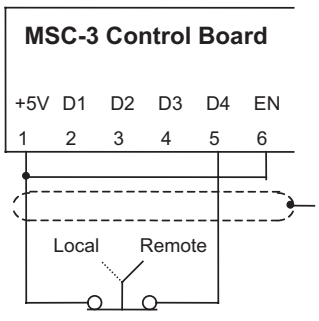
The function of terminals D1...4 are programmable. In this configuration (Terminal config 4) their functions are:
D1 ~STOP
D2 FWD & LATCH
D3 REV & LATCH
D4 REMOTE
These terminals can be programmed for many other functions. See page 53



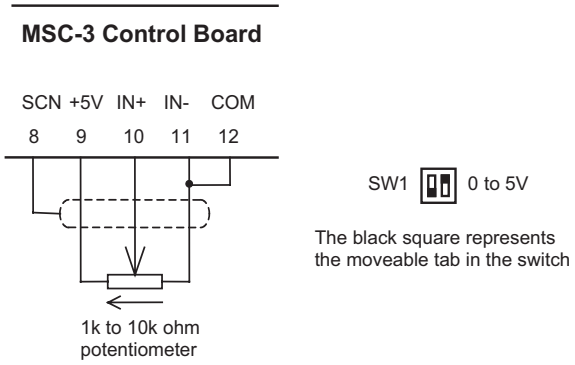
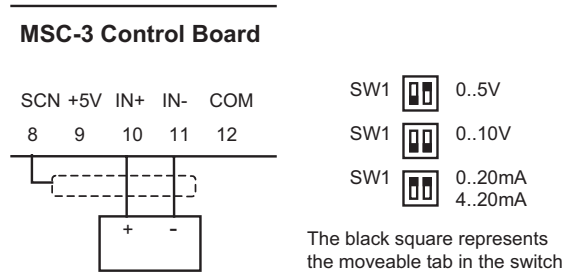
Local / Remote Selection

The Local/Remote Selection can be used in conjunction with any of the above circuits. Wire terminals 5 and 6 as shown.

In “local” the MSC-3 is stopped and started from the front panel console. In “remote”, the MSC-3 stop / start is controlled from the terminal strip. The source of the speed reference in both modes may be independently configured to come from a wide variety of sources including the terminal strip, console up/down buttons, preset values and the output of optional features such as the PID controller and networked communications



STEP 3. Choose your speed reference and connect it as shown

Speed control from an external potentiometer This is typically used for simple manual speed control. See also Console Reference below.	
Speed control from an external signal Set SW1 as shown *i* If a **4 to 20 mA** reference is to be used select REMOTE from the REFERENCES menu. AN1 should be displayed. Press Enter. Set the REF AT 0% to -25%. Press Enter	
Preset speed This provides a single fixed speed.	Select REMOTE from the REFERENCES menu. Use the arrows to display the options. Press Enter when PRESET is displayed. Now set your desired preset speed. No speed reference wiring is necessary
Console reference This uses the Up and Down arrows on the front panel to control the speed.	Select REMOTE from the REFERENCES menu. Use the arrows to display the options. Press Enter when CONSOLE is displayed. No speed reference wiring is necessary.

STEP 4 Follow the instructions on page 34 for MSC-3 startup, setting the parameters according to the table below. Alternative values may be used to suit the application.

Menu	Item	Suggested Setting	Page for detailed information
Input/Output	Terminal strip configuration	G01 TERMINAL CFG = G05 CONFIG 4	53
	Relay 1	G15 RELAY 1 = O00 RUN (Default setting)	59
	Relay 2	G16 RELAY 2 = O01 TRIP (Default setting)	
Motor	Motor Voltage	B01 MOTOR VOLTS = Motor nameplate voltage	41
	Motor Amps	B02 MOTOR AMPS = Motor nameplate amps	
	Motor Hz	B03 MOTOR Hz = Motor nameplate frequency	
	Motor RPM	B04 MOTOR RPM = Motor nameplate RPM	
Protection	Current Limit	D01 CURRENT LIMIT = Motor nameplate current +10%	45
	I^2t (thermal overload)	D02 I2t = Motor nameplate current	
	Reverse	D05 Reverse = ENABLE	
Stop/Start	Reset by PF	E10 RESET BY PF = H00 ENABLE	48
References	Remote	F01 REMOTE = AN1	49
Performance	Acceleration Time	C04 ACCEL TIME = 10 sec	43
	Deceleration Time	C05 DECEL TIME = 10 sec	

STEP 5 Now connect the wire to terminal 6.

End of Procedure

Application: Machine drive with forward and reverse jog

This setting is for a typical industrial process that requires stop/start with the ability to jog the machine in both directions. A roll forming machine may be controlled this way. The speed signal could be from the ▲and ▼ buttons on the console or a remote potentiometer.

Procedure

STEP 1. Complete the power wiring according to the instructions on pages 7 to 15

STEP 2. Connect your control wiring as shown

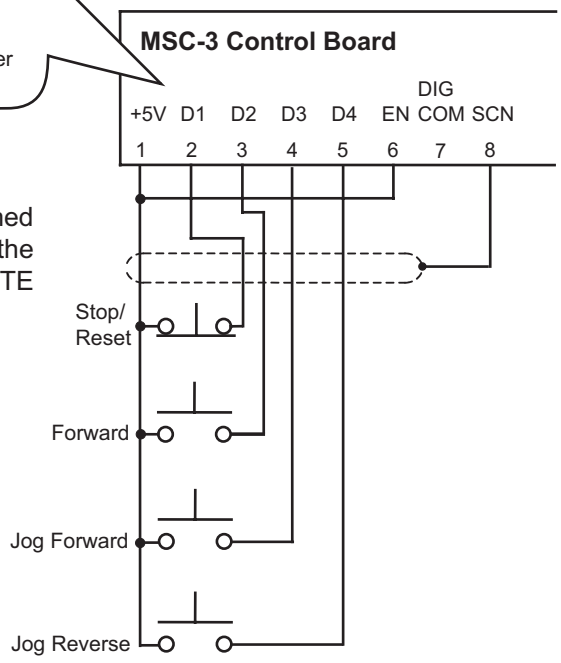
.

CAUTION

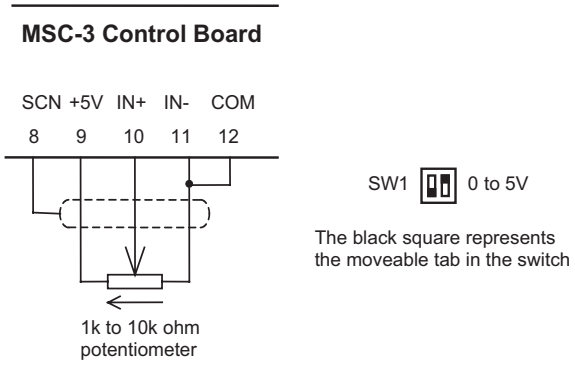
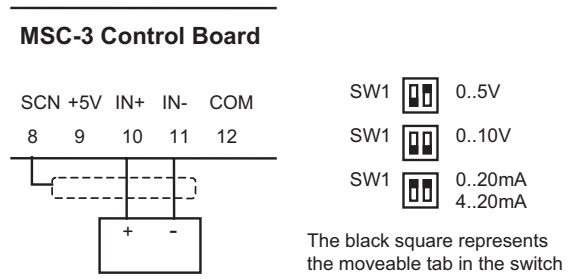
Do not connect the wire to terminal 6 yet. The terminal configuration cannot be changed while the MSC-3 is enabled.

The function of terminals D1...4 are programmable. In this application their functions are:
D1 ~STOP
D2 FWD & LATCH
D3 JOG FWD
D4 JOG REV
These terminals can be programmed for many other functions. See page 53

Note: Since no terminal is assigned to the REMOTE function, the MSC-3 will operate in the REMOTE mode by default. See page 58.



STEP 3. Choose your speed reference and connect it as shown

Speed control from an external potentiometer This is typically used for simple manual speed control. See also Console Reference below.	
Speed control from an external signal Set SW1 as shown *i* If a **4 to 20 mA** reference is to be used select REMOTE from the REFERENCES menu. AN1 should be displayed. Press Enter. Set the REF AT 0% to -25%. Press Enter	
Console reference This uses the Up and Down arrows on the front panel to control the speed.	Select REMOTE from the REFERENCES menu. Use the arrows to display the options. Press Enter when CONSOLE is displayed. No speed reference wiring is necessary.

STEP 4 Follow the instructions on page 34 for MSC-3 startup, setting the parameters according to the table below. Alternative values may be used to suit the application.

Menu	Item	Suggested Setting	Page for detailed information
Input/Output	Terminal strip configuration	G01 TERMINAL CFG = G05 CONFIG 4	53
	Terminal strip configuration	G13 DIG IN3 = I09 JOG FWD	58
	Terminal strip configuration	G14 DIG IN4 = I10 JOG REV	58
	Relay 1	G15 RELAY 1 = O00 RUN (Default setting)	59
	Relay 2	G16 RELAY 2 = O01 TRIP (Default setting)	
Motor	Motor Voltage	B01 MOTOR VOLTS = Motor nameplate voltage	41
	Motor Amps	B02 MOTOR AMPS = Motor nameplate amps	
	Motor Hz	B03 MOTOR Hz = Motor nameplate frequency	
	Motor RPM	B04 MOTOR RPM = Motor nameplate RPM	
Protection	Current Limit	D01 CURRENT LIMIT = Motor nameplate current +10%	45
	I^2t (thermal overload)	D02 I2t = Motor nameplate current	
	Reverse	D05 Reverse = ENABLE	
Stop/Start	Reset by PF	E10 RESET BY PF = H00 ENABLE	48
References	Remote	F01 REMOTE = Set to the source chosen in step 3	49
	Jog forward speed	F04 JOG FWD = PRESET	50
	Jog reverse speed	F05 JOG REV = PRESET	
Performance	Acceleration Time	C04 ACCEL TIME = 10 sec	43
	Deceleration Time	C05 DECEL TIME = 10 sec	

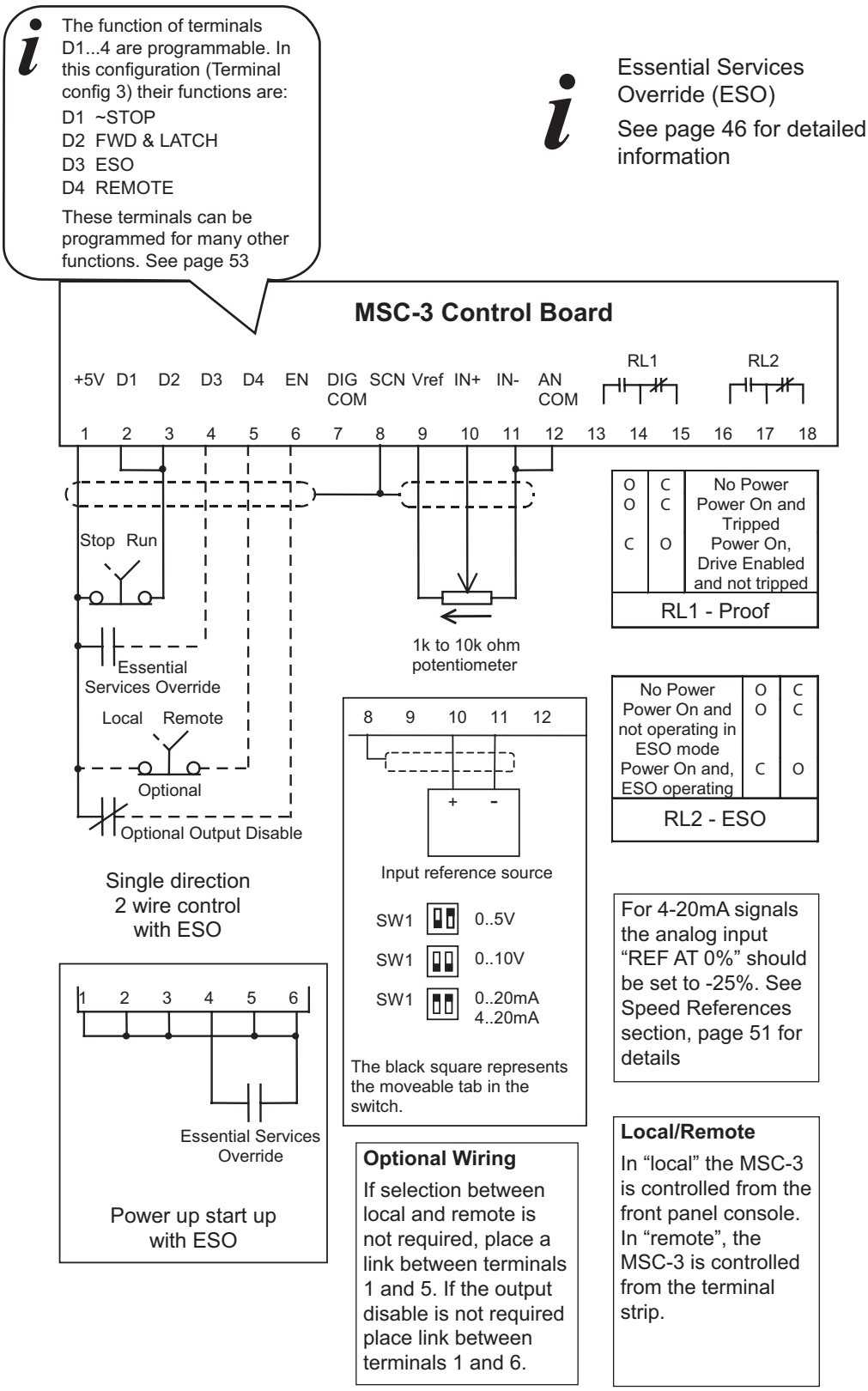
STEP 5 Now connect the wire to terminal 6.

End of Procedure

HVAC Terminals Typical Connection Diagram – Terminal Config 3

General

This section shows the typical configuration applicable to pump and fan drives in the HVAC industry. Typically these will be controlled from an external speed signal, frequently supplied from the output of a building management system. Terminal Config 3 is selected by setting the menu item G01 TERMINAL CFG on the G00 INPUT/OUTPUT menu to G04 CONFIG 3. See page 53. Note that specific setup instructions are provided for the more common HVAC applications in the sections that follow this.



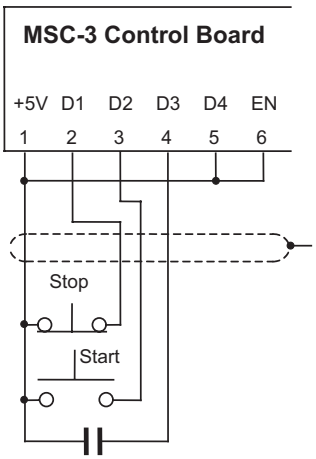
Quick Setup for Config 3.

Features	Forward Operation Local / Remote selection from a contact closure or from the console. See page 40 for details of remote override operation. Local operation is from the console and Remote is from the terminal strip. The Essential Services Override feature can be enabled.

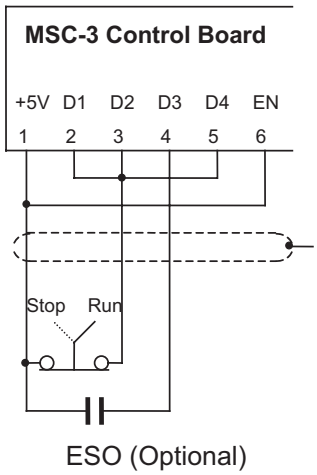
Procedure

STEP 1. Complete the power wiring according to the instructions on pages 7 to 15

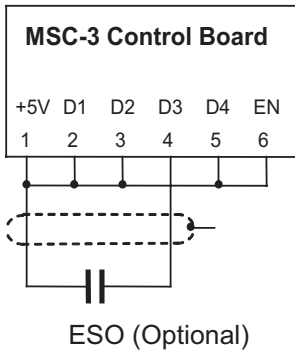
STEP 2. Choose your control method from one of the following. Connect your control wiring as shown



Pushbutton control
(3 - wire control)



Switch or contact control
(2 - wire control)



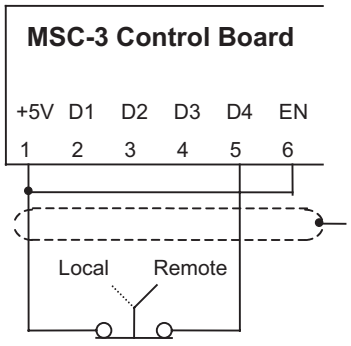
Power up start
MSC-3 will start as soon as power is applied

CAUTION
Do not connect the wire into terminal 6 yet. The terminal configuration cannot be changed while the MSC-3 is enabled.

Essential Services Override (ESO)
See page 46 for detailed information

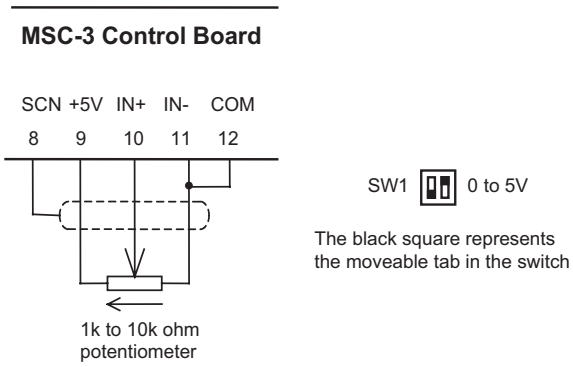
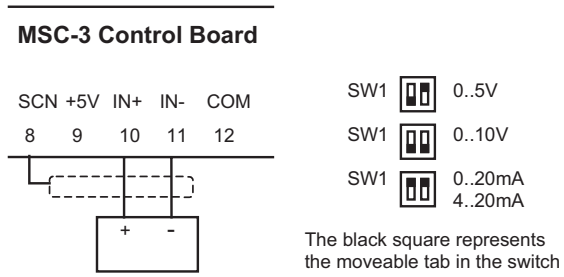
Local / Remote Selection

The Local/Remote Selection can be used in conjunction with any of the above circuits. Wire terminals 5 and 6 as shown. The Local/Remote selection can be overridden from the control console. See Remote Override Operation on page 40.



In “local” the MSC-3 is stopped and started from the front panel console. In “remote”, the MSC-3 stop / start is controlled from the terminal strip. The source of the speed reference in both modes may be independently configured to come from a wide variety of sources including the terminal strip, console up/down buttons, preset values and the output of optional features such as the PID controller and networked communications.

STEP 3. Choose your speed reference and connect it as shown.

Speed control from an external potentiometer This is typically used for simple manual speed control. See also Console Reference below.	
Speed control from an external signal Set SW1 as shown. If a **4 to 20mA** reference is to be used, select REMOTE from the REFERENCES menu. AN1 should be displayed. Press Enter. Set the REF AT 0% to –25%. Press Enter.	
Preset speed This provides a single fixed speed.	Select REMOTE from the REFERENCES menu. Use the arrows to display the options. Press Enter when PRESET is displayed. Now set your desired preset speed. No speed reference wiring is necessary
Console reference This uses the Up and Down arrows on the front panel to control the speed.	Select REMOTE from the REFERENCES menu. Use the arrows to display the options. Press Enter when CONSOLE is displayed. No speed reference wiring is necessary.

STEP 4. Follow the instructions on page 34 for MSC-3 startup, setting the parameters according to the table below. Alternative values may be used to suit the application.

Menu	Item	Suggested Setting	Page for detailed information
Input/Output	Terminal strip configuration	G01 TERMINAL CFG = G04 CONFIG 3	53
	Relay 1	G15 RELAY 1 = O00 RUN	59
	Relay 2	G16 RELAY 2 = O01 TRIP	
Motor	Motor Voltage	B01 MOTOR VOLTS = Motor nameplate voltage	41
	Motor Amps	B02 MOTOR AMPS = Motor nameplate amps	
	Motor Hz	B03 MOTOR Hz = Motor nameplate frequency	
	Motor RPM	B04 MOTOR RPM = Motor nameplate RPM	
Protection	Current Limit	D01 CURRENT LIMIT = Motor nameplate current +10%	45
	I^2t (thermal overload)	D02 I2t = Motor nameplate current	
Stop/Start	Auto Restart	E08 A/Rs ALLOWED = 5 starts	48
	Reset by PF	E10 RESET BY PF = H00 ENABLE	
References	Remote	F01 REMOTE = AN1	49
	ESO	F03 ESO=PRESET (100%)	
	Ramp time in ESO	F06 ESO RAMP TIME = 10 sec	
Performance	Acceleration Time	C04 ACCEL TIME = 60 sec	43
	Deceleration Time	C05 DECEL TIME = 60 sec	

STEP 5. Now connect the wire to terminal 6.

End of procedure

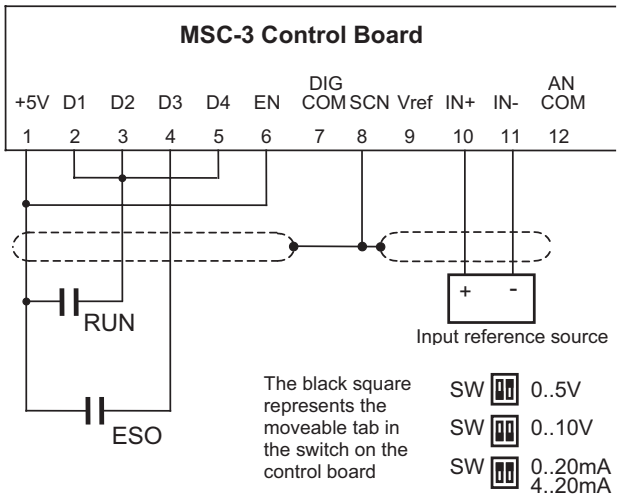
Application: Supply air or smoke spill fan

This setup is for a typical HVAC supply air or smoke spill fan application that requires speed control from a remote signal source for normal operation, a preset speed during essential services operation and local control from the front panel console. Prior to commissioning, you will need to know the type of speed signal is to be used (0-10V, 4-20mA etc)

Procedure

STEP 1. Complete the power wiring according to the instructions on pages 7 to 15

STEP 2. Connect the control and signal wiring as shown. Set the switches on the control board to suit the type of signal[2].



CAUTION

Do not connect the wire to terminal 6 yet. The terminal configuration cannot be changed while the MSC-3 is enabled.

Essential Services Override (ESO)

See page 46 for detailed information

STEP 3. Follow the instructions on page 34 for MSC-3 startup, setting the parameters according to the table below. Alternative values may be used to suit the application.

Menu	Item	Suggested Setting	Page for detailed information
Input/Output	Terminal strip configuration	G01 TERMINAL CFG = G04 CONFIG 3	53
	Relay 1	G15 RELAY 1 = O00 RUN	59
	Relay 2	G16 RELAY 2 = O01 TRIP	
Motor	Motor Voltage	B01 MOTOR VOLTS = Motor nameplate voltage	41
	Motor Amps	B02 MOTOR AMPS = Motor nameplate amps	
	Motor Hz	B03 MOTOR Hz = Motor nameplate frequency	
	Motor RPM	B04 MOTOR RPM = Motor nameplate RPM	
Protection	Current Limit	D01 CURRENT LIMIT = Motor nameplate current +10%	45
	I^2t (thermal overload)	D02 I2t = Motor nameplate current	
Stop/Start	Auto Restart	E08 A/Rs ALLOWED = 5 starts	48
	Reset by PF	E10 RESET BY PF = H00 ENABLE	
References	Remote	F01 REMOTE = AN1	49
	ESO	F03 ESO=PRESET (100%)	
	Ramp time in ESO	F06 ESO RAMP TIME = 10 sec	
Performance	Acceleration Time	C04 ACCEL TIME = 60 sec	43
	Deceleration Time	C05 DECEL TIME = 60 sec	

STEP 4. Now connect the wire to terminal 6.

End of procedure

[2] Set SW1 as shown. If a **4 to 20mA** reference is to be used, select REMOTE from the REFERENCES menu. AN1 should be displayed. Press Enter. Set the REF AT 0% to –25%. Press Enter.

Application: Return air fan

This setup is for a typical HVAC return air fan application that requires speed control from a remote signal source for normal operation, and local control from the front panel console. Prior to commissioning, you will need to know the type of speed signal is to be used (0-10V, 4-20mA etc).

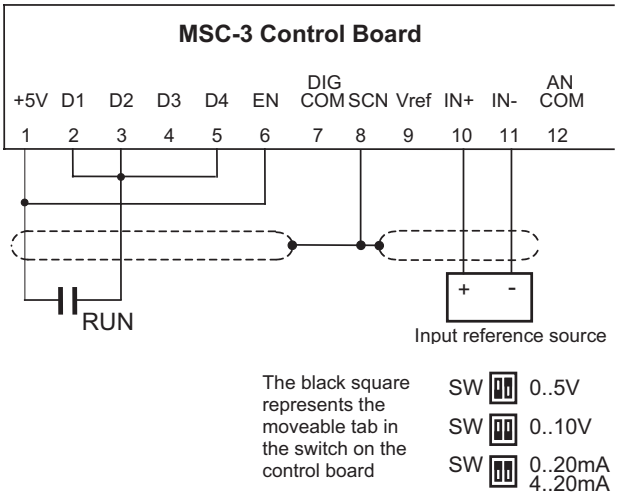
Procedure

STEP 1 Complete the power wiring according to the instructions on pages 7 to 15

STEP 2 Connect the control and signal wiring as shown. Set the switches on the control board to suit the signal type[3].

CAUTION

Do not connect the wire to terminal 6 yet. The terminal configuration cannot be changed while the MSC-3 is enabled.



STEP 3 Follow the instructions on page 34 for MSC-3 startup, setting the parameters according to the table below. Alternate values may be used to suit the application.

Menu	Item	Suggested Setting	Page for detailed information
Input/Output	Terminal strip configuration	G01 TERMINAL CFG = G04 CONFIG 3	53
	Relay 1	G15 RELAY 1 = O00 RUN	59
	Relay 2	G16 RELAY 2 = O01 TRIP	
Motor	Motor Voltage	B01 MOTOR VOLTS = Motor nameplate voltage	41
	Motor Amps	B02 MOTOR AMPS = Motor nameplate amps	
	Motor Hz	B03 MOTOR Hz = Motor nameplate frequency	
	Motor RPM	B04 MOTOR RPM = Motor nameplate RPM	
Protection	Current Limit	D01 CURRENT LIMIT = Motor nameplate current +10%	45
	I^2t (thermal overload)	D02 I2t = Motor nameplate current	
Stop/Start	Auto Restart	E08 A/Rs ALLOWED = 5 starts	48
	Reset by PF	E10 RESET BY PF = H00 ENABLE	
References	Remote	F01 REMOTE = AN1	49
Performance	Acceleration Time	C04 ACCEL TIME = 60 sec	43
	Deceleration Time	C05 DECEL TIME = 60 sec	

STEP 4 Now connect the wire to terminal 6

End of Procedure

[3] Set SW1 as shown. If a **4 to 20mA** reference is to be used, select REMOTE from the REFERENCES menu. AN1 should be displayed. Press Enter. Set the REF AT 0% to –25%. Press Enter.

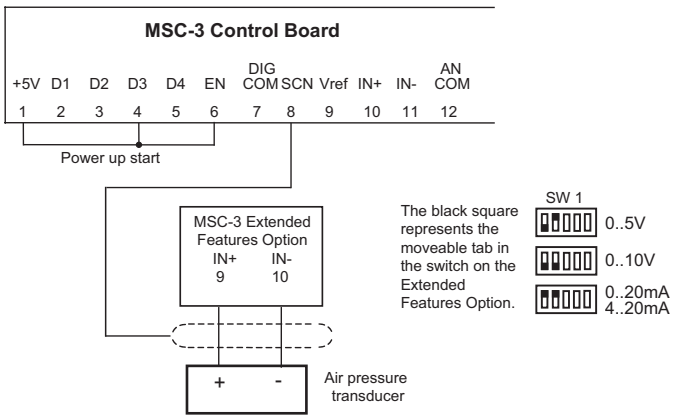
Application: Stair pressurisation fan with internal PID

This setup is for a typical HVAC stair pressurisation fan application that requires air pressure control using an air pressure transducer and PID controller function provided by the MSC-3 extended features option. The MSC-3 is configured to run in essential services override (ESO) mode. Prior to commissioning, you will need to know the type of air pressure transducer signal that is to be used (0-10V,4-20mA etc).

Procedure

STEP 1 Complete the power wiring according to the instructions on pages 7 to 15

STEP 2 Connect the control wiring as shown.



CAUTION

Do not connect the wire to terminal 6 yet. The terminal configuration cannot be changed while the MSC-3 is enabled.

Essential Services Override (ESO)

See page 46 for detailed information

STEP 3 Connect the signal wiring from the air pressure transducer as shown. Consult the pressure transducer manufacturer's literature for power supply requirements of the transducer. Set the switches on the extended features option board to suit the type of signal.

Set SW1 on the Extended Features Option as shown. If a **4 to 20mA** reference is to be used, select REMOTE from the REFERENCES menu. AN1 should be displayed. Press Enter. Press ▲ until you see P22 ANALOG INPT. Press Enter. Set the REF AT 0% to –25%. Press Enter.

STEP 4 Follow the instructions on page 34 for MSC-3 startup, setting the parameters according to the table below. Alternate values may be used to suit the application.

Menu	Item	Suggested Setting	Page for detailed information
Input/Output	Terminal strip configuration	G01 TERMINAL CFG = G04 CONFIG 3	53
	Relay 1	G15 RELAY 1 = O00 RUN	59
	Relay 2	G16 RELAY 2 = O01 TRIP	
Motor	Motor Voltage	B01 MOTOR VOLTS = Motor nameplate voltage	41
	Motor Amps	B02 MOTOR AMPS = Motor nameplate amps	
	Motor Hz	B03 MOTOR Hz = Motor nameplate frequency	
	Motor RPM	B04 MOTOR RPM = Motor nameplate RPM	
Protection	Current Limit	D01 CURRENT LIMIT = Motor nameplate current +10%	45
	I^2t (thermal overload)	D02 I2t = Motor nameplate current	
Stop/Start	Auto Restart	E08 A/Rs ALLOWED = 5 starts	48
	Reset by PF	E10 RESET BY PF = H00 ENABLE	
References	ESO	F03 ESO =P38.. PID OUTPUT	49
	Ramp Time in ESO	F06 ESO RAMP TIME = 10 sec	
PID Control	PID set point value	P33 SV CHOICE = PRESET 1 Set to % of transducer full scale equivalent to required pressure.	Extended Features Option Manual
Performance	Acceleration Time	C04 ACCEL TIME = 10 sec	43
	Deceleration Time	C05 DECEL TIME = 10 sec	

STEP 5 Now connect the wire to terminal 6

End of Procedure

Application: Stair pressurisation fan with external PID

This setup is for a typical HVAC stair pressurisation fan application that requires air pressure control using an air pressure transducer and a PID controller external to the MSC-3. The MSC-3 is configured to run in essential services override (ESO) mode. Prior to commissioning, you will need to know the type of speed signal that is to be used (0-10V, 4-20mA etc) between the output of the external PID controller and the MSC-3.

Procedure

STEP 1 Complete the power wiring according to the instructions on pages 7 to 15

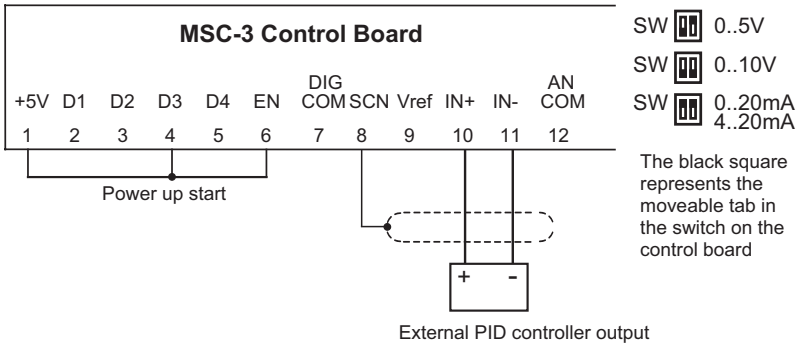
STEP 2 Connect the control wiring as shown.

CAUTION

Do not connect the wire to terminal 6 yet. The terminal configuration cannot be changed while the MSC-3 is enabled.

Essential Services Override (ESO)

See page 46 for detailed information



STEP 3 Connect the signal wiring from the external PID controller as shown. Consult the PID controller manufacturer's literature for other connections and power supples required by the PID controller. Set the switches on the control board to suit the type of signal[4].

STEP 4 Follow the instructions on page 34 for MSC-3 startup, setting the parameters according to the table below. Alternate values may be used to suit the application.

Menu	Item	Suggested Setting	Page for detailed information
Input/Output	Terminal strip configuration	G01 TERMINAL CFG = G04 CONFIG 3	53
	Relay 1	G15 RELAY 1 = O00 RUN	59
	Relay 2	G16 RELAY 2 = O01 TRIP	
Motor	Motor Voltage	B01 MOTOR VOLTS = Motor nameplate voltage	41
	Motor Amps	B02 MOTOR AMPS = Motor nameplate amps	
	Motor Hz	B03 MOTOR Hz = Motor nameplate frequency	
	Motor RPM	B04 MOTOR RPM = Motor nameplate RPM	
Protection	Current Limit	D01 CURRENT LIMIT = Motor nameplate current +10%	45
	I^2t (thermal overload)	D02 I2t = Motor nameplate current	
Stop/Start	Reset by PF	E10 RESET BY PF = H00 ENABLE	48
References	ESO	F03 ESO = AN1	
	Ramp time in ESO	F06 ESO RAMP TIME = 10 sec	
Performance	Acceleration Time	C04 ACCEL TIME = 10 sec	43
	Deceleration Time	C05 DECEL TIME = 10 sec	

STEP 5 Now connect the wire to terminal 6

End of procedure

[4] Set SW1 as shown. If a **4 to 20mA** reference is to be used, select REMOTE from the REFERENCES menu. AN1 should be displayed. Press Enter. Set the REF AT 0% to –25%. Press Enter.

Application: Cooling tower fan with reverse acting internal PID

This setup is for a typical cooling tower fan application that requires water temperature control using a water temperature transducer and the PID controller function provided by the MSC-3 extended features option board. Prior to commissioning, you will need to know the type of temperature sensor signal that is to be used (0-10V, 4-20mA etc).

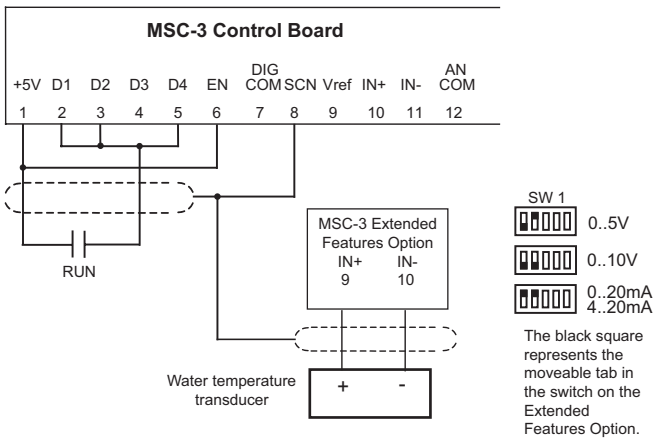
Procedure

STEP 1 Complete the power wiring according to the instructions on pages 7 to 15

STEP 2 Connect the control wiring as shown.

CAUTION

Do not connect the wire to terminal 6 yet. The terminal configuration cannot be changed while the MSC-3 is enabled.



STEP 3 Connect the signal wiring from the water temperature transducer as shown. Consult the transducer manufacturer's literature for power supply requirements of the transducer. Set the switches on the Extended Features Option to suit the type of signal.

Set SW1 on the Extended Features Option as shown. If a **4 to 20mA** reference is to be used, select REMOTE from the REFERENCES menu. AN1 should be displayed. Press Enter. Press ▲ until you see P22 ANALOG INPT. Press Enter. Set the REF AT 0% to –25%. Press Enter.

STEP 4 Follow the instructions on page 34 for MSC-3 startup, setting the parameters according to the table below. Alternate values may be used to suit the application.

Menu	Item	Suggested Setting	Page for detailed information
Input/Output	Terminal strip configuration	G01 TERMINAL CFG = G04 CONFIG 3	53
	Relay 1	G15 RELAY 1 = O00 RUN	59
	Relay 2	G16 RELAY 2 = O01 TRIP	
Motor	Motor Voltage	B01 MOTOR VOLTS = Motor nameplate voltage	41
	Motor Amps	B02 MOTOR AMPS = Motor nameplate amps	
	Motor Hz	B03 MOTOR Hz = Motor nameplate frequency	
	Motor RPM	B04 MOTOR RPM = Motor nameplate RPM	
Protection	Current Limit	D01 CURRENT LIMIT = Motor nameplate current +10%	45
	I^2t (thermal overload)	D02 I2t = Motor nameplate current	
Stop/Start	Auto Restart	E08 A/Rs ALLOWED = 5 starts	48
	Reset by PF	E10 RESET BY PF = H00 ENABLE	
References	Remote	F03 REMOTE = P38.. PID OUTPUT	49
Performance	Acceleration Time	C04 ACCEL TIME = 10 sec	43
	Deceleration Time	C05 DECEL TIME = 10 sec	
PID Control	PID Setpoint variable	P33 SV CHOICE = PRESET1 (set to % equal to the required temperature proportion of transducer full scale)	Extended Features Option Manual
	Proportional band control	P26 PB(%) = -300 Note: Negative value gives reverse acting PID	

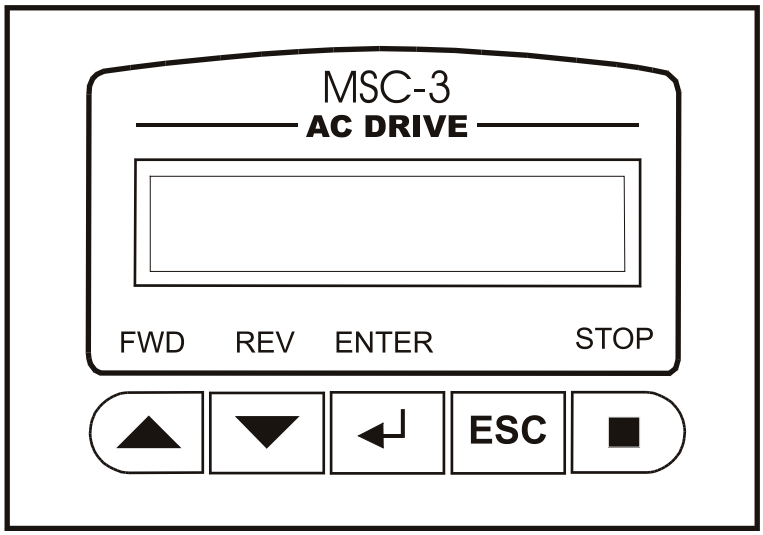
STEP 5 Now connect the wire to terminal 6

End of procedure

MSC-3 Start up

Connect the input and motor power wiring in accordance with the installation information on pages 7 - 15. Select the terminal configuration you require from the table on page 53. Connect the control wiring according to the appropriate Control Wiring Diagram or follow a quick setup. The MSC-3 is now ready to run. Before applying power ensure that rotation of the motor shaft will not cause injury or damage.

After applying power it is recommended that you at least go through the MOTOR, PERFORMANCE and the INPUT/OUTPUT menus to set up the MSC-3 before running the motor to prevent any unexpected motor operation. The MSC-3 is supplied with a link between the En terminal and the +5V terminal which is all that is required to run the MSC-3 from the console. A connection between these two terminals must always be made for the motor to run.



The five pushbuttons and display form a console through which drive features and settings are altered to suit the application. When the MSC-3 is first powered up, the start banner is displayed for approximately 2 seconds. An example of the start banner is shown below. It displays the drive size, software version and the temperature of the MSC-3 hardware. While the banner is displayed the internal fan is switched on to verify it's operation. If the fan is not required it will then be turned off.

```
R11
V1.53        23C
```

MSC-3 Run mode

Once the start banner is removed the display is set in the Run Mode. The top line contains the run variable. The second line contains the speed reference and the drive status. An example of the Run Mode display is shown below:

```
25.0 Hz
50.0   FWD
```

The example shows that the desired output speed is 50 Hz and the motor is rotating at 25 Hz in the forward direction as indicated by the status.

In local mode, to start the drive, select a direction by pressing either of the run buttons: ▲FWD or ▼REV button. Use the ▲ FWD button to increase the speed reference and the ▼ REV button to decrease it. The motor should accelerate up to the desired speed. If it does not, refer to the Trouble Shooting Guide on page 66 of this manual.

If the motor shaft rotates in the wrong direction remove the input power, wait for the MSC-3 to discharge and swap any two motor phase wires. Re-apply input power and select a direction by pressing ▲ FWD or ▼ REV.

Operation and access to the Run Mode and Menu Mode is done with the console push buttons. The action of each push button changes with the mode of operation and the state of the drive. The following table describes how the console push buttons affect the drive control.

Console Push Button operations

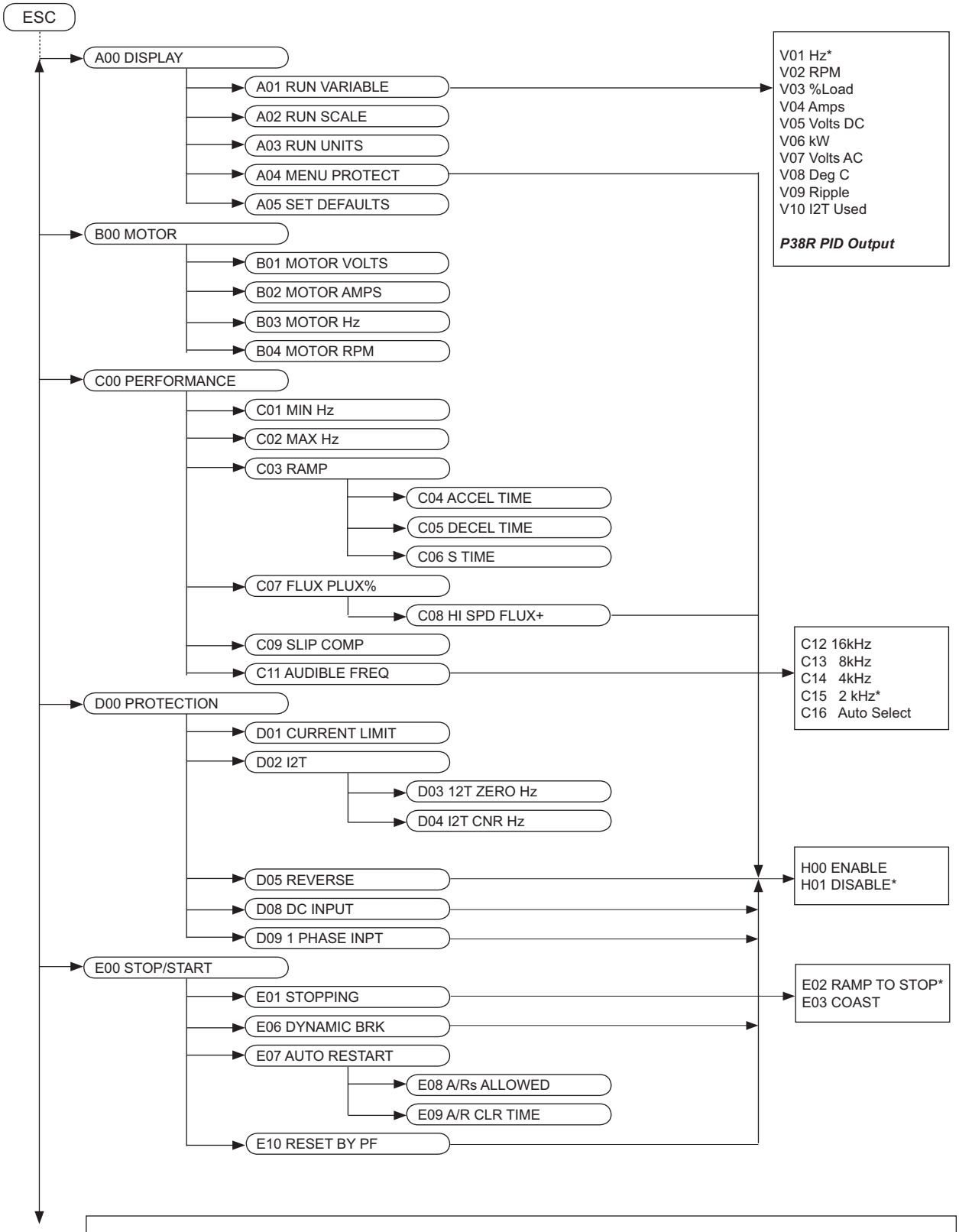
Console Mode	Motor Running	Motor Stopped
Menu mode used for entering setup information *i* Press ESC from the run display mode to enter menu mode.	• Pressing STOP will stop the motor • Pressing ▲ or ▼ will either select another menu item or adjust a setting • Pressing ↵ will select the displayed menu item or accept the value being adjusted. • Pressing ESC will abort value adjustment or the menu currently displayed. If the currently dispalyed menu is the top of the menu tree, the console changes mode to the Run Display mode	• Pressing STOP will not reset trip conditions to allow trip messages to be viewed after exiting menu mode • Pressing ▲ or ▼ will either select another menu item or adjust a setting • Pressing ↵ will select the displayed menu item or accept the value being adjusted. • Pressing ESC will abort value adjustment or the current menu. If the current menu is the top of the menu tree, the console changes mode to the Run Display mode
Run Display mode - when the CONSOLE REF **is** the active speed source	• Pressing STOP will stop the motor • Pressing ▲ or ▼ will either increase or decrease the motor speed • Pressing ↵ will have no effect • Pressing ESC will abort the Run Display mode and the console changes to the Menu mode	• Pressing STOP will reset any trip condition • If no trip is present, pressing ▲ or ▼ will either start the motor running forward or reverse (internally latched). • If a trip is present, ▲ and ▼ adjust the speed reference without running the motor. • Pressing ↵ will toggle the drive operation between local and Remote if the Remote Override feature is enabled see page 40. If the Remote Override feature is not enabled pressing will have no effect. • Pressing ESC will abort the Run Display mode and the console changes to the Menu mode
Run Display mode - when the CONSOLE REF **is not** the active speed source	• Pressing STOP will stop the motor • Pressing ▲,▼ or ↵ will have no effect • Pressing ESC will abort the Run Display mode and the console changes to the Menu mode	• Pressing STOP will reset any trip condition. • Pressing ▲, ▼ will have no effect. • Pressing ↵ will toggle the drive operation between local and Remote if the Remote Override feature enabled. If the Remote Override feature is not enabled pressing will have no effect. • Pressing ESC will abort the Run Display mode and the console changes to the Menu mode.

MSC-3 Menu mode

The Menu mode is entered from the Run mode by pressing the ESC push button (pressing ESC again will return to Run mode). Use the ▲ and ▼ push buttons to display each menu item. To enter the menu press the ↵ push button. This action will either display another menu or display a setting ready for adjustment.

Control Console Menu

The following pages show the structure of the control console menu.



↵ Enter selects menu group (e.g. A00 DISPLAY) or parameter (e.g. V01 Hz)

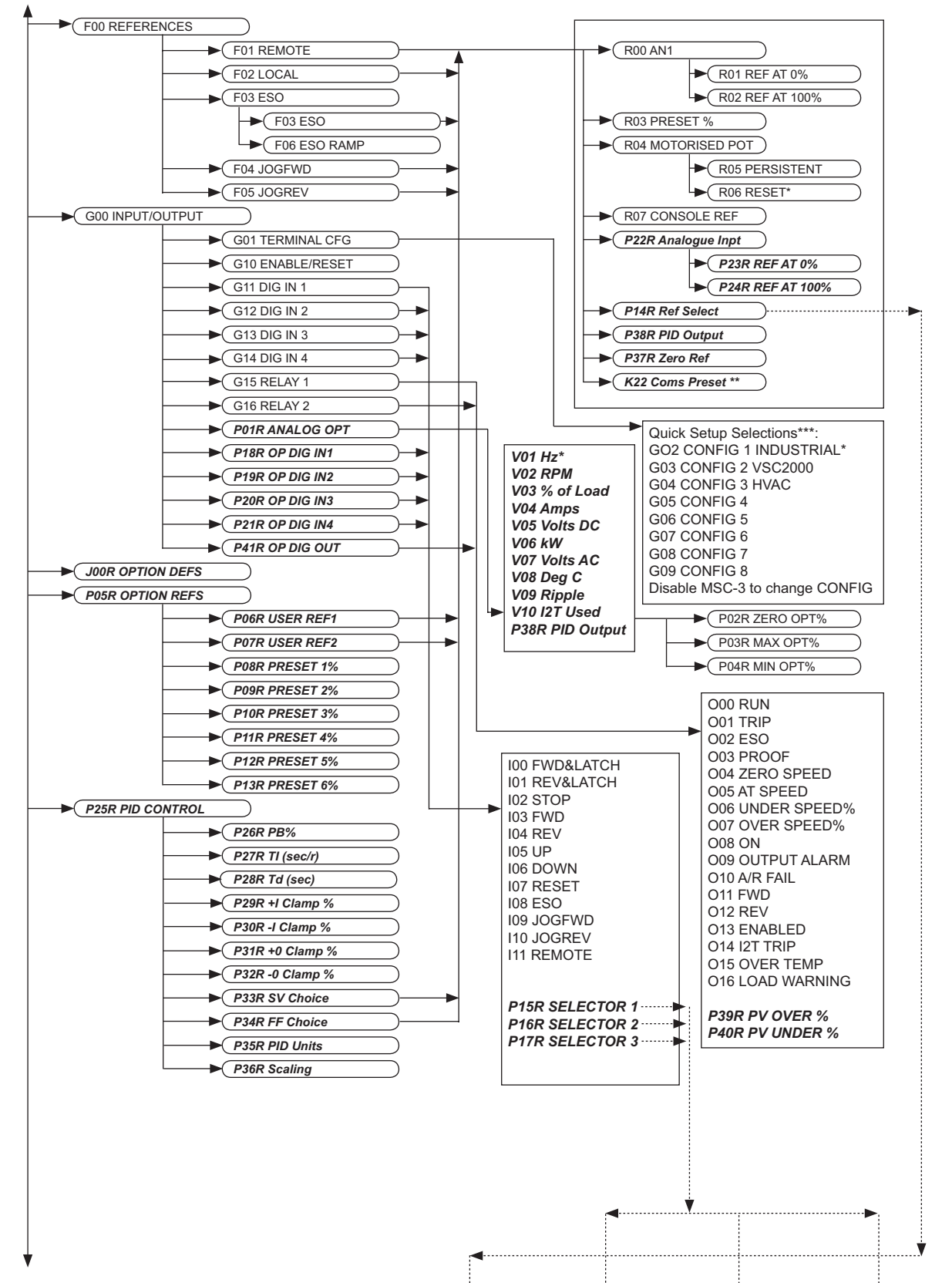
▲(Up) or ▼(Down) moves within menu group or for adjustable parameters changes the parameter value

↵ Saves adjusted parameter value

ESC Ignores adjusted parameter value or retuns to previous menu level

Bold Italic Parameters on this page appear automatically on fitting the Extended Features Option card

* Indicates default setting e.g. default for A01 RUN VARIABLE is V01 Hz



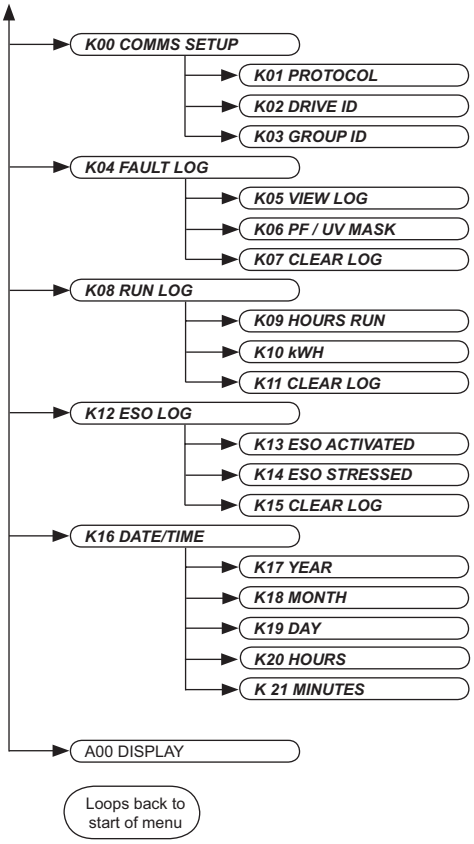
Bold Italic Parameters on this page appear automatically on fitting the Extended Features Option e.g. ***P22R Analog Inpt*** is the analogue input of option card fitted in the right slot, left slot would be ***P22L Analog Inpt***.

* Indicates default setting

** Any communications option card fitted

*** Quick setup configures individual terminals to pre-assigned functions; configuration number is not memorised.

P14R Ref Select	*P15R Selector 1*	*P16R Selector 2*	*P17R Selector 3*
P06R User Ref 1	Low	Low	Low
P07R User Ref 2	Low	Low	High
P08R Preset 1	Low	High	Low
P09R Preset 2	Low	High	High
P10R Preset 3	High	Low	Low
P11R Preset 4	High	Low	High
P12R Preset 5	High	High	Low
P13R Preset 6	High	High	High



i The parameters shown here are specifically for the Modbus protocol communication option. Communication options for other protocols will have parameters specific to that protocol as well as the more general parameters shown here. See individual communications option instruction manuals for further information.

Bold Italic Parameters on this page appear automatically on fitting the Modbus option card

A00 DISPLAY

This menu allows selection of run variables and, in the case of output frequency, adjustment of its display format and units. It also provides a restore factory defaults function.

A01 RUN VARIABLE

A single run variable is selected from this menu for display on the run screen.

V01 Hz	Output Frequency
V02 RPM	Motor Speed
V03 % Load	Relative Motor Load
V04 Amps	Drive ouput current
V05 Volts DC	DC link voltage
V06 kW	Drive output power
V07 Volts AC	Drive output voltage
V08 C	Power circuit temperature (Celsius)
V09 Ripple	A number proportional to the RMS current in the DC bus capacitors, provided for factory diagnostic purposes
V10 I^2t used	Motor thermal overload level

A02 RUN SCALE

Default Value: 50.0

The default run variable is output frequency in Hz. This is the only run variable that may be re-scaled. It can be changed to any number from 1.0 to 9999 (or 999.9 with one decimal place). Set this to the value that you want to see when the MSC-3 is operating at maximum speed.

With ***A02 RUN SCALE*** displayed on the top line, press enter and the run scale value is displayed ready for edit. Use the up and down push buttons to adjust each individual digit. Press Enter to move to the next digit. To abandon the adjustment at any time, press the ESC push button.

Once the last digit has been adjusted, press Enter. The value remains on the display and is waiting for decimal point assignment. Use the up and down push buttons to shift the decimal point and Enter to accept the position.

Press ESC to return to ***A00 DISPLAY.***

A03 RUN UNITS

Default Value: Hz

The MSC-3 is able to display the output frequency in user defined units. The default setting is Hz, but it can be changed, so that the display will show user preferred units. For example, mtr/min, Cans/hr or anything else up to 8 characters. The output frequency is the only run variable whose units can be changed. The available characters are found in Appendix A

With ***A03 RUN UNITS*** displayed on the top line press Enter and the existing run units are displayed on the second line. Use the up and down push buttons to select a different character.

When the desired character is displayed, press Enter and the next character may now be adjusted. Repeat this seven more times. Changes to the run units can be abandoned at any point by pressing the ESC push button.

When the eighth character is selected, pressing Enter will accept the new units setting.

A04 Menu Protect

The feature protects the entire menu mode with a code so that settings and configurations are protected from unauthorized changes. After you enable this feature, return to the Run Screen. The next time anyone presses ESC to enter the Menu mode the following message will appear:

A07 Enter Code
0

Use the up and down buttons to adjust the code value to the number 1470. Press Enter to accept. If entered correctly, the familiar menu mode will be displayed. If the correct code is not entered you are returned back to the run screen.

Remote override

Alternative code values are used to activate and de-activate the remote override feature. Note that the ***A07 Enter Code*** display is accessed either by enabling menu protection, as described above, and then pressing ESC from the RUN screen or alternatively by powering up the MSC-3 with the ESC console push button depressed.

Code Value	Effect
1470	Allows entry to Menu Mode when Menu Protection is enabled
1473	Activates the remote override feature
1474	De-activates the remote override feature

Remote override operation

De-activated State

- When in the de-activated state, the drive will run according to the established remote / local logic rules.
- This state is identifiable by the familiar “FWD” and “REV” status message on the run display.

Activated State

The user is able to alternate between local and remote mode operation by pressing the Enter push button.

When in the activated state, the status field of the run display will show the user which mode (local or remote) is functioning for the selected direction (in that mode) and is indicated by one of the following: “FWD REM”, “FWD LOC”, “REV REM” or REV LOC”.

A05 SET CTL DEFS

This menu allows the factory default parameters to be reinstalled. The MSC-3 must be disabled before you can restore the defaults. Pressing the Enter button will cause the message ***A06 CHECK WIRING*** to be displayed. This is intended as a warning and an opportunity to confirm that terminal wiring is suited to the default settings, otherwise unexpected drive operation may result.

Pressing the ENTER button again will cause the defaults to be loaded.

B00 MOTOR

This menu allows you to enter motor nameplate information. Press the Enter button to view and modify Motor Volts, Motor Amps, Motor Hz and Motor rpm.

B01 MOTOR VOLTS

Default value: 230, 240, 415, 460 or 575 V (depends on model)

Range: 200..900 V

Use the up or down push buttons to adjust this setting to the motor nameplate voltage. Press Enter when finished and the motor nameplate current is displayed or ESC to abort the adjustment

B02 MOTOR AMPS

Default value: The current listed on page 65 under Continuous current for general purpose rating for the particular MSC-3 model.

Range: 18 to 137% of drive overload current listed in the MSC-3 Output Current Specifications table on page 65.

Use the up or down push buttons to adjust this setting to the motor nameplate current in amps. Press Enter when finished and the motor frequency is displayed or ESC to abort the adjustment.

Entering the Nameplate Current of your motor determines the operation points for the Flux Plus (page 43) and Slip Comp (page 44) features. This setting is not used to limit the output current of the MSC-3. Refer to ***D01 CURRENT LIMIT*** for that particular feature.

B03 MOTOR Hz

Default value: 50 or 60 Hz

Range: 30..200 Hz

Use the up or down push buttons to adjust this setting to the motor nameplate frequency (Hz). Press Enter when finished or ESC to abort the adjustment. This setting does not affect the minimum or the maximum frequency output of the MSC-3. Refer to ***C01 MIN Hz*** and ***C02 MAX Hz*** for those features.

B04 MOTOR RPM

Default value: 1465 or 1765 RPM

Range: 500 RPM...(60 times the ***B03 MOTOR Hz*** entered previously) RPM

Enter the motor nameplate RPM data. Use the ▲ or ▼ push buttons to adjust this setting to the motor nameplate speed (RPM). Press Enter when finished or ESC to abort the adjustment.

C00 PERFORMANCE

This section allows you to set the motor performance characteristics.

C01 MIN Hz

Default value: 0 Hz

Range: 0 to 195Hz

This sets the frequency that the MSC-3 will run when given a run signal. The value is entered in Hz. There must be a difference of at least 5Hz between the MIN Hz and the MAX Hz setting. For example, if MAX Hz is set to 45Hz, then the largest allowed value for MIN Hz is 40Hz. Use the up or down push buttons to adjust the MIN Hz value, press Enter to accept the value or press ESC to abort the adjustment. It is possible to use the full span of the analog input to adjust the speed reference through the remaining reduced speed range. For example: Max Hz = 50Hz and Min Hz = 20Hz, the analog input ***R01 Ref at 0%*** should be set to 40%. Zero at the analog input will produce a reference of 20Hz. Full span at the input will produce a reference of 50Hz.

C02 MAX Hz

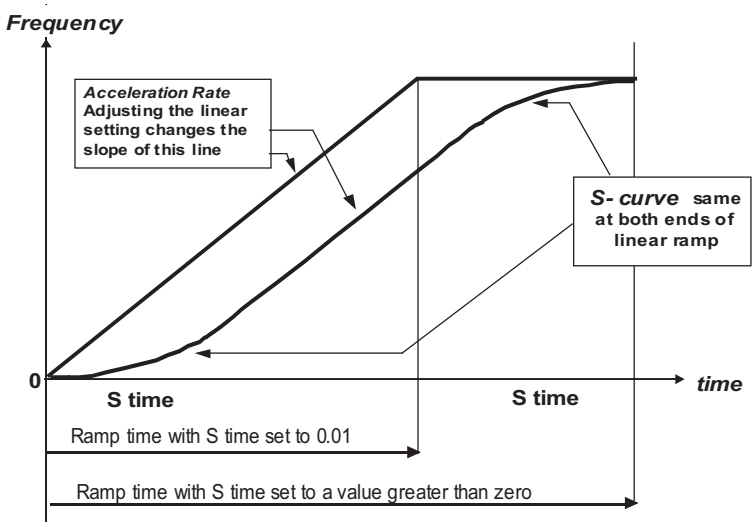
Default value: 50 or 60Hz (depends on model)

Range: 5Hz to 200Hz

This sets the frequency that the drive will run with the speed reference at maximum. There must be a difference of at least 5Hz between the MIN Hz and the MAX Hz setting. Changing this value scales the ***A02 RUN SCALE*** by the proportional amount. Use the up or down push buttons to adjust the MAX Hz value, press Enter to accept the value or press ESC to abort the adjustment.

C03 Ramp

The MSC-3 has a programmable Ramp with adjustable acceleration, deceleration and S-curve rates. Individual settings are provided for the linear and curved portions of the ramp



When the motor accelerates, the ACCEL TIME and S TIME settings are used. When the motor decelerates, the DECEL TIME and S TIME settings are used. Press Enter to adjust these parameters.

CAUTION

A separate ramp setting is used during Essential Services Override (ESO) operation. See ***F06 ESO Ramp*** on page 49 for details.

Alterations to any ramp parameter is not permitted while the drive is operating in ESO mode, (see page 46 for more information on ESO)

C04 ACCEL TIME

Default value: 10 sec

Range: 0.5 to 600 sec

The ACCEL TIME is the time taken for the motor to go from zero speed up to motor rated speed (assuming minimum S TIME). An MSC-3 with Motor Hz set to 50 Hz and an ACCEL TIME of 10 seconds will take 10 seconds to go from 0 Hz to 50 Hz. Use the up or down buttons to adjust the ACCEL TIME or press ESC to abort adjustment.

C05 DECEL TIME

Default value: 10 sec

Range: 0.5 to 600 sec

The DECEL TIME is the time taken for the motor to go from motor rated speed down zero speed (assuming minimum S TIME). An MSC-3 with Motor Hz set to 50 Hz and a DECEL TIME of 10 seconds will take 10 seconds to go from 50 Hz to 0 Hz. Use the up or down buttons to adjust the DECEL TIME or press ESC to abort adjustment.

C06 S TIME

Default value: 0.01 sec

Range: 0.01 to 40.00 sec

The S TIME is the time taken for the motor to reach the limit of acceleration (as set by the rated speed and the ACCEL TIME or DECEL TIME). Using the S TIME ensures smooth speed increases and decreases. The longer the S TIME, the smoother the speed transition.

The S TIME will extend the ramp time as set by the ACCEL and DECEL TIME. The ramp time is now approximately equal to the S TIME plus ACCEL TIME or DECEL TIME.

C07 Flux plus %

Default value: 25%

Range: 0 to 200% of adjustment range

The MSC-3 uses a sensorless flux vector control algorithm to control the motor operation. This control algorithm provides independent control of motor flux throughout the speed range and is highly robust against motor parameter changes. It uses the motor nameplate parameters entered in the B00 MOTOR menu as the basis for its calculations to produce the correct flux in the motor. For a motor to produce full torque it must have the correct flux applied to it. This is particularly critical at low speed. Flux Plus adjusts the motor flux estimate to provide additional control where specific adjustments to the motor torque response are required.

This feature enables an adjustment in the flux vector algorithm that can increase motor flux to produce more torque for the same motor current. The amount of extra torque produced will vary from motor to motor depending on motor size, efficiency and the operating speed.

Increase the value to produce more torque. This should be done in small steps to ensure the drive does not go into Current Limit. If the drive does go into current limit decrease the Flux Plus value slightly. This is the maximum torque that the motor can produce.

Use the up or down buttons for the adjustment. Press Enter when adjusted or ESC to abort adjustment.

C08 Hi Spd Flux+

Available Choices: H00 ENABLE

H01 DISABLE (default)

When this is disabled the flux plus decreases with increasing speed. This allows more efficient operation of the MSC-3 on loads that have a high starting torque but do not require any extra torque during normal operation. If your load requires high torque throughout the entire speed range Enable Hi Spd Flux+. Press Enter to view the setting. Use the up or down push button to enable or disable Hi Spd Flux+. Press Enter to accept the new setting or ESC to abandon.

C09 SLIP COMP

Default value: 0%

Range: 0 to 150% of slip speed

Motor slip is the difference between the shaft speed and the frequency applied to the motor (synchronous speed) and is dependent on load. Slip Comp can provide compensation for this varying slip to produce near constant shaft speed under varying loads. The MSC-3 estimates the slip of the motor using the parameters entered in the MOTOR parameters menu and the motor load. A value of 100% nominally correct for the slip speed implied by the ***B04 MOTOR RPM*** setting. Flux Plus may be used in conjunction with Slip Comp to provide increased output torque at low speeds. Press Enter then use the up and down buttons to adjust the amount of SLIP COMP. When adjusted, press Enter to accept the new setting or ESC to abort the adjustment.

C11 AUDIBLE FREQ

Available Choices:

C12 16kHz
C13 8kHz
C14 4kHz
C15 2kHz (default)
C16 Auto select

This value sets the maximum frequency that the drive uses in the creation of its PWM output voltage. This frequency is noticeable as an audible sound that the motor makes. Usually higher settings produce less audible noise but increase the switching losses, which produces more heat in the drive. For most efficient operation select 2 kHz. Press Enter then use the up or down buttons to choose the AUDIBLE FREQ. Press Enter when finished to accept the choice or ESC to abort. The ***C16 AUTO SELECT*** automatically chooses the highest audible frequencies that is consistent with the measured heat sink temperature and other operating conditions of the MSC-3.

D00 PROTECTION

This section lets you set the motor protection features.

D01 CURRENT LIM

Default value: 110% of the current listed on page 65 under Continuous current for general purpose rating for the particular MSC-3 model.

Range: 18 to 100% of drive overload current listed in the MSC-3 Output Current Specifications table on page 65.

This sets the maximum output current of the MSC-3. If excessive load is applied to the motor, the drive will only apply this amount of current to the motor until the overload condition is removed. Current limiting is achieved by reducing the speed of the motor. The Current Limit value cannot be set higher than the maximum overload current for the drive.

Press Enter then use the up or down buttons to adjust the CURRENT LIM. Press Enter when finished to accept the adjustment or ESC to abort.

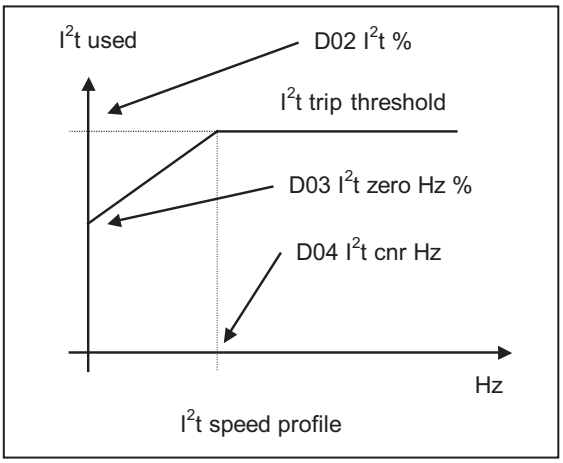
D02 I2t

The I^2t feature estimates the heating of the motor according to the motor load. When the estimated heating exceeds I^2t setting, the drive will trip on I^2t. For a motor running at 110% of its I^2t current this will take approximately two minutes. The time to trip will shorten with higher motor currents.

I^2t motor heating estimate data is maintained while ever power is applied to the MSC-3 regardless of stopping or starting the motor.

If power is removed from the drive after an I^2t trip, the motor should be allowed to cool down before the inverter is restarted. Motors running highly loaded at low speeds should have external cooling and an external motor thermal sensing device such as microtherms or thermistors for protection.

The I^2t feature has the ability to set the trip threshold as a function of output frequency. This allows the I^2t to protect motors that have reduced cooling at low speeds because they are not externally cooled. The diagram below is an example of the I^2t trip threshold profile.



CAUTION

The I^2t function is disabled during Essential Services Override (ESO) operation. See page 46 for more information.

D02 I2t

Default value: The current listed on page 65 under Continuous current for general purpose rating for the particular MSC-3 model.

Range: 18 to 100% of the current listed on page 65 under Continuous current for general purpose rating for the particular MSC-3 model.

This sets the upper limit of I^2t and is entered in amps. This is equivalent to the usual I^2t setting. Use the up and down push buttons to adjust the D02 I2t value and press Enter to accept the value or ESC to abandon changes.

D03 I2t zero Hz

Default value: The current listed on page 65 under Continuous current for general purpose rating for the particular MSC-3 model.

Range: 18 to 100% of the current listed on page 65 under Continuous current for general purpose rating for the particular MSC-3 model.

This sets the trip threshold when the speed is zero. This value cannot be set higher than the ***D02 I2t*** value set above. Use the up and down push buttons to adjust the ***D03 I2t zero Hz*** value and press Enter to accept the value or ESC to abandon changes.

D04 I2t cnr Hz

Default value: 10Hz

Range: 2 to 200Hz

The D04 I2t cnr Hz value sets the frequency above which the profile uses the trip threshold as set by ***D02 I2t***. Below this frequency the I^2t value is set by the slope on the I^2t profile. Use the up and down push buttons to adjust the D04 I2t value and press Enter to accept the value or ESC to abandon changes.

D05 Reverse

Available Choices: H00 ENABLE

H01 DISABLE (default)

The MSC-3 is shipped with its reverse direction disabled to prevent damage to mechanical devices or hazardous equipment operation caused by the motor running backwards. Press Enter to view the setting. Use the up or down push button to enable or disable Reverse. Press Enter to accept the new setting or ESC to abandon.

D08 DC INPUT

Available Choices: H00 ENABLE

H01 DISABLE (default)

This feature allows the MSC-3 to operate from a DC Input Supply. The DC Supply voltage should be at least 1.414 times higher than the motor voltage. Press Enter to view the setting. Use the up or down push button to enable or disable DC Input. Press Enter to accept the new setting or ESC to abandon.

D09 1 phase Inpt

Available Choices: H00 ENABLE

H01 DISABLE (default)

This feature allows the MSC-3 to operate from a single phase electrical supply. Press Enter to view the setting. Use the up or down push button to enable or disable Phase Input. Press Enter to accept the new setting or ESC to abandon.

Essential Services Override

There are circumstances in some applications for which it is desirable to disable certain of the protective features of the MSC-3. These are situations where continued operation has a higher priority than preventing damage to the MSC-3 or associated motor. A typical example is a building air conditioning application in which a fan is required to operate as part of a smoke clearance system. Various standards, for example, AS/NZS 1668.1:1998: *The use of ventilation and air conditioning in buildings - Fire and smoke control in multi-compartment buildings* require that all thermal protection be disabled during operation in a smoke clearance mode and equipment allowed, if necessary, to run to destruction.

The MSC-3 provides a special mode, Essential Services Override (ESO), to give effect to these requirements. Operation in ESO requires a control terminal to be configured for the ESO function and that this terminal to be connected to +5V (terminal 1) whenever ESO operation is required.

During ESO operation the MSC-3 is forced to run and the following protective functions are disabled:

- Heatsink over temperature protection
- I^2t protection
- Motor thermistor protection (if fitted)
- Supply Fail

In addition, the Auto Restart function is automatically enabled with unlimited auto restarts permitted.

In order to allow the MSC-3 to be independently optimised for both the usual operating condition and operation in ESO mode, separate parameters are provided for ESO and non ESO operating modes.

Function	Parameter for normal (non - ESO) operation	Parameter for ESO operation
Acceleration time	C04 ACCEL TIME	F06 ESO RAMP
Deceleration time	C05 DECEL TIME	
Source of speed reference	F01 REMOTE F02 LOCAL F04 JOGFWD F05 JOGREV	F03 ESO

In addition, Relay Output Function O02 (see page 59 under ***G15 RELAY 1***) may be used to indicate that the MSC-3 is in ESO mode.

WARNING regarding Essential Services Override

The Essential Services Override (ESO) feature provides a “run to destruction” mode of operation for applications that justify this approach. For applications in which this approach is not mandatory, the safety and other implications of the ESO operating mode should be carefully considered in the light of alternative approaches before choosing to use the ESO functionality of the MSC-3. It is fundamental to the ESO mode of operation that all protection against overheating of the MSC-3 and the associated motor is disabled. This may represent a fire or other hazard. Damage to the MSC-3 due to overheating during ESO operation is not covered by warranty.

Equipment that has been exposed to ESO operation under conditions that may have been outside the normal boundaries of rated operation should be inspected for damage and internal component degradation prior to being returned to service in a critical application. This inspection and any necessary repairs should be conducted irrespective of whether the MSC-3 appears to be working normally or not. Only competent personnel should undertake this work.

CAUTION

Any use of the Essential Services Override feature should be arranged to comply with all local rules and regulations concerning the particular application.

E00 STOP/START

This section sets the motor stopping and starting modes.

E01 STOPPING

Available Choices: E02 RAMP TO STOP (default)
E03 COAST

This controls the operation of the MSC-3 when any stop signal is given.

RAMP TO STOP means that the MSC-3 will continue to control the motor in order to bring it to a stop in the time set by the DECEL TIME and S TIME.

COAST means that the MSC-3 will stop controlling the motor and allow it to coast to a stop, just as if the power supply had been disconnected.

E06 DYNAMIC BRK

Available Choices: H00 ENABLE
H01 DISABLE (default)

Dynamic Braking provides the means for dissipating the motor regenerative energy into an external resistor. This may be required when the MSC-3 experiences regenerative currents from an overhauling load or a high inertia load that is required to decelerate rapidly. Dynamic Braking requires the dynamic braking option to be connected to the MSC-3. Please see the dynamic braking instruction manual for resistor sizing and dynamic braking application information.

Use the up or down buttons to select either Enable or Disable. Press Enter to accept the selection or ESC to abort.

E07 AUTO RESTART

Auto Restart allows the MSC-3 to automatically attempt to restart after a trip occurs. If the MSC-3 trips, it will wait 10 seconds then attempt to clear the fault. If it is unsuccessful it will keep trying every ten seconds. It will do this the number of times specified in A/Rs ALLOWED. If the fault is cleared and the drive runs without tripping for the ***E09 A/R CLR TIME*** the number of auto restarts attempted will start counting from one again. If the trip is cleared by any other means the fault count will start from one again.

Note: Alteration to any of the Auto Restart parameters is not permitted while the MSC-3 is operating in ESO mode.

E08 A/Rs ALLOWED

Default value: 0

Range: 0 to 15 restarts

This number indicates how many times the MSC-3 will attempt to restart after a trip. For the motor to run after the trip is cleared, the drive must be given a valid run command. Select 0 restarts in order to de-activate Auto Restart.

Use the up or down buttons to adjust A/Rs ALLOWED. Press Enter to accept the adjustment or ESC to abort.

E09 A/R CLR TIME

Default value: 20 min

Range: 0.1 to 20 min

If the MSC-3 operates for the ***E09 A/R CLR TIME*** without any trips occurring the number of restarts is reset to the value of ***E08 A/Rs ALLOWED***. Set the ***E09 A/R CLR TIME*** to 0.1min for infinite auto restarts.

Use the up or down buttons to adjust ***E09 A/R CLR TIME***. Press Enter to accept the adjustment or ESC to abort.

E10 Reset by PF

Available Choices: H00 ENABLE
H01 DISABLE (default)

Enabling this facility allows the MSC-3 to reset all trips when a momentary power failure occurs. This feature is useful in power-up start applications because trips may be cleared without any extra switch logic by turning the power off and straight back on again without waiting for the drive to completely power down.

Use the up or down buttons to select either Enable or Disable. Press Enter to accept the selection or ESC to abort.

F00 REFERENCES

This lets you set the speed references for all the MSC-3 operating modes. When options e.g. Extended Features Option are fitted the extra input options will appear where the word “Options” appears in the lists below. More preset speeds or a second analog input are examples of this.

For more information on the different drive operating modes see the Control Connections and Configurations on page 17

F01 REMOTE

Choices:
R00 AN1 (default)
R03 PRESET %
R04 MOTORIZD POT
R07 CONSOLE REF
Options‡

When the drive is operating in remote mode it will take its speed reference from this source. Use the up and down push buttons to select a reference and press Enter to accept the selection or ESC to abandon.

F02 LOCAL

Choices:
R00 AN1
R03 PRESET
R04 MOTORIZD POT
R07 CONSOLE REF (default)
Options‡

When the drive is operating in local mode it will take its speed reference from this source. Use the up and down push buttons to select a reference and press Enter to accept the selection or ESC to abandon.

F03 ESO

Choices:
R00 AN1
R03 PRESET (default)
R04 MOTORIZD POT
R07 CONSOLE REF
Options‡

When the drive is operating in ESO mode it will take its speed reference from this source. Use the up and down push buttons to select a reference and press Enter to accept the selection or ESC to abandon.

If Reverse operation is required in ESO enter the desired speed as a negative value.

F06 ESO Ramp

Default value: 10.0 sec
Range: 0.5 to 600 sec

When the drive is operating in ESO mode it will use this ramp setting for acceleration and deceleration instead of the ***C04 ACCEL TIME*** and ***C05 DECEL TIME*** settings.

The ESO Ramp time is the time taken for the motor to go from zero speed up to motor rated speed (assuming minimum S TIME). A MSC-3 with the Motor Hz set to 50 Hz and an ESO Ramp of 10 seconds will take 10 seconds to go from 0Hz to 50Hz. Use the up or down buttons to adjust the ESO Ramp or press ESC to abort adjustment.

‡ Various additional speed reference options will appear in the list when an option e.g. Extended Features Option, is fitted.

F04 JOGFWD

Choices:
R00 AN1
R03 PRESET (default)
R04 MOTORIZD POT
R07 CONSOLE REF
Options‡

When the drive is running in JOGFWD it will take its speed reference from this source. Use the up and down push buttons to select a reference and press Enter to accept the selection or ESC to abandon.

F05 JOGREV

Choices:
R00 AN1
R03 PRESET (default)
R04 MOTORIZD POT
R07 CONSOLE REF
Options‡

When the drive is running in JOGREV it will take its speed reference from this source. Use the up and down push buttons to select a reference and press Enter to accept the selection or ESC to abandon.

‡ Various additional speed reference options will appear in the list when an option e.g. Extended Features Option, is fitted.

Speed References

R00 AN1

When the Analog Input is selected as a speed reference for any of the different operating modes, two parameters need to be checked. The MSC-3 will let you do this every time the analog input is selected as a reference. They are ***R01 REF AT 0%*** and ***R02 REF AT 100%***. Use the up or down buttons to change the values (if required). Press enter to accept the value or ESC to abort.

MSC3 Analog Input Scaling

To calculate the values for REF AT 0% and REF AT 100% you need to know the following:

- Two analog input values and the speed required at each value
- The maximum speed.
- The input range, 5V, 10V or 20mA

Now use the following formulae to calculate the values for REF AT 0% and REF AT 100%

$$m = \frac{\frac{highspeed - lowspeed}{max\ speed}}{highinput - lowinput}$$

$$REFAT0\% = (\frac{highspeed}{max\ speed} - m * highinput) * 100$$

$$REFAT100\% = 100 * m * inputrange + REFAT0\%$$

Examples:

Standard 4-20mA At 4mA input we want 0Hz and at 20mA input we want 50Hz, maximum speed 50Hz using the 0-20mA input range.	**Bipolar Input** At 1V input we want 40Hz in reverse and at 4V input we want 30Hz in forward, maximum speed 40Hz using the 0-5V input range.
$m = \frac{\frac{50-0}{50}}{20-4} = 0.0625$ $REFAT0\% = (\frac{50}{50} - 0.0625 * 20) * 100 = -25$ $REFAT100\% = 100 * 0.0625 * 20 - 25 = 100$	$m = \frac{\frac{30+40}{40}}{4-1} = 0.583$ $REFAT0\% = (\frac{30}{40} - 0.583 * 4) * 100 = -158$ $REFAT100\% = 100 * 0.583 * 5 - 158 = 133$
Reduced Input Range At 2V input we want 30Hz and at 4V input we want 40Hz, maximum speed 60Hz using the 0-10V input range.	**Inverse Acting Bipolar Input** At 10V input we want 60Hz in reverse and at 0V input we want 60Hz, maximum speed 60Hz using the 0-10V input range.
$m = \frac{\frac{40-30}{60}}{4-2} = 0.083$ $REFAT0\% = (\frac{40}{60} - 0.083 * 4) * 100 = 33$ $REFAT100\% = 100 * 0.083 * 10 + 33 = 117$	$m = \frac{\frac{60+60}{60}}{0-10} = -0.2$ $REFAT0\% = (\frac{60}{60} + 0.2 * 0) * 100 = 100$ $REFAT100\% = 100 * -0.2 * 10 + 100 = -100$

R01 REF AT 0%

Default value: 0%

Range: -1000% to 1000%

This value specifies what the reference will be when 0% of the input signal is present at the analog input terminals. For a 4 to 20mA input signal, ***R01 REF AT 0%*** must be set to –25%.

R02 REF AT 100%

Default value: 100%

Range: -1000% to 1000% of input span

This value specifies what the reference will be when 100% of the input signal present at the analog input terminals.

R03 PRESET

Default value: 60%

Range: -100% to 100% of ***CO2 MAX Hz***

If PRESET is chosen as the speed source you must enter the preset speed value. Use the up or down buttons to adjust the preset speed. The preset speed is entered in % of ***CO2 MAX Hz.*** Press Enter to accept the speed value or press ESC to abort.

R04 MOTORIZD POT

Motorised Pot operation requires two input terminals, Up and Down. If the Up terminal is energised the drive speed will increase. If the Down terminal is energised the speed will decrease. If neither is energised the drive maintains a constant speed. If MOTORIZD POT is selected as the speed source you must select the mode of operation.

Available choices: R05 PERSISTENT
R06 RESET (default)

Use the up or down buttons to select either ***R05 PERSISTENT*** or ***R06 RESET***. Press Enter to accept the selection or ESC to abort.

In PERSISTENT mode the Motorized Pot speed will be remembered when power is removed. The Motorized Pot reference will return to this value the next time the MSC-3 is run.

In RESET mode the Motorized Pot speed will not be remembered when power is removed. The Motorized Pot reference will always start from zero after power is applied.

R07 CONSOLE REF

When this is selected, the reference is set from the console using the up and down arrows when the MSC-3 is in the run mode.

G00 INPUT/OUTPUT

There are two ways to assign terminal strip functions in the MSC-3:

- Choose a standard terminal configuration from the standard list. See ***G01 TERMINAL CFG*** below.
- Create a custom terminal configuration. See page 56.

Standard Terminal Configuration

G01 TERMINAL CFG

The simplest way to set a terminal configuration is to choose from one of the standard terminal configurations tabulated below. From the console menu select ***G01 TERMINAL CFG*** by pressing enter. Use the up arrow and down arrow buttons to move through the list of standard terminal configurations CONFIG 1 - CONFIG 8. When you have chosen a configuration press the enter button. Selecting one of these loads the terminals with the listed functions. **The MSC-3 does not display the configuration selected, but remembers the individual terminal functions.** It does this, so that you can then modify any of the terminals to suit your specific application. This also means that every time you go to the ***G01 TERMINAL CFG*** menu, the first option displayed is ***G02 CONFIG 1***. To see the actual terminal configuration, you must look at each terminal individually.

Note: The MSC-3 must be disabled[5] to select another terminal configuration.

Remember if you make a mistake press the escape button twice. This will take you out of the menu mode and move you into the run mode.

Standard Terminal Configurations Table

Term Config.	D1 2	D2 3	D3 4	D4 5	EN 6	RL1 13,14,15	RL2 16,17,18	Refer to page
G02 CONFIG 1 Industrial	RESET	~STOP	FWD & LATCH	REMOTE	ENABLE	RUN	TRIP	54
G03 CONFIG 2 VSC 2000	RESET	~STOP	FWD & LATCH	REV & LATCH	ENABLE	RUN	TRIP	54
G04 CONFIG 3 HVAC	~STOP	FWD & LATCH	ESO	REMOTE	ENABLE/ RESET	PROOF	ESO	54
G05 CONFIG 4	~STOP	FWD & LATCH	REV & LATCH	REMOTE	ENABLE/ RESET	RUN	TRIP	54
G06 CONFIG 5	~STOP	FWD & LATCH	JOGFWD	REMOTE	ENABLE/ RESET	RUN	TRIP	55
G07 CONFIG 6	FWD	REV	JOGFWD	JOGREV	ENABLE/ RESET	RUN	TRIP	55
G08 CONFIG 7	~STOP	FWD & LATCH	UP	DOWN	ENABLE/ RESET	RUN	TRIP	55
G09 CONFIG 8	FWD	UP	DOWN	REMOTE	ENABLE/ RESET	RUN	TRIP	55

~ STOP means the logical inverse of STOP i.e. this input must have 5V applied for the drive to run.

[5] MSC-3 is disabled by disconnecting terminal 6. This is equivalent to applying zero volts to terminal 6.

G02 CONFIG 1 Industrial

Terminal	D1 2	D2 3	D3 4	D4 5	EN 6	RL1 13,14,15	RL2 16,17,18
Function	RESET	~STOP	FWD & LATCH	REMOTE	ENABLE	RUN	TRIP

1. Sets the REMOTE speed reference to ***R00 AN1***.
2. Sets the LOCAL speed reference to the CONSOLE REF.
3. To change either of the above references go to ***F00 REFERENCES*** in the menu, see page 49 and select an alternate reference choice **after** you have selected this terminal configuration.
4. See page 18 for typical examples of wiring for this terminal configuration.

G03 CONFIG 2 VSC2000

Terminal	D1 2	D2 3	D3 4	D4 5	EN 6	RL1 13,14,15	RL2 16,17,18
Function	RESET	~STOP	FWD & LATCH	REV & LATCH	ENABLE	RUN	TRIP

1. The MSC-3 only runs in remote. The remote reference can be set to any available option.
2. AN1 is the default speed reference.
3. To run the drive in reverse the Reverse Direction must be enabled.

G04 CONFIG 3 HVAC

Terminal	D1 2	D2 3	D3 4	D4 5	EN 6	RL1 13,14,15	RL2 16,17,18
Function	~STOP	FWD & LATCH	ESO	REMOTE	ENABLE/ RESET	PROOF	ESO

1. Sets the REMOTE speed reference to AN1.
2. Sets the LOCAL speed reference to the CONSOLE REF.
3. To change either of the above references go to G14 DIG IN 4 in the menu and select an alternate after you have selected this terminal configuration.
4. Sets the ESO speed reference to the PRESET speed. To change this reference go to A34 DIG IN 3 in the menu to select an alternate speed source.
5. See page 26 for typical examples of wiring for this terminal configuration.

G05 CONFIG 4

Terminal	D1 2	D2 3	D3 4	D4 5	EN 6	RL1 13,14,15	RL2 16,17,18
Function	~STOP	FWD & LATCH	REV & LATCH	REMOTE	ENABLE/ RESET	RUN	TRIP

1. Sets the REMOTE speed reference to AN1.
2. Sets the LOCAL speed reference to the CONSOLE REF.
3. To change either of the above references go to G14 DIG IN 4 in the menu and select an alternate after you have selected this terminal configuration.
4. See page 22 for typical examples of wiring for this terminal configuration.

G06 CONFIG 5

Terminal	D1 2	D2 3	D3 4	D4 5	EN 6	RL1 13,14,15	RL2 16,17,18
Function	~STOP	FWD & LATCH	JOGFWD	REMOTE	ENABLE/ RESET	RUN	TRIP

1. Sets the REMOTE speed reference to AN1.
2. Sets the LOCAL speed reference to the CONSOLE REF.
3. To change either of the above references go to ***G14 DIG IN 4*** in the menu and select an alternate after you have selected this terminal configuration.
4. JOGFWD uses the internal PRESET as the jog speed source. Go to ***G13 DIG IN 3*** to change JOGFWD speed reference.

G07 CONFIG 6

Terminal	D1 2	D2 3	D3 4	D4 5	EN 6	RL1 13,14,15	RL2 16,17,18
Function	FWD	REV	JOGFWD	JOGREV	ENABLE/ RESET	RUN	TRIP

1. The MSC-3 only runs in remote.
2. Analog Input 1 is the speed reference for FWD and REV.
3. JOGFWD and JOGREV use the internal PRESET as the jog speed source. Go to ***G13 DIG IN 3*** or ***G14 DIG IN 4*** to change the jog speed or source after you have selected this terminal configuration.
4. The FWD and REV inputs are non latching. This means a direction signal must be held continuously to make the motor run.

G08 CONFIG 7

Terminal	D1 2	D2 3	D3 4	D4 5	EN 6	RL1 13,14,15	RL2 16,17,18
Function	~STOP	FWD & LATCH	UP	DOWN	ENABLE/ RESET	RUN	TRIP

1. The MSC-3 only runs in remote.
2. The Motorised potentiometer in persistent mode is the speed reference in remote.
3. How fast you can change the Motorized Pot reference is defined by the ramp settings.

G09 CONFIG 8

Terminal	D1 2	D2 3	D3 4	D4 5	EN 6	RL1 13,14,15	RL2 16,17,18
Function	FWD	UP	DOWN	REMOTE	ENABLE/ RESET	RUN	TRIP

1. Sets the REMOTE speed reference to the Motorized Potentiometer. The UP and DOWN buttons on the console operate in parallel to the Up and Down terminals. They will change the value of the motorized pot but will not start the motor.
2. Sets the LOCAL speed reference to the CONSOLE REF. The console then behaves as normal.
3. To change either of the above references, go to G14 DIG IN 4 in the menu and select an alternate after you have selected this terminal configuration.
4. FWD input is non latching.

G10 Enable/Reset

Available Choices: H00 ENABLE
H01 DISABLE (Default)

This sets the operation of the Enable terminal between being purely an enable terminal and also being able to reset a trip condition. When set to ENABLED, applying a positive edge to the ENABLE input will attempt to reset a trip condition. When this feature is set to DISABLED the ENABLE input cannot reset the MSC-3 after a trip.

Use the up and down push buttons to select ENABLED or DISABLED. Press Enter to accept the setting or Esc to abort.

Custom Terminal Configuration

G11 DIG IN1

G12 DIG IN2

G13 DIG IN3

G14 DIG IN4

These four menu items permit an individual function assignment to each input terminal. Pressing enter on these menu items presents a list of input functions with the currently assigned function being presented first. These terminals are all active high.

Some input functions require the selection of one or more speed references. When these functions are selected the choice of speed reference will follow with the currently assigned reference displayed first. The list of speed references is as per the ***F00 REFERENCES*** menu item.

Use the up and down push buttons to move through the list, press Enter to select the new function or ESC to abort.

Control Terminal Functions

Function	Description	Parameters
I00 FWD & LATCH	A momentary contact closure on this input will start the motor in the forward direction. When the input is removed the motor continues to run in the forward direction (latching). It requires an I02 ~STOP function to be assigned in order to break the latch and stop the motor.	None
I01 REV & LATCH	A momentary contact closure on this input will start the motor in the reverse direction. When the input is removed the motor continues to run in the reverse direction (latching). It requires I02 ~STOP function to be assigned in order to break the latch and stop the motor. The reverse direction must be enabled for the motor to run backwards.	None
I02 ~STOP	This input is required to be held for the motor to run. If it is opened any latched input is cleared and the motor will stop running. This is used with FWD & LATCH and REV & LATCH to stop the motor. This function is ignored in LOCAL mode.	None
I03 FWD	While this input is held the motor will run in the forward direction. When the input is removed the motor will stop running (non latching). The I03 FWD function disregards the state of the I02 ~STOP input and the drive will not stop while I03 FWD input is present and the Enable input is wired to +5V. Both I03 FWD & I04 REV inputs must be wired to +5 to activate bipolar operation.	None
I04 REV	While this input is held the motor will run in the reverse direction. When the input is removed the motor will stop running (non latching). The I04 REV function disregards the state of the I02 ~STOP input and the drive will not stop while I04 REV input is present and the Enable input is wired to +5V. Both I03 FWD & I04 REV inputs must be wired to +5 to activate bipolar operation.	None
I05 UP	Increases the motorised pot reference.	None
I06 DOWN	Decreases the motorised pot reference. For the UP and Down terminals to have an effect the motorised pot must be selected as a speed source. They also require other terminals to stop and start the motor.	None
I07 RESET	Will attempt to reset a trip condition.	None

Function	Description	Parameters

I08
ESO
	While this input is held the MSC-3 will operate in essential services override (ESO). After selecting this function you will be asked for a speed source to be selected.
	When this input is activated:
	• The motor runs at the selected ESO speed,
	• The following trips are ignored:
	  • Supply Fail
	  • Over Temp
	  • I^2t Trip
	  • Thermistor
	• Infinite auto restart of all other trips is enabled
	• The ramp acceleration and deceleration times are set by ***F06 ESO RAMP***. See page 49.
	• Auto Restart and Ramp parameters cannot be changed whilst ESO is in operation
	• Bipolar reference mode is activated
	• Reverse operation may occur and is dependent on speed source. Refer to ***F03 ESO*** of the ***F00 REFERENCES*** menu for ESO speed source selection.
		ESO
		speed reference

I09 JOGFWD	Contact closure on this input will run the motor forward at the JOGFWD speed. It will also clear any latched inputs. When the contact is opened the motor will stop. After selecting this function you will be asked for a speed reference to be selected.	JOGFWD speed reference
I10 JOGREV	Contact closure on this input will run the motor reverse at the JOGREV speed. It will also clear any latched inputs. When the contact is opened the motor will stop. After selecting this function you will be asked for a speed reference to be selected.	JOGREV speed reference
I11 REMOTE	Contact closure on this input means that the MSC-3 will follow the control inputs on the terminal strip and the motor will run at the speed set by the Remote speed reference. When the contact is opened the MSC-3 will be controlled from the console and will run at the speed set by the Local speed reference. This input requires other terminals to stop and start the motor. After selecting this function you will be asked for a Remote speed reference and a Local speed reference to be selected. **If the I11 REMOTE function is not assigned to an input terminal, remote mode operation is assumed.**	2 speed references

G15 RELAY1

G16 RELAY2

These two menu items permit an individual function assignment to each relay output. Pressing enter on these menu items presents a list of output functions with the currently assigned function being presented first.

Some relay functions require a value to be set. When these functions are selected the chance to set the value will follow with the current value displayed first.

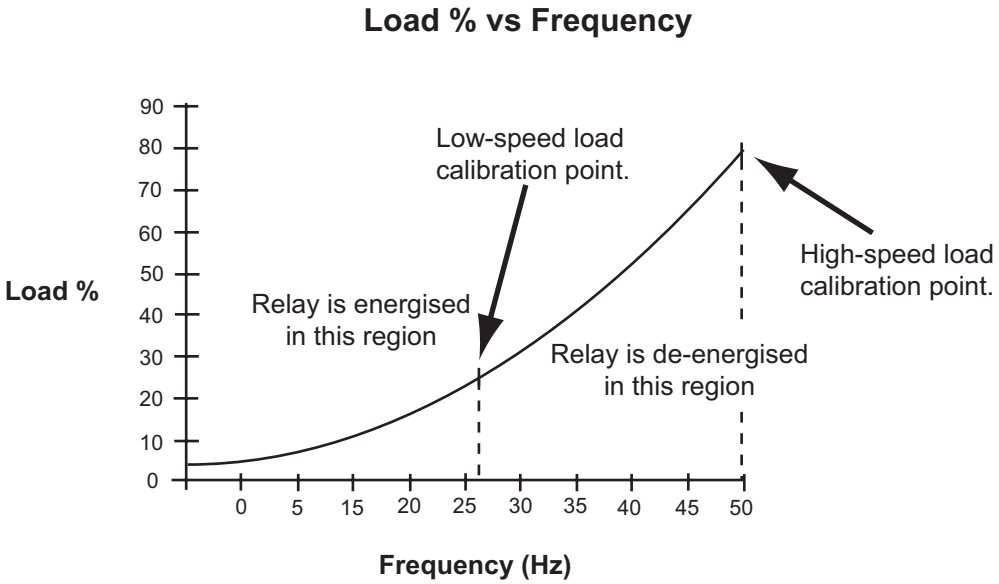
Use the up and down push buttons to move through the list, press Enter to select the new function or ESC to abort.

Relay Output Functions

Function	Indication when energised	Parameters
O00 RUN	Indicates that the drive is running in either forward or reverse.	None
O01 TRIP	Indicates the presence of a trip that has stopped the output of the drive	None
O02 ESO	Indicates that the MSC-3 is in the essential services mode.	None
O03 PROOF	Indicates that the MSC-3 is enabled and not tripped.	None
O04 ZERO SPEED	Indicates that the MSC-3 is at zero speed.	None
O05 AT SPEED	Indicates that the motor speed is equal to the reference speed.	None
O06 UNDER SPEED %	Indicates that the motor speed is below the entered value	% of CO2 MAX Hz
O07 OVER SPEED %	Indicates that the motor speed is above the entered value	% of CO2 MAX Hz
O08 ON	The relay is energized.	None
O09 OUTPUT ALARM	Indicates that the drive output current is more than 12.5% of motor rated current. See page 58.	None
O10 A/R FAIL	Indicates that the drive could not auto restart as all restarts have been exhausted.	None
O11 FWD	Indicates that the motor is running in the forward direction.	None
O12 REV	Indicates that the motor is running in the reverse direction.	None
O13 ENABLED	Indicates that the MSC-3 is enabled.	None
O14 I2t TRIP	Indicates that the I^2t motor overload feature has activated.	None
O15 OVER TEMP	Indicates that the MSC-3 is too hot for safe operation.	None
O16 LOAD WARNING	Indicates that the motor load is above the preset characteristic line. See detail description following.	2 Calibration points

O16 LOAD WARNING

The Load Warning feature of the MSC3 functions as a warning indication of abnormalities in the operating load characteristics of the motor and load. The indication of an abnormality is resolved by comparing the immediate load signal value to an idealised quadratic load characteristic. If the immediate load is less than the idealised load for the operating speed, the abnormality is detected. The graph below illustrates a load characteristic.



The function is set up for failsafe operation. When the load is in the region above the characteristic line, or the MSC-3 is stopped, the relay is energised. If the detected load is in the region below this line, the relay is de-energised.

Setup

Load ratings of an application are not required for the calibration of the feature. Instead two calibration points are used to set up the idealised load characteristic. Setup for the load warning feature is done after other custom settings have been made (eg Auto restart, I^2t, current limit, etc). The procedure is as follows:

1. Check the motor settings (voltage, current, frequency and speed) are correct.
2. Check the maximum frequency is correct.
3. Run the motor and load towards the low speed end of the speed range.
4. Determine which output relay to use (RELAY1, RELAY2, etc) and go to the function selection for this output.

For example RELAY1.

* From the run display press ESC to display the ***A00 DISPLAY*** menu.
* Use the 'Up' or 'Down' push buttons to find ***G00 INPUT/OUTPUT*** and press 'Enter'.
* Use the 'Up' or 'Down' push buttons to find ***G15 RELAY1*** and press 'Enter'.
* Use the 'Up' or 'Down' push buttons to find ***O16 LOAD WARNING*** and press 'Enter'.

The display shows ***O16 LOAD WARNING*** on the top line and the bottom line is blank.

5. Press the 'Down' push button. This will record the present speed and load. Press 'ESC' several times to return to the run display.
6. Run the motor and load towards the high speed end of the speed range.
7. Return to the chosen relay output function selection

Continuing the above example.

* From the run display press ESC to display the ***A00 DISPLAY*** menu.
* Use the 'Up' or 'Down' push buttons to find ***G00 INPUT/OUTPUT*** and press 'Enter'.
* Use the 'Up' or 'Down' push buttons to find ***G15 RELAY1*** and press 'Enter'.
* Use the 'Up' or 'Down' push buttons to find ***O16 LOAD WARNING*** and press 'Enter'.

The display shows ***O16 LOAD WARNING*** on the top line and the bottom line is blank.

8. Press the ‘Up’ push button. This will record the present speed and load. Press ‘ESC’ several times to return to the run display.
9. This checklist sets up the Load Warning feature and assigns the indications to one of the digital outputs.

O09 OUTPUT ALARM

This relay function is designed as a status indication. It indicates the presence of a load abnormality by comparing the motor current to a fixed threshold of 12.5% of the motor rated name-plate current when the MSC-3 is running. The usual application of this function is to sense the disconnection of the motor. ***O16 LOAD WARNING*** should be used for sensing the motor load torque. The table below lists the states of the relay and the corresponding conditions.

Let: $I_{Threshold}$ = 12.5% of the ***B02 MOTOR AMPS*** value

mag(Is) < $I_{Threshold}$	Relay NO	Relay NC	Comment
False	Closed	Open	Correct operation
True	Open	Closed	The drive cannot sense sufficient motor current

This function is assigned to a relay by selecting ***O09 OUTPUT ALARM*** as that relay’s logic function.

Display Messages

The MSC-3 displays a variety of messages on the second line of its display to indicate the drive status. These messages may be divided into two types, trip messages and run messages.

The MSC-3 will protect itself under a variety of fault conditions. When one of these conditions is experienced the MSC-3 will trip, shut down the motor output and display one of the following messages. The message will be displayed until the fault is cleared and a reset signal is applied.

Trip Message	Meaning
OPT SC	An output short circuit has been detected. This is caused by either an Over Current or a Ground Fault on the motor terminals.
OV	The DC Bus voltage has exceeded its maximum value.
OC	The output current has exceeded the MSC-3's intermittent output current rating.
DC LOW	The DC Bus voltage has fallen below its minimum threshold.
PWR FAIL	All input phases on the input power supply are either low or missing.
SUPPLY F	There is a problem with the input power supply. One phase is either partially or totally missing and motor operation will be impaired.
OT	The MSC-3 is too hot.
I2T TRIP	An I^2t trip has occurred.
OVR PWR	The motor's absorbed power exceeds the MSC-3 rating when operating from a single phase supply.
CHARGING	There has been a fault whilst charging the DC Bus capacitors.

The following messages indicate the current operating condition of the MSC-3.

Run Message	Meaning
CHARGING	The MSC-3 is waiting for the DC Bus capacitors to be fully charged before running the motor.
OPTION TRIP e.g. OT THERM	Option Trip Messages Thermistor trip on Extended Features Option
C LIMIT	The motor is drawing its maximum overload current.
V LIMIT	The motor is regenerating or the input voltage is too high.
ESO	The MSC-3 is operating in Essential Services Override mode
OPTION STATUS	Option Status Messages
FWD	The MSC-3 is running in the FWD direction.
REV	The MSC-3 is running in the REV direction.
FWD REM	The MSC-3 is running in the FWD direction in remote mode.
FWD LOC	The MSC-3 is running in the FWD direction in local mode.
REV REM	The MSC-3 is running in the REV direction in remote mode.
REV LOC	The MSC-3 is running in the REV direction in local mode.
ENABLED	The MSC-3 has an enable signal but no direction selected.
NOT EN	The MSC-3 is ON but has no enable signal so it is not able to turn a motor.

MSC-3 Specifications

Input Supply Voltage	
MSC-3R	380 to 480Vac, 3Ø
MSC-3J	440 to 600Vac, 3Ø
MSC-3L	208 to 240Vac, 3Ø
All these voltages have a tolerance of -15% to +10%	

Input Frequency
48 to 62 Hz

Output Voltage	
MSC-3R	0 to 480Vac, 3Ø
MSC-3J	0 to 600Vac, 3Ø
MSC-3L	0 to 240Vac, 3Ø
The output voltage can not be higher than the input voltage	

Output Frequency	
Range:	0 to 200Hz
Resolution:	0.1%
Linearity:	0.2% of maximum frequency

Enclosure Rating
IP30 (NEMA 1) IP66 (NEMA 4)

Environmental Rating	
Storage Temperature:	
-20 to +70ºC	-4 to 158ºF
Operating Temperature:	
0 to 40ºC	32 to 104ºF
0 to 50ºC†	32 to 122ºF†
†Dependent on load current	
Relative Humidity:	5 to 95% Non Condensing
Altitude:	0 to 1000m 0 to 3281 feet

Standards Compliance	
Models marked with this symbol comply with the Australian EMC Framework requirements	
Models marked with this symbol are listed by Underwriters Laboritories Inc and comply with UL 508C	
The I^2t function complies with IEC 60947-4-1 Ed. 2.0B (2000) and AS/NZS 3947.4.1:2001: *Low voltage switchgear and control gear - Contactors and motor starters - Electromechanical contactors and motor starters* thermal overload specification class 10A.	

Local Controls
Up, Down, Enter, Escape, Stop/Reset

Terminal Strip
Digital Inputs
+5V and DIG COM
5Vdc Supply,
40mA max current
D1 to D4 and EN Digital Inputs
Logic High 3 to 5Vdc
Logic Low 0 to 2Vdc
Analog Input
Vref and AN COM
+5Vdc Supply
5mA max current
IN+ and IN-
Differential Input
0 to 5V range
0 to 10V range
0 to 20mA range
4 to 20mA range
Common mode range
± 25 Vdc to AN COM
Relay Outputs
2 Form C Outputs (single pole change over contacts)
Contact Rating (Resistive load)
5A@250Vac
5A@30Vdc
Contact Rating (Inductive load)
2A@250Vac
2A@30Vdc

User Parameters	
Motor Voltage	200 to 900V
The output voltage cannot exceed the input voltage	
Motor Current	
25 to 180% of continuous general purpose rating	
Motor Frequency	30 to 200Hz
Motor Speed	
500 to 60 x Motor Frequency in rpm	
Minimum Frequency	0 to 195Hz
Maximum Frequency	5 to 200Hz
Acceleration time	0.5 to 600s
Deceleration time	0.5 to 600s
S time	0.01 to 40s
Flux Plus	0 to 200%
Slip Comp	0 to 150% of slip speed
Audible Frequency[6]	2 to 16kHz
Current Limit	18 to 100% of overload current rating
I^2t	18 to 100% of max cont current
I^2t Zero Hz	18 to 100% of max cont current
I^2t cnr Hz	2 to 200Hz
Drive Stopping	Ramp to stop
	Coast to stop
	Dynamic braking
Auto Restart	Number of restarts: 0 to 20
	Reset time: 0.1 to 20 minutes
References	
	Analog Input
	Console Reference
	Preset
	Motorised Potentiometer
The following functions can be enabled or disabled:	
	Menu Protect
	Reverse Direction
	High Speed Flux Plus
	DC Input
	Dynamic Braking
	Reset by Power Failure
	Remote override
	1 Phase Input

[6] This is the frequency apparent in motor acoustic noise. The audible frequency is automatically reduced according to heat sink temperature and load current.

Model	Max. Supply Short Circuit Rating (Amps rms Symmetrical)	Max. Fuse Size	Fuse Class	Max. Wire Size	Max. Tightening Torque
240V					
MSC-3L3	18,000A, 240V	20	J	10 A.W.G (6mm^2)	15.6 in.lb (1.76Nm)
MSC-3L5	18,000A, 240V	20	J	10 A.W.G (6mm^2)	15.6 in.lb (1.76Nm)
MSC-3L7	18,000A, 240V	20	J	10 A.W.G (6mm^2)	15.6 in.lb (1.76Nm)
MSC-3L11	18,000A, 240V	20	J	10 A.W.G (6mm^2)	15.6 in.lb (1.76Nm)
MSC-3L15	18,000A, 240V	60	T	6 A.W.G (16mm^2)	16 in.lb (1.8Nm)
MSC-3L20	18,000A, 240V	60	T	6 A.W.G (16mm^2)	16 in.lb (1.8Nm)
MSC-3L23	18,000A, 240V	60	T	6 A.W.G (16mm^2)	16 in.lb (1.8Nm)
MSC-3L30	18,000A, 240V	60	T	6 A.W.G (16mm^2)	16 in.lb (1.8Nm)
MSC-3L40	18,000A, 240V	60	T	6 A.W.G (16mm^2)	16 in.lb (1.8Nm)
MSC-3L55†	18,000A, 240V	200	T	2/0 A.W.G (70mm^2)	120 in.lb (13.6Nm)
MSC-3L82†	18,000A, 240V	200	T	2/0 A.W.G (70mm^2)	120 in.lb (13.6Nm)
MSC-3L109†	18,000A, 240V	200	T	2/0 A.W.G (70mm^2)	120 in.lb (13.6Nm)
MSC-3L140†	18,000A, 240V	200	T	2/0 A.W.G (70mm^2)	120 in.lb (13.6Nm)
MSC-3L170†	18,000A, 240V	200	T	2/0 A.W.G (70mm^2)	120 in.lb (13.6Nm)
480V					
MSC-3R3	18,000A, 480V	20	J	10 A.W.G (6mm^2)	15.6 in.lb (1.76Nm)
MSC-3R5	18,000A, 480V	20	J	10 A.W.G (6mm^2)	15.6 in.lb (1.76Nm)
MSC-3R7	18,000A, 480V	20	J	10 A.W.G (6mm^2)	15.6 in.lb (1.76Nm)
MSC-3R11	18,000A, 480V	20	J	10 A.W.G (6mm^2)	15.6 in.lb (1.76Nm)
MSC-3R15	18,000A, 480V	60	T	6 A.W.G (16mm^2)	16 in.lb (1.8Nm)
MSC-3R20	18,000A, 480V	60	T	6 A.W.G (16mm^2)	16 in.lb (1.8Nm)
MSC-3R23	18,000A, 480V	60	T	6 A.W.G (16mm^2)	16 in.lb (1.8Nm)
MSC-3R30	18,000A, 480V	60	T	6 A.W.G (16mm^2)	16 in.lb (1.8Nm)
MSC-3R40	18,000A, 480V	60	T	6 A.W.G (16mm^2)	16 in.lb (1.8Nm)
MSC-3R55†	18,000A, 480V	200	T	2/0 A.W.G (70mm^2)	120 in.lb (13.6Nm)
MSC-3R82†	18,000A, 480V	200	T	2/0 A.W.G (70mm^2)	120 in.lb (13.6Nm)
MSC-3R109†	18,000A, 480V	200	T	2/0 A.W.G (70mm^2)	120 in.lb (13.6Nm)
MSC-3R140†	18,000A, 480V	200	T	2/0 A.W.G (70mm^2)	120 in.lb (13.6Nm)
MSC-3R170†	18,000A, 480V	200	T	2/0 A.W.G (70mm^2)	120 in.lb (13.6Nm)
600V					
MSC-3J3	18,000A, 600V	20	J	10 A.W.G (6mm^2)	15.6 in.lb (1.76Nm)
MSC-3J5	18,000A, 600V	20	J	10 A.W.G (6mm^2)	15.6 in.lb (1.76Nm)
MSC-3J7	18,000A, 600V	20	J	10 A.W.G (6mm^2)	15.6 in.lb (1.76Nm)
MSC-3J11	18,000A, 600V	20	J	10 A.W.G (6mm^2)	15.6 in.lb (1.76Nm)
MSC-3J15	18,000A, 600V	60	T	6 A.W.G (16mm^2)	16 in.lb (1.8Nm)
MSC-3J20	18,000A, 600V	60	T	6 A.W.G (16mm^2)	16 in.lb (1.8Nm)
MSC-3J23	18,000A, 600V	60	T	6 A.W.G (16mm^2)	16 in.lb (1.8Nm)
MSC-3J30	18,000A, 600V	60	T	6 A.W.G (16mm^2)	16 in.lb (1.8Nm)
MSC-3J40	18,000A, 600V	60	T	6 A.W.G (16mm^2)	16 in.lb (1.8Nm)

- Inverse-time circuit breakers can be used provided that the let-through energy (I^2t) and peak let through current (Ip) is less than that of the maximum fuse rating specified.
- Use Copper Conductors Only.

† Not included in UL listing

MSC-3 Output Current Specifications

Model	Continuous Current for General Purpose Rating (A) Typically variable torque applications	Continuous Current for Extended Duty Rating (A) Typically constant torque applications	Over Load Current (A)[7]
MSC-3*3	3.6	3.1	4.7
MSC-3*5	5.0	4.2	6.3
MSC-3*7	7.2	6.1	9.0
MSC-3*11	10.8	9.1	13.4
MSC-3*15	14.9	12.7	19.0
MSC-3*20	19.7	16.7	25.0
MSC-3*23	22.5	19.1	28.6
MSC-3*30	30.1	25.6	38.4
MSC-3*40	40.3	34.1	51.1
MSC-3*55	55.0	46.6	69.9
MSC-3*82	82.0	68.9	104.3
MSC-3*109	109	92.0	138.6
MSC-3*140	140	116.9	178
MSC-3*170	170	132.6	199
* L, R or J for models up to MSC-3 *40. L or R for models MSC-3 *55 and up.			

These currents apply to all ranges MSC-3 at an ambient temperature of 40ºC (104ºF) independent of the input voltage. MSC-3 may be applied at higher ambient temperatures at reduced ratings. Please consult the factory for ratings for ambients above 40ºC (104ºF).

[7] 60 second rating

MSC-3 Trouble Shooting Guide

Symptom	Cause	Remedy
Front Display does not illuminate.	Input power wiring not connected properly.	Check input power wiring, refer to the MSC-3 Electrical Installation Diagram.
	Input voltage not within specification.	Measure the input voltage at the MSC-3 input terminals. Check with specifications.
Motor does not rotate when UP button on the Console is pressed.	Enable signal is not active.	Check that the EN terminal is connected to +5V. Check that the ENABLED message is displayed.
	MSC-3 is in REMOTE	Check that if you have a remote terminal it is not at +5V with respect to DIG COM.
	Speed is set to minimum	Increase speed by holding down the UP button.
Motor does not rotate when remote START signal is activated.	Incorrect control signal wiring.	Check control wiring to terminals and the terminal functions assigned. Refer to Control Wiring Diagrams and Terminal Configurations.
	Enable signal is not active.	Check that the EN terminal is connected to +5V. Check that the ENABLED message is displayed.
	MSC-3 is in LOCAL	Check that your remote terminal is at +5V with respect to DIG COM.
	A direction has not been selected.	Check that either a FWD or a REV terminal has been assigned and that it is at +5V with respect to DIG COM.
		If the reverse direction is selected ensure that reverse is enabled from the Protection menu.
	Speed signal is not correctly connected.	Check the REMOTE speed source in the References menu. Ensure that this source is not at zero.
Motor does not accelerate in the time set by the *ACCEL* ramp and C LIMIT message appears .	Current limit circuit is operating.	This is a normal operating mode for the MSC-3. When the load is being accelerated too fast, the MSC-3 limits current drawn by the motor by extending the acceleration ramp time. A faster Accel time is not possible with this Current Limit setting. Increase the ACCEL time until the C LIMIT message disappears
	CURRENT LIM set too low.	Increase *CURRENT LIM* value so that the MSC-3 is not prematurely limiting current. Check that the motor does not overheat with the new setting.
C LIMIT message appears continuously	Motor mechanically overloaded.	Check the actual load is within the motor's capacity at the required speed.
	Motor shaft jammed.	Check the mechanical drive system.
	Fault in motor or motor wiring.	Check that motor is wired correctly.
	Incorrect motor voltage selected.	Enter correct MOTOR VOLTAGE from the *MOTOR* menu
	Incorrect motor frequency selected.	Enter correct MOTOR FREQUENCY from the *MOTOR* menu.
	FLUX PLUS is set too high.	Reduce the FLUX PLUS setting.

Symptom	Cause	Remedy
Motor does not decelerate in the time set by the *DECEL* ramp and V LIMIT message appears.	Voltage limit circuit is operating.	This is a normal operating mode for the MSC-3. When the load is being decelerated too fast, the MSC-3 limits the voltage regenerated by the motor by extending the deceleration ramp time. Increase the DECEL time to make this message disappear. If faster or controlled deceleration is required fit a dynamic braking module.
V LIMIT message appears continuously.	Input voltage has exceeded maximum rating.	See MSC-3 General Specifications for input voltage ratings.
OPT SC message appears	Short circuit on motor terminals. Earth Fault on motor terminals	Check wiring to motor terminals. Check wiring to motor terminals.
OC	Motor current was greater than the MSC-3's maximum current.	Check drive and motor current ratings.
OV message appears.	Input voltage has exceeded maximum ratings. Motor is overhauling.	See general specification and check the input is within ratings. Check input supply for voltage transients. Fix the external source. Ensure load cannot overdrive the motor. If necessary fit dynamic braking.
OT message	Ventilation problem. Drive is constantly overloaded.	Ensure operating ambient temperature is within specification. Check fans are rotating freely and there is no build up of dust or debris in blades. Visually examine the heatsink fins for build up of dust and debris. Check the MSC-3 continuous current and ambient temperature rating.
Motor is unstable.	*SLIP COMP* is set too high. *FLUX PLUS* set too high. Incorrect motor voltage selected. Incorrect motor frequency selected. *CURRENT LIMIT* is set too low.	Check that MOTOR NAMEPLATE RPM setting is equal to the motor rated speed. Check that NAMEPLATE CURRENT setting is equal to the motor nameplate current. Reduce SLIP COMP setting. Reduce FLUX PLUS setting. Enter correct MOTOR VOLTAGE from the MOTOR menu. Enter correct *MOTOR FREQUENCY* from the *MOTOR* menu. Increase *CURRENT LIMIT* setting.
Excessive Motor Heating.	Motor is running at low speeds for long times. Motor damaged or incorrectly wired. Incorrect motor voltage selected. Incorrect motor frequency selected.	Do not run the motor heavily loaded at low speeds for long periods unless the motor has been suitably de-rated or is force cooled. Check the motor and motor wiring for faults. Enter correct *MOTOR VOLTAGE* from the *MOTOR* menu. Enter correct *MOTOR FREQUENCY* from the *MOTOR* menu.

Your MSC-3 Setup Notes

Photocopy this page or complete in pencil

Site Designator .....

MSC-3 Serial No. .....

User Parameters **Date**.....

	User	Default		User	Default
A00 DISPLAY			**E00 STOP/START**		
A01 RUN VARIABLE		Hz	E01 STOPPING		RAMP
A02 RUN SCALE		50.0	E06 DYNAMIC BRK		Disabled
A03 RUN UNITS		Hz	E08 A/Rs ALLOWED		0
A04 Menu Protect		Disabled	E09 A/R CLR TIME		20
B00 MOTOR			E10 Reset by PF		Disabled
B01 MOTOR VOLTS		*	**F00 REFERENCES**		
B02 MOTOR AMPS		*	F01 REMOTE		AN1
B03 MOTOR Hz		*	F02 LOCAL		CONSOLE
B04 MOTOR RPM		*	F03 ESO		PRESET %
C00 PERFORMANCE			F06 ESO Ramp		10.0
C01 MIN Hz		0	F04 JOGFWD		PRESET %
C02 MAX Hz		*	F05 JOGREV		PRESET %
C04 ACCEL TIME		10.0	**G00 INPUT/OUTPUT**		
C05 DECEL TIME		10.0	G01 TERMINAL CFG		1
C06 S Time		0.01	G10 Enable/Reset		Disabled
C07 Flux plus %		25	G11 DIG IN1		RESET
C08 Hi Spd Flux +		Disabled	G12 DIG IN2		STOP
C09 SLIP COMP		0	G13 DIG IN3		FWD + L
C11 AUDIBLE FREQ		2 kHz	G14 DIG IN4		REMOTE
D00 PROTECTION			G15 RELAY 1		RUN
D01 CURRENT LIM		*	G16 RELAY 2		TRIP
D02 I2t		*	R01 REF AT 0%		0
D03 I2t zero Hz		*	R02 REF AT 100%		100
D04 I2t cnr Hz		10	R03 PRESET %		60%
D05 Reverse		Disabled	R04 MOTORIZD POT		RESET
D08 DC INPUT		Disabled			
D09 1 phase Inpt		Disabled			

* Drive Specific

Appendix A - MSC-3 Character Set

Appendix B - MSC-3 transportation sizes and weights

The table below lists the approximate dimensions and weights for MSC-3 models in the standard packing material.

Model	Enclosure Type	Shipping Dimensions	Weight without Choke	Weight with Choke	Packaging
MSC-3*3 MSC-3*5 MSC-3*7 MSC-3*11	Chassis A IP30 / NEMA 1 (No DC Choke)	280 x 300 x 184mm 11 x 11.8 x 7.3in	4Kg		Carton
MSC-3*3 MSC-3*5 MSC-3*7 MSC-3*11	Optional DC Bus Choke for Chassis A IP30 / NEMA 1	175 x 335 x 145mm 6.9 x 13.2 x 5.7in		3.6Kg Choke only	Carton
MSC-3*3 MSC-3*5 MSC-3*7 MSC-3*11	Chassis A IP66 / NEMA 4	330 x 387 x 380mm 13 x 15.2 x 15in	7.1Kg	10Kg	Carton
MSC-3*15 MSC-3*20 MSC-3*23 MSC-3*30	Chassis B All types	540 x 400 x 360mm 21.3 x 15.7 x 14.2in	20Kg	25.6Kg	Carton
MSC-3*40	Chassis B All types			27.5Kg	Carton
MSC-3*55	Chassis C All types	520 x 750 x 440mm 20.5 x 29.5 x 17.3in	46Kg	72Kg	Pallet
MSC-3*82	Chassis C All types		48Kg	74Kg	Pallet
MSC-3*109	Chassis C All types		50Kg	76Kg	Pallet
MSC-3*140	Chassis C All types		62Kg	80Kg	Pallet
MSC-3*170	Chassis C All types			78Kg	Pallet

Appendix C - Glossary

~STOP	The logical inverse of STOP. This circuit must be closed for the MSC-3 to run.
2-wire control	Control of the stop / start function by a simple contact closure (eg a start / run switch contact).
3-wire control	Control of the stop / start function by momentary contacts, typically separate start and stop pushbuttons. This arrangement has the advantage of preventing an inadvertent re-start following a power outage.
AN COM	The common terminal to which all analog inputs on the MSC-3 are referenced. This is separate to the DIG COM to reduce the possibility of interference between analog and digital functions.
AWG	American Wire Gauge
Console	The pushbuttons and LCD display on the front of the MSC-3
Constant Torque	A load characteristic in which the driving torque requirement is largely independent of speed. e.g. a horizontal conveyer
DC Bus Choke	An inductor connected in series with the DC bus inside the MSC-3. This provides several benefits including reducing the harmonic content of the AC line current.
DIG COM	The common terminal to which all digital inputs on the MSC-3 are referenced.
EMC	Electromagnetic Compatibility. The arrangement of emission and immunity levels to achieve functional coexistence between various items of equipment in a given environment.
EN	The enable input on the MSC-3.
ESO	Essential Services Override. A mode of operation that disables certain protection features in order to allow the MSC-3 and/or the motor to run to destruction in certain circumstances, for example clearing smoke from a building.
HVAC	Heating, Ventilation and Air Conditioning [industry]
IEC	International Electrotechnical Commission, publisher of many standards related to electrical / electronics technology.
IN+, IN-	These are the designations of differential analog inputs on the MSC-3. The MSC-3 will respond to the difference between the two inputs, rather than the voltage between either input and AN COM.
JOG	A control input that causes motion only while it is active (ie non-latched) that is usually used to manually operate equipment for the purposes of setting up or alignment prior to continuous operation.
LATCH	A feature of a control input that requires only a momentary signal (e.g. contact closure) to provide sustained (latched) operation.
Local	Operation of the MSC-3 from the console pushbuttons on the enclosure.
NEMA	[The American] National Electrical Manufacturer's Association, publishers of various NEMA standards.
PF	Power factor. The ratio of real (active or in-phase) current to the total current in an AC circuit.
PID	A type of automatic controller that seeks to drive a measured value (e.g. temperature, pressure etc) to a preset value by means of a control effort (e.g. motor speed) determined by proportional, integral, and derivative functions.
PID, reverse acting	A PID control system in which an increase in control effort (e.g. motor speed) results in a decrease in the measures variable (e.g. temperature). A common example is a cooling tower where an increase in fan speed causes a reduction in water temperature.
Ramp	A control function within the MSC-3 that controls the rate at which the motor speed can increase or decrease.
Remote	Operation of the MSC-3 via connections made to the control board terminal strip.
RMS	Technically, Root-Mean-Square. A method of measuring an AC voltage or current that gives the same numerical result as a DC voltage or current would on the basis of heating effect.

RMS line current	AC input current measured in a way that reflects the true heating value of the current.
SCN	The terminal on the MSC-3 for the connection of the screen of all cabled associated with analog and digital control functions.
UL	Underwriters Laboratories Inc. An American organization involved in product safety standards and certification.
Variable Torque	A load characteristic in which the driving torque requirement is significantly influenced by speed. This term is most often used to describe the load characteristic of centrifugal fans and pumps.
VRef	A reference voltage (5.0V) available on the MSC-3 control terminal strip to assist in generating a speed reference voltage etc.

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