MSC-3

Extended Features Option
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

Contents

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.

This option manual should be read in conjunction with the MSC-3 instruction manual.

Ensure that both of the instruction manuals are 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.

Firmware

This manual applies to MSC-3 Extended Features Option with firmware revision 1.19. The firmware revision is marked on the back of the Extended Features Option.

This Extended Feature Option firmware revision is compatible with MSC-3 control board firmware revisions 1.49 and up.

MSC-3 Extended Features Option Description

The Extended Features Option extends the feature list of the MSC-3. Features include:

Thermal protection input

Standard motor protection thermistors may be directly connected to this input (see pages 13 and 26). A separate thermistor protection relay is not required. Alternatively, other protection devices that present a normally closed contact such as thermal overload relays and thermal switches may be used. The thermal protection input requires no user set up and is active at all times except when MSC-3 is operating in the Essential Services Override (ESO) mode.

Analog input

The input may be set for voltage or current input by on board DIP switch combinations (see pages 19 and 26). The analog input may be used as an additional speed reference or used in conjunction with the built in PID controller as the process variable. When used with the PID controller, the analog input may be rescaled through the menus of the MSC-3. A comparator function (under and over) is available on the analog signal.

Transducer Power Supply

A 24V, 20mA power supply is provided to allow “loop powered” 4-20mA transducers to be used in conjunction with the analog input without the need to have an external power supply for this purpose (see page 26).

Analog output

The output may be set for voltage or current output by on board DIP switch combinations (see pages 13 and 26). This feature permits internal signals of the MSC-3 to be accessed by external monitoring equipment such as panel meter displays, etc.. Signals available are: output frequency, motor speed, relative motor load, DC link voltage, drive output power, drive output voltage, power circuit temperature, motor thermal overload and the PID output signal.

Digital inputs

Four additional digital inputs are provided (see pages 18 and 26). The function of each input is user selectable. These inputs may be assigned to any of the functions available to the MSC-3 Control Board digital inputs as well as being used to control the reference selector function.

Relay Output

An additional relay output is provided (see pages 25 and 26). The function of the relay is user selectable and may be assigned to any of the functions available for the relays on the MSC-3 Control Board. The PID status functions PV Under and PV Over are also available.

User and Preset speed reference selection

The Extended Features Option has a speed reference selector where combinations of digital inputs select up to 8 speed references: 2 user selectable reference sources (e.g. analog input, motorised potentiometer) and 6 preset speeds. The reference selector function is controlled by three digital inputs (see pages 11 and 16).

PID Controller

The in built PID controller function with anti-windup has been designed to integrate into the MSC-3 control system with minimal user intervention (see page 22). The PID controller is tuned by changing parameters through the MSC-3 menus and is able to use the reference selection capabilities as the set point or feed forward reference.

Installation

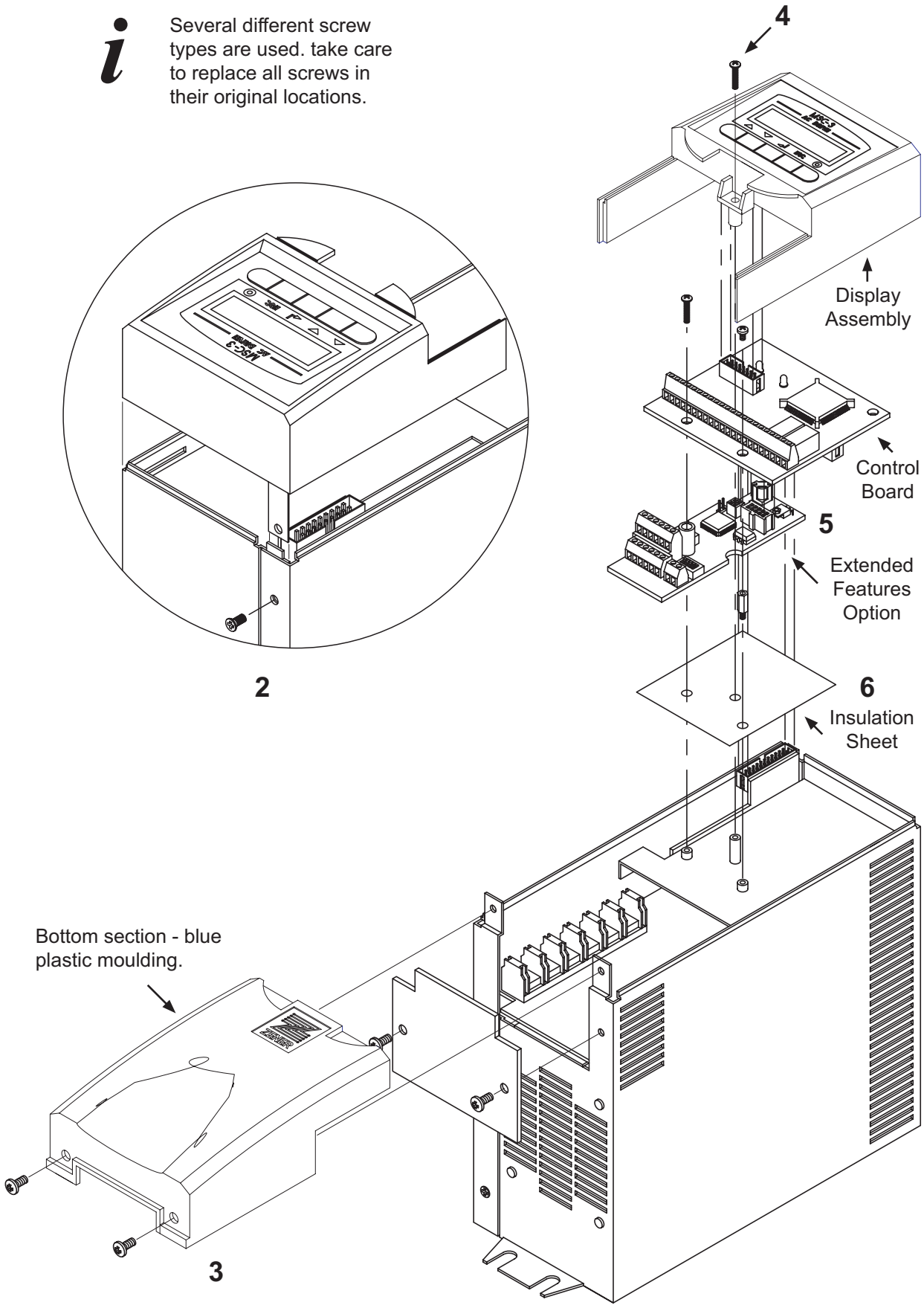
There are hazardous voltages inside MSC-3 whenever it is connected to an electrical supply and for sometime afterwards.

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 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.

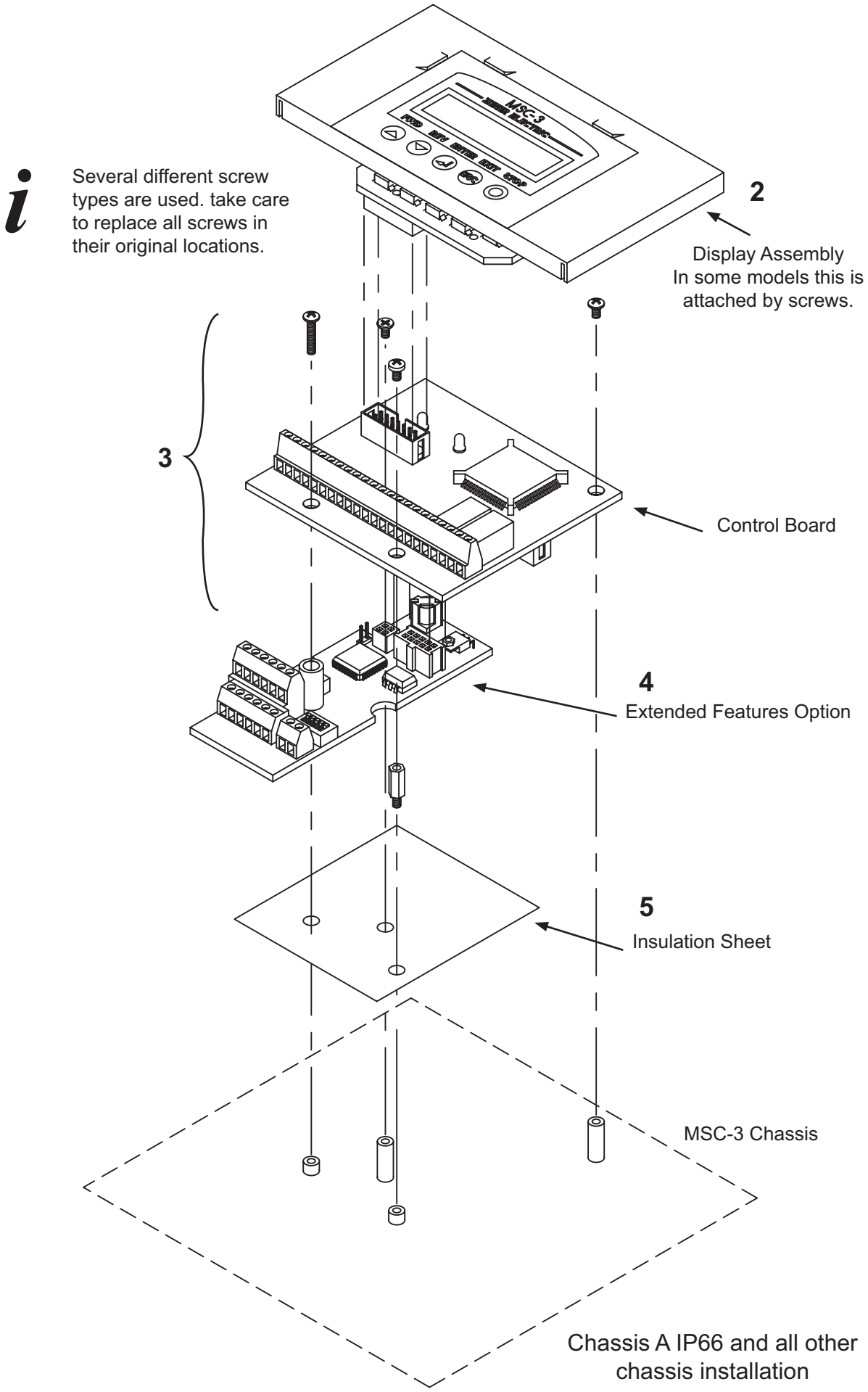
IP30 Chassis A Installation

1. Ensure all power sources have been removed for at least 11 minutes and that they remain that way for the rest of the installation.
2. Remove the screw from the top of the enclosure.
3. Remove the bottom section of the MSC-3 blue plastic moulding to reveal the power terminals.
4. Remove the screw holding the control board/display assembly and pull it off the drive.
5. Turn the control board/display assembly over and plug the Extended Features Option into one of the available option connectors.
6. Lay the insulation sheet on top off the exposed metal work and replace the control board/display/ option assembly.
7. Replace the original mounting screw and install the Extended Features Option mounting screw. The Extended Features Option is ready for control wiring. Refer to the wiring diagram for wiring examples.
8. Once control wiring is complete replace the bottom moulding.
9. When the MSC-3 is switched on, restore defaults for each new option fitted or existing options that occupy an alternate connector. Refer to the J00 OPN DEFAULTS section on page 13 of this manual for details.

Several different screw types are used. take care to replace all screws in their original locations.



IP30 Chassis A Installation


Several different screw types are used. take care to replace all screws in their original locations.
2
Display Assembly
In some models this is attached by screws.
3
Control Board
4
Extended Features Option
5
Insulation Sheet
MSC-3 Chassis
Chassis A IP66 and all other chassis installation

Installation

There are hazardous voltages inside MSC-3 whenever it is connected to an electrical supply and for sometime 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 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.

IP 66 Chassis A Installation and all other chassis

1. Ensure all power sources have been removed for at least 11 minutes and that they remain that way for the rest of the installation.
2. Open the front door, remove any screws securing the display assembly and lift it off.
3. Remove the screws securing the control board to the chassis and lift of the control board.
4. Turn the control board over and plug the Extended Features Option into one of the available option connectors.
5. Lay the insulation sheet on top off the exposed metal work and replace the control board/option assembly.
6. Replace the control board and display assembly and appropriate screws. The Extended Features Option is ready for control wiring. Refer to the wiring diagram for wiring examples.
7. Once control wiring is complete close the front door.
8. When the MSC-3 is switched on, restore defaults for each new option fitted or existing options that occupy an alternate connector. Refer to the J00 OPN DEFAULTS section on page 13 of this manual for details.

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Extended Features Option Menus

Refer to the MSC-3 Startup Section in the MSC-3 Instruction Manual for an explanation of the MSC-3 Menu System.

The menus of the MSC-3 are extended when Extended Features Options are fitted. The extensions are the additional features that the option brings to the MSC-3. As there may be two of the same Extended Features Options fitted, duplication of features occurs.

Appended to the code field of each option menu item is either an 'L' for left hand side option or an 'R' for right hand side option. Use the 'L' or 'R' to identify each of the duplicated features.

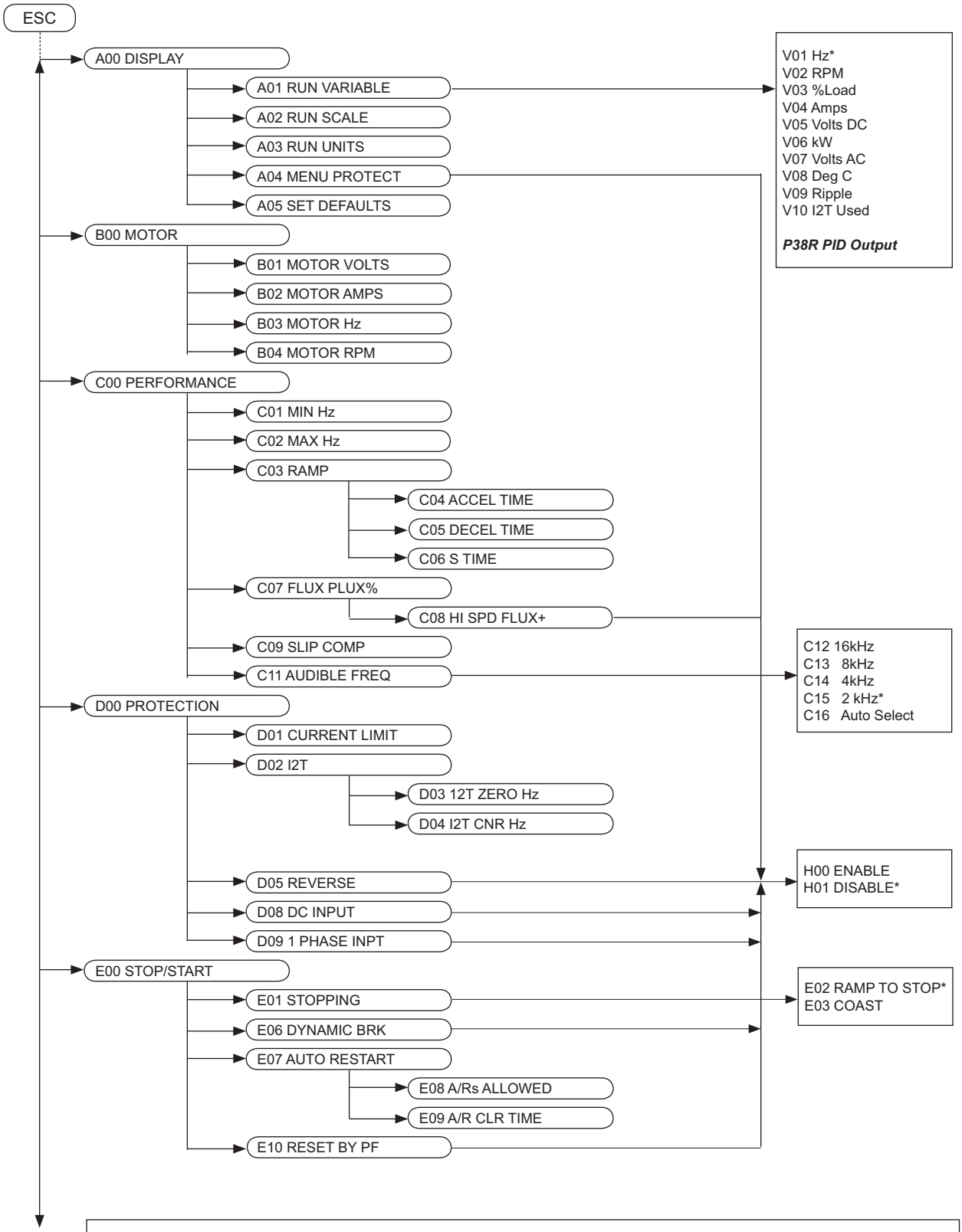
For example, to restore factory defaults for the Extended Features Option installed on the left hand side, the J00L OPN DEFAULTS menu item must be found.

i The remainder of this manual will not use the 'L' or 'R' when describing menu items or features as the MSC-3 Extended Features Option may be installed in either location.

The control console menu structure, with the Extended Features Option fitted is shown on the following pages.

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)

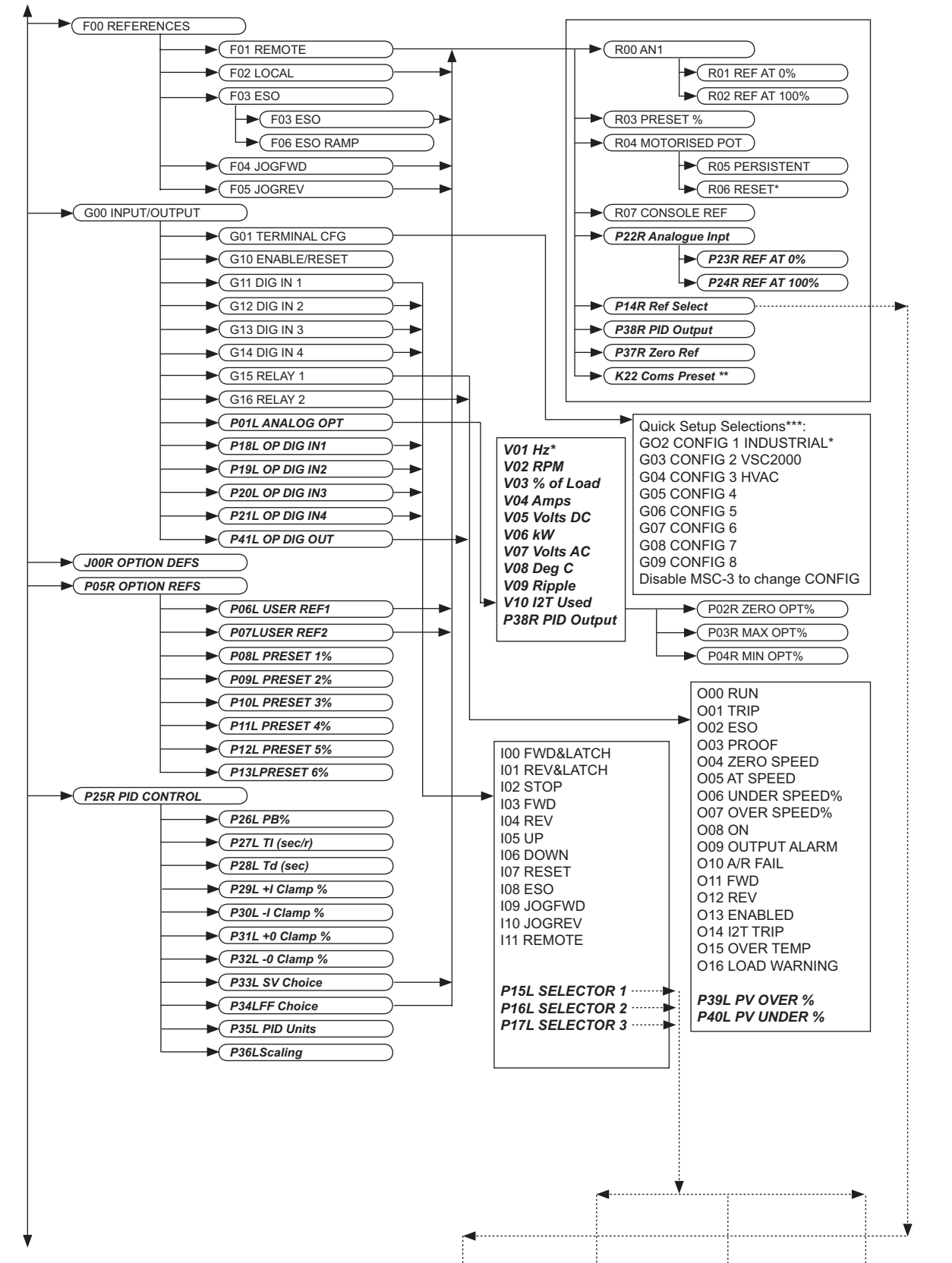
▲(Up) or ▼(Down) moves within menu group or for adjustable parameters changes the parameter value

↵ 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



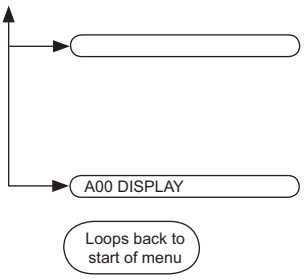
Bold Italic Parameters on this page appear automatically on fitting the Extended Features Option e.g. ***P22R Analog Inpt*** is the analogue input of option card fitted in the right slot, left slot would be ***P22L Analog Inpt***.

* Indicates default setting

** Any communications option card fitted

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

P14L Ref Select	*P15L Selector 1*	*P16L Selector 2*	*P17L Selector 3*
P06L User Ref 1	Low	Low	Low
P07L User Ref 2	Low	Low	High
P08L Preset 1	Low	High	Low
P09L Preset 2	Low	High	High
P10L Preset 3	High	Low	Low
P11L Preset 4	High	Low	High
P12L Preset 5	High	High	Low
P13L Preset 6	High	High	High



Additional menu items will appear here if another option board is fitted.

Option Defaults

J00 OPN DEFAULTS

Menu location: See page 11.

Use the up (▲) and down (▼) push buttons to find the **J00 OPN DEFAULTS** menu when the option needs to be initialized to a known state.

IMPORTANT! Restoring factory defaults must be done when the option is commissioned. This is necessary to ensure option settings are updated with connector position information for correct feature identification and operation.

With **J00 OPN DEFAULTS** displayed, press Enter and the message J01 Check Option is displayed as a reminder that unexpected behaviour may result due to existing wiring. Press Enter to restore factory defaults.

If the **J00 OPN DEFAULTS** menu cannot be found the Extended Features Option may be initialized by the following procedure:

1. Follow the installation procedure for disassembly details to access the Extended Features Option. Remove the Extended Features Option and locate **J1**.
2. Ensure **J1** is linked and reinstall the option as per the installation procedure.
3. Power the MSC-3 up for several seconds and then power it down. Wait at least 11 minutes for the power capacitors inside the MSC-3 to discharge to less than 50 VDC. Refer to Hazardous Voltage Warning on page 1. The link across **J1** has to be removed. Follow the installation procedure for disassembly details to access the Extended Features Option.
4. Locate **J1** and remove the link and reinstall as per the installation procedure.

Thermal Protection Input

The Extended Features Option provides thermal protection through the TH+ and TH- terminals (see page 26). To use the thermal input, remove the factory installed wire link and wire in its place the thermal device leads. The MSC-3 will stop the motor and display the message OT THERM when the thermal device activates or in the case of a thermistor when its resistance is greater than approximately 3300 Ohms.

The thermal protection input is a hardware feature that is always active and so does not require any user setup. Thermal devices include thermistors, thermal switch, thermal overload.

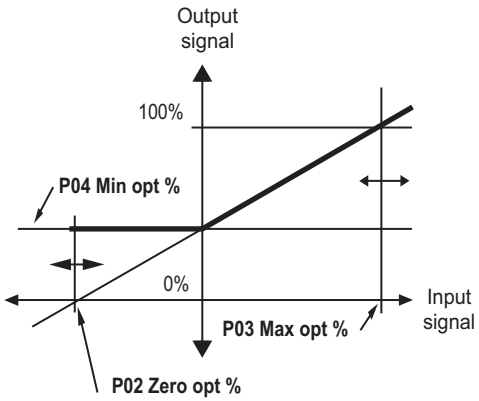
Analog Output

A hardware component of Extended Features Option is a single isolated analog output (see page 26) that is configurable for 0-5V, 0-10V, 0-20mA or 4-20mA by setting the DIP switch as shown.

Range	Extended Features Option SW1		
	3	4	5
0-5V	off	**ON**	**ON**
0-10V	**ON**	off	**ON**
0-20mA	off	off	off
4-20mA**	off	off	off

** See **P02 Zero opt %** and **P04 Min opt %** to specify 4 mA offset.

Several settings contribute to the analog output configuration. They are **P01 Analog Opt, P02 Zero opt %, P03 Max opt %. and P04 Min opt %**. The MSC-3 will display the present settings each time the analog output menu is entered. The following graph shows how these values affect output scaling



P01 Analog Opt

Default value: **V01 Hz**

Menu location: The **G00 INPUT/OUTPUT** menu

Choose from:

Signal	Comment	0 Output	Full Scale Output
V01 Hz	Output frequency	0	MAX Hz
V02 rpm	Motor speed	0	Synchronous motor rpm
V03 %Load	Relative Motor load	0	Overload current[1,2]
V04 Amps	Drive output current	0	Overload current[1]
V05 Volts DC	DC link voltage	0	1.69 x Vout AC max
V06 kW	Drive output power	0	1.69 x Vout AC max x Overload current
V07 Volts AC	Drive output voltage	0	1.1 x Vout AC max
V08 ºC	Power circuit temperature (Celsius)	-273 (Celsius)	227 (Celsius)
V09 Ripple	A number proportional to the RMS current in the DC bus capacitors, provided for factory diagnostic purposes	Not Applicable	Not Applicable
V10 I^2t used	Motor thermal overload level	0	Overload current
P38 PID Output	PID output	0	MAX Hz

This menu requires a signal source selection from the list of available signals. Use the up and down push buttons to move through the list. Press Enter to make your choice or ESC to abandon.

P02 Zero opt %

Default value: **0%**

Menu location: The **P01 Analog Opt** menu

Range: -100 to 100% of chosen signal

This value specifies the percentage of the chosen signal that will produce zero output at the analog output terminals. Also, if the chosen signal goes below this value, zero output is found at the output terminals.

For example, with V02 rpm as the chosen signal, a 4 to 20mA output is required for the speed range. Set P02 Zero opt % to -25% and P03 Max opt % to 100%.

[1] See MSC-3 output current specification in the MSC-3 Instruction Manual.

[2] Based on a Power Factor of 0.85.

P03 Max opt %

Default value: 100%

Menu location: The **P01 Analog Opt** menu

Range: -1000 to 1000% of chosen signal

This value specifies the percentage of the chosen signal that will produce maximum output at the analog output terminals. Also, if the chosen signal goes above this value, maximum output is maintained at the analog output terminals.

P04 Min opt %

Default value: 0%

Menu location: The **P01 Analog Opt** menu

Range: 0 to 100% of output signal

This value specifies the minimum output value permitted at the analog output terminals under all conditions. If the signal to be output is below this value, it will be ignored and the minimum value is output instead.

For example, with **V01 Hz** as the chosen signal, a 0 to 5V output is required for the speed range 0 to 50 Hz. It is required that if the speed drops below 10Hz the output is not to drop below 1V. In this case set the P04 Min Opt % to 20%.

Analog Output Setup Checklist

1. Set the Extended Features Option DIP switches (SW1-3,4,5) for the output signal type to be used (voltage signal or current signal) and connect your monitoring equipment.
2. Find the **P01 Analog Opt** menu item in the **G00 INPUT/OUTPUT** menu.
3. Choose the signal source.
4. Check and/or adjust the **P02 Zero Opt %.**
5. Check and/or adjust the **P03 Max Opt %.**
6. Check and/or adjust the **P04 Min Opt %.**

Extended Features Option References

P05 OPTION REFS

This menu contains the additional references of the Extended Features Option. Extra references include six presets and two user selectable references that are selected by digital input wiring. The next section (Reference Selector) explains how the digital inputs select a reference.

User Selectable References

P06 User Ref 1

Default value: **R00 AN1** (Terminals 10 & 11 on MSC-3 Control Board)

P07 User Ref 2

Default value: **P22 Analog Input** (Terminals 9 & 10 on Extended Features Option Board)

Menu location: **P05 OPTION REFS** menu (see page 11)

The above two user selectable references can each be mapped to anyone of the following selections:

R00 AN1	Control board analog input
R03 PRESET	Control board preset
R04 MOTORIZED POT	Control board Motorized potentiometer
R07 CONSOL REF	Control board console reference
P22 Analog inpt	Extended Features Option analog input
P14 Ref select	Extended Features Option reference selector
P38 PID output	Extended Features Option PID controller output
P37 Zero ref	Extended Features Option zero reference

Note: If **P14 Ref Select** is chosen for either **P06 User Ref 1** or **P07 User Ref 2**, zero speed is used as the speed reference.

Preset References

P08 Preset 1

P09 Preset 2

P10 Preset 3

P11 Preset 4

P12 Preset 5

P13 Preset 6

Default values: 10,20,30,40,50,60 % (respectively)

Menu location: **P05 OPTION REFS** menu

Range: -100 % to +100 % of the **C02 MAX Hz** value or

-100 % to +100 % of the Process variable range if used for the PID set point.

The preset speeds provide extra speed references for the MSC-3. When a preset is selected it is adjusted using the console Up and Down push buttons. Setting a negative preset value will specify a reverse speed reference provided reverse operation has been enabled and the FWD and REV inputs are wired to +5V.

Reference Selector

P14 Ref Select

Menu location: F00 References and P05 Option Refs (see page 11)

Three digital inputs i.e. P15 Selector 1, P16 Selector 2 and P17 Selector 3 are used to define the active reference of P14 Ref Select according to the logic table below.

Active Speed Reference	**P15 Selector 1**	**P16 Selector 2**	**P17 Selector 3**
P06 User Ref 1	Low	Low	Low
P07 User Ref 2	Low	Low	High
P08 Preset 1	Low	High	Low
P09 Preset 2	Low	High	High
P10 Preset 3	High	Low	Low
P11 Preset 4	High	Low	High
P12 Preset 5	High	High	Low
P12 Preset 6	High	High	High

The defaults (see page 18) has the Extended Features Option digital input P18 OP DIG IN1 mapped to P15 Selector 1, P19 OP DIG IN2 to P16 Selector 2 and P20 OP DIG IN2 to P17 Selector 3. The high or low state of selector 1...3 can then be defined through the digital inputs e.g. to make Selector 1 high, apply 5Vdc to terminal D1 (P18 OP DIG IN1).

Example

If F01 REMOTE is set as P14L Ref Select and P06L User Ref 1 is set as R00 AN1 (default) and P07L User Ref 2 is set to P22L Analog Input (default) and the digital inputs on the Extended Features Option Board D1 (P15L Selector 1), D2 (P16L Selector 2) and D3 (P17 Selector 3) are all low, then the active remote reference is P06L User Ref 1 which is analog input AN1 (see dotted lines and logic table in parameter list mapping at the bottom of page 11).

If digital input D3 is high, then the active remote reference is P07L User Ref 2 which is analog input P22L Analog Input. If all digital inputs are high then the active remote reference is P12L Preset 6.

Reference Selector Setup Checklist

1. Find the **P05 OPTION REFS** menu item in the first setup menu after the running display.
2. Find the **P06 User Ref 1** menu item and check the selected reference source.
3. Find the **P07 User Ref 2** menu item and check the selected reference source.
4. The remaining menu items in the **P05 OPTION REFS** menu are for the preset speeds. Check each preset as required.
5. A list of digital inputs appears in the **G00 INPUT/OUTPUT** menu. Check each digital input function to be aware of which terminals are assigned the speed selector functions **P15 Selector 1, P16 Selector 2 and P17 Selector 3**. By default they are assigned to **P18 OP DIG IN 1, P19 OP DIG IN 2 and P20 OP DIG IN 3** respectively.
6. Connect the necessary reference selection wires to these terminals (refer to the connections diagram for example wiring).
7. Find the **F00 REFERENCES** menu item in the first setup menu and know the mode(s) in which reference selection is required e.g. Remote mode. Choose **P14 Ref select** as the speed reference for this mode.

Extended Features Option Digital Inputs

P18 OP DIG IN 1

Default value: P15 Selector 1

P19 OP DIG IN 2

Default value: P16 Selector 2

P20 OP DIG IN 3

Default value: P17 Selector 3

P21 OP DIG IN 4

Default value: **I01 REV&LATCH**

Menu location: The **G00 INPUT/OUTPUT** menu (see page 11)

Choose from:

I00 FWD&LATCH	Control board foward & latch input function
I01 REV&LATCH	Control board reberse & lach input function
I02~STOP	Control board / Stop input function
I03 FWD	Control board forward input function
I04 REV	Control board reverse input function
I05 UP	Control board motorized pot up inut function
I06 DOWN	Control board motorized pot down input function
I07 RESET	Control board trip reset input function
I08 ESO	Control board essential services override input function
I09 JOGFWD	Control board jog forward input function
I10 JOGREV	Control board jog reverse input function
I11 REMOTE	Control board remote input function
P15 Selector 1	Extended Features Option selector input 1 function
P16 Selector 2	Extended Features Option selector input 2 function
P17 Selector 3	Extended Features Option selector input 3 function

Use the Up and Down push buttons to select a reference and press Enter to accept or Esc to abort.

Changing Extended Features Option digital input functions with wiring still connected will require power to be removed until the display blanks out and then power reapplied.

Extended Features Option Analog Input

A hardware component of the Extended Features Option is a single analog input that is configurable for 0-5V, 0-10V, 0-20mA or 4-20mA by setting the DIP switch as shown.

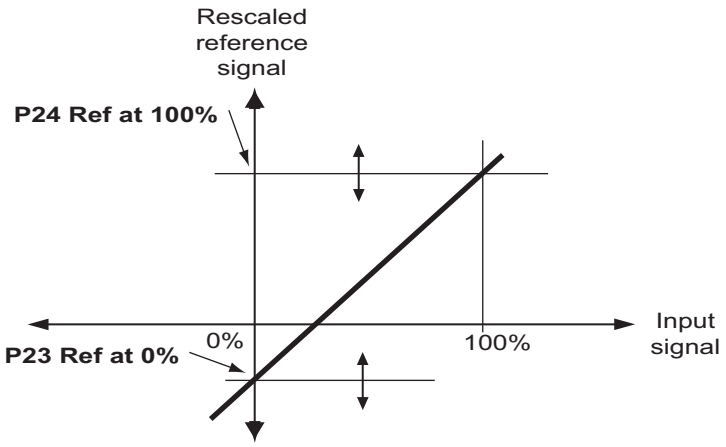
Range	Extended Features Option SW1	
	1	2
0-5V	off	**ON**
0-10V	off	off
0-20mA	**ON**	**ON**
4-20mA**	**ON**	**ON**

**For a 4 to 20 mA input signal, P23 Ref at 0% must be set to -25%.

P22 Analog input

Menu location: Reference selection list (F00 References see page 11)

The analog input of the Extended Features Option requires two parameters to rescale the reference. They are **P23 Ref at 0%** and **P24 Ref at 100%**. Each time the **P22 Analog input** is selected in the menu, each value may be checked or adjusted as needed. The following graph shows how these two values affect input rescaling.



P23 Ref at 0%

Menu location: The P22 Analog input menu from Reference Selector List (F00 References see page 11)

Range: -1000% to 1000%

Default value: 0 %

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 20 mA input signal, P23 Ref at 0% must be set to -25%.

P24 Ref at 100%

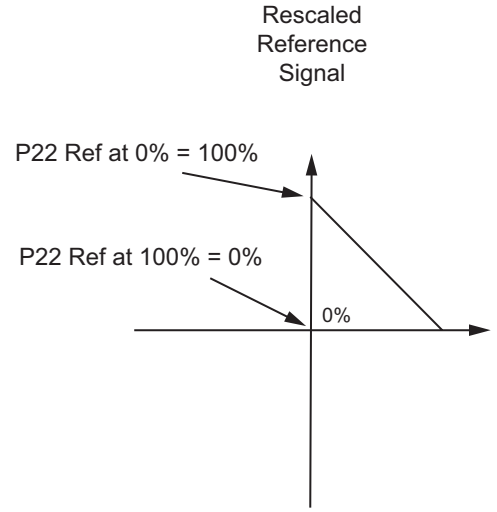
Menu location: The P22 Analog input menu from Reference Selector List (F00 References see page 11)

Range: -1000% to 1000%

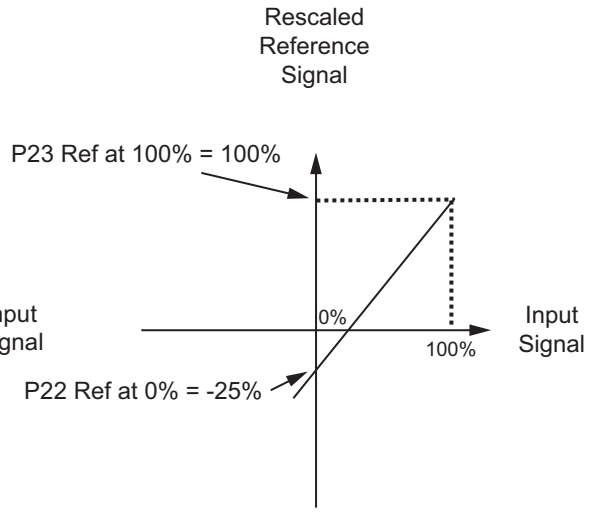
Default value: 100 %

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

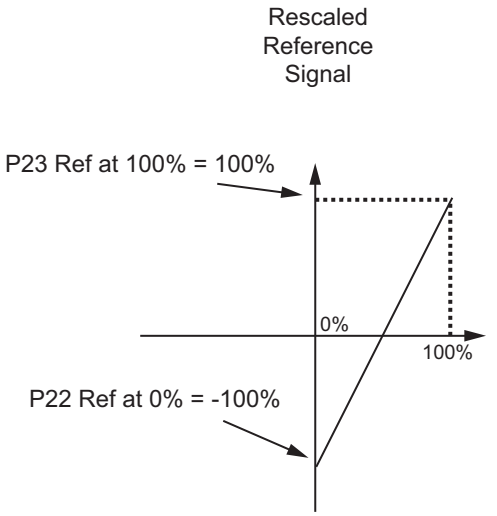
Examples of some analog input scaling:



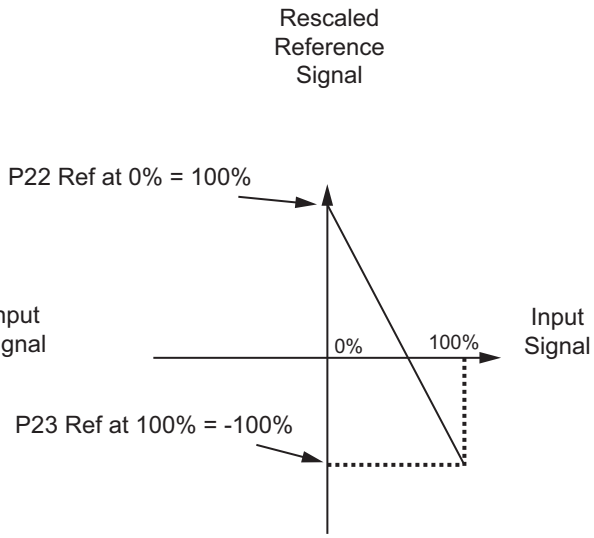
Inverse Acting Input



4 to 20mA Input



Bipolar Input



Inverse Acting
Bipolar Input

REFERENCE SIGNAL SCALING

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.
$m = \frac{\frac{40-30}{60}}{4-2} = 0.083$ $REFAT0\% = (\frac{40}{60} - 0.083 * 4) * 100 = 33$ $REFAT100\% = 100 * 0.083 * 10 + 33 = 117$	$m = \frac{\frac{60+60}{60}}{0-10} = -0.2$ $REFAT0\% = (\frac{60}{60} + 0.2 * 0) * 100 = 100$ $REFAT100\% = 100 * -0.2 * 10 + 100 = -100$

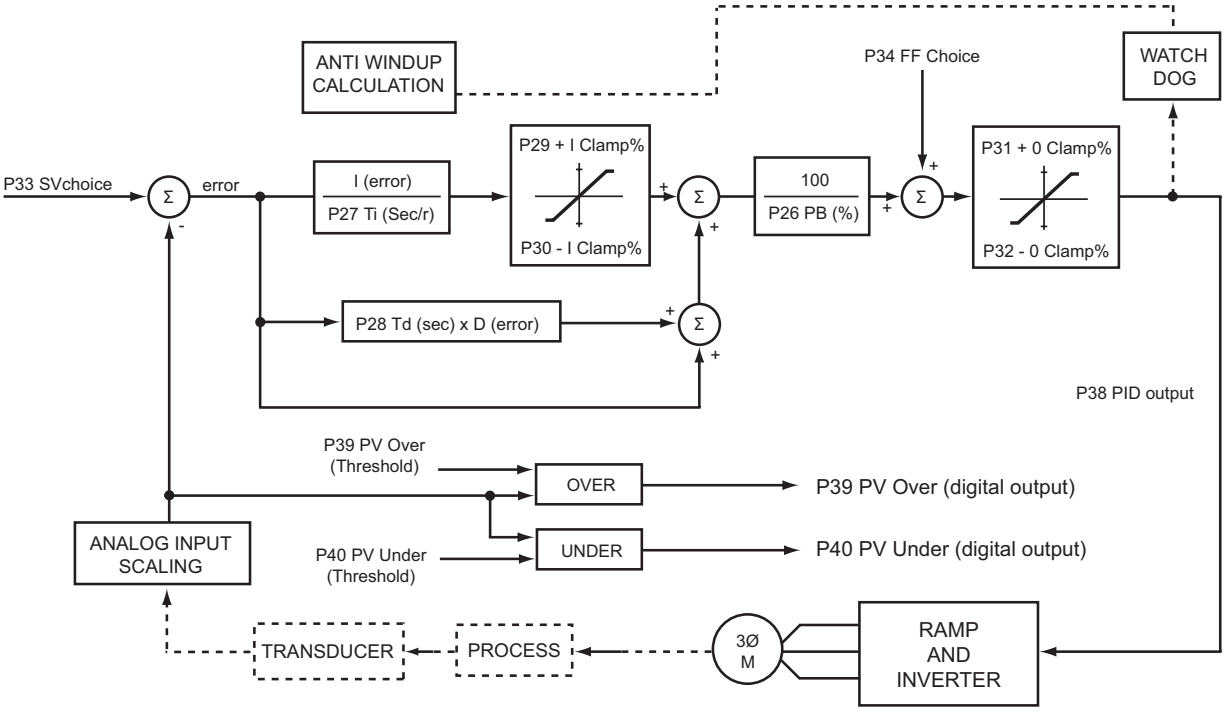
PID CONTROLLER

The PID controller of the MSC-3 include the following features:

- Adjustable Integrator anti-windup
- Adjustable Output saturation with anti-windup
- Open loop to closed loop initialization
- Selectable set point and feed forward input signals
- Input / Output signal spanning
- Process variable UNDER and OVER Alarm

PID Structure

PID controllers (also referred to as Three-Term controllers) are used to stabilize and/or regulate a process at a desired operating point. PID controllers function by finding the difference between the required operating point (the Setpoint Variable or SV) and a measured process quantity (the Process Variable or PV). This difference between the two signals is called the 'error'. In regulator mode, the PID controller operates to reduce the error to zero at which point the measured quantity is equal to the required operating point.



PID FUNCTION BLOCK DIAGRAM

PID Menu Structure

P25 PID Control

Menu location: The first setup menu

This menu is the entry point for the PID controller menus where adjustments can be made. When the menu is selected, using the Up and Down pushbuttons will scroll through the PID parameter menu. The table below lists the parameters that may be adjusted. When each parameter is selected for adjustment use the up and down push buttons to adjust, Enter to select and Esc to abort.

Parameter	Default Value	Minimum	Maximum	Units
P26 PB (%)	300	-1000	1000	%
P27 Ti (sec/r)	2.00	0 (note1)	20.00	sec/r
P28 Td (sec)	0.00	0.00	5.00	sec
P29 +I Clamp %	100	0	100	%
P30 -I Clamp %	-100	-100	0	%
P31 +O Clamp %	100	0	100	%
P32 -O Clamp %	-100	-100	0	%
P33 SV Choice	**R00 AN1**	(note 2)		
P34 FF Choice	**P37 Zero Ref**	(note 2)		
P35 PID Units	%	(note 3)		
P36 Scaling	100	1.0	9999	(note 4)

Notes:

(1) A value of less than 0.05 will disable the integrator action.

(2) Reference choices are made from the list of available references. Motorised pot or Reference Selector of another Extended Features Option are unavailable for use with PID. If selected, a reference of zero will be used.

(3) Units contain a maximum of eight characters chosen from the set of characters found in appendix A.

(4) Units are those entered at the **P35 PID Units** menu. Upon acceptance of the scale value the decimal point is ready to be specified. The decimal point position is adjusted using the up & down pushbuttons and is accepted by the Enter push button and aborted with the Esc push button.

PID Speed Reference

P38 PID output

Menu location: Reference selection list (F00 References see page 11)

Selecting the **P38 PID output** as the speed reference will connect the PID controller to the MSC-3 speed controller. The PID controller uses the standard features of the MSC-3 as its output stage that provides the necessary power to drive the process.

The PID loop is closed when **P38 PID output** is selected as the reference for the inverter. This may be done either by terminal function (Remote, local…) or through the reference selector. The PID controller output is accessed regularly and each access resets the internal PID watchdog function. The role of the internal PID watchdog is to determine when the PID controller is to be initialised.

PID Run Variable

P38 PID Output

Menu location: Run Variable selection list

When the P38 PID Output is the selected run variable, the displayed information is different from regular MSC-3 operation. The table below indicates the operational differences.

	Mode	
	Standard MSC-3 Display	**PID controller display**
Top Line	Run variable (speed, load, etc). If **VO1 Hz** selected, the value is displayed according to the scale and units entered in the **A02 RUN SCALE** and **A03 RUN UNITS** menus.	The process variable displayed according to the **P35 PID Units** and **P36 PID Scale**
Bottom Line	The speed reference displayed according to the scale entered in the **A02 RUN SCALE** menu.	The value of the setpoint variable according to the **P36 PID Scale**.

PID Digital Outputs

P39 PV Over %

Default value: 80%

Range: -100 to 100%

Menu location: Digital output selection list

The P39 PV Over function (when assigned to a relay) will activate when the PV output is above the P39 PV Over threshold. The threshold may be adjusted when this function is selected. There is a 2% switching hysteresis around the threshold. This function is available even when the PID controller is not in use.

P40 PV Under %

Default value: 20%

Range: -100 to 100%

Menu location: Digital output selection list

The P40 PV Under function (when assigned to a relay) will activate when the PV output is under the P40 PV Under threshold. The threshold may be adjusted when this function is selected. There is a 2% switching hysteresis around the threshold. This function is available even when the PID controller is not in use.

Extended Features Option Digital Output

P41 Op Dig out

Default values: O00 RUN

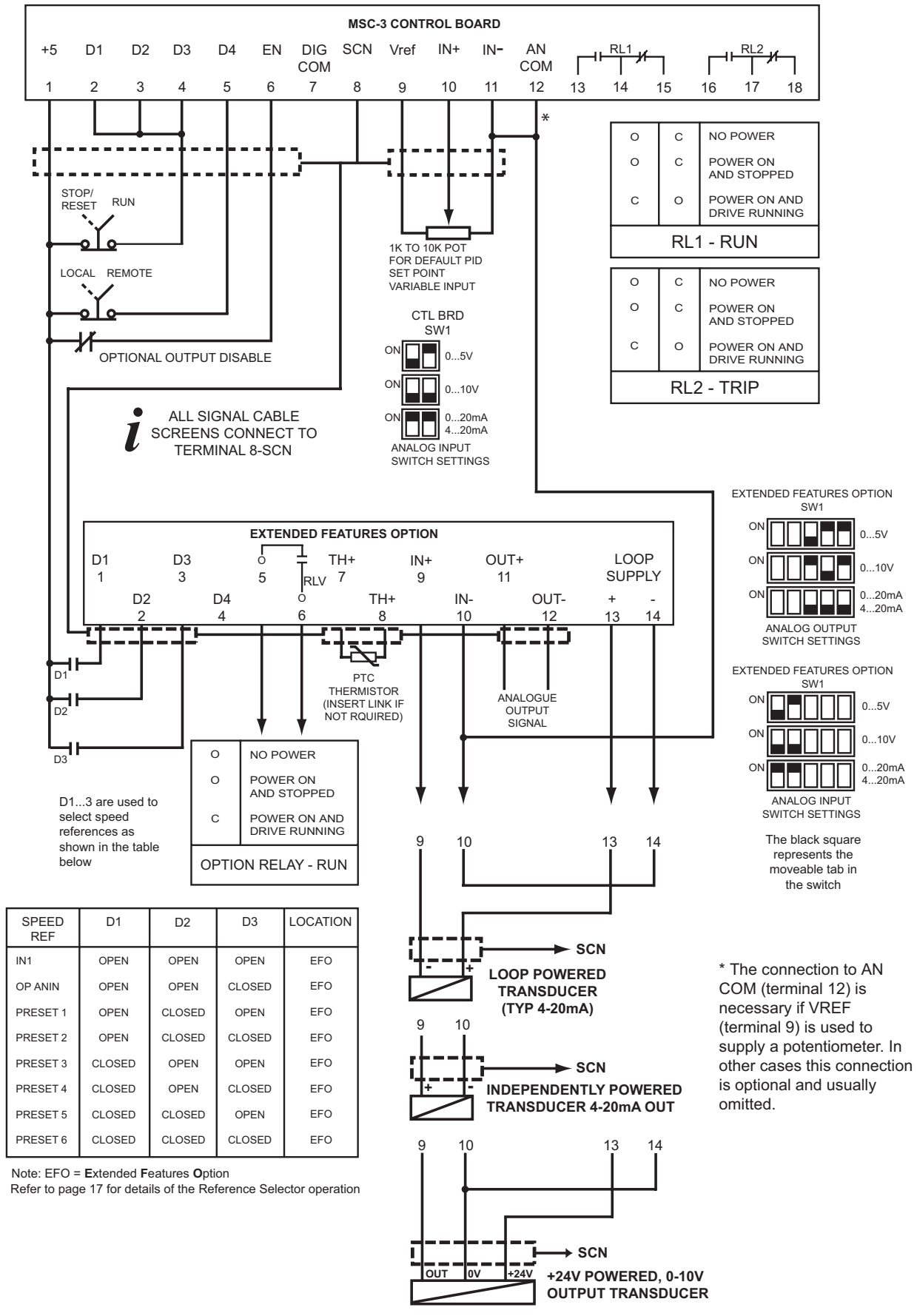
Menu location: G00 INPUT/OUTPUT menu

Choose from:

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. See page 46 of the MSC-3 manual.	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 61 of the MSC-3 manual.	None
O10 A/R FAIL	Indicates that the drive could not auto restart as all restarts have been exhausted. See page 48 of the MSC-3 manual.	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. See page 45 of the MSC-3 manual.	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 page 60 of the MSC-3 manual.	2 Calibration points
P39 PV OVER %	Indicates that the process variable is over the threshold value. See page 24 of this manual.	% of CO2 MAX Hz
P40 PV UNDER %	Indicates that the process variable is under the threshold value. See page 24 of this manual.	% of CO2 MAX Hz

Use the up and down push buttons to move through the list of relay output functions and press Enter to select the displayed function or Escape to abandon the selection.

PID Control Wiring



SPEED REF	D1	D2	D3	LOCATION
IN1	OPEN	OPEN	OPEN	EFO
OP ANIN	OPEN	OPEN	CLOSED	EFO
PRESET 1	OPEN	CLOSED	OPEN	EFO
PRESET 2	OPEN	CLOSED	CLOSED	EFO
PRESET 3	CLOSED	OPEN	OPEN	EFO
PRESET 4	CLOSED	OPEN	CLOSED	EFO
PRESET 5	CLOSED	CLOSED	OPEN	EFO
PRESET 6	CLOSED	CLOSED	CLOSED	EFO

Note: EFO = **E**xtended **F**eatures **O**ption
Refer to page 17 for details of the Reference Selector operation

* The connection to AN COM (terminal 12) is necessary if VREF (terminal 9) is used to supply a potentiometer. In other cases this connection is optional and usually omitted.

Setup Checklist and Tuning

1. Control Wiring (Assumes factory defaults are loaded)

All wiring must be done while the MSC-3 is disconnected from the power supply. Refer to the Control Wiring Diagram for details

1.1. Wire in the transducer that measures the process variable (PV) to the analog input of the Extended Features Option.

1.2. Wire in the set point variable (SV) to the analog input found on the control board.

1.3. Wire in any metering device to the analog output of the Extended Features Option

1.4. Ensure the signal levels are compatible with the input/output specifications of each feature. Refer to the PID Control Wiring diagram for details.

2. Source selection

Variation from the default SV and FF references are done in the P33 SV choice, and P34 FF choice menus. If variations are made rewire as necessary

3. Preparing for PID Control

3.1. After initial power on alter any MSC-3 settings and/or selections.

3.2. Specifically check the desired maximum motor frequency at which the process may be safely driven. Refer to C02 MAX Hz to check the maximum Hz setting.

3.3. Perform any analog input adjustments of each analog input in use.

3.4. Perform any analog output adjustments of each analog output in use.

3.5. Perform any PID parameter adjustments e.g.. P26 PB (%), P27 Ti (sec/r), etc.

4. Tuning

The following steps are applicable in most cases. However, running the controller system without defined limits must be done with caution in case excessive speeds result in hazardous conditions or damage.

4.1. PV signal verification: run the drive/motor/process in open loop mode if possible at a known speed and check the feedback signal is correct for the operating point.

4.2. If possible, operate the system at the maximum (safe) operating point and verify that the PV signal is now at the expected level.

4.3. Switch off the integrator by setting P27 Ti (sec/r) to zero.

4.4. To close the loop the MSC-3 inverter speed reference (Remote, Local, ESO, JOGFWD or JOGREV) must be set to P38 PID output.

4.5. Closing the loop: after the loop has been closed observe the PV behaviour. If the system is unstable increase the P26 PB (%) to stabilize the system. In general, increasing the P26 PB (%) will stabilize the system. Decreasing P26 PB (%) will produce a faster response at the expense of system stability.

4.6. If the system response oscillates momentarily, the system is under damped. An increase of the derivative time P28 Td (sec) can improve damping but excessive use may increase the systems response to noise.

4.7. Allow the system to settle. If the PV value does not equal the SV value then the system has a steady state error. To remove steady state error, set the P27 Ti (sec/r) to the maximum. Decrease the P27 Ti (sec/r) remove the steady state error more rapidly.

4.8. Minor adjustments to P26 PB (%), P27 Ti (sec/r) and P28 Td (sec) may be performed to achieve the desired system response. Use the PID Tuning Summary below for general remedies to common problems.

4.9. Change the P35 PID Units and P36 Scaling to represent the signal PV and SV signals correctly.

5. PID Tuning Summary:

Problem	Remedy
In open loop the PV does not match the desired operating point	Check the transducer signal and check the analog input settings of the **P22 Analog input** menu.
In closed loop operation the system is unstable	Increase the P26 PB (%) or decrease the **P28 Td (sec)**.
The system responds too slowly	Decrease the **P26 PB (%)** or decrease the **P27 Ti (sec/r)**.
The system oscillates momentarily	Increase the **P26 PB (%)** or decrease the **P28 Td (sec)**.
PV does not equal the SV	Increase the **P26 PB (%)** or decrease the **P28 Td (sec)**. A steady state error exists and is removed by using the **P27 Ti (sec/r)**. Start with a large value and then decrease it until a satisfactory response to a SV change is observed.

Application Examples

Step by step procedures are shown in the MSC-3 instruction manual for the following applications that utilise features on the Extended Features Option.

Application: Stair pressurisation fan with internal PID

See page 31 of the MSC-3 manual. 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).

Application: Cooling tower fan with reverse acting internal PID

See page 33 of the MSC-3 manual. 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).

Application: Water pumping with automatic pressure control

See page 21 of the MSC-3 manual. 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).

A similar application is shown on pages 30 and 31 of this manual.

Application: Constant Pressure Water Pumping

This setup is for constant pressure water pumping application that requires water pressure control using a water pressure transducer and PID controller function provided by the MSC-3 extended features option. 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 of the MSC-3 Instruction Manual

STEP 2 Connect the control wiring as shown on page 27.

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 of the MSC-3 Instruction Manual for MSC-3 startup, setting the parameters according to the table below. Alternate values may be used to suit the application. See page 23 for information on tuning the PID performance.

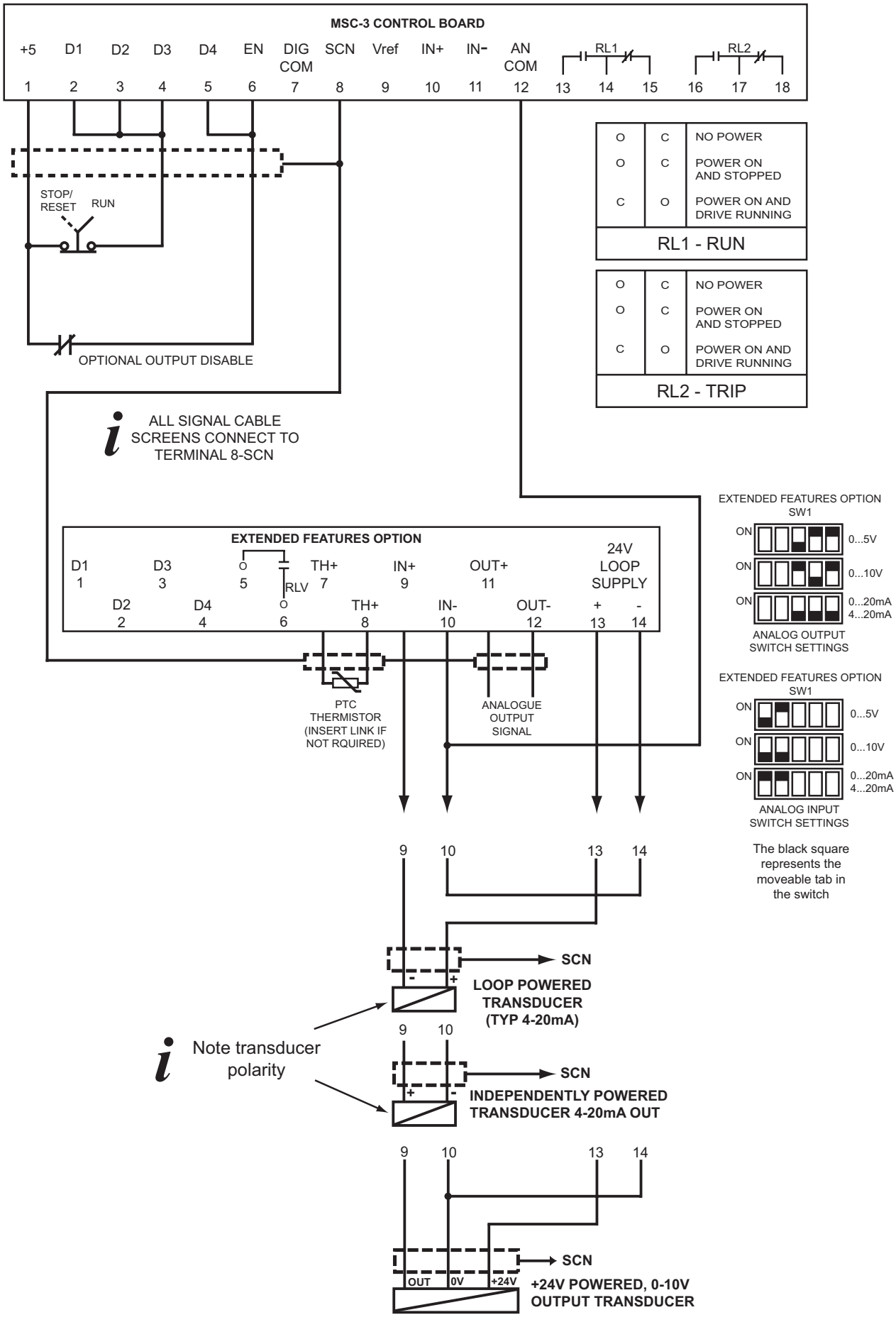
Menu	Item	Suggested Setting	MSC-3 Instruction Manual page for detailed information
Input/Output	Terminal strip configuration	G02 TERMINAL CFG = G02 CONFIG 1 (Factory default)	53
	Relay 1	G15 RELAY 1 = O00 RUN (Factory default)	59
	Relay 2	G16 RELAY 2 = O01 TRIP (Factory default)	
Motor	Motor Voltage	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 Set to % of transducer full scale equivalent to required pressure.	52
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

***** To suit application.

Application: Constant Pressure Water Pumping



Your MSC-3 Extended Features Option Setup Notes

Photocopy this page or complete in pencil

Site Designator .....

MSC-3 Serial No. .....

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

	User	Default		User	Default
ANALOG OUTPUT			**PID CONTROLLER**		
P01 Analog Opt		V01 Hz	**P26 PB (%)**		300 %
P02 Zero opt %		0%	**P27 Ti (sec/r)**		2.00 sec/r
P03 Max opt %		100%	**P28 Td (sec)**		0.00 sec
P04 Min opt %		0%	**P29 +I Clamp %**		100 %
ANALOG INPUT			**P30 -I Clamp %**		-100 %
P23 Ref at 0%		0%	**P31 +O Clamp %**		100 %
P24 Ref at 100%		100%	**P32 -O Clamp %**		0 %
DIGITAL OUTPUT			**P33 SV choice**		R00 AN1
P41 Op Dig out		O00 RUN	**P34 FF choice**		P37 Zero Ref
DIGITAL INPUT			**P35 PID Units**		%
P18 OP DIG IN 1		P15 Selector 1	**P36 Scaling**		100
P19 OP DIG IN 2		P16 Selector 2	**P39 PV Over %**		80 %
P20 OP DIG IN 3		P17 Selector 3	**P40 PV Under %**		20 %
P21 OP DIG IN 4		Rev & Latch			
EXTENDED FEATURES OPTION REFERENCES					
P06 User Ref 1		R00 AN1			
P07 User Ref 2		P22 Analog input			
P08 Preset 1		10 %			
P09 Preset 2		20 %			
P10 Preset 3		30%			
P11 Preset 4		40 %			
P12 Preset 5		50 %			
P13 Preset 6		60 %			

Specifications

Thermal Protection

- TH+ (terminal 7) / TH- (terminal 8)
- Thermistor 3300 Ohms nominal @ rated temperature.
- Microtherm, thermal switch or thermal overload.

Analog input

- IN+ (terminal 9) / IN- (terminal 10)
- Differential input configurable as either: 0 to 5V; 0 to 10V; 0 to 20mA; 4 to 20mA
- Common mode range: +/- 25Vdc to AN COM of the MSC-3 control board

Tranducer Power Supply

- 24V +15% -10%, 20mA
- Short circuit protected

Analog output

- OUT+ (terminal 11) / OUT- (terminal 12)
- Differential output configurable as either: 0 to 5V; 0 to 10V; 0 to 20mA; 4 to 20mA
- Common mode range: +/- 42Vdc to chassis
- Menu selectable signal source.

Digital inputs

- D1 (terminal 1), D2 (terminal 2) , D3 (terminal 3) and, D4 (terminal 4)
- Used in conjunction with MSC-3 control board +5V supply
- Logic low 0~2V, logic high 3~5V
- Loading 5 mA / input maximum

Digital output

- O+ (terminal 5) / O- (terminal 6)
- Contact current ratings: Resistive load: 1A at 30Vac, 0.75A at 42Vdc
  Inductive load: 0.4A at 30Vac
- Contact voltage rating: 30 Vac, 42.4 Vdc
- Menu selectable logic sources

Preset speeds

- Six internal preset speed specified as a percentage of either:
  +/-100 % of the **C02 MAX Hz** value or
  +/-100 % of the Process variable range if used for the PID set point

PID controller

- Adjustable Integrator anti-windup
- Adjustable Output saturation with anti-windup
- Open loop to closed loop initialization
- Selectable set point and feed forward input signals
- Input / Output signal spanning
- Process variable UNDER and OVER Alarm

PID Specifications

Display

- LCD back-lit display
- Display of set point and process variables
- Custom units and display scaling
- Clamp indication messages

PID Inputs

- Choice of any available reference for set point, process variables and feed forward inputs including presets and analogue inputs (0-5V, 0-10V, 4-20mA)
- Adjustable span for analog inputs

PID Outputs

- The analog output may be configured for 0-5V, 0-10V, 0-20mA, 4-20mA
- Galvanically isolated to ±42 Volts
- Adjustable span for analog output
- Output signals available for output: PID output

Digital Outputs

- A total of 3 relay outputs: two available as standard and one present on the option
- Additional outputs: PV over alarm, PV under alarm.

Alarms

- PV Under and Over alarms

Proportional Band

- Adjustable range -1000...1000 % (negative PB% inverts the PID output)

Integral Time

- Adjustable range 0...20.00 seconds / repeat (Ti = 0 disables integral action).

Derivative Time

- Adjustable range 0 ...5.00 seconds

Integrator clamp

- Adjustable range ±100% of the maximum output frequency

Output clamp

- Adjustable range ±100% of the maximum output frequency

Resolution

- ±32,767 steps

Accuracy

- 0.4% 8 bit sampling, 255 steps ± 1 step

Sample time

- 50 ms

Glossary

PB (%)

The proportional band is defined as the percentage of input signal required to produce 100% output signal. This value adjusts the 'loop gain' of the system. In general a larger PB (%) value will result in a smaller loop gain and subsequently increase system stability.

Ti (sec/r)

The integral time is the number of seconds the integrator output takes to repeat a constant input signal level. For example, if Ti = 5 sec/r and a 10Hz step from 0 Hz is applied to the integrator input, the output will equal (or repeat) the input of 10Hz, 5 seconds later (assuming PB % of 100 %).

The action of the integrator within the PID is to accumulate the error signal fed into it. If the error signal is positive, the integrator output will rise (a negative error will cause the integrator output to fall). The integrator signal will continue to rise (or fall) until either a steady state is reached or the output encounters a limit either +I Clamp or –I Clamp.

+I Clamp %

This value specifies the upper clamp value of the integrator output. If the integrator output reaches this clamp value, the anti wind up mechanism activates and the integrator output is held at the +I Clamp % value. If the error signal becomes negative, the integrator output will instantly begin to fall.

-I Clamp %

This value specifies the lower clamp value of the integrator output. If the integrator output reaches this clamp value, the anti wind up mechanism activates and the integrator output is held at the -I Clamp % value. If the error signal becomes positive, the integrator output will instantly begin to rise.

+O Clamp %

This value specifies the upper clamp value of the PID output. If the integrator output reaches this clamp value, the anti wind up mechanism activates and the PID output is held at the +O Clamp % value. If the error signal becomes negative, the PID output will instantly begin to fall.

-O Clamp %

This value specifies the lower clamp value of the PID output. If the integrator output reaches this clamp value, the anti wind up mechanism activates and the PID output is held at the -O Clamp % value. If the error signal becomes positive, the PID output will instantly begin to rise.

Set point (SV)

The set point is the value that the system output is required to reach and maintain. For example, a process requires gas pressure in a chamber to be maintained at 100 kPa and so the set point is set to 100 kPa.

Process variable (PV)

Is the output quantity of the process. For example chamber pressure. The sensing equipment measures this quantity and is the feed back quantity.

Feed FWD

The feed forward is primarily used to help linearize the system and is the value that allows the operating point to be shifted, leaving the PID controller to regulate about this operating point. For example in a web tensioning system the feed forward input sets the operating speed and the PID maintains the tension.

Display Scaling

The MSC-3 allows the SV and PV values to be rescaled to display with meaningful values. For example a pressure chamber is operated at full motor speed and the feed back transducer produces an electrical signal that corresponds to 200.0 kPa. The Scaling value should set to "200.0".

Display units

The MSC-3 allows the SV and PV values to be displayed with meaningful units. For example a pressure chamber is operated at full motor speed and the feed back transducer produces an electrical signal that corresponds to 200.0 kPa. The Scaling value should set to "200.0" and Units set to "kPa".

DIP Switch

A small, printed circuit board mounted switch generally used for configuration setting.

DIP = Dual Inline Package

Australian Manufacturers

ZENER ELECTRIC PTY LIMITED

ACN 001 595 428

DELIVERY ADDRESS
366 Horsley Road
MILPERRA
NSW 2144
AUSTRALIA

POSTAL ADDRESS
P.O. Box 4462
MILPERRA DC
NSW 1891
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