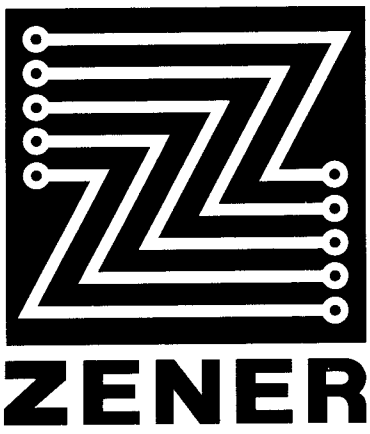
MSC

INSTRUCTION MANUAL



Australian Manufacturers of Variable Speed AC Motor Drives and Soft-Starters

ZENER TECHNOLOGY AND QUALITY ASSURANCE

Since 1978 Zener Electric has supplied many thousands of AC drives to Australian Industries. These drives have been installed into numerous applications resulting in a wealth of in house experience.

The Zener VSC 2000 AC motor variable speed controller is the culmination of this expertise, modern technology and industrial application requirements.

The Zener Quality Assurance program ensures that every VSC 2000 manufactured has proven to operate correctly in the production test bay before dispatch.

VSC 2000 PRODUCT WARRANTY

Zener Electric warranty the VSC 2000 against defective workmanship and materials for a period of 24 months from the date of dispatch. Such defects will be rectified free of charge for both labour and material, at Zener Electric's premises subject to:

1. Zener Electric's customer raising an order upon Zener for service and/or repairs, subject to a warranty claim. The order is to state particulars of the model and serial number, the date of original purchase and invoice/delivery docket number.
2. All damage resulting from incorrect installation or use other than in accordance with the instruction manuals issued by Zener Electric is excluded from this warranty.
3. The Warranty being rendered invalid if the product is misused or if any unauthorised alteration, modification or substitution of any part of the product be made or the serial number of the product is defaced or altered.
4. The cost of transportation (both ways) is to be met by the owner if it is necessary to return the product, or any part of it, to Zener Electric's premises.
5. A charge being accepted by the owner for traveling time and expenses incurred in connection with warranty service at the user's site as requested by the owner.
6. If the product was not purchased from Zener Electric directly, then a warranty claim must be lodged with the original supplier in the first instance. Repairs will not be effected by Zener Electric unless approved by the original supplier.
7. Goods not of our own manufacture incorporated in our supply or merchanted by us, carry their maker's warranty only.
8. Goods returned for claim under warranty will be accepted on the condition that should the claim be rejected then all costs, including inspection, will be charged to the customer's account.
9. Zener Electric is not liable for any consequential loss.

SAFETY

Your VSC 2000 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 VSC 2000. The Installation Manual should be completely read and understood before attempting to connect or operate the VSC 2000. Only skilled personnel should install this equipment.

THE CONTENTS OF THIS MANUAL ARE SUBJECT TO CHANGE WITHOUT NOTICE

Table of Contents

Scope

This document is intended as a guide to install and safely power-up the MSC range of Varible Frequency AC Motor Drives. It contains essential information to complete the task. All Warnings and Recommendations should be followed, and in case of uncertainty please contact Zener Electric for written clarification if necessary.

Conventions

Words that are capitalised such as INPUT 1, ACCEL or Stop refer to inputs, settings or control buttons on, or used on the MSC in an installation. Words that are in **Bold** such as **MSC Adjustments** refer to sections in this document.

Receiving

Inspect the MSC for shipping damage. If any damage is found report it to the carrier immediately. Access the inside of the controller and check for any visible signs of damage. DO NOT ATTEMPT TO OPERATE THE MSC IF ANY OBVIOUS DAMAGE EXISTS.

After initial inspection the MSC may be re-packed and stored in a clean, dry location until ready for use. DO NOT store this equipment in any area where the ambient temperature will rise above 70°C (158°F) or drop below -20°C (-4°F). DO NOT store this equipment in areas of high condensation or corrosive atmosphere. Proper storage is necessary to ensure satifactory controller start-up and performance.

MSC General Specifications

INPUT POWER SUPPLY

Refer to the **MSC Electrical Installation Diagram** for details of input power supply for each MSC model.

INPUT VOLTAGE TOLERANCE

MSC-S and MSC-L,	208 Vac - 15% (177 Vac min)
	240 Vac + 10% (264 Vac max)
DC Input	295 Vdc - 15% (250 Vdc min)
	340 Vdc + 10% (374 Vdc max)
MSC-M and MSC-R,	346 Vac - 15% (294 Vac min)
	460 Vac + 10% (506 Vac max)
DC Input	490 Vdc - 15% (416 Vdc min)
	650 Vdc + 10% (715 Vdc max)
MSC-S5	104 Vac to 120 Vac only

OUTPUT VOLTAGE

MSC-S and MSC-L	MSC-M and MSC-R
0 to 240 Vac	0 to 415 Vac
0 to 230 Vac	0 to 460 Vac
0 to 220 Vac	0 to 380 Vac
0 to 208 Vac	0 to 346 Vac
	0 to 440 Vac

The output voltage cannot exceed the input voltage. When the MSC is operated from a DC supply, the DC input voltage must be at least 1.4 x the required motor voltage.

OUTPUT CURRENT

1.5 x drive rated current for MSC-M & MSC-S
1.1 x drive rated current for MSC-R
Intermittent current ratings for 2 minutes.

OUTPUT FREQUENCY

Switch Selectable Frequency Ranges:

Minimum: 1 Hz
Maximum: 50, 75, 100 Hz / 60, 90, 120 Hz

STANDARD LOCAL CONTROLS

Speed Control Potentiometer
Forward - Stop/Reset - Reverse controls

REMOTE SPEED INPUT SIGNALS

Input One:
Potentiometer (1000 to 10,000 Ohms)
0 to 5 Vdc (Rin > 100,000 Ohms)
0 to 10 Vdc (Rin = 20,000 Ohms)

Input Two:
4 to 20 mAdc (Rin = 250 Ohms)

If Input Two is greater than 2 mA, then it will override Input One and the Local Speed Potentiometer.

REMOTE CONTROL INPUTS

Forward, Reverse, Enable/Reset inputs suitable for two or three wire Stop/Start control using isolated (voltage free) contacts.
Remote input to select Local or Remote Stop/Start control.

Note: The Enable/Reset input is always active to facilitate motor O/L contacts or auxiliary stop circuits.

ACCELERATION/DECELERATION TIMES

Independently adjustable over the range:
0.5 to 120 seconds

Note: The adjustment is non-linear for more accurate control of short times.

START BOOST

Continuously adjustable to accurately control motor starting torque.

FREQUENCY RESOLUTION

0.1% of selected maximum frequency

FREQUENCY STABILITY

175 parts per million / °C

LINEARITY

0.25% of selected maximum frequency

CONTROL METHOD

Sine Wave Coded Pulse Width Modulation (PWM)

PROTECTIVE CIRCUITS

I^2t Overload, Earth/Ground Fault, Short Circuit, Over Current, Under Voltage, Over Voltage and Over Temp.

STATUS INDICATION

Power On, Enabled, Current Limit, I^2t, Over Current, Over Voltage, Earth/Ground Fault and Over Temp.

ACCEL LIMIT CIRCUIT

Reduces acceleration rate as necessary to avoid nuisance Over Current tripping.

DECEL LIMIT CIRCUIT

Reduces deceleration rate as necessary to avoid nuisance Over Voltage tripping.

AMBIENT TEMPERATURE RANGE

Operating:	0°C (32°F) to 45°C (113°F)
Storage:	-20°C (-4°F) to 70°C (158°F)
Humidity:	0 - 95% relative humidity, Anticondensating

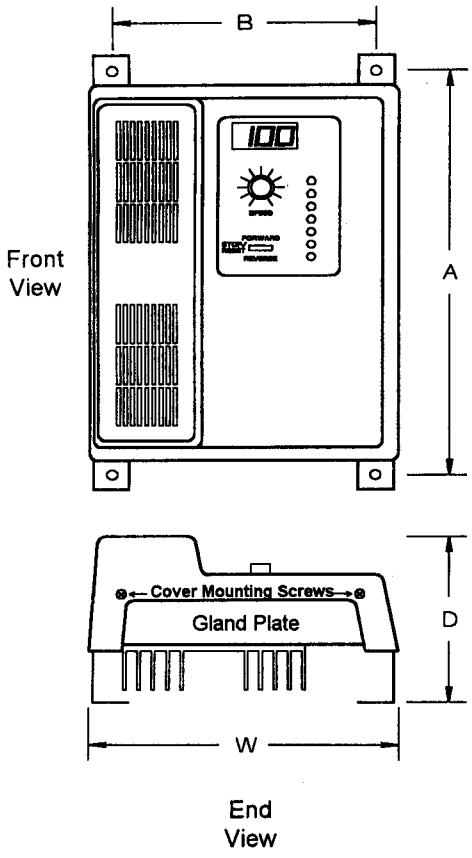
ISOLATION

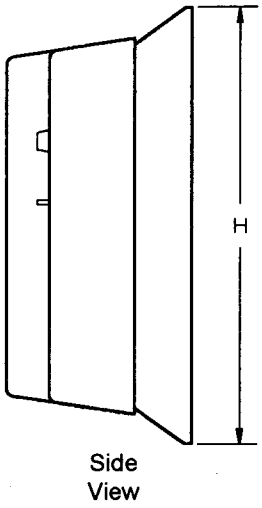
Terminals 10 (switch common), 12 (shield) and 15 (signal common) are internally connected to Earth (Ground) potential.

ENCLOSURE RATING

Enclosed MSC:	IP 30	(NEMA 1)
	IP 54	(NEMA 2)
	IP 55	(NEMA 12).

MSC Small Chassis - Mechanical Installation Diagram





Dimensions		
	mm	in
A	316	12.4
B	184	7.25
H	340	13.4
W	220	8.7
D	135	5.3

1. Mounting holes are 8mm (5/16 inch) diameter.
2. Dimension tolerance: +/- 1mm (+/- 0.04 inches).
3. All dimensions are in milli-metres/inches.

Cover Removal

1. Remove the cover mounting screws at the base of the MSC.
2. Gently pull the base of the cover away from the chassis and then lift it up to release it from the locating pins at the top.

IMPORTANT

1. The MSC must be mounted in a vibration free location.
2. Allow 100mm (4 inches) above, below and in front of the MSC for ventilation.
3. Mount the MSC vertically, away from other heat radiating sources.
4. Do not mount the MSC in direct sunlight or on hot surfaces.
5. If the MSC is mounted inside an enclosure, the total heat dissipation must be allowed for (see note*).
6. Operating temperature range: 0 to 45°C (32 to 113°F).
7. Rel. humidity 0 to 95%, anticondensating.
8. Protect the MSC against dust build-up and dripping or sprayed liquids - applies to IP30 enclosure.
9. The cover and gland plate should be removed before drilling cable holes.
10. Do not allow metal shavings or any other conductive material to enter the MSC or damage may result.

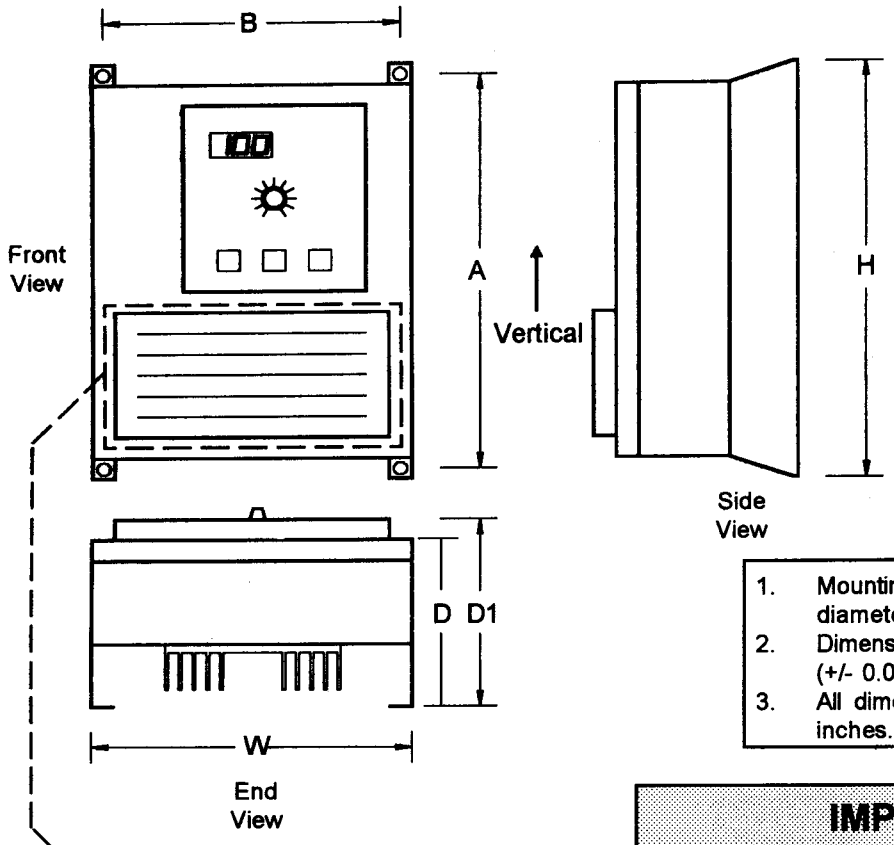
*Subtract packaging weight of 1.2 kg (2.6 lb) for net.

Models

MSC Model Number	Enclosure Type	Shipping Weight * kg (lb)
MSC-S3	IP 30	2.9 (6.4)
MSC-S4	IP 30	3.4 (7.5)
MSC-S5	IP 30	3.6 (7.9)
MSC-S7	IP 30	3.8 (8.4)
MSC-M3	IP 30	3.8 (8.4)
MSC-M4	IP 30	3.8 (8.4)
MSC-M5	IP 30	3.9 (8.6)

*Note: Due to the thermal characteristics of power electronic VS drives, please consult ZENER sales for any applications that require a different type or size of enclosure or mounting.

MSC Medium Chassis - Mechanical Installation Diagram



Dimensions		
	mm	in
A	436	17.2
B	254	10.0
H	460	18.1
W	280	11.4
D	170	6.7
D1	200	7.8

1. Mounting holes are 8mm (5/16 inch) diameter.
2. Dimension tolerance: +/- 1mm (+/- 0.04 inches).
3. All dimensions are in millimetres/ inches.

Front ventilation area shown varies depending on enclosure type. IP 30 has an open grille. IP 54 has a filter cover (shown). IP 55 has no vents at all. Refer to Models table below for enclosure types available for each MSC model.

*Subtract packaging weight of 2.8 kg (6.2 lb) for net.

Models		
MSC Model Number	Enclosure Type	Shipping Weight* kg (lbs)
MSC-S3	IP 55	8.1 (17.8)
MSC-S4	IP 55	8.2 (18.0)
MSC-S5	IP 55	8.3 (18.3)
MSC-S7	IP 55	8.5 (18.7)
MSC-M3	IP 55	8.5 (18.7)
MSC-M4	IP 55	8.7 (19.1)
MSC-M5	IP 55	8.7 (19.1)
MSC-L10	IP 54	10.5 (22.4)
MSC-L17	IP 54	11.1 (24.2)
MSC-R13	IP 30,54	10.3 (22.6)
MSC-R17	IP 30,54	11.2 (24.6)
MSC-R24	IP 30,54	11.7 (25.7)

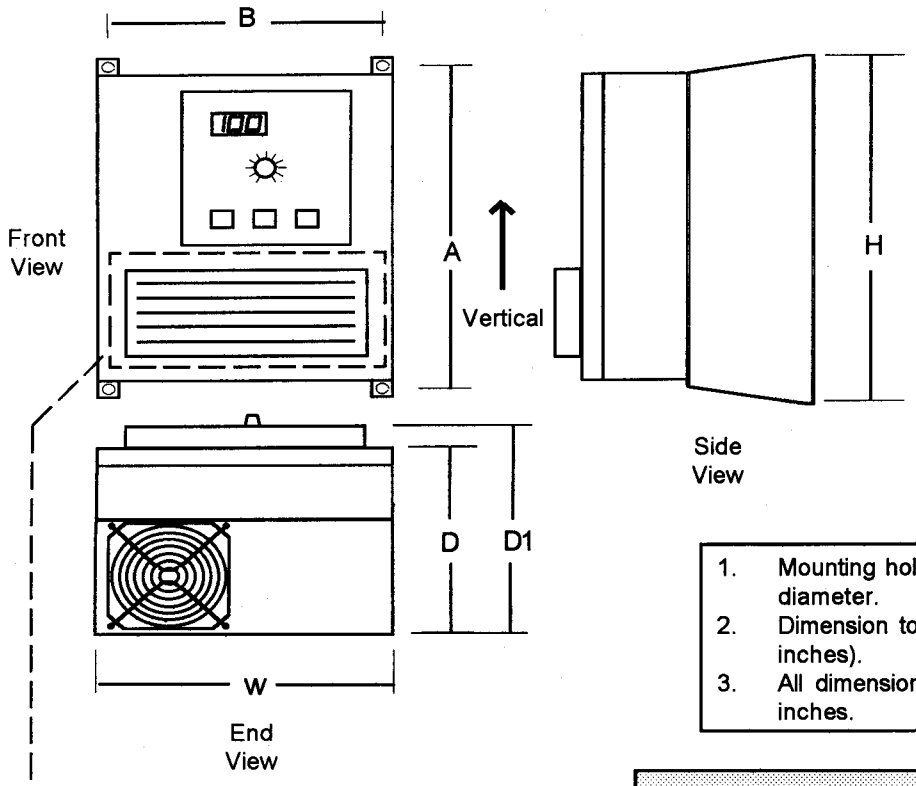
IMPORTANT

A. This chassis size must be mounted against a flat panel surface to ensure correct air flow for heat dissipation*.
B. IP 54 enclosures must have periodic inspection of the air filters to prevent excessive dust build-up leading to restricted air flow.

1. The MSC must be mounted in a vibration free location.
2. Allow 100mm (4 inches) above, below and in front of the MSC for ventilation.
3. Mount the MSC vertically, away from other heat radiating sources.
4. Do not mount the MSC in direct sunlight or on hot surfaces.
5. If the MSC is mounted inside an enclosure, the total heat dissipation must be allowed for (see note).
6. Operating temperature range: 0 to 45°C (32 to 113°F).
7. Rel. humidity 0 to 95%, anticondensating.
8. Protect the MSC against dust build-up and dripping or sprayed liquids - applies to IP30 enclosure.
9. The gland plate should be removed before drilling cable holes.
10. Do not allow metal shavings or any other conductive material to enter the

*Note: Due to the thermal characteristics of power electronic VS drives, please consult ZENER sales for any applications that require a different type or size of enclosure or mounting.

MSC Large Chassis - Mechanical Installation Diagram



Dimensions		
	mm	in
A	436	17.2
B	254	10.0
H	460	18.1
W	280	11.4
D	220	8.6
D1	250	9.8

1. Mounting holes are 8mm (5/16 inch) diameter.
2. Dimension tolerance: +/- 1mm (+/- 0.04 inches).
3. All dimensions are in millimetres/ inches.

Front ventilation area shown varies depending on enclosure type. IP 30 has an open grille. IP 54 has a filter cover (shown). IP 55 has no vents at all. Refer to Models table below for enclosure types available for each MSC model.

IMPORTANT

A. This chassis size must be mounted against a flat panel surface to ensure correct air flow for heat dissipation.*
B. IP 54 enclosures must have periodic inspection of the air filters to prevent excessive dust build-up leading to restricted air flow.

1. The MSC must be mounted in a vibration free location.
2. Allow 100mm (4 inches) above, below and in front of the MSC for ventilation.
3. Mount the MSC vertically, away from other heat radiating sources.
4. Do not mount the MSC in direct sunlight or on hot surfaces.
5. If the MSC is mounted inside an enclosure, the total heat dissipation must be allowed for (see note).
6. Operating temperature range: 0 to 45°C (32 to 113°F).
7. Rel. humidity 0 to 95%, anticondensating.
8. Protect the MSC against dust build-up and dripping or sprayed liquids - applies to IP30 enclosure.
9. The gland plate should be removed before drilling cable holes.
10. Do not allow metal shavings or any other conductive material to enter the MSC or damage may result.

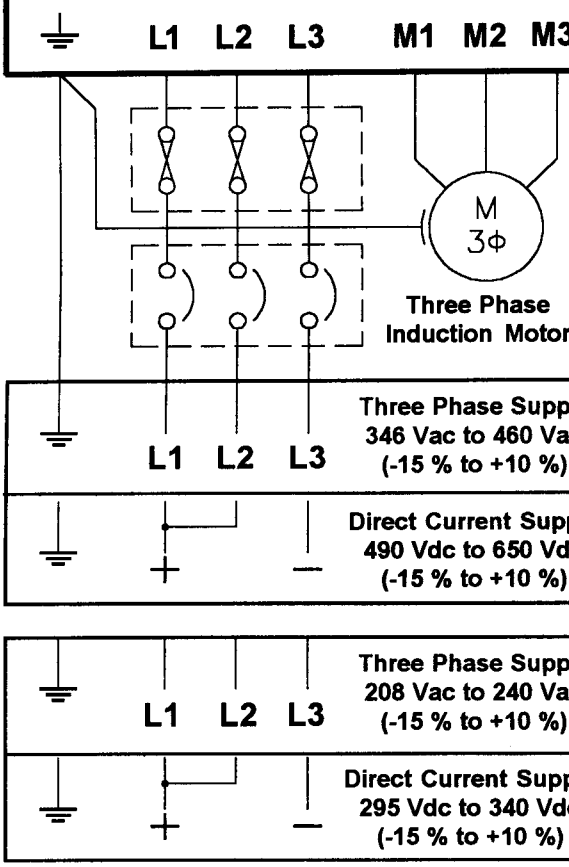
* Subtract packaging weight of 3.8 kg (8.4 lb) for net.

Models		
MSC Model Number	Enclosure Type	Shipping Weight* kg (lbs)
MSC-R33	IP 30,54	18.0 (39.6)
MSC-R39	IP 30,54	18.4 (40.5)

*Note: Due to the thermal characteristics of power electronic VS drives, please consult ZENER sales for any applications that require a different type or size of enclosure or mounting.

MSC Electrical Installation Diagram - 3 Phase

Three Phase Input
MSC-M, MSC-R, and MSC-L Power Wiring Diagram



For compliance with EMC standards, the motor wiring and ground conductor must be enclosed together in a continuous metallic sheath or conduit which has good contact to both the motor and the inverter.
The sheath should contain only the wiring from one inverter and associated motor cables, and no other conductors should be included.

IMPORTANT

1. Either fuses or a circuit breaker should be connected as shown. Fast semiconductor fuses are not required.

2. Cable sizes should be selected according to local codes or standards. Refer to the tables for input currents.

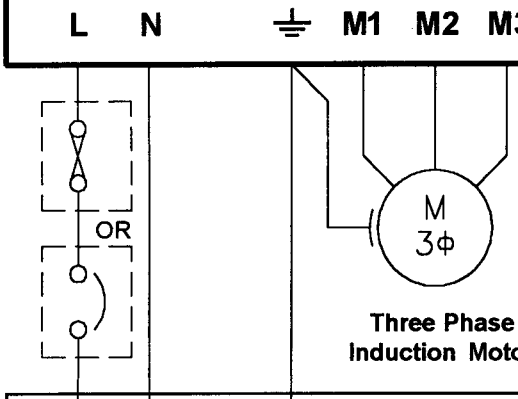
3. For complete motor thermal protection, microtherms or thermistors should be installed in the motor winding.

Motor Volts (Vac)	**MSC-M: 346, 380, 415, 440, 460** **MSC-R: 346, 380, 415, 440, 460** **MSC-L: 208, 220, 230, 240**

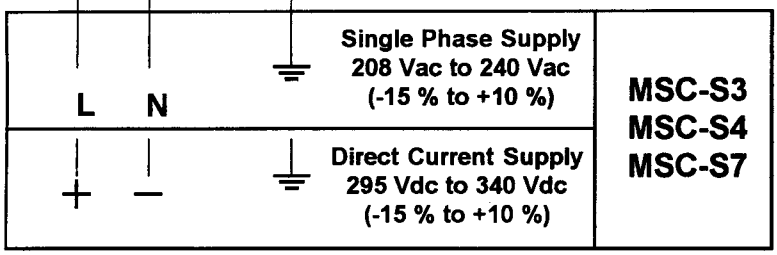
MSC Model Numbers and Rated Current					Maximum Fuse and Circuit Breaker Ratings		
Input Voltage			Rated Output Current(A)		RMS Input Current (A)		Fuse or CB
110V	240V	415V	Continuous	Intermittent	Continuous	Intermittent	Rating (A)
		MSC-M3	3.0	4.5	3.9	5.8	**10**
		MSC-M4	4.0	6.0	5.2	7.8	**10**
		MSC-M5	5.2	7.7	6.5	9.8	**10**
	MSC-L10		10.0	15.0	13.0	19.5	**20**
	MSC-L17		17.0	26.0	22.1	33.1	**50**
		MSC-R13	13.0	15.0	16.9	18.6	**20**
		MSC-R17	17.0	19.5	22.1	24.3	**25**
		MSC-R24	24.0	26.0	31.2	34.3	**50**
		MSC-R33	33.0	36.5	41.3	45.5	**50**
		MSC-R39	39.0	43.0	48.8	53.7	**60**

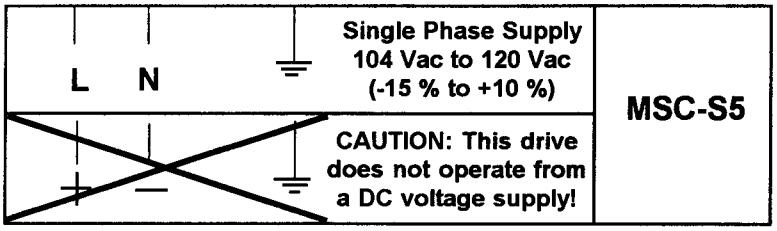
MSC Electrical Installation Diagram - Single Phase

Single Phase Input
MSC-S Power Wiring Diagram



For compliance with EMC standards, the motor wiring and ground conductor must be enclosed together in a continuous metallic sheath or conduit which has good contact to both the motor and the inverter chasis.
The sheath should contain only the wiring from one inverter and associated motor cables, and no other conductors should be included.





IMPORTANT

Note the different input voltage conditions above for MSC-S5.

IMPORTANT

1. Either fuses or a circuit breaker should be connected as shown. Fast semiconductor fuses are not required.

2. Cable sizes should be selected according to local codes or standards. Refer to the tables for input currents.

3. For complete motor thermal protection, microtherms or thermistors should be installed in the motor winding.

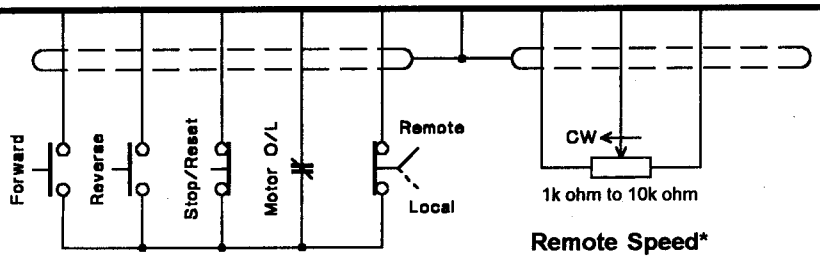
Motor Voltage (Vac)	MSC-S: 208, 220, 230, 240

MSC Model Numbers and Rated Current					Maximum Fuse and Circuit Breaker Ratings		
Input Voltage			Rated Output Current(A)		RMS Input Current (A)		Fuse or CB
110V	240V	415V	Continuous	Intermittent	Continuous	Intermittent	Rating (A)
	MSC-S3		3.0	4.5	6.0	9.0	**10**
	MSC-S4		4.0	6.0	8.5	13.0	**15**
MSC-S5			5.2	7.7	21.0	32.0	**32**
	MSC-S7		7.0	10.5	15.5	24.0	**25**

MSC Control Wiring Diagram

MSC Control Terminals

FWD	REV	EN RST	SW COM	REM	SCN	+5V	INPUT 1	SIG COM	INPUT 2
7	8	9	10	11	12	13	14	15	16

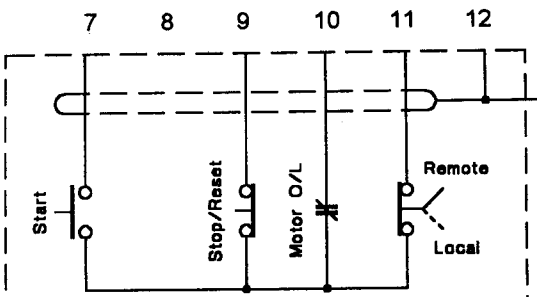


Forward/Reverse Push button Control

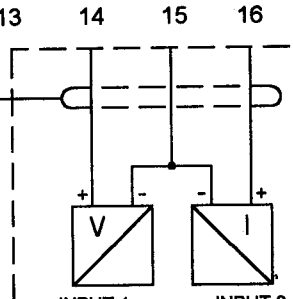
Remote Speed* Potentiometer

ISOLATION

Terminals 10, 12 and 15 are internally connected to Earth (Ground) potential.



Single Direction Push button Control



INPUT 1
0 to 10 Vdc
OR
0 to 5 Vdc
OR
a potentiometer
connected as
shown above

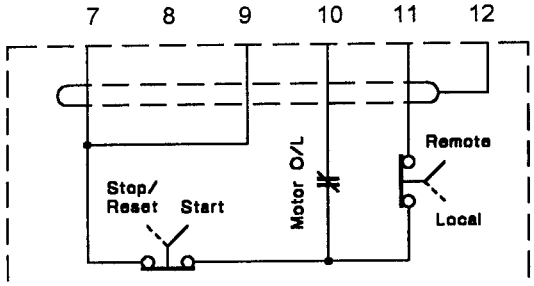
INPUT 2
4 to 20 mA

*The Local/Remote switch does not affect the speed control signals. Remote speed signals are selected by setting links on the MSC control board.

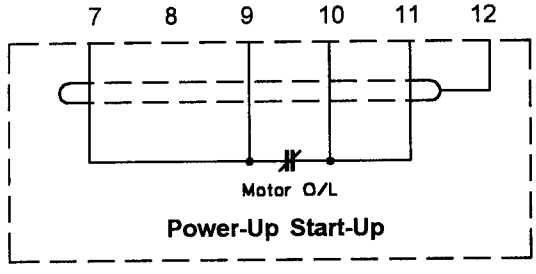
Input 2 overrides Input 1 and the Local Speed potentiometer if a signal greater than 2mA is present.

Refer to the **MSC Adjustment Diagram** for details of speed input selection.

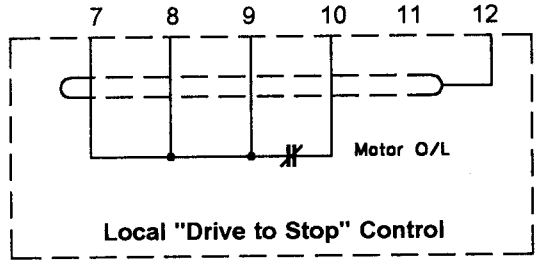
Remote Speed Control Signals



Single Direction Two Wire Control



Power-Up Start-Up



Local "Drive to Stop" Control

IMPORTANT

1. Keep **low voltage control wiring** seperated from power cabling in accord with good electrical practice.

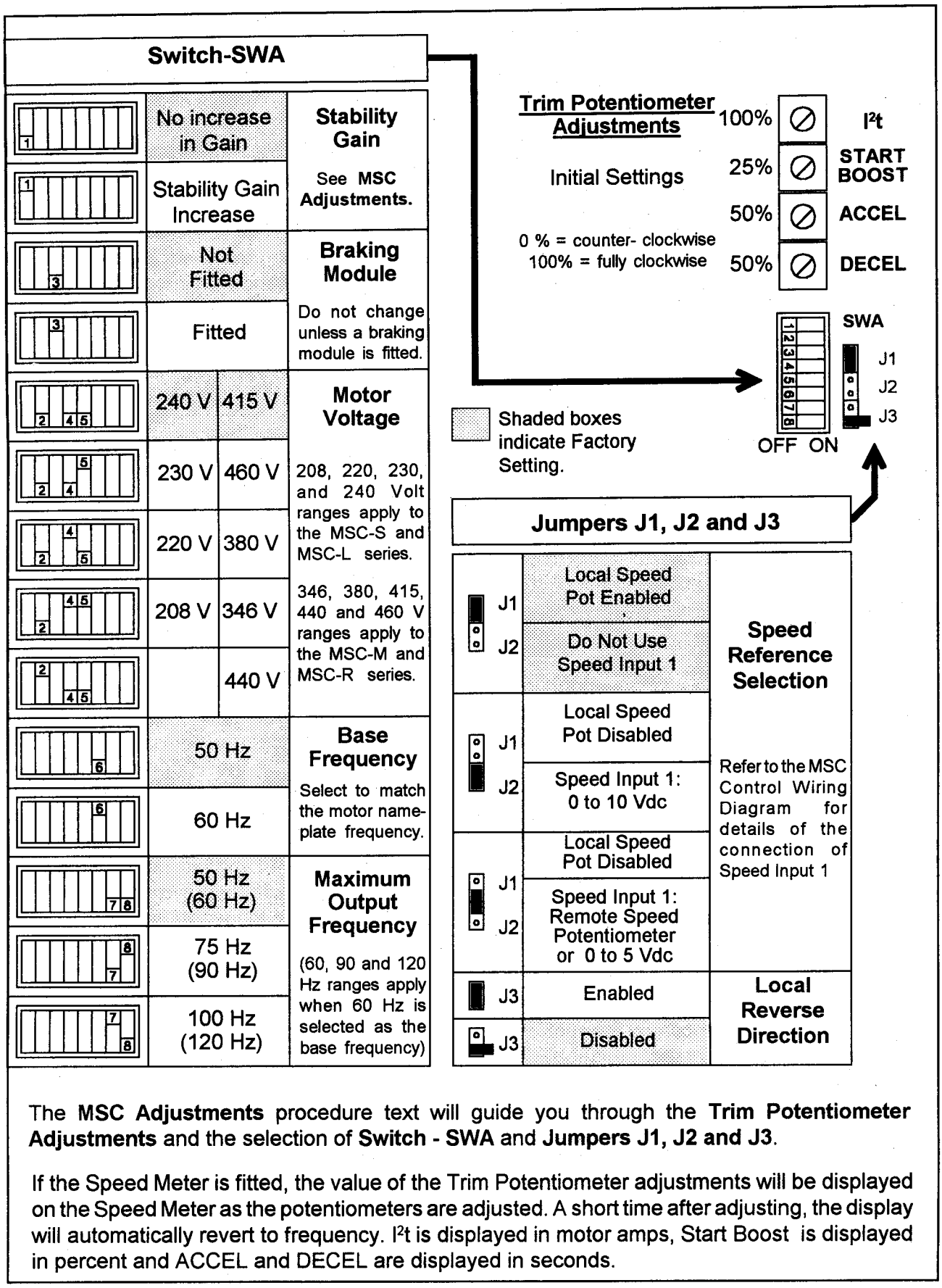
2. **Shielded Cable** is recommended for ALL wiring to terminals 7 through 16. The shield wire should be connected at only one end, preferably to terminal 12 (SCN).

3. **Remote Control Switch Contacts** must be "Voltage Free". Control contacts must be rated for 10 mA at 5 Vdc.

4. **Local/Remote Switch** must be closed for the remote controls to operate. If only remote controls are required, terminals 10 and 11 must be linked.
The remote Enable/Reset input is always active and so terminals 9 and 10 must be linked if only local controls are required.

5. **Motor Overload Contact**. If motor overload protection devices (such as microtherms or thermistors) are installed in the motor, the trip contact may be connected as shown.

MSC Adjustments Diagram



The **MSC Adjustments** procedure text will guide you through the **Trim Potentiometer Adjustments** and the selection of **Switch - SWA** and **Jumpers J1, J2 and J3**.

If the Speed Meter is fitted, the value of the Trim Potentiometer adjustments will be displayed on the Speed Meter as the potentiometers are adjusted. A short time after adjusting, the display will automatically revert to frequency. I^2t is displayed in motor amps, Start Boost is displayed in percent and ACCEL and DECEL are displayed in seconds.

MSC Start-Up Procedure

Warning: Ensure that input power supply has been removed and the filter capacitors are fully discharged before attempting any work inside the MSC.

For safety wear a face shield when working inside MSC enclosure if power is applied or keep covers closed.

Connections

Remove the cover from the MSC to make connections and set adjustments observing due care. Connect the input wiring and the motor wiring to the MSC as shown in the **MSC Electrical Installation Diagram**.

CAUTION: 1/ Single phase induction motors are NOT suitable for operation from the MSC.

2/ If you are using an **MSC-S** or **MSC-L** and intend to use a 380, 400 or 415 volt AC Star or WYE connected motor, it must be reconnected in Delta to operate at 220, 230 or 240 volt AC respectively.

3/ If any motor isolators are used, a 2 second delay before re-connection of any motor to the MSC output is required to allow motor defluxing and avoid overvoltage transients.

WARNING: Above output switching is not recommended while the MSC is enabled.

Before applying power it is recommended that **MSC Adjustments** be read and understood to ensure safe operation of the drive/motor configuration.

Before running a motor, ensure that the direction of rotation will not damage machinery or harm personnel.

The MSC can be operated from local front panel controls or by remote controls as shown in the **MSC Control Wiring Diagrams.**

'Drive to Stop' Operation

'Drive to Stop' means that when the MSC is stopped it will continue to control the motor in order to bring it to a stop at the rate set by the DECEL adjustment. 'Coast to Stop' means that when the MSC is stopped, it will stop controlling the motor (stop producing PWM output voltage) and allow the motor to coast to a stop just as if the power supply had been disconnected.

The MSC is shipped with 'Local Drive to Stop' Control (terminals 7, 8 and 9 connected to 10). This means the local controls will operate and the MSC will drive to a stop when Stop is selected. If 'Coast to Stop' is required, remove the links between terminals 7, 8, 9 and 10 and link only terminals 9 and 10 instead.

When controlling the MSC through control terminals 7, 8 and 9, 'Drive to Stop' can be achieved by closing the switches on terminals 7 and 8 simultaneously until the MSC stops. If it is required that the MSC remains stopped, open the switch on terminal 9.

Fault Indicators

On application of power to the MSC the Power indicator should illuminate. Should an external fault occur, the MSC output will shut down (Stop), one of four red LED fault indicators will illuminate and a Status code is displayed on the Speed Meter (if one is fitted). Faults indicated are Over Current, Over Voltage, Earth/ Ground Fault and Over Temperature.

If the MSC I^2t Motor Protection circuit activates, the MSC will Stop, the yellow Current Limit indicator will flash on/off and a colon will appear on the Speed Meter display indicating the motor may be getting too hot. The MSC will not re-start until time has elapsed to allow the motor to cool. When ready, the Current Limit indicator will change from an even on/off flash cycle to a short on flash followed by a longer off time.

If a message appears on the Speed Meter refer to **Status Messages** and **Trouble Shooting Guide** for details on possible faults and remedies.

Start-Up

With the SPEED pot. or Speed signal at zero, activate the Start circuit or select a direction FORWARD or REVERSE. The ENABLED LED should illuminate. If not see the **MSC Trouble Shooting Guide**. Slowly increase the Speed reference (clockwise) and check the motor for rotation.

If the rotation is in the wrong direction, press/select STOP, disconnect power and

wait for capacitors to fully discharge. Swap any two motor phase wires, re-apply power and press/select START.

Increase the SPEED reference to maximum and the motor should accelerate to full speed. This should take approximately 10 seconds if the ACCEL adjustment is set at 50%.

If the motor is reluctant to rotate, slowly increase the START BOOST adjustment until the motor rotates normally. Do not increase this adjustment any further than necessary to obtain proper operation or excessive motor

heating may result. Now make any ACCEL, DECEL and I^2t adjustments to suit the application.

MSC Adjustments

To make adjustments the cover of the MSC must be removed and the Control board located. Take due care when working with electrically live equipment observing the **Warning** above in **Start-Up Procedure**. The location and function of adjustments are shown on the **MSC Adjustment Diagram**. They allow adjustment of the drive to suit the application and are made in three ways, by the setting of;

- selection switches, Switch SWA, positions 1 to 8,
- Jumpers J1,J2 and J3,
- trim potentiomenter adjustments I^2t, START BOOST, ACCEL and DECEL.

The descriptions below describe the adjustments and how to use them. Trim pots can be adjusted while the drive is running a motor, however, safety should always be the first consideration. Other adjustments should be made with the drive/motor stopped.

Switch - SWA

Stability Gain (SWA: 1)

Available on MSC-M10 upwards, the default setting is OFF. Set ON, the gain of the stability feedback signal is increased, which may be needed, for example when driving high efficiency motors with low slip characteristics, or when driving small motors with an oversized MSC.

Braking Module (SWA: 3)

Only used when a Dynamic Braking Module has been 'Fitted' to the MSC.

Motor Voltage (SWA: 2, 4 & 5)

Set to enter the correct motor nameplate voltage. Default values 240 / 415 volts.

Base Frequency (SWA: 6)

Set to the Motor nameplate 50 or 60 Hz. Default is 50 Hz.

Maximum Output Frequency (SWA: 7, 8)

Default setting is 50 (60) Hz range. The MSC will provide constant torque operation up to 50 (60) Hz and constant power operation above 50 (60) Hz. For Electronic Overdrive select 75 (90) Hz or 100 (120) Hz range.

Jumpers J1, J2 and J3

Speed Reference Selection (J1, J2)

There are three speed control signal options on the MSC;

- **Local Speed Potentiometer**,
- **Speed Input 1**: 0 to 10 or 0 to 5 volt DC or Remote Speed Potentiometer,
- **Speed Input 2**: 4 to 20 mA DC Current Input.

Local Speed Pot. or Speed Input 1 are selected by J1 and J2 as shown in the **MSC Adjustment Diagram**. Speed Input 2 is always active and will overide either of the above if a signal greater than 2 mA is present.

Note: The Local/Remote input on the MSC Control terminals <u>will not</u> select between <u>Local Speed Pot</u>. or <u>Speed Input 1</u>. It only selects between local Start/Stop and remote Start/Stop control.

Local Reverse Direction Selection (J3)

Default setting is Disabled as damage may occur if a motor inadvertantly runs backwards. NOTE: The Remote Reverse Input , Control terminal 8, remains active regardless of J3 position and should be left to unconnected unless remote Reverse (or Drive Stop) is required.

Trim Pot. Adjustments

These can be used to fine tune the MSC to an application. If an MSC Speed Meter is fitted, the exact value of the Trim Pot. Adjustment will be displayed. Shortly after the adjustment has stabilised the display will automatically revert to displaying frequency. I^2t is displayed in amps, Start Boost is displayed in percent and Accel and Decel are displayed in seconds.

I^2t - Motor Protection

I^2t is a solid state motor protection feature which simulates bi-metallic, or eutectic motor thermal overload sensing circuits. When properly adjusted, I^2t will provide equivalent motor protection. However, I^2t is only suited to single motor applications and will not provide adequate descrimnation for protection of mulitiple motor applications.

To adjust I^2t to the motor in use, read the rated motor current from the motor nameplate data and adjust the I^2t trim pot to this value. If the Speed Meter is fitted the I^2t value will be displayed in amps as it is adjusted. If the motor current is more than the rated current of the MSC, set the I^2t adjustment fully clockwise.

If a Speed Meter is not fitted, adjust the I^2t as follows: Setting the pot to 100% (fully clockwise) will set I^2t current at the continuous rated current of the MSC. At 0% (fully counter-clockwise) I^2t current is set equal to 50% of the MSC continuous rated current. At 50% on the pot , the I^2t is 75% of MSC continuous rated current.

START BOOST Adjustment

This adjustment allows accurate control of the torque available to start a motor. The initial adjustment should be at 25%. If at start-up the motor will not rotate, slowly increase START BOOST until the motor rotates normally. Do not increase the adjustment any further than is necessary to obtain proper operation or excessive motor heating may result.

Increasing Start Boost too far may result in the CURRENT LIMIT indicator illuminating and the motor failing to accelerate. This indicates the motor is drawing too much current and Start Boost should be reduced and/or the Accel adjustment increased.

ACCEL Adjustment

This allows adjustment of the acceleration rate to suit the application. The default setting is 50%. If set for rapid acceleration the motor may draw excessive current activating the Accel Limit circuit, and the CURRENT LIMIT indicator will illuminate. The MSC will limit the acceleration rate to it's intermittent current rating (110% or 150% of rated current), and faster acceleration cannot be achieved at this motor load level.

DECEL Adjustment

Similar to Accel but for deceleration of the motor. Default setting is 50%. If adjusted for rapid deceleration the motor may regenerate excessively, activating the Decel Limit circuit. If this happens, the CURRENT LIMIT indicator will illuminate and the MSC will limit deceleration rate to avoid excessive regeneration.

If the application requires short deceleration times, an MSC Dynamic Braking Module may be required which can dissipate excessive braking energy into a resistor bank as heat.

Your set-up notes.....

I^2t.....
BOOST.....
ACCEL.....
DECEL.....

SWA	OFF	ON
1	–	–
2	–	–
3	–	–
4	–	–
5	–	–
6	–	–
7	–	–
8	–	–
J1	closed / open	
J2	closed / open	
J3	closed / open	

Quadra Drive

Quadra Drive is a software (EPROM) option for MSC-S and MSC-M drives only. It was designed to allow 'quieter' operation of a motor when used to drive fans*, where the noise generated by the switching transistors is considered objectionable. Drives fitted with this option have the following features:

- Square Law V/Hz
- I^2t fixed at maximum
- Start Boost fixed at 25%
- I^2t adjustment pot adjusts Maximum Speed
- Start Boost adjustment pot selects Minimum speed.

***This option is only suitable for applications where the torque required increases proportionally to the square of the speed.**

Auto Restart

This optional feature allows the MSC to automatically restart after tripping on any of the fault conditions. Once the fault has cleared, if the MSC is Enabled it will wait 10 seconds and then attempt to re-start.

The MSC allows for 5 re-starts in a 10 minute period, starting from the time when the first fault occurred. If the fault condition is still present after the fifth attempt, the MSC will not try to restart until the Stop (Enable/Reset) circuit is activated. The 10 minute timer may be reset by activating the Stop (Enable/Reset) circuit.

The MSC will not re-start if the controller is not enabled or if a direction (FWD or REV) is not activated. To verify if Auto Restart is installed remove the cover and locate the EPROM memory chip. The second line of text on the EPROM label should include "AUTO RT" or "A/R".

WARNING: This option can make the MSC start without warning. Personnel should be protected from any machinery driven by the MSC.

HAND/OFF/AUTO Operation

This option is available on some models of MSC's for the manual selection of the speed reference source and of the Start\Stop method according to the following:

Switch Selection: HAND

- Speed set by the Local Pot or Terminal 14 (selected by J1 and J2 - see **Adjustment Diagram**).
- Use FWD and REV inputs to select "Drive to Stop" mode (see **Control Wiring Information**).

Drive runs forward only.

Switch Selection: STOP/RESET

Drive stops and faults are reset.

Switch Selection: AUTO

- Speed set by terminal 16 (4 to 20 mA - input2).
- Use FWD, and EN/RST inputs for Start/Stop.
- Use FWD and REV inputs to select "Drive to Stop" mode.

Note: Jumper J3 must be fitted for the AUTO position to work (see **Adjustment Diagram**).

If the REM input terminal 11 is closed:

- the 4 to 20 mA speed reference input 2 is always selected.
- The HAND/OFF/AUTO switch is ignored.

Use the FWD, REV and EN/RST input terminals 7, 8 and 9 for Start and Stop.

To confirm if HAND/OFF/AUTO is installed locate the EPROM memory chip (as described in **Auto Restart** above) and look for "H/O/A" on the second line of text of the EPROM label.

If HAND/OFF/AUTO is fitted, Power-up Start-up is enabled when the Control Wiring is as shown in the **Control Wiring Diagram**, and either REM input terminal 11 is closed or HAND/OFF/AUTO is in the AUTO position.

See **Warning** given in **Auto Restart** above.

MSC Option Boards

Option Boards are plug-in cards designed to allow a greater versatility on the MSC line of drives. Only one card can be fitted on the MSC. See the **MSC Multi Option Board Manual** (Document No. IM00044) for more details on Option Boards 2 and 3.

Option Board 1

This provides an analog (0 to 10 volt DC) speed output signal suited for remote monitoring, connection to an analog meter, or for external control of other equipment or connection to a PLC for example. It also provides two Status Relay Outputs: a Fault Relay for remote monitoring; and an Enabled or Zero Speed Relay for remote monitoring or control of a fitted mechanical braking unit.

Option Board 2

This provides the following features:

- Status Relay Outputs: Fault Relay and Enabled or Zero Speed
- Control of LCD Status indication
- Analog Speed Output Signal (0 to 10 volt DC)
- Minimum and Maximum Speed Adjustments
- Span and Zero adjustments
- Speed Signal Inversion (Reverse Acting Speed Signals)
- Jog Speed or Speed Override

Option Board 3

This provides all the feature of Option Board 2, plus an RS-485 Serial Communications Interface.

Option Board 4

This provides the features of Option Board 1 with the additional feature of 5 selectable speed reference inputs. These 5 speed references can be either external 0 - 5 Vdc or 0 - 10 Vdc signals, or can be a fixed reference, each adjustable by an individual trim pot on the option board. You can have any combinations of the above references. Only one input can be selected at one time to be fed as the selected speed reference into the MSC controller. One of the 5 Speed references on the Option 4 board is selected via a volt free contact on each of 5 speed select inputs.Contact closure connection is to the Input Select switch common.

Status Indications

When the Speed Meter is fitted to the MSC, the Status is displayed on the Speed Meter as well as on the status indication LEDs. The table below shows the meaning of each status code as it appears on the Speed Meter display:

0.0	MSC Disabled
E 0.0	Enabled at zero speed
PF	Power Failure or Phase Failure
dclo	Under Voltage Trip
dchi	Over Voltage Trip
OC	Over Current Trip
Ot	Over Temperature Trip
I2t	I^2t Trip (electronic overload)
EF	Earth Fault Trip
x:xx	Colon indicates Current Limit or Voltage Limit

MSC Trouble Shooting Guide

Symptom	Cause	Remedy
POWER indicator does not illuminate.	Input power wiring not connected properly.	Check input power wiring, refer to the **MSC Power Wiring Diagram**.
	Input voltage not within specification.	Measure the input voltage at MSC input terminals. Check with specifications.
ENABLED indicator does not illuminate when the Start circuit is activated. No other fault indicators illuminate.	Input voltage not within specification.	Measure the input voltage at MSC input terminals. Check with specifications.
	Control wiring not connected properly.	Check all wiring to terminals 7,8,9,10 and 11. Refer to the **MSC Control Wiring Diagram**.
	Remote ENABLE input not active.	If using local controls, check that terminal 9 is connected to terminal 10. Refer to the **MSC Control Wiring Diagram**.
	External fault in control wiring.	Check operator control devices.
	DC Input Supply not connected properly.	Check connection of DC supply, refer to the **MSC Power Wiring Diagram**.
When the MSC is started and the speed signal is increased, the motor does not rotate and the CURRENT LIMIT indicator does not illuminate.	Speed control signal not properly connected.	Check wiring to terminals 13,14,15 and 16. Refer to the **MSC Control Wiring Diagram**.
	Incorrect speed input selected.	Check the selection of jumpers J1 and J2. Refer to the **MSC Adjustment Diagram**.
	START BOOST too low.	Increase the START BOOST adjustment.
	Incorrect motor voltage range selected.	Check the motor voltage range selection against the **MSC Adjustment Diagram**.
	Incorrect output frequency selection.	Check the output frequency range selection against the **MSC Adjustment' Diagram**.
	Fault in motor or motor wiring.	Check the motor and the motor wiring.
	Incorrect motor voltage.	Check the motor voltage. If you have an MSC-S or MSC-L and you are using a 380, 400 or 415 Vac star (wye) connected motor, re-connect it in delta to operate at 220, 230 or 240 Vac.
The CURRENT LIMIT indicator illuminates when the speed signal is increased. The motor will not accelerate.	START BOOST too high.	Reduce START BOOST adjustment.
	ACCEL time too short.	Increase ACCEL adjustment.
	Incorrect motor voltage range selected.	Check motor voltage range selection.
	Motor rating is much higher than MSC rating.	Use an MSC with a rating greater than 75% of the motor rating.
	Motor shaft jammed.	Check the mechanical drive system.
	Motor mechanically overloaded.	Check the actual mechanical load is within the motor's capacity at the required speed.
	Fault in motor or motor wiring.	Check the motor and the motor wiring.
	Incorrect motor voltage.	Check the motor voltage.
The CURRENT LIMIT indicator illuminates during deceleration and the motor will not decelerate.	Motor is continuously overhauling.	Fit a braking module.
	Motor rating is much higher than MSC rating.	Use an MSC with a rating greater than 75% of the motor rating.
CURRENT LIMIT indicator illuminates when MSC not Enabled.	Input Supply voltage is too high.	Measure the Input Supply voltage at the MSC terminals and compare with specifications.

MSC Trouble Shooting Guide

Symptom	Cause	Remedy
CURRENT LIMIT indicator flashes on and off. (I^2t trip)	Motor is mechanically overloaded.	Check actual mechanical load is within the motor's capacity at the required speed.
	Motor shaft is jammed.	Check the mechanical drive system.
	I^2t Adjustment is not set properly.	Make sure I^2t Adjustment is set to match the motor current. Refer to the **Start Up Procedure**.
	The START BOOST is high and the motor is running at low speeds for a long time.	This may cause the MSC to operate above it's continuous rated current for long periods.. Do not let the motor current exceed rated continuous current for long periods
	Incorrect motor voltage range selection.	Check the motor voltage range selection against the **MSC Adjustment Diagram.**
	Motor is wrong voltage.	Check the motor voltage.
Motor does not run at the desired speed.	Incorrect frequency range selected.	Check selection of frequency range against the **MSC Adjustment Diagram**.
	Incorrect speed signal.	Check that the speed reference is correct.
OVER VOLTAGE indicator illuminates.	Input voltage is not within specification.	Check input voltage at terminals is within rated voltage specification.
	DECEL time too short.	Increase the DECEL adjustment.
OVER CURRENT indicator illuminates.	START BOOST too high.	Reduce START BOOST adjustment.
	Incorrect motor voltage range selected.	Check motor voltage range against **MSC Adjustment Diagram**.
	ACCEL time too short.	Increase ACCEL adjustment.
	Short circuit in motor or motor wiring.	Check motor and motor wiring for faults.
	Open circuit in motor or motor wiring.	Check motor and motor wiring for faults.
OVER TEMPERATURE indicator illuminates.	Ventilation problem.	Check ventilation.
	High ambient temperature.	Ambient temperature must be below 45°C (113°F) for the enclosed MSC to operate normally.
EARTH FAULT indicator illuminates.	Earth fault in motor or motor wiring.	Check motor and motor wiring for faults.
Motor is unstable.	Incorrect motor voltage range selected.	Check motor voltage range selection against the **MSC Adjustment Diagram**.
	ACCEL time too short.	Increase ACCEL adjustment.
	DECEL time too short.	Increase DECEL adjustment.
Excessive motor heating.	START BOOST is high and motor is running at low speeds for long times.	Do not run the motor at low speeds for long periods with high START BOOST unless the motor has been suitably derated.
	Incorrect motor voltage range selected.	Check the motor voltage range against the **MSC Adjustment Diagram**.
	Motor speed too high.	Check the frequency range selection.
	Motor is overloaded.	Check that the motor is not overloaded.
	Motor damaged or incorrectly wired.	Check the motor and the motor wiring for faults.
	Wrong voltage motor.	Check the motor voltage.