MVS

SOFT STARTER

AuCom
THE SOFT START SPECIALISTS

USER MANUAL

Contents

CONTENTS

Section 1 Caution Statements

This symbol is used throughout this manual to draw attention to topics of special importance to the installation and operation of MVS Series soft starters.

Caution Statements cannot cover every potential cause of equipment damage but can highlight common causes of damage. It is the installer's responsibility to read and understand all instructions in this manual prior to installing, operating or maintaining the starter, to follow good electrical practice including applying appropriate personal protective equipment and to seek advice before operating this equipment in a manner other than as described in this manual.

- Read and understand the entire manual before installing operating, or maintaining the starter. Follow all applicable local and national codes.
- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices.
- Use only electrically insulated tools and clothing and insulated protective gear when working around electrical equipment.
- Disconnect all power and ensure that the starter is de-energised before servicing the starter.
- Do not rely on visual indications such as switch position or fuse removal for determining a de-energised condition. Always assume that a terminal is energised until it is checked with a properly rated meter to ensure that a terminal is de-energised and grounded.
- Isolate the soft starter completely from the power supply before attempting any maintenance work.
- Always use a properly rated voltage sensing device to confirm power is off.
- Before servicing the starter, ensure that all static charge has been discharged by grounding it with an appropriate grounding device.
- Metal swarf in the cabinet can cause equipment failure.
- Do not apply voltage to the control input terminals. These are active 24 VDC inputs and must be controlled with potential free contacts.
- Contacts or switches operating the control inputs must be suitable for low voltage, low current switching (ie gold flash or similar).
- Cables to the control inputs must be segregated from mains voltage and motor cabling.
- Some electronic contactor coils are not suitable for direct switching with PCB mount relays. Consult the contactor manufacturer/ supplier to confirm suitability.

The examples and diagrams in this manual are included solely for illustrative purposes. The information contained in this manual is subject to change at any time and without prior notice. In no event will responsibility or liability be accepted for direct, indirect or consequential damages resulting from the use or application of this equipment.

WARNING - ELECTRICAL SHOCK HAZARD

MVS soft starters contain dangerous voltages when connected to mains voltage. Only a competent electrician should carry out the electrical installation. Improper installation of the motor or the soft starter may cause equipment failure, serious injury or death. Follow this manual and local electrical safety codes.

SHORT CIRCUIT

MVS soft starters are not short circuit proof. After severe overload or short circuit, the operation of the soft starter should be fully tested.

GROUNDING AND BRANCH CIRCUIT PROTECTION

It is the responsibility of the user or person installing the soft starter to provide proper grounding and branch circuit protection according to local electrical safety codes.

ARC FLASH HAZARD

Soft starters have a potential risk of arc flash. When insulation or isolation between electrified conductors is breached or can no longer withstand the applied voltage, a short circuit occurs through the air. This may cause a phase-to-ground and/or a phase-to-phase fault.

AuCom soft starters have been designed to mitigate an arc fault, however it is the responsibility of the site engineer to ensure that personnel are protected from serious injury that may result from an arc fault.

Although unlikely, arc fault can be caused by:

- Contamination in the insulation caused by deterioration over time
- Inadequate insulation system on cable terminals
- Overvoltage
- Incorrect protection coordination settings
- Overheating of the contact area, due to incorrect tightening of connections
- Introduction of foreign matter, including swarf, vermin, tools or maintenance equipment left in the starter

Section 2 General Description

2.1 Overview

The MVS provides compact and robust soft start solutions for control of medium voltage motors. MVS soft starters provide a complete range of motor and system protection features and have been designed for reliable performance in the most demanding installation situations.

Each MVS soft starter comprises two elements:

- a power assembly
- a controller module

The power assembly and controller module are supplied as a pair and share the same serial number. Care should be taken during installation to ensure the correct controller and power assembly are used together.

Each MVS is also supplied with two fibre-optic cables, to connect the controller module to the power assembly, and three non-conduction lead assemblies, allowing the soft starter to be tested with a low-voltage motor (< 500 VAC).

2.2 Feature List

Starting
- Constant current
- Current ramp

Stopping
- Coast to stop
- Soft stop

Protection
- Under/ Overvoltage
- Mains frequency
- Phase sequence
- Shorted SCR
- Motor overload (thermal model)
- Instantaneous overcurrent (two stages)
- Time-overcurrent
- Ground fault
- Undercurrent
- Current Imbalance
- Motor thermistor
- Excess start time
- Power circuit
- Auxiliary trip

Interface
- Remote control inputs (3 x fixed, 2 x programmable)
- Relay outputs (3 x fixed, 3 x programmable)
- Analog output (1 x programmable)
- Serial port (with module)

Human Interface
- Starter status LEDs
- Event log (99 positions, date and time stamped)
- Trip log (8 positions, date and time stamped)
- Counters (starts, hours-run, kWh)
- Metering (current, voltage, power factor, kWh)
- User-programmable metering screen
- Multi-level password protection
- Emergency stop push button

Power Connection
- 50 A to 390 A, nominal
- 2300 VAC to 13800 VAC

Accessories (optional)
- Modbus RTU Interface
- Profibus Interface
- DeviceNet Interface
- Synchronous motor control
- PC Software
- Overvoltage protection
- Control supply transformer
- MV/LV Control transformer

2.3 Key Features

MVS soft starters offer several special functions to ensure ease of use and to provide optimal motor control in all environments and applications.

- Customisable Protection

The MVS offers comprehensive protection to ensure safe operation of the motor and soft starter. The protection characteristics can be customised extensively to match the exact requirements of the installation.

Use parameter group 3 to set the conditions in which each protection mechanism will activate.

> Example: use parameter 3-A *Undercurrent Level* to set the level for an undercurrent trip and parameter 3-B *Undercurrent Trip Delay* to set a delay on the trip.

Use parameter group 21 to select the soft starter's response when a protection mechanism activates. Each protection can be set to trip the starter, activate a warning flag, or be ignored. All protection activations are recorded in the event log, regardless of the protection class setting.

> Example: Use parameter 21-B *Undercurrent* to select the response for an undercurrent trip (trip, warn or write to log). The default response is trip.

NOTE
MVS soft starters have built-in trip points to ensure operation remains within the soft starter's capability. These internal trips cannot be overridden. Certain faults within the MVS will also prevent the soft starter from operating. Refer to *Troubleshooting* on page 62 for details.

- Advanced Thermal Modelling

Intelligent thermal modelling allows the soft starter to predict whether the motor can successfully complete a start. The MVS uses information from previous starts to calculate the motor's available thermal capacity, and will only permit a start which is predicted to succeed.

This feature can be enabled or disabled using parameter 3-L *Restart Temperature Check*.

- Comprehensive Event and Trip Logging

The MVS has a 99-place event log to record information on soft starter operation. A separate trip log stores detailed information about the last eight trips.

- Informative Feedback Screens

A large-format screen allows the MVS to display important information clearly. Comprehensive metering information, details of starter status and last start performance allow easy monitoring of the starter's performance at all times.

- Dual Parameter Set

The MVS can be programmed with two separate sets of operating parameters. This allows the soft starter to control the motor in two different starting and stopping configurations.

The secondary motor settings (parameter groups 12 and 13) are ideal for slip-ring motors, dual speed motors, or conventional (squirrel-cage) motors which may start in two different conditions (such as loaded and unloaded conveyors).

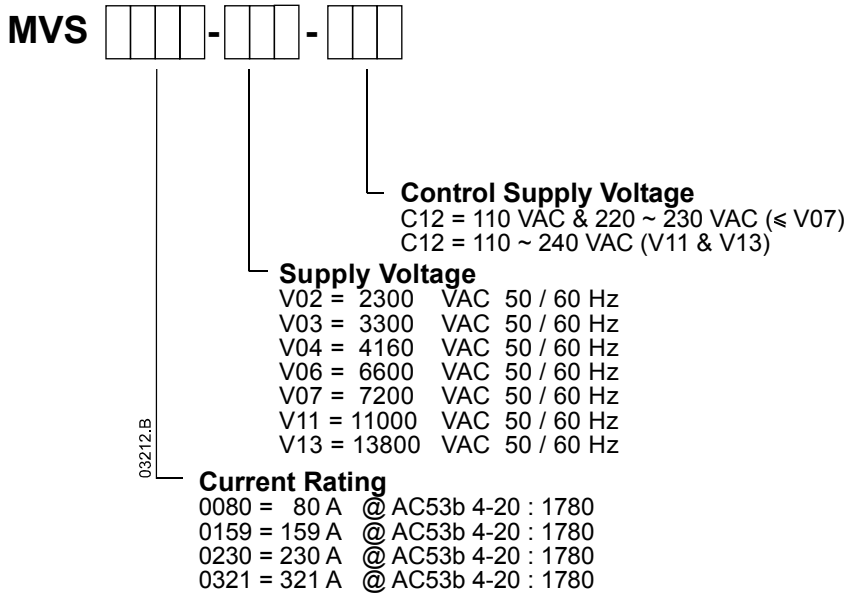
NOTE
MVS soft starters are not suitable for controlling two separate motors. The secondary parameter set should only be used for a secondary configuration of the primary motor.

The MVS will use the secondary motor settings to control a start when instructed via a programmable input (refer to parameters 4-C and 4-D *Input A or B Functionality*).

- Fibre Optics

The MVS uses two-line fibre optic connections between the low voltage control module and the high voltage power assembly for electrical isolation. This fibre optic link simplifies installation of chassis mount MVS starters into custom panels.

2.4 Model Codes



Section 3 Specifications

3.1 Current Ratings

(At 1000 m.)

Two starts per hour

	3.5-15 : 1785		4.0-20 : 1780		4.0-30 : 1770		5.0-30 : 1770		5.0-60 : 1740	
	40 °C	50 °C	40 °C	50 °C	40 °C	50 °C	40 °C	50 °C	40 °C	50 °C
MVS0080	96	91	80	74	72	66	59	55	46	42
MVS0159	190	177	159	147	143	132	117	109	91	84
MVS0230	282	261	230	213	201	185	165	152	121	111
MVS0321	393	363	321	296	279	257	229	211	168	154

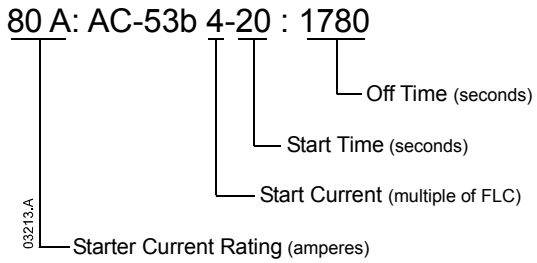
Three starts per hour

	4.0-20 : 1180		4.0-30 : 1170		5.0-30 : 1170		5.0-60 : 1140	
	40 °C	50 °C	40 °C	50 °C	40 °C	50 °C	40 °C	50 °C
MVS0080	73	68	65	60	53	49	40	37
MVS0159	146	135	129	119	106	98	79	73
MVS0230	207	190	175	162	144	132	101	93
MVS0321	288	265	244	225	200	184	141	129

Four starts per hour

	4.0-20 : 880		4.0-30 : 870		5.0-30 : 870		5.0-60 : 840	
	40 °C	50 °C	40 °C	50 °C	40 °C	50 °C	40 °C	50 °C
MVS0080	68	63	59	54	48	45	35	33
MVS0159	136	125	117	108	96	89	70	65
MVS0230	188	173	157	144	129	118	88	81
MVS0321	262	241	218	200	179	164	122	112

AC53b Utilisation Category Format



Starter Current Rating: The full load current rating of the soft starter given the parameters detailed in the remaining sections of the utilisation code.

Start Current: The maximum available start current.

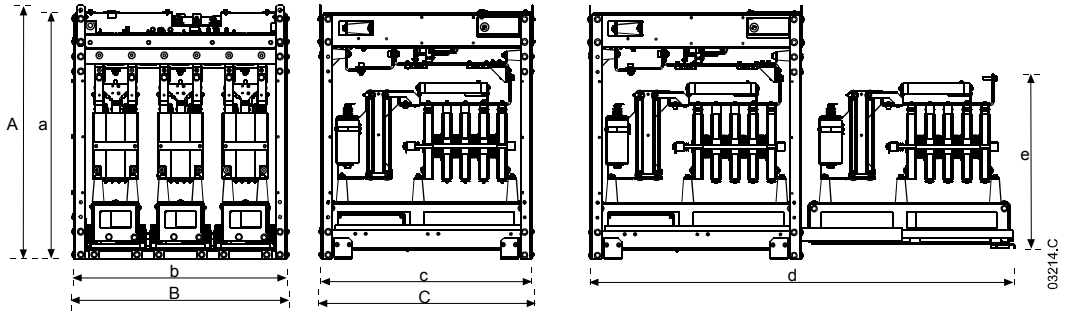
Start Time: The maximum allowable start time.

Off Time: The minimum allowable time between the end of one start and the beginning of the next start.

Contact your local supplier for ratings under operating conditions not covered by these ratings charts.

Dimensions and Weights

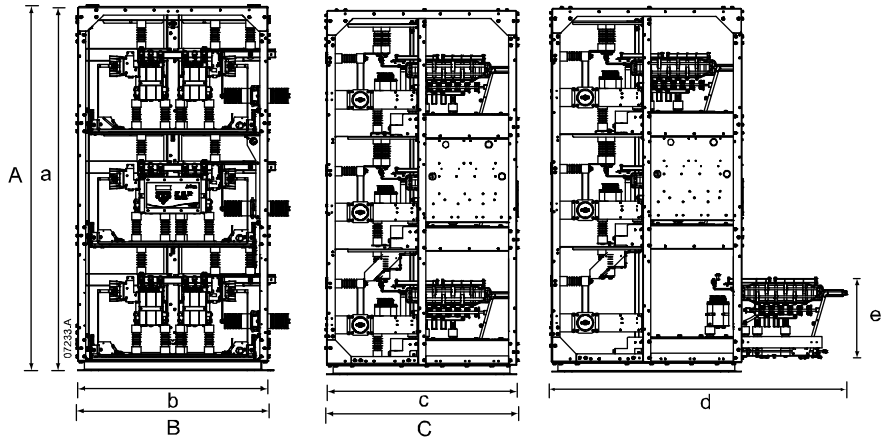
- Models V02 ~ V07 (Power Assembly)



Front view Side view Phase arm extended

	A	B	C	a	b	c	d	e	Weight
	mm (inch)	mm (inch)	mm (inch)	mm (inch)	mm (inch)	mm (inch)	mm (inch)	mm (inch)	kg (lb)
MVSxxxx-V02	772 (30.4)	669 (26.3)	667 (26.3)	750 (29.5)	658 (25.9)	650 (25.6)	1302 (51.3)	531 (20.9)	165 (363.8)
MVSxxxx-V03									
MVSxxxx-V04									
MVSxxxx-V06	832 (32.8)	875 (34.5)	817 (32.2)	810 (31.9)	864 (34.0)	800 (31.5)	1559 (61.4)	551 (21.7)	217 (478.4)
MVSxxxx-V07									

- Models V11 and V13 (Power Assembly)

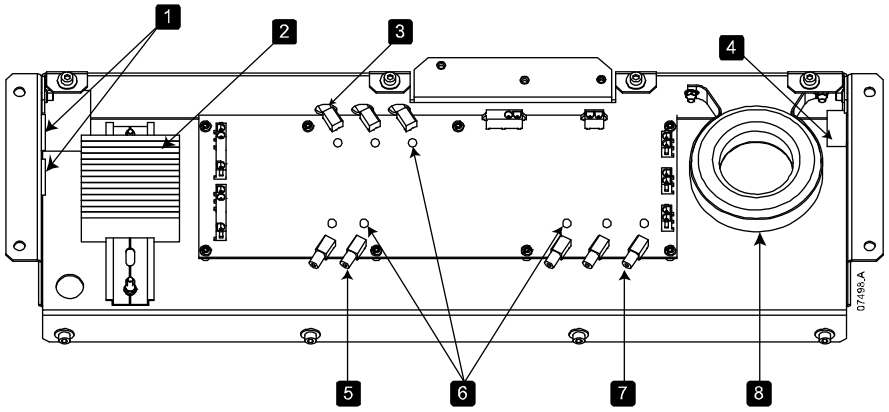


Front view Side view Phase arm extended

	A	B	C	a	b	c	d	e	Weight
	mm (inch)	mm (inch)	mm (inch)	mm (inch)	mm (inch)	mm (inch)	mm (inch)	mm (inch)	kg (lb)
MVSxxxx-V11	2210 (87.0)	1170 (46.0)	1170 (46.0)	2220 (87.4)	1150 (45.3)	1150 (45.3)	1785 (70.3)	510 (20.1)	720 (1587)
MVSxxxx-V13									

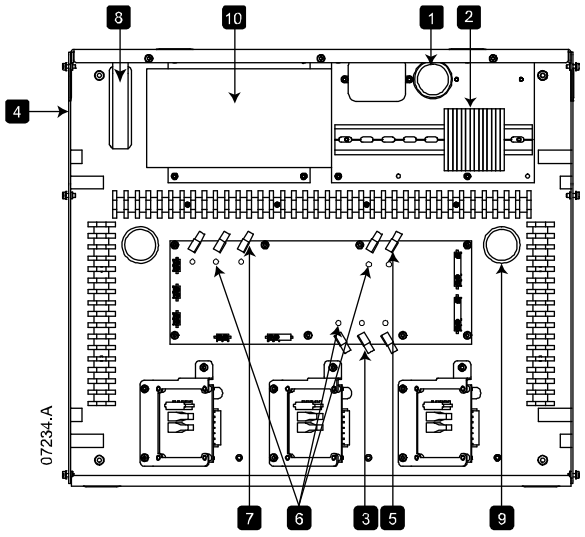
Low Voltage Section

- Models V02 ~ V07



1	Access holes for LV control supply
2	Control connection terminal block
3	Gate firing fibre optic connectors
4	Access hole for CT cables
5	Fibre connections to controller
6	LEDs
7	Non-conduction readback fibre optic connectors
8	Ground current CT

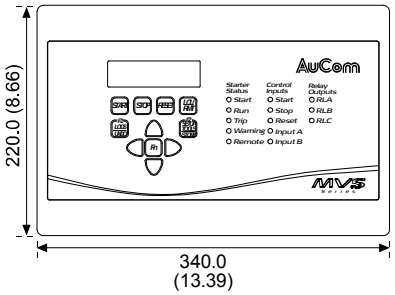
- Models V11 and V13



1	Access holes for LV control supply
2	Control connection terminal block
3	Gate firing fibre optic connectors
4	Access hole for CT cables
5	Fibre connections to controller
6	LEDs
7	Non-conduction readback fibre optic connectors
8	Ground current CT
9	Access hole for MVS Controller fibre optic cable
10	Switch mode power supply (SMPS)

Controller

The MVS Controller is suitable for use with all MVS soft starters.

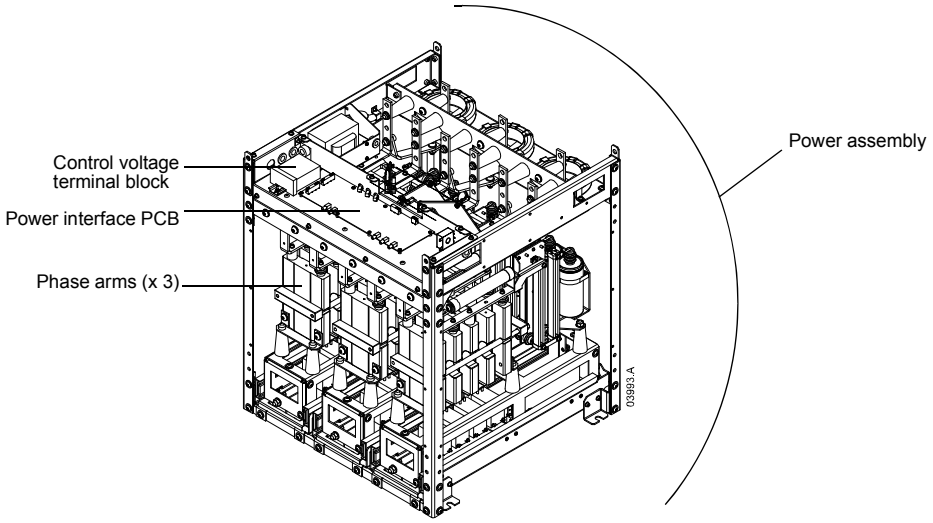


Dimensions are shown in mm (inch)

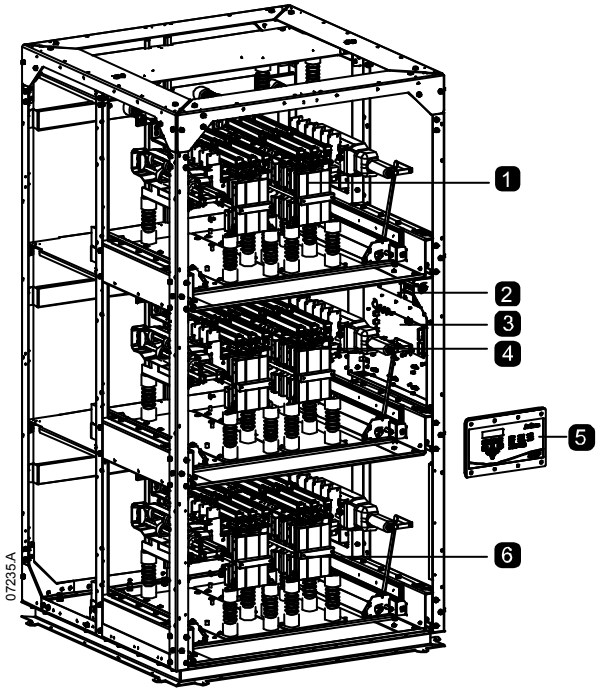
Weight: 2.1 kg (4.63 lb)

3.2 Key Components

Key Components (models V02 ~ V07)



Key Components (models V11 and V13)



1	Phase arm
2	Control voltage terminal block
3	Power interface PCB
4	Phase arm
5	MVS Controller
6	Phase arm

3.3 General Technical Data

Supply	
Mains Voltage	
MVSxxxx-V02	2.3 kV Phase-phase
MVSxxxx-V03	3.3 kV Phase-phase
MVSxxxx-V04	4.2 kV Phase-phase
MVSxxxx-V06	6.6 kV Phase-phase
MVSxxxx-V07	7.2 kV Phase-phase
MVSxxxx-V11	11.0 kV Phase-phase
MVSxxxx-V13	13.8 kV Phase-phase
Rated Frequency (fr)	50/60 Hz
Rated lightning impulse withstand voltage (U_p)	
MVSxxxx-V02 ~ 04	45 kV
MVSxxxx-V06 ~ V07	45 kV
MVSxxxx-V11	85 kV
MVSxxxx-V13	85 kV
Rated power frequency withstand voltage (U_d)	
MVSxxxx-V02 ~ V04	11.5 kV
MVSxxxx-V06 ~ V07	20 kV
MVSxxxx-V11 ~ V13	35 kV
Rated normal current (I_r)	
MVS0080-Vxx	80 A [1]
MVS0159-Vxx	159 A [1]
MVS0230-Vxx	230 A [1]
MVS0321-Vxx	321 A [1]
Rated short-time withstand current (asymmetrical RMS peak) (I_k)	
MVSxxxx-V02 ~ V07	48 kA [2]
MVSxxxx-V11 ~ V13	75 kA [3]
Form Designation	Bypassed semiconductor motor starter form 1
Control Inputs	
Start (Terminals C23, C24)	24 VDC, 8 mA approx
Stop (Terminals C31, C32)	24 VDC, 8 mA approx
Reset (Terminals C41, C42)	24 VDC, 8 mA approx
Input A (Terminals C53, C54)	24 VDC, 8 mA approx
Input B (Terminals C63, C64)	24 VDC, 8 mA approx
Motor Thermistor (Terminals B4, B5)	Trip point > 2.3 kΩ

NOTE
All control inputs are potential free. Do not apply external voltage to these inputs.

Low Voltage Supply	
Rated Voltage	
MVSxxxx-V02 ~ 07	110 or 220 ~ 240 V
MVSxxxx-V11 ~ 13	110 ~ 240 V (±10%)
Rated Frequency	50/60 Hz
Typical power consumption	
MVSxxxx-V02 ~ 07	70 W [4] continuous
MVSxxxx-V11 ~ 13	100 W [4] continuous
Outputs	
Relay Outputs	8 A @ 250 VAC resistive 10 A @ 250 VAC 15 p.f. 0.3 8 A @ 30 VDC resistive
Main Contactor (Terminals 13, 14)	Normally Open
Bypass Contactor (Terminals 23, 24)	Normally Open
Run Output/ PFC (Terminals 33, 34)	Normally Open
Output Relay A (Terminals 43, 44)	Normally Open
Output Relay B (Terminals 51, 52, 54)	Changeover
Output Relay C (Terminals 61, 62, 64)	Changeover
Analog Output (Terminals B10, B11)	0-20 mA or 4-20 mA
Environmental	
Degree of Protection	
Power Assembly	IP00

Controller	IP54/ NEMA 12
Operating Temperature	- 10 °C to + 60 °C
Storage Temperature	- 25 °C to + 55 °C - 25 °C to + 70 °C (< 24 hours)
Humidity	5% to 95% Relative Humidity
Pollution Degree	Pollution Degree 3
Vibration	Designed to IEC 60068

EMC Emission

Equipment Class (EMC)	Class A
Conducted Radio Frequency Emission	10 kHz to 150 kHz: < 120 - 69 dB µV 0.15 MHz to 0.5 MHz: < 79 dB µV 0.5 MHz to 30 MHz: < 73 dB µV
Radiated Radio Frequency Emission	0.15 MHz to 30 MHz: < 80-50 dB µV/m 30 MHz to 100 MHz: < 60-54 dB µV/m 100 MHz to 2000 MHz: < 54 dB µV/m

This product has been designed for Class A equipment. Use of the product in domestic environments may cause radio interference, in which case the user may be required to employ additional mitigation methods.

EMC Immunity

Electrostatic Discharge	6 kV contact discharge, 8 kV air discharge
Radio Frequency Electromagnetic Field	80 MHz to 1000 MHz: 10 V/m
Fast Transients 5/50 ns (main and control circuits)	2 kV line to earth, 1 kV line to line
Surges 1.2/50 µs (main and control circuits)	2 kV line to earth, 1 kV line to line
Voltage dip and short time interruption	5000 ms (at 0% nominal voltage) (safe shutdown)

Average Heat Dissipation of Power Circuit [1]

Voltage Rating	MVS0080	MVS0159	MVS0230	MVS0321
V02	240 W	290 W	270 W	310 W
V03	265 W	365 W	330 W	410 W
V04	270 W	370 W	340 W	420 W
V06	305 W	460 W	410 W	530 W
V07	310 W	465 W	410 W	530 W
V11	375 W	630 W	550 W	740 W
V13	415 W	720 W	620 W	850 W

Standards Approvals

C✓	EMC requirements
CE	EMC EU Directive

[1] Rated at AC53b 4-20:1780. Refer to *Current Ratings*.
[2] Short circuit current, with appropriate R rated fuses fitted.
[3] It is critical that the circuit breaker and associated protection relay are set to trip <150 ms. Failure to do so could result in SCR rupture and subsequent arc fault.
[4] Excludes contactors and/or circuit breakers.

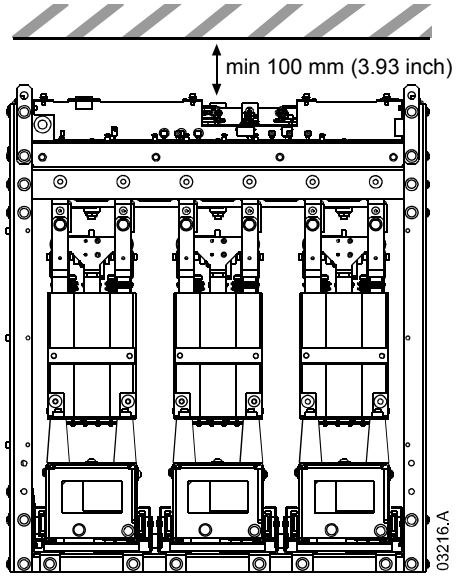
Section 4 Installation

NOTE
The MVS soft starter should only be installed in a restricted access location suitable for electrical equipment.

4.1 Mounting Instructions - Power Assembly

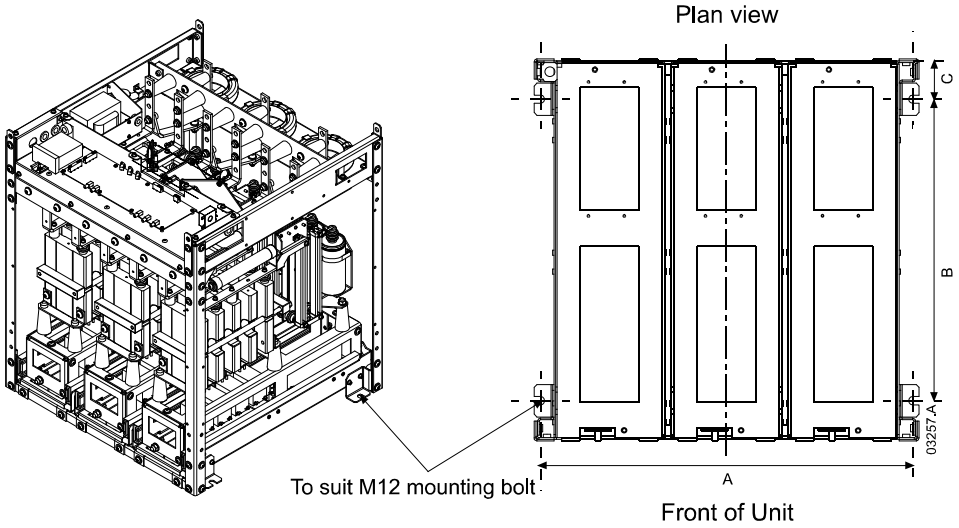
All MVS models are rated IP00 and must be installed inside an enclosure.

No clearance is required below or at the sides. For models V02 ~ V07, the power assembly should be installed with 100 mm clearance above for isolation. Models V11 and V13 require no additional clearance beyond the external frame.



Mounting Points (models V02 ~ V07)

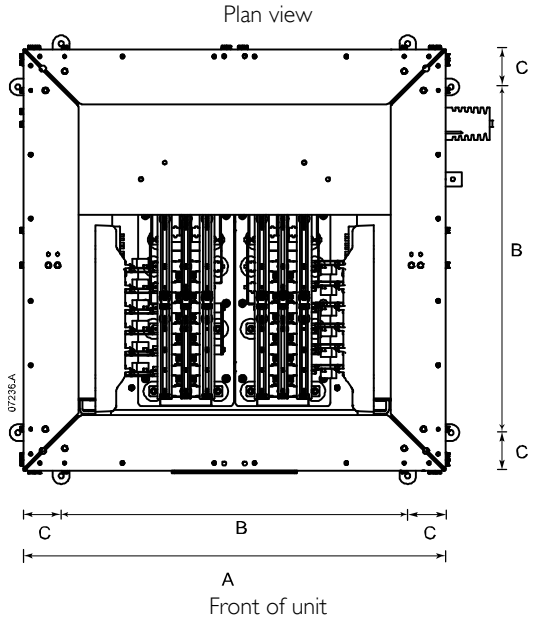
The power assembly is mounted in place using four M12 bolts. One bolt is required through each corner at the base of the unit, tightened to a torque of 40 Nm. Individual phase arms are secured within the frame using one M10 nut and two M10 high tensile grade 8.8 bolts complete with Belleville washers, all tightened to a torque of 28 ~ 30 Nm.



Mounting Points (models V11 and V13)

For V11 and V13 models, the power assembly is mounted in place using eight M12 bolts (two bolts per side at 944 mm centres). Individual phase arms are secured within the frame using two locking rods and two lock nuts, tightened to a torque of 10 Nm.

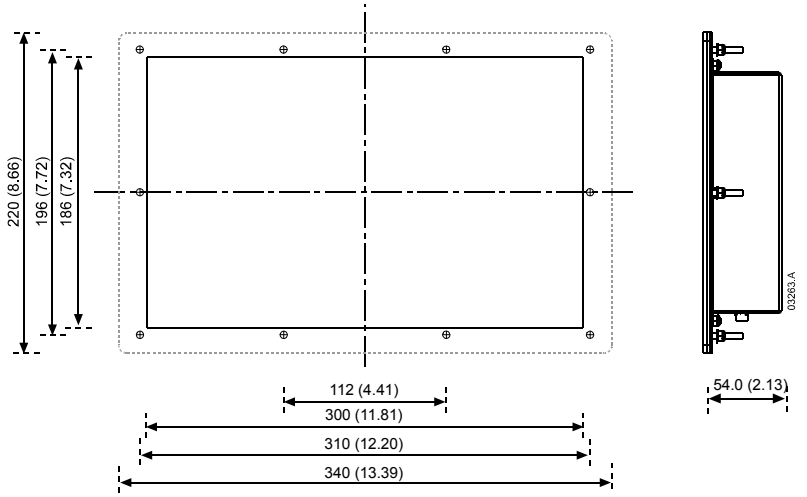
MVS models V11 and V13 come with a travel plinth. For installation the frame should be bolted into a panel with eight M12 bolts, tightened to a torque of 28 ~ 30 Nm.



	A mm (inch)	B mm (inch)	C mm (inch)
MVSxxxx-V02	636 (25.04)	513 (20.20)	68.5 (2.70)
MVSxxxx-V03			
MVSxxxx-V04			
MVSxxxx-V06	842 (33.15)	663 (26.10)	68.5 (2.70)
MVSxxxx-V07			
MVSxxxx-V11	1150 (45.28)	944 (37.17)	103 (4.06)
MVSxxxx-V13			

4.2 Mounting Instructions - MVS Controller

The MVS Controller can be secured in place with ten M4 nuts, affixed to the studs on the back of the controller.

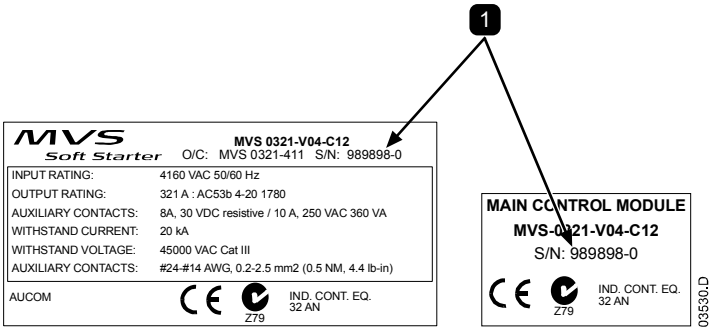


To mount the controller, make a 186 mm x 300 mm cutout at the desired mounting location. Ensure adequate clearance (54 mm) is available behind the mounting location.

Drill 5 mm holes to accommodate the studs on the controller. Fit the controller through the cutout and tighten the nuts onto the studs.

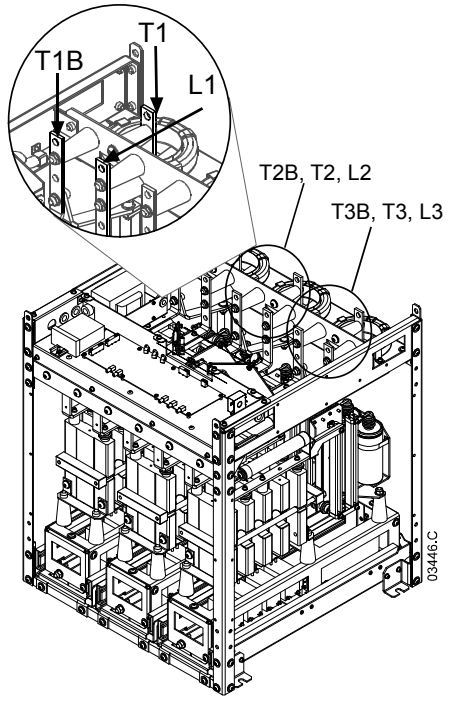
NOTE
Before installation, always ensure that you are using the correct controller for the soft starter. This can be checked by comparing the serial number on the back of the controller with the serial number on the front of the power assembly.

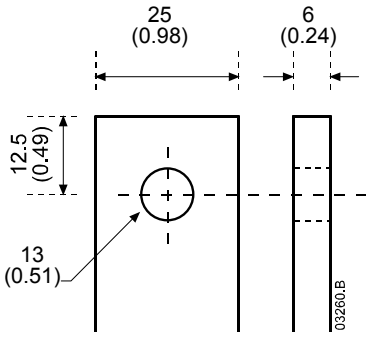
1	Serial number



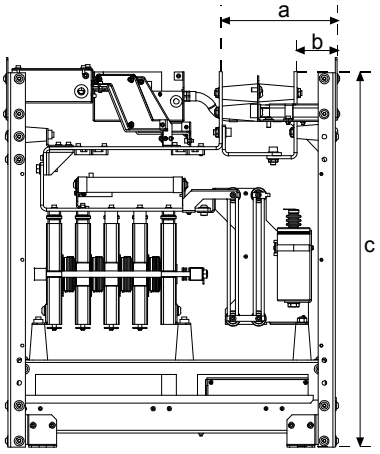
4.3 Power Terminations

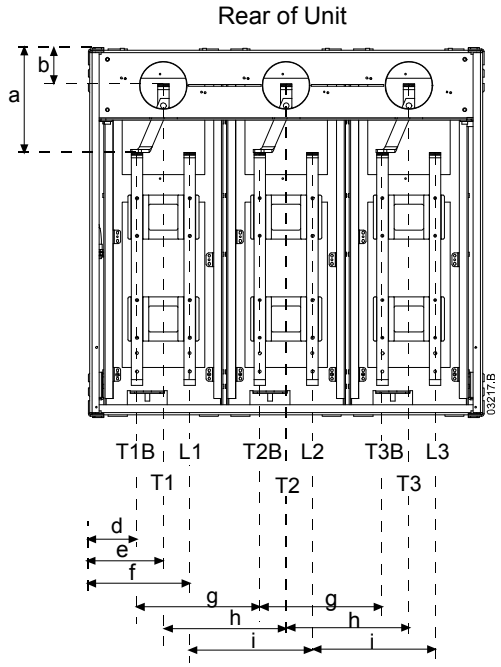
Models V02 ~ V07





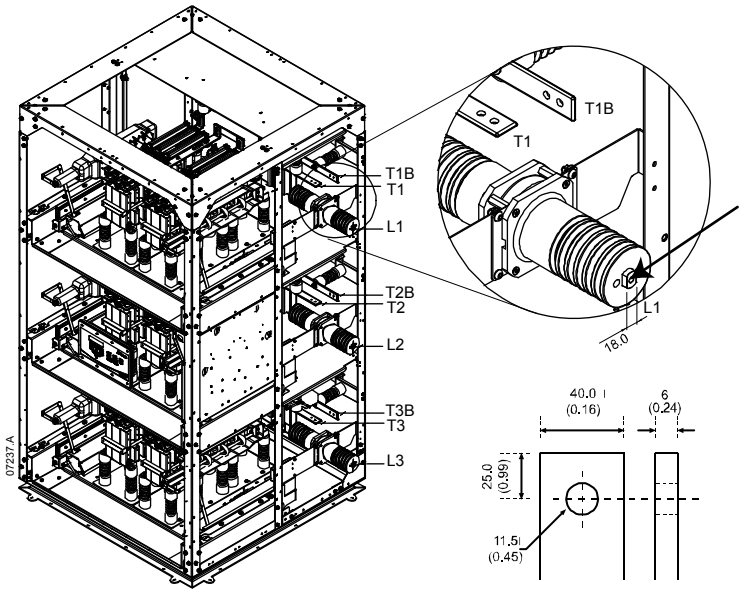
Use only M10 high tensile grade 8.8 threaded fasteners for all terminations. Use a pre-load torque setting between 28 ~ 30 Nm. Use only Belleville washers.





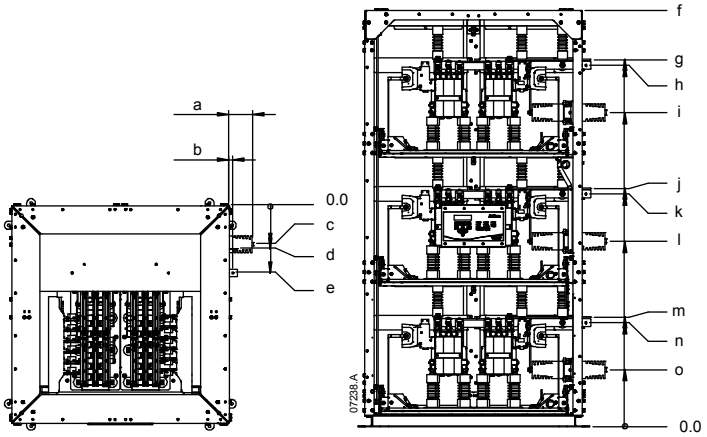
	a	b	c	d	e	f	g	h	i
	mm (inch)	mm (inch)	mm (inch)	mm (inch)	mm (inch)	mm (inch)	mm (inch)	mm (inch)	mm (inch)
MVSxxxx-V02	228 (8.98)	79 (3.11)	744 (29.29)	79 (3.11)	129 (5.08)	179 (7.05)	200 (7.87)	200 (7.87)	200 (7.87)
MVSxxxx-V03									
MVSxxxx-V04									
MVSxxxx-V06	228 (8.98)	79 (3.11)	804 (31.65)	107 (4.19)	164 (6.46)	222 (8.72)	268 (10.55)	268 (10.55)	268 (10.55)
MVSxxxx-V07									

Models V11 and V13



M10 x 30 mm thread depth.
Ensure at least 25 mm minimum thread engagement.

Bus bar termination detail



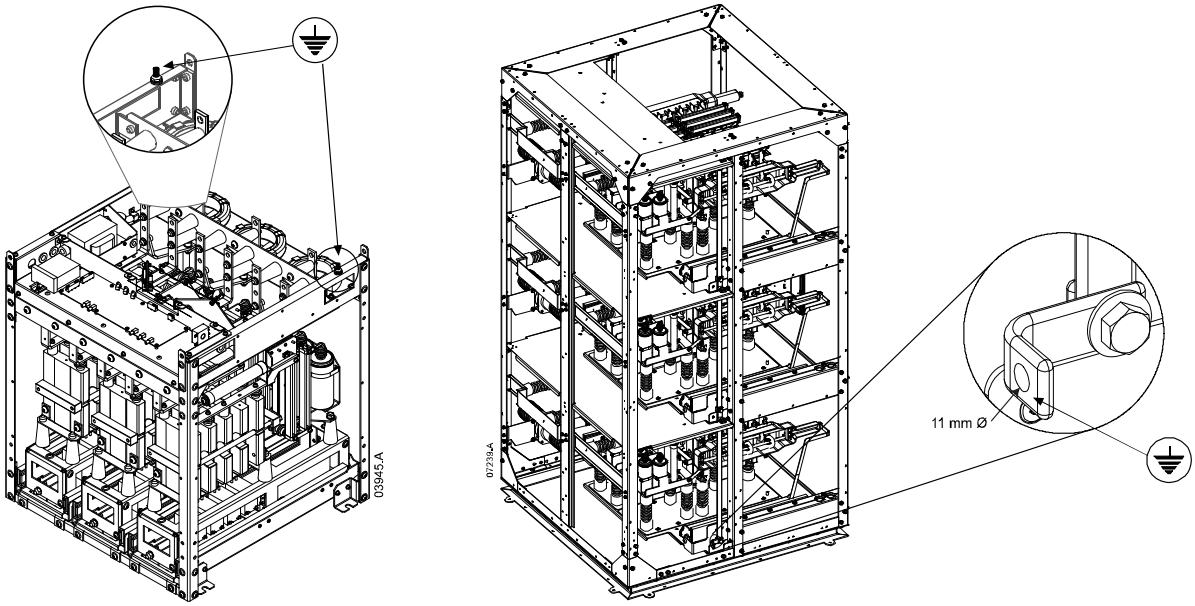
Use only M10 high tensile grade 8.8 threaded fasteners for all terminations. Use a pre-load torque setting between 28 ~ 30 Nm. Use only Belleville washers.

	a	b	c	d	e
	mm (inch)	mm (inch)	mm (inch)	mm (inch)	mm (inch)
MVSxxxx-V11	127.8 (5.03)	19.8 (0.78)	203.5 (8.01)	228.0 (8.98)	355.0 (13.98)
MVSxxxx-V13					

	f	g	h	i	j	k	l	m	n	o
	mm (inch)	mm (inch)	mm (inch)	mm (inch)	mm (inch)	mm (inch)	mm (inch)	mm (inch)	mm (inch)	mm (inch)
MVSxxxx-V11	2200 (86.6)	1965.5 (77.4)	1936.5 (76.2)	1686.5 (66.4)	1274.8 (50.2)	1245.8 (49.0)	995.8 (39.2)	584.1 (23.0)	555.1 (21.9)	305.1 (12.0)
MVSxxxx-V13										

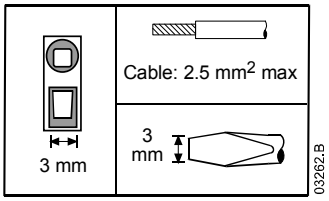
4.4 Earth Terminations

A 10 mm earth stud is located on each side of the power assembly, at the rear of the unit. Use only M10 high tensile grade 8.8 threaded fasteners for all terminations. Use a pre-load torque setting between 28 ~ 30 Nm. Use only Belleville washers.



4.5 Control Terminations

On the control voltage terminal block, control wiring is secured in place by 3 mm spring terminals. Use a screwdriver to open the terminal clamp, then insert the wire into the terminal cage. Release the clamp by removing the screwdriver.



4.6 Control Wiring

The soft starter can be controlled in three ways:

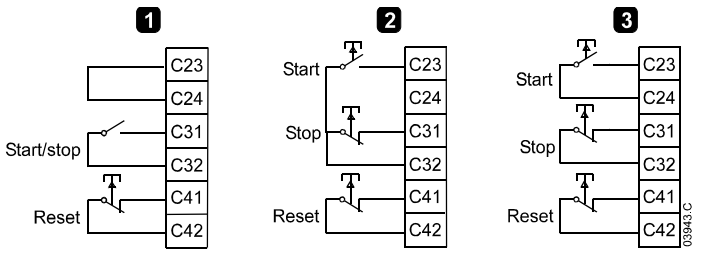
- using the buttons on the MVS Controller
- via remote inputs
- via a serial communication link

The LCL/RMT button controls whether the MVS will respond to local control (via the MVS Controller) or remote control (via the remote inputs). The Local LED on the MVS Controller is on when the soft starter is in local control mode and off when the soft starter is in remote control mode. The remote LED on the MVS is on when the soft starter is in Remote mode and off when in Local mode.

Serial communication is always enabled in local control mode, and can be enabled or disabled in remote control mode (refer to parameter 4-B).

The STOP button on the MVS Controller is always enabled.

The MVS has three fixed inputs for remote control. These inputs should be controlled by contacts rated for low voltage, low current operation (gold flash or similar).



1	Two-wire control
2	Three-wire control
3	Four-wire control

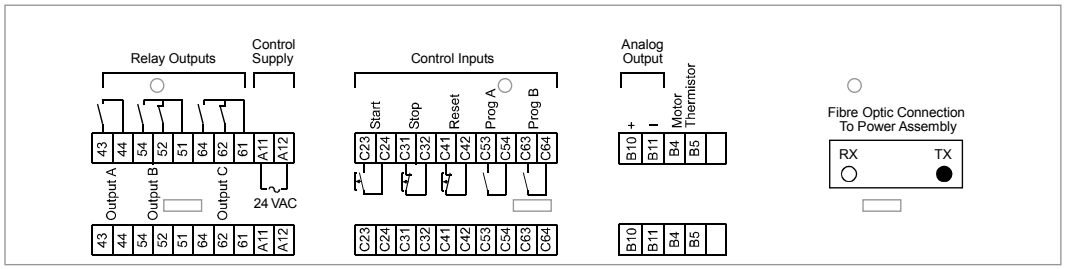
The reset input is normally closed.

CAUTION
Do not apply voltage to the control input terminals. These are active 24 VDC inputs and must be controlled with potential free contacts.

Cables to the control inputs must be segregated from mains voltage and motor cabling.

4.7 Terminal Block (MVS Controller)

Terminations on the MVS Controller use plug-in terminals. Unplug the terminal blocks, complete the wiring, then re-plug the terminal blocks into the controller.



4.8 Power Circuits

Overview

MVS soft starters are designed to operate as part of a system including other components. A main contactor and bypass contactor are required in all installations. MVS models V02 ~ V07 must be installed with fuses. MVS models V11 ~ V13 must be installed with either fuses or a circuit breaker.

The following additional components may also be required:

- main isolator/ earth switch
- R rated protection fuses
- power factor correction
- line inductors
- transient/ overvoltage protection
- MV/LV control supply transformer

Main Contactor

The MVS must always be installed with a main contactor. Select a contactor with an AC3 rating greater than or equal to the full load current rating of the connected motor or there is an option for a circuit breaker above 7.2 kV.

The main contactor is associated with terminals L1, L2, L3 on the supply side of the soft starter. The coil is associated with output terminals 13, 14 of the MVS (refer to *Standard Power Circuit Configuration*).

To ensure that the potentially dangerous medium voltage area is isolated from the low voltage control area, power is supplied to the main contactor coil from the control voltage terminal block (refer to *Internal Wiring* on page 26).

Bypass Contactor

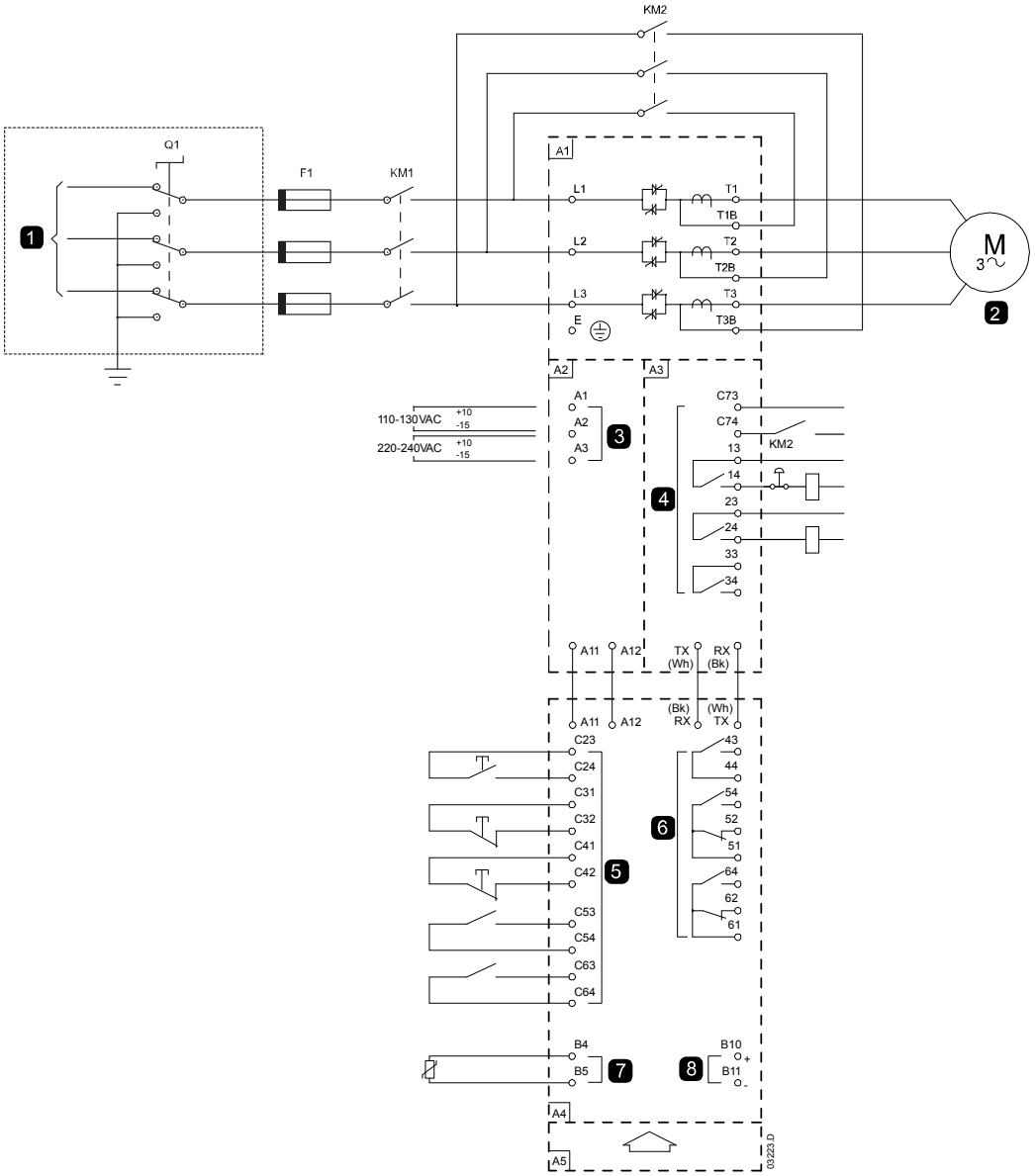
The MVS must always be installed with a bypass contactor. Select a contactor with an AC1 rating greater than or equal to the full load current rating of the connected motor or there is an option for a circuit breaker above 7.2 kV.

The bypass contactor is associated with terminals L1, L2, L3 on the supply side of the soft starter, and bypass terminals T1B, T2B, T3B on the motor side. The coil is associated with output terminals 23, 24, and the auxiliary Normally Open contact is associated with input terminals C73, C74 of the soft starter (refer to *Diagram: Standard Power Circuit Configuration*).

To ensure that the potentially dangerous medium voltage area is isolated from the low voltage control area, power is supplied to the bypass contactor coil from the control voltage terminal block (refer to *Diagram: Internal Wiring* on page 26).

Complete Power Circuit Configuration (models V02 ~ V07)

MVS power circuit with main contactor, bypass contactor, main isolator/ earth switch, R Rated fuses and control supply. Configured for two-wire start/ stop control. Models V02 to V07 must be installed with backup/R-rated fuses (refer to R-Rated Protection Fuses)

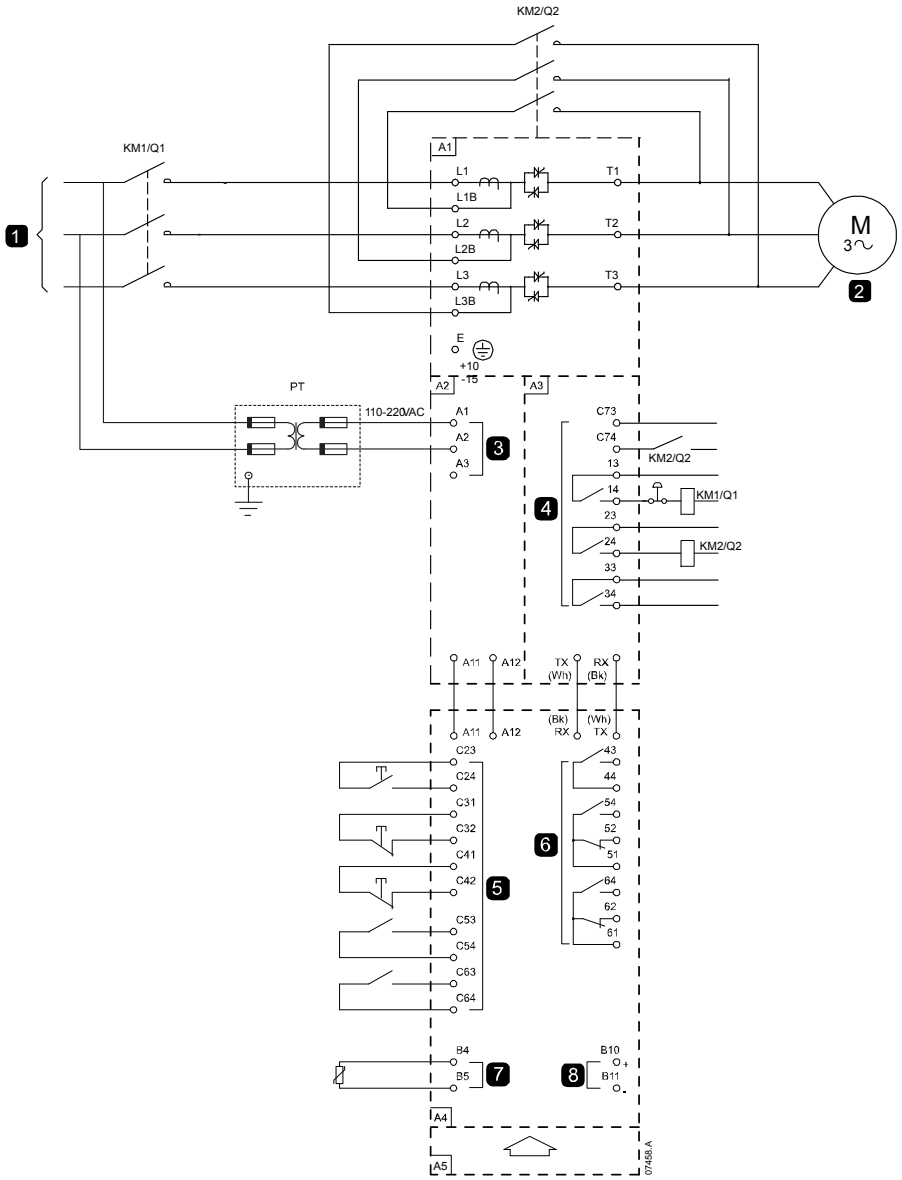


A1	Power assembly
1	3 Phase 50/60 Hz Supply
Q1	Main isolator
F1	R-Rated protection fuses
KM1	Main contactor
KM2	Bypass contactor
2	To motor
A2	Control voltage terminals
3	Control supply
A3	Control connection terminals
4	Relay outputs
C73-74	Bypass contactor feedback signal
13-14	Main contactor KM1 or feedback signal
23-24	Bypass contactor KM2 or Bypass circuit breaker Q2
33-34	Run output (PFC) (refer to *Diagram: Internal Wiring* on page 26).

A4	Controller
5	Remote control inputs
C23-24	Start
C31-32	Stop
C41-42	Reset
C53-54	Programmable input A
C63-64	Programmable input B
6	Programmable outputs
43-44	Programmable output A
51, 52, 54	Programmable output B
61, 62, 64	Programmable output C
7	Thermistor input
8	Analog output
A5	Communications module (optional)

Complete Power Circuit Configuration (models V11 and V13)

MVS power circuit with main contactor/circuit breaker and bypass contactor/circuit breaker. Configured for two-wire start/ stop control with optional MV/LV potential transformer.



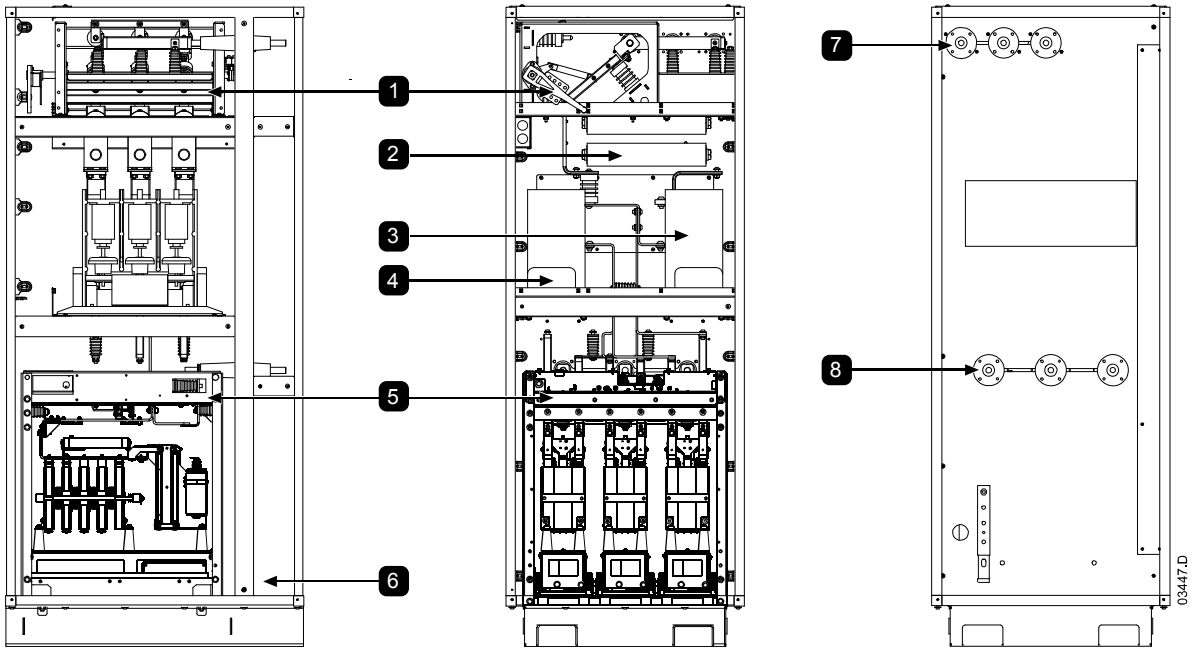
A1	Power assembly
1	3 Phase 50/60 Hz Supply
KM1/Q1	Main contactor or circuit breaker
KM2/Q2	Bypass contactor or circuit breaker
2	To motor
A2	Control voltage terminals
3	Control supply
A3	Control connection terminals
4	Relay outputs
C73-74	Bypass contactor or circuit breaker feedback signal
13-14	Main contactor KM1 or circuit breaker Q1
23-24	Bypass contactor KM2 or Bypass circuit breaker Q2
33-34	Run output (PFC) (refer to *Diagram: Internal Wiring* on page 26).

A4	Controller
5	Remote control inputs
C23-24	Start
C31-32	Stop
C41-42	Reset
C53-54	Programmable input A
C63-64	Programmable input B
6	Programmable outputs
43-44	Programmable output A
51, 52, 54	Programmable output B
61, 62, 64	Programmable output C
7	Thermistor input
8	Analog output
A5	Communications module (optional)

Enclosures (models V02 ~ V07)

MVS soft starters can be installed easily into standard enclosures to provide a complete motor control cabinet. The compact size of the power assembly leaves room for auxiliary equipment to be installed.

The power assembly should be mounted at the bottom of the enclosure, and the MVS Controller can be mounted on the front panel. The diagrams below illustrate a possible configuration for installation.

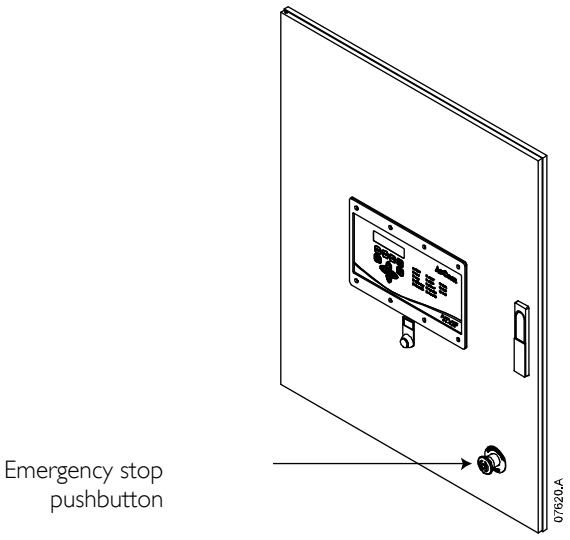


Side view Front view Rear view

1	Main isolator/earth switch	5	Power assembly
2	Fuses	6	Rear cabling compartment
3	Main contactor	7	Input terminals, M18 (tighten to 20 Nm)
4	Bypass contactor	8	Output terminals, M18 (tighten to 20 Nm)

Emergency Stop Button

In the event of an emergency, press the emergency stop button located on the front of the panel.

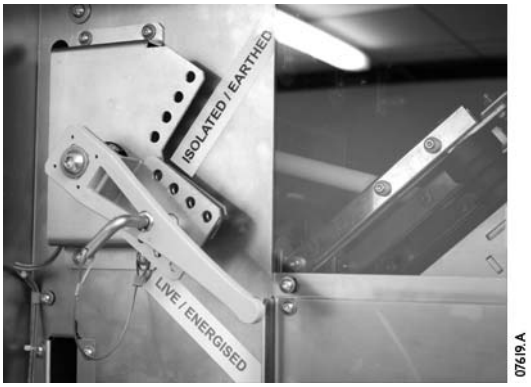


Main Isolator/ Earth Switch (models V02 ~ V07)

A main isolator/ earth switch can be connected on the supply side of the main contactor (refer to Complete Power Circuit Configuration on page 21)

CAUTION
The main isolator/ earth switch should only be operated when the motor is not running.

To open the isolator, pull out the pin and switch off. If the starter is operating, removing the pin will open the main contactor.



R Rated Protection Fuses

If specified, R Rated protection fuses can be installed on the supply side of the soft starter to provide Type 2 coordination and short circuit protection for the motor branch circuit. The appropriate fuse should be selected from the table below, based on the motor's rated full load current. MVS models V02 ~ V07 must be installed with fuses.

Fuse ratings:

Starter Rated FLC	Fuse
80 A	6R
159 A	12R
230 A	18R
321 A	24R

Fuse type code formats:

	System Voltage 2.3 kV	System Voltage 3.3 ~ 4.2 kV	System Voltage 6 ~ 7.2 kV
Ferraz	A240Rrr	A480Rrr-1	A072xxDxRO-rr
Bussmann	JCK-x-rr	JCL-x-rr	JCR-x-rr

rr = R rating of the fuse
x = physical format of the fuse (select according to installation requirements)

Examples:

6R fuse for 2.3 kV: A240R6R or JCK-A-6R
12R fuse for 3.3 kV: A480R12R-1 or JCL-B-12R
18R fuse for 6.6 kV: A072B1DARO-18R or JCR-B-18R

Power Factor Correction

NOTE
Do not connect power factor correction capacitors to the output of MVS soft starters. If static power factor correction is employed, it must be connected to the supply side of the soft starter.

Power factor correction capacitors should be selected based on the motor data and the required final power factor.

If power factor correction capacitors are being used, select a contactor according to the required kVAr. The contactor must be connected on the supply side of the soft starter. The power factor correction capacitor contactor coil is associated with output terminals 33, 34 of the soft starter's power interface PCB.

To ensure that the potentially dangerous medium voltage area is isolated from the low voltage control area, power is supplied to the power factor correction capacitor contactor coil from the control voltage terminal block (refer to Internal Wiring diagram on page 26).

NOTE
The capacitor bank must be fed from the supply side of the soft starter.

Line Inductors

Line inductors are required if the cable run between the soft starter and the motor is greater than 200 m. Line inductors should be installed outside the panel, between the soft starter output (terminals T1, T2, T3) and the motor. Contact your local supplier for selection details.

Transient/ Overvoltage Protection

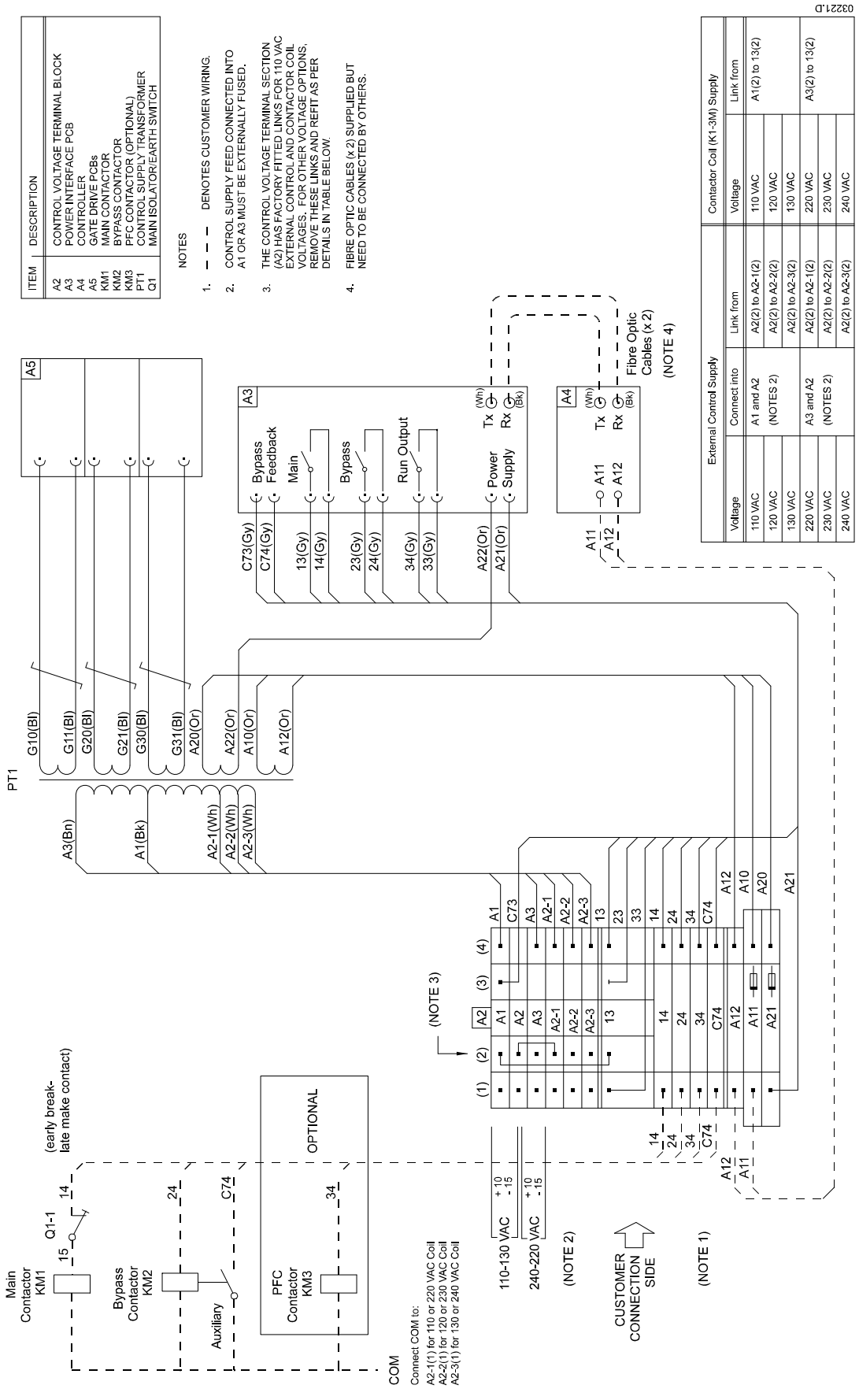
Overvoltage protection should be installed if there is a risk of high voltage transients at the installation. If required, use the optional Overvoltage Protection Kit. Contact your local supplier for details.

Control Supply Transformer (PT/VT)

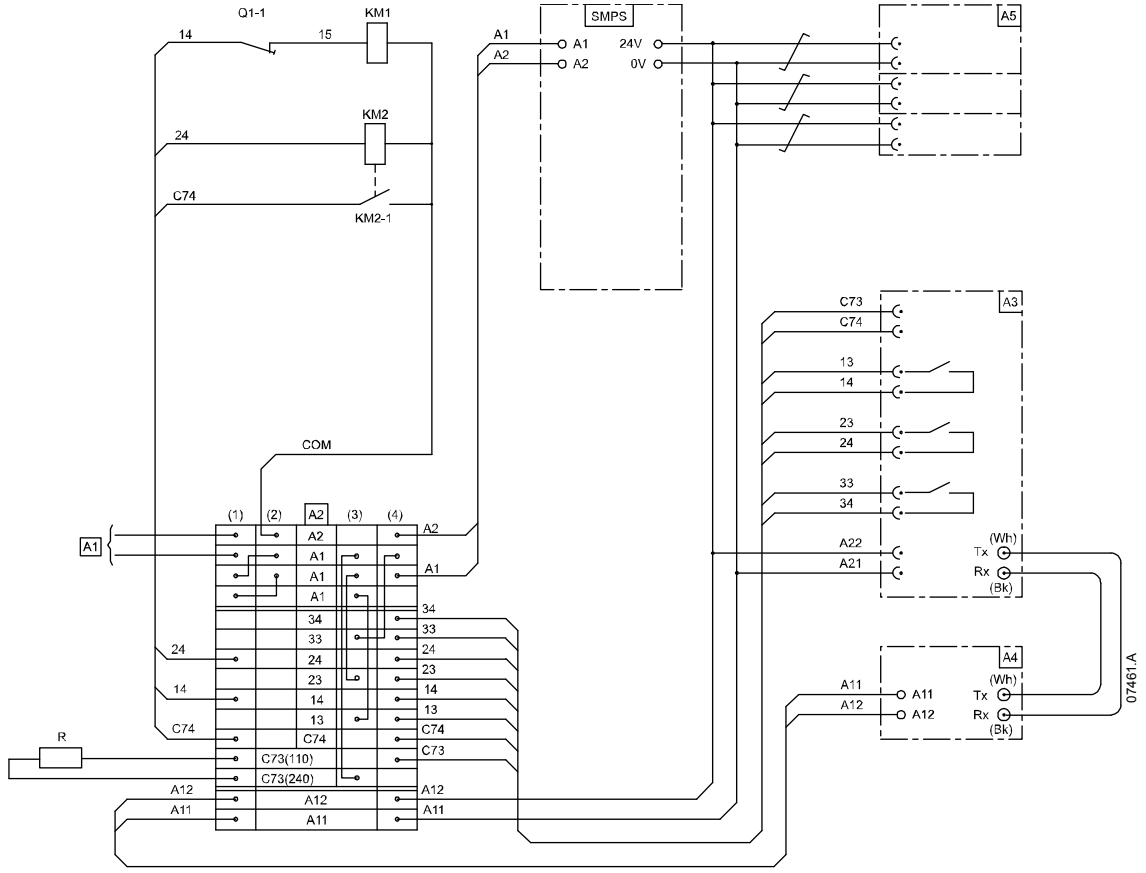
The MVS requires a low voltage control supply. If low voltage is not available, a transformer is required. Use a transformer with primary voltage matching the MV mains voltage, and secondary voltage to suit the MVS starter. Use a single phase 500 VA transformer with protection fuses on both the primary and secondary sides (refer to *Complete Power Circuit Configuration* on page 22).

Section 5 Internal Wiring

5.1 Internal Wiring (models V02 ~ V07)



5.2 Internal Wiring (models V11 and V13)



A1	Control supply
A2	Control voltage terminal block
A3	Power Interface PCB
A4	Controller
A5	Gate Drive PCBs
SMPS	Switch mode power supply (control)
KM1	Main contactor or circuit breaker
KM2	Bypass contactor
Tx, Rx	Fibre optic cables

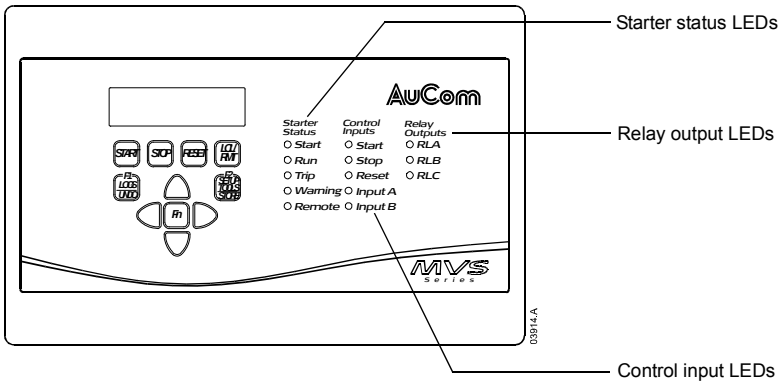
Q1-1	Main isolator/earth switch (early break, late make contact)
R	Resistor
C73, C74	Bypass feedback
13, 14	Main contactor/output
23-24	Bypass contactor/breaker output
33, 34	Run output for PFC contactor
A21, A22	Electronics power supply

NOTE
A resistor is not required for 110 V control supply.
If using circuit breakers instead of contactors, contact AuCom for more information.

Section 6 Keypad and Feedback

6.1 LEDs

The MVS Controller has 13 LEDs for at-a-glance monitoring of starter status.



The Starter Status LEDs report the operating status of the soft starter:

- The Start LED is on while the starter is starting, running or stopping.
- The Run LED is on while the starter is running.
- The Trip LED is on when a trip has occurred.
- The Warning LED is on while a warning is active.
- The Remote LED is on when remote mode is selected.

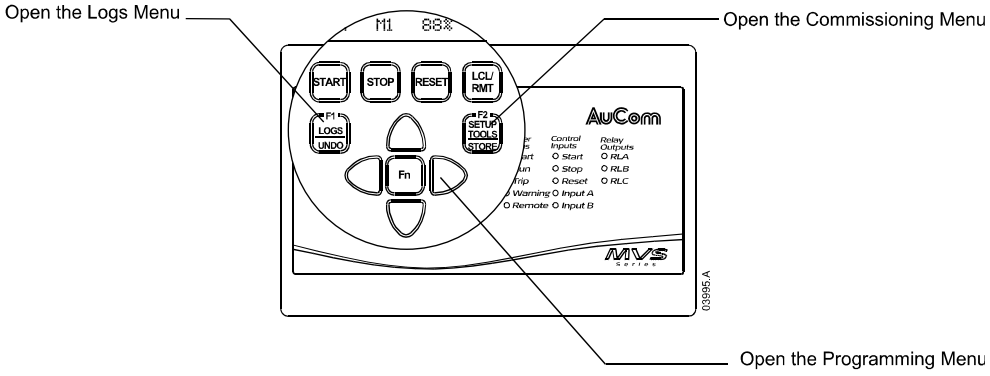
The Control Input LEDs activate when a signal is present at the corresponding control terminals.

The Relay Output LEDs activate when the corresponding output relay is active.

6.2 Menus

Configuration and control of the soft starter is managed via the MVS Controller. Information is arranged in three menus:

- The Programming Menu provides access to all programmable parameters. The Programming Menu is accessed by pressing the ► button.
- The Commissioning Menu provides access to tools which assist setup when the soft starter is deployed. The Commissioning Menu is accessed by pressing the SETUP TOOLS button.
- The Logs Menu provides viewing access to the Event and Trip Logs and the soft starter's performance counters. The Logs Menu is accessed by pressing the LOGS button.



Navigation

NOTE
The menus can only be accessed from the metering screens. You cannot open a menu from inside another menu.

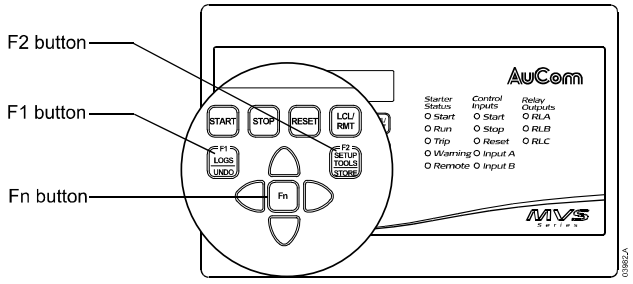
Use the ▲ and ▼ buttons to scroll through the items in a menu.

To view the items in a sub-menu, press the ► button. To close the sub-menu and return to the previous level, press ◄.

Menu Shortcuts

The MVS Controller offers keyboard shortcuts for fast access to commonly used parameters. Use parameters 11-B and 11-C (*F1 and F2 Pushbutton Function*) to select the shortcut target.

To use the shortcuts, press the FN button and either the F1 (LOGS) or F2 (SETUP TOOLS) button at the same time.



Altering Parameter Values

To change a parameter value:

- scroll to the appropriate parameter in the Programming Menu and press ► to enter edit mode.
- to alter the parameter setting, use the ▲ and ▼ buttons. Pressing ▲ or ▼ once will increase or decrease the value by one (1). If the button is held for longer than five seconds, the value will increase or decrease at a faster rate.
- to save changes, press STORE. The setting shown on the display will be saved and the MVS Controller will return to the parameter list.
- to cancel changes, press UNDO. The MVS Controller will ask for confirmation, then return to the parameter list without saving changes.
- to end edit mode, press UNDO. The MVS Controller will return to the parameter list and any unsaved changes will be lost.

You can access the Programming Menu at any time, including while the soft starter is running. Any changes to the start profile take effect after the next start. All other changes take effect immediately.

6.3 Security

Adjustment Lock

You can lock the Programming Menu to prevent users from altering parameter settings. The adjustment lock can be turned on and off using parameter 20-B.

If a user attempts to change a parameter value or access the Commissioning Menu when the adjustment lock is active, an error message is displayed:

```
Access Denied
Adj Lock is On
```

Access Code

Critical parameters (parameter group 20 and higher) are protected by a four-digit security access code, preventing unauthorised users from viewing or modifying parameter settings.

When a user attempts to enter a restricted parameter group, the MVS Controller prompts for an access code. The access code is requested once for the programming session, and authorisation continues until the user closes the menu.

To enter the access code, use the ◄ and ► buttons to select a digit, and the ▲ and ▼ buttons to change the value. When all four digits match your access code, press STORE. The MVS Controller will display an acknowledgement message before continuing.

```
Enter Access Code
****
```

STORE

```
Access Allowed
Supervisor
```

To change the access code, use parameter 20-A.

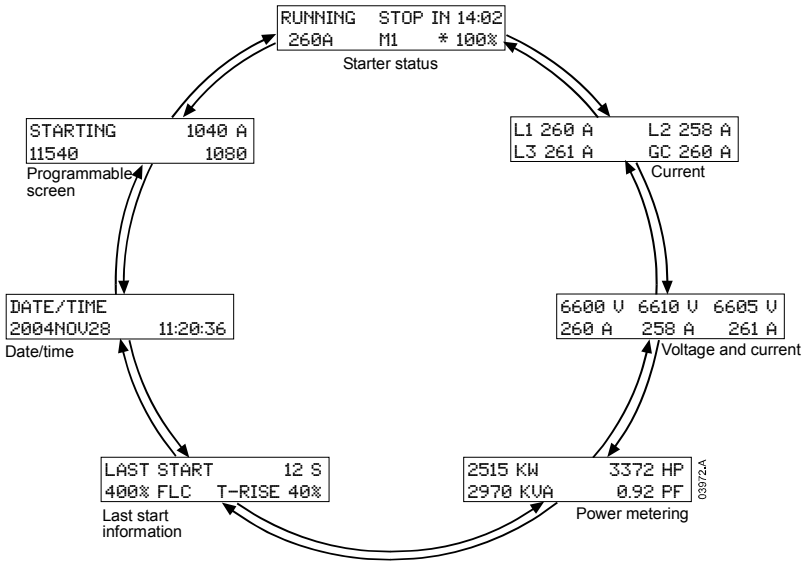
6.4 Displays

The MVS Controller displays a wide range of performance information about the soft starter. The top half of the screen shows real-time information on current or motor power (as selected in parameter 9-L). Use the ▲ and ▼ buttons to select the information shown on the bottom half of the screen.

- Starter status
- Motor temperature
- Current
- Motor power
- Voltage
- Last start information
- Date and time

Metering Screens

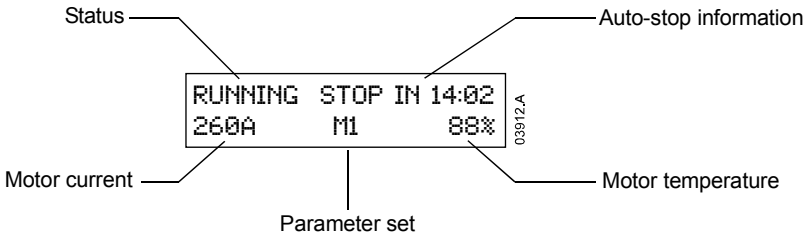
The MVS uses metering screens to display information on the soft starter's performance. Use the ▲ and ▼ buttons to move between metering screens.



Pressing the ► button while viewing the Date/Time screen lets the user set the date and time on the MVS Controller. Pressing the ► button at any other screen opens the Programming Menu.

Starter Status

The **starter status** screen shows real-time details of the starter's status, including current and temperature:



The information on the screen is arranged as follows:

- top left: status information (Ready, Starting, Running, Stopping or Tripped).
- top right: auto-stop information.
- bottom left: motor current (mean average of three phases).
- bottom centre: parameter set currently in use (primary (M1) or secondary (M2)).
- bottom right: motor temperature (based on the thermal model).

When the motor temperature approaches the trip level, the temperature will flash.

When the motor's thermal capacity will not permit a restart, an asterisk appears in front of the temperature.

When a warning occurs, the top line of the status screen alternates with the warning type. The lower line continues to display current and temperature information:

Current Imbalance		
260 A	M1	88%

RUNNING		stop in 14:02
260 A	M1	88%

When a trip occurs, the status screen is replaced by details of the trip type:

Tripped
Current Imbalance

When operating in Emergency Mode, the screen shows "Emergency Operation":

Emergency Operation		
260 A	M1	88%

Current

The **current** screen shows real-time details of the ground current and the line current on each phase:

L1 260A	L2 258A
L3 261A	GC 1A

When current is not being measured, the display will show 0.

Voltage and Current

The **voltage and current** screen shows real-time line voltage and line current on each phase:

6600V	6610V	6605V
260A	258A	261A
L1	L2	L3

When the motor is not running, the display will show in place of voltage and 0 A current.

Power Metering

The **power metering** screen shows details of total motor power, motor horsepower, motor active power and power factor.

2515 kW	3372 hp
2970 kVA	0.92 pf

Last Start Information

The **last start information** screen shows details of the most recent successful start:

- start duration (seconds)
- maximum start current drawn (as a percentage of motor full load current)
- calculated rise in motor temperature

Last start 12 Sec	
400 %	40% T-rise

If data is not available from the last start, the display will show 0 for each field.

Date/Time

The **date/time** screen shows the current system date and time (24 hour format):

Date/Time
2004Nov22 11:20:36

To adjust the current date and time, press the ► button while viewing the Date/Time metering screen. Use the ◄ and ► buttons to select which part of the date or time to edit, and use the ▲ and ▼ buttons to change the value.

Pressing **STORE** from the seconds element stores the current value and returns to the metering screens. To return to the metering screens without saving changes, press the ◄ button repeatedly.

Programmable Screen

The **programmable screen** shows the information selected in parameters 11-D to 11-G.

The default settings are starter state, motor current, kWh and hours run.

Section 7 Programming Menu

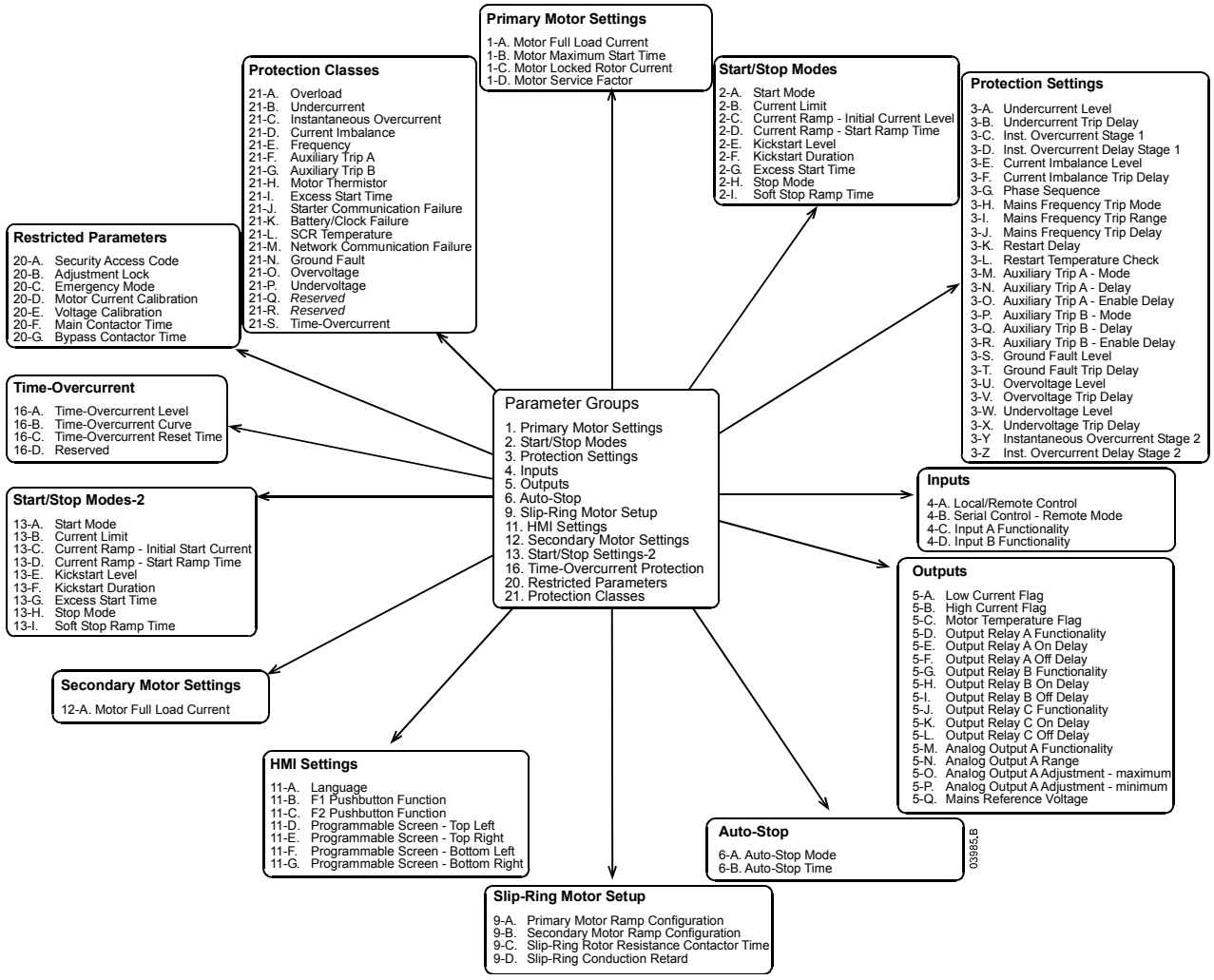
The Programming Menu provides access to programmable parameters.

To open the Programming Menu, press the ► button while viewing the metering screens.

Items in the Programming Menu are grouped into sets of related parameters. Use the ▲ and ▼ buttons to move between parameters groups and between the parameters in each group.

The security access code must be entered to access parameters in parameter group 20 or higher.

7.1 Programming Menu



You can access the Programming Menu at any time, including while the soft starter is running. Any changes to the start profile take effect after the next start.

Parameter Group	Parameters
Primary Motor Settings	1-A Motor Full Load Current 1-B Motor Locked Rotor Current Time 1-C Motor Locked Rotor Current 1-D Motor Service Factor
Start/Stop Modes-1	2-A Start Mode 2-B Current Limit 2-C Current Ramp – Initial Start Current 2-D Current Ramp – Start Ramp Time 2-E Kickstart Current Level 2-F Kickstart Duration 2-G Excess Start Time 2-H Stop Mode 2-I Soft Stop Ramp Time

Protection Settings	3-A Undercurrent Level 3-B Undercurrent Trip Delay 3-C Instantaneous Overcurrent Stage 1 3-D Instantaneous Overcurrent Delay Stage 1 3-E Current Imbalance Level 3-F Current Imbalance Trip Delay 3-G Phase Sequence 3-H Mains Frequency Trip Mode 3-I Mains Frequency Trip Range 3-J Mains Frequency Trip Delay 3-K Restart Delay 3-L Restart Temperature Check 3-M Auxiliary Trip A – Mode 3-N Auxiliary Trip A – Delay 3-O Auxiliary Trip A – Enable Delay 3-P Auxiliary Trip B – Mode 3-Q Auxiliary Trip B – Delay 3-R Auxiliary Trip B – Enable Delay 3-S Ground Fault Level 3-T Ground Fault Trip Delay 3-U Overvoltage Level 3-V Overvoltage Trip Delay 3-W Undervoltage Level 3-X Undervoltage Trip Delay 3-Y Instantaneous Overcurrent Stage 2 3-Z Instantaneous Overcurrent Delay Stage 2
Inputs	4-A Local/Remote Control 4-B Serial Control – Remote Mode 4-C Input A Functionality 4-D Input B Functionality
Outputs	5-A Low Current Flag 5-B High Current Flag 5-C Motor Temperature Flag 5-D Output Relay A – Functionality 5-E Output Relay A – On Delay 5-F Output Relay A – Off Delay 5-G Output Relay B – Functionality 5-H Output Relay B – On Delay 5-I Output Relay B – Off Delay 5-J Output Relay C – Functionality 5-K Output Relay C – On Delay 5-L Output Relay C – Off Delay 5-M Analog Output A – Functionality 5-N Analog Output A – Range 5-O Analog Output A – Adjustment (maximum) 5-P Analog Output A – Adjustment (minimum) 5-Q Mains Reference Voltage
Auto-Stop	6-A Auto-Stop Mode 6-B Auto-Stop Time
Slip-Ring Motor Setup	9-A Primary Motor Ramp Configuration 9-B Secondary Motor Ramp Configuration 9-C Slip-Ring Rotor Resistance Contactor Time 9-D Slip-Ring Conduction Retardation
HMI Settings	11-A Language 11-B F1 Pushbutton Function 11-C F2 Pushbutton Function 11-D Programmable Screen – Top Left 11-E Programmable Screen – Top Right 11-F Programmable Screen – Bottom Left 11-G Programmable Screen – Bottom Right
Secondary Motor Settings	12-A Motor Full Load Current
Start/Stop Modes-2	13-A Start Mode 13-B Current Limit

	13-C Current Ramp – Initial Start Current 13-D Current Ramp – Start Ramp Time 13-E Kickstart Current Level 13-F Kickstart Duration 13-G Excess Start Time 13-H Stop Mode 13-I Stop Ramp Time
Time-Overcurrent Protection	16-A Time-Overcurrent Level 16-B Time-Overcurrent Curve 16-C Time-Overcurrent Reset Time 16-D *Reserved*
Restricted Parameters	20-A Security Access Code 20-B Parameter Lock 20-C Emergency Mode 20-D Motor Current Calibration 20-E Voltage Calibration 20-F Main Contactor Time 20-G Bypass Contactor Time
Protection Classes	21-A Overload 21-B Undercurrent 21-C Instantaneous Overcurrent 21-D Current Imbalance 21-E Mains Frequency 21-F Auxiliary Trip A 21-G Auxiliary Trip B 21-H Motor Thermistor 21-I Excess Start Time 21-J Starter Communications Timeout 21-K Battery/Clock Fail 21-L SCR Temperature Model 21-M Network Communications Timeout 21-N Ground Fault 21-O Overvoltage 21-P Undervoltage 21-Q *Reserved* 21-R *Reserved* 21-S Time-Overcurrent

7.2 Parameter Descriptions

1 Primary Motor Settings

The Primary Motor Settings parameters configure the soft starter to suit the primary motor profile.

The motor thermal model, which governs motor overload protection and motor temperature calculations, is based on parameters 1-A to 1-D.

1-A Motor Full Load Current

Range: 5 – 550 A **Default:** 100 A

Description: Matches the starter to the connected motor's full load current (amperes). Set to the full load current (FLC) rating shown on the motor nameplate.

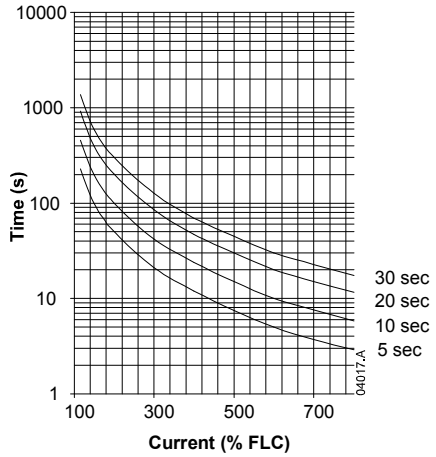
1-B Motor Locked Rotor Current Time

Range: 0:01 – 2:00 (minutes:seconds) **Default:** 0M:10S

Description: Sets the maximum length of time the motor can run at locked rotor current before reaching its maximum temperature. This setting is used by the thermal model to calculate the motor's thermal capacity.

A motor's thermal capacity is the maximum time the motor can maintain locked rotor current conditions from cold. This information is available from the motor datasheet or direct from the motor supplier.

The diagram below shows typical maximum start time curves for a motor with locked rotor current of 600% full load current, when starting from cold.



Set to the maximum allowable start time at locked rotor current, according to the motor datasheet.

1-C Motor Locked Rotor Current

Range: 400% – 1200% FLC **Default:** 600% FLC

Description: Sets the locked rotor current of the connected motor, as a percentage of full load current. Set according to the motor datasheet.

1-D Motor Service Factor

Range: 100% – 160% FLC **Default:** 105% FLC

Description: Sets the motor service factor used by the thermal model, as a percentage of motor full load current. Set according to the motor datasheet.

2 Start/Stop Modes-1

2-A Start Mode

Options: CONSTANT CURRENT **Default:** CONSTANT CURRENT

Description: Selects the start mode.

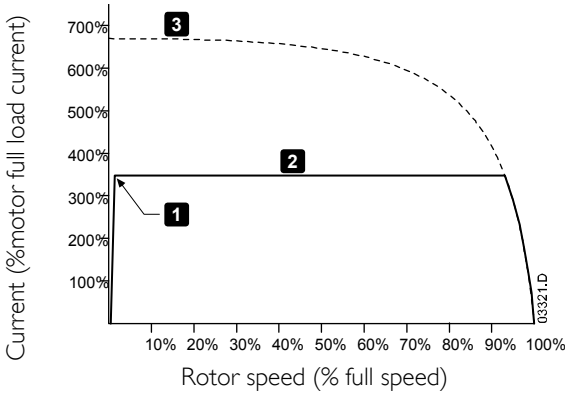
Constant current mode can be used to provide either a current limit or current ramp start, depending on the settings of parameters 2-B, 2-C and 2-D.

2-B Current Limit

Range: 100% – 600% FLC **Default:** 400% FLC

Description: Sets the current limit for constant current starting, as a percentage of motor full load current. Set so that:

- The motor is supplied with sufficient start current to enable it to produce torque adequate to easily accelerate the connected load.
- The desired start performance is obtained.
- The soft starter ratings are not exceeded.



1: Initial current (parameter 2-C)
2: Current limit (parameter 2-B)
3: Full voltage current

2-C Current Ramp - Initial Start Current

Range: 100% – 600% FLC **Default:** 400% FLC

Description: Sets the initial start current level for current ramp start mode, as a percentage of motor full load current.

Parameters 2-C and 2-D are used together to control current ramp start mode. If current ramp starting is not required, set the initial start current (parameter 2-C) equal to the current limit (parameter 2-B).

Use current ramp starting in applications where:

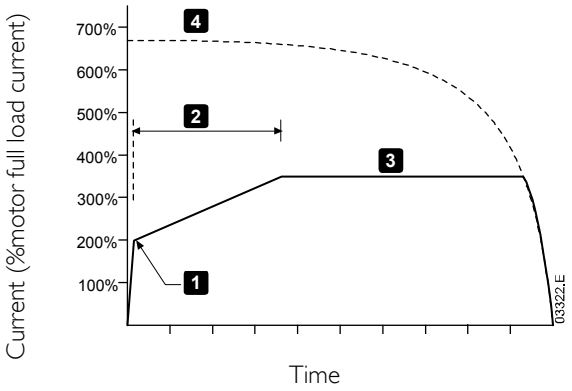
- Required start torque can vary between starts, for example a conveyor which may start loaded or unloaded. Set the initial start current (parameter 2-C) to a level that will start the motor in a light load condition, and the current limit (parameter 2-B) to a level that will let the motor reach full speed in the high load condition.
- Starting time of an easily broken away load needs to be extended, for example a centrifugal pump where pipeline pressure needs to build up slowly.
- The motor is running from a limited generator set supply, and a slower application of load will allow greater time for the supply to respond.

Set the initial start current so that the motor begins to accelerate immediately after a start is initiated.

2-D Current Ramp - Start Ramp Time

Range: 1 – 60 seconds **Default:** 1 second

Description: Sets the ramp time (in seconds) for current ramp starting. Set the ramp time to optimise start performance.



1: Initial current (parameter 2-C)
2: Start ramp time (parameter 2-D)
3: Current limit (parameter 2-B)
4: Full voltage current

2-E Kickstart Current Level

Range: 100% – 700% FLC **Default:** 500% FLC

Description: Sets the kickstart current level, as a percentage of motor full load current.

Kickstart provides extra torque at the beginning of a start, for the period specified in parameter 2-F. This can be useful for starting loads that require high breakaway torque but then accelerate easily (for example flywheel loads such as presses). Set as required.

NOTE
Kickstart subjects the mechanical equipment to increased torque levels. Ensure the motor, load and couplings can handle the additional torque before using this feature.

2-F Kickstart Duration

Range: 0 – 2000 milliseconds **Default:** 0 (off)

Description: Sets the duration for the kickstart function in milliseconds. Set as required.

NOTE
Kickstart subjects the mechanical equipment to increased torque levels. Ensure the motor, load and couplings can handle the additional torque before using this feature.

2-G Excess Start Time

Range: 0:00 – 4:00 minutes:seconds **Default:** 0M:20S

Description: Sets the maximum time allowed for the motor to reach full speed.
Set for a period slightly longer than required for a normal healthy start. The starter will trip if the start extends beyond the programmed limit, indicating that the load has stalled or start torque requirements have increased substantially since the previous start.

A setting of 0 disables this protection.

NOTE
Ensure the excess start time setting is within the starter rated capability. This ensures the starter is also protected from abnormal overload conditions.

2-H Stop Mode

Options: COAST TO STOP; TIMED VOLTAGE RAMP **Default:** COAST TO STOP

Description: Selects the active stop mode.

Coast to Stop: When a stop command is given, the soft starter removes all voltage from the motor and the motor slows according to the inertia of the load. This stop mode is suitable for high inertia loads.

Timed Voltage Ramp: The soft starter reduces the voltage supplied to the motor in a linear manner, reaching zero voltage at the end of the ramp time (parameter 2-I). Timed voltage ramp stopping is suitable for high friction loads such as pumping or conveyor applications.

Select the most appropriate stop mode for the application.

2-I Soft Stop Ramp Time

Range: 0:00 – 1:40 minutes:seconds **Default:** 0M:00S (off)

Description: Sets the ramp time for soft stopping the motor using timed voltage ramp soft stop. If using a main contactor, the contactor must remain closed until the end of the stop ramp time. Use the Main Contactor output relay (terminals 13, 14) to control the main contactor.

3 Protection Settings

These parameters determine when the soft starter's protection mechanisms will activate. The activation point for each protection mechanism can be set to suit the installation.

The soft starter responds to protection events by tripping, warning, or writing the event to the event log. The response is determined by the Protection Classes settings (parameter group 21). The default response is a trip.

NOTE
The protection settings are vital for safe operation of the soft starter and motor. Defeating the protection may compromise the installation and should only be done in the case of emergency.

3-A Undercurrent Level

Range: 0% – 100% FLC **Default:** 20% FLC

Description: Sets the trip point for undercurrent protection, as a percentage of motor full load current. Set to a level below the motor's normal working range and above the motor's magnetising (no load) current (typically 25% to 35% of rated full load current).

A setting of 0% disables undercurrent protection.

NOTE
Undercurrent protection is only active during run.

3-B Undercurrent Trip Delay

Range: 0:00 – 4:00 minutes:seconds **Default:** 0M:05S

Description: Sets the duration required for an undercurrent state to continue before a trip occurs. Set as required.

3-C Instantaneous Overcurrent Stage 1

Range: 80% – 600% FLC **Default:** 400% FLC

Description: Sets the trip point for instantaneous overcurrent protection, as a percentage of motor full load current. Set as required.

NOTE
Instantaneous overcurrent protection is only active during run.

This setting must be set to coordinate with parameter 3-Y.

3-D Instantaneous Overcurrent Delay Stage 1

Range: 0:00 – 1:00 minutes:seconds **Default:** 0M:00S

Description: Sets the duration required for current to exceed the level set in parameter 3-C before a trip occurs. Set as required.

3-E Current Imbalance Level

Range: 10% – 50% **Default:** 20%

Description: Sets the maximum allowable imbalance between the highest and lowest currents on all three phases, calculated as a percentage of the highest current. The factory setting is suitable for most applications. The level can be adjusted if required to suit site-specific conditions.

NOTE
Current imbalance detection is desensitised by 50% during starting and soft stopping.

3-F Current Imbalance Trip Delay

Range: 0:00 – 4:00 minutes:seconds **Default:** 0M:03S

Description: Sets the duration required for a current imbalance state to continue before a trip occurs. Set as required.

3-G Phase Sequence

Options: ANY SEQUENCE **Default:** ANY SEQUENCE
POSITIVE ONLY
NEGATIVE ONLY

Description: Selects which phase sequences the soft starter will allow at a start. The starter examines the sequence of the phases at its input terminals and trips if the actual sequence does not match the selected option. Set as required.

NOTE
Phase sequence protection is only active during the pre-start checks.

3-H Mains Frequency Trip Mode

Options: OFF **Default:** START/RUN
START ONLY
START/RUN
RUN ONLY

Description: Selects the operating states during which the starter will monitor for a mains frequency trip. Set as required.

3-I Mains Frequency Trip Range

Options: ± 2 HZ **Default:** ± 5 HZ
± 5 HZ
± 10 HZ
± 15 HZ

Description: Selects the tolerance for variations in mains frequency before the soft starter trips. Set as required.

NOTE
Selecting a higher tolerance for variation may compromise motor life. Only select a higher tolerance after due consideration of effects on the motor and driven equipment.

3-J Mains Frequency Trip Delay

Range: 0:00 – 4:00 minutes:seconds **Default:** 0m:00s

Description: Sets the duration required for a mains frequency disturbance to continue outside the range selected in parameter 3-I, before a trip occurs. Set if required to allow continued motor operation during extreme but temporary under- and over-frequency conditions that can endanger motor life.

NOTE
If the mains frequency drops below 35 Hz or rises above 75 Hz, the starter will trip immediately.

3-K Restart Delay

Range: 00:01 – 60:00 minutes:seconds **Default:** 00M:10S

Description: Sets the minimum time between the end of a stop and the beginning of the next start. During the restart delay period, the display shows the time remaining before another start can be attempted. Set as required.

NOTE
The restart delay is measured from the end of each stop. Changes to the restart delay setting take effect after the next stop.

3-L Restart Temperature Check

Options: OFF **Default:** OFF
ON

Description: Selects whether the soft starter will check whether sufficient thermal capacity is available to complete a start successfully, before attempting to start. The check compares the temperature rise from the last motor start with the available thermal capacity. Set as required.

3-M Auxiliary Trip A - Mode

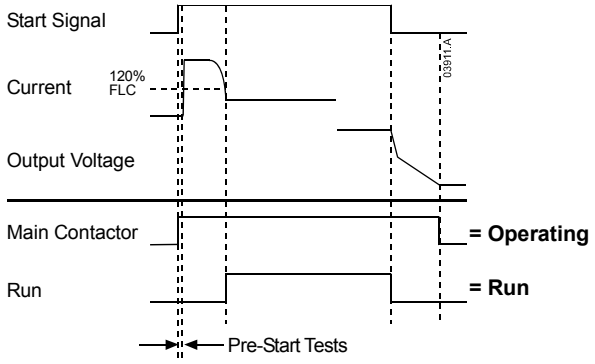
Options: ALWAYS ACTIVE **Default:** ALWAYS ACTIVE
OPERATING ONLY
RUN ONLY

Description: Selects when the starter will monitor Input A for an auxiliary trip condition.

Always Active: An auxiliary trip can occur at any time when the MVS Controller is receiving power.

Operating Only: An auxiliary trip can occur while the soft starter is running, stopping or starting (including pre-start checks).

Run Only: An auxiliary trip can only occur after the soft starter has successfully completed a start and entered running state.



3-N Auxiliary Trip A - Delay

Range: 0:00 – 4:00 minutes:seconds **Default:** 0M:00S

Description: Sets a delay between activation of Input A and a trip. Set as required.

3-O Auxiliary Trip A - Enable Delay

Range: 00:00 – 30:00 minutes:seconds **Default:** 00M:00S

Description: Sets a delay before an auxiliary trip can occur on Input A, after the soft starter has entered the state selected in parameter 3-M. Set as required.

3-P Auxiliary Trip B - Mode

Options: ALWAYS ACTIVE **Default:** ALWAYS ACTIVE
OPERATING ONLY
RUN ONLY

Description: Selects when the starter will monitor Input B for an auxiliary trip condition. Refer to parameter 3-M *Auxiliary A Trip - Mode* for further details.

3-Q Auxiliary Trip B - Delay

Range: 0:00 – 4:00 minutes:seconds **Default:** 0M:00S

Description: Sets a delay between activation of Input B and a trip. Set as required.

3-R Auxiliary Trip B - Enable Delay

Range: 00:00 – 30:00 minutes:seconds **Default:** 00M:00S

Description: Sets a delay before an auxiliary trip can occur on Input B, after the soft starter has entered the state selected in parameter 3-P. Set as required.

3-S Ground Fault Level

Range: 1 – 40 A **Default:** 10 A

Description: Sets the trip point for ground fault protection, in amperes. Ground fault is a dynamic trip based on phase current measurements every half-cycle. Ground fault current is the vector summation of the individual phase currents. Set as required.

NOTE
Ground fault protection is only active during run.

3-T Ground Fault Trip Delay

Range: 0:01 – 4:00 minutes:seconds **Default:** 0M:03S

Description: Sets the duration required for the ground current to exceed the level specified in parameter 3-S before a trip occurs. Set as required.

3-U Overvoltage Level

Range: 100 – 14000 V **Default:** 7200 V

Description: Sets the trip point for overvoltage protection. Set as required.

3-V Overvoltage Trip Delay

Range: 0:00 – 4:00 minutes:seconds **Default:** 0M:05S

Description: Sets the duration required for an overvoltage state to continue before a trip occurs. Set as required.

3-W Undervoltage Level

Range: 100 – 14000 V **Default:** 100 V

Description: Sets the trip point for undervoltage protection. Set as required.

3-X Undervoltage Trip Delay

Range: 0:00 – 4:00 minutes:seconds **Default:** 0M:05S

Description: Sets the duration required for an undervoltage state to continue before a trip occurs. Set as required.

3-Y Instantaneous Overcurrent Stage 2

Range: 30 – 4400 AMPS **Default:** 4400 AMPS

Description: Sets the trip point for instantaneous overcurrent – Stage 2 - protection, as a percentage of motor full load current. Set as required.

This threshold time level depends on the soft starter configuration. This protection function uses the main switching element.

If the main switching element is a contactor (protected by a fuse), then this function must be coordinated with the fuse to ensure that the contactor does NOT open if the current level is higher than the maximum break current.

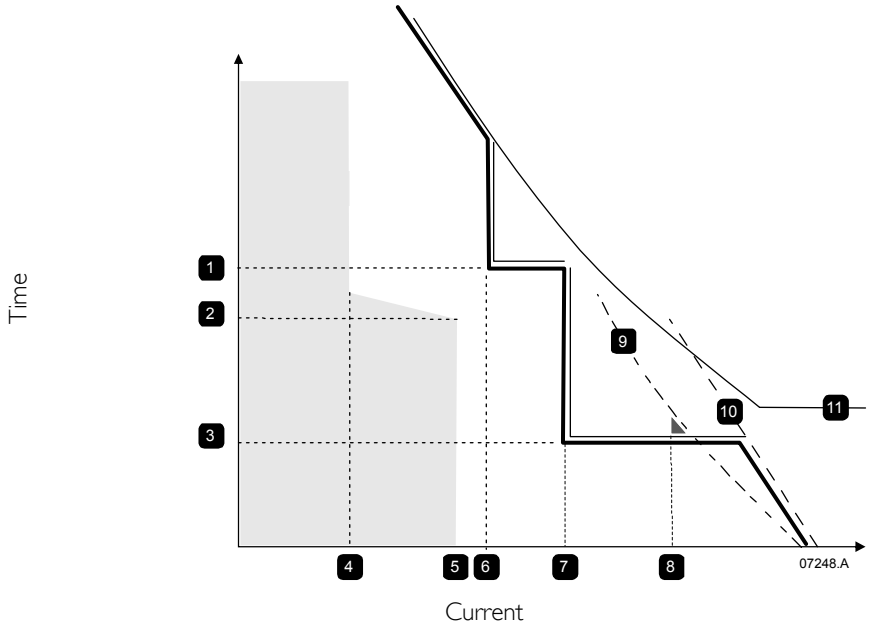
If the main switching element is a breaker, then this delay must be minimised to provide the best possible protection to the SCR.

There are two instantaneous trip functions, stage 1 and 2. These protection functions are configured to be complementary. It is recommended that stage 1 be set such that is triggers at lower current/higher time values than Stage 2.

When Stage 1 triggers, a controlled stop is performed whereby the SCRs conduct current for some time, whereas stage 2 only opens the main switching device.

Stage 1 must be configured to protect the SCR. Furthermore, stage 2 must be configured to protect the main switching device.

Example: Contactor and Fuse

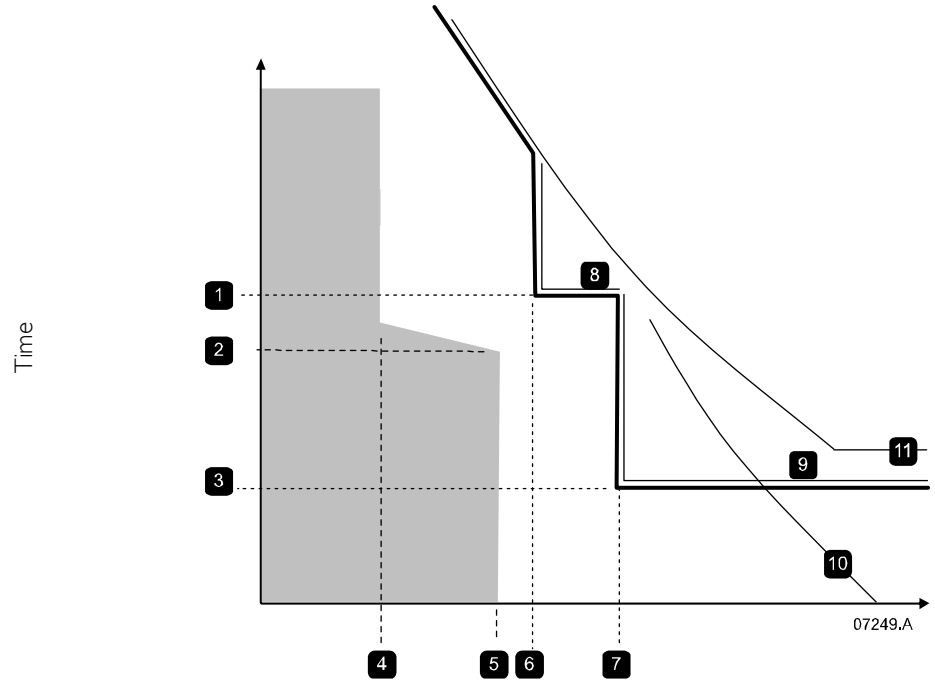


1	Instantaneous Overcurrent Stage 1 (3D)
2	20 seconds
3	Instantaneous Overcurrent Delay (3Z)
4	FLC
5	4 x FLC
6	Instantaneous Overcurrent Stage 1 (3C)

7	Instantaneous Overcurrent Stage 2 (3Y)
8	Unprotected region
9	SCR
10	Fuse
11	Overload curve

Shaded area indicates motor operation

Example: Circuit Breaker



1	Instantaneous Overcurrent Delay Stage1 (3D)
2	20 seconds
3	Instantaneous Overcurrent Delay (3Z)
4	FLC
5	4 x FLC
6	Instantaneous Overcurrent (3C)

7	Instantaneous Overcurrent Stage 2 (3Y)
8	Stage 1
9	Stage 2
10	SCR
11	Time-current

Shaded area indicates motor operation

3-Z Instantaneous Overcurrent Delay Stage 2

Range: 10 – 1000mS **Default:** 10 mS

Description: Sets the duration required for current to exceed the level set in parameter 3-Y before a trip occurs. Set as required.

This threshold time level depends on the soft starter configuration. This protection function uses the main switching element.

If the main switching element is a contactor (protected by a fuse), then this function must be coordinated with the fuse to ensure that the contactor does NOT open if the current level is higher than the maximum break current.

If the main switching element is a breaker, then this delay must be minimised to provide the best possible protection to the SCR.

4 Inputs

4-A Local/Remote Control

Options: Button always active
Button active when off
Local control only
Remote control only

Default: Button always active

Description: Enables and disables the local control buttons and remote control inputs. Also determines when and if the **LCL/RMT** button can be used to switch between local and remote control. The **STOP** button on the MVS Controller is always enabled.

Button always active: LCL/RMT button is always enabled.

Button active when off: LCL/RMT button is enabled when the starter is off (not starting, stopping or running).

Local control only: All remote inputs are disabled.

Remote control only: Local control buttons (**START**, **RESET**, **LCL/RMT**) are disabled.

CAUTION
When using two-wire remote control, the soft starter will restart immediately if the remote start input is still active.

4-B Serial Control - Remote Mode

Options: Disable in remote
Enable in remote

Default: Enable in remote

Description: Selects whether the starter will accept Start, Stop and Reset commands from the serial network when in Remote mode. The **Force Comms Trip**, **Local/Remote Control** and **Test Start** commands are always enabled.

4-C Input A Functionality

Options: Parameter set selection **Default:** Auxiliary trip (N/O)
Auxiliary trip (N/O)
Auxiliary trip (N/C)
Local/remote select
Emergency mode operation
Emergency stop (N/C)

Description: Determines the functionality of Input A.

Parameter Set Selection: The MVS can be programmed with two separate sets of motor and starting data. The primary parameter set is programmed using parameters 1-A to 2-I. The secondary parameter set is programmed using parameters 12-A to 13-I. To activate the secondary parameter set, parameter 4-C must be set to Parameter Set Selection and there must be a closed circuit across C53-C54 when a start command is given.

Auxiliary Trip (Normally Open): The MVS can be tripped by a remote circuit connected to Input A. When parameter 4-C is set to Auxiliary Trip (N/O), a closed circuit across C53-C54 trips the soft starter. Functionality of the auxiliary trip feature can be adjusted using parameters 3-M *Auxiliary Trip A - Mode*, 3-N *Auxiliary Trip A - Delay*, 3-O *Auxiliary Trip A - Enable Delay*.

Auxiliary Trip (Normally Closed): The MVS can be tripped by a remote circuit connected to Input A. When parameter 4-C is set to Auxiliary Trip (N/C), an open circuit across C53-C54 trips the soft starter. Functionality of the auxiliary trip feature can be adjusted using parameters 3-M *Auxiliary Trip A - Mode*, 3-N *Auxiliary Trip A - Delay*, 3-O *Auxiliary Trip A - Enable Delay*.

Local/Remote Select: Input A can be used to select between local and remote control, instead of using the **LCL/RMT** button on the MVS Controller. Selecting this option disables the **LCL/RMT** button, and the soft starter will ignore any Local/Remote select command from the serial communications network. An open circuit across the input selects local control and a closed circuit selects remote control.

NOTE
To use Input A to select between local and remote control, parameter 4-A must be set to Button Always Active or Button Active When Off.

Emergency Mode Operation: In emergency mode the soft starter continues to run until stopped, ignoring all trips and warnings. When parameter 4-C is set to Emergency Mode Operation, closing the circuit across C53-C54 activates emergency mode operation as described in parameter 20-C *Emergency Mode*. Opening the circuit ends emergency mode and returns control to the normal control circuits. The MVS stops the motor using the stop mode selected in parameter 2-H or 13-H *Stop Mode*.

Emergency Stop (Normally Closed): The MVS can be commanded to perform an emergency stop, ignoring the soft stop mode set in parameter 2-H *Stop Mode*. When parameter 4-C is set to Emergency Stop and the circuit across C53-C54 is opened, SCR firing stops, the main and bypass contactors open, and the motor coasts to stop.

4-D Input B Functionality

Options: Refer to parameter 4-C **Default:** AUXILIARY TRIP (N/O)

Description: Determines the functionality of Input B. Refer to parameter 4-C for details. Use parameters 3-P *Auxiliary Trip B - Mode*, 3-Q *Auxiliary Trip B - Delay*, 3-R *Auxiliary Trip B - Enable Delay* to adjust functionality if required.

NOTE
If Input A and Input B are both configured for Parameter Set Selection or Local/Remote Select, the state of Input A will take priority.

5 Outputs

5-A Low Current Flag

Range: 1% – 100% FLC **Default:** 50% FLC

Description: Sets the current level at which the low current flag operates, as a percentage of motor full load current. Hysteresis is built in.

The low current flag can be assigned to one of the programmable output relays for indication of motor current lower than the programmed value. The flag is cleared when the current rises above the activation level by 10% of the programmed motor full load current (parameter 1-A).

5-B High Current Flag

Range: 50% – 600% FLC **Default:** 100% FLC

Description: Sets the current level at which the high current flag operates, as a percentage of motor full load current. Hysteresis is built in.

The high current flag can be assigned to one of the programmable output relays for indication of motor current in excess of the programmed value. The flag is cleared when the current falls below the activation level by 10% of the programmed motor full load current (parameter 1-A).

5-C Motor Temperature Flag

Range: 0% – 160% **Default:** 80%

Description: Sets the temperature at which the motor temperature flag operates, as a percentage of the motor's thermal capacity.

The motor temperature flag can be assigned to one of the programmable output relays for indication that the motor temperature (as calculated by the motor thermal model) exceeds the programmed value. A trip occurs when motor temperature (calculated by the thermal model) reaches the value set in parameter 1-D *Motor Service Factor*.

5-D Output Relay A Functionality

Options: OFF (not used) **Default:** MAIN CONTACTOR
MAIN CONTACTOR
RUN

TRIP
WARNING
LOW CURRENT FLAG
HIGH CURRENT FLAG
MOTOR TEMPERATURE FLAG
AUXILIARY TRIP A
AUXILIARY TRIP B
ROTOR RESISTANCE CHANGEOVER

Description: Determines the functionality of Output Relay A. Output Relay A is normally open.

Main Contactor: The relay will close when starter receives a start command. The relay remains closed as long as the motor is receiving voltage.

Run: The relay will close when the motor is running at full voltage, after the start has finished.

Trip: The relay will close when the starter trips.

Warning: The relay will close when a protection mechanism activates and the starter issues a warning.

Low Current Flag: The relay will close when the low current flag activates, as specified in parameter 5-A *Low Current Flag*.

High Current Flag: The relay will close when the high current flag activates, as specified in parameter 5-B *High Current Flag*.

Motor Temperature Flag: The relay will close when the motor temperature flag activates, as specified in parameter 5-C *Motor Temperature Flag*.

Auxiliary Trip A: The relay will close when a trip occurs on Input A, as specified in parameter 3-M *Auxiliary Trip A - Mode*.

Auxiliary Trip B: The relay will close when a trip occurs on Input B, as specified in parameter 3-P *Auxiliary Trip B - Mode*.

Rotor Resistance Changeover: The relay will close when the high rotor resistance current ramp has reached full voltage, allowing use with a slip-ring motor (refer to *Using the MVS to Control a Slip-Ring Motor* on page 67).

NOTE
In all cases, there can be a delay between the condition and the relay closing, as specified in parameter 5-E *Output Relay A On Delay*.

5-E Output Relay A On Delay

Range: 0:00 – 5:00 minutes:seconds **Default:** 0M:00S
Description: Determines the delay before Output Relay A closes, after being commanded to do so.

5-F Output Relay A Off Delay

Range: 0:00 – 5:00 minutes:seconds **Default:** 0M:00S
Description: Determines the delay before Output Relay A opens, after being commanded to do so.

5-G Output Relay B Functionality

Options: Refer to parameter 5-D **Default:** RUN
Description: Determines the functionality of Output Relay B. Output Relay B is a changeover relay. Refer to parameter 5-D *Output Relay A Functionality* for details.

5-H Output Relay B On Delay

Range: 0:00 – 5:00 minutes:seconds **Default:** 0M:00S
Description: Determines the delay before Output Relay B switches over, after being commanded to do so.

5-I Output Relay B Off Delay

Range: 0:00 – 5:00 minutes:seconds **Default:** 0M:00S
Description: Determines the delay before Output Relay B switches over, after being commanded to do so.

5-J Output Relay C Functionality

Options: Refer to parameter 5-D **Default:** TRIP
Description: Determines the functionality of Output Relay C. Output Relay C is a changeover relay. Refer to parameter 5-D *Output Relay A Functionality* for details.

5-K Output Relay C On Delay

Range: 0:00 – 5:00 minutes:seconds **Default:** 0M:00S

Description: Determines the delay before Output Relay C switches over, after being commanded to do so.

5-L Output Relay C Off Delay

Range: 0:00 – 5:00 minutes:seconds **Default:** 0M:00S

Description: Determines the delay before Output Relay C switches over, after being commanded to do so.

5-M Analog Output A Functionality

Options: CURRENT (% FLC) **Default:** CURRENT (% FLC)
VOLTAGE (% MAINS)
MOTOR TEMPERATURE (% MOTOR SERVICE FACTOR)
MOTOR KW (%)
MOTOR KVA (%)
POWER FACTOR

Description: Sets the functionality of Analog Output A. Performance of the analog output signal can be adjusted using parameters 5-N, 5-O and 5-P.

5-N Analog Output A Range

Options: 0-20 MA **Default:** 4-20 MA
4-20 MA

Description: Selects the range for Analog Output A.

5-O Analog Output A Adjustment - maximum

Range: 0% – 600% **Default:** 100%

Description: Calibrates the upper limit of Analog Output A to match the signal read on an external current measuring device. Set so that the current measured on the analog output simulation is 20 mA at 100%.

5-P Analog Output A Adjustment - minimum

Range: 0% – 600% **Default:** 0%

Description: Calibrates the lower limit of Analog Output A to match the signal read on an external current measuring device. Set so that the current measured on the analog output simulation at 0% is 0 mA or 4 mA, as determined by parameter 5-N.

5-Q Mains Reference Voltage

Options: 100 – 14000 V **Default:** 400 V

Description: Provides the reference voltage for the analog output.

6 Auto-Stop

These parameters define how the auto-stop parameters will control the soft starter.

6-A Auto-Stop Mode

Options: OFF **Default:** OFF
TIMER
CLOCK

Description: Sets the mode for the auto-stop function. Parameter 6-A is used in conjunction with parameter 6-B to determine auto-stop operation.

Off: The soft starter ignores any auto-stop time setting in parameter 6-B and runs until a stop command is received.

Timer: The soft starter auto-stops after the interval specified in parameter 6-B, measured from the start command.

Clock: The soft starter auto-stops at the time specified in parameter 6-B.

6-B Auto-Stop Time

Range: 0:01 – 24:00 hours:minutes **Default:** 0H:01M (off)

Description: Sets the time for the auto-stop function. Parameter 6-B is used in conjunction with parameter 6-A to determine auto-stop operation as follows:

6-A Auto-Stop Mode	6-B Auto-Stop Time	Soft Starter Action
Off	3:34	The soft starter ignores the time setting and continues to run.
Timer	3:34	The soft starter will perform a stop 3 hours 34 minutes after start command.
Clock	3:34	The soft starter will perform a stop at 3:34 am (24-hour clock).

9 Slip-Ring Motor Setup

These parameters allow the soft starter to be configured for use with a slip-ring motor.

9-A Primary Motor Ramp Configuration

Options: SINGLE RAMP **Default:** SINGLE RAMP
DUAL RAMP

Description: Selects whether to use a single or dual current ramp profile for soft starting, when using the primary motor set. Set to single ramp for squirrel cage induction motors, or dual ramp for slip-ring induction motors.

9-B Secondary Motor Ramp Configuration

Options: SINGLE RAMP **Default:** SINGLE RAMP
DUAL RAMP

Description: Selects whether to use a single or dual current ramp profile for soft starting, when using the secondary motor set. Refer to parameter 9-A for details.

9-C Slip-Ring Rotor Resistance Contactor Time

Range: 100 – 500 milliseconds **Default:** 150 milliseconds

Description: Sets the delay between the rotor resistance relay closing and the low resistance current ramp starting.

Slip-ring motors can be started using a rotor resistance method. This approach requires an output relay to be programmed to Rotor Resistance Changeover (parameters 5-D, 5-G or 5-J) and wired to reduce rotor resistance to provide suitable torque for the application. The motor is started by providing a current limit ramp to full conduction under high rotor resistance, then the relay is used to lower rotor resistance and a second current limit ramp is provided. Running state commences when full conduction is reached.

This parameter only applies if parameter 9-A or 9-B *Motor Ramp Configuration* is set to dual ramp.

Set so that the contactor has enough time to close, but the motor does not slow down.

9-D Slip-Ring Conduction Retard

Range: 10 – 90% **Default:** 50%

Description: Sets the level of conduction at the start of the second current limit ramp, as a percentage of full conduction (refer to parameter 9-C *Slip-Ring Rotor Resistance Contactor Time* for details). Set so that no current pulse occurs, but the motor retains enough speed to start correctly.

11 HMI Settings

These parameters allow the operation of the MVS Controller's interface to be tailored to individual users' requirements.

11-A Language

Options: ENGLISH **Default:** ENGLISH

Description: Selects the language for message display.

11-B F1 Pushbutton Function

Options: NONE **Default:** AUTO-START/STOP MENU
AUTO-START/STOP MENU

Description: Selects the menu shortcut for button **F1** on the MVS Controller.

None: Pressing **F1** has no effect.

Auto-Start/Stop: Pressing **F1** together with **FN** accesses the Auto-Stop settings in the Programming Menu.

11-C F2 Pushbutton Function

Options: Refer to parameter 11-B **Default:** NONE

Description: Selects the menu shortcut for button **F2** on the MVS Controller. Refer to parameter 11-B *F1 Pushbutton Function* for details.

11-D Programmable Screen - Top Left

Options: STARTER STATE **Default:** STARTER STATE
MOTOR CURRENT
MAINS VOLTAGE
MOTOR POWER FACTOR
MAINS FREQUENCY
RUNNING POWER (kW)
RUNNING POWER (HP)
MOTOR TEMPERATURE
MOTOR kWH
HOURS RUN

Description: The programmable screen allows the user to select four variables to display on-screen, for at-a-glance monitoring of starter status. Parameter 11-D selects which variable to display at the top left of the screen.

- Motor current and mains voltage values are the mean average of all three phases.
- Motor power factor and motor temperature values are calculated by the soft starter.

11-E Programmable Screen - Top Right

Options: Refer to parameter 11-D **Default:** MOTOR CURRENT

Description: Parameter 11-E selects which parameter to display at the top right of the programmable screen. Refer to parameter 11-D for a list of available variables.

11-F Programmable Screen - Bottom Left

Options: Refer to parameter 11-D **Default:** MOTOR kWH

Description: Parameter 11-F selects which parameter to display at the bottom left of the programmable screen. Refer to parameter 11-D for a list of available variables.

11-G Programmable Screen - Bottom Right

Options: Refer to parameter 11-D **Default:** HOURS RUN

Description: Parameter 11-G selects which parameter to display at the bottom right of the programmable screen. Refer to parameter 11-D for a list of available variables.

12 Secondary Motor Settings

The Secondary Motor Settings parameters configure the soft starter to suit the secondary motor profile.

12-A Motor Full Load Current

Range: 5 – 550 A **Default:** 100 A

Description: Sets the starter for the secondary motor's full load current (amperes). Refer to parameter 1-A for details.

13 Start/Stop Modes-2

13-A Start Mode

Options: CONSTANT CURRENT **Default:** CONSTANT CURRENT

Description: Selects the start mode. Refer to parameter 2-A for details.

13-B Current Limit

Range: 100% – 600% FLC **Default:** 400% FLC

Description: Sets the current limit for constant current starting, as a percentage of motor full load current. Refer to parameter 2-B for details.

13-C Current Ramp - Initial Start Current

Range: 100% – 600% FLC **Default:** 400% FLC

Description: Sets the initial start current level for current ramp start mode, as a percentage of motor full load current. Refer to parameter 2-C for details.

13-D Current Ramp - Start Ramp Time

Range: 1 – 60 seconds **Default:** 1 second

Description: Sets the ramp time (in seconds) for current ramp starting. Refer to parameter 2-D for details.

13-E Kickstart Current Level

Range: 100% – 700% FLC **Default:** 500% FLC

Description: Sets the kickstart current level, as a percentage of motor full load current. Refer to parameter 2-E for details.

13-F Kickstart Duration

Range: 0 – 2000 milliseconds **Default:** 0 (off)

Description: Sets the duration for the kickstart function in milliseconds. Refer to parameter 2-F for details.

13-G Excess Start Time

Range: 0:00 – 4:00 minutes:seconds **Default:** 0M:20S

Description: Sets the maximum time allowed for the motor to reach full speed. Refer to parameter 2-G for details.

13-H Stop Mode

Options: COAST TO STOP **Default:** COAST TO STOP
TIMED VOLTAGE RAMP

Description: Selects the active stop mode. Refer to parameter 2-H for details.

13-I Soft Stop Ramp Time

Range: 0:00 – 1:40 minutes:seconds **Default:** 0M:00S

Description: Sets the ramp time for soft stopping the motor. Refer to parameter 2-I for details.

16 Time-Overcurrent Protection

The time-overcurrent protection settings provide overload protection for the motor using a fixed thermal model. The time-overcurrent protection is based on IEEE standard C37.112-1996.

If required, time-overcurrent protection can be used instead of the motor overload and instantaneous overcurrent protection mechanisms - refer to Motor Overload Protection on page 63 for information on optimising motor protection.

16-A Time-Overcurrent Maximum Level

Range: 100% – 999% FLC **Default:** 999% FLC

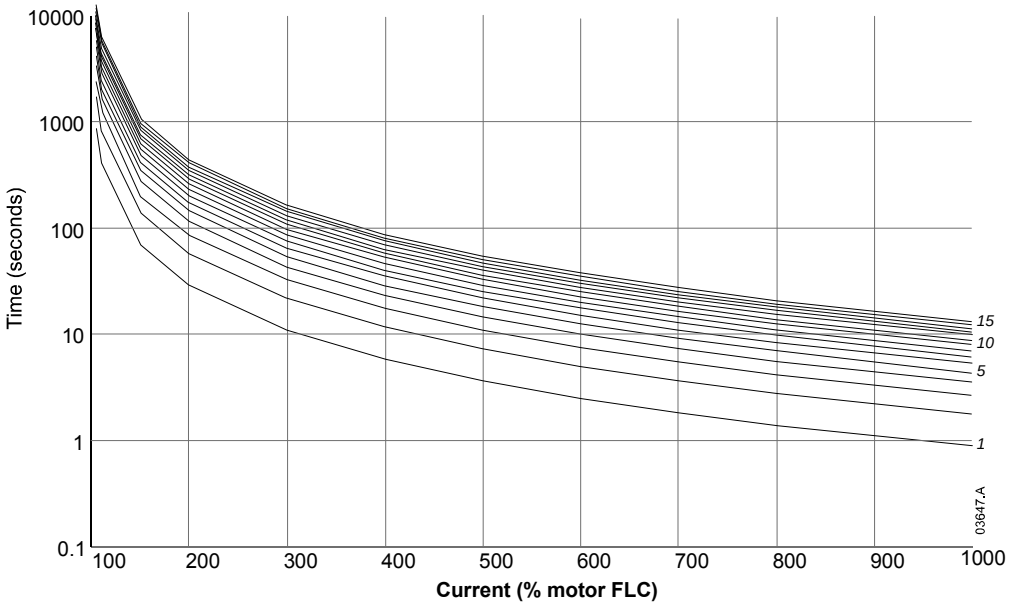
Description: Sets the current level at which the starter will immediately trip on overcurrent, as a percentage of motor full load current.

16-B Time-Overcurrent Curve

Range: 0 – 15 **Default:** 0

Description: Selects the curve used by the starter for time-overcurrent protection.

The time-overcurrent model defines 15 protection curves. The curves define the time that the starter will allow the motor to continue operating at levels above full load current before causing a trip. Setting parameter 16-B to 0 disables the time-overcurrent protection.



Select the curve which most closely matches the specifications on the motor datasheet. Use the motor's locked rotor current figure to select the appropriate column (current level), then select the curve that best matches the motor's maximum start time at locked rotor current. If no curve exactly matches the maximum start time, select the next higher curve.

For example, for a motor with locked rotor current of 600% and maximum start time of 20 seconds, select curve 8. For a motor with locked rotor current of 500% and maximum start time of 50 seconds, select curve 14.

If the maximum start time is greater than the curves allow, disable the time-overcurrent protection and use the motor thermal model.

NOTE
It may be necessary to select a higher curve if using soft stop.

Time-Overcurrent curves

The table below shows the time to trip (in seconds) for each curve.

	Current Level (% Motor FLC)										
Curve	105%	110%	150%	200%	300%	400%	500%	600%	700%	800%	1000 %
1	853	416	70	29	10	5	3	2	1	1	0
2	1707	833	140	58	21	11	7	5	3	2	1
3	2561	1250	210	87	32	17	10	7	5	4	2
4	3414	1666	280	116	43	23	14	10	7	5	3
5	4268	2083	350	145	54	29	18	12	9	6	4
6	5122	2500	420	175	65	35	21	15	10	8	5
7	5976	2916	490	204	76	40	25	17	12	9	6
8	6829	3333	560	233	87	46	29	20	14	11	7
9	7682	3750	630	262	98	52	32	22	16	12	8
10	8537	4166	700	291	109	58	36	25	18	13	8
11	9390	4583	770	320	120	64	40	27	20	15	9
12	10244	5000	840	350	131	70	43	30	21	16	10
13	11097	5416	910	379	142	75	47	32	23	18	11
14	11951	5833	980	408	153	81	51	35	25	19	12
15	12805	6250	1050	437	164	87	54	37	27	20	13

16-C Time-Overcurrent Reset Time

Range: 0:02 – 4:00 minutes:seconds **Default:** 0M:20S

Description: When the time-overcurrent model is being used for motor protection, this parameter sets the time required for the motor to return from 100% to 0% of its time-overcurrent capacity, when not operating (ie at zero current).

When the time-overcurrent model is being used for fuse style protection, this parameter sets the time required for the fuse to return from maximum temperature to ambient temperature when not operating (ie at zero current). Set according to the motor or fuse datasheet.

16-D Reserved

Description: This parameter is reserved for future use.

20 Restricted Parameters

20-A Security Access Code

Range: 0000 – 9999 **Default:** 0000

Description: Changes the current security access code. Use the ◄ and ► buttons to select which digit to alter. Use the ▲ and ▼ buttons to change the displayed value to the desired setting.

20-B Adjustment Lock

Options: OFF
ON

Default: OFF

Description: Allows the soft starter to be protected from unauthorised parameter changes via the Programming Menu and prevents unauthorised access to the Commissioning Menu.

Off: Allows full access to the Commissioning Menu and permits an operator to read and write operating parameter values without explicit authorisation. Explicit authorisation is still required to access restricted system parameters (parameter group 20 and above).

On: Prevents access to the Commissioning Menu and requires the security access code to be entered before users can modify operating parameter settings. General settings can be viewed without authorisation.

NOTE
Changes to the Adjustment Lock setting take effect after the Programming Menu has been closed.

20-C Emergency Mode

Options: OFF
ON

Default: OFF

Description: Selects whether the soft starter will permit emergency mode operation. In emergency mode, the soft starter will start (if not already running) and continue to operate until commanded to stop, ignoring all trips.

Emergency mode operation is controlled using a programmable input (parameters 4-C or 4-D), and the soft starter will continue to run as long as the input remains closed.

20-D Motor Current Calibration

Range: 85% – 115% **Default:** 100%

Description: Adjusts the soft starter's current monitoring circuits. The MVS is factory-calibrated with an accuracy of ± 5%. This parameter can be used to adjust the current readout to match an external current metering device.

Set as required, using the following formula:

$$\text{Calibration (\%)} = \frac{\text{Current shown on MVS display}}{\text{Current measured by external device}}$$

$$\text{eg } 102\% = \frac{66\text{ A}}{65\text{ A}}$$

NOTE
This adjustment affects all current-based functions.

20-E Voltage Calibration

Range: 85% – 115% **Default:** 100%

Description: Adjusts the soft starter's voltage monitoring circuits. The MVS is factory-calibrated with an accuracy of ± 5%. This parameter can be used to adjust the voltage readout to match an external voltage metering device.

Set as required, using the following formula:

$$\text{Calibration (\%)} = \frac{\text{Voltage shown on soft starter display}}{\text{Voltage measured by external device}}$$

$$\text{e.g. 90\%} \quad \frac{6000}{6600}$$

NOTE
This adjustment affects all voltage-based functions.

20-F Main Contactor Time

Range: 100 – 500 milliseconds **Default:** 500 milliseconds

Description: Sets the delay period between the starter switching the main contactor output (terminals 13, 14) and beginning the pre-start checks (before a start) or entering the not ready state (after a stop). Set according to the specifications of the main contactor used.

20-G Bypass Contactor Time

Range: 100 – 500 milliseconds **Default:** 500 milliseconds

Description: Sets the delay period before the starter switches the bypass contactor output (terminals 23, 24) and transitions from starting to running, after the motor voltage has reached 100% in a start; or before the starter commences the stop ramp, after a stop command. Set according to the specifications of the bypass contactor used.

21 Protection Classes

These parameters determine how the soft starter will react when a protection event occurs.

Each protection event can be set to trip the starter, activate a warning flag, or be ignored. The soft starter writes every protection event to the event log, regardless of the trip or warning response. The default response is to trip the soft starter.

NOTE
The protection settings are vital for safe operation of the soft starter and motor. Defeating the protection may compromise the installation and should only be done in the case of emergency.

The protection activation point for each protection can be set in parameter group 3.

21-A ~ 21-S Protection Classes

Options: TRIP STARTER **Default:** TRIP STARTER
WARNING AND LOG
LOG ONLY

Description: Selects the starter's response to each protection.

- 21-A *Motor Overload*
- 21-B *Undercurrent*
- 21-C *Instantaneous Overcurrent*
- 21-D *Current imbalance*
- 21-E *Mains Frequency*
- 21-F *Auxiliary Trip A*
- 21-G *Auxiliary Trip B*
- 21-H *Motor Thermistor*
- 21-I *Excess Start Time*
- 21-J *Starter Communications Timeout*
- 21-K *Battery/Clock Fail*
- 21-L *SCR Temperature*
- 21-M *Network Communication Timeout*
- 21-N *Ground Fault*
- 21-O *Overvoltage*
- 21-P *Undervoltage*
- 21-Q Reserved
- 21-R Reserved
- 21-S *Time-overcurrent*

Section 8 Commissioning

8.1 Commissioning Menu

The Commissioning Menu provides access to commissioning and testing tools.

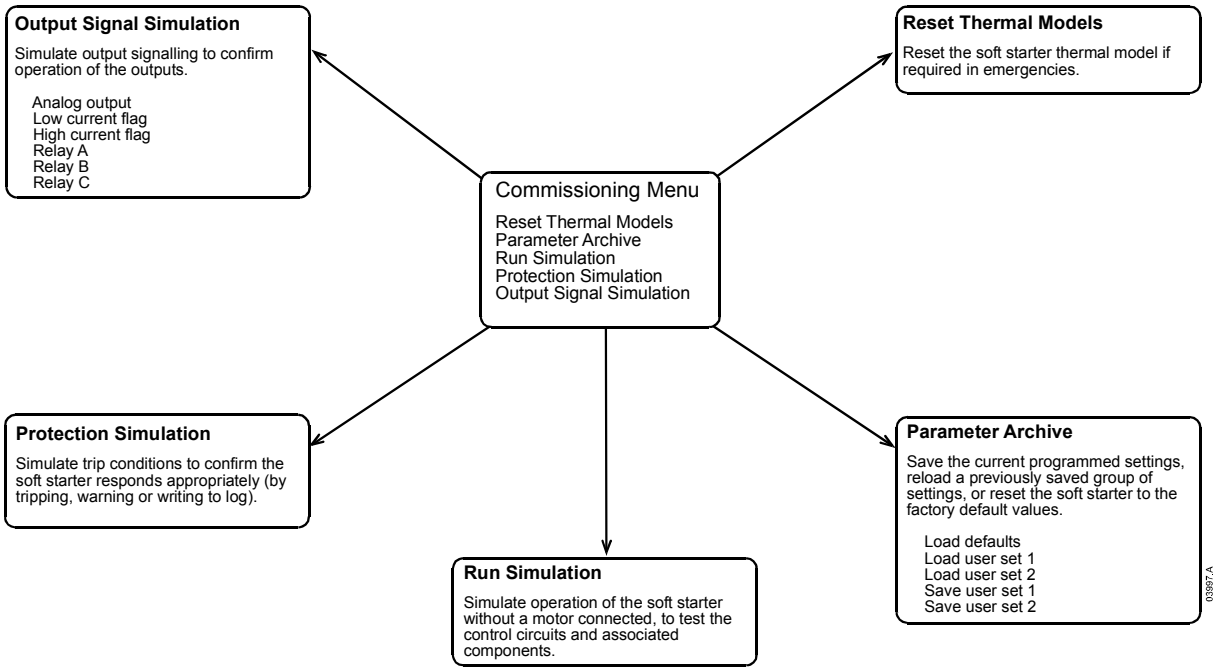
To open the Commissioning Menu, press the SETUP TOOLS button while viewing the metering screens.

To navigate through the Commissioning Menu:

- to scroll to the next or previous item, press the ▲ or ▼ button.
- to open an item for viewing, press the ► button.
- to return to the previous level, press the ◄ button.
- to close the Commissioning Menu, press the SETUP TOOLS button.

NOTE
The Commissioning Menu is only available if the Programming Menu is unlocked (parameter 20-B *Adjustment Lock* is set to Off).

8.2 Commissioning Menu



8.3 Simulation Tools

Software simulation functions let you test the soft starter's operation and control circuits without connecting the soft starter to mains voltage. The MVS has three simulation modes:

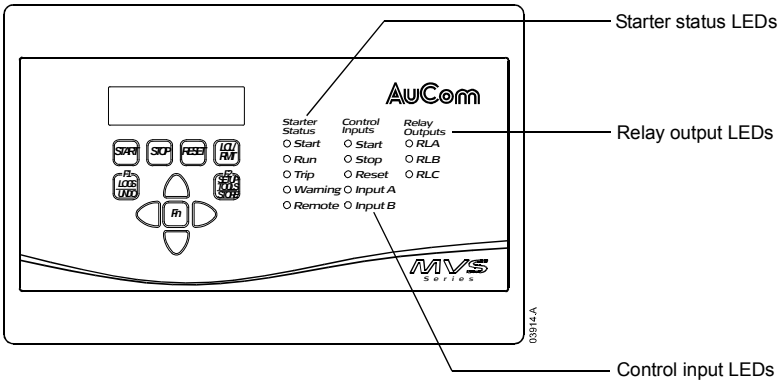
- Run simulation: simulates a motor starting, running and stopping to confirm that the soft starter and associated equipment have been installed correctly.
- Protection simulation: simulates activation of each protection mechanism to confirm that the soft starter and associated control circuits are responding correctly.
- Output signal simulation: simulates output signalling to confirm that outputs and associated control circuits are operating correctly.

The simulation tools are accessed via the Commissioning Menu. The simulations are only available when the soft starter is in Ready state, control voltage is available and the MVS Controller is active.

NOTE
Access to the simulation tools is protected by the security access code.
The default access code is 0000.

Run Simulation

The MVS Controller allows the user to simulate a motor starting, running and stopping, in order to confirm that the soft starter and any auxiliary switchgear have been installed correctly. Feedback is provided via the display and the status LEDs.



The run simulation provides a safe method of confirming that the installation is operating as expected. The simulation is particularly useful to confirm the correct configuration of the main and bypass contactors, fibre-optic controls and programmable outputs.

The simulation can be terminated at any time by pressing the UNDO button. The MVS Controller will return to the Commissioning Menu.

NOTE
The soft starter must be disconnected from mains voltage, and control voltage must be available for the MVS Controller. During the simulation, the soft starter checks that mains voltage is not present but performs no other pre-start checks.

The simulation is only available when the soft starter is in Ready state.

To activate the run simulation:

1. Open the Commissioning Menu and select Run Simulation.

```
Simulation Mode
                    Run sim >
```

2. To enter the run simulation, press the ► button.

```
          Ready
   Wait for start sig
```

3. Press the START button.

```
     Pre-Start Checks
                        >
```

The soft starter will perform its pre-start checks. If parameter 5-D (*Output Relay A Functionality*) is set to Main Contactor, the Relay A LED on the MVS Controller activates.

4. Press the ► button to proceed to the next stage of the simulation. The MVS simulates starting.

```
     Starting  Phase 1
                        >
```

The Start LED activates on the MVS Controller and the Phase 1 firing LED blinks on the power interface PCB.

5. Press the ► button to proceed to the next stage of the simulation. The MVS simulates running.

```
     Running  Phase 2
   Wait for Stop Signal
```

The bypass contactor closes and the Run LED activates on the MVS Controller. The Phase 2 firing LED blinks on the power interface PCB. If parameter 5-G (*Output Relay B Functionality*) is set to Run, the Relay B LED on the MVS Controller activates.

6. Press the STOP button to proceed to the next stage of the simulation. The MVS simulates stopping.

```
     Stopping - Phase 3
                        >
```

The bypass contactor opens and the Run and Relay B LEDs on the MVS Controller turn off. The Phase 3 firing LED blinks on the power interface PCB.

7. Press the ► button to proceed to the next stage of the simulation. The MVS returns to the stopped state.

The main contactor opens and all LEDs turn off.

8. Press the ► button to terminate the simulation and return to the Commissioning Menu.

Protection Simulation

The MVS Controller allows the user to simulate activation of each protection mechanism, in order to confirm that the soft starter is responding to each situation correctly.

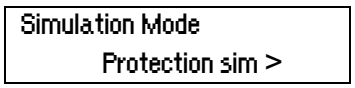
NOTE
The soft starter must be disconnected from mains voltage, and control voltage must be available for the MVS Controller. During the simulation, the soft starter checks that mains voltage is not present but performs no other pre-start checks.

The simulation is only available when the soft starter is in Ready state.

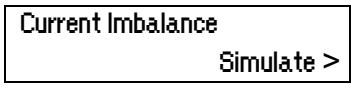
The protection simulation allows the user to confirm that protection events are being reported correctly on the display and across the communication network.

To activate the protection simulation:

1. Open the Commissioning Menu and select Protection Simulation.



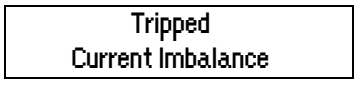
2. Press the ► button to open the protection list. The display will indicate the first simulation in the list.



3. Use the ▲ and ▼ buttons to select a protection to simulate. The following protection conditions are available to simulate:

   Motor overload
   Undercurrent
   Instantaneous overcurrent
   Current imbalance
   Mains frequency
   Auxiliary trip A
   Auxiliary trip B
   Motor thermistor
   Excess start time
   Starter communication failure
   Battery/ Clock failure
   SCR temperature model
   Network communication failure
   Ground fault
   Overvoltage
   Undervoltage
   Time-overcurrent

4. Hold down the ► button to simulate the selected protection. The simulation will continue as long as the button is held down. The soft starter's response depends on the protection class setting (parameter group 21).



Release the ► button to end the simulation. Use ▲ or ▼ to select another simulation, or press ◄ to return to the Commissioning Menu.

NOTE
If the protection class is set to Trip, reset the soft starter before simulating another protection. If the protection class is set to Warning or Log, no reset is required.

Signalling Simulation

The MVS Controller allows the user to simulate output signalling in order to confirm that the outputs are operating correctly.

NOTE
The soft starter must be disconnected from mains voltage, and control voltage must be available for the MVS Controller. During the simulation, the soft starter checks that mains voltage is not present but performs no other pre-start checks.

The simulation is only available when the soft starter is in Ready state.

To activate the signalling simulation:

1. Open the Commissioning Menu and select Signalling Simulation.

```
Simulation Mode
      Output Signal Sim    >
```

2. Press the ► button to open the simulation list. The display will indicate the first simulation in the list.

```
Analog Output
                  Simulate >
```

3. Use the ▲ and ▼ buttons to select a simulation. The following signals are available to simulate:

   Analog output
   Low current flag [1]
   High current flag [1]
   Motor temperature flag [1]
   Relay A
   Relay B
   Relay C

   [1] To test the flags, set an output relay (parameters 5-A to 5-C) to the appropriate function and monitor the relay's behaviour.

4. Once the required simulation is displayed, press ► to confirm the selection.

```
Low Current Flag
                  Simulate >
```

5. Press the ▲ button to start the simulation. Pressing the ▼ button stops the signal.

```
Low Current Flag
      ▲ On  ▼ Off
```

While the signal is being simulated, the display will indicate On. While the signal is not being simulated, the display will indicate Off.

6. Once the simulation is complete, press ◄ to return to the simulation list.
7. Press ▲ or ▼ to select another simulation, or press ◄ again to return to the Commissioning Menu.

Analog Output Simulation

The analog output simulation uses the ▲ and ▼ buttons to change the analog output current at terminals B10, B11 of the MVS Controller.

```
Analog Output
0%                4 mA
```

Attach an external current measuring device to terminals B10, B11 of the MVS Controller. Use the ▲ or ▼ button to adjust the percentage value in the lower left hand corner of the display. The current measuring device should indicate the same level of current as shown at the lower right corner of the display.

8.4 Low Voltage Test Mode

The MVS can be connected to a low voltage motor (≤ 500 VAC) for testing. This allows the user to thoroughly test the soft starter and its associated power and control circuits. The low voltage test mode provides a means of testing the soft starter's configuration without requiring a full medium voltage test facility.

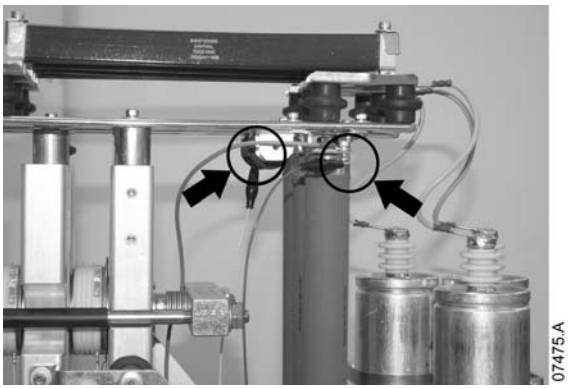
For models V06 and higher, one non-conduction resistor assembly must be connected to each phase arm (three assemblies are supplied with the soft starter). The non-conduction resistor assembly is not required for models V02 ~ V04.

During the low voltage test, the soft starter's input, output and protection settings can be tested. Low voltage mode is not suitable for testing soft starting or soft stopping performance.

Non-Conduction Resistor Assembly

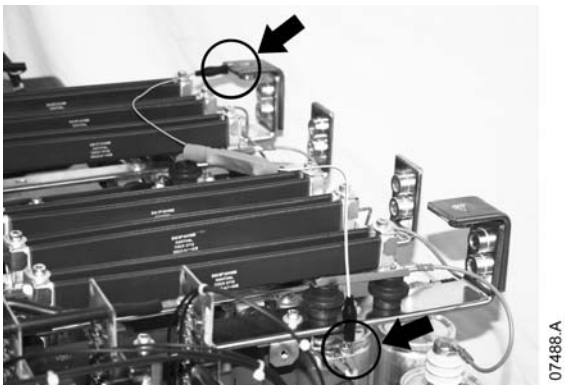
MVSxxxx-V06, V07

Clip one end of the resistor assembly to the bolt on the non-conduction PCB. The non-conduction PCB is located on the side of the phase arm, at the top of the long round grading resistor (on the right hand side of the phase arm when viewed from the front). There is a small steel bracket just in front of the PCB. Pass the other end of the assembly through the phase arm, in front of the three grading resistors, and clip it to the steel bracket in front of the grading resistor on the other side of the phase arm (this bracket looks the same as the bracket in front of the non-conduction PCB).



MVSxxxx-V11, V13

Clip one end of the resistor assembly to the bolt on the non-conduction PCB. The non-conduction PCB is located on the side of the phase arm, at the top of the long round grading resistor (on the right hand side of the phase arm when viewed from the front). Pass the other end of the assembly over the phase arm and clip it to the bus bar at the other side of the phase arm.



WARNING
After low voltage mode testing, ensure that the non-conduction resistor assembly is removed from each phase arm before connecting the soft starter to a medium voltage motor. If the non-conduction resistor assemblies remain on the phase arms, the soft starter may suffer severe damage.

To operate the MVS in low voltage test mode:

1. Isolate the soft starter from the motor and the mains supply.
2. Connect one non-conduction resistor assembly to each phase arm.
3. Connect T1, T2, T3 of the soft starter to a three phase motor with full load current of 5 ~ 20 A. Connect L1, L2, L3 of the soft starter to three phase mains supply with voltage less than 500 VAC (frequency 50 Hz or 60 Hz).
4. Set parameter 1-A *Motor Full Load Current* to the value shown on the motor name plate. Set parameters 3-U *Overvoltage Level* and 3-W *Undervoltage Level* to suit the low voltage mains supply.
5. Switch on control and mains supply, and use the MVS to start the motor. The start command can be sent from the MVS Controller or via the remote input. Monitor the soft starter's display and verify the line voltage readings.
6. Stop and restart the motor several times to confirm correct and consistent operation.
7. When testing is complete, isolate the soft starter from the mains supply. Disconnect the soft starter from the motor and mains voltage, then remove control voltage. Remove the non-conduction resistor assembly from each phase arm.

8.5 Thermal Model Reset

The soft starter's advanced thermal modelling software monitors the motor's performance during each start and throughout the running cycle. This allows the soft starter to calculate the motor's temperature and ability to start successfully at any time.

The soft starter's thermal model can be reset if required.

```
Reset Thermal Models
                    Reset >
```

In order to reset the thermal model, press the ► button. At the confirmation prompt, press STORE to confirm or UNDO to cancel the action. Cancelling the action returns to the Commissioning Menu.

When the thermal model has been reset, the screen will briefly display a confirmation message, then return to the previous screen.

```
Reset Thermal Models
Reset
```

8.6 Parameter Archive

The parameter archive menu allows users to:

- restore the MVS to factory default settings
- save the current parameter settings to an internal file
- reload parameter settings from an internal file

The MVS can store two separate user-defined files.

1. To select a parameter archive function, scroll to the Parameter Archive screen in the Commissioning Menu then press the ► button.

```
Parameter Archive
                  Load/Save >
```

2. Use the ▼ button to select the desired function.

```
Load Defaults
                       Load >
```

The options are:

- Load defaults
- Load user set 1
- Load user set 2
- Save user set 1
- Save user set 2

3. When the screen shows the required function, press the ► button. The MVS will prompt for confirmation.

```
Save User Set 1
        Ok/STORE
```

4. Press STORE to confirm or UNDO to cancel the action. Cancelling the action returns to the previous screen.

When the action has been completed, the display will briefly confirm success then return to the main status screen.

8.7 Logs Menu

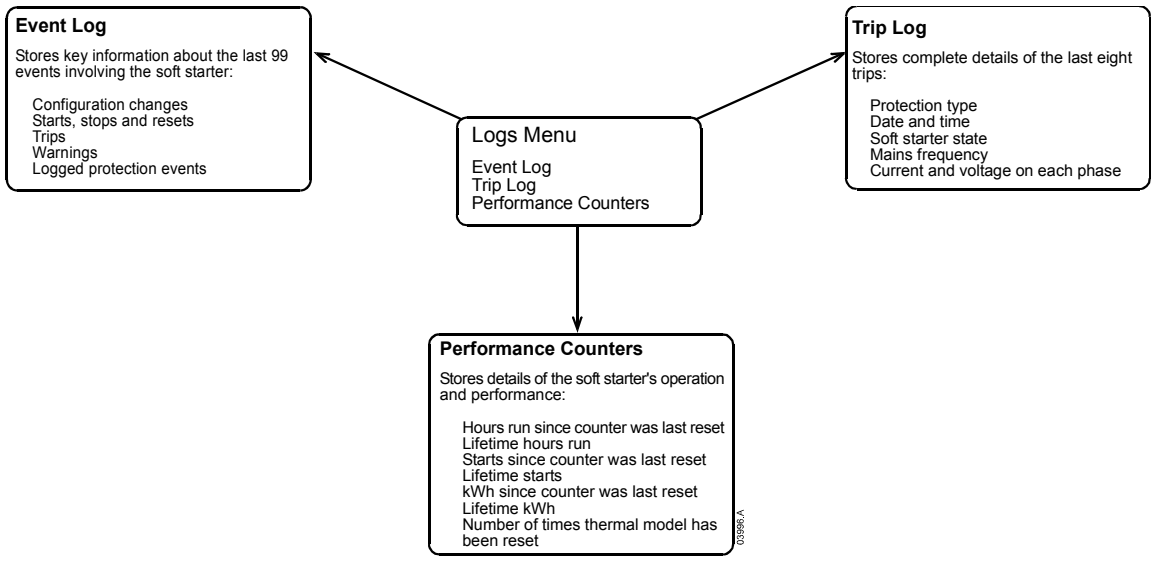
The Logs Menu provides information on events, trips and starter performance.

To open the Logs Menu, press the LOGS button while viewing the metering screens.

To navigate through the Logs Menu:

- to open a log, press the ► button.
- to scroll through the entries in each log, press the ▲ and ▼ buttons.
- to view details of a log entry, press the ► button.
- to return to the previous level, press the ◄ button.
- to close the Logs Menu, press the LOGS button.

Logs Menu

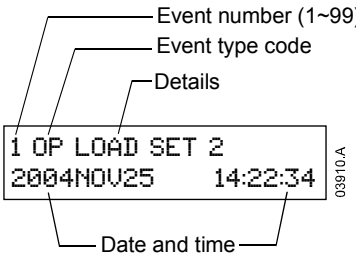


Event Log

The event log stores time-stamped details of the starter's 99 most recent events (actions, warnings and trips). Event 1 is the most recent and event 99 is the oldest stored event.

To view items in the event log, press the ► button from the main event log screen. Use the ▲ and ▼ buttons to navigate through the log and view events. To close the log and return to the main display, press ◄.

The event log stores a brief description of each event. When viewed, the top line shows event number, description and type; the bottom line shows the date and time stamp for the event.



Different details are recorded depending on the nature of the event.

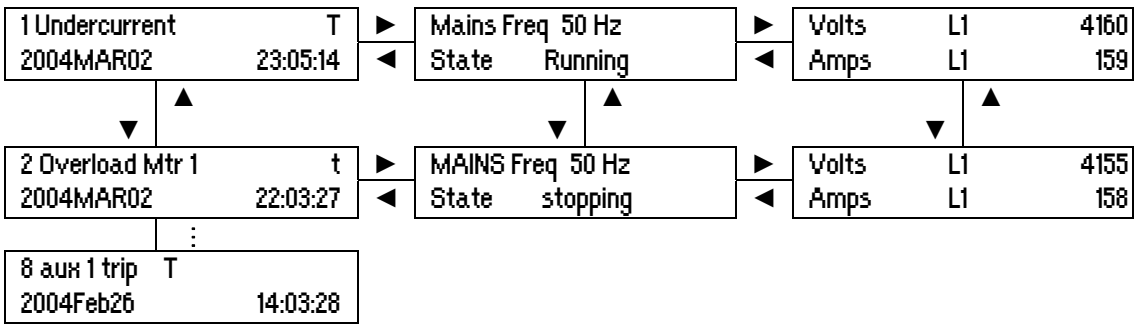
Type Code	Event Type	Details
	Protection	xxxxxxxxxxxxxxxx y xxxxxxxxxxxxxxxx = protection name y = protection type T – trip W – warning L – log only
CTRL PWR	Control Power	OFF – power removed RESTORE – power restored
OP	Operation	Load Defaults = restore default settings Load set 1 = load stored parameter set 1 Load set 2 = load stored parameter set 2 RESET Thermal = reset thermal model RESET hrs run = reset hours run counter RESET starts = reset starts counter RESET kwh = reset kWh counter Save set 1 = save user parameter set 1 Save set 2 = save user parameter set 2 SET Time = set date/ time clock

		SIM protect = protection simulation **SIM run =** run simulation **SIM signal =** signalling simulation
PROG	Programming	**xx-x y zzz** **xx-x** = parameter number **y** = number of adjacent parameters adjusted **zzz** = command source **LCL** – local pushbuttons **SRL** – serial connection
RESET	Reset	**LCL** – reset via local pushbuttons **RMT** – reset via remote inputs **SRL** – reset via serial connection
START	Start	**www xxx y z** **www** = command source **LCL** – local controller **RMT** – remote inputs **SRL** – serial connection **xxx** = start time (seconds) **y** = parameter set **1** = primary motor settings **2** = secondary motor settings **z** = start type **N** = normal **E =** emergency
STOP	Stop	**xxx yyy** **xxx** = command source **LCL** – local pushbuttons **RMT** – remote inputs **SRL** – serial connection **yyy** = stop mode **CST** – coast to stop **SFT** – soft stop

Trip Log

When a protection feature activates to trip the starter, details of the trip cause and starter state are recorded in the trip log.

The trip log stores details of the eight most recent trip conditions. Trip 1 is the most recent and trip 8 is the oldest stored trip. The MVS stores information about the current and voltage on each phase when the trip occurred, and you can access details about each phase by using the ◄ and ► buttons. Details of the next trip are accessed using the ▲ and ▼ buttons. To close the log and return to the main display, press ◄.

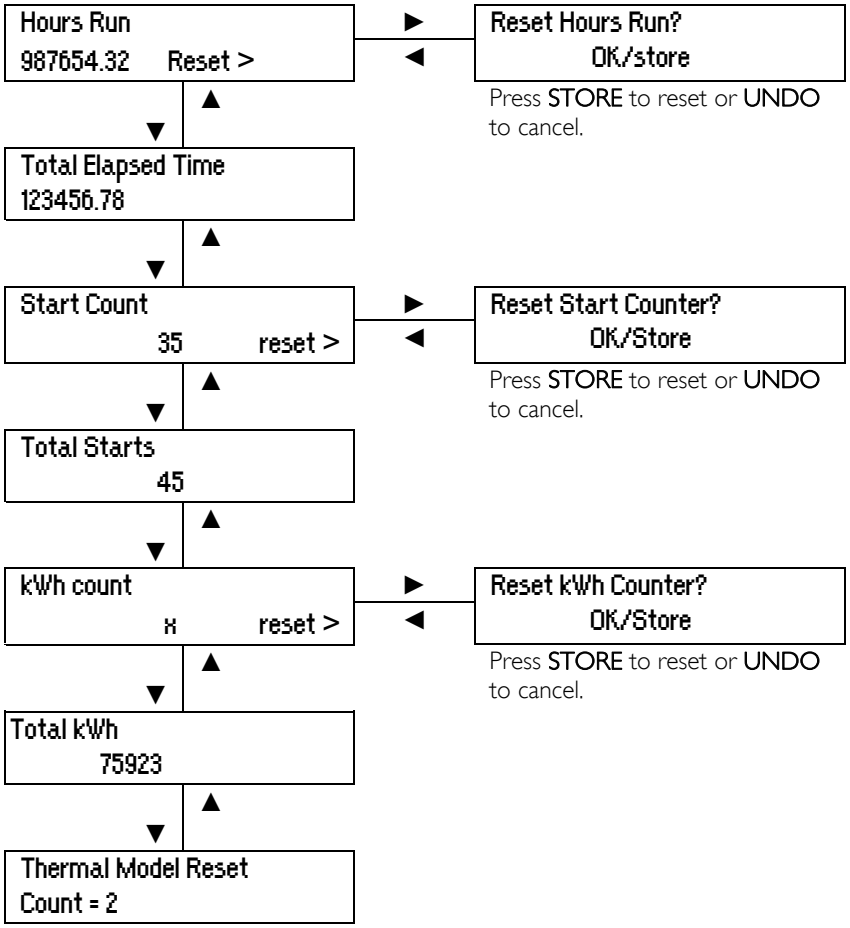


NOTE
If the soft starter's real time clock fails, events will be recorded with the incorrect time stamp.

Performance Counters

The performance counters store details of the starter's lifetime operation.

To view the information in each counter, use the ▼ button to scroll through the list. To reset a counter, press the ► button from the appropriate screen and press the STORE button to confirm the action.



Section 9 Operation

CAUTION
We recommend testing the soft starter's setup on a low voltage motor before beginning operation on a medium voltage motor. This allows the operator to test that the soft starter is correctly connected to the auxiliary equipment.

9.1 Using the MVS to Control a Motor

To soft start the motor, press the START button on the MVS Controller or activate the Start remote input. The motor will start using the start mode selected in parameter 2-A.

To stop the motor, press the STOP button on the MVS Controller or activate the Stop remote input. The motor will stop using the stop mode selected in parameter 2-H.

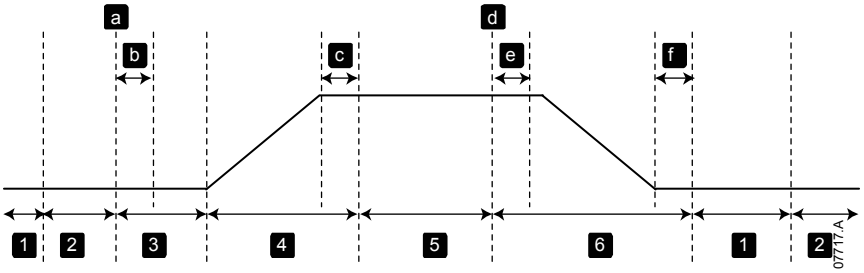
To emergency stop the motor, press the local STOP and RESET buttons at the same time. Alternatively, one of the programmable inputs can be configured for emergency stop (parameters 4-C and 4-D). The soft starter will remove power from the motor and open the main contactor, and the motor will coast to stop.

To reset a trip on the soft starter, press the RESET button on the MVS Controller or activate the Reset remote input.

9.2 Operating States

Start and Run States

The MVS soft starter has six operating states, and performs the following actions in each state:



State		Starter actions
1	Not ready	Control power is on and the starter performs system checks. The starter may be waiting for the motor to cool before allowing a start.
2	Ready	The starter is initialised and waiting for a start command.
3	Pre-start checks	A start command has been received (a). The main contactor closes (b) and the starter performs connection checks.
4	Starting	The starter ramps the SCRs up to full conduction and closes the bypass contactor (c).
5	Running	The motor is running normally.
6	Stopping	A stop command has been received (d). The starter opens the bypass contactor (e), ramps the SCRs down to no conduction, then opens the main contactor (f).

Trip States

The starter's response to a trip depends on the starter's state when the trip occurs.

- Trip while starting (bypass contactor not yet closed)

State	Starter action
Not Ready	Perform system checks.
Ready	Wait for start command.
Start command received	Main contactor closes.
Pre-start checks	Perform connection checks.
Starting	Ramp up SCR firing angles.
Trip command	Turn SCRs off then open main contactor.
Tripped	Wait for reset command.
Reset command received	Trip cleared and starter returns to Ready state.

- Trip while running (bypass contactor closed)

State	Starter action
Not Ready	Perform system checks.
Ready	Wait for start command.
Start command received	Main contactor closes.
Pre-start checks	Perform connection checks.
Starting	Ramp up SCR firing angles.
Full conduction	SCRs at 100% conduction. Verify current is < 120% FLC then close bypass contactor.
Running	Normal motor run state (bypassed mode).
Trip command	Open bypass contactor. Turn SCRs off then open main contactor.
Tripped	Wait for reset command.
Reset command received	Trip cleared and starter returns to Ready state.

- Instantaneous Overcurrent Stage 2 trip

The main contactor opens immediately, regardless of the starter's state.

9.3 Motor Protection

Motor, System and Soft Starter Protection Mechanisms

The MVS incorporates extensive protection features to ensure safe operation of the motor, system and soft starter. Most protection features can be customised to suit the installation. Use parameter group 3 to control the situation where the protections will activate and parameter group 21 to select the soft starter's response. The default response is to trip the soft starter.

- Protection Coordination

Check protection settings on the supply side of the starter to ensure correct discrimination with the soft starter.

When using fuse/main contactors, set the breaker current parameter, to coordinate the fuse and contactor. The contactor must not open if the current is above its maximum value. If motor current is greater than breaker current, the fuse must act first. The breaker current must be less than the contactor's fault break current level. In this case all other overcurrent protection parameters must not act.

When using a breaker, set breaker time so that the maximum trip time is < 150 ms.

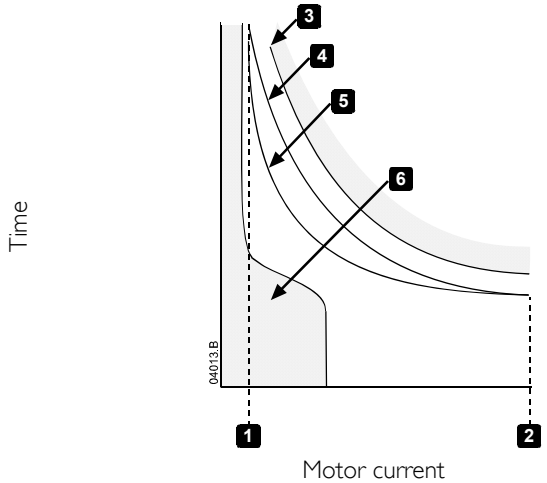
Voltage must not be continuously maintained on the phase arms while the motor is off. Short circuit protective equipment must be present in all installations.

- Motor Overload Protection

The MVS offers two forms of motor overload protection:

- a motor thermal model that monitors the performance of the motor and calculates its status at all times. This protection is based on the motor information programmed in parameter group 1, and the thermal model adjusts itself according to the motor's recent operating history (including temperature rise from previous operation). This model provides finer motor protection than the time-overcurrent model, if the programmed motor information is accurate.
- a time-overcurrent model that calculates the motor's status according to a predefined performance curve. This method is based on IEEE standard C37.112-1996 (*Inverse-Time Characteristic Equations for Overcurrent Relays*) and provides similar protection to a relay. This model may suit users familiar with time-overcurrent protection models, but provides coarse motor protection.

The two methods offer similar kinds of protection and we recommend using only one of the two methods.



1	Motor service factor
2	Locked rotor current
3	Motor failure curve
4	Motor thermal model protection curve
5	Time-overcurrent protection curve
6	Typical motor operating current

NOTE
The soft starter can only be protected from short circuits by suitably selected R Rated fuses.

Motor Thermal Model Protection

To enable motor and starter protection using the motor thermal model, the soft starter must be programmed with accurate information on the motor's characteristics.

1. Set parameters 1-B *Motor Maximum Start Time*, 1-C *Motor Locked Rotor Current* and 1-D *Motor Service Factor* according to the motor datasheet.
2. Use instantaneous overcurrent protection (parameters 3-C, 3-D, 3-Y and 3-Z) to provide protection for locked rotor situations. Refer to individual parameters for details.
3. Disable the time-overcurrent protection by setting parameter 16-B *Time-Overcurrent Curve* to 0.

Time-Overcurrent Motor Protection

To enable motor overload protection using the time-overcurrent model:

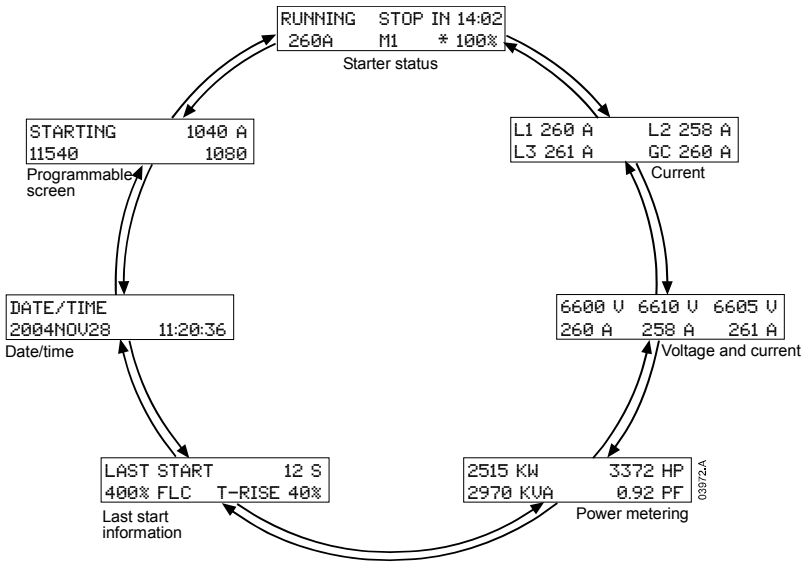
1. Use the motor locked rotor current and maximum start time (locked rotor time) to select the most appropriate protection curve in parameter 16-B *Time-Overcurrent Curve*.
2. Set parameter 16-C *Time-Overcurrent Reset Time* to the time required for the motor to cool from running temperature to ambient temperature, when not operating (ie at zero current). If this information is not available, use a value at least three times as long as the maximum start time.
3. Set parameter 16-A *Time-Overcurrent Maximum Level* to a value 10% higher than the motor's locked rotor current, as a percentage of the motor's full load current.
4. Disable the motor thermal model by setting parameters 1-B *Motor Maximum Start Time* to 2:00, 1-C *Motor Locked Rotor Current* to 1200%, 1-D *Motor Service Factor* to 160% and parameter 21-A to Log Only.

NOTE
When the motor thermal model is disabled, the motor temperature information displayed on the metering screens will not be accurate.

Operating Feedback

- Metering Screens

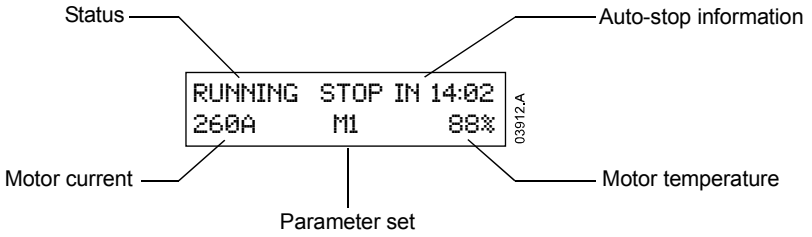
The MVS uses metering screens to display information on the soft starter's performance. Use the ▲ and ▼ buttons to move between metering screens.



Pressing the ► button while viewing the Date/Time screen lets the user set the date and time on the MVS Controller. Pressing the ► button at any other screen opens the Programming Menu.

- Starter Status

The **starter status** screen shows real-time details of the starter's status, including current and temperature:



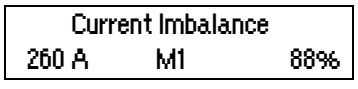
The information on the screen is arranged as follows:

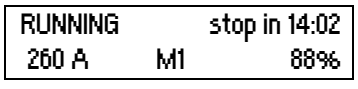
- top left: status information (Ready, Starting, Running, Stopping or Tripped).
- top right: auto-stop information.
- bottom left: motor current (mean average of three phases).
- bottom centre: parameter set currently in use (primary (M1) or secondary (M2)).
- bottom right: motor temperature (based on the thermal model).

When the motor temperature approaches the trip level, the temperature will flash.

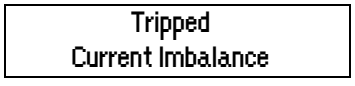
When the motor's thermal capacity will not permit a restart, an asterisk appears in front of the temperature.

When a warning occurs, the top line of the status screen alternates with the warning type. The lower line continues to display current and temperature information:

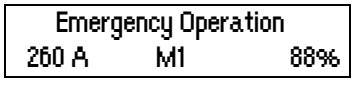




When a trip occurs, the status screen is replaced by details of the trip type:



When operating in Emergency Mode, the screen shows "Emergency Operation":



- Current

The **current** screen shows real-time details of the ground current and the line current on each phase:

L1 260A	L2 258A
L3 261A	GC 1A

When current is not being measured, the display will show 0.

- Voltage and Current

The **voltage and current** screen shows real-time line voltage and line current on each phase:

6600V	6610V	6605V
260A	258A	261A
L1	L2	L3

When the motor is not running, the display will show in place of voltage and 0 A current.

- Power Metering

The **power metering** screen shows details of total motor power, motor horsepower, motor active power and power factor.

2515 kW	3372 hp
2970 kVA	0.92 pf

- Last Start Information

The **last start information** screen shows details of the most recent successful start:

- start duration (seconds)
- maximum start current drawn (as a percentage of motor full load current)
- calculated rise in motor temperature

Last start 12 Sec	
400 %	40% T-rise

If data is not available from the last start, the display will show 0 for each field.

- Date/Time

The **date/time** screen shows the current system date and time (24 hour format):

Date/Time
2004Nov22 11:20:36

To adjust the current date and time, press the ► button while viewing the Date/Time metering screen. Use the ◄ and ► buttons to select which part of the date or time to edit, and use the ▲ and ▼ buttons to change the value.

Pressing **STORE** from the seconds element stores the current value and returns to the metering screens. To return to the metering screens without saving changes, press the ◄ button repeatedly.

- Programmable Screen

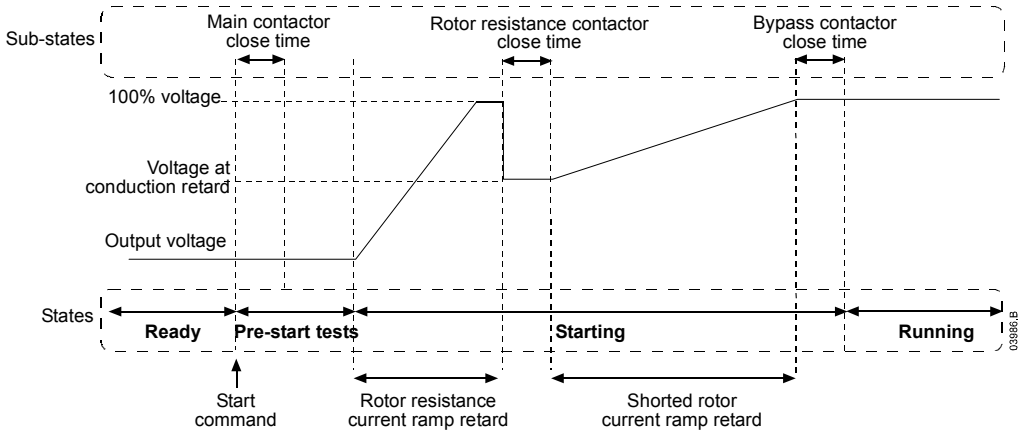
The **programmable screen** shows the information selected in parameters 11-D to 11-G.

Starting	1040A
11540	1080

The default settings are starter state, motor current, kWh and hours run.

Using the MVS to Control a Slip-Ring Motor

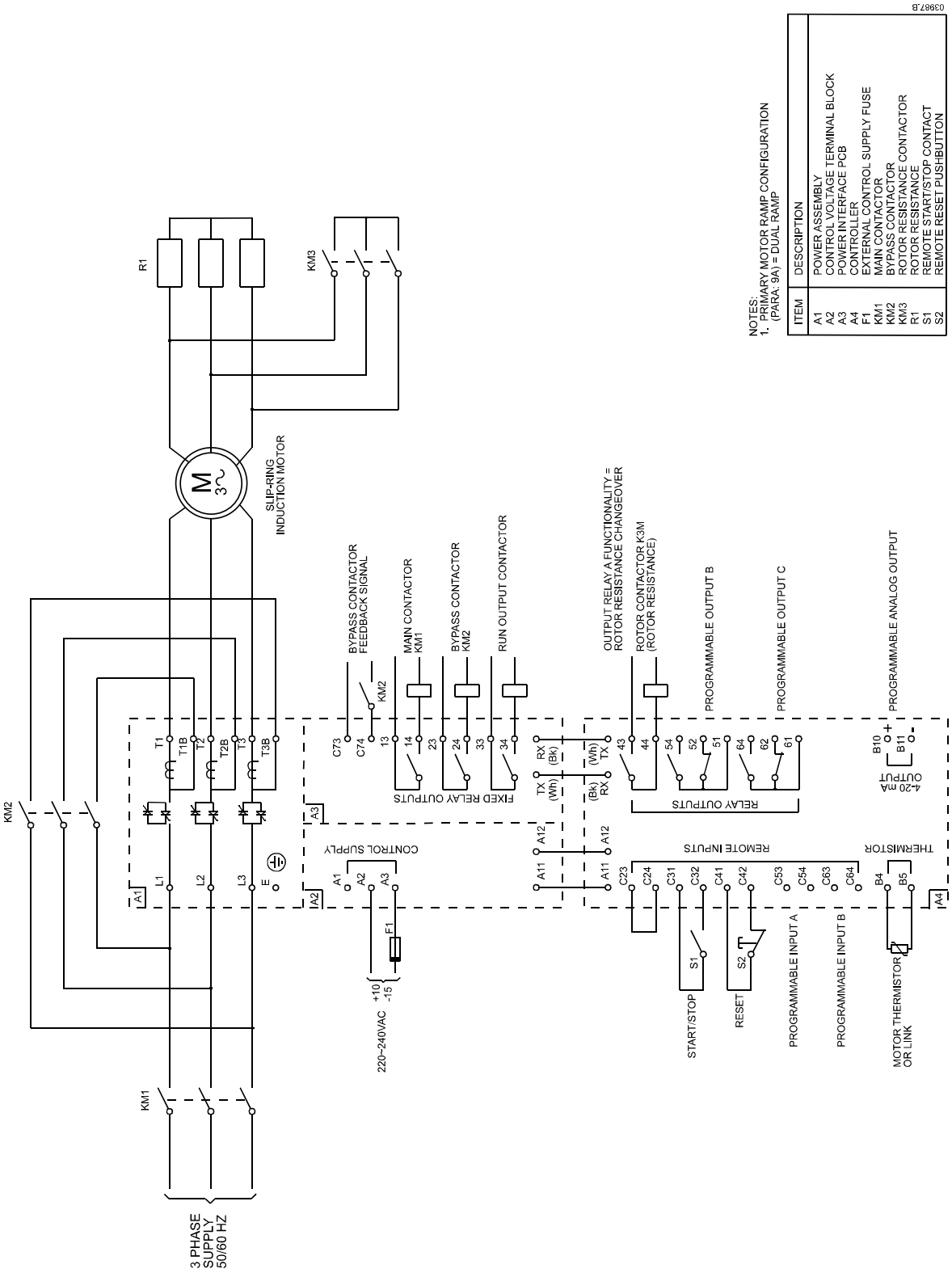
The MVS can be used to control a slip-ring motor, using rotor resistance.



In order to use the MVS with a slip-ring motor, set the following parameters:

- parameter 9-A or 9-B *Primary or Secondary Motor Ramp Configuration* must be set to dual ramp
- an output relay (parameters 5-D to 5-J) must be set to rotor resistance. Wire the relay to reduce the rotor resistance to provide suitable torque for the application.
- parameter 9-C *Slip-Ring Rotor Resistance Contactor Time* defines the time between the rotor resistance contactor closing and the start of the shorted rotor current ramp. Set a time which is:
  - long enough for the rotor resistance contactor to close
  - short enough for the motor to retain speed
- parameter 9-D *Slip-Ring Conduction Retard* defines the level of conduction at the start of the shorted rotor current ramp. Set a value which is:
  - low enough to avoid a current pulse
  - high enough for the motor to retain speed

Slip-Ring Motor Connection



Section 10 Troubleshooting

The MVS provides extensive information to help the operator diagnose and remedy any operating difficulties.

In addition to the motor and load protection features already described, the MVS reports in detail on the starter's own state. Any internal failure will cause the soft starter to trip, and full details will be recorded in the trip log and event log.

10.1 Protection Responses

When a protection condition is detected, the MVS will write this to the event log and may also trip or issue a warning. The soft starter's response to some protections may depend on the Protection Classes settings (parameter group 21).

If the MVS trips you will need to reset the soft starter before restarting. If the MVS has issued a warning, the soft starter will reset itself once the cause of the warning has been resolved.

Some protections cause a fatal trip. This response is pre-defined and cannot be overridden. These protection mechanisms are designed to protect the soft starter, or can be caused by a fault within the soft starter.

10.2 Diagnosing Problems

The following tables can help you diagnose the cause of problems with your MVS.

Error Messages

The MVS may trip or issue a warning with the following error messages. The starter's behaviour can be adjusted using parameter group 3 *Protection Settings* and parameter group 21 *Protection Classes*

.Error Message	Description	Suggested Solution
Aux Trip A	Input A has activated to trip the soft starter. Related parameters: 3-M, 3-N, 3-O, 4-C, 21-F	Identify and resolve the condition which caused Input A to activate.
Aux Trip B	Input B has activated to trip the soft starter. Related parameters: 3-P, 3-Q, 3-R, 4-D, 21-G	Identify and resolve the condition which caused Input B to activate.
Battery/Clock	A verification error has occurred on the real time clock in the MVS Controller. Related parameters: 21-K	The battery powering the clock is running low. Contact your local supplier.
CRNT imbalance	The MVS has detected an imbalance in the line current. Related parameters: 3-E, 3-F, 21-D NOTE Current imbalance detection is desensitised by 50% during starting and soft stopping.	Current imbalance can be caused by problems with the motor or the environment, such as: • an imbalance in the incoming mains voltage • a problem with the motor windings • a light load on the motor • loss of one or more phases on the input or output Check all power connections and cabling. Ensure the starter is configured appropriately for site conditions. Current imbalance can also be caused by problems within the soft starter, or by incorrect power cabling. • If you have recently replaced or repaired a phase arm, the connector at the back of the phase arm may not be securely plugged into the connector on the body of the power assembly. Remove the securing bolts and slide the phase arm out, then slide it back in firmly. Ensure the connectors on the PCBs meet properly then retighten the bolts.

		• There may be an open circuit SCR gate lead, or damage to the SCR gate. Check the SCR gate connections (check at the SCRs and at the firing PCB). Consult your local supplier for details of the SCR gate testing procedure. • The cabling between the external bypass contactor and the soft starter power terminations may be incorrect. Ensure the bypass contactor is connected to L1, L2, L3 and T1B, T2B, T3B of the soft starter.
Frequency	The mains frequency has varied from the nominal frequency. Related parameters: 3-H, 3-I, 3-J, 21-E	The mains frequency may be below the nominal frequency. Check that the MVS is configured appropriately for site conditions. If the MVS is connected to a generator set supply, the generator may be too small or could have a speed regulation problem. Check that the generator set is suitable for the application.
Ground Fault	Ground current (monitored through a dedicated current transducer) has exceeded the selected level. Related parameters: 3-S, 3-T, 21-N	Test the insulation of the output cables and the motor. Identify and resolve the cause of any earth fault.
Inst Overcrnt	The starter has detected a sharp rise in motor current. Related parameters: 3-C, 3-D, 21-C	The motor has probably experienced a locked rotor condition (shearpin), which may indicate a jammed load. Check the load and resolve the cause.
Motor Overload	The motor temperature (calculated by the soft starter's thermal model) has reached or exceeded the maximum allowable temperature. Related parameters: 1-A, 1-B, 1-C, 1-D, 21-A	Overload can be caused by damaged motor bearings or excessive throughput. Resolve the cause of the overload and allow the motor to cool. If you think the soft starter has tripped incorrectly, check the parameter settings.
Mtr Thermistor	The external resistance across the motor thermistor input (terminals B4-B5) has exceeded 2k4 Ω. Related parameters: 21-H	If the starter tripped at power-up, no thermistor is present at terminals B4-B5. If you are not using a thermistor, you must attach a link across terminals B4-B5. If the starter tripped during operation, the temperature of the motor winding has increased. Identify the cause of the overheating (this may require a complete motor test). Allow the motor to cool before restarting.
Network Comms	The network master or serial interface device has sent a trip command to the MVS or there may be network communication problems. Related parameters: 21-M	Check the network for causes of inactivity.
Overvoltage	Mains voltage has exceeded the selected level. Related parameters: 3-U, 3-V, 21-O	There has been a voltage surge on the mains. Potential causes include problems with a transformer tap regulator or off-loading of a large transformer load. Check that the starter is configured appropriately for local conditions. Monitor the mains voltage to determine the cause of the voltage fluctuation, and resolve the cause.
SCR Temp Model	The temperature within the soft starter's enclosure is too high and the temperature of an SCR junction has exceeded 120 °C. Related parameters: 21-L	The MVS may be under-rated for the operating conditions. • Check that the soft starter is being used within its rated capacity in the environment (appropriate starts per hour in the ambient temperature).

		• Check the temperature inside the enclosure, and ensure that there is adequate ventilation. If the temperature inside the enclosure is normal and the MVS is operating within its specifications, contact your local supplier for advice.
Starter Comms	There has been no activity between the MVS Controller and the serial interface device for 10 seconds. Related parameters: 21-J	There is a problem with the connection between the MVS Controller and the communications interface, or the communications interface has failed. Remove and reinstall the interface. If the problem persists, contact your local supplier.
Time-Overcrnt	The soft starter has experienced a motor overload or instantaneous overcurrent condition, causing the time-overcurrent thermal model to reach its trip threshold. Related parameters: 16-A, 16-B, 16-C, 21-S NOTE The MVS cannot be reset until the overcurrent reset time has elapsed.	Check that the time-overcurrent protection settings are appropriate and are coordinated with other current-based protection settings. Check that the motor and load are healthy.
Undercurrent	The current has fallen below the selected value. Related parameters: 3-A, 3-B, 21-B	The motor has lost its load. Potential causes include broken components (shafts, belts or couplings), or a pump running dry.
Undervoltage	Mains voltage has fallen below the selected level. Related parameters: 3-W, 3-X, 21-P	There has been a voltage dip on the mains. Potential causes include an undersized supply transformer, or adding a large non-linear load to the system. Monitor the mains voltage to determine the cause of the voltage fluctuation, and resolve the cause. Check that the starter is configured appropriately for local conditions.
XS Start Time	The motor was unable to accelerate to full speed in the time allowed. Related parameters: 2-B, 2-C, 2-G, 21-I	The start current was not sufficient to accelerate the motor to full speed. The motor may have experienced an abnormal increase in loading - check for overloading or a jammed load. If the load is not jammed, check that the start current is set to an appropriate level or increase the maximum start time.

Non-Adjustable Protection Classes

The following table describes protection mechanisms which cannot be adjusted using parameter group 3 and parameter group 21. These protection mechanisms will always trip the soft starter and the cause must be resolved before the soft starter can be operated again.

Error Message	Description	Suggested Solution
Bypass Fail	The bypass contactor has welded closed or is not operating correctly. There may be a problem with the control circuit or the contactor coil.	Check the condition of the bypass contactor's main poles. Check the operation of the contactor control circuitry and contactor coil. Check that the Bypass Contactor Time setting (20-G) is appropriate for the application. NOTE You can use the Run Simulation to check the bypass contactor's operation without mains voltage connected.
EEPROM Fail	An error occurred loading data from the EEPROM to RAM when the MVS Controller powered up.	There may a fault on the MVS Controller or power interface PCB. Remove and restore control voltage. If the problem persists, contact your local supplier.
L1 Shorted SCR L2	The SCR in one or more phase arms has shorted.	Contact your local supplier for recommended test and replacement procedures.

Shorted SCR L3 Shorted SCR		 NOTE SCR damage always has an external cause. This is usually overvoltage, overcurrent or overtemperature.
Mtr Connection	There is a problem with the soft starter's connection to the motor	The motor is connected incorrectly, or no motor is connected to the soft starter. • Ensure the motor is connected to terminals T1, T2, T3 using in-line (three wire) connection. The MVS does not support inside delta (six wire) connection. • Check each output phase of the soft starter for power circuit continuity.
Phase Sequence	The phase sequence on the soft starter's input terminals (L1, L2, L3) does not conform to the sequence permitted in parameter 3-G.	Check the phase sequence on L1, L2, L3 and ensure parameter 3-G is suitable for the installation.
Power Loss	One or more phases is missing.	• One or more of the mains supply fuses or motor protection fuses may have blown. Check that the mains supply is connected to L1, L2, L3 and all fuses are healthy. • One or more poles may be missing from the main contactor. Check the condition of the main contactor. • Check that the main contactor closes when a start command is given, and remains closed until the end of a soft stop. If you have altered the Main Contactor Time setting (parameter 20-F), you may need to increase this value.

Internal Soft Starter Errors

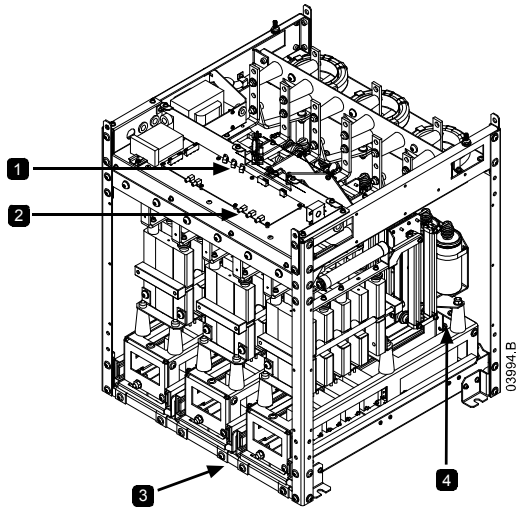
The following error messages report internal soft starter errors. These faults must be resolved before the soft starter can be operated again.

Error Message	Description	Suggested Solution
Assy Power Low	Control voltage to the power interface PCB has dropped below the required level.	Check that the control voltage transformer and control circuit fuses are healthy, and that voltage is present at the terminal block (terminals A1-A2 or A2-A3) within the specified range.
Cond 1 Invalid Cond 2 Invalid Cond 3 Invalid	There is a problem with the SCR firing or feedback system.	• Check that the fibre-optic cables between the power interface PCB and the non-conduction PCBs are properly connected. Use the run simulation to check that all three non-conduction LEDs on the power interface PCB operate correctly. [1] • The value of the grading resistor may not be suitable for the nominal mains voltage. If you are using a low voltage motor for testing purposes, contact your local supplier for advice.
Control Volts Low	Control voltage to the MVS Controller has dropped below the required level.	Check that the control voltage transformer and control circuit fuses are healthy, and that voltage is present at terminals A11, A12 within the specified range.
Current Reading	There is an error in the current monitoring circuit.	Check the connections between the power interface PCB and the current transformers. If the connections are all sound, there may be a fault in the power interface PCB. Contact your local supplier for advice.
Gate Drive Fail	There is a problem with the SCR gate drive.	• Check that the fibre-optic cables between the power interface PCB and the gate drive firing PCB are firmly connected. Use the run simulation to check that the firing LEDs on the power interface PCB operate correctly. [1] • Check the fuses on each gate drive power

		supply PCB. [2] • There may be a fault with the power interface PCB, gate drive firing PCBs or one of the gate drive power supply PCBs. [2] Contact your local supplier for advice.
Int Comms Fail	Communication has failed between the MVS Controller and the power interface PCB.	• Check that the MVS Controller is receiving control voltage within the specified range (terminals A11, A12). • Check that the fibre-optic cables between the MVS Controller and the interface PCB are firmly connected. • Check that each fibre-optic cable is emitting light at the Rx end.
Motor Conn T1 **Motor Conn T2** **Motor Conn T3**	One of the motor connections is missing, or the power interface PCB is not receiving non-conduction signals.	• Ensure the motor is connected to terminals T1, T2, T3 using in-line (three wire) connection. The MVS does not support inside delta (six wire) connection. • Check that the fibre-optic cables between the power interface PCB and the non-conduction PCBs are firmly connected. Use the run simulation to check that all three non-conduction LEDs on the power interface PCB operate correctly. [1]
Synch A Missing **Synch B Missing**	The voltage detection system has failed.	The voltage dividing resistors (located between L1, L2, L3 and the power interface PCB) have failed or the power interface PCB may be faulty. Contact your local supplier for advice.

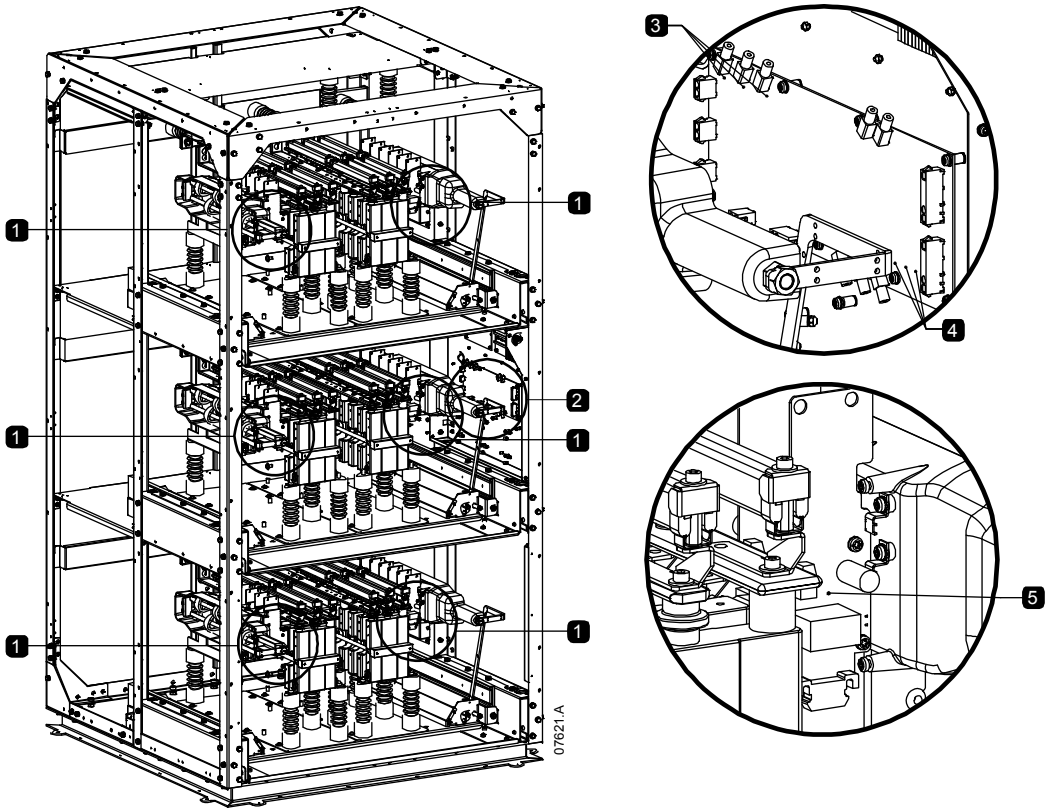
[1] The non-conduction and firing LEDs are located on the power interface PCB. The non-conduction LEDs should dim during starting, and should be off when the bypass contactor closes. The firing LEDs should be on during starting, and off just before the bypass contactor closes and the soft starter enters run mode.
[2] The gate drive firing PCBs, gate drive power supply PCBs and non-conduction PCBs are located on individual phase arms.

MVS (models V02 ~ V07)



1	Firing LEDs (Red)	3	AuCom Gate drive firing PCB, gate drive power supply PCB, non-conduction PCB. **OR**
2	Non-conduction LEDs (Green)	4	Enerpro Gate drive firing PCB gate drive power supply PCB, non-conduction PCB.

MVS (models V11 and V13)



1	Gate Drive Firing PCB
2	Power Interface PCB
3	Power Interface Firing LEDs (Red)

4	Non-conduction LEDs (Green)
5	Gate Drive Firing LEDs

General Faults

This table describes situations where the soft starter does not operate as expected but does not trip or give a warning.

Symptom	Probable Cause

Soft starter does not respond to commands.	• If the soft starter does not respond to the START or RESET button on the MVS Controller:
	  • The soft starter may be in Remote control mode. When the soft starter is in Remote control mode, the Remote LED on the MVS Controller is active. Press the LCL/RMT button once to change to Local control (refer to parameter 4-A *Local/Remote Control* for details).
	• If the soft starter does not respond to commands from the control inputs:
	  • The soft starter may be in Local control mode. When the soft starter is in Local control mode, the Remote LED on the MVS Controller is not active. Press the LCL/RMT button once to change to Remote control (refer to parameter 4-A *Local/Remote Control* for details).
	  • The control wiring may be incorrect. Check that the remote start, stop and reset inputs are configured correctly (refer to *Control Wiring* on page 19 for details).
	  • The signals to the remote inputs may be incorrect. Test the signalling by activating each input signal in turn. The appropriate remote control input LED should activate on the MVS Controller.
	  • The soft starter will only execute a start command from the remote inputs if the remote reset input is closed. Check that the remote reset input is also active (the Reset LED on the starter will be on).
	• If the soft starter does not respond to a start command from either the local or remote controls:
	  • The soft starter may be waiting for the restart delay to elapse. The

	length of the restart delay is controlled by parameter 3-K *Restart Delay.* • The motor may be too hot to permit a start. If parameter 3-L *Restart Temperature Check* is set to Check, the soft starter will only permit a start when it calculates that the motor has sufficient thermal capacity to complete the start successfully. Wait for the motor to cool before attempting another start. • The emergency stop function may be active. If parameter 4-C or 4-D is set to Emergency Stop and there is an open circuit on the corresponding input, the MVS will not start. If the emergency stop situation has been resolved, close the circuit on the input.
The soft starter does not control the motor correctly during starting.	• Start performance may be unstable when using a low Motor Full Load Current setting parameter 1-A). This can affect use on a small test motor with full load current between 5 A and 50 A. • Power factor correction (PFC) capacitors must be installed on the supply side of the soft starter. To control a dedicated PFC capacitor contactor, connect the contactor to run relay terminals.
Motor does not reach full speed.	• If the start current is too low, the motor will not produce enough torque to accelerate to full speed. The soft starter may trip on excess start time. NOTE Make sure the motor starting parameters are appropriate for the application and that you are using the intended motor starting profile. If parameter 4-C or 4-D is set to Motor Set Select, check that the corresponding input is in the expected state. • The load may be jammed. Check the load for severe overloading or a locked rotor situation.
Erratic motor operation.	• The SCRs in the MVS require at least 5 A of current to latch. If you are testing the soft starter on a motor with full load current less than 5 A, the SCRs may not latch correctly.
Soft stop ends too quickly.	• The soft stop settings may not be appropriate for the motor and load. Review the settings of parameters 2-H, 2-I, 13-H and 13-I. • If the motor is very lightly loaded, soft stop will have limited effect.
A reset does not occur after an Auto-Reset, when using a remote 2-wire control.	• The remote 2-wire start signal must be removed and reapplied for a re-start.
Remote start/stop command is overriding Auto Start/Stop settings when using remote 2-wire control.	• Auto Start/Stop function should only be used in LOCAL mode or in tandem with REMOTE mode, 3 and 4-wire control.
Parameter settings cannot be stored.	• Make sure you are saving the new value by pressing the STORE button after adjusting a parameter setting. If you press ◀, the change will not be saved. • Check that the adjustment lock (parameter 20-B) is turned off. If the adjustment lock is on, settings can be viewed but not changed. You need to know the security access code to change the adjustment lock setting. • The EEPROM may be faulty on the MVS Controller or the power interface PCB. A faulty EEPROM will also trip the soft starter, and the MVS Controller will display the message EEPROM Fail. Contact your local supplier for advice.

Section 11 Maintenance

11.1 Maintenance Schedule

The table below lists the minimum maintenance requirements. Your maintenance program may include more frequent maintenance. In certain environmental conditions (such as dusty or humid environments), increase the frequency of maintenance to every year.

Part	Instructions	Timing
Switch	Check contact condition	Every 2 years
Contactor – main	Check for wear, torque bolts	Every 2 years
Contactor – bypass	Check for wear, torque bolts	Every 2 years
Contactor for PFCC	Check for wear, torque bolts	Every 2 years
Control terminals	Check tightness	Every 2 years
Earthing terminals	Check tightness	Every 2 years
Cable lug	Check tightness	Every 2 years
General MVS	Cleanliness	Every 2 years

11.2 Tools required

MVS starters can be serviced with the following tools:

- Allen keys (standard metric)
- 16 mm spanners
- 16 mm socket
- Torque wrench <20 Nm
- Torx drive screwdriver #20
- Small flat bladed screwdriver 3 mm
- Multimeter
- Insulation tester

11.3 Thermal Image

After completing commissioning of the MVS, take a thermal image of the bus bars and other critical parts.

As part of the annual maintenance program, compare a recent thermal image with the post-commissioning image.

Perform the usual inspection for dust and debris.

11.4 Contactor Maintenance

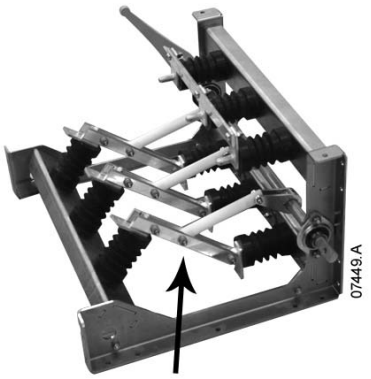
Refer to your contactor manual for operation and maintenance instructions.

1. As part of normal operation, run the withstand voltage test at not less than half the rated test value.
2. Follow the manufacturer's maintenance instructions and check the torque values on all connections.

11.5 Isolation Switch Maintenance

WARNING
Do not operate the switch while current is flowing (motor or capacitor).
The isolation switch is designed for use in an AuCom MVS panel and it is not designed for outdoor use.
The isolation switch must be installed with a breaker or similar device on the supply side to limit the prospective fault energy. Fuses must be used on the motor side of the switch.

1. Isolate the power supply before beginning any work on the isolation switch.
2. Inspect the switch contacts for signs of wear. If there is evidence of wear, contact your local supplier for replacement parts.
3. Check that the microswitch activates when opening the switch knives slightly.
4. Check the grub screw is tightened to 6 Nm.
5. With the switch in the closed position check the contact resistance for each pole of the switch. Adjust the tension on all poles to 15 μΩ (± 5 μΩ).
6. Use a lint-free cloth to clean the isolation switch. Warm soapy water may be necessary in cleaning.
7. Wipe the main contacts and main knives with Electrolube (Electrolube part # CG35A) at points of contact.



Adjust to 15 μΩ (± 5 μΩ)

11.6 Phase Arm Assembly Alignment (models V11 and V13)

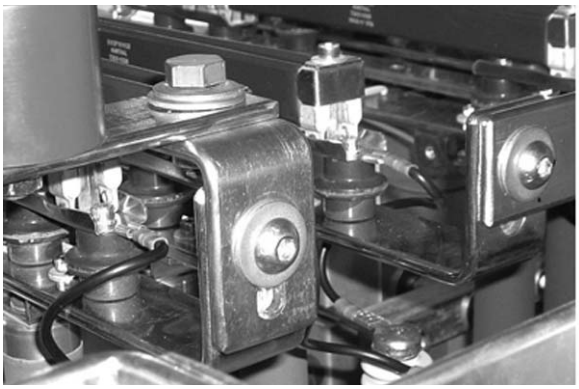
The phase arm locates itself at the fully withdrawn state when sliding in and out of the frame.

During the commissioning process, during maintenance and when installing a phase arm check the phase arm alignment.

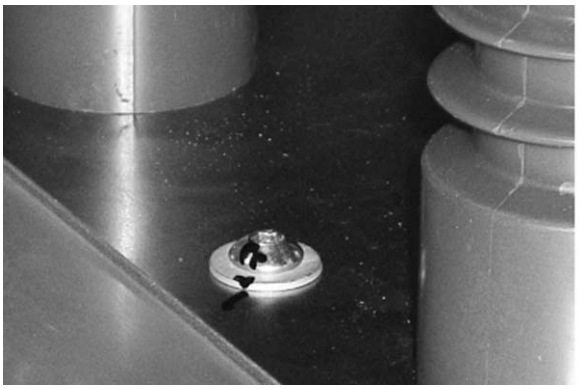
WARNING
Do not extend more than one phase arm at any one time.

NOTE
Torque all bolts after alignment.

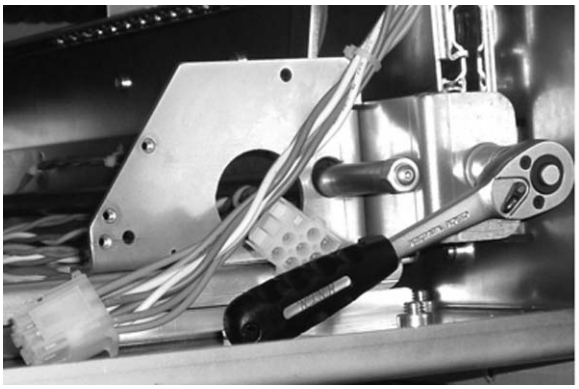
1. Loosen both rear bus bar captive bolts and four (4) domed socket head cap screws on the rear of the phase arm. The bus bar captive bolts are loose at the point of resistance.



2. Loosen the phase block mounting bolts on both sides of the phase assembly that hold it to the tray.
3. Remove the phase arm locking nuts on both sides.



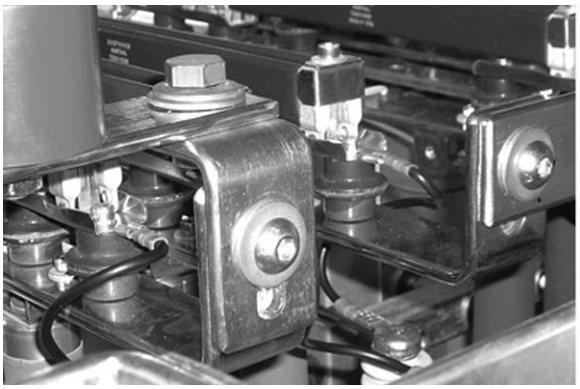
4. Slide out the phase arm assembly.
5. Slide in the phase arm assembly to check alignment.
6. Align the phase block on left or right as required.
7. Align and secure the main phase connection captive bolts.
8. Tighten locking rod on both sides to 10 Nm.
9. Tighten nut and washer on both sides of the phase arm to 10 Nm.
10. Secure dome head bolts (nip and secure) on the bus work to 30 Nm.
11. Secure the cap head dome bolts on the phase blocks. Torque to 12 Nm.
12. Re-adjust if required by repeating steps 3-10 above.



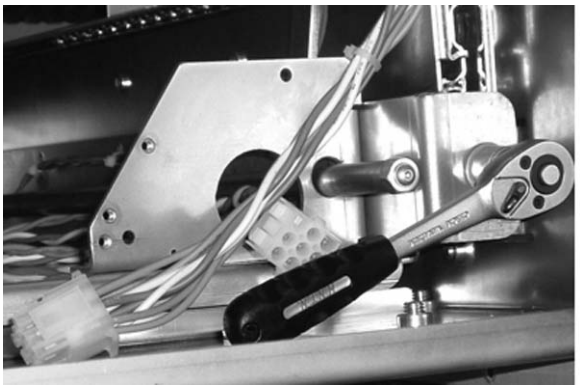
11.7 Removing Phase Arms (models V11 and V13)

WARNING
Do not extend more than one phase arm at any one time.

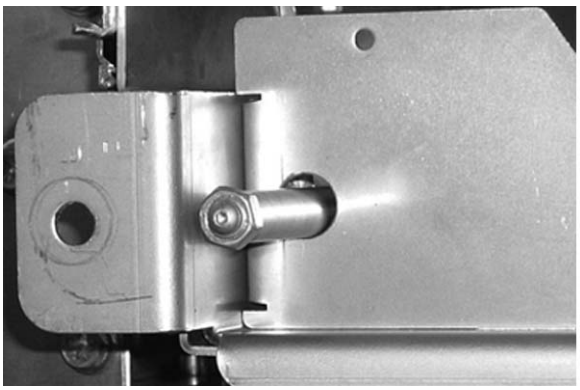
1. Undo the two phase connection bolts at the rear of the phase arm.


07450.A

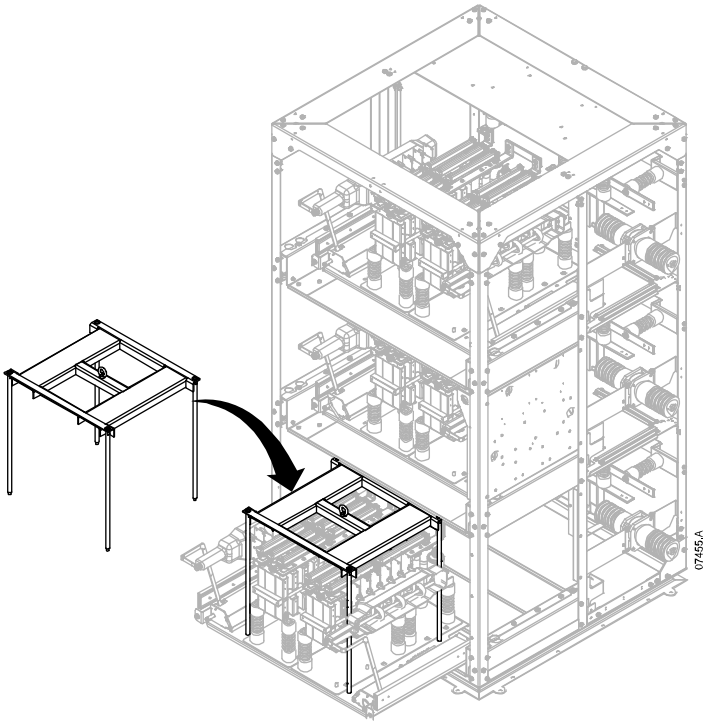
2. Remove the nut and washer and undo the rod bolt on both sides.
3. Unplug the controls on the right hand side.


07451.A

4. Withdraw the phase arm.


07454.A

Removing Phase Arms with a Lifting Frame



To remove a phase arm with a forklift:

1. Slide the phase arm out from the panel.
2. Place the lifting frame on the phase arm and tighten bolts.
3. Position the forks at 210 mm from fork to fork.
4. Taking care not to touch any other components, slowly slide the forks into the fork guide slot under the lifting frame.
5. Raise forks slightly to allow frame to clear location holes.
6. Remove the phase arm.

To remove a phase arm using a hoist:

1. Slide the phase arm out from the panel.
2. Secure a cable from the hoist to the lifting eye
3. Lift the phase arm slowly, stabilising the phase arm to prevent it spinning.

Section 12 Appendix

12.1 Parameter Record

If you require assistance from your supplier or a service technician, please note all parameter settings in the table below.

No.	Function			
1	Primary Motor Settings	User Set 1	User Set 2	Default
1-A	Motor Full Load Current			100 A
1-B	Motor Locked Rotor Current Time			0m:10s
1-C	Motor Locked Rotor Current			600%
1-D	Motor Service Factor			105%
2	Start/Stop Modes-1			
2-A	Start Mode			constant current
2-B	Current Limit			400%
2-C	Current Ramp – Initial Start Current			400%
2-D	Current Ramp – Start Ramp Time			1s
2-E	Kickstart Current Level			500%
2-F	Kickstart Duration			0 ms
2-G	Excess Start Time			0m:20s
2-H	Stop Mode			coast to stop
2-I	Soft Stop Ramp Time			0m:00s
3	Protection Settings			
3-A	Undercurrent Level			20%
3-B	Undercurrent Trip Delay			0m:05s
3-C	Instantaneous Overcurrent Stage 1			400%
3-D	Instantaneous Overcurrent Delay Stage 1			0m:00s
3-E	Current Imbalance Level			20%
3-F	Current Imbalance Trip Delay			0m:03s
3-G	Phase Sequence			any
3-H	Mains Frequency Trip Mode			start/ run
3-I	Mains Frequency Trip Range			±5 Hz
3-J	Mains Frequency Trip Delay			0m:00s
3-K	Restart Delay			0m:10s
3-L	Restart Temperature Check			off
3-M	Auxiliary Trip A – Mode			always active
3-N	Auxiliary Trip A – Delay			0m:00s
3-O	Auxiliary Trip A – Enable Delay			0m:00s
3-P	Auxiliary Trip B – Mode			always active
3-Q	Auxiliary Trip B – Delay			0m:00s
3-R	Auxiliary Trip B – Enable Delay			0m:00s
3-S	Ground Fault Level			10 A
3-T	Ground Fault Trip Delay			0m:03s
3-U	Overvoltage Level			7200 V
3-V	Overvoltage Trip Delay			0m:05s
3-W	Undervoltage Level			100 V
3-X	Undervoltage Trip Delay			0m:05s
3Y	Instantaneous Overcurrent Stage 2			4400 Amps
3Z	Instantaneous Overcurrent Delay Stage 2			10 ms
4	Inputs			
4-A	Local/Remote Control			button always active
4-B	Serial Control – Remote Mode			enable in remote
4-C	Input A Functionality			auxiliary trip (N/O)
4-D	Input B Functionality			auxiliary trip (N/O)
5	Outputs			
5-A	Low Current Flag			50%
5-B	High Current Flag			100%
5-C	Motor Temperature Flag			80%

5-D	Output Relay A Functionality			main contactor
5-E	Output Relay A On Delay			0m:00s
5-F	Output Relay A Off Delay			0m:00s
5-G	Output Relay B Functionality			run
5-H	Output Relay B On Delay			0m:00s
5-I	Output Relay B Off Delay			0m:00s
5-J	Output Relay C Functionality			trip
5-K	Output Relay C On Delay			0m:00s
5-L	Output Relay C Off Delay			0m:00s
5-M	Analog Output A Functionality			current
5-N	Analog Output A Range			4-20 mA
5-O	Analog Output A Adjustment - maximum			100%
5-P	Analog Output A Adjustment - minimum			0%
5-Q	Mains Reference Voltage			400 V
6	Auto-Stop			
6-A	Auto-Stop Mode			off
6-B	Auto-Stop Time			0h:01m
9	Slip-Ring Motor Setup			
9-A	Primary Motor Ramp Configuration			single ramp
9-B	Secondary Motor Ramp Configuration			single ramp
9-C	Slip-Ring Rotor Resistance Contactor Time			150 ms
9-D	Slip-Ring Conduction Retard			50%
11	HMI Settings			
11-A	Language			English
11-B	F1 Pushbutton Function			auto-stop menu
11-C	F2 Pushbutton Function			none
11-D	Programmable Screen – Top Left			starter state
11-E	Programmable Screen – Top Right			current
11-F	Programmable Screen – Bottom Left			kWh
11-G	Programmable Screen – Bottom Right			hours run
12	Secondary Motor Settings			
12-A	Motor Full Load Current			100 A
13	Start/Stop Modes-2			
13-A	Start Mode			constant current
13-B	Current Limit			400%
13-C	Current Ramp – Initial Start Current			400%
13-D	Current Ramp – Start Ramp Time			1 s
13-E	Kickstart Current Level			500%
13-F	Kickstart Duration			0 ms
13-G	Excess Start Time			0m:20s
13-H	Stop Mode			coast to stop
13-I	Soft Stop Ramp Time			0m:00s
16	Time-Overcurrent Protection			
16-A	Time-Overcurrent Level			999%
16-B	Time-Overcurrent Curve			2
16-C	Time-Overcurrent Reset Time			0m:20s
16-D	Reserved			
20	Restricted Parameters			
20-A	Security Access Code			0000
20-B	Adjustment Lock			off
20-C	Emergency Mode			off
20-D	Motor Current Calibration			100%
20-E	Voltage Calibration			100%
20-F	Main Contactor Time			500 ms
20-G	Bypass Contactor Time			500 ms
21	Protection Classes			
21-A	Motor Overload			trip
21-B	Undercurrent			trip
21-C	Instantaneous Overcurrent			trip

21-D	Current Imbalance			trip
21-E	Mains Frequency			trip
21-F	Auxiliary Trip A			trip
21-G	Auxiliary Trip B			trip
21-H	Motor Thermistor			trip
21-I	Excess Start Time			trip
21-J	Starter Communication Timeout			trip
21-K	Battery/Clock Fail			trip
21-L	SCR Temperature			trip
21-M	Network Communication Trip			trip
21-N	Ground Fault			trip
21-O	Overvoltage			trip
21-P	Undervoltage			trip
21-Q	Reserved			
21-R	Reserved			
21-S	Time-Overcurrent			trip

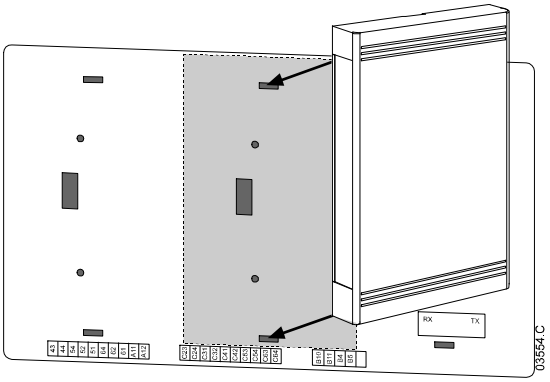
12.2 Accessories

Communication Interfaces

MVS Series soft starters support network communication using the Profibus, DeviceNet and Modbus RTU protocols, via an easy-to-install communications module.

- Installing Communication Interfaces

Communication interfaces attach to the back of the MVS Controller:



- Modbus Interface

PIM-MB-01

The Modbus Interface enables control and monitoring via a Modbus RTU network.

Refer to the Modbus Interface Instructions for further details.

- Profibus Interface

PIM-PB-01

The Profibus Interface enables control and monitoring via a Profibus network.

Refer to the Profibus Interface Instructions for further details.

- DeviceNet Interface

PIM-DN-01

The DeviceNet Interface enables control and monitoring via a DeviceNet network.

Refer to the DeviceNet Interface Instructions for further details.

- Trip Codes (Serial Communication Network)

Description	Profibus DP	Modbus RTU	DeviceNet
Shorted stack (SCR)	0	0	103
Excess start time	1	1	101
Motor overload	2	2	20
Motor thermistor	3	3	75
Current imbalance	4	4	26
Supply frequency	5	5	55
Phase sequence	6	6	54
Instantaneous overcurrent	7	7	28
Power circuit/ Power loss	8	8	50
Undercurrent	9	9	29
Starter overtemperature	10	10	21
Motor connection	11	11	102
Auxiliary trip A	12	12	11
FLC out of range	13	13	61
Incorrect control card	14	14	60
Starter communication failure (between interface and soft starter)	15	15	113
Network communication failure (between interface and network)	16	16	114
Internal error	17	17	104
Overvoltage	18	18	52
Undervoltage	19	19	51
Ground fault	20	20	27
EEPROM failure	23	23	62
Auxiliary trip B	24	24	110
Bypass contactor failure	25	25	105
L1 phase loss	26	26	23
L2 phase loss	27	27	24
L3 phase loss	28	28	25
L1 shorted SCR	29	29	115
L2 shorted SCR	30	30	116
L3 shorted SCR	31	31	117
Motor 2 overload	32	32	118
SCR temperature model	34	34	120
Clock failure	35	35	121
Motor thermistor failure	36	36	122
Analog input trip	46	46	132
Miscellaneous	n/a	n/a	70
No trip	255	255	0

Other MVS Accessories

Other accessories available to enhance your MVS starter include:

- RTD protection relays
- Power meters
- Indication lamps
- Start, stop and reset pushbuttons
- Local/remote selector switch
- Internal panel light for low voltage section
- 100 watt panel heater
- Power supply and contactor for motor heater
- Control transformers
- Metering VT
- Other accessories may be available on request.

PC Software (AuCom)

WinMaster is a purpose-designed software suite for control and monitoring of up to 99 soft starters. WinMaster is compatible with all AuCom soft starter ranges.

Feature	CSX	CSX*i*	IMS2	EMX3	MVS
Operational Control (Start, Stop, Reset, Quick Stop)	●	●	●	●	●
Starter Status Monitoring (Ready, Starting, Running, Stopping, Tripped)	●	●	●	●	●
Performance Monitoring (Motor Current, Motor Temperature)		●	●	●	●
Upload Parameter Settings			●	●	●
Download Parameter Settings			●	●	●

To use WinMaster with the MVS, the soft starter must be fitted with a Modbus Interface (PIM-MB-01) or a Remote Operator (PIM-RO-01).

Refer to the WinMaster User Manual for further details.

AuCom

AuCom Electronics Ltd
123 Wrights Road
PO Box 80208
Christchurch 8440
New Zealand
T +64 3 338 8280
F +64 3 338 8104
E enquiry@aucom.com
W www.aucom.com