USER MANUAL

MVE Soft Starter

RIGHT FROM THE START

AuCom

MOTOR CONTROL SPECIALISTS

Contents

1. About This Manual

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
Indicates a hazard that may cause personal injury or death.

CAUTION
Indicates a hazard that may damage the equipment or installation.

NOTE
Provides helpful information.

1.1 User Manual Version

This user manual (710-17074-00F) is compatible with MVE soft starters using version 1.31 control software and version 2.36 interface software. For other software versions, please contact AuCom for the correct user manual.

Software versions are displayed on the screen at power up.

Software versions: Control software, interface software, Keypad

2. Caution Statements

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 equipment, 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 MVE. Follow all applicable local and national codes.
- Apply appropriate personal protective equipment (PPE) and clothing, and follow safe electrical work practices.
- Disconnect all power and ensure that the MVE is de-energised before servicing the equipment.
- 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 and ensure that a terminal is de-energised and grounded.
- Isolate the MVE completely from the power supply before attempting any work on the MVE or motor.
- Always use a properly rated voltage sensing device to confirm power is off.
- Before servicing the MVE, 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.
- The control inputs are powered by the soft starter. Do not apply external voltage to the control input terminals.
- 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 contactor coils are not suitable for direct switching with PCB mount relays.

WARNING - ELECTRICAL SHOCK HAZARD

The MVE contains dangerous voltages when connected to mains voltage. Only a qualified electrician should carry out the electrical installation. Improper installation of the motor or the MVE may cause equipment failure, serious injury or death. Follow this manual and local electrical safety codes.

SHORT CIRCUIT

The MVE is not short circuit proof. After severe overload or short circuit, the operation of the MVE should be fully tested by an authorised service agent.

GROUNDING AND BRANCH CIRCUIT PROTECTION

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

ARC FLASH HAZARD

Medium voltage equipment has 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.

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

AuCom medium voltage equipment has 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.

3. General Description

3.1 Overview

The MVE provides compact and robust soft start solutions for control of medium voltage motors. MVE 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.

The main components of a MVE soft starter are:

- Power assembly (3 x phase arms)
- Multilingual controller with FO cables
- Power interface board
- 3 x CTs – 1000:1

3.2 Feature List

Starting

- Constant Current
- Current Ramp

Stopping

- Coast To Stop
- Soft stop

Protection

- Undervoltage / Overvoltage (27, 59)
- Mains frequency (81)
- Phase sequence (47)
- Shorted SCR (3)
- Motor Overload (thermal model) (49, 51)
- Instantaneous Overcurrent (two stages) (50)
- Time-overcurrent (51)
- Ground Fault (50G)
- Undercurrent (37)
- Current Imbalance (46, 60)
- Motor thermistor (26, 49)
- Excess Start Time (48)
- Power circuit (32)
- Auxiliary trip (94, 95)

Extensive input and output options

- 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)

Comprehensive feedback

- Starter status LEDs
- Date and time stamped event logging
- Operational counters (number of starts, hours-run, kWh)
- Performance monitoring (current, voltage, power factor, kWh)
- User-programmable monitoring screen
- Multi-level password protection

Accessories (optional)

- Communication modules: Ethernet (Profinet, Modbus TCP, Ethernet/IP), Profibus, DeviceNet, Modbus RTU, and USB

3.3 Key Features

MVE 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 MVE 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 *4 Protection Settings* on page 48 to set the conditions in which each protection mechanism will activate.

Example: Use parameter 4C *Undercurrent* to set the level for an undercurrent trip and parameter 4D *Undercurrent Delay* to set a delay on the trip.

Use *16 Protection Action* on page 60 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 16C *Undercurrent* to select the response for an undercurrent trip (trip, warn or write to log). The default response is trip.

NOTE
MVE 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 MVE will also prevent the soft starter from operating. Refer to *Troubleshooting* on page 66 for details.

- **Advanced Thermal Modelling**

Intelligent thermal modelling allows the soft starter to predict whether the motor can successfully complete a start. The MVE 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 4N *Motor Temperature Check*.

- **Comprehensive Event and Trip Logging**

The MVE 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. Refer to *Starter Trip and Event Logger Software* on page 7 for details. For further information, or to download the software, visit www.aucom.com.

- **Informative Feedback Screens**

A digital display screen allows the MVE 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 MVE 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 9 and 10) are ideal for conventional (squirrel-cage) motors which may start in two different conditions (such as loaded and unloaded conveyors).

NOTE
The MVE is not suitable for controlling two separate motors. The secondary parameter set should only be used for a secondary configuration of the primary motor.

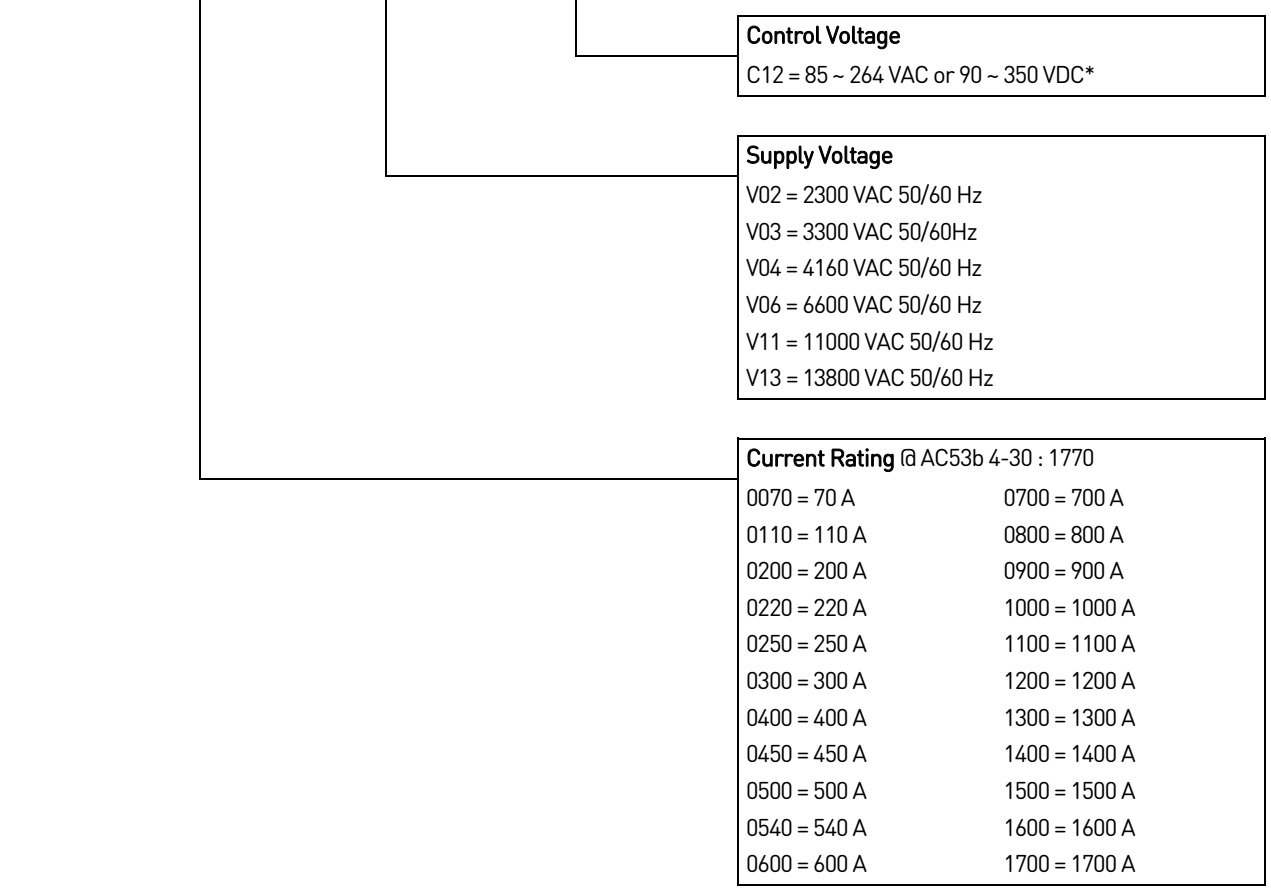
The MVE will use the secondary motor settings to control a start when instructed via a programmable input (refer to parameters 6A and 6F, *Input A or B Function*).

- **Fibre-Optics**

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

3.4 Model Code

MVE- [ ][ ][ ][ ] – [ ][ ][ ] – [ ][ ][ ]



Control Voltage
C12 = 85 ~ 264 VAC or 90 ~ 350 VDC*

Supply Voltage
V02 = 2300 VAC 50/60 Hz
V03 = 3300 VAC 50/60Hz
V04 = 4160 VAC 50/60 Hz
V06 = 6600 VAC 50/60 Hz
V11 = 11000 VAC 50/60 Hz
V13 = 13800 VAC 50/60 Hz

Current Rating @ AC53b 4-30 : 1770

0070 = 70 A	0700 = 700 A
0110 = 110 A	0800 = 800 A
0200 = 200 A	0900 = 900 A
0220 = 220 A	1000 = 1000 A
0250 = 250 A	1100 = 1100 A
0300 = 300 A	1200 = 1200 A
0400 = 400 A	1300 = 1300 A
0450 = 450 A	1400 = 1400 A
0500 = 500 A	1500 = 1500 A
0540 = 540 A	1600 = 1600 A
0600 = 600 A	1700 = 1700 A

* Control voltage input range using an approved switch mode power supply unit with 24 VDC, 10 A (minimum) output capacity.

3.5 Accessories

Communication Interfaces

MVE soft starters support network communication via easy-to-install communications interfaces. Each soft starter can support one communications interface at a time.

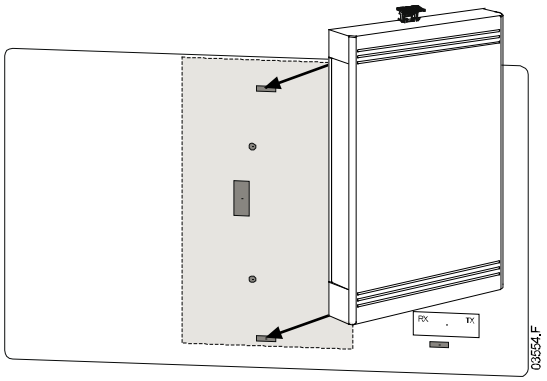
Available protocols:

Ethernet (Profinet, Modbus TCP, Ethernet/IP), Profibus, DeviceNet, Modbus RTU, and USB.

Protocol	Order code
Ethernet/IP	PIM-EI-01
DeviceNet	PIM-DN-01
Modbus RTU	PIM-MB-01
Modbus TCP	PIM-MT-01
Profibus	PIM-PB-01
Profinet	PIM-PN-01
USB	PIM-USB-01

- **Installing Communication Modules**

Communication modules attach to the back of the controller:



LV motor test resistor assembly

LV motor test resistor assemblies are used for low voltage motor testing. They reduce the resistance across a phase arm, increasing the strength of the non-conduction feedback signals. For more information, refer to Low Voltage Test Mode.

Starter Trip and Event Logger Software

The Starter Trip and Event Logger Software allows you to download the trip and event logs from the soft starter, for separate analysis.

The software is compatible with all AuCom medium voltage soft starters using control software version 1.29 or later.

To use the Starter Trip and Event Logger Software with the MVE, the soft starter must be fitted with a USB Module (PIM-USB-01) or a Modbus Module (PIM-MB-01).

For further information, or to download the software, visit www.aucom.com.

4. Specifications

Supply

Mains Voltage (U_r)

MVE-xxxx-V02	2.3 kV Phase-phase
MVE-xxxx-V03	3.3 kV Phase-phase
MVE-xxxx-V04	4.16 kV Phase-phase
MVE-xxxx-V06	6.6 kV Phase-phase
MVE-xxxx-V11	11.0 kV Phase-phase
MVE-xxxx-V13	13.8 kV Phase-phase
Rated Frequency (fr)	50/60 Hz

Rated lightning impulse withstand voltage (U_p) [1]

MVE-xxxx-V02 ~ V06	60 kV
MVE-xxxx-V11	75 kV
MVE-xxxx-V13	95 kV

Rated power frequency withstand voltage (U_d) [1]

MVE-xxxx-V02 ~ V06	20 kV
MVE-xxxx-V11 ~ V13	~ 42 kV

Rated normal current (I_r)

MVE-0070-Vxx	70 A
MVE-0110-Vxx	110 A
MVE-0200-Vxx	200 A
MVE-0220-Vxx	220 A
MVE-0250-Vxx	250 A
MVE-0300-Vxx	300 A
MVE-0360-Vxx	360 A
MVE-0400-Vxx	400 A
MVE-0450-Vxx	450 A
MVE-0500-Vxx	500 A
MVE-0540-Vxx	540 A
MVE-0600-Vxx	600 A
MVE-0700-Vxx	700 A
MVE-0800-Vxx	800 A
MVE-0900-Vxx	900 A
MVE-1000-Vxx	1000 A
MVE-1100-Vxx	1100 A
MVE-1200-Vxx	1200 A
MVE-1300-Vxx	1300 A
MVE-1400-Vxx	1400 A
MVE-1500-Vxx	1500 A
MVE-1600-Vxx	1600 A
MVE-1700-Vxx	1700 A

Rated short-time withstand current (symmetrical RMS) (I_k) [2]

MVE-xxxx-V02 ~ V06	48 kA
MVE-xxxx-V11 ~ V13	50 kA
Form designation	Bypassed semiconductor motor starter form 1
Control voltage	85 ~ 264 VAC or 90 ~ 350 VDC [3]
Rated Frequency	50/60 Hz
Typical power consumption	70 W continuous [4]

Inputs

Inputs on Controller

Start (C23, C24)	24 VDC, 8 mA approx
Stop (C31, C32)	24 VDC, 8 mA approx
Reset (C41, C42)	24 VDC, 8 mA approx
Input A (C53, C54)	24 VDC, 8 mA approx
Input B (C63, C64)	24 VDC, 8 mA approx
Motor thermistor (B4, B5)	Trip point > 3.6 kΩ
	Reset > 1.6 kΩ

Inputs on power interface board

Bypass readback input (C73, C74)	24 VDC, 8 mA approx
Fan Fail (C1, C2)	24 VDC, 8 mA approx
DOL protection activated (C3, C4)	24 VDC, 8 mA approx
Power supply fail input (C5, C6)	24 VDC, 8 mA approx

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

Outputs

Outputs on Controller

Output Relay A (43, 44)	Normally Open
Output Relay B (51, 52, 54)	Changeover
Output Relay C (61, 62, 64)	Changeover
Analog output (B10, B11)	0-20 mA or 4-20 mA

Ratings of output relays on Controller

	10 A @ 250 VAC resistive
	6 A @ 250 VAC 15 p.f. 0.3
	10 A @ 30 VDC resistive

Outputs on power interface board

Main contactor (13, 14)	Normally Open
Bypass contactor (23, 24)	Normally Open
Run Output/ PFC (33, 34)	Normally Open
Phase arm power supply control relay output (43, 44)	Normally Open

Environmental

Degree of Protection

Power Assembly	IP00
Controller	IP54/ NEMA 12
Operating temperature	- 10 ˚C to + 60 °C, above + 50 °C with derating
Humidity	5%~95% Relative Humidity
Storage temperature	- 25 ˚C to + 70 ˚C
Humidity	5%~95% Relative Humidity
Operating Altitude	0~1000 m, above 1000 m with derating
Pollution degree	Pollution Degree 3
Vibration	Designed to IEC 60068-2-6-Fc

EMC Emission (Designed to IEC 60947-4-2)

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 to 30 MHz: < 73 dB µV
Radiated radio frequency emission	0.15 MHz to 30 MHz: < 80-50 dB µV/m
	30 to 100 MHz: < 60-54 dB µV/m
	100 MHz to 2000 MHz: < 54 dB µV/m

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

EMC Immunity (Designed to IEC 60947-4-2)

Electrostatic Discharge	6 kV contact discharge, 8 kV air discharge
Radio Frequency Electromagnetic Field	80 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 (safe shutdown)	5000 ms (at 0% nominal voltage)

[1] Higher ratings may be available on request.

[2] Short circuit current, with appropriately rated fuses fitted.

[3] Control voltage input range using an approved switch mode power supply unit with 24 VDC, 10 A (minimum) output capacity.

[4] Excludes contactors and/or circuit breakers.

5. Receiving and Storage

5.1 Receiving

Inspect equipment as soon as possible for any damage that may have occurred during transit. Before accepting delivery, examine packaging for any signs of damage. A damaged package may indicate that the panel and internal components may also be damaged.

Check that the shipping manifest accounts for all equipment delivered. Any missing or damaged equipment should be noted on the freight bill and the carrier notified immediately. A record of the missing or damaged equipment should also be sent to AuCom.

NOTE

Avoid using heavy or sharp-edged tools while unpacking, as these may damage the equipment. Use nail pliers to separate all four sides of the wooden packaging box.

5.2 Storage

If immediate installation is not possible, the equipment should be stored in its original packaging in a clean and dry area indoors. Always store panels upright on their wooden pallets to keep them off the floor and allow air to pass under it freely.

NOTE

Equipment can be stored for a maximum of 12 months from the date of packaging as the quality of the packaging material degrades over time.

The following storage conditions should be met:

Temperature	- 25 ˚C to + 70 ˚C
Relative humidity	5% ~ 95%
Rate of change of temperature	0.5 °C/min

STORAGE

The MVE must be stored in its original packaging in a clean and dry environment. The MVE should be unpacked only after the equipment room is ready for installation. Particular care should be taken to avoid exposure of the electronics to cement and/or concrete dust.

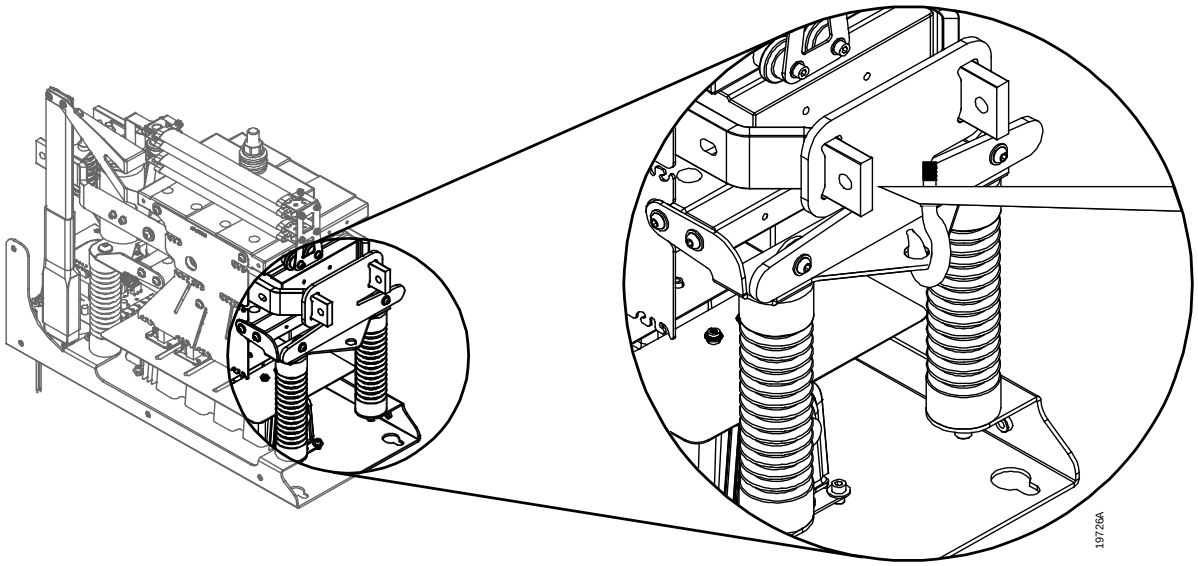
6. Installation

6.1 Lifting and Moving

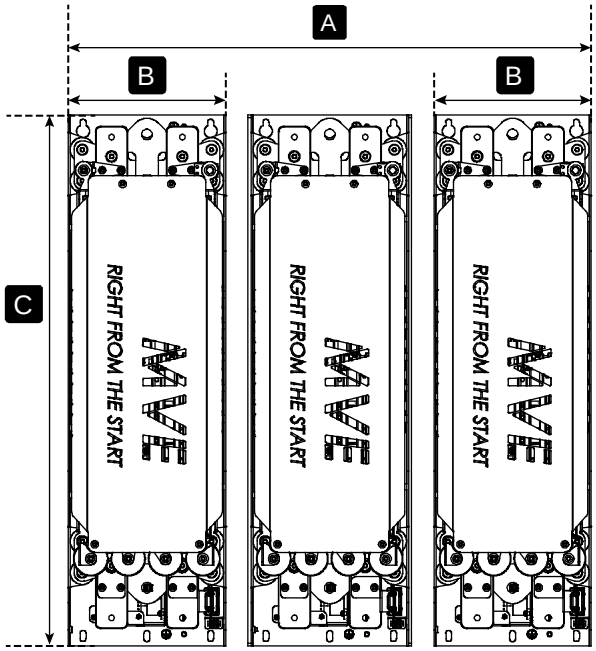
Use a lifting hook to lift each phase arm.

WARNING
MVE phase arms are heavy (>30 kg). Do not attempt to lift by hand.

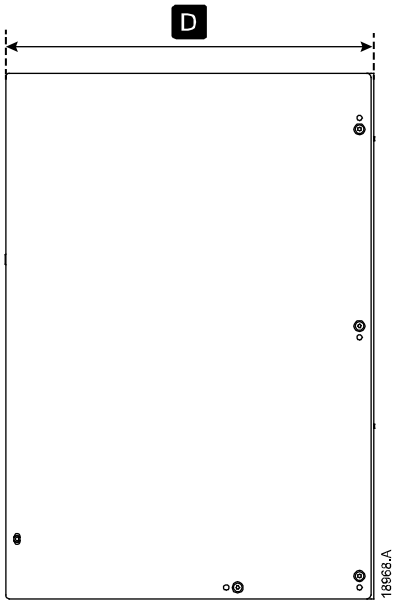
CAUTION
To avoid damage, only use the lifting eye.



6.2 Dimensions and Weights



Front view



Side view

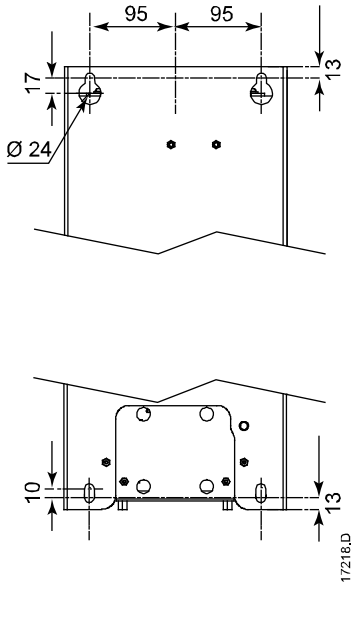
	A	B	C	D	Weight (phase arm)
	mm (inch)	mm (inch)	mm (inch)	mm (inch)	kg (lb)
MVE-V02: 0070~0540			584	508	38.4 (84.7)
MVE-V03: 0070~0540	750	246	(23.0)	(20.0)	39.5 (87.1)
MVE-V04: 0070~0540	(29.5)	(9.7)			
MVE-V06: 0070~0540			652	666	58.9 (127.9)
			(25.7)	(26.2)	
MVE-V02: 0600~1700					140.5 (309.7)
MVE-V03: 0600~1700	961	320	1340	832	175
MVE-V04: 0600~1700	(37.8)	(12.6)	(52.8)	(32.8)	(385.8)
MVE-V06: 0600~1700					209.3 (461.4)
MVE-V11: 0070~0540	978	308	1000	602	105 (231.5)
	(38.5)		(39.4)	(23.7)	
MVE-V13: 0070~0540	1048	(12.1)	1100	764	125 (275.6)
	(41.3)		(43.3)	(30.1)	
MVE-V11: 0600~1700	For typical values, please consult AuCom				
MVE-V13: 0600~1700					

6.3 Mounting Points

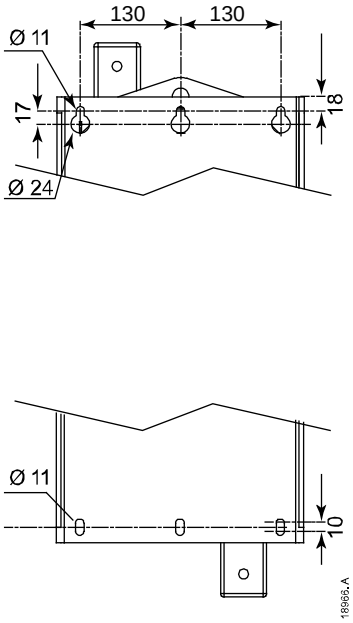
Each phase arm is mounted in place using M10 bolts. The bolts must be grade 8.8 or better.

Fix the top bolts in place in the enclosure, then position the phase arm over the bolts. Secure the phase arm in position with the bottom bolts.

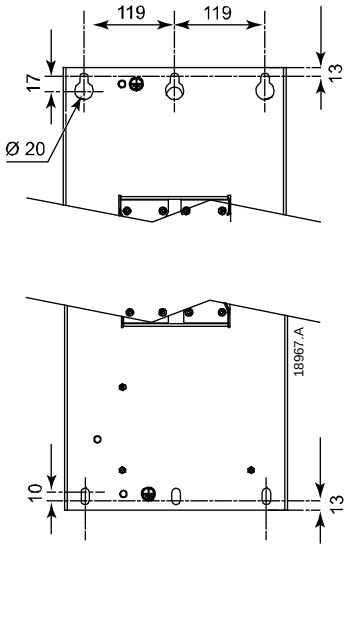
V02~V06
0070 A ~ 0540 A



V02~V06
0600 A ~ 1700 A



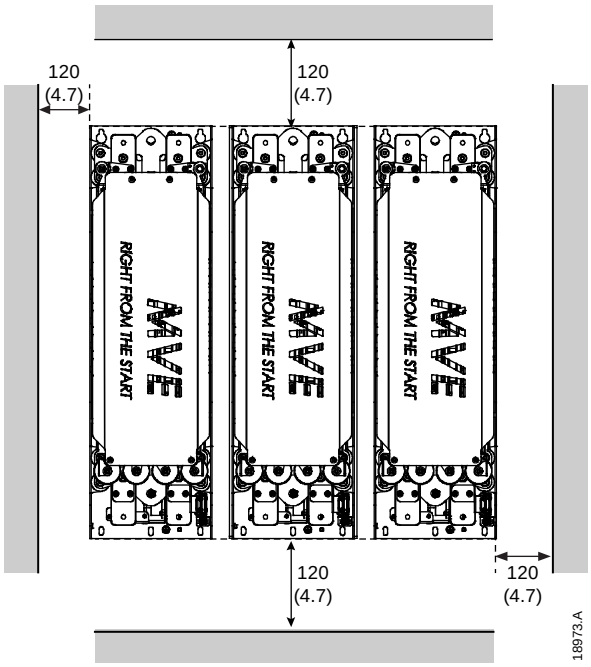
V11~V13
0070 A ~ 0540 A



MVE-0600~1700, V11~V13: For typical values, please consult AuCom.

6.4 Clearance Requirements

The phase arms are rated IP00 and must be installed inside an enclosure.



6.5 Power Terminations

Use only M10 high tensile grade 8.8 threaded fasteners for all terminations.

Use a pre-load torque setting between 28 ~ 30 Nm.

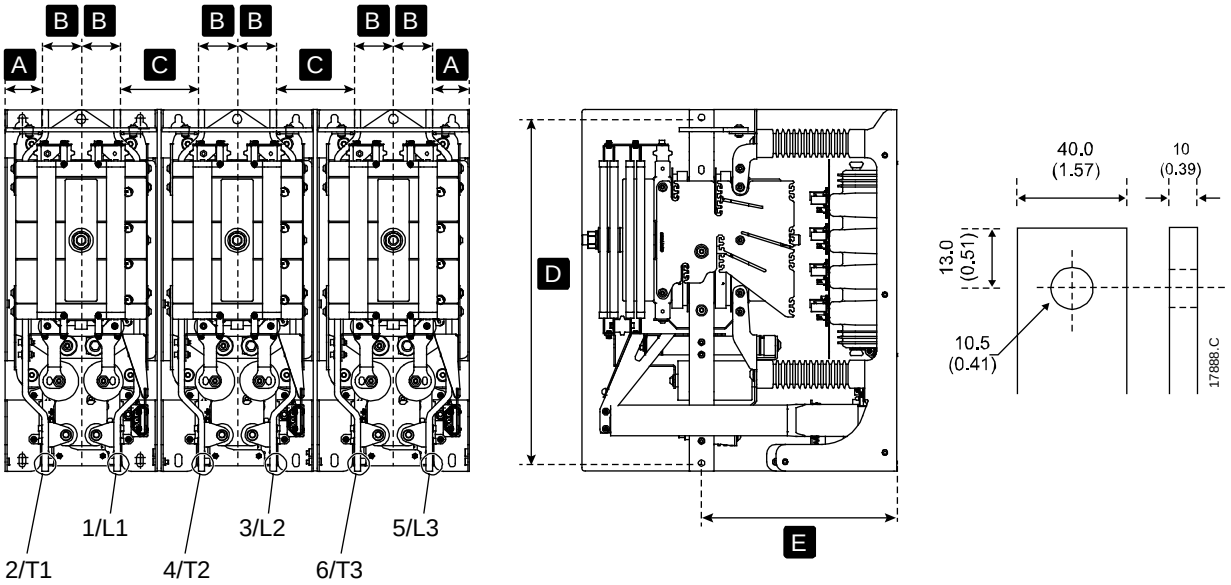
Use only Belleville washers.

NOTE
Aluminium busbars must be free from oxide and contaminants, and the connection must be pasted with anti-oxidant compound.

NOTE
After the phase arm has been installed in the panel, perform an earth bonding test between the mounting frame and the main earth bus to confirm that the frame is adequately earthed.

MVE-0070~0540, V02 ~ V04

NOTE
For these models, terminations can be made at either end of the input and output busbars.

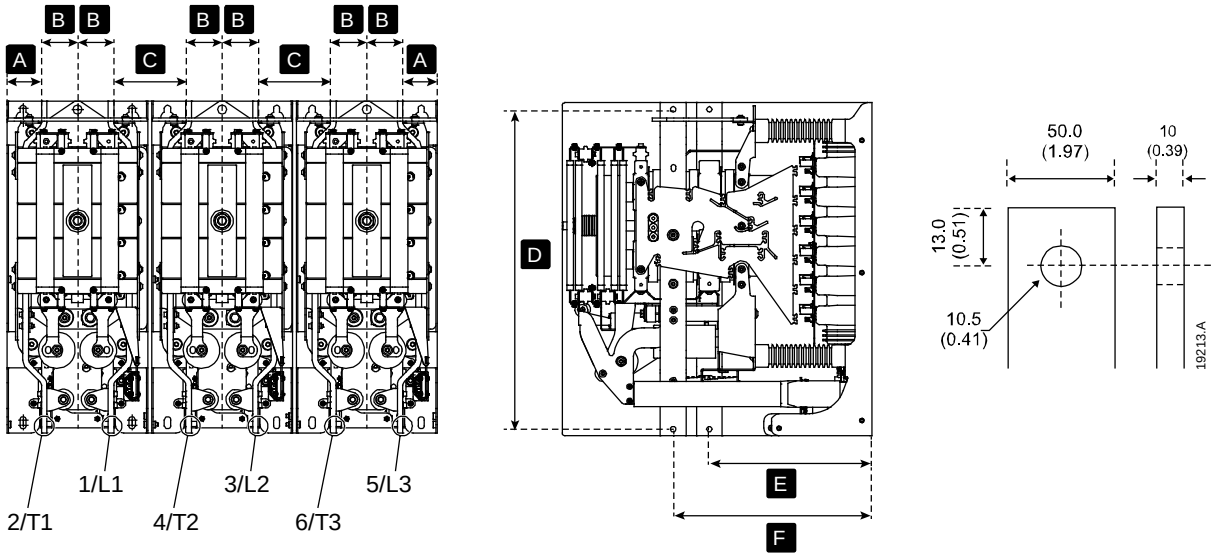


	A mm (inch)	B mm (inch)	C mm (inch)	D mm (inch)	E mm (inch)
MVE-0070-V02 ~ MVE-0540-V02					
MVE-0070-V03 ~ MVE-0540-V03	60 (2.4)	63 (2.5)	126 (5.0)	558 (22.0)	315 (12.4)
MVE-0070-V04 ~ MVE-0540-V04					

MVE-0070~0540, V06

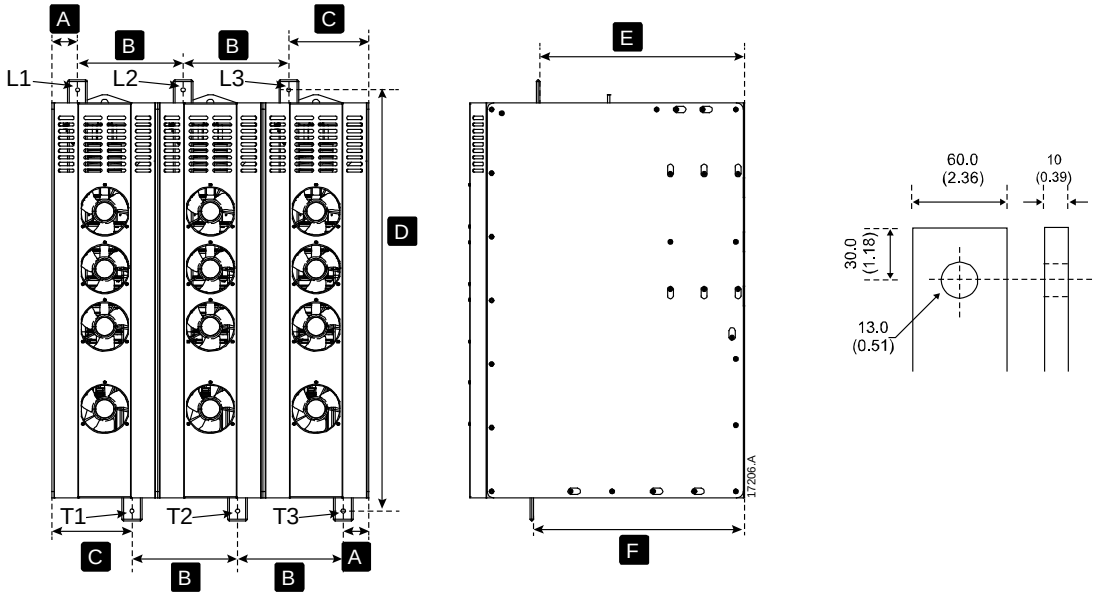
NOTE

For these models, terminations can be made at either end of the input and output busbars.



	A mm (inch)	B mm (inch)	C mm (inch)	D mm (inch)	E mm (inch)	F mm (inch)
MVE-0070-V06 ~	60	63	126	626	315	385
MVE-0540-V06	(2.4)	(2.5)	(5.0)	(24.6)	(12.4)	(15.2)

MVE-0600-1700, V02~V06

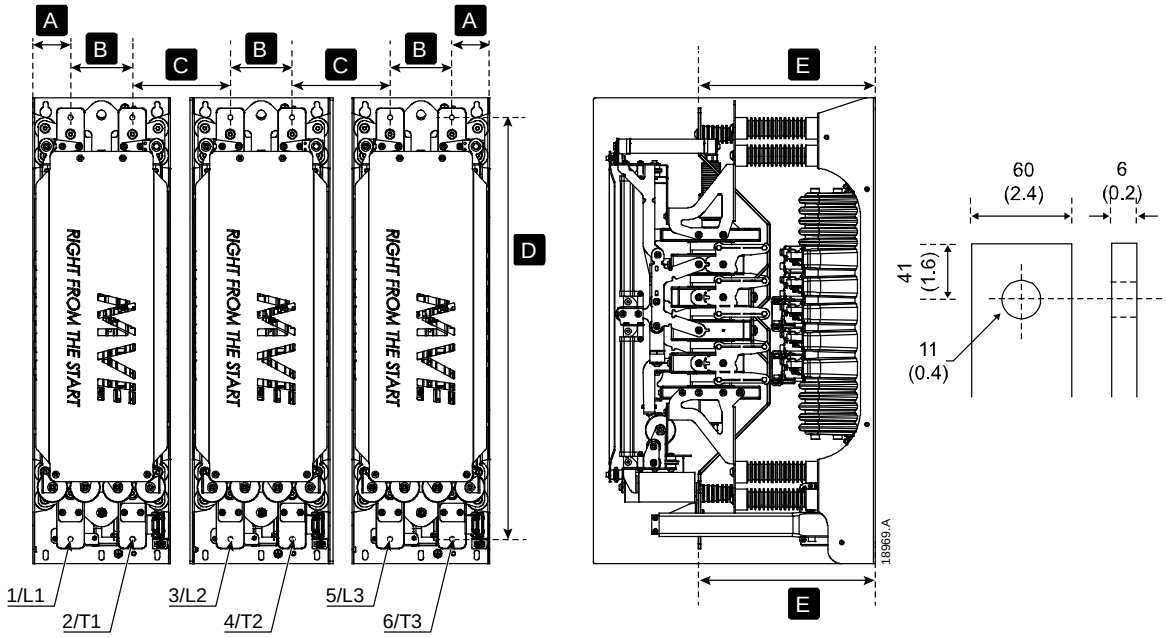


	A mm (inch)	B mm (inch)	C mm (inch)	D mm (inch)	E mm (inch)	F mm (inch)
MVE-0600-V02 ~ MVE-1700-V02						
MVE-0600-V03 ~ MVE-1700-V03	77 (3.1)	320 (12.6)	242 (9.5)	1280 (50.4)	620 (24.4)	640 (25.2)
MVE-0600-V04 ~ MVE-1700-V04						
MVE-0600-V06 ~ MVE-1700-V06						

MVE-V11-V13

NOTE

For these models, terminations can be made at either end of the input and output busbars.

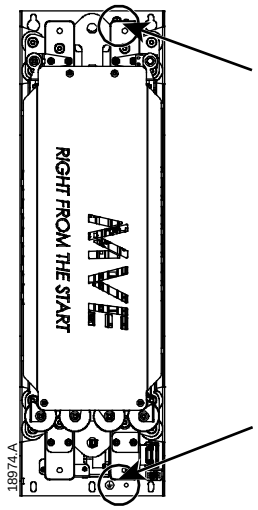


	A mm (inch)	B mm (inch)	C mm (inch)	D mm (inch)	E mm (inch)
MVE-0070-V11 ~ MVE-0540-V11	88 (12.1)	132 (5.2)	232 (7.8)	1000 (39.4)	378 (14.9)
MVE-0070-V13 ~ MVE-0540-V13			197 (9.1)	1100 (43.3)	148 (16.5)
MVE-0600-V11 ~ MVE-1700-V11	For typical values, please consult AuCom				
MVE-0600-V13 ~ MVE-1700-V13					

6.6 Earth Terminations

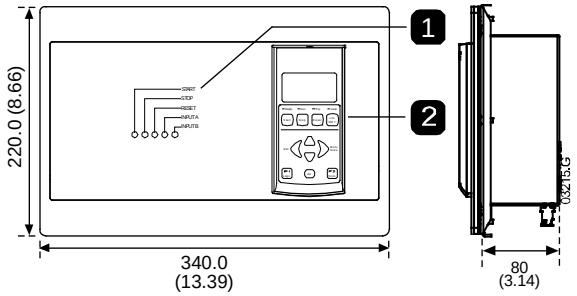
Models V02~V06 do not include earth studs.

Models V11~V13 have two 10 mm earth studs, at the rear of each phase arm close to the mounting points. 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.



6.7 Controller Mounting

The controller is suitable for use with all MVE soft starters.



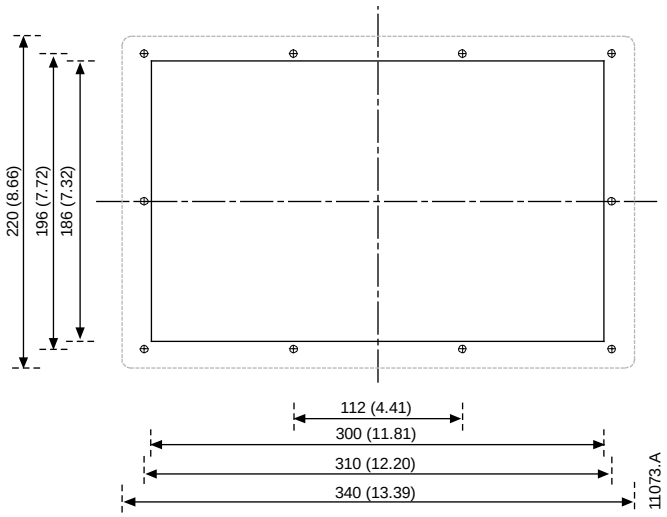
1	Control input LEDs
2	Keypad

Dimensions are shown in mm (inch).

Weight: 2.1 kg (4.63 lb)

Mounting Instructions - Controller

The controller is secured into place using ten M4 nuts, affixed to the studs on the back of the controller.



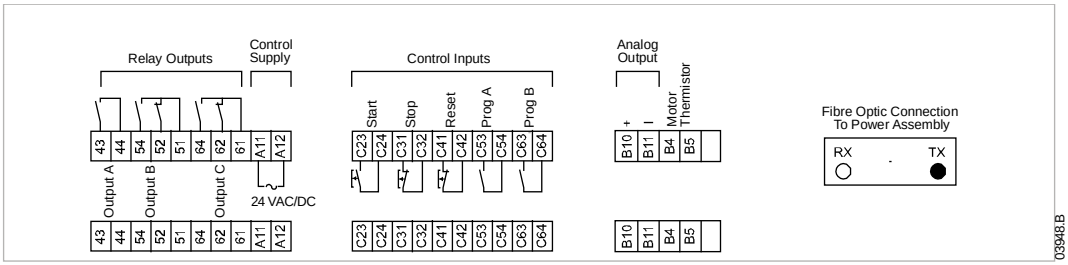
To mount the controller, make a 186 mm x 300 mm cutout at the desired mounting location. Ensure adequate clearance (>85 mm) is available behind the mounting location. If you intend to use a communication module, allow for a minimum clearance of 120 mm behind the mounting panel.

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

6.8 Terminations on the Controller

Terminal Block (controller)

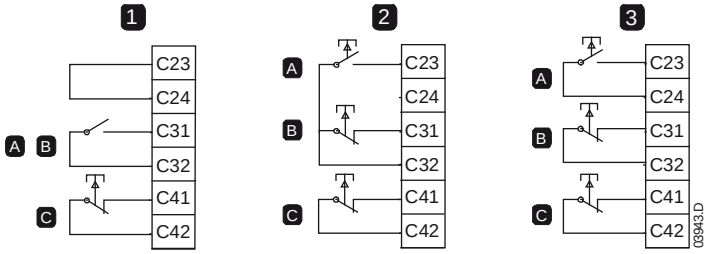
Terminations on the controller use plug-in terminals. Unplug the terminal blocks, complete the wiring, then re-plug the terminal blocks into the controller.



6.9 Wiring for Remote Control

Control Wiring

The MVE 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
A	Start
B	Stop
C	Reset

CAUTION

The control inputs are powered by the soft starter. Do not apply external voltage to the control input terminals.

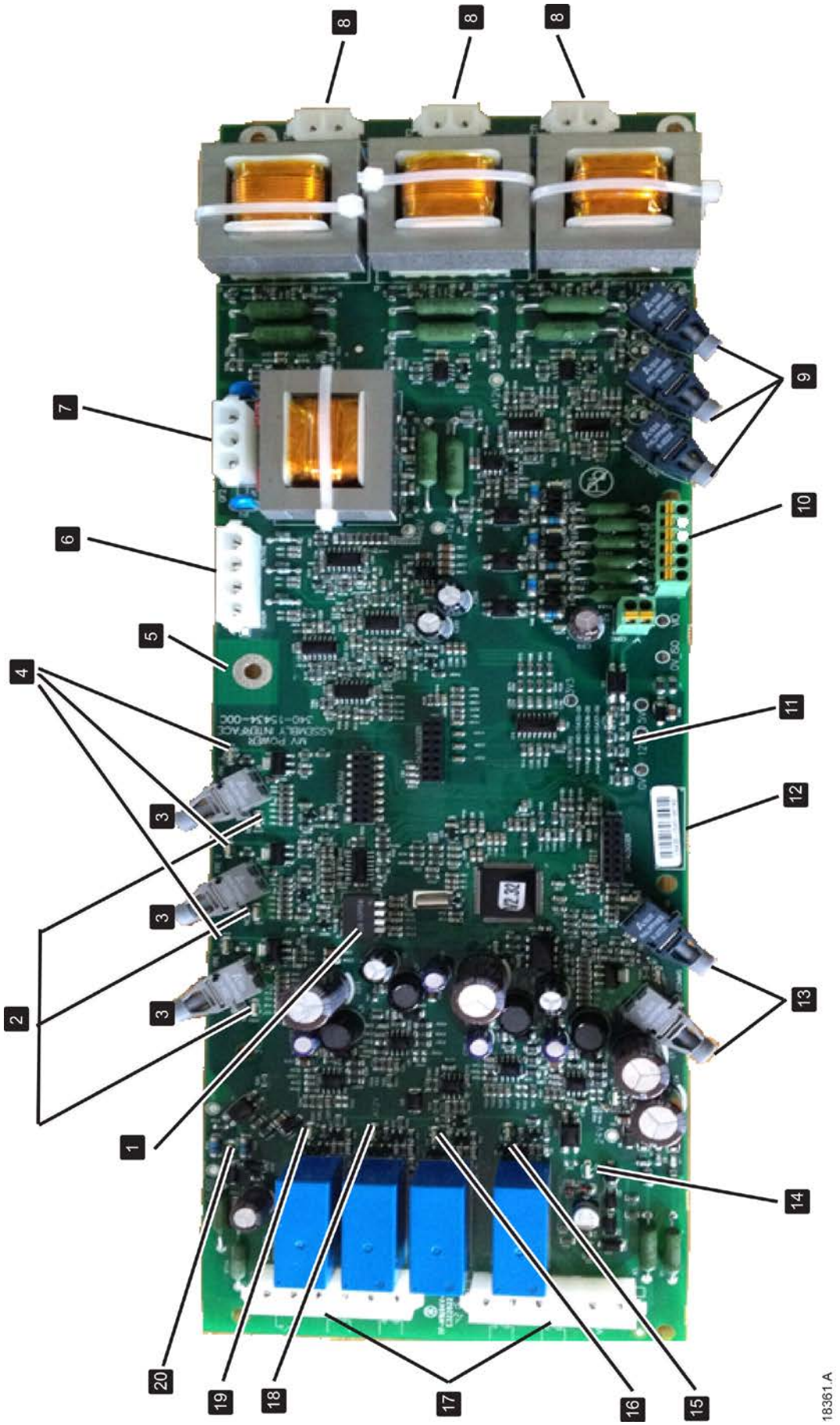
Cables to the control inputs must be segregated from mains voltage and motor cabling.

The reset input can be normally open or normally closed. Use parameter 6M to select the configuration.

NOTE

Reset input is normally closed by default.

6.10 Terminations on the Power Interface Board



1	CT ratio selector DIP switch S1 (refer to *CT Current Measurement* on page 25)	
2	Non-conduction LEDs (green)	
3	Gate firing fibre-optic connectors	
4	Firing status LEDs (red)	
5	Earth termination point (for voltage sensing ground connections)	
6	Voltage sensing input connector (V0 ~ V3)	
7	Ground fault CT connector (GF1, GF2)	
8	Line CT connectors (CT1 [L11/L12], CT2 [L21/L22], CT3 [L31/L32])	
9	Non-conduction readback fibre-optic connectors	
10	Fan Fail (C1, C2), DOL protection activated (C3, C4) and Power supply fail input (C5, C6)	
11	ID resistors	
12	Serial number	
13	Fibre-optic connections and LEDs to controller (Rx = Green, Tx = Red)	
14	Control supply input and LED (green)	
15	Phase arm power supply control relay output and LED (green)	
16	PFC contactor relay output and LED (green)	
17	Control terminals (refer to *Internal Panel Wiring* on page 27)	
	C73, C74	Bypass readback input (BPR)
	13, 14	Main device relay output (MC)
	23, 24	Bypass device relay output (BC)
	33, 34	PFC contactor relay output (PF)
	43, 44	Phase arm power supply control relay output (PAPS)
	V In (A1, A2)	Control supply input
18	Bypass device relay output and LED (green)	
19	Main device relay output and LED (green)	
20	Bypass readback input and LED (green)	

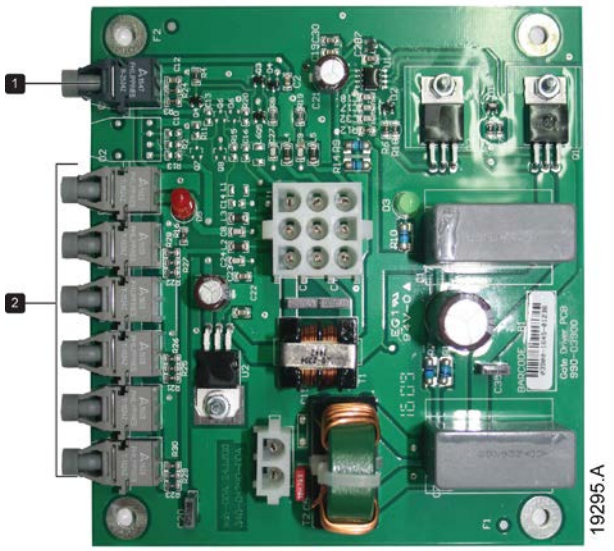
NOTE

The fan fail (C1, C2) and power supply fail (C5, C6) inputs are wire linked and inactive by default.

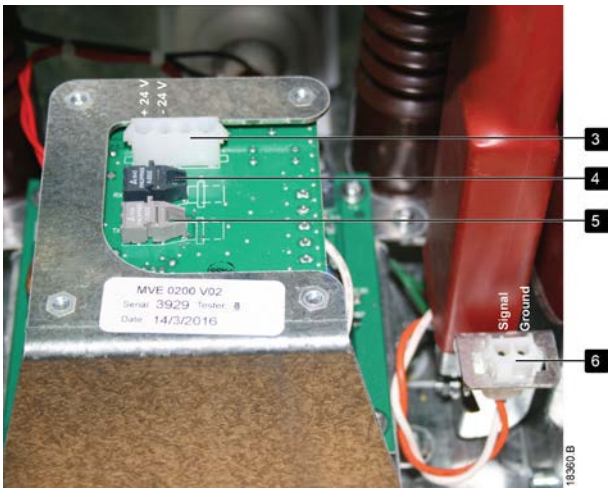
6.11 Terminations for Adapter Board and Gate Drive Board

- **MVE-0070~0540, V02~V06**

Gate drive board - Layout view

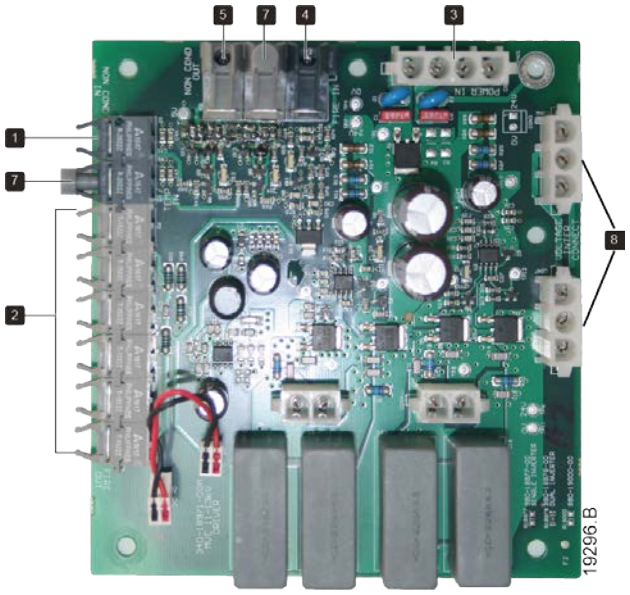


Adapter board - Installed view

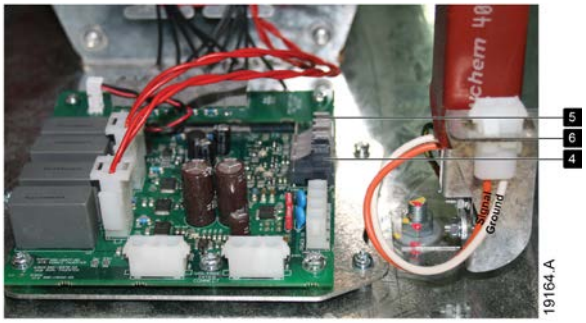


- **MVE-0070~0540, V11~V13**

Gate drive board - Layout view



Gate drive board - Installed view



1	Non-conduction fibre-optic connector (Rx)
2	Firing transformer fibre-optic connectors (Tx)
3	Power supply connector (24 VDC)
4	Firing signal (Rx) from power interface board
5	Non-conduction signal (Tx) to power interface board
6	Voltage sensing connector
7	*Reserved* - do not use
8	*Reserved* - do not use

6.12 Power Circuits

Overview

MVE 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. MVE must be installed with fuses.

Additional components may also be required to comply with soft starter panel specifications.

Main Contactor

The MVE 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.

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 MVE (refer to *Power Circuit Configuration* on page *24*).

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 Panel Wiring* on page 27).

Bypass Contactor

The MVE 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.

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 *Power Circuit Configuration* on page 24).

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 *Internal Panel Wiring* on page 27).

R Rated Protection Fuses

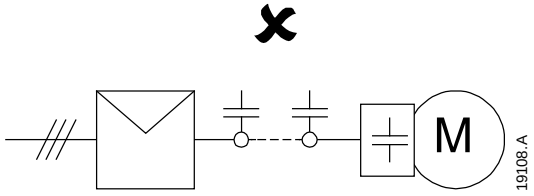
R Rated protection fuses can be installed on the supply side of the soft starter to provide Type 1 coordination and short circuit protection for the motor branch circuit. MVE must be installed with fuses. Select the appropriate fuse based on the motor's rated full load current.

Power Factor Correction

CAUTION

Power factor correction capacitors must be connected to the input side of the soft starter. Connecting power factor correction capacitors to the output side will damage the soft starter

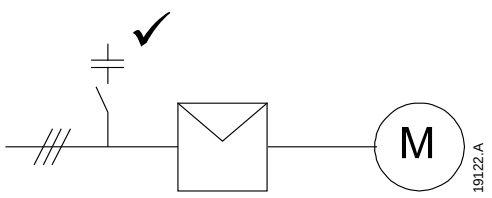
Incorrect installation



Power factor correction capacitors should be selected based on the motor data and the required final power factor. Select a contactor according to the required kVAr.

Power factor correction capacitors must be connected to the supply side of the soft starter.

Correct installation



The soft starter must control the power factor correction capacitor contactor. Use the run output (terminals 33, 34 on the power interface board).

Transient/ Overvoltage Protection

Overvoltage protection should be installed if there is a risk of high voltage transients at the installation. Contact your local supplier for details.

Line Inductors

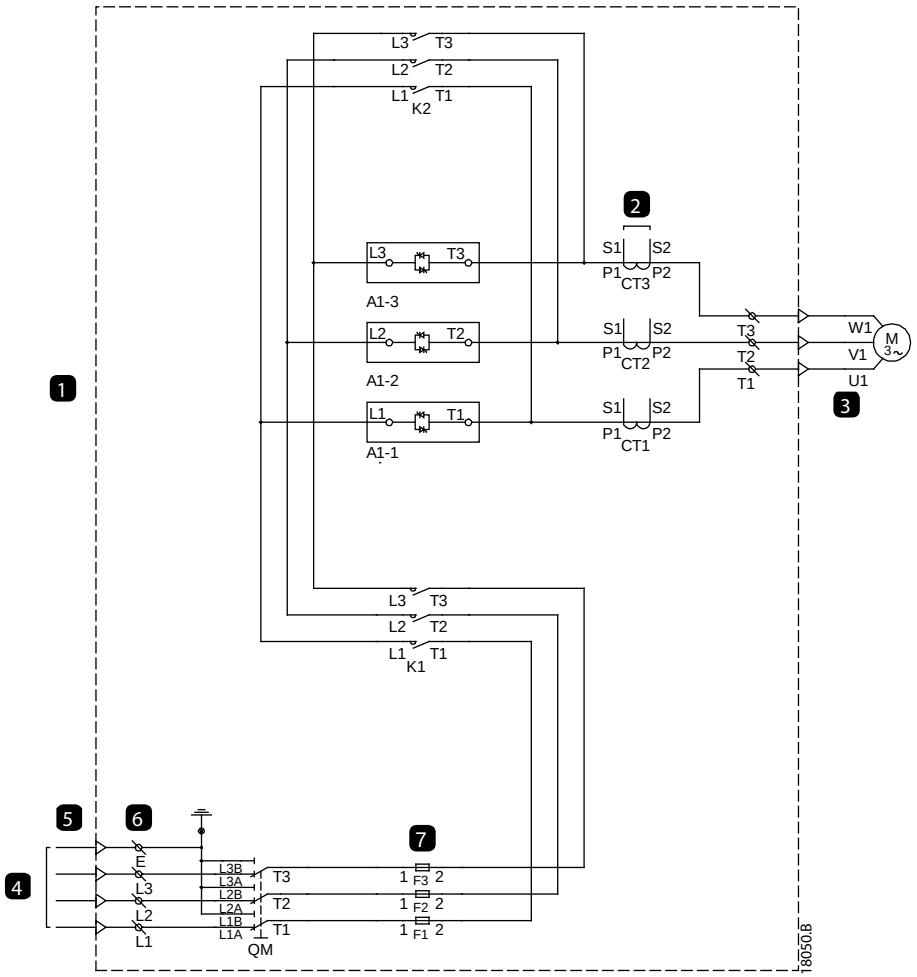
Output line inductors may be required depending on various factors, including the soft starter model, the system operating voltage, the cable type, and the length of the cable run between the soft starter and the motor.

If required, line inductors are typically installed in a shielded caged enclosure at the soft starter end of the motor cable.

To find out if line inductors are required for your specific installation, contact your local supplier for advice. You will need to provide information about the motor output cable, including the cable length and its capacitance per km.

Power Circuit Configuration

MVE power circuit with main contactor, bypass contactor, main isolator/ earth switch, R Rated fuses and current transformers. MVE must be installed with backup/R-rated fuses.



1	Soft starter panel
A1-1 ~ A1-3	Phase arms 1 ~ 3
2	Current transformers (refer to *Internal Panel Wiring* on page 27)
3	Motor cables
4	Three-phase supply
5	Supply cables
6	Panel earth bar
QM	Main isolator / Earth switch disconnector

L1-L3	Input power terminals (supply side)
T1-T3	Output power terminals (motor side)
7	Fuses (F1-3)
K1	Main contactor
K2	Bypass contactor

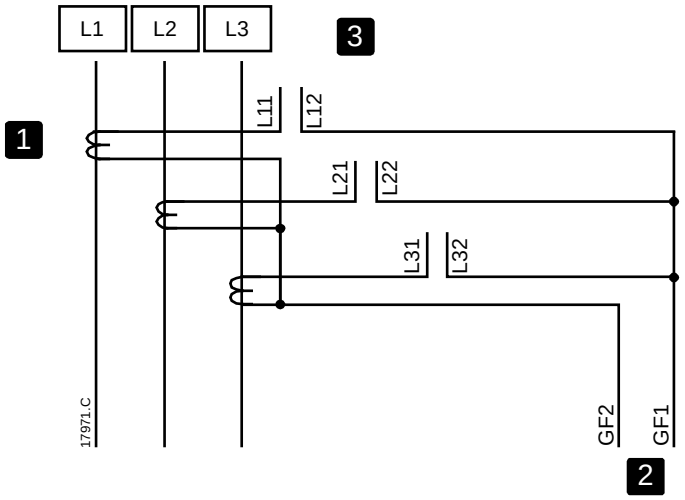
6.13 CT Current Measurement

The MVE supports the summation and zero sequence methods of ground current measurement.

The line current transformers supplied with the soft starter are 1000:1 ratio. The MVE also supports customer-supplied 500:1 CTs if required. If 500:1 CTs are used, the setting of switch S1 on the power interface board must be changed.

Summation method ground current measurement

- **Connection diagram: ground current summation CTs**



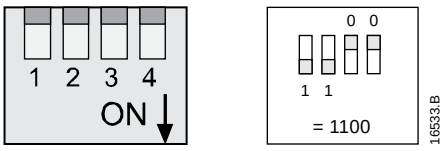
1	Line current transformers (1000:1)
2	Ground current input to Power Interface PCB
3	Individual phase inputs to Power Interface PCB

- **Switch settings for summation method**

NOTE
The soft starter will check the switch settings when control power is applied. If the switch settings are changed, control power must be cycled for the new setting to take effect.

Line CT ratio	Switch setting
500:1	0100
1000:1	1100

- **Example settings for S1**

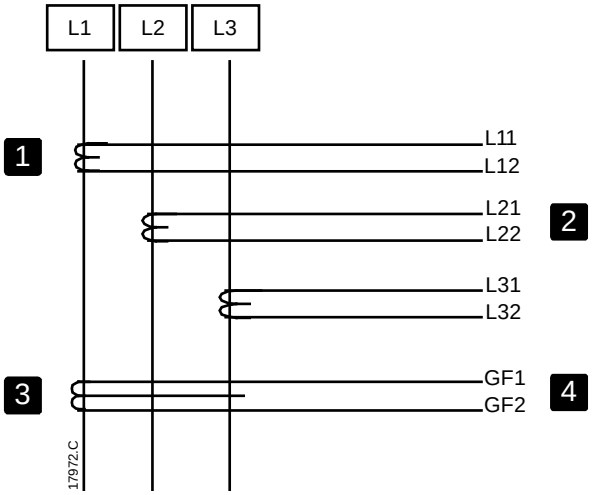


NOTE
Dip switch 1 on S1 is closest to the control terminal connectors. Dip switch 4 is closest to the CT connectors.

Zero sequence method ground current measurement

NOTE
Zero sequence ground current measurement requires an additional customer-supplied ground current CT. In all cases, the CT must be 1000:1, 1 VA, minimum protection class rating 5P10.

- **Connection diagram: ground current zero sequence CTs**



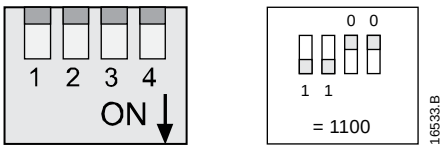
1	Line current transformers (1000:1)
2	Individual phase inputs to Power Interface PCB
3	Zero sequence current transformer (1000:1)
4	Ground current input to Power Interface PCB

- **Switch settings for zero sequence method**

NOTE
The soft starter will check the switch settings when control power is applied. If the switch settings are changed, control power must be cycled for the new setting to take effect.

Line CT ratio	Zero sequence CT ratio	Switch setting
500:1	1000:1	1010
1000:1	1000:1	1100

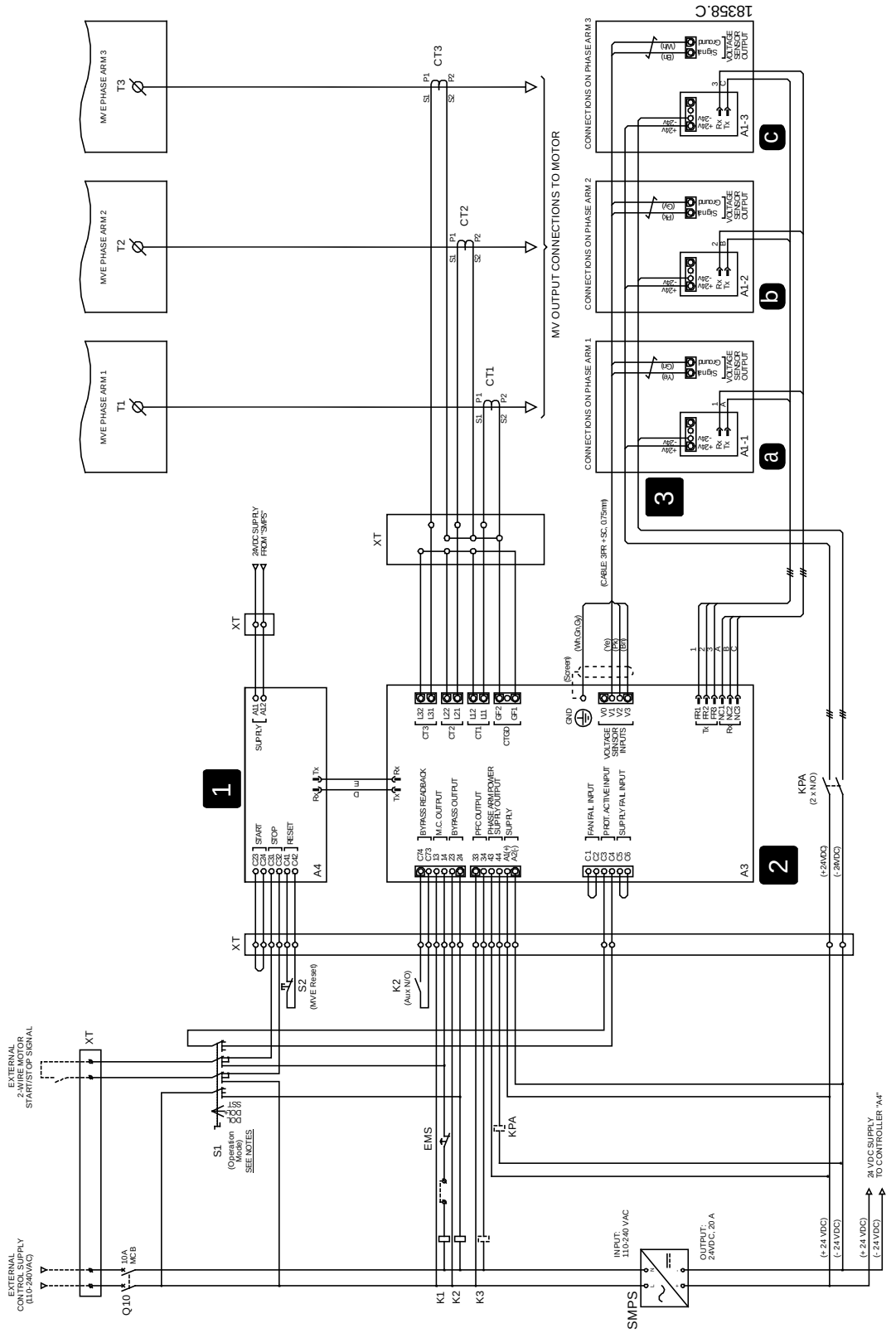
- **Example settings for S1**



NOTE
Dip switch 1 on S1 is closest to the control terminal connectors. Dip switch 4 is closest to the CT connectors.

6.14 Internal Panel Wiring

Internal connection wiring diagram. This information is intended for panel builders when integrating and wiring the MVE into a panel.



1	Controller (A4)	3	Gate drive adapter PCB and voltage sensing connectors
2	Power interface board (A3)	a ~ c	Phase arm 1 ~ Phase arm 3 (A1-1 ~ A1-3)

6.15 Operation mode selector switch (S1)

The MVE can soft start the motor, or can DOL start the motor with or without protection. Use the operation mode selector switch (S1) to select the start mode.

SST position (soft start)

- The customer's external control signals start and stop the motor.
- The MVE performs a normal soft start.
- All soft starter protections are active.
- Relay outputs on the soft starter's power interface board control the line, bypass and PFC contactors.

DOL+ position (DOL with protection)

- The customer's external control signals start and stop the motor.
- The line and bypass contactors start the motor DOL.
- All soft starter protections are active.
- Relay outputs on the soft starter's power interface board control the line, bypass and PFC contactors.

NOTE
This mode allows the motor to be started when there is a fault with one of the soft starter phase arms. The controller and power interface board must be in healthy working state.

DOL position (DOL without protection)

- The customer's external control signals start and stop the motor.
- The line and bypass contactors start the motor DOL.
- All soft starter protections are bypassed.
- The line and bypass contactors are controlled by the start and stop control signals.
- The PFC contactor (if used) must be controlled by a separate manual switch.

NOTE
This mode allows emergency operation of the motor when there is a major failure of any soft starter component. Back-up fuses provide short circuit protection. Additional protections such as motor protection or RTD overtemperature may be available if separate protection equipment is installed.

6.16 Phase arm power supply switching

The 24 VDC power supply to each phase arm must be switched via a control relay operated from output 43, 44 on the power interface board. Refer to *Internal Panel Wiring* on page 27.

The control relay (KPA) must have a contact switching rating > 9A @ 24 VDC.

6.17 Approved switch mode power supply units

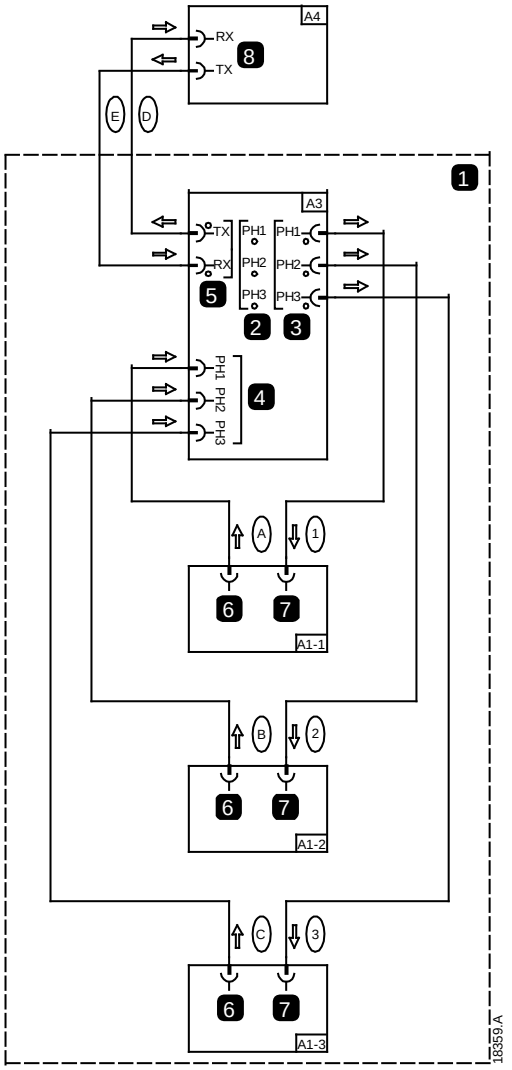
The following 24 VDC switch mode power supplies are tested and approved for use with MVE:

1. Delta power supply DRM-24V480W1PN
2. LUTZ power supply CPSB1-480-24

CAUTION
Use of other power supplies is at the risk of the installer and/or end user. AuCom accepts no responsibility for damage or incorrect operation resulting from the use of unapproved power supplies.

6.18 Internal Fibre-Optic Connections

Internal fibre-optic cable connection diagram. This information is intended for panel builders.



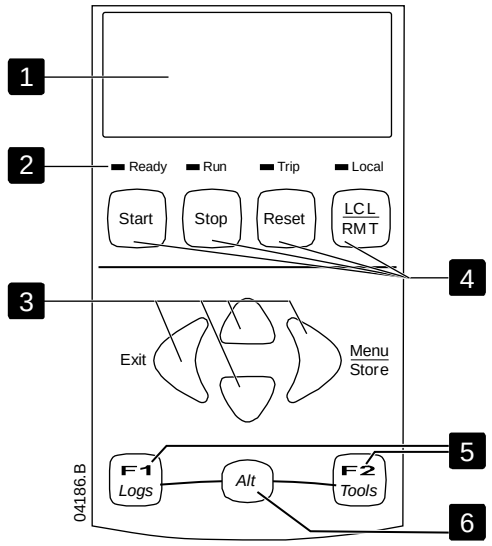
1	Power assembly (including 3 phase arms)
A1-1 ~ A1-3	Non-conduction PCBs mounted at bottom of each phase arm
6	Non-conduction [Tx] connector
7	Firing [Rx] connector
A3	Interface PCB
2	Non-conduction status LEDs (green)
3	Firing [Tx] connectors and Firing status LEDs (red)
4	Non-conduction [Rx] connectors
5	Connectors to controller [Rx, Tx] and status LEDs (green / red)
A4	Controller
8	Connectors to interface PCB [Rx, Tx] and status LEDs (green / red)

NOTE

The connector sockets for the fixed fibre-optic Transmit (Tx) and Receive (Rx) are mounted on the Interface PCB (A3) and on the three Non-conduction PCBs (A1-1, A1-2 and A1-3).

- Transmit (Tx) fibre-optic sockets are light grey colour.
- Receive (Rx) fibre-optic sockets are dark grey colour.

7. Controller



1	Four-line display for status and programming details.
2	Status LEDs
3	Menu navigation buttons: ◀ : Exit the menu or parameter, or cancel a parameter change. ▶ : Enter a menu or parameter, or save a parameter change. ▲ / ▼ : Scroll to the next or previous menu or parameter, or change the setting of the current parameter.
4	Soft starter local control buttons
5	Shortcut buttons for quick access to common tasks.
6	Alt button. Use with F1 or F2 to open performance logs or commissioning tools.

7.1 Starter Status LEDs

LED name	On	Flashing
Ready	The motor is stopped and the starter is ready to start.	The motor is stopped and the starter is waiting for the *Restart Delay* (parameter 4M) or *Motor Temperature Check* (parameter 4N).
Run	The motor is in run state (receiving full voltage).	The motor is starting or stopping.
Trip	The starter has tripped.	The starter is in warning state.
Local	The starter is in Local control mode.	--

If the starter is in remote control mode, the Local LED will be off.

If all LEDs are off, the starter is not receiving control voltage.

NOTE
When the Controller is powered up, the Ready LED flashes for 5 seconds as part of the initialisation routine.

7.2 Menu Shortcuts

The F1 and F2 buttons offer keyboard shortcuts to the Auto-Stop menu. Use parameters 8B and 8C (*8B, 8C – F1 and F2 Button Action* on page 56) to select the shortcut target.

7.3 Displays

The 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 8D). Use the ▲ and ▼ buttons to select the information shown on the bottom half of the screen.

- Starter status
- User programmable screen
- Motor temperature
- Current
- Motor power
- Voltage
- Last start information
- Date and time
- Performance graphs
- SCR conduction

Operating Feedback

NOTE
Screens shown here are with the default settings.

- **Starter Status**

The starter status screen shows details of the starter's operating status, including motor current, power and temperature.

```
            0A
Ready
M1 000%              000.0kW
```

- **Programmable screen**

The MVE's user-programmable screen can be configured to show the most important information for the particular application. Use parameters 8E to 8H to select which information to display.

```
            0A
Ready
00000 kWh            00000hrs
```

- **Motor Temperature**

The temperature screen shows which motor data set is in use, and the temperature of the motor as a percentage of total thermal capacity.

```
            0A
Primary Motor Set
➤ M1 000%            M2 000%
```

NOTE
M2 xxx% temperature is not applicable to this product.

- **Current monitoring screen**

The current screen shows real-time line current on each phase.

```
            0A
 Phase Currents (Gnd Crnt XX.XA)
000.0A     000.0A     000.0A
```

- **Motor Power**

The motor power screen shows motor power (kW, HP and kVA) and power factor.

```
            0A
000.0kW              0000HP
0000kVA              -.--pf
```

- **Voltage**

The voltage screen shows real-time line voltage across each phase.

```
            0A
Line Voltages
00000      00000      00000
```

- **Last Start Information**

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

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

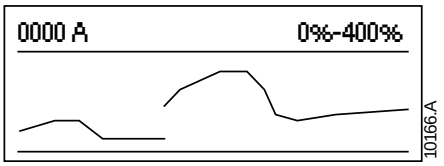
```
            0A
Last start           000 s
000 % FLC          Δ Temp 0%
```

- **Date and Time**

The date/time screen shows the current system date and time (24 hour format). For details on setting the date and time, refer to *Set Date and Time* on page 32.

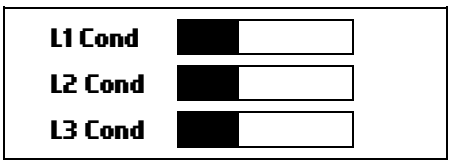
- **Performance Graph**

The performance graph provides a real-time display of operating performance. Use parameters 8I~8L to select which information to display.



- **SCR Conduction Bargraph**

The SCR conduction bargraph shows the level of conduction on each phase.



7.4 Display Calibration

The displayed values for current, voltage and power factor can be calibrated if required. Contact your local supplier for advice.

7.5 Commissioning Menu (Tools)

The Commissioning Menu provides access to commissioning and testing tools.

Press ALT then TOOLS to open the Tools.

The Commissioning Menu is protected by the access code.

The default access code is 0000.

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 ◀ repeatedly.

7.6 Set Date and Time

To set the date and time:

1. Open the Commissioning Menu.
2. Scroll to the date/time screen.
3. Press the ▶ button to enter edit mode.
4. Press the ▶ and ◀ buttons to select which part of the date or time to edit.
5. Use the ▲ and ▼ buttons to change the value.
6. To save changes, press the ▶ button. The MVE will confirm the changes.
   To cancel changes, press the ◀ button.

7.7 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 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 controller is active.

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

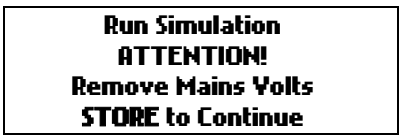
Run Simulation

To use the run simulation:

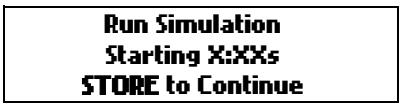
1. Open the Commissioning Menu.
2. Scroll to Run Simulation and press ▶.

3. Press START or activate the start input. The MVE simulates its pre-start checks and closes the main contactor relay. The Run LED flashes.

NOTE
If mains voltage is connected, an error message is shown. Remove mains voltage and proceed to the next step.



4. Press ▶. The MVE simulates starting. The Run LED flashes.



5. Press ▶. The MVE simulates running. The Run LED stays on without flashing and the bypass contactor relay closes.

6. Press STOP or activate the stop input. The MVE simulates stopping. The Run LED flashes and the bypass contactor relay opens.

7. Press ▶. The Ready LED flashes and the main contactor relay opens.

8. Press ▶ to return to the commissioning menu.

NOTE
Run simulation can be exited at any stage by pressing the ◀.

Protection Simulation

The protection simulation simulates activation of each protection mechanism to confirm that the soft starter and associated control circuits are responding correctly.

To use the protection simulation:

1. Open the Commissioning Menu.
2. Scroll to Protection Simulation and press ▶.
3. Use the ▲ and ▼ buttons to select the protection you want to simulate.
4. Press and hold ▶ to simulate the selected protection.
5. The screen is displayed momentarily. The soft starter's response depends on the Protection Action setting (parameter group 16).

6. Use ▲ or ▼ to select another simulation, or press ◀ to exit.

NOTE
If the protection trips the soft starter, reset before simulating another protection. If the protection action is set to 'Warn and Log', no reset is required.

If the protection is set to 'Warn and Log', the warning message can be viewed only while the ▶ button is pressed.

If the protection is set to 'Log only', nothing appears on the screen but an entry will appear in the log.

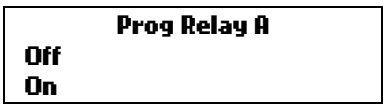
Output Signal Simulation

The output signal simulation simulates output signalling to confirm that outputs and associated control circuits are operating correctly.

NOTE
To test operation of the flags (motor temperature and low/high current), set an output relay to the appropriate function and monitor the relay's behaviour.

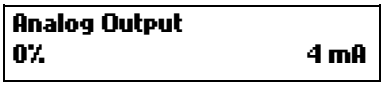
To use the output signal simulation:

1. Open the Commissioning Menu.
2. Scroll to Output Signalling Simulation and press ▶.
3. Use the ▲ and ▼ buttons to select a function to simulate, then press ▶.
4. Use the ▲ and ▼ buttons to turn the signal on and off.
   To confirm correct operation, monitor the state of the output.
5. Press ◀ to return to the simulation list.



Analog Output Simulation

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

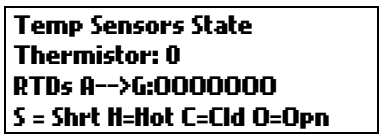


Attach an external current measuring device to terminals B10, B11 of the controller. Use the ▲ or ▼ button to adjust the percentage value in the lower left hand corner of the display. The current measuring device should indicate the same level of current as shown at the lower right corner of the display.

7.8 Input/Output Status

Temperature Sensors State

This screen shows the state of the motor thermistors and RTD/PT100s.



NOTE
The use of RTDs is not supported by this product and this screen will always indicate 0 (ie Open) for RTDs A->G.

Digital I/O State

This screen shows the current status of the digital inputs and outputs.

The top line of the screen shows the start, stop, reset and programmable inputs A and B, then '00'. The screen shows input C23~C24 closed with all other inputs open.

The bottom line of the screen shows programmable output A, the fixed Run output, programmable outputs B and C, then '000'. The screen shows all outputs open.

Analog I/O State

This screen shows the current status of the Analog I/O.

NOTE
Input is not supported by this product and this screen will always indicate Input: - - - - %

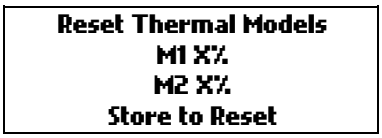
7.9 Reset Thermal Models

The soft starter's thermal modelling software constantly monitors the motor's performance. This allows the starter to calculate the motor's temperature and ability to start successfully at any time.

The thermal model for the active motor can be reset if required.

1. Open the Commissioning Menu.
2. Scroll to Reset Thermal Models and press ▶.
3. At the confirmation prompt press STORE to confirm or ◀ to cancel the action. You may have to enter your access code.
4. Select Reset and press ▶.

   Selecting Do Not Reset returns to previous screen.



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

CAUTION
Resetting the motor thermal model will compromise thermal model protection and may compromise motor life. Only reset the thermal model in an emergency.

7.10 Programming Menu

The Programming Menu lets you view and change programmable parameters that control how the MVE operates.

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

To open the Programming Menu, press the MENU button while viewing the monitoring screens.

To navigate through the Programming Menu:

- to scroll through parameter groups, press the ▲ or ▼ button.
- to open a submenu, press the ▶ button.
- to view the parameters in a group, press the ▶ button.
- to return to the previous level, press the ◀ button.
- to close the Programming Menu, press ◀ repeatedly.

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 15B.

To lock the programming menu:

1. Open the Programming Menu.
2. Open the Extended Menu.
3. Select 'Advanced'.
4. Enter the Access Code.
5. Select parameter 15B *Adjustment Lock*
6. Select and store 'Read Only'.

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

Access Denied Adj Lock is On

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 unit. 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 controller will return to the parameter list.
- to cancel changes, press **EXIT**. The controller will ask for confirmation, then return to the parameter list without saving changes.

Load/Save Settings

The Load/Save Settings menu requires an access code and allows users to:

- Load the MVE's parameters with default values
- Load parameter settings from an internal file
- Save the current parameter settings to an internal file

In addition to the factory default values file, the MVE can store two user-defined parameter files. These files contain default values until a user file is saved.

NOTE
Load defaults will not reset any changes to parameter group 20 'Restricted'.

To load or save settings:

1. Open the Programming Menu
2. Scroll to Load/Save Settings and press the ▶ button.
3. Scroll to the required function and press the ▶ button. Enter the access code when prompted.

Load Defaults Load Backup Load User Set 1

4. At the confirmation prompt, select YES to confirm or NO to cancel and then **STORE** to load/save the selection.

   When the action has been completed, the screen will briefly display a confirmation message, then return to the Load/Save Settings screen

Load Defaults No Yes

Access Code

Critical parameters (parameter group 15 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 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 controller will display an acknowledgement message before continuing.

Enter Access Code 0###
STORE
Access Allowed SUPERVISOR

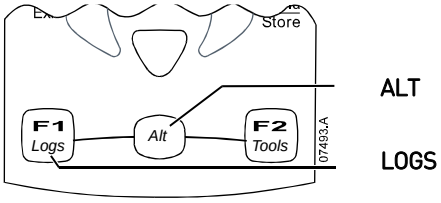
To change the access code, use parameter 15A.

7.11 Monitoring

Logs Menu

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

To open the Logs Menu, press **ALT** then **LOGS** 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 ◀ repeatedly.

• Trip Log

The Trip Log stores details of the eight most recent trips, including the date and time the trip happened. Trip 1 is the most recent and trip 8 is the oldest stored trip.

To open the Trip Log:

1. Press **ALT** then **LOGS** to open the Logs.
2. Scroll to Trip Log and press ▶.
3. Use the ▲ and ▼ buttons to select a trip to view, and press ▶ to display details.
4. Use the ▲ and ▼ buttons to scroll through available details.

To close the log and return to the main display, press ◀ repeatedly.

• Event Log

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

To open the Event Log:

1. Press **ALT** then **LOGS** to open the Logs.
2. Scroll to Event Log and press ▶.
3. Use the ▲ and ▼ buttons to select an event to view, and press ▶ to display details.

To close the log and return to the main display, press ◀ repeatedly.

• Starter Trip and Event Logger Software

The Starter Trip and Event Logger Software allows you to download the trip and event logs from the soft starter, for separate analysis.

The software is compatible with all AuCom medium voltage soft starters using control software version 1.29 or later.

For further information, or to download the software, visit www.aucom.com.

- **Performance Counters**

The performance counters store statistics on the starter's operation:

- Hours run (lifetime and since counter last reset)
- Number of starts (lifetime and since counter last reset)
- Motor kWh (lifetime and since counter last reset)
- Number of times the thermal model has been reset

The resettable counters (hours run, starts and motor kWh) can only be reset if the *Adjustment Lock* (parameter 15B) is set to Read & Write.

To view the counters:

1. Open the Logs Menu.
2. Scroll to Counters and press ▶.
3. Use the ▲ and ▼ buttons to scroll through the counters. Press ▶ to view details.
4. To reset a counter, press STORE (enter access code if required) then use the ▼ button to select Reset. Press STORE to confirm the action.

To close the counters and return to the main display, press the ◀ repeatedly.

7.12 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.

Start, Stop and Reset Commands

The soft starter can be controlled in three ways:

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

The LCL/RMT button controls whether the MVE will respond to local control (via the controller) or remote control (via the remote inputs).

The Local LED on the controller is on when the soft starter is in local control mode and off when the soft starter is in remote control mode.

Control via the fieldbus communication network is always enabled in local control mode, and can be enabled or disabled in remote control mode (parameter 6R *Comms in Remote*). Control via the serial communication network requires an optional communication module.

The STOP button on the controller is always enabled.

Using the Soft Starter to Control a Motor

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

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

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

To stop the motor with a coast to stop, regardless of the setting of parameter 2H *Stop Mode*, press the local STOP and RESET buttons at the same time. The soft starter will remove power from the motor and open the main contactor, and the motor will coast to stop.

Timed Voltage Ramp

Timed voltage ramp (TVR) soft starting ramps the application of voltage to the motor over a defined time period. The voltage ramp reduces the initial starting torque and slows the motor's rate of acceleration.

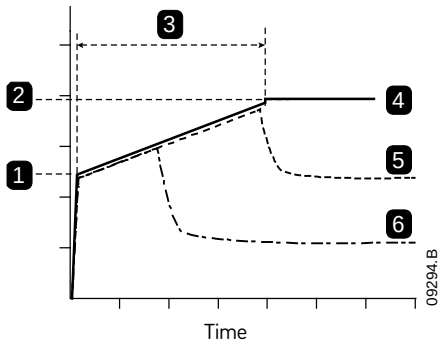
TVR starting can be useful for applications where multiple motors of different sizes are connected in parallel, and/or the loads are not mechanically linked.

NOTE
TVR soft starting is not suitable for high inertia loads (such as fans), which require a high level of voltage to accelerate the load.

NOTE
For multiple motors of the same sizes, and/or mechanically coupled loads, use constant current starting.

For a timed voltage ramp start, the following are typical values and can be adjusted to suit your specific application:

1. Add the FLC value of all the connected motors. Use this combined value to set parameter 1A *Motor Full Load Current*. (Note that the combined value must not exceed the starter rating.)
2. Set parameter 2C *Initial Current* to 100%, parameter 2D *Current Limit* to 600% and set the ramp time as required (parameter 2B *Start Ramp Time*).

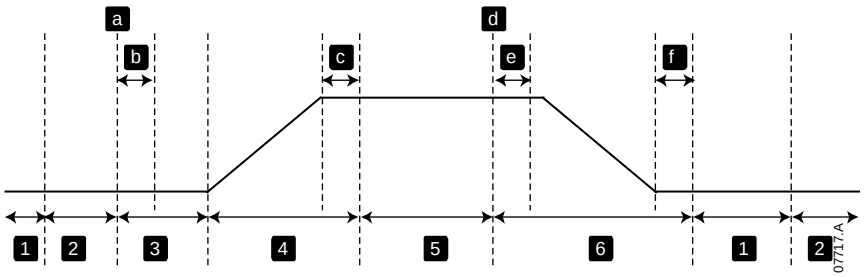


1: *Initial Current* (parameter 2C)
2: *Current Limit* (parameter 2D)
3: *Start Ramp Time* (parameter 2B)
4: Full voltage
5: Motor 1 current
6: Motor 2 current

Operating States

• Start and Run States

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



Starter State		Starter actions
1	Not ready	Control power is on. The starter may be in Restart Delay mode or waiting for the motor to cool down 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 a series of internal and external 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	Function
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 Not Ready state or 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 Not Ready or Ready state.

▪ Instantaneous Overcurrent Stage 2 trip

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

Motor Protection

• Motor, System and Soft Starter Protection Mechanisms

The MVE 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 4 Protection Settings to control the situation where the protections will activate and parameter group 16 Protection Action 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 coordination with the parameters of the soft starter.

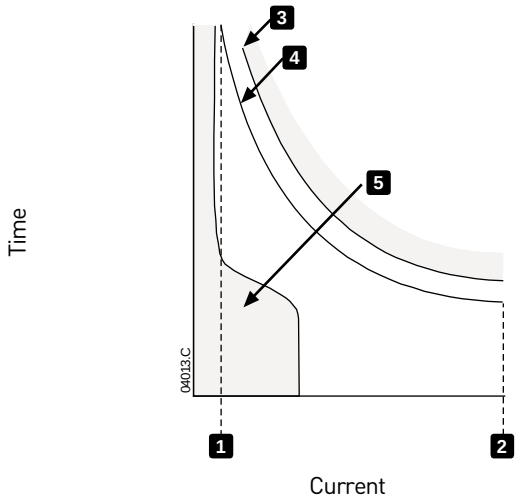
When using fuse and main contactors, set the upstream circuit breaker protection parameters according to the ratings for fuse and contactor. The contactor must not open if the current is above its maximum breaking current value. The fuse must act first or the upstream breakers instantaneous trip level must be less than the contactor's maximum breaking current level.

If using circuit breakers only, set the soft starter's maximum instantaneous trip time < 150 ms. Always use a suitable external protection relay with a circuit breaker to ensure instantaneous overcurrent trip functionality.

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

▪ Motor Overload Protection

The MVE offers thermal model motor overload protection which monitors the performance of the motor and calculates its temperature in all states. This protection is based on the motor information programmed in parameter groups 1 and 9, and the thermal model adjusts itself according to the motor's recent operating history (including temperature rise from previous operation).



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

• Motor Thermal Model Protection Set-up

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 1B *Locked Rotor Time*, 1C *Locked Rotor Current* and 1D *Motor Service Factor* according to the motor datasheet.
2. Use instantaneous overcurrent protection (parameters 4E, 4F) to provide protection for locked rotor situations. Refer to individual parameters for details.
3. Use instantaneous overcurrent protection stage 2 (parameters 4U, 4V) to trip circuit breaker or main contactor in the event of extreme overcurrent situations.

7.13 Standard Menu

The standard menu provides access to commonly used parameters, allowing the user to configure the MVE as required for the application. For details of individual parameters, refer to *Parameter Descriptions* on page 46.

1		**Motor Data-1**
	1A	*Motor Full Load Current*
2		**Start/Stop Modes-1**
	2A	*Start Mode*
	2B	*Start Ramp Time*
	2C	*Initial Current*
	2D	*Current Limit*
	2H	*Stop Mode*
	2I	*Stop Time*
3		**Auto-Start/Stop**
	3C	*Auto-Stop Type*
	3D	*Auto-Stop Time*
4		**Protection**
	4A	*Excess Start Time*
	4C	*Undercurrent*
	4D	*Undercurrent Delay*
	4E	*Instantaneous Overcurrent*
	4F	*Instantaneous Overcurrent Delay*
	4G	*Phase Sequence*
6		**Inputs**
	6A	*Input A Function*
	6B	*Input A Name*
	6C	*Input A Trip*
	6D	*Input A Trip Delay*
	6E	*Input A Initial Delay*
	6F	*Input B Function*
	6G	*Input B Name*
	6H	*Input B Trip*
	6I	*Input B Trip Delay*
	6J	*Input B Initial Delay*
7		**Outputs**
	7A	*Relay A Function*
	7B	*Relay A On Delay*
	7C	*Relay A Off Delay*
	7D	*Relay B Function*
	7E	*Relay B On Delay*
	7F	*Relay B Off Delay*
	7G	*Relay C Function*
	7H	*Relay C On Delay*
	7I	*Relay C Off Delay*
	7M	*Low Current Flag*
	7N	*High Current Flag*
	7O	*Motor Temperature Flag*

8		**Display**
	8A	*Language*
	8B	*F1 Button Action*
	8C	*F2 Button Action*
	8D	*Display A or kW*
	8E	*User Screen - Top Left*
	8F	*User Screen - Top Right*
	8G	*User Screen - Bottom Left*
	8H	*User Screen - Bottom Right*

7.14 Extended Menu

The extended menu gives access to all of the MVE's programmable parameters.

1		**Motor Data-1**
	1A	*Motor Full Load Current*
	1B	*Locked Rotor Time*
	1C	*Locked Rotor Current*
	1D	*Motor Service Factor*
2		**Start/Stop Modes-1**
	2A	*Start Mode*
	2B	*Start Ramp Time*
	2C	*Initial Current*
	2D	*Current Limit*
	2E	*Reserved*
	2F	*Kickstart Time*
	2G	*Kickstart Level*
	2H	*Stop Mode*
	2I	*Stop Time*
3		**Auto-Start/Stop**
	3A	*Reserved*
	3B	*Reserved*
	3C	*Auto-Stop Type*
	3D	*Auto-Stop Time*
4		**Protection**
	4A	*Excess Start Time*
	4B	*Excess Start Time-2*
	4C	*Undercurrent*
	4D	*Undercurrent Delay*
	4E	*Instantaneous Overcurrent*
	4F	*Instantaneous Overcurrent Delay*
	4G	*Phase Sequence*
	4H	*Current Imbalance*
	4I	*Current Imbalance Delay*
	4J	*Frequency Check*
	4K	*Frequency Variation*
	4L	*Frequency Delay*
	4M	*Restart Delay*
	4N	*Motor Temperature Check*
	4O	*Ground Fault Level*

	4P	*Ground Fault Delay*
	4Q	*Undervoltage*
	4R	*Undervoltage Delay*
	4S	*Overvoltage*
	4T	*Overvoltage Delay*
	4U	*Instantaneous Overcurrent S2*
	4V	*Instantaneous Overcurrent Delay S2*
5		**Auto-Reset Trips (*Reserved*)**
	5A	*Reserved*
6		**Inputs**
	6A	*Input A Function*
	6B	*Input A Name*
	6C	*Input A Trip*
	6D	*Input A Trip Delay*
	6E	*Input A Initial Delay*
	6F	*Input B Function*
	6G	*Input B Name*
	6H	*Input B Trip*
	6I	*Input B Trip Delay*
	6J	*Input B Initial Delay*
	6K	*Reserved*
	6L	*Reserved*
	6M	*Remote Reset Logic*
	6N	*Reserved*
	6O	*Reserved*
	6P	*Reserved*
	6Q	*Local/Remote*
	6R	*Comms in Remote*
7		**Outputs**
	7A	*Relay A Function*
	7B	*Relay A On Delay*
	7C	*Relay A Off Delay*
	7D	*Relay B Function*
	7E	*Relay B On Delay*
	7F	*Relay B Off Delay*
	7G	*Relay C Function*
	7H	*Relay C On Delay*
	7I	*Relay C Off Delay*
	7J	*Reserved*
	7K	*Reserved*
	7L	*Reserved*
	7M	*Low Current Flag*
	7N	*High Current Flag*
	7O	*Motor Temperature Flag*
	7P	*Analog Output A*
	7Q	*Analog A Scale*
	7R	*Analog A Maximum Adjustment*
	7S	*Analog A Minimum Adjustment*

	7T	*Reserved*
	7U	*Reserved*
	7V	*Reserved*
	7W	*Reserved*
8		**Display**
	8A	*Language*
	8B	*F1 Button Action*
	8C	*F2 Button Action*
	8D	*Display A or kW*
	8E	*User Screen - Top Left*
	8F	*User Screen - Top Right*
	8G	*User Screen - Bottom Left*
	8H	*User Screen - Bottom Right*
	8I	*Graph Data*
	8J	*Graph Timebase*
	8K	*Graph Maximum Adjustment*
	8L	*Graph Minimum Adjustment*
	8M	*Mains Reference Voltage*
9		**Motor Data-2**
	9A	*Reserved*
	9B	*Motor FLC-2*
	9C	*Reserved*
	9D	*Reserved*
	9E	*Reserved*
10		**Start/Stop Modes-2**
	10A	*Start Mode-2*
	10B	*Start Ramp-2*
	10C	*Initial Current-2*
	10D	*Current Limit-2*
	10E	*Reserved*
	10F	*Kickstart Time-2*
	10G	*Kickstart Level-2*
	10H	*Stop Mode-2*
	10I	*Stop Time-2*
11		**RTD/PT100 (*Reserved*)**
	11A	*Reserved*
12		**Slip-Ring Motors**
	12A	*Motor Data-1 Ramp*
	12B	*Motor Data-2 Ramp*
	12C	*Changeover Time*
	12D	*Slip Ring Retard*
15		**Advanced**
	15A	*Access Code*
	15B	*Adjustment Lock*
	15C	*Emergency Run*
16		**Protection Action**
	16A	*Motor Overload*
	16B	*Excess Start Time*

16C	*Undercurrent*
16D	*Instantaneous Overcurrent*
16E	*Current Imbalance*
16F	*Frequency*
16G	*Input A Trip*
16H	*Input B Trip*
16I	*Motor Thermistor*
16J	*Starter Communication*
16K	*Network Communication*
16L	*Reserved*
16M	*Battery/Clock*
16N	*Ground Fault*
16O	*Reserved*
16P	*Reserved*
16Q	*Reserved*
16R	*Reserved*
16S	*Reserved*
16T	*Reserved*
16U	*Reserved*
16V	*Undervoltage*
16W	*Overvoltage*

7.15 Parameter Descriptions

1 Motor Data-1

The parameters in Motor Data-1 configure the soft starter to match the connected motor. These parameters describe the motor's operating characteristics and allow the soft starter to model the motor's temperature.

1A – Motor FLC

Range: 5 - 1200 A **Default:** 100 A

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

1B – Locked Rotor Time

Range: 0:01 - 0:40 (minutes:seconds) **Default:** 10 seconds

Description: Sets the maximum length of time the motor can sustain locked rotor current from cold before reaching its maximum temperature. Set according to the motor datasheet.

1C – Locked Rotor Current

Range: 400% - 700% FLC **Default:** 600%

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

1D – Motor Service Factor

Range: 100% - 120% **Default:** 105%

Description: Sets the motor service factor used by the thermal model. If the motor runs at full load current, it will reach 100%. Set according to the motor datasheet.

2 Start/Stop Modes-1

2A – Start Mode

Options: Constant Current (default)

Description: Selects the soft start mode.

2B – Start Ramp Time

Range: 0:01 - 3.00 (minutes:seconds) **Default:** 1 second

Description: Sets the ramp time for current ramp starting (from the initial current to the current limit).

2C – Initial Current

Range: 50% - 600% FLC **Default:** 400%

Description: Sets the initial start current level for current ramp starting, as a percentage of motor full load current. Set so that the motor begins to accelerate immediately after a start is initiated.
If current ramp starting is not required, set the initial current equal to the current limit.

2D – Current Limit

Range: 50% - 600% FLC **Default:** 400%

Description: Sets the current limit for constant current and current ramp soft starting, as a percentage of motor full load current.

2E – Reserved

Description: This parameter is reserved for future use.

2F – Kickstart Time

Range: 0 – 2000 milliseconds **Default:** 0000 milliseconds

Description: Sets the kickstart duration. A setting of 0 disables kickstart.

2G – Kickstart Level

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

Description: Sets the level of the kickstart current.

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

2H – Stop Mode

Options: Coast To Stop (default)
TVR Soft Stop

Description: Selects the stop mode.

2I – Stop Time

Range: 0:00 - 4:00 (minutes:seconds) **Default:** 0 second

Description: Sets the time for soft stopping the motor using timed voltage ramp.
If a main contactor is installed, the contactor must remain closed until the end of the stop time.

3 Auto-Stop

The MVE can be programmed to stop automatically, after a specified delay or at a specified time of day.

WARNING
This function should not be used in conjunction with remote two-wire control.
The soft starter will still accept start and stop commands from the remote inputs or serial communication network. To disable local or remote control, use parameter 6Q.

3A, 3B – Reserved

Description: These parameters are reserved for future use.

3C – Auto-Stop Type

Options:	Off (default)	The soft starter will not auto-stop.
	Timer	The soft starter will auto-stop after a delay from the next start, as specified in parameter 3D.
	Clock	The soft starter will auto-stop at the time programmed in parameter 3D.

Description: Selects whether the soft starter will auto-stop after a specified delay, or at a time of day.

3D – Auto-Stop Time

Range: 00:01 - 24:00 (hours:minutes) **Default:** 1 minute

Description: Sets the time for the soft starter to auto-stop, in 24 hour clock format.

4 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 Action settings. The default response is a trip.

CAUTION

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.

4A – Excess Start Time

Excess start time is the maximum time the MVE will attempt to start the motor. If the motor does not transition to Run mode within the programmed limit, the starter will trip. Set for a period slightly longer than required for a normal healthy start. A setting of 0 disables excess start time protection.

Range: 0:00 - 2:00 (minutes:seconds) **Default:** 20 seconds

Description: Set as required.

4B – Excess Start Time-2

Range: 0:00 - 2:00 (minutes:seconds) **Default:** 20 seconds

Description: Set as required.

4C – Undercurrent

Range: 0% - 100% **Default:** 20%

Description: Sets the trip point for undercurrent protection, as a percentage of motor full load current. Set to a level between the motor's normal working range and the motor's magnetising (no load) current (typically 25% to 35% of full load current). A setting of 0% disables undercurrent protection.

4D – Undercurrent Delay

Range: 0:00 - 4:00 (minutes:seconds) **Default:** 5 seconds

Description: Slows the MVE's response to undercurrent, avoiding trips due to momentary fluctuations.

4E, 4F – Instantaneous Overcurrent

The MVE can be configured to trip if the average current of all three phases exceeds a specified level while the motor is running.

Refer to *4U, 4V – Instantaneous Overcurrent Stage 2* on page 50 for more information and examples.

Parameter 4E *Instantaneous Overcurrent*

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

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

Parameter 4F *Instantaneous Overcurrent Delay*

Range: 0:00 - 1:00 (minutes:seconds) **Default:** 0 second

Description: Slows the MVE's response to overcurrent, avoiding trips due to momentary overcurrent events.

NOTE

This protection is only active during run and must be coordinated with *Instantaneous Overcurrent Stage 2* (parameters 4U, 4V).

4G – Phase Sequence

Options: Any Sequence
Positive Only (default)
Negative Only

Description: Selects which phase sequences the soft starter will allow at a start. During its pre-start checks, the starter examines the sequence of the phases at its input terminals and trips if the actual sequence does not match the selected option.

4H – Current Imbalance

Range: 10% - 50% **Default:** 30%

Description: Sets the trip point for current imbalance protection.

4I – Current Imbalance Delay

Range: 0:00 - 4:00 (minutes:seconds) **Default:** 5 seconds

Description: Slows the MVE's response to current imbalance, avoiding trips due to momentary fluctuations.

NOTE
The MVE will display a Current Imbalance trip only when phase loss at the supply terminals occurs during Run mode. When a phase loss occurs during other modes of operation, the MVE will trip on Motor Connection.

4J – Frequency Check

Options: Do Not Check
Start Only
Start/Run
Run Only (default)

Description: Determines when and if the starter will monitor for a frequency trip.

4K – Frequency Variation

Options: ± 2 Hz
± 5 Hz (default)
± 10 Hz
± 15 Hz

Description: Selects the soft starter's tolerance for frequency variation.

4L – Frequency Delay

Range: 0:01 - 4:00 (minutes:seconds) **Default:** 5 seconds

Description: Slows the MVE's response to frequency disturbances, avoiding trips due to momentary fluctuations.

NOTE
If the mains frequency drops below 35 Hz or rises above 75 Hz, the starter will trip immediately, irrespective of the settings for Frequency Trip parameters.

4M – Restart Delay

Range: 00:01 - 60:00 (minutes:seconds) **Default:** 30 minutes

Description: The MVE can be configured to force a delay 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.

4N – Motor Temperature Check

Options: Do Not Check (default)
Check

Description: Selects whether the MVE will verify the motor has sufficient thermal capacity for a successful start. The soft starter compares the motor's calculated temperature with the temperature rise from the last motor start and only operates if the motor is cool enough to start successfully.

4O – Ground Fault Level

Range: 1 A - 40 A **Default:** 1 A

Description: Sets the trip point for ground fault protection. Ground fault is a dynamic trip based on phase current measurements every half-cycle.

4P – Ground Fault Delay

Range: 0:01 - 4:00 (minutes:seconds) **Default:** 3 seconds

Description: Slows the MVE's response to ground fault variation, avoiding trips due to momentary fluctuations.

NOTE

Ground fault accuracy is within ± 1 A of the set value.

4Q – Undervoltage Level

Range: 100 – 18000 V **Default:** 100 V

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

4R – Undervoltage Trip Delay

Range: 0:00 – 4:00 (minutes:seconds) **Default:** 5 seconds

Description: Slows the MVE's response to undervoltage, avoiding trips due to momentary fluctuations.

4S – Overvoltage Level

Range: 100 – 18000 V **Default:** 7200 V

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

4T – Overvoltage Trip Delay

Range: 0:00 – 4:00 (minutes:seconds) **Default:** 5 seconds

Description: Slows the MVE's response to overvoltage, avoiding trips due to momentary fluctuations.

4U, 4V – Instantaneous Overcurrent Stage 2

The MVE has two instantaneous trip functions, stage 1 and 2. These protection functions are configured to be complementary.

Stage 1 must be configured to protect the motor against a locked rotor (shearpin) situation during run mode. Stage 1 should trigger at lower current/higher time values than Stage 2.

Stage 2 must be configured to protect the main switching device. When Stage 2 triggers, the starter opens the main switching device.

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 until the fuse ruptures.

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

Parameter 4U *Instantaneous Overcurrent S2*

Range: 30 A – 4400 A **Default:** 4400 A

Description: Sets the trip point for instantaneous overcurrent stage 2 protection in amperes. Set as required.

Parameter 4V *Instantaneous Overcurrent Delay S2*

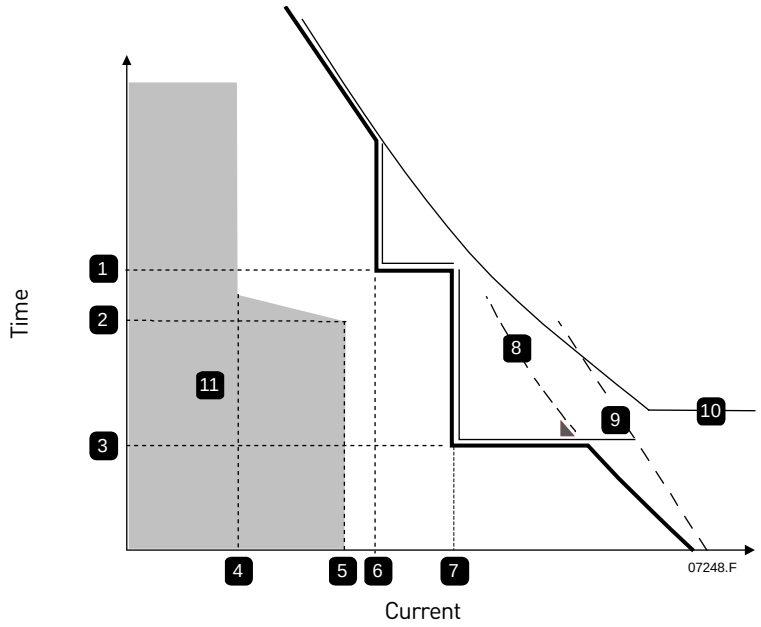
Range: 10 – 1000 ms **Default:** 10 milliseconds

Description: Sets the duration required for current to exceed the level set in parameter 4U before a trip occurs. Set as required.

NOTE

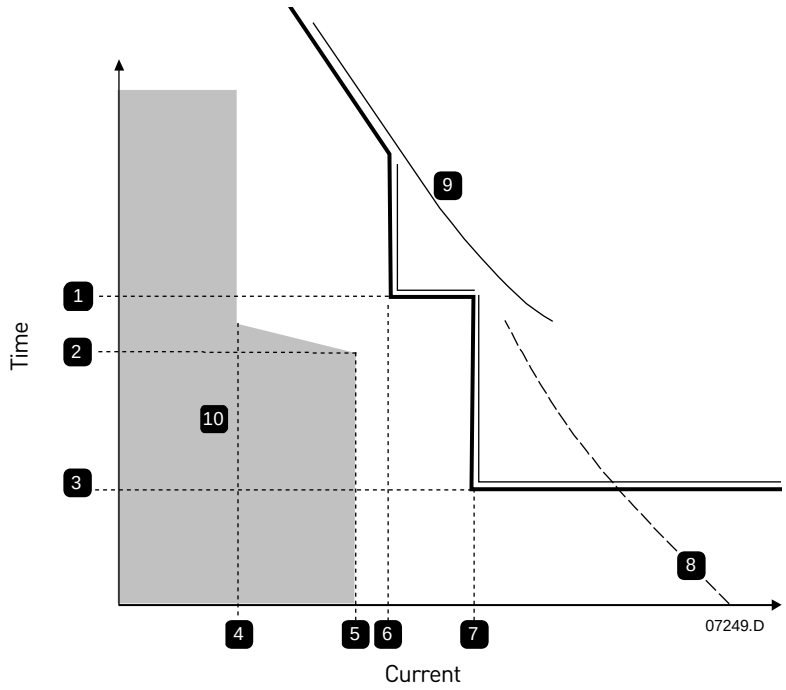
This protection is active during starting, running and stopping. It must be coordinated with *Instantaneous Overcurrent* (parameters 4E, 4F).

Example: Contactor and Fuse



1	Instantaneous Overcurrent Delay - Stage 1 (4F)
2	Motor start time
3	Instantaneous Overcurrent Delay - Stage 2 (4V)
4	FLC
5	Motor start current
6	Instantaneous Overcurrent- Stage 1 (4E)
7	Instantaneous Overcurrent - Stage 2 (4U) to trip external upstream breaker
8	Fuse
9	SCR
10	Thermal model curve
11	Motor operation (shaded area of graph)

Example: Circuit Breaker



1	Instantaneous Overcurrent Delay - Stage 1 (4F)
2	Motor start time
3	Instantaneous Overcurrent Delay - Stage 2 (4V)
4	FLC
5	Motor start time
6	Instantaneous Overcurrent -Stage 1 (4E)
7	Instantaneous Overcurrent -Stage 2 (4U) to trip main breaker
8	SCR
9	Thermal model curve
10	Motor operation (shaded area of graph)

5 Auto-Reset Trips (Reserved)

This parameter group is reserved for future use.

6 Inputs

The MVE has two programmable inputs, which allow remote control of the soft starter.

6A – Input A Function

Options:	Motor Set Select	The MVE can be configured with two separate sets of motor data. To use the secondary motor data, parameter 6A must be set to 'Motor Set Select' and C53, C54 must be closed when a start command is given. The MVE checks which motor data to use at a start, and will use that motor data for the entire start/stop cycle.
	Input Trip (N/O) (default)	Input A can be used to trip the soft starter. When parameter 6A is set to Input Trip (N/O), a closed circuit across C53, C54 trips the soft starter. (Refer to parameters 6C, 6D, 6E)
	Input Trip (N/C)	When parameter 6A is set to Input Trip (N/C), an open circuit across C53, C54 trips the soft starter. (Refer to parameters 6C, 6D, 6E)
	Local/Remote Select	Input A can be used to select between local and remote control, instead of using the **LCL/RMT** button on the controller. When the input is open, the starter is in local mode and can be controlled via the controller. When the input is closed, the starter is in remote mode. The **START** and **LCL/RMT** buttons are disabled, and the soft starter will ignore any Local/Remote select command from the serial communications network. To use Input A to select between local and remote control, parameter 6Q must be set to 'LCL/RMT Anytime' or 'LCL/RMT When Off'.
	Emergency Run	In emergency run the soft starter continues to run until stopped, ignoring all trips and warnings (refer to parameter 15C for details). Closing the circuit across C53, C54 activates emergency run. Opening the circuit ends emergency run and the MVE stops the motor.
	Starter Disable	The MVE can be disabled via the control inputs. An open circuit across C53, C54 will disable the starter. The MVE will not respond to start commands. If running, the soft starter will allow the motor to coast to stop, ignoring the soft stop mode set in parameter 2H.
Description:	Selects the function of Input A.	

6B – Input A Name

Options:	Input Trip (default)	Controller
	Low Pressure	PLC
	High Pressure	Vibration
	Pump Fault	Field Trip
	Low Level	Interlock Trip
	High Level	Motor Temp
	No Flow	Motor Prot
	Starter Disable	Feeder Prot
Description:	Selects a message for the controller to display when Input A is active.	

6C – Input A Trip

Options:	Always Active (default)	A trip can occur at any time when the soft starter is receiving power.
	Operating Only	A trip can occur while the soft starter is running, stopping or starting.
	Run Only	A trip can only occur while the soft starter is running.
Description:	Selects when an input trip can occur.	

6D – Input A Trip Delay

Range:	0:00 - 4:00 (minutes:seconds)	**Default:**	0 second
Description:	Sets a delay between the input activating and the soft starter tripping.		

6E – Input A Initial Delay

Range: 00:00 - 30:00 (minutes:seconds) **Default:** 0 second

Description: Sets a delay before an input trip can occur, after the soft starter has entered the state selected in 6C.

6F, 6G, 6H, 6I, 6J – Input B Trip

Parameters 6F~6J configure the operation of Input B, in the same way as parameters 6A~6E configure Input A. Refer to Input A for details.

- 6F *Input B Function* (**Default:** Input Trip (N/O))
- 6G *Input B Name* (**Default:** Input Trip)
- 6H *Input B Trip* /**Default:** Always Active)
- 6I *Input B Trip Delay* (**Default:** 0:00)
- 6J *Input B Initial Delay* (**Default:** 0:00)

6K, 6L – Reserved

These parameters are reserved for future use.

6M – Remote Reset Logic

Options: Normally Closed (default)
Normally Open

Description: Selects whether the MVE's remote reset input (terminals C41, C42) is normally open or normally closed.

6N, 6O, 6P – Reserved

These parameters are reserved for future use.

6Q – Local/Remote

Options:	LCL/RMT Anytime (default)	**LCL/RMT** button is always enabled.
	LCL/RMT When Off	**LCL/RMT** button is enabled when the starter is off.
	Local Control Only	The **LCL/RMT** button and remote start/stop inputs are disabled.
	Remote Control Only	The **START** and **LCL/RMT**) buttons are disabled.

Description: Selects when the **LCL/RMT** button can be used to switch between local and remote control, and enables or disables the local control buttons and remote control inputs.
The **STOP** button on the controller is always enabled.
The reset input and **RESET** button on the controller are always enabled.

WARNING
The **STOP** button on the controller is always enabled. When using two-wire remote control, the soft starter will restart if the remote start/stop and reset inputs are still active.

6R – Comms in Remote

Options: Disable Control in RMT
Enable Control in RMT (default)

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

7 Outputs

The MVE has three programmable outputs, which can be used to signal different operating conditions to associated equipment.

7A – Relay A Function

Options:	Off	Relay A is not used.
	Main Contactor (default)	The relay closes when the MVE receives a start command, and remains closed as long as the motor is receiving voltage.
	Run	The relay closes when the starter changes to run state.
	Trip	The relay closes when the starter trips (refer to parameter 16A to 16X).
	Warning	The relay closes when the starter issues a warning (refer to parameter 16A to 16X).
	Low Current Flag	The relay closes when the low current flag activates while the motor is running (refer to parameter 7M *Low Current Flag*).
	High Current Flag	The relay closes when the high current flag activates while the motor is running (refer to parameter 7N *High Current Flag*).
	Motor Temperature Flag	The relay closes when the motor temperature flag activates (refer to parameter 7O *Motor Temperature Flag*).
	Input A Trip	The relay closes when Input A activates to trip the soft starter.
	Input B Trip	The relay closes when Input B activates to trip the soft starter.
	Motor Overload	The relay closes when the starter trips on Motor Overload.
	Current Imbalance	The relay closes when the starter trips on Current Imbalance.
	Undercurrent	The relay closes when the starter trips on Undercurrent.
	Instantaneous overcurrent	The relay closes when the starter trips on Instantaneous Overcurrent.
	Frequency	The relay closes when the starter trips on Frequency.
	Ground Fault	The relay closes when the starter trips on Ground Fault.
	Heatsink Overtemperature	Not applicable
	Phase Loss	The relay closes when the starter trips on Phase Loss.
	Motor Thermistor	The relay closes when the starter trips on Motor Thermistor.
	Changeover Contactor	The relay closes when the high rotor resistance current ramp has reached full voltage, allowing use with a slip-ring motor.
	Undervoltage	The relay closes when the mains voltage drops below the level set in parameter 4Q.
	Ready	The relay closes when the starter transitions into Ready mode.
	Local	The relay is open when the starter is in local control mode, and closed in remote control mode.

Description: Selects the function of Relay A (normally open).

7B – Relay A On Delay

Range: 0:00 - 5:00 (minutes:seconds) **Default:** 0 second

Description: Sets the delay for closing Relay A.

7C – Relay A Off Delay

Range: 0:00 - 5:00 (minutes:seconds) **Default:** 0 second

Description: Sets the delay for re-opening Relay A.

7D~7I – Output Relays B and C

Parameters 7D~7I configure the operation of Relays B and C in the same way as parameters 7A~7C configure Relay A. Refer to Relay A for details.

Relay B is a changeover relay.

- 7D *Relay B Function* **Default:** Run
- 7E *Relay B On Delay* **Default:** 0 second
- 7F *Relay B Off Delay* **Default:** 0 second

Relay C is a changeover relay.

- 7G *Relay C Function* **Default:** Trip
- 7H *Relay C On Delay* **Default:** 0 second
- 7I *Relay C Off Delay* **Default:** 0 second

7J, 7L – Reserved

These parameters are reserved for future use.

7M – Low Current Flag

The MVE has low and high current flags to give early warning of abnormal operation. The current flags can be configured to indicate an abnormal current level during operation, between the normal operating level and the undercurrent or instantaneous overcurrent trip levels. The flags can signal the situation to external equipment via one of the programmable outputs.

The flags clear when the current returns within the normal operating range by 10% of the programmed flag value.

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

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

7N – High Current Flag

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

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

7O – Motor Temperature Flag

The MVE has a motor temperature flag to give early warning of abnormal operation. The flag can indicate that the motor is operating above its normal operating temperature but lower than the overload limit. The flag can signal the situation to external equipment via one of the programmable outputs.

Range: 0% - 160% **Default:** 80%

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

7P, 7Q, 7R, 7S – Analog Output A

The MVE has an analog output, which can be connected to associated equipment to monitor motor performance.

Parameter 7P *Analog Output A*

Options:

Current (% FLC) (default)	Current as a percentage of motor full load current.
Motor Temp (%)	Motor temperature as a percentage of the motor rated current (calculated by the soft starter's thermal model).
Motor kW (%)	Motor kilowatts. 100% is motor FLC (parameter 1A) multiplied by mains voltage. Power factor is assumed to be 1.0. $\frac{\sqrt{3} \cdot V \cdot I_{FLC} \cdot pf}{1000}$
Motor kVA (%)	Motor kilovolt amperes. 100% is motor FLC (parameter 1A) multiplied by mains voltage. $\frac{\sqrt{3} \cdot V \cdot I_{FLC}}{1000}$
Motor pf	Motor power factor, measured by the soft starter.
Voltage (%Mains)	The average voltage measured on three phases as a percentage of the mains voltage.

Description: Selects which information will be reported via Analog Output A.

Parameter 7Q *Analog A Scale*

Range: 0-20 mA
4-20 mA (default)

Description: Selects the range of the analog output.

Parameter 7R *Analog A Maximum Adjustment*

Range: 0% - 600% **Default:** 100%

Description: Calibrates the upper limit of the analog output to match the signal measured on an external current measuring device.

Parameter 7S *Analog A Minimum Adjustment*

Range: 0% - 600% **Default:** 0%

Description: Calibrates the lower limit of the analog output to match the signal measured on an external current measuring device.

7T~7W – Reserved

These parameters are reserved for future use.

8 Display

These parameters allow the controller to be tailored to individual users' requirements.

8A – Language

Options:

English (default)	Português
Chinese	Français
Español	Italiano
Deutsch	Russian

Description: Selects which language the controller will use to display messages and feedback.

8B, 8C – F1 and F2 Button Action

Options: None
Setup Auto-Start/Stop

Description: Selects the function of the **F1** and **F2** buttons on the controller.

- 8B *F1 Button Action* **Default:** Setup Auto-Start/Stop
- 8C *F2 Button Action* **Default:** None

8D – Display A or kW

Options: Current (default)
Motor kW

Description: Selects whether the MVE will display current (amperes) or motor kilowatts on the main monitoring screen.

8E, 8F, 8G, 8H – User-Programmable Screen

Options:

Blank	Displays no data in the selected area, allowing long messages to be shown without overlapping.
Starter State	The starter's operating state (starting, running, stopping or tripped). Only available for top left and bottom left positions on the screen.
Motor Current	The average current measured on three phases.
Motor pf	The motor's power factor, measured by the soft starter.
Mains Frequency	The average frequency measured on three phases.
Motor kW	The motor's running power in kilowatts.
Motor HP	The motor's running power in horsepower.
Motor Temp	The motor's temperature, calculated by the thermal model.
kWh	The number of kilowatt hours the motor has run via the soft starter.
Hours Run	The number of hours the motor has run via the soft starter.
Analog Input	n/a
Mains Voltage	The average voltage measured on three phases.

Description: Selects which information will be displayed on the programmable monitoring screen.

- 8E *User Screen - Top Left* **Default:** Starter State
- 8F *User Screen - Top Right* **Default:** Blank
- 8G *User Screen - Bottom Left* **Default:** kWh
- 8H *User Screen - Bottom Right* **Default:** Hours Run

8I, 8J, 8K, 8L – Performance Graphs

The MVE has a real-time performance graph to report the behaviour of critical operating parameters.

Parameter 8I *Graph Data*

Options:	Current (% FLC) (default)	Current as a percentage of motor full load current.
	Motor Temp (%)	Motor temperature as a percentage of the motor rated current (calculated by the soft starter's thermal model).
	Motor kW (%)	Motor kilowatts. 100% is motor FLC (parameter 1A) multiplied by mains voltage. Power factor is assumed to be 1.0. $\frac{\sqrt{3} \cdot V \cdot I_{FLC} \cdot pf}{1000}$
	Motor kVA (%)	Motor kilovolt amperes. 100% is motor FLC (parameter 1A) multiplied by mains voltage. $\frac{\sqrt{3} \cdot V \cdot I_{FLC}}{1000}$
	Motor pf	Motor power factor, measured by the soft starter.
	Voltage (%Mains)	The average voltage measured on three phases as a percentage of the mains voltage.

Description: Selects which information the graph will display.

Parameter 8J *Graph Timebase*

Options:	10 seconds	10 minutes
	30 seconds	30 minutes
	1 minute (default)	1 hour
	5 minutes	

Description: Sets the graph time scale. The graph will progressively replace the old data with new data.

Parameter 8K *Graph Maximum Adjustment*

Range: 0% – 600% **Default:** 400%

Description: Adjusts the upper limit of the performance graph.

Parameter 8L *Graph Minimum Adjustment*

Range: 0% – 600% **Default:** 0%

Description: Adjusts the lower limit of the performance graph.

8M – Mains Reference Voltage

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

Description: Provides the reference voltage for the analog output and performance graphs.

9 Motor Data-2

The MVE can support two different starting and stopping motor data sets.

To select the secondary motor data set, a programmable input must be configured to parameter set selection (parameters 6A and 6F) and the input must be active when the soft starter receives a start signal.

NOTE

You can only choose which motor data set to use while the soft starter is stopped.

9A ~ 9E – Secondary Motor Settings

Parameter 9A *Reserved*

This parameter is reserved for future use.

Parameter 9B *Motor FLC-2*

Range: 5 - 1000 A **Default:** 100 A

Description: Sets the secondary motor's full load current.

Parameter 9C *Reserved*

This parameter is reserved for future use.

Parameter 9D *Reserved*

This parameter is reserved for future use.

Parameter 9E *Reserved*

This parameter is reserved for future use.

10 Start/Stop-2

10A ~ 10I – Start/Stop-2

Refer to Start/Stop-1 (parameters 2A~2I) for details.

Parameter 10A *Start Mode-2*

Options: Constant Current (default)

Description: Selects the soft start mode.

Parameter 10B *Start Ramp-2*

Range: 0:01 - 3.00 (minutes:seconds) **Default:** 1 second

Description: Sets the ramp time for current ramp starting (from the initial current to the current limit).

Parameter 10C *Initial Current-2*

Range: 50% - 600% **Default:** 400%

Description: Sets the initial start current level for current ramp starting, as a percentage of motor full load current. Set so that the motor begins to accelerate immediately after a start is initiated.
If current ramp starting is not required, set the initial current equal to the current limit.

Parameter 10D *Current Limit-2*

Range: 50% - 600% FLC **Default:** 400%

Description: Sets the current limit for constant current and current ramp soft starting, as a percentage of motor full load current.

Parameter 10E *Reserved*

Description: This parameter is reserved for future use.

Parameter 10F *Kickstart Time-2*

Range: 0 - 2000 (milliseconds) **Default:** 0000 milliseconds

Description: Sets the kickstart duration. A setting of 0 disables kickstart.

Parameter 10G *Kickstart Level-2*

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

Description: Sets the level of the kickstart current.

Parameter 10H *Stop Mode-2*

Options: Coast To Stop (default)
TVR Soft Stop

Description: Selects the stop mode.

Parameter 10I *Stop Time-2*

Range: 0:00 - 4:00 (minutes:seconds) **Default:** 0 second

Description: Sets the stop time.

11 RTD/PT100 (Reserved)

This parameter group is reserved for future use.

12 Slip-Ring Motors

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

12A – Motor 1 Ramp

Options: Single Ramp (default)
Dual Ramp

Description: Selects whether to use a single or dual current ramp profile for soft starting. Set to single ramp for non-slip ring induction motors, or dual ramp for slip-ring induction motors.

12B – Motor 2 Ramp

Options: Single Ramp (default)
Dual Ramp

Description: Selects whether to use a single or dual current ramp profile for soft starting. Set to single ramp for non-slip ring induction motors, or dual ramp for slip-ring induction motors.
Parameter 12B selects the ramp configuration for the secondary motor.

12C – Changeover 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. Set so that the contactor has enough time to close, but the motor does not slow down.
Parameter 12C only applies if parameter 12A or 12B is set to 'Dual Ramp', and an output relay is set to 'Changeover Contactor'.

12D – Slip-Ring Retard

Range: 10% - 90% **Default:** 50%

Description: Sets the level of conduction after the rotor resistance contactor closes, as a percentage of full conduction. Set so that no current pulse occurs, but the motor retains enough speed to start correctly.

15 Advanced

15A – Access Code

Range: 0000 - 9999 **Default:** 0000

Description: Sets the access code to control access to restricted sections of the menus.
Use the ◀ and ▶ buttons to select which digit to alter and use the ▲ and ▼ buttons to change the value. After the last digit is set press **STORE**.

NOTE
In the event of a lost access code, contact your supplier for master access code that allows you to re-program a new access code.

15B – Adjustment Lock

Options:	Read & Write (default)	Allows users to alter parameter values in the Programming Menu.
	Read Only	Prevents users altering parameter values in the Programming Menu. Parameter values can still be viewed.

Description: Selects whether the controller will allow parameters to be changed via the Programming Menu.

15C – Emergency Run

Options: Disable (default)
Enable

Description: Selects whether the soft starter will permit emergency run operation. In emergency run, the soft starter will start (if not already running) and continue to operate until emergency run ends, ignoring stop commands and trips.
Emergency run is controlled using a programmable input.

CAUTION

Continued use of Emergency Run is not recommended. Emergency Run may compromise the starter life as all protections and trips are disabled.

Using the starter in 'Emergency Run' mode will void the product warranty.

16 Protection Action

These parameters define how the soft starter will respond to different protection events. The soft starter can trip, issue a warning, or ignore different protection events as required. All protection events are written to the event log. The default action for all protections is to trip the soft starter.

CAUTION

Defeating the protection may compromise the starter and motor, and should only be done in the case of emergency.

16A~16W – Protection Actions

Options: Trip Starter (default)
Warn and Log
Log Only

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

- 16A *Motor Overload*
- 16B *Excess Start Time*
- 16C *Undercurrent*
- 16D *Instantaneous Overcurrent*
- 16E *Current Imbalance*
- 16F *Frequency*
- 16G *Input A Trip*
- 16H *Input B Trip*
- 16I *Motor Thermistor*
- 16J *Starter Communication*
- 16K *Network Communication*
- 16L *Reserved*
- 16M *Battery/Clock*
- 16N *Ground Fault*
- 16O~16U *Reserved*
- 16V *Undervoltage*
- 16W *Overvoltage*

20 Restricted

These parameters are restricted for Factory use and are not available to the user.

8. Commissioning

There are three main stages when commissioning the MVE:

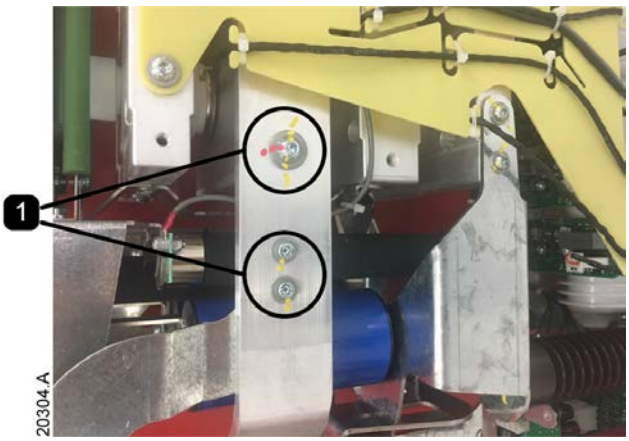
1. Physical checks - mechanical assemblies (power assembly and enclosure)
2. Physical checks - electrical assemblies (power supplies and subsystem)
3. Operating tests (motor simulation, low voltage test mode, medium voltage commissioning test)

8.1 Physical Checks: Mechanical Assemblies

Power assembly

Before beginning the commissioning process, ensure that the power assembly is in good condition (see also *Receiving* on page 11) and all connections are correct.

1. All critical bolts on the power assembly are checked and marked in the factory (1). Check that all marks are still aligned.
   If any marks are out of alignment, contact your local supplier for advice. See *Power Terminations* on page 15 for details on phase arm termination.
2. Check the fibre-optic connections for any loss/poor connection. Check also the fibre-optic cables for any sign of visible damage or sharp bend.
3. Check all other connections and leads on PCBs.
4. Check each phase arm visually for any sign of damage.



Enclosure

Check that the enclosure contains all agreed components (a list is included in the electrical drawings) and is in a fit state for commissioning, including safety precautions and adequate isolation between the low voltage and medium voltage compartments.

1. Check that all agreed components have been installed into the enclosure and have been fitted correctly, with adequate insulation and tight connections:
   - power circuit as per electrical drawing, including terminations, etc.
   - cable connections
   - earth bonding
   - isolator / earthing switch mechanism
   - input / output bushing
2. Check that all LV connections < M5 (e.g. LV control terminals) are tight.
3. Check that there is no swarf, dust or other foreign material in the enclosure.

8.2 Physical Checks: Electrical Assemblies

Power supplies and subsystem

Run the following test to ensure that the MVE power supply and electrical subsystem show the expected characteristics.

1. Disconnect the power supply connector on the controller.
2. Disconnect the power supply and relay connectors on the power interface board.
3. For each phase arm, disconnect the power supply to the gate drive board and adaptor board (depending on the model, see *Terminations for Adapter Board and Gate Drive Board* on page 22)
4. To check the SCRs, perform an insulation resistance test with a voltage range of 500 ~ 1000 V (using a resistance insulation tester).
   1. Test L1~L3 to earth and T1~T3 to earth. The result must be > 1 MΩ.
   2. Test L1~T1, L2~T2, L3~T3. The result must be as follows:

V02	V03-V04	V06	V11
100 kΩ	200 kΩ	300 kΩ	500 kΩ

5. Either
   - check the test report on insulation resistance values for motor, input and output cables etc., or
   - witness the test performed by others
6. Check that the auxiliary/control supply is as expected.
   1. Measure and record the voltage between each phase and a neutral point.
   2. Measure and record the voltage between each phase and earth.
7. Check that the neutral point is properly earthed (at least on the LV supply transformer side, but preferably also at the main distribution board).

   Measure and record the voltage between the neutral point and earth.
   - Check that the voltage at all electronic power supply connectors is 22-26 VAC.
   - Check that the voltage for the contactors (at the connector block) match the voltage for the contactor coil circuit (as specified on schematic diagrams, see 13-A2).
8. Connect the 24 VAC connector to the power interface PCB. Ensure that the power supply LED illuminates and the fibre-optic TX LED flashes. For more information on LED locations, see *Terminations on the Power Interface Board* on page 20.
9. Connect the 24 VAC connector to the controller. Ensure that the start-up message is displayed on the LCD (indicating the software versions, see *User Manual Version* on page 2).
10. Connect the 24 VAC connectors to the gate drive circuits. Ensure that the LEDs on each circuit board illuminate. For more information on the gate drive board applicable to your product version, *see Terminations for Adapter Board and Gate Drive Board* on page 22.

8.3 Operating Tests

Motor simulation

Use the MVE simulation functions to ensure that the soft starter is connected correctly to associated equipment.

1. Disconnect the soft starter from the mains supply.
2. Set the date and time and all necessary parameters.
3. Operate the Run Simulation using the keypad on the controller (see *Run Simulation* on page 33).
   1. Check that the relays on the power interface PCB operate and activate the MV contactors. Also ensure that the firing signals are received at the gate drive board on each phase's power assembly.
   2. Check that the following LEDs activate at each stage of the simulation (see *Terminations on the Power Interface Board* on page 20):
      - LEDs 'FIRE 1' and 'MC' during starting
      - LEDs 'FIRE 2', 'BC' and 'BPR' during running
      - LEDs 'FIRE 3' and 'MC' during stopping.
4. Operate the Protection Simulation and confirm that the MVE responds as expected (see *Protection Simulation* on page 33).
5. Operate the Output Signal Simulation and confirm that the MVE provides output signalling as expected (see *Output Signal Simulation* on page 34).
6. Confirm that the soft starter trips if the thermistor link is not present.

Low Voltage Test Mode

The MVE can be connected to a low voltage motor (≤ 500 VAC) for testing. To conduct the low voltage test you need to use an LV motor test resistor assembly (part number 995-03946-00). 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.

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

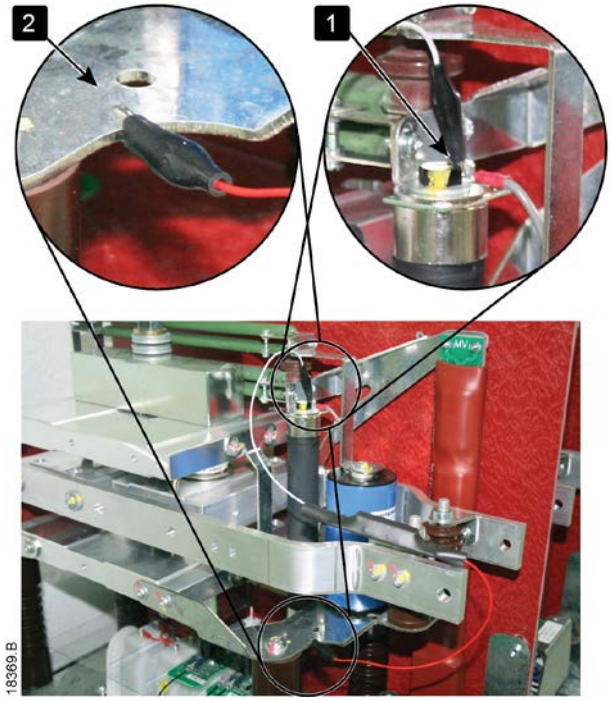
The FLC for the low voltage motor must be ≥ 5 A (see parameter 1A *Motor Full Load Current*). The typical value for parameter 2D *Current Limit* is 130%.

- **Connect the LV motor test resistor assembly**

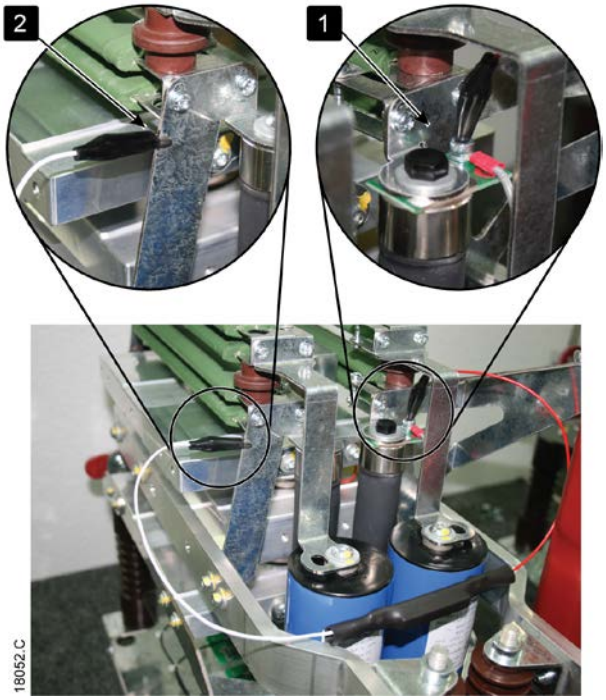
  - **MVE-0070~0540**

1. 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 (refer to illustrations).
2. Clip the other end of the assembly to the steel bracket behind the grading resistor on the other side of the phase arm.

V02



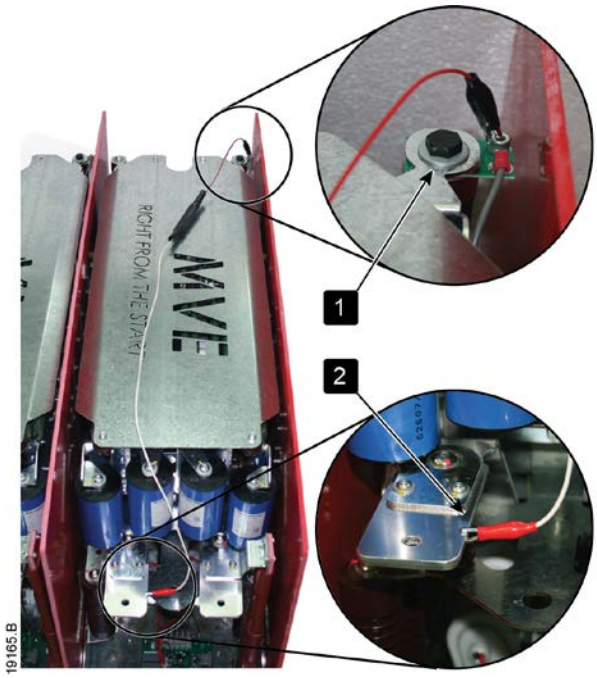
V04~V06



  - **MVE-0070~0540, V11-V13**

1. Clip one end of the resistor assembly to the bolt on the non-conduction PCB. The non-conduction PCB is located at the back right corner of the phase arm.
2. Clip the other end of the assembly to the busbar at the front left of the phase arm (refer to illustrations).

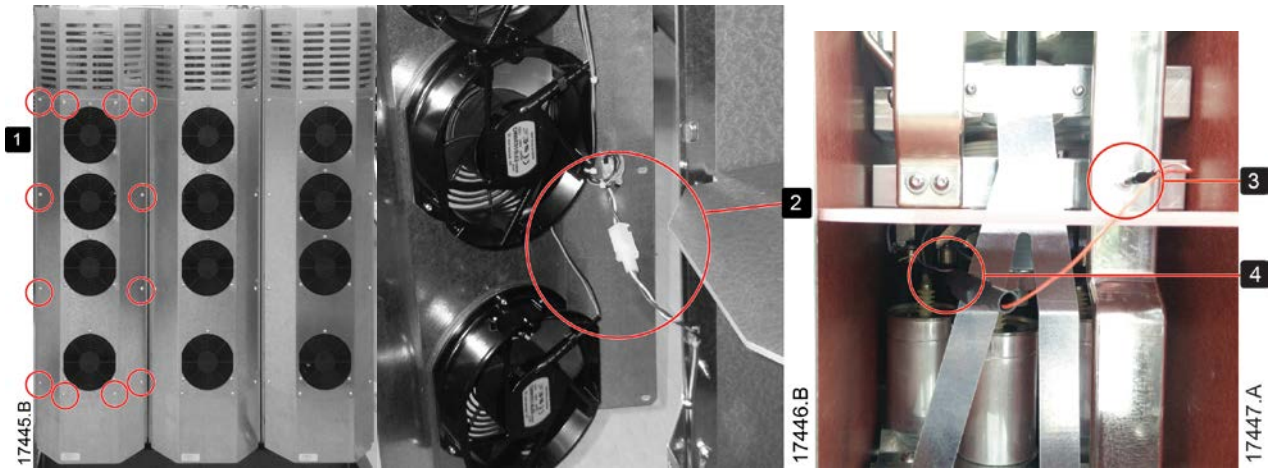
V11~V13



- **MVE-0900~1700, V06**

The fan assembly must be removed from each phase arm before the resistor assembly can be connected. The same process must be followed for each phase arm.

1. Remove the 12 screws holding each fan assembly in place 1. Do not remove the 3 screws holding each fan in place.
2. Disconnect the fan control wiring plug 2.
3. Clip one end of the resistor assembly to the bolt on the busbar 3.
4. Clip the other end of the assembly to the small bolt just below the bushing under the insulating panel 4.



- **Low Voltage Operation**

WARNING

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

CAUTION

After low voltage mode testing, any fan control wiring must be reconnected and the fan assemblies must be screwed to the front of each phase arm before connecting to the medium voltage mains supply.

To operate the MVE in low voltage test mode:

1. Isolate the soft starter from the motor and the mains supply.
2. Connect one LV motor test resistor assembly to each phase arm.
3. Connect T1, T2, T3 of the soft starter to a three phase motor with full load current ≥ 5 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 *1A Motor Full Load Current* to the value shown on the motor name plate.
5. Switch on control and mains supply, and use the MVE to start the motor. The start command can be sent from the controller or via the remote input. Monitor the soft starter's display and verify the line current and 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 and control supply. Disconnect the soft starter from the motor.

Medium Voltage Commissioning Test

Check the motor datasheets and motor terminal boxes to ensure that no capacitors are installed internally or cabled to the motor terminal box.

Check that no capacitors are directly connected onto the soft starter output connection (see *Power Factor Correction* on page 23).

Review the parameter settings for MV motor operation.

1. Ensure that all LV motor test resistor assemblies or linking wires are removed from each phase arm.
2. Set parameters according to the motor data and application requirements.
3. Program inputs and outputs as per site requirement.

4. Connect the soft starter to the medium voltage supply, and connect the motor to the soft starter. Do not connect motor to the load (i.e. the motor must be uncoupled from the load).
5. Use the soft starter to operate the motor and verify that the rotation meets the site requirements with quick start/stop.
6. Stop the motor.
7. Connect the MV motor to the load and use the soft starter to operate the motor.
8. Monitor parameters such as Voltage, Current, and Power. Calibrate the voltage and current readouts as required.
9. Once calibration is completed, record all parameter settings in *Parameter Defaults* on page 73).
10. Use the Load/Save Settings menu to save the programmed settings as "User set 1" (see *Load/Save Settings* on page 36).

9. Troubleshooting

The MVE 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 MVE 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.

9.1 Protection Responses

When a protection condition is detected, the MVE will write this to the event log and may also trip or issue a warning. The soft starter's response depends on the Protection Action setting (parameter group 16).

Some protection responses cannot be adjusted by the user. These trips are usually caused by external events (such as phase loss) or by a fault within the soft starter. These trips do not have associated parameters and cannot be set to Warn or Log.

If the MVE trips you will need to identify and clear the condition that triggered the trip, then reset the soft starter before restarting. To reset the starter, press the RESET button on the controller or activate the Reset remote input.

If the MVE has issued a warning, the soft starter will reset itself once the cause of the warning has been resolved.

Summary of soft starter responses to protection events

Protection response setting	Response actions			
	LED "Trip"	Trip relay output (parameter 7A, 7D, 7G = 'Trip')	Write to event log	Write to trip log
Trip Starter	On	Yes	Yes	Yes
Warn and Log	Flashing	No	Yes	No
Log Only	Off	No	Yes	No

9.2 Trip Messages

This table lists soft starter's protection mechanisms and the probable cause of the trip. Some of these can be adjusted using parameter group 4 Protection Settings and parameter group 16 Protection Action, other settings are built-in system protections and cannot be set or adjusted.

Display	Possible cause/Suggested solution
Battery/clock	A verification error has occurred on the real time clock, or the backup battery voltage is low. If the battery is low and the power is off, date/time settings will be lost. The MVE will continue to soft start and soft stop correctly. Reprogram the date and time. The battery is not removable. In order to replace the battery, the main control PCB must be replaced. Related parameters: 16M
Bypass fail (bypass contactor)	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. This trip is not adjustable.  NOTE You can use the Run Simulation to check the bypass contactor's operation without mains voltage connected.
Controller	This is a name selected for a programmable input. Refer to Input A trip.

Display	Possible cause/Suggested solution
Current imbalance	Current imbalance can be caused by problems with the motor, the environment or the installation, such as: • An imbalance in the incoming mains voltage • A problem with the motor windings • A light load on the motor • A phase loss on input terminals L1, L2 or L3 during Run mode An SCR that has failed open circuit. A failed SCR can only be definitely diagnosed by replacing the SCR and checking the starter's performance. Related parameters: 4H, 4I, 16E
Current Read Err Lx	Where 'X' is 1, 2 or 3. Internal fault (PCB fault). The output from the CT circuit is not close enough to zero when the SCRs are turned off. Contact your local supplier for advice. This trip is not adjustable. Related parameters: None
EEPROM fail	• An error occurred loading data from the EEPROM to RAM when the controller powered up. • "Load User Set" has been selected but no saved file is available. Reset the fault and then reload the default settings. If the problem persists, contact your local distributor. Related parameters: None
Excess start time	The motor was unable to accelerate to full speed in the time allowed. Excess start time trip can occur in the following conditions: • parameter 1A *Motor Full Load Current* is not appropriate for the motor • parameter 2D *Current Limit* has been set too low • parameter 2B *Start Ramp Time* has been set greater than the setting for 4A *Excess Start Time* setting • The motor may have experienced an abnormal increase in loading or might be jammed. Related parameters: 1A, 2A-2D, 4A, 16B
Feeder Prot	This is a name selected for a programmable input. Refer to Input A trip.
Field Trip	This is a name selected for a programmable input. Refer to Input A trip.
Frequency	The mains frequency has gone beyond the specified range. Check for other equipment in the area that could be affecting the mains supply, particularly variable speed drives and switch mode power supplies (SMPS). If the MVE is connected to a generator set supply, the generator may be too small or could have a speed regulation problem. Related parameters: 4J, 4K, 4L, 16F
Ground fault	Ground current (monitored through a dedicated current transformer) has exceeded the selected level. Test the insulation of the output cables and the motor. Identify and resolve the cause of any ground fault. Related parameters: 4O, 4P, 16N
Heatsink overtemperature	The soft starter is operating at a dangerously high temperature. • Check if ventilation and cooling are adequate. • Reduce the number of consecutive starts by increasing the value set in parameter 4M *Restart Delay*. Related parameters: 4M
High Level	This is a name selected for a programmable input. Refer to Input A trip.
High Pressure	This is a name selected for a programmable input. Refer to Input A trip.
Input A trip	The soft starter's programmable input is set to a trip function and has activated. Resolve the trigger condition. Related parameters: 6A, 6B, 6C, 6D, 6E, 6F, 6G, 6H, 6I, 6J, 16G, 16H

Display	Possible cause/Suggested solution
Instantaneous overcurrent	There has been a sharp rise in motor current, probably caused by a locked rotor condition (shearpin) while running. This may indicate a jammed load. A trip may also occur when a medium level fault current has been detected. This may indicate a system short circuit. Related parameters: 4E, 4F, 16D
Instantaneous overcurrent S2	There has been a sharp rise in output current, possibly caused by a short circuit condition. Identify and resolve the cause of the fault. Related parameters: 4U, 4V, 16D
Int Comms Fail	Communication has failed between the controller and the power interface board. • Check that the controller is receiving control voltage within the specified range (terminals A11, A12). • Check that the fibre-optic cables between the controller and the interface board are firmly connected. • Check that each fibre-optic cable is emitting light at the Rx end. This trip is not adjustable.
Interlock Trip	This is a name selected for a programmable input. Refer to Input A trip.
Internal fault 94 ~ Internal fault 98	There has been an internal communication error within the soft starter. Remove then restore control power. This trip is not adjustable.
Internal fault 99 – Internal fault 101	There is a problem with the non-conduction fibre-optic connections. Internal Fault 99 corresponds to phase 1, Internal Fault 100 corresponds to phase 2, Internal Fault 101 corresponds to phase 3. • Check that the fibre-optic cable is properly connected between the non-conduction PCB on the phase arm and the non-conduction readback connector on the power interface board. • If the problem persists, replace the fibre-optic cable. This trip is not adjustable.
Internal fault 105	The power interface board is faulty or damaged. Replace the board. This trip is not adjustable.
Internal fault 106	The selected configuration for the CT ratio selection switches on the power interface board is not valid. • Check the DIP switch settings on the interface PCB. Refer to *CT Current Measurement*. This trip is not adjustable.
Internal fault 107	Mains voltage has been applied to the starter but no start signal has been received. • The starter will wait 5 seconds for a start signal, after mains voltage is applied. • The starter will wait 30 seconds after a stop signal, before checking for mains voltage. This trip is not adjustable.
Internal fault X	The MVE has tripped on an internal fault. Contact your local supplier with the fault code (X). Related parameters: None
L1 phase loss **L2 phase loss** **L3 phase loss**	During pre-start checks the starter has detected a phase loss as indicated. In run state, the starter has detected that the current on the affected phase has dropped below 2% of the starter's nominal FLC for more than 1 second, indicating that either the incoming phase or connection to the motor has been lost. Check the supply and the input and output connections at the starter and at the motor end. Phase loss can also be caused by a failed SCR, particularly an SCR that has failed open circuit. A failed SCR can only be definitely diagnosed by replacing the SCR and checking the starter's performance. Related parameters: None
L1-T1 shorted **L2-T2 shorted** **L3-T3 shorted**	During prestart checks the starter has detected a shorted power assembly or a short within the bypass contactor as indicated. This trip is not adjustable.
Low Control Volts	Control voltage to the controller has dropped below the required level. • Check that supply voltage at the power interface board is 24 VAC/VDC (± 20 %). This trip is not adjustable.
Low Level	This is a name selected for a programmable input. Refer to Input A trip.

Display	Possible cause/Suggested solution
Low Pressure	This is a name selected for a programmable input. Refer to Input A trip.
Motor connection	There is a problem with the soft starter's connection to the motor. If only one phase is affected, the error message will indicate which phase (T1, T2, T3). • Ensure the motor is connected to terminals T1, T2, T3 using in-line (three wire) connection. The MVE does not support inside delta (six wire) connection. • Check that the fibre-optic cables between the power interface board and the MVE are firmly connected. • Check each output phase of the soft starter for power circuit continuity. This trip will also occur when there is a phase imbalance across the soft starter's input terminals L1, L2, L3, during starting and stopping. Related parameters: None
Motor Connection Tx	Where 'X' is 1, 2 or 3. The motor is not connected correctly to the soft starter. • Check individual motor connections to the soft starter for power circuit continuity. Check connections at the motor terminal box. This trip is not adjustable. Related parameters: None
Motor overload	The motor has reached its maximum thermal capacity. Overload can be caused by: • The soft starter protection settings not matching the motor thermal capacity • Excessive starts per hour or start duration • Excessive current • Damage to the motor windings Resolve the cause of the overload and allow the motor to cool. Related parameters: 1A, 1B, 1C, 1D, 9B, 16A
Motor Prot	This is a name selected for a programmable input. Refer to Input A trip.
Motor Temp	This is a name selected for a programmable input. Refer to Input A trip.
Motor thermistor	The external resistance across the motor thermistor input (terminals B4, B5) has exceeded 2.4 kΩ. • 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. Resolve the cause of the overheating. Related parameters: 16I
Network communication (between device and network)	There is a network communication problem, or the network master may have sent a trip command to the starter. Check the network for causes of communication inactivity.
No Flow	This is a name selected for a programmable input. Refer to Input A trip.
Overvoltage	There has been a voltage surge on the mains. Causes can 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. Related parameters: 4S, 4T, 16W
Phase sequence	The phase sequence on the soft starter's input terminals (L1, L2, L3) is not valid. Check the phase sequence on L1, L2, L3 and ensure the setting in parameter 4G is suitable for the installation.
PLC	This is a name selected for a programmable input. Refer to Input A trip.
Power loss	The starter is not receiving mains supply on one or more phases when a start command is given. • Check that the main contactor closes when a start command is given, and remains closed until the end of a soft stop. • Check MVE fuses and confirm that all three mains supply phases are present. This trip is not adjustable.

Display	Possible cause/Suggested solution
Pump Fault	This is a name selected for a programmable input. Refer to Input A trip.
Starter communication (between device and soft starter)	There could be a problem with the connection between the soft starter and the optional communications module. Remove and reinstall the module. If the problem persists, contact your local distributor. The communications module has been powered down while the soft starter remains powered up. Related parameters: 16J
Starter Disable	This is a name selected for a programmable input. Refer to Input A trip.
Undercurrent	The motor has experienced a sharp drop in current, caused by loss of load. Causes can include broken components (shafts, belts or couplings), or a pump running dry. Related parameters: 4C, 4D, 16C
Undervoltage	Mains voltage has fallen below the level selected in parameter 4Q. Causes can include an undersized supply or adding a large load to the system. • 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. Related parameters: 4Q, 4R, 16V
Vibration	This is a name selected for a programmable input. Refer to Input A trip.
V2C Fail Px	Where 'X' is 1, 2 or 3. The voltage detection system has failed. The voltage dividing resistors have failed or the power interface board may be faulty. Contact AuCom for advice.

9.3 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
The soft starter does not respond to the START or RESET button on the controller.	• The soft starter may be in Remote control mode. When the soft starter is in Remote control mode, the Local LED on the starter is off. Press the LCL/RMT button once to change to Local control.
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 Local LED on the starter is on. Press the LCL/RMT button once to change to Remote control. • 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 starter.
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 4M *Restart Delay*. • The motor may be too hot to permit a start. If parameter 4N *Motor 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 starter may be disabled via a programmable input. If parameter 6A is set to Starter Disable and there is an open circuit on C53, C54, the MVE will not start. If there is no further need to disable the starter, close the circuit on the input.  NOTE Parameter 6Q *Local/Remote* controls when the LCL/RMT button is enabled.

Symptom	Probable Cause
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 a programmable input 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 MVE 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 soft stop settings. • If the motor is very lightly loaded, soft stop will have limited effect.
Remote start/stop command is overriding Auto-Stop settings when using remote two-wire control.	• Auto-Stop should only be used in remote mode with three-wire or four-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 **EXIT**, the change will not be saved. • Check that the adjustment lock (parameter 15B) is set to *Read & Write*. If the adjustment lock is set to *Read Only*, 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 controller. A faulty EEPROM will also trip the soft starter, and the controller will display the message Parameter Out Of Range. Contact your local supplier for advice.
ATTENTION! Remove Mains Volts	• The soft starter will not activate Run Simulation with three-phase power connected. This prevents unintentional direct on-line (DOL) start.
Current values shown on the display are incorrect.	• Check that the setting of the CT ratio selector DIP switch on the power interface board matches the ratio of the CT used. Refer to *CT Current Measurement*.

10. Maintenance

10.1 Safety

NOTE
The MVE is not user serviceable. The unit should only be serviced by authorised service personnel. Unauthorised tampering with the unit will void the product warranty.

Electrical shock risk

The voltages present in the following locations can cause severe electric shock and may be lethal:

- AC supply cables and connections
- Output cables and connections
- Many internal parts of the starter, and external option units

The AC supply must be disconnected from the starter using an approved isolation device before any cover is removed from the starter or before any servicing work is performed.

10.2 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
Filters	Check and clean	Every 3 months (every 6 weeks in dusty environments)
Control terminals	Check tightness	Every 2 years
Earthing terminals	Check tightness	Every 2 years
Cable lugs	Check tightness	Every 2 years
General MVE	Cleanliness	Every 2 years

10.3 Tools required

MVE 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

10.4 Thermal Image

After completing commissioning of the MVE and after the motor has been running fully loaded, take a thermal image of the busbars and other critical parts.

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

Perform the usual inspection for dust and debris.

11. Appendix

11.1 Parameter Defaults

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

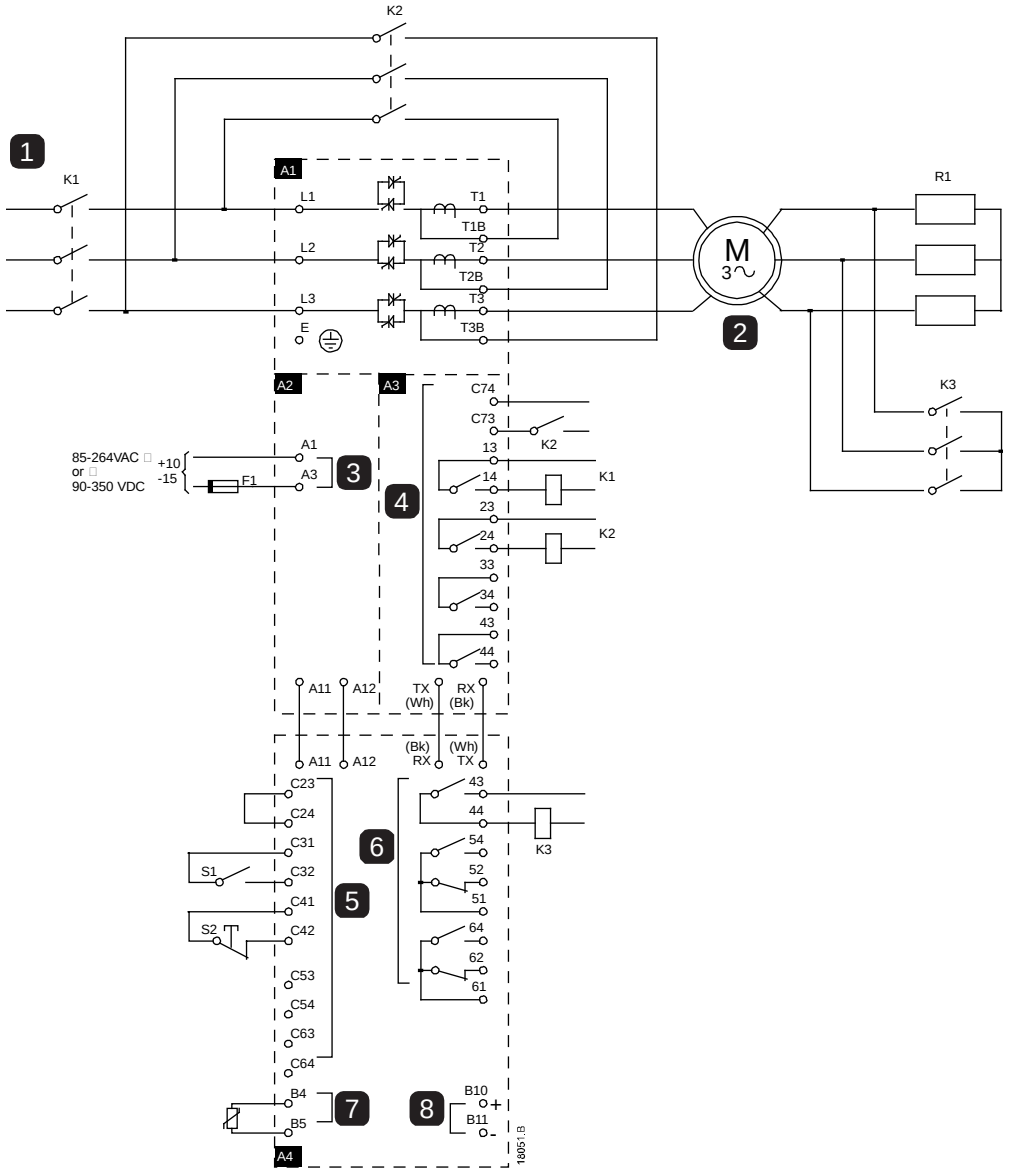
1	Primary Motor Settings	User Set 1	User Set 2	Default Value
1A	*Motor Full Load Current*			100 A
1B	*Locked Rotor Time*			00m:10s
1C	*Locked Rotor Current*			600% FLC
1D	*Motor Service Factor*			105%
2	**Start/Stop Modes-1**			
2A	*Start Mode*			Constant Current
2B	*Start Ramp Time*			00m:01s
2C	*Initial Current*			400% FLC
2D	*Current Limit*			400% FLC
2E	*Reserved*			
2F	*Kickstart Time*			0 ms
2G	*Kickstart Level*			500% FLC
2H	*Stop Mode*			Coast To Stop
2I	*Stop Time*			00m:00s
3	**Auto-Start/Stop**			
3A	*Reserved*			
3B	*Reserved*			
3C	*Auto-Stop Type*			Off
3D	*Auto-Stop Time*			00h:01m
4	**Protection Settings**			
4A	*Excess Start Time*			00m:20s
4B	*Excess Start Time-2*			00m:20s
4C	*Undercurrent*			20% FLC
4D	*Undercurrent Delay*			00m:05s
4E	*Instantaneous Overcurrent*			400% FLC
4F	*Instantaneous Overcurrent Delay*			00m:00s
4G	*Phase Sequence*			Positive Only
4H	*Current Imbalance*			30%
4I	*Current Imbalance Delay*			00m:05s
4J	*Frequency Check*			Run
4K	*Frequency Variation*			±5 Hz
4L	*Frequency Delay*			00m:05s
4M	*Restart Delay*			30m:00s
4N	*Motor Temperature Check*			Do Not Check
4O	*Ground Fault Level*			1 A
4P	*Ground Fault Delay*			00m:03s
4Q	*Undervoltage*			100 V
4R	*Undervoltage Delay*			00m:05s
4S	*Overvoltage*			7200 V
4T	*Overvoltage Delay*			00m:05s
4U	*Instantaneous Overcurrent S2*			4400 A
4V	*Instantaneous Overcurrent Delay S2*			10 ms

5	**Auto-Reset Trips (*Reserved*)**	
5A	*Reserved*	
6	**Inputs**	
6A	*Input A Function*	Input Trip (N/O)
6B	*Input A Name*	Input Trip
6C	*Input A Trip*	Always Active
6D	*Input A Trip Delay*	00m:00s
6E	*Input A Initial Delay*	00m:00s
6F	*Input B Function*	Input Trip (N/O)
6G	*Input B Name*	Input Trip
6H	*Input B Trip*	Always Active
6I	*Input B Trip Delay*	00m:00s
6J	*Input B Initial Delay*	00m:00s
6K	*Reserved*	
6L	*Reserved*	
6M	*Remote Reset Logic*	Normally Closed (N/C)
6N	*Reserved*	
6O	*Reserved*	
6P	*Reserved*	
6Q	*Local/Remote*	LCL/RMT Anytime
6R	*Comms in Remote*	Enable Control in RMT
7	**Outputs**	
7A	*Relay A Function*	Main Contactor
7B	*Relay A On Delay*	00m:00s
7C	*Relay A Off Delay*	00m:00s
7D	*Relay B Function*	Run
7E	*Relay B On Delay*	00m:00s
7F	*Relay B Off Delay*	00m:00s
7G	*Relay C Function*	Trip
7H	*Relay C On Delay*	00m:00s
7I	*Relay C Off Delay*	00m:00s
7J	*Reserved*	
7K	*Reserved*	
7L	*Reserved*	
7M	*Low Current Flag*	50% FLC
7N	*High Current Flag*	100% FLC
7O	*Motor Temperature Flag*	80%
7P	*Analog Output A*	Current (% FLC)
7Q	*Analog A Scale*	4-20 mA
7R	*Analog A Maximum Adjustment*	100%
7S	*Analog A Minimum Adjustment*	0%
7T	*Reserved*	
7U	*Reserved*	
7V	*Reserved*	
7W	*Reserved*	

8	**Display**	
8A	*Language*	English
8B	*F1 Button Action*	Setup Auto-Start/Stop
8C	*F2 Button Action*	None
8D	*Display A or kW*	Current
8E	*User Screen - Top Left*	Starter State
8F	*User Screen - Top Right*	Blank
8G	*User Screen - Bottom Left*	kWh
8H	*User Screen - Bottom Right*	Hours Run
8I	*Graph Data*	Current (% FLC)
8J	*Graph Timebase*	10 seconds
8K	*Graph Maximum Adjustment*	400%
8L	*Graph Minimum Adjustment*	0%
8M	*Mains Reference Voltage*	400 V
9	**Motor Data-2**	
9A	*Reserved*	
9B	*Motor FLC-2*	100 A
9C	*Reserved*	
9D	*Reserved*	
9E	*Reserved*	
10	**Start/Stop Modes-2**	
10A	*Start Mode-2*	Constant Current
10B	*Start Ramp-2*	00m:01s
10C	*Initial Current-2*	400% FLC
10D	*Current Limit-2*	400% FLC
10E	*Reserved*	
10F	*Kickstart Time-2*	0 ms
10G	*Kickstart Level-2*	500% FLC
10H	*Stop Mode-2*	Coast To Stop
10I	*Stop Time-2*	00m:00s
11	**RTD/PT100 (*Reserved*)**	
11A	*Reserved*	
12	**Slip-Ring Motors**	
12A	*Motor Data-1 Ramp*	Single Ramp
12B	*Motor Data-2 Ramp*	Single Ramp
12C	*Changeover Time*	150 ms
12D	*Slip Ring Retard*	50%
15	**Advanced**	
15A	*Access Code*	0000
15B	*Adjustment Lock*	Read & Write
15C	*Emergency Run*	Disable

16	Protection Action	
16A	*Motor Overload*	Trip Starter
16B	*Excess Start Time*	Trip Starter
16C	*Undercurrent*	Trip Starter
16D	*Instantaneous Overcurrent*	Trip Starter
16E	*Current Imbalance*	Trip Starter
16F	*Frequency*	Trip Starter
16G	*Input A Trip*	Trip Starter
16H	*Input B Trip*	Trip Starter
16I	*Motor Thermistor*	Trip Starter
16J	*Starter Communication*	Trip Starter
16K	*Network Communication*	Warn and Log
16L	*Reserved*	
16M	*Battery/Clock*	Warn and Log
16N	*Ground Fault*	Trip Starter
16O	*Reserved*	
16P	*Reserved*	
16Q	*Reserved*	
16R	*Reserved*	
16S	*Reserved*	
16T	*Reserved*	
16U	*Reserved*	
16V	*Undervoltage*	Trip Starter
16W	*Overvoltage*	Trip Starter
20	**Restricted**	

11.2 Slip-Ring Motor Connection

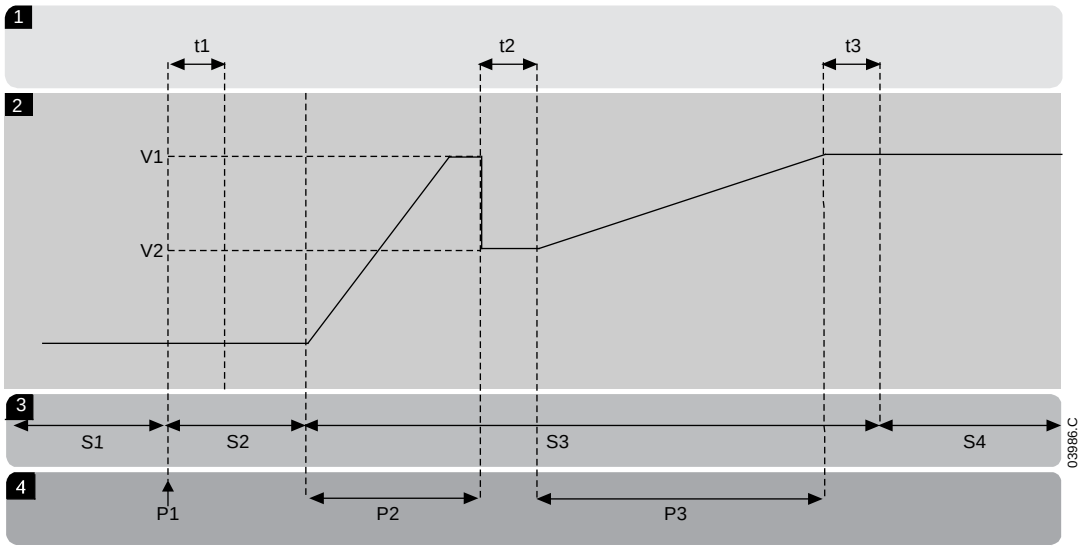


A1	Power assembly
1	3 Phase 50/60 Hz Supply
K1	Main contactor
K2	Bypass contactor
2	Motor
R1	Slip-ring rotor resistance
K3	Changeover contactor
A2	Control voltage terminals
3	Control supply
A3	Power interface board
4	Relay outputs
C73~C74	Bypass contactor feedback signal
13~14	Main contactor K1
23~24	Bypass contactor K2
33~34	Run relay output
43~44	Phase arm power supply control relay output

A4	Controller
5	Remote control inputs
C23~C24	Control Input - Start
C31~C32	Control Input - Stop
C41~C42	Control Input - Reset
C53~C54	Control Input - Programmable input A
C63~C64	Control Input - Programmable input B
6	Programmable outputs
43, 44	Relay output A (7A= Changeover contactor)
51, 52, 54	Relay output B
61, 62, 64	Relay output C
7	Motor thermistor input
8	Analog output

Using the MVE to Control a Slip-Ring Motor

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



1	Sub-states
t1	Main contactor close time
t2	Rotor resistance contactor close time
t3	Bypass contactor close time
2	Output voltage
V1	100% voltage
V2	Slip-ring retard voltage

3	States
S1	Ready
S2	Pre-start tests
S3	Starting
S4	Running
4	Phases of operation
P1	Start command
P2	Rotor resistance current ramp
P3	Shorted rotor current ramp

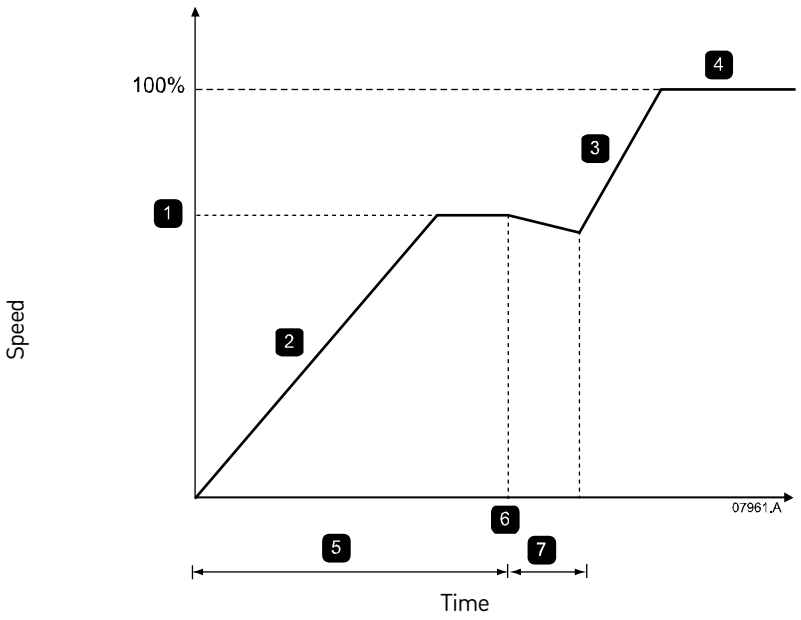
- **Commissioning**

1. Configure the MVE as follows:

   Parameter settings:

   - Parameter 7A *Relay A Function*
     - Select 'Changeover Contactor'
   - Parameter 7B *Relay A On Delay*
     - Set this to the maximum time (5m:00s).
   - Parameter 12A *Motor Data-1 Ramp*
     - Select 'Dual Ramp' (for slip-ring induction motor control)
   - Parameter 12C *Changeover Time*
     - Default setting is 150 milliseconds. Set this to a value just greater than the changeover contactor (K3) pole closing time.
   - Parameter 12D *Slip Ring Retard*
     - Default setting is 50%. Set this parameter to a value which is high enough to cause the motor to instantly accelerate once the rotor resistance (R1) has been bridged out and low enough to avoid a motor current pulse.

2. Start the motor under normal load conditions and record the time it takes to reach a constant speed with external rotor resistance (R1) in the circuit. Stop the motor soon after a constant speed has been reached. Change parameter 7B to the recorded time value.
3. Start the motor under normal load conditions and monitor the motor speed behaviour and motor current when the changeover contactor (K3) switches in to short-out the rotor resistance (R1)
   If the motor does not start to accelerate immediately after changeover, increase the setting of parameter 12D.
   If there is a pulse in motor current immediately after changeover, reduce the setting of parameter 12D.



1	R1 constant speed
2	First ramp
3	Second ramp
4	Run mode (I < 120% FLC)
5	Parameter 7B
6	K3 closes
7	Parameter 12C

NOTE

To use the secondary motor settings, parameter 12B *Motor Data-2 Ramp* must be set to 'Dual Ramp'.

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