## Contents

## 1 Safety

## 1.1 Safety

### 1.1.1 Warnings

When reading this manual you will come across different symbols that require special attention. The symbols used are the following:

| | **NB!**<br>Indicates something to be noted by the reader |
|---|---|

| | Indicates a general warning |
|---|---|

| | Indicates a high voltage warning |
|---|---|

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

| | WARNING - ELECTRICAL SHOCK HAZARD<br>MCD 500 soft starters contain dangerous voltages when connected to mains voltage. Only a competent electrician should carry out the electrical installation. Improper installation of the motor or the soft starter may cause equipment failure, serious injury or death. Follow this manual and local electrical safety codes. |
|---|---|

| | Disconnect the soft starter from mains voltage before carrying out repair work.<br>It is the responsibility of the user or person installing the soft starter to provide proper grounding and branch circuit protection according to local electrical safety codes.<br>Do not connect power factor correction capacitors to the output of MCD 500 soft starters. If static power factor correction is employed, it must be connected to the supply side of the soft starter. |
|---|---|

The motor can be stopped by means of digital or bus commands while the soft starter is connected to the mains, if the soft starter is in **Auto On** mode.

1. If personal safety considerations make it necessary to ensure that no unintended start occurs,
   these stop functions are not sufficient.

2. A motor that has been stopped may start if faults occur in the electronics of the soft starter, or a temporary fault in the supply mains or the motor connection ceases.

| | AUTO-START<br>Use the auto-start feature with caution. Read all the notes related to auto-start before operation. |
|---|---|

**1**

Equipment containing electrical components may not be disposed of together with domestic waste.

It must be collected separately as electrical and electronic waste according to local and currently valid legislation.

# 2 Introduction

The MCD 500 is an advanced digital soft start solution for motors from 7 kW to 800 kW. MCD 500 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.

### 2.1.1 Feature List

**Models for all connection requirements**
- 21 A to 1600 A (in-line connection)
- In-line or inside delta connection
- Internally bypassed up to 215 A
- Mains voltage: 200 - 525 VAC or 380 - 690 VAC
- Control voltage: 24 VAC/VDC, 110 - 120 VAC or 220 - 240 VAC

**User-friendly LCP**
- Loggings
- Real-time graphs
- SCR conduction bar graph

**Tools**
- Application setups
- Date and time stamped event log with 99 entries
- 8 most recent trips
- Counters
- Protection simulation
- Output signal simulation

**Inputs and Outputs**
- Local or remote control input options (3 x fixed 1 x programmable)
- Relay outputs (3 x programmable)
- Analog programmable output
- 24 VDC 200 mA supply output

**Start and run modes**
- AAC - Adaptive Acceleration Control
- Constant current
- Current ramp
- Kickstart
- Jog
- Emergency run operation

**Stop modes**
- AAC - Adaptive Acceleration Control
- Timed voltage ramp soft stop
- DC brake
- Soft brake
- Emergency stop

**Other features**
- Auto start/stop timer
- Second order thermal model
- Battery backup of clock and thermal model
- Optional DeviceNet, Modbus or Profibus communication modules

**Comprehensive protection**
- Wiring/Connection/Supply
  - Motor connection
  - Phase sequence
  - Power loss
  - Individual phase loss
  - Mains frequency
- Current
  - Excess start time
  - Current imbalance
  - Undercurrent
  - Instantaneous overcurrent
- Thermal
  - Motor thermistor
  - Motor overload
  - Bypass relay overload
  - Heatsink temperature
- Communication
  - Network comms
  - Starter comms
- External
  - Input trip
- Starter
  - Individual shorted SCR
  - Battery/Clock

**2**

### 2.1.2 Type Code

MCD 5 ☐☐☐☐▨ - ☐☐ - ▨▨▨ - ▨▨ - ☐☐

Current rating
0021 = 21 A, AC53b 3-30:330
0037 = 37 A, AC53b 3-30:330
0043 = 43 A, AC53b 3-30:330
0053 = 53 A, AC53b 3-30:330
0068 = 68 A, AC53b 3-30:570
0084 = 84 A, AC53b 3-30:570
0089 = 89 A, AC53b 3-30:570
0105 = 105 A, AC53b 3-30:570
0131 = 131 A, AC53b 3-30:570
0141 = 141 A, AC53b 3-30:570
0195 = 195 A, AC53b 3-30:570
0215 = 215 A, AC53b 3-30:570
0245 = 245 A, AC53a 3-30:50-6
0360 = 360 A, AC53a 3-30:50-6
0380 = 380 A, AC53a 3-30:50-6
0428 = 428 A, AC53a 3-30:50-6
0595 = 595 A, AC53a 3-30:50-6
0619 = 619 A, AC53a 3-30:50-6
0790 = 790 A, AC53a 3-30:50-6
0927 = 927 A,AC53a 3-30:50-6
1200 = 1200 A, AC53a 3-30:50-6
1410 = 1410 A, AC53a 3-30:50-6
1600 = 1600 A, AC53a 3-30:50-6

B = Bypassed
C = Non-bypassed

Mains voltage
T5 = 200 - 525 VAC
T7 = 380 - 690 VAC

Frame size
G1 = 0021 ~ 0105 A
G2 = 0131 ~ 0215 A
G3 = 0245 A
G4 = 0360 A ~ 0927 A
G5 = 1200 A ~ 1600 A

Not used

IP rating
00 = IP00
20 = IP20

Control voltage
CV1 = 24 VAC/VDC
CV2 = 110-120 VAC or 220-240 VAC

17HA38211

▨ = Not selectable

# 3 Installation

## 3.1 Mechanical Installation
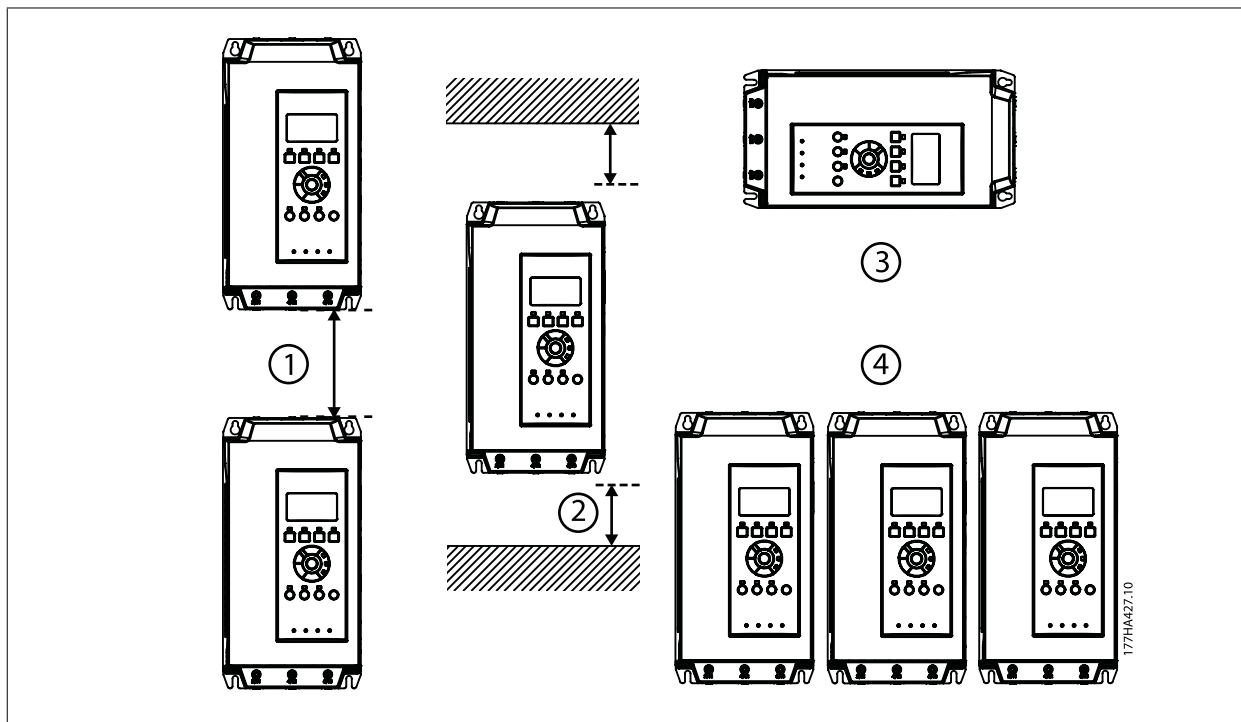


| | |
|---|---|
| **1** | MCD5-0021B - MCD5-0245C: Allow 100 mm (3.94 inches) between soft starters. |
| | MCD5-0360C - MCD5-1600C: Allow 200 mm (7.88 inches) between soft starters. |
| **2** | MCD5-0021B - MCD5-0215B: Allow 50 mm (1.97 inches) between the soft starter and solid surfaces. |
| | MCD5-0245C: Allow 100 mm (3.94 inches) between the soft starter and solid surfaces. |
| | MCD5-0360C - MCD5-1600C: Allow 200 mm (7.88 inches) between the soft starter and solid surfaces. |
| **3** | The soft starter may be mounted on its side. Derate the soft starter's rated current by 15%. |
| **4** | Soft starters may be mounted side by side with clearance of 50 mm (1.97 inches) on both sides. |

**3**

## 3.2 Dimensions and Weights
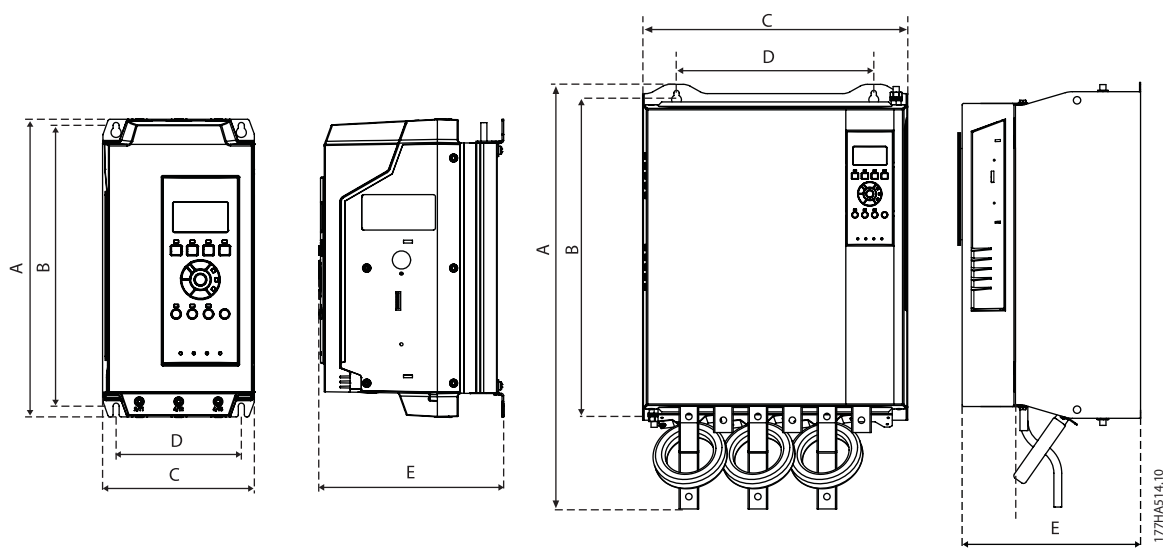


| Model | A mm (inches) | B mm (inches) | C mm (inches) | D mm (inches) | E mm (inches) | Weight kg (lbs) |
|---|---|---|---|---|---|---|
| MCD5-0021B MCD5-0037B MCD5-0043B MCD5-0053B MCD5-0068B | 295 (11.6) | 278 (10.9) | 150 (5.9) | 124 (4.9) | 183 (7.2) | 4.2 (9.3) |
|  |  |  |  |  |  | 4.5 (9.9) |
| MCD5-0084B MCD5-0089B MCD5-0105B |  |  |  |  | 213 (8.14) | 4.9 (10.8) |
| MCD5-0131B MCD5-0141B MCD5-0195B MCD5-0215B | 438 (17.2) | 380 (15.0) | 275 (10.8) | 248 (9.8) | 250 (9.8) | 14.9 (32.8) |
| MCD5-0245C | 460 (18.1) | 400 (15.0) | 390 (15.4) | 320 (12.6) | 279 (11.0) | 23.9 (52.7) |
| MCD5-0360C MCD5-0380C MCD5-0428C MCD5-0595C MCD5-0619C MCD5-0790C MCD5-0927C | 689 (27.1) | 520 (20.5) | 430 (16.9) | 320 (12.6) | 302 (11.9) | 35 (77.2) |
|  |  |  |  |  |  | 45 (99.2) |
| MCD5-1200C MCD5-1410C MCD5-1600C | 856 (33.7) | 727 (28.6) | 585 (23.0) | 500 (19.7) | 364 (14.3) | 120 (264.6) |

# 4 Electrical Installation

## 4.1.1 Control Wiring

The soft starter can be controlled in three ways:

- using the buttons on the LCP

- via remote inputs

- via a serial communication link

**4**

The MCD 500 will always respond to a local start or stop command (via the **Hand On** and **Off** buttons on the LCP). Pressing the **Auto On** button selects remote control (the MCD 500 will accept commands from the remote inputs). In remote mode, the Auto On LED will be on. In local mode, the Hand On LED will be on if the MCD 500 is starting or running and the Off LED will be on if the MCD 500 is stopped or stopping.

## 4.1.2 Control Terminals

Control terminations use 2.5 mm$^2$ plug-in terminal blocks. Different models require control voltage to different terminals:

| | |
|---|---|
| CV1 (24 VAC/VDC) | A5, A6 |
| CV2 (110 - 120 VAC) | A5, A6 |
| CV2 (220 - 240 VAC) | A4, A6 |
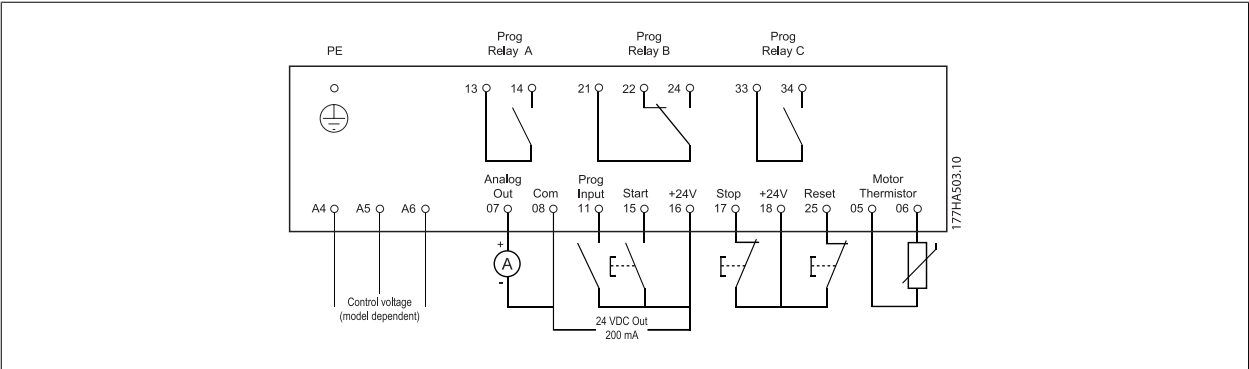


**NB!**
If you are not using a thermistor, do not short terminals 05, 06.

### 4.1.3 Remote Inputs

The MCD 500 has three fixed inputs for remote control. These inputs should be controlled by contacts rated for low voltage, low current operation (gold flash or similar).
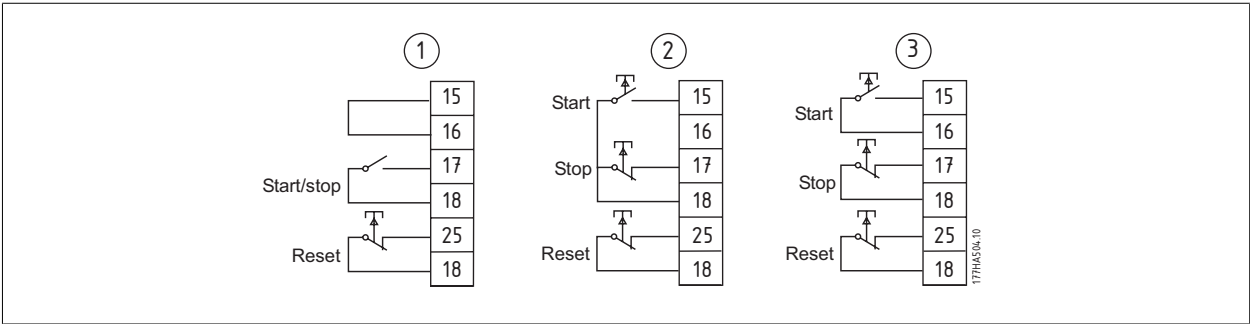


| | |
|---|---|
| 1 | Two-wire control |
| 2 | Three-wire control |
| 3 | Four-wire control |

The reset input can be normally open or normally closed. Use par. 3-8 to select the configuration.

> **!**
>
> Do not apply voltage to the control input terminals. These are active 24 VDC inputs and must be controlled with potential free contacts.
> Cables to the control inputs must be segregated from mains voltage and motor cabling

### 4.1.4 Serial Communication

Serial communication is always enabled in local control mode, and can be enabled or disabled in remote control mode (see par. 3-2).

### 4.1.5 Earth Terminal

Earth terminals are located at the back of the soft starter.
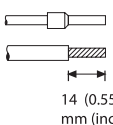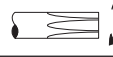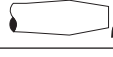
- MCD5-0021B - MCD5-0105B have one terminal, on the input side.
- MCD5-0131B - MCD5-1600C have two terminals, one on the input side and one on the output side.

### 4.1.6 Power Terminations

Use only copper stranded or solid conductors, rated for 75° C.

> **NB!**
>
> Some units are aluminium bus bars. When connecting power terminations, we recommend cleaning the surface contact area thoroughly (using an emery or stainless steel brush) and using an appropriate jointing compound to prevent corrosion.

**4**



| | | Cable sizes |
| | | mm² AWG |
| | | 6-50 10-1/0 |

14 (0.55) mm (inch)

| Torx T20 x 150 | Torque |
| | Nm Ft-lb |
| Flat 7mm x 150 | 4 2.9 |

MCD5-0021B - MCD5-0105B

8.5 mm
12.5 mm
19 mm      6 mm
8.5 Nm (6.3 ft-lb)
177HA517.10

MCD5-0131B

10.5 mm
12.5 mm
19 mm      6 mm
8.5 Nm (6.3 ft-lb)
177HA518.10

MCD5-0141B - MCD5-0215B

177HA516.10

10.5 mm
16 mm
32 mm      6 mm
17 Nm (12.5 ft-lb)
177HA519.10

MCD5-0245C

10.5 mm
23 mm
32 mm      13 mm
38 Nm (28.5 ft-lb)
177HA520.10

MCD5-0360C - MCD50927C

12.5 mm
25 mm
51 mm      16 mm
58 Nm (42.7 ft-lb)
177HA521.10

MCD5-1200C - MCD5-1600C

The bus bars on models MCD5-0360C - MCD5-1600C can be adjusted for top or bottom input and output as required. For step-by-step instructions on adjusting the bus bars, refer to the supplied insert.
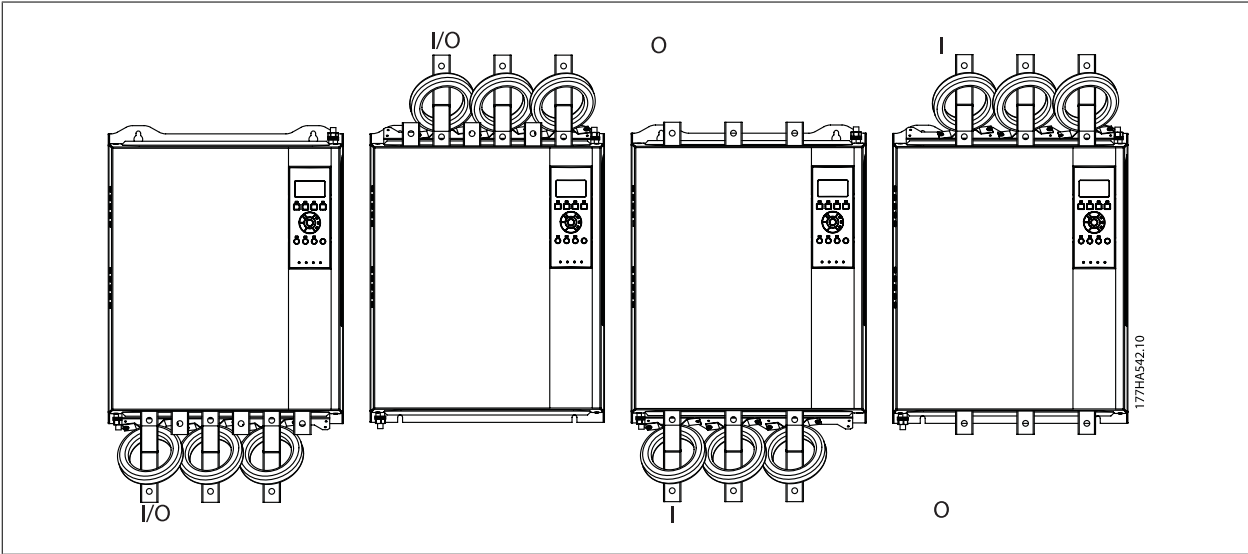


| I/O | Input/Output |
| I | Input |
| O | Output |

### 4.1.7 Motor Connection

MCD 500 soft starters can be connected to the motor in-line or inside delta (also called three-wire and six-wire connection). The MCD 500 will automatically detect the motor connection and perform the necessary calculations internally, so it is only necessary to program the motor full load current (par. 1-1).

**NB!**
For personnel safety, the power terminals on models up to MCD5-0105B are protected by snap-off tabs. When using large cables, it may be necessary to break off these tabs.
Models which are internally bypassed do not require an external bypass contactor.

## 4.1  In-Line Installation

### 4.2.1  In-line Installation, Internally Bypassed
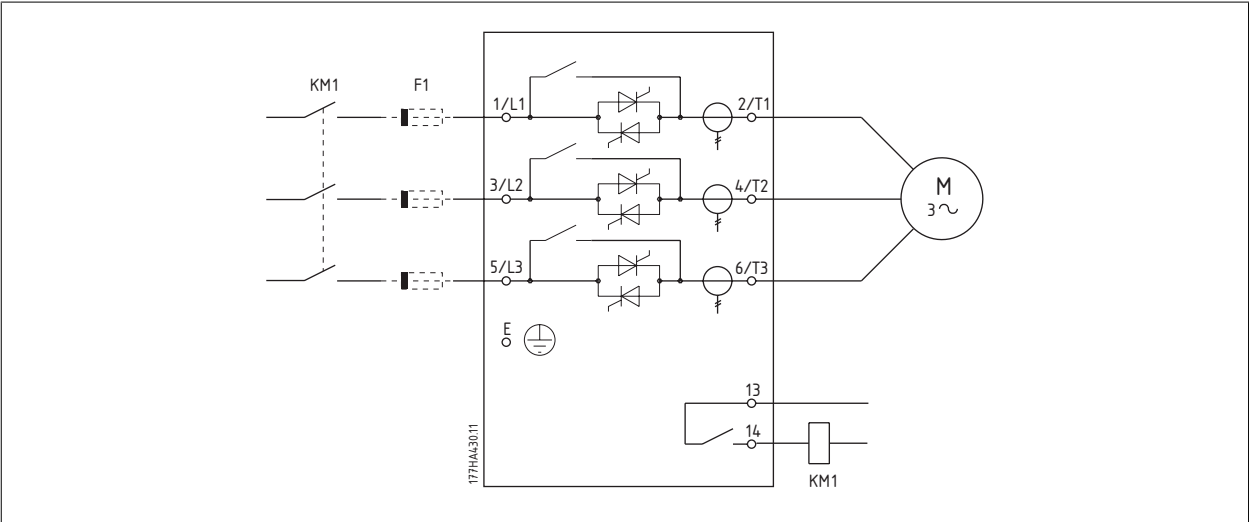


| KM1 | Main contactor (optional) |
|-----|---------------------------|
| F1  | Fuses (optional)          |

### 4.2.2  In-line Installation, Non-bypassed
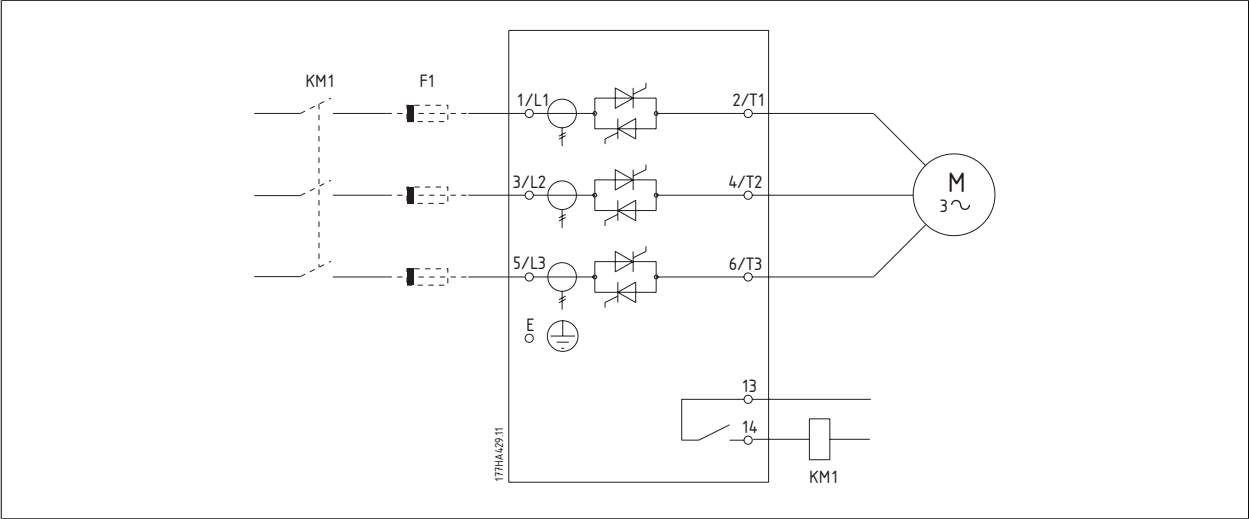


| KM1 | Main contactor (optional) |
|-----|---------------------------|
| F1  | Fuses (optional)          |

### 4.2.3 In-line Installation, Externally Bypassed

Non-bypassed models have dedicated bypass terminals, which allow the soft starter to continue providing protection and monitoring functions even when bypassed via external contactor. The bypass contactor must be connected to the bypass terminals and controlled by a programmable output configured to Run (see par. 4.1 - 4.9).
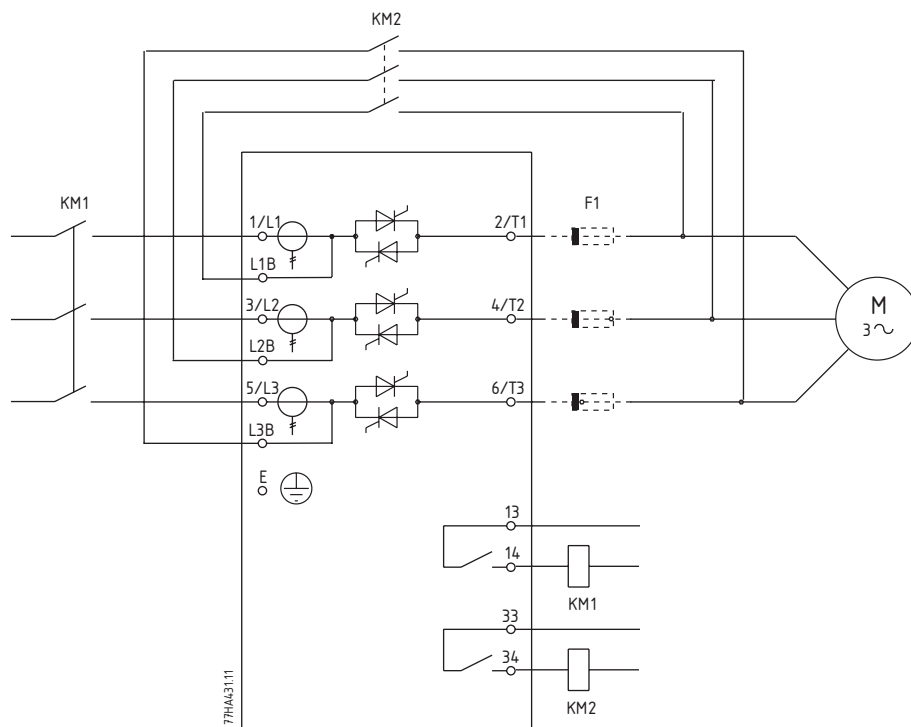


| KM1 | Main contactor |
| KM2 | Bypass contactor |
| F1 | Fuses (optional) |

**NB!**
The bypass terminals on MCD5-0245C are T1B, T2B, T3B. The bypass terminals on MCD5-0360C ~ MCD5-1600C are L1B, L2B, L3B. The fuses can be installed on the input side if required.

## 4.2  Inside Delta Installation

**NB!**
When connecting the MCD 500 in inside delta configuration, always install a main contactor or shunt trip circuit breaker.

### 4.3.1 Inside Delta Installation, Internally Bypassed
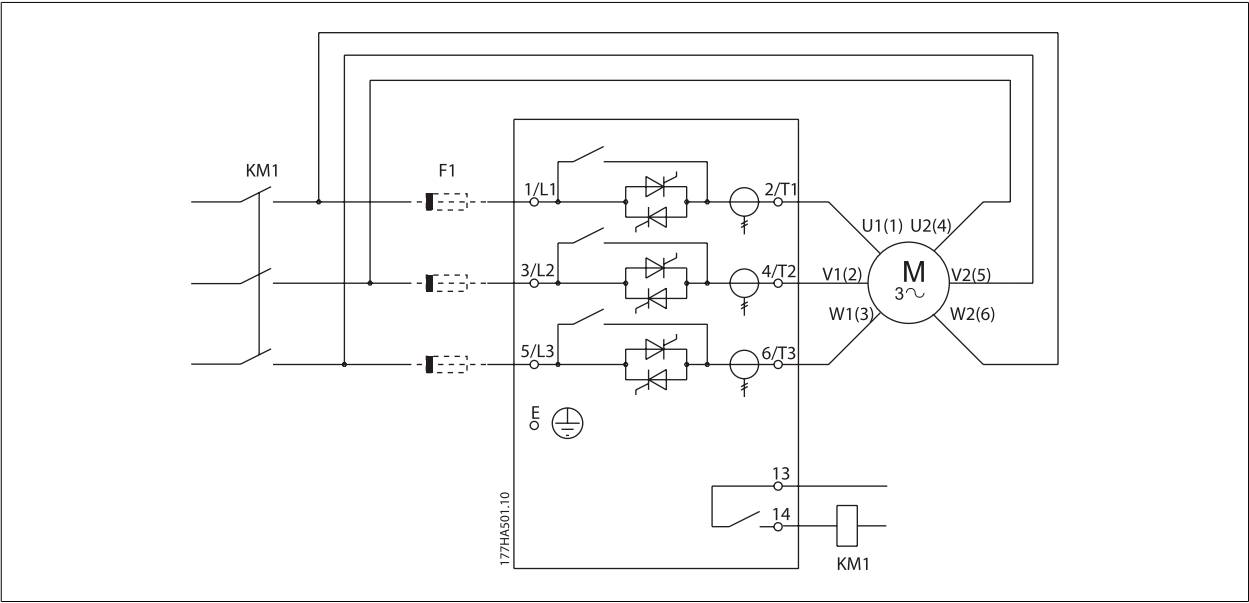


| KM1 | Main contactor |
| F1 | Fuses (optional) |

### 4.3.2 Inside Delta Installation, Non-bypassed
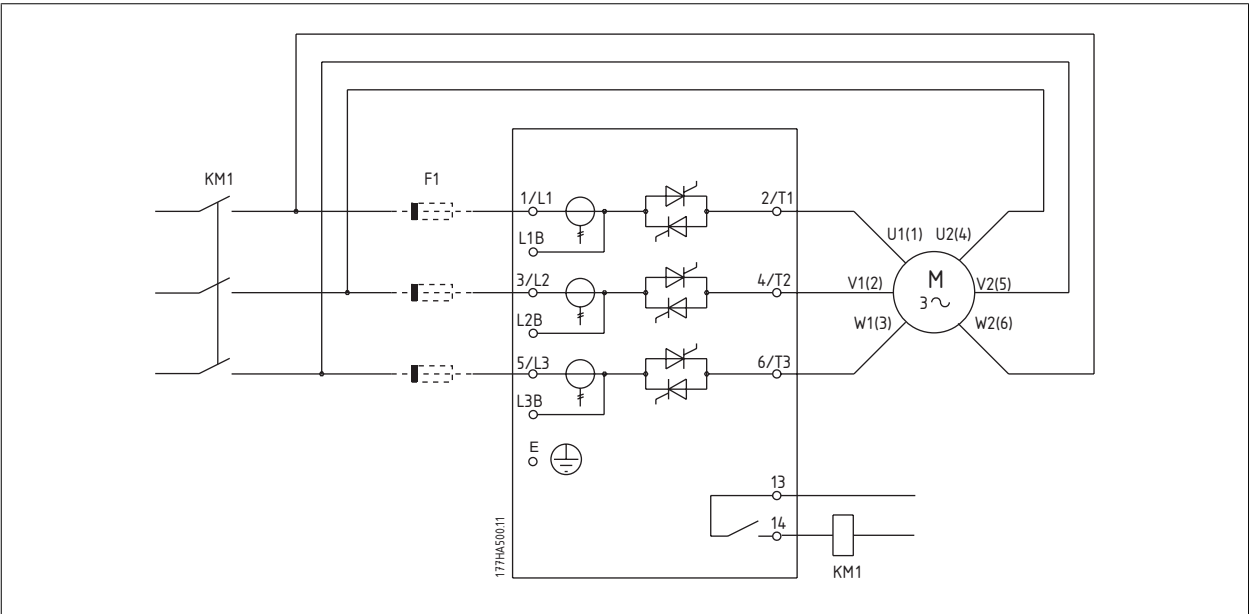


| KM1 | Main contactor |
| F1 | Fuses (optional) |

### 4.3.3  Inside Delta Installation, Externally Bypassed

Non-bypassed models have dedicated bypass terminals, which allow the MCD 500 to continue providing protection and monitoring functions even when bypassed via an external bypass contactor. The bypass relay must be connected to the bypass terminals and controlled by a programmable output configured to Run (see par. 4-1 - 4-9).
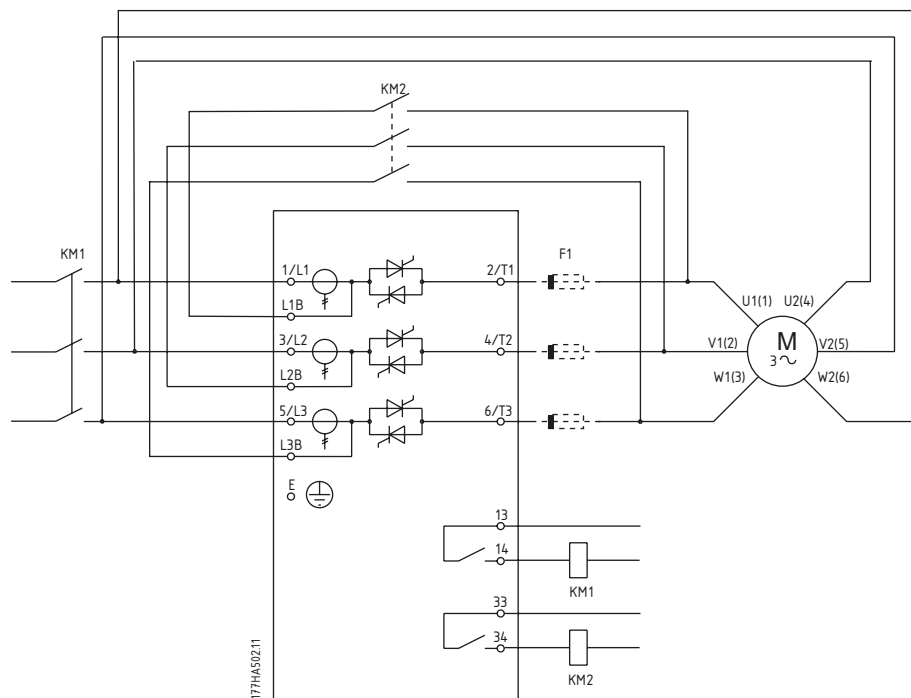


| KM1 | Main contactor |
| KM2 | Bypass contactor |
| F1 | Fuses (optional) |

**NB!**
The bypass terminals on MCD5-0245C are T1B, T2B, T3B. The bypass terminals on MCD5-0360C - MCD5-1600C are L1B, L2B, L3B. The fuses can be installed on the input side if required.

## 4.3  Current Ratings

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

All ratings are calculated at altitude of 1000 metres and ambient temperature of 40° C.

### 4.4.1  In-line Connection (Bypassed)

> **NB!**
> Models MCD5-0021B - MCD5-0215B are internally bypassed. Models MCD5-0245C - MCD5-1600C require an external bypass contactor.

**4**

| | AC-53b 3-30:330 | AC-53b 4-20:340 | AC-53b 4.5-30:330 |
|---|---|---|---|
| MCD5-0021B | 21 A | 17 A | 15 A |
| MCD5-0037B | 37 A | 31 A | 26 A |
| MCD5-0043B | 43 A | 37 A | 30 A |
| MCD5-0053B | 53 A | 46 A | 37 A |
| | **AC-53b 3-30:570** | **AC-53b 4-20:580** | **AC-53b 4.5-30:570** |
| MCD5-0068B | 68 A | 55 A | 47 A |
| MCD5-0084B | 84 A | 69 A | 58 A |
| MCD5-0089B | 89 A | 74 A | 61 A |
| MCD5-0105B | 105 A | 95 A | 78 A |
| MCD5-0131B | 131 A | 106 A | 90 A |
| MCD5-0141B | 141 A | 121 A | 97 A |
| MCD5-0195B | 195 A | 160 A | 134 A |
| MCD5-0215B | 215 A | 178 A | 148 A |
| MCD5-0245C | 255 A | 201 A | 176 A |
| MCD5-0360C | 360 A | 310 A | 263 A |
| MCD5-0380C | 380 A | 359 A | 299 A |
| MCD5-0428C | 430 A | 368 A | 309 A |
| MCD5-0595C | 620 A | 540 A | 434 A |
| MCD5-0619C | 650 A | 561 A | 455 A |
| MCD5-0790C | 790 A | 714 A | 579 A |
| MCD5-0927C | 930 A | 829 A | 661 A |
| MCD5-1200C | 1200 A | 1200 A | 1071 A |
| MCD5-1410C | 1410 A | 1319 A | 1114 A |
| MCD5-1600C | 1600 A | 1600 A | 1353 A |

### 4.4.2  AC-53 Rating for Bypassed Operation



141 A : AC-53b : 4.5-30 : 570

Starter Current Rating
Start Current (multiple of FLC)
Start Time (seconds)
Off Time (seconds)

177HA281.11
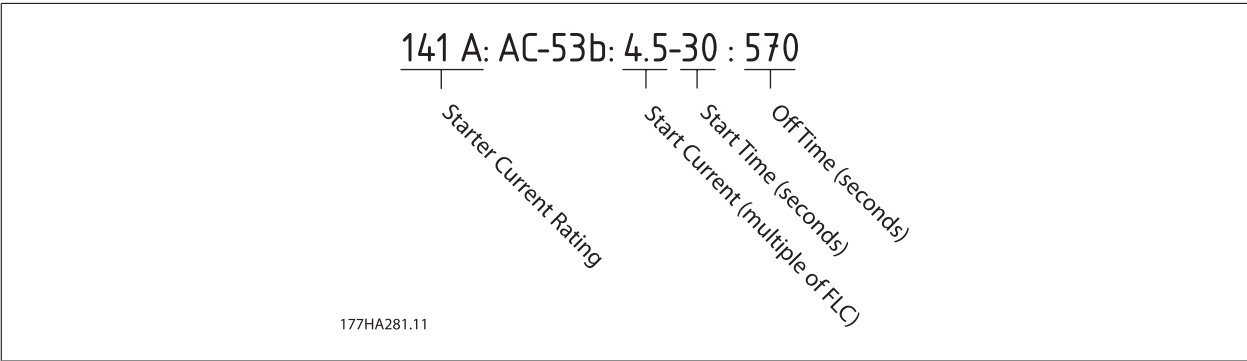
All ratings are calculated at altitude of 1000 metres and ambient temperature of 40° C.

### 4.4.3 In-line Connection (Non-bypassed/Continuous)

| | AC-53a<br>3-30:50-6 | AC-53a<br>4-20:50-6 | AC-53a<br>4.5-30:50-6 |
|---|---|---|---|
| MCD5-0245C | 245 A | 195 A | 171 A |
| MCD5-0360C | 360 A | 303 A | 259 A |
| MCD5-0380C | 380 A | 348 A | 292 A |
| MCD5-0428C | 428 A | 355 A | 300 A |
| MCD5-0595C | 595 A | 515 A | 419 A |
| MCD5-0619C | 619 A | 532 A | 437 A |
| MCD5-0790C | 790 A | 694 A | 567 A |
| MCD5-0927C | 927 A | 800 A | 644 A |
| MCD5-1200C | 1200 A | 1135 A | 983 A |
| MCD5-1410C | 1410 A | 1187 A | 1023 A |
| MCD5-1600C | 1600 A | 1433 A | 1227 A |

### 4.4.4 AC-53 Rating for Continuous Operation



245 A : AC-53a : 4.5-30 : 70-10

Starter Current Rating
Start Current (multiple of FLC)
Start Time (seconds)
On-load Duty Cycle
Starts Per Hour

177HA280.11
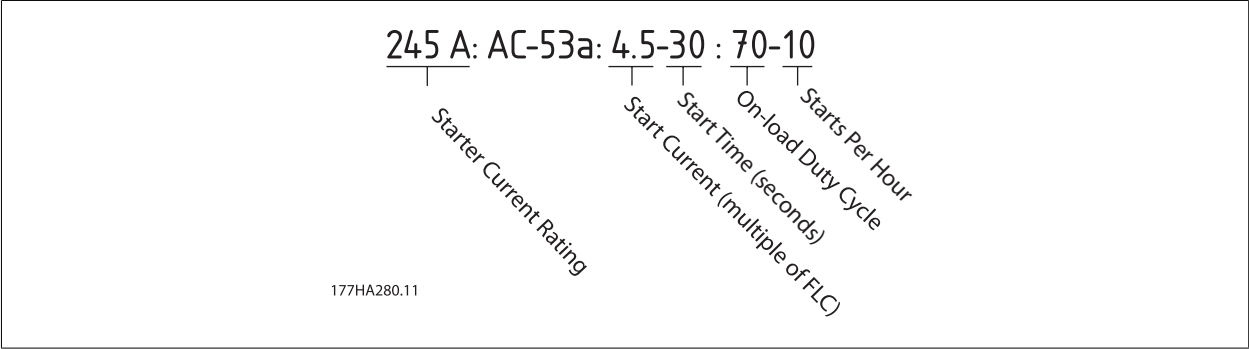
All ratings are calculated at altitude of 1000 metres and ambient temperature of 40° C.

### 4.4.5 Inside Delta Connection (Bypassed)

**NB!**

Models MCD5-0021B ~ MCD5-0215B are internally bypassed. Models MCD5-0245C ~ MCD5-1600C require an external bypass contactor.

| | AC-53b 3-30:330 | AC-53b 4.20-:340 | AC-53b 4.5-30:330 |
|---|---|---|---|
| MCD5-0021B | 32 A | 26 A | 22 A |
| MCD5-0037B | 56 A | 47 A | 39 A |
| MCD5-0043B | 65 A | 56 A | 45 A |
| MCD5-0053B | 80 A | 69 A | 55 A |
| | **AC-53b 3-30:570** | **AC-53b 4-20:580** | **AC-53b 4.5-30:570** |
| MCD5-0068B | 102 A | 83 A | 71 A |
| MCD5-0084B | 126 A | 104 A | 87 A |
| MCD5-0089B | 134 A | 112 A | 92 A |
| MCD5-0105B | 158 A | 143 A | 117 A |
| MCD5-0131B | 197 A | 159 A | 136 A |
| MCD5-0141B | 212 A | 181 A | 146 A |
| MCD5-0195B | 293 A | 241 A | 201 A |
| MCD5-0215B | 323 A | 268 A | 223 A |
| MCD5-0245C | 383 A | 302 A | 264 A |
| MCD5-0360C | 540 A | 465 A | 395 A |
| MCD5-0380C | 570 A | 539 A | 449 A |
| MCD5-0428C | 645 A | 552 A | 463 A |
| MCD5-0595C | 930 A | 810 A | 651 A |
| MCD5-0619C | 975 A | 842 A | 683 A |
| MCD5-0790C | 1185 A | 1072 A | 869 A |
| MCD5-0927C | 1395 A | 1244 A | 992 A |
| MCD5-1200C | 1800 A | 1800 A | 1607 A |
| MCD5-1410C | 2115 A | 1979 A | 1671 A |
| MCD5-1600C | 2400 A | 2400 A | 2030 A |

### 4.4.6 AC-53 Rating for Bypassed Operation

141 A : AC-53b : 4.5-30 : 570

Starter Current Rating

Start Current (multiple of FLC)

Start Time (seconds)

Off Time (seconds)

177HA281.11

All ratings are calculated at altitude of 1000 metres and ambient temperature of 40° C.

### 4.4.7 Inside Delta Connection (Non-bypassed/Continuous)

| | AC-53a<br>3-30:50-6 | AC-53a<br>4-20:50-6 | AC-53a<br>4.5-30:50-6 |
|---|---|---|---|
| MCD5-0245C | 368 A | 293 A | 257 A |
| MCD5-0360C | 540 A | 455 A | 389 A |
| MCD5-0380C | 570 A | 522 A | 438 A |
| MCD5-0428C | 643 A | 533 A | 451 A |
| MCD5-0595C | 893 A | 773 A | 629 A |
| MCD5-0619C | 929 A | 798 A | 656 A |
| MCD5-0790C | 1185 A | 1042 A | 851 A |
| MCD5-0927C | 1391 A | 1200 A | 966 A |
| MCD5-1200C | 1800 A | 1702 A | 1474 A |
| MCD5-1410C | 2115 A | 1780 A | 1535 A |
| MCD5-1600C | 2400 A | 2149 A | 1841 A |

### 4.4.8 AC-53 Rating for Continuous Operation

245 A : AC-53a : 4.5-30 : 70-10

Starter Current Rating
Start Current (multiple of FLC)
Start Time (seconds)
On-load Duty Cycle
Starts Per Hour

177HA280.11
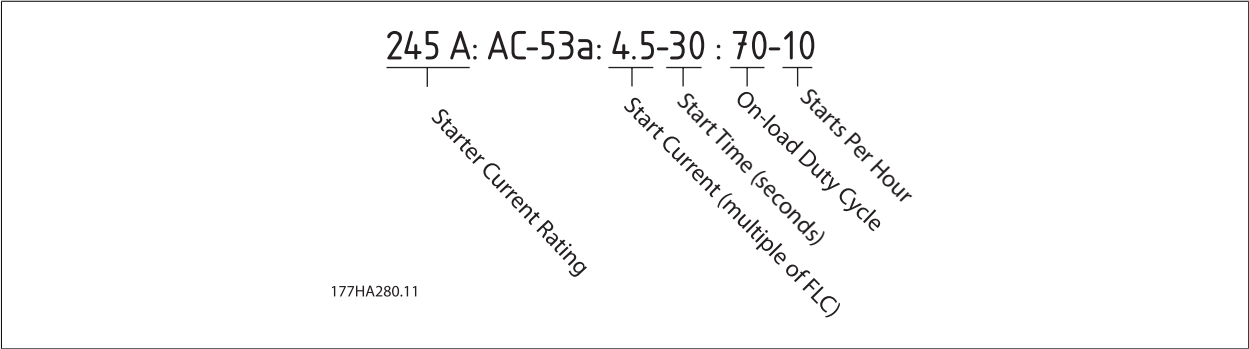
All ratings are calculated at altitude of 1000 metres and ambient temperature of 40° C.

## 4.4  Minimum and Maximum Current Settings

The MCD 500's minimum and maximum full load current settings depend on the model:

| Model | In-line Connection | | Inside Delta Connection | |
|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum |
| MCD5-0021B | 5 A | 23 A | 7 A | 34 A |
| MCD5-0037B | 9 A | 43 A | 13 A | 64 A |
| MCD5-0043B | 10 A | 50 A | 15 A | 75 A |
| MCD5-0053B | 11 A | 53 A | 16 A | 79 A |
| MCD5-0068B | 15 A | 76 A | 23 A | 114 A |
| MCD5-0084B | 19 A | 97 A | 29 A | 145 A |
| MCD5-0089B | 20 A | 100 A | 30 A | 150 A |
| MCD5-0105B | 21 A | 105 A | 32 A | 157 A |
| MCD5-0131B | 29 A | 145 A | 44 A | 217 A |
| MCD5-0141B | 34 A | 170 A | 51 A | 255 A |
| MCD5-0195B | 40 A | 200 A | 60 A | 300 A |
| MCD5-0215B | 44 A | 220 A | 66 A | 330 A |
| MCD5-0245B | 51 A | 255 A | 77 A | 382 A |
| MCD5-0360B | 72 A | 360 A | 108 A | 540 A |
| MCD5-0380B | 76 A | 380 A | 114 A | 570 A |
| MCD5-0428B | 86 A | 430 A | 129 A | 645 A |
| MCD5-0595B | 124 A | 620 A | 186 A | 930 A |
| MCD5-0619B | 130 A | 650 A | 195 A | 975 A |
| MCD5-0790B | 158 A | 790 A | 237 A | 1185 A |
| MCD5-0927B | 186 A | 930 A | 279 A | 1395 A |
| MCD5-1200B | 240 A | 1200 A | 360 A | 1800 A |
| MCD5-1410B | 282 A | 1410 A | 423 A | 2115 A |
| MCD5-1600B | 320 A | 1600 A | 480 A | 2400 A |

**4**

## 4.5  Bypass Contactor

MCD 500 soft starters with model numbers MCD5-0021B - MCD5-0215B are internally bypassed and do not require an external bypass contactor.

MCD 500 soft starters with model numbers MCD5-0245C - MCD5-1600C are not internally bypassed and may be installed with an external bypass contactor. Select a contactor with an AC1 rating greater than or equal to the full load current rating of the connected motor.

## 4.6  Main Contactor

A main contactor must be installed if the MCD 500 is connected to the motor in inside delta format and is optional for in-line connection. Select a contactor with an AC3 rating greater than or equal to the full load current rating of the connected motor.

## 4.7  Circuit Breaker

A shunt trip circuit breaker may be used instead of a main contactor to isolate the motor circuit in the event of a soft starter trip. The shunt trip mechanism must be powered from the supply side of the circuit breaker or from a separate control supply.

## 4.8  Power Factor Correction

If power factor correction is used, a dedicated contactor should be used to switch in the capacitors. 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.

## 4.9 Fuses

Semiconductor fuses can be used for Type 2 coordination and to reduce the risk of damage to SCRs from transient overload currents.

HRC fuses (such as Ferraz AJT fuses) can be used for Type 1 coordination.

> **NB!**
> Adaptive Acceleration Control (AAC) controls the motor's speed profile, within the programmed time limit. This may result in a higher level of current than traditional control methods.

For applications using Adaptive Acceleration Control to soft stop the motor with stop times greater than 30 seconds, motor branch protection should be selected as follows:

- Standard HRC line fuses: Minimum 150% motor full load current
- Motor rated line fuses: Minimum rating 100/150% motor full load current
- Motor control circuit breaker minimum long time setting: 150% motor full load current
- Motor control circuit breaker minimum short time setting: 400% motor full load current for 30 seconds

Fuses recommendations are calculated for 40° C, up to 1000 m.

> **NB!**
> Fuse selection is based on a 400% FLC start for 20 seconds in conjunction with standard published starts per hour, duty cycle, 40° C ambient temperature and up to 1000 m altitude. For installations operating outside these conditions, consult your local supplier.
> **NB!**
> These fuse tables contain recommendations only, always consult your local supplier to confirm the selection for your particular application.

For models marked - there is no suitable fuse.

### 4.10.1 Bussman Fuses - Square Body (170M)

| Model | SCR I²t (A²s) | Supply Voltage (≤ 440 VAC) | Supply Voltage (≤ 575 VAC) | Supply Voltage (≤ 690 VAC) |
|---|---|---|---|---|
| MCD5-0021B | 1150 | 170M1314 | 170M1314 | 170M1314 |
| MCD5-0037B | 8000 | 170M1316 | 170M1316 | 170M1316 |
| MCD5-0043B | 10500 | 170M1318 | 170M1318 | 170M1318 |
| MCD5-0053B | 15000 | 170M1318 | 170M1318 | 170M1318 |
| MCD5-0068B | 15000 | 170M1319 | 170M1319 | 170M1318 |
| MCD5-0084B | 512000 | 170M1321 | 170M1321 | 170M1319 |
| MCD5-0089B | 80000 | 170M1321 | 170M1321 | 170M1321 |
| MCD5-0105B | 125000 | 170M1321 | 170M1321 | 170M1321 |
| MCD5-0131B | 125000 | 170M1321 | 170M1321 | 170M1321 |
| MCD5-0141B | 320000 | 170M2621 | 170M2621 | 170M2621 |
| MCD5-0195B | 320000 | 170M2621 | 170M2621 | 170M2621 |
| MCD5-0215B | 320000 | 170M2621 | 170M2621 | 170M2621 |
| MCD5-0245C | 320000 | 170M2621 | 170M2621 | 170M2621 |
| MCD5-0360C | 238000 | 170M6010 | 170M6010 | 170M6010 |
| MCD5-0380C | 320000 | 170M6011 | 170M6011 | - |
| MCD5-0428C | 320000 | 170M6011 | 170M6011 | - |
| MCD5-0595C | 1200000 | 170M6015 | 170M6015 | 170M6014 |
| MCD5-0619C | 1200000 | 170M6015 | 170M6015 | 170M6014 |
| MCD5-0790C | 2530000 | 170M6017 | 170M6017 | 170M6016 |
| MCD5-0927C | 4500000 | 170M6019 | 170M6019 | 170M6019 |
| MCD5-1200C | 4500000 | 170M6021 | - | - |
| MCD5-1410C | 6480000 | - | - | - |
| MCD5-1600C | 12500000 | 170M6019* | - | - |

* Two parallel connected fuses required per phase.

**4**

### 4.10.2 Bussman Fuses - British Style (BS88)

| Model | SCR I$^2$t (A$^2$s) | Supply Voltage (< 440 VAC) | Supply Voltage (< 575 VAC) | Supply Voltage (< 690 VAC) |
|---|---|---|---|---|
| MCD5-0021B | 1150 | 63FE | 63FE | 63FE |
| MCD5-0037B | 8000 | 120FEE | 120FEE | 120FEE |
| MCD5-0043B | 10500 | 120FEE | 120FEE | 120FEE |
| MCD5-0053B | 15000 | 200FEE | 200FEE | 200FEE |
| MCD5-0068B | 15000 | 200FEE | 200FEE | 200FEE |
| MCD5-0084B | 512000 | 200FEE | 200FEE | 200FEE |
| MCD5-0089B | 80000 | 280FM | 280FM | 280FM |
| MCD5-0105B | 125000 | 280FM | 280FM | 280FM |
| MCD5-0131B | 125000 | 280FM | 280FM | 280FM |
| MCD5-0141B | 320000 | 450FMM | 450FMM | 450FMM |
| MCD5-0195B | 320000 | 450FMM | 450FMM | 450FMM |
| MCD5-0215B | 320000 | 450FMM | 450FMM | 450FMM |
| MCD5-0245C | 320000 | 450FMM | 450FMM | 450FMM |
| MCD5-0360C | 238000 | - | - | - |
| MCD5-0380C | 320000 | 400FMM* | 400FMM | 400FMM* |
| MCD5-0428C | 320000 | - | - | - |
| MCD5-0595C | 1200000 | 630FMM* | 630FMM* | - |
| MCD5-0619C | 1200000 | 630FMM* | 630FMM* | - |
| MCD5-0790C | 2530000 | - | - | - |
| MCD5-0927C | 4500000 | - | - | - |
| MCD5-1200C | 4500000 | - | - | - |
| MCD5-1410C | 6480000 | - | - | - |
| MCD5-1600C | 12500000 | - | - | - |

* Two parallel connected fuses required per phase.

### 4.10.3 Ferraz Fuses - HSJ

| Model | SCR I²t (A²s) | Supply Voltage (< 440 VAC) | Supply Voltage (< 575 VAC) | Supply Voltage (< 690 VAC) |
|---|---|---|---|---|
| MCD5-0021B | 1150 | HSJ40** | HSJ40** | |
| MCD5-0037B | 8000 | HSJ80** | HSJ80** | |
| MCD5-0043B | 10500 | HSJ90** | HSJ90** | |
| MCD5-0053B | 15000 | HSJ110** | HSJ110** | |
| MCD5-0068B | 15000 | HSJ125** | HSJ125** | |
| MCD5-0084B | 51200 | HSJ175 | HSJ175** | |
| MCD5-0089B | 80000 | HSJ175 | HSJ175 | |
| MCD5-0105B | 125000 | HSJ225 | HSJ225 | |
| MCD5-0131B | 125000 | HSJ250 | HSJ250** | |
| MCD5-0141B | 320000 | HSJ300 | HSJ300 | |
| MCD5-0195B | 320000 | HSJ350 | HSJ350 | Not suitable |
| MCD5-0215B | 320000 | HSJ400** | HSJ400** | |
| MCD5-0245C | 320000 | HSJ450** | HSJ450** | |
| MCD5-0360C | 238000 | | | |
| MCD5-0380C | 320000 | | | |
| MCD5-0428C | 320000 | | | |
| MCD5-0595C | 1200000 | | | |
| MCD5-0619C | 1200000 | Not suitable | Not suitable | |
| MCD5-0790C | 2530000 | | | |
| MCD5-0927C | 4500000 | | | |
| MCD5-1200C | 4500000 | | | |
| MCD5-1410C | 6480000 | | | |
| MCD5-1600C | 12500000 | | | |

** Two series connected fuses required per phase,

### 4.10.4 Ferraz Fuses - North American Style (PSC 690)

| Model | SCR I²t (A²s) | Supply Voltage < 440 VAC | Supply Voltage < 575 VAC | Supply Voltage < 690 VAC |
|---|---|---|---|---|
| MCD5-0021B | 1150 | A070URD30XXX0063 | A070URD30XXX0063 | - |
| MCD5-0037B | 8000 | A070URD30XXX0125 | A070URD30XXX0125 | A070URD30XXX0125 |
| MCD5-0043B | 10500 | A070URD30XXX0125 | A070URD30XXX0125 | A070URD30XXX0125 |
| MCD5-0053B | 15000 | A070URD30XXX0125 | A070URD30XXX0125 | A070URD30XXX0125 |
| MCD5-0068B | 15000 | A070URD30XXX0160 | A070URD30XXX0160 | A070URD30XXX0160 |
| MCD5-0084B | 51200 | A070URD30XXX0200 | A070URD30XXX0200 | A070URD30XXX0200 |
| MCD5-0089B | 80000 | A070URD30XXX0200 | A070URD30XXX0200 | A070URD30XXX0200 |
| MCD5-0105B | 125000 | A070URD30XXX0315 | A070URD30XXX0315 | A070URD30XXX0315 |
| MCD5-0131B | 125000 | A070URD30XXX0315 | A070URD30XXX0315 | A070URD30XXX0315 |
| MCD5-0141B | 320000 | A070URD30XXX0315 | A070URD30XXX0315 | A070URD30XXX0315 |
| MCD5-0195B | 320000 | A070URD30XXX0450 | A070URD30XXX0450 | A070URD30XXX0450 |
| MCD5-0215B | 320000 | A070URD30XXX0450 | A070URD30XXX0450 | A070URD30XXX0450 |
| MCD5-0245C | 320000 | A070URD30XXX0450 | A070URD30XXX0450 | A070URD30XXX0450 |
| MCD5-0360C | 238000 | A070URD33XXX0630 | A070URD33XXX0630 | A070URD33XXX0630 |
| MCD5-0380C | 320000 | A070URD33XXX0700 | A070URD33XXX0700 | - |
| MCD5-0428C | 320000 | A070URD33XXX0700 | A070URD33XXX0700 | - |
| MCD5-0595C | 1200000 | A070URD33XXX1000 | A070URD33XXX1000 | A070URD33XXX1000 |
| MCD5-0619C | 1200000 | A070URD33XXX1000 | A070URD33XXX1000 | A070URD33XXX1000 |
| MCD5-0790C | 2530000 | A070URD33XXX1400 | A070URD33XXX1400 | A070URD33XXX1400 |
| MCD5-0927C | 4500000 | A070URD33XXX1400 | A070URD33XXX1400 | A070URD33XXX1400 |
| MCD5-1200C | 4500000 | A055URD33XXX2250 | - | - |
| MCD5-1410C | 6480000 | A055URD33XXX2250 | - | - |
| MCD5-1600C | 12500000 | - | - | - |

XXX = blade type. Refer to Ferraz catalog for details.

### 4.10.5  Ferraz Fuses - European Style (PSC 690)

| Model | SCR I²t (A²s) | Supply Voltage < 440 VAC | Supply Voltage < 575 VAC | Supply Voltage < 690 VAC |
|---|---|---|---|---|
| MCD5-0021B | 1150 | 6.9URD30D11A0050 | 6.9URD30D11A0050 | 6.9URD30D11A0050 |
| MCD5-0037B | 8000 | 6.9URD30D11A0125 | 6.9URD30D11A0125 | 6.9URD30D11A0125 |
| MCD5-0043B | 10500 | 6.9URD30D11A0125 | 6.9URD30D11A0125 | 6.9URD30D11A0125 |
| MCD5-0053B | 15000 | 6.9URD30D11A0125 | 6.9URD30D11A0125 | 6.9URD30D11A0125 |
| MCD5-0068B | 15000 | 6.9URD30D11A0160 | 6.9URD30D11A0160 | 6.9URD30D11A0160 |
| MCD5-0084B | 51200 | 6.9URD30D11A0200 | 6.9URD30D11A0200 | 6.9URD30D11A0200 |
| MCD5-0089B | 80000 | 6.9URD30D11A0200 | 6.9URD30D11A0200 | 6.9URD30D11A0200 |
| MCD5-0105B | 125000 | 6.9URD30D11A0315 | 6.9URD30D11A0315 | 6.9URD30D11A0315 |
| MCD5-0131B | 125000 | 6.9URD30D11A0315 | 6.9URD30D11A0315 | 6.9URD30D11A0315 |
| MCD5-0141B | 320000 | 6.9URD30D11A0315 | 6.9URD30D11A0315 | 6.9URD30D11A0315 |
| MCD5-0195B | 320000 | 6.9URD31D11A0450 | 6.9URD31D11A0450 | 6.9URD31D11A0450 |
| MCD5-0215B | 320000 | 6.9URD31D11A0450 | 6.9URD31D11A0450 | 6.9URD31D11A0450 |
| MCD5-0245C | 320000 | 6.9URD31D11A0450 | 6.9URD31D11A0450 | 6.9URD31D11A0450 |
| MCD5-0360C | 238000 | 6.9URD33D11A0630 | 6.9URD33D11A0630 | 6.9URD33D11A0630 |
| MCD5-0380C | 320000 | 6.9URD33D11A0700 | 6.9URD33D11A0700 | 6.9URD33D11A0700 |
| MCD5-0428C | 320000 | 6.9URD33D11A0700 | 6.9URD33D11A0700 | 6.9URD33D11A0700 |
| MCD5-0595C | 1200000 | 6.9URD33D11A1000 | 6.9URD33D11A1000 | 6.9URD33D11A1000 |
| MCD5-0619C | 1200000 | 6.9URD33D11A1000 | 6.9URD33D11A1000 | 6.9URD33D11A1000 |
| MCD5-0790C | 2530000 | 6.6URD33D11A1400 | 6.6URD33D11A1400 | - |
| MCD5-0927C | 4500000 | 6.6URD33D11A1400 | 6.6URD33D11A1400 | - |
| MCD5-1200C | 4500000 | 6.9URD233PLAF2200 | 6.9URD233PLAF2200 | - |
| MCD5-1410C | 6480000 | 6.9URD233PLAF2200 | 6.9URD233PLAF2200 | 6.9URD233PLAF2200 |
| MCD5-1600C | 12500000 | 6URD233PLAF2800 | 6URD233PLAF2800 | - |

### 4.10.6 Ferraz Fuses - AJT

| Model | SCR I²t (A²s) | Supply Voltage ≤ 440 VAC | Supply Voltage ≤ 575 VAC | Supply Voltage ≤ 690 VAC |
|---|---|---|---|---|
| MCD5-0021B | 1150 | AJT25 | AJT25 | |
| MCD5-0037B | 8000 | AJT50 | AJT50 | |
| MCD5-0043B | 10500 | AJT50 | AJT50 | |
| MCD5-0053B | 15000 | AJT60 | AJT60 | |
| MCD5-0068B | 15000 | AJT80 | AJT80 | |
| MCD5-0084B | 512000 | AJT100 | AJT100 | |
| MCD5-0089B | 80000 | AJT100 | AJT100 | |
| MCD5-0105B | 125000 | AJT125 | AJT125 | |
| MCD5-0131B | 125000 | AJT150 | AJT150 | |
| MCD5-0141B | 320000 | AJT175 | AJT175 | |
| MCD5-0195B | 320000 | AJT200 | AJT200 | |
| MCD5-0215B | 320000 | AJT250 | AJT250 | Not suitable |
| MCD5-0245C | 320000 | AJT300 | AJT300 | |
| MCD5-0360C | 238000 | AJT400 | AJT400 | |
| MCD5-0380C | 320000 | AJT450 | AJT450 | |
| MCD5-0428C | 320000 | AJT450 | AJT450 | |
| MCD5-0595C | 1200000 | A4BQ600 | A4BQ600 | |
| MCD5-0619C | 1200000 | A4BQ800 | A4BQ800 | |
| MCD5-0790C | 2530000 | A4BQ1200 | A4BQ1200 | |
| MCD5-0927C | 4500000 | A4BQ1200/ A4BT1100 | A4BQ1200 A4BT1100 | |
| MCD5-1200C | 4500000 | A4BQ1600 | A4BQ1600 | |
| MCD5-1410C | 6480000 | A4BQ2000 | A4BQ2000 | |
| MCD5-1600C | 12500000 | A4BQ2500 | A4BQ2500 | |

## 4.10  Schematic Diagrams

### 4.11.1  Internally Bypassed Models



| | |
|---|---|
| **1** | Control supply (model dependent) |
| **2** | Outputs |
| 07, 08 | Programmable analog output |
| 16, 08 | 24 VDC output |
| **3** | Remote control inputs |
| 11, 16 | Programmable input |
| 15, 16 | Start |
| 17, 18 | Stop |
| 25, 18 | Reset |
| **4** | Motor thermistor input (PTC only) |
| **5** | Relay outputs |
| 13, 14 | Relay output A |
| 21, 22, 24 | Relay output B |
| 33, 34 | Relay output C |

## 4.11.2 Non-bypassed Models



| **1** | Control supply (model dependent) |
|---|---|
| **2** | Outputs |
| 07, 08 | Programmable analog output |
| 16, 08 | 24 VDC output |
| **3** | Remote control inputs |
| 11, 16 | Programmable input |
| 15, 16 | Start |
| 17, 18 | Stop |
| 25, 18 | Reset |
| **4** | Motor thermistor input (PTC only) |
| **5** | Relay outputs |
| 13, 14 | Relay output A |
| 21, 22, 24 | Relay output B |
| 33, 34 | Relay output C |

**NB!**
* MCD5-0245C current transformers are located on the output. Bypass terminals are labelled T1B, T2B and T3B.

# 5 Application Examples

## 5.1 Motor Overload Protection

Motor overload protection in the MCD 500 uses a second order thermal model. This calculates the motor temperature based on the thermal properties of two components:

- Motor Body: This has a large thermal capacity and affects the long term behaviour of the motor.

- Motor windings: These have a low thermal capacity and affects the short term thermal behaviour of the motor.

The thermal model also takes into account the influence of motor current, iron losses, winding resistance losses, and different cooling rates during run and at standstill.

The value displayed on the LCP is the value of the winding model as a percentage of the rated capacity of the motor.

The MCD 500 calculates the motor's thermal capacity based on the settings in *Primary Motor Set*.
Par. 1-1 *Motor FLC* should be set to the motor's rated FLC. Do not add the overload rating as this is computed by the MCD-500.

## 5.2 AAC Adaptive Acceleration Control

AAC Adaptive Acceleration Control is a new form of motor control based on the motor's own performance characteristics. With AAC, the user selects the starting or stopping profile that best matches the load type and the starter automatically controls the motor to match the profile. The MCD 500 offers three profiles - early, constant and late acceleration and deceleration.

AAC uses two algorithms, one to measure the motor's characteristics and one to control the motor. The MCD 500 uses the first start to determine the motor's characteristics at zero speed and at maximum speed. During each subsequent start and stop, the starter dynamically adjusts its control to ensure the motor's actual performance matches the selected profile throughout the start. The starter increases power to the motor if the actual speed is too low for the profile, or decreases power if the speed is too high.

## 5.3 Starting Modes

### 5.3.1 Constant Current

Constant current is the traditional form of soft starting, which raises the current from zero to a specified level and keeps the current stable at that level until the motor has accelerated.

Constant current starting is ideal for applications where the start current must be kept below a particular level.



1: Initial current (Par. 1-5)
2: Current limit (Par. 1-4)
3: Full voltage current
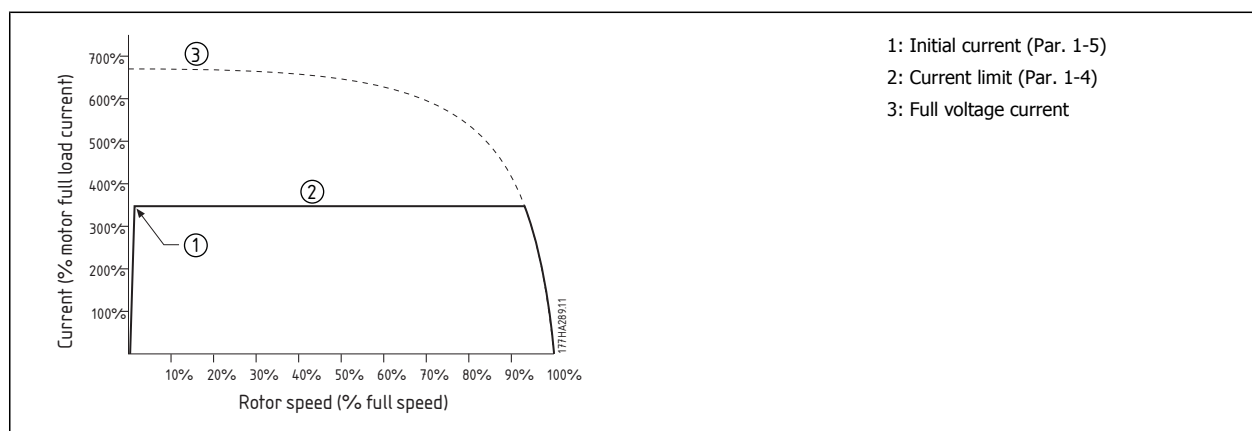
### 5.3.2 Current Ramp

Current ramp soft starting raises the current from a specified starting level (1) to a maximum limit (3), over an extended period of time (2).

Current ramp starting can be useful for applications where:

- the load can vary between starts (for example a conveyor which may start loaded or unloaded). Set the initial current (Par. 1-5) to a level that will start the motor with a light load, and the current limit (Par. 1-4) to a level that will start the motor with a heavy load.
- the load breaks away easily, but starting time needs to be extended (for example a centrifugal pump where pipeline pressure needs to build up slowly).
- the electricity supply is limited (for example a generator set), and a slower application of load will allow greater time for the supply to respond.
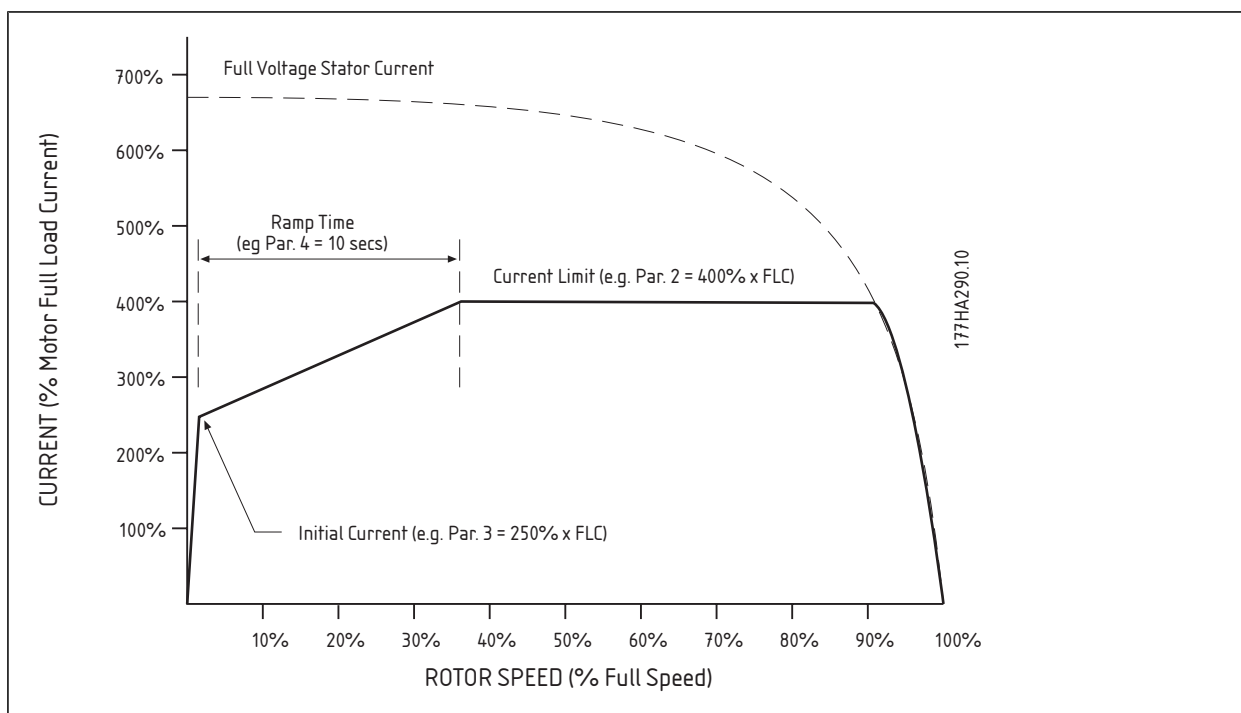


### 5.3.3 AAC Adaptive Acceleration Control

To use AAC Adaptive Acceleration Control to control starting performance:

1. Select Adaptive Control from the Start Mode menu (Par. 1-3)
2. Set the desired Start Ramp Time (Par. 1-6)
3. Select the desired Adaptive Start Profile (Par. 1-13)
4. Set a start Current Limit (Par. 1-4) sufficiently high to allow a successful start. The first AAC start will be a Constant Current start. This allows the MCD 500 to learn the characteristics of the connected motor. This motor data is used by the MCD 500 during subsequent AAC Adaptive Acceleration Control starts.

Adaptive start profile (Par. 1-13):

1. Early acceleration
2. Constant acceleration
3. Late acceleration
4. Start ramp time (Par. 1-6)

**5**

**NB!**
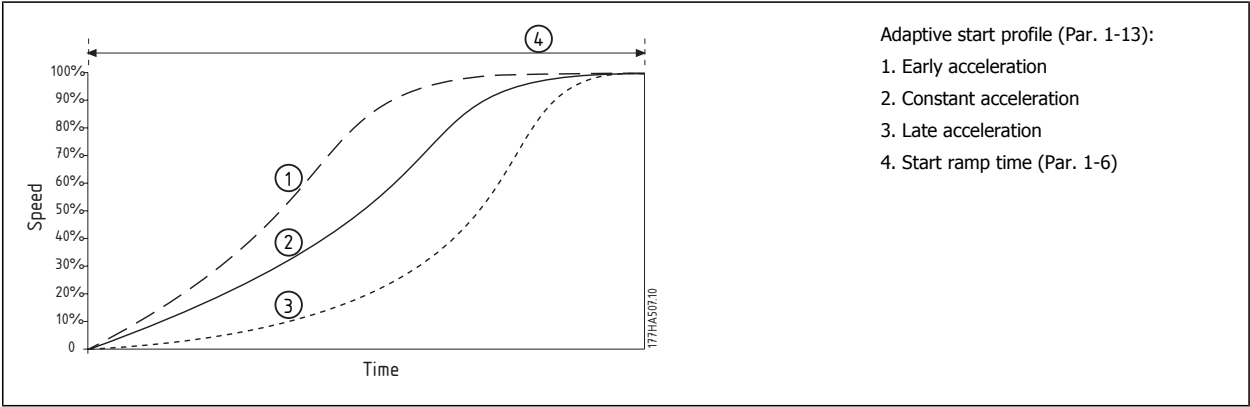
AAC will control the load according to the programmed profile. Start current will vary according to the selected acceleration profile and the programmed start time.

AAC cannot start the motor faster than a direct on-line (DOL) start.

If replacing a motor connected to an MCD-500 programmed for AAC starting or stopping, or if the starter has been tested on a different motor prior to actual installation, the starter will need to learn the characteristics of the new motor. To force the MCD-500 into learn mode, adjust par. 1-12 Adaptive Control Gain as follows:

If 1-12 is at default setting of 75%, adjust to 76%.

If 1-12 is not at default setting of 75%, adjust to 75%.

### 5.3.4 Kickstart

Kickstart provides a short boost of extra torque at the beginning of a start, and can be used in conjunction with current ramp or constant current starting.

Kickstart can be useful to help start loads that require high breakaway torque but then accelerate easily (for example flywheel loads such as presses).



1: Kickstart level (Par. 1-7)
2: Kickstart time (Par. 1-8)
3: Initial current (Par. 1-5)
4: Start ramp time (Par. 1-6)
5: Current limit (Par. 1-4)
6: Full voltage current

## 5.4 Stopping Modes

### 5.4.1 Coast to Stop

Coast to stop lets the motor slow at its natural rate, with no control from the soft starter. The time required to stop will depend on the type of load.

**5**

### 5.4.2 TVR Soft Stop

Timed voltage ramp reduces the voltage to the motor gradually over a defined time. The load may continue to run after the stop ramp is complete.

Timed voltage ramp stopping can be useful for applications where the stop time needs to be extended, or to avoid transients on generator set supplies.
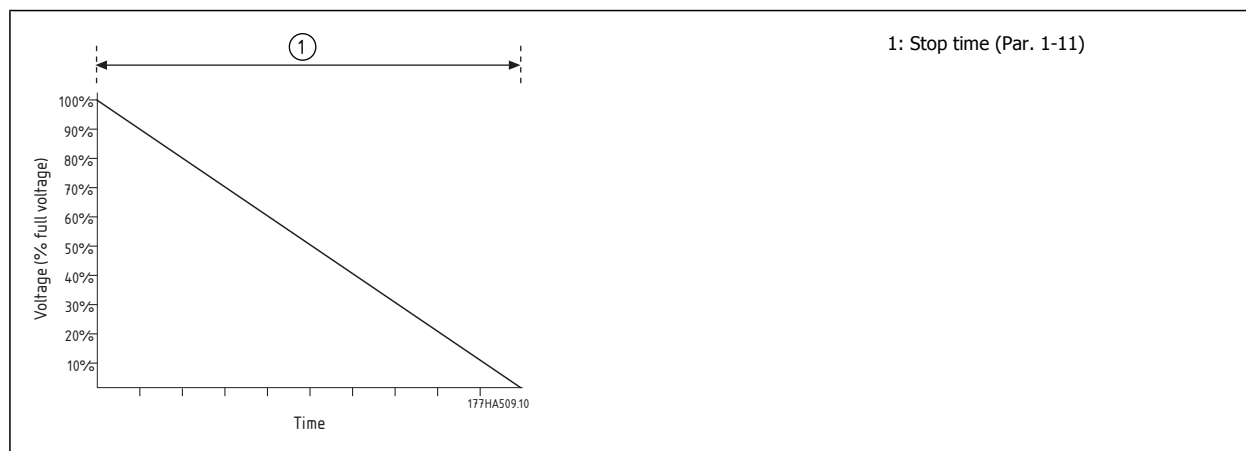


1: Stop time (Par. 1-11)

### 5.4.3 AAC Adaptive Acceleration Control

To use AAC Adaptive Acceleration Control to control stopping performance:

1. Select Adaptive Control from the Stop Mode menu (Par. 1-10)

2. Set the desired Stop Time (Par. 1-11)

3. Select the required Adaptive Stop Profile (Par. 1-14)



AAC Adaptive stop profile (Par. 1-14):

1. Early deceleration
2. Constant deceleration
3. Late deceleration
4. Stop time (Par. 1-10)
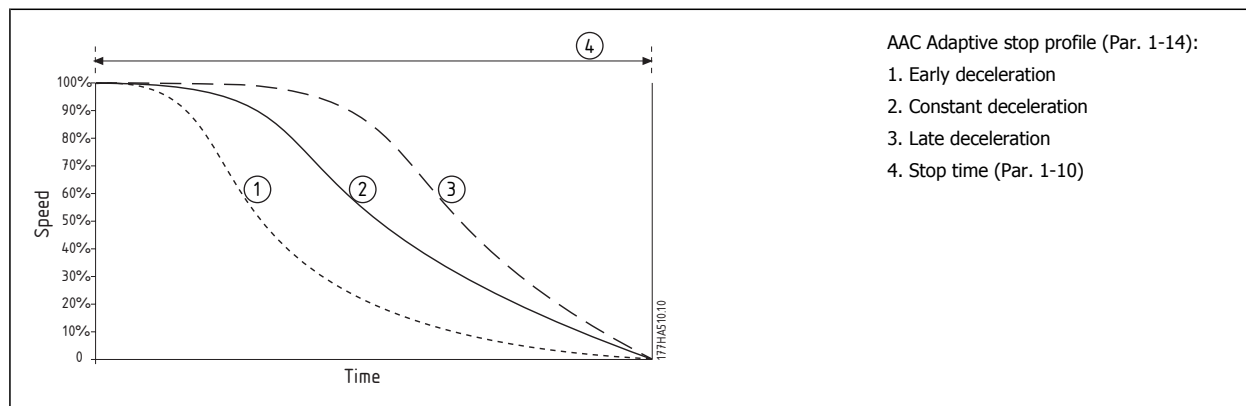
**NB!**
AAC will control the load according to the programmed profile.

**NB!**
AAC does not actively slow the motor down and will not stop the motor faster than a coast to stop. To shorten the stopping time of high inertia loads, use brake.

**NB!**
If replacing a motor connected to an MCD 500 programmed for AAC starting or stopping, or if the starter has been tested on a different motor prior to actual installation, the starter will need to learn the characteristics of the new motor. To force the MCD 500 into learn mode, adjust parameter 1-12 Adaptive Control Gain as follows:

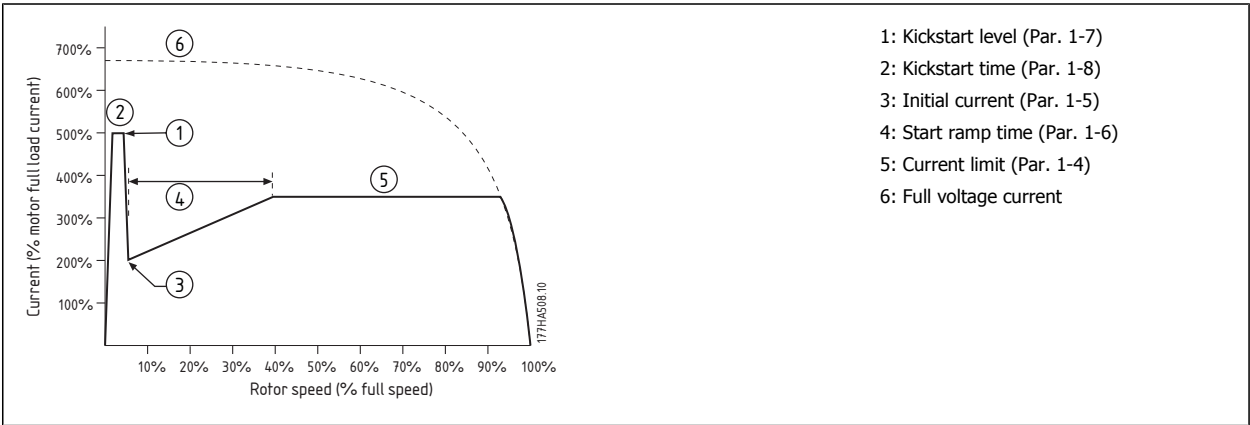If 1-12 is at default setting of 75%, adjust to 76%.

If 1-12 is not at default setting of 75%, adjust to 75%.

### 5.4.4 Brake

---

**NB!**

If the brake torque is set too high, the motor will stop before the end of the brake time and the motor will suffer unnecessary heating which could result in damage.

---

MCD 500 braking:

- Does not require the use of a DC brake contactor

- Controls all three phases so that the braking currents and associated heating is evenly distributed through the motor.



1: Stop time (Par. 1-11)
2: Brake time (Par. 1-16)
3: Coast to stop time
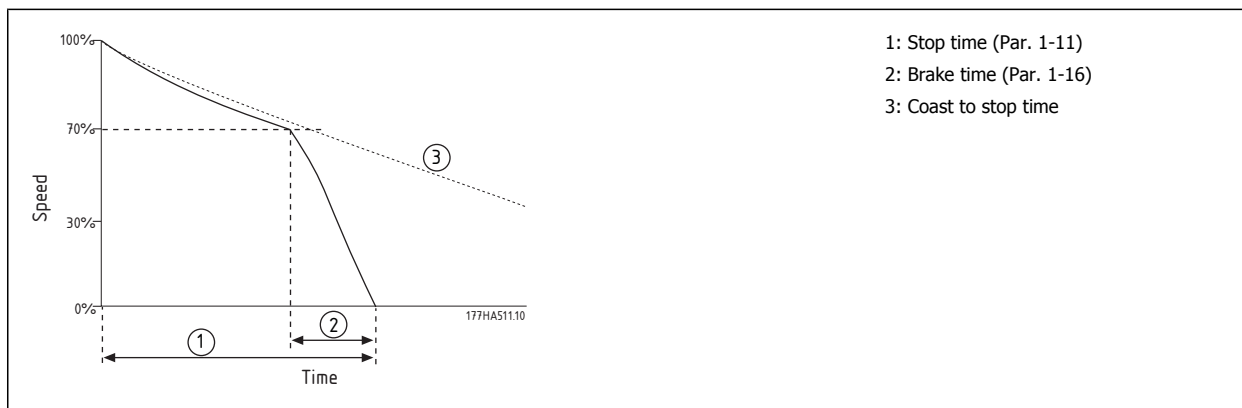
Braking has two stages:

1. Pre-brake: Provides an intermediate level of braking to slow motor speed to a point where full brake can be operated successfully (approximately 70% speed).

2. Full brake: Brake provides maximum braking torque, but is ineffective at speeds greater than approximately 70%.

To configure the MCD 500 for brake operation:

1. Set Par. 1-11 for the desired stopping time duration (1). This is the total braking time and must be set sufficiently longer than the brake time (Par 1-16) to allow the pre-braking stage to reduce motor speed to approximately 70. If the stop time is too short, braking will not be successful and the motor will coast to stop.

2. Set Brake Time (Par. 1-16) to approximately one quarter of the programmed Stop Time. This sets the time for the Full Brake stage (2).

3. Adjust the Brake Torque (Par. 1-15) so that the desired stopping performance is achieved. If set too low, the motor will not stop completely and will coast to stop by the end of the braking period.

Contact your local supplier for further information for installations using an external zero-speed sensor (e.g. applications with variable load during the braking cycle).

## 5.5 Jog Operation

Jog runs the motor at reduced speed, to allow alignment of the load or to assist servicing. The motor can be jogged in either forward or reverse direction.

The maximum available torque for jog is approximately 50% - 75% of motor full load torque (FLT) depending on the motor. Available jog torque in reverse is approximately 50% - 75% of the jog torque in forward direction. To set the jog torque level, use Par. 15-8.

---

**NB!**

Setting Par. 15-8 above 50% may cause increased shaft vibration.

---

**5**



1. Jog Forward
2. Jog Reverse
3. Normal Operation
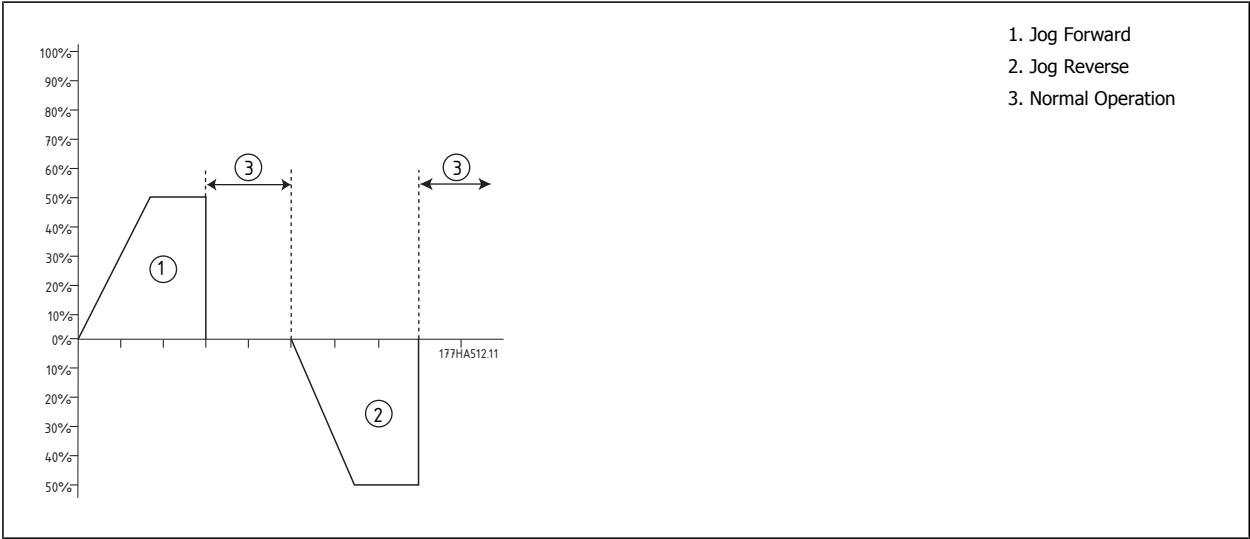
To activate jog operation, use a programmable input (Par. 3-3). If any other command is received when jogging, the starter will stop and await a new command.

---

**NB!**
Jog is only available for the primary motor. Soft start and soft stop are not available during jog operation.

---

Slow speed running is not intended for continuous operation due to reduced motor cooling. Jog changes the motor's heating profile and reduced the accuracy of the motor thermal model. Do not rely on motor overload protection to protection to protect the motor during jog operation.

---

## 5.6 Inside Delta Operation

AAC, Jog and Brake functions are not supported in inside delta (six-wire) operation. If these functions are programmed when the starter is connected inside delta the behaviour is as given below:

| | |
|---|---|
| AAC Start | The starter performs a Constant Current Start. |
| AAC Stop | The starter performs a TVR Soft Stop if Stop Time is >0 secs. If Stop Time is set to 9 secs the starter performs a Coast to Stop. |
| Jog | The starter issues a warning with the error message Unsupported Option. |
| Brake | The starter performs a Coast to Stop. |

---

**NB!**
When connected in inside delta, current imbalance is the only phase loss protection that is active during run. Do not disable current imbalance protection during inside delta operation.

---

Inside delta operation is only possible with mains voltage ≤ 600 VAC.

## 5.7 Typical Start Currents

Use this information to determine the appropriate start current for your application.

**NB!**
These start current requirements are appropriate and typical in most circumstances, However, the performance and start torque requirements of motors and machines do vary. For further assistance, contact your local supplier.

**5**

| Application | Typical Start Current |
|---|---|
| **General & Water** | |
| Agitator | 4.0 x FLC |
| Centrifugal pump | 3.5 x FLC |
| Compressor (Screw, unloaded) | 3.0 x FLC |
| Compressor (Reciprocating, unloaded) | 4.0 x FLC |
| Conveyor | 4.0 x FLC |
| Fan (damped) | 3.5 x FLC |
| Fan (undamped) | 4.5 x FLC |
| Mixer | 4.5 x FLC |
| Positive displacement pump | 4.0 x FLC |
| Submersible pump | 3.0 x FLC |
| **Metals & Mining** | |
| Belt conveyor | 4.5 x FLC |
| Dust collector | 3.5 x FLC |
| Grinder | 3.0 x FLC |
| Hammer mill | 4.5 x FLC |
| Rock crusher | 4.0 x FLC |
| Roller conveyor | 3.5 x FLC |
| Roller mill | 4.5 x FLC |
| Tumbler | 4.0 x FLC |
| Wire draw machine | 5.0 x FLC |
| **Food Processing** | |
| Bottle washer | 3.0 x FLC |
| Centrifuge | 4.0 x FLC |
| Dryer | 4.5 x FLC |
| Mill | 4.5 x FLC |
| Palletiser | 4.5 x FLC |
| Separator | 4.5 x FLC |
| Slicer | 3.0 x FLC |
| **Pulp and Paper** | |
| Dryer | 4.5 x FLC |
| Re-pulper | 4.5 x FLC |
| Shredder | 4.5 x FLC |
| **Petrochemical** | |
| Ball mill | 4.5 x FLC |
| Centrifuge | 4.0 x FLC |
| Extruder | 5.0 x FLC |
| Screw conveyor | 4.0 x FLC |
| **Transport & Machine Tool** | |
| Ball mill | 4.5 x FLC |
| Grinder | 3.5 x FLC |
| Material conveyor | 4.0 x FLC |
| Palletiser | 4.5 x FLC |
| Press | 3.5 x FLC |
| Roller mill | 4.5 x FLC |
| Rotary table | 4.0 x FLC |
| **Lumber & Wood products** | |
| Bandsaw | 4.5 x FLC |
| Chipper | 4.5 x FLC |
| Circular saw | 3.5 x FLC |
| Debarker | 3.5 x FLC |
| Edger | 3.5 x FLC |
| Hydraulic power pack | 3.5 x FLC |
| Planer | 3.5 x FLC |
| Sander | 4.0 x FLC |

## 5.8  Installation with Main Contactor

The MCD 500 is installed with a main contactor (AC3 rated). Control voltage must be supplied from the input side of the contactor.

The main contactor is controlled by the MCD 500 Main Contactor output, which by default is assigned to Output Relay A (terminals 13, 14).

**5**
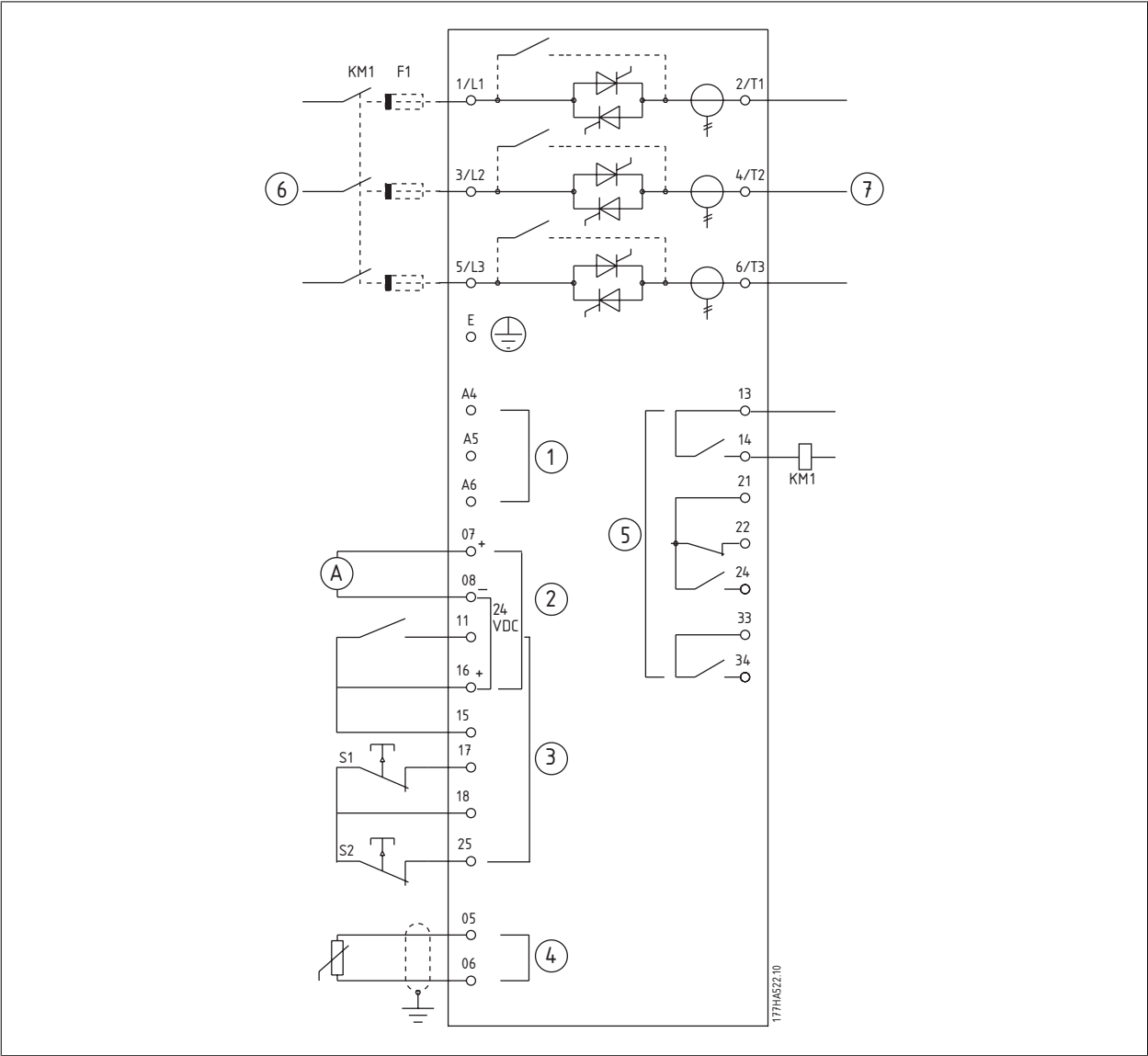


| 1 | Control voltage (model dependent) | KM1 | Main contactor |
|---|---|---|---|
| 2 | 24 VDC output | F1 | Semiconductor fuses (optional) |
| 3 | Remote control inputs | S1 | Start /stop |
| 4 | Motor thermistor input (PTC only) | S2 | Reset contact |
| 5 | Relay outputs | 13, 14 | Relay output A |
| 6 | 3-phase supply | 21, 22, 24 | Relay output B |
| 7 | Motor terminals | 33, 34 | Relay output C |

**Parameter settings:**

- Par. 4-1 *Relay A Function*

    - Select Main Contactor - assigns the Main Contactor function to Relay Output A (default value).

## 5.9 Installation with Bypass Contactor

The MCD 500 is installed with a bypass contactor (AC1 rated). The bypass contactor is controlled by the MCD 500 Run Output which by default is assigned to Output Relay B (terminals 21, 22, 24).
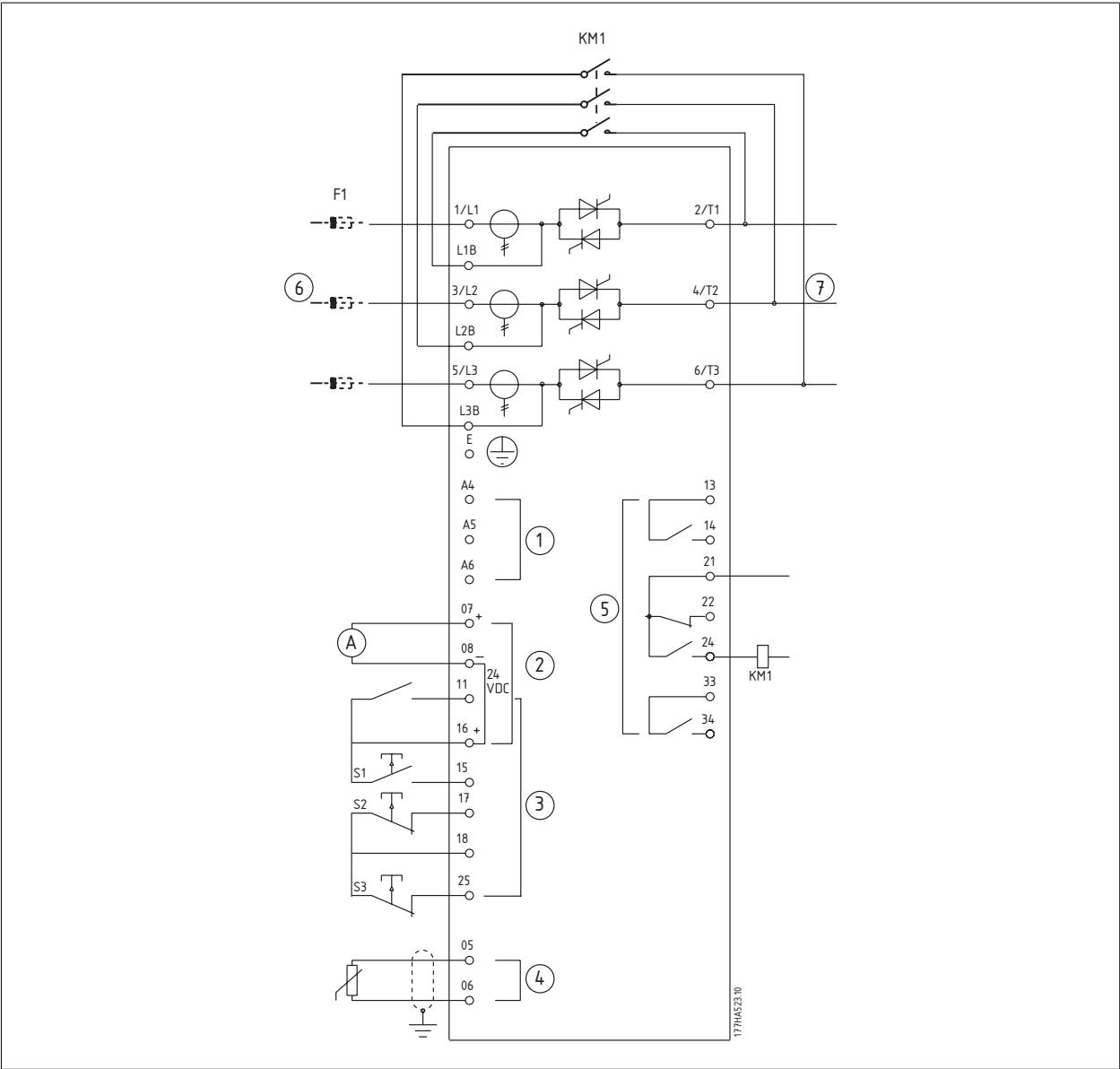


| 1 | Control voltage (model dependent) | KM1 | Bypass contactor |
|---|---|---|---|
| 2 | 24 VDC output | F1 | Semiconductor fuses (optional) |
| 3 | Remote control inputs | S1 | Start contact |
| 4 | Motor thermistor input (PTC only) | S2 | Stop contact |
| 5 | Relay outputs | S3 | Reset contact |
| 6 | 3-phase supply | 13, 14 | Relay output A |
| 7 | Motor terminals | 21, 22, 24 | Relay output B |
| | | 33, 34 | Relay output C |

**Parameter settings:**

- Parameter 4-4 _Relay B Function_

  - Select Run - assigns the run output function to Relay Output B (default value).

## 5.10 Emergency Run Operation

In normal operation the MCD 500 is controlled via a remote two wire signal (terminals 17, 18).

Emergency Run is controlled by a two wire circuit connected to Input A (terminals 11, 16). Closing Input A causes the MCD 500 to run the motor and ignore all trip conditions.
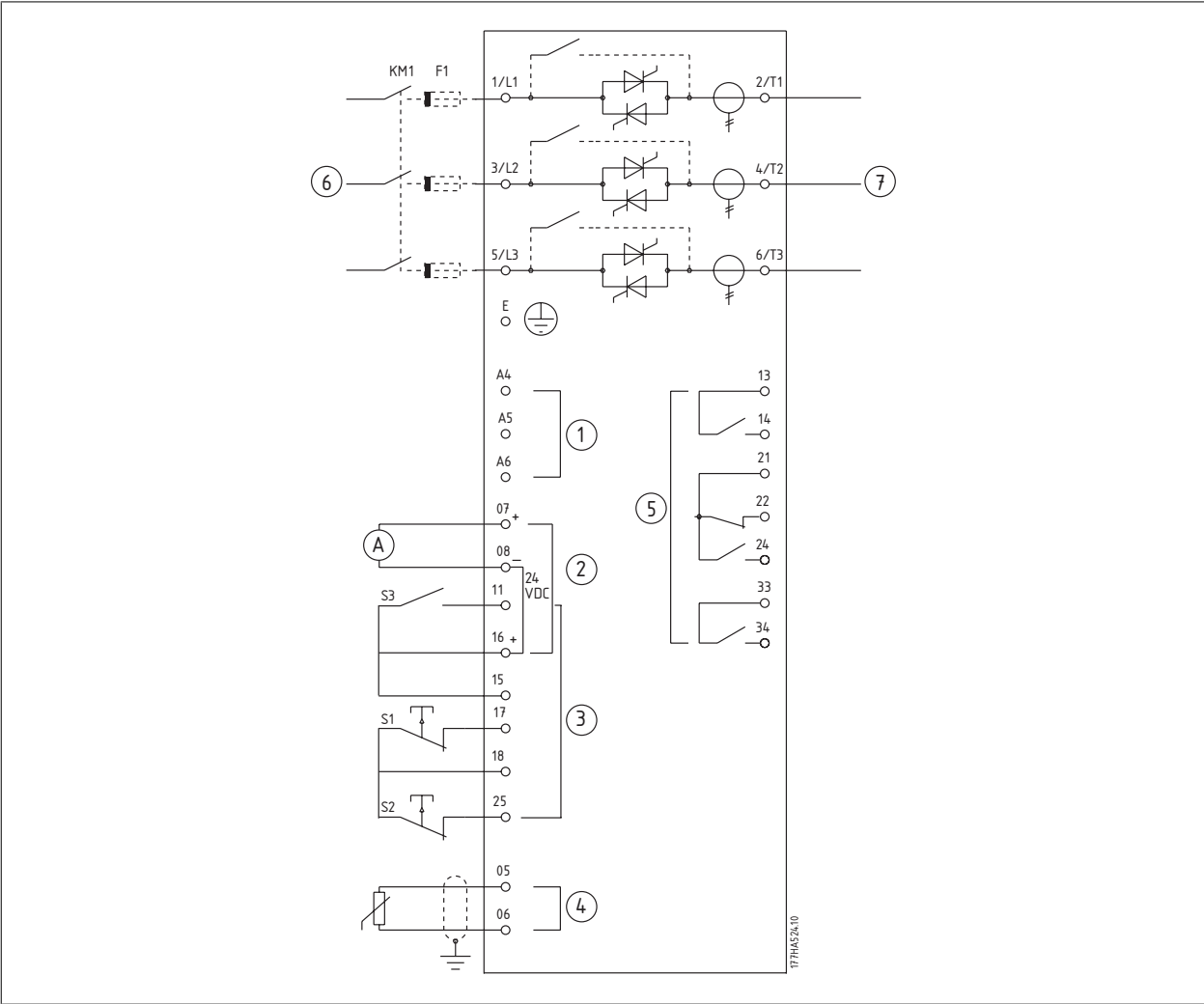


| 1 | Control voltage (model dependent) | S1 | Start/stop contact |
|---|---|---|---|
| 2 | 24 VDC output | S2 | Reset contact |
| 3 | Remote control inputs | S3 | Emergency Run contact |
| 4 | Motor thermistor input (PTC only) | 13, 14 | Relay output A |
| 5 | Relay outputs | 21, 22, 24 | Relay output B |
| 6 | 3-phase supply | 33, 34 | Relay output C |
| 7 | Motor terminals | | |

**Parameter settings:**

- Par. 3-3 *Input A Function*

    - Select Emergency Run - assigns Input A to Emergency Run Function

- Par. 15-3 (*Emergency Run*)

    - Select Enable - Enables the Emergency Run mode

## 5.11 Auxiliary Trip Circuit

In normal operation the MCD 500 is controlled via a remote two wire signal (terminals 17, 18).

Input A (terminals 11, 16) is connected to an external trip circuit (such as a low pressure alarm switch for a pumping system). When the external circuit activates, the soft starter trips, which stops the motor.



| 1 | Control voltage (model dependent) | S1 | Start/stop contact |
|---|---|---|---|
| 2 | 24 VDC output | S2 | Reset contact |
| 3 | Remote control inputs | S3 | Auxiliary trip contact |
| 4 | Motor thermistor input (PTC only) | 13, 14 | Relay output A |
| 5 | Relay outputs | 21, 22, 24 | Relay output B |
| 6 | 3-phase supply | 33, 34 | Relay output C |
| 7 | Motor terminals | | |
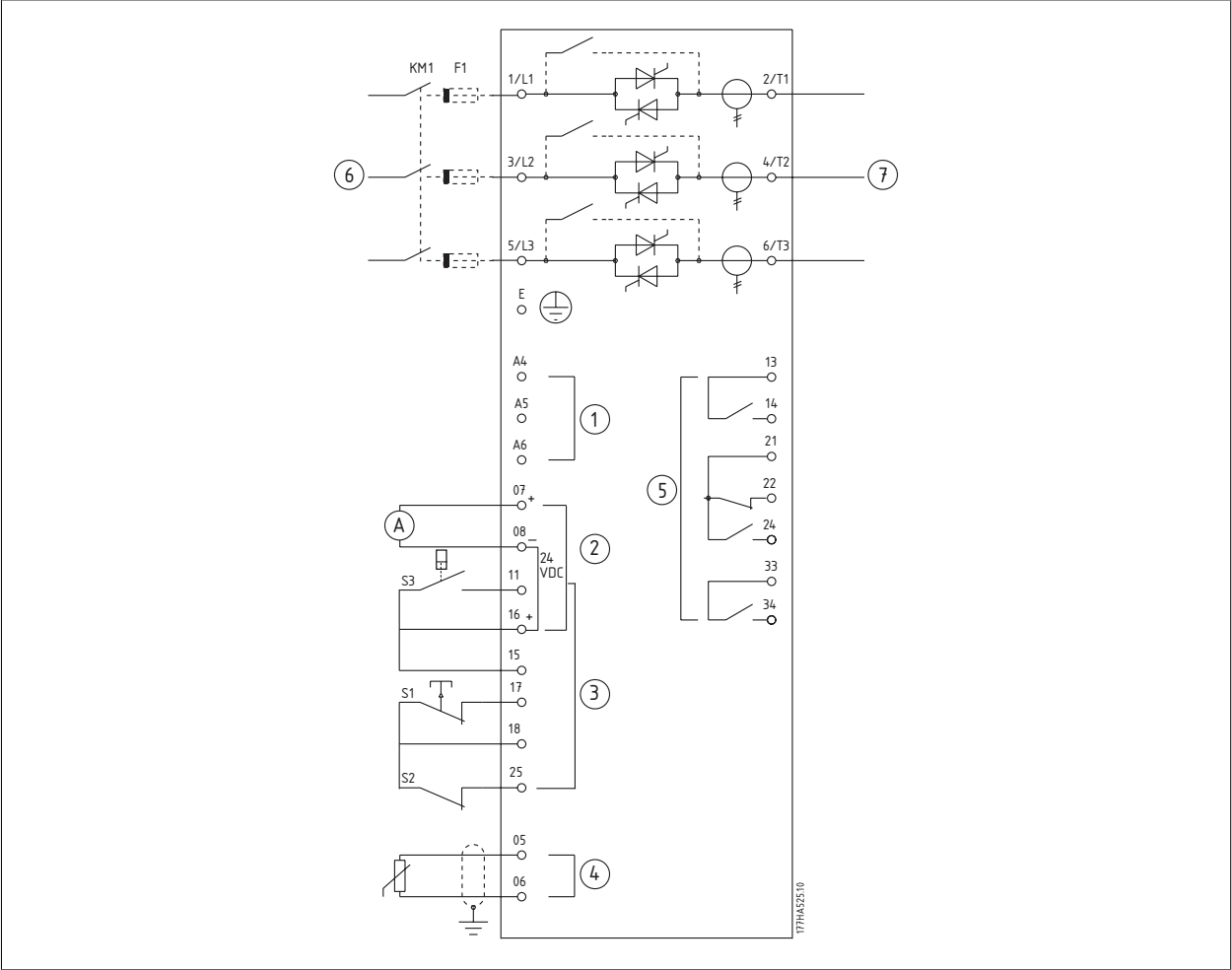
**Parameter settings:**

- Par. 3-3 *Input A Function*
    - Select Input Trip (N/O) assigns the Input A to Auxiliary Trip (N/O) function
- Par. 3-4 *Input A Name*
    - Select a name e.g. Low Pressure - assigns a name to Input A.
- Par. 3-8 *Remote Reset Logic*
    - Select as required e.g. Normally Closed - the input behaves like a normally closed contact.

## 5.12  Soft Braking

For high inertia loads the MCD 500 can be configured for soft braking.

In this application the MCD 500 is employed with forward run and braking contactors. When MCD 500 receives a start signal (button S1), it closes the forward run contactor (KM1) and controls the motor according to the programmed primary motor settings.

When the MCD 500 receives a stop signal (button S2), it opens the forward run contactor (KM1) and closes the braking contactor (KM2) after a delay of approximately 2-3 seconds (KT1). KA3 is also closed to activate the secondary motor settings, which should be user programmed for the desired stopping performance characteristics.

When motor speed approaches zero, the external shaft rotation sensor (A2) stops the soft starter and opens the braking contactor (KM2).
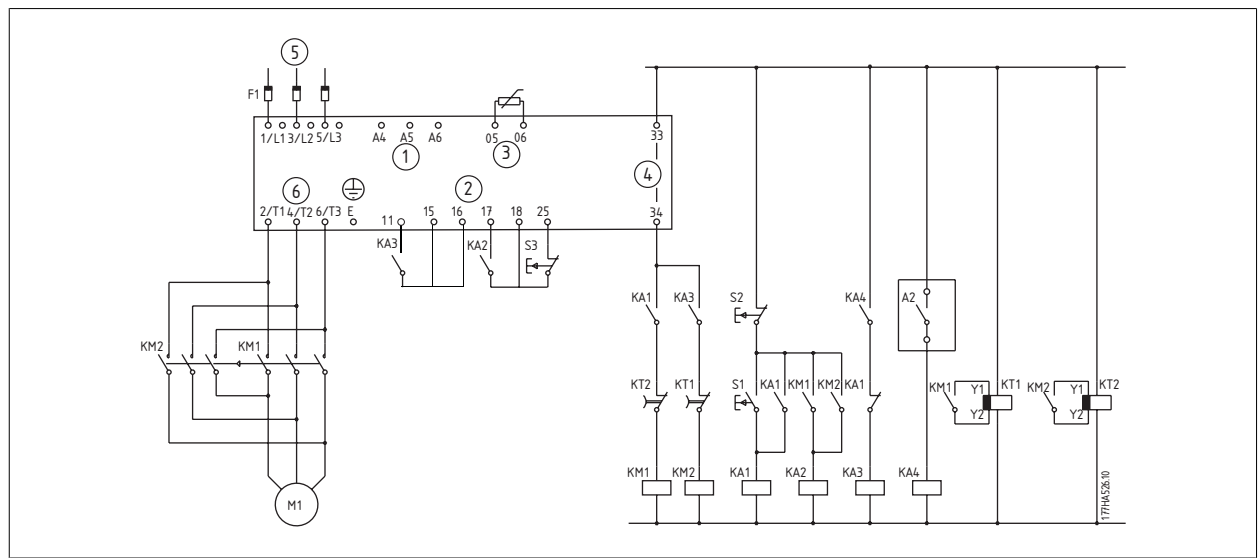


| 1 | Control voltage (model dependent) | KA3 | Brake relay |
|---|---|---|---|
| 2 | Remote control inputs | KA4 | Rotation sensing relay |
| 3 | Motor thermistor input (PTC only) | KM1 | Line contactor (Run) |
| 4 | Relay outputs | KM2 | Line contactor (Brake) |
| 5 | 3-phase supply | KT1 | Run delay timer |
| 6 | Motor terminals | KT2 | Brake delay timer |
| A2 | Shaft rotation sensor | S1 | Start contact |
| KA1 | Run relay | S2 | Stop contact |
| KA2 | Start relay | S3 | Reset contact |

**Parameter settings:**

- Par. 3-3 *Input A Function*

  - Select Motor Set Select - assigns Input A for Motor set selection

  - Set starting performance characteristics using the primary motor set (parameter group 1)

  - Set braking performance characteristics using the secondary motor settings (parameter group 7)

- Par. 4-7 *Relay C Function*

  - Select Trip - assigns Trip function to Relay Output C

**NB!**
If the MCD-500 trips on supply frequency (Par. 16-5 *Frequency*) when the braking contactor KM2 opens, modify the setting of Pars. 2-8 - 2-10.

## 5.13 Two Speed Motor

The MCD 500 can be configured for control of dual speed Dahlander type motors, using a high speed contactor (KM1), low speed contactor (KM2) and a star contactor (KM3).

---

**NB!**
Pole Amplitude Modulated (PAM) motors alter the speed by effectively changing the stator frequency using external winding configuration. Soft starters are not suitable for use with this type of two-speed motor.

---

When the soft starter receives a high speed start signal, it closes the high speed contactor (KM1) and star contactor (KM3), then controls the motor according to the primary motor settings (par. 1-1 - 1-16.)

When the soft starter receives a low speed start signal, it closes the low speed contactor (KM2). This closes Input A and the MCD 500 controls the motor according to the secondary motor settings (par. 7-1 - 7-16).
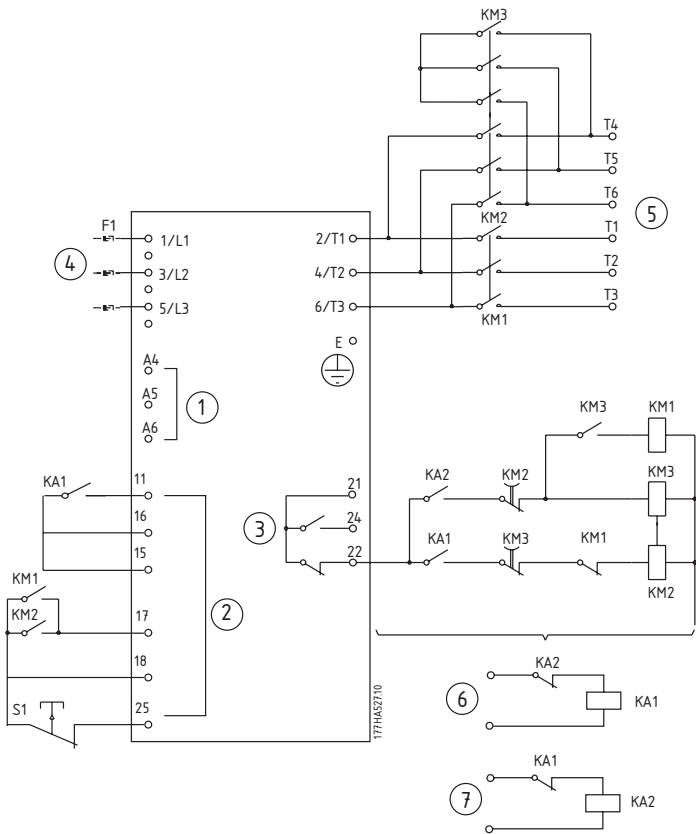


| 1 | Control voltage | KA1 | Remote start relay (low speed) |
|---|---|---|---|
| 2 | Remote control inputs | KA2 | Remote start relay (high speed) |
| 3 | Relay outputs | KM1 | Line contactor (high speed) |
| 4 | 3-phase supply | KM2 | Line contactor (low speed) |
| 5 | Motor terminals | KM3 | Star contactor (high speed) |
| 6 | Remote low-speed start input | S1 | Reset contact |
| 7 | Remote high-speed start input | 21, 22, 24 | Relay output B |

> **NB!**
> Contactors KM2 and KM3 must be mechanically interlocked.

**Parameter settings:**

- Par. 3-3 *Input A Function*

    - Select Motor Set Select - assigns Input A for Motor set selection

    - Set high speed performance characteristics using par. 1-1 - 2-9

    - Set low speed performance characteristics using par. 7-1 - 7-16.

- Par. 4-4 *Relay B Function*

    - Select Trip - assigns Trip function to Relay Output B

> **NB!**
> If the MCD 500 trips on supply frequency (Par. 16-5 *Frequency*) when the high-speed start signal (7) is removed, modify the setting of pars. 2-8 - 2-10.

**5**

**6**

# 6 Operation

## 6.1 The LCP
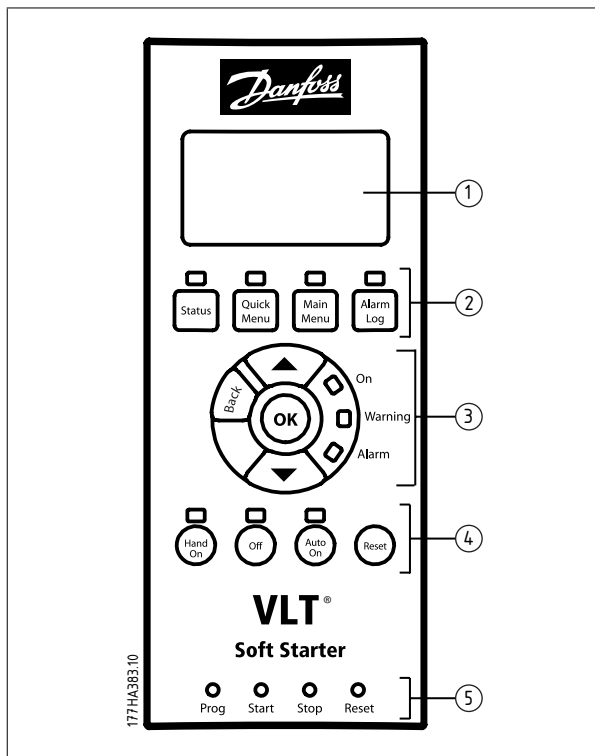


| 1 | Four-line display for status and programming details. |
|---|---|
| **2** | Display control buttons: |
| | **Status**: Return to the status displays |
| | **Quick Menu**: Open the Quick Menu |
| | **Main Menu**: Open the Main Menu |
| | **Alarm Log**: Open the Alarm Log |
| **3** | Menu navigation buttons: |
| | **BACK**: Exit the menu or parameter, or cancel a parameter change |
| | **OK**: Enter a menu or parameter, or save a parameter change |
| | **▲ ▼**: Scroll to the next or previous menu or parameter, change the setting of the current parameter or scroll through the status screens. |
| **4** | Soft starter local control buttons: |
| | **Hand On**: Start the motor and enter local control mode. |
| | **Off**: Stop the motor (only active in Hand On mode). |
| | **Auto On**: Set the starter to Auto On mode. |
| | **RESET**: Reset a trip (Hand On mode only). |
| **5** | Remote input status LEDs. |

## 6.2 Control Methods

The MCD 500 can be controlled via the control buttons on the LCP (local control), via the remote inputs (remote control) or via the serial communication network.

- Local control is only available in Hand On mode.

- Remote control is only available in Auto On mode.

- Control via the serial communication network is always disabled in Hand On mode, and Start/Stop commands via the serial network may be enabled or disabled in Auto On mode by changing the setting of Par. 3-2 *Comms in Remote*.

The MCD 500 can also be configured to auto-start or auto-stop. Auto-start/stop operation is only available in Auto On mode, and must be configured using pars. 5-1 - 5-4. In Hand On mode, the starter will ignore any auto-start/stop setting.

To switch between Hand On and Auto On modes, use the local control buttons on the LCP.

**HAND ON**: Start the motor and enter Hand On mode.
**OFF**: Stop the motor and enter Hand On mode.
**AUTO ON**: Set the starter to Auto On mode.
**RESET**: Reset a trip (Hand On mode only).

The MCD 500 can also be set to allow local control only or remote control only, using par. 3-1 *Local/Remote*.

If par. 3-1 is set to *Remote Control Only*, the OFF button is disabled and the motor must be stopped by remote control or via the serial communication network.

| | **Hand On mode** | **Auto On mode** |
|---|---|---|
| To soft start the motor | press the HAND ON button on the LCP | activate the Start remote input |
| To stop the motor | press the OFF button on the LCP | activate the Stop remote input |
| To reset a trip on the starter | press the RESET button on the LCP | activate the Reset remote input |
| Auto start/stop operation | Disabled | Enabled |

To emergency stop the motor, press the local OFF 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. Emergency stop can also be controlled via a programmable input.

**NB!**
Brake and Jog functions operate only with in-line connected motors (see *Inside Delta Operation*)

## 6.3  Local Control Buttons

If Par. 3-1 is set to LCL/RMT Anytime or LCL/RMT When OFF, the **Hand On** and **Auto On** buttons are always active. If the MCD-500 is in Auto On mode, pressing the **Hand On** button will enter Hand On mode and start the motor.

If Par. 3-1 is set to Remote Control Only, the **Off** button is disabled and the motor must be stopped by remote control or via the serial communication network.

## 6.4  Displays

The LCP displays a wide range of performance information about the soft starter. Press the **STATUS** button to access the status display screens, then use the ▲ and ▼ buttons to select the information to display. To return to the status screens from within a menu, press the **BACK** button repeatedly or press the **STATUS** button.

- Temperature monitoring
- Programmable screen (see Par. 8-2 - 8-5)
- Current
- Frequency
- Motor power
- Last start information
- Date and time
- SCR Conduction bar-graph
- Performance graphs

**NB!**
Screens shown here are with the default settings.

### 6.4.1  Temperature Monitoring Screen (S1)

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

The temperature monitoring screen is the default status screen.

```
Ready                                                   S1
MS1                     000.0A              000.0kW
                  Primary Motor Set
M1 000%
```

### 6.4.2  Programmable Screen (S2)

The MCD 500's user-programmable screen can be configured to show the most important information for the particular application. Use parameters 8-2 to 8-5 to select which information to display.

```
Ready                                                   S2
MS1                     000.0A              000.0kW
                        -.-- pf
00000 hrs
```

### 6.4.3  Average Current (S3)

The average current screen shows the average current of all three phases.

```
Ready                                                   S3
MS1                     000.0A              000.0kW
                        0.0A
```

### 6.4.4  Current Monitoring Screen (S4)

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

```
Ready                                                   S4
MS1                     000.0A              000.0kW
                   Phase currents
000.0A                  000.0A               000.0A
```

### 6.4.5  Frequency Monitoring Screen (S5)

The frequency screen shows the mains frequency as measured by the soft starter.

```
Ready                                                   S5
MS1                     000.0A              000.0kW
                        00.0Hz
```

**6**

### 6.4.6 Motor Power Screen (S6)

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

| Ready | | S6 |
|---|---|---|
| MS1 | 000.0A | 000.0kW |
| 000.0kW | | 0000HP |
| 0000kVA | | -. - - pf |

### 6.4.7 Last Start Information (S7)

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

- start duration (seconds)

- maximum start current drawn (as a percentage of motor full load current)

- calculated rise in motor temperature

| Ready | | S7 |
|---|---|---|
| MS1 | 000.0A | 000.0kW |
| Last start | | 000 s |
| 000 % FLC | | ΔTemp 0% |

### 6.4.8 Date and Time (S8)

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

| Ready | | S8 |
|---|---|---|
| MS1 | 000.0A | 000.0kW |
| | YYYY MMM DD | |
| | HH:MM:SS | |

### 6.4.9 SCR Conduction Bargraph

The SCR conduction bargraph shows the level of conduction on each phase.
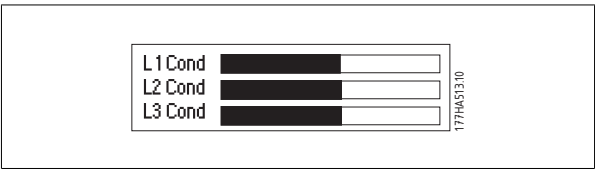
### 6.4.10 Performance Graphs

The MCD 500 can display real-time performance information for:

- Current

- Motor temperature

- Motor kW

- Motor kVA

- Motor power factor

The newest information is displayed at the right hand edge of the screen. The graph can be paused to analyse data by pressing and holding the OK button. To re-start the graph, press and hold OK.



**6**

**7**
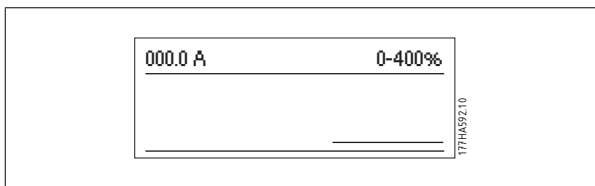
# 7 Programming

You can access the programming menus at any time, including while the soft starter is running. All changes take effect immediately.

## 7.1 Access Control

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 LCP 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 **BACK** and **OK** buttons to select a digit, and the ▲ and ▼ buttons to change the value. When all four digits match your access code, press **OK**. The LCP will display an acknowledgement message before continuing.

To change the access code, use par. 15-1.

| Enter Access Code |
| :---: |
| #### |
| OK |

| Access Allowed |
| :---: |
| SUPERVISOR |

**NB!**
The simulation tools and counter resets are also protected by the security access code.
The default access code is 0000.

You can lock the menus to prevent users from altering parameter settings. The adjustment lock can be set to allow Read & Write, Read Only or No Access using Par. 15-2.

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

| Access Denied |
| :---: |
| Adj Lock is On |

## 7.2  Quick Menu

### 7.3.1  Quick Setup

Quick setup provides access to commonly used parameters, allowing the user to configure the MCD 500 as required for the application. For details of individual parameters, see *Parameter Descriptions*.

| | |
|---|---|
| **1** | **Primary Mtr Set** |
| 1-1 | Motor FLC |
| 1-3 | Start Mode |
| 1-4 | Current Limit |
| 1-5 | Initial Current |
| 1-6 | Start Ramp Time |
| 1-9 | Excess Start Time |
| 1-10 | Stop Mode |
| 1-11 | Stop Time |
| **2** | **Protection** |
| 2-1 | Phase Sequence |
| 2-4 | Undercurrent |
| 2-5 | Undercurrent Dly |
| 2-6 | Inst Overcurrent |
| 2-7 | Inst Overcurrent Dly |
| **3** | Inputs |
| 3-3 | Input A Function |
| 3-4 | Input A Name |
| 3-5 | Input A Trip |
| 3-6 | Input A Trip Dly |
| 3-7 | Input A Initial Dly |
| **4** | Outputs |
| 4-1 | Relay A Function |
| 4-2 | Relay A On Delay |
| 4-3 | Relay A Off Delay |
| 4-4 | Relay B Function |
| 4-5 | Relay B On Delay |
| 4-6 | Relay B Off Delay |
| 4-7 | Relay C Function |
| 4-8 | Relay C On Delay |
| 4-9 | Relay C Off Delay |
| 4-10 | Low Current Flag |
| 4-11 | High Current FLag |
| 4-12 | Motor Temp Flag |
| **5** | Start/Stop Timers |
| 5-1 | Auto-Start Type |
| 5-2 | Auto-Start Time |
| 5-3 | Auto-Stop Type |
| 5-4 | Auto-Stop Time |
| **8** | Display |
| 8-1 | Language |
| 8-2 | User Scrn Top L |
| 8-3 | User Scrn Top R |
| 8-4 | User Scrn Btm L |
| 8-5 | User Scrn Btm R |

## 7.3.2 Application Setups

The application setups menu makes it easy to configure the MCD 500 for common applications. The MCD 500 selects the parameters relevant to the application and suggests a typical setting, and you can adjust each parameter to suit your exact requirements.

On the display the highlighted values are suggested values and the values indicated by a ▶ are the loaded values.

Always set par. 1-1 *Motor FLC* to match the motor's nameplate full load current. The suggested value for motor FLC is the starter's minimum FLC.

| Pump Centrifugal | Suggested Value | Compressor Recip | Suggested Value |
|---|---|---|---|
| Motor FLC | | Motor FLC | |
| Start Mode | Adaptive Control | Start Mode | Adaptive Control |
| Adaptive Start Profile | Early Acceleration | Adaptive Start Profile | Constant Acceleration |
| Start Ramp Time | 5 seconds | Start Ramp Time | 10 seconds |
| Current Limit | 350% | Current Limit | 450% |
| Stop Mode | Adaptive Control | | |
| Adaptive Stop Profile | Late Deceleration | | |
| Stop Time | 15 seconds | | |
| **Pump Submersible** | | **Conveyor** | |
| Motor FLC | | Motor FLC | |
| Start Mode | Adaptive Control | Start Mode | Adaptive Control |
| Adaptive Start Profile | Early Acceleration | Adaptive Start Profile | Late Acceleration |
| Start Ramp Time | 5 seconds | Start Ramp Time | 15 seconds |
| Current Limit | 350% | Current Limit | 400% |
| Stop Mode | Adaptive Control | Stop Mode | Adaptive Control |
| Adaptive Stop Profile | Late Deceleration | Adaptive Stop Profile | Constant Deceleration |
| Stop Time | 5 seconds | Stop Time | 5 seconds |
| **Fan Damped** | | **Crusher Rotary** | |
| Motor FLC | | Motor FLC | |
| Start Mode | Adaptive Control | Start Mode | Adaptive Control |
| Adaptive Start Profile | Constant Acceleration | Adaptive Start Profile | Constant Acceleration |
| Start Ramp Time | 15 seconds | Start Ramp Time | 20 seconds |
| Current Limit | 350% | Current Limit | 400% |
| | | Excess Start Time | 30 seconds |
| | | Locked Rotor Time | 20 seconds |
| **Fan Undamped** | | **Crusher Jaw** | |
| Motor FLC | | Motor FLC | |
| Start Mode | Adaptive Control | Start Mode | Adaptive Control |
| Adaptive Start Profile | Constant Acceleration | Adaptive Start Profile | Constant Acceleration |
| Start Ramp Time | 20 seconds | Start Ramp Time | 30 seconds |
| Current Limit | 400% | Current Limit | 450% |
| Excess Start Time | 30 seconds | Excess Start Time | 40 seconds |
| Locked Rotor Time | 20 seconds | Locked Rotor Time | 30 seconds |
| **Compressor Screw** | | | |
| Motor FLC | | | |
| Start Mode | Adaptive Control | | |
| Adaptive Start Profile | Constant Acceleration | | |
| Start Ramp Time | 10 seconds | | |
| Current Limit | 400% | | |

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### 7.3.3 Loggings

The Loggings menu allows the user to view performance information in real-time graphs.

- Current (%FLC)
- Motor Temp (%)
- Motor kW (%)
- Motor kVA (%)
- Motor pf

The newest information is displayed at the right hand edge of the screen. The graph can be paused to analyse data by pressing and holding the OK button. To re-start the graph, press and hold OK.

## 7.3  Main Menu

The Main Menu button provides access to menus for setting up the MCD 500 for complex applications and for monitoring its performance.

### 7.4.1 Parameters

Parameters lets you view and change all programmable parameters that control how the MCD 500 operates.

To open Parameters, press the **Main Menu** button then select Parameters.

To navigate through Parameters:

- to scroll through parameter groups, press the ▲ or ▼ button.
- to view the parameters in a group, press the **OK** button.
- to return to the previous level, press the **BACK** button.
- to close Parameters, press the **BACK** button.

To change a parameter value:

- scroll to the appropriate parameter and press **OK** to enter edit mode.
- to alter the parameter setting, use the ▲ and ▼ buttons.
- to save changes, press **OK**. The setting shown on the display will be saved and the LCP will return to the parameter list.
- to cancel changes, press **Back**. The LCP will return to the parameter list without saving changes.

### 7.4.2 Parameter Shortcut

The MCD 500 also includes a parameter shortcut, which allows you to directly access a parameter within the Parameters menu.

- To access the parameter shortcut, press the **MAIN MENU** button for three seconds
- Use the ▲ or ▼ button to select the parameter group.
- Press **OK** or **BACK** to move the cursor.
- Use the ▲ or ▼ button to select the parameter number.

```
Parameter shortcut
              Please enter a
             Parameter number
                  01-01
```

### 7.4.3 Parameter List

| 1 | **Primary Mtr Set** | 4 | **Outputs** | 7-11 | Stop Time-2 |
|---|---|---|---|---|---|
| 1-1 | Motor FLC | 4-1 | Relay A Function | 7-12 | Adaptv Ctrl Gain-2 |
| 1-2 | Locked Rotor Time | 4-2 | Relay A On Delay | 7-13 | Adaptv Start Prof-2 |
| 1-3 | Start Mode | 4-3 | Relay A Off Delay | 7-14 | Adaptv Stop Prof-2 |
| 1-4 | Current Limit | 4-4 | Relay B Function | 7-15 | Brake Torque-2 |
| 1-5 | Initial Current | 4-5 | Relay B On Delay | 7-16 | Brake Time-2 |
| 1-6 | Start Ramp Time | 4-6 | Relay B Off Delay | **8** | **Display** |
| 1-7 | Kickstart Level | 4-7 | Relay C Function | 8-1 | Language |
| 1-8 | Kickstart Time | 4-8 | Relay C On Delay | 8-2 | User Scrn Top L |
| 1-9 | Excess Start Time | 4-9 | Relay C Off Delay | 8-3 | User Scrn Top R |
| 1-10 | Stop Mode | 4-10 | Low Current Flag | 8-4 | User Scrn Btm L |
| 1-11 | Stop Time | 4-11 | High Current FLag | 8-5 | User Scrn Btm R |
| 1-12 | Adaptv Control Gain | 4-12 | Motor Temp Flag | 8-6 | Graph Timebase |
| 1-13 | Adaptv Start Profile | 4-13 | Analog Output A | 8-7 | Graph Max Adj |
| 1-14 | Adaptv Stop Profile | 4-14 | Analog A Scale | 8-8 | Graph Min Adj |
| 1-15 | Brake Torque | 4-15 | Analog A Max Adj | 8-9 | Mains Ref Volt |
| 1-16 | Brake Time | 4-16 | Analog A Min Adj | **15** | **Restrict Paramtr** |
| **2** | **Protection** | **5** | **Start/Stop Timers** | 15-1 | Access Code |
| 2-1 | Phase Sequence | 5-1 | Auto-Start Type | 15-2 | Adjustment Lock |
| 2-2 | Current Imbalance | 5-2 | Auto-Start Time | 15-3 | Emergency Run |
| 2-3 | Current Imbal Dly | 5-3 | Auto-Stop Type | 15-4 | Current Calibrat |
| 2-4 | Undercurrent | 5-4 | Auto-Stop Time | 15-5 | Main Cont Time |
| 2-5 | Undercurrent Dly | **6** | **Auto-Reset** | 15-6 | Bypass Cont Time |
| 2-6 | Inst Overcurrent | 6-1 | Auto-Reset Action | 15-7 | Motor Connection |
| 2-7 | Inst Ocrnt Dly | 6-2 | Maximum Resets | 15-8 | Jog Torque |
| 2-8 | Frequency Check | 6-3 | Reset Dly Grp A & B | **16** | **Protection Action** |
| 2-9 | Freq Variation | 6-4 | Reset Delay Grp C | 16-1 | Motor Overload |
| 2-10 | Frequency Delay | **7** | **Secondary Mtr Set** | 16-2 | Current Imbalance |
| 2-11 | Restart Delay | 7-1 | Motor FLC-2 | 16-3 | Undercurrent |
| 2-12 | Motor Temp Check | 7-2 | Lock Rotor Time-2 | 16-4 | Inst Overcurrent |
| **3** | **Inputs** | 7-3 | Start Mode-2 | 16-5 | Frequency |
| 3-1 | Local/Remote | 7-4 | Current Limit-2 | 16-6 | Heatsink Overtemp |
| 3-2 | Comms in Remote | 7-5 | Initial Crnt-2 | 16-7 | Excess Start Time |
| 3-3 | Input A Function | 7-6 | Start Ramp-2 | 16-8 | Input A Trip |
| 3-4 | Input A Name | 7-7 | Kickstart Lvl-2 | 16-9 | Motor Thermistor |
| 3-5 | Input A Trip | 7-8 | Kickstart Time-2 | 16-10 | Starter Comms |
| 3-6 | Input A Trip Dly | 7-9 | Excess Strt Time-2 | 16-11 | Network Comms |
| 3-7 | Input A Initial Dly | 7-10 | Stop Mode-2 | 16-12 | Battery/Clock |
| 3-8 | Remote Reset Logic | | | | |

## 7.4  Primary Motor Settings

**NB!**
Default settings are marked with *.

The parameters in Primary Motors Settings 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.

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## 1-1 Motor FLC

| Option: | Function: |
|---|---|
| Model dependent | Matches the starter to the connected motor's full load current. Set to the full load current (FLC) rating shown on the motor nameplate. |

## 1-2 Locked Rotor Time

| Range: | Function: |
|---|---|
| 10 secs*  [0:01 - 2:00 (min:sec)] | Sets the maximum length of the time the motor can run at locked rotor current from cold before reaching its maximum temperature. Set according to the motor datasheet.<br>If this information is not available, we recommend the value should be less than 20 seconds. |

## 1-3 Start Mode

| Option: | Function: |
|---|---|
| | Selects the soft start mode. See *Starting Modes* in chapter *Application Examples* for more details. |
| Constant Current | |
| Adaptive Control* | |

## 1-4 Current Limit

| Range: | Function: |
|---|---|
| 350%*  [100% - 600% FLC] | Sets the current limit for constant current and current ramp soft starting, as a percentage of motor full load current. See *Starting Modes* in chapter *Application Examples* for more details. |

## 1-5 Initial Current

| Range: | Function: |
|---|---|
| 350%*  [100% - 600% FLC] | 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.<br>If current ramp starting is not required, set the initial current equal to the current limit. See *Starting Modes* in chapter *Application Examples* for more details. |

## 1-6 Start Ramp Time

| Range: | Function: |
|---|---|
| 10 secs*  [1 - 180 secs] | Sets the total start time for an AAC Adaptive Control start or the ramp time for current ramp starting (from the initial current to the current limit). See *Starting Modes* in chapter *Application Examples* for more details. |

## 1-7 Kickstart Level

| Range: | Function: |
|---|---|
| 500%*  [100% - 700% FLC] | Sets the level of the kickstart current. |

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

## 1-8 Kickstart Time

| Range: | Function: |
|---|---|
| 0000 msecs*  [0 - 2000 msecs] | Sets the kickstart duration. A setting of 0 disables kickstart. See *Starting Modes* in chapter *Application Examples* for more details. |

## 1-9 Excess Start Time

| Range: | Function: |
|---|---|
| | Excess start time is the maximum time the MCD 500 will attempt to start the motor. If the motor does not reach full speed 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. |
| 20 secs*  [0:00 - 4:00 (min:secs)] | Set as required. |

| 1-10  Stop Mode | |
| --- | --- |
| **Option:** | **Function:** |
| | Selects the stop mode. See *Stopping Modes* in chapter *Application Examples* for more details. |
| Coast to Stop* | |
| TVR Soft Stop | |
| Adaptive Control | |
| Brake | |

| 1-11  Stop Time | |
| --- | --- |
| **Range:** | **Function:** |
| 0 secs*  [0:00 - 4:00 (min:secs)] | Sets the time for soft stopping the motor using timed voltage ramp or Adaptive Control (AAC). If a main contactor is installed, the contactor must remain closed until the end of the stop time. Use a programmable output configured to Run to control the main contactor. Sets the toal stopping time when using brake. See *Stopping Modes* in chapter *Application Examples* for more details. |

| 1-12  Adaptv Control Gain | |
| --- | --- |
| **Range:** | **Function:** |
| 75%*  [1% - 200%] | Adjusts the performance of AAC adaptive acceleration control. See *AAC Adaptive Acceleration Control* in chapter *Application Examples* for more details. |

> **!** We recommend leaving the gain setting at the default level unless AAC performance is not satisfactory. If the motor accelerates or decelerates quickly at the end of a start or stop, increase the gain setting by 5%~10%. If the motor speed fluctuates during starting or stopping, decrease the gain setting slightly.

| 1-13  Adaptv Start Profile | |
| --- | --- |
| **Option:** | **Function:** |
| | Selects which profile the MCD 500 will use for an AAC adaptive acceleration control soft start. See *Starting Modes* in chapter *Application Examples* for more details. |
| Early Acceleration | |
| Constant Acceleration* | |
| Late Acceleration | |

| 1-14  Adaptv Stop Profile | |
| --- | --- |
| **Option:** | **Function:** |
| | Selects which profile the MCD 500 will use for an AAC adaptive acceleration control soft stop. See *Stopping Modes* in chapter *Application Examples* for more details. |
| Early Deceleration | |
| Constant Deceleration* | |
| Late Acceleration | |

### 7.5.1  Brake

Brake uses DC injection to actively slow the motor. See *Stopping Modes* in chapter *Application Examples* for more details.

| 1-15  Brake Torque | |
| --- | --- |
| **Range:** | **Function:** |
| 20%*  [20 - 100%] | Sets the amount of brake torque the MCD 500 will use to slow the motor. |

| 1-16   Brake Time | |
| --- | --- |
| **Range:** | **Function:** |
| 1 sec*     [1 - 30 secs] | Sets the duration for DC injection during a braking stop. |

> **NB!**
> Parameter 1-16 is used in conjunction with Par. 1-11. See *Brake* for details.

## 7.5 Protection

| 2-1   Phase Sequence | |
| --- | --- |
| **Option:** | **Function:** |
| | 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 of the actual sequence does not match the selected option. |
| Any sequence* | |
| Positive only | |
| Negative only | |

### 7.6.1 Current Imbalance

The MCD 500 can be configured to trip if the currents on the three phases vary from each other by more than a specified amount. The imbalance is calculated as the difference between the highest and lowest currents on all three phases, as a percentage of the highest current.

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

| 2-2   Current Imbalance | |
| --- | --- |
| **Range:** | **Function:** |
| 30%*     [10% - 50%] | Sets the trip point for current imbalance protection. |

| 2-3   Current Imbal Dly | |
| --- | --- |
| **Range:** | **Function:** |
| 3 secs*     [0:00 - 4:00 (min:secs)] | Slows the MCD 500's response to current imbalance, avoiding trips due to momentary fluctuations. |

### 7.6.2 Undercurrent

The MCD 500 can be configured to trip if the average current of all three phases drops below a specified level while the motor is running.

| 2-4   Undercurrent | |
| --- | --- |
| **Range:** | **Function:** |
| 20%*     [0% - 100%] | 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. |

| 2-5   Undercurrent Dly | |
| --- | --- |
| **Range:** | **Function:** |
| 5 secs*     [0:00 - 4:00 (min:secs)] | Slows the MCD 500's response to undercurrent, avoiding trips due to momentary fluctuations. |

### 7.6.3 Instantaneous Overcurrent

The MCD 500 can be configured to trip if the average current of all three phases exceeds a specified level while the motor is running.

| 2-6  Inst Overcurrent | |
| --- | --- |
| **Range:** | **Function:** |
| 400%*    [80% - 600% FLC] | Sets the trip point for instantaneous overcurrent protection, as a percentage of motor full load current. |

| 2-7  Inst Ocrnt Delay | |
| --- | --- |
| **Range:** | **Function:** |
| 0 secs*    [0:00 - 1:00 (min:secs)] | Slows the MCD 500's response to overcurrent, avoiding trips due to momentary overcurrent events. |

### 7.6.4  Frequency Trip

The MCD 500 monitors mains frequency throughout operation, and can be configured to trip is the frequency varies beyond a specified tolerance.

| 2-8  Frequency Check | |
| --- | --- |
| **Option:** | **Function:** |
| Do not Check | |
| Start Only | |
| Start/Run* | |
| Run Only | |
| | Determines when the starter will monitor for a frequency trip. |

| 2-9  Freq Variation | |
| --- | --- |
| **Option:** | **Function:** |
| | Selects the soft starter's tolerance for frequency variation. |
| | **NB!** Running a motor outside its specified frequency for long periods can cause damage and premature failure. |
| ± 2 Hz | |
| ± 5 Hz* | |
| ± 10 Hz | |
| ± 15 Hz | |

| 2-10  Frequency Delay | |
| --- | --- |
| **Range:** | **Function:** |
| 1 sec*    [0:01 - 4:00 (min:sec)] | Slows the MCD 500's response to frequency disturbances, avoiding trips due to momentary fluctuations. |
| | **NB!** If the mains frequency drops below 35 Hz or rises above 75 Hz, the starter will trip immediately. |

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## 2-11 Restart Delay

**Range:**

10 secs*   [00:01 - 60:00 (min:secs)]

**Function:**

The MCD 500 can be configured to force a delay between the end of a stop and the beginning of the next start. During the restart delay, the display shows the time remaining before another start can be attempted.

> **NB!**
> The restart delay is measured from the end of each stop. Changes to the restart delay setting take effect immediately.

## 2-12 Motor Temp Check

**Option:**

**Function:**

Selects whether the MCD 500 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.

Do not Check*

Check

## 7.6 Inputs

## 3-1 Local/Remote

**Option:**

**Function:**

Selects when the **AUTO ON** and **HAND ON** buttons can be used to switch to Hand On or Auto On modes.

| | |
|---|---|
| Lcl/Rmt anytime* | The user can change between local and remote control at any time. |
| Local Control Only | All remote inputs are disabled. |
| Remote Control Only | Selects whether the starter can be used in Hand On or Auto On modes. |

## 3-2 Comms in Remote

**Option:**

**Function:**

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

Disable Ctrl in RMT

Enable Ctrl in RMT*

## 3-3 Input A Function

**Option:**

**Function:**

Selects the function of Input A.

| | |
|---|---|
| Motor Set Select* | The MCD 500 can be configured with two separate sets of motor data. The primary motor data is programmed using Par. 1-1 to 1-16. The secondary motor data is programmed using Par. 7-1 to 7-16.<br>To use the secondary motor data, Par. 3-3 must be set to Motor Set Select and 11, 16 must be closed when a start command is given. The MCD 500 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) | Input A can be used to trip the soft starter. When Par. 3-3 is set to Input Trip (N/O), a closed circuit across 11, 16 trips the soft starter (Par. 3-5, 3-6, 3-7). |
| Input Trip (N/C) | When Par. 3-3 is set to Input Trip (N/C), an open circuit across 11, 16 trips the soft starter (Par. 3-5, 3-6, 3-7). |
| Local/Remote Select | Input A can be used to select between local and remote control, instead of using the buttons on the LCP. When the input is open, the starter is in local mode and can be controlled via the LCP. When the input is closed, the starter is in remote mode. The **HAND ON** and **AUTO ON** buttons are |

disabled, and the soft starter will ignore any Local/Remote select command from the serial com-
munications network.

To use Input A to select between local and remote control, Par. 3-1 must be set to LCL/RMT Anytime.

| | |
|---|---|
| Emergency Run | In emergency run the soft starter continues to run until stopped, ignoring all trips and warnings (see Par. 15-3 for details).<br>Closing the circuit across 11, 16 activates emergency run.<br>Opening the circuit ends emergency run and the MCD 500 stops the motor. |
| Emergency Stop | The MCD 500 can be commanded to emergency stop the motor, ignoring the soft stop mode set in Par. 1-10.<br>When the circuit across 11, 16 is opened, the soft starter allows the motor to coast to stop. |
| Jog Forward | Activates jog operation in a forward direction (will operate only in Remote mode). |
| Jog Reverse | Activates jog operation in reverse direction (will operate only in Remote mode). |

## 3-4  Input A Name

**Option:** **Function:**

Selects a message for the LCP to display when Input A is active.

Input Trip*
Low Pressure
High Pressure
Pump Fault
Low Level
High Level
No Flow
Emergency Stop
Controller
PLC
Vibration Alarm

## 3-5  Input A Trip

**Option:** **Function:**

Selects when an input trip can occur.

| | |
|---|---|
| Always Active* | 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. |

## 3-6  Input A Trip Dly

**Range:** **Function:**

0 secs*    [0:00 - 4:00 (min:secs)]    Sets delay between the input activating and soft starter tripping.

## 3-7  Input A Initial Dly

**Range:** **Function:**

0 secs*    [00:00 - 30:00 (min:secs)]    Sets a delay before an input trip can occur. The initial delay is counted from the time a start signal is received. The state of the input is ignored until the initial delay has elapsed.

## 3-8  Remote Reset Logic

**Option:** **Function:**

Selects whether the MCD 500's remote reset input (terminals 25, 18) is normally open or normally closed.

Normally Closed*
Normally Open

## 7.7  Outputs

| 4-1  Relay A Function | |
|---|---|
| **Option:** | **Function:** |
| | Selects the function of Relay A (normally open). |
| Off | Relay A is not used |
| Main Contactor* | The relay closes when the MCD 500 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. |
| Warning | The relay closes when the starter issues a warning. |
| Low Current Flag | The relay closes when the low current flag activates (Par. 4-10 *Low Current Flag*). |
| High Current Flag | The relay closes when the high current flag activates (Par. 4-11 *High Current Flag*). |
| Motor Temp Flag | The relay closes when the motor temperature flag activates (Par. 4-12 *Motor Temperature Flag*). |

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### 7.8.1  Relay A Delays

The MCD 500 can be configured to wait before opening or closing Relay A.

| 4-2  Relay A On Delay | |
|---|---|
| **Range:** | **Function:** |
| 0 secs*　　[0:00 - 5:00 (min:secs)] | Sets the delay for closing Relay A. |

| 4-3  Relay A Off Delay | |
|---|---|
| **Range:** | **Function:** |
| 0 secs*　　[0:00 - 5:00 (min:secs)] | Sets the delay for re-opening Relay A. |

### 7.8.2  Relays B and C

Parameters 4-4 to 4-9 configure the operation of Relays B and C in the same way as parameters 4-1 to 4-3 configure Relay A.

| 4-4  Relay B Function | |
|---|---|
| **Option:** | **Function:** |
| | Selects the function of Relay B (changeover). |
| Off | Relay B is not used |
| Main Contactor | The relay closes when the MCD 500 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. |
| Warning | The relay closes when the starter issues a warning. |
| Low Current Flag | The relay closes when the low current flag activates (Par. 4-10 *Low Current Flag*). |
| High Current Flag | The relay closes when the high current flag activates (Par. 4-11 *High Current Flag*). |
| Motor Temp Flag | The relay closes when the motor temperature flag activates (Par. 4-12 *Motor Temperature Flag*). |

| 4-5  Relay B On Delay | |
|---|---|
| **Range:** | **Function:** |
| 0 secs*　　[0:00 - 5:00 (min:secs)] | Sets the delay for closing Relay B. |

| 4-6  Relay B Off Delay | |
| --- | --- |
| **Range:** | **Function:** |
| 0 secs*  [0:00 - 5:00 (min:secs)] | Sets the delay for re-opening Relay B. |

| 4-7  Relay C Function | |
| --- | --- |
| **Option:** | **Function:** |
| | Selects the function of Relay C (normally open). |
| Off | Relay C is not used |
| Main Contactor | The relay closes when the MCD 500 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. |
| Warning | The relay closes when the starter issues a warning. |
| Low Current Flag | The relay closes when the low current flag activates (Par. 4-10 *Low Current Flag*). |
| High Current Flag | The relay closes when the high current flag activates (Par. 4-11 *High Current Flag*). |
| Motor Temp Flag | The relay closes when the motor temperature flag activates (Par. 4-12 *Motor Temperature Flag*). |

| 4-8  Relay C On Delay | |
| --- | --- |
| **Range:** | **Function:** |
| 0 secs*  [0:00 - 5:00 (min:secs)] | Sets the delay for closing Relay C. |

| 4-9  Relay C Off Delay | |
| --- | --- |
| **Range:** | **Function:** |
| 0 secs*  [0:00 - 5:00 (min:secs)] | Sets the delay for re-opening Relay C. |

### 7.8.3  Low Current Flag and High Current Flag

The MCD 500 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 motor full load current.

| 4-10  Low Current Flag | |
| --- | --- |
| **Range:** | **Function:** |
| 50%*  [1% - 100% FLC] | Sets the level at which the low current flag operates, as a percentage of motor full load current. |

| 4-11  High Current Flag | |
| --- | --- |
| **Range:** | **Function:** |
| 100%*  [50% - 600% FLC] | Sets the level at which the high current flag operates, as a percentage of motor full load current. |

### 7.8.4  Motor Temperature Flag

The MCD 500 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 fo the programmable outputs.

| 4-12  Motor Temp Flag | |
| --- | --- |
| **Range:** | **Function:** |
| 80%*  [0% - 160%] | Sets the level at which the motor temperature flag operates, as a percentage of the motor's thermal capacity. |

### 7.8.5 Analog Output A

The MCD 500 has an analog output, which can be connected to associated equipment to monitor motor performance.

| 4-13 Analog Output A | |
|---|---|
| **Option:** | **Function:** |
| | Selects which information will be reported via analog output A. |
| Current (% FLC)* | Current as a percentage of motor full load current. |
| Motor Temp (%) | Motor temperature as a percentage of the motor service factor (calculated by the soft starter's thermal model). |
| Motor kW (%) | Motor kilowatts. 100% is motor FLC (Par. 1-1) multiplied by mains reference voltage (Par. 8-9). Power factor is assumed to be 1.0. $$\frac{\sqrt{3} \times V \times I_{FLC} \times pf}{1000}$$ |
| Motor kVA (%) | Motor kilovolt amperes. 100% is motor FLC (Par. 1-1) multiplied by mains reference voltage (Par. 8-9). $$\frac{\sqrt{3} \times V \times I_{FLC}}{1000}$$ |
| Motor pf | Motor power factor, measured by the soft starter. |

| 4-14 Analog A Scale | |
|---|---|
| **Option:** | **Function:** |
| | Selects the range of the output. |
| 0-20 mA | |
| 4-20 mA* | |

| 4-15 Analog A Max Adj | |
|---|---|
| **Range:** | **Function:** |
| 100%*　　[0% - 600%] | Calibrates the upper limit of the analog output to match the signal measured on an external current measuring device. |

| 4-16 Analog A Min Adj | |
|---|---|
| **Range:** | **Function:** |
| 0%*　　[0% - 600%] | Calibrates the lower limit of the analog output to match the signal measured on an external current measuring device. |

## 7.8 Start/Stop Times

> ! The auto-start timer overrides any other form of control. The motor may start without warning.

| 5-1 Auto-Start Type | |
|---|---|
| **Option:** | **Function:** |
| | Selects whether the soft starter will auto-start after a specified delay, or at a time of day. |
| Off* | The soft starter will not auto-start. |
| Timer | The soft starter will auto-start after a delay from the next stop, as specified in Par. 5-2. |
| Clock | The soft starter will auto-start at the time programmed in Par. 5-2. |

| 5-2 Auto-Start Time | |
|---|---|
| **Range:** | **Function:** |
| 1 min*　　[00:01 - 24:00 (hrs:min)] | Sets the time for the soft starter to auto-start, in 24 hour clock format. |

## 5-3  Auto-Stop Type

| Option: | Function: |
|---|---|
| | Selects whether the soft starter will auto-stop after a specified delay, or at a time of day. |
| Off* | The soft starter will not auto-stop. |
| Time | The soft starter will auto-stop after a delay from the next start, as specified in Par. 5-4. |
| Clock | The soft starter will auto-stop at the time programmed in Par. 5-4. |

## 5-4  Auto-Stop Time

| Range: | | Function: |
|---|---|---|
| 1 min* | [00:01 - 24:00 (hrs:min)] | Sets the time for the soft starter to auto-stop, in 24 hour clock format. |

# 7.9  Auto-Reset

The MCD 500 can be programmed to automatically reset certain trips, which can help minimise operating downtime. Trips are divided into three categories for auto-reset, depending on the risk to the soft starter:

| Group | |
|---|---|
| A | Current Imbalance |
| | Phase Loss |
| | Power Loss |
| | Mains Frequency |
| B | Undercurrent |
| | Instantaneous Overcurrent |
| | Input A Trip |
| C | Motor Overload |
| | Motor Thermistor |
| | Starter Overtemperature |

Other trips cannot be automatically reset.

This function is ideal for remote installations using 2-wire control in Auto On mode. If the 2-wire start signal is present after an auto-reset, the MCD 500 will restart.

## 6-1  Auto-Reset Action

| Option: | Function: |
|---|---|
| | Selects which trips can be auto-reset. |
| Do not Auto-Reset* | |
| Reset Group A | |
| Reset Group A & B | |
| Reset Group A, B & C | |

## 6-2  Maximum Resets

| Range: | | Function: |
|---|---|---|
| 1* | [1 - 5] | Sets how many times the soft starter will auto-reset, if it continues to trip. The reset counter increases by one each time the soft starter auto-resets, and decreases by one after each successful start/stop cycle. |

**NB!**
The reset counter will return to 0 if the starter is manually reset.

### 7.10.1 Auto-Reset Delay

The MCD 500 can be configured to wait before auto-resetting a trip. Separate delays can be set for trips in Groups A and B, or in Group C.

| 6-3 Reset Dly Grp A & B | |
|---|---|
| **Range:** | **Function:** |
| 5 secs* [00:05 - 15:00 (min:secs)] | Sets the auto-reset delay for Group A and Group B trips. |

| 6-4 Reset Dly Grp C | |
|---|---|
| **Range:** | **Function:** |
| 5 min* [5 - 60 (minutes)] | Sets the auto-reset delay for Group C trips. |

## 7.10 Secondary Motor Set

| 7-1 Motor FLC-2 | |
|---|---|
| **Range:** | **Function:** |
| [Motor dependent] | Matches the starter to the second motor's full load current. Set to the full load current (FLC) rating shown on the motor nameplate. |

| 7-2 Locked Rotor Time-2 | |
|---|---|
| **Range:** | **Function:** |
| 10 secs* [0:01 - 2:00 (min:secs)] | Sets the maximum length of the time the motor can run at locked rotor current from cold before reaching its maximum temperature. Set according to the motor datasheet. If this information is not available, we recommend the value should be less than 20 seconds. |

| 7-3 Start Mode-2 | |
|---|---|
| **Option:** | **Function:** |
| | Selects the start mode for the secondary motor. |
| Constant Current | |
| Adaptive Control* | |

| 7-4 Current Limit-2 | |
|---|---|
| **Range:** | **Function:** |
| 350%* [100% - 600% FLC] | Sets the current limit for constant current and current ramp soft starting, as a percentage of motor full load current. |

| 7-5 Initial Crnt-2 | |
|---|---|
| **Range:** | **Function:** |
| 350%* [100% - 600% FLC] | 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. |

| 7-6 Start Ramp Time-2 | |
|---|---|
| **Range:** | **Function:** |
| 10 secs* [1 - 180 secs] | Sets the total start time for an AAC Adaptive Control start or the ramp time for current ramp starting (from the initial current to the current limit). |

| 7-7 Kickstart Level-2 | |
|---|---|
| **Range:** | **Function:** |
| 500%* [100% - 700% FLC] | Sets the level of the kickstart current. |

| 7-8 Kickstart Time-2 | |
|---|---|
| **Range:** | **Function:** |
| 0000 msecs* [0 - 2000 msecs] | Sets the kickstart duration. A setting of 0 disables kickstart. |

## 7-9 Excess Start Time-2

**Range:**  **Function:**

Excess start time is the maximum time the MCD 500 will attempt to start the motor. If the motor does not reach full speed 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.

20 secs*  [0:00 - 4:00 (min:secs)]  Set the excess time for the secondary motor.

## 7-10 Stop Mode-2

**Option:**  **Function:**

Selects the stop mode for the secondary motor.

Coast to Stop*

TVR Soft Stop

Adaptive Control

Brake

## 7-11 Stop Time-2

**Range:**  **Function:**

0 secs*  [0:00 - 4:00 (min:secs)]  Sets the time for soft stopping the motor using timed voltage ramp or Adaptive Control (AAC). If a main contactor is installed, the contactor must remain closed until the end of the stop time. Use a programmable output configured to Run to control the main contactor. Sets the toal stopping time when using brake.

## 7-12 Adaptv Ctrl Gain-2

**Range:**  **Function:**

75%*  [1% - 200%]  Adjusts the performance of AAC adaptive acceleration control.

> **!** We recommend leaving the gain setting at the default level unless AAC performance is not satisfactory.
> If the motor accelerates or decelerates quickly at the end of a start or stop, increase the gain by setting by 5% - 10%. If the motor speed fluctuates during starting or stopping, decrease the gain setting slightly.

## 7-13 Adptv Start Profile-2

**Option:**  **Function:**

Selects which profile the MCD 500 will use for an AAC adaptive acceleration control soft start.

Early Acceleration

Constant Acceleration*

Late Acceleration

## 7-14 Adptv Stop Profile-2

**Option:**  **Function:**

Selects which profile the MCD 500 will use for an AAC adaptive acceleration control soft stop.

Early Deceleration

Constant Deceleration*

Late Acceleration

## 7-15 Brake Torque-2

**Range:**  **Function:**

20%*  [20 - 100%]  Sets the amount of brake torque the MCD 500 will use to slow the motor.

| 7-16  Brake Time-2 | |
| --- | --- |
| **Range:** | **Function:** |
| 1 sec*    [1 - 30 secs] | Sets the duration for DC injection during a braking stop. |

> **NB!**
> Parameter 7-16 is used in conjunction with Par. 7-11.

## 7.11  Display

| 8-1  Language | |
| --- | --- |
| **Option:** | **Function:** |
| | Selects which language the LCP will use to display messages and feedback. |
| English* | |
| Chinese (中文) | |
| Spanish (Español) | |
| German (Deutsch) | |
| Portuguese (Português) | |
| French (Français) | |
| Italian (Italiano) | |
| Russian (Русский) | |

### 7.12.1  User Programmable Screen

Selects which four items will be displayed on the programmable monitoring screen.

| 8-2  User Scrn Top L | |
| --- | --- |
| **Option:** | **Function:** |
| | Selects the item displayed in the top left part of the screen. |
| 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 L" and "Btm L". |
| 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. |

| 8-3  User Scrn Top R | |
| --- | --- |
| **Option:** | **Function:** |
| | Selects the item displayed in the top right part of the screen. |
| 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 L" and "Btm L". |
| 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. |

### 8-4  User Scrn Btm L

| Option: | Function: |
|---|---|
| | Selects the item displayed in the bottom left part of the screen. |
| 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 L" and "Btm L". |
| 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. |

### 8-5  User Scrn Btm R

| Option: | Function: |
|---|---|
| | Selects the item displayed in the bottom right part of the screen. |
| 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 L" and "Btm L". |
| 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. |

## 7.12.2  Performance Graphs

The loggings menu allows the user to view performance information in real-time graphs.

The newest information is displayed at the right hand edge of the screen. The graph can be paused to analyse data by pressing and holding the OK button. To re-start the graph, press and hold OK.

### 8-6  Graph Timebase

| Option: | Function: |
|---|---|
| | Sets the graph time scale. The graph will progressively replace the old data with new data. |
| 10 secs* | |
| 30 secs | |
| 1 min | |

| 5 minutes |
| 10 minutes |
| 30 minutes |
| 1 hour |

## 8-7 Graph Max Adj

| Range: | | Function: |
|---|---|---|
| 400%* | [0% - 600%] | Adjusts the upper limit of the performance graph |

## 8-8 Graph Min Adj

| Range: | | Function: |
|---|---|---|
| 0%* | [0% - 600%] | Adjusts the lower limit of the performance graph. |

## 8-9 Mains Reference Voltage

| Range: | | Function: |
|---|---|---|
| 400 V* | [100 - 690 V] | Sets the nominal voltage for the LCP's monitoring functions. This is used to calculate motor kilowatts and kilovolt amperes (kVA), but does not affect the MCD 500's motor control protection. Enter the measured mains voltage. |

**7**

# 7.12 Restricted Parameters

## 15-1 Access Code

| Range: | | Function: |
|---|---|---|
| 0000* | [0000 - 9999] | Sets the access code to enter the simulation tools and counter resets or the restricted section of the Programming Menu (parameter group 15 and higher). |

Use the **BACK** and **OK** buttons to select which digit to alter and use the ▲ and ▼ buttons to change the value.

> **NB!**
> 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.

## 15-2 Adjustment Lock

| Option: | Function: |
|---|---|
| | Selects whether the LCP will allow parameters to be changed via the Programming Menu. |
| Read & Write* | 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. |
| No Access | Prevents users adjusting parameters in the Programming Menu unless an access code is entered. |

> **NB!**
> Changes to the Adjustment Lock setting take effect only after the Programming Menu has been closed.

## 15-3 Emergency Run

| Option: | Function: |
|---|---|
| | 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. |

## 15-4  Current Calibrat

**Range:**

100%*       [85% - 115%]

**Function:**

Motor Current Calibration calibrates the soft starter's current monitoring circuits to match an external current metering device.

Use the following formula to determine the necessary adjustment:

$$Calibration\,(\%) \;=\; \frac{Current\ shown\ on\ MCD\ 500\ display}{Current\ measured\ by\ external\ device}$$

$$e.g.\ 102\,\% \;=\; \frac{66\ A}{65\ A}$$

> **NB!**
> This adjustment affects all current-based functions.

## 15-5  Main Cont Time

**Range:**

150 msecs*   [100 - 2000 msecs]

**Function:**

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

## 15-6  Bypass Contactor Time

**Range:**

150 msecs*   [100 - 2000 msecs]

**Function:**

Sets the starter to match the bypass contactor closing time. Set according to the specifications of the bypass contactor used. If the time is too short, the starter will trip.

## 15-7  Motor Connection

**Option:**

**Function:**

Selects the soft starter will automatically detect the format of the connection to the motor.

| |
|---|
| Auto-Detect* |
| In-line |
| Inside Delta |

## 15-8  Jog Torque

**Range:**

50%*        [20% - 100%]

**Function:**

Sets the torque level for jog operation. See the section *Jog Operation* for more details.

> **NB!**
> Setting Par. 15-8 above 50% may cause increased shaft vibration.

## 7.13  Protection Action

| 16-1 - 16-12  Protection Action | |
| --- | --- |
| **Option:** | **Function:** |
| | Selects the soft starter's response to each protection. |
| | •     16-1 Motor Overload |
| | •     16-2 Current Imbalance |
| | •     16-3 Undercurrent |
| | •     16-4 Inst Overcurrent |
| | •     16-5 Frequency |
| | •     16-6 Heatsink Overtemp |
| | •     16-7 Excess Start Time |
| | •     16-8 Input A Trip |
| | •     16-9 Motor Thermistor |
| | •     16-10 Starter/Comms |
| | •     16-11 Network/Comms |
| | •     16-12 Battery/Clock |
| Trip Starter* | |
| Warn and Log | |
| Log Only | |

## 7.14  Factory Parameters

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

# 8 Tools

To access Tools, open the Main Menu, scroll to Tools and press **OK**.

## 8.1  Set Date and Time

To set the date and time:

1. Open the Tools Menu.

2. Scroll to *Set Date & Time*.

3. Press the **OK** button to enter edit mode.

4. Press the **OK** button to select which part of the date or time to edit.

5. Use the ▲ and ▼ buttons to change the value.

To save changes, press the **OK** button repeatedly. The MCD 500 will confirm the changes. To cancel changes, press the **BACK** button repeatedly.

## 8.2  Load/Save Settings

The MCD 500 includes options to:

- Load defaults: Load the MCD 500's parameters with default values

- Load User Set 1: Reload previously saved parameter settings from an internal file

- Save User Set 1: Save the current parameter settings to an internal file

In addition to the factory default values file, the MCD 500 can store a user-defined parameter file. This file contains default values until a user file is saved.

**To load or save parameter settings:**

1. Open the Tools Menu.

2. Use the ▼ button to select the required function, then press the **OK** button.

3. At the confirmation prompt, select YES to confirm or NO to cancel and then **OK** to load/save the selection or exit the screen.

| Tools |
|---|
| Load Defaults |
| Load User Set 1 |
| Save User Set 1 |

| Load Defaults |
|---|
| No |
| Yes |

When the action has been completed, the screen will briefly display a confirmation message, then return to the status screens.

## 8.3 Reset Thermal Model

> **NB!**
> This function is protected by the security access code.

The MCD 500's advanced thermal modelling software constantly monitors the motor's performance. This allows the MCD 500 to calculate the motor's temperature and ability to start successfully at any time.

The thermal model can be reset if required.

1. Open Tools.

2. Scroll to Reset Thermal Model and press **OK**.

3. At the confirmation prompt, press **OK** to confirm then enter the access code, or press **Back** to cancel the action.

4. Select Reset or Do Not Reset, then press **OK**. When the thermal model has been reset, the MCD 500 will return to the previous screen.

```
Reset Thermal Model
M1 X%
OK to Reset
```

```
Reset Thermal Model
Do Not Reset
Reset
```

> **!** Adjusting the motor thermal model may compromise motor life and should only be done in the case of emergency.

**8**

## 8.4 Protection Simulation

> **NB!**
> This function is protected by the security access code.

Software simulation functions let you test the soft starter's operation and control circuits without connecting the soft starter to mains voltage.

The MCD 500 can simulate each different protection, in order to confirm that the soft starter is responding correctly and reporting the situation on the display and across the communication network.

**To use the protection simulation:**

1. Open the Main Menu.

2. Scroll to Protection Sim and press **OK**.

3. Use the ▲ and ▼ buttons to select the protection you want to simulate.

4. Press **OK** to simulate the selected protection.

5. The protection message is displayed while **OK** is pressed. The soft starter's response depends on the Protection Action setting (parameter group 16).

6. Press **BACK** to return to the simulation list.

7. Use ▲ or ▼ to select another simulation, or press **BACK** to return to the Main Menu.

```
MS1                  000.0A              0000.0kW
Tripped
Selected Protection
```

> **NB!**
> If the protection trips the soft starter, reset before simulating another protection. If the protection action is set to 'Warn or Log', no reset is required.
> If the protection is set to 'Warn & Log', the warning message can be viewed only while the '**OK**' button is pressed.
> If the protection is set to 'Log only', nothing appears on the screen but an entry will appear in the log.

## 8.5 Output Signal Simulation

> **NB!**
> This function is protected by the security access code.

The LCP allows the user to simulate output signalling in order to confirm that the output relays are operating correctly.

> **NB!**
> 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 Main Menu.

2. Scroll to Output Signal Sim and press **OK**, then enter the access code.

3. Use the ▲ and ▼ buttons to select a simulation, then press **OK**.

4. Use the ▲ and ▼ buttons to turn the signal on and off. To confirm correct operation, monitor the state of the output.

5. Press **BACK** to return to the simulation list.

```
                        Prog Relay A
Off
On
```

## 8.6 Digital I/O State

This screen shows the current status of the Digital I/O in order.

The top line of the screen shows the start, stop, reset and programmable input.

The bottom line of the screen shows programmable outputs A, B and C.

The screen shot shows the stop input (17) as closed (1) and the start, reset and Input A inputs (15, 25, 11) as open (0). Relay A (13, 14) is closed and relays B and C (21, 22, 24 and 33, 34) are open,

```
                        Digital I/O State
Inputs: 0100
Outputs: 100
```

## 8.7 Temp Sensors State

This screen shows the state of the motor thermistor.
The screen shot shows the thermistor state as O (open).

```
                        Temp Sensors State
Thermistor: O
S = shrt H=hot C=cld O=opn
```

## 8.8  Alarm Log

The **Alarm Log** button opens the Alarm Logs, which contains a Trip Log, Event Log, and Counters which store information on the MCD 500's operating history.

### 8.9.1  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.  Open the Alarm Logs.
2.  Scroll to Trip Log and press **OK**.
3.  Use the ▲ and ▼ buttons to select a trip to view, and press **OK** to display details.

To close the log and return to the main display, press **BACK**.

### 8.9.2  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.  Open the Alarm Logs.
2.  Scroll to Event Log and press **OK**.
3.  Use the ▲ and ▼ buttons to select an event to view, and press **OK** to display details.

To close the log and return to the main display, press **BACK**.

### 8.9.3  Counters

> **NB!**
> This function is protected by the security access code.

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 correct access code is entered.

To view the counters:

1. Open the Alarm Logs.

2. Scroll to Counters and press **OK**.

3. Use the ▲ and ▼ buttons to scroll through the counters. Press **OK** to view details.

4. To reset a counter, press **OK** then enter the access code. Select Reset, then press **OK** to confirm.

To close the counter and return to the Alarm Logs, press **BACK**.

**9**

# 9 Troubleshooting

When a protection condition is detected, the MCD 500 will write this to the event log and may also trip or issue a warning. The soft starter's response to some protections may depend on the Protection Action settings (parameter group 16).

If the MCD 500 trips you will need to reset the soft starter before restarting. If the MCD 500 has issued a warning, the soft starter will reset itself once the cause of the warning has been resolved.

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

## 9.1  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 2 *Protection* 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. Reprogram the date and time.<br>Related Pars.: 16-12 |
| Current Imbalance | Current imbalance can be caused by problems with the motor, the environment or the installation, such as:<br>- An imbalance in the incoming mains voltage<br>- A problem with the motor windings<br>- A light load on the motor<br><br>Current imbalance can also be caused by incorrect cabling between the external bypass contactor and the soft starter or an internal problem with the soft starter, 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.<br>Related Pars.: 2-2, 2-3, 16-2 |
| Excess Start Time | Excess start time trip can occur in the following conditions:<br>- The FLC setting is wrong<br>- The Current Limit has been set too low<br>- The Start Ramp Time has been set greater than the Excess Start Time setting<br><br>The Start Ramp Time is set too short for a high inertia load when using adaptive acceleration control<br>Related Pars.: 1-1, 1-6, 1-4, 1-9, 7-9, 7-1, 7-6, 7-4, 16-7 |
| FLC Too High | The MCD 500 can support higher motor FLC values when connected to the motor using inside delta configuration rather than in-line connection. If the soft starter is connected in-line but the selected motor FLC is above the in-line maximum, the soft starter will trip at start.<br>Related Pars.: 1-1, 7-1 |
| Frequency | The mains frequency has gone beyond the specified range.<br>Check for other equipment in the area that could be affecting the mains supply (particularly variable speed drives).<br>If the MCD 500 is connected to a generator set supply, the generator may be too small or could have a speed regulation problem.<br>Related Pars.: 2-8, 2-9, 2-10, 16-5 |

*Danfoss*

| Display | Possible cause/Suggested solution |
|---|---|
| Heatsink Overtemp | Check if cooling fans are operating. If mounted in an enclosure check if ventilation is adequate. |
| | On models with internal bypass, the cooling fans will operate: |
| | - During the Start sequence and for 10 minutes after transition to Run. |
| | - For 10 minutes after Stop. |
| | Models without internal bypass will operate the cooling fans from a Start until 10 minutes after a Stop. |
| | Related Pars.: 16-6 |
| Input A Trip | Identify and resolve the condition which caused Input A to activate. |
| | Related Pars.: 3-3, 3-4, 3-5, 3-6, 3-7, 16-8 |
| Inst Overcurrent | The motor has experienced a sharp rise in motor current, probably caused by a locked rotor condition (shearpin) while running. This may indicate a jammed load. |
| | Related Pars.: 2-6, 2-7, 16-4 |
| Internal Fault X | The MCD 500 has tripped on an internal fault. Contact your local supplier with the fault code (X). |
| | Related Pars.: None |
| L1 Phase Loss | During prestart checks the starter has detected a phase loss as indicated. |
| L2 Phase Loss | In run state, the starter has detected that the current on the affected phase has dropped below 3.3% of |
| L3 Phase Loss | the programmed motor 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 Pars.: None |
| L1-T1 Shorted | During prestart checks the starter has detected a shorted SCR or a short within the bypass contactor as |
| L2-T2 Shorted | indicated. |
| L3-T3 Shorted | Related Pars.: none |
| Low Control Volts | The internal 24 VDC rail has dropped below 19V. This may have been caused by a fluctuation of the control supply. Reset the trip. If the problem persists: |
| | • The 24 V supply in the main control PCB may be faulty; or |
| | • the bypass driver PCB may be faulty (internally bypassed models only). |
| | These trips cannot be reset. Contact your local supplier for advice. |
| | Related Pars: None |
| Motor Overload/ | The motor has reached its maximum thermal capacity. Overload can be caused by: |
| Motor 2 Overlaod | - The soft starter protection settings not matching the motor thermal capacity. |
| | - Excessive starts per hour |
| | - Excessive throughput |
| | - Damage to the motor windings. |
| | Resolve the cause of the overload and allow the motor to cool. |
| | Related Pars.: 1-1, 1-2, 1-3, 1-4, 7-1, 7-2, 7-3, 7-4, 16-1 |
| Motor Connection | The motor is not connected correctly to the soft starter for inline or inside delta use. |
| | - Check individual motor connections to the soft starter for power circuit continuity. |
| | - Check connections at the motor terminal box. |
| | Related Pars.: 15-7 |
| Motor Thermistor | The motor thermistor input has been enabled and: |
| | - The resistance at the thermistor input has exceeded 3.6 kΩ for more than one second. |
| | - The motor winding has overheated. Identify the cause of the overheating and allow the motor to cool before restarting. |
| | - The motor thermistor input has been open. |
| | Note: If a valid motor thermistor is no longer used, a 1.2 kΩ resistor must be fitted across terminals 05, 06. |
| | Related Pars.: 16-9 |
| Network Comms | The network master has sent a trip command to the starter, or there may be a network communication problem. |
| | Check the network for causes of communication inactivity. |
| | Related Pars.: 16-11 |

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| Display | Possible cause/Suggested solution |
|---|---|
| Parameter out of Range | - A parameter value is outside the valid range.<br><br>The starter will load the default value for all affected parameters. Press **MAIN MENU** to go to the first invalid parameter and adjust the setting.<br>Related Pars.: None |
| Phase Sequence | The phase sequence on the soft starter's input terminals (L1, L2, L3) is not valid.<br>Check the phase sequence on L1, L2, L3 and ensure the setting in Par. 2-1 is suitable for the installation.<br>Related Pars.: 2-1 |
| Power Loss | The starter is not receiving mains supply on one or more phases when a Start Command is given.<br>Check that the main contactor closes when a start command is given, and remains closed until the end of a soft stop.<br>Related Pars.: 15-5 |
| Starter Comms | - There is 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.<br><br>- There is an internal communications error within the soft starter. Contact your local distributor.<br><br>Related Pars.: 16-10 |
| Thermistor Cct | The thermistor input has been enabled and:<br>- The resistance at the input has fallen below 20 Ω (the cold resistance of most thermistors will be over this value) or<br><br>- A short circuit has occurred. Check and resolve this condition.<br><br>Check that a PT100 (RTD) is not connected to 05, 06.<br>Related Pars.: None. |
| Time - Overcurrent | The MCD 500 is internally bypassed and has drawn high current during running. (The 10A protection curve trip has been reached or the motor current has risen to 600% of the motor FLC setting.)<br>Related Pars.: None |
| 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.<br>Related Pars.: 2-4, 2-5, 16-3 |
| Unsupported Option | The selected function is not available (e.g. jog is not supported in inside delta configuration).<br>Related Pars.: None |

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## 9.2  General Faults

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

| Symptom | Probable Cause |
|---|---|
| Soft starter does not respond to commands. | - If the soft starter does not respond to the **RESET** button on the LCP: <br><br>The soft starter may be in Auto On mode and will only accept commands from the remote control inputs. In Auto On mode, the Auto On LED on the LCP is active. Press the **Hand On** or **Off** button to enable control via the LCP (this will also send a start or stop command to the MCD 500). <br><br> - If the soft starter does not respond to commands from the control inputs: <br><br>The soft starter may be in Hand On mode and will only accept commands from the LCP. When the soft starter is in Hand On control mode, the Off or Hand On LED on the LCP is active. To change to Auto On mode, press the **Auto On** button once. <br><br>The control wiring may be incorrect. Check that the remote start, stop and reset inputs are configured correctly (=> *Control Wiring* for details). <br><br>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 LCP. <br><br>The soft starter will only execute a start command from the remote inputs if the remote stop input is inactive and the remote reset input is activated (the Reset LED on the starter will be on). <br><br> - If the soft starter does not respond to a start command from either the local or remote controls: <br><br>The soft starter may be waiting for the restart delay to elapse. The length of the restart delay is controlled by Par. 2-11 *Restart Delay*. <br><br>The motor may be too hot to permit a start. If Par. 2-12 *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. <br><br>The emergency stop function may be active. If Par. 3-3 is set to Emergency Stop and there is an open circuit on the corresponding input, the MCD 500 will not start. If the emergency stop situation has been resolved, close the circuit on the input. |
| The soft starter does not control the motor correctly during starting. | - Start performance may be unstable when using a low Motor Full Load Current setting Par. 1-1). This can affect use on a small test motor with full load current between 5 A and 50 A. <br><br> - Power factor correction (PFC) capacitors must be installed on the supply side of the soft starter. To control a dedicated PFC capacitor contactor, connect the contactor to run relay terminals. |
| Motor does not reach full speed. | - If the start current is too low, the motor will not produce enough torque to accelerate to full speed. The soft starter may trip on excess start time. <br><br> **NB!** <br> Make sure the motor starting parameters are appropriate for the application and that you are using the intended motor starting profile. If Par. 3-3 is set to Motor Set Select, check that the corresponding input is in the expected state. <br><br> - The load may be jammed. Check the load for severe overloading or a locked rotor situation. |
| Erratic motor operation. | - The SCRs in the MCD 500 require at least 5 A of current to latch. If you are testing the soft starter on a motor with full load current less than 5 A, the SCRs may not latch correctly. |
| Soft stop ends too quickly. | - The soft stop settings may not be appropriate for the motor and load. Review the settings of Pars. 1-10, 1-11, 7-10 and 7-11. <br><br> - If the motor is very lightly loaded, soft stop will have limited effect. |
| AAC adaptive acceleration control, DC brake and Jog functions not working | - These features are only available with in-line installation. If the MCD 500 is installed inside delta, these features will not operate. |

| Symptom | Probable Cause |
|---|---|
| A reset does not occur after an Auto-Reset, when using a remote 2-wire control. | - The remote 2-wire start signal must be removed and reapplied for a re-start. |
| Remote start/stop command is overriding Auto Start/Stop settings when using remote 2-wire control. | - Auto Start/Stop function should only be used in HAND ON mode or in tandem with HAND OFF mode, 3 and 4-wire control. |
| After selecting AAC the motor used an ordinary start and/or the second start was different to the first. | - The first AAC start is current limit so that the starter can learn from the motor characteristics. Subsequent starts use AAC. |
| Non-resettable THERMISTOR FAIL trip, when there is a link between Thermistor input 05, 06 or when the motor thermistor connected between 05, 06 is permanently removed. | - The thermistor input is enabled once a link is fitted and short circuit protection has activated.<br>Remove the link then load the default parameter set. This will disable the thermistor input and clear the trip.<br>Place a 1k2 Ω resistor across the thermistor input.<br>Turn thermistor protection to 'Log only' (Par. 16-9). |
| Parameter settings cannot be stored. | - Make sure you are saving the new value by pressing the **OK** button after adjusting a parameter setting. If you press **BACK**, the change will not be saved.<br>- Check that the adjustment lock (Par. 15-2) is set to Read/Write. If the adjustment lock is on, settings can be viewed but not changed. You need to know the security access code to change the adjustment lock setting.<br>- The EEPROM may be faulty on the Main Control PCB. A faulty EEPROM will also trip the soft starter, and the LCP will display the message *Par. Out of Range*. Contact your local supplier for advice. |

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# 10 Specifications

| Supply | |
|---|---|
| **Mains voltage (L1, L2, L3)** | |
| MCD5-xxxx-T5 | 200 VAC - 525 VAC (± 10%) |
| MCD5-xxxx-T7 | 380 VAC - 600 VAC (± 10%) (inside delta connection) |
| MCD5-xxxx-T7 | 380 VAC - 690 VAC (± 10%) (earthed star supply system only) |
| **Control voltage (A4, A5, A6)** | |
| CV1 (A5, A6) | 24 VAC/VDC (± 20%) |
| CV2 (A5, A6) | 110~120 VAC (+ 10% / - 15%) |
| CV2 (A4, A6) | 220~240 VAC (+ 10% / - 15%) |
| **Current consumption (maximum)** | |
| CV1 | 2.8 A |
| CV2 (110 - 120 VAC) | 1 A |
| CV2 (220 - 240 VAC) | 500 mA |
| Mains frequency | 50/60 Hz (± 10%) |
| Rated insulation voltage to earth | 600 VAC |
| Rated impulse withstand voltage | 4 kV |
| Form designation | Bypassed or continuous, semiconductor motor starter form 1 |

| Short circuit capability | |
|---|---|
| Coordination with semiconductor fuses | Type 2 |
| Coordination with HRC fuses | Type 1 |
| MCD5-0021B to MCD5-0105B | prospective current 600 VAC: 10 kA / 480 VAC: 65 kA |
| MCD5-0131B to MCD5-0215B | prospective current 600 VAC: 18 kA / 480 VAC: 65 kA |
| MCD5-0245C to MCD5-0927C | prospective current 480/600 VAC: 85 kA |
| MCD5-1410 to MCD5-1600C | prospective current 480/600 VAC: 100 kA |

| Electromagnetic capability (compliant with EU Directive 89/336/EEC) | |
|---|---|
| EMC Emissions | IEC 60947-4-2 Class B and Lloyds Marine No 1 Specification |
| EMC Immunity | IEC 60947-4-2 |

| Inputs | |
|---|---|
| Input Rating | Active 24 VDC, 8 mA approx |
| Start (15, 16) | Normally open |
| Stop (17, 18) | Normally closed |
| Reset (25, 18) | Normally closed |
| Programmable input (11, 16) | Normally open |
| Motor thermistor (05, 06) | Trip >3.6 kΩ, reset <1.6kΩ |

| Outputs | |
|---|---|
| Relay Outputs | 10A @ 250 VAC resistive, 5A @ 250 VAC AC15 pf 0.3 |
| **Programmable Outputs** | |
| Relay A (13, 14) | Normally open |
| Relay B (21, 22, 24) | Changeover |
| Relay C (33, 34) | Normally open |
| Analog Output (07, 08) | 0-20 mA or 4-20 mA (selectable) |
| Maximum load | 600 Ω (12 VDC @ 20 mA) |
| Accuracy | ± 5% |
| 24 VDC Output (16, 08) Maximum load | 200 mA |
| Accuracy | ± 10% |

| Environmental | |
|---|---|
| **Protection** | |
| MCD5-0021B - MCD5-0105B | IP20 & NEMA, UL Indoor Type 1 |
| MCD5-0131B - MCD5-1600C | IP00, UL Indoor Open Type |
| Operating temperature | -10° C to 60° C, above 40° C with derating |
| Storage temperature | - 25° C to + 60° C |

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| Operating Altitude | 0 - 1000 m, above 1000 m with derating |
|---|---|
| Humidity | 5% to 95% Relative Humidity |
| Pollution degree | Pollution Degree 3 |

| Heat Dissipation | |
|---|---|
| During start | 4.5 watts per ampere |
| During run | |
| MCD5-0021B - MCD5-0053B | = 39 watts approx |
| MCD5-0068B - MCD5-0105B | = 51 watts approx |
| MCD5-0131B - MCD5-0215B | = 120 watts approx |
| MCD5-0245C - MCD5-0927C | 4.5 watts per ampere approx |
| MCD5-1200C - MCD5-1600C | 4.5 watts per ampere approx |

| Certification | |
|---|---|
| C✓ | IEC 60947-4-2 |
| UL/ C-UL | UL 508 |
| CE | IEC 60947-4-2 |
| CCC (Pending) | GB 14048-6 |
| Marine (MCD5-0021B - MCD5-0215B only) | Lloyds Marine No 1 Specification |
| RoHS | Compliant with EU Directive 2002/95/EC |

## 10.1  Accessories

### 10.2.1  Communication Modules

MCD 500 soft starters support network communication using the Profibus, DeviceNet and Modbus RTU protocols, via an easy-to-install communications module. The communications module plugs directly onto the side of the starter.

- 175G9000 Modbus Module
- 175G9001 Profibus Module
- 175G9002 DeviceNet Module
- 175G9009 MCD USB Module

### 10.2.2  PC Software

MCD PC Software can be used in conjunction with a communications module to provide the following functionality for networks of up to 99 soft starters.

| Feature | MCD-201 | MCD-202 | MCD-3000 | MCD500 |
|---|---|---|---|---|
| Operational control (Start, Stop, Reset, Quick Stop) | ● | ● | ● | ● |
| Starter status monitoring (Ready, Starting, Running, Stopping, Tripped) | ● | ● | ● | ● |
| Performance monitoring (motor current, motor temperature) | | ● | ● | ● |
| Upload parameter settings | | | ● | ● |
| Download parameter settings | | | ● | ● |

The PC software available from Danfoss's website is:

- WinMaster: VLT® Soft Starter software for control, configuration and management
- MCT10: VLT® software for configuration and management.

### 10.2.3 Finger Guard Kit

Finger guards may be specified for personnel safety and can be used on MCD 500 soft starter models 0131B - 1600C. Finger guards fit over the soft starter terminals to prevent accidental contact with live terminals. Finger guards provide IP20 protection.

- MCD5-0131B ~MCD5-0215B: 175G5662
- MCD5-245C: 175G5663
- MCD5-0360C ~MCD5-0927C: 175G5664
- MCD5-1200C ~MCD5-1600C: 175G5665

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## 11 Bus Bar Adjustment Procedure (MCD5-0360C - MCD5-1600C)

**NB!**
Many electronic components are sensitive to static electricity. Voltages so low that they cannot be felt, seen or heard, can reduce the life, affect performance, or completely destroy sensitive electronic components. When performing service, proper ESD equipment should be used to prevent possible damage from occurring.

All units are manufactured with input and output bus bars at the bottom of the unit as standard. The input and/or output bus bars can be moved tot he top of the unit if required.

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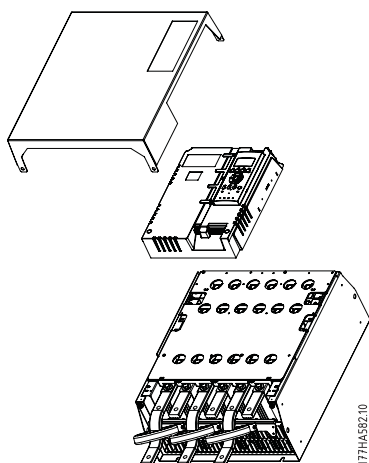
1. Remove all wiring and links from the soft starter before dismantling the unit.

2. Remove the unit cover (4 screws).

3. Unscrew the main plastic and fold away from the starter (4 screws).

4. Unplug the keypad loom from CON 1 (see note).

5. label each SCR firing loom with the number of the corresponding terminal on the main control PCB, then unplug the looms.

6. Unplug the thermistor, fan and CT wires from the main control PCB.

**NB!**
Remove the main plastic slowly to avoid damaging the keypad wiring loom which runs between the main plastic and the backplane PCB.
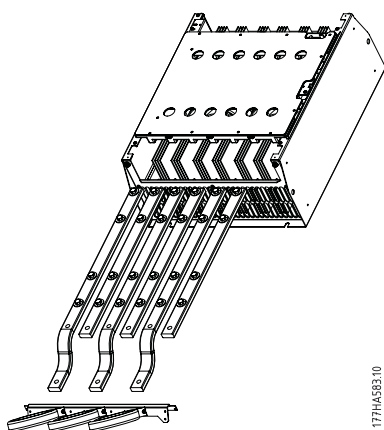
1. Unscrew and remove the magnetic bypass plates (models MCD5-0620C to MCD5-1600c ONLY).

2. Remove the CT assembly (three screws).

3. Identify which bus bars are to be moved. Remove the bolts holding these bus bars in place then slide the bus bars out through the bottom of the starter (four bolts per bus bar).
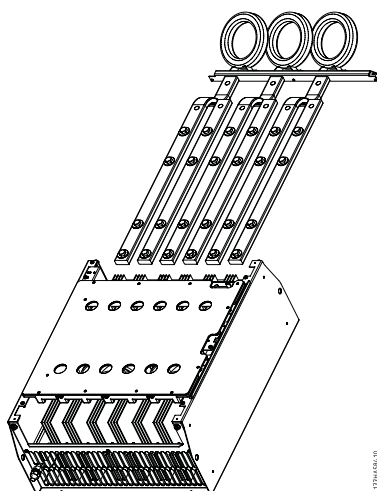
1. Slide the bus bars in through the top of the starter. For input bus bars, the short curved end should be outside the starter. For output bus bars, the unthreaded hole should be outside the starter.

2. Replace the dome washers with the flat face towards the bus bar, then tighten the bolts holding the bus bars in place to 20 Nm.

3. Place the CT assembly over the input bus bars and screw the assembly to the body of the starter (see note).

4. Run all wiring to the side of the starter and secure with cable ties.

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**NB!**
If moving the input bars, the CTs must also be reconfigured.

1. Label the CTs L1, L2 and L3 (L1 is leftmost when working from the front of the starter). Remove the cable ties and unscrew the CTs from the bracket.

2. Move the CT bracket to the top of the starter. Position the CTs for the correct phases, then screw the CTs to the bracket. For models MCD5-0360C - MCD5-0930, the CTs must be placed on an angle (the left hand legs of each CT will be on the top row of holes and the right hand legs will be on the bottom tabs).

**11**