*Danfoss*

# Service Guide
# VLT® Soft Starter MCD 500

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# Contents

VLT® Soft Starter MCD 500

 MG17L802

**1**

# 1 Introduction

## 1.1 Purpose of the Manual

The purpose of this guide is to provide detailed technical information and instructions to enable an authorized technician to identify faults and perform repairs on the VLT® Soft Starter MCD 500.

The service guide includes the following information:

- Troubleshooting and test instructions.

- Exploded views of the different models.

- Spare part lists with ordering numbers.

## 1.2 Additional Resources

Other resources are available to understand advanced soft starter operation.

- The *Operating Guide* provides detailed information for the installation and start-up of the soft starter.

- The *Design Guide* entails all technical information about the soft starter and customer design and applications.

- Optional equipment is available that can change some of the information described in these publications. Be sure to consult the instructions supplied with the options for specific requirements.

Supplementary publications and manuals are available from Danfoss. See *drives.danfoss.com/downloads/portal/#/* for listings.

## 1.3 Document Version

This guide is regularly reviewed and updated. All suggestions for improvement are welcome. *Table 1.1* shows the document version.

| Edition | Remarks |
|---------|---------|
| MG17L8 | Introductory chapter added. Ordering number for current transformers for models 0021B ~ 0105B changed. |

**Table 1.1 Document Version**

# 2 Safety

**2**

The following symbols are used in this guide:

## ⚠WARNING

**Indicates a potentially hazardous situation that could result in death or serious injury.**

## ⚠CAUTION

**Indicates a potentially hazardous situation that could result in minor or moderate injury. It can also be used to alert against unsafe practices.**

## *NOTICE*

**Indicates important information, including situations that can result in damage to equipment or property.**

## 2.1.1 Qualified Personnel

Correct and reliable transport, storage, installation, operation, and maintenance are required for the trouble-free and safe operation of the soft starter. Only qualified personnel are allowed to install or operate this equipment.

Qualified personnel is defined as trained staff, who are authorized to install, commission, and maintain equipment, systems, and circuits in accordance with pertinent laws and regulations. Additionally, the personnel must be familiar with the instructions and safety measures described in this manual.

## ⚠WARNING

### ELECTRICAL SHOCK HAZARD

**VLT® Soft Starter MCD 500 contains dangerous voltages when connected to mains voltage. Only a qualified electrician should carry out the electrical installation. Improper installation of the motor or the soft starter can cause death, serious injury, or equipment failure. Follow the guidelines in this manual and local electrical safety codes.**
**Models MCD5-0360C ~ MCD5-1600C:**
**Treat the busbar and heat sink as live parts whenever the unit has mains voltage connected (including when the soft starter is tripped or waiting for a command).**

## ⚠WARNING

### PROPER GROUNDING

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

## ⚠WARNING

### IMMEDIATE START

**In auto-on mode, the motor can be controlled remotely (via remote inputs) while the soft starter is connected to mains.**
**MCD5-0021B ~ MCD5-0961B:**
**Transportation, mechanical shock, or rough handling may cause the bypass contactor to latch into the On state.**

**To prevent the motor from starting immediately on first commissioning or operation after transportation:**
- **Always ensure that the control supply is applied before the power.**
- **Applying control supply before power ensures that the contactor state is initialized.**

## ⚠WARNING

### UNINTENDED START

**When the soft starter is connected to AC mains, DC supply, or load sharing, the motor can start at any time. Unintended start during programming, service, or repair work can result in death, serious injury, or property damage. The motor can start with an external switch, a fieldbus command, an input reference signal from the LCP or LOP, via remote operation using MCD PC Software, or after a cleared fault condition.**

**To prevent unintended motor start:**
- **Press [Off]/[Reset] on the LCP before programming parameters.**
- **Disconnect the soft starter from mains.**
- **Completely wire and assemble the soft starter, motor, and any driven equipment before connecting the soft starter to AC mains, DC supply, or load sharing.**

# ⚠WARNING

## SAFETY OF PERSONNEL

**The soft starter is not a safety device and does not provide electrical isolation or disconnection from the supply.**

- **If isolation is required, the soft starter must be installed with a main contactor.**

- **Do not rely on the start and stop functions for safety of personnel. Faults occurring in the mains supply, the motor connection, or the electronics of the soft starter can cause unintended motor starts or stops.**

- **If faults occur in the electronics of the soft starter, a stopped motor may start. A temporary fault in the supply mains or loss of motor connection can also cause a stopped motor to start.**

**To provide safety of personnel and equipment, control the isolation device through an external safety system.**

## *NOTICE*

**Before changing any parameter settings, save the current parameter to a file using MCD PC Software or the *Save User Set* function.**

## *NOTICE*

**Use the *autostart* feature with caution. Read all the notes related to *autostart* before operation.**

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. Responsibility or liability is never accepted for direct, indirect, or consequential damage resulting from the use or application of this equipment.

2

MG17L802 5

# 3 Troubleshooting

When a protection condition is detected, the VLT® Soft Starter MCD 500 writes this condition to the event log and may also trip or issue a warning. The soft starter response depends on the protection action settings (*parameter group 16 Protection Actions*).

Some protection responses cannot be adjusted. Usually, external events (for example phase loss) or a fault within the soft starter cause these trips. These trips do not have associated parameters and cannot be set to *Warn* or *Log*.

If the soft starter trips:
1. Identify and clear the condition that triggered the trip.
2. Reset the soft starter.
3. Restart the soft starter.

To reset the soft starter, press [Reset] or activate the *Reset remote* input.

If the soft starter has issued a warning, it resets itself when the cause of the warning has been resolved.

## 3.1 Functional Tests

Use the tests described in this section to identify the cause of problems with the soft starter.

## 3.1.1 Testing the MCD 500 with a Small Motor

The VLT® Soft Starter MCD 500 can be connected to a small motor for testing. During this test, the control input and relay output protection settings of the soft starter can be tested. This test mode is not suitable for testing soft starting or soft stopping performance.

### NOTICE
**When testing the soft starter with a small motor, ensure that *parameter 1-1 Motor Full Load Current* is set to the minimum allowable value.**
**The FLC of the test motor must be at least 2% of the soft starter minimum FLC (see *chapter 7.2.1 Minimum and Maximum Current Settings*).**

## 3.1.2 Power Circuit Test

This procedure tests the soft starter power circuit, including:
- SCR.
- Interface PCB.
- Main control PCB.

Use a 500 V DC insulation tester on the 200 Ω scale or a standard multimeter (voltmeter).

1. Isolate the soft starter from the incoming mains supply and remove the control voltage.
2. Disconnect the motor cables and any external bypass contactor cables from the soft starter.
3. Allow the soft starter to cool to room ambient temperature.
4. Using a meter, check the resistance across each phase of the soft starter in both directions.

     4a     L1 to T1.

     4b     T1 to L1.

     4c     L2 to T2.

     4d     T2 to L2.

     4e     L3 to T3.

     4f     T3 to L3.

5. If any reading is less than 200 Ω, the SCR or internal bypass relay has failed short circuit and must be replaced.
6. To prevent a repeated SCR failure, investigate the cause of the SCR damage.

### NOTICE
**Events that damage SCRs often damage the backplane PCB as well, although the main control PCB is undamaged.**

1. **Replace the damaged SCRs and backplane PCB.**
2. **Check for correct operation before replacing the main control PCB.**

**External influences that almost always cause SCR damage.**

- **If the MOVs and/or surrounding circuitry on the backplane PCB show signs of physical damage, the most likely cause is overvoltage.**

- **If the MOVs and/or surrounding circuitry on the backplane PCB do not show signs of physical damage, the most likely cause is overcurrent.**

See *chapter 5.5.1 SCRs and SCR Connection* for information on typical causes of SCR damage.

3

### 3.1.3 Start Performance Test

This procedure tests that the soft starter operates correctly during start-up.

1. Connect the soft starter to mains voltage, control voltage, and to a motor.

2. Set *parameter 1-1 Motor FLC* to match the full load current of the motor.

3. Set *parameter 1-3 Start mode* to *Constant current*.

4. Set *parameter 1-4 Current limit* to a level which supplies sufficient start current to enable the connected motor to accelerate to full speed.

    4a Calculate the expected start current by multiplying *parameter 1-1 Motor FLC* by *parameter 1-4 Current limit*.

    4b If the secondary parameter set is being tested, multiply *parameter 7-1 Motor FLC-2* by *parameter 7-4 Current limit-2*.

5. Initiate a start and measure the actual start current. To measure the actual start current, view the phase current display or use a clip-on ammeter.

If the measured current is equal to the actual start current on all 3 phases, the soft starter performs correctly.

### *NOTICE*

**During start mode, the *On* LED on the LCP flashes.**

### 3.1.4 Run Performance Test

This procedure tests for correct operation of the soft starter during run mode.

This test is performed using an AC voltmeter.

1. Measure the voltage across each phase (L1–T1, L2–T2, L3–T3). This result should be close to the nominal mains voltage (phase voltage for in-line connection and mains voltage for inside delta connection).

    1a If the voltage is 0, the SCR on that phase may have failed.

    1b If the voltage is not equivalent to the nominal mains voltage, the bypass contactor may be damaged and should be replaced (internally bypassed models only).

2. Command the soft starter to start. When the soft starter starts, measure the voltage across each phase.

    2a For units which are not bypassed, the voltage should drop to less than 2 V AC just before the soft starter reaches run mode.

    2b For units with internal bypass contactors, the voltage should be less than 0.5 V AC when the soft starter reaches run mode.

    2c If the voltage remains near nominal voltage, the SCR does not fire correctly. Check the connections between the main control PCB and the SCRs.

If the voltage starts near nominal mains voltage and then drops to less than 2 V AC just before reaching run mode, the soft starter operates correctly. Thus, the soft starter is not the cause of the starting problem.

### 3.1.5 Bypass Contactor Test

This procedure tests the operation of the internal bypass contactors. Use this test if the soft starter trips with:
- Bypass failure.
- Time overcurrent.
- Heat sink overtemperature.

This test is performed using an AC voltmeter.

1. Measure the voltage across each phase (L1–T1, L2–T2, L3–T3). This result should be close to the nominal mains voltage (phase voltage for in-line connection and mains voltage for inside delta connection).

    1a If the voltage is 0, replace the bypass contactor.

2. Command the soft starter to start. When the *Run* LED stops flashing, the bypass contactor closes with an audible sound.

    2a If the bypass contactors do not close, the bypass contactor, main control PCB, model PCB, or bypass driver PCB (G2B) is faulty. Alternatively, there is a faulty connection between these components.

3. When the soft starter runs, measure the voltage across each phase. This result should be <0.5 V AC.

4. Command the soft starter to stop and listen for the bypass contactor to open.

**3**

4a    If the soft starter is configured for soft stop, the bypass contactor opens when the *Run* LED starts flashing.

4b    If the soft starter is not configured for soft stop, the bypass contactor closes when the *Run* LED turns off.

### *NOTICE*

**The bypass contactors used in the G1B enclosure size are latching. The soft starter control circuits are designed to open the bypass contactors even when losing control voltage. However, it is still possible that the bypass contactor is closed when there is no control supply to the soft starter. The bypass contactors open when control voltage is applied.**

## 3.1.6 Control Input Test

This procedure tests the condition of the soft starter control inputs. This test is performed using a wire link.

1.    Disconnect all external wiring from the soft starter control inputs.

2.    Control voltage must still be connected to the soft starter.

3.    Navigate to the soft starter digital I/O view.

4.    Connect a wire link between each input.

**Test results**

•    If the corresponding LED lights up and the shown status of the input changes, the input operates correctly.

•    If the LED does not light up or the shown status does not change, the main control PCB is damaged.

## 3.1.7 After Repair Tests

### *NOTICE*

**The servicing technician is responsible for ensuring that all electrical safety tests have been completed in accordance with local regulations.**

To test that the soft starter functions correctly after reassembly:

1.    Apply control power only to the soft starter.

2.    Ensure that the welcome screen shows the correct firmware version.

3.    Perform a *Run simulation* test using both the LCP and remote switches.

4.    Connect mains supply and motor. Test that the soft starter functions as expected.

To test the soft starter operation with a small motor (that is a motor with a current rating much lower than that of the soft starter):

1.    Use the *Tools* menu to load the *Factory Default* parameter file for the soft starter.

2.    Disable *parameter 2-4 Undercurrent Trip*.

3.    Connect a small motor to the motor terminals of the soft starter. Test that the soft starter functions as expected.

### *NOTICE*

**Ensure that *parameter 2-4 Undercurrent Trip* is reset to its default value after conducting tests.**

## 3.2 Trip Messages

*Table 3.1* lists the protection mechanisms in the soft starter and the probable cause of the trip. Some of these protection mechanisms 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 |
|---------|-----------------------------------|
| Awaiting data | The LCP does not receive data from the control PCB. Check the cable connection and the fitting of the display on the soft starter. |
| Battery/clock | A verification error has occurred on the real-time clock, or the back-up battery voltage is low. If the battery is low and the power is off, date/time settings are lost. Reprogram the date and time. Related parameter: <br> • *Parameter 16-12 Battery Clock*. |
| Controller | Name selected for a programmable input. Refer to *Input A trip*. |

3

| Display | Possible cause/suggested solution |
| --- | --- |
| Current imbalance | Problems with the motor, the environment, or the installation can cause current imbalance, 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>• A phase loss on mains terminals L1, L2, or L3 during run mode.<br><br>An SCR that has failed open circuit. A failed SCR can only be diagnosed accurately by replacing the SCR and checking the soft starter performance.<br>Related parameters:<br>• *Parameter 2-2 Current Imbalance*.<br>• *Parameter 2-3 Current Imbalance Delay*.<br>• *Parameter 16-2 Current Imbalance*. |
| Current read err Ix | Where X is 1, 2, or 3.<br>Internal fault (PCB fault). The output from the current transformer circuit is not close enough to 0 when the SCRs are turned off. Contact the local Danfoss supplier for advice.<br>This trip is not adjustable.<br>Related parameters: None. |
| Excess start time | Excess start time trip can occur under the following conditions:<br>• *Parameter 1-1 Motor FLC* is not appropriate for the motor.<br>• *Parameter 1-4 Current Limit* has been set too low.<br>• *Parameter 1-6 Start Ramp Time* has been set higher than the setting in *parameter 1-9 Excess Start Time Setting*.<br>• *Parameter 1-6 Start Ramp Time* is set too short for a high inertia load when using adaptive control.<br><br>Related parameters:<br>• *Parameter 1-1 Motor FLC*.<br>• *Parameter 1-4 Current Limit*.<br>• *Parameter 1-6 Start Ramp Time*.<br>• *Parameter 1-9 Excess Start Time*.<br>• *Parameter 7-1 Motor FLC-2*.<br>• *Parameter 7-4 Current Limit-2*.<br>• *Parameter 7-6 Start Ramp-2*.<br>• *Parameter 7-9 Excess Strt Time-2*.<br>• *Parameter 16-7 Excess Start Time*. |
| Firing fail px | Where X is phase 1, 2, or 3.<br>The SCR did not fire as expected. Check for faulty SCRs and internal wiring faults.<br>This trip is not adjustable.<br>Related parameters: None. |
| FLC too high | The soft starter can support higher motor full load current 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 programmed setting for *parameter 1-1 Motor FLC* exceeds the in-line maximum, the soft starter trips at start (see *chapter 7.2.1 Minimum and Maximum Current Settings*).<br>If the soft starter is connected to the motor using inside delta configuration, check that the soft starter detects the connection correctly. Contact the local Danfoss supplier for advice.<br>Related parameters:<br>• *Parameter 1-1 Motor FLC*.<br>• *Parameter 7-1 Motor FLC-2*. |

| Display | Possible cause/suggested solution |
|---|---|
| Frequency | The mains frequency is outside of the specified range.<br>Check for other equipment in the area that could be affecting the mains supply, particularly frequency converters and switch mode power supplies (SMPS).<br>If the soft starter is connected to a generator-set supply, the generator may be too small or could have a speed control problem.<br>Related parameters:<br>• *Parameter 2-8 Frequency Check*.<br>• *Parameter 2-9 Frequency Variation*.<br>• *Parameter 2-10 Frequency Delay*.<br>• *Parameter 16-5 Frequency*. |
| Heat sink overtemp | Check that cooling fans are operating. If mounted in an enclosure, check if ventilation is adequate. Fans operate during start, run, and for 10 minutes after the soft starter exits the stop state.<br><br>*NOTICE*<br>**Models MCD5-0021B ~ MCD4-0053B and MCD5-0141B do not have a cooling fan. Models with fans operate the cooling fans from a start until 10 minutes after a stop.**<br><br>Related parameters:<br>• *Parameter 16-6 Heat sink Overtemp*. |
| High level | Name selected for a programmable input. Refer to *Input A trip*. |
| High pressure | Name selected for a programmable input. Refer to *Input A trip*. |
| Input A trip | The programmable input is set to a trip function and has activated. Resolve the trigger condition.<br>Related parameters:<br>• *Parameter 3-3 Input A Function*.<br>• *Parameter 3-4 Input A Name*.<br>• *Parameter 3-5 Input A Trip*.<br>• *Parameter 3-6 Input A Trip Delay*.<br>• *Parameter 3-7 Input A Initial Delay*.<br>• *Parameter 16-8 Input A Trip*. |
| Instantaneous overcurrent | There has been a sharp rise in motor current, probably caused by a locked rotor condition (shear pin) while running. Check for a jammed load.<br>Related parameters:<br>• *Parameter 2-6 Instantaneous Overcurrent*.<br>• *Parameter 2-7 Instantaneous Overcurrent Delay*.<br>• *Parameter 16-4 Inst Overcurrent*. |
| Internal fault X | The soft starter has tripped on an internal fault. Contact the local Danfoss supplier with the fault code (X).<br>Related parameters: None. |
| L1 phase loss<br>L2 phase loss<br>L3 phase loss | During prestart, check that the soft starter has detected a phase loss as indicated.<br>In run state, the soft starter has detected that the current on the affected phase has dropped below 3.3% of the programmed motor FLC for more than 1 s. This current drop indicates that either the incoming phase or connection to the motor has been lost.<br>For the soft starter and the motor, check:<br>• The supply connections.<br>• The input connections.<br>• The output connections.<br>A failed SCR can also cause phase loss, particularly an SCR that has failed open circuit. A failed SCR can only be diagnosed accurately by replacing the SCR and checking the soft starter performance.<br>Related parameters: None. |

3

| Display | Possible cause/suggested solution |
|---|---|
| L1-T1 shorted<br>L2-T2 shorted<br>L3-T3 shorted | During prestart checks, the soft starter has detected a short-circuited SCR or a short circuit within the bypass contactor as indicated.<br>Related parameters: None. |
| Low control volts | The soft starter has detected a drop in the control voltage.<br><br>• Check the external control supply (terminals A4, A5, A6) and reset the soft starter.<br><br>If the external control supply is stable:<br>• Check if the 24 V supply on the main control PCB is faulty; or<br><br>• Check if the bypass driver PCB is faulty (internally bypassed models only).<br><br>This protection is not active in ready state.<br>Related parameters:<br>• *Parameter 16-13 Low Control Volts*. |
| Low level | Name selected for a programmable input. Refer to *Input A trip*. |
| Low pressure | Name selected for a programmable input. Refer to *Input A trip*. |
| Motor overload/<br>Motor 2 overload | The motor has reached its maximum thermal capacity.<br>The following can cause overload:<br>• The soft starter protection settings do not match the motor thermal capacity.<br><br>• Excessive starts per hour.<br><br>• Excessive throughput.<br><br>• Damage to the motor windings.<br><br>Resolve the cause of the overload and allow the motor to cool.<br>Related parameters:<br>• *Parameter 1-1 Motor FLC*.<br><br>• *Parameter 1-2 Locked Rotor Time*.<br><br>• *Parameter 1-3 Start Mode*.<br><br>• *Parameter 1-4 Current Limit*.<br><br>• *Parameter 7-1 Motor FLC-2*.<br><br>• *Parameter 7-2 Locked Rotor Time-2*.<br><br>• *Parameter 7-3 Start Mode-2*.<br><br>• *Parameter 7-4 Current Limit-2*.<br><br>• *Parameter 16-1 Motor Overload*. |
| Motor connection tx | Where X is 1, 2, or 3.<br>The motor is not connected correctly to the soft starter for in-line or inside delta use.<br>• Check individual motor connections to the soft starter for power circuit continuity.<br><br>• Check connections at the motor terminal box.<br><br>This trip is not adjustable.<br>Related parameters:<br>• *Parameter 15-7 Motor Connection*. |

**3**

| Display | Possible cause/suggested solution |
|---|---|
| Motor thermistor | The motor thermistor input has been enabled and: <br> • The resistance at the thermistor input has exceeded 3.6 kΩ for more than 1 s. <br> • The motor winding has overheated. Identify the cause of the overheating and allow the motor to cool before restarting. <br> • The motor thermistor input has been opened. <br><br> **NOTICE** <br> **If a valid motor thermistor is no longer used, fit a 1.2 kΩ resistor across terminals 05 and 06.** <br><br> Related parameters: <br> • *Parameter 16-9 Motor Thermistor*. |
| Network communication (between module and network) | The network master has sent a trip command to the soft starter, or there could be a network communication problem. <br> Check the network for causes of communication inactivity. <br> Related parameters: <br> • *Parameter 16-11 Network/Comms*. |
| No flow | Name selected for a programmable input. Refer to *Input A trip*. |
| Not ready | Check if the soft starter disable function is active. If *parameter 3-3 Input A Function* is set to *Starter disable* and there is an open circuit on terminals 11 and 16, the soft starter does not start. |
| Parameter out of range | • A parameter value is outside the valid range. <br><br> The soft starter loads the default value for all affected parameters. To go to the first invalid parameter and adjust the setting, press [Main Menu]. <br> Related parameters: None. |
| Phase sequence | The phase sequence on the soft starter mains terminals (L1, L2, L3) is not valid. <br> Check the phase sequence on L1, L2, and L3, and ensure that the setting in *parameter 2-1 Phase Sequence* is suitable for the installation. <br> Related parameters: <br> • *Parameter 2-1 Phase Sequence*. |
| PLC | Name selected for a programmable input. Refer to *Input A trip*. |
| Power loss | The soft starter is not receiving mains supply on 1 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> If testing the soft starter with a small motor, it must draw at least 2% of its minimum FLC setting on each phase. <br> Related parameters: None. |
| Pump fault | Name selected for a programmable input. Refer to *Input A trip*. |
| Starter/communication (between module and soft starter) | • 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 the local distributor. <br> • There is an internal communication error within the soft starter. Contact the local distributor. <br><br> Related parameters: <br> • *Parameter 16-10 Starter/Comms*. |
| Starter disable | Name selected for a programmable input. Refer to *Input A trip*. |
| Thermistor cct (thermistor circuit) | The thermistor input has been enabled and: <br> • The resistance at the input has dropped below 20 Ω (the cold resistance of most thermistors is above this value) or <br> • A short circuit has occurred. Check and resolve this condition. <br><br> Check that a PT100 (RTD) is not connected to terminals 05 and 06. <br> Related parameters: None. |

| Display | Possible cause/suggested solution |
|---|---|
| Time - overcurrent | The soft starter is internally bypassed and has drawn high current during running. (The 10 A protection curve trip has been reached, or the motor current has risen to 600% of the motor FLC setting.)<br>Related parameters: 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 parameters:<br>• *Parameter 2-4 Undercurrent*.<br>• *Parameter 2-5 Undercurrent Delay*.<br>• *Parameter 16-3 Undercurrent*. |
| Unsupported option (function not available in inside delta) | The selected function is not available (for example jog is not supported in inside delta configuration).<br>Related parameters: None. |
| Vibration | Name selected for a programmable input. Refer to *Input A trip*. |
| VZC fails px | Where X is 1, 2, or 3.<br>Internal fault (PCB fault). Contact the local Danfoss supplier for advice.<br>This trip is not adjustable.<br>Related parameters: None. |

**Table 3.1 Trip Messages**

## 3.3 General Faults

*Table 3.2* describes situations where the soft starter does not operate as expected but neither trips nor issues a warning.

| Symptom | Probable cause |
|---|---|
| The soft starter is not ready. | Check input A (11, 16). Check if the soft starter is disabled via a programmable input. If *parameter 3-3 Input A Function* is set to *Starter disable*, and there is an open circuit on the corresponding input, the soft starter does not start. |
| The soft starter does not respond to the [Hand On] and [Reset] keys. | Check if the soft starter is in auto-on mode. When the soft starter is in auto-on mode, the hand-on LED on the soft starter is off. Press [Auto On] once to change to local control. |
| The soft starter does not respond to commands from the control inputs. | • The soft starter is waiting for the restart delay to elapse. *Parameter 2-11 Restart delay* controls the length of the restart delay.<br><br>• The motor may be too hot to allow a start. If *parameter 2-12 Motor temperature check* is set to *Check*, the soft starter only allows 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>• Check if the soft starter is disabled via a programmable input. If *parameter 3-3 Input A Function* is set to *Starter disable*, and there is an open circuit on terminals 11 and 16, the soft starter does not start. If there is no further need to disable the soft starter, close the circuit on the input.<br><br>**NOTICE**<br>*Parameter 3-1 Local/remote* **controls when the [Auto On] is enabled.** |

**3**

| Symptom | Probable cause |
|---------|----------------|
| The soft starter does not respond to a start command from either the local or remote controls. | • The soft starter may be waiting for the restart delay to elapse. *Parameter 2-11 Restart delay* controls the length of the restart delay.<br><br>• The motor may be too hot to allow a start. If *parameter 2-12 Motor temperature check* is set to *Check*, the soft starter only allows a start when it calculates that the motor has sufficient thermal capacity to complete the start successfully.<br><br>• Check if the soft starter is disabled via a programmable input. If *parameter 3-3 Input A function* is set to *Starter disable*, and there is an open circuit on terminals 11 and 16, the soft starter does not start. If there is no further need to disable the soft starter, close the circuit on the input.<br><br>**NOTICE**<br>*Parameter 3-1 Local/remote* **controls when [Auto On] is enabled.** |
| The soft starter does not control the motor correctly during start. | • Start performance may be unstable when using a low motor FLC setting (*parameter 1-1 Motor FLC*). This can affect use on a small test motor with full load current of 5–50 A.<br><br>• Install power factor correction (PFC) capacitors 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 does not produce enough torque to accelerate to full speed. The soft starter may trip on excess start time.<br><br>**NOTICE**<br>**Make sure that the motor starting parameters are appropriate for the application and that the intended motor starting profile is used. If** *parameter 3-3 Input A Function* **is set to** *Motor Set Select*, **check that the corresponding input is in the expected state.**<br><br>• Check if the load is jammed. Check the load for severe overloading or a locked rotor situation. |
| Erratic motor operation. | • The SCRs in the soft starter require at least 5 A of current to latch. If testing the soft starter on a motor with full load current less than 5 A, the SCRs may not latch correctly. |
| Erratic and noisy motor operation. | If the soft starter is connected to the motor using inside delta configuration, the soft starter may not be detecting the connection correctly. Contact the local Danfoss supplier for advice. |
| Soft stop ends too quickly. | • The soft stop settings may not be appropriate for the motor and load. Review the settings of:<br><br>    - *Parameter 1-10 Stop Mode*.<br><br>    - *Parameter 1-11 Stop Time*.<br><br>    - *Parameter 7-10 Stop Mode-2*.<br><br>    - *Parameter 7-11 Stop Time-2*.<br><br>• If the motor is lightly loaded, soft stop has limited effect. |
| Adaptive control, DC brake, and jog functions not working. | • These features are only available with in-line installation. If the soft starter is installed inside delta, these features do not operate. |
| A reset does not occur after an auto-reset when using a remote 2-wire control. | • Remove and reapply the remote 2-wire start signal for a restart. |
| Remote start/stop command overrides autostart/stop settings when using remote 2-wire control. | • Only use autostart/stop in auto-on mode with 3-wire or 4-wire control. |

| Symptom | Probable cause |
|---|---|
| After selecting adaptive control, the motor used an ordinary start and/or the 2nd start was different from the 1st start. | • The 1st adaptive control start is *Current limit*. The soft starter then learns from the motor characteristics. Subsequent starts use adaptive control. |
| Non-resettable *Thermistor Cct* trip, when there is a link between thermistor inputs 05 and 06, or when the motor thermistor connected between 05 and 06 is permanently removed. | • The thermistor input is enabled once a link is fitted and short-circuit protection has activated. <br><br> Remove the link, then load the default parameter set. This disables the thermistor input and clears the trip. <br> Place a 1.2 kΩ resistor across the thermistor input. <br> Turn thermistor protection to *Log only* (*parameter 16-9 Motor Thermistor*). |
| Parameter settings cannot be stored. | • Make sure to save the new value by pressing [OK] after adjusting a parameter setting. If pressing [Back], the change is not saved. <br><br> • Check that the adjustment lock (*parameter 15-2 Adjustment Lock*) is set to *Read/Write*. If the adjustment lock is on, settings can be viewed, but not changed. Knowing the security access code is necessary to change the adjustment lock setting. <br><br> • The EEPROM may be faulty on the main control PCB. A faulty EEPROM also trips the soft starter, and the LCP shows the message *Par. Out of Range*. Contact the local Danfoss supplier for advice. |
| The LCP shows message *Awaiting data*. | The LCP does not receive data from the control PCB. Check the cable connection. |

**Table 3.2 General Fault Messages**

# 4 Service Instructions

## 4.1 Enclosure Sizes

The physical layout and spare parts for VLT® Soft Starter MCD 500 vary according to the size of the soft starter. MCD 500 soft starters can be grouped into 5 classes (enclosure sizes) as follows:

| Class | MCD 500 models |
|-------|----------------|
| G1B   | MCD5-0021B |
|       | MCD5-0037B |
|       | MCD5-0043B |
|       | MCD5-0053B |
|       | MCD5-0068B |
|       | MCD5-0084B |
|       | MCD5-0089B |
|       | MCD5-0105B |
| G2B   | MCD5-0131B |
|       | MCD5-0141B |
|       | MCD5-0195B |
|       | MCD5-0215B |
| G3B   | MCD5-0245B |
|       | MCD5-0331B |
|       | MCD5-0396B |
| G4B   | MCD5-0469B |
|       | MCD5-0525B |
|       | MCD5-0632B |
|       | MCD5-0744B |
|       | MCD5-0826B |
|       | MCD5-0961B |
| G3C   | MCD5-0245C |
| G4C   | MCD5-0360C |
|       | MCD5-0380C |
|       | MCD5-0428C |
|       | MCD5-0595C |
|       | MCD5-0619C |
|       | MCD5-0790C |
|       | MCD5-0927C |
| G5C   | MCD5-1200C |
|       | MCD5-1410C |
|       | MCD5-1600C |

**Table 4.1 MCD 500 Enclosure Sizes**

16 MG17L802

## 4.1.1 MCD5-0021B ~ MCD5-0053B (G1B)
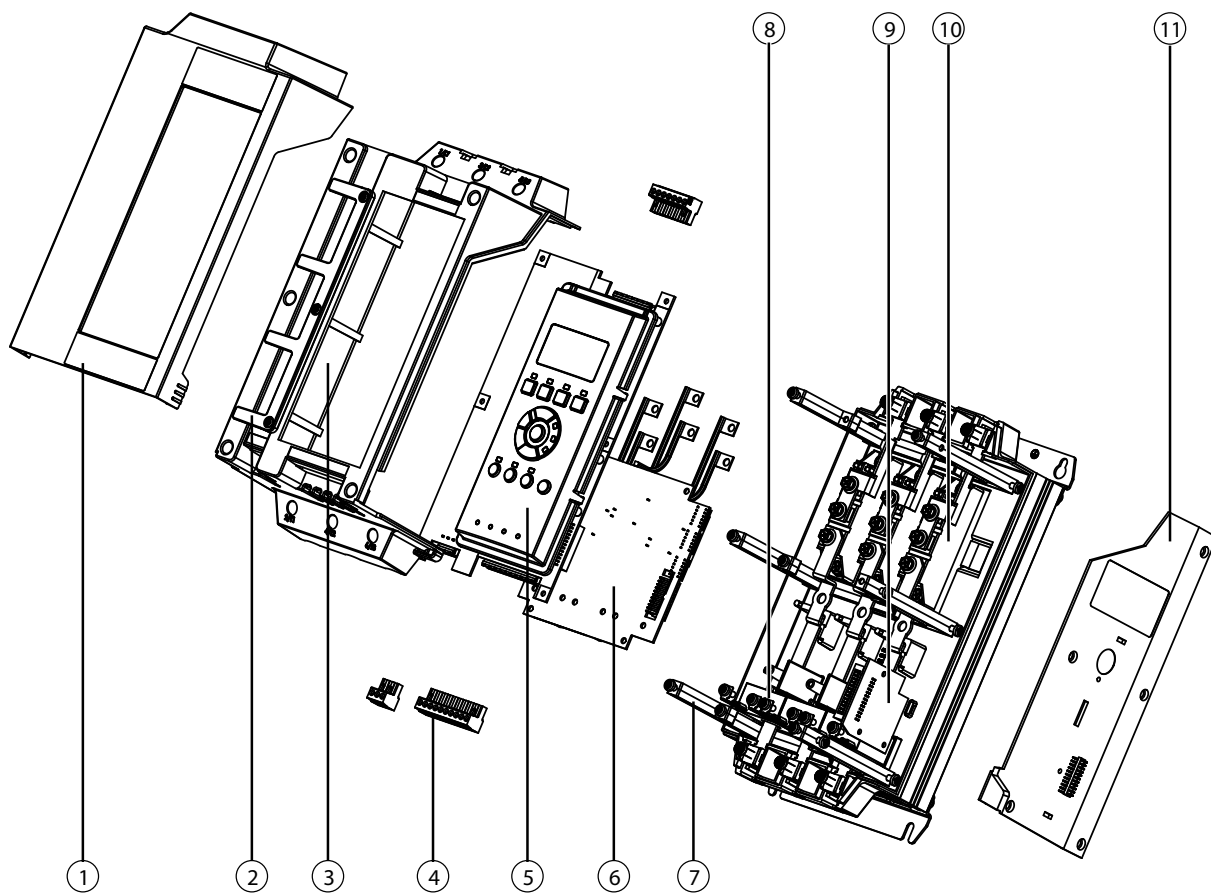


| | | | |
|---|---|---|---|
| 1 | Cover | 7 | Current transformers |
| 2 | Cable guide | 8 | Mounting posts |
| 3 | Main plastic | 9 | Backplane PCB |
| 4 | Terminal blocks | 10 | SCRs |
| 5 | LCP and main control PCB | 11 | Side plastic |
| 6 | Model PCB | | |

**Illustration 4.1 Exploded View of MCD5-0021B ~ MCD5-0053B (G1B)**
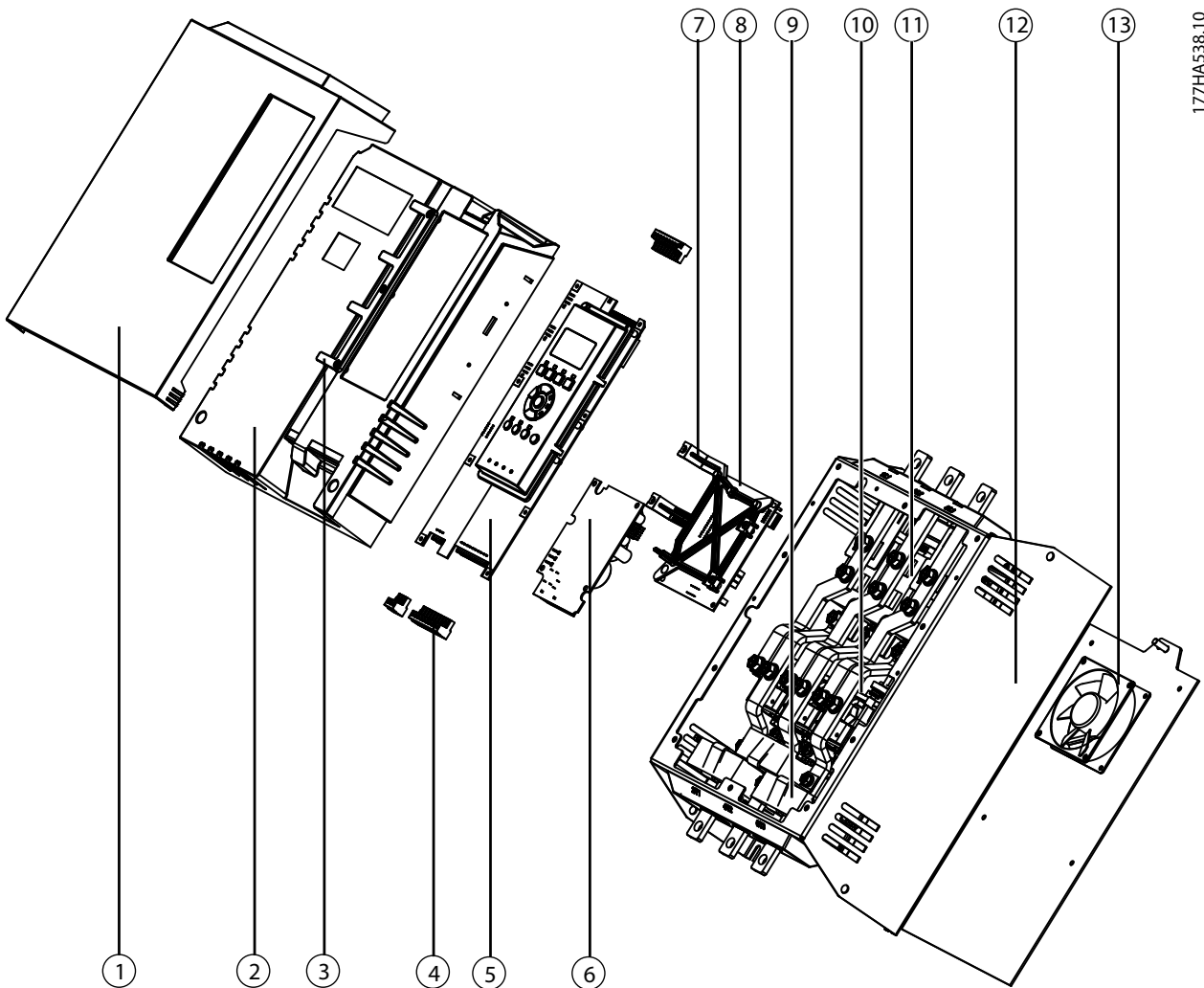
## 4.1.2 MCD5-0068B ~ MCD5-0105B (G1B)
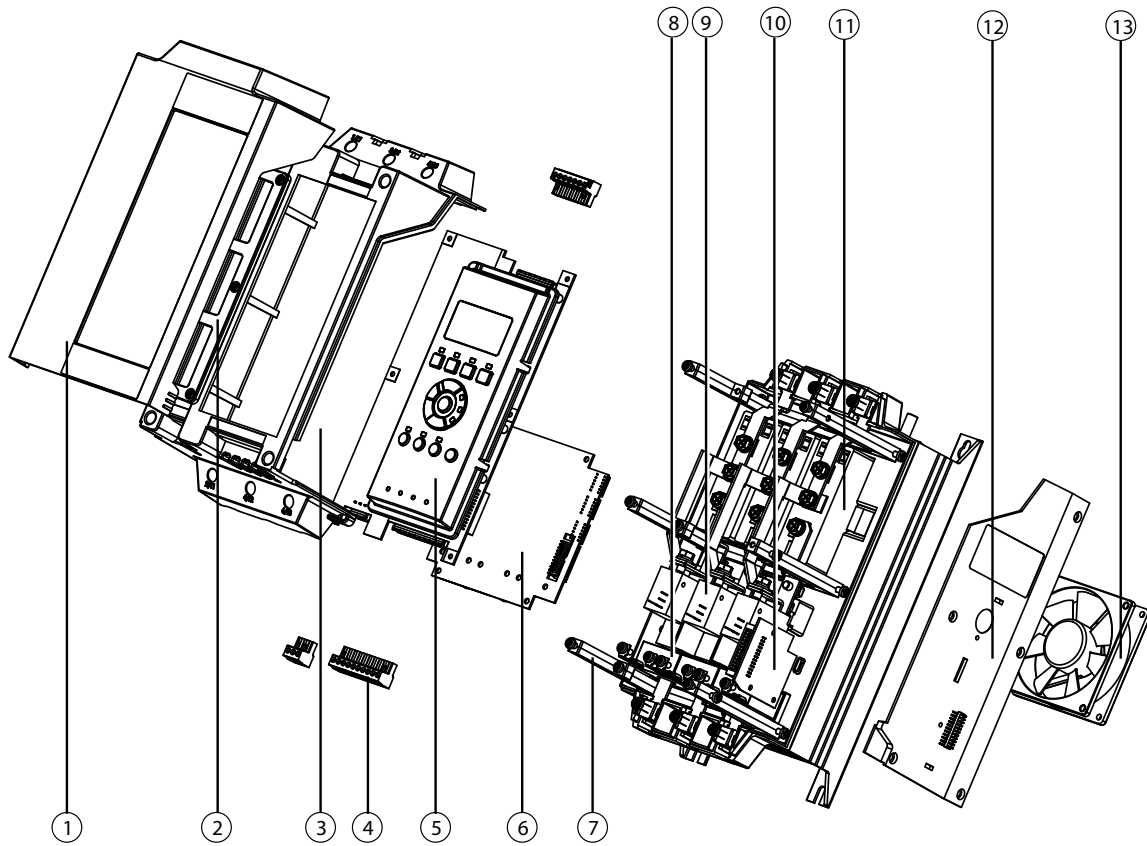


| 1 | Cover | 8 | Mounting posts |
|---|---|---|---|
| 2 | Cable guide | 9 | Bypass contactors |
| 3 | Main plastic | 10 | Backplane PCB |
| 4 | Terminal blocks | 11 | SCRs |
| 5 | LCP and main control PCB | 12 | Side plastic |
| 6 | Model PCB | 13 | Fan |
| 7 | Current transformers | | |

**Illustration 4.2 Exploded View of MCD5-0068B ~ MCD5-0105B (G1B)**

## 4.1.3 MCD5-0131B ~ MCD5-0215B (G2B)



| 1 | Cover | 8 | Model PCB |
|---|---|---|---|
| 2 | Main plastic | 9 | Current transformers |
| 3 | Cable guide | 10 | Bypass contactors |
| 4 | Terminal blocks | 11 | SCRs |
| 5 | LCP and main control PCB | 12 | Main body |
| 6 | Bypass Driver PCB | 13 | Fan and bracket |
| 7 | Support plastic | | |

**Illustration 4.3 Exploded View of MCD5-0131B ~ MCD5-0215B (G2B)**

## 4.1.4 MCD5-0245B ~ MCD5-0396B (G3B)



**Illustration 4.4 Exploded View of MCD5-0245B ~ MCD5-0396B (G3B)**
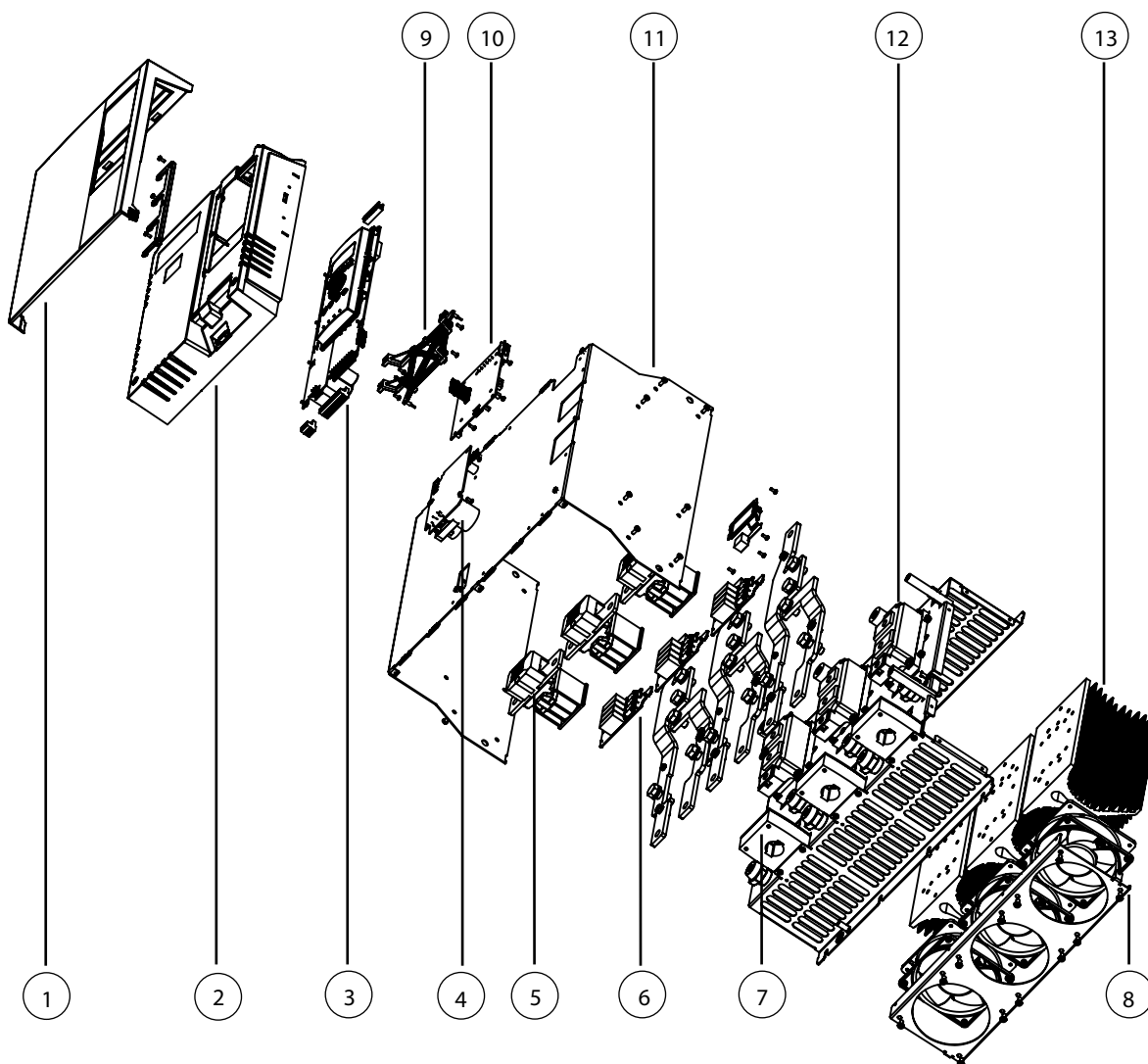
| | | | | | |
|---|---|---|---|---|---|
| 1 | Cover | 6 | Snubber assembly | 11 | Main chassis (see notice) |
| 2 | Main plastic | 7 | Current transformers | 12 | SCRs |
| 3 | LCP and main control PCB | 8 | Fan assembly | 13 | Heat sink |
| 4 | Bypass driver PCB | 9 | Support plastic | | |
| 5 | Bypass contactors | 10 | Model PCB | | |

## *NOTICE*

**When refitting the main chassis of G3B units, ensure that the insulator card is bent upwards as shown in *Illustration 4.5*.**
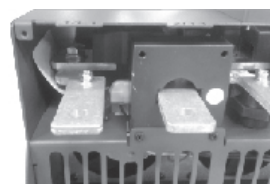


**Illustration 4.5 MCD 500 G3B Insulator Card**

## 4.1.5 MCD5-0245C (G3C)



**Illustration 4.6 Exploded View of MCD5-0245C (G3C)**
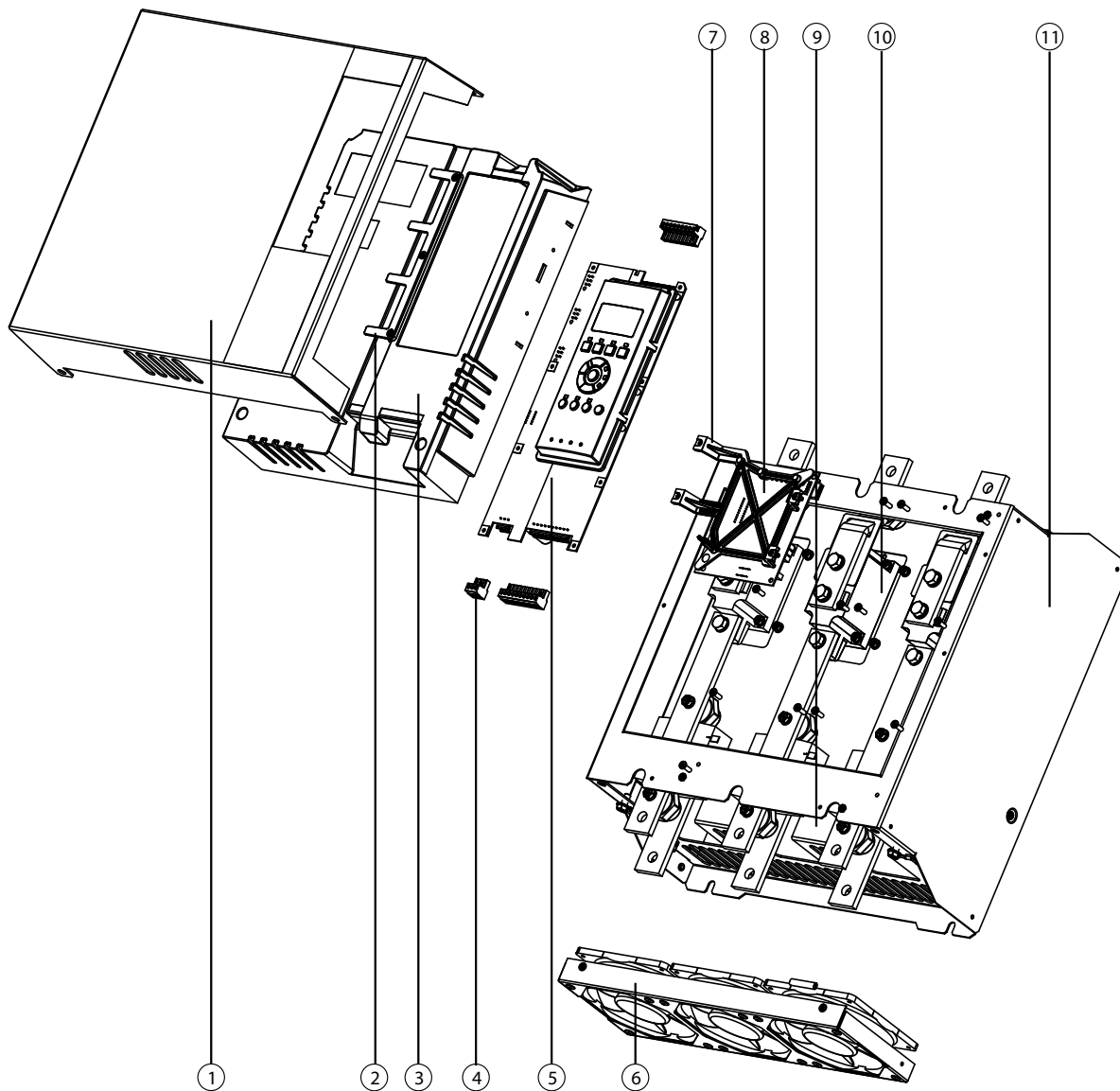
| 1 | Cover | 7 | Support plastic |
|---|-------|---|-----------------|
| 2 | Cable guide | 8 | Model PCB |
| 3 | Main plastic | 9 | Current transformers |
| 4 | Terminal blocks | 10 | SCRs |
| 5 | LCP and main control PCB | 11 | Main body |
| 6 | Fan assembly | | |

## 4.1.6 MCD5-0469B ~ MCD5-0961B (G4B)
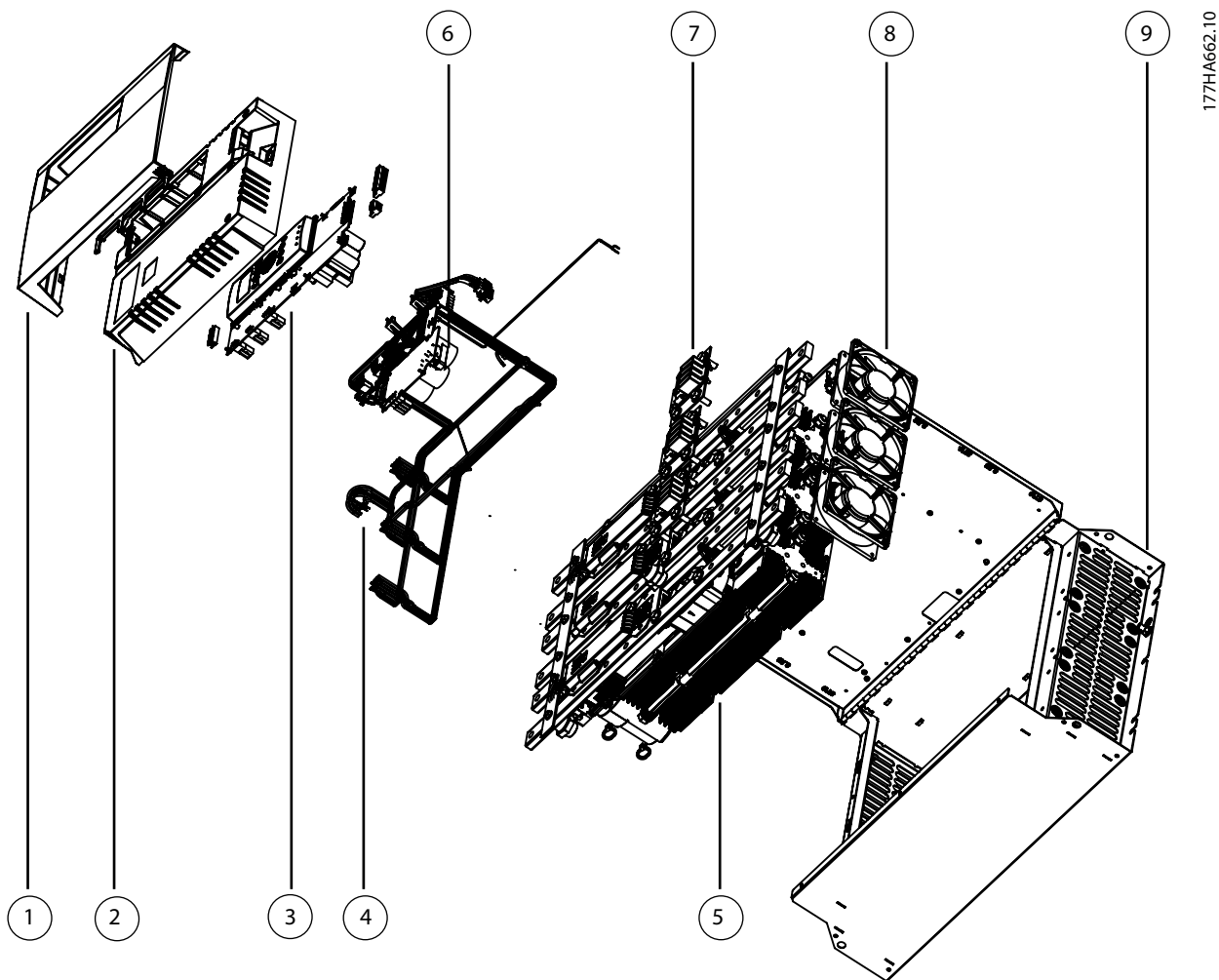


| | | | |
|---|---|---|---|
| 1 | Cover | 6 | Bypass driver PCB |
| 2 | Main plastic | 7 | Snubber assembly |
| 3 | LCP and main control PCB | 8 | Fan assembly |
| 4 | Wiring loom (wiring harness) | 9 | Main chassis |
| 5 | Phase arm (SCR phase module) | | |

**Illustration 4.7 Exploded View of MCD5-0469B ~ MCD5-0961B (G4B)**

## 4.1.7 MCD5-0360C ~ MCD5-0927C (G4C)
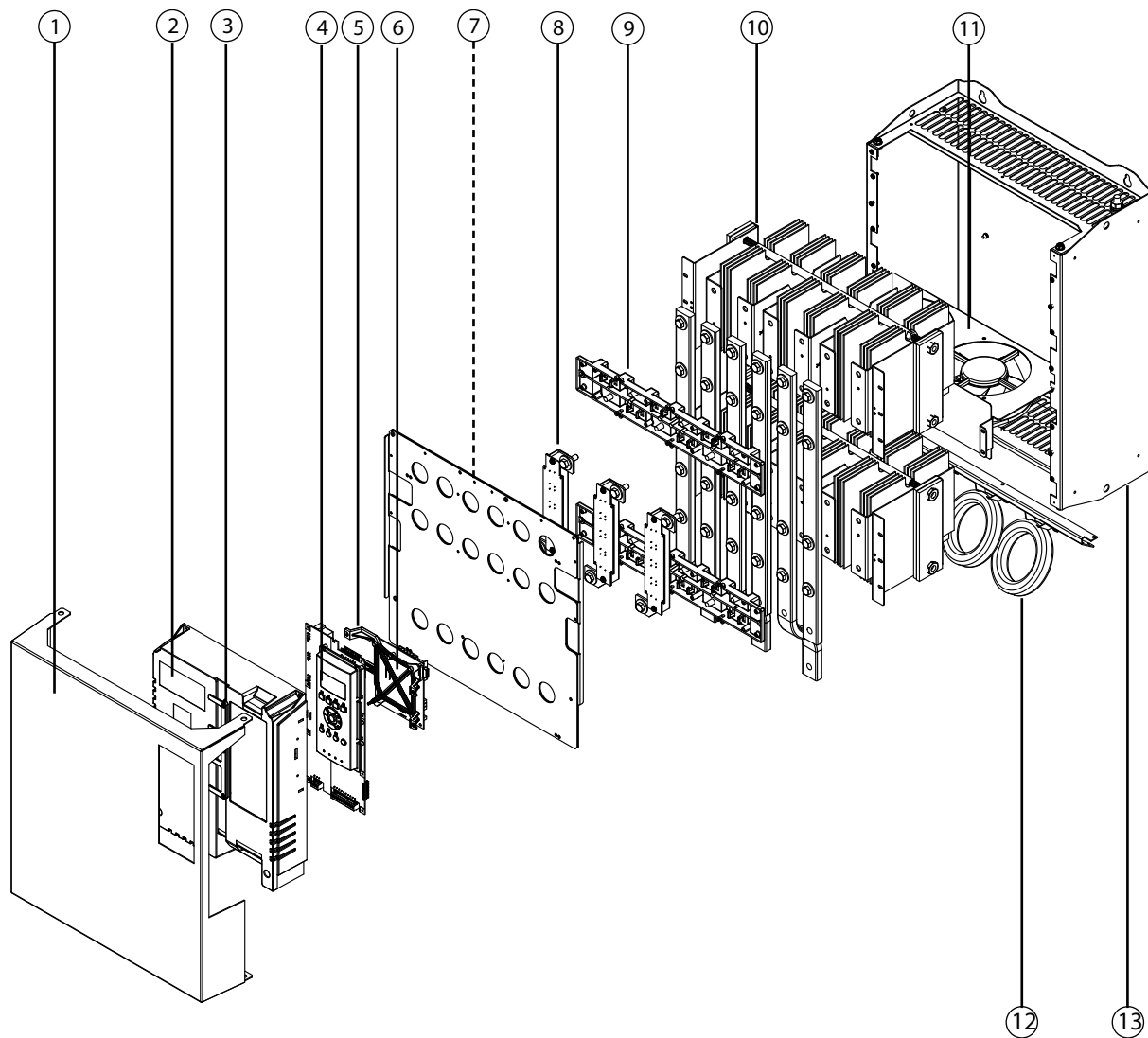


| 1 | Cover | 8 | Snubber assembly |
|---|---|---|---|
| 2 | Main plastic | 9 | Module mount and spacer plastic |
| 3 | Cable guide | 10 | Power assembly (SCR power assembly) |
| 4 | Support plastic | 11 | Fan assembly |
| 5 | Model PCB | 12 | Current transformer assembly |
| 6 | Module mount and spacer plastic | 13 | Main body |
| 7 | Magnetic bypass plate (models 0595C ~ 0927C) | | |

**Illustration 4.8 Exploded View of MCD5-0360C ~ MCD5-0927C (G4C)**

## 4.1.8 MCD5-1200C ~ MCD5-1600C (G5C)
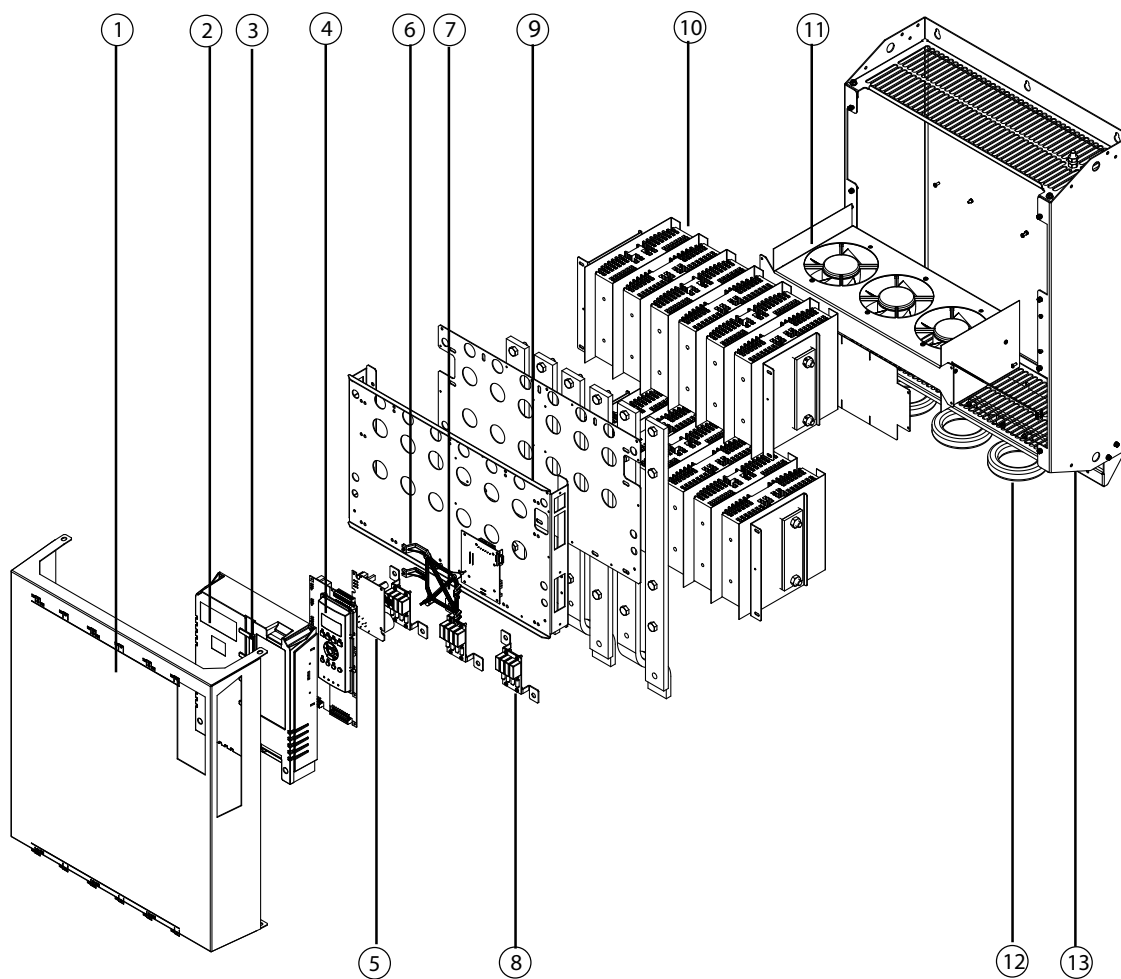


| 1 | Cover | 8 | Snubber assembly |
|---|---|---|---|
| 2 | Main plastic | 9 | Magnetic bypass plate |
| 3 | Cable guide | 10 | Power assembly (SCR power assembly) |
| 4 | LCP and main control PCB | 11 | Fan assembly |
| 5 | Bypass driver PCB | 12 | Current transformer assembly |
| 6 | Support plastic | 13 | Main body |
| 7 | Model PCB | | |

**Illustration 4.9 Exploded View of MCD5-1200C ~ MCD5-1600C (G5C)**

## 4.2 Identifying the Soft Starter Version

The soft starter version is the last 2 digits of the first part of the serial number on the nameplate.
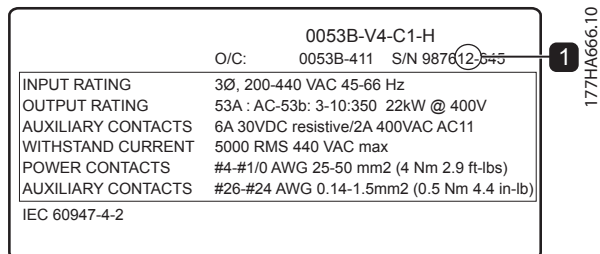


| 1 | Version number |
|---|---|

**Illustration 4.10 Nameplate**

# 5 Spare Parts

## NOTICE

**Unless otherwise indicated, spare part kits contain only 1 of each item. All images in this section are indicative.**

## 5.1 Main Control PCB

Each soft starter requires 1 main control PCB.

## NOTICE

**Kits 175G56** do not support the control panel LCP 501 and are only used with MCD 500 units version 09 or earlier. Kits 175G57** are fully backwards compatible.**

| Model | CV1 | | CV2 | |
|---|---|---|---|---|
| | T5 | T7 | T5 | T7 |
| MCD5-0021B | | | | |
| MCD5-0037B | | | | |
| MCD5-0043B | | | | |
| MCD5-0053B | 175G5603 | 175G5604 | 175G5601 | 175G5602 |
| MCD5-0068B | 175G5703 | 175G5704 | 175G5701 | 175G5702 |
| MCD5-0084B | | | | |
| MCD5-0089B | | | | |
| MCD5-0105B | | | | |
| MCD5-0131B | | | | |
| MCD5-0141B | | | | |
| MCD5-0195B | | | | |
| MCD5-0215B | | | | |
| MCD5-0245B | | | | |
| MCD5-0331B | | | | |
| MCD5-0396B | | | | |
| MCD5-0469B | | | | |
| MCD5-0525B | | | | |
| MCD5-0632B | | | | |
| MCD5-0744B | | | | |
| MCD5-0826B | 175G5607 | 175G5608 | 175G5605 | 175G5606 |
| MCD5-0961B | 175G5707 | 175G5708 | 175G5705 | 175G5706 |
| MCD5-0245C | | | | |
| MCD5-0360C | | | | |
| MCD5-0380C | | | | |
| MCD5-0428C | | | | |
| MCD5-0595C | | | | |
| MCD5-0619C | | | | |
| MCD5-0790C | | | | |
| MCD5-0927C | | | | |
| MCD5-1200C | | | | |
| MCD5-1410C | | | | |
| MCD5-1600C | | | | |

**Table 5.1 Ordering Numbers for Main Control PCB**

177HA558.10

**Illustration 5.1 Main Control PCB Ordering Numbers 175G5601–175G5604 and 175G5701–175G5704**



177HA559.10

**Illustration 5.2 Main Control PCB Ordering Numbers 175G5605–175G5608 and 175G5705–175G5708**
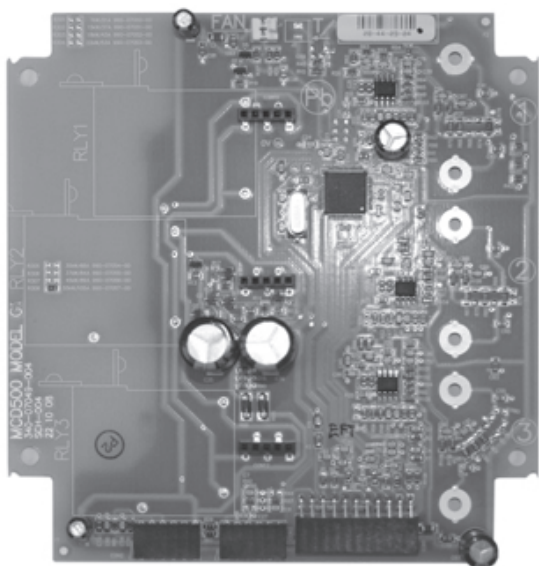
## 5.2 Model PCB

Each soft starter requires 1 model PCB.

| Model | Ordering number |
|---|---|
| MCD5-0021B | 175G5609 |
| MCD5-0037B | 175G5610 |
| MCD5-0043B | 175G5611 |
| MCD5-0053B | 175G5612 |
| MCD5-0068B | 175G5613 |
| MCD5-0084B | 175G5614 |
| MCD5-0089B | 175G5615 |
| MCD5-0105B | 175G5616 |
| MCD5-0131B | 175G5617 |
| MCD5-0141B | 175G5618 |
| MCD5-0195B | 175G5619 |
| MCD5-0215B | 175G5620 |
| MCD5-0245B | 175G5710 |
| MCD5-0331B | 175G5711 |
| MCD5-0396B | 175G5712 |
| MCD5-0469B | 175G5713 |
| MCD5-0525B | 175G5714 |
| MCD5-0632B | 175G5715 |
| MCD5-0744B | 175G5716 |
| MCD5-0826B | 175G5717 |
| MCD5-0961B | 175G5718 |
| MCD5-0245C | 175G5621 |
| MCD5-0360C | 175G5622 |
| MCD5-0380C | 175G5623 |
| MCD5-0428C | 175G5624 |
| MCD5-0595C | 175G5625 |
| MCD5-0619C | 175G5626 |
| MCD5-0790C | 175G5627 |
| MCD5-0927C | 175G5628 |
| MCD5-1200C | 175G5629 |
| MCD5-1410C | 175G5630 |
| MCD5-1600C | 175G5631 |

**Table 5.2 Ordering Numbers for Model PCB**
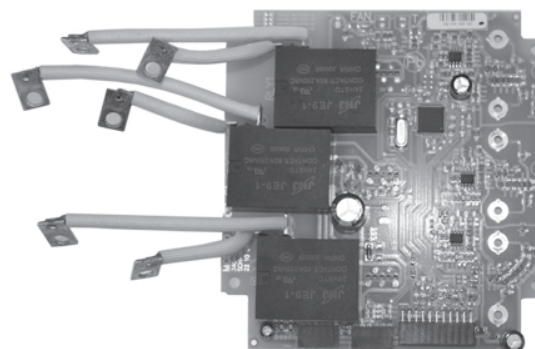


177HA560.10

**Illustration 5.3 Model PCB Ordering Numbers 175G5609–175G5612**

**5**



177HA561.10

**Illustration 5.4 Model PCB Ordering Numbers 175G5613–175G5616**
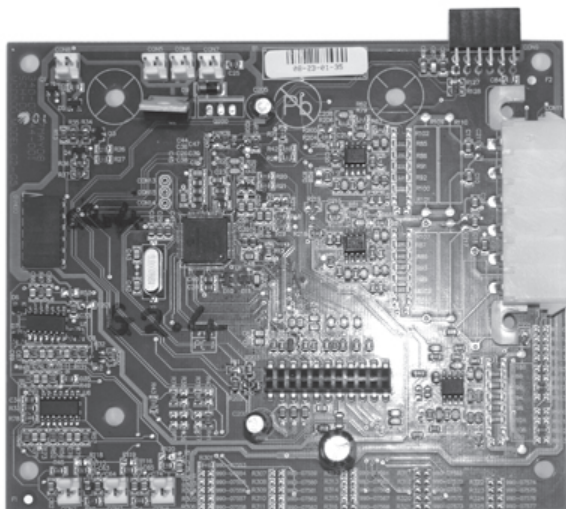


177HA562.10

**Illustration 5.5 Model PCB Ordering Numbers 175G5617–175G5718**

## 5.3 Backplane PCB

Models MCD5-0021B ~ MCD5-0105B require 1 backplane PCB.

| Model | Ordering number |
|---|---|
| MCD5-0021B | 175G5632 |
| MCD5-0037B | |
| MCD5-0043B | |
| MCD5-0053B | |
| MCD5-0068B | |
| MCD5-0084B | |
| MCD5-0089B | |
| MCD5-0105B | |
| MCD5-0131B | Not required |
| MCD5-0141B | |
| MCD5-0195B | |
| MCD5-0215B | |
| MCD5-0245B | |
| MCD5-0331B | |
| MCD5-0396B | |
| MCD5-0469B | |
| MCD5-0525B | |
| MCD5-0632B | |
| MCD5-0744B | |
| MCD5-0826B | |
| MCD5-0961B | |
| MCD5-0245C | |
| MCD5-0360C | |
| MCD5-0380C | |
| MCD5-0428C | |
| MCD5-0595C | |
| MCD5-0619C | |
| MCD5-0790C | |
| MCD5-0927C | |
| MCD5-1200C | |
| MCD5-1410C | |
| MCD5-1600C | |

**Table 5.3 Ordering Numbers for Backplane PCB**
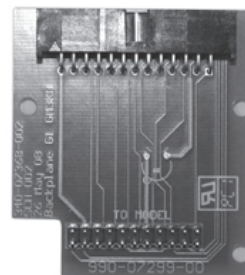


177HA563.10

**Illustration 5.6 Backplane PCB Ordering Number 175G5632**

## 5.4  Bypass Driver PCB

Models MCD5-0131B ~ MCD5-0215B require 1 bypass driver PCB.

| Model | Ordering number |
|---|---|
| MCD5-0021B | Not required |
| MCD5-0037B | |
| MCD5-0043B | |
| MCD5-0053B | |
| MCD5-0068B | |
| MCD5-0084B | |
| MCD5-0089B | |
| MCD5-0105B | |
| MCD5-0131B | 175G5633 |
| MCD5-0141B | 175G5698[1] |
| MCD5-0195B | |
| MCD5-0215B | |
| MCD5-0245B | 175G5719 |
| MCD5-0331B | |
| MCD5-0396B | |
| MCD5-0469B | |
| MCD5-0525B | |
| MCD5-0632B | 175G5720 |
| MCD5-0744B | |
| MCD5-0826B | |
| MCD5-0961B | |
| MCD5-0245C | Not required |
| MCD5-0360C | |
| MCD5-0380C | |
| MCD5-0428C | |
| MCD5-0595C | |
| MCD5-0619C | |
| MCD5-0790C | |
| MCD5-0927C | |
| MCD5-1200C | |
| MCD5-1410C | |
| MCD5-1600C | |

**Table 5.4 Ordering Numbers for Bypass Driver PCB**

1) Bypass contactor upgrade: Refer to Product Note PN04 MCD 500 Bypass Contactor Upgrade for more information.
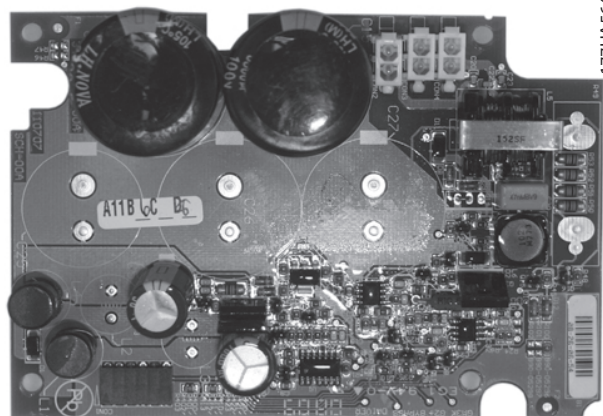


**Illustration 5.7 Bypass Driver PCB Ordering Number 175G5633**
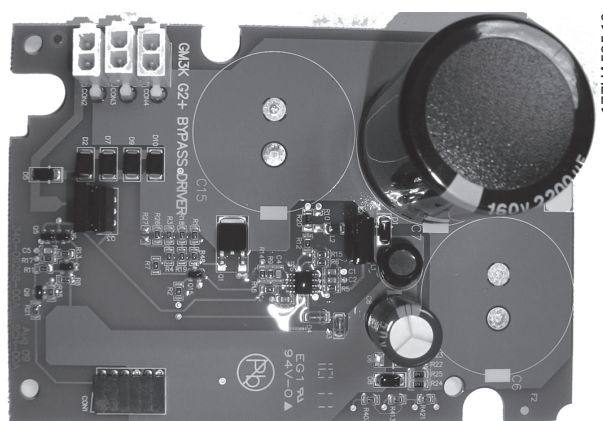


**Illustration 5.8 Bypass Driver PCB Ordering Number 175G5698**
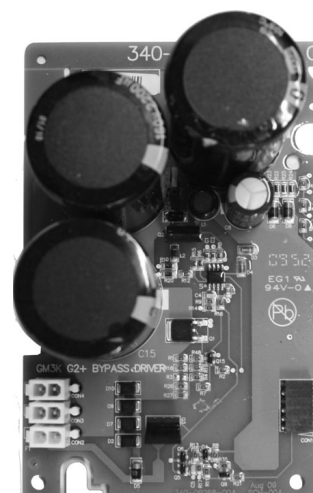


**Illustration 5.9 Bypass Driver PCB Ordering Numbers 175G5719, 175G5720**

## 5.5 SCRs and SCR Connections

Models MCD5-0021B ~ MCD5-0396B use SCRs. Each soft starter requires 3 SCRs.

| Model | Ordering number |
|---|---|
| MCD5-0021B | 175G5119 |
| MCD5-0037B | 175G5120 |
| MCD5-0043B | 175G5121 |
| MCD5-0053B<br>MCD5-0068B | 175G5122 |
| MCD5-0084B | 175G5123 |
| MCD5-0089B | 175G5124 |
| MCD5-0105B<br>MCD5-0131B | 175G5634 |
| MCD5-0141B | 175G5635 |
| MCD5-0195B | 175G5126 |
| MCD5-0215B<br>MCD5-0245B<br>MCD5-0245C | 175G5127 |
| MCD5-0331B<br>MCD5-0396B | 175G5721 |

**Table 5.5 Ordering Numbers for SCRs**
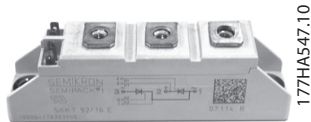


**Illustration 5.10 SCRs Ordering Numbers 175G5119–175G5122**
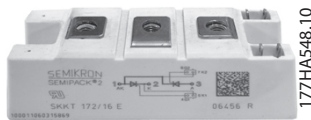


**Illustration 5.11 SCRs Ordering Numbers 175G5123, 175G5124, 175G5634**



**Illustration 5.12 SCRs Ordering Numbers 175G5635, 175G5126, 175G5127**

## NOTICE

**Spare part kits can include either Semikron or Eupec SCRs. These SCRs are fully interchangeable in MCD 500 units and can be mixed within the same soft starter.**

## NOTICE

**SCR firing loom connections may be different from different manufacturers. Ensure that the wiring of connections matches the SCR type.**

Connect the firing looms according to *Illustration 5.14* to *Illustration 5.22*.



**Illustration 5.13 SCRs for Models 0021 ~ 0068**
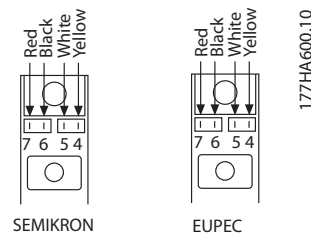


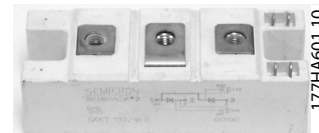**Illustration 5.14 Connection Diagram for Models 0021 ~ 0068**



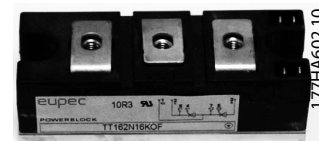**Illustration 5.15 Semikron SCR for Models 0084 ~ 0131**



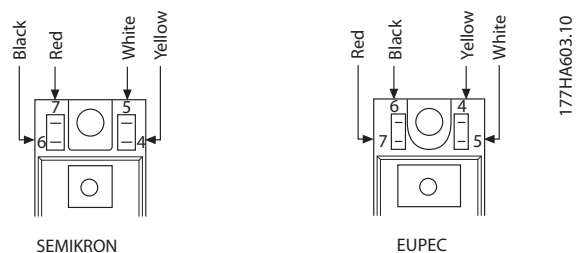**Illustration 5.16 Eupec SCR for Models 0084 ~ 0131**



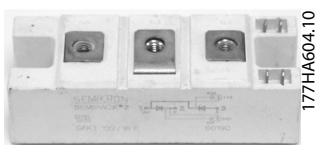**Illustration 5.17 Connection Diagram for Models 0084 ~ 0131**

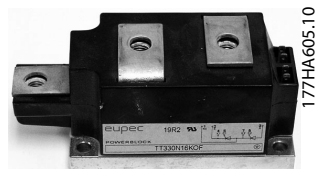**Illustration 5.18 Semikron SCR for Models 0141 ~ 0245**



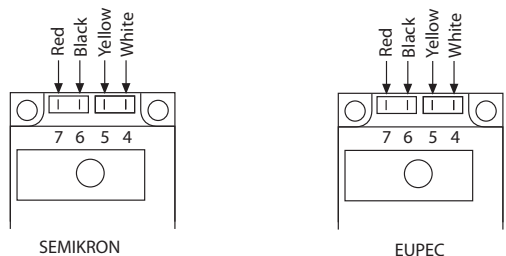**Illustration 5.19 Eupec SCR for Models 0141 ~ 0245**



**Illustration 5.20 Connection Diagram for Models 0141 ~ 0245**



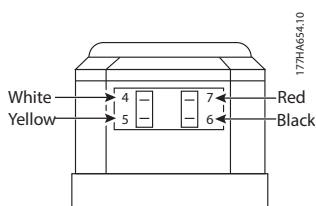**Illustration 5.21 SCR for Models 0331 ~ 0396**



**Illustration 5.22 Connection Diagram for Models 0331 ~ 0396**

## 5.6 Power Assemblies (SCR Power Assemblies)

Models MCD5-0632B ~ MCD5-0961B use phase arms (SCR phase modules). Each soft starter requires 3 phase arms.

| Model | Ordering number |
|-------|-----------------|
| MCD5-0469B | 175G5722 |
| MCD5-0525B | 175G5723 |
| MCD5-0632B | 175G5724 |
| MCD5-0744B | 175G5725 |
| MCD5-0826B | 175G5726 |
| MCD5-0961B | 175G5727 |

**Table 5.6 Ordering Numbers for Phase Arms (SCR Phase Modules)**

Models MCD5-0360C ~ MCD5-1600C use power assemblies. Each soft starter requires 2 power assemblies.

| Model | Ordering number |
|-------|-----------------|
| MCD5-0360C | 175G5636 |
| MCD5-0380C | 175G5637 |
| MCD5-0428C | 175G5638 |
| MCD5-0595C | 175G5639 |
| MCD5-0619C | 175G5640 |
| MCD5-0790C | 175G5641 |
| MCD5-0927C | 175G5642 |
| MCD5-1200C | 175G5643 |
| MCD5-1410C | 175G5644 |
| MCD5-1600C | 175G5645 |

**Table 5.7 Ordering Numbers for Power Assemblies**



**Illustration 5.23 Power Assemblies Ordering Numbers 175G5636–175G5642**

**5**

**5**



**Illustration 5.24 Power Assemblies Ordering Numbers 175G5643–175G5645**
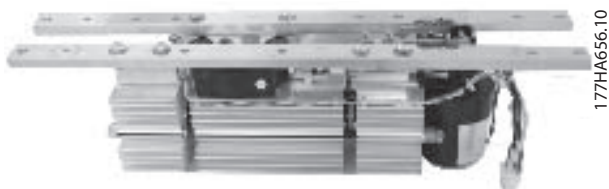


**Illustration 5.25 Power Assemblies Ordering Numbers 175G5722–175G5727**

## 5.7 Snubber Assemblies

Models MCD5-0245B ~ MCD5-0961B and T7 (AC input) models MCD5-0360C ~ MCD5-1600C use snubber assemblies. Each soft starter requires 3 snubber assemblies.

Each snubber kit includes 3 snubber assemblies.

| Model | Ordering numbers |
|---|---|
| MCD5-0245B | 175G5728 |
| MCD5-0331B | |
| MCD5-0396B | |
| MCD5-0469B | 175G5729 |
| MCD5-0525B | |
| MCD5-0632B | |
| MCD5-0744B | |
| MCD5-0826B | |
| MCD5-0961B | |
| MCD5-0360C | 175G5699 |
| MCD5-0380C | |
| MCD5-0428C | |
| MCD5-0595C | |
| MCD5-0619C | |
| MCD5-0790C | |
| MCD5-0927C | |
| MCD5-1200C | 175G5700 |
| MCD5-1410C | |
| MCD5-1600C | |

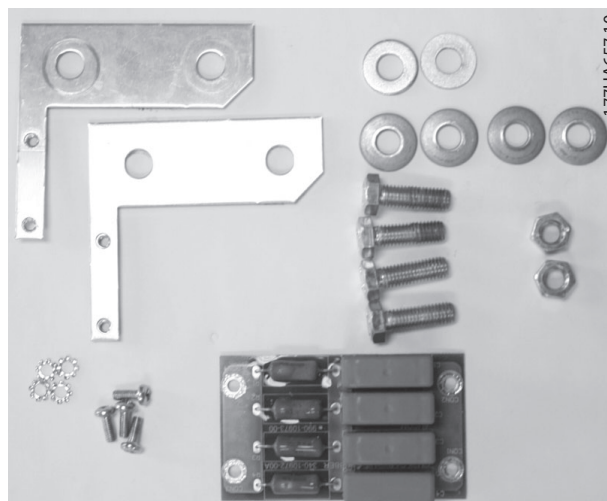**Table 5.8 Ordering Numbers for Snubber Assemblies**



**Illustration 5.26 Snubber Assemblies Ordering Number 175G5728**
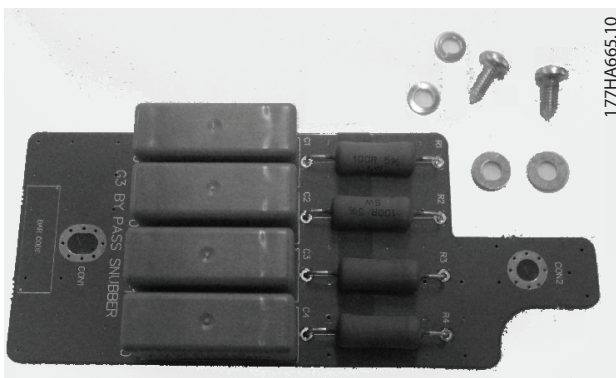
**Illustration 5.27 Snubber Assemblies Ordering Number 175G5729**



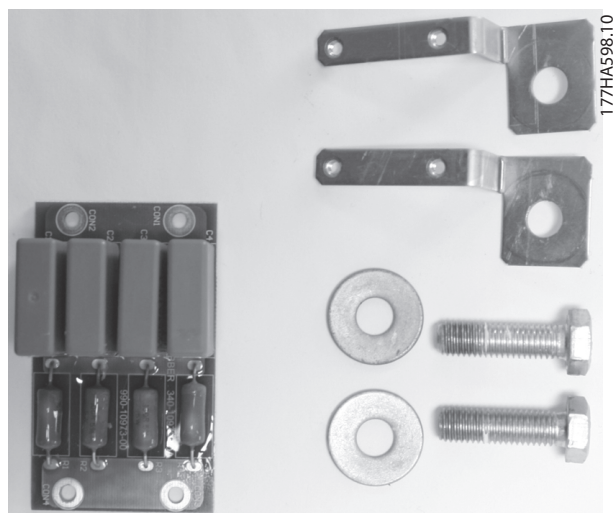**Illustration 5.28 Snubber Assemblies Ordering Number 175G5699**



**Illustration 5.29 Snubber Assemblies Ordering Number 175G5700**

## 5.8 Fans

Certain models include a fan. The number of fans required differs between units and is shown in *Table 5.9*.

| Model | Part number | Quantity |
|---|---|---|
| MCD5-0021B | Not required | – |
| MCD5-0037B | | |
| MCD5-0043B | | |
| MCD5-0053B | | |
| MCD5-0068B | 175G5646 | – |
| MCD5-0084B | | |
| MCD5-0089B | | |
| MCD5-0105B | | |
| MCD5-0131B | | |
| MCD5-0141B | Not required | – |
| MCD5-0195B | 175G5646 | 1 |
| MCD5-0215B | | |
| MCD5-0245B | 175G5647 | 3 |
| MCD5-0331B | | |
| MCD5-0396B | | |
| MCD5-0469B | | |
| MCD5-0525B | | |
| MCD5-0632B | | |
| MCD5-0744B | | |
| MCD5-0826B | | |
| MCD5-0961B | | |
| MCD5-0245C | | |
| MCD5-0360C | | |
| MCD5-0380C | | |
| MCD5-0428C | | |
| MCD5-0595C | | |
| MCD5-0619C | 175G5648 | 2 |
| MCD5-0790C | | |
| MCD5-0927C | | |
| MCD5-1200C | 175G5648 | 3 |
| MCD5-1410C | | |
| MCD5-1600C | | |

**Table 5.9 Ordering Numbers for Fans**

**Illustration 5.30 Fan Ordering Numbers 175G5646, 175G5647**



**Illustration 5.31 Fan Ordering Number 175G5648**

## 5.9 Current Transformers

Each soft starter requires 3 current transformers.

| Model | Ordering number |
|---|---|
| MCD5-0021B | 175G5649 |
| MCD5-0037B | |
| MCD5-0043B | |
| MCD5-0053B | |
| MCD5-0068B | |
| MCD5-0084B | |
| MCD5-0089B | |
| MCD5-0105B | |
| MCD5-0131B | 175G9048 |
| MCD5-0141B | |
| MCD5-0195B | |
| MCD5-0215B | |
| MCD5-0245B | |
| MCD5-0331B | |
| MCD5-0396B | |
| MCD5-0469B | 1) |
| MCD5-0525B | |
| MCD5-0632B | |
| MCD5-0744B | |
| MCD5-0826B | |
| MCD5-0961B | |
| MCD5-0245C | 175G9048 |
| MCD5-0360C | 175G5652 |
| MCD5-0380C | 175G5653 |
| MCD5-0428C | |
| MCD5-0595C | 175G5654 |
| MCD5-0619C | |
| MCD5-0790C | 175G5655 |
| MCD5-0927C | 175G5656 |
| MCD5-1200C | 175G5657 |
| MCD5-1410C | 175G5658 |
| MCD5-1600C | 175G5659 |

**Table 5.10 Ordering Numbers for Current Transformers**

*1) The current transformers for models MCD5-0469B ~ MCD5-0961B are included in the phase arm.*



**Illustration 5.32 Current Transformers Ordering Numbers 175G9048**

**Illustration 5.33 Current Transformers Ordering Numbers 175G5649**



**Illustration 5.34 Current Transformers Ordering Numbers 175G5652-175G5659**

## 5.10  Bypass Contactors

Some models are internally bypassed. The bypass contactor for models MCD5-0021B ~ MCD5-0053B is included in the model PCB. The bypass contactors for models MCD5-0632B ~ MCD5-0961B are included in the phase arm. Each soft starter requires 3 bypass contactors.

| Model | Ordering number |
|---|---|
| MCD5-0021B | Not required |
| MCD5-0037B |  |
| MCD5-0043B |  |
| MCD5-0053B |  |
| MCD5-0068B | 175G5660 |
| MCD5-0084B |  |
| MCD5-0089B |  |
| MCD5-0105B |  |
| MCD5-0131B | 175G5661 (version 02 or earlier) |
| MCD5-0141B | 175G5697 (version 03 and later)[1] |
| MCD5-0195B |  |
| MCD5-0215B |  |
| MCD5-0245B | 175G0121 |
| MCD5-0331B |  |
| MCD5-0396B | 175G0122 |
| MCD5-0469B |  |
| MCD5-0525B |  |
| MCD5-0245C | Not required |
| MCD5-0360C |  |
| MCD5-0380C |  |
| MCD5-0428C |  |
| MCD5-0595C |  |
| MCD5-0619C |  |
| MCD5-0790C |  |
| MCD5-0927C |  |
| MCD5-1200C |  |
| MCD5-1410C |  |
| MCD5-1600C |  |

**Table 5.11 Ordering Numbers for Bypass Contactors**

*1) Bypass contactor upgrade. 175G5697 supersedes 175G5661. For more information, refer to Product Note PN04 MCD 500 Bypass Contactor Upgrade and PN15 MCD500 G2 Bypass Contactor Service Spares.*
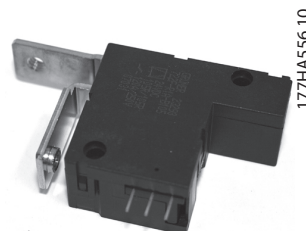


**Illustration 5.35 Bypass Contactors Ordering Number 175G5660**

**Illustration 5.36 Bypass Contactors Ordering Numbers 175G5661 and 175G5697**



**Illustration 5.37 Bypass Contactors Ordering Numbers 175G0121 and 175G0122**

## 5.11　Plastic Components

The following body plastic components are available for VLT® Soft Starter MCD 500.

| Model | Cover | Main plastic compo- nent | Cable guide | Mounting posts |
|---|---|---|---|---|
| MCD5-0021B | | | | |
| MCD5-0037B | | | | |
| MCD5-0043B | | | | |
| MCD5-0053B | 175G5667 | 175G5671 | | 175G5670 (set of 3) |
| MCD5-0068B | | | | |
| MCD5-0084B | | | | |
| MCD5-0089B | | | | |
| MCD5-0105B | | | | |
| MCD5-0131B | | | | |
| MCD5-0141B | | | | |
| MCD5-0195B | | | | |
| MCD5-0215B | | | | |
| MCD5-0245B | | | | |
| MCD5-0331B | | | | |
| MCD5-0396B | 175G5668 | | | |
| MCD5-0469B | | | 175G5669 | |
| MCD5-0525B | | | | |
| MCD5-0632B | | | | |
| MCD5-0744B | | | | |
| MCD5-0826B | | 175G5672 | | Not required |
| MCD5-0961B | | | | |
| MCD5-0245C | | | | |
| MCD5-0360C | | | | |
| MCD5-0380C | | | | |
| MCD5-0428C | | | | |
| MCD5-0595C | | | | |
| MCD5-0619C | Not required | | | |
| MCD5-0790C | | | | |
| MCD5-0927C | | | | |
| MCD5-1200C | | | | |
| MCD5-1410C | | | | |
| MCD5-1600C | | | | |

**Table 5.12 Ordering Numbers for Plastic Components**

**Illustration 5.38 Plastic Components Ordering Numbers 175G5667 and 175G5668**



**Illustration 5.41 Plastic Components Ordering Number 175G5670**



**Illustration 5.39 Plastic Components Ordering Numbers 175G5671 and 175G5672**



**Illustration 5.40 Plastic Components Ordering Number 175G5669**

## 5.11.1 Complete Plastic Components

The complete plastic components kit contains the following items:

- 175G5673:
    - 175G5667
    - 175G5671
    - 175G5669
    - 175G5670
    - Side plastic
    - Plastic base
- 175G5674:
    - 175G5668
    - 175G5672
    - 175G5669
    - Support plastic
- 175G5675:
    - 175G5672
    - 175G5669
    - Support plastic

| Model | Complete plastic component kits |
|---|---|
| MCD5-0021B | 175G5673 |
| MCD5-0037B | |
| MCD5-0043B | |
| MCD5-0053B | |
| MCD5-0068B | |
| MCD5-0084B | |
| MCD5-0089B | |
| MCD5-0105B | |
| MCD5-0131B | 175G5674 |
| MCD5-0141B | |
| MCD5-0195B | |
| MCD5-0215B | |
| MCD5-0245B | |
| MCD5-0331B | |
| MCD5-0396B | |
| MCD5-0469B | |
| MCD5-0525B | |
| MCD5-0632B | |
| MCD5-0744B | |
| MCD5-0826B | |
| MCD5-0961B | |
| MCD5-0245C | 175G5675 |
| MCD5-0360C | |
| MCD5-0380C | |
| MCD5-0428C | |
| MCD5-0595C | |
| MCD5-0619C | |
| MCD5-0790C | |
| MCD5-0927C | |
| MCD5-1200C | |
| MCD5-1410C | |
| MCD5-1600C | |

**Table 5.13 Ordering Numbers for Complete Plastic Component Kits**

## 5.12   Control Panel LCP 501 Upgrade Kit

A remote mountable LCP, control panel LCP 501, is available for use with VLT® Soft Starter MCD 500. An upgrade kit containing new body plastics is required to use control panel LCP 501 with MCD 500 units of version 09 or earlier.

## *NOTICE*

**A new main control PCB is also required to support the control panel LCP 501. See** *chapter 5.1 Main Control PCB* **for details.**

| Model | Upgrade kit | Control panel LCP 501 |
|---|---|---|
| MCD5-0021B | | |
| MCD5-0037B | | |
| MCD5-0043B | | |
| MCD5-0053B | 175G0097 | |
| MCD5-0068B | | |
| MCD5-0084B | | |
| MCD5-0089B | | 175G0096 |
| MCD5-0105B | | |
| MCD5-0131B | | |
| MCD5-0141B | 175G0098 | |
| MCD5-0195B | | |
| MCD5-0215B | | |
| MCD5-0245B | | |
| MCD5-0331B | | |
| MCD5-0396B | | |
| MCD5-0469B | | |
| MCD5-0525B | – | – |
| MCD5-0632B | | |
| MCD5-0744B | | |
| MCD5-0826B | | |
| MCD5-0961B | | |
| MCD5-0245C | | |
| MCD5-0360C | | |
| MCD5-0380C | | |
| MCD5-0428C | | |
| MCD5-0595C | | |
| MCD5-0619C | 175G0098 | 175G0096 |
| MCD5-0790C | | |
| MCD5-0927C | | |
| MCD5-1200C | | |
| MCD5-1410C | | |
| MCD5-1600C | | |

**Table 5.14 Ordering Numbers for Control Panel LCP 501 Upgrade Kit**



**Illustration 5.42 LCP 501 Upgrade Kit Ordering Number 175G0096**



**Illustration 5.43 LCP 501 Upgrade Kit Ordering Numbers 175G0097 and 175G0098**

**5**

## 5.13 Busbars

Each soft starter requires a total of 6 busbars (3 inputs and 3 outputs). Each kit contains 3 busbars (unless otherwise stated) and fixing accessories if applicable.

| Model | Input | Output |
|---|---|---|
| MCD5-0021B | 175G5677 | 175G5678 |
| MCD5-0037B | | |
| MCD5-0043B | | |
| MCD5-0053B | | |
| MCD5-0068B | 175G5679 | 175G5680 |
| MCD5-0084B | 175G5681 | 174G5682 |
| MCD5-0089B | | |
| MCD5-0105B | | |
| MCD5-0131B | 175G5696 | 175G5683 |
| MCD5-0141B | 175G5684 | 175G5685 |
| MCD5-0195B | | |
| MCD5-0215B | | |
| MCD5-0245B | Available on request | Available on request |
| MCD5-0331B | | |
| MCD5-0396B | | |
| MCD5-0469B | | |
| MCD5-0525B | | |
| MCD5-0632B | | |
| MCD5-0744B | | |
| MCD5-0826B | | |
| MCD5-0961B | | |
| MCD5-0245C | 175G5686 | 175G5687 (set of 6) |
| MCD5-0360C | 175G5688 | 175G5689 |
| MCD5-0380C | | |
| MCD5-0428C | | |
| MCD5-0595C | | |
| MCD5-0619C | | |
| MCD5-0790C | | |
| MCD5-0927C | 175G5690 | 175G5691 |
| MCD5-1200C | 175G5692 | 175G5693 |
| MCD5-1410C | | |
| MCD5-1600C | 175G5694 | 175G5695 |

**Table 5.15 Ordering Numbers for Busbars**
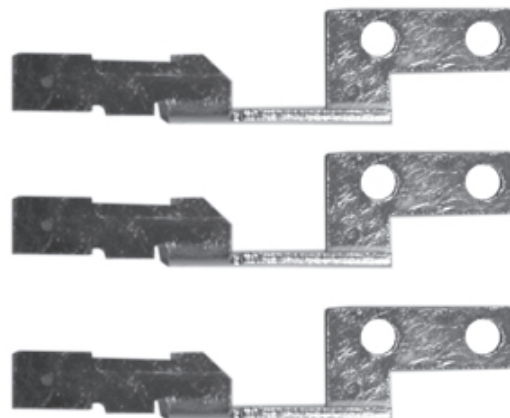


**Illustration 5.44 Busbar Ordering Number 175G5677**



**Illustration 5.45 Busbar Ordering Numbers 175G5679 and 175G5681**



177HA575.10

**Illustration 5.46 Busbar Ordering Numbers 175G5678, 175G5680, and 175G5682**
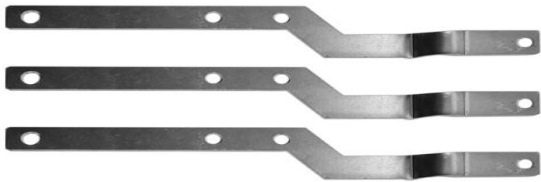
**Illustration 5.47 Busbar Ordering Numbers 175G5696 and 175G5684**



**Illustration 5.48 Busbar Ordering Numbers 175G5683 and 175G5685**
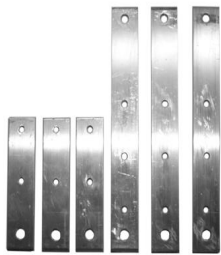


**Illustration 5.49 Busbar Ordering Number 175G5686**



**Illustration 5.50 Busbar Ordering Number 175G5687**



**Illustration 5.51 Busbar Ordering Numbers 175G5688, 175G5690, 175G5692, and 175G5694**



**Illustration 5.52 Busbar Ordering Numbers 175G5689, 175G5691, 175G5693, and 175G5695**

**5**

## 5.14 Other Spare Parts

The spare parts in *Table 5.16* are also available.

| Model | Cage clamps | Connector plugs |
|---|---|---|
| MCD5-0021B | 175G5666 (set of 3) | 175G5676 (set of 3) |
| MCD5-0037B | | |
| MCD5-0043B | | |
| MCD5-0053B | | |
| MCD5-0068B | | |
| MCD5-0084B | | |
| MCD5-0089B | | |
| MCD5-0105B | | |
| MCD5-0131B | Not required | |
| MCD5-0141B | | |
| MCD5-0195B | | |
| MCD5-0215B | | |
| MCD5-0245B | | |
| MCD5-0331B | | |
| MCD5-0396B | | |
| MCD5-0469B | | |
| MCD5-0525B | | |
| MCD5-0632B | | |
| MCD5-0744B | | |
| MCD5-0826B | | |
| MCD5-0961B | | |
| MCD5-0245C | | |
| MCD5-0360C | | |
| MCD5-0380C | | |
| MCD5-0428C | | |
| MCD5-0595C | | |
| MCD5-0619C | | |
| MCD5-0790C | | |
| MCD5-0927C | | |
| MCD5-1200C | | |
| MCD5-1410C | | |
| MCD5-1600C | | |

**Table 5.16 Ordering Numbers for Other Spare Parts**



**Illustration 5.53 Other Spare Parts Ordering Number 175G5666**



**Illustration 5.54 Other Spare Parts Ordering Number 175G5676**

# 6 Avoiding Damage

## 6.1 SCRs

### 6.1.1 Typical Causes of SCR Damage

Generally, overcurrent, overvoltage, or overtemperature cause SCR damage. To prevent damage, check that the soft starter has been installed properly. Common causes of SCR problems include:

**Overcurrent**

- Cable fault on soft starter output.
- Motor fault.
- Start current and/or start time exceed the soft starter rating.
- Starts per hour exceed the soft starter rating.

**Overvoltage**

- Supply transient or surge.
- Lightning strike (direct or indirect) on supply.
- Motor fault.
- Loose connection in power circuit, before or after the soft starter.
- Power factor correction connected to the output of the soft starter.
- Overcorrected bulk power factor correction on a lightly loaded system causing severe ringing voltages.

**Overtemperature**

- Blocked heat sinks or restricted ventilation.
- Inadequate ventilation.
- Excessive ambient temperatures.
- Bypass relay fails to close during running (internally bypassed starters only).

### 6.1.2 Protecting SCRs

Modern SCRs are rugged and reliable. However, the risk of SCR damage can be reduced by using semiconductor fuses and/or a main contactor.

### 6.1.3 Semiconductor Fuses

Semiconductor fuses reduce the potential for SCR damage caused by short circuits on the output of the soft starter.

Protection systems such as circuit breakers or HRC fuses do not operate quickly enough to protect SCRs from short circuits.

### 6.1.4 Main Contactors

SCRs are most vulnerable to overvoltage damage when voltage is applied to their input terminal while they are off. In this condition, the SCR blocks the full mains voltage. Using a main contactor to remove voltage from the SCR input when the soft starter is off eliminates the risk of SCR damage due to overvoltage.

## 6.2 Output Relays

VLT® Soft Starter MCD 500 has 3 programmable output relays. These relays are often used to control external contactors.

The electronic contactor coils used in many contactors have a high initial inrush current. If the contactor coil is switched directly, the internal relays of the soft starter can be damaged.

### 6.2.1 Using the Soft Starter to Switch a Contactor

Before using the soft starter output relay to switch an electronic contactor coil, consult the contactor manufacturer. Some contactor manufacturers (for example Klockner-Moeller) state that PCB mount relays cannot be used for direct switching of their electronic contactor coils.

If this is case, there are 2 solutions:

- Use the output relay to control a slave relay. This slave relay can then be used to switch the electronic contactor coil circuit directly.
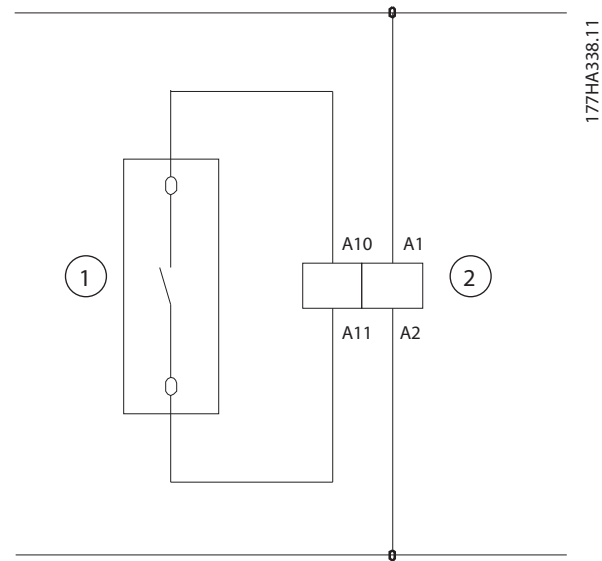
**6**
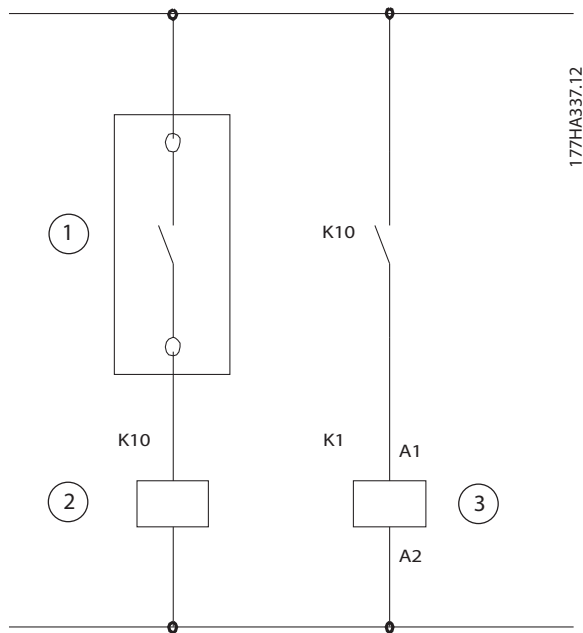
| 1 | Soft starter output relay |
|---|---|
| 2 | Slave relay coil |
| 3 | Contactor coil |

**Illustration 6.1 Relay Controlling a Slave Relay**

- If the contactor has a volt-free electronic input (low voltage/low current), the output relay can be wired directly into this input for contactor control.



| 1 | Soft starter output relay |
|---|---|
| 2 | Contactor coil |

**Illustration 6.2 Output Relay Directly Wired to a Volt-free Electronic Input**

## 6.3 Control Input

Operate VLT® Soft Starter MCD 500 with external 2-wire or 3-wire control signals. Configure and wire external switches into control input terminals 17 and 25.

- External switches operating the control inputs must be rated for the control voltage being used and a continuous current of 100 mA.

- Incorrect configuration and wiring of the external contacts/switches to the control input terminals can cause damage.

- If long cable runs are used, wiring must be twisted pair or shielded cable and must be separated from AC power cables by at least 300 mm (984.2 ft).

# 7 Appendix

## 7.1 Bolts and Tightening Torques

When assembling soft starter components, tighten each bolt using a calibrated torque driver set to the appropriate assembly torque. *Table 7.1* to *Table 7.5* indicate the different types of bolts and bolt tightening torques for each assembly.

### 7.1.1 Input/Output Busbars to SCRs

| Model | Bolt size | Torque (Nm) |
|---|---|---|
| MCD5-0021B | M5x12 | 4 |
| MCD5-0037B | | |
| MCD5-0043B | | |
| MCD5-0053B | | |
| MCD5-0068B | | |
| MCD5-0084B | M6x16 | 4 |
| MCD5-0089B | | |
| MCD5-0105B | | |
| MCD5-0131B | M6x16 | 5 |
| MCD5-0141B | M8x20 | 9 |
| MCD5-0195B | | |
| MCD5-0215B | | |
| MCD5-0245B | | |
| MCD5-0331B | M10x20 | 12 |
| MCD5-0396B | | |
| MCD5-0469B | M8x25 | 20 |
| MCD5-0525B | | |
| MCD5-0632B | | |
| MCD5-0744B | | |
| MCD5-0826B | | |
| MCD5-0961B | | |
| MCD5-0245C | M8x20 | 8 |
| MCD5-0360C | M8x16 | 12 |
| MCD5-0380C | | |
| MCD5-0428C | | |
| MCD5-0595C | | |
| MCD5-0619C | | |
| MCD5-0790C | | |
| MCD5-0927C | | |
| MCD5-1200C | M10x35 | 20 |
| MCD5-1410C | | |
| MCD5-1600C | | |

**Table 7.1 Tightening Torque Busbars to SCRs**

### 7.1.2 SCRs to Heat Sink

| Model | Bolt size | Torque (Nm) |
|---|---|---|
| MCD5-0021B | M5x16 | 5 |
| MCD5-0037B | | |
| MCD5-0043B | | |
| MCD5-0053B | | |
| MCD5-0068B | | |
| MCD5-0084B | | |
| MCD5-0089B | | |
| MCD5-0105B | | |
| MCD5-0131B | | |
| MCD5-0141B | | |
| MCD5-0195B | M5x20 | 5 |
| MCD5-0215B | | |
| MCD5-0245B | | |
| MCD5-0331B | M6x30 | 5 |
| MCD5-0396B | | |
| MCD5-0469B | Not required | Not required |
| MCD5-0525B | | |
| MCD5-0632B | | |
| MCD5-0744B | | |
| MCD5-0826B | | |
| MCD5-0961B | | |
| MCD5-0245C | M5x20 | 4 |
| MCD5-0360C | Not required | Not required |
| MCD5-0380C | | |
| MCD5-0428C | | |
| MCD5-0595C | | |
| MCD5-0619C | | |
| MCD5-0790C | | |
| MCD5-0927C | | |
| MCD5-1200C | | |
| MCD5-1410C | | |
| MCD5-1600C | | |

**Table 7.2 Tightening Torque SCRs to Heat Sink**

### 7.1.3 Bypass Contactor Connections

| Model | Bolt size | Torque (Nm) |
|---|---|---|
| MCD5-0021B<br>MCD5-0037B<br>MCD5-0043B<br>MCD5-0053B | M5x12 | 4 |
| MCD5-0068B<br>MCD5-0084B<br>MCD5-0089B<br>MCD5-0105B | M6x12 | 4 |
| MCD5-0131B<br>MCD5-0141B | M5x12 | 4 |
| MCD5-0195B<br>MCD5-0215B<br>MCD5-0245B | M8x20 | 8 |
| MCD5-0331B<br>MCD5-0396B | M10x30 | 20 |
| MCD5-0469B<br>MCD5-0525B | M10x25 | 20 |
| MCD5-0632B<br>MCD5-0744B<br>MCD5-0826B<br>MCD5-0961B | Not required | Not required |
| MCD5-0245C | M8x20 | 8 |
| MCD5-0360C<br>MCD5-0380C<br>MCD5-0428C<br>MCD5-0595C<br>MCD5-0619C<br>MCD5-0790C<br>MCD5-0927C<br>MCD5-1200C<br>MCD5-1410C<br>MCD5-1600C | Not required | Not required |

Table 7.3 Tightening Torques Bypass Contactor Connections

### 7.1.4 Current Transformer Busbar Assembly

| Model | Bolt size | Torque (Nm) |
|---|---|---|
| MCD5-0245C | M6x16 | 4 |

Table 7.4 Tightening Torques Current Transformer Busbar Assembly

### 7.2 Minimum and Maximum Current Settings

The minimum and maximum full load current settings depend on the soft starter model:

| Model | In-line connection | | Inside delta connection | |
|---|---|---|---|---|
| | Minimum [A] | Maximum [A] | Minimum [A] | Maximum [A] |
| MCD5-0021B | 5 | 23 | 5 | 34 |
| MCD5-0037B | 9 | 43 | 9 | 64 |
| MCD5-0043B | 10 | 50 | 10 | 75 |
| MCD5-0053B | 11 | 53 | 11 | 79 |
| MCD5-0068B | 15 | 76 | 15 | 114 |
| MCD5-0084B | 19 | 97 | 19 | 145 |
| MCD5-0089B | 20 | 100 | 20 | 150 |
| MCD5-0105B | 21 | 105 | 21 | 157 |
| MCD5-0131B | 29 | 145 | 29 | 217 |
| MCD5-0141B | 34 | 170 | 34 | 255 |
| MCD5-0195B | 40 | 200 | 40 | 300 |
| MCD5-0215B | 44 | 220 | 44 | 330 |

| Model | In-line connection | | Inside delta connection | |
|---|---|---|---|---|
| | Minimum [A] | Maximum [A] | Minimum [A] | Maximum [A] |
| MCD5-0245B | 51 | 255 | 51 | 382 |
| MCD5-0245C | 51 | 255 | 51 | 382 |
| MCD5-0331B | 70 | 350 | 70 | 525 |
| MCD5-0360C | 72 | 360 | 72 | 540 |
| MCD5-0380C | 76 | 380 | 76 | 570 |
| MCD5-0396B | 85 | 425 | 85 | 638 |
| MCD5-0428C | 86 | 430 | 86 | 645 |
| MCD5-0469B | 100 | 500 | 100 | 750 |
| MCD5-0525B | 116 | 580 | 116 | 870 |
| MCD5-0595C | 124 | 620 | 124 | 930 |
| MCD5-0619C | 130 | 650 | 130 | 975 |
| MCD5-0632B | 140 | 700 | 140 | 1050 |
| MCD5-0790C | 158 | 790 | 158 | 1185 |
| MCD5-0744B | 164 | 820 | 164 | 1230 |
| MCD5-0826B | 184 | 920 | 184 | 1380 |
| MCD5-0927C | 186 | 930 | 186 | 1395 |
| MCD5-0961B | 200 | 1000 | 200 | 1500 |
| MCD5-1200C | 240 | 1200 | 240 | 1800 |
| MCD5-1410C | 282 | 1410 | 282 | 2115 |
| MCD5-1600C | 320 | 1600 | 320 | 2400 |

**Table 7.5 Minimum and Maximum Current Settings**

## 7.3 Symbols, Abbreviations, and Conventions

| AC | Alternating current |
|---|---|
| DC | Direct current |
| FLC | Full load current |
| LCP | Local control panel |
| MOV | Metal oxide varistor |
| PCB | Printed circuit board |
| PFC | Power factor correction |
| SCR | Silicon-controlled rectifier |

**Table 7.6 Symbols and Abbreviations**

**Conventions**

Numbered lists indicate procedures.
Bullet lists indicate other information.

Italicized text indicates:
- Cross-reference.
- Link.
- Parameter name.

All dimensions in drawings are in [mm].

# Index