Introduction

The purpose of this manual is to provide technical information and instructions that will enable the user to identify faults and effect repairs on the Danfoss VLT 5000 Series Adjustable Frequency Drives:
VLT 5001-5052/ 6002-6052, 380-500 VAC
VLT 5001-5027/ 6002-6027, 200-230 VAC

The first section of this manual covers the description and sequence of operations. Section Two covers fault messages and provides troubleshooting charts both in the form of flow and symptom/cause. Section Three describes the various tests and methods used to evaluate the drives' condition. Section Four covers the removal and replacement of the various components. Section Five discusses application-specific information.

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

Warning!
The Adjustable Frequency Drive (AFD) contains dangerous voltages when connected to the line voltage. Only a competent technician should carry out the service.

For Your Safety
DO NOT touch the electrical parts of the AFD when the AC line is connected. After the AC line is disconnected *wait at least 15 minutes* before touching any of the components.

When repairs or inspection is made the AC line *must be disconnected.*

The STOP key on the control panel *does not disconnect* the AC line.

During operation and programming of the parameters the motor *may start without warning. Activate the STOP key* when changing data.

Tools Required

The following tools will be sufficient to troubleshoot and repair all units covered in this manual:

- ESD protection Kit
- Digital multi-meter
- Clamp-on amp-meter
- Analog voltmeter
- Flat head screw drivers
- High voltage tester
- Phillips screw drivers
- Torx drivers - T10, T15, T20, T25, T27, T30
- Socket wrench Kit with torx screws
- Extension 250 mm
- Magnetic tools
- Indicator colour
- Pliers - socket wrench (size 8 mm and 10 mm) + open-end wrench (size 8 mm)
- Torque wrench

VLT 5000/6000 Product Overview

The VLT 5000/6000 series inverters are available in power sizes from 1 Hp - 500 Hp/0,75 kw in the 380 - 500 V range and 1Hp - 50 Hp/0,75-37kw in the 200 V range.

These models are available in Chassis, Nema 1 or Nema 12 enclosures. (IP 20 and IP 54)

There are three hardware configurations available for all sizes of drives, they are: Standard (ST), Standard with Brake (SB), and Extended with Brake (EB).

The SB and EB units contain all logic and hardware necessary to connect an external resistor to provide dynamic braking.

The EB configuration offers connection terminals for load sharing capabilities between multiple VLT 5000/ 6000 units, plus input terminals for a remote 24 V DC power supply to maintain control logic during removal of the AC input power.

VLT 5000/6000 Servicing

Because of the design of the lower power drives (VLT 5001- 5006/6002-6006, 200 V and 5001 - 5011/ 6002-6011, 380-500 V) it is not practical to perform repairs on these units in the field. The typical service transaction in this case would be to exchange the entire unit.

Servicing for the larger models can be performed by replacing defective modules. It is recommended, due to the physical design, that the unit is removed from the installation or panel and placed on a suitable workbench prior to disassembly of the unit.

■ VLT 5000/6000 IP 20 unit control card

Together with the LCP section and the aluminium carrier, the VLT 5000/6000 IP20 unit control card forms one unit.
To remove this unit, carry out the following steps:

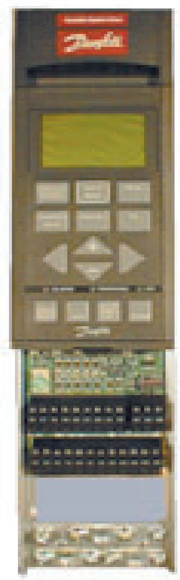
- Remove the plastic covering from beneath the display.
- Detach the leads attached to the earth and tension relieving clips.
- Remove the control card plug connectors.
- Undo the two Torx T20 screws to the left and right of the middle strain reliever. These two screws are protected against loss.
- Lift the carrier profile as illustrated above.
- Carefully detach the strip connecting leads from the MK103 / 104 plugs.
- Lift the unit again and unhook it from the top mount.

Tip:
If the control card is equipped with an options card, the latter is mounted on the back of the aluminium carrier. Four strip leads make the connection over the FK1 A-D plug connector to the control card. Detach the external connecting leads to this options card at the options card before removing the carrier.

NB!
The control card as a spare part is supplied without LCP, aluminium carrier and Eproms.

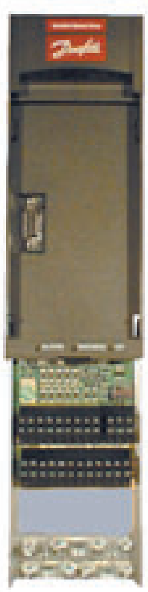
VLT 5000/6000 IP20 unit control card

Control card with LCP operating unit and aluminium carrier chassis:



The IP 20 unit control card forms a unit with the aluminium carrier and the LCP operating component inserted.

Control card with (LCP component already removed):



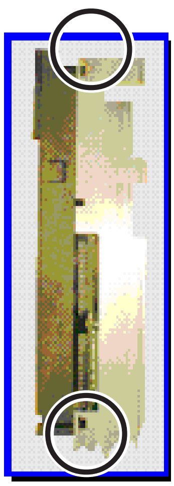
The LCP operating component can be removed quite simply from IP 20 units.

- Grasp the recess below the Danfoss logo, while at the same time detaching the operating unit.

Tip:
The 'Alarm', 'Warning' and 'On' LEDs also operate when the LCP has been detached.
The converter can also operate without the LCP.

Side view of the control card carrier chassis:

Disassembling the display unit



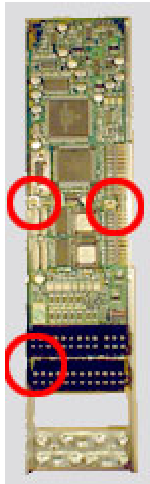
- To remove the display unit, press the display unit snap-in slides on the left of the aluminium carrier.

NB!
Do not press the slides on the right of the display piece marked here.

Warning
Risk of breakage!

VLT 5000/6000 IP20 unit control card

Control card with aluminium carrier chassis:

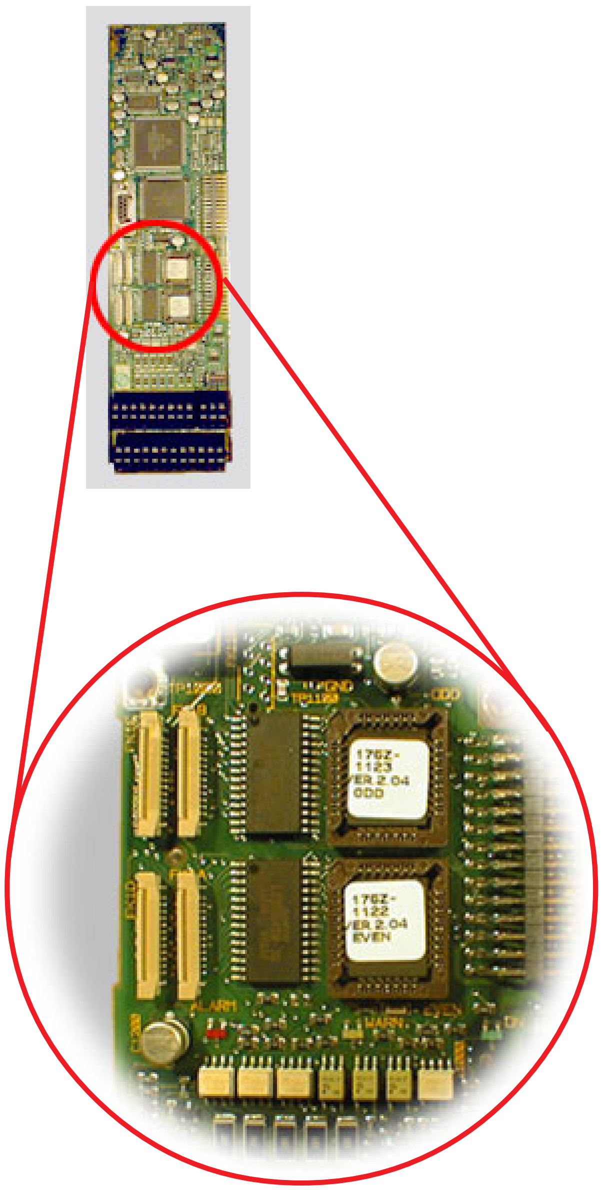


Disassembling the control card

- Undo the three Torx T10 screws on the control card.
- Unhook the control card on the right side of the aluminium carrier and remove it.
- Before removing, detach the option cards at the FK1 A-D plug connectors.

NB!
The control card as a spare part is supplied without LCP, aluminium carrier, and Eproms.

Printed control board disassembled:



The illustration on the right shows the control card as a spare part with Eproms inserted.
The Eproms are programmed with the appropriate unit´s software.
The software version can be read off the Eproms stickers.
The top Eprom bears the destignation "ODD", the lower one"Even". Pay attention to this when changing Eproms.

Tip:
When disassembling the Eproms use only a PLCC extraction toll.

Detailed view, Eproms and option connections:
You can see the four plug connectors for connecting option cards on the left near the two Eproms.

They are designed FK1A through to FK1D, starting from the bottom right and moving antoclockwise.

The strip leads inserted are contacted by pressing the clamping devices on the plug connectors.

Warning!
Please make sure they are mounted properly.

Description of Operation

Logic Section

The control card contains the majority of the logic section. The heart of the control card is a microprocessor which controls and supervises all functions of the unit's operation. In addition, a separate PROM contains the parameter sets which characterize the unit and provide the user with the definable data enabling the unit to be adjusted to meet the customer's specific application requirements. The definable data is then stored in an EEPROM which provides security during power-down and also allows flexibility for future changes as needed. A custom integrated circuit generates the PWM waveform which is then sent on to the interface circuitry located on the power card.

This PWM waveform is created using an improved control scheme called VVC^{plus}, which is a further development of the VVC (Voltage Vector Control) system used in the VLT 3000 Series. VVC^{plus} provides a variable frequency and voltage to the motor in such a way that it matches the requirements of the motor. The dynamic response of the system is such that it changes to meet the changing requirements of the motor.

Also, part of the logic section is the LCP (Local Control Panel). This is a removable keypad/display mounted on the front of the unit. The keypad or MMI (Man/Machine Interface) provides the interface between the human programmer and the digital logic.

Programming is accomplished through the use of nine of the fourteen keys available on the keypad. The additional five keys provide local control and display monitoring functions.

The backlit LCD (Liquid Crystal Display) has a total of four alpha-numeric lines providing the user with menu selection, unit status and fault diagnostic information.

In addition, the LCP can be removed during the operation to prevent undesired program changes. With the addition of a remote mounting kit, the LCP can be mounted in a remote location of up to three meters away.

A series of customer accessible terminals are provided for the input such commands as: Run, Stop, Forward, Reverse and Speed reference. Terminals are also provided to supply output signals to peripheral devices for the purpose of monitoring the control.

In addition, the control card is capable of communicating via serial link with outside devices such as personal computers or programmable logic controllers.

The control card provides two voltage supplies for use from the customer terminal strip. The 24VDC is used for switching functions such as: Start, Stop and Forward/Reverse. A 10VDC supply is also available to use with speed reference circuitry.

The analog and digital output signals are powered through a third non customer accessible supply.

All three supplies can be isolated from one another to eliminate ground loop problems in the control input circuitry.

Provisions have been made on the control card assembly for the future addition of option modules such as: synchronizing control, special communication options or custom operating software.

Logic To Power Interface

The Logic to Power Interface isolates the high voltage components of the power section from the low voltage signals of the Logic Section. This is accomplished on the Power Card. All communication between the control logic and the rest of the unit passes through the Power Card. This communication includes: DC bus voltage monitoring, line voltage monitoring, output current monitoring, temperature sensing, inrush control and the gate drive firing signals.

The Power Card also contains a Switch Mode Power Supply (SMPS) which provides the unit with 24 V DC, +14 V DC, -14 V DC and 5 V DC operating supplies. All logic and interface circuitry is powered by the SMPS. Normally the SMPS is fed by the DC bus voltage, however, in the Extended version of the drive, it is possible to power it with an external 24 V DC power supply. This enables operation of the logic circuitry without the power section being energized. Circuitry for controlling the cooling fan power auto transformer is also provided on the Power Card.

In units with Dynamic Brake options, the logic and firing circuitry for the brake operation are also contained on the Power Card.

In addition to passing the communication pertaining to output current to the control logic, much of the fault processing of output short circuit and ground fault conditions is done on the Power Card. A custom IC called an Application Specific Integrated Circuit (ASIC) continually monitors output current conditions with respect to: peak amplitude, rate of rise (di/dt) and leakage current (ground fault). At the point that any of these conditions are considered critical, the gate drive signals are immediately shut-off and an alarm signal is sent to the control logic for displaying the fault information.

Also located on the Power Card is a second relay for monitoring the status of the VLT. The relay is Form C, meaning it has one normally open contact and one normally closed contact on a single throw. The contacts of the relay are rated for a maximum load of 240 V AC at 2 Amps.

Power Section

The Power section contains the Soft Charge Circuitry, SCR/Diode modules (rectifier), the DC Bus Filter Circuitry, often referred to as the Intermediate Circuit, Motor Coils, and the Output IGBT (Isolated Gate Bi-polar Transistor) modules which make up the Inverter Section.

In conjunction with the SCR/Diode modules the soft charge circuit limits the inrush current when power is first applied and the DC bus capacitors are charging. This is accomplished by the SCR's in the modules being held off while charging current passes through the soft charge resistors, thereby limiting the current. The DC bus circuitry smooths the pulsating DC voltage created by the conversion from the AC supply. The number of DC bus capacitors will vary depending on the VLT size with the VLT 5250 having 20. The DC coil is a single unit with two coils wound on a common core. One coil is placed in the positive side of the bus and the other in the negative. The DC coil serves to aid in the reduction of line harmonics.

The Inverter section is made up of six IGBT's commonly referred to as switches. It is necessary to have one switch for each half phase or a total of six. These six IGBT's may be found incorporated into various packages. In very small units, typically under 10Hp, all six IGBT's will be in a single module called six-pack. In the VLT 5060 - 5100/ 6062-6100 two switches are contained in a single module, called a dual pack, for a total of three and in VLT 5125-5250/ 6125-6275 each switch is in a single module for a total of six modules in all.

The Motor coils serve to provide a limit to the rate of current rise (di/dt) during peak demands of the output. They serve their greatest purpose during the high and fast rising currents experienced during ground faults or short circuits on the output. The Motor coil is a single assembly with three coils wound on a common core.

Power Card Replacement

The replacement power card is used for ST, SB and EB units. For this reason, some initial programming of the "On-Board" EEPROM is required.

When the replacement card is powered initially, it automatically starts in the "Service Mode". In this mode there are 11 parameters which must be set according to the VLT being serviced. 6 parameters for HVAC (00+01+03+04+05+06)

The four arrow keys on the Local Control Panel (LCP) are used to select the appropriate value for the parameters. Once the correct value is selected, pressing the "OK" key enters the value and goes to the next parameter. See the Service mode table for the correct settings.

To restart the Service Mode press and hold the "Quick Menu", "Cancel" and "<" (arrow left) keys while powering the unit.

Spare Part Service Mode date for VLT 5000/6000

Menu Parameter [1]	Value (Where to find) [2]	Notes 3,4
	Error! Bookmark not defined.	
00 Brand		
	1: Danfoss 2: Bauer 3: Brook Hansen 4: Neutral brand	Possible to change brand,meaning brand specific texts.
01 VLT SALES NUMBER		
	Red label on VLT	Possible to change x in 175Zxxxx
02 POWER SECTION		
	Red label on VLT only VLT 5000	Select type: -STANDARD -STANDARD WITH BRAKE -EXTENDED WITH BRAKE
03 ENCLOSURE TYPE		
	Look on VLT	Select type: – BOOKSTYTLE – COMPACT – IP 54 (compact)
04 ENCAPSULATION IP		
	Red Label on VLT	Select type: – IP 00 – IP 20 – IP 54
05 ENCAPSULATION NEMA		
	Red label on VLT	Select type: – CHASSIS – NEMA 4 – NEMA 12
06 RFI FILTER		
	VLT 5001-11:Then RFI CLASS B1 VLT 5016-52+ Vlt 6000 with RFI: Then RFI CLASS B1 else NONE	Select type: - NONE (No built-in RFI filter) - RFI CLASS A1 - RFI CLASS B1
07 FAN TYPE		
	VLT 5000+VLT 6000 Then ON-OFF CONTROLI.	Select type: – NO FAN – ON-OFF CONTROL – PWM CONTROL
08 BRAKE TYPE		
	If (VLT 5000) *with* brake: Then WITH SHORT PROTECT else NONE	Select type: – NONE (no brake function in drive) – WITH SHORT PROTECT
09 EXTERNAL 24V		
	If (VLT 5000) *extended:* Then YES else NO	Select type: – NO (no external 24 V in drive) – YES (with 24 V external supply)
10 FAST DISCHARGE		
	If (voltage 5000) *extended:* Then YES else NO	Select type: - NO (No fast discharge possible) - YES (with fast discharge)
11 LOAD SHARING TYPE		
	If (VLT 5000) *extended:* Then TYPE 5 else NONE	Select type: - NONE (No load sharing possible) - TYPE 5 (With load sharing between rectifier and DC-coils. Inrush after load sharing. 2 coils)

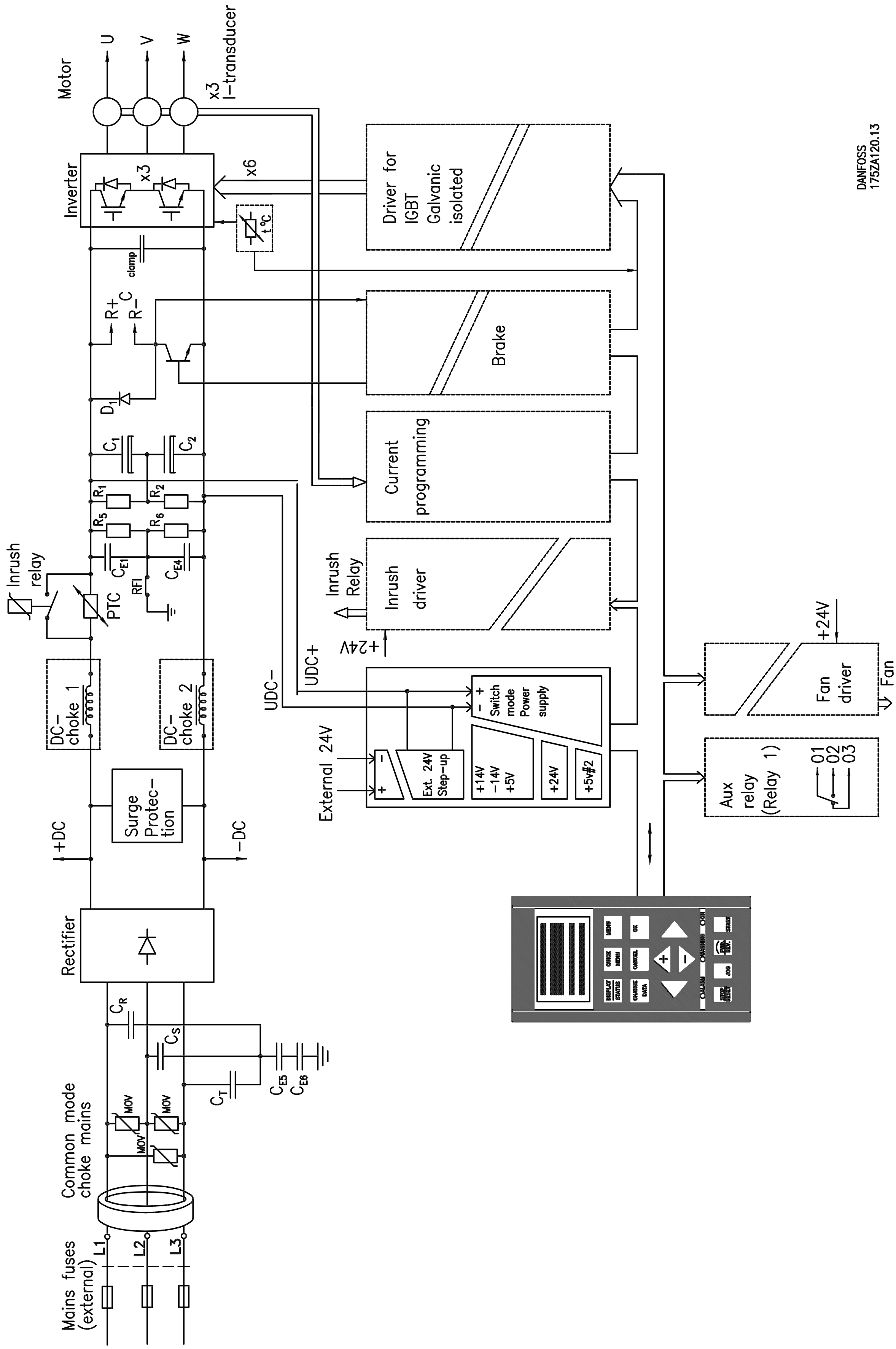
1. Lists the menu parameter after a power-up (only the first time with a spare part power card.
   To re-start "Service Mode "PUSH (QUICK MENU) + [CANCEL] + [<] at power-up.
2. Value as it is today (POWER UNIT DB ID, parameter 627 = 1.34), which may change !
3 In the Design Guide for VLT 5000, the values for menu parameter 01,02, 03, 04, 05 and 06 cab be found.
4 Only the most used select types are shown.

■ Intermediate Voltage Limits

[U.u.c]

Nominal voltage	200-240 V series	380-500 V series
SMPS undervoltage disable/enable	170	310
Inrush circuit disable	208	400
Inverter undervoltage disable	211	402
Control card undervoltage warning	222	423
Inverter undervoltage enable	227	442
Power down enable	232	443
Overvoltage warning (without brake)	384	801
Brake enable voltage	390	808
Brake maximum voltage	397	823
Inverter overvoltage enable	400	830
Overvoltage warning (with brake)	405	840
Overvoltage inverter stop	425	855

■ Key Diagram for VLT 5000/6000



■ "Ground Fault" Trips

Trips occuring from ground faults are usually the result of short circuits to earth ground either in the motor or the wiring to the motor. The VLT detects ground faults by monitoring all three phases of output and looking for severe imbalances in those currents. When a "Ground Fault" trip occurs it is necessary to measure the resistance if the motor windings and wiring with respect to earth ground. The instrument normally used for this purpose is a Megohmmeter or commonly referred to as a "Megger". Many times these resistance readings are taken with a common Ohmmeter, which is actually incapable of detecting any shorts other than those that are virtually direct. A Megger has the capability of supplying higher voltages, typically 500 volts or more, which enables the Megger to detect breakdowns in insulation or higher resistance shorts which cannot be picked up through the use of an Ohmmeter. When using a megger, it is necessary to disconnect the motor leads from the output to the VLT. The measurements should then be taken so that the motor and all associated wiring and connections are captured in the test. When reading the results of the Megger test, the rule of the thumb is any reading less than 500 Megohms should be suspect. Solid, dry wiring connections normally result in a reading of infinity.

Since the VLT monitors output current to detect ground faults, there is also the possibility that the current sensors and/or the detection circuitry in the VLT could also be the cause of a ground fault. Tests can be made on this circuitry to isolate the possibilities. Refer to the Dynamic Test procedures on "Testing for Current Feedback". Consult the factory for additional assistance.

■ "Overcurrent" Trips

Trips due to "OVERCURRENT" can be caused by short circuits on the output of the unit or by instantaneous high currents occuring so rapidly that the unit's current limit cannot respond.

Short circuit trips are generally a result of a phase-to-phase short in the motor winding or in the wiring between the unit and the motor. Short circuit trips are easily diagnosed by removing the motor leads from the unit and performing a phase-to-phase resistance test on the motor leads. This resistance read in ohms will normally be quite low so it is important to have the ohmmeter set on its lowest resistance scale to avoid mis-interpreting the readings observed.

■ Applications Overcurrent Trips

Incorrect motor setting can also cause this type of fault. If the settings of Motor Voltage (parameter 108) or Stator Reactance (parameter 109) are incorrect, the result can be excessive current draw by the motor. This is more common in start-up related problems, however, if this type of problem occurs in an existing installation it is recommended to check these settings to ensure that they have not been changed or tampered with.

Instantaneous overcurrent trips are caused by the current rising so fast on the output that the unit cannot respond. One example of this situation is in applications where the unit is running at speed and an output contactor is closed between the unit and the motor. At the point the contactor is closed, the motor is effectively seen as a short circuit to the unit. During this time the unit will attempt to gain control of the motor by employing current limits. If the current limit function is unable to limit the current to acceptable levels, the result will be an "OVERCURRENT" trip. The important consideration in applications such as this is that the unit is properly sized to handle the inrush currents.

A second example of instantaneous overcurrent is that experienced in applications with windmilling loads. A large fan has not yet been commanded to run; however, air movement is causing the fan to rotate. When the unit is started it must first drive the fan to zero speed and then begin the acceleration process from there. The amount of current required may be so great and rise so rapidly that the current limit function cannot control the process. The result is an "OVERCURRENT" trip. However, this situation can also be solved by a VLT feature, "Flying Start". With the flying start feature employed the VLT will interrogate the motor to determine its effective frequency and match the VLT output to the same frequency. Flying start results in a smooth start and full control of the load current.

■ "Overvoltage" Trips Due to Regenerative Applications

Regenerative energy is created when the load overhauls the motor. This means that the motor is being forced by the inertia of the load to rotate at the speed greater than the command speed. When overhauling occurs, the motor acts as a generator and the voltage generated is returned to the DC capacitor bank in the unit.

Regeneration is most commonly found in applications with high inertia loads and medium to fast decelerating ramps. However, even an unloaded motor ramped down fast enough can cause regeneration to occur.

It is most common that regeneration is experienced during ramping, although loads such as flywheels will generate regenerative energy to some degree on every cycle.

Since the unit can absorb approximately 15 percent of the motor's rated power in regenerated energy, this phenomena will go unnoticed in most applications.

When the energy returned, combined with the DC Bus voltage, exceeds the upper voltage limit, the unit responds in different ways to limit the voltage rise. If the returned energy is occuring during ramp down (to stop or to lower speed), the unit will automatically adjust the decelerating ramp in an attempt to limit the voltage. In more severe instances, the ramp may even stop for periods of time to allow the voltage to dissipate. During these periods while regeneration is occuring, the words "HIGH VOLTAGE" can be observed flashing in the control card display. If the returned energy is returned at a high enough level and/or so fast that the unit cannot respond, the unit will trip on "OVERVOLTAGE".

To prevent a trip from occuring, one solution is to lengthen the decelerating ramp. Another solution is to release the motor using the "Motor Coast" function. The "Flying Start" function is usually employed when using this method.

In very high inertia applications where a short decelerating time is required an SB or EB unit may be needed.

The Dynamic Brake function combines a power IGBT, the electronics for controlling it and a resistor bank of sufficient wattage to dissipate the unwanted energy. The Dynamic Brake monitors the level of the DC Bus voltage. When the voltage level exceeds permissible limits, the IGBT is switched on and the excess DC Bus voltage is dissipated in the resistor bank.

Particular attention must be paid to the proper sizing of the resistor bank. Consult your local representative or the factoy for assistance in selecting the appropriate Dynamic Brake option and dynamic brake resistors for your application.

■ "Overvoltage" Trips Due to Unequal Phase to Ground Voltages on the Input Line

In some installations the input three phase power is feed from a transformer with a Delta secondary configuration. Usually this is not a problem, although sometimes the phase to ground relationship is not equal on all three phases. When it occurs, frequent "Overvoltage" trips can result due to the RFI filtering circuitry in the drive reacting to this inequality. This normally only occurs in smaller units, typically 1-10 Hp.

In this event, the RFI filter capacitors must be disconnected from ground. This is done by opening the "RFI Switch" in the drive. Refer to the VLT 5000/ 6000 Instruction manual for location of this switch.

Troubleshooting

Prior to diving into a repair, here are a few tips that if followed will make the job easier and may prevent unnecessary damage to good components.

1. First and foremost respect the voltages produced by the drive. Always verify the presence of line voltage and bus voltage before working on the unit. Also remember that some points in the drive are referenced to the negative bus and are at bus potential even though you may not expect it.

2. Never power up a unit which has had power removed and is suspected of being faulty. If a short circuit exists within the unit, applying power is likely to result in further damage. The safe approach is to conduct the Static Test Procedures. The static tests check all high voltage components for short circuits. The tests are relatively simple to make and can save money and downtime in the long run.

3. The safest method of conducting tests on the drive is with the motor disconnected. In this way a faulty component that was overlooked or the unfortunate slip of a test probe will generally result in a unit trip instead of further damage.

4. Following the replacements of parts, test run the unit with the motor disconnected. Start the unit at zero speed and slowly ramp the speed up until the speed is at least above 40 Hz. Monitor the phase output voltage on all three motor terminals to check for balance (an analog voltmeter will work best here). If balanced, the unit is ready to be tested on a motor. If not, further investigation is necessary.

5. Never attempt to defeat fault protection devices within the drive. This will only result in unwanted component damage and may result in personal injury as well.

6. Always use factory approved replacement parts. The unit has been designed to operate within certain specifications. Incorrect parts may effect performance and result in further damage to the unit.

7. Read the instruction and service manuals. A thorough understanding of the unit is the best approach. If ever in doubt consult the factory or an authorized repair center for assistance.

Troubleshooting Recommendations

When approaching a machine or system that is not functioning properly, a good recommendation is to observe the message in the display of the drive. With the diagnostic information available in the unit, an idea can easily be formulated as to which direction to look to find the cause of the problem.

One can determine with this information whether the problem is, for instance, in the motor wiring or if it is a defective brake resistor, etc. The absence of any message at all in the display can indicate a problem in the incoming AC line voltage. Even the absence of a fault message can indicate the direction to look for a problem. If, for instance, the relay that closes to provide a run command to the drive is not functioning, there will be no fault condition sensed by the drive. It merely has not received a run command.

When troubleshooting, it is important to remember that the control logic can only respond to the commands that it receives. The possibility exists that due to a failure in control card, the commands do not reach the C.P.U. to be processed. For this reason it is necessary to isolate the fault to the control commands, programming or the drive itself. The control commands shall be checked first. This includes confirming that the contact closures and analog signals are present at the proper terminals of the drive.

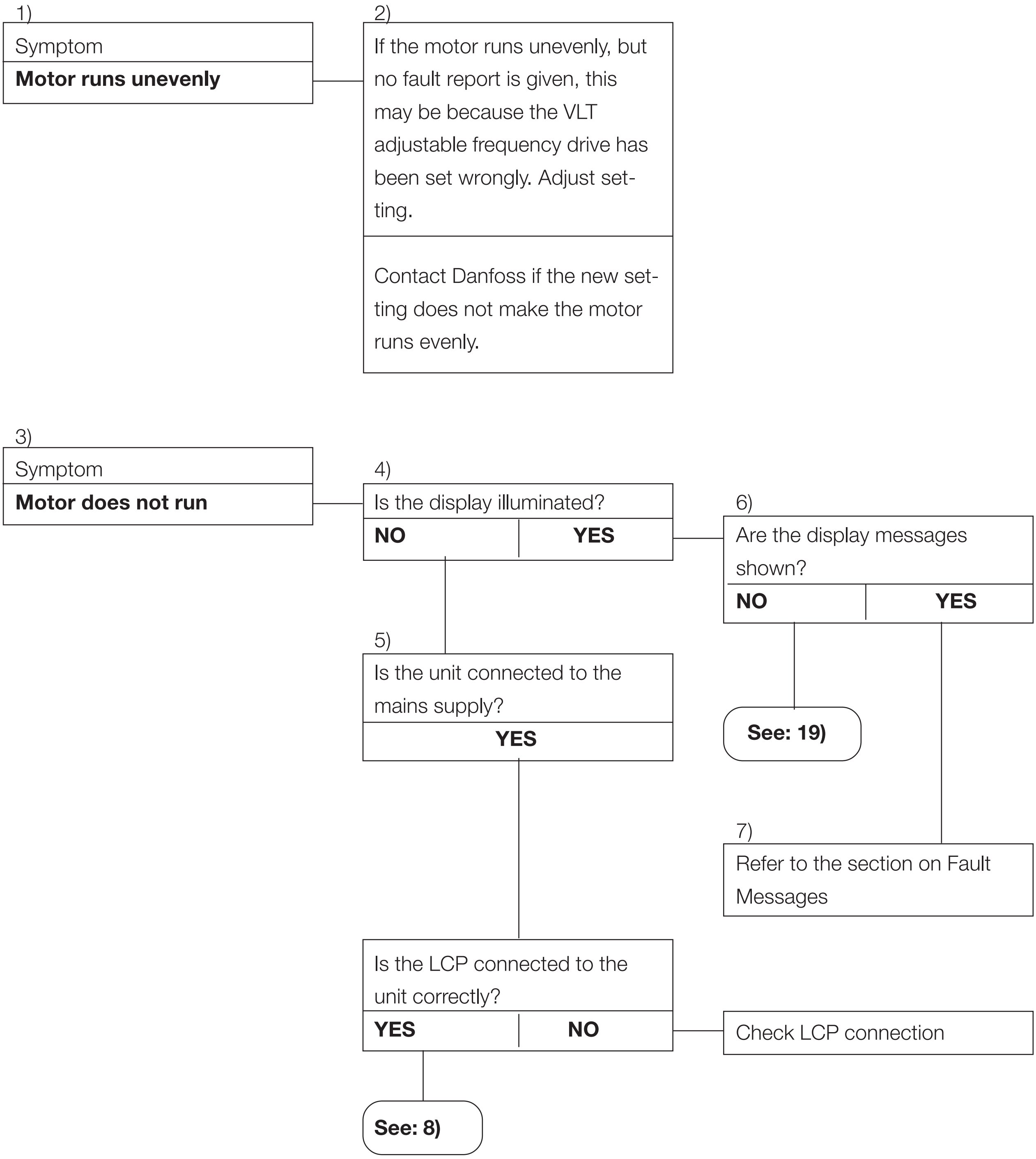
Never assume that a signal is present because it is supposed to be. A meter should be used to confirm the presence of signals at the drive terminals.

Secondly, the programming of the drive should be confirmed to insure that the terminals used are set to accept the signals connected. Each digital and analog input terminal can be programmed to respond in very different ways. If there is a concern whether the remote controls are functioning correctly it is possible to take control of the drive at the keypad to confirm proper operation. A word of caution here: prior to taking control of the unit at the keypad, insure that all other equipment associated with the drive is prepared to operate. In many cases safety interlocks are installed which can only be activated through the use of the normal control start.

It is also important to ensure that the remainder of the programming is correct for the system. For instance, incorrect settings of one or more of the motor parameters can result in poor performance of the motor drawing excess current, even causing the unit to trip when there is no real fault condition.

As there must be a command for the control card to respond, there may also be situations where the control card displays unknown information or that the performance be affected in an unknown manner, such as speed instability. In these cases the first thought may be to replace the control card. However, this type of erroneous operation is usually due to electrical noise injected into control signal wiring. Although the control card has been designed to reject such interference, noise of sufficient amplitude can, in fact, affect the performance of the control card. In these situations it is necessary to investigate the wiring practices used. For example, the control wiring should never be run in parallel with higher voltage wiring, including power, motor, and brake resistor leads. Shielded cable should also be used if the control wiring is to be run long distances. Termination of the shield should be done according to the installation manual. This is especially important in installations that require compliance with “CE” specifications.

In the event that one or more of the customer supplied line fuses blow, it is not recommended to replace the fuse and reapply power without further investigation. Blown line fuses usually indicate a problem in the power section of the drive. The Static Test Procedures as outlined in this manual should be performed to check for any shorted power components.


1)
Symptom
Motor runs unevenly
2)
If the motor runs unevenly, but no fault report is given, this may be because the VLT adjustable frequency drive has been set wrongly. Adjust setting.
Contact Danfoss if the new setting does not make the motor runs evenly.
3)
Symptom
Motor does not run
4)
Is the display illuminated?
NO
YES
5)
Is the unit connected to the mains supply?
YES
6)
Are the display messages shown?
NO
YES
See: 19)
7)
Refer to the section on Fault Messages
Is the LCP connected to the unit correctly?
YES
NO
Check LCP connection
See: 8)

8)
Symptom
No fault report or light in display

9)
Have prefuses for the VLT adjustable frequency drive blown?
NO **YES**

10)
Perform Static Test Procedure on power components.

11)
Is the control card overloaded? Disconnect all control signals wires on the control card. (Remove control plugs).
Does that remove the fault?
NO **YES**

12)
Check that the previous points are in order: The fault may have been caused by a short-circuiting of the control signals. Perhaps the 24 V supply has short circuited.

13)
Measure the DC Bus voltage at +UDC and –UDC. Verify that they are approximately 1.4 x the AC line voltage. Is the DC Bus voltage within range?
NO **YES**

14)
Replace the Power Card. Does the problem disappear?
NO **YES**

Resume operation

15)
Replace the Control Card.
Does the problem disappear?
NO **YES**

Resume operation

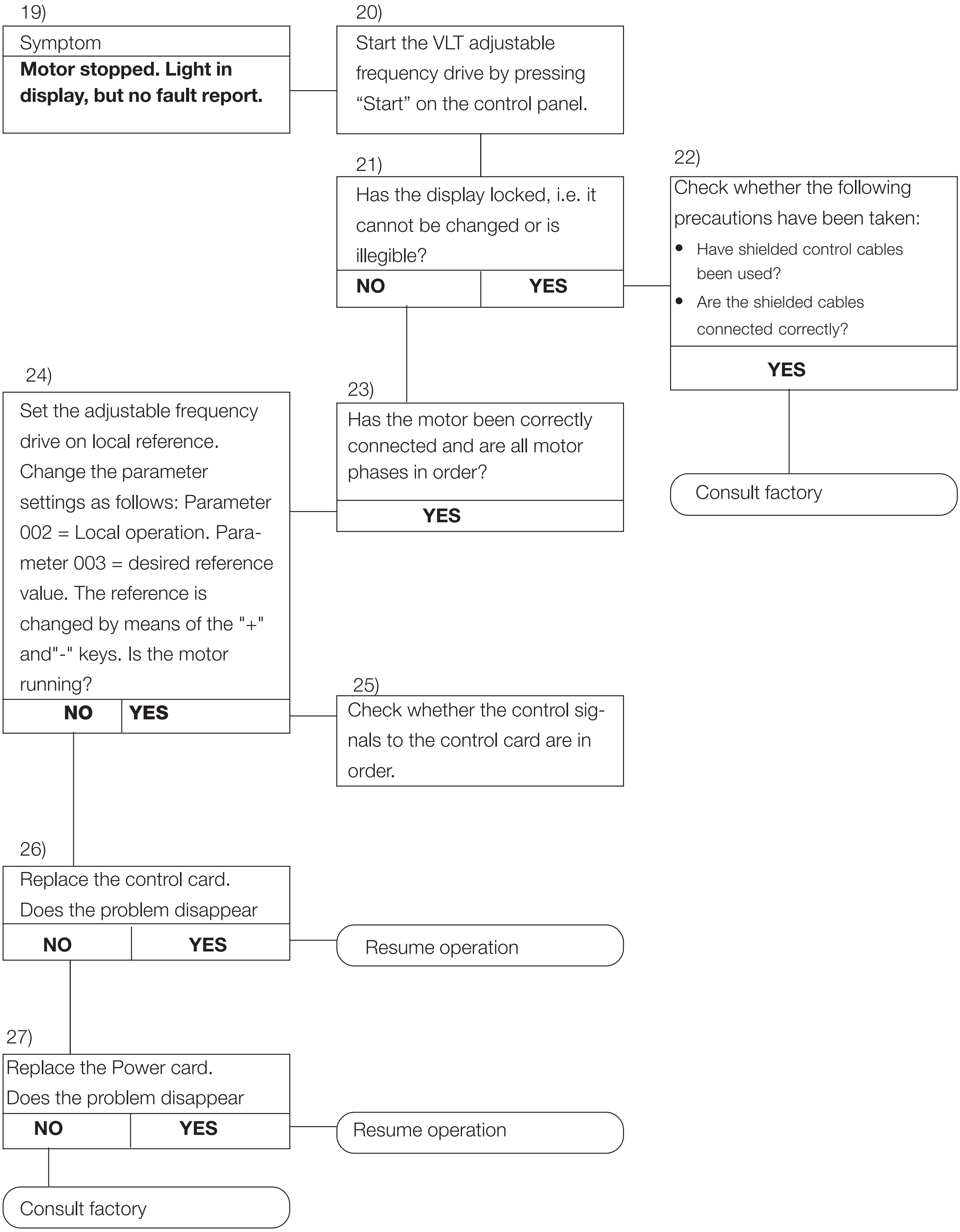
Test the Soft Charge Circuit Rectifier, and DC Bus Capacitors.

16)

17)

Replace the Relay Card. Does the problem disappear?
NO
YES

Consult factory


19)
Symptom
Motor stopped. Light in display, but no fault report.
20)
Start the VLT adjustable frequency drive by pressing "Start" on the control panel.
21)
Has the display locked, i.e. it cannot be changed or is illegible?
NO
YES
22)
Check whether the following precautions have been taken:
• Have shielded control cables been used?
• Are the shielded cables connected correctly?
YES
Consult factory
23)
Has the motor been correctly connected and are all motor phases in order?
YES
24)
Set the adjustable frequency drive on local reference. Change the parameter settings as follows: Parameter 002 = Local operation. Parameter 003 = desired reference value. The reference is changed by means of the "+" and"-" keys. Is the motor running?
NO
YES
25)
Check whether the control signals to the control card are in order.
26)
Replace the control card. Does the problem disappear
NO
YES
Resume operation
27)
Replace the Power card. Does the problem disappear
NO
YES
Resume operation
Consult factory

Symptom/Cause Charts

Symptom/cause charts are generally directed towards the more experienced technician. The intent of these charts is to provide a range of possible causes for a specific symptom. In doing so, these charts provide a direction, but with limited instruction.

Symptom	Possible Causes
1. Control Card Display Is Not Lit.	Incorrect or missing input voltage
	Incorrect or missing DC Bus voltage
	Remote control wiring loading the power supply
	Defective Control Card
	Defective Interface /ILD Card
	Defective Relay Card
	Defective or disconnected ribbon cables
2. Blown Input Line Fuses	Shorted Rectifier module
	Shorted IGBT
	Shorted DC Bus
	Shorted brake IGBT
3. Motor Operation unstable (Speed Fluctuating)	Start compensation set too high
	Slip Compensation set too high
	Improper current feedback
	PID Regulator or Auxiliary Reference mis-adjusted
	Control signal noise
4. Motors Draws High Current But Cannot Start. (May appear to rock back and forth)	Start voltage too high in special motor mode
	Open winding in motor
	Open connection to motor
	One inverter phase missing. Test output phase balance.
5. Motor Runs Unloaded But Stalls When Loaded. (Motor may run rough and VLT may trip).	Current Limit set too low
	One half of one inverter phase missing. Test output phase balance.

Symptom	Possible Causes
6. Unbalanced Input Phase Currents. **NB:** Slight variations in phase currents are normal. Variations greater than 5% require investigation.	Input line voltage unbalanced Faulty connection on input wiring Fault in plant power transformer Input Rectifier module faulty (open diode).
7. Unbalanced Motor Phase Currents. **NB:** Slight variations in phase currents are normal. Variations greater than 5% require investigation	Open motor winding Faulty motor connection Fault in inverter section (see Symptom No.6.)

Static Test Procedures

All tests will be made with a meter capable of testing diodes. Use a digital multi-meter set on the Diode scale or an analog ohmmeter. Before making any checks disconnect all input, motor and brake resistor connections.

Caution:
Allow sufficient time for the DC Bus Capacitors to fully discharge before beginning any testing. The presence of bus voltage can be tested by connecting a voltmeter set to read up to 1000 V DC to the +UDC and -UDC terminals.

Testing the Input Rectifier

The purpose of making tests on the rectifier is to rule out failures in this device, either shorted or open diodes. Failure of the rectifier module will usually result in blown input line fuses. It should be noted that blown line fuses can also be the result of shorted IGBT module(s) or damaged DC Bus capacitor. See the section on "Testing the Inverter Section". For measurements where an open circuit is expected the meter may show some initial continuity as the DC Bus capacitors charge up. This is normal and to be expected.

1. For ST and SB versions, remove the front cover and locate the +UDC and –UDC bus bars across the top of the IGBT modules. For EB version units, this is not necessary as the DC Bus can be accessed at terminals 88 (–UDC) and 89 (+UDC).

2. Connect the positive (+) meter lead to -UDC. Connect the negative (–) meter lead to terminals 91 (L1), 92 (L2), and 93 (L3) in turn. Each reading should show diode drop (x6)..

3. Reverse the meter leads connecting the negative (–) meter to +UDC and the positive (+) meter lead to terminals 91 (L1), 92 (L2), and 93 (L3) in turn. Each reading should be open (x6).

Incorrect readings could indicate a faulty Rectifier Module. Refer to the section "Testing the Softcharge Circuit". Whenever faulty power components are found, always check for other faulty components in surrounding circuitry. Often a component failure can cause subsequent failures in other components.

■ Testing the Soft Charge Circuit

The Soft Charge Circuit in these units consists of one or more PTC resistor with a contactor connected across them so that when the contactor pulls-in, it shorts out the PTC resistor(s).

1. Locate the Soft Charge Contactor mounted above the IGBT Modules. On most models it will be located above the two IGBT Module to the left side.

2. With an ohmmeter set for R x 1 scale, measure the resistance across the open contacts. At room temperature, the resistance reading should be about 16 - 40 Ohms.

NB:
on some units, the contactor is located in such a way that it is difficult to access half of the terminals. On these units, the reading can be taken from the bottom three terminals of the contactor and the +UDC bus bar across the top of the IGBT Modules.

Incorrect reading could indicate a damaged Contactor, Relay Card or problems with the DC Bus Capacitors. If a Balance Resistor is open, replace the resistor along with all DC Bus Capacitors.

Testing Gate Drive Firing Circuits

Caution:
The gate firing signals are referenced to the negative DC Bus and are therefore at Bus potential. Extreme care must be taken to prevent personal injury or damage to equipment.
Oscilloscopes, when used, should be equipped with isolation devices.

The individual gate drive firing pulses originate from the Power Card. These signals are then distributed to the individual IGBT's. An oscilloscope is the instrument of choice when observing waveforms; however, when a scope is not available, a simple test can be made with a DC voltmeter. When using a voltmeter, compare the gate pulse voltage readings between phases. A missing gate pulse or an incorrect gate pulse have a different average voltage when compared with the other pulse outputs. At very low frequencies (below 10 Hz) the voltmeter reading will tend to bounce around as the pulses pattern changes. Above 10 Hz the reading will stabilize. When using an oscilloscope, the test points remain the same, as shown. These tests must be made with the motor disconnected.

The internal impedance of a meter or scope can induce problems to the IGBTs. Disconnect IGBT from power card before measuring. Mount jumpers on connectors MK 1 – 2 and 3.

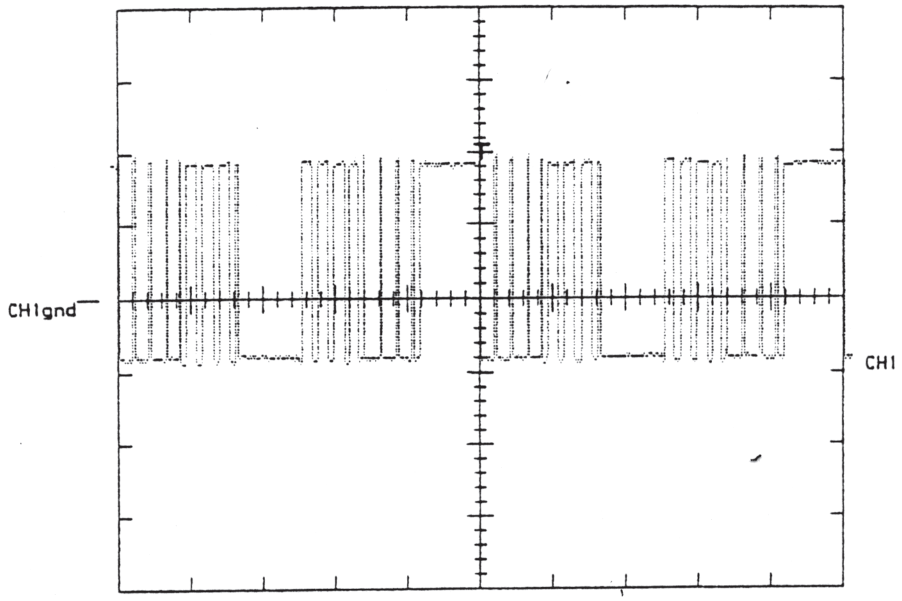
1. Measure the resistance at each of the six test points. Each test point should read approximately 5-10 k Ohm with rectifiers mounted.

2. Apply power and run the unit up to 50 Hz. Measure each of the six IGBT gate pulse signals.

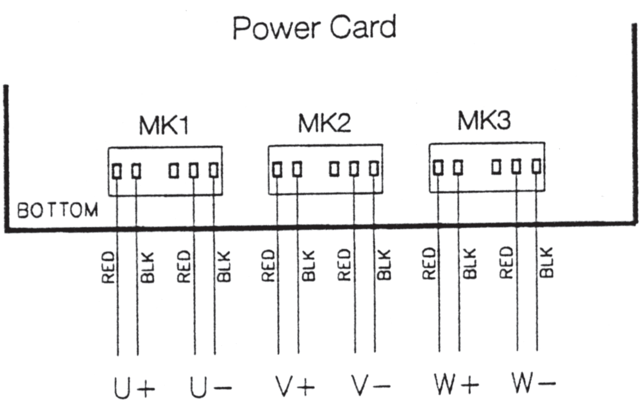
3. If gate pulses are missing or the readings are inconsistent, remove power, remove the three IGBT gate wire harnesses from the Power Card and measure the gate pulse signals directly at the Power Card Connectors.

There may be a slight DC shift in voltage readings between the positive and negative half IGBT gate signals.

■ Gate Pulses @ 20 Hz,10 V/Div, 10 mS/Div



■ Gate Pulse pin-outs



Testing the Inverter Section

The purpose in testing the inverter section is to rule out failures in the IGBT power modules. If a short circuit is discovered during testing, the particular module can be pinpointed by noting the output terminal indicating the short circuit. When looking into the unit at the IGBT modules, the "U" phase is to the left, "V" phase is in the middle, and the "W" phase is on the right. Before beginning the test, ensure that the motor and brake resistor are disconnected.

1. Connect the positive (+) meter lead to -UDC. Connect the negative (–) meter lead to terminals 96 (U), 97 (V), and 98 (W) in turn. Each reading should show diode drop.

2. Reverse the meter leads connecting the negative (–) meter lead to +UDC and the positive (+) to terminals 96 (U), 97 (V), and 98 (W) in turn. Each reading should show be open.

Incorrect readings indicate a damaged IGBT module. Refer to the section on "Removing and Replacing Components".

Replacement of IGBT Modules (Removal)

- Remove the three connection screws from the top of the IGBT module to be replaced. Loosen the connection screws on the remaining IGBT modules.
- Remove the two mounting screws from the IGBT module to be replaced.
- Slide the module out from under the bus bars.
- Apply silicon grease 3 µm thick to the entire base of the replacement IGBT module.
- Slide the new IGBT module in place under the bus bars. Tighten the mounting screws.

NB!
On some units the Precharge Contactor will have to be unbolted and moved to one side to allow sufficient room to slide the module out.

Tightening torques, VLT 5000/6000

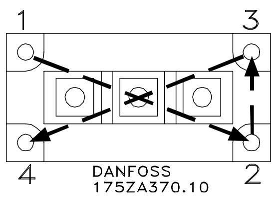
The tightening torques for IGBTs and rectifer bridges for vlt 5001-5052 and VLT 6002-6062 are stated in the table below:

Tightening torques, IGBT/rectifier bridge - Heatsink			Wires	
Unit type	Pre-tightening	Final tightening	5mm. screw	6mm. screw
VLT5001-5052/6002-6062	0,4-0,9	1,8-2,2	2,1-2,3	3,0-3,4
5062-5072-5102 / 6072-6100-6122		3,0-3,4		

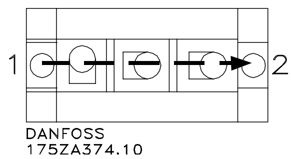
Installation

1. Prior to installing the IGBT ensure the surface area of the heatsink is clean of dirt and excess thermal compound.
2. Before installing the IGBT, place the thermal pad provided on the surface of the heatsink aligning it with the IGBT mounting holes.
3. Place the IGBT in position. Install the mounting screws and tighten by hand until the head is flush with the surface of the IGBT.
4. Identify the IGBT style and adhere to the following tightening patterns and torque specifications as each connection to the IGBT is made.

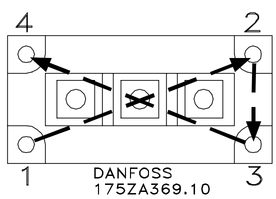
The following figures show tightening patterns. First hand tighten until the screw head is flush. Second torque to one-third of the value listed above in the pattern shown:



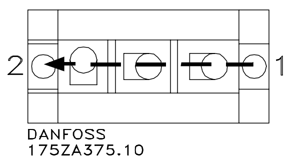
OR



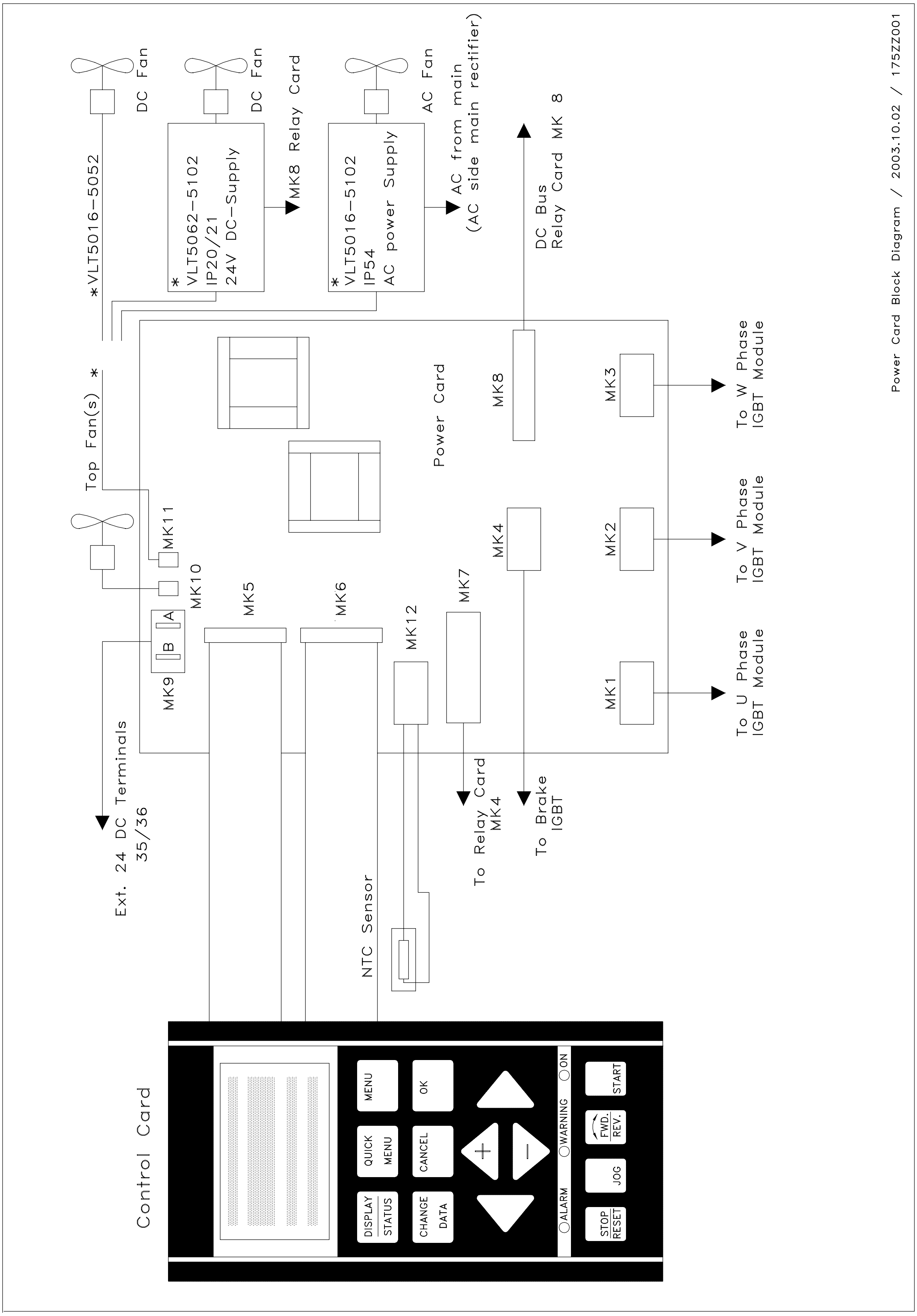
The following figures show final tightening patterns. Final torque to the value listed above in the pattern shown:



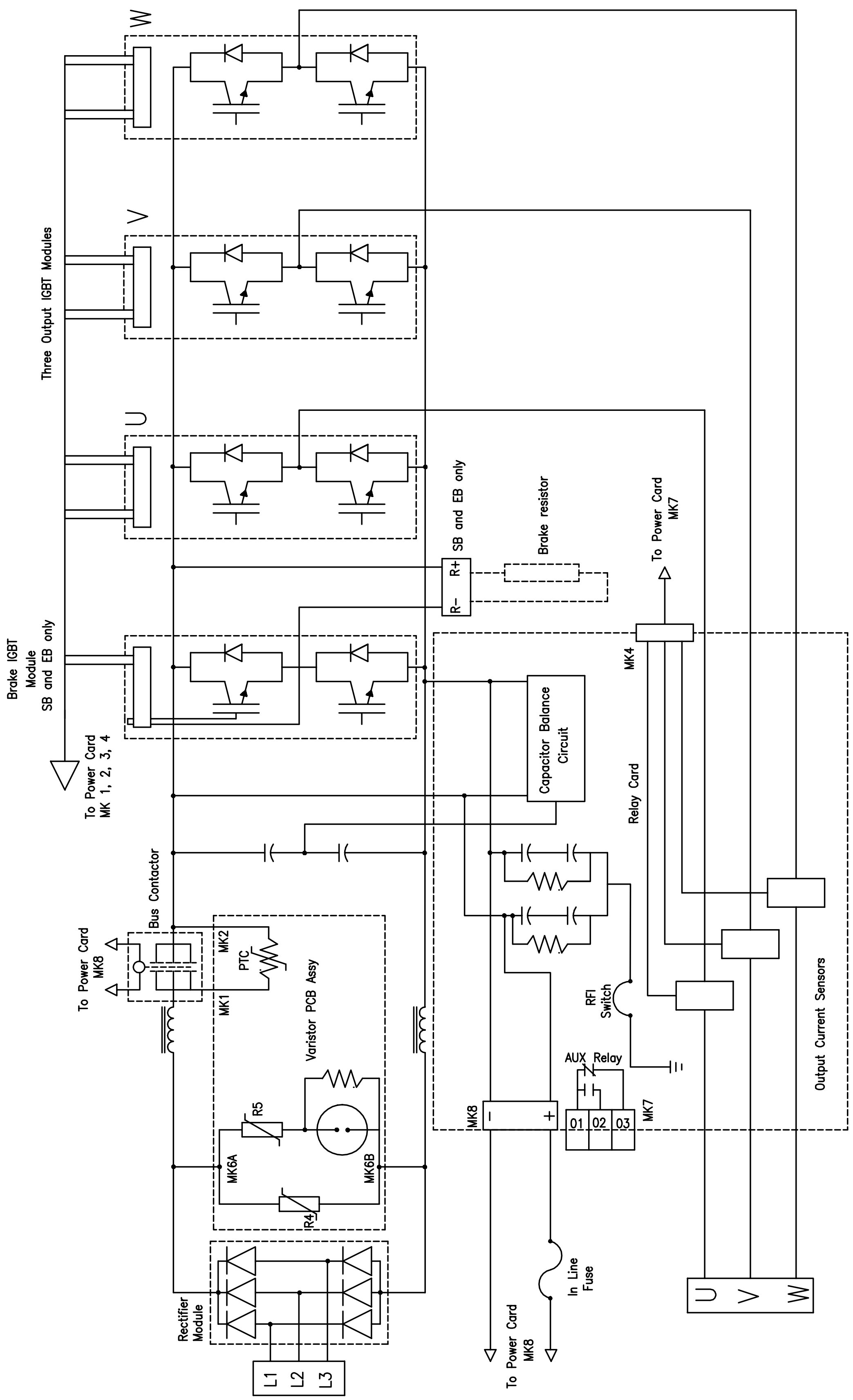
OR



■ Power Card Block Diagram



Block Wiring Diagram



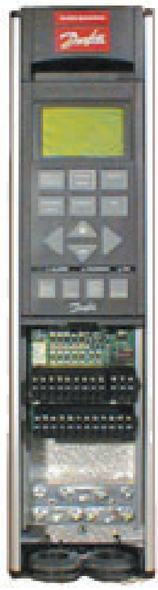
Disassembling the VLT 5001-5/6002-5 book-size IP 20 unit

Full view of the VT 5001-5/6002-5 protection rating IP 20:

Disassembling the control card

- Remove the connecting space cover below the operating and display unit.

Tip:
See the product manual or the chapter, "IP 20 unit control card"



View of the unit with the connecting space cover removed:

Disassembling the control card:

- Detach the control card's drive leads at the strain relievers.
- Remove the connector from the drive leads at the control card.
- Undo the two Torx screws (T20) to the left and right of the middle earthing and strain relieving clip.
- Lift the control card with the carrier profile, remove the strip connecting wire to the power unit.
- Remove the control card and put it aside, ESD protected.

View of the unit with the control card removed:

Disassembling the power card

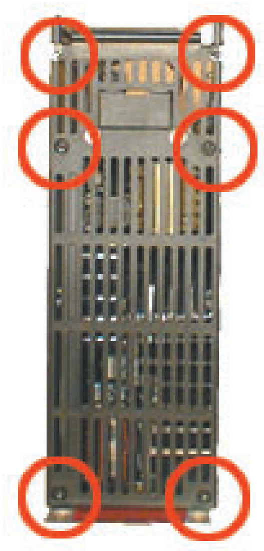
- Lay the unit flat ont the work surface, with the right side of the casing facing upwards.
- Undo the three Torx T10 screws.

■ **Disassembling the VLT 5001-5/6002-5 book-size IP 20 unit.**
View of the back of the VLT unit.

■ **Disassembling the power card (cont.)**
- Remove the three Torx T10 screws on the back of the casing.

View of the top part of the VLT unit (casing cover):

■ **Disassembling the power card (cont.)**
- Undo the six Torx T10 fastening screws.
- Remove the casing cover

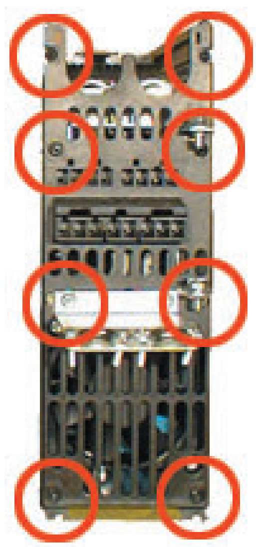


View of the bottom part of the VLT unit (bottom cover):

■ **Disassembling the power card (cont.)**
- Remove the fastening plate for strain relieving and earthing of the armouring.
- Remove the two SW 10 hexagonal earthing screws.
- Remove the eight marked Torx T10 screws.

Note:
The screws marked A connect the PE transverse bracing; they are"gold chrome".

Tip:
The bottom cover is only loosened, it cannot be removed yet.

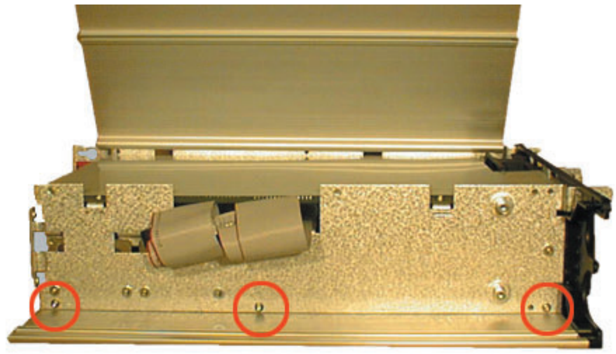


■ **Disassembling the VLT 5001-5/6002-5 book-size IP 20 unit.**

View of the unit with the control card and casing cover removed:

■ **Disassembling the power card (cont.)**

- Take off the right side of the casing facing upwards.
- Remove the insulating film.
- Remove the three Torx T10 screws to the lower side.

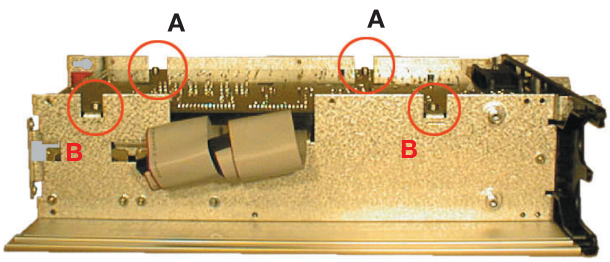


Tip:
Place the insulating film you have removed on the side of the casing previously laid aside so that you do not forget it when reassembling.

View of the unit with the control card, casing cover, side and insulating film removed:

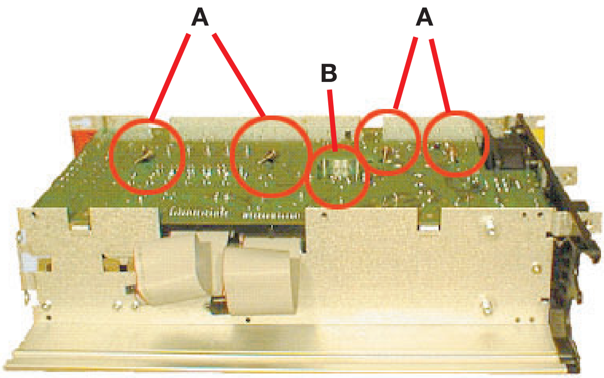
■ **Disassembling the power card (cont.):**

- Remove the two Torx T15 screws marked A
- Loosen the two Torx T15 screws marked B, but leave them screwed in, as they will be removed later.



■ Disassembling the VLT 5001-5/6002-5 book-size IP 20 unit

View of the unit with the control card, casing cover, side and insulating film removed:



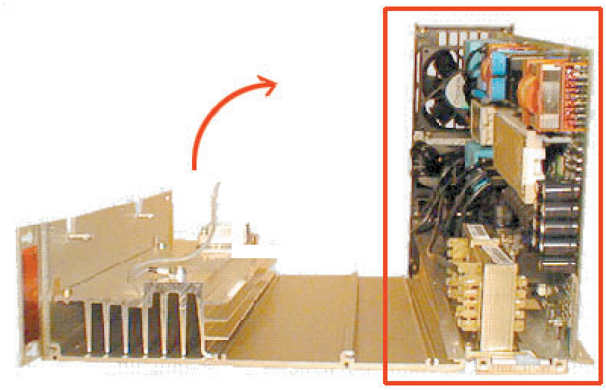
■ Disassembling the power card (cont.)

- Remove the two Torx T20 (A) fastening screws from the rectifier module and the two from the inverter module.
- Slightly raise the left side of the power card and detach the connecting lead of the thermosensor to the MK 50 plug connector.

■ With the brake chopper option:

- Unfasten the (B) IGBT brake clip.

View of the unit with the power card detached from the cool profile:



■ Disassembling the power card (cont.)

- Lift the power card with the cover plate and fitted intermediate circuit coils.
- Hold up the card, now remove the two Torx T15 fastening screws from the power card to the cover plate.
- Place the power card and cover plate with the intermediate circuit coils down on the solder side.

Disassembling the VLT 5001-5/6002-5 book-size IP20 unit

Power card, cover plate with intermediate circuit coils and bottom cover of casing:

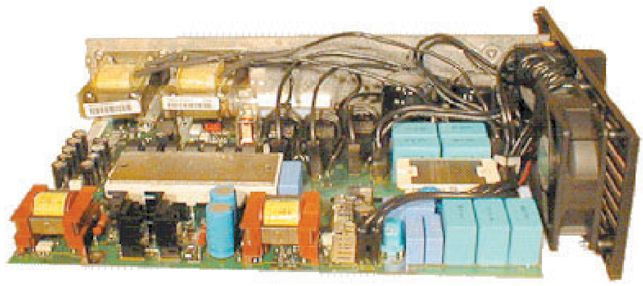
Separating the power card lead connections

Detach all the lead connections between the bottom cover and the power card.

Tip:

The plug connectors are locked in place by a lock on the power card connection plugs. To detach them, pull only the black plastic protective sleeves. With two-pin and three-pin connections, always use pointed pliers.

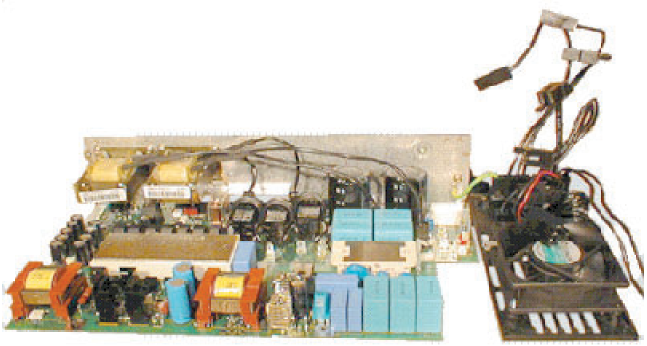
Power card with intermediate circuit coils connected:



Separating the power card lead connections (cont.)

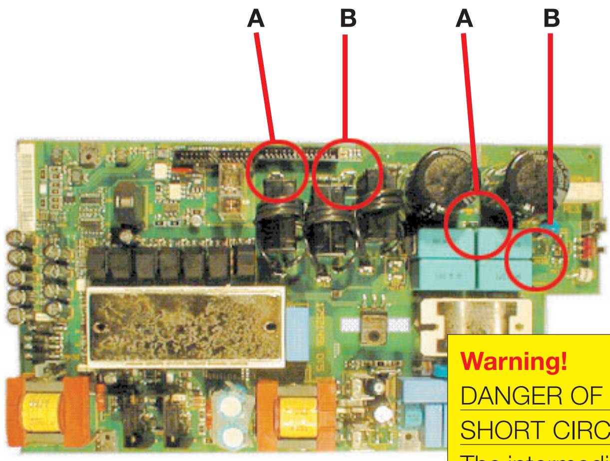
- Remove the connections to the two intermediate circuit coils.
- Put the defective power card aside, ESD protected.
- Prepare the replacement card for connection.
- Position the power card and reassemble all the connecting leads. Be careful with the wiring!

The following pages show the power card connection points in detail.



■ Disassembling the VLT 5001-5/6002-5 book-size IP 20 unit

View of the power card – intermediate circuit coil connection points:

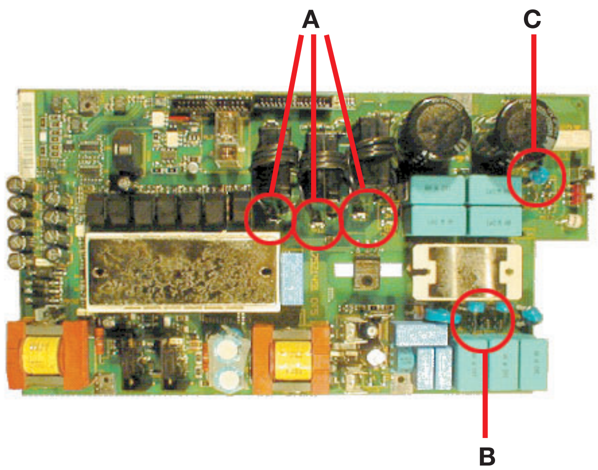


Warning!
DANGER OF
SHORT CIRCUIT
The intermediate circuit coil connections must not be mixed up.

A: MK3 short, MK4 long connection lead intermediate circuit coil (plus) ‘top’.

B: MK1 short, MK2 long connection lead intermediate circuit coil (minus) ‘bottom’.

View of the power card - mains, motor and relay plug connector, connection points:



A: MK11/12/13 motor plug connector, connection series U-96/V-97/W-98.

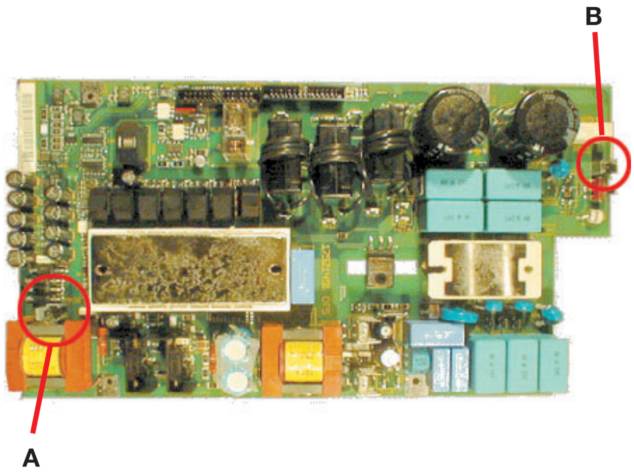
B: MK10 three-pin mains lead connection point L1-91/L2-92/L3-93.

C: MK17 connection point to the relay contacts 01/02/03.

■ Disassembling the VLT 5001-5/6002-5 book-size IP 20 unit

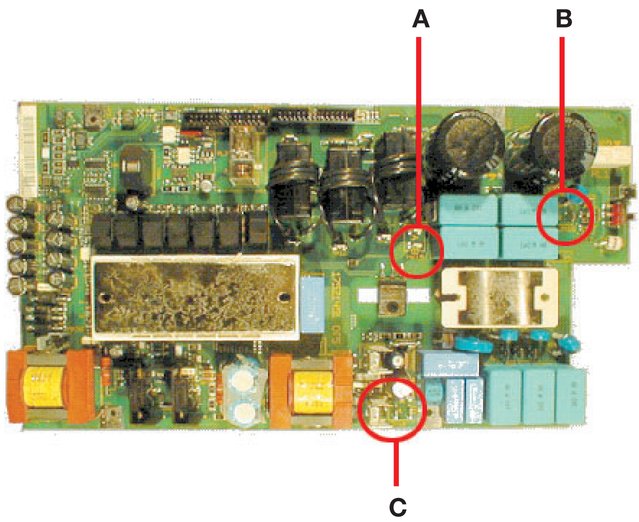
View of the power card - ventilator and NTC temperature sensor connection points:

A: MK50 NTC thermosensor connection.
B: MK40 ventilator connection.



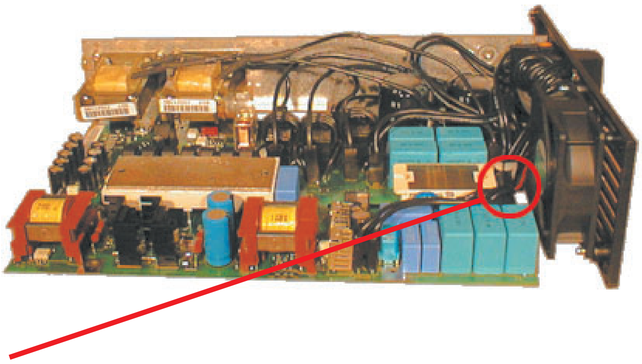
View of the power card - connection points for options:

The connection points marked are assigned when the frequency converter is equipped with the corresponding options.
A: MK15 option, brake chopper R(–)-81 / R(+)-82.
B: MK16 option, intermediate circuit coupler UDC(–)-88 / UDC(+)-89.
C: MK18 option, external 24 VDC supply 24 V(–)-35 / 24 V(+)-36.
These connectors are available in 2-pin design.



Disassembling the VLT 5001-5/6002-5 book-size IP 20 unit

Power card, cover plate with intermediate circuit coils and bottom cover of the casing:



Assembling the power card

- Connect the strip connection leads to the power card.
- Reconnect all the lead connections to the bottom part (see pages 38 and 39 of this chapter).

Connection sequence:

1. Ventilator connection	MK40	(cable clip)
2. Brake chopper option	MK15	(cable clip)
3. Mains inlet	MK10	(cable clip)
4. Relay connection	MK17	
5. Intermediate circuit coupler option	MK16	(cable clip)
6. Ext. 24 VDC supply option	MK18	(cable clip)
7. Motor leads	MK11/12/13	

- Connect the lead connectors to the intermediate circuit coils.

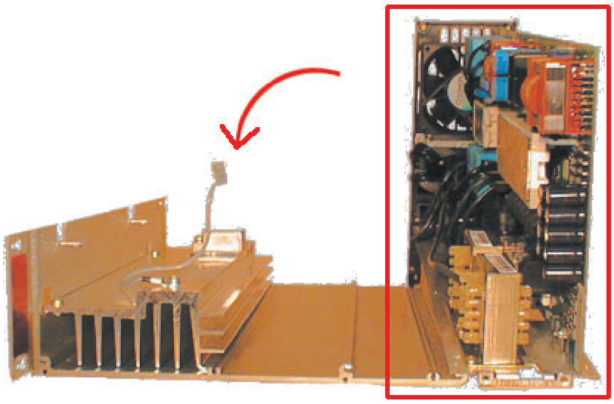
Tip:
Be careful with the wiring. In the rectifier area, the leads must be inserted into the cable clip (arrow). You must also ensure that the leads are prevented from chafing on the ventilator rotor.

- Clear the power semiconductor assembly surfaces of any adherent extraneous material and apply a wafer-thin layer of heat conduction paste (transparent silicone).

Tip:
Brake chopper option
The IGBT TR46 brake does not require any heat conduction paste. Nevertheless, you must be especially careful in ensuring that the insulating film stuck to the heat sink is intact.

Disassembling the VLT 5001-5/6002-5 book-size IP 20 unit

View of the unit with the power card prepared for assembly:



Assembling the power card (cont.)

- Set up the card together with the intermediate circuit coils mounted on the cover plate and the bottom cover attached.
- Screw in the two Torx T15 screws on the edge of the card to the cover plate.
- Position the power card and then lower it onto the heat sink.
- Mount the temperature sensor connection lead onto MK50.
- Screw the three cover plate Torx T10 screws back into the underside and tighten them up. Make sure the alignment of the cover plate with the side is correct.
- For the time being, loosely screw the two Torx T15 power card screws into the rear wall.
- Tighten the rectifier and inverter module fastening screws in two stages, provisionally with a torque of 0.8 and finally with a torque of 1.8 nm.
- Tighten up the power card fastening screws with a final torque of 1.2 nm.
- Position the IGBT brake clip and lock into place. (Brake chopper option).
- Reposition the insulating film on the side wall.
- Put the side wall in place.
- Rescrew all the fastening screws to the base and side walls and tighten them up.

Tip:

for a simpler classification of the Torx T10 screws

The ‘black’ screws connect plastics with metals. The ‘golden’ screws are electrical inter-connections between the metal parts.

- Put the control card in place, position the strip connection leads, tighten the two Torx T20 screws.
- Reassemble all the connection leads, reposition the strain relievers and armouring clip.
- Perform a function test.

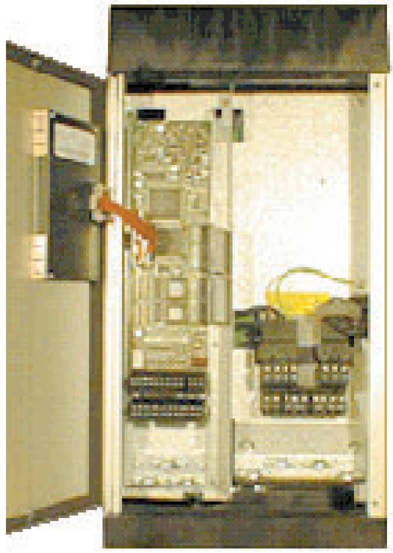
Disassembling the VLT 5001-5/6002-5 Compact IP 54 unit

Full view of the VLT 5001-5/6002-5 protection rating IP54:

Opening the unit door.

Unscrew the two recessed-head screws.

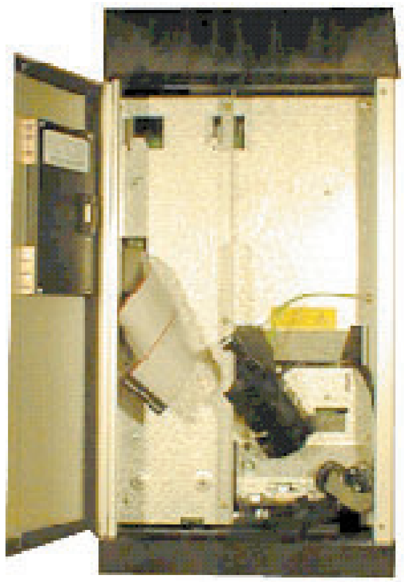
View of the unit with the door open:



Removing the control card

- Carefully remove the connecting wire from the control card to the LCP operating unit mounted in the door.
- Undo the control card's drive lead to the strain relievers. Remove the connector from the drive leads to the control card.
- Unscrew the two Torx screws (T20) to the left and right of the middle earthing and strain-relieving clip.
- Lift the control card with the carrier profile, remove the strip connecting wires to the power unit.
- Remove the control card and put it aside.

View of the unit with the control card removed:



Dismantling the cover plate

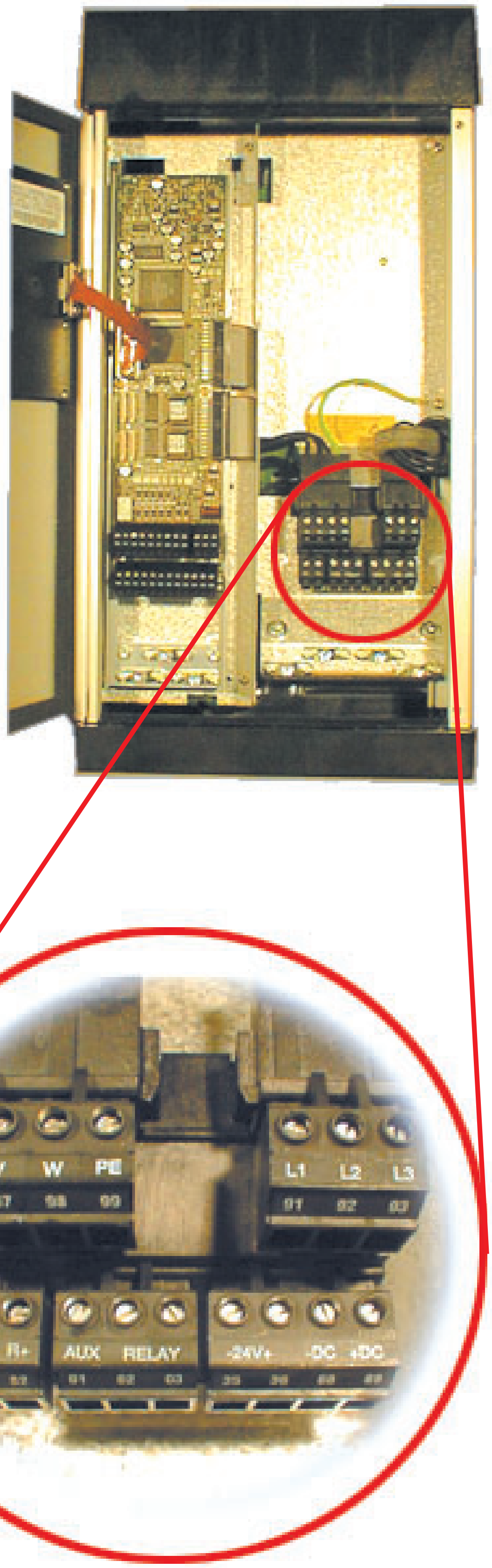
- Detach the earthing and strain-relieving clips.
- Remove all the power connectors to the connecting block.
- Detach the connecting block by pressing the two interlocking slides on the underside.
- Detach the two plug fixtures for mains and motor by pressing the side locks.

■ Disassembling the VLT 5001-5/6002-5 Compact IP 54 unit

Detailed view of the plug connector unit:

Tip:
The connections for braking resistance, ext. 24 V DC supply and intermediate circuit coupler are to be found only on instruments with these options.

The plug connector unit is equipped with a locking attachment. It can be separated from the cover plate without using a tool.



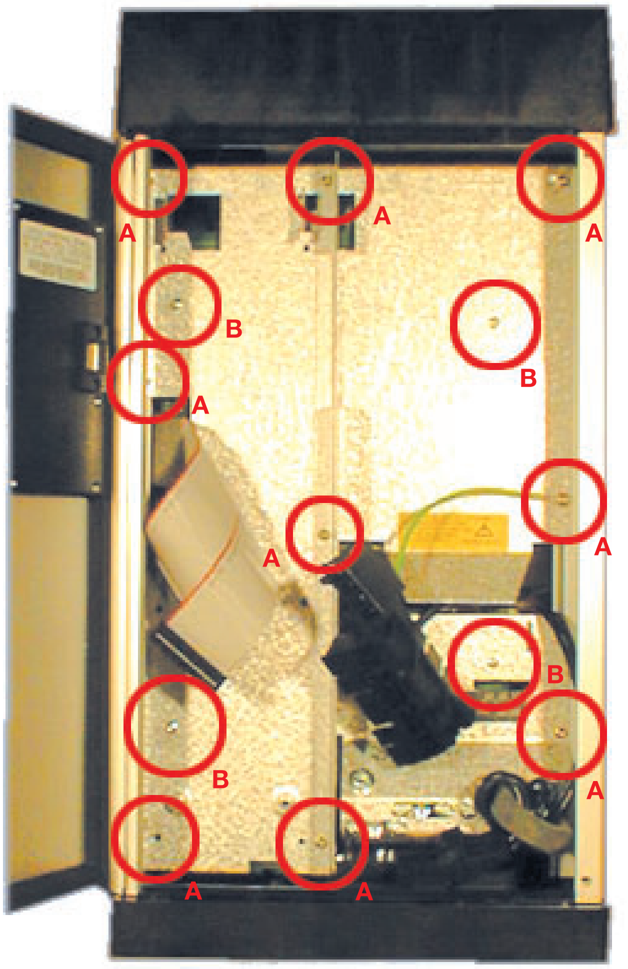
■ Dismantling:

The click-in slides on the plug connector unit are located on the underside beneath the connector for braking resistance ‘R-/R+’ and intermediate circuit coupler ‘DC-/DC+’.
Press the two click-in slides immediately above the plate edge, lift the connecting block and remove it from the upper hook.

The plug connector units can be detached from the mains input ‘L1/L2/L3’ and the motor connection ‘U/V/W/PE’ separately.
The plug unit can be removed by pressing the click-in slides on both sides.

■ Disassembling the VLT 5001-5/6002-5 Compact IP 54 unit

View of the unit with the control card already disassembled:



■ Dismantling the cover plate:

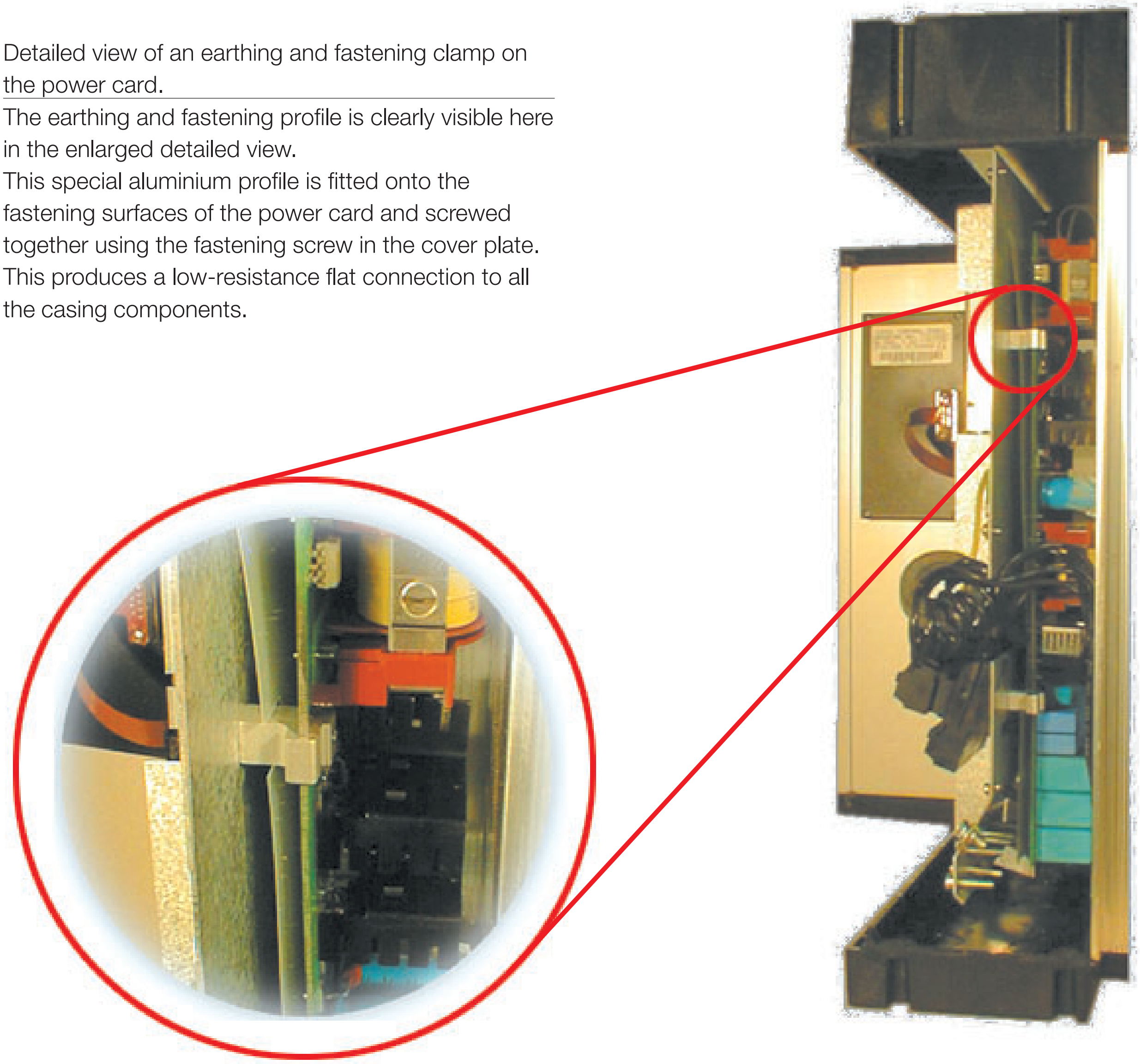
- To dismantle the cover plate, loosen the Torx T10 fastening screws marked A.
- The four recessed-head screws T10 marked B connect the power card to the cover plate, and these must also be removed.

Tip:
The protective conductor of the motor attachment plug is connected to the middle fastening screw on the cover plate.

■ Disassembling the VLT 5001-5/6002-5 Compact IP 54 unit

Detailed view of an earthing and fastening clamp on the power card.

The earthing and fastening profile is clearly visible here in the enlarged detailed view.
This special aluminium profile is fitted onto the fastening surfaces of the power card and screwed together using the fastening screw in the cover plate.
This produces a low-resistance flat connection to all the casing components.



Disassembling the VLT 5001-5/6002-5 Compact IP 54 unit

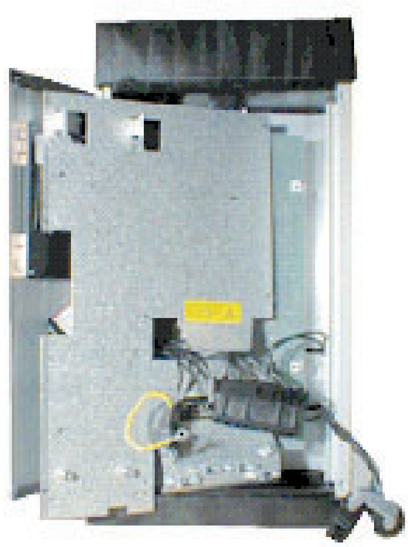
View of the unit with the cover plate detached:

Removing the cover plate

- Push the cover plate downwards into the connecting space.
- Align the right plate edge with the casing aperture and lift it out of the casing.
- Lift the top plate edge from the casing, then the whole left side of the plate.

Follow the plug connector wiring accordingly.

View of the unit with the cover plate detached:



Removing the cover plate

- Feed the right side of the plate back into the casing.
- Thread the plug connector wiring out of the plate section.

View of the unit with the control card and cover plate removed:

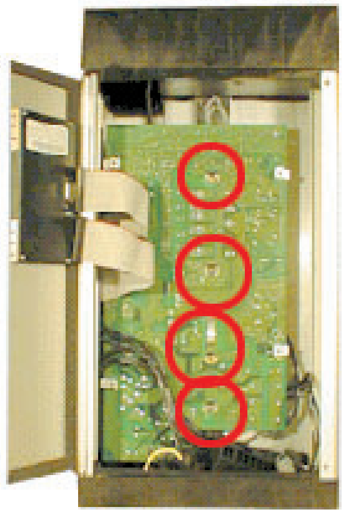
Removing the insulating film

- Pull the insulating film out between the attachment plug leads and remove.

Tip:
Place the insulating film on the cover plate, so that you will not forget it when reassembling.

■ Disassembling the VLT 5001-5/6002-5 Compact IP 54 unit

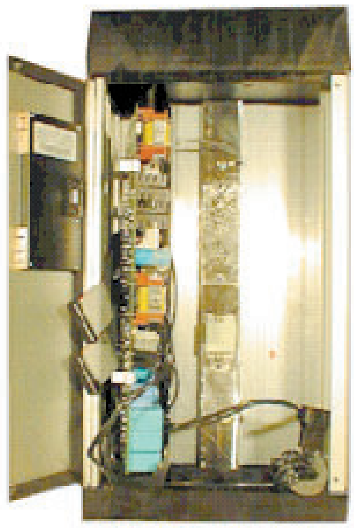
View of the unit with the control card and cover plate removed:



■ Disassembling the power card
- Undo the four Torx T15 fastening screws from the rectifier and inverter module.

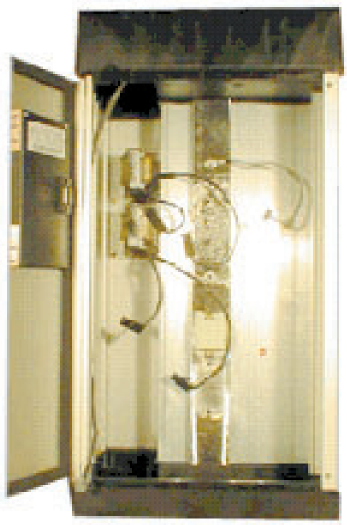
■ With the brake chopper option:
- Remove the fastening brace of the IGBT brake to the heat sink.

View of the unit with the control card and cover plate removed:



■ Removing the power card
- Lift the card on the right side and carefully push it left into the casing.
- Undo the plug connectors of the temperature sensor / MK50 above and the ventilator / MK40 below.
- Undo the connections to the two intermediate circuit coils on MK1 / MK2 top coil (positive) and on MK3 / MK4 bottom coil (negative).

View of the unit with the control card, cover plate and power card removed:



■ Replacing the temperature sensor or DC coil
The NTC temperature sensor is centrally mounted in the upper part of the heat sink and is connected to the heat sink by a Torx T15 fastening screw. The resistance level of the sensor is about 10 kW at 20°C.

The intermediate circuit coils are mounted in the side of the casing left of the heat sink. The two coils are identical.

Disassembling the VLT 5001-5/6002-5 Compact IP 54 unit

Installing the replacement power card:

- Prepare the replacement card and place it on the ESD work surface.
- Undo the wiring connections of the plug connector unit to the disassembled card.
- Connect the plug connector unit to the replacement card.

Note:
The following pages, with the heading 'View of the power card', show the connection points in detail.

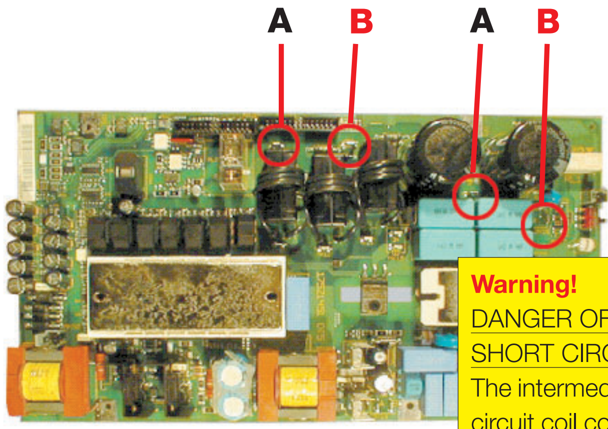
Tip:
The flat plug connectors are locked in place by an interlock to the power card connection lugs. In order to unfasten the plug, pull only on the black plastic protective sleeve. With two-pin and three-pin connections, use pointed pliers.
Do not use force.

■ Disassembling the VLT 5001-5/6002-5 Compact IP 54 unit

View of the power card - connection points of the intermediate circuit coils:

A: MK3 short, MK4 long connecting lead intermediate circuit coil (plus) 'top'.

B: MK1 short, MK2 long connecting lead intermediate circuit coil (minus) 'bottom'.



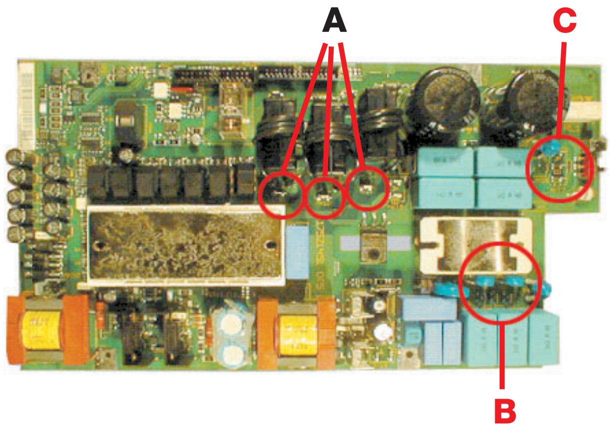
Warning!
DANGER OF SHORT CIRCUIT
The intermediate circuit coil connections must not be mixed up.

View of the power card - mains, motor and relay plug connector, connection points:

A: MK11/12/13 motor plug connector attachment series U-96/V-97/W-98.

B: MK10 three-pin connection point to mains supply L1-91/L2-92/L3-93.

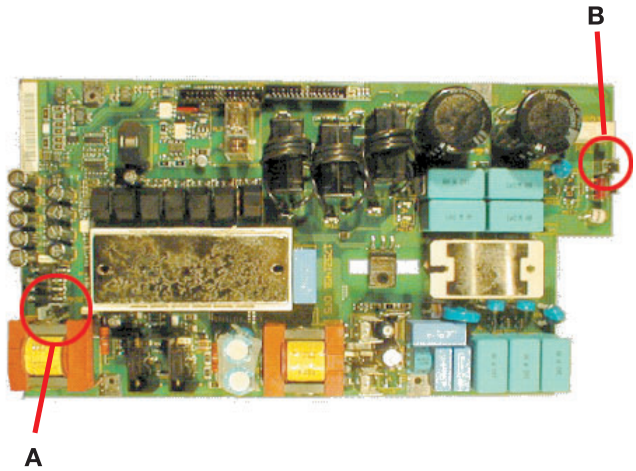
C: MK17 connection point to relay contacts 01/02/03.



■ Disassembling the VLT 5001-5/6002-5 Compact IP 54 unit

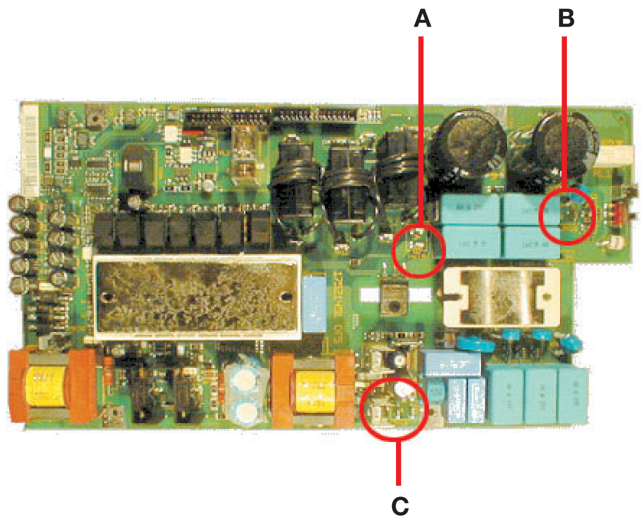
View of the power card - ventilator and NTC temperature sensor connection points:

A: MK50 Connection of the NTC thermostatic sensor
B: MK40 ventilator connection.



View of the power card - connection points with options:

The connection points marked are assigned when the frequency converter is equipped with the corresponding options.
A: MK15 brake chopper R(–)-81 / R(+)-82 option.
B: MK16 intermediate circuit coupler UDC(–)-88 / UDC(+)-89 option.
C: MK18 external 24 VDC supply 24 V(–)-35 / 24 V(+)-36 option .
These connectors are available in the two-pin design.



■ Disassembling the VLT 5001-5/6002-5 Compact IP54 unit

Installing the replacement power card: (cont.)

Wiring
Once again, this enables all the connection leads to be seen at the same time.

- Check the wiring prior to inserting the power card into the casing.
- Run the leads for motor connection and braking resistance option connection under the left side of the card. The connections to the AUX relay can be made on the left side or in the card's ventilator section, as illustrated here.

All other leads should be connected on the right side above the card.

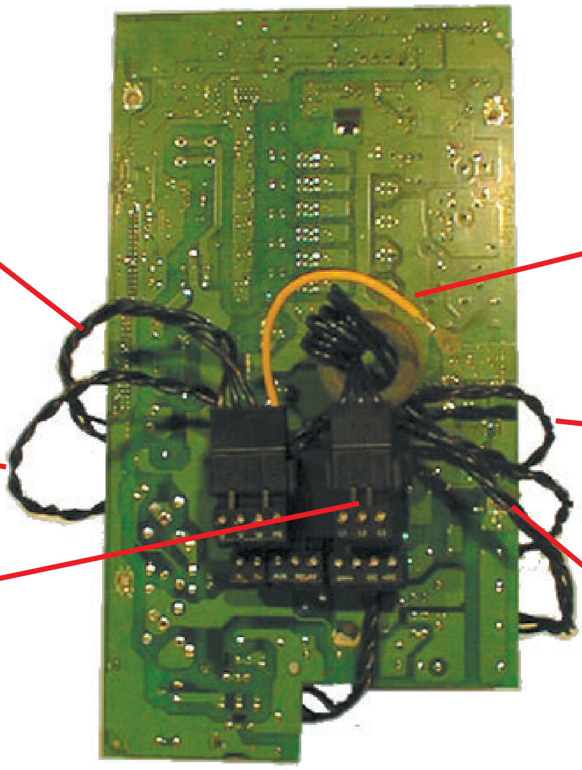
Tip:
The connection lead for the intermediate circuit coupler must be inserted into the plastic clip attached to the card.

Warning ! :
Before tightening the power module fastening screws, check the wiring once more. Visual check through the ventilator apertures.

Motor connection
U-96 / V-97 / W-98
MK11/MK12/
MK13
each 1-pin

Option
Braking resistance
R(–)81 - R(+)82
MK15 B - MK15 A
2-pin

AUX relay
01 / 02 / 03
MK17 C / B / A
3-pin



Option
External 24 V DC(–)35 / (+)36
MK18 A / MK18 B
2-pin

Option
Link option
(–)DC88 / (+)DC89
MK16 A / MK16 B
2-pin

Mains supply
L1-91/L2-92/L3-93
MK10 C / B / A
3-pin

Disassembling the VLT 5001-5/6002-5 Compact IP54 unit

Installing the replacement power card: (cont.)

- Transfer the fastening and earthing profile onto the replacement card.
- Attach the strip connecting leads onto the control card.
- Clear the power semiconductor assembly surfaces of any adherent foreign bodies and apply a thin layer of heat conduction paste (transparent silicone).
- The card can then be turned and inserted into the casing in such a way that the connections to the intermediate circuit coils, the ventilator and the temperature sensor can be restored.
- Place the power card in its final position and then lower it onto the heat sink.

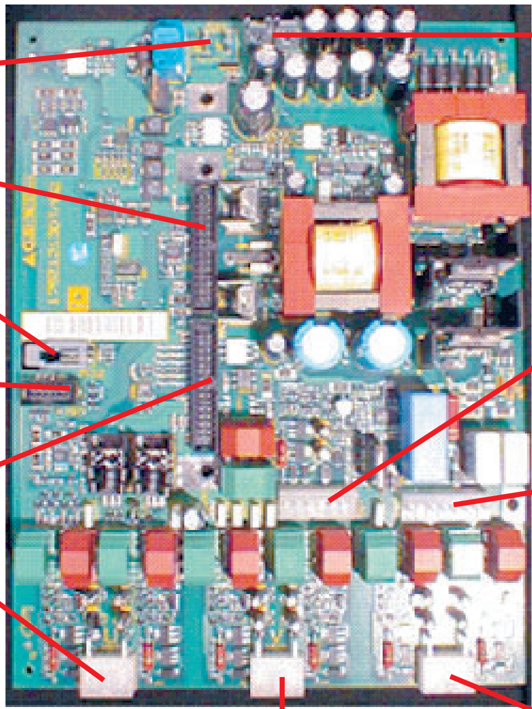
Warning.
Do not jam any leads between the heat sink and the power components.

- Tighten the fastening screws from the rectifier and inverter module in two stages, with a provisional torque of 0.8 and a final torque of 1.8 nm.
- Position the IGBT brake brace and snap it into place (brake chopper option).
- Insert the insulating film.
- Put the cover plate back in place, loosely screw in the four power card earthing and fastening screws, insert the cover plate fastening screws into the sides of the casing and tighten.

Tip:
The motor plug PE connection must be connected with the middle screw on the right side of the casing.

- Insert the longitudinal cross bar and screw in tight.
- Now apply a final tightening to the four power card earthing and fastening screws.
- Click the plug connector unit and the plug fixture for mains and motor plugs back into place.
- Replace the control card carrier, insert the strip connection leads, tighten the two Torx T20 screws.
- Reposition all the connection leads, reinstall the strain relievers and armouring clip.
- Perform a function test.

■ Interface Card / Power Card Plug connectors



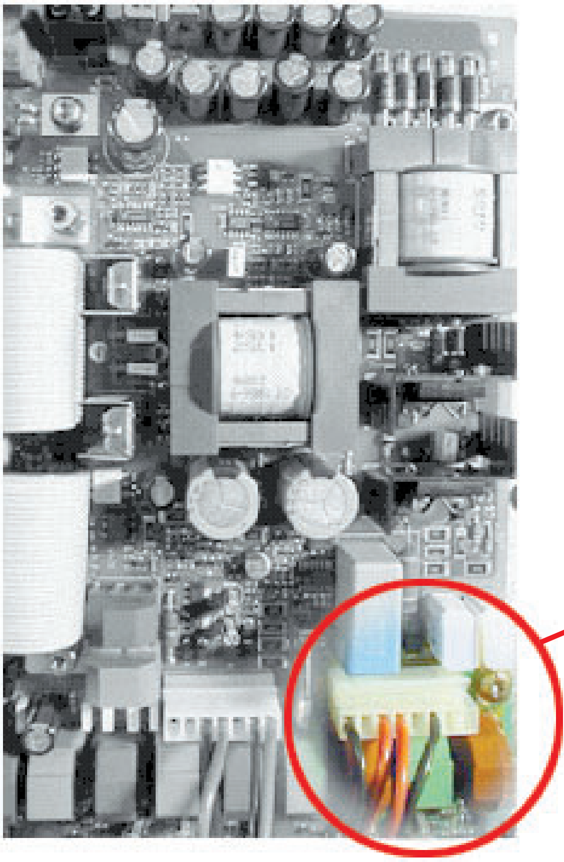
The above illustrates the interface card / power card in the fully equipped 'Expanded Version with Brake'. The cards are identical in composition and design for VLT 5016-52/6016-6052 400-500 V and VLT 5008-27/ 60028-6027 200 V. Only the extended version is available as a spare part.

■ Description of the plug connectors:

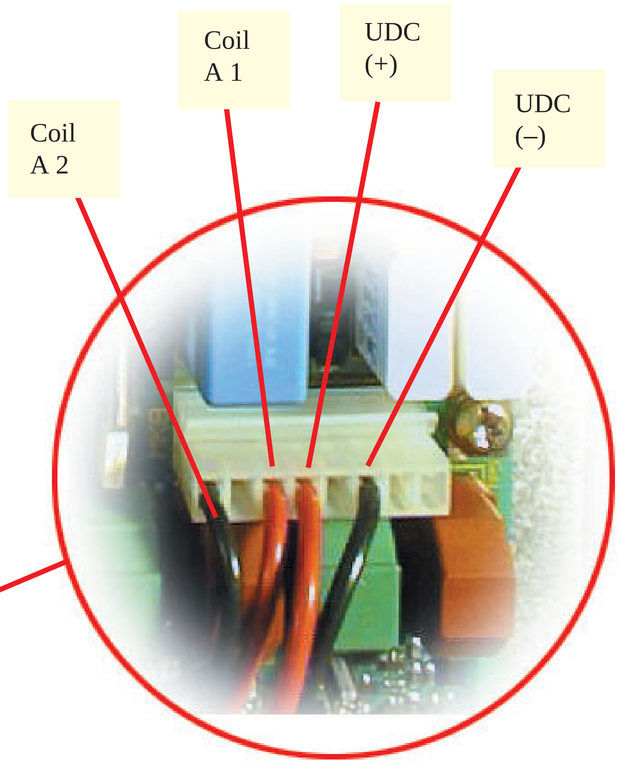
- MK 1 / MK 2 / MK 3: select signals of the 8-pin inverter module plug connector.
- MK 4: 7-pin plug connector. Brake - IGBT - module drive.
- The contact assignment of the drive leads is in each case 1 (red) / 5 (black) = G2 / E2 negative module branch and 4 (red) / 8 (black) = G1 / E1 positive module branch.
- MK 5 / MK 6: 30-pin strip lead connections to control card.
- MK 7: 10-pin strip lead connection to the current-measuring card.
- MK 8: 8-pin plug connector. Interface card / power card supply drive connection to the loading cover coil.
- MK 9: 2-pin plug-in connections. External 24 VDC A = (–) / B = (+) supply.
- MK 10 / MK 11: 2-pin plug connector. Supply to, and regulation of, the ventilators.
- MK 12: 2-pin plug connector. NTC heat sink temperature sensor connection.

NB!
Note: When tightening the connecting screws, do not exceed a torque of 1,5 nm.

■ Interface card / power card Plug Connectors



Partial view interface card / power card



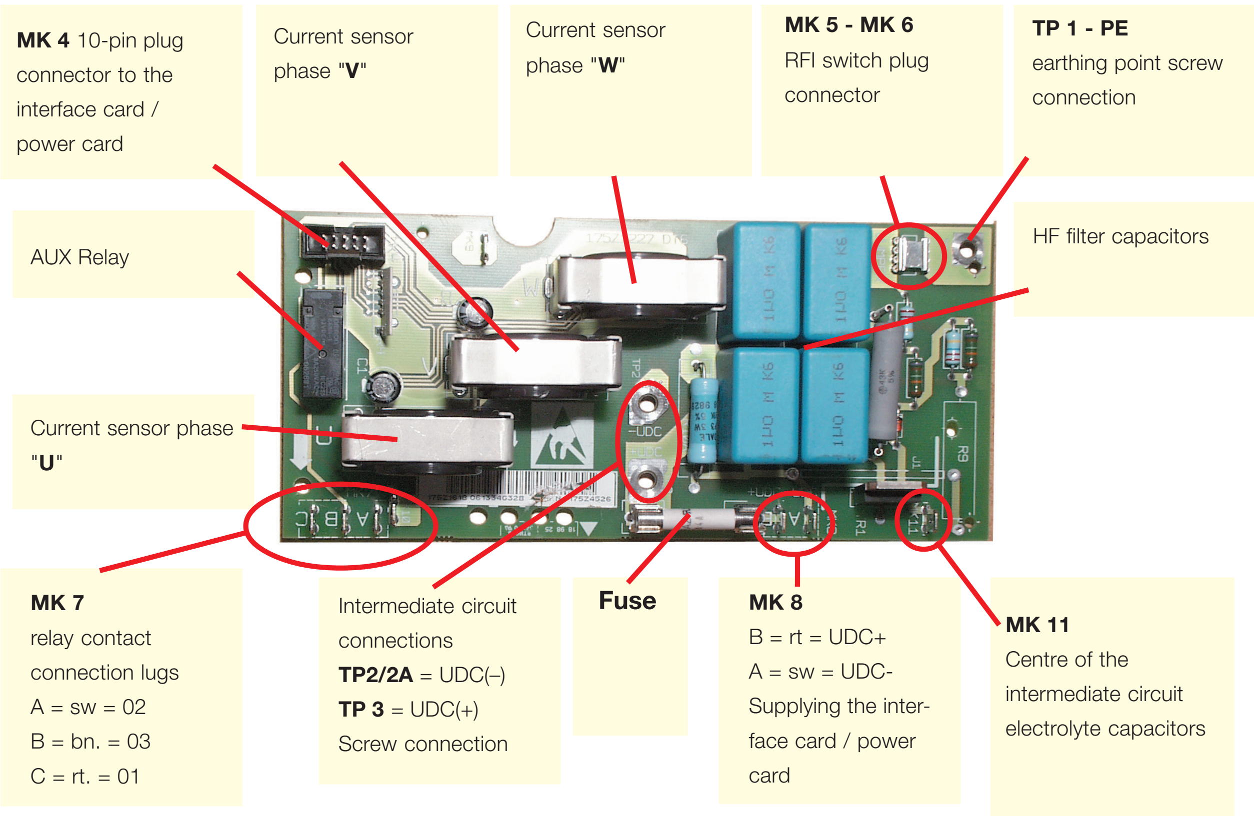
MK 8 Plug connector

It is via the MK 8 plug connector, illustrated enlarged in section here, that the switching network unit placed on the interface card / power card is supplied with DC voltage from the VLT intermediate circuit.
The leads marked UDC (+)/(–) are connected to the MK 8 plug connector on the current-measuring card. It is via the current-measuring card TP2 and TP3 connection points that the intermediate circuit voltage is directly tapped on the intermediate circuit capacitor connector bars.

The leads marked coil A1 and coil A2 are connected to the loading cover coil connections. Coil connection A1 ‘red lead’ carries UDC (+) intermediate circuit potential. Coil connection A2 ‘black lead’ is connected to UDC (–) of the intermediate circuit via a switching transistor on the interface card / power card. The switching transistor is not triggered by the interface card with the preset PWM switching pattern until the intermediate circuit capacitor loading phase is complete when the VLT is turned on and the intermediate circuit voltage is stable.

■ **Servicing tip**:
With units not yet connected to the intermediate circuit, for a quick static test of the power unit, they can be connected up to the intermediate circuit over the leads marked UDC (+)/(–), provided there are suitable multimeter sensor tips. However, in order to prevent erroneous measurements, ensure that the fuse (where applicable) and the lead connections are intact.

■ VLT 5000/6000 current-measuring card



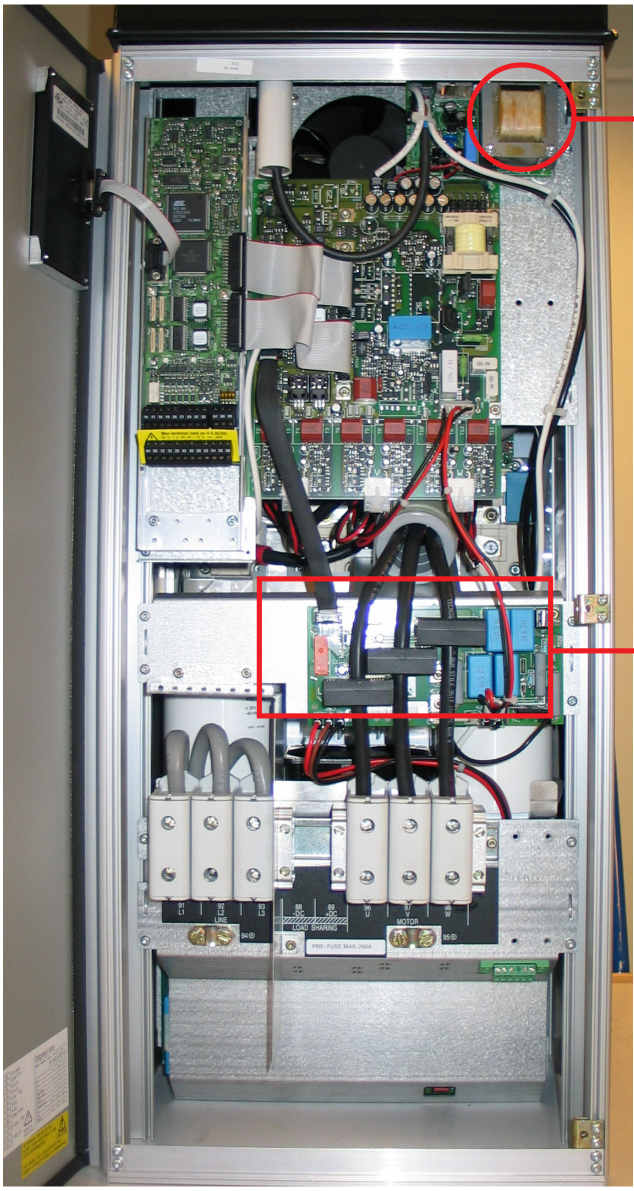
The VLT 5016-32/6016-6032 400/500 V / VLT 5008-16/6008-6016 200 V current-measuring cards are essentially identical in design. In the VLT 5042/52/ 6042/52 400/500 V / VLT 5032/27/6032/27 200 V, the current transformers are located externally in the VLT instead of directly on the card as previously.

- TP 1 screw and spacing bolts form the filter capacitor PE connection.
- TP 2 (TP 2A) / TP 3 connection to the UDC (–) / UDC (+). Two Torx T15 screws connect these points to the intermediate circuit capacitors.
- MK 5 / MK 6 plug connector for 10-pin strip ‘RFI switch’. Connection point of the intermediate circuit HF filter capacitors with PE potential. If this connection is opened, e.g. by operating the units in the IT network environment, one side must be mounted in such a way that the wire jumper is protected against loss.
- MK 7 three-pin plug connector. Connection of the relay contacts to the ’01/02/03' junction terminal.
- MK 8 this two-pin plug connector is connected to the TP 2 (TP 2A) / TP 3 connections. Here, the interface card / power card UDC (-/+) supply is tapped.
- MK 9 / MK 10 (**not featured** in the illustration) are not assigned.
- MK 11 connection to the centre of the intermediate circuit electrolyte capacitors fuse.
- Fuse from mid-1997, a fuse was introduced into the red lead for protection purposes, in order to cut off the energy supply from the switching network unit or the loading cover coil in the event of a defect or short circuit..

NB!
Note: When tightening the connecting screws, do not exceed the max. torque of 1.5 nm.

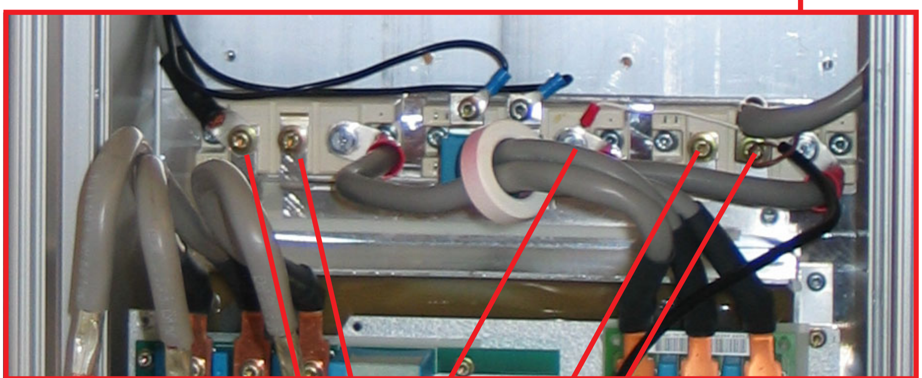
Tips and tricks for service on VLT5062 – 5102 (6072 – 6122)

In general the units are build up as the known VLT5016 – 5052.
The image below will only show the important differences on the drives in the enclosures IP20 and IP54.



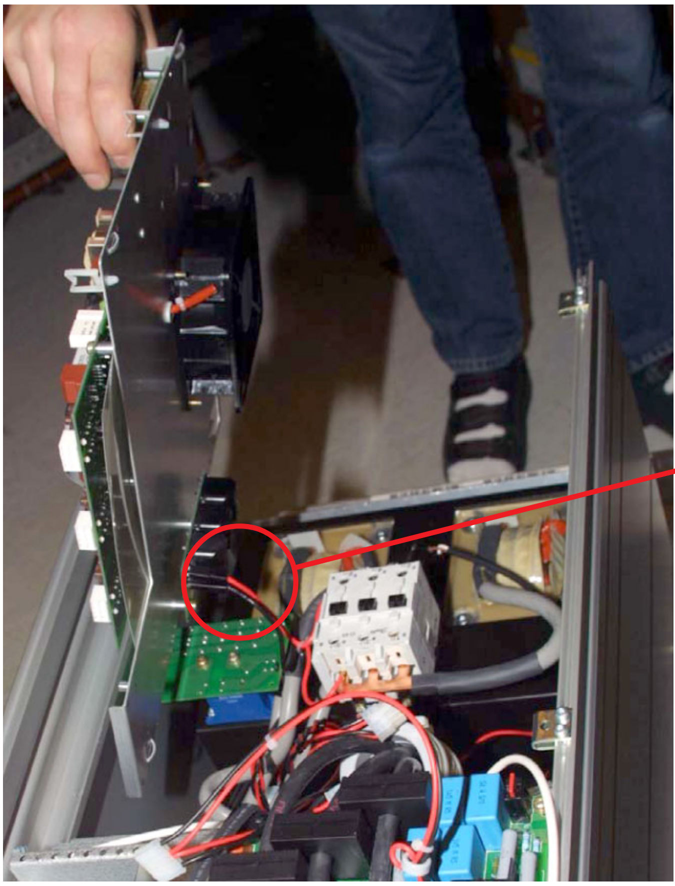
IP54:
New, the main heatsink fan is supplied by the autotransformer placed in upper right corner. See drawing page 29.

Rectifier terminals

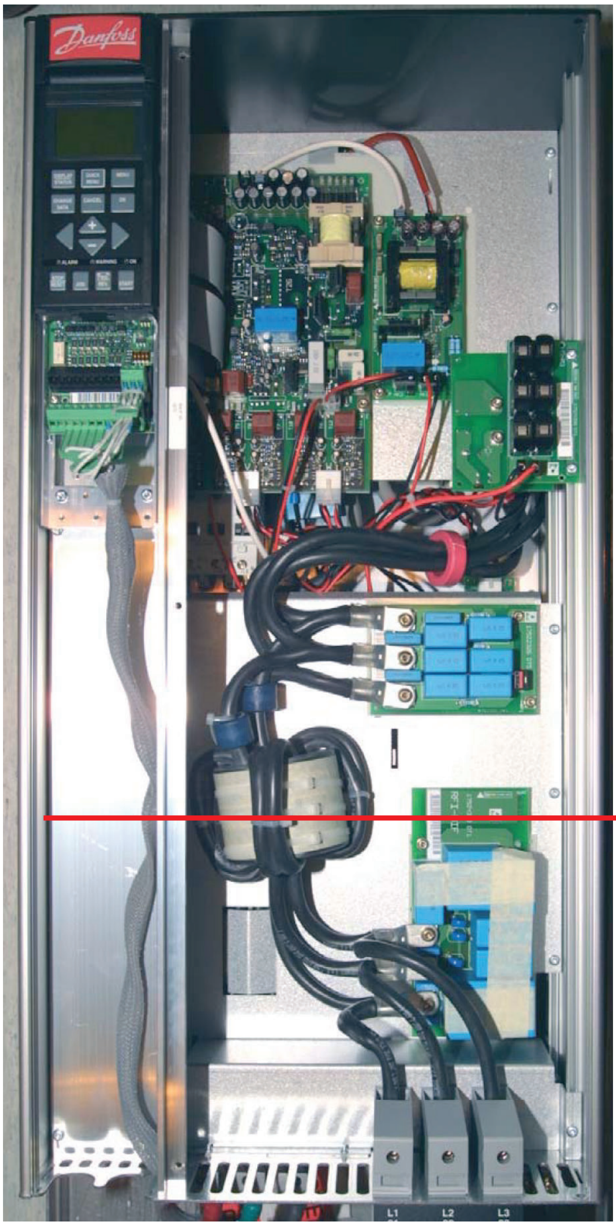


Be careful by reassembling the rectifier. The screws where the cables are mounted, the screws are shorter in the VLT® 5072/5102 - IP20 / IP54 (6102/6122)

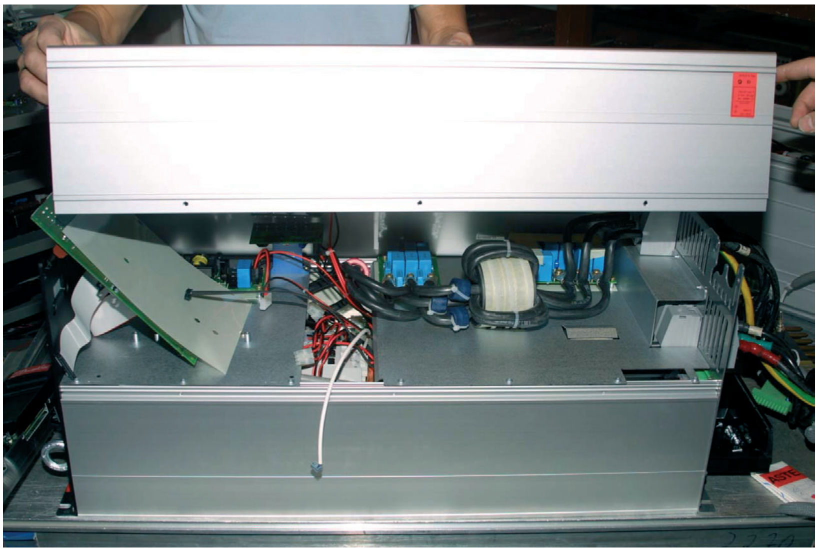
Screw length <u>max. 12 mm.</u>
The use of longer terminal screws will cause damage to the rectifier.



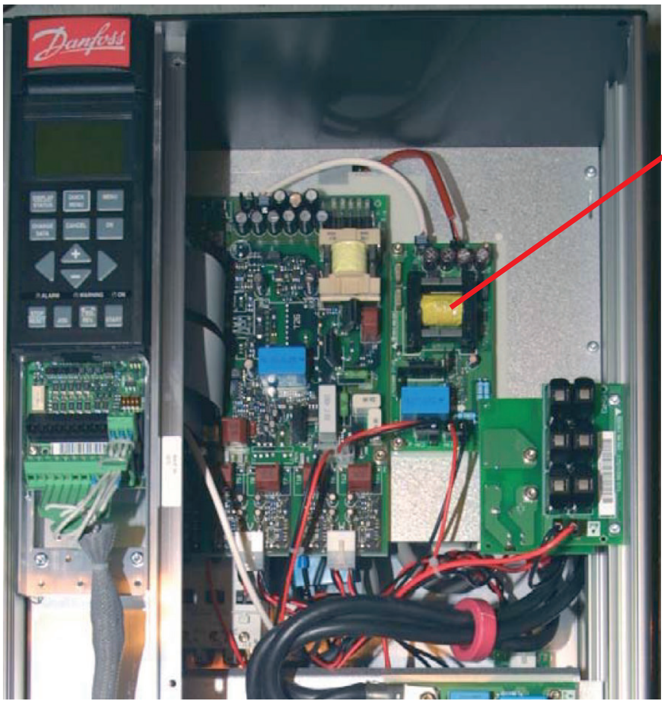
IP54:
When dismounting the mounting plate for the powercard and internal fan, take care of the wiring to the PTC's in the soft charge circuit.



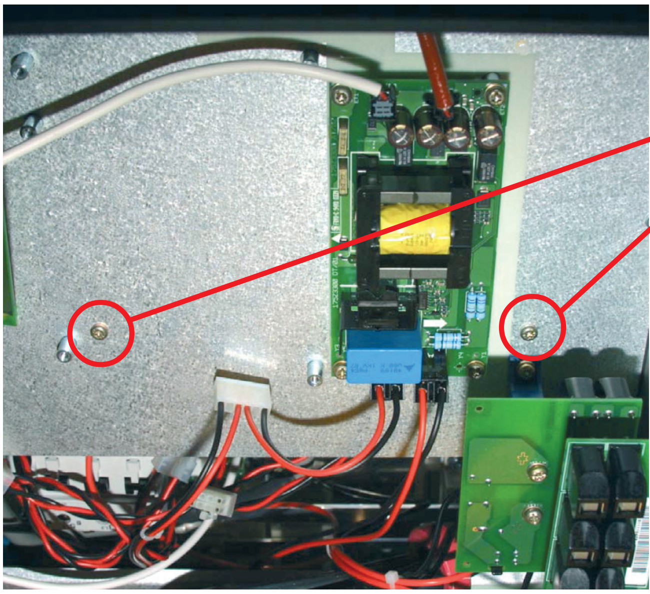
IP20:
When dismounting the power card in the IP20 enclosure, it will be eased by removing the side panel.
See picture below.



IP20:
Remove the side panel to gain access for dismantling the powercard.

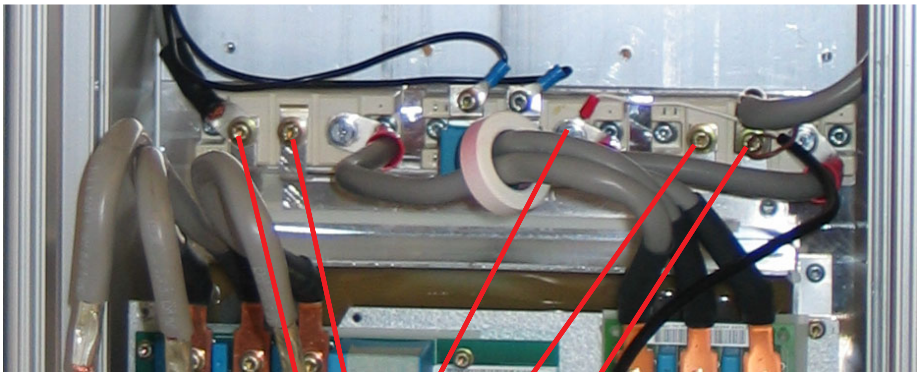


IP20 :
It is not possible to remove the mounting plate with the power card still in place.
Remove the power card first.



IP20:
Below the power card you will find one of the screws for the mounting plate. Also, another screw is located next to the soft charge circuit.

■ Rectifier terminal screws



Be careful while reassembling the rectifier. The screws where the cables are mounted are shorter in the VLT® 5072/5102 - IP20 / IP54 (6102/6122)

Refer to page 28 for torque specifications.

Screw length <u>max. 12 mm.</u>

The use of longer terminal screws will cause damage to the rectifier.