ENGINEERING
TOMORROW

Compressor Drives
Troubleshooting Check List

CDS 302/CDS 303

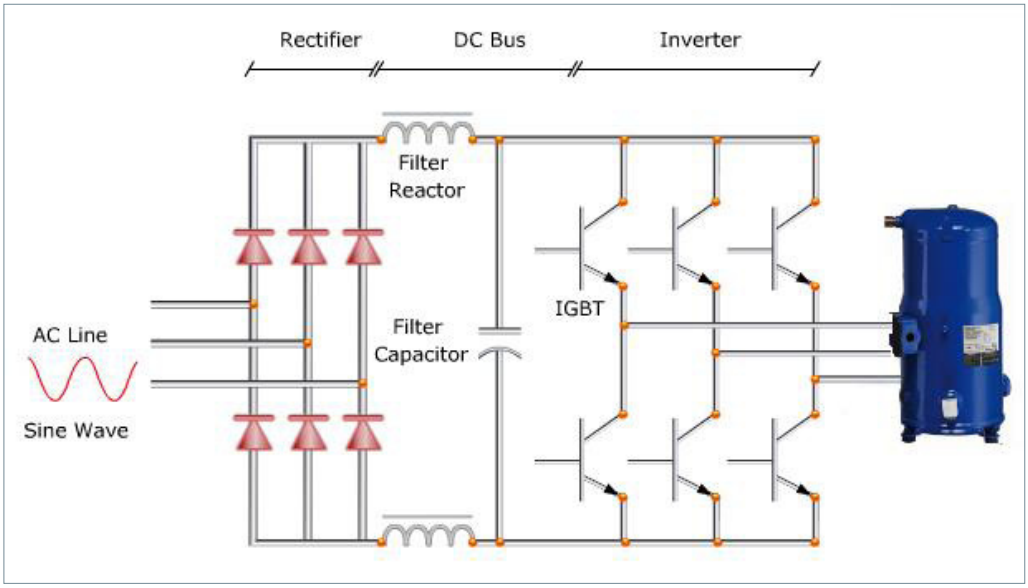
http://cc.danfoss.com

Content

Many frequency converters that are sent back to Danfoss every year for factory analysis are diagnosed with No Fault Found (NFF). Establishing whether a frequency converter is faulty or not prior returning it to the factory can increase the uptime of the compressor solution, reduce the unnecessary use of resources and limit the number of NFF.

The purpose of this check list is to facilitate users, field technicians, engineers and service personnel working with Danfoss frequency converters to identify faults and perform a first diagnosis on the drive before sending it to inspection and analysis.

PERFORM THE FOLLOWING FAULT DIAGNOSIS BEFORE RETURNING A FREQUENCY CONVERTER FOR FACTORY INSPECTION.
CHECK ALL POSSIBILITIES.
IN CASE OF DOUBT, PLEASE SEEK DANFOSS SUPPORT.



Frequency Converters (FC) contain dangerous voltages when connected to the line voltage. Only a competent technician should carry out the service.

Some instructions should be compulsorily followed to ensure safety while working with the FC.

- Do not touch electrical parts of the FC when the AC line is connected.
- Frequency converters contain DC-link capacitors that can remain charged even when the frequency converter is not powered. To avoid electrical hazards, disconnect AC mains, any permanent magnet type motors, and any remote DC-link power supplies, including battery backups, UPS and DC-link connections to other frequency converters.
- Wait for at least **20 minutes** before touching any of the components.
- When repair or inspection is done, 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. So you have to activate the STOP key when changing data.

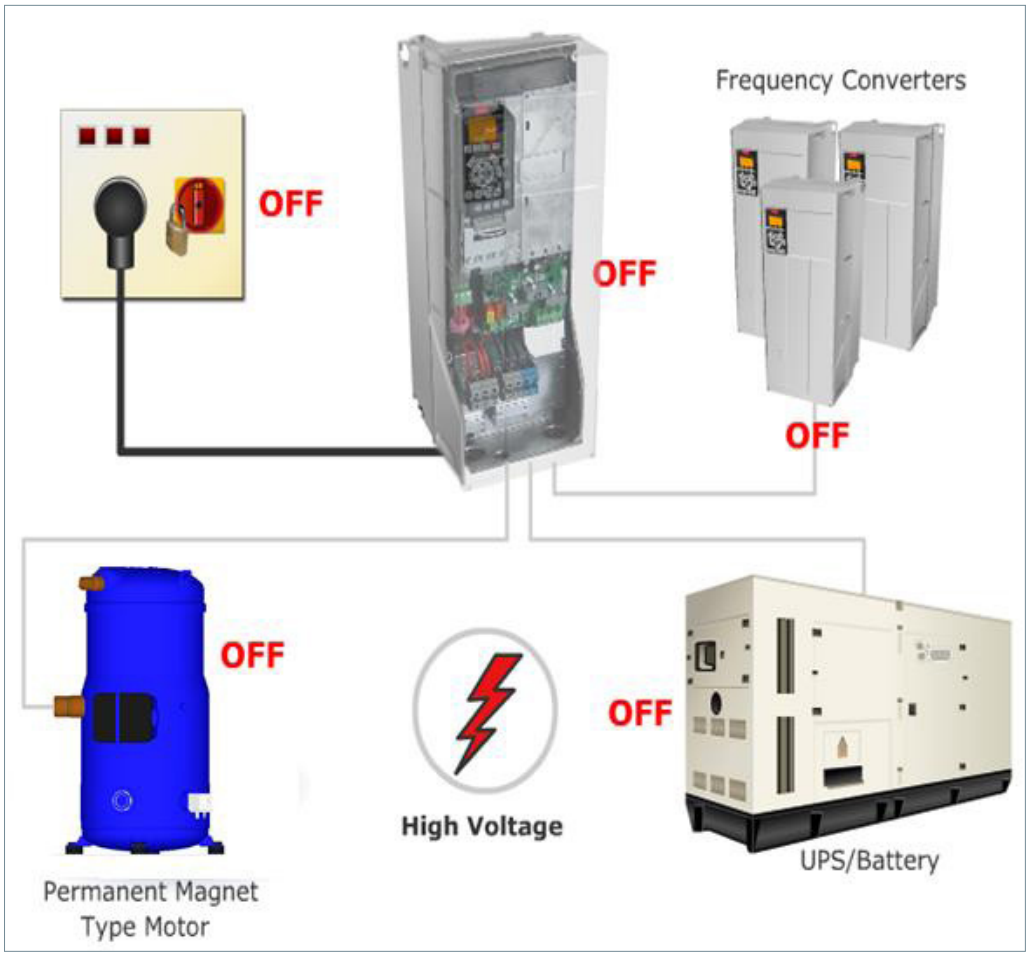


Figure 1: Drive must be turned OFF for 20min before repair can start

Check List	Diagnostics	
WARNINGS and ALARM	Fault detection via LCP: messages are displayed when the frequency converter fault circuit detects a faulty condition or an unresolved fault. A **warning** light flashing display indicates potential problems. **There are two levels of alarms;** Reset Alarms and Trip-lock Alarms.	a) In case of reset alarm: you can stop and then start the unit. b) In case of trip-lock alarm, you have to disconnect the mains, wait for dark display, then stop and start.
Alarm Log	Check the content of the alarm log. 5 latest alarms are available through the "Alarm Log" button key on the LCP. **Check the alarm code and refer to the troubleshooting session of the Operating Instructions VLT® CDS 302 and CDS 303 on page 135. It contains guidance for the complete list of alarms and warnings.**	**If the troubleshooting suggested does not resolve the problem, please contact Danfoss for support.** **Do not exchange the drive before contacting Danfoss support.**

Figure 2: WARNINGS and ALARM messages are displayed when the frequency converter fault detects a faulty condition

Check List	Initial Trouble Shooting (visual inspection of the installation)	
	This list shows a variety of conditions that should be inspected visually as a part of initial troubleshooting.	Display: Warnings, alarms, drive status; fault history and many other items are available on the local control panel of the drive.
Input power wiring	Check for loose connections. Check for proper fusing. Check for blown fuses.	
Output to motor	Check for loose connections. Check for switching components in the output circuit. Check for faulty contacts in the switch gear.	
Grounding	The drive requires a dedicated ground wire from its chassis to the building ground. It is also suggested that the motor be grounded to the drive chassis. The use of conduit or mounting	of the drive to a metal surface is not considered a suitable ground. Check for good grounding connections that are tight and free of oxidation.
Control wiring	Check for broken or damaged wires and connections. Check the voltage source of the signals. Though not always necessary depending	on the installation condition, the use of shield cable or a twisted pair is recommended. Ensure the shield is terminated correctly.
Programming	Check that the drive parameter settings are correct according to the motor, application and I/O configuration.	
Compressor Motor	Check nameplate of the Compressor. Ensure the compressor matches the drive. Check that drive's	compressor par. 1-13 is set according to the compressor e.g.:

ID	Name	Setup 1	Factory Setup	Unit
113	Compressor Selection	VZH117-R410A	VZH117-R410A	

Cable routing	Avoid routing motor wiring. AC line wiring and signal wiring in parallel. If parallel routing is unavailable, try to maintain a separation of 15-	20cm between the cables or separate them with a grounded conductive partition. Avoid routing cables through free air.
Peripheral equipment (sensors, contactors, etc)	Look for peripheral equipment such as switches or input fuses circuit breakers that may be in the input power side of the drive or output side of the motor. Examine operation and condition of	these items as possible causes for operational faults. Check function and installation of pressure sensors or temperature sensors etc. used for feedback to the drive.
Trip on over Temperature	Check the operational status of all cooling fans. Check for blockage or constrained air passages.	
Drive interior	Drive interior must be free of dirt, metal, chips, moisture and corrosion. Check for burnt or damaged power components or carbon deposits that were the result of a disastrous component	failure. Check for cracks or breaks in the housing of the power semiconductors or pieces of broken components housing loose inside the unit.
EMC Precautions	Check for proper installation with regards to electromagnetic capability. Refer to the CDS manual, in the chapter "How to install" and then	" Electrical Installation – EMC Protection " for further details.
Vibration	Look for unusual amounts of vibration to which the drive may be subject. The drive should be	mounted solidly or the use of shock mounts employed.
Environmental conditions	Under specific conditions these units can be operated within a maximum ambient temperature of 50°C (24h average maximum	45 °C). Humidity level must be less than 95% non-condensing. Check for harmful airborne contaminates such as sulphur based compounds.
Proper clearance	These drives require a top and bottom clearance of 10cm to ensure proper airflow for cooling.	Drives with exposed heat sinks out the back of the drive must be mounted on a flat solid surface.

Fault Symptoms - Display of the drive

A fault must have been ocurred when there is:

a) No Display in the LCP (blank)
b) Intermittent display in the LCP

No display (blank display)

There are three LED indicators lights near the bottom of the LCP.

If the green power on LED is illuminated but the backlit display is dark, this indicates that the LCP itself is defective and must be replaced.

It should be certain that the display is completely dark. An error code exists in the drive which indicates that communications may have failed with the control card.

This is typically seen when an option card has been installed in the drive and is either not connected properly or is malfunctioning.

• If neither indication is available, then the source of the problem may be elsewhere.

Figure 3: No Display in the LCP (blank)

Intermittent display

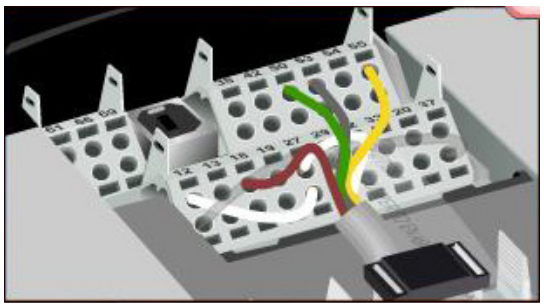
Cutting out or flashing of the entire display and power LED indicates that the power supply (SMPS) is shutting down as a result of being overloaded.

This may be due to improper control wiring or a fault within the drive itself.

Figure 4: intermittent display

• The first step is to rule out the problem in the control wiring.

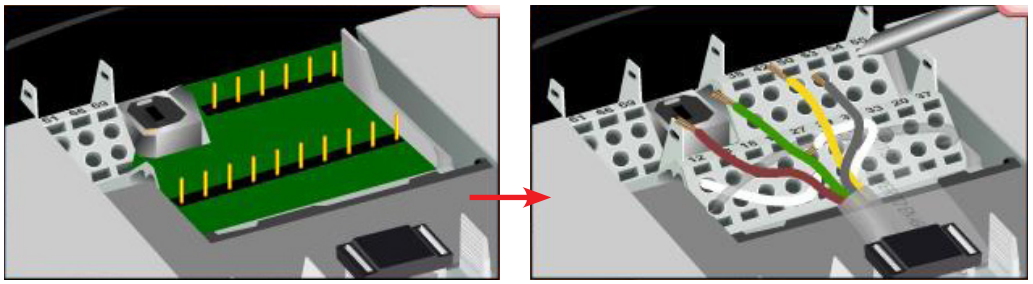
Figure 5: Check control cables



• Disconnect all control wiring by unplugging the control terminal blocks from the control card.

• If the display stays lit then the problem is in the control wiring.

Figure 6: Disconnect all control wiring



All control wiring should be checked for shorts or incorrect connections.

• If the display continues to cut out, the fault can be located in either the LCP itself or on the Power card.

Fault Symptoms in the compressor (motor):

Motor will not run

• First verify that the unit is properly powered up and there is no warning or alarm .

• The most common cause of this is either incorrect control logic or an incorrectly programmed drive.

Such occurrences will result in one or more of the following status messages being displayed:

LCP Stop

The LCP stop message is displayed when the OFF key has been pressed.

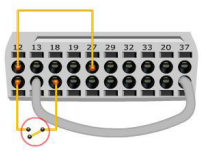
The bottom section of the display will also be flashing when this occurs.

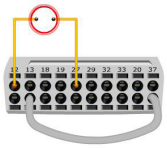
Figure 7: LCP stop = OFF key pressed

Stand by (figure 8)

The stand by message is displayed when there is no start signal at terminal 18.

Ensure that a start command is present at terminal 18.



Check List	Trouble shooting	
Stop (figure 9)	Message displayed when the Terminal 27 is low (no signal).	Ensure that terminal 27 is logic 1 (pressure switch).
Figure 9: Check pressure switch		
Run OK: 25Hz	The RUN OK status display indicates that a run command has been given to the drive but the reference (speed command) is zero or missing.	Check the control wiring to ensure that a proper reference signal is present at the drive input terminals and that the unit is properly programmed to accept the signal provided.
Quick tip:	Improperly connected wiring or interrupted wiring is a common service issue for a motor	not operating or the drive not responding to a remote input.

The common drives and motor problems occur due to an error in the
- Control logic
- Programming
- Motor/load
- Internal drive

Control logic problems

Control logic problem occurs when the drive does not respond to a given command.

Control logic problem is located by using the status information displayed by the drive.

Correct reading indicates that the desired signal is detected by the microprocessor of the drive.

If there is not a correct indication, the next step is to determine whether the signal is present at the control terminals of the drive.

This can be performed with a voltmeter or oscilloscope.

Figure 10: checking control signal in the control card

- **If the signal is present at the terminal, the control card is defective and must be replaced.**
- **If the signal is not present, the problem is external to the drive.**

The circuitry providing the signal along with its associated wiring must then be checked.

Programming problems

Three areas where programming errors may affect the drive and motor operation are motor settings, references and limits, and I/O configuration.

The drives must be set up correctly for the compressors connected to it. If not, the compressor may fail to start or use higher than normal amount of current.

Check if the correct compressor is selected in par. 1-13.

Any references or limits set incorrectly will result in less than acceptable drive performance.

In case of doubt, reset the drive to factory settings using par. 14-22.

Download again the OEM settings using the copy and paste function in par. 0-50.

IGBT, Motor or load problems

The motor or motor wiring can develop a phase to phase or phase to ground short resulting in alarm indication and a trip of the unit.

A motor with the unbalanced or non-symmetrical impedances on all the three phases can result in uneven or rough operation or unbalanced output current.

- To determine whether the problem is internal or external to the drive, disconnect the motor from the drive output terminals.
- Perform the dynamic output test procedure on all three phases with a digital voltmeter.
- **If the three voltage measurements are balanced, the drive is functioning correctly. The problem is therefore external to the drive.**
- **If the voltage measurements are not balanced, the drive is malfunctioning.**

This typically means that one or more output IGBT is not switching on and off correctly.

If one of the IGBT fails, the drive is damaged and must be replaced.

Procedure to conduct the dynamic test to check the IGBT

Dynamic tests have to be done without the compressor connected to UVW connector, and the Drive has to be programmed to a proxy 50Hz at start.

The Dynamic test can indicate if one of the IGBT doesn't switch, and the output voltage will drop on the fault terminal, UVW.

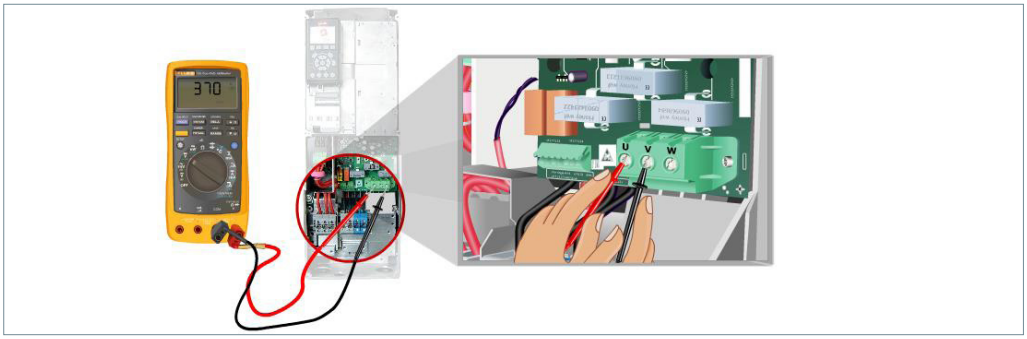
Program the multimeter to AC 1000V RM.

- Connect the positive terminal of the multimeter lead to the U connector, and connect the negative terminal to the V terminal.
- Connect the positive terminal of the multimeter lead to the U connector, and connect the negative terminal to the W terminal.
- Connect the positive terminal of the multimeter lead to the V connector, and connect the negative terminal to the W terminal.

The meter reading will be between 360V - 380V when performing the dynamic test at 400V mains and 50Hz/3000RPM output depending on instrument used.

The reading should be within ±1.5 percent. When the reading exceeds this, the IGBT is damaged.

Figure 11: Dynamic test



Faults in the drive

Drive temperature sensor / Over temperature fault

- If the drive is stopped and cooled, the LCP reading shall show the ambient temperature.
- If not, the temperature sensor or temperature measurement circuit is defective.

Current sensor fault

When a current sensor fails, it is indicated sometimes by an earth fault alarm that cannot be reset, even with the motor leads disconnected.

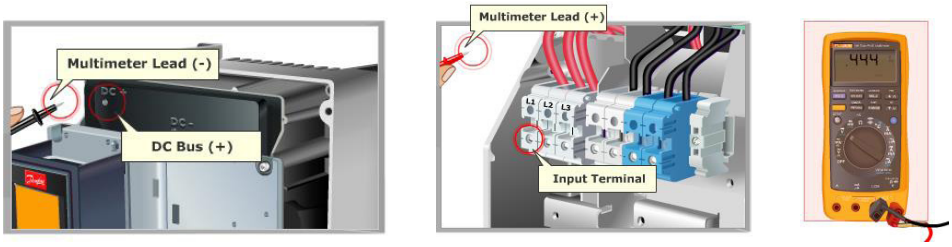
- Disconnect the motor from the drive, and then observe the current in the display of the drive.
- If the motor is disconnected from the unit, the LCP shall read out 0.00A.
- If anything else is shown, this indicates a defective current sensor.

Note: Both faults above are non-reparable. Drive needs to be replaced

Check List	Common drives and motor problems	
EMC - Electro Magnetic Compatibility		
Effects of EMI	Electro Magnetic compliance or EMC are the voltage and current which are not sinusoidal but pulsating. Electromagnetic Compatibility (EMC) concerns for typical commercial and industrial equipment. EMI related disturbances to drive operation are uncommon, but the following detrimental EMI effects may be seen: • Motor speed fluctuations • Serial communication transmission errors • Drive CPU exception faults • Unexplained drive trips	Detrimental Effects To These Systems May Include The Following: • Pressure/flow/temperature signal transmitter signal distortion or aberrant behaviour • Radio and TV interference • Telephone interference • Computer network data loss • Digital control system faults
Sources of EMI	Drives utilize Insulated-Gate Bipolar Transistors (IGBTs) to provide an efficient and cost effective means to create the Pulse Width Modulated (PWM) output waveform necessary for accurate motor control.	These devices rapidly switch the fixed DC bus vo ltage creating a variable frequency, variable voltage PWM waveform. This high rate of voltage change [dV/dt] is the primary source of the drive generated EMI.

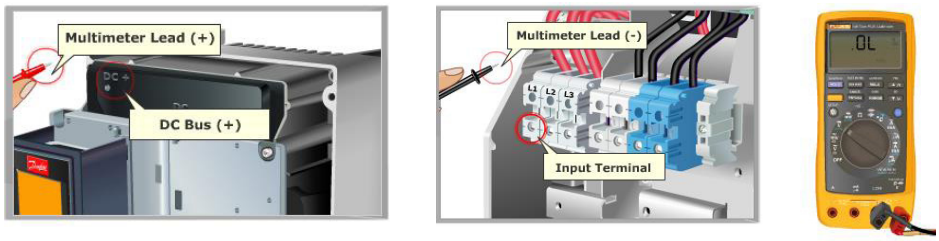
Check List	Static test procedures	
	POWER MUST BE OFF / MAINS AND MOTOR CABLES DISCONECTED! Verification of: Rectifier (input, mains) / IGBT (Output, motor)	• **If rectifier or IGBT fail, the complete power card has to be exchanged, since in the CDS drives, the rectifier and IGBT are integrated in one power card.**
Rectifier test (static)		
Symptom:	Failure of the rectifier module will usually result in blown input line fuses.	Procedure to conduct the static test on rectifier:
Step 1	• Connect the negative terminal of the multimeter meter lead to the positive DC bus. • Connect the positive terminal of the multimeter lead to the input terminal L1,L2,L3 in turn.	• **The multimeter should show the diode drop of around 0.44 volt on the three terminals.**

Figure 12: Multimeter should read a voltage drop of 0,4V



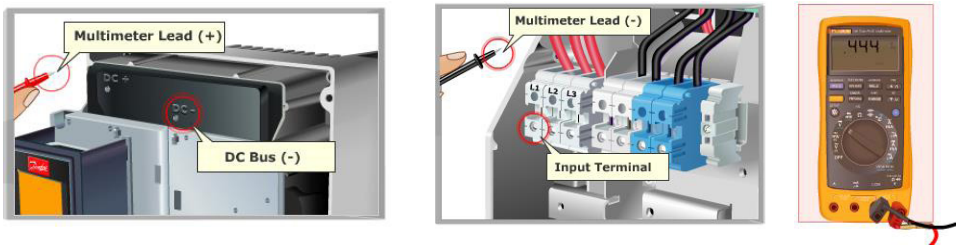
Step 2	Now reverse the meter leads, i.e. connect the positive terminal of the meter lead to the positive DC bus.	• Connect the negative terminal of the meter lead to the input terminals L1, L2, L3 in turn. • **The multimeter should show diode open.**

Figure 13: Multimeter should show diode open



Step 3	Now repeat the procedure by connecting to **the negative DC bus** in order to the test the lower part of the rectifier bridge which consist of diodes	• Connect the negative terminal of the meter lead to the input terminals L1, L2, L3 in turn. • **The multimeter should show the diode drop of around 0.44 volt on the three terminals.**

Figure 14: Multimeter should show a diode drop of 0,44V

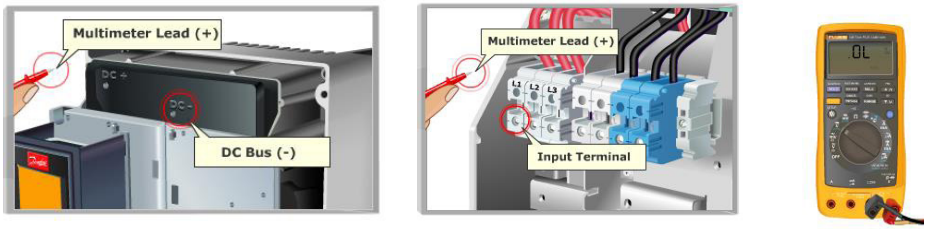


Step 4

Now reverse the meter leads, i.e. connect the negative terminal of the meter lead to the negative DC bus.

- Connect the positive terminal of the meter lead to the input terminals L1, L2, L3 in turn.
- **The multimeter should show diode open.**

Figure 15: The multimeter should show diode open



Note: A diode drop reading will vary depending on the model of the ohm meter

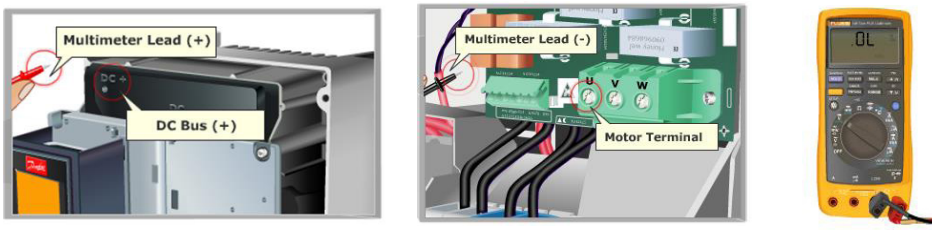
IGBT static test

IGBT's are placed on the output of the CDS drives

Step 1

- Connect the positive terminal of the multimeter lead to the positive DC bus.
- Connect the negative terminal of the multimeter lead to the motor terminal U, V, W in turn.
- **The multimeter should show the diode open.**

Figure 16: The multimeter should show diode open

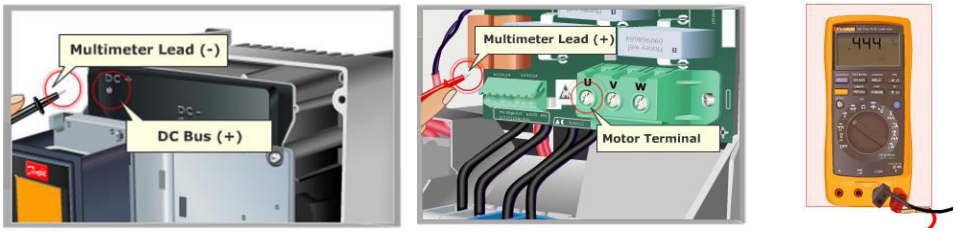


Step 2

Now reverse the meter leads, i.e. connect the negative terminal of the meter lead to the positive DC bus.

- Connect the positive terminal of the meter lead to the motor terminals U, V, W in turn.
- **The multimeter should show the diode drop of around 0.4 volt on the three terminals.**

Figure 17: The multimeter should show the diode drop of around 0.4 volt on the three terminals

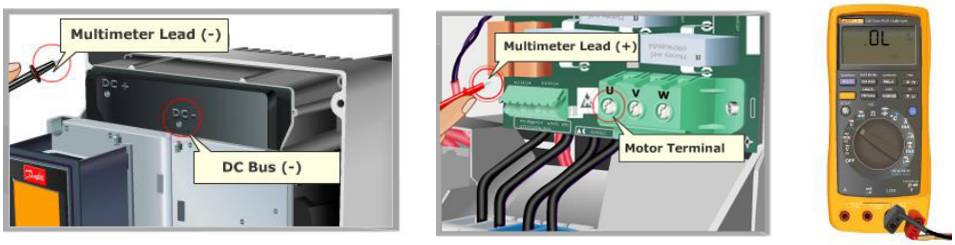


Step 3

Now repeat the procedure by connecting to the negative DC bus in order to test the second set of IGBTs.

- Connect the negative terminal of the multimeter lead to the negative DC bus.
- Connect the positive terminal of the multimeter lead to the motor terminal U, V, W in turn.
- **The multimeter should show open diode.**

Figure 18: The multimeter should show open diode



Step 4

Now reverse the meter leads, i.e. connect the positive terminal of the meter lead to the negative DC bus.

- Connect the negative terminal of the meter lead to the motor terminals U, V, W in turn.
- **The multimeter should show diode drop around 0.4 volts.**

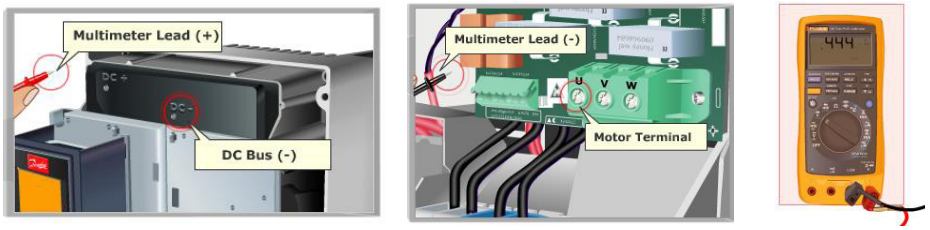


Figure 19: The multimeter should show diode drop around 0.4 volts

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Danfoss Commercial Compressors

is a worldwide manufacturer of compressors and condensing units for refrigeration and HVAC applications. With a wide range of high quality and innovative products we help your company to find the best possible energy efficient solution that respects the environment and reduces total life cycle costs.

We have 40 years of experience within the development of hermetic compressors which has brought us amongst the global leaders in our business, and positioned us as distinct variable speed technology specialists. Today we operate from engineering and manufacturing facilities spanning across three continents.

Danfoss Turbocor Compressors

Danfoss Inverter Scrolls

Danfoss Scrolls

Danfoss Optyma Condensing Units

Danfoss Maneurop Reciprocating Compressors

Danfoss Light Commercial Refrigeration Compressors

Our products can be found in a variety of applications such as rooftops, chillers, residential air conditioners, heatpumps, coldrooms, supermarkets, milk tank cooling and industrial cooling processes.

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