# Power supply testing on Danfoss DC powered refrigeration systems

## A note on controllers

1. Older (pre-1995ish) four-pin controllers for BD2.0, 2.5, and 3.0.
   The Danfoss version of these controllers had no voltage alarm. There is replacement version available from Frigoboat that has an LED which flashes when the voltage reaches 11.5v (23.5v) and then glows steadily and stops the compressor when the voltage reaches 10.5v (23v). The compressor will attempt to start again when the voltage rises above 11.5v (23v).
2. Current three-pin controllers for BD35 and BD50. These controllers have provision for a 12v diagnostic LED to be connected, download the manual BD35 BD50F Fault Diagnostic

## Test Procedure

To properly test the power supply to a Danfoss powered 12v or 24v system, the following testing procedure must be carried out. This will establish whether the power supply feeding the system is free of bad, loose and/or high-resistance connections. Reading the voltage on the panel or at the batteries is meaningless, as is the fact of a new installation or new batteries. Size and the capacity of the battery bank is irrelevant.

1. Turn off the breaker (or remove the fuse) supplying DC power to the system.
2. Unplug one of the thermostat leads at the controller.
3. Using a multi-meter, read the DC voltage at the battery terminal(s).
4. Connect the multi-meter reading DC voltage to the power terminals (+ and -) on the controller so that it can be left connected and monitored.
5. Turn on the breaker (or install the fuse) to the system.
6. Check that the voltage is the same as the voltage seen at the battery terminals.
7. Whilst watching the multi-meter, reconnect the thermostat lead and monitor the voltage continuously before, during, and after the compressor starts or attempts to start.

## Interpreting results

- If the power supply is free of loose, bad, and/or high resistance connections, the voltage reading at “5” above will stay very stable and only drop slightly when the compressor starts. As a general rule, on a 12v system the reading should not drop below 12v.
- If, when the compressor attempts to start, the voltage reading drops significantly, a bad electrical connection should be suspected. If the voltage drop is sufficient to fall below the 10.5v (23v) cut-off built in to the controller, the compressor will stop. (At this point the voltage may return to it’s original reading.) The fan or pump will continue to run for approx. 45 seconds and then the compressor will attempt a re-start. If the voltage is then above 11.5v (23.5v) the compressor will start or attempt to re-start again.
  **WARNING** If the multi-meter being used is a digital model that is slow to react, the voltage may drop below 10.5v (23v) and then recover too quickly to register on the meter. This can lead to the situation where the compressor starts then stops from low voltage, the voltage returns to it’s original value, and you read no significant drop on the meter.
- If the compressor starts and runs OK but stops after a short while, the voltage may be gradually dropping towards and below the 10.5v (23v) cut-off point. This should be easily identified on the meter.
- If the nature of the fault is such that the voltage reading at “5” above drops below 10.5v (23v) even before the compressor attempts to start, a very bad electrical connection must be suspected. This is because even the small load of the fan or pump relay, both less that 0.5 amp (0.25 amp), is seemingly sufficient to reduce the voltage considerably.

## What to look for

A loose and/or high-resistance connection can be anywhere in the supply between the batteries and the controller. i.e. a bad breaker or fuse, a loose or corroded screw connection, a poorly made or corroded crimp connection, a damaged section of wire, etc. **HINT** A good place to look first is the negative (ground) connection, especially on a European-built boat. These tend to be multiple, common connections that are added to over time.

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