Danger
Please utilize extreme caution when performing work within the drive cabinet. When opening the cabinet: be certain the drive protective shield is in place, wear appropriate PPE (Personal Protective Equipment), follow lock out-tag out procedures, and ensure all safety procedures are followed.

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Introduction
This manual has been designed to provide you with fundamental knowledge about troubleshooting the HPM Variable Speed Drive (VSD).

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Recommended Tools

- Volt Meter with an Diode setting
- Motor Megger Capable of delivering a 1000 Volts
- Milliohm Meter electrical or battery operated
- Hall Effect Sensor Checker
- Stator Installation/Removal Tool
- Rotor Removal Tool
- Torex Driver Set
- Lap Top Computer
- Nirvana Service Tool
- Nirvana Services Tool Cable
1.0 Safety First

**Danger**
Please utilize extreme caution when performing work within the drive cabinet. When opening the cabinet: be certain the drive protective shield is in place, wear appropriate PPE (Personal Protective Equipment), follow lock out-tag out procedures, and ensure all safety procedures are followed.

**Safety First**

**WARNING**
Hazardous voltage. Can cause severe injury or death.

**WARNING**
After switching off the machine at its local isolator. WAIT AT LEAST 15 MINUTES for the capacitors to fully discharge before removing the drive cover. With caution, verify DC bus voltage is zero before servicing.

**WARNING—HIGH VOLTAGE**
Do not attempt any work. Read manual. Trained service personnel only. Remove electrical supply. Wait 15 minutes. Check for zero voltage. Proceed with caution.

**Note**
Always use approved electrically insulated gloves.

**Danger**
- The drive has various voltages present on the power terminal blocks and in cables connected to them that may cause fatal electrical shocks.
- The drive contains capacitors which remain charged at a fatal voltage for a period of time even after the power supply has been removed.
- Do not perform operations on the drive without first manually opening the power supply circuit to the drive. Lock out and tag out the fused isolator or circuit breaker to prevent accidents.
- After performing any operations on the drive, replace the protective covers before restoring power.

A Variable Speed Drive is contained within the compressor starter cabinet.
2.0 Variable Speed Drive (VSD) Overview

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**Danger**

Please utilize extreme caution when performing work within the drive cabinet. When opening the cabinet: be certain the drive protective shield is in place, wear appropriate PPE (Personal Protective Equipment), follow lock out-tag out procedures, and ensure all safety procedures are followed.
3.0 VSD Drive Faults 0—44

HPM VSD Troubleshooting

Troubleshooting

Danger
Please utilize extreme caution when performing work within the starter cabinet. When opening the cabinet: be certain the drive protective shield is in place, wear appropriate PPE (Personal Protective Equipment), follow lock out-tag out procedures, and ensure all safety procedures are followed.

Note:
Prior to beginning any troubleshooting procedures, it is important to understand that loose terminal connections, blown fuses or improperly engaged plugs can be a cause for faults to be issued. A thorough inspection and correction, if required, can save time and effort lost looking for the wrong thing.

The drive has the capability to monitor itself for proper operation and should a problem arise, the drive will issue an alarm that immediately stops the compressor. The cause for the alarm is indicated on the display of the Intellisys controller. The alarms are listed as a sequence of letters and numbers.

Examples could be “VSD Fault 0” or “VSD Fault 29”. A total of 44 faults are possible within the drive; some of which are not active. VSD indicates Variable Speed Drive and the number indicates the specific fault.

The following description of active faults is intended to guide a trained technician during the problem investigation. The “not active” alarms are merely listed to maintain the numerical sequence and therefore have no text or description.

It is assumed the technician has access to, and is capable of operating, various test devices such as voltmeters within both AC and DC circuits. Is capable of checking winding resistance, checking diodes and reading schematics among other tasks.

Drive Faults

Note:
The following VSD faults are displayed by the SGNs FACEPLATE

VSD Fault 0 - DC Bus Over-Voltage
This fault will occur should the voltage exceed approximately 785 volts DC, VSD Fault 0 will be issued. The alarm is issued whether the motor is running or not.

The DC bus voltage is directly proportional to the AC voltage supplied to the compressor and high incoming AC voltage is the usual cause for this alarm.

Example: on a 480 volt system, the AC voltage must be less than 528 volts (480 + 10%).

Since the relationship between AC and DC is a multiplier of 1.4142, the max DC voltage is calculated at 746 volts DC.
VSD Fault 1 - Over-Current
This fault will occur instantaneous "do not exceed" over-current condition. The setting and rapid response is part of the drive parameter settings and pre-programmed.

There are two blue coloured current transformers fitted over motor leads U and V on the T2 drive, the T1 drive has 3 current transformers on U, V and W leads, that continuously monitor the VSD output current, and in the event that this current exceeds the pre-set threshold the alarm is activated.

Input & Output Power Terminals for T2 Drive

Output terminals U, V and W
- Output voltage 0 to 400V
- 0 to 300Hz for HPM motor D type

VSD Fault 2 - Current Imbalance
This fault will occur if the measured current to the drive motor on leads U, V & W are not within 2%. This can be caused by improperly tightened U, V & W motor leads.

VSD Fault 3 - Drive Temperature Too High
(For Chassis Drives Only)
This fault will occur if the drive ambient temperature exceeds the 115°

VSD Fault 4 - Not Active (reserved)

VSD Fault 5 - Internal Power Supply (For Chassis Drives Only)

VSD Fault 6 - Microprocessor
This fault will occur if there is a failure of the drive control board micro processor. This fault will occur if the drive control board 24 volts DC is lost.
3.0 VSD Drive Faults 0—44

Danger
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VSD Fault 7 - Encoder (Hall Effect Sensors)
This fault will occur if the feedback from the hall effect sensor is lost.

VSD Fault 8 - Encoder Loss
Same fault as VSD 7.

VSD Fault 9 - Not Active (reserved).

VSD Fault 10 - Bus Oscillation
This fault will occur if the DC BUS voltage rapidly rising and falling resulting to a 10% change of the DC bus voltage displayed reading.

VSD Fault 11 - Not Active (reserved)

VSD Fault 12 - Mains Failure (Loss of Incoming Power)
This fault will occur if the drive does not read a incoming power supply while the compressor is running.

VSD Fault 13 - Phase Missing
Similar to VSD Fault 12 but is calculated using parameters at full load conditions.

VSD Fault 14 - Mains Under Voltage
This fault will occur if the incoming voltage supply to drive is not within -10% of VSD’s rated voltage.

VSD Fault 15 – Mains Over Voltage
This fault will occur if the incoming voltage supply to drive has exceeds +10% of VSD’s rated voltage.

VSD Fault 16 – DC Bus Under Voltage
This will occur if the incoming voltage supply to the drive is not within -10% of VSD’s rated voltage.

VSD Fault 17 – Not Active (reserved)

VSD Fault 18 – Not Active (reserved)

VSD Fault 19 – Motor PTC Probe
Confirm ambient temperature is within specification (less than 115°F / 46°C) and airflow is not restricted.
Reset Intellisys and attempt to start compressor.
If compressor runs, investigate ambient air temperature and cooling airflow at time alarm was issued. See Last Alarm Recall.
If VSD Fault 18 immediately returns after starting compressor, check Hall Effect sensors. Replace as required.

VSD Fault 19 – Not Active (reserved)

VSD Fault 20 – Not Active (reserved)

VSD Fault 21 – Not Active (reserved)

VSD Fault 22 - Current Overload
This fault will occur after the drive motor has been in an overload condition for a period of time.

VSD Fault 23 - Motor Under Speed
This fault will occur when the drive is not getting the start command, which is given by the K1 relay. If contact is not made when the start command is given, the SGN or SGNe Controller will issue VSD Fault 23.

VSD Fault 24 – Not Active (reserved)

VSD Fault 25 – Not Active (reserved)

VSD Fault 26 – Motor Over Speed
This fault will occur when the main motor is exceeding the maximum RPM parameter setting in the drive.

VSD Fault 27 – Not Active (reserved)

VSD Fault 28 – Not Active (reserved)

VSD Fault 29 – IGBT (For Chassis Drive Only)
This fault will occur due to a short circuit or very high temperature of the output transistors.

VSD Fault 30 – Not Active (reserved)
3.0 VSD Drive Faults 0—44

HPM VSD Troubleshooting

Troubleshooting

Danger
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VSD Fault 31 – Motor Phase
This fault will occur if the drive is detecting a missing motor phase connection at the U, V & W at the drive output.

VSD Fault 32 – Not Active (reserved)

VSD Fault 33 – Rectifier Temperature
This fault will occur when the input bridge heat sinks has exceeded the maximum 110°C (230°F) temperature trip point.

VSD Fault 34 – Inverter Temp., Phase U.
This fault will occur when the output heat sinks has exceeded the maximum 110°C (230°F) temperature trip point.

VSD Fault 35 - Inverter Temp., Phase V.
This fault will occur when the output heat sinks has exceeded the maximum 110°C (230°F) temperature trip point.

VSD Fault 36 - Inverter Temp., Phase W.
This fault will occur when the output heat sinks has exceeded the maximum 110°C (230°F) temperature trip point.

VSD Fault 37 – +15 volts power supply for Hall Effect Sensors.
This fault will occur when the Hall Effect Sensor +15 volts DC is short circuit or no-longer present.

VSD Fault 38 – +24 volts DC power supply.
This fault will occur when the +24 volts DC is short circuit or no-longer present.

VSD Fault 39 – IGBT Fault Phase U
This fault will occur when the IGBT has intermittently experienced a short circuit of the U phase.

VSD Fault 40 – IGBT Fault Phase V
This fault will occur when the IGBT has intermittently experienced a short circuit of the V phase.

VSD Fault 41 – IGBT Fault Phase W
This fault will occur when the IGBT has intermittently experienced a short circuit of the W phase.

VSD Fault 42 – Rectifier Fault
This fault will occur when the rectifier temperature has exceed the maximum temperature allowed during operation.

VSD Fault 43 – Ambient Temperature
This fault will occur if a high temperature is read by the control board inside the drive box.

VSD Fault 44 – Diagnostic Fault
This fault will occur when power is applied to the drive if a problem is detected when VSD performs its self diagnostics, the latest software will not allow the alarm to be reset as a problem which exists may cause further damage to occur.
VSD self diagnostic test.
The drive automatically conducts a “Auto-Diagnosis” of the power modules every time the drive powers up.

The VSD Fault 44 (Diagnostic Fault) is issued when a fault occurs. This alarm cannot be reset, as the problem which exists may cause further damage.

Whenever Fault 44 is issued, the SGNe Controller will also display a primary fault which provides additional information about the possible fault and its location. This picture shows VSD Fault 44 and Primary Fault 9, which indicates that the issue is related to the VFD Drive’s component, control or wiring associated with Phase U or W. Please refer to page 35 for an explanation of other primary faults.

At this point, the Technician can find additional information about the fault by accessing Service Menu 348 (Diagnostic Memory), as Error Code 1 and Error Code 2 will be display there, as shown in the following picture.

In this picture, the Error Code 1 displays value 2, which is related to the possible malfunction of U or W current transformers on T1 and T2 drives. For additional details refer to page 35 of this section of the manual. Error Code 2 is of secondary importance.

VSD manual diagnostic tests through Service Menu 348
Access to the internal drive diagnostics is done through service Menu 348. Access to this menu is accomplished with the compressor off in a ready to start condition. Menu 348 is entered in the service menu selection in the Factory set points. In the service menu 348 you will see the following 3 tests.

These three tests must only be done by certified IR Technicians through Service Menu “348”. 
4.0 Drive Diagnostics—Tests

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Note
A Control/Interface Boards test should always be performed even though the fault may be indicating a power module fault. This test must be carried out because the Control or Interface board could still be faulty and could be giving corrupt diagnostic information. So both tests must always be performed to make sure the appropriate procedures are followed when performing these tests.

1. Control/Interface (Electronic Board) Test.

Starting conditions:
1. Turn off the incoming power supply to the drive,
2. Wait for 15 minutes
3. Then disconnect all the terminals off the control board except for the SGN Intellisys communication connector and the Ribbon Cable.
4. Turn on the incoming power to conduct the test

To select the Control Interface Test, depress the select key on the SGNE with Control Interface Test high-lighted.

The high-light will shift to the setting section under the main parameter heading.

Depress the Set button as the Control Interface test is being conducted. “0” will be displayed in the setting section.

Numbers are displayed after the test is completed,

If the test passed the value 1 will be displayed.
1 = Pass

If the test failed, Primary Faults 2 or 3 will be displayed.
2 = Control board failure
3 = Interface board failure
4.0 Drive Diagnostics—Tests

2. The Power Module Test

Starting conditions:
1. The main power must be applied to KM1 contactor.
2. The motor must be connected to the drive outputs.
3. Ensure that terminal PX2 digital input ENABLE is linked with the circuit common 0 volts. These connection points are labelled on the drive control board by terminal strip PX2. If the input is not correct, the VSD fault 44 will be issued.

The power module test is conducted with the motor stopped. Once the test begins, the drive reduces its DC Bus voltage down to 55 volts DC then the Diagnosis will start. Depending on the size of the compressor, the diagnosis may last a couple of minutes depending on how long the DC bus takes to reduce to the 55 volts DC.

Note:
Power Module Test takes approximately 5–10 minutes to do. There is no exit command so, if there is a need to exit from the test before completion, it can be done by cycling the incoming power. All connections to the control board and all electronic components must be properly connected to do this test.

Note:
A Control/Interface Boards test should always be performed even though the fault may be indicating a power module fault. This test must be carried out because the Control or Interface board could still be faulty and could be giving corrupt diagnostic information. So both tests must always be performed to make sure the appropriate procedures are followed when performing these tests.

If the test passed, a “1” will be displayed.

If the test failed, one of the following Primary Fault Codes will be displayed below the Power Module Test text on the SGNe Faceplate, as shown in the following picture.

- 2 = Failure on the U phase module
- 3 = Failure on the V phase module
- 4 = Failure on the W phase module
- 5 = Rectifier Failure
- 6 = Motor or motor connections failure
- 7 = U and V phase module failure
- 8 = V and W phase module failure
- 9 = U and W phase module failure
- 10 = Enable logic input not connected to OV

There will be additional information indicating Error.
5.0 VSD Voltage Checks

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**Incoming voltage**

**Fuses on PL5**

- **T1 modular drive**
- **T2 modular drive**

**Note**
Power must be isolated before performing the following checks.

Check these 2 fuses in case of DC Bus Under Voltage Fault.
6.0 Winding Insulation Test

HPM VSD Troubleshooting
Troubleshooting

**Danger**
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**Note**
Power must be isolated before performing the following checks.

**HPM Motor Winding Test**
When the Insulation test is performed, the instrument used for this purpose (Megger or other brand) induces 1000k VDC to motor windings. The high voltage spike might affect operation of sophisticated controllers or its memory cards. Therefore, before the winding insulation test is carried out, remove Hall Effect Sensor cable connection from the Control Board.

1. Isolate the compressor from the main incoming voltage supply. Lock and tag the Disconnect switch in the open position.
2. Allow 15 minutes for the VSD to discharge capacitors.
3. Open enclosure doors to expose VSD.
4. Remove motor leads protective cover.
5. Check with a suitable meter that all voltages have dissipated before beginning work on the VSD.
6. Disconnect motor leads from U, V and W on the bottom of the VSD.
7. Connect one cable of the Insulator Tester to the main Ground connection of the VSD.
8. Connect one other cable of the Tester to each of the motor leads (one at a time) and test. Set the Tester to at least 1KV. Each cable should give a minimum value of Infinity (20M Ohms).

**Note**
Contamination of the stator can cause the readings to out of specification.

9. If the motor tests correctly, reconnect motor cables to the VSD in the correct sequence.
10. If the motor fails the test, replace the stator.

Use an Insulation Tester (Megger or other brand) connecting one of the 2 cables to the earth terminal, the other cable to the motor leads U, V and W one after the other (motor leads are disconnected from the drive and the sensors from the control board).

![Megger connected](image1)

Set ≥ 1KV

![Motor Leads](image2)

![Megger connected](image3)
**Motor winding resistance values**

The motor can be tested using a Megger to test for a phase to earth short fault. But if a megger is not available or if additional trouble shooting is required, a Milliohm meter can be used to measure the resistance of the motor windings phase to phase.

The table below shows the resistance expected values when measuring the resistance of the windings phase to phase on the various motors.

<table>
<thead>
<tr>
<th>Motor Type</th>
<th>Motor Voltage</th>
<th>Min Resistance (20ºC)</th>
<th>Max Resistance (20ºC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>60HP 400V</td>
<td>60.0</td>
<td>13.8</td>
<td>15.2</td>
</tr>
<tr>
<td>45KW 200V</td>
<td>20.0</td>
<td>3.9</td>
<td>4.4</td>
</tr>
<tr>
<td>50HP 400V</td>
<td>60.0</td>
<td>23.3</td>
<td>25.7</td>
</tr>
<tr>
<td>37KW 200V</td>
<td>20.0</td>
<td>6.5</td>
<td>7.2</td>
</tr>
<tr>
<td>75HP Oil Free</td>
<td>40.0</td>
<td>14.25</td>
<td>15.75</td>
</tr>
<tr>
<td>55KW 200V</td>
<td>20.0</td>
<td>4.4</td>
<td>5</td>
</tr>
<tr>
<td>100HP 400V</td>
<td>60.0</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>75KW 400V</td>
<td>60.0</td>
<td>18.5</td>
<td>20.5</td>
</tr>
<tr>
<td>55KW 200V</td>
<td>20.0</td>
<td>6.6</td>
<td>7.4</td>
</tr>
<tr>
<td>150HP 400V</td>
<td>60.0</td>
<td>10.5</td>
<td>11.5</td>
</tr>
<tr>
<td>110KW 400V</td>
<td>40.0</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>200HP 400V</td>
<td>40.0</td>
<td>5.15</td>
<td>5.75</td>
</tr>
<tr>
<td>160KW 400V</td>
<td>40.0</td>
<td>5.15</td>
<td>5.75</td>
</tr>
<tr>
<td>250/300HP</td>
<td>25.0</td>
<td>5.15</td>
<td>5.75</td>
</tr>
<tr>
<td>186/223KW</td>
<td>186</td>
<td>5.15</td>
<td>5.75</td>
</tr>
</tbody>
</table>

**How to perform Milliohm motor resistance test**

For motors 50 to 100 HP, require that the individual motor leads labeled 1 to be connected together. This can be done by using a bolt and nut to tightly hold them together, and the same for 2 and 3.

A 150 to 200 HP in most cases are connected in this manner from the factory and should not be separated for testing. The picture below illustrates how the test should be performed.

The purpose of this test is to look and compare resistance values. The difference in the resistance should be less than 2%.

A bad reading may result to a possible:

- Cut coil
- Short circuit between coil turns
- A defective weld
6.0 Winding Insulation Test

How to perform a Dielectric Test with an HIPOT tester (High Potential Tester)

It is highly recommended that the HPM stator is removed from the compressor package. If failed to do so, leakage ground during test could damage other electrical components.

The tester settings should be 1800 VAC–50/60Hz

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Current reading on Intellisys

<table>
<thead>
<tr>
<th>At max load, the motor current must not exceed:</th>
</tr>
</thead>
<tbody>
<tr>
<td>230V mains</td>
</tr>
<tr>
<td>196 amps for 60TL</td>
</tr>
<tr>
<td>230 Amps for 75TL</td>
</tr>
<tr>
<td>145 amps for 100T (100T=75HP)</td>
</tr>
<tr>
<td>190 amps for 120T (120T=100HP)</td>
</tr>
<tr>
<td>305 amps for 180T (180T=125 to 150HP)</td>
</tr>
<tr>
<td>395 amps for 220T (200T=200HP)</td>
</tr>
<tr>
<td>535 amps for 340T (340T=300HP)</td>
</tr>
</tbody>
</table>
Three Hall Effect Sensors are located at the non-drive end of the HPM Motor, these are embedded in the Stator windings. They can be easily removed or installed using three screws.

The Hall Effect Sensors provide the speed and winding temperature feedback to the PL1 Control Board through terminal PX4.

To carry out the test:

1. Isolate the compressor from the main incoming voltage supply. Lock and tag the isolation switch in the open position.
2. Allow 15 minutes for the VSD to discharge capacitors.
3. Open enclosure doors to expose the VSD.
4. Check with a suitable meter that all voltages have dissipated before beginning work on the VSD.
5. Remove rear cover of drive motor to permit rotating by hand.

Test 1—Mechanical Damage

1. Disconnect Hall Effect Cable from PX4 on the Control Board, plug type is DB9 Type.
2. Inspect cable pins and matching receptacle connections for damage or bent pins.
3. Remove cover of plug and inspect solder connection of the wires for damage.
4. Inspect entire length of the cable for damage. If cable and connections are in good condition, proceed to Test 2 (refer to page XX).
7.0 Hall Effect Sensor Checks

Test 2—Power Supply to the Hall effect

1) On T1 or T2, disconnect terminal strips PX1 and PX2 (on chassis it is P1 and P2) from the Control Board.
2) Trip and switch off MCB2 and MCB5 (T1 and chassis drive) to prevent the SGNe Intellisys from powering up. On T2, MCB2 only.
3) Re-connect main incoming supply voltage to the unit. Isolation contactor KM1 should remain de-energised and the VSD should only receive control power. Caution must be taken as the panel has voltage present.
4) Set digital multi-meter to DC Volts.
5) Connect Black probe of multi-meter to either of the 2 pins of P5.
6) Locate the small transistor just to the left of the PX4 connector. The transistor has 3 pins on the left side. The pins are numbered
   - **Chassis Drive**: 1-top, 2-middle, 3-bottom.
   - **Module Drive**: 1-bottom, 2-middle, 3-top.

**Note:**
- P5 is located in the middle of the control board.
- P5 is marked and described as 2 small bare pins.
- P5 is the ground connection for the Control Board.

7) Connect the Red probe of the multi-meter to Pin 3 - Chassis Drive or Pin 1 - Module Drive. The voltage should be ~ +14 Volts DC.
8) If voltage is not present, replace the Control Board.
7.0 Hall Effect Sensor Checks

**Test 3—Test Signals from Sensors**

1) Connect special adapter CPN 3833332 between PX4 on the Control Board and the Hall Effect Sensor Cable.

2) Set digital multi-meter to DC Volts.

3) Connect Black probe of multi-meter to either of the 2 pins on P5.

4) Connect Red probe of multi-meter to Red wire of the adapter. Rotate motor by hand and observe measurement. The meter should read between +12 and +13 volts DC alternating to between 0 and +1 volts DC.

5) Repeat the test with the Black wire of the adapter. The meter should read between +10 and +12 volts DC alternating to between 0 and +1 volts DC.

6) Repeat the test with the Yellow wire of the adapter. The meter should read between +10 and +12 volts DC alternating to between 0 and +1 volts DC.

7) If voltage does not rise to between +10 and +12 volts DC for any of the 3 sensors, replace the Hall Effect Sensor Assembly.

The Hall Effect Sensor adaptor has five labels indicate the following: R, B, Y, P, G which are the initials of:

- **R** red wire of the sensor
- **B** black wire of the sensor
- **Y** yellow wire of the sensor
- **P** purple wire of the motor PTC
- **G** green wire of the motor PTC

### Hall Effect Sensors

### Motor PTC probe
7.0 Hall Effect Sensor Checks

Test 4—Motor PTC probe

1) Set digital multi-meter to Ohms.
2) Connect multi-meter between Purple and Green wires of special adapter, the meter should show a resistance value of approximately 60 Ohms ± 20% (New Hall Effect Sensors)* at 70°F (20°C) ambient temperature.
3) If correct value is not confirmed, replace the Hall Effect Sensor Assembly.

* Note: The resistance value may vary depending on the manufacturer and model of the Hall Effect Sensor.

---

**Danger**
Please utilize extreme caution when performing work within the starter cabinet. When opening the cabinet: be certain the drive protective shield is in place, wear appropriate PPE (Personal Protective Equipment), follow lock out-tag out procedures, and ensure all safety procedures are followed.
8.0 Control Board (PL1)

HPM VSD Troubleshooting

Troubleshooting

**Danger**

Please utilize extreme caution when performing work within the starter cabinet.
When opening the cabinet: be certain the drive protective shield is in place, wear appropriate PPE (Personal Protective Equipment), follow lock out-tag out procedures, and ensure all safety procedures are followed.

The diagnosis is the main addition to the Modular Drive software with a significant improvement of its processing speed.

The PCB design has been optimized from the previous version. The modbus interface is supported by the control board directly, no more communication board to plug in. The number of terminals has been reduced to meet the need of Nirvana compressor.

**Main functions:**
- Generates the Pulse Width Modulation (PWM) to regulate the speed and the torque of the motor
- Performs the drive diagnosis
- Controls the rectifier bridge for the pre-loading of the capacitors at power up and allows the diagnosis to be carried out
- Supports the Modbus interface

**Monitors the temperature of the IGBT chips and the rectifier bridge**

**Advantages:**
- Drive auto diagnosis
- Accurate monitoring of temperature measurement of the IGBT chips as well as the rectifier
- Integrated Modbus communication interface
- Varnished board

![Control Board Diagram]

- Microprocessor
- Ribbon cable connector from interface PCB
- PX1
- PX
- Intellisys communication terminal PX3
- Hall effect sensor terminal PX4
**Danger**

Please utilize extreme caution when performing work within the starter cabinet. When opening the cabinet: be certain the drive protective shield is in place, wear appropriate PPE (Personal Protective Equipment), follow lock out-tag out procedures, and ensure all safety procedures are followed.

### Replacement

1. Isolate the compressor from the main incoming voltage supply. Lock and tag the isolation switch in the open position.
2. Allow 15 minutes for the VSD to discharge capacitors.
3. Open enclosure doors to expose VSD.
4. Remove protective grate from front of VSD.
5. Check with a suitable meter that all voltages have dissipated before beginning work on the VSD.
6. Unplug PX1 and PX2 from bottom of the Control Board.
7. Remove the Hall Effect Sensor plug from PX4 located on side of Control Board.
8. Remove the Communication Plug from PX3 located on side of Control Board.
9. Remove ribbon cable from bottom of Control Board.
10. Remove the small mounting screw from each corner of the Control Board.

Reverse this procedure to install a new Control Board.
9.0 Interface Board (PL2)

Interface Board
The general task of this board is to interface with the control board and the power components.

Main functions:
- Makes the PWM signals available by the IGBT driver boards, signals provided by the control PCB
- Measures the AC incoming voltage and the DC Bus voltage to inform the microprocessor about voltages
- Takes the current information coming from the IGBT driver boards
- Interfaces the rectifier heat sink thermal sensor for the control PCB
- Creates different voltages: +15V & -15V for the IGBT driver boards +8V for the control board +24V for the control PCB terminal
9.0 Interface Board (PL2)

**Danger**
Please utilize extreme caution when performing work within the starter cabinet. When opening the cabinet: be certain the drive protective shield is in place, wear appropriate PPE (Personal Protective Equipment), follow lock out-tag out procedures, and ensure all safety procedures are followed.

Interface PCB & ID Board (PL2)

- Ribbon cable connector from Control PCB
- IGBT cable connector
- 200 V electronic control supply connector
- Connector cable from DC Bus
- ID BOARD plugged in here

**Interface PCB & Distribution PC**
The duty of this electronic PCB is the same as the T1 or the T2 drive. However, because the T2 is made of 3 modules instead of only 1 for the T1 drive, the IGBT firing orders must be shared between each module of the T2. This is the reason an additional PCB must be used with the T2 drive.

**For T2 only.**
You must to be sure that the ribbon cables are connected to the Distribution Board as specified below:
- From Output Power Module U to P5 (located at left).
- From Output Power Module V to P4 (located at middle).
- From Output Power Module W to P3 (located at right).
PL2 Replacement

1. Isolate the compressor from the main incoming voltage supply. Lock and tag the isolation switch in the open position.
2. Allow 15 minutes for the VSD to discharge capacitors.
3. Open enclosure doors to expose VSD.
4. Remove protective grate from front of VSD.
5. Check with a suitable meter that all voltages have dissipated before beginning work on the VSD.
6. Fold down Control Board power/interface board assembly.
7. Unplug all cables from the Interface Board.
8. Remove the small I.D. Board from the Interface Board, taking care not to cause damage to pins of the plugs. Remove plastic stand-offs. They will be needed on new board.
9. Install new Interface Board, reversing the above procedure.

Note:
On the T2 drive it will be necessary to remove the sharing board.
Replacement I/D Board

1. Isolate the compressor from the main incoming voltage supply. Lock and tag the isolation switch in the open position.
2. Allow 15 minutes for the VSD to discharge capacitors.
3. Open enclosure doors to expose the VSD.
4. Remove protective grate from front of VSD.
5. Check with a suitable meter that all voltages have dissipated before beginning work on the VSD.
7. The I.D. Board is installed on the Interface Board using 2 plugs and held in position by plastic stand-offs.
8. Gently remove the I.D. Board from the Interface Board, taking care not to cause damage to the plugs.
9. Install new I.D. Board to the Interface Board, again taking care not to cause damage to pins of plugs.
10. Re-use plastic stand-offs from original board.
11. Fold up into place Control Board, Power/Interface Board assembly.
12. Replace the protective grate.
13. Close VSD enclosure doors.
14. Re-apply power to the unit.
15. Run an Internal Electronic Board Diagnostic Test (page 24)
16. If the test is satisfactory, re-run the unit.
Input (Rectifier) Module
The Input (Rectifier) Module consists of the following major components:

- EMC Board
- Thyristor Firing Printed Circuit Board
- Thyristor Packs

Note
Power must be isolated before performing the following checks.

Note
3 Thyristor packs
TH1, TH2, and TH3
**Danger**
Please utilize extreme caution when performing work within the starter cabinet. When opening the cabinet: be certain the drive protective shield is in place, wear appropriate PPE (Personal Protective Equipment), follow lock out-tag out procedures, and ensure all safety procedures are followed.

The **EMC board** is screwed onto the triggering board.

Capacitors and MOVs are to comply international standards regarding emission and immunity protection against surge voltages (MOV).

---

**Note**
Power must be isolated before performing the following checks.

This is the **thyristor firing board**. The firing is directly controlled by the microprocessor of the control board.

No leads are required between the boards and the thyristors. The links between each PCB are made of spacers and screws that make the rectifier module particularly compact.

It provides pre loading function of the capacitors regulation of the DC Bus at 55V during diagnostic test.

Thyristors firing command connector (other end to the control PCB)

---

**Note**
Power must be isolated before performing the following checks.

Red wires for the rectifier firing connected to the gate of the thyristors TH1, TH2 and TH3.
**Danger**
Please utilize extreme caution when performing work within the starter cabinet.
When opening the cabinet: be certain the **drive protective shield is in place**, wear appropriate **PPE (Personal Protective Equipment)**, follow **lock out-tag out** procedures, and **ensure all safety procedures are followed**.

---

### 11.0 Input (Rectifier) Module

#### Replacing the Input rectifier module for T1 Drives

1. Disconnect the power supply leads L1, L2 and L3.
2. Remove connector to unplug located on the triggering board, behind the EMC PCB.
3. This screw must be unbolted to disconnect the choke lead.
4. This screw must be unbolted to disconnect the choke lead.
5. Unbolt the 4 screws to release the complete rectifier module.

#### Replacing the Input rectifier module for T2 Drives

1. To remove the input rectifier module, the choke leads of the DC Bus must be disconnected from the module.
2. Remove the connector located on the triggering board, behind the EMC.
3. Disconnect the power supply leads L1, L2 and L3.
4. Unbolt this screw to release the DC Bus lead.
5. Unbolt this screw to release the DC Bus lead.
6. Unbolt the 4 screws to release the complete rectifier module.

---

*Note*
Power must be isolated before performing the following checks.
11.0 Input (Rectifier) Module

**Thermal Sensor**

The only visible thermal probe on the modular drive is the probe located below the rectifier bridge and directly connected to the triggering board. This probe monitors the temperature of the rectifier module and is screwed on its heat sink.

The max temperature allowed is 90°C (194°F). Temperature reading is available from the screen of the Intellisys.

The temperature probe of the output modules is internally monitored by the IGBT driver board from the transistor ships. The temperature information is then forwarded through the interface board to the control board with the IGBT firing order command cables. Temperature measurements are accessible from the Intellisys controller. The temperature trip point is 110°C (230°F).

**Note**

Power must be isolated before performing the following checks.

**RECTIFIER PROBE TEMPERATURE CHART, ± 2%**

<table>
<thead>
<tr>
<th>°C</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
<th>45</th>
<th>50</th>
<th>55</th>
<th>60</th>
<th>65</th>
<th>70</th>
</tr>
</thead>
<tbody>
<tr>
<td>°F</td>
<td>68</td>
<td>77</td>
<td>86</td>
<td>95</td>
<td>104</td>
<td>113</td>
<td>122</td>
<td>131</td>
<td>140</td>
<td>149</td>
<td>158</td>
</tr>
<tr>
<td>Ω</td>
<td>588</td>
<td>606</td>
<td>624</td>
<td>643</td>
<td>660</td>
<td>678</td>
<td>701</td>
<td>723</td>
<td>746</td>
<td>770</td>
<td>793</td>
</tr>
</tbody>
</table>
12.0 Output (Inverter) Module

Each Output (Inverter) Module is made of 3 IGBT transistors with the included IGBT driver board associated to the transistors.

T1 drive is made of only one IGBT module. Because of the 3 transistors per module, one module supports the 3 output phases U, V and W.

T2 drive has 3 IGBT (inverter) modules. Each of them is dedicated to one output phase U, V or W.

The IGBT module has got its own capacitor bank, number of capacitors may vary depending on drive rating.

The IGBT module has got an internal temperature probe built-into the heart of the IGBT chip.

Output IGBT Power Module for T1

The IGBT transistors are hidden by this white cover which protects the IGBT driver board. The bars marked U, V and W are connected to each transistor. The 3 current transformers (in blue) are linked to the driver board that relays the current information to the interface board.

Note

Power must be isolated before performing the following checks.
**Danger**
Please utilize extreme caution when performing work within the starter cabinet. When opening the cabinet: be certain the drive protective shield is in place, wear appropriate PPE (Personal Protective Equipment), follow lock out-tag out procedures, and ensure all safety procedures are followed.

---

### DC BUS Capacitors
Capacitors are rated for nominal input voltage specified, they are connected in series in order to handle the DC Bus voltage. The DC Bus is app. 670V during running, 790V maximum for the T type drive or 325V running and 360V maximum for the TL low voltage drives.

#### Advantages:
- Only one balancing resistor within the T1 drive
- Balancing resistors protected against mechanical shocks

---

**Output IGBT Power Module for T2**

- IGBT driver board (one per module)
- Balancing resistors
- Capacitor bank
- Holes for module handling & mounting
- Connection points to the DC Bus bars
- Current transformer
- 3 IGBT transistors (behind the board)

---

22 k Ohms resistors used to balance the voltage on the capacitors.

Only one resistor to balance the DC Bus voltage on the capacitors.
Current Transformers

On the T1 Module Drive there are 3 current transformers (called LEM) installed on the U, V & W bars. They are powered by the IGBT driver board in white. They give a sine wave image of the outgoing current used by the microprocessor of the control board to regulate the current provided to the motor.

On the T2 Modular Drive, only 2 current transformers (called LEM) installed on the U & V bars. They are powered by the 2 IGBT driver boards.

Note
Power must be isolated before performing the following checks.
Danger
Please utilize extreme caution when performing work within the starter cabinet. When opening the cabinet: be certain the drive protective shield is in place, wear appropriate PPE (Personal Protective Equipment), follow lock out-tag out procedures, and ensure all safety procedures are followed.

Replacing IGBT power modules for T1 drives

1. All the terminals have been removed from the control board. Disconnect the 3 motor leads from the drive.
2. Disconnect the 200V supplied from T1 step down transformer in the SGNe Control Panel.
3. Unbolt the 2 screws per metal bracket which supports the white plastic bracket of the boards.
4. Disconnect the IGBT firing cable connector from the IGBT driver board.

Note
Power must be isolated before performing the following checks.
5. Take out the complete white plastic bracket with its 2 metal supports.

Disconnect the DC bus connector from PL5

6. Disconnect the choke leads from the DC Bus connections of the drive.

7. Unbolt the 4 screws at each corner of the power module.

Release the module from the PDM

8. Visible location of the module after removing.
Replacing IGBT power modules for T2 drives

To release at least one module, the 2 bars of the DC Bus must be removed. This means all the screws have to be unbolted along the bars to free the choke leads and the 3 modules.

One pair of screws are used on both sides of the module. To release the module, unbolt the 4 screws (2 per module). For the U phase power IGBT module, which supports the electronic boards, refer to the procedure explaining the T1 drive to remove the plastic support bracket and the electronic boards.

⚠️ Note
Power must be isolated before performing the following checks.

⚠️ Note
Power must be isolated before performing the following checks.

This screw must remain because it holds the entire drive in vertical position

These screws must be unbolted to release the DC Bus bars

This screw must remain because it holds the entire drive in a vertical position

These screws must be unbolted to release the module. The other screws are located on the other side of the module, at the bottom of the capacitor bank.
13.0 Module Test

**Input and Output Module Tests**

1. The Unit must be isolated (locked/Tagged out) from the power supply
2. Wait at least 15 minutes before removing any connections
3. Check for 0 voltage
4. Disconnect main cables to the input rectifier
5. Disconnect cables from the HPM motor

The tests for the input rectifier and the output inverter modules are similar.

**Danger**

Please utilize extreme caution when performing work within the drive cabinet. When opening the cabinet: be certain the drive protective shield is in place, wear appropriate PPE (Personal Protective Equipment), follow lock out-tag out procedures, and ensure all safety procedures are followed.

The locations to connect the multimeter are:
- First probe to: the 2 points (+ DC Bus and - DC Bus)
- Second probe to: the L1, L2 and L3 terminals to test the input rectifier bridge and U, V and W terminals to test the output transistors
- The Multimeter must be set on Diode test.
Input and Output Module Tests

Short Circuit Test

Test to carry out:
Test one after the other phases L1, L2 and L3 of the input bridge with the DC Bus bars

Test condition:
- Electronic of UMV switched off.
- Input power bolts L1, L2 and L3 not connected.
- No motor connected

Measuring device needed:
- One multi-meter set on diode test.

Correct Outcome:

T1 Input (Rectifier) Module Test

The multi-meter must read OL
14.0 T1 Input (Rectifier) Module Test

**T1 Input (Rectifier) Module Tests**

**Diode and Capacitor Test**

**Test to carry out:**
Test one after the other phases L1, L2 and L3 of the input bridge with the DC Bus bars.

**Test condition:**
- Electronic of UMV switched off.
- Input power bolts L1, L2 and L3 not connected.
- No motor connected.

**Measuring device needed:**
- One multi-meter set on diode test.

**Correct outcome:**
- 0.34v = Diode threshold
- Char = Capacitor charging

**Danger**
Please utilize extreme caution when performing work within the drive cabinet. When opening the cabinet: be certain the drive protective shield is in place, wear appropriate PPE (Personal Protective Equipment), follow lock out-tag out procedures, and ensure all safety procedures are followed.
15.0 T1 Output (Inverter) Module Test

T1 Output (Inverter) Module Test

Test to carry out:
Test one after the other phases of the output (inverter) module with DC Bus.

Test condition:
- Electronic of UMV switched off.
- Input power bolts L1, L2 and L3 not connected.
- No motor connected.

Measuring device needed:
- One multi-meter set on diode test.

Correct Outcome:
0.29v = IGBT free wheel diode threshold
Char = Capacitor charging
**Danger**

Please utilize extreme caution when performing work within the drive cabinet. When opening the cabinet: be certain the drive protective shield is in place, wear appropriate PPE (Personal Protective Equipment), follow lock out-tag out procedures, and ensure all safety procedures are followed.

---

**15.0 T1 Output (Inverter) Module Test**

**Test to carry out:**

Test one after the other phases of the input bridge with DC Bus.

**Test condition:**
- Electronic of UMV switched off.
- Input power bolts L1, L2 and L3 not connected.
- No motor connected.

**Measuring device needed:**
- One multi-meter set on diode test.

**Correct Outcome:**

0,29v = IGBT free wheel diode threshold

Char = Capacitor charging

---

HPM Variable Speed Drive (VSD) Troubleshooting Manual

Page 42

Ingersoll Rand Global Service Education Team

Issue: 05/Davidson, August, 2007. ©Ingersoll Rand Proprietary Information
**Danger**
Please utilize extreme caution when performing work within the drive cabinet. When opening the cabinet: be certain the drive protective shield is in place, wear appropriate PPE (Personal Protective Equipment), follow lock out-tag out procedures, and ensure all safety procedures are followed.

### T2 Input (Rectifier) Module Test

#### Short Circuit Test

**Test to carry out:**
Test one after the other phases L1, L2 and L3 of the input bridge with the DC Bus bars

**Test condition:**
- Electronic of UMV switched off.
- Input power bolts L1, L2 and L3 not connected.
- No motor connected.

**Measuring device needed:**
- One multimeter set on diode test.

**Correct Outcome:**
- OL = opened circuit

---

![T2 Input (Rectifier) Module Test Diagram]
16.0 T2 Input (Rectifier) Module Test

**Diode & Capacitor Tests**

**Test to carry out:**
Test one after the other phases L1, L2 and L3 of the input bridge with the DC Bus bars.

**Test condition:**
- Electronic of UMV switched off.
- Input power bolts L1, L2 and L3 not connected.
- No motor connected.

**Measuring device needed:**
- One multi-meter set on diode test.

**Correct Outcome:**

- Char = Capacitor charging
- 0.38v = Diode voltage threshold

---

**Danger**

Please utilize extreme caution when performing work within the drive cabinet. When opening the cabinet: be certain the drive protective shield is in place, wear appropriate PPE (Personal Protective Equipment), follow lock out-tag out procedures, and ensure all safety procedures are followed.
17.0 T2 Output (Inverter) Module Test

T2 Output (Inverter) Module Test
Test to carry out:
Test one after the other phases of the input bridge with DC Bus.

Test condition:
• Electronic of UMV switched off.
• Input power bolts L1, L2 and L3 not connected.
• No motor connected.

Measuring device needed:
• One multi-meter set on diode test

Correct Outcome:
0,35v = IGBT free wheel diode threshold
Char = Capacitor charging

Danger
Please utilize extreme caution when performing work within the drive cabinet.
When opening the cabinet: be certain the drive protective shield is in place, wear appropriate PPE (Personal Protective Equipment), follow lock out-tag out procedures, and ensure all safety procedures are followed.
18.0 Complete Drive Replacement

Replacing the entire T1 drive
To release the entire drive, the choke leads have to be previously disconnected.

1) Disconnect the choke leads
2) Disconnect all connections to the terminals
3) Disconnect the 200V electronic supply
4) Disconnect the power leads like L1, L2, L3, U, V and W
5) Release the entire drive. Undo 3 screws per side.

Replacing the entire T2 drive

1) Disconnect the choke leads
2) Disconnect all connections to the terminals
3) Disconnect the 200V electronic supply
4) Disconnect the power leads like L1, L2, L3, U, V and W
5) Release the entire drive. Undo 5 screws per side.
**Danger**
Please utilize extreme caution when performing work within the drive cabinet. When opening the cabinet: be certain the drive protective shield is in place, wear appropriate PPE (Personal Protective Equipment), follow lock out-tag out procedures, and ensure all safety procedures are followed.

---

**T1—VFD Bolts Torque Settings**
Connecting power leads to the Drive

<table>
<thead>
<tr>
<th>Label</th>
<th>Functions</th>
<th>Terminal connection</th>
<th>Max terminal screw tightening</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Bolt size</td>
<td>Nm / lbf.in</td>
</tr>
<tr>
<td>L1, L2, L3</td>
<td>3-phase incoming supply</td>
<td>M8</td>
<td>12 / 106,21</td>
</tr>
<tr>
<td>LC1, LC2</td>
<td>DC choke connection</td>
<td>M8</td>
<td>12 / 106,21</td>
</tr>
<tr>
<td>U, V, W</td>
<td>Output connection to motor</td>
<td>M8</td>
<td>12 / 106,21</td>
</tr>
<tr>
<td>PE</td>
<td>Earthing / ground connection point</td>
<td>M8</td>
<td>12 / 106,21</td>
</tr>
</tbody>
</table>
20.0  T1 VFD Bolts Torque Settings

**Danger**
Please utilize extreme caution when performing work within the drive cabinet. When opening the cabinet: be certain the drive protective shield is in place, wear appropriate PPE (Personal Protective Equipment), follow lock out-tag out procedures, and ensure all safety procedures are followed.

**T1—VFD Bolts Torque Settings**
Tightening the output and rectifier modules.

The modules are tied to the main chassis by eight YR01 nuts (four per module)

YR01
M8 Hex lock nuts (comby S) with attached conical spring washer.

[Image of a diagram showing the locations of YR01 bolts and their torque settings.]

12 Nm / 106
T1—VFD Bolts Torque Settings

Mounting the Electronic Board on the U phase module

Use TB.9 metallic bracket and TB.10 assembly.

BY07 Hexagonal pan head tapping screw 2.9mm x 9.5mm (diam x length).
**Danger**
Please utilize extreme caution when performing work within the drive cabinet. When opening the cabinet: be certain the drive protective shield is in place, wear appropriate PPE (Personal Protective Equipment), follow lock out-tag out procedures, and ensure all safety procedures are followed.

---

**T1—VFD Bolts Torque Settings**

Install **TB.9** Metallic bracket on the IGBT output module and **TB.10** board-bracket assembly using four **YR04** nuts.

**YR04**
M6 hex lock nuts (Comby S) with attached conical spring washer

Also connect **TP.1** earth strap to the metallic

---

![Image of T1 VFD Bolts Torque Settings](image-url)

**YR04**

5 Nm / 44.25 lbf.in

TP.1

YR04

5 Nm / 44.25 lbf.in
20.0 T1 VFD Bolts Torque Settings

**Danger**
Please utilize extreme caution when performing work within the drive cabinet. When opening the cabinet: be certain the drive protective shield is in place, wear appropriate PPE (Personal Protective Equipment), follow lock out-tag out procedures, and ensure all safety procedures are followed.

T1—VFD Bolts Torque Settings

**Mounting the PL.5 Board**

Connect the PL2 Board using three VS27 screws.

**VS27**
Hexalobular flange head tapping screw 4mm x 6mm (diam x length)

Mounting the thermal probe on the rectifier module.

**2 Nm / 17.70 lbf.in**
20.0 T1 VFD Bolts Torque Settings

**Danger**
Please utilize extreme caution when performing work within the drive cabinet. When opening the cabinet: be certain the drive protective shield is in place, wear appropriate PPE (Personal Protective Equipment), follow lock out-tag out procedures, and ensure all safety procedures are followed.

**T1—VFD Bolts Torque Settings**

**Mounting PL4**

- Use four **VS27** screws to mount **PL4**
- Use five **VS27** screws to wire **PL4**
- Use three **VS27** screws to wire **PL3**

**VS27**
Hexalobular flange head tapping screw 4mm x 6mm (diam x length)

![Image of VFD components with VS27 screws highlighted]

**2 Nm / 17.70 lbf.in**

![Image of VFD components with torque settings indicated]
**Danger**

Please utilize extreme caution when performing work within the drive cabinet. When opening the cabinet: be certain the drive protective shield is in place, wear appropriate PPE (Personal Protective Equipment), follow lock out-tag out procedures, and ensure all safety procedures are followed.

**T2—VFD Bolts Torque Settings**

Connecting the Power Leads to the Drive
Danger
Please utilize extreme caution when performing work within the drive cabinet. When opening the cabinet: be certain the drive protective shield is in place, wear appropriate PPE (Personal Protective Equipment), follow lock out-tag out procedures, and ensure all safety procedures are followed.

T2—VFD Bolts Torque Settings

Tightening output and rectifier Modules

Each module is tied to the main chassis by using four YR01 nuts.

YR01 M8 Hex lock nuts (comby S) with attached conical spring washer

12 Nm / 106 lbf.in
T2—VFD Bolts Torque Settings

**Tightening DC Bus Bars**

Install TB2 and TB3 using twelve ZL02 washers and twelve HF33 screws.

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HF33</td>
<td>M8 hex cap screw fully threaded</td>
</tr>
<tr>
<td>ZL02</td>
<td>Conical spring washer for socket head cap screw Diam = 8</td>
</tr>
</tbody>
</table>
T2—VFD Bolts Torque Settings

Mounting the Electronic Board on the U phase Module

Install TB.9 metallic bracket on the U phase Module and the TB.10 board-bracket assembly using the four YR04 nuts.

Mounting the PL.5 Board

Connect the PL2 board using three VS27 screws.

YR04 | M6 hex lock nuts (Comby S) with attached conical spring washer

VS27 | Hexalobular flange head tapping screw 4mm x 6mm (diam x length)
**Danger**
Please utilize extreme caution when performing work within the drive cabinet. When opening the cabinet: be certain the drive protective shield is in place, wear appropriate PPE (Personal Protective Equipment), follow lock out-tag out procedures, and ensure all safety procedures are followed.

## 20.0 T2 VFD Bolts Torque Settings

### Mounting the Thermal Probe

![Image of thermal probe mounting]

- Mount **PL.4** using four **VS27** screws.
- Wire **PL.4** using five **VS27** screws.
- Wire **PL.3** using three **VS27** screws.

### Mounting **PL.4**

- Mount **PL.4** using four **VS27** screws.
- Wire **PL.4** using five **VS27** screws.
- Wire **PL.3** using three **VS27** screws.

### VS27

- Hexalobular flange head tapping screw 4mm x 6mm (diam x length)

**T2 VFD Bolts Torque Settings**

- **2 Nm / 17.70 lbf.in**
Danger
Please utilize extreme caution when performing work within the drive cabinet. When opening the cabinet: be certain the drive protective shield is in place, wear appropriate PPE (Personal Protective Equipment), follow lock out-tag out procedures, and ensure all safety procedures are followed.

Cooling System for the T1 Drive

Fan supply
Input rectifier duct
Output IGBT duct
Drive fan
DC Choke
Drive
Air inlet with filter

Cooling System for the T2 Drive

Air outlet (air blown into the compressor enclosure and exhausted by the main package blower)
The 4 heat sinks of the drive
Blower + motor
Ducts
Air inlet from bottom of the
21.0 VFD Cooling

**Danger**
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**VFD Cooling**

Fan voltage measurement
Nirvana Drive / Motor Investigation Site Log

This form must be completed in FULL and returned with all Nirvana VFD parts returned as part of a warranty claim. Claims will not be settled until this form has been completed and returned with the part replaced.
### HPM VSD Troubleshooting

#### Danger

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#### 22.0 Site Log

**N37 -160 KW, Nirvana, Drive / Motor Investigation Site Log**

<table>
<thead>
<tr>
<th>IntelliSys Fault 2</th>
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<tbody>
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### 22.0 Site Log

**N37 - 160 KW, Nirvana, Drive / Motor Investigation Site Log**

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**Revision Updates and History**

**Date:** August 2007

**REV. 05**

**Comments:**

- All page references have been changed to section
- Milliohm meter test procedure has been added
- Motor resistance phase to phase values added to manual
- HIPOT testing procedure added to manual
- Drive error codes have been removed
- New Site Log Sheet added

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