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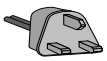
Yaskawa Electric America

Unit Troubleshooting Manual
Section Two: Power Checks
GPD 506/P5 and GPD 515/G5
(0.4 ~ 160kW)

Section Two:
Power Checks



Power Checks

TEST PROCEDURE CHECKLIST

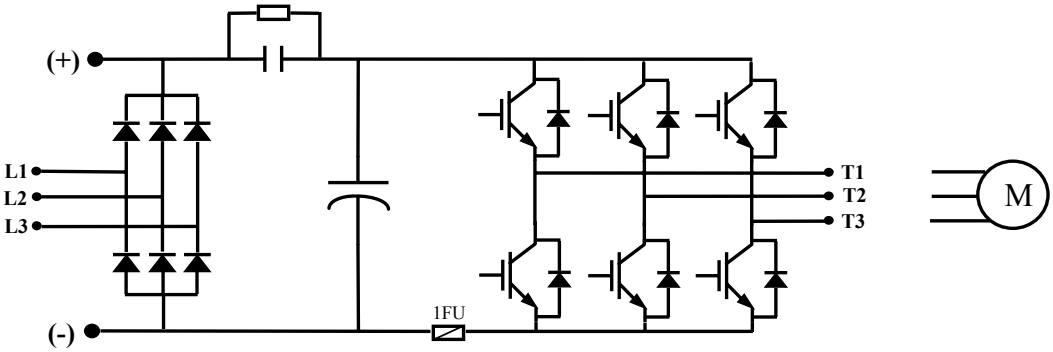
Check box when completed

- ❑ *1. Remove the DC bus fuse and replace it with a 30W, 500 ohm resistor.*
- ❑ *2. Apply power to terminals L1, L2, & L3.*
- ❑ *3. Check the DC bus voltage.*
- ❑ *4. Check the 15V power supply.*
- ❑ *5. Check the (-15V) power supply. (GPD515/G5 only)*
- ❑ *6. Check the isolated 24V power supply.*
- ❑ *7. Check the output voltage waveform.*
- ❑ *8. Check the gate firing pulses (if necessary).*
- ❑ *9. Remove the 500 ohm resistor, re-install the DC bus fuse.*
- ❑ *10. Run the motor.*
- ❑ *11. Check the output current waveform.*
- ❑ *12. Check the control board inputs and outputs.*
- ❑ *13. Check the PG pulses. (GPD515/G5 only)*

⚠ *WARNING*

LETHAL VOLTAGES ARE PRESENT!

Extreme caution must be used when working on the inverter. Make sure the charge LED is not lit and the DC bus voltage is below 10VDC before touching any components. The motor must be disconnected to perform the following tests!

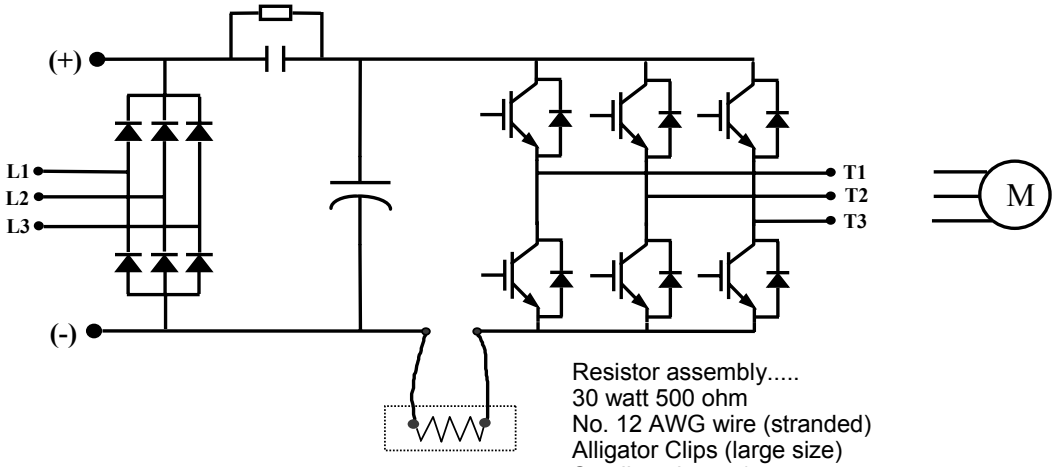


Main Circuit Diagram

Remove DC Bus Fuse

Step 1

Remove the DC bus fuse and replace it with a 30 watt 500 ohm resistor.



Resistor assembly.....
30 watt 500 ohm
No. 12 AWG wire (stranded)
Alligator Clips (large size)
Small enclosure*

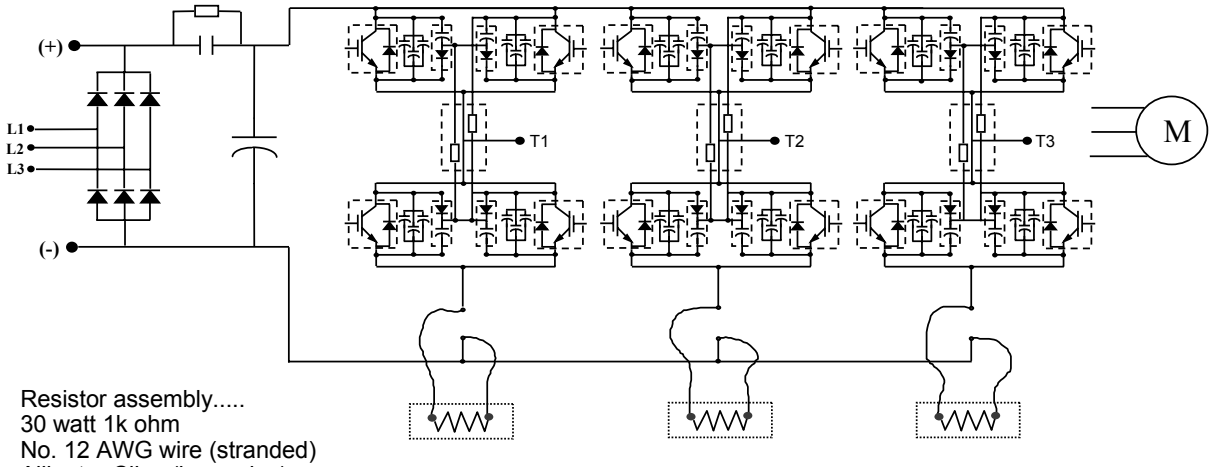
* In case of a short, the enclosure will contain the resistor if it fragments.

Remove DC Bus Fuse(s)

for models 2030 through 2075 and 4055 through 4160

Step 1

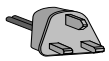
Remove the DC bus fuse(s) and replace with a 30 watt 1 k ohm resistor.



Resistor assembly.....
30 watt 1k ohm
No. 12 AWG wire (stranded)
Alligator Clips (large size)
Small enclosure*

* In case of a short, the enclosure will contain the resistor if it fragments.

Apply Power



CAUTION

Step 2

Apply the appropriate AC voltage (230V/460V/600V) to the input terminals marked L1, L2, and L3 and watch for the following signs of trouble.

1. The 30W 500 Ohm resistor gets hot.
2. The DC bus voltage is low.
   - For a 230V inverter with 230V AC applied to the input, the DC bus voltage should be approximately 325VDC.
   - For a 460V inverter with 460V AC applied to the input, the DC bus voltage should be approximately 650VDC.
   - For a 600V inverter with 600V AC applied to the input, the DC bus voltage should be approximately 845VDC.
3. The digital operator displays an undervoltage fault.
4. No display on the digital operator.

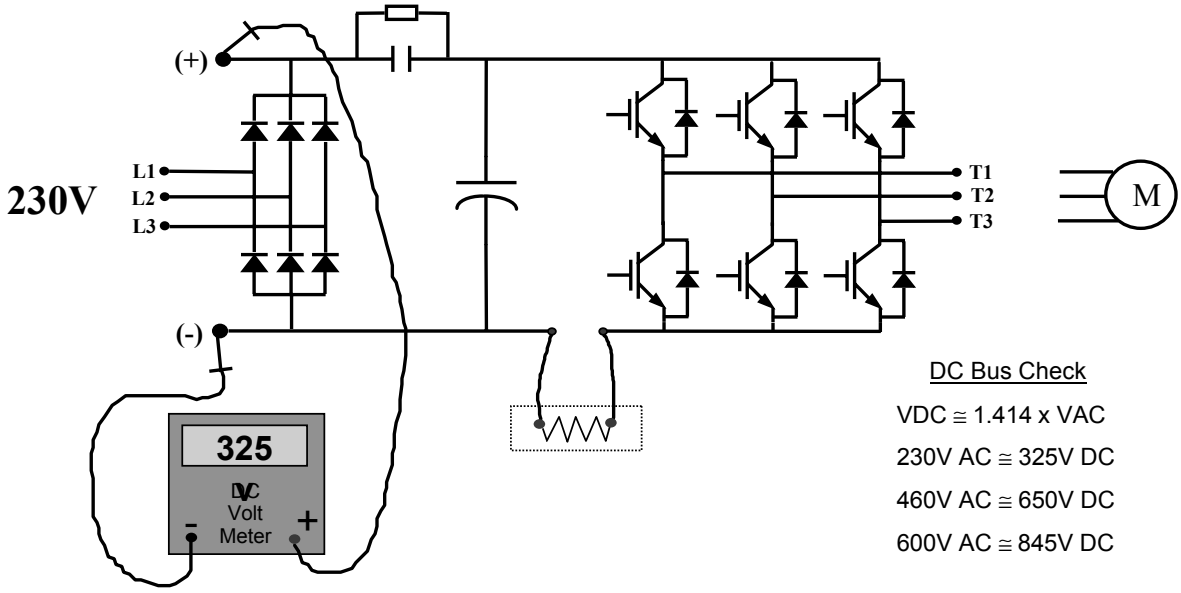
If any of these conditions occur, Turn off the power immediately!

It is possible that there is still a short between the positive and negative portions of the DC bus. Refer to page 10 and perform the checks without power again.

Check The DC Bus Voltage

Step 3

With a DC voltmeter set to the highest scale, measure the DC bus voltage at the (+) and (-) terminals.



DC Bus Check

VDC ≅ 1.414 x VAC

230V AC ≅ 325V DC

460V AC ≅ 650V DC

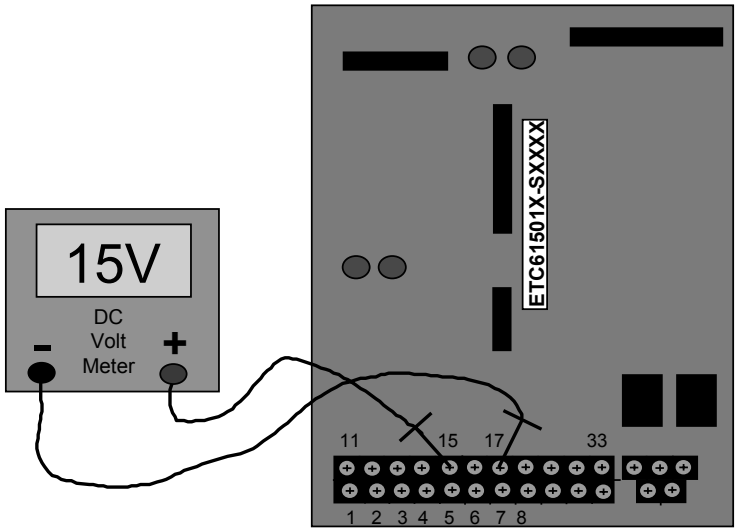
600V AC ≅ 845V DC

Power Supply Check (15V)

Step 4 (For GPD 515/G5 models)

Measure the 15V power supply on the control board at terminals 15 and 17 (Gnd).

GPD 515/G5

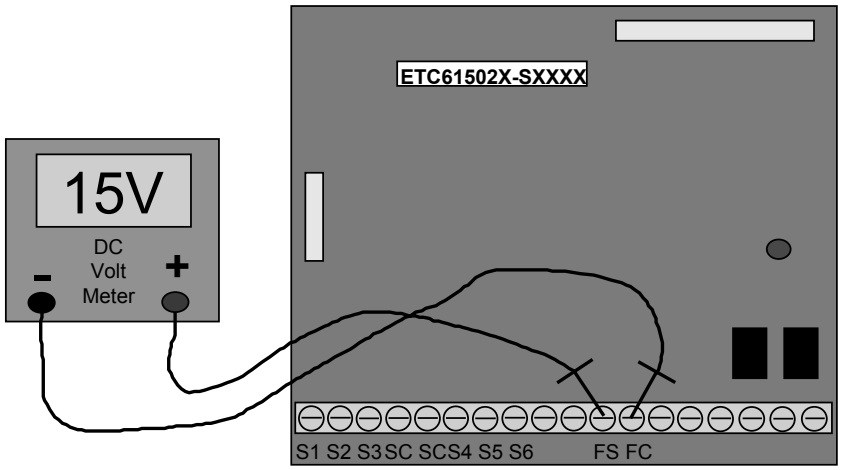


Power Supply Check (15V)

Step 4 (For GPD 506/P5 models)

Measure the 15V power supply on the control board at terminals FS and FC (Gnd).

GPD 506/P5

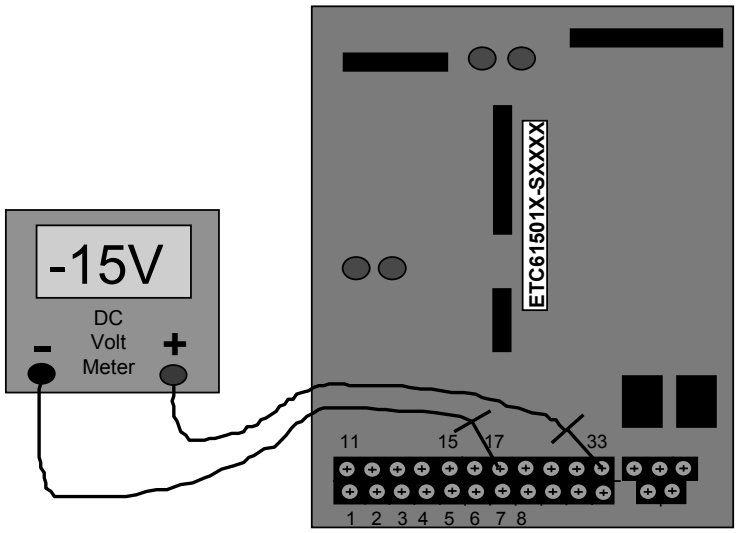


Power Supply Check (-15V)

Step 5 (For GPD 515/G5 models)

Measure the (-15V) power supply on the control board at terminals 33 and 17 (Gnd).

GPD 515/G5

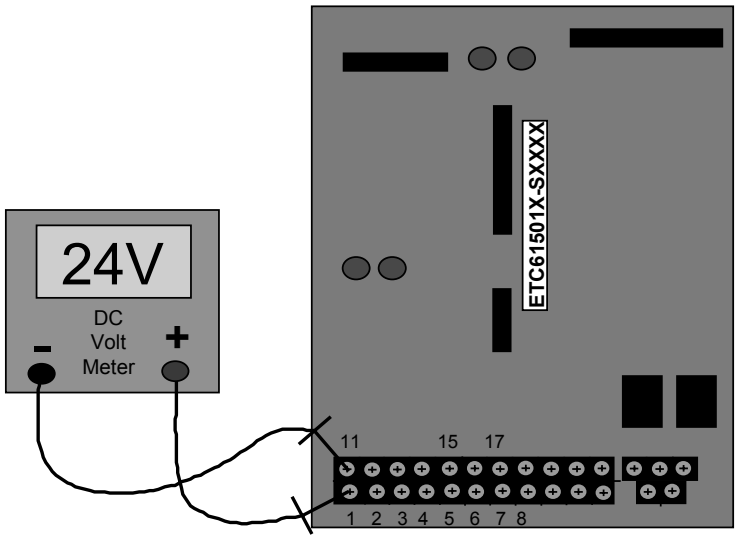


Power Supply Check (24V)

Step 6 (For GPD 515/G5 models)

Measure the isolated 24V power supply on the control board at terminals 1 ~ 8 using terminal 11 (Gnd) as a common point.

GPD 515/G5

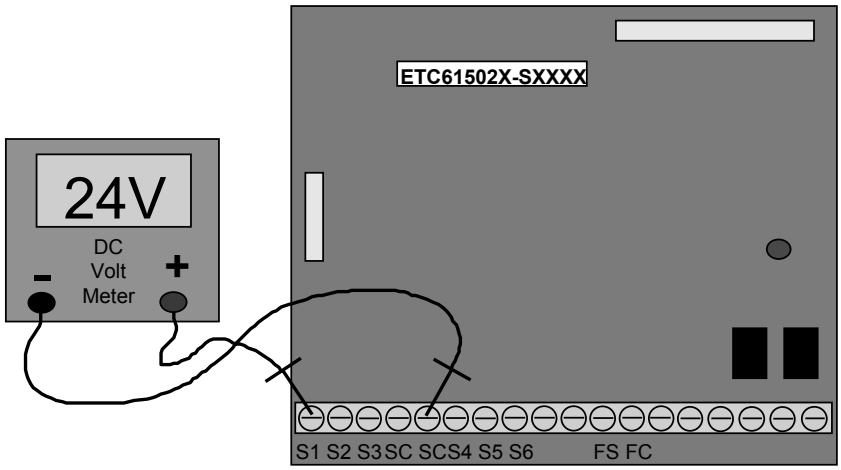


Power Supply Check (24V)

Step 6 (For GPD 506/P5 models)

Measure the isolated 24V power supply on the control board at terminals S1 ~ S6 using terminal SC (Gnd) as a common point.

GPD 506/P5



Output Voltage Waveform

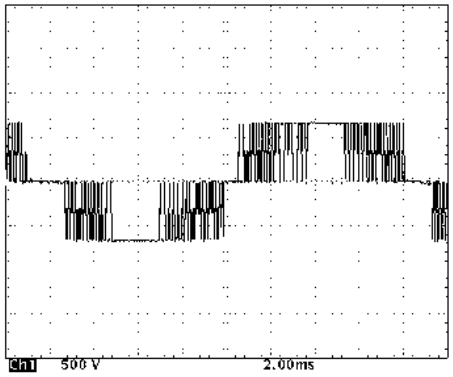
Step 7

Test Equipment - Ungrounded oscilloscope with X 100 probe

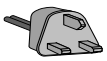
Set scope to 500V/division and 2mSeconds, in order to observe the output voltage waveform.

Before attempting to run the inverter, make a list of all the parameters that have been changed from the factory settings. Initialize the drive and set it up to accept a run command and frequency reference from the digital operator.

1. Using the oscilloscope, measure between T1 and T2.
2. Run the inverter up to 60 Hz, watching the waveform as it accelerates.
3. Compare the waveform with the waveform shown below.
4. Stop the inverter.
5. Repeat steps 1 through 4 measuring T1 to T3 and T2 to T3.



Gate Circuit Check



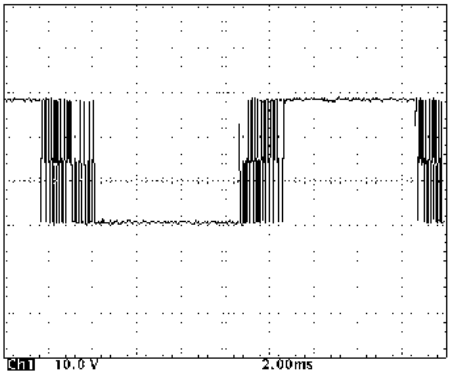
for models 0.4kw through 15kW

Step 8 (Only perform this test if the Output waveform is not working properly)
Test Equipment - Ungrounded oscilloscope with X 10 probe

Set scope to 10V/division and 2mSeconds, in order to observe the gate firing pulses.

1. Using the oscilloscope, measure between the gate and emitter pins which lead to the output IGBT.
2. Run the inverter at 60HZ, and compare the waveform you see with the one shown below.
3. Stop the inverter.
4. Repeat steps 1 through 3 measuring all six gate pulses.

• Never power up the inverter with the Gate wires removed or the IGBT will be damaged!



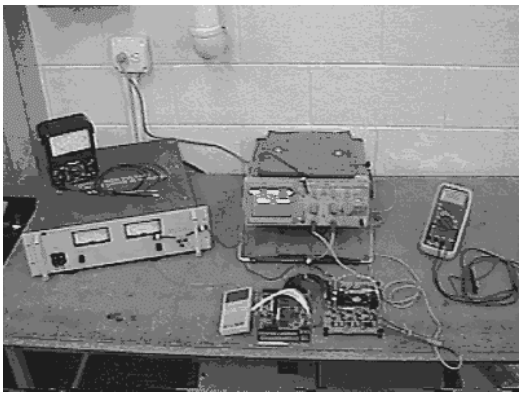
Gate Circuit Check

for models 18kW through 160kW

Step 8 (Only perform this test if the Output waveform is not working properly)

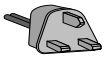
When an output transistor has been replaced, the firing circuit on the gate drive board should be tested. With the gate drive board mounted inside the inverter, it is difficult to access the test points to thoroughly test the gate firing circuit. It is recommended that the gate drive board and the control board be removed from the inverter and tested on a test bench.

- Never power up the inverter with the gate wires removed or the IGBT(s) will be damaged!



Step 8

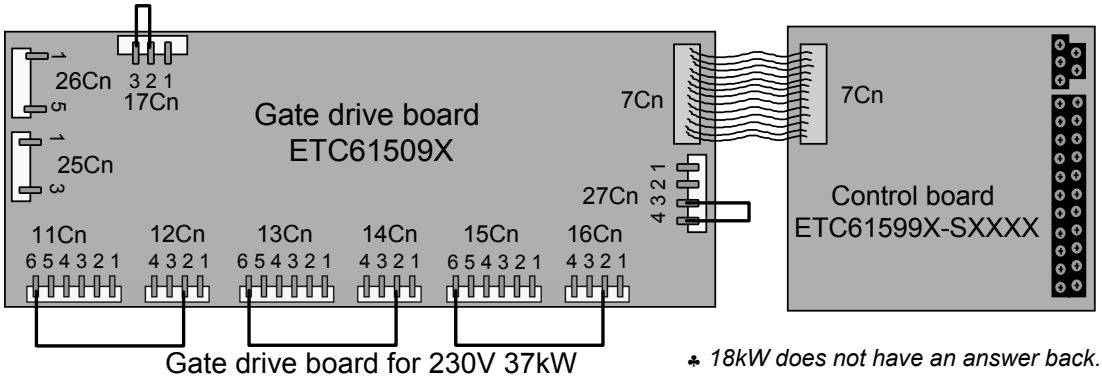
Gate Circuit Check



Test Equipment - Ungrounded oscilloscope with X 10 probe, DC Voltmeter, jumper wires.

1. Making sure that the power is not applied to the inverter, and the DC Bus voltage is below 10V, remove the gate drive board and the control board.
2. Using the following chart, attach jumper wires to the gate drive board or a fault will occur.

	Size	Jumper #1 (for Short Circuit)	Jumper #2 (for Short Circuit)	Jumper #3 (for Short Circuit)	Jumper #4 (for answer back)	Jumper #5 (for fan fault)
230V	18kW, 22kW	16CN pin 2 to 6	17CN pin 2 to 6	18CN pin 2 to 6	11CN pin 1 to 2	12CN pin 2 to 3
	30kW ~ 75kW	15CN pin 6 to 16CN pin 2	13CN pin 6 to 14CN pin 2	11CN pin 6 to 12CN pin 2	27CN pin 3 to 4	17CN pin 2 to 3
460V	18kW ~ 45kW	16CN pin 2 to 6	17CN pin 2 to 6	18CN pin 2 to 6	11CN pin 1 to 2 ♣	12CN pin 2 to 3
	55kW ~ 160kW	15CN pin 6 to 16CN pin 2	13CN pin 6 to 14CN pin 2	11CN pin 6 to 12CN pin 2	27CN pin 3 to 4	17CN pin 2 to 3
600V	18kW ~ 22kW	15CN pin 4 to 16CN pin 2	13CN pin 4 to 14CN pin 2	11CN pin 4 to 12CN pin 2	not required	not required
	30kW ~ 160kW	15CN pin 4 to 16CN pin 2	13CN pin 4 to 14CN pin 2	11CN pin 4 to 12CN pin 2	23CN pin 3 to 4	not required



Gate drive board for 230V 37kW

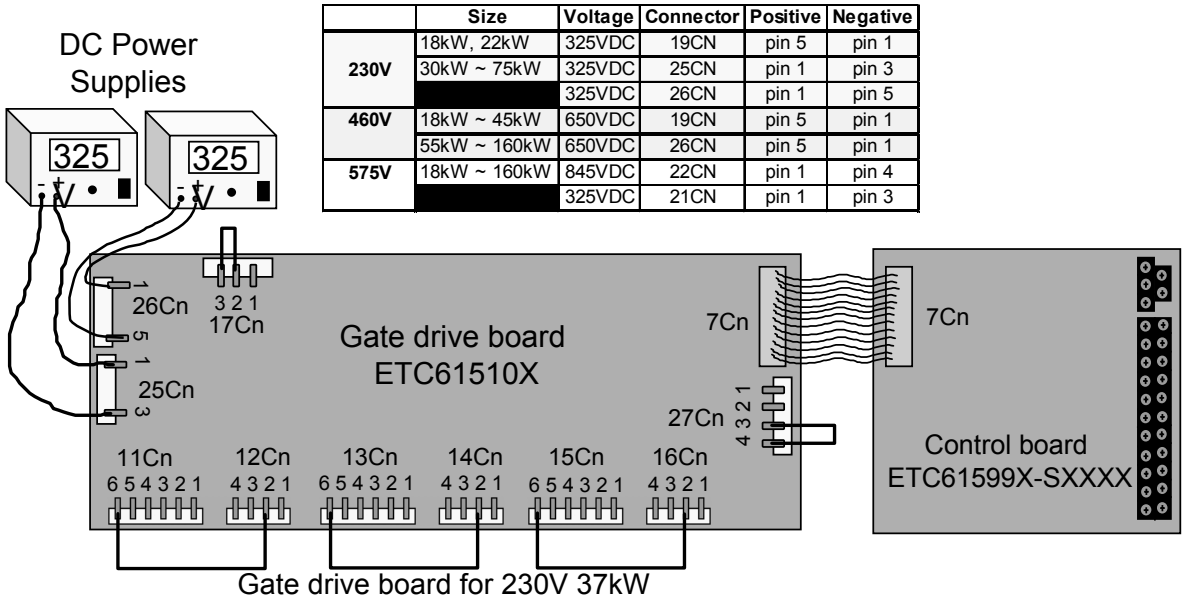
♣ *18kW does not have an answer back.*

Gate Circuit Check

Step 8

Test Equipment - Ungrounded oscilloscope with X 10 probe, DC Voltmeter, jumper wires.

3. Apply power to the gate drive board using the following chart.

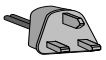


	Size	Voltage	Connector	Positive	Negative
230V	18kW, 22kW	325VDC	19CN	pin 5	pin 1
	30kW ~ 75kW	325VDC	25CN	pin 1	pin 3
		325VDC	26CN	pin 1	pin 5
460V	18kW ~ 45kW	650VDC	19CN	pin 5	pin 1
	55kW ~ 160kW	650VDC	26CN	pin 5	pin 1
575V	18kW ~ 160kW	845VDC	22CN	pin 1	pin 4
		325VDC	21CN	pin 1	pin 3

The table below is for A through C spec boards.

	Size	Voltage	Connector	Positive	Negative
230V	18kW, 22kW	325VDC	19CN	pin 5	pin 1
	30kW ~ 75kW	325VDC	25CN	pin 1	pin 3
460V	18kW ~ 45kW	650VDC	19CN	pin 5	pin 1
	55kW ~ 160kW	325VDC	25CN	pin 1	pin 3
		650VDC	26CN	pin 1	pin 5

Gate Circuit Check



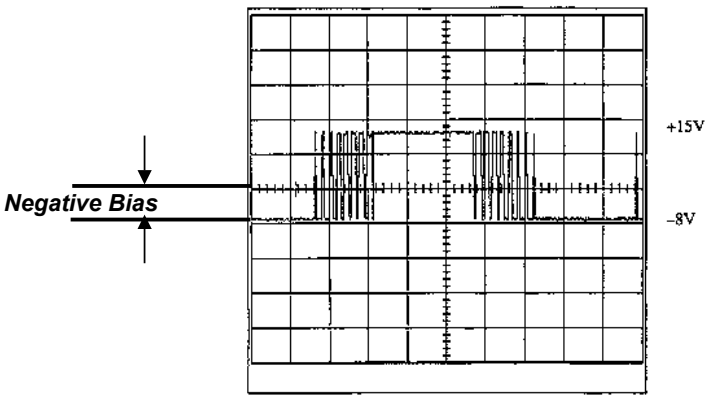
Step 8

Test Equipment - Ungrounded oscilloscope with X 10 probe

Set scope to 2V/div. and 2mSec., in order to observe the gate firing pulses.

4. Using the oscilloscope, measure between the gate and emitter pins which lead to the output IGBT.
5. Run the inverter at 60HZ, and compare the waveform you see with the one shown below.
6. Stop the inverter.
7. Repeat steps 1 through 3 measuring all six gate pulses.

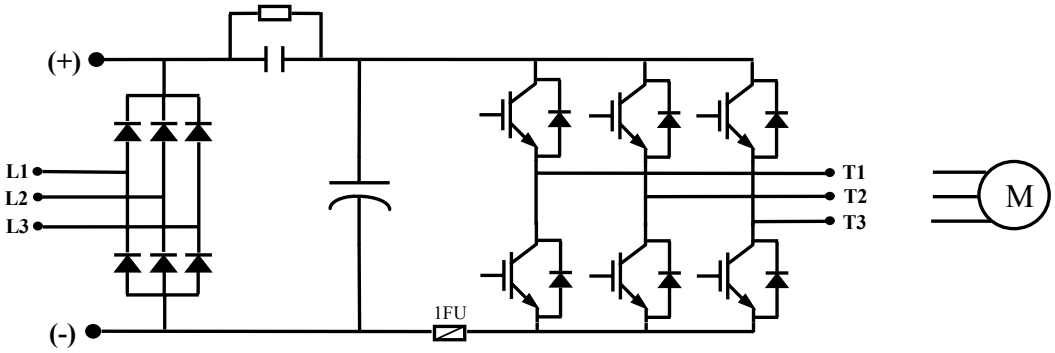
• Never power up the inverter with the gate wires removed or the IGBT will be damaged!



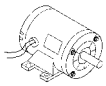
Install DC Bus Fuse

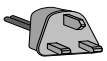
Step 9

Shut the power off to the inverter drive and lock it out if possible. Allow the DC bus to discharge. When the charge LED has gone out, use a DC voltmeter to check the DC bus voltage. When the DC bus voltage reaches 10 VDC, it is safe to work inside the unit. Remove the resistor and re-install the DC bus fuse.



Main Circuit Diagram





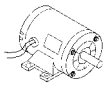
Run The Motor

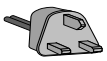
Step 10

1. Making sure that the power is not applied to the inverter, and the DC Bus voltage is below 10V, hook up the motor to the output terminals labeled T1, T2, and T3.
2. Apply power to the inverter.
3. Set the acceleration time and the deceleration time to 10 seconds.

GPD 515/G5	**GPD 506/P5**
Acceleration time (C1-01)	Acceleration time 1 (n019)
Deceleration time (C1-02)	Deceleration time 1 (n020)

4. Set the frequency reference for 6 Hz.
5. Give the inverter a forward run command. Observe the motor for abnormal operation. Repeat this step giving the inverter a reverse run command.
6. Set the frequency reference to 30 Hz and run the motor in both directions once again observing the operation.
7. Set the frequency reference to 60 Hz and run the motor once again.
8. Give the inverter a stop command.





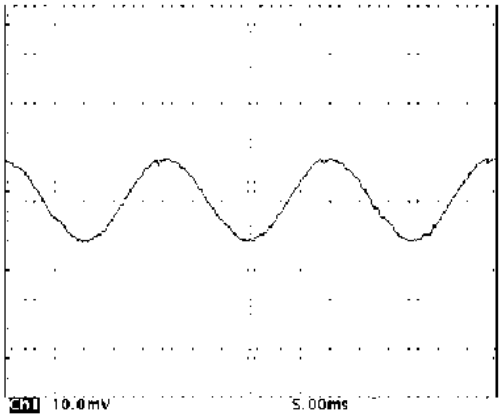
Output Current Waveform

Step 11

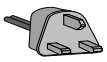
Test Equipment - Ungrounded oscilloscope with clamp on current probe.

Set scope to 10mV/division and 5mSeconds, in order to observe the output current waveform.

1. Using the clamp on current probe, clamp the probe to one of the output leads T1, T2, or T3.
2. Run the inverter up to 60 Hz, watching the waveform as it accelerates.
3. Compare the waveform with the waveform shown below. (Output will vary with load)
4. Stop the inverter.
5. Repeat steps 1 through 4 with the two remaining output leads.



Control Board Inputs/Outputs



Step 12 (for GPD 515/G5 models)

The following procedure may be used to thoroughly test the functions of the contact inputs/outputs and analog inputs/outputs of the control board.
(A GPD515/G5 test board is required to perform these steps)

1. With the power removed, install the test board to the terminal strip of the control board.
2. Apply power and perform a 2-wire factory initialization by setting A1-03 =2220. Change the access level (A1-01) to the advanced level (set value 4)

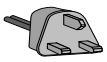
Digital & Analog Input Terminals

3. View monitor U1-10 (Input Term Sts), close and then open switches 1 through 8 and watch the display change from a “0” to a “1”.
4. View monitor U1-01 (Frequency Ref) and turn potentiometer RV1 (terminal 13) and watch the reference change.
5. Close switch #5, view monitor U1-01 (Frequency Ref) and turn potentiometer RV2 (terminal 16) and watch the reference change. Open switch #5.

Analog Outputs

6. Change parameter H4-04 (terminal 23 sel) to 1 (frequency ref) and H4-05 (terminal 23 gain) to 1, turn potentiometer RV1 until the frequency reference is 60Hz. The bar graph DSP2 should be illuminated. Close switch #1 and the bar graph DSP1 should fully illuminate when the output reaches 60 Hz. Open switch #1.

Control Board Inputs/Outputs



Step 12 (for GPD 515/G5 models)

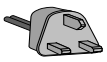
Digital Outputs

7. Monitor LED #2 (terminal 25), the LED should be on. Command the inverter to run at 60Hz, the LED should go off and LED #1 (terminal 9) should illuminate. LED #3 (terminal 26) should illuminate when the inverter is operating at 60Hz. Command the inverter to stop.

Fault Contacts

8. When the inverter is not in a fault state, LED #5 (terminal 19) will be on. Close switch #3, EF3 will be displayed and LED #4 (terminal 18) will illuminate. Open switch #3 and press the reset key.
9. Perform a 2-wire factory initialization by setting A1-03 =2220.
10. Remove power and remove the test board.

Control Board Inputs/Outputs



Step 12 (for GPD 506/P5 models)

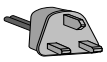
The following procedure may be used to thoroughly test the functions of the contact inputs/outputs and analog inputs/outputs of the control board.
(A GPD506/P5 test board is required to perform these steps)

1. With the power removed, install the test board to the terminal strip of the control board.
2. Apply power and perform a 2-wire factory initialization by setting n001 =8. Change the access level (n001=3) to read/write to all parameters.

Digital & Analog Input Terminals

3. View the monitor U-07 (Input Terminal Status), close and then open switches 1 through 6 and watch the individual digits on the digital operator turn on and off.
4. Monitor Fref (Frequency reference) and turn potentiometer RV1 (FV) and watch the reference change.
5. Set parameter n039=8 (Freq. Ref. Input Select), then view monitor Fref (Frequency Reference). Close switch #6 and turn potentiometer RV2 (terminal FI) and watch the reference change. The reference will change but will not be accurate because terminal FI is configured for a 4-20mA input. If jumper J1 on the control board is cut, set parameter n043=0. The terminal is now configured for a 0-10V input and the reference will now be accurate. Open switch #6 when finished.

Control Board Inputs/Outputs



Step 12 (for GPD 506/P5 models)

Analog Output

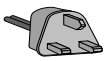
6. Turn potentiometer RV1 until the frequency reference is 60Hz and close switch #1. The bar graph DSP1 will be fully illuminated when the output reaches 60Hz. Open switch #1.

Digital Output

7. Monitor LED #1 (terminal M1), the LED should be off. Command the inverter to run at 60Hz, the LED should go on. Stop the inverter by opening switch #1.

Fault Contacts

8. When the inverter is not in a fault state, LED #3 (terminal MB) will be on. Close switch #3, EF3 will be displayed and LED #2 (terminal MA) will illuminate. Open switch #3 and press the reset key.
9. Perform a 2-wire factory initialization by setting n001 =8.
10. Remove power and remove the test board.



Checking PG Pulses

Step 13 (for GPD 515/G5 models)

Test Equipment - Ungrounded oscilloscope with x10 probe.

Set scope to 5V/division and .01mSeconds, in order to observe the PG pulses.

When operating the GPD 515/G5 in the Closed Loop Flux Vector mode, a pulse generator (PG) must be connected to the motor and a PG-X2 option card must be installed on the control board. The pulse generator sends two pulses ("A" & "B") and their complements (A & B) to the PG-X2 card. These pulses are necessary for direction data, velocity data, and for vector calculations. The following procedure may be used to verify the signals from the pulse generator.

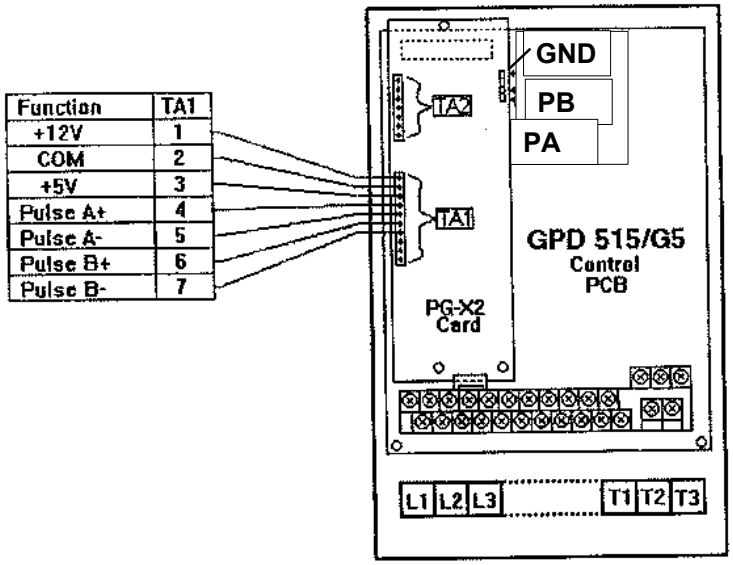
1. View the motor speed monitor (U1-05) and if possible, rotate the shaft of the motor with your hand in the clockwise direction. (This is determined by standing in front of the motor with the shaft facing you) A positive motor speed should be displayed. When the motor and PG are wired correctly, the motor shaft will rotate in the clockwise direction when a forward run command is given. If the shaft is rotated in the counter clockwise direction, a negative motor speed will be displayed.
2. Using channel 1 of the oscilloscope, connect the probe between the test pins labeled "PA" and "Gnd" located on the PG-X2 option card. Connect the test probe attached to channel 2 to test pins "PB" and "Gnd" also on the PG-X2 card. (see next page for wiring diagram)

Checking PG Pulses

Step 13 (for GPD 515/G5 models)

Test Equipment - Ungrounded oscilloscope with x10 probe.

Connect scope as shown below.



Using channel 1 of the oscilloscope, connect the probe between the test pins labeled **"PA"** and **"Gnd"** located on the PG-X2 option card. Connect the test probe attached to channel 2 to test pins **"PB"** and **"Gnd"** also on the PG-X2 card.

Checking PG Pulses

Step 13 (for GPD 515/G5 models)

Test Equipment - Ungrounded oscilloscope with x10 probe.

Set scope to 5V/division and .01mSeconds, in order to observe the PG pulses.

3. Command the inverter to run in the forward direction with a reference of 60 Hz. The “A” pulse (channel 1) should lead the “B” pulse (channel 2) by 90°. Compare the waveforms with the picture below.