

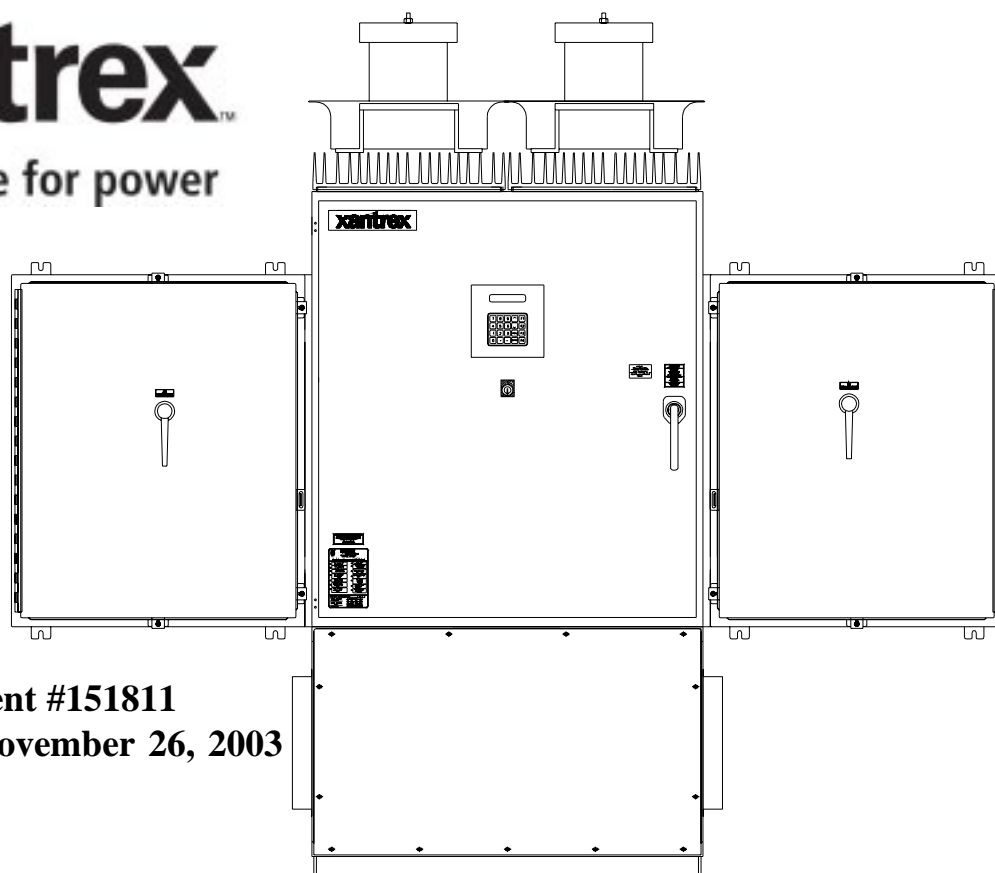
# OPERATION and MAINTENANCE MANUAL

for

## MODEL PV-225208

225 kW Grid-Tied Photovoltaic Inverter

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### IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS - THIS MANUAL CONTAINS IMPORTANT INSTRUCTIONS FOR XANTREX TECHNOLOGY MODEL PV-225208 GRID TIED PHOTOVOLTAIC INVERTER THAT SHALL BE FOLLOWED DURING INSTALLATION AND MAINTENANCE OF THE PV-225208.

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## **INTRODUCTION**

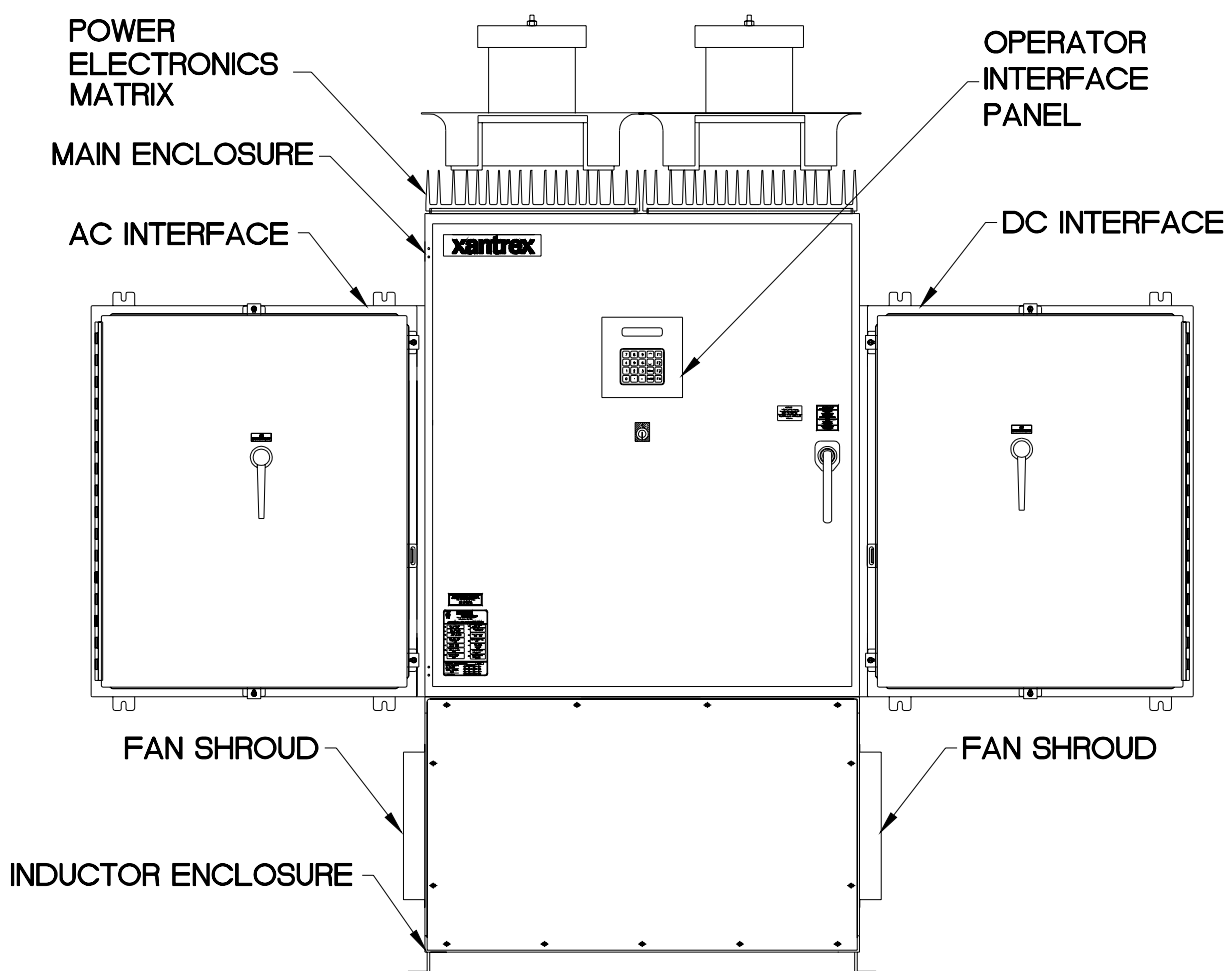
The Xantrex Technology Model PV-225208 is a current following grid tied photovoltaic inverter, utilizing state-of-the-art IPM (Intelligent Power Module), insulated gate bi-polar transistors (IGBT's) and gate drive circuits to allow interface of a photovoltaic array with a utility grid. The PV-225208 consists of an inverter bridge, photovoltaic controller, and associated control electronics. The PV-225208 control software provides for complete overall system control with a variety of protection and safety features.

## **MAJOR COMPONENTS**

The major components of the PV-225208 are identified in Figure 1-1. Control components are identified in Figure 1-2. For specific control components see Drawing No. 151808 located in Section 7 (Appendix).

### **Main Enclosure**

This enclosure is NEMA-3R rated. The PV-225208 main enclosure contains the power electronic inverter bridge, electrical and electromechanical control components, power supplies, system sensing circuits, and the PV-225208 embedded control unit. Also found within the main enclosure are some of the system protection devices (sense and control power fuses).



**Figure 1-1**

### **AC Interface Enclosure**

This enclosure is NEMA-3R rated. The AC Interface serves as the connection between the isolation transformer/utility and the PV-225208. This enclosure is where the AC line fuses and AC disconnect switch reside. For specific control components see Drawing No. 151809 in Section 7 (Appendix).

### **DC Interface Enclosure**

This enclosure is NEMA-3R rated. The DC Interface serves as the connection interface between the PV array and the PV-225208. This enclosure is where the DC disconnect switch and DC contactor reside. For specific control components see Drawing No. 151810 in Section 7 (Appendix).

### **CAUTION**

The fuses within the PV-225208 are intended for protecting the PV-225208 control circuitry only. They are not intended to provide protection for the PV array or external cabling.

### **Power Electronics Matrix**

The power electronics converters are located at the top of the PV-225208 Main Enclosure. Each matrix is comprised of switching transistors (IGBTs), transistor gate drive electronics, a laminated power bus, DC capacitor bank, and an aluminum extrusion heat sink with a cooling fan. A fan is located above each matrix heatsink.

The PV array is tied logically to the matrix DC bus via the DC interface enclosure. The embedded control unit manages the transfer of power between the DC bus and the utility grid.

### **Operator Interface**

The operator interface is located on the front door of the PV-225208 main enclosure. It consists of an On/Off switch and a keypad with liquid crystal display for control and monitoring purposes. All interface components are NEMA-3R rated. Refer to Section 4 for detailed operation instructions.

### **Inductor Enclosure**

This enclosure is NEMA-3R rated. It contains the necessary filter components to insure the PV-225208 line currents and voltages meet IEEE-519 and UL1741 harmonic distortion requirements. Mounted on the right and left side of the lower enclosure are inductor fans to allow cooling of the line filter components within. This enclosure also serves as the mounting base for the PV-225208 main enclosure.

## **CONTROL COMPONENTS**

The following assemblies are contained within the PV-225208 main enclosure as shown in Figure 1-2. For specific control components see Drawing No. 151808 in Section 7 (Appendix).

### **Power Distribution Panel**

This panel contains many of the Electro-mechanical, protective, and control power components necessary to support the operation of the PV-225208.

#### Power Control Unit (PCU)

The PCU is a Digital Signal Processor (DSP) based control board that performs numerous control and diagnostic functions associated with PV-225208 operation. Its most significant tasks are control of PV-225208 electromechanical components and power electronics converters, signal conditioning for high voltage signal inputs and communication with the operator interface panel and system sensors. The PCU also contains the necessary DC power supplies to support its operation.

#### INTERCONNECTION STANDARDS COMPLIANCE

The PV-225208 has been tested and listed by Underwriters Laboratories to be in compliance with **UL1741 Static Inverters And Charge Controllers For Use In Photovoltaic Power Systems**, as well as **IEEE-929-2000 Recommended Practice For Utility Interface Of Photovoltaic (PV) Systems**.

IEEE-929-2000 provides guidance regarding equipment and functions necessary to ensure compatible operation of photovoltaic systems which are connected in parallel with the electric utility. UL1741 is the standard applied by Underwriters Laboratory to the PV-225208 to verify it meets the recommendations of IEEE-929-2000. Refer to both documents for details of these recommendations and test procedures.

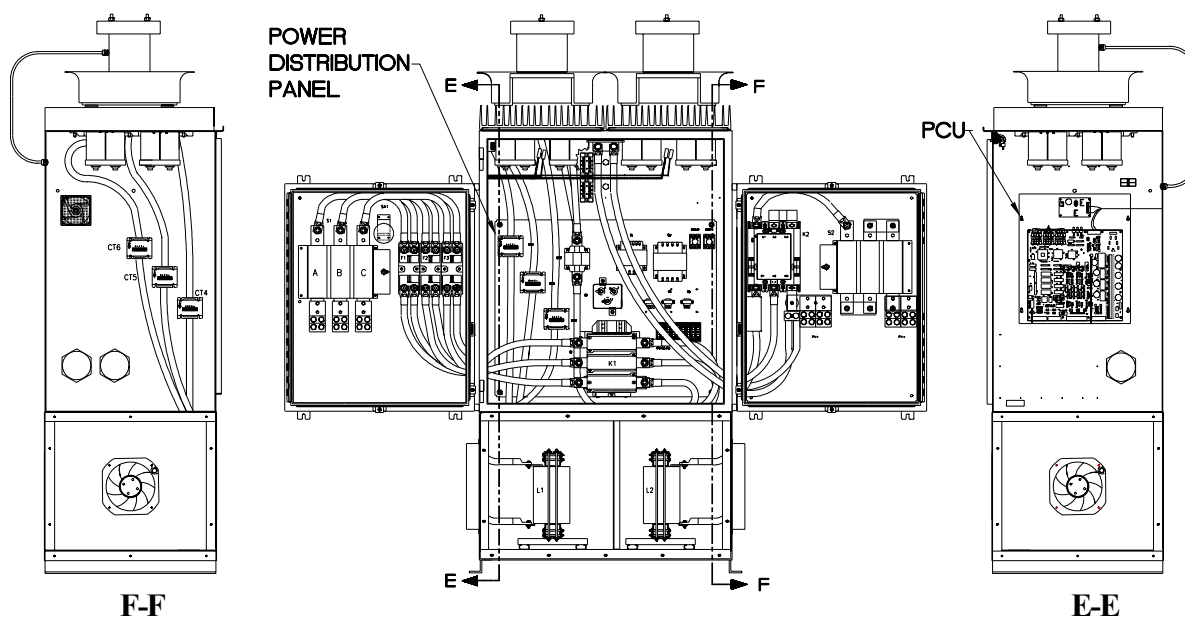


Figure 1-2

## **SPECIFICATIONS**

The PV-225208 has been designed for photovoltaic power systems, which operate within the following specifications. Application of the PV-225208 in a manner inconsistent with these specifications may cause damage to the PV-225208 and other system components, and is a violation of the terms of the warranty.

Nominal AC Line Voltage	208 VAC, +10% -12%
Maximum AC Line Current	695 ARMS (at low line voltage)
Nominal Line Frequency	60 Hz, +0.5 -0.7 Hz
Continuous AC Output Power	225.0 kW @ 208 VAC 3 Phase
PV Maximum Voltage	600 VDC
Peak Power Tracking Window	330*-600 VDC
PV Minimum Peak Power Tracking Voltage	330 VDC
PV Maximum Operating Current	710 ADC
Maximum PV Array Short Circuit Current	1100 ADC
PV Configuration	Monopolar negative grounded
Operating Temperature	** -20 to 50° C
Storage Temperature	-40 to 50° C
Maximum Ambient Temperature Rating	50° C
Relative Humidity	To 95%, Non-condensing
Elevation	Derated above 6,600 feet
Dimensions (in inches)	87 X 102 X 27
Weight	Approx. 1935 lbs.
Enclosure Type	NEMA 3R
UL Listing File	File-E199356

\*Dependent on actual AC line voltage. Refer to Section 4 for detail on the minimum power tracking voltage.

\*\*If ambient temperature is between -20 to 0° C, the unit must be powered up in standby for at least one hour prior to going on-line.

## **EQUIPMENT SYMBOL**

Chassis ground – Customer supplied system ground connection point. This symbol may be found near a stud within the main enclosure. It is provided as a location to bond the electrical system equipment ground.



## SAFETY FEATURES

### WARNING

**The PV-225208 enclosure contains exposed high voltage conductors. The enclosure doors should remain locked, except during maintenance or testing. These servicing instructions are for use by qualified personnel only. To reduce the risk of electric shock, do not perform any servicing other than that specified in the operating instructions unless you are qualified to do so. Do not open the cabinet doors if extreme moisture is present (rain or heavy dew).**

#### On/Off Switch

The PV-225208 incorporates a maintained position on/off switch located on the front door of the main enclosure. Under normal conditions, the on/off switch is in the on position. Turning the switch to the off position will initiate a controlled shutdown of the PV-225208 and open the A/C contactor within the unit. The A/C contactor cannot be closed unless the switch is in the on position. The PV-225208 is prevented from being restarted until the on/off switch is turned back to the on position. Cycling the on/off switch will reset the PV-225208 and attempt to clear any system fault.

#### Main Enclosure Door Interlock Switch

The front door of the PV-225208 main enclosure is equipped with an interlock switch to preclude operation in the event of the front door being opened. It is required that the PV-225208 main enclosure door handle be padlocked during normal operation.

### WARNING

**The PV-225208 will immediately shutdown if the front door is opened during operation. It is required that the PV-225208 main enclosure door handle be padlocked during normal operations. Please make sure the unit is powered down, and isolated from the utility grid and PV panels, prior to opening the front door. Allow 5 minutes for any stored potentials to be discharged, prior to opening the unit.**

#### Disconnect Switches

Both AC & DC switches are equipped with lockout hasps for personnel safety. The switch enclosure door will not open while the PV-225208 is running. In addition, the switch handle and shaft provide a door interlock. The door cannot be opened when the switch is in the "on" position. The PV disconnect switch is equipped with an auxiliary contact block which enables the switch to be used as a load break PV disconnect. In the event a disconnect switch is opened while the PV-225208 is processing power from the PV array, the contact block will signal the PCU to stop processing power before the switch opens.

#### Fault Reporting

Any fault conditions are reported to the operator interface. The LCD will display a text description of the fault. Refer to Section 5, Troubleshooting, for detailed descriptions of system fault conditions.

#### PV Ground Fault Detection

The PV-225208 is equipped with ground fault detection circuitry (see section 3, installation and section 7, system schematic for further detail). Upon detection of 10 amps of ground fault current, the PV-225208 executes an orderly shutdown, and annunciates a ground fault at the operator interface. The PV-225208 will remain faulted until the ground fault is remedied and cleared at the operator interface (see section 5, troubleshooting).

### Over/Under Voltage and Frequency

The over/under frequency and voltage detection setpoints have been chosen to be in compliance with IEEE-929 and UL1741.

Fault Condition (% of Nominal)	Voltage Range	Trip Time
VAC < 50%	VAC < 104	6 Cycles
50% < VAC < 88%	104 < VAC < 183	2 Seconds
88% < VAC < 110%	183 < VAC < 228	Normal Operation
110% < VAC < 137%	228 < VAC < 285	2 Seconds
137% < VAC	285 < VAC	2 Cycles
f < rated -0.7	f < 59.3	6 Cycles
f > rated +0.5	f > 60.5	6 Cycles

### Anti Island Protection

A digital phase-shift-loop (PSL) circuit is implemented in the DSP inverter controller to prevent “Islanding” of the PV-225208.

The DSP continuously makes minor adjustments to the power factor phase angle above and below unity. In the event of a utility outage, these adjustments destabilize the feedback between the inverter and the remaining load, resulting in an over/under frequency or voltage condition. The PV-225208 then performs an orderly shutdown. The fault condition will remain until the utility voltage and frequency have returned to normal for 5 minutes.

This method has been extensively tested and proven to exceed the requirements of UL 1741.

## ISOLATION PROCEDURE

The following procedure should be followed to de-energize the PV-225208 for maintenance:

WARNING
<b>The terminals of the PV input may be energized if the arrays are energized. In addition, allow 5 minutes for all capacitors within the main enclosure to discharge after disconnecting the PV-225208 from AC and DC sources.</b>

1. Turn the on/off switch to the off position.
2. Open the DC interface (PV array) disconnect switch.
3. Open the AC interface disconnect switch.
4. Open the isolation transformer circuit breaker.
5. Install lockout devices on the isolation transformer circuit breaker and PV disconnect switch.



## ISOLATION TRANSFORMER REQUIREMENTS

The PV-225208 UL1741 certification requires the use of a Xantrex Technology specified 225 kVA WYE/WYE isolation transformer between the inverter AC output and the utility interconnection (See Appendix in Section 7 for transformer dimensions and specifications. This custom 225 kVA isolation transformer is not part of the 225 kVA inverter, but can be ordered as a separate item. If maintaining the listing to UL1741 is not a requirement for your application, contact Xantrex Technology for a fact sheet describing the installation options and precautions for installing this inverter in a photovoltaic system that does not require UL1741 compliance.

### WARNING

**Xantrex Technology requires installing an isolation transformer between the PV-225208 inverter and the point of utility interconnection. Failure to do so could result in catastrophic damage to the PV-225208 as well as the utility distribution system and will void the product warranty.**

#### Inverter Side Isolation Transformer Requirements

The inverter side of the isolation transformer is configured as a WYE, and is rated for 208 VAC. **The neutral (X0) connection on the inverter side must be left floating.** If the neutral is tied to ground, the inverter will be damaged internally at power-up.

#### Utility Side Isolation Transformer Requirements

The utility side windings of the isolation transformer are configured WYE, and must match the voltage at the utility inter-tie. Verify that the transformer supplied matches the voltage requirement. Also, the transformer is supplied with a neutral connection on the utility side. Connection of this utility-side neutral does not affect the operation of the inverter. Check local jurisdiction for their requirements regarding the connection of this neutral.

Contact your Xantrex Technology distributor if you have any questions regarding isolation transformer requirements.

## TORQUE AND WIRE GAUGE SPECIFICATIONS

The following torque specifications are to be used on all electrical interfaces made during installation of the PV-225208.

Torque Table	
Terminal Block or Bolt Size	Torque Setting
3/8-16 Bolt (AC)	250 in lbs./28.2 Nm
Terminal Block (DC+, DC-, & DC Neutral)	275 in lbs/31.1 Nm

The following table shows acceptable wire gauges to be connected to the PV-225208 AC and DC inputs.

Wire Gauge Table	
Termination	Wire Range AWG
Compression Lug (AC)	Up to 4 600MCM-#2 Conductors Per Phase
Compression Lug (DC+ and DC-)	Up to 8 600MCM-#2 Conductors for each (+) and (-)
Terminal Block (DC Neutral)	Up to 2 350MCM-#6 Conductors

## INSTALLATION INSTRUCTIONS

CAUTION
<b>All wiring methods shall be in accordance with the National Electrical Code ANSI/NFPA 70. All power conductors interfacing to the PV-225208 should be sized in accordance with the National Electric Code ANSI/NFPA 70 and local codes. Large gauge wire must have a minimum bend radius dependent upon the wire gauge (refer to the National Electric Code, Article 373-6B). Take care to keep the wire bundles away from any sharp edges which may damage wire insulation over time. Xantrex Technology recommends using 250 MCM, 105 degrees C, minimum, copper wire for all connections to the PV-225208.</b>

### Ventilation Considerations

Maintain a minimum of 12" clearance in back , front and both sides of the PV-225208 for proper cooling fan operation.

### Installation

1. Move the PV-225208 into place. Lift the PV-225208 from beneath the lower enclosure with a forklift as shown in **Figure 3-1**. (See following page.)
2. Anchor the lower enclosure feet to the floor with a 1/2" anchor bolts.
3. Install all conduits needed for cable entry in the shaded areas of both AC and DC interface enclosures as shown in **Figure 3-2**. (See following page).

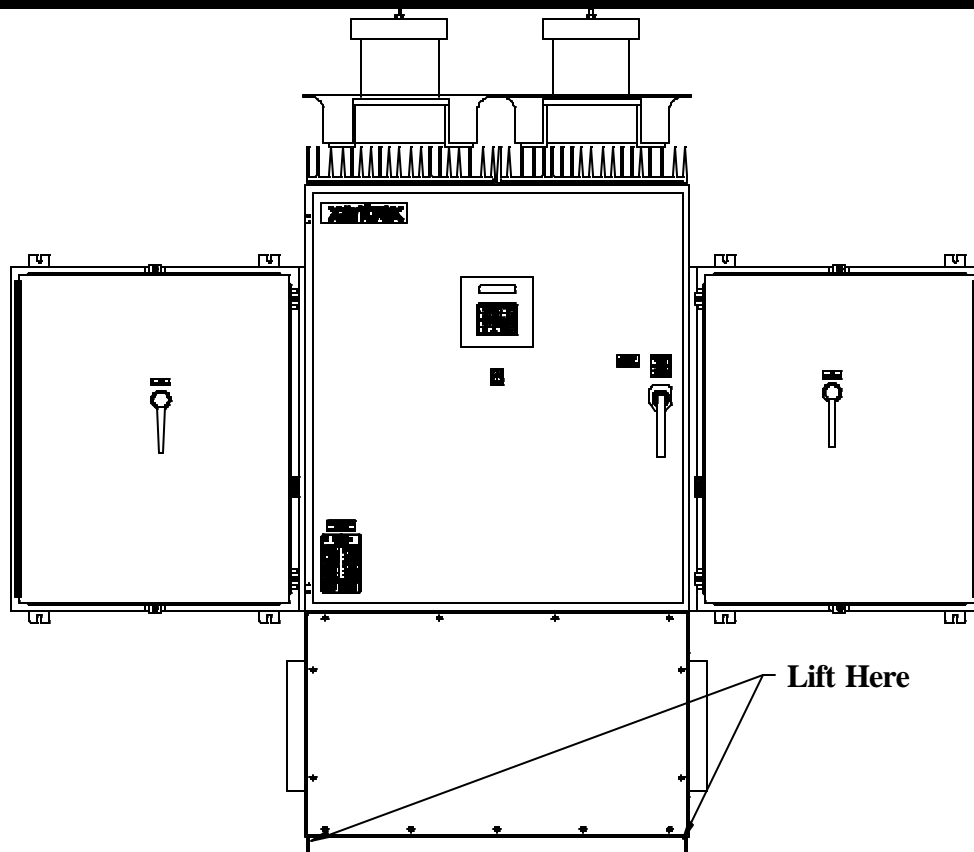


Figure 3-1

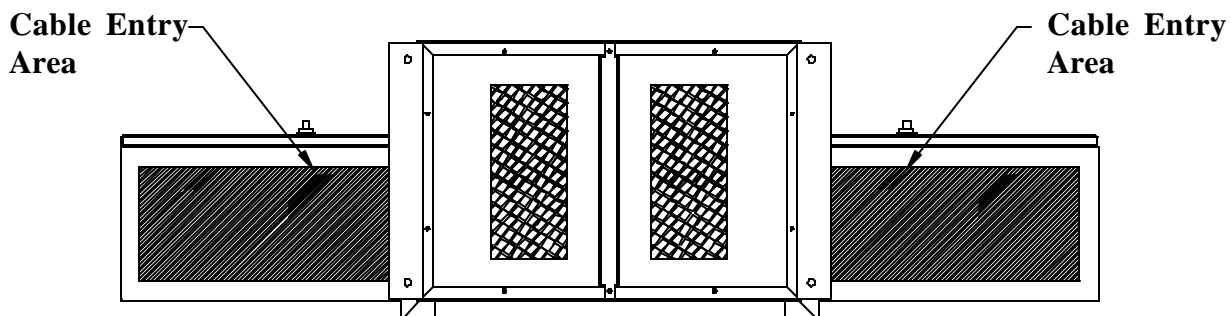


Figure 3-2

### Array Grounding

NEC 690-41/42 requires the PV array to be earth grounded. The PV-225208 chassis is also bonded to the PV safety ground terminal block. Refer to the system schematic in the appendix for further wiring configuration.

## SECTION 3

### INSTALLATION AND INITIAL TURN-ON

#### Ground Fault Detection

The PV-225208 is equipped with a ground fault detection circuit and current transducer (CT1 in illustration). This circuit is active when the PV array is grounded as described in the previous section. In the event of a greater than 10 amp ground fault, the PV-225208 will execute an orderly shutdown and annunciates a ground fault at the operator interface. The PV-225208 will remain faulted until the ground fault is remedied and cleared at the operator interface (see section 5, Troubleshooting).



#### CAUTION

**The input and output circuits are isolated from the enclosure and the system grounding, if required by sections 690-41, 690-42 and 690-43 of the National Electric Code, ANSI/NFPA 70, is the responsibility of the installer.**

### INTERCONNECTION WIRING

#### CAUTION

**To reduce the risk of fire, connect only to a circuit provided with 800 amperes @208VAC, or 400 amperes @480VAC maximum branch circuit overcurrent protection in accordance with the National Electrical Code, ANSI/NFPA 70.**

The following wires for connecting the PV-225208 to external devices are not provided by Xantrex Technology: (See installation diagram on pages 3-5.)

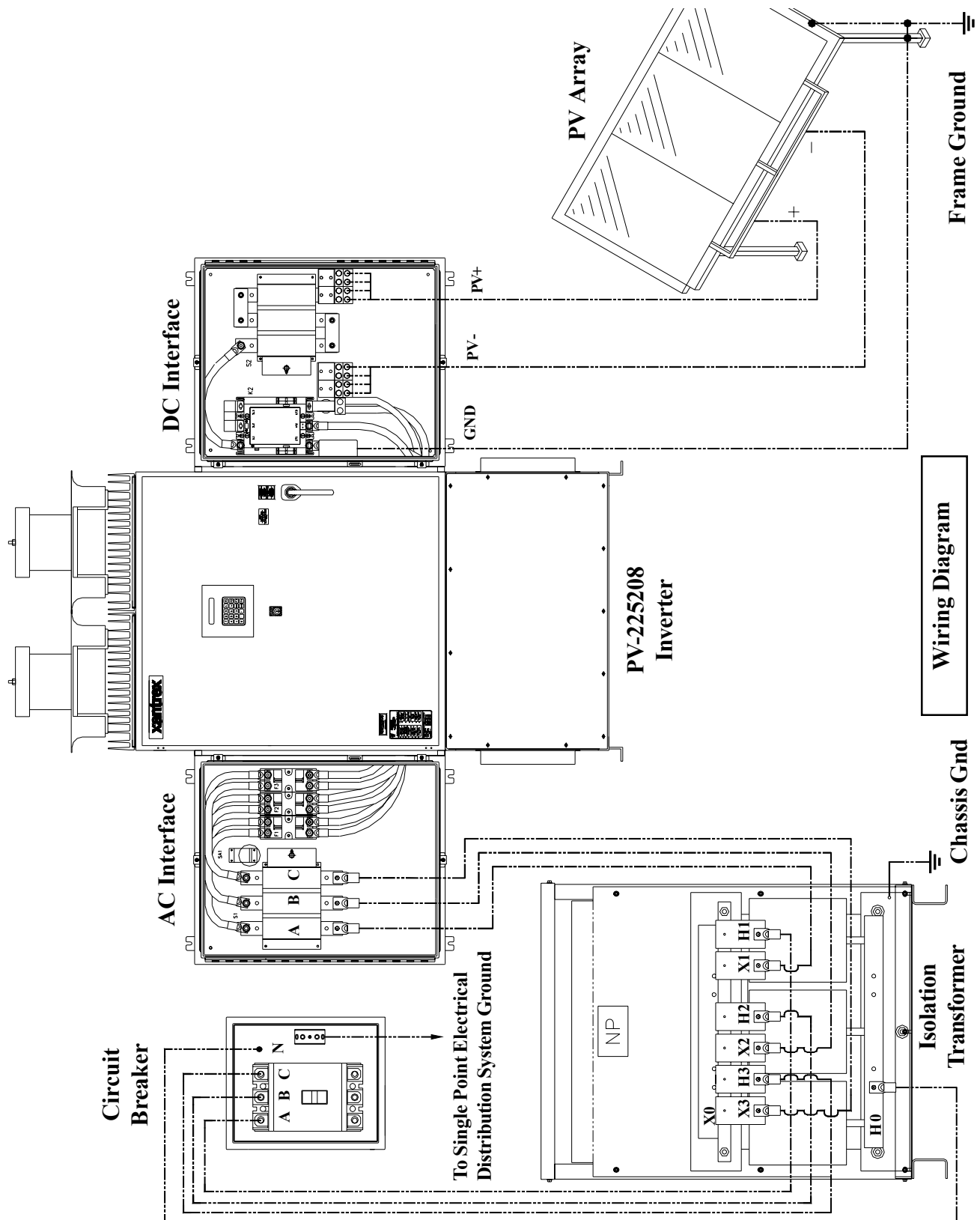
- Connect 3-Phase 208 VAC inverter output (AC Disconnect switch) to terminals of the 208 VAC inverter side of isolation transformer. **The neutral on the inverter side of the isolation transformer must be left floating. Ground loops will exist when the inverter starts switching, which will cause the inverter to shut down due to phase over-currents and will result in damage to the PV-225208. Also, insure that this neutral is not bonded to the isolation transformer frame.** Be sure to maintain proper phasing as shown in the system schematic found in Section 7.
- Connect Isolation transformer grid side terminals 1, 2, and 3 to line circuit breaker. Be sure to maintain proper phasing as shown in the system schematic found in Section 7.
- PV frame ground to ground terminal block (TB3).
- Connect PV+, PV-, and PV Safety ground to the DC interface enclosure's designated terminations. See Section 7 for further detail .

#### CAUTION

**When connecting external AC wires to the PV-225208, positive phasing sequence must be maintained throughout the installation process. Refer to the System Schematic in Section 7 of this manual for proper phasing convention.**

Install all wires listed above. Refer to the Appendix in Section 7 for layout of the AC and DC interface enclosures. Refer to the system schematic in Section 7 for more detailed terminal locations.

# SECTION 3 INSTALLATION AND INITIAL TURN-ON



## **INITIAL TURN ON PROCEDURE**

The following must be performed by an approved Technician:

The following procedures are intended to verify correct installation and proper operation of the PV-225208. These steps are to be followed sequentially. Do not continue if any of the steps or results are unclear. Refer to Section 4 for a detailed description of system operation. Refer to Section 5 for fault condition descriptions and troubleshooting. Refer to Section 7 for detailed system schematics.

### **Visual Inspection, Isolation Transformer WYE/WYE**

- Verify the isolation transformer circuit breaker is open.
- If a phase rotation meter is available, verify proper phase rotation at the line side of the isolation transformer circuit breaker.
- Insure the neutral on the inverter side is left floating. **If the inverter side neutral is tied to ground, the inverter will not function properly. Also, insure that the neutral is not bonded to the isolation transformer frame.**
- Verify the inverter 208 VAC conductors are connected to the isolation transformer.
- If the wires are marked, verify they follow the sequence on the line side of the isolation transformer and circuit breaker.
- Verify the utility conductors are properly connected to the isolation transformer.

### **Visual Inspection, PV-225208**

- Insure AC and DC disconnect switches are opened.
- Remove the front cover from the inductor enclosure, open the door of the main enclosure, and disconnect enclosures and inspect.
- Verify all wire connections are tight.
- Inspect the fiber optic cables between the PCU and the matrix driver boards. All fibers should be snap-locked into their respective receivers/transmitters.
- Insure all connector jack screws on the PCU and matrix driver board are tight.
- Verify AC phase connections landed at the AC interface enclosure.

### **Visual Inspection, PV Array Wiring**

- Verify the PV+, PV-, and PV safety ground are isolated from each other. The safety ground must not be tied to PV-.
- Verify all PV fuses are installed.

### **Initial Power**

- Turn the On/Off switch, located on the front door to off.
- With the DC disconnect switch opened, close one of the PV array string disconnect switches.
- Carefully measure VDC across the PV +/- terminal block. The value should be the same as at the PV array string disconnect switch. It should also be positive.
- Close the PV disconnect switch.
- Carefully measure VDC between the DC contactor negative (-) terminal and the DC switch positive

(+) terminal. The value should be the same as at the PV array string disconnect switch. It should also be positive.

- Open all PV string disconnect switches.
- Close the isolation transformer circuit breaker.
- Verify 208 VAC voltage across the AC disconnect switch. If a phase rotation meter is available, verify proper phase rotation at the AC disconnect switch.
- Close the AC disconnect switch.
- Verify 208 VAC voltage across the AC line fuses F1-3.

#### System Verification

- Upon applying 208 VAC power to the PV-225208, observe the operator interface panel. After approximately 15 seconds, the panel should finish initialization and will probably report a fault condition.
- Remedy any faults reported. To clear a fault condition, press the <ENTER> key twice. If the fault message does not change, the fault condition is still present. Most likely, any faults seen at this point will be related to PV-225208 safety switches. To disable the door interlock switch with the main enclosure door opened, pull the switch shaft out. It will lock in its 'maintenance' position. Once all faults are cleared the system will read 'Sleeping' or 'Keyswitch Disable' depending on the position of the On/Off switch. To re-enable interlock, push the shaft in and close the door.
- Scroll up the menu until 'Enter Read Parameter:' is displayed.
- Press <Enter>, then <19>. This is line voltage frequency being read by the PCU. It should read 60.0 +0.5, -0.7.
- Verify the On/Off switch is in the 'Off' position.
- Close the PV array string disconnect switches.
- Close the PV-225208 DC disconnect switch.
- Press <F2> on the operator interface panel. If the PV voltage is above the PV Start Voltage setpoint, the second line should read 'Waking Up'. Once the PV Start Time is exceeded, the PV-225208 should transition to 'Power Tracking'.
- The power tracker was previously limited to 25% of PV-225208 rated power. Once the PV-225208 has stabilized operation (approximately 20 seconds), scroll through the main operator interface panel menu. Verify all phase voltages and currents are closely balanced.
- Scroll to 'Enter Read Parameter:' Press <ENTER> then <17> <ENTER> to view ground fault current value. This value should be equal to or very close to zero. Continue to monitor this value as the PV-225208 is commanded to higher power levels.
- Enter the write parameter menu and increase the 'I PPT Max %' to 50. Exit the write parameter menu and verify all operating values are proper.
- Continue to increment 'I PPT Max %' to 100. Depending upon solar conditions, the PV-225208 may not operate at full power. If the PV array is not experiencing full sun, the PV maximum power tracker will regulate the PV voltage to maintain maximum PV power output. To determine if the PV-225208 has reached it's maximum power output, enter <20> at the 'Enter Read Parameter:' '0' means the PV-225208 has not reached maximum power, contrarily, '1' means the PV-225208 has reached maximum power and executed the modified peak power tracker to limit output power.
- The PV-225208 is now fully operational.



**Power Tracker Fine Tuning:**

- All PV-225208 operating parameters have been set at the factory, based upon prior experience with PV arrays. Contact your Xantrex Technology distributor for further information.
- It is recommended that the PV-225208 be watched during Wake-Up and Sleep Test. If the PV-225208 cycles between operating and sleeping at either of these times, the condition setpoints are not set properly (refer to section 4 for detailed description of PV-225208 state transitions). The PV225208 should not cycle if the setpoints are set properly.

**NOTE**

**Some field adjustable parameters are password protected and may only be changed by trained service technicians. In particular are parameters relating to utility protection setpoints. Any changes to these setpoints should be agreed upon by the local utility and the equipment owner.**

**NOTE**

**Visually inspect the exterior surfaces for any damage (nicks, chips, exposed base metal and scratches) that may have occurred during shipment or installation. Touch up or recoat using White NISSEN Feltip Paint Marker, or equivalent to prevent rust or corrosion.**



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## DESCRIPTION OF SYSTEM OPERATION

### Overview

The PV-225208 is a fully automated grid-tied photovoltaic inverter. Manual interaction or control of the inverter is necessary only in the event of a system fault. The following conditions govern PV-225208 operation:

- Stable utility voltage and frequency must be present for all states of operation.
- Fault states are automatic from any state of operation. A fault will cause the PV-225208 to immediately stop processing all power. The fault condition will be reported to the operator interface.
- The on/off switch, located on the front door of the PV-225208, must be switched to the on position for all operating states.
- Cycling the on/off switch attempts to clear any system faults and return the PV-225208 to normal operation.

### Operating States

A state machine implemented within the PCU control software governs the operation of the PV225208. There are five steady-state operating states and numerous intermediate transition states. The intermediate transition states provide an orderly progression from one operating state to the next. The user has the ability to manually transition the PV-225208 between operating states from the operator interface keypad. Manual transitions are initiated by entering a 'Goal State', where the goal state is the desired operating state. Given all applicable system parameters are within acceptable limits, and the request is valid within the state machine, the PV-225208 will initiate the proper sequence of operations necessary to progress to the requested goal state. Refer to Figure 4-3 for a description of valid state transitions.

- **Shutdown:** The line interface controller is idle. The PCU monitors the status of the PV array and utility grid, waiting in standby until the PV array is available to produce power to the grid.
- **Fault:** The PV-225208 has encountered a fault condition. When this happens, regardless of the PV-225208 state-of-operation, the PV-225208 will stop processing all power and execute an orderly system shutdown. A description of the fault and fault code will appear on the operator interface LCD. The Fault state may be cleared from the keypad once the cause of the fault has been corrected. See Section 5 for a complete description of all fault codes.
- **Manual Current:** This operating state is provided to evaluate the existing PV array V-I characteristics. The PV controller regulates a constant amount of PV current as commanded by the user from the operator interface keypad, up to the PV current limit of the PV-225208. If the user commands more PV current than is available, the DC bus voltage will drop below the minimum bus voltage level and the PV-225208 will return to Sleeping mode.
- **Matrix Test:** This operating state is provided to verify proper operation of the matrix and associated control electronics. There is no power transfer between the PV and utility in this mode.
- **Power Tracking:** This is the standard operating state of the PV-225208. The PV-225208 maximum power tracker will demand maximum power from the PV array, given sufficient PV irradiance.

The user should be aware of the following conditions governing PV-225208 state transitions:

- Utility power must be present for all states of operation.
- Fault states are automatic from any state of operation. A fault will cause the PV-225208 to immediately stop processing all power. The fault condition will be reported to the operator interface LCD.
- Most PV-225208 faults are latching and must be cleared at the operator interface keypad before transitioning to another operating state.
- The On/Off switch, located on the front door of the PV-225208, must be in the On position for all operating states except Matrix Test, in which case it must be in the Off position.

## **OPERATION FEATURES**

### **Fixed Unity Power Factor Operation**

The Xantrex PV Series grid tied inverters maintain unity power factor during operation. The control software constantly senses utility voltage, and constructs the output current waveform to match the utility voltage. The PV line of inverters are not capable of operation without the presence of normal utility voltage, nor are they capable of varying the output power factor off unity.

### **Utility Voltage/Frequency Fault Automatic Reset**

In the event of a utility voltage or frequency excursion outside of preset limits, the PV-225208 will stop operation and annunciate a fault at the operator interface. Once the utility voltage has stabilized within acceptable limits for a period of at least five minutes, the PV-225208 will automatically clear the fault and resume normal operation. Voltage and frequency fault setpoints are detailed later in this section.

### **Active Island Detection**

Much concern has been given to the possibility of an inverter causing a 'utility island' condition during a utility power outage. An island condition is defined as grid tied inverter maintaining operation and supporting a load that has been isolated from the utility power source. This requires the load to be closely balanced to the output power of the inverter as well as having a resonant frequency close to 60Hz. Needless to say, this is an extremely remote possibility. To insure this condition does not occur, the PV-225208 control software contains an active phase-shift-loop algorithm, which destabilizes a balanced load, which may otherwise be capable of maintaining inverter operation in the absence of utility voltage. This feature has been extensively tested and proven to exceed the safety requirements of UL-1741 and IEEE-929-2000.

### **Ground Fault Detection**

The PV-225208 is equipped with a ground fault detection circuit and current transducer. In the event of a 10 amp ground fault, the PV-225208 will execute an orderly shutdown and annunciates a ground fault at the operator interface. (See Section 5, Troubleshooting).

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### **Current Imbalance Detection**

In the event of phase-to-phase current imbalance of greater than 20% between phases, the inverter will execute an orderly shutdown, and annunciate a fault at the operator interface. See Section 5, Troubleshooting, for further information on this fault condition.

### **DC Overvoltage Detection**

In the event of DC voltage greater than 600Vdc, the PV-225208 will execute an orderly shutdown and annunciate a fault to the operator interface. If DC voltage remains greater than 600Vdc, the PV-225208 may be irreparably damaged. See Section 5, troubleshooting for further information on this fault condition.

### **Peak Power Tracking**

The PV-225208 control software employs an active PV peak power tracker designed to maintain maximum power output from the PV array at all times of operation. The peak power voltage point varies primarily depending upon the temperature of the PV cells. The PV-225208 constantly seeks the optimum voltage and current operating points of the PV array to maintain maximum PV power output. Upon PV wake-up, the power tracker will increase power while ramping PV array voltage to the PV maximum power voltage reference setpoint (PPT V Ref). The change rate is governed by the power point ramp time setpoint (PPT Ramp T). Once the PV voltage is ramped to the reference setpoint, the PCU begins to adjust the commanded PV voltage around the reference setpoint, seeking maximum PV power. The power tracker may only adjust the operating voltage +/- 20% of PPT V Ref. The PV maximum power voltage step and update rate are user settable (PPT V Step and PPT Rate, respectively).

If available PV power is above the maximum allowable power level of the PV-225208, the power tracker will increase voltage as needed to maintain output power below rated maximum.

The minimum operating voltage of the PV-225208 is 330 VDC. The power tracker will not track voltage below this point, regardless of the reference voltage setpoint.

### **Automatic Sleep Test**

Toward the end of every solar day, the PV-225208 automatically determines when to stop producing power dependent upon the output power of the inverter. As the net output power of the PV-225208 nears zero, a timer is started to allow the inverter to ride through any brief irradiance reductions.

## **OPERATOR INTERFACE**

The operator interface display consists of two main menu levels: The read parameter menu and the write parameter menu. The read parameter menu consists of all system parameters, the date and time. These can be viewed any time the PV-225208 has control power.

The write parameter menu consists of a goal state sub-menu, and all system write parameters. The write parameter menu is password protected and may only be changed by trained service technicians. In particular are parameters relating to utility protection setpoints. These have been set in the factory to

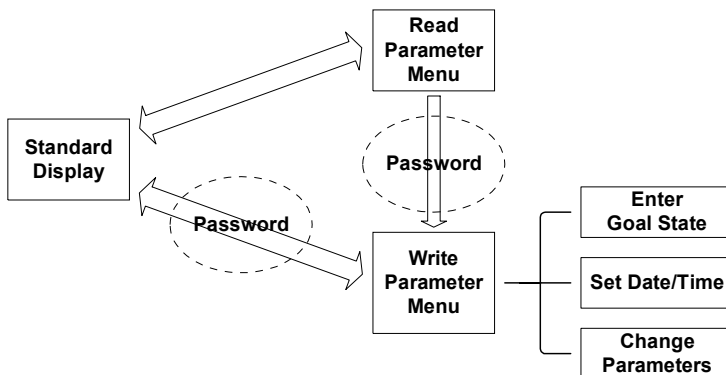
the limits mandated by UL1741. Any changes to these setpoints should be agreed upon by the local utility and the equipment owner. The ability to adjust the voltage and frequency setpoints with respect to the actual utility voltage and frequency has been provided as a simulation tool to verify the PV-225208 accurately detects and responds to a utility excursion. This test should only be performed by a trained service technician. It is possible to adjust the setpoints in a manner that will prevent the PV-225208 from functioning.

Upon system power up, the operator interface LCD will display the system operating state on the first line. The second line will display the date and time. This is the standard display.

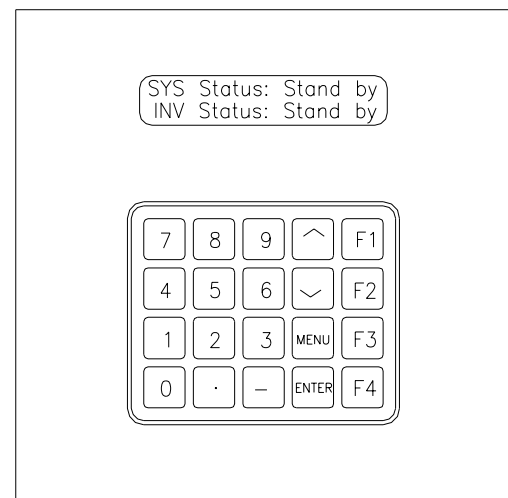
Refer to Section 7, Appendix for a complete description of all system read/write parameters.

**NOTE**

**The operator interface display will reset itself to the standard display if there is no input for 30 seconds.**



**Figure 4-1**  
**Operator Interface Flow Chart**



**Figure 4-2**  
**Operator Interface Keypad**

## Viewing Read/Write Parameters Values

To display any parameter, use the ^ or v keys on the operator interface keypad to scroll through the read/write parameters. The v key will scroll downward through the menu and the ^ key will scroll upward. Upon reaching the end of the menu, it will roll-over to the beginning.

Write parameter values are password protected; however, they may be viewed in the read parameter menu without entering a password. From the standard display press the  $\wedge$  key. The display will read 'Enter Parameter ID:'. Enter the desired write parameter ID, then press the 'Enter'.

Refer to Section 7: Appendix, for a table of all read/write parameters and their descriptions.

### **Changing Write Parameter Values**

From the standard display or anywhere in the read parameter menu, you may access the write parameter menu by pressing the <MENU> key. This will ask for a password. Enter the password and press the <ENTER> button. Use the  $\wedge$  or  $\vee$  key on the operator interface keypad to scroll through the write parameters. To change the displayed parameter, press the <ENTER> button. Enter the desired value and press <ENTER>. If the value entered is outside the acceptable range for the parameter, the original value will remain. To leave the write parameter menu press the <MENU> button repeatedly until the standard display shows on the LCD.

Refer to Section 7: Appendix, for a table of all read/write parameters and their descriptions.

### **Commanding Goal State Changes**

From the standard display press the <MENU> key. This will ask for a password. Enter the password and press the <ENTER> button. The LCD will prompt 'Change Goal State?'. Press <ENTER> again. The goal state menu will show on the LCD. Scroll through the goal state menu with the  $\wedge$  or  $\vee$  keys until the desired goal state is reached. Press <ENTER>. The LCD will prompt: 'Press F4 to Confirm'. Press <F4> and the PV-225208 will transition to this goal state. If the goal state requested violates the conditions of the state machine, the PV-225208 will remain in the previous state of operation.

### **Setting the Date and Time**

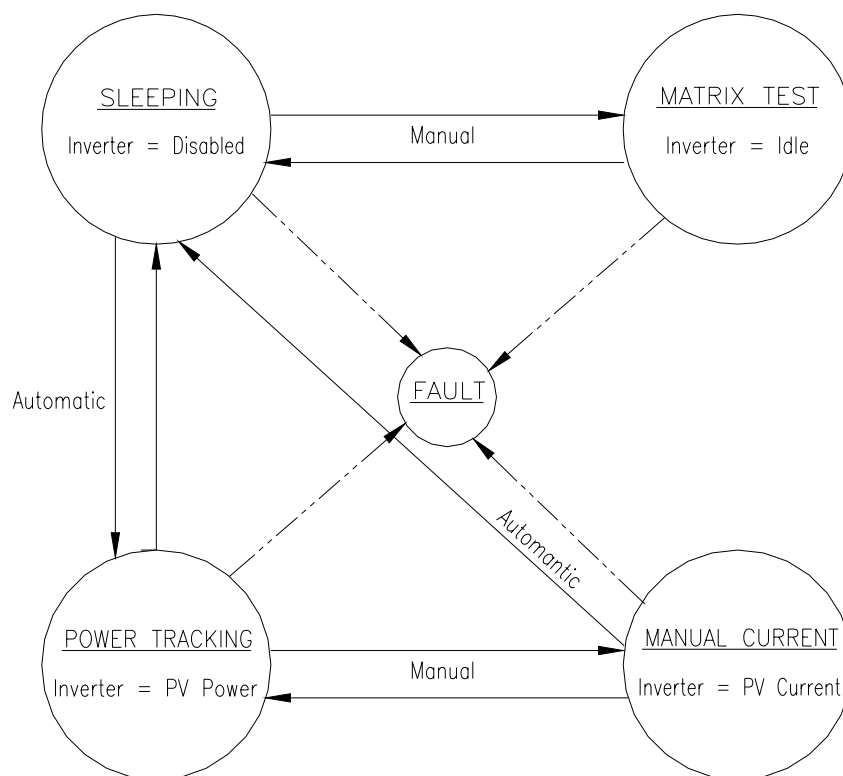
From the standard display enter the write parameter menu (see previous). From the 'Change Goal State?' prompt, scroll up with the  $\wedge$  key until date/time parameter is reached. Press the enter key. The date/time will be replaced with an underscore. Enter the proper date/time in a six digit format. For example: The date is entered month-day-year: April 28, 2002 is entered 042802 <ENTER>. The time is entered in military hours-minutes-seconds: 4:30 pm is entered 163000 <ENTER>. If the date/time is entered incorrectly the original value will remain. Press <MENU> to return to the standard display.

## **MANUAL STATE TRANSITIONS**

Refer to previous sections on commanding PV-225208 goal states.

- **Sleeping  $\rightarrow$  Matrix Test  $\rightarrow$  Sleeping:**

Turn the On/Off switch to the Off position. Command the PV-225208 to Matrix Test. Once the user has completed the test, command the PV-225208 to Sleeping. If the On/Off switch is turned to On while the PV-225208 is in the Matrix Test state, the PV-225208 will transition to Sleeping.



**Figure 4-3**  
**PV-225208 State Machine**

• **Power Tracking → Manual Current → Power Tracking or Sleeping:**

Verify the PV manual current parameter (I Manual %) is set to the desired percent of rated. Command the PV-225208 to Manual Current mode from the operator interface keypad. While in the manual current mode, the user may change the PV manual current parameter. However, the user may demand greater current than the capacity of the PV array. If this causes the PV voltage to drop below the minimum operating voltage (330 Vdc), the PV-225208 will transition to Sleeping.

To exit the Manual Current mode the user must manually command the PV-225208 to either Power Tracking or Sleeping.

**AUTOMATIC STATE TRANSITIONS**

• **Sleeping → Power Tracking → Sleeping:**

The On/Off switch must be turned to the On position. Once the PV voltage exceeds the PV voltage start setpoint (PV V Start) the PV-225208 will start a wake-up timer (PV T Start). If the PV voltage remains above the PV start voltage setpoint for the duration of the wake-up timer, the PV-225208 will transition to Power Tracking.

If the PV power drops below the PV power stop setpoint (PV P Stop) the PV-225208 will start a PV sleep timer (PV T Stop). If the PV voltage and power remain below their respective setpoints for the duration of the sleep timer, the PV-225208 will transition to Sleeping.

- **Any State → Fault:**

If the PV-225208 encounters a fault, regardless of operating state, it will transition to the Fault state. The PV-225208 will remain in this state until the fault condition has been remedied and cleared via the front panel.

A description of the fault will show on the first line of the operator interface LCD. The second line of the LCD will read 'Clear Fault?'. To clear a fault press <ENTER>. The PV-225208 will transition to Sleeping. If the fault does not clear, the fault condition has not been corrected. If the 'Clear Fault?' message is not shown on the second line of the LCD, scroll through the read parameter menu with the ^ or V keys until the message appears.

## **AUTO-RESTART FEATURE**

In the event of a utility voltage or frequency surge or sag, which causes the inverter to shut down, the PV-225208 will automatically transition to a fault condition. Once the utility recovers for a period of five minutes, the PV-225208 will automatically clear the fault, then resume normal operation.

## **ISOLATION PROCEDURE**

The following procedure should be followed to de-energize the PV-225208 for maintenance:

1. Turn the On/Off switch to the Off position.
2. Open the DC interface (PV array) disconnect switch.
3. Open the AC interface disconnect switch.
4. Open the isolation transformer circuit breaker.
5. Install lockout devices on the isolation transformer circuit breaker and PV disconnect switch.

### **WARNING**

**The terminals of the PV input may be energized if the arrays are energized. In addition, allow 5 minutes for all capacitors within the main enclosure to discharge after disconnecting the PV-225208 from AC and DC sources.**

## **TURN-ON PROCEDURE**

Refer to Section 3 for a detailed first-time turn on procedure.

1. Remove any lockout devices from the isolation transformer circuit breaker and PV disconnect switch.
2. Close the isolation transformer circuit breaker.
3. Close the AC interface disconnect switch.
4. Close DC interface (PV array) disconnect switch.
5. Turn the On/Off switch to the On position.

After a 15 second initialization period, the PV-225208 will automatically transition to 'Waking Up', given the PV voltage is greater than the PV V Start setpoint.



## GENERAL

In the event of a fault, the PV-225208 will annunciate the condition at the operator interface. The PV-225208 will execute an orderly shutdown and remain faulted until the fault is cleared (manually or automatically).

In general, the operator should respond to any PV-225208 fault as follows:

1. The source of the fault should be sought by referring to the following chart.
2. Rectify the fault condition and attempt to clear the fault by cycling the on/off switch.
3. If the problem cannot be corrected, note and write down the fault code and description, then contact your Xantrex Technology distributor for assistance or service.

## ALARM AND FAULT CONDITIONS

### WARNING

**Lethal energy may be stored within each matrix assembly. Use extreme caution when troubleshooting. After disconnect all sources of power, wait at least 5 minutes for internal capacitors to discharge.**

**(H)** - Fault triggered by hardware.

**(S)** - Fault triggered by software.

#### **0000 - No Faults**

No fault conditions are detected.

#### **002C/012C - Matrix Over-Temperature (S)**

The temperature of the matrix (002C Matrix 1; 012C Matrix 2) aluminum heat sink exceeded 85°C.

Possible causes:

- External cooling fan inoperable
- Air flow on heat sink impeded due to accumulation of debris
- Operation above rated ambient temperature for an extended period of time

#### **002E - State Machine Failure (S)**

Software has encountered an undefined state.

Attempt to clear the fault by either cycling control power or pressing the black reset button in the lower left corner of the PCU. If the fault is sustained, replacement or service of the PCU will be necessary.

#### **002F – Parameter Out Of Date (S)**

Software has determined that the system variables within the operator interface panel do not match the ones in the PCU. Generally this fault may be cleared and normal operation resumed.

#### **0031 - Ground Current Fault (S)**

The earth safety ground current has exceeded the maximum programmed value (Max Gnd Flt I).



Possible causes:

- Inspect the PV array for ground faults.
- CT8 defective: Troubleshoot the ground fault CT8, located on the power distribution panel of the main enclosure (see system schematic drawing in Section 7), using the procedures described in fault YY27.

#### **0032 - PV Overvoltage (S)**

The PV voltage has exceeded the maximum programmed limit (PV Max Volt).

Check the PV input voltage at the PV disconnect switch. If the voltage is below 600 VDC, clear the alarm and restart the PV-225208.

#### **0040 - In Programming Mode (S)**

System is in reload PROM mode.

#### **0042 - Bad Memory (S)**

The static memory test failed upon system initialization. This fault is generally transient in nature.

Attempt to clear the fault by either cycling control power or pressing the black reset button in the lower left corner of the PCU. If the fault is sustained, replacement or service of the PCU will be necessary.

#### **0045 – Line Matrix Failure to Turn On (S)**

#### **0046 – Line Matrix Failure to Turn Off (S)**

Software was not able turn on or turn off the indicated switching matrix.

Attempt to clear the fault by either cycling control power or pressing the black reset button in the lower left corner of the PCU. If the fault is sustained, replacement or service of the PCU will be necessary.

#### **0061 – Line AC Frequency Too Low (S)**

The AC line frequency fell below the allowable limit.

This fault is self-clearing. Once the utility frequency has recovered within the acceptable operating range, the PV-225208 will automatically clear this fault and resume normal operation after 5 minutes. If the fault will not clear, verify the adjustable setpoint is below the actual utility frequency. If the fault is sustained, contact your Xantrex Technology distributor for assistance or service.

#### **0062 - Line AC Frequency Too High (S)**

The AC frequency exceeded the allowable limit.

This fault is self-clearing. Once the utility frequency has recovered within the acceptable operating range, the PV-225208 will automatically clear this fault and resume normal operation after 5 minutes. If the fault will not clear, verify the adjustable setpoint is above the actual utility frequency. If the fault is sustained, contact your Xantrex Technology distributor for assistance or service.

**0063 - AC Voltage Too Low (S)**

The AC Inverter voltage fell below the minimum programmed limit (Min AC Volt).

This problem was caused by the utility. Clear the fault and restart the PV-225208.

Possible causes:

- High momentary load which forces the inverter to current limit
- Fuses F1, F2, F3, F4, F5 or F6 blown
- SSR-1 inoperable
- Contactor K1 inoperable
- Utility voltage fell below the allowable limit.

This fault is self-clearing. Once the utility voltage has recovered within the acceptable operating range, the PV-225208 will automatically clear this fault and resume normal operation after 5 minutes. If the fault will not clear, verify the adjustable setpoint is below the actual utility voltage. If the fault is sustained, contact your Xantrex Technology distributor for assistance or service.

**0064 - AC Voltage Too High (S)**

The inverter controller voltage exceeded the maximum-programmed limit (Max AC Volt).

Possible causes:

- SSR-1 inoperable
- Contactor K1 inoperable
- Utility voltage exceeded the allowable limit.

This fault is self-clearing. Once the utility voltage has recovered within the acceptable operating range, the PV-225208 will automatically clear this fault and resume normal operation after 5 minutes. If the fault will not clear, verify the adjustable setpoint is above the actual utility voltage. If the fault is sustained, contact your Xantrex Technology distributor for assistance or service.

**012A - Interrupt Time-Out (S)**

The PCU was not able to service the interrupt for approximately 1 second.

Attempt to clear the fault and restart the PV-225208 by pressing the black reset button on the lower left corner of the PCU. If the fault is sustained, replacement or service of the PCU will be necessary.

**0230 – Door Interlock Switch Open (H)**

The door interlock lock switch located in the inside upper left corner of the main enclosure door is open.

If the switch is closed and the fault still registers on the front panel, isolate the PV-225208 from external power, then:

- Verify continuity across the switch contact block while the switch is closed.
- Verify continuity between PCU-J2-5 and PCU-J3-3.

**0430 - PV Auxiliary Switch Open (H)**

The dry contact auxiliary switch mounted to the PV disconnect switch has been toggled. The auxiliary switch should be opened when the PV disconnect switch is open. If the fault will not clear when the PV disconnect switch is closed:

- Isolate PV-225208 from utility power.
- Close PV disconnect switch and check continuity between PCU J3-3 and PCU J2-7. If there is no continuity, inspect wiring between the PCU and the auxiliary switch (see page 2 of the system schematic for further detail).

#### **XX25/XX26 - Line Gate Drive Fault (S)**

One of the IGBT gate drive boards signaled the PCU that there was a fault. The second two digits refer to which matrix has the fault. XX25 refers to matrix 1 and XX26 refers to matrix 2. The particular device at which the fault was detected is indicated by the first two digits of the fault code, as follows:

XX:    01 = Phase A+    02 = Phase A-  
         04 = Phase B+    08 = Phase B-  
         10 = Phase C+    20 = Phase C-

If more than one phase faults simultaneously, the error code will contain the summation of phase fault values. For example, if phase A+ and B+ of matrix 1 fault simultaneously, the error will read 0525.

Make sure the fiber optics for the device and matrix in question are properly connected to the driver board. Similarly, make sure the fiber is properly connected at the PCU.

Clear the fault and restart the PV-225208. If the fault is sustained, contact your Xantrex Technology distributor for assistance or service.

#### **YY27/YY28 - Line Over-Current Fault (S)**

Current in one phase of the matrix has exceeded the allowable limit. YY27 refers to matrix 1 and YY28 refers to matrix 2. The faulted phase is indicated by the first two digits of the fault code, as follows:

YY:    01 = Phase A  
         02 = Phase B  
         04 = Phase C

If more than one phase faults simultaneously, the error code will contain the summation of phase fault values. For example, if phase A and C of matrix 1 fault simultaneously, the error will read 0527.

Possible causes:

- AC system wiring short: Inspect the AC power system for short circuits.
- PCU Power Supply is defective: Verify +/-15Vdc sources, referenced to analog ground, on the PCU. There are labeled test points on the PCU circuit board. Note: There are two isolated +15Vdc power supplies labeled +15Vdc and +15Vdc Drv. The +15Vdc Drv power supply provides power for the matrix driver boards only.
- Faulty CT wiring: Verify the wiring between the PCU power supply and the CT is properly connected and undamaged. Refer to page 2 of the system schematic in Section 7.
- CT defective: Locate the current transducer for the matrix and phase in question (see control components drawing in Section 7). With a digital multi-meter measure the voltage from CT pins 1, 2, and 3 to chassis ground. Pins 1 and 3 should read approximately +15 and -15Vdc respectively. These voltages are sourced directly from the PCU. Pin 2 should read less than 20mV when no current is passing through the CT window. If Pin 2 reads greater than 20mV, and the supply voltages are on

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Pins 1 and 3 are correct, the CT may be damaged.

Clear the fault and restart the PCU. If the fault is sustained contact your Xantrex Technology distributor for assistance or service.

**0828 – PV Over-Current Fault (S)**

Current through the PV CT has exceeded the allowable limit.

Possible causes:

- PV system wiring short: Inspect the PV power system for short circuits.
- PCU Power Supply is defective: Verify +/-15Vdc sources, referenced to analog ground, on the PCU. There are labeled test points on the PCU circuit board. Note: There are two isolated +15Vdc power supplies labeled +15Vdc and +15Vdc Drv. The +15Vdc Drv power supply provides power for the matrix driver boards only.
- Faulty CT wiring: Verify the wiring between the PCU and the CT is properly connected and undamaged. Refer to the system schematic in Section 7.
- CT defective: Locate the current transducer for the PV leg in question (see control components drawing in Section 7). With a digital multi-meter measure the voltage from CT pins 1, 2, and 3 to chassis ground. Pins 1 and 3 should read approximately +15 and -15Vdc respectively. These voltages are sourced directly from the PCU. Pin 2 should read less than 20mV when no current is passing through the CT window. If Pin 2 reads greater than 20mV, and the supply voltages are on Pins 1 and 3 are correct, the CT may be damaged

Clear the fault and restart the PCU. If the fault is sustained contact your Xantrex Technology distributor for assistance or service.

**8021 - DC Bus Voltage High (H)**

The DC Bus voltage has exceeded the maximum allowable limit.

This fault is generally transient in nature. Clear the fault and attempt to restart the PV-225208.

## PERIODIC MAINTENANCE

Xantrex Technology recommends that the following preventative maintenance be carried out on the PV-225208:

### *Monthly intervals or as required:*

NOTE
<b>Visually inspect the exterior surfaces for any damage (nicks, chips, exposed base metal and scratches). Touch up or recoat using White NISSEN Feltip Paint Marker, or equivalent to prevent rust or corrosion.</b>

#### **Aluminum Extrusion Heatsink**

Accumulation of dirt and debris on the aluminum extrusion heatsinks and fans will decrease the ability to transfer heat, which can cause the PV-225208 to shutdown on over-temperature alarms. Inspect the aluminum extrusion heatsinks and fans for accumulation of dirt and debris. Clean if debris is present.

#### **Fan Operation**

Verify proper operation of the heatsink cooling fans, located above the matrix heatsinks. The fans operate when the K1 contactor is closed. Remove any debris from the fans.

#### **Internal Circulation Fan:**

Verify the internal circulation fan is operating whenever there is utility power applied to the PV-225208.

#### **Inductor Enclosure Cooling Fans:**

Verify these fans operate whenever the PV-225208 is processing power.

### *Six month intervals:*

(See Isolation Procedure located on page 6-2, and perform prior to the following)

#### **Enclosure Seals**

Inspect the enclosure access panel seal. If damaged, replace with equivalent closed cell foam gasket. Call your Xantrex Technology distributor for factory replacements or specifications.

#### **Electrical Connections**

Inspect the condition of all wiring within the PV-225208. Inspect all wire crimps and connections for damage caused from high temperature. Check for corrosion. Replace any damaged wires. Verify all mechanical connections are sufficiently tightened. Verify all conduction surfaces are clean and free of corrosion.

Mechanical electrical connections will loosen over time. This is caused primarily by thermal cycling during normal operation. As connections loosen, electrical impedance will increase at the connection, eventually leading to fire and component damage. It is critical to check all electrical connections every six months.

#### **Inductor Enclosure**

Access the inductor enclosure and remove any accumulated dirt and debris. Vacuum enclosure whenever dust or dirt is present.

### **ISOLATION PROCEDURE**

The following procedure should be followed to de-energize the PV-225208 for maintenance:

<b>WARNING</b>
<b>The terminals of the PV input may be energized if the arrays are energized. In addition, allow 5 minutes for all capacitors within the enclosure to discharge after shutting down the PV-225208.</b>

1. Turn the on/off switch to the off position.
2. Open the DC interface (PV array) disconnect switch.
3. Open the AC interface disconnect switch.
4. Open the isolation transformer circuit breaker.
5. Install lockout devices on the isolation transformer circuit breaker and PV disconnect switch.

### **TURN-ON PROCEDURE**

Refer to Section 3 for a detailed first-time turn on procedure.

1. Remove any lockout devices from the isolation transformer circuit breaker and PV disconnect switch.
2. Close the isolation transformer circuit breaker.
3. Close the AC interface disconnect switch.
4. Close the DC interface (PV array) disconnect switch.
5. Turn the on/off switch to the on position.

After a 15 second initialization period and a 5 minute wake up period, the PV-225208 will automatically begin power tracking, given the PV voltage is greater than the PV start voltage setpoint.

## FAULTS CODES

Refer to section 5 for detailed fault code descriptions.

H - Fault(s) triggered by hardware

S - Fault(s) triggered by software

Error Code	Fault Source(s)	H/S
0000	No Faults	
002C	Matrix Over-Temperature	(S)
002E	State Machine Failure	(S)
002F	Software Parameter Out of Date	(S)
0031	Ground Current Fault	(S)
0032	PV Over-Voltage	(S)
0040	In Programming Mode	(S)
0042	Bad Memory	(S)
0045	Line Matrix Control Failure to Turn On	(S)
0046	Line Matrix Control Failure to Turn Off	(S)
0061	Line Frequency Too Low	(S)

Error Code	Fault Source(s)	H/S
0062	Line Frequency Too High	(S)
0063	Line Voltage Too Low	(S)
0064	Line Voltage Too High	(S)
012A	Interrupt Time-Out	(S)
0230	Door Interlock	(H)
0430	PV Auxiliary Contact Block	(H)
XX25	Line Matrix Gate Drive	(S)
YY27	Line Matrix Over-Current	(S)
0828	PV Over-Current	(S)
8021	DC Bus Voltage Too High	(H)

## READ/WRITE PARAMETER MENU

### Read-Only Parameters

Parameters	ID	Type	Units	Data Limits	Default	Descriptions
Current Operating State	1	Read	N/A	N/A	N/A	<b>Current States:</b> 0-Initilizing 1-Key-Disabled 2-Sleeping 3-Starting 4-Power-Tracking 5-Manual Current 6-Matrix Test 7-Faulted
System Goal State	2	Read	N/A	N/A	N/A	<b>Goal States:</b> 0-Shut Down 1-Power-Tracking 2-Manual Current 3-Matrix Test

Parameters	ID	Type	Units	Data Limits	Default	Descriptions
Fault Code	3	Read	N/A	N/A	N/A	See Fault Codes Above
Inverter State	4	Read	N/A	N/A	N/A	<b>Inverter States:</b> 0-Shut Down 1-Standby 2-Starting 3-Main-Setting 4-On-Line
Line A-B Voltage	5	Read	Vrms	N/A	N/A	Line to Line Voltage
Line B-C Voltage	6	Read	Vrms	N/A	N/A	Line to Line Voltage
Line C-A Voltage	7	Read	Vrms	N/A	N/A	Line to Line Voltage
Line A Current	8	Read	Arms	N/A	N/A	
Line B Current	9	Read	Arms	N/A	N/A	
Line C Current	10	Read	Arms	N/A	N/A	
Inverter Real Power	11	Read	kVA	N/A	N/A	
Inverter Matrix Temperature	12	Read	°C	N/A	N/A	
PV State	13	Read	N/A	N/A	N/A	<b>PV States:</b> 0-Shut Down 1-Sleep 2-Wakeup 3-Online 4-Sleep-Test
PV Voltage	14	Read	VDC	N/A	N/A	
PV Current	15	Read	ADC	N/A	N/A	
PV Power	16	Read	kW	N/A	N/A	
Ground Fault Current	17	Read	Arms	N/A	N/A	
Peak Power On/Off	18	Read	N/A	N/A	N/A	0-On 1-Off
Inverter Frequency	19	Read	Hz	N/A	N/A	
Maximum Inverter Power	20	Read	kVA	N/A	N/A	Maximum Line Power Recorded by PCU



Parameters	ID	Type	Units	Data Limits	Default	Descriptions
Maximum PV Power	21	Read	kW	N/A	1:1	Maximum Line Power Recorded by PCU
Maximum Inverter Current (phase A)	22	Read	Arms	N/A	1:1	Maximum Line Current Recorded by PCU
Commanded PV Current	23	Read	ADC	N/A	1:1	Maximum PV Current Available to be Commanded by the PV Power Tracker
Maximum AC Voltage	32	Write	Volts	$190 < V < 229$	229	Maximum AC Voltage fault setpoint *
Minimum AC Voltage	33	Write	Volts	$183 < V < 220$	183	Minimum AC Voltage fault setpoint *
Maximum AC Frequency	34	Write	Hz	$59.3 < \text{Hz} < 60.5$	60.5	Maximum AC Frequency fault setpoint *
Minimum AC Frequency	35	Write	Hz	$59.3 < \text{Hz} < 60.5$	59.3	Minimum AC Frequency fault setpoint *
Maximum Ground Fault Interrupt	36	Write	Amps	$1 < I < 20$	10	Ground fault current setpoint
PPT V Ref	37	Write	Volts	$300 < V < 600$	400	Peak Power Tracker Reference Voltage
PV V Start	38	Write	Volts	$300 < V < 600$	440	PV power tracker wake-up voltage
PV T Start	39	Write	Sec	$0 < T < 1200$	300	Time delay for PV wake-up
PV T Stop	40	Write	Sec	$0 < T < 1200$	20	Time delay for PV sleep test
PV P Stop	41	Write	kW	$0.2 < \text{kW} < 10.0$	1.0	PV power point to begin sleep test timer

\* Inverter trips off line within two cycles on over/under voltage and frequency faults. It should be noted that the voltage trip limits can be up to 1% off from the actual grid voltage at full load due to the 1% regulation of the isolation transformer. The PV-225208 uses phase to phase voltage measurement to detect the under/over voltage trip limits. For an unbalanced, single phase voltage variation of +10% and -12% as per UL1741 the trip limits must be set to 220V for maximum AC voltage and 193V for minimum AC voltage. Consult your local utility for their specific requirement.

Parameters	ID	Type	Units	Data Limits	Default	Descriptions
I PPT Max %	42	Write	%	$0 < \% < 100$	100	Percent of maximum allowable PV power tracker mode current
I Manual %	43	Write	%	$0 < \% < 100$	25	Percent of maximum allowable PV manual mode current
PPT Enable	44	Write	N/A	0 or 1	1	Turns power tracker on or off. If off the power tracker will regulate voltage at the reference setpoint. 0 = Off 1 = On
PPT Rate	45	Write	Sec	$0.1 < T < 10.0$	0.5	Power tracker update rate
PPT V Step	46	Write	Volts	$0 < V < 10.0$	1.0	Voltage perturbation step of power tracker

## WARRANTY AND CERTIFICATION

Xantrex Inverter Warranty Registration

Underwriters Laboratories Compliance Of Standard UL1741

## DRAWINGS LIST

151828 : Schematic, System, Grid Tied PV Inverter, PV-225208

151807 : Envelope Drawing, Grid Tied Inverter, PV-225208

151808 : Enclosure, Main, Control Components, PV-225208

151809 : Enclosure, AC Interface, PV-225208

151810 : Enclosure, DC Interface, PV-225208

151812 : Transformer, 225 kVA, 3-Pole, 60 Hz, 98% Efficient, 208Y/120 or 480Y/277



Xantrex Technology, Inc.  
Distributed Power Markets  
161G South Vasco Road  
Livermore, CA 94550 USA  
Phone +1 925.245.5400  
Fax +1 925.245.1022

## **XANTREX PV SERIES LIMITED WARRANTY AND REGISTRATION**

Xantrex Technology warrants all equipment supplied to Customer under this purchase order against defects in workmanship and material for a period of (12) twelve months from delivery, provided that the equipment has been operated and maintained in accordance with the service manual provided with the equipment. Should Customer give Xantrex written notice of any such defects within the warranty period, and Xantrex's inspection confirms the existence of such defects, Xantrex shall correct the defects, either by repair or replacement, at its sole option.

For wall-mounted products (generally, below 30 kW in rating), defective products must be returned to Xantrex or its Authorized Service Center in the original or equivalent packaging. The cost of transportation and insurance on items returned for service is at the Customer's expense. Return transportation and insurance expense shall be borne by Xantrex.

For floor mounted inverter products (generally, 30 kW in rating and above), warranty repairs or replacements are performed at the installation site. Xantrex's material, labor, freight and travel/living expenses associated with such repair or replacement shall be borne by Xantrex.

In either case, Customer's labor and travel/living expense shall be borne by Customer. Xantrex will assume no expense, liability or responsibility for repairs made by or for Customer without written authority from Xantrex. Xantrex shall not be responsible for any consequential, incidental or similar damages.

THE FOREGOING WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Project Name \_\_\_\_\_  
Customer PO # \_\_\_\_\_  
Inverter Serial # \_\_\_\_\_  
Delivery Date \_\_\_\_\_

Xantrex Authorized Signature:

\_\_\_\_\_

Date

Customer Authorized Signature:

\_\_\_\_\_

Date



Underwriters Laboratories Inc.®

333 Pfingsten Road  
Northbrook, Illinois 60062-2096  
United States Country Code (1)  
(847) 272-8800  
FAX No. (847) 272-8129  
<http://www.ul.com>

# NOTICE OF AUTHORIZATION TO APPLY THE UL MARK

Northbrook Office

August 9, 2002

Kantrex Technology Inc  
Attn: Mr. Doug Blodgett  
PO BOX 5049  
LIVERMORE CA 94551

Our Reference: File E199356, Project 02NKL9844

Subject: Model PV225, Pv Grid Tied Three Phase Utility Interactive Inverter,  
Provided With An External Isolation Transformer

Dear Mr. Blodgett:

We have completed our engineering investigation under the above project number and find the products comply with the applicable requirements.

This letter temporarily supplements the UL Follow-Up Services Inspection Procedure and serves as authorization to apply the UL Listing Mark, only at the factory under UL's Follow-Up Service Program, to the above products, which are constructed as described below:

Similar to the subject model which was submitted to UL for this investigation, the UL requirements covering the product will be in the Follow-Up Services Inspection Procedure, File E199356, Volume1.

To provide the manufacturer with the intended authorization to use the UL Mark, the addressee must send a copy of this Notice and all attached material to each manufacturing location currently authorized in the appropriate UL File Procedure.

This authorization is effective for 90 days only from the date of this Notice and only for products at the indicated manufacturing locations. Records covering the product are now being prepared and will be sent to the indicated manufacturing locations in the near future. Please note that Follow-Up Services Procedures are sent to the manufacturers only unless the Applicant specifically requests this document.

Products produced, which bear the UL Mark, shall be identical to those evaluated by UL and found to comply with UL's requirements. If changes in construction are discovered, authorization to use the UL Mark may be withdrawn and products that bear the UL Mark may have to be revised (in the field or at the manufacturer's facility) to bring them into compliance with UL's requirements.

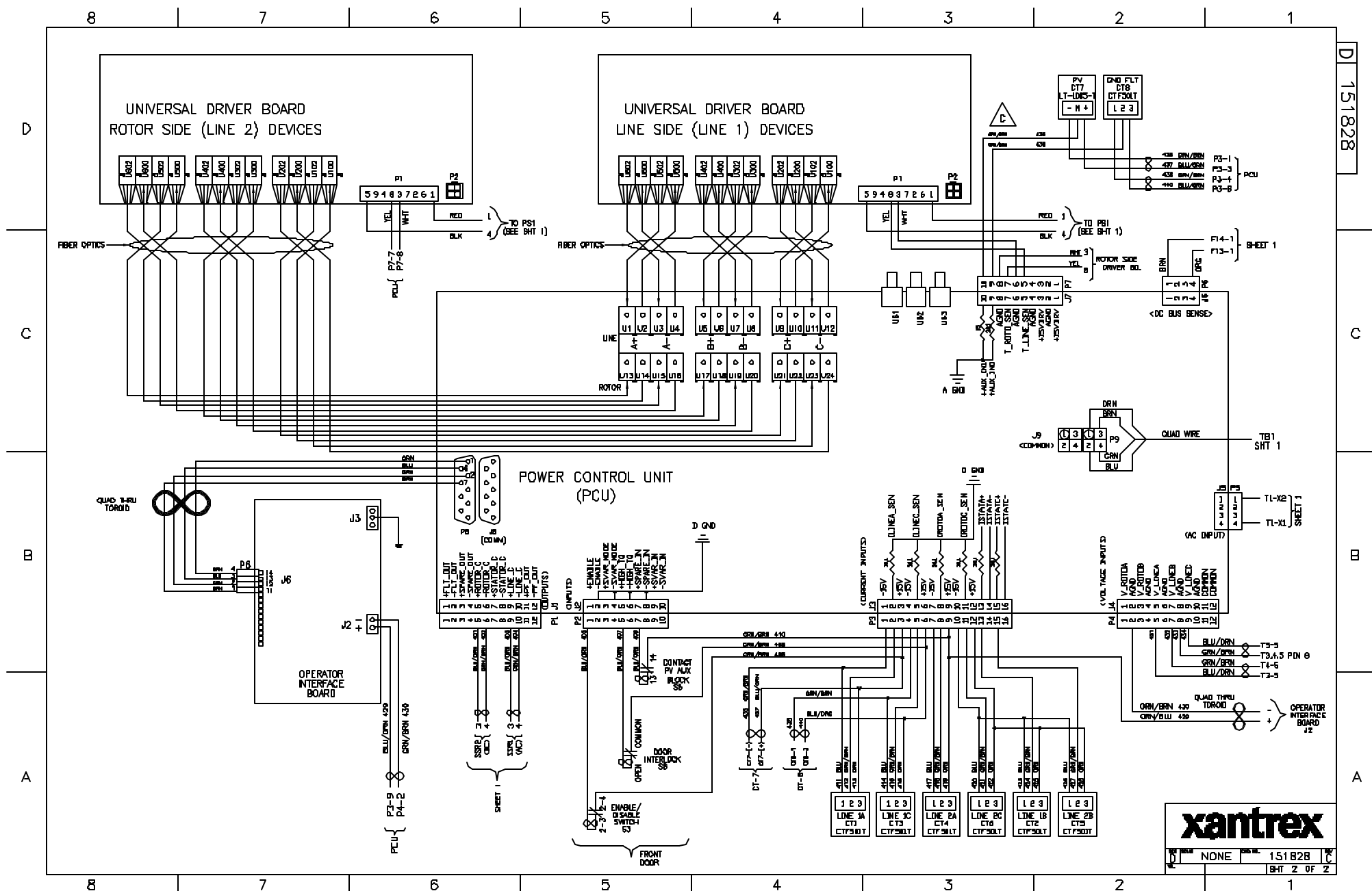
Respectfully,

Walter T. Jurek (Ext. 42884)  
Senior Engineering Associate  
Conformity Assessment Services - 3013MNBK  
E-mail: [Walter.T.Jurek@us.ul.com](mailto:Walter.T.Jurek@us.ul.com)

Reviewed by

Timothy P. Zgonena (Ext. 43051)  
Staff Engineer  
Conformity Assessment Services - 3013MNBK  
E-mail: [Timothy.P.Zgonena@us.ul.com](mailto:Timothy.P.Zgonena@us.ul.com)





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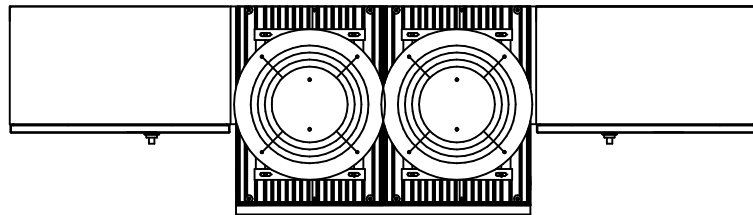
NOTES: UNLESS OTHERWISE SPECIFIED

1. DO NOT LIFT INVERTER FROM MATRIX LIFTING EYE BRACKETS.  
THE PURPOSE OF THE BRACKETS ARE FOR LIFTING THE  
MATRIX ONLY.  
2. APPROX. WEIGHT= 1835 LBS.

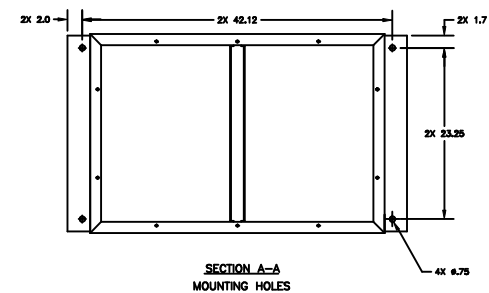
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REV	CHANGE	DATE	BY	CHKD	QTY	APP	APP
A	ECO 132	11-11-02	GB				

D 151807

D

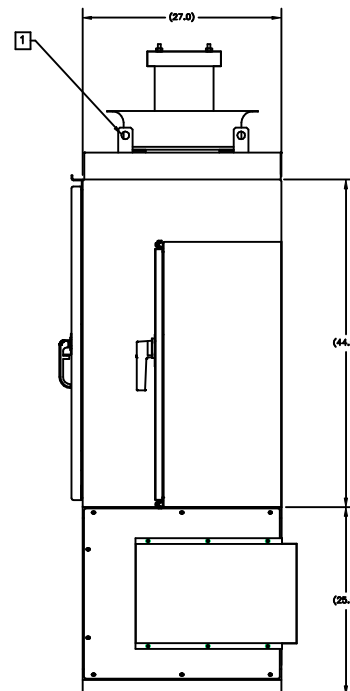
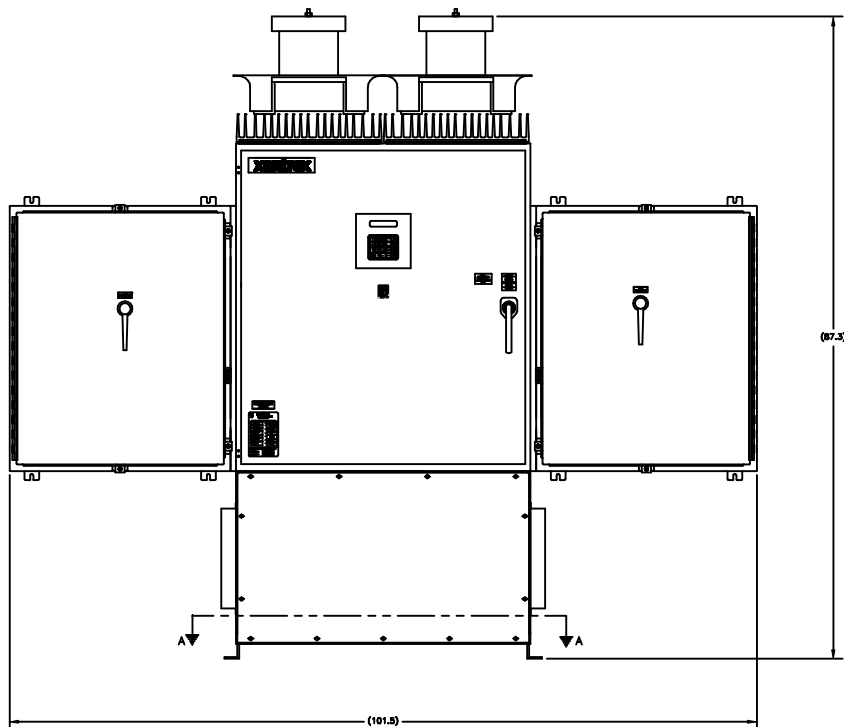


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DRAWN BY: BELTRAN		DATE: 07-22-02		ALL DIMENSIONS IN INCHES	
ENGR BY:				ENVELOPE, GRID TIED	
QTY BY:				INVERTER, PV225208	
MFG BY:				NONE 151807	
				SHT 1 OF 1	

# xantrex

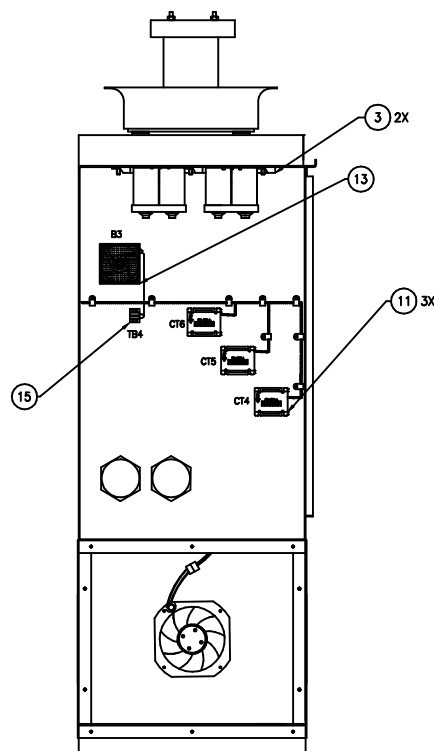
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REV	CHANGE	DATE	BY	CHKD	Q.LTY.	APP
A	ECO 132	11-11-02	GB			

D  
151808

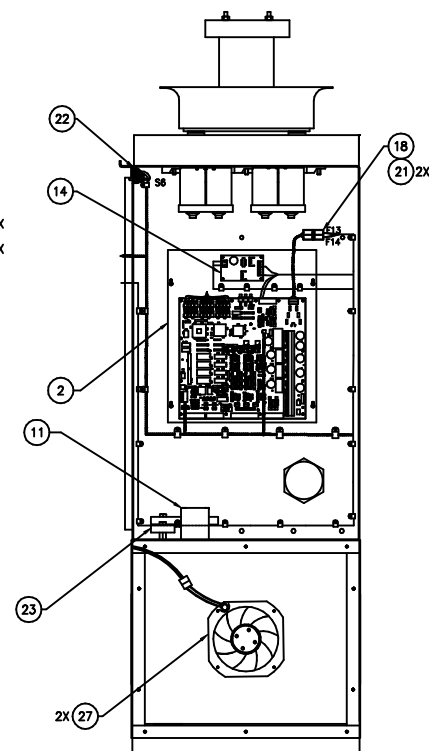
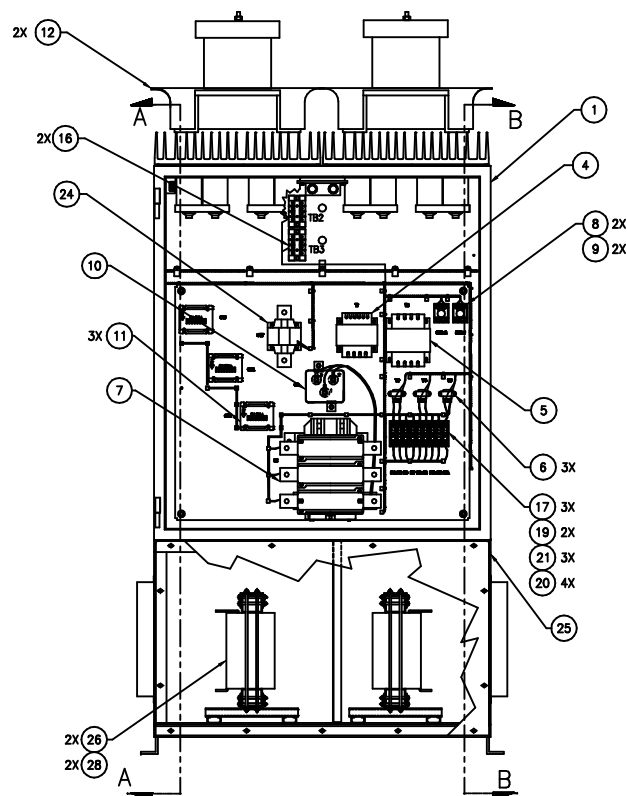
C

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SECTION B-B



SECTION A-A

SEE SEPARATE BILL OF MATERIAL

DATE	BY	DATE	BY
11-05-02	ENGR BY:	11-05-02	ENGR BY:
11-05-02	Q.LTY BY:	11-05-02	Q.LTY BY:
11-05-02	MFG BY:	11-05-02	MFG BY:

xantrex			
ENCLOSURE, MAIN, CONTROL COMPONENTS, PV-225208			
Q.LTY	NONE	151808	A
SHT 1 OF 2			

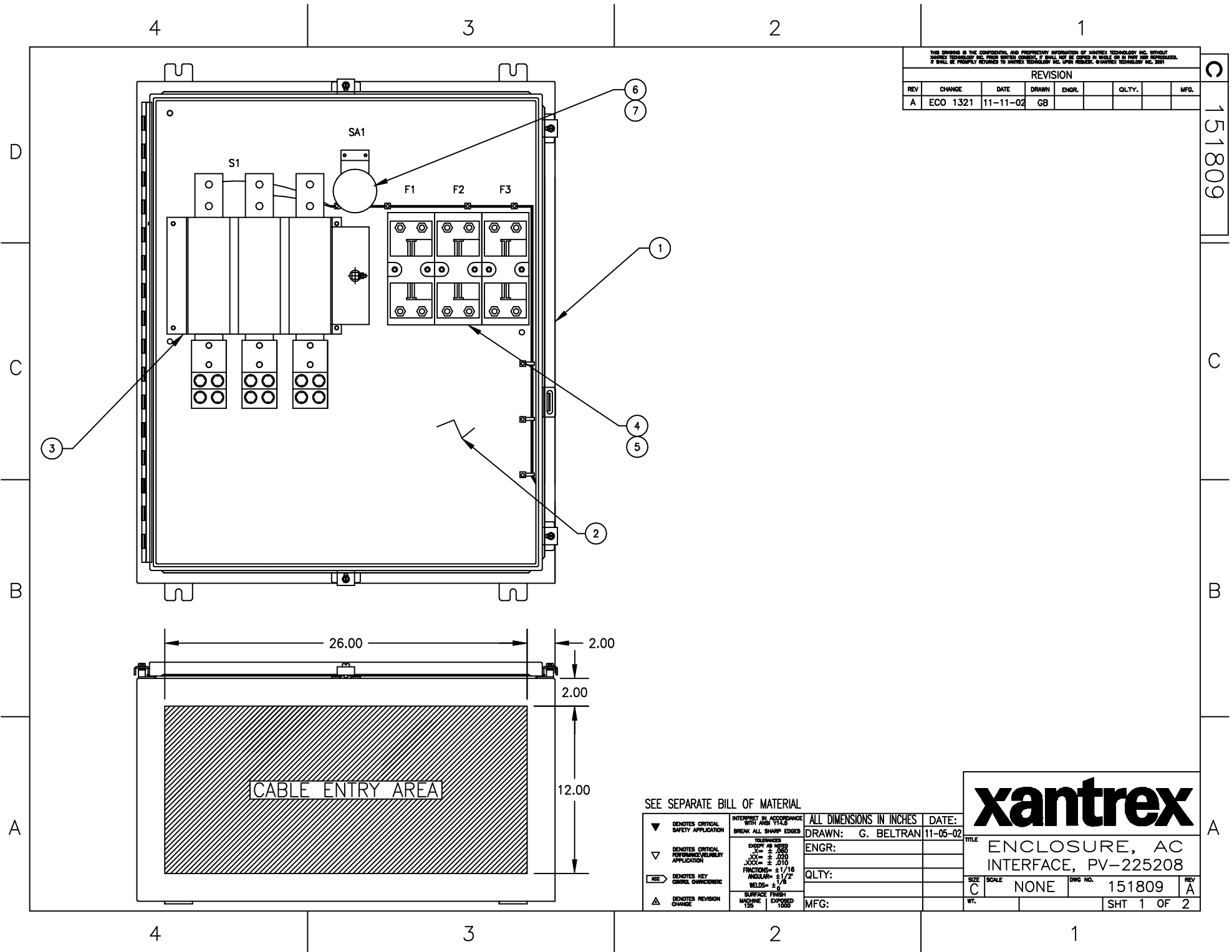


**Xantrex Technology Inc. PV-225208**  
**Photovoltaic Inverter**  
**Major Parts List**

**Assembly Description: Main Enclosure, Control Components, PV-225208**

**Xantrex Technology Assembly # 151808**

Item #	Qty	Reference Designator	Xantrex Technology Part #	Description
<b>Upper Enclosure</b>				
1	1	-	1-151751-01	Fab, Enclosure, Upper, 2 Bay, PV225208
2	1	-	1-151775-01	Assy, PCU, W/Power Supply, PV225208
3	2	-	1-150209-02	Assy, Matrix
4	1	T1	1-151614-01	Transformer, 208:24V, 250VA, 1Phase
5	1	T2	1-151615-01	Transformer, 208:120V, 500VA, 1 Phase
6	3	T3,T4,T5	1-151774-01	Transformer, 2.4V, 5V 1-Phase
7	1	K1	1-150204-03	Contactor, 630A, 3-Phase
8	2	SSR1,SSR2	1-112129-01	SSR, 10A, 240V
9	2	C4,C5	1-111196-01	Capacitor, .15uF, 1000V, Ceramic Disc
10	1	C1	1-151782-01	Capacitor, 10 KVAR, 3P, 600V
11	7	CT1,2,3,4,5,6,8	1-113712-01	CT, Hall Effect, 500A, AC
12	2	B1,B2	1-151187-01	Fan, 1/4 HP, 208VAC, 1-Phase
13	1	B3	1-151023-01	Fan, 120V, 4", Internal
14	1	PS1	1-160006-01	Power Supply, Single Out, +15VDC
15	1	TB4	1-150343-01	Block, Terminal, 2-Pos
16	2	TB2,TB3	1-119154-01	Block, Terminal, 4-Pos, 600V
17	3	F4-12	1-112590-03	Block, Fuse, 600V, 3-Pole
18	1	F13,14	1-112590-01	Block, Fuse, 600V, 2-Pole
19	2	F7,8	1-117452-02	Fuse, 15A, 500VDC
20	4	F9-12	1-117452-07	Fuse, 6A, 500VDC
21	5	F4-6,13,14	1-117452-04	Fuse, 1A, 500VDC
22	1	S6	1-150329-01	Switch, Interlock, Door
23	1	TB1	1-150329-01	Switch, Interlock, Door
24	1	CT7	1-151787-01	Current, Transducer, 1000A
<b>Lower Enclosure</b>				
25	1	-	1-151750-01	Fab, Enclosure, Lower, 2 Bay, PV225208
26	2	L1,L2	1-151605-01	Reactor, 3PH, 130uH, 312 Arms
27	2	B4,B5	1-151024-01	Fan, 10", 600 CFM
28	2	TS1,TS2	1-151530-02	Thermostat, Disk, Snap, 157 to 169C
<b>Enclosure Door (Not Shown)</b>				
29	1	-	1-151128-02	Assy, LCD, W/Keypad
30	1	S3	1-117906-01	Switch, On/Off, 2 Pole
31	2	-	1-150326-01	Contact Block, NC



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REVISION						
REV	CHANGE	DATE	DRAWN	ENGR.	Q.LTY.	MFG.
A	ECO 1321	11-11-02	GB			

SEE SEPARATE BILL OF MATERIAL

▼	DENOTES CRITICAL SAFETY APPLICATION	INTERPRET IN ACCORDANCE WITH ANSI Y14.5 BREAK ALL SHARP EDGES	ALL DIMENSIONS IN INCHES		DATE:
▼	DENOTES CRITICAL PERFORMANCE/RELIABILITY APPLICATION		DRAWN: G. BELTRAN	11-05-02	
■	DENOTES KEY CONTROL CHARACTERISTIC		ENGR:		
▲	DENOTES REVISION CHANGE		QLTY:		
			MFG:		

**xantrex**

ENCLOSURE, AC  
INTERFACE, PV-225208

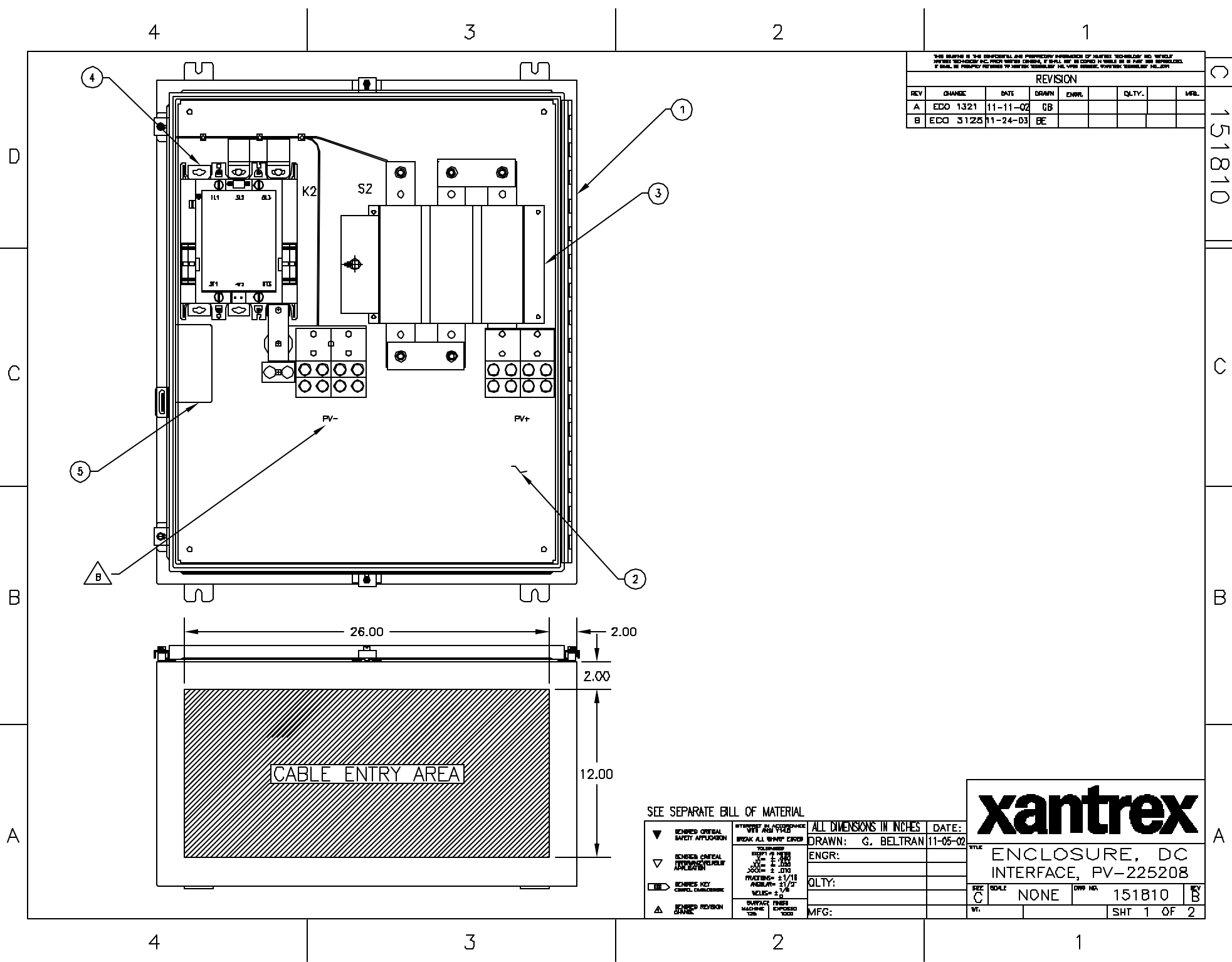
SIZE C SCALE NONE DWG NO. 151809 REV A

WT. SHT 1 OF 2

**Xantrex Technology Inc. PV-225208**  
**Photovoltaic Inverter**  
**Major Parts List**

**Assembly Description: Enclosure, AC Interface, PV-225208**  
**Xantrex Technology Assembly # 151809**

Item #	Qty	Reference Designator	Xantrex Technology Part #	Description
1	1	-	1-151784-01	Fab, Enclosure, DC Interface, PV225208
2	1	-	1-151754-01	Fab, Panel, Encl, AC, PV225208
3	1	S1	1-151669-03	Switch, Dscnct, Non-Fuse, 600V, 800A
4	3	F1-3	1-151465-03	Fusebase, Sq Body Fuse Style
5	3	F1-3	1-151785-01	Fuse, Sq Body, 800A, 700V
6	1	SA1	1-114653-01	Arrestor, Surge, MOV, 650V
7	1	-	1-119648-01	Bracket, Surge Arrestor, Mntg



REVISION						
REV	CHANGE	DATE	DRAWN	ENGR	Q.LTY.	MFG.
A	EDO 1321	11-11-02	GB			
B	EDO 3125	11-24-03	BE			

SEE SEPARATE BILL OF MATERIAL

REWORK CRITICAL SAFETY ATTENTION	REWORK CRITICAL SAFETY ATTENTION	REWORK KEY CRITICAL CHARACTER	REWORK REVISION CHANGE
WITNESS SIGNATURE	WITNESS SIGNATURE	WITNESS SIGNATURE	WITNESS SIGNATURE
DATE	DATE	DATE	DATE
ALL DIMENSIONS IN INCHES	ALL DIMENSIONS IN INCHES	ALL DIMENSIONS IN INCHES	ALL DIMENSIONS IN INCHES
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ENGR:	ENGR:	ENGR:	ENGR:
Q.LTY:	Q.LTY:	Q.LTY:	Q.LTY:
MFG:	MFG:	MFG:	MFG:

**xantrex**

ENCLOSURE, DC  
INTERFACE, PV-225208

SCALE NONE DOW NO. 151810

SHT 1 OF 2

**Xantrex Technology Inc. PV-225208**  
**Photovoltaic Inverter**  
**Major Parts List**

**Assembly Description: Enclosure, DC Interface, PV-225208**  
**Xantrex Technology Assembly # 151810**

Item #	Qty	Reference Designator	Xantrex Technology Part #	Description
1	1	-	1-151783-01	Fab, Enclosure, DC Interface, PV225208
2	1	-	1-151755-01	Fab, Panel, Encl, DC, PV225208
3	1	S2	1-151669-04	Switch, Dscnct, Non-Fuse, 600V, 1200A
4	1	K2	1-151786-01	Contactora, 3P, 750A, 120VAC coil
5	1	TB5	1-151792-01	Block, Power Distribution, 1 Pole

## **SOURCE CONTROL SPECIFICATION**

DOC NO.	REV	ECO	DATE	DRAWN	Q.C.	ENGR	MFG
	A	1321	12/9/2002	CRF			
151812							

### **PART DESCRIPTION**

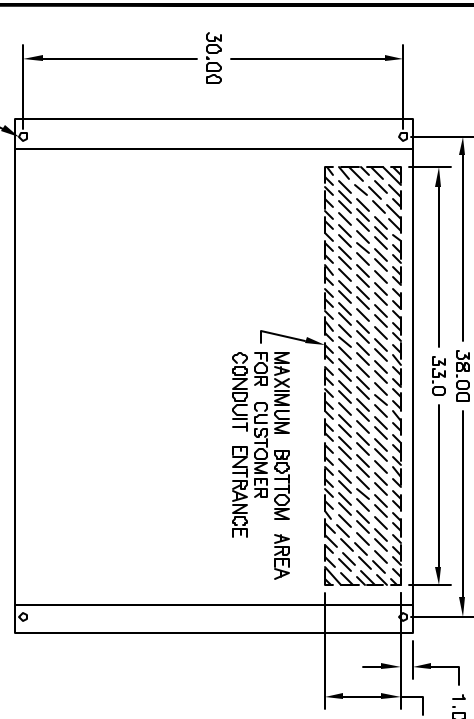
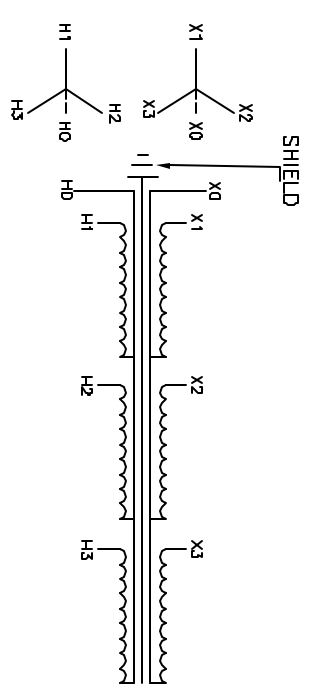
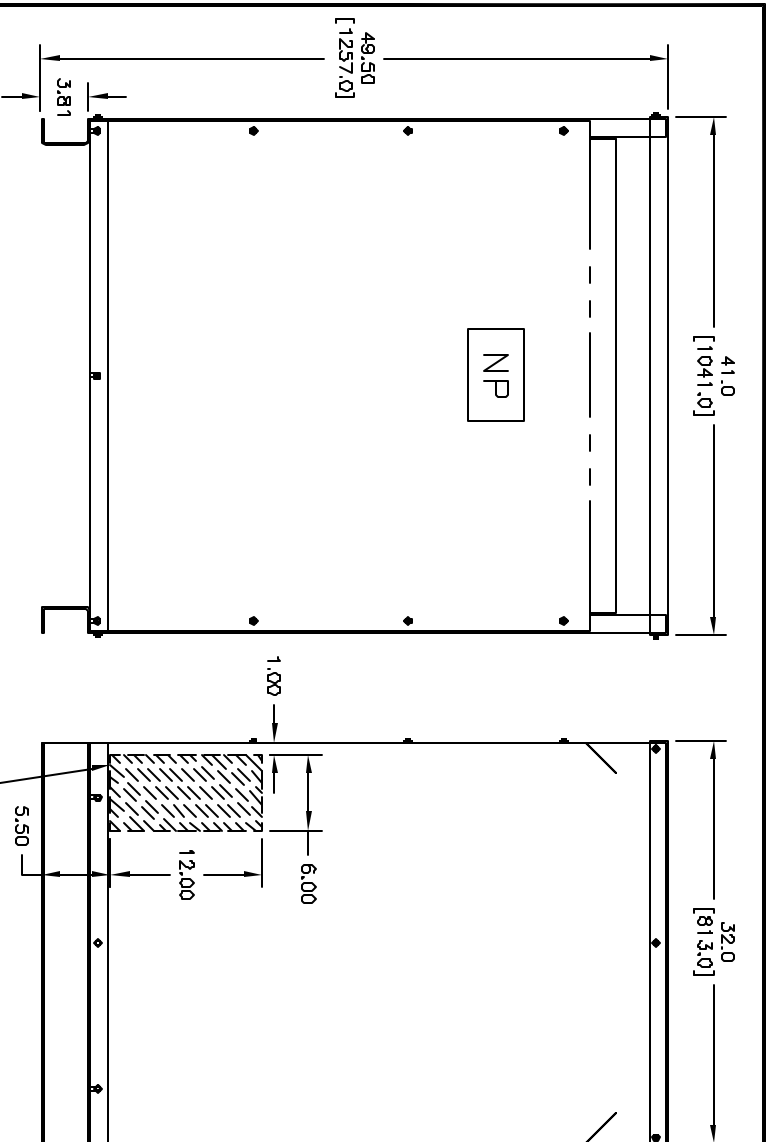
*XFMR, 225KVA, 3 PHASE, 60Hz, 208Y*

### **MANUFACTURER**

*SQUARE D*

<b>MFG'S PART NO.</b>		<b>XANTREX PART NO.</b>
208Y208	225TQ56373 (Custom Built)	1-151812-01
208Y480	225TQ56374 (Custom Built)	1-151812-02

**DATA SOURCE:** <http://www.squared.com/>



NOTES:  
CULUS LISTED  
NEMA 2 VENTILATED ENCLOSURE  
COPPER WOUND  
MINIMUM CLEARANCE OF 6" MUST BE  
MAINTAINED BETWEEN VENT OPENINGS  
AND OTHER OBSTRUCTIONS  
USE WEATHERSHIELD CAT WS382 FOR NEMA 3R

THE DIMENSIONS ON THIS DRAWING ARE  
SUBJECT TO CHANGE. PLEASE VERIFY IF  
DIMENSIONS ARE CRITICAL.

225 KVA GENERAL PURPOSE TRANSFORMER  
CATALOG NO. 225TQ56374R1



**SQUARE D COMPANY**

DRAWN BY: BA DATE: 08/12/02

DWG NAME A-Q56374R1-A-4

REV NO -