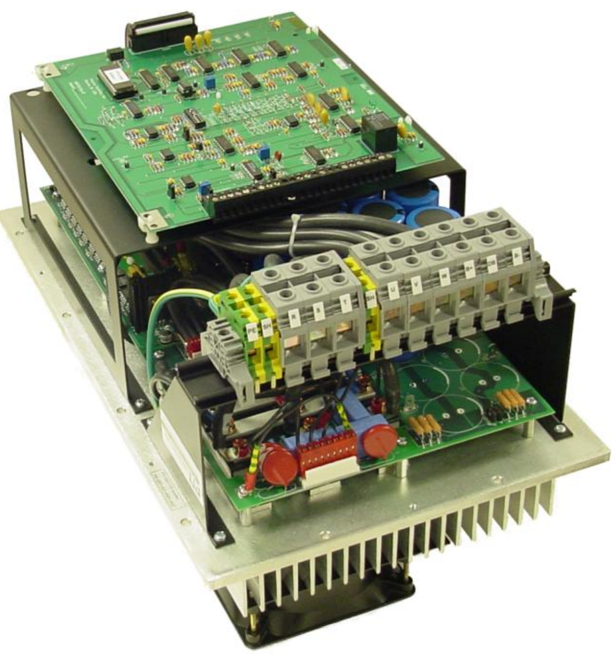
Plasma Technics, Inc.®

INSTALLATION & OPERATION MANUAL
SSD330 / 1105 / 1100 SERIES

Version: Rev 3.2



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NOTE:
THIS MANUAL COVERS 3.2 INVERTERS DESIGNATED AS SSD1105-330

The information contained in this manual is considered accurate to the best knowledge of the supplier at the time of publication. The manufacturer, however, assumes no liability for errors that may exist. The supplier reserves the right to change data and specifications without notice.

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What's new or different about the Rev 3.2 product

Pulse width start-up ramp to enable soft start at the selected frequency.
Bus compensation is available when PDM is used.
Internal voltage pot can be used as a trimmer for the external voltage pot.
PDM blanking methods enhanced, similar to SSD110.
Fine tune PDM and Freq. maximums to 10.0v.

Table of Contents:

1. Unpacking

1.1 Verify delivery.

Check that you received the inverter and optional equipment that was ordered.

Verify that the part numbers match your purchase order and that the correct options have been installed.

Report any discrepancies to your supplier.

1.2 Inspect for damage.

Inspect the inverter for damage that may have occurred during shipment. Visually examine the contents for obvious problems.

If damage is found, do not operate the inverter. Report the problem immediately to your supplier.

1.3 After the initial inspection.

Your inverter can be repacked and stored for future use. Choose a storage location that is clean and dry.

Do not store in ambient temperatures below 5° F or above 158° F (-15°C to 70° C)

Do not store in wet areas or areas of high condensation.

Do not store in corrosive environments.

2. Mechanical Mounting.

Proper mechanical installation of the SSD1105 is necessary to ensure both reliable and efficient operation and ease of maintenance.

2.1 Mounting Environment

The inverter should be mounted in an environment that is free from the following:

!*Corrosive or volatile vapors. Dust and particles, Excessive moisture.*

!*Shock, Excessive vibration, Temperature extremes*!

The following environmental specifications apply:

Ambient operating temperature: 32° to 104° F (0° to 40° C)

Relative humidity: 5 to 90%, non-condensing.

Altitude (maximum): 3,310 ft (1,000 m), de-rating for altitude is 1% for every 100m above 1000m.

2.2 Mounting Considerations

The following should be considered when planning the physical installation of your SSD1105.

Leave enough clearance for access to all electrical connections.

Allow room for troubleshooting.

Allow at least 3 inches of clearance above and below the unit to permit adequate cooling airflow.

The SSD1105 **must be fan cooled** in order for the inverter to be run at full output power. In the final installation the convection cooled SSD1105 should be mounted with the cooling fins vertical so as to maximize the affects of normal convection cooling. Fan cooled can be mounted in any orientation

Allow a minimum clearance of 1.0" between units when mounted side by side.

Separate conduit is required for line voltage and control wiring.

2.3 How to Mount the Inverter

Figures 2.1 shows the mechanical layout of the SSD1105 inverter with standard flange mounting. Refer to this drawing when planning your layout. The SSD1105 should be mounted to a secure sub-panel or frame.

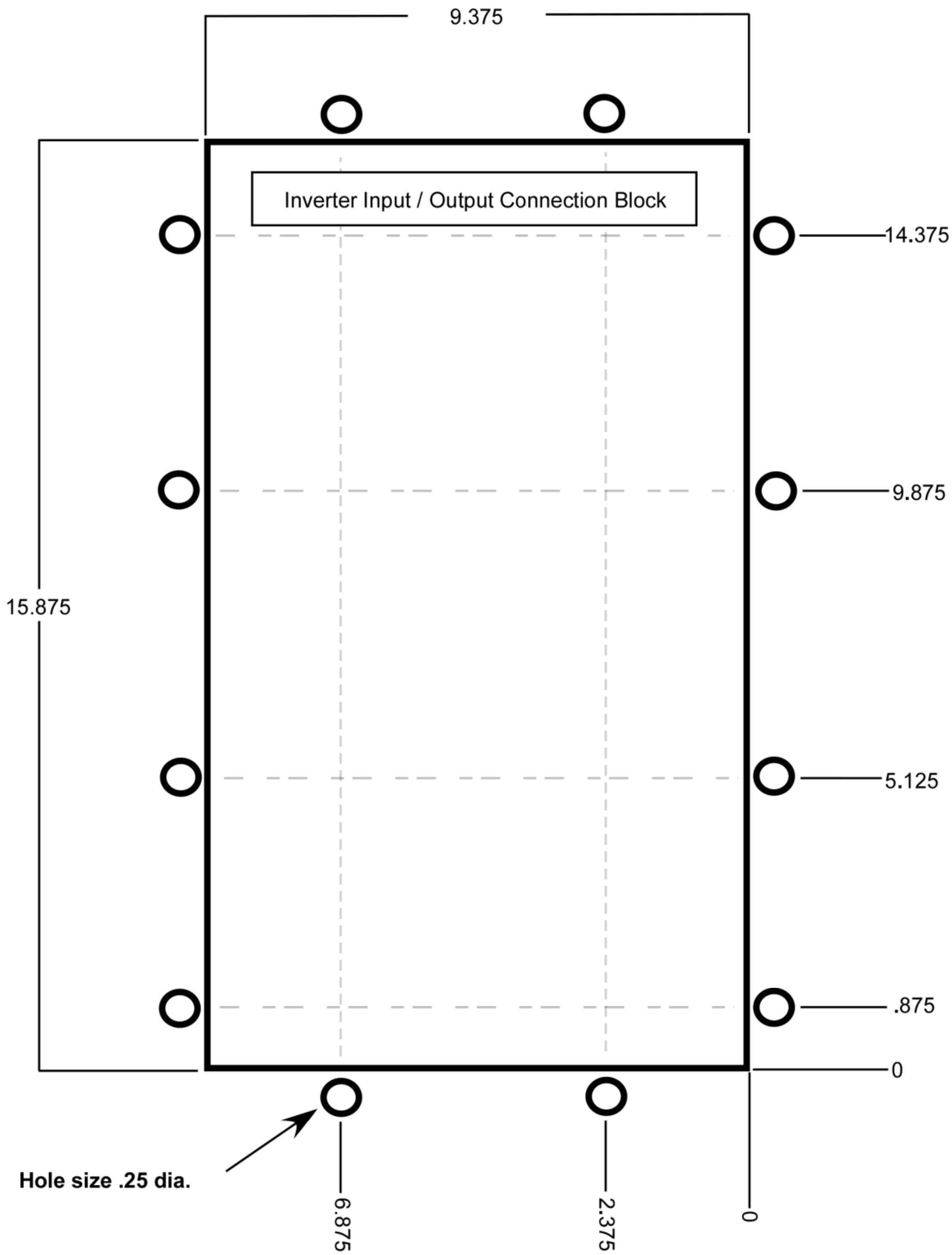
CAUTION:

Make sure the mounting rack is secure before mounting the inverter onto it. Equipment damage could result from an improperly mounted rack or inverter.


INSULATION SYSTEM
CLASS H2
CURRENT CONTROLS
HIPOT
TESTED
INSULATION SYSTEM
CLASS H2
CURRENT CONTROLS
HIPOT
TESTED

Fig. 2.1

SSD330 /1105 Series [Form 17N]
Flange Mount Cutout and Hole Pattern



***Edge of mount holes are 1/8" from cutout.**

Fig 2.2

3. Electrical Installation

3.1 Wiring Standards and Codes

The installation personal is responsible for following the wiring plan produced by the design engineer for the specific application.

All wiring must conform to the following standards:
National Electrical Code, Publication NFPA No. 70.
All local and national codes which apply.

The supplier cannot assume responsibility for the compliance or noncompliance to any code governing the proper installation of this equipment.

3.2 Inverter Electrical Connection Wire Sizing

Refer to the rating of the inverter and the National Electrical Code, Publication NFPA No. 70, Article 310, and any local codes that may apply for wire sizing and selection.

3.3 Case Ground

Each of the inverters must be connected to ground at their case ground terminal. A grounding electrode conductor or bonding jumper must be connected from the ground terminal to either a grounding electrode buried in the earth or a suitable plant ground with solid connections to earth ground. Refer to NFPA No. 70, Article 250, for details on grounding and grounding electrodes.

3.4 Safety Grounding

The case ground connections should be made at the ground terminals. The case ground of the various system components should be connected to the star grounding bus of the cabinet. A grounding electrode conductor or bonding jumper must be connected from the star grounding bus to either a grounding electrode buried in the earth or a suitable plant ground with solid connections to earth ground. Refer to NFPA No. 70, Article 250, for details on grounding and grounding electrodes.

3.5 Soft Charge

Built into inverter.

3.6 Surge Protection

Built into inverter.

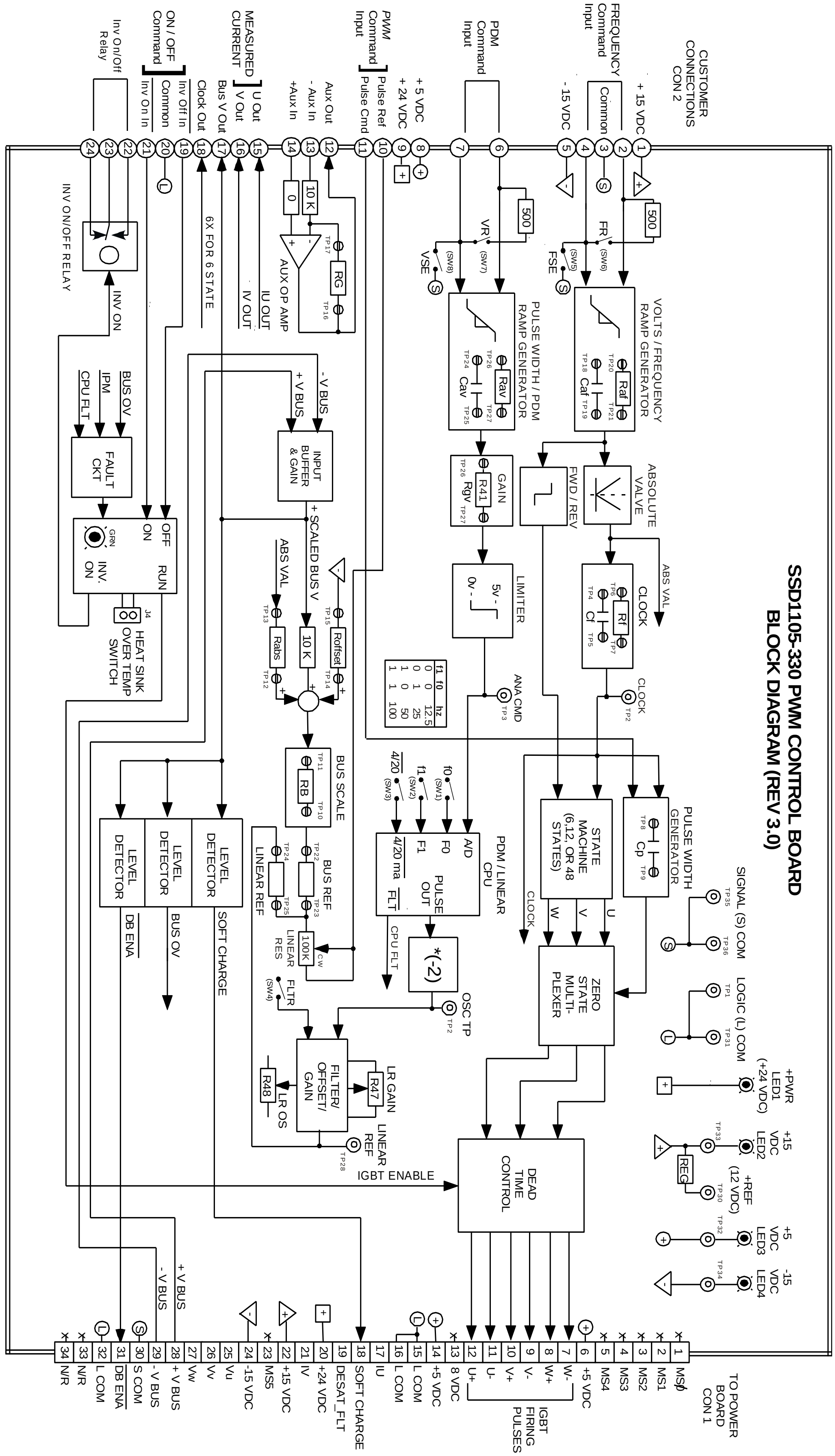


Figure 3.1. General Inverter Block Diagram

SSD330 PDM Control Board (Rev #3.1) Component, Switch and Potentiometer Setups

Designator	Connection		Default	Component Used	Description	Setup Procedure
Raf	TP20	TP21	1meg	Res 1/4 Watt 1%	ON command Pulse Width Ramp Time	Smaller resistance will decrease the ramp time.
Caf	TP18	TP19	Open	Cap Cer 50V 10%	ON command Pulse Width Ramp Time	Smaller resistance will decrease the ramp time.
Rav	TP26	TP27	Open	Res 1/4 Watt 1%	PDM Ramp Time	Smaller resistance will decrease the voltage command acceleration time.
Cav	TP24	TP25	Open	Cap Cer 50V 10%	PDM Ramp Time	Larger capacitance will increase the voltage command acceleration time.
Rgv	TP26	TP27	Factory	Res 1/4 Watt 1%	Voltage Command Gain	Factory select
Rg	TP17	TP18	User Defined	Res 1/4 Watt 1%	Auxiliary Op Amp Gain configured by user	RG is the feedback resistor for the customer available auxiliary operational amplifier. Amplifier connections are on, connector J1, Pin 11 (output) Pin 12 (10K ohm negative input) Pin 13 (zero ohm negative input).
Rf	TP06	TP07	User Defined	Res 1/4 Watt 1%	Maximum Clock Frequency	Smaller resistance will increase the maximum frequency. 130k for 2.3khz system.
Cf	TP04	TP5	User Defined	Cap Cer 50V 10%	Maximum Clock Frequency	Larger capacitance will decrease the maximum frequency.
Cp	TP08	TP09	User Defined	Cap Cer 50V 10%	Pulse Width (Break Point) Frequency	Larger capacitance will decrease the maximum break point frequency.
BUS REF	TP22	TP23	IN	Jumper	Bus Reference For PDM Control	Required for this mode.
LINEAR REF	TP24	TP25	OPEN	Jumper	Linear or PDM Reference For Pulse Width Control	Default
Rb	TP10	TP11	Factory	Res 1/4 Watt 1%	Bus Scaling	Scales the compensation for the applied line voltage. 24.3k for 460v system.
Roffset	TP14	TP15	Factory	Res 1/4 Watt 1%		Scales the compensation for the applied line voltage. 68k for 460v system.
S COM	TP35			Test Point	Test Point	Signal Common
S COM	TP35			Test Point	Test Point	Signal Common
L COM	TP01			Test Point	Test Point	Logic Common
L COM	TP31			Test Point	Test Point	Logic Common
+15 vdc	TP33			Test Point	Test Point	
-15 vdc	TP34			Test Point	Test Point	
+5 vdc	TP32			Test Point	Test Point	
OSC TP	TP02			Test Point	Test Point	PDM fundamental frequency output.
LINEAR REF	TP28			Test Point	Test Point	Used to adjust LR_Gain and LR_OS pots.
CLOCK	TP02			Test Point	Test Point	6x actual output to load
ANA CMD	TP03			Test Point	Test Point	Pulse width signal to microprocessor.
F0	SW1		User Defined	Setup Switch	Setup Switch	Used to select PDM frequency.
F1	SW2		User Defined	Setup Switch	Setup Switch	Used to select PDM frequency.
Not 4/20	SW3		User Defined	Setup Switch	Setup Switch	Converts PDM input from voltage to current type (4/20).
FLTR	SW4		ON	Setup Switch	Setup Switch	ON for linear pulse with control, OFF for full pulse width and PDM control.
FSE	SW5		ON	Setup Switch	Setup Switch	For single ended input. Grounds terminal 4 when ON.
FR	SW6		OFF	Setup Switch	Setup Switch	Converts Freq input from voltage to current type (4/20).
VR	SW7		OFF	Setup Switch	Setup Switch	Converts Voltage input from voltage to current type (4/20).
VSE	SW8		ON	Setup Switch	Setup Switch	For single ended input. Grounds terminal 7 when ON.
LR GAIN	RXX		Factory Set	Potentiometer	Potentiometer	Factory adjustsment to meet user application.
LR OS	RXX		Factory Set	Potentiometer	Potentiometer	Factory adjustsment to meet user application.
Linear RES	RXX		Full CCW	Potentiometer	Potentiometer	Factory adjustsment to meet user application.

Figure 3.2. Set-up Reference Chart

SSD1105-330 Power Connections

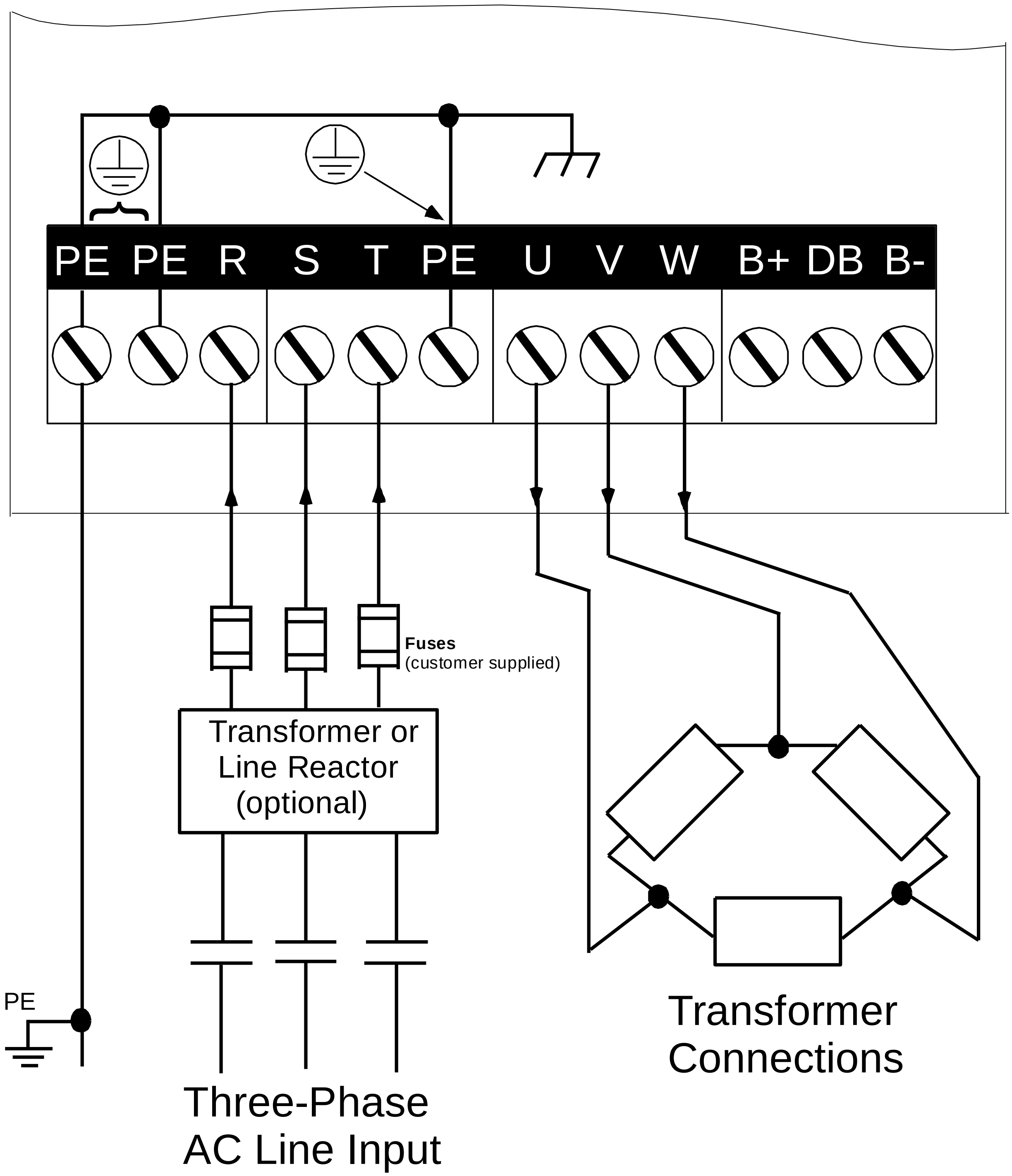
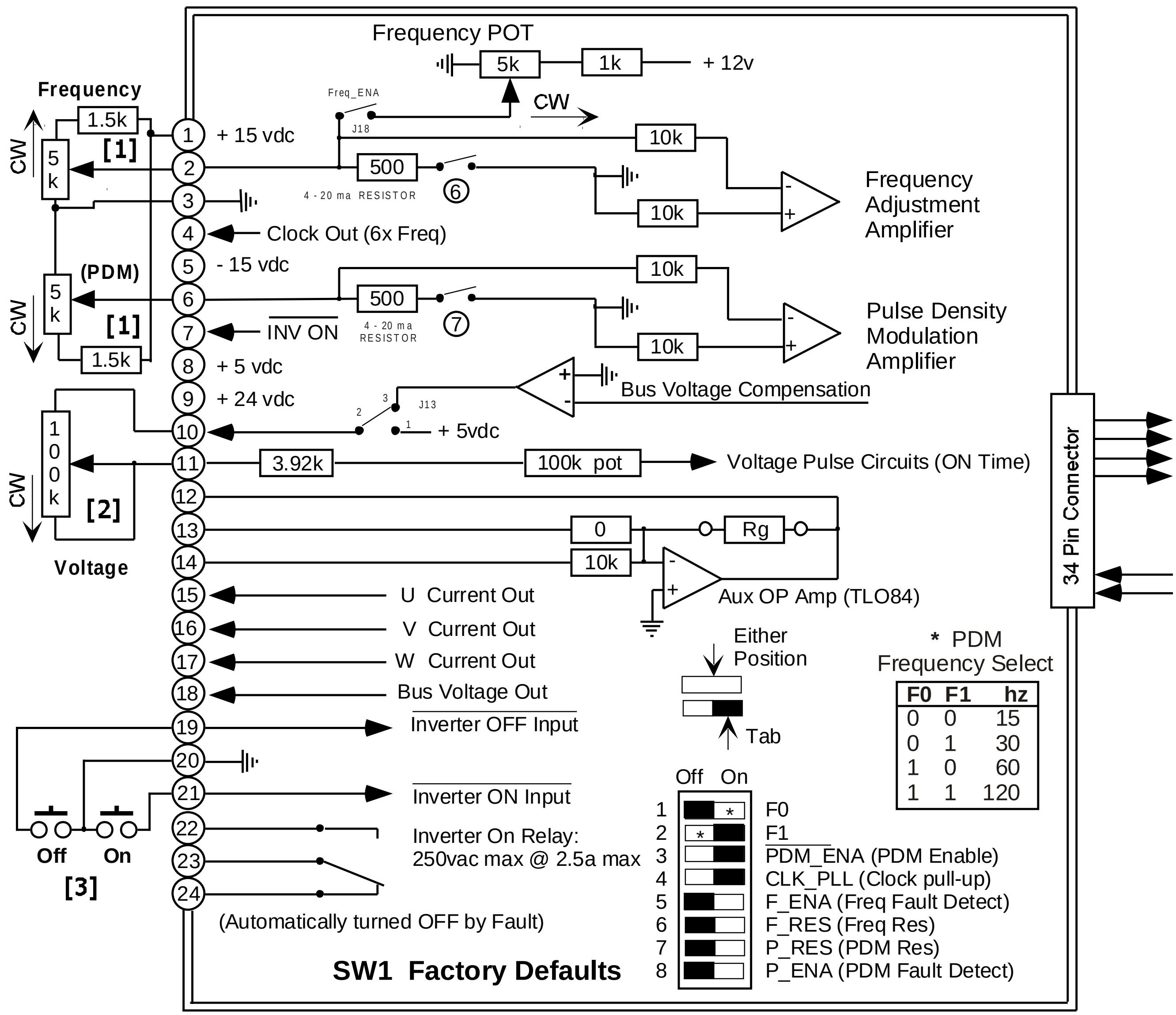


Figure 3.3. Power Connections

SSD331-110x-xxx Series Interface Card



Bus voltage at terminal 17 is normalized:
4v for 400dc (240vac system) or 4v for 800dc (480vac system).

Load currents for U, V and W are available via a buffering Op-amp at terminals 15-17. The output level (0-5vdc) is normalized for all power platform power ratings.

Outputs 4 and 7 are open collectors pulled to ground, capable of 0-50v, 500ma sink.

Grounding either #3 or #9 usually reduces signal noise.

[1] Optional to obtain full use of potentiometer range.

[2] Optional remote pot, keep wires as short as possible. On-board pot, jumper 10-11.

[3] Optional SPDT Toggle Switch or Relay.

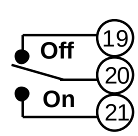


Figure 3.4. PDM Connections

4. Inverter Component Selection and Calculations

4.1 Ratings and Measurements

It is very important to measure, evaluate and understand the electrical performance of the system.

Wattage can be measured using a 3ϕ wattmeter like the Fluke 41 or 43 series.

The general rule for any type of transformer that determines the maximum primary amps ***regardless*** of applied primary volts is: **Nameplate VA / Configured Volts (not applied volts)**
Example: 1000va / 240v = 4.17a max or 3000va / 240v = 12.5a max.
Note that maximum primary amps is not related to applied volts. If the applied primary voltage is 50% of the rated value then the va rating of the transformer has effectively been cut in half.

To continue with this example, if the expected ozone performance is being achieved with 50% of rated primary voltage then it is likely that the output voltage rating of the transformer is twice as high as it should be. Under these conditions the inverter input current could be well within its rating but the transformer could be at twice its rated primary current. This is why it is essential to also measure the transformer primary current. If a voltmeter is available rather than an amp meter then the primary current can be reasonably estimated by taking the inverter input watts and dividing it by the measured primary volts. For the purpose of this example 200vac is measured. Using the above numbers: 2340w / 200v = 11.7a.
You can see this 11.7a is nearly the rating of the transformer, which in this configuration is 12.5a.

Note: the output voltage (pulse width) will increase as the frequency is increased if the frequency is below the SSD break frequency (usually 800hz). If the frequency control is going to be substantially increased it is recommended that the pulse width (voltage) control be reduced first.

4.2 Output Voltage Calculations

The RMS output line-to-line voltage (VLL) and its maximum value are partially determined by the input voltage. The Approximate maximum output voltage is calculated by using Equation 4.1.

Equation 4.2

Vo (RMS) Max = 1.1547*Vi (VRMS) or

Vo (RMS) Max = 1.1547*Vi (VDC)/ √(2)

The output voltage (VLL) is determined by the pulse width (Tp), at a selected Frequency (f). The pulse width (Tp) is set by the combination of Cp and an external resistor or potentiometer Rp, connected across pins 19 and 20 of terminal Con2. The appropriate pulse width calculation is shown in Equation 4.2. If Cp or Rp is increased, the pulse width will increase if the frequency is not changed the RMS output voltage will also increase and visa versa.

Equation 4.3

$Tp \cong 0.77 * (Rp + 4750) * (0.001 * 10^{-6} + Cp)$ in seconds.

4.3 IGBT State Machine Control

The SSD1105 creates a frequency six times that of the output frequency, which can be measured directly between common 20 and output 18 (TTL) of Con2. This allows the SSD1105 to set up a state machine, for each output cycle, with six unique states. To describe the states for one cycle, we will start with the first output off state. In this state the output will be disabled for $1/6^{th}$ of the output cycle, independent of the output frequency. The pulse of the next clock will increment the inverter to the next state. In the next state (2) the clock triggers a monostable, which creates a pulse of a width (Tp) as shown in the Equation 4.2. In this state one of two things can happen, either the monostable will time out driving the output to the off, or the clock will arrive, changing to the next state (3), once again triggering the monostable keeping the output in the on. Once the second pulse is complete or the next clock pulse arrives (4), the output will be returned to an off condition. If Tp is greater than $1/6^{th}$ of the output cycle, the output is disabled for $1/6^{th}$ of the complete cycle. At this time the negative side of the output will run through the same sequence as the positive portion of the cycle creating a modified sign wave output. See example 4.1.

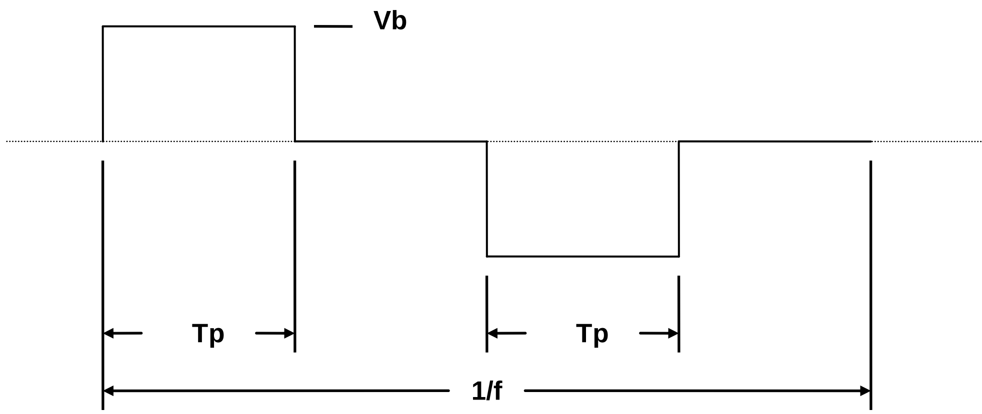
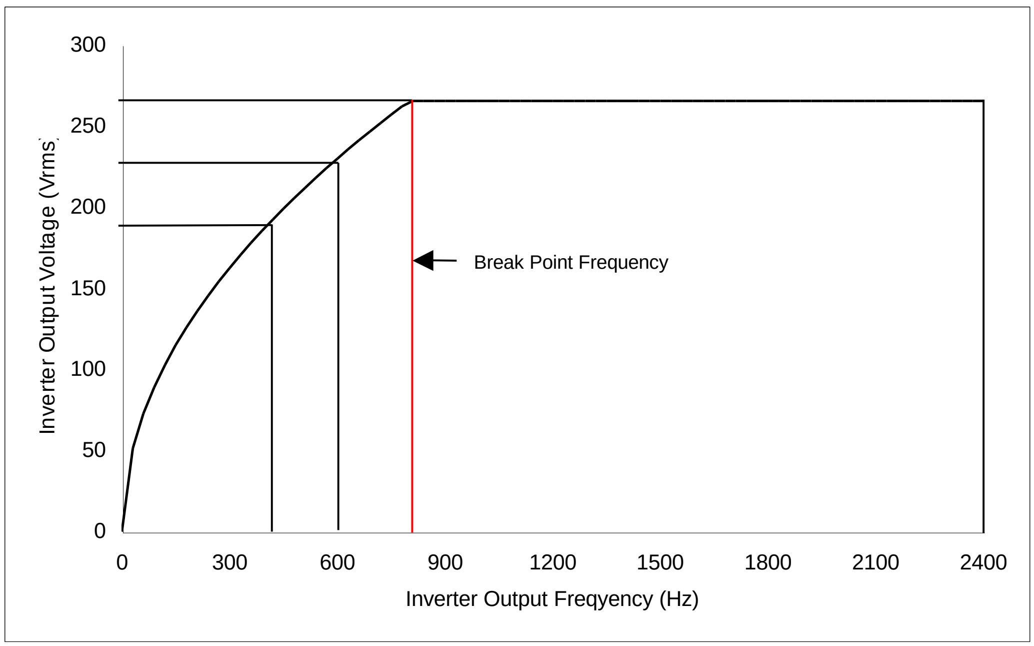


Figure 1



Graph 4.1 Inverter Output Vrms Vs Commanded Frequency

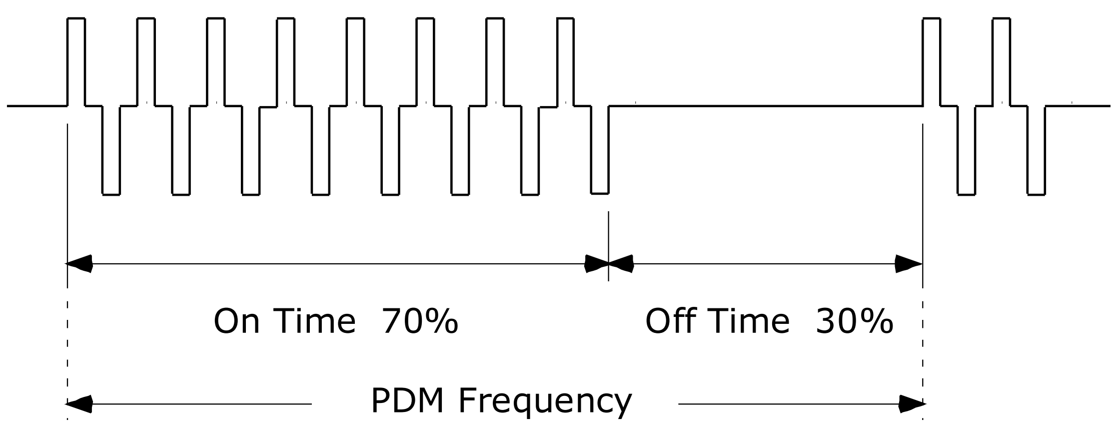


FIGURE 2

4.4 Output Frequency Calculations

The external voltage applied to the frequency amplifier controls the output frequency, see Figure 1 for connection details. Setting the frequency range and limits are determined by Rf and Cf as shown in Equation 4.3.

Equation 4.3

$$F\ (Hz) \cong \frac{2.7 * 10^{-6} * (1 * 10^{6} + Rf)}{Rf * (1032 * 10^{-12} + Cf)}$$

4.5 Start-up Pulse Width Ramp Time

When the output is switched on, the pulse width ramps from a narrow pulse to the pulse width defined by the user setting of the voltage potentiometer. The soft engauge ramp time is user adjustable. No addition of components results in a ramp-up of 1 second. Change the desired rate by selecting the proper Cav and Rav. The output will change zero to full in a time of no less then Ta seconds as calculated in Equation 4.4. Adding a Cav capacitor to the turrets will increase the start time and adding a resistance to Rav turret will reduce the voltage ramp.

Equation 4.4

$$Ta\ (sec) \cong Rav * Cav$$

Table 4.1 (see next page)

Table 4.1

Tuning Component	Location
Cav	Tp24 to Tp25
Rav	Tp26 to Tp27
Cf	Tp4 to Tp5
Rf	Tp6 to Tp7
Cp	Tp8 to Tp9
Rp	Con2 Terminals 10 to 11

5. Start-up

5.1 Transformer Configuration Jumpers

It is necessary however to be certain the load i.e.: transformer and optional lamp are properly jumpered for the expected primary voltage.

PTI has 2 transformer types that are routinely used with the SSD1105: 100-HLHxx302/D230 and 55-HLHxx102/D115. The 55-HLHxx102/D115 is rated for 120v or 240v operation, 1kva at 1.2khz. While this transformer can be operated at 600hz one must be very careful to reduce the input voltage in half so as to prevent over heating and burn out. This reduction will also reduce the power available for said transformer to 600va. Increasing the frequency above 1.2khz is no problem either as long as the case temp limits are observed. Frequencies at or above 2khz generally yields excessive transformer heat however, if full rated power is applied. The HSH series transformers will operate to 5 to 10khz however. This transformer can easily be driven to power levels beyond its means by the SSD1105.

The same general rules also apply to the 100-HLHxx302/D230, which is rated at 3kva at 1.2khz. It has a primary of either 230 or 460v. This transformer obviously a better match for the capacity of the SSD1105.

PTI has several voltage output levels available in the 3kva Case100 series. If you are uncertain as to the proper high voltage level needed in your application it is recommended that the transformer be strapped for 460v operation while the inverter has 230 applied. This will reduce the output high voltage by 50%. I.E. A 10kv transformer would produce 5kv and is also de-rated in power from 3kva to 1.5kva. The need for this test configuration is mandated by the measurement of rated or nearly rated inverter input current while having a relatively low transformer primary voltage measurement, say 100-140v (240ac inverter input). Contact PTI if this condition occurs so as to select a more suitable transformer.

5.2 Safety Considerations

DANGER

To avoid injury to personnel and/or damage to equipment only qualified personnel should perform the procedures outlined in this chapter. This personal must understand both the electrical and mechanical components associated with the application.

Thoroughly read and understand the following procedures before beginning the start-up process.

The following specific safety procedures must be observed when performing any maintenance or adjustments on the amplifier.

Always turn off and lock out AC power at the main machine disconnects switch. Do this before touching any electrical or mechanical components.

High voltage may be present even with all electrical power supplies disconnected.

Use an appropriate meter to verify that all DC bus capacitor banks have been discharged before working on any equipment. Do not rely exclusively on high voltage RED LED indicator for bus voltage, as dangerous voltage levels may remain even when the indicator is off.

Follow industry recognized safety procedures. Use only one hand to hold test equipment probes, wear approved eye protection, etc. Before energizing the inverter, make sure that device(s) connected to the output of the inverter will not result in injury or damage to equipment. Keep unnecessary personnel out of the immediate work area. Never leave an inverter cabinet open and unattended.

5.3 Start-up Procedure

To ensure a complete checkout and test, check off each step as it is completed. If the proper event does not occur while performing this start-up procedure, do not continue. Take the appropriate action to correct the malfunction before proceeding.

- Ensure the main disconnect switch is locked off. High voltage may be present even with all electrical power supplies are disconnected. Use an appropriate meter to verify that all DC bus capacitor banks have been discharged before working on any equipment. Do not rely exclusively on RED LED indicator of bus voltage, as dangerous voltage levels may remain even when indicator is off.
- Verify that the inverter mounting has been performed in accordance with the guidelines listed in Chapter 2.
- Inspect the inverter to verify that all optional modules have been selected and installed according to the system drawings and documentation.
- Verify that all wiring has been installed according to the wiring plan produced by the design engineer and according to the guidelines listed in Chapter 3 for proper connection, grounding, wire size, labeling, routing and applicable codes. The SSD330-110X does not have internal fusing. Install appropriate input and output(optional) fusing.
- Verify that all electrical terminals, screws, nuts, and bolts are securely fastened.
- Apply three-phase AC power to the inverter.
- Check to make sure that all 4 of the GREEN status LED’s are on.
- NOTE that either pins 20 or 3 should be used as the common for the voltage or frequency measurements below.
- Adjust the pulse width pot (voltage), on pin 10-11 to provide the minimum pulse width (full ccw).
- Set PDM pot, on pin 6, to about 50% (mid rotation).
- Set the frequency input, pins 2, to provide roughly the expected system frequency. This can be done using the frequency output found on pin 18. Pin 18 will read the internal clock which is 6 times the actual output frequency.

Most DVM's include a frequency counter, but if not available,adjust the freq. pot to full CW.

- Turn on the inverter. The large GREEN LED will indicate the inverter is in the on condition and supplying power to the output terminals. If
- With the oscilloscope or meter monitoring the output. Adjust the voltage and frequency inputs to verify that the inverter has been set up properly.
- Turn off the inverter and disconnect input power. Once the RED LED located on the lower platform has switched off connect the intended load.
- Return all inputs to minimum output settings. With a true RMS amp meter monitor the output current as you bring up the output to its intended operating level.
- While the inverter is operating at this level, check for overheating which may be a sign of an overloaded the inverter.

6 First Time Users

Read this manual cover to cover.
These procedures are to be performed only by a technician with experience in high voltage electronics.

6.1 Test Procedures

The SSD330-110X provides a wide range of independent voltage and frequency control with the ability to customize the performance as desired. Output can have multiple transformers if within the SSD rating.

6.1.1 The recommended test setup requires

SSD Power input monitored with true RMS volt, amps and watts if available. Fluke 41B or 43B.

SSD output monitored with TRMS voltmeter, frequency counter and/or oscilloscope.

Transformer high voltage output measured by TRMS voltmeter and high voltage probe. For high voltage measurement, use oscilloscope, Tektronics probe P6015 or equivalent (1-800-426-2200). The Fluke, high-voltage multimeter probe commonly used for 60hz measurements (80k-40) **will not yield correct readings <u>above</u> 60hz.**

Transformer primary is best monitored using Tek differential probe P52xx and current using Fluke high-speed current clip 80i-110s or equiv.

6.1.2 Power Input Connections

Connect per fig. 3.3 using 3 phase voltage specified on the inverter nameplate.

6.1.3 Power Output Connections

For initial lab experiments, all power output lines should be fused. This is a precaution to ensure the unit is protected against an unforeseen accident during lab testing. Start with fusing levels of 50% of product rating until such time as the technician understands the SSD1105 and how the complete system responds. This will prevent damage to the components of the ozone system, (inverter, transformer, generator) while its performance familiarity is learned.

It is recommended to do the initial start-up **tests using a light bulb as the load and not the transformer.** This will allow the technician to become familiar with the controls before connecting the actual load. This will enable validation of proper hook up and also provide visual feedback as the controls are adjusted. It is also recommended that the light bulb load remain connected for the initial tests on the transformer. This will continue to provide visual feedback during the adjustment process.

If 240 volt source is applied then use two 40 - 60 watt bulbs; if 480v is applied then four bulbs of equal rating can be wired in series and placed across any two of the output terminals.

6.2 Control Connections and Jumpers

The SSD330 is considerably more complex than its predecessor. Take time to understand the on board controls and jumpers. This revision has been improved to include the advanced control functions of the SSD110.

6.2.1 Potentiometer Connections

PULSE WIDTH CONTROL CONNECTIONS: The potentiometer (Rp) is used to adjust output voltage. This potentiometer controls pulse width, which is manifested as output voltage to the load. Connect the 100k potentiometer to pins 10 and 11 as shown in figure 3.4. When the external pot is used, the on-board control (LINEAR RES) must be set to minimum (full CCW) to achieve full range of the off-board pot. Like the SSD110, the on-board pot is in series with the off board pot and can be used as a high limit control for the off-board pot. Because pulse width tends to a one time adjust, the SSD is factory configured with a jumper between pins 10 and 11 thereby enabling the LINEAR RES pot as the only control for pulse width..

FREQUENCY CONTROL CONNECTION: The 5k pot with 3 connection pigtails controls ***output frequency***. The SSD is configured for a range specified by the customer, which can be from 5hz to 20khz. See figure 3.2. Connect the frequency potentiometer (typically 5k) to pins 1, 2 and 3, as shown in figure 3.4. Typically for ozone use it is configured for a full power range of 800hz to 2.5khz. The pot can be remote mounted if desired using 2 or 3 conductor shielded cable. Note that while the SSD can be adjusted for frequencies below the lower break frequency, in this case 800hz, the SSD will automatically reduce the output pulse width for frequencies below said break frequency thus reducing the maximum power output. This automatic compensation protects the transformer and inverter against the excessive currents that would result from this frequency mismatch.

PULSE DENSITY MODULATION CONNECTION:

The 5k pot connects to pin 6 and shares a 15vdc power connection on pins 1 and 3. PDM can be controlled via external pot or command signal as well. The PDM frequency is adjusted via the binary selection switches F0(sw1) and F1(sw2).

The SSD does not contain any power line input voltage jumpers and is specifically designed for the customer specified voltage, 240v, 480, 575v.

Auxiliary Amplifier Use:

An Aux Amp is available for any utility purpose needed by the customer (TLO84). For example, it can be used to scale, invert, level shift and add if desired. Gain is adjusted by soldering a resistor to the Rg turrets. It is supplied by the same internal power supply that operates the SSD circuits, ±15v. Load impedance should not be less than 1k, usable rails of ±12v. See Fig 3.2 and 3.4.

-Reconfiguring Operating Frequency-

Use the chart below to determine desired operating frequency. Change the resistor and capacitor as the chart specifies. The location of Rf1 and Cp1 are shown in Figure 6.2. On the chart find the intersection of the two arrows, this is the approximate location of Rf1 and Cf1.

Internal Pot 5v Ref BrkPt/Max (Hz)	**External Pot Bus Ref BrkPt/Max** (Hz)	**Max** (Hz)	**Rf1** (ohms)	**Cf1** (µf)	**Cp1** (µf)
55 / 410	40 / 145	2k	Open	.01	.5
300 / 2.0k	200 / 740	2k	Open	.01	.1
650 / 4.5k	450 / 1.6k	20k	Open	Open	.047
950 / 7.0k	650 / 2.5k	20k	Open	Open	.033
1.4k / 11k	1k / 3.8k	20k	Open	Open	.022
19k / 20k *	15k / 20k *	20k	Open	Open	Open
20k / 30k *	15k / 30k *	30k	10k	Open	Open
5K / 30k *	7k / 11k *	30k	10k	Open	.0068
7k / 30k *	5k / 25k *	30k	10k	Open	.0022

Notes: Values given are nominal.
Values taken with on-board voltage and freq pots set to max CW.
Max = Max usable freq; is defined as a turn down to 20%.
* = Turn down to 10% or less.
BkPt = BreakPoint Freq, lowest freq that produces full output voltage (also full pulse width).

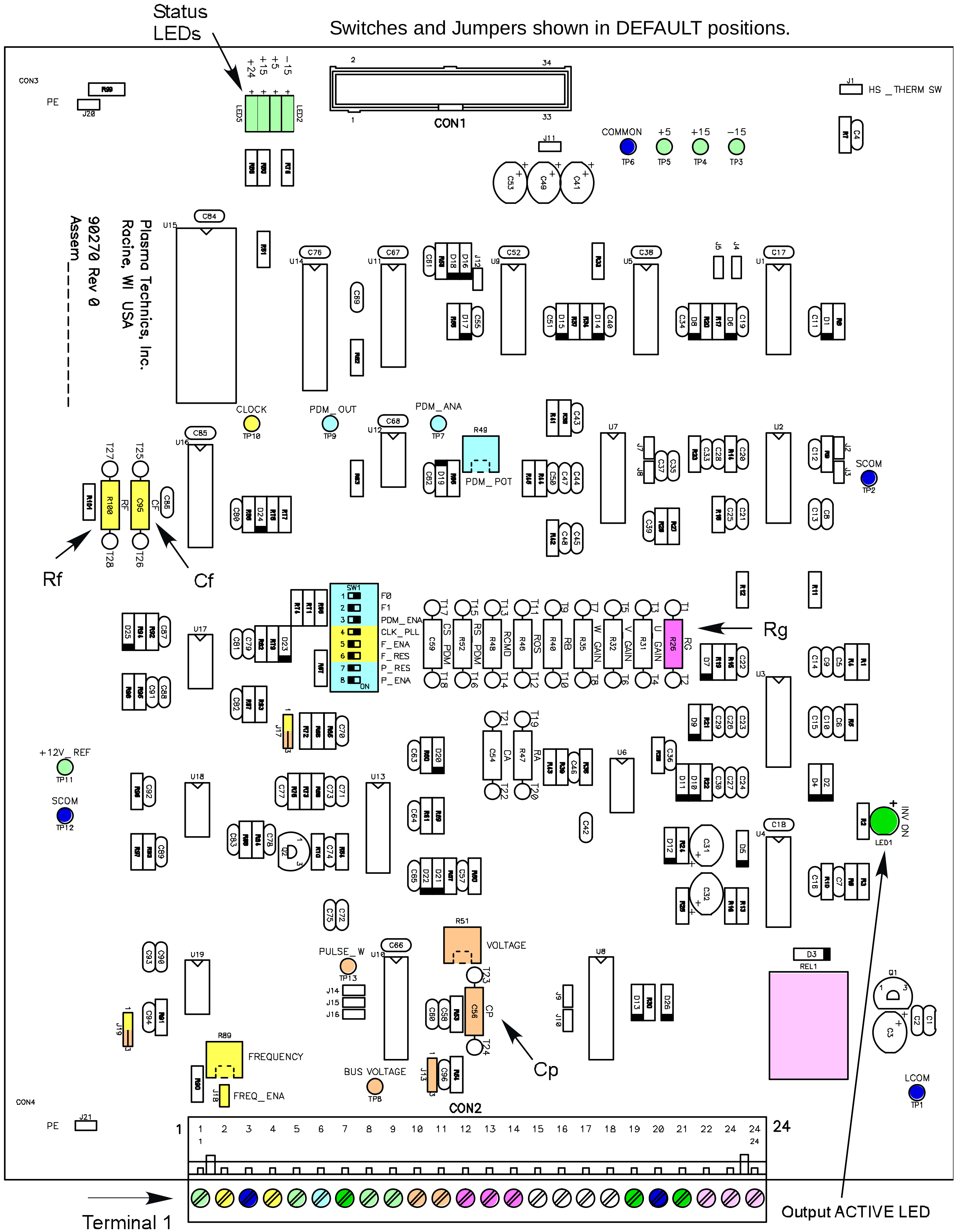


Figure 6.2. Part Locations

6.2.2 On/Off Switch Connection

Connect the inverter ON/OFF switch. A SPDT switch is wired to NC pin 19 the common to pin 20 and NO to pin 21. For bench testing the switch can be connected directly to the terminal block. It can also be remote wired. Momentary push buttons can be used for normal 'push ON / push OFF' machine control type interface. See Fig. 3.4.

6.2.3 On Board Controls and Jumper

Linear_Res pot:

This pot is in series with the external voltage pot connected to pins 10 & 11. Normal position when the external pot is used is full CCW. It can be used as a low limit trimmer for the external pot if desired. If desired, the external voltage pot can be replaced by a jumper from 10 to 11 and the on board pot can be used as the voltage adjustment. This is a 10 turn pot.

LR_Gain pot (Linear Gain):

Factory adjusted to customize inverter to specific application.

LR_OS (Linear Offset) pot:

Factory adjusted to customize inverter to specific application.

On Board Dip Switches:

See the 'SSD330 Circuit Board Component and Pot Setups' for specific details, Fig. 3.2.
This model must be configured with TP22 & TP23 (Bus Comp) jumpered. **Do not change or remove this jumper!**

6.2.4 Power Connections

The SSD does not contain any fuses. It is recommended for bench experimenting that all input legs be fused at the beginning levels with 50% of the expected load value. Connect to R – S – T in any order. It is recommended that all used output legs should also be fused with values not exceeding the peak rating of the supplied SSD (FAST fuses). This redundant fusing is not required once the bench-testing phase is complete.

While the low voltage control wiring is not connected to either power line, caution should be used to prevent the potentiometers and switch connections from shorting to any other conductive material. A nonconductive test surface is recommended.

- Connect the load or loads to the inverter outputs U – V - W on connector as shown in Fig 3.3. Note that output legs U and V have current LEMS built into the power platform which enable the current being supplied to the transformers to be monitored. See Fig 3.4.

The SSD1105 control card includes a group green LED's which indicate the **status of all low voltage power supplies.** **CAUTION** must be taken when the status LED's are on as the output is capable of being activated. The large GREEN LED will indicate that the SSD1105 output is enabled and able to provide voltage to the output terminals. The SSD1105 contains a safety start up protection circuit, which prevents the output from turning on when the main power is applied to the inverter even if the ON/OFF switch is in the ON position. The SSD1105 is only enabled on the transition of this switch from OFF to ON.

The SSD1105 does not require any **input voltage configuration** strapping. See Section 7 for the specifications to determine maximum input and loading conditions.

The SSD1105 contains **power line soft start** to eliminate high current starting surges which would normally occur when the AC power line feed is applied. A 'ON' command is deferred for about 1 second until the initial power up sequence is complete.

The power platform also includes **power factor correction** components which correct the fully loaded power factor to the range of .94 to .98

Also included is power line **phase loss detection** which prevents a power section overload should one of the input phases drop out. It should be noted that the unit can be operated on a single phase feed if the output load is relatively small.

The SSD1105 will automatically disengage the output if the power line voltage is below or above the **safe operating window** for the unit.

6.2.5 Test Equipment Connections

If an oscilloscope is used to observe the output waveforms be certain to use an oscilloscope equipped with differential inputs or a differential probe .

IMPORTANT-neither output leg can be grounded.

NOTE: Unless the scope power connection is isolated, the normal scope ground clip is grounded and could destroy either the SSD or equipment connected to it unless the above external fusing is added by the user.

CAUTION: Connecting any of the inverter outputs to earth ground may cause injury to personnel and/or damage to equipment!

CAUTION: Never float the oscilloscope by isolating the ground connection to the oscilloscope and allowing the scope chassis to be insulated from a ground. This may also cause injury to personnel and/or damage to equipment!

6.2.6 Cooling Requirements

The SSD1105 contains all necessary cooling fans. These fans operate on 24vdc for uniform performance. It is always a good policy to provide air movement within the control cabinet. See altitude de-rating information contained in specification section 7, below.

6.3 PLC or Computer Interface

It is recommended that control cable connection to PLC's and computers are done using shielded cable and run separately from the power leads. The SSD1105 power supplies are isolated and therefore connecting the signal common to a PLC is not a problem.

PLC or Computer control: The inputs can also be PLC (programmable logic controller) or computer driven if desired. PDM and frequency inputs can use either a voltage source or current source, depending on dip switch settings found in Fig 3.2. The PLC ground and/or common is connected to pin 3. Remote control of pulse width (voltage) is rarely needed. Consult factory for details. Usually, remote interfaces to PDM and Frequency provide sufficient control of the load.

- ON/OFF CONNECTION: A SPDT switch can be wired to terminals **#19 - 21**. For bench testing the switch can be connected directly to the terminal block, but remote wired if desired. Note that push buttons can also be used if desired – see schematic. The SSD replicates the control logic found in Push – ON, Push – OFF contactor control systems. These control inputs can also be PLC controlled. See block diagram.

  If an 'ON' is present when the AC feed is connected, the inverter output will not be engaged. An 'OFF' followed by 'ON' will engage the output.

  While the low voltage control wiring is not committed to either power line, caution should be used to prevent the pot and switch connections from shorting to any other conductive material while testing. A insulated test surface is recommended.

6.4 Test Procedure Steps

- Switch SSD1105 ON/OFF to OFF position.
- Set (Freq. Pot.) potentiometer to minimum command frequency.
- Set (Voltage) potentiometer to mid rotation.

- Enable the SSD1105 by setting the ON/OFF to the ON position.

- Adjust the frequency and voltage potentiometer; observe the changes in the brightness of the lights connected to the output. Also monitor the true RMS meter and/or the oscilloscope until you become familiar with the operation of the SSD1105 inverter. Check frequencies and voltage levels in order to make sure that the inverter has been setup correctly.

CAUTION: The output voltage will increase as the frequency is increased. If the frequency control is going to substantially increase it is recommended that the pulse width (Voltage) control be reduced first.

6.5 System Tuning Goals

- A tuned system using either standalone transformers or a separate transformer and choke combination can only be effectively tuned to optimum by using a P6015 high voltage probe connected to the high voltage output of the transformer.
- Adjust the freq to max, PDM to max, begin increasing pulse width (voltage) to about 100v (for 240v line) while observing that the AC input current is not excessive.
- Sweep the freq down until an output voltage peak is found. A resonant point can also be found at ½ the frequency of the fundamental resonant freq. The fundamental will have the purest sine wave however. Adjust power using the pulse width control to 100% of the max needed for the application and measure the voltage being applied to the transformer primary using TRMS meter. The voltage should be above 190v. If it is not then the transformer output voltage is too high and a lower voltage model should be substituted. Conversely, if the primary voltage is above 260v a higher voltage model is needed. (Assumes a 240AC feed. Double above values for 480vac feed.)
- Slowly lower the freq below the resonant point until the ozone output peaks. The drop in freq should be within 10% of the peak freq.
- Adjust pulse width again so as to obtain 100% of desired ozone output while being sure that power and current limits are not exceeded.
- Reduce the PDM control to obtain the desired system output performance. PDM provides a linear control of output versus command signal. Linear turn-down to 1% using PDM is possible.
- Set the PDM modulation frequency using dip switches F0 and F1. For best controllability, use a rate of at least 1/10 to 1/20 of the fundamental frequency. For example, if the inverter is set in the 1200hz range, then 120hz modulation frequency can be used. For improved PDM resolution use a lower mod. freq. such as 60, 30, 15hz.

- As a general rule optimum system efficiency is obtained at resonance however some types of cell loads yield improved efficiency at frequencies below resonance. It is always a good idea to sweep a wide frequency range while also adjusting pulse width (voltage) so as to hold inverter input power constant. This method will reveal the most efficient ozone production frequency.

6.6 Troubleshooting

- If a system has been functional but now will not start when the ON/OFF is turned ON:

  Are all of the small green LED's located on the top circuit card on? If not check input fusing. If it will not hold a slow-blow which is 25% above the inverter rating than make arrangements for RMA.
- If the Green led (Inverter-On) winks on and off when ON/OFF is engaged:

  Disconnect any loads connected to the output terminal. This includes measurement instruments to be certain they are not causing a short by grounding one of the outputs.

  Turn ON/OFF to ON position. If it still winks out when turned ON then obtained return RMA from PTI.

  If it stays ON, then either the load has been damaged or the SSD is pulse width control is turned up too high which is causing an over current condition in one or more of the outputs. Consult factory to discuss this issue.

7. Specifications

Power line Soft Start.
Displacement power factor: 0.9 to 0.96 at full load.
Overload current: 120% of rated for 1 min.
Over and Under voltage detect and disable.
Power line Phase Loss detect and shut down.
Over Temp sensing and shut down.
Maximum AC input current: see name tag.
Dry form 'C' relay contacts available which follow 'ON'.
Inverter Output Type: 3 phase Full Bridge, Six-IGBT's.
Load Symmetry Requirements: None.
Regeneration: Capacitor bank energy storage.
Operating temperature: 32° to 131° F (0° to 55° C).
Storage temperature: 5° to 158° F (-15° to 70° C).
Relative humidity: 95% maximum, non-condensing.
Altitude: To 3,310 ft. (1,000 m) at rating.

7.1 Inverter Selection / Information Guide

Model Number	Nominal Input (VRMS)	Per Leg Input (ARMS)	Total Output (KW)	Output Leg Current (ARMS)

8. Warranty

PTI warrants that its Products will be free from defects in workmanship and materials under normal use and service for a period of 90 days from the date of delivery pursuant to section 2 of these Terms and Conditions of Sale. This warranty is void in cases of damage in transit, negligence, abuse, abnormal usage, misuse, and/or accidents, or improper installation and maintenance.

PTI's sole obligation under this warranty shall be, upon prompt written notice by Buyer of any defect, to repair or replace without charge, F. C. A. Racine, Wisconsin, any defective part or parts expressly warranted herein against defects by PTI. This warranty covers only replacement or repair of defective parts at PTI's main office and does not include field service travel and living expenses. In no event shall PTI be liable for incidental, consequential, or other damage. PTI's aggregate liability with respect to defective products shall be limited to the moneys paid by Buyer to PTI for the defective products manufactured by PTI.

On equipment furnished by PTI, but manufactured by others, the written warranty of the manufacturer, if any, will be assigned to Buyer if assignment is reasonably practicable. However, PTI does not adopt or guarantee or represent that the manufacturer will comply with any of the terms of the warranty of such manufacturer.

PTI will not reimburse Buyer for any expenses incurred by Buyer in repairing or replacing any defective Products, except for those incurred with the prior written permission of PTI.

9. Disclaimer of Warranties

PTI and buyer agree that the warranties in the preceding section are exclusive and in lieu of all other express or implied warranties, including, but not limited to, implied warranties of merchantability and fitness for a particular purpose. PTI hereby disclaims and excludes all other express or implied warranties. Any oral or written description of the Products is for the sole purpose of identifying the Products and shall not be construed as an express warranty.