



OPERATING AND MAINTENANCE

INSTRUCTIONS

MODEL S251-250

WIDE BAND SOLID STATE AMPLIFIER

DOCUMENT NUMBER
S251-250MNL V1.0

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SECTION 1.0

INTRODUCTION

Congratulations on the purchase of your new Wide Band Amplifier from Instruments For Industry, Inc. Your new Wide Band Amplifier incorporates the finest advancements in state of the art solid-state electronics technology available in a compact, portable and versatile package. Your Wide Band Amplifier's quality, performance and trouble free operation depends on you thoroughly reading through this manual and familiarizing yourself with its proper operation and usage.

Your Wide Band Amplifier comes with the following accessories, be sure to check your packaging for the items listed below before disposing of the packaging.

CONTENTS

(For a typical Wide Band Amplifier)

Quantity

Description

- | | |
|---|---|
| 1 | High Power Wide Band Amplifier, Model S251-250 |
| 1 | AC power line cord |
| 1 | Operation and Instruction Manual, Doc. No. S251-250 |
| 1 | Amplifier Data Sheets (Included with Unit) |

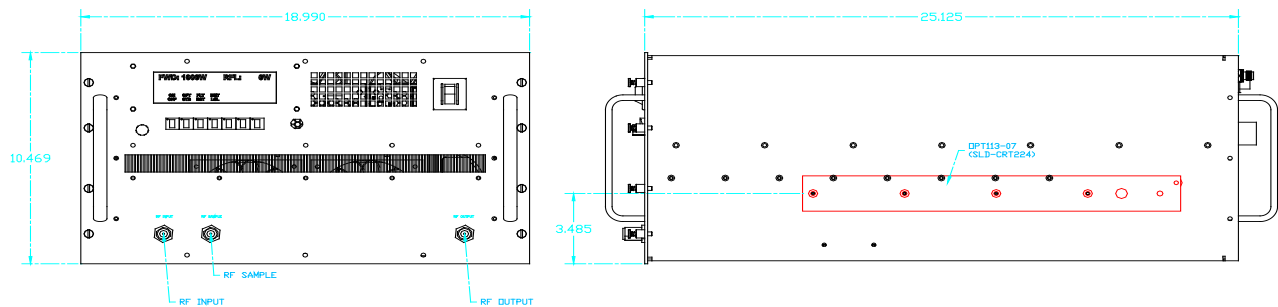


FIGURE 1.0
S251-250 ILLUSTRATION



SECTION 2.0

GENERAL DESCRIPTION

The Instruments for Industry, Inc. (IFI) manufactured S251-250 Wide Band Amplifier is a Bench Top or rack mount amplifier providing 250 Watts of RF power from 800 MHz to 2500 MHz instantaneously.

The Amplifier features a Color Touchscreen that displays continuous forward and reflected power in three-digit metering. The display also scrolls to provide the operator with operating status and self-diagnostic fault indications.

The Amplifier is unconditionally stable and incorporates protection circuits that monitor and control the VSWR input and outputs so the amplifier cannot be damaged by any mismatched load.

The Amplifier may be equipped with an IEEE-488 BUS & RS232 interfaces, which allows the amplifier to be remotely controlled through the use of a computer.

To operate the Amplifier, connect the single phase power line cord to the IEC connector on the rear panel.



SECTION 3.0

WARRANTY INFORMATION

Instruments For Industry, Inc. (IFI) warrants each product of its manufacture to be free from any defect in material and workmanship for a period of three years from shipment to the original purchaser. All warranty returns, however, must first be authorized by our factory office representative. Refer to the Service Section for information on how to return items for warranty repair.

Warranty liability shall be limited to repair or replacement of, or part thereof, which proves to be defective after inspection by IFI. This warranty shall not apply to any IFI product that has been disassembled, modified, physically or electrically damaged or any product that has been subjected to conditions exceeding the applicable specifications or ratings.

IFI shall not be liable for any direct or consequential injury, loss or damage incurred through the use, or the inability to use, any IFI product.

IFI reserves the right to make design changes to any IFI product without incurring any obligation to make the same changes to previously purchased units.

This warranty is the full extent of obligation and liability assumed by IFI with respect to any and all IFI products. IFI neither makes, nor authorizes any person to make, any other guarantee or warranty concerning IFI Products.



SECTION 4.0

GENERAL INFORMATION

4.1 SCOPE OF THIS MANUAL

This manual is intended to inform a qualified transmitter operator or technician of the normal operating and maintenance procedures for the S251-250. It is not intended to be a course of instruction for unqualified personnel.

4.2 GENERAL SPECIFICATIONS

The specifications listed below represent the minimum performance characteristics at the time of delivery.

SPECIFICATIONS

Frequency Response:	800 - 2500 MHz
Power Output:	Minimum 250 Watts
AC Source:	220VAC, 50/60, Single Phase
Power Gain:	54 dB
Input Impedance:	Nominal 50 Ohms unbalanced
Output Impedance:	Nominal 50 Ohms unbalanced
Input Signal Levels:	< 0 dBm (1.0 mW) See data sheet for specific input drive levels
Duty Cycle:	CW
Spurious:	-50dBc



4.3 PROTECTION CIRCUITS

The S251-250 is designed with a variety of protection circuits to provide safeguards for the amplifier should any adverse electrical conditions occur or if the amplifier accidentally experiences operator deviation of the design application. Listed below are the safeguards built into the S251-250.

4.3.1 Over Heat Protection

The S251-250 critical components are mounted to heat sinks, which are, in turn, air cooled by four fans. Should an over heating condition occur, either through component failure or by a restricted airflow, the S251-250 contains heat sensors that will shut down the system. As a result, the air inlet and outlet openings should be free of obstructions for proper cooling of the amplifier. Operation is restored after Fault Reset when the amplifier cools to normal temperature levels.

4.3.2 Input Protection

The S251-250 is designed to operate with less than a 0 dBm (1.0 mW) input signal however, to prevent overdriving the amplifier, the Input Protection circuit will activate if the input signal exceeds 3 dBm (2.0 mW) and will automatically compensate for the increased input signal by reducing the gain of the preamplifier. Even though the amplifier has an Input Protection Circuit, overdriving the amplifier is not recommended; refer to paragraph 5.1.2 for more details.

4.3.3 Output Protection

The S251-250 incorporates a microprocessor controlled Output Protection Circuit which monitors the Forward Power Meter indication and limits the output power. This feature protects the amplifier from being over driven and causing damage to the power transistors.

It is important to note that this feature only operates when the Forward and Reverse Sample Ports on the amplifier have 50 Ohm Terminations installed.

IMPORTANT NOTE:

The S251-250 Sample RF Output connector must be terminated with the supplied 50 Ohm load if the output is not being used. Should the S251-250 be operated without a termination on the Sample RF Output connection will jeopardize the accuracy of the metering and output protection; which are based on the Forward Power Readings, which may result in damaging the amplifier and voiding the unit's warranty.



4.3.4 Power Supply Faults

The Power Supply Fault circuit monitors the 50 VDC, ± 12 VDC and 5 VDC power supplies and produces a fault indication should any voltage level deviate from normal operating parameters. Each power supply voltage output is monitored and displayed to indicate the power supplies are operating within design parameters. Some units may have Green Status LED Indicators in addition to the Controller Display. Should any power supply voltage deviate from the design parameters, the corresponding power supply fault will be displayed

4.3.5 Mismatch Protection

The S251-250 is designed to operate with a tuned 50 Ohm load and should any mismatching of the 50 Ohm load occur, the Reverse Power, also called Reflective Power, will increase producing a high VSWR. The S251-250 microprocessor monitors the Reverse Power levels by utilizing a Dual Directional Coupler and begins to turn down the gain of the preamplifier when the Reflected Power exceeds 40%. The Reverse Power is also displayed on the LCD Display for operator monitoring for any mismatched load.

4.3.6 Short Circuit Protection

The S251-250 utilizes three different power supply voltages, + 32 VDC, ± 12 VDC and the + 5 VDC, each of the power supplies are designed with a short circuit and overload protection device.



4.4 STATUS INDICATORS, CONTROLS AND CONNECTORS

The S251-250 has various controls and status indicators, which are identified below and can be visually located on Figure 1.0, S251-250 Illustration and Figure 2.0, S251-250 Rear Panel Illustration. A narrative description for the function and purpose of each control and status indicator is provided within paragraphs 4.4.1 and 4.4.2.

S251-250 RF AMPLIFIER

Front Panel:

Local/Remote Switch
Amp ON / OFF Switch
Operate / Standby Switch
Fault/Reset Switch
Color Touchscreen Display
RF Input, N Type, Female
FWD Sample Port, 'N' Type Female
RF Output, N Type, Female

Rear Panel:

AC PWR, IEC Power Connector
ALC INPUT, BNC Type (Optional)
INTERLOCK, BNC Type (Optional)
IEEE-488, Connector
RS232 Connector
RF Input, N Type, Female
FWD Sample Port, 'N' Type Female
RF Output, N Type, Female

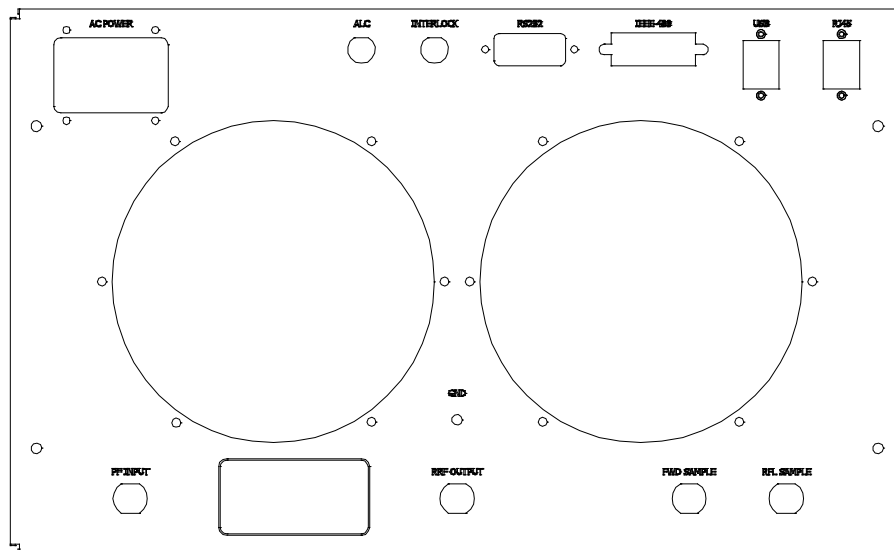


FIGURE 2.0
S251-250 REAR PANEL ILLUSTRATION



4.4.1 S251-250 PANEL STATUS INDICATORS

<u>INDICATOR</u>	<u>FUNCTION</u>
FAULT INDICATOR	<p>The Fault indicator displays a fault when either a Thermal, Power Supply or Module Fault occurs on Front panel display. Some units may have Green Status LED Indicators in addition to the Controller Display.</p> <p>A Thermal Fault occurs when the amplifier is operating outside design temperatures. Should an excessive temperature condition occur, the +50 VDC Supply is shut down and a Power Supply fault is indicated. Once the thermal condition returns to the operational limits, the +50VDC Supply will activate.</p> <p>A Power Supply Fault is displayed when the +50 VDC Power Supply voltage shuts down.</p>
Hi VSWR	<p>When the Hi VSWR fault is displayed; the amplifier is subjected to a condition where the Reflected Power exceeds 40%. The microprocessor turns down the gain of the preamplifier and displays the Reverse Power on the LCD Display.</p>
RMT /LCL	<p>When remote displays on the front panel the amplifier is in the remote control mode of operation via the IEEE-488 GBIP Bus. The address selection can be done through the front panel using the Control Knob. Follow instructions on the LCD display.</p>
TOTL/OPRT HOUR	<p>Elapsed time Indication on the LCD display, presents total hours of the amplifier or operate hours that it has been energized.</p>



4.4.2 S251-250 CONTROLS

CONTROL

FUNCTION

Local	When depressed, the amplifier is restored to the local control from the GPIB mode of control.
ALC Switch	The optional Automatic Leveling Control (ALC) is a feature, which selects the method for leveling, either internal, external or manual.
Power ON/OFF	The Power On/Off switch is a circuit breaker that is used as an On/Off switch as well as a circuit protection device. This switch turns the driver either on or off.
Control Level Adjust Knob	<p>The optional Level Adjust control is a ten-turn pot, which allows a minimum of a 30 dB range of gain. Turning the control Counter Clockwise (CW) produces a minimum gain.</p> <p>Important Note: If the amplifier is not equipped with this option, the display will still indicate a GAIN percentage (refer to Figure 5.0). This percentage indication is still controlled by Level Adjust Control but the both the Level Adjust Control and the corresponding GAIN percentage indication has no effect on the amplifier gain.</p>
FLT/RST	The Reset/Fault (FLT/RST) is a reset switch that resets the fault indication. If a fault indication is present, the fault indication can remove the by depressing this switch.
OPR/STB	The Operate/Standby (OPR/STB) switch which when the switch is set in the Standby mode, the Power Supply is turned off to the amplifier circuitry. When set in the Operate mode, the Power Supply delivers voltage to the amplifier circuitry.



4.5 OPERATING INSTRUCTIONS

4.5.1 Power On

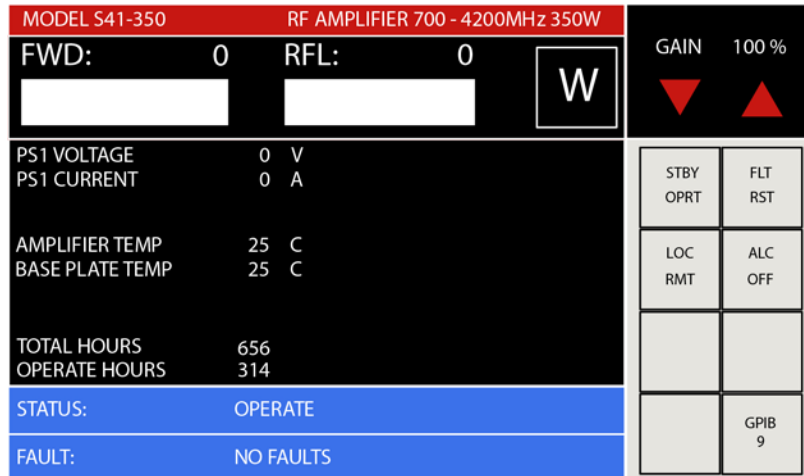


FIGURE 3.0 – FRONT PANEL DISPLAY (START-UP MENU)

Apply power to the unit using the front panel ON/OFF switch. When the circuit breaker or AC Power On switch is energized, An IFI Splash Screen will be displayed after the Microprocessor (MPU) booting cycle this whole process will be about 45 seconds. The Screen in Figure 3.0 will appear after the booting process



4.5.3 - Entering the GPIB Address

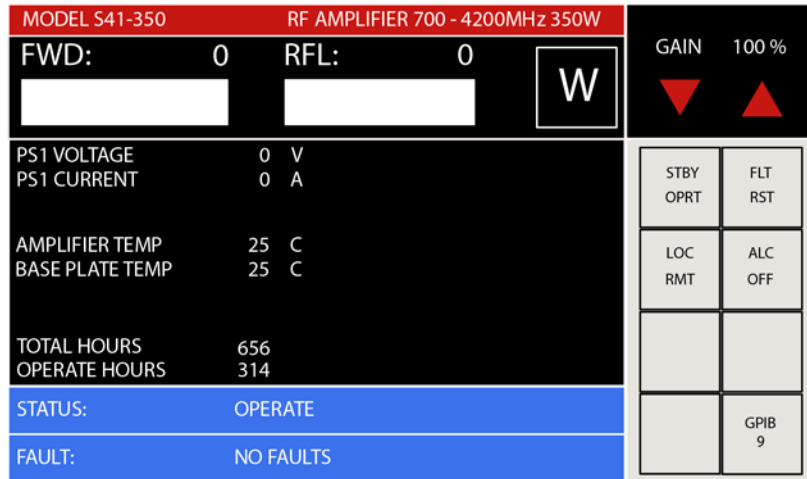


FIGURE 4.0 - GPIB ADDRESS

The GPIB Address can be changed by selecting the GPIB Button . Pressing the Button will scroll through the numbers There are 31 numbers 1 through 31 .



4.5.4 Turning ON the Amplifier

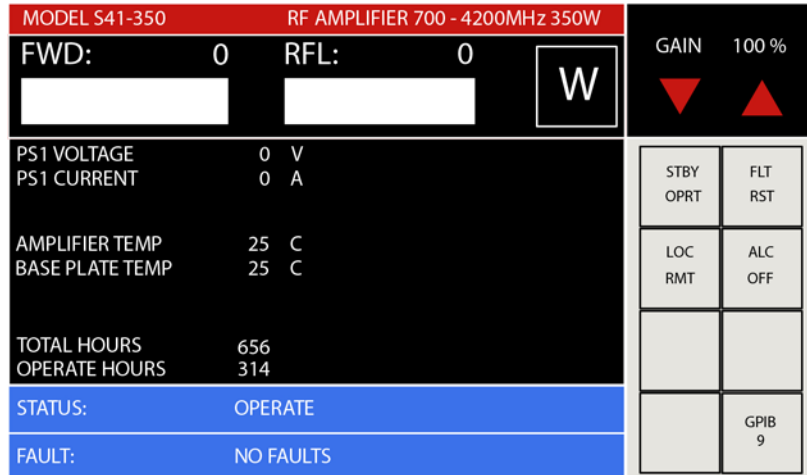


FIGURE 5.0 – MAIN MENU AND STATUS DISPLAY (Typical)

The amplifiers status can be monitored using the Main Menu. The Gain (GAIN), Total Hours Operating Hours, Amplifier and Base Plate Temperature, STATUS and Faults, Forward (FWD) and Reflected (RFL) Status are continuously displayed.

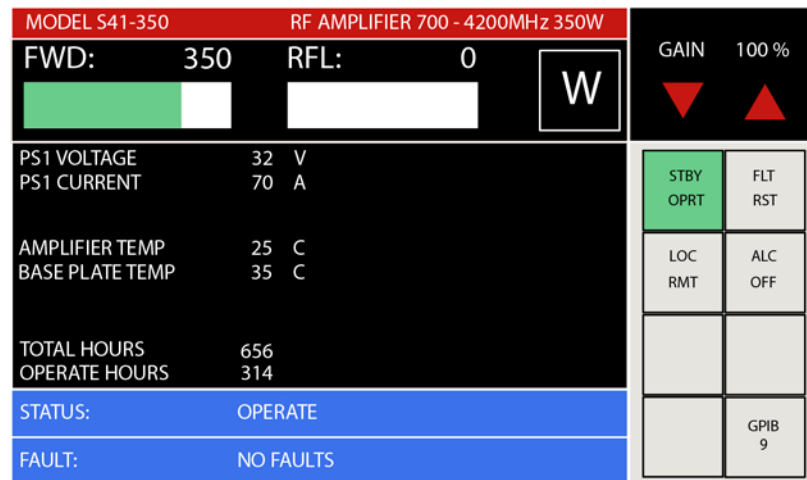


FIGURE 6.0 – TURNING ON THE AMPLIFIER (Typical)

1. From the MAIN MENU in Figure 6.0, press the STBY /OPRT Soft Key and the color of the button will change to Green
2. The display will show the Main DC power supply Voltage and current as per AMPLIFIER operating data sheet (enclosed in the manual).



4.6 DATA SHEETS

Provided with each S251-250 are specific Amplifier Data Sheets measured from the amplifier using a calibrated 50 Ohm Pad to assist the operator in maximizing the performance of the Wide Band Amplifier.

The Amplifier Data Sheets are provided with each amplifier exhibiting the actual metering indication required to produce rated power output as indicated on the data sheet. The actual metering values were derived by measuring the power output of the amplifier using a calibrated Power Meter and a calibrated 30 dB Attenuator Pad by inducing an appropriate input signal level to obtain rated power output. Once the appropriate signal level has been determined to obtain the desired power level, the actual Front Panel Metering Indication correlates to that power level.

The amplifier data sheets provide the operator with the over all frequency response of the amplifier in perspective to the amplifier operating frequency ranges. The amplifier data sheets provide the operator with the actual gain of the amplifier over the frequency band.

The Amplifier Data Sheets are located within Appendix A



SECTION 5.0

PRINCIPLES OF OPERATION

5.1 PROPER USAGE AND WARNINGS

5.1.1 Controlling Power Output

With a nominal 50 ohm resistive load and an input signal appropriate to produce a power output within the limitations specified above, the amplifier may be placed in operation. To interrupt the output, simply interrupt the input signal or increase the input attenuation setting to produce commensurate output level reduction. The amplifier may be run indefinitely at rated output. Output power is usually measured with a power meter and suitable power attenuators.

5.1.2 Input Signal Levels

The S251-250 is designed to operate with less than a 0 dBm (1.0 mW) input signal however, to prevent over driving the amplifier, the Input Protection circuit will activate if the input signal exceeds 3 dBm (2.0 mW) and will automatically compensate for the increased input signal by reducing the gain of the preamplifier.

It is not advisable to overdrive any amplifier and depend on protection circuits to maintain proper gain control. IFI makes available with each shipped amplifier, specific amplifier data so the operator will know the proper input signal levels to more efficiently operate the amplifier. Refer to the test data sheets information located in Paragraph 4.6 herein.

5.1.3 Sample RF Output Cautions

The S251-250 Sample RF Output connector located on the rear panel must be terminated with the supplied 50 Ohm load if the output is not being used. Should the S251-250 be operated without a termination on the Sample RF Output connection, the lack of loading will jeopardize the accuracy of the metering and output protection; which are based on the Forward Power Readings.

Important Note: If the amplifier is operated without the 50 Ohm termination, damage to the amplifier may occur which would void the units warranty.



5.2 FEATURES OF THE S251-250 AMPLIFIER

The S251-250 amplifier is intended for applications requiring high gain and power output to 200 Watts, over a wide range of frequencies, without tuning adjustments. The S251-250 amplifies an input signal source over the frequency range from 800 MHz to 2500M Hz and at a minimum gain of 53dB

FIGURE 7.0
S251-250 SCHEMATIC DIAGRAM

5.2.1 Preamplifier or Optional Preamplifier/Attenuator

The S251-250 amplifier has a preamplifier with approximately 10dB gain; which is powered from an independent low voltage power supply.

If the amplifier is equipped with the Optional Preamplifier/Attenuator, it provides the amplifier with remote level control and leveling capability over the entire operating frequency range. With the front panel level control set at maximum output it has a nominal 4 dB gain and can be adjusted with the front panel level control over a greater than 30 dB range.



5.2.2 Power Amplifier - continued

This amplifier consists of four amplification sections, the final stage having four cascaded high-power, push-pull devices operating in parallel and combined through a transmission type impedance transformer.

5.3 MANUAL LEVEL CONTROL

Manual level control is accomplished by adjusting the front panel ten-turn potentiometer, located on the power supply control unit, to a reference voltage setting between 0 to 5 volts.

5.3.1 Automatic Level Control

In this mode, the S251-250 serves as the voltage comparator and variable gain stage. It will enable the maintenance of a constant RF voltage vs. frequency at the input to an imperfect load or a virtually constant E-Field at a measurement point in space. For further information regarding the ALC operation, refer to Section 6.0.

5.4 OPTIONAL FEATURES

5.4.1 Interlock Feature

The Interlock Feature is an option for the S251-250 that utilizes an Electro Magnetic Interference (EMI) Testing Room door switch that is mounted to the door in such a manner that when opened, the switch will automatically induce an ordered shut down of the amplifier and produce a STAND-BY MODE indication on the LCD Metering Display. When the door is closed, the amplifier resumes previous testing conditions.

The advantage to this feature is providing an additional safety feature for the growing concerns for potential hazards due to exposure to EMI Fields. With the Interlock option, all Testing Personnel will be protected from accidental exposure to EMI Fields. Should the operator desire this optional feature, the amplifier can be returned to IFI for installation. Refer to Section 8.0 for Equipment Return Procedure.



SECTION 6.0

AUTOMATIC LEVELING CONTROL

6.1 ALC FEATURES

The Automatic Leveling Control (ALC) switch located on the front panel has three positions, 'INT', 'OFF' and 'EXT'. Described below are the features of each position

Important Note: Figures 5.0 and 6.0 indicates the display for a typical amplifier and the ALC option is indicated however if the amplifier is not equipped with this option, the ALC option will not be displayed.

6.1.1 The 'INT' Position

The 'INT' or Internal position enables the amplifier to automatically level on an RF power level selected by an operator displayed on the Forward Power reading located on the Front Panel LCD display. Using the 'INT' feature, no external sources are required for leveling control and the operator determined power level will be automatically maintained even though the frequency or input signal levels might change. Refer to Paragraph 6.2 for the procedure to operate the amplifier in the 'INT' mode.

6.1.2 The 'OFF' Position

The 'OFF' position enables the amplifier to operate in a passive mode with no automatic features controlling input drive levels or output power levels. In this mode, the operator has full manual control of the amplifier including the input signal gain, frequency and power output. As a result, the operator must be fully knowledgeable of the effects of these variables in relationship to the operating characteristics of the amplifier. With this in mind, the two most important factors are the dB flatness of the amplifier over the operating frequency range and the rated output power of the amplifier.

Depending on the response curve provided on the S21 Parameter Plot for the amplifier flatness, which is located within Appendix A, and the size of the frequency steps of the signal generator can increase or decrease the power level by as much as 4 dB. This is the result of the design tolerance of the amplifier to operate within a ± 2 dB over the rated frequency range. A ± 2 dB tolerance means that the maximum deflection from minimum to maximum of the flatness curve can represent a delta change up to 4 dB. With this factor in mind, it is advisable to identify the specific frequencies that represent the greatest change from the nominal 0 dB level and adjust the input signal accordingly in so that the amplifier is not over driven beyond the rated power specification. Taking these precautions will prolong the reliability on the amplifier.



6.1.3 The 'EXT' or External Position

The S251-250 serves as the voltage comparator and variable gain stage. It will enable the maintaining of a constant RF voltage vs. frequency at the input to an imperfect load or a virtually constant E-Field at a measurement point in space.

The front panel, ALC control, switches direct level control from the front panel Level Control potentiometer to the output of a linear comparator. The comparator output level is dependent on the reference input from the front panel Level Control and the input from the aforementioned detected voltage or E-Field. The total gain of the leveling loop serves to maintain the output of the comparator virtually constant and thus maintain the desired test level at the remote detector or remote E-Field sensor.

The 'EXT' position enables the amplifier to automatically control an operator determined power level by means of an external 0.0 to 5.0 VDC reference source connected to the External Source connector. An example of a 0.0 to 5.0 VDC external input would be the output of a LDI or an EFS. Refer to Paragraph 6.3 for procedures on leveling with an external voltage level.

6.2 LEVELING USING THE 'INT' MODE

When in the INT position, no outside controls are required. The only equipment required is a frequency generator and the intended load. The procedure to use Internal ('INT') Leveling is described below:

- 1) Turn the RF Level Potentiometer fully counter clockwise to Full Attenuation.
- 2) Set the ALC Switch to the 'INT' position.
- 3) Set the Signal Generator to the proper input drive level to obtain the desired power level. Identify the desired testing parameters and determine the required input drive levels from the Amplifier Data Sheets provided within Appendix A. It is important to determine that sufficient signal drive signal is generated to obtain and maintain the desired programmed power level. An adequate load capable to operate within the power requirements should also be selected.
- 4) Adjust the RF Level Potentiometer until the desired Forward Power Level is displayed on the front panel LCD display.
- 5) The amplifier is now ready to sweep a frequency range and automatically maintain the desired power level with no further adjustments required. The power level will be maintained at the operator set level and remain independent of changes to the input frequency or input signal level.
- 6) When sweeping the frequency range, best results are obtained at a sweep rate that is slower than 500 ms.



6.3 LEVELING USING THE 'EXT' MODE

When operating the amplifier in the External (EXT) mode, it is important to understand that the power output levels are determined by the external voltage reference source. The applicable Amplifier Data Sheets should be reviewed to determine the appropriate drive signal level so that the amplifier does not exceed the specified power output rating. As described in paragraph 6.1.2, due to the flatness curve tolerances at certain frequencies, the rated power output power could be exceeded by an additional 40% and that will jeopardize the longevity of the amplifier. The amplifier should not be over driven and should a particular application require additional power beyond the rated power of the S251-250, contact IFI's Customer Service for additional high powered amplifiers.

Detailed below are specific applications for using the External (EXT) Mode with a variety of external inputs.

6.3.1 Constant RF Voltages Verses Frequency At A Remote Load

With remote detectors suitably rated for power and frequency, the S251-250 provides the means for feeding a mismatched load with constant RF drive voltage over the entire frequency range. Full leveling, at half the S251-250 rated output power, is realizable with most reasonable load variations. Extremely mismatched loads, particularly those presenting near short circuit conditions to the amplifier, will reduce the maximum voltage leveling capability of the system. Load impedance variation from 50 Ohms to an open circuit will permit peak voltage leveling within the VSWR capability of the amplifier. Variations in impedance from 50 Ohms down to a short circuit will rapidly diminish the peak voltage leveling capability toward zero. Amplifier VSWR limitations will, of course, further limit the maximum leveled voltage into mismatched low impedance loads.

To operate in this mode, after selecting the desired band, place the ALC switch in the EXT position. Connect the ALC on the rear panel to the detected output port on the remote detector. Connect the remote detector in series with the S251-250 output and at the input to the load. The system is now ready for operation. Amplitude adjustments can be made with the level control as in manual operation.

NOTE: When the S251-250 is used as a driver for higher power amplifiers, automatic level control can be accomplished in the same manner but at the power and frequency limitations of the driven amplifier.



SECTION 7.0

IEEE-488.2 INTERFACE

7.1 INTRODUCTION

The Instruments For Industry, Inc. (IFI) Amplifiers can be operated remotely from a personal computer having an IEEE-488 interface. This interface allows the amplifier to be remotely controlled over the General Purpose Interface Bus (GPIB) by sending commands to the amplifier. Additionally, amplifier status and forward and reverse power readings may be read over the GPIB. All functions can be controlled by coded messages sent over the interface bus via the 24-pin socket connector on the rear panel of the unit. IEEE-488.2 Standard is implemented, which defines the protocols and syntax of commands. The GPIB command codes for the IFI Amplifier series are discussed on subsequent pages and, for ease of identification; the command codes are identified within the text by bold capital characters. For full information on the IEEE protocols and syntax the IEEE-488.2 Standard should be consulted.

7.2 REMOTE INITIALIZATION

When the amplifier receives a command over the GPIB, it automatically switches to REMOTE operation, pressing the LOCAL key on the front panel returns the unit to normal manual local operation. The initial state of the amplifier after power-on is the full attenuation condition. The ZEROATT command must be sent in order for the amplifier to be able to generate output power.

7.3 GPIB ADDRESS

The GPIB address of the amplifier is set by via the Front panel using the Control knob at the start up menu..

NOTES ON USING NATIONAL INSTRUMENTS' GPIB CONTROLLERS:

In order for the amplifier to operate correctly with a National Instruments GPIB controller card, the following must be done: (Items 1-5 are done in the IBCONF program.)

1. Set "Terminate reads on **EOS**" to **yes**.
2. Set "Set **EOI** with **EOS** on Writes" to **yes**.
3. Set the **EOS** byte to **0Ah** (an ASCII line feed character).
4. Set "Send **EOI** at end of writes" to **yes**.
5. Set "Enable **repeat addressing**" to **yes** at the board level.
6. When sending command strings to the amplifier, a carriage return character (**0Dh**) followed by a line feed character (**0Ah**), must always be appended to the command, otherwise the amplifier will wait indefinitely for the **CR-LF** combination. If this happens the unit will have to be powered off and back on to reset this condition. (The interface device will automatically assert the **EOI** line during the **LF** if items 2 - 4, above, are set to yes in the IBCONF program.) As an example, when issuing the zero attenuation command using the IBIC or WIBIC program, the command string would look like this: "**ZA\r\n**". (The **\r** is National Instruments' notation for the carriage return, and the **\n** is the line feed or 'new line' character.) Notice that the commands are upper case only.



Commands for Solid State Amplifier

Code	Amplifier Function
STBY	Standby & Returns ' SB '
OPRT	Operate & Returns ' ON '
RESET	Fault Reset & Returns ' STANDBY '
ATTUxx	Increase Attenuation (xx- # of steps) [Response with Gain value, ' GAIN: XXXXX % ']
ATTDxx	Decrease Attenuation (xx- # of steps) [Response with Gain value, ' GAIN: XXXXX % ']

REQUEST STATUS

Code	AMPLIFIER STATUS
STATUS	
	STANDBY
	OPERATE
	FAULT
FAULT	DETAILED MESSAGE
	THERMAL FAULT
	PWR SUPPLY 1 FAULT
	PWR SUPPLY 2 FAULT, [If Applicable]
	PWR SUPPLY 3 FAULT, [If Applicable]
	PWR SUPPLY 4 FAULT, [If Applicable]
	NO FAULTS



REQUEST AMPLIFIER STATUS
(POWER AND METERING)

CODE	Amplifier FUNCTION
POWERFWD	Returns Forward Power Value in Watts, ' POWER FWD: XXXXX W '
POWERRFL	Returns Reflected Power Value in Watts, ' POWER RFL: XXXXX W '
PS1V	Returns Power Supply 1 Volts Value in Volts, ' PWRSPLYV1: XXXXX V '
PS1I	Returns Power Supply 1 Current Value in Amps, ' PWRSPLYI1: XXXXX A '
PS2V	Returns Power Supply 2 Volts Value , [If Applicable]
PS2I	Returns Power Supply 2 Current Value [If Applicable]
PS3V	Returns Power Supply 3 Volts Value , [If Applicable]
PS3I	Returns Power Supply 3 Current Value [If Applicable]
PS4V	Returns Power Supply 4 Volts Value , [If Applicable]
PS4I	Returns Power Supply 4 Current Value [If Applicable]
TOTALH	Returns Total hours unit is on, ' TOTAL HRS: XXXXX '
OPERATEH	Returns Operation Hours Value, ' OPERATE HRS: XXXXX '
BAND1	Selects Band 1 of Operation [In Dual Band units only]
BAND2	Selects Band 2 of Operation [In Dual Band units only]
NOLEV	Selects NO Leveling [Optional]
INTLEV	Selects INTERNAL Leveling [Optional]
EXTLEV	Selects EXTERNAL Leveling [Optional]
QUIETOFF	Selects QUIETING to OFF [Optional]
QUIETAUTO	Selects QUIETING to AUTO mode [Optional]
QUIETSTATUS	Returns Quieting mode of operation [Optional] 'QUIETING OFF' 'QUIETING AUTO'
ZEROATT	Sets the Amplifier for ZERO Attenuation & Returns, ' GAIN: 00100 % '
FULLATT	Sets the Amplifier for FULL Attenuation & Returns, ' GAIN: 00000 % '
GAIN	Returns Gain Value in percentage, ' GAIN: XXXXX% '
MODEL	Returns Model number of the unit
SN	Returns Serial number of the unit
*IDN?	Returns ASCII response comprising of four data fields in the format <Manufacturer>, <Model>, <Serial Number>, <Firmware Version>
*RST	Reset Command, Sets the Amplifier to the factory default power up state (reboots MPU)

NOTES:

1. ALL GPIB COMMANDS AND REQUESTS MUST CONSIST ENTIRELY OF UPPER CASE ALPHANUMERIC CHARACTERS.
2. WHEN SENDING COMMAND STRINGS TO THE AMPLIFIER, A CARRIAGE RETURN CHARACTER (**0Dh**) FOLLOWED BY A LINE FEED CHARACTER (**0Ah**), MUST ALWAYS BE APPENDED TO THE COMMAND, and OTHERWISE THE AMPLIFIER WILL WAIT INDEFINITELY FOR THE **CR-LF** COMBINATION.



RS-232 or USB

Operation of Serial Port on RF Amplifier

1 – Connect serial port of amplifier to computer using a null modem cable or a standard serial cable with a null modem adapter.

2 – Use a program such as Hyperterm to communicate with the amplifier. (To reach “Hyperterm” on windows ’98 go to Start → Programs → Accessories → Communications → Hyper Terminal. In Hyper terminal double click on

In Hyperterm do the following:



- 2.1 Enter a name and choose an icon.
- 2.2 In the connect using box select “Direct to Com1”.
- 2.3 Click OK.
- 2.4 Select 9600 baud.
- 2.5 In Data Bits select 8
- 2.6 In Parity Select “None”
- 2.7 In Stop bits select “1”.
- 2.8 In Flow control select “None”
- 2.9 Press enter.

3 – If you use Hyperterm steps 2.1 to 2.9 will set up Com1 to communicate at 9600 baud, 8 bits, and no parity with 1 stop bit.

4 – Turn amplifier line power ON.

To place the amplifier in remote operation type in a valid command such as “STATUS”. The amplifier will then go into remote operation and the status will be displayed on the computer. **The same commands as above.**



5 – When used with an RS-232 or RS-422 interface each character that is sent to the amplifier is echoed back.

RS-422

Communication Interface

Communication Standard	RS422
Communication Baud Rate	19200
Communication Update Rate	50 Hz
Average Data Latency	100 mSec
Data Latency Variation	100 mSec
Control Functions	Status Request, Mode Selection, BIT activation
Report Data	Amplifier Status, BIT results

Data rate is 9600 baud, 1 or 2 stop bits, no parity.

Example

The commands are the same as above.

Command: Place unit in operate mode

ASCII String sent to amplifier: ON(cr)(lf)

Hex equivalent of string: 0x4f, 0x4e, 0x0d, 0x0a

Response: None

Response String from amplifier: None

Example of response: N/A

Hex value of example: N/A

Command: Read forward power

ASCII String to amplifier: POWERFWD(cr)(lf)

Hex equivalent of string: 0x50, 0x4f, 0x57, 0x45, 0x52, 0x46, 0x57, 0x44, 0x0d, 0x0a

Action: None

Response: Responds with forward power

Response String from amplifier: POWER FWD: xxxxx W(cr)(lf)

Where xxxxx is the value of the power

Example of response : POWER FWD: 09005 W(cr)(lf)

Hex value of example :

0x50, 0x4f, 0x57, 0x45, 0x52, 0x20, 0x46, 0x57, 0x44, 0x3a, 0x20, 0x30, 0x39, 0x30, 0x30, 0x35, 0x20, 0x57, 0x0a, 0x0d



SECTION 8.0

MAINTENANCE AND SERVICING

8.1 PERIODIC MAINTENANCE

The only periodic maintenance required on the S251-250 amplifier system is ensuring that the cooling vents are not obstructed in such a manner that the airflow is restricted. Periodic cleaning of the vents may be required depending on the degree of dust in the atmosphere.

8.2 SERVICING THE AMPLIFIER

Servicing of the amplifier by the operator is not recommended. Most of the internal circuitry requires special and unique test instruments to trouble shoot, align and calibrate the circuits. Should servicing be required, refer to Paragraph 8.3.

8.2.1 TROUBLESHOOTING

<i>PROBLEM</i>	<i>CAUSE</i>	<i>SOLUTION</i>	<i>COMMENTS</i>
Touchscreen display blank	No service voltages	Check line power. Check service voltages, +12VDC, -12Vdc, 5VDC	Connect AC line to specified Prime power source. Refer to S/N tag on unit
Amp will not go to Operate mode	Door interlock open,	Check that door interlock BNC connector is terminated with either 50 Ohms or short.	
Power Supply fault	Main Power supply faulty	Check either for 32VDC	Check on the LCD display for the fault description.
Thermal fault	Over-heating	Make sure airflow is adequate and ambient temperature within the limit.	
Meter Inaccuracy	Un-terminated Forward and/or Reverse Sample Ports	Use 50 Termination on Forward and Reverse Sample Ports	





8.3 EQUIPMENT RETURN PROCEDURE

Should the S251-250 require repair or it is recommended that the reader follow the Equipment Return Procedure so the equipment can be repaired or calibrated and returned in an efficient and timely manner.

8.3.1 Request a RMA Number

Contact the IFI Service Department either in writing or by calling (631) 467-8400 and request a Return Material Authorization (RMA) Number.

The RMA Number is the method IFI uses to prepare its services for returned material in transit and acts as a tracking document for the returned material through the repair or process.

The RMA also documents the customer's specific instructions or reason related to the return of the material.

8.3.2 Return All Accessories

In the interest of saving time and expediting the repair or process, return all the associated accessories described in Section 1.0 when returning the equipment for repair.

In many cases, a faulty accessory could give the illusion that the equipment itself has failed. For this reason it is important to return all the accessories with the equipment. It is also IFI's policy to verify performance of all associated accessories of Section 1.0 before returning the equipment to service.

8.3.3 Packaging The Equipment

When returning equipment to the manufacturer, always wrap each accessory separately, and provide sufficient protective material around each item to prevent damage from handling and shipping conditions. It is **strongly** recommended the equipment be returned in its **original wooden crate** (or equivalent) for maximum protection. Cardboard boxes do not provide sufficient protection of the equipment.

8.3.4 Reference The RMA Number

As detailed in Paragraph 8.3.1, always reference the IFI assigned RMA Number on your Packing List and Purchase Order and when any inquiries are made.



APPENDIX A

AMPLIFIER DATA SHEETS



APPENDIX B

DRAWINGS

BOM **S251-250 BILL OF MATERIALS (BOM)**
901031 **INTERCONNECT, S251-250**

Bill of Materials

Fiished Good	Product Description	Lot#	Build Qty	Rev Ltr
S251-300	SSA, 0.8-2.5 GHz, 300W		0	A

Level	Product Code	Component	Product Description	Qty Req'd	Revision	Designation	Seq#	Manufacturer Info / Notes
1	S251-300	0I-901014	INTERCONNECT DIAGRAM - S2505-300, 200	0	A			
1	S251-300	0O-850052	OUTLINE DRAWING - SMX100	0	C		85	
1	S251-300	302352	SIDE - CHANNEL, 24 inch LONG	3	G		21	
1	S251-300	302355	PARTITION	2	A			
1	S251-300	302372	PARTITION - LOW BAND	1	B			
1	S251-300	302456	COVER - 7in. CHASSIS	2	B		27	
1	S251-300	302464	PAN - POWER SUPPLY	1	L		39	
1	S251-300	302470	BRACKET - MPU BD	1	I		29	
1	S251-300	302511	PANEL - FRONT - 7in. H	1	I		20	
1	S251-300	302511-G-S	PANEL - FRONT - SCREENED AND PAINTED GREY	1	F		32	
1	S251-300	302512	PANEL - BACK - 7in. H	1	F		31	
1	S251-300	302512-S	PANEL - BACK - SCREENED ONLY NO PAINT	1	E		97	
1	S251-300	302601	BRACKET - COUPLER	1	E		34	
1	S251-300	303186	BRACKET, POWER SUPPLY RQ65 MOUNTING	1	B	W/ pow-rq65d	92	
1	S251-300	400359	TOP HEATSINK LAYOUT - HIGH BAND	1	R		11	
1	S251-300	400365	BOTTOM HEATSINK LAYOUT - LOW BAND	1	G		84	
1	S251-300	500499-1	SWITCH/LED BOARD ASSY	1	A		3	
1	S251-300	500523-48	SS - HALLEFFECT/PS SENSING BD, for 48V PS	1	A			
1	S251-300	500536	BOARD ASSY - MPU MICROCHIP 8680 PROCESSOR	1	B		97	
1	S251-300	500540	PS -ENABLE XSTR BD ASS'Y	1	B			
1	S251-300	500699-5	VOLTAGE ATTENUATOR ASSY 500MHz to 3000MHz Low Gain	1	B			
1	S251-300	500710-1000	EQUALIZER, S21	1	B			
1	S251-300	700543-40	RIBBON CABLE - IEEE-488 - A1P10-GPIB	1			93	
1	S251-300	700544-08	MPU-DISPLAY RIBBON CABLE	1				
1	S251-300	700545-08	MPU-500499-1 RIBBON CABLE	1				
1	S251-300	700589-32	MPU-RS232 RIBBON CABLE	1				
1	S251-300	700589-40	MPU-RS232 RIBBON CABLE	1		A1-J4		
1	S251-300	700823	ASSY, PREAMP MODULE, 100 - 3500 MHz 2W P1dB-38 dB Gain 4W SAT 28V, 1.5A, no regulators	1	B			
1	S251-300	700862	DO NOT USE AMPLIFIER MODULE, 800 to 3000 MHz 45W CREE X4 100Watts 32VDC.	1	G			
1	S251-300	700863	ASSY, 20W 800-3000 MHz 2 X Cree 45W +32VDC	1	A			
1	S251-300	700900	RF MODULE, 500-2500MHZ 300W 4-GAN +50V	2	B			
1	S251-300	800100-07	CABLE - RF - .141 FLEX - SMA/MALE - N/MALE	1	A			

Bill of Materials

Finished Good	Product Description	Lot#	Build Qty	Rev Ltr
S251-300	SSA, 0.8-2.5 GHz, 300W		3	A

Level	Product Code	Component	Product Description	Qty Req'd	Revision	Designation	Seq#	Manufacturer Info / Notes
1	S251-300	800101-06	CABLE - RF - EZ FLEX .141 - SMA/M-SMA/M	3			89	
1	S251-300	800101-07	CABLE - RF - EZ FLEX .141 SMA/M SMA/M	1				
1	S251-300	800101-12	CABLE - RF - EZ FLEX .141 SMA/M SMA/M	3				
1	S251-300	800101-8	CABLE - RF - EZ FLEX .141 SMA/M SMA/M	1			90	
1	S251-300	800102-12	CABLE - RF - .141 FLEX - SMA/M-N/F PRECISION BULKHEAD	1			92	
1	S251-300	800102-30	CABLE - RF - .141 FLEX - SMA/M-N/F PRECISION BULKHEAD	1			93	
1	S251-300	800134-72	CABLE - RF ASSY - CABLE RG-174A - BNC/F BLKHD	2			97	
1	S251-300	ATT-VAT6G-3	ATTEN - FIXED COAX SMA M/F - DC-6 GHZ - 2W - 3DB	2			84	
1	S251-300	ATT-VAT6G-4	ATTEN - FIXED COAX SMA M/F - DC-6 GHZ - 2W - 4DB	2				
1	S251-300	CBR-R112P12A	BREAKER - CKT - SINGLE POLE - ROCKER - 12 AMPS - GREY	1			91	
1	S251-300	CON-08500114	CONN - PIN - CONTACT 0.100 SERIES	14			14	
1	S251-300	CON-102387-2	CONN - IDC FEMALE WIRE APPLIED HOUSING - 14 PIN - .	1		A1-P5	15	
1	S251-300	CON-102387-3	CONN - IDC FEMALE WIRE APPLIED HOUSING - 16 PIN - .	1		A1-P8	16	
1	S251-300	CON-102387-8	CONN - IDC FEMALE WIRE APPLIED HOUSING - 34 PIN -	1		A1-P9	17	
1	S251-300	CON-2201-12	CONN - 12 PIN - MOLEX 0.100in.	1		A4-P1	18	
1	S251-300	CON-2201-2	CONN - 0.100in. HOUSING WITH LOCKING RAMP - 2 POSITIO	2		PS1,A9P2	41	
1	S251-300	CON-39-01-2020	CONN - 2 PIN MOLEX - FEMALE	2			70	
1	S251-300	CON-39-01-2060	CONN - 6 PIN - FEMALE - MOLEX	1		A8P1	38	
1	S251-300	CON-39-01-2100	CONN - SOCKET HOUSING 10 PIN - FEMALE - DUAL ROW	1			62	
1	S251-300	CON-39-01-3023	CONN - 2 PIN - MALE - MOLEX	1			63	
1	S251-300	CON-553636	CONN - GPIB - ACCESSORY - MTG HDW, IEEE-488	1			64	
1	S251-300	CON-553636	CONN - GPIB - ACCESSORY - MTG HDW, IEEE-488	1		w/ W11		
1	S251-300	CON-554349-1	CONN - 554349-1 GPIB AMP - TWT/SST # W/F	1		w/ W11		
1	S251-300	CON-87523-6	CONN - CONTACT - SNAP IN - PINS	64		A1,P9,A1P8,A1P5	65	
1	S251-300	CON-B52C4U02T	CONN - PLUG - 5MM - R/A - 2 POS.	1		A1P2	66	
1	S251-300	CON-COA-UG657/U	CONN - BNC BULKHEAD RECEPTACLE COAX	1				Interlock rear panel
1	S251-300	COR-17602	VOLEX AC LINE CORD 16AWG 6' 7in.	1			85	
1	S251-300	COU-BDC6265N/SMA	COUPLER BIDIRECTIONAL - 500-3000MHz - 50dB - 500W -N/F MAINLINE - SMA PORTS	1	A			
1	S251-300	DIS-DMF5005	DISPLAY - MODULE - LCD - 240X64 DO	1			48	
1	S251-300	DIV-2W500M2500M200	POWER DIVIDER/COMBINER - 2 WAY - COAXIAL - 500-2500MHZ - 200W CW , N/out, SMA/ins, IL=0.4dB	1				

Bill of Materials

Fiished Good	Product Description	Lot#	Build Qty	Rev Ltr
S251-300	SSA, 0.8-2.5 GHz, 300W		1	A

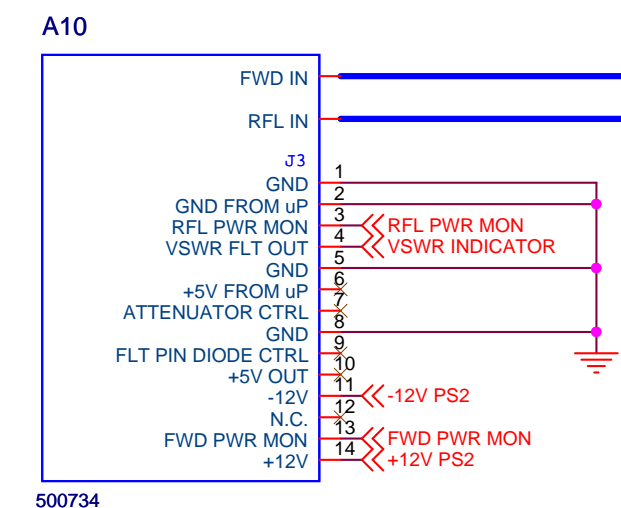
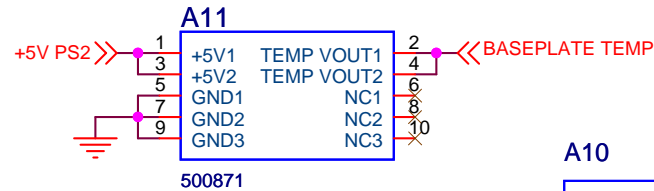
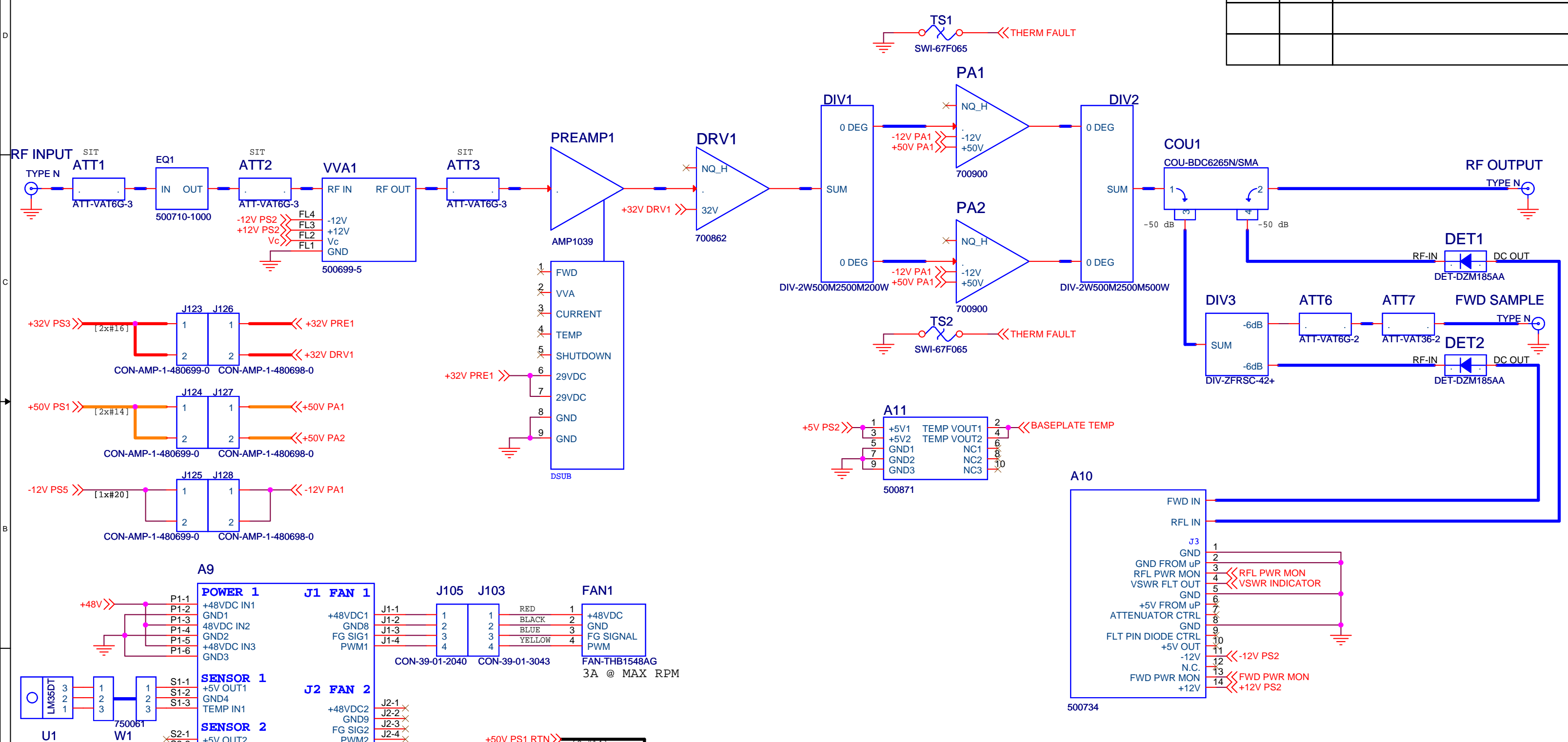
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1	S251-300	DIV-2W500M2500M500	POWER DIVIDER/COMBINER - 2 WAY - COAXIAL - 500-2500MHZ - 500W CW , N FEMALE, IL=0.4dB	1				
1	S251-300	DIV-ZFRSC-42+	DIVIDER, 0.75W, DC TO 4200 MHz	2	A			
1	S251-300	FAN-03245	FAN - GUARD - 6in. OR 08126	1			68	
1	S251-300	FAN-4	FAN - 4 INCH GUARD	1			42	
1	S251-300	FAN-JQ24B2	FAN - 6in. - 24VDC (12-28VDC) - 250CFM - 0.8 Static Pressure, 54.3 dB(A)	1	A		43	
1	S251-300	FER-T502525T	FERRITE CORES - TOROID - CN20 MATERIAL - SIZE 0.5in. OD - 0.25in. ID	2		HB PA 500516 x 2	44	
1	S251-300	FER-T7325	FERRITE CORES - TOROID - CN20 MATERIAL - SIZE 0.75in. OD - 0.375in.	5				
1	S251-300	FER-ZW-43813TC	FERRITE -TOROID 1.5in.OD 0.75ID	1			96	
1	S251-300	FIL-5110.1533.1	FILTER - LINE - IEC EMI - 15A - 115/230 SINGLE PHASE	1			85	
1	S251-300	FLT-HP800MSMA	FILTER HIGH PASS - COAXIAL - Fco=710MHz - SMA M/F	1				
1	S251-300	HAN-245-26	HANDLE - 6.0 in. x 1.5 in. OVAL, BLACK OXIDE - 10-32 THD, SS	2			46	
1	S251-300	HDW-HOL-3092	HDW - PLUG - BLACK 1/2 HOLE H.H. SMI, 1/8 PANEL THK	2			87	
1	S251-300	HDW-HOL-790-3158	HDW - PLUG - HOLE - 5/8 BLACK PLASTIC, 1/8 PANEL THK	2			47	
1	S251-300	HDW-PLA-FTH-1	HDW - RICHIO WIRE TIE HOLDER	0			59	
1	S251-300	HDW-SC-21005	HDW - MOUNTING - RS232	1			95	
1	S251-300	KNO-RKP3SB	KNOB - SKIRTED - BLACK TEXTURE	1			40	
1	S251-300	POW-RQ65D	PS, QUAD OUTPUTS, 5V @ 8A, 12V @ 3A, 24V @ 1.5A, - 12V @ 1A	1	NR	W/ 303186	93	
1	S251-300	POW-RSP1500-48	PWR SPLY,1500W,48V 32A,PFC, MEANWELL, Size, 5inch x 11inch x 3.3inch	1	NR			
1	S251-300	POW-RSP-150-24	PS - 150 WATT - 24VOLT RSP-150-24 NOT SP-150-24	1				
1	S251-300	POW-SP300W27V	PS - 27VDC OUT -300W - 85-264VAC INPUT LINE - SIZE 9in.X4	1				
1	S251-300	RES-MO2-10K	RESISTOR - 10K - 2 W - METAL OXIDE - METAL OX	1			96	
1	S251-300	SWI-67F065	SWITCH - THERMAL 65 C - NO - CLOSE ON RISE - TO220	2			54	
1	S251-300	TER-333	SOLDER LUG ZERICK	2		w/ TS1,TS2		
1	S251-300	TER-35559	16-14 WIRE -#6 NYLON INS.BLOC	0			55	
1	S251-300	TER-572-4863-01-0516	CAMBION TERMINAL EG & G OBS	3		w/ D3,D4		
1	S251-300	TER-S05305FN	MIDLAN ROSS BLUE QUICK DISCONNECT - 16/14 - FULLY INSULATED	5			56	

Bill of Materials

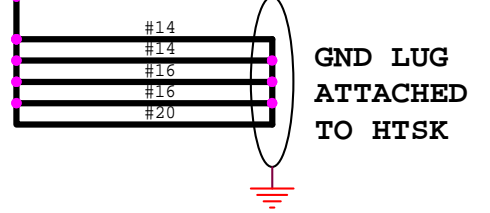
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S251-300	SSA, 0.8-2.5 GHz, 300W		1	A

Level	Product Code	Component	Product Description	Qty Req'd	Revision	Designation	Seq#	Manufactor Info / Notes
1	S251-300	TER-STR-8-141	TERMINAL STRIP-BLOCK DOUBLE - 0.438 SPACING - 20A - #14 AWG - 8 POS. -6-32	1			57	
1	S251-300	TER-STR-MS-8-141	MARKER - TERMINAL STRIP	1			58	
1	S251-300	TRM-BNC50ITLK	TERMINATION 50HMS - 1W - BNC MALE WITH GROUND CABLE	1		w/ con-coa-ug657		
1	S251-300	TRM-CXDC18GN2WC	TERMINATION RF - 50 OHMS - COAXIAL - 2W - DC-18 GHZ - N MALE CONN WITH	1		w/ W4		
1	S251-300	TYR-08461	SMALL TYWRAP PADS	0			61	
1	S251-300	Y-CLIP-L	CLIP - CABLE - RIBBON - LARGE	1			92	

REVISION HISTORY		
DATE	REV	DESCRIPTION
6/5/2017	1	INITIAL RELEASE



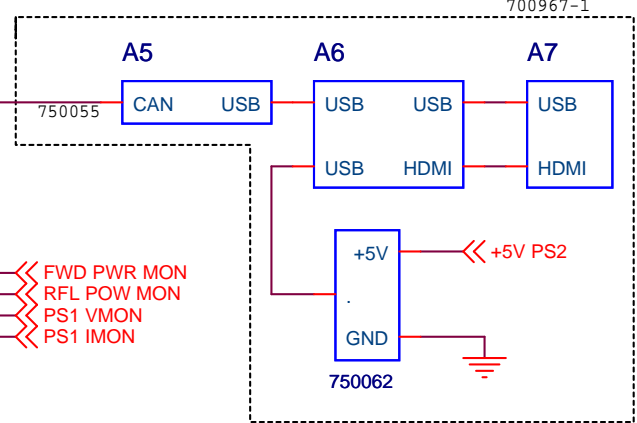
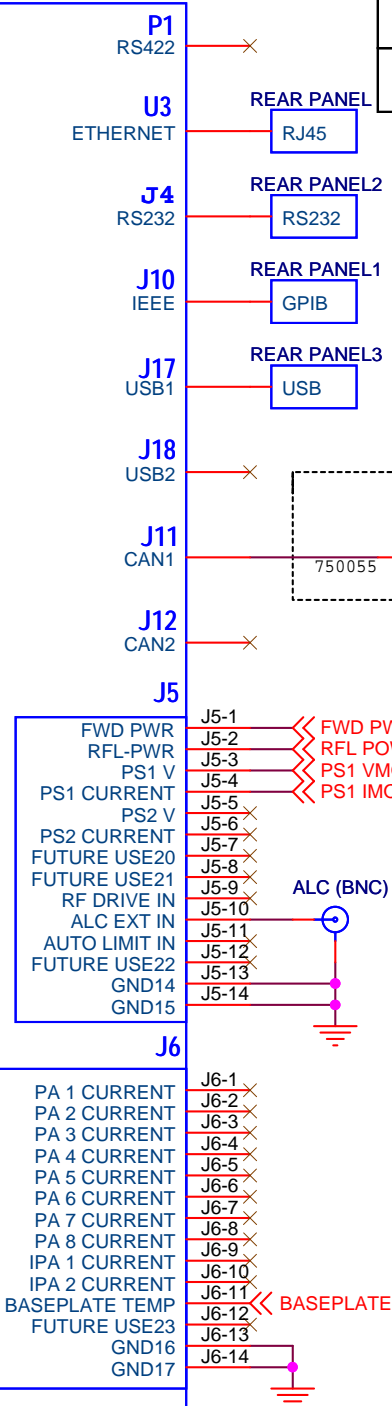
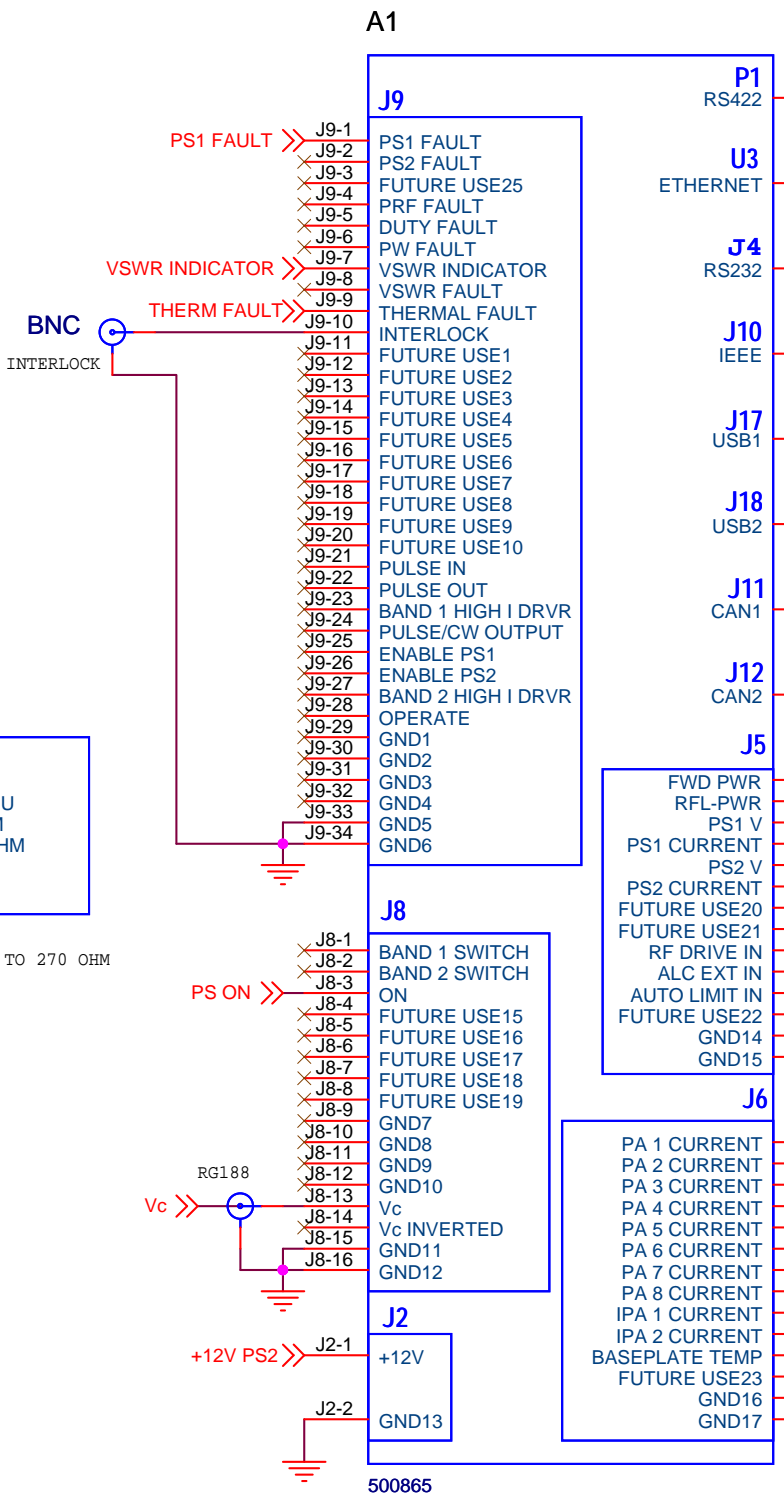
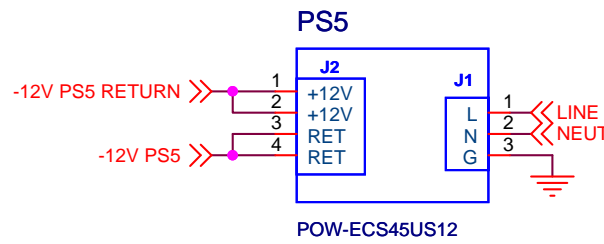
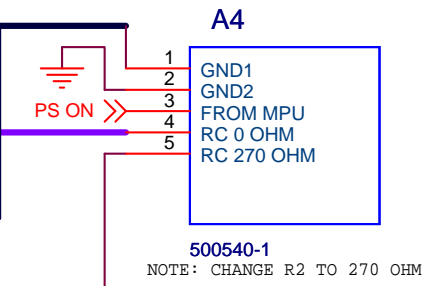
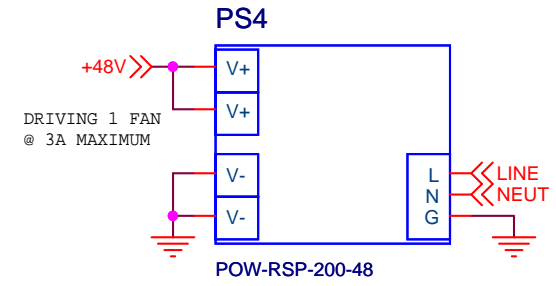
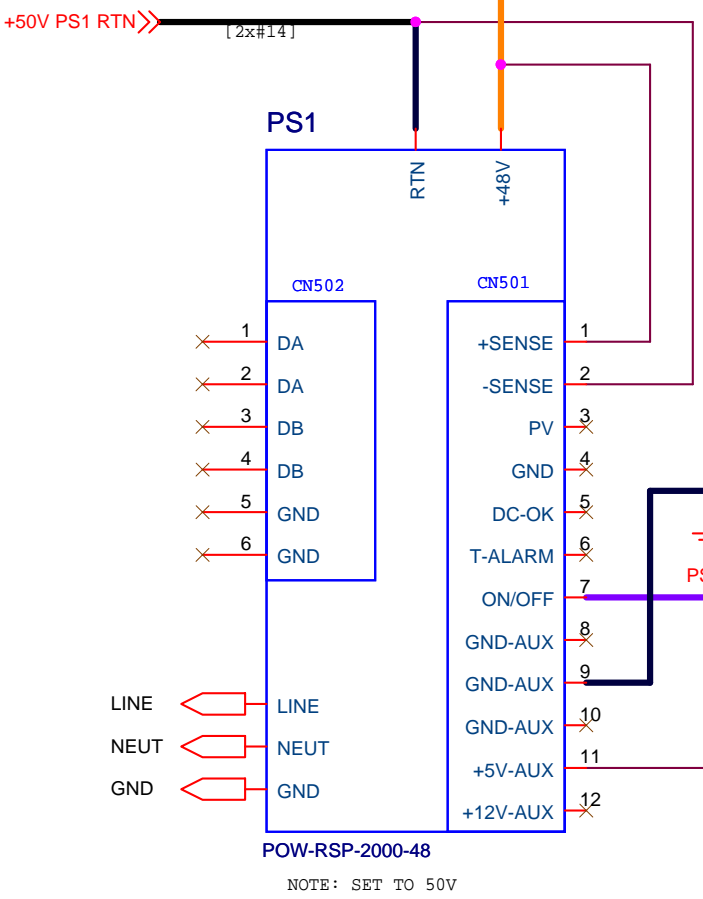
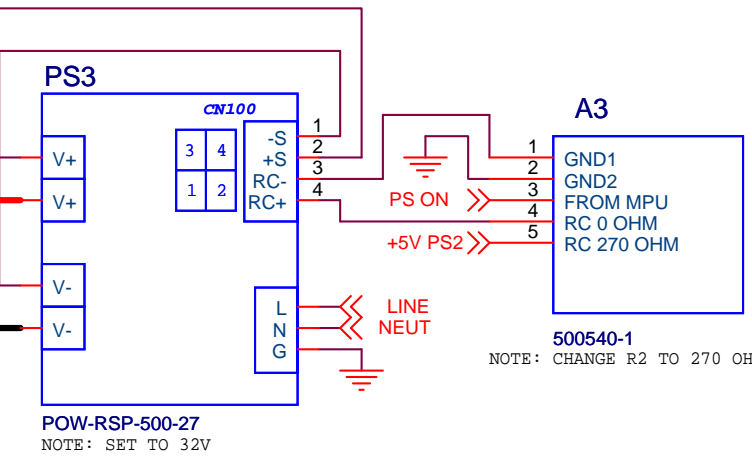
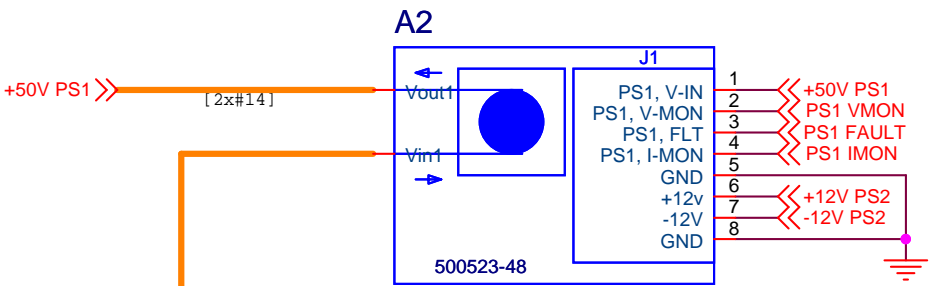
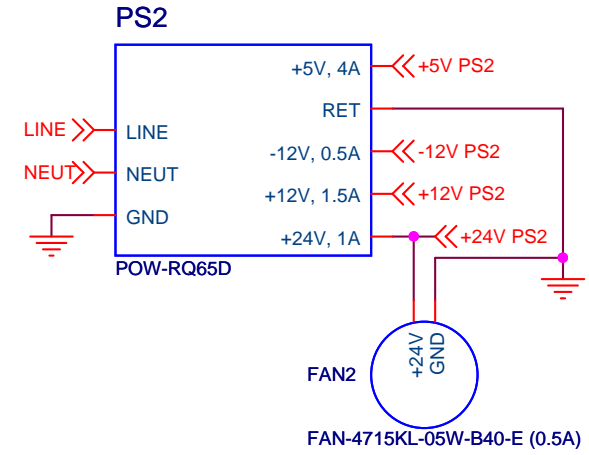
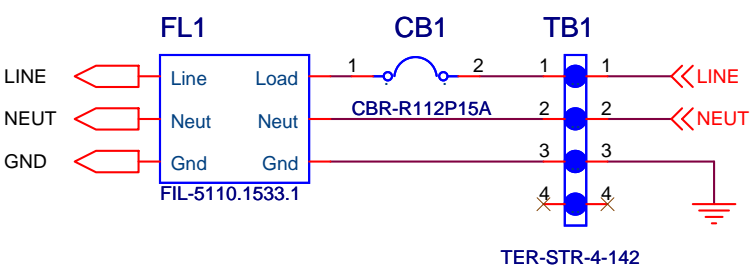
APPROVALS		DATE	INSTRUMENTS FOR INDUSTRY		
DRAWN BY: J CAMPANELLA		6/5/2017	903 S. 2ND STREET, RONKONKOMA, NY. 11779		
CHECKED BY:			TITLE		
APPROVED BY: TBD		TBD	S251-250 PA, RF BLOCK		
REVISED BY: TBD		TBD	Size	CAGE Code	DWG NO
			B	01105	901097
			Scale	Tuesday, June 06, 2017	Sheet 1 of 2



110-220VAC UNIVERSAL 1PH, 3 WIRES

REVISION HISTORY

DATE	REV	DESCRIPTION
6/1/2017	1	INITIAL RELEASE



APPROVALS		DATE	INSTRUMENTS FOR INDUSTRY		
DRAWN BY: J CAMPANELLA		6/1/2017	903 S. 2ND STREET, RONKONKOMA, NY. 11779		
CHECKED BY:			TITLE: S251-250 PS INTERCONNECT		
APPROVED BY: TBD		TBD	Size B	CAGE Code 01105	DWG NO 901097
REVISED BY: TBD		TBD	Scale	Tuesday, June 06, 2017	Sheet 2 of 2