INSTALLATION, OPERATION, AND

PREVENTATIVE MAINTENANCE

M A N U A L

HPA KA ODU
0104600600rE

For Use With Model Numbers...

T05KO
TL05KO

Service Center Headquarters and Design Center

West Coast Operations

811 Hansen Way

Palo Alto, CA 94303

Manufacturing

East Coast Operations

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Georgetown, ON

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PROPRIETARY INFORMATION

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Chapter 1
Introduction

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1.1 Overview

The CPI High Power Ka ODU is designed for satellite communication earth stations, satellite newsgathering vehicles, and flyaway applications. The key feature of these amplifiers permits direct mounting to antenna structures, thereby eliminating transmission line losses encountered in conventional remotely mounted arrangements. For this reason, these amplifiers are referred to as Outdoor Unit Traveling Wave Tube Amplifiers "ODU TWTAs."

Table 1-1 shows the model numbers, frequency ranges, and power outputs of these amplifiers. Figure 1-1 is a photograph of the ODU. All models have a generic appearance.

Table 1-1. ODU Amplifiers

Model Number	Frequency Range (GHz)	Rated Power at Output Flange (Watts)
T05KO-A	27.50 – 30.00	425/415 CW (NOTE1)
T05KO-B	30.00 – 31.00	425/415 CW (NOTE1)
T05KO-C	27.50 – 30.00	425/415 CW (NOTE1)
T05KO-D	30.00 – 31.00	425/415 CW (NOTE1)
TL05KO-C	27.50 – 30.00	415 Peak (NOTE2)
TL05KO-D	30.00 – 31.00	415 Peak (NOTE2)
TL05KO-E	27.50 – 30.00	415 Peak (NOTE2)
TL05KO-F	30.00 – 31.00	415 Peak (NOTE2)
TL05KO-G	27.50 – 30.00	415 Peak (NOTE2)
TL05KO-H	28.00 – 29.31	415 Peak (NOTE2)
TL05KO-J	28.00 – 29.31	415 Peak (NOTE2)
TL05KO-K	29.00 – 31.00	415 Peak (NOTE2)
TL05KO-T	27.50 – 31.00	415 Peak (NOTE2)
TL05KO-U	27.50 – 31.00	415 Peak (NOTE2)
TL05KO-V	27.50 – 30.00	415 Peak (NOTE2)
TL05KO-W	30.00 – 31.00	415 Peak (NOTE2)
TL05KO-Y	27.00 – 30.05	415 Peak (NOTE2)

Table 1-1 Notes:

1. With the optional harmonic filter installed 415W output power is available.
2. At the time of purchase 250W, 300W, or 350W CW output power is determined. This option is TWT dependant and cannot be changed in the field. This amplifier does not provide 415 W of power at the flange. The 415W power level is provided as a reference point only so that desired backoff can be calculated.

By industry convention, the rated power of an amplifier is the output power of the high power-amplifying component, a traveling wave tube (TWT). The output power available to the user at the amplifier output flange is lower. A technical description of the amplifier can be found in the "*Drawings*" chapter.

Figure 1-1. 500W Ka ODU (Front View)

1.2 Equipment Description

The power supply and RF components are housed in a rugged and compact weatherproof enclosure. The overall dimensions are 10.25x10.50x22.25 inches or 261x267x566 millimeters, excluding the connectors and mounting brackets. It weights 55lbs or 25kg without options. The ODU is digital ready for wideband, single or multiple-carrier satellite service in the Ka frequency band. It is air-cooled taking in air from the bottom and exhausting it at the rear. The ODU can operate at ambient temperature ranging from -40 to +50 C, with an option that allows operation to +60C.

The power supply section includes the power factor correction, power processor, and high voltage regulation circuitry. RF components include the TWT, the solid state intermediate power amplifier (SSIPA), I/O isolation circuits, input attenuator, RF detectors, and output harmonic filter. Monitor and control circuits are included to permit safe, efficient, and reliable operation.

The ODU is operated remotely via an interconnect cable attached to the connector located on the amplifier's front panel. Through this interface control, fault and monitoring functions are available. The *"Outline"* drawing in the *"Drawings"* chapter, provides detailed dimensions and the interface connector locations. Figure 1-2 shows a simplified RF block diagram.

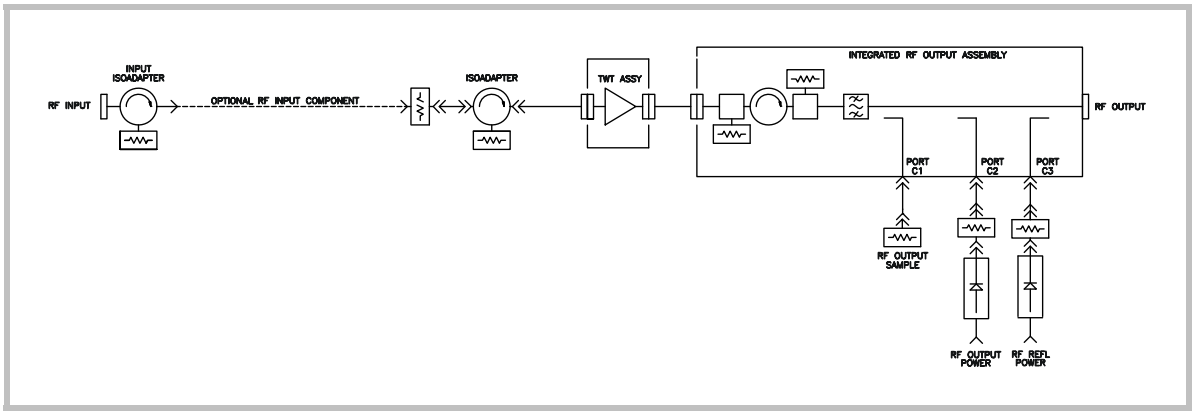

Figure 1-2. Simplified RF Block Diagram

1.3 Standard Features

This section provides details on the standard features included on all base models. Some optional features replace standard features. Refer to the "Optional Features" section for details.

1.3.1 Ethernet Interface

The built-in Ethernet interface provides the communication port through which the amplifier can be monitored and controlled. Ethernet interface provides an industry-standard 10 Base-T interface that supports the TCP/IP, FTP, and NTP protocols. Due to the Ethernet port's high speed, communication with the amplifier is much faster: The FTP protocol allows the operator to download logs from, and upload firmware to, the amplifier. The NTP protocol allows the operator to automatically synchronize the time and date with that of a host computer.

1.3.2 Web Browser Interface

The web browser enables a PC to remotely monitor and control the amplifier. The software loaded on the amplifier communicates using the TCP/IP protocol through the PC's Ethernet LAN connection. Meter readings and status information can be displayed simultaneously in multiple web browser windows.

1.3.3 Front Panel Interface

The front panel interface shows the current status and state of the amplifier through the use of labeled LEDs indicators. Three weatherized buttons for transmit/standby, reset, and local/remote are provided for basic control via the front panel interface.

1.3.4 Legacy Switch Controller Interface

The Legacy switch controller interface is provided standard and used when the amplifier is optionally installed as a sub component in a RF switching or combining system. This interface is connected to the jumper plug when not in use. This interface is explained in detail in the "*External Interfaces*" chapter.

1.4 Optional Features

This section provides details on optional features available to the amplifier. Optional features are installed and tested at the factory to ascertain proper functionality.

1.4.1 Remote Control Unit (RCU)

The Remote Control Unit is rack-mountable and is able to duplicate all of the controls and indicators of the amplifier interface. The RCU communicates with the amplifier via serial or Ethernet interface. The panel requires a source of AC power, and includes the connectors to build an interconnect cable for the amplifier, but not normally the cable.

1.4.2 SIM Switch Interface

This interface uses the theory behind controller area networks (CAN). Each amplifier and waveguide switch is daisy chained together to provide monitor and control for the redundant or power/frequency combining switch system. These interface ports should remain terminated with the weatherized connectors provided when not in use.

1.4.3 SSIPA

The solid state integral power amplifier (SSIPA) provides additional gain to the overall gain of the amplifier. The SSIPA has an internal pin diode attenuator with a step size of 0.1dB and a range of 0dB to 30dB.

1.4.4 Linearizer or LIPA

A linearizer is used to improve the AM/PM, third order intermodulation products, spectral regrowth, and NPR performance. A linearized unit operating at 4 dB total output backoff and a non-linearized unit operating at 7 dB total output backoff would have similar performance for these four parameters. The linearizer can be tuned through the optional CPI remote panel or through the web browser. In addition the linearizer functions the LIPA has all the function of a SSIPA as well.

1.4.5 Block-Up Converter or BIPA

The block-up converter (BUC) operates in the L-Band frequency band. The BUC converts an L-Band input frequency to the frequency required by the TWT internal to the amplifier. All BUC's can operate with a local oscillation frequency, or be phase locked to a high-stability oscillation reference. The oscillation frequency is provided by either multiplexing the input signal with a reference, applying an external reference, or by an internal local oscillator. In addition the block up conversion functions of the BUC, a BIPA can function as an SSIPA as well.

1.4.6 Serial Remote Port

The serial remote port allows the amplifier to be monitored and controlled using RS-232 or RS-422 serial communications. The serial remote port, when installed, is located at the rear of the amplifier. Two pins on the serial remote port are designated for an external interlock which overrides all other controls when an 'open' is detected. The computer interface protocol document is provided in the drawings chapter of this manual.

1.5 About This Manual

This manual describes the installation, operation, and preventative maintenance procedures.

The Operational Warnings and Safety Section that precedes Chapter 1 contains practical guidelines regarding safe High Voltage and Microwave Radiation operating practices.

Chapter 1, "*Introduction*," provides a brief overview of the amplifier and this manual.

Chapter 2, "*Unpacking and installation,*" contains procedures for unpacking and installing.

Chapter 3, "*Operation*", describes the controls and indicators of the RF amplifier and the procedures to use for initial checkout after the amplifier has been installed. This chapter also describes the procedures for normal start-up, shutdown, and operational modes.

Chapter 4, "*Preventative Maintenance,*" describes the procedures for scheduled maintenance and return of equipment to CPI.

Chapter 5, "*Drawings,*" contains relevant engineering amplifier drawings and specifications.

The Appendices contain additional topics such as "Service and Warranty" information, supplementary data, and optional features.

1.6 Conventions

Symbols and conventions used throughout this manual are described in the following sections.

1.6.1 Notes and Cautions

General notes, cautions, or warnings, provide additional commentary or technical information. They identify conditions, operations, or procedures that could potentially damage the equipment, induce physical strain, maim, or kill people. This includes heavy weights, sharp edges or protrusions, and chemical hazards. They are identified by the following symbol:

1.6.2 Electrical or RF Warnings

Electrical warnings identify conditions, operations, or procedures that expose the operator to potentially lethal high voltages and are identified by the following symbol:

Microwave radiation warnings identify conditions, operations, or procedures that expose people to microwave radiation sources that could cause serious injuries, particularly to the eyes and are identified by the following symbol:

1.6.3 Text Conventions

When operator action is required for software entries, the action required is capitalized and the action object is capitalized and may be bold for emphasis. For example, PRESS **ENTER**.

Labels for Front Panel controls and indicators are capitalized. For example, RESET.

Sometimes the actual labels are abbreviated. For Example, TWT TEMP.

Italics are used in references to other manuals and other parts of this manual, such as: See *Indoor SSPA Service Manual*.

Chapter 2
Unpacking and Installation

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2.1 Overview

This chapter contains instructions for unpacking and installing the amplifier. Read all instructions to become familiar before proceeding.

2.2 Pre-Inspection

Inspect the exterior of the shipping container(s) for evidence of damage in shipment. If damage is evident, immediately contact the carrier that delivered the equipment and submit a damage report. Failure to do so could invalidate future claims.

2.3 Unpacking

Carefully unpack and remove all items from the shipping container(s). Inspect the interior of the container for damage. Save all packing material until all inspections are complete. It is recommended that all packing material be saved for potential future use. Verify that all items listed on the packing slips have been received.

Inspect all items for evidence of damage in shipment. If damage seems evident, immediately contact the carrier that delivered the equipment and file a claim. Failure to do so could invalidate future claims.

2.4 Installation

Installation includes mechanical, electrical power connections, remote control interface, and RF connections.

2.4.1 Amplifier Installation

Refer to the outline drawing in the *"Drawings"* chapter for dimensions and mounting information.

The amplifier may be mounted using the three tapped holes located on each side of the chassis, six total refer to the "*Outline*" drawing in the "*Drawings*" chapter. These holes are 1/4 20 UNC threaded and are 0.38 inch deep. In order to provide secure mounting, screws dressed with locking hardware must be used in all six holes. If the amplifier is mounted to an antenna, the structure must be capable of supporting the additional load of the amplifier plus any wind loading effects, which may occur.

It is recommended that locations subject to electrical interference, such as that from motor contactors, be avoided.

The amplifier is air-cooled. The intake and exhaust areas must not be blocked. The air intake must be given two inches of clearance and the air exhaust must be given four inches of clearance. The hot air exhaust should be directed away from the air intake. For further information see the "*Outline*" drawing located in the "*Drawings*" chapter and the *"Operational Warnings"* document located at the front of this manual.

2.4.2 Cooling Considerations

The internal fan air cools the amplifier drawing air in from the bottom of the unit and exhausting it through the duct located at the rear.

To insure proper operation of the amplifier, the following guidelines must be observed:

1. There must be at least two inches of clearance on the bottom of the unit (air intake).
2. There must be at least four inches of clearance behind the unit that has the exhaust ducts (the end with the visible cooling fins).
3. The hot exhaust air must be directed away from the air intake.
4. The area below the air intake must be free of foreign material, loose dirt, debris, and any other material that may be drawn toward the unit that may block the air intake area.

2.4.3 Electrical Power Connections

Electrical power connections include the prime power connector and the chassis ground. Connector locations are located on the front panel and displayed in figure 2-1.

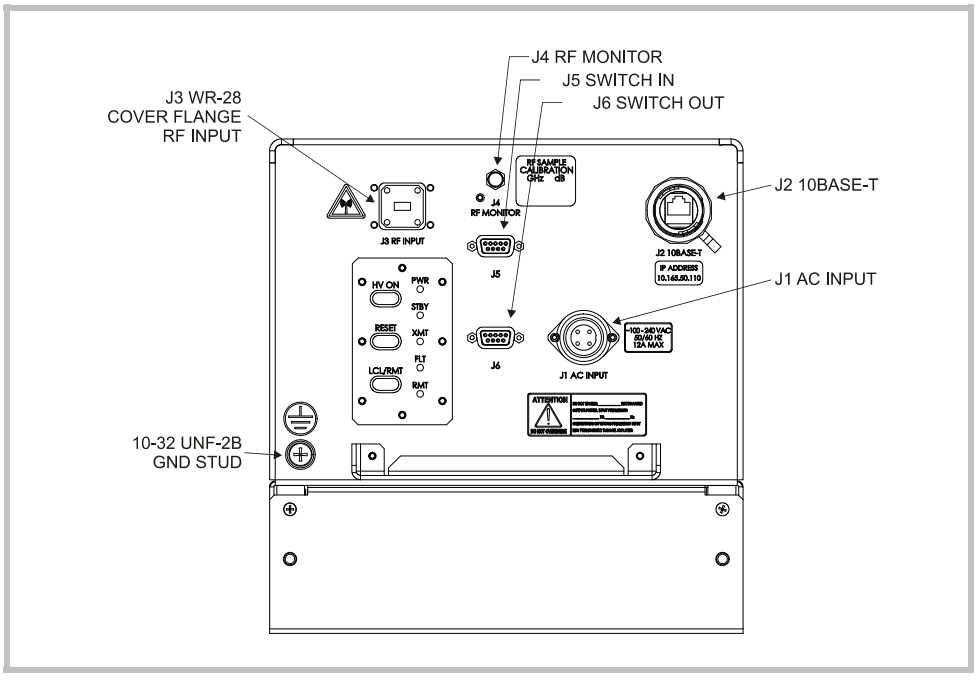

Figure 2-1. Prime Power Connector Locations

2.4.3.1 Prime Power (J1)

WARNING! DO NOT APPLY PRIME POWER TO THE AMPLIFIER UNTIL YOU ARE DIRECTED TO DO SO.

Prime power is applied to connector J1 (AC IN) located on the front panel. Prime power is 100 - 240VAC +/- 10% (nominal), 47-63 Hz. The proper voltage is indicated on a label located on exhaust end of unit. A prime power mating connector is supplied in the ship kit with the unit. The pins of the prime power connector should be wired as follows:

Pin 1 - line (or Phase A)	Pin 3 - Neutral (or Phase B)
Pin 2 - No connection	Pin PE - Protective Earth

Prepare the prime power cable but do not connect the cable to the amplifier at this time.

2.4.3.2 Grounding

Proper grounding of the amplifier to the station protective earth bus is necessary for personnel and equipment safety. The 10-32 UNF-2B threaded ground stud on the front panel is used for grounding. #14AWG wire or larger is recommended for the grounding cable. The amplifier should be protected against direct lightning strikes.

2.4.4 Ethernet Interface (J2)

This port is a standard RJ-45, 10BaseTx weatherized receptacle. A weatherized mating plug for the Ethernet cable is provided in the ship kit. A mating connector for this interface must be built using shielded twisted pair RJ-45 jack and cable.

The operator uses a Java enabled web browser and TCP/IP protocol to interface with the amplifier. Instructions on connecting to the amplifier can be found in the "*Operation*" chapter.

Warning: The Ethernet port is only weatherized when connected to a properly assembled Ethernet cable built with the weatherized mating connector provided in the ship kit. Failure to use the weatherized mating connector will allow moisture into the amplifier and void the warranty.

Note: The baud rate is fixed at 9600 and cannot be changed. This ensures both Ethernet and serial communications can be established.

2.4.5 Waveguide Connections (J3 & J4)

The RF input and output waveguide flanges are located on the front and rear panel respectively. The RF input waveguide flange is WR-28 or WR-34 (optional) grooved and the RF output waveguide flange is WR-34. Both waveguide flanges have four through holes that will fit size 4-40 screws. An O-ring gasket is supplied in the ship kit for both the input and output waveguide flanges.

To install waveguide to the input or output flange, proceed as follows:

1. Install the O-ring gasket into the grooved portion of the waveguide flange.

Warning: Do not allow dirt and debris to enter the waveguide flange or mating waveguide as this will result in high VSWR and may damage equipment or the amplifier.

2. Position the interconnecting waveguide so that it aligns precisely with the waveguide flange.

Caution: If flange alignment is not precise or if the installation is subject to motion or severe vibration, a flexible waveguide section should be installed.

3. After alignment is verified in all three planes, loosely attach the interconnecting waveguide to the input waveguide flange of the amplifier with 4-40 stainless steel screws, flat-washers, and lock-washers. Start all bolts and verify proper alignment.
4. A progressive tightening procedure is recommended. Tighten each screw until the lock washer starts to compress before proceeding to the next one. Repeat until all screws have been partially tightened.
5. Starting with the first screw, fully tighten them to the desired torque level (4.3 in. lbs. for 4-40 screws). Over-tighten can strip threads or distort the mating flange. Refer to figure 2-2 for the tightening sequence.
6. Repeat steps 1 to 5 for both the input and output waveguide flanges. WR-34 grooved input and WR-28 grooved output are options.

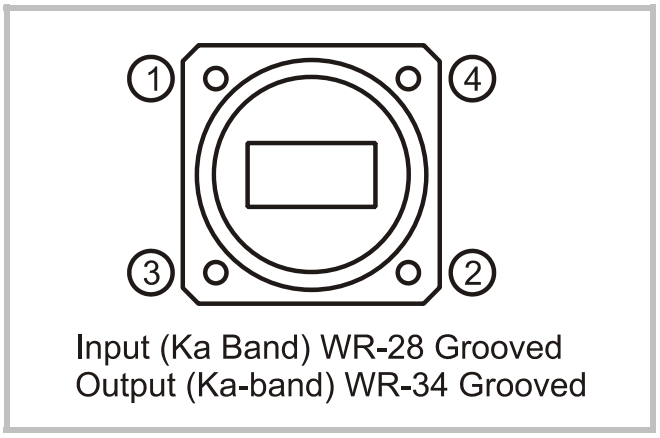

Figure 2-2. Tightening Sequence

2.4.6 Legacy Switch Interface (J5)

Connector J5 is a DB 9-pin female (socket) weatherized connector that is typically used when the amplifier is a part of a redundant RF switching system.

On standard units not equipped with optional switch controller, the Legacy Switch Interface provides the relay-reported amplifier status and RF inhibit command required by an external waveguide switch controller as well as two external interlock inputs. The status relays can be configured for several purposes, as described below. The only command on this interface, RF Inhibit, is active at all times and is not subject to the control mode hierarchy.

Note: A jumper plug is supplied in the ship kit with the amplifier. If the amplifier is to be used in a standalone configuration, this connector must be used. The amplifier will indicate an interlock fault and RF inhibit if this connector is removed or not securely fastened.
The jumper plug should be wired as follows:
-Jumper pin 4 to pin 9
-Jumper pin 3 to pin 8

Table 2-1. J5 Pin Designations

Pin #	Signal Name
1	Chassis Ground
2	Relay NO
3	External Interlock
4	RF Inhibit
5	Chassis Ground
6	Relay NC
7	Relay Common
8	External Interlock Rtn
9	RF Inhibit Rtn

Table 2-1 Notes:

1. Outputs are dry-circuit relay contacts rated up to 50 VDC, 50 mA.
2. External interlocks and RF Inhibit inputs are optically isolated. Maximum open circuit voltage present is 16 VDC. Typical operating current is 3 mA.
3. The RF Inhibit and External Interlock require a maintained closed-contact with RF Inhibit return and External Interlock return respectively for normal operation.
4. An open RF Inhibit or External Interlock will cause an RF Inhibit or Fault respectively.

2.4.6.1 Relay Definition

One available status relay can be programmed to indicate one of several conditions. The configuration of these relays is controlled through the Ethernet interface port.

Note:
During operation, there is continuity between the "NC" and "Relay Common" contacts. The relay will become open when a fault occurs.
During operation, there is no continuity between the "NO" and "Relay Common" contacts. The relay will become closed when a fault occurs.

The configuration definitions are given below.

Fault

The fault state is indicated by the fault status. The Auto Fault Recycle capabilities enables under some circumstances of cycling back to a normal operating state.

Low RF

The Low RF status indicates that the Low RF Alarm or the Low RF Fault state is engaged. A waveguide switch may use the signal generated to trigger the switching action. The Low RF status has two modes, Flexible and Rigid.

In Rigid mode the Low RF status will indicate the RF output is below the Low RF Alarm level when this condition occurs, except during an RF Switch RF Inhibit command. The Rigid mode can be thought of as the strictest operation of the Low RF status.

In Flexible mode the Low RF status will indicate the RF output is below the Low RF Alarm level any time this condition occurs *during the Transmit state*, except during an RF Inhibit. If RF Inhibit is activated while the Low RF Relay indicates a low RF condition, the Low RF Relay will not change state. (It will continue to indicate Low RF.) Once the RF Inhibit disappears, the Low RF Relay will report existing conditions. The Flexible mode allows the amplifier to operate in any normal operating state without effecting switch controller in automated switching mode.

Note: The Low RF status will <u>not</u> assert during a Fault state.

Sum Fault

The Sum Fault status indicates a latched into the fault state. When latched into the Fault state, the operator must clear the fault source and issue a Reset command to return it to a normal operating condition.

Transmit

Transmit indicates that the Beam is turned on and the RF is not inhibited. This is the normal operating state of the amplifier. The amplifier will cease transmitting (and the Transmit indication will be negated) if the interlock circuit opens.

Beam On

Beam On tracks the Beam state (HV applied to TWT).

2.4.7 Optional SIM Switch Interface (J5, J6)

The Switch Interface Module (SIM) switch system is designed to simplify the interface between microwave waveguide switches (WGS) and CPI products. The SIM circuitry consists of a power supply, microcontroller, and WGS motor drive. All switch system monitor and control functionality is located on the SIM. A ribbon cable or off-the-shelf shielded cable with D-sub connectors is required to interface with the SIM. This allows multiple SIMs to be easily daisy chained together and no patch panels are required.

A SIM switch system consists of up to sixteen SIMs and up to sixteen amplifiers. The SIMs and amplifiers communicate with each other over a CAN (Controller Area Network) bus operating at 100K baud. In addition to the CAN bus there is also a RS-232 serial interface which is used to automatically identify the location of each SIM eliminating the need for DIP switches and jumpers. CAN bus termination is required at the first amplifier and the last SIM.

The first SIM (SIM 1) which plugs into the amplifier chain is considered the "Master SIM" and all other SIMs are slaves. Switch system configuration, status, amplifier priority, along with other information is stored in SIM 1. SIM 1 monitors the status of the amplifiers and determines what WGSs need to change position in order to backup a failed amplifier.

When a WGS is rotated its SIM broadcasts the WGS position to all devices connected to the CAN bus. Each amplifier monitors the position of all WGSs and will inhibit RF should a rotating WGS be within that amplifiers signal path. Detailed information can be found in the switch system manual provided.

2.4.8 Optional Serial Remote Port (J10)

The serial remote port allows the amplifier to communicate via RS-232 or RS-422. A 10-pin circular weatherized mating connector is provided in the ship kit to build a mating cable. The port is located on the rear panel of the amplifier below the RF output WG flange. This port includes an external interlock that must be thru connected to the interlock return when not used to prevent a latched fault. A CIF protocol is provided in the "*Drawings*" chapter of this manual. Refer to table 2-2 and figure 2-3. The factory default serial settings are as follows:

Address: 48 (Decimal)

Baud Rate: 9600

Parity: Even

Word Length: 7-bits

Protocol: STX/ETX

Check Byte: Yes

CR: No

LF: No

Note: Only the address and protocol can be changed. These fields can be modified through the configuration screen. Refer to the "Config Screen" section in the "Operation" chapter.

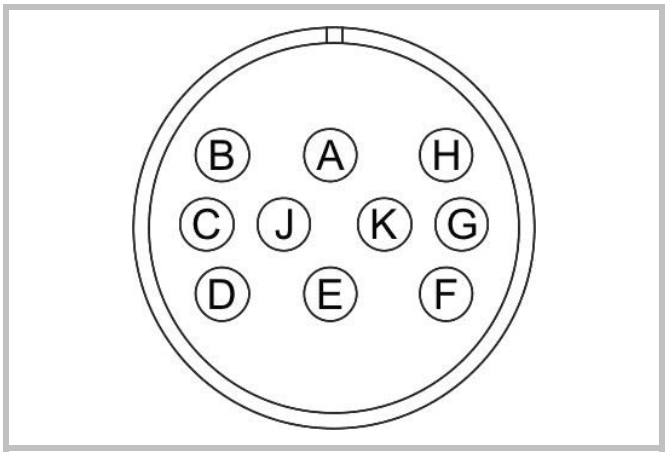

Figure 2-3. Serial Remote Port Pin Locations

Table 2-2. Serial Remote Port Pin Designations

Pin	Description
A	RS-422 Tx (+)
B	RS-422 Tx (-)
C	RS-422 GND
D	RS-422 Rx (-)
E	RS-422 Rx (+)
F	RS-232 Tx
G	RS-232 Rx
H	RS-232 GND
J	Programmable(NOTE1)
K	Programmable(NOTE1)

Table 2-2 Notes:

1. Pins J and K can be configured for an external interlock, an RF inhibit, or OFF/Disabled. Refer to the "Config Screen" section in the "Operation" chapter setup information.

Warning: Do not solely depend on interlock pins J and K on the optional serial interface as a safety interlock as these pins are controlled by software. The system installer and operators working with this equipment should keep in mind the software could fail or this software setting can be changed. It is recommended a hardwired safety interlock is used with this feature.

2.4.9 Optional RF Output Monitor

The RF output monitor is a 2.9mm female coaxial connector located on the front panel. The coupler calibration data at set frequency ranges is located beside the connector.

Warning: This connector should be terminated with the 50 ohm termination provided on the front panel when not in use.
Do not apply excessive force to this connector as it is easily damaged.
Damage due to not terminating or applying excessive force to the RF output monitor may void the warranty.

WARNING! THERE IS A POTENTIAL FOR OSCILLATION IF THE RF INPUT WAVEGUIDE IS NOT FASTENED PROPERLY AND THE RF OUTPUT MONITOR IS NOT TERMINATED. OSCILLATION CAN DAMAGE THE TWT OR CAUSE RF RADIATION LEAKAGE AND MAY VOID THE WARRANTY.

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Chapter 3
Operation

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3.1 Overview

The amplifier is operated remotely via the Ethernet interface. Each amplifier is configured and thoroughly tested at the factory. Once installed, it should be monitored at initial power on to ascertain that it functions properly. The following sections describe procedures for PC interfacing, pre-power on, navigating the control panel, and initial power on with checkout.

3.2 Operational Overview

Note: Before applying power ensure all initial power-on and checkout procedures have been completed. See the "Initial Power-On and Checkout" chapter for instructions.

An initial self-test will be conducted by the amplifier when prime power is applied. When initializing has completed the operator switches from STANDBY state to TRANSMIT state, sets the desired output level, and applies the RF input. The input signal is amplified and output to the antenna.

During operation, the 'Amp Status' screen is used to control the amplifier. Transmit, standby, RF inhibit, automatic level control (ALC), and manual mode are the control parameters that can be accessed from the 'Amp Status' screen. The amp status screen is discussed in a later section.

When the amplifier is ready to be shutdown, the operator clicks on the **STANDBY** button and confirms the selection by clicking "yes" in the command confirmation screen. With the RF input drive disabled the operator allows a few minutes for the fans to cool the TWT before removing power.

3.3 PC Interfacing

The operator can use a PC, connected to the 10base-T connector J2 on the front panel for control and monitor. The mating connector RJ-45 plug is supplied in the ship kit. The RJ-45 cable should form a complete airtight seal when connected. When connecting to a remote control unit (1RU) the Ethernet cable used should be wired as a straight through. When connecting to a PC the Ethernet cable used should be wired as a crossed-over. The IP address is factory set and can be changed from the factory setting after the initial power on is complete. A PC should be used to setup the Ethernet address of the amplifier.

3.3.1 Finding the IP address

The Default IP address should be192.168.000.254. However it may not be set to this address if the unit was used and the address was changed. To find the address a program called address scanner is provided. This software is provided with this manual on CD. The program can be loaded onto a PC and it must be un-zipped. After un-zipping the program run it and initiate an IP scan. The program will return with the IP address of the amplifier. Use the program to change the address if necessary or use the IP address to access the ODU Web page.

3.3.2 Configuring the PC

Configure the PC to communicate with the amplifier using the following steps:

1. Open network connections.
2. Right click on the LAN connection.
3. Click properties.
4. Select Internet protocol (TCP/IP).
5. Click properties.
6. The Internet protocol properties screen should appear. See figure 3-1.
7. Fill in the subnet mask field with 255.255.255.0
8. Fill in the IP address with the address provided on the front panel label of the amplifier.
9. Change the last number in the IP address from 1-255 so it is different from the units IP address.

Your PC workstation is setup for connection with the amplifier.

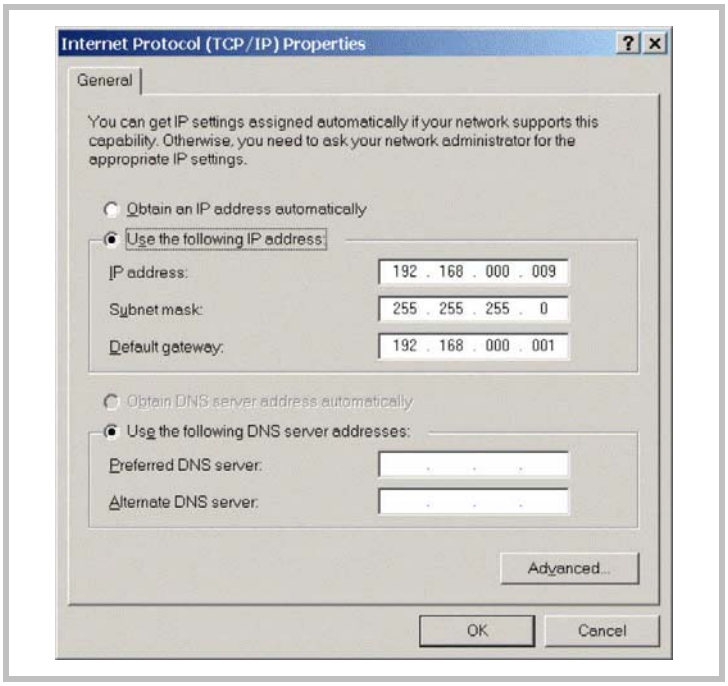


Figure 3-1. TCP/IP Properties Example

3.3.3 Connecting To a Remote Controller

Refer to the remote control unit (RCU) installation and operation manual for connection details.

3.4 Pre-Power On Procedure

Before applying prime power to the ODU, verify that the following conditions have been met:

1. AC prime power is 100 - 240 VAC +/- 10%, 47-63 Hz, as indicated by the label located on exhaust end of unit, and single phase.
2. Connect the AC power cord to J1 and ensure AC power is not turned on.
3. A ground strap is connected from the installation sites' ground bus to the ¼ - 20 UNC 2B ground screw-mounting hole located on the amplifier's front panel.
4. The RF input and RF output waveguide flanges are connected to proper matching waveguide which is securely tightened.
5. The waveguide load used should be rated for two times the rated output power of the amplifier.
6. Check all sources RF power to ascertain they are off.
7. There is at least 2 inches of clearance at the air intake and 4 inches of clearance at the exhaust.
8. The exhaust/intake areas are not blocked.
9. Use a power meter to set the RF input drive to a level equal to or below –40dBm. Use a spectrum analyzer to verify that the operation in the proper frequency range.
10. Verify the RF output port is connected to the mating output flange leading to the antenna feed, or to RF load rated at 200 watts minimum. Verify that all waveguide flange hardware is properly tightened and the antenna is pointing upward and free of obstruction.
11. Apply power to the PC and launch the browser.

Warning: Failure to verify these pre-power conditions may cause damage or malfunction. Operating the equipment before verifying these items may void the warranty.

3.5 Navigating the Control Panel

The amplifier is monitored and controlled via a web browser. The software loaded on the amplifier transforms the web browser into a user interface (UI). This section describes data organization and navigation of the UI.

3.5.1 Data Organization

During normal operation, the amp status screen displays the control mode, state of operation (either transmit or standby), any fault or alarm conditions, RF output level, and power mode. The left side panel of the web interface displays the operator accessible screens. These screens contain amplifier information and control settings. The left side of the screen allows the operator to navigate to the following screens:

- Amp Status
- Email
- Amp Info
- Meter Log
- Setpoints
- IP Settings
- Set Login
- Manual

3.5.2 Navigation and Data Entry

Navigation is performed using the mouse to select a system screen. Multiple web browsers can be opened to view different screens at the same time. When inputting data the operator either selects a value from a drop down menu or inputs the data into the field using the keyboard. Settings are saved on the amplifier by clicking the **APPLY** button.

3.5.3 Fault Message

If a fault occurs, it will be indicated by a red flashing message box that appears in the browser interface. Initially, the fault will be non-latching and the amplifier will attempt to recycle the fault three times before the fault becomes latched. A latched fault condition causes the unit to fall out of a transmit state.

The fault must be cleared before the amplifier can be placed back into the transmit state. All recycled faults should be investigated to determine the root cause even if the amplifier returned to a normal operating state. Refer to the "Fault Recovery" section of this chapter for details on resetting latched faults. A list of amplifier messages can be found in the appendices of this manual.

3.5.4 Alarm Message

Like the Fault message there are user settable limits that can cause alarm conditions. Alarms unlike Faults do not prevent the amplifier from operating and do not cause a fault state or Standby condition. An alarm state is indicated by a yellow flashing message box that appears in the browser interface.

When an alarm is generated by an exceeded operator settable limit it should be evaluated. If the Alarm is not operator settable, someone that has technical knowledge about the operation of the amplifier should be contacted to ascertain if the alarm is critical to the operation. The list of messages from the amplifier can be found in the appendices of this manual.

3.6 Initial Power-On and Checkout

Initial power on should not be attempted until all "pre-power procedures" in this chapter have been successfully completed. A qualified operator who has read and understood the *"Operation"* chapter should perform this section. Initial power on consists of initial check, user preference settings, trip limits, verifying meter readings, and communications setup.

3.6.1 Initial Check, Standby

When switched on, the microprocessor controllers perform a series of self-tests to ensure the ability to control and monitor. Once the initial tests (POST) are successfully completed, the amplifier initiates a heater time delay (HTD) to warm up the TWT heater. The HTD cycle is 30 minutes if equipment has been powered down for more then 48 hours or three minutes if the equipment has been powered off for less then 48 hours. Proceed as follows:

Caution: Do not operate the amplifier in standby for more than 3 hours as this will reduce the operating life. After 3 hours in the standby state a "Heater Timeout Alarm" will be displayed. After 4 hours in the standby state a "Heater Timeout Fault" will occur requiring the operator to perform a manual reset and wait the full 3 minute HTD (warm up) before the transmit state can be entered. Refer to section 3.10 for details on extending the amplifiers' operating life.

1. Turn on the prime power distribution system so that AC power is applied at J1.
2. Verify that the cooling fan comes on after AC power is applied.

Caution: If the XMT LED is flashing on the front panel controls press the HV ON button located on the front panel of the amplifier or the amplifier will go directly into transmit once the HTD cycle is completed.

Note: The amplifier should be in the STANDBY mode at this time. If the amplifier is not in standby mode click on the standby icon in the Amp Status screen and confirm the selection.

3. Enter the default IP address found on the front panel label in the web page of the PC.
4. A login screen will appear as shown in figure 3-2. Enter the default user name and password as follows: **User Name: cpi** **Password: cpi**

Figure 3-2. Login Screen

5. The amp status screen will be shown. Refer to figure 3-3.

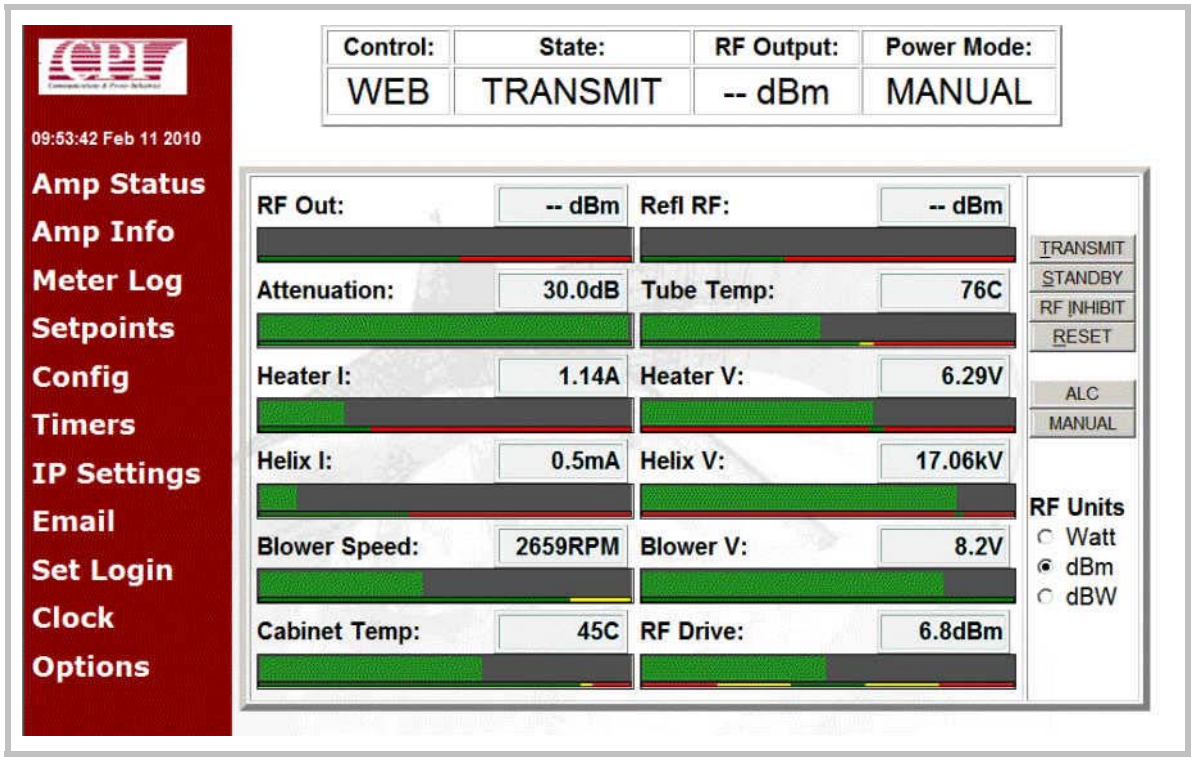


Figure 3-3. Amp Status Screen and Menu

6. The heater time delay (HTD) countdown will begin. After the countdown the amplifier will indicate the **STANDBY** state.
7. Leave the amplifier in the **STANDBY** state for a minimum of 30 minutes, but no more than 2 hours, before proceeding. This conditioning step is required every time the amplifier has been powered off for more than 48 hours. Skip this step if a 30 minute HTD has occurred.
8. Verify the RF drive is off and a matched waveguide load is connected to the amplifier output flange.
9. Press the "TRANSMIT" button and verify this selection by pressing "OK". Since this is the first time the amplifier is placed in the **TRANSMIT** state since it has left the factory, leave it in the **TRANSMIT** state for a minimum of two hours before proceeding.

Caution: Do not apply RF drive at this time. During operation and while performing sections 3.6.2 and 3.6.3, it is recommended the amplifier is left in the transmit state.

3.6.2 Preference Settings

Before operation at the installation site, the operator configurable preference settings can be adjusted to meet requirements. Table 3-1 shows user-configurable preference settings.

Table 3-1. User-configurable preference settings.

Name	Setting	System Setting Tab
ALC Set PT	Automatic loop control	Setpoints
Manual RF Set PT	Manual RF level	Setpoints
Attenuation Set PT	Attenuation level	Setpoints
Confirm Transmit Selection	Prompts user to confirm transmit	Options
Confirm Standby Selection	Prompts user to confirm standby	Options
Confirm Inhibit Selection	Prompts user to confirm inhibit	Options

3.6.3 Verify Factory Settings

To verify the factory settings click on the setpoint menu on the left panel of the web browser labeled "Setpoint" and use table 3-2 as a guide.

Table 3-2. Factory Settings

Fault Name	T05KO Series (CW)	TL05KO Series (Peak)			
	500W CW	350W CW	300W CW	250W CW	400W CW
Low RF Alarm	0W	0W	0W	0W	0W
Low RF Fault	0W	0W	0W	0W	0W
High RF Alarm	400W	290W	245W	215W	340W
High RF Fault	450W	300W	255W	225W	355W
High Reflected RF Alarm	20W	20W	20W	20W	20W
High Reflected RF Fault NOTE 1	25W	25W	25W	25W	25W

Table 3-2 Notes:

1. Factory Set. Do not change.

3.6.4 Changing the Amplifier IP Address

The IP address of the amplifier should be changed to suit the network the amplifier will become a part of. Changing the IP address requires that after applying the changes the amplifier must be shutdown (powered off) and restarted.

Use the following instructions to change the IP address of the amplifier:

1. When connected to the amplifier click on the 'IP Settings' screen.
2. Enter a new IP address, subnet mask, and default gateway following the standards set by the TCP/IP networking philosophy. These setting should be provided by your network administrator.
3. Click the Apply button.
4. If the amplifier was in operation allow it to cool down in standby before proceeding to the next instruction.
5. Remove AC power from the amplifier and wait three minutes.
6. Apply AC power to the amplifier.

Note: If done correctly communication between the amplifier and the PC should be lost. To reestablish communication follow the instructions in the 'PC Interfacing' section at the beginning of this chapter using the new IP settings.

3.6.5 Initial Check with the Beam On

Proceed as follows:

1. Verify all the pre-power on procedures have been completed before continuing with the initial check, beam on.
2. Verify there are no faults or alarms. Any faults or alarms must be evaluated and cleared before proceeding.
3. Verify that the drive to the amplifier is at -40dbm and that an external power meter and sensor is connected to the RF monitor port on the amplifier.
4. Determine the attenuation setting by going to the Setpoints tab in the Web control page. Adjust the attenuation to at least 10db.
5. On the source select an input frequency at mid band. Starting at –40 dBm, slowly increase the RF drive level until rated output is achieved. Adjust the attenuation control if necessary.
6. If the factory test data is available, compare the test data with the readings in the WEB page and the gain of the amplifier (input / output power).

Warning: Do not exceed a RF drive of -14dBm Max.

7. Click the **STANDBY** icon to end the initial check H.V. on.

3.7 Web Browser Screens

There are 12 screens available to the operator when accessing the amplifier through the web browser. These include the amp status, amp info, meter log, setpoints, config, IP settings, email, set login, time, and options. They are accessible by clicking on the screen to be accessed on the left side panel. All web browser screens are detailed in this section.

Note: All screen shots shown are for reference only and any technical data presented in them is representative only. For actual amplifier settings refer to the "Verify Factory Settings" section in this chapter.

3.7.1 Amp Status Screen

The amp status screen displays 12 continuously monitored parameters. All screens display the control type, the amplifier state, RF output, power mode, and any fault however these parameters can only be changed while in the 'Amp Status' screen. Therefore if a fault occurs or a state change is required the operator must access the 'Amp Status' screen to reset the fault or change the operational state. The operator may also click transmit, standby, RF inhibit, reset, ALC, or manual. These icons are defined in table 3-3. The amp status screen is shown in the figure below.

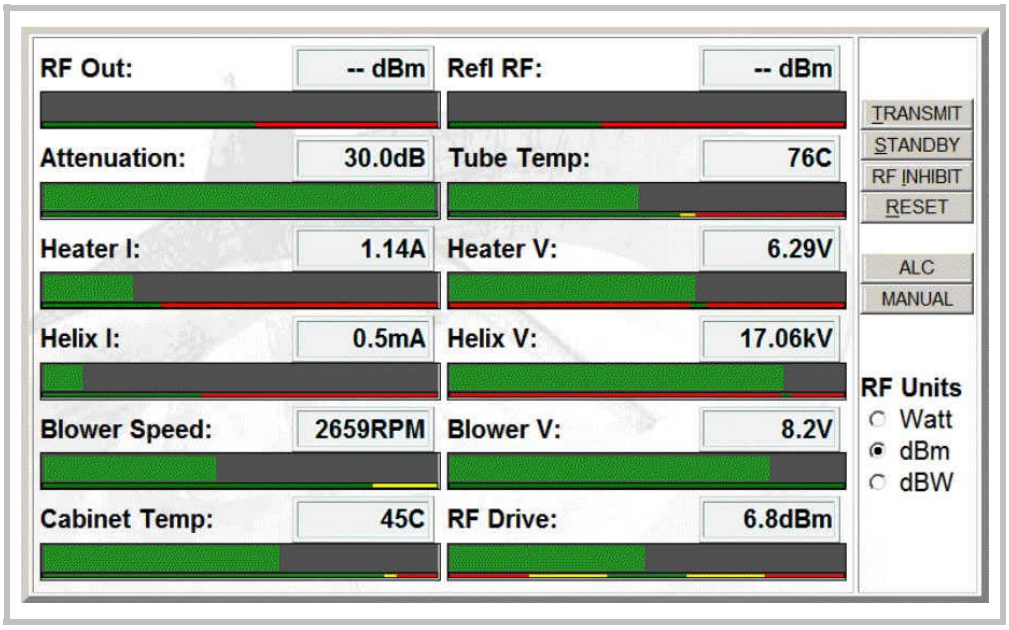


Figure 3-4. Amp Status Screen

Table 3-3. Amp Status Button Definition

Button	Definition
Transmit	Toggles the standby state to a transmit state.
Standby	Toggles the transmit state to a standby state.
RF Inhibit	Stops the RF input from reaching the TWT so it is not amplified.
Reset	Recycles faults so normal operation can resume.
ALC[1]	(Automatic Level Control) Continuously adjusts the variable attenuator of the SSIPA to maintain the RF output power set in the 'Setpoints' screen. In ALC mode the output power will remain constant if temperature or RF input drive would otherwise change it.
Manual[1]	When manual mode is selected the variable attenuator of the SSIPA is automatically adjusted to achieve RF output power set in the 'Setpoints' screen. In manual mode the output power will change as temperature and RF input drive changes.

Table 3-3 Notes:

1. The range of power adjustment is relative to the range of the attenuator.

3.7.2 Amp Info Screen

The amp info screen displays the amplifier type, and serial number. The version of the main, PS, BIPA, and RF software loaded on the amplifier is displayed as well. From this screen the amplifier can be given a name by typing it in the "Amp Name" box and clicking **APPLY**.

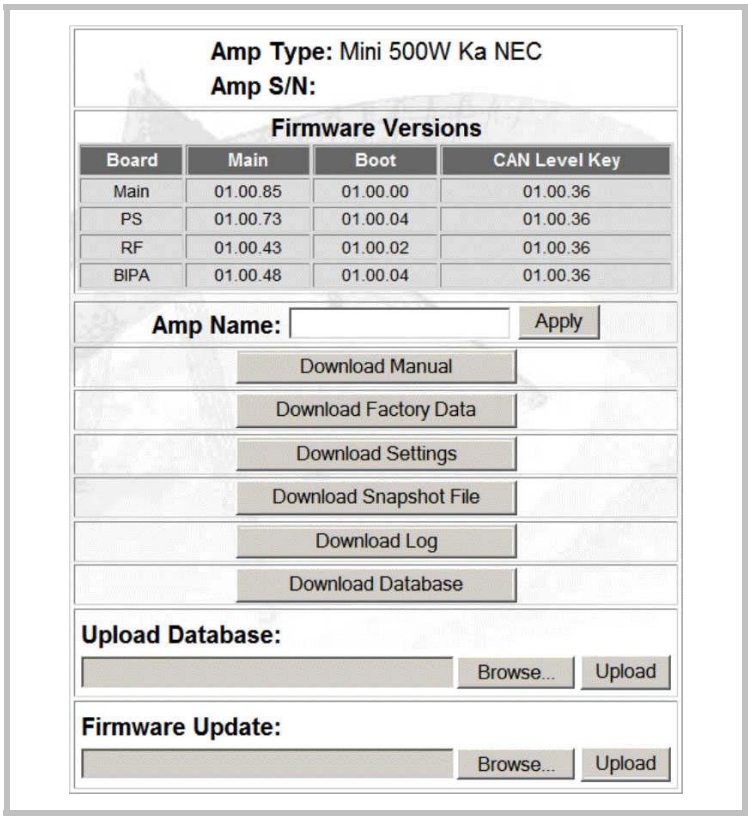


Figure 3-5. Amp Info Screen

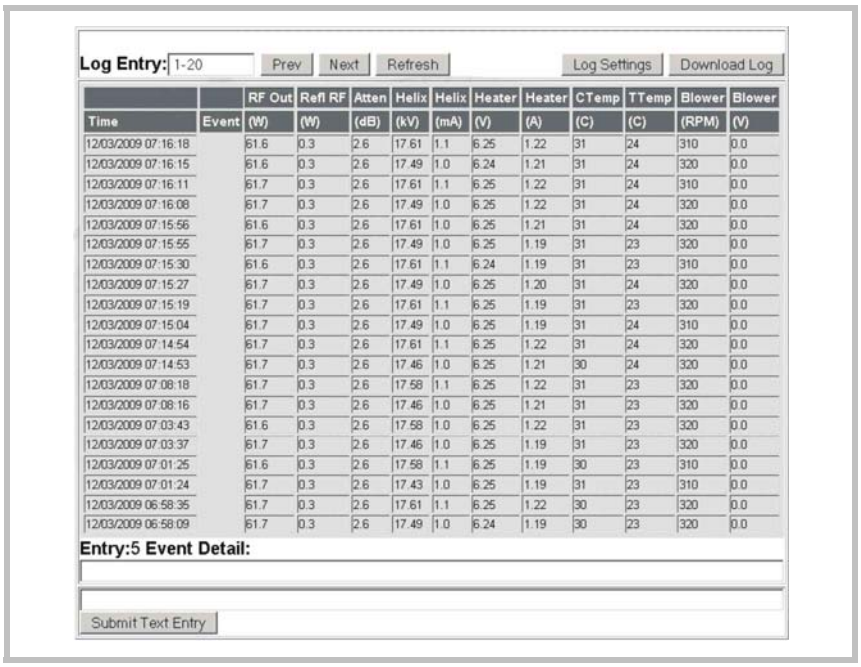
- Clicking the **Download Manual** button to retrieve the manual from the amplifiers memory.
- Clicking on the **Download Factory Data** button will retrieve an Excel file containing the amplifiers test data, and an as built record.
- Clicking on the **Download Settings** button will retrieve a text file containing the amplifiers current settings.
- Clicking on the **Download Snapshot File** button will retrieve a .csnp file that can be opened using Snapshot Viewer program.
- Clicking on the **Download Log** button will retrieve the meter log file. This file can be saved as either a text file and imported into a spread sheet for viewing.
- Clicking on the **Download Database** button will save all the amplifiers settings in a file. This file can then be used to "clone" another amp with the same settings using the "Upload Database" field.

To update the firmware select the firmware file location using the *"Browse"* feature. Click *"Upload"* to load the new firmware.

3.7.3 Meter Log Screen

The meter log screen displays twenty entries at any given time however can be set to display anywhere from 1 to 1000 entries. The previous and next button will move the displayed entries in blocks of ten. It is recommended the factory settings remain unchanged.

Special events, such as service or related activities can be entered in the meter log manually by typing text in the Event Detail box and clicking the **Submit** button. The meter log is downloadable for device history purposes by clicking the **Download Log** button and saving the text file. The event text entry in the meter log cannot be modified.



Time	Event	RF Out (W)	Refl RF (W)	Atten (dB)	Helix (kV)	Helix (mA)	Heater (V)	Heater (A)	CTemp (C)	TTemp (C)	Blower (RPM)	Blower (V)
12/03/2009 07:16:18		61.6	0.3	2.6	17.61	1.1	6.25	1.22	31	24	310	0.0
12/03/2009 07:16:15		61.6	0.3	2.6	17.49	1.0	6.24	1.21	31	24	320	0.0
12/03/2009 07:16:11		61.7	0.3	2.6	17.61	1.1	6.25	1.22	31	24	310	0.0
12/03/2009 07:16:08		61.7	0.3	2.6	17.49	1.0	6.25	1.22	31	24	320	0.0
12/03/2009 07:15:56		61.6	0.3	2.6	17.61	1.0	6.25	1.21	31	24	320	0.0
12/03/2009 07:15:55		61.7	0.3	2.6	17.49	1.0	6.25	1.19	31	23	320	0.0
12/03/2009 07:15:30		61.6	0.3	2.6	17.61	1.1	6.24	1.19	31	23	310	0.0
12/03/2009 07:15:27		61.7	0.3	2.6	17.49	1.0	6.25	1.20	31	24	320	0.0
12/03/2009 07:15:19		61.7	0.3	2.6	17.61	1.1	6.25	1.19	31	23	320	0.0
12/03/2009 07:15:04		61.7	0.3	2.6	17.49	1.0	6.25	1.19	31	24	310	0.0
12/03/2009 07:14:54		61.7	0.3	2.6	17.61	1.1	6.25	1.22	31	24	320	0.0
12/03/2009 07:14:53		61.7	0.3	2.6	17.46	1.0	6.25	1.21	30	24	320	0.0
12/03/2009 07:08:18		61.7	0.3	2.6	17.58	1.1	6.25	1.22	31	23	320	0.0
12/03/2009 07:08:16		61.7	0.3	2.6	17.46	1.0	6.25	1.21	31	23	320	0.0
12/03/2009 07:03:43		61.6	0.3	2.6	17.58	1.0	6.25	1.22	31	23	320	0.0
12/03/2009 07:03:37		61.7	0.3	2.6	17.46	1.0	6.25	1.19	31	23	320	0.0
12/03/2009 07:01:25		61.6	0.3	2.6	17.58	1.1	6.25	1.19	30	23	310	0.0
12/03/2009 07:01:24		61.7	0.3	2.6	17.43	1.0	6.25	1.19	31	23	310	0.0
12/03/2009 06:58:35		61.7	0.3	2.6	17.61	1.1	6.25	1.22	30	23	320	0.0
12/03/2009 06:58:09		61.7	0.3	2.6	17.49	1.0	6.24	1.19	30	23	320	0.0

Figure 3-6. Meter log screen

3.7.3.1 Log Settings

The 'Log Settings' screen is used to change the limits which will generate log entries. The log setting value for each parameter determines when a log entry is generated when exceeded.

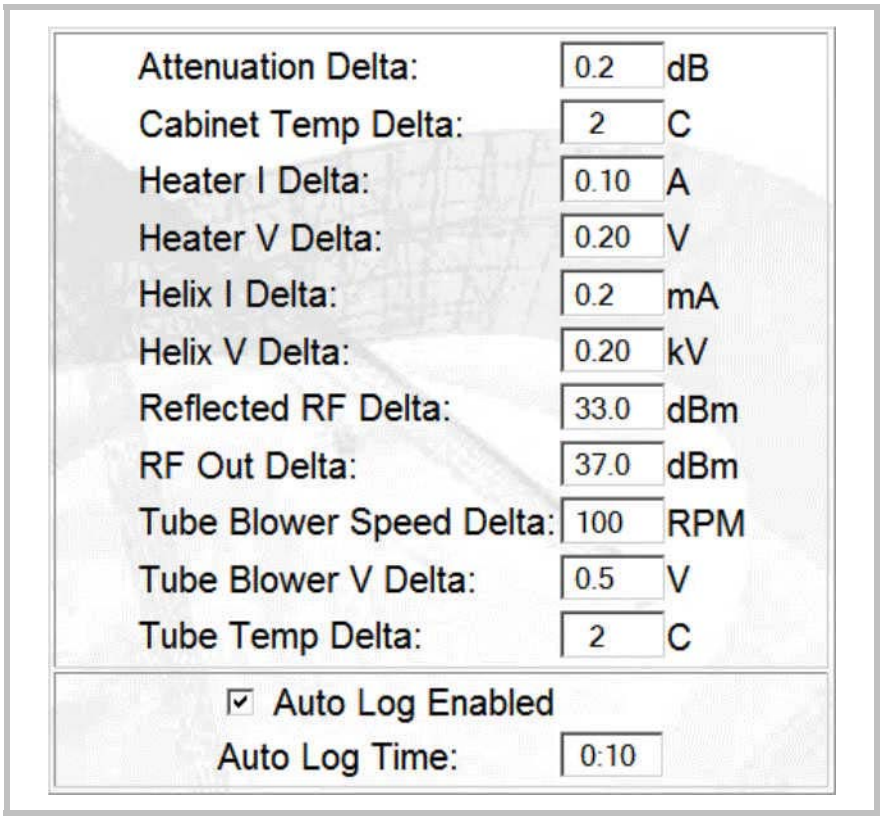


Figure 3-7. Log Setting Screen

3.7.4 Setpoints Screen

The amplifier fault and alarm trip-points can be entered from the set point screen. **Fault trip-limits are factory-set and should NOT be adjusted.** Fault and alarm trip points protect the amplifier from damage by disabling RF or fore warning the operator of upcoming fault conditions.

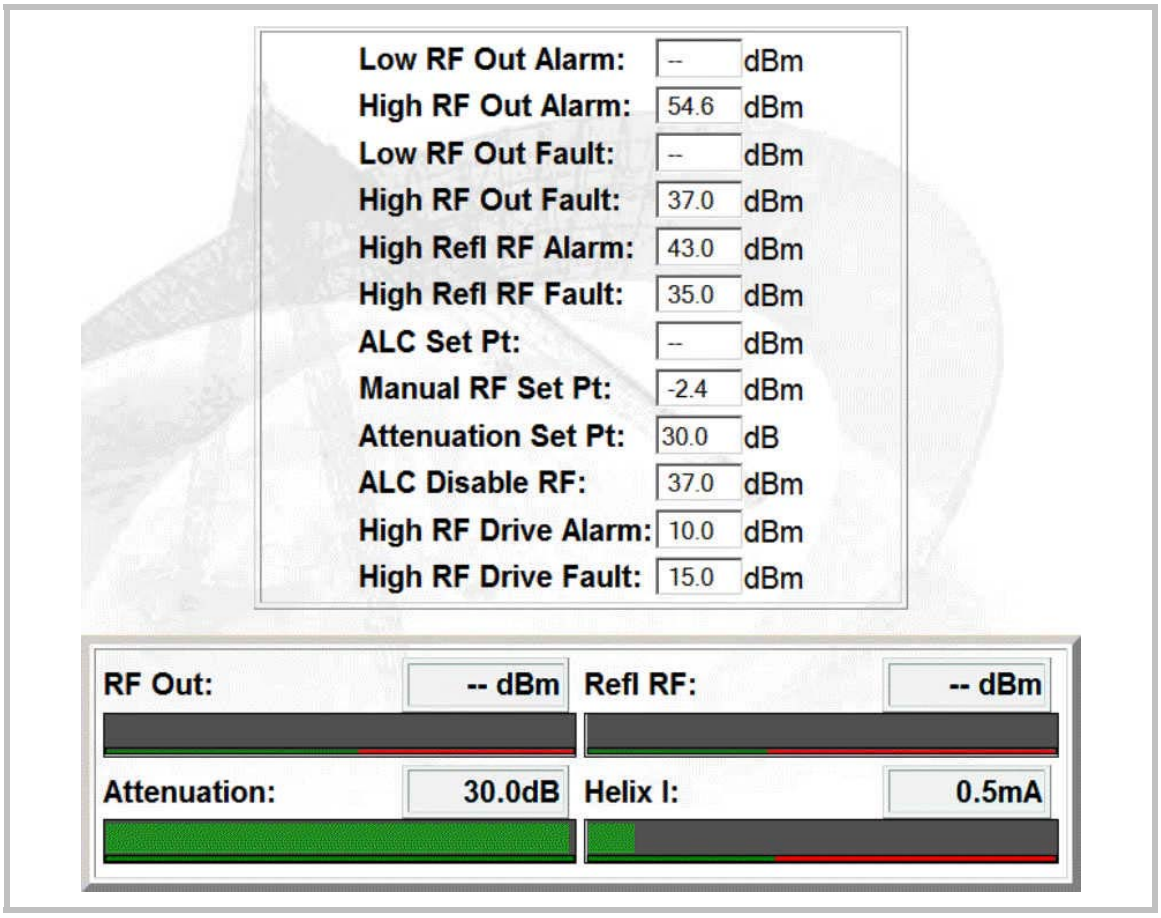


Figure 3-8. Setpoints screen

Caution: Factory settings can be found in the "Verify Factory Settings" section of this chapter. Settings shown in the figure should not be used.

3.7.5 Config Screen

The 'Config' screen displays standard and optional features configured on the amplifier. Interface ports and optional equipment can be modified or adjusted through the software granting the ability to setup the amplifier for a specific application. If an option with configurable settings is included in the amplifier it will be shown in the 'Config' screen.

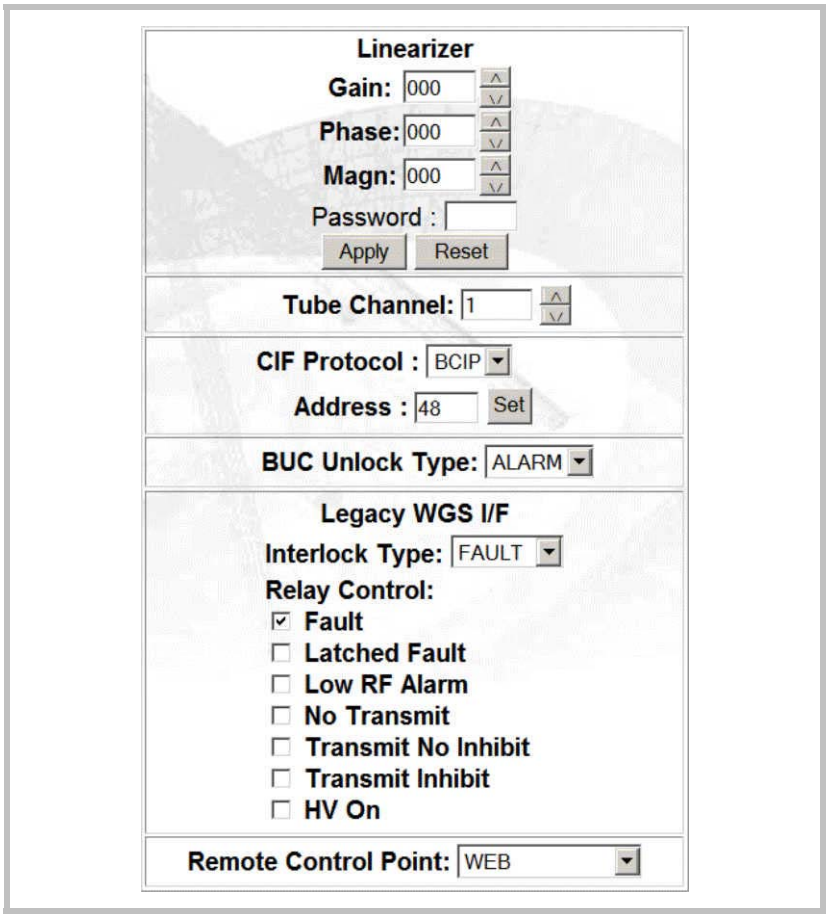


Figure 3-9. Config Screen

The linearizer configuration will only be shown if a linearizer is installed. The three linearizer settings gain, phase, and magnitude can be adjusted between the ranges of 0 to 255 for each tube channel. Adjustments can only be made if the correct password has been entered. This password will be provided by CPI if needed. The linearizer is tuned at the factory for the entire frequency band of the amplifier to meet specification.

Tube channels can be changed using the "Tube Channel" field below the linearizer settings. There can be a maximum of 8 tube channel presets.

The CIF Protocol field is operator selectable between binary computer interface protocol (BCIP) or ASCII computer interface protocol (ACIP). The address field sets the CIF address of the amplifier. No two amplifiers in a system can have the same address. The BCIP the address range is 17-255 and the ACIP address range is 48-111.

The 'BUC Unlock Type' field is operator selectable to FAULT or ALARM. If the reference signal of the BUC either drifts or is removed either a fault or alarm will be generated by the amplifier.

The Legacy WGS I/F will only be shown if the legacy WGS I/F option is installed. The 'Interlock Type' field selects if the external interlock generates an ALARM or a FAULT and is operator settable.

The 'Relay Control' is used to select the conditions which will activate the WGS I/F relay.

The 'Remote Control Point' is used to determine which interface the amplifier will be controlled through. It can be set to either "Ethernet CIF", "Serial CIF", "WEB Browser" or "Remote". All interfaces have the ability to control the amplifier.

3.7.6 Timers

The 'Timers' screen displays the unit on time, heater on time, heater off time, transmit time, and HTD.

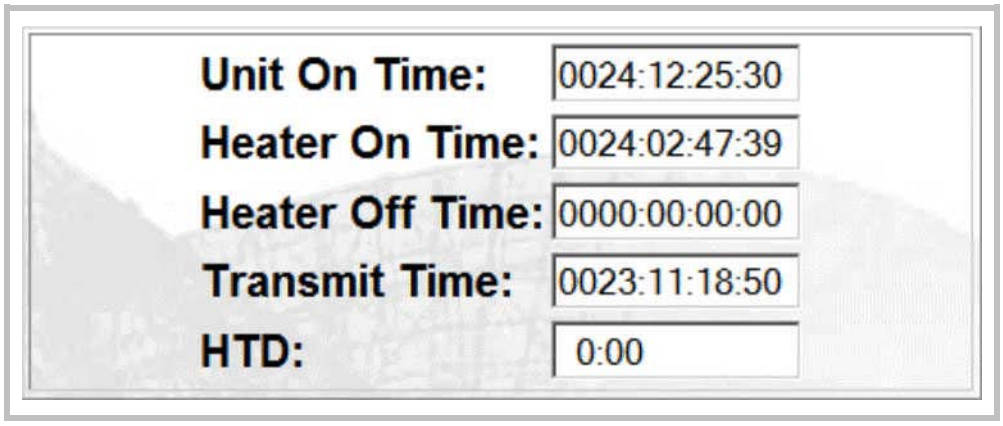


Figure 3-10. Timers screen

3.7.7 IP Settings Screen

The default IP address can be found on the front of the amplifier. The user may reset the IP address through the 'IP Settings' screen. For the new settings to take place the unit must be powered off and back on again.

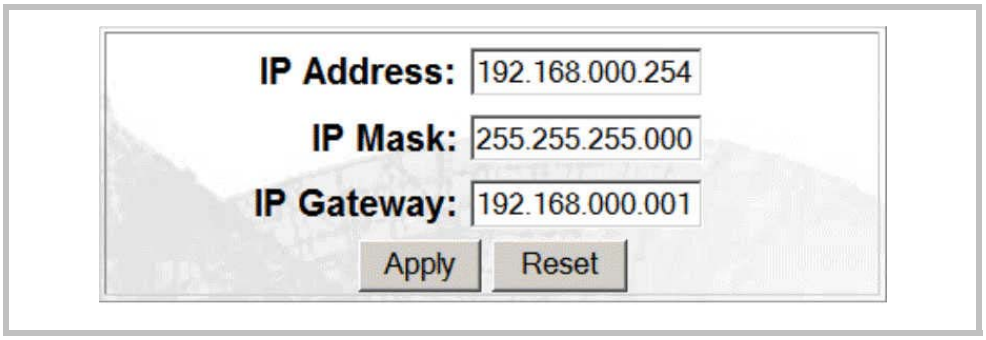


Figure 3-11. IP settings screen

3.7.8 Email Screen

The email screen can be set up to send the alarm/fault and the meter log to an assigned e-mail address. The **HOLD OFF** period can be set to a user specified time in minutes, which the amplifier will not send the same fault/alarm message. Alarm/fault events and meter logs will be sent when the check box is marked and the **SUBMIT** button is clicked. **RESET** will clear all entries on the email screen.

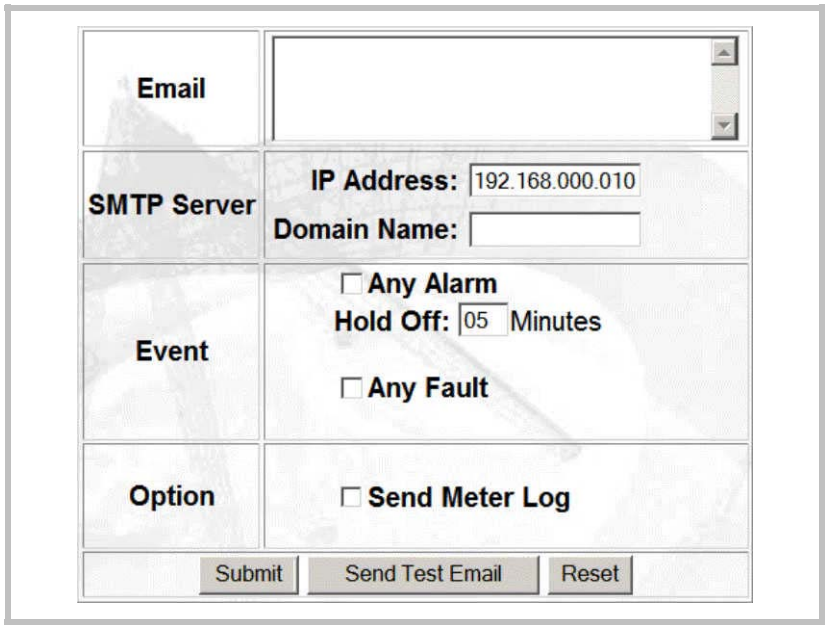


Figure 3-12. Email screen

3.7.9 Set Login Screen

The 'Set Login' screen is used to change the user name and password. All fields must be filled out. Click the **Apply** button to save the changes.

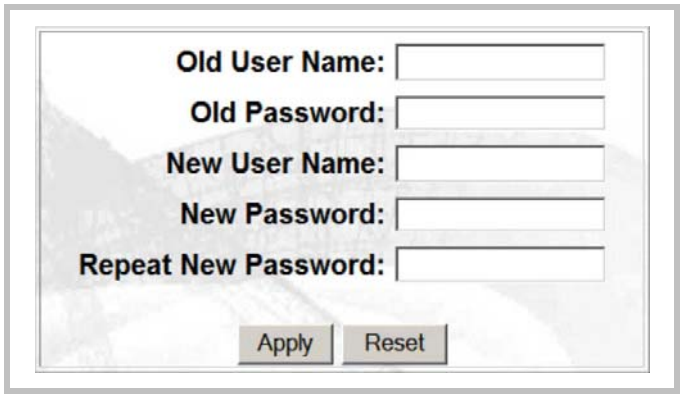


Figure 3-13. Set login screen

3.7.10 Clock Screen

The time screen is used to set either automatically or manual the current time and date. The operator can type in the hour, minute, second, month, day, and year and click **Apply** button for the new settings to be loaded. Alternately the amplifier can be given a network time protocol (NTP) server address to automatically retrieve the time and date.

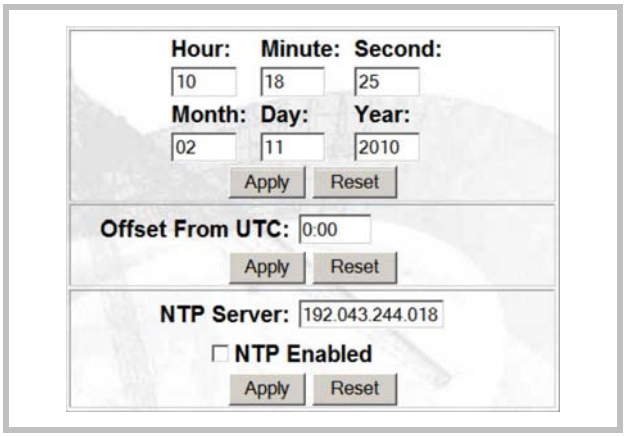


Figure 3-14. Clock Screen

3.7.11 Options Screen

The options screen is used to set operator preferences during amplifier operation. It helps avoid mis-clicks through confirmation prompts and allows the operator to save the current operating state in the memory of the amplifier.

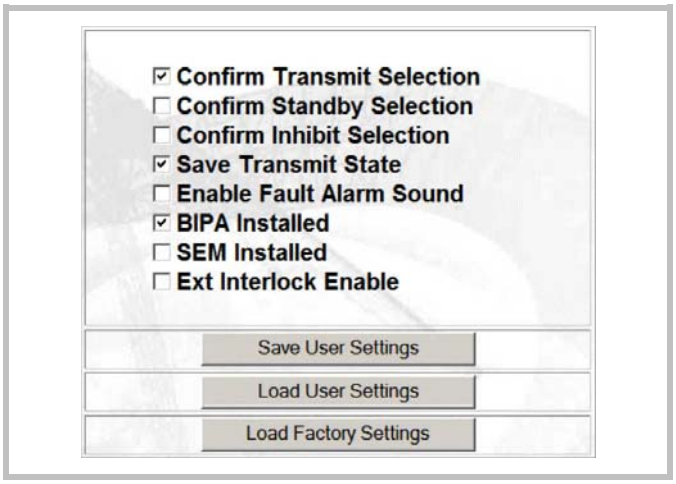


Figure 3-15. Options Screen

The 'Confirm Transmit Selection' when enabled, will prompt the operator with an "Are You Sure" message box in the browser whenever the **TRANSMIT** button is pushed from the "Amp Status" screen.

The 'Confirm Standby Selection' when enabled, will prompt the operator with an "Are You Sure" message box in the browser whenever the **STANDBY** button is pushed from the "Amp Status" screen.

The 'Confirm Inhibit Selection' when enabled, will prompt the operator with an "Are You Sure" message box in the browser whenever the **RF INHIBIT** button is pushed from the "Amp Status" screen.

The 'Save Transmit State' when enabled, will allow an amplifier which was powered off in transmit state to automatically return to the transmit state when powered on again.

The 'Enable Fault Alarm Sound' when enabled, will play an audible alarm in the web-browser whenever the amplifier has faulted. When using this feature remember to check all sound settings of the PC to ascertain they are working properly.

The 'BIPA Installed' shows whether a BIPA is installed (checkmark) or not (unchecked). This is determined at the factory and cannot be disabled by the operator.

The 'SEM Installed' shows whether the switch expansion module (SEM) is installed (checkmark) or not (unchecked). This field is operator selectable and should not be enabled if the amplifier is not in a SIM switch system. A resulting "Switch Interlock Fault" will result when this field is enabled and the amplifier is not used in a SIM switch system.

When the 'SEM Installed' is enabled, a "Switch Ctrl" screen will be available to the operator. The "Switch Ctrl" screen is used to set parameters and provide control of the switch system. Detailed operation of the "Switch Ctrl" screen is provided in the switch system manual.

The 'Ext Interlock Enable' selects of the external interlock is enabled (checked) or not (unchecked). The external interlock pin must be connected to the common pin on the J5 connector when Legacy is installed as a standard feature. This interlock should not be enabled when the SIM switch option is purchased.

The **Save User Settings** button saves all the current settings to non volatile amplifier memory.

The **Load User Settings** button will load the saved setting in the NV amplifier memory.

The **Load Factory Settings** will load the factory configured settings.

3.8 Front Panel Controls and Indicators

The front panel push button and LED display is shown in the figure below. Table 3-4 lists the front panel controls and indicators and defines the function of each listed item.

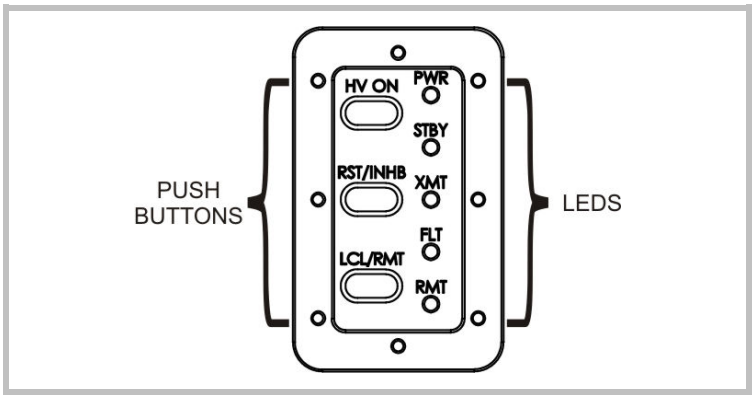


Figure 3-16. Front Panel Push Button and LED Display

Table 3-4. Front Panel Controls and Indicators

Label	Type	Function
RST/INHB (NOTE 1)	Push Button Switch	When pressed, will remove the latched fault state. The fault LED will be off and the standby LED will become lit. If pressed when the amplifier is not in a latched fault state; toggles the RF inhibit ON or OFF.
HV ON(NOTE 1)	Push Button Switch	When pressed, toggles between the transmit state (HV ON) and standby state (HV OFF). The XMIT LED will be lit when the amplifier is in the transmit state and off when in the standby state.
LCL/RMT	Push Button Switch	When pressed, toggles between LOCAL and REMOTE control. A lit RMT LED indicates REMOTE mode and the operator can set and monitor system parameters remotely. All local control is disabled in this state except for the LCL/RMT push button. An unlit RMT LED indicates LOCAL mode and the operator can only change the operating state of the amplifier or reset faults.
PWR	LED(green)	Is lit when power on self test has completed.
STBY (Standby)	LED(amber)	Is lit when there are no faults, and HV is OFF.
XMT (Transmit)	LED(green)	Will blink during beam on sequence (BONS). Will blink during transmit heater time delay (XHTD). Is lit when in the amplifier is in transmit state (HV ON).
FLT	LED(red)	Will blink when the amplifier is latched in a fault state. Pressing the RST/INHB push button will clear the fault.
RMT	LED(amber)	Is lit when the amplifier is set for remote operation. Is off when the amplifier is set for local operation.

Table 3-4 Notes:

1. This switch is active in LOCAL mode only.

3.8.1 Communication Port Manual Reset

If the communication port settings are unknown, a manual communication port reset is required. To perform the reset use the following instructions:

1. With the power off hold down both the RST/INHB and LCL/RMT front panel buttons.
2. Apply prime power.
3. When the internal blower initiates a self check release the RST/INHB and LCL/RMT front panel buttons. The default communication port settings are shown in table 3-5.

Table 3-5. Parameter and Manual Reset Default Setting

Parameter	Manual Reset Default Setting
ACIP Amp Address	48
BCIP Amp Address	48
IP Address	192.168.000.254
IP Gateway	192.168.000.001
IP Mask	255.255.255.000
NTP Server Address	192.043.244.018
SMTP IP Address	192.168.000.010

3.9 Shutdown and Recovery

The following procedures describe normal shutdown.

1. Press **STANDBY** button. Verify the amplifier is in a standby state and wait 5 minutes.
2. When the amplifier has cooled, remove main AC power from the amplifier.

3.9.1 AC Power Interruption

In the event of AC power interruptions, the ODU will automatically return to the state it was in prior to the AC power interruption. Emergency shutdown can be performed in one of the following two ways:

1. Turn off the main AC to the ODU.
2. Unplug J1.

3.9.2 Fault Recovery

Before resetting a latched fault determine the nature of the fault. If the fault is caused by one of the user settable limits then determine if the cause is the limit setting, the RF drive level, or the output load. If any of the faults that are not user settable occur call CPI or get a trained local technical consultant. Refer to the fault messages in the "Messages" appendix of this manual for detail. Once the cause of the fault is identified and cleared recover from a fault by using the following instructions:

1. Click on the 'Amp Status' screen.
2. Click on the RESET button.

If the fault persists and it is not critical try to determine the cause of the fault. If trip limits must be changed make a record of the changes in the meter log screen using a text entry. If the fault persists call CPI or get a trained local technical consultant.

3.10 Maximizing Operational Life

Caution: Operation in the standby state for 3 hours will initiate a "Heater Timeout Alarm". Operation in the standby state for 4 hours will cause a "Heater Timeout Fault". To recover from this fault a manual reset is required. Resetting this fault will place the amplifier in the heater time delay (HTD=approx. 3 minutes) to warm up the heater. During HTD state the amplifier cannot be placed in transmit.

Operation in the standby state is not recommended for extended periods of time (ie. longer than 3 hours). Prolonged operation in the standby state tends to occur when the amplifier is used in a 1:N configuration or when the amplifier is used to carry occasional traffic and the operator may want to save power during the "off-air" period. Table 3-6 details the best to worst desirable mode of amplifier operation.

Table 3-6. Maximizing Operational Life

Maximize Tube Life	Heater Voltage	Beam Voltage	RF Power	RF Inhibit
1. BEST (NOTE1)	OFF	OFF	OFF	OFF
2.	ON	ON	BACKOFF	OFF
3.	ON	ON	RATED	OFF
4. WORST	FULL or REDUCED (NOTE2)	OFF	OFF	ON or OFF

Table 3-6 Notes:

1. Prime power is removed from connector J1. After a few days without prime power, the internal TWT requires conditioning as TWT's typically become gassed over time when no power is applied. Refer to the "Preventative Maintenance" chapter for conditioning details.
2. After a few minutes in standby the amplifier enters a heater backoff state (HBO) which slightly reduces the heater voltage to run cooler.

Chapter 4
Preventative Maintenance

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4.1 Overview

This chapter provides instructions for routine maintenance of the amplifier. It includes procedures and test equipment for scheduled maintenance tasks and amplifier performance testing. Guidelines for protecting parts from electrostatic discharge are also included in this chapter.

Caution: Improper maintenance of the amplifier may void the warranty. For additional information, see Appendix A, "Warranty & Support Information"

The amplifier's internal memory contains a an alarm or fault log which can be used to easily understand the long term operating conditions that the amplifier has experienced. This log can be downloaded, and e-mailed which can be helpful in identifying trends or potential problems.

4.2 Scheduled Preventive Maintenance

Note: There are additional preventive maintenance tasks that require a service technician who has attended a formal training program for servicing the amplifier. (See Table 4-2).

To function safely and effectively, the amplifier requires periodic maintenance by the operator. No maintenance is required for the electrical components inside the amplifier. Refer to Table 4-1 for the Preventive Maintenance tasks to be performed by operators. Table 4-2 outlines preventive maintenance tasks to be performed by a service technician. Operator Preventive maintenance includes visual inspection and cleaning. Some of these tasks require the AC power removed. Details are listed in the following paragraphs.

Table 4-1. Preventive Maintenance Performed by Operators

Tasks	Weekly	1 Mo.	3 Mo.	6 Mo.	1 Yr.
Review Amplifiers Internal Log	X				
Perform visual inspection		X			
[1]Cooling fan(s) Inspection			X		

Table 4-1 Notes:

1. Cleaning may be required more or less frequently than shown, depending on the environment of operation.

Table 4-2. Preventive Maintenance Performed by Technician

Tasks	Weekly	1 Mo.	3 Mo.	6 Mo.	1 Yr.
Review and Dump Amplifier Log		X			
Perform initial Power ON check			X		
Air system maintenance				X	
Run performance tests					X
Fan Replacement(NOTE1)					A/R
Spare Conditioning(NOTE2)			X(min)	X(max)	

Table 4-2 Notes:

1. Replace fan after 50,000 hours of operation.
2. This procedure is recommended for conditioning spare TWTs and amplifiers used on occasion. This maintenance task must be completed if the amplifier has been powered off for more then 48 hours and every 3 to 6 months for spare amplifiers and TWTs.

NOTE! PERSONS PERFORMING MAINTENANCE PER TABLE 4-2 MUST BE SERVICE PERSONNEL WHO HAVE ATTENDED FORMAL TRAINING FOR SERVICE OF THE AMPLIFIER.

4.3 Operator's Preventative Maintenance

WARNING! OPERATORS SHOULD NOT REMOVE COVERS WITH ELECTRICAL HAZARD INDICATORS. ONLY SERVICE TECHNICIANS SHOULD REPAIR, REPLACE, OR PLUG IN PARTS

Warning: before attempting any cleaning, remove all power. When using solvents, provide adequate ventilation and avoid breathing fumes. When cleaning with air, wear safety goggles and use clean, dry compressed air not exceeding 25 psi (1.75 kg/cm).

4.3.1 Review Amplifiers Internal Log

The amplifiers internal log can be accessed via the serial or web page. Review of the log to identify any abnormal changes in operating conditions such as voltages, currents, temperatures of the tube or internal cooling, and any faults or alarms. Download the log once a month.

4.3.2 Visual Inspection

At one-month intervals, the amplifier should be visually inspected for physical defects. If the equipment is subject to severe environmental conditions, inspections should be performed more frequently.

The event log is a good source for clues that could indicate an intermittent or marginal condition. Any increase in reflected power, temperature or unexplained fault conditions could point to a deteriorating condition.

The circuit breaker must be off while the following general inspection is performed.

Perform the following visual inspection:

1. Check that all connector plugs are properly seated in their mating connectors and have not been damaged. Only have a service technician replace any bad connector plugs and reseat any that are dislodged.
2. Inspect cables for signs of discoloration, broken, and bad insulation. A service technician should repair or replace cables as needed.
3. Inspect all waveguide for discoloration, cracks, loose connectors, and proper sealing. Contact a qualified service technician for waveguide repairs.
4. Check for other defects. These include, but are not limited to, wear, breakage, deterioration, fungus, excess moisture, and mounting integrity. Contact a qualified service technician for repairs.
5. Inspect the air intake and clean it if necessary.

4.3.3 Unit Cleaning

Look for signs of dirt or moisture contamination, which can cause short-circuiting, arcing, corrosion, or overheating. Use a lint-free cloth, a small vacuum cleaner, or a compressed-air blower at low pressure to clean contaminated areas.

Warning: When using compressed air wear proper eye protection. Do not use pressure blowers to clean debris from your person.

4.3.4 Fan Inspection

Contact a local service technician for fan replacement parts. Feel the amplifier for abnormal vibration indicating a fan balance or bearing problem. Listening for unusual or atypical sounds can indicate a problem and should be investigated. Examination of the log files for inconsistencies may indicate degraded fan performance. A trained technician can perform replacements as covered in the CPI service manual, or contact the CPI service center.

Caution: Observation may be required more or less frequently than shown, depending on the site environment.

4.4 Technician's Preventative Maintenance

NOTE! SERVICE TECHNICIANS MUST BE SERVICE PERSONNEL WHO HAVE ATTENDED FORMAL TRAINING FOR SERVICE OF THE AMPLIFIER.

WARNING! REMOVE ALL POWER TO THE UNIT BEFORE TOUCHING ANY COMPONENTS.

4.4.1 Review and Dump Amplifiers Internal Log

The amplifiers internal log can be accessed via the serial or web page. Review of the log to identify any abnormal changes in operating conditions such as voltages, currents, temperatures of the tube or internal cooling, and any faults or alarms. Download the log once a month.

4.4.1 Initial Power-On Check

Every three months the initial power-on and checkout procedure in the *"Initial Power-On and Checkout"* chapter should be performed.

4.4.2 Air System Maintenance

The amplifier must be checked for airflow to insure proper transfer of heat away from the internal heatsink. The measurement of airflow temperature, the inspection, and elimination of any contaminants restricting the airflow must be performed periodically. The recommended cycle is three months, but may be required more often if conditions warrant it.

4.4.3 Run Performance Tests

Once a year run the performance tests in the *"Performance Testing"* section to ensure amplifier performance.

4.4.4 Fan Replacement

After 50,000 hours of operation or if the fans have problems, the fan should be replaced. Contact CPI service for instructions.

Caution: Fan Replacement may be required more or less frequently than shown, depending on the site environment.

4.5 Performance Testing

Once a year perform the tests for power and gain, radiation levels, and record their results. If the results change dramatically consult the service manual for troubleshooting and repair.

4.5.1 Power and Gain Performance Test

Follow these steps to test the amplifier for power and gain. Record the results on the "Power and Gain Test Data Sheet" provided in table 4-3.

1. Connect equipment as shown in figure 4-1 "Performance Test Setup".
2. Turn off the synthesizers RF output. Set the input drive level to minimum and the amplifier attenuation to maximum.
3. Set the synthesizer to center wave (CW). The same frequencies should be used every time preventative maintenance is performed so that a trend chart can be developed.
4. Turn on the synthesizer's RF output.
5. Slowly decrease the amplifier's attenuation until it reaches 0 or the amplifier has reached rated power. If rated power is reached and there is still attenuation place a 10 dB fixed attenuator and perform steps 1 through 5 again.
6. Increase the drive level until the amplifier has reached rated power.
7. Calculate the gain at rated power and record on the test data sheet.

   Gain = P_{out} (dBm) – P_{in} (dBm)
8. Reduce the drive level until the amplifier is at rated power –10dB. It may be necessary to use a 10dB fixed attenuator at the input to achieve a reliable input power measurement. Remember to inhibit or put the amplifier in standby when physically breaking the RF input chain.
9. Calculate the small signal gain, and record the result on the test data sheet.
10. Repeat for the all frequencies shown on the "Test Data Sheet" table 4-3.

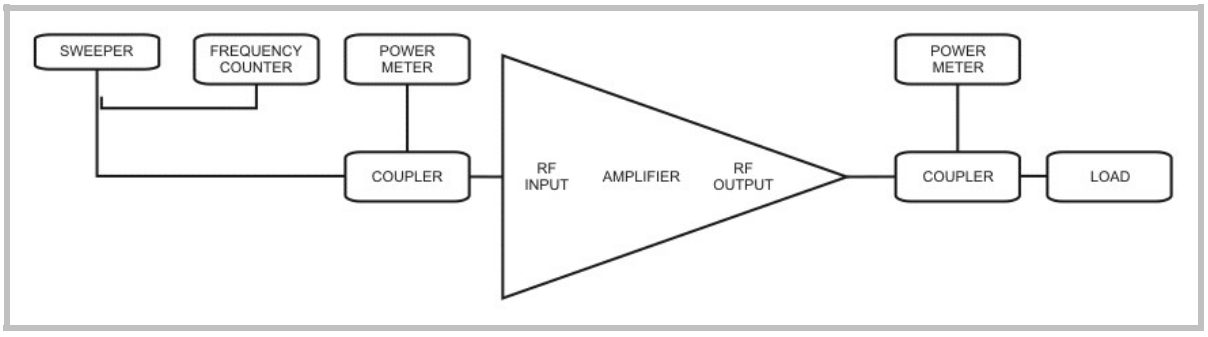

Figure 4-1. Performance Test Setup

Table 4-3. Power and Gain Test Data Sheet

Amplifier Model Number: _____

Amplifier Serial Number: _____

Frequency		Small Signal Gain (10dB backoff rated power)	Gain @ Rated Power
Low:	_____	_____	_____
Center-Low:	_____	_____	_____
Center:	_____	_____	_____
Center-High:	_____	_____	_____
High:	_____	_____	_____

Notes:

4.5.2 RF Radiation Measurement

To measure radiation levels:

1. Starting at 40dBm perform steps 2 and 3 for each 3dB increase until rated output power has been reached.
2. Using a radiation probe, measure the highest level of RF leakage around the amplifier, at less then 12 inches away from any point source.
3. Record the measured value(s). Measured levels should be less then 1mW/cm². If this value is exceeded. Remove power to tighten joints, install grounds or gaskets to eliminate leakage.

Note: If any RF radiation levels are to be measured, it is a good idea to check for RF leakage as above.

4.6 Conditioning Spares

The following procedure is recommended for conditioning spare amplifiers. It is also applicable for amplifiers used on occasional or are turned off for more then 48 hours. The following list presents the conditions for operating the TWT (ranked from most to least desirable effects on the life of the TWT):

- Amplifier continuously running in the Beam On state with RF ON.
- Beam on, RF off during downtime.
- Beam and heater off during long downtime.

Note: Running the TWT at 0.3 V above the heater voltage on the label can reduce the TWT life by as much as one half.

Amplifiers and TWTs which have been turned off for prolonged periods of time require the following procedure every 3 to 6 months:

Note: If the spare TWT is to be tested, follow the instructions in TWT Replacement. If the spare TWT is to be tested, follow the instructions in "TWT Replacement". Refer to the product maintenance manual.

1. All steps in the "*Unpacking and Installation*" chapter should be completed before attempting this procedure.
2. Turn the amplifier on with **NO RF DRIVE** applied. The amplifier will transition from **HTD** to the **STANDBY** state.
3. Leave the amplifier in the **STANDBY** state for a minimum of 30 minutes, but no more than 2 hours, before proceeding. Skip this step if a 30 minute HTD has occurred.
4. Place the amplifier in the **TRANSMIT** state for a minimum of 2 hours before proceeding. Verify the helix current has stabilized.

5. If the amplifier operates in transmit without fault, continue. If not refer to service manual.
6. Apply RF slowly up to the point of rated power. Follow the instructions in the 'RF Radiation Measurement' section.
7. Run with and without RF input for a minimum of 30 minutes after the Helix current has stabilized. The time required to stabilize varies with the age of the tube, storage time, and storage conditions.
8. Operate the HPA at 3db back off for 1 hour.
9. Follow the instructions in the 'Performance Testing' section.
10. Put the amplifier in the STANDBY state and allow the blower to cool the TWT prior to removing AC power. This should take anywhere from 5 to 10 minutes.

4.7 TWT General Operational Guidelines

Once the amplifier is in service, it is important that the operation is preformed correctly. The three guidelines to TWT amplifier operation are as follows:

1. A backup amplifier must be left in transmit when in a redundant switch system (1:N). Leaving the amplifier in standby with the heater on for several hours will cause the cathode to age quickly reducing the TWT's operating life. Gas build up will "poison" the cathode degrade performance.
2. The heat sink fins must be kept clean. If the heatsink fins become clogged, the collector will overheat, producing gas over time. The gassing effect will "poison" the cathode degrading performance.
3. The heater must be operated at the nameplate voltage for the particular TWT. A voltage setting too high or too low can cause premature failure. However, when the TWT is old and the beam current drops due to cathode depletion, the heater voltage can be raised 5 percent without causing any harm. Refer to the service manual for the procedure on raising the heater voltage.

4.8 Protecting Parts from ESD

Static electricity is a familiar phenomenon; except for an occasional mild shock or annoying "static cling," it does not seem very serious to most personnel handling integrated circuit (IC) parts or assemblies. Unfortunately, many electronic components can be damaged or destroyed by electrostatic discharge (ESD) at potentials well below a person's range of feeling. This damage can occur before, during, or after the part is installed.

People often carry 1000 to 5000 volts of static charge and do not feel any discharge of less than 3500 to 4000 V. Components mounted on a printed circuit board face increased risk of ESD damage because each printed conductor (wire) is a path connecting several devices. A discharge to that conductor stresses several devices at once.

Passive as well as active components are susceptible, and the damage ranges from a slight degradation of a parameter to catastrophic failures, such as short circuits. In many cases, damaged parts exhibit no visible physical damage, even under microscopic examination.

4.8.1 Precautions

ESD damage can be prevented for the most part by following these precautions:

1. Treat all electronic parts and assemblies as static sensitive.
2. Do not touch leads, pins, or traces while handling parts.
3. Keep parts in original containers until ready for use.
4. Discharge static before handling devices by touching a grounded metallic surface such as a cabinet. For personal grounding, use a wrist strap grounded through a 1-megohm resistor.
5. Do not slide static-sensitive devices over any surface.

4.8.2 Workstation Practices

Handle all sensitive parts or assemblies at static-safe workstations. A static-safe workstation provides the following features:

- A conductive tablemat grounded through a 1-megohm resistor.
- A conductive wrist strap wired to a connector on the mat through a 1-megohm resistor.
- A common ground point at each workstation.
- A work area free of nonconductors, including all common plastics, "polybags," cardboard, cigarette packages, candy wrappers, work envelopes, synthetic mats, and ungrounded metal plates. Carpeting should not be used on floors, work surfaces, or shelving.
- Do not allow clothing to come in contact with components or assemblies. Roll up sleeves to keep them away from sensitive parts. Antistatic smocks should be worn.
- Gloves, if used, should be made of cotton or antistatic materials only.
- Brushes, if needed, should have natural, not synthetic, bristles.
- If walking is necessary and wrist straps cannot be worn, use a conductive floor mat in conjunction with conductive shoe heels.
- Transport and store electrostatic-sensitive devices only in static-protective containers. No paper or cards should be placed inside the containers. A label attached to each container should warn personnel to observe proper handling precautions.
- Transportation carts should have carrying surfaces covered by conductive mats and should have at least two conductive wheels. Verify that carts, wheels, casters, frames, and shelves are conductive. Do not transport sensitive electronic equipment on a rubber-wheeled cart being pushed by a person wearing crepe- or heavy-rubber-soled shoes; this promotes very high levels of electrostatic charge.

4.8.3 Workstation Upkeep

Perform the following checks at the static-safe workstation on a weekly basis:

1. Monitor each workstation for proper grounding, safe procedures, and static hazards.
2. Check electrical grounds and wrist-strap continuity with an ohmmeter.
3. Check workstations, including materials and containers, with a static meter.
4. Spray a commonly available antistatic solution on a clean cotton cloth and wipe the surfaces of workbenches, hand tools, and chairs.
5. Clean conductive mats with mild detergent and water or with antistatic solution. This removes dirt and wax, which can insulate the surface and render it nonconductive.

4.8.4 Packaging

Package parts properly for storage or transportation in the following manner:

Attach a static warning label on the outside of each applicable envelope and container. (A JEDEC/EIA ESDS symbol is preferred.) Pack parts for storage or transportation in antistatic packaging; pack the parts tightly to prevent motion that could generate static.

Note: The best protective enclosure is a Faraday cage, which shunts any inductive charges around the part, providing complete protection. Metal, metalized plastic, and carbon-loaded plastic bags are all examples of Faraday cages. Metalized plastic has the advantage that it is semitransparent and its contents can be seen without opening it. The often-used "pink poly" bags afford less protection.

4.9 Customer Service

Refer to the "Warranty and Support Information" appendix, for CPI Satcom contact, service, and return information.

Chapter 5
Drawings

This chapter contains the drawings for the HPA Ka ODU.

Table 5-1. HPA Ka ODU Drawings

Drawing Name	Number
Technical Description, 500W CW	TD166
Technical Description, 500W Peak	TD173
Amp Search, (ZIP file)(NOTE1)	0101401500
Interconnect Diagram 500W Peak (Thales)	0104129900
RF Block Diagram 500W Peak (Thales)	0104130100
Binary Based CIF Protocol	0104161100
Interconnect Diagram 500W CW	0104351700
Outline Drawing, 500W Ka Band ODU	0104600100
RF Block Diagram 500W CW	0104600200
RF Block Diagram 500W Peak (NEC)	0104614200
Interconnect Diagram 500W Peak (NEC)	0104614300
Ship Kit	0104616100

Table 5-1 Notes:

1. This software is provided on the softcopy manual CD. The software is a ZIP file and must be extracted before use.

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Appendix A
Customer Support and Warranty Information

For details, refer to separate supplements included following this page.

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Appendix B
L-Band BUC Option

B.1 Overview

The L-Band RF input signal is converted by the Block Up-Converter (BUC) to the frequency band of the amplifier.

Each amplifier is provided with a label indicating the correct L-Band input frequencies accepted by the BUC. This label is shown in figure B-1. The bandwidth of the L-Band input frequency is typically the same bandwidth as the amplifier's output frequency bandwidth.

Warning: Ensure that the proper L-band frequency range is not exceeded or damage may result. Damage due to an improper frequency input may not be covered in the warranty of the amplifier.

This appendix provides information on BUC operation and explains the three types of frequency references which can be used.

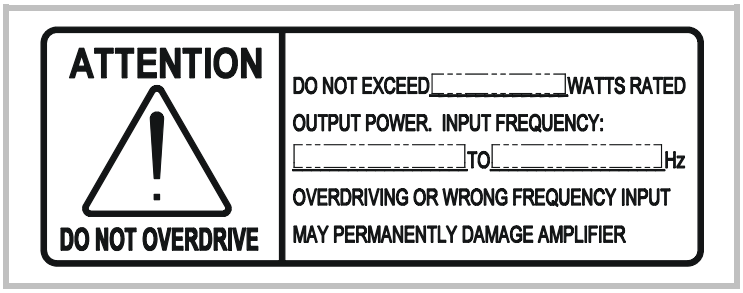

Figure B-1. RF Warning Label

Note: Refer to the amplifier specifications in the "Drawings" chapter for performance of the amplifier with a BUC.

B.2 General Operation

The BUC converts the L-Band input frequency to the frequency required by the TWT through adding the frequency of local oscillation (F_{LO}) to the L-Band input frequency.

All BUC's require a reference signal to operate properly. This reference signal is typically 10MHz, however can be a different value. If the BUC F_{LO} reference fails or drifts outside of the capture range, a "BUC alarm" or "BUC fault" signal will be reported by the amplifier.

In the event that the BUC F_{lo} becomes unlocked and a fault signal is reported the amplifier will inhibit RF and shutdown HV to the TWT. A reset command will restore the amplifier to normal operation once the fault has cleared.

The F_{LO} reference can be supplied in one of the following three ways:

- Multiplexed - F_{LO} reference is multiplexed with the L-Band input signal.
- Internal - F_{LO} reference is generated internal to the BUC.
- External - F_{LO} reference through a dedicated reference port.

Caution: For multiplexed and external F_{LO} reference BUC's, the L-band input signal must be free of the spurious signals that can cause poor performance. Spurious signals may also cause the amplifier to fail.

B.2.1 Multiplexed Reference

Most L-band modems now have a built-in 10 MHz reference. A multiplexed reference BUC is configured to accept this reference multiplexed with the L-band input signal on the same connector. This is CPI's standard configuration and is recommended for most applications. The level of the F_{LO} reference should be +5 to -5 dBm at the amplifiers input.

Caution: A multiplexer should be used rather than a combiner. In case of using a combiner, band pass filters should be added to modems' output or a 10 dB fixed attenuator can be added to each combiner's input.

B.2.2 Internal Reference

An internal F_{LO} reference signal with ±1 ppm stability is included in the BUC. The oscillator performance is not as precise as a GPS reference, but it is adequate for many applications.

B.2.3 External Reference

This allows the user to connect a system 10 MHz reference through a separate amplifier input. The external reference is used for systems that need to slave all amplifiers to a common timing reference, such as the GPS signal. The F_{LO} reference level required is +5 to -5 dBm.

Appendix C
Messages

C.1 Messages from the Amplifier

The amplifier will indicate alarm and fault events in a flashing text box which appears in the web browser. Alarm text messages will flash yellow and fault messages will flash red. There are many limits that are not operator adjustable. When these limits are exceeded, they can cause a variety of alarms and faults. Never reset the amplifier on a non-operator settable fault or alarm. Have anything that is not high power limit, low power limit, reflected power limit faults investigated by a qualified technical person. The amplifier setup should be verified in the *"Pre-Power On Procedure"* section located in the *"Operation"* chapter.

The following two tables indicate whether a fault or alarm is operator settable, factory settable, or a status indicator.

Table C-1. Fault Messages

Section	Limit – Status Indicator	Operator Settable	Factory Setting	Status Indicator
BIPA	BUC LOCK			X
	EEPROM			X
	WGSIF INTERLOCK			X
	HIGH RF DRIVE	X		
RF	HIGH POWER LIMIT	X		
	LOW POWER LIMIT	X		
	REFLECTED POWER LIMIT	X		
MAIN	BBRAM			X
	BIPA COMM			X
	BIPA RESTARTED			X
	CAN BUS			X
	CAN LEVEL KEY			X
	EEPROM			X

Table C-1. Fault Messages (continued)

Section	Limit – Status Indicator	Operator Settable	Factory Setting	Status Indicator
MAIN (con't)	PS COMM			X
	PS RESTARTED			X
	RF COMM			X
	RF RESTARTED			X
	SEM COMM			X
	SEM RESTARTED			X
	SYSTEM			X
POWER SUPPLY	CABINET TEMPERATURE LIMIT		X	
	EEPROM			X
	HEATER CURRENT LIMIT		X	
	HEATER OVER VOLTAGE		X	
	HEATER UNDER VOLTAGE		X	
	HELIX CURRENT LIMIT		X	
	HELIX OVER VOLTAGE		X	
	HELIX UNDER VOLTAGE		X	
	HELIX VOLTAGE DETECTED			X
	TUBE BLOWER UNDER SPEED			X
	TUBE OVER TEMP		X	
	TUBE OVER TEMP SWITCH			X

Table C-2. Alarm Messages

Section	Limit – Status Indicator	Operator Settable	Factory Setting	Status Indicator
BIPA	BUC LOCK			X
	I2C TIMEOUT			
	HIGH RF DRIVE	X		
POWER SUPPLY	CABINET OVER TEMPERATURE		X	
	I2C TIMEOUT			X
	TUBE BLOWER OVER SPEED		X	
	TUBE OVER TEMPERATURE		X	
MAIN	LOW BATTERY			X
	RTC FAILURE			X
RF	ALC LIMIT			X
	HIGH REFLECTED RF	X		
	HIGH RF OUT	X		
	LOW RF OUT	X		
SWITCH	AMP IDENT CONFLICT			X
	SIM	X		X

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