# INSTALLATION, OPERATION, AND

# PREVENTATIVE MAINTENANCE

# *M A N U A L*

## SuperLinear® Ku OUTDOOR TWT AMPLIFIER 0104160600rA

For Use With Model Numbers...

TL02UO


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## PROPRIETARY INFORMATION

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# Safety

## Introduction

In addition to the *High Voltage Equipment Personnel Operating Guidelines* in this chapter, included by reference are the following pertinent sections of the International Standard EN60215, *Safety Requirements for Radio Transmitting Equipment*:

Appendix D, Guidance on Assessing the Competence of Personnel for Designation as Skilled, and also Sub-clause 3.1 of the Standard.

Appendix E, Guidance on Safety Precautions to be Observed by Personnel Working on Radio Transmitting Equipment, and also Sub-clauses 3.2, 3.7, and 22.1 of the Standard.

## High Voltage Equipment

### Personnel Operating Guidelines

This document presents operating practices for operators and technicians who work with high voltage equipment. Any voltage above 48V is viewed as "high voltage." Prime power (115 to 440VAC) is dangerous because potentials are known to cause death or injury.

Electrical circuits operate quickly and do not provide a careless individual with a second chance. Hazards associated with high voltage are consistent and predictable. **A switch that is in the OFF position does not indicate the unit is safe**.

***Warning: The guidelines presented in this chapter are not academic. They are based on the experience of engineers and technicians who have years of experience with high voltage circuits and equipment.***

### When Is Voltage "High"?

Any voltage that can kill or injure is considered high voltage. Prime power voltages generally do not jump the air gap between the operator and equipment. Usually, exposed circuit elements such as a terminal, exposed wire, or a non-insulated surface must be touched.

Prime power in some equipment can be "floating" above ground. If one hand is placed on the equipment chassis and the other on an earth ground, there is potential to be injured, or killed. 440VAC can stimulate an involuntary muscle response that either throws a person across a room or seizes and holds a person across the voltage terminals. Potential sufficient to drive 200 milliamps through the body will hold it indefinitely.

## General Guidelines

In addition to the above, the following practices are proven effective for personnel who deal with high voltage equipment.

a. **Hands off.** Avoid contact with potential sources of high voltage. Keep hands out of the equipment when it is operating.

b. **Create a favorable environment for safe operations.** It is easy to forget high voltage hazards when distracted. Stop all high voltage work when there is a crowd of people around. Check and remove trip hazards in the area. Do not operate high voltage equipment when tired or on medication that may cloud judgment or perception. Make sure pens, jewelry, and employee badges do not come in contact with high voltage equipment.

c. **Never work on high voltage circuits alone.** Be sure the person watching knows what to do in an emergency (e.g., how to shut equipment off, first aid, who to call, etc.)

d. **Use the one hand when working with high voltage circuits.** Many people recommend that one hand be put in a pocket or behind the back when using a probe or other piece of equipment inside a high voltage section. Receiving a shock through the right hand keeps the path of damage away from the heart.

e. **Do not float measuring equipment above ground.** Make all measurements with respect to ground.

f. **Discharge high voltage capacitors.** High voltage capacitors store a lot of energy for long periods of time. High voltage capacitors can recover high voltage after discharge and reach lethal levels.

g. **Do not depend on the automatic features to save you.** It is difficult to tell if a circuit is disabled. Component errors or miss wiring can disable the function of built in safety features. **Each and every time a piece of high voltage equipment is powered on, use a discharging device with a long handle to discharge all high voltage capacitor.**

h. Take personal responsibility to assure that equipment is tagged and locked out so high voltage cannot be turned on during service. Precautions include a lock on circuit breakers, disconnecting the high voltage power source, and using interlocks that prevent high voltage turn on. Know where power disconnects are and use them. DO NOT rely on others to turn off the high voltage and make sure equipment is tagged and locked out.

i. **Set up test equipment with the power off.** Double check power cords for cracks or breaks before powering on equipment. Apply power to the unit when the operator's hands are out of the equipment.

j. **Use probes rated for high voltage measurements.** The voltage rating of the probe should exceed the maximum possible voltage at the test point. Length of the probe should be adequate to prevent accidental contact of the circuitry

k. **Do not become over-confident.** Always maintain a healthy respect for high voltage. Equipment may be dangerous to the operator unless proper safety and operation practices are observed.

l. **A good operating practice is to check the potential between the equipment chassis and the earth ground**. As voltage levels increase, the protection from insulation and air gap diminishes. For example, in a piece of equipment that involves beam voltages of about 16kV, the beam transformers appear safe with massive insulation on the outside of the coils. **Physical contact with the beam coil when the system is operating can be fatal.** Although the equipment has warnings of the presence of high voltage, it is virtually impossible to pin point every danger in a system.

m. If an operator is not trained on the function and hazards associated with the equipment, they should not handle the equipment. The greatest protection, when dealing with high voltage equipment, is detailed knowledge of that equipment.

n. **Avoid unorganized equipment setups**. Take the time to make sure equipment setups are organized to allow proper operation and maintenance to occur.

o. **Make sure all high voltage and ground connections are secure**. Fasten leads using all the hardware provided. The only safe connection is a mechanically secure one.

p. **Watch out for exposed high voltage leads**. Some connectors depend on circuit loading to avoid arcing between closely spaced terminals. Loaded high voltage lines or plugs can lead to arcing.

q. **Shut off the high voltage when performing a low voltage measurement**. It does not make sense to increase the danger of being shocked needlessly. There are times when high voltage cannot be shut off during a low voltage measurement. Most of the time this is not the case.

r. **Remove test equipment when finishing a measurement program.** Many instruments have been destroyed or damaged because a test program was conducted in a haphazard manner, rather than in an orderly progression from start to finish. Tragedy can be avoided by applying an order to the operator's method.

s. **Be cautious when making filament voltage measurements.** The cathode of the tube is elevated above (or below) ground and the filament voltage usually cannot be measured with reference to ground. Assure the high voltage cannot be turned on when making measurements. This includes disconnecting the high voltage drive source, locking breakers, shorting out appropriate leads, enabling interlocks, and anything else to prevent accidental injury.

t. **When troubleshooting, assume switches are defective.** A high voltage switch may be shut off, but if the switch were defective, the high voltage would still be on. Units have the potential to shock or kill if a switch has failed.

u. **Make sure that workstations are sturdy.** Flimsy work surfaces, and supports for equipment present a real threat to the operator. DO NOT use a setup that is known to be unstable and/or dangerous.

v. **Use a 5-minute rule.** Wait at least 5 minutes after shutting off equipment before working on it. The 5-minute rule pertains to the dielectrics or insulators used in high voltage circuits that can store a charge. While the amount of charge stored is a function of the size of the dielectric, a 5-minute rule provides an adequate margin for safety.

# Microwave Radiation

## Personnel Operating Guidelines

This guideline presents operating practices appropriate for operators and technicians who work with equipment involving microwave radiation. Levels of microwave radiation that do not cause immediate physical discomfort can cause long term complications.

CPI Satcom Division equipment amplifies an RF signal from an external source. Operating amplifiers with the input not terminated may cause oscillation and high levels of RF radiation.

**WARNING! PROTECT YOURSELF AND OTHERS AROUND FROM UNWANTED RF RADIATION. ALWAYS TERMINATE THE AMPLIFIERS INPUT AND OUTPUT WITH A TERMINATION BEFORE TURNING THE HIGH VOLTAGE ON. THIS WILL REDUCE THE CHANCE OF OSCILLATION DUE TO NOISE OF THE INTERNAL AMPLIFIER.**

## Microwave Discussion

Limiting exposure to microwave radiation prevents unwanted biological effects. Local radiation levels can be detected with the proper equipment. The suggested permissible level of RF radiation is 1mW/cm² for duration of 30 minutes. This is only a suggested guideline and it is up to the end user of the product to establish the permissible RF radiation exposure level.

## General Microwave Guidelines

These guidelines provide practical approaches to control unwanted RF radiation associated with the operation and servicing of CPI Satcom Division equipment. The following approaches have proven effective in both laboratory and field environments:

**NOTE! IF THESE GUIDELINES ARE FOLLOWED THE POTENTIAL FOR RF RADIATION EXPOSURE WILL BE MINIMIZED.**

a. Always terminate the output waveguide with an RF load capable of dissipating full CW RF power. Fasten loads with hardware provided before applying prime power to the amplifier.

b. Terminate the input to avoid the possibility of the amplifier oscillating. Terminate the input before applying prime power to the amplifier.

c. Do not look into the output port of the powered RF amplifier. Eyes are particularly vulnerable. Looking into an output waveguide flange may cause cataracts.

d. Shut off the amplifier if RF radiation is detected. The operator should put the amplifier in standby or shut off the breaker if RF radiation is detected. Consult management if the microwave radiation exceeds 1mw/ cm². Examine the physical unit with the high voltage OFF for visible cracks in the output waveguide.

e. If it is only possible to detect the source of the leak with the amplifier in transmit. Drive the amplifier at a low output power level and use an RF radiation meter to locate the leak. Once the leak is found, put the amplifier in standby or turn it off.

f. Work quickly to minimize RF radiation exposure. RF radiation exposure is directly proportional to power level and time exposed. Exposure to RF radiation can cause both thermal and non-thermal biological effects.

# Physical Safety

## General Lifting Guidelines

One person can typically lift a maximum weight of 40 lbs safely. However, the actual weight that can safely be lifted will depend on the fitness level of the person doing the lifting and on the lifting technique used.

## Extending Rack Slides

**Serious injuries may result from heavily loaded rack assemblies.** Racks must be securely bolted to the floor in all four corners to prevent tipping when slides are extended to accept units. Verify all slides are securely mounted and all latches and stops are functioning properly.

**Serious injury can occur to hands, fingers, or clothing becoming caught in slides.** Exercise caution when sliding units into and out of a rack paying close attention to hands, fingers and clothing.

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# Chapter 1
# Introduction

## 1.1 Overview

The CPI SuperLinear® ODU (SL 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 "ODU TWTAs."

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

**Table 1-1. SL ODU Amplifiers**

| Model Number | Frequency Range (GHz) | Rated Power (Watts) |
|---|---|---|
| TL02UO-A | 14.00 – 14.50 | 40W CW |
| TL02UO-B | 13.75 – 14.50 | 40W CW |
| TL02UO-C | 12.75 – 14.50 | 40W CW |
| TL02UO-E | 13.75 – 14.50 | 100W CW |

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.


**Figure 1-1. SuperLinear® ODU (Front View)**

The SL ODU amplifier, Model TL02UO provides linear power at the output flange in a rugged and compact weatherproof enclosure. The overall dimensions are 8.5x8.5x15 inches, excluding the connectors and mounting brackets. It weighs less than 26lbs.

The SL ODU is digital ready for wideband, single or multiple-carrier satellite service in the Ku frequency band. It is air-cooled with air intake from the bottom and exhaust at the rear end. The SL ODU can operate at ambient temperature ranging from -40 to +60 C.

Outline drawing 01041601, in the drawing section, provides all the detailed dimensions and the interface connectors.

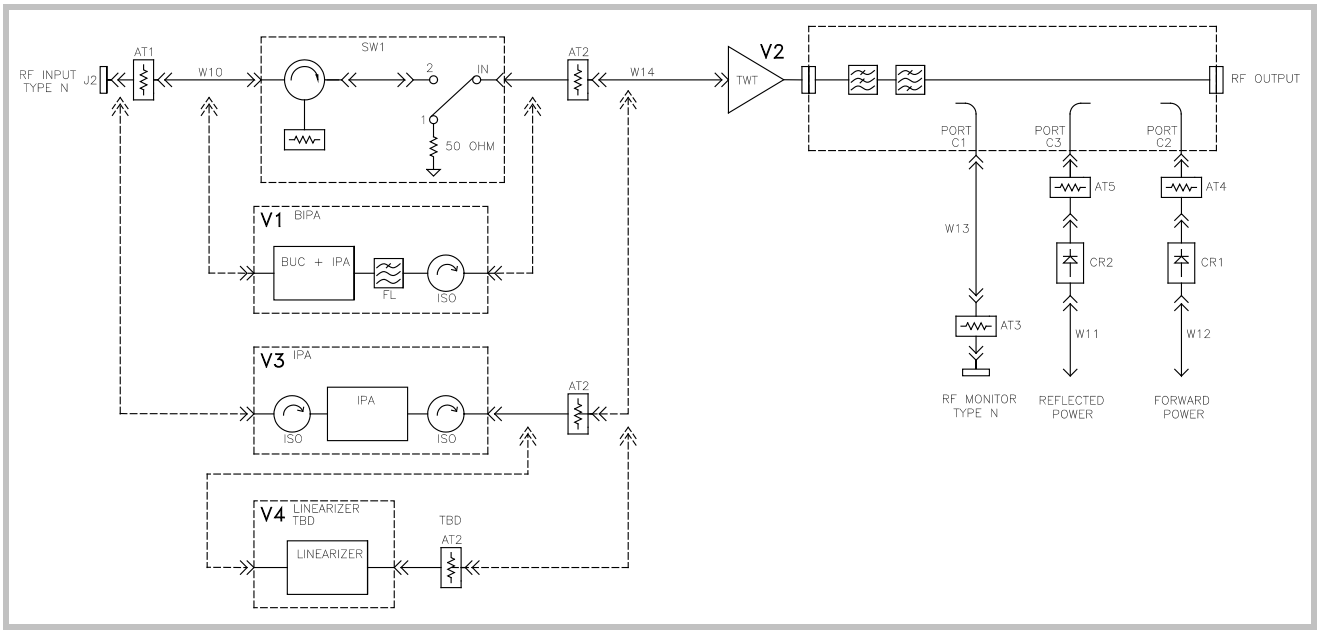


**Figure 1-2. SL ODU RF Diagram**

## 1.2 Optional Features

The SL ODU has the following optional features:

- L-Band BUC
- Remote Control Panel
- External Isolator
- 1:1 Redundant Switch Controller
- Extended Frequency Range

# 1.3 About This Manual

This manual describes the SL ODU installation and operation procedures.

The Operational Warnings and Safety Section that precede Chapter 1 provides practical guidelines regarding High Voltage and Microwave Radiation operating practices.

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

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

Chapter 3, "*Initial Power ON and Checkout*", describes the controls and indicators on the front panel of the SL ODU and the procedures to use for initial checkout after the amplifier has been installed.

Chapter 4, "*Interfaces,*" describes, the SL ODU external interfaces and external connector pin-outs. The commands used to setup the serial interface hardware characteristics.

Chapter 5, "*Operation,*" describes the procedures for normal start-up and shutdown, and describes the operational modes of the SL ODU.

Chapter 6, "*Maintenance,*" describes the procedures for scheduled maintenance and the procedures for return of equipment to CPI.

Chapter 7, "*Drawings,*" contains relevant engineering drawings and specifications of the SL ODU Amplifier.

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

# 1.4 Conventions

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

## 1.4.1 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:

## 1.4.2 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:

## 1.4.3 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 *Service Manual*.

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# Chapter 2
# Unpacking and Installation

## 2.1 Overview

This chapter contains instructions for unpacking and installing the ODU.

## 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 of the ODU includes:

- Mechanical installation
- Electrical power connections
- Remote control interface
- RF connections

## 2.4.1 Amplifier Installation

Refer to the appropriate Outline Drawing in Chapter 6 *"Drawings"* for outline and mounting information.

The amplifier may be mounted using the six tapped holes located on the side (refer to the Outline Drawing). These holes are 1/4 20 UNC threaded and are 0.38 inch deep. In order to provide secure mounting, screws 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. For further information see the outline drawing and the yellow Operational Warnings document located at the front of this manual.

## 2.4.2 Cooling Considerations

The ODU is air-cooled by an internal fan that draws air in from the bottom of the unit and is exhausted through ducts located at the back. Refer to outline drawing, 01041601 in Chapter 6, "*Drawings*".

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

- There must be at least four inches of clearance on the bottom of the unit (air intake).
- There must be at least four inches of clearance behind the unit that has the exhaust ducts (the end with the visible cooling fins).
- The hot exhaust air must be directed away from the air intake area.
- 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 and block the air intake area.

## 2.4.3 Electrical Power Connections

All electrical connections to the amplifier are located on the front panel (Figure 2-1).

### 2.4.3.1 Prime Power (J1)

**WARNING! DO NOT APPLY POWER TO THE AMPLIFIER UNTIL YOU ARE DIRECTED TO DO SO IN THE PROCEDURE.**

Prime power is applied to connector J1 (AC IN) located on the front panel of the ODU. Prime power is 110 - 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 2 – No connection
Pin 3 - Neutral (or Phase B)
Pin PE – Ground

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 ODU amplifier to the station ground bus or to earth ground is necessary for personnel and equipment safety. The ¼ UNC-2B threaded ground hole on the amplifier 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.

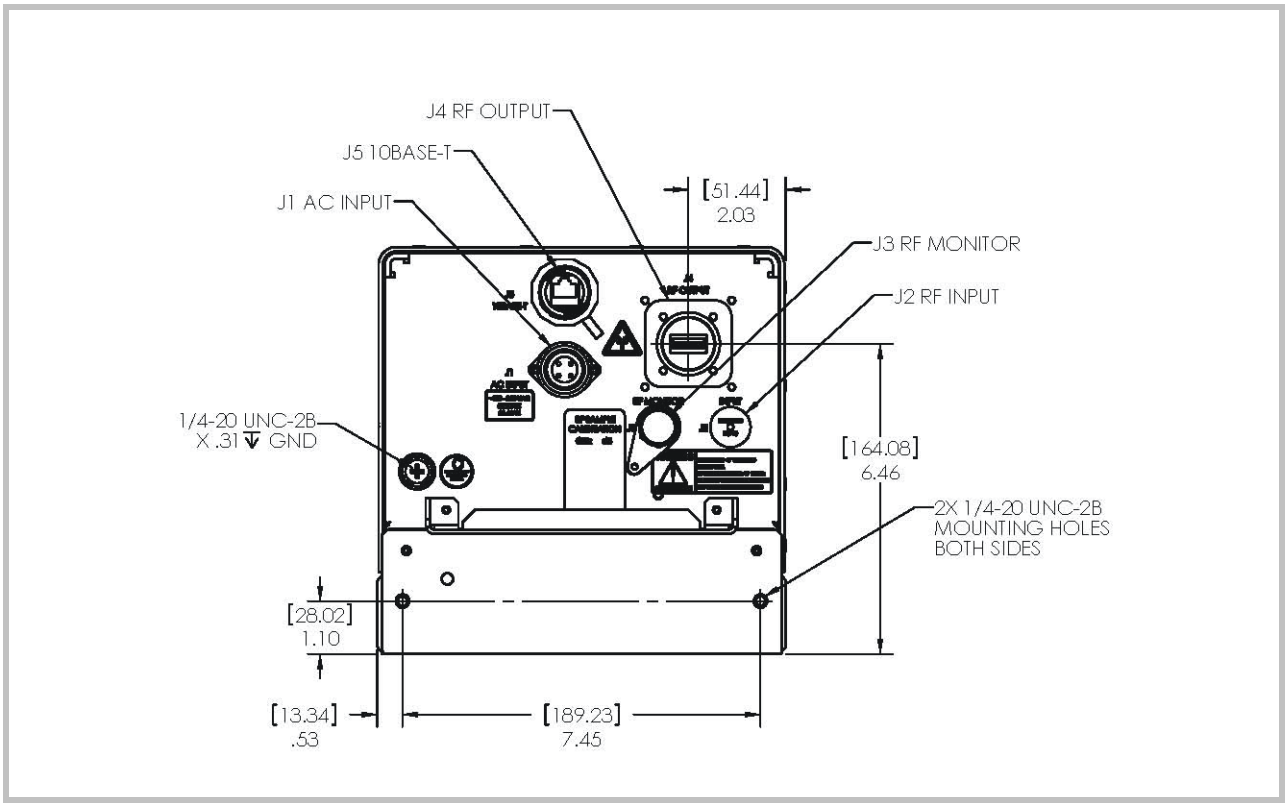


**Figure 2-1. ODU Connector Locations**

## 2.4.4 Remote Control Interface (J5)

The operator can use a PC connected to J5 ("REMOTE") to remotely monitor and control the amplifier. J5 is a 10 Base T Ethernet type connector. This interface is weatherized when connected to an Ethernet cable assembled with the mating circular connector provided in the amplifiers ship kit. Instructions on using this connector are provided in the ship kit as well.

When this interface is not in use the weatherized cap attached to the interface should be left on to prevent moisture from entering the soft shell chassis.

***Warning: Using Ethernet cables that have not been equipped with the proper mating circular connector will not provide a weatherized seal and will allow moisture to enter the soft shell chassis. Damage resulting from not using the circular mating connector provided will void the warranty.***

## 2.4.5 RF Coaxial Cable Connections (J2, J3)

Refer back to Figure 2-1 for connector locations. Prepare a user supplied RF drive coaxial cable and connect it to RF Input connector J2. A output power monitor cable can be connected directly to front panel connector J3 (44 dB nominal coupling). Tighten the connector(s).

***Note: Position the coaxial cables so that there is no stress on connectors J2 or J3.***

## 2.4.6 RF Output Waveguide Flange Connection (J4)

The output waveguide flange of the ODU is located on the front panel (Figure 2-1). The mating connection is a WR-75G (Ku) flat waveguide flange with four through holes (6-32 clearances). An O-ring gasket is supplied in the ship kit.

To install the waveguide flange, proceed as follows:

1. Install the O-ring gasket supplied in the ship kit to the output flange of the ODU.
2. Position the interconnecting waveguide so that it aligns precisely with the waveguide flange at the rear of the ODU.

***Note: If flange alignment is not precise or if the installation is subject to motion or severe vibration, a flexible waveguide section should be installed between the output of the ODU and the interconnecting waveguide.***

3. After alignment is verified in all three planes, loosely attach the interconnecting waveguide to the output waveguide flange of the ODU with 6-32 stainless steel screws, flat washers, lock washers, and nuts. Start all bolts and verify proper alignment.
4. A progressive tightening procedure is recommended. Tighten each bolt until the lock washer starts to compress and then proceed to the next bolt, until you have partially tightened all the bolts.
5. Starting with the first bolt, fully tighten them to the desired torque level (8 in. lbs. for 6-32 screws). Do not over-tighten the screws because this can strip the threads or distort the mating flange.

Chapter 3 contains startup procedures.

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# Chapter 3
# Initial Power On and Checkout

## 3.1 Overview

The ODU is operated in the remotely through an Ethernet interface (J5). Each amplifier is configured and thoroughly tested at the factory. Once the ODU is installed it should be monitored at initial power on to ascertain that it still functions properly. This section describes procedures for Ethernet interfacing, pre-power on, initial power on with checkout, and navigating the control panel.

## 3.2 Ethernet Interface

The operator can use a PC, connected to the 10base-T connector J5 on the front panel, to control and monitor the ODU. The mating connector RJ-45 plug is supplied in the ship kit. The RJ-45 cable should be wired pin to pin and form a complete weatherized seal when connected to uncapped Ethernet Hub or crossed-over to a PC 's Ethernet port. The IP address can be changed from the factory default setting. To setup the Ethernet on a PC complete 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. (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 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 computer is ready to connect to the ODU.

The default user name and password are as follows (case sensitive):

**USER NAME: cpi**

**PASSWORD: cpi**


**Figure 3-1. Internet Protocol (TCP/IP)**

## 3.3 Pre-Power On Procedure

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

1. AC prime power is 110 - 240 VAC +/- 10%, 47-63 Hz, as indicated by the label located on exhaust end of unit, and single phase.
2. The AC power cord is connected to J1, but the AC power is not turned on.
3. A ground strap is connected from the station's ground bus to the ¼ - 20 UNC 2B ground screw-mounting hole located on the amplifier front panel.
4. The RF Input and RF Output are connected to a matched source and test load. RF input power is off.
5. All RF connections are terminated and tight.
6. There is at least 4 inches of clearance at the front and rear of the amplifier. (The fan and exhaust areas are not blocked.)
7. Use a power meter to set the RF input drive to a level equal to or below –20dBm. Use a spectrum analyzer to verify that the RF carrier is with the operating frequency range.

8. The RF output port is connected to the mating output flange leading to the antenna feed, or to RF load rated at 100 watts minimum. Verify that all waveguide flange hardware is properly tightened and the antenna is pointing upward and free of obstruction.
9. Power on the PC or the Ethernet hub (if any) with the approximate RJ45 cable. A crossover cable is needed if the Ethernet connection is between the PC and the ODU. Launch the Internet Explorer browser.

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

## 3.4 Navigating the Control Panel

The ODU is monitored and controlled via a web browser on a personal computer (PC) or laptop. The amplifiers software provides an interface for the operator.

### 3.4.1 Data Organization

During normal operation, the amp status screen of the ODU displays the status, control mode, state of operation (either transmit or standby), any fault or alarm conditions, RF output level, power mode, and twelve meter readings. Figure 3-2 displays a typical amp status screen.

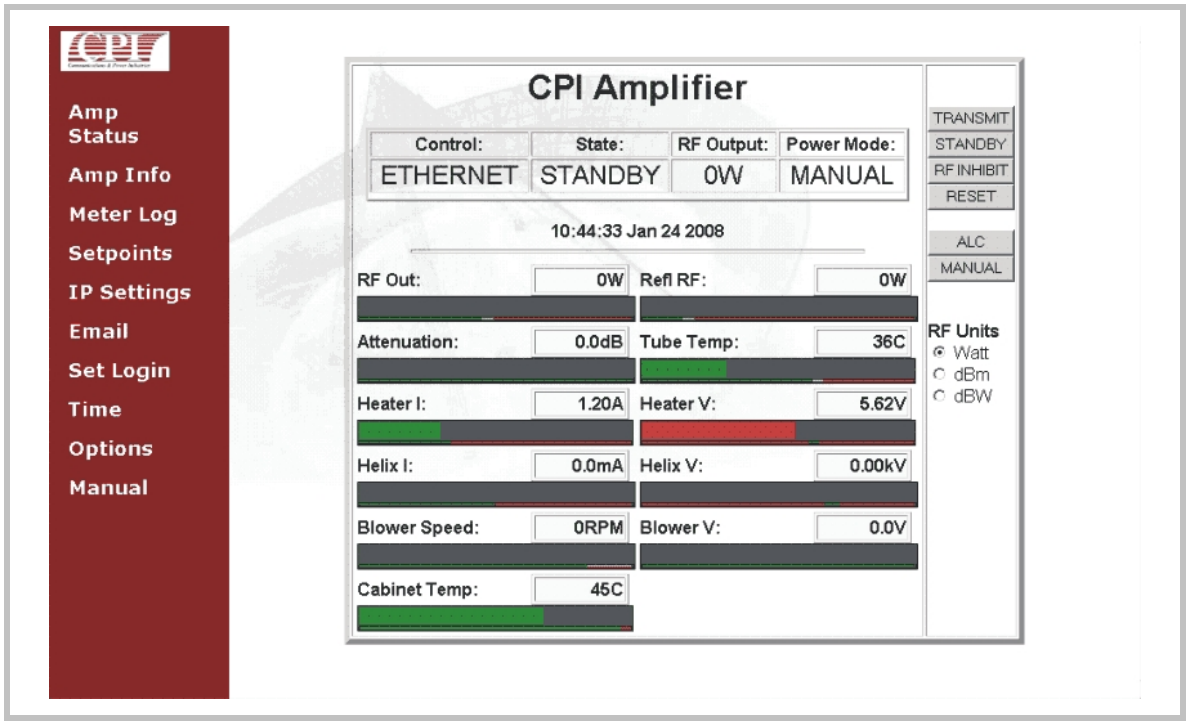



**Figure 3-2 Typical Amp Status Screen**

### 3.4.2 Navigation

The left side of the screen allows the user to navigate to the following menus:

- Amp status
- Email
- Amp info
- Meter log
- Setpoints
- IP settings
- Set login
- Manual

To navigate the software menu click on any of the menus listed above.

## 3.5 Initial Power-On and Checkout

Initial power on should not be attempted until all pre-power procedures (Section 3.3) have been successfully completed. A qualified operator should perform section 3.5. Initial power on consists of initial check, user preference settings, trip limits, verifying meter readings, and Ethernet setup.

### 3.5.1 Initial Check, Standby

***Note: The amplifier should be in the STANDBY mode at this time.***

Each time the ODU is switched on, the microprocessor controllers perform a series of self-tests to ensure the ability to control and monitor the ODU. Once the initial tests (POST) are successfully completed, the amplifier initiates a heater time delay (HTD) cycle of three minutes to allow the traveling wave tube (TWT) heater to warm up.

Proceed as follows:

1. Turn on the prime power distribution system so that AC power is applied at J1.
2. Enter the default IP address " http://192.168.100.100/ " in the web page of the PC.
3. A login screen will appear. Enter the default user name "cpi" and password "cpi". The main ODU operation screen will appear.
4. Verify that the cooling fan comes on after AC power is applied:

5. Logging onto the ODU within three minutes of the power-on sequence will indicate " State: HTD Y: XX). HTD signifies the TWT is in Heater Time Delay. After three minutes of HTD the state becomes "Standby ".

## 3.5.2 User Preference Settings

Table 3-1 shows user-configurable preference settings. Before the ODU is used at the installation site, these user-configurable settings may be set to meet the user's requirements.

**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 | Promts user to confirm inhibit | Options |

## 3.5.3 Check Factory Default Values

To check the factory default values click on the setpoint menu on the left to verify table 3-2.

**Table 3-2a. Factory set values (TL02UO-A/B/C)**

| Fault Name | Default Setting |
|---|---|
| Low RF Alarm | 0W |
| High RF Alarm | 45W |
| Low RF Fault | 0W |
| High RF Fault | 50W |
| High Reflected RF Alarm | 3W |
| High Reflected RF Fault | 4W |

**Table 3-2b. Factory set values (TL02UO-E)**

| Fault Name | Default Setting |
|---|---|
| Low RF Alarm | 0W |
| High RF Alarm | 105W |
| Low RF Fault | 0W |
| High RF Fault | 112W |
| High Reflected RF Alarm | 4W |
| High Reflected RF Fault | 5W |

## 3.5.4 Initial Check, Beam On (Transmit)

***Note: The amplifier should be in the STANDBY mode at this time.***

Proceed as follows:

1. Verify that the amplifier output is terminated with a RF load capable of dissipating full rated power.
2. Verify that the RF Drive is OFF.
3. Verify that the amplifier is in standby state in the amp status screen. If the fault indicator is ON, verify the fault, click the **RESET** icon to clear the fault.
4. Verify that a power meter is connected to the RF monitor.
5. Click the transmit icon and confirm the selection
6. After approximately 3 seconds, the Beam On Sequence (BONS) should complete.
7. Starting at –40 dBm, slowly increase the RF drive until rated output is achieved.

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

8. Click the standby icon to end the initial check H.V. on.

# Chapter 4
# Operation

## 4.1 Overview

This chapter describes the operation of the ODU. It presents a brief overview of operation and explains how to monitor and control the ODU. It gives procedures for switching the ODU on and off, changing operation modes, displaying and changing settings, and conducting routine tests.

## 4.2 Operational Overview

The operator uses the software loaded on the ODU through an Ethernet connection to navigate and operate the ODU.

***Note: Before starting the ODU for the first time that the initial power-on and checkout procedures have been performed. See Chapter 3 "Initial Power-On and Checkout" for instructions.***

An initial self-test will be conducted when prime power is connected. When the unit is finished initializing the operator switches the ODU from STANDBY mode to TRANSMIT mode, sets the desired output level, and applies the RF input. The ODU amplifies the input signal and outputs it to the antenna.

During operation, the Amp Status Screen can be used to control or adjust numerous settings, such as transmit, standby, RF inhibit, ALC, and manual.

When the ODU is ready for shutdown, the user clicks on the STANDBY key and clicks "yes" in the command confirmation screen. Wait a few minutes to allow cooling of the TWT.

# 4.3 Control Panel

The amp status screen of the ODU is illustrated in Figure 4-1.

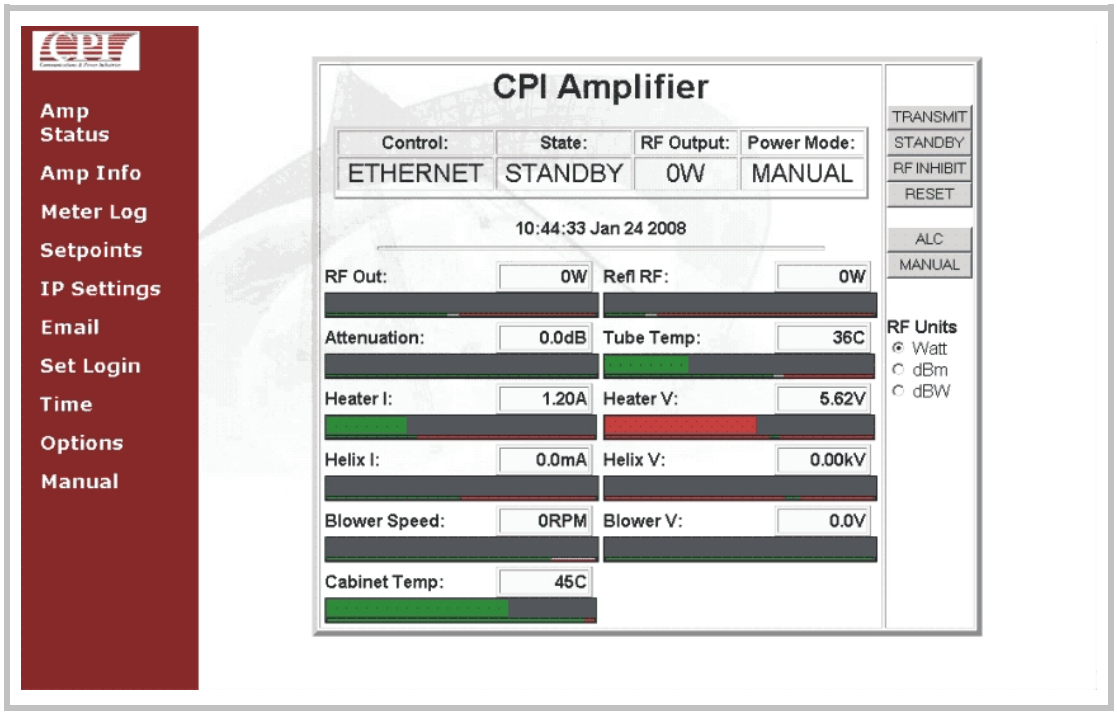



**Figure 4-1. Amp Status Screen**

The control panel is displayed on the left hand side of the amp status screen. Refer to **Chapter 3** *"Initial Power-On and Checkout"* for "Data Organization", and "Navigation"

### 4.3.1 The Amp Status Screen

Figure 4-1 illustrates the amp status screen. The amp status screen displays up to 12 monitored parameters, control type, amplifier state, RF output, and power mode. The operator may also click transmit, standby, RF inhibit, reset, ALC, or manual. These icons are defined in table 4-1.

**Table 4-1. Amp status icon definition.**

| Icon | Definition |
|---|---|
| Transmit | Puts the amplifier in beam-on state. |
| Standby | Turns the beam off from a beam on state. |
| RF Inhibit | Inhibits the RF from reaching the TWT in transmit or standby state. |
| Reset | Recycles that faults that occur. |
| ALC | Adjusts the variable attenuator to maintain a set output power. (Automatic Loop Gain Control) |
| Manual | Allows the user to manually adjust the variable attenuator. |

### 4.3.2 Amp Info Screen

The amp info screen displays the amplifiers serial number, main controller software version, the power supply (PS) software version, the BIPA software version, the RF controller software version, and the amplifiers name. The amp info screen allows the operator to download factory data and update firmware. Figure 4-2 displays the amp info screen.

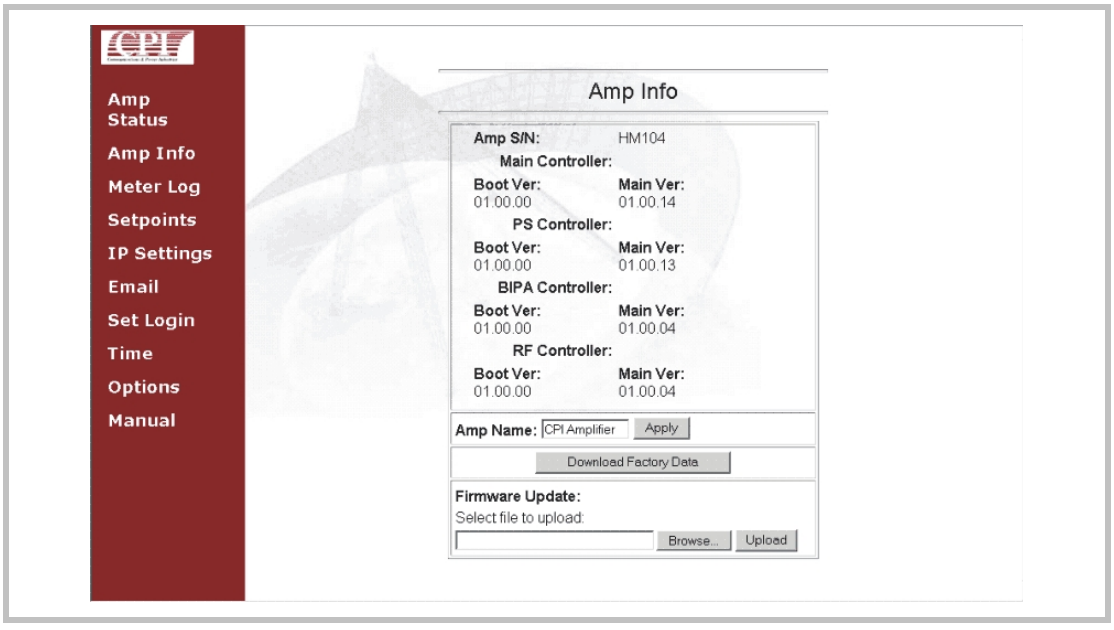
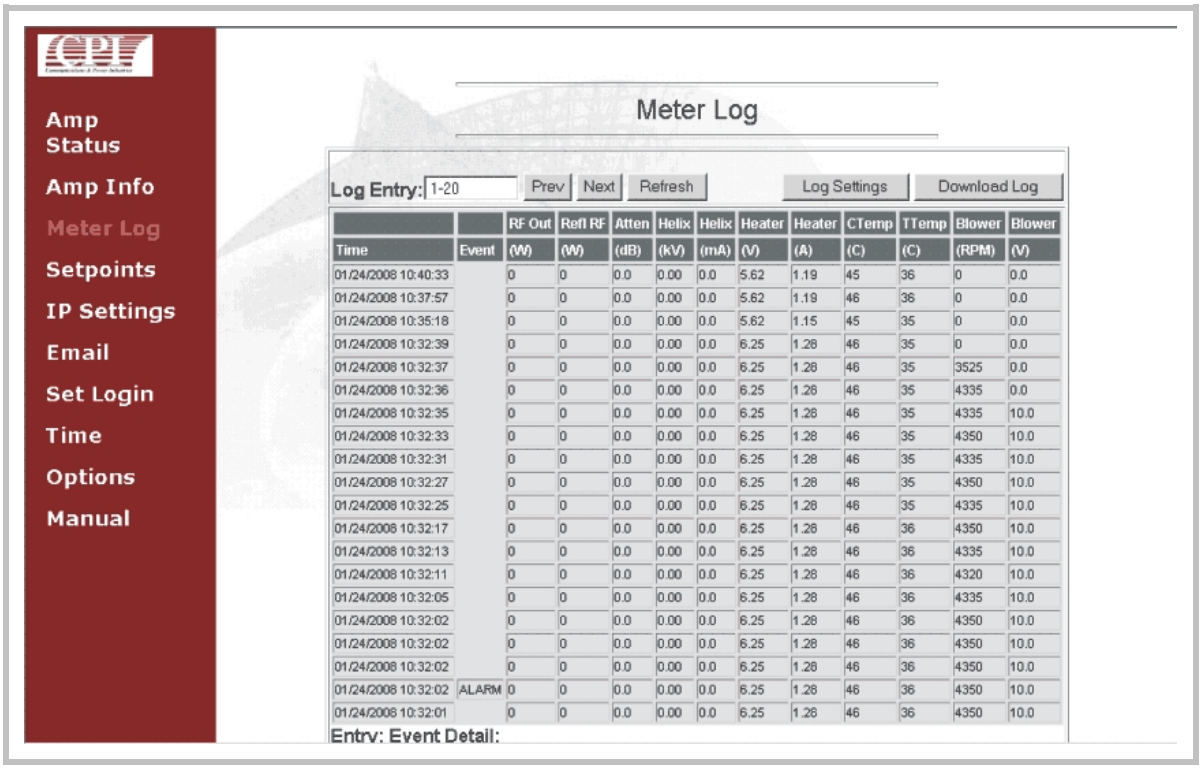



**Figure 4-2. Amp info screen**

## 4.3.3 Meter Log Screen

The meter log screen displays twenty entries on the screen but can be set to display anywhere from 1 to 1000 entries. The previous and next button will move the displayed entries in a block of ten. The event is created only when the meter reading is exceeding the limit (delta) in the log settings window. The operator may change the limits in the log settings screen. It is recommended the default 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 clicking submit. The meter log can be downloaded for device history purposes. The event text entry in the meter log cannot be erased. Figure 4-3 displays a typical meter log screen.




| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01/24/2008 10:40:33 | | 0 | 0 | 0.0 | 0.00 | 0.0 | 5.62 | 1.19 | 45 | 36 | 0 | 0.0 |
| 01/24/2008 10:37:57 | | 0 | 0 | 0.0 | 0.00 | 0.0 | 5.62 | 1.19 | 46 | 36 | 0 | 0.0 |
| 01/24/2008 10:35:18 | | 0 | 0 | 0.0 | 0.00 | 0.0 | 5.62 | 1.15 | 45 | 35 | 0 | 0.0 |
| 01/24/2008 10:32:39 | | 0 | 0 | 0.0 | 0.00 | 0.0 | 6.25 | 1.28 | 46 | 35 | 0 | 0.0 |
| 01/24/2008 10:32:37 | | 0 | 0 | 0.0 | 0.00 | 0.0 | 6.25 | 1.28 | 46 | 35 | 3525 | 0.0 |
| 01/24/2008 10:32:36 | | 0 | 0 | 0.0 | 0.00 | 0.0 | 6.25 | 1.28 | 46 | 35 | 4335 | 0.0 |
| 01/24/2008 10:32:35 | | 0 | 0 | 0.0 | 0.00 | 0.0 | 6.25 | 1.28 | 46 | 35 | 4335 | 10.0 |
| 01/24/2008 10:32:33 | | 0 | 0 | 0.0 | 0.00 | 0.0 | 6.25 | 1.28 | 46 | 35 | 4350 | 10.0 |
| 01/24/2008 10:32:31 | | 0 | 0 | 0.0 | 0.00 | 0.0 | 6.25 | 1.28 | 46 | 35 | 4335 | 10.0 |
| 01/24/2008 10:32:27 | | 0 | 0 | 0.0 | 0.00 | 0.0 | 6.25 | 1.28 | 46 | 35 | 4350 | 10.0 |
| 01/24/2008 10:32:25 | | 0 | 0 | 0.0 | 0.00 | 0.0 | 6.25 | 1.28 | 46 | 35 | 4335 | 10.0 |
| 01/24/2008 10:32:17 | | 0 | 0 | 0.0 | 0.00 | 0.0 | 6.25 | 1.28 | 46 | 36 | 4350 | 10.0 |
| 01/24/2008 10:32:13 | | 0 | 0 | 0.0 | 0.00 | 0.0 | 6.25 | 1.28 | 46 | 36 | 4335 | 10.0 |
| 01/24/2008 10:32:11 | | 0 | 0 | 0.0 | 0.00 | 0.0 | 6.25 | 1.28 | 46 | 36 | 4320 | 10.0 |
| 01/24/2008 10:32:05 | | 0 | 0 | 0.0 | 0.00 | 0.0 | 6.25 | 1.28 | 46 | 36 | 4335 | 10.0 |
| 01/24/2008 10:32:02 | | 0 | 0 | 0.0 | 0.00 | 0.0 | 6.25 | 1.28 | 46 | 36 | 4350 | 10.0 |
| 01/24/2008 10:32:02 | | 0 | 0 | 0.0 | 0.00 | 0.0 | 6.25 | 1.28 | 46 | 36 | 4350 | 10.0 |
| 01/24/2008 10:32:02 | | 0 | 0 | 0.0 | 0.00 | 0.0 | 6.25 | 1.28 | 46 | 36 | 4350 | 10.0 |
| 01/24/2008 10:32:02 | ALARM | 0 | 0 | 0.0 | 0.00 | 0.0 | 6.25 | 1.28 | 46 | 36 | 4350 | 10.0 |
| 01/24/2008 10:32:01 | | 0 | 0 | 0.0 | 0.00 | 0.0 | 6.25 | 1.28 | 46 | 36 | 4350 | 10.0 |

**Figure 4-3. Meter log screen**

## 4.3.4 Setpoints Screen

The amplifier fault and alarm trip-points can be entered from the set point screen. **Fault trip-points are factory-set and MUST NOT be adjusted.** Automatic loop control (ALC) is used to maintain a constant output power by automatically adjusting the attenuation setting. Manual RF set is to change the RF output power to the level entered in this field. The setting of ALC and Manual RF will depend on the RF input drive level and the initial attenuation setting. It is good practice to start with some attenuation when using ALC and Manual RF mode. The attenuation set will adjust the attenuation value and display when a new value is entered into the field. Figure 4-4 displays a typical setpoints screen.

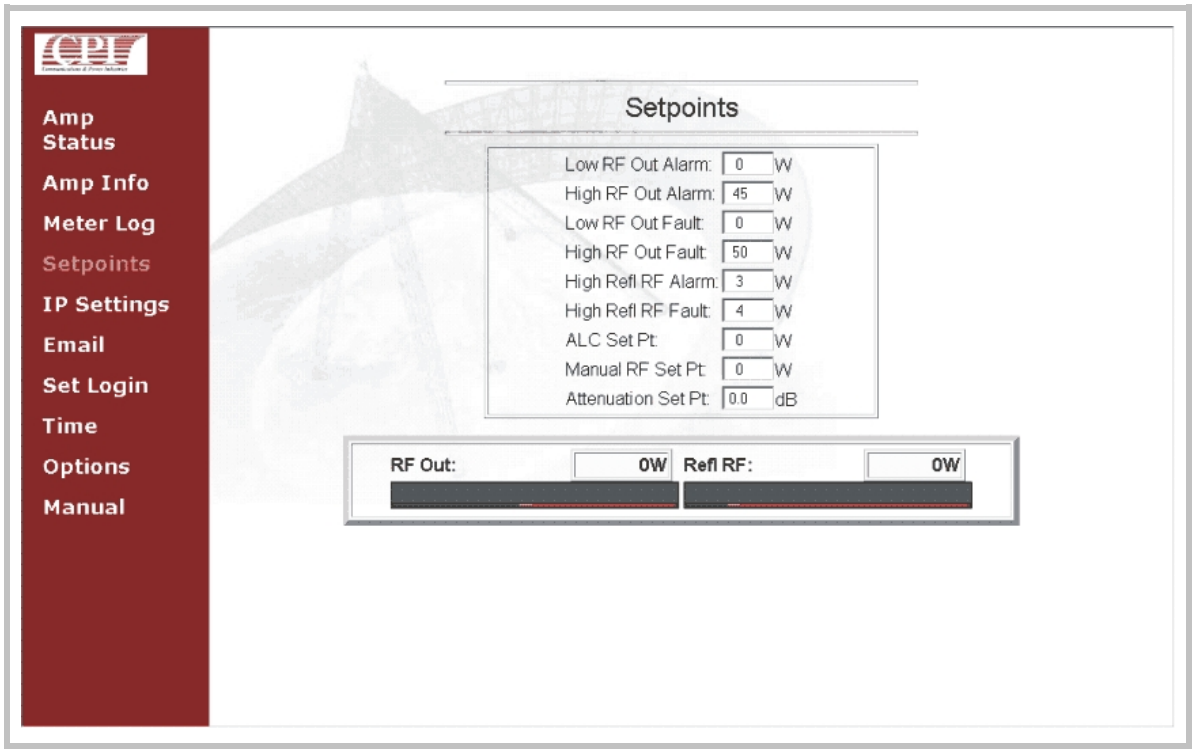



**Figure 4-4. Setpoints screen**

## 4.3.5 IP Settings Screen

The default IP address is located on the front of the amplifier. This IP address shall be entered in a web browser along the user name and password. User may reset the IP address of the ODU through the IP settings screen.

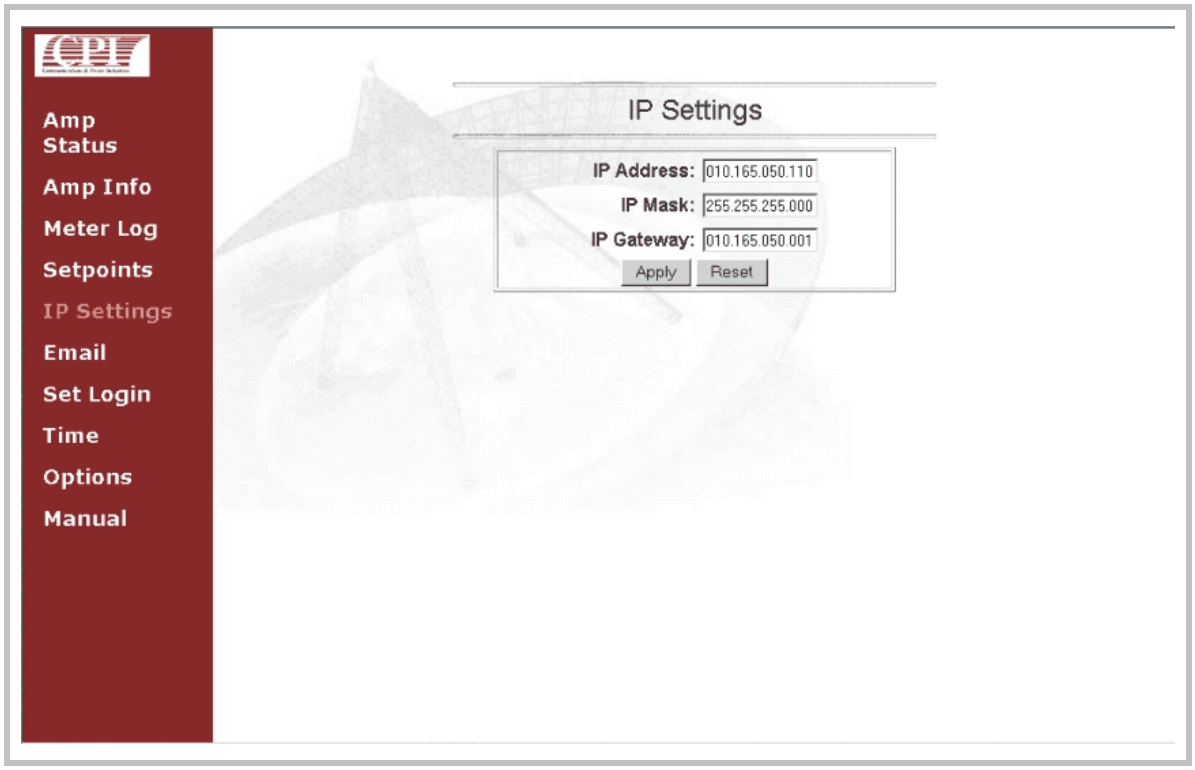



**Figure 4-5. IP settings screen**

## 4.3.6 Email Screen

The email screen can send the Alarm/Fault or Meter log to the designated E-mail address. The **Hold Off** period can be used to avoid sending the same message in a very short time period. Alarm/Fault event or/and Meter log will be sent when the check box is marked and the submit icon is clicked. Reset will clear all entries to start over.

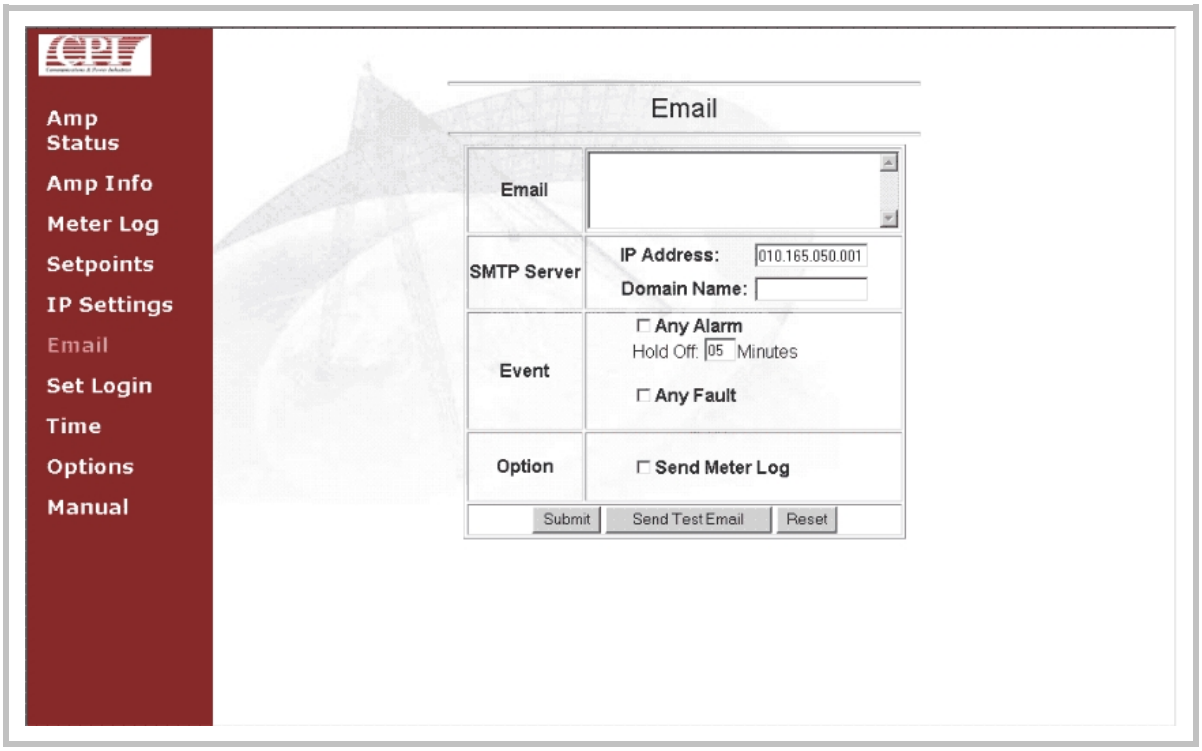



**Figure 4-6. Email screen**

## 4.3.7 Set Login Screen

This screen is used to change the user's name and password. After applying the new user name or password keep a copy in a retrievable location.


**Figure 4-7. Set login screen**

## 4.3.8 Time Screen

This screen is used to set the current time. The operator can also set the network time protocol (NTP) to automatically update the time on the amplifier.

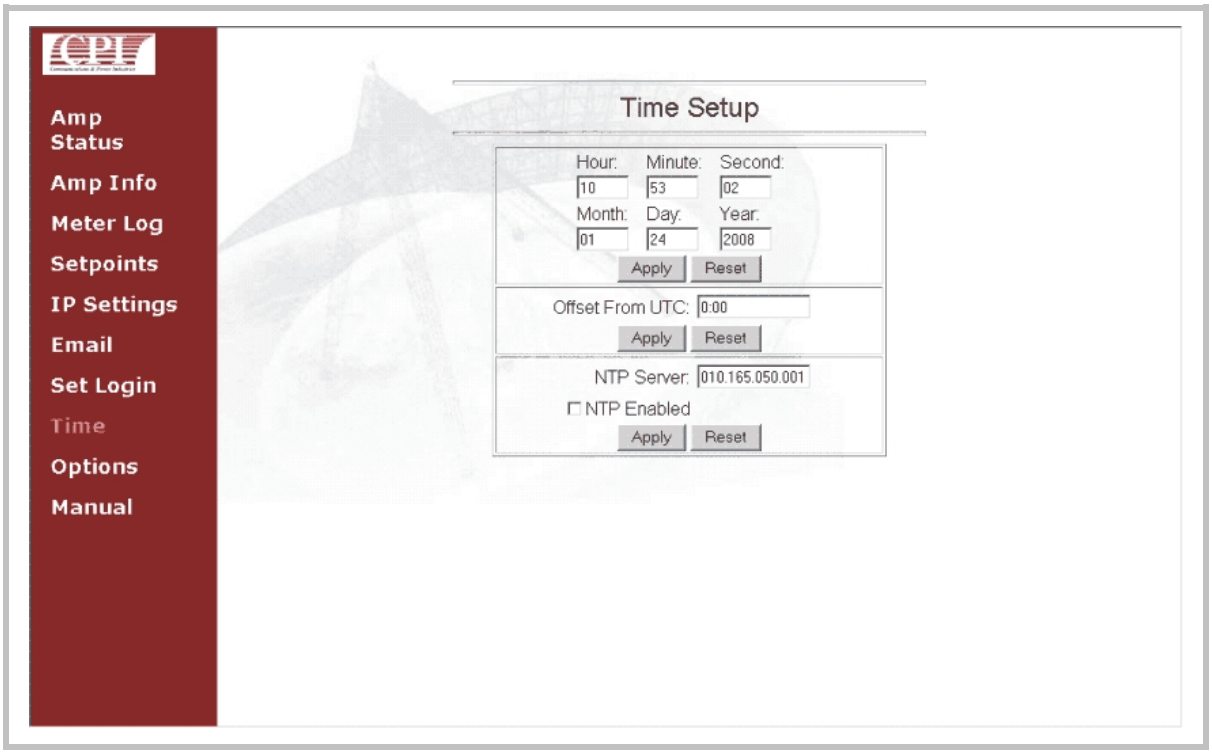



**Figure 4-8. Time Screen**

## 4.3.9 Options Screen

The options screen, figure 4-9, allows the user enable a prompt when performing any of the following tasks:

- Enabling transmit. (Figure 4-10)
- Enabling standby. (Figure 4-11)
- Enabling RF inhibit. (Figure 4-12)

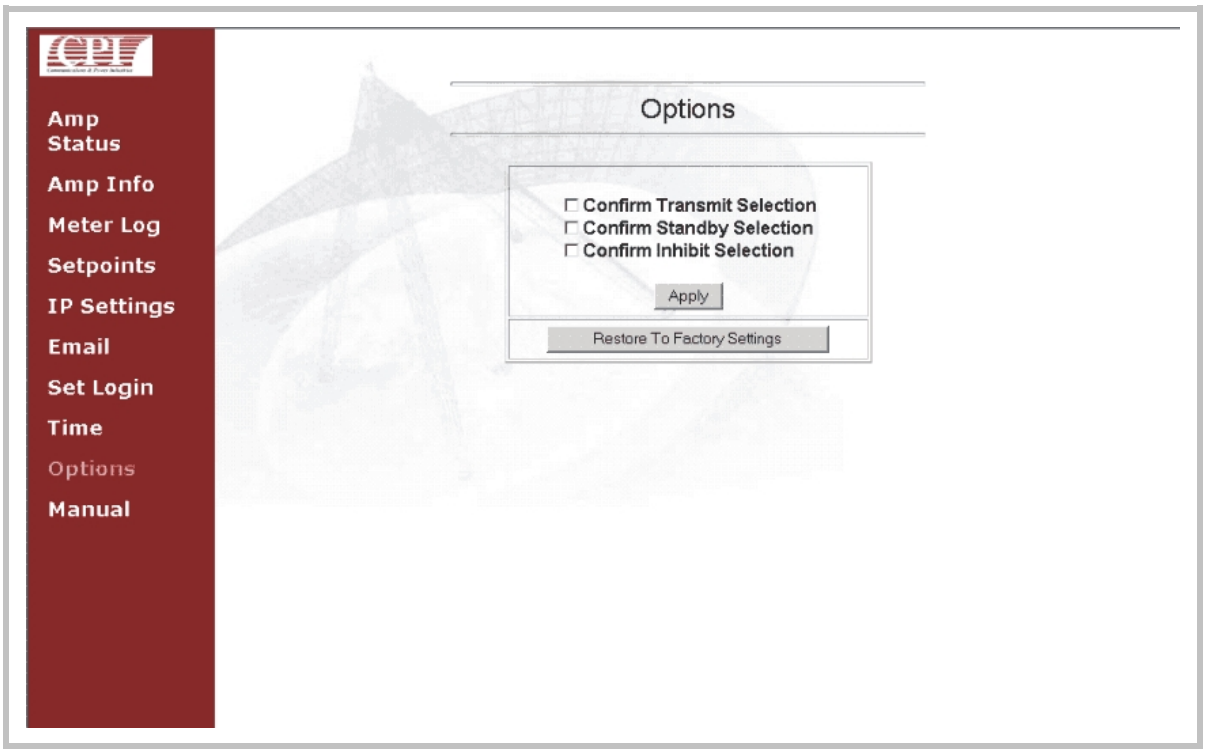



**Figure 4-9. Options screen**

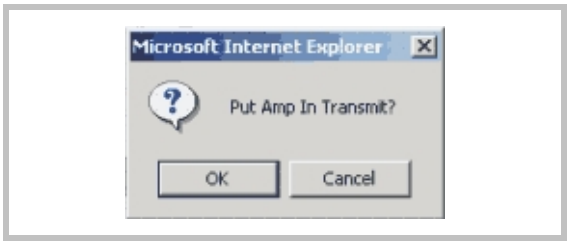



**Figure 4-10. Transmit prompt screen**

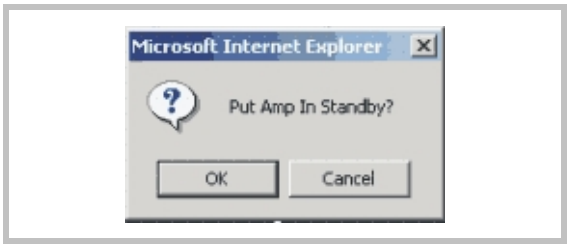



**Figure 4-11. Standby prompt screen**

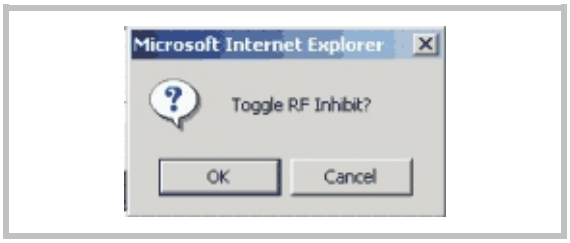



**Figure 4-12. RF inhibit toggle screen**

### 4.3.10 Manual Screen

The manual screen will display a brief summary of this manual.

## 4.4 Shutdown and Recovery

The following procedures describe normal shutoff.

1. Press STANDBY key to place the ODU in standby state. Verify the amp status screen displays "Standby".
2. Wait 5 minutes.
3. Turn off the main circuit breaker to the ODU.

### 4.4.1 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

- Turn off the main circuit breaker supplying AC to the ODU.

  Or

- Unplug J1.

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# Chapter 5
# Maintenance

## 5.1 Overview

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

***Note: Improper maintenance of the ODU 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.

## 5.2 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 ODU. (See Table 5-2).***

To function safely and effectively, the ODU requires periodic maintenance by the operator. No maintenance is required for the electrical components inside the ODU.

Refer to Table 5-1 for the Preventive Maintenance tasks to be performed by operators. Table 5-2 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 sections.

**Table 5-1. Preventive Maintenance Performed by Operators**

| Tasks | Daily | 1 Mo. | 3 Mo. | 6 Mo. | 1 Yr. |
|---|---|---|---|---|---|
| Log meter readings | X | | | | |
| Perform visual inspection | | X | | | |
| [1]Cooling fan(s) Inspection | | | X | | |

Table 5-1 Notes:

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

**Table 5-2. Preventive Maintenance Performed by Technician**

| Tasks | Daily | 1 Mo. | 3 Mo. | 6 Mo. | 1 Yr. |
|---|---|---|---|---|---|
| Perform initial Power ON check | | | X | | |
| Air system maintenance | | | | X | |
| Run performance tests | | | | | X |
| [1]Fan Replacement | | | | | A/R |

Table 5-2 Notes:

1. Replace fan after 50,000 hours of operation.

**WARNING! PERSONS PERFORMING MAINTENANCE PER TABLE 5-2 MUST BE SERVICE PERSONNEL WHO HAVE ATTENDED FORMAL TRAINING FOR SERVICE OF THE ODU.**

**Table 5-3. Recommended Test Equipment**

| Item | Description | Example (Equivalent may be substituted) |
|---|---|---|
| 1(1) | Swept Signal generator, capable of CW and swept operation, compatible with Scalar Analyzer, item 2. | HP 8360, 8350 |
| 2(1) | Scalar Network Analyzer, complete with dual detector probes. Should have dual markers, with delete mode. Compatible with Swept Signal Generator, item 1. | HP 8757 |
| 3(1) | Vector Network Analyzer | HP 8720D |
| 4(2) | Microwave Frequency Counter | HP5340A |
| 5 | RF Splitter, precision 2 way, 50 Ohms, Type N, DC to 18 GHz | HP 11667A |
| 6 | RF Power Meter complete with power sensors, Type N, 50 Ohms, power measurement range -30 to +20 dBM | HP 437B, 438A meter<br>HP 8481 sensor |
| 7 | Variable Attenuator, 0 to 25 dB, DC to 18 GHz, 50 Ohms | Merrimac ASM 25-11K |
| 8 | High quality, low loss RF test cables as required for test set up | |
| 9 | RF Radiation Detector | Narda 8718 meter with 8621 probe |
| 10 | Calibrated Waveguide Directional Coupler | Narda, HP, etc. |
| 11 | Dummy Load, 100 W | Waveline, Narda, etc. |

Table 5-3 Notes:

Items 1 and 2 are replaceable by item 3.

Item 3 is replaceable by items 1 and 2.

Item 4 is required only if item 1 is not digitally controlled or phase locked.

# 5.3 Operator's Preventative Maintenance

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

***Note: 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).***

## 5.3.1 Visual Inspection

At one-month intervals, the ODU 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 discolored, broken, or bad insulation. A service technician should repair or replace cables as needed.
3. Inspect all waveguide for discoloration, cracks, loose connectors, and improper sealing. Contact a qualified service technician for 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.

## 5.3.2 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.

### 5.3.3 Fan Inspection

Contact your local service technician for fan replacement parts.

Periodically feel unit for abnormal vibration that would indicate a fan balance issue or bearing problem. Also listening to the unit for unusual or atypical sounds can indicate a problem. Unusual sounds or vibration should be investigated.

Examination of the log files for inconsistencies can be an indication of degraded fan performance. A trained technician can perform replacements as covered in the CPI service manual, or the user can contact the CPI service center.

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

## 5.4 Technician's Preventative Maintenance

**WARNING! SERVICE TECHNICIANS MUST BE SERVICE PERSONNEL WHO HAVE ATTENDED FORMAL TRAINING FOR SERVICE OF THE ODU.**

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

### 5.4.1 Initial Power-On Check

Every three months the initial power-on and checkout procedure in **Chapter 3**, *"Initial Power-On and Checkout"* should be performed.

### 5.4.2 Air System Maintenance

The ODU must be checked for airflow to insure it is properly transferring heat away from the internal heat sink. This means that 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.

### 5.4.3 Run Performance Tests

Once a year run the performance tests in section 5.5 to ensure Indoor SSPA's performance.

### 5.4.4 Fan Replacement

After 50,000 hours of operation or if the fans have problems, the fan should be replaced.

Contact CPI service for instructions.

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

## 5.5 Performance Testing

Once a year perform the tests for power and gain, radiation levels, and record their results. If the results are not satisfactory refer to the ODU service manual for troubleshooting and repair.

### 5.5.1 Power And Gain Performance Test

Follow these steps to test the ODU for power and gain. Record the results on the "Power and Gain Test Data Sheet" provided in table 5-4.

1. Connect equipment as shown in figure 5-1 "Performance Test Setup".
2. Turn off the synthesizers RF output. Set the input drive level to minimum and the ODU 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 the synthesizer's RF output. Increase the drive level until rated power is reached.
5. Calculate the gain at rated power and record on the test data sheet.

   Gain = $P_o$ (dBm) – $P_i$ (dBm)
6. Reduce the drive level until the ODU 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.
7. Calculate the small signal gain, and record the result on the test data sheet.
8. Repeat for the low and high frequency band of the ODU.

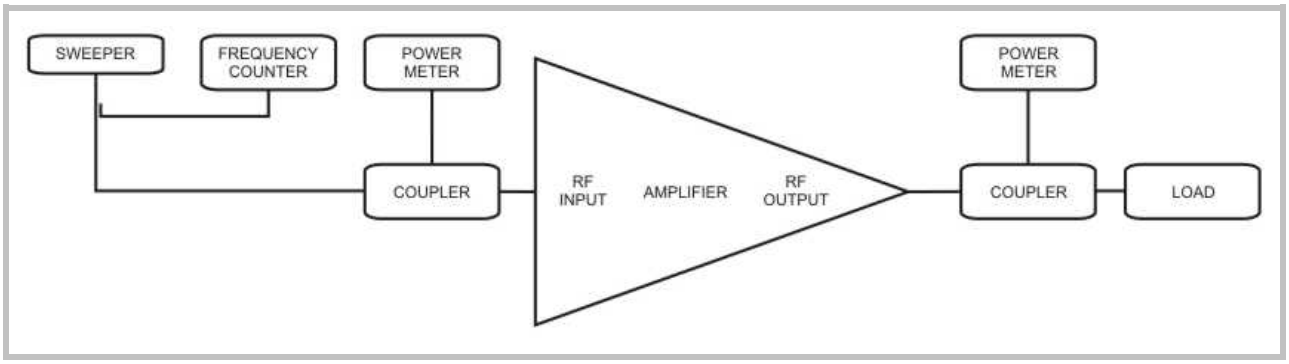


**Figure 5-1. Performance Test Setup**

**Table 5-4. Power and Gain Test Data Sheet**

| | Frequency | | |
|---|---|---|---|
| | Low Band | Center Band | High Band |
| Gain @ Rated | | | |
| Small Signal Gain | | | |

## 5.5.2 RF Radiation Measurement

To measure the ODU radiation levels:

1. Adjust the ODU for rated power.
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. Shut down the ODU and tighten the joints or install grounding 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.***

# 5.6 Protecting Parts from Electrostatic Discharge

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, a damaged part exhibits little or no visible physical damage, even under microscopic examination.

## 5.6.1 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 rack or cabinet. For personal grounding, use a wrist strap grounded through a 1-megohm resistor.
5. Do not slide static-sensitive devices over any surface.

## 5.6.2 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 swivel 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. Sleeves should be rolled high enough 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 produces very high levels of electrostatic charge.

### 5.6.3 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 possible 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.

### 5.6.4 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.***

## 5.7 Customer Service

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

# Chapter 6
# Drawings

The SuperLinear® ODU drawings listed below are included in this chapter.

**Table 6-1. Drawings**

| Title | Drawing Number |
|---|---|
| Marketing Datasheet, TL02UO | MKT214 |
| Outline, 250W Ku-Band SuperLinear® ODU | 0104160100 |
| RF Block Diagram, 250W Ku-Band SuperLinear® ODU | 0104160200 |
| Interconnect Diagram, 250W Ku-Band SuperLinear® ODU | 0104160300 |
| Assembly, Power Supply, 250W Ku-Band SuperLinear® ODU | 0104162000 |
| Kit, Ship, 250W Ku-Band SuperLinear® ODU | 0104166800 |
| RF Block Diagram 100W Ku-Band ODU | 0104750000 |

***Note:***

***CDROM Manual: Drawing files are in the "Drawings" folder.***

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# Appendix A
# Warranty & Support Information

For details, refer to separate supplement included with this manual.

HARD COPY: Refer to Warranty and Support supplement located at the front of this manual.

CD (If applicable): Refer to separate folder titled "Warranty and Support"

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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.

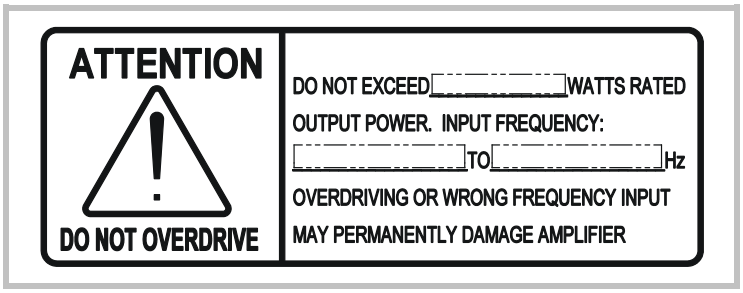


**Figure B-1. RF Warning Label**

***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.