1. GENERAL DESCRIPTION

1.1. INTRODUCTION

This manual contains installation and operating information for the Crescend High Power VHF Power Amplifier. The manual is organized into three sections as follows:

Section 1. General Description

Section 2. Installation

Section 3. Operating Information

1.2. PRODUCT DESCRIPTION

The Crescend Technologies High Power VHF RF power amplifier is designed for paging and other VHF applications that use a single carrier constant envelope waveform. The amplifier is designed to be powered from a 48 VDC source, but optionally incorporates an internal AC power supply. The amplifier covers a 150-174 MHz without retuning. Amplifier specifications are shown in Table 1-1. There are four input ranges available as shown in Table 1-2. Closed loop power control is used to maintain a constant output power under varying voltage, signal input level, frequency and output load conditions. Several design features work to protect the amplifier under adverse conditions.

The amplifier is designed to fit into 5.25 inches (3RU) of vertical 19 inch rack space. The front panel includes LED indicators for monitoring status and alarm conditions. This information is also accessible via a monitor connector on the rear of the amplifier. The fan assembly draws ambient air in from the front and blows the air across the heat sink fins out the back of the amplifier.

- Notice: The manufacturer's rated output power of this equipment (see Table 1-1) is specified for single carrier operation using constant-envelope modulation. This equipment is NOT designed for multiple-carrier operation, nor is it intended to be used with non-constant envelope modulation types.

Table 1-1. Amplifier Specifications

Specification	Value
Instantaneous Bandwidth	150-174MHz
Output Power	350W
Input Impedance	50Ω
Output Impedance	50Ω

Table 1-2. Amplifier Input Power Ranges

Input Power Designator Code	Input Power Range	Nominal Gain (350W Output)
5	5-10 W	18.5dB
10	10-20 W	15.5dB
20	20-50 W	12.4dB
50	50-100 W	8.5dB

2. INSTALLATION

2.1 INSTALLATION INSTRUCTIONS

The amplifier is designed for installation in a rack that permits access to the rear of the rack for connection of DC power, RF, and monitor/control cables. The amplifier must have a minimum of 3 inches of open space in front and to the rear of the chassis to allow adequate air flow and ventilation.

To install the amplifier proceed as follows:

1. Mount the amplifier in equipment rack and secure in place.
2. Connect a properly sized 50 ohm cable and load (antenna) to the RF OUT connector on rear of amplifier.
3. Connect the transceiver/exciter output to RF IN connector on rear of amplifier.
4. If monitoring of PA is desired, connect alarm cable to MONITOR connector on rear of amplifier module. See section 3 for more details about monitor pins.
5. Connect ground wire to ground stud on rear of amplifier if desired.
6. If unit is the 48 VDC version, measure primary DC input voltage of power supply. DC input voltage should be +48 +/- 0.5VDC. Turn off DC voltage.
   NOTE:
   - Make sure power supply DC is well filtered and well behaved with minimal voltage overshoot.
   - Keep DC wires as short as possible to minimize inductance induced voltage transients.
   - Size DC Wires properly to handle the load current to minimize voltage drop.

   WARNING: Turn off external primary DC power before connecting DC power cables.

7. Connect positive primary power wire (+48VDC) to terminal marked +48VDC and negative primary power wire to GND terminal next to it on rear of amplifier.
8. Check your work before applying DC voltage to the system. Make certain all connections are tight and the DC wires are going to the correct terminals.
9. If the unit has the optional power supply: Connect unpowered AC cord to AC plug on rear of amplifier.
10. Refer to Section 2.2 for initial start-up procedures.

2.2 INITIAL STARTUP

To perform the initial start-up, proceed as follows:

1. Check to ensure that all input and output cables are properly connected and tightened.

Note: Use high quality coaxial cable and connectors. Properly install all connectors for reliability.

CAUTION: Before applying power, make sure that the input and output of the amplifier are properly terminated in 50 ohms. **Do not operate the amplifier without a load attached.** Refer to Table 1-1 for input power requirements. Excessive input power will damage the amplifier.

NOTE: The output coaxial cable between the amplifier and antenna must be 50 ohm cable and adequately sized to handle the rated power level with additional stresses from high VSWR taken into account.

2. Apply 48 VDC from your power supply or AC mains power (depending on whether amplifier has optional power supply) to the amplifier with the supplied line cord. The fans will power on. Check that all four fans are running.

3. Visually check the indicators on the front of the amplifier and verify the following:
   a. The PWR ON indicator (green) is on.
   b. All other LED indicators (red and yellow) are off.

4. Set the external exciter power level so that it is within the specified input power range and apply the RF signal to the amplifier input port. The amplifier will deliver nominally 350W at the output connector. The green exciter drive status LED will illuminate when the RF drive is detected. This LED is meant to give the user a general indication that the exciter is active and is delivering output power when troubleshooting an alarm condition. However, it does not indicate that the minimum input power level has necessarily been reached.

5. Remove the RF input signal. The output power will drop to zero. Only the Power On indicator will be illuminated. Amplifier is ready for use.

3. OPERATING INFORMATION

3.1 INTRODUCTION

This section contains general amplifier operating information

3.2 STATUS INDICATORS AND MONITOR CONNECTOR

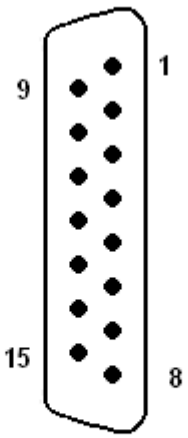
The amplifier status indicators and alarms are described in Tables 3-1 and 3-2.

Table 3-1. High Power VHF Amplifier Status LED Indicators

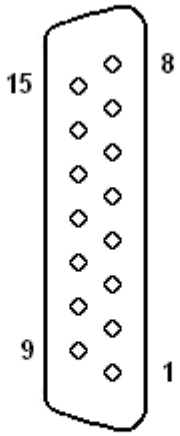
STATUS LED	FUNCTION
PWR ON	Green LED. Illumination indicates unit is on
EXCITER DRIVE	Green LED. Illumination indicates RF input power has been applied
HIGH TEMP	Red LED. Activates when the amplifier exceeds a safe operating temperature. Unit shuts down until safe operating temperature returns
HIGH VSWR	Red LED. Activates when load VSWR $\geq$ 3:1. Amplifier shuts down. Alarm active until RF input removed and reapplied
HIGH INPUT	Yellow LED. Illumination indicates RF input power exceeds safe ~125% of rated input power. Alarm active until RF input removed
LOW OUTPUT	Yellow LED. Activates when power drops due to low gain

Table 3-2. Monitor Connector Description

PIN NO	NAME	DESCRIPTION
1	POWER CTL	Output Power Level Control
2	LOW PWR	Alarm - Low Output Power
3	HI INPUT	Alarm - RF Input Power Above Maximum Rating
4	REV PWR	Reverse Power Voltage
5	GND	Ground Return
6	FORM C (NC)	Normally Closed Pin of Form C Relay
7	FORM C (COM)	Common Pin of Form C Relay
8	FORM C (NO)	Normally Open Pin of Form C Relay
9	RF DRIVE	Minimum RF Input Drive Indicator
10	HI TEMP	Alarm - High Temperature Amplifier Shutdown
11	HI VSWR	Alarm - High VSWR
12	FWD PWR	Forward Power Voltage
13	GND	Ground Return
14	GND	NOT FOR EXTERNAL CONNECTION - DO NOT USE
15	N.C.	



Male Plug
(Front View)
Amplifier Connector



Female Socket
(Front View)
Matching Interface

3.3 RF ENERGY EXPOSURE AWARENESS, CONTROL INFORMATION, and OPERATIONAL INSTRUCTIONS for COMPLIANCE with FCC RF EXPOSURE LIMITS

NOTICE: This power amplifier product is intended for use in environments in which personnel have full knowledge of their exposure and can exercise control over their exposure to meet FCC limits. This power amplifier is NOT authorized for use by the general population, consumer, or for use under conditions where unintended or accidental exposure may occur.

This power amplifier product generates electromagnetic energy in the radio frequency (RF) spectrum to provide communications between users over a distance. RF energy is one specific form of electromagnetic energy. Other forms include, but are not limited to, sunlight and x-rays. RF energy, however, should not be confused with these other forms of electromagnetic energy, which when used improperly, can cause biological damage. Very high levels of x-rays, for example, can damage tissues and genetic material.

Experts in science, engineering, medicine, health, and industry work with organizations to develop standards for safe exposure to RF energy. These standards provide recommended acceptable levels for personnel who may be exposed to RF energy. The RF exposure levels described therein include substantial margins of protection.

When properly installed and used, Crescend power amplifier products meet all government-established RF exposure levels. In addition, Crescend recommends specific operating instructions for users of its power amplifier products. These instructions are important because they inform users about RF energy exposure and provide simple procedures on how to control it.

Please refer to the following Web sites for more information on the nature of RF energy exposure and how to control your exposure to assure compliance with established RF exposure limits.

http://www.fcc.gov/oet/rfsafety/rf-faqs.html
http://www.osha.gov/SLTC/radiofrequencyradiation/index.html

Federal Communication Commission Regulations

The FCC rules require manufacturers to comply with the FCC RF energy exposure limits for communication devices before they can be marketed in the U.S. The FCC further requires users to be fully aware of and able to control their exposure to meet RF energy exposure limits. This document includes operating instructions and information required to control your RF exposure and to satisfy compliance requirements.

RF Exposure Compliance, Control Guidelines and Operating Instructions

To control exposure to yourself and others and to ensure compliance with the RF exposure limits, always adhere to the following guidelines.

• Crescend power amplifier products are intended for use in fixed communication locations (e.g. base station sites). The antenna installation must comply with the following requirements to ensure optimum performance and compliance with the RF energy exposure limits required by the FCC.

1) The antenna should be mounted outside the site building on a roof, tower, or other support structure such that its location is inaccessible to personnel within the Minimum Permissible Exposure radius (see below).

2) The licensee must undertake the responsibility to manage the site in accordance with the applicable regulatory requirements. This may include, but is not limited to, providing advisory notices to all personnel who may be exposed to RF energy in the vicinity of the antenna, restricting access to areas adjacent to the antenna, or ceasing use of the power amplifier when RF energy exposure safety cannot be guaranteed.

• When the power amplifier is operating, a front panel LED will be illuminated. The power amplifier will be generating measureable RF energy exposure when transmitting.

• The maximum permissible exposure (MPE) radius is unique to each base site installation and is based on several factors such as the transmitter power output level, antenna gain, feed line loss, etc. It is the responsibility of the licensee to determine the MPE for the base site installation.

1) For operation below 300 MHz, the maximum exposure limit is 0.2 mw/cm^2.

2) An example calculation of the MPE radius for a 350 Watt VHF transmitter installation having a 5 dBi gain antenna and 1dB of feedline loss is provided below:

$Po = 350000$ mWatts $\quad f = 150 - 174$ MHz

$dBd = 2.85$ antenna gain in dBd

$G1 = dBd + 2.15$ gain in dBi $\quad S = 0.2 \ \frac{mW}{cm^2}$

$G1 = 5$ dBi

$CL = 1.0$ dB coax loss

$G = G1 - CL$ effective antenna gain (dB)

$Gn = 10^{\frac{G}{10}}$

$Gn = 2.512$ gain (numeric)

$R = \sqrt{\frac{(Po \cdot Gn)}{4\pi \cdot S}}$ $\quad R = 591.5$ distance (cm) required for compliance

$inches = \frac{R}{2.54}$ $\quad inches = 232.9$

$feet = \frac{inches}{12}$ $\quad feet = 19.4$

3) In instances where the effective antenna gain (antenna gain – feedline loss) differs from the example above, the MPE radius must be calculated by the licensee. The table below presents the results of calculations of the MPE radius for a 350 Watt VHF transmitter having various effective antenna gain values.

Effective Antenna Gain (dBi)	Minimum Safe Distance (meters)	Minimum Safe Distance (feet)
3.0	5.27	17.29
4.0	5.92	19.42
5.0	6.64	21.78
6.0	7.45	24.44
7.0	8.35	27.39
8.0	9.37	30.74
9.0	10.52	34.51
10.0	11.80	38.71

- Warning

Failure to observe the minimum safe distance radius may result in exposure to RF radiated energy in excess of the FCC Maximum Permissible Exposure (MPE) limit. The licensee is responsible for the safe operation of the base site and must ensure that the Maximum Permissible Exposure limits are observed at all times.