***INSTRUCTION MANUAL***

***for***

# HIGH GAIN
# MICROWAVE PREAMPLIFIER

Model: **PAM-118H**

# Table of Contents





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# 1. Introduction

This manual includes descriptions of product features, typical electrical performance parameters, specifications, and instructions for use. Also included are important safety precautions, warranty, and maintenance information.

The test procedures and guidance provided herein are for general guidance and are correct based on our understanding of the current, relevant standards at the time this manual was written. However, the information may become dated or may be inappropriate for some applications.

The user is cautioned to refer and adhere to the appropriate standards, rules, procedures, practices, and/or relevant interpretations thereof for your application in order to ensure proper application of the test.





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# 2. Products Available from Com-Power


Antennas


Antenna Kits


Absorbing Clamps


Coupling/Decoupling Networks (CDNs)


Comb Generators


Current Probes & Injection Probes


Emissions Test Systems


Conducted Immunity Test Systems


Impedance Stabilization Networks (ISNs)


Line Impedance Stabilization Networks (LISNs)


Antenna Masts


Near-Field Probe Sets


Preamplifiers


Power Amplifiers


Spectrum Analyzers


Surge Generators


Transient Limiters

Turntables


Antenna Tripods

www.com-power.com

# 3. Product Information

## 3.1 Incoming Inspection

If shipping damage to the product or any accessories is suspected; or if the package contents are incomplete, contact Com-Power or your Com-Power distributor.

Please check the contents of the package against the package inventory in section 3.2 to ensure that you have received all applicable items.

## 3.2 Package Inventory

***STANDARD ITEMS:***

- ✓ **PAM-118H** High Gain Microwave Preamplifier
- ✓ Pre-installed Battery Pack
- ✓ 12 VDC (regulated) Power Adapter/Battery Charger
- ✓ Instruction Manual
- ✓ Calibration Data
- ✓ Calibration Certificate Traceable to NIST

***OTIONAL ITEMS:***

- ✓ ISO 17025 Accredited Calibration Certificate

## 3.3 Product Safety Information

### 3.3.1 Product Hazard Symbols Definitions

The hazard symbols appearing on the product exterior are defined below.

This symbol indicates that the product is sensitive to electrostatic discharge events. In order to avoid product damage due to electrostatic discharge, the preamplifier should be grounded by an appropriate grounding wire connected to the grounding stud on the front panel of the product. When handling the product, and especially when connecting or disconnecting RF connections, the user should be appropriately grounded with an ESD strap, or discharge his/her self prior to handling. In addition, the same precautions apply to any handling of antennas connected to the preamplifier input via coaxial cabling.

### 3.3.2 General Safety Instructions

The following safety instructions have been included in compliance with safety standard regulations. Please read them carefully.

- **READ AND RETAIN INSTRUCTIONS** - Read all safety and operating instructions before operating the instrument. Retain all instructions for future reference.
- **HEED WARNINGS** - Adhere to all warnings on the instrument and operating instructions.
- **FOLLOW INSTRUCTIONS** - Follow all operating and use instructions.
- **WATER AND MOISTURE** - Do not use the instrument near water.
- **HEAT** - The instrument should be situated away from heat sources such as heat registers or other instruments which produce heat.
- **CLEANING** – Clean the instrument outside surfaces of the device with a soft, lint-free cloth. If necessary, a mild detergent may be used.
- **NON-USE PERIODS** - Unplug the power cords of the instrument and remove the internal battery pack when it will be left unused for a long period of time.
- **OBJECT AND LIQUID ENTRY** - Take care that objects do not fall into the instruments and that liquids are not spilled into the enclosure through openings.
- **DEFECTS AND ABNORMAL STRESS** - Whenever it is likely that the normal operation has been impaired, make the equipment inoperable and secure it against further operation.
- **SITTING OR CLIMBING** - Do not sit or climb upon the instrument or use it as a step or ladder.
- **ENVIRONMENTAL CONDITIONS** - This equipment is designed for indoor use. Ambient temperature range during operation should be between 5° C to 40° C.
- **STORAGE AND PACKAGING** - The device should only be stored at a temperature between –25 and +70 °C. During extended periods of storage, protect the device from dust accumulation. The original packaging should be used if the device is transported or shipped again. If the original packaging is no longer available, the device should be packed carefully to prevent mechanical damage.

## 3.4 Product Features

### 3.4.1 Front Panel Features

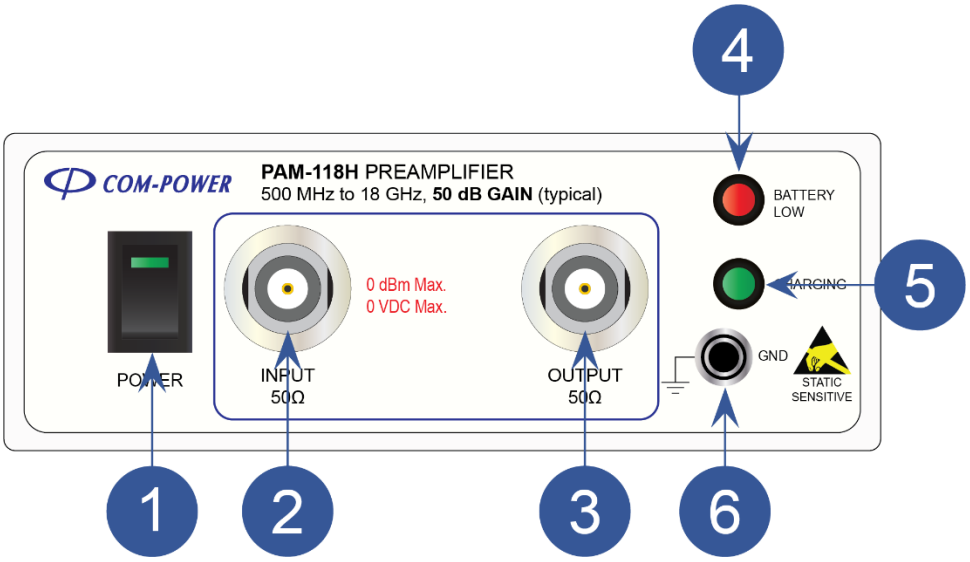


Figure 1 – Front Panel Features

1. **Power Switch**
   Toggles preamplifier power ON/OFF. Built-in LED ignites when the preamplifier is ON.
2. **RF Input Port**
   The Coaxial input port of the preamplifier.
3. **RF Output Port**
   The Coaxial output port of the preamplifier.
4. **Battery Low Indicator**
   When lit, it indicates that the battery voltage is getting low.
5. **Battery Charging Indicator**
   When lit, it indicates that the internal battery pack is being charged.
6. **Grounding Stud**
   Single point ground for ESD protection. Accepts 4 mm banana plug or spade connector.


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### 3.4.2 Rear Panel Features

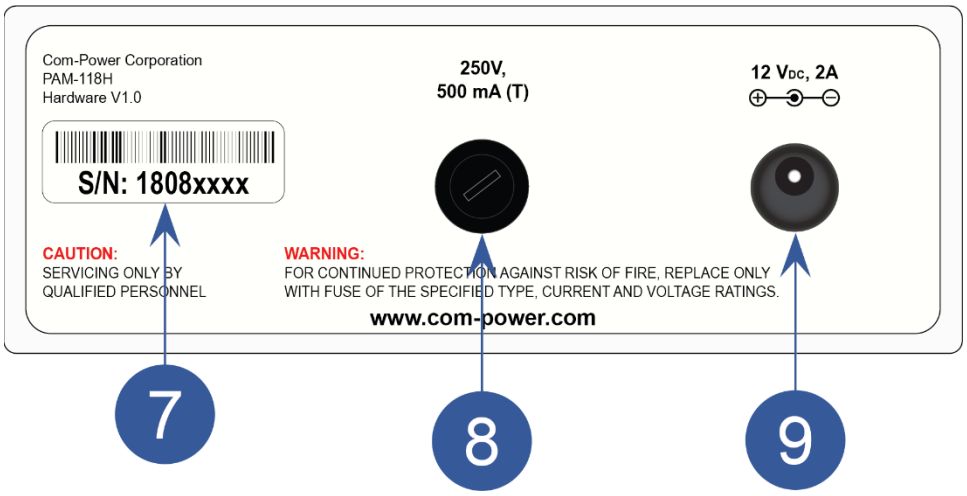



Figure 2 – Rear Panel Features

7 **Serial Number Sticker**
Shows the product serial number.

8 **Fuse Holder**
Subassembly where the fuse is located. The PAM-118H uses a type T, 250V, 500 mA fuse.

9 **Power Input Port**
The external power input port where the 12 VDC Power Adapter/Battery Charger connects to the preamplifier.

## 3.5 Product Specifications

### Table 1 – Product Specifications

| | |
|---|---|
| *Product* | **High Gain Microwave Preamplifier** |
| *Model* | **PAM-118H** |
| *Frequency Range* | **500 MHz to 18 GHz** |
| *Gain* | **50 dB** *(typical)* |
| *Gain Flatness* | **±2.5 dB** *(maximum)* |
| RF Input/Output Impedance | **50Ω** *(nominal)* |
| RF Input/Output Connectors | **Precision N-type** *(female)* |
| VSWR (Input Port) | **1.7:1** *(maximum)* |
| *VSWR (Output Port)* | **2:1** *(maximum)* |
| Noise Figure | **<4 dB** *(typical)* |
| $P_{OUT}$ @ 1 dB Compression | **+9 dBm** *(typical)* |
| $P_{OUT}$ @ 3 dB Intercept Point | **+17 dBm** *(typical)* |
| Maximum RF Input Level | **0 dBm** |
| Maximum DC Input Level | **0 Volts DC** |
| Reverse Isolation | **>50 dB** *(typical)* |
| *Battery Pack* | **6 Volts, 2 Ah NiMH** *(rechargeable)* |
| *Battery Charge Time* | **16 Hours** *(typical)* |
| *Battery Operating Time* | **13 Hours** *(new, fully-charged battery)* |
| *DC Power Adapter/Battery Charger* | **+12 Volts DC, 2 Amperes** *(regulated)* |
| *DC Adapter Connector Type* | **5.5 x 2.1 mm Plug** |
| *Fuse Type* | **250V, 500 mA (T)** |
| *Dimensions (L x W x H)* | **8.25 x 6 x 2.375 inches** *(210 x 152 x 60 mm)* |
| *Weight* | **2.5 lbs.** *(1.13 kg)* |
| *Calibration* | **NIST** *(included)*, **ISO 17025 Accredited** *(added cost)* |

*All values are typical unless specified.*
*All specifications are subject to change without notice.*

## 3.6 Product Dimensions

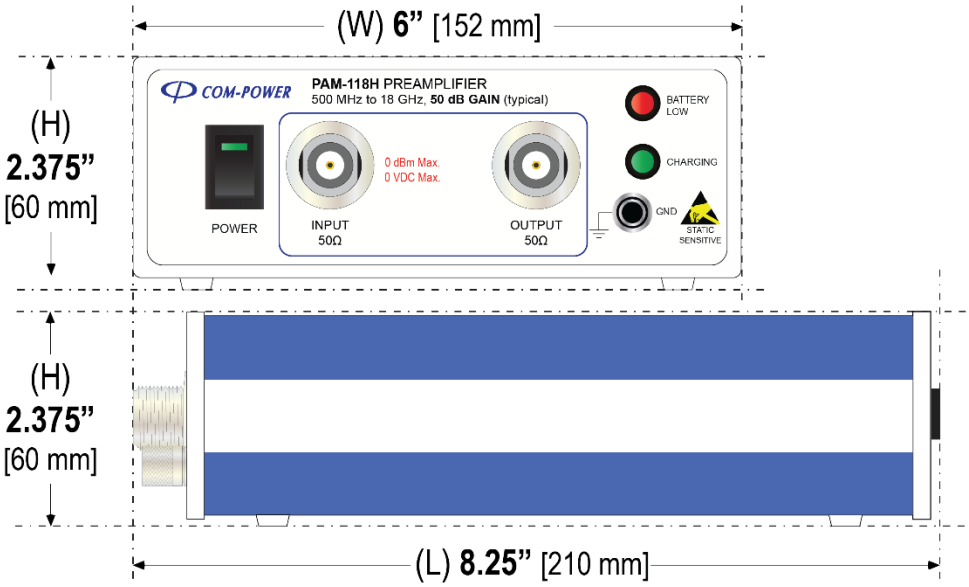



Figure 3 – Product Dimensional Diagram

## 3.7 Typical Performance Data

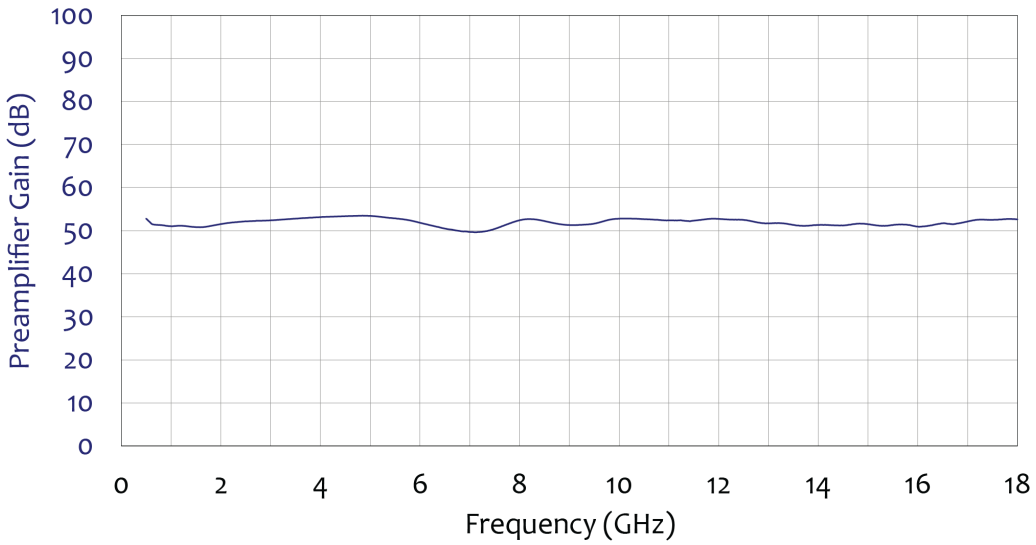



Figure 4 – Typical Preamplifier Gain

# 4. Calibration

Typically, preamplifier gain is the only parameter that requires periodic calibration. Preamplifier calibration involves applying a known signal level to the preamplifier input while measuring the level at the preamplifier output. The difference between the two is the gain of the preamplifier.

An example of a typical test setup for measuring preamplifier gain using a network analyzer is shown in Figure 5. A RESPONSE-THRU calibration of the network analyzer is performed with the two network analyzer cables connected together with a THRU standard (or female-to-female adapter), followed by the gain measurement with the preamplifier connected. The S21 results are the gain values.

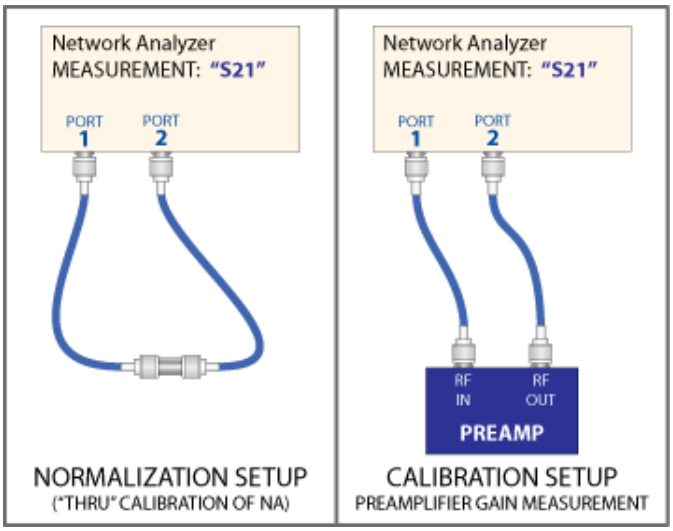
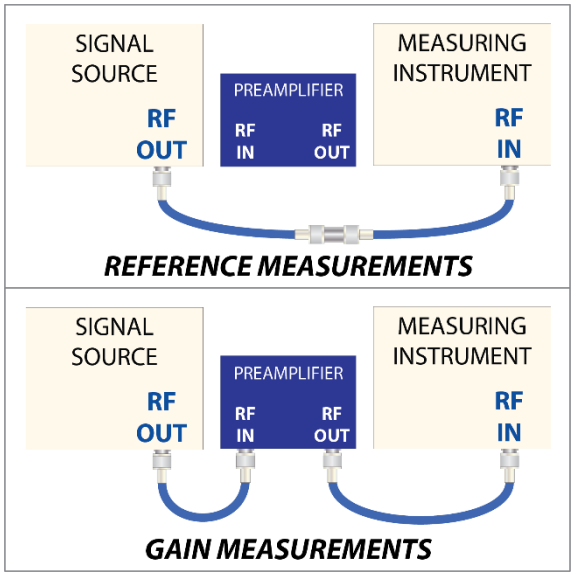



**Figure 5 –Gain Measurement with Network Analyzer**




An example setup using a signal generator and spectrum analyzer/receiver is shown in Figure 6. Reference data is taken with the RF cables connected together with a female-to-female adapter, followed by gain measurements with the preamplifier. The preamplifier gain is equal to the gain measurement data minus the reference measurement data.

**NOTE:** The most common pitfall associated with preamplifier gain measurements is applying too much power to the preamp input. This puts the preamp into saturation, yielding gain values that are lower than actual. The applied signal level should be no greater than -50 dBm (57 dBµV).

**Figure 6 – Gain Measurement with Signal Generator/Spectrum Analyzer**

# 5. Application

The intended primary application for the PAM-118H preamplifier is field strength measurements associated with EMI compliance testing. In order to achieve the necessary measurement sensitivity and signal-to-noise ratio, a preamplifier amplifies the signals picked up by the test antenna without significantly increasing the noise floor of the measurement system.

The test antenna connects directly to the coaxial input connector of the preamplifier. The preamplifier's output is connected to the input of the measuring instrument. This arrangement is illustrated in Figure 7.

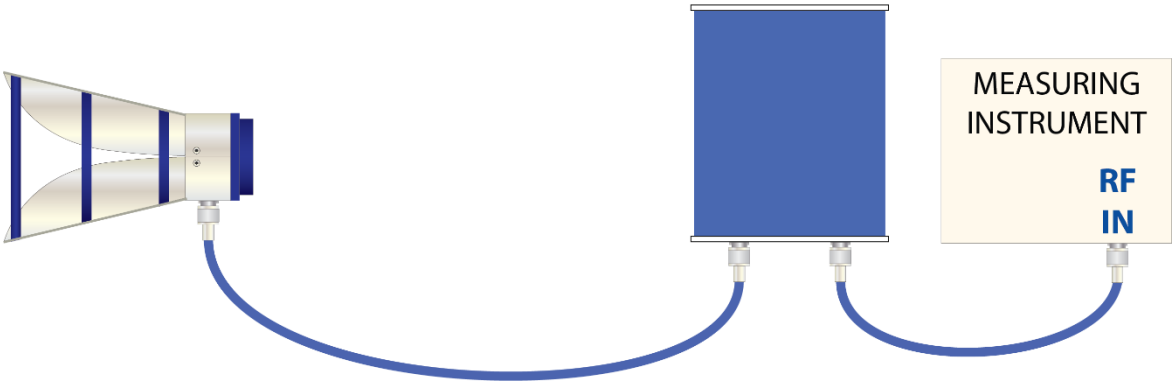



Figure 7 – Typical Measurement System for Field Strength Measurements

## 5.1 Measurement Correction

When making field strength measurements, the raw measured values must be corrected in order to determine the actual field strength. The antenna factor and the insertion loss of the coaxial measurement cables must be added to the value measured.

The preamplifier gain has to be subtracted, as shown in the following equation:

$$\underset{(\text{in } dB\mu V/m)}{\text{Field Strength}} = \underset{(\text{in } dB\mu V)}{\text{Measured Value}} + \underset{(\text{in } dB/m)}{\text{Antenna Factor}} + \underset{(\text{in } dB)}{\text{Cable Loss}} - \underset{(\text{in } dB)}{\text{Preamp Gain}}$$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## 5.2 Preamplifier Saturation

Preamplifier saturation is a common problem during EMI tests. Suppose a high amplitude signal (or signals) is picked up by the test antenna and delivered to the input of the preamplifier. In that case, saturation can occur. If the preamplifier is in saturation, the gain will decrease in a non-linear manner, leading to inaccurate measurements.

To check for non-linear preamplifier response due to saturation, insert a 10 dB attenuator between the test antenna and preamplifier input. If the signal (or signals) amplitude does not decrease by 10 dB, then the preamplifier is most likely being saturated.

Testing of intentional radiators (transmitters) often causes saturation issues, wherein the fundamental emission saturates the preamp. In such cases, high-pass or notch filters may be used at the preamp input to reduce the amplitude of the fundamental frequency.

## 5.3 Battery Operation

The PAM-118H will operate on battery power until the battery voltage drops below the minimum voltage level necessary to maintain stable operation.

The battery low indicator LED on the front panel will turn on when the battery voltage nears this minimum voltage. The preamplifier can still be used with confidence when the battery-low LED is lit. The gain will remain constant.

The preamplifier gain will remain steady until the voltage reaches this minimum voltage level; at which point the amplifier will automatically power down. When this happens, the green LED indicator on the preamplifier's front-panel power switch will turn off.

At this point, the AC/DC adapter provided with the preamp must be used to charge the battery. The preamplifier can still be used normally while the battery is charging.

If and when the battery pack no longer holds a charge, a replacement battery pack can be purchased from Com-Power. See section 5.4 for instructions on replacing the battery pack.

**TIP:** *In order to prolong the life of the battery pack, it is recommended to NOT leave the AC adapter/battery charger plugged in continuously. The preamplifier should be operated on battery power as much as possible, and only be plugged in when the battery needs to be charged.*

## 5.4 Battery Replacement

Replacement batteries can be ordered directly from Com-Power. To replace the battery pack, remove the four screws holding the white battery compartment plate in place, as shown in Figure 8(a).

The battery pack is clamped to the bottom of the battery plate. Remove the battery pack by disconnecting the battery cable and lifting the bracket by unscrewing the nut on either side of the bracket, as shown in Figure 8(b). Follow the reverse process to install the new battery pack.

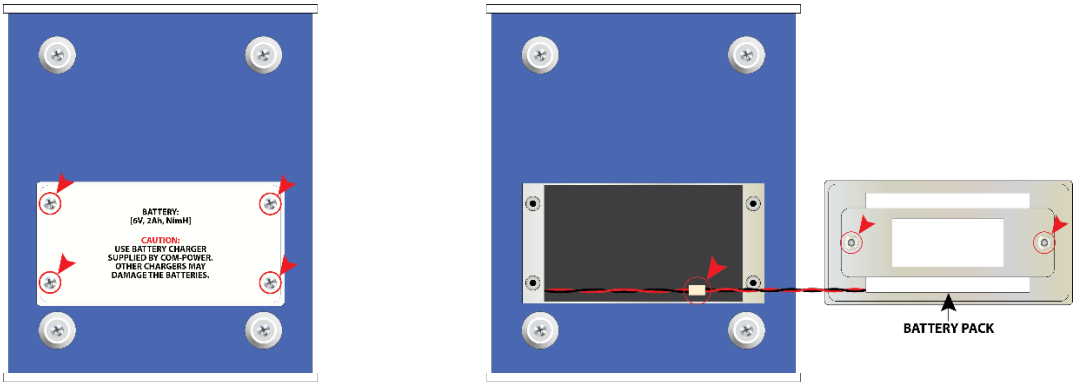


Figure 8 – Replacing the Battery Pack

# 6. Warranty

Com-Power warrants to its Customers that the products it manufactures will be free from defects in materials and workmanship for a period of three (3) years. This warranty shall not apply to:

- Transport damages during shipment from your plant.
- Damages due to poor packaging.
- Products operated outside their specifications.
- Products Improperly maintained or modified.
- Consumable items such as fuses, power cords, cables, etc.
- Normal wear
- Calibration
- Products shipped outside the United States without the prior knowledge of Com-Power.

In addition, Com-Power shall not be obliged to provide service under this warranty to repair damage resulting from attempts to install, repair, service, or modify the instrument by personnel other than Com-Power service representatives.

Under no circumstances does Com-Power recognize or assume liability for any loss, damage, or expense arising, either directly or indirectly, from the use or handling of this product, or any inability to use this product separately or in combination with any other equipment.

When requesting warranty services, it is recommended that the original packaging material be used for shipping. Damage due to improper packaging will void the warranty.

In the case of repair or complaint, Please visit our website www.com-power.com and fill out a service request form (http://com-power.com/repairservicereq.asp). Our technical assistance personnel will contact you with an RMA number. The RMA number should be displayed in a prominent location on the packaging and on the product, along with a description of the problem, and your contact information.

# 7. Maintenance

This product contains no user serviceable parts. If the unit does not operate or needs calibration, please contact Com-Power Corporation. Any modifications or repairs performed on the unit by someone other than an authorized factory trained technician will void warranty.

The exterior surface may be cleaned with mild detergent and then be wiped with a dry, clean, lint-free cloth. The coaxial connectors can be cleaned using isopropyl alcohol and a cotton swab. Use care to avoid liquids or other foreign objects entering the chassis.


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