TRIAD RF SYSTEMS

Amplifier / BDA

Troubleshooting Manual

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Triad RF Systems, Inc.

www.triadrf.com

Notice

Triad RF Systems reserves the right to make changes to its products or discontinue any of its products or offerings without notice.

Triad warrants the performance of its products to the specifications applicable at the time of sale in accordance with Triad's standard warranty.

Revision History

Version	Date	Changes	Author
1.0	6/27/18	Initial Release	Chris DeAngelis

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1. Overview

This document provides examples and remedies to common questions/issues with Triad RF Systems' commercial off the shelf (COTS) Power Amplifier (PA) and Bi-Directional Amplifier (BDA) product line.

The instructions provided here will require a copy of the product's specification sheet, which can be obtained from our website at www.triadrf.com.

Certain custom-designed products may have been supplied with a different set of operating manuals or interface control documents. In those cases, the recommendations of the documents supplied supersede the ones contained in this manual.

For any additional information, or to suggest any clarifications / additions to this document, please contact support@triadrf.com

⚠ **Notes that accompany the warning symbol denote instructions and guidelines that must be followed. Failure to follow these guidelines may result in damage to the amplifier that is not covered by Triad's product warranty.**

2. DC Power Issues

2.1 Unit will not turn on when voltage is applied

2.1.1 DC Connector Wiring

Consult the section of the product's specification sheet listing the connector pins, types, and voltage levels in or out of them. Ensure that they are connected to the appropriate circuitry in the system.

Inspect both the wire harness and connector on the amplifier for damage or debris, then connect either the Triad-supplied or self-assembled mating connector. Ensure that the connector orientation is correct and that any locking features (tabs, captive screws) are used.

Ensure that the cables or wires used for +VDC and GND are the proper length and gauge based on the product's operating voltage and DC current draw.

Check all I/O connections listed on product's spec sheet and ensure the proper corresponding connections have been made between the amplifier and the radio.

⚠ **Take care to note which pins are inputs and which are outputs for the product you are working with, along with their safe voltage ranges. Applying a voltage to an output pin, or applying an incorrect voltage to an input pin may result in damage to the amplifier.**

2.1.2 Power Supply Voltage Rating

Most Triad products employ the use of over/under voltage protection. However, exceeding the normal operating voltage range will cause the unit to shut down and may result in permanent damage to the amplifier.

Consult the product's specification sheet carefully. The supply voltage provided should fall within the voltage range listed in the product's specification sheet. Many of our products employ internal DC-DC conversion to accept a wide range of input voltages, but some do not.

⚠ **Over / under voltage conditions outside of the range listed on the specification sheet should be avoided, even if the protection feature is present.**

2.1.3 Power Supply Current Rating

Consult the amplifier's spec sheet for the quiescent and operating current draw of the PA/BDA.

When DC power is supplied to the unit, there will be an inrush current drawn as some internal components charge up (e.g. bypass capacitors, internal DC-DC converter filters). Refer to the spec sheet of the amplifier for a plot of inrush current, which is provided with most units.

A good general guideline (if system size / weight allows) is to select a power supply that can supply 1.2x the maximum expected current draw of the amplifier when implemented in your system. If this exceeds the maximum current rating of the power supply, this may result in the supply going into over-current protection mode.

Note:

Most units' operating current draw increases with an increase in drive power (and corresponding RF output power). Newer specification sheets contain a plot of current

draw vs. RF output power. If your system does not intend to operate the amplifier at its maximum rated output power, refer to the plots provided to size an appropriate power supply.

Contact support@triadrf.com if you have followed the above guidelines, but experience a power supply going into over-current protection mode during amplifier power-up. Applications engineering can provide some additional guidance on managing inrush current without having to resort to using a larger power supply.

2.1.4 "Enable" or "Tx/Rx" TTL Control Line

While some Triad BDAs are configured with Automatic Tx/Rx switching, some units require the Tx/Rx switching to be manually controlled via the TTL switching control line supplied by the radio. Please consult the Triad BDA integration manual for your radio for more information and instructions on making the proper connections. **If no Triad BDA integration manual for your radio exists please contact** support@triadrf.com **for help with radio integration.**

Every Triad amplifier is available with a pre-wired connector harness. The part number is CBLXX where XX is a 2 digit number – the appropriate cable P/N is listed on the product spec sheet. Cable harnesses can be purchased from Triad, or a drawing of the harness can be emailed upon request if self-assembly of the harness is preferred. Contact support@triadrf.com for a drawing set.

2.2 Unit Powers Down After Some Time of Use

2.2.1 Insufficient Heatsinking

For most applications, appropriate heatsinking is required on all PA and BDA products that have not been ordered with the heatsink option, or that are not units with integrated cooling.

All amplifiers should be conduction cooled through their baseplate mounting surface, and during operation, the baseplate temperature must not exceed the operating temp range listed in the spec sheet.

Some products have an over-temperature protection feature built in, which will automatically shut off the amplifier if it exceeds a certain baseplate temperature. Once this thermal shutdown occurs, the unit will remain in an off state until the temperature decreases about 10 degrees Celsius from the thermal shutdown point, at which point it will turn back on.

2.2.2 Tips for proper heatsinking:

If the amplifier is going to be installed into a system that has the heatsinking built in (e.g. internal system heatsinks or cold plates), ensure that the following guidelines are followed:

- The heatsink surface that the amplifier's baseplate is going to be mounted to should be milled, skim cut, and / or polished to a smooth finish.
- The heatsink surface must be clean and free of any objects that will interfere with proper interfacing with the amplifier baseplate.
- Use all of the mounting screw holes provided on the amplifier housing to affix it to the heatsink. Some of these screw holes have been specifically located near heat generating parts and are critical for correct heat transfer.
- A thermal interface material (TIM) must be used between the amplifier baseplate and the heatsink surface. Examples of appropriate materials include Laird T-

GON 800, Tennmax GP5000, and Dow-Corning 340 Thermal Grease. T-GON sheets can be purchased through Triad if needed.

- If using a TIM that is in sheet form, ensure that the sheet is cut to a size that completely covers the amplifier baseplate.
- If using thermal grease, follow the application instructions carefully.

⚠ **Failure to follow the above guidelines could lead to an amplifier overheating.**

⚠ **Some products do not feature over-temperature protection – consult the spec sheet carefully to verify. Failure to keep the PA within its safe baseplate operating temperature range may cause damage not covered by the warranty.**

3. RF/Data Issues

3.1 Intermittent or Non-Existent Data Link

3.1.1 RF Connections

Before making any RF connections, inspect both the connectors on the amplifier and your system's connectors. Ensure both connector interfaces are clean and free of damage, dirt, or foreign objects.

Use a calibrated wrench to tighten SMA / N connectors to the appropriate torque when installing the amplifier in your system.

For amplifiers that feature snap in connectors (such as SMP or MMCX), ensure that the connector is aligned correctly and that an positive tactile click is felt when installing it.

SSPA Connections

SSPAs will have their input and output RF connections labelled "RF IN" and "RF OUT", respectively. Connect an antenna or an appropriate 50 Ohm load to the RF OUT port and the radio / RF stimulus to the RF IN port.

BDA Connections

BDAs will have their input and output RF connections labelled "RADIO" and "ANTENNA", respectively. Connect an antenna or an appropriate 50 Ohm load to the ANTENNA port and the radio / RF stimulus to the RADIO port.

⚠ **Before turning on the SSPA / BDA, ensure that the RF input power to the amplifier is set appropriately. This will avoid amplifier damage, or damage to system components downstream from the amplifier.**

3.1.2 DC / Control Connections

Inspect both the wire harness and connector on the amplifier for damage or debris, then connect either the Triad-supplied or self-assembled mating connector. Ensure that the connector orientation is correct and that any locking features (tabs, captive screws) are used.

Consult the section of the product's specification sheet listing the connector pins, types, and voltage levels in or out of them. Ensure that they are connected to the appropriate circuitry in the system.

3.1.3 Radio Power Level Causing Amplifier Saturation

At a certain point, excess radio power can run the amplifier into saturation. Once this happens, the Signal to Noise Ratio (SNR) may become too high for the radios to make a successful connection between them.

If this seems to be the case, start by reducing the radio output power by 0.5 dB or 1 dB steps. Each time the power is decreased, take note of the data link and check the Signal to Noise Ratio (SNR) on each radio. Some radios will have trouble maintaining a data connection at SNR levels lower than 15.

3.2 Data Transfer Rate Lower Than Desired

3.2.1 EVM level / Modulation

With an increase in output power also comes an increase in Error Vector Magnitude (EVM). Once the EVM reaches a certain threshold, most radios will change the modulation scheme in order to maintain the best data rate to match the EVM conditions. As EVM increases, the radio may switch to a more basic modulation scheme, which in turn will reduce the data transfer rate.

Start by reducing the output power of your radio by a small step, running a bandwidth test each time. Take note of the modulation scheme or data rate, and verify that the data rate increases as the power level decreases. Take note of the point is reached where decreasing the output power does not increase the data rate, as this will likely be the optimal power level for the system.

For continuing issues, or to request any clarifications or additions to this document, please contact support@triadrf.com