Bi-Directional Amplifier Extends Range of Data, Video, and Communications Links

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There are a large number of commercial and military data links and other communications applications in which the ability to “bolt on” additional RF output power to a low-powered transceiver while increasing its receive performance can dramatically expand the host system’s range. Examples include remotely-controlled mobile robots that search disaster sites (or a building suspected of housing the enemy), small UAVs increasingly used for police surveillance and various non-law enforcement scenarios, and enterprise voice, data, and video surveillance or communications networks that need to serve a larger area than when they were installed. In general, any communications link can benefit from such a cost-effective solution.

To serve these applications, Triad RF Systems has introduced the Model TTRM1010 bi-directional amplifier module (Figure 1) that delivers 5 W (+37 dBm) from 30 MHz to 3 GHz in a compact, rugged enclosure measuring only 3.25 x 2 x 1 in.

The TTRM1010 is best defined by what it is not — a consumer-grade “BDA” that many people use as a cheap way to increase the performance of wireless-enabled devices inside their homes. While many of these products are well-made, they are not suited for operating in the environmental conditions typically encountered in unmanned vehicle applications. Further, these mass-market devices are typically not available in frequency bands other than those used by commercial telecommunications operators. The TTRM1010 contains numerous features that benefit military and high-end commercial users. These features include high-performance transmit and receive sections, high-speed switching, and a power supply with a wide input voltage range of +9 to +30 VDC (Figure 2).

The module is constructed with the RF transmit section on the top side of a multi-layer board and the receive section on the bottom side to provide isolation between the two. The wide-input-range DC supply is housed in its own section that sits on top of the RF portion. This modular approach provides high temperature range of -20º C to +85º C and an altitude up to 30,000 ft.

An Application Example

In a UGV application (Figure 3), a TTRM1010 can be integrated between the transceiver and the antenna on both the control station and on the robot’s transceiver. These transceivers’ radio cards often have low RF output power that limits their range and sometimes their performance within that range. The substantial increase in power provided by the TTRM1010 can significantly extend this range while the improved receiver performance helps ensure return path sensitivity matches requirements of prime contractors.
the extended range of the transmit path.

In cases in which an amplifier cannot be utilized at both ends of the RF link, a directional antenna in conjunction with a single TTRM1010 can be used at the control site to enhance performance. Link budget gains can still be achieved in this case, as the front end of the TTRM1010’s LNA section often has a lower noise figure than the transceiver’s receive chain. The same scenario can be applied to unmanned sea or air-based platforms.

One of the key advantages of the TTRM1010 is its broad range of operating frequencies. Many systems operate in the Industrial, Scientific, and Medical (ISM) bands and the TTRM1010 operates on these widely-used frequencies. Other systems, especially those used by the Department of Defense, operate at other frequencies accommodated by the TTRM1010 as well, and still others operate in bands allocated for use in applications such as port surveillance, many of which the TTRM1010 also supports. The ability to operate from HF through S-band also allows a single TTRM1010 to accommodate system changes or to be used in different systems within an organization.

The transmit section of the TTRM1010 has a typical Third Order Intercept Point (OIP3) of 47 dBm, gain of 23 dB +/-1 dB, and typical harmonic and spurious signal rejection of -60 dBc, providing a very linear RF signal from the transmitter. The receive section has gain of 20 dB +/-1.5 dB. Switching time from transmit to receive is less than 2 µs, and typical return loss of both sections ranges from -14 to -16 dB. The module is switched to transmit or receive states via a TTL input, and an analog voltage output is provided for temperature monitoring.

One of the most common problems faced by amplifier manufacturers is units that have been returned for repair resulting from damage by use of an out-of-range or reversed supply voltage. These kinds of returns can easily be prevented, avoiding repair costs and down time for both the customer and supplier. The TTRM1010 (and all of Triad RF Systems’ amplifier products) solves this problem by using a circuit that shuts down the amplifier and protects sensitive components when the input voltage is too high, too low, or reversed. This protection is active during initial turn on and when the amplifier is in operation.

While the TTRM1010 operates from a supply voltage as low as +9 VDC and as high as +30 VDC, during testing it has been exposed to a reversed input voltage as high as 50 VDC without damage. The amplifier is also protected against over-temperature conditions. The TTRM1010 is the latest member of the company’s bi-directional amplifier product line, which includes the TTRM1006 (1 W or 5 W, 20 MHz to 2.5 GHz) and narrowband models designed for specific applications. Detailed specifications are shown in Table 1. All models can be weatherized and many parameters can be varied to meet specific customer requirements. More information is available at www.triadrf.com or 1-(855) 558-1001.

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UHF, low pass filter that covers the 10 to 500 MHz band and has an average power rating of 400W CW. It incurs a rejection of 45 dB minimum at the 750 to 3000 MHz band, and power rating of 25W CW from 501 to 5000 MHz.

Werlatone LTE Band 14 Ceramic Duplexer This high performance LTE ceramic duplexer was designed and built for use in public safety communication and commercial cellular applications. It operates in Band 14 and offers low insertion loss and high isolation to enable clear communications in the LTE network.

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