

MILITARY MICROWAVES

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ZERO dB™ COAXIAL CABLE ASSEMBLIES FOR HIGH PERFORMANCE AIRCRAFT



TIMES MICROWAVE SYSTEMS
Wallingford, CT

Times Microwave Systems has recently developed an integrated LNA package to allow the location of a low-noise amplifier (LNA) at the antenna, ahead of the cable assembly, in high-performance aircraft. The use of an LNA directly at the antenna is not a new idea. Most satellite receivers take advantage of this technique and the ubiquitous DBS antennas on many homes all have an LNA built into the feed horns. However, what is an easy job for a home receiver becomes a very difficult one for high-performance aircraft, due to size constraints and environmental problems, including vibration.

Times Microwave Systems has solved this with an LNA built into the connector of the aircraft cable assembly requiring no additional space or power to be needed at the antenna. A photo of the assembly is shown above. The LNA is a balanced configuration employing Lange couplers to maintain a good VSWR at the input and output. The assembly also includes a limiter at the input to protect the LNA from power levels up to +30 dBm (1 W). A schematic of the amplifier assembly is shown in **Figure 1**. The amplifier has a

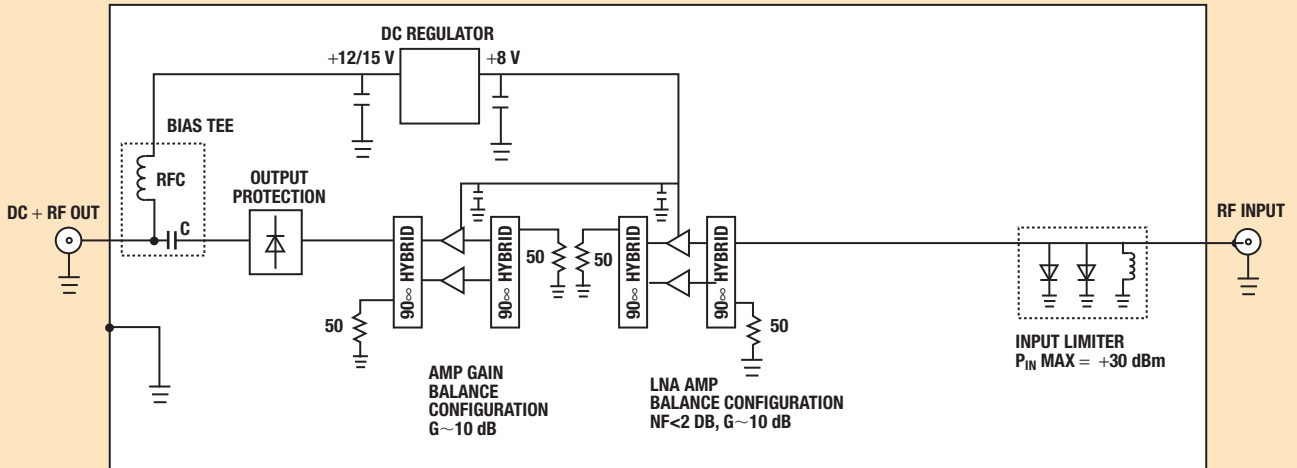
noise figure of less than 3 dB with a gain of 20 dB. It has a demonstrated MBTF of 100,000 hrs. per MIL-STD-810 and can provide both temperature compensation to flatten the delta loss to within about 0.5 dB and equalization of ± 1.0 dB from 500 MHz to 18 GHz in the bands of operation. While not shown in this model, a bi-directional switching device to allow amplification in the receive mode and a by-pass for transmitted power can also be incorporated.

The amplifier is powered through a bias tee at the opposite end of the cable. It accepts standard aircraft 28 VDC through a standard military connector or other customer specified interfaces and regulates and filters it to 12 to 15 VDC. The schematic of the bias tee is shown in **Figure 2**. The 12 to 15 V from the bias tee and cable is further regulated down to 8 V in the amplifier assembly for use by the LNA and any other related circuitry. The minimum isolation of the bias tee is 50 dB.

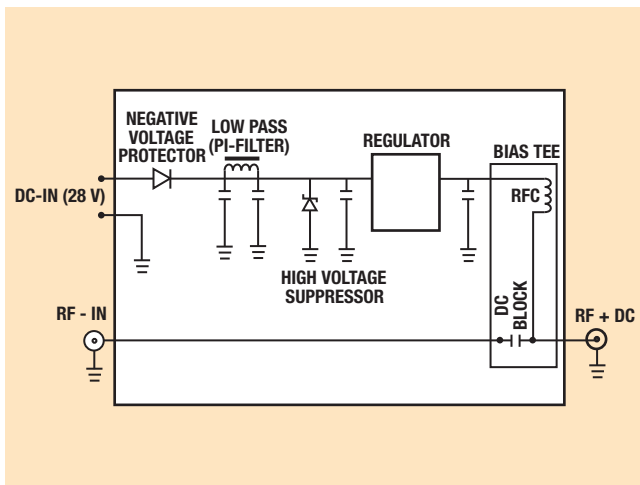
NOISE FIGURE CONSIDERATIONS

The obvious advantage of this assembly is the improvement in noise figure of

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▲ Fig. 1 Amplifier assembly schematic.



▲ Fig. 2 Bias tee schematic.

the system. The cascaded noise figure of a system is

$$\text{Noise Figure}_{\text{dB}} = 10 \text{ Log } F$$

$$F_{\text{cascade}} = F_1 + \frac{F_2 - 1}{G_1} + \frac{F_3 - 1}{G_1 G_2} \dots \text{etc.}$$

Any resistive loss prior to the first stage, such as a 12 dB cable loss, will add directly to the noise figure. However, with an LNA having a 3 dB noise figure and 20 dB of gain in front of the cable, the cascaded noise figure of the system is 3.31 dB, thus virtually eliminating the effect of the cable.

CONCLUSION

A unique cable assembly with built-in LNA and power supply functions has been developed for high-performance military aircraft in order to eliminate the traditional cable losses between the antenna and the receivers, which are located remotely from the antenna on the aircraft. The major specifications are a noise figure of less than 3 dB, gain of 20 dB, frequency bands from 500 MHz to 18 GHz and input protection up to +30 dBm. The assembly is designed to operate from 28 V unfiltered aircraft power with a maximum current of 1 A (200 mA typical).

