TESTING RADAR SYSTEM PERFORMANCE

Steve Shaw, Applications Engineer, Wireless Telecom Group, looks at how to test a primary or secondary radar system using a simple RF setup

Due to ever increasing commercial air travel and heightened security concerns for the military, it is now more important than ever that aviation radar systems perform at their optimal levels. As well as the ever present natural sources of interference, our airways are filled with more and more sources of artificial interference. The natural background noise is fairly constant, but the increase in wireless communications traffic can cause unintentional interference in radar receive bands. Added to this, there is also a risk from intentional interference, or jamming by hostile entities. These factors make it important to characterise your radar system and clearly understand its limitations.

UFX 7000A

Primary Radar is a pulse modulated sinusoidal carrier signal. The output of this type of radar has short duration pulse bursts with fast rise-time power envelopes to allow detailed target resolution, whilst long pauses between pulses provides enough time for distant signals to return without interfering with the next pulse. These high power pulsed signals may have rise times under 10ns with pulse widths in the microsecond or sub-microsecond range. The low duty cycles create large peak to average ratios, therefore making accurate power measurements with traditional thermal detectors difficult. So in this case, a wide dynamic range peak power sensor is required in order to accurately measure the power of the transmitted pulse.

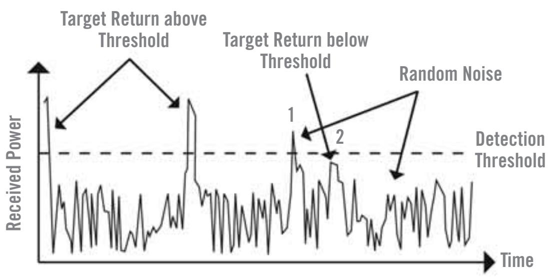

Figure 1

These types of radar signals require large system signal to noise ratios (SNR) to locate and define the target properly. Hence the receiver portion of a radar system must be resistant to natural background RF radiation, unintentional wireless communication signal interference and jamming. An advanced peak power meter in conjunction with a precisely controlled noise generator to enable the accurate setting of SNR is therefore a powerful method of testing radar system performance.

Figure 1 shows a typical return signal from a pulsed radar system, including the target signature, random noise and deterministic false alarms. A specific threshold must be determined to discriminate between the real target and the noise. The minimum power value that can be sensed is equivalent to the minimum detectable signal of the radar receiver, and this level must be calculated in order to determine the maximum detection range of the system. Point 1 is a false positive, where the noise is above the test threshold, and point 2 is an undetected target return below the threshold. These kinds of issues can be resolved by the latest DSP circuitry by averaging out the common mode noise and correlating deterministic events that rise above the detection threshold.

To test a system, the transmitted signal is passed through a directional coupler so that a peak power meter such as a Boonton 4500B can measure any system mismatch. The ratio of forward to reflected power, or return loss, is an important figure because the actual transmit power determines the maximum working distance of the radar system. The radar transmitter's output trigger pulse can be used as an external trigger input to the peak power meter. A Noise Generator such as a UFX 7000A is used to emulate any type of interference signal at precise SNR levels in order to disturb the receiver system. This type of simple set up is relevant for both ground and airborne systems.