Checking Microwave Radio Performance with a Simple ERP/MDS Test Unit
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Before heading for the hills with 10 GHz equipment around contest time, we in the San Diego Microwave Group check the Effective Radiated Power (ERP) and Minimum Discernable Signal (MDS) with the simple setup described in this article. We hold the test sessions at the June and July meetings in preparation for the ARRL 10 GHz & UP Contest in August and September. The advantage to having two sessions is that it provides a second opportunity to verify improvements or allow participation if the first session is missed. The test unit works with both wide band and narrow-band radios.

The overall setup consists of a pole mounted X-Band converter unit connected by coax to a signal source (for MDS) and an amplifier/power meter located near the radios to be tested some 200-300 feet away. The MDS test need to be performed first to align the radio antennas with that of the converter. A signal generator is connected to the IF coax and a suitable frequency (145 MHz) and power level (-40 dBm set to transmit an easily detectable carrier around 10368 MHz at the output of the converter. The radio antennas are peaked for maximum signal as the power level of the signal generator is reduced to the point where it is no longer detectable by the radios. The level at which the signal can just be detected is considered the MDS. The ERP measurement is performed by connecting the IF coax to the amplifier and power meter. Each radio transmits one at a time and the power meter reading recorded. The variable attenuator is adjusted to keep the reading in a suitable power range for the power meter and amplifier.. For the amplifier used, the maximum output power was about +10 dBm and the power meter range is about –20 to + 10 dBm so the attenuator was adjusted to keep the reading in the –20 to 0 dBm range.

The choice of the IF frequency for the converter depends on what is available for a 10 GHz local oscillator but needs to be low enough to keep the losses reasonable through hundreds of feet of coax. The amplifier gain and maximum output need to be based on the power meter characteristics. The signal generator needs to match the IF frequency chosen, have suitable stability for CW work (NB only), and have variable output (may be an external attenuator).

The Converter consists of a Frequency West Brick as a 10,223 MHz local oscillator for a mixer used as an upconverter for MDS and down converter for ERP. The converter has a 13 dB horn antenna connected to the mixer RF port. Power is supplied by a 12V battery on the ground with a DC/DC converter supplying the required voltage for the Local Oscillator. The coax used is 300 feet of RG-59 which was readily available. No attempt to correct matching losses for the 75 ohm coax has been made. The loss of the coax and mixer as well as the amplifier gain was measured at the operating frequencies. It is not really necessary if only relative measurements are to be performed but it does allow a good comparison between measured and calculated values.

The results of the test are entered into the spreadsheet, which then calculates the ERP based on dish size in inches and estimated PA output of the radio under test. The distance in feet from the radios to the converter is input to the sheet, which then calculates the path loss in dB. For ERP, the sheet provides calculated ERP, measured ERP and the difference between them. For MDS at this time, only the signal generator level is recorded and is used for relative measurements.