HEWLETT hp PACKARD

ACCURATE RECEIVER SENSITIVITY MEASUREMENTS

application note 68

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This Note describes a very accurate technique for making microwave receiver sensitivity measurements. Standard, readily available test instruments are used for the measurement and even the measurement technique itself is very simple. The technique either eliminates or greatly minimizes several of the sources of error that normally occur in typical receiver sensitivity measurements. The basic setup is shown in Figure 1.

The procedure is as follows:

1. The signal generator output is adjusted to as low a level as can be accurately read on the power meter. With temperature-compensated power measuring equipment, such as the hp 431B Power Meter and appropriate temperature-compensated thermistor mount, this level can be in the -20 to -25 dbm range. At this stage, the power actually delivered to the receiver is less than the measured amount by the coupling factor of the directional coupler used. For example, with -20 dbm reference established on the power meter and a 20-db directional coupler, the power level into the receiver is -40 dbm.
2. Note the reading of the signal generator output attenuator dial corresponding to this initial condition. Since the actual power level is being monitored with an external power meter, a signal source can be used for this measurement just as well as a signal generator; the only requirement is that the generator/source used in the test must contain an accurate and variable output attenuator. In the frequency range 0.8 to 4.5 Gc, the hp 8614B or 8616B Signal Sources are especially convenient; these sources contain a friction clutch arrangement on the output attenuator dial system which permits the digital readout of the attenuator setting to be placed at any convenient figure. Thus, the dial setting in this example could be set to indicate 40 db, representing the -40 dbm level actually present at the input to the receiver.
3. Reduce the signal generator/source output until the receiver under test indicates the minimum discernible signal (or whatever other criterion is used to define the sensitivity for the particular receiver under test). This sensitivity can then be read from the signal generator/source attenuator dial; it is simply the additional attenuation in db below the reference setting established in step 2 added to the absolute power reference first established in step 1 (referred, of course, to the input of the receiver).

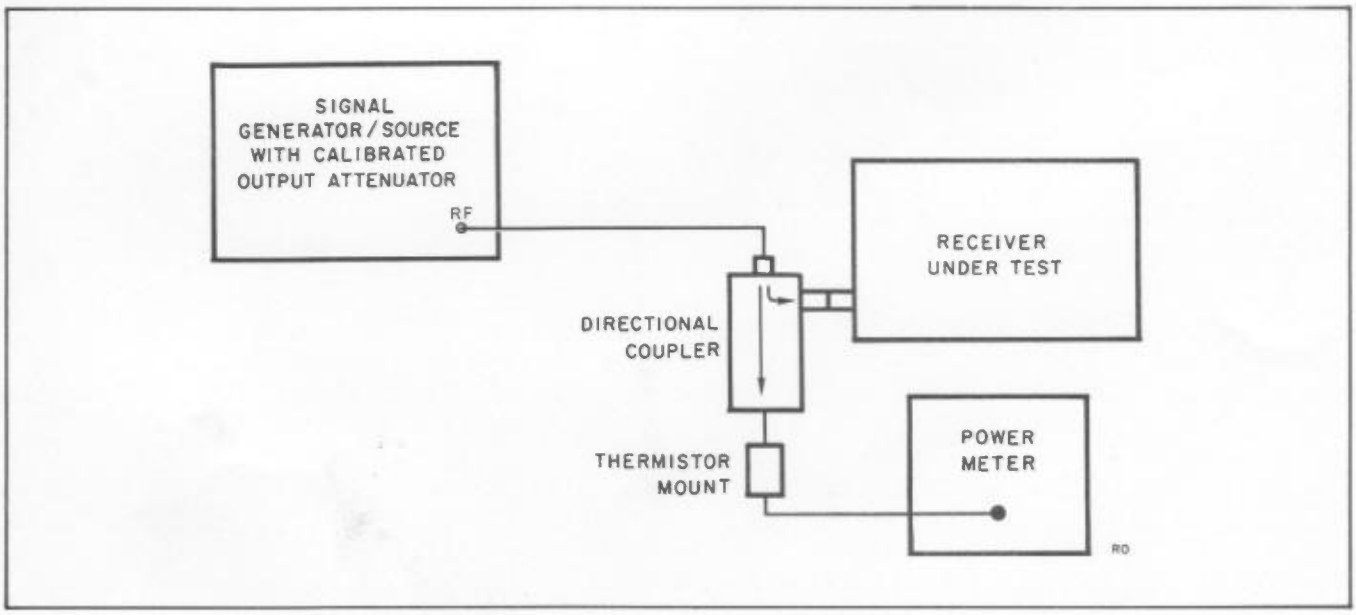

Figure 1. Basic Setup for Receiver Sensitivity Measurements

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The reasons this technique provides more accurate sensitivity measurements are:

1. All power measurements are effectively made right at the input to the receiver so the insertion loss of the cable used to connect the signal generator/source to the receiver does not enter into the measurement.

2. Measurement uncertainties due to mismatch losses are considerably reduced because directional couplers will typically exhibit SWRs well under 1.2 or 1.25 in coax (even less in waveguide) whereas a signal generator's output attenuator system typically may have SWRs in the range of 1.5 to 2.

3. Because an accurate power meter and thermistor mount are used, the initial absolute power level reference is more precisely known that would be the case were reliance placed only on the absolute power calibration of the signal generator (±1 db to ±2 db is a typical specification for absolute power output accuracy of precision signal generators).

4. Because a fairly large amount of accurately known attenuation (i.e., the coupling factor of the directional coupler) is installed between the signal generator/source and the receiver under test, the range of attenuation over which the signal generator's attenuator must be moved to reach the point of maximum receiver sensitivity is correspondingly reduced, thereby reducing the magnitude of errors resulting from possible non-linearities in the signal generator output attenuator system. This sort of error is usually small, however, particularly with well-designed, well-shielded signal generators or sources which employ waveguide-beyond-cutoff type output attenuators (0.06 db/10 db is the specified maximum deviation from linearity for the hp 8614A/B and 8616A/B instruments).

Hewlett-Packard offers a complete line of precision microwave measurement instruments which can be used to perform the above sensitivity measurements. In addition to signal generators and sources, power meter and thermistor mounts, hp manufacturers precision directional couplers for both waveguide and coaxial systems, thereby providing complete coverage. Your hp Field Engineer will be pleased to assist you in implementing this measurement technique.

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