Application Note

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Insertion power measurements with the 9102 and 9103 Handheld Spectrum Analyzers

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Insertion power measurements with the 9102 and 9103 Handheld Spectrum Analyzers

This document describes a method of measuring both the transmitted and reflected power, and explains a suitable measuring setup based on Willtek's 9102 or 9103 Handheld Spectrum Analyzer with the 9162 Insertion Power Sensor. Typical examples for applications include measurements at transmitters with a relatively high output power, such as:

- Acceptance and service tests at base stations and antenna systems, as well as mobile radio installations
- Power measurements at radio equipment and relay stations
- Power measurements at lab equipment, such as RF amplifiers

The hand-portable 9102 or 9103 with built-in battery supports spectrum and power measurements anywhere.

Method of measuring the power

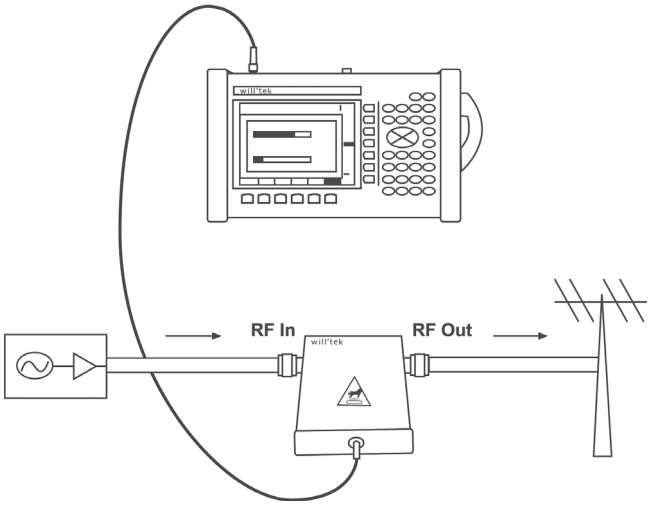
In most cases, you will measure power within a selected frequency range: The power density is integrated over a certain frequency range and RMS-averaged over several measurements. For measurements of small power, typically a highly sensitive diode measuring head is used. This device senses power over a relatively wide frequency range, although its optimum accuracy is achieved within a specified range. Alternatively, thermal measuring heads are available that can measure the RMS value over a wide power range, independent of the form of the signal. With a peak value measuring head, however, the maximum power is captured, but this is of no interest in most cases where communication systems are checked.

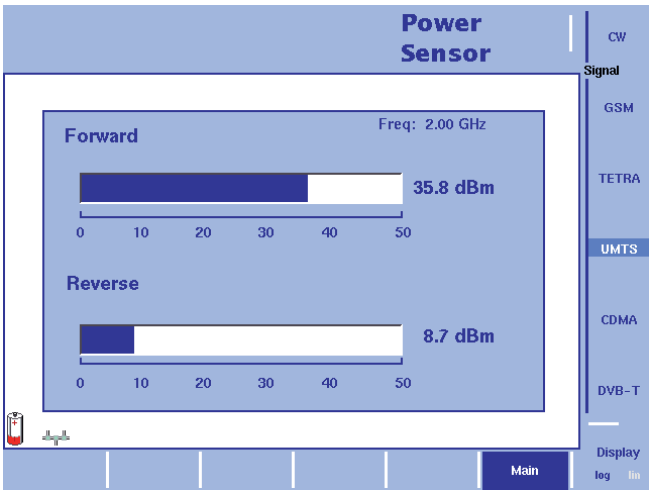
In measuring devices that operate for broadband measurements, the diode measuring heads are available either as terminating or as insertion power sensors. Capacitive coupling is applied to couple the insertion power sensor to the high frequency wire, allowing measurements of the reflected power as well. From the combination of transmitted and reflected power, the VSWR and the return loss can be calculated. These measurements are of interest usually for power levels above a watt and for a certain frequency range, so insertion power sensors are typically restricted in power and frequency range.

Willtek's insertion power meter

The 9162 Insertion Power Sensor is a measuring head capturing the transmit power in the range from 70 MHz to 2.7 GHz and at levels between +20 and +47 dBm. The power sensor is connected to the 9102 or 9103 Handheld Spectrum Analyzer by way of a data cable; the spectrum analyzer continuously displays the measured power both numerically and as a bar chart.

Normally, one connector is used to apply the signal under test to the spectrum analyzer. The 9162 Insertion Power Sensor, however, uses two N-type connectors so that the measuring head can be coupled to the running system at minimal impact. The two connectors facilitate measurements of both the transmit power and the reflected power. The two results can either be indicated in linear terms (i.e. in watts) or on a logarithmic scale (in dBm).





Signal form and frequency impact the result

As explained above, inexpensive diode sensors are optimised for a certain frequency range. The 9162 Insertion Power Sensor covers a relatively wide range; the centre frequency of the signal to be measured should be entered in the 9102 or 9103 with an accuracy of 1 MHz, as the 9162 corrects the measurement according to the frequency response internally stored. This way, the measurement accuracy is optimised!

The effective power of a standard CW or FM signal is easy to measure. Modern, digital signal formats, however, pose new challenges for the power measurement. Modulation schemes such as pi/4 DQPSK, 8PSK and 16QAM all have their special peak to average power ratio (crest factor). Moreover, when taking measurements of TDMA signals, you will only want to know the effective power in the active time; averaging over another time interval or including overshoots in the rising or falling edge would lead to wrong or different results.

In the 9102 and 9103, you can select the appropriate communication system you are testing (e.g. GSM, UMTS, DVB-T). With this particular information, the 9102 and 9103 can adjust filters and measurement intervals, so that the effective power is captured most precisely.

So by setting up the signal type and frequency, you can optimise the measurement accuracy depending on the signal to be tested.

Connections and setup

In order to carry out the measurement, you will need a 9102 or 9103 Handheld Spectrum Analyzer with the 9162 Insertion Power Sensor and suitable cables. Please proceed as follows:

1. Connect the cable attached to the 9162 Insertion Power Sensor with the Multi Port of the 9102 or 9103 Handheld Spectrum Analyzer.

2. Connect the signal source (e.g. transmitter, radio equipment or amplifier) to the RF In plug of the 9162 Insertion Power Sensor using an RF cable with N-type connector.

3. Connect the RF Out plug of the 9162 Insertion Power Sensor with the signal sink (e.g. an antenna or a terminating impedance) using an RF cable with N-type connector.

4. Power on the 9102 or 9103. You will need instrument software version 5.00 or higher; up-to-date instrument software can be found on the Internet at www.willtek.com.

5. Select MODE > Power Sensor for the Power Sensor menu.

6. Press the FREQ key and enter the centre frequency of the signal to be measured.

7. Select the signal type with a press on the appropriate softkey (CW, GSM, TETRA etc.).

Power measurements will now be taken at the highest possible accuracy.

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Note: Specifications, terms and conditions are subject to change without prior notice.

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