ImmersionRC RF Power Meter

Operator's Manual

October 2013 Edition, Preliminary

Overview

The ImmersionRC RF Power Meter is a hand-held, self-contained, RF Power meter, for signals in the 1MHz-8GHz range, with power levels from -50dBm to 0dBm. An external attenuator extends this range to allow the testing of pulsed, and CW transmitters.

It has a number of uses, including:

- Validation of power levels emitted from CW (continuous wave) downlinks, on 1.2, 2.4, 5.8GHz
- Validation of power levels emitted from UHF uplinks (pulsed RF, FHSS)
- Field testing of FPV equipment
- Antenna testing, radiation pattern measurements

Specification

- 1MHz thru 8GHz, calibrated on common bands used for FPV/UAV
- -50dBm thru 0dBm power level without attenuator
- Programmable attenuator setting, readout corrected
- USB, or DC power jack power source, 6V-16V
- Calibrated against traceable test equipment at > 100 frequency/power combinations.
- Standard high-quality SMA connector
- Un-attenuated VSWR: <1.5:1 below 1GHz, <1.7:1 1GHz -> 8GHz.
- Attenuated VSWR: <1.05:1 below 1GHz, <1.5:1 1GHz -> 8GHz (typical)
  - *Note that the Attenuated VSWR depends primarily on the performance of the attenuator used. The value shown here is typical using the 30dB attenuator shipped with the meter.*

Attenuators

The power meter, without an external attenuator, is suitable for testing antennas, plotting radiation patterns, etc.

For use testing the power output of A/V transmitters, R/C equipment, UHF links, etc., an external attenuator must be used. This will drop the power level down to a level that the power meter can measure, without being damaged.

WARNING: Do not exceed the maximum input power level of 0dBm, or permanent damage may be caused.

When choosing attenuators, it is advisable to ensure that the frequency range exceeds that which will be measured with the meter. Cheaper attenuators may well be calibrated at lower frequencies, but at 2.4GHz/5.8GHz, they will introduce measurement errors.

In order to connect the power meter, with attached attenuator, to an RF source, it is recommended to use either a very short length of coaxial cable, with male SMA on each end, or a short adapter.

A suitable semi-rigid cable is included with the RF power meter.

HINT: Since SMA connectors are easily damaged by repeated connection/disconnection, it is recommended to connect the attenuator directly to the power meter, and use the SMA adapter to connect to the RF source. The adapter will be much cheaper to replace than the attenuator, if the connector is damaged.

User Interface

The LCD display shows the measured attenuation value, along with the attenuation value, and the current frequency.
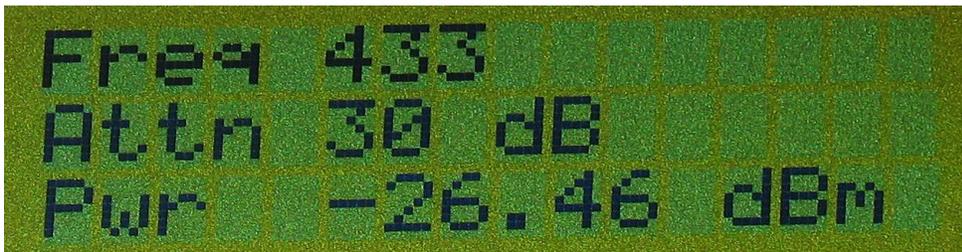
Three push-buttons are available, and comprise the entire (simple) user-interface.

The top button will decrement the frequency; the bottom button will increment it.
The center button enters the menu, where the setup of the power meter   may be adjusted:

Contrast: LCD contrast, not normally necessary to change this, but it the display is difficult to read, it may help to adjust this.

Mode: **Peak** or **Avg,** use Avg mode for a more precise reading of continuous RF sources, such as A/V transmitters. Use **Peak** for pulsed sources, such as UHF uplinks, or wireless networking equipment.

Mode: dBm or **mW**. Measurement readout format.

Attenuation: Enter the attenuation, in dB, of any attached attenuator(s). For multiple stages of attenuation, enter the total attenuation (e.g. 10dB + 10dB = 20dB of attenuation).
If calibration data for the attenuator is available, use the **Fine Attenuation** control also.

NOTE: If the Pwr value is flashing, the measured power is outside of the power meter's range, either too low, or too high. The former is just a warning that the displayed value is not accurate (and will occur when power is applied with no RF connection), the latter is a warning that the meter may be damaged.

Firmware Upgrade

If for any reason a firmware upgrade is needed, be sure to use a version of the ImmersionRC Tools later than March 2010 to upgrade.

Using the correct version of this tool will ensure that the calibration curves, measured during testing, are preserved, and therefore the accuracy of the device is preserved also.

It is highly recommended not to upgrade firmware in the power meter unless instructed to by ImmersionRC.

Examples of Use

Example 1: Comparing Antennas

This example is relatively simple, two antennas (possibly equivalent antennas from two different vendors) are available, and are to be compared.

For this particular example, 5.8GHz omni-directional whips are to be compared.

First, setup the transmitter, on a tripod, ideally in an open area without much RF pollution, with few reflective surfaces. A 25mW 5.8GHz transmitter works fine for this. Attach a 'known good' 5.8GHz antenna onto the Tx, and power it up.

Setup the power meter for 5800MHz, Average mode (not Peak), and attenuator setting at 0dB.

Screw the first of the whips to be compared onto it, vertically (same polarization as the transmitter) and place it on another tripod.

Adjust the distance between tripods until the power meter reads approx. -25dBm (the mid-point of the range of the device).

When the meter is around -25dBm (anywhere from -20 thru -30 will be just fine), make a note of the precise reading, and switch the antenna on the power meter for the second (or subsequent) to be compared with.

For each antenna to be compared, make a note of the readings. Note that a higher reading (= less negative) means a higher RF power received.

For example:

> Antenna 1: -25dBm
> Antenna 2: -27dBm
> Antenna 3: -23dBm

For this example, Antenna 3 is showing 4dB greater received power than antenna 2.

Example 2: Measuring UHF output power

Connect the output of the device to be tested to the power meter, with an appropriate attenuator.

For power levels around 500mW, a 30dB attenuator is suitable.
For power levels up to 2W, use a 40dB attenuator instead.

Enter the menu on the power meter, and enter the attenuator value. If you know precisely (calibrated attenuator), enter the fine attenuation also.

On the second page of the menu, select **Peak** power mode, and select either dBm, or mW for the readout, depending upon how you prefer to display power readings.

Exit the menu, select the appropriate frequency range using the left/right buttons, and apply power to the meter, and the device under test.

Example 3: Measuring A/V Tx output power

Connect the output of the device to be tested to the power meter, with an appropriate attenuator.

For power levels around 500mW, a 30dB attenuator is suitable.
For power levels up to 2W, use a 40dB attenuator instead.

Enter the menu on the power meter, and enter the attenuator value. If you know precisely (calibrated attenuator), enter the fine attenuation also.

On the second page of the menu, select **Avg** power mode, and select either dBm, or mW for the readout, depending upon how you prefer to display power readings.

Exit the menu, select the appropriate frequency range using the left/right buttons, and apply power to the meter, and the device under test.