Measuring Antenna Gain with the help of RFME Signal source and Power Detector:

This application note describes how to use the RFME Signal source and Power detector to test various passive components. By using these testing setups the designers and manufacturers can measure performance of components and circuits used in various systems. The discussion also includes the transmission of a known signal with the help of the RFME signal source and measuring of amplitude level with the help of RFME power detector.

An antenna is a specialized transducer that converts the radio-frequency field into AC or vice-versa. Antenna come in all shapes and sizes.

To do the measurements of any component the user first needs to take the direct reading with the help of two 50 Ohms coaxial cable and an adaptor in between.

For eg. Take the RFME Signal Source and set its frequency to 2.45GHz and signal level of -1dBm is given to the RFME Power Detector with the help of the coaxial cable as shown in the Figure: 1. A signal of -1.6dBm can be easily measured at RFME Power Detector. That means there is a loss of -0.6dB in the coaxial cable connected in between both the units.

The setup below shows selection of the Single mode with the switch position at 'S" on RFME Signal Source and in the RFME Power Detector the switch is selected for dBm. Thus on RFME Signal Source it will display "2.450" for 2.45GHz and on RFME Power Detector, the results will be displayed in dBm as "-01.6" for -1.6 dBm.

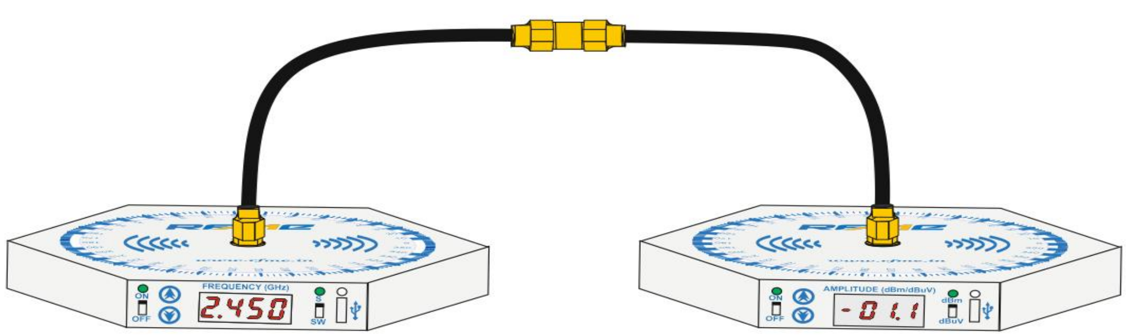


Figure: 1

1) **Test Setup:**

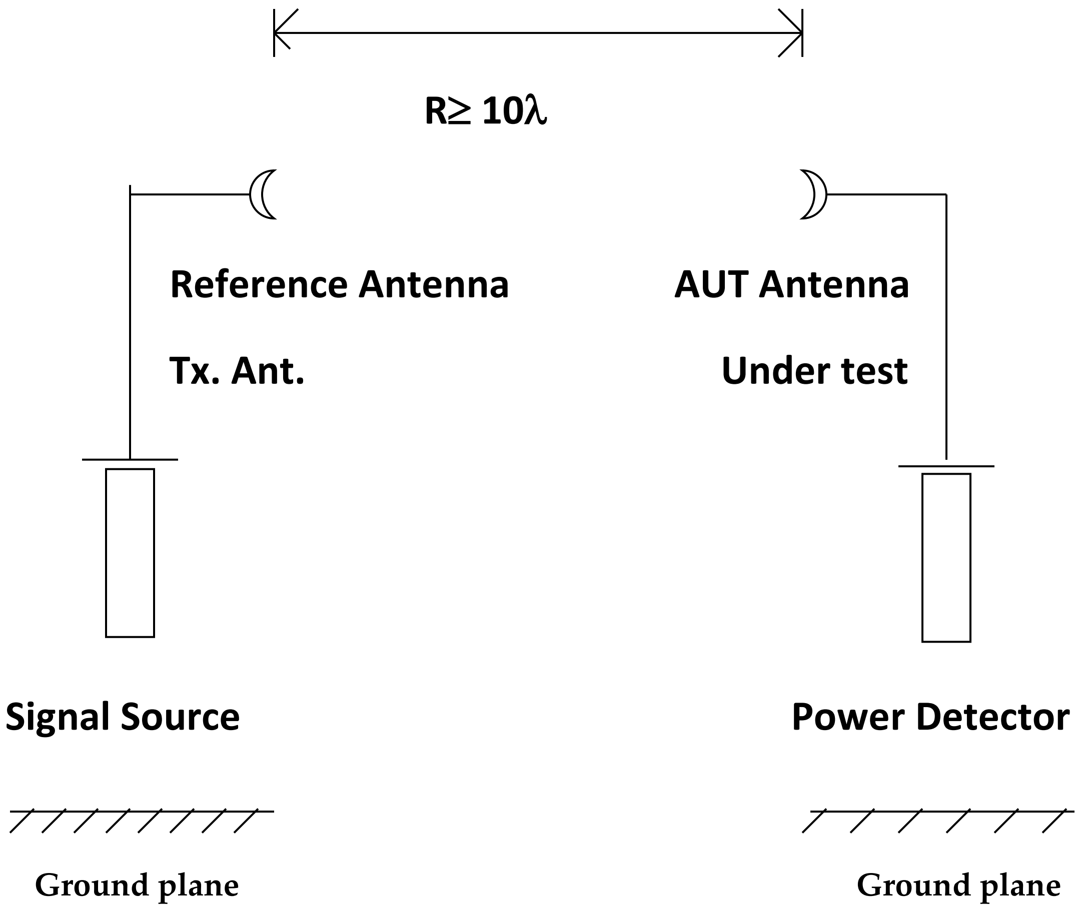


Figure: 2

As per test setup the minimum 1M X 1M open test area is required, distance between two antennas should be more than 10λ. Both testing devise should have proper ground plan.

2) **Antenna Test Method:**

To Calibrate or test any antenna two methods are there.

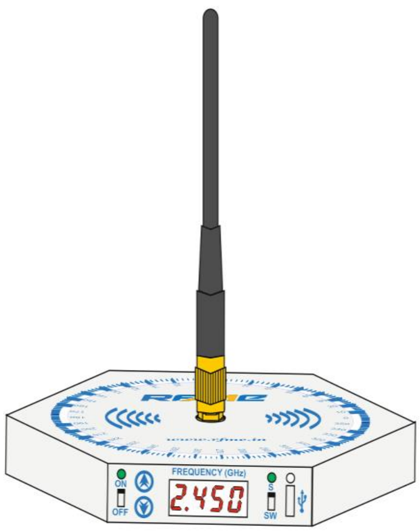
a) One known and one unknown antenna test method.

b) Two unknown antenna test method.

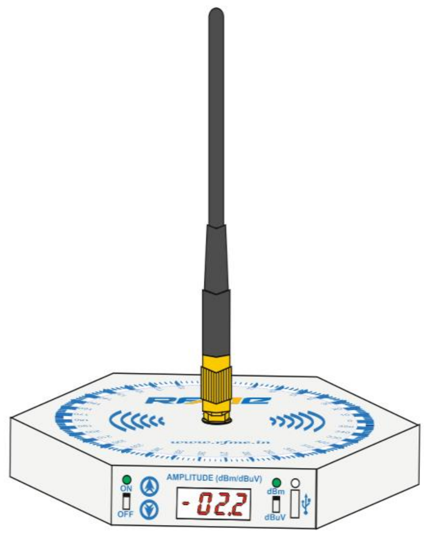
a) **One known and one unknown antenna test method:**

To apply this method user need one known gain antenna and one antenna that need to be test.

- **Step 1:** Check output power level coming from signal source using the power detector with known cables loss and subtract the loss from power detector data, that is direct output power coming from signal source as per figure 1:



Signal Source setup with known antenna.



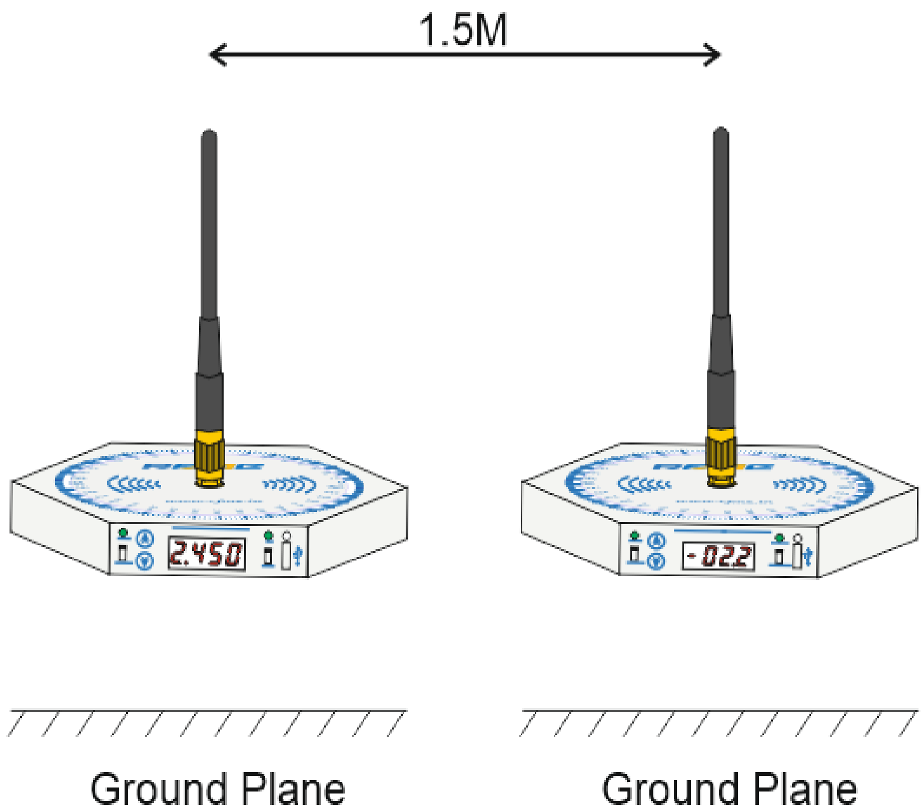
Power Detector setup with unknown antenna.

- **Step 2:** Attach known antenna with respective Signal source (Ex: if antenna is designed for 2.4 GHz, then Signal source should be of 2.4 GHz range). And antenna under test with power detector.
- **Step 3:** Keep the signal source setup attached with antenna at certain point and power detector setup attached with antenna at the distance of 1.5 M far from the signal source in LOS (line of sight) and at the height of electrical maxima point (It should be minimum 1M). Calculate the FSL (Free space loss) for 1.5M at testing frequency (Ex: 2.4GHz).

$$FSL = 20 \log 4\pi R/\lambda$$

Where: R is distance between two antenna

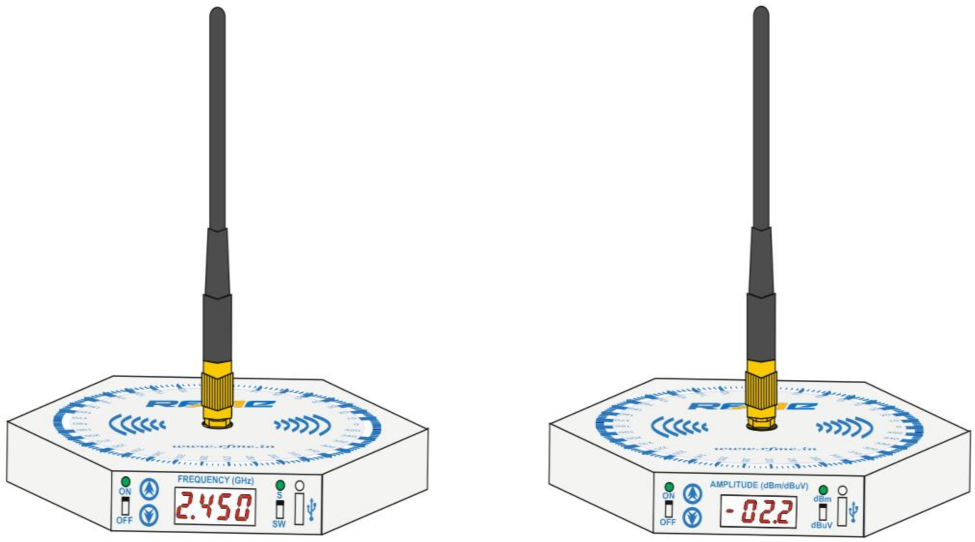
λ is wave length at particular test frequency



- FSL at 1.5M for 2.4 GHz is -43.56 dBm.
- If the known antenna gain is +2 dBm then FSL will be -41.56 dBm. Take the reading of power level from the Power Detector. If it is lower than -41.56 dBm, it means designed antenna or AUT (Antenna under test) is having a loss.
  EX: Power Detector input power is -44.67 dBm than AUT having a loss of 3.11 dBm.
- If the Power Detector receives the power -40.1 dBm, then Antenna is having gain of 1.46 dBm.

b) Two unknown antenna test method:

- For this test Method, the user needs to have two same Unknown gain antenna. Follow the same process (method (a)). Note power level displayed at the power detector and divide by two. The resultant output is the gain or loss for the both antenna.



Signal Source Setup with unknown antenna

Power Detector Setup with unknown antenna

- EX: Calculated FSL is -43.56 dBm, and the received power on power detector is -46.5 dBm, then loss for both antenna is [(-46.5 dBm + 43.56 dBm)/2], that is -1.47 dBm loss of each antenna.

- Same way received power is -39.5 dBm. That means the gain for both the antennas is [(-39.5+43.56)/2] that is 2.03 dBm gain of each antenna.

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