Power-Mapper Information and Training:

Technical details for experts and Teachers.

The Power-Mapper is actually calibrated in uA of current collected by the antenna which is 50R. Each antenna is accurately tuned by hand at the factory to be perfect for EU at 866MHz and USA at 915MHz it's centre frequency is 908MHz.

You are measuring an average of 50uA current flow at full scale (100) this is about 0.125uW of power when the -7dB attenuator is off and the metre is reading 100.

Here is the best way to estimate your transmit power. You will need to put the Power-Mapper on a non conductive surface; you will also need to move away from the metre to take the measurements.

The measurement will be a mixture of the direct wave and the reflected waves, so at a site location no meter will be totally accurate. (You will need a test chamber and a test house to get accurate measurements for FCC or CE approvals etc.)

Key to the Scale:

dB value measurements. When the needle is at 100%, this 0dB, and measure dBs down from this RF power level.

It's common practice to move the meter to a position where its reading is 100; for strong signals you can use the -7dB attenuator so the meter is not too far away to read the scale.

dB's down 50=-3dB, 25=-6dB, 12=-9dB, 6.3=-12dB, 3=-15dB each -3 dB step will give about 25% reduction in Range due to the square law effect. Half the power and the range only reduces by 25%.

A log dB scale has been added to show dBs down from 100% power (or any other power you want as a reference for your dB measurement. Remember, dB's are always a comparison with some reference power value, like the full legal power limit or some other fixed power level like 1mW or 1W for example.

When moving the meter you may see large changes within small distances; this indicates that you have a lot of reflections from the ground and/or conductive objects in the building.

Turn the meter on its side to see power in the Horizontal plane. A circular polarised antenna will be -3dB down from a linear; however the linear antenna will show almost no power in the orthogonal plain.

RFID transmit limits.

EU ---With the -7 dB attenuator on; full scale is reached at about 1 Meter when approximately 2W ERP is transmitted. (Open environment)

USA --With the -7dB attenuator on; full scale is reached at about 4 feet when approximately 4W EIRP is transmitted. (Open environment)

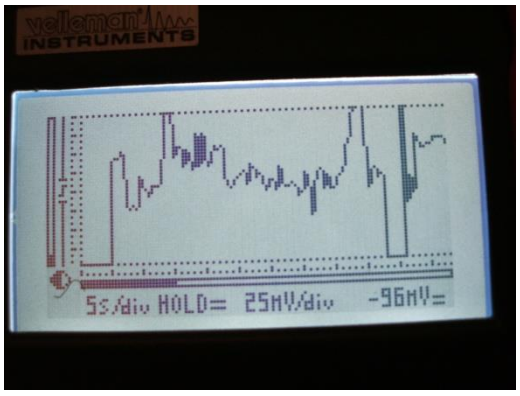
(A hand held reader transmitting 500mW should therefore give a range of 75cm with the -7dB attenuator switched on)

EIRP = ERP + 2.15 dB

Teaching RFID

These tools were first developed for teaching RFID; they also make fantastic installation aids and research tools.

Data logging; the Power-Mapper with a Pico Scope, or pocket oscilloscope to data log your environment over time temperature and humidity changes.



Interesting experiment

One interesting demonstration is to use a circular polarised antenna under a normal metal roller bed and then show, with the meter above the roller bed, that the circular polarised field has become linearly polarised and surprisingly, the field is now at right angles to the rollers. This is a shock to most students, as it is totally non intuitive.

It can be explained in a simple way. The E filed is killed by the metal rollers leaving just one polarisation of the H field to penetrate the rollers, this H field then re creates another orthogonal E field.

Another teaching demo is the reflected power from a metal plate. I use a Power-Mapper just behind the antenna and a metal plate in front. As the plate is moved the Power-Mapper shows the reflected nulls as the power is re-radiated with a voltage zero and a H field maximum from the metal surface. So as the metal is moved the recreated E field forms constructive and destructive interference at the meter, making the needle move up and down. The -7dB attenuator is useful in this demonstration.

Another demo, which surprises students, is the Knee high null you get when using a circular polarised antennas (or linear on its side). These nulls are due to destructive interference, and can be seen very easily by simply holding the Power-Mapper on its side and moving it up and down around knee height. Nulls can be seen best at a distance of about 15 feet from the antenna when at full power. 4W EIRP USA, 2W ERP in Europe. Switch off the attenuator for this test.

Data logging

You can simply load the output of the metre with various values of resistor to calibrate for work closer to the antenna. The meter won't be damaged, even with a shorted output. To plot the peak power use a 47uF capacitor across the output terminals; without this the signal modulation from the reader will be an average value.

Without this capacitor you can view the modulation coming from the reader on an oscilloscope and measure dead times etc in the time division multiplexed signal.

Note. If the meter reads zero you may still see a tag at that position due to reflections from people etc; it is very difficult to get a clean RF field , more difficult than you think; so moving the meter just 8cm can radically change the signal reading.

Remember that the power reading on the meter will depend on distance as a square law and also, unless you are in a test chamber, you will get reflection nulls; this means you can only do an approximate measurement with any power meter in your lab or at the installation site; never the less your results are very meaningful as they represent the real environment. People working blind, without a meter, will assume that the field is smooth and constant and so create installations that yield widely varying and perplexing results.

You will see how important height and movement are to RFID; basically you are moving the tag through a 70 degree cone with its point at the antenna; so be aware of moving tags too close to the antenna, they will be in the field for a very short time. Pointing antennas down

conveyer belts rather than across the conveyer will radically improve results, Also choosing the right sessions setting and Q value is very important for reliable repeatable results.

The meter will also show you how metal screening causes big nulls in the signal. Metal screening is only recommended when the tag is moving through the destructive nulls. Use the Power Mapper to show that you have a high RF signal level at the tag location; otherwise you will have inconsistent results.

One other problem that baffles installers of RFID systems is vibration! If there are vibrating metal objects such as moving role cages in the RF field of view of the antenna, reads can be adversely affected or even blocked completely. The role cage vibrations modulate the massive reflected RF signal off the role cage, sometimes swamping the RFID receivers IF or direct conversion system. The metal vibrations can be at ultrasonic frequencies so you won't be able to hear the problem.

Reducing the vibration by damping and measuring on a smooth surface can dramatically improve results.

Fluids can be tested with the meter; they show not only absorption behind a bottle but also the absorption in front of the bottle and the reflections from the sides of the bottle.

The meter will help you see, and understand, the RF field; after some hours of use you will start to see the environment with radio eyes.

We would like to thank you for using our meters and hope you have fun gaining understanding about RF signals and Electromagnetic waves in general.

RFMAX