Transmission Loss Measurements with the iVA Cable & Antenna Analyzer

Part 3: Antenna Pattern Measurements

Application Note

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Introduction

Parts 1 & 2 of this Application Note showed how the iVA's Transmission mode can be used to accurately measure cable insertion loss and antenna-to-antenna isolation. In this final part we shall explore the use of Transmission mode to perform antenna radiation pattern measurements.

Equipment Setup

Figure 1 depicts a typical equipment setup for an antenna pattern measurement. As shown, setup requires two antennas:

- Antenna Under Test (AUT): This is the antenna whose radiation pattern we want to measure.
- Measurement Antenna: Antenna used to transmit/receive a test signal to/from the AUT.
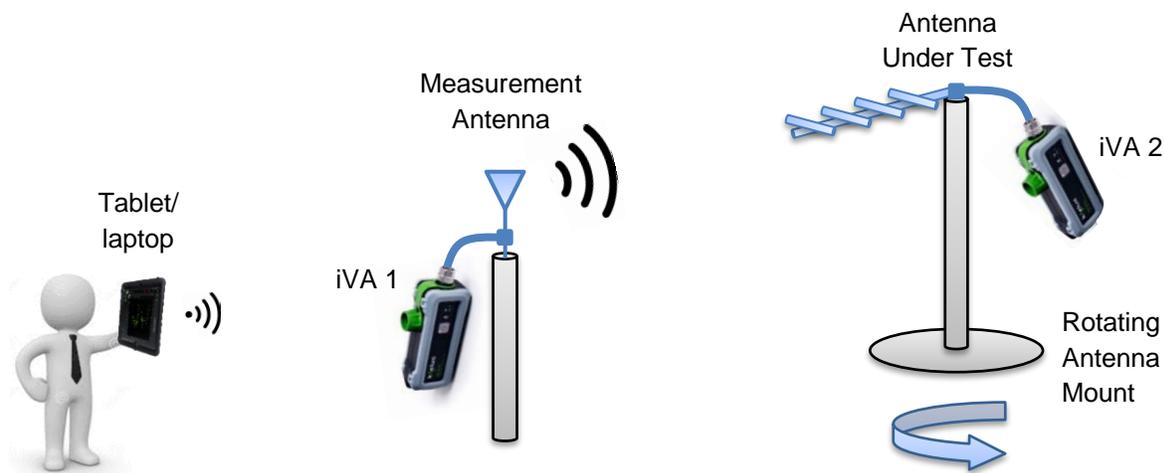
Figure 1. Typical equipment setup for an antenna pattern measurement.

Mount the AUT on a platform that can rotate through a 360° range in the horizontal plane in small, precisely defined angular increments. Mount the measurement antenna on a fixed support with its main beam orientated towards the AUT. The height of both antennas above the ground should be greater than the first Fresnel zone radius.

Connect each antenna to its own iVA. It is assumed that the iVAs have already been calibrated and configured for a Transmission measurement according to the procedure described in Part 1. The small size and weight of the iVAs allows them to be either connected directly to the RF ports of the antennas, or attached to the antenna mounting structures with a simple cable tie or Velcro strap, as shown in Figure 2.

As the iVAs are Class 1 Bluetooth devices, they can maintain a robust connection to the user device at ranges of several hundred metres in an open field environment. This allows the AUT and the measurement antenna to be spaced well apart in order to avoid any near-field interactions.

You are now ready to perform an antenna pattern measurement.

(a) iVA attached to antenna mast with Velcro strap.

(b) iVA connected directly to RF port of antenna.

(c) iVA affixed to antenna mount with cable tie.

Figure 2. iVA units connected to antennas in a variety of mounting configurations.

Measure Antenna Pattern

The procedure for measuring the radiation pattern of the AUT is as follows:

1. Go to the Reports screen in Unify and create a new report.

2. Go to the Transmission Mode screen in Unify and specify the frequency sweep settings.

3. Position the AUT and measurement antenna so that their main beams are pointing directly towards each other. This can be achieved by initiating a Transmission measurement in continuous sweep mode, and adjusting the antennas until the transmission loss is a minimum.

4. Rotate the AUT in small angular increments from 0° to 360°. At each angular position:
   a. Perform a Transmission sweep
   b. Record the results

5. OPTIONAL STEP: If you wish to determine the gain of the AUT in dBi (i.e. gain relative to an isotropic radiator), replace the AUT with a dipole antenna. Align the dipole antenna so that its main beam points directly towards the measurement antenna. Perform a Transmission sweep and record the results. These results can be used later to scale the antenna gain plot with units of dBi.

6. When all Transmission measurements have been completed, go to the Reports screen in Unify and save your report under a suitable filename. This will generate a zip file containing all of your results, which can be transferred to a PC for post-processing.

Plotting the Antenna Pattern

In order to plot the radiation pattern of the AUT, first connect the host device to a PC with a USB cable, and transfer the zip file containing your Transmission results from the host device to the PC.

Unzip the results file to a suitable folder. The Transmission sweep results at each angle (as well as the dipole antenna measurement, if applicable) are stored in a separate CSV file with a unique time stamp.

The CSV files can now be imported into an analysis package like MATLAB or a dedicated plotting utility in order to generate the final polar plot, along with figures of merit like half-power beamwidth, front-to-back ratio, maximum sidelobe level, maximum gain and bandwidth.

Figure 3 shows a typical set of results, measured by the authors using a purpose-built antenna range. In this example, the AUT was an off-the-shelf outdoor panel antenna with an operating frequency range of 806–960 MHz. The measured gain of the AUT at 830 MHz is 5.8 dBi, while the half-power beamwidth is approximately 80°.
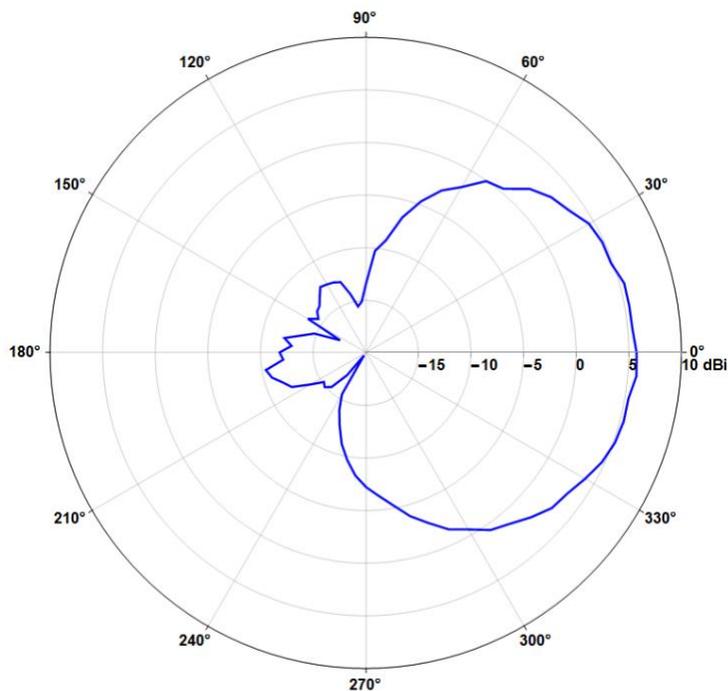
Figure 3. Measured azimuthal radiation pattern of an outdoor panel antenna at 830 MHz.

Automation Speeds Up the Measurement Process

The iVA comes with an Application Programming Interface (API) that allows the user to connect to a pair of iVAs with their own in-house application software. If the user also possesses a computer-controlled turntable for the AUT, this opens up the possibility of performing fully automated antenna pattern measurements. Such an arrangement is obviously faster and more reliable than a series of manual measurements, and also allows the use of smaller angular steps to capture the antenna pattern in the greatest possible detail.