MPD MICROWAVE PRODUCT DIGEST
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Wireless Antenna Measurements

by Dr. Donald G. Bodnar
Vice President
MI Technologies

We are witnessing an explosive expansion of RF transmitting and receiving products due to consumer demand for wireless voice and data connectivity and the availability of cost-effective technology to produce such products and services. Developers of these new products are keenly interested in the pattern, gain and polarization of their products. Traditional antenna measurement equipment can provide the needed information but usually at a prohibitively high price since such test equipment was designed for general purpose, very high precision aerospace applications. Many of the features needed in aerospace antenna measurements are not required in wireless applications. For example, aerospace measurements are often made at 35 or 95 GHz while wireless communication devices often work at 800 or 1,900 MHz. In addition, phase and amplitude measurements are made in the aerospace applications while wireless measurements usually only require amplitude information.

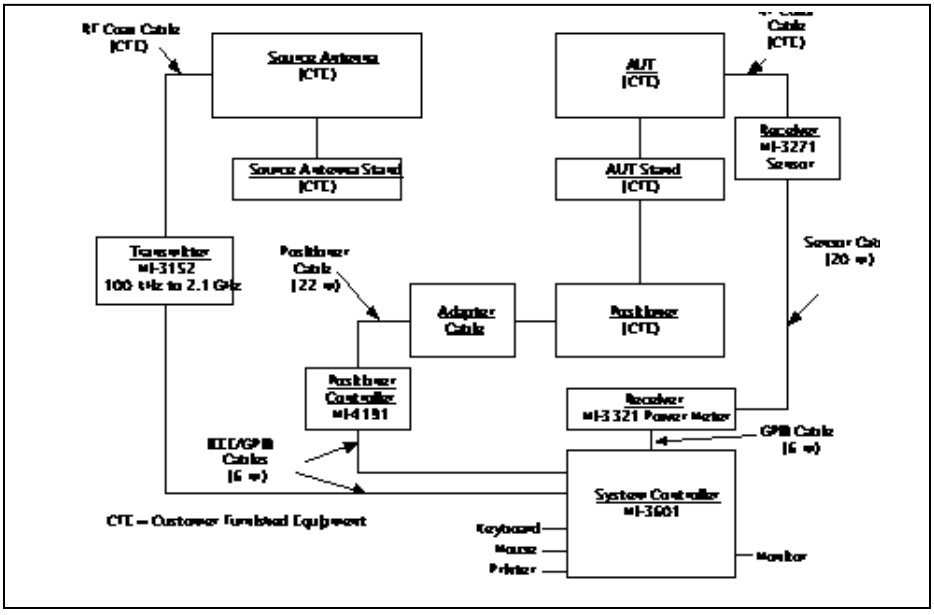

Figure 1. Wiring diagram for typical MI-3610 Antenna Amplitude Measurement System.

MI Technologies has expanded its traditional line of antenna measurement products to include a complete offering for testing wireless communications products. These include indoor and outdoor far-field measurement systems as well as near-field measurement systems. This article will only cover far-field measurement systems and the MI-3610 Amplitude Measurement System in particular. The configuration for this system is shown in **Figure 1**.

MI Technologies can provide a turnkey antenna measurement system consisting of a shielded anechoic chamber, a MI-3610 controller, receiver, transmitter, positioner and source antenna. In addition, MI Technologies' modern instrumentation can be configured with a variety of customerfurnished instruments from other manufacturers.

MI-3610 – Amplitude Measurement System

The MI-3610 Amplitude Measurement System is an integrated cost-effective solution consisting of the instrumentation and the software necessary for the measurement and evaluation of modern antennas for the wireless/PCS market and in antenna ranges for amplitude-only measurements. The system supports out-door and in-door far-field types of antenna measurements in either a manual or automatic mode.

The basic MI-3610 accurately measures side-lobe levels to –40 dB with a noise floor of approximately –70 dBm. The addition of an optional low-noise amplifier (LNA) permits the measurement of –50 dB sidelobes. The use of the MI-3200 Power Meter, coupled with an optional low-noise amplifier, and using the MI-3151 source ensures maximum accuracy and dynamic range. The MI-3610 comes complete with software to provide control of the test equipment. During acquisi-

tion the software displays a real-time plot of the amplitude as a function of scan position. The Analysis module calculates antenna parameters such as beam width, beam peak, location and depth of nulls, location and level of side-lobes, and gain. The Plot module displays single and multiple traces in polar or rectangular formats.

Controller Subsystem

The system controller computer is a desktop PC that controls all instruments via an IEEE/GPIB bus and collects and analyzes the measured data.

Acquisition and Analysis Software

The MI-3610 Acquisition and Analysis Software consists of a Graphical Use Interface (GUI) to set up the measurement system, the modules to perform the data acquisition and collection, the modules to provide real-time visual confirmation of the acquired data, the modules to perform post-acquisition data visualization, and general utilities to present and print the data.

Use of Windows NT

The MI-3610 software is written for the Microsoft Windows NT, operating system. Windows NT, facilitates the structuring of window-based and mouse-enabled Graphical User Interfaces (GUIs), making maximum use of pull down menus and context sensitive help. The MI-3610 GUI enables a natural and intuitive dialogue between the operator and the system.

User Interface

The MI-3610 User Interface is designed to make the operation of the system user friendly and intuitive. When the system is started, the display shown below is presented to the user. The user can then enter the test parameters (frequency, scan parameters), and then click on Run to start the acquisition. While the acquisition is in progress, a real-time plot of the pattern is displayed.

At the conclusion of the acquisition the user can Analyze, Plot, Print or Save the pattern.

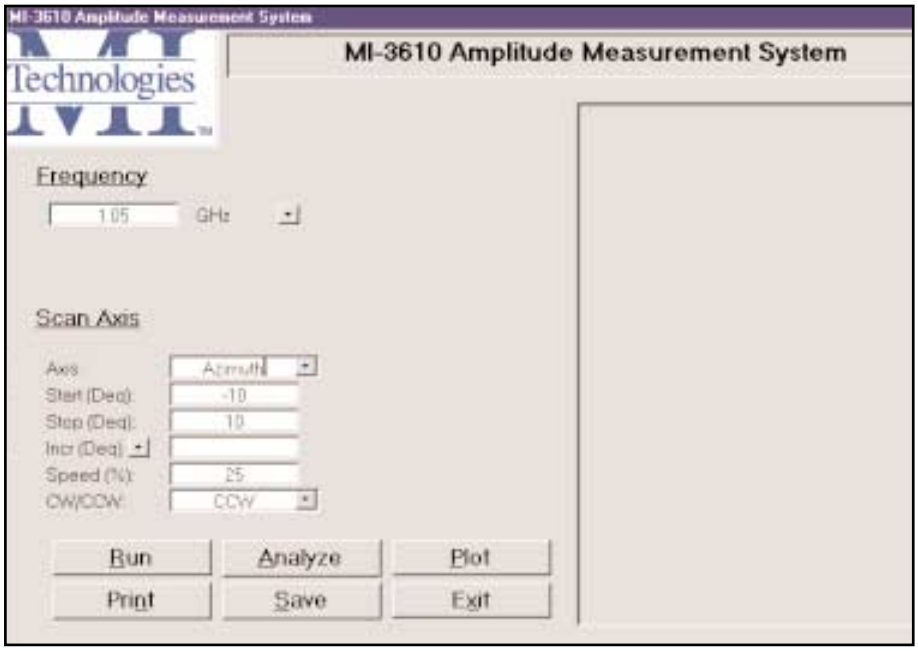

Figure 3a

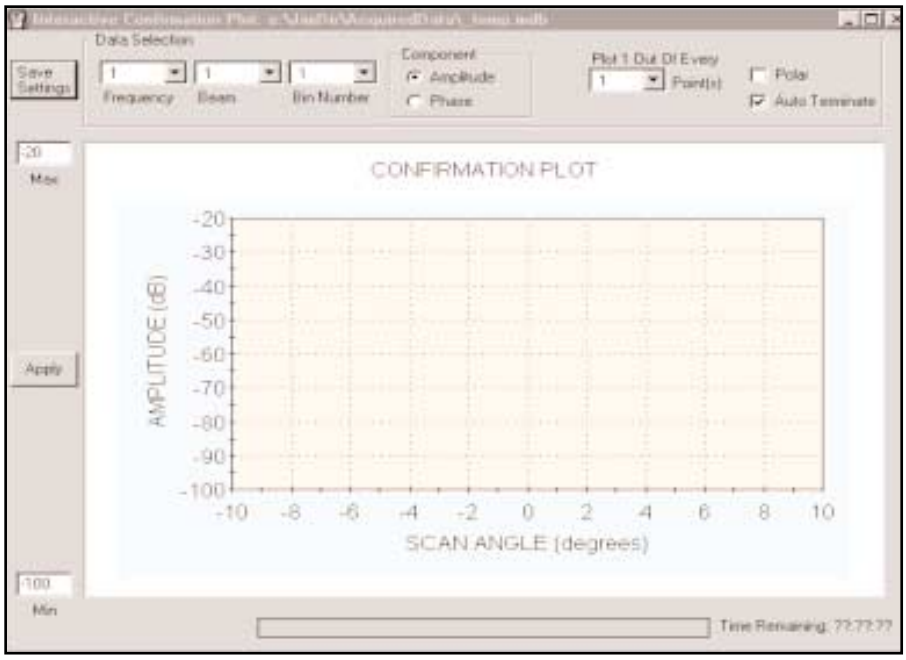

Figure 3b

The main screen for the MI-3610 is shown in **Figure 3a.** The confirmation plot panel is shown in **Figure 3b** (previous page)

Analysis

If the user selects Analyze, the last trace that was acquired is analyzed and the results displayed as shown in **Figure 4** on the previous page.

The Pattern Analysis program is designed to compute standard angular performance parameters of interest for principal plane cuts of simple antennas. A scan of AUT data is analyzed for any or all of the following parameters:

a) Angular location of the beam peak in the scan axis
b) Amplitude in dB of the beam peak value
c) Locates the 3 dB points (relative to the scan's peak) and calculates the 3 dB beam width from the measured data.

- Amplitude (in dB) and/or location (in degrees) of the first nulls on

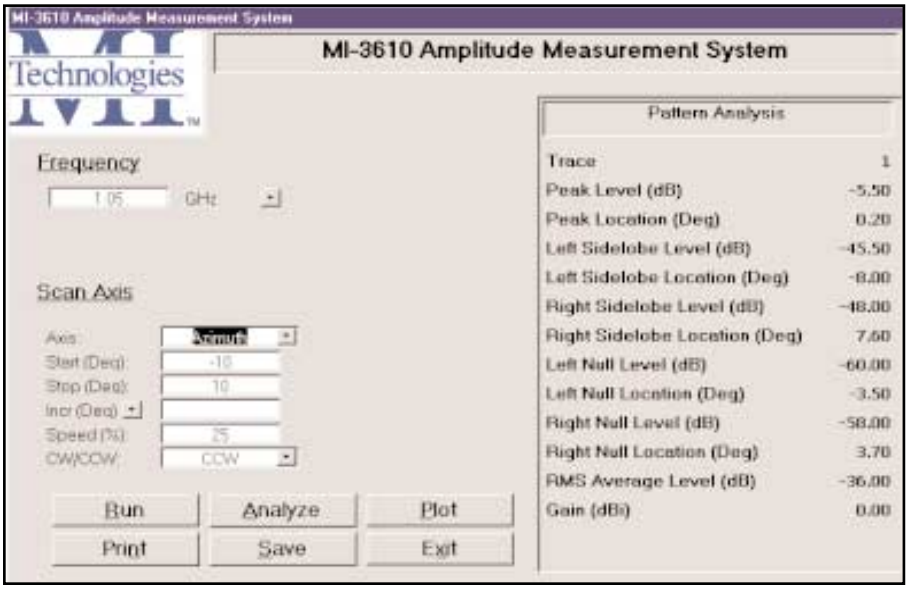

Figure 4

both sides of the main beam — the nulls are designated the left and right nulls. The left null is the null that occurs in angles prior to the main beam location in the rotation sense of the scan axis. That is, the left null will have an angle that precedes the main beam. The right null occurs after the main beam in the rotation sense of the scan axis. Then searches are per formed to locate actual data points as follows:

Right Null = global minimum between beam peak and calculated position of first right side lobe. The program performs parabolic fit to the three data points closest to thelocated minimum to calculate the actual position and value of the null.

Left Null = global minimum between beam peak and calculated position of first left side lobe. The program performs parabolic fit to the three data points closest to the located minimum to calculate the actual position and value of the null.

- Amplitude in dB and location in degrees of the first side lobes on both sides of the main beam — the context of left and right side lobes is as described in the preceding paragraph.

  Right Side Lobe = global maximum between the calculated position of first right null and calculated position of second right null. The program performs parabolic fit to the three data points closest to the located minimum to calculate the actual position and value of the side lobe.

  Left Side Lobe = global maximum between the calculated position of first left null and calculated position of second left null. The program performs parabolic fit to the three data points closest to the located minimum to calculate the actual position and value of the side lobe.

- An angular zone outside the main beam area can be defined. This zone can be used to determine the highest side lobe outside the main beam and first side lobe region. For some antennas, the highest side lobe outside the main zone may be of interest.

- The same angular zone outside the main beam area can be used to compute a RMS value of all data in that zone. This parameter can be used as a measure of the interference rejection of the antenna. For this parameter, all data in the specified zone on both sides of the main beam are squared, summed and then averaged in the linear magnitude domain. The resultant average is converted to dB as the output value.

- The analysis can compute the average value of the entire scan returning a dB value that is from the linear magnitude domain average of all scan data.

- Several beam widths can be computed. The 3 dB and 10 dB beam widths are computed as standards. A user-specified beam width is also computed. Decide on the level change from the peak signal, such as the 1-dB beam width. The beam width is computed as the angular difference between the specified signal level (relative to the scan's peak) on both sides of the peak signal. If the data do not fall exactly on the desired levels, the closest two angles of data that span the desired level are interpolated.
  As an option, all parameters can be normalized to the peak signal value, returning all parameters as relative to the scan peak. This option does not affect the reported peak value or beam widths.

Summary

Clearly, wireless communications products need to be tested accurately, quickly and inexpensively to ensure their high performance in the marketplace. MI Technologies is giving top priority to solving this problem with development of hardware and software testing solutions to meet requirements for high volume, high speed production that are also cost effective to keep the product cost low.

For more information contact:
Dr. Donald C. Bodnar
Vice President,
New Business Development
MI Technologies
dbodnar@mi-technologies.com
678-475-8317

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BASE STATION earth STATION

MI Technologies' MI-3610 Antenna Amplitude Measurement System provides fast, cost-effective antenna measurement capability from 100 MHz to 8 GHz in outdoor or indoor far-field antenna measurement configurations. The new antenna amplitude measurement system is designed to meet the needs of the Wireless and PCS antenna markets. The MI-3610 accurately measures sidelobe levels to –40 dB with a noise floor level of approximately –70 dBm. Use of the MI-3200 Power Meter, coupled with an optional low-noise amplifier and the MI-3151 signal source ensures maximum accuracy and dynamic range. The MI-3610 comes complete with software to provide control of the test equipment. The system can acquire antenna patterns manually or automatically. During acquisition, the software displays a real-time plot of the amplitude as a function of scan position. The Analysis module calculates antenna parameters such as beam width beam peak, location and depth of nulls, location and level of side-lobes and gain. The Plot module displays single and multiple traces in polar or rectangular formats. The MI-3610 Acquisition and Analysis Software consists of a Graphical User Interface (GUI) to set up the measurement system, perform the data acquisition and collection, provide real-time visual confirmation of the acquired data, perform post-acquisition data visualization and present and print the data.

MI Technologies
4500 River Green Parkway, Suite 200, Duluth, GA 30096
Tel: (678) 475-8300 Fax (678) 475-8391
email:sales@mi-technologies.com
www.mi-technologies.com