/Inritsu

Indoor Mapping

With the Anritsu E-Series Spectrum Master™, Cell Master™, and Site Master™ (Option 431)

Introduction

Spectrum analyzers provide accurate RF power measurements over a wide frequency range. With an antenna attached, RF power measurement becomes Received Signal Strength (RSSI). RSSI measurements can be combined with on-screen map displays to become a very versatile solution for mapping the coverage of RF transmitters.

The Anritsu E-Series Spectrum Master, Cell Master, and Site Master models with spectrum analysis capability can include Option 431, Coverage Mapping. This option supports both indoor and outdoor mapping needs.

In this application note, you will learn how to fully operate the instrument with accordance to the indoor mapping process. Indoor mapping does not require Option 31, GPS. Instead, the user must report the user's location in reference to the map to the instrument. The E-Series Anritsu Spectrum Master, Cell Master, and Site Master models sport a touch screen user interface making it easy to report locations of indoor measurements by just touching the on-screen map.

Anritsu Map Master

Note: A USB flash drive is required to transfer MAP (.map) files to the instrument.

For indoor mapping, a PC software program called "Map Master" must be used in order to convert map picture files to a MAP file for the instrument to read. Map Master is located on the CD provided with the instrument, or can be downloaded and installed from the Anritsu website. (www.anritsu.com)

First you must locate a map image of the indoor area to be measured in a common picture format.
(JPEG, GIF, TIFF, PNG).

The user can convert JPEG, GIF, TIFF, or PNG files to MAP (.map) files which can then be read by the instrument. The ideal image size would be close to 666 pixels x 420 pixels (~1.6:1 ratio).

Download, install and run the Map Master application. Select **File | Open**. Browse through your folders, select the indoor image file, and click **Open**. Once the file has been opened, a prompt asks whether to Geo Embed the map. Select **No**, because we are going to be using this indoors. To save it to a USB flash drive, go to **File** and then click **Save/Save** As. Set the destination to the USB, and press **Save**.
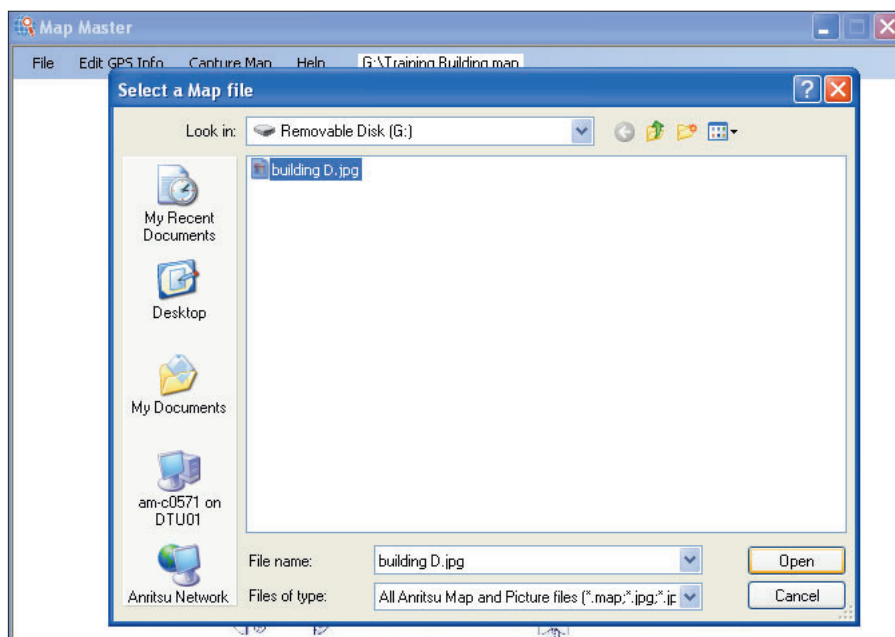

Figure 1: Loading a picture file

Use Anritsu Map Master to open the image of the compatible file types. (JPEG, GIF, TIFF, or PNG)
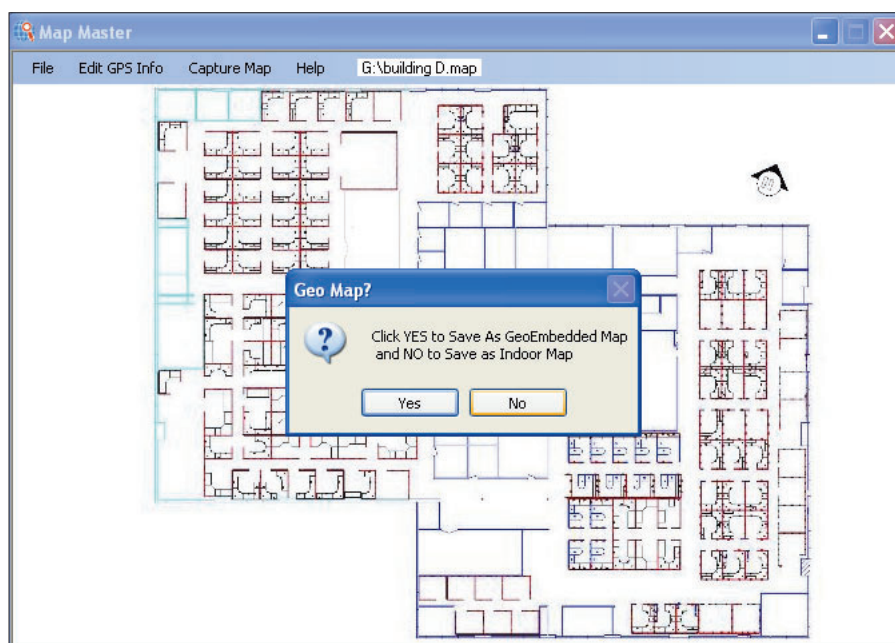

Figure 2: GeoEmbedded Map

Once opened, select **No** to save as indoor map, and save it to a USB flash drive.

Getting Started

Prior to conducting the indoor mapping survey, the analyzer itself must first be configured to properly measure the signals of interest. Knowledge of various parametrics such as anticipated signal strength and variation, potential presence of interfering signals, and noise sources should be used in determining analyzer settings. A brief summary of the main analyzer setups is shown below. However, the user may want to refer to the instrument user manual for more detailed guidance.

1. Bandwidth Parameters
   a. Resolution Bandwidth (RBW): minimum bandwidth over which one can separate two signals for viewing. The RBW can be decreased for viewing closely spaced signals at the expense of acquisition time. A low RBW is also advantageous in limiting noise distortion and resolution of low-level signals.
   b. Video Bandwidth (VBW): used for averaging and filtering noise. This is particularly useful in discerning low-level signals in the presence of noise.

2. Reference Level, Pre-Amplifier and Attenuator
   a. Reference Level: Input signal levels are referenced to the top line of the graticule, known as the reference level. Depending on the amount of power anticipated in the signals to be measured, the reference level should be adjusted accordingly.
   b. Pre-Amplifier and Attenuator: In order to present the proper signal level to the analyzer detection circuits, pre-amplification or attenuation can be adjusted on the signal input. The attenuator can be automatically adjusted as a function of the reference level. In general, signals below -40 dBm can use the pre-amplifier while signals over -30 dBm should be attenuated. For example, if the reference level setting is 20 dBm, attenuation should be set to 50 dB for a mixer input of -30 dBm.

3. Detector Type
   a. Various detection circuits can be utilized. These include Peak, RMS, Negative and Sample. The type of detection is predicated on the user's measurement needs.

4. Filtering
   a. Filtering should be used to measure signals in the presence of interferers. Filters can be added to the input of the analyzer to discriminate between wanted and unwanted signals, avoiding corruption of the measurement with adjacent high level signals.

5. Frequency
   a. Select frequency to be measured.

To access the Coverage Mapping menu, either press the main menu icon **SPA Coverage Mapping**, or press the **Shift + Measure (4)** key, the **More**, and then the **Coverage Mapping** submenu key.

Note: For some instruments, this shortcut will not show up. Users can add it by pressing the **Shift + Measure (4)** key, the **More**, and then by holding the **Coverage Mapping** soft key for at least 3 seconds.
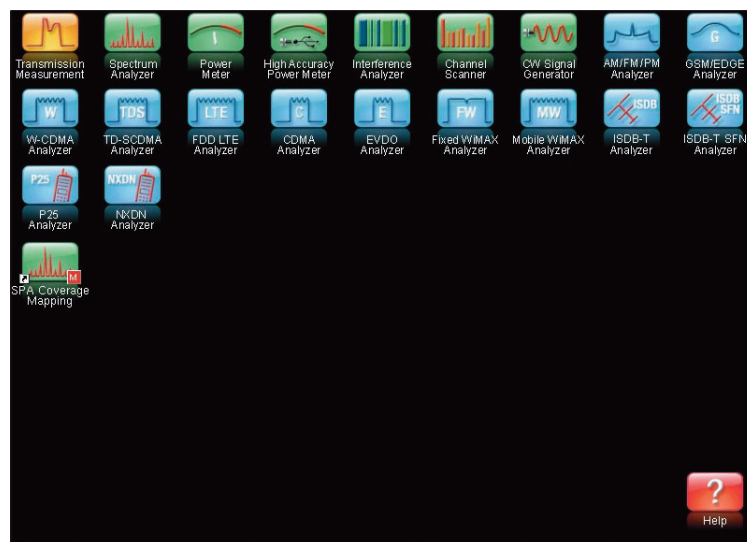

Figure 3: SPA Coverage Mapping

From the instrument, access the main menu by pressing the **Menu** key, and then to access the Coverage Mapping menu, touch the icon **SPA Coverage Mapping**

Setting Parameters

Before you begin Coverage Mapping, the parameters should be adjusted appropriately. In order to do so, first access the coverage mapping menu. Once there, select **Measurement Setup** and then to edit the measurement settings, touch the **RSSI** button. The threshold RSSI values provide the user with easy visibility of the power level.

Better than Excellent

Between Excellent and Very Good

Between Very Good and Good
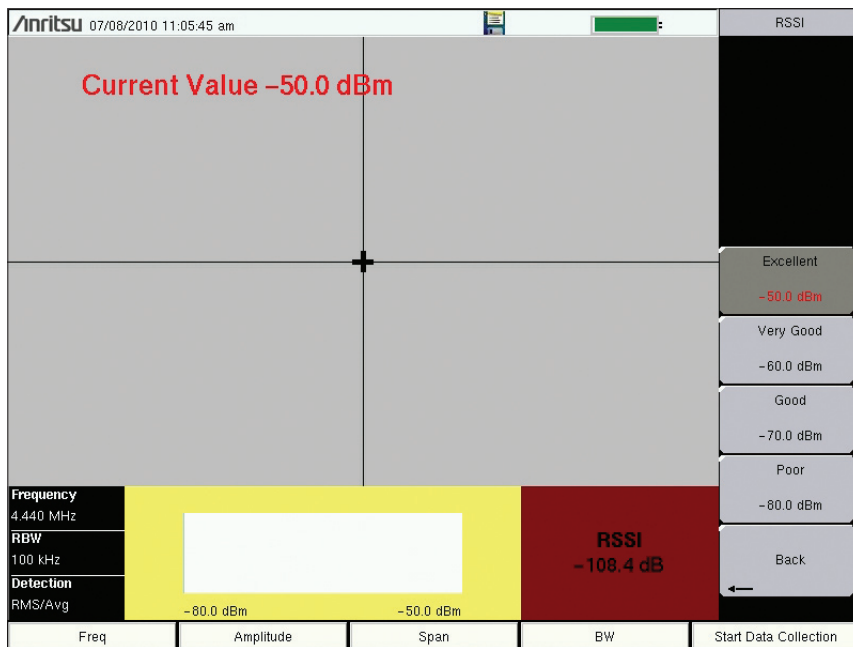
Between Good and Poor

Worse than Poor

Figure 4: RSSI

The thresholds for the dBm values can be altered so the measurement indications on the map are colored appropriately for the expected signal levels.

Data Collection

Another setting that can be personalized is the way the data is recorded. In the coverage mapping menu, select **Point Distance/Time Setup**. Once there, you can set the way it records data by either time or distance, and the intervals of which it collects the data. If the collection setting was set to time, the instrument will interpolate data points between the starting and ending position in a straight line. If the distance option was set, the user receives a data point whenever the position is noted by the user, indicated by either touching the screen or by using the keypad.
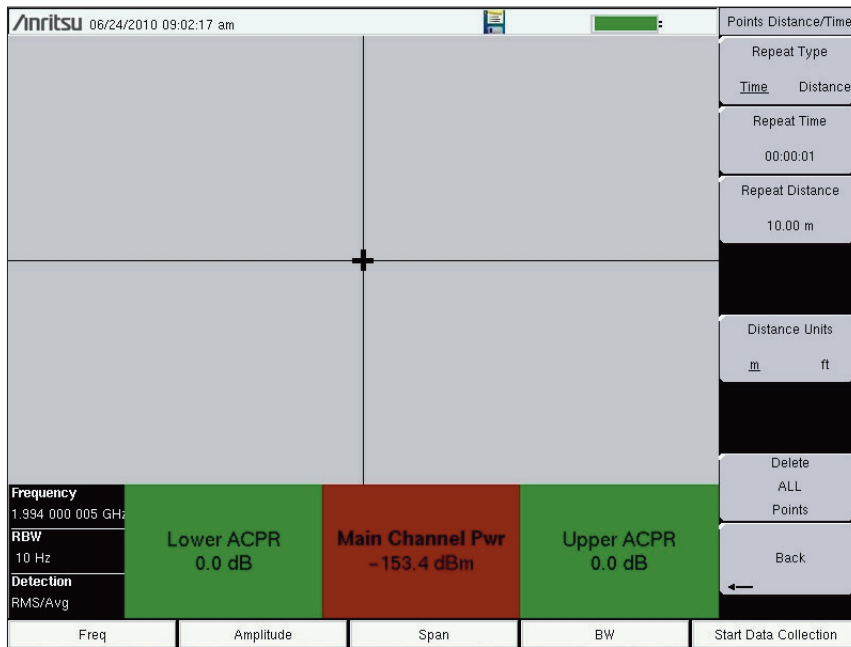
Figure 5: Data Collection Settings

Indoor Mapping

To begin Coverage Mapping, you first must open the MAP (.map) file created earlier. Insert the USB flash drive into the USB port of the instrument. From there, at the Coverage Mapping menu, touch **Save/Recall Points/Map**. In the Mapping Save/Recall submenu, touch **Recall a Map**. Find the file from the USB you inserted, and press **Enter** on the keypad. The map should now appear on the screen. You can set your position relative to the map with either the touch screen, or the keypad arrows. To begin, touch the **Start Data Collection** key, and move where needed. Once all the needed points have been plotted, press **Stop Data Collection** to finish.
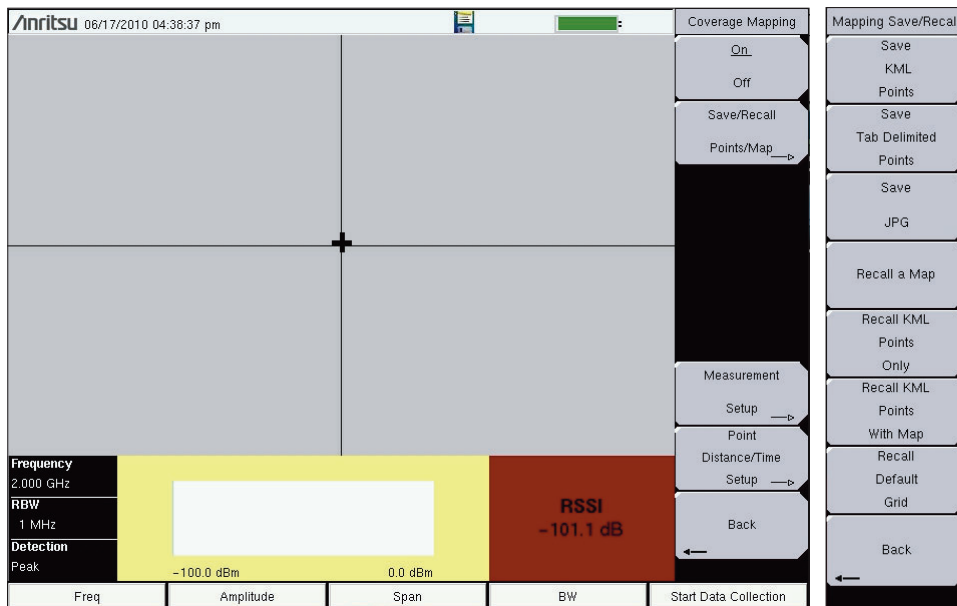

Figure 6: Recalling a Map

From the Coverage Mapping menu, select **Save/Recall Points/Map** and in the next menu, **Recall a Map**
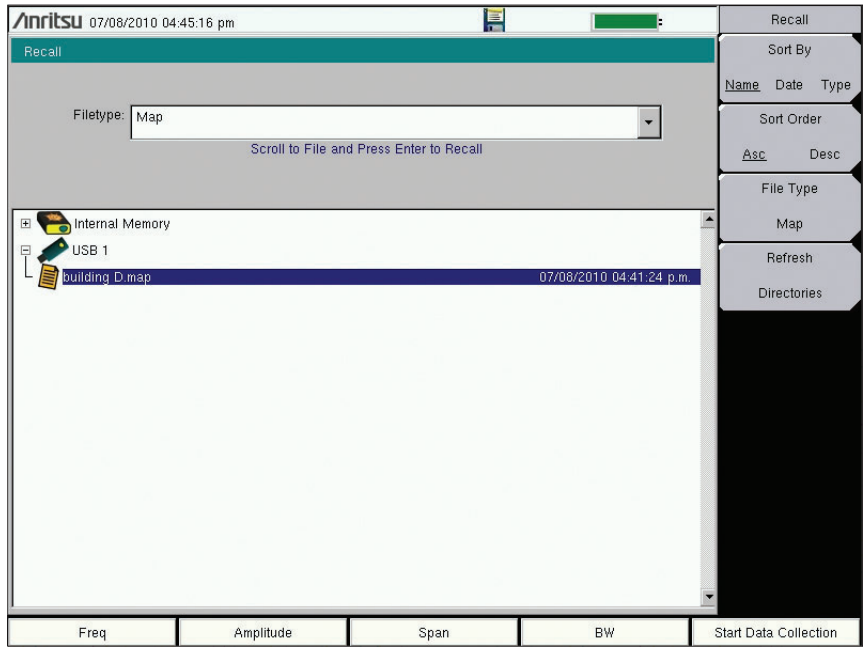
Figure 7: Selecting MAP file

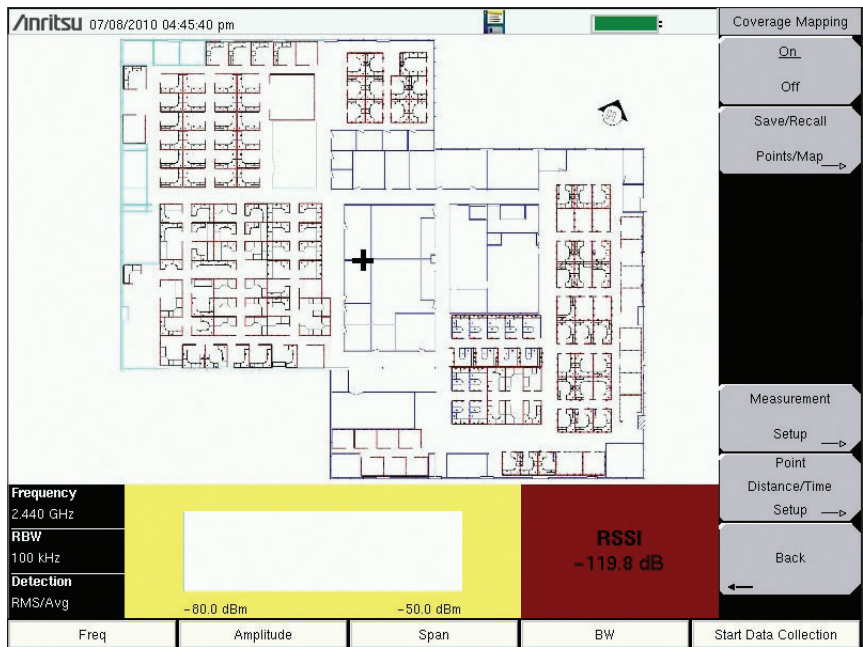Select the MAP (.map) file from the USB and press **enter** on the keypad.

Figure 8: Setting User Position

With the touch-screen or arrows on the keypad, the user's position can be set.
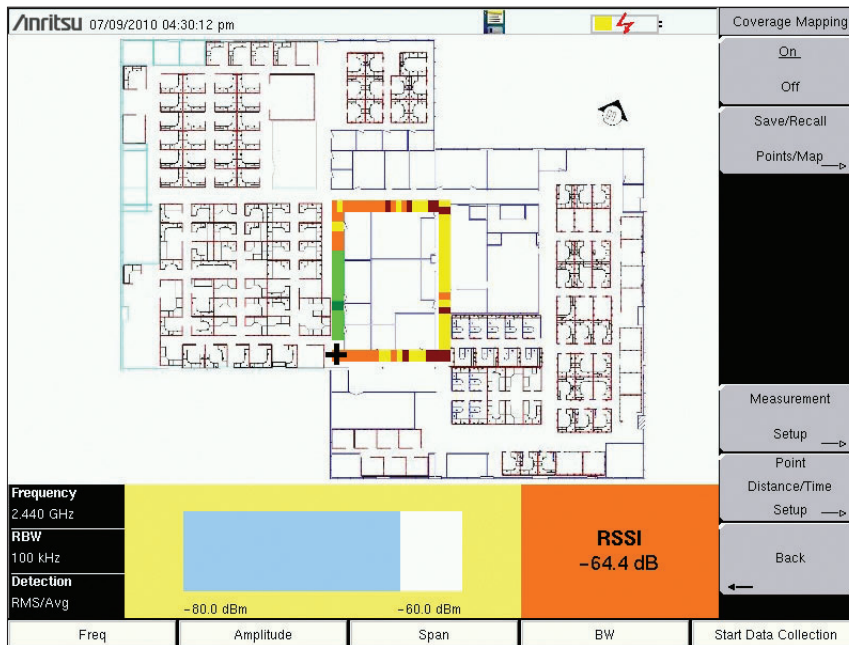
Figure 9: Time Setting

Figure 10: Distance Setting

By pressing **Start Data Collection**, the user can move to the area needed, and by telling the instrument the user's location in reference to the map either with the touch-screen or by using the keypad and enter keys, multiple data points can be created. The instrument will interpolate the points as shown in **Figure 9** if the time setting was selected. In **Figure 10**, the distance option was selected, and shows how you are able to effectively coverage map specific key areas. When finished, press **Stop Data Collection**.

Saving the Data Collected

Once Data Collection is complete, the data points can be saved as a KML file, a tab delimited text file (.mtd), and/or a JPEG. When it is saved as a KML file, the data points can be later recalled by the instrument to be used once again. For viewing the data collected however, it is recommended that the data be saved as a tab delimited file (.mtd) and/or a JPEG. A tab delimited file can be opened with notepad or Excel for easy viewing and report generation.

To begin, access the Mapping Save/Recall submenu from the Coverage Mapping Menu. From there, touch **Save KML Points**, **Save Tab Delimited Points**, or **Save JPG**. A pop-up save prompt comes up, where the filename and file type can be changed. Once finished, press enter on the keypad or touch screen to save. The file can then be copied to the USB, transferred and opened.
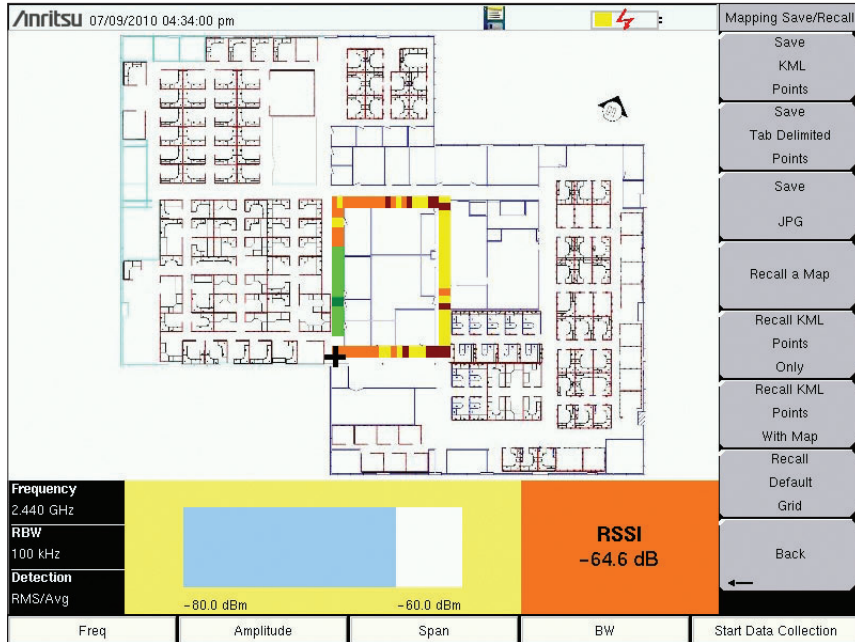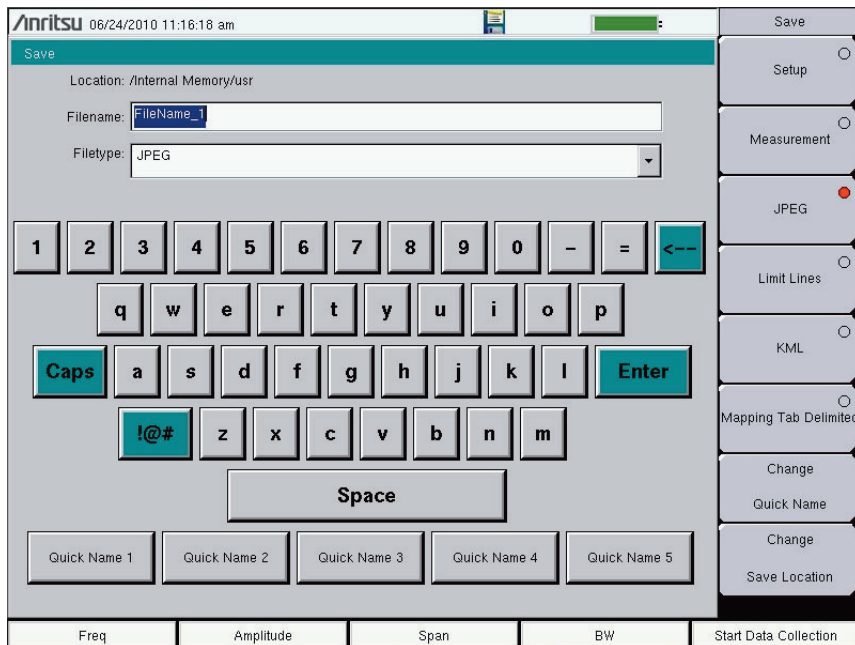

Figure 11: Saving Data Points

Figure 12: Saving the File

Change the needed fields, and press **Enter** in order to save the file.

Analyzing the Data

When saved as a tab delimited file (.mtd), the points recorded by the instrument can later be opened by a program such as Excel, to be viewed and analyzed.

Once opened, looking at the file from top to bottom, the first things you see are the rows 1-16. It has basic information, such as the file mode, model, serial number, and date the mapping was done. The actual data below is divided into columns. Columns A-F is only relevant for outdoor mapping, but the columns G-AE pertain to both coverage and indoor mapping.

Column G - the system date

Column H - the system time

Column I - the mode the instrument was in

Column J - what type of data was collected

Column K - the values recorded by the instrument

Columns L-AE corresponds to the setup of the instrument. The way that the setup is organized, columns N, P, R, and T have the actual setting values, and the preceding columns indicate the user of what exactly the following values mean.

Column N - the frequency

Column P - the RBW setting

Column R - the VBW setting

Column T - the detection type

The columns U-AC shows the threshold values designated by the user earlier. You can look at the value placed in column K and refer to columns U-AC to determine the strength of the RF power measurement. At the very end, in the column AE, errors, if any, are listed. There are three possible values: ADC over range; saturation; and none.

The colors shown by the instrument provide easy viewing for the user when determining signal strength, but by viewing the file as a tab delimited file, the actual raw data can be seen.

Figure 13: Viewing the Data

The data can then be opened by other software programs for analysis and report generation.

Conclusion

Facility managers often need to verify Public Safety, Broadcast and Personal communications systems operate throughout the facility. Point location measurements of spectrum analyzer displays are commonly used to document signal levels.

The Anritsu E-Series Spectrum Master™, Cell Master™, and Site Master™ models are powerful battery operated instruments that can support a wide range of signal types. With the addition of option 431, Coverage Mapping users can easily make measurements and create detailed maps and reports of indoor coverage.

Notes

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