Product Brochure

Anritsu

Spectrum Master™

Compact Handheld Spectrum Analyzer

MS2712E
100 kHz to 4 GHz

MS2713E
100 kHz to 6 GHz

Anritsu Introduces its Next Generation Compact Spectrum Analyzer

The wireless communications market is rapidly growing as the telecommunications and defense sectors continue to evolve. Whether you are installing, troubleshooting, or solving problems for military communications facilities, public safety providers, or wireless service providers, Anritsu has a solution.

Anritsu's new Spectrum Master has been designed for technicians, installers, field radio frequency (RF) engineers, and contractors who struggle with both keeping track of the growing number of interfering signals and assessing signal quality on a wide range of increasingly complex signals. Easy-to-use, integrated and high performing, the Spectrum Master helps users address those challenges and more. Its feature-rich and compact design helps users comply to regulatory requirements, manage and maximize efficiency, improve system up-time, and increase revenue – all in a rugged and field-proven device designed to withstand even the most punishing conditions.

This next generation of Anritsu's best-in-class Spectrum Master series is ideal for spectrum monitoring, interference analysis, RF and microwave measurements, field strength measurements, transmitter spectrum analysis, electromagnetic field strength, signal strength mapping, and overall field analysis of cellular 2G/3G/4G, land mobile radio, Wi-Fi, and broadcast signals.

DESIGNED FOR FIELD USE

The Spectrum Master was designed specifically for field environments. Weighing less than 3.45 kg, it is small compact and easy to carry. Its field replaceable Li-Ion battery typically lasts for more than 3 hours, and a new bright 8.4-inch color display provides visibility even in broad daylight. With an operating temperature range from -10 °C to 55 °C, a rugged case and splash proof design, the Spectrum Master works in the most extreme weather conditions with guaranteed performance anywhere and anytime.

INTEGRATED SOLUTION

The Spectrum Master is a multifunctional instrument that eliminates the need for you to carry and learn multiple instruments. It can be configured to include a broad range of parameters, including a 4 GHz or 6 GHz spectrum analyzer, an interference analyzer with signal mapping, coverage mapping, 2-port transmission measurement with built-in 32V bias tee, channel scanner, power meter, high accuracy power meter, AM/FM/PM Analyzer, and GPS receiver for time/location stamping and accuracy enhancements.

In addition, the Spectrum Master can be equipped with a GSM/EDGE Analyzer, W-CDMA/HSDPA Analyzer, TD-SCDMA Analyzer, CDMA Analyzer, EV-DO Analyzer, Fixed and Mobile WiMAX Analyzer, LTE Analyzer, ISDB-T Analyzer, P25, and NXDN Analyzer, thus eliminating the need to carry multiple instruments to the field.

EASY-TO-USE

The new Spectrum Master leverages the user interface from Anritsu's popular MS2721B analyzer, giving users intuitive spectrum analyzer menus. A touchscreen keypad combination provides you with an intuitive menu-driven interface designed to give a familiar menu structure with quick access to popular measurements.

KEY FACTS

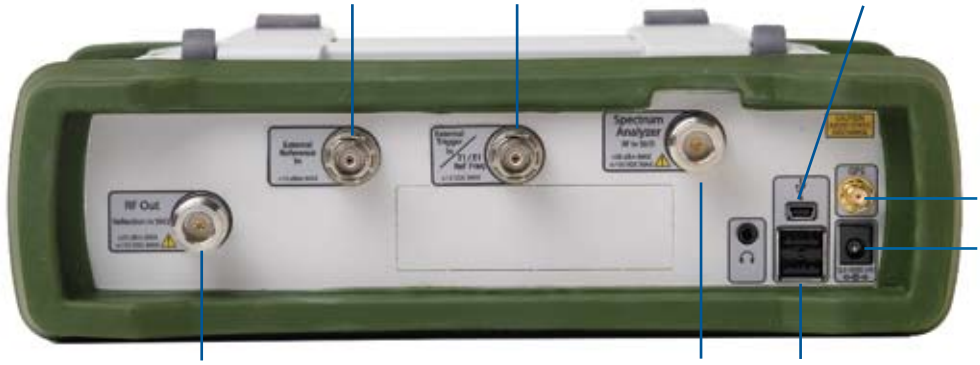
- 100 kHz to 4 GHz (MS2712E)
- 100 kHz to 6 GHz (MS2713E)
- One-button measurements: ACPR, Channel Power, Field Strength, Occupied BW, AM/FM/SSB Demod
- Interference Analyzer: Spectrogram, Signal Strength, RSSI, Signal ID, Interference Mapping
- Indoor and Outdoor Coverage Mapping
- 3GPP Signal Analyzers: GSM/EDGE, W-CDMA/HSDPA, TD-SCDMA/HSDPA, LTE
- 3GPP2 Signal Analyzers: cdmaONE/CDMA2000 1X, CDMA2000 1xEV-DO
- IEEE 802.16 Signal Analyzers: Fixed WiMAX, Mobile WiMAX
- ISDB-T Signal Analyzer
- P25 and NXDN Signal Analyzers
- DANL: > -162 dBm typical DANL (normalized to 1 Hz)
- Dynamic range: >95 dB
- +33 dBm TOI typical @ 6 GHz
- < Phase Noise: -100 dBc/Hz @ 10 kHz offset
- Frequency accuracy: < ± 50 ppb with GPS on
- Detection methods: Peak, RMS, Negative, Sample, Quasi-peak
- Save-on-event: Automatically saves a sweep when crossing a limit line or at the end of the sweep.
- Gated sweep: View pulsed or burst signals only when they are on, or off.
- Three hours of battery life
- Touch-screen display
- USB port
- 8.4-inch Touchscreen TFT display
- Lightweight: <3.45 kg

Integrated Measurement Capabilities

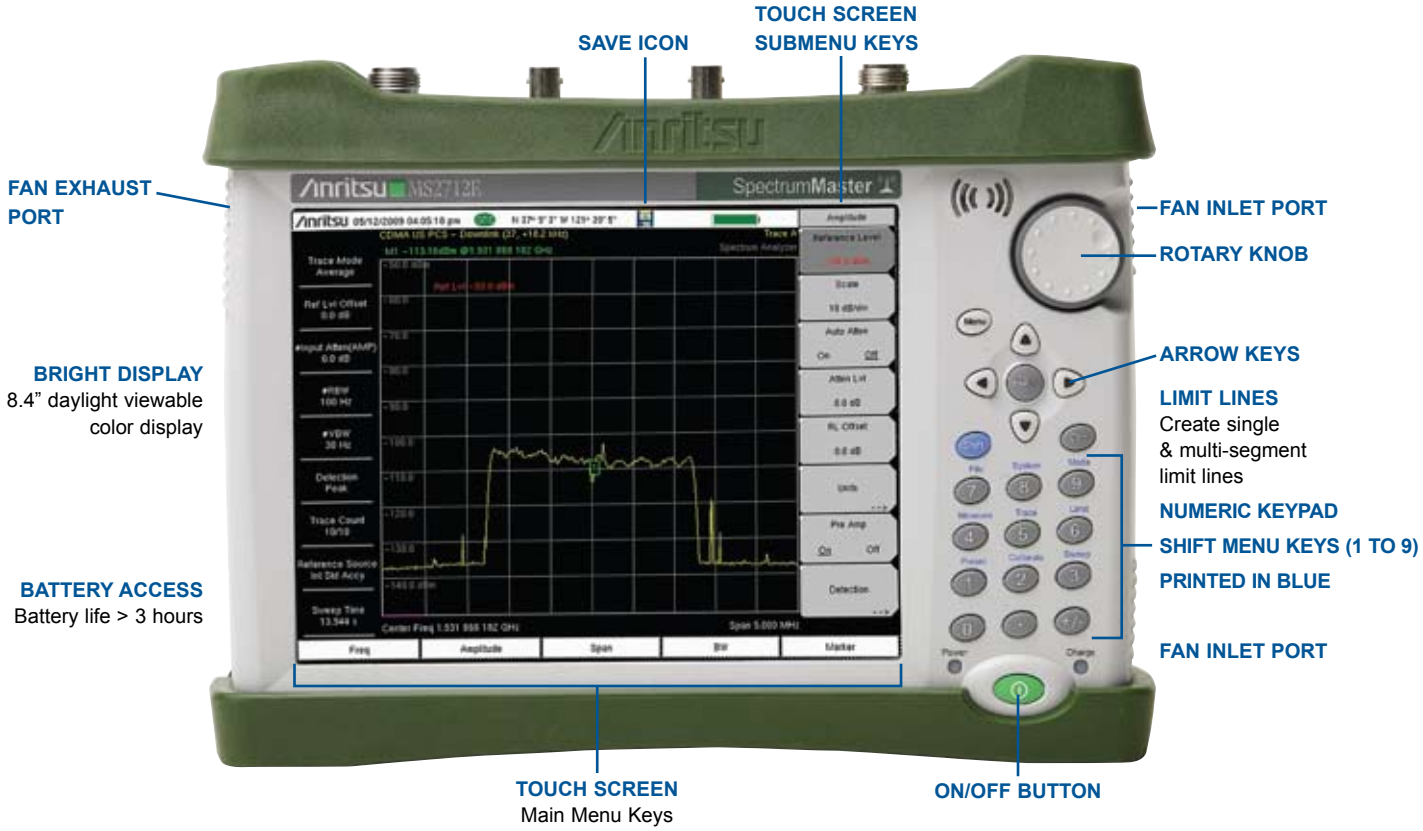
CONFIGURATION OVERVIEW

FUNCTION	DESCRIPTION
Spectrum Analyzer, 100 kHz to 4/6 GHz	Locates and identifies various signals over a wide frequency range. Detects signals as low as -152 dBm with phase noise better than -100 dBc/Hz.
Interference Analyzer (Option 25)	Includes everything you need to monitor, identify, and locate interference using the spectrogram display, RSSI, Signal ID, signal strength meter, and interference mapping.
Coverage Mapping (Option 431)	Provides indoor and outdoor mapping capabilities of RSSI, and ACPR measurement levels.
GPS receiver (Option 31)	Provides location and UTC time information. Also improves the accuracy of the reference oscillator.
2-port Transmission Measurement (Option 21)	Offers high and low power settings for both active and passive measurements. Better than 80 dB dynamic range.
Bias Tee (Option 10)	Possesses a built-in 32 V bias tee that can be turned on as needed and applied to the RF In port.
High Accuracy Power Meter (Option 19)	Connects high accuracy 4, 6, 8, 18, and 26 GHz USB power sensors with better than ± 0.16 dB accuracy.
Power Meter (Option 29)	Makes channelized transmitter power measurements.
Channel Scanner (Option 27)	Measures the power of multiple transmitted signals. Scans up to 1200 channels using Script Master.
CW Signal Generator (Option 28)	Provides CW source to test low noise amplifiers and repeaters. (Needs external CW generator kit.)
Gated Sweep (Option 90)	Views pulsed or burst signals such as WiMAX, GSM, and TD-SCDMA only when they are on.
AM/FM/PM Analyzer (Option 509)	Analyzes AM/FM/PM signals and measures FM/PM deviation, AM depth, SINAD, Total Harmonic Distortion and much more.
10 MHz Bandwidth Demod (Option 9)	The 10 MHz BW demod option enables users to turn the Spectrum Master in to a Signal Analyzer.
GSM/GPRS/EDGE Measurements (Option 40, 41)	RF and Demod Measurements enables end users to increase data rate and capacity by ensuring good signal quality.
W-CDMA/HSDPA Measurements (Option 44, 45, 65, 35)	Uses Spectrum Master's RF, Demod, and OTA measurements to verify frequency error, multipath signals, EVM and much more.
LTE (Option 541, 542, 546)	Spectrum Master's LTE Measurements enables users to make RF, Demod, and OTA Measurements. Verify ACLR, Cell ID, Frequency Error, EVM, and much more.
TD-SCDMA/HSDPA Measurements (Option 60, 61, 38)	The TD-SCDMA/HSDPA analyzer includes RF, Demod, and OTA measurements and the ability to measure EVM and Peak CDE. It also includes an OTA Tau scanner.
cdmaOne/CDMA2000 1X (Option 42, 43, 33)	RF, Demodulation, and OTA measurements. Measures EVM, Noise floor, ACPR and much more.
Fixed and Mobile WiMAX (Option 46, 47, 66, 67, 37)	RF Demod, and OTA Measurements verify Cell ID, Sector ID, Preamble, EVM, RCE, and much more.
ISDB-T (Option 30, 32)	Makes RF and demod measurements to verify Spectrum Mask and MER. Ensures digital TV transmitters are configured according to license agreements.
P25 Analyzer and Coverage (Option 520, 522)	Provides technicians with RF, demodulation, OTA, and mapping capabilities to assure proper performance of a P25 transmitter.
NXDN Analyzer and Coverage (Option 530, 532)	Provides technicians with RF, demodulation, OTA, and mapping capabilities to assure proper performance of a NXDN transmitter.

Designed for the Field



ALL CONNECTORS ARE CONVENIENTLY LOCATED ON THE TOP PANEL, LEAVING THE SIDES CLEAR FOR HANDHELD USE.



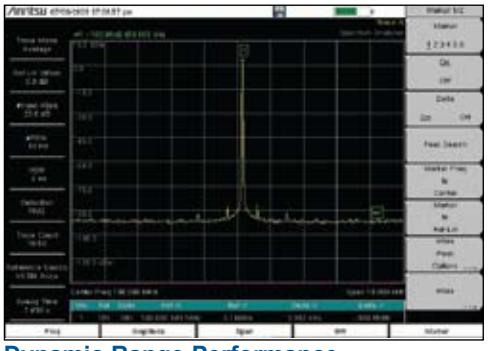
Convenient Soft Case and Tilt Bail

TILT BAILS ARE INTEGRATED INTO THE CASE AND SOFT CASE FOR BETTER SCREEN VIEWING

Best Performance in its Class

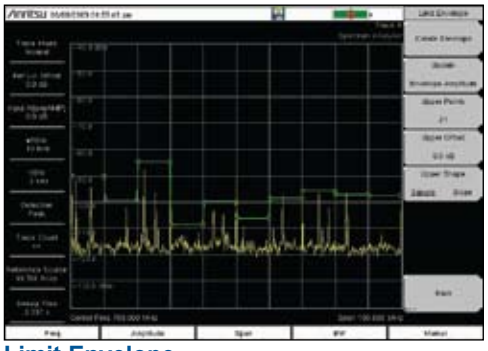
Anritsu's MS2712E and MS2713E Spectrum Master spectrum analyzers provide users with high-performance for field environments and for applications requiring mobility. There is no other spectrum analyzer in this class that can deliver the same performance.

The combination of its performance and compact design makes it ideal for a broad range of activities, including spectrum monitoring, interference analysis, field strength measurements, transmitter spectrum analysis, electromagnetic field strength, signal strength mapping, and overall field analysis of cellular 2G/3G/4G, land mobile radio, Wi-Fi, and broadcast signals.

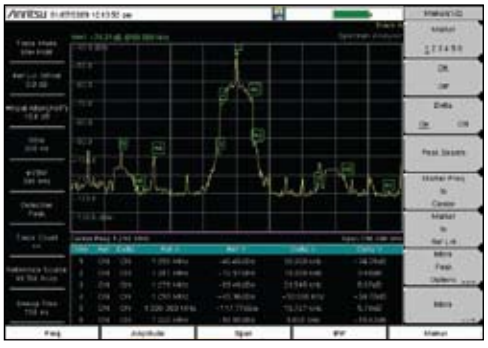


Dynamic Range Performance

Low Level Performance



Limit Envelope



Comprehensive Marker Menu

HIGH PERFORMANCE

The dynamic range is better than 95 dB in 10 Hz RBW, enabling measurement of very small signals in the presence of much larger signals. The picture demonstrates the dynamic range in the Spectrum Master

DISPLAYED AVERAGE NOISE LEVEL

Spectrum Master delivers impressive and best-in-class DANL performance. With the built-in pre-amp, better than -152 dBm DANL can typically be realized in 10 Hz RBW and -162 dBm when normalized to 1 Hz. This low-level performance capability is essential when looking for low-level interference signals.

GPS-ASSISTED FREQUENCY ACCURACY

With GPS Option 0031 the frequency accuracy is < 50 ppb. This additional accuracy is important when characterizing 3GPP signals using counted frequency markers. Also all measurements can be GPS tagged for exporting to maps.

SIMPLE BUT POWERFUL FOR FIELD USE

Convenience is a must in the field. This is why the Spectrum Master is equipped with features that will enhance productivity in the field.

The Spectrum Master is equipped with limit lines for all user levels. You can create single limit lines and segmented limit lines in one step using the one-button limit envelope feature.

The Spectrum Master automatically sets the fastest sweep possible while still ensuring accurate measurements. This allows users to rely on the instrument to optimize accuracy and consistency.

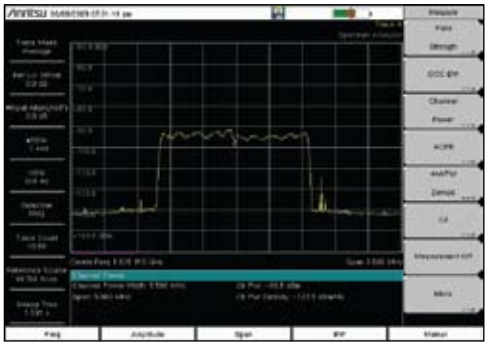
Auto Attenuation ties the input attenuation to the reference level eliminating the need for the user to determine how much attenuation is needed.

Six regular and six delta markers can be displayed with a marker table that can be turned on as needed. The capability to measure noise level in terms of dBm/Hz or dBµV/Hz is a standard feature of the Spectrum Master.

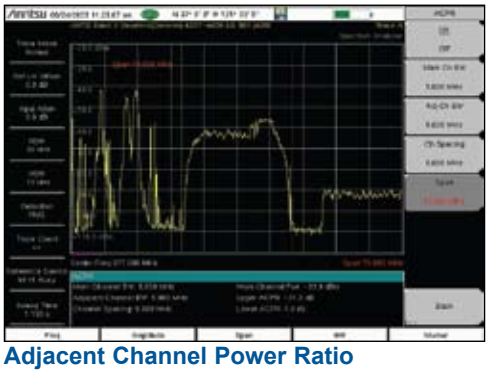
Master Transmitter Testing

SMART MEASUREMENTS FOR TRANSMITTER SYSTEMS

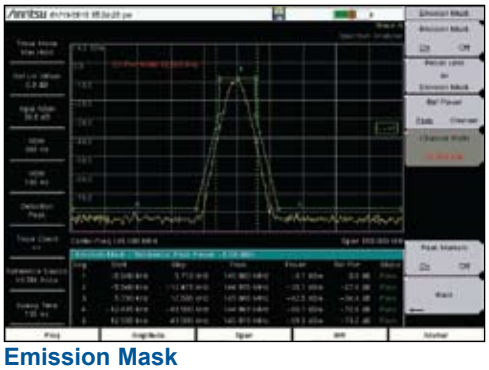
Commonly needed transmitter measurements are built in and can be accessed easily. These include field strength, occupied bandwidth, channel power, adjacent channel power ratio (ACPR), and emission mask.



Occupied Bandwidth



Adjacent Channel Power Ratio



Emission Mask

OCCUPIED BANDWIDTH

This measurement determines the amount of spectrum used by a modulated signal. The Spectrum Master allows you to choose between two different methods of determining bandwidth: the percent-of-power method or the “x” dB down method.

ADJACENT CHANNEL POWER RATIO

Adjacent Channel Power Ratio is a common transmitter measurement. High ACPR will create interference for neighboring carriers. This measurement can be used to replace the traditional two-tone Intermodulation Distortion (IMD) test for system non-linear behavior.

FIELD STRENGTH MEASUREMENTS

The Spectrum Master can determine the effects of electromagnetic fields caused by transmitter systems. Specific antenna factors of the connected antenna are automatically taken into account, and field strength is displayed directly in dBµV/m. The Spectrum Master also supports a wide range of directional antennas. If you are using a different antenna, Master Software Tools can be used to edit the antenna list and upload the custom antenna list to the instrument to accurately measure the maximum field strength.

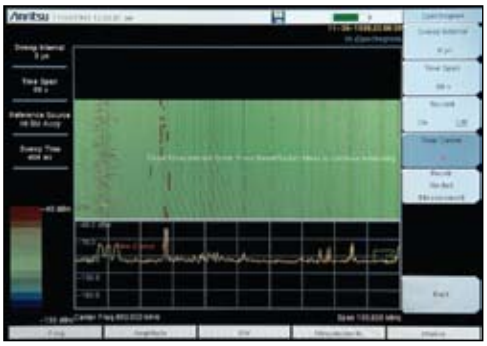
EMISSION MASK

The emission mask is a segmented upper limit line that will display frequency range, peak power and frequency, relative power and pass/fail status for each segment of the mask. The emission mask must have at least two segments. Emission mask adjusts to the peak power value of transmitted signal level per government emission mask requirements.

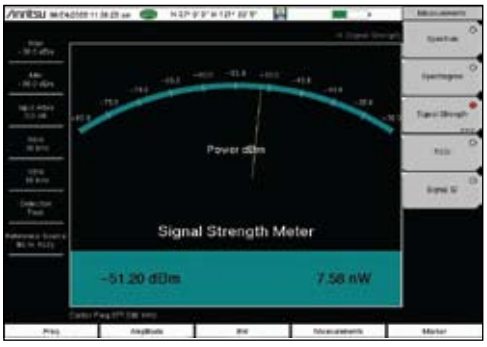
Master the Location of Interference

As the wireless industry continues to expand, more diverse uses for the radio spectrum emerge, and the number of signals that may potentially cause interference is constantly increasing.

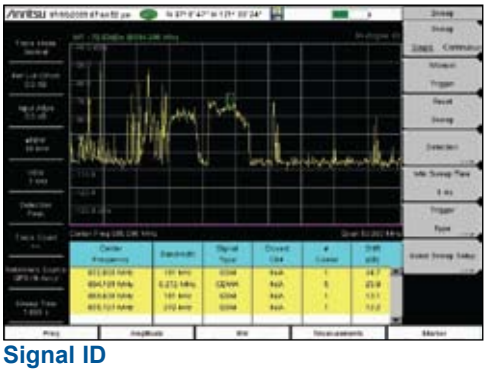
Compounding the problem are the many sources that can generate interference, including intentional radiators, un-intentional radiators, and self interference. Interference causes Carrier-to-Interference degradation robbing the network of capacity. The goal of these measurements is to resolve interference issues as quickly as possible.



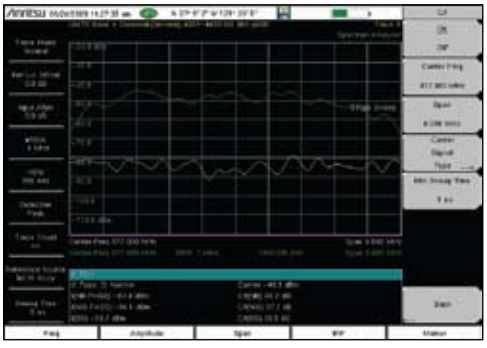
Spectrogram Display



Signal Strength Meter



Signal ID



Carrier-to-Interference (C/I)

INTERFERENCE ANALYSIS (OPTION 25)

The interference analyzer option provides you with a spectrogram display, RSSI, signal strength meter, signal ID, and signal mapping capabilities. Spectrum Master's integrated spectrum analyzer can detect signals as low as –152 dBm.

SPECTROGRAM DISPLAY

This option provides you with a three-dimensional display of frequency, power, and time of the spectrum activity to identify intermittent interference and track signal levels over time. The dual display screen allows for easy viewing of both the spectrum and 3D display. The Spectrum Master allows you to save a history of data up to one week.

RECEIVED SINGLE STRENGTH INDICATOR (RSSI)

You can use the Spectrum Master's RSSI measurement to observe the signal strength of a single frequency over time, and collect data for up to one week.

SIGNAL STRENGTH METER

The Spectrum Master's signal strength meter can locate an interfering signal by using a directional antenna and measuring the signal strength. It displays power in Watts or dBm, in the graphical analog meter display and by an audible beep proportional to its strength.

SIGNAL ID

Spectrum Master's signal ID feature in the interference analyzer can help you quickly identify the type of the interfering signal. You can configure this measurement to identify all signals in the selected band or to simply monitor one single interfering frequency. The Spectrum Master then displays results that include center frequency, signal bandwidth, and signal type (FM, GSM/GPRS/EDGE, W-CDMA/HSDPA, CDMA/EV-DO, Wi-Fi, P25, NXDN).

CARRIER-TO-INTERFERENCE MEASUREMENT

Spectrum Master's carrier-to-interference measurement capability makes it simple for you to determine if the level of interference will affect users in the intended service area.

AM/FM/SSB DEMODULATION

A built-in demodulator for AM, narrowband FM, wideband FM and single sideband allows you to easily identify the interfering signal.

Pin Point Location of Interfering Signal with Interference Mapping

Interference Mapping with Google Earth™

INTERFERENCE MAPPING

The Interference Mapping measurement eliminates the need to use printed maps and draw lines to triangulate the interfering signal.

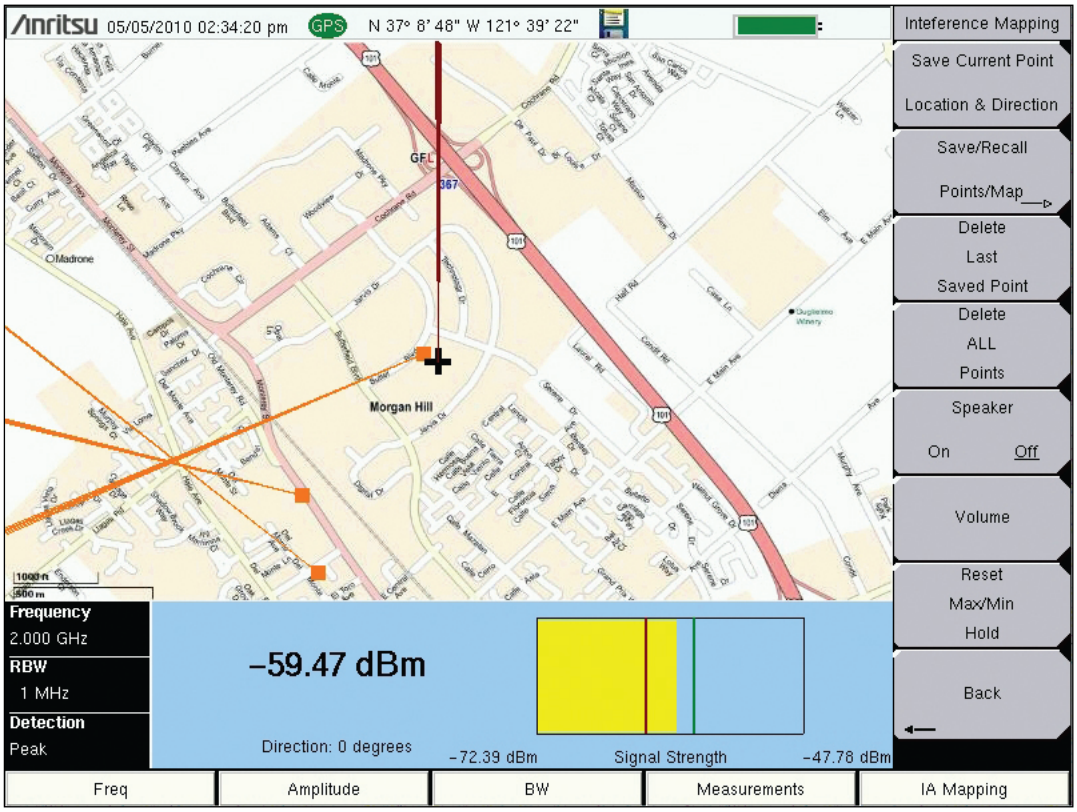
Using Map Master, it is easy to convert maps and make them compatible with the Spectrum Master. With a valid GPS signal, the instrument identifies the user location on the map. Using one of the recommended Anritsu Yagi antennas, you can identify the direction of the interfering signal and input the angle information with the rotary knob. With two or more lines from different locations, it is possible to obtain an estimate location of the interfering signal. The Interference Mapping can be done directly on the Spectrum Master. Files can also be saved as kml and opened with Google Earth™.

DIRECTIONAL ANTENNAS

Anritsu offers more than eight different directional antennas covering a wide range of frequency bands including: 822 to 900 MHz, 885 to 975 MHz, 1710 to 1880 MHz, 1850 to 1990 MHz, 2400 to 2500 MHz, 1920 to 2170 MHz, 500 to 3000 MHz, and 600 to 21000 MHz.

GPS ANTENNA

The 2000-1528-R GPS antenna and Option 31 are required for the interference mapping and coverage mapping measurements.



On Screen Interference Mapping

Indoor and Outdoor Coverage Mapping Solutions (Option 0431)

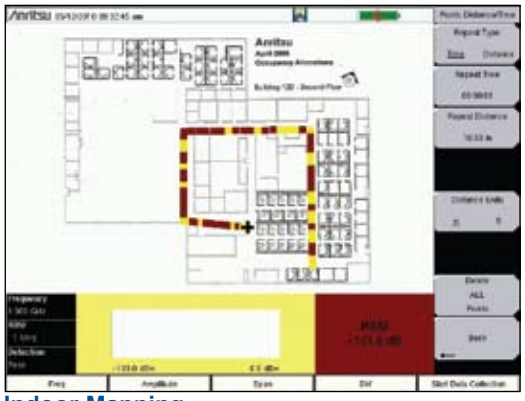
There is a growing demand for coverage mapping solutions. Anritsu's Coverage Mapping measurements option provides wireless service providers, public safety users, land mobile ratio operators, and government officials with indoor and outdoor mapping capabilities

Outdoor Mapping

OUTDOOR MAPPING

With a GPS antenna connected to the instrument and a valid GPS signal, the instrument monitors RSSI and ACPR levels automatically. Using a map created with Map Master, the instrument displays maps, the location of the measurement, and a special color code for the power level. The refresh rate can be set up in time (1 sec, minimum) or distance.

The overall amplitude accuracy coupled with the GPS update rate ensures accurate and reliable mapping results



Indoor Mapping

INDOOR MAPPING

When there is no GPS signal valid, the Spectrum Master uses a start-walk-stop approach to record RSSI and ACPR levels. You can set the update rate, start location, and end location and the interpolated points will be displayed on the map.

Saved KML File

EXPORT KML FILES

Save files as KML or JPEG. Open kml files with Google Earth™.
When opening up a pin in Google Earth, center frequency, detection method, measurement type, and RBW are shown on screen.

Create maps with Map Master

MAP MASTER

The Map Master program creates maps compatible with the Spectrum Master. Maps are created by typing in the address or by converting existing JPEG, TIFF, BMP, GIF, and PNG files to MAP files. Utilizing the built-in zoom in and zoom out features, it is easy to create maps of the desired location and transfer to the instrument with a USB flash card. Map Master also includes a GPS editor for inputting latitude and longitude information of maps from different formats.

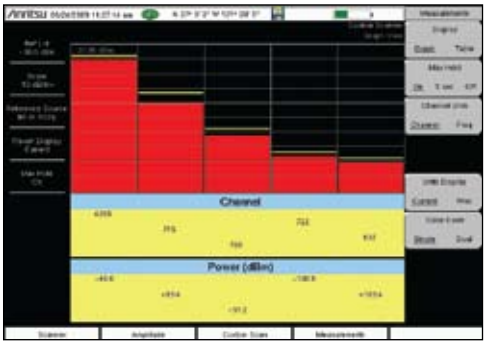
Power Measurements for a Wide Range of Applications

The Spectrum Master supports many different power measurements, including the channel scanner, high accuracy power meter, internal power meter, and channel power measurement.

Power Meter

High Accuracy Power Meter

High Accuracy Power Sensors



Channel Scanner

CHANNEL POWER

Use Spectrum Master's channel power measurement to determine the power and power density of a transmission channel. Using the built-in signal standard list, you can measure the channel power of a wide range of signals.

POWER METER (OPTION 29)

Spectrum Master's internal power meter provides power measurements without any additional tools and is ideal for making channelized power measurements. You can display the results in both dBm and Watts. This option is easy to use and requires limited setup entries.

HIGH ACCURACY POWER METER (OPTION 19)

Anritsu's high accuracy power meter option enables you to make high accuracy RMS measurements. This capability is perfect for measuring both CW and digitally modulated signals such as CDMA/EV-DO, GSM/EDGE, WCDMA/HSDPA, and P25. You can select from a wide range of USB sensors delivering better than ± 0.16 dB accuracy. An additional benefit of using the USB connection is that a separate DC supply (or battery) is not needed because the necessary power is supplied by the USB port.

- PSN50 High Accuracy RF Power Sensor, 50 MHz to 6 GHz, –30 dBm to +20 dBm, True-RMS
- MA24104A Inline High Power Sensor, 600 MHz to 4 GHz, +3 dBm to +51.76 dBm (150W), True-RMS
- MA24106A High Accuracy RF Power Sensor, 50 MHz to 6 GHz, –40 dBm to +23 dBm, True-RMS
- MA24108A Microwave USB Power Sensor, 10 MHz to 8 GHz, –40 dBm to +20 dBm, True-RMS
- MA24118A, Microwave USB Power Sensor, 10 MHz to 18 GHz, –40 dBm to +20 dBm, True-RMS
- MA24126A, Microwave USB Power Sensor, 10 MHz to 26 GHz, –40 dBm to +20 dBm, True-RMS

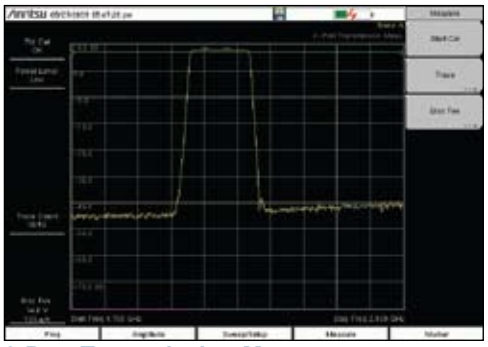
PC POWER METER

These power sensors can be used with a PC running Microsoft Windows® via USB. They come with PowerXpert™ application, a data analysis, and control software. The application has abundant features, such as data logging, power versus time graph, big numerical display, and many more, that enable quick and accurate measurements.

CHANNEL SCANNER (OPTION 27)

The channel scanner option measures the power of multiple transmitted signals, making it very useful for simultaneously measuring channel power of up to 20 channels in GSM, TDMA, CDMA, W-CDMA, HSDPA, and public safety networks. You can select the frequencies or the scanned data to be displayed, either by frequencies or the channel number. And in the custom setup menu, each channel can be custom built with different frequency bandwidth, or with channels from different signal standards. With Script Master, scans can be automated for up to 1200 channels.

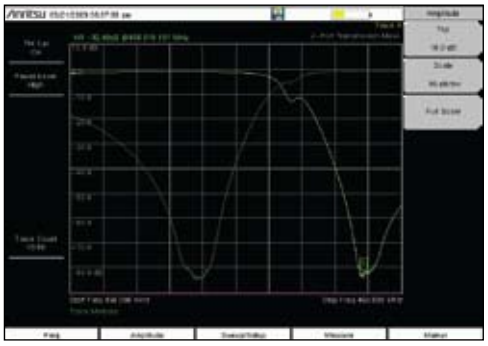
Passive and Active 2-Port Measurements



2-Port Transmission Measurements

2-PORT TRANSMISSION MEASUREMENTS (OPTION 21)

Spectrum Master's 2-port transmission measurement capability allows you to make gain, isolation, and insertion loss measurements of passive and active devices such as filters, cables, attenuators, duplexers, and tower-mounted amplifiers. Transmission measurement can also be used to make antenna-to-antenna isolation measurements and for repeater testing. Two power levels provide you with high (~ 0 dBm) and low (~ -30 dBm) power settings.



Duplexer Measurement

BIAS TEE (OPTION 10)

The built-in bias tee can be turned on as needed to place +12V to +32V on the center conductor of the RF In port, eliminating the need for you to carry external supplies in the field.

DUPLEXERS

Fast sweep speeds, 80 dB dynamic range, and easy-to-use trace math menus make the Spectrum Master well suited for duplexer applications.

Valuable Options and Features

GPS Receiver

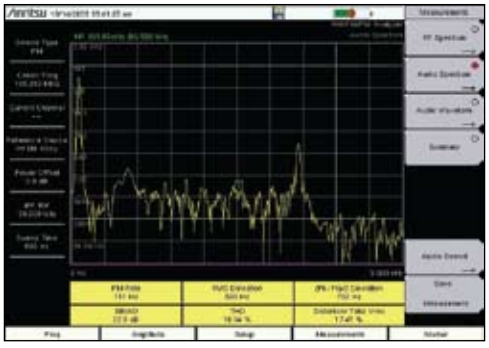
GPS RECEIVER (OPTION 31)

Spectrum Master's GPS option can be used to confirm the exact measurement location (longitude, latitude, altitude) and Universal Time (UTC) information. Each trace can be stamped with location information to ensure you are taking measurements at the right location.

In addition, the GPS option enhances the frequency accuracy of the internal reference oscillator. Within three minutes of acquiring the GPS satellite, the built-in GPS receiver provides a frequency accuracy to better than 50 ppb.

CW SIGNAL GENERATOR (OPTION 28)

This option provides a CW signal generator from 2 MHz to 2 GHz. The signal at the output port can be set high (approximately 0 dBm) or low (–30 dBm). With the use of the CW Signal Generator Kit's attenuator connected to the RF port, the level can be varied in 1 dB steps, giving you the ability to generate signals as low as -110 dBm for receiver sensitivity measurements. The included splitter divides the signal, allowing for a simultaneous power measurement.



AM/FM/PM Analyzer

AM/FM/PM ANALYZER (OPTION 509)

The AM/FM/PM analyzer provides analysis and display of analog modulation. Four measurement displays are provided.

The RF Spectrum display shows the spectrum with carrier power, frequency, and occupied BW. The Audio Spectrum display shows the demodulated audio spectrum along with the Rate, RMS deviation, Pk-Pk/2 deviation, SINAD, Total Harmonic Distortion (THD), and Distortion/Total. Audio Waveform display shows the time-domain demodulated waveform. Finally, there is a Summary Table Display that includes all the RF and Demod parameters.

Touchscreen keyboard

BUILT-IN KEYBOARD

The built-in touchscreen keyboard gives you access to a fully functional keyboard, saving valuable time in the field when entering trace names. You can create shortcuts to customer-configurable user "quick names" to program frequently used words.

Menus with shortcut icons

MENUS WITH SHORTCUT ICONS

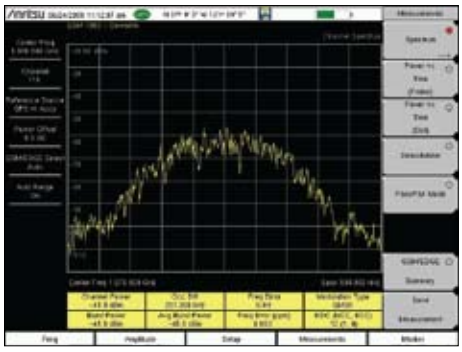
Find your favorite measurements quickly by pressing the menu key. Create shortcuts for popular measurements, setups, and functions by simply holding down any key for more than three seconds. This display shows the menu with standard measurements and with the lower part filled with shortcut icons.

LOCAL LANGUAGE SUPPORT

Spectrum Master features eight languages, including English, Japanese, Chinese, Italian, French, German, Spanish, and Korean. Two custom user-defined languages can be uploaded into the instrument using Master Software Tools.

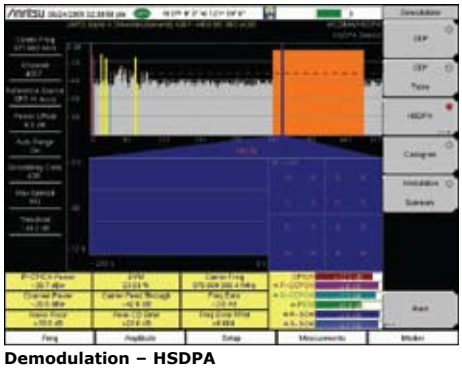
Spectrum Master™ Compact Handheld Spectrum Analyzer Features

Introduction to Signal Analyzers



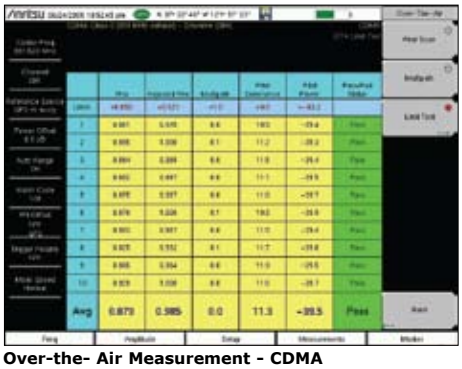
RF Measurement – GSM

High Frequency Error will cause calls to drop when mobiles travel at higher speed. In some cases, cell phones cannot hand off into, or out of the cell.



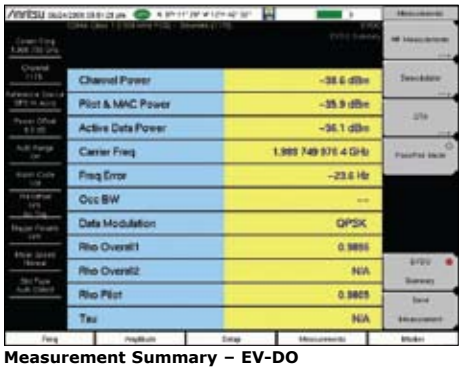
Demodulation – HSDPA

This is the single most important signal quality measurement. Poor EVM leads to dropped calls, low data rate, low sector capacity, and blocked calls.



Over-the- Air Measurement - CDMA

Having low multi-path and high pilot dominance is required for quality Rho measurements OTA. Poor Rho leads to dropped and blocked calls, and low data rate.



Measurement Summary – EV-DO

Having a summary of all key measurements is a quick way for a technician to see the health of the base station and record the measurements for reference.

Signal Analyzers

The Spectrum Master features Signal Analyzers for the major wireless standards around the world. The Signal Analyzers are designed to test and verify the:

- RF Quality
- Modulation Quality
- Downlink Coverage Quality

of the base stations' transmitters. The goal of these tests are to improve the Key Performance Indicators (KPIs) associated with:

- Call Drop Rate
- Call Block Rate
- Call Denial Rate

By understanding which test to perform on the Spectrum Master when the KPIs degrade to an unacceptable level, a technician can troubleshoot down to the Field Replacement Unit (FRU) in the base station's transmitter chain. This will minimize the problem of costly no trouble founds (NTF) associated with card swapping. This will allow you to have a lower inventory of spare parts as they are used more efficiently.

Troubleshooting Guides

The screen shots on this page are all measurements made over-the-air with the MS2713E on commercial base stations carrying live traffic. To understand when, where, how, and why you make these measurements Anritsu publishes Troubleshooting Guides which explains for each measurement the:

- Guidelines for a good measurement
- Consequences of a poor measurement
- Common Faults in a base station

These *Troubleshooting Guides for Base Stations* are one-page each per Signal Analyzer. They are printed on tear-resistant and smudge-resistant paper and are designed to fit in the soft case of the instrument for easy reference in the field. They are complimentary and their part numbers can be found in the ordering information.

- GSM/GPRS/EDGE Base Stations
- W-CDMA/HSDPA Base Stations
- CDMA2000 1X Base Stations
- CDMA2000 1xEV-DO Base Stations
- Fixed WiMAX Base Stations
- Mobile WiMAX Base Stations
- TD-SCDMA/HSDPA Base Station

Signal Analyzers

GSM/GPRS/EDGE
W-CDMA/HSDPA
cdmaOne/CDMA2000 1X
CDMA2000 1xEV-DO
Fixed WiMAX
Mobile WiMAX
TD-SCDMA
P25
NXDN

Typical Signal Analyzer Options

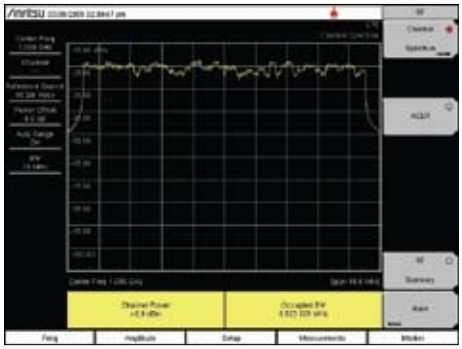
RF Measurements
Demodulation
Over-the-Air Measurements

Signal Analyzer Features

Measurement Summary Display
Pass/Fail Limit Testing

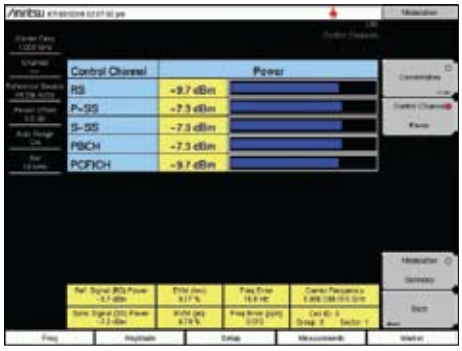
Spectrum Master™ Compact Handheld Spectrum Analyzer Features

LTE Signal Analyzers (Options 0541, 0542, 0546)



RF Measurements – Occupied Bandwidth

The bandwidth that contains 99% of the total carrier power. Excessive occupied bandwidth means excessive adjacent channel interference.



Modulation Quality – EVM

High or low values will create larger areas of cell-to-cell interference and create lower data rates near cell edges. Low values affect in-building coverage.

Over-the-Air Measurements – Sync Signal Power

Check for uneven amplitude of sub-carriers. Data will be less reliable on weak sub-carriers, creating a lower over-all data rate.

Pass/Fail Test

Set up common test limits, or sets of limits, for each instrument. Inconsistent settings between base stations, leads to inconsistent network behavior.

LTE Signal Analyzers

The Spectrum Master features three LTE measurement modes:

- RF Measurements
- Modulation Measurements
- Over-the-Air Measurements (OTA)

The goal of these measurements is to increase data rate and capacity by accurate power settings, ensuring low out-of-channel emissions, and good signal quality. These attributes help to create a low dropped call rate, a low blocked call rate, and a good customer experience.

Cell site technicians or RF engineers can make measurements Over-the-Air (OTA) to spot-check a transmitter's coverage and signal quality without taking the cell site off-line. When the OTA test results are ambiguous one can directly connect to the base station to check the signal quality and transmitter power.

Adjacent Channel Leakage Ratio (ACLR)

Adjacent Channel Leakage Ratio (ACLR) measures how much BTS signal gets into neighboring RF channels. ACLR checks the closest (adjacent) and the second closest (alternate) channels. Poor ACLR can lead to interference with adjacent carriers and legal liability. It also can indicate poor signal quality which leads to low throughput.

Cell ID (Sector ID, Group ID)

Cell ID indicates which base station is being measured OTA. The strongest base station at your current location is selected for measurement. Wrong values for Cell ID lead to inability to register. If the cause is excessive overlapping coverage, it also will lead to poor EVM and low data rates

Frequency Error

Frequency Error is a check to see that the carrier frequency is precisely correct. The Spectrum Master can accurately measure Carrier Frequency Error OTA if the instrument is GPS enabled. Calls will drop when mobiles travel at higher speed. In some cases, cell phones cannot hand off into, or out of the cell.

Sync Signal Mapping

Sync Signal Scanner can be used with the GPS to save scan results for later display on a map. The EVM of the strongest synch signal available at that spot is also recorded. The Cell, Sector, and Group ID information is also included so that it's easier to interpret the results. Once the Synch Signals are mapped, it becomes much easier to understand and troubleshoot any interference or coverage issues.

RF Measurements (Option 0541)

Channel Spectrum
- Channel Power
- Occupied Bandwidth

ACLR

Modulation Measurements (10 MHz Bandwidth) (Option 0542)

Constellation
- Reference Signal Power
- Sync Signal Power
- EVM
- Frequency Error
- Carrier Frequency
- Cell ID
- Sector ID
- Group ID

Control Channel Power
- RS
- P-SS
- S-SS
- PBCH
- PCFICH

Over-the-Air Scanner (OTA) (Option 0546)

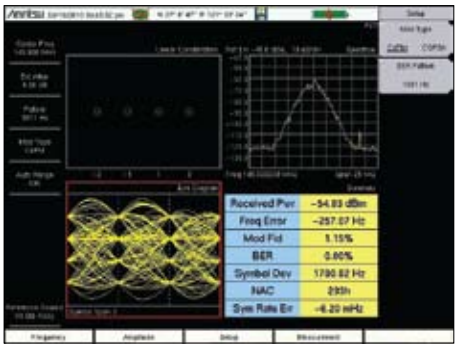
Synch Signal Power (Six Strongest)
- Power
- Cell ID
- Sector ID
- Group ID

Dominance

Auto-Save with GPS Tagging and Logging

Spectrum Master™ Compact Handheld Spectrum Analyzer Features

P25 Analyzer and P25 Coverage (Options 0520, 0522)

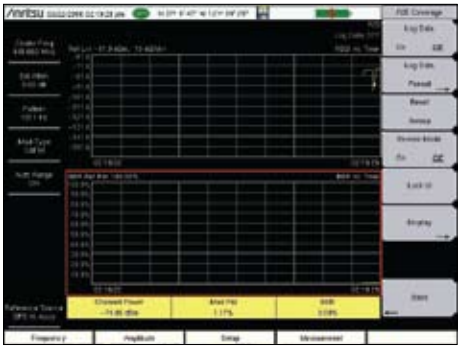


Four measurement screen view

The Four Screen view provides a quick overall summary of P25 transmitter performance.

Summary Display

The Summary display gives a quick numerical view of a P25 transmitter.



P25 Coverage

The Coverage mode provides view of the BER, RSSI or Modulation Fidelity in a dual screen view. When Log Data is turned on all three parameters are logged to external USB memory along with GPS location and time.

P25 Analyzers

The Spectrum Master features two P25 measurement modes

- P25 Analyzer
- P25 Coverage

The goal of the P25 Analyzer is to provide technicians with the measurements needed to assure proper performance of a P25 transmitter. Six measurement screens can be presented individually or 4 at a time to quickly see the overall performance of a P25 transmitter.

Two P25 demodulators are available to support C4FM and CQPSK (LSM) P25 transmitters.

The Summary screen gives a quick numerical view of a P25 transmitter. The spectrum display gives an indication if there are interferers present that may degrade the bit error rate.

The Eye Diagram View provides an indication of baseband fidelity of a P25 transmitter. With Over-the-air measurements the Eye Diagram can indicate phase distortion from multipath

Option 0522 adds GPS-based coverage measurements to the P25 Analyzer. With a GPS antenna (P/N 2000-1258-R) and GPS receiver (Option 0031) installed, P25 RSSI, BER and Modulation Fidelity measurements are logged to a file on external USB memory once per second (approximately) and attached to the GPS location and time. The file is appended every 551 measurements to provide one file up to the USB memory size. Two file formats are provided, Tab Separated Value for viewing coverage data with Microsoft Excel or into third party coverage prediction software and .kml for direct viewing with Google Earth.

The kml file format supports viewing coverage measurements with Google Earth as colored push pins.

P25 Analyzer Measurements (Option 0520)

Received Power
Frequency Error
Modulation Fidelity
NAC (hex)
Symbol Rate Error
BER (1011 Hz, O.153, Voice, and Control Channel)

Graphs

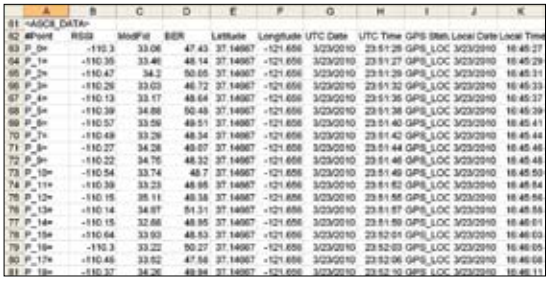
Constellation
Linear Constellation
Spectrum (25 kHz span)
Histogram
Eye Diagram
Summary Display

P25 Coverage Measurements (Option 0522)

BER
RSSI
Modulation Fidelity

Graphs

RSSI vs. Time
BER vs. Time
Modulation Fidelity vs. Time



P25 Tab Separated Output

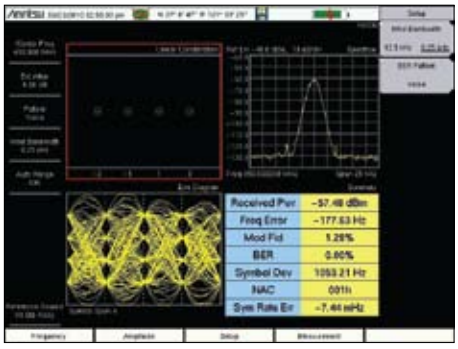
The tab Separated file format supports viewing coverage measurements with Microsoft Excel or with third party coverage prediction software.

P25 .kml output

The kml file format supports viewing coverage measurements with Google Earth as colored push pins.

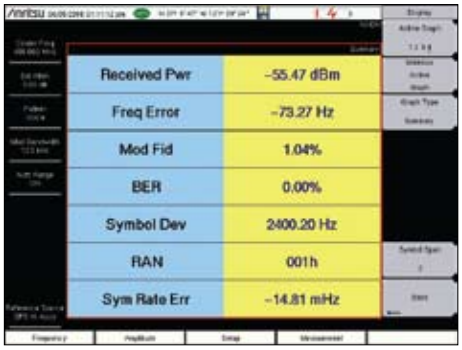
Spectrum Master™ Compact Handheld Spectrum Analyzer Features

NXDN Analyzer and NXDN Coverage (Options 0530, 0532)



Four measurement screen view

The Four Screen view provides a quick overall summary of NXDN transmitter performance.



Summary Display

The Summary display gives a quick numerical view of a NXDN transmitter.

NXDN Coverage

The Coverage mode provides view of the BER, RSSI or Modulation Fidelity in a dual screen view. When Log Data is turned on all three parameters are logged to external USB memory along with GPS location and time.

NXDN Analyzers

The Spectrum Master features two NXDN measurement modes

- NXDN Analyzer
- NXDN Coverage

The goal of the NXDN Analyzer measurements is to provide technicians with the measurements needed to assure proper performance of a NXDN transmitter. Six measurement views can be presented individually or 4 at a time to quickly see the overall performance of a NXDN transmitter.

Two NXDN demodulators are available to support 6.25 kHz and 12.5 kHz transmitters.

The Summary display gives a quick numerical view of a NXDN transmitter. The spectrum display gives an indication if there are interferers present that may degrade the bit error rate.

The Eye Diagram View provides an indication of baseband fidelity of a NXDN transmitter. With Over-the-air measurements the Eye Diagram can indicate phase distortion from multipath

Option 0532 adds GPS-based coverage measurements to the NXDN Analyzer. With a GPS antenna (P/N 2000-1258-R) and GPS receiver (Option 0031) installed, NXDN RSSI, BER and Modulation Fidelity measurements are logged to a file on external USB memory once per second (approximately) and attached to the GPS location and time. The file is appended every 551 measurements to provide one file up to the USB memory size. Two file formats are provided, Tab Separated Value for viewing coverage data with Microsoft Excel or into third party coverage prediction software and .kml for direct viewing with Google Earth.

The kml file format supports viewing coverage measurements with Google Earth as colored push pins.

NXDN Analyzer Measurements (Option 0530)

Received Power
Frequency Error
Modulation Fidelity
RAN (hex)
Symbol Rate Error
BER (1011 Hz, O.153, Voice, and Control Channel)

Graphs

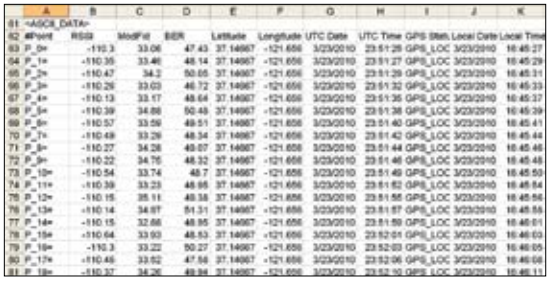
Constellation
Linear Constellation
Spectrum (25 kHz span)
Histogram
Eye Diagram
Summary Display

NXDN Coverage Measurements (Option 0532)

BER
RSSI
Modulation Fidelity

Graphs

RSSI vs. Time
BER vs. Time
Modulation Fidelity vs. Time



NXDN Tab Separated Output

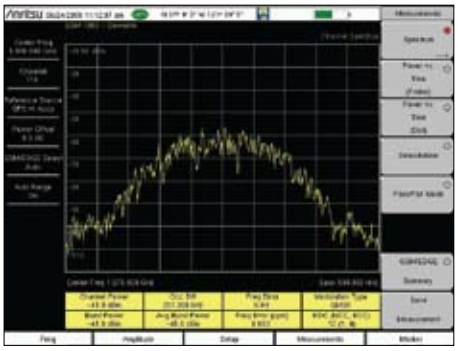
The tab Separated file format supports viewing coverage measurements with Microsoft Excel or with third party coverage prediction software.

NXDN .kml output

The kml file format supports viewing coverage measurements with Google Earth as colored push pins.

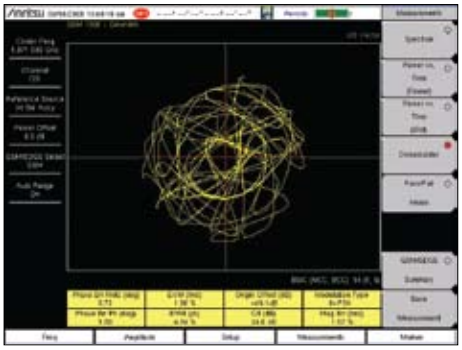
Spectrum Master™ Compact Handheld Spectrum Analyzer Features

GSM/GPRS/EDGE Signal Analyzers (Options 0040, 0041)



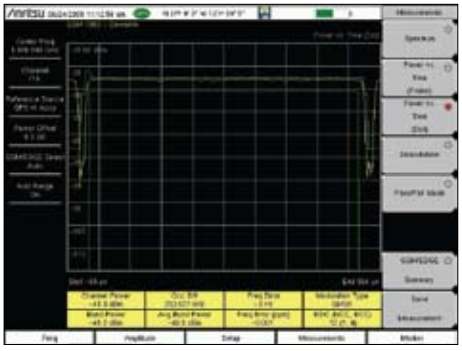
RF Measurement – Occupied Bandwidth

Excessive occupied bandwidth can create interference with adjacent channels or be a sign of poor signal quality, leading to dropped calls.



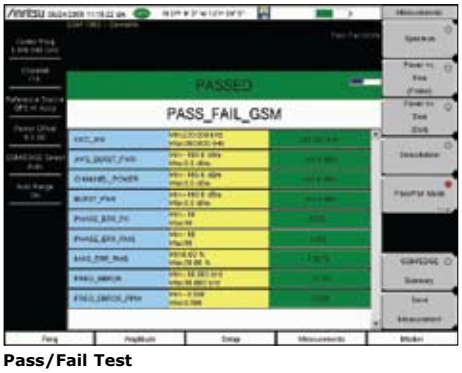
Demodulation – Error Vector Magnitude (EVM)

This is the single most important signal quality measurement. Poor EVM leads to dropped calls, low data rate, low sector capacity, and blocked calls.



RF Measurement – Average Burst Power

High or low values will create larger areas of cell-to-cell interference and create lower data rates near cell edges. Low values create dropouts and dead zones.



Pass/Fail Test

Set up common test limits, or sets of limits, for each instrument. Inconsistent settings between base stations, leads to inconsistent network behavior.

GSM/GPRS/EDGE Analyzers

The Spectrum Master features two GSM/GPRS/ EDGE measurement modes.

- RF Measurements
- Demodulation

The goal of these measurements is to increase data rate and capacity by accurate power settings, ensuring low out-of-channel emissions, and good signal quality. These attributes help to create a low dropped call rate, a low blocked call rate, and a good customer experience.

Cell site technicians or RF engineers can make measurements Over-the-Air (OTA) to spot-check a transmitter's coverage and signal quality without taking the cell site off-line. When the OTA test results are ambiguous one can directly connect to the base station to check the signal quality and transmitter power.

For easy identification of which cell you are measuring the Base Station Identity Code (BSIC) gives the base station id, the Network Color Code (NCC) identifies the owner of the network, and the Base Station Color Code (BCC) provides the sector information.

Carrier-to-Interference (C/I)

C/I indicates the quality of the received signal. It also can be used to identify areas of poor signal quality. Low C/I ratios will cause coverage issues including dropped calls, blocked calls, and other handset reception problems.

Phase Error

Phase Error is a measure of the phase difference between an ideal and actual GMSK modulated voice signal. High phase error leads to dropped calls, blocked calls, and missed handoffs.

Origin Offset

Origin Offset is a measure of the DC power leaking through local oscillators and mixers. A high Origin Offset will lower EVM and Phase Error measurements and create higher dropped call rates.

Power versus Time (Slot and Frame)

Power versus Time (Slot and Frame) should be used if the GSM base station is setup to turn RF power off between timeslots. When used OTA, this measurement can also spot GSM signals from other cells. Violations of the mask create dropped calls, low capacity, and small service area issues.

RF Measurements (Option 0040)

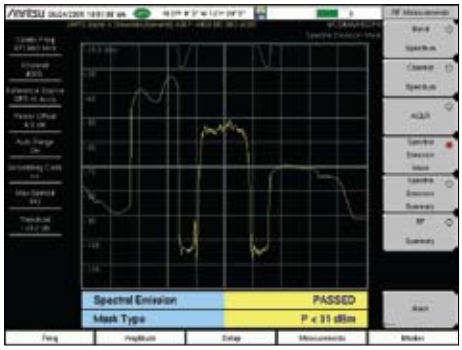
- Channel Spectrum
  - Channel Power
  - Occupied Bandwidth
  - Burst Power
  - Average Burst Power
  - Frequency Error
  - Modulation Type
  - BSIC (NCC, BCC)
- Multi-channel Spectrum
- Power vs. Time (Frame/Slot)
  - Channel Power
  - Occupied Bandwidth
  - Burst Power
  - Average Burst Power
  - Frequency Error
  - Modulation Type
  - BSIC (NCC, BCC)

Demodulation (Option 0041)

- Phase Error
- EVM
- Origin Offset
- C/I
- Modulation Type
- Magnitude Error
- BSIC (NCC, BCC)

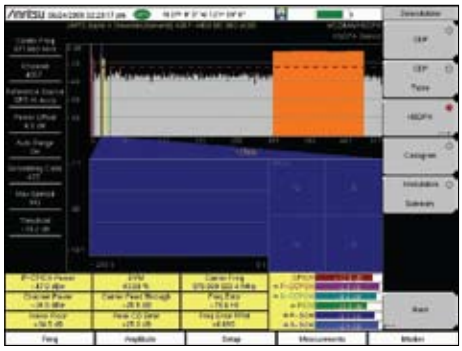
Spectrum Master™ Compact Handheld Spectrum Analyzer Features

W-CDMA/HSDPA Signal Analyzers (Options 0044, 0045 or 0065, 0035)



RF Measurements – Spectral Emissions Mask

The 3GPP spectral emission mask is displayed. Failing this test leads to interference with neighboring carriers, legal liability, and low signal quality.

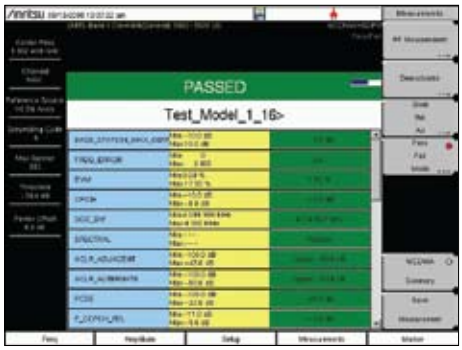


Demodulation – Error Vector Magnitude (EVM)

This is the single most important signal quality measurement. Poor EVM leads to dropped calls, low data rate, low sector capacity, and blocked calls.

Over-the-Air Measurements – Scrambling Codes

Too many strong sectors at the same location creates pilot pollution. This leads to low data rate, low capacity, and excessive soft handoffs.



Pass/Fail Test

Set up common test limits, or sets of limits, for each instrument. Inconsistent settings between base stations leads to inconsistent network behavior.

W-CDMA/HSDPA Signal Analyzers

The Spectrum Master features four W-CDMA/ HSDPA measurement modes:

- RF Measurements
- Demodulation (two choices)
- Over-the Air Measurements (OTA)

The goal of these measurements is to increase data rate and capacity by accurate power settings, ensuring low out-of-channel emissions, and good signal quality. These attributes help to create a low dropped call rate, a low blocked call rate, and a good customer experience.

Cell site technicians or RF engineers can make measurements Over-the-Air (OTA) to spot-check a transmitter's coverage and signal quality without taking the Node B off-line. When the OTA test results are ambiguous one can directly connect to the base station to check the signal quality and transmitter power.

Frequency Error

Frequency Error is a check to see that the carrier frequency is precisely correct. The Spectrum Master can accurately measure Carrier Frequency Error OTA if the instrument is GPS enabled. Calls will drop when mobiles travel at higher speed. In some cases, cell phones cannot hand off into, or out of the cell.

Peak Code Domain Error (PCDE)

Peak Code Domain Error is a measure of the errors between one code channel and another. High PCDE causes dropped calls, low signal quality, low data rate, low sector capacity, and blocked calls.

Multipath

Multipath measurements show how many, how long, and how strong the various radio signal paths are. Multipath signals outside tolerances set by the cell phone or other UE devices become interference. The primary issue is co-channel interference leading to dropped calls and low data rates.

Pass/Fail Mode

The Spectrum Master stores the five test models covering all eleven test scenarios specified in the 3GPP specification (TS 25.141) for testing base station performance and recalls these models for quick easy measurements.

RF Measurements (Option 0044)

- Band Spectrum
- Channel Spectrum
  - Channel Power
  - Occupied Bandwidth
  - Peak-to-Average Power
- Spectral Emission Mask
- Single carrier ACLR
- Multi-carrier ACLR

Demodulation (Option 0045 or 0065)

- Code Domain Power Graph
  - P-CPICH Power
  - Channel Power
  - Noise Floor
  - EVM
  - Carrier Feed Through
  - Peak Code Domain Error
  - Carrier Frequency
  - Frequency Error
  - Control Channel Power
  - Abs/Rel/Delta Power
    - CPICH, P-CCPCH
    - S-CCPCH, PICH
    - P-SCH, S-SCH
  - HSDPA (Option 0065 only)
    - Power vs. Time
    - Constellation
- Code Domain Power Table
  - Code, Status
  - EVM, Modulation Type
  - Power, Code Utilization
  - Power Amplifier Capacity
- Codogram

Over-the-Air (OTA) Measurements (Option 0035)

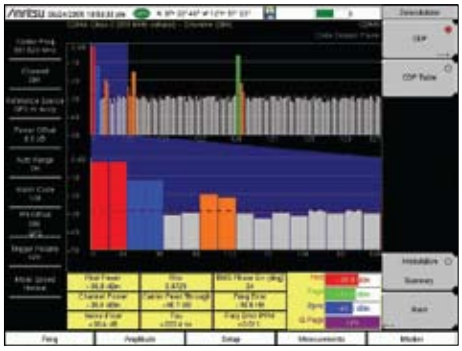
- Scrambling Code Scanner (Six)
  - Scrambling Codes
  - CPICH
  - E_c/I_o
  - E_c
  - Pilot Dominance
  - OTA Total Power
- Multipath Scanner (Six)
  - Six Multipaths
  - Tau
  - Distance
  - RSCP
  - Relative Power
  - Multipath Power

Spectrum Master™ Compact Handheld Spectrum Analyzer Features

cdmaOne/CDMA2000 1X Signal Analyzers (Options 0042, 0043, 0033)

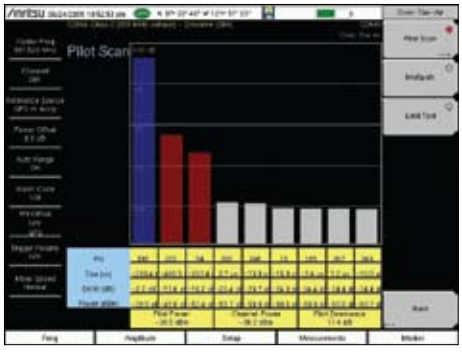
RF Measurements – Spectral Emissions Mask

The 3GPP spectral emission mask is displayed. Failing this test leads to interference with neighboring carriers, legal liability, and low signal quality.



Modulation Quality – EVM

High or low values will create larger areas of cell-to-cell interference and create lower data rates near cell edges. Low values affect in-building coverage.



Over-the-Air Measurements – Sync Signal Power

Check for uneven amplitude of sub-carriers. Data will be less reliable on weak sub-carriers, creating a lower over-all data rate.

Pass/Fail Test

Set up common test limits, or sets of limits, for each instrument. Inconsistent settings between base stations leads to inconsistent network behavior.

CDMA Signal Analyzers

The Spectrum Master features three CDMA measurement modes:

- RF Measurements
- Demodulation
- Over-the Air Measurements (OTA)

The goal of these measurements is to increase data rate and capacity by accurate power settings, ensuring low out-of-channel emissions, and good signal quality. These attributes help to create a low dropped call rate, a low blocked call rate, and a good customer experience.

Cell site technicians or RF engineers can make measurements Over-the-Air (OTA) to spot-check a transmitter's coverage and signal quality without taking the cell site off-line. When the OTA test results are ambiguous one can directly connect to the base station to check the signal quality and transmitter power.

Adjacent Channel Power Ratio (ACPR)

ACPR measures how much of the carrier gets into neighboring RF channels. ACPR, and multi-channel ACPR, check the closest (adjacent) and second closest (alternate) RF channels for single and multicarrier signals. High ACPR will create interference for neighboring carriers. This is also an indication of low signal quality and low capacity, which can lead to blocked calls.

RMS Phase Error

RMS Phase Error is a measure of signal distortion caused by frequency instability. Any changes in the reference frequency or the radio's internal local oscillators will cause problems with phase error. A high reading will cause dropped calls, low signal quality, low data rate, low sector capacity, and blocked calls.

Noise Floor

Noise Floor is the average level of the visible code domain noise floor. This will affect Rho. A high noise floor will result in dropped calls, low signal quality, low data rate, low sector capacity, and blocked calls.

E_c/I_o

E_c/I_o indicates the quality of the signal from each PN. Low E_c/I_o leads to low data rate and low capacity.

RF Measurements (Option 0042)

- Channel Spectrum
  - Channel Power
  - Occupied Bandwidth
  - Peak-to-Average Power
- Spectral Emission Mask
- Multi-carrier ACPR

Demodulation (Option 0043)

- Code Domain Power Graph
  - Pilot Power
  - Channel Power
  - Noise Floor
  - Rho
  - Carrier Feed Through
  - Tau
  - RMS Phase Error
  - Frequency Error
  - Abs/Rel/ Power
    - Pilot
    - Page
    - Sync
    - Q Page
- Code Domain Power Table
  - Code
  - Status
  - Power
  - Multiple Codes
  - Code Utilization

Over-the-Air (OTA) Measurements (Option 0033)

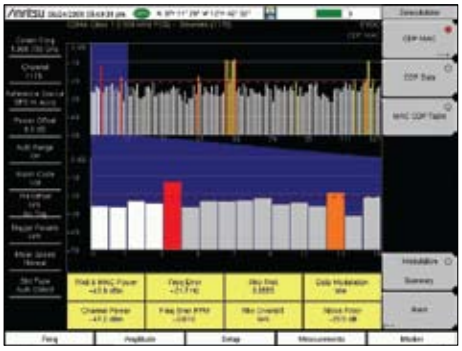
- Pilot Scanner (Nine)
  - PN
  - E_c/I_o
  - Tau
  - Pilot Power
  - Channel Power
  - Pilot Dominance
- Multipath Scanner (Six)
  - E_c/I_o
  - Tau
  - Channel Power
  - Multipath Power
- Limit Test – 10 Tests Averaged
  - Rho
  - Adjusted Rho
  - Multipath
  - Pilot Dominance
  - Pilot Power
  - Pass/Fail Status

Spectrum Master™ Compact Handheld Spectrum Analyzer Features

CDMA2000 1xEV-DO Signal Analyzers (Options 0062, 0063, 0034)

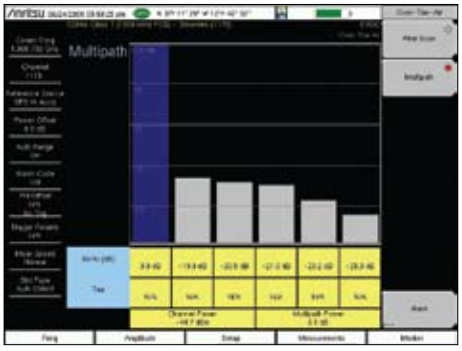
RF Measurements – Pilot and MAC Power

High values will create pilot pollution. High or low values will cause dead spots/dropped calls and cell loading imbalances/blocked calls.



Demodulation – Frequency Error

Calls will drop when mobiles travel at higher speed. In some cases, cell phones cannot hand off into, or out of the cell, creating island cells.



Over-the-Air Measurements – Multipath

Too much Multipath from the selected PN Code is the primary issue of co-channel interference leading to dropped calls and low data rates.

Pass/Fail Test

Set up common test limits, or sets of limits, for each instrument. Inconsistent settings between base stations leads to inconsistent network behavior.

EV-DO Signal Analyzers

The Spectrum Master features three EV-DO measurement modes.

- RF Measurements
- Demodulation
- Over-the Air Measurements (OTA)

The goal of these measurements is to increase data rate and capacity by accurate power settings, ensuring low out-of-channel emissions, and good signal quality. These attributes help to create a low dropped call rate, a low blocked call rate, and a good customer experience.

Cell site technicians or RF engineers can make measurements Over-the-Air (OTA) to spot-check a transmitter's coverage and signal quality without taking the cell site off-line. When the OTA test results are ambiguous one can directly connect to the base station to check the signal quality and transmitter power.

Spectral Emission Mask (SEM)

SEM is a way to check out-of-channel spurious emissions near the carrier. These spurious emissions both indicate distortion in the signal and can create interference with carriers in the adjacent channels. Faults lead to interference and thus, lower data rates, for adjacent carriers. Faults also may lead to legal liability and low in-channel signal quality.

Rho

Rho is a measure of modulation quality. Rho Pilot, Rho Mac, and Rho Data are the primary signal quality tests for EV-DO base stations. Low Rho results in dropped calls, low signal quality, low data rate, low sector capacity, and blocked calls. This is the single most important signal quality measurement.

PN Codes

PN Code overlap is checked by the pilot scanner. Too many strong pilots create pilot pollution which results in low data rate, low capacity, and excessive soft handoffs.

Over-the-Air (OTA) Pilot Power

OTA Pilot Power indicates signal strength. Low OTA Pilot Power causes dropped calls, low data rate, and low capacity.

RF Measurements (Option 0062)

- Channel Spectrum
  - Channel Power
  - Occupied Bandwidth
  - Peak-to-Average Power
- Power vs. Time
  - Pilot & MAC Power
  - Channel Power
  - Frequency Error
  - Idle Activity
  - On/Off Ratio
- Spectral Emission Mask
- Multi-carrier ACPR

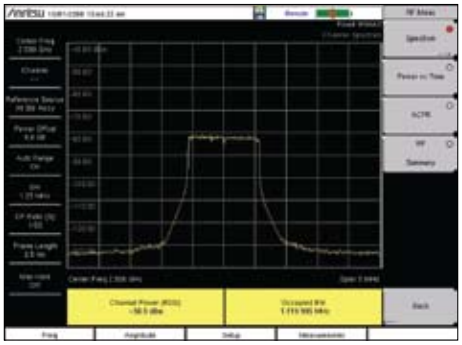
Demodulation (Option 0063)

- MAC Code Domain Power Graph
  - Pilot & MAC Power
  - Channel Power
  - Frequency Error
  - Rho Pilot
  - Rho Overall
  - Data Modulation
  - Noise Floor
- MAC Code Domain Power Table
  - Code
  - Status
  - Power
  - Code Utilization
- Data Code Domain Power
  - Active Data Power
  - Data Modulation
  - Rho Pilot
  - Rho Overall
  - Maximum Data CDP
  - Minimum Data CDP

Over-the-Air (OTA) Measurements (Option 0034)

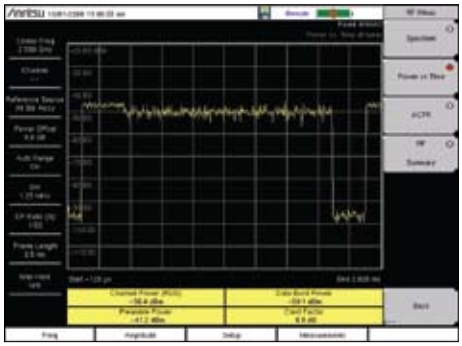
- Pilot Scanner (Nine)
  - PN
  - E_c/I_o
  - Tau
  - Pilot Power
  - Channel Power
  - Pilot Dominance
- Mulitpath Scanner (Six)
  - E_c/I_o
  - Tau
  - Channel Power
  - Multipath Power

IEEE 802.16 Fixed WiMAX Signal Analyzers (Options 0046, 0047)



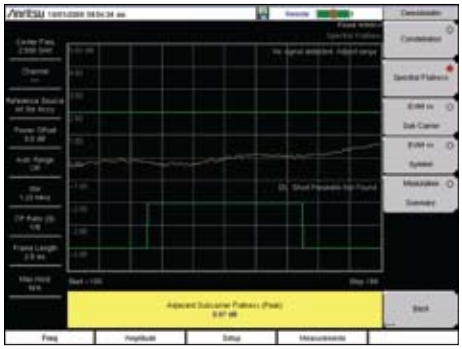
RF Measurements – Occupied Bandwidth

The bandwidth that contains 99% of the total carrier power. Excessive occupied bandwidth means excessive adjacent channel interference.



RF Measurement – Preamble Power

High or low values will create larger areas of cell-to-cell interferences and create lower data rates near cell edges. Low values affect in-building coverage.



Demodulation – Spectral Flatness

Check for uneven amplitude of sub-carriers. Data will be less reliable on weak sub-carriers, creating a lower over-all data rate.

Pass/Fail Test

Set up common test limits, or sets of limits, for each instrument. Inconsistent settings between base stations leads to inconsistent network behavior.

Fixed WiMAX Signal Analyzers

The Spectrum Master features two Fixed WiMAX measurement modes:

- RF Measurements
- Demodulation

The goal of these measurements is to increase data rate and capacity by accurate power settings, ensuring low out-of-channel emissions, and good signal quality. These attributes help to create a low dropped call rate, a low blocked call rate, and a good customer experience.

Cell site technicians or RF engineers can make measurements Over-the-Air (OTA) to spot-check a transmitter's coverage and signal quality without taking the cell site off-line. When the OTA test results are ambiguous one can directly connect to the base station to check the signal quality and transmitter power.

Adjacent Channel Power Ratio (ACPR)

Adjacent Channel Power Ratio (ACPR) measures how much BTS signal gets into neighboring RF channels. ACPR checks the closest (adjacent) and the second closest (alternate) channels. Poor ACPR can lead to interference with adjacent carriers and legal liability. It also can indicate poor signal quality which leads to low throughput.

Base Station ID

Base Station ID indicates which base station is being measured OTA. The strongest base station at your current location is selected for measurement. Wrong values for base station ID lead to inability to register. If the cause is excessive overlapping coverage, it also will lead to poor RCE and low data rates.

Relative Constellation Error (RCE)

RCE, when used Over-the-Air (OTA), is a test that is ideal for checking received signal quality. High RCE leads directly to low data rate, which creates dissatisfied customers and lowers the data capacity of the sector. Very high RCE results in dropped calls, timeouts, and inability to register.

Adjacent Subcarrier Flatness (Peak)

Adjacent Subcarrier Flatness (Peak) is measured between one sub-carrier and the next. Poor flatness will give the weaker sub-carriers a high bit error rate and lower capacity. Data will be less reliable on weak sub-carriers, creating a lower over-all data rate.

RF Measurements (Option 0046)

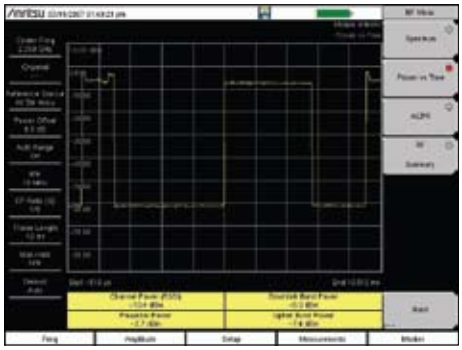
- Channel Spectrum
  - Channel Power
  - Occupied Bandwidth
- Power vs. Time
  - Channel Power
  - Preamble Power
  - Data Burst Power
  - Crest Factor
- ACLR

Demodulation (Option 0047)

- Constellation
  - RCE (RMS/Peak)
  - EVM (RMS/Peak)
  - Frequency Error
  - Carrier Frequency
  - Base Station ID
- Spectral Flatness
  - Adjacent Subcarrier Flatness
- EVM vs. Subcarrier/Symbol
  - RCE
  - EVM
  - Frequency Error
  - Carrier Frequency
  - Base Station ID

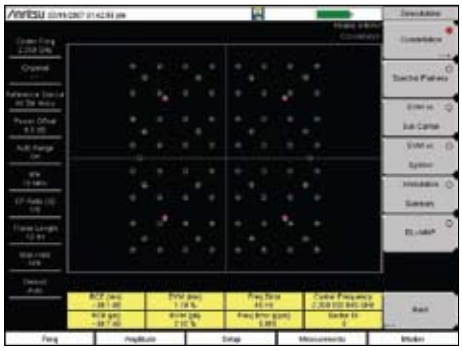
Spectrum Master™ Compact Handheld Spectrum Analyzer Features

IEEE 802.16 Mobile WiMAX Signal Analyzers (Options 0066, 0067, 0037)



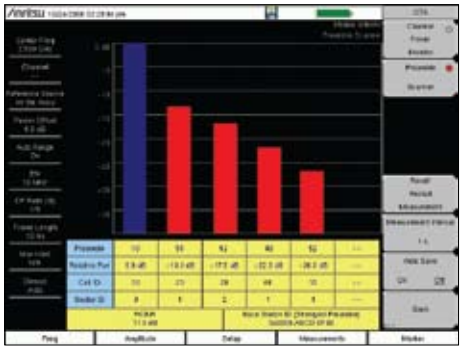
RF Measurement – Preamble Power

High or low values will create larger areas of cell-to-cell interference and create lower data rates near cell edges. Low values affect in-building coverage.



Demodulation – Frequency Error

Calls will drop when user's equipment travels at high speed. In severe cases, handoffs will not be possible at any speed, creating island cells.



Over-the-Air Measurements – PCINR

A low Physical Carrier to Interference plus Noise Ratio (PCINR) indicates poor signal quality, low data rate and reduced sector capacity.

Pass/Fail Test

Set up common test limits, or sets of limits, for each instrument. Inconsistent settings between base stations leads to inconsistent network behavior.

Mobile WiMAX Signal Analyzers

The Spectrum Master features three Mobile WiMAX measurement modes:

- RF Measurements
- Demodulation
- Over-the Air Measurements (OTA)

The goal of these measurements is to increase data rate and capacity by accurate power settings, ensuring low out-of-channel emissions, and good signal quality. These attributes help to create a low dropped call rate, a low blocked call rate, and a good customer experience.

Cell site technicians or RF engineers can make measurements Over-the-Air (OTA) to spot-check a transmitter's coverage and signal quality without taking the cell site off-line. When the OTA test results are ambiguous one can directly connect to the base station to check the signal quality and transmitter power.

Cell ID, Sector ID, and Preamble

Cell ID, Sector ID, and Preamble show which cell, sector, and segment are being measured OTA. The strongest signal is selected automatically for the additional PCINR and Base Station ID measurement. Wrong values for cell, sector and segment ID lead to dropped handoffs and island cells. If the cause is excessive coverage, it also will lead to large areas of low data rates.

Error Vector Magnitude (EVM) Relative Constellation Error (RCE)

RCE and EVM measure the difference between the actual and ideal signal. RCE is measured in dB and EVM in percent. A known modulation is required to make these measurements. High RCE and EVM causes low signal quality, low data rate, and low sector capacity. This is the single most important signal quality measurement.

Preamble Mapping (Mobile WiMAX)

Preamble Scanner can be used with the GPS to save scan results for later display on a map. PCINR ratio for the strongest WiMAX preamble available at that spot. The Base Station ID and Sector ID information are also included so that it's easier to interpret the results. Once PCINR data is mapped, it becomes much easier to understand and troubleshoot any interference or coverage issues.

RF Measurements (Option 0066)

Channel Spectrum
- Channel Power
- Occupied Bandwidth

Power vs. Time
- Channel Power
- Preamble Power
- Downlink Burst Power
- Uplink Burst Power

ACPR

Demodulation (Option 0067)

Constellation
- RCE (RMS/Peak)
- EVM (RMS/Peak)
- Frequency Error
- CINR
- Base Station ID
- Sector ID

Spectral Flatness
- Adjacent Subcarrier Flatness

EVM vs. Subcarrier/Symbol
- RCE (RMS/Peak)
- EVM (RMS/Peak)
- Frequency Error
- CINR
- Base Station ID
- Sector ID

DL-MAP (Tree View)

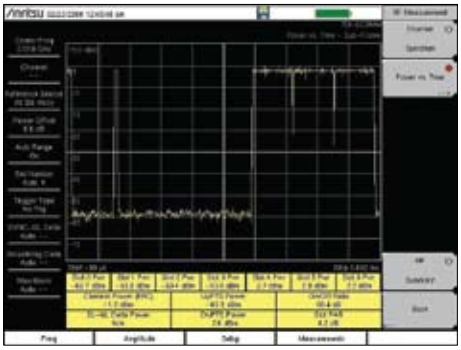
Over-the-Air (OTA) (Option 0037)

Channel Power Monitor

Preamble Scanner (Six)
- Preamble
- Relative Power
- Cell ID
- Sector ID
- PCINR
- Dominant Preamble
  - Base Station ID

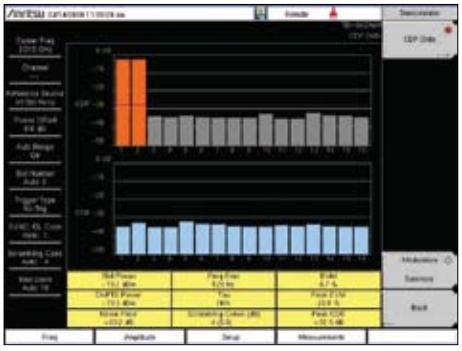
Spectrum Master™ Compact Handheld Spectrum Analyzer Features

TD-SCDMA/HSDPA Signal Analyzers (Options 0060, 0061, 0038)



RF Measurement – Time Slot Power

Empty downlink slots with access power will reduce the sensitivity of the receiver and the size of the sector. This will cause dropped and blocked calls.



Demodulation – Scrambling Code

Scrambling Code measurements provide a check for the BTS settings. Scrambling Code errors can cause a very high dropped call rate on hand off.

Over-the-Air Measurements – Code Scanner

Excessive sync codes produce too much co-channel interference, which leads to lower capacity, low data rate and excessive handoffs.

Pass/Fail Test

Set up common test limits, or sets of limits, for each instrument. Inconsistent settings between base stations leads to inconsistent network behavior.

TD-SCDMA/HSDPA Signal Analyzers

The Spectrum Master features three TD-SCDMA/HSDPA measurement modes:

- RF Measurements
- Demodulation
- Over-the Air Measurements (OTA)

The goal of these measurements is to increase data rate and capacity by accurate power settings, ensuring low out-of-channel emissions, and good signal quality. These attributes help to create a low dropped call rate, a low blocked call rate, and a good customer experience.

Cell site technicians or RF engineers can make measurements Over-the-Air (OTA) to spot-check a transmitter's coverage and signal quality without taking the cell site off-line. When the OTA test results are ambiguous one can directly connect to the base station to check the signal quality and transmitter power.

Error Vector Magnitude (EVM) EVM is the ratio of errors, or distortions, in the actual signal, compared to a perfect signal. EVM faults will result in poor signal quality to all user equipment. In turn, this will result in extended hand off time, lower sector capacity, and lower data rates, increasing dropped and blocked calls.

Peak Code Domain Error (Peak CDE)

Peak CDE is the EVM of the worst code. Code Domain displays show the traffic in a specific time slot. Peak CDE faults will result in poor signal quality to all user equipment. In turn, this will result in extended hand off time, lower sector capacity, and lower data rates.

OTA Tau Scanner E_c/I_o

E_c/I_o faults indicate excessive or inadequate coverage and lead to low capacity, low data rates, extended handoffs, and excessive call drops.

DwPTS OTA Power Mapping

DwPTS OTA Power when added to E_c/I_o gives the absolute sync code power which is often proportional to PCCPCH (pilot) power. Use this to check and plot coverage with GPS. Coverage plots can be downloaded to PC based mapping programs for later analysis. Poor readings will lead to low capacity, low data rates, excessive call drops and call blocking.

RF Measurements (Option 0060)

- Channel Spectrum
  - Channel Power
  - Occupied Bandwidth
  - Left Channel Power
  - Left Channel Occ B/W
  - Right Channel Power
  - Right Channel Occ B/W
- Power vs. Time
  - Six Slot Powers
  - Channel Power (RRC)
  - DL-UL Delta Power
  - UpPTS Power
  - DwPTS Power
  - On/Off Ratio
  - Slot Peak-to-Average Power
- Spectral Emission

Demodulation (Option 0061)

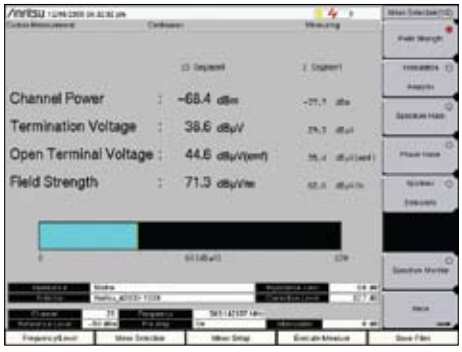
- Code Domain Power/Error (QPSK/8 PSK/16 QAM)
  - Slot Power
  - DwPTS Power
  - Noise Floor
  - Frequency Error
  - Tau
  - Scrambling Code
  - EVM
  - Peak EVM
  - Peak Code Domain Error

Over-the-Air (OTA) Measurements (Option 0038)

- Code Scan (32)
  - Scrambling Code Group
  - Tau
  - E_c/I_o
  - DwPTS Power
  - Pilot Dominance
- Tau Scan (Six)
  - Sync-DL#
  - Tau
  - E_c/I_o
  - DwPTS Power
  - Pilot Dominance

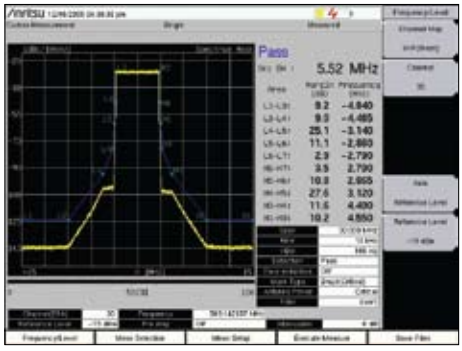
Spectrum Master™ Compact Handheld Spectrum Analyzer Features

ISDB-T Signal Analyzers (Options 0030, 0032)



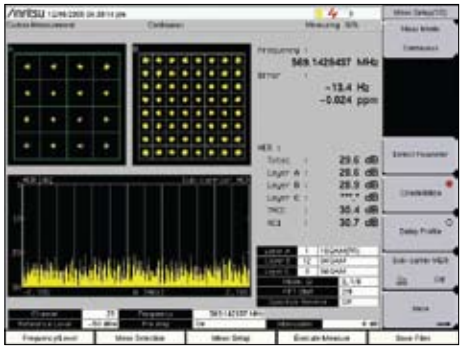
RF Measurements – Signal Power

The Signal Power screen showing the transmission channel power and signal field strength used to assess suitable reception coverage area.



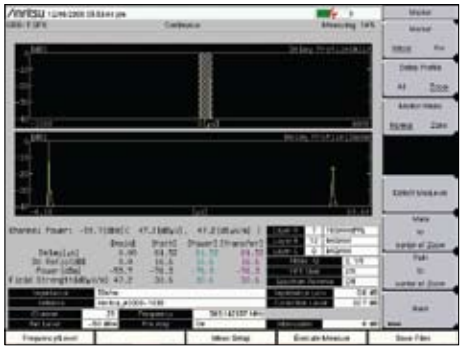
RF Measurements – Spectrum Mask

The Spectrum Mask measurement is shown. ISDB-T systems in Japan and South America call for different spectrum mask specifications. Both are catered for.



Signal Analysis – Constellation and MER

This is the single most important signal quality measurement. Poor MER leads to higher received errors which can cause serious picture degradation.



SFN Analysis – Delay Profile

This measurement indicates whether signals from different transmitters in an SFN are received correctly to prevent interference and high received errors.

ISDB-T Signal Analyzer

The Spectrum Master features options that enable area survey measurements and the installation and field maintenance of ISDB-T digital broadcasting equipment in accordance with ARIB (Japan) and ABNT (Brazil) standards.

The user has three measurement modes to choose from depending on the his skill level and test environment: Custom, where specific measurements and setups are chosen; Easy, where some setup parameters are automatically set or detected; Batch, where the user can specify all relevant measurements, setups and channels for automatic measurement and results' display for fast and efficient field testing.

The goal of all measurements is to ensure digital TV transmitters are configured according to license agreements and optimized for error-free reception over the entire coverage area helping to create an excellent televisual experience.

Field Strength

Field Strength (dBµV/m) measurement enables a technician to assess whether signals will be detected at a location with sufficient power for good TV reception. The antenna factors of the antenna used for measurement can be compensated for to facilitate easy measurement comparison.

Modulation Error Ratio (MER)

MER is the fundamental measurement in digital TV broadcast systems. It quantifies the modulation signal quality directly. It is essential for managing signal margin and the deterioration of equipment with time, as well as for maintaining stable broadcast services. MER is independent of modulation type so MER measurements can be easily compared.

Delay Profile

This function measures the difference in time and frequency of multi-path signals caused by reflections from obstacles or from other transmitters. By measuring the channel frequency response, the multi-path effect or frequency selective fading can be observed. It is important that all signals from reflections or other transmitters are received within the guard interval to prevent inter-symbol interference which will cause reception degradation. Delay Profile measurement is useful for adjusting the timing of SFN repeaters to achieve this.

RF Measurements (Option 0030)

- Signal Power
  - Channel Power
  - Termination Voltage
  - Open Terminal Voltage
  - Field Strength
- Spectrum Monitor
  - Channel Power
  - Zone Center Channel
  - Zone Center Frequency
- Spectrum Mask
  - Mask (Standard A) Japan
  - Mask (Standard B) Japan
  - Mask (Critical) Brazil
  - Mask (Sub-critical) Brazil
  - Mask (Non-critical) Brazil
- Phase Noise
- Spurious Emissions

Signal Analysis (Option 0030)

- Constellation (w/zoom)
  - Layer A, B, C, TMCC
- Sub-carrier MER
- Delay Profile (w/zoom)
- Frequency Response
- Measured Data
  - Frequency
  - Frequency Offset
  - MER (Total, Layer A/B/C, TMCC, AC1)
  - Modulation (Layer A/B/C)
  - Mode, GI
  - Sub-carrier MER w/marker
  - Delay w/marker
  - Frequency Response w/marker

Measurement Modes (Option 0030)

- Custom
  - User specified measurement and setup parameters
- Easy
  - User specified measurements. Some setup parameters are automatically set or detected
- Batch
  - User specified measurements and channels for automatic measurement, display of results and storage

SFN Analysis (Option 0032)

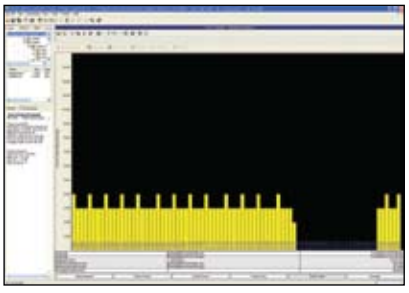
- Delay Profile (w/zoom)
- Inband Spectrum
- Measured Data
  - Channel Power
  - Delay
  - DU Ratio
  - Power
  - Field Strength

Master Software Tools - the Power Behind the Spectrum Master

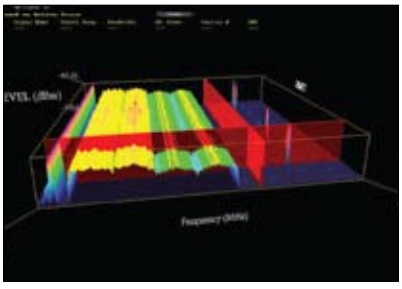
Master Software Tools (MST) is a powerful PC software post-processing tool designed to enhance the productivity of technicians in report generation, data analysis, and testing automation. Master Software Tools can be downloaded from anritsu.com.

Connect to PC using USB

Report Generation



Histogram



3D Spectrogram view

FAST DOWNLOADS
Download all measurements to MST with a single menu selection.

REPORT GENERATION
Create reports with company logo, GPS tagging information, calibration status, and serial number of the instrument for complete reporting. Add custom company logos.

COMPARE TRACES
Use MST to build a record of all traces. Easy-to-use trace overlay features allow for easy comparison with historical traces.

TRACE RENAMING
Rename hundreds of traces in minutes using the trace rename tool in MST.

SCRIPT MASTER™
Script Master is an automation tool that allows the user to embed the operator's test procedure inside the Spectrum Master. Using Channel Scanner Script Master, the user can create a list of up to 1200 channels and let the Spectrum Master sequence through the channels 20 at a time and automatically make measurements.

INTERFERENCE MONITORING
Data collected on the instrument can be analyzed and diagnosed easily with MST. These applications include: Folder Spectrogram, which creates a composite file of multiple traces for quick review; an *.avi movie can be generated for playback analysis; a Histogram that allows filtering of data and that searches for the number of occurrences and the time of day; and 3D Spectrogram for in-depth analysis with 3-axis rotation viewing and zoom control.

PRODUCT UPDATES
The product update tool will ensure that you always use the latest instrument firmware.

GROUP EDIT
Add limit lines and markers to all the traces in one folder with just one click.

FULL TRACE RETRIEVAL
Download and archive hundreds of traces instantly to your PC without opening them.

Ordering Information

	MS2712E	MS2713E	Description
	100 kHz to 4 GHz	100 kHz to 6 GHz	Spectrum Analyzer
	Options	Options	
	MS2712E-0021	MS2713E-0021	2-Port Transmission Measurement
	MS2712E-0010	MS2713E-0010	Bias-Tee
	MS2712E-0031	MS2713E-0031	GPS Receiver (Requires Antenna P/N 2000-1528-R)
	MS2712E-0019	MS2713E-0019	High-Accuracy Power Meter****
	MS2712E-0029	MS2713E-0029	Power Meter
	MS2712E-0025	MS2713E-0025	Interference Analyzer***
	MS2712E-0027	MS2713E-0027	Channel Scanner
	MS2712E-0431	MS2713E-0431	Coverage Mapping***
	MS2712E-0090	MS2713E-0090	Gated Sweep
	MS2712E-0028	MS2713E-0028	C/W Signal Generator (Requires Option 0021) (Requires CW Signal Generator Kit, P/N 69793)
	MS2712E-0509	MS2713E-0509	AM/FM/PM Analyzer Measurements
	MS2712E-0009	MS2713E-0009	10 MHz BW Demod
	MS2712E-0040	MS2713E-0040	GSM/GPRS/EDGE RF Measurements*
	MS2712E-0041	MS2713E-0041	GSM/GPRS/EDGE Demodulation*
	MS2712E-0044	MS2713E-0044	W-CDMA/HSDPA RF Measurements*
	MS2712E-0045	MS2713E-0045	W-CDMA Demodulation*
	MS2712E-0065	MS2713E-0065	W-CDMA/HSDPA Demodulation*
	MS2712E-0035	MS2713E-0035	W-CDMA/HSDPA Over-the-Air Measurements**
	MS2712E-0520	MS2713E-0520	P25 Analyzer Measurements*
	MS2712E-0522	MS2713E-0522	P25 Coverage Measurements*
	MS2712E-0530	MS2713E-0530	NXDN Analyzer Measurements*
	MS2712E-0532	MS2713E-0532	NXDN Coverage Measurements*
	MS2712E-0541	MS2713E-0541	LTE RF Measurements**
	MS2712E-0542	MS2713E-0542	LTE Modulation Quality**
	MS2712E-0546	MS2713E-0546	LTE Over-the-Air Measurements**
	MS2712E-0060	MS2713E-0060	TD-SCDMA/HSDPA Measurements*
	MS2712E-0061	MS2713E-0061	TD-SCDMA/HSDPA Demodulation*
	MS2712E-0038	MS2713E-0038	TD-SCDMA/HSDPA Over-the-Air Measurements*
	MS2712E-0042	MS2713E-0042	cdmaOne/CDMA2000 1X RF Measurements*
	MS2712E-0043	MS2713E-0043	cdmaOne/CDMA2000 1X Demodulation*
	MS2712E-0033	MS2713E-0033	cdmaOne/CDMA2000 1X Over-the-Air Measurements**
	MS2712E-0062	MS2713E-0062	CDMA2000 1xEV-DO RF Measurements*
	MS2712E-0063	MS2713E-0063	CDMA2000 1xEV-DO Demodulation*
	MS2712E-0034	MS2713E-0034	CDMA2000 1xEV-DO Over-the-Air Measurements**
	MS2712E-0046	MS2713E-0046	IEEE 802.16 Fixed WiMAX RF Measurements*
	MS2712E-0047	MS2713E-0047	IEEE 802.16 Fixed WiMAX Demodulation*
	MS2712E-0066	MS2713E-0066	IEEE 802.16 Mobile WiMAX RF Measurements*
	MS2712E-0067	MS2713E-0067	IEEE 802.16 Mobile WiMAX Demodulation*
	MS2712E-0037	MS2713E-0037	IEEE 802.16 Mobile WiMAX Over-the-Air Measurements*
	MS2712E-0030	MS2713E-0030	ISDB-T Digital Video Measurements*
	MS2712E-0032	MS2713E-0032	ISDB-T SFN Measurements*
	MS2712E-0098	MS2713E-0098	Standard Calibration (ANSI Z540-1-1994)
	MS2712E-0099	MS2713E-0099	Premium Calibration to Z540 plus test data

*Requires Option 0009, **Requires Option 0009 and Option 0031, ***Requires Option 0031, ****Requires External Power Sensor

Ordering Information

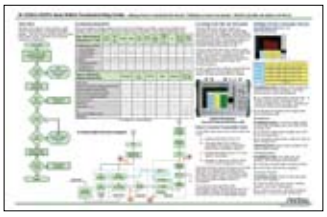
Power Sensors (For complete ordering information see the respective datasheets of each sensor)

Model Number	Description
PSN50	High Accuracy RF Power Sensor, 50 MHz to 6 GHz, +20 dBm
MA24104A	Inline High Power Sensor, 600 MHz to 4 GHz, +51.76 dBm
MA24106A	High Accuracy RF Power Sensor, 50 MHz to 6 GHz, +23 dBm
MA24108A	Microwave USB Power Sensor, 10 MHz to 8 GHz, +20 dBm
MA24118A	Microwave USB Power Sensor, 10 MHz to 18 GHz, +20 dBm
MA24126A	Microwave USB Power Sensor, 10 MHz to 26 GHz, +20 dBm

Manuals (soft copy included on MST CD and at www.us.anritsu.com)

Part Number	Description
10580-00251	Spectrum Master User Guide (Hard copy included)
10580-00242	2-Port Transmission Measurement
10580-00231	Spectrum Analyzer Measurement Guide - Interference Analyzer, Channel Scanner, Gated Sweep, CW Signal Generator, AM/FM/PM Analyzer, Interference Mapping, Coverage Mapping
10580-00234	3GPP Signal Analyzer Measurement Guide - GSM/EDGE, W-CDMA/HSDPA, TD-SCDMA/HSDPA, LTE
10580-00235	3GPP2 Signal Analyzer Measurement Guide - CDMA, EV-DO
10580-00236	WiMAX Signal Analyzer Measurement Guide - Fixed WiMAX, Mobile WiMAX
10580-00237	Digital TV Measurement Guide - DVB-T/H, ISDB-T
10580-00243	P25 and NXDN Measurement Guide
10580-00240	Power Meter Measurement Guide - High Accuracy Power Meter
10580-00256	Programming Manual

Troubleshooting Guides (soft copy included on MST CD and at www.us.anritsu.com)



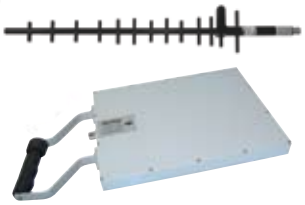
Part Number	Description
11410-00551	Spectrum Analyzers
11410-00472	Interference
11410-00466	GSM/GPRS/EDGE Base Stations
11410-00566	LTE eNode Testing
11410-00463	W-CDMA/HSDPA Base Stations
11410-00465	TD-SCDMA/HSDPA Base Stations
11410-00467	cdmaOne/CDMA2000 1X Base Stations
11410-00468	CDMA2000 1xEV-DO Base Stations
11410-00470	Fixed WiMAX Base Stations
11410-00469	Mobile WiMAX Base Stations

Standard Accessories (included with instrument)

Part Number	Description
10580-00251	Spectrum Master User Guide (includes Bias-Tee, GPS Receiver)
3-68736	Soft Carrying Case
2300-498	MST CD: Master Software Tools, User/Measurement Guides, Programming Manual, Troubleshooting Guides, Application Notes
633-44	Rechargeable Li-Ion Battery
40-168-R	AC-DC Adapter
806-141-R	Automotive Cigarette Lighter Adapter
3-2000-1498	USB A/5-pin mini-B Cable, 10 feet/305 cm
11410-00511	Spectrum Master™ MS2712E, MS2713E Technical Data Sheet One Year Warranty (Including battery, firmware, and software) Certificate of Calibration and Conformance

Optional Accessories

Directional Antennas



Part Number	Description
2000-1411	822 MHz to 900 MHz, N(f), 10 dBd, Yagi
2000-1412	885 MHz to 975 MHz, N(f), 10 dBd, Yagi
2000-1413	1710 MHz to 1880 MHz, N(f), 10 dBd. Yagi
2000-1414	1850 MHz to 1990 MHz, N(f), 9.3 dBd, Yagi
2000-1415	2400 MHz to 2500 MHz, N(f), 10 dBd, Yagi
2000-1416	1920 MHz to 2170 MHz, N(f), 10 dBd, Yagi
2000-1519	500 MHz to 3 GHz, log periodic

Portable Antennas

2000-1200-R	806 MHz to 866 MHz, SMA(m), 50 Ω
2000-1473-R	870 MHz to 960 MHz, SMA(m), 50 Ω
2000-1035-R	896 MHz to 941 MHz, SMA(m), 50 Ω (1/4 wave)
2000-1030-R	1710 MHz to 1880 MHz, SMA(m), 50 Ω (1/2 wave)
2000-1474-R	1710 MHz to 1880 MHz with knuckle elbow (1/2 wave)
2000-1031-R	1850 MHz to 1990 MHz, SMA(m), 50 Ω (1/2 wave)
2000-1475-R	1920 MHz to 1980 MHz and 2110 MHz to 2170 MHz, SMA(m), 50 Ω
2000-1032-R	2400 MHz to 2500 MHz, SMA(m), 50 Ω (1/2 wave)
2000-1361-R	2400 MHz to 2500 MHz, 5000 MHz to 6000 MHz, SMA(m), 50 Ω
2000-1636-R	Antenna Kit (Consists of: 2000-1030-R, 2000-1031-R, 2000-1032-R, 2000-1200-R, 2000-1035-R, 2000-1361-R, and carrying pouch)

Filters

1030-114-R	806 MHz to 869 MHz, N(m) to SMA(f), 50 Ω
1030-109-R	824 MHz to 849 MHz, N(m) to SMA(f), 50 Ω
1030-110-R	880 MHz to 915 MHz, N(m) to SMA(f), 50 Ω
1030-105-R	890 MHz to 915 MHz Band, 0.41 dB loss, N(m) to SMA(f), 50 Ω
1030-111-R	1850 MHz to 1910 MHz, N(m) to SMA(f), 50 Ω
1030-106-R	1710 MHz to 1790 MHz Band, 0.34 dB loss, N(m) to SMA(f), 50 Ω
1030-107-R	1910 MHz to 1990 MHz Band, 0.41 dB loss, N(m) to SMA(f), 50 Ω
1030-112-R	2400 MHz to 2484 MHz, N(m) to SMA(f), 50 Ω
1030-149-R	High Pass, 150 MHz, N(m) to N(f), 50 Ω
1030-150-R	High Pass, 400 MHz, N(m) to N(f), 50 Ω
1030-151-R	High Pass, 700 MHz, N(m) to N(f), 50 Ω
1030-152-R	Low Pass, 200 MHz, N(m) to N(f), 50 Ω
1030-153-R	Low Pass, 550 MHz, N(m) to N(f), 50 Ω
1030-155-R	2500 MHz to 2700 MHz, N(m) to N(f), 50 Ω

Attenuators

3-1010-122	20 dB, 5 W, DC to 12.4 GHz, N(m) to N(f)
42N50-20	20 dB, 5 W, DC to 18 GHz, N(m) to N(f)
42N50A-30	30 dB, 50 W, DC to 18 GHz, N(m) to N(f)
3-1010-123	30 dB, 50 W, DC to 8.5 GHz, N(m) to N(f)
1010-127-R	30 dB, 150 W, DC to 3 GHz, N(m) to N(f)
3-1010-124	40 dB, 100 W, DC to 8.5 GHz, N(m) to N(f), Uni-directional
1010-121	40 dB, 100 W, DC to 18 GHz, N(m) to N(f), Uni-directional
1010-128-R	40 dB, 150 W, DC to 3 GHz, N(m) to N(f)

Optional Accessories

Phase-Stable Test Port Cables, Armored w/ Reinforced Grip (recommended for cable & antenna line sweep applications)

15RNFN50-1.5-R	1.5 m, DC to 6 GHz, N(m) to N(f), 50 Ω
15RDFN50-1.5-R	1.5 m, DC to 6 GHz, N(m) to 7/16 DIN(f), 50 Ω
15RDN50-1.5-R	1.5 m, DC to 6 GHz, N(m) to 7/16 DIN(m), 50 Ω
15RNFN50-3.0-R	3.0 m, DC to 6 GHz, N(m) to N(f), 50 Ω
15RDFN50-3.0-R	3.0 m, DC to 6 GHz, N(m) to 7/16 DIN(f), 50 Ω
15RDN50-3.0-R	3.0 m, DC to 6 GHz, N(m) to 7/16 DIN(m), 50 Ω

Phase-Stable Test Port Cables, Armored (recommended for use with tightly spaced connectors and other general purpose applications)

15NNF50-1.5C	1.5 m, DC to 6 GHz, N(m) to N(f), 50 Ω
15NN50-1.5C	1.5 m, DC to 6 GHz, N(m) to N(m), 50 Ω
15NDF50-1.5C	1.5 m, DC to 6 GHz, N(m) to 7/16 DIN(f), 50 Ω
15ND50-1.5C	1.5 m, DC to 6 GHz, N(m) to 7/16 DIN(m), 50 Ω
15NNF50-3.0C	3.0 m, DC to 6 GHz, N(m) to N(f), 50 Ω
15NN50-3.0C	3.0 m, DC to 6 GHz, N(m) to N(m), 50 Ω

Adapters

1091-26-R	SMA(m) to N(m), DC to 18 GHz, 50 Ω
1091-27-R	SMA(f) to N(m), DC to 18 GHz, 50 Ω
1091-80-R	SMA(m) to N(f), DC to 18 GHz, 50 Ω
1091-81-R	SMA(f) to N(f), DC to 18 GHz, 50 Ω
1091-172	BNC(f) to N(m), DC to 1.3 GHz, 50 Ω
510-102	N(m) to N(m), DC to 11 GHz, 50 Ω, 90 degrees right angle

Precision Adapters

34NN50A	Precision Adapter, N(m) to N(m), DC to 18 GHz, 50 Ω
34NFNF50	Precision Adapter, N(f) to N(f), DC to 18 GHz, 50 Ω

Backpack and Transit Case

67135	Anritsu Backpack (For Handheld Instrument and PC)
760-243-R	Large Transit Case with Wheels and Handle

Miscellaneous Accessories

2000-1528-R	GPS Antenna, SMA(m)
69793	CW Signal Generator Kit
2000-1520-R	USB Flash Drive
2000-1374	External Charger for Li-Ion Batteries
2300-532	Map Master CD

Notes

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