BTS Master™
MT8221B
High-Performance Handheld Base Station Analyzer

20 MHz Demodulation Bandwidth
Signal Analyzers for 2G, 3G, WiMAX and LTE
Vector Signal Generator
Introduction

The BTS Master MT8221B is a high-performance handheld base station analyzer that has been specifically developed to support emerging 4G standards as well as installed 2G, 3G and WiMAX networks. The MT8221B’s platform introduces:

- 20 MHz demodulation capability for future LTE modulation quality testing
- Vector Signal Generator (400 MHz to 6 GHz) for comprehensive receiver testing
- 30-MHz Zero-Span IF Output for external demodulation of virtually any other wideband signal

The BTS Master features over 30 analyzers in one to meet virtually every measurement need. Standard features are:

- 2-port Cable and Antenna Analyzer: 400 MHz to 4 GHz
- Spectrum Analyzer: 150 kHz to 7.1 GHz
- Power Meter: 10 MHz to 7.1 GHz

A user can select from many options including:

- High Accuracy Power Meter
- Interference Analyzer
- Channel Scanner
- 3GPP Signal Analyzers
  - GSM/EDGE, W-CDMA/HSDPA, TD-SCDMA/HSDPA
- 3GPP2 Signal Analyzers
  - cdmaONE/CDMA2000 1X, CDMA2000 1xEV-DO
- IEEE 802.16 Signal Analyzers
  - Fixed WiMAX, Mobile WiMAX
- Backhaul Analyzers: E1, T1, T3/T1

Signal Analyzers have three methods for verifying the performance of a base station transmitter by measuring:

- RF Quality
- Modulation Quality (20 MHz ready)
- Downlink Coverage Quality

Meeting Key Performance Indicators (KPIs)

Degradation in KPIs, such as dropped call and/or blocked call rates due to a malfunction at the cell site or due to interference, can be easily and accurately diagnosed down to the base station field replaceable unit (FRU) or the offending interfering signal with the BTS Master MT8221B.

Master Software Tools (MST)

MST is a PC program that post processes data collected on your instrument. It provides an efficient Report Generator for line sweeps and powerful data analysis tools for spectrum clearing and interference monitoring. And the Remote Access Tool allows supervisor to see and control the instrument over the Internet.

With Anritsu’s design know-how and demanding production testing and performance verification you can count on the BTS Master to give you years of reliable dependable service.
Troubleshooting Fast
An Anritsu exclusive is its Signal Analysis Over-the-Air (OTA) Pass/Fail Tests. Technicians and RF engineers can quickly determine the health of a cell site with a one-step Pass/Fail test. A one-step OTA Pass/Fail test verifies:

- Antenna Feed Line Quality
- Base Station RF Quality
- Base Station Modulation Quality

If a cell site passes, the technician can move on to the next cell site. If the test fails, the BTS Master equips the technician to troubleshoot:

- Feed lines and antenna systems
- Base station field replaceable units
- Downlink coverage issues
- Interference problems
- Backhaul bit-error-rates

By quickly determining the health of the cell site with Pass/Fail testing, the cell site technician becomes more productive and the BTS Master equips him with the tools to properly diagnose the root-cause of the problem minimizing costly no trouble found parts and service calls.

Network Reliability
Studies have shown that network reliability plays a significant part in subscriber churn. Leading reasons stated for churn are:

- Dropped calls
- Poor coverage
- Network outages

As wireless users come to depend more and more on their wireless service they expect more and more in network performance. This makes it more critical than ever to meet your KPI optimization goals for network availability, network quality, and network coverage. Ultimately it is about eliminating reasons for demanding subscribers to churn.

Network Maintenance and Return on Investment
By outfitting cell site technicians with BTS Masters an operator can attack these reasons for churn. Benchmarking undertaken by Anritsu has shown that technicians equipped with base station analyzers provides them with the necessary tools to troubleshoot degrading KPIs which in-turn can reduce churn.

Learn what the return on investment is on equipping more technicians with the BTS Master MT8221B Base Station Analyzers from your local Anritsu sales professional. The BTS Master MT8221B Base Station Analyzer can become your vital tool to achieving optimal network performance.
Cable and Antenna Analyzer

The BTS Master features 1-port and 2-port Cable and Antenna Analysis to be able to test and verify the performance of nearly every feed-line and antenna component. This includes:

- Connectors
- Cables/Jumpers
- Antenna Isolation
- Diplexers/Duplexers
- Tower Mounted Amplifiers

The goal of these measurements is to maximize the coverage, data rate and capacity with problem-free antenna systems minimizing dropped calls and blocked calls for a good customer experience.

Antenna Systems Failure Mechanisms

Maintenance is an on-going requirement as antenna systems’ performance can degrade at any point in time due to:

- Loose connectors
- Improperly weatherized connectors
- Pinched cables
- Poor grounding
- Corroded connectors
- Lightning strikes
- Strong winds misaligning antennas
- Rain getting into cables
- Bullet holes/nails in the cable

Making Measurements Easier

The BTS Master provides features for making measurements easier to perform and to analyze test results such as:

- FlexCal™ eliminates the need to recalibrate when changing frequencies
- High RF Immunity for testing in harsh RF environments
- Trace Overlay compares reference traces to see changes over time
- Limit Lines and Alarming for providing reference standards
- High Power output to test tower-top components without climbing the tower
- Internal Bias-Tee to power up TMAs for testing when off-line
- GPS tagging of data to verify location of tests
- Master Software Tools for post-analysis and report generation

Testing 4G MIMO Cable Systems

New 4G networks are deploying MIMO antenna systems that have to be phase matched to get the maximum data rate and capacity. The BTS Master provides 1-port and 2-port phase measurements for phase matching cables. Using trace math makes relative phase measurements simple.
Spectrum Analyzer

The BTS Master features the most powerful handheld spectrum analyzer for field use with unmatched performance such as:

- Sensitivity
- Dynamic Range
- Phase Noise
- Frequency Accuracy
- Resolution Bandwidth (RBW)

The goal of the Spectrum Analyzers’ measurements is to be able to monitor, measure, and analyze RF signals and their environments. It finds rouge signals, measures carriers and distortion, and verifies base stations’ signal performance. It validates carrier frequency and identifies desired and undesired signals.

Simple But Powerful

The BTS Master features dedicated routines for one-button measurements and for more in-depth analysis s the technician has control over the setting and features not even found on lab-grade benchtop spectrum analyzers, for instance:

- Multiple sweep detection methods – true RMS detector, quasi-peak, ...
- Multiple traces and control – three traces, trace math, ...
- Advanced marker functions – noise marker, frequency counter, ...
- Advanced limit line functions – one-button envelope creation, relative, ...
- Save-on-Event – automatically saves a sweep when crossing a limit line
- Gated sweep - view pulsed or burst signals only when they are on, or off

The BTS Master automatically sweeps as fast as possible for the selected settings consistent with accurate results.

GPS-Assisted Frequency Accuracy

With GPS Option 0031 the frequency accuracy is 25 ppb (parts per billion). After the GPS antenna is disconnected, the accuracy is 50 ppb for three days. Also all measurements can be GPS tagged for exporting to maps.

Rx Noise Floor Testing

The BTS Master can measure the Rx Noise Floor on the uplink a base station using the channel power measurement. An elevated noise floor indicates interference and leads to call blocking, denial of services, call drops, low data rate, and low capacity.

**Measurements**

- One Button Measurements
  - Field Strength – in dBm/m² or dBmV/m
  - Occupied Bandwidth - 1% to 99% of power
  - Channel Power - in specified bandwidth
  - ACPR - adjacent channel power ratio
  - AM/FM/SSB Demodulation - audio out only
  - C/I - carrier-to-interference ratio
- Gated Sweep – Option 0090

**Sweep Functions**

- Sweep
  - Single/Continuous, Manual Trigger, Reset
  - Minimum Sweep Time
- Detection
  - Peak, RMS, Negative, Sample, Quasi-peak
- Triggers
  - Free Run, External, Video, Change Position, Manual

**Trace Functions**

- Traces
  - 1-3 Traces (A, B, C), View/Blank, Write/Hold
- Trace A Operations
  - Normal, Max Hold, Min Hold, Average, Number of Averages, (always the live trace)
- Trace B Operations
  - A → B, B→C, Max Hold, Min Hold
- Trace C Operations
  - A → C, B→C, Max Hold, Min Hold, A - B → C, B - A → C, Relative Reference (dB), Scale

**Marker Functions**

- Markers
  - 1-6 Markers each with a Delta Marker, or Marker 1 Reference with 6 Delta Markers
- Marker Types
  - Fixed, Tracking, Noise, Frequency Counter
- Marker Auto-Position
  - Peak Search, Next Peak (Right/Left), Peak Threshold %, To Channel, To Center, To Reference Level, Delta Marker to Span
- Marker Table
  - 1-6 markers’ frequency & amplitude plus delta markers’ frequency offset & amplitude

**Limit Line Functions**

- Limit Lines
  - Upper/Lower, Limit Alarm, Default Limit
- Limit Line Edit
  - Frequency, Amplitude, Add/Delete Point, Add Vertical, Next Point Left/Right
- Limit Line Move
  - To Current Center Frequency, By dB or Hz, To Marker 1, Offset from Marker 1
- Limit Line Envelope
  - Create, Update Amplitude, Number of Points (41), Offset, Shape Square/Slope
- Limit Line Advanced
  - Absolute/Relative, Mirror, Save/Recall

**Occupied Bandwidth**

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

**Adjacent Channel Power Ratio (ACPR)**

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.

**Carrier-to-Interference (C/I)**

Low C/I ratios will cause coverage issues including dropped calls, blocked calls, and other handset reception problems.

**Gated Sweep – Option 0090**

The gate is in the off-time of this WiMAX signal, which would let the user see interfering signals or user signals when the base station is not transmitting.
Power Meters

The BTS Master offers standard built-in Power Meter utilizing the Spectrum Analyzer and an optional High Accuracy Power Meter requiring external power sensors.

Setting the transmitter output power of a base station properly is critical to the overall operation of wireless network. A 1.5 dB change in power levels means a 15% change in coverage area.

To much power means overlapping coverage which translates into cell-to-cell self interference. To little power, to little coverage, creates island cells with non-overlapping cell sites and reduced in-building coverage. High or low values will cause dead zones/dropped calls, lower data rates/reduced capacity near cell edges, and cell loading imbalances/blocked calls.

High Accuracy Power Meter (Option 19)

For the most accurate power measurement requirements select the high accuracy measurement option with a choice of sensors with:

- Frequency ranges: 10 MHz to 18 GHz
- Power ranges: -40 dBm to +51.76 dBm
- Measurement uncertainties: ≤±0.18 dB

These sensors enable users to make accurate measurements for CW and digitally modulated signals for 2G/3G and upcoming 4G wireless networks.

The power sensor easily connects to the BTS Master via a USB A/mini-B cable. An additional benefit of using the USB connection is that a separate DC supply (or battery) is not needed since the necessary power is supplied by the USB port.

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.

Remote Power Monitoring via LAN

A USB-to-LAN hub converter enables power monitoring via the Internet across continents, if desired.
Interference is a continuously growing problem for wireless network operators. Compounding the problem are the many sources that can generate interference such as:

- Intentional Radiators
- Unintentional Radiators
- Self Interference

Interference causes Carrier-to-Interference degradation robbing the network of capacity. In many instances interference can cause an outage to a sector, a cell, and/or neighboring cells. The goal of these measurements is to resolve interference issues as quickly as possible.

**Monitoring Interference**

The BTS Master offers many tools for monitoring intermittent interferers over time to determine patterns:

- **Spectrogram**
- **Received Signal Strength Indicator (RSSI)**
- **Remote Monitoring over the Internet**
- **Save-on-Event – crossing a limit line**

**Master Software Tools for your PC features diagnostic tools for efficient analysis of the data collected during interference monitoring. These features include:**

- **Folder Spectrogram – creates a composite file of multiple traces for quick review**
- **Movie playback – playback data in the familiar frequency domain view**
- **Histogram – filter data and search for number of occurrences and time of day**
- **3D Spectrogram – for in-depth analysis with 3-axis rotation viewing control**

**Identifying Interference**

The BTS Master provides several tools to identify the interference – either from a neighboring wireless operator, illegal repeater or jammer, or self-interference:

- **Signal ID (up to 12 signals at once)**
- **Signal Analyzer Over-the-Air Scanners**
- **Channel Scanner (up to 1200 channels, 20 at a time)**

**Locating Interference**

Once interference has been identified the Signal Strength Meter with its audible output beep coupled with a directional antenna makes finding the interference easier.
BTS Master™ Base Station Analyzer Features

Vector Signal Generator Option (Option 0023)

Vector Signal Generator (VSG)
The BTS Master’s Vector Signal Generator is designed to be a signal source to facilitate base station field testing of the receiver’s basic performance when it comes to:

- Sensitivity
- Adjacent Channel Selectivity
- Blocking
- Intermodulation Rejection

The BTS Master has the flexibility to generate three signals in a variety of combinations:

- Modulated, CW, AWGN (Additive White Gaussian Noise)
- Wanted Signals (modulated or CW)
  - One signal at 10 MHz or less (with no interferer present)
  - One signal at 5 MHz or less (with interferer present)
  - With or without AWGN
- Interferer (modulated or CW)
  - One interferer at 5 MHz or less
  - With or without AWGN

The BTS Master has the ability output complex waveforms. As an example, you generate a W-CDMA signal and an GSM interferer. It offers the capability to generate complex waveforms including:

- LTE, TD LTE
- W-CDMA, HSPA
- TD-SCDMA, TD-HSPA
- GSM, GPRS, EDGE,
- CDMA2000 1X, 1x EV-DO
- Fixed WiMAX, Mobile WiMAX
- AM, FM
- QPSK, QAM

The BTS Master VSG has an output power range to meet most testing requirements from -124 dBm to 0 dBm.

Users can define their patterns in either MATLAB ® or ASCII. Master Software Tools Patter Converter can upload them into the BTS Master.

At the initial release the MT8221B will have a set of basic signals and other patterns will be added on a periodic basis.

(Check the Technical Datasheet for the latest specifications and pattern offerings).
BTS Master™ Base Station 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 BTS 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 BTS 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 MT8221B 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
GSM/GPRS/EDGE Analyzers

The BTS 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 your 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.
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.

Pass/Fail Mode
The BTS 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.
BTS Master™ Base Station Analyzer Features

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

RF Measurements

channel Spectrum
channel power
occupied Bandwidth
peak-to-Average power
Spectral Emission Mask
multi-carrier ACPR

Demodulation

Option 43

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

CDMA Signal Analyzers

The BTS Master features three CDMA measurement modes:
- RF Measurements
- Demodulation
- Over-the-Air Measurements (OTA)

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.

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.

\[ E_{\text{I}_0} \]

\( E_{I_I} \) indicates the quality of the signal from each PN. Low \( E_{I_I} \) leads to low data rate and low capacity.
**BTS Master™ Base Station Analyzer Features**

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

**EV-DO Signal Analyzers**
The BTS 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.

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**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_{b}/N_{0}
  - Tau
  - Pilot Power
  - Channel Power
  - Pilot Dominance
- Multipath Scanner (Six)
  - E_{b}/N_{0}
  - Tau
  - Channel Power
  - Multipath Power

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**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 (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 un-even 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 BTS 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 BTS Master can accurately measure Carrier Frequency Error OTA if the instrument is GPS enabled or in GPS holdover. 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.
Fixed and Mobile WiMAX Signal Analyzers (Options 0046, 0047, 0066, 0067, 0037)

The BTS Master features two Fixed WiMAX and three Mobile WiMAX measurement modes:

- RF Measurements
- Demodulation (up to 10 MHz)
- Over-the-Air Measurements (OTA) (Mobile only)

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.
BTS Master™ Base Station Analyzer Features

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

**TD-SCDMA/HSDPA Signal Analyzers**
The BTS 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.

**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_{R} / I_o**
E_{R} / 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 Ec/Io 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_{R} / I_o
  - DwPTS Power
  - Pilot Dominance
- Tau Scan (Six)
  - Sync-DL#
  - Tau
  - E_{R} / I_o
  - DwPTS Power
  - Pilot Dominance
- Auto-Save with GPS Tagging and Logging

**Bi-Polar Violation (BPV)**
BPVs occur when the polarity does not switch every time a “1” is transmitted. BPVs are symptoms of low signal quality and result in lower, or no, throughput.

**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.
Bi-Polar Violation (BPV)
BPVs occur when the polarity does not switch every time a “1” is transmitted. BPVs are symptoms of low signal quality and result in lower, or no, throughput.

 Histogram – Cyclic Redundancy Check (CRC)
CRC errors result in a lower overall throughput for the T1 link. CRC errors can indicate problems bad enough to shut down the link.

Rx Signal Measurements – Vpp
Unusually low Vpp leads to a high bit error rate or alarms, loss of sync and loss of carrier. Unusually high Vpp leads to signal clipping and bit errors.

BF Channel Measurements
Verifies the level and frequency of the BF Channel. Through the speaker the tester can make an audible assessment of the signal quality of the circuit.

Backhaul Analyzers
The BTS Master features three Backhaul Analyzer measurement modes:
- E1 Analyzer
- T1 Analyzer
- T13/T1 Analyzer

The goal of these measurements is to maximize throughput for the cell site so the base station can operate at maximum call capacity and data rates for a good customer experience.

Wireless operators need to test the backhaul circuits prior to acceptance from the Telco and for troubleshooting faults. When troubleshooting cell site technicians or RF engineers first step is decide if the fault is on the Telco side of the demarcation point or on the wireless operator's side, since that determines who needs to fix the fault.

When identifying faults, the troubleshooting can often be done by monitoring an in-service signal, looking for data related errors. However, in some cases, in-service testing is not enough, and an out-of-service test must be performed.

Bit Error Rate Test (BERT)
A Bit Error Rate Test will measure how accurately a backhaul circuit can send and receive data. BER testing is always an out-of-service activity. Errors will cause re-transmissions and a lower overall data rate. Large numbers of errors will shut down the circuit.

Frame Loss
Frame Loss counts errors in the framing bits. Framing errors do not accumulate as fast as other errors. When monitored for extended periods of time, framing errors can become a valuable indication of signal quality. Frame Loss result in lower, or no, throughput.

Carrier Loss
Carrier Loss keeps track of times that the carrier is interrupted which means the line is dropped and the cell site is off the air.

Frequency Accuracy
Frequency refers to the number of bits per second on the backhaul line. Poor frequency accuracy leads to slipped frames and data loss.
Master Software Tools

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.

Trace Rename Utility and Group Edit
Trace Rename Utility allows a user to rename filenames, titles, and subtitles globally. Group Edit allows users to edit the actual traces simultaneously on similar files, both without opening the files.

Trace Editor
For VNA traces, select markers to peak and valley and displays individual values for Return Loss, Cable Loss, VSWR, Magnitude, Phase and milliRho. For SPA measurements set limit line envelopes, edit limit lines segments and turn on and off segments. Also, edit frequency and amplitude parameters.

Folder Spectrogram
Folder Spectrogram – creates a composite file of up to 15,000 multiple traces for quick review, also create:
- Peak Power, Total Power, and Peak Frequency plotted over time
- Histogram – filter data and plot number of occurrences over time
- Minimum, Maximum, and Average Power plotted over frequency
- Movie playback – playback data in the familiar frequency domain view
- 3D Spectrogram – for in-depth analysis with 3-axis rotation viewing control

Script Master™
Script Master is an automation tool which allows the user to embed the operator’s test procedure inside the BTS Master. This feature is available for GSM/EDGE, WCDMA/HSDPA and Channel Scanner applications.

In W-CDMA/HSDPA and GSM/EDGE the user can include instructions in the form of pictures and text to help the technicians configure their setup prior to the test. One test can be configured to run across both W-CDMA and GSM modes.

Using Channel Scanner Script Master, the user can create a list of up to 1200 channels and let the BTS Master sequence through the channels 20 at a time and automatically make measurements.
All Connectors are conveniently located on the top panel, leaving the sides clear for handheld use.

Handheld Size: 315 x 211 x 94 mm (12.4 x 8.3 x 3.7 in), Lightweight: 4.9 kg (10.7 lbs)
BTS Master™ MT8221B Base Station Analyzer Ordering Information

Ordering Information

<table>
<thead>
<tr>
<th>MT8221B</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>400 MHz to 4 GHz</td>
<td>Cable and Antenna Analyzer</td>
</tr>
<tr>
<td>150 kHz to 7.1 GHz</td>
<td>Spectrum Analyzer</td>
</tr>
<tr>
<td>150 kHz to 7.1 GHz</td>
<td>Power Meter</td>
</tr>
</tbody>
</table>

Options

<table>
<thead>
<tr>
<th>Options</th>
<th>Description</th>
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<tbody>
<tr>
<td>MT8221B-0010</td>
<td>Bias-Tee</td>
</tr>
<tr>
<td>MT8221B-0031</td>
<td>GPS Receiver (Requires Antenna P/N 2000-1528-R)</td>
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<tr>
<td>MT8221B-0019</td>
<td>High-Accuracy Power Meter</td>
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<tr>
<td>MT8221B-0025</td>
<td>Interference Analyzer</td>
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<tr>
<td>MT8221B-0027</td>
<td>Channel Scanner</td>
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<tr>
<td>MT8221B-0089</td>
<td>Zero-Span IF Output</td>
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<tr>
<td>MT8221B-0090</td>
<td>Gated Sweep</td>
</tr>
<tr>
<td>MT8221B-0023</td>
<td>Vector Signal Generator</td>
</tr>
<tr>
<td>MT8221B-0040</td>
<td>GSM/GPRS/EDGE RF Measurements</td>
</tr>
<tr>
<td>MT8221B-0041</td>
<td>GSM/GPRS/EDGE Demodulation</td>
</tr>
<tr>
<td>MT8221B-0044</td>
<td>W-CDMA/HSDPA RF Measurements</td>
</tr>
<tr>
<td>MT8221B-0045</td>
<td>W-CDMA Demodulation</td>
</tr>
<tr>
<td>MT8221B-0065</td>
<td>W-CDMA/HSDPA Demodulation</td>
</tr>
<tr>
<td>MT8221B-0035</td>
<td>W-CDMA/HSDPA Over-the-Air Measurements*</td>
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<tr>
<td>MT8221B-0060</td>
<td>TD-SCDMA/HSDPA Measurements</td>
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<tr>
<td>MT8221B-0061</td>
<td>TD-SCDMA/HSDPA Demodulation</td>
</tr>
<tr>
<td>MT8221B-0038</td>
<td>TD-SCDMA/HSDPA Over-the-Air Measurements</td>
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<tr>
<td>MT8221B-0541</td>
<td>LTE RF Measurements</td>
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<tr>
<td>MT8221B-0542</td>
<td>LTE Modulation Measurements</td>
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<tr>
<td>MT8221B-0546</td>
<td>LTE Over-the-Air Measurements</td>
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<tr>
<td>MT8221B-0042</td>
<td>cdmaOne/CDMA2000 1X RF Measurements</td>
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<tr>
<td>MT8221B-0043</td>
<td>cdmaOne/CDMA2000 1X Demodulation</td>
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<tr>
<td>MT8221B-0033</td>
<td>cdmaOne/CDMA2000 1X Over-the-Air Measurements*</td>
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<tr>
<td>MT8221B-0062</td>
<td>CDMA2000 1xEV-DO RF Measurements</td>
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<td>MT8221B-0063</td>
<td>CDMA2000 1xEV-DO Demodulation</td>
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<td>MT8221B-0034</td>
<td>CDMA2000 1xEV-DO Over-the-Air Measurements*</td>
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<tr>
<td>MT8221B-0046</td>
<td>IEEE 802.16 Fixed WiMAX RF Measurements</td>
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<td>MT8221B-0047</td>
<td>IEEE 802.16 Fixed WiMAX Demodulation</td>
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<tr>
<td>MT8221B-0066</td>
<td>IEEE 802.16 Mobile WiMAX RF Measurements</td>
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<tr>
<td>MT8221B-0067</td>
<td>IEEE 802.16 Mobile WiMAX Demodulation</td>
</tr>
<tr>
<td>MT8221B-0037</td>
<td>IEEE 802.16 Mobile WiMAX Over-the-Air Measurements</td>
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<tr>
<td>MT8221B-0051</td>
<td>T1 Analyzer</td>
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<tr>
<td>MT8221B-0052</td>
<td>E1 Analyzer</td>
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<tr>
<td>MT8221B-0053</td>
<td>T3/T1 Analyzer</td>
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<tr>
<td>MT8221B-0098</td>
<td>Standard Calibration to Z540</td>
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<tr>
<td>MT8221B-0099</td>
<td>Premium Calibration to Z540 plus test data</td>
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*Requires GPS Receiver Option 0031

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

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Description</th>
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<tbody>
<tr>
<td>PSN50</td>
<td>High Accuracy RF Power Sensor, 50 MHz to 6 GHz, +20 dBm</td>
</tr>
<tr>
<td>MA24104A</td>
<td>Inline High Power Sensor, 600 MHz to 4 GHz, +51.76 dBm</td>
</tr>
<tr>
<td>MA24106A</td>
<td>High Accuracy RF Power Sensor, 50 MHz to 6 GHz, +23 dBm</td>
</tr>
<tr>
<td>MA24108A</td>
<td>Microwave USB Power Sensor, 10 MHz to 8 GHz, +20 dBm</td>
</tr>
<tr>
<td>MA24118A</td>
<td>Microwave USB Power Sensor, 10 MHz to 18 GHz, +20 dBm</td>
</tr>
</tbody>
</table>
# BTS Master™ MT8221B Base Station Analyzer Ordering Information

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

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>10580-00207</td>
<td>BTS Master User Guide (Hard copy included)</td>
</tr>
<tr>
<td>10580-00230</td>
<td>- Bias-Tee, GPS Receiver</td>
</tr>
<tr>
<td>10580-00231</td>
<td>Spectrum Analyzer Measurement Guide</td>
</tr>
<tr>
<td>10580-00240</td>
<td>- Interference Analyzer, Channel Scanner, IF Output, Gated Sweep</td>
</tr>
<tr>
<td>10580-00232</td>
<td>Power Meter Measurement Guide - High Accuracy Power Meter</td>
</tr>
<tr>
<td>10580-00233</td>
<td>Vector Signal Generator Measurement Guide</td>
</tr>
<tr>
<td>10580-00234</td>
<td>3GPP Signal Analyzer Measurement Guide - GSM/EDGE, W-CDMA/HSDPA, TD-SCDMA/HSDPA, LTE</td>
</tr>
<tr>
<td>10580-00235</td>
<td>3GPP2 Signal Analyzer Measurement Guide - CDMA, EV-DO</td>
</tr>
<tr>
<td>10580-00236</td>
<td>WiMAX Signal Analyzer Measurement Guide - Fixed WiMAX, Mobile WiMAX</td>
</tr>
<tr>
<td>10580-00238</td>
<td>Backhaul Analyzer Measurement Guide - T1, E1, T3/T1</td>
</tr>
<tr>
<td>10580-00208</td>
<td>Programming Manual</td>
</tr>
<tr>
<td>10580-00209</td>
<td>Maintenance Manual</td>
</tr>
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</table>

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

<table>
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<td>11410-00472</td>
<td>Interference</td>
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<tr>
<td>11410-00466</td>
<td>GSM/GPRS/EDGE Base Stations</td>
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<tr>
<td>11410-00463</td>
<td>W-CDMA/HSDPA Base Stations</td>
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<tr>
<td>11410-00465</td>
<td>TD-SCDMA/HSDPA Base Stations</td>
</tr>
<tr>
<td>11410-00467</td>
<td>cdmaOne/CDMA2000 1X Base Stations</td>
</tr>
<tr>
<td>11410-00468</td>
<td>CDMA2000 1xEV-DO Base Stations</td>
</tr>
<tr>
<td>11410-00470</td>
<td>Fixed WiMAX Base Stations</td>
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<tr>
<td>11410-00469</td>
<td>Mobile WiMAX Base Stations</td>
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## Standard Accessories (included with instrument)

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>10580-00207</td>
<td>BTS Master User Guide (includes Bias-Tee and GPS Receiver)</td>
</tr>
<tr>
<td>65681</td>
<td>Soft Carrying Case</td>
</tr>
<tr>
<td>633-44</td>
<td>Rechargeable Li-Ion Battery</td>
</tr>
<tr>
<td>40-168-R</td>
<td>AC/DC Power Supply</td>
</tr>
<tr>
<td>806-141-R</td>
<td>Automotive Cigarette Lighter 12 Volt DC Adapter</td>
</tr>
<tr>
<td>3-806-152</td>
<td>Cat 5e Crossover Patch Cable, 7 feet/213 cm</td>
</tr>
<tr>
<td>2000-1371-R</td>
<td>Ethernet Cable, 7 feet/213 cm</td>
</tr>
<tr>
<td>3-2000-1498</td>
<td>USB A-mini B Cable, 10 feet/305 cm</td>
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<tr>
<td>2000-1520-R</td>
<td>USB Memory Drive</td>
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<tr>
<td>1091-27-R</td>
<td>Type-N male to SMA female adapter</td>
</tr>
<tr>
<td>1091-172</td>
<td>Type-N male to BNC female adapter</td>
</tr>
<tr>
<td>11410-00442</td>
<td>BTS Master™ MT8221B Technical Data Sheet One Year Warranty (Including battery, firmware, and software) Certificate of Calibration and Conformance</td>
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</tbody>
</table>
## BTS Master™ MT8221B Base Station Analyzer Ordering Information

### Optional Accessories

#### Calibration Components, 50 Ω

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSLN50-1</td>
<td>Precision Open/Short/Load, N(m), 42dB, 6.0 GHz, 50 Ω</td>
</tr>
<tr>
<td>OSLNF50-1</td>
<td>Precision Open/Short/Load, N(f), 42dB, 6.0 GHz, 50 Ω</td>
</tr>
<tr>
<td>2000-1618-R</td>
<td>Precision Open/Short/Load, 7/16 DIN(m), 6.0 GHz, 50 Ω</td>
</tr>
<tr>
<td>2000-1619-R</td>
<td>Precision Open/Short/Load, 7/16 DIN(f), 6.0 GHz, 50 Ω</td>
</tr>
<tr>
<td>22N50</td>
<td>Open/Short, N(m), DC to 18 GHz, 50 Ω</td>
</tr>
<tr>
<td>22NF50</td>
<td>Open/Short, N(f), DC to 18 GHz, 50 Ω</td>
</tr>
<tr>
<td>SM/PL-1</td>
<td>Precision Load, N(m), 42 dB, 6.0 GHz</td>
</tr>
<tr>
<td>SM/PLNF-1</td>
<td>Precision Load, N(f), 42 dB, 6.0 GHz</td>
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#### Calibration Components, 75 Ω

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<th>Description</th>
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<tr>
<td>22N75</td>
<td>Open/Short, N(m), DC to 3 GHz, 75 Ω</td>
</tr>
<tr>
<td>22NF75</td>
<td>Open/Short, N(f), DC to 3 GHz, 75 Ω</td>
</tr>
<tr>
<td>26N75A</td>
<td>Precision Termination, N(m), DC to 3 GHz, 75 Ω</td>
</tr>
<tr>
<td>26NF75A</td>
<td>Precision Termination, N(f), DC to 3 GHz, 75 Ω</td>
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#### Phase-Stable Test Port Cables, Armored w/ Reinforced Grip (ideal for contractors and other rugged applications)

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>15RNFN50-1.5-R</td>
<td>1.5 m, DC to 6 GHz, N(m) - N(f), 50 Ω</td>
</tr>
<tr>
<td>15RDNF50-1.5-R</td>
<td>1.5 m, DC to 6 GHz, N(m) - 7/16 DIN(f), 50 Ω</td>
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<tr>
<td>15RDN50-1.5-R</td>
<td>1.5 m, DC to 6 GHz, N(m) - N(f), 50 Ω</td>
</tr>
<tr>
<td>15RNFN50-3.0-R</td>
<td>3.0 m, DC to 6 GHz, N(m) - N(f), 50 Ω</td>
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<tr>
<td>15RDNF50-3.0-R</td>
<td>3.0 m, DC to 6 GHz, N(m) - 7/16 DIN(f), 50 Ω</td>
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<tr>
<td>15RDN50-3.0-R</td>
<td>3.0 m, DC to 6 GHz, N(m) - 7/16 DIN(m), 50 Ω</td>
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#### Phase-Stable Test Port Cables, Armored (ideal for use with tightly spaced connectors and other general use applications)

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
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<tbody>
<tr>
<td>15NNF50-1.5C</td>
<td>1.5 m, DC to 6 GHz, N(m) - N(f), 50 Ω</td>
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<tr>
<td>15NN50-1.5C</td>
<td>1.5 m, DC to 6 GHz, N(m) - N(m), 50 Ω</td>
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<tr>
<td>15NDF50-1.5C</td>
<td>1.5 m, DC to 6 GHz, N(m) - N(f), 50 Ω</td>
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<td>15ND50-1.5C</td>
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<td>15NNF50-3.0C</td>
<td>3.0 m, DC to 6 GHz, N(m) - N(f), 50 Ω</td>
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<td>15NN50-3.0C</td>
<td>3.0 m, DC to 6 GHz, N(m) - N(m), 50 Ω</td>
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#### Adapters

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<tbody>
<tr>
<td>1091-26-R</td>
<td>SMA(m) - N(m), DC to 18 GHz, 50 Ω</td>
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<tr>
<td>1091-27-R</td>
<td>SMA(f) - N(m), DC to 18 GHz, 50 Ω</td>
</tr>
<tr>
<td>1091-80-R</td>
<td>SMA(m) - N(f), DC to 18 GHz, 50 Ω</td>
</tr>
<tr>
<td>1091-81-R</td>
<td>SMA(f) - N(f), DC to 18 GHz, 50 Ω</td>
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<tr>
<td>1091-172</td>
<td>BNC(f) - N(m), DC to 1.3 GHz, 50 Ω</td>
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<tr>
<td>510-90</td>
<td>7/16 DIN(f) - N(m), DC to 7.5 GHz, 50 Ω</td>
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<tr>
<td>510-91</td>
<td>7/16 DIN(f) - N(f), DC to 7.5 GHz, 50 Ω</td>
</tr>
<tr>
<td>510-92</td>
<td>7/16 DIN(m) - N(m), DC to 7.5 GHz, 50 Ω</td>
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<tr>
<td>510-93</td>
<td>7/16 DIN(m) - N(f), DC to 7.5 GHz, 50 Ω</td>
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<td>510-96</td>
<td>7/16 DIN(m) - 7/16 DIN(f), DC to 7.5 GHz, 50 Ω</td>
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<tr>
<td>510-97</td>
<td>7/16 DIN(f) - 7/16 DIN(f), DC to 7.5 GHz, 50 Ω</td>
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<tr>
<td>1091-379-R</td>
<td>7/16 DIN(f) - 7/16 DIN(f), DC to 6 GHz, 50 Ω, w/ Reinforced Grip</td>
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<tr>
<td>510-102-R</td>
<td>N(m) - N(m), DC to 11 GHz, 50 Ω, 90 degrees right angle</td>
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#### Precision Adapters

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
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<tbody>
<tr>
<td>34NN50A</td>
<td>Precision Adapter, N(m) - N(m), DC to 18 GHz, 50 Ω</td>
</tr>
<tr>
<td>34NFF50</td>
<td>Precision Adapter, N(f) - N(f), DC to 18 GHz, 50 Ω</td>
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#### Miscellaneous Accessories

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
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<tbody>
<tr>
<td>2000-1528-R</td>
<td>GPS Antenna, SMA(m)</td>
</tr>
<tr>
<td>2000-1374</td>
<td>External Charger for Li-Ion Batteries</td>
</tr>
</tbody>
</table>

#### Backpack and Transit Case

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>67135</td>
<td>Anritsu Backpack (For Handheld Instrument and PC)</td>
</tr>
<tr>
<td>760-243-R</td>
<td>Large Transit Case with Wheels and Handle</td>
</tr>
</tbody>
</table>
### Directional Antennas

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000-1411-R</td>
<td>824-896 MHz, N(f), 10 dBi, Yagi</td>
</tr>
<tr>
<td>2000-1412-R</td>
<td>885-975 MHz, N(f), 10 dBi, Yagi</td>
</tr>
<tr>
<td>2000-1413-R</td>
<td>1710-1880 MHz, N(f), 10 dBi, Yagi</td>
</tr>
<tr>
<td>2000-1414-R</td>
<td>1850-1990 MHz, N(f), 9.3 dBi, Yagi</td>
</tr>
<tr>
<td>2000-1415-R</td>
<td>2400-2500 MHz, N(f), 10 dBi, Yagi</td>
</tr>
<tr>
<td>2000-1416-R</td>
<td>1920-2170 MHz, N(f), 10 dBi, Yagi</td>
</tr>
<tr>
<td>2000-1519-R</td>
<td>500-3000 MHz, log periodic</td>
</tr>
<tr>
<td>2000-1617</td>
<td>600-21000 MHz, N(f), 5-8 dBi to 12 GHz, 0-6 dBi to 21 GHz, log periodic</td>
</tr>
</tbody>
</table>

### Portable Antennas

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000-1200</td>
<td>806-866 MHz, SMA(m), 50 Ω</td>
</tr>
<tr>
<td>2000-1473</td>
<td>870-960 MHz, SMA(m), 50 Ω</td>
</tr>
<tr>
<td>2000-1035</td>
<td>896-941 MHz, SMA (m), 50 Ω (1/4 wave)</td>
</tr>
<tr>
<td>2000-1030</td>
<td>1710-1880 MHz, SMA(m), 50 Ω (1/2 wave)</td>
</tr>
<tr>
<td>2000-1474</td>
<td>1710-1880 MHz with knuckle elbow (1/2 wave)</td>
</tr>
<tr>
<td>2000-1031</td>
<td>1850-1990 MHz, SMA(m), 50 Ω (1/2 wave)</td>
</tr>
<tr>
<td>2000-1475</td>
<td>1920-1980 MHz and 2110-2170 MHz, SMA(m), 50 Ω</td>
</tr>
<tr>
<td>2000-1032</td>
<td>2400-2500 MHz, SMA(m), 50 Ω (1/2 wave)</td>
</tr>
<tr>
<td>2000-1361</td>
<td>2400-2500, 5000-6000 MHz, SMA(m), 50 Ω</td>
</tr>
<tr>
<td>2000-1616</td>
<td>20-21000 MHz, N(f), 50 Ω</td>
</tr>
</tbody>
</table>

### Bandpass Filters

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1030-114-R</td>
<td>806-869 MHz, N(m) - SMA(f), 50 Ω</td>
</tr>
<tr>
<td>1030-109-R</td>
<td>824-849 MHz, N(m) - SMA (f), 50 Ω</td>
</tr>
<tr>
<td>1030-110-R</td>
<td>880-915 MHz, N(m) - SMA (f), 50 Ω</td>
</tr>
<tr>
<td>1030-105-R</td>
<td>890-915 MHz Band, 0.41 dB loss, N(m) - SMA(f), 50 Ω</td>
</tr>
<tr>
<td>1030-111-R</td>
<td>1850-1910 MHz, N(m) - SMA (f), 50 Ω</td>
</tr>
<tr>
<td>1030-106-R</td>
<td>1710-1790 MHz Band, 0.34 dB loss, N(m) - SMA(f), 50 Ω</td>
</tr>
<tr>
<td>1030-107-R</td>
<td>1910-1990 MHz Band, 0.41 dB loss, N(m) - SMA(f), 50 Ω</td>
</tr>
<tr>
<td>1030-112-R</td>
<td>2400-2484 MHz, N(m) - SMA (f), 50 Ω</td>
</tr>
<tr>
<td>1030-155-R</td>
<td>2500-2700 MHz, N(m) - N(f), 50 Ω</td>
</tr>
</tbody>
</table>

### Attenuators

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-1010-122</td>
<td>20 dB, 5 W, DC to 12.4 GHz, N(m)-N(f)</td>
</tr>
<tr>
<td>42N50-20</td>
<td>20 dB, 5 W, DC to 18 GHz, N(m) - N(f)</td>
</tr>
<tr>
<td>42N50A-30</td>
<td>30 dB, 5 W, DC to 18 GHz, N(m) - N(f)</td>
</tr>
<tr>
<td>3-1010-123</td>
<td>30 dB, 50 W, DC to 8.5 GHz, N(m)-N(f)</td>
</tr>
<tr>
<td>1010-127-R</td>
<td>30 dB, 150 W, DC to 3 GHz, N(m) - N(f)</td>
</tr>
<tr>
<td>3-1010-124</td>
<td>40 dB, 100 W, DC to 8.5 GHz, N(m)-N(f), Uni-directional</td>
</tr>
<tr>
<td>1010-121</td>
<td>40 dB, 100 W, DC to 18 GHz, N(m)-N(f), Uni-directional</td>
</tr>
<tr>
<td>1010-128-R</td>
<td>40 dB, 150 W, DC to 3 GHz, N(m) - N(f)</td>
</tr>
</tbody>
</table>

### T1/E1 Extender Cables

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>806-16-R</td>
<td>Bantam Plug to Bantam Plug</td>
</tr>
<tr>
<td>3-806-116</td>
<td>Bantam Plug to BNC</td>
</tr>
<tr>
<td>3-806-117</td>
<td>Bantam &quot;Y&quot; Plug to RJ48</td>
</tr>
<tr>
<td>3-806-169</td>
<td>72 inch (1.8 m) BNC to BNC, 75 1/2 RG59 Type Coax Cable</td>
</tr>
<tr>
<td>806-176-R</td>
<td>Bantam Plug to Alligator Clips</td>
</tr>
</tbody>
</table>