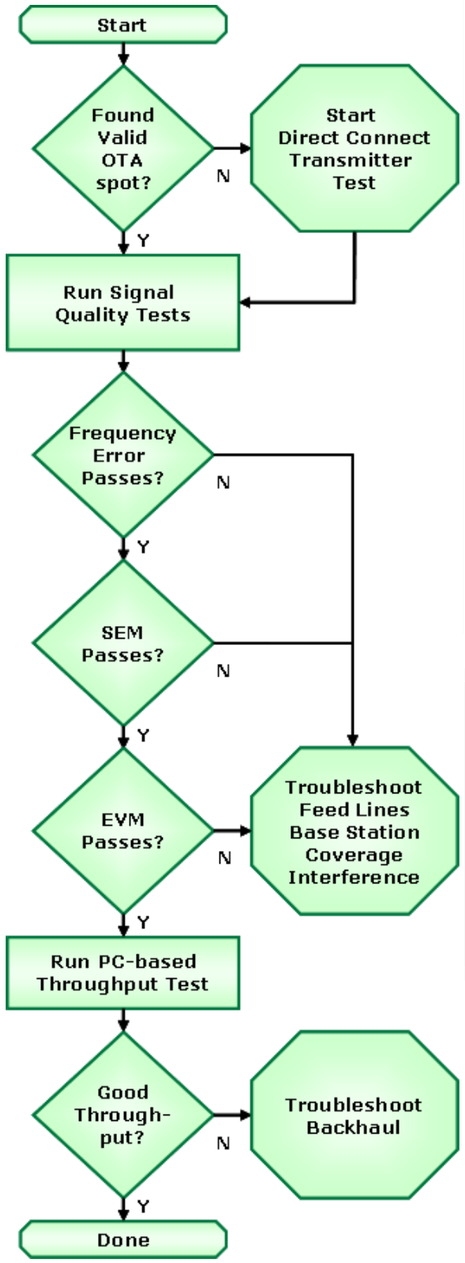
LTE eNodeB Troubleshooting Guide – utilizing Anritsu's Handheld BTS Master™, Cell Master™ or Spectrum Master™ with Options 0541, 0542 and 0546

Start Here

Use Over-the-Air (OTA) tests to spot-check a transmitter's coverage and signal quality. Use the Direct Connect tests to check transmitter power and EVM when the OTA test results are ambiguous.



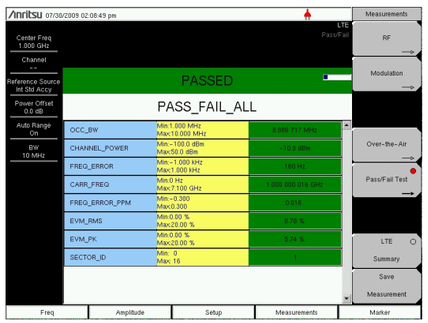
Troubleshooting Hints

These two tables provide guidance from the first indication of a fault, a poor Key Performance Indicator (KPI), to the BTS Master, Cell Master or Spectrum Master test, and finally, to the field replaceable unit.

Key Performance Indicators vs. Test	Sync Power	RS Power	Occupied BW, ACLR, & SEM	EVM (pk)	EVM (rms)	Freq Error	Rx Noise Floor	OTA EVM
Call/Session Blocking								
Power shortage	X	X		X				
Resource Block shortage			X	XX	XX			
UL Interference			X				XX	
Call/Session Drop								
Radio Link Timeout	X	X		X	X	X	X	X
UL Interference			X				X	
DL Interference	X	X		X	X	X		X

Test vs. BTS Field Replaceable Units	Freq Ref	Signal Generation	MCPA	Filters	Antenna	Antenna Down Tilt
Sync Power		X	XX		X	
RS Power		X	XX		X	
Occupied BW		X	XX	XX		
Adjacent Channel Leakage Ratio (ACLR)		X	X	XX	X	
Spectral Emission Mask (SEM)		X	X	XX	X	
Error Vector Magnitude Peak (EVM pk)		X	XX			
Error Vector Magnitude EVM (rms)		X	X	X	X	
Frequency Error	XX					
OTA EVM		X	X	X	X	X

x = probable, xx = most probable



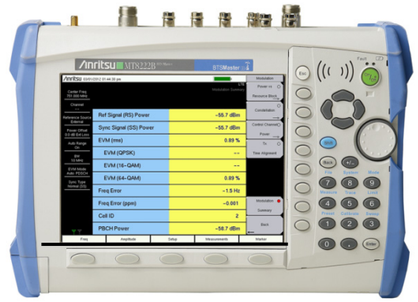
Pass Fail measurements simplify OTA and Direct Connect Transmitter Test with user specified Limit sets

Locating Over-the-Air Test Spots

To test an eNodeB Over-the-Air (OTA) it is necessary to find a location with good Sync Signal (SS) dominance. The SS dominance measurements are ideal for this task. OTA testing requires SS dominance readings higher than 10 dB.

To find a good OTA test site, look for a place squarely in the sector, a block or two from the tower, and away from surfaces that may reflect radio waves. A directional antenna will help to screen out unwanted signals.

In some urban areas, locating a good OTA site can be difficult. In these cases, it may be quicker to connect to the BTS for testing.



Anritsu BTS Master™

Direct Connect Transmitter Tests

Transmitter tests can be run while connected to the:

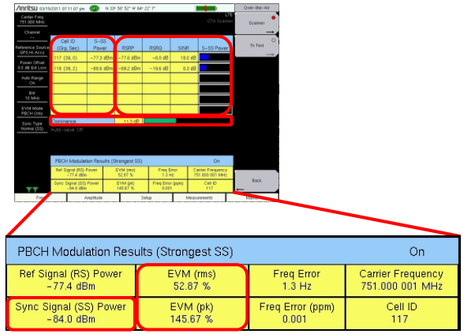
- Output of the eNodeB (Point "A").
- Test port (Point "B") which is essentially the output of the Multi-Carrier Power Amplifier (MCPA).
- Input to the MCPA (Point "C") if the signal is accessible
- Frequency reference system (Point "D") for carrier frequency errors

The goal of these measurements is to increase data rate and capacity by accurate power settings, low out-of-channel emissions, and good signal quality tests. Good signals allow the cell to generate more revenue and provide a better return on investment.

The antenna is the last link in the transmission path. If connected at point "A", it is helpful to sweep the antenna(s) at the same time, to ensure a high quality signal.

Multiple Sector Coverage Checks

Sync Signal Power, Dominance, Cell ID, and EVM



Sync Signal (S-SS) affects cell size. S-SS is also used OTA to check coverage. It should be highest near the tower, declining to a minimum level at the handoff point. More information on SS is provided elsewhere in this guide.

Dominance: The strength of the strongest S-SS compared to the others.

EVM, RSRP, RSRQ, and SINR all indicate the quality of the received signal. In this screen, EVM is measured on the PBCH signal, so as to not be affected by traffic.

Cell, Group, and Sector ID: Identifies the source of the OTA signals detected.

Guidelines:

Dominance: Higher than 10 dB for OTA signal quality testing.

EVM: Established from a known good base station at a location where the dominance figure is over 10 dB.

Cell, Group, and Sector ID: Should be set as defined by engineering.

Consequences:

Poor Dominance: Poor spot to test the BTS OTA. May be a result of excessive coverage, which will result in a loss of system capacity due to excessive co-channel interference.

Poor EVM: Call drops, call blocking, low data rate, and low capacity.

Wrong Cell, Group or Sector ID: Dropped handoffs and island sectors.

Common Faults: Antenna down tilt, damaged antennas, control channel power settings, and co-channel interference.

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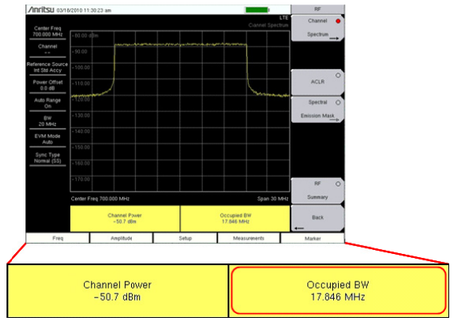
Channel Spectrum

Occupied Bandwidth



The transmitter's signal should be centered in the display, which indicates that the proper RF channel has been chosen. This display is also useful when looking for gross RF problems.

Occupied Bandwidth measures the width of the frequency spectrum occupied by the transmitter's signal. The Occupied Bandwidth contains 99% of the signal's power.

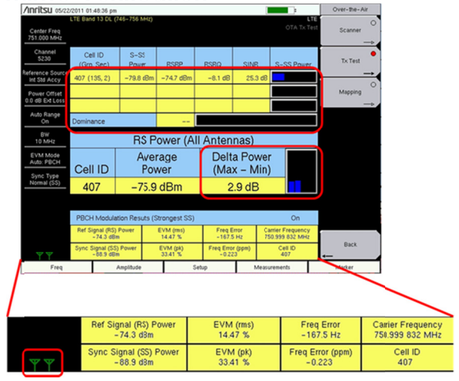
Guideline: The defined LTE Occupied Bandwidths are 1.4, 3.0, 5.0, 10, 15, and 20 MHz.

Consequences: Excessive Occupied BW results in interference with neighboring carriers, dropped calls, and low capacity.

Common Faults: The Tx filters, MCPA, Signal Processing, and antennas may contribute to Occupied Bandwidth faults.

Tx Test

MIMO Verification



Tx Test measurement can be used OTA to verify low co-channel interference, MIMO operation, EVM and frequency error. It is particularly useful for Remote Radio Head (RRH) installations where it's difficult to get direct access to the transmitters. However, it can also be used directly connected to verify each MIMO transmitter. The MIMO indicator verifies which transmitter is connected.

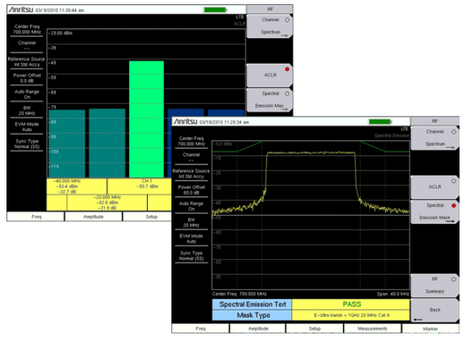
Guideline: OTA as a quality indicator: one cell ID detected (use directional antenna) or >20 dB dominance, RS Delta power < 3 dB, EVM < 10%. Frequency Error < 10 Hz (GPS). Measure at installation, track changes.

Consequences: Poor or no MIMO operation will result in poor throughput, low sector capacity, dropped and blocked calls. Low dominance means high co-channel interference with similar consequences.

Common Faults: disconnected or inter-sector cross connected MIMO transmitters, faulty MCPA, poor antenna installation.

Out-of-Channel Emissions

Adjacent Channel Leakage Ratio (ACLR)
Spectral Emission Mask (SEM)



ACLR and SEM are used to measure how much of the transmitted signal leaks into adjacent channels.

ACLR measures how much of the carrier gets into neighboring RF channels and checks the closest (adjacent) and second closest (alternate) RF channels on LTE signals.

Guidelines: -45 dBc for the adjacent channels, -45 dBc for the alternate channels.

Consequences: The eNodeB will create interference for neighboring carriers. This is also an indication of low signal quality and low capacity, which can lead to blocked calls.

Common Faults: Check Tx filter, MCPA and channel cards. Also, the antenna system can generate intermodulation due to corrosion.

SEM checks closer to the signal than ACLR does. It also is sensitive to absolute power levels. Regulators in many countries require regular measurements of spectral emissions.

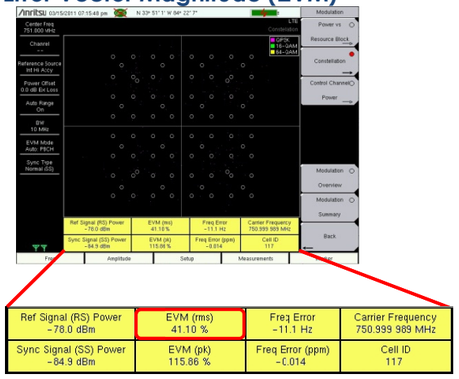
Guideline: Below the mask. Power levels matter; use correct external attenuation value.

Consequences: Failing this test leads to interference with neighboring carriers, legal liability, and low signal quality.

Common Faults: Check amplifier output filtering first. Also look for intermodulation distortion or spectral re-growth.

Signal Quality Tests

Error Vector Magnitude (EVM)



EVM is the ratio of errors, or distortions, in the actual signal, compared to a perfect signal. EVM, in this screen, measures the PBCH, if there is no data traffic, and the PDSCH if there is traffic.

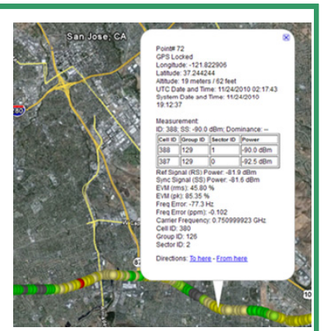
EVM is the most important signal quality measurement and is reported by modulation type also in the Modulation Summary screen.

Guideline: 17.5% for QPSK modulation, 12.5% for 16 QAM modulation, and 8% for 64 QAM modulation when done hooked up to the eNodeB.

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

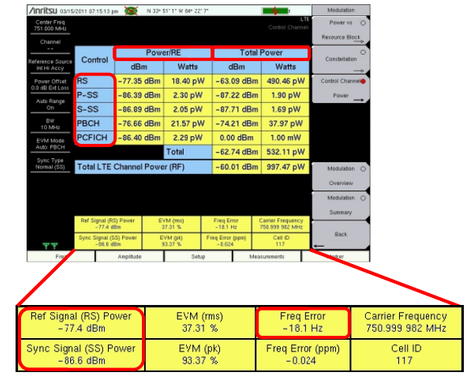
Common Faults: EVM faults can be caused by distortion in the channel cards, power amplifier, filter, or antenna system.

OTA Mapping, with Google Maps, allows analysis of signal quality at a particular location, or series of locations. This is an excellent way to find coverage and interference problems.



Support Signals

Control Channels and Syn Signal (SS Power)



Control Channels are used to allow user equipment to find and use the LTE network and to assess RF channel quality.

Power/RE is the Resource Element power, which is often reported by User Equipment. Total Power per control channel is often reported by e-NodeB equipment.

Guideline: Control Channels typically are all set to the same power level. However, usage may vary as experience with LTE increases.

Consequences: Control channels set at the wrong levels may prevent user equipment from detecting the cell or registering. This may in turn cause dropped calls or data sessions and blocked calls.

Common Faults: Improper settings in the signal processing and control section of the eNodeB.

Sync Signal (SS) Power sets cell size. It's the average of P-SCH and S-SCH. A 1.5 dB change means 15% change in coverage area.

SS is an in-service measurement if the BTS has a test port.

Use the high accuracy power meter and a test signal for the best accuracy (±0.16 dB)

Guideline: The signal should be within ± 2.0 dB of specification under normal conditions.

Consequences: High values create excessive cell overlap leading to interference and low capacity. High or low values will cause low capacity, dropped and blocked calls.

Common Faults: Check MCPA calibration followed by large VSWR faults and damaged connectors.

Rx Noise Floor

When looking for uplink interference a good first step is to check the Rx Noise Floor. To do this, connect to an Rx test port, or the Rx antenna, for the affected sector and make measurements when calls are not up.

Look first for a high received Rx noise floor by using the LTE RF channel power measurement on the uplink channel.

Also, use the spectrum analyzer to check for signals outside the Rx channel but still passed through the Rx filter.

Guideline: Less than approximately –80 dBm received noise floor when no calls are up. This level varies with the LTE RF channel bandwidth.

Consequences: Call blocking, denial of services, call drops, low data rate, and low capacity.

Common Faults: Receiver desensitization from co-channel interference, in-band interference, or passive intermodulation.

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