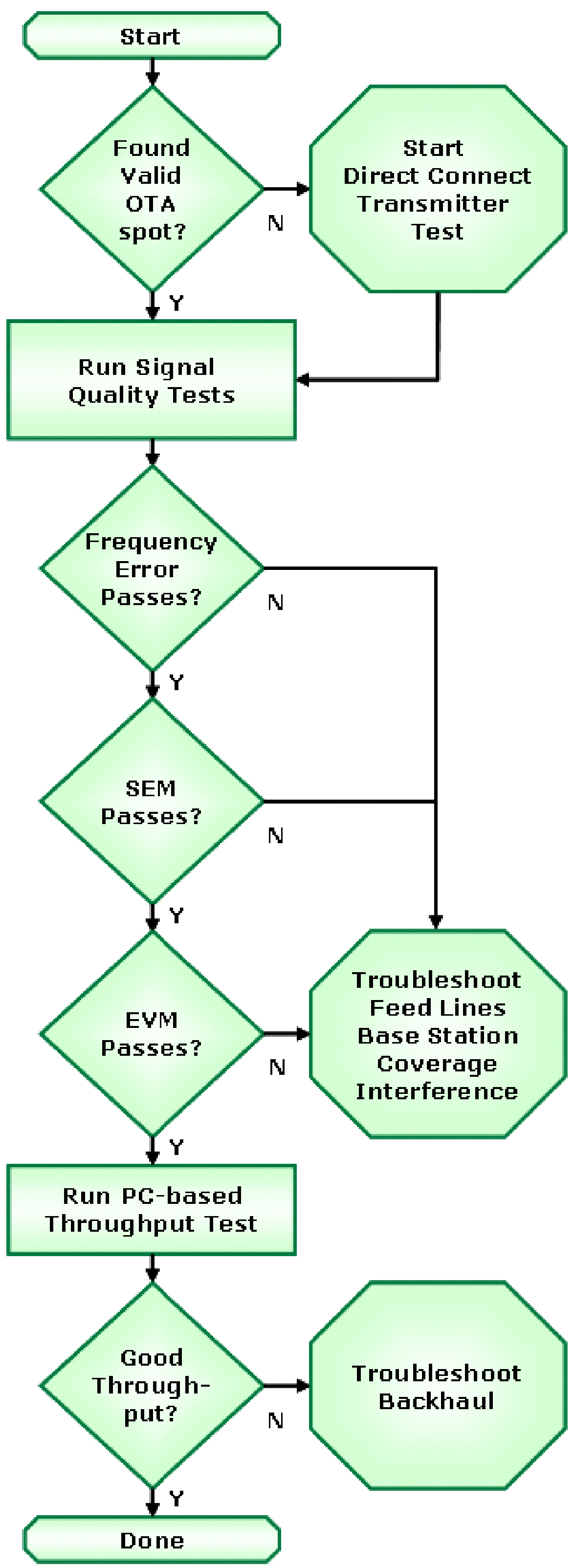
TD-LTE eNodeB Troubleshooting Guide – utilizing Anritsu's Handheld BTS Master™, Cell Master™ or Spectrum Master™ with Options 0551, 0552 and 0556

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.



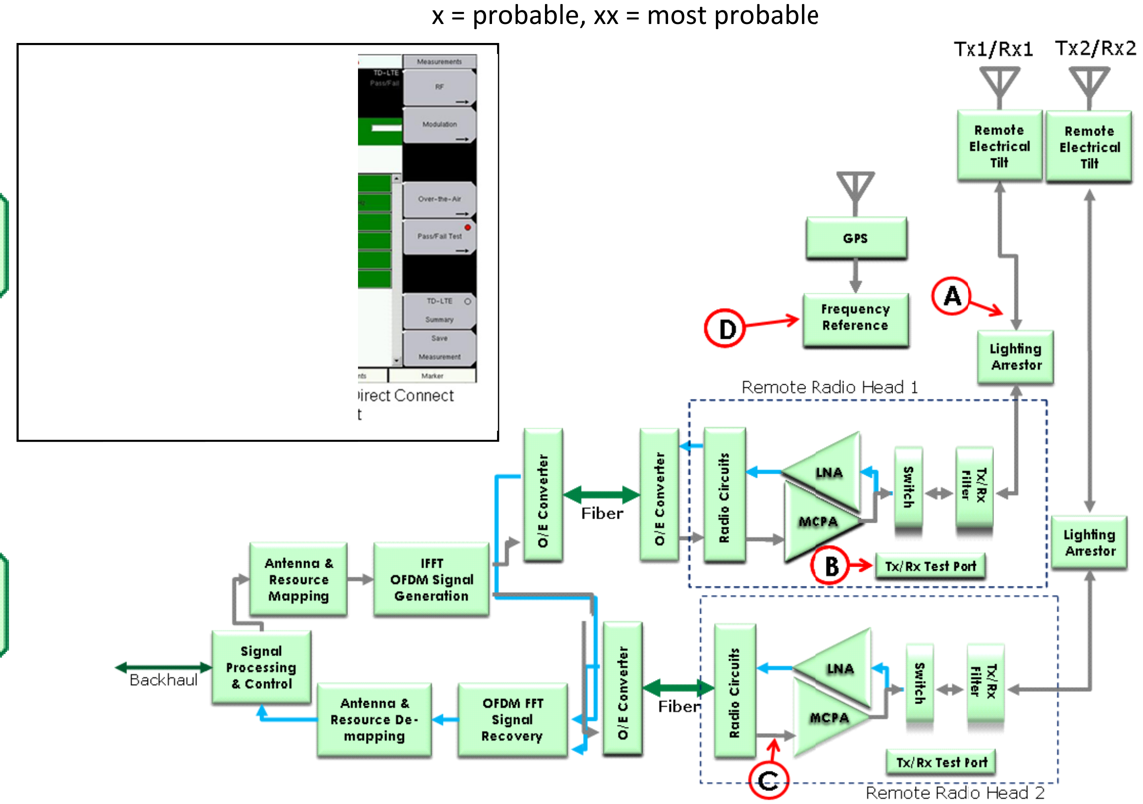
Troubleshooting Hints

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



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:

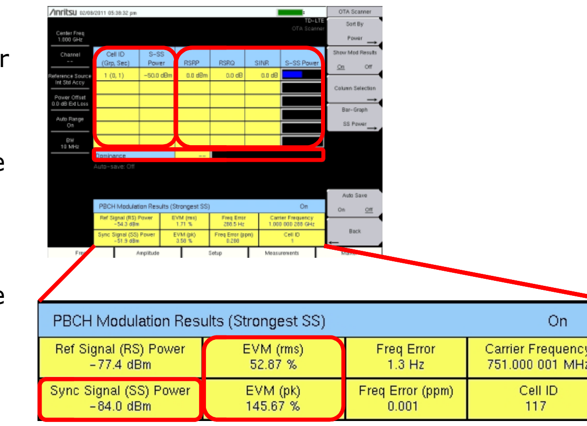
- Output of the eNodeB (Point "A").
- Test port (Point "B") which is essentially the output of the Multi-Carrier Power Amplifier (MCPA) or the input to the receiver, depending on the timing.
- Input to the MCPA (Point "C") if the signal is accessible
- Frequency reference system (Point "D") for carrier 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 (SS) affects cell size. SS is also used OTA to check coverage. It should be highest near the tower, declining to a minimum level at the handoff point.

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

EVM indicates 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: Should be lower than 17.5% when Dominance 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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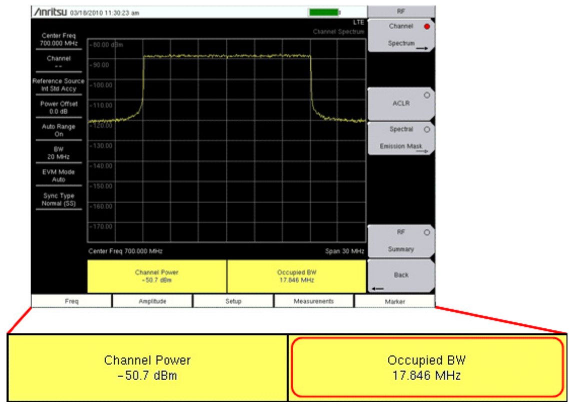
Channel Spectrum
Occupied Bandwidth



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 such as a low or missing signal.

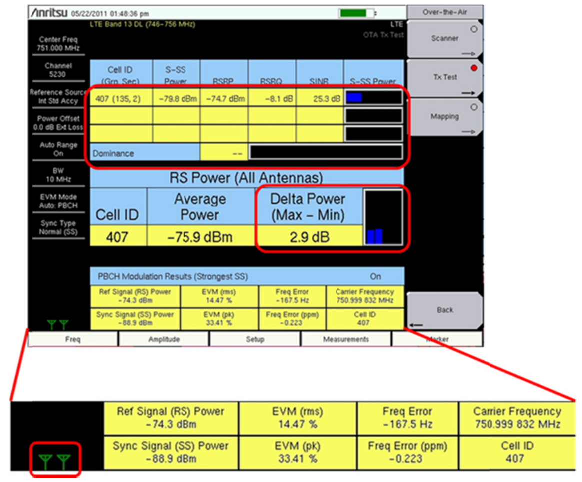
Occupied Bandwidth measures the width of the frequency spectrum occupied by the transmitter's signal. The Occupied Bandwidth contains 99% of the signal's power.

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, OTA 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.

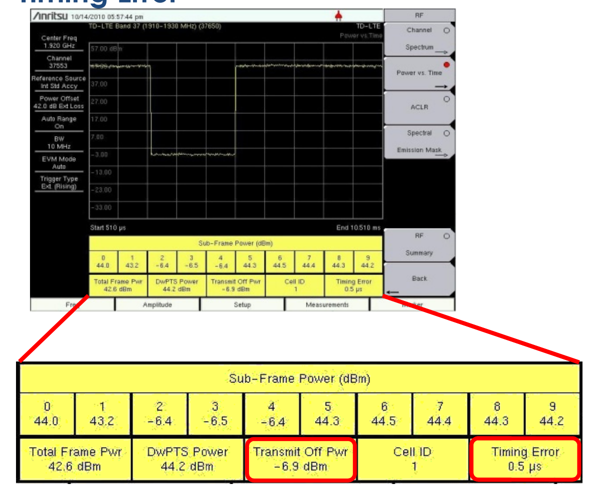
However, it can also be used in direct connect configuration to verify each MIMO transmitter. The MIMO indicator verifies which transmitter is connected.

Guideline: OTA as a quality indicator - One cell ID detected at measurement position (use directional antenna) or at least 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 misconnected (inter-sector cross connections) MIMO transmitters, faulty power amplifiers, poor antenna installation.

Power vs. Time
Timing Error



Timing Error is a measure of how well eNodeB's and TD-LTE base stations are synchronized.

Transmit Off Pwr is a measure of the received power when the eNodeB is not transmitting. See the Rx Noise Floor section for details.

Guideline: Timing Error maximum values will be determined by experience. However, a value of 10% of the shortest guard period, or 100 micro-seconds, is approximately right.

Consequences: Excessive timing error leads directly to co-channel interference with neighboring eNodeB's and TD-LTE base stations.

Common Faults: Poor GPS signal or a faulty timing distribution system.

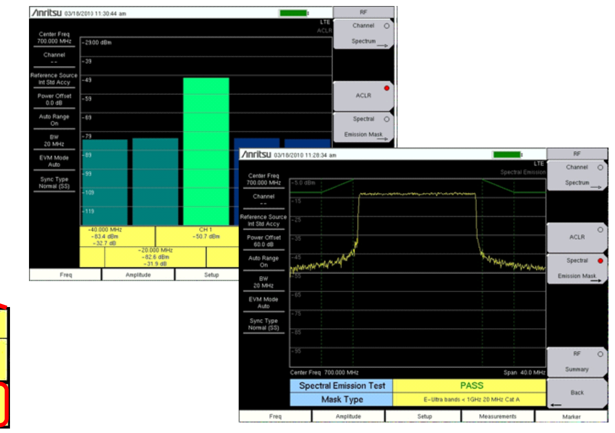
Frequency Error (second column from the left) is a check to see that the carrier frequency is precisely set.

Guideline:+/- 0.05 ppm

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

Common Faults: GPS faults, reference frequency system errors, failures in the clock distribution system, and backhaul faults.

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 is used to look for error conditions further away, and SEM is used to look for error conditions closer to the carrier.

ACLR measures how much of the carrier gets into neighboring RF channels. ACLR checks the closest (adjacent) and second closest (alternate) RF channels on TD–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: First, check the Tx filter, then the MCPA and the channel cards. Also, the antenna system can generate intermodulation due to corrosion.

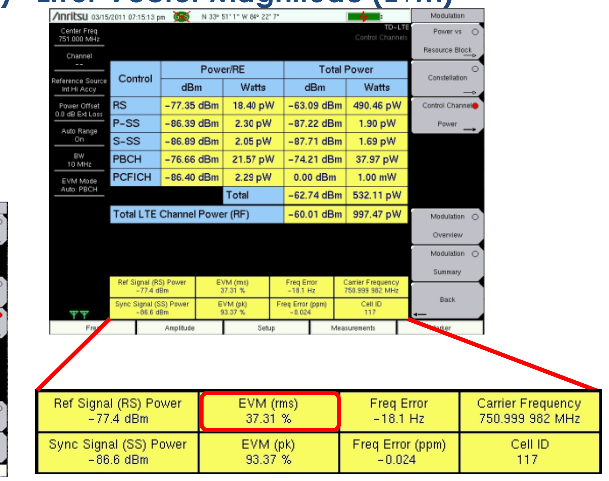
SEM checks closer to the signal than ACLR does. It also is sensitive to absolute power levels. Regulators in many countries require regular measurements of spectral emissions.

Guideline: Must be below the mask. Received power levels matter so be sure to use the right 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
Error Vector Magnitude (EVM)



EVM is the ratio of errors, or distortions, in the actual signal, compared with 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 single most important signal quality measurement.

EVM by modulation type is also reported in the Modulation Summary screen.

Guideline: 17.5% for QPSK modulation, 12.5% for 16 QAM modulation and 8% for 64 QAM modulation when measured while connected to the eNodeB.

Consequences: Poor EVM leads to dropped calls, low signal quality, low data rate, low sector capacity, and blocked calls.

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

Rx Noise Floor

When looking for uplink interference a good first step is to check the Rx Noise Floor. To do this, check the Power vs. Time measurement.

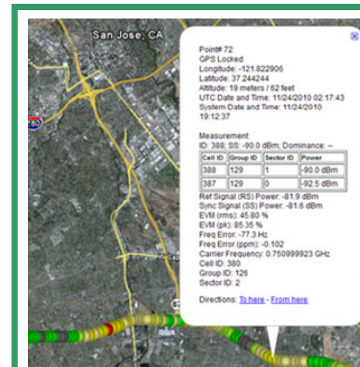
The Transmit Off Power level both shows and measures co-channel interference when connected to an antenna port.

Another good idea is to use the spectrum analyzer to check for signals outside the Tx/Rx band but still passed through the Tx/Rx filter.

Guideline: Less than approximately –80 dBm. This level varies with the TD- 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.



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

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