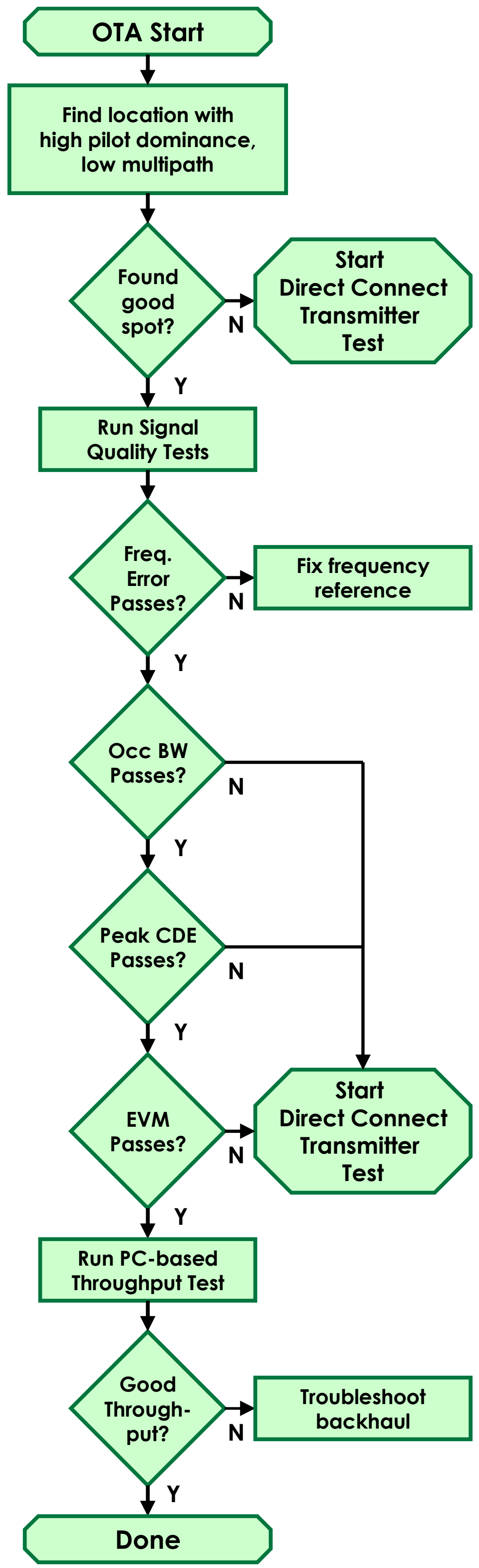
TD-SCDMA/HSDPA Base Station Troubleshooting Guide – utilizing Anritsu's Handheld BTS Master™, Cell Master™, or Spectrum Master™ with Options 38/60/61

Start Here

Use BTS 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 when the OTA test results are ambiguous.



Troubleshooting Hints

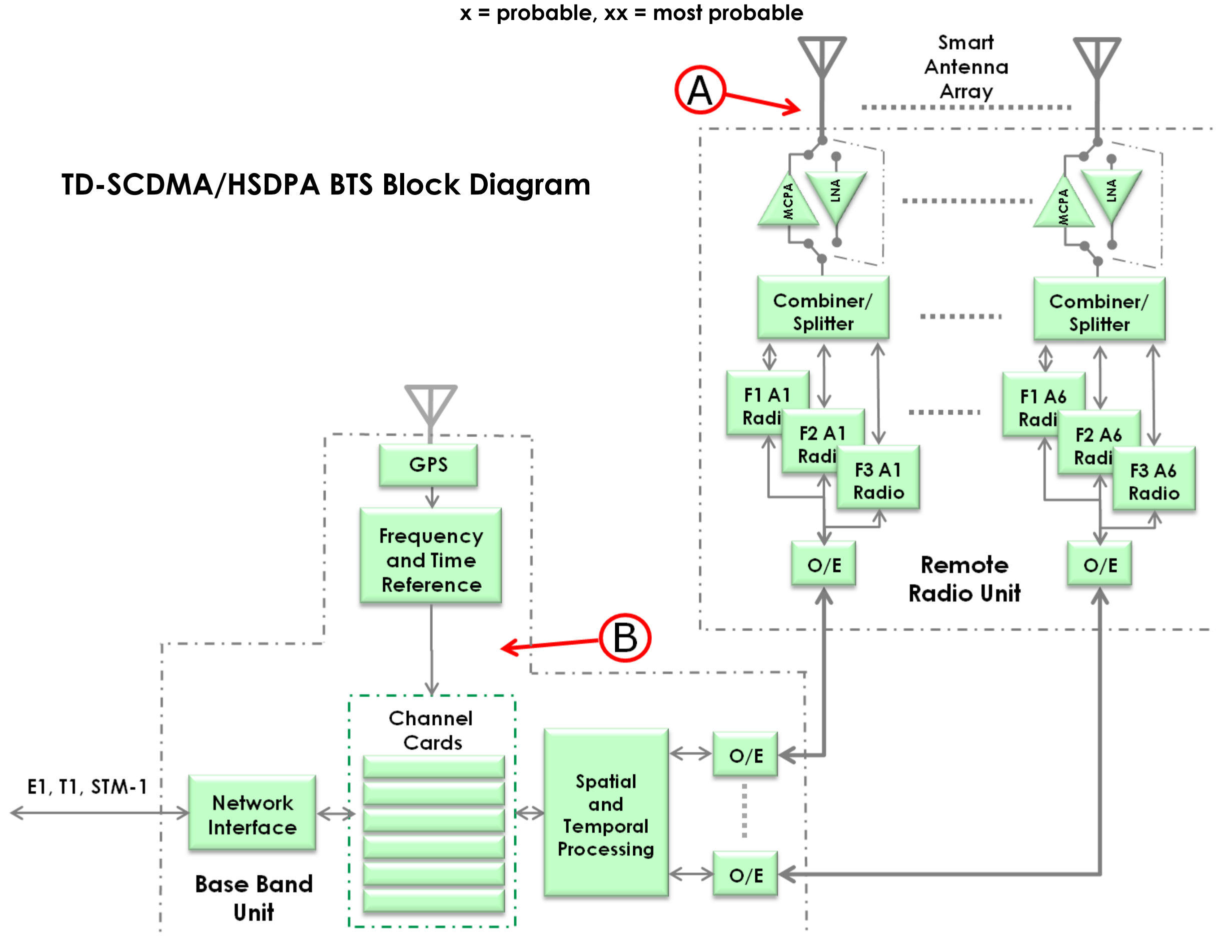
These two tables provide guidance from the first indication of a fault, a poor Key Performance Indicator (KPI), to the BTS or Spectrum Master test, and finally, to the field replaceable unit.

Key Performance Indicators vs. Test	Ch. Power	Occ BW	Empty DL Slot Power	Slot PAR	EVM	Peak CDE	Freq. Error	Noise Floor	E_c/I_o	Tau Over-lap
Access failures										
Resource Shortage	x		x		x	x	x	x	x	x
UL Interference (BLER)			xx							
Call Drop										
Radio Link Timeout	x		x	x	xx	xx	x	x	x	x
UL Interference (BLER)			xx							
DL Interference (BLER)		x		x	xx	xx	x	x	xx	xx

Test vs. BTS Field Replaceable Units	Freq Ref	Ch Cards	Radios	MCPA	Antenna Return Loss	Antenna Down Tilt	Uplink Inter-ference
Channel Power		x	x	xx	x		
Occupied Band Width		x	x	x	x		
Empty DL Slot Power		x	x	x			xx
Slot Peak Average Ratio		x	x	xx	x		
Error Vector Magnitude		x	x	xx	xx		
Peak Code Domain Error		xx		x			
Frequency Error	xx						
Noise Floor		xx	x	x	x		
Scrambling Code		xx					
E_c/I_o				x	x	xx	
Tau Scanner Overlap				x		xx	
Sync Scanner				x		xx	

x = probable, xx = most probable

TD-SCDMA/HSDPA BTS Block Diagram



Locating Over-the-Air Test Spots

To test a BTS Over-the-Air (OTA) it is necessary to find a location with good pilot dominance and low multipath. The BTS Master is ideal for this task. OTA testing requires a pilot dominance 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 for the BTS Master 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 hook up to the BTS for testing.

Anritsu BTS Master™
Pass/Fail screen provides status of BTS

Direct Connect Transmitter Tests

A. Transmitter tests can be run while hooked up to the output of the BTS (Point "A"). It is possible to test by either replacing an antenna with a high power 50 Ohm attenuator and a BTS Master, or by installing a coupler in-line with the signal. If a test port is available, it can also be used.

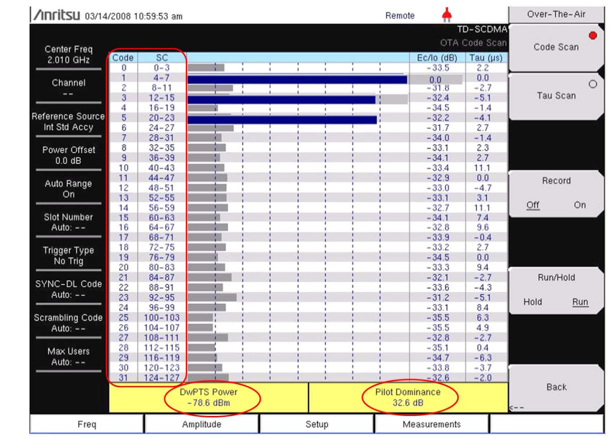
B. Hook up to the frequency reference system (Point "B") for carrier frequency errors.

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. Good signals allow the cell to provide a better return on investment.

The antenna, and the antenna run, is the last link in the transmission path. If damaged or weathered, it can degrade the signal. Because of this, it is helpful to sweep the antenna system whenever the antenna run has been detached for BTS transmitter testing.

Multiple Sector Coverage Checks

Sync Codes, Scrambling Codes, DwPTS Power & Pilot Dominance



Sync and Scrambling codes indicate which sectors are present at the current location. Too many strong signals in one sector create co-channel interference. Sync codes are detailed here. Scrambling codes are grouped here and specifically measured on the code domain screen.

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. Coverage plots can be downloaded to PC based mapping programs for later analysis.

Pilot Dominance helps locate a good spot for Over-the-Air signal quality testing.

Guidelines:

Sync Codes: 3 or fewer codes within 10 dB of the dominant code over 95% of the coverage area.

DwPTS OTA Power: Higher than -88 dBm over 95% of the coverage area.

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

Consequences:

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

DwPTS OTA Power: Low capacity, low data rates, excessive call drops and call blocking.

Common Faults:

Sync Codes and DwPTS OTA Power:
Excessive or inadequate coverage can be caused by antenna down tilt errors, improper pilot power, and repeaters. DwPTS Over-the-Air power is also affected by building shadows and other obstructions.

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Single Sector Coverage Checks

E_c/I_o, Tau

These two OTA measurements for the six strongest sync codes serve as a troubleshooting tool for coverage issues. If further detail is needed, the strongest scrambling code can be identified on the code domain screen.

E_c/I_o indicates the strength of the signal from the six strongest base stations.

Tau indicates the distance of the signal from the source. Radio waves travel 1 kilometer in 3.3 microseconds.

Guidelines:

E_c/I_o should be higher than -2 dB over 95% of the coverage area.

Tau should be lower than the distance to the three nearest base stations.

Consequences:

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

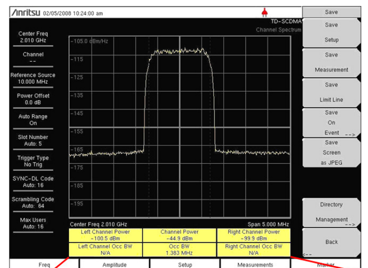
Tau faults lead to excessive coverage, co-channel interference, long handoffs, and low signal quality.

Common Faults:

E_c/I_o and Tau faults are often caused by Antenna down tilt issues, improper BTS power levels, and improper use of repeaters.

RF Measurements

Channel Power
Occupied Bandwidth (Occ BW)



Left Channel Power -100.5 dBm	Channel Power -44.9 dBm	Right Channel Power -99.9 dBm
Left Channel Occ BW N/A	Occ BW 1.383 MHz	Right Channel Occ BW N/A

Channel Power sets cell size. A 1.5 dB change in power levels means approximately a 15% change in coverage area.

Channel Power (RRC) and an in-service power measurement, **DwPTS Power**, are available on the Time Slot Power screen.

Use the high accuracy power meter for the best accuracy (± 0.16 dB).

Occ BW (Occupied Bandwidth) is the RF spectrum that contains 99% of the RF Power.

Guidelines:

Channel Power typically should be within +/- 1.0 dB of specification. This also applies to Channel Power RRC and DwPTS Power.

Occ BW typically between 1.3 and 1.6 MHz.

Consequences:

Channel Power errors will cause either co-channel interference or poor coverage at cell boundaries, leading to dropped calls, extended handoffs, low capacity, and blocked calls.

Occ BW errors will cause interference with neighboring RF channels creating lower signal quality and reducing capacity.

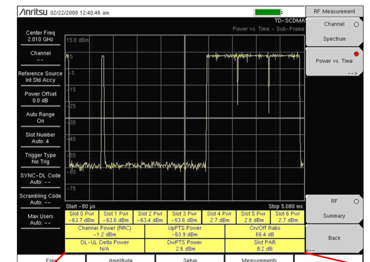
Common Faults:

For **Channel Power** faults check the amplifier power settings, then look for large VSWR faults and damaged connectors. Channel cards and radio units may also need to be checked.

For **Occ BW** issues, trace the fault through the signal path. Antennas, amplifiers, radios, and channel cards are all likely suspects.

Time Slot Power

(Time vs. Power)
Empty Slots, Slot PAR



Slot 0 Pwr -63.7 dBm	Slot 1 Pwr -63.6 dBm	Slot 2 Pwr -63.4 dBm	Slot 3 Pwr -63.6 dBm	Slot 4 Pwr 2.7 dBm	Slot 5 Pwr 2.8 dBm	Slot 6 Pwr 2.7 dBm

Channel Power (RRC) -1.2 dBm	UpPTS Power -63.9 dBm	On/Off Ratio 66.4 dB
DL-UL Delta Power N/A	DwPTS Power 2.6 dBm	Slot PAR 8.2 dB

Empty downlink slots can be used to estimate interference, and also, self-interference of the transmitter during uplink time. Measuring the power of these slots provides an indication of how well the transmitter turns off.

Slot PAR is the peak to average ratio of a slot. If it is too low, the amplifier is compressing (distorting) the signal.

Guidelines:

Empty downlink slots should have less than -82 dBm of transmit power when measured at the base station.

Slot PAR should typically be above 6 dB.

Consequences:

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

Slot PAR faults indicate signal quality issues. Follow up with EVM and Peak CDE measurements for further information.

Common Faults:

Empty downlink slots with excessive power are caused by the Tx amplifier not turning off enough. Trace the fault through the signal path.

Slot PAR faults can be caused by low supply voltage to the amplifier which restricts the amplifier headroom. Other likely causes are excess signal strength at the amplifier input, radio units, and channel cards.

Signal Quality Tests

Error Vector Magnitude (EVM) &
Peak Code Domain Error (Peak CDE)

Slot Power -79.2 dBm	Freq Error 529 Hz	EVM 8.7 %
DwPTS Power -79.3 dBm	Tau N/A	Peak EVM 26.9 %
Noise Floor -33.2 dB	Scrambling Codes (dB) 4 (0.0)	Peak CDE -32.3 dB

Code Domain displays show the traffic in a specific time slot.

EVM is the ratio of errors, or distortions, in the actual signal, compared to a perfect signal.

Peak Code Domain Error (Peak CDE) is the EVM of the worst code. It is used to spot the worst case distortion caused by either amplifier compression or channel card issues.

Guidelines:

EVM should be 12.5 % or less when coupled to the transmitter's output.

Peak CDE should be lower than -28 dB at a spreading factor of 16.

Consequences:

EVM or 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. These faults will create a higher than necessary dropped and blocked call rate.

Common Faults:

EVM faults can be caused by distortion in the channel cards, radios, power amplifier, or antenna system. Trace the fault through the signal chain to resolve.

Peak CDE faults are likely caused by channel cards or an amplifier with a high output or low supply voltage.

Signal Quality Tests

Frequency Error
Noise Floor
Scrambling Code

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 it is GPS enabled or in GPS holdover.

Noise Floor is a general code domain check for signal quality. Any sort of code domain modulation error will raise the code domain noise floor.

Scrambling Code measurements provide a check for the BTS settings.

Guidelines:

Frequency Error should be less than:

Wide Area BTS:	+/- 0.05 ppm
Local area BTS:	+/- 0.1 ppm

Noise Floor should be less than -20 dB.

Scrambling Code should be as specified.

Consequences:

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.

A **Noise Floor** at a higher power level is the first indication of signal quality problems. Follow up with other checks, such as EVM, to narrow the problem down.

Scrambling Code errors can cause a very high dropped call rate on hand off.

Common Faults:

For **Frequency Error**, first check the reference frequency and the reference frequency distribution system. If a GPS frequency reference is used, check it as well.

For **Noise Floor** problems check for channel card cross talk, amplifier faults, and antenna issues. Also follow up with EVM and Peak CDE measurements.

Scrambling Code errors are likely caused by an error setting the scrambling code value.

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