Start Here
Use BTS Over-the-Air (OTA) tests to spot-check a transmitters' 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.

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OTA Start

Test vs. BTS Field Replaceable Units

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<th>Test vs. BTS Field Replaceable Units</th>
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OTA Signal Quality Test

Locating Over-the-Air Test Spots
To test a BTS Over-the-Air (OTA) it is necessary to find a good location. 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 good location will have a C/I ratio better than 20 dB. A directional antenna for the BTS Master will help to screen out unwanted signals and improve the OTA C/I reading.

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.

GSM/GPRS/EDGE BTS Block Diagram

Anritsu BTS Master™

OTA Start

Find location several blocks from tower, square to face, and away from reflective surfaces

Start Direct Connect Transmitter Test

Pass/Fail screen provides status of BTS Direct Connect Transmitter Tests

Direct Connect Transmitter Tests
Transmitter tests can be run while hooked up to the:

A. Output of the BTS (Point “A”).
B. Test port (Point “B”) which is essentially the output of all of the amplifiers.
C. Output of the power amplifiers (Point “C”).

The goal of these measurements is to increase voice coverage, data rate, and EDGE capacity by accurate power settings, low out-of-channel emissions, and good signal quality. Good signals allow the cell to have better capacity and a better return on investment. The antenna is the last link in the transmission path. If hooked up at point “A”, it is helpful to sweep the antenna(s) at the same time, to ensure a high quality signal.

G/SY/M/GPRS/EDGE BTS Block Diagram

OTA Signal Quality Test

Carrier to Interference (C/I) Base Station Identity Code (BSIC)

The Carrier to Interference (C/I) ratio indicates the quality of the received signal. This measurement can be used to locate a good spot for OTA testing. It also can be used to identify areas of poor signal quality.

The Base Station Identity Code (BSIC) gives the base station id. The Network Color Code (NCC) identifies the owner of the network. The Base Station Color Code (BCC) identifies the sector.

Guidelines:
C/I ratios for OTA signal quality testing should be higher than 20 dB.
C/I ratios for coverage testing, should be higher than 10 dB over 95% of the coverage area.
BSIC, NCC, and BCC numbers should be as specified by the network operator.

Consequences:
C/I ratios under 20 dB will prevent accurate OTA signal quality testing. EDGE data rates will also be affected.
C/I ratios under 10 dB will cause coverage issues including dropped calls, blocked calls, and other handset reception problems.
BSIC, NCC, and BCC faults indicate coverage issues that lead to dropped calls.

Common Faults:
For OTA signal quality testing, the C/I ratio will vary with location. Be aware that interference or a faulty BTS may cause a low C/I.
For coverage and BSIC issues, check for a weak signal or excessive coverage from another sector. Check antenna down tilt, BTS power, BTS signal quality, and look for interference.
Cell Size
Power Meter Measurements
Average Burst Power

Guard Period Measurements
Power vs. Time (Slot)
Power vs. Time (Frame)

Out-of-Channel Emissions
Occupied Bandwidth (Occ BW)
Frequency Error

Signal Quality Tests
Phase Error (for GSM)
Pass Fail Mode

Signal Quality Tests for EDGE
Error Vector Magnitude (EVM)
Origin Offset

The High Accuracy Power Meter can measure RF power to an accuracy of ± 0.16 dB. Traffic channels may need to be changed to BCCH channels for the duration of the test.

**Average Burst Power**, shown to the right, can be used in-service on all channels.

**Guidelines**: Most network operators set their base stations to within ±1.0 dB of specification.

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

**Common Faults**: Common faults include lack of amplifier calibration, radio drift, large VSWR errors, damaged connectors, and damaged antennas.

**Rx Noise Floor**

When looking for uplink interference a good first step is to check the Rx Noise Floor. To do this, hookup to a Rx test port, or the Rx antenna, for the affected sector and make measurements on the receive channel when calls are not up. Look first for a high received Rx noise floor by using the GSM channel power measurement on the uplink channel. Also check for signals outside the Rx channel but still passed through the Rx filter. These signals can cause receiver de-sense, a reduction in receiver sensitivity that effectively lowers the cell’s receive coverage.

**Rx Noise Floor (continued)**

**Guideline**: Less than approximately –100 dBm received noise floor when no calls are up.

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

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

**Intermodulation products can cause interference and in turn may be caused by a combination of strong signals and corruption. This corrosion can be in the antenna, connectors, or nearby rusty metal. This issue is often called the rusty bolt syndrome.

**Occupied Bandwidth** is a measurement of the spectrum used by the carrier. The occupied bandwidth contains 99% of the signal’s RF power.

**Guideline**: Occupied bandwidth should be between 230 kHz and 280 kHz for GSM signals.

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

**Common Faults**: Check for proper carrier filtering and distortion caused by high amplifier power levels. Faulty radios, filters, and bad antennas can also cause occupied bandwidth problems.

**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.

**Guideline**: Frequency Error should be less than ± 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**: First, check the reference frequency and the reference frequency distribution system. Check the backhaul and if used, the GPS.

**Phase Error** is a measure of the difference between an ideal and actual GMSK modulated voice signal. Phase Error measurements are required for the GMSK modulated signals used for GSM voice transmissions.

**Guideline** For GMSK signals, phase error should be:
- Less than 5% for RMS Phase Error
- Less than 20% for Peak Phase Error

**Consequences**: Poor signal quality leading to dropped calls, blocked calls, and missed handoffs.

**Common Faults**: Phase faults can be caused by distortion in the radio units or power amplifier. Trace the fault through the signal chain to find the faulty Field Replaceable Unit.

**Pass Fail Mode** (shown on the previous page as the BTS Master screen) is a way to set up common test limits, or sets of limits, for each instrument.

**Guideline**: A green “Pass” field is required for all tests.

**Consequences**: Inconsistent settings between base stations, leading to inconsistent network behavior.

**Common Faults**: Failures come from BTS aging, hard faults, and variable standards.

**Error Vector Magnitude (EVM)** measures the difference between an ideal and an actual 8-PSK signal. EVM measurements are required for the 8-PSK modulated signals used for EDGE data transmissions.

**Guideline**: For 8-PSK signals, EVM should be:
- Less than 7% for EVM (rms), measured before any passive combiners
- Less than 22% for EVM (pk), measured before any passive combiners
- Less than 20% for Peak Phase Error

**Consequences**: Dropped calls, blocked calls, low data rate, and low sector capacity.

**Common Faults**: Radio units, power amplifiers, filters and antenna system can cause EVM faults. Trace the fault through the signal chain to find the faulty Field Replaceable Unit.

**Origin Offset** is a measure of the DC power leaking through local oscillators and mixers. This fault lowers signal quality and is normally caused by radio units and up-converters.

**Guideline**: Origin Offset should be less than -30 dB for EDGE measurements.

**Consequences**: Origin Offset faults will lower EVM and Phase Error measurements and create higher dropped call rate.

**Common Faults**: Origin Offset is created in the radio units: Amplifiers and passive components do not create this error.

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Document No. 11410-00466, Rev A Printed in the United States 2008-10