RF Testing of TD-SCDMA Mobiles Using Agilent Test & Measurement Solutions

Agilent Technologies
Jul. 18th, 2006
Agenda of Today

• Introduction
  – Agilent TD-SCDMA Test Solutions Overview
  – TD-SCDMA Mobile Tx Tests
  – TD-SCDMA Mobile Rx Tests

• Transmitter Tests

• Receiver Tests

• Summary
## Agilent TD-SCDMA Test Solutions Roadmap

<table>
<thead>
<tr>
<th>Calendar Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007+</th>
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<tbody>
<tr>
<td><strong>Agilent PSA Performance Spectrum Analyzer</strong></td>
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<td><strong>Today</strong></td>
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<td>Opt 211 RF Power Meas</td>
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<td><strong>std-compliant PVT measurement</strong></td>
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<td><strong>TSM real-time #411</strong></td>
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<td><strong>Agilent 89601A Vector Signal Analysis Software</strong></td>
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<tr>
<td>Opt 211 pA01 Update (PVT)</td>
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<td>Ver 6.10 (Midable sync)</td>
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<tr>
<td>Ver 6.20 (HSDPA/8PSK)</td>
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<td>MC ARB N7612B</td>
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<td><strong>1st to support HSDPA</strong></td>
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<td><strong>Market for TD-SCDMA</strong></td>
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<td><strong>China 3G license</strong></td>
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## Agilent Spectrum/Signal Analyzer Platforms

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<th>Manufacturing</th>
<th>I&amp;M</th>
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<th>PSA</th>
<th>E440 6</th>
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<td>89600 VSA</td>
<td>BTS Test</td>
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<tr>
<td><strong>Our focus now on TD-SCDMA</strong></td>
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</table>

**Agilent Technologies**

**TD-SCDMA UE Testing**
Agilent Restricted
July 18, 2006
Agilent PSA High Performance SA
Analyzer Platform for TD-SCDMA

- 6.7, 13.2, 26.5, 43, 44 and 50 GHz Models
- Power suite for most comm standards
- Opt 211 for TD-SCDMA Power Measurements
- Time Gated Sweep
- Link to 89600 modulation analysis PC SW
  • Flexible modulation analysis
  • TD-SCDMA modulation analysis
  • Systems >80MHz BW with 89600 VXI
- Phase Noise, Noise Figure Personalities
  • 80MHz WB DIF with 14-bit ADC
  • Quasi-peak and EMI Res BW
  • ACP speed-ups
  • 8902 replacement features
- Flexible modulation analysis personality

Amplitude Accuracy:
- ± 0.62 dB Total accuracy (up to 3 GHz)
- ± 0.24 dB 95% Confidence
- ± 0.16 dB Typical

Display Averaged Noise Level:
- -154 dBm/Hz 1.2-2.5GHz Guaranteed
- -155 dBm/Hz 1.2-2.5GHz Typical

with preamp #1DS:
- -168 dBm/Hz 1.2-2.5GHz Guaranteed
- -169 dBm/Hz 1.2-2.5GHz Typical
Agilent 89600 Vector Signal Analysis SW
VSA Platform for TD-SCDMA

- Simultaneous time, frequency and modulation domain analysis
- A wide range of leading edge modulation analysis formats for early time-to-market designs
  - TD-SCDMA modulation analysis
- A wide range of display formats to allow best visualization of your signal
- Powerful error analysis tools to highlight problems
- Signal capture and playback (in slow motion)
- Save data for output to signal source or ADS
- Consistent measurements & GUI across multiple test planes

Supported Front-ends:
Analyzers: PSA, ESA, E4406
VXI HW: 89610/11, 89640/41 (2-CH)
Oscilloscopes: Infiniium, 6000 series
Logic Analyzers: 169xx/168x/169x series
Digital Inputs: DSIM + N50101A
OBT: N4010A
Agilent ESG Vector Signal Generators

Source Platform for TD-SCDMA

Key Contributions

- Up to 6 GHz
- 160 MHz RF mod BW (ext IQ)
- 80 MHz RF mod BW (int BBG)
- Up to 100 MSa/s + upsampling HW
- 64 MSa playback/1 GSa storage
- Unrivaled signal creation
- Advanced baseband capability
- Modern connectivity

Target Market

- Mobile communications
- Wireless connectivity
- Audio/video broadcasting
- General purpose

Target Applications

- RF and baseband component and transceiver test
- R&D design and verification
- Manufacturing

The benchmark reference signal

Models

E4438C 1-6 GHz ESG Vector Signal Generator
E443xB1-4 GHz ESG Vector Signal Generators
Reference Specifications for Mobile Testing

3GPP 2004-3 release 5 / 3GPP TDD 1.28 Mcps option:

1. **TS 25.102-V5.6.0(2003-12)**
   - User Equipment (UE) radio transmission and reception (TDD)

2. **TS 34.122-V5.0.0(2003-12)**
   - Terminal conformance specification; Radio transmission and reception (TDD)

3. **TS 25.221-V5.5.0(2003-09)**
   - Physical channels and mapping of transport physical channels (TDD)

4. **TS 25.222-V5.6.0(2003-12)**
   - Multiplexing and channel coding (TDD)

5. **TS 25.223-V5.3.0(2003-03)**
   - Spreading and modulation (TDD)

6. **TS 25.224-V5.7.0(2003-12)**
   - Physical layer procedures (TDD)

7. **TS 25.225-V5.7.0(2004-03)**
   - Physical layer – Measurements (TDD)

8. **TS 25.105-V5.5.0(2003-12)**
   - Base Station (BS) radio transmission and reception (TDD)

9. **TS 25.142-V5.6.0(2003-12)**
   - Base Station (BS) conformance testing (TDD)
## Mobile Transmitter RF Testing Items

**TS 34.122-V5.0.0 (2003-12):**

<table>
<thead>
<tr>
<th>Sub-clause</th>
<th>Name of Test Item</th>
<th>Test Limit</th>
<th>Test Configuration</th>
<th>Agilent Test Instruments</th>
<th>Supplemental Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.2</td>
<td>Maximum Output Power</td>
<td>vary by power class and single/mutil codes</td>
<td>A.1</td>
<td>PSA opt 211</td>
<td></td>
</tr>
<tr>
<td>5.3</td>
<td>Frequency Stability</td>
<td>±0.1 ppm</td>
<td>A.1</td>
<td>PSA SA Mode</td>
<td></td>
</tr>
<tr>
<td>5.4.1.3</td>
<td>Open Loop Power Control</td>
<td>vary by power level</td>
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<td>PSA opt 211 could do with proper triggering</td>
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<td>Close Loop Power Control</td>
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<td>PSA opt 211</td>
<td>manual test using 89601+PSA or VXI HW with deep memory</td>
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<tr>
<td>5.4.4</td>
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<td>below defined mask</td>
<td>A.1</td>
<td>PSA opt 211</td>
<td></td>
</tr>
<tr>
<td>5.4.5</td>
<td>Out-of-synchronisation handling of output power for continuous</td>
<td>NA</td>
<td>A.1</td>
<td>PSA opt 211</td>
<td></td>
</tr>
<tr>
<td>5.4.6</td>
<td>Out-of-synchronisation handling of output power for discontinuous transmission</td>
<td>NA</td>
<td>A.1</td>
<td>PSA opt 211</td>
<td></td>
</tr>
<tr>
<td>5.5.1</td>
<td>Occupied Bandwidth</td>
<td>&lt; 1.6 MHz</td>
<td>A.1</td>
<td>PSA opt 211</td>
<td></td>
</tr>
<tr>
<td>5.5.2.1</td>
<td>Spectrum Emission Mask</td>
<td>below defined mask</td>
<td>A.1</td>
<td>PSA opt 211</td>
<td></td>
</tr>
<tr>
<td>5.5.2.2</td>
<td>ACLR (Adjacent Channel Leakage Power Ratio)</td>
<td>&lt; 33 dB for 1st adj ch &lt; 43 dB for 2nd adj ch</td>
<td>A.1</td>
<td>PSA opt 211</td>
<td></td>
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<tr>
<td>5.5.3</td>
<td>Spurious Emissions</td>
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<td></td>
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<tr>
<td>5.6</td>
<td>Transmit Intermodulation</td>
<td>&lt; 31 dB for 1.6MHz offset &lt; 41 dB for 3.2MHz offset</td>
<td>A.2</td>
<td>PSA SA Mode</td>
<td></td>
</tr>
<tr>
<td>5.7.1</td>
<td>EVM (Error Vector Magnitude)</td>
<td>&lt; 17.5%</td>
<td>A.1</td>
<td>PSA + 89601</td>
<td></td>
</tr>
<tr>
<td>5.7.2</td>
<td>Peak Code Domain Error</td>
<td>&lt; -21dB</td>
<td>A.1</td>
<td>PSA + 89601</td>
<td></td>
</tr>
</tbody>
</table>
Signal Analysis Solutions for Tx Testing

• PSA option 211 for RF power measurements
  • Transmit Power
  • Power vs. Time (Time Mask, OFF Power)
  • Adjacent Channel Power (ACP)
  • Spurious Emissions
  • Spectrum Emission Mask (SEM)
  • Multi Carrier Power
  • Occupied Bandwidth (OBW)

• 89601A option B7N for demod measurements
  • Composite EVM
  • Peak Code Domain Error (PCDE)
  • Rho, Freq error, I/Q offset, Gain Imb., Quad error
  • Code Domain Power (CDP)
  • Demod bits
# Mobile Receiver RF Testing Items

**TS 34.122-V5.0.0 (2003-12):**

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<tr>
<td>6.2</td>
<td>Reference Sensitivity Level</td>
<td>BER &lt; 1e-3 at -108 dBm / 1.28MHz</td>
<td>A.3</td>
<td>ESG + N5101A + N7612A SW</td>
<td></td>
</tr>
<tr>
<td>6.3</td>
<td>Maximum Input Level</td>
<td>BER &lt; 1e-3 at -25 dBm / 1.28MHz</td>
<td>A.3</td>
<td>ESG + N5101A + N7612A SW</td>
<td></td>
</tr>
<tr>
<td>6.4</td>
<td>Adjacent Channel Selectivity (ACS)</td>
<td>BER &lt; 1e-3 in presence of unwanted signal at adj ch</td>
<td>A.4</td>
<td>ESG + N5101A + N7612A SW, 2nd ESG + N7612B Arb SW</td>
<td>+/-1.6 MHz, modulated</td>
</tr>
<tr>
<td>6.5</td>
<td>In-band Blocking Characteristics</td>
<td>BER &lt; 1e-3 in presence of unwanted signal in-band</td>
<td>A.4</td>
<td>ESG + N5101A + N7612A SW, 2nd ESG + N7612B Arb SW</td>
<td>+/-3.2 MHz and +/-4.8 MHz, modulated</td>
</tr>
<tr>
<td>6.5</td>
<td>Out-of-band Blocking Characteristics</td>
<td>BER &lt; 1e-3 in presence of unwanted signal out-of-band</td>
<td>A.5</td>
<td>ESG + N5101A + N7612A SW, 2nd ESG</td>
<td>CW</td>
</tr>
<tr>
<td>6.6</td>
<td>Spurious Response</td>
<td>BER &lt; 1e-3 in presence of unwanted CW signal</td>
<td>A.5</td>
<td>ESG + N5101A + N7612A SW, 2nd ESG</td>
<td>depending on out-of-band blocking, CW</td>
</tr>
<tr>
<td>6.7</td>
<td>Intermodulation Characteristics</td>
<td>BER &lt; 1e-3 in presence of unwanted 2 signals</td>
<td>A.7</td>
<td>ESG + N5101A + N7612A SW, 2nd ESG + N7612B Arb SW, 3rd ESG</td>
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<tr>
<td>6.8</td>
<td>Spurious Emissions</td>
<td>below defined mask</td>
<td>A.8</td>
<td>PSA opt 211</td>
<td></td>
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</tbody>
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TD-SCDMA Test Solutions Based on ESG Platform

• Receiver test solution (BER)
  – N7612A TD-SCDMA LCR Real-time Source

• Component test solution
  – N7612B TD-SCDMA LCR Multi-carrier Arb Source (Early Release)
Signal Creation Solution for Rx BER Testing

BB board-N5101A in PCI Extension Box or Desktop PC

ESG with #601 or 602

Digital I/Q Interface

LAN or GPIB

CB232

N7612A TD-SCDMA LCR Real-time Source (ESG + N5101A PCI Card)

- Channel Coding (Physical, Transport)/(Multi-Code, Multi-RU, Multi-Timeslot)
  - Physical Channel
  - Transport Channel
  - Midamble Offset (max user number per each timeslot)
- Control channel message decoding (BCH, P-CCPCH, S1/S2 change, user file)
- UpPTS/DwPTS decoding/detection
- Synchronization (SFN)
- TFCI, TPC decoding (Slot format support)
- BER/BLER test (all RMC except 2M)
- AWGN, OCNS
Agenda of Today

• Introduction
  – Agilent TD-SCDMA Test Solutions Overview
  – TD-SCDMA Mobile Tx Tests
  – TD-SCDMA Mobile Rx Tests

• Transmitter Tests

• Receiver Tests

• Summary
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<td>&lt; 43 dB for 2nd adj ch</td>
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<td>A.2</td>
<td>PSA SA Mode</td>
<td>manual test using PSA opt 211 also possible</td>
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<td></td>
<td>&lt; 41 dB for 3.2MHz offset</td>
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**Tx Test Configuration**

Test configuration A.1 for Tx Basic Test (all excluding intermod):

- SS
- TX
- RX
- Ior
- MS under Test
- RX/TX
- PSA
- 89601
Tx Test Configuration (cont’d)

Test configuration A.2 for Tx Intermod Test:

SS

TX

RX

PSA

ESG

RX/TX

MS under Test

CW interference
RF Power Measurements with PSA Opt#211

Transmit Power
Power versus Time
Adjacent Channel Power
Multi-Carrier Power
Spurious Emissions
Spectrum Emission Mask
Occupied Bandwidth
PSA TD-SCDMA Option 211: Transmit Power

Used for sub-clause 5.2 (Max Tx Pwr), 5.4.2 (Min Tx Pwr) and 5.4.1.3 (Open Loop Pwr Ctrl)

Quickly and accurately measure the transmit power

- Measure traffic time-slots, UpPTS, and DwPTS
- View a single burst or a complete ten ms frame
- Display results as minimum, maximum, and mean values
- Trigger from RF burst for UE signal
- Enable RMS or log averaging
PSA TD-SCDMA Option 211: Power vs. Time

Used for sub-clause 5.4.3 (Tx OFF Pwr) and 5.4.4 (Tx ON/OFF Time Mask)

*Excellent solution* to provide standard-compliant dynamic range for ON/OFF ratio using 2 sweeps with different atten/preamp setup.

- Use a standard-compliant, consecutive timeslot power vs. time mask (95dB for UE)
- Measure Tx ON/OFF power
- Trigger from *RF burst trigger for UE signal*
- Trigger delay and ramp-up/down time
- User-adjustable mask delay
- Change X-scale to zoom in for ramp-up/down details
PSA TD-SCDMA Option 211: Power vs. Time

**PvT Measurement with X-axis setup for ramp-up time**

- **Agilent 17:37:16 Aug 6, 2004**
- **TD-SCDMA**
- **Display**
  - **Limit Mask** On Off
  - **Burst Lines** On Off
  - **Trigger Line** On Off
  - **Ref Position** Left Ctr Right
- **Span** Scale/Div 10.00 μs
- **Ramp Lines** On Off
- **“Zoom out” bottom window**
  - **Trig Delay Diff** 3.200 μs
  - **Transmit Off Power** -74.25 dBm
  - **Full Burst Width** 655.2 μs
  - **Ramp Up Time** 2.400 μs

- **X-Scale setup to check the trace by segment**
- **Ramp-up/down lines**

- **Ref** 19.74 dBm
- **12.00 dB/μs**
- **RF Envelope**

- **Mean Transmit Power** 13.44 dBm
- **Full Burst Width** 655.2 μs
- **Transmit Off Power** -74.25 dBm
- **Current Data**
  - **Mean Transmit Power** 13.44 dBm
  - **Max Pt** 18.01 dBm
  - **Min Pt** -83.95 dBm

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PSA TD-SCDMA Option 211: ACP

Used for sub-clause 5.5.2.2 (ACLR)

Monitor adjacent channel emissions

- Default standard-compliant limit lines
- Limit line customization of up to six offsets (relative and absolute)
- Trigger from RF burst trigger for UE signal
- Absolute, relative, absolute or relative, or absolute and relative fail masks
- The ability to examine traffic time slots or pilot time slots (UpPTS or DwPTS)
PSA TD-SCDMA Option 211: SEM
Used for sub-clause 5.5.2.1 (SEM)

Verify standard compliance of spectrum emissions

- View spectrum and tabular results simultaneously on a single screen
- Trigger from RF burst trigger for UE signal
- Select average and number of averages
- Adjustable offset frequency, reference bandwidth, and limit values (relative and absolute)
- Use a standard-compliant SEM for BTS and MS
PSA TD-SCDMA Option 211: Occupied Bandwidth

Used for sub-clause 5.5.1 (OBW)

Perform occupied bandwidth measurement

- One button OBW measurement with PASS/FAIL
- Trigger from RF burst trigger for UE signal
- Select average and number of averages
- OBW in % or x dB down bandwidth (same as Power Suite)
PSA TD-SCDMA Option 211: Spurious Emissions

Used for sub-clause 5.5.3 (Spur)

Perform fast spur searches and verify standard compliance

- Has standard compliant user-defined Tx band parameters
- Performs measurements conformant to MS General & Additional Spurious Emissions Requirements
- Allows for post-measurement spur examination
- Has a fast spur measure feature

![Graph showing spurious emissions measurement results]

### Spurious Emissions

<table>
<thead>
<tr>
<th>Spur</th>
<th>Range</th>
<th>Frequency</th>
<th>Amplitude</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>3</td>
<td>727.6 MHz</td>
<td>-76.37 dBm</td>
<td>-13.00 dBm</td>
</tr>
<tr>
<td>23</td>
<td>3</td>
<td>156.5 MHz</td>
<td>-76.39 dBm</td>
<td>-13.00 dBm</td>
</tr>
<tr>
<td>24</td>
<td>3</td>
<td>563.9 MHz</td>
<td>-76.46 dBm</td>
<td>-13.00 dBm</td>
</tr>
<tr>
<td>25</td>
<td>3</td>
<td>938.6 MHz</td>
<td>-76.49 dBm</td>
<td>-13.00 dBm</td>
</tr>
<tr>
<td>26</td>
<td>4</td>
<td>4000 MHz</td>
<td>-60.99 dBm</td>
<td>-13.00 dBm</td>
</tr>
</tbody>
</table>

Prototype Instrument – Not For Sale

Agilent Technologies
Modulation Analysis with 89601A

89601A option B7X for demod measurements
- Composite EVM
- Peak Code Domain Error (PCDE)
- Rho, Freq error, I/Q offset, Gain Imb., Quad err
- Code Domain Power (CDP)
- Demod bits

Flexible Time Synchronization
- UpPTS or Midamble

Three Levels of Analysis
- Level 1: Sub-frame Overall Analysis
- Level 2: Time Slot Analysis
  - Composite EVM
  - Code Domain Power/Error
- Level 3: Code Channel Analysis
  - Symbol EVM, demod bits
Composite EVM and Rho on the Block Diagram

**Note:** QPSK here could also be 8PSK and 16QAM (HSDPA)
89601 Opt B7X: Composite EVM

Used for sub-clause 5.7.1 (EVM)

Measure the modulation quality of selected time slot

- EVM is just one of the result metrics provided
- RMS, Peak and Peak position provided
- EVM for midamble also provided for traffic timeslot
89601 Opt B7X: Composite EVM on UpPTS

SYNC-UL real chip sequence

Composite EVM on UpPTS
Code Domain Analysis on the Block Diagram

**TD-SCDMA Transmitter**

- Coding Interleav.
- Segment
- QPSK Mapping
- OVSF Spreading
- Complex Scrambling
- RRC
- I/Q Mod.

**Midamble**

- I/Q Demod.
- RRC
- Subtract Midamble
- Complex Descrambling

**Active channel power**

- OVSF Despread
- Channel power vs. time
- Code domain power

**Measurement (Meas.)**

- QPSK Decoding
- Ideal bits
- QPSK Mapping
- Demodulated bits

**Note:** QPSK here could also be 8PSK and 16QAM (HSDPA)
Code Domain Power- Measurement algorithms

Despreading

- Sum over OVSF length
- Normalize by OVSF length
- (W_{Q=1}^{-1})

Demodulated bits
- QPSK map
- QPSK decoding

Channel power versus time
- Channel EVM
- Average over measurement length
- \( \frac{\sum}{T} \)

There is a despreader for every code at every SF!

Composite Signal

+ Noise

Map

Scrambling Code

C_{Q=1}^K

C_{Q=2}^K

C_{Q=3}^K

C_{Q=4}^K

\vdots

C_{Q=4}^K
Composite CDP Display – Code CHs at Different SFs

Data rate and power level for $C^{K=7}_{Q=8}$
Projected Difference: Code Domain Error

- Required by the specifications...

  Tx error >> channel error
  CDE from Tx impairments >> CDE from Gaussian noise

  Peak code domain error occurs here because of Tx impairments

  Gaussian noise + Tx impairment

  Channel
Code Domain Error on the Block Diagram

**Note:** QPSK here could also be 8PSK and 16QAM (HSDPA)
CDE and Peak CDE Displays

Composite CDE display at SF=16

Peak Active CDE

Peak CDE
89601 Opt B7X: Peak Code Domain Error

Used for sub-clause 5.7.2 (PCDE)

Measure the code domain error of selected time slot

- PCDE is just one of the result metrics provided
- PCDE and Peak Active CDE provided
- Peak position available from CDE traces

![Screenshot of Agilent 89600 Vector Signal Analyzer showing measurements for 89601 Opt B7X, including PCDE and Peak Active CDE values.]
Agenda of Today

• Introduction
  – Agilent TD-SCDMA Test Solutions Overview
  – TD-SCDMA Mobile Tx Tests
  – TD-SCDMA Mobile Rx Tests

• Transmitter Tests

• Receiver Tests

• Summary
## Mobile Receiver RF Testing Items

**TS 34.122-V5.0.0 (2003-12):**

<table>
<thead>
<tr>
<th>Sub-clause</th>
<th>Name of Test Item</th>
<th>Test Limit</th>
<th>Test Configuration</th>
<th>Agilent Test Instruments</th>
<th>Supplemental Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.2</td>
<td>Reference Sensitivity Level</td>
<td>BER &lt; 1e-3 at -108 dBm / 1.28MHz</td>
<td>A.3</td>
<td>ESG + N5101A + N7612A SW</td>
<td></td>
</tr>
<tr>
<td>6.3</td>
<td>Maximum Input Level</td>
<td>BER &lt; 1e-3 at -25 dBm / 1.28MHz</td>
<td>A.3</td>
<td>ESG + N5101A + N7612A SW</td>
<td></td>
</tr>
<tr>
<td>6.4</td>
<td>Adjacent Channel Selectivity (ACS)</td>
<td>BER &lt; 1e-3 in presence of unwanted signal at adj ch</td>
<td>A.4</td>
<td>ESG + N5101A + N7612A SW, 2nd ESG + N7612B Arb SW</td>
<td>+/-1.6 MHz, modulated</td>
</tr>
<tr>
<td>6.5</td>
<td>In-band Blocking Characteristics</td>
<td>BER &lt; 1e-3 in presence of unwanted signal in-band</td>
<td>A.4</td>
<td>ESG + N5101A + N7612A SW, 2nd ESG + N7612B Arb SW</td>
<td>+/-3.2 MHz and +/-4.8 MHz, modulated</td>
</tr>
<tr>
<td>6.5</td>
<td>Out-of-band Blocking Characteristics</td>
<td>BER &lt; 1e-3 in presence of unwanted signal out-of-band</td>
<td>A.5</td>
<td>ESG + N5101A + N7612A SW, 2nd ESG</td>
<td>CW</td>
</tr>
<tr>
<td>6.6</td>
<td>Spurious Response</td>
<td>BER &lt; 1e-3 in presence of unwanted CW signal</td>
<td>A.5</td>
<td>ESG + N5101A + N7612A SW, 2nd ESG</td>
<td>depending on out-of-band blocking, CW</td>
</tr>
<tr>
<td>6.7</td>
<td>Intermodulation Characteristics</td>
<td>BER &lt; 1e-3 in presence of unwanted 2 signals</td>
<td>A.7</td>
<td>ESG + N5101A + N7612A SW, 2nd ESG + N7612B Arb SW, 3rd ESG</td>
<td></td>
</tr>
<tr>
<td>6.8</td>
<td>Spurious Emissions</td>
<td>below defined mask</td>
<td>A.8</td>
<td>PSA opt211</td>
<td></td>
</tr>
</tbody>
</table>
Rx Test Configuration

Test configuration A.3 for Rx Basic Test (Sensitivity/Max Level):

```
ESG +  
N5101A  +  
N7612A   
```

Control PC

BER

SS

I_{or}

TX

RX/TX

BER

I_{or}

MS under Test
Rx Test Configuration

Test configuration A.4 for Rx Test with Interference (ACS):

- **Control PC**
- **SS**
- **ESG + N5101A + N7612A**
- **RX/TX Ior**
- **Ior**
- **Σ**
- **Io**
- **BER**
- **MS under Test**
- **RX/TX Ioc**

ESG + N7612B Arb as interference
Rx Test Configuration

Test configuration A.5 for Rx Test with Interference (Blocking/Spurious Response):

SS

ESG + N5101A + N7612A

ESG as CW interference

TX

Ior

̂Ior

Σ

I_{blocking}

MS under Test

Control PC

RX

BER

RX/TX

Io
Rx Test Configuration

Test configuration A.7 for Rx Test with Interference (Intermod):

- ESG as CW interference
- ESG + N7612B Arb as interference
- MS under Test

Diagram:
- Control PC
- ESG + N5101A + N7612A
- SS
- TX
- RX
- BER
- RX/TX
- Io
- Io
- Ioc
- Σ
- Ior
- Ior
Rx Test Configuration

Test configuration A.8 for Rx Test for Spurious Emissions:

- MS under Test
- RX/TX
- PSA
TD-SCDMA Transport and Physical Layer Structure

- **Transport Layer**
  - TCH-T Information Bits
  - Add CRC & Tail Bits
  - Conv. Encoder
  - Rate Matching
  - Reordering & Interleaving
  - Segment

- **Physical Layer**
  - MUX
  - QPSK Mapping
  - OVSF Spread Code
  - Complex Scrambling Code
  - Split Real
  - Imag
  - Pulse Shape
  - MIDAMBLE basic binary code \( \{m_1, \ldots, m_n\} \)
  - TPC
  - TFCI
  - SS

- **Transport Layer**
  - Transport Channel Mux
  - Bit Scrambling
  - RU Mapping

- **Physical Layer**
  - Fully Coded DPCH Data bits
  - Conv. Encoder
  - Rate Matching
  - Interleaving
  - Reordering
  - CRC & Tail Bits
  - MUX
Receiver Test Metrics – BER /BLER/FER

• Individual bit errors (BER)

• Data blocks or frames (BLER) Ratio (BLER)

System Simulator (SS)
Reference Bits
10110001101

Transmitter
BER/BLER Measurement
Receiver

Noise Distortion Spurs

Frame Error Ratio (FER)

Receiver

Baseband BER/BLER

Earlier stages of UE design verification

Loopback BER/BLER

UE conformance testing

 unanimous

TD-SCDMA & WCDMA

TD-SCDMA & W-CDMA
cdma2000

Transmitter

Recovered Bit
Stimulus signal for BER/BLER Measurements

TD-SCDMA Receiver

RF Front end → I/Q Demod → RRC → Extract Midamble → Complex Descrambling → Multiple User Detection → OVSF De-spreading → QPSK Decoder → DEMUX

MUX → QPSK Mapping → OVSF Spreading → Complex Scrambling → RRC → I/Q MOD

Add CRC & Tail Bits → Conv. Encoder → Rate Matching → Reordering& Interleaving → Segment → Transport Channel Mux → Bit Scrambling → RU Mapping

DPCH data → PC → TFCI → SS → DPCH data → DCH → RU Mapping

Stimulus signal for BER/BLER Measurements
Stimulus Signal for BER/BLER Using N7612A

RMC is defined as BER/BLER test channel in 3GPP standard.
Stimulus signal for BLER Measurements

Choose pre-configured setup for TD-SCDMA conformance fading cases

Manually configure # of paths, fading profile, vehicle speed, relative delay, and relative mean power (loss) for different propagation conditions

Choose C/N or Eb/No to configure AWGN source
Stimulus signal for RF performance measurements

TD-SCDMA Receiver

- RF Front end
- I/Q Demod
- RRC
- QPSK Mapping
- OVSF Spreading
- Complex Scrambling
- RRC
- I/Q MOD
- MUX

Channel Estimation

Joint Detection

QPSK Decoder

DEMUX

PC

TFCI

SS

Uncoded DCH

Composite EVM

Code Domain Analysis

Noise Figure

Transport Channel Demux

Segment

Reordering & Deinterleaving

Rate Matching

Conv. Decoder

Tail Bit Discard

CRC Detect

Uncoded DCH

PC

TFCI

SS

DCH

Complex De-scrambling

DCH

Composite EVM

Code Domain Analysis

Noise Figure
Stimulus signal for functional verification

Use appropriate random sequences, fixed or custom data sequences (user files) to verify functions and troubleshoot problems.
Stimulus signal for functional verification

Table 7.2.1.2.2a: DCH parameters in static propagation conditions (1,28Mcps TDD Option)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Unit</th>
<th>Test 1</th>
<th>Test 2</th>
<th>Test 3</th>
<th>Test 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of DPCHo</td>
<td></td>
<td>8</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Scrambling code and basic midamble code number*</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>DPCH Channelization Codes*</td>
<td>C(k,Q)</td>
<td>C(i,16)i=1,2</td>
<td>C(i,16)i=1...8</td>
<td>C(i,16)i=1...8</td>
<td>C(i,16)i=1...10</td>
</tr>
<tr>
<td>DPCHo Channelization Codes*</td>
<td>C(k,Q)</td>
<td>C(i,16)3? i ?10</td>
<td>C(i,16)9? i ?10</td>
<td>C(i,16)9? i ?10</td>
<td>-</td>
</tr>
<tr>
<td>$\frac{DPCH_{o} - E_c}{I_{or}}$</td>
<td>dB</td>
<td>-10</td>
<td>-10</td>
<td>-10</td>
<td>0</td>
</tr>
<tr>
<td>$I_{oc}$</td>
<td>DBm/1,28MHz</td>
<td></td>
<td></td>
<td></td>
<td>-60</td>
</tr>
<tr>
<td>Information Data Rate</td>
<td>Kbps</td>
<td>12.2</td>
<td>64</td>
<td>144</td>
<td>384</td>
</tr>
</tbody>
</table>

*Note: Refer to TS 25.223 for definition of channelization codes, scrambling code and basic midamble code.

DPCHo is defined as OCNS like 3GPP FDD
Agenda of Today

• Introduction
  – Agilent TD-SCDMA Test Solutions Overview
  – TD-SCDMA Mobile Tx Tests
  – TD-SCDMA Mobile Rx Tests

• Transmitter Tests

• Receiver Tests

• Summary
Summary

• TD-SCDMA Mobile RF testing (Tx/Rx) can be fully supported by using Agilent test and measurement solutions:
  – PSA and 89601 for Rx testing
  – ESG and N7612A SW for Rx BER Testing
  – ESG and N7612B SW (Early Release) for Rx RF Testing

• Agilent is fully involved in the activities of CCSA and working with TD-SCDMA customers (BTS, mobile, components mfg, etc.) to make it successful.
BACKUP SLIDES
N7612A SW Feature List

- Channel Coding (Physical, Transport)/(multi Code, Multi RU, Multi Timeslot)
  - Physical Channel;
    DPCH/P-CCPCH/S-CCPCH/PICH/PRACH/PUSCH/PDSCH/
    DwPCH/UpPCH/FPACH/DPCHo (PhyCH)
- Transport Channel
  DCH/BCH/RACH
  RMC UL 12.2 kbps, 12.2 kbps multi code, 64 kbps, 144 kbps, 384 kbps
  RMC DL 12.2 kbps, 64 kbps, 144 kbps, 384 kbps
  RMC BCH 12.3 kbps
  RMC RACH mapped to 1 code SF16, 1 code SF8, 1 code SF4
- Midamble offset (max user number per each timeslot)
- Control channel message decoding (BCH, P-CCPCH, S1/S2 change, user file)
- Up/Down PTS decoding/detection
- Synchronization (SFN)
- TFCI, TPC decoding (Slot format support)
- Channel Equalization, Quality Estimate (Transport channel BER, AWGN)
- BER/BLER test (all RMC except 2M)
- AWGN, OCNS
## Mobile Performance Testing Items

**TS 34.122-V5.0.0 (2003-12):**

<table>
<thead>
<tr>
<th>Sub-clause</th>
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<th>Supplemental Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.2</td>
<td>Demodulation in static propagation conditions</td>
<td>BLER should be below the defined curve</td>
<td>A.9</td>
<td>ESG + N5101A + N7612A SW</td>
<td></td>
</tr>
<tr>
<td>7.3</td>
<td>Demodulation in multipath fading conditions</td>
<td>BLER should be below the defined curve</td>
<td>A.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.5</td>
<td>Power Control in Downlink</td>
<td>BLER should be below the defined curve</td>
<td>A.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.6</td>
<td>Power Control in Uplink</td>
<td>UE output power</td>
<td>A.9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>