安捷倫科技
TD-SCDMA研討會
2006年10月13日
ACLNR效能高达–76 dBC的信号产生器

這麼深的範圍誰能跟我比？

ACLNR (3GPP W-CDMA) –71 dBc

–76 dBc

–65 dBc

–70 dBc

(SCPI) 1.2 ms

Signal Studio

W-CDMA・WiMAX・cdma2000/1xEV・GSM/EDGE・WLAN・TD-SCDMA

探索各種可能性的極限！新的Agilent MXG信号产生器可讓您測試設計的極限。無線通訊技術的變化已經不再是慢慢浮現了，而是波濤洶涌而至，也不光是測試技術需要同步發展的問題，還要能預測未來的需求。重要的是：搶先一步、找出致勝點、全力以赴。

Agilent MXG信号产生器

<table>
<thead>
<tr>
<th>ACLR (3GPP W-CDMA)</th>
<th>–71 dBc：測得的效能可達–76 dBc（單一載波）</th>
</tr>
</thead>
<tbody>
<tr>
<td>切換速度 (SCPI)</td>
<td>1.2 ms</td>
</tr>
<tr>
<td>簡易的自行維護能力</td>
<td>執行現場校準的時間不到一小時</td>
</tr>
<tr>
<td>Signal Studio軟體</td>
<td>W-CDMA・WiMAX・cdma2000/1xEV・GSM/EDGE・WLAN・TD-SCDMA</td>
</tr>
</tbody>
</table>

如欲瞭解新的Agilent MXG提供您何等空前的測效能，請至www.agilent.com.tw/find/possible。

這無疑是信號產生的極致表現！

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www.agilent.com.tw/find/possible

Agilent Technologies

台灣安捷倫科技股份有限公司
速度快達5 ms的信號分析儀 — 儀器界的F1
繫好安全帶享受F1極速的快感

換檔試試各種可能性！新推出的Agilent MXA打破了所有速度的限制，量測時間硬是比其它信號分析儀快了三倍左右。在保持領先的壓力之下，更加需要縮短測試時間，MXA信號分析儀具備的速度與性能優勢可以協助您先馳得點。重要的是：搶先一步、找出致勝點、全力以赴。

欲瞭解新的MXA提供您何等空前的執行速度，請至www.agilent.com.tw/find/possible。這無疑是信號分析的極致表現！

Agilent MXA中階信號分析儀

<table>
<thead>
<tr>
<th>標記峰值搜尋時間</th>
<th>&lt; 5 ms</th>
</tr>
</thead>
<tbody>
<tr>
<td>W-CDMA ACLR (0.2 dB，1 sigma)</td>
<td>F 14 ms</td>
</tr>
<tr>
<td>量測模式切換速度</td>
<td>&lt; 75 ms</td>
</tr>
<tr>
<td>分析帶變頻寬</td>
<td>25 MHz</td>
</tr>
<tr>
<td>絕對振幅準確度</td>
<td>0.3 dB</td>
</tr>
<tr>
<td>W-CDMA ACLR的動態範圍</td>
<td>73 dB</td>
</tr>
</tbody>
</table>

想進一步瞭解產品或索取相關資訊
請與安捷倫科技客戶服務中心聯絡
0800 047 866
tm_taiwan@agilent.com
www.agilent.com.tw/find/possible
研討會時程

13:30-13:50  來賓報到 下午茶時間

13:50-14:00  開場

14:00-14:30  TD-SCDMA 市場趨勢與規格更新

14:30-15:30  TD-SCDMA 技術簡介與量測挑戰

15:30-16:00  下午茶時間

16:00-16:30  TD-SCDMA 系統驗證與解決方案
Agenda

• TD-SCDMA Evolution in China

• TD-SCDMA Test Requirement Analysis
**TD-SCDMA Evolution Milestones**

- **1995**: CWILL and CATT founded XinWei (信威) SCDMA
- **1998**: CATT and Siemens proposed TD-SCDMA as 3G candidate to ITU
- **2000**: TD-SCDMA standard adopted by ITU as TDD option for IMT2000
- **2002**: 155MHz band allocated by SRMC
- **2003**: Start to migrated from TSM to LCR
- **2005**: TD-SCDMA field trial started
- **2007**: License???

**TD-SCDMA Industrialization Roadmap**

- **1st Trial**: 3G trials with WCDMA and cdma2000 – finished in Sept. 2004
- **2nd Trial**: TD-SCDMA R&D and industrialization trial - finished in Mar. 2005
- **3rd Trial**: Application trial: -finished in Feb. 2006
**TD-SCDMA Pre-commercial Trial in China**

3+2 Sites

- Baoding (China telecom) : Datang/ASB+ TD-Tech
- Qingdao (China Netcom) : Datang/ASB+ZTE
- Xiamen (China Mobile) : TD-Tech + ZTE
- Beijing (China Netcom) : Datang/ASB + Potevio
- Shanghai (MTNet) : ZTE

- About 100 Node B SFN in each middle size city
- Purpose: IOT of network equipment and terminal
- Status: SFN trial closed in Aug. and MFN trial is targeted to be finished by end of 2006

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**China TD-SCDMA Food Chain**

**Component Manufacturers/R&D**
- Mobile Phone Components
  - Chipset vendor: T3G, Commit, Spreadtrum, DaTang, ADI
  - R&D: 

**Conformance Test**
- RITT, MT-Net, SRMC
- 1

**Equipment Manufacturers**
- DaTang, LG, Samsung, Amoi, TCL, Hisense, UT, Lenovo, DBtel, Inventec, Bird
- Agilent, Wiltek, Anritsu, R&S, Starpoint, ZhongYou

**Service Providers**
- Operators
  - China Mobile
  - China Netcom
  - Mobile TV
  - Internet Access
  - Game
  - Mobile Telephony
  - HK H3G
  - Smart tone

**Users**
- 6

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**Device Mfger**
- DaTang; TD Tech
- ZTE; Potevio
- Agilent; Tek; Anritsu; R&S;

**Repeater Mfger**
- 2

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TD-SCDMA Standard Organization

CCSA: China Communications Standards Association
- China Communications Standards Association (CCSA) was founded on December 18, 2002.
- Agilent China is the member of CCSA.
- CWTS (China Wireless Telecommunication Standards group) was founded in 1999 and became one of the Technical Committees (TC5) of CCSA, Responsible for Chinese wireless telecommunication standards.
- TD-SCDMA specification development started since 2001.

Standard Document- International

3GPP 2004-3 release 5 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-RF
- 3. TS 34.123-V5.0.0(2003-12) Terminal conformance specification-Protocol
- 4. TS 25.105-V5.5.0(2003-12) Base Station (BS) radio transmission and reception (TDD)
- 5. TS 25.142-V5.6.0(2003-12) Base Station (BS) conformance testing (TDD)
Standard Document-Domestic

Ministry of Information Industry published the local standard in Jan., 2006

1. YD/T 1365 无线接入网络设备技术要求
2. YD/T 1366 无线接入网络设备测试方法
3. YD/T 1367 终端设备技术要求
4. YD/T 1368 终端设备测试方法

TD-SCDMA Industrialization Organization

TDIA: TD-SCDMA Industry Alliance

- Founded by 8 Chinese companies, including DTmobile, Huawei etc. More than 40 members now
- IPR pool sharing across TDIA members

TD-SCDMA Forum

- To promote the advancement and perfection of TD-SCDMA technology
- To providing a platform for all kind of people worldwide to exchange ideas
- Broad participation, more than 400 members now.
TD-SCDMA Regulatory Test in China

◆ 电信设备入网核准：泰尔实验室（CTTL）
  ➢ RF & Protocol conformance test; Application test; IOT

◆ 无线设备型号核准：国家无线电管理委员会（SRMC）
  ➢ EMC, RF conformance, SAR

TD-SCDMA Regulatory Test Requirement

◆ RF – TS34.122
◆ Protocol – TS34.123-1/2/3
◆ UICC/USIM – TS31.120
◆ Acoustic – TS26.131/2
◆ EMC
  – TS34.124 EMC requirements for mobile terminals
◆ Safety
  – TR34.907 Report on electrical safety requirements and regulations
◆ SAR
  – TR34.925 SAR requirements and regulations in different regions
Agenda

• TD-SCDMA Evolution in China

• TD-SCDMA Test Requirement Analysis

TD-SCDMA Test Requirement Analysis
TD-SCDMA UE Test Requirement Analysis

Segmented by UE working group:

◆ Conformance Test: Conformance system oriented

◆ R&D Design Verification Test: Instruments and pre-conformance system oriented

◆ Production Test: Flexible, efficient automation test system oriented

◆ Service and Maintenance Test: Low cost simple call test oriented

_Multi-format and Call Mode will be finally required in UE test_

TD-SCDMA RAN RF Test Requirement Analysis

Segmented by RAN working group

◆ Network Equipment Provider: Reliability, Repeatability and Efficient automation test system oriented

➢ Module Test & Function Test

◆ MCPA Test: ACPR and Spurious; Reliability and Repeatability

◆ Repeater Test: ACPR and Spurious; Cost effective solution

_Single Format and Test Mode will be more popular in RAN RF test_
TD-SCDMA Network Test Requirement Analysis

Segmented by NETWORK working group

- Driver Test: Coverage, Pilot pollution, Interference, Handover
- Signaling monitoring test: Multiple links and correlated monitor
- Pressure test: Heavy traffic loading to Node B and RNC

Very similar to WCDMA network test requirement !!!

Thank you for your time!
TD-SCDMA Technology Update

Agenda

• What is TD-SCDMA
• GSM vs WCDMA vs TD-SCDMA
• Standards
What is TD-SCDMA

Chinese contribution to the international family of Mobile Radio Systems for 3G services of UMTS and IMT 2000.

Harmonize with UTRA-TDD in 3GPP and became one option of UTRA-TDD, called as 1.28Mcps TDD or low chip rate (LCR) TDD, narrow band TDD.

Standardization work is carried out in CCSA and 3GPP.

TD-SCDMA Forum is promoting this technology over the industry.

TD-SCDMA Industry Alliance: plan, coordinate the development schedule of TD-SCDMA industrial activities.

Pre-commercial trial is on-going.

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TD-SCDMA Technology Evolution

- **TSM**: TD-SCDMA System for Mobile (over GSM)
- **LCR**: Low Chip Rate of IMT-TDD
- **N-carrier**: Defined in CCSA
- **HSDPA**: High Speed Downlink Packet Access
- **Multi-carrier**
TD-SCDMA Technology
Resource structure

- 1.6Mhz per carrier
- 7 timeslots per frame
- 16 codes per timeslot

Carrier 1
Carrier 2
Carrier 3

OVSF Codes

TS0 TS1 TS2 TS3 TS4 TS5 TS6
DwPTS UpPTS
GHz GHz

TD-SCDMA Technology
Frame structure

Frame Structure

2 subframes

SP: Switching point
TD-SCDMA Technology

DwPTS & UpPTS

DwPTS: Downlink synchronization, Cell search

SYNC-DL: 64chips, 32 groups (Base Station Separation)

Phase: Position index of the P-CCPCH

S1(135,45,225,135) – Next four frames are P-CCPCHs

S2(315,225,315,45) – Next four frames are not the P-CCPCHs

UpPTS: Uplink Synchronization, Random Access

SYNC-UL: 128chips, 32 groups (8 codes)

Traffic time slot

1. Basic slot Format:

<table>
<thead>
<tr>
<th>352chips</th>
<th>144chips</th>
<th>352chips</th>
<th>16chips</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data1</td>
<td>Midamble</td>
<td>Data2</td>
<td>G</td>
</tr>
</tbody>
</table>

Spread Factor: Uplink: SF = 1, 2, 4, 8, 16

Modulation: QPSK, 8PSK (2Mbps)

2. Slot Format with L1 Signaling:

SubFrame 1

<table>
<thead>
<tr>
<th>5ms</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS TPC</td>
</tr>
</tbody>
</table>

SubFrame 2

<table>
<thead>
<tr>
<th>5ms</th>
</tr>
</thead>
<tbody>
<tr>
<td>TFC1B</td>
</tr>
<tr>
<td>TFC1B</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5ms</th>
</tr>
</thead>
<tbody>
<tr>
<td>TFC1B</td>
</tr>
<tr>
<td>TFC1B</td>
</tr>
</tbody>
</table>
TDSCDMA Technology

Midamble

Consists of 144 chips, from 128 basic midamble sequences with 128 chips long

128 sequences divided into 32 group to corresponding to 32 SYNC-DL codes, and each group consists of 4 different basic midamble sequence, i.e., each BS has 4 different midamble.

Midamble used by each user has a shift from basic midamble code

Used as training sequence

• Channel estimate for uplink and downlink
• Power measurement
• Keep uplink synchronization

TD-SCDMA Technology

Channels

Transport channels

– Transport channels are the services offered by layer 1 to the higher layers.
– A transport channel is defined by how and with what characteristics data is transferred over the air interface.
– A general classification of transport channels is into two groups:
  • Dedicated Channels, using inherent addressing of UE
  • Common Channels, using explicit addressing of UE if addressing is needed

Physical channels

– Physical Channels have a three Layer Structure:
  • Timeslot: 675 usec slot consisting of a number of Symbols
  • Radio frame: 5 ms frame consisting of 7 timeslots
  • System frame numbering
– Time slots are used in the sense of a TDMA component to separate different user signals in time and code domain.
  • Code domain: OVSF code with a spreading factor of 1, 2, 4, 8, or 16.
TD-SCDMA Technology
Transport vs. Physical Channels

- 3GPP Supports the Concept of Multiple Services Sharing a Physical Connection
- The Concept of “Transport” Channels is used to Support these Services
- Adds an Extra Layer Where Transport Channel are Multiplexed together Prior to Transmission on a Physical Channel

TD-SCDMA Technology
Transport channel to physical channel mapping

<table>
<thead>
<tr>
<th>Transport channels</th>
<th>Physical channels</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCH</td>
<td>Dedicated Physical Channel (DPCH)</td>
</tr>
<tr>
<td>BCH</td>
<td>Primary Common Control Physical Channels (P-CCPCH)</td>
</tr>
<tr>
<td>PCH</td>
<td>Secondary Common Control Physical Channels (S-CCPCH)</td>
</tr>
<tr>
<td>FACH</td>
<td>Secondary Common Control Physical Channels (S-CCPCH)</td>
</tr>
<tr>
<td>RACH</td>
<td>Physical Random Access Channel (PRACH)</td>
</tr>
<tr>
<td>USCH</td>
<td>Physical Uplink Shared Channel (PUSCH)</td>
</tr>
<tr>
<td>DSCH</td>
<td>Physical Downlink Shared Channel (PDSCH)</td>
</tr>
<tr>
<td>HS-DSCH</td>
<td>Physical High-Speed-Downlink Shared Channel (PHSDSCH)</td>
</tr>
<tr>
<td></td>
<td>Down link Pilot Channel (DwPCH)</td>
</tr>
<tr>
<td></td>
<td>Up link Pilot Channel (UpPCH)</td>
</tr>
<tr>
<td></td>
<td>Fast Physical Access Channel (FPACH)</td>
</tr>
<tr>
<td></td>
<td>Paging Indicator Channel (PICH)</td>
</tr>
</tbody>
</table>
TD-SCDMA Technology
Example: Transport channel mapping onto the physical channel

![Diagram showing transport channel mapping]

TD-SCDMA Technology
Physical layer procedure

![Diagram showing physical layer procedure]

Code ch 0
Code ch 1
Code ch 2
Code ch 3
Code ch 4
Code ch 5
Code ch 6
Code ch 7
Code ch 8
Code ch 9
Code ch A
Code ch B
Code ch C
Code ch D
Code ch E
Code ch F

BCH onto the P-CCPCHs

BCH

Ts0

DwPTS

UpPTS

Ts1

Ts6

Midamble

I

Q

Spreading

Scrambling

TDM

Q

To antenna

I

FIR

\cos w_t

Q

FIR

\sin w_t
TD-SCDMA Technology
Transport Channel Coding/Multiplexing

- Data arrives to the coding/multiplexing unit in form of transport block sets, once every transmission time interval.
- The total number of basic physical channels per frame is given by the maximum number of time slots and the maximum number of CDMA codes per time slot.
- An alternative way of multiplexing services is to use multiple CCTrCHs (Coded Composite Transport Channels), which corresponds to having several parallel multiplexing chains, resulting in several data streams, each mapped to one or several physical channels.
- Radio frame equalization performs padding of bits.
- Interleaving: 10, 20, 40, 80ms
- Repetition coding and/or puncturing is used for rate matching.

TD-SCDMA Technology
Channel Coding

The length of CRC can be 0, 8, 16, 24.

Channel coding

- Convolutional coding: 1/2, 1/3, constraint length 9
- Turbo coding: 1/3 for non-real time service (>32kbps)
- No coding

<table>
<thead>
<tr>
<th>Type of TrCH</th>
<th>Coding scheme</th>
<th>Coding rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCH</td>
<td>Convolutional coding</td>
<td>1/3</td>
</tr>
<tr>
<td>PCH</td>
<td>Convolutional coding</td>
<td>1/3, 1/2</td>
</tr>
<tr>
<td>RACH</td>
<td>No coding</td>
<td>1/2</td>
</tr>
<tr>
<td>DCH, DSCH, FACH, USCH</td>
<td>Turbo coding</td>
<td>1/3</td>
</tr>
<tr>
<td></td>
<td>No coding</td>
<td></td>
</tr>
</tbody>
</table>
TD-SCDMA Technology

HSDPA

Key Technologies

- AMC: QPSK, 16QAM, Turbo Coding
- H-ARQ: Chase Combing, Incremental Redundancy Combing
- Fast Cell Selection

HSDPA Channels

- HS-DSCH
  - Downlink transport channel shared by several UEs. Using the same SF, time multiplex
- HS-SCCH
  - DL physical channel, carries higher layer control information for HS-DSCH
- HS-SICH
  - UL physical channel, carries higher layer control information and the Channel Quality Indicator CQI for HS-DSCH
**TD-SCDMA Technology Summary**

- Duplex mode: TDD
- Access method: FDMA/TDMA/CDMA
- Chip rate: 1.28Mcps
- Bandwidth: 1.6MHz
- Frame length: 10ms (5ms subframes)
- Spreading Factor: 1/2/4/8/16
- Modulation: QPSK /8PSK(2Mb/s), 16QAM (HSDPA)
- Channel Coding: Convolution/Turbo
- Interleaving period: 10/20/40/80ms
- Uplink Synchronization: 1/8 chip
- Power control: open/close loop(200Hz)

**GSM vs WCDMA vs TD-SCDMA**

- **GSM**
  - TDMA
  - FDD
  - GMSK
  - BW: 200KHz
  - Voice & low data rate
  - CS

- **GPRS**

- **EDGE**
  - CDMA+TDMA
  - TDD
  - QPSK
  - BW: 1.6MHz
  - Chip rate: 1.28MHz
  - Voice & low and medium data rate
  - CS & PS

- **TD-SCDMA**
  - CDMA+TDMA
  - TDD
  - QPSK
  - BW: 1.6MHz
  - Chip rate: 1.28MHz
  - Voice & low and medium data rate
  - CS & PS

- **WCDMA**

- **HDSPA**

- **HSUPA**
  - CDMA
  - FDD
  - QPSK
  - BW: 5MHz
  - Chip rate: 3.84MHz
  - Voice & low and medium data rate
  - CS & PS
Standards

• Standard work is carried out in 3GPP and CCSA
  – Basically consistent
  – CCSA defined some China specific features (N-Carrier)

• 3GPP release 5 / 3GPP TDD 1.28 Mcps option (Download from http://www.3gpp.org)
  – 1. TS 25.102 User Equipment (UE) radio transmission and reception (TDD)
  – 2. TS 25.105 Base Station (BS) radio transmission and reception (TDD)
  – 3. TS 25.142 Base Station (BS) conformance testing (TDD)
  – 4. TS 25.221 Physical channels and mapping of transport channels onto physical channels (TDD)
  – 5. TS 25.222 Multiplexing and channel coding (TDD)
  – 6. TS 25.223 Spreading and modulation (TDD)
  – 7. TS 25.224 Physical layer procedures (TDD)
  – 8. TS 25.225 Physical layer – Measurements (TDD)
  – 9. TS 34.122 Terminal conformance specification; Radio transmission and reception (TDD)

• CCSA Standards. (Contact Xiang Feng to get China Standards)

Base Station Transmitter RF Testing Items
TS 25.142-V5.5.0 (2003-6):

<table>
<thead>
<tr>
<th>Sub-clause</th>
<th>Name of Test Item</th>
<th>Test Limit</th>
<th>Agilent Test Instruments</th>
<th>Supplemental Information</th>
<th>Test Instrument Tolerance in 3GPP Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.2</td>
<td>Maximum Output Power</td>
<td>vary by power class and single/mutil codes</td>
<td>PSA opt 211</td>
<td></td>
<td>±0.7 dB (95 %)</td>
</tr>
<tr>
<td>6.3</td>
<td>Frequency Stability</td>
<td>±0.05ppm or ±0.1 ppm</td>
<td>PSA SA Mode</td>
<td></td>
<td>±12 Hz (95 %)</td>
</tr>
<tr>
<td>6.4.2</td>
<td>Power control steps</td>
<td>1dB, 2dB, 3dB</td>
<td>PSA opt 211 could do with proper triggering</td>
<td></td>
<td>single step: 0.1 dB ten steps: 0.3 dB</td>
</tr>
<tr>
<td>6.4.3</td>
<td>Power Control Dynamic range</td>
<td>~30dB</td>
<td>manual test using 89601+PSA or VXI HW with deep memory</td>
<td></td>
<td>±0.3B</td>
</tr>
<tr>
<td>6.4.4</td>
<td>Minimal output Power</td>
<td>max output power-30dB</td>
<td>PSA opt 211</td>
<td></td>
<td>0.7dB</td>
</tr>
<tr>
<td>6.4.5</td>
<td>Primary CCPCH Power</td>
<td>vary by power class</td>
<td>PSA opt 211</td>
<td></td>
<td>0.8dB</td>
</tr>
<tr>
<td>6.4.6</td>
<td>Differential accuracy of P-CCPCH power</td>
<td>±0.5dB</td>
<td>PSA opt 211</td>
<td></td>
<td>±0.1dB</td>
</tr>
<tr>
<td>6.5.1</td>
<td>Transmit OFF power</td>
<td>-82dBm</td>
<td>PSA opt 211</td>
<td></td>
<td>2dB</td>
</tr>
<tr>
<td>6.5.2</td>
<td>Transmit ON/OFF time mask</td>
<td>ON/OFF template</td>
<td>PSA opt 211</td>
<td></td>
<td>Tx power limit = -82 dBm: 2.0 dB Tx power limit = -42 dBm: 0.7 dB</td>
</tr>
<tr>
<td>6.6.1</td>
<td>Occupied Bandwidth</td>
<td>&lt; 1.6 MHz</td>
<td>PSA opt 211</td>
<td></td>
<td>0kHz</td>
</tr>
<tr>
<td>6.6.2.1</td>
<td>Spectrum Emission Mask</td>
<td>below defined mask</td>
<td>PSA opt 211</td>
<td></td>
<td>1.5 dB</td>
</tr>
<tr>
<td>6.6.2.2</td>
<td>ACLR (Adjacent Channel Leakage Power Ratio)</td>
<td>&lt; 40 dB for 1st adj ch &lt; 45 dB for 2nd adj ch</td>
<td>PSA opt 211</td>
<td></td>
<td>0.8 dB</td>
</tr>
<tr>
<td>6.6.3</td>
<td>Spurious Emissions</td>
<td>below defined mask</td>
<td>PSA opt 211</td>
<td></td>
<td>0dB</td>
</tr>
<tr>
<td>6.7</td>
<td>Transmit Intermodulation</td>
<td>&lt;40 dB for 1.6MHz offset &lt;45 dB for 3.2MHz offset</td>
<td>PSA SA Mode</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.8.1</td>
<td>EVM (Error Vector Magnitude)</td>
<td>&lt;12.5%</td>
<td>PSA + 89601</td>
<td></td>
<td>0%</td>
</tr>
<tr>
<td>6.8.2</td>
<td>Peak Code Domain Error</td>
<td>&lt;28dB</td>
<td></td>
<td></td>
<td>10dB</td>
</tr>
</tbody>
</table>
### Base Station Receiver RF Testing Items
**TS 34.142-V5.5.0 (2003-6):**

<table>
<thead>
<tr>
<th>Sub-clause</th>
<th>Name of Test Item</th>
<th>Test Limit</th>
<th>Agilent Test Instruments</th>
<th>Supplemental Information</th>
<th>Test Instrument Tolerance in 3GPP Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.2</td>
<td>Reference Sensitivity Level</td>
<td>BER &lt; 1e-3 at -110/-96 dBm / 1.28MHz</td>
<td>ESG+N7612B</td>
<td></td>
<td>±0.7 dB</td>
</tr>
<tr>
<td>7.3</td>
<td>Dynamic range</td>
<td>BER &lt; 1e-3 at -80/66 dBm / 1.28MHz with AWGN -76/-62 dBm / 1.28MHz</td>
<td>ESG+N7612B</td>
<td></td>
<td>±1.2 dB</td>
</tr>
<tr>
<td>7.4</td>
<td>Adjacent Channel Selectivity (ACS)</td>
<td>BER &lt; 1e-3 in presence of unwanted signal at adj ch</td>
<td>ESG + N7612B, 2nd ESG + N7612B Basic</td>
<td>+/−1.6 MHz, modulated</td>
<td>0 dB</td>
</tr>
<tr>
<td>7.5</td>
<td>Blocking Characteristics</td>
<td>BER &lt; 1e-3 in presence of unwanted signal in-band</td>
<td>ESG+N7612B</td>
<td>+/−3.2 MHz and +/−4.8 MHz, modulated</td>
<td>0 dB</td>
</tr>
<tr>
<td>7.6</td>
<td>Intermodulation Characteristics</td>
<td>BER &lt; 1e-3 in presence of unwanted 2 signals</td>
<td>ESG + N7612B, 2nd ESG + N7612B basic, 3rd ESG</td>
<td></td>
<td>0 dBm</td>
</tr>
<tr>
<td>7.7</td>
<td>Spurious Emissions</td>
<td>below defined mask</td>
<td>PSA opt 211</td>
<td></td>
<td>0 dBm</td>
</tr>
</tbody>
</table>

### 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>Agilent Test Instruments</th>
<th>Supplemental Information</th>
<th>Test Instrument Tolerance in 3GPP Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.2</td>
<td>Maximum Output Power</td>
<td>vary by power class and single/multi codes</td>
<td>PSA opt 211</td>
<td></td>
<td>±0.7 dB (95 %)</td>
</tr>
<tr>
<td>5.3</td>
<td>Frequency Stability</td>
<td>±0.1 ppm</td>
<td>PSA SA Mode</td>
<td></td>
<td>±10 Hz (95 %)</td>
</tr>
<tr>
<td>5.4.1.3</td>
<td>Open Loop Power Control</td>
<td>vary by power level</td>
<td>PSA opt 211 could do with proper triggering</td>
<td>±1.0 dB (95 %)</td>
<td></td>
</tr>
<tr>
<td>5.4.1.4</td>
<td>Close Loop Power Control</td>
<td>vary by step size</td>
<td></td>
<td></td>
<td>±1.0 dB (95 %)</td>
</tr>
<tr>
<td>5.4.2</td>
<td>Minimal Transmit Power</td>
<td>≤-49 dBm</td>
<td>PSA opt 211</td>
<td></td>
<td>1.0 dB (95 %)</td>
</tr>
<tr>
<td>5.4.3</td>
<td>Transmit OFF Power</td>
<td>≤-65 dBm</td>
<td>PSA opt 211</td>
<td></td>
<td>1.0 dB (95 %)</td>
</tr>
<tr>
<td>5.4.4</td>
<td>Transmit ON/OFF Time Mask</td>
<td>below defined mask</td>
<td>PSA opt 211</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.4.5</td>
<td>Out-of-synchronisation handling of output power for continuous transmission</td>
<td>NA</td>
<td></td>
<td></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></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.5.1</td>
<td>Occupied Bandwidth</td>
<td>≤ 1.6 MHz</td>
<td>PSA opt 211</td>
<td></td>
<td>100 kHz</td>
</tr>
<tr>
<td>5.5.2.1</td>
<td>Spectrum Emission Mask</td>
<td>below defined mask</td>
<td>PSA opt 211</td>
<td></td>
<td>1.5 dB</td>
</tr>
<tr>
<td>5.5.2.2</td>
<td>ACLR (Adjacent Channel Leakage Power Ratio)</td>
<td>≤ 33 dB for 1st adj ch</td>
<td>PSA opt 211</td>
<td></td>
<td>0.8 dB</td>
</tr>
<tr>
<td>5.5.3</td>
<td>Spurious Emissions</td>
<td>below defined mask</td>
<td>PSA opt 211</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.6</td>
<td>Transmit Intermodulation</td>
<td>≤ 31 dB for 1.6MHz offset</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.7.1</td>
<td>EVM (Error Vector Magnitude)</td>
<td>≤ 17.5%</td>
<td>PSA + 89601</td>
<td></td>
<td>±2.5 % (95 %)</td>
</tr>
<tr>
<td>5.7.2</td>
<td>Peak Code Domain Error</td>
<td>≤ -21dB</td>
<td>PSA + 89601</td>
<td></td>
<td>±1.0 dB (95 %)</td>
</tr>
</tbody>
</table>
## Mobile Receiver RF Testing Items

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

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<td>BER &lt; 1e-3 at -108 dBm / 1.28MHz</td>
<td>ESG+N7612B</td>
<td></td>
<td>&lt;0.7 dB (95 %)</td>
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<td>6.3</td>
<td>Maximum Input Level</td>
<td>BER &lt; 1e-3 at -25 dBm / 1.28MHz</td>
<td>ESG+N7612B</td>
<td></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>ESG + N7612B, 2nd ESG</td>
<td>+/-1.6 MHz, modulated</td>
<td>0 dB</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>ESG + N7612B, 2nd ESG</td>
<td>+/-3.2 MHz and +/-4.8 MHz, modulated</td>
<td>0 dB</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>ESG + N7612B, 2nd ESG</td>
<td>CW</td>
<td>0 dB</td>
</tr>
<tr>
<td>6.6</td>
<td>Spurious Response</td>
<td>BER &lt; 1e-3 in presence of unwanted CW signal</td>
<td>ESG + N7612B, 2nd ESG</td>
<td>depending on out-of-band blocking, CW</td>
<td>0 dB</td>
</tr>
<tr>
<td>6.7</td>
<td>Intermodulation Characteristics</td>
<td>BER &lt; 1e-3 in presence of unwanted 2 signals</td>
<td>ESG + N7612B, 2nd ESG</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.8</td>
<td>Spurious Emissions</td>
<td>below defined mask</td>
<td>PSA opt 211</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

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

Agilent Technologies

## 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 89601A Vector Signal Analysis Software</strong></td>
<td><strong>Opt B7N Demod</strong></td>
<td><strong>Ver 6.10 (Midable sync)</strong></td>
<td><strong>Ver 6.20 (HSDPA/8PSK)</strong></td>
<td></td>
<td></td>
<td><strong>NEW!!</strong></td>
</tr>
<tr>
<td><strong>1st demod in the world</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>1st to support HSDPA</strong></td>
</tr>
<tr>
<td><strong>TSM real-time #411</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>China 3G license?</strong></td>
</tr>
<tr>
<td><strong>LCR Real-time N7612A</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MC ARB N7612B</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**TD-SCDMA UE Testing**

Agilent Restricted

July 18, 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 Spectrum/Signal Analyzer Platforms

<table>
<thead>
<tr>
<th>R&amp;D</th>
<th>Manufacturing</th>
<th>I&amp;M</th>
</tr>
</thead>
<tbody>
<tr>
<td>89600 VSA</td>
<td>E4406 VSA</td>
<td></td>
</tr>
<tr>
<td>PSA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Our focus now on TD-SCDMA
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:
\[ \pm 0.62 \text{ dB} \quad \text{Total accuracy (up to 3 GHz)} \]
\[ \pm 0.24 \text{ dB} \quad 95\% \text{ Confidence} \]
\[ \pm 0.16 \text{ dB} \quad \text{Typical} \]

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

with preamp #1DS:
-168 dBm/Hz \quad 1.2-2.5GHz Guaranteed
-169 dBm/Hz \quad 1.2-2.5GHz Typical

Res BW: 1Hz to 8MHz

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:
Analizers: 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 Vector Signal Generators

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

Performance
- 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

ESG

MXG

Performance optimized for component manufacturing
- Fastest switching speed
  - enables increased throughput
- Best ACPR performance
  - allows more test margin and improves yield
- Reliability and simplified self-maintenance
  - maximizes uptime

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 channels onto 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/multi 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>
<td>A.1</td>
<td>PSA opt 211</td>
<td>with proper triggering</td>
</tr>
<tr>
<td>5.4.1.4</td>
<td>Close Loop Power Control</td>
<td>vary by step size</td>
<td>A.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.4.2</td>
<td>Minimal Transmit Power</td>
<td>&lt; -49 dBm</td>
<td>A.1</td>
<td>PSA opt 211</td>
<td></td>
</tr>
<tr>
<td>5.4.3</td>
<td>Transmit OFF Power</td>
<td>&lt; -65 dBm</td>
<td>A.1</td>
<td>PSA opt 211</td>
<td></td>
</tr>
<tr>
<td>5.4.4</td>
<td>Transmit ON/OFF Time Mask</td>
<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></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></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</td>
<td>A.1</td>
<td>PSA opt 211</td>
<td></td>
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<td>5.5.3</td>
<td>Spurious Emissions</td>
<td>below defined mask</td>
<td>A.1</td>
<td>PSA opt 211</td>
<td></td>
</tr>
<tr>
<td>5.6</td>
<td>Transmit Intermodulation</td>
<td>&lt; 31 dB for 1.6MHz 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>
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<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
<table>
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<tr>
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<td></td>
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<tr>
<td>6.3</td>
<td>Maximum Input Level</td>
<td>BER &lt; 1e-3 at -25 dBm / 1.28MHz</td>
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<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>
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<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>
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<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>
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<td>Intermodulation Characteristics</td>
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<td>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>
</tr>
</tbody>
</table>

**TD-SCDMA Test Solutions Based on ESG Platform**

![Diagram of TD-SCDMA Test Solutions](image)

- External PC ESG/MXG
- LAN/GPIB
- Waveform Download/ESG?MXG Control
- Trigger 1
- Trigger 2
- MCPA
- RF
- RF
- UE
- PSA opt.211/89601
- DIQ
Agenda of Today

- Introduction
  - Agilent TD-SCDMA Test Solutions Overview
  - TD-SCDMA Mobile Tx Tests
  - TD-SCDMA Mobile Rx Tests
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>single/multi codes</td>
<td></td>
<td></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>
<td>A.1</td>
<td>PSA opt 211 could do</td>
<td>with proper triggering</td>
</tr>
<tr>
<td>5.4.1.4</td>
<td>Close Loop Power Control</td>
<td>vary by step size</td>
<td>A.1</td>
<td>PSA opt 211</td>
<td>manual test using 89601+PSA or VXI HW with deep memory</td>
</tr>
<tr>
<td>5.4.2</td>
<td>Minimal Transmit Power</td>
<td>&lt; -49 dBm</td>
<td>A.1</td>
<td>PSA opt 211</td>
<td></td>
</tr>
<tr>
<td>5.4.3</td>
<td>Transmit OFF Power</td>
<td>&lt; -65 dBm</td>
<td>A.1</td>
<td>PSA opt 211</td>
<td></td>
</tr>
<tr>
<td>5.4.4</td>
<td>Transmit ON/OFF Time Mask</td>
<td>below defined mask</td>
<td>A.1</td>
<td>PSA opt 211</td>
<td></td>
</tr>
<tr>
<td>5.5.1</td>
<td>Out-of-synchronisation handling of output</td>
<td>NA</td>
<td>A.1</td>
<td>PSA opt 211</td>
<td></td>
</tr>
<tr>
<td></td>
<td>power for continuous transmission</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.5.2.1</td>
<td>Occupied Bandwidth</td>
<td>≤ 1.6 MHz</td>
<td>A.1</td>
<td>PSA opt 211</td>
<td></td>
</tr>
<tr>
<td>5.5.2.2</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></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>
</tr>
<tr>
<td>5.5.3</td>
<td>Spurious Emissions</td>
<td>below defined mask</td>
<td>A.1</td>
<td>PSA opt 211</td>
<td></td>
</tr>
<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>manual test using PSA opt 211 also possible</td>
</tr>
<tr>
<td>5.7.1</td>
<td>EVM (Error Vector Magnitude)</td>
<td>≤ 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>≤ -21dB</td>
<td>A.1</td>
<td>PSA + 89601</td>
<td></td>
</tr>
</tbody>
</table>
Tx Test Configuration

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

Test configuration A.2 for Tx Intermod 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 setups

- 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

---

<table>
<thead>
<tr>
<th>Meas Setup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg Number</td>
</tr>
<tr>
<td>Avg Mode</td>
</tr>
<tr>
<td>Average Type</td>
</tr>
<tr>
<td>Meas Time</td>
</tr>
<tr>
<td>Trig Source</td>
</tr>
</tbody>
</table>

---

![Power vs. Time Diagram](image)

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

*X-Scale setup to check the trace by segment*

**Ramp-up/down lines**

**"Zoom out" bottom window**

---

<table>
<thead>
<tr>
<th>Display</th>
<th>Span</th>
<th>X-Scale setup to check the trace by segment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit Mask</td>
<td>Off</td>
<td>Scale/Div 10.00 µs</td>
</tr>
<tr>
<td>Burst Lines</td>
<td>Off</td>
<td>Ref Value 2.907 ms</td>
</tr>
<tr>
<td>Trigger Line</td>
<td>Off</td>
<td>Ref Position Left Ctr Right</td>
</tr>
<tr>
<td>Ramp Lines</td>
<td>Off</td>
<td>X-Scale setup to check the trace by segment</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>Display</th>
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<tr>
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<td>Off</td>
<td>Ref Position Left Ctr Right</td>
</tr>
<tr>
<td>Ramp Lines</td>
<td>Off</td>
<td>X-Scale setup to check the trace by segment</td>
</tr>
</tbody>
</table>
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, or relative and absolute 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)

![Image of occupied bandwidth measurement](image)

**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
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 error
- Code Domain Power (CDP)
- Demod bits

Flexible Time Synchronization
- UpPTS or Midamble

Three Levels of Analysis

- Level 1: Sub-frame Overall Analysis
- Composite EVM
- Code Domain Power/Error
- Level 2: Time Slot Analysis
- 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
**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 Des-scrambling

**Measurement**
- QPSK Decoding
- Ideal bits
- Demodulated bits

**Channel Power**
- Channel power vs. time
- Code domain power

**Channel EVM**
- Midamble
- I/Q Demod
- RRC
- Subtract Midamble
- Complex Des-scrambling
- QPSK Decoding
- Ideal bits
- 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
- Average over measurement length

**Channel Power**
- Channel power versus time
- Channel EVM

**Demodulated bits**
- QPSK map
- Demodulated bits

**There is a despreader for every code at every SF!**
**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
Code Domain Error on the Block Diagram

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

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>6.6</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>6.7</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 opt 211</td>
<td></td>
</tr>
</tbody>
</table>

### Rx Test Configuration

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

![Rx Test Configuration Diagram](image-url)
Rx Test Configuration

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

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

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

- ESG as CW interference
- ESG + N7612B Arb as interference
- Control PC
- BER
- SS
- TX
- RX
- RX/TX

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
- Transport Channel Mux
- Bit Scrambling
- RU Mapping

**Physical Layer**
- MUX
- QPSK Mapping
- OVSF Spread Code
- Complex Scrambling Code
- Split Real
- Imag
- MUX
- MIDAMBLE basic binary code \( \{m_1, ..., m_n\} \)

**Receiver Test Metrics – BER /BLER/FER**

- **Individual bit errors**
  - Bit Error Ratio (BER)

- **Data blocks or frames**
  - Block Error Ratio (BLER)
  - Frame Error Ratio (FER)

**System Simulator (SS)**
- Reference Bits
  - 10110001101
- Error Ratio

**DUT**
- Recovered Bits
- Baseband BER/BLER
- Baseband BER/BLER
- Loopback BER/BLER
- Earlier stages of UE design verification
- UE conformance testing
Stimulus signal for BER/BLER Measurements

TD-SCDMA Receiver

- RF Front end
- I/Q Demod
- RRC
- Extract Midamble
- Complex Descrambling
- Multiple User Detection
- OVSF Despreading
- QPSK Decoder
- DEMUX
- PC
- TFCI
- SS
- DPCH data
- DCH

BER/BLER

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

Stimulus signal for RF performance measurements

Choose C/N or Eb/No to configure AWGN source

Uncoded DCH

MUX

QPSK Mapping

OVSF Spreading

Complex Scrambling

RRC

I/Q MOD

TD-SCDMA Receiver

RF Front end

I/Q Demod

RRC

Transport Channel Demux

Segment Rate Matching Conv. Decoder Tail Bit Discard CRC Detect

PC TFCI SS Uncoded DCH

Noise Figure Composite EVM Code Domain Analysis
Stimulus signal for functional verification

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

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 DPCH_0</td>
<td>8</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Scrambling code and basic midamble code number*</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>DPCH Channelization Codes*</td>
<td>C(k,Q)</td>
<td>C(0,16)</td>
<td>C(1,16)</td>
<td>C(1,16)</td>
<td>C(1,16)</td>
</tr>
<tr>
<td></td>
<td>in 1,8</td>
<td>in 1,8</td>
<td>in 1,8</td>
<td>in 1,8</td>
<td>in 1,8</td>
</tr>
<tr>
<td>DPCHo Channelization Codes*</td>
<td>C(k,Q)</td>
<td>C(0,16)</td>
<td>C(1,16)</td>
<td>C(1,16)</td>
<td>C(1,16)</td>
</tr>
<tr>
<td></td>
<td>37</td>
<td>97</td>
<td>97</td>
<td>97</td>
<td></td>
</tr>
<tr>
<td>EDGE VC E C_v</td>
<td>dB</td>
<td>-10</td>
<td>-10</td>
<td>-10</td>
<td>0</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.
Introduction To Measurement Systems Division (MSD)

Leading systems solution provider and measurement technology enabler in wireless and automotive markets

Focus on:

- Wireless handset R&D and manufacturing
- Wireless LAN
- Base station
- Automotive industries
Test Systems Solution
Designing and Implementing Systems

Agilent’s systems solution provides efficiency and confidence through the standards validation phases and as you maximize your resources for new production line deployment.

Mobile Test Life Cycle

Technology/Platform Design

- Architecture
  - Architecture Stage
    - Design / Simulate a new device that will meet cost, performance, size, feature requirements
- Technology Development
  - Technology Stage
    - Baseband Development
    - Baseband Support Systems Development
    - RFICs Development
- Platform Development
  - Platform Stage
    - Baseband HW & FW Integration
    - Baseband & RF/IQ IC Integration
    - API & SDK (e.g. Brew) Development
- Product Design
  - Product Stage
    - RF Circuit Design
    - Printed Circuit Board Design
    - RF & Baseband Integration
    - Mechanical Design

Application Software Development

Integration & Verification Cycle

Reference Design

Reference Platform Vertical Integration

TTM “pressure ramp”
### System Solutions

- TD-SCDMA UE RF conformance test system
- TD-SCDMA UE RF design verification and NPI test system
- TD-SCDMA UE production test system
- TD-SCDMA Node B RF module test system

### GS8800 系列产品满足不同测试应用场景

GS-8800 is a Scalable Product family with an easy to Upgrade solution; operating under a common hardware and software platform

<table>
<thead>
<tr>
<th>GS-8800 Bench-Top</th>
<th>GS-8800 Super Lite</th>
<th>GS-8800 Lite</th>
<th>GS-8800 (Standard)</th>
<th>GS-8800 Plus</th>
</tr>
</thead>
<tbody>
<tr>
<td>GS-8800 SW OBT/SS, PS</td>
<td>GS-8800 SW OBT/SS, PS</td>
<td>GS-8800 SW OBT/SS, PS, PSA, ESG</td>
<td>GS-8800 SW OBT/SS, PS, PSA, System Full Automation</td>
<td>GS-8800+ SW OBT/SS, PS, PSA, System, Full Automation</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Development</th>
<th>Development</th>
<th>Development</th>
<th>Validation</th>
<th>Conformance</th>
</tr>
</thead>
</table>
TD-SCDMA UE Conformance Test System

TD-SCDMA 测试覆盖表 - 发射机

<table>
<thead>
<tr>
<th>Transmitter</th>
<th>5.2 UE maximum output power</th>
<th>✓</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5.3 UE frequency stability</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>5.4 Output power dynamics</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>5.4.1 Uplink Power control</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>5.4.1.3 Open loop power control</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>5.4.1.4 Closed loop power control</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>5.4.2 Minimum output power</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>5.4.3 Transmit OFF power</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>5.4.4 Transmit ON/OFF Time Mask</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>5.4.5 Out-of-synchronization handling of output power for continuous transmission</td>
<td>✓</td>
</tr>
</tbody>
</table>
|             | 5.4.6 Out-of-synchronization handling of output power for discontinuous transmission | ✓ *
|             | 5.5 Output RF spectrum emissions | ✓ |
|             | 5.5.1 Occupied bandwidth    | ✓ |
|             | 5.5.2 Out of band emission  | ✓ |
|             | 5.5.2.1 Spectrum emission mask | ✓ |
|             | 5.5.2.2 Adjacent channel leakage power ratio (ACLR) | ✓ |
|             | 5.5.3 Spurious emissions    | ✓ |
|             | 5.6 Transmit inter-modulation | ✓ |
|             | 5.7 Transmit modulation     | ✓ |
|             | 5.7.1 Error Vector Magnitude | ✓ |
|             | 5.7.2 Peak Code Domain Error | ✓ |
TD-SCDMA 测试覆盖表 – 接收机及性能测试

<table>
<thead>
<tr>
<th>Receiver</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6.2</td>
<td>Reference Sensitivity Level</td>
<td>✓</td>
</tr>
<tr>
<td>6.3</td>
<td>Maximum Input Level</td>
<td>✓</td>
</tr>
<tr>
<td>6.4</td>
<td>Adjacent Channel Selectivity (ACS)</td>
<td>✓</td>
</tr>
<tr>
<td>6.5</td>
<td>Blocking Characteristics</td>
<td>✓</td>
</tr>
<tr>
<td>6.6</td>
<td>Spurious Response</td>
<td>✓</td>
</tr>
<tr>
<td>6.7</td>
<td>Inter-modulation Characteristics</td>
<td>✓</td>
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<td>6.8</td>
<td>Spurious Emission</td>
<td>✓</td>
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<tr>
<th>Performance</th>
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<tr>
<td>7.2</td>
<td>Demodulation in static propagation conditions</td>
<td>✓</td>
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<tr>
<td>7.3</td>
<td>Demodulation of DCH in multi-path fading conditions</td>
<td>✓</td>
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<tr>
<td>7.3.1</td>
<td>Demodulation of DCH in multi-path fading Case1</td>
<td>✓</td>
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<td>7.3.2</td>
<td>Demodulation of DCH in multi-path fading Case2</td>
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<td>7.3.3</td>
<td>Demodulation of DCH in multi-path fading Case3</td>
<td>✓</td>
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<td>7.5</td>
<td>Power control in downlink</td>
<td>✓</td>
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<tr>
<td>7.5.3</td>
<td>1.28 Mcps TDD option, constant BLER Target</td>
<td>✓</td>
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<td>7.6</td>
<td>Uplink Power Control</td>
<td>✓</td>
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TD-SCDMA UE Conformance Test System

Key Reasons to Select Agilent Conformance System

- Industry standard UMTS test platform, GCF certified
- Aligned with regulatory test house in China
- Easy protocol upgrade
- Best UE compatibility
- Expandable for RRM test
TD-SCDMA UE Design Verification and NPI Test System

GS8800 Lite/Std Config

- E4445A PSA
- E4438C ESG
- SP6010/E5515C
- E4416A PM
- 66319D PS
- N1960A RF I/F
- TD-SCDMA UE DV Personality

What you can get with the GS8800 Lite

- Based on industry mature design verification test platform
- Multi format and multi band support
- High cost performance ratio for UE pre-conformance test
- Widely used and proved H/W building block in TD industry
- Major chipsets solution supportable
- Dual Mode phone calibration and verification test in single platform
- NPI production platform for several K’s phone, 500-1000 units/week
Typical Production Line for Dual Mode TD UE

Calibration Tests:
- All Formats in One
- MXG/MXA based solution,

Call Processing Tests:
- Dual Test Stations
- GSM/UMTS Call Test — E5515C
- TD-SCDMA Call Test — SS+MXA

TD-SCDMA UE 射频性能测试系统
(RF Performance System)

- The system contains:
  - IPC
  - RF box for interconnection
  - E444xA PSA (w/ #211)
  - 66321A Power Supply
  - 89601A software
  - E4438C Signal Generator
  - N5101A Card
  - Signal Studio software

- The system can be placed at bench top or installed in a EIA-19 Inch Rack for easy movement.
Agilent TD-SCDMA Cal Station

What you can get with Agilent TD Cal Station

- Integrated auto test platform
- Designed for dual mode phone test
- Aligned with major chipset and RDH customer
- Auto cal s/w kits for most chipsets
- Support most TCs in Section 5&6, TS34.122 as well as power consumption test
Thank you for your time!
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台灣安捷倫科技股份有限公司

台北市104 達興南路一段2 號8 樓
電話：(02) 8772-5888

桃園縣平鎮市324 高雙路20 號
電話：(03) 492-9666

台中市文心路一段552 號12 樓C室
電話：(04) 2310-6914

高雄市802高雄市四維三路8號25樓之1
電話：(07) 535-5035

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Issued date : 10/2006
Updated data : 10/2006
Printed in Taiwan 10/2006

中文版：5989-5734ZHA