Agilent E1969A TD-SCDMA_GSM Fast Switch Test Application


For the E5515C (8960) wireless communications test set

Technical Overview

Key Capabilities

• User-configurable fixed reference channel (FRC) enable HSDPA data throughput testing in RB test mode

• TD-SCDMA real-time downlink source

• FM and GPS receiver calibration in one box

• AMR voice and echo

• TD-SCDMA to GSM system handover

Extend Agilent’s 8960 (E5515C) platform to TD-SCDMA, offering measurements compliant with 3GPP TS34.122 as the industry test standard.

With E1969A TD-SCDMA_GSM fast switch test application, Agilent’s 8960 (E5515C) test set covers TD-SCDMA user equipment (UE) test based on 3GPP standards. On a single hardware platform, the E5515C, all 2G & 3G formats are supported with corresponding licenses: GSM/GPRS/EGPRS, W-CDMA/HSDPA/HSUPA, HSPA+, TD-SCDMA, CDMA2000®, 1xEV-DO rev A/rev B.


E1969A-101 is designed to be used under non-signaling mode without an integrated TD-SCDMA protocol stack while E1969A-201 supports signaling mode. E1969A-403 supports the HSDPA data throughput testing in radio bearer (RB) test mode.

Reach high-volume production goals by moving prototypes quickly into production with this test solution’s fast and repeatable measurements, accurate characterization, and ease of programming. Realize rapid deployment and lower costs by just upgrading software on your existing 8960.
<table>
<thead>
<tr>
<th>Key Capabilities (continued)</th>
<th>TD-SCDMA</th>
<th>TD-HSDPA</th>
</tr>
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<tbody>
<tr>
<td>Channel power</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Occupied bandwidth</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Transmit on/off time mask</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Waveform quality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Error vector magnitude (EVM)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>• Frequency error</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>• Peak code domain error (PCDE)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Adjacent channel leakage ratio</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Spectrum emission mask</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Closed loop power control</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Open loop power control</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Dynamic power</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Single-ended BER</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Frequency stability</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Spectrum monitor</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Rx measurement</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loopback BER</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Block error ratio</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>HSDPA block error ratio</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
1. Needs the solution under non-signaling mode that requires TD-SCDMA chipset support
2. Uses single-ended BER measure under non-signaling mode that requires TD-SCDMA chipset support
3. Requires use of external spectrum analyzer
4. Requires use of external spectrum analyzer and source
5. Requires use of external source

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>5.2 Maximum output power</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>5.3 Frequency stability</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>5.4.1.3 Open loop power control</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>5.4.1.4 Closed loop power control (CLPC)</td>
<td>Yes¹</td>
<td>Yes</td>
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<tr>
<td>5.4.2 Minimum output power</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>5.4.3 Transmit off power</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>5.4.4 Transmit on/off time mask</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>5.4.5 Out-of-synchronization handing of output power (continuous)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.4.6 Out-of-synchronization handing of output power for (discontinuous)</td>
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<tr>
<td>5.5.1 Occupied bandwidth (OBW)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>5.5.2.1 Spectrum emission mask (SEM)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>5.5.2.2 Adjacent channel leakage power ratio (ACLR)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>5.5.3 Spurious emissions</td>
<td>Yes³</td>
<td>Yes³</td>
</tr>
<tr>
<td>5.6 Transmit intermodulation</td>
<td>Yes⁴</td>
<td>Yes⁴</td>
</tr>
<tr>
<td>5.7.1 Error vector magnitude (EVM)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>5.13.2 Peak code domain error (PCDE)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
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<tr>
<th></th>
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<tbody>
<tr>
<td>6.2 Reference sensitivity</td>
<td>Yes²</td>
<td>Yes</td>
</tr>
<tr>
<td>6.3 Maximum input level</td>
<td>Yes²</td>
<td>Yes</td>
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<tr>
<td>6.4 Adjacent channel selectivity (ACS)</td>
<td>Yes⁵</td>
<td>Yes⁵</td>
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<tr>
<td>6.5 Blocking characteristics</td>
<td>Yes³</td>
<td>Yes³</td>
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<td>6.6 Spurious response</td>
<td>Yes³</td>
<td>Yes³</td>
</tr>
<tr>
<td>6.7 Intermodulation characteristics</td>
<td>Yes³</td>
<td>Yes³</td>
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<tr>
<td>6.8 Spurious emissions</td>
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<td></td>
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<table>
<thead>
<tr>
<th>3GPP TS 34.122 Test description</th>
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<th>E1969A-403</th>
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<tbody>
<tr>
<td>9.3.1 HS-DSCH throughput for fixed reference channels</td>
<td>Yes⁵</td>
<td>Yes⁵</td>
</tr>
<tr>
<td>9.3.2 HS-DSCH throughput for variable reference channels</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.3.3 Reporting of HS-DSCH channel quality indicator</td>
<td></td>
<td></td>
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<tr>
<td>9.3.4 HS-SCCH detection performance</td>
<td></td>
<td></td>
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What to Order for TD-SCDMA

<table>
<thead>
<tr>
<th>Model number</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>E5515C</td>
<td>8960 Series 10 wireless communications test set</td>
</tr>
<tr>
<td>E5515C-003</td>
<td>Flexible CDMA base station emulator</td>
</tr>
<tr>
<td>E5515C-002</td>
<td>Second RF source</td>
</tr>
<tr>
<td>E1969A</td>
<td>TD-SCDMA_GSM fast switch test application</td>
</tr>
<tr>
<td>E1969A-101</td>
<td>TD-SCDMA non-signaling test mode</td>
</tr>
<tr>
<td>E1969A-201</td>
<td>TD-SCDMA signaling mode</td>
</tr>
<tr>
<td>E1969A-202</td>
<td>GSM/GPRS/EGPRS mobile test application</td>
</tr>
<tr>
<td>E1969A-403</td>
<td>TD-HSDPA</td>
</tr>
</tbody>
</table>

Technical Specifications


Specifications describe the test set’s warranted performance and are valid for the unit’s operation within the stated environmental ranges unless otherwise noted. All specifications are valid after a 30-minute warm-up period of continuous operation.

Supplemental characteristics are intended to provide typical, but non-warranted, performance parameters that may be useful in applying the instrument. These characteristics are shown in italics and labeled as “typical” or “supplemental.” All units shipped from the factory meet these typical numbers at +25 °C ambient temperature without including measurement uncertainty.

1. Minimum of 1-year (-1SY) STSC is required with initial purchase of the system. 2-year (U1908AS-2SY) or 3-year (U1908AS-3SY) STSC is optional.
2. Use this option number to purchase STSC renewal: 1-year, 2-year (U1908AS-2RY) or 3-year (U1908AS-3RY), instead of using U1905A part numbers.
TD-SCDMA Mode (test and active cell)

Call connection types

AMR voice: standard voice call with audio loopback for a quick check of voice functionality for 12.2 k rate; also many more AMR rates, such as 4.75, 5.15, 5.9, 6.7, 7.4, 7.95, 10.2, and 12.2 k
- UE and BS origination 12.2 k
- UE and BS release

TDD test mode: TDD test mode allows you to test the parametric performance of your UE’s transmitter and receiver without call processing. In TDD test mode, the test set does not send signaling information on the downlink. Rather, it continuously generates a downlink signal and searches for a corresponding uplink signal. The UE must synchronize to the downlink signal and send and appropriate uplink signal, which the test set uses to measure the UE’s transmitter and receiver performance. Any changes to the UE configuration must be accomplished by directly sending commands to the UE from a system controller through a proprietary digital interface.

RB test mode: fast conformance test calls with significant configuration control and testing capabilities
- BS origination and release
- Support symmetrical RMCs at 12.2 rates. The symmetrical RMC are typically used for transmitter testing and receiver testing user BER (via loopback type 1) or BLER (via loopback type 2)

Inter-system handover: dual-mode functionality is required for most TD-SCDMA phones, as GSM is an integral part in the majority of devices shipping today. Inter-system handovers provide a means to validate dual-mode performance at your desk instead of roaming on a real network
- Blind handovers from TD-SCDMA to GSM
- Configurable landing GSM cell
- Test control to GSM voice
- TD-SCDMA AMR voice to GSM voice

1. Customer-installed instrument must have required options and firmware/software for system to function properly
2. For battery emulation for UE without battery or/and to automate UE power cycling
3. Extra for convenience use to avoid frequent change of SIM within multiple UEs
TD-SCDMA RF generator

Frequency ranges (MHz):
Band a  2010 to 2025
Band f  1880 to 1920

These two bands are currently assigned in China for TD-SCDMA.

Frequency/Channel setting: by channel number or MHz (test mode only)
Frequency accuracy: same as timebase reference
Frequency setting resolution: 1 Hz
Output port control: control of RF source routing to either the RF IN/OUT port or the RF OUT ONLY port
RF IN/OUT cell power output range: -115 to -13 dBm/1.28 MHz
This range is the hardware range with amplitude offset = 0. The actual power range is defined by adding the value of associated Amplitude Offset to the range in the table.
RF IN/OUT AWGN signal output level range: -115 to -15 dBm/1.28 MHz
RF IN/OUT VSWR:
< 1.14:1, 400 to 500, 700 to 1000 MHz
< 1.2:1, 1700 to 2000 MHz
< 1.4:1, 2000 to 2700 MHz
RF IN/OUT reverse power: +37 dBm peak (5 W peak)
RF OUT ONLY cell power output range: -115 to -5 dBm/1.28 MHz
RF OUT ONLY reverse power: +24 dBm peak (250 mW peak)
Absolute output level accuracy: < ±1.2 dB
RF output EVM: < 10% (typical < 3%)
Carrier feed through: < -25 dB (typical < -35 dB)
Downlink channel power level: all downlink timeslot power levels are fixed to the cell power. The physical channels in one timeslot have separate relative powers and the relative power of the channels in one time slot must sum to 100% of the timeslot power. In test mode, all downlink channels’ power levels and states are fixed except DPCH and DPCHO.
Downlink pilot on DwPTS relative level: 0 dB
AWGN channel relative level range: settable to -25 to +10 dB relative to the user-set CDMA cell power with 0.01 dB resolution
Primary CCPCH relative level: -3 dB
PICH relative level: -3.02 dB
DPCH relative level: settable from -30 to 0 dB with 0.01 dB resolution
DPCHO channel relative level: automatically calculated from the relative level of DPCH to provide the set cell power
Downlink CDMA modulation type: QPSK per 3GPP standard
Modulation type: QPSK per 3GPP standard
QPSK residual EVM: < 10%, typically < 3%
QPSK carrier feed through: < -25 dBc, typically < -35 dBc

TD-SCDMA RF analyzer

Frequency ranges for uplink channels (MHz):
Band a  2010 to 2025
Band f  1880 to 1920

Frequency/Channel setting: by channel number or MHz (test mode only)
Maximum input level: +37 dBm peak (5 W peak)
Input level setting range: -70 to +30 dBm/1.28 MHz
Demodulation chip rate: 1.28 Mcps
Real-time demodulation of: uplink DPCH
TD-HSDPA Mode (active cell)

**Call connection types**

- **RB test mode**
  - BS origination and release
  - HSDPA RB test mode is operated on the downlink, simultaneously supporting as symmetrical RMC of 12.2 kbps.

**TD-HSDPA RF generator**

**Downlink channel power level:** all downlink timeslot power levels are fixed to the cell power. The physical channels in one timeslot have separate relative powers and the relative power of the channels in one time slot must sum to 100% of the timeslot power

- **HS-SCCH relative level:** -6.03 dB if only one HS-SCCH channel is configured; -6.97 dB if four HS-SCCH channels are configured
- **HS-DSCH relative level:** 0 dB

**TD-HSDPA RF analyzer**

**Real-time demodulation of:** uplink DPCH and HS-SICH

**CW mode**

Under CW mode, an unmodulated continuous wave (CW), a FM signal or a reduced single channel GPS source signal can be generated on the downlink; the level and frequency of the CW signal can be changed; for FM signal, besides the level, frequency, some other FM related parameters such as FM deviation and modulation frequency are also settable; for GPS signal, the power level, satellite ID and data patterns can be changed. No uplink demodulation or channel decoding is available with CW mode.

**CW signal generation**

- **Frequency ranges:** 450 to 496 MHz, 700 to 800 MHz, 810 to 960 MHz, 1700 to 1920 MHz, 2010 to 2025 MHz
- **Accuracy and stability:** Same as timebase reference

**Supplemental characteristics**

- **Typical CW frequency switching speed:** < 10 ms to be within <0.1 ppm of final frequency
- **Operating frequency range:** 292 to 2700 MHz
- **Setting resolution:** 1 Hz

**RF amplitude**

- **Output level range at RF IN/OUT:** -10 to -13 dBm
- **Output level range at RF OUT ONLY:** -10 to -5 dBm

- **Absolute output level accuracy:** < ±1.0 dB
- **VSWR at RF IN/OUT:** < 1.14:1 for 450 to 496 MHz and 810 to 960 MHz, < 1.2:1 for 1.7 to 1.99 GHz
- **Reverse power at RF IN/OUT:** < 2.5 W continuous, < 5 W peak bursted power
- **Reverse power at RF OUT ONLY:** < 500 mW continuous
### Supplemental characteristics

**Typical output level accuracy:** < ±0.5 dB  
**Typical output level repeatability at RF IN/OUT (returning to the same frequency and level):** < ±0.1 dB  
**Typical VSWR at RF OUT ONLY:**  
- < 1.4:1 for 450 to 496 MHz and 810 to 960 MHz, < 1.45:1 for 1.7 to 1.99 GHz  
**Typical isolation from RF OUT ONLY port to RF IN/OUT port (when the RF generator is routed to the RF OUT ONLY port):**  
- > 60 dB for 450 to 496 MHz and 810 to 960 MHz, > 40 dB for 1.7 to 1.99 GHz  
**Operating level range at RF IN/OUT:** -127 to -10 dBm  
**Operating level range at RF OUT ONLY:** -119 to -2 dBm

### FM signal generation

These specifications apply to an E5515C test set when used with an E5520A FM adapter.

Output signal amplitude and distortion specifications for FM testing with the E5515C and E5520A are supplemental.

#### Amplitude

**Conversion gain through E5520A:** -20.00 dB  
**Output level range:** -20 to -40 dBm  
**Output level accuracy:** ±1 dB at 76 to 108 MHz and -30 to -10 dBm

#### Frequency Modulation

**Rate range:** 50 Hz to 20 kHz  
**Deviation range:** 0 to 75 kHz  
**Deviation accuracy:** ±5% + residual FM at 1 kHz rate  
**Residual FM:** < 30 Hz at 50 Hz to 20 kHz

#### Single Channel GPS Source

A reduced single channel GPS signal can be generated for GPS receiver C/N0 test. The signal can be output from either RF IN/OUT or RF OUTPUT ONLY.

**Signal frequency:** 1575.42 MHz  
**Signal level range:** -70 dBm ~-125 dBm  
**Satellite ID:** 1~ to 37  
**Chip rate:** 1.023 Mcps  
**Code support:** C/A code  
**Signal level accuracy:**  
- <±1.0 dB for signal level from -70~ 116 dBm  
- <±1.5 dB for signal level from -116~ 125 dBm
Measurements Technical Specifications

Transmitter measurements

Channel power measurement
Measurement method: the average power measured in one time slot
Mean power: measured with a bandwidth of at least \((1 + \alpha)\) * chip rate, where \(\alpha = 0.22\) and chip rate = \(1.28\) Mc/s
RRC filtered mean power: measured with a root-raised cosine (RRC) filter with roll-off \(\alpha = 0.22\) and a bandwidth equal to the chip rate \((1.28\) MHz)
Measurement level range: -65 to +28 dBm/1.28 MHz; measured signal level is expected within ±9 dB of the expected power and has < 10.0 dB crest factor
Frequency capture range: -20 to +20 kHz from the expected measurement receiver frequency
Timing capture range: -25 to +25 chips from the measurement trigger
Measurement interval: 1 timeslot excluding the guard period, 662.5 µs
Measurement accuracy (at ±10 °C from the calibration temperature): < ±1 dB for -65 to 30 dBm \((\text{typically} < ±0.6\) dB)
Measurement triggers: auto, immediate, protocol, external, and RF rise
Temperature range: +20 to +55 °C

Waveform quality measurement
Measurement method: the measurement is used to cover the following tests
Error vector magnitude (EVM): the difference between the measured waveform and the theoretical modulated waveform (the error vector). Both waveforms pass through a matched root raised cosine filter with bandwidth \(1.28\) MHz and roll-off \(\alpha = 0.22\). Both waveforms are then further modified by selecting the frequency, absolute phase, absolute amplitude, and chip clock timing so as to minimize the error vector. The EVM result is defined as the square root of the ratio of the mean error vector power to the mean reference signal power expressed as a %
Frequency stability (frequency error): the difference of the modulated carrier frequency between the RF transmission from the UE and the RF transmission from the BS
Peak code domain error: computed by projecting the error vector power onto the code domain at a specific spreading factor. The error power for each code is defined as the ratio to the mean power of the projection onto the code, to the mean power of the composite reference waveform expressed in dB. And the peak code domain error is defined as the maximum value for code domain error
Measurement level range: -25 to +28 dBm/1.28 MHz; measured signal level is expected within ±9 dB of the expected power and has < 10.0 dB crest factor
Frequency capture range: -20 to +20 kHz from the expected measurement receiver frequency for TD-SCDMA channel type; -2 to +2 kHz from the expected measurement receiver frequency for HSDPA channel type
Timing capture range: -25 to +25 chips from the measurement trigger
Measurement interval: 1 timeslot excluding the guard period, 662.5 µs
Measurement EVM range: < 20%rms
Measurement accuracy (at +10 °C from the calibration temperature): RMS EVM: < 2%
Frequency error: ±10 Hz + timebase accuracy
Measurement triggers: auto, immediate, protocol, external, and RF rise
Measurements Technical Specifications

Transmitter measurements (Continued)

Other reported parameters:
• magnitude error
• phase error
• origin offset
• timing error

Temperature range: +15 to +55 °C

Adjacent channel leakage ratio (ACLR)

Measurement method: the ratio of the RRC filtered mean power centered on the adjacent channel frequency to the RRC filtered mean power centered on the assigned channel frequency. The adjacent channels are located at ±1.6 MHz and ±3.2 MHz offsets

Measurement level range: +5 to +28 dBm/1.28 MHz; measured signal level is expected within ±9 dB of the expected power and has < 10.0 dB crest factor

Frequency capture range: -20 to +20 kHz from the expected measurement receiver frequency

Timing capture range: -25 to +25 chips from the measurement trigger

Measurement accuracy: (at ±10 °C from the calibration temperature) ±0.8 dB (typically ±0.5 dB) for measurements at -33 dBc at ±1.6 MHz offsets and -43 dBc at ±3.2 MHz offsets

Residual ACLR floor: < -55 dBc for ±1.6 MHz offsets, < -60 dBc for ±3.2 MHz offsets

Measurement interval: 1 timeslot excluding the guard period, 662.5 µs

Temperature range: +15 to +55 °C

Transmit on/off power (TOOP)

Measurement method: check whether the RRC filtered mean power versus time meets the specified mask. The test set measures three timeslots excluding the leading and the lagging guard period

Measurement level range: -65 to +28 dBm/1.28 MHz; measured signal level is expected within ±9 dB of the expected power and has < 10.0 dB crest factor

Frequency capture range: -20 to +20 KHz from the expected measurement receiver frequency for TD-SCDMA channel type; -2 to +2 KHz from the expected measurement receiver frequency for HSDPA channel type

Timing capture range: -25 to +25 chips from the measurement trigger

TOOP noise floor: -72 dBm (-75 dBm noise floor plus 3 dB saturation recovery error)

Measurement interval: 3 timeslots excluding the leading and the lagging guard period

Measurement triggers: auto, RF rise, protocol, immediate, and external

Temperature range: +15 to +55 °C
Measurements Technical Specifications

Transmitter measurements

(Continued)

**Spectrum emission mask (SEM)**

**Measurement method:** a relative measurement of the out-of-channel emissions to the in-channel power. The in-channel power is measured after filtering the signal with $\alpha = 0.22$, root-raised cosine (RRC) filter. The out-of-channel emissions are measured using a Gaussian filter with either in a 30 kHz or 1 MHz noise bandwidth. The out-of-channel power applies to frequencies that are between 0.8 and 4.0 MHz away from the center carrier frequency.

**Measurement level range:** +5 to +28 dBm/1.28 MHz; measured signal level is expected within ±9 dB of the expected power and has < 10.0 dB crest factor.

**Frequency capture range:** -20 to +20 kHz from the expected measurement receiver frequency for TD-SCDMA channel type; -2 to +2 KHz from the expected measurement receiver frequency for HSDPA channel type.

**Measurement accuracy (at ±10 °C from the calibration temperature):** <±1.5 dB (typically +0.8 dB) for the following offsets:

<table>
<thead>
<tr>
<th>Frequency offsets</th>
<th>Levels (dBc)</th>
<th>Meas BW</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.8 to 1.8 MHz</td>
<td>-35 - 14 $* \left( \frac{\Delta f}{\text{MHz}} - 0.8 \right)$</td>
<td>30 kHz</td>
</tr>
<tr>
<td>1.8 to 2.4 MHz</td>
<td>-49 - 17 $* \left( \frac{\Delta f}{\text{MHz}} - 1.8 \right)$</td>
<td>30 kHz</td>
</tr>
<tr>
<td>2.4 to 4.0 MHz</td>
<td>-44</td>
<td>1 MHz</td>
</tr>
</tbody>
</table>

**Timing capture range:** -25 to +25 chips from the measurement trigger.

**Measurement interval:** 1 timeslot excluding the guard period, 662.5 µs.

**Measurement triggers:** auto, RF rise, protocol, immediate, and external.

**Temperature range:** +15 to +55 °C.

**Occupied bandwidth (OBW)**

**Measurement method:** the measure of bandwidth containing a specified percentage of the total integrated power of the transmitted spectrum, centered on the assigned channel frequency.

**Measurement level range:** +5 to +28 dBm/1.28 MHz; measured signal level is expected within ±9 dB of the expected power and has < 10.0 dB crest factor.

**Frequency capture range:** -20 to +20 kHz from the expected measurement receiver frequency for TD-SCDMA channel type; -2 to +2 KHz from the expected measurement receiver frequency for HSDPA channel type.

**Timing capture range:** -25 to +25 chips from the measurement trigger.

**Measurement interval:** 1 timeslot excluding the guard period, 662.5 µs.

**Measurement triggers:** auto, RF rise, protocol, immediate, and external.

**Measurement accuracy (at ±10 °C from the calibration temperature):** < ±30 kHz.

**Temperature range:** +15 to +55 °C.
Dynamic power (DPOW)
Measurement method: measures a series of power levels for a step sequence. Provides a fast power calibration method that covers the typical 85 dB (from -55 to +28 dBm) dynamic range of a TD-SCDMA mobile station.

Measurement level range: -55 to +28 dBm/1.28 MHz; For the trigger steps, the step power is expected to be within +9 to -9 dB of the expected power; For the measurement steps, the first step power is expected to be within +9 to -9 dB of the initial step power; The relative power difference between adjacent step is expected to be within +9 to -20 dB.

Frequency capture range: -20 to +20 kHz from the expected measurement receiver frequency.

Timing capture range: -25 to +25 chips from the measurement trigger.

Measurement interval: 1 timeslot excluding the guard period when the sync mode is ‘Midamble’; 784 chips when the sync mode is ‘None’.

Measurement accuracy (at ±10 °C from the calibration temperature): < ±1 dB for -65 to 30 dBm (typically <±0.6 dB).

Measurement triggers: RF rise, protocol, and external.

Concurrent capabilities: dynamic power measurement cannot be made concurrently with other measurements. Dynamic power measurement cannot be made while the HSDPA RMC connection is provided.

Temperature range: +15 to +55 °C

Closed loop power control (CLPC) measurement
Measurement method: the closed loop power is defined as the relative power differences between RRC filtered mean power of original timeslot and that of the target timeslot without transient duration. It’s the user’s responsibility to drive UE output power to the right level as the start power of the first segment. UE should work in test mode to be able to synchronize with downlink signals on timing and frequency, and transmit traffic burst on TS1 without call connection, the power of which is under closed loop power control. When this measurement is initiated, the given number of DOWN TPC commands followed by the given number of UP TPC commands will be sent on the downlink traffic slot, one TPC command per one subframe. The UE output power on TS1 in continuous subframe would be measured.

Measurement level range: -55 to +28 dBm/1.28 MHz; first step power should be within ±6 dB of the expected power. Relative power difference between adjacent steps is expected to be within ±6 dB. The crest factor is expected to be < 10.0 dB.

Frequency capture range: -20 to +20 kHz from the expected measurement receiver frequency.

Timing capture range: -25 to +25 chips from the measurement trigger.

Measurement data capture period: 1 timeslot excluding the guard period, 662.5 μs.

Measurement triggers: RF rise, protocol, and external.

Concurrent capabilities: Closed loop power control measurement cannot be made concurrently with other measurements. Close loop power control measurement cannot be made while the HSDPA RMC connection is provided.
Measurements Technical Specifications

Transmitter measurements (Continued)

Measurement accuracy (at ±10 °C from the calibration temperature):

Absolute power: < ±1 dB for −65 to 30 dBm (typically < ±0.6 dB)
Relative power:
- < ±0.15 dB for range 1.5 dB (-50 to +28 dBm/1.28 MHz)
- < ±0.25 dB for range 1.5 dB (-55 to -50 dBm/1.28 MHz)
- < ±0.25 dB for range 3 dB (-50 to +28 dBm/1.28 MHz)
- < ±0.3 dB for range 3 dB (-55 to -50 dBm/1.28 MHz)
- < ±0.3 dB for range 4.5 dB (-55 to +28 dBm/1.28 MHz)
- < ±0.5 dB for range 24 or 36 dB (-55 to +28 dBm/1.28 MHz)

Temperature range: +15 to +55 °C

Open loop power control (OLPC) measurement

Measurement method: the open loop power control is the ability of the UE transmitter to sets its output power to a specific value. When the open loop power control measurement is initiated, the test set captures the first UpPTS burst in an access sequence, and measures the RRC filtered mean power in UpPTS timeslot

Measurement level range: -60 to +28 dBm/1.28 MHz; measured signal level is expected to be within +10 to -20 dB of the expected power

Frequency capture range: -20 to +20 kHz from the expected measurement receiver frequency

Timing capture range: -32 to +32 chips from the ideal UpPTS position with 0 time offset

Measurement interval: 127 chips excluding 0.5 chips on each edge of the 128 chips UpPTS on part

Concurrency capabilities: Open loop power control measurement cannot be made concurrently with other measurements. Open loop power control measurement cannot be made while the HSDPA RMC connection is provided

Temperature range: +15 to +55 °C
Measurements Technical Specifications

Receiver measurements

Loopback BER measurement
Measurement method: data loopback (mode 1 in 3GPP TS 34.109)
Concurrency capabilities: Loopback BER measurement cannot be made concurrently with CLPC/ILPC, TD-SCDMA Dynamic Power, BLER and HSDPA BLER measurement; loopback BER measurements can be made concurrently with all other measurements.

BER measurement input level range: -50 to +28 dBm/3.84 MHz
Final results: measured BER, number of errors, number of bits tested, uplink missing blocks, CRC errors, and loopback delay

Block error ratio
Measurement method: the UE is configured to loop back the data bits and the CRC bits from the downlink transport blocks into the uplink transport blocks on the DPCH; a comparison is made in the test set by generating a CRC using the data bits received on the uplink and comparing the calculated CRC against the CRC received in the uplink transport block
Reported parameters: measured BLER, block error count, number of blocks tested, and uplink missing blocks
Concurreny capabilities: BLER measurements cannot be made concurrently with loopback BER, HSDPA BLER measurement, dynamic power measurement, open loop power control measurement or close loop power control measurements, or while speech is provided on the downlink; BLER measurements can be made concurrently with all other measurements

HSDPA block error ratio
Measurement method: test set counts the ACK/NACK/statDTX on UE HS-DPCCH and uses the results to calculate BLER
Reported parameters: measured BLER, number of blocks tested, throughput, number of ACKs, number of NACKs, and number of stat DTxs
Concurreny capabilities: HSDPA BLER measurements cannot be made concurrently with loopback BER, BLER measurement, dynamic power measurement, open loop power control measurement or close loop power control measurements, or while speech is provided on the downlink; BLER measurements can be made concurrently with all other measurements

Frequency stability measurement
Types of signals measured: analog and AMPS signals with or without SAT and with frequency modulation index β < 3.0 radians
Frequency capture range: signal must be within ±200 kHz of test set’s expected frequency
Measurement rate range: 100 Hz to 15 kHz
Minimum input level: signal at test set’s RF IN/OUT must have analog Tx power > -30 dBm
Measurement trigger source: immediate
Measurement additional filter: pass band = 30 kHz; stop frequency at ±60 kHz (-25 dB attenuation)
Available result: RF frequency and RF frequency error
Multi-measurement capabilities: 1 to 999 measurements, minimum, maximum, average, and standard deviation in Hz for all results and worst case RF frequency error in ppm result
Concurreny capabilities: frequency stability measurement can be made concurrently with all analog measurements

Common measurements
**Spectrum monitor**

**Measurement modes:** swept mode or zero span

**Frequency ranges:** although the spectrum monitor is available at any frequency supported by the test set, specifications apply only inside of the calibrated bands: 450 to 496 MHz, 700 to 800 MHz, 810 to 960 MHz, 1.7 to 1.99 GHz, and 2.48 to 2.58 GHz

**Frequency spans, resolution bandwidth range:**
Span and RBW can be independently set, except for zero span; zero span can only be set with the RBW combinations shown below
(Specifications only apply for span and RBW combinations shown in the following table):

<table>
<thead>
<tr>
<th>Span</th>
<th>RBW</th>
<th>Displayed dynamic range</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 MHz</td>
<td>5 MHz</td>
<td>50</td>
</tr>
<tr>
<td>80 MHz</td>
<td>1 MHz</td>
<td>55</td>
</tr>
<tr>
<td>40 MHz</td>
<td>300 kHz</td>
<td>60</td>
</tr>
<tr>
<td>20 MHz</td>
<td>100 kHz</td>
<td>65</td>
</tr>
<tr>
<td>12 MHz</td>
<td>100 kHz</td>
<td>65</td>
</tr>
<tr>
<td>10 MHz</td>
<td>100 kHz</td>
<td>65</td>
</tr>
<tr>
<td>5 MHz</td>
<td>30 kHz</td>
<td>70</td>
</tr>
<tr>
<td>4 MHz</td>
<td>30 kHz</td>
<td>70</td>
</tr>
<tr>
<td>2.5 MHz</td>
<td>10 kHz</td>
<td>75</td>
</tr>
<tr>
<td>1.25 MHz</td>
<td>3 kHz</td>
<td>80</td>
</tr>
<tr>
<td>500 kHz</td>
<td>1 kHz</td>
<td>80</td>
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<tr>
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<td>1 MHz</td>
<td>55</td>
</tr>
<tr>
<td>0</td>
<td>300 kHz</td>
<td>60</td>
</tr>
<tr>
<td>0</td>
<td>100 kHz</td>
<td>65</td>
</tr>
</tbody>
</table>

**RBW filter types:** flattop in swept mode, Gaussian in zero span

**Zero span sweep time:** settable from 50 μs to 70 ms

**Zero span offset time:** settable from 0 to 10 s

**Reference level range:** settable from -50 to +37 dBm or automatically determined

**Averaging capabilities:** settable between 1 and 999, or off

**Marker functions:** three independent markers with modes of normal, delta, and off; operations are peak search, marker to expected power, and marker to expected frequency

**Concurrency capabilities:** spectrum monitor analysis can be performed concurrently with all measurements
Supplemental characteristics

Typical level accuracy

- $< \pm 2 \text{ dB for signals within 50 dB of a reference level}$
- $-10 \text{ dBm and RBW } < 5 \text{ MHz,}$
- $< \pm 2 \text{ dB for signals within 30 dB of a reference level}$
- $-10 \text{ dBm and RBW } = 5 \text{ MHz using 5 averages,}$
- $< \pm 3.5 \text{ dB for signals }> -70 \text{ dBm and within 50 dB of a reference level}$
- $< -10 \text{ dBm with RBW } < 5 \text{ MHz}$

Displayed average noise level: $< -90 \text{ dBm for reference level of } -40 \text{ dBm and 30 kHz bandwidth}$

Typical residual responses: $< -70 \text{ dB with input terminated, reference level of } -10 \text{ dBm and RF generator power } < -80 \text{ dBm}$

Typical spurious responses: $< -50 \text{ dBc with expected frequency tuned to carrier, carrier } > 420 \text{ MHz, signal and reference level at } -10 \text{ dBm and all spectral components within 100 MHz of carrier}$

Frequency resolution: 1 Hz
Marker amplitude resolution: 0.01 dB

Aging rates: $< \pm 0.1 \text{ ppm per year, } < \pm 0.005 \text{ ppm peak-to-peak per day during any 24-hour period starting 24 hours or more after a cold start}$

Temperature stability: $< +0.01 \text{ ppm frequency variation from } 25 \degree C \text{ over the temperature range } 0 \text{ to } 55 \degree C$

Warm-up times: Five minutes to be within $\pm 0.1 \text{ ppm of frequency at one hour, 15 minutes to be within } \pm 0.01 \text{ ppm of frequency at one hour}$

Typical accuracy after a 30-minute warm-up period of continuous operation is derived from: $\pm \text{(time since last calibration) } \times \text{ (aging rate) } + \text{ (temperature stability) } + \text{ (accuracy of calibration)}$

Typical initial adjustment: $\pm 0.03 \text{ ppm}$

External reference input
Input frequency: 10 MHz

Input frequency range: typically $< \pm 5 \text{ ppm of nominal reference frequency}$

Input level range: typically 0 to +13 dBm

Input impedance: typically 50 Ohms

External reference output
Output frequency: same as timebase (internal 10 MHz OCXO or external reference input)

Typical output level: typically $> 0.5 \text{ V rms}$

Output impedance: typically 50 Ohms

Remote programming
GPIB: IEEE Standard 488.2

Remote front panel lockout: allows remote user to disable the front panel display to improve GPIB measurement speed

Implemented functions: T6, TE0, L4, LE0, SH1, AH1, RL1, SR1, PP0, DC1, DT0, C0, and E2
General Specifications

Dimensions (H x W x D): 8.75 x 16.75 x 24.63 inches (222 x 426 x 625 mm), 7 rack spaces high

Weight: 66 lbs (30 kg)

Display: 10.5 inches (26.7 cm), active matrix, color, liquid crystal

Manual user interface: traditional front panel type or remote computer driven with graphical UI

LAN (local area network) port (for firmware upgrades only): RJ-45 connector, 10 base T Ethernet with TCP/IP support

Operating conditions: 0 to +55 °C, 30 g/m³ absolute humidity (95%/+32 °C, 28%/+55 °C relative humidity)

Storage conditions: -20 to +70 °C, 50 g/m³ absolute humidity, non-condensing (90%/+65 °C relative humidity)

Power: 88 to 135 Vac, 193 to 269 Vac, 50 to 60 Hz, typically 550 VA maximum

Calibration interval: 2 years

EMI: conducted and radiated interference meets CISPR-11, susceptibility meets IEC 1000-4-2, 1000-4-3, and 1000-4-4

Radiated leakage due to RF generator: typically < 2.5 μV induced in a resonant dipole antenna one inch from any surface except the underside and rear panel set RF generator output frequency and output level of -40 dBm

Spurious leakage: typically < 5 μV induced in a resonant dipole antenna one inch from any surface on the front half of all sides of the instrument at frequencies other than the RF generator output frequency and output level of -40 dBm with no cable connected to the rear panel LAN port

Power consumption: typically 400 to 450 W continuous
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Revised: October 14, 2010

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Printed in USA, February 4, 2011
5990-5591EN