Agilent E1963A W-CDMA Mobile Test Application

Includes E1963A-403 HSDPA test modes
E1963A-413 HSUPA test modes
E1963A-405 HSDPA 14.4M bps test modes
E1963A-423 HSPA+ test modes
E1999A-202 Enhanced fast device tune
E1999A-206 Single channel GPS source

For the E5515C (8960) Wireless Communications Test Set

Technical Overview

With the most complete test functionality for 3GPP TS34.121 Section 5 and 6 tests, E1963A Options 403,405 and 413 provide fast, flexible measurements and options in user equipment (UE) connectivity, giving design and manufacturing test engineers more flexibility in creating test plans and the assurance that designs meet technology standards. The option 423 supports 64QAM downlink modulation and RB test mode connection.

Key Capabilities
- Fast device calibration across level and frequency simultaneously
- Test HSPA devices as defined in 3GPP TS34.121
- Switch between HSPA sub-test conditions while on an active connection
- Test all UMTS technologies with one connection maintained throughout
- Test all frequency bands I through XIV

<table>
<thead>
<tr>
<th>Tx measurements</th>
<th>W-CDMA</th>
<th>HSDPA</th>
<th>HSUPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal power</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Channel power</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Adjacent channel leakage ratio</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Waveform quality</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Spectrum emission mask</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Phase discontinuity</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Inner loop power</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupied bandwidth</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Code domain power</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>IQ constellation</td>
<td>Yes</td>
<td>Yes-</td>
<td>Yes</td>
</tr>
<tr>
<td>Tx on/off power</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Frequency stability</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Dynamic power analysis</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Tx dynamic power</td>
<td>Yes</td>
<td></td>
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<tr>
<td>Spectrum monitor</td>
<td>Yes</td>
<td>Yes</td>
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<table>
<thead>
<tr>
<th>Rx measurements</th>
<th>W-CDMA</th>
<th>HSDPA</th>
<th>HSUPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loopback BER</td>
<td>Yes</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>BLER on DPCH (W-CDMA)</td>
<td>Yes</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>HBLER on HS-DPCCH (HSDPA)</td>
<td>N/A</td>
<td>Yes</td>
<td>N/A</td>
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3GPP TS 34.121 Adherence

<table>
<thead>
<tr>
<th>3GPP TS 34.121</th>
<th>Test description</th>
<th>E1963A</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.2</td>
<td>Maximum output power</td>
<td>Yes</td>
</tr>
<tr>
<td>5.2A</td>
<td>Maximum output power with HS-DPCCH (Release 5 only)</td>
<td>Yes</td>
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<tr>
<td>5.2AA</td>
<td>Maximum output power with HS-DPCCH (Release 8 and later)</td>
<td>Yes</td>
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<tr>
<td>5.2B</td>
<td>Maximum output power with HS-DPCCH and E-DCH</td>
<td>Yes</td>
</tr>
<tr>
<td>5.2C</td>
<td>UE-relative code-domain power accuracy</td>
<td>Yes</td>
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<tr>
<td>5.2D</td>
<td>UE relative code domain power accuracy for HS-DPCCH and E-DCH</td>
<td>Yes</td>
</tr>
<tr>
<td>5.3</td>
<td>Frequency error</td>
<td>Yes</td>
</tr>
<tr>
<td>5.4.1</td>
<td>Open loop power control</td>
<td>Yes</td>
</tr>
<tr>
<td>5.4.2</td>
<td>Inner loop power control</td>
<td>Yes</td>
</tr>
<tr>
<td>5.4.3</td>
<td>Minimum output power</td>
<td>Yes</td>
</tr>
<tr>
<td>5.4.4</td>
<td>Out-of-sync handling of output power</td>
<td>Yes</td>
</tr>
<tr>
<td>5.5.1</td>
<td>Transmit off power</td>
<td>Yes</td>
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<tr>
<td>5.5.2</td>
<td>Transmit on/off time mask</td>
<td>Yes</td>
</tr>
<tr>
<td>5.6</td>
<td>Change of TFC</td>
<td>Yes</td>
</tr>
<tr>
<td>5.7</td>
<td>Power setting in UL compressed mode</td>
<td>Yes</td>
</tr>
<tr>
<td>5.7A</td>
<td>HS-DPCCH</td>
<td>Yes</td>
</tr>
<tr>
<td>5.8</td>
<td>Occupied bandwidth (DBW)</td>
<td>Yes</td>
</tr>
<tr>
<td>5.9</td>
<td>Spectrum emission mask (SEM)</td>
<td>Yes</td>
</tr>
<tr>
<td>5.9A</td>
<td>Spectrum emission mask with HS-DPCCH</td>
<td>Yes</td>
</tr>
<tr>
<td>5.9B</td>
<td>Spectrum emission mask with E-DCH</td>
<td>Yes</td>
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<tr>
<td>5.10</td>
<td>Adjacent channel leakage power ratio (ACLR)</td>
<td>Yes</td>
</tr>
<tr>
<td>5.10A</td>
<td>ACLR with HS-DPCCH</td>
<td>Yes</td>
</tr>
<tr>
<td>5.10B</td>
<td>ACLR with E-DCH</td>
<td>Yes</td>
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<tr>
<td>5.11</td>
<td>Spurious emissions</td>
<td>Yes</td>
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<tr>
<td>5.12</td>
<td>Transmit intermodulation</td>
<td>Yes</td>
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<tr>
<td>5.13.1</td>
<td>Error vector magnitude (EVM)</td>
<td>Yes</td>
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<tr>
<td>5.13.1A</td>
<td>Error vector magnitude (EVM) with HS-DPCCH</td>
<td>Yes</td>
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<tr>
<td>5.13.2A</td>
<td>EVM and phase discontinuity with HS-DPCCH</td>
<td>Yes</td>
</tr>
<tr>
<td>5.13.2</td>
<td>Peak code domain error</td>
<td>Yes</td>
</tr>
<tr>
<td>5.13.2A</td>
<td>Relative code domain error with HS-DPCCH</td>
<td>Yes</td>
</tr>
<tr>
<td>5.13.2B</td>
<td>Relative code domain error with HS-DPCCH and E-DCH</td>
<td>Yes</td>
</tr>
<tr>
<td>5.13.3</td>
<td>Phase discontinuity measurement</td>
<td>Yes</td>
</tr>
<tr>
<td>5.13.4</td>
<td>PRACH preamble quality</td>
<td>E6703X</td>
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What to Order for W-CDMA/HSPA

<table>
<thead>
<tr>
<th>Model number</th>
<th>Description</th>
</tr>
</thead>
<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>E1963A</td>
<td>W-CDMA mobile test application</td>
</tr>
<tr>
<td>E1963A-403</td>
<td>HSDPA test modes</td>
</tr>
<tr>
<td>E1963A-413</td>
<td>HSUPA test modes</td>
</tr>
<tr>
<td>E1963A-405</td>
<td>HSDPA 14.4Mbps TM</td>
</tr>
<tr>
<td>E1963A-423</td>
<td>HSPA+ test modes</td>
</tr>
<tr>
<td>E1999A-202</td>
<td>Enhanced fast device tune measurement</td>
</tr>
<tr>
<td>E1999A-206</td>
<td>Single channel GPS source</td>
</tr>
</tbody>
</table>

What to Order for UMTS

<table>
<thead>
<tr>
<th>Model number</th>
<th>Description</th>
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<tbody>
<tr>
<td>E5515C</td>
<td>8960 Series 10 Wireless Communications Test Set</td>
</tr>
<tr>
<td>E5515C-002</td>
<td>Second RF source</td>
</tr>
<tr>
<td>E5515C-003</td>
<td>Flexible CDMA base station emulator</td>
</tr>
<tr>
<td>E1963A</td>
<td>W-CDMA mobile test application</td>
</tr>
<tr>
<td>E1963A-403</td>
<td>HSDPA test modes</td>
</tr>
<tr>
<td>E1963A-405</td>
<td>HSDPA 14.4Mbps test mode</td>
</tr>
<tr>
<td>E1963A-413</td>
<td>HSUPA test modes</td>
</tr>
<tr>
<td>E1963A-423</td>
<td>HSPA+ test modes</td>
</tr>
<tr>
<td>E1999A-202</td>
<td>Enhanced fast device tune measurement</td>
</tr>
<tr>
<td>E1999A-206</td>
<td>Single channel GPS source</td>
</tr>
</tbody>
</table>

Feature Options List for W-CDMA/HSPA

<table>
<thead>
<tr>
<th>Model number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1963A-401</td>
<td>End-to-end video</td>
</tr>
<tr>
<td>E1963A-402</td>
<td>Video loopback</td>
</tr>
<tr>
<td>E1963A-403</td>
<td>HSDPA test modes</td>
</tr>
<tr>
<td>E1963A-405</td>
<td>HSDPA 14.4Mbps test mode</td>
</tr>
<tr>
<td>E1963A-408</td>
<td>Enhanced Audio (real-time vocoder, WB-AMR, DAI)</td>
</tr>
<tr>
<td>E1963A-409</td>
<td>Adv. SMS</td>
</tr>
<tr>
<td>E1963A-413</td>
<td>HSUPA test modes</td>
</tr>
<tr>
<td>E1963A-423</td>
<td>HSPA+ test modes</td>
</tr>
</tbody>
</table>

1 Requires use of external source
2 Requires use of external spectrum analyzer
3 Requires use of external spectrum analyzer and source
4 Internal fading is possible using Baseband Studio. Most of these tests require external instrumentation such as faders. Consult TS34.121 for details.
5 Requires Feature option license
Related Literature
Agilent 8960 Wireless Communications Test Set HSPA Applications, photocard, 5989-7515EN

Concepts of HSDPA, application note, 5989-2365EN

HSDPA in the Agilent Technologies 8960 Wireless Communications Test Set, application note, 5989-3444EN

8960 Series 10 Wireless Communications Test Set, configuration guide, 5968-7873E

Technical Specifications
These specifications apply to an E5515C mainframe with Option 003 (or E5515B/T upgraded to equivalent configuration) when used with the latest E1963A test application or the E1987A test application.

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.

For More Information
Learn more about the E1963A test application and Options 403 and 413 for HSPA at:
www.agilent.com/find/E1963A
www.agilent.com/find/8960news

For details on the manufacturing test solutions visit:
www.agilent.com/find/8960mfg

What Included in This Technical Overview
This data sheet is organized in four sections:
• HSPA Specifications
• W-CDMA Specifications
• HSPA and W-CDMA Common Technical Specifications
• General Specifications
HSPA/HSPA+ Specifications
(E1963A Option 403, 405, 413 and 423)

Call connection types
HSPA FDD test mode
HSPA FDD test modes are supported by the E1963A. FDD test mode provides Layer 1 functionality only. No higher-level signaling is provided or accepted. No higher-level call processing operations are performed. The test set assumes that the user has appropriately configured the UE.

FDD test mode allows you to test the parametric performance of your UE’s transmitter and receiver without call processing. In FDD test mode, the test set does not send any 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 an 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.


FRC H-Set support

<table>
<thead>
<tr>
<th>H-Set</th>
<th>Modulation</th>
<th>Nominal avg. inf. Bit rate (Mbps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>QPSK, 16QAM</td>
<td>0.534, 0.777</td>
</tr>
<tr>
<td>2</td>
<td>QPSK, 16QAM</td>
<td>0.801, 1.166</td>
</tr>
<tr>
<td>3</td>
<td>QPSK, 16QAM</td>
<td>1.601, 2.332</td>
</tr>
<tr>
<td>4</td>
<td>QPSK</td>
<td>0.534</td>
</tr>
<tr>
<td>5</td>
<td>QPSK</td>
<td>0.801</td>
</tr>
<tr>
<td>6</td>
<td>QPSK, 16QAM</td>
<td>3.219, 5.689</td>
</tr>
<tr>
<td>8</td>
<td>64QAM</td>
<td>13.252</td>
</tr>
<tr>
<td>10</td>
<td>QPSK, 16QAM</td>
<td>4.68, 8.774</td>
</tr>
</tbody>
</table>

HSPA RB test mode
RB test mode uses signaling to establish a test control connection between the test set and UE, allowing you to test the parametric performance of your UE’s transmitter and receiver. In RB test mode, the test set provides signaling to establish a connection between the UE and the test set. The test set can also signal the UE to change its configuration and alter the uplink signal. The test set measures the uplink signal to determine the UE’s transmitter and receiver performance. RB test mode is operated on the downlink, simultaneously supporting a symmetrical RMC (Reference Measurement Channel) of 12.2 kbps. This symmetrical RMC is typically used for transmitter testing and receiver testing using BER.


HSPA handovers
To support the HSPA tests and sub-test conditions specified in the 3GPP standards, the Transport Channel Reconfiguration procedure allows you to change HSPA parameters while on a live connection. $\beta_c$, $\beta_d$, $\Delta$ACK,$\Delta$NACK, $\Delta$CQI, CQI feedback cycle ($k$), CQI repetition factor, Ack-Nack repetition factor, and default DPCH offset (DOFF) parameters can all be modified without dropping the HSPA connection. In addition, when using the user-defined DL configuration for HSDPA in RB test mode, the number of HARQ processes and UE IR buffer size can be changed on a live HSDPA connection to provide flexibility in testing multiple configurations.

The Radio Bearer Reconfiguration allows you to handover from a CS Domain or CS/PS Domain HSDPA RB Test Mode connection or HSPA RB Test Mode connection to a (non-HSDPA/non-HSPA) symmetrical RMC. The Radio Bearer Reconfiguration also allows you to change many other network parameters as part of the reconfiguration.

You can also hand over between channels within a band and between bands using the Physical Channel Reconfiguration procedure. This allows you to test channels in the low, middle, and high frequency portions of each UE-supported band without dropping the HSPA connection.


Inter-system handovers
Almost all UEs support multiple formats today. To speed the process of testing multiple formats with call processing, you can perform handovers from HSPA to GSM and from HSPA to W-CDMA. If your test plan requires testing HSPA followed by GSM, GPRS, and/or EGPRS, you can hand over from an HSPA FRC to GSM test mode using the system handover. If your test plan requires testing W-CDMA as well, you can hand over from an HSPA FRC to a W-CDMA RMC, then use the existing W-CDMA RMC to GSM test mode system handover to test GSM, GPRS, and/or EGPRS.


HSDPA user-defined downlink
Verify your device’s HSDPA throughput at the MAC-hs level with the user-defined downlink (DL) in the E1983A Option 403 and 405. Flexibly configure the 8960 to provide up to a 14.4 Mbps Radio Bearer (RB) test mode signal for testing HS-DSCH category 9 and 10 devices by setting the number of active HS-PDSCHs, transport block size index, modulation type, inter-TTI, number of HARQ processes, and UE incremental redundancy (IR) buffer size. HSPA+ option supports DL 64QAM and throughput is up to 21 Mbps.

HSPA RF generator

W-CDMA channels active in HSPA mode

<table>
<thead>
<tr>
<th>Channel</th>
<th>(spread factor)</th>
<th>Default assignment</th>
<th>Alternate choices</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPICH (256)</td>
<td>256</td>
<td>0</td>
<td>--</td>
</tr>
<tr>
<td>P-CCPCH (256)</td>
<td>256</td>
<td>1</td>
<td>--</td>
</tr>
<tr>
<td>PICH (256)</td>
<td>256</td>
<td>16</td>
<td>channel code settable</td>
</tr>
<tr>
<td>DPCH, 12.2 kpbs RMC</td>
<td>(128)</td>
<td>20</td>
<td>within available code</td>
</tr>
</tbody>
</table>

HSDPA

<table>
<thead>
<tr>
<th>Channel</th>
<th>(spread factor)</th>
<th>Default assignment</th>
<th>Alternate choices</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS-SCCH-1 (128)</td>
<td>(128)</td>
<td>2</td>
<td>channel code settable</td>
</tr>
<tr>
<td>HS-SCCH-2 (128)</td>
<td>(128)</td>
<td>6</td>
<td>within available code</td>
</tr>
<tr>
<td>HS-SCCH-3 (128)</td>
<td>(128)</td>
<td>9</td>
<td>range</td>
</tr>
<tr>
<td>HS-SCCH-4 (128)</td>
<td>(128)</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>HS-PDSCH (16)</td>
<td>(16)</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>OCNS HSDPA (128)</td>
<td>(128)</td>
<td>122, 123, 124, 125, 126, 127</td>
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</tbody>
</table>

HSUPA

<table>
<thead>
<tr>
<th>Channel</th>
<th>(spread factor)</th>
<th>Default assignment</th>
<th>Alternate choices</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-AGCH (256)</td>
<td>(256)</td>
<td>42</td>
<td>channel code settable</td>
</tr>
<tr>
<td>E-HICH (128)</td>
<td>(128)</td>
<td>22</td>
<td>within available code</td>
</tr>
<tr>
<td>E-RGCH (128)</td>
<td>(128)</td>
<td>22</td>
<td>range</td>
</tr>
</tbody>
</table>

Common pilot channel relative level: -20 to 0 dB

Primary CCPCH relative level: -20 to 0 dB

PICH relative level: -20 to 0 dB

DPCH relative level: settable from -30 to 0 dB with 0.01 dB resolution

HS-SCCH relative level of individual code channels:
HS-SCCH channel can be off but at least one channel is in presence. For 64QAM downlink, at least two channels are in presence. the channel level is settable from -20 to 0 dB

HS-PDSCH relative level of all active code channels:
settable from -20 to 0 dB

Primary sync channel relative level: always the same as P-CCPCH

Downlink CDMA modulation

Modulation type: QPSK, 16QAM and 64 QAM per 3GPP standard

QPSK residual EVM: < 10%, typically < 3%

QPSK carrier feed through: < -25 dBc, typically < -35 dBc
nominal ambient performance: < -45 dBc

16QAM residual EVM: typically < 3%

16QAM carrier feed through: typically < -35 dBc
nominal ambient performance: < -45 dBc

OCNS – orthogonal channel noise source
composed of 6 channels per Table E.5.5 in Annex E of 3GPP 34.121. OCNS channel can be off but at least 1 OCNS channel is in presence.

OCNS channel relative level range: automatically calculated from other code channel relative levels to provide the composite W-CDMA cell power, but user-allocated channel level available.

http://wireless.agilent.com/RFcomms/refdocs/wcdma/wcdma_gen_bse_gen_info.php#BCGCBAHE
HSPA RF analyzer (measurements only)

Real-time demodulation of: uplink – DPCH, HS-DPCCH, E-DCH

Tx measurements
Channel power measurement
Measurement bandwidth
  RRC filter off: measured with a bandwidth greater than \((1 + \alpha) \cdot \text{chip rate}\), where \(\alpha = 0.22\) and chip rate = \(3.84\, \text{Mcps}\)
  RRC filter on: measured with a filter that has a root-raised cosine (RRC) filter response with roll-off \(\alpha = 0.22\) and a bandwidth equal to the chip rate \(3.84\, \text{MHz BW} \) centered on the active uplink channel)

Measurement range: \(-61\) to \(+28\, \text{dBm/3.84 MHz}\)

Measurement interval: settable from 0.01 to 12 ms

Measurement accuracy (at \(\pm\, 10\, ^\circ\text{C}\) from the calibration temperature):
  \(< \pm1.0\, \text{dB (typically } < \pm0.5\, \text{dB)}\) for measurement intervals of 333 \(\mu\text{s}\) to 12 \(\text{ms}\) over 698 to 1024 MHz, 1400 to 1500 MHz and 1700 to 2000 MHz
  \(< \pm1.0\, \text{dB (typically } < \pm0.55\, \text{dB)}\) for measurement intervals of 333 \(\mu\text{s}\) to 12 \(\text{ms}\) over 2480 to 2580 MHz,
  \(< \pm1.0\, \text{dB (typically } < \pm0.6\, \text{dB)}\) for measurement intervals of 67 to \(< 333\, \mu\text{s}\) over 698 to 1024 MHz, 1400 to 1500 MHz and 1700 to 2000 MHz

Measurement triggers: auto, immediate, protocol, RF rise, external, and HS-DPCCH


Phase discontinuity
Measurement method: the measured results include the phase discontinuity (defined as the phase difference of adjacent timeslots) as well as all waveform quality results for each timeslot

Input power level range:
  Phase discontinuity: \(-61\) to \(+28\, \text{dBm}/3.84\, \text{MHz}\)
  Other measurements: \(-25\) to \(+28\, \text{dBm}/3.84\, \text{MHz}\)

Input frequency ranges: 800 to 1000 MHz, 1700 to 1990 MHz

Phase discontinuity range: \(\pm180\, \text{degrees}\)

EVM range: 0 to 35\% rms

Phase discontinuity measurement accuracy:
  \(< \pm2.4\, \text{degrees (typically } < \pm1.7\, \text{degrees)}\) for input levels of \(-25\) to \(+28\, \text{dBm}/3.84\, \text{MHz}\)
  \(< \pm2.6\, \text{degrees (typically } < \pm1.8\, \text{degrees)}\) for input levels of \(-51\) to \(< -25\, \text{dBm}/3.84\, \text{MHz}\)

Other reported parameters with phase discontinuity: all measurements found in the waveform quality measurement are also available; the specifications are the same in both measurements, including the input power range of the waveform quality measurement

Measurement interval: 617 \(\mu\text{s} = (1\, \text{timeslot } (667\, \mu\text{s}) - 25\, \mu\text{s transient periods at either side of the nominal timeslot boundaries})\) or 283 \(\mu\text{s} (0.5\, \text{timeslot } (333\, \mu\text{s}) - 25\, \mu\text{s transient periods at either side of the nominal timeslot boundaries})\)

Measurement triggers: protocol, external, and HS-DPCCH

Temperature range: \(+20\) to \(+55\, ^\circ\text{C}\)

Concurrency capabilities: phase discontinuity measurements cannot be made concurrently with other measurements

Waveform quality measurement (HSDPA)

**Waveform quality measurement**: composite EVM

**Measurement format**: HPSK

**Measurement chip rate**: 3.84 Mcps

**Input level range**: -25 to +28 dBm/3.84 MHz

**Measurement range**: ≤ 35% EVM

**Measurement interval**: 0.5 to 1.0 timeslot with choice to include or exclude 25 µs transient periods

**EVM measurement accuracy (including the effects of residual EVM)**:

![](image1)

**Residual frequency error**:

- < ±(5 Hz + timebase accuracy) for a measurement interval of 1 timeslot
- < ±(7 Hz + timebase accuracy) for a measurement interval of 0.5 timeslot

**Frequency error measurement accuracy**:

![](image2)

**Peak code domain error accuracy**:

- < ±0.4 dB for code power levels > -25 dB

**Timing error measurement range**: ±10 µs

**Timing error measurement accuracy**: < ±0.5 chips ( ±130 ns)

**IQ tuning**

All measurements found in the waveform quality measurement are also available in the IQ tuning measurement; the specifications are the same in both measurements.

**Measurement triggers**: auto, protocol, immediate, external, and HS-DPCCH

**HS-DPCCH trigger alignment**: adjustable over subframes 0 to 5

**timeslots Ack Nack or CDI

**subslots 0 to 0.5 timeslot

**Other reported parameters with EVM**:

- frequency error
- magnitude error
- phase error
- origin offset
- timing error
- peak code domain error

**Frequency error measurement range**: ±1 kHz
HSPA Code domain power
Code domain power accuracy:
< ±0.4 dB for code power level > -25 dB

Relative code domain error (RCDE) accuracy:
< ±0.5 dB for RCDE level > -20 dB

Relative code domain power accuracy (RCDPA):
< ±0.2 dB for code power level from ≥ -10 to 0 dB
< ±0.3 dB for code power level from ≥ -15, -10 dB
< ±0.4 dB for code power level from ≥ -20, -15 dB

All measurements found in the waveform quality measurement are also available in the code domain measurement; the specifications are the same in both measurements.

Measurement triggers: immediate, protocol, external, auto, HS-DPCCH and Even Frame


Dynamic power analysis
Measurement method: graphical display of the uplink power waveform including HS-DPCCH, DPCH versus time; by using the HS-DPCCH trigger source, results will be aligned to the HS-DPCCH

Input power level range: -61 to +28 dBm/3.84 MHz

Measurement level ranging: auto

Data capture range: combination of number of steps and step length cannot exceed 58.26 ms

Measurement bandwidth: selectable RRC filter on or off

Measurement interval: settable from 0.01 to 12 ms (must be less than or equal to the step length)

Measurement accuracy: (at +10 °C from calibration temperature with measurement interval 333 µs to 12 ms):

<table>
<thead>
<tr>
<th>Input level range</th>
<th>Measurement accuracy</th>
<th>Frequency range</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 25 dB</td>
<td>&lt; ±1.0 dB,</td>
<td>800 to 1000 MHz</td>
</tr>
<tr>
<td></td>
<td>typically &lt; ±0.5 dB</td>
<td>1700 to 2000 MHz</td>
</tr>
<tr>
<td></td>
<td>&lt; ±1.0 dB,</td>
<td>2480 to 2580 MHz</td>
</tr>
<tr>
<td></td>
<td>typically &lt; ±0.55 dB</td>
<td></td>
</tr>
<tr>
<td>&lt; 35 dB</td>
<td>&lt; ±1.0 dB,</td>
<td>800 to 1000 MHz</td>
</tr>
<tr>
<td></td>
<td>typically &lt; ±0.55 dB</td>
<td>1700 to 2000 MHz</td>
</tr>
<tr>
<td></td>
<td>&lt; ±1.0 dB,</td>
<td>2480 to 2580 MHz</td>
</tr>
<tr>
<td></td>
<td>typically &lt; ±0.6 dB</td>
<td></td>
</tr>
<tr>
<td>&lt; 40 dB</td>
<td>&lt; ±1.0 dB,</td>
<td>800 to 1000 MHz</td>
</tr>
<tr>
<td>with RRC filter on</td>
<td>typically &lt; ±0.55 dB</td>
<td>1700 to 2000 MHz</td>
</tr>
<tr>
<td></td>
<td>&lt; ±1.0 dB,</td>
<td>2480 to 2580 MHz</td>
</tr>
<tr>
<td></td>
<td>typically &lt; ±0.7 dB</td>
<td></td>
</tr>
</tbody>
</table>

Measurement triggers: RF rise, external, and HS-DPCCH

HS-DPCCH trigger alignment: adjustable over subframes 0 to 5


Adjacent channel leakage ratio (ACLR)
Measurement method: ratio of the filtered mean transmitted power to the filtered mean power in an adjacent channel; both the transmitted and the adjacent channel powers are measured with a filter that has a RRC response with roll-off α = 0.22 and a bandwidth equal to the chip rate

Input power level range: +5 to +28 dBm/3.84 MHz

Input frequency ranges: 698 to 1000 MHz, 1400 to 1500 MHz, 1700 to 2000 MHz, and 2480 to 2580 MHz

Measurement level ranging: auto

Measurement accuracy: < ±0.8 dB (typically < ±0.5 dB), including the effects of the residual floor, for measurements at -33 dBc at ±5 MHz offsets and -43 dBc at ±10 MHz offsets, and ±10 °C from the calibration temperature

Residual ACLR floor: < -48 dBc for ±5 MHz offsets, < -58 dBc for ±10 MHz offsets

Measurement triggers: auto, protocol, immediate, external, HS-DPCCH

Trigger alignment: adjustable over subframes 0 to 5

Measurement interval: 1 timeslot

Measurement result: dBC relative to in-channel transmitted power

**Spectrum emission mask (SEM)**

**Measurement method:** ratio of the transmitted power (3.84 MHz BW RRC) to offset frequencies, which are between 2.5 MHz and 12.5 MHz away from the UE center carrier frequency; the offset frequencies are measured in 30 kHz or 1 MHz bandwidths, depending on the offset

**Input power level range:** +5 to +28 dBm/3.84 MHz

**Input frequency ranges:** 698 to 1000 MHz, 1400 to 1500 MHz, 1700 to 2000 MHz, and 2480 to 2580 MHz

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

<table>
<thead>
<tr>
<th>Frequency offset</th>
<th>Levels (dBc)</th>
<th>Meas BW</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5 to 3.5 MHz</td>
<td>-35 – 15 * Δf/MHz - 2.5</td>
<td>30 kHz</td>
</tr>
<tr>
<td>3.5 to 7.5 MHz</td>
<td>-35 – 1 * Δf/MHz - 3.5</td>
<td>1 MHz</td>
</tr>
<tr>
<td>7.5 to 8.5 MHz</td>
<td>-39 – 10 * Δf/MHz - 7.5</td>
<td>1 MHz</td>
</tr>
<tr>
<td>8.5 to 12.5 MHz</td>
<td>-49</td>
<td>1 MHz</td>
</tr>
</tbody>
</table>

Basic requirement of SEM measurement for all bands

**Additional requirement of SEM measurement for Band II, IV and X**

<table>
<thead>
<tr>
<th>Frequency offset</th>
<th>Levels (dBm)</th>
<th>Meas BW</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5 to 3.5 MHz</td>
<td>-15dBm</td>
<td>30 kHz</td>
</tr>
<tr>
<td>3.5 to 12.5 MHz</td>
<td>-13dBm</td>
<td>1 MHz or 100KHz</td>
</tr>
</tbody>
</table>

Additional requirement of SEM measurement for Band V

<table>
<thead>
<tr>
<th>Frequency offset</th>
<th>Levels (dBm)</th>
<th>Meas BW</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5 to 3.5 MHz</td>
<td>-15dBm</td>
<td>30 kHz</td>
</tr>
<tr>
<td>3.5 to 12.5 MHz</td>
<td>-13dBm</td>
<td>1 MHz or 100KHz</td>
</tr>
</tbody>
</table>

Additional requirement of SEM measurement for band XII, XIII and XIV

**Measurement triggers:** auto, protocol, immediate, external, and HS-DPCCH

**HS-DPCCH trigger alignment:** adjustable over subframes 0 to 5

**Rx measurements**

**HSDPA/HSPA+ block error ratio**

**Measurement method:** test set counts the ACK/NACK/statDTX on UE HS-DPCCH and uses the results to calculate BLER

**BLER measurement input level range:** -50 to +28 dBm/3.84 MHz

**Reported parameters:** measured BLER, number of blocks tested, throughput, number of ACKs, number of NACKs, number of stat DTXs, and median CQI

**Concurrency capability:** HSDPA BLER measurements cannot be made concurrently with phase discontinuity, PRACH Tx on/off, or inner loop power measurements, or while speech is provided on the downlink; HSDPA BLER measurements can be made concurrently with all other measurements, including W-CDMA loopback BER and BLER


**HSDPA bit error ratio**

**Measurement method:** the 8960 can be configured so that BER can be measured externally using the 8960 downlink and external UE monitoring software


---

3 This spec is only for basic requirement setting of SEM
**W-CDMA Specifications**

**Call connection types**

**End-to-end video conferencing (Option 401)**

Imaging testing real-time mobile video conferencing at your own desk!

The E1963A, when configured as a two-instrument system, provides true H324 call setup with live video and audio from both mobile devices.

With only one E5515C, Loop back video call can be setup with option 402.

Validate compatibility by testing interoperability between your mobile and the competitor models offered for the same network.

- complete call setup, mobile origination, and mobile release
- 64k circuit-switched UDI channel
- H324 call setup


**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


**FDD test mode**

FDD test mode allows you to test the parametric performance of your UE’s transmitter and receiver without call processing. In FDD 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**
- **Symmetrical configuration:** W-CDMA modes support symmetrical RMCs at 12.2, 64, 144 and 384 k rates. These symmetrical RMCs are typically used for transmitter testing and receiver testing user BER (via loopback type 1) or BLER (via loopback type 2)
- **Asymmetric configuration:** the asymmetrical RMCs use either a 12.2 k channel or a 64 k channel on the uplink. The primary purpose of the symmetrical RMCs is to provide a way to make a BLER measurement by counting retransmission requests that the UE sends. There is no need for data loopback in this mode


**Inter-system handover**

Dual-mode functionality is required for most W-CDMA 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.

When operated in conjunction with compressed mode, this feature can very closely emulate the basics of a real handover as made on the network.

- blind handovers from W-CDMA to GSM
- configurable landing GSM cell
- test control to GSM voice
- W-CDMA AMR voice to GSM voice

**W-CDMA RF generator**

**W-CDMA channels**

<table>
<thead>
<tr>
<th>Channel (spread factor)</th>
<th>Default assignment</th>
<th>Alternate choices</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPICH (256)</td>
<td>0</td>
<td>--</td>
</tr>
<tr>
<td>P-CCPCH (256)</td>
<td>1</td>
<td>--</td>
</tr>
<tr>
<td>S-CCPCH (64)</td>
<td>7</td>
<td>All these channel codes are settable within respective available code range</td>
</tr>
<tr>
<td>AICH (256)</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>PICH (256)</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>DPCH, 3.4 kbps RMC (256)</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>DPCH, 12.2 kbps RMC (128)</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>DPCH, 64 kbps RMC (32)</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>DPCH, 144 kbps RMC (16)</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>DPCH, 384 kbps RMC (8)</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>OCNS (test model 1)</td>
<td>128</td>
<td></td>
</tr>
</tbody>
</table>

RF generator level accuracy is derived from the 99th percentile observations with 95% confidence (corresponds to an expanded uncertainty with a 95% confidence (k=2)) at ambient conditions, then qualified to include the environmental effects of temperature and humidity.

**RF IN/OUT cell power absolute output level accuracy**

**AWGN off:**

- $\pm 1.1$ dB, at -109 to -7 dBm/3.84 MHz and $< 2300$ MHz
- $\pm 1.5$ dB, typically $\pm 1.0$ dB, at -109 to -15 dBm/3.84 MHz and $\geq 2300$ MHz

**RF OUT ONLY cell power absolute output level accuracy**

**AWGN off:**

- $\pm 1.1$ dB, at -109 to -12 dBm/3.84 MHz and $< 2300$ MHz
- $\pm 1.5$ dB, typically $\pm 1.0$ dB, at -109 to -15 dBm/3.84 MHz and $\geq 2300$ MHz

**Common pilot channel relative level:** -20 to 0 dB

**Primary sync channel relative level:** always the same as P-CCPCH

**Secondary sync channel relative level:** always the same as P-CCPCH

**Primary CCPCH relative level:** -20 to 0 dB

**Downlink CDMA modulation**

- **Modulation type:** QPSK per 3GPP standard
- **Residual EVM:** $< 10\%$, typically $< 3\%$
- **Carrier feed through:** $< -25$ dBc, typically $< -35$ dBc, nominal ambient performance: $< -45$ dBc

**OCNS – orthogonal channel noise source**

- Composed of 16 channels per Table E.3.6 in Annex E of 3GPP 34.121
- **OCNS channel relative level range:** automatically calculated from other code channel relative levels to provide the set CDMA cell power

**Relative CDMA channel level accuracy:** $< \pm 0.2$ dB

**W-CDMA RF analyzer**
(measurements only)

Real-time demodulation of: uplink DPCH

**W-CDMA Tx measurements**

**Thermal power measurement**

Measurement bandwidth: > 5 MHz; if other signals are present outside of this frequency range, reduced measurement accuracy will result

Measurement data capture period: 10 ms

Measurement range: -10 to +28 dBm; usable to -20 dBm with degraded accuracy

Measurement level ranging: auto

Auto zero function: measurement automatically zeros the thermal power meter (no user control)

Measurement accuracy: (with 10 internal averages)
- 375 to 500 MHz < ±6.6%, typically < ±3.0%
- 698 to 1000 MHz < ±6.0%, typically < ±3.0%
- 1400 to 1500 MHz < ±7.2%, typically < ±3.7%
- 1700 to 2000 MHz < ±7.2%, typically < ±3.7%
- 2480 to 2580 MHz < ±8.7%, typically < ±3.7%

Temperature range: +20 to +55 °C


**Channel power measurement**

Measurement bandwidth

RRC filter off: measured with a bandwidth greater than \((1 + \alpha) \cdot \text{chip rate}\), where \(\alpha = 0.22\) and chip rate = 3.84 Mc/s

RRC filter on: measured with a filter that has a root-raised cosine (RRC) filter response with roll-off \(\alpha = 0.22\) and a bandwidth equal to the chip rate (3.84 MHz BW centered on the active uplink channel)

Measurement range: -61 to +28 dBm/3.84 MHz

Measurement interval: settable from 0.01 to 12 ms

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

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

- < ±1.0 dB (typically < ±0.5 dB) for measurement intervals of 333 µs to 12 ms over 698 to 1024 MHz, 1400 to 1500 MHz and 1700 to 2000 MHz
- < ±1.0 dB (typically < ±0.55 dB) for measurement intervals of 333 µs to 12 ms over 2480 to 2580 MHz
- < ±1.0 dB (typically < ±0.55 dB) for measurement intervals of 67 to < 333 µs over 698 to 1024 MHz, 1400 to 1500 MHz and 1700 to 2000 MHz

Temperature range: +20 to +55 °C

Temperature drift: typically 0.1 dB per 10 °C temperature change

Fast device tune measurement

Description: Allows simultaneous calibration of a device’s Tx output power and Rx input level across level and frequency in a single sweep (per frequency band). The device must operate in a test mode which forces it to transmit a predefined series of power steps at various uplink frequencies, and also forces it to simultaneously tune its receiver to perform measurements (such as RSSI) of the test set’s signal at various downlink frequencies and power levels.

Input frequency ranges: 698 to 1000 MHz, 1400 MHz to 1500 MHz, 1700 to 1990 MHz, and 2480 to 2580 MHz

Tx power measurement input level range: -61 to +28 dBm/3.84 MHz

Tx power measurement level change between adjacent steps:
- < 20 dB for 20 ms step size
- < 10 dB for 10 ms step size

Tx power measurement accuracy (at ±10 degrees from calibration temperature): < ±1.0 dB

Rx level output range at RF IN/OUT port: -109 to -15 dBm/3.84 MHz

Rx level output range at RF OUT ONLY port: -109 to -7 dBm/3.84 MHz

Rx level change between adjacent steps: < 20 dB

Rx level accuracy with W-CDMA modulation: < ±1.1 dB

Rx level setting: < 5.1 ms to be within 0.1 dB

Concurrency capabilities: fast device tune measurements cannot be made concurrently with other measurements

Waveform quality measurement

Waveform quality measurement: composite EVM
Measurement format: HPSK
Measurement chip rate: 3.84 Mcps
Input level range: -25 to +28 dBm/3.84 MHz
Measurement range: ≤ 35% EVM
Measurement interval: 1 timeslot

Measurement accuracy (including the effects of residual EVM):

EVM measurement accuracy:
< 2.8% rms, typically < 2.4% rms, for UE EVM ≥ 1% rms, < 2200 MHz
< 3.2% rms, typically < 2.8% rms, for UE EVM ≥ 1% rms, 2300 to 2580 MHz

Other reported parameters with EVM:
- frequency error
- magnitude error
- phase error
- origin offset
- timing error
- peak code domain error

Frequency error measurement range: ±1 kHz

Residual frequency error: < ± (5 Hz + timebase accuracy)

Peak code domain error accuracy: < ±0.3 dB for levels > -25 dB
Timing error measurement range: ± 10 µs
Timing error measurement accuracy: < ±0.5 chips (±130 ns)
Temperature range: +20 to +55 °C


IQ tuning
All measurements found in the waveform quality measurement are also available in the IQ tuning measurement; the specifications are the same in both measurements.

Adjacent channel leakage ratio (ACLR)

Measurement method: ratio of the filtered mean transmitted power to the filtered mean power in an adjacent channel; both the transmitted and the adjacent channel powers are measured with a filter that has a RRC response with roll-off $\alpha = 0.22$ and a bandwidth equal to the chip rate.

Input power level range: $+5$ to $+28$ dBm/3.84 MHz

Input frequency ranges: 698 to 1000 MHz, 1400 to 1500 MHz, 1700 to 2000 MHz, and 2480 to 2580 MHz

Measurement level ranging: auto

Measurement triggers: auto, protocol, immediate, and external

Measurement interval: 1 timeslot

Measurement result: dBC relative to in-channel transmitted power

Measurement accuracy: $\leq \pm 0.8$ dB (typically $\leq \pm 0.5$ dB) including the effects of the residual floor, for measurements at $-33$ dBC at $\pm 5$ MHz offsets and $-43$ dBC at $\pm 10$ MHz offsets, and $\pm 10$ °C from the calibration temperature

Residual ACLR floor: $< -53$ dBC for $\pm 5$ MHz offsets, $< -63$ dBC for $\pm 10$ MHz offsets

Temperature range: $+20$ to $+55$ °C


Occupied bandwidth (OBW)

Measurement method: bandwidth containing 99% of the total integrated power of the transmitted signal, centered on the channel frequency

Input power level range: $+5$ to $+28$ dBm

Input frequency ranges: 800 to 1000 MHz, 1700 to 1990 MHz

Measurement accuracy: $\leq \pm 0.6$ kHz

Measurement triggers: auto, protocol, immediate, and external

Temperature range: $+20$ to $+55$ °C

http://wireless.agilent.com/rfcmmms/refdocs/wcdma/wcdma_meas_occup_bw_desc.php

Spectrum emission mask (SEM)

Measurement method: ratio of the transmitted power (3.84 MHz BW RRC) to offset frequencies, which are between 2.5 and 12.5 MHz away from the UE center carrier frequency; the offset frequencies are measured in 30 kHz or 1 MHz bandwidths, depending on the offset.

Input power level range: $+5$ to $+28$ dBm/3.84 MHz

Input frequency ranges: 698 to 1000 MHz, 1400 to 1500 MHz, 1700 to 2000 MHz, and 2480 to 2580 MHz

Measurement accuracy: $\leq \pm 1.5$ dB (typically $\leq \pm 0.8$ dB) for the following offsets ($\pm 10$ °C from the calibration temperature):

<table>
<thead>
<tr>
<th>Frequency offset</th>
<th>Levels (dBC)</th>
<th>Meas BW</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5 to 3.5 MHz</td>
<td>$\frac{-35 - 15 \cdot \Delta f}{\text{MHz}} : 2.5$</td>
<td>30 kHz</td>
</tr>
<tr>
<td>3.5 to 7.5 MHz</td>
<td>$\frac{-35 - 1 \cdot \Delta f}{\text{MHz}} : 3.5$</td>
<td>1 MHz</td>
</tr>
<tr>
<td>7.5 to 8.5 MHz</td>
<td>$\frac{-39 - 10 \cdot \Delta f}{\text{MHz}} : 7.5$</td>
<td>1 MHz</td>
</tr>
<tr>
<td>8.5 to 12.5 MHz</td>
<td>-49</td>
<td>1 MHz</td>
</tr>
</tbody>
</table>

Measurement triggers: auto, protocol, immediate, and external


Code domain power

Code domain power accuracy: $\leq \pm 0.3$ dB for code power level $> -25$ dB

All measurements found in the waveform quality measurement are also available in the code domain measurement; the specifications are the same in both measurements


PRACH transmit on/off power

Measurement method: the measure of the ON power of the PRACH preamble burst, along with the OFF power preceding the burst and the OFF power following the burst

Input power level range:
- ON power: $-40$ to $+28$ dBm/3.84 MHz
- OFF power: $-61$ to $-55$ dBm/3.84 MHz

Input frequency ranges: 800 to 1000 MHz, 1700 to 1990 MHz

Measurement accuracy: $\leq \pm 1.0$ dB (typically $\leq \pm 0.5$ dB) within $\pm 10$ °C from the calibration temperature

Nominal trigger range: expected power $\pm 9$ dB

Temperature range: $+20$ to $+55$ °C

Concurrency capabilities: PRACH Tx on/off measurements cannot be made concurrently with other measurements


4 Refer to HSPA SEM spec in page 9 for additional requirements
Phase discontinuity

Measurement method: the measured results include the phase discontinuity (defined as the phase difference of adjacent timeslots) as well as all waveform quality results for each timeslot

Input power level range:
- Phase discontinuity: -61 to +28 dBm/3.84 MHz
- Other measurements: -25 to +28 dBm/3.84 MHz

Input frequency ranges: 800 to 1000 MHz, 1700 to 1990 MHz

Phase discontinuity range: ±180 degrees

EVM range: 0 to 35% rms

Phase discontinuity measurement accuracy:
- < ±2.4 degrees (typically < ±1.7 degrees) for input levels of -25 to +28 dBm/3.84 MHz
- < ±2.6 degrees (typically < ±1.9 degrees) for input levels of -51 to < -25 dBm/3.84 MHz

Other reported parameters with phase discontinuity: all measurements found in the waveform quality measurement are also available; the specifications are the same in both measurements, including the input power range of the waveform quality measurement

Measurement interval: 617 µs (= 1 timeslot (667 µs) – 25 µs transient periods at either side of the nominal timeslot boundaries)

Measurement trigger: protocol and external

Temperature range: +20 to +55 °C

Concurrency capabilities: phase discontinuity measurements cannot be made concurrently with other measurements


Tx dynamic power measurement

Measurement method: captures a user-defined trace consisting of 20, 40, or 80 ms duration power steps with user-defined step size produced by a test mode in the UE under test; measures the total power in a 3.84 MHz bandwidth centered on the active uplink center frequency in each step period

Measurement data capture period: 667 µs

Measurement trigger: Tx signal output by the mobile station must provide a pulse (off-on-off) followed by the stepped power burst beginning at the user specified output power

Measurement range: -61 to +28 dBm/3.84 MHz

Measurement level ranging: none; user must set the test set’s receiver power control field to manual and set the receiver power to the expected full power of the power sweep produced by the UE

Measurement accuracy: (calibrated against average power and within ±10 degrees of calibration temperature; calibration must occur between 20 to 55 °C);
- < ±1.0 dB (typically < ±0.5 degrees) over 15 to 55 °C, 698 to 1000 MHz, 1400 to 1500 MHz and 1700 to 2000 MHz
- < ±1.0 dB (typically < ±0.55 dB) over 15 to 55 °C and 2480 to 2580 MHz

Measurement step duration (time): 20, 40, or 80 ms

Measurement step size: -90.00 to -0.01 dB

Measurement number of steps: 0 to 99

Measurement result: a graph displaying the discrete power at each power step along with numeric power results for each step

Measurement graphical controls: marker on/off with position, trace start step, trace span, and return to default scale

Concurrency capabilities: Tx dynamic power measurements cannot be made concurrently with other measurements

Calibrate function: uses the channel power calibration function

Extended range dynamic power measurement

Measurement method: allows measurement of a UE’s transmitter output power across its entire dynamic power (up to 90 dB) in one measurement cycle. This measurement requires the UE be put into a test mode which forces it to transmit up to two power sequences and analyzes the resulting UE output power using the test set.

Measurement bandwidth: selectable RRC filter on or off

Measurement range: -61 dBm to +28 dBm/3.84 MHz

Measurement accuracy:
- ±1.0 dB, typically ±0.5 dB at top 25 dB of dynamic range
- ±1.0 dB, typically ±0.55 dB at top 30 dB of dynamic range
- ±1.0 dB, typically ±0.55 dB at top 35 dB of dynamic range with RRC filter on

Measurement trigger: RF rise, external

Temperature range: +20 to +55°C

Temperature drift: typically < 0.1 dB per 10°C temperature change

Inner loop power

Measurement method: inner loop power control in the uplink is the ability of the UE transmitter to adjust its output power in accordance with one or more TPC commands received in the downlink; the absolute and relative power is reported for each power step.

Measurement range: -61 to +28 dBm/3.84 MHz

Input frequency ranges: 800 to 1000 MHz, 1700 to 1990 MHz

Measurement accuracy:
- Absolute power: < ±1.0 dB, typically < ±0.5 dB
- Relative power:
  - < ±0.1 dB for range ≤ 1.5 dB (-51 to +28 dBm/3.84 MHz)
  - < ±0.184 dB for range ≤ 1.5 dB (-61 to -51 dBm/3.84 MHz)
  - < ±0.15 dB for range ≤ 3 dB (-51 to +28 dBm/3.84 MHz)
  - < ±0.174 dB for range ≤ 3 dB (-61 to -51 dBm/3.84 MHz)
  - < ±0.3 dB for range ≤ 26 dB (-61 to +28 dBm/3.84 MHz)

Temperature range: +20 to +55 °C

Temperature drift: typically < 0.1 dB per 10 °C temperature change for the absolute power measurements; typically < 0.025, 0.02, and 0.05 dB over +20 to +55 °C temperature range for relative power ranges of 1.5, 3, and 26 dB respectively

Concurrency capabilities: inner loop power measurements cannot be made concurrently with other measurements.

Dynamic power analysis

Measurement method: graphical display of a series of channel power measurement for a user-defined number of steps and step lengths.

Input level range: -61 to +28 dBm/3.84 MHz

Data capture range: combination of number of steps and step length cannot exceed 58.26 ms

Measurement bandwidth: selectable RRC filter on or off

Measurement interval: settable from 0.01 to 12 ms (must be less than or equal to the step length)

Measurement accuracy: (at +10 °C from calibration temperature with measurement interval 333 µs to 12 ms):

<table>
<thead>
<tr>
<th>Input level range</th>
<th>Measurement accuracy</th>
<th>Frequency range</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 25 dB</td>
<td>&lt; ±1.0 dB, typically &lt; ±0.5 dB</td>
<td>800 to 1000 MHz</td>
</tr>
<tr>
<td></td>
<td>&lt; ±1.0 dB, typically &lt; ±0.55 dB</td>
<td>1700 to 2000 MHz</td>
</tr>
<tr>
<td></td>
<td>2480 to 2580 MHz</td>
<td></td>
</tr>
<tr>
<td>≤ 35 dB</td>
<td>&lt; ±1.0 dB, typically &lt; ±0.55 dB</td>
<td>800 to 1000 MHz</td>
</tr>
<tr>
<td></td>
<td>&lt; ±1.0 dB, typically &lt; ±0.6 dB</td>
<td>1700 to 2000 MHz</td>
</tr>
<tr>
<td></td>
<td>2480 to 2580 MHz</td>
<td></td>
</tr>
<tr>
<td>≤ 40 dB</td>
<td>&lt; ±1.0 dB, typically &lt; ±0.55 dB</td>
<td>800 to 1000 MHz</td>
</tr>
<tr>
<td>with RRC filter on</td>
<td>&lt; ±1.0 dB, typically &lt; ±0.7 dB</td>
<td>1700 to 2000 MHz</td>
</tr>
<tr>
<td></td>
<td>2480 to 2580 MHz</td>
<td></td>
</tr>
</tbody>
</table>

Measurement triggers: external, RF rise


Rx measurements

Loopback bit error ratio

Measurement method: data loopback (mode 1 in 3GPP TS 34.109)
BER measurement input level range: -50 to +28 dBm/3.84 MHz

Reported parameters:
Intermediate results: measured bit error ratio, number of errors, number of bits tested, uplink missing blocks, uplink CRC errors, and loopback delay
Final results: measured BER, number of errors, number of bits tested, uplink missing blocks, CRC errors, and loopback delay

Concurrency capabilities: BER measurements cannot be made concurrently with BLER, phase discontinuity, PRACH Tx on/off, or inner loop power measurements, or while speech is provided on the downlink; loopback BER measurements can be made concurrently with all other measurements


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

BLER measurement input level range: -50 to +28 dBm/3.84 MHz

Reported parameters: measured BLER, block error count, number of blocks tested, and uplink missing blocks

Concurrency capabilities: BLER measurements cannot be made concurrently with loopback BER, phase discontinuity, PRACH Tx on/off, or inner loop power measurements, or while speech is provided on the downlink; BLER measurements can be made concurrently with all other measurements

HSPA and W-CDMA Common Technical Specifications

RF generator

Downlink frequency
Frequency ranges (MHz):
- Band I (IMT-2000) 2112.4 to 2167.6
- Band II (US PCS) 1932.4 to 1987.6
- Band III (DCS/PCS) 1807.4 to 1877.6
- Band IV 2112.4 to 2152.6
- Band V (US Cellular) 871.5 to 887.5
- Band VI (Japan 800) 877.4 to 882.6
- Band VII (UMTS 2600) 2622.4 to 2687.6
- Band VIII (UMTS 900) 927.4 to 957.6
- Band IX (UMTS 1700) 1847.4 to 1949.4
- Band X (UMTS Extended) 728 to 746
- Band XI (UMTS 1500) 1430.4 to 1450.4
- Band XII (UMTS 700) 698 to 716
- Band XIII(UMTS 700) 777 to 787
- Band XIV(UMTS 700) 788 to 798

Frequency/Channel setting: by channel number or MHz (test mode only)
Frequency accuracy: same as timebase reference
Frequency setting resolution: 1 Hz


Downlink amplitude
Output port control: control of RF source routing to either the RF IN/OUT port or the RF OUT ONLY port

Composite signal level: the sum of the user-set values of the cell power and the AWGN source measured in a root-raised cosine filter response with a roll off α = 0.22 and a 3.84 MHz BW; if the cell power is ON, the AWGN level must be set to within -20 dB to +10 dB of the cell power. Note: The composite signal level is not settable, however it is reported by the test set

RF IN/OUT cell power output range: -115 to -13 dBm/3.84 MHz
RF IN/OUT AWGN signal output level range: -115 to -20 dBm/ 3.84 MHz
RF IN/OUT VSWR:
- 1.14:1, 400 to 500, 700 to 1000 MHz
- 1.2:1, 1700 to 2000 MHz
- 1.41, 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/3.84 MHz
RF OUT ONLY reverse power: +24 dBm peak (250 mW peak)

Measurement calibrate function: calibrates the channel power, ACLR, SEM, waveform quality, OBW, and code domain measurements over the specified frequency range of the test set against the thermal power measurement, no external cabling is required to perform this function

Measurement calibration time: < 180 seconds
Measurement calibration temperature range: valid ±10°C from previously calibrated temperature
AWGN channel relative level range: settable to -20 dB to +10 dB relative to the user-set CDMA cell power with 0.01 dB resolution

RF analyzer

Measurement input frequency ranges:
- 698 to 1000 MHz
- 1400 to 1500 MHz
- 1700 to 1990 MHz
- 2480 to 2580 MHz

Frequency ranges for uplink channels (MHz):
- Band I (IMT-2000) 1922.4 to 1977.6
- Band II (US PCS) 1852.4 to 1907.6
- Band III (DCS/PCS) 1712.4 to 1782.6
- Band IV 1712.4 to 1752.6
- Band V (US Cellular) 826.4 to 846.6
- Band VI (Japan 800) 832.4 to 837.6
- Band VII (UMTS 2600) 2502.4 to 2567.6
- Band VIII (UMTS 900) 882.4 to 912.6
- Band IX (UMTS 1700) 1752.4 to 1782.4
- Band X (UMTS Extended) 1712.4 to 1767.6
- Band XI (UMTS 1500) 1430.4 to 1450.4
- Band XII (UMTS 700) 698 to 716
- Band XIII(UMTS 700) 777 to 787
- Band XIV(UMTS 700) 788 to 798

Frequency/Channel setting: by channel number or MHz (test mode only)

Input level setting range: -70 to +30 dBm/3.84 MHz

Receiver ranging:
Auto (active closed loop power control): the test set uses TPC commands to the UE to adjust its transmit power as needed to achieve the "UE Target Power"
Manual mode: user enters expected power; provides calibrated results if actual power is within +9 dB of the user-entered level
Demodulation chip rate: 3.84 Mcps

Maximum input level: +37 dBm peak (5 W peak)
Amplitude scaling: settable from 0.1 to 20 dB/division in 0.1 dB steps
Trigger source: immediate, protocol, RF rise, external, auto
Trigger delay: settable between ±50 ms
Peak threshold: settable from -120 to +37 dBm
Peak excursion: settable from 1.2 to 100 dB
Trace functions: clear write, max hold, min hold
Detector type: peak or sample
Tx measurements

Spectrum monitor

Operating modes: active cell and test mode

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: 698 to 1000 MHz, 1400 to 1500 MHz, 1700 to 2000 MHz, and 2480 to 2580 MHz

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 dB</td>
</tr>
<tr>
<td>80 MHz</td>
<td>1 MHz</td>
<td>55 dB</td>
</tr>
<tr>
<td>40 MHz</td>
<td>300 kHz</td>
<td>60 dB</td>
</tr>
<tr>
<td>20 MHz</td>
<td>100 kHz</td>
<td>65 dB</td>
</tr>
<tr>
<td>12 MHz</td>
<td>100 kHz</td>
<td>65 dB</td>
</tr>
<tr>
<td>10 MHz</td>
<td>100 kHz</td>
<td>65 dB</td>
</tr>
<tr>
<td>5 MHz</td>
<td>30 kHz</td>
<td>70 dB</td>
</tr>
<tr>
<td>4 MHz</td>
<td>30 kHz</td>
<td>70 dB</td>
</tr>
<tr>
<td>2.5 MHz</td>
<td>10 kHz</td>
<td>75 dB</td>
</tr>
<tr>
<td>1.25 MHz</td>
<td>3 kHz</td>
<td>80 dB</td>
</tr>
<tr>
<td>500 kHz</td>
<td>1 kHz</td>
<td>80 dB</td>
</tr>
<tr>
<td>125 kHz</td>
<td>300 Hz</td>
<td>80 dB</td>
</tr>
<tr>
<td>0</td>
<td>1 MHz</td>
<td>55 dB</td>
</tr>
<tr>
<td>0</td>
<td>300 kHz</td>
<td>60 dB</td>
</tr>
<tr>
<td>0</td>
<td>100 kHz</td>
<td>65 dB</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

- ≤2 dB for signals within 50 dB of a reference level
- > -10 dBm and RBW < 5 MHz
- ≤2 dB for signals within 30 dB of a reference level
- > -10 dBm and RBW = 5 MHz using 5 averages,
- < ≤3.5 dB for signals > -70 dBm and within 50 dB of a reference level
- < ≤10 dBm with RBW < 5 MHz

Displayed average noise level: < -90 dBm for reference level of -40 dBm and 30 kHz bandwidth

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

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

Frequency resolution: 1 Hz

Marker amplitude resolution: 0.01 dB

Audio generator

Frequency
Operating range: 100 Hz to 20 kHz, typically 1 Hz to 20 kHz
Accuracy: same as timebase reference
Frequency resolution: 0.1 Hz

Output level (from AUDIO OUTPUT connector)
Ranges: 0 to 1 V peak, 1 to 9 V peak (into > 600 Ohms)
Accuracy: < ± (1.5% of setting + resolution) when output is DC coupled
Distortion: < 0.1% for 0.2 to 9 V peak into > 600 Ohms
Coupling mode: selectable as DC or AC (5 µF in series with output)
Typical maximum output current: 100 mA peak into 8 Ohms
Typical output impedance: < 1.5 Ohms at 1 kHz when output is DC coupled
Typical DC offset (when output is DC coupled):
< 1 mV peak for 0 to 1 V peak
< 10 mV peak for 1 to 9 V peak
Output level resolution: < 0.5 mV for 0 to 1 V peak output, < 5.0 mV for 1 to 9 V peak output

http://wireless.agilent.com/rfcoms/refdocs/wcdma/wcdma_conf_audio_out.php#BJFBAIEH

Audio analyzer

(All specifications for the audio analyzer apply to signals present at test set’s AUDIO IN ports)
Audio analyzer de-emphasis: 750 µs, de-emphasis settable as off or on
Audio analyzer expander: settable as off or on with reference level setting of 10 mV to 10 V
Audio analyzer filters: settable choices of none, C-message, 50 Hz to 15 kHz band pass, 300 Hz to 15 kHz band pass, or 100 Hz bandwidth tunable band pass tunable over 300 Hz to 15 kHz

http://wireless.agilent.com/rfcoms/refdocs/wcdma/wcdma_meas_aafan_desc.php#BJFBAIEH

Audio level measurement
Types of signals measured: sinusoidal audio signals
Measurement frequency range: 100 Hz to 15 kHz
AUDIO IN level range: 7.1 mV to 20 V peak (5 mV to 14.1 V rms)
Measurement accuracy: < ± (2% of reading + resolution) for 100 Hz to 8 kHz, < ± (3% of reading + resolution) for > 8 kHz to 10 kHz
Measurement THD plus noise: < 200 µV rms
Measurement detector: selectable choices of rms and peak
Measurement trigger source: immediate
Available result: audio level
Multi-measurement capabilities: 1 to 999 measurements, average, minimum, maximum, and standard deviation results
Concurrency capabilities: audio level measurements can be made concurrently with all other measurements
Typical external input impedance: 100 k Ohms in parallel with 105 pF
Measurement resolution: 0.01 dB


SINAD measurement
Types of signals measured: sinusoidal audio signals
Measurement frequency range: 100 Hz to 10 kHz
AUDIO IN level range: 42.4 mV to 20 V peak (30 mV to 14.1 V rms)
Measurement accuracy: < ±1.0 dB for SINAD <44 dB
Residual THD plus noise: < -60 dB or 200 µV rms, whichever is greater
Measurement trigger source: immediate
Available result: SINAD ratio
Multi-measurement capabilities: 1 to 999 measurements, minimum, maximum, average, and standard deviation results
Concurrency capabilities: SINAD measurements can be made concurrently with all analog and audio measurements
Measurement resolution: 0.01 dB

Distortion measurement

**Types of signals measured:** sinusoidal audio signals

**Measurement frequency range:** 100 Hz to 10 kHz

**AUDIO IN level range:** 42.4 mV to 20 V peak (30 mV to 14.1 V rms)

**Measurement accuracy:** $< \pm 12\%$ of reading ($\pm 1.0$ dB) for distortion $0.67\%$

**Residual THD plus noise:** $< -60$ dB or 200 $\mu$V rms, whichever is greater

**Measurement trigger source:** immediate

**Available result:** audio distortion

**Multi-measurement capabilities:** 1 to 999 measurements, minimum, maximum, average, and standard deviation results

**Concurrency capabilities:** distortion measurements can be made concurrently with all analog and audio measurements

**Measurement resolution:** 0.1%


Audio frequency measurement

**Types of signals measured:** sinusoidal audio signals

**Measurement frequency range:** 100 Hz to 15 kHz

**AUDIO IN level range:** 7.1 mV to 20 V peak (5 mV to 14.1 V rms)

**AUDIO IN signal conditions:** signal at test set’s AUDIO IN must have signal-to-noise ratio $> 30$ dB

**Measurement accuracy:** $< 0.1$ Hz averaged over 10 measurements, $< 1.0$ Hz for a single measurement

**Measurement THD plus noise:** $< 200 \mu$V rms

**Measurement trigger source:** immediate

**Available result:** audio frequency

**Multi-measurement capabilities:** 1 to 999 measurements, minimum, maximum, average, and standard deviation results

**Concurrency capabilities:** frequency measurements can be made concurrently with all other measurements

**Measurement resolution:** 0.1 Hz


Frequency stability measurement

**Types of signals measured:** analog and AMPS signals with or without SAT and with frequency modulation index $\beta < 3.0$ radians

**Frequency capture range:** signal must be within $\pm 200$ 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

**Frequency and frequency error measurement accuracy:**

<table>
<thead>
<tr>
<th>Measurement accuracy</th>
<th>Input signal modulation</th>
<th>Input signal frequency range</th>
</tr>
</thead>
<tbody>
<tr>
<td>$&lt; \pm (1$ Hz + timebase accuracy)</td>
<td>None</td>
<td>800 to 960 MHz</td>
</tr>
<tr>
<td>$&lt; \pm (10$ Hz + timebase accuracy)</td>
<td>Frequency modulation with $\beta &lt; 3.0$ radians</td>
<td>800 to 960 MHz</td>
</tr>
</tbody>
</table>

**Measurement accuracy:** typically $< +(1$ Hz + timebase accuracy) for an input signal with SAT, $< +(3.3$ Hz + timebase accuracy for an input signal with $\beta = 1$ radian

**Measurement trigger source:** immediate

**Available result:** RF frequency and RF frequency error

**Multi-measurement capabilities:** 1 to 999 measurements, minimum, maximum, average, and standard deviation results for RF frequency and worst case RF frequency error in ppm result

**Concurrency capabilities:** frequency stability measurements can be made concurrently with all analog and audio measurements

**Measurement resolution for frequency and frequency error measurement results in Hz:** typically 1 Hz

**Measurement resolution for frequency error measurement result in ppm:** typically 0.01 ppm


Single Channel GPS Source(E1999A-206)

With the option E1999A-206 and hardware option 003, E5515C can generate a single channel GPS signal with C/A code to simulate one satellite. Some key parameters such as Satellite ID and signal level are settable.

**GPS signal Frequency:** 1.57542 GHz

**GPS signal level:** $-70$ to $-125$ dBm

**Satellite ID:** 1 to 37

**Chip rate:** 1.023 Mcps

**Code supported:** C/A code

http://wireless.agilent.com/rfcomms/refdocs/wcdma/wcdma_meas_1canal_freq_desc.php
Timebase specifications

Internal high stability 10 MHz oven-controlled crystal oscillator (OCXO)

Aging rates: < ±0.1 ppm per year, < ±0.005 ppm peak-to-peak per day during any 24-hour period starting 24 hours or more after a cold start

Temperature stability: < +0.01 ppm frequency variation from 25 °C over the temperature range 0 to 55 °C

Warm-up times: Five minutes to be within ±0.1 ppm of frequency at one hour, 15 minutes to be within ±0.01 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: ±0.03 ppm

External reference input

Input frequency: 10 MHz

Input frequency range: typically < ±5 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 V rms

Output impedance: typically 50 Ohms

Remote programming

GPIOB: 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

Power consumption: typically 400 to 450 W continuous

For more product information visit our Web site http://www.agilent.com/find/e1963a