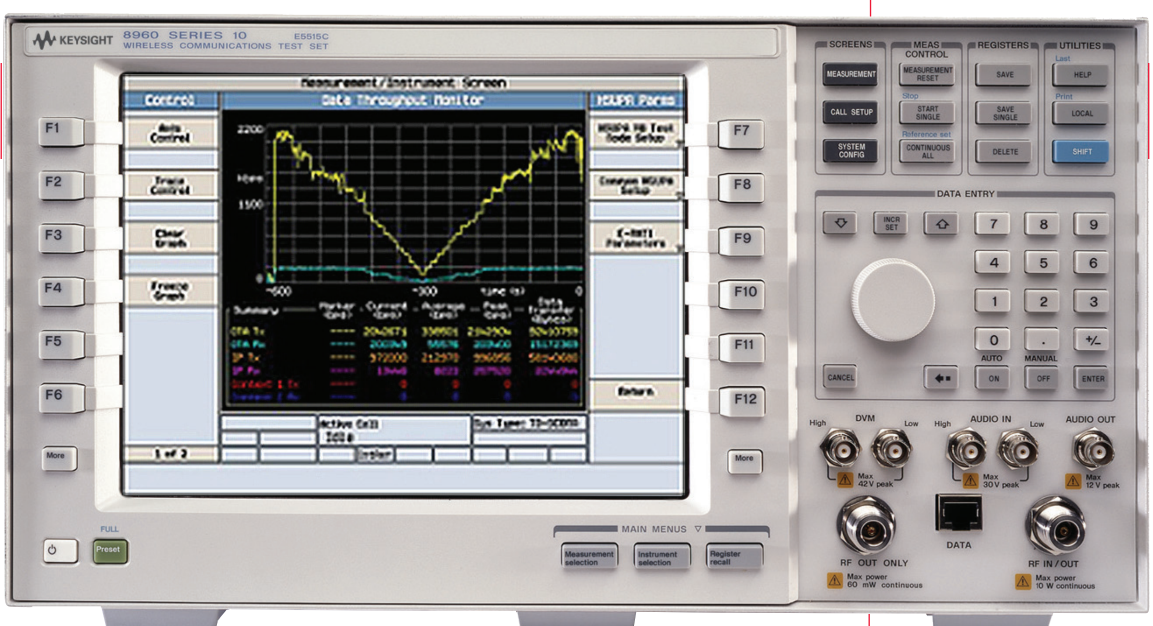
Keysight E1969A
TD-SCDMA_GSM Fast Switch Test Application

Technical Overview



For the 8960 Series 10 (E5515C/E)
wireless communications test set

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Achieve more with the Keysight Technologies 8960 Series 10 (E5515C/E) platform and TD-SCDMA_GSM fast switch test application.

With the E1969A TD-SCDMA_GSM fast switch test application, the 8960 Series 10 (E5515C/E) test set covers TD-SCDMA user equipment (UE) test based on 3GPP standards. On a single hardware platform, the E5515C/E, all 2G and 3G formats are supported with corresponding licenses: GSM/GPRS/EGPRS, W-CDMA/HSDPA/HSUPA, HSPA+, TD-SCDMA/TD-HSPA, cdma2000®, 1xEV-DO Rev A/Rev B.

The E1968A GSM/GPRS/EGPRS test application is bundled together with TD-SCDMA/TD-HSPA options (E1969A-101, E1969A-201, E1969A-403, E1969A-413, E1969A-407, E1969A-408, E1969A-502, and E1969A-503) in the E1969A to meet dual-mode requirements on all TD-SCDMA/TD-HSPA devices.

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 and E1969A-413 support the TD-HSPA data throughput testing in radio bearer (RB) test mode.

E1969A-407 allows you to enable protocol decoding functionality. Wireless protocol advisor software supplies messaging for the mobile and network from MAC layer all the way to IP. Triggering and filtering functionality lets you set up troublesome scenarios, such as intermittent failures. That means you can begin the scenario on Friday and come back Monday morning to a bounded and focused protocol log of exactly what happened surrounding the particular issue.

Unlike other technologies supported on the 8960 Series 10, TD-SCDMA uses a test application instead of a lab application. The E1969A test application, which includes typical lab application functionality, is accessed using feature options. Combining feature options with the test application gives you the quickest access to the latest capabilities and provides a flexible way to tailor the solution to your exact needs.

The TD-SCDMA real-time Vocoder E1969A-408 is another key feature for 8960 TD-SCDMA capability. It includes a real time encoder for downlink audio test and decoder for the uplink test. Together with the external audio generator and analyzer, the 8960 can perform the phone audio functional test at a phone production or QA station; together with artificial ear and mouth, the 8960 can do the acoustic test as defined in 3GPP TS 26.131 and TS 26.132.

With the E1959A-501 inter-RAT with TD-LTE and E1969A-502 packet data service, the previous lab application functionality is available in the E1969A test application. This gives developers the only instrument available that provides a systematic approach to root-cause analysis of high throughput issues in the mobile protocol stack, from decoded L1 to IP layer and inter-RAT.

The newly-released feature option, E1969A-503, allows the 8960 to verify a phone's performance with voice and data simultaneous service. It supports different simultaneous services configurations such as AMR 12.2 k with packet data 384 k/384 k, or HSUPA/HSDPA, and different user scenarios from either data or voice connection to a simultaneous service (voice + data) connection.

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 Series 10.

Key Capabilities

- Test TD-HSPA devices (HS-DSCH Categories 1-15 and E-DCH Categories 1-6) as defined in 3GPP TS 34.122
- Switch between TD-HSPA sub-test conditions while on an active connection
- TD-SCDMA–LTE inter-RAT handovers when coupled with the Keysight Technologies, Inc. E7515A UXM wireless communications test set for LTE
- TD-SCDMA real-time downlink source
- AMR voice and echo
- FM and GPS receiver calibration in one box
- TD-SCDMA to GSM system handover
- TD-SCDMA real time Vocoder
- TD-SCDMA voice and data simultaneous services

With support for voice, short message service (SMS), packet data call connections, and protocol decoding, design changes in anything from RF to TCP can be quickly validated with a complete regression test of mobile functions right at your desk—helping you get your job done faster.

Table 1. Capabilities by wireless technology

	TD-SCDMA	TD-HSDPA	TD-HSUPA
Tx measurement			
Channel power	Yes	Yes	Yes
Occupied bandwidth	Yes	Yes	No
Transmit on/off time mask	Yes	Yes	No
Waveform quality	Yes	Yes	Yes
Adjacent channel leakage ratio	Yes	Yes	Yes
Spectrum emission mask	Yes	Yes	Yes
Closed loop power control	Yes	No	No
Open loop power control	Yes	No	No
Dynamic power	Yes	No	No
Single-ended BER	Yes	Yes	No
Frequency stability	Yes	Yes	No
Spectrum monitor	Yes	Yes	No
Spectrum monitor	Yes	Yes	No
Rx measurement			
Loopback BER	Yes	Yes	No
Block error ratio	Yes	No	No
HSDPA block error ratio	No	Yes	No

3GPP TS 34.122 Adherence

3GPP TS 34.122	Test description	E1969A-101	E1969A-201	E1969A-403	E1969A-413
5.2	Maximum output power	Yes	Yes		
5.2A	Maximum output power with E-DCH				Yes
5.2B	Maximum output power with HS-SICH and DPCH			Yes	
5.3	Frequency stability	Yes	Yes		
5.4.1.3	Open loop power control		Yes		
5.4.1.4	Closed loop power control (CLPC)	Yes[1]	Yes		
5.4.2	Minimum output power	Yes	Yes		
5.4.3	Transmit off power	Yes	Yes		
5.4.4	Transmit on/off time mask	Yes	Yes		
5.4.5	Out-of-synchronization handing of output power (continuous)		Yes		
5.4.6	Out-of-synchronization handing of output power for (discontinuous)		Yes		
5.5.1	Occupied bandwidth (OBW)	Yes	Yes		
5.5.2.1	Spectrum emission mask (SEM)	Yes	Yes		
5.5.2.1A	Spectrum emission mask (SEM) with E-DCH				Yes
5.5.2.1B	Spectrum emission mask (SEM) with HS-SICH and DPCH			Yes	
5.5.2.2	Adjacent channel leakage power ratio (ACLR)	Yes	Yes		
5.5.2.2A	Adjacent channel leakage power ratio (ACLR) with E-DCH				Yes
5.5.2.2B	Adjacent channel leakage power ratio (ACLR) with HS-SICH and DPCH			Yes	
5.5.3	Spurious emissions	Yes[3]	Yes[3]		
5.6	Transmit intermodulation	Yes[4]	Yes[4]		
5.7.1	Error vector magnitude (EVM)	Yes	Yes		
5.7.1A	Error vector magnitude (EVM) with E-DCH				Yes
5.7.1B	Error vector magnitude (EVM) with HS-SICH and DPCH			Yes	
5.7.2	Peak code domain error (PCDE)	Yes	Yes		
6.2	Reference sensitivity	Yes[2]	Yes		
6.3	Maximum input level	Yes[2]	Yes		
6.4	Adjacent channel selectivity (ACS)	Yes[5]	Yes[5]		
6.5	Blocking characteristics	Yes[5]	Yes[5]		
6.6	Spurious response	Yes[5]	Yes[5]		
6.7	Intermodulation characteristics	Yes[5]	Yes[5]		
6.8	Spurious emissions	Yes[3]	Yes[3]		
9.3.1	HS-DSCH throughput for fixed reference channels			Yes[6]	
9.3.2	HS-DSCH throughput for variable reference channels			Yes[6]	
9.3.3	Reporting of HS-DSCH channel quality indicator			Yes[6]	
9.3.4	HS-SCCH detection performance			Yes[6]	
11.1	HS-DSCH throughput for fixed reference channels				Yes[6]
11.2	HS-DSCH throughput for variable reference channels				Yes[6]

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.
6. Requires use of external fader.

What to Order for TD-SCDMA

Model number	Description
E5515C/E	8960 Series 10 wireless communications test set
E5515C-003	Flexible CDMA base station emulator
E5515C-002	Second RF source
E1969A	TD-SCDMA_GSM fast switch test application
E1969A-101	TD-SCDMA non-signaling test mode
E1969A-201	TD-SCDMA signaling mode
E1969A-403	TD-HSDPA
E1969A-407	TD-SCDMA Prot Log
E1969A-408	TD-SCDMA RT Vocoder
E1969A-413	TD-HSUPA
E1969A-501	Inter-RAT with TD-LTE
E1969A-502	Packet data service
E1969A-503	Simultaneous services

Technical Specifications

These specifications apply to an E5515C mainframe with Option 003, or E5515E when used with the latest E1969A test application. Specifications in this document focus on TD-SCDMA-related parts of E1969A (options E1969A-101 and -201). For GSM/GPRS/EGPRS-related specifications, refer to *Keysight E1968A GSM/GPRS/EGPRS Test Application*, Technical Overview (5990-4520EN).

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". 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 typcally 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. Together with the E7515A UXM one box tester, the 8960 supports handover functionalities such as CSFB, RRC release with redirection between TD-SCDMA and TD-LTE networks

- Blind handovers from TD-SCDMA to GSM
- Configurable landing GSM cell
- Test control to GSM voice
- TD-SCDMA AMR voice to GSM voice
- RRC redirect from TD-LTE to TD-SCDMA
- RRC redirect from TD-SCDMA to TD-LTE
- CSFB from TD-LTE to TD-SCDMA

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 UE devices.

TD-SCDMA RF generator

Frequency ranges (MHz):

Band 34:	2010 to 2025	Band 40:	2300 to 2400
Band 39:	1880 to 1920	Band 41:	2496 to 2690

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

Frequency accuracy: Same as timebase reference

Frequency setting resolution: *Typically 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 MHz and 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%, *typically < 3%*

Carrier feed through: < –25 dB, *typically < –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 timeslot must sum to 100% of the timeslot power. In test mode, power levels and states of all downlink channels 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 (MHz):

Band 34:	2010 to 2025	Band 39:	1880 to 1920
Band 40:	2300 to 2400	Band 41:	2496 to 2690

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-HSPA mode (active cell)

Call connection types

RB test mode:

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

TD-HSPA 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 timeslot must sum to 100% of the timeslot power

HS-SCCH relative level: –6.02 dB if only one HS-SCCH channel is configured; –6.97 dB if four HS-SCCH channels are configured; –6.02 dB, –7.78 dB, –8.45 dB, and –6.02 dB for FRC1a, FRC1b, FRC2, and FRC3 respectively if TD-HSUPA is configured

HS-DSCH relative level: 0 dB, –0.79 dB, –1.46 dB for FRC1b, FRC2 respectively if TD-HSUPA is configured

E-PUCH relative level: 0 dB

E-AGCH relative level: –6.02 dB, –3.01 dB, –8.45 dB, and –6.02 dB for FRC1a, FRC1b, FRC2, and FRC3 respectively

E-HICH0 relative level: –9.03 dB, –6.02dB, –11.46 dB and –9.03 dB for FRC1a, FRC1b, FRC2 and FRC3 respectively

E-HICH1 relative level: –9.03 dB, –6.02dB, –11.46 dB and –9.03 dB for FRC1a, FRC1b, FRC2 and FRC3 respectively

Downlink CDMA modulation
Modulation type: QPSK and 16QAM per 3GPP standard
QPSK residual EVM: < 10%, *typically < 3%*
QPSK carrier feed through: < –25 dBc, *typically < –35 dBc*

TD-HSPA RF analyzer

Real-time demodulation of: DPCH, HS-SICH and E-DCH
Downlink CDMA modulation
Modulation type: QPSK per 3GPP standard
QPSK residual EVM: < 10%, *typically < 3%*
QPSK carrier feed through: < –25 dBc, *typically < –35 dBc*

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

Downlink CDMA modulation
Modulation type: QPSK and 16QAM per 3GPP standard
  QPSK residual EVM: < 10%, *typically < 3%*
  QPSK carrier feed through: < –25 dBc, *typically < –35 dBc*

TD-HSDPA RF analyzer

Real-time demodulation of: Uplink DPCH and HS-SICH

CW mode

Under CW mode, an unmodulated continuous wave (CW), an 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, and 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/E test set when used with an E5520A FM adapter. Output signal amplitude and distortion specifications for FM testing with the E5515C/E 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 to –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 to –116 dBm

< ±1.5 dB for signal level from –116 to –125 dBm

Measurements Technical Specifications

Transmitter measurements

Channel power measurement

Measurement method: The average power measured in one timeslot

Mean power: Measured with a bandwidth of at least (1 + α) x chip rate, where α = 0.22 and chip rate = 1.28 Mcps

RRC filtered mean power: Measured with a root-raised cosine (RRC) filter with roll-off α = 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 a < 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):

TD-SCDMA and TD-HSDPA: < ±1 dB (typically < ±0.6 dB) for –65 to 30 dBm

TD-HSUPA: < ±1 dB (typically < ±0.6 dB) for –65 to 30 dBm, Bands 34 and 39
< ±1 dB (typically < ±0.6 dB) for –50 to 30 dBm, Bands 40 and 41
< ±1.3 dB (typically < ±0.8 dB) for –60 to –50 dBm, Band 40 typically
< ±0.8 dB for –65 to –50 dBm, Band 41

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 α = 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. The peak code domain error is defined as the maximum value for code domain error

Measurement level range: –25 to +28d Bm/1.28 MHz; measured signal level is expected within ±9 dB of the expected power and has a < 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

Measurements Technical Specifications

Transmitter measurements continued

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

RMS EVM:

TD-SCDMA and TD-HSDPA, < 2%,
TD-HSUPA: < 3%, typically< 2%

Frequency error:

TD-SCDMA and TD-HSDPA: < ±10Hz + timebase accuracy
TD-HSUPA: < ±15Hz + timebase accuracy, typically < ±10Hz

Peak code domain error:

< ±0.2 dB (typically < ±0.15 dB) for Bands 34 and 39
< ±0.25 dB (typically < ±0.2 dB) for Bands 40 and 41

Measurement triggers: Auto, immediate, protocol, external, and RF rise **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 a < 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

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

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: < ±0.2 dB *(typically < ±0.15 dB)* for Bands 34 and 39
< ±0.25 dB *(typically < ±0.2 dB)* for Bands 40 and 41

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 α = 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 a < 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

Frequency offsets	Levels (dBc)	Meas BW
0.8 to 1.8 MHz	$\left\{-35 - 14 \times \left[\frac{\Delta f}{\text{MHz}} - 0.8\right]\right\}$	30 kHz
1.8 to 2.4 MHz	$\left\{-49 - 17 \times \left[\frac{\Delta f}{\text{MHz}} - 1.8\right]\right\}$	30 kHz
2.4 to 4.0 MHz	-44	1 MHz

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 a < 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, *typically*

< ±10 kHz

Temperature range: +15 to +55 °C

Measurements Technical Specifications

Transmitter measurements continued

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 *(typically < ±0.6 dB)* for –65 to 28 dBm, Bands 34 and 39

Typically < ±0.6 dB for –60 to 28 dBm, Band 40

Typically < ±0.7 dB for –60 to 28 dBm, Band 41

Measurement triggers: RF rise, protocol, and external

Concurrency 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

Concurrency 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 (Bands 34 and 39, –50 to +28 dBm/1.28 MHz)
< ±0.25 dB for range 1.5 dB (Bands 34 and 39, –55 to –50 dBm/1.28 MHz)
< ±0.2 dB *(typically < ±0.15 dB) for range 1.5 dB (Bands 40 and 41, –50 to +28 dBm/ 1.28 MHz)*
< ±0.3 dB *(typically < ±0.15 dB) for range 1.5 dB (Band 40, –60 to –50 dBm /1.28 MHz)*
< ±0.4 dB *(typically < ±0.2 dB) for range 1.5 dB (Band 41, –60 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 set 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 the 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

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

Absolute power:

< ±1 dB *(typically < ±0.5 dB)* for –50 to +28 dBm, Bands 34 and 39
< ±1.1 dB *(typically < ±0.6 dB)* for –60 to –50 dBm, Bands 34 and 39
< ±1 dB *(typically < ±0.6 dB)* for –50 to +28 dBm, Bands 40 and 41
< ±1.5 dB *(typically < ±0.8 dB)* for –60 to –50 dBm, Band 40 *typically < ±0.8 dB for –60 to –50 dBm, Band 41*

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; loop-back 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

Concurrency capabilities: BLER measurements cannot be made concurrently with loop-back BER, HSDPA BLER measurement, dynamic power measurement, open loop power control measurement, 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

Concurrency capabilities: HSDPA BLER measurements cannot be made concurrently with loopback BER, BLER measurement, dynamic power measurement, open loop power control measurement, close loop power control measurements, or while speech is provided on the downlink; BLER measurements can be made concurrently with all other measurements

Common measurements

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 ±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

Concurrency capabilities: Frequency stability measurement can be made concurrently with all analog measurements

Spectrum monitor

Measurement modes: Swept mode or zero span

Frequency ranges: Although the spectrum monitor is available at any frequency sup-ported 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. (Specifi-cations only apply for span and RBW combinations shown in the following table):

Span	RBW	Displayed dynamic range
100 MHz	5 MHz	50
80 MHz	1 MHz	55
40 MHz	300 kHz	60
20 MHz	100 kHz	65
12 MHz	100 kHz	65
10 MHz	100 kHz	65
5 MHz	30 kHz	70
4 MHz	30 kHz	70
2.5 MHz	10 kHz	75
1.25 MHz	3 kHz	80
500 kHz	1 kHz	80
125 kHz	300 kHz	80
0	1 MHz	55
0	300 kHz	60
0	100 kHz	65

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; opera-tions 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*

Spectrum monitor continued

Supplemental characteristics continued

Frequency resolution: *1 Hz*
Marker amplitude resolution: *0.01 dB*

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: 5 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: *±(time since last calibration) x (aging rate) + (temperature stability) + (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

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 myKeysight

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