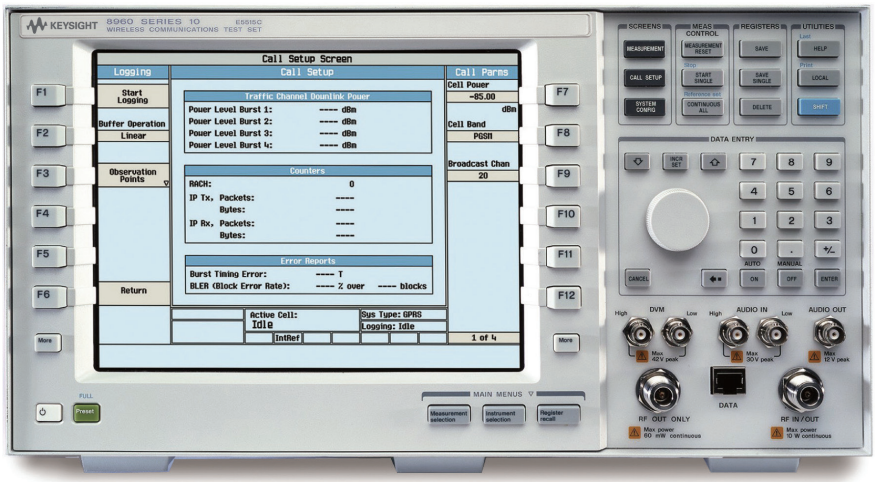
Keysight Technologies

E1966A 1xEV-DO Terminal Test Application

For the 8960 Series 10 (E5515C/E)

Wireless Communications Test Set

Technical Overview



KEYSIGHT TECHNOLOGIES

Unlocking Measurement Insights

Introduction

Accelerate high data rate testing—achieve greater confidence in your 1xEV-DO wireless access terminals

The Keyight Technologies, Inc. 8960 Series 10 (E5515C/E) wireless communications test set, used with the Keysight E1966A 1xEV-DO test application is the first complete, one-box solution for testing all of the 1xEV-DO parametric configurations, while providing physical channel testing at the highest data rates. The E1966A is designed for manufacturing, as well as developers and designers of leading-edge 1xEV-DO wireless access terminals (ATs).

Key Features

- Supports 1xEV-DO Release 0 FTAP/RTAP, and optionally 1xEV-DO Release A FETAP/RETAP (Option 102) and Release B FMCTAP/RMCTAP (Option 103) call processing for accurate physical layer performance qualification
- Supports new forward link packet configurations (Option 104) including those using 64QAM that boost the potential data throughput from 3.1 up to 4.9 Mbps with one box or from 9.3 to 14.7 Mbps with three boxes over FMCTAP/RMCTAP
- Supports Release B multi-carrier physical layer test with one box in IS-856 test mode
- Reduces the risk of returns and recalls by testing packet error rate at all QPSK, 8PSK, 16QAM, and 64QAM forward link modulation modes supported in the 1xEV-DO Release 0, Release A, and Release B standards. Verifies new reverse link modulation formats including 8PSK supported in the 1xEV-DO Release A standard (Option 102)
- Supports all commercialized bands—0 (including Band subclass 4 for China Telecom), 1, 3, 4, 5, 6, 7, 10, 11, 12, 14, 15, 18, and 19
- Single channel GPS source simulates one satellite for calibration of UE's built-in GPS receiver (Option E1999A-206)
- IS-856 test mode allows receiver testing without call processing
- E1987A fast switch test application enables rapid switching between the E1966A 1xEV-DO test application and the E1962B cdma2000® test application for dual mode phone test
- Options 405, 406, and 407 offer fading, multi-unit synchronization, and protocol logging features for mobile design and verification

E1966A Functionality Overview

Flexible network emulation for physical layer test

The E1966A 1xEV-DO test application supports flexible call processing for physical layer testing of 1xEV-DO ATs. Establishing sessions with the test set is completely automatic once the test set is configured with the correct frequency band, channel, and sector ID. The test set automatically handles random ATI requests from access terminals, UATI assignment, and session negotiation. Once a session is established, test connections are initiated by a single connect command. When connected, powerful active, closed-loop power control can be used to manipulate the ATs as required for testing. Tests across multiple channels and frequency bands are fast and simple using the one-button handoff commands.

Standardized, call processing-based test mode connections

The E1966A supports physical layer testing through the standardized FTAP/RTAP over-the-air protocols (forward and reverse test application protocols). FTAP allows accurate receiver packet error rate measurements by eliminating the dynamic behaviors of the 1xEV-DO system. RTAP provides control of the ATs' reverse link enabling accurate reverse link measurements. RTAP allows such measurements as channel power, waveform quality, code domain power, and Tx spurious emissions.

Option 102 – 1xEV-DO Release A and B test support

The E1966A Option 102 supports testing of the 1xEV-DO Release A physical layer subtype 2 air interface using the enhanced test application protocol. Call processing with this new air interface is simple and easy using one-button commands—just like it is with the existing Release 0 functionality. Option 102 adds support for all of the new forward traffic channel configurations and enables accurate PER testing under realistic conditions using the new FETAP protocol (forward enhanced test application protocol). Using the new RETAP protocol (reverse enhanced test application protocol), all of the new subtype 2 reverse channel packet sizes and modulation types are easily tested for such parameters as power, waveform quality, code domain power, and Tx spurious emissions. The option also supports testing of the new 1xEV-DO Release B physical layer subtype 3 air interface using the multi-carrier test application protocol on signal carrier.

Option 103 – 1xEV-DO multi-carrier test support

The E1966A Option 103 supports testing of the 1xEV-DO Release B physical subtype 3 air interface that includes multiple carriers using the new multi-carrier test application protocol. Up to three test sets can be interconnected via LAN and clock signals, to generate and analyze devices that support multi-carrier operation. Call processing with this air interface is simple and easy using one button commands from the test set designated as the multi-carrier master unit—the same as it is with the existing Release 0/A functionality. The multi-carrier master controls all main call processing functions and coordinates control with up to two other E5515C/E units designated as auxiliary units. As test standards define all multi-carrier tests to be performed on a per carrier basis, each test set makes independent measurements on each carrier. Option 103 supports all defined FMCTAP and RMCTAP multi-carrier test cases for: waveform quality and frequency accuracy, maximum RF output power, conducted spurious emissions, forward traffic channel performance in AWGN, sensitivity and dynamic range and with an external signal generator, and single tone desensitization.

E1966A Functionality Overview (Continued)

Option 104 – 1xEV-DO optional DRC support

The E1966A Option 104 supports testing of the 1xEV-DO Release B physical subtype 3 air interface that includes the optional subtype 3 DRC values (including those forward traffic formats that use 64QAM). Up to 4.9 Mbps physical layer tests can be made with one test set, or 14.7 Mbps with three test sets, via FMCTAP and RMCTAP. The option also supports demodulation testing of these DRC values using FMCTAP.

Table: Optional DRC values[1]

Forward traffic format (bits, slots, preamble)	Nom rate	Modulation	DRC
(1024, 4, 64)	153.6	QPSK	0x10
(2048, 4, 64)	307.2	QPSK	0x10
(3072, 4, 64)	460.8	QPSK	0x10
(1024, 4, 64)	153.6	QPSK	0x11
(2048, 4, 64)	307.2	QPSK	0x11
(4096, 4, 64)	614.4	QPSK	0x11
(1024, 4, 64)	153.6	QPSK	0x12
(2048, 4, 64)	307.2	QPSK	0x12
(5120, 4, 64)	768.0	8PSK	0x12
(2048, 4, 64)	307.2	QPSK	0x13
(6144, 4, 64)	921.6	16QAM	0x13
(1024, 4, 64)	153.6	QPSK	0x14
(7168, 4, 64)	1075.2	16QAM	0x14
(8192, 4, 64)	1228.8	16QAM	0x15
(2048, 2, 64)	614.4	QPSK	0x16
(6144, 2, 64)	1843.2	64QAM	0x16
(1024, 2, 64)	307.2	QPSK	0x17
(7168, 2, 64)	2150.4	64QAM	0x17
(8192, 2, 64)	2457.6	64QAM	0x18
(2048, 1, 64)	1228.8	QPSK	0x19
(6144, 1, 64)	3686.4	64QAM	0x19
(1024, 1, 64)	614.4	QPSK	0x1a
(7168, 1, 64)	4300.8	64QAM	0x1a
(8192, 1, 64)	4915.2	64QAM	0x1a

1. Shaded lines are canonical formats.

E1966A Functionality Overview (Continued)

Option 405 – Fading tests

E5515C/E Option 004 adds a rear panel digital bus that enables fading when it is used with Keysight's Baseband Studio for fading solution. The E1966A provides receiver fading tests with unprecedented accuracy and repeatability, at a very attractive price point. Baseband I/Q data from the Keysight E5515C/E wireless communications test set is sent via the digital bus to the N5106A. The N5106A (PXB) software configures the user-selected fading profile. After digital fading, AWGN can be digitally added to the waveform. The resulting waveform is then returned to the test set via the digital bus for modulation. This solution eliminates almost all associated calibrations and provides rock-solid repeatability

Option 406 – Multi-unit synchronization

Option 406 allows any test set to be time-synchronized to another test set that is running either a CDMA or 1xEV-DO test application or lab application. The multi-unit synchronization supports simulation of mobile behaviors with two base stations. Typical applications are idle/softer handoff, pilot detection, and hybrid mode simulation.

Option 407 – Protocol logging

Option 407 provides extensive logging of messages at the air interface signaling layer, PPP layer, and IP layer in both the forward and reverse directions, and an output protocol stream to external PC software, Wireless Protocol Advisor. This information is useful for debugging manufacturing test flow and identifying problems.

1xEV-DO test mode support

Receiver test without active call processing is supported in the E1966A 1xEV-DO test application through the IS-856 test mode. In test mode, the E1966A provides an accurate 1xEV-DO Release 0 forward link signal that allows access terminals supporting test mode operation to achieve time alignment. At this point, the AT can be directed to demodulate the forward traffic channel that is continuously transmitted by the test set. The packet error rate of the AT can then be read from the AT using the AT's test mode control software. In addition, AT transmitter measurements such as channel power, Tx spurious emissions, waveform quality, code domain power, and time response of open loop power can be made in test mode.

Easy upgrade for existing CDMA-capable 8960 Series 10 test sets

Units that support the CDMA test applications, like the E1962B, are easily upgraded to 1xEV-DO test capabilities. It's a simple firmware upgrade with no hardware requirements. Option 102 (1xEV-DO Release A support) does require a hardware upgrade for E5515Cs with serial prefix less than GB4604xxxxxx. Units with hardware that supports Option 102 do not require further hardware upgrades to support the Option 103 multi-carrier capability.

E1966A Functionality Overview (Continued)

1xEV-DO call processing

- UATI assign
- Session negotiation
- FTAP and RTAP support
- FMCTAP and RMCTAP support (optional)
- Session open
- Connect/disconnect
- FETAP and RETAP support (optional)
- Release B optional DRC (optional)

Tx measurements

- Average power
- Code domain power
- Modulation quality
- Spectrum monitor
- Tx dynamic power
- Channel power
- Access probe power
- Time response of open loop power
- Tx spurious emissions
- Fast device tune (optional)

Rx measurements

- FTAP/FETAP/FMCTAP loopback
- Dynamic range
- Data rate control performance
- Sensitivity
- PER with AWGN

Technical Specifications

These specifications apply to all E5515Es, or E5515C mainframe with Option 003, and an E1966A test application of firmware revision A.09.13 or higher.

Specifications describe the test set's warranted performance and are valid over the entire operation and 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 additional information useful in applying the instrument by giving typical, but non-warranted performance parameters. 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 without including measurement uncertainty.

Analog Specifications

CW RF generator	
Frequency	
Available frequency range	292 to 2700 MHz
Specified frequency ranges	421 to 494 MHz, 800 to 960 MHz, and 1700 to 2000 MHz
Accuracy and stability	Same as timebase reference
Test signal	CW, AM (56% depth with 20 kHz rate), or DSB-SC (carrier + upper side-band spaced 20 kHz apart). Requires approximately 3 seconds to switch between test signal selections
Amplitude	
Available output level range	–127 to –10 dBm
Specified output level range	–116 to –15 dBm
Absolute output level accuracy	< ±1.0 dB, *typically* < ±0.5 dB (Level accuracy at RF generator output levels > –30 dBm may be degraded by simultaneous reception and transmission when applied Tx power is > 32 dBm)
VSWR at RF IN/OUT	< 1.14:1, 400 to 1000 MHz
Nominal ambient test signal level accuracy	*< ±1.1 dB*

Analog Specifications (Continued)

Spectrum monitor	
Input frequency ranges	411 to 420 MHz 450 to 484 MHz 821 to 934 MHz 1700 to 1980 MHz
Reference level	Auto or manual
Manual reference level range	+37 to –50 dBm
Display dB per division	20.0 to 0.1 dB per division
Level measurement accuracy	*Typically < ±1.0 dB 15 to 55 °C (Calibrated against average power and within ±10 degrees of calibration temperature. Calibration must occur between 20 to 55 °C)*
Display frequency span and resolution bandwidth (coupled)	

Span	**RBW**
0 Hz	300 kHz
125 kHz	300 Hz
500 kHz	1 kHz
1.25 MHz	1 kHz
2.5 MHz	10 kHz
4 MHz	30 kHz
5 MHz	30 kHz
10 MHz	100 kHz
12 MHz	100 kHz
20 MHz	100 kHz
40 MHz	300 kHz
80 MHz	1 MHz
100 MHz	5 MHz

Trigger	RF rise, immediate, protocol, or external
Trigger arm	Single or continuous
Trigger delay	–50 to 50 ms
Detector	Peak detection or sample detection
Trace mode	Clear write, max hold, or min hold
Markers	Three user markers
Marker modes	Off, position, or delta
Marker functions	Peak search, marker to expected frequency, and marker to expected power

Analog Specifications (Continued)

Audio generator	
Frequency	
Operating range	100 Hz to 20 kHz, *typically 1 Hz to 20 kHz*
Accuracy	Same as timebase reference
Frequency resolution	Typically 0.1 Hz
Output level (from Audio Output connector)	
Ranges	0 to 1 V peak, 1 to 9 V peak (into > 600 Ω)
Accuracy	< ±(1.5% of setting + resolution) when output is DC coupled
Distortion	< 0.1% for 0.2 to 9 V peak into > 600 Ω
Coupling mode	Selectable as DC or AC (5 µF in series with output)
Maximum output current	*Typically 100 mA peak into 8 Ω*
Output impedance	*Typically < 1.5 Ω at 1 kHz when output is DC coupled*
DC offset (when output is DC coupled)	*Typically < 1 mV peak for 0 to 1 V peak* *Typically < 10 mV peak for 1 to 9 V peak*
Output level resolution	*Typically < 0.5 mV for 0 to 1 V peak output,* *< 5.0 mV for 1 to 9 V peak output*
Audio analyzer de-emphasis	750 µs, de-emphasis settable as Off or On
Audio analyzer expandor	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

Audio analyzer specifications (All specifications for the audio analyzer apply to signals present at test set's AUDIO IN ports)	
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 to 15 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
External input impedance	Typically 100 kΩ in parallel with 105 pF
Measurement resolution	Typically 0.3% of expected level setting or 0.2 mV, whichever is greater

Analog Specifications (Continued)

Audio analyzer specifications (Continued) (All specifications for the audio analyzer apply to signals present at test set's AUDIO IN ports)	
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	*Typically 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	< ±12% of reading (±1.0 dB) for distortion > 0.67%
Residual THD plus noise	< –60 dB or 200 µV 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	*Typically 0.1%*

Analog Specifications (Continued)

Audio analyzer specifications (Continued) (All specifications for the audio analyzer apply to signals present at test set's AUDIO IN ports)	
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 ration > 30 dB
Measurement accuracy	< 0.1 Hz averaged over 10 measurements < 1.0 Hz for a single measurement
Measurement THD plus noise	< 200 µV 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	*Typically 0.1 Hz*

1xEV-DO Call Processing Functionality

Resident formats	1xEV-DO
Call processing timing tolerance	*Mobile transmissions must be typically within ±6 µs of test set's transmitted pilot channel clock timing for proper reverse channel acquisition*
Overhead messages	Sync message with real-time long code and system time update, quick configuration message, sector parameters message, and access parameters message
Protocol stack	1xEV-DO Release 0 using test application protocol (TAP – includes both FTAP and RTAP)
Base station parameters	ACKChannelGain, DRCChannelGain, DataOffsetNom, DataOffset9k6, DataOffset19k2, DataOffset38k4, DataOffset76k8, and DataOffset153k6
Call control (one button commands)	Access network open connection Access network close connection Access network close session Access terminal open connection Access terminal close connection
Supported applications	FTAP and RTAP only
Access parameters	OpenLoopAdjust, ProbeInitialAdjust, ProbeNumStep, PreambleLength, PowerStep, ProbeSequenceMax, and PreferredControlChannelCycle

1xEV-DO Call Processing Functionality (Continued)

System parameters	ColorCode, CountryCode, SectorID, and SubnetMask		
Protocol status	Idle, UATI request, session negotiation, session open, session closing, paging, connect request, connection negotiation, connected, connection closing, and handoff		
Forward control channel data rate	Selectable between 38.4 or 78.6 kbps		
Session terminal displayed parameters	Session seed, hardware ID, assigned UATI, and assigned MAC index		
Hardware ID types supported	ESN, MEID, “NNNN”		
Activity factor	100% only		
AT directed packets	User-adjustable percentage (0 up to 100%) of forward traffic packets directed to the AT under test. Default value of 50% per AT minimum performance specification. Packets not direct to the AT under test are sent to another MAC address that is not in use		
Limited TAP mode	On or Off with default of Off. This field is required to be set to On if the AT uses a firmware revision that does not support the full test application protocol as required by standard		
ACK channel bit fixed mode attribute	On or Off		
FTAP mode	Loopback		
Call limit	Selectable On or Off. When On, the test set ignores all access terminal access attempts		
Handoff support	Hard handoff to new channel or band		
R-DRC fixed mode attribute	On or Off. Default of On. When in the On state, the test transmits the user-set forward traffic rate. When in the Off state, the test set transmits the forward configuration per the received DRC value transmitted by the AT		
DRC length	Fixed to 8 slots		
R-ACK channel mode	Fixed to force decoding of each packet over its full number of slots		
Session close timer	0 to 3240 minutes		
Configurable attributes	Preferred control channel cycle: AT or AN specified		
Pilot drop	0 to 63 (0 to –31.5 dB)		
Forward TCH data rates (DRC fixed mode only)	38.4 kbps 76.8 kbps 153.6 kbps 307.2 kbps 307.2 kbps 614.4 kbps 614.4 kbps 921.6 kbps 1228.8 kbps 1228.8 kbps 1843.2 kbps 2457.6 kbps	16 slots, QPSK 8 slots, QPSK 4 slots, QPSK 2 slots, QPSK 4 slots, QPSK 1 slot, QPSK 2 slots, QPSK 2 slots, 8PSK 1 slot, QPSK 2 slots, 16QAM 1 slot, 8PSK 1 slot, 16QAM	(DRC=0x1) (DRC=0x2) (DRC=0x3) (DRC=0x4) (DRC=0x5) (DRC=0x6) (DRC=0x7) (DRC=0x8) (DRC=0x9) (DRC=0xA) (DRC=0xB) (DRC=0xC

1xEV-DO Call Processing Functionality (Continued)

Max forward packet duration	2 to 16 slots. Forces the test set to stop transmission of slots after the user-set value	
Forward early termination state	On or Off (default value of Off). When On, the test set early terminates slots when signaled by the reverse ACK channel	
Reverse TCH data rates (RTAP fixed mode only)	9.6 kbps 19.2 kbps 38.4 kbps 78.6 kbps 153.6 kbps	Min rate = 1, max rate = 1 Min rate = 2, max rate = 2 Min rate = 3, max rate = 3 Min rate = 4, max rate = 4 Min rate = 5, max rate = 5
Reverse link closed loop bit rate	Fixed to 600 per second	
Reverse link closed loop power control modes	Active Alternating – alternating 0 and 1 power bits All up All down	

Application	**Limited TAP = On**		**Limited TAP = Off**	
	FTAP	**RTAP**	**FTAP**	**RTAP**
FTAP parameter assignment message contents				
ACK channel bit fixed mode	If ACK channel bit fixed mode attribute is on, attribute sent = ACK channel bit (NACK), if Off then attribute is not sent			
DRC fixed mode value	FTAP rate	Attribute not sent	FTAP rate	
DRC fixed mode cover	Not sent		Not sent	
Loopback mode	Enabled		Enabled	Not sent
RTAP parameter assignment message contents				
Test packets	Message sent with no attributes	Enabled Min and max	Message sent with no attributes	Enabled Min and max
Packet rate mode		Rate = RTAP rate		Rate = RTAP rate
Test set configuration				
Forward test packets sent	Yes	No	Yes	Yes
Effect on connection if application changed	Connection is maintained			

1xEV-DO Call Processing Functionality (Continued)

Settable system time	
Functionality	Allows user to set the system time for the CDMA system. System time is retained during power-off using the internal real-time clock
CDMA system date	User-settable in the format of yyyy.mm.dd for the year, month, and day
CDMA system time	User-settable in the format of hh.mm.ss for the hour, minute, and seconds. Input resolution is 2 seconds
Leap seconds	User-settable from 0 to 255 seconds
Local time offset	User-settable in the format of hh.mm from 00.00 to 15.30 in 30 minute increments
Daylight savings time indicator	On or Off

Option 102 – Release A and B Call Processing Functionality

(Requires serial prefix equal to or higher than GB4604xxxx or equivalent hardware)

Protocol stack	1xEV-DO Release A and B
Supported applications	Test application protocol (TAP including both FTAP and RTAP) in physical layer subtype 0 Enhanced test application protocol (ETAP including FETAP and RETAP) in physical layer subtype 2 Multi-carrier test application protocol (MCTAP including FMCTAP and RMCTAP) in physical layer subtype 3
Physical layer subtype	Subtype 0, subtype 2 or subtype 3. Default of subtype 2
Supported subtype 0 protocols	Default access channel MAC protocol, default forward traffic channel MAC protocol, default reverse traffic channel MAC protocol, and default control channel MAC protocol
Supported subtype 2 protocols	Default access channel MAC protocol or enhanced access channel MAC protocol, enhanced forward traffic channel MAC protocol, subtype 3 reverse traffic channel MAC protocol, and default control channel MAC protocol
Supported subtype 3 protocols	Default access channel MAC protocol, enhanced access channel MAC protocol, the default control channel MAC protocol, the multicarrier forward traffic channel MAC protocol and the Multicarrier Reverse Traffic Channel MAC protocol
Call control (one button commands)	Access network open connection Access network close connection Access network close session Access terminal open connection Access terminal close connection
Protocol status	Idle, UATI request, session negotiation, session open, session closing, paging, connect request, connection negotiation, connected, connection closing, handoff

Option 102 – Release A and B Call Processing Functionality (Continued)

(Requires serial prefix equal to or higher than GB4604xxxx or equivalent hardware)

Base station parameters	
PL subtype 0	Data offset nom, data offset 9k6, data offset 19k2, data offset 38k4, data offset 76k8, data offset 153k6, ACK channel gain, and DRC channel gain
PL subtype 2	ACK channel gain, DRC channel gain, auxiliary pilot channel gain, RRI channel gain pre-transition 0, RRI channel gain post-transition 0, RRI channel gain pre-transition 1, RRI channel gain post-transition 1, RRI channel gain pre-transition 2, RRI channel gain post-transition 2, RRI channel gain pre-transition 3, auxiliary pilot channel min payload, DSC length, short packets enabled threshold
PL subtype 3	All base station parameters used by PL subtype 0 and PL subtype2 are validated for PL subtype 3 multicarriers (main carrier, auxiliary carrier 1 and auxiliary carrier 2)
PL2 traffic channel gain parameters	For each of the 12 reverse channel payload packet sizes, the following parameters are available (96 total): low latency T2P transition, low latency termination target, low latency TxT2P pre-transition, low latency TxT2P post-transition, high capacity TxT2P pre-transition, and high capacity TxT2P post-transition
Access channel subtype (release A/B)	Enhanced (subtype 1 and subtype 3) or default (subtype 0). Default of enhanced
Access parameters	Open loop adjust, probe initial adjust, probe power step, probe num step, probe sequence max, and preamble length
Enhanced access parameters	Open loop adjust, probe initial adjust, probe power step, probe num step, and probe sequence max. Preamble length fixed to 16 slots
System parameters	Sector ID, country code, color code, subnet mask, and preferred control channel cycle
Reverse data transmission mode	High capacity or low latency. Default of high capacity
Forward control channel data rate	Selectable between 38.4 or 78.6 kbps
Session terminal displayed parameters	Session seed, hardware ID, assigned UATI, and assigned MAC index
Hardware ID types supported	ESN, MEID, “NNNN”
Activity factor	100% only
AT directed packets	User-adjustable percentage (0 up to 100%) of forward traffic packets directed to the AT under test. Default value of 50% per AT minimum performance specification. Packets not direct to the AT under test are sent to another MAC address that is not in use
Limited TAP mode	On or Off with default of Off. This field is required to be set to On if the AT uses firmware revisions that do not support the full test application protocol as required by standard

Option 102 – Release A and B Call Processing Functionality (Continued)

(Requires serial prefix equal to or higher than GB4604xxxx or equivalent hardware)

Base station parameters (Continued)	
ACK channel bit fixed mode	On or Off
FETAP mode	Loopback (in physical layer subtype 2)
MCTAP mode	Loopback (in physical layer subtype 3)
Max forward packet duration	2 to 16 slots. Forces the test set to stop transmission of slots after the user-set value
Call limit	Selectable On or Off. When On, the test set ignores all access terminal access attempts
Handoff support	Hard handoff to a new channel or band
R-DRC fixed mode attribute	On or Off. Default of On. When in the On state, the test transmits the user-set forward traffic configuration (determines the rate). When in the Off state, the test set transmits the forward configuration per the received DRC value transmitted by the AT
DRC length	Fixed to 8 slots
DSC length	User selection of 8, 16, 24. 32, 40, 48, 56, 64, 72, 80, 88, 96, 104, 112, 120, 128, 136, 144, 152, 160, 168, 176, 184, 192, 200, 208, 216, 224, 232, 240, 248, or 256 slots. Default of 64 slots
R-ACK channel mode	Never (all NAK), subpacket 0 (All ACK), subpacket 1, subpacket 2, or subpacket 3. Default of never
Session close timer	0 to 3240 minutes
Configurable attributes	Preferred control channel cycle: AT or AN specified Rate 1M8 supported control: AT or AN specified
Preferred control channel cycle	AT or AN specified
Pilot drop	0 to 63 (0 to 31.5 dB)

Option 102 – Release A and B Call Processing Functionality (Continued)

(Requires serial prefix equal to or higher than GB4604xxxx or equivalent hardware)

PL subtype 2 forward TCH format (DRC fixed mode on only – shaded lines are canonical formats)					
(Bits,	**Slots,**	**Preamble)**	**Nom rate**	**Modulation**	**DRC**
(128,	16,	1024)	4.8 kbps	QPSK	DRC=0x1
(256,	16,	1024)	9.6 kbps	QPSK	DRC=0x1
(512,	16,	1024)	19.2 kbps	QPSK	DRC=0x1
(1024,	16,	1024)	38.4 kbps	QPSK	DRC=0x1
(128,	8,	512)	9.6 kbps	QPSK	DRC=0x2
(256,	8,	512)	19.2 kbps	QPSK	DRC=0x2
(512,	8,	512)	38.4 kbps	QPSK	DRC=0x2
(1024,	8,	512)	76.8 kbps	QPSK	DRC=0x2
(128,	4,	256)	19.2 kbps	QPSK	DRC=0x3
(256,	4,	256)	38.4 kbps	QPSK	DRC=0x3
(512,	4,	256)	76.8 kbps	QPSK	DRC=0x3
(1024,	4,	256)	153.6 kbps	QPSK	DRC=0x3
(128,	2,	128)	38.4 kbps	QPSK	DRC=0x4
(256,	2,	128)	76.8 kbps	QPSK	DRC=0x4
(512,	2,	128)	153.6 kbps	QPSK	DRC=0x4
(1024,	2,	128)	307.2 kbps	QPSK	DRC=0x4
(512,	4,	128)	76.8 kbps	QPSK	DRC=0x5
(1024,	4,	128)	153.6 kbps	QPSK	DRC=0x5
(2048,	4,	128)	307.2 kbps	QPSK	DRC=0x5
(128,	1,	64)	76.8 kbps	QPSK	DRC=0x6
(256,	1,	64)	153.6 kbps	QPSK	DRC=0x6
(512,	1,	64)	307.2 kbps	QPSK	DRC=0x6
(1024,	1,	64)	614.4 kbps	QPSK	DRC=0x6
(512,	2,	64)	153.6 kbps	QPSK	DRC=0x7
(1024,	2,	64)	307.2 kbps	QPSK	DRC=0x7
(2048,	2,	64)	614.4 kbps	QPSK	DRC=0x7
(2048,	2,	64)	307.2 kbps	8PSK	DRC=0x8
(3072,	2,	64)	921.6 kbps	8PSK	DRC=0x8
(512,	1,	64)	307.2 kbps	QPSK	DRC=0x9
(1024,	1,	64)	614.4 kbps	QPSK	DRC=0x9
(2048,	1,	64)	1288.8 kbps	QPSK	DRC=0x9
(4096,	2,	64)	1288.8 kbps	16QAM	DRC=0xA
(1024,	1,	64)	614.4 kbps	QPSK	DRC=0xB
(3072,	1,	64)	1843.2 kbps	8PSK	DRC=0xB
(4096,	1,	64)	2457.6 kbps	16QAM	DRC=0xC
(5120,	2,	64)	1536.0 kbps	16QAM	DRC=0xD
(5120,	1,	64)	3072.0 kbps	16QAM	DRC=0xE

Option 102 – Release A and B Call Processing Functionality (Continued)

(Requires serial prefix equal to or higher than GB4604xxxx or equivalent hardware)

PL subtype 2 R-data packet size (RETAP fixed mode only)				
	Bits	**Rate after 1 sub-packet**	**Modulation**	**Walsh length**
	128	19.2 kbps	BPSK	4
	256	38.4 kbps	BPSK	4
	512	76.8 kbps	BPSK	4
	768	115.2 kbps	BPSK	4
	1024	153.6 kbps	BPSK	4
	1536	230.4 kbps	QPSK	4
	2048	307.2 kbps	QPSK	4
	3072	460.8 kbps	QPSK	2
	4096	614.4 kbps	QPSK	2
	6144	921.6 kbps	QPSK	4 and 2
	8192	1228.8 kbps	QPSK	4 and 2
	12288	1843.2 kbps	8PSK	4 and 2
Auxiliary pilot channel min payload	User selection of 128, 256, 512, 768, 1024, 1536, 2048, 3072, 4096, 6144, 8192, or 12288 bits. Default of 3072 bits			
Short packets enabled threshold	User selection of 1024, 2048, 3072, or 4096 bits. Default of 4096 bits			
Reverse link closed loop bit rate	Fixed to 150 per second for PL subtype 2, fixed to 600 per second for PL subtype 0			
Reverse link closed loop power control modes	Active Alternating – alternating 0 and 1 power bits All up All down			

Option 102 – Release A and B Call Processing Functionality (Continued)

(Requires serial prefix equal to or higher than GB4604xxxx or equivalent hardware)

	Enhanced test application protocol = FETAP	**Enhanced test application protocol = RETAP**
FETAP parameter assignment message		
DRC value fixed mode	If DRCValueFixedMode attribute is On, attribute sent: – F-traffic format If DRCValueFixedMode attribute is Off, attribute not sent	
DRC cover fixed mode	Attribute not sent	
Ack channel bit fixed mode	If Ack channel bit fixed mode attribute is On, – Attribute sent: ACK channel bit (fixed setting) If Ack channel bit fixed mode attribute is Off, attribute not sent	
Loopback mode	Attribute sent: Enable	Attribute not sent
Ack channel modulation type fixed mode	Ack channel bit fixed mode attribute is On: – Attribute sent: ACK channel modulation (reverse ACK subtype 2) Otherwise: Attribute not sent	
RETAP parameter assignment message		
RETAP test packets enabled	Attribute not sent	Attribute sent: Enable (0x01)
Packet rate mode		Attribute not sent
Packet payload size mode		Attribute sent: – min = R-data packet size – max = R-data packet size
Enhanced access channel rate mode	Attribute sent: Enhanced access rate	
Burst period mode	Attribute not sent	Attribute sent: – LinkFlowID based on R-data transmission mode – Period = Burst period
Burst size mode		Attribute sent: – LinkFlowID based on R-data transmission mode – Size = Burst size

Option 103 – Multi-carrier Call Processing Functionality

(Requires E5515E or E5515C with serial prefix equal to or higher than GB4604xxxx or equivalent hardware and a license for Option 102 1xEV-DO Release A and B feature option and Option 406 Multi-Unit Sync feature option)

Protocol stack	1xEV-DO Release B, Release A, or Release 0 (multi-carrier only in B)
Supported applications	Forward multi-carrier test application protocol in physical layer subtype 3 (FMCTAP) Reverse multi-carrier test application enhanced test application protocol in physical layer subtype 3 (RMCTAP)
Multi-carrier test set configuration	Main, auxiliary, and single (default single)
Number of supported carriers	Supports 1, 2, or three carriers using 1, 2, or 3 E5515C/E test sets inter-connected via LAN. One unit is designated the multi-carrier master while 1 or 2 other test sets are designated as auxiliary carrier units. The main unit controls the call processing for all connected units.
Multi-carrier setup parameters	Auto setup external 8960 Series 10 1 state, external 8960 Series 10 IP address, auto setup external 8960 Series 10 2 state, and external 8960 Series 10 2 IP Address
Automatic multicarrier setup	Execute command on the main unit that performs the external device connection to all connected test sets and the required synchronization for all connected test set
Multi-unit connection status	Displays testset configuration, local carrier state, connected carriers, external device 1 status (connected with IP address or not connected) and external device 2 status (connected with IP address or not connected)
Physical layer subtype	Subtype 3
Supported subtype 3 protocols	Default access channel MAC protocol or enhanced access channel MAC protocol, enhanced forward traffic channel MAC protocol, subtype 3 reverse traffic channel MAC protocol, and default control channel MAC protocol
Call control (from main unit only)	Access network open connection Access network close connection Access network close session Access terminal open connection Access terminal close connection Hard handoff to new band and/or channel
Protocol status	Idle, Idle + Idle (Aux unit) UATI request, session negotiation, session open, session closing, paging, connect request, connection negotiation, connected, connected + connected (Aux unit), connection closing, handoff
Multi-carrier attributes in use	Max number forward links supported, max number reverse links supported, max sub-active sets, max forward link bandwidth no jammer, max forward link bandwidth jammer, max reverse link bandwidth, forward feedback multiplexing, max optional data rate, and max optional payload size
Parameters independently set on main	All main unit settings, and for both Aux 1 test set and Aux 2 test set the following parameters: carrier state, channel, forward traffic DRC, F-traffic packet length, R-data packet size, DRC value fixed mode, ACK channel bit fixed mode, ACK channel modulation, ACK channel gain, DRC channel gain, DRC length and channel drop rank
Parameters set on main only	Cell band, all cell parameters, all access parameters, all enhanced access parameters, all channel gain parameters, closed Loop power control parameters
Parameters set on each individual test set	Cell power, physical layer subtype, all generator parameters, call drop timer, Tx timing advance, max AT power, and all measurement parameters

1xEV-DO Test Mode Functionality

Protocol stack	1xEV-DO Release 0 overhead messages only with fixed traffic channel		
Base station parameters	ACKChannelGain, DRCChannelGain, DataOffsetNom, DataOffset9k6, DataOffset19k2, DataOffset38k4, DataOffset76k8, and DataOffset153k6		
Call control (one button commands)	None		
Access parameters	OpenLoopAdjust, ProbeInitialAdjust, ProbeNumStep, PreambleLength, PowerStep, ProbeSequenceMax, and PreferredControlChannelCycle		
System parameters	ColorCode, CountryCode, SectorID, and SubnetMask		
Protocol status	No protocol support other than overhead messages		
Forward control channel data rate	Selectable between 38.4 or 78.6 kbps		
Activity factor	100% only		
AT directed packets	Adjustable percentage (0 to 100%) of forward traffic packets directed to the AT under test. Default value of 50% per AT minimum performance specification. Packets not direct to the AT under test are sent to another MAC address that is not in use		
MAC index	5 to 63. Must be set to match AT expected value		
Pilot drop	0 to 63 (0 to –31.5 dB)		
Forward TCH data rates	38.4 kbps 76.8 kbps 153.6 kbps 307.2 kbps 307.2 kbps 614.4 kbps 614.4 kbps 921.6 kbps 1228.8 kbps 1228.8 kbps 1843.2 kbps 2457.6 kbps	16 slots, QPSK 8 slots, QPSK 4 slots, QPSK 2 slots, QPSK 4 slots, QPSK 1 slot, QPSK 2 slots, QPSK 2 slots, 8PSK 1 slot, QPSK 2 slots, 16QAM 1 slot, 8PSK 1 slot, 16QAM	(DRC=0x1) (DRC=0x2) (DRC=0x3) (DRC=0x4) (DRC=0x5) (DRC=0x6) (DRC=0x7) (DRC=0x8) (DRC=0x9) (DRC=0xA) (DRC=0xB) (DRC=0xC)
Expected reverse TCH data rate	9.6 kbps 19.2 kbps 38.4 kbps 78.6 kbps 153.6 kbps		
Reverse link closed loop bit rate	Fixed to 600 per second		
Reverse link closed loop power control modes	Alternating – alternating 0 and 1 power bits All up All down		
Settable system time			
Functionality	Allows user to set the system time for the CDMA system. System time is retained during power-off using the internal real-time clock		
CDMA system date	Settable in the format yyyy.mm.dd for the year, month, and day		
CDMA system time	Settable in the format of hh.mm.ss for the hour, minute, and seconds. Input resolution is 2 seconds		
Leap seconds	Settable from 0 to 255 seconds		
Local time offset	Settable in the format of hh.mm from 00.00 to 15.30 in 30 minute increments		
Daylight savings time indicator	On or Off		

1xEV-DO RF Generator

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

Channels		
Additive white Gaussian noise source	Yes	
AWGN bandwidth	Typically 1.8 MHz < BW < 2.1 MHz	
1xEV-DO cell with the following multiplexed channels	F-Pilot, F-MAC, F-CCH, and F-TCH	
PN offset	Selectable from 0 to 511	
Frequency		
Frequency range	US cellular band	860.04-893.97 MHz channels 1-799, 991-1023, 1024-1323, 1324-1424
	US PCS band	1930-1990 MHz, channels 0-1199
	Korean PCS band	1840-1870 MHz, channels 0-599
	Japan CDMA band	Approx. 832-869.9875 MHz, channels 1-799, 801-1039, 1041-1199, 1201-1600
	IMT-2000 band	2110-2169.950 MHz, channels 0-1199
	NMT-450 band	Approx. 421-494 MHz, channels 1-300, 539-871, 1039-1473, 1792-2016
	Secondary 800 MHz band	Approx. 851-869 MHz, and 935-940 MHz, channels 0-719, 720-919
	US PCS 1.9 GHz band	1930-1995 MHz, channels 0-1299
	AWS band	2110-2155 MHz, channels 0-899
	Cellular Upper 700 band	776-788 MHz, channels 0-240
	400 MHz European PAMR band	420-494 MHz, channels 1-2016
	800 MHz PAMR band	915-921 MHz, channels 0-239
	700 MHz Public Safety Band	757-769 MHz, channels 0-240
	Lower 700 MHz Band	728-746 MHz, channels 0-360
	US in-flight band	849.750-850.25 MHz and 894.750-895.25 MHz, channels 2, 4, 6, 8, 10
Frequency setting	By channel number	

1xEV-DO RF Generator (Continued)

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

Amplitude		
Output port control	User control of RF source routing to either the RF IN/OUT port or the RF OUT ONLY port	
RF IN/OUT composite signal level	Sum of the user-set values of the 1xEV-DO cell power and the AWGN source	
RF IN/OUT 1xEV-DO cell output level range (AWGN off)	–120 dBm/1.23 MHz to –13 dBm/1.23 MHz	
RF IN/OUT AWGN output level range	–120 dBm/1.23 MHz to –20 dBm/1.23 MHz *over-range available with reduced performance to –15 dBm/1.23 MHz*	
RF IN/OUT 1xEV-DO cell absolute output level accuracy (AWGN off)	< ±1.1 dB, –109 to –15 dBm/1.23 MHz *typically ±0.62 dB, –109 to –15 dBm/1.23 MHz*	
RF IN/OUT composite absolute output level accuracy (AWGN on)	< ±1.2 dB, –109 to –20 dBm/1.23 MHz *typically ±0.7 dB, –109 to –20 dBm/1.23 MHz*	
RF IN/OUT reverse power	+37 dBm peak (5 W peak)	
RF IN/OUT VSWR	< 1.14:1 < 1.2:1 < 1.32:1	400 to 1000 MHz 1700 to 2000 MHz 2010 to 2180 MHz
RF OUT ONLY composite signal level	Sum of the user-set values of 1xEV-DO cell power and the AWGN source	
RF OUT ONLY 1xEV-DO cell output level range (AWGN off)	–115 dBm/1.23 MHz to –5 dBm/1.23 MHz	
RF OUT ONLY AWGN output level range	–115 dBm/1.23 MHz to –12 dBm/1.23 MHz *over-range available with reduced performance to –7 dBm/1.23 MHz*	
RF out only 1xEV-DO cell absolute output level accuracy (AWGN off)	< ±1.1 dB, –109 to –7 dBm/1.23 MHz *typically < ±0.62 dB, –109 to –7 dBm/1.23 MHz*	
RF out only composite absolute output level accuracy (AWGN on)	< ±1.2 dB, –109 to –12 dBm/1.23 MHz *typically < ±0.7 dB, –109 to –12 dBm/1.23 MHz*	
RF out only reverse power	+24 dBm peak (250 mW peak)	
RF out only VSWR	*Typically < 1.3:1 for 400 to 500 MHz, < 1.4:1 for 800 to 1000 MHz, and < 1.45:1 for 1.7 to 2.2 GHz*	
Isolation *(from RF out only port to RF in/out when the RF source is routed to the RF out only port)*	*Typically > 40 dB*	
AWGN channel relative level range	Settable to ±35 dB relative to the total power (user-set 1xEV-DO cell power plus AWGN power) with 0.01 dB resolution	
Relative AWGN level accuracy	*Typically < ±0.2 dB for AWGN levels of less than or equal to ±20 from the total set RF power. Useable to ±35 relative levels from total RF power with degraded relative level accuracy*	

1xEV-DO RF Generator (Continued)

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

1xEV-DO modulation	
Modulation type	QPSK, 8PSK, or 16QAM depending on F-TCH data rate
Modulation quality – Residual rho – Residual EVM	 > 0.99 < 10%, typically < 4%
Carrier feedthrough	*Typically < –35 dBc*

1xEV-DO RF Generator (Option 102 – Release A)

Amplitude	
H-ARQ/L-ARQ relative channel level	–6.00 to –30 dB, default of –9 dB
P-ARQ relative channel level	–6.00 to –30 dB, default of –9 dB
RPC relative channel level	–6.00 to –30 dB, default of –9 dB

1xEV-DO RF Analyzer (measurements only)

1xEV-DO modulation		
H-ARQ modulation type	Bi-polar keying or on-off keying, default of bi-polar keying	
Frequency range (reverse channels)	US cellular band	1-799, 991-1023, 1024-1323, 1324-1424
	US PCS band	0-1199
	Korean PCS band	0-599
	Japan CDMA band	1-799, 801-1039, 1041-1199, 1201-1600
	IMT-2000 band	0-1199
	NMT-450 band	1-300, 539-871, 1039-1473, 1792-2016
	Secondary 800 band	0-719, 720-919
	US PCS 1.9 GHz band	0-1299
	AWS band	0-899
	400 MHz European PAMR band	410-484 MHz, channels 1-2016
	800 MHz PAMR band	870-876 MHz, channels 0-239
	700 MHz Public Safety Band	787-799 MHz, channels 0-240
	Lower 700 MHz Band	698-716 MHz, channels 0-360
Input level range	–71 to +35 dBm/1.23 MHz	

1xEV-DO RF Analyzer (measurements only) (Continued)

Receiver ranging	
Auto mode	Autoranges to the ideal RF power level for the nominally expected open loop response. Provides calibrated results if actual received power is within ±9 dB of the expected open loop power
Manual mode	User enters expected power. If the Active mode is selected, the test set uses closed loop power control to drive the mobile to the expected power. Otherwise, the mobile's Tx power must be within ±9 dB of the expected power to provide calibrated results

1xEV-DO Analyzer

1xEV-DO modulation		
Input frequency ranges	411 to 484 MHz	
	800 to 1000 MHz	
	1700 to 2000 MHz	
Detector type	Thermal detector	
Maximum input level	+37 dBm peak (5 W peak)	
Measurement range	–10 to +30 dBm	
Measurement level ranging	Auto	
Measurement data capture period	10 ms	
Measurement trigger	1.67 ms (slot trigger)	
Measurement result	Average power	
Concurrency support	Average power measurements can be made concurrently with all 1xEV-DO measurements that support concurrency	
Measurement accuracy –10 to +30 dBm	(Accuracy with 10 internal averages, all up power control bits and R-TCH rate set to 153.6 kbps): 400 to 500 MHz 800 to 1000 MHz 1700 to 2000 MHz	 < ±6.9%, typically < ±3.0% < ±6.2%, typically < ±3.0% < ±7.4%, RF out only port < ±8.2%, *typically < ±3.3%*
Measurement repeatability	*Typically < ±0.05 dB*	
Measurement resolution	0.01 dBm	
Zero function	Auto zeroes (no user control)	

1xEV-DO Analyzer (Continued)

Access probe power measurement	
Input frequency ranges	411 to 420 MHz 450 to 484 MHz 821 to 934 MHz 1700 to 1980 MHz
Measurement method	Measures the total power in a 1.23 MHz bandwidth centered on the active reverse channel center frequency
Measurement data capture period	1.67 ms
Measurement trigger	Amplitude rise only
Maximum input level	+37 dBm/1.23 MHz peak (5 W peak)
Measurement range	–54 to +30 dBm
Measurement level ranging	Auto and manual
Measurement accuracy	< ±1 dB 15 to 55 °C, typically < ±0.5 dB (Calibrated against average power and within ±10 degrees of calibration temperature. Calibration must occur between 20 to 55 °C)
Measurement result	Access probe power in a 1.23 MHz bandwidth
Concurrency capabilities	None

Tuned channel power measurement	
Input frequency ranges	411 to 420 MHz 450 to 484 MHz 821 to 934 MHz 1700 to 1980 MHz
Measurement method	Measures the total power in a 1.23 MHz bandwidth centered on the active reverse channel center frequency
Measurement data capture period	0.3125 ms (very fast mode) and 1.67 ms (fast mode)
Measurement trigger	1.67 ms clock (slot trigger)
Maximum input level	+37 dBm/1.23 MHz peak (5 W peak)
Measurement range	–61 to +30 dBm, usable to < –69 dBm/1.23 MHz with reduced accuracy
Measurement level ranging	Auto and manual
Measurement accuracy	< ±1 dB 15 to 55 °C for the fast mode, typically < ±0.5 dB < ±1.1 dB for 15 to 55 °C for the very fast mode, typically < ±0.5 dB. (Calibrated against average power and within ±10 degrees of calibration temperature. Calibration must occur between 20 to 55 °C)
Measurement resolution	0.01 dBm/1.23 MHz
Measurement result	Channel power in a 1.23 MHz bandwidth
Concurrency capabilities	Channel power measurements can be made concurrently with all 1xEV-DO measurements that support concurrency
Calibrate function	Calibrates the channel power measurement over the entire operating frequency range of the test set against the average power measurement; no external cabling is required
Calibration time	Typically < 120 seconds

1xEV-DO Analyzer (Continued)

Modulation quality measurement	
Input frequency ranges	411 to 484 MHz 800 to 1000 MHz 1700 to 2000 MHz
Measurement chip rate	1.2288 Mcps
Modulation measurement method	Multi-code rho and EVM with code domain results
Maximum input level	+37 dBm/1.23 MHz peak (5 W peak)
Input level range	–25 to +30 dBm/1.23 MHz for reverse rates of 9.6 kbps, *usable to –50 dBm/1.23 MHz at 9.6 kbps with reduced accuracy; sensitivity reduces with increased reverse data rates*
Modulation quality measurement range	1 to 40% EVM (For signals with < ±6 µs time error and < ±1 kHz frequency error)
Measurement interval	1 to 8 slots (1.67 up to 13.33 ms) for PL subtype 0 1 to 4 slots (1.67 up to 6.67 ms) for PL subtype 2
Measurement trigger	27 ms (frame trigger)
Modulation quality measurement accuracy	< ±1.25 rms + residual error for 1% < EVM < 20%
Modulation quality measurement residuals	
Residual rho Residual EVM Residual time error Frequency error sidual code domain power	> 0.999 < 4% rms, typically < 3.1% ±0.11 µs ±15 Hz plus timebase error < –35 dBc
Code domain power relative measurement accuracy	< ±0.005 relative to a total power for linear code domain powers from 0.05 to 1.0
Code domain results	
Code domain power graph	Displays the power in all 16 Walsh coded channels (16 bit) for both the I channel and the Q channel; reported power in each graph is relative to the total combined I and Q channel power; red bars indicate active channels, while yellow bars indicate inactive channels
Code domain table	Displays the Walsh code, spread factor, code domain power (at SF=16), total code domain power, and code power relative to the R-Pilot channel for each active reverse channel; possible active channels R-Pilot, R-RRI, R-ACK, R-DRC, and R-TCH
Code domain power and noise graph	Displays the power and noise in all 16 Walsh coded channels (16 bits) for both the I channel and the Q channel; reported power in each graph is relative to the total combined I and Q channel power, red bars indicate active channels, while yellow bars indicate noise in each channel
Measurement results	Rho, frequency error, time error, carrier feedthrough, phase error, amplitude error, and EVM
Statistical measurement results	Provides minimum, maximum, and average for rho, frequency error, time error, carrier feedthrough, phase error, amplitude error, and EVM when multi-measurement mode is active
Concurrency capabilities	Supports concurrency with all other 1xEV-DO concurrent measurements

1xEV-DO Analyzer (Continued)

Tx spurious emissions	
Input frequency ranges	411 to 420 MHz 450 to 484 MHz 821 to 934 MHz 1700 to 1980 MHz
Measurement data capture period	5 ms
Measurement trigger	1.67 ms (slot trigger)
Maximum input level	+37 dBm/1.23 MHz peak (5 W peak)
Measurement range	0 to +30 dBm
Measurement level ranging	Auto
Concurrency capabilities	Tx spurious emissions measurements can be made concurrently with all 1xEV-DO measurements that support concurrency
Tx spurious emissions Test Case 1 (for one carrier)	
Measurement method	Measures the active carrier power in a 1.23 MHz bandwidth, then measures the power in a 30 kHz bandwidth at two offsets above and below the active carrier and displays the ratio of the offset powers to the active carrier power in dBc
Measurement offsets	
Frequencies < 1000 MHz	±885 kHz, ±1.98 MHz
Frequencies > 1000 MHz	±1.25 MHz, ±1.98 MHz
Measurement bandwidth	
Active carrier	1.23 MHz
Offsets	30 kHz synchronously tuned, five pole filter with approximately Gaussian shape
Marker relative level accuracy	
±885 kHz, ±1.25 MHz offsets	< ±0.4 dB, *typically* < *±0.2 dB*
±1.98 MHz offsets	< ±0.8 dB, *typically* < *±0.5 dB*
Measurement residual relative power	
±885 kHz, ±1.25 MHz offsets	< –62 dBc/30 kHz BW
±1.98 MHz offsets	< –66 dBc/30 kHz BW
Mobile pass/fail limits (per C.S0033)	
Auto mode	
– Frequencies < 1000 MHz	–42 dBc/30 kHz for ±885 kHz offsets –54 dBc/30 kHz for ±1.98 MHz offsets
– Frequencies > 1000 MHz	–42 dBc/30 kHz for ±1.25 MHz offsets –50 dBc/30 kHz for ±1.98 MHz offsets
Manual mode	Settable from –10 to –65 dBc with 0.01 dB resolution
Numeric results	Relative power in dBc/30 kHz for each of the four offset frequencies

1xEV-DO Analyzer (Continued)

Tx spurious emissions (Continued)	
Tx spurious emissions Test Case 1 (for one carrier) (Continued)	
Graphical results	
Graph	Single trace with C.S0033 standard limit lines and one bar representing the channel power and four bars representing the relative power at the four offset frequencies
Amplitude range	0 to –80 dB
Tx spurious emissions Test Case 2 (for two carriers)	
Measurement method	Measures the active carrier power in a 1.23 MHz bandwidth, then measures the power in a 1 MHz bandwidth at two offsets above and below the active carrier and displays the absolute power of the offset powers in dBm
Measurement offsets	
Frequencies < 1000 MHz Frequencies > 1000 MHz	±885 kHz, ±1.885 MHz ±1.25 MHz, ±2.25 MHz
Measurement bandwidth	
Active carrier	1.23 MHz
Offsets	1 MHz synchronously tuned, five pole filter with approximately Gaussian shape
Marker relative level accuracy	
±885 kHz, ±1.25 MHz ±1.885 MHz and ±2.25 MHz offsets	< ±1 dB, *typically* < *±0.6 dB*
Measurement residual relative power	
±885 kHz, ±1.25 MHz ±1.885 MHz and ±2.25 MHz offsets	< –55 dBc/1 MHz BW
Mobile pass/fail limits (per C.S0033)	
Auto mode	
– Frequencies < 1000 MHz	6 dBm/1 MHz for ±885 kHz offsets –13 dBm/1 MHz for ±1.885 MHz offsets
– Frequencies > 1000 MHz	6 dBm/1 MHz for ±1.25 MHz offsets –13 dBm/1 MHz for ±2.25 MHz offsets
Manual mode	Settable from –10 to –65 dBc with 0.01 dB resolution
Numeric results	Absolute power in dBm/1 MHz for each of the four offset frequencies
Graphical results	
Graph	Single trace with C.S0033 standard limit lines and one bar representing the channel power and four bars representing the absolute power at the four offset frequencies
Amplitude range	0 to –80 dB

1xEV-DO Analyzer (Continued)

Tx spurious emissions (Continued)	
Tx spurious emissions Test Case 3 (for three carriers)	
Measurement method	Measures the active carrier power in a 1.23 MHz bandwidth, then measures the power in a 30 kHz bandwidth at the adjacent and 1st alternate offsets above and below the active carrier and measures the power in a 1 MHz bandwidth at the 2nd alternate offsets above and below the active carrier, displays the absolute power of the offset powers in dBm
Measurement offsets	
Adjacent offsets	±2.5 MHz
1st Alternate offsets	Settable from ±2.7 MHz to ±3.47 MHz, default of 3.47 MHz
2nd Alternate offsets	Settable from ±3.5 MHz to ±6.5 MHz, default of ±6.5 MHz
Measurement bandwidth	
Active carrier	1.23 MHz
Offsets	30 kHz synchronously tuned, five pole filter with approximately Gaussian shape for the adjacent and 1st alternate offsets 1 MHz synchronously tuned, five pole filter with approximately Gaussian shape for the 2nd alternate offsets
Marker relative level accuracy	
Adjacent offsets	< ±1.3 dB, *typically* < *±0.65 dB*
1st Alternate offsets	< ±1.4 dB, *typically* < *±0.75 dB*
2nd Alternate offsets	< ±1 dB, *typically* < *±0.6 dB*
Measurement residual relative power	
Adjacent offsets	< –70 dBc/30 kHz BW
1st Alternate offsets	< –70 dBc/30 kHz BW
2nd Alternate offsets	< –55 dBc/1 MHz BW
Mobile pass/fail limits (per C.S0033)	
Auto mode – 2.5 MHz to 2.7 MHz – 2.7 MHz to 3.5 MHz – 3.5 MHz to 7.5 MHz	 –14 dBm / 30 kHz – [14 + 15 × (Δf – 2.7 MHz)] dBm / 30 kHz – [13 + 1 × (Δf – 3.5 MHz)] dBm / 1 MHz
Manual mode	Settable from –10 to –65 dBc with 0.01 dB resolution
Numeric results	Absolute power in dBm/30 kHz for the adjacent and 1st alternate offset frequencies and in dBm/1 MHz for the alternate offset frequencies
Graphical results	
Graph	Single trace with C.S0033 standard limit lines and one bar representing the channel power and six bars representing the absolute power at the six offset frequencies
Amplitude range	0 to –80 dB

1xEV-DO Analyzer (Continued)

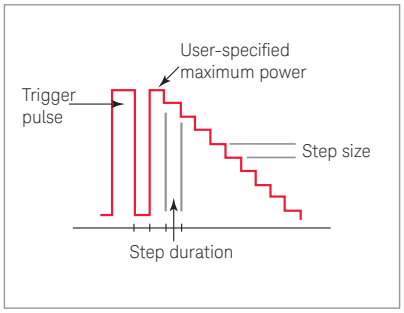
Time response of open loop power control measurement	
Input frequency ranges	411 to 420 MHz 450 to 484 MHz 821 to 934 MHz 1700 to 1980 MHz
Measurement method	Measures the open loop power versus time response of a mobile to a 20 dB step in the test set's cell power. User must set the ACK channel fixed mode bit to Off and set AT directed packets to 0% in order to achieve valid measurement results
Measurement data capture period	100 ms
Measurement trigger	User initiated
Maximum input level	+37 dBm/1.23 MHz peak (5 W peak)
Measurement range	–46 to +30 dBm (final level after ±20 dB step in cell power)
Measurement level ranging	Auto
Measurement cell power step size	+20, –20 dB
Marker relative level accuracy	±0.5 dB
Marker time accuracy	±540 µs
Measurement limits	Time versus amplitude mask per C.S0033
Graphical results – Graph – Time display resolution – Time display range – Amplitude range	 Single trace with C.S0033 standard limit lines 270 µs 0 to +100 ms –5 to +30 dB
Available results	Pass or fail result and trace of 371 data points available via GPIB
Concurrency capabilities	None. Selecting this measurement automatically closes all other active measurements

Packet error rate measurement	
PER measurement method	FTAP loopback
PER input level measurement range	–65 dBm/1.23 MHz to +30 dBm/1.23 MHz
PER measurement residual error rate	$< 1 \times 10^{-6}$ for input levels in the specified input level measurement range and within ±9 dB of the expected input power
Confidence limit range	Definable from 80.0 to 99.9% and Off
PER reported parameters	
Intermediate results	PER, number of FTAP packets sent, number of FTAP packets received, number of FTAP physical packet slots, and number of FTAP MAC packets received
Final results	PER, number of FTAP packets sent, number of FTAP packets received, number of FTAP physical packet slots, number of FTAP MAC packets received, and one of the following: passed confidence limit, failed confidence limit, or maximum frames
Concurrency capabilities	PER measurements can be made concurrently with all 1xEV-DO measurements that can run while in a FTAP connection

1xEV-DO Analyzer (Continued)

Packet error rate measurement (Continued)	
Conditions for terminating PER test	
Max packets	Maximum number of packets to test
Failed	Measured PER failed the specified PER limit with specified confidence
Passed	Measured PER passed the specified PER limit with specified confidence

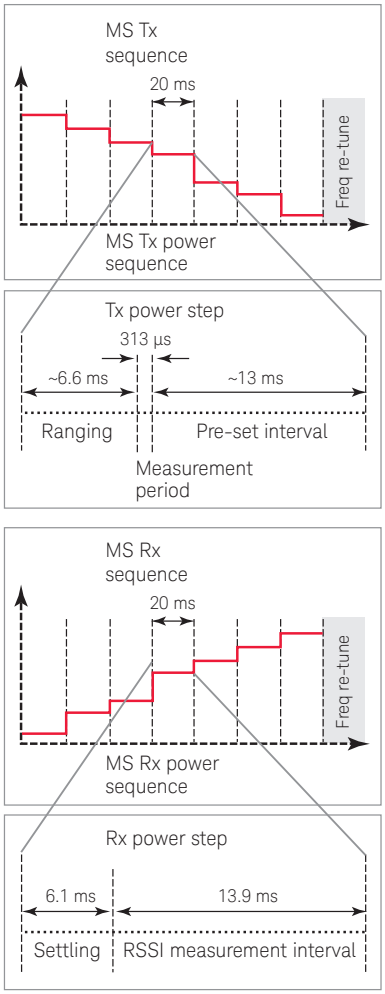
Tx dynamic power measurement	
Input frequency ranges	411 to 420 MHz 450 to 484 MHz 821 to 934 MHz 1700 to 1980 MHz
Measurement method	Captures a user-defined trace consisting of 20, 40, or 80 ms duration power steps with user-defined step size produced by a test mode in the mobile station under test; measures the total power in a 1.23 MHz bandwidth centered on the active reverse channel center frequency in each step period
Measurement data capture period	1.25 ms
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
Maximum input level	+37 dBm/1.23 MHz peak (5 W peak)
Measurement range	–61 to +30 dBm, usable to < *–69 dBm/1.23 MHz with reduced accuracy*
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 mobile station
Measurement accuracy	< ±1 dB 15 to 55 °C, *typically* < *±0.5 dB.* (Calibrated against average power and within ±10 degrees of calibration temperature. Calibration must occur between 20 to 55 °C)
Measurement resolution	0.01 dBm/1.23 MHz
Measurement step duration time	20, 40, or 80 ms
Measurement step size	–0.01 to –90.0 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	None
Calibrate function	Uses the channel power calibration function



Fast Device Tune Measurement

E1999A-202 FDT Enhanced

Fast device tune measurement	
Input frequency ranges	411 to 420 MHz 450 to 484 MHz 821 to 934 MHz 1700 to 1980 MHz
Measurement method	Allows user definition of an RF source power output sequence simultaneously with a Tx power measurement sequence each consisting of 10 or 20 ms duration steps with user-defined step size. Sequence can be defined to repeat over a number of frequencies inside of a single frequency band. This measurement requires a test mode in the mobile station in order to operate. Measures the total power in a 1.23 MHz bandwidth centered on the active reverse channel center frequency in each step period
Measurement data capture period	0.313 µs
Maximum input level	+37 dBm/1.23 MHz peak (5 W peak)
Measurement range	–61 to +30 dBm, usable to < –69 dBm/1.23 MHz with reduced accuracy
Measurement capture range	Mobile station's transmit power must be within ±9 dB of the expected power per the ranging configuration
Measurement accuracy	< ±1 dB 15 to 55 °C for the fast mode, typically < ±0.5 dB. (Calibrated against average power and within ±10 degrees of calibration temperature. Calibration must occur between 20 to 55 °C)
Measurement resolution	0.01 dBm/1.23 MHz
Measurement step duration (time)	10 or 20 ms
Number of frequency steps	1 to 20
Number of amplitude steps	1 to 20 steps at each specified frequency
Maximum steps in a sequence	Up to 20 out of the possible 40 entries in each table
MS Tx frequency step table	1 to 40 entries, with each value in MHz
MS Tx power step table	1 to 40 entries, with each value in dBm
MS Rx frequency step table	1 to 40 entries, with each value in MHz
MS Rx power step table	1 to 40 entries, with each value in dBm
MS Tx frequency step start index	0 to 39
MX Tx power step start index	0 to 39
MS Rx frequency step start index	0 to 39
MS Rx power step start index	0 to 39
RF generator settling time	< 6.1 ms to be within ±0.1 dB of the final value
RF generator modulation accuracy	*Typically < 3.1%*
RF generator level accuracy	Same as listed under 1xEV-DO RF generator specifications
Concurrency capabilities	None
Calibrate function	Calibrates all measurement functions



Single Channel GPS Source

E1999A-206 single channel GPS source

Single channel GPS source	
GPS signal output	RF IN/OUT or RF OUTPUT only
GPS signal frequency	1.57542 GHz
GPS signal output level range	–70 to –125 dBm
GPS signal output level accuracy	< ±1.0 dB, –70 to –116 dBm < ±1.5 dB, –116 to –125 dBm
Code type	Coarse/Acquisition (C/A)
Chip Rate	1.023 Mcps
Settable parameters	Satellite ID, data patterns and filters

Timebase Specifications

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

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
Accuracy	After a 30-minute warm-up period of continuous operation is derived from typically ±(time since last calibration) x (aging rate) + (temperature stability) + (accuracy of calibration)
Initial adjustment	Typically ±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 Ω*
External reference output	
Output frequency	Same as timebase (internal 10 MHz OCXO or external reference input)
Output level	*Typically > 0.5 V rms*
Output impedance	*Typically 50 Ω*
Trigger output	
Frame clock output	Selectable output of 1.67 ms, 26.67 ms, 426.67 ms, or 2 s

Option 004 Digital Bus Specifications

Option 004 digital bus	
Functionality	Allows baseband, digital I/Q data from the signal generator to be sent to an external N5101A Baseband Studio PCI card for fading and then returned to the test set for modulation
Connector	Rear panel, 50-pin, high density
Signal generator ALC mode	Closed or open (default of closed). Open loop mode must be used during fading to maintain the desired signal characteristics
ALC open loop calibration	Calibrates the RF source when operating in the ALC open loop mode. The accuracy remains valid with a ±5 °C window of the temperature at which the calibration was performed
ALC open loop RF in/out composite absolute output level accuracy	
	(Specification for temperatures within ±5 °C of the last ALC open loop calibration temperature and with one calibration every 24 hours. Actual operating level must be adjusted by the LBO value when operating with the Baseband Studio fader to determine which specification range applies):
420 to 490 MHz	*Typically < ±1.55 dB, > –27.5 dBm/1.23 MHz, typically < ±1.55 dB, –27.5 to –61.5 dBm/1.23 MHz, typically < ±1.6 dB, < –61.5 dBm/1.23 MHz*
830 to 975 MHz	*Typically < ±1.60 dB, > –27.5 dBm/1.23 MHz, typically < ±1.50 dB, –27.5 to –61.5 dBm/1.23 MHz, typically < ±1.65 dB, < –61.5 dBm/1.23 MHz*
1800 to 1880 MHz	*Typically < ±1.75 dB, > –27.5 dBm/1.23 MHz,*
1925 to 1990 MHz	*Typically < ±1.65 dB, –27.5 to –61.5 dBm/1.23 MHz,*
2100 to 2175 MHz	*Typically < ±1.80 dB, < –61.5 dBm/1.23 MHz*
ALC open loop RF out only composite absolute output level accuracy	
	(Specification for temperatures within ±5 °C of the last ALC open loop calibration temperature and with one calibration every 24 hours. Actual operating level must be adjusted by the LBO value when operating with the Baseband Studio fader to determine which specification range applies):
420 to 490 MHz	*Typically < ±1.60 dB, > –17 dBm/1.23 MHz, typically < ±1.55 dB, –17 to –51 dBm/1.23 MHz, typically < ±1.6 dB, < –51 dBm/1.23 MHz*
830 to 975 MHz	*Typically < ±1.60 dB, > –17 dBm/1.23 MHz, typically < ±1.55 dB, –17 to –51 dBm/1.23 MHz, typically < ±1.65 dB, < –51 dBm/1.23 MHz*
1800 to 1880 MHz	*Typically < ±1.75 dB, > –17 dBm/1.23 MHz,*
1925 to 1990 MHz	*Typically < ±1.65 dB, –17 to –51 dBm/1.23 MHz,*
2100 to 2175 MHz	*Typically < ±1.80 dB, < –51 dBm/1.23 MHz*
ALC open loop carrier feedthrough	*Typically < 40 dBc, (nominal ambient < 47 dBc after IQ calibration)*

General Specifications

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	
Save/recall registers		
Storage capacity	Five registers that store the complete instrument state except for active cell call processing status (fixed labels of register 1 to 5); registers are non-volatile	
Recall	Allows user to recall one of the five stored instrument states	
Measurement speed		
Measurement name	One measurement	Ten measurements
Channel power (fast mode)	22 ms	157 ms
Channel power (very fast mode)	9 ms	34 ms
Average power	231 ms	2066 ms
Waveform quality (PLO) 1 slot	270 ms	2425 ms
Waveform quality (PLO) 8 slots	1752 ms	17088 ms
Tx spurious response	303 ms	2299 ms
Time response of open loop power	1141 ms	NA

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