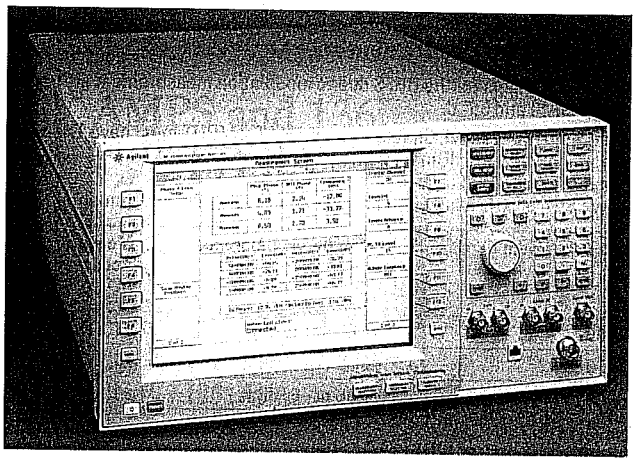
Wireless Mobile & Base Station Test Sets

8960 Series 10 Mobile Phone Manufacturing Test Set



8960 Series 10 Wireless Communications Test Set

High Production Output Test for Mobile Manufacturing

In high-volume mobile manufacturing, test throughput and test yield are key to meeting production output goals. The Agilent Technologies 8960 Series 10 wireless communications test set offers mobile manufacturers immediate competitive advantages. Developed for high-volume, automated mobile phone manufacturing test, the proven Agilent Technologies 8960 Series 10 test set offers speed, accuracy, repeatability, multi-format capability, ease of programming, and format-flexible architecture. For the mobile manufacturer, this helps lower test costs and improve production output.

Test Speed
The 8960 Series 10 can reduce individual test times 30% to 300% compared to previous generation test equipment. Faster measurement means manufacturer's can test a given production volume with fewer test sets, thereby lowering the cost of test and saving floor space. It also gives manufacturers the option to improve mobile phone quality or yield by running additional tests. To deliver this speed, the test set incorporates hardware that has been optimized with fast processing algorithms, a high level command language, and multiple path, multiple processor technology.

Accuracy and Repeatability
Speed is only important if a test set is accurate and repeatable. The built in accuracy and repeatability of the 8960 makes manufacturers confident of their phone quality and can be used to improve phone yield and increase phone output. The 8960 earns its accuracy and repeatability by undergoing extensive environmental qualification and production specification verification.

Multi-Format
The 8960 can be configured for GSM, GPRS, TIA/EIA-136, AMPS and IS-2000 mobile phones. Manufacturers can test multi-format phones with a single test set, change production from one format to another to meet changing demand, or manufacture different format mobile phones on the same line. For the manufacturer, this means faster response to market changes, less downtime for changeovers, and improved test set utilization.

Automated Test
Designed for automated test, the 8960 remote user interface provides high level test commands specific to mobile phone formats. Complex measurement processing, error handling, and statistical functions are built-in and executed with a single command. For the manufacturer, high-level commands simplify test code development and maintenance. New production gets ramped to volume more quickly and test support costs are reduced.

Flexible Architecture
Format-flexible architecture is designed to grow with 3G mobile phone technologies. The 8960 is a flexible test set that Agilent Technologies designed to meet the needs of mobile manufacturers now and into the future. As mobile phone technology advances, the 8960 will evolve. New formats will be added and test set hardware changed to provide the needed functionality. Agilent Technologies plans to offer flexible upgrade paths to allow previous models to test new formats where practical.

Test Set Configuration
The building blocks of the Agilent Technologies 8960 are mobile phone format specific test applications and generic test set hardware. Agilent Technologies will continue to add new mobile phone formats and improve existing test applications. To get up-to-date configuration information, go to the 8960 web site at **www.agilent.com/find/8960support/literature/configuration guide**

Key Information

8960 Series 10 web site at: **www.agilent.com/find/8960support**
8960 Series 10 Wireless Communications Test Set Configuration Guide, p/n 5968-7880E
8960 Series 10 Multi-Format Test Set Photocard, p/n 5980-0286E

Functionality and Specifications

Mobile phone format specific detail for the 8960 Series 10 is listed on subsequent pages. Ordering information follows the technical information at the end of the 8960 pages.

8960 Series 10 GSM Mobile Test Set (E5515B with E1960A)

Transmitter Measurements

- Frequency error
- Output power
- Phase error (peak and rms)
- Power versus time (burst mask comparison)
- Burst timing
- Output RF spectrum due to switching
- Output RF spectrum due to modulation

Receiver Measurements

- Burst-by-burst bit error ratio (fast BER)
- Normal bit error ratio (BER)

Audio Functionality

- Speech echo back to mobile station
- Audio generator encoded on downlink TCH
- Audio generator
- Audio level measurement
- Uplink speech level measurement

GSM Functionality

- Mobile Station Power Output Level Control: Meets GSM phase one and phase two power control levels
- Traffic Channels: TCH/FS – full rate speech
- Broadcast Channel Configuration: BCCH + CCCH + SDCCH/4
- Signaling Protocol Setup: FACCH
- Audio Speech Echo: One-second fixed delay
- Measurement Coordination: Flexible control of burst type, ARFCN, and timeslot

Call Processing Functionality

MS Origination, BS origination, MS release, BS release, Intra-cell channel assignments, Inter-cell handovers

SAACH reporting of servicing cell: RX quality, RX level, TX level, Timing advance

SACCH reporting of first neighbor cell: Channel number, Base station color code (BCC), RX level, Network color code (NCC)

Counters reported: RACH count, Corrupt burst count, Page count, Decode error count, Missing burst count

Last location information reported: Location area code (LAC), Mobile country code (MCC), Mobile network code (MNC)

Mobile-reported information: International mobile subscriber identity (IMSI), International mobile equipment identity (IMEI), Revision level, Power class, Supported band, Called number

Signaling Modes

Full Signaling Call Setup (active cell mode): Protocol used to establish, maintain, change channels and power levels, and terminate the link.

Limited Signaling Call Setup (test mode): Protocol used only to maintain a link established by the mobile station, over-the-air signaling and capability to demodulate and decode uplink RACH (random access channel) bursts is not available.

8960 Series 10 GSM Technical Specifications (E5515B with E1960A)

RF (Downlink) Generator Specifications

RF generator specifications apply to both RF generators in the 8960

RF Frequency

Frequency Range: 810 to 960 MHz, 1.7 to 1.99 GHz
Accuracy and Stability: Same as timebase reference

RF Amplitude

Output Level Range: –110 to –13 dBm
Absolute Output Level Accuracy: <±1.0 dB

GSM Signal Generation

Peak Phase Error: <±4 degrees
rms Phase Error: <1 degree
Frequency Error: <±0.02 ppm plus timebase reference

Spectral Purity

Non-Harmonics:
<-55 dBc for 100 to ≤1500 kHz offsets from carrier
<-68 dBc for >1500 kHz offsets from carrier

Transmitter Measurement Specifications

Phase and Frequency Error Measurement
Minimum Input Level: Signal at test set's RF IN/OUT must have TX output power ≥–15 dBm for warranted performance
Frequency Error Measurement Accuracy:
<±12 Hz plus timebase accuracy for normal bursts
<±18 Hz plus timebase accuracy for RACH bursts
RMS Phase Error Measurement Accuracy: <1 degree
Peak Phase Error Measurement Acuracy: <4 degrees

Transmitter Output Power Measurement
Minimum Input Level: signal at test set's RF IN/OUT must have TX output power ≥–30 dBm for warranted performance

Measurement Accuracy between 20 and 55° C:

Frequency Range	Amplitude Range	Measurement Accuracy
810 to 960 MHz	+4 to +43 dBm	<±0.32 dB
1.7 to 1.99 GHz	–20 to +43 dBm	<±0.42 dB

Output RF Spectrum (ORFS) Due to Modulation Measurement

All specifications for the ORFS due to modulation measurement are valid between 20 and 55° C.
Minimum Input Level: Signal at test set's RF IN/OUT must have TX output power ≥–10 dBm for warranted performance
Measurement Accuracy (referenced to output power in a 30 kHz bandwidth and averaged over 100 measurements):

kHz Offset from Carrier	Power Below Reference (Whichever is Highest)	Measurement Accuracy
±100	–10 dB or –46 dBm	±1.5 dB
±200	–40 dB or –46 dBm	±1.5 dB
±250	–43 dB or –46 dBm	±1.5 dB
±400 to ±1800	–62 dB or –66 dBm	±1.5 dB

Output RF Spectrum (ORFS) Due to Switching Measurement
All specifications for the ORFS due to switching measurement are valid between 20 and 55 oC.
Minimum Input Level: Signal at test set's RF IN/OUT must have TX output power ≥–10 dBm

Audio Generator Specifications

Frequency
Operating Range: 100 Hz to 5 kHz
Accuracy: Same as timebase reference

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 ± measurement resolution)
Distortion: <0.1% for 0.2 to 9 V peak into ≥600 Ω

Audio Measurement Specifications

Audio Level Measurement
Measurement Range: 200 Hz to 8 kHz
Measurement Accuracy: ± (2% of reading ± measurement resolution)

Uplink Speech Level Measurement
Types of Signals Measured: Speech present on uplink TCH pulsed with 50% duty cycle at a 10 Hz rate
Measurement Range: 200 Hz to 8.6 kHz
Measurement Accuracy: Observed inaccuracies are due to mobile phone encoder errors since the algorithm in the 8960 contributes no bit errors

8960 Series 10 GPRS Mobile Test Set (E5515B with E1964A)

Multi-slot Configurations
1x1, 2x1, 3x1, 2x2

Coding Schemes
CS-1 and CS-4

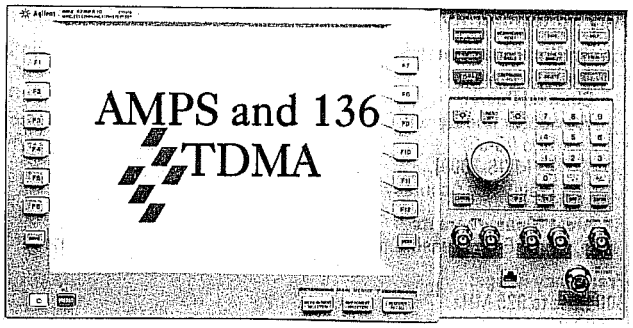
Frequency Bands
GSM, EGSM, DCS1800, PCS1900

Signaling Modes
Active Cell, Test Mode (2), CW

ETSI Test Mode with Loopback

Transmitter Measurement
Single slot measurements:
ORFS for both modulation and switching
Multi-slot measurements:
Transmitter Power
Phase and Frequency Error
Power/Time template with ETSI multi-slot mask

Receiver Measurements
Bit Error Ratio (BER)
Block Error Ration (BLER)



AMPS/136 (TDMA) Mobile Test Set (E5515B with E1961A)

NEW

Measurements

Transmitter Measurements
- RF Frequency Error and Frequency
- Output power
- FM Deviation Distortion and Frequency
- Modulation Accuracy
- Error Vector Magnitude (EVM & EVM10)
- Magnitude and Phase Error
- Frequency Error
- Origin Offset
- Adjacent Channel Power
- IQ tuning

Receiver Measurement
- Loopback Bit Error Rate (LBER)

Audio Functionality
- Audio generator
- Audio analyzer (level, SINAD, distortion, frequency)
- Expandor, de-emphasis and filtering

Call Processing Functionality
- Origination from BS or MS
- Release from BS or MS
- Digital and analog modes (ACC, AVC, DCCH, DTC)
- Selectable call setup parameters
- Handoffs between all bands and all modes
- MAHO reporting: RSSI, BER ranges, and neighboring cell power.

Signaling Modes

Full Signaling Call Setup (active cell mode): Protocol used to establish, maintain, change channels and power levels, and terminate the link.
Limited Signaling Call Setup (test mode): Protocol used only to maintain a link established by the mobile station, over-the-air signaling and capability to demodulate and decode uplink RACH (random access channel) bursts is not available
CW (cw mode): Provides unbursted, unmodulated RF signals over the operating frequency and amplitude ranges.Used to test mobile phone functions by setting desired RF frequency and amplitude.

RF Generator Specifications

RF Frequency
Frequency Range: 800 to 960 MHz, 1.7 to 2.0 GHz
Accuracy and Stability: Same as timebase reference

RF Amplitude
Output Level Range: –116 to –15 dBm
Absolute Output Level Accuracy: < ± 1.0 dB
Typical VSWR at RF IN/OUT: <1.2:1 for 800 to 960 MHz; <1.25:1 for 1.7 to 2.0 GHz

FM and SAT Signal Generation
FM Rate Range: 100 Hz to 20 kHz
FM Deviation Range: 0 to 20 kHz for combined SAT, internal and external deviation
Residual FM: <7 Hz rms in a CCITT bandwidth

TDMA Signal Generation
Frequency Error: < ± (4 Hz + timebase error)
EVM: < 3.0% rms
Origin Offset: <–35 dBc

E1961A
E5515B

Audio Generator Specifications

Frequency
Operating Range: 100 Hz to 20 kHz
Accuracy: Same as timebase reference

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)
Distortion: < 0.1% for 0.2 to 9 V peak (into ≥600 Ω)

Analog & Digital RF Analyzer Specifications

Analog TX Power Measurement
Minimum Input Level: Signal at test set's RF IN/OUT must have analog TX power >–30 dBm for warranted performance
Measurement Accuracy (for 20° C to 55° C): <±0.32 dB for 800 to 960 MHz, <±0.42 dB for 1.7 to 2.0 GHz
Deviation and Frequency Measurement Rate Range: 100 Hz to 15 kHz
Distortion Measurement Rate Range: 100 Hz to 10 kHz
Residual FM: <7 Hz rms in a C-message bandwidth, <1.5 Hz rms in a 100 Hz bandwidth using the tunable band pass filter
Frequency Stability Measurement
Measurement Accuracy (for signals with no modulation):
<±(1 Hz + timebase accuracy) for 800 to 960 MHz,
<±(3.5 Hz + timebase accuracy) for 1.7 to 2.0 GHz

Digital Transmitter Specifications

Modulation Accuracy Measurement
EVM Accuracy: < ± (2% of reading + residual EVM)
Origin Offset Accuracy: < ± 0.5 dB for origin offset ≥–40 dBc
Frequency Error Accuracy: < ± (10 Hz + timebase accuracy)

Digital TX Power Measurement
Minimum Input Level: Signal at test set's RF IN/OUT must have digital TX power ≥–30 dBm for warranted performance
Measurement Accuracy (for 20° C to 55° C): < ± 0.38 dB for 800 to 960 MHz, < ±0.48 dB for 1.7 to 2.0 GHz

Adjacent and Channel Power Measurement

Measurement Accuracy for ±30, ±60 and ±90 kHz Offsets: <±1.2 dB

Audio Analyzer Specifications

Filter 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 Level Measurement
AUDIO IN Level Range: 7.1 mV to 20 V peak (5 mV to 14.1 V rms)
Measurement Accuracy:<±(2% of reading + resolution) for 100 Hz to <8 kHz, <±(3% of reading + resolution) for > 8 kHz to 20 kHz
Measurement THD Plus Noise: <200 mV rms
Measurement Resolution: 0.3% of expected level setting or 0.2 mV, whichever is greater

Audio Frequency Measurement

AUDIO IN Level Range: 7.1 mV to 20 V peak (5 mV to 14.1 V rms)
Measurement Accuracy: <0.1 Hz averaged over 10 measurements, <1.0 Hz for a single measurement
Measurement THD Plus Noise: <200 µV

SINAD and Distortion Measurements

Measurement Frequency Range: 100 Hz to 10 kHz
AUDIO IN Level Range: 42.4mV to 20V peak (30mV to 14.1Vrms)
SINAD Measurement Accuracy: < ± 1.0 dB for SINAD < 44 dB
Distortion Measurement Accuarcy: <±12% (±1.0 dB) for distortion >0.67%
Residual THD Plus Noise: <–60 dB or 200 mV rms, whichever is greater

Note: E1961A tests mobiles per TIA/EIA 137 specifications

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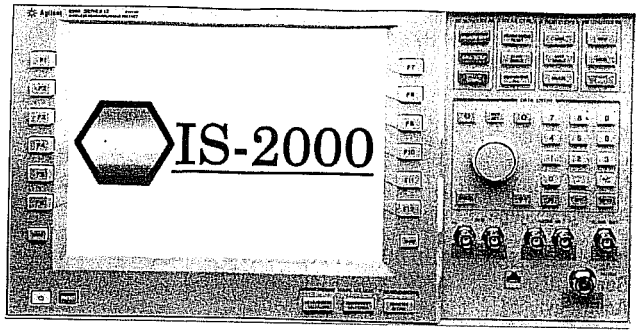
Wireless Mobile & Base Station Test Sets

8960 Series 10 Mobile Phone Manufacturing Test Set (cont.)



IS-2000 Mobile Test Mode Test Set (E5515T with E1962A)

The E1962A Test Application, when combined with the 8960 Series 10 Wireless Communications Test Set Model E5515T, provides IS-2000 mobile phone RF parametric test capability without call processing using special test modes that must be built into the IS-2000 mobile phone.

The E1962A has been designed specifically for R&D engineers and early manufacturers of IS-2000 mobile phones. It provides IS-2000 forward link emulation which allows the mobile phone to synchronize and camp onto the forward link. Once camped onto the forward link, the mobile must be directed to decode the forward traffic channel using a built-in test mode. When the mobile phone begins to decode the forward traffic channel and transmits back to the test set, waveform quality, average power, and channel power transmitter measurements can be performed. By using a mobile phone internal Frame Error Rate counter, receiver measurements such as sensitivity and demodulation with AWGN can also be performed.

Using test modes built into the IS-2000 mobile phone, the following tests can be performed:

TX Tests
- Maximum Power
- Minimum Power
- Waveform Quality (including frequency error)
- Open Loop Power Accuracy
- Open Loop Power Calibration Procedure

RX Tests
- Sensitivity
- Dynamic Range
- Demodulation of the F-FCH with AWGN

The E1962A with the E5515T also provide flexible IS-2000 forward link emulation including control of the Pilot, Sync, Paging, F-FCH, S-SCH, AWGN levels, and data rates for a variety of R&D testing applications.

Key Functionality

Transmitter Measurements
- **Average Power**
- **Channel Power**
- **Waveform Quality**
  - Rho (IS-95)
  - EVM (IS-2000)
  - Frequency Accuracy

Receiver Measurements
None, Frame Error Measurement must be performed by mobile phone

Frequency Range:
800 MHz to 925 MHz
1700 MHz to 2170 MHz

Overhead Channels:
- **F-Pilot** with user settable PN Offset.
- **F-Sync** with real-time long code and system-time update, and updates for user-entered parameters such as SID, NID, P_REV, and PN OFFSET.
- **F-Paging** with real-time overhead messages.

Protocol Stack: limited to IS-2000 Revision 0 Sync channel message and overhead messages on the Paging channel, no call processing.
Base Station Parameters: NID, SID, Country Code (BCC), Network Code (BNC), Reverse Link Traffic Pilot Gain.
Chip Rate: 1.2288 Mcps.
Forward Radio Configuration Support:
- Radio Config 1
- Radio Config 2
- Radio Config 3.
- Radio Config 4.
- Radio Config 5.

Channel Coding: Convolutional and Turbo
Traffic Data Source: PRBS (CCITT 2 15-1 pattern).
Forward-SCH Data Rates (one F-SCH):
RC3: 9.6, 19.2, 38.4, 76.8 kbps.
RC4: 9.6, 19.2, 38.4, 76.8, 153.6 kbps.
RC5: 14.4, 28.8, 57.6, or 115.2 kbps.
Reverse Link Closed Loop Power Control Modes:
'ALTERNATING' - Alternating 0 and 1 power bits
'ALL UP'
'ALL DOWN'

Signal Generator

CDMA Channels:
F-Pilot, F-Sync, F-Paging, F-FCH, F-SCH, F-OCNS
CDMA Modulation:
Parallel BPSK for Pilot, Sync, and Paging channels and Complex QPSK for the F-FCH per IS-2000.
AWGN: Minimum bandwidth of 1.8 MHz

CDMA Analyzer

Average Power Measurement
Measurement Bandwidth: at least 1.8 MHz
Tuned Channel Power Measurement
Measurement Bandwidth: Measures the total power in a 1.23 MHz bandwidth centered on the active reverse channel center frequency.
Modulation Quality Measurement
Measurement Chip Rate: 1.2288 Mcps.
Modulation Measurement Format
OQPSK (RC1, RC2) or HPSK (RC3, RC4, and RC5).
Modulation Quality Measurement
rho/EVM.
Frame Error Rate Measurement
No internal measurement. Must be implemented in mobile phone.

General Specifications

Power Requirements: 100 to 240 VAC, 50 to 60Hz
Power Consumption: 550 VA maximum
Operating Temperature: 0° C to 55° C
Size: 222 mm H x 426 mm W x 625 mm D (8.75 in x 16.75 in x 24.63 in)
Weight: 30 kg (66 lb)

Ordering Information

	Price
Test Set Hardware	
E5515B 8960 series 10 wireless communications mainframe (Requires at least one test application, see below)	$42,500
E5515T 8960 series 10 IS-2000 test mode mainframe (Requires E1962A Test Application, see below)	SPOA
Option 002 Second RF Source (Required for E1960A GSM and E1964A GPRS mobile test applications)	$4,000
Option AX3 Handles	$148
Option AX4 Rack flange kit without handles	$83
Option AX5 Rack flange kit with handles	$208
Option B8A Performance verification at installation.	$465
Option UK6 Commercial calibration certificate with test data	$450
Option W30 3-year customer return repair service	$1,290
Option W50 5-year customer return repair service	$2,580
Test Applications	
E1960A 8960 series 10 GSM mobile test application. (Requires E5515B Option 002,second RF source)	$8,500
E1961A 8960 series 10 AMPS/136 mobile test application	$10,500
E1962A 8960 series 10 IS-2000 test mode application (Requires E5515T mainframe)	SPOA
E1964A 8960 series 10 GPRS mobile test application (Requires E5515B Option 002,second RF source and E1960A, GSM test application)	SPOA
Option 0B0 Delete documentation set (No paper guides, cards, user documentation CD-ROM, or test application CD-ROM)	$0
Option 0BK Printed manuals (reference, calibration, and assembly level repair)	$450

POA = Price on application

E5515B
E5515T
E1960A
E1961A
E1962A
E1964A

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