Agilent 8960 Series 10
with TIA/EIA 136 and AMPS

Data Sheet

For the E5515B/C/T mainframes and the E1961A and E1985A test applications

Analog transmitter measurements
- analog Tx power
- RF frequency and frequency error
- FM deviation and distortion
- modulation frequency

Analog receiver measurements
These measurements can be made using the RF generator and audio analyzer:
- SINAD
- audio harmonic distortion
- hum and noise
- expandor
- audio frequency response

Digital transmitter measurements
- modulation accuracy (includes rms EVM, rms EVM 10, origin offset, frequency error, rms phase error and rms magnitude error)
- digital Tx power
- adjacent first alternate and second alternate channel powers
- IQ tuning

Digital receiver measurement
- loopback bit error rate (BER)

Signal generation functionality
- RF generator
- audio generator
- RF IN/OUT port
- RF OUT ONLY port

RF analysis functionality
- general purpose spectrum monitor

Audio analyzer functionality
- audio level measurement using rms or peak detector
- SINAD measurement
- distortion measurement
- frequency measurement
- swept audio measurement
- expandor on or off
- 750 microseconds de-emphasis on or off

Audio analyzer filters
User-selectable choice of none or:
- C-message
- 100 Hz bandwidth tunable band pass
- 50 Hz to 15 kHz band pass
- 300 Hz to 15 kHz band pass

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Mobile-reported information
- electronic serial number (ESN)
- mobile identification number (MIN)
- phone number
- station class mark (SCM)
- mobile protocol capability indication for analog control channels (MPCI)
- protocol version for digital control channels
- rate capability for digital control channels
- called number
- MAHO BER on digital traffic channels
- MAHO RSSI on digital traffic channels and neighboring channels

AMPS/136 functionality
- **mobile station power output level control:** meets TIA/EIA 136 and 136A power control levels
- **digital traffic channels:** full rate speech
- **audio speech echo:** minimum reasonable delay
- **analog measurement coordination:** flexible control of ACC channel number and SID, AVC channel number and power level, SAT color code, FM rate and FM deviation

- **digital measurement coordination:** flexible control of DCCH band, channel number, DVCC, SID, MCC, SOC and burst size, DTC band, channel number, power level, timeslot, DVCC, burst size, vocoder type and induced error level
- **external trigger:** signal output each frame with user-settable timeslot and bit

Signalling modes
- **full signalling call setup (active cell mode):** protocol used to establish, maintain, change channels and power levels and terminate the link. Full signalling is available with analog and digital signals in both bands.
- **no signalling call setup (test mode):** mobile station is set up on a channel without the test set. Test set provides RF generator output and RF and audio analysis input. Test mode with no signalling is available with analog and digital signals in both bands.

Call processing functionality

	ACC	Cell. DCCH	PCS DCCH	AVC	Cell. DTC	PCS DTC
Camp	Yes	Yes	Yes	NA	NA	NA
Register	Yes	Yes	Yes	NA	NA	NA
Originate	To AVC	To AVC	To AVC	From ACC	From ACC	
	To cell. DTC	To cell. DTC	To cell. DTC	From cell. DCCH	From cell. DCCH	From cell. DCCH
		To PCS DTC	To PCS DTC	From PCS DCCH	From PCS DCCH	From PCS DCCH
Page	To AVC	To AVC	To AVC	From ACC	From ACC	
	To cell. DTC	To cell. DTC	To cell. DTC	From cell. DCCH	From cell. DCCH	From cell. DCCH
		To PCS DTC	To PCS DTC	From PCS DCCH	From PCS DCCH	From PCS DCCH
Conversation	NA	NA	NA	Yes	Yes	Yes
Hand off	NA	NA	NA	To AVC	To AVC	To AVC
				To cell. DTC	To cell. DTC	To cell. DTC
					To PCS DTC	To PCS DTC
MS release	From AVC	From AVC	From AVC	To ACC	To ACC	To ACC
	From cell. DTC	From cell. DTC	From cell. DTC	To cell. DCCH	To cell. DCCH	To cell. DCCH
	From PCS DTC	From PCS DTC	From PCS DTC	To PCS DCCH	To PCS DCCH	To PCS DCCH
BS release	From AVC	From AVC	From AVC	To ACC	To ACC	To ACC
	From cell. DTC	From cell. DTC	From cell. DTC	To cell. DCCH	To cell. DCCH	To cell. DCCH
	From PCS DTC	From PCS DTC	From PCS DTC	To PCS DCCH	To PCS DCCH	To PCS DCCH

Table 1. Call processing functionality.

Technical specifications

These specifications apply to the following hardware and software:
- E5515B mainframes
- E5515C mainframes
- E5515T mainframes with cdma2000 upgrade installed (E5515TU x62)
- E1961A test application of firmware revision A.07
- E1985A test application of firmware revision B.01

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 and within the frequency ranges of 800 to 960 MHz and 1.7 to 2.0 GHz. All specifications apply to both RF IN/OUT and RF OUT ONLY ports unless stated otherwise.

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," and apply at 25 °C.

RF generator specifications

RF generator specifications also apply to option 002 second RF source.

RF frequency
Frequency ranges: 800 to 960 MHz, 1.7 to 2.0 GHz
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: -116 to –15 dBm
Output level range at RF OUT ONLY: -116 to –7 dBm
Absolute output level accuracy: < ±1.0 dB
VSWR at RF IN/OUT: < 1.14:1 for 800 to 960 MHz, < 1.2:1 for 1.7 to 2.0 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 800 to 960 MHz, < 1.45:1 for 1.7 to 2.0 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 800 to 960 MHz, > 40 dB for 1.7 to 2.0 GHz
Operating level range at RF IN/OUT: -127 to –10 dBm
Operating level range at RF OUT ONLY: -119 to –2 dBm
Output level setting resolution: 0.1 dB
Typical output level switching time: < 50 ms to be within 0.05 dB of final level (non-bursted)

Spectral purity
Harmonics: ≤ -25 dBc for levels ≤ -17 dBm
Subharmonics: ≤ -40 dBc
Non-harmonics:
< -55 dBc for 100 to ≤ 1500 kHz offsets from carrier
< -68 dBc for > 1500 kHz offsets from carrier

Supplemental characteristics
Typical non-harmonic performance:
< -55 dBc for 3 to < 100 kHz offsets
< -53 dBc for line-related non-harmonics
Typical spurious due to receiver LO leakage:
< -50 dBm spurious at 105 ± 2.5 MHz below expected transmitter frequency and its second harmonic

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
Internal FM accuracy: < ±(3.5 percent + residual FM) at a 1 kHz rate
External FM accuracy: < ±(5 percent + residual FM) at a 1 kHz rate
FM flatness: < ±5 percent relative to a 1 kHz rate
FM distortion (THD plus noise): < 0.5 percent for > 4 kHz deviation at a 1 kHz rate in a CCITT bandwidth
External FM input sensitivity: 20 kHz deviation per V
Maximum external FM input level: 1 V peak
SAT frequencies: 5970, 6000 or 6030 Hz
SAT deviation: fixed at 2 kHz

Supplemental characteristics
FM rate resolution: 5 Hz
FM deviation resolution: 5 Hz

TDMA signal generation
Frequency error: < ±(4 Hz + timebase error)
EVM: < 3.0 percent rms
Magnitude error: < 2.1 percent rms
Phase error: < 1.2 degrees rms
Origin offset: < -35 dBc

Audio generator specifications

Frequency

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

Supplemental characteristics
Typical operating range: 1 Hz to 20 kHz
Frequency resolution: 0.1 Hz

Output level from AUDIO OUT connector

Ranges: 0 to 1 V peak, 1 to 9 V peak (into ≥ 600 Ω)
Accuracy: < ±(1.5 percent of setting + resolution) when output is DC coupled
Distortion: < 0.1 percent for 0.2 to 9 V peak into ≥ 600 Ω
Pulse mode: pulsed audio signal at a 10 Hz rate with 50 percent duty cycle, user-selectable as on or off
Coupling mode: user-selectable as DC or AC (5 µF in series with output)

Supplemental characteristics
Typical maximum output current: 100 mA peak into 8 Ω
Typical output impedance: < 1.5 Ω at 1 kHz when output is DC coupled
Typical DC offset (when output is DC coupled):
< 1 mV peak for 0 to 1 V peak output, < 10 mV peak for 1 to 9 V peak output
Output level resolution: < 0.5 mV for 0 to 1 V peak output, < 5.0 mV for 1 to 9 V peak output

Manual operation of RF analyzer

When manually controlling the RF analyzer (receiver) in the 8960, the following ranges are available. The RF analyzer meets the demodulation and transmitter measurement specifications as listed within the frequency ranges of 800 to 960 MHz and 1.7 to 2.0 GHz, and within the amplitude ranges specified for the demodulator and for each transmitter measurement. The rest of the total available range is overrange functionality that is not specified.

Frequency

Ranges applicable to demodulation and transmitter specifications: 800 to 960 MHz and 1.7 to 2.0 GHz

Supplemental characterics
Operating frequency range: 292.5 to 2700 MHz

Transmitter and receiver measurement specifications

The time until a measurement times-out and returns control to the user can be set independently for each measurement. All measurements return a measurement integrity result indicating the accuracy and usefulness of each measurement's results.

Frequency coverage and amplitude range
Unless otherwise noted, all specifications apply to frequencies of 800 to 960 MHz and 1.7 to 2.0 GHz, signals with peak input power at the test set's RF IN/OUT not higher than +37 dBm and temperatures of 0 to +55 °C. Input signal Tx power at the test set's RF IN/OUT must be within ±3 dB of the test set's expected power for warranted performance.

Demodulation receiver specifications

Simultaneous demodulation and measurements
Measurements can be performed at the same time that the test set is demodulating data to maintain a link since the test set's RF analyzer provides dedicated signal paths for demodulation and measurements.

Analog demodulation frequency capture range: signal must be within ±2 kHz of test set's expected frequency
Digital demodulation frequency capture range: signal must be within ±200 Hz of test set's expected frequency
Digital demodulation sensitivity: ≥ -30 dBm for BER measurements

Supplemental characteristics
Typical analog demodulation sensitivity: ≥ -40 dBm for maintaining a link
Typical digital demodulation sensitivity: ≥ -40 dBm for maintaining a link

Analog receiver measurements
SINAD, distortion, hum and noise, expandor and audio frequency response measurements can be made using the audio analyzer. Refer to the audio analyzer section for specifications.

Digital receiver measurement specifications

Loopback bit error rate (BER) measurement

Types of signals measured: Data field bits are transponded by the mobile station under static conditions (no fading).
Minimum input level: signal at test set's RF IN/OUT must have digital Tx power ≥ -30 dBm
Measurement data pattern: PRBS-15
Numerical results: number of bits tested, BER, bit error count
Multi-measurement capabilities: 1000 to 999,000 bits
Concurrency capabilities: Loopback BER measurements can be made concurrently with all digital transmitter measurements and audio measurements.

Supplemental characteristics
Measurement resolution: 0.01 percent

Analog transmitter measurement specifications

Analog Tx power measurement

Types of signals measured: CW or AMPS signals with or without SAT
Frequency capture range: Signal must be within ±100 kHz of test set's expected frequency for warranted performance.
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 to +55 °C):
< ±0.27 dB for 800 to 960 MHz, < ±0.28 dB when RF OUT ONLY is selected for signal generation
< ±0.29 dB for 1.7 to 2.0 GHz, < ±0.33 dB when RF OUT ONLY is selected for signal generation
VSWR at RF IN/OUT: < 1.14:1 for 800 to 960 MHz, < 1.2:1 for 1.7 to 2.0 GHz
Measurement trigger source: immediate
Measurement synchronization: none required
Numerical result: output power
Multi-measurement capabilities: 1 to 999 bursts; minimum, maximum, average and standard deviation results
Concurrency capabilities: Analog Tx power measurements can be made concurrently with all analog and audio measurements.

Supplemental characteristics
Extended amplitude range: Results are provided for signals at test set's RF IN/OUT with analog Tx power within -10 and +5 dB of expected power.

Typical measurement accuracy:

Specification	Ranges
< ±0.11 dB	800 to 960 MHz
	-10 to +37 dBm
< ±0.13 dB	800 to 960 MHz
	-30 to < -10 dBm
< ±0.14 dB	1.7 to 2.0 GHz
	-30 to +37 dBm

Typical measurement repeatability: < ±0.05 dB
Measurement resolution: 0.01 dB

Frequency modulation measurement

Types of signals measured: analog and AMPS signals with or without SAT
Frequency capture range: Signal must be within ±2.5 kHz of test set's expected frequency for warranted performance.
Deviation and frequency measurement rate range: 100 Hz to 15 kHz
Distortion measurement rate range: 100 Hz to 10 kHz
Measurement deviation range: 0 to 16 kHz
Minimum input level: Signal at test set's RF IN/OUT must have analog Tx power ≥ -15 dBm for warranted performance.
rms deviation measurement accuracy: < ±(2 percent of reading + residual FM effects)
Peak deviation measurement accuracy: < ±(3 percent of reading + residual FM effects)
Distortion measurement accuracy: < ±12 percent of reading (±1.0 dB) ± residual FM effects
Frequency measurement accuracy (for input signals with ratio of deviation to residual FM > 30 dB): < ±0.1 Hz averaged over 10 measurements, < ±1.0 Hz for a single measurement
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
Measurement trigger source: immediate
Measurement synchronization: none required

Measurement detector: user-selectable choices of rms, peak+ and peak-

Measurement filtering: user-settable choices of none, 100 Hz bandwidth band pass tunable over 300 Hz to 15 kHz, C-message, 50 Hz to 15 kHz band pass or 300 Hz to 15 kHz band pass

Measurement de-emphasis: 750 µs user-settable as off or on

Measurement expandor: user-settable as off or on

Numerical results: FM deviation level, FM distortion and modulation frequency

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

Concurrency capabilities: Frequency modulation measurements can be made concurrently with all analog and audio measurements.

Supplemental characteristics
Deviation measurement resolution: 1 Hz
Distortion measurement resolution: 0.1 percent
Frequency measurement resolution: 0.1 Hz

Frequency stability measurement
Types of signals measured: analog and AMPS signals with or without SAT and with frequency modulation index (ß) < 3.0 radians

Frequency capture range: Signal must be within ±200 kHz of test set's expected frequency for warranted performance.

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 for warranted performance.

Frequency and frequency error measurement accuracy:

Measurement accuracy	Input signal conditions
< ±(1 Hz + timebase accuracy)	No modulation 800 to 960 MHz
< ±(3.5 Hz + timebase accuracy)	No modulation 1.7 to 2.0 GHz
< ±(10 Hz + timebase accuracy)	FM with ß < 3.0 radians 800 to 960 MHz 1.7 to 2.0 GHz

Measurement trigger source: immediate
Measurement synchronization: none required
Numerical results: 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 RF frequency error in ppm result

Concurrency capabilities: Frequency stability measurements can be made concurrently with all analog and audio measurements.

Supplemental characteristics
Typical measurement accuracies: < ±(1 Hz + timebase accuracy) for an input signal with SAT, < ±(3.3 Hz + timebase accuracy) for an input signal with ß = 1 radian
Measurement resolution for frequency and frequency error results in Hz: 1 Hz
Measurement resolution for frequency error result in ppm: 0.01 ppm

Digital transmitter measurement specifications

Modulation accuracy measurement
Types of signals measured: normal, full-rate DTC bursts

Frequency capture range: Signal must be within ±1 kHz of test set's expected frequency for warranted performance.

Minimum input level: Signal at test set's RF IN/OUT must have digital Tx power ≥ -20 dBm for warranted performance.

EVM measurement accuracy: < ±(2 percent of reading + residual EVM)

Origin offset measurement accuracy: < ±0.5 dB for origin offset ≥ -40 dBc

Phase error measurement accuracy: < ±(2 percent of reading + residual phase error)

Magnitude error measurement accuracy: < ±(2 percent of reading + residual magnitude error)

Frequency error measurement accuracy: < ±(10 Hz + timebase accuracy)

Residual EVM: < 1.0 percent rms
Residual magnitude error: < 0.7 percent rms
Residual phase error: < 0.4 degrees rms
Residual origin offset: < -50 dBc

Measurement trigger sources: RF rise, protocol, immediate, auto

Measurement trigger delay: user-settable between ±20 ms

Measurement synchronization: sync word

Numerical results: rms EVM, rms EVM 10, rms magnitude error, rms phase error, origin offset, frequency error

Multi-measurement capabilities: 1 to 999 bursts; minimum, maximum, average and standard deviation for all results and worst case frequency error result

Concurrency capabilities: Modulation accuracy measurements can be made concurrently with all digital and audio measurements.

Supplemental characteristics

EVM measurement resolution: 0.01 percent
Origin offset measurement resolution: 0.01 dB
Magnitude error measurement resolution: 0.01 percent
Phase error measurement resolution: 0.01 degrees
Frequency error measurement resolution: 0.01 Hz

Digital Tx power measurement

Types of signals measured: normal, full-rate DTC bursts
Frequency capture range: signal must be within ±1 kHz of test set's expected frequency for warranted performance
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 to +55 °C): < ±0.33 dB, < ±0.37 dB when RF OUT ONLY is selected for signal generation
VSWR at RF IN/OUT: < 1.14:1 for 800 to 960 MHz, < 1.2:1 for 1.7 to 2.0 GHz
Measurement trigger sources: RF rise, protocol, immediate, auto
Measurement trigger delay: user-settable between ±20 ms
Measurement synchronization: sync word
Numerical result: output power
Multi-measurement capabilities: 1 to 999 bursts; minimum, maximum, average and standard deviation results
Concurrency capabilities: Digital Tx power measurements can be made concurrently with all digital and audio measurements.

Supplemental characteristics

Extended amplitude range: Results are provided for signals at test set's RF IN/OUT with digital Tx power within -10 and +5 dB of expected power.

Typical measurement accuracy:

Specification	Ranges
< ±0.13 dB	800 to 960 MHz -30 to < -10 dBm
< ±0.10 dB	800 to 960 MHz -10 to +37 dBm
< ±0.15 dB	1.7 to 2.0 GHz -30 to < -10 dBm
< ±0.16 dB	1.7 to 2.0 GHz -10 to +37 dBm

Typical measurement repeatability: < ±0.05 dB
Measurement resolution: 0.01 dB

Adjacent and alternate channel power measurement

Types of signals measured: normal, full-rate DTC bursts
Frequency capture range: signal must be within ±200 Hz of test set's expected frequency for warranted performance
Minimum input level: Signal at test set's RF IN/OUT must have digital Tx power ≥ -15 dBm for warranted performance.
Relative measurement accuracy:
< ±1.2 dB for the following conditions.

Offset from carrier	Power below reference (whichever is highest)
±30 kHz	-26 dB or –50 dBm
±60 kHz	-45 dB or –60 dBm
±90 kHz	-45 dB or –60 dBm

Measurement trigger sources: RF rise, protocol, immediate, auto
Measurement trigger delay: user-settable between ±20 ms
Measurement synchronization: none required
Numerical results: adjacent channel power at ±30 kHz offsets, first alternate channel power at ±60 kHz offsets and second alternate channel power at ±90 kHz offsets with all results relative to carrier power level
**Multi-measurement capabilities:** 1 to 999 bursts; minimum, maximum, average and standard deviation results
Concurrency capabilities: Adjacent and alternate channel power measurements can be made concurrently with all digital and audio measurements.
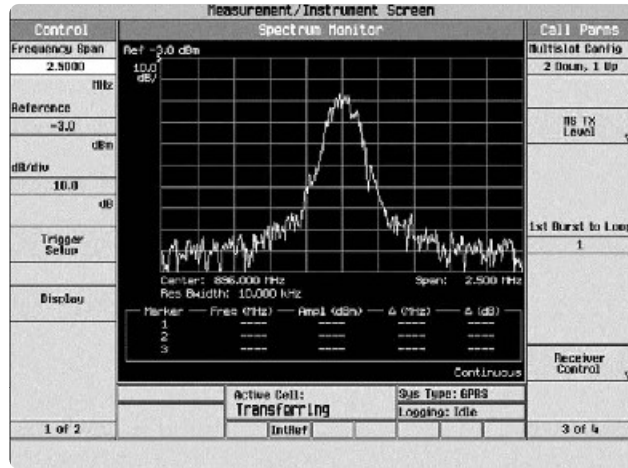
Supplemental characteristics

Measurement resolution: 0.1 dBc
Typical adjacent channel power noise floor versus expected input level at 820 MHz:

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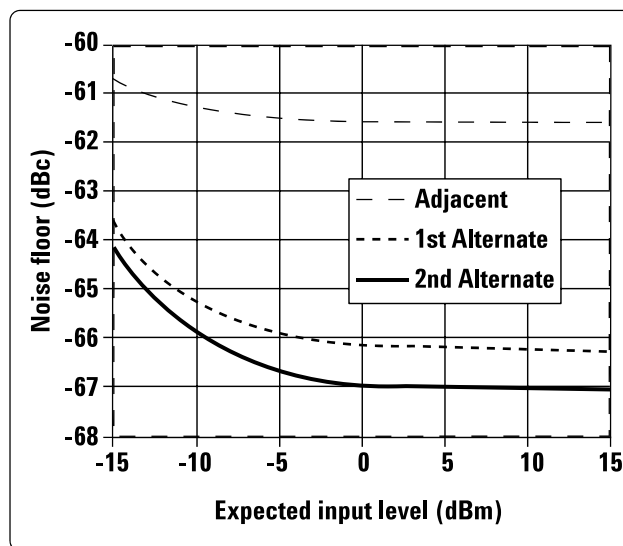
General-purpose spectrum monitor

Use the general-purpose spectrum monitor to view signals while on a call.

Operating modes: active cell and test mode
Measurement modes: swept mode or zero span
Frequency ranges: Although the spectrum monitor is available at any frequency supported by the test set, specifications apply only inside of the calibrated bands: 450 to 496 MHz, 810 to 960 MHz and 1.7 to 1.99 GHz.

Frequency spans, resolution bandwidth, displayed dynamic range: coupled with the following combinations available:

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

RBW filter types: flattop in swept mode, Gaussian in zero span
Zero span sweep time: user-settable from 50 μs to 70 ms
Zero span offset time: user-settable from 0 to 10 s
Reference level range: user-settable from -50 to +37 dBm or automatically determined
Amplitude scaling: user-settable from 0.1 to 20 dB/division in 0.1 dB steps
Trigger source: immediate, protocol, RF rise, external, auto
Trigger delay: user-settable between ±50 ms
Peak threshold: user-settable from -120 to +37 dBm
Peak excursion: user-settable from 1.2 to 100 dB
Trace functions: clear write, max hold, min hold
Detector types: peak or sample
Averaging capabilities: user-settable between 0 and 123 or off
Marker functions: three independent markers with modes of normal, delta and off. Operations are peak search, marker to expected power.
Concurrency capabilities: Spectrum monitor analysis can be performed concurrently with all measurements.

Supplemental characteristics
Typical level accuracy:
< ±2 dB for signals within 50 dB of a reference level ≥ -10 dBm and RBW < 5 MHz

< ±2 dB for signals within 30 dB of a reference level < -10 dBm and RBW = 5 MHz using 5 averages

< ±3.5 dB for signals > -70 dBm and within 50 dB of a reference level < -10 dBm with RBW < 5 MHz
Displayed average noise level: < -90 dBm for reference level of -40 dBm and 30 kHz bandwidth
Typical residual responses: < -70 dB with input terminated, reference level of -10 dBm and RF generator power < -80 dBm
Typical spurious responses:
< -50 dBc with expected frequency tuned to carrier, carrier > 420 MHz, signal and reference level at -10 dBm and all spectral components within 100 MHz of carrier
Frequency resolution: 1 Hz
Marker amplitude resolution: 0.01 dB

IQ tuning measurement

Types of signals measured: normal, full-rate DTC bursts, non-bursted signals with π/4 DQPSK modulation and CW signals

Frequency capture range (for any mobile burst): signal must be within ±200 Hz of test set's expected frequency for warranted performance

Minimum input level: signal at test set's RF IN/OUT must have Tx output power ≥ -15 dBm for warranted performance

Relative measurement accuracy at -16 to +16 kHz offset from carrier (referenced to highest signal component and averaged over 10 measurements):
< ±1.0 dB for 0 to –35 dB below reference power
< ±2.0 dB for < -35 to –50 dB below reference power

Relative measurement accuracy at ±(1 to 15) MHz offset from carrier (referenced to highest signal component and averaged over 10 measurements):
< ±1.5 dB for 0 to –35 dB below reference power
< ±2.5 dB for < -35 to –50 dB below reference power

Measurement trigger sources: RF rise, immediate

Measurement trigger delay: user-settable between ±20 ms

Measurement synchronization: RF amplitude

Reference offset frequency: user-settable between ±16 kHz

Offset frequencies: four offsets user-settable between ±16 kHz or off

Spur measurement frequency: user-settable over ±(1 to 15) MHz or off

Numerical results: Each offset frequency level in dB referenced to level at reference offset frequency and spur power in dB referenced to level at reference offset frequency.

Multi-measurement capabilities: 1 to 999 bursts, average results

Concurrency capabilities: IQ tuning measurements can be made concurrently with all other measurements

Supplemental characteristics
Level measurement resolution: 0.1 dB

Audio analyzer specifications

All specifications for the audio analyzer apply to signals present at test set's AUDIO IN ports.

Audio analyzer de-emphasis: 750 microseconds de-emphasis user-settable as off or on

Audio analyzer expandor: user-settable as off or on with reference level setting of 10 mV to 10 V

Audio analyzer filters: user–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 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 percent of reading + resolution) for 100 Hz to ≤ 8 kHz, < ±(3 percent of reading + resolution) for > 8 kHz to 15 kHz

Measurement THD plus noise: < 200 μV rms

Measurement detector: user-selectable choices of rms and peak

Measurement trigger source: immediate

Measurement synchronization: none required

Numerical result: audio level

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

Concurrency capabilities: Audio level measurements can be made concurrently with all other measurements.

Supplemental characteristics
Typical measurement accuracy: < ±1.2 percent of reading for 100 Hz to ≤ 8 kHz and 20 mV to 20 V peak
Typical external input impedance: 100 kΩ in parallel with 105 pF
Measurement resolution: 0.3 percent of expected level setting or 0.2 mV, whichever is greater

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 < 43.5 dB

Residual THD plus noise: < -60 dB or 200 μV rms, whichever is greater

Measurement trigger source: immediate

Measurement synchronization: none required

Numerical 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.

Supplemental characteristics
Measurement resolution: 0.01 dB

Distortion measurement

Types of signals measured: sinusoidal audio signals
Measurement frequency range: 100 Hz to 10 kHz
AUDIO IN level range: 42.4 mV to 20 V peak
(30 mV to 14.1 V rms)
Measurement accuracy: < ±12 percent of reading
(±1.0 dB) for distortion > 0.67 percent
Residual THD plus noise: < -60 dB or 200 uV rms,
whichever is greater
Measurement trigger source: immediate
Measurement synchronization: none required
Numerical 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.

Supplemental characteristics
Measurement resolution: 0.1 percent

Audio frequency measurement

Types of signals measured: sinusoidal audio signals
Measurement frequency range: 100 Hz to 15 kHz
AUDIO IN level range: 7.1 mV to 20 V peak (5 mV to
14.1 V rms)
AUDIO IN signal conditions: signal at test set's
AUDIO IN must have signal-to-noise ratio > 30 dB for
warranted performance
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
Measurement synchronization: none required
Numerical result: audio frequency
Multi-measurement capabilities: 1 to 999 measurements;
minimum, maximum, average and standard deviation
results
Concurrency capabilities: Audio frequency measurements
can be made concurrently with all other measurements.

Supplemental characteristics
Measurement resolution: 0.1 Hz

Swept audio measurement

Measurement description: The swept audio measurement
coordinates the audio generator and audio analyzer in
the 8960 to make audio level, audio distortion, and
SINAD measurements at several user-specified audio
frequencies. An audio signal is generated from the 8960
and applied to the device under test. An audio signal
from the device under test is then input to the 8960's
audio analyzer for analysis at each frequency.

Types of signals measured: sinusoidal audio signals
Measurement frequency range (for warranted perform-
ance): 300 Hz to 15 kHz for audio level measurements,
300 Hz to 10 kHz for distortion and SINAD measurements
AUDIO IN level ranges (for warranted performance):
7.1 mV to 20 V peak (5 mV to 14.1 V rms) for audio level
measurements, 42.4 mV to 20 V peak (30 mV to
14.1 V rms) for distortion and SINAD measurements
AUDIO OUT level range: 0 to 9 V peak (into ≥ 600 Ω)
Audio generator output level accuracy: < ±(1.5 percent
of setting + resolution) when output is DC coupled
Audio level measurement accuracy: < ±(2 percent of
reading + resolution) for 100 Hz to ≤ 8 kHz, < ±(3 percent
of reading + resolution) for > 8 kHz to 15 kHz
Audio distortion measurement accuracy: < ±12 percent
of reading (±1.0 dB) for distortion > 0.67 percent
SINAD measurement accuracy: < ±1.0 dB for SINAD
< 43.5 dB
Audio generator output level distortion: < 0.1 percent
for 0.2 to 9 V peak into ≥ 600 Ω
Measurement THD plus noise: < -60 dB or 200 µV rms,
whichever is greater
Number of points: user-settable from 1 to 60 frequencies
Measurement detector: user-selectable choices of rms
and peak
Measurement trigger source: immediate
Measurement synchronization: none required
Numerical results: audio level, audio distortion and
SINAD at each user-specified frequency
Multi-measurement capabilities: 1 to 999 measurements;
minimum, maximum, average, and standard deviation
results
Concurrency capabilities: Swept audio measurements
can be made concurrently with all transmitter and
receiver measurements, but cannot be made concurrently
with audio analyzer measurements. In addition, some
audio generator settings are locked when a swept audio
measurement is in progress.

Supplemental characteristics
Typical audio level measurement accuracy: < ±1.2 percent
of reading for 100 Hz to ≤ 8 kHz and 20 mV to 20 V peak
Audio level measurement resolution: 0.3 percent of
expected level setting or 0.2 mV, whichever is greater
Distortion measurement resolution: 0.1 percent
SINAD measurement 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

Supplemental characteristics
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

Supplemental characteristics
Input frequency range: < ±5 ppm of nominal reference frequency
Input level range: 0 to +13 dBm
Input impedance: 50 Ω nominal

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

Supplemental characteristics
Typical output level: ≥ 0.5 V rms
Output impedance: 50 Ω nominal

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
Functions implemented: T6, TE0, L4, LE0, SH1, AH1, RL1, SR1, PP0, DC1, DT0, C0, E2

General specifications
Dimensions (H x W x D): 8.75 x 16.75 x 24.63 inches (222 x 426 x 625 mm)
Weight: 66 lbs (30 kg)
Display: 10.5 inches (26.7 cm), active matrix, color, liquid crystal

LAN (local area network) port: RJ-45 connector, 10 Base T Ethernet with TCP/IP support
Operating temperature: 0 to +55 °C
Storage temperature: -20 to +70 °C
Power: 88 to 135 VAC, 193 to 269 VAC, 50 to 60 Hz, 550 VA maximum
Calibration interval: two years
EMI: conducted and radiated interference meets CISPR-11, susceptibility meets IEC 1000-4-2, 1000-4-3 and 1000-4-4

Supplemental characteristics
Typical power consumption: 400 to 450 W continuous
Typical radiated leakage: < 2.5 µV induced in a resonant dipole antenna one inch from any surface except the underside and rear panel at set RF generator frequency and output level of –40 dBm
Typical spurious leakage: < 5 µV induced in a resonant dipole antenna one inch from any surface on the front half of all sides of the instrument at frequencies other than the RF generator output frequency and output level of -40 dBm with no cable connected to the rear-panel LAN port
Typical measurement speed: Measured using a 600 MHz Pentium® processor. Measurement speeds include the time to capture each burst. Measurement speeds may vary depending on controller GPIB environment and processor speed.

	One measurement	Five measurements
Analog Tx power	*14 ms*	*38 ms*
Frequency modulation (with deviation result)	*116 ms*	*420 ms*
Frequency modulation (with deviation and distortion results)	*146 ms*	*455 ms*
Frequency stability	*134 ms*	*574 ms*
Modulation accuracy (without EVM 10 result)	*40 ms*	*120 ms*
Digital Tx power	*20 ms*	*101 ms*
Adjacent and alternate channel power	*88 ms*	*349 ms*
Audio analyzer (with level result)	*63 ms*	*271 ms*
Audio analyzer (with level, SINAD and distortion results)	*91 ms*	*305 ms*
Swept audio (with level result at 5 points using tunable BPF)	*560 ms*	*2.44 s*

Ordering information
For the most up-to-date ordering information, please refer to the configuration guide, literature number 5968-7873E, and on the web at: **www.agilent.com/find/8960**

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Korea:
(tel) (080) 769 0800
(fax) (080)769 0900
Latin America:
(tel) (305) 269 7500
Taiwan:
(tel) 0800 047 866
(fax) 0800 286 331
Other Asia Pacific
Countries:
(tel) (65) 6375 8100
(fax) (65) 6755 0042
Email: tm_ap@agilent.com
Contacts revised: 05/27/05

For more information on Agilent Technologies' products, applications or services, please contact your local Agilent office. The complete list is available at:

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