

# Agilent E1968A GSM/GPRS/EGPRS Test Application

## Data Sheet

For the E5515B/C wireless communication test set  
and the E1987A Fast Switching Test Application.

**Produce high volume quality phones at the lowest possible cost**

### Flexible

- The E1968A includes all essential connection types and signaling options necessary for a complete GSM/GPRS/EGPRS manufacturing test solution

### Fast

- **Digital ORFS** – up to 20x faster
- **Dynamic power** – fast automatic signaling or non-signaling method for Tx output power calibration
- **Phase and amplitude versus time (PAVT)** – measurement for calibration of polar modulated devices

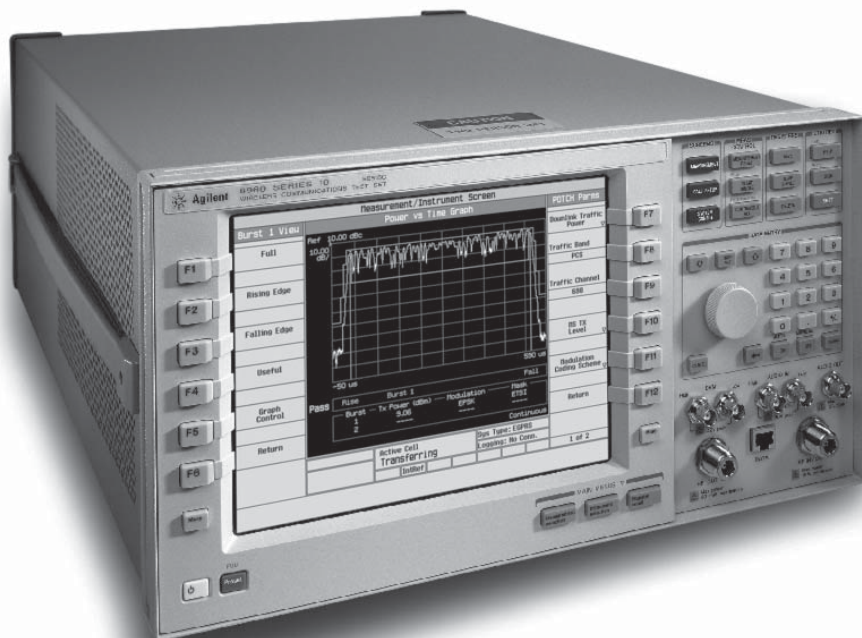
### New Key Features

- Fast device calibration across level and frequency simultaneously
- Extended multislot power versus time measurement – simultaneous measurement of all bursts up to four uplink time slots
- Extended multislot transmit power measurement – simultaneous measurement of all bursts up to four uplink time slots

## GSM/GPRS/EGPRS Signaling and Base Station Emulation

The E1968A GSM/GPRS/EGPRS mobile test application gives you the test solution designed especially for your GSM/GPRS/EGPRS test requirements of transceivers and wireless terminals by delivering the

speed and flexibility needed for high-volume, automated production-test environments. Since this solution is based on the high-performance E5515C (8960) test set, you will get speed and concurrent measurement capability, providing immediate benefits that translate into a competitive advantage for mobile-phone manufacturers. This significantly cuts test times, helping reduce the manufacturing cost per phone.



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## Audio Functionality

- Choice of speech encoded on downlink TCH: none, echo, 300 Hz sine, 1 kHz sine, 3 kHz sine, or PRBS-15, multi-tone, or custom
- GSM analog audio measurement (audio level, distortion, frequency, SINAD)

## Receiver Measurements

- GSM burst-by-burst bit error ratio (fast BER)
- GSM bit error ratio (BER)
- GPRS/EGPRS multislot BER
- GPRS/EGPRS multislot block error ratio (BLER)

## Transmitter Measurements

- GSM/GPRS/EGPRS multislot transmit power
- EGPRS multislot-tolerant transmit power
- 8PSK multislot-tolerant modulation accuracy (peak, rms, 95th percentile and sample EVM; frequency, magnitude and phase errors; origin offset suppression; IQ imbalance)
- GMSK multislot-tolerant frequency error
- GMSK multislot-tolerant phase error (peak and rms with confidence limits)
- Multislot power versus time (burst mask comparison with settable masks)
- Burst timing
- Multislot-tolerant output RF spectrum due to modulation and switching
- IQ tuning
- GSM decoded audio level
- Dynamic power
- Phase and amplitude versus time (PAvT)

## Instruments

- Audio generator
- General-purpose spectrum monitor
- GSM multi-tone audio

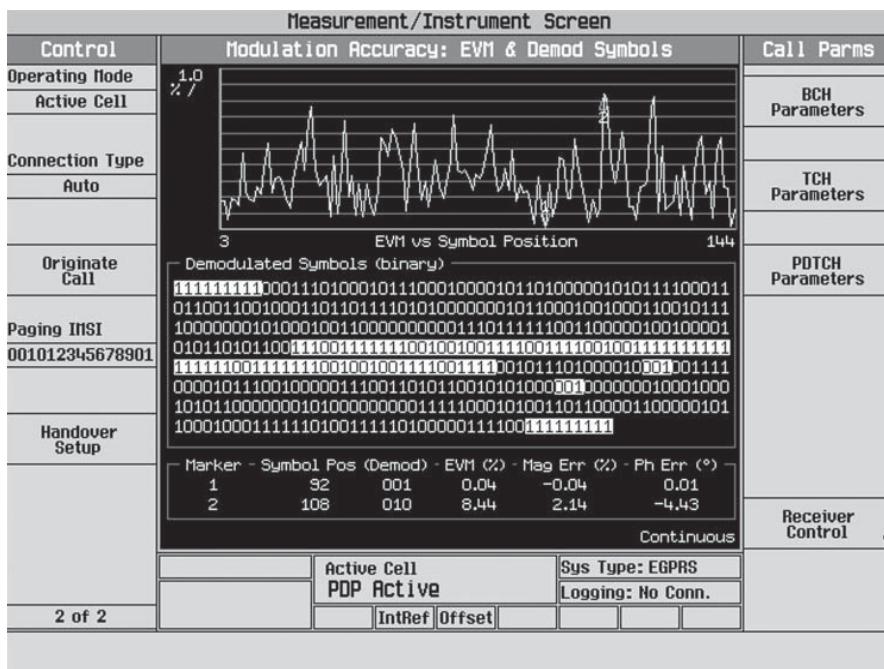


Figure 1. Use graphical measurement results to troubleshoot your EGPRS wireless device.

## Integrated GSM, GPRS, and EGPRS Functionality

- Switch between GSM, GPRS, and EGPRS serving cells
- Switch between data and voice connections without losing camp or attach
- Establish a voice or data connection after initial GPRS attach

## GSM Functionality

**Mobile station power output level control:** meets GSM phase one and phase two power control levels

**Traffic channels:** TCH/FS — FR, EFR, and HR speech modes

**Broadcast channel configuration:** BCCH + CCCH + SDCCH/4

**Signaling protocol setup:** FACCH audio speech echo with one-second fixed delay

## GPRS Functionality

**Multislot classes supported:** 1 through 12

**Control channels:** BCH on timeslot 0 on any ARFCN in any band

**Broadcast channel configuration:** FCCH + SCH + BCCH + CCCH + SDCCH/4 (0-3) + SACCH/C4 (0-3)

**Downlink PDTCH:** one, two, three, or four on the same PDTCH ARFCN with one or two PDTCH amplitudes settable between 0 and 55 dB below BCH amplitude; amplitudes in adjacent timeslots selectable as off, PRL (power reduction level) one, or PRL two

## EGPRS Functionality

**Multislot classes supported:** 1 through 6 for all operating modes, 7 through 12 for EGPRS BCH+PDTCH operating modes and other operating modes in some configurations

**Control channels:** BCH on timeslot 0 on any ARFCN in any band

**Broadcast channel configuration:** FCCH + SCH + BCCH + CCCH + SDCCH/4 (0-3) + SACCH/C4 (0-3)

**Downlink PDTCH:** one, two, three, or four on the same PDTCH ARFCN with one or two PDTCH amplitudes settable between 0 and 55 dB below BCH amplitude; amplitudes in adjacent timeslots selectable as off, PRL one, or PRL two

## Call Processing Functionality

- GSM 450 MHz, GSM 480 MHz, GSM 750 MHz, GSM 850 MHz, T-GSM 810 MHz, PGSM 900 MHz, EGSM 900 MHz, RGSM 900 MHz, DCS 1800 MHz, PCS 1900 MHz bands
- GSM MS and BS origination
- GSM MS and BS release
- GPRS mobile-initiated attach and detach
- GPRS and EGPRS packet data transfers on uplink and downlink
- Intra-cell channel assignments
- Inter-cell handovers between all bands
- Handover from W-CDMA to GSM (with E1987A test application)
- BA table with 16 settable neighbor cells
- External triggers provide a signal output each frame with settable timeslot, bit, and option to include or exclude the idle frame

## BCH setup and parameters

- Settable downlink power, band, and channel number
- Settable maximum control channel power used by the MS for access bursts of 0 to 31
- Settable maximum control channel power offset value for DCS 1800 MHz band of 0 to 3
- Band indication of DCS or PCS

## GSM TCH parameters

- Settable downlink TCH power including power in unused bursts, uplink band, channel number, and power level
- Channel modes of FR, EFR, and HR, plus HR subchannel of 0 or 1
- Settable uplink timeslot of 1 to 7
- Settable timing advance of 0 to 63
- Mobile loopback of off, type A, type B, or type C as defined in ETSI 04.14 or 3GPP 44.014
- Downlink TCH speech types of none, echo, 300 Hz sine, 1 kHz sine, 3 kHz sine, or PRBS-15, multi-tone or custom

## GPRS and EGPRS PDTCH parameters

- Settable downlink PDTCH power including power in unused bursts, uplink band, channel number, and power level
- GPRS coding schemes of CS-1, CS-2, CS-3, or CS-4
- EGPRS uplink modulation coding schemes of MCS-1, MCS-2, MCS-3, MCS-4, MCS-5, MCS-6, MCS-7, MCS-8, or MCS-9
- EGPRS downlink modulation coding schemes: same as uplink, MCS-1, MCS-2, MCS-3, MCS-4, MCS-5, MCS-6, MCS-7, MCS-8, or MCS-9
- EGPRS modulation coding scheme of 8PSK clear coded in EGPRS BCH+PDTCH operating mode
- (E)GPRS multislot configurations of 1x1, 1x2, 1x3, 1x4, 2x1, 2x2, 2x3, 3x1, 3x2, 4x1 (downlink x uplink)
- Selection of which contiguous downlink bursts to loop back on the uplink with connection type ETSI type B or SRB loopback
- Selection of which uplink burst to use for multislot-tolerant RF measurements

## Cell parameters

- Three-digit MNC off or on in PCS 1900 MHz and GSM 850 MHz bands
- Settable MCC, MNC, LAC, RAC, NCC, and BCC
- Option to get IMEI at call setup
- Mobile DTX on or off
- Paging mode reorganized or normal
- Settable paging multiframes of 2 to 9
- Repeat paging on or off
- Tx level FACCH signaling on or off
- Symmetric or asymmetric uplink frame segmentation

## Handover setup

- GSM traffic band, traffic channel, timeslot, channel mode, half-rate speech subchannel, MS Tx level
- GPRS traffic band, traffic channel, coding scheme, multislot configuration, P0, MS Tx level burst 1, MS Tx level burst 2
- EGPRS traffic band, traffic channel, downlink modulation coding scheme, uplink modulation coding scheme, multislot configuration, P0, MS Tx level burst 1, MS Tx level burst 2

## Protocol control

- RLC/MAC header off or on in GPRS BCH+PDTCH operating mode
- RLC/MAC header selectable as uplink or downlink in EGPRS BCH+PDTCH operating mode
- RLC/MAC packet timeslot reconfigure off or on
- RLC/MAC packet power timing advance on or off
- Settable RLC/MAC block poll rate of 1 to 256
- RLC/MAC frame start position of relative, absolute or immediate
- LLC BLER FCS of valid or corrupt
- Settable LLC payload patterns for connection types ETSI type B or for BLER with corrupt FCS of all zeros, all ones, alternate bits, alternate pairs, alternate quads, PRBS-15, fixed 2B (hex), custom, GMM information for BLER

## Receiver control

- Expected power control auto or manual
- manual power of bursts 1 and 2 settable in dBm
- Measurement frequency auto or settable in MHz
- Modulation format control auto or manual
- Manual modulation of bursts 1 and 2 selectable as GMSK or 8PSK

## DUT information

- International mobile subscriber identity (IMSI)
- International mobile equipment identity (IMEI) (if selected)
- GPRS multislot class
- EGPRS multislot class
- GMSK power class
- 8PSK power class

## Counters reported

- RACH count
- Corrupt burst count
- Page count
- Decode error count
- Missing burst count

## Errors reported

- Burst timing error
- BLER (block error rate)

## Last location information reported

- Location area code (LAC)
- Mobile country code (MCC)
- Mobile network code (MNC)

## SACCH reports (on a GSM voice call)

- Timing advance
- Tx level
- Rx level
- Rx qual

## Neighbor cell reports

- Channel number
- Base station color code (BCC)
- Rx level
- Network color code (NCC)

## Operating Modes

### Active cell GSM, GPRS, or EGPRS:

A BCH is generated on the downlink. Attach and detach procedures, voice and packet data transfers on the uplink(s), and downlink(s) can be executed. TCH and PDTCH band and channel, GSM timeslot, GSM channel mode, GPRS and EGPRS multislot configurations, GPRS coding scheme, EGPRS uplink and downlink modulation coding schemes, and downlink and uplink power level(s) can be changed. All transmitter measurements can be made. GSM, GPRS, or EGPRS is used as the serving cell.

Six connection types are available in the active cell operating modes as follows

- **(E)GPRS connection type ETSI type A:** test mode A as defined in ETSI 04.14 or 3GPP 44.014; the downlink is terminated once the uplink has been established
- **(E)GPRS connection type ETSI type B (unack):** test mode B as defined in ETSI 04.14 or 3GPP 44.014 with MS in RLC acknowledged mode; downlink PDTCH(s) data is generated and the mobile loops back the downlink data on the uplink(s); BER and BLER measurements can be made
- **(E)GPRS connection type ETSI type B (ack):** test mode B as defined in ETSI 04.14 or 3GPP 44.014 with MS in RLC acknowledged mode; downlink PDTCH(s) data is generated and the mobile loops back the downlink data on the uplink(s); BER and BLER measurements can be made
- **(E)GPRS connection type BLER:** Agilent-proprietary data connection with the primary purpose of calculating BLER

- **Connection type auto:** a GSM voice call or GPRS or EGPRS data connection can be initiated by the mobile; the test set can initiate a GSM voice call; if a voice call is in progress, data transfer requests are ignored; network-initiated GSM voice call while a GPRS or EGPRS data transfer is in progress causes the data connection to be terminated
- **EGPRS connection type SRB loopback:** an EGPRS Layer 1 loopback mode for testing BER as defined in ETSI 04.14 or 3GPP 44.014

### Cell off:

All signaling and RF power output is discontinued; this mode is used mainly for adjusting cell parameters that cannot be changed when a live cell is operating

The following seven operating modes use limited signaling for call setup. Protocol is used only to maintain a link established by the mobile station. Over-the-air signaling and capability to demodulate and decode uplink random access channel (RACH) bursts are not available.

- **GSM BCH:** a broadcast channel (BCH) without a traffic channel (TCH) is generated on the downlink and mobile station level information is carried on the broadcast control channel (BCCH)
- **GSM BCH+TCH:** a BCH and TCH are generated on the downlink; mobile station level information is carried on the BCCH and the downlink slow associated control channel (SACCH); timing advance changes are sent on the downlink SACCH; a call can be established by manually synchronizing the mobile station with the TCH and turning on the mobile station's TCH at the same absolute radio frequency channel number (ARFCN) and timeslot as the test set's TCH; during a call, demodulation and channel decoding of the uplink are available, although no messages are decoded
- **GPRS BCH:** a BCH is generated on the downlink, but no uplink demodulation occurs
- **GPRS BCH+PDTCH(s):** a BCH and PDTCH(s) are generated on the downlink and the downlink multislot configuration can be changed; a forced call can be established if the mobile is manually synchronized to the test set's downlink and the mobile's uplink PDTCH(s) uses the same ARFCN and timeslot(s) as the downlink; when a forced call is established, BER and BLER measurements can be made and demodulation and channel decoding of the uplink are available, although no messages are decoded
- **EGPRS BCH:** a BCH is generated on the downlink, but no uplink demodulation occurs
- **EGPRS BCH+PDTCH(s):** a BCH and PDTCH(s) are generated on the downlink and the downlink multislot configuration can be changed; a forced call can be established if the mobile is manually synchronized to the test set's downlink and the mobile's uplink PDTCH(s) uses the same ARFCN and timeslot(s) as the downlink; when a forced call is established, BER and BLER measurements can be made and demodulation and channel decoding of the uplink are available, although no messages are decoded
- **CW:** an unmodulated continuous wave (CW) signal is generated on the downlink; the level and frequency of the CW signal can be changed; no uplink demodulation or channel decoding is available



## Technical Specifications

These specifications apply to an E5515C mainframe with Option 002 when used with the E1968A test application of firmware revision A.08 or higher, or the E1987A test application of firmware revision A.06 or higher. Depending on the exact configuration, earlier E5515C and E5515B instruments may require hardware upgrades to obtain certain features and capability. Features which may require hardware upgrades include: EGPRS (all capability), higher EGPRS multislot classes, spectrum monitor, RF out only port, phase and amplitude versus time (PAvT), and ORFS digital filter option.

CAUTION: Loading an application onto your E5515 test set that is not compatible with your E5515's hardware revision can cause your E5515 to lock-up. For information on application/E5515 compatibility go to <http://www.agilent.com/find/E5515> and select the relevant link to either E5515B Release Notes or E5515C Release Notes. Always refer to this information before loading an application.

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 (downlink) generator specifications

RF generator specifications apply to both RF generators in the 8960.

#### RF frequency

##### Frequency ranges:

450 to 496 MHz, 700 to 800 MHz, 810 to 960 MHz, 1.7 to 1.99 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:

-110 to -13 dBm

##### Output level range at RF OUT ONLY:

-110 to -5 dBm

RF generator level accuracy is derived from 95th 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.

##### Absolute output level accuracy:

< ±1.0 dB

##### VSWR at RF IN/OUT:

< 1.14:1 for 450 to 496 MHz and 810 to 960 MHz, < 1.2:1 for 1.7 to 1.99 GHz

##### Reverse power at RF IN/OUT:

< 2.5 W continuous, < 5 W peak burst power

##### Reverse power at RF OUT ONLY:

< 500 mW continuous

#### Supplemental characteristics

##### Typical output level accuracy:

< ±0.5 dB

##### Typical output level repeatability at RF IN/OUT (returning to the same frequency and level):

< ±0.1 dB

##### Typical VSWR at RF OUT ONLY:

< 1.4:1 for 450 to 496 MHz and 810 to 960 MHz, < 1.45:1 for 1.7 to 1.99 GHz

##### Typical isolation from RF OUT ONLY port to RF IN/OUT port (when the RF generator is routed to the RF OUT ONLY port):

> 60 dB for 450 to 496 MHz and 810 to 960 MHz, > 40 dB for 1.7 to 1.99 GHz

##### Operating level range at RF IN/OUT:

-127 to -10 dBm

##### Operating level range at RF OUT ONLY:

-119 to -2 dBm

##### Output level setting resolution:

0.1 dB

## GMSK signal generation

### Absolute output level accuracy with GMSK modulation on:

Specification	Ranges
< ±1.10 dB	Single slot from -110 to -13 dBm
< ±1.10 dB	1 multislot level between -110 and -13 dBm
< ±1.50 dB	2 multislot levels ≤ 20 dB apart between -110 and -70 dBm

### Peak phase error:

< ±4 degrees

### rms phase error:

< 1 degree

### Frequency error:

< ±0.01 ppm plus timebase reference

### Amplitude flatness:

< ±0.3 dB for single-slot GMSK signals,  
< ±1.0 dB for multislot GMSK signals

### Supplemental characteristics

#### Typical absolute output level accuracy with GMSK modulation on:

Specification	Ranges
< ±0.55 dB	Single slot from -110 to -13 dBm
< ±0.55 dB	1 multislot level between -110 and -13 dBm
< ±0.85 dB	2 multislot levels ≤ 20 dB apart between -110 and -70 dBm

#### Typical burst modulation on/off ratio (referenced to lowest signal level):

> 50 dB

## 8PSK signal generation

### Absolute output level accuracy with 8PSK modulation on:

Specification	Ranges
< ±1.10 dB	Single slot from -110 to -13 dBm
< ±1.10 dB	1 multislot level between -110 and -13 dBm
< ±1.50 dB	2 multislot levels ≤ 20 dB apart between -110 and -70 dBm

### rms EVM:

< 4%

### Origin offset suppression:

> 35 dB

### Frequency error:

< ±0.02 ppm plus timebase reference

### Supplemental characteristics

#### Typical absolute output level accuracy with 8PSK modulation on:

Specification	Ranges
< ±0.57 dB	Single slot from -110 to -13 dBm
< ±0.57 dB	1 multislot level between -110 and -13 dBm
< ±0.85 dB	2 multislot levels ≤ 20 dB apart between -110 and -70 dBm

### 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 for spurious at  $105 \pm 2.5$  MHz below expected transmitter frequency and its second harmonic

## RF analyzer functionality

### RF frequency

#### Ranges applied to demodulation and transmitter specifications:

450 to 496 MHz, 700 to 800 MHz, 810 to 960 MHz, and 1.7 to 1.99 GHz

#### Supplemental characteristics

##### Operating 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.

EGPRS 8PSK measurements are GMSK-tolerant. Any GMSK bursts are detected and discarded. Measurements continue when the next 8PSK burst is detected. EGPRS GMSK measurements are also 8PSK-tolerant.

### Frequency coverage and amplitude range

Unless otherwise noted, all specifications apply to frequencies of 450 to 496 MHz, 700 to 960 MHz, and 1.7 to 1.99 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 transmit power (defined as the average power over the useful part of the burst) at the test set's RF IN/OUT must be within ±3 dB of the test set's expected power for warranted performance.

## Receiver measurement specifications

### Simultaneous demodulation and measurements

The test set's RF analyzer provides dedicated signal paths for demodulation (maintaining the link) and measurements to be performed simultaneously.

**Demodulation frequency capture range:**  
signal must be within  $\pm 100$  kHz of test set's expected frequency for warranted performance

**Single-slot demodulation sensitivity:**  
 $\geq -30$  dBm for BER and BLER measurements

**Multislot demodulation sensitivity:**  
all uplink timeslots  $\geq -30$  dBm for maintaining a data link when

- adjacent GMSK timeslots from GPRS signals are  $\leq 25$  dB different in level,
- adjacent GMSK timeslots from EGPRS signals are  $\leq 20$  dB different in level, or
- adjacent 8PSK timeslots are  $\leq 10$  dB different in level

### Supplemental characteristics

**Typical demodulation sensitivity:**  
 $\geq -40$  dBm for maintaining a link

## GSM BER measurement

**Types of signals measured:**  
compares 260 bits of speech data using mobile phone loopback with or without signaling of erased speech frames

**Minimum input level:**  
uplink signals at test set's RF IN/OUT must have transmit power  $\geq -30$  dBm for warranted performance

**Residual BER:**  
 $< 10^{-6}$

**Mobile loopback:**  
in active cell operating modes as type A or type B must be selected

**Measurement type:**  
selectable as residual type Ia, residual type Ib, residual type II, type Ia, type Ib, or type II

**Signaling loopback control:**  
selectable as on or off

**Data patterns:**  
selectable in GSM BCH+TCH operating mode as all zeros, all ones, alternate bits, alternate pairs, alternate quads, PRBS-15, fixed 2B (hex), multi-tone, or custom

**Closed-loop signaling delay:**  
settable between 0 and 5 s

**Speech frames delay:**  
settable between 1 and 15 frames or automatically determined

**Measurement unit:**  
selectable as percent or count

**Numerical results:**  
BER, number of bits tested, number of bad bits, frame erasure (FER) for residual measurement types, cyclic redundancy check (CRC) for non-residual measurement types, speech frame delay, Rx level, Rx qual

**Multi-measurement capabilities:**  
1 to 999,000 bits

**Concurrency capabilities:**  
GSM BER measurements cannot be made concurrently with GSM FBER measurements, GSM decoded audio level measurements, or while speech is provided on the downlink TCH; GSM BER measurements can be made concurrently with all other measurements

## Supplemental characteristics

**Measurement resolution:**  
0.01 percent

### GSM fast bit error ratio (FBER) measurement

**Types of signals measured:**  
comparison of 114 bits of interleaved data with mobile phone in burst-by-burst loopback

**Minimum input level:**  
uplink signal at test set's RF IN/OUT must have transmit power  $\geq -30$  dBm for warranted performance

**Residual BER:**  
 $< 10^{-6}$

**Measurement data pattern:**  
PRBS-15

**Mobile loopback:**  
in active cell operating mode type C must be selected

**TDMA frame delay:**  
settable between 0 and 26 frames or automatically determined

**Signaling loopback control:**  
on or off

**Closed-loop signaling delay:**  
settable between 0 and 5 s

**Measurement unit:**  
selectable as percent or count

**Numerical results:**  
number of bits tested, FBER, number of bad bits, TDMA frame delay, Rx level, Rx qual

**Multi-measurement capabilities:**  
1 to 999,000 bits

**Concurrency capabilities:**  
GSM FBER measurements cannot be made concurrently with GSM BER measurements, GSM decoded audio level measurements, or while speech is provided on the downlink TCH; GSM FBER measurements can be made concurrently with all other measurements

## Supplemental characteristics

**Measurement resolution:**  
0.01 percent



## **(E)GPRS multislot BER measurement**

### **Types of signals measured:**

PRBS-15 data sent on GMSK or 8PSK downlink PDTCH(s) and looped back by the mobile

### **Minimum input level:**

for warranted performance, uplink signals at test set's RF IN/OUT must have transmit power  $\geq -30$  dBm and

- $\leq 25$  dB difference in power between levels of adjacent GMSK timeslots sent on GPRS signals,
- $\leq 20$  dB difference in power between levels of adjacent GMSK timeslots sent on EGPRS signals, or
- $\leq 10$  dB difference in power between levels of adjacent 8PSK timeslots

### **Residual BER:**

$< 10^{-6}$

### **Connection types:**

ETSI type B in active cell GPRS or EGPRS operating mode or SRB loopback in active cell EGPRS operating mode

### **Measurement data patterns:**

with data connection type ETSI B (unack) and data looped back by the mobile, selectable as all zeros, all ones, alternate bits, alternate pairs, alternate quads, PRBS-15, fixed 2B (hex), or custom

### **GPRS block delay:**

settable from 1 to 12 blocks or automatically determined

### **EGPRS close loop signaling delay:**

settable from 0 to 5 s

### **EGPRS loopback delay:**

from 0 to 20

### **GPRS zero bad blocks:**

settable as off or on; when on, all bits within a bad block are set to zero

### **Numerical results:**

number of bits tested, BER, bit error count, GPRS block delay, EGPRS loopback delay

### **Multi-measurement capabilities:**

1 to 999,000 bits

### **Concurrency capabilities:**

(E)GPRS BER measurements cannot be made concurrently with (E)GPRS BLER measurements, but can be made concurrently with all other measurements

### **Supplemental characteristics**

#### **Measurement resolution:**

0.01 percent

## **(E)GPRS multislot BLER measurement**

### **Types of signals measured:**

GMSK data looped back by the mobile using connection type ETSI type B (unack), 8PSK data looped back by the mobile using connection type SRB loopback, or information reported by the mobile in Packet\_Uplink\_Ack\_Nack messages using connection type ETSI type B (ack) or BLER

### **Minimum input level:**

for warranted performance, uplink signals at test set's RF IN/OUT must have transmit power  $\geq -30$  dBm and

- $\leq 25$  dB difference in power between levels of adjacent GMSK timeslots sent on GPRS signals,
- $\leq 20$  dB difference in power between levels of adjacent GMSK timeslots sent on EGPRS signals, or
- $\leq 10$  dB difference in power between levels of adjacent 8PSK timeslots

### **Connection types:**

settable as ETSI type B (unack), ETSI type B (ack), BLER (for GPRS), or SRB loopback (for EGPRS)

### **Measurement data patterns:**

with data connection type ETSI B (unack) and data looped back by the mobile, selectable as all zeros, all ones, alternate bits, alternate pairs, alternate quads, PRBS-15, or fixed 2B (hex), or custom

### **Block delay:**

settable between 1 and 6 blocks or automatically determined

### **Numerical results:**

number of blocks tested, BLER, block error count, BLER of each burst (for connection type ETSI type B (ack), or BLER), level of each downlink burst, block delay

### **Multi-measurement capabilities:**

1 to 99,000 blocks

### **Concurrency capabilities:**

GPRS/EGPRS BLER measurements cannot be made concurrently with GPRS/EGPRS BER measurements, but can be made concurrently with all other measurements

### **Supplemental characteristics**

#### **Measurement resolution:**

0.01 percent

## Transmitter measurement specifications

Unless otherwise specified, transmitter measurements can be performed in active cell (GSM), active cell (GPRS), and active cell (EGPRS) operating modes.

### GMSK multislot-tolerant phase and frequency error measurement

#### Types of signals measured:

normal GMSK bursts from GPRS or EGPRS signals, RACH bursts for a single uplink timeslot only

#### Multislot input signal conditions:

≤ 30 dB difference in power level between adjacent timeslots

#### Multislot signal measurement capability:

measurement of one user-specified timeslot transmitted as a single timeslot or two adjacent timeslots

#### GPRS frequency capture range:

signal must be within ±100 kHz of test set's expected frequency for warranted performance

#### EGPRS 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 transmit 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

*When using the RF generator as the RF reference frequency for the mobile, the RF generator frequency error relative to the timebase reference must be added*

#### rms phase error measurement accuracy:

< 1 degree

#### Peak phase error measurement accuracy:

< 4 degrees

#### Trigger sources:

RF rise, protocol, immediate, auto, external

#### Trigger delay:

settable between ±2.31 ms

#### Trigger qualification:

on or off

#### Burst synchronization:

midamble, RF amplitude, none for a single uplink timeslot; midamble for two uplink timeslots and all EGPRS signals

#### Confidence level:

settable from 80 to 99.99 percent

#### Peak phase error pass/fail maximum limit:

settable between 0 and 20 degrees

#### rms phase error pass/fail maximum limit:

settable between 0 and 5 degrees

#### Frequency error pass/fail maximum limit:

settable between 0 and 0.1 ppm

#### Numerical results:

rms and peak phase error, frequency error, pass/fail for each result

#### Displayed graphical results:

peak phase error in degrees versus bits and demodulated bits with settable marker and pass/fail limits, variable bit and amplitude axes

#### Multi-measurement capabilities:

1 to 999 bursts; maximum, minimum, and average phase and frequency error, and worst-case frequency error results

#### Concurrency capabilities:

GMSK multislot-tolerant phase and frequency error measurements can be made concurrently with all other measurements

### Supplemental characteristics

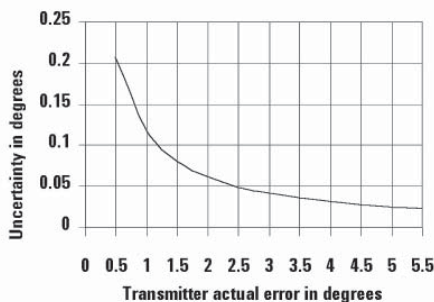
#### Frequency error measurement resolution:

0.01 Hz

#### Phase error measurement resolution:

0.01 degrees

#### Typical rms phase error uncertainty versus transmitter actual error:



## 8PSK multislot-tolerant modulation accuracy measurement

All specifications for the 8PSK multislot-tolerant modulation accuracy measurement are valid for the frequency ranges 700 to 800 MHz, 810 to 960 MHz, and 1.7 to 1.99 GHz.

### Types of signals measured:

normal 8PSK bursts

### Multislot input signal conditions:

≤ 30 dB difference in power level between adjacent timeslots

### Multislot signal measurement capability:

measurement of one user-specified timeslot transmitted as a single timeslot or two adjacent timeslots

### 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 8PSK burst power ≥ -15 dBm for warranted performance

### Residual rms EVM:

< 1 percent

### rms EVM measurement accuracy:

< +(0.75 - 0.025 x rms EVM in percent) or -(0.75 + 0.025 x rms EVM in percent) for measured average rms EVM between 1 and 10 percent

### Sample EVM measurement accuracy:

< ±4 percent

### Frequency error measurement accuracy:

< ±10 Hz plus timebase accuracy

### Origin offset suppression measurement accuracy:

< ±1.5 dB for measured origin offset suppression between 25 and 40 dB

### Trigger sources:

RF rise, protocol, immediate, auto, external

### Trigger delay:

settable between ±2.31 ms

### Burst synchronization:

midamble

### Numerical results:

rms, peak, and 95th percentile EVM, frequency error, origin offset suppression, amplitude droop, rms and peak magnitude errors and phase errors, IQ imbalance; sample EVM and probability as part of sample EVM histogram

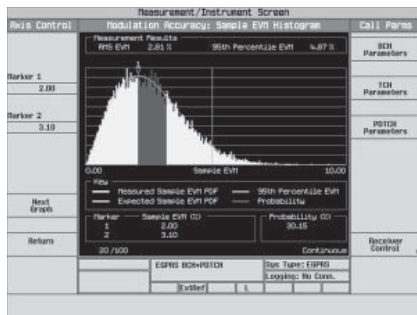


Figure 2: EGPRS modulation accuracy measurement includes a graphical sample EVM histogram to observe your device's statistical EGPRS performance.

### Displayed graphical results:

EVM versus symbol, demodulated symbols in octal and binary, magnitude error versus symbol, phase error versus symbol, sample EVM histogram with plots of measured sample EVM PDF, expected sample EVM PDF, 95th percentile EVM, and probability with settable markers and variable axes

### Multi-measurement capabilities:

1 to 999 bursts; maximum, minimum, and average results

### Concurrency capabilities:

8PSK multislot-tolerant modulation accuracy measurements can be made concurrently with all other measurements

### Supplemental characteristics

#### EVM measurement resolution:

0.01 percent

#### Frequency error measurement resolution:

0.01 Hz

#### Origin offset suppression measurement resolution:

0.01 dB

#### Amplitude droop measurement resolution:

0.01 dB

#### Magnitude error measurement resolution:

0.01 percent

#### Phase error measurement resolution:

0.01 degrees

#### IQ imbalance measurement resolution:

0.01 dB

#### Probability measurement resolution:

0.01 percent

## GSM/GPRS/EGPRS multislot transmit power measurement

The following specifications are valid when the burst capture range is set to **Single**:

### Types of signals measured:

normal GMSK bursts sent as GSM or GPRS signals, CW, RACH bursts for a single uplink timeslot only

### Multislot input signal conditions:

≤ 30 dB difference in power level between adjacent timeslots

### Multislot signal measurement capability:

measurement of one user-specified timeslot transmitted as a single timeslot or two adjacent timeslots

### 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 transmit power ≥ -25 dBm for warranted performance

### Measurement accuracy at RF IN/OUT port between +20 and +55 °C:

Accuracy (dBm)	Frequency (MHz)	Timeslot
< ±0.27	810 to 960	Single slot and multislot at the same level
< ±0.29	450 to 496 700 to 800 1700 to 1990	
< ±0.52	810 to 960	Multislot at different levels
< ±0.54	450 to 496 700 to 800 1700 to 1990	

### Measurement accuracy when RF OUT ONLY port is selected for signal generation (in addition to measurement accuracy at RF IN/OUT port):

Accuracy	Frequency
< ±0.01 dB	450 to 496 MHz 700 to 800 MHz 810 to 960 MHz
< ±0.04 dB	1700 to 1990 MHz

### VSWR at RF IN/OUT:

< 1.14:1 for 450 to 496 MHz and 700 to 960 MHz, < 1.2:1 for 1.7 to 1.99 GHz

### Trigger sources:

RF rise, protocol, immediate, auto, external

### Trigger delay:

settable between ±2.31 ms

**Burst synchronization:**

RF amplitude (GSM/GPRS midamble-synchronized transmit power result is available as part of the multislot power versus time measurement)

**Numerical result:**

GMSK transmit power

**Multi-measurement capabilities:**

1 to 999 bursts; minimum, maximum, average, and standard deviation results

**Concurrency capabilities:**

GSM/GPRS multislot-tolerant transmit power measurements can be made concurrently with all other measurements

**Supplemental characteristics****Extended amplitude range:**

results are provided for signals at test set's RF IN/OUT port for transmit power within -10 and +5 dB of expected power

**Typical measurement accuracy at RF IN/OUT port:**

Accuracy (dB)	Frequency (MHz)	Timeslot
< ±0.10	450 to 496	Single slot and
< ±0.13	700 to 800	multislot at the
	810 to 960	same level
< ±0.14	1700 to 1990	
< ±0.32	450 to 496	Multislot at
< ±0.36	700 to 800	different levels
	810 to 960	
< ±0.38	1700 to 1990	

**Typical measurement accuracy when RF OUT ONLY port is selected for signal generation (in addition to typical measurement accuracy at RF IN/OUT port):**

Accuracy	Frequency
< ±0.01 dB	450 to 496 MHz
	700 to 800 MHz
	810 to 960 MHz
< ±0.04 dB	1700 to 1990 MHz

**Typical measurement repeatability:**

< ± 0.05 dB

**Measurement resolution:**

0.01 dB

The following specifications are valid when the burst capture range is set to **All**:

**Types of signals measured:**

normal GMSK bursts sent as GSM or GPRS signals, normal GMSK and 8PSK bursts sent as EGPRS signals, CW, RACH bursts for a single uplink timeslot only

**Multislot input signal conditions:**

< 30 dB difference in power level between adjacent time slots. When autoranging is off, input signal transmit power must be within ±3 dB for highest burst and +3 dB/-30 dB for other bursts relative to expected power of highest burst; when autoranging is on, input signal transmit power must be within +3 dB/-30dB for all bursts

**Multislot signal measurement capability:**

simultaneous measurement of all bursts up to four uplink timeslots in the multislot Class 12 configuration

**Frequency capture range:**

signal must be within ±100 kHz of the test set's expected frequency for warranted performance

**Minimum input level:**

for warranted performance, signal at test set's RF IN/OUT must have transmit power > -25 dBm for GMSK transmit power or 8PSK burst power, and > -20 dBm for 8PSK estimated carrier power

**Measurement accuracy for GMSK transmit power at RF IN/OUT port between +20 and +55 °C:**

Accuracy (dBm)	Frequency (MHz)	Timeslot
< ±0.27	700 to 800	Single slot
	810 to 960	
< ±0.29	450 to 496	
	1700 to 1990	
< ±0.32	700 to 800	Multislot at the
	810 to 960	same level
< ±0.34	450 to 496	
	1700 to 1990	
< ±0.70	700 to 800	Multislot at
	810 to 960	different levels
< ±0.72	450 to 496	
	1700 to 1990	

**Measurement accuracy for 8PSK burst power at RF IN/OUT port between +20 and +55 °C:**

Accuracy (dBm)	Frequency (MHz)	Timeslot
< ±0.32	700 to 800	Single slot
	810 to 960	
< ±0.33	450 to 496	
	1700 to 1990	
< ±0.36	700 to 800	Multislot at
	810 to 960	the same level
< ±0.37	450 to 496	
	1700 to 1990	
< ±0.75	700 to 800	Multislot at
	810 to 960	different levels
< ±0.76	450 to 496	
	1700 to 1990	

**Measurement accuracy for 8PSK estimated carrier power at RF IN/OUT port between +20 and +55 °C:**

Accuracy (dBm)	Frequency (MHz)	Timeslot
< ±0.42	700 to 800	Single slot
	810 to 960	
< ±0.43	450 to 496	
	1700 to 1990	
< ±0.46	700 to 800	Multislot at
	810 to 960	the same level
< ±0.47	450 to 496	
	1700 to 1990	
< ±0.85	700 to 800	Multislot at
	810 to 960	different levels
< ±0.86	450 to 496	
	1700 to 1990	

**Measurement accuracy when RF OUT ONLY port is selected for signal generation (in addition to measurement accuracy at RF IN/OUT port):**

Accuracy	Frequency
< ±0.01 dB	450 to 496 MHz
	700 to 800 MHz
	810 to 960 MHz
< ±0.04 dB	1700 to 1990 MHz

**VSWR at RF IN/OUT:**

< 1.14:1 for 450 to 496 MHz and 700 to 960 MHz, < 1.2:1 for 1.7 to 1.99 GHz

**Trigger sources:**

RF rise, protocol, immediate, auto, external

**Trigger delay:**

settable between ±2.31 ms

**Burst synchronization:**

midamble

**Numerical result:**

GMSK transmit power, 8PSK burst power, 8PSK estimated carrier power

**Multi-measurement capabilities:**

1 to 999 bursts; minimum, maximum, average, and standard deviation results

**Concurrency capabilities:**

GSM/GPRS/EGPRS multislot transmit power measurements can be made concurrently with all other measurements

### Supplemental characteristics

#### Extended amplitude range:

results are provided for signals at test set's RF IN/OUT port for transmit power within -10 and +5 dB of expected power

#### Typical measurement accuracy for GMSK transmit power at RF IN/OUT port:

Accuracy (dB)	Frequency (MHz)	Timeslot
< ±0.10	700 to 800 810 to 960	Single slot
< ±0.11	450 to 496 1700 to 1990	
< ±0.14	700 to 800 810 to 960	Multislot at the same level
< ±0.15	450 to 496 1700 to 1990	
< ±0.29	700 to 800 810 to 960	Multislot at different levels
< ±0.30	450 to 496 1700 to 1990	

#### Typical measurement accuracy for 8PSK burst power at RF IN/OUT port:

Accuracy (dB)	Frequency (MHz)	Timeslot
< ±0.14	700 to 800 810 to 960	Single slot
< ±0.15	450 to 496 1700 to 1990	
< ±0.17	700 to 800 810 to 960	Multislot at the same level
< ±0.17	450 to 496 1700 to 1990	
< ±0.33	700 to 800 810 to 960	Multislot at different levels
< ±0.34	450 to 496 1700 to 1990	

#### Typical measurement accuracy when RF OUT ONLY port is selected for signal generation (in addition to typical measurement accuracy at RF IN/OUT port):

Accuracy (dB)	Frequency (MHz)
< ±0.01	450 to 496 700 to 800 810 to 960
< ±0.04	1700 to 1990

Typical measurement repeatability:  
< ± 0.05 dB

Measurement resolution:  
0.01 dB

### EGPRS multislot-tolerant transmit power measurement

#### Types of signals measured:

normal GMSK and 8PSK bursts sent as EGPRS signals

#### Multislot input signal conditions:

≤ 30 dB difference in power level between adjacent timeslots

#### Multislot signal measurement capability:

measurement of one user-specified timeslot transmitted as a single timeslot or two adjacent timeslots

#### Frequency capture range:

signal must be within ±1 kHz of test set's expected frequency for warranted performance

#### Minimum input level:

for warranted performance, signal at test set's RF IN/OUT must have transmit power

- ≥ -25 dBm for GMSK transmit power or 8PSK burst power, and
- ≥ -20 dBm for 8PSK estimated carrier power

#### Measurement accuracy for GMSK transmit power or 8PSK burst power at RF IN/OUT port between +20 and +55 °C:

Accuracy (dB)	Frequency (MHz)	Timeslot
< ±0.32	700 to 800 810 to 960	Single slot and multislot at the same level
< ±0.34	450 to 496 1700 to 1990	
< ±0.57	700 to 800 810 to 960	Multislot at different levels
< ±0.59	450 to 496 1700 to 1990	

#### Measurement accuracy for 8PSK estimated carrier power at RF IN/OUT port between +20 and +55 °C:

Accuracy (dB)	Frequency (MHz)	Timeslot
< ±0.40	700 to 800 810 to 960	Single slot and multislot at the same level
< ±0.42	450 to 496 1700 to 1990	
< ±0.65	700 to 800 810 to 960	Multislot at different levels
< ±0.67	450 to 496 1700 to 1990	

#### Measurement accuracy when RF OUT ONLY port is selected for signal generation (in addition to measurement accuracy at RF IN/OUT port):

Accuracy	Frequency
< ±0.01 dB	450 to 496 MHz 700 to 800 MHz 810 to 960 MHz
< ±0.04 dB	1700 to 1990 MHz

#### VSWR at RF IN/OUT:

< 1.14:1 for 450 to 496 MHz and 700 to 960 MHz, < 1.2:1 for 1.7 to 1.99 GHz

#### Trigger sources:

RF rise, protocol, immediate, auto, external

#### Trigger delay:

settable between ±2.31 ms

#### Burst synchronization:

midamble

#### Numerical results:

GMSK transmit power, 8PSK burst power, 8PSK estimated carrier power

#### Multi-measurement capabilities:

1 to 999 bursts; minimum, maximum, average, and standard deviation results

#### Concurrency capabilities:

EGPRS multislot-tolerant transmit power measurements can be made concurrently with all other measurements

### Supplemental characteristics

#### Extended amplitude range:

results are provided for signals at test set's RF IN/OUT port for transmit power within -10 and +5 dB of expected power

#### Typical measurement accuracy for GMSK transmit power or 8PSK burst power at RF IN/OUT port:

Accuracy (dB)	Frequency (MHz)	Timeslot
< ±0.15	700 to 800 810 to 960	Single slot and multislot at the same level
< ±0.16	450 to 496 1700 to 1990	
< ±0.35	700 to 800 810 to 960	Multislot at different levels
< ±0.36	450 to 496 1700 to 1990	

#### Typical measurement accuracy when RF OUT ONLY port is selected for signal generation (in addition to typical measurement accuracy at RF IN/OUT port):

Accuracy	Frequency
< ±0.01 dB	450 to 496 MHz 700 to 800 MHz 810 to 960 MHz
< ±0.04 dB	1700 to 1990 MHz

Typical measurement repeatability:  
< ± 0.05 dB

Measurement resolution:  
0.01 dB



## Multislot power versus time measurement

All specifications for the multislot power versus time measurement are valid between +20 and +55 °C and using high linearity ranging mode. GSM/GPRS/EGPRS multislot transmit power measurement or EGPRS multislot-tolerant transmit power measurement accuracy specifications apply to output power results.

### Types of signals measured:

normal GMSK and 8PSK bursts, CW, RACH bursts for a single uplink timeslot only

### Multislot input signal conditions:

≤ 30 dB difference in power level between adjacent timeslots

### Multislot signal measurement capability:

measurement of a single GMSK or 8PSK uplink timeslot or two adjacent GMSK and/or 8PSK uplink timeslots

### Frequency capture ranges:

GSM or GPRS signal must be within ±10 kHz and EGPRS 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 transmit power ≥ -15 dBm for warranted performance

### Mask placement timing accuracy:

< ±0.1 symbols with midamble synchronization

### Relative measurement accuracy (referenced to average output power during useful part of burst):

Specification	Power range
< ±0.5 dB	-7 to +1 dB for GMSK bursts -7 to +4 dB for 8PSK bursts
< ±1.0 dB	-20 to < -7 dB
< ±2.0 dB	-32 to < -20 dB
< ±2.7 dB	-50 to < -32 dB, ≥ -46 dBm <sup>1</sup>
< ±3.0 dB	-60 to < -50 dB, ≥ -46 dBm <sup>1</sup>

<sup>1</sup> For measurements on the second burst in a multislot configuration where the first burst is at a higher power than the second burst, the minimum power is the higher of the following three cases:

- -60 dB below reference
- -70 dB below reference plus the offset between the two burst power levels
- -46 dBm

### Trigger sources:

RF rise, protocol, immediate, auto, external

### Trigger delay:

settable between ±2.31 ms

### Burst synchronization:

midamble, RF amplitude, none for a single GSM or GPRS uplink timeslot; midamble for two GSM or GPRS uplink timeslots or any EGPRS uplink timeslots

### Tx power method:

estimated carrier power or average burst power

### Ranging mode:

high linearity or high dynamic range

### Marker measurement points:

12 time points within each burst are definable

### PCS ETSI limit:

selection of narrow or relaxed mask in PCS 1900 MHz band

### Mask types:

selectable as ETSI, custom 1, custom 2, or no mask for each burst and ETSI, custom, or no mask for guard period between bursts

### Numerical results:

- for entire single or multislot signal: pass/fail for rising edge, active part(s), falling edge, and guard period
- for each burst: GMSK transmit power or 8PSK burst power, worst case upper mask limit margin and time, worst case lower mask limit margin and time, amplitude at marker measurement points

### Displayed graphical results:

- for single-slot signals: fixed dBc versus  $\mu$ s views of full, rising edge, falling edge, and useful part of burst
- for multislot signals: fixed dBc versus  $\mu$ s views of both bursts, guard period, burst 1, and burst 2
- for all signals: ETSI-defined mask, pass/fail indicators, settable marker, and variable time and amplitude axes

### Multi-measurement capabilities:

1 to 999 bursts; minimum, maximum, average, and standard deviation results

### Concurrency capabilities:

multislot power versus time measurements can be made concurrently with all other measurements

### Supplemental characteristics

#### Typical relative measurement accuracy:

< ±0.25 dB over -7 to +1 dB for GMSK bursts, < ±0.25 dB over -4 to +4 dB for 8PSK bursts

#### Typical dynamic range and typical noise floor:

for measurement of the second burst in a multislot configuration with the first burst > 10 dB higher than the second burst,

- **typical dynamic range:**  
> (lesser of 74 dB or 84 dB minus power offset between bursts), or
- **typical noise floor:**  
< -62 dBm, whichever dominates

For all other single and multislot signals

- **typical dynamic range:**  
> 74 dB, or
- **typical noise floor:**  
< -62 dBm, whichever dominates

#### Measurement resolution:

0.01 dB



## Burst timing error measurement

Burst timing error measurement result is available on call setup screen.

### Types of signals measured:

normal GMSK or 8PSK bursts, RACH bursts for a single uplink timeslot only

### Measurement capture range:

signal must be within  $\pm 3 T$  (bit periods) of test set's expected position

### Minimum input level:

signal at test set's RF IN/OUT must have transmit power  $\geq -30$  dBm and  $\leq 20$  dB difference in levels of adjacent timeslots

### Numerical result:

burst timing error

### Concurrency capabilities:

burst timing error measurements can be made concurrently with all other measurements, but burst timing result is not available when PDTCH(s) are not active

### Supplemental characteristics

#### Typical measurement repeatability:

$< \pm 0.25 T$  (0.923  $\mu$ s)

#### Measurement resolution:

0.25 T (0.923  $\mu$ s)

## Multislot-tolerant output RF spectrum (ORFS) measurement

All specifications for the multislot-tolerant ORFS measurement are valid between +20 and +55 °C. GSM/GPRS/EGPRS multislot transmit power measurement or EGPRS multislot-tolerant transmit power measurement accuracy specifications apply to output power result. These specifications apply to E5515C mainframes with Option 002 supplied after serial number GB46040001 January 2006.

**Modulation measurement implementation:** performed using a five-pole, synchronously-tuned 30 kHz RBW filter averaged over 40 bits

**Switching measurement implementation:** performed using a five-pole, synchronously-tuned 30 kHz RBW filter with peak hold during the whole burst

### Types of signals measured:

GMSK or 8PSK normal bursts

### Multislot input signal conditions:

$\leq 30$  dB difference in power level between adjacent timeslots

**Multislot signal measurement capability:** measurement of one user-specified timeslot transmitted as a single timeslot or two adjacent timeslots

### Frequency capture range:

signal must be within  $\pm 200$  Hz of test set's expected frequency for warranted performance

### Minimum input level:

signal at test set's RF IN/OUT must have transmit power  $\geq -10$  dBm for warranted performance

### Filter options:

digital, analog, and auto

### Trigger sources:

RF rise, protocol, immediate, auto, external

### Trigger delay:

settable between  $\pm 2.31$  ms

### Burst synchronization:

RF amplitude for GSM or GPRS signals, midamble for EGPRS signals

### Measurement offsets:

22 modulation and 8 switching offsets from carrier are definable

### Pass/fail limits:

ETSI or user-defined

### Numerical results:

modulation and switching results at each selected offset, output power, transmit power in 30 kHz bandwidth, modulation and switching pass/fail indicators, modulation type

### Displayed graphical results:

fixed dB versus frequency views of modulation, switching, or both modulation and switching, settable marker and pass/fail limits, modulation and switching pass/fail indicators, variable frequency and amplitude axes

### Multi-measurement capabilities:

1 to 999 measurements; average modulation result, maximum switching result

### Concurrency capabilities:

multislot-tolerant ORFS measurements can be made concurrently with all other measurements

### Modulation dynamic range:

$-74$  dBr digital filter-type for default offset frequencies 600 to 1800 kHz, power +10 dBm or greater

### Supplemental characteristics

#### Typical modulation dynamic range:

- $-74$  dBr digital filter-type for full spectrum, power 0 dBm or greater
- $-74$  dBr analogue filter-type for full spectrum, power +10 dBm or greater

#### Typical switching dynamic range:

$-70$  dBc/ $-60$  dBm (whichever is greater) at 600, 1200, and 1800 kHz offsets, power +10 dBm or greater

## Phase and amplitude versus time (PAvT) measurement

Optional PAVT measurement, requires separate license, orderable as part number E1968A-410

All specifications for the PAVT measurement are valid between +20 and +55 °C

### Types of signals measured:

CW only – discrete amplitude step waveform or continuous ramp waveform

### Waveform type:

discrete or continuous

### Trigger sources:

RF rise, immediate, external

### Trigger delay:

settable between 0 to 10 ms

### Trigger threshold:

settable between 0 to 30 dB

### Measurement timeout:

settable between 0.1 to 999.9 s

### Continuous measurement count:

settable between 1 to 5000

### Continuous measurement delay:

settable between 0 to 500 ms

### Discrete step width:

settable between 0.1 to 400 ms

### Discrete step count:

settable between 1 to 512

### Discrete step center:

settable between 0.05 to 399.95 ms

### Concurrency capabilities:

PAvT measurements cannot be made concurrently with any other measurements

## Fast device tune (FDT) measurement

Optional FDT measurement, requires separate license, orderable as part number E1999A-201

All specifications for the FDT measurement are valid for the frequency ranges 450 to 496 MHz, 740 to 960 MHz, and 1700 to 1990 MHz

### FDT (downlink) generator specifications

#### FDT absolute output level accuracy with GMSK modulation on:

Specification	Ranges
< ±2.10 dB	Single slot from –110 to –13 dBm
< ±2.10 dB	1 multislots level between –110 and –13 dBm
< ±2.50 dB	2 multislots levels ≤ 20 dB apart

#### Peak phase error:

< ±5 degrees

#### RMS phase error:

< 1 degree

#### Frequency error:

< ±0.02 ppm plus timebase reference

### Supplemental characteristics

Typical FDT absolute output level accuracy with GMSK modulation on:

Specification	Ranges
< ±1.40 dB	Single slot from –110 to –13 dBm
< ±1.40 dB	1 multislots level between –110 and –13 dBm
< ±1.70 dB	2 multislots levels ≤ 20 dB apart

Typical burst modulation on/off ratio (referenced to lowest signal level):

> 50 dB

## FDT transmit power measurement specifications:

### Input signal conditions:

first slot has to be the highest burst, and power level of first timeslot has to be within ± 3dB of expected power

### Multislots signal measurement capability:

measurement of up to seven timeslots

### Minimum input level:

for warranted performance, signal at test set's RF IN/OUT must have transmit power ≥ 14 dBm for first timeslot, and ≥ –25 dBm for second to seventh timeslot

### Measurement accuracy for FDT GMSK transmit power at RF IN/OUT port between +20 and +55 °C:

Accuracy (dBm)	Frequency (MHz)
< ±0.85	700 to 800
	810 to 960
< ±0.87	450 to 496
	1700 to 1990

### Frequency capture range:

signal must be within ±70 kHz of test set's expected frequency for warranted performance

### VSWR at RF IN/OUT:

< 1.14:1 for 450 to 496 MHz and 700 to 960 MHz, < 1.2:1 for 1.7 to 1.99 GHz

### Trigger sources:

fixed as protocol trigger (RF rising trigger for the first step)

### Trigger delay:

±2.31 ms

### Concurrency capabilities:

fast device tune measurements cannot be made concurrently with other measurements

### Supplemental characteristics

Typical measurement accuracy for FDT GMSK transmit power at RF IN/OUT port between +20 and +55 °C:

Accuracy (dBm)	Frequency (MHz)
< ±0.40	700 to 800
	810 to 960
< ±0.41	450 to 496
	1700 to 1990

### Typical measurement repeatability:

< ±0.05 dB

### Measurement resolution:

0.01 dB

## General-purpose spectrum monitor

### Operating modes:

active cell and test mode

### Measurement modes:

swept mode or zero span

### Frequency ranges:

although the spectrum monitor is available at any frequency supported by the test set, specifications apply only inside of the calibrated bands:

450 to 496 MHz, 700 to 800 MHz, 810 to 960 MHz, and 1.7 to 1.99 GHz

### Frequency spans, resolution bandwidth, displayed dynamic ranges:

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:

settable from 50  $\mu$ s to 70 ms

### Zero span offset time:

settable from 0 to 10 s

### Reference level range:

settable from -50 to +37 dBm or automatically determined

### Amplitude scaling:

settable from 0.1 to 20 dB/division in 0.1 dB steps

### Trigger source:

immediate, protocol, RF rise, external, auto

### Trigger delay:

settable between  $\pm$ 50 ms

### Peak threshold:

settable from -120 to +37 dBm

### Peak excursion:

settable from 1.2 to 100 dB

### Trace functions:

clear write, max hold, min hold

### Detector type:

peak or sample

### Averaging capabilities:

settable between 1 and 999, or off

### Marker functions:

three independent markers with modes of normal, delta, and off; operations are peak search, marker to expected power, and marker to expected frequency

### Concurrency capabilities:

spectrum monitor analysis can be performed concurrently with all measurements

### Supplemental characteristics

#### Typical level accuracy:

- $\pm 2$  dB for signals within 50 dB of a reference level  $\geq -10$  dBm and RBW  $< 5$  MHz,
- $\pm 2$  dB for signals within 30 dB of a reference level  $< -10$  dBm and RBW = 5 MHz using 5 averages,
- $\pm 3.5$  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

## GSM decoded audio level measurement

The MS needs to be stimulated with a pulsed audio signal at a 10 Hz rate with 50 percent duty cycle for the decoded audio level measurement to provide accurate results.

### Types of signals measured:

encoded audio present on uplink TCH

### Measurement range:

200 Hz to 3.6 kHz

### Measurement accuracy:

observed inaccuracies are due to MS encoder errors since the algorithm in the test set contributes no bit errors

### Band pass filter capabilities:

100 Hz bandwidth, tunable from 200 Hz to 3.6 kHz, selectable as on or off

### Measurement trigger source:

immediate

### Measurement synchronization:

none required

### Numerical result:

rms audio level

### Multi-measurement capabilities:

1 to 999 measurements; average, minimum, maximum, and standard deviation results

### Concurrency capabilities:

GSM decoded audio level measurements cannot be made concurrently with GSM BER or GSM FBER measurements; GSM decoded audio level measurements can be made concurrently with all other measurements

### Supplemental characteristics

#### Measurement resolution:

0.01 percent

## 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  $\geq 600 \Omega$ )

**Accuracy:**  
<  $\pm(1.5\%$  of setting + resolution) when output is DC coupled

**Distortion:**  
< 0.1 percent for 0.2 to 9 V peak into  $\geq 600 \Omega$

**Pulse mode:**  
pulsed audio signal at a 10 Hz rate with 50 percent duty cycle, selectable as on or off (for use with the GSM decoded audio level measurement)

**Coupling mode:**  
selectable as DC or AC (5  $\mu\text{F}$  in series with output)

### Supplemental characteristics

**Typical maximum output current:**  
100 mA peak into  $8 \Omega$

**Typical output impedance:**  
<  $1.5 \Omega$  at 1 kHz when output is DC coupled

**Typical DC offset (when output is DC coupled):**  
< 1 mV 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

## GSM analog audio measurement specifications

All analog audio measurement specifications apply to signals present at test set's AUDIO IN ports.

**De-emphasis:**  
750  $\mu\text{s}$  de-emphasis selectable as off or on

**Expander:**  
selectable as off or on with reference level setting of 10 mV to 10 V

**Filters:**  
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

## GSM analog 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:**

- <  $\pm(2$  percent of reading + resolution) for 100 Hz to  $\leq 8$  kHz,
- <  $\pm(3$  percent of reading + resolution) for > 8 to 20 kHz

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

**Measurement detectors:**  
rms or peak

**Measurement trigger source:**  
immediate

**Measurement synchronization:**  
none required

**Numerical result:**  
audio level

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

**Concurrency capabilities:**  
GSM analog audio level measurements cannot be made concurrently with GSM multi-tone audio, but can be made concurrently with all other measurements

### Supplemental characteristics

**Typical measurement accuracy:**  
<  $\pm 1.2$  percent of reading for 100 Hz to  $\leq 8$  kHz and 20 mV to 20 V peak

**Typical external input impedance:**  
100 k $\Omega$  in parallel with 105 pF

**Measurement resolution:**  
0.3 percent of expected level setting or 0.2 mV, whichever is greater

## **GSM analog audio distortion measurement**

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

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

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

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

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

**Measurement trigger source:**  
immediate

**Measurement synchronization:**  
none required

**Numerical result:**  
audio distortion

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

**Concurrency capabilities:**  
GSM analog audio distortion measurements  
cannot be made concurrently with GSM  
multi-tone audio, but can be made concur-  
rently with all other measurements

### ***Supplemental characteristics***

**Measurement resolution:**  
*0.1 percent*

## **GSM analog 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  $\mu$ V rms

**Measurement trigger source:**  
immediate

**Measurement synchronization:**  
none required

**Numerical result:**  
audio frequency

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

**Concurrency capabilities:**  
GSM analog audio frequency measurements  
cannot be made concurrently with GSM  
multi-tone audio, but can be made concur-  
rently with all other measurements

### ***Supplemental characteristics***

**Measurement resolution:**  
*0.1 Hz*

## **GSM analog audio 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:**  
<  $\pm 1.0$  dB for SINAD < 43.5 dB

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

**Measurement trigger source:**  
immediate

**Measurement synchronization:**  
none required

**Numerical result:**  
SINAD ratio

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

**Concurrency capabilities:**  
GSM analog audio SINAD measurements  
cannot be made concurrently with GSM  
multi-tone audio, but can be made concur-  
rently with all other measurements

### ***Supplemental characteristics***

**Measurement resolution:**  
*0.01 dB*

## GSM multi-tone audio

### Downlink audio measurement mode

#### Description:

test set generates a multi-tone audio signal and encodes it into speech frames sent on the downlink traffic channel; the MS decodes the received speech frames and provides audio output via a speaker connected to the test set's AUDIO IN port

#### Applicable specifications:

GSM analog audio measurement specifications apply to measured results

#### Analyzer downlink reference level:

settable between 100 mV and 5 V

#### Multi-tone audio generator downlink levels:

total level settable between 0 and 70 percent of 0 dB reference or 1 to 20 levels are settable between 0 and 70 percent of 0 dB reference, where the total level of all tones must be < 70 percent of 0 dB reference

#### Expected AUDIO IN peak voltage:

settable between 1 mV and 20 V peak

### Uplink audio measurement mode

#### Description:

test set generates a multi-tone audio signal out of the AUDIO OUT port connected to the MS's microphone; the MS encodes the tones into speech frames on the uplink traffic channel and the test set decodes the received speech frames

#### Applicable specifications:

audio generator specifications apply to multi-tone audio signal at the AUDIO OUT port; GSM decoded audio level measurement specifications apply to measured results

#### Analyzer uplink reference level:

settable between 1 and 100 percent of 0 dB reference

#### Multi-tone audio generator uplink levels:

total level settable between 0 and 4.5 V rms, or 1 to 20 levels are settable between 0 and 4.5 V rms, where the total level of all tones must be < 4.5 V rms

## Both measurement modes

#### Analyzer 0 dB reference mode:

absolute or relative

#### Analyzer reference tone:

settable between 1 and 20 Hz

#### Device settling time:

settable between 20 ms and 1 s

#### SINAD/Distortion (on audio tone 1) state:

on or off

#### Multi-tone audio generator

##### frequencies:

1 to 20 frequencies are settable between 10 Hz and 4 kHz or off; 7 preset states are selectable as multi-tone 140, multi-tone 100, single tone 300 Hz, single tone 1 kHz, single tone 3 kHz, all tones off, and none

##### Multi-tone audio analyzer frequencies:

use multi-tone audio generator frequencies or 1 to 20 frequencies are settable between 10 Hz and 4 kHz

##### Multi-tone audio level limits:

upper and lower limits are settable between  $\pm 100$  dB for 1 to 20 audio tones

##### Numerical results:

audio level, frequency, SINAD, distortion, total generator audio level, total measurement audio level, measurement mode, 0 dB reference

##### Graphical results:

level and frequency of each audio tone with limits, settable marker and axes

## Timebase specifications

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

#### Aging rates:

<  $\pm 0.1$  ppm per year, <  $\pm 0.005$  ppm peak-to-peak per day during any 24-hour period starting 24 hours or more after a cold start

#### Temperature stability:

<  $\pm 0.01$  ppm frequency variation from +25 °C over the temperature range 0 to +55 °C

#### Warm-up times:

5 minutes to be within  $\pm 0.1$  ppm of f frequency at one hour, 15 minutes to be within  $\pm 0.01$  ppm of frequency at one hour

### Supplemental characteristics

#### Typical accuracy after a 30-minute warm-up period of continuous operation is derived from:

$\pm[(\text{time since last calibration}) \times (\text{aging rate}) + (\text{temperature stability}) + (\text{accuracy of calibration})]$

#### Typical initial adjustment:

$\pm 0.03$  ppm

### External reference input

#### Input frequency:

10 MHz

### Supplemental characteristics

#### Input frequency range:

<  $\pm 5$  ppm of nominal reference frequency

#### Input level range:

0 to +13 dBm

#### Input impedance:

50  $\Omega$  nominal

### External reference output

#### Output frequency:

same as timebase (internal 10 MHz OCXO or external reference input)

### Supplemental characteristics

#### Typical output level:

$\geq 0.5$  V rms

#### Output impedance:

50  $\Omega$  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:

222 x 426 x 625 mm  
(8.75 x 16.75 x 24.63 inches)

### Weight:

30 kg (66 lbs)

### Display:

26.7 cm (10.5 inches), active matrix, color, and liquid crystal

### LAN (local area network) port:

RJ-45 connector, 10 Base T Ethernet with TCP/IP support

### Operating conditions:

0 to +55 °C, 30 g/m<sup>3</sup> absolute humidity (95 percent/+32 °C, 28 percent/+55 °C relative humidity)

### Storage conditions:

-20 to +70 °C, 50 g/m<sup>3</sup> absolute humidity, non-condensing (90 percent/+65 °C relative humidity)

### Power:

88 to 135 VAC, 193 to 269 VAC, 50 to 60 Hz, 550 VA maximum

### Calibration interval:

2 years

### EMI:

conducted and radiated interference meets CISPR-11, susceptibility meets IEC 1000-4-2, 1000-4-3, and 1000-4-4

## Supplemental characteristics

### Typical power consumption:

400 to 450 W continuous

### Typical radiated leakage due to RF generator:

< 2.5  $\mu$ V induced in a resonant dipole antenna one inch from any surface except the underside and rear panel at set RF generator output frequency and output level of -40 dBm with no cable connected to rear-panel LAN port

## Test Subscriber Identification Module (SIM) Cards

Test SIM cards are available for purchase from Agilent. Two types are available as follows

- **Programmed GSM SIM card micro-size:** fits most current wireless devices (about 15 x 25 mm), part number 08922-61887
- **Programmed UMTS SIM card micro-size:** fits most current wireless devices (approximately 15 x 25 mm), part number E5515-61286

## Ordering Information

For current ordering information, please refer to the configuration guide, literature number 5968-7873E, on the Web at

[www.agilent.com/find/8960](http://www.agilent.com/find/8960)

For more information on ordering test SIM cards, visit the Agilent site at

[www.parts.agilent.com](http://www.parts.agilent.com)



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