

Test Equipment Solutions Datasheet

Test Equipment Solutions Ltd specialise in the second user sale, rental and distribution of quality test & measurement (T&M) equipment. We stock all major equipment types such as spectrum analyzers, signal generators, oscilloscopes, power meters, logic analysers etc from all the major suppliers such as Agilent, Tektronix, Anritsu and Rohde & Schwarz.

We are focused at the professional end of the marketplace, primarily working with customers for whom high performance, quality and service are key, whilst realising the cost savings that second user equipment offers. As such, we fully test & refurbish equipment in our in-house, traceable Lab. Items are supplied with manuals, accessories and typically a full no-quibble 2 year warranty. Our staff have extensive backgrounds in T&M, totalling over 150 years of combined experience, which enables us to deliver industry-leading service and support. We endeavour to be customer focused in every way right down to the detail, such as offering free delivery on sales, covering the cost of warranty returns BOTH ways (plus supplying a loan unit, if available) and supplying a free business tool with every order.

As well as the headline benefit of cost saving, second user offers shorter lead times, higher reliability and multivendor solutions. Rental, of course, is ideal for shorter term needs and offers fast delivery, flexibility, try-before-you-buy, zero capital expenditure, lower risk and off balance sheet accounting. Both second user and rental improve the key business measure of Return On Capital Employed.

We are based near Heathrow Airport in the UK from where we supply test equipment worldwide. Our facility incorporates Sales, Support, Admin, Logistics and our own in-house Lab.

All products supplied by Test Equipment Solutions include:

- No-quibble parts & labour warranty (we provide transport for UK mainland addresses).
- Free loan equipment during warranty repair, if available.
- Full electrical, mechanical and safety refurbishment in our in-house Lab.
- Certificate of Conformance (calibration available on request).
- Manuals and accessories required for normal operation.
- Free insured delivery to your UK mainland address (sales).
- Support from our team of seasoned Test & Measurement engineers.
- ISO9001 quality assurance.

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Signal Sources

202

Digital/I-Q Modulation

HP ESG-D1000A
HP ESG-D2000A
HP ESG-D3000A
HP ESG-D4000A

- 250 kHz up to 4.0 GHz
- Built-in digital modulation formats for CDMA, DECT, GSM, NADC, PDC, PHS, and TETRA (Options H03/UN3/UN4)
- Analog I and Q
- Superior level accuracy
- Step sweep (frequency, power and list)
- Wideband FM and phase modulation
- Internal data generator and burst capabilities

HP ESG-D Series Digital and Analog Signal Generators



The HP ESG-D series of RF signal generators provide a wide range of digital modulation capabilities, in addition to a comprehensive feature set and excellent analog performance—all at an affordable price. The first in a new generation of signal generators, they provide excellent modulation accuracy and stability, as well as unprecedented level accuracy. They are ideally suited to meet the demanding requirements of today's digital receiver test, component test and local oscillator applications.

Built-in Personalities for Common Communication Standards

Internally generate $\pi/4$ DQPSK, GMSK, GFSK, signals to meet the test requirements of NADC, PDC, PHS, TETRA, GSM, and DECT receivers with Options UN3/UN4. Test CDMA mobile components and enable transmitter tests by generating QPSK and OQPSK signals with Option H03. A choice of internal or external data generation, and flexible framing and time-slot configuration capabilities is available. In addition, adjustable data rates, filter factors, and burst shaping provides operators enormous measurement versatility.

Flexible Frames and Timeslots, as well as Internal Burst and Data Generation

Easily configure timeslots to simulate different types of traffic, control, or synchronization channels (or bursts). Generate mobile- or base-station transmissions for a variety of digital communications standards with the internal burst capabilities. Also, reduce the need for external equipment with comprehensive data generation capabilities.

Broadband I and Q Modulation

Use the analog I and Q inputs to generate the complex modulation formats (such as BPSK, QPSK, and 16QAM), required for the development and testing of RF digital communications systems. A built-in quadrature modulator processes the I and Q input signals to provide superior modulation accuracy and stability over a 10 MHz (1 dB) bandwidth.



HP ESG-D4000A

Excellent Level Accuracy

Make sensitivity tests accurately and efficiently with the wide power range (+13 to -136 dBm) and superior level accuracy of the HP ESG-D series RF signal generators. Level accuracies of better than ± 1.1 dB for the built-in modulation formats and typically less than ± 0.6 dB, ensures precise measurement of even the most sensitive digital receivers.

Wideband FM and Phase Modulation

Extremely stable dc FM precisely reproduces digital signaling for FM receivers with selective squelch control. Wideband phase modulation capabilities are useful for satellite communications applications, offering deviations up to 90 radians and 6 MHz rates.

Specifications

- Frequency**
 - HP ESG-D1000A: 250 kHz to 1000 MHz
 - HP ESG-D2000A: 250 kHz to 2000 MHz
 - HP ESG-D3000A: 250 kHz to 3000 MHz
 - HP ESG-D4000A: 250 kHz to 4000 MHz

For Analog Specifications, see ESG Series on page 196.

- Wide Band AM**
 - Rate (1 dB bandwidth, typical):
 - ALC On: 400 Hz - 10 MHz
 - ALC Off: dc - 10 MHz
 - Input: I input
 - Impedance: 50 Ω
 - Sensitivity: 0.5 V = 100%

Level Accuracy with Digital Modulation

(With ALC on; relative to CW; with PRBS-modulated data; if using I/Q inputs, $= \sqrt{I^2 + Q^2} = 0.5 V_{rms}$ nominal)¹
 $\pi/4$ DQPSK or QPSK Formats: ± 0.15 dB (with raised cosine or root-raised cosine filter and $\alpha \geq 0.35$; with 10 kHz < symbol rate < 1 MHz; at RF freq. > 25 MHz; power < max. specified -3 dBm).
Constant Amplitude Formats (FSK, GSMK, etc.): no degradation in power level accuracy
Level Accuracy with ALC Off²: ± 0.3 dB, typical (after power search is executed; relative to CW level accuracy with ALC on; if external I/Q is enabled: $\sqrt{I^2 + Q^2} = 0.5 V_{rms}$)

4

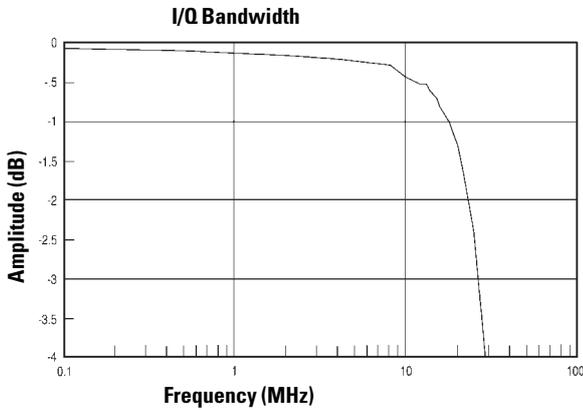
HP ESG-D1000A
 HP ESG-D2000A
 HP ESG-D3000A
 HP ESG-D4000A

4

IQ Modulation

I&Q Inputs:

Input Impedance: 50 Ω
Full Scale Input: $\sqrt{I^2 + Q^2} = 0.5 V_{rms}$
External Input Bandwidth (1 dB): 10 MHz, typical



Adjustments/Impairments (nominal):

DC Offset: (I and Q independently adjustable) +100%
I/Q Gain Ratio: ± 4 dB

DC Vector Accuracy²: (relative to full scale, power ≤ + 7 dBm)

	< 0.6	0.6 to 2	2 to 3.7	≤ 4
Frequency (GHz)	< 0.6	0.6 to 2	2 to 3.7	≤ 4
Static EVM¹ (rms)	< 0.75%	< 0.5%	0.75%	< 1%
Magnitude Error¹ (rms)	< 0.5%	< 0.35%	< 0.5%	< 0.75%
Phase Error¹ (rms)	< 0.35°	< 0.25°	< 0.35°	< 0.5°
Origin Offset (dBc)	< -46	< -46	< -40	< -40

¹ Measured at full scale with origin offset removed.

Burst Envelope

On/Off Ratio: $V_{in} \leq -1.05 V$
 ≤ 3 GHz: > 75 dB
 > 3 GHz: > 60 dB
Rise/Fall Time: < 2 μs, typical
Minimum Burst Rate:
 ALC On: 10 Hz, typical
 ALC Off: DC
External Input: Ext 1
Input Impedance: 50 Ω
Input Voltage: RF Off: -1.0 V; RF On: 0 V

	NADC	PDC	PHS	TETRA	DECT	GSM (DCS, PCS)
Modulation Format	π/4 QPSK				GFSK	GMSK
Data Rate (default, kbits/sec)	48.6	42	384	36	1,152	270.83
Adjustment Range (kbits/sec)	40 to 75.5	40 to 75.5	320 to 605	31 to 37.8	922 to 1209.6	163 to 300
Filter	Root Raised Cosine or Raised Cosine				Gaussian	
Default Value	α = 0.35	α = 0.5	α = 0.5	α = 0.35	B _s T = 0.5	B _s T = 0.3
Range (α or B_sT)	0.3, 0.35, 0.4, 0.5, 0.6				0.2 to 0.7 in 0.05 steps	
Error Vector Magnitude¹ (% rms)	Cont. Burst	Cont. Burst	Cont. Burst	Cont. Burst		
Optimize EVM Mode	1.4 1.9	1.9 1.8	1.5 1.5	1.5 1.9	N/A	N/A
Optimize EVM Mode (typical)	0.8 1.4	0.9 1.4	0.9 0.9	0.8 1.5	N/A	N/A
Optimize ACP Mode (typical)	1.4 1.8	1.0 1.2	1.2 1.2	3.1 3.2	N/A	N/A
Global Phase Error¹ (rms/pk)	N/A	N/A	N/A	N/A	N/A	0.8° / 2.8° 0.25° / 1.5°(typ.)
Deviation Accuracy¹ (kHz)	N/A	N/A	N/A	N/A	6.1 (2.5, typ)	N/A
Channel Spacing (kHz)	30	25	300	25	1,728	200
Adjacent Channel Power¹ (ACP) (Optimize ACP Mode dBc, typical)	Cont. Burst	Cont. Burst	Cont. Burst	Cont. Burst	N/A	Cont. Burst
at Adjacent Channel ³	-35 -34	— —	— —	-68 -65	N/A	-38 -37
at 1st Alternate Channel ³	-75 -73	-71 -69	-76 -75	-77 -76	N/A	-71 -69
at 2nd Alternate Channel ³	-78 -77	— —	-78 -77	-79 -79	N/A	-81 -79
at 3rd Alternate Channel ³	-78 -78	-78 -78	— —	-79 -79	N/A	-83 -81
Supported Burst Types	Custom, Up/Down TCH	Custom, Up/Down TCH, Up Vox	Custom, TCH, Sync	Custom, Up Control 1 & 2, Up Normal, Down Normal, Down Sync	Custom, Dummy B 1 & 2, Traffic B, Low Capacity	Custom, Normal, FCorr, Sync, Dummy, Access
Scramble Capabilities	—	—	Yes	Yes	—	—

¹ Specifications apply for the frequency range, data rates, root raised cosine filter and filter factors (α or B_sT) specified for each standard, and at power levels ≤ + 7 dBm (≤ 4 dBm for TETRA).

² ACP for TETRA is measured over a 25 kHz bandwidth, with an 18 kHz root raised cosine filter applied.

³ The "channel spacing" determines the offset size of the adjacent and alternate channels: Adjacent Chan. offset = 1 x channel spacing, 1st Alt. Chan. = 2 x channel spacing, 2nd Alt. Chan. = 3 x channel spacing, etc.

Signal Sources

Digital/I-Q Modulation (cont'd)

Optional I/Q Baseband Generator (UN3/UN4)

Data Structure

Frames and timeslots may be configured as different types of traffic or control channels. The data field of a timeslot can accept user file, PRBS (PN9 or PN15), or external data with the appropriate clock.

Internal Data

Pseudo-Random Patterns: Continuous PN9 or PN15

Repeating Sequence: Any 4-bit sequence

Downloadable Data

Type: Serial data

Minimum Size: Must fill entire field for which it was selected

Maximum Size (Pattern RAM): 1 Mbits (Option UN3), 8 Mbits (Option UN4)

Maximum Size (User File): 128 kbytes

External Data

Type: Serial data

Inputs: Data, bit/symbol clocks (accepts rates $\pm 5\%$ of specified data rate)

Reference Frequency: Internal or External 1, 2, 5, 10 MHz reference. (Data clock can be locked to an external 13 MHz GSM reference)

Frame Trigger Delay Control

Range: 0 to 65,000 bits

Resolution: 1 bit

Internal Burst Shape Control

Rise/Fall Time Range: Up to 30 bits

Rise/Fall Delay Range: 0 to 63.5 bits (varies w/standard)

I/Q Outputs

Level: $(\sqrt{I^2 + Q^2} = 0.5 V_{rms})$, nominal

$\pi/4$ DQPSK EVM (optimize EVM Mode): 2% (1% typ.)

GMSK Global Phase Error: 1° rms

GFSK Deviation Accuracy: 8 kHz

Optional Forward or Reverse Single-Channel CDMA Capability (Option H03)

The following table provides performance characteristics of Option H03 which apply over the 700 to 900 MHz and 1500 to 2000 MHz frequency ranges; performance at IF bands is comparable with PCS bands. High Crest mode optimizes internal settings to minimize distortion. Option H03 is not compatible with Options 1EH, UN3, or UN4.

Modulation Types: QPSK, offset QPSK (OQPSK)

Frequency Range: 250 kHz to maximum instrument frequency

Level Range: -127 to +7 dBm

Level Accuracy

With Modulation Off: ± 0.5 dB ($25^\circ \pm 5^\circ$ C)

With Modulation On: ± 0.1 dB additional error, typical

Chip (Symbol) Rate: 1.2288 MHz, adjustable from 650 kHz to 1.25 MHz

FIR Filters

Standard: As defined by IS-95

Modified: For reduced spurious emissions, meets IS-95 error function

Spreading: Conforms to IS-95, may be turned on or off

Internal Data: Continuous PN9, PN15, and 4-bit repeating sequences

External Data: Accepts serial data with corresponding data clock and symbol sync

Downloadable Data: Serial data up to 1 Mbits long

Spurious Emissions: (In 30 kHz BW, ≤ 0 dBm output level, high crest factor mode on, modified filter, equalizer off)

Freq. (MHz)	0.885–1.25 offsets	1.25–1.98 offsets	> 1.98 offsets
700–900	≤ -68 dBc (-71 dBc typ.)	≤ -74 dBc typ.	≤ -77 dBc typ.
1500–2000	≤ -62 dBc (-66 dBc typ.)	≤ -69 dBc typ.	≤ -77 dBc typ.

RHO (< 4 dBm, typical)

QPSK: Equalizer on: 0.998; equalizer off: 0.945

OQPSK: Standard filter: 0.998; modified filter: 0.997

Pilot Time Offset (typical): $< \pm 1$ μ s

Error Vector Magnitude: (< 4 dBm, RF and baseband, typ.)

	Equalizer On	Equalizer Off
Standard Filter	< 2 % rms	< 1.3 % rms
Modified Filter	< 4 % rms	< 4 % rms
Rear Panel Outputs	Even Second, Chip (Bit) Clock	Baseband I and Q

Coherent Carrier Out⁶

Range: 250 MHz to maximum carrier frequency

Level: 0 dBm ± 5 dB, typical

Impedance: 50 Ω

Remote Programming

Interface: HP-IB (IEEE-488.2-1987) with Listen and Talk. RS-232.

Control Languages: SCPI version 1992.0, also compatible with HP 8656B and 8657A/B/D/J mnemonics

Functions Controlled: All front-panel functions except power switch and knobs

IEEE-488 Functions: SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT0, CO, E2

General

Power Requirements: 90 to 254 V; 50, 60, or 400 Hz; 200 W maximum

Operating Temperature Range: 0 to 55° C

Leakage: Conducted and radiated interference meets MIL-STD-461B RE02 Part 2 and CISPR 11

Storage Registers: Up to 100 storage registers, up to 10 sequences available

Weight: < 12.7 kg (28 lb) net; < 21 kg (46 lb) shipping

Dimensions: 133 mm H x 426 mm W x 432 mm D (5.25 in H x 16.8 in W x 17 in D in)

Key Literature

HP ESG and ESG-D Series Brochure, p/n 5965-9088E

ESG Series Technical Specifications, p/n 5965-3096E

Source Selection Guide, p/n 5965-3094E

Ordering Information

HP ESG-D1000A E4430A

HP ESG-D2000A E4431A

HP ESG-D3000A E4432A

HP ESG-D4000A E4433A

Opt 001 Upgrade 1EH to UN3, baseband I/Q generator with 1 Mbit pattern RAM

Opt 002 Upgrade 1EH to UN3, baseband I/Q generator with 8 Mbit pattern RAM

Opt 003 Retrofit UN4, baseband I/Q generator with 8 Mbit pattern RAM

Opt 1CM Rackmount kit, p/n 5063-9214

Opt 1CN Front handle kit, p/n 5063-9227

Opt 1CP Rackmount kit with handles, p/n 5063-9221

Opt 1E5 Add high stability time base

Opt 1EM Move all front panel connectors to rear panel

Opt H03 Single Channel CDMA Capability

Opt UN3 Add baseband I/Q generator with 1 Mbits of pattern RAM (includes premodulation filtering, PRBS, and DECT, GSM, NADC, PDC, PHS, and TETRA standards)

Opt UN4 Add baseband I/Q generator with 8 Mbits of pattern RAM (includes premodulation filtering, PRBS, and DECT, GSM, NADC, PDC, PHS, and TETRA standards)

Opt W30 Three-year warranty

Opt W50 Five-year warranty

Accessories

Transit Case p/n 9211-1296

HP 83300A Remote Interface

¹ Typically, level accuracy with ALC on will be maintained with drive levels between 0.25 and 1.0 V_{rms} .

² When applying external I/Q signals with ALC off, output level will vary directly with I/Q input level.

³ Valid for 10 days after executing internal calibration routine, provided temperature is maintained within $\pm 5^\circ$ C of calibration temperature.

⁴ Selecting the raised cosine filter degrades instrument switching speed by 40 ms.

⁵ Valid for 30 days after executing the internal calibration routine, provided temperature is maintained within $\pm 5^\circ$ C if calibration temperature.

⁶ Coherent carrier is modulated by FM or FM when enabled.