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Agilent E1445A
Arbitrary Function Generator

Data Sheet

- **1-Slot, C-size, message based**
- **13-bit resolution, 40 MSa/s**
- **256 kSa waveform segment memory**
- **Waveform and frequency hopping with sweep function**
- **Direct access to high-speed registers**
- **Built-in self-test**



Agilent E1445A

Description

The Agilent E1445A Arbitrary Function Generator is a **C-size, 1-slot, message-based VXI module.** It provides the flexibility to produce virtually any waveform needed.

The deep memory allows downloading a large number of waveforms at once, and can store up to 128 waveforms using SCPI programming. The memory sequencer lets you link waveform segments together in any order. These sequences can be repeated 1 to 64 k times or continuously. Within a sequence, the segments can be repeated up to 4,096 times using only one sequence memory entry. This memory structure lets you build large, complex waveforms out of small segments.

Refer to the Agilent Technologies Website for instrument driver availability and downloading instructions, as well as for recent product updates, if applicable.

Produce Complex Waveforms

Essentially, there are two memories built into the E1445A:

1. 256 kSa segment memory that supplies the digital-to-analog converter (DAC) with its output values; and

2. 32 k-segment sequence memory that defines how the segments are consecutively linked together at full speed.

The memory sequencer lets you link waveform segments together in any order. These sequences can be repeated 1 to 64 k times or continuously. Within a sequence, the segments can be repeated up to 4,096 times using only one sequence memory entry. This memory structure lets you build large, complex waveforms out of small segments.

Precisely Control the Frequency

One of the clocks is created by the Direct Digital Synthesis (DDS) technique. With DDS, you get very high resolution. This allows you to precisely set the frequencies you need.

For signals with the lowest phase noise, crystal oscillators with divider circuits are also on-board to clock the DAC. This allows you to set values like 20 MSa/s with minimal jitter.

Hop Frequencies

Frequency hopping is done easily by programming a list of frequencies and instructing the internal microprocessor to step through the list. As an added benefit, the frequency changes are phase continuous. Using this feature, you can produce bursts of several tones.

Drive the DAC Directly

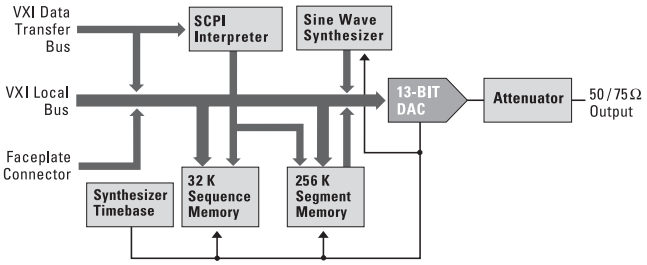
When you have an extremely long or indeterminate waveform, you can use the VXI Local Bus or the faceplate connector to drive the DAC directly. This lets your process define the waveform being produced by the E1445A. Local Bus speed is limited to 7.4 MSa/s typical. Neither is paced by the internal time base, they must be paced externally.

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Control and Synchronize Other Instruments

A programmable marker places a pulse on the Marker Out BNC. This marker can appear in any location in the segment memory. You can use the marker to synchronize other instruments, such as an oscilloscope or a digital functional tester.



Product Specifications

Waveforms

Arbitrary waveform function: Yes
Standard waveforms: Sine, square, ramp, and triangle
Resolution: 13 bits (12 bits for sine)
Sample rate generation method: Direct digital synthesis (DDS) or time base sources with digital dividers

Sample rate using DDS:*

Mode:	Resolution	Range (Sa/s):
DDS normal	0.01 Sa/s	0.01 to 10.7 M
DDS doubled	0.02 Sa/s	0.02 to 21.4 M

**** Internal 42.94 MHz crystal***

Sample rate: (Resolution using non-DDS timebase) (time base frequency)/(divider), divider = 1, 2, 3, 2N (N = 1 to 64 k), max. 40 MSa/s
Waveform segment memory: 256 kSa
Maximum number of segments: 256 using SCPI
Sequence memory: 32,768 segments
Maximum number of waveforms in memory: 128 using SCPI
Waveform sequence looping (burst output mode): 1 to 65,536 cycles or continuous
Segment looping: 1 to 4,096
Waveform hoppng: Programmed in memory or randomly using register access via VXI Data Transfer Bus (P1), VXI Local Bus (P2), or faceplate connector
Modulation: FSK, PM

Frequency Rates

Sample rate: 40 MSa/s
Time base sources: Internal 40 MHz and 42.9 MHz crystals (50 ppm); VXI CLK10 line; VXI ECLTrig lines; faceplate BNC
Maximum waveform frequency: 10.7 MHz sine, 5 MHz square, 100 kHz ramp/ triangle using 100 samples per cycle
Sweep: Linear and log frequency
Frequency sweep range: 0.01 Hz to 10 MHz
Frequency hop range: 0.01 Hz to 10 MHz
Frequency hop rate: Up to 500 kHz using registers, 800 Hz using SCPI
Frequency shift (FSK) rate: Up to 2 M changes/s
Phase modulation rate: Up to 500 kHz
Phase modulation source: Software, VXI Local Bus (P2), or faceplate connector
Square waveform rise time: 17 ns typical

Output

Amplitude: ± 10.2 V max. (open circuit)
Output impedance (software selectable): 50 or 75 Ω (output also calibrated for open circuit)
Voltage amplitude range: ± 5.1 V in 1.25 mV steps in 50 Ω, ± 10.2 V in 2.5 mV steps in to high impedance.
Monotonicity: >11 bits
Differential nonlinearity (dc): 4 LSB
Amplitude accuracy (dc): ± (0.3% + 5 mV) into 50 Ω
Output
Maximum offset: ± 5 V into 50 Ω
Maximum output: ± 5.5 V AC+DC into 50 Ω
Amplitude accuracy (ac): ± (0.1 dB + attenuator error + ac flatness) (Absolute)
Sine total harmonic distortion with internal filters applied:

Frequency Range	Harmonic Level
0.1 - 250 kHz	–60 dBc
0.25 - 4 MHz	–60 dBc + 20 log (f/250 k)
4 MHz - 10 MHz	–36 dBc

Note: f = output frequency
Sine spurious nonharmonic distortion:

Frequency Range	Non-harmonic Level
10 Hz - 1 MHz	–60 dBc or –60 dBm, *(whichever is greater)*
1 MHz - 4 MHz	–50 dBc
4 MHz - 10 MHz	–45 dBc

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AC flatness:

Frequency Range	Flatness
0.1 Hz - 100 kHz	0.05 dB
100 - 250 kHz	0.1 dB
1 kHz - 10 MHz	0.2 dB

Note: relative to 1 kHz with internal filters

Attenuator range: 0 to 30 dB in 0.01 steps

Attenuator error: 0 dB at max output level, 0.05 dB at other levels

Output filters (software selectable): 250 kHz, 5-pole Bessel; 10 MHz, 7-pole Bessel; no filter applied

Auxiliary Input/Output

VXI Local Bus: Data to DAC (**not** synchronized to time base and limited to 7.4 MSa/s typical), data to segment memory, waveform selection, phase modulation

Trigger sources: Auto, hold, software, VXI TTLTRG, VXI ECLTRG, or faceplate BNC

Faceplate Connectors

Ref/sample in BNC: Frequency reference, sample clock

Start arm in BNC: Start arm

Stop trig/FSK/gate in BNC: Trigger clock gate, Trigger stop, FSK

Marker out: Any point, start of sequence, sample clock, reference frequency, frequency/phase change

Digital port: Data to DAC or segment memory, waveform selection, phase modulation

VXI TTLTRG lines: Sample clock, gate, sweep arm/trigger, FSK input

VXI ECLTRG lines: Sample clock, reference frequency, start arm, all marker outputs

General Specifications

VXI Characteristics

VXI device type: Message based

Data transfer bus: A16, A32, D8/16/32 slave only

Size: C

Slots: 1

Connectors: P1/2

Shared memory: None

VXI busses: Local Bus A-row, Local Bus C-row, TTL Trigger Bus, ECL Trigger Bus

C-size compatibility: n/a

Instrument Drivers

See the Agilent Technologies Website (http://www.agilent.com/find/inst_drivers) for driver availability and downloading.

Command module firmware: n/a

Command module firmware rev: n/a

I-SCPI Win 3.1: n/a

I-SCPI Series 700: n/a

C-SCPI LynxOS: n/a

C-SCPI Series 700: n/a

Panel Drivers: Yes

VXI*plug&play* Win Framework: No

VXI*plug&play* Win 95/NT Framework: Yes

VXI*plug&play* HP-UX Framework: No

Module Current

	I_{PM}	I_{DM}
+5 V:	3.5	0.2
+12 V:	0.1	0.1
–12 V:	0.13	0.06
+24 V:	0.22	0.17
–24 V:	0.34	0.17
–5.2 V:	2.5	0.12
–2 V:	1.2	0.2

Cooling/Slot

Watts/slot: 44.00

ΔP mm H_2O: 0.50

Air Flow liter/s: 3.50

Ordering Information

Description	Product No.
C-Size Arbitrary Function Generator	E1445A
Service Manual	E1445A 0B3
Germany - German Localization	E1445A ABD
France - French Localization	E1445A ABF
Japan - Japanese Localization	E1445A ABJ
Backplane Connector Shield Kit	E1400-80920

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