# Agilent E1439C/D
# 95 MSa/s Digitizer with 70 MHz IF Input

Data Sheet

95Msa/s  ADC+
FILTER+ FIFO
70MHz IF INPUT

Access Overload

Intermodule ( ECL )

Clock

Sync

Ext Clock/Ref

Ext Trigger

Analog In

5Vrms  Max

Agilent
E1439C

VXI
bus

95Msa/s  ADC+
FILTER+ FIFO
70MHz IF INPUT

I/O
Data

XMT
RCV

Access Overload

XMT        RCV

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Agilent
E1439D

VXI
bus
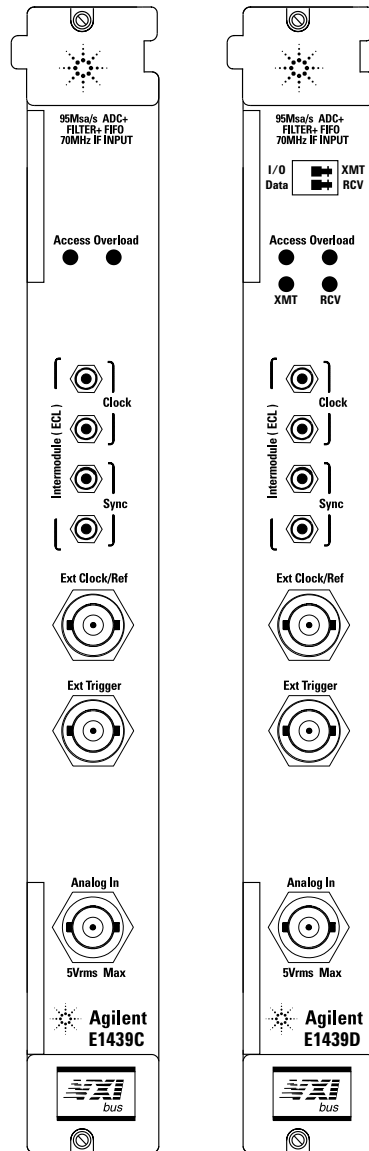
The Agilent E1439C/D is ideal for applications in RF signal acquisition, analysis, and high-resolution ATE. It has a baseband input and a 70 MHz IF input, both with 36 MHz bandwidth. The single-channel 95 MSa/s digitizer combines exceptional spurious-free dynamic range with alias-protected signal conditioning, center-frequency tunable digital filters, and a large signal capture memory, all in a single-wide C-size VXI module. The only difference between the C and D versions is the E1439D includes a 2.5 Gbit/sec optical front panel data port and support for the VXI local bus.

Agilent Technologies

# Specifications

**Input Specification**

| | |
|---|---|
| Input characteristics | BNC connector, shell grounded to chassis. |
| | 50 Ω impedance. |
| | dc coupled or ac coupled through 0.2 μF capacitor. |
| | Input signal can be switched to ground. |
| | 36 MHz anti-alias filter with bypass switch. |
| Input ranges | |
| Baseband path | One range, –21 dBm, 28.2 mVp |
| 70 MHz IF path | –36 dBm to +12 dBm, in 1 dB steps |
| | 5.02 mVp to 1.26 Vp, in 1 dB steps |
| ADC overload level | 0 dBfs (typical) |
| Maximum input power | +24 dBm |
| Return loss of 50 Ω input impedance | |
| Baseband path, 0.1 to 36 MHz | > 15 dB (1.4 : 1 VSWR) |
| 70 MHz IF path, 52 to 88 MHz | > 9 dB (2.1 : 1 VSWR) |
| Amplitude accuracy (power measurement, 0 to –40 dBfs, anti-alias filter on) | |
| Baseband path, at 10 MHz | ±0.7 dB |
| 70 MHz IF path, at 70 MH | ±1.5 dB |
| Flatness (excluding digital filter response) | |
| Baseband path, 0 to 36 MHz, relative to 10 MHz | +0.5, –1.2 dB |
| Baseband path, AAF off, at 100 MHz | –15 dB (typical) |
| 70 MHz IF path, 52 to 88 MHz, relative to 70 MHz | +0.5, –3.2 dB |
| Phase response deviation from linear phase (group delay) (excluding digital filter response) | |
| Baseband path, 10 to 36MHz | < 30 ns (typical) |
| 70 MHz IF path, 52 to 88 MH | < 120 ns (typical) |
| DC offset, baseband path | |
| Auto-zero accuracy | ±5% fs (typical) |
| Temperature drift | < ±0.1 mV/°C (typical) |
| Input bias current, baseband path | < 100 μA (typical) |
| IF filter and anti-alias filter stopband rejection (input range ≤ 0 dBm) | |
| Baseband path, 59 MHz to 200 MHz | > 65 dB |
| 70 MHz IF path, 0 to 43 MHz and 102 to 200 MHz | > 75 dB |

# Specifications (continued)

**Input Specification (continued)**

| | |
|---|---|
| Signal-to-noise ratio (full scale input, full bandwidth, excluding distortion, anti-alias filter on. See noise, distortion and spur specs.) | > 60 dB (typical) |

Input noise density (before applying amplitude flatness correction, anti-alias filter on, internal sample clock)

| | |
|---|---|
| Baseband path | |
| 100 kHz to 36 MHz | < –132 dBfs/Hz |
| 10 kHz to 100 kHz | < –130 dBfs/Hz |
| 1 kHz to 10 kHz | < –122 dBfs/Hz |
| 100 Hz to 1 kHz | < (–92 –10 LOG(f)) dBfs/Hz |
| Sensitivity | < –154 dBm/Hz (typical) |
| 70 MHz IF path | |
| 0 dBm range, 52 kHz to 88 MHz | < –132 dBfs/Hz |
| Sensitivity, on most sensitive range | < –163 dBm/Hz |

| | |
|---|---|
| Residual responses (with 50 Ω termination at input connector, in-band responses) | < –90 dBfs |

Harmonic distortion, aliased harmonic distortion, and spurious responses.
IF path input signal amplitudes ≤ 0 dBm.

| 20—30° C (add 3 dB at other temperatures) | 2nd order | 3rd order |
|---|---|---|
| IF path, input signals 0 to –9 dBfs | < –60 dBc | < –62 dBc |
| BB path, input signals 0 to –9 dBfs | < –63 dBc | < –65 dBc |
| Input signals –9 to –20 dBfs | < –68 dBc | < –70 dBc |
| Input signals < –20 dBfs | < –68 dBc or < –88 dBfs | < –70 dBc or < –90 dBfs |

Intermodulaton distortion
Two in-band signals 1 MHz apart, ≤ 0 dBm.
Measured in dBc, relative to one signal.
Includes $2^{nd}$ order and $3^{rd}$ order distortion
of the baseband path, and $3^{rd}$ order
distortion of the IF path (add 3 dB for
$2^{nd}$ order distortion of IF path).

| 20° C to 30° C (add 3 dB at other temperatures) | 2nd order | 3rd order |
|---|---|---|
| Each signal –6 to –14 dBfs | < –63 dBc | < –65 dBc |
| Each signal –14 to –20 dBfs | < –68 dBc | < –70 dBc |
| Each signal < –20 dBfs | < –68 dBc or < –88 dBfs | < –70 dBc or < –90 dBfs |
| $3^{rd}$ order distortion, each input –16 dBfs | –80 dBc (typical) | |

# Specifications (continued)

**Input Specification (continued)**

| | |
|---|---|
| Phase noise density (single sideband power density, absolute or residual. < 0.05G vibration, block data transfer mode, see Note 1.) | |
| Baseband path, 10 MHz signal | |
| $\Delta f$ = 10 kHz | < −128 dBc/Hz (typical) |
| $\Delta f$ = 1 kHz | < −120 dBc/Hz (typical) |
| $\Delta f$ = 100 Hz, residual only | < −110 dBc/Hz (typical) |
| IF path, 80 MHz signal | |
| $\Delta f$ = 10 kHz | < −110 dBc/Hz (typical) |
| $\Delta f$ = 1 kHz | < −102 dBc/Hz (typical) |
| $\Delta f$ = 100 Hz, residual only | < −92 dBc/Hz (typical) |

| | |
|---|---|
| Discrete sidebands (5 Hz to 100 kHz $\Delta f$, see Notes 1 and 2) | |
| Baseband path, 10 MHz signal | |
| $\Delta f$ > 20 kHz | < −90 dBc |
| $\Delta f$ < 20 kHz | < −90 dBc (typical, Note 1) |
| Inter-module clock via VXI lines | < −80 dBc (typical) |
| IF path, 80 MHz signal | |
| $\Delta f$ > 20 kHz | < −72 dBc |
| $\Delta f$ < 20 kHz | < −72 dBc (typical, Note 1) |

Note 1. Phase noise and sidebands performance at frequency offsets of less than 20 kHz may be degraded by noise and ripple on the VXI power supplies.

Note 2. Specifications for Dynamic Range, Spurious Responses and Sidebands require the mainframe containing the E1439C/D to have optional RFI backplane shields installed. They are not required for MFRAME1. In addition, all modules in the mainframe must comply with the VXI 1.4 specification for ECL trigger lines, the 10 MHz VXI system clock must be turned off, and the E1439C/D External Clock input must be disconnected when not being used. Dynamic range specifications require 24-bit data resolution, and the level of any External Clock or External Reference must be at least 0 dBm.

# Specifications (continued)

## Sample Clock and DSP Specifications

| | |
|---|---|
| Clock sources | |
| Internal sample clock frequency | 95 MSa/s |
| External reference for internal clock | 10 MHz |
| External sample clock frequency range | 10 MHz to 102.4 MHz, baseband only |

| | |
|---|---|
| Internal clock specifications | |
| Frequency accuracy, 0—40° C | ±7 ppm |
| Frequency accuracy, 40—55° C | ±10 ppm |
| External reference lock range | ±6 ppm (typical) |

| | |
|---|---|
| Clock input/output characteristics | |
| External sample clock/reference input | BNC connector. ac-coupled comparator with 1 KΩ impedance. Accepts TTL, ECL, or > −6 dBm sine waves |
| External trigger input | For ECL, the input is ac coupled, 1 kΩ, edge sensitive. For TTL, the input is dc coupled, 1 kΩ, TTL levels. (TTL trigger is currently only available on the E1439D.) |
| Inter-module front panel clock/sync | SMB connector, ECL-10K compatible |
| Inter-module VXI backplane clock/sync | VXI backplane ECLTRG lines |
| 10 MHz reference output | SMB connector +8 dBm |

| | |
|---|---|
| Multi-module sampling skew | |
| Within mainframe, uncorrected | < 10 ns (typical) |
| Between mainframes, 1meter cable, uncorrected | < 25 ns (typical) |
| Resolution of correction | 5 ps (nominal) |

| | |
|---|---|
| Digital decimation filters | 17 octave steps (40 MHz to 305 Hz), < 0.215 dB ripple, software correctable |

| | |
|---|---|
| Digital local oscillator | < 0.01 Hz tuning resolution |

## Regulatory Compliance

| | |
|---|---|
| Safety standards | Designed for compliance to EN 61010-1(1993) |

| | |
|---|---|
| Radiated emissions and immunity | EN 61326-1 (see Note 2, page 4) |

## Environmental

| | |
|---|---|
| Operating restrictions | |
| Maximum altitude | 4600 meters, above 2285 meters derate operating temperature by −3.6° C per 1000 meters |
| Ambient Temperature | 0—55° C |
| Humidity | 10—90% at 40° C, non-condensing |

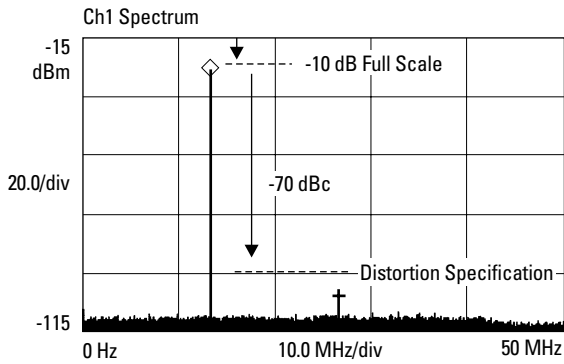## Optical serial front panel data port (E1439D only)

| | |
|---|---|
| Standard support | Draft standard VITA 17.1, 1 Gbit/sec and 2.5 Gbit/sec |

| | |
|---|---|
| Connector | Dual LC receptacle |

| | |
|---|---|
| Optical type | Multi-mode fiber, 850 mm wavelength |

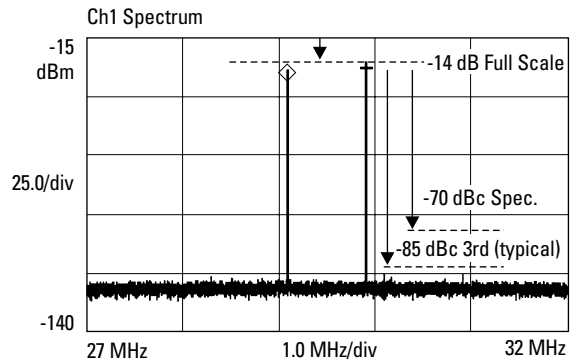| | |
|---|---|
| Maximum length | 100 meters |

# Typical Performance Charts

The following charts are included as supplemental, non-warranted characteristics

**Performance Benchmarks** (Benchmarks are included as supplemental, non-warranted characteristics)

| | |
|---|---|
| VXI/VME continous data transfer rate (From E1439C to MXI-II VXI controller, D32 VME word size) | 2.2 MBytes/s |
| Local bus data transfer rate (From E1439D to ideal consumer) | 63 MBytes/s |
| Library function control of module (MXI-II VXI controller) Measurement start Center frequency change (raw) | 8.5 μs 600 μs |

Ch1 Spectrum

-15 dBm

-10 dB Full Scale

20.0/div

-70 dBc

Distortion Specification

-115

0 Hz          10.0 MHz/div          50 MHz

**Harmonic Distortion performance with a −25 dBm 13 MHz signal on the −15 dBm range**

Ch1 Spectrum

-15 dBm

-14 dB Full Scale

25.0/div

-70 dBc Spec.

-85 dBc 3rd (typical)
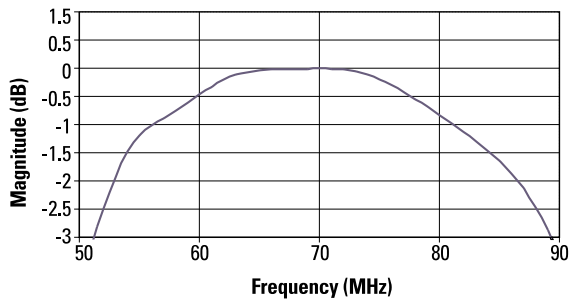
-140

27 MHz          1.0 MHz/div          32 MHz

**Intermodulation Distortion performance with two −14 dBfs tones near 30 MHz on the −15 dBm range**
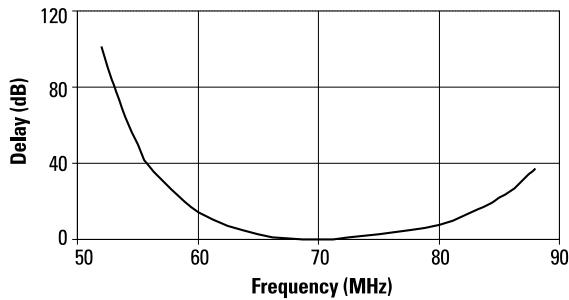
# Typical Performance Charts (continued)

The following charts are included as supplemental, non-warranted characteristics
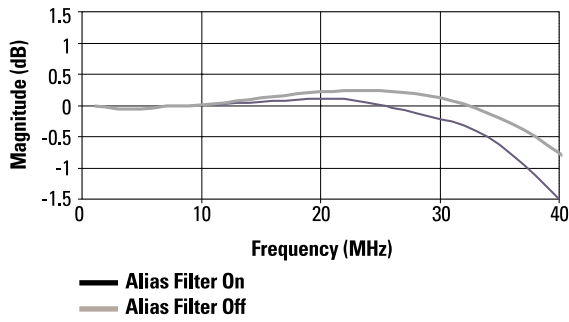


**Baseband Path Response versus Frequency**



**IF Path Response versus Frequency**



**IF Path Group Delay versus Frequency**

**General**

| VXI standard information | Conforms to VXI revision 1.4. See Note 1, page 4 concerning section B.8.6, Conducted Susceptibility.<br>C-size, single slot width.<br>Register based programming.<br>"Slave" Data Transfer Bus functionality.<br>A16 address capability.<br>D16/D32 data capability.<br>Local Bus capability.<br>Requires ECLTRG0 and ECLTRG1 lines for module synchronization. |
|---|---|

| VXI power requirements | dc Current | Dynamic Current |
|---|---|---|
| +5V (E1439C): | 5 A | 0.8 A |
| +5V (E1439D): | 7 A | 0.8 A |
| −5.2V: | 2 A | 0.1 A |
| −2V: | 1.0 A | 0.1 A |
| +12V: | 1 A | 0.3 A |
| −12V: | 0.4 A | 0.1 A |
| +24V: | 0.04 A | 0.06 A |
| −24V: | 0.04 A | 0.06 A |
| +5V Standby: | 0.0 A | 0.0 A |

| VXI cooling requirements | |
|---|---|
| E1439C | |
|   For 10° C rise above < 55° C: | 3.3 liters/second, 0.67 mm $H_2O$ |
|   For 15° C rise above < 50° C: | 2.2 liters/second, 0.30 mm $H_2O$ |
| E1439D | |
|   For 10° C rise above < 55° C: | 4.2 liters/second, 1.00 mm $H_2O$ |
|   For 15° C rise above < 50° C: | 2.8 liters/second, 0.50 mm $H_2O$ |

| Warm-up time | 15 Minutes |
|---|---|

| Calibration interval | 1 Year (no field adjustments) |
|---|---|

**Specification Note**
Specifications describe warranted performance over a temperature range of 0–55° C, after a 15-minute warm up from ambient conditions. Supplemental characteristics identified as "typical" and "characteristic" provide useful information by giving non-warranted performance parameters. Typical performance is applicable from 20–30° C.

**Warranty**
This product is distributed, warranted, and supported by Agilent Technologies.

The E1439C/D comes with a 1-year warranty. During that period, the unit will either be replaced or repaired, at Agilent Technologies' option, and returned to the customer without charge.

**Ordering Information**

| | |
|---|---|
| E1439C/D | 95 MSa/s AD with filter and memory |
| E1439C/D-001 | 1.2 GB FIFO memory |
| E1439C/D-144 | 144 MB FIFO memory |
| E1439C/D-288 | 288 MB FIFO memory |

**Product Web site**

For the most up-to-date and complete application and product information, please visit our product Web site at:
**www.agilent.com/find/vxi**

Agilent Communications Intelligence Information:
**www.agilent.com/find/AD**

## Abbreviations

**Fs**  sample rate of DAC

**Fc**  cut off frequency of high pass or low pass filters

**dBfs**  dB relative to full scale amplitude range

**dBc**  dB relative to carrier amplitude

**Typical**  Typical, non-warranted, performance specification included to provide general product information

## Related Literature

| Publication Title | Publication Type | Publication Number |
|---|---|---|
| E1437A 20 MSample/Second ADC with Filter and FIFO | Product Overview | 5965-6893E |
| E1437A 20 MSample/Second ADC with Filter and FIFO | Technical Specifications | 5965-9774E |
| E1438C/D 100 MSample/Second Digitizer with DSP and Memory | Product Overview | 5968-7348E |
| E1438C/D 100 MSample/Second Digitizer with DSP and Memory | Data Sheet | 5968-8233E |
| E1439C/D VXI 70 MHz IF ADC with Filters and Memory | Product Overview | 5980-1261E |
| E9830A Delay Memory Module | Product Overview | 5968-7349E |
| Agilent Test System and VXI | Products Catalog | 5980-0307E |

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