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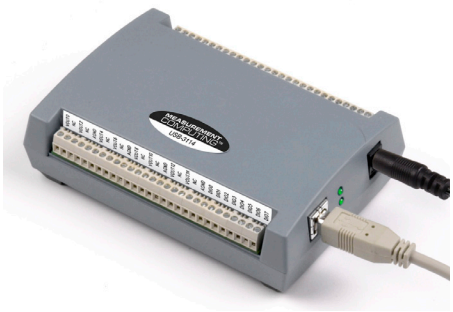
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Find the *Measurement Computing USB-3114* at our website: *Click HERE*

USB-3100 Series

USB Voltage and Current Output



The USB-3100 Series provides up to 16 voltage/current output channels, with some devices offering high-drive analog outputs.



The USB-3101FS includes 4 simultaneous output channels with 250 Vrms channel-to-ground isolation.

Features

- 4, 8, or 16 analog outputs
- 16-bit resolution
- Update rates from 100 S/s to 100 kS/s
- 4, 8, or 16 analog current outputs available
- High-drive output available
- Digital I/O, counter/timer available
- Synchronous update available

Supported Operating Systems

- Windows® 10/8/7/Vista®XP 32/64-bit
- Linux® (except for USB-3101FS)

Overview

The USB-3100 Series are voltage and current output USB 2.0 full-speed devices.

Each device provides four, eight, or 16 voltage outputs. The USB-3102/3104/3106 also provide four, eight, or 16 current outputs. All devices provide synchronous and concurrent voltage updates. All USB-3100 Series devices except the USB-3101FS provide eight digital I/O lines and one 32-bit event counter.

Analog Output

All USB-3100 Series devices provide either four, eight, or 16 channels of 16-bit analog output.

USB-3101FS: Each channel has a fixed ±10 V voltage output range. Outputs can be updated individually or simultaneously. Each channel has a D/A converter (DAC) that produces a voltage signal. Each channel also has ±30 V overvoltage and indefinite short-circuit protection. The USB-3101FS has 250 Vrms channel-to-ground isolation that protects the device and computer from ground spikes and ensures a reliable data stream, making it suitable for high-voltage applications.

All Other USB-3100 Series Devices: Each channel is software-selectable for either a bipolar voltage output range of ±10 V or a unipolar range of 0 V to 10 V. Channel outputs can be updated individually or simultaneously.

Current Output (USB-3102/3104/3106 Only)

These devices provide 0 mA to 20 mA of current output. Each DAC controls a voltage/current channel pair simultaneously. Each channel pair can be updated individually or simultaneously.

Synchronous DAC Updates

All USB-3100 Series devices except the USB-3101FS have a synchronous DAC load connection pin that simultaneously updates DAC outputs on multiple devices. You can configure this with software as an input (slave mode) or as an output (master mode).

Digital I/O

All USB-3100 Series devices except the USB-3101FS have eight bidirectional DIO lines. All digital pins are floating by default. A screw terminal connection is provided to configure for pull-up (+5 V) or pull-down (0 V).

Counter Input

Each USB-3100 Series device except for the USB-3101FS has a 32-bit event counter for counting TTL pulses. The counter increments when the TTL levels transition from low to high. The counter accepts frequency inputs of up to 1 MHz.

USB-3100 Series Selection Chart

Model	Voltage Output	Update Rate	Current Output	DIO	Counter/ Timer	Isolation
USB-3101	4	100 S/s	—	8	1	—
USB-3102	4	100 S/s	4	8	1	—
USB-3103	8	100 S/s	—	8	1	—
USB-3104	8	100 S/s	8	8	1	—
USB-3105	16	100 S/s	—	8	1	—
USB-3106	16	100 S/s	16	8	1	—
USB-3110	4 high-drive	100 S/s	—	8	1	—
USB-3112	8 high-drive	100 S/s	—	8	1	—
USB-3114	16 high-drive	100 S/s	—	8	1	—
USB-3101FS	4	100 kS/s	—	—	—	250 Vrms ch-to-gnd

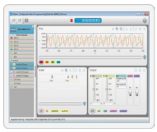
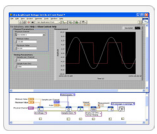
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USB-3100 Series

Software

Software Support

The USB-3100 Series is supported by the software in the table below.

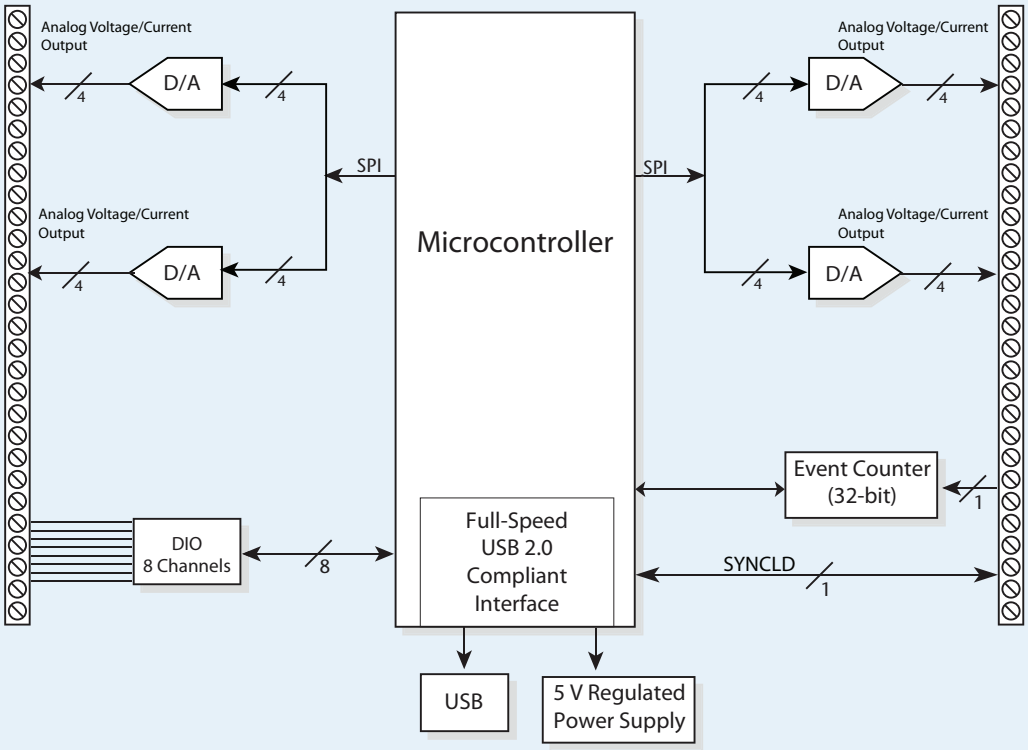
Ready-to-Run Applications		
DAQami™		Data acquisition companion software with drag-and-drop interface that is used to acquire, view, and log data, and generate signals. DAQami can be configured to log analog, digital, and counter channels, and to view that data in real-time or post-acquisition on user-configurable displays. Logged data can be exported for use in Excel® or MATLAB®. Windows OS DAQami is included with the free MCC DAQ Software bundle. Install DAQami and try the fully-functional software for 30 days. After 30 days, all features except for data logging and data export will continue to be available – data logging and data export features can be unlocked by purchasing the software.
InstaCal™		An interactive installation, configuration, and test utility for MCC hardware. Windows OS InstaCal is included with the free MCC DAQ Software bundle.
TracerDAQ™ and TracerDAQ Pro		Virtual strip chart, oscilloscope, function generator, and rate generator applications used to generate, acquire, analyze, display, and export data. Supported features may vary by hardware. The Pro version provides enhanced features. Windows OS TracerDAQ is included with the free MCC DAQ Software bundle. TracerDAQ Pro is available as a purchased software download.
General-Purpose Programming Support		
Universal Library™ (UL) for Windows		Library for developing applications in C, C++, VB, C# .Net, VB .Net, and Python on Windows. The UL for Windows is included with the free MCC DAQ Software bundle. The UL Python API for Windows is available on GitHub (github.com/mccdaq/mcculw).
UL for Linux® (except for the USB-3101FS)		Library for developing applications in C, C++, and Python on Linux. UL for Linux is available on GitHub (github.com/mccdaq/uldaq). Open-source, third-party Linux drivers are also available for supported MCC devices.
Application-Specific Programming Support		
ULx for NI LabVIEW™		A comprehensive library of VIs and example programs for NI LabVIEW that is used to develop custom applications that interact with most MCC devices. Windows OS ULx for NI LabVIEW is included with the free MCC DAQ Software bundle.
DASYLab®		Icon-based data acquisition, graphics, control, and analysis software that allows users to create complex applications in minimal time without text-based programming. Windows OS DASYLab is available as a purchased software download. An evaluation version is available for 28 days.
MATLAB® driver (except for the USB-3101FS)		High-level language and interactive environment for numerical computation, visualization, and programming. The Mathworks Data Acquisition Toolbox™ allows users to acquire data from most MCC PCI and USB devices. Visit www.MathWorks.com for more information about the Data Acquisition Toolbox.

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USB-3106 Block Diagram

With 16 channels of analog voltage/current output, the USB-3106 contains a superset of the analog output features of these USB-3100 Series devices:

- USB-3101: 4 voltage output channels
- USB-3102: 4 voltage/current output channels
- USB-3103: 8 voltage output channels
- USB-3104: 8 voltage/current output channels
- USB-3105: 16 voltage output channels

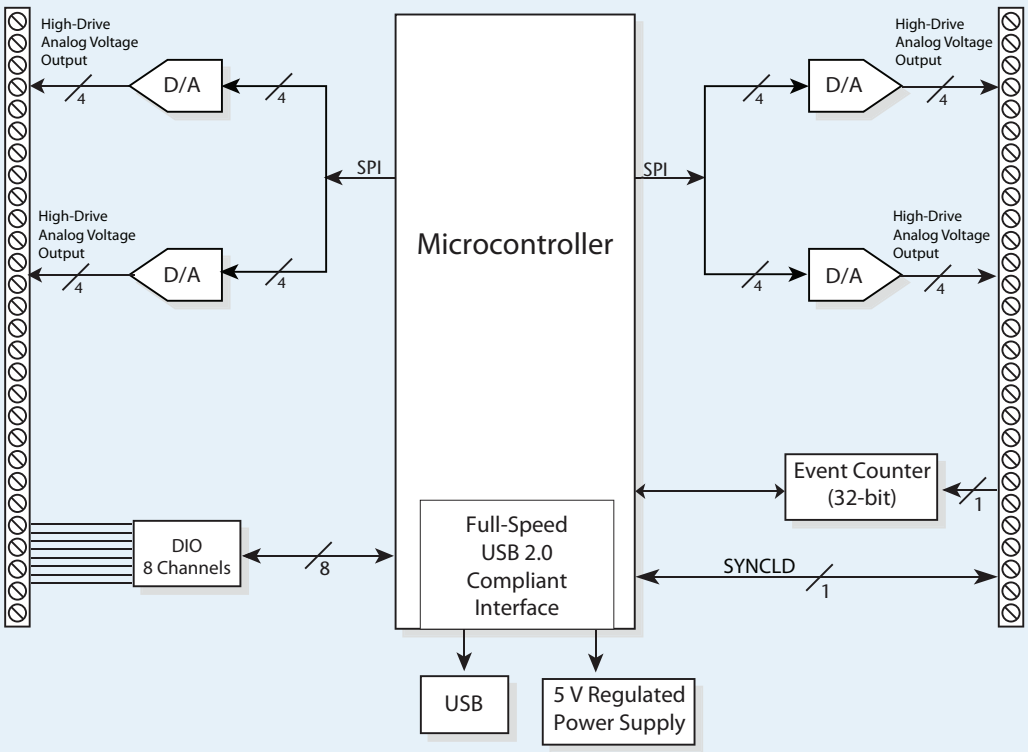


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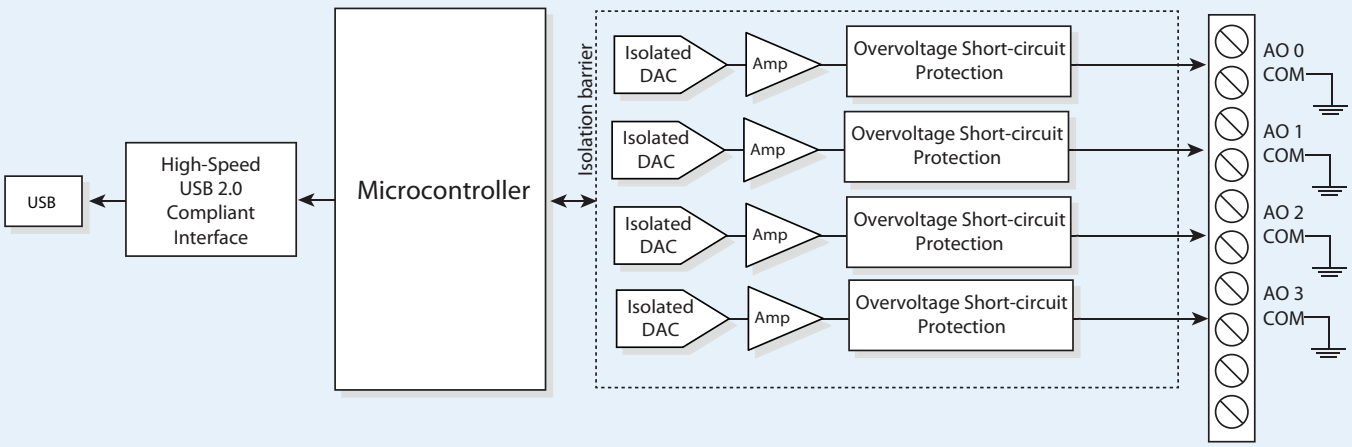
USB-3114 Block Diagram

With 16 channels of high-drive analog voltage output, the USB-3114 contains a superset of the analog output features of these USB-3100 Series devices:

- USB-3110: 4 voltage output channels
- USB-3112: 8 voltage output channels



USB-3101FS Block Diagram



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Specifications – all devices except USB-3101FS

Analog Voltage Output

D/A Converter: DAC8554
Number of Channels
USB-3101/3102/3110: 4
USB-3103/3104/3112: 8
USB-3105/3106/3114: 16
On the USB-3102/3104/3106, each DAC8554 output controls a voltage and current output channel-pair simultaneously. Writing to voltage channel 0 also updates current channel 0; conversely, writing to current channel 0 also updates voltage channel 0. Disconnect unused voltage and current output channels.
Resolution: 16 bits
Output Ranges (Software-Selectable)
Calibrated: ±10 V, 0 V to 10 V
Uncalibrated: ±10.2 V, –0.04 V to 10.08 V
Output Transient
±10 V to (0 V to 10 V) or (0 V to 10 V) to ±10 V Range Selection: The output defaults to 0 V when the output voltage range is reconfigured, the host computer is reset, shut down, or suspended, or a reset command is issued to the device.
Duration: 5 µs typ
Amplitude: 5 V p-p typ
Host Computer is Reset, Powered On, Suspended, or a Reset Command is Issued to Device: The duration depends on the enumeration process of the host computer. Typically, the output is stable after two seconds.
Duration: 2 s typ
Amplitude: 2 V p-p typ
Initial Power On
Duration: 50 ms typ
Amplitude: 5 V peak typ
Differential Nonlinearity: The max specification applies to the operating temperature range, and accounts for max errors due to the software calibration algorithm (Cal mode) and DAC8554 nonlinearities
Calibrated: ±1.25 LSB typ, –2 LSB to +1 LSB max
Uncalibrated: ±0.25 LSB typ, ±1 LSB max
Output Current
VOUTx Pins
USB-3101 through USB-3106: ±3.5 mA typ
USB-3110: ±40 mA max
USB-3112/3114: ±40 mA max single channel, ±180 mA total load current
Output Short-Circuit Protection
VOUTx Connected to AGND
USB-3101 through USB-3106: Indefinite
USB-3110/3112/3114: ±100 ms max
Output Coupling: DC
Power On and Reset State
DACs Cleared to Zero-Scale: 0 V, ±50 mV typ
Output Range: 0 V to 10 V
Output Noise
0 V to 10 V Range: 14.95 µVrms typ
±10 V Range: 31.67 µVrms typ
Settling Time
To 1 LSB Accuracy: 25 µS typ
Slew Rate
USB-3101 Through USB-3106
0 V to 10 V Range: 1.20 V/µS typ
±10 V Range: 1.20 V/µS typ
USB-3110/3112/3114
0 V to 10 V Range: 2.0 V/µS typ
±10 V Range: 4.0 V/µS typ
Throughput
Single-channel: 100 Hz max, system-dependent
Multichannel: 100 Hz/#ch max, system-dependent

Absolute Accuracy Components – Calibrated Output

Range (V)	% of Reading	Offset (mV)	Temp. Drift (%/°C)	Absolute Accuracy at FS
±10	±0.0183	±1.831	0.00055	±3.661 mV
0 to 10	±0.0183	±0.915	0.00055	±2.746 mV

Absolute Accuracy – Calibrated Output
±10 V: ±4.0 LSB
0 V to 10 V: ±22.0 LSB
Relative Accuracy (±LSB)
±10 V , 0 V to 10 V: 4.0 typ, 12.0 max

Analog Current Output (USB-3102/3104/3106)

Number of Channels
USB-3102: 4
USB-3104: 8
USB-3106: 16
Each DAC8554 output controls a voltage and current output channel-pair simultaneously. Writing to voltage channel 0 also updates current channel 0; conversely, writing to current channel 0 also updates voltage channel 0. Disconnect unused voltage and current output channels.
Resolution: 16 bits
Output Ranges
Calibrated: 0 mA to 20 mA typ
Uncalibrated: 0 mA to 25 mA typ
Compliance voltage range (calibrated output): 8 V min, 36 V max. Formulas to calculate the max load resistance for current output circuit operation:
Calibrated output: Load Resistance = (compliance voltage – 6 V)/0.020 A
Uncalibrated output: Load Resistance = (compliance voltage – 6 V)/0.025 A
Differential Nonlinearity
Calibrated: ±1.25 LSB typ, –2 LSB to 1 LSB max
Uncalibrated: ±0.25 LSB typ, –1 LSB to 1 LSB max
The max specification applies to the entire operating temperature range, and accounts for max errors due to the software calibration algorithm (in calibrated mode only) and the DAC8554 nonlinearities.
Absolute accuracy: ±0.05% of full-scale range (compliance voltage = 13 V, load resistance = 100 Ω)
IOUTx leakage current: 100 nA typ for each individual IOUT channel (all zeros written to IOUTx channel
Settling time: 25 µS typ (full scale step to 1 LSB accuracy; compliance voltage = 12 V, load resistance = 500 Ω
Throughput
Single-channel: 100 Hz max, system-dependent
Multichannel: 100 Hz/#ch max, system-dependent

Analog Output Calibration

Recommended Warm-Up Time: 15 minutes min
Onboard Precision Reference
DC Level: 5.000 V ±1 mV max.
Tempco: ±10 ppm/°C max.
Long-Term Stability: ±10 ppm/SQRT(1000 hrs)
Calibration Method
USB-3101 Through USB-3106: Software calibration
USB-3110/3112/3114: SW calibration (V_{OUTx} R_{load} = 20 mA fixed resistive load)
Calibration Interval: 1 year

Digital I/O

Digital Logic Type: CMOS
Number of I/O: 8
Configuration: Independently-configured for input or output
Pull-Up/Pull-Down Configuration: Software-selectable; all pins floating (default)
For pull-down, connect the DIO CTL pin to a DGND pin. For pull-up, connect the DIO CTL pin to the +5 V pin.
Digital I/O Input Loading: TTL (default); 47 kΩ (pull-up/pull down configurations)
Digital I/O Transfer Rate (System-Paced): System-dependent, 33 to 1000 port reads/writes or single bit reads/writes per second.
Input High Voltage: 2.0 V min, 5.5 V absolute max
Input Low Voltage: 0.8 V max, –0.5 V absolute min
Output High Voltage (IOH = –2.5 mA): 3.8 V min
Output Low Voltage (IOL = 2.5 mA) : 0.7 V max
Power On and Reset State: Input

Synchronous DAC Load

Pin name: SYNCLD, Schmitt trigger input, over-current protected with a 200 Ω series resistor.
Power On and Reset State: Input
Pin Type: Bidirectional; output the internal D/A LOAD signal, or receive the D/A LOAD signal from an external source.
Termination: Internal 100 kΩ pull-down
Input Clock Rate: 100 Hz max

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Clock Pulse Width
Input: 1 µs min
Output: 5 µs min
Input Leakage Current: ±1.0 µA typ
Input High Voltage: 4.0 V min, 5.5 V absolute max
Input Low Voltage: 1.0 V max, –0.5 V absolute min
Output High Voltage
IOH = –2.5 mA: 3.3 V min
No Load: 3.8 V min
Output Low Voltage
IOL = 2.5 mA: 1.1 V max
No Load: 0.6 V max
When set for input, the analog outputs can be updated immediately or when a positive edge is detected with software. SYNCLD must be at a low logic level for DAC outputs to be updated immediately. If an external source is pulling the pin high, no update occurs.

Counter

Pin Name: CTR
Number of Channels: 1
Resolution: 32-bits
Counter Type: Event counter
Input Type: TTL, rising edge triggered
Counter Read/Write Rates (Software-Paced)
Counter Read/Write: System dependent, 33 to 1000 reads per second
Schmidt Trigger Hysteresis: 20 mV to 100 mV
Input Leakage Current: ±1.0 µA typ
Input Frequency: 1 MHz max
High Pulse Width: 500 nS min
Low Pulse Width: 500 ns min
Input High Voltage: 4.0 V min, 5.5 V absolute max
Input Low Voltage: 1.0 V max, –0.5 V absolute min

Environmental

Operating temperature
USB-3101/3103/3105: 0 ˚C to 70 ˚C
All other devices: 0 ˚C to 50 ˚C
Storage temperature: –40 ˚C to 85 ˚C
Relative humidity (RH): 0% to 90% RH, noncondensing

Power

Supply current (USB enumeration): <100 mA
Supply current (quiescent): Total quiescent current requirement includes up to 10 mA for the status LED. This does not include any potential loading of the digital I/O bits, +5 V user terminal, or the VOUTx outputs.
USB-3101/3102: 140 mA typ
USB-3103/3104/3110: 160 mA typ
USB-3105/3106: 200 mA typ
USB-3112: 225 mA max
USB-3114: 355 mA max
+5 V user output voltage range: 4.5 V to 5.25 V (USB power is within specified limits)
+5 V user output current: 10 mA max (total current sourced from the +5V for general use; includes any additional contribution due to DIO loading.
USB-3102/3104/3106
ITEST output voltage range: 13 V, ±1% typ
ITEST output current: 30 mA max
Refers to the total maximum amount of current that can be sourced from the ITEST user terminal, which should only be used for biasing individual IOUTx outputs to facilitate functional testing. Place a load resistor of 100 Ω between the ITEST pin and the IOUTx pin for proper operation)
External power (USB-3110/3112/3114 only)
Output voltage: 5 V, ±5%
Output wattage: 10 W
Power jack configuration: Two conductor
Power jack barrel diameter: 6.3 mm
Power Jack pin diameter: 2.0 mm
Power jack polarity: Center positive

Mechanical

Dimensions (L × W × H): 127.0 × 88.9 × 35.6 mm (5.0 × 3.5 × 1.4 in.)

Specifications – USB-3101FS

Analog Voltage Output

Number of Channels: 4
D/A Converter Resolution: 16 bit
D/A Converter Type: String
Output Range: ±10 V
Power On Voltage: 0 V
Operating Voltage: ±10.7 V nominal, ±10.3 V min, ±11 V max
Current Drive: ±1 mA per channel max
Output Impedance: 0.1 Ω
Stability:
Offset Drift: ±80 µV/ºC
Gain Drift: 6 ppm/ ºC
Protection
Overvoltage: ±30 V
Short-Circuit: Indefinitely
Update Time
One Channel: 3 µs
Two Channels: 5 µs
Three Channels: 7.5 µs
Four Channels: 9.5 µs
Update Rate: 100 kS/s per channel max
Noise: 260 µVrms
Slew Rate: 4 V/µs
Crosstalk: 76 dB
Settling Time:
100 pF Load to 1 LSB
FS Step: 20 µs
3 V Step: 10 µs
0.1 V Step: 8 µs
Glitch Energy
256 Steps, Worst Case: 2 mV for 2 µs
Capacitive Drive: 1,500 pF min

Monotonicity: 16 bits
Differential Nonlinearity: –1 to 2 LSBs max
Integral Nonlinearity (Endpoint): 16 LSBs max

Accuracy		
Measurement Conditions	**% of Reading**	**% of Range (Range is Equal to ±10.7 V)**
Calibrated, max (–40 to 70 ºC)	0.35%	0.75%
Calibrated, typ (25 ºC, ±5 ºC)	0.01%	0.1%
Uncalibrated, max (–40 to 70 ºC)	2.2%	1.7%
Uncalibrated, typ (25 ºC, ±5 ºC)	0.3%	0.25%

Environmental

Operating temperature: –40 ˚C to 70 ˚C
Storage temperature: –40 ˚C to 85 ˚C
Operating humidity: 10% to 90% RH non-condensing
Storage humidity: 5% to 95% RH non-condensing

Power

Power consumption: 625 mW max
Thermal dissipation at 70 ˚C: 625 mW max

Mechanical

Dimensions (L × W × H): 114.3 × 139.7 × 38.1 mm (4.5 × 5.5 × 1.5 in.)
Weight: 544 g (1.2 lb)

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Ordering Information

Hardware

Part No.	Description
USB-3101FS	USB-based four-channel, 16-bit, 100 kS/s, simultaneously updating analog output device with USB cable
USB-3101	USB-based four-channel, 16-bit, analog voltage output device with one 32-bit counter, eight DIO lines, and USB cable
USB-3102	USB-based four-channel, 16-bit, analog voltage/current output device with one 32-bit counter, eight DIO lines, and USB cable
USB-3103	USB-based eight-channel, 16-bit analog voltage output device with one 32-bit counter, eight DIO lines, and USB cable
USB-3104	USB-based eight-channel, 16-bit analog voltage/current output device with one 32-bit counter, eight DIO lines, and USB cable
USB-3105	USB-based 16-channel, 16-bit voltage output device with one 32-bit counter, eight DIO lines, and USB cable
USB-3106	USB-based 16-channel, 16-bit voltage/current output device with one 32-bit counter, eight DIO lines, and USB cable
USB-3110	USB-based four-channel, 16-bit high-drive analog output device with one 32-bit counter, eight DIO lines, USB cable, and PS-5V2AEPS power supply
USB-3112	USB-based eight-channel, 16-bit high-drive analog output device with one 32-bit counter, eight DIO lines, USB cable, and PS-5V2AEPS power supply
USB-3114	USB-based 16-channel, 16-bit high-drive analog output device with one 32-bit counter, eight DIO lines, USB cable, and PS-5V2AEPS power supply

Accessories and Cables (for USB-3101FS only)

ACC-107	Backshell with 10-position connector block (quantity 1)
ACC-121	10-position detachable screw terminal connector blocks (quantity 10)

Software also Available from MCC

Part No.	Description
DAQami	Data acquisition companion software for acquiring data and generating signals
TracerDAQ Pro	Out-of-the-box virtual instrument suite with strip chart, oscilloscope, function generator, and rate generator – professional version
DASYLab	Icon-based data acquisition, graphics, control, and analysis software

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