

USB-3101FS

Analog Voltage Output

User's Guide



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COMPUTING™**

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About this User's Guide

What you will learn from this user's guide

This user's guide explains how to install, configure, and use the USB-3101FS so that you get the most out of its analog output features.

This user's guide also refers you to related documents available on our web site, and to technical support resources.

Conventions in this user's guide

For more information on ...

Text presented in a box signifies additional information and helpful hints related to the subject matter you are reading.

Caution! Shaded caution statements present information to help you avoid injuring yourself and others, damaging your hardware, or losing your data.

<#:#> Angle brackets that enclose numbers separated by a colon signify a range of numbers, such as those assigned to registers, bit settings, etc.

bold text **Bold** text is used for the names of objects on the screen, such as buttons, text boxes, and check boxes. For example:
1. Insert the disk or CD and click the **OK** button.

italic text *Italic* text is used for the names of manuals and help topic titles, and to emphasize a word or phrase. For example:
The *InstaCal* installation procedure is explained in the *Quick Start Guide*.
Never touch the exposed pins or circuit connections on the board.

Where to find more information

The following electronic documents provide helpful information relevant to the operation of the USB-3101FS.

- MCC's *Specifications: USB-3101FS* (the PDF version of the *Specifications* chapter in this guide) is available on our web site at www.mccdaq.com/pdfs/USB-3101FS.pdf.
- MCC's *Quick Start Guide* is available on our web site at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.
- MCC's *Guide to Signal Connections* is available on our web site at www.mccdaq.com/signals/signals.pdf.
- MCC's *Universal Library User's Guide* is available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-user-guide.pdf.
- MCC's *Universal Library Function Reference* is available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-functions.pdf.
- MCC's *Universal Library for LabVIEW™ User's Guide* is available on our web site at www.mccdaq.com/PDFmanuals/SM-UL-LabVIEW.pdf.

USB-3101FS User's Guide (this document) is also available on our web site at www.mccdaq.com/PDFmanuals/USB-3101FS.pdf.

Safety guidelines

You can connect hazardous voltages to the USB-3101FS screw terminals. A hazardous voltage is a voltage greater than $42.4 V_{pk}$ or 60 VDC to earth ground. Take the following precautions if you connect hazardous voltages to the USB-3101FS:

- Caution!** Ensure that hazardous voltage wiring is performed only by qualified personnel adhering to local electrical standards.
- Caution!** Do *not* mix hazardous voltage circuits and human-accessible circuits on the same device.
- Caution!** Make sure that devices and circuits connected to the USB-3101FS are properly insulated from human contact.
- Caution!** When device terminals are hazardous voltage LIVE ($>42.4V_{pk}/60$ VDC), ensure that devices and circuits connected to the USB-3101FS are properly insulated from human contact. Use the ACC-107 backshell with 10-position connector block to ensure that the terminals are not accessible.

Introducing the USB-3101FS

Overview: USB-3101FS features

This user's guide contains all of the information you need to connect the USB-3101FS to your computer and to the signals you want to control.

The USB-3101FS is a USB 2.0 full-speed device that is supported under popular Microsoft® Windows® operating systems. The USB-3101FS is fully compatible with both USB 1.1 and USB 2.0 ports.

The USB-3101FS is a 16-bit, 4-channel, 100 kS/s analog output device. The output range is ± 10 V.

All signal connections are made to detachable screw terminals. The USB-3101FS is powered by the +5 volt USB supply from your computer. No external power is required.

USB-3101FS block diagram

USB-3101FS functions are illustrated in the block diagram shown here.

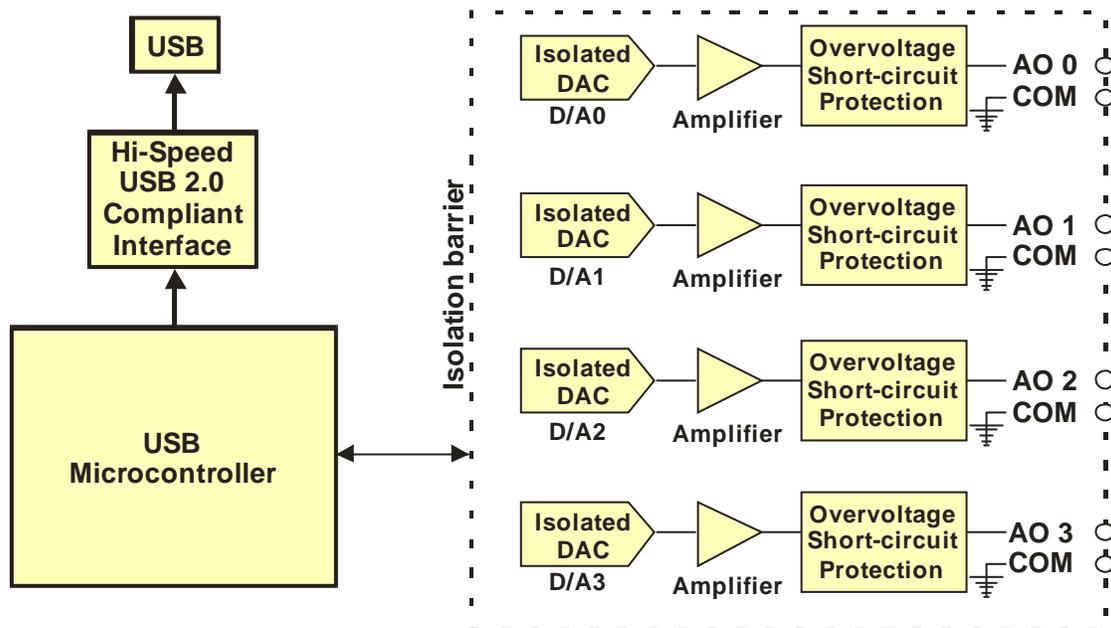


Figure 1. USB-3101FS functional block diagram

Software features

For information on the features of *InstaCal* and the other software included with your USB-3101FS, refer to the *Quick Start Guide* that shipped with your device. The *Quick Start Guide* is also available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.

Check www.mccdaq.com/download.htm for the latest software version.

Installing the USB-3101FS

What comes with your USB-3101FS shipment?

The following items are shipped with the USB-3101FS.

Hardware

- USB-3101FS



- USB cable (2 meter length)



Additional documentation

In addition to this hardware user's guide, you should also receive the *Quick Start Guide* (available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf). This booklet supplies a brief description of the software you received with your USB-3101FS and information regarding installation of that software. Please read this booklet completely before installing any software or hardware.

Optional accessories

- ACC-107 — backshell with 10-position connector block (quantity 1). Additional details are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=586&pf_id=1871.
- ACC-121 — 10-position detachable screw terminal connector block (quantity 10). Additional details are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=586&pf_id=1872.

Unpacking the USB-3101FS

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the USB-3101FS from its packaging, ground yourself using a wrist strap or by simply touching the computer chassis or other grounded object to eliminate any stored static charge.

If your USB-3101FS is damaged, notify Measurement Computing Corporation immediately by phone, fax, or e-mail.

- Phone: 508-946-5100 and follow the instructions for reaching Tech Support.
- Fax: 508-946-9500 to the attention of Tech Support
- Email: techsupport@mccdaq.com

For international customers, contact your local distributor where you purchased the USB-3101FS. Click on this link www.measurementcomputing.com/sales.asp to locate your distributor.

Installing the software

Refer to the *Quick Start Guide* for instructions on installing the software on the *Measurement Computing Data Acquisition Software CD*. This booklet is available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.

Installing the hardware

Install the MCC DAQ software before you install your board

The driver needed to run your board is installed with the MCC DAQ software. Therefore, you need to install the MCC DAQ software before you install your board. Refer to the *Quick Start Guide* for instructions on installing the software.

Be sure you are using the latest system software

Before you install your USB-3101FS, run Windows Update to update your operating system with the latest USB drivers.

To connect the USB-3101FS to your system, turn your computer on, and connect the USB cable to a USB port on your computer or to an external USB hub that is connected to your computer. The USB cable provides power and communication to the USB-3101FS.

When you connect the USB-3101FS for the first time, a series of **Found New Hardware** popup balloons (Windows XP) or dialogs (other Windows versions) open as the USB-3101FS is detected by your computer. When the last balloon or dialog closes, the installation is complete. The LED on the USB-3101FS blinks steadily to indicate that the device is initialized and receiving power.

Caution! Do not disconnect **any** device from the USB bus while the computer is communicating with the USB-3101FS, or you may lose data and/or your ability to communicate with the USB-3101FS.

Allow the USB-3101FS to operate for at least 30 minutes before using the device. This warm up time is required to achieve the specified rated accuracy of measurements.

Calibrating the USB-3101FS

The USB-3101FS is shipped fully calibrated. Calibration coefficients are stored in EEPROM. Return the device to Measurement Computing Corporation when calibration is required. The normal calibration interval is once per year.

Functional Details

Components

The USB-3101FS has the following external components:

- Screw terminal connectors
- USB port
- LED
- Strain relief slot for USB cable

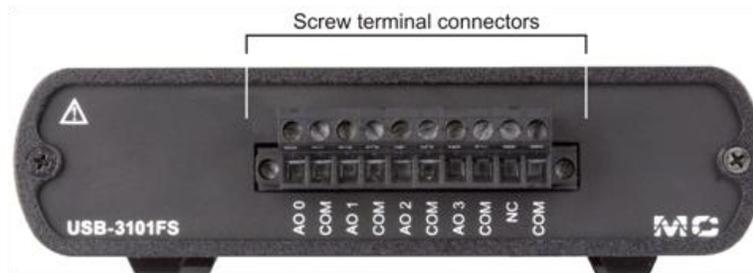


Figure 2. Front panel (Screw terminal connections)

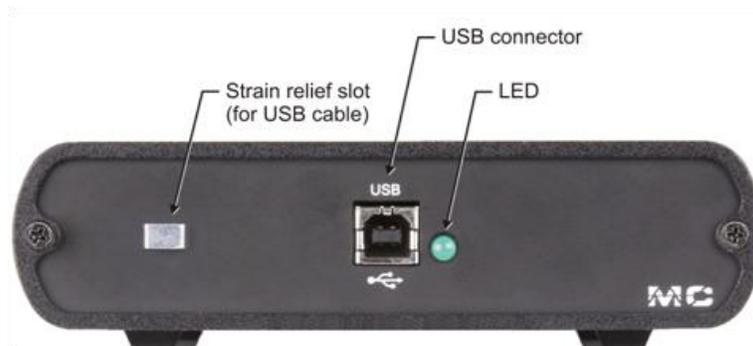


Figure 3. Rear panel (USB connection and LED)

Screw terminals

The USB-3101FS has a ten-position detachable screw terminal block that provide connections for four analog output channels. Signal assignments are listed in the following table.

Screw terminal pin assignments

Terminal	Signal
0	AO 0
1	Common (COM)
2	AO 1
3	Common (COM)
4	AO 2
5	Common (COM)
6	AO 3
7	Common (COM)
8	NC (No connection)
9	Common (COM)

Connect the positive lead of a voltage signal to the A0 terminals. Use 12 AWG to 24 AWG wires to connect the signals. Common terminals (COM) are internally connected to the isolated ground reference of the device.

Analog outputs (AO 0 to AO 3)

The voltage output range for each channel is set at ± 10 V. The channel outputs may be updated individually or simultaneously.

USB connector

The USB connector provides +5 V power and communication. The voltage supplied through the USB connector is system-dependent, and may be less than 5 V. No external power supply is required.

LED

The LED indicates the device status. It uses up to 5 mA of current and cannot be disabled. Refer to the following table for the possible LED states.

LED States

LED State	Device status
Not lit	The device is not connected to a USB port or hub.
Continuous single-blink	The device is operating normally.
Continuous double-blink	The device is connected to a USB 1.1 Full-Speed port or hub, which may affect performance. Optimum performance requires connections to a USB 2.0 Hi-Speed host controller (480 Mbps) and USB 2.0 high-speed hubs.

Strain relief slot for USB cable

Use the strain relief slot to keep the USB cable from disconnecting from the device inadvertently. Feed a tie wrap through the slot and secure to the USB cable when it is connected to the device.

High-voltage applications

For high voltage applications, we recommend using the ACC-107 backshell with ten-position connector block to ensure that the terminals are not accessible. The backshell also provides strain relief to protect the screw terminals.

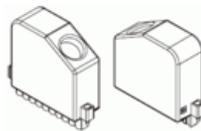


Figure 4. ACC-107 backshell with ten-position connector block

Additional details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=586&pf_id=1871.

Connecting a load

Connect the positive lead of the load to the AO terminal, and the ground of the load to the COM terminal.

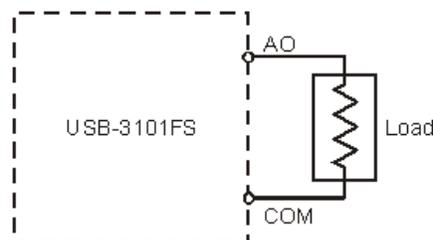


Figure 5. Connecting a load to the device

Analog output circuitry

The USB-3101FS channels share a common ground that is isolated from the system. Each channel has a digital-to-analog converter (DAC) that produces a voltage signal.

Each channel also has ± 30 V overvoltage and indefinite short-circuit protection.

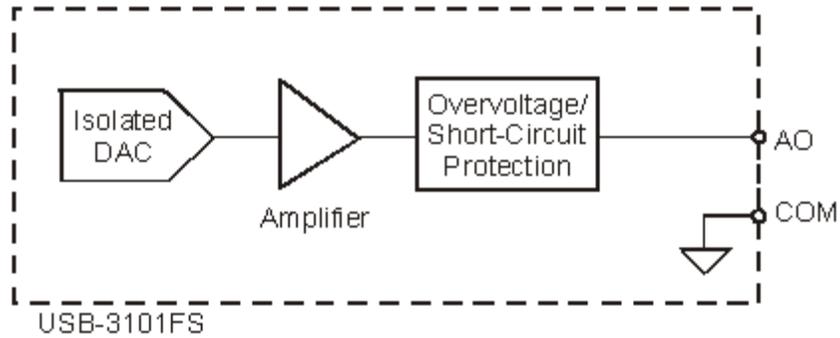


Figure 6. Analog output circuitry for one channel

Specifications

All specifications are subject to change without notice.

Typical for the range -40 to 70 °C unless otherwise noted.

All voltages are relative to COM unless otherwise noted.

Analog output

Table 1. Analog output specifications

Parameter	Conditions	Specification
Number of channels		4
D/A converter resolution		16-bit
D/A converter type		String
Output range		± 10 V
Operating voltage		± 10.7 V, nominal ± 10.3 V, minimum ± 11 V, maximum
Current drive		± 1 mA per channel, maximum
Output impedance		0.1Ω
Stability	Offset drift	$\pm 80 \mu\text{V}/^\circ\text{C}$
	Gain drift	$6 \text{ ppm}/^\circ\text{C}$
Protection	Overvoltage	± 30 V
	Short-circuit	Indefinitely
Update time	One channel	$3 \mu\text{s}$
	Two channels	$5 \mu\text{s}$
	Three channels	$7.5 \mu\text{s}$
	Four channels	$9.5 \mu\text{s}$
Update rate		100 kS/s per channel, maximum
Noise		$260 \mu\text{V}_{\text{rms}}$
Slew rate		$4 \text{ V}/\mu\text{s}$
Crosstalk		76 dB
Settling time	100 pF load, to 1 LSB	FS step: $20 \mu\text{s}$
		3 V step: $10 \mu\text{s}$
		0.1 V step: $8 \mu\text{s}$
Glitch energy	256 steps, worst case	2 mV for $2 \mu\text{s}$
Capacitive drive		$1,500 \text{ pF}$, minimum
Monotonicity		16-bits
Differential non-linearity		-1 to 2 LSBs, maximum
Integral non-linearity (endpoint)		16 LSBs, maximum

Accuracy

Table 2. Analog input accuracy

Measurement conditions	Percent of reading	Percent of range (Note 1)
Calibrated, maximum (–40 to 70 °C)	0.35%	0.75%
Calibrated, typical (25 °C, ±5 °C)	0.01%	0.1%
Uncalibrated, maximum (–40 to 70 °C)	2.2%	1.7%
Uncalibrated, typical (25 °C, ±5 °C)	0.3%	0.25%

Note 1: The range is equal to ± 10.7 V.

Power

Table 3. Power specifications

Parameter	Specification
Power on voltage	0 V
Power consumption	625 mW, maximum
Thermal dissipation at 70 °C	625 mW, maximum

Bus interface

Table 4. General specifications

Parameter	Specification
USB specification	USB 2.0 Hi-Speed mode (480 Mbps) is recommended. Otherwise, USB 1.1 Full-Speed mode (12 Mbps).

Environmental

Table 5. Environmental specifications

Parameter	Specification
Operating temperature range	–40 to 70 °C
Storage temperature range	–40 to 85 °C
Ingress protection	IP 40
Operating humidity	10 to 90% relative humidity, non-condensing
Storage humidity	5 to 95% relative humidity, non-condensing
Maximum altitude	2000 meters (6561.679 feet)
Pollution degree (IEC60664)	2

Safety voltages

Table 6. Safety voltage specifications

Parameter	Conditions	Specification
Channel-to-COM		±11 V maximum
Isolation	Channel-to-channel	No isolation between channels
Channel-to-earth ground	Continuous	250 V _{rms} , Measurement Category II (Note 2)
	Withstand	2,300 V _{rms} , verified by a 5 second dielectric withstand test

Note 2: Measurement Category II is for measurements performed on circuits directly connected to the electrical distribution system. This category refers to local-level electrical distribution, such as that provided by a standard wall outlet, for example 115 V for U.S. or 230 V for Europe.

Caution! Do not connect the device to signals or use for measurements within Measurement Categories III or IV.

Mechanical

Table 7. Mechanical specifications

Parameter	Specification
Dimensions	4.5" L x 5.5" W x 1.5" H
Weight	1.2 lbs. (544 grams)

Screw terminal connector

Table 8. Screw terminal connector specifications

Connector type	Screw terminal
Screw terminal wiring	12 to 24 AWG copper conductor wire with 10 mm (0.39 in.) of insulation stripped from the end.
Torque for screw terminals	0.5 to 0.6 N · m (4.4 to 5.3 lb. · in.)

Connector pin out

Terminal	Signal
0	AO 0
1	Common (COM)
2	AO 1
3	Common (COM)
4	AO 2
5	Common (COM)
6	AO 3
7	Common (COM)
8	NC (No connection)
9	Common (COM)

Accessory products

Table 9. Screw terminal connector specifications

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

CE Declaration of Conformity

Manufacturer: Measurement Computing Corporation
Address: 10 Commerce Way
Suite 1008
Norton, MA 02766
USA

Measurement Computing Corporation declares under sole responsibility that the product

USB-3101FS

to which this declaration relates is in conformity with the relevant provisions of the following standards or other documents:

Category: Electrical equipment for measurement, control and laboratory use.

EC EMC Directive 2004/108/EC: General Requirements, EN 61326-1:2006 (IEC 61326-1:2005).

Emissions: IEC 61326-2-1:2005.

- EN 55011 (1990)/CISPR 11 Radiated emissions: Group 1, Class A
- EN 55011 (1990)/CISPR 11 Conducted emissions: Group 1, Class A

Immunity: EN 61326-1:2006, Table 3.

- IEC 61000-4-2 (1995): Electrostatic Discharge immunity, Criteria B.
- IEC 61000-4-3 (1995): Radiated Electromagnetic Field immunity, Criteria A.

To maintain compliance to the standards of this declaration, the following conditions must be met.

- The host computer, peripheral equipment, power sources, and expansion hardware must be CE compliant.
- All I/O cables must be shielded, with the shields connected to ground.
- I/O cables must be less than 3 meters (9.75 feet) in length.
- The host computer must be properly grounded.
- Equipment must be operated in a controlled electromagnetic environment as defined by Standards EN 61326:2006, or IEC 61326:2005.

Declaration of Conformity based on tests conducted by Chomerics Test Services, Woburn, MA 01801, USA in September, 2008. Test records are outlined in Chomerics Test Report #EMI5135.08.

We hereby declare that the equipment specified conforms to the above Directives and Standards.



Carl Haapaoja, Director of Quality Assurance

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