

# USB-3106

16 analog voltage output (16-bit), 16 analog current output (16-bit)  
Eight digital I/O, one 32-bit event counter  
Full-speed USB 2.0 device

## User's Guide



# **USB-3106**

## **USB-based Analog Output**

### **User Guide**



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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-3106 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-3106.

- MCC's *Specifications: USB-3106* (the PDF version of the *Specifications* chapter in this guide) is available on our web site at [www.mccdaq.com/pdfs/Specs/USB-3106-spec.pdf](http://www.mccdaq.com/pdfs/Specs/USB-3106-spec.pdf).
- MCC's *Quick Start Guide* is available on our web site at [www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf](http://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](http://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](http://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](http://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](http://www.mccdaq.com/PDFmanuals/SM-UL-LabVIEW.pdf).

*USB-3106 User's Guide* (this document) is also available on our web site at [www.mccdaq.com/PDFmanuals/USB-3106.pdf](http://www.mccdaq.com/PDFmanuals/USB-3106.pdf).

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# Introducing the USB-3106

## Overview: USB-3106 features

This user's guide contains all of the information you need to connect the USB-3106 to your computer and to the signals you want to control. The USB-3106 is part of the Measurement Computing brand of USB-based data acquisition products.

The USB-3106 is a USB 2.0 full-speed device that is supported under popular Microsoft® Windows® operating systems. The USB-3106 is fully compatible with both USB 1.1 and USB 2.0 ports.

The USB-3106 provides 16 channels of analog voltage output, 16 channels of analog current output, eight digital I/O connections, and one 32-bit event counter.

The USB-3106 has four quad (4-channel) 16-bit digital-to-analog converters (DAC). Each D/A converter output controls a voltage and current channel pair simultaneously.

You set the voltage output range of each DAC channel independently with software for either bipolar, unipolar or current. The bipolar range is  $\pm 10$  V, the unipolar range is 0 to 10 V, and the analog current range is 0 to 20 mA. Each voltage/current channel pair can be updated individually or simultaneously. A bidirectional synchronization connection allows you to simultaneously update the DAC outputs on multiple devices.

The USB-3106 features eight bidirectional digital I/O connections. You can configure the DIO lines as input or output in one 8-bit port. All digital pins are floating by default. A screw terminal connection is provided for pull-up (+5 V) or pull-down (0 volts) configuration.

The 32-bit counter can count TTL pulses.

The USB-3106 is powered by the +5 volt USB supply from your computer. No external power is required. All I/O connections are made to the screw terminals located along each side of the USB-3106.



Figure 1. USB-3106

## USB-3106 block diagram

USB-3106 functions are illustrated in the block diagram shown here.

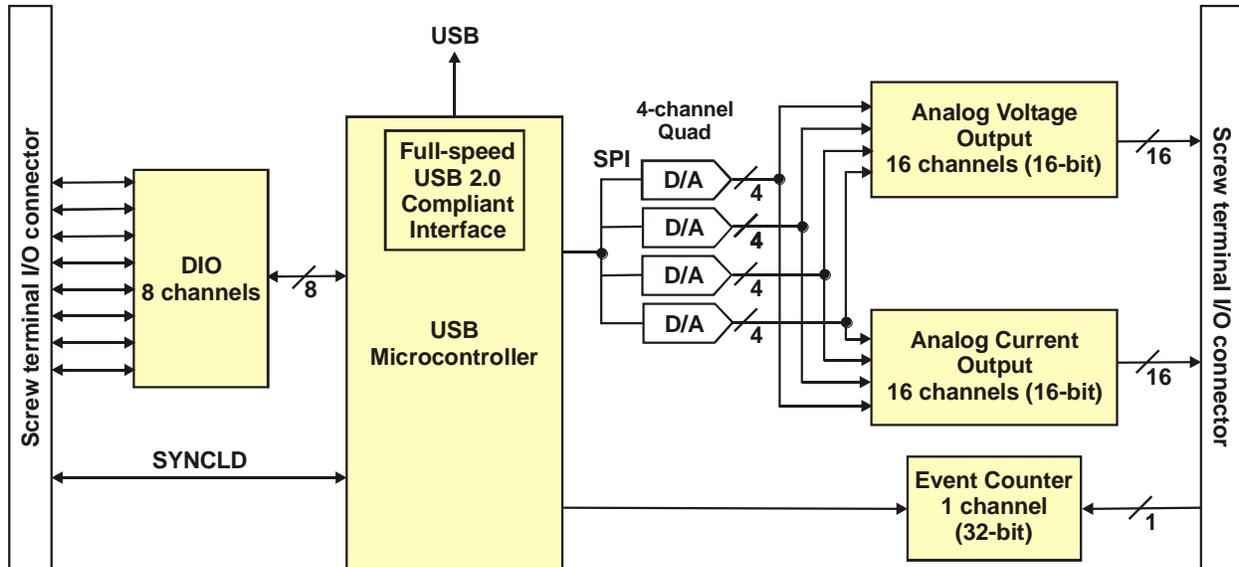


Figure 2. USB-3106 block diagram

## Software features

For information on the features of *InstaCal* and the other software included with your USB-3106, 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](http://www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf).

Check [www.mccdaq.com/download.htm](http://www.mccdaq.com/download.htm) for the latest software version or versions of the software supported under less commonly used operating systems.

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## Installing the USB-3106

### What comes with your USB-3106 shipment?

The following items are shipped with the USB-3106.

#### Hardware

- USB-3106 device



- 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](http://www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf)). This booklet supplies a brief description of the software you received with your USB-3106 and information regarding installation of that software. Please read this booklet completely before installing any software or hardware.

### Unpacking the USB-3106

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the USB-3106 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 any components are missing or 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](mailto:techsupport@mccdaq.com)

## 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](http://www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf).

## Installing the hardware

### Be sure you are using the latest system software

Before you connect the USB-3106, make sure that you are using the latest versions of the USB drivers.

Before installing the USB-3106, download and install the latest Microsoft Windows updates. In particular, when using Windows XP, make sure you have XP Hotfix KB822603 installed. This update is intended to address a serious error in Usbport.sys when you operate a USB device. You can run Windows Update or download the update from [www.microsoft.com/downloads/details.aspx?familyid=733dd867-56a0-4956-b7fe-e85b688b7f86&displaylang=en](http://www.microsoft.com/downloads/details.aspx?familyid=733dd867-56a0-4956-b7fe-e85b688b7f86&displaylang=en). For more information, refer to the Microsoft Knowledge Base article "Availability of the Windows XP SP1 USB 1.1 and 2.0 update." This article is available at [support.microsoft.com/?kbid=822603](http://support.microsoft.com/?kbid=822603).

## Connecting the USB-3106 to your system

To connect the USB-3106 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-3106.

When you connect the USB-3106 for the first time, a **Found New Hardware** popup balloon (Windows XP) or dialog (other Windows versions) appears as the USB-3106 is detected by your computer.



After the USB-3106 is installed, the popup balloon or dialog states "Your new hardware is installed and ready to use," and the power LED should flash and then remain lit. This indicates that communication is established between the USB-3106 and your computer.



**Caution!** Do not disconnect **any** device from the USB bus while the computer is communicating with the USB-3106, or you may lose data and/or your ability to communicate with the USB-3106.

**If the power LED turns off**

If the power LED is illuminated but then turns off, the computer has lost communication with the USB-3106. To restore communication, disconnect the USB cable from the computer, and then reconnect it. This should restore communication, and the power LED should turn back *on*.

**Calibrating the USB-3106**

The USB-3106 is shipped fully calibrated. Calibration coefficients are stored in the device FLASH memory. Return the device to Measurement Computing Corporation when calibration is required. The normal calibration interval is once per year.

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## Functional Details

### External components

The USB-3106 has the following external components, as shown in Figure 3.

- USB connector
- Status LED
- Power LED
- Screw terminal banks (2)

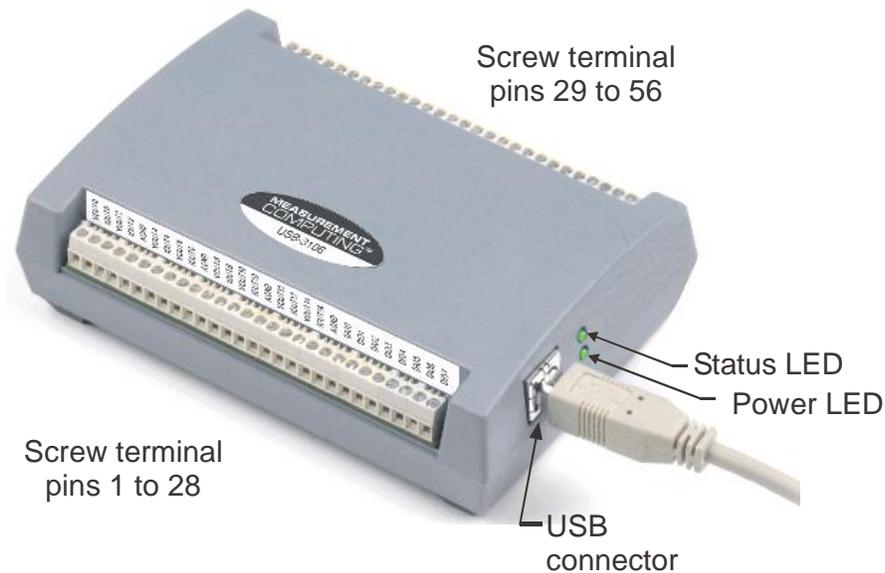


Figure 3. USB-3106 external components

### USB connector

The USB connector provides 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.

### Status LED

The Status LED indicates the communication status of the USB-3106. It flashes when data is being transferred, and is off when the USB-3106 is not communicating. This LED uses up to 10 mA of current and cannot be disabled.

### Power LED

The power LED lights up when the USB-3106 is connected to a USB port on your computer or to an external USB hub that is connected to your computer.

## Screw terminal banks

The USB-3106 has two rows of screw terminals—one row on the top edge of the housing, and one row on the bottom edge. Each row has 28 connections. Use 16 AWG to 30 AWG wire gauge when making screw terminal connections. Pin numbers are identified in Figure 4.

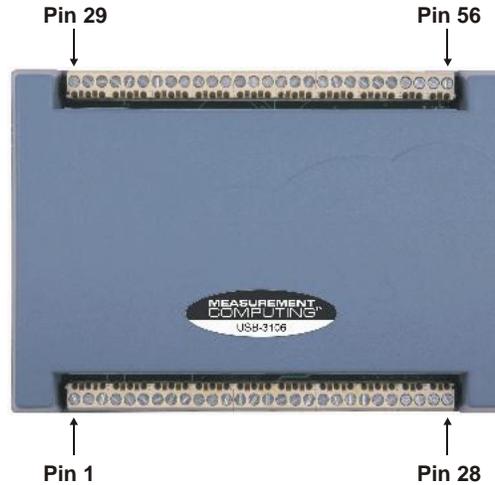


Figure 4. USB-3106 screw terminal pin numbering

### Screw terminal – pins 1-28

The screw terminals on the bottom edge of the USB-3106 (pins 1 to 28) provide the following connections:

- Eight analog voltage output connections (**VOUT0**, **VOUT2**, **VOUT4**, **VOUT6**, **VOUT8**, **VOUT10**, **VOUT12**, **VOUT14**)
- Eight analog current output connections (**IOUT0**, **IOUT2**, **IOUT4**, **IOUT6**, **IOUT8**, **IOUT10**, **IOUT12**, **IOUT14**)
- Four analog ground connections (**AGND**)
- Eight digital I/O connections (**DIO0** to **DIO7**)

### Screw terminal – pins 29-56

The screw terminals on the top edge of the USB-3106 (pins 29 to 56) provide the following connections:

- Eight analog voltage output connections (**VOUT1**, **VOUT3**, **VOUT5**, **VOUT7**, **VOUT9**, **VOUT11**, **VOUT13**, **VOUT15**)
- Eight analog current output connections (**IOUT1**, **IOUT3**, **IOUT5**, **IOUT7**, **IOUT9**, **IOUT11**, **IOUT13**, **IOUT15**)
- Four analog ground connections (**AGND**)
- One SYNC terminal for external clocking and multi-unit synchronization (**SYNCLD**)
- Three digital ground connections (**DGND**)
- One current test connection (**ITEST**)
- One external event counter connection (**CTR**)
- One digital I/O pull-up/down resistor connection (**DIO CTL**)
- One voltage output power connection (**+5 V**)

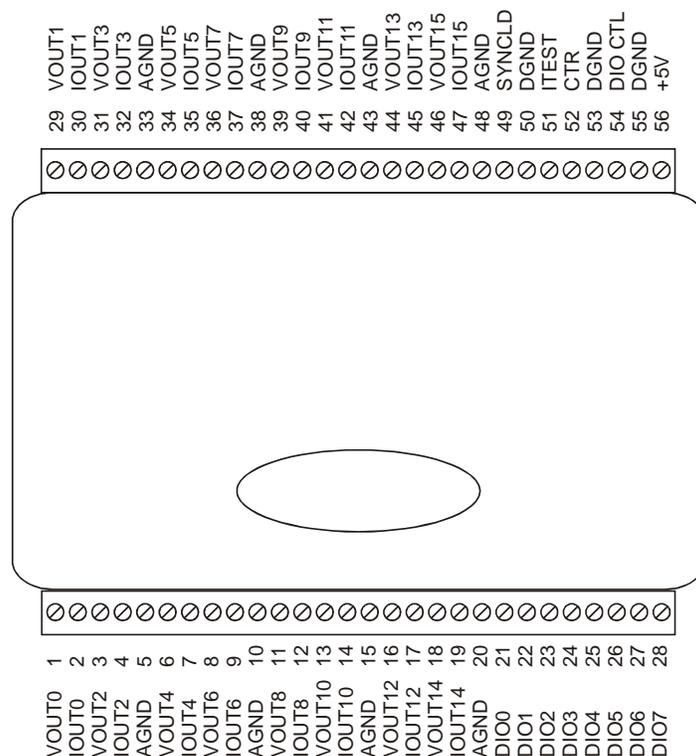


Figure 5. USB-3106 signal pin out

### Analog voltage output terminals (VOUT0 to VOUT15)

The screw terminal pins labeled **VOUT0** to **VOUT15** are voltage output terminals (see Figure 5). The voltage output range for each channel is software-programmable for either bipolar or unipolar. The bipolar range is  $\pm 10$  V, and the unipolar range is 0 to 10 V.

Each D/A converter output controls a voltage and current channel pair simultaneously. When you write to a voltage output, its associated current output is also updated. Each channel pair can be updated individually or simultaneously.

Leave each pair of unused voltage and current outputs disconnected.

### Analog current output terminals (IOUT0 to IOUT15)

The screw terminal pins labeled **IOUT0** to **IOUT15** are current output terminals (see Figure 5). The current range for each channel is 0 to 20 mA.

Each D/A converter output controls a voltage and current channel pair simultaneously. When you write to a current output, its associated voltage output is also updated. Each channel pair can be updated individually or simultaneously. Leave each pair of unused voltage and current outputs disconnected.

Figure 6 shows a typical analog current output circuit. A minimum of 8 VDC must be available at  $IOUTn$ . A maximum of 36 VDC external excitation voltage is used to power the loop. Consider the drop across the load when selecting the supply voltage.

A typical application uses a 24 V loop supply. The loop can use either a grounded load where the supply floats, or a grounded supply where the load floats. Each connection method is shown in Figure 6.

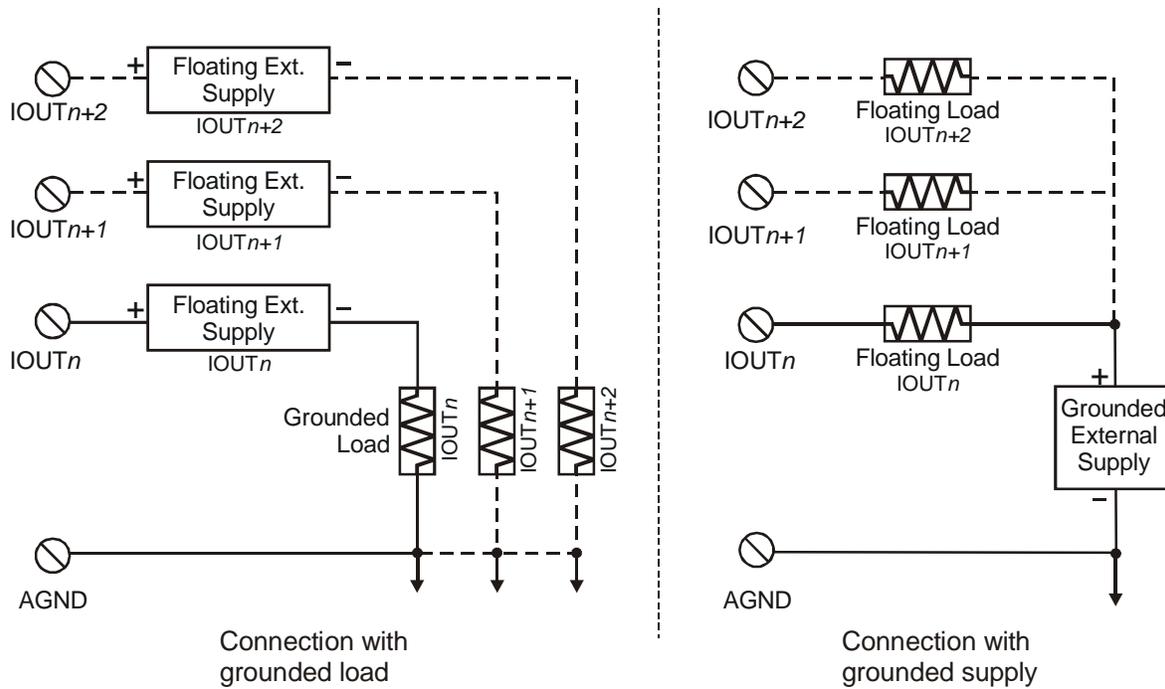


Figure 6. Typical analog current output circuit

Refer to the manufacturer's information for the device being controlled for additional details.

### Current Test terminal (ITEST)

The **ITEST** connection (pin 51) is used with *InstaCal* to test the functionality of the analog current output (IOUT) pins. The ITEST connection circuit is shown in Figure 7.

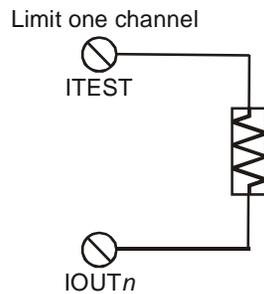


Figure 7. Current output test circuit

Do not test more than one current output pin at a time. The **ITEST** output is not adequate for application use. It is intended for test purposes only.

## Digital I/O terminals (DIO0 to DIO7)

You can connect up to eight digital I/O lines to the screw terminals labeled **DIO0** to **DIO7** (pins 21 through 28). You can configure each digital bit for either input or output.

When you configure the digital bits for input, you can use the digital I/O terminals to detect the state of any TTL level input. Refer to the switch shown in Figure 8 and the schematic shown in Figure 9. When the switch is set to the +5 V USER input, DIO7 reads *TRUE* (1). If you move the switch to DGND, DIO7 reads *FALSE* (0).

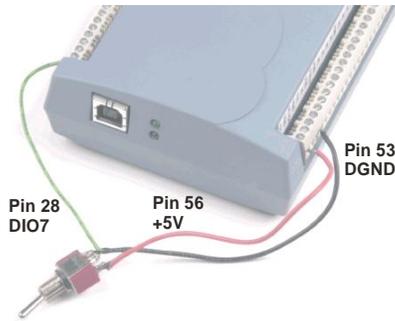


Figure 8. DIO7 detecting the state of a switch

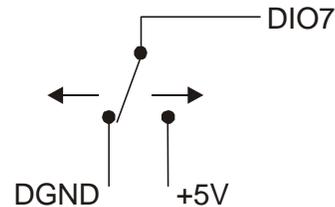


Figure 9. Schematic showing DIO7 detecting the state of a switch

### For more information on digital signal connections

For more information on digital signal connections and digital I/O techniques, refer to the *Guide to Signal Connections* (available on our web site at [www.mccdaq.com/signals/signals.pdf](http://www.mccdaq.com/signals/signals.pdf)).

## Digital I/O control terminal (DIO CTL) for pull-up/down configuration

All digital pins are floating by default. When inputs are floating, the state of unwired inputs are undefined (they may read high or low). You can configure the inputs to read a high or low value when they aren't wired. Use the **DIO CTL** connection (pin 54) to configure the digital pins for pull-up (inputs read high when unwired) or pull-down (inputs read low when unwired).

- To pull up the digital pins to +5V, wire the **DIO CTL** terminal pin to the **+5V** terminal pin (pin 56).
- To pull down the digital pins to ground (0 volts), wire the **DIO CTL** terminal pin to a **DGND** terminal pin (pin 50, 53, or 55).

## Ground terminals (AGND, DGND)

Eight analog ground (**AGND**) connections provide a common ground for all analog voltage and current output channels. Three digital ground (**DGND**) connections provide a common ground for the **DIO**, **CTR**, **SYNCLD** and **+5V** connections.

## Synchronous DAC load terminal (SYNCLD)

The synchronous DAC load connection (pin 49) is a bidirectional I/O signal that allows you to simultaneously update the DAC outputs on multiple devices. You can use this pin for two purposes:

- Configure as an input (slave mode) to receive the D/A LOAD signal from an external source.  
When the SYNCLD pin receives the trigger signal, the analog outputs are updated simultaneously.

### SYNCLD pin must be logic low in slave mode for immediate update of DAC outputs

When the SYNCLD pin is in slave mode, the analog outputs can be updated immediately or when a positive edge is seen on the SYNCLD pin (this is under software control.)

The SYNCLD pin must be at a low logic level for DAC outputs to update immediately. If the external source supplying the D/A LOAD signal is pulling the SYNCLD pin high, no update will occur.

Refer to the "USB-3100 Series" section in the *Universal Library User's Guide* for information on how to update DAC outputs immediately.

- Configure as an output (master mode) to send the internal D/A LOAD signal to the SYNCLD pin.  
You can use the SYNCLD pin to synchronize with a second USB-3106 and simultaneously update the DAC outputs on each device. Refer to [Synchronizing multiple units](#) below.

Use *InstaCal* to configure the SYNCLD mode as master or slave. On power up and reset the SYNCLD pin is set to slave mode (input).

Refer to the "USB-3100 Series" section in the *Universal Library User's Guide* for information on how to configure the USB-3106 with the Universal Library.

## Counter terminal (CTR)

The **CTR** connection (pin 52) is the input to the 32-bit event counter. The internal counter increments when the TTL levels transition from low to high. The counter can count frequencies of up to 1 MHz.

## Power terminal (+5V)

The **+5 V** connection (pin 56) draws power from the USB connector. This terminal is a +5V output.

**Caution!** The +5V terminal is an output. Do not connect to an external power supply or you may damage the USB-3106 and possibly the computer.

## Synchronizing multiple units

You can connect the **SYNCLD** terminal pin (pin 49) of two USB-3106 units together in a master/slave configuration and simultaneously update the DAC outputs of both devices. Do the following.

1. Connect the SYNCLD pin of the master USB-3106 to the SYNCLD pin of the slave USB-3106.
2. Configure the SYNCLD pin on the slave device for input to receive the D/A LOAD signal from the master device. Use *InstaCal* to set the direction of the SYNCLD pin.
3. Configure the SYNCLD pin on the master device for output to generate an output pulse on the SYNCLD pin.

Set the Universal Library `SIMULTANEOUS` option for each device. Refer to the *Universal Library User's Guide* for information on how to configure the USB-3106 with the Universal Library.

When the SYNCLD pin on the slave device receives the signal, the analog output channels on each device are updated simultaneously.

An example of a master/slave configuration is shown here.

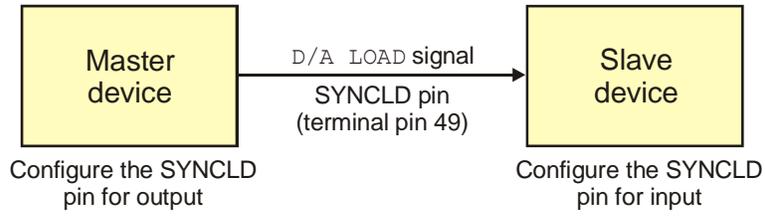


Figure 10. Synchronizing the update of multiple devices

## Specifications

Typical for 25 °C unless otherwise specified.

Specifications in *italic text* are guaranteed by design.

### Analog voltage output

Table 1. Analog voltage output specifications

| Parameter                              | Conditions  | Specifications  |
|--|---|---|
| Digital to Analog converter            |   | DAC8554   |
| Number of channels<br>(Note 1)         |   | 16  |
| Resolution                             |   | 16 bits   |
| Output ranges                          | Calibrated  | $\pm 10$ V, 0 to 10 V<br>Software configurable          |
|  | Un-calibrated   | $\pm 10.2$ V, -0.04 to 10.08 V<br>Software configurable |
| Output transient                       | $\pm 10$ V to (0 to 10 V) or<br>(0 to 10 V) to $\pm 10$ V range<br>selection.<br>(Note 2)         | Duration: 5 $\mu$ S typ.<br>Amplitude: 5V p-p typ.      |
|  | Host PC is reset, powered on,<br>suspended or a reset command is<br>issued to device.<br>(Note 3) | Duration: 2 S typ.<br>Amplitude: 2V p-p typ.            |
|  | Initial power on  | Duration: 50 mS typ.<br>Amplitude: 5V peak typ.         |
| Differential non-linearity<br>(Note 4) | Calibrated  | $\pm 1.25$ LSB typ.<br>-2 LSB to +1 LSB max.            |
|  | Un-calibrated   | $\pm 0.25$ LSB typ.<br>$\pm 1$ LSB max.                 |
| Output current                         | VOUTx pins  | $\pm 3.5$ mA typ.                                       |
| Output short-circuit protection        | VOUTx connected to AGND   | Indefinite  |
| Output coupling                        |   | DC  |
| Power on and reset state               |   | DACs cleared to zero-scale: 0 V, $\pm 50$ mV typ.       |
|  |   | Output range: 0-10V                                     |
| Output noise                           | 0 to 10 V range   | 14.95 $\mu$ Vrms typ.                                   |
|  | $\pm 10$ V range  | 31.67 $\mu$ Vrms typ.                                   |
| Settling time                          | <i>to 1LSB accuracy</i>   | <i>25 <math>\mu</math>S typ.</i>                        |
| Slew rate                              | 0 to 10 V range   | 1.20 V/ $\mu$ S typ.                                    |
|  | $\pm 10$ V range  | 1.20 V/ $\mu$ S typ.                                    |
| Throughput                             | Single-channel  | 100 Hz max., system dependent                           |
|  | Multi-channel   | 100 Hz/#ch max., system dependent                       |

**Note 1:** Each of the four DAC8554 outputs controls a VOUTx and IOUTx channel-pair simultaneously. So, for example, when writing to channel VOUT0, the associated IOUT0 channel will also be updated. Conversely, when writing to channel IOUT0, the associated VOUT0 channel is also updated. Unused VOUTx and IOUTx output channels should be left disconnected.

**Note 2:** The USB-3106 output voltage level defaults to 0V whenever the output voltage range is reconfigured.

The USB-3106 output voltage level will also default to 0V:

- 1) Whenever the host PC is reset, shut down or suspended.
- 2) If a reset command is issued to the device.

**Note 3:** The duration of this particular output transient is highly dependent on the enumeration process of the host PC. Typically the output of the USB-3106 is stable after 2 seconds.

**Note 4:** The maximum differential non-linearity specification applies to the entire 0 to 50 °C temperature range of the USB-3106. This specification also accounts for the maximum errors due to the software calibration algorithm (in Calibrated mode only) and the DAC8554 digital to analog converter non-linearities.

Table 2. Absolute accuracy specifications – calibrated output

| Range      | Accuracy ( $\pm$ LSB) |
|------------|-----------------------|
| $\pm 10$ V | 14.0                  |
| 0 to 10 V  | 22.0                  |

Table 3. Absolute accuracy components specifications – calibrated output

| Range      | % of reading | Offset ( $\pm$ mV) | Temp drift (%/°C) | Absolute accuracy at FS ( $\pm$ mV) |
|------------|--------------|--------------------|-------------------|-------------------------------------|
| $\pm 10$ V | $\pm 0.0183$ | 1.831              | 0.00055           | 3.661                               |
| 0 to 10 V  | $\pm 0.0183$ | 0.915              | 0.00055           | 2.746                               |

Table 4. Relative accuracy specifications

| Range                  | Relative accuracy ( $\pm$ LSB) |           |
|------------------------|--------------------------------|-----------|
| $\pm 10$ V , 0 to 10 V | 4.0 typ.                       | 12.0 max. |

## Analog current output

Table 5. Analog current output specifications

| Parameter                            | Conditions  | Specifications                               |
|--------------------------------------|---|--|
| Number of channels<br>(Note 5)       |   | 16   |
| Resolution                           |   | 16 bits                                      |
| Output ranges                        | Calibrated  | 0 to 20 mA typ.                              |
|                                      | Uncalibrated  | 0 to 25 mA typ.                              |
| Compliance voltage range<br>(Note 6) | Calibrated output   | +8 V min.<br>+36 V max.                      |
| Differential non-linearity (Note 7)  | Calibrated  | $\pm 1.25$ LSB typ.<br>-2 LSB to +1 LSB max. |
|                                      | Un-calibrated   | $\pm 0.25$ LSB typ.<br>-1 LSB to +1 LSB max. |
| Absolute accuracy                    | Compliance voltage = +13V<br>Resistive load = 100 $\Omega$                            | $\pm 0.05\%$ of full scale range             |
| IOUTx leakage current                | All zeros written to IOUTx channel  | 100nA typ. (each individual IOUT channel)    |
| Settling time                        | Full scale step to 1LSB accuracy<br>Compliance voltage = 12V,<br>Rload = 500 $\Omega$ | 25 $\mu$ S typ..                             |
| Throughput                           | Single-channel  | 100 Hz max., system dependent                |
|                                      | Multi-channel   | 100 Hz/#ch max., system dependent            |

**Note 5:** Each of the four DAC8554 outputs controls a VOUTx and IOUTx channel-pair simultaneously. So, for example, when writing to channel VOUT0, the associated IOUT0 channel will also be updated. Conversely, when writing to channel IOUT0, the associated VOUT0 channel is also updated. Unused VOUTx and IOUTx output channels should be left disconnected.

**Note 6:** The following formula will calculate the maximum load resistance for correct IOUT circuit operation. The compliance voltage applied should not exceed the limits specified in Table 5.

- Calibrated Output:  
Load Resistance = (Compliance Voltage – 6 V)/0.020 A
- Un-Calibrated Output:  
Load Resistance = (Compliance Voltage – 6 V)/0.025 A

**Note 7:** The maximum differential non-linearity specification applies to the entire 0 to 70 °C temperature range of the USB-3106. This specification also accounts for the maximum errors due to the software calibration algorithm (in Calibrated mode only) and the DAC8554 digital to analog converter non-linearities.

## Analog output calibration

Table 6. Analog output calibration specifications

| Parameter                    | Conditions | Specifications                              |
|------------------------------|------------|---|
| Recommended warm-up time     |            | 15 minutes min.                             |
| On-board 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           |            | Software calibration                        |
| Calibration interval         |            | 1 year                                      |

## Digital input/output

Table 7. Digital I/O specifications

|  |   |
|--|---|
| Digital logic type                       | CMOS  |
| Number of I/O                            | 8   |
| Configuration                            | Independently configured for input or output  |
| Pull-up/pull-down configuration (Note 8) | User configurable<br>All pins floating (default)                                      |
| Digital I/O input loading                | TTL (default)   |
|  | 47K ohms (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   |

**Note 8:** Pull up and pull down configuration area available using the DIO CTL terminal block pin 54. The pull down configuration requires the DIO CTL pin (pin 54) to be connected to a DGND pin (pin 50, 53 or 55). For a pull up configuration, the DIO CTL pin should be connected to the +5V terminal pin (pin 56).

## Synchronous DAC Load

Table 8. SYNCLD I/O specifications

| Parameter                     | Conditions    | Specification                                  |
|-------------------------------|---------------|--|
| Pin name                      |               | SYNCLD (terminal block pin 49)                 |
| Power on and reset state      |               | Input  |
| Pin type                      |               | Bidirectional                                  |
| Termination                   |               | Internal 100K ohms pull-down                   |
| Software selectable direction | Output        | Outputs internal D/A LOAD signal.              |
|                               | Input         | Receives D/A LOAD signal from external source. |
| Input clock rate              |               | 100 Hz max                                     |
| Clock pulse width             | Input         | 1 $\mu$ s min                                  |
|                               | Output        | 5 $\mu$ s min                                  |
| <i>Input leakage current</i>  |               | $\pm 1.0 \mu$ A <i>typ.</i>                    |
| 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 (Note 9)  | IOH = -2.5 mA | 3.3 V min                                      |
|                               | No load       | 3.8 V min                                      |
| Output low voltage (Note 10)  | IOL = 2.5 mA  | 1.1 V max                                      |
|                               | No load       | 0.6 V max                                      |

**Note 9:** SYNCLD is a Schmitt trigger input and is over-current protected with a 200 Ohm series resistor.

**Note 10:** When SYNCLD is in input mode, the analog outputs may either be updated immediately or when a positive edge is seen on the SYNCLD pin (this is under software control.) However, the pin must be at a low logic level in order for the DAC outputs to be updated immediately. If an external source is pulling the pin high, no update will occur.

## Counter

Table 9. CTR I/O specifications

| Parameter                                  | Conditions    | Specification                                  |
|--|---------------|--|
| Pin name                                   |               | CTR  |
| Number of channels                         |               | 1  |
| Resolution                                 |               | 32-bits  |
| Counter type                               |               | Event counter                                  |
| Input type                                 |               | TTL, rising edge triggered                     |
| Counter read/writes rates (software paced) | Counter read  | System dependent, 33 to 1000 reads per second. |
|  | Counter write | System dependent, 33 to 1000 reads per second. |
| Schmidt trigger hysteresis                 |               | 20 mV to 100 mV                                |
| <i>Input leakage current</i>               |               | $\pm 1.0 \mu$ A <i>typ.</i>                    |
| Input frequency                            |               | 1 MHz max.                                     |
| <i>High pulse width</i>                    |               | 500 ns <i>min.</i>                             |
| <i>Low pulse width</i>                     |               | 500 ns <i>min.</i>                             |
| Input high voltage                         |               | 4.0 V min, 5.5 V absolute max                  |
| Input low voltage                          |               | 1.0 V max, -0.5 V absolute min                 |

## Memory

Table 10. Memory specifications

|                      |                      |               |                     |
|----------------------|----------------------|---------------|---------------------|
| EEPROM               | 256 bytes            |               |                     |
| EEPROM configuration | <b>Address range</b> | <b>Access</b> | <b>Description</b>  |
|                      | 0x000-0x0FF          | Read/write    | 256 bytes user data |

## Microcontroller

Table 11. Microcontroller specifications

|                |   |
|----------------|---|
| Type           | High performance 8-bit RISC microcontroller |
| Program memory | 16,384 words                                |
| Data memory    | 2,048 bytes                                 |

## Power

Table 12. Power specifications

| Parameter                               | Conditions                         | Specification          |
|---|------------------------------------|------------------------|
| Supply current                          | USB enumeration                    | < 100 mA               |
| Supply current (Note 11)                | Quiescent current                  | 200 mA typ.            |
| +5V user output voltage range (Note 12) | Available at terminal block pin 56 | 4.5 V min, 5.25 V max. |
| +5V user output current (Note 13)       | Available at terminal block pin 56 | 10 mA max.             |
| ITEST output voltage range              | Available at terminal block pin 51 | 13 V, $\pm 1\%$ typ.   |
| ITEST output current (Note 14)          | Available at terminal block pin 51 | 30 mA max.             |

**Note 11:** This is the total quiescent current requirement for the USB-3106 which 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, ITEST, or the VOUTx/IOUTx outputs.

**Note 12:** Output voltage range assumes USB power supply is within specified limits.

**Note 13:** This refers to the total amount of current that can be sourced from the +5 V user terminal (pin 56) for general use. This specification also includes any additional contribution due to DIO loading.

**Note 14:** This refers to the total maximum amount of current that can be sourced from the ITEST user terminal (pin 51). The ITEST terminal pin should only be used for biasing individual IOUTx outputs in order to facilitate functional testing. A load resistor of 100  $\Omega$  should be placed in series between the ITEST pin and the IOUTx pin for proper operation.

## USB specifications

Table 13. USB specifications

|                          |  |
|--------------------------|--|
| USB device type          | USB 2.0 (full-speed)   |
| USB device compatibility | USB 1.1, 2.0   |
| USB cable length         | 3 meters max.  |
| USB cable type           | A-B cable, UL type AWM 2527 or equivalent (min 24 AWG VBUS/GND, min 28 AWG D+/D-). |

## Environmental

Table 14. Environmental specifications

|                             |                         |
|-----------------------------|-------------------------|
| Operating temperature range | 0 to 50 °C              |
| Storage temperature range   | -40 to 85 °C            |
| Humidity                    | 0 to 90% non-condensing |

## Mechanical

Table 15. Mechanical specifications

|            |                                      |
|------------|--------------------------------------|
| Dimensions | 127 mm (L) x 88.9 mm (W) x 35.56 (H) |
|------------|--------------------------------------|

## Main connector and pin out

Table 16. Main connector specifications

|                  |                  |
|------------------|------------------|
| Connector type   | Screw terminal   |
| Wire gauge range | 16 AWG to 30 AWG |

| Pin | Signal Name | Pin | Signal Name |
|-----|-------------|-----|-------------|
| 1   | VOUT0       | 29  | VOUT1       |
| 2   | IOUT0       | 30  | IOUT1       |
| 3   | VOUT2       | 31  | VOUT3       |
| 4   | IOUT2       | 32  | IOUT3       |
| 5   | AGND        | 33  | AGND        |
| 6   | VOUT4       | 34  | VOUT5       |
| 7   | IOUT4       | 35  | IOUT5       |
| 8   | VOUT6       | 36  | VOUT7       |
| 9   | IOUT6       | 37  | IOUT7       |
| 10  | AGND        | 38  | AGND        |
| 11  | VOUT8       | 39  | VOUT9       |
| 12  | IOUT8       | 40  | IOUT9       |
| 13  | VOUT10      | 41  | VOUT11      |
| 14  | IOUT10      | 42  | IOUT11      |
| 15  | AGND        | 43  | AGND        |
| 16  | VOUT12      | 44  | VOUT13      |
| 17  | IOUT12      | 45  | IOUT13      |
| 18  | VOUT14      | 46  | VOUT15      |
| 19  | IOUT14      | 47  | IOUT15      |
| 20  | AGND        | 48  | AGND        |
| 21  | DIO0        | 49  | SYNCLD      |
| 22  | DIO1        | 50  | DGND        |
| 23  | DIO2        | 51  | ITEST       |
| 24  | DIO3        | 52  | CTR         |
| 25  | DIO4        | 53  | DGND        |
| 26  | DIO5        | 54  | DIO CTL     |
| 27  | DIO6        | 55  | DGND        |
| 28  | DIO7        | 56  | +5V         |

# CE Declaration of Conformity

Manufacturer: Measurement Computing Corporation  
Address: 10 Commerce Way  
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USA

Measurement Computing Corporation declares under sole responsibility that the product

## USB-3106

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: Electromagnetic Compatibility, EN 61326-1:2006, (IEC 61326-1:2005)

Emissions:

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

Immunity: EN61326-1:2006, (IEC 61326-1:2005) Table 3 Immunity requirements for equipment used in controlled EM environments.

- IEC 61000-4-2 (2001): Electrostatic Discharge immunity.
- IEC 61000-4-3 (2002): Radiated Electromagnetic Field immunity.

To maintain the safety, emission, and immunity standards of this declaration, the following conditions must be met.

- The host computer, peripheral equipment, power sources, and expansion hardware must be CE compliant.
- Equipment must be operated in a controlled electromagnetic environment as defined by Standards EN 61326-1:2006, or IEC 61326-1:2005.
- Shielded wires must be used for all I/Os and must be less than 3 meters (9.75 feet) in length.
- The host computer must be properly grounded.
- The host computer must be USB2.0 compliant.
- A protective ESD wrist strap should be used when connecting or disconnecting leads from screw terminal blocks.

**Note:** Data acquisition equipment may exhibit noise or increased offsets when exposed to high RF fields (>1V/m) or transients.

Declaration of Conformity based on tests conducted by Chomerics Test Services, Woburn, MA 01801, USA in January, 2007. Test records are outlined in Chomerics Test Report #EMI4712.07. Further testing was conducted by Chomerics Test Services, Woburn, MA. 01801, USA in November, 2008. Test records are outlined in Chomerics Test report #EMI5193.08.

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



Carl Haapaoja, Director of Quality Assurance

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