DI-2108-P USB Data Acquisition (DAQ) System

Model DI-2108-P

DATAQ INSTRUMENTS
www.dataq.com

Drive

⚠ 0-25V Max + − + − + − + − + − + − + − + −
D0 Event   D1 Record   D2 Rate   D3 Count   D4   D5   D6   +5V GnD

Button

	Connecting	Idle	Recording	Armed	Rearmed	Busy	Error
USB	○ ●	● ●	● ●	--	--	--	●
Drive	○ ●	● ●	● ●	● ●	● ●	● ●	●

Status

USB

CH1   CH2   CH3   CH4   CH5   CH6   CH7   CH8
+ − + − + − + − + − + − + − + −   ⚠ ±150V Max
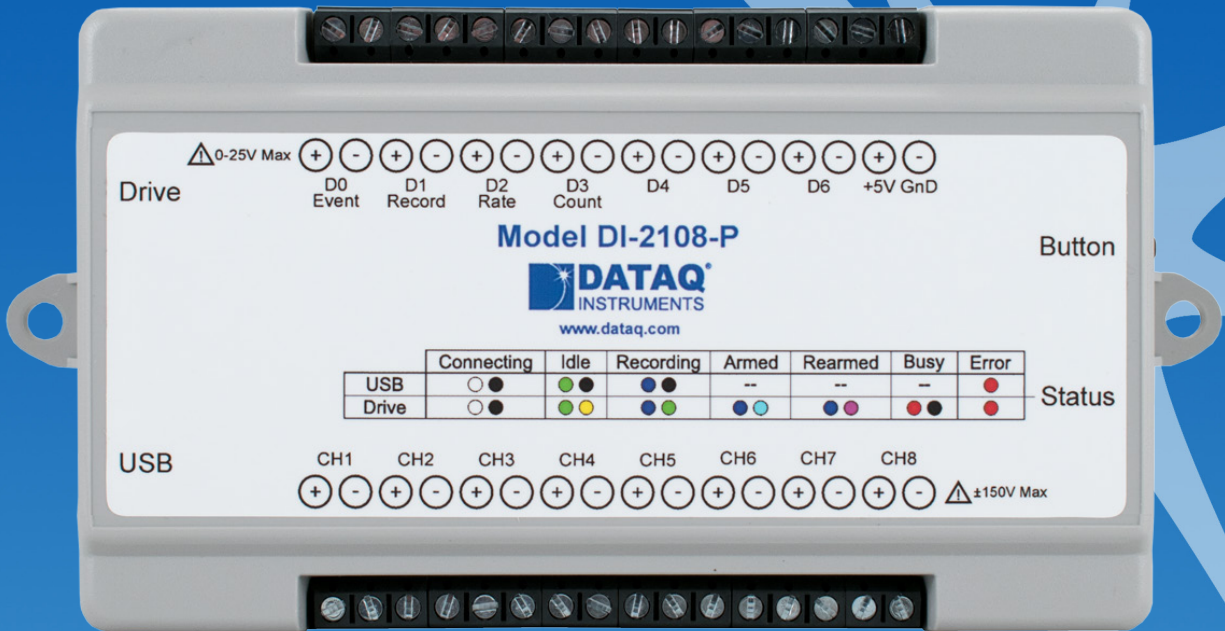
- ✓ **Eight armored analog differential inputs**
  - ✓ **Up to ±150 V without damage**
  - ✓ **80 dB common mode rejection**
- ✓ **Multi-unit synchronization for higher channel count applications**
- ✓ **PC-connected or stand-alone operation to USB flash drive**
- ✓ **Programmable ranges: ±2.5, ±5, ±10, 0-5, 0-10 Volts**
- ✓ **16-bit analog-to-digital resolution**
- ✓ **Up to 160 kHz sample throughput rate**
- ✓ **Seven digital ports**
  - ✓ **Programmable per port as input or switch**
  - ✓ **Support for rate measurements to 50 kHz**
  - ✓ **Support for 16-bit counter**
- ✓ **Software support includes:**
  - ✓ **Ready-to-run WinDaq software**
  - ✓ **Published protocol for software development in all operating systems**
  - ✓ **.NET class**

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Analog Subsystem

Model DI-2108-P delivers premium analog performance at a surprisingly affordable price. Eight analog input channels provide differential measurement flexibility and programmable ±2.5, 5, 10 V bipolar and 0-5 and 0-10 V unipolar ranges per channel. The differential input configuration provides noise rejection, easily adapts to single-ended signal sources, and is protected up to ±150 V dc or peak ac so that inevitable measurement mishaps will not harm the instrument. Bipolar ranges measure signals above and below zero, while resolution is effectively doubled on unipolar ranges. The front end feeds a fixed resolution, 16-bit ADC. The maximum sampling throughput rate of the DI-2108-P is 160 kHz.

Digital Port Subsystem

The DI-2108-P provides 7 digital ports, each configurable as an input or a switch. Input protection is provided to 25 V. When activated as inputs two ports allow dual functionality as discrete inputs, or programmed as a counter or rate input. The rate input features a 50 kHz maximum measurement allocated over twelve programmable measurement ranges (10 Hz to 50 kHz full scale.) The counter input provides 16-bit resolution and a terminal count value of 65,535. The discrete, counter, and rate inputs are members of the same internal scan list used by the analog input channels. This means that all enabled elements are acquired synchronously, which allows meaningful comparisons between analog and digital channels. For example, the rate input measuring engine speed allows rpm data to be acquired in lock-step with analog data. Configured as a switch a digital port can be used to control external loads up to 25 V @ 100 mA, and the switch can be controlled asynchronously without interfering with the scanning process.

Stand-alone Operation

A USB drive is used to record data in stand-alone mode. The DI-2108 can record continuously using a circular buffer with pre-defined trigger conditions or a record-until-full approach supporting remote start/stop. A push button allows manual start/stop control over the recording process. With a flash memory card incorporating SLC technology, throughput rates up to 160 kHz can be achieved. That rate drops to 50 kHz when using pSLC card, and 20 kHz using a flash memory card incorporating MLC. The included WinDaq data acquisition software makes configuring the DI-2108 for stand-alone operation quick and intuitive. Use WinDaq to set up channels and create a reference file. That reference file can then be copied to the USB drive and used for quick setup.

Multi-unit Synchronization Using ChannelStretch™

Need more channels? No problem. The DI-2108-P's unique ChannelStretch™ technology allows multiple units to be synchronized to expand channel count without clumsy external cabling. Synchronize up to sixteen instruments, all running at full-speed, for a total of 128 analog and 112 digital ports and a maximum throughput rate of at least 480 kHz. Channels across all units align in time to within 10 μS.

DI-2108-P Close-up

Digital I/O Ports 0-6
D0 Event Markers in WinDaq; D1 Remote Start/Stop in WinDaq; D2 Can be used for Rate applications; D3 Can be used as a Counter channel; D6 General-purpose for DI-2108-P
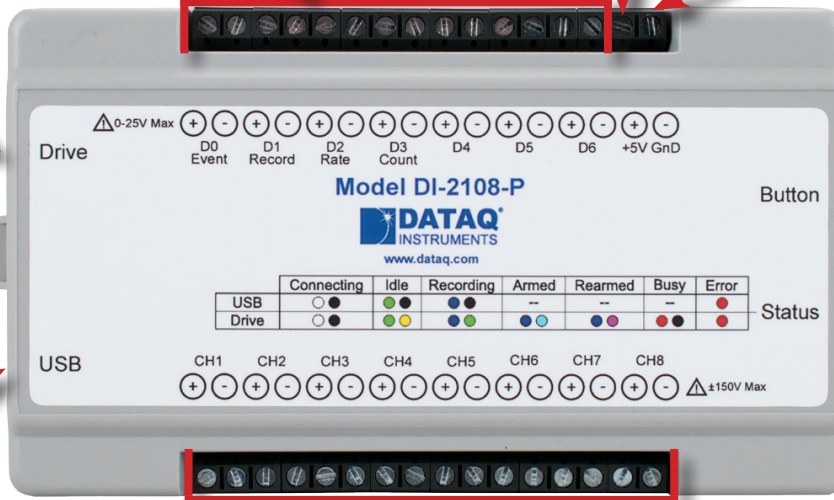
+5V Out
Max Current = 100mA

Ground

Remote Event push-button
Trigger events either from the remote event inputs (through WinDaq software) or by pushing this button.

Drive
USB flash drive port for stand-alone data logging

Bulkhead Mounting Ears

Mini-B USB connection

LED Indication
Flashing green: Ready
Flashing blue: Scanning
Flashing red: Buffer overflow
Flashing red/blue: Handled buffer overflow
Solid white: Event button
Other solid colors: Error

Analog In Channels 1-8
Programmable ranges: ±2.5, ±5, ±10, 0-5, 0-5 Volts
Up to ±150 V without damage

DI-2108-P Major Features and Benefits

Eight Analog Input Channels

Measure as many as eight system variables at once. Programmable ranges per channel are ±2.5, ±5, ±10, 0-5, 0-5 Volts.

Differential Analog Input Configuration

Enhanced noise immunity.

Synchronize Multiple Units

Expand time-aligned channel count by adding more units.

Armored Inputs Absorb Mistakes

Analog inputs are protected to ±150 V and digital inputs up to 25 V.

Fast, 160 kHz Sample Throughput Rate

Observe fast phenomena that other products in the DI-2108-P price range would miss.

16-bit ADC Resolution

Supports measurement sensitivity of up to 100 µV on its most sensitive, and 400 µV on its least sensitive range.

Stand-alone Data Logger Operation

Store data to flash drives at throughput rates up to 160kHz.

Pre/Post Tigger Storage to USB Memory

Set trigger levels to record up to 2G (combined) of pre- and post-trigger data (total file size of 4G).

Seven Digital Ports

Folds discrete I/O into the measurements process. Each bit is programmable as an input or as a switch.

Rate Measurement Channel

Measures pulse rate as may be acquired from a pickup for rpm measurement, or sensor to measure flow.
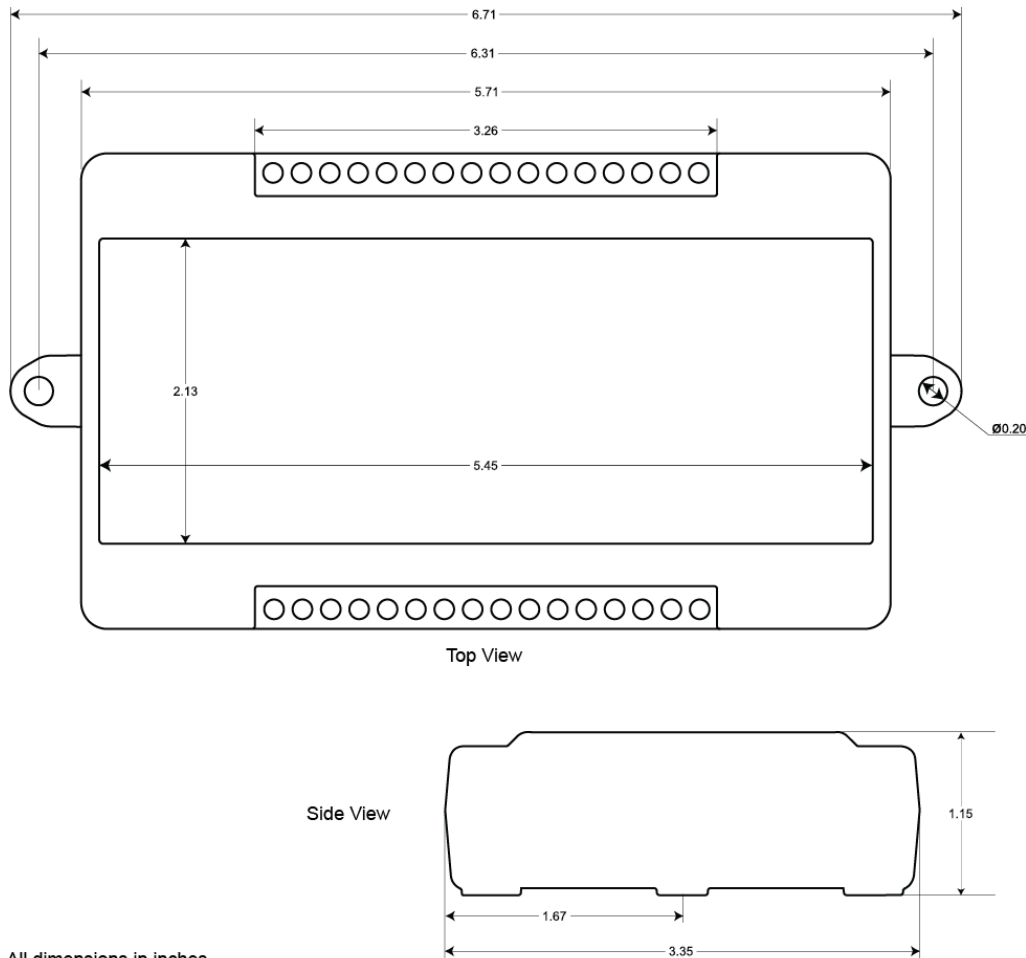
Counter Channel

Tallies the number of pulses applied. Useful for integrating rate information, like flow rate to volume, or simply the number of definable events.
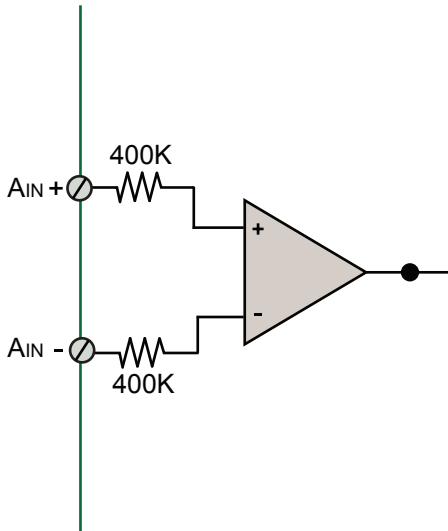
Software Support

Offered with ready-to-run WinDaq software and documented command protocol for OS-independent use.
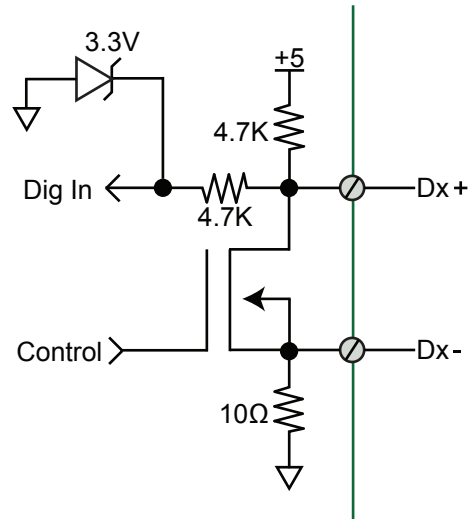
DI-2108-P Dimensional Drawing

Top View

Side View

All dimensions in inches

Analog Input

Digital Port

Synchronize Multiple Units with ChannelStretch™ Technology

Need more channels? Add another unit. Add up to fifteen more for a total of 128 analog channels and 112 digital ports to a maximum throughput rate ≥ 480 kHz using the DI-2108-P's ChannelStretch™ technology. Multiple DI-2108-Ps connected to the same USB hub automatically synchronize to within 10 µS between units. If you need more USB ports to accommodate more DI-2108-P units, simply cascade multiple USB hubs to expand port count. Best of all, when using WinDaq software the enabled channels of all synced units flow into the same WinDaq application. They're displayed and stored together as though they all originated from a single instrument. Synchronized instruments must have the same sample rate per channel, and have the same number of enabled channels independent of channel type or gain factor. The WinDaq/Unlock option *per instrument* is required to synchronize two or more DI-2108-Ps when using WinDaq software.

ChannelStretch™ Technology

16 units max
Max throughput ≥ 480 kHz
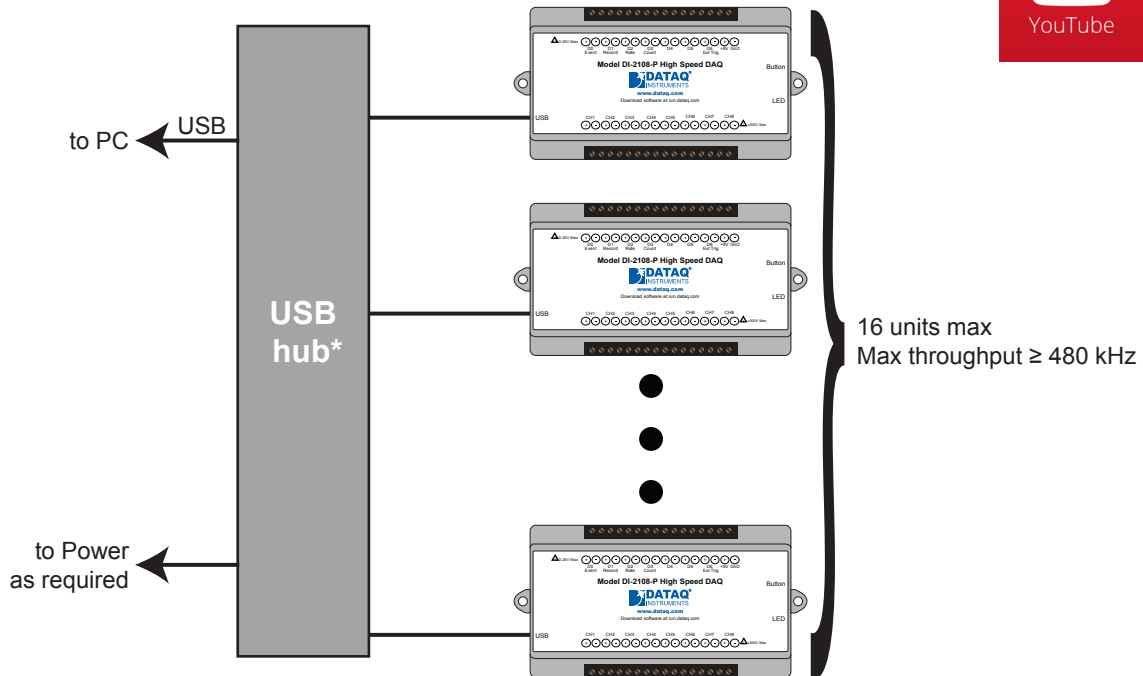
*DATAQ Instruments 7-port USB hub (part number 2000310). Cascade for a higher port count.

DI-2108-P Scan List Flexibility

The DI-2108-P maintains an internal scan list of as many as eleven different items at once. The maximum sample throughput rate is 160 kHz, one enabled channel can be sampled at that rate, two enabled channels at 80 kHz each, etc. The scan list can be populated with any combination of analog input channels, digital input ports, the rate channel, and the counter channel. Scan list positions for analog channels support the analog channel number and also the measurement range, allowing the latter to be assigned independently per channel.

Item	Scan List Positions	Comments
Analog channels	Up to eight	One scan list position is consumed for each enabled analog channel
Digital inputs	One	All seven digital ports are read simultaneously with one entry in the scan list
Rate channel	One	
Counter channel	One	

DI-2108-P Analog Measurements

Eight analog input channels with independent programmable gain are supported by the DI-2108-P. Each offers differential input capability with rejection of common mode voltages (those that appear simultaneously and in-phase on both inputs.) These channels are also hardened to tolerate excessive voltages to protect against wiring mishaps (see specifications.)
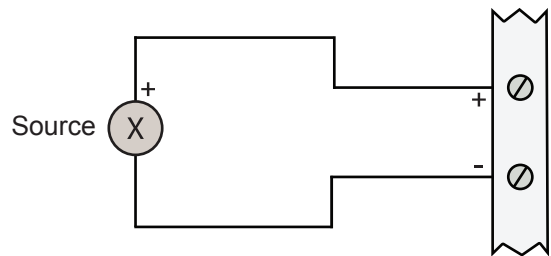
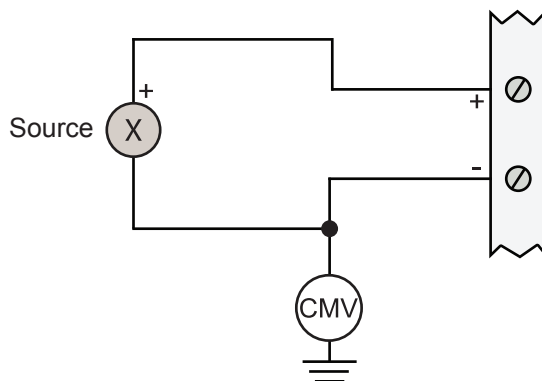| Measurement Mode	Measurement Range (V)	Measurement Resolution (μV)
Biploar	±2.5	100
	±5	200
	±10	400
Unipolar	0-5	100
	0-10	200

4-20 mA current (low-side or high-side shunt)
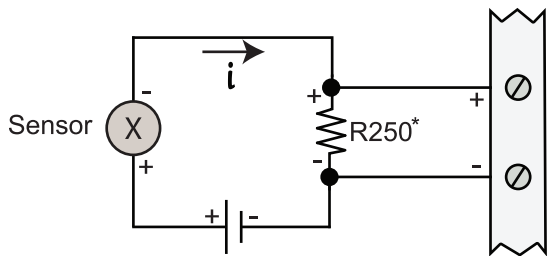
*Optional (see ordering guide)

Voltage source

### Voltage source with common mode voltage

DI-2108-P Rate and Count Measurements

Digital ports D2 and D3 can be programmed for multiple functions. Both can be programmed as discrete inputs or outputs. In addition, port D2 can be programmed as a rate input and port D3 as a counter input. When programmed to measure rate and/or count the DI-2108-P adds these measurements to its internal scan list along with any other analog or digital data so that all measurements are acquired in the same time frame. Rate measurements in the range of 10 Hz to 50 kHz are possible across twelve programmable full scale ranges. Use the rate input to extract rpm data from a rotating device, or to acquire flow information from a pulse-type flow sensor. Count measurements up to 65,536 are supported by the D3 port. Use count to integrate flow to get volume, or use it simply to tally events in a given process.
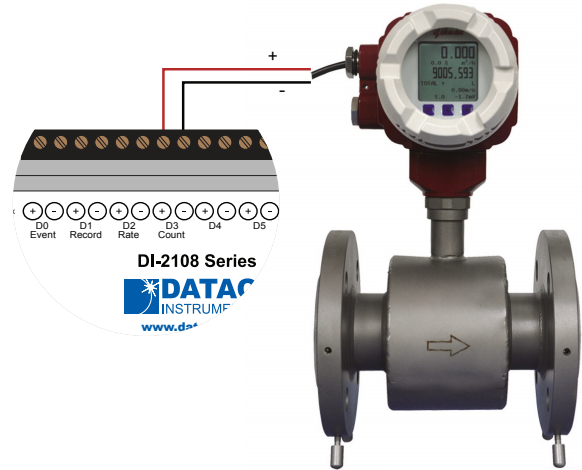
Rpm from rate

The DI-2108's Rate input is used to acquire a frequency representing rpm, flow, or any other pulse stream.
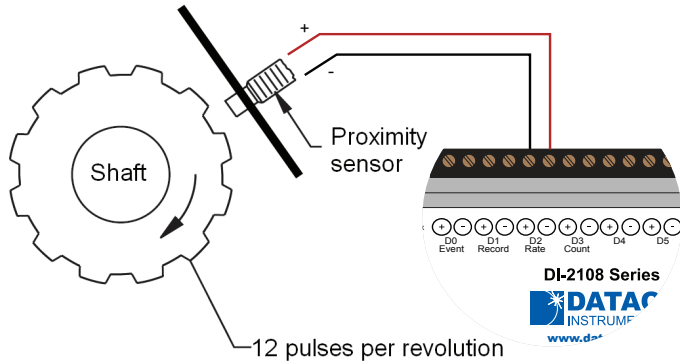
Flow/volume

Use the DI-2108's Count input to accumulate a tally of applied discrete pulses to track test cycles, extract volume from flow, or any other general-purpose totalizing application.

General-purpose Digital Port Operation

Each DI-2108-P digital port can be configured as a digital input or used as a switch to control an external load. Ports are configured by a MOSFET that defines the port's function, where the MOSFET is either on or off. When the MOSFET is off the port is available as a discrete input. Turning the MOSFET on allows the port to function like a switch for loads up to 25 V and 100 mA. Care should be exercised when configuring the load to be switched to ensure that the digital port is not damaged:
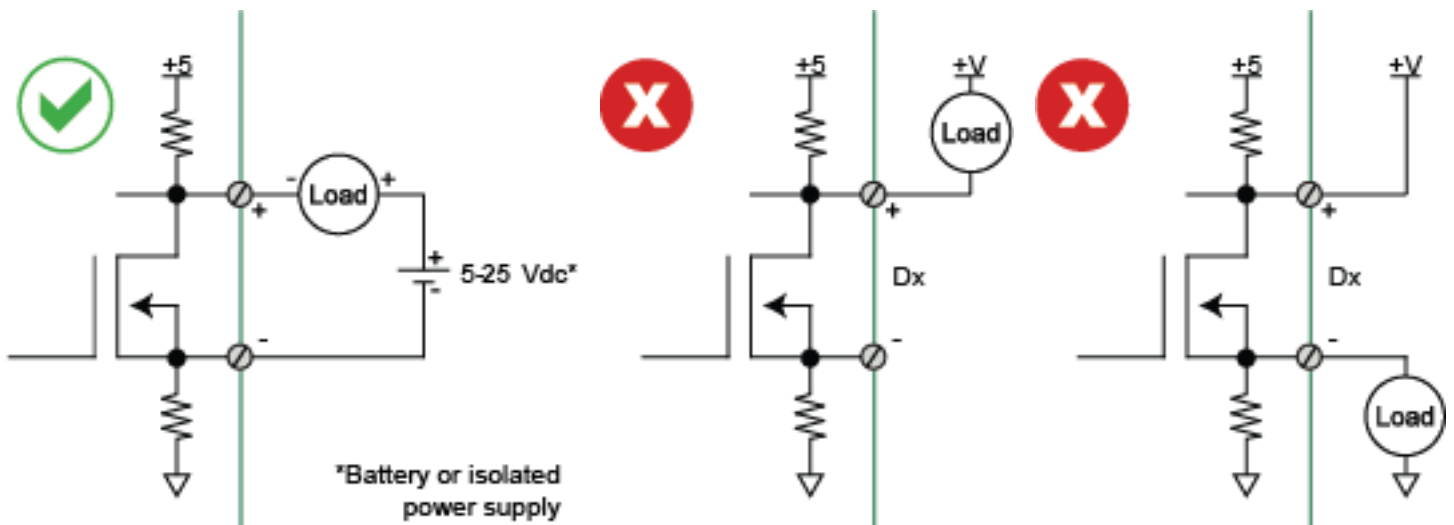
Setup

Double-click and enter the channels you want to acquire into the WinDaq scan list. These can be channels from a single or multiple units. Click to select an analog, rate, or count channel. Click to define a single to 8-channel display — either triggered sweep (oscilloscope-like) or scrolling (chart recorder-like). Click again to define a sample rate ranging from 18 samples per minute to 160,000 samples per second.
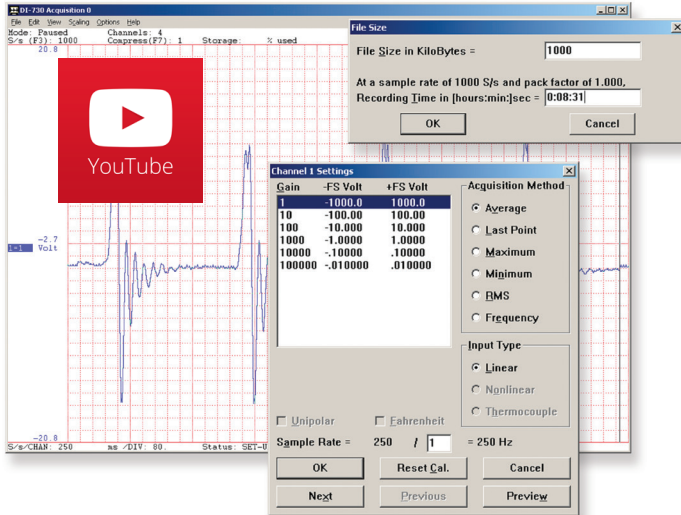

Calibrate

Define calibration per channel to display waveform values in meaningful units such as psi, °F or °C, amps, rpm, watts, horsepower — any unit of measure you need.
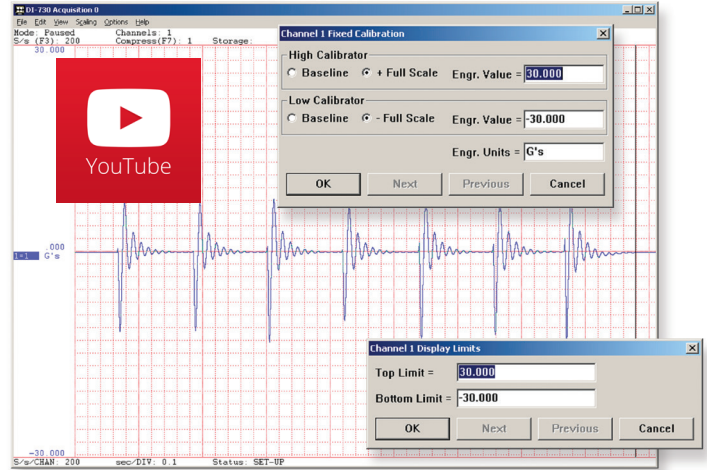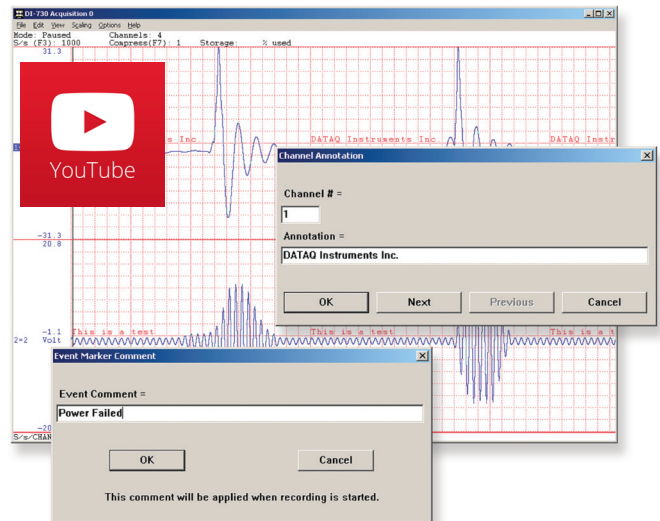

Record

Choose a continuous waveform recording mode or the triggered mode with selectable trigger level, slope, and post-trigger times. WINDAQ automatically time- and date-stamps, then streams acquired data to disk — record as much data as you need. At the same time, WINDAQ supplies a real-time graphical display of any or all channels so you always know where you are and where you're going.
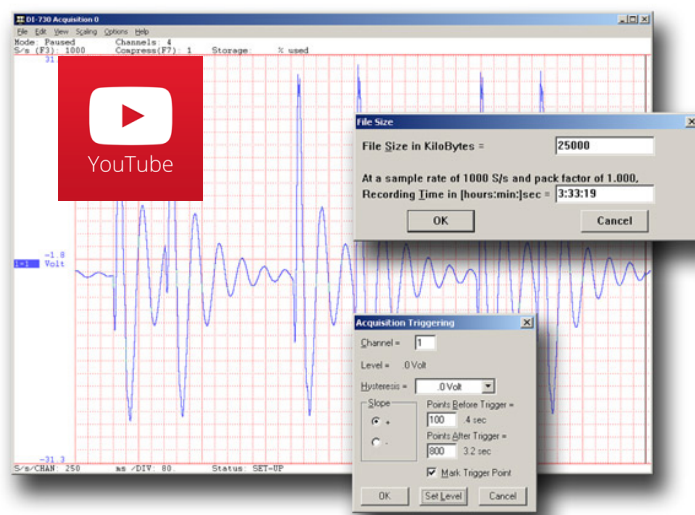
Annotate

Of course, you can label any channel with text that describes it — "Motor 1," "Engine speed," "Vertical position," etc. But WINDAQ also allows you to supply commented event markers while you record — "Beginning test phase 1," "Small vibrations noticed," "Starting cool-down cycle," etc. Your comments and our acquired data combine to form a complete diary of your data acquisition session.

Playback

Recording is only half the solution. WɪɴDᴀQ's Waveform Browser playback software allows you to graphically manipulate waveforms in ways you've never seen on a PC. Compress an entire recording to one screen-width for a bird's eye view, then expand around an area of interest for a closer look. Use the cursor to measure amplitudes and timing with precision. Move to any event marker with the click of a mouse button.

Multitask

Double your productivity and let WɪɴDᴀQ record while you review last week's results from your spreadsheet, or compose a memo with your word processor. You can even play back data already stored to disk while you're still recording.
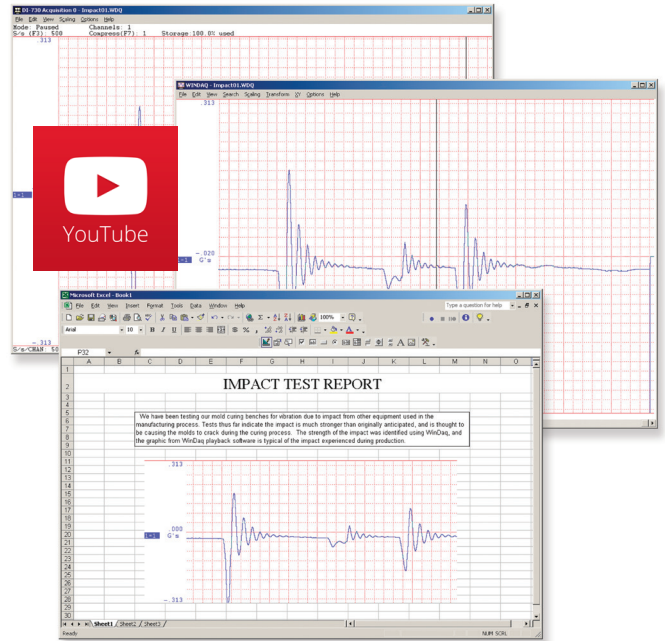
Analyze

Waveform interpretation is easy with our built-in analysis functions. Apply frequency and filtering analysis with the WɪɴDᴀQ Waveform Browser FFT and DFT functions. Analyze any range of waveform data with the statistics function. Use X-Y plotting to examine the relationship of one channel to another. Optional Advanced CODAS analysis functions allow waveform peak detection, integration, differentiation, arithmetic operations, and more.
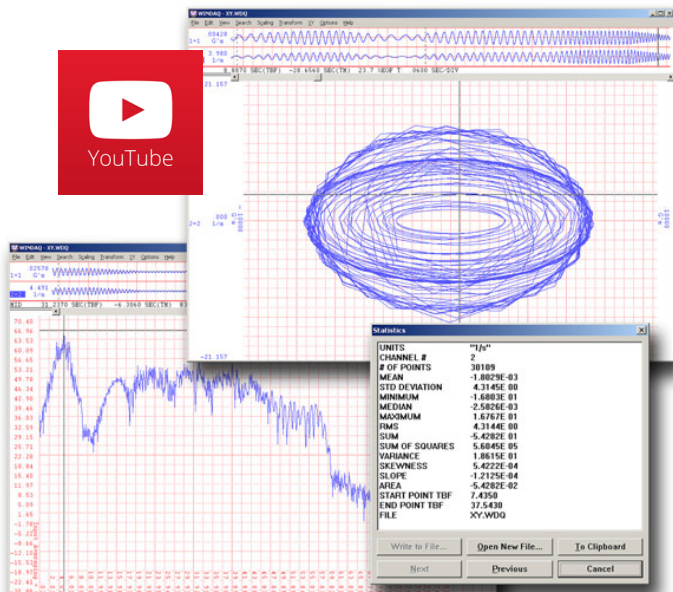
Export

The WɪɴDᴀQ Waveform Browser can export any range of data to your spreadsheet, or any other analysis or presentation package you use. You can even copy a graphical image displayed by the WɪɴDᴀQ Waveform Browser and paste it directly into a word processing document. Finally, export any range of waveform graphics to your printer for a hard copy record.
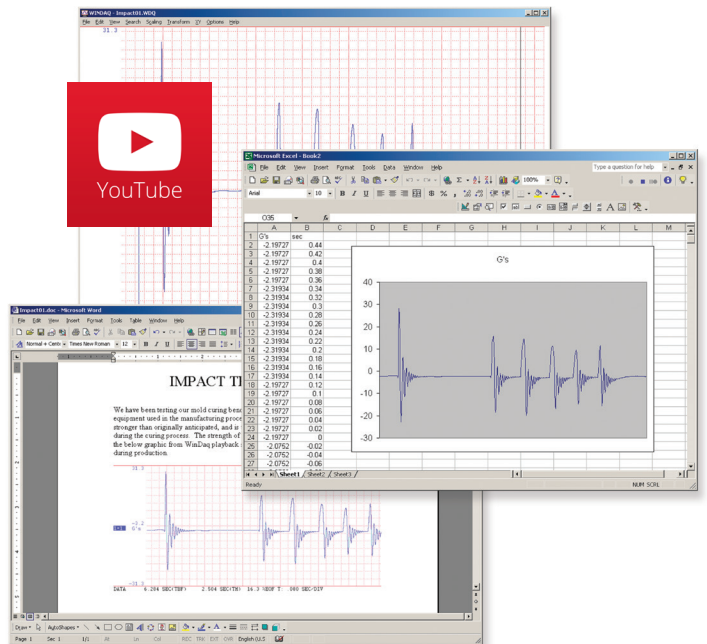
Stand-alone Data Logger Operation

A USB drive can be used to record and store up to 32GB of data. The DI-2108-P can record continuously using a circular buffer (with pre-defined trigger conditions) or record-until-full approach. A push button allows manual start/stop control over the recording process. A multi-color LED shows the status of the DI-2108-P (Record, Standby, Busy, Error).

Varying degrees of flash memory technology will influence performance when recording in stand-alone mode. With a flash memory card incorporating SLC technology, throughput rates up to 160 kHz can be achieved. That rate drops to 50 kHz when using a pSLC card, and 10 kHz using a flash memory card incorporating MLC or some other branded technology.

Please Note: The DI-2108-P cannot be connected to your computer's USB port when recording to the USB thumb drive.

Flash Technology	Speed
MLC/Generic	Up to 20 kHz
pSLC	Up to 50 kHz
SLC	>50 kHz

Triggering with Stand-alone Operation

Set a trigger and the amount of pre and post trigger data scans to capture only the data you want.

With a trigger and number pre/post trigger scans selected, you can capture just the data you're interested in, before and after an event occurs. Choose a trigger level on any analog channel and acquire up to 2 G of pre and post trigger data to a USB drive. You can choose a trigger channel, trigger level and the number of pre and post trigger scans. The auto rearm option enables you to continuously create new files each time the threshold level is breached.

This is particularly useful in the case of a destructive test. For example, when ramping up current to a motor until a failure occurs, you're likely interested in how the motor behaved just prior to the failure, and what happened immediately thereafter. Was the failure gradual, or sudden? Were there indicators leading up to the failure? Triggered storage allows you to hone in on that information.
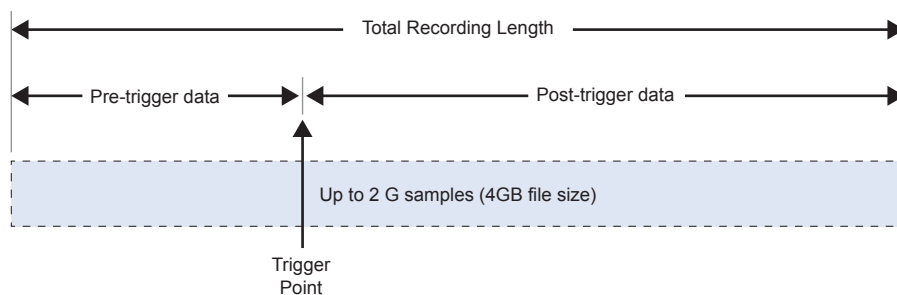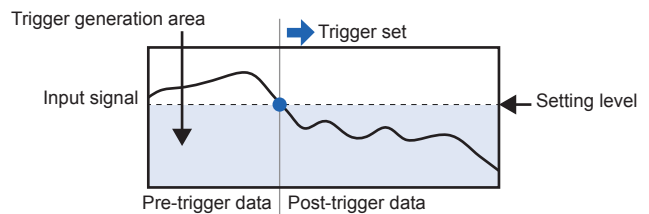

Specify the trigger channel, level, rising or falling slope.

Rising Slope
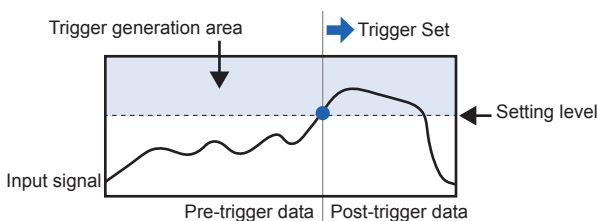
Falling Slope

Stand-alone Setup

The stand-alone configuration for the DI-2108-P is performed using the WinDaq Dashboard. With the DI-2108-P plugged into an available USB port, run the WinDaq Dashboard, select the device you would like to configure, and select "Stand Alone Setup" from the "Configure" menu. Configurable settings include:

• Enable analog channel and setup

• Enable digital channels.

• File Storage mode including record on trigger conditions.

• Sample Rate selection as sampling interval.

• File Storage Format: WinDaq or CSV.

• Record on Power Startup option.

• Save Configuration and Load Configuration utility.

Four Analog Channel Reporting Modes

The DI-2108-P can be configured per channel to report just the last sample acquired like other data acquisition products. Unlike other products three additional reporting modes, selectable per analog channel, provide much more flexibility when reporting oversampled data:

- **Average value**
  Oversampled data is passed through an average algorithm. The number of samples included in the average is the ratio of the burst sample rate to programmed channel sample rate.

- **Maximum value**
  Oversampled data is evaluated for the maximum value. Use Maximum to peak-detect complex waveforms.

- **Minimum value**
  Oversampled data is evaluated for the minimum value. Use Minimum to valley-detect complex waveforms.

All four operating modes are supported by WinDaq software. And, since they are applied by DI-2108-P firmware, custom programs can easily leverage these features without incremental programming overhead.

Published Instrument Protocol

Sometimes you can't use a ready-to-run application like WinDaq. You need to develop your own software to perform in precisely the way you need. That requirement defines the need for programming support so you have the tools necessary to move forward.

Included DI-2108-P Protocol Documentation

As you probably suspect when you run our point-and-click WinDaq data acquisition software, there's a lot going on beneath the surface. WinDaq software needs to take the data acquisition configuration that you design using its menu system and communicate that to the hardware. These are things such as sample rate, the number of channels enabled, the specific channel numbers enabled, etc. Diving down to the lowest level of program activity, past the WinDaq user interface, beyond the device driver to the actual commands sent to the data acquisition hardware and the format of the responses they evoke, is the protocol. The protocol defines the exact set of commands a program can send to the hardware, and how the hardware will react as a result. So, if you know the command and response definitions for the DI-2108-P (i.e. its protocol), the instrument can be folded into virtually any operating system and any programming language: Python, C++, Linux, Windows, OSX, etc., etc. The choice is yours.
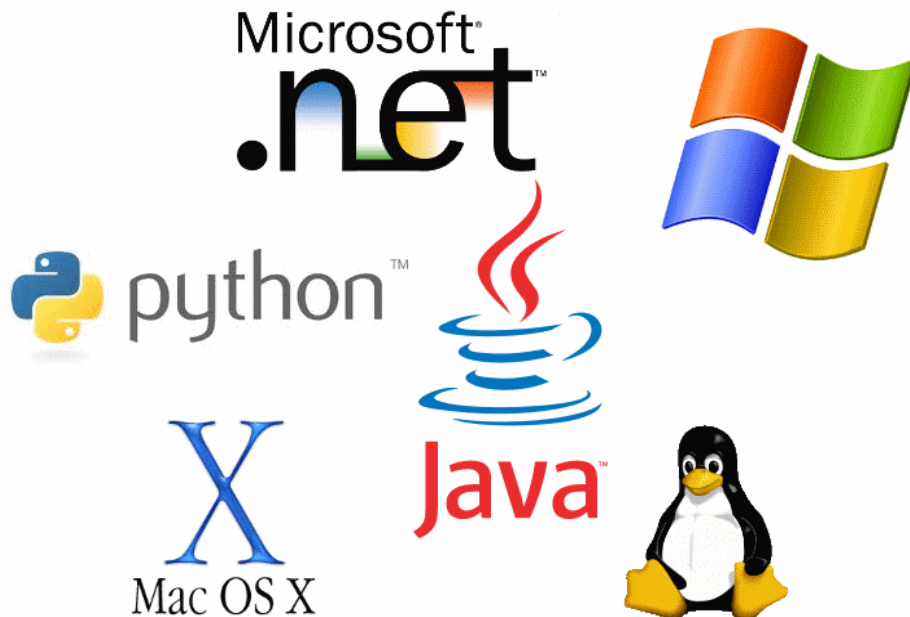
DI-2108-P Specifications

Signal I/O

Analog Inputs

Number of Channels:	8
Configuration:	Differential
Measurement range per channel:	Programmable ±2.5, ±5, ±10, 0-5, 0-10 Volts
Input impedance:	800 kΩ differential
Dc accuracy:	±0.05% of range 25°C, excluding common mode error
Absolute maximum input without damage:	±150 V dc or peak ac (normal mode + common mode)
Common mode range:	±228 V dc or peak ac
Common mode rejection ratio: dc to 60Hz 0Ω unbalance	90 dB typical
Channel-to-channel crosstalk rejection:	110 dB typical

Digital Ports

Number of ports:	7
Type:	MOSFET switch
Configuration:	Programmable as digital input or switch
Pull-up value:	4.7 kΩ
Input high voltage threshold:	2.4V
Input low voltage threshold:	0.8V
Absolute maximum applied voltage (V):	0 ≤ V ≤ 25 V

Reserved Digital Inputs

Port 1:	WinDaq remote events
Port 2:	WinDaq remote start/stop
Port 3:	Rate input
Port 4:	Count input

ADC Characteristics

Analog Inputs

ADC Resolution:	16-bit
Resolution applied to measurements:	>15.6-bit
Maximum sample throughput:	160 kHz throughput
Minimum sample throughput:	Hardware: 1.831 kHzwith WinDaq software: 0.305 Hz
Sample rate timing accuracy:	50 ppm (typical over 24 hours)

Digital Ports Programmed as Switch

Maximum drain voltage:	25 V
Maximum sink current:	100 mA

Power

Power consumption:	<1.0 Watt, via USB interface

Removable Memory

Type:	MLC, pSLC, or SLC flash memory (with USB SD card reader); USB thumb drive
Required Format:	FAT32

Synchronized Performance

Number of synced units: (PC-dependent)	16 units max; Throughput ≥ 480 kHz
Channel skew between any 2 units:	10 µS, typical
Setup constraints:	Syncs only with other model DI-2108-P instruments. Same number of enabled channels per synced unit (type does not matter) Same sample throughput rate per synced unit. All units connected to the same USB controller using one or more hubs.

Count/Rate

Digital port assignment:	Count: Port 2 configured as input Rate: Port 3 configured as input
Internal pull-up value:	4.7 kΩ
Input high voltage threshold:	2.4V
Input low voltage threshold:	0.8V
Terminal count:	65,535
Maximum rate frequency:	50 kHz (20 kHz with a single enabled channel and 160 kHz sampling rate)
Minimum rate frequency:	0.5 Hz
Maximum count frequency:	50 kHz

Indicators and Connections

Interface:	USB 2.0 (mini-B style connector)
Status LED:	Single multi-color LED

	Connecting	Idle	Recording	Armed	Rearmed	Busy	Error
USB	○●	●●	●●	—	—	—	●
Drive	○●	●●	●●	●●	●●	●●	●

Input connections:	Two 16-position screw terminal strips
USB A Connector:	USB drive for stand-alone data logging
Button:	Multi-function control

Environmental

Operating temperature:	0 to 50 °C
Operating humidity:	0 to 90 %RH, non-condensing
Storage temperature:	-20 to 60 °C
Storage humidity:	0 to 90 %RH, non-condensing

Physical Characteristics

Enclosure:	Polycarbonate ABS, 0.080 inch thickness
Mounting:	Desktop; bulkhead
Dimensions (overall):	6.68W × 3.28D × 1.13H in 169.67W × 83.31D × 28.7H mm
Weight:	5.7oz. (162 grams)

Software Support

WinDaq Software:	OS support: Visit http://www.dataq.com/products/windaq/window-compatability.
Programming:	Instrument protocol

Ordering Guide

Description			Order No.
DI-2108-P USB DAQ Includes instrument, USB cable, screwdriver, 32GB USB flash drive with callibration certificate (pdf) and WinDaq software (also available via download).	DI-2108-P	**USB Hub** 7-port, powered USB hub.	2000310
250Ω 4-20 mA shunt resistor ±0.1%, 0.5 Watts max., ±50 ppm/°C	R250	**WinDaq/Unlock** Applies to WinDaq software only. Allows more than four channels to be recorded from a single device. Also required per synced DI-2108-P.	WINDAQ/ Unlock- 2108-EMAIL
MLC Flash Memory Card Low-speed micro SD flash memory card. Recommended for recording rates under 20 kHz throughput.	2000351	**Flash Card Reader** Flash memory card reader for micro SD cards.	2000352
16GB pSLC Flash Memory Card High-speed micro SD flash memory card. Recommended for recording rates from 20 kHz throughput to 50kHz.	101014-16-MS	**4GB SLC Flash Memory Card** High-speed micro SD flash memory card. Recommended for recording rates over 50 kHz throughput.	101014-4-HS
32GB pSLC Flash Memory Card High-speed micro SD flash memory card. Recommended for recording rates from 20 kHz throughput to 50kHz.	101014-32-MS	**8GB SLC Flash Memory Card** High-speed micro SD flash memory card. Recommended for recording rates over 50 kHz throughput.	101014-8-HS

DATAQ®
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Fax: 330-666-5434

Data Acquisition Product Links
(click on text to jump to page)
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