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

- Eight armored analog differential inputs
  - Up to ±300 V without damage
  - 80 dB common mode rejection
  - Multi-unit synchronization for higher channel count applications
  - 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
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 ±300 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.

Packaging and Controls
We’ve released the DI-2108-P in a new, sleek, low-profile package to allow it to fit in almost any location. Rubber feet on the bottom of the case prevent it from sliding around in your workspace. A multi-color LED conveys device status at a glance, and a side-mounted pushbutton provides manual event marking capability when used with WinDaq software.

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.
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 ±300 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.

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
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

*DATAQ Instruments 7-port USB hub (part number 2000310). Cascade for a higher port count.
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.

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

### 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.)

<table>
<thead>
<tr>
<th>Measurement Mode</th>
<th>Measurement Range (V)</th>
<th>Measurement Resolution (μV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bipolar</td>
<td>±2.5</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>±5</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>±10</td>
<td>400</td>
</tr>
<tr>
<td>Unipolar</td>
<td>0-5</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>0-10</td>
<td>200</td>
</tr>
</tbody>
</table>

**4-20 mA current (low-side or high-side shunt)**

*Optional (see ordering guide)*

**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.

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**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. WinDaq’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 WinDaq 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 WinDaq 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 WinDaq 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 WinDaq 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.
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.
### 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
- **Input accuracy:** ±0.05% of range 25°C, excluding common mode error
- **Absolute maximum input without damage:** ±300 V dc or peak ac
- **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

#### ADC Characteristics
- **ADC Resolution:** 16-bit
- **Resolution applied to measurements:** >16.5-bit
- **Maximum sample throughput:** 160 kHz throughput
- **Minimum sample throughput:** Hardware: 1.831 kHz with 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 consumption:** <1.0 Watt, via USB interface

### Synchronized Performance
- **Number of synced units:** 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)
- **Indicator light:** Multi-color LED
- **Input connections:** Two 16-position screw terminal strips

### 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
- **Programming:** Instrument protocol

### Ordering Guide

<table>
<thead>
<tr>
<th>Description</th>
<th>DI-2108-P USB DAQ</th>
<th>DI-2108-P USB Hub</th>
<th>Order No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order No.</td>
<td>2000310</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DI-2108-P USB DAQ</td>
<td>Includes instrument, USB cable, screwdriver, and WinDaq software via download.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7-port, powered USB hub.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>250Ω 4-20 mA shunt resistor</strong></td>
<td>R250</td>
<td></td>
<td></td>
</tr>
<tr>
<td>±0.1%, 0.5 Watts max., ±50 ppm/°C</td>
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</tbody>
</table>

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**Data Acquisition Product Links**

(click on text to jump to page)

*Data Acquisition | Data Logger*

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