Warranty and Service Policy

Product Warranty
DATAQ Instruments, Inc. warrants that this hardware will be free from defects in materials and workmanship under normal use and service for a period of 1 year from the date of shipment. DATAQ Instruments' obligations under this warranty shall not arise until the defective material is shipped freight prepaid to DATAQ Instruments. The only responsibility of DATAQ Instruments under this warranty is to repair or replace, at its discretion and on a free of charge basis, the defective material.

This warranty does not extend to products that have been repaired or altered by persons other than DATAQ Instruments employees, or products that have been subjected to misuse, neglect, improper installation, or accident.

DATAQ Instruments shall have no liability for incidental or consequential damages of any kind arising out of the sale, installation, or use of its products.

Service Policy
1. All products returned to DATAQ Instruments for service, regardless of warranty status, must be on a freight-prepaid basis.

2. DATAQ Instruments will repair or replace any defective product within 5 days of its receipt.

3. For in-warranty repairs, DATAQ Instruments will return repaired items to the buyer freight prepaid. Out of warranty repairs will be returned with freight prepaid and added to the service invoice.
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1. Introduction

This manual contains information designed to familiarize you with the features and functions of the DI-2108-P USB data acquisition system.

Features

The DI-2108-P data acquisition instrument is a portable data recording module that communicates through your computer's USB port. Power is derived from the interface port so no external power is required. Features include:

- 8 fixed differential analog inputs protected to ±300V (transient).
- 7 digital ports protected to +25V.
- 16-bit measurement resolution
- Programmable measurement ranges of ±2.5, ±5, ±10, 0-5, and 0-10 Volts.
- Up to 160 kHz maximum throughput sampling rate.
- A push-button to tag remote events in WinDaq software.
- LED indication for easy notification of device status.
- Free WinDaq/Lite data acquisition recording software. Records up to four channels of data. Purchase an unlock code to record more than four channels.
- Counter channel.
- Frequency channel.
- ChannelStretch™ Technology allows you to sync up to 16 units with a total throughput of 480kHz or more (requires unlock code for each device).
- Included .Net Class supports programming the DI-2108-P under any .Net programming language.*
- Fully documented instrument protocol for programming the device in operating systems other than Windows.*

*ChannelStretch requires that each device be unlocked when used with WinDaq software. WinDaq unlock is not required for ChannelStretch if programming devices yourself using the .Net class or instrument protocol.

Analog Inputs

The DI-2108-P features eight differential channel inputs located on a single sixteen-position screw terminal block for easy connection and operation. Measurement ranges of ±2.5, ±5, ±10, 0-5, or 0-10 Volts are programmable on a per channel basis. Analog channels are protected to ±300 V dc or peak ac.

Utilize the functionality of WinDaq software to experience all the features encased in these small, inexpensive instruments. Unlock code required to record more than four channels of any type.

Digital I/O

The DI-2108-P contains seven digital ports, which may be used as a general-purpose digital input or for a specific function as designated on the device. Digital port D0 may be used for WinDaq Events; Digital port D1 may be used for WinDaq remote Start/Stop; Digital port D2 may be used for rate measurements; Digital port D3 may be used for counts; Digital ports D4-D6 are general purpose digital input port. Please Note: Digital outputs are not supported in WinDaq software. Each port may be configured as a switch using third-party software.
Software

All software required to record and playback waveforms is included with the purchase of any DI-2108-P data acquisition system via download.

**WINDAQ® Recording and Playback Software**

WINDAQ Acquisition and WINDAQ Waveform Browser allow you to record and playback data acquired through your instrument. WINDAQ software is an invaluable resource to record and analyze your data and is available for free from our web site (www.dataq.com).

WINDAQ Lite Data Acquisition software (free) can be used to record waveforms directly and continuously to disk while monitoring a real time display of the waveforms on-screen. It operates, displays, and records up to four channels in real time. An optional unlock code is available to record the rest of the channels on the device or to allow you to sync multiple units.

WINDAQ Waveform Browser playback software (also known as “WWB”) offers an easy way to review and analyze acquired waveforms. A built-in data file translator allows the user to display multiple waveforms acquired by WINDAQ Acquisition software or any of a wide range of data acquisition packages. The software’s disk-streaming design allows data files of any length to be graphically displayed rapidly, in normal or reverse time directions. Seven standard cursor-based measurements, frequency domain, and statistical analysis functions help simplify waveform analysis and interpretation. WINDAQ Waveform Browser is free and installed when installing WINDAQ Software.

**Help**

All WINDAQ software utilizes context-sensitive help. Help may be accessed through the Help menu or by pressing the F1 key with any pull-down menu item selected. This will take you directly to the Help topic most relevant to that particular function or feature. Help topics discuss in detail each function available in the software.
2. Specifications

**Analog Inputs**

- Number of Channels: 8
- Channel 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: ±300 V dc or peak ac (normal mode + common mode)
- Common mode range: ±228 V dc or peak ac
- Common mode rejection ratio: 90 dB typical
- dc to 60 Hz 0Ω unbalanced
- 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**

- Resolution: 16-bit
- Resolution applied to measurements: >15.6-bit
- Max. sample throughput rate: 160 kHz throughput
- Min. sample throughput rate: 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: 25V
- Maximum sink current: 100 mA
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 (with total160 kHz burst 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

Power
Power Consumption: <1.0 Watt, via USB interface

Environmental
Operating Temperature: 0°C to 50°C (32°F to 122°F)
Operating Humidity: 0 to 90% non-condensing
Storage Temperature: -20°C to 60°C (-4°F to 140°F)
Storage Humidity: 0 to 90% non-condensing

Physical Characteristics
Enclosure: Polycarbonate ABS, 0.080 inch thickness
Mounting: Desktop; bulkhead
(169.67D × 83.31W × 28.7H cm.)
Weight: 5.7 oz. (162 grams)
Software Support

WINDAQ software: OS support: Check online at http://www.dataq.com/products/windaq/windows-compatibility/

Programming: Instrument Protocol, .NET class
3. Installation

The following items are included with each DI-2108-P USB Data Acquisition System. Verify that you have the following:

- A DI-2108-P USB data acquisition instrument.
- 6-foot USB cable.
- A DATAQ Instruments screwdriver for signal lead connections.

If an item is missing or damaged, call DATAQ Instruments at 330-668-1444. We will guide you through the appropriate steps for replacing missing or damaged items. Save the original packing material in the unlikely event that your unit must, for any reason, be sent back to DATAQ Instruments.

Install WINDAQ Software

All software for the DI-2108-P can be installed via a downloadable executable directly from the DATAQ Instruments website. No CD is shipped with the device. You may burn the executable onto a CD or USB drive to transport the software to a computer with no internet connection.

1. Disconnect all DATAQ Instruments USB devices from your Computer.


3. You must subscribe to our newsletter in order to get the software download link (you can opt-out after download).

4. Save the file to your local hard drive.

5. Double-click on the downloaded file to extract the program and begin software installation.
6. Follow the on-screen prompts and enter any required information.

7. Software installation is complete - you will now see a “Successful Installation” box - click **OK** to exit WINDAQ Installation.

You can now plug the device(s) into your PC. Click on the appropriate program group (specified above — default is Start > Programs > WINDAQ) and click on “DATAQ Instruments Hardware Manager” to access WINDAQ software.

**Connect the Instrument to Your Computer**

DI-2108-P instruments can be connected to your computer’s USB port using the provided USB cable. No external power is required. Connect one end of the communications cable to the instrument port and the other to your PC’s port.

*Note:* *Use a powered USB hub or a USB port on your PC. Non-powered USB hubs may not have sufficient power to run the instrument.*
4. Controls, Indicators, and Connections

Please note: The Micro SD card slot is not used in the DI-2108-P. Allowing foreign materials to enter the device through the Micro SD card slot may result in damage to the instrument.

Mini-B USB Connection

Use the supplied USB cable to connect and power the instrument through your computer’s USB port.

Screw Terminals

All input signal connections are made to the 16-port screw terminals. Each terminal is labeled on the instrument case.

⚠️ CAUTION ⚠️

Never touch exposed screw terminal connector pins or screws.

To avoid ESD damage in handling the device, take the following precautions:

Ground yourself with a grounding strap or by touching a grounded object before and during your handling of the instrument.
**DI-2108-P Signal Connections**

Refer to the following for screw terminal port identification.

<table>
<thead>
<tr>
<th>Ch#</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ch1-Ch8</td>
<td>Analog channels 1-8 (Programmable ±2.5, ±5, ±10, 0-5, 0-10 Volts, ±300V transient max.)</td>
</tr>
<tr>
<td>D0 EVENT</td>
<td>WinDAQ Remote Event Marker (or general-purpose)</td>
</tr>
<tr>
<td>D1 RECORD</td>
<td>WinDAQ Remote Start/Stop (or general-purpose)</td>
</tr>
<tr>
<td>D2 RATE</td>
<td>Rate Input (or general-purpose)</td>
</tr>
<tr>
<td>D3 COUNT</td>
<td>Counter Input (or general-purpose)</td>
</tr>
<tr>
<td>D4 and D5</td>
<td>General-purpose digital ports</td>
</tr>
<tr>
<td>D6 EXT TRIG</td>
<td>General-purpose for DI-2108-P</td>
</tr>
</tbody>
</table>

+5V: +5 V out. Max current = 100mA.

GnD: Ground.

**Connecting Signal Leads**

Connect signal leads to the DI-2108-P:

1. Insert the stripped end of a signal lead into the desired terminal directly under the screw.
2. Tighten the pressure flap by rotating the screw clockwise with a small screwdriver. Make sure that the pressure flap tightens only against the signal wire and not the wire insulation. Do not over-tighten.
3. Tug gently on the signal lead to ensure that it is firmly secured.
When an input signal is connected and WinDAQ Acquisition software is run, WinDAQ’s real time display immediately reveals the input waveform on your computer’s monitor.

**Analog Inputs**

Eight differential analog inputs measure ±2.5, ±5, ±10, 0-5, 0-10 Volts (CH1 to CH8, programmable per channel). Designed to withstand ±300 V dc or peak ac.

Use the following diagram to connect Analog Input Channel 1.
Specify a full scale range for the channel in the menu item **Edit > Channel Settings**.

±2.5, ±5, and ±10 Volts are available. Select Unipolar for ranges of 0-5V or 0-10V.

Scroll through all enabled channels with the **Next** and **Previous** buttons.
**Digital Ports**
The DI-2108 contains 7 general-purpose digital ports. Each digital port can be configured as a digital input or used as a switch to control an external load (up to 25 V and 100 mA). Many of the ports also provide specific functionality in WINDAQ or a third-party program.

- D0 Event is for WINDAQ Remote Events. This bit inserts an event marker in your data.
- D1 Record is for WINDAQ Remote Storage. This bit can be programmed to begin recording data.
- D2 Rate is for Rate measurements: 10Hz to 50kHz.
- D3 Count is for Counter/Timer measurements up to 65,536.
- D4 and D5 are general-purpose digital inputs.
- D6 Ext Trig is a general-purpose digital input on the DI-2108-P.

Equivalent Digital I/O Circuit:
**WINDAQ Remote Events (D0 Event)**

To use a switch closure or TTL signal to record WINDAQ Event Markers, connect signal leads to the appropriate Remote Control Event terminals on the DI-2108-P as shown below.

Once the switch closure or TTL signal is connected, activate Remote Events through WINDAQ Acquisition Software. Events may be automatically placed on the rising or falling edge of the trigger signal. Use the menu command **Options > Remote Events +** to set WINDAQ to place event markers on low-to-high transitions of the Event input. Use the menu command **Options > Remote Events -** to set WINDAQ to place event markers on high-to-low transitions of the Event input.

Event markers may also be placed in your data file manually by pressing the push button on the DI-2108-P Instrument. You must enable Remote Events in WINDAQ to use the button (use the menu command **Options > Remote Events +** or **Options > Remote Events -**).
An example event marker in a WinDAQ data file is shown below.

*Please Note: Event Markers do not display in the real-time WinDAQ acquisition software - they only display in the WinDAQ playback software (WWB).
WinDaq Remote Storage (D1 Record)
To use a switch closure or TTL signal to begin recording data remotely, connect signal leads to the appropriate Remote Control Record terminals on the DI-2108-P as shown below.

Once the switch closure or TTL signal is connected, activate Remote Storage (Record) through WinDaq Acquisition Software. Storage to Disk may be automatically placed on the rising or falling edge of the trigger signal. Use the menu command Options > Remote Storage 1 to set WinDaq to begin recording on low-to-high transitions of the Record input. Use the menu command Options > Remote Storage 0 to set WinDaq to begin recording on high-to-low transitions of the Record input.

WinDaq Rate (D2 Rate)
Enable channel 10 to record Rate, or the number of falling-edge transitions per unit of time that are applied to this input. Click on Edit > Channels in the WinDaq Acquisition menu to open the Channel Selection grid. Channel 10 is
the designated Rate channel. Click on the Channel 10 channel box to enable/disable Rates. The Channel 10 channel box will display an “R” when enabled.

Connect any TTL pulse stream (25 VDC max) to the D2 Rate channel on the DI-2108-P.

Select Channel 10 in the channel display, then select Edit > Channel Settings in the menu to specify a full scale range for the Rate channel. Ranges of 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, and 50000 Hz are available. Choose a range that comes closest to your expected full scale rate or frequency. For example, if you need to measure the output of a flow meter that can measure a maximum flow rate of 100 gallons per minute, and the output
frequency at that rate is 100 Hz, you would choose the 100 Hz range setting. A range setting of 200 Hz full scale sac-
ifices half of the instrument's resolution at 200 gallons per minute, and a range of 50 Hz allows measurements to
only 50 gallons per minute full scale.

Check the "Cycles/min" box to display and select frequencies reported in cycles per minute instead of cycles per sec-
ond (the measurement interval remains the same). Tachometer measurements in units of RPM (revolutions per min-
ute) is just one example that benefits from selecting this option. For example, if the 100 Hz range setting is selected
and "Cycles/min" is checked, the full scale range is actually 6000 cycles per minute.

Please Note: To measure the maximum rate, which is defined as 2 times the Maximum Sample Rate/Channel, the cur-
rent values of Maximum Sample Rate/Channel divided by Sample Rate per Channel MUST be an integer.

WinDaq Counter (D3 Count)
Enable channel 11 to record Counts, or the number of falling-edge transitions that are applied to this input. The count
may be reset via WinDaq software or under program control as necessary. Click on Edit > Channels in the WinDaq
Acquisition menu to open the Channel Selection grid. Channel 11 is the designated Count channel. Click on the Channel 11 channel box to enable/disable Counts. The Channel 11 channel box will display a “C” when enabled.

The counter channel accumulates counts over time whether recording or in standby mode as soon as the Counter channel is enabled. The accumulated values will be recorded to your data file unless you reset the counts to zero. The maximum count value is 65,535 before the counter resets to zero automatically.

Use the Edit > **Reset Count** command in WinDAQ Acquisition software to reset counts immediately to zero. This feature is available in both standby and record modes.

Use the Edit > Preferences > **Reset Count on New File Record** in WinDAQ Acquisition software to reset the count at the start of a new file or when using the Edit > Preferences > Record Next File on Full or Open Next File on Full feature to reset counts to zero every time a new file is started.

Use the Edit > Preferences > **Reset Count on Manual Record** in WinDAQ Acquisition software to reset counts to zero every time you begin or resume recording a data file using the File > Record command (F4).
Connect any TTL pulse stream (25 VDC max) to the D3 Count channel on the DI-2108-P.

General Purpose Digital Inputs

Enable Channel 9 for general-purpose digital input functions. Click on **Edit > Channels** in the WINDAQ Acquisition menu to open the Channel Selection grid. Channel 9 is the designated Digital Input channel. Click on the Channel 9 channel box to enable/disable the digital inputs. The Channel 9 channel box will display an “I” when enabled.
Channel 9 records and displays all the digital inputs, even the state of the Rate and Count inputs if those channels are enabled. With Channel 9 selected in the display window click Scaling > Digital Plot to show a digital display and make the data more meaningful on screen.

**General Purpose Digital Outputs**
Take care when configuring the load to be switched to ensure that the digital port is not damaged:
4-20mA Current Loop Measurements

Use the following diagram for 4-20mA current loop measurement connections.

![Diagram showing 4-20mA current loop connections]

The shunt resistor should be placed on the low side of the circuit as shown below:

![Diagram showing shunt resistor placement]

Model DI-2108-P High Speed DAQ

Download software at run.dataq.com

www.dataq.com

Shunt Resistor

Model R250

4-20 mA current source

Current Loop Transmitter

I 4-20mA

Loop Power Supply

250Ω

Shunt Resistor

To DI-2108-P Analog Input Channel
Set the engineering units as desired and define upper/lower levels in WinDAQ as 1V = 4mA for the low value and 5V = 20mA for the high value. For example, when using WinDAQ Acquisition software, in the EU Settings dialog box:

![Channel 1 Engineering Unit Settings](image)

Enter the following values:

<table>
<thead>
<tr>
<th>Volt</th>
<th>EU</th>
<th>EU Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Level</td>
<td>5</td>
<td>20 mA</td>
</tr>
<tr>
<td>Lower Level</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>


You can also associate these values to a physical measurement such as pressure, load, flow, torque, etc. Read the Help files for more information regarding Engineering Units Settings.

**LED Indicator**

The DI-2108-P provides a multicolor LED for instrument status and notification.

**Flashing Green:** Indicates power is applied via the USB cable and the device is idle.

**Flashing Blue:** Indicates the device is in use either by WinDAQ Acquisition Software or a custom user-developed program.

**Flashing Red:** Indicates a buffer overflow.

**Flashing Red/Blue:** Indicates buffer overflow that the software recovers from causing gaps in recorded data.

**Solid White:** Indicates when the Event Button is pushed or the Event terminals are connected via a relay contact or digital input.

**Flashing Yellow:** Indicates the device that contains the selected channel in WinDaq Acquisition software when scanning multiple synced devices.

**All other Solid colors:** Indicates error.

**ChannelStretch™**

Connect up to 16 DI-2108-P devices with a powered USB hub (or multiple cascaded/connected powered USB hubs) to record more than 8 channels of data to a single WinDaq file. This provides a total of up to 128 analog channels and 112 digital ports at a maximum throughput rate of 480 kHz. Cascade multiple USB hubs to expand port count. Synchronized instruments must have the same sample rate 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.
Connection
All device must be on the same USB hub or controller* in order to synchronize data acquisition.

*Please Note: Because of the way Windows operating systems manage USB controllers, the only way to be absolutely sure you are on the same controller is to use a powered USB hub.
**Channel Selection**

Devices are listed in the Channel Selection grid in alpha-numeric order of the serial numbers of the device. Devices must be connected to the USB hub before starting WinDaq.

Enable the same number of channels in each device you would like to record data from.
Sample Rate

The sample rate for DI-2108-P devices is set as a per device throughput rate or “Sample Rate/Device.” Select **Edit > Sample Rate** in the main menu or press **F3**.

The sample rate per channel is displayed in the lower left corner of the WinDaq screen at S/s/CHAN: (samples per second per channel).

Total throughput rate is displayed in the top-left portion of the WinDaq screen at S/s (F3). For example, if two devices are connected and the Sample Rate/Device is 400, S/s would be 800.
5. Unlock WinDaq

The DI-2108-P will record up to four channels using WinDaq/Lite software. An unlock code is required to record more than 4 channels. Go to http://www.dataq.com/products/di-2108-p/ to purchase the unlock code (click on the Accessories tab) or call 330-668-1444. Once purchased, you will be given a Key code to enter into WinDaq.

1. Start WinDaq Acquisition software.

2. Click the menu item Help > Unlock WinDaq.

3. Enter the Key in the appropriate dialog boxes.

4. Click OK.

You can now record all the channels available on your device.
6. Dimensional Drawing

All dimensions in inches