SDAQ-216/218

Standalone Ethernet DAQ for
Distributed Machine Condition Monitoring

User's Manual



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LEADING EDGE COMPUTING

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Revision History

Revision	Release Date	Description of Change(s)
1.0	2023-03-20	Initial Release

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Preface

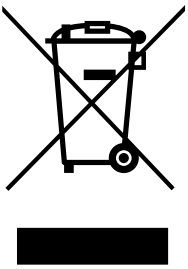
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Conventions

Take note of the following conventions used throughout this manual to make sure that users perform certain tasks and instructions properly.

NOTE: Additional information, aids, and tips that help users perform tasks.

CAUTION: Information to prevent ***minor*** physical injury, component damage, data loss, and/or program corruption when trying to complete a task.

WARNING: Information to prevent ***serious*** physical injury, component damage, data loss, and/or program corruption when trying to complete a specific task.

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1 Introduction

With the advent of IoT, more field devices are connecting to the Internet. Instead of being distributed at each field site, systems can be monitored and managed from a central control room. In this scenario, machine condition monitoring systems play a crucial role. Monitoring devices are typically deployed at the OT site, but by using an Ethernet-based data acquisition system (DAQ), machine conditions can be monitored remotely by IT staff.

The ADLINK SDAQ-216/218 is a standalone Ethernet DAQ that acquires voltage and current signals from a monitored machine which represent the machine status, with a threshold setting mechanism reporting important results to the backend server. This in turn dramatically reduces network bandwidth traffic as well as the backend server’s computing burden.

The SDAQ-216/218 is designed for on-site process automation in the field. When recovering from a power failure, the system will automatically resume its previous running state. The SDAQ-216/218's compact size also makes it easy to install in the limited confines of an electrical control cabinet.

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1.1 Features

- Standalone Ethernet DAQ for edge computing
- RESTful API reports machine conditions to IT system
- Built-in web console for easy configuration and to facilitate use as a portable DAQ
- Supports TCP socket (client mode) to transmit data actively
- Supports custom filtering algorithms for edge data
- 8- or 16-channel, 16-bit analog input up to 250 kS/s
- System automatically resumes its previous running state upon power recovery
- 1x RS-485 port for serial communication with Modbus RTU protocol
- 8-channel isolated digital input/output
- Two 1 Gb Ethernet ports for cascading

1.2 Applications

- Distributed machine condition monitoring
- Machine status detection through voltage and current signal

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1.3 Specifications

1.3.1 General Specifications

System Specifications	
Ethernet (1 Gb)	2x RJ-45 Ethernet ports (1 IP, Ethernet cascade when powered on)
MCU	ARM Cortex A9 1.0 GHz
NAND Flash (eMMC)	32 GB
Memory	DDR3 RAM 1 GB
USB	2x USB 2.0 (for Wi-Fi dongle and USB storage only)
Power Supply	9 to 30V DC power input (optional: 40W AC-DC adapter, P/N 31-62138-0000)
Power Consumption	SDAQ-216: 5.5 W max. SDAQ-218: 6.7 W max.
Communication Interfaces	Web console, RESTful API, TCP socket (client mode), DAQPilot SDK
Digital Temperature Sensor (TI LMT01)	-50°C to 150°C (with 3 meter cable)

1.3.2 Analog Input

Analog Input Specifications	
Number of Channels	8 for SDAQ-218, 16 for SDAQ-216
Resolution	16-bit
Maximum Sampling Rate	250 kS/s and can be shared by selected channels. 100 KHz for multi-channel gain queue
Input Range (voltage)	±10V, ±2.5V, ±1.25V, ±312.5mV
Input Range (current)	0 to 20mA
Input Configuration	16 single-ended, or 8 pseudo-differential
Input Coupling	DC
Input Impedance	1 GΩ, 249.0 Ω (input resistor) for current mode
Sensor Type	Voltage: 0.5 to 4.5V DC , 1 to 5V DC, 0 to 5V DC, 0 to 10V DC Current: 4 to 20mA

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Analog Input Specifications	
Offset Error	Voltage mode: ±1 mV (± 10 V) Current mode: ±0.01 mA (typical)
Gain Error	Voltage mode: ±0.05% of FSR (± 10 V) Current mode: ±0.13% of FSR (typical)
-3dB Bandwidth	>100 Hz
Flatness	±0.1dB (20 Hz to 30 KHz)
Trigger Sources	Software, digital trigger, analog trigger, built-in button
Overvoltage Protection	±15 V
Input Impedance	SDAQ-216: >1G ohm SDAQ-218: ±249 ohms
CMRR	105 dB for ±1.25 V & ±0.3125 V 95 dB for ±2.5 V 85 dB for ±10 V
SFDR	100 dB for ±10 V, Diff
THD	103 dB for ±10 V, Diff
SINAD	86 dB for ±10 V, Diff
SNR	87 dB for ±10 V, Diff
ENOB	14-bit for ±10 V, Diff

1.3.3 Isolated Digital I/O

Isolated Digital I/O Specifications	
Number of I/O	4-ch digital input and 4-ch digital output
Digital Type	TTL input: 0-5 V for DI / Open drain for DO
Input Logic Level	Logic low: VIL = 0.8 V max., IIL = 0.2 mA max. Logic high: VIH = 2.0 V min., IIH = 0.2 mA max.
Supplied Voltage	5 to 35V DC (for DO open drain)
Input Frequency Range	500 KHz for 1 µs pulse
Max. Sink Current	250 mA @ 100% duty (per channel)
Overvoltage Protection	DO: -50V to +50V; DI: 0V to +5V
Supported Modes	• Static digital input/output • Tachometer support (DI 0 only; range: 0.6 Hz to 500 kHz; 500 kHz for 1 microsecond) • External digital trigger in

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1.3.4 Analog Ouptut Specifications

Analog Ouptut Specifications	
Resolution	16-bit
Number of Channels	2 channels for voltage and current
Maximum Update Rate	100 Ksps and settling time 10 µs
Output Range	AO Current output: Maximum Load: 600 ohm AO Voltage Output Range: ±10 V AO Current Output Range: 0 to 20mA, No waveform generator support
AO Accuracy: Offset Error	Voltage mode: ±0.6mV, 2LSB Current mode: ±1µA, 3LSB
AO Accuracy: Gain Error	Voltage mode: ±0.05% FSR Current mode: ±0.05% FSR
INL	≤1LSB
DNL	≤1LSB
Output Driving Capacity	±5 mA
Slew Rate	2.0 V/µs
Settling Time (0.1% of Full Scale)	10 µs for 100 Ksps
Rising Time	10 µs
Falling Time	10 µs

1.3.5 Mechanical

Mechanical Specifications	
Dimensions	110.5 (L) x 40 (W) x 126.5 (H) mm
Connectors	2x 6-pin and 2x 14-pin spring-type terminal block
Front Panel LEDs	4
Housing	Metal, IP30
Mounting	DIN rail mount kit (optional: wall mount kit, P/N 34-51112-0000)

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1.3.6 Environmental

Environmental Specifications	
Operating Temperature	0°C to 70°C (32°F to 158°F)
Storage Temperature	-20°C to 85°C (-4°F to 185°F)
Humidity	Approx. 95% @ 40°C (non-condensing)
Vibration	Operating: 5 Grms, 5-500 Hz, 3 axes
Shock	Operating: 100 G, half sine 11 ms duration
EMC	EN61000-6-4/EN61000-6-2
EMI	FCC Part 15B Class A, CISPR 32
EMS	IEC 61000-4-2 ESD: Contact: 4 kV; Air: 8 kV IEC 61000-4-3 RS: 80 MHz to 1.0 GHz, 10 V/m IEC 61000-4-4 EFT: Power: 2 kV; Signal 2 kV IEC 61000-4-5 Surge: Power 0.5 kV; Signal 1 kV IEC 61000-4-6 CS: 0.15 MHz to 80 MHz, 10 V IEC 61000-4-8 PFMF
Safety	IEC 61010-1, IEC 61010-2-201 (pending)

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1.4 Mechanical Drawings

1.4.1 Dimensions

Units: mm

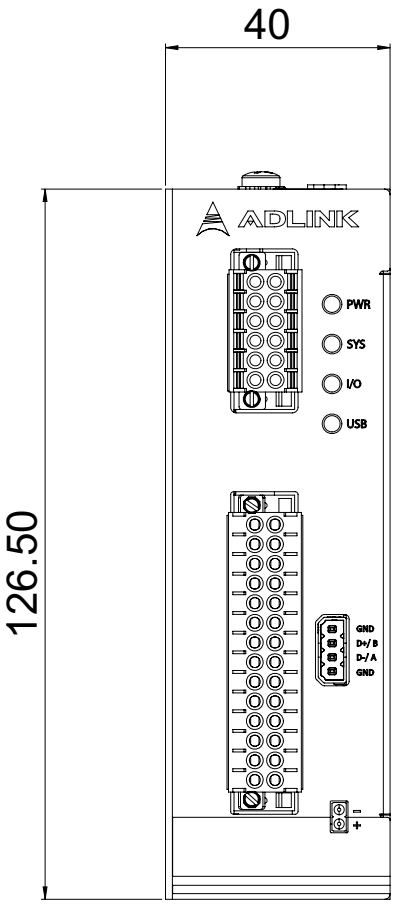


Figure 1-1: Front View

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Units: mm

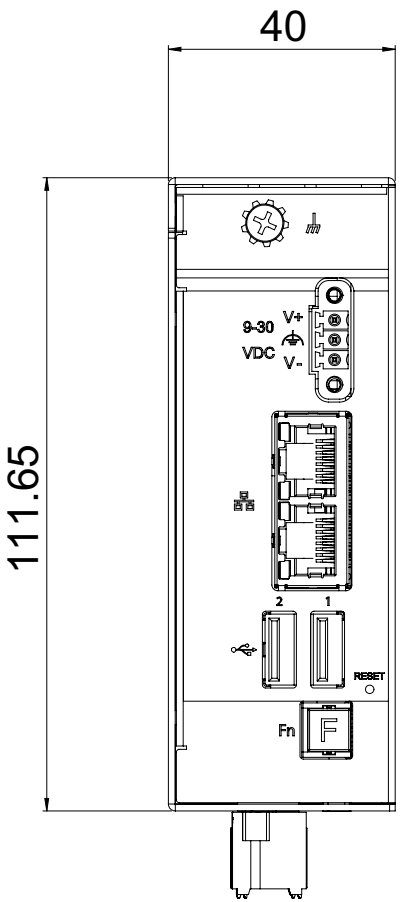


Figure 1-2: Top View

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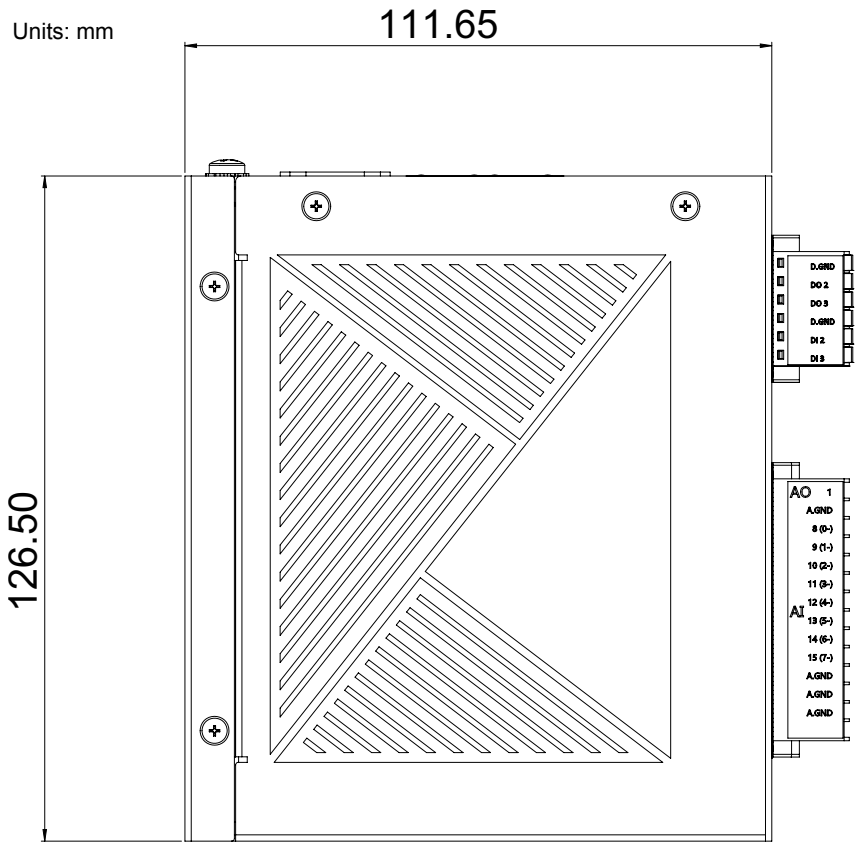


Figure 1-3: Left Side View

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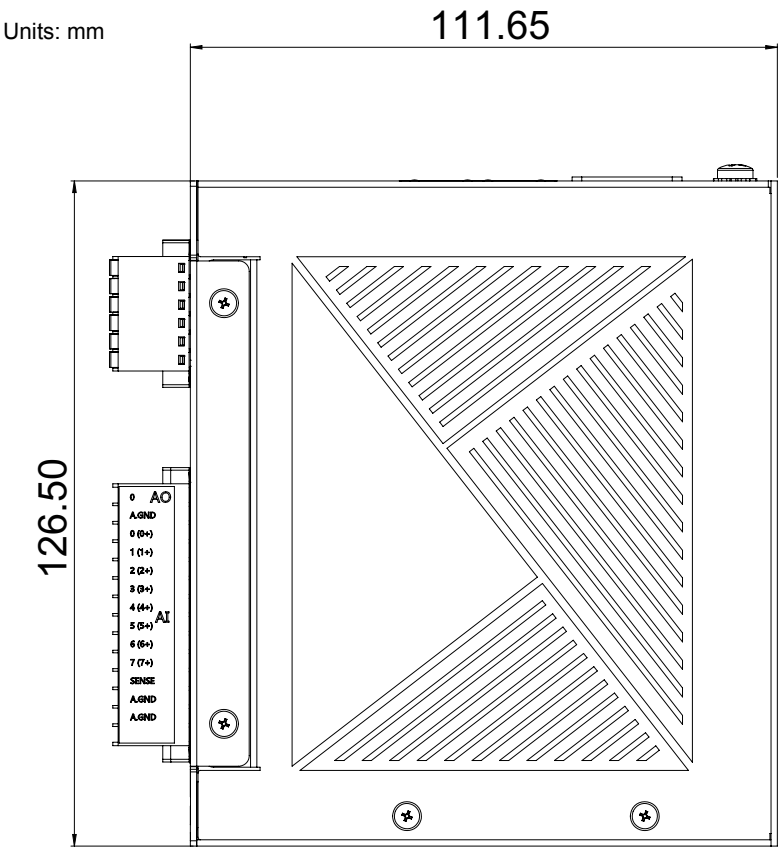


Figure 1-4: Right Side View

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1.4.2 DIN Rail Mount

The DIN rail mount may be attached to the SDAQ-216/218 using two flat head screws (included).

Units: mm

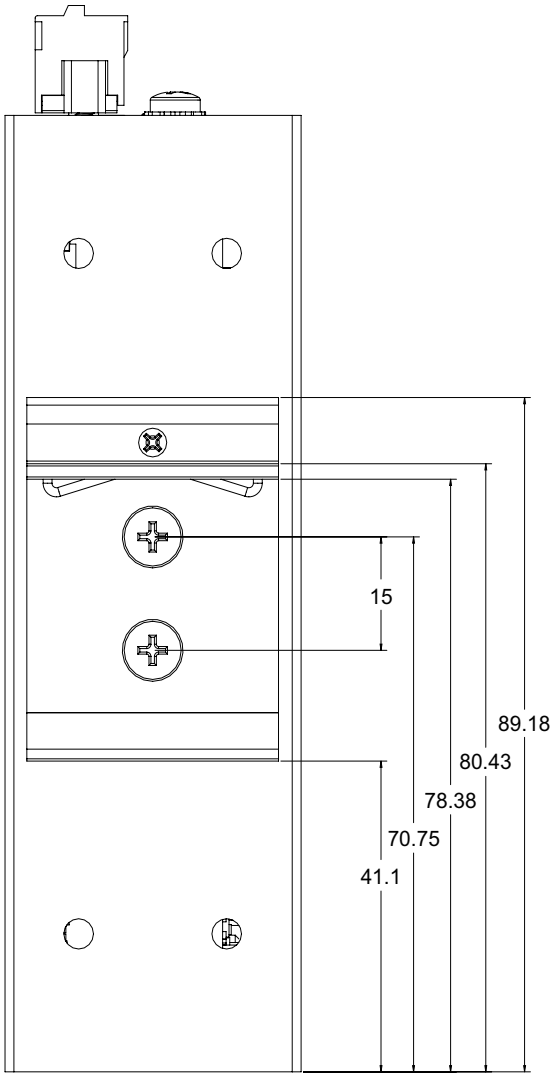


Figure 1-5: DIN Rail Mount Dimensions

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1.4.3 Wall Mount

The optional wall mount bracket may be attached to the SDAQ-216/218 via four pan head screws (included with wall mount kit, P/N 34-51112-0000; see also Figure 1-7 on page 13).

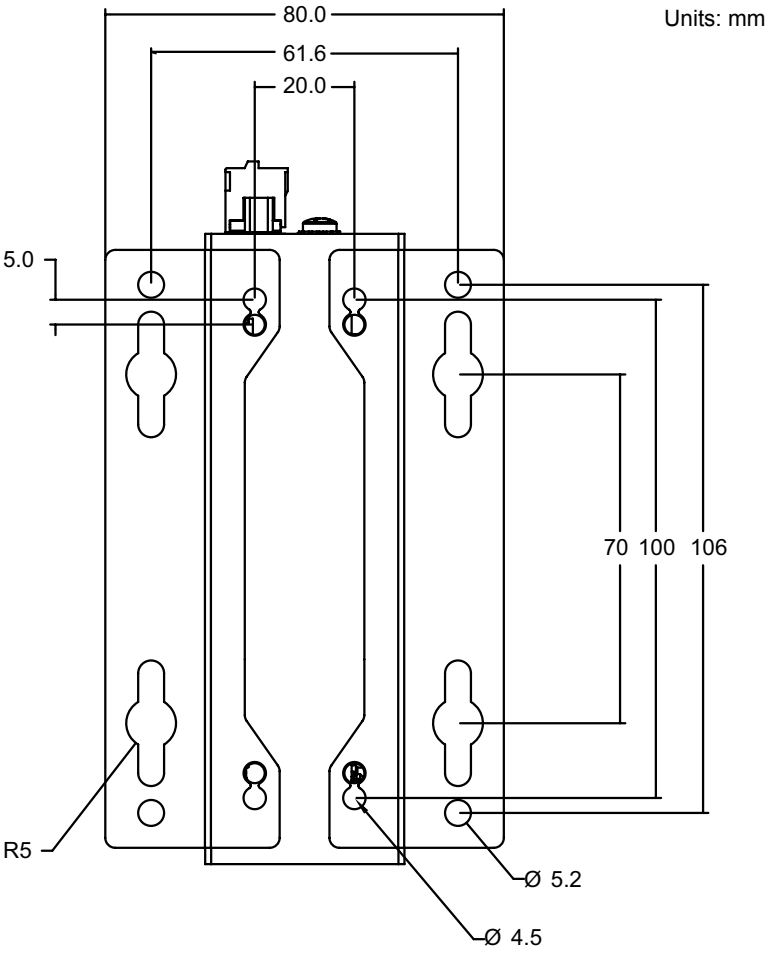


Figure 1-6: Wall Mount Dimensions

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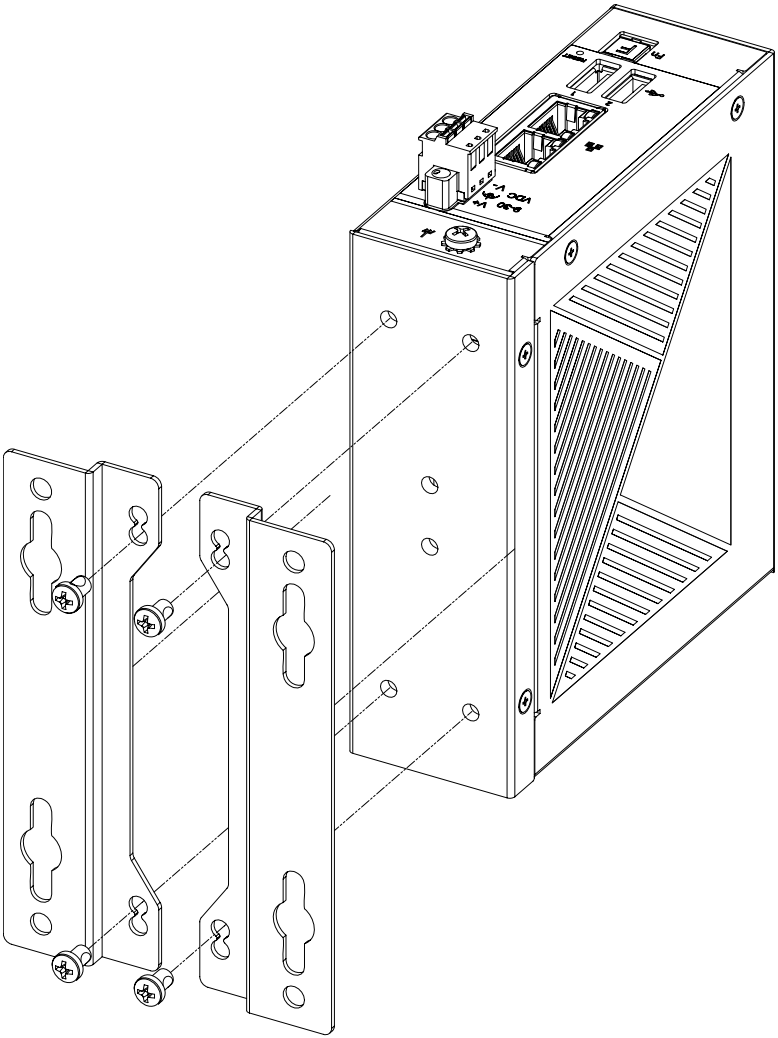


Figure 1-7: Wall Mount Assembly

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1.5 I/O Connectors

The SDAQ-216/218 provides rich peripherals, including:

- 8 or 16 analog inputs
- 4 digital input and 4 digital output connections
- 1 RS-485 port
- 1 temperature sensor input
- 2 USB 2.0 (for Wi-Fi dongle and USB storage only)
- 1 hotkey for triggering
- 1 reset pin for restoring the device to factory default settings
- 2 Ethernet ports for host connection and cascading
- 4 LED indicator lights

1.5.1 Analog Input and Analog Output

The SDAQ-216/218 module is equipped with a 2x14-pin terminal block for analog output and analog input. There are 2 analog output channels and 16 channels for analog input. The A.GND pin is for grounding.

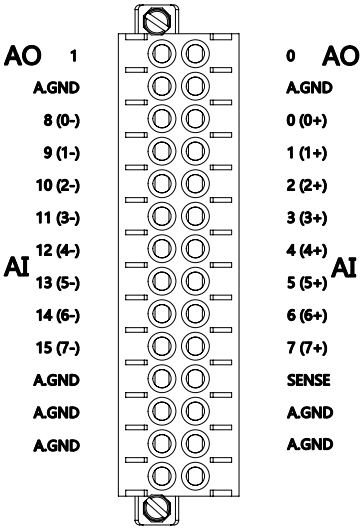


Figure 1-8: Analog Input/Output Connector

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1.5.2 Digital Input and Output

The SDAQ-216/218 provides 4 digital input and 4 digital output channels labeled DI and DO 0, 1, 2, and 3. Use **D.GND** for signal grounding with digital input/output. Use **A.GND** for signal grounding with analog input.

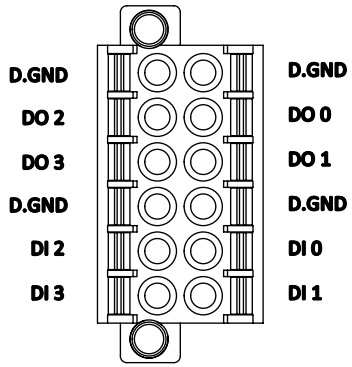
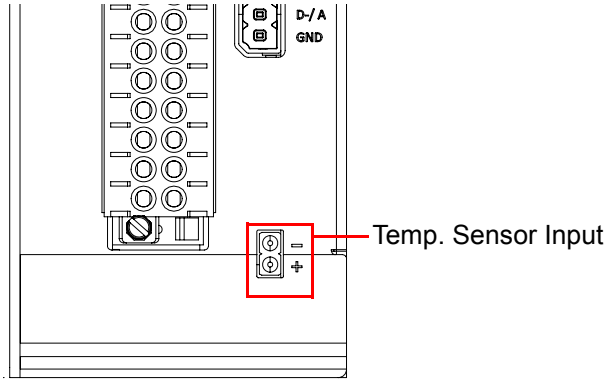


Figure 1-9: Digital Input/Output Connector

1.5.3 Temperature Sensor Input

The SDAQ-216/218 allows you to monitor the temperature of a target device or environment between -50 to 150°C using the temperature sensor provided. Connect the temperature sensor leads to the connector as shown.



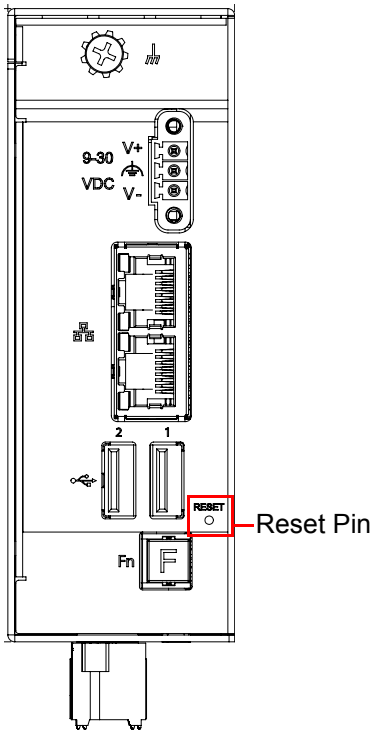
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1.5.4 Reset Pin for Factory Default

Restore the SDAQ-216/218 to its factory default settings using a paper clip or similar item inserted into the reset pin hole button and pressing the reset button for three seconds until the device reboots.

NOTE:

Users can optionally configure the SDAQ-216/218 to retain its current network settings rather than restoring the factory defaults. See “Web Console Login” on page 37.



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1.5.5 Ethernet Ports

The SDAQ-216/218 has two GbE ports with one MAC address. Either port can be used for connecting to a host PC, leaving the second port available for cascading. The default static IP address is 169.254.1.1.

LED1 (Amber)	LED2 (Green)	Link/Activity
OFF	OFF	Link off
OFF	ON	1000 Link/Activity (Tx, Rx)
ON	OFF	100 Link/Activity (Tx, Rx)
ON	ON	10 Link/Activity (Tx, Rx)

1.5.6 LED Indicators

The SDAQ-216/218 has four LEDs located on the front panel.

LED	Function	Description
PWR	Power input	▶ OFF: Device is not powered ▶ Steady red: Device is powered
SYS	Boot up and system status	▶ OFF: Powered off ▶ Flashing red, then steady red for about 35 seconds: Booting up ▶ Steady green: System ready ▶ Steady red: System error **Note**: Connect the SDAQ-216/218 to a host PC via Ethernet cable before powering it on to bypass the three minute boot up process.
I/O	Analog input	▶ Flashing: Analog data is being captured ▶ OFF: No data is being captured from FPGA
USB	USB Device	▶ Slow flashing green: A USB device is detected and ready to use. ▶ Fast flashing green: Data read/write activity

1.5.7 USB Ports

USB ports can be used to add a Wi-Fi dongle. Contact your ADLINK sales representative for more information.

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2 Getting Started

2.1 Unpacking the SDAQ-216/218

Ensure that the following items are included in the package. If any items are missing, contact your sales representative for assistance.

- SDAQ-216/218
- DIN rail mount kit with 2x flat head screws
- Temperature sensor with 3 meter cable
- Quick Start Guide
- Optional accessories (if applicable):
  - Wall mount kit with 4x pan head screws
  - 40W AC-DC adapter



Before unpacking, check the shipping carton for any damage. If the shipping carton and/or contents are damaged, inform your dealer immediately. Retain the shipping carton and packing materials for inspection. Obtain authorization from your dealer before returning any product to ADLINK.

2.2 Connecting to I/O

1. For analog input, plug in the accelerometer with a BNC type connector.
2. For digital input or output, insert the signal wires into the terminal block.
3. Use a CAT 5 type Ethernet cable to connect a host PC to one of the Ethernet ports on the top panel. To create a daisy chain of multiple SDAQ-216/218 devices, use the second Ethernet port to cascade them together. Cascading reduces the number of ports needed to connect devices.



If connecting SDAQ-216/218 devices in a daisy chain, only use a sequence configuration: do **not** use a ring configuration. A ring configuration will cause network communications to fail.

4. For temperature measurement, plug a two-pin temperature sensor connector into the front panel ports before attaching the temperature sensor to the target area to be measured.

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2.3 Connecting/Disconnecting Power

1 Before turning on the power source, connect the positive and negative wires from a 9 to 30V DC power source to the terminal block.

2. Turn on the power source. If the power was connected correctly, the front panel red PWR LED will light up.

If the SDAQ-216/218 needs to be shut down, turn off the power source.

To remove the power wires, use a flat head screwdriver to push the orange slots on the terminal block and then pull out the wires.



Ensure the power source is turned off before connecting or removing the power wires.

2.4 Checking Device Status

1 When power is supplied, the PWR LED will be red. The SYS LED will initially blink red, then turn to a steady red for about 35 seconds, then change to a steady green indicating the device has successfully booted up.

2. Log into the device's web console for additional status information and configuration options. see "Web Console Login" on page 37.

2.5 Usage Scenarios

The SDAQ-216/218 is designed for distributed machine condition monitoring and can be used in many kinds of scenarios. Choose the most suitable scenario depending on the system infrastructure, data type, and frequency of data retrieval.

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2.5.1 Deploy User-Developed Analytics Apps

The DAQPilot ACE software allows users to easily manage Smart DAQ devices and deploy user-developed applications on them.

DAQPilot ACE provides the following features:

- IDE for Python programming allowing users to develop and debug iApps remotely
- Provides a dashboard widget to show the data immediately
- Auto-discovers all supported devices on the local network
- Tags function allows users to identify or group multiple devices
- Deploys iApp to device via one-click function

For more information, see “DAQPilot” on page 23.

2.5.2 Configuration / Portable DAQ

Use the web console to configure device information, system settings, network settings, and test measurement analog input settings. For portable DAQ usage, the SDAQ-216/218 has a built-in dashboard to show the results of acquired data. The web-based console is also a convenient tool for users unfamiliar with DAQ behavior or programming. see “Web Console” on page 37.

2.5.3 Periodic Polling (REST API)

Many distributed machine condition monitoring applications acquire device status periodically, for example, every minute, or hourly. The SDAQ-216/218 retains captured data in the REST data format. Especially in IT systems, user applications frequently adopt REST APIs because they are intuitive. The SDAQ-216/218 emulates all functions supported by REST APIs, and the SDAQ-216/218 embedded middleware executes related operations and transfers the filtered data in JSON format. All queries from a REST command are handled by the SDAQ-216/218 and reply accordingly. see “DAQ Missions” on page 67.

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2.5.4 Continuous Data (DAQPilot SDK)

Some applications need to acquire streaming data continuously. To transmit high volumes without data loss, raw data without any transformation is best. For users needing to access the DAQ library directly, the DAQPilot SDK is the proper method. By using the streaming API, all queried raw data may bypass the SDAQ-216/218's middleware and route directly to the host PC via Ethernet. see "Continuous Data" on page 69.

2.5.5 Passive Data (TCP Socket)

For passively retrieving data, it is suitable to use a TCP socket with the SDAQ-216/218 in client mode. Whenever data is generated, the SDAQ-216/218 will be triggered to establish a TCP connection with the host PC and actively transmit the data. see "Web Console" on page 37.

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3 DAQPilot

DAQPilot is a software package for ADLINK DAQ products. It provides an integrated management utility that includes device management, iApp creation and allows deployment of user-defined data analytics to DAQ devices for enhanced smart capabilities and provides a unified SDK that allows users to stream continuous time-series data. The SDK is task-oriented and optimized for typical DAQ applications.

It available for download on the SDAQ-216/218 product web page:

SDAQ-216: https://www.adlinktech.com/Products/Data_Acquisition/SmartDAQ/SDAQ-216

SDAQ-218: https://www.adlinktech.com/products/Data_Acquisition/SmartDAQ/SDAQ-218

3.1 DAQPilot ACE

DAQPilot ACE is able to auto-discover all supported devices on the local network and features an intuitive user interface for providing device management functionalities including displaying device information, iApp deployment to devices and setting Tags to identify or group multiple devices. Tags are a convenient way for mass iApp deployment to grouped devices.

3.1.1 Installation

For optimal performance, make sure that the ACE software is properly installed on a client system computer that is properly linked with all ACE devices on the same LAN.

1. Install ACE devices.
2. Connect each ACE device to the same LAN with an Ethernet cable.
3. Power on each ACE device.

Note: It can take up to 2 minutes for the devices to link-up.

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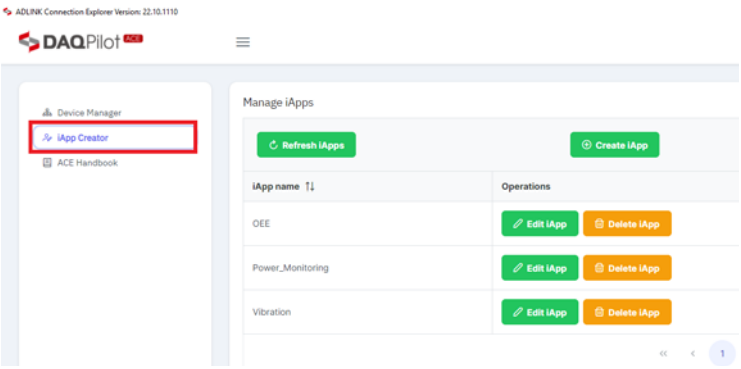
3.2 iApp Development and Device Management

ACE contains two major parts, iApp development and device management. This section includes a tutorial on how to create an iApp before deployment. iApps are saved in a repository and can be deployed to devices through the device management function.

3.2.1 iApp Development

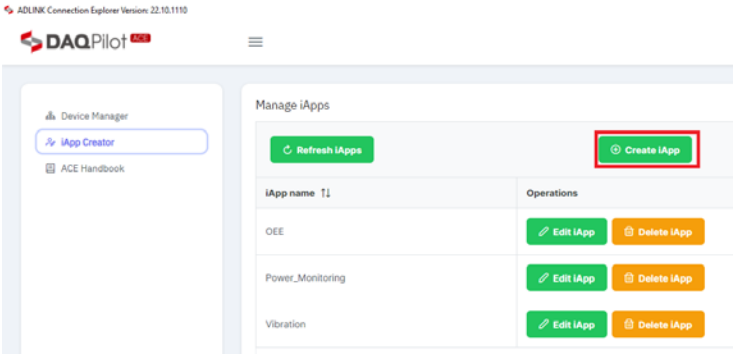
Follow these steps to create a Python-based iApp.

1. Click **iApp Creator** from the left sidebar.

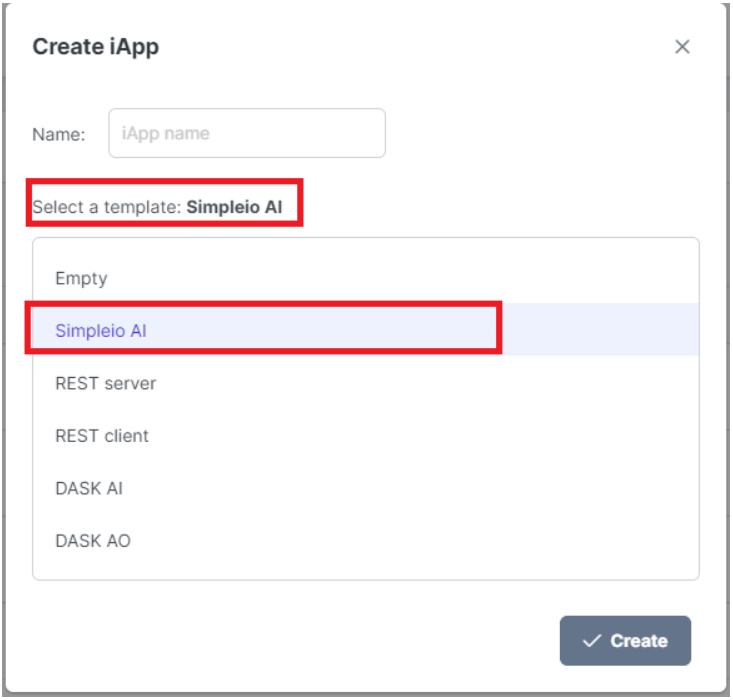


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2. Click **Create iApp** to create a new iApp.

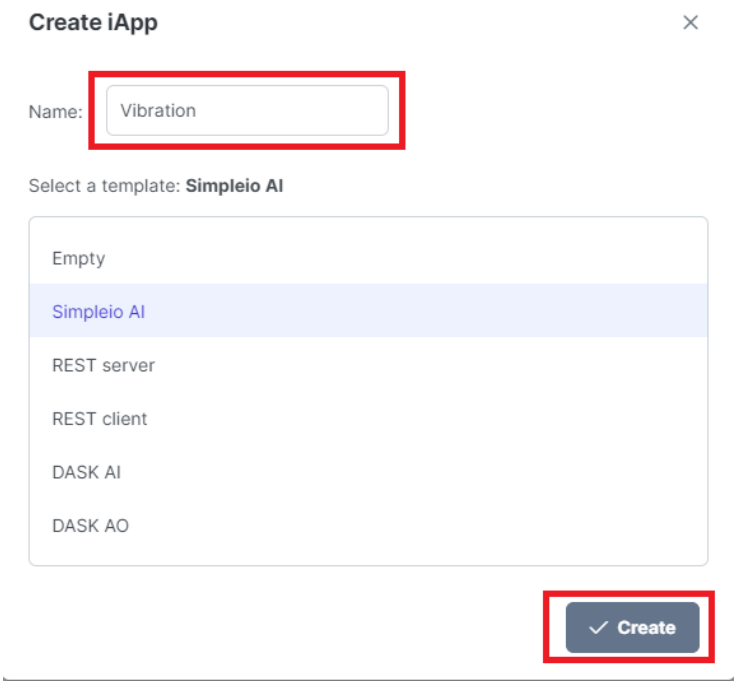


3. Enter a name in the iApp name textbox.

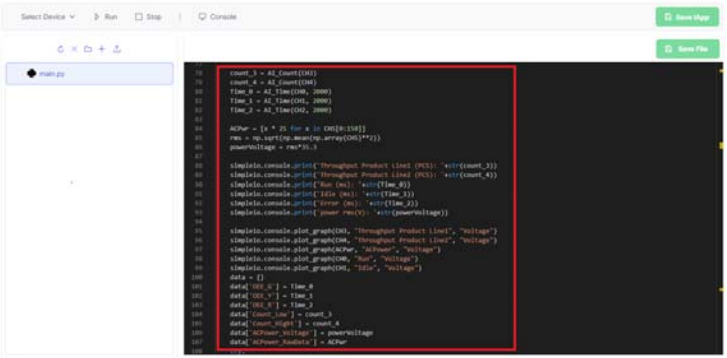


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4. Select an iApp template to start from. A new iApp will be automatically loaded into the editor.

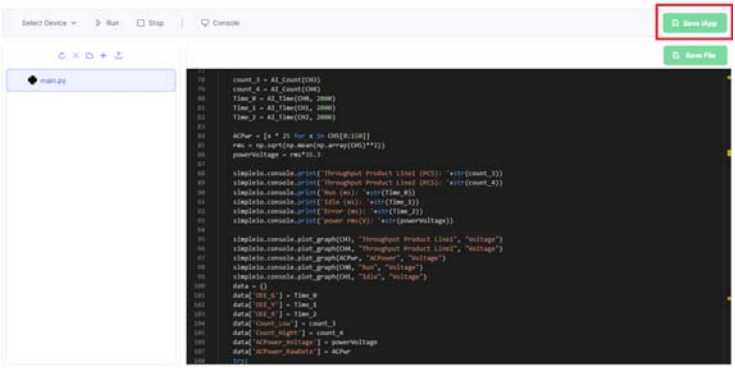


5. Edit the iApp as necessary.



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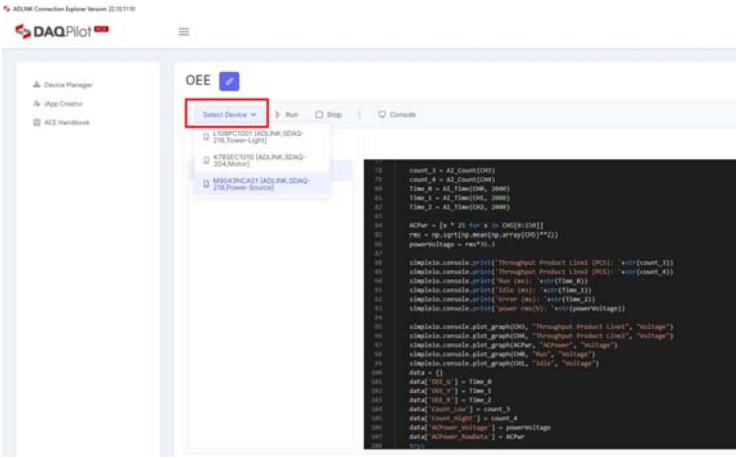
6. Click **Save iApp** when editing is completed.



3.2.2 iApp Deployment

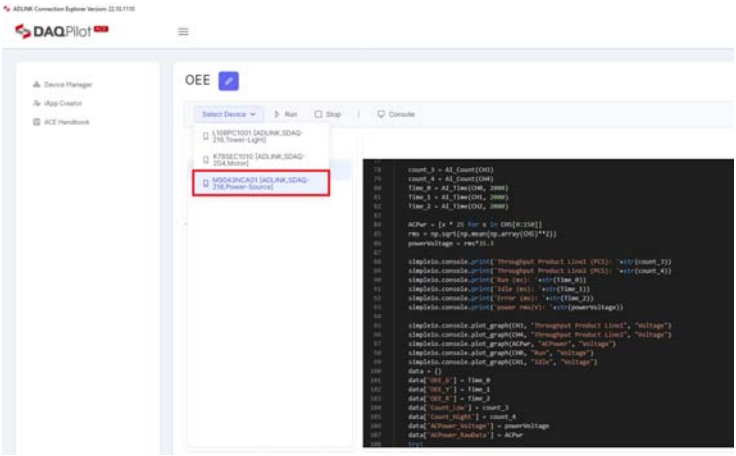
Follow these steps to deploy an iApp.

1. Click **Select Device** on the menu bar.

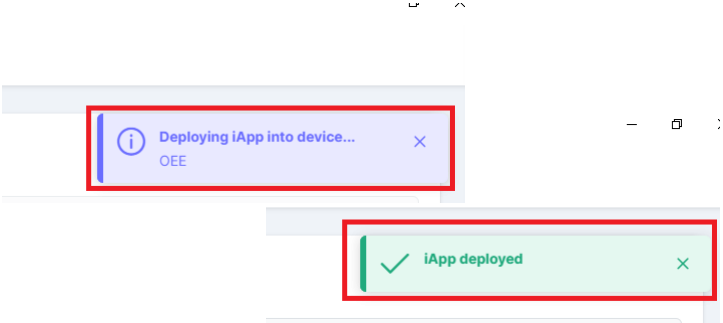


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2. Select the target device to be deployed.

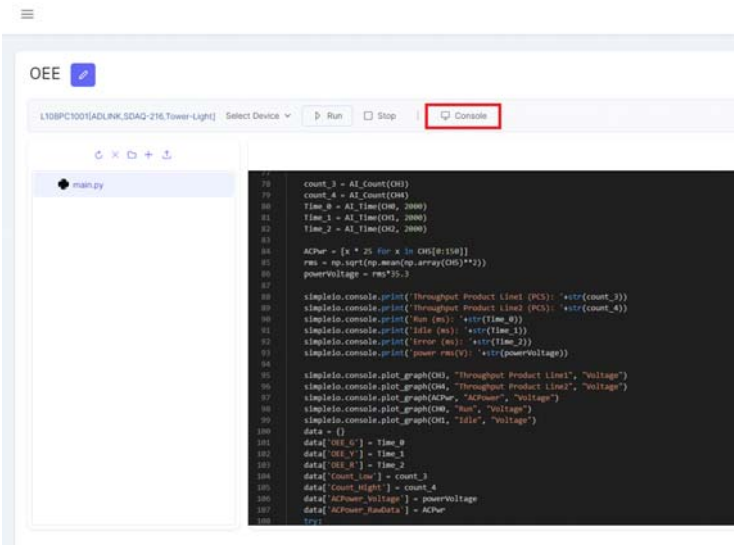


3. Click **Run** and wait for the deployment to finish.

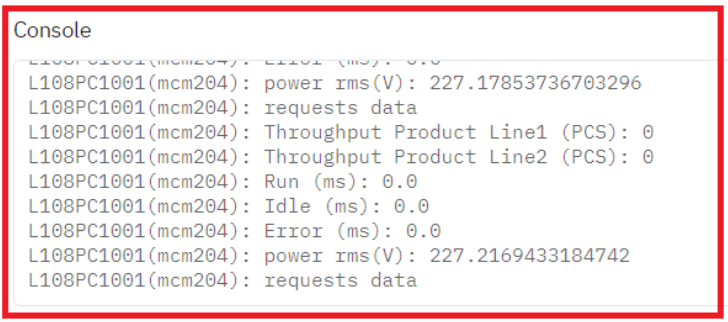


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4. Click **Console** on the menu bar.



5. Console view shows that the iApp deployed to the remote device is running.

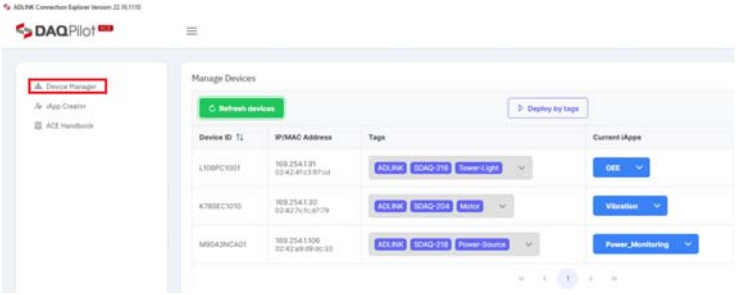


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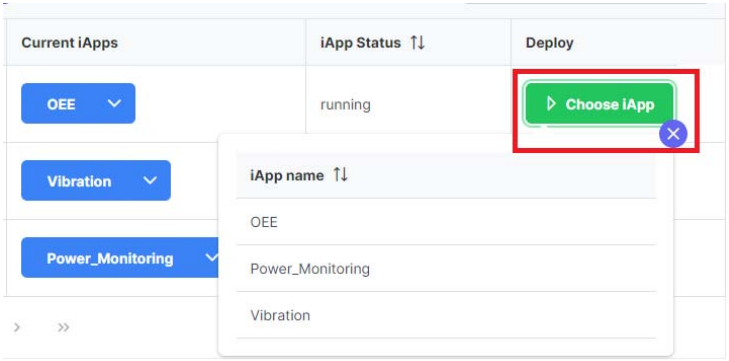
3.2.3 Device Management

Follow these steps to deploy an iApp to a single device.

1. Click **Device Manager** on the the left sidebar.

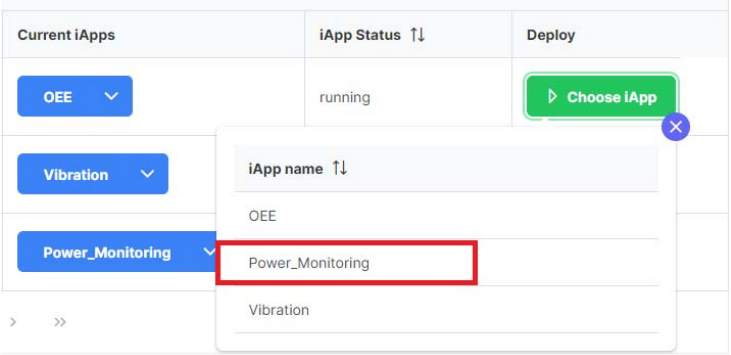


2. For a targeted device, click **Choose iApp**.



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3. Select a target iApp to deploy to start deployment.

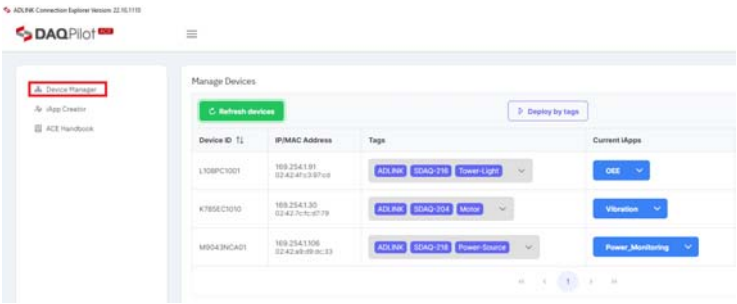


4. The selected iApp is deployed to the target device.

3.2.4 Assign Tags to Devices

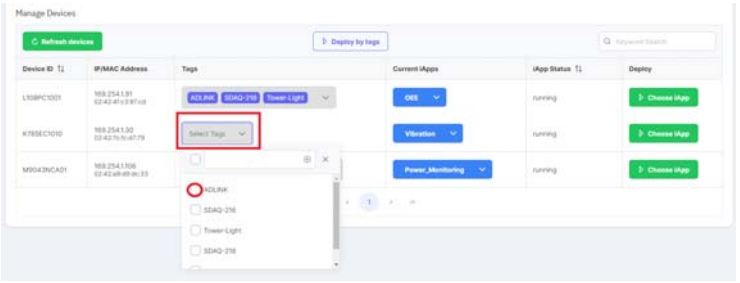
Tags can be assigned to devices for device naming or mass deployment. Follow these steps to assign a name to a device.

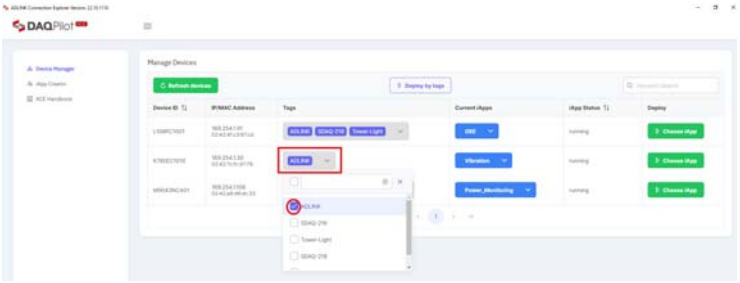
1. Click **Device Manager** on the left sidebar.



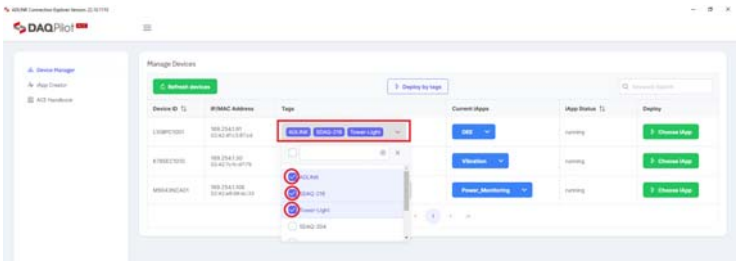
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2. To select a targeted device, click the dropdown menu under Tags.



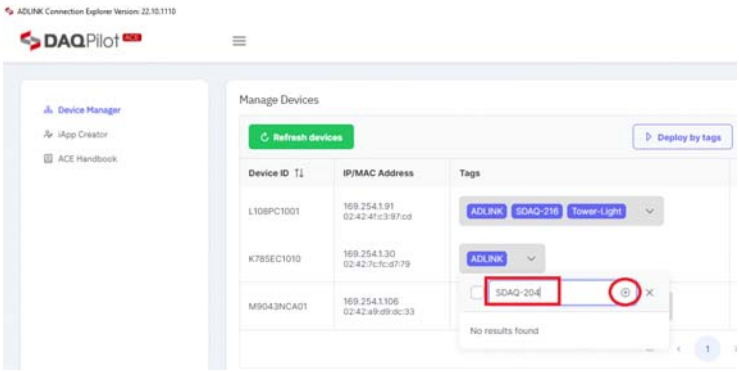


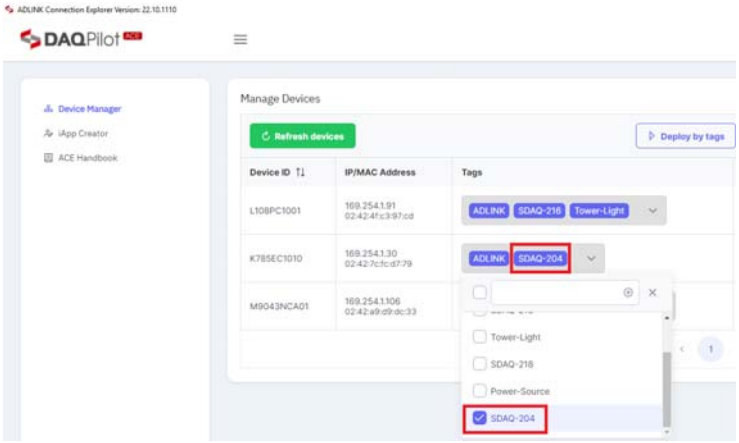
3. Select a tag to list the devices.

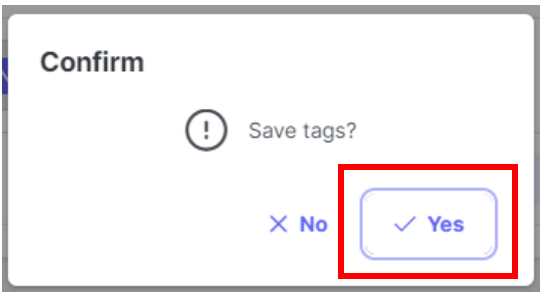


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4. To create new tag, click **+**, and then save it.





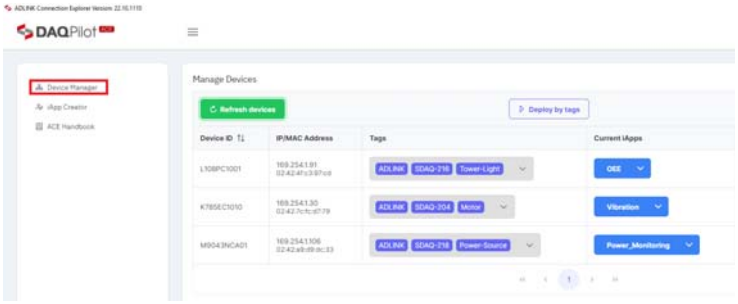


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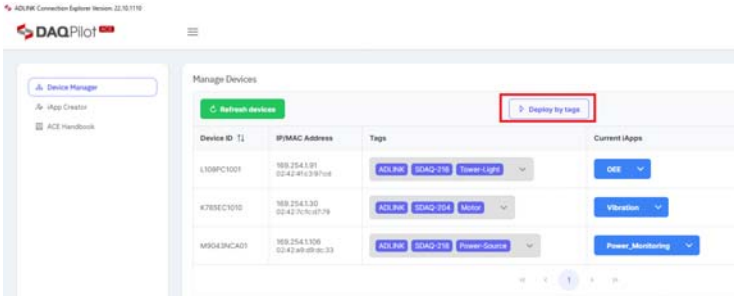
3.2.5 Deploy an iApp to Multiple Devices with Tags

Follow these steps to deploy an iapp to multiple devices with tags.

1. Click **Device Manager** on the left sidebar.

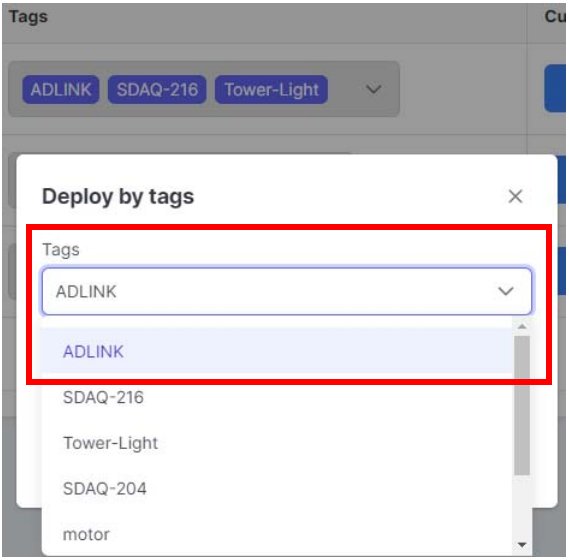


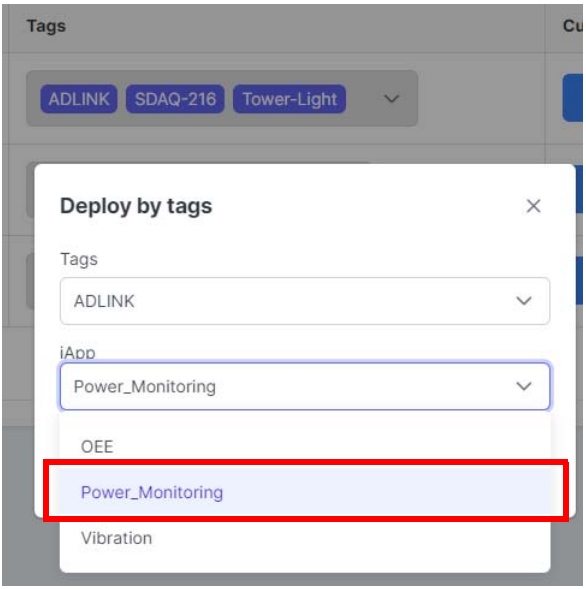
2. Click **Deploy by tags**.



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3. Select a tag and a target iApp to deploy and click **Deploy**. The target iApp will be deployed to the target device.





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4 Web Console

This chapter describes how to use the built-in web console to configure the SDAQ-216/218 and view captured data.

4.1 Web Console Login

After the SDAQ-216/218 has been successfully powered on and a host PC has been connected to it, do one of the following: (1) set the PC's network setting to either DHCP mode or link local mode; or (2) modify the PC's IP address to be on the same network segment as the device (169.254.x.x). Next, open a web browser on the PC (Google Chrome is recommended) to access the web console via one of the following options.

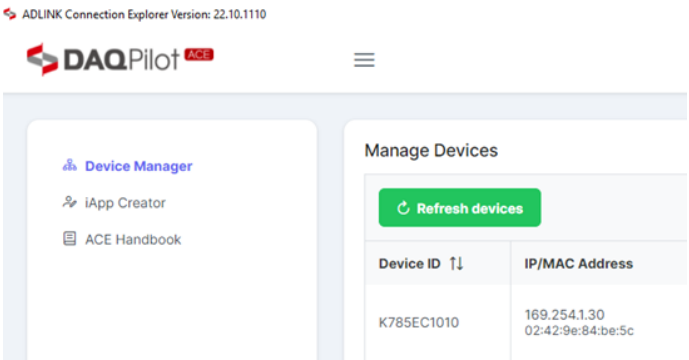
Option 1: IP Address

1. Get the IP from the DAQPilot ACE (see step 2 below). DAQPilot ACE available for download on the SDAQ-216/218 product web page:

   SDAQ-216: https://www.adlinktech.com/Products/Data_Acquisition/SmartDAQ/SDAQ-216

   SDAQ-218: https://www.adlinktech.com/products/Data_Acquisition/SmartDAQ/SDAQ-218

2. In the web browser's address bar, enter the IP address (e.g., http://169.254.1.30).



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Option 2: Hostname

Connect the SDAQ-216/218 to a network component (switch/router) with DNS functionality, then enter the SDAQ-216/218's hostname in the address bar of the host PC's web browser, prefaced by http:// (e.g., http://mcm216-j801ns1001). A unique default hostname is generated for each SDAQ-216/218 device and can be found on the label of the box it was shipped in. The hostname can be changed within the web console.

After using either method, the web console will display within roughly 30 seconds, presenting the user with a login screen.

The default username is **administrator** and the default password is **Adlink6166**.

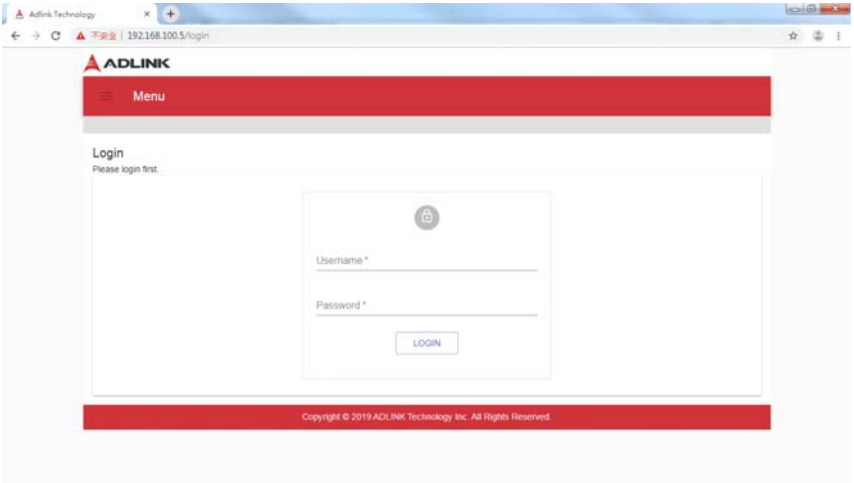


Figure 4-1: Web Console Login Page

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Immediately after logging in to the Web Console, **DAQPilot Setting** must be disabled beofre continuing.

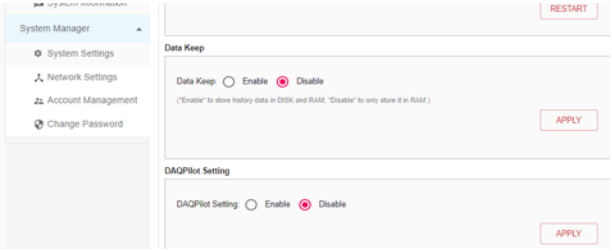


Figure 4-2: Disabling DAQPilot Setting

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4.2 Web Console Menu

The web console menu bar includes the following items.

- Mission Manager
  - Device Setting
  - Mission Management
  - Peripheral
- Data Manager
  - Data Capture
  - Data History
  - Data Condition
  - TCP Socket
  - USB Storage
  - Modbus TCP Server
  - Modbus RTU Mater
- Information
  - System information
- System Manager
  - System Setting
  - Network Setting
  - Account Management
  - Change Password

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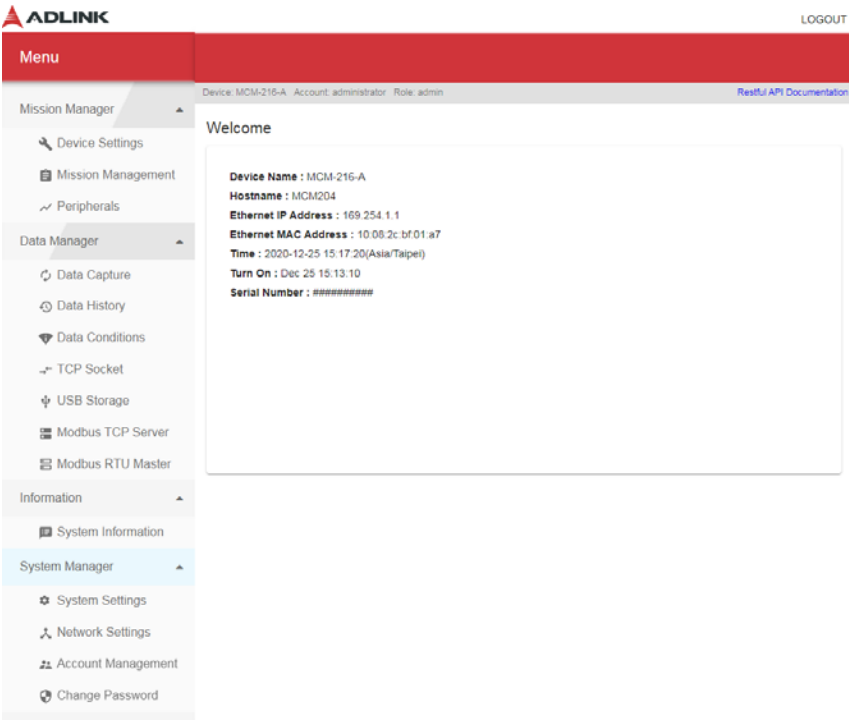


Figure 4-3: Web Console Welcome Page

Depending on the host PC screen size and resolution, the menu list might be collapsed. Click the menu icon to expand the menu.

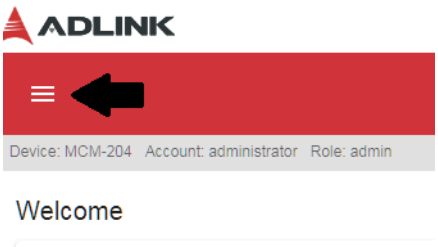


Figure 4-4: Menu Icon

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4.2.1 Information/System Information

The System Information page shows the device software version, general information, I/O channel status, and network status.

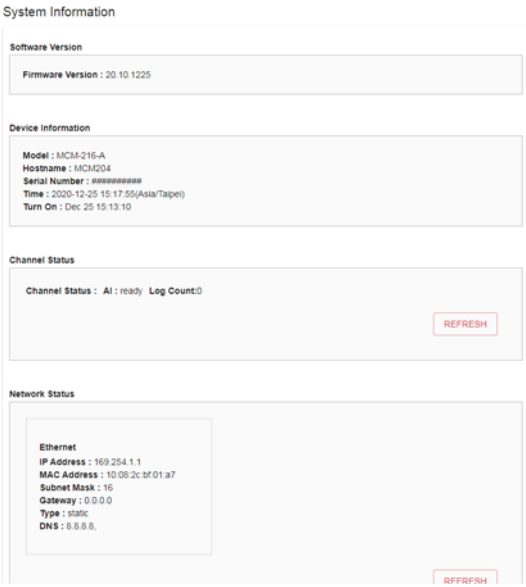


Figure 4-5: System Information

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4.2.2 Mission Manager/Peripheral

Peripheral digital input/output and temperature sensor information is shown on this page. The Status area shows the current status of the peripherals. Select **REFRESH** to update the status.

Four digital input/output devices can be used. Each can be adjusted for either input or output mode. To enable/disable digital input/output, mark the appropriate check boxes as necessary.

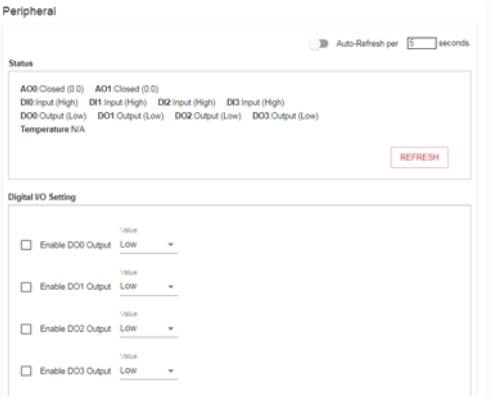


Figure 4-6: Peripheral Devices

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4.2.3 Data Manager/Data History

Historical data can be retrieved in this page. Choosing a specific time period will speed up the data search.

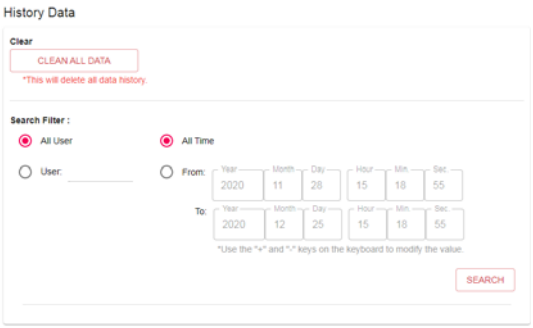


Figure 4-7: Data History

4.2.4 Mission Manager/Mission Management

A mission is a setting of I/O parameters with an intended output method. The SDAQ-216/218 will execute the same settings even after a reboot, so if Repeat Times is set to 0 (endless data capture), the SDAQ-216/218 will run its previous mission after reboot. To configure the I/O parameters for another mission, delete the current mission.

Channel Status shows if the AI and DI/O are running a mission or are ready to be assigned a new mission.

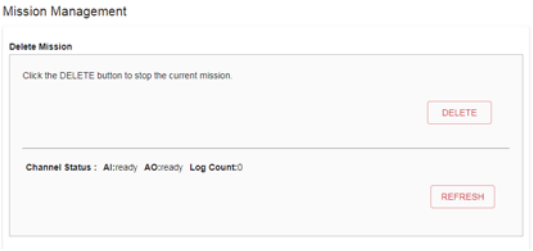


Figure 4-8: Mission Management

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4.2.5 System Manager/Change Password

This page is used to change the password of each SDAQ-216/218, whether there is a single device or multiple daisy chained devices. It is recommended that each device have a unique password since the default password for every SDAQ-216/218 is identical.

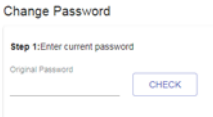


Figure 4-9: Change Password

4.2.6 System Manager/Account Management

This page manages user accounts and access privileges.

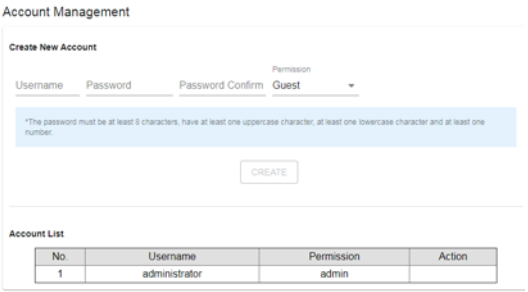


Figure 4-10: Account Management

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4.2.7 System Manager/Network Setting

This page manages various system settings.

Hostname: The device's hostname can be modified by entering a new hostname here and clicking the **APPLY** button. A hostname can be used instead of an IP address to access a specific device's web console. See "Web Console Login" on page 37 for details.

Keep Network Setting: Select **Enable** to retain network settings even after the device has been reset to factory defaults.



Figure 4-11: Network Settings

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4.2.8 System Manager/System Setting

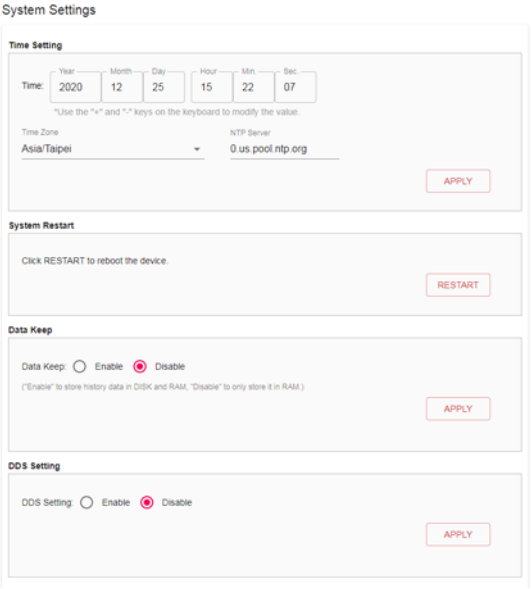


Figure 4-12: System Settings

System Restart: Since the device may be deployed in at a remote site, if it is necessary to reboot the device, click **RESTART** to soft reboot the device.

Data Keep: By default, the SDAQ-216/218 stores history data only in RAM and the data is lost when the system reboots. Select **Enable** to also save history data to internal storage. The amount of disk space allocated for this purpose is 300MB. When that limit is reached, data that has gone for the longest period of time without being accessed will be overwritten first, thus preserving the data that has been accessed most recently.

Device Calibration: The SDAQ-216/218 can be recalibrated if necessary. Though the SDAQ-216/218 is factory-calibrated before shipment and associated calibration constants are written to the on-board EEPROM, it is possible that, over time or depending on temperature conditions, recalibration may become necessary.

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Customization Library Upload: This function runs custom formulas on the SDAQ-216/218 according to a given file. See “Custom Filtering Algorithms” on page 56.

Firmware Upgrade: A firmware upgrade file can be uploaded to the SDAQ-216/218 through this feature. These files will periodically be provided through the product web page:

SDAQ-216: https://www.adlinktech.com/Products/Data_Acquisition/SmartDAQ/SDAQ-216

SDAQ-218: https://www.adlinktech.com/products/Data_Acquisition/SmartDAQ/SDAQ-218

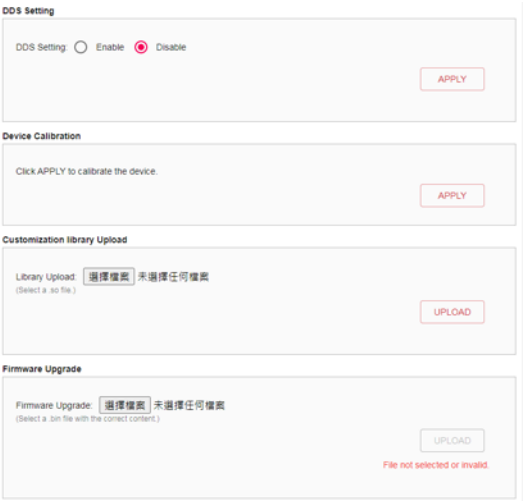


Figure 4-13: Upload Customization/Firmware Files

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4.2.9 Data Manger/TCP Socket (for one-shut query mode)

The SDAQ-216/218 supports TCP socket communication as a socket client. Enter the IP address and port number of the remote TCP socket server. Different analog input channels can be mapped to different ports. Select **ADD RULE** to add the TCP server to the Socket Connection List.

The Status column shows the communications status with the corresponding TCP socket server. If the socket is disconnected, select **RE-CONNECT ALL** to re-establish the connection.

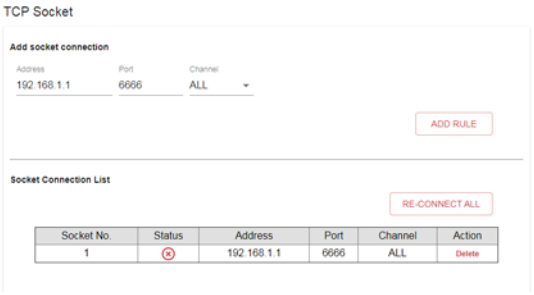


Figure 4-14: TCP Socket

After setting the TCP socket connection and creating a DAQ mission, data generated by the SDAQ-216/218 will immediately begin transmitting to the TCP server side.

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4.2.10 Device Manager/Modbus TCP Server

In addition to the REST API, the Modbus TCP protocol can be used to access data generated from the MCM-216/218. The MCM-216/218 acts as a Modbus TCP server, and a remote Modbus TCP client can actively query the MCM-216/218.

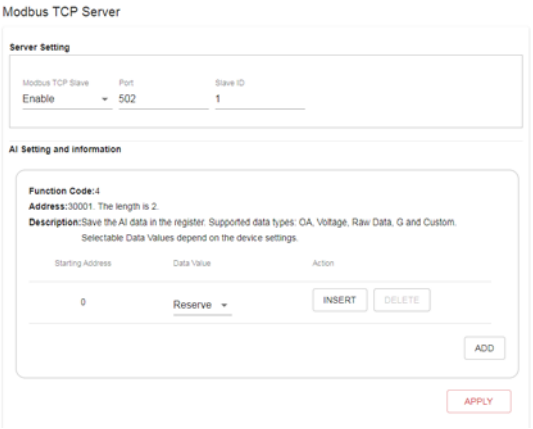


Figure 4-15: Modbus TCP Server

Enable the Modbus TCP function, set a Modbus port number and assign a Slave ID to the MCM-216/218.

Before creating the Modbus register list, be sure to add a data type in each channel. Otherwise, the data value in the Modbus setting will only have Reserve and temperature as default. See “DAQ Mission” on page 55.

Once the device setting page has been set and applied, all the created device types for each channel will be shown in a list under Data Value.

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The following examples show channels AI0 with two data types, AI1 with one data type, and AI2 with one data type.

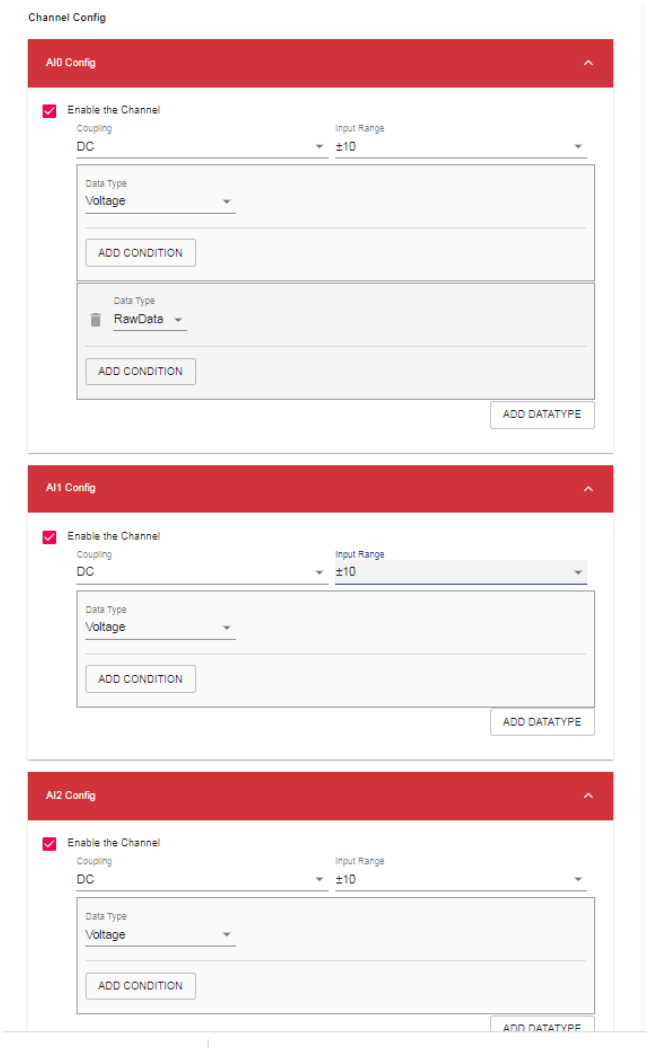


Figure 4-16: Data Types for Modbus TCP

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In the Modbus TCP settings page, the data value column will show the created data types. Each data type in an analog input channel occupies 2 modbus registers read by modbus function code 4, starting from address 30001.

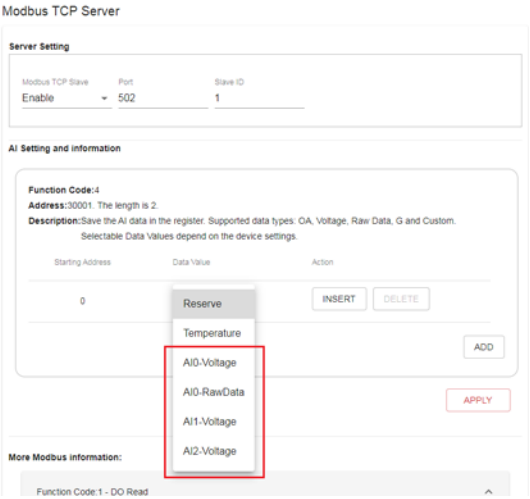


Figure 4-17: Modbus TCP Created Data Types

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Now, you can allocate the register sequence accordingly.

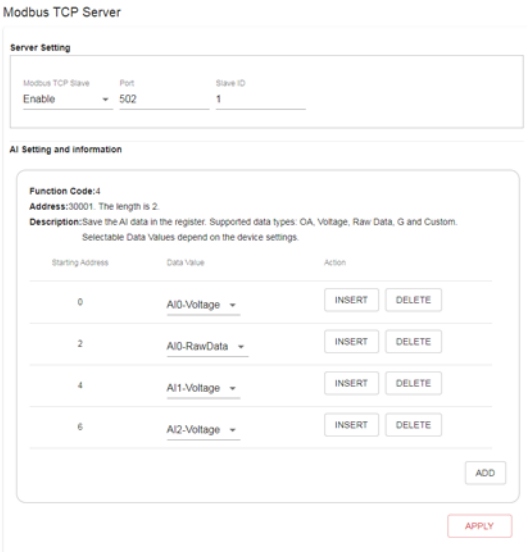


Figure 4-18: Data Value Starting Address Allocation

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Other peripherals, such as digital input, digital output, and analog output can be operated by different Modbus function codes and addresses.

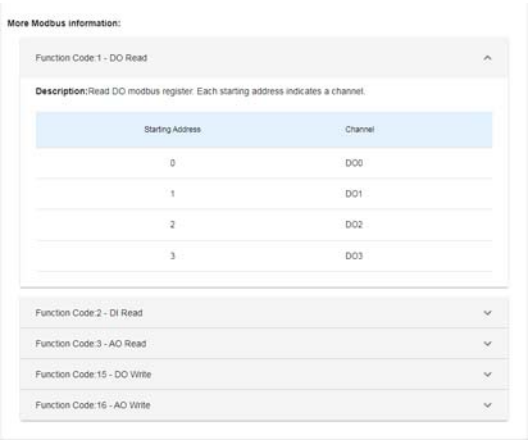


Figure 4-19: Modbus Function Codes

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4.3 DAQ Mission

The SDAQ-216/218 performs signal detection. Related parameters can be set via the **Mission Manger/Device Setting** page.

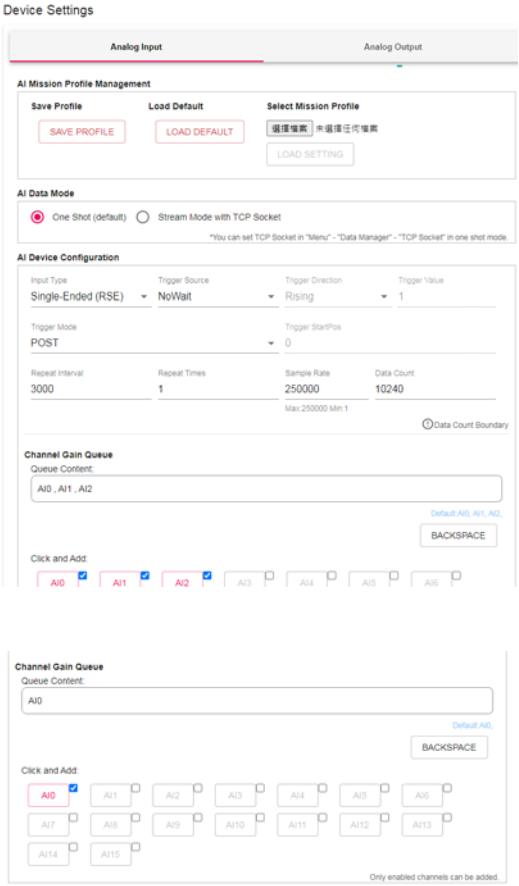


Figure 4-20: Device Configuration

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AI Data Mode: There are two kinds of data query modes.

One Shut Mode queries data by time interval. By configuring all the settings, including repeat interval, repeat times, and sample rate, the device will query data accordingly.

Streaming Mode, with a TCP socket, queries data continuously. Hence, the repeat interval and repeat time settings are unavailable. Once the data has been queried from FPGA, the data will then be transmitted to the host PC via TCP socket. Set the IP and port number of the TCP socket server accordingly.

Input Type selects the wiring method, either single-end or pseudo-differential.

Trigger Modes

Analog input supports post, delay, middle, gate, post trigger with retrigger, and delay trigger with retrigger modes.

Post-Trigger Acquisition Mode (no retrigger)

Post-trigger acquisition is indicated in applications where data is to be collected after a trigger event, as shown.

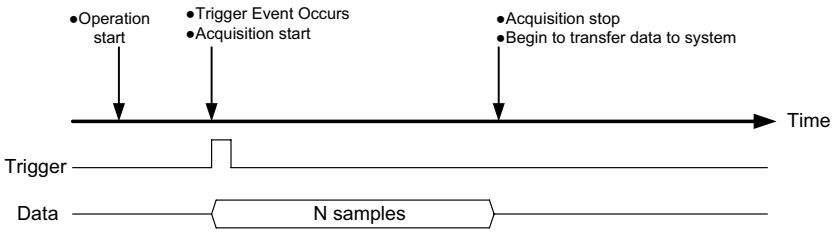


Figure 4-21: Post Trigger without Retrigger

Pre-trigger Acquisition (no retrigger)

Collects data before the trigger event, with acquisition starting once specified function calls are executed to begin the pre-trigger operation, and stopping when the trigger event occurs. If the trigger event occurs after the specified amount of data has been acquired, the system stores only data preceding the trigger

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event by a specified amount, as shown. Note that N must be equal to or less than 8k samples for all analog input channels.

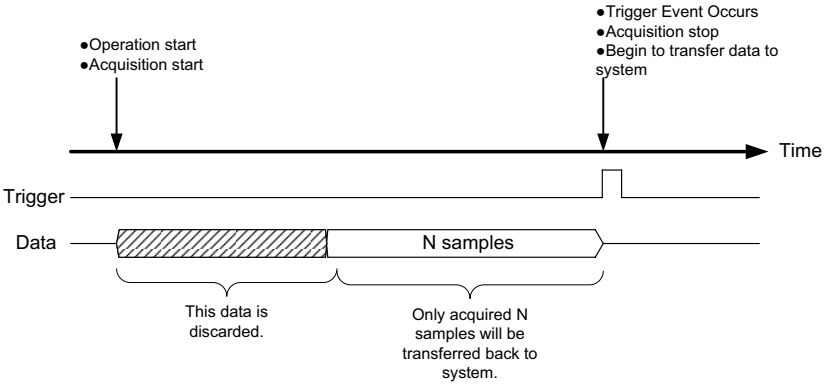


Figure 4-22: Pre-trigger Mode Operation (valid trigger only)

The trigger event occurs after the specified amount of data has been acquired. However, if the trigger event occurs before the specified amount of data has been acquired, the acquisition engine ignores the trigger signal until the specified amount of data has been acquired, as shown.

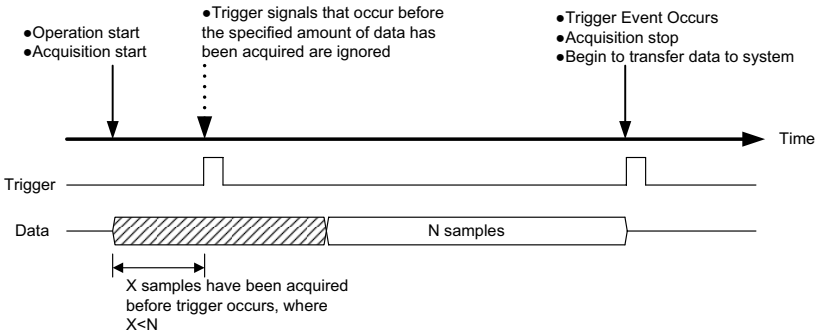


Figure 4-23: Pre-trigger Mode Operation (w/ invalid trigger)

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Delay-Trigger Acquisition (no retrigger)

Delays data collection after the trigger event, as shown. The delay count is specified by a 32-bit counter value, such that the maximum delay count is (2^{32}-1) when the minimum delay count is 1.

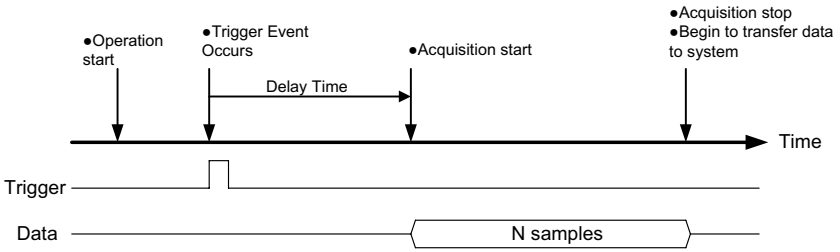


Figure 4-24: Delay-Trigger Mode Operation

Middle-Trigger Acquisition

Middle-trigger acquisition is indicated when data is to be collected before and after the trigger event. The amount of stored data before and after trigger event can be set individually (M and N samples), as shown. Please note that M+N must be equal to or less than 8k samples for all analog input channels, and that the trigger event can only be accepted when the specified amount of data has been acquired (M samples), otherwise the trigger event will be ignored.

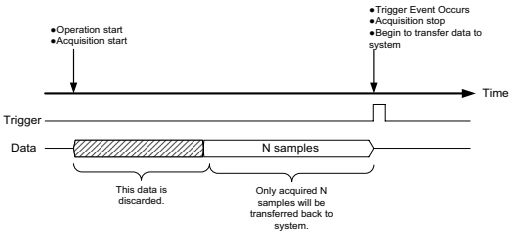


Figure 4-25: Middle-Trigger Acquisition

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Gated Trigger

Gated-trigger acquisition is indicated in applications where data is to be collected when trigger events are set to level high/low, and acquisition suspended when trigger events are set to the opposite level. The process repeats until the specified amount of data is acquired.

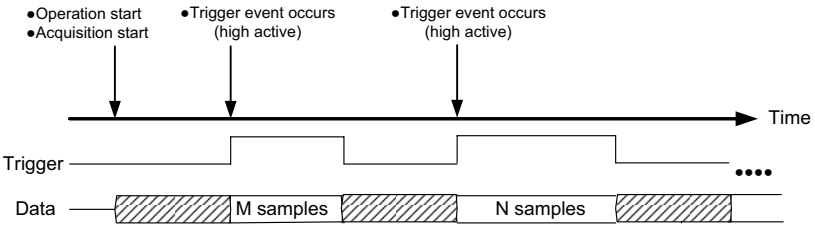


Figure 4-26: Gated Trigger

Post-Trigger or Delay-Trigger Acquisition with Re-Trigger

Post-trigger or delay-trigger acquisition with re-trigger function is indicated in applications where data is to be collected after several trigger events. The number of scans after each trigger and the re-trigger number are valid from 1 to the buffer size allocated in kernel space. The process repeats until the specified amount of re-trigger signals is detected.

Repeat Interval is the interval between each data capture, in milli-seconds. Each data query consists of data capture via FPGA plus data filtering via MCU. The time required for data filtering may vary according to the complexity of the filtering algorithm. If the time required for handling data exceeds the repeat interval, the next time query will be started immediately. It is recommended that this value be set.

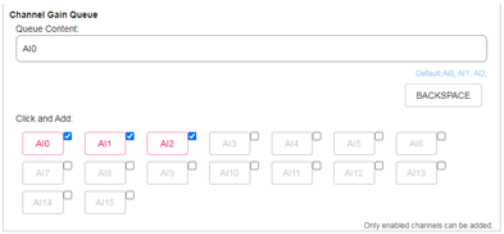
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Repeat Times is the total number of times the data is to be captured. For endlessly repeating data capture, set to 0.

WARNING:

Warning! If you are using a customized algorithm as your **Data Type**, it is strongly recommended to set **Repeat Times** to 1 for the first attempt, then to 10 for a limited data capture test. Once you have confirmed the algorithm is running as intended, you can set **Repeat Times** to 0 for repeated data capture.

Set **Sample Rate** and **Data Count** accordingly. Selecting the pen icon to display a convenient sliding tool with fine-tuned (+/-) adjustments.



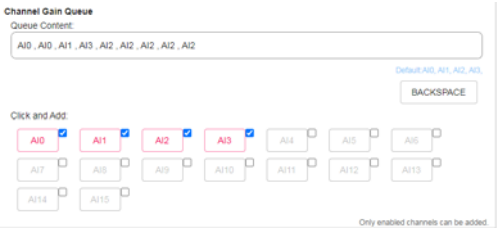
The MCM-216/218 provides the **Channel Gain Queue** function to dynamically allocate sampling size. By default, the selected channels will equally share the maximized sample rate. However, sampling rates can be allocated as necessary between channels. For example, when choosing 16 channels with a 250 kS/s sample rate, each channel will use 15.625 (250/16) as its sample rate. If a channel needs a higher sample rate, set the value accordingly.

To set the sample rate. first check the desired channels, then select the checkbox for each channel to include them in Queue Content. The sequence in Queue Content represents the allocated unit that each channel requires. Click as many times on the channel as needed. The sample rate will be shared according to the Queue Content.

As the figure below shows, channels 0, 1, 2, and 3 are selected. The sequence is AI0, AI0, AI1, AI3, AI2, AI2, AI2, AI2, AI2, and AI2. Hence, channel 0 will occupy 2/10 of the maximum sample rate. Channel 1 and 3 will occupy 1/10 of the maximum sample rate. Channel 2 will occupy 6/10 of the maximum sample rate. You

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can manually set the sample rate according to the device each channel connects to.



For each analog input channel, click **DataType** to choose which data type to use for the output.

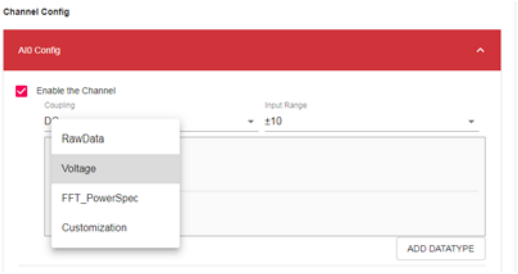
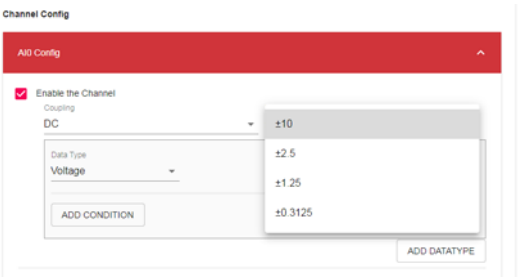


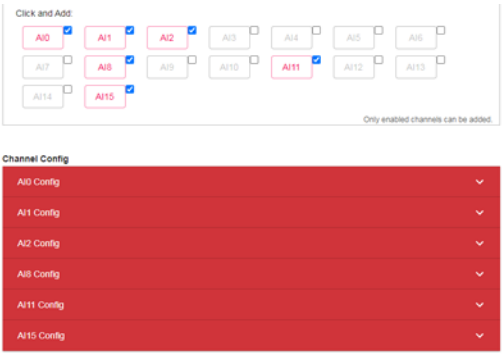
Figure 4-27: DataType

An input range can be selected, as below.



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Depending on the channels selected, the Channel Config properties of each channel will be shown.



The SDAQ-216/218 has built-in functionality for several common data types and also supports user-customized data types, as detailed in the table below. If two or more data types are required for an analog input channel, select **ADD DATATYPE** for each additional data type.

Data Type	Description
Raw Data	The raw data generated by ADC (16-bit, 2's complement)
Voltage	Transferred from raw data
FFT_PowerSpec	Power spectrum transferred by fast Fourier transform (FFT)
Customization	Customized data type set by user

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ADD CONDITION provides an event warning mechanism. When a given condition is triggered, a warning message will display on the **Data Condition** page.

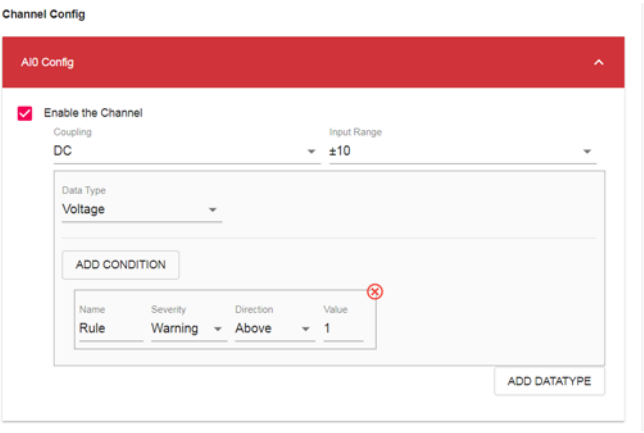
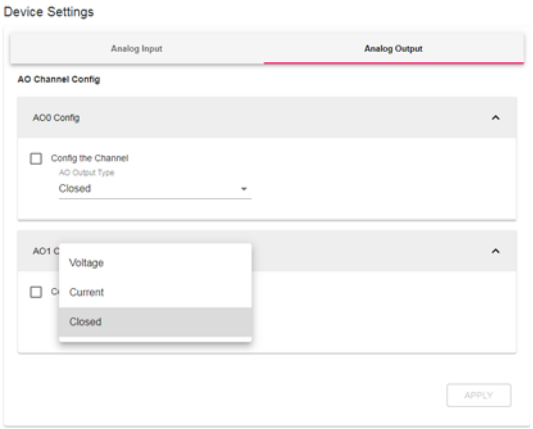


Figure 4-28: Add Condition

After the desired settings have been configured, click **APPLY** to activate your changes.

Analog Output



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The MCM-216/218 has two analog output channels: output voltage, or current with a predefined value.



The **Data Manager/Data Capture** page displays DAQ results in real time. You can use the data capture function in lab testing or as a portable DAQ device. Raw data and Voltage can be converted to charts for troubleshooting.



Figure 4-29: Data Capture

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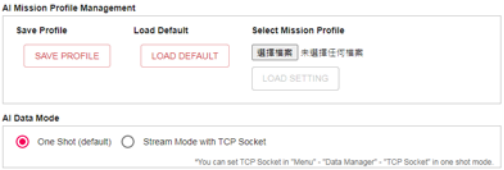


Figure 4-30: Device Settings

Settings may be saved as a Mission Profile (JSON file) for backup or for convenient duplication on other SDAQ-216/218 devices. Click **SAVE PROFILE** to download the file to your PC. To import a Mission Profile to an SDAQ-216/218 device, click **Choose File** under **Select Mission Profile** and select the desired configuration file. All settings will change according to that file. Alternatively, clicking **LOAD DEFAULT** will restore all settings to their default values. After any change to device settings, the **APPLY** button must be clicked in order to activate the changes.

If a mission is already running while attempting to apply new changes, a confirmation window will appear. If you're ready for the SDAQ-216/218 to cancel its previous mission and start running the new mission, click **YES**.

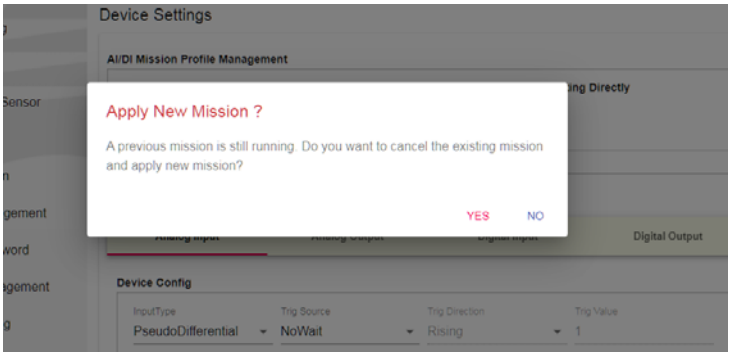


Figure 4-31: Apply a New Mission

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5 DAQ Missions

The SDAQ-216/218 supports various modes of operation that users can choose from to quickly integrate into their systems.

5.1 Usage Behaviors

IEPE sensors transmit raw data to the SDAQ-216/218 which can then be filtered to other kinds of data types that are more application appropriate, such as overall vibration values (ISO 10816) for mechanical vibration data. The overall vibration value data size is greatly reduced in comparison to raw data, so the backend server receives much less data for analysis. Data filtering is best suited to applications requiring continual information updates at a given time interval, such as every minute, which the user can then review periodically.

In contrast to data filtering, some applications, such as lab testing, require continuous raw data for analysis. However, continuous transmission of large amounts of raw data places a heavy burden on the backend server and takes up more network bandwidth. Evaluate your bandwidth and application requirements carefully in order to adopt the most suitable programming method for your needs.

There are three major usage behaviors: Periodic Polling, Continuous Data, and Passive Data. Choosing between them depends on how frequently data must be retrieved. Figure 5-1 on page 68 can serve as a guide for selecting the appropriate usage behavior for system integration based on polling data frequency.

For the periodic polling mode, SDAQ-216/218 provides a REST API and sample code in C#, Python, and JavaScript. Alternatively, for continuous data mode, SDAQ-216/218 provides a DAQPilot SDK and associated C/C++ sample code.

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5.1.1 Web Console

The SDAQ-216/218 has a built-in, easy-to-use web console that implements all device functionalities. By logging into the web console through a connected host PC, users can see all of the device's current settings, each feature it provides, and any vibration data it has collected. See "Web Console" on page 37.

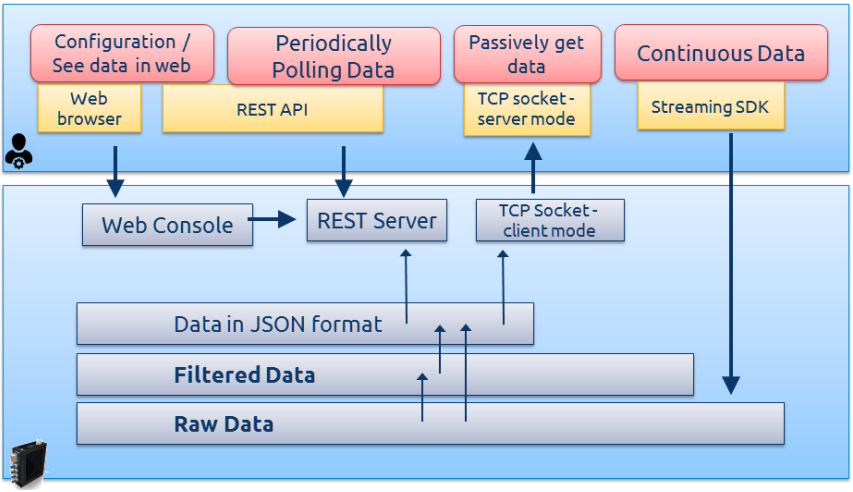


Figure 5-1: Operational Modes

5.1.2 Periodic Polling

A RESTful API is provided to facilitate periodic data polling. The REST document can be found on the web console's menu bar.

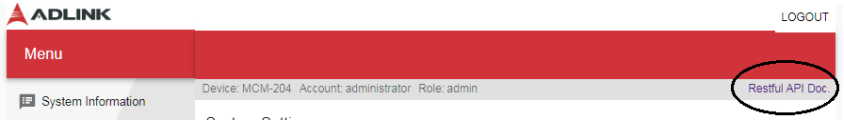


Figure 5-2: RESTful API

Using this API, functionalities shown in the web console can be implemented in your own custom software. Function references and sample code in Python, JavaScript, and C# are available for download on the SDAQ-216/218 product web page:

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SDAQ-216: https://www.adlinktech.com/Products/Data_Acquisition/SmartDAQ/SDAQ-216

SDAQ-218: https://www.adlinktech.com/products/Data_Acquisition/SmartDAQ/SDAQ-218

5.1.3 Continuous Data

To use continuous data mode, first install the DAQPilot SDK, available for download on the SDAQ-216/218 product web page:

SDAQ-216: https://www.adlinktech.com/Products/Data_Acquisition/SmartDAQ/SDAQ-216

SDAQ-218: https://www.adlinktech.com/products/Data_Acquisition/SmartDAQ/SDAQ-218

After installation, sample code and function references can be found in the C:\Program Files\ADLINK\DAQPilot folder.

Before using the DAQPilot SDK, DAQPilot Setting must be enabled via the SDAQ-216/218 web console.

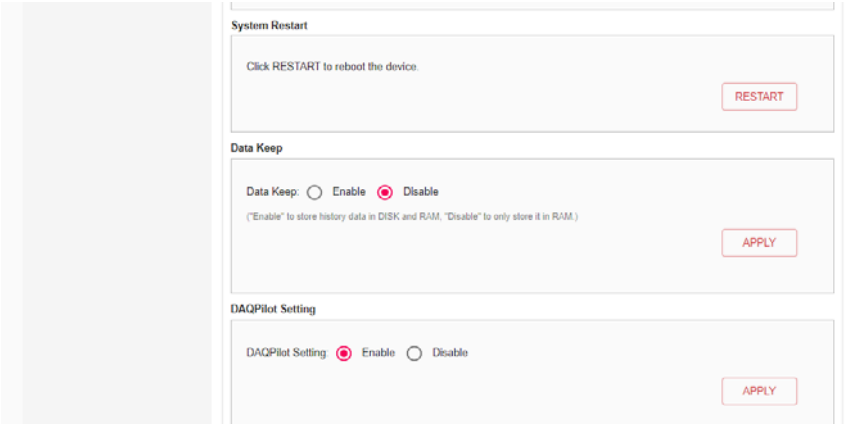


Figure 5-3: DAQPilot Setting

WARNING:

- When using DAQPilot, the host server and SDAQ-216/218 **must** be deployed to the same network segment.
- It is strongly recommended **not** to use the REST API for querying continuous data.

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5.1.4 Passive Data

The conventional message exchange pattern of the SDAQ-216/218 for Periodic Polling and Continuous Data modes is request-response, with the SDAQ-216/218 serving as responder. After receiving a query from the host, the SDAQ-216/218 responds with the requested data. However, for some applications it's desirable for the host server to passively wait for data from the client. In such cases, a TCP socket function can instruct the SDAQ-216/218 to automatically send data to the host server whenever data is generated. See "Data Manger/TCP Socket (for one-shut query mode)" on page 49.

5.2 Custom Filtering Algorithms

The SDAQ-216/218 offers flexible support options for custom filtering algorithms. Users can easily import their own domain-knowledge algorithms to the SDAQ-216/218. Custom filtering algorithms must be written in C or C++ and compiled under Linux.

Use the following steps to create a custom filtering algorithm.

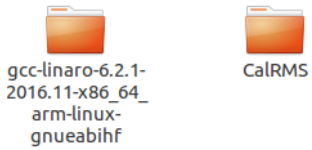
1. Download and extract the Linux toolchain:

   https://releases.linaro.org/components/toolchain/binaries/6.2-2016.11/arm-linux-gnueabihf/gcc-linaro-6.2.1-2016.11-x86_64_arm-linux-gnueabihf.tar.xz

2. Download CustomizedAlgo.zip from the SDAQ-216/218 web page and extract the CalStatistic (C++) and CalRMS (C) sample program folders.

   https://www.adlinktech.com/Products/Data_Acquisition/SmartDAQ/SDAQ-216/218

3. Place the extracted CalRMS and Linux toolchain folders in the same file path.

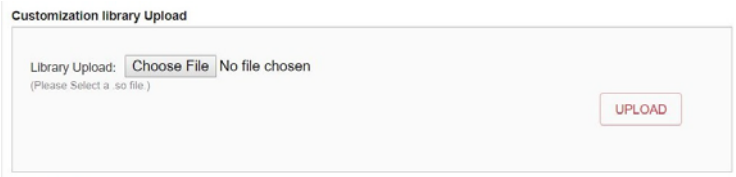


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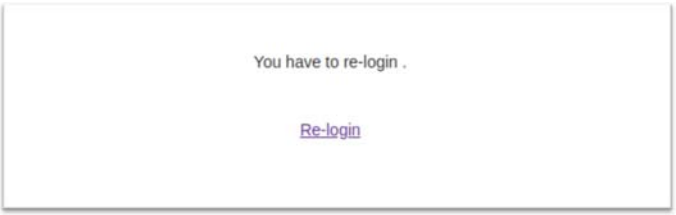
4. Run the “make” command from within the CalRMS folder to generate a customAlgo.so file.



5. Upload customAlgo.so to the SDAQ-216/218 from the web console System Setting page.

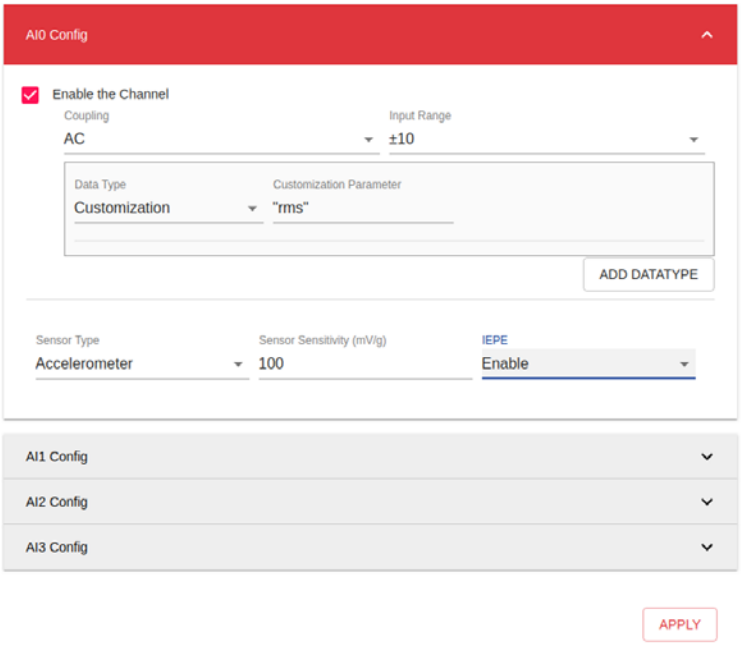


6. After it uploads, log back into the web console.



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7. After logging in, choose Customization as the data type, set parameters as needed, then click **APPLY** to apply the task to the SDAQ-216/218.



8. Check the results on the data capture page.



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Important Safety Instructions

For user safety, please read and follow all instructions, Warnings, Cautions, and Notes marked in this manual and on the associated device before handling/operating the device, to avoid injury or damage.

S'il vous plaît prêter attention stricte à tous les avertissements et mises en garde figurant sur l'appareil , pour éviter des blessures ou des dommages.

- Read these safety instructions carefully.
- Keep the User's Manual for future reference.
- Read the Specifications section of this manual for detailed information on the recommended operating environment.
- The device can be operated at an ambient temperature of 50ºC.
- When installing/mounting or uninstalling/removing device, or when removal of a chassis cover is required for user servicing:
  - Turn off power and unplug any power cords/cables.
  - Reinstall all chassis covers before restoring power.
- To avoid electrical shock and/or damage to device:
  - Keep device away from water or liquid sources.
  - Keep device away from high heat or humidity.
  - Keep device properly ventilated (do not block or cover ventilation openings).
  - Always use recommended voltage and power source settings.
  - Always install and operate device near an easily accessible electrical outlet.
  - Secure the power cord (do not place any object on/over the power cord).
  - Only install/attach and operate device on stable surfaces and/or recommended mountings.
- If the device will not be used for long periods of time, turn off and unplug it from its power source
- Never attempt to repair the device, which should only be serviced by qualified technical personnel using suitable tools

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- A Lithium-type battery may be provided for uninterrupted backup or emergency power.



Risk of explosion if battery is replaced with one of an incorrect type; please dispose of used batteries appropriately.
Risque d'explosion si la pile est remplacée par une autre de type incorrect. Veuillez jeter les piles usagées de façon appropriée.

- The device must be serviced by authorized technicians when:
  - The power cord or plug is damaged.
  - Liquid has entered the device interior.
  - The device has been exposed to high humidity and/or moisture.
  - The device is not functioning or does not function according to the User's Manual.
  - The device has been dropped and/or damaged and/or shows obvious signs of breakage.
- Disconnect the power supply cord before loosening the thumbscrews and always fasten the thumbscrews with a screwdriver before starting the system up.
- It is recommended that the device be installed only in a server room or computer room where access is:
  - Restricted to qualified service personnel or users familiar with restrictions applied to the location, reasons therefor, and any precautions required.
  - Only afforded by the use of a tool or lock and key, or other means of security, and controlled by the authority responsible for the location.

	**BURN HAZARD** Touching this surface could result in bodily injury. To reduce risk, allow the surface to cool before touching. ***RISQUE DE BRÛLURES*** *Ne touchez pas cette surface, cela pourrait entraîner des blessures.* *Pour éviter tout danger, laissez la surface refroidir avant de la toucher.*

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Getting Service

Ask an Expert: https://www.adlinktech.com/en/Askanexpert

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