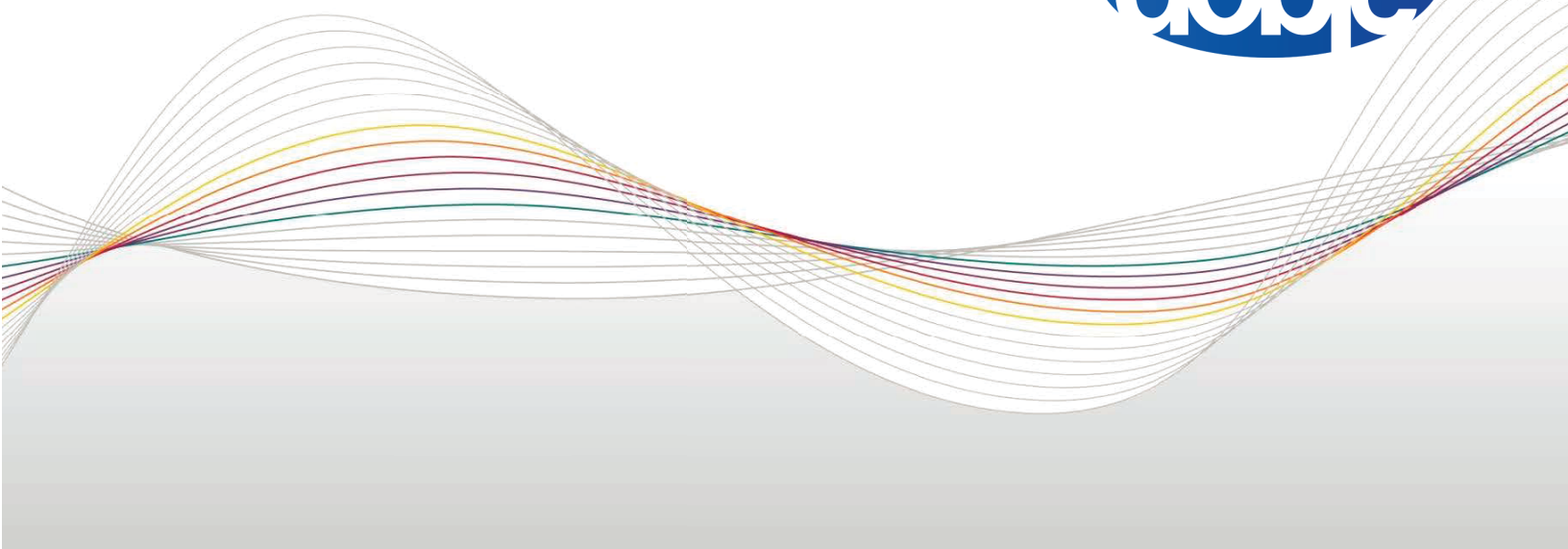
Calisto N1
User Guide



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Preface

The Calisto N1 is a compact data logger with Remote Terminal Unit like capabilities, powered by doblePRIME software. It provides a built-in webserver to manage user access, alert settings, alert management and data visualization. Standard communication protocols include Modbus and DNP3, allowing data to be moved between Calisto N1 and other applications such as SCADA. Integration with other Doble devices that also run PRIME application is seamless and easy via a proprietary protocol.

Who Should Read this Guide

This guide is intended for two sets of Calisto N1 users:

- Doble customers
- Doble technical support employees

It is assumed that all readers are familiar with professional standards and safety practices.

Document Conventions

This document uses two special typefaces to indicate particular kinds of information:

- **Bold**—Used for software controls such as buttons, check boxes, or other items that are clicked or selected. Also used for text displayed in the user interface, such as an error message or prompt. Examples:

  Click **Close**.

  Go to the **Sources** tab.

- `Monospace`— Any text you must type in is shown in this typeface:

  Example: Type in `1500 ms`.

Safety Instructions

Read all safety instructions before using the Calisto N1 instrument.

Notes, Cautions, and Warnings

This document uses notes, cautions, and warnings to provide specialized information and to alert you to potential safety hazards, as follows:

Note: Notes provide supplemental information that may apply to only some circumstances.

Caution: Cautions provide information that prevents damage to hardware or data.

Warning: Warnings provide information about anything that can affect operator health.

Legal

For Doble's complete legal statements, refer to "LEGAL NOTICE" on page 89.

Orderly Measures

- The cover of the cable management space should be secured during normal use and only removed by authorised personnel. Risk of electric shock from hazardous live voltages under this cover. Isolate the unit before removing the cover.
- Equipment should be operated in accordance with these instructions. Failure to do so may impair protection of the user from hazards.
- Equipment contains no user serviceable parts.

Support

For customer service, contact Doble.

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1. Overview

The Calisto N1 can build from a single component to a comprehensive transformer monitor covering partial discharge (PD), bushings, operational data connected to Dissolved Gas Analysis (DGA) and third-party monitors.

- 4AD is a data recorder that accepts current (4-20mA) and integrates and displays data from multiple sensors. Alerts and status from dry contacts can be wired to the Digital Input channels, enabling alarms to be raised up on logical state change.
- Serial communication ports to poll data from slave devices in the field such as DGAs, power meter and other Intelligent Electronic Device (IED). The IEDs can be daisy-chained to allow polling of several devices per communication port. Data can also be transferred to SCADA systems via serial communication.
- Modbus and DNP3 TCP protocols allow data to be transferred from IEDs in the field to SCADA masters via Ethernet or serial connection.
- Display and navigation keypad for viewing latest measurements and alerts without needing a computer.

N1 may be installed in several schemes:

- Standalone (no host PC required; channel control, expert system, local visual alerts and alarm relays are included)
- Networked to any Doble PRIME condition monitoring module
- Networked to a third-party supervisor, e.g., SCADA system with Modbus, DNP3 TCP protocols

2. Hardware Reference

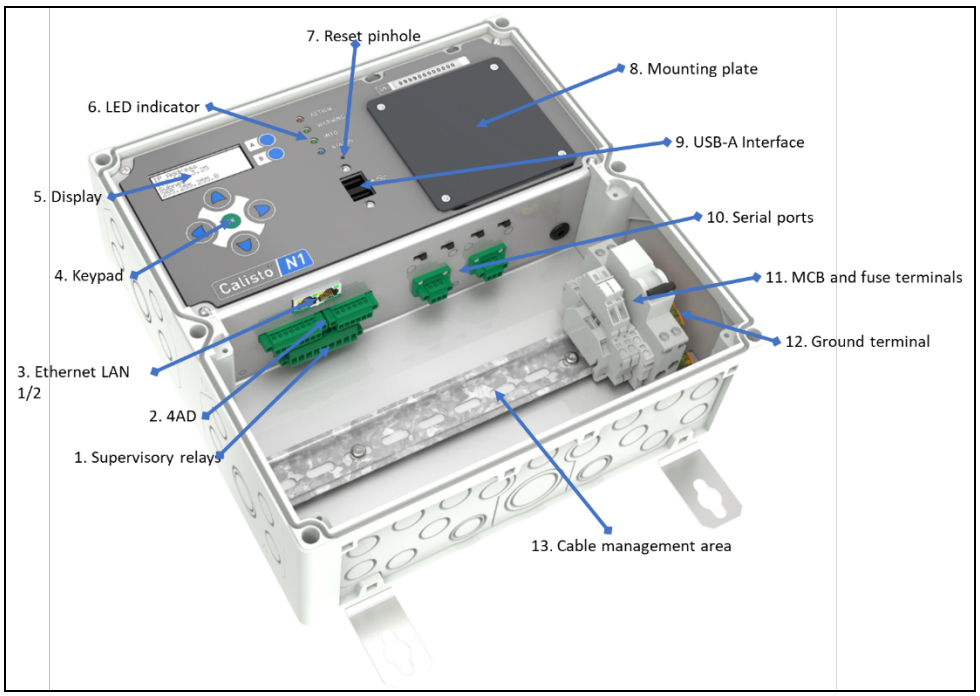

Figure 1 - Calisto N1 Components List

Component	Description
1. Supervisory relays	Dry contact relays to output system alert
2. 4AD	Analog and Digital input card
3. Ethernet LAN 1/2	Dual switch. Access to eth0 (network 1) and eth1 (network 2)
4. Keypad	LCD navigation control
5. Display	Shows the latest measurements
6. LED Indicator	Indicates the current highest system alert
7. Reset pinhole	Reset IP to default address
8. Mounting plate	Mounting plate for third-party accessories

Component	Description
9. USB-A interface	Supports firmware updates
10. Serial ports	Two RS485 ports with line biasing and termination resistor controls
11. MCB and fused terminals	Two-pole MCB and fused terminal. 115-230VAC power input
12. Ground terminal	Ground connection
13.Cable Management Area	Space for cable management and mounting accessories on the DIN rail

Table 1 *Hardware List*

3. Getting Started

This chapter describes the basics of how to wire the power, safety ground, serial connection, connection to a network, how to interpret alarm indications, and DIN Rail terminals. To access the cable management space, remove the plate that is covering the circuit breaker.

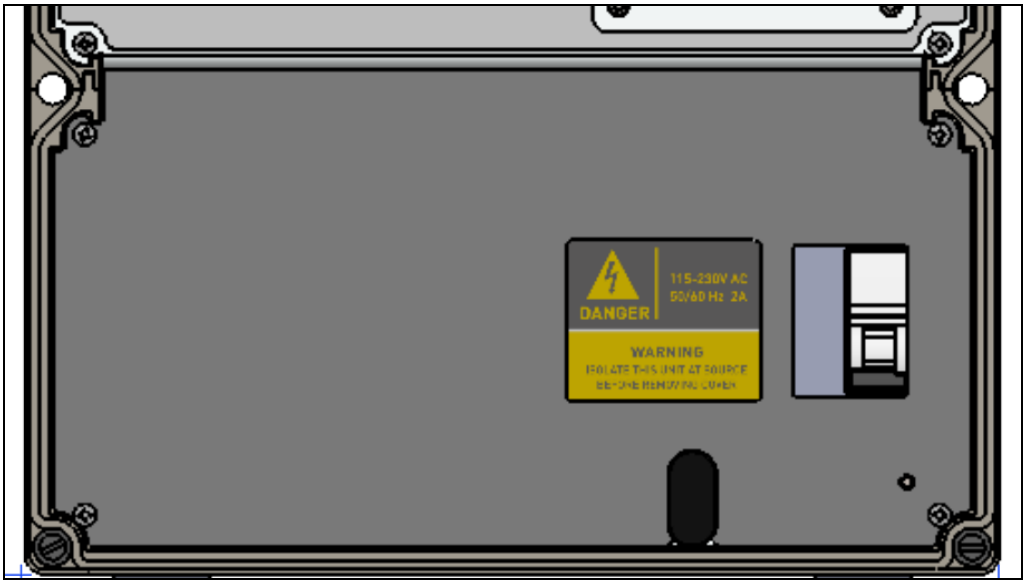

Figure 2 - Cable Management Space Cover

Mains Connection and Grounding

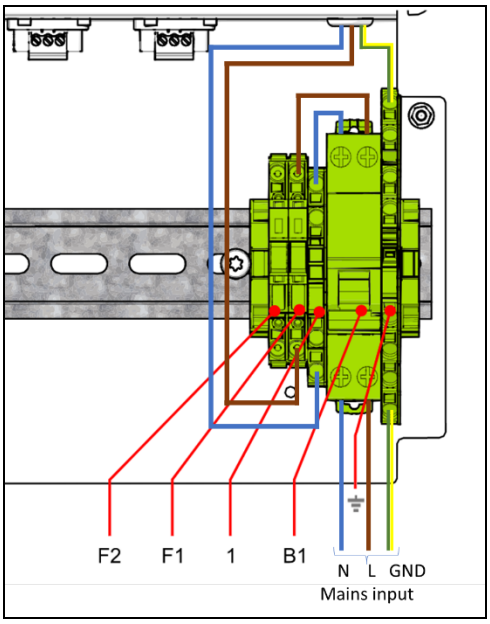

Figure 3 - Mains Input Detail

Terminal/Element	Description
F2 (Spare)	Fuse F2, 3.15A slow-blow
F1	Fuse F1, 3.15A slow-blow
1	Neutral terminal
B1	Mini Circuit Breaker curve C, 6A

Connect the power cable L-N to the Mini Circuit Breaker B1. The neutral terminal is indicated on the MCB.

Warning: Risk of fire. Always use a mains supply cord with adequate rating.

The unit is designed to operate from 115VAC to 230VAC and maximum current of 2A.

Also, F1 has a 3.15A fuse fitted in the Fused Terminal to break the live during a fault. Make sure the fuse is present in the pivoting fuse holder and the terminal is closed before powering up.

Fuse F2 is a spare fuse terminal to feed an auxiliary device, for example, an external PSU.

Warning: Risk of electric shock. Always attach the ground cable to the ground terminal before powering the unit.

Network Connection

There are two different types of ports to allow data to be transferred in or out of Calisto N1; Ethernet LAN 1/2 and the RS485. Both ports are managed by the PRIME application through the web interface.

Ethernet - LAN 1/2

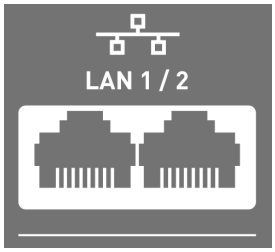

Figure 4 - Dual Ethernet Switch Detail

The LAN 1/2 dual Ethernet switch allows simultaneous connection of Calisto N1 to two devices over Ethernet. It's a convenient way to have N1 connected to an Ethernet device in the field and to your PC, at the same time, without needing an external network switch.

Internally, the dual Ethernet switch is connected to two different Ethernet interfaces, eth0 and eth1. Having two Ethernet interfaces enable Calisto N1 to segment the LAN, isolating Station Bus and Sensor Bus.

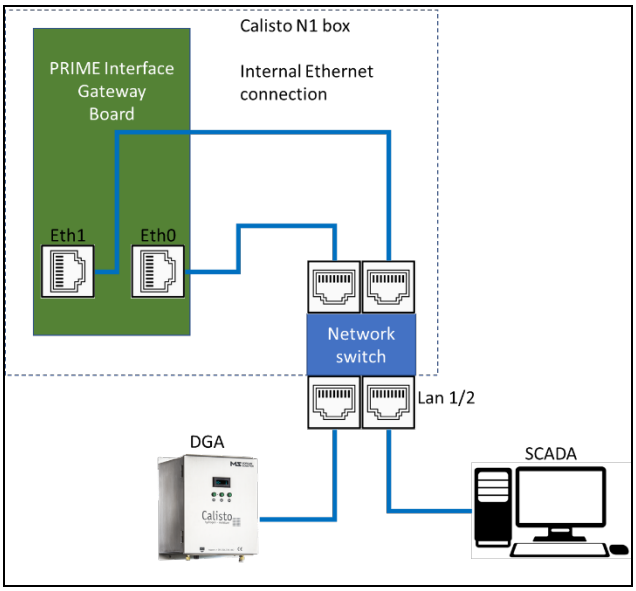

Figure 5 - Representation of Internal Ethernet Connection

These ports can provide the following service:

Service	Description
Configuration	Configure system settings and monitors via a web browser
Data visualization	View dashboard, charts, and export data via a web browser
Collect data from IEDs in the field	Communication with slave IEDs over Modbus and DNP3 protocols
Send data to an aggregator	Communication with a SCADA master over Modbus and DNP3 protocols
Time synchronization	Sync time with a server over NTP
Diagnostics	Maintenance terminal
PRIME and Calisto database synchronization	Synchronize the database between Doble devices running PRIME application in a seamless way

Table 2 *Services available over ethernet*

Either eth0 or eth1 can be used to connect to N1 and a web browser is required to access the web interface to configure the system or view the data.

Serial Ports

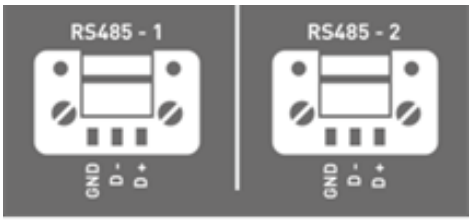

Figure 6 - RS485 port detail

The serial interface is a 2-wire RS485 that enables communication with master or slave devices over long cabling distances in electrically noisy environments. The RS485 network can support multiple slaves on the same channel or a single master. Serial communication supports Modbus or DNP3 protocols.

These ports provide the following service:

Service	Description
Sensor Bus	Communication with slave monitors over Modbus or DNP3 protocols
Station Bus	Communication with a SCADA master over Modbus or DNP3 protocols

Line Biasing and Resistor Termination

In RS-485 networks, there are periods of time when no driver actively drives the bus, such as when one driver relinquishes the bus to another driver. During this time, the termination resistors collapse the differential bus voltage to 0V, which is an undefined input level for many RS-485 receivers. Line biasing is one way to alleviate this problem. A resistor network of pull-up and pull-down resistors whose voltage divider actions provide a differential DC bus voltage when no driver is actively driving the bus.

To minimize signal errors due to noise over long cable lengths, the 120 Ohms termination resistor may be enabled to match the RS485 device impedance to that of the cable. It is recommended that the two 120 Ohms termination resistors should be placed at both far ends of the cable.

If you experience intermittent problems with communication to devices in the field, consider enabling both line biasing and termination resistor switched for the respective RS485 port being used.

To enable line biasing and/or termination resistor, use the switches located above the RS485 terminal. There is a set of switches for each port.

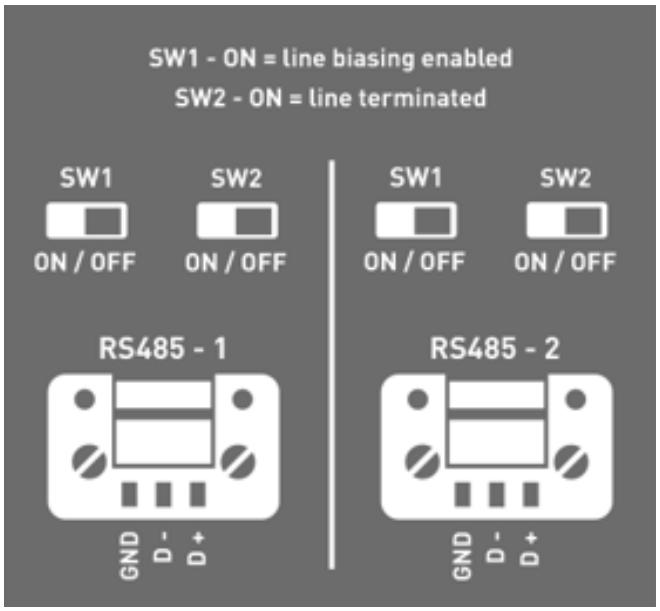

Figure 7 - Line Biasing and Termination Resistor Switches

Status Indicator and the IP Reset Pinhole

The front panel shows the current alert level of the asset being monitored. The reset pinhole below the LED indicator resets the IP address to factory default. The reset procedure does not delete the data or configuration of the unit.

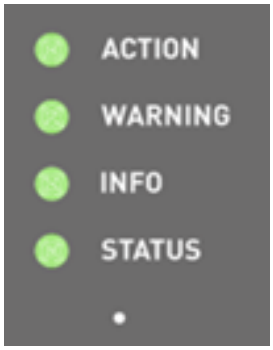

Figure 8 - LED Indicators and Reset Pinhole Location on the Front Panel

The Calisto N1 supports the generation of Communication, Information, Warning, and Action alerts.

Color	Meaning/Significance	Description
Red	Action	A measured event requiring immediate attention
Yellow	Warning	A measured event requiring further investigation
Green	Info	A measured event providing information
Blue	Status	Indication of device condition

Table 3 LED Indicator Status

Interpreting Alerts on the Front Panel

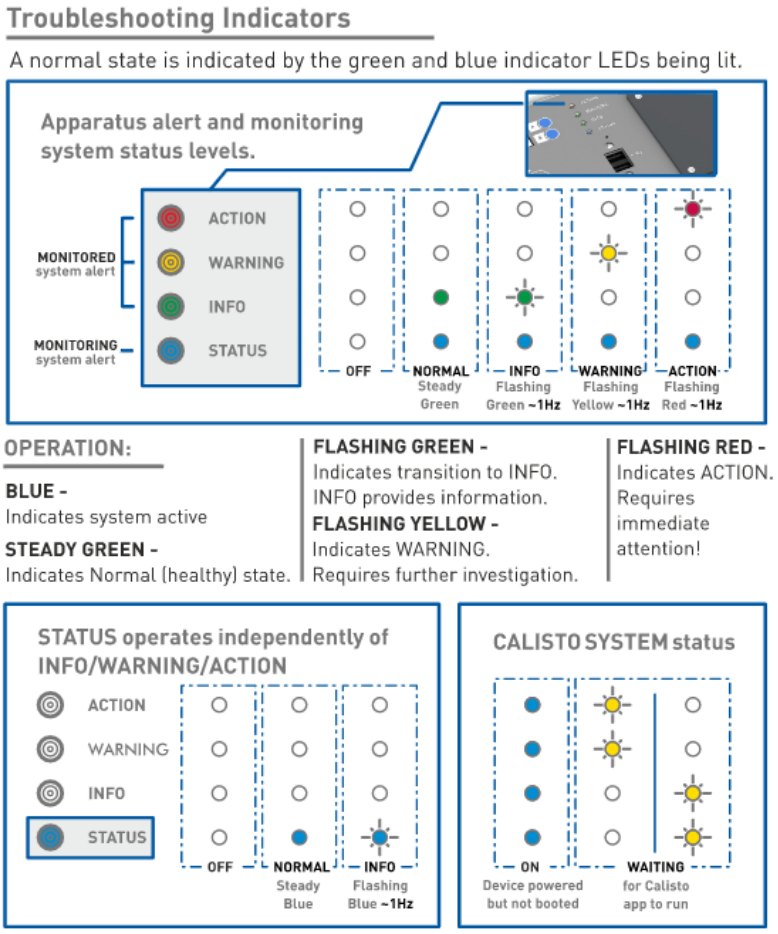

Figure 9 - LED Indicators Behavior

The blue and green indicators will light up steadily if the device has no configuration – factory default setting. It indicates no abnormal measurement, and it's the default behaviour of a new uncommissioned unit.

After N1 is commissioned, the status of the indicators will change according to the alert thresholds set on the unit, alert sent from third-party monitors, and doblePrime monitors.

IP Reset Procedure

Just below the LED lights, you find the pinhole, Figure 8, for resetting the unit. This procedure only resets the IP address, and no changes to the configuration or database are made. Reset procedure:

- Insert and hold a paperclip or similar in the pinhole. The LEDs will go out, then light up in sequence bottom to top when all the LEDs start flashing at the same time you can release the paperclip from the pinhole.
- After the paperclip is removed from the pinhole, the unit will perform a reset

- The IP of LAN 1/2 will fall back to the default address for each interface:
  - eth0: 192.168.0.19
  - eth1: 192.168.1.234

Supervisory Relays

Relay outputs are based on alert status and are dry contact type – voltage free. The operation of the relays can be seen in the diagram below:

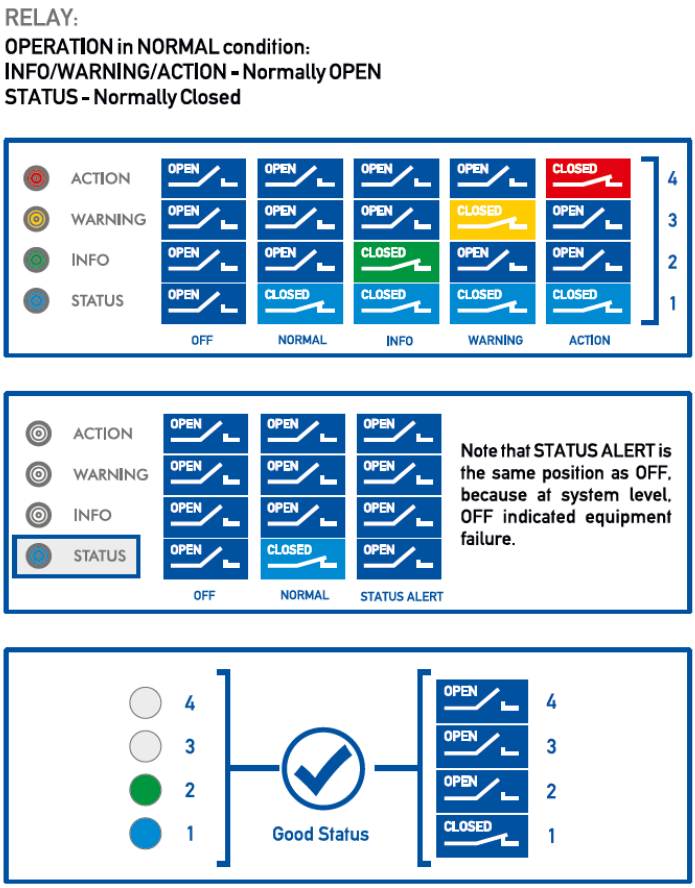

Figure 10 - Supervisory relays are driven by alerts only

The contact can be wired to an LED tower or the control room to monitor the alerts remotely.

4. Installation

The Calisto N1 and its ancillaries come fitted into a IP65 glass fiber reinforced polycarbonate enclosure. The transparent polycarbonate cover allows viewing the display and status LED.

You will find the DIN rail and the terminals in the cable management space with enough room to accommodate internal and field wiring. Remove the knockout at the bottom to feed the field wiring through the holes.

Use the external fixing lugs for mounting the enclosure on a flat wall surface. They can be fixed to the box base at an angle of 0°, 45°, or 90°.

For more information about the mechanical details, consult "Dimensions" on page 95.

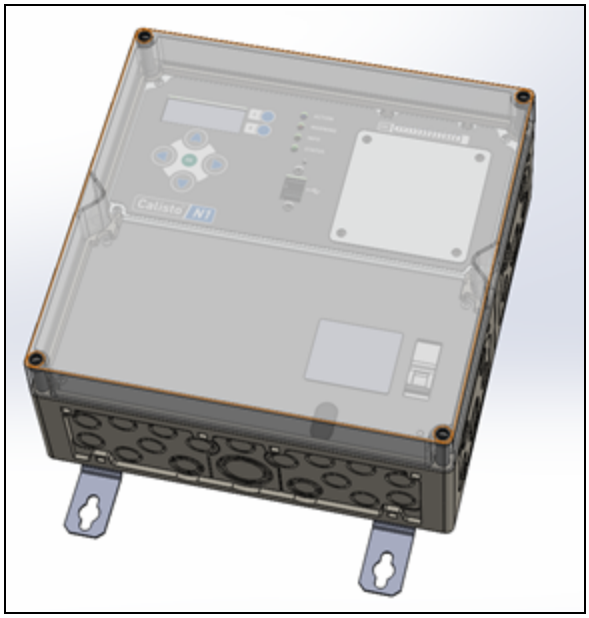

Figure 11 - Calisto N1 enclosure and fixing lugs

RS485 Wiring to Third Party Devices

The Calisto N1 can be used with any third-party device, e.g., DGA monitor and power meter, as long as they can communicate over Modbus or DNP3 protocol. The PRIME application that runs on N1 provides a number of ready-to-use communication drivers. If you cannot find the driver for the monitor you want N1 to communicate with then you can create your own driver using the Generic Monitor feature. To find out more where to find Monitor drivers available or how to create a Monitor, see "Configuration" on page 27.

An example of how to wire the RS485 network is shown below. If more than one monitor is connected to the RS485 port, then it must be connected in a daisy-chain configuration.

Other network topologies, e.g., star and ring, are discouraged as they might cause intermittent communication problems in the network.

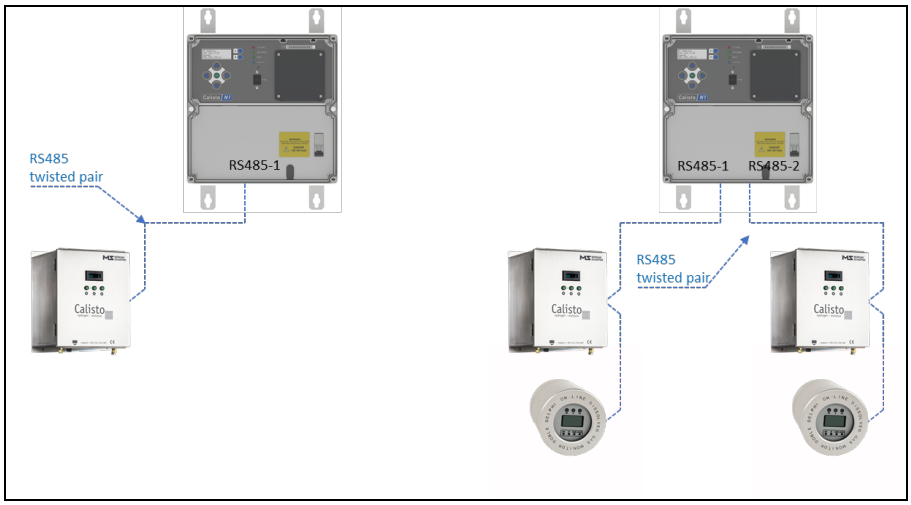

Figure 12 - RS485 network examples

Note: Always use shielded twisted pair cables for the RS485 network and do not exceed the cable length over 1000 meters to avoid comms issues.

It's recommended that the line biasing of the respective RS485 port being used to communicate with the monitor to be enabled. Long lines may need a 120 Ohms termination resistor to be added at the end of the line and the termination resistor of the respective RS485 port being used to communicate with the monitor to be enabled.

Having said that, each situation must be evaluated individually because of many factors that can influence the overall shielding and impedance of the network.

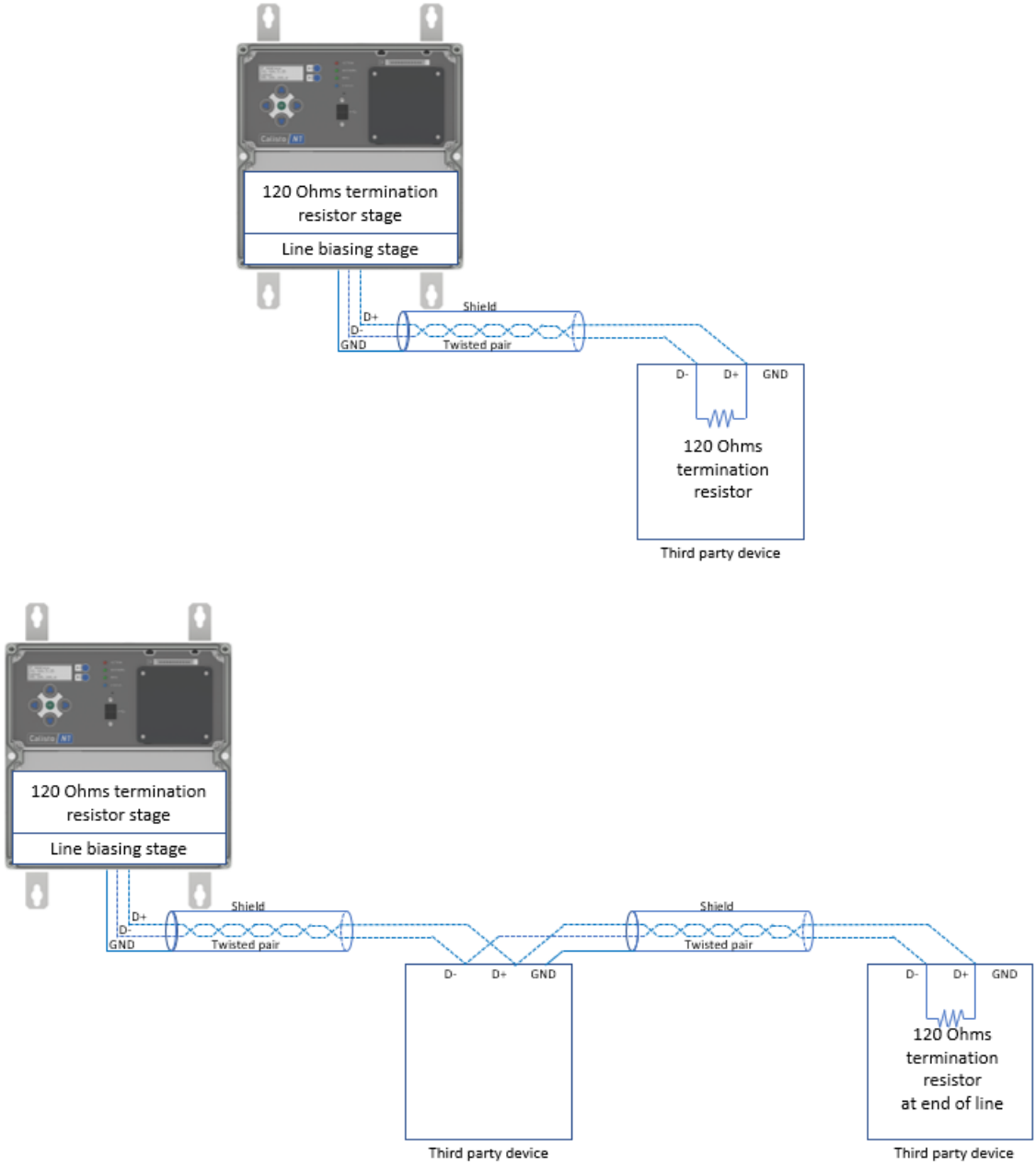

Figure 13 - RS485 wiring and installation and best practices

5. User Interface

Communication with Calisto N1 requires a static IP address to be set on your PC. Follow the steps described below to configure your PC network interface to prior accessing the web interface.

1. Power up the N1 device. Wait until the blue and green LEDs on the front panel of the N1 remain lit, indicating that the device has finished booting. This typically takes about 1 minute. After booting, the N1 will require an additional 30 seconds to initiate communication.
2. Connect your computer's network adapter to LAN1/2 port using an ethernet cable.
3. Set your computer's IP address and subnet to match the N1 subnet. Refer to the suggested IP address in the figure below for connecting to eth1/Network 2.

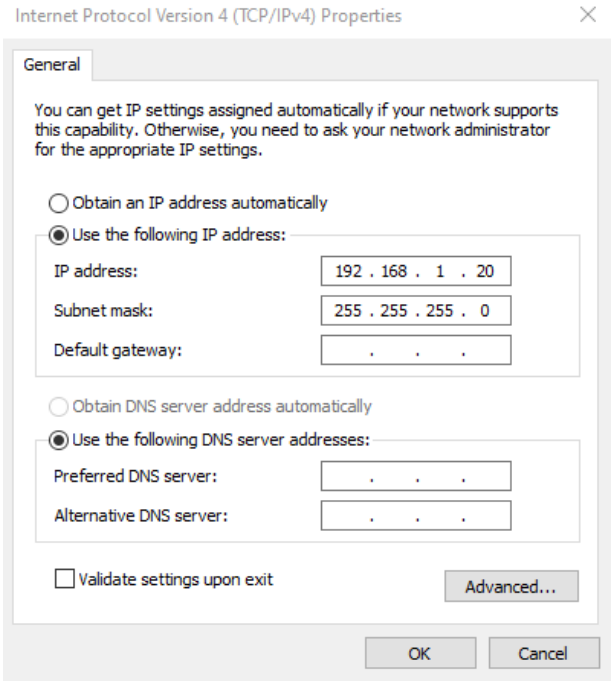

Figure 14 - PC Ethernet settings

4. Open a browser and enter the IP address in the URL bar. If you configured your PC's Ethernet adapter using the suggested configuration in the figure above, enter **192.168.1.234** in the URL bar and press Enter.

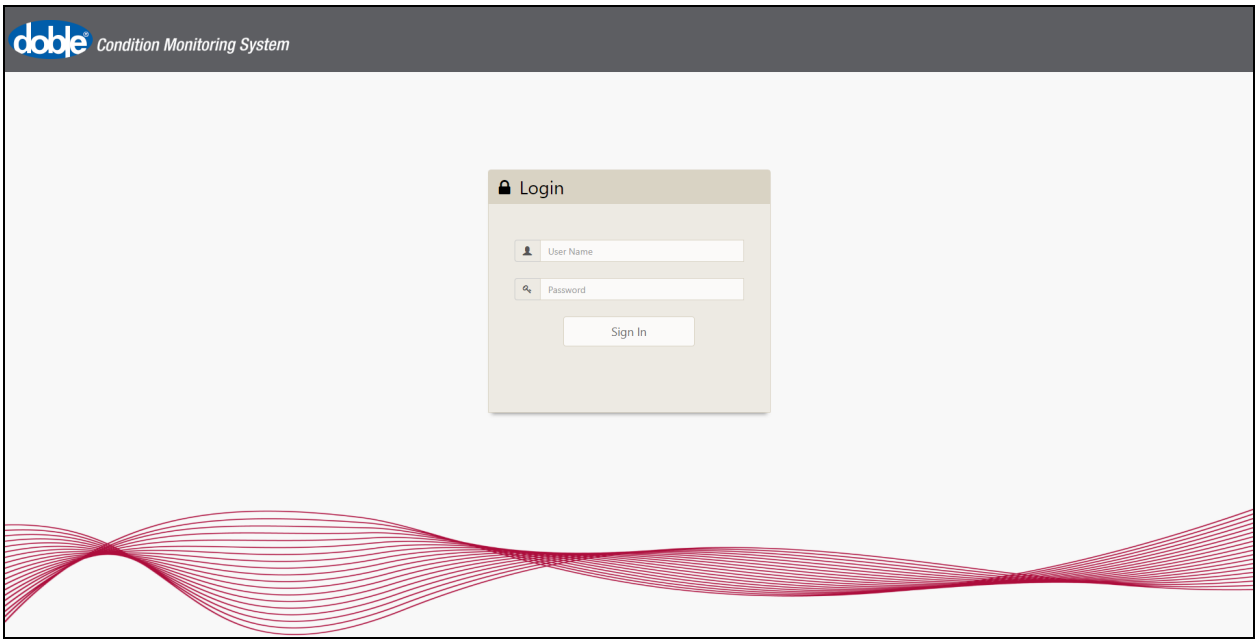

Figure 15 - PRIME login page

5. Enter your username and password. Default administrator credential:
   - Username: dobleAdmin
   - Password: dobleAdmin1!

> **Caution:** If you enter an incorrect password three times in a row, your user account will be locked out for an hour. In the event of an account lockout, you have two options: either try logging in with a different account or wait for an hour before attempting to log in again using the same account.

6. (Optional) If this is the first time you have logged in, Doble recommends that you change your password immediately. Do not continue to use the password provided by Doble. Please consult the dobePRIME 3.5 User Guide for more details.
7. Click **Sign In**.

The PRIME web interface application is shown after a valid credential is entered. From this interface, you can configure the system, view measurement, view alerts, and check your assets' health.

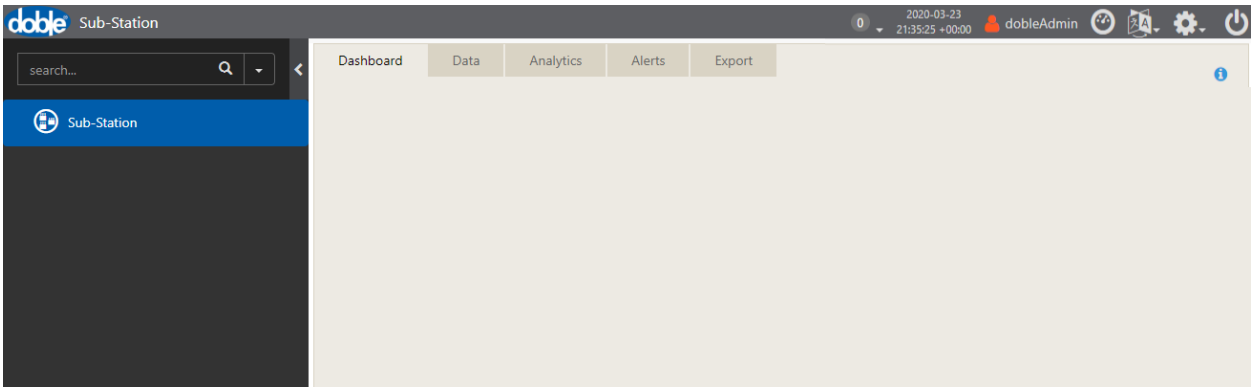

Figure 16 - PRIME Dashboard

This user guide primarily focuses on describing the main tools for setting up and commissioning Calisto N1 devices. For more detailed information about the PRIME interface and other available tools in the application, please refer to the doblePRIME 3.5 user guide, which can be found at [https://www.doble.com/support/downloads/on-line-monitoring-downloads/].

6. Configuration

In the real world, the asset you want to monitor has sensors mounted on it and is wired up to the Monitor device. The Calisto N1 application allows users to translate this concept from the real world into entities, channels and monitor instance in the software.

The asset entity is a representation of the real-world asset. The Monitor, e.g., DGA, PD Monitor, is named Monitor Instance, and the sensor is called a channel.

To start the configuration of the system, start by creating the asset in the application. Then instantiate the monitor type you want to use and assign the channels, its sensors, to the asset.

This chapter covers how to create an asset, configure monitor instances, assign a channel to the asset then, finally, commission the monitor to start logging the data.

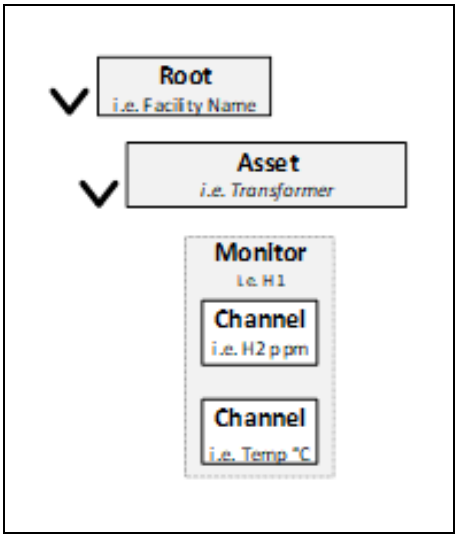

Figure 17 - The entities in the PRIME application

Create an Asset

The asset is an entity representation of the real-world asset which “owns” the channels. It represents physical location where the sensors are installed and it is depicted on the asset tree diagram.

1. To add an asset, click the Gear icon on the top-right of the title bar, then Click Asset Configuration.

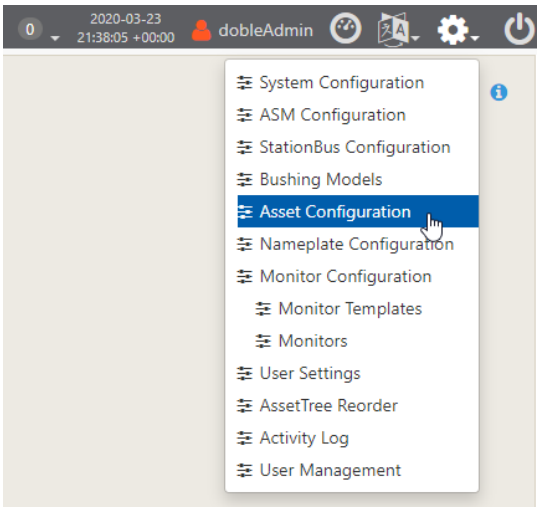

Figure 18 - Asset configuration option at the gear icon

The Asset Configuration tab appears in the Feature Panel.

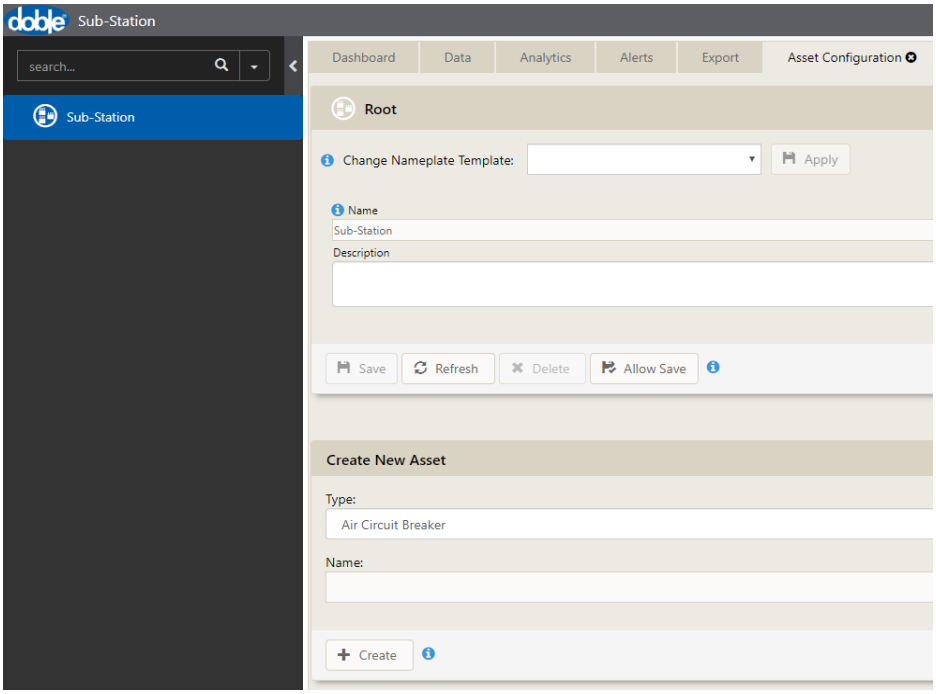

Figure 19 - Asset Configuration tab

The root name may be defined as required, generally used to describe the location of the monitoring system, e.g., Substation 1, Powerplant West.

2. After entering a suitable name in the field, Click on "Allow Save" and "Save" before proceeding.
3. Click the Type drop-down list in the Create New Asset section.

4. Select the asset type that best represents the real asset you are monitoring. The following options are available:
   - Air Circuit Breaker
   - Auto Transformer with Tertiary
   - Auto Transformer w/o Tertiary
   - Bushing (single)
   - Cable
   - Circuit Breaker
   - Dry Type Transformer
   - Generator
   - LTC
   - Oil Circuit Breaker
   - SF6 Circuit Breaker
   - System
   - Three Winding Transformer
   - Transformer
   - Two Winding Transformer
   - Unknown Asset
   - Vacuum Circuit Breaker
   - Voltage Transformer
   - [AG] Asset Group
   - [CG] Bushing Set
   - [CG] Channel Group
5. Enter the name of the asset you are creating in the Name field.

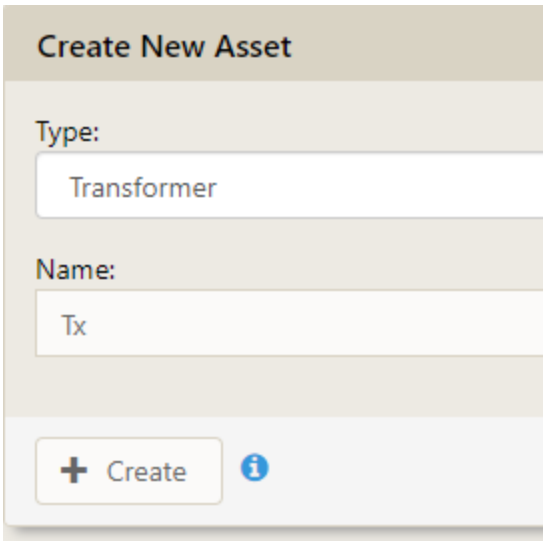

Figure 20 - Creating a transformer asset

Click **Create**. An asset created notification appears at the top-right of the window.

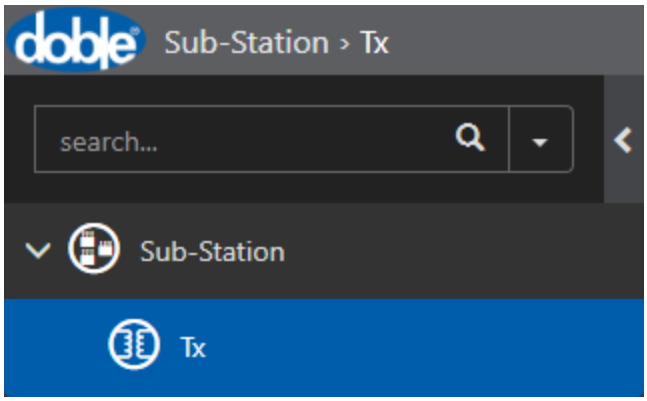

Figure 21 - Recently created asset in the asset tree pane

Create as many assets as required to represent your installation and where the sensor and monitors are mounted on.

4AD Monitor Configuration

This section describes how to configure the 4AD monitor to record analog and digital data. Feeding extra information into the monitor adds some context regarding the operation of the asset and help to investigate issues that may arise.

Configure the 4AD Monitor Instance

The 4AD monitor instance is the entity representing the 4AD monitor on PRIME application. The monitor is responsible for recording analog and digital signals.

Click the Gear icon on the top-right of the title bar. Under the Monitor Configuration, click on Monitors.

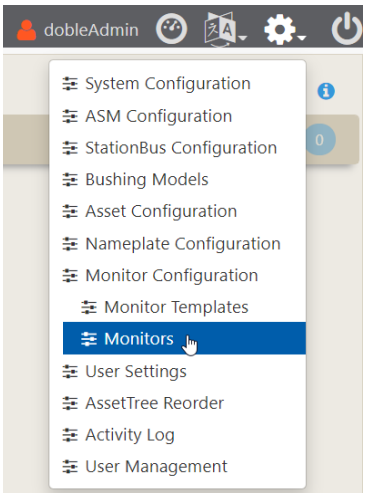

Figure 22 - List monitors

The Monitors tab appears in the feature menu. The 4AD monitor is shown on Monitors list.

Hardware	Function
4AD	4 Analog Input channels - 4 to 20 mA. For more information check 4AD card configuration section
	4 Digital Input Channels. For more information check 4AD card configuration section

To start editing the monitor, click on the corresponding double arrow under the Channels.

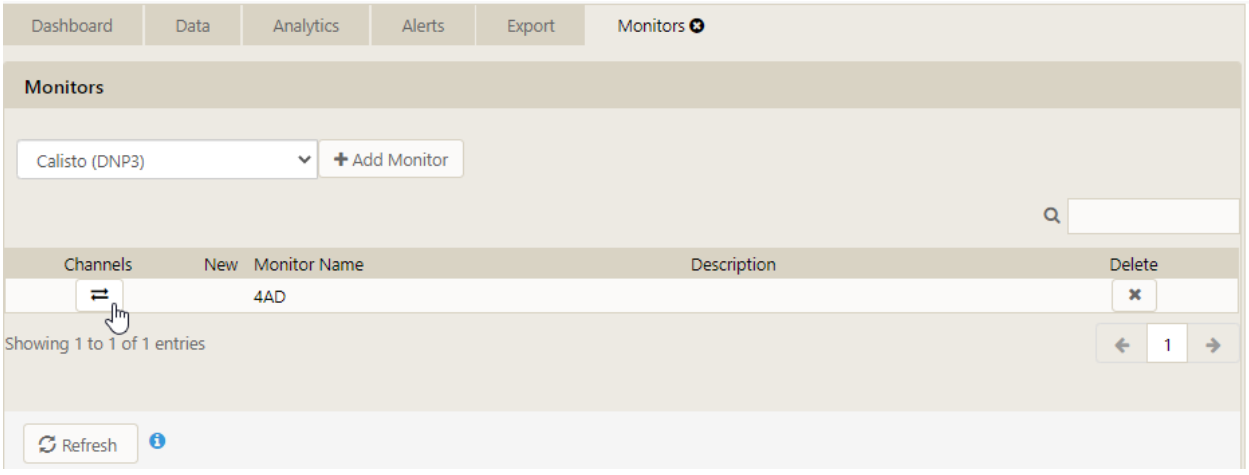

Figure 23 - Monitor instance. Click on Monitor Channels to edit the settings.

The 4AD monitor configuration page allows you to modify the communication settings and assign the created asset to the channels. The channels represent the physical inputs of the

unit, connected to different types of transducers such as temperature, current, or dry contacts. By assigning the asset to a channel, the asset can display the measurements or alerts from that channel on the dashboard.

As the 4AD manages both analog and digital inputs, you will see all the channels in the same list. The four first channels are analog input channels, and the other four are digital input channels.

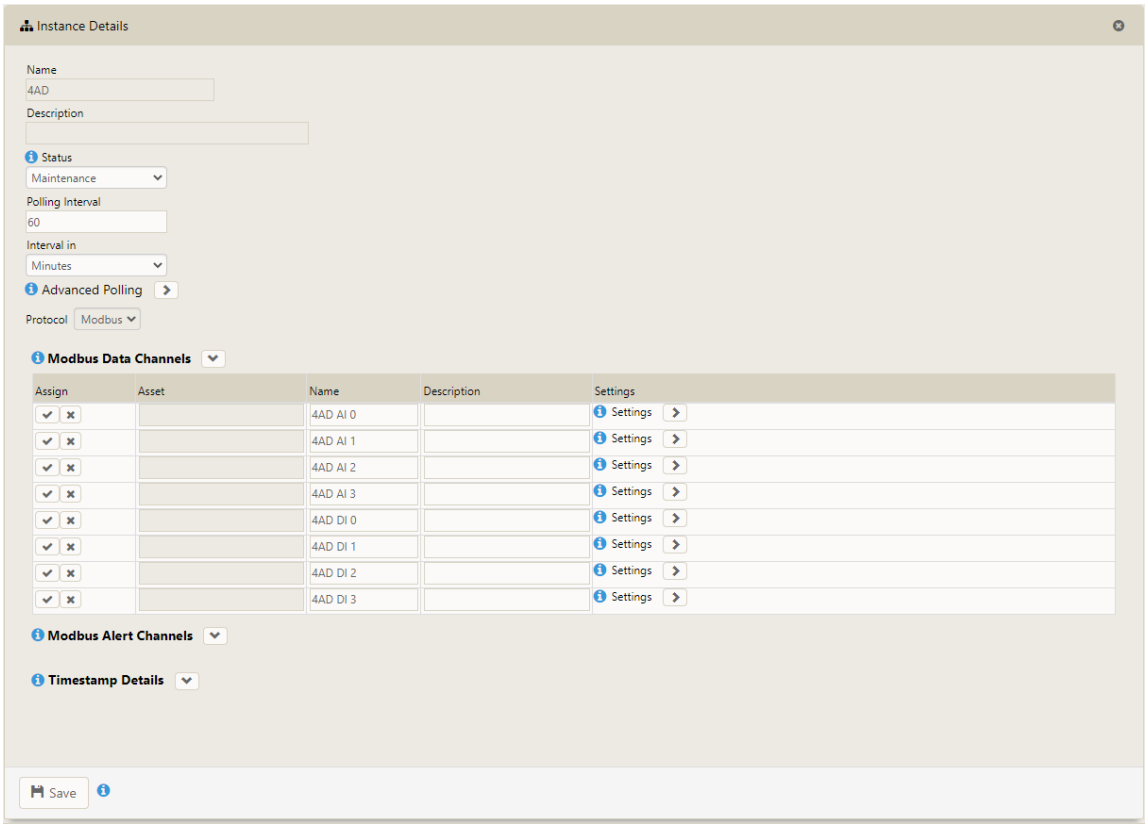

Figure 24 - 4AD Monitor instance. Analog and digital inputs

Analog Input Settings

Assign channels to any asset and apply appropriate scale to convert the measurements to engineering units.

Assigning the Asset to the Channel

Locate the asset you're interested in within the asset tree and click on it to select it. This will highlight the asset in blue. Then, click on the checkmark next to the channels you want to associate with the asset. The name of the asset will be copied into the Asset field, and the checkbox will change its color to green.

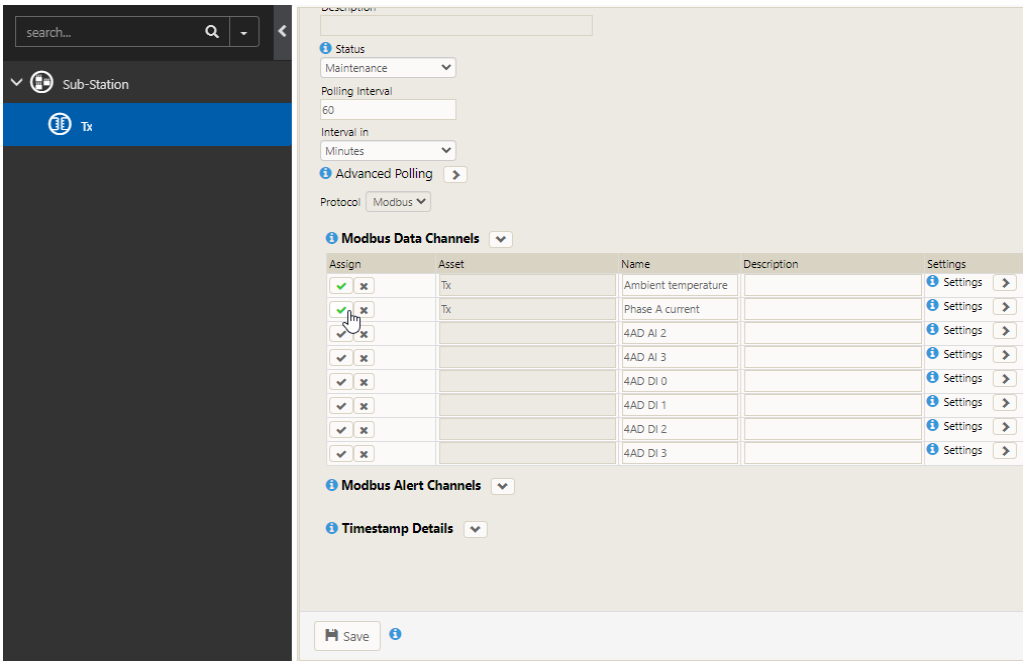

Figure 25 - Assigning a channel to an asset

Give the channel a suitable name so you can easily identify it in the asset tree.

Channel Settings

The raw output of the 4AD is not scaled and free of unit of measurement. To derive the engineering value, it is necessary to scale the raw output and assign appropriate unit of measurement.

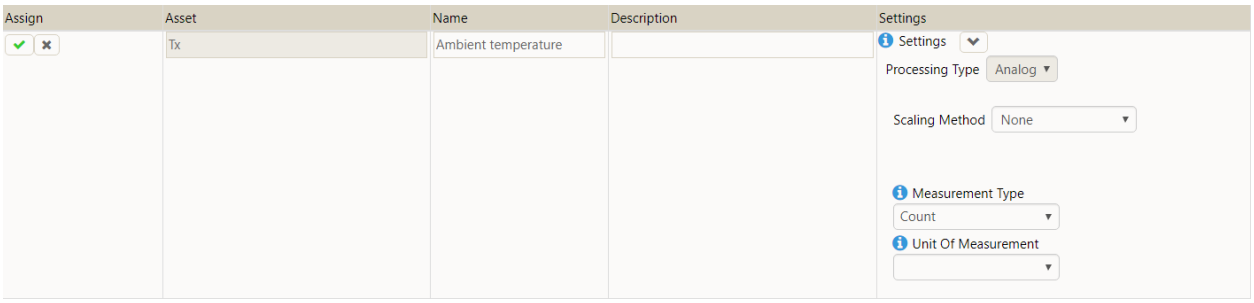

Figure 26 - Analog channel settings

General Settings

Processing Type	Analog Type channel

Scaling Method	None: Raw value range from 4000 to 20000 counts
	y=mx+c: Convert raw data to engineering units by using the slope-intercept form
	Linear interpolation: Not applicable to the 4AD
Measurement Type	Select the measurement type for the presentation of results, e.g., temperature, concentration.
Unit of Measurement	The appropriate list of UoMs are presented according to selected Measurement Type

Table 4 Analog channel settings

The y=mx+c Scaling Method

When y=mx + c is selected, you can enter the coefficients of the slope-intercept formula

where: $m = \frac{Multiply}{Divide}$ & $c = Offset$.

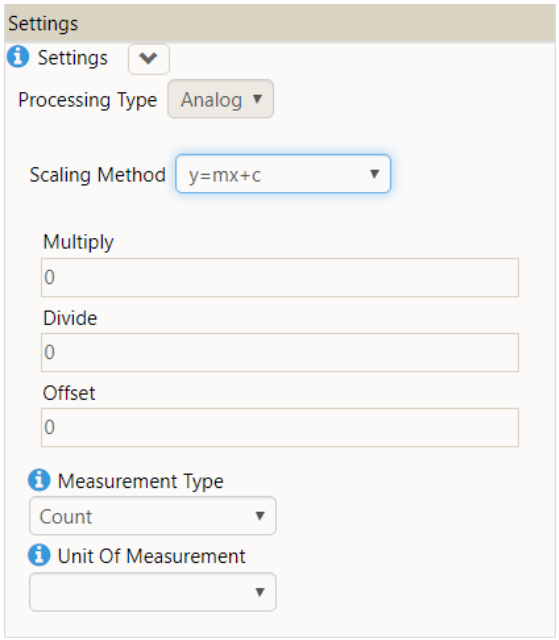

Figure 27 - Scaling method. The slope-intercept parameters

The slope must be entered as Multiply, Divide and offset constants. Please refer to the example below:

Suppose you want to integrate a current transducer to the N1, and upon reviewing the transducer's specifications, you come across the following information:

Suppose you want to integrate a current transducer to the N1, and upon reviewing the transducer specifications, you come across the following information:

Input: AC 0-1600 A

Output: 4-20 mA

On the N1 device, the 4AD module converts the analog input signal to counts, providing the raw digitalized measurement internally to PRIME. The PRIME application receives these raw measurements, or counts, and then applies the appropriate scale to convert the data into engineering units.

4AD Input range: 4-20 mA

4AD Output range: 4000-20000 counts

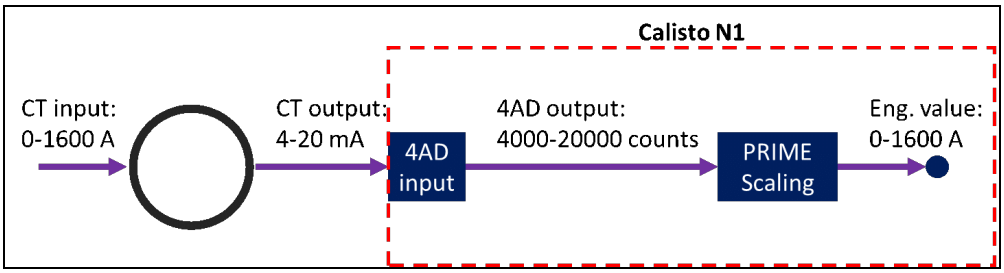

Figure 28 - Visual representation of the data conversion chain

Should you want to plot it on a chart, assume that the x-axis is represented by the 4AD output and y-axis by the transducer input current. Alternatively, we can view the data in table format.

x-axis Raw Measurement	y-axis Current
4000 counts	0 A
20000 counts	1600 A

The next step is to calculate the slope:

$$(y - y_0) = m(x - x_0)$$

$$m = \frac{(y - y_0)}{(x - x_0)}$$

$$m = \frac{(1600 - 0)}{(20000 - 4000)} = \frac{1600}{16000} = \frac{1}{10} = 0.1$$

Back to the equation, find the slope-intercept form:

$$(y - y_0) = m(x - x_0)$$
$$(y - 0) = 0.1(x - 4000)$$
$$y = 0.1x - 400$$

As stated previously:

$$m = \frac{Multiply}{Divide} \;\&\; c = Offset$$

Therefore:

Multiply = 1, Divide = 10, and c = -400

$$m = \frac{1}{10} = 0.1 \; and \; c = -400$$

Data in table format:

Transducer input	Transducer output	4AD card raw output	Slope-intercept form	Multiply	Divide	Offset
0-1600 A	4 to 20 mA	4000 to 20000 counts	y = 0.1x - 400	1	10	-400
				or		
				10	100	-400

Table 5 4AD scaling example, slope-intercept formula

Note: The minimum value for Divide is 1. Do not enter decimals in the Multiply, Divide and Offset fields. Decimals are ignored.

Digital Input settings

Assign channels to any asset and apply the label to identify the channel state.

Assigning the Asset to the Channel

Locate the asset you're interested in within the asset tree and click on it to select it. This will highlight the asset in blue. Then, click on the checkmark next to the channels you want to associate with the asset. The name of the asset will be copied into the Asset field, and the checkbox will change its color to green.

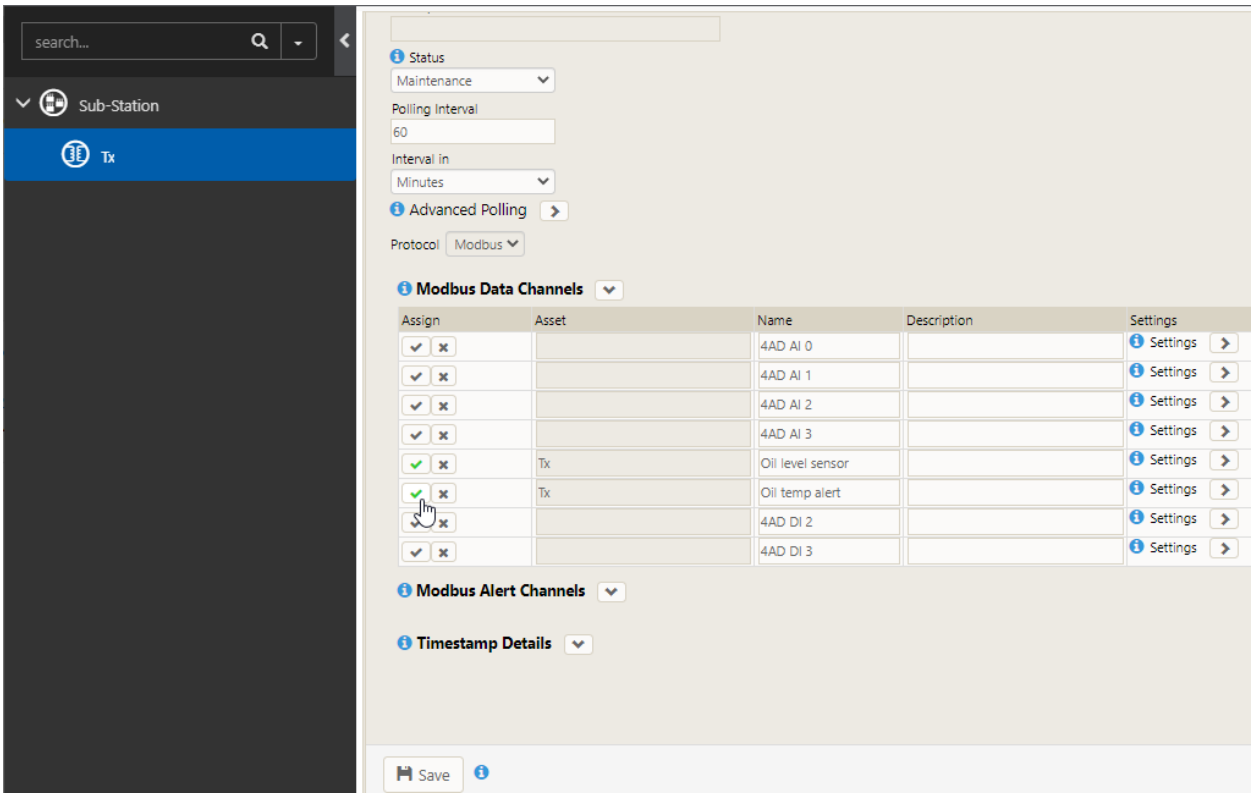

Figure 29 - Assigning a channel to an asset

Give the channel a suitable name so you can easily identify it on the asset tree.

Channel Settings

The raw output of the 4AD is not scaled and free of unit of measurement. To derive the engineering value, it is necessary to scale the raw output and assign appropriate unit of measurement.

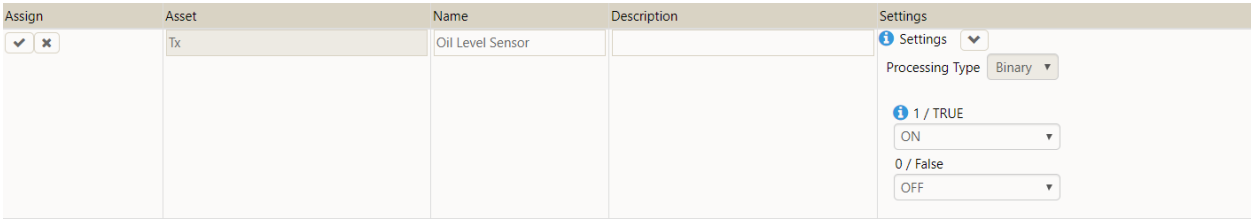

Figure 30 - Digital Channel Settings

General Settings

Processing type	Binary type
1/TRUE	Pick a label to describe the state of the channel when in the input is in high-state
0/FALSE	Pick a label to describe the state of the channel when in the input is in low-state

Table 6 Digital settings

Commissioning the 4AD Monitor

Monitor fields details	
Name	4D
Description	Blank
Status	Commissioned: Start collecting data from the monitor; Maintenance: Stop collecting data from the monitor. Previous data collected will continue to be available and visible to the user; Decommissioned: Stop collecting data from the monitor. Previous data collected will not be deleted form the database but will not be visible to the user. Can be reversed back to commissioned or maintenance state
Polling Interval	The interval at which Calisto N1 receives data from the 4AD card
Interval in	Select Interval in seconds or minutes.

Table 7 4AD monitor settings

To save the change click Save in the panel footer. Allow PRIME application to acknowledge the changes; it is an automatic process and can take up to 3 minutes. After this process, you will start seeing data on the Dashboard page. Refresh the web browser tab according to the polling rate and latest measured timestamp to see fresh data on the Dashboard.

Calisto H1 Monitor Configuration

This section describes how to configure Calisto H1 monitor. The H1 monitor can be configured on the system even if the sensor is not connected to Calisto N1.

Configure the Calisto H1 Monitor Instance

The Calisto H1 (Modbus) instance is the entity representing the H1 monitor on the PRIME application. Upon successful communication to Calisto H1 sensor the monitor will save H2 concentration and oil temperature onto the database.

1. Click the Gear icon on the top-right of the title bar. Under the Monitor Configuration, click on Monitors.

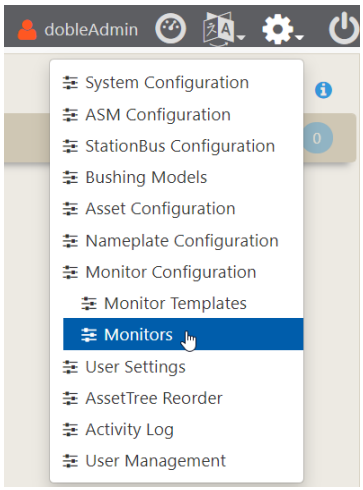

Figure 31 - List Monitors

2. The Monitors tab appears in the feature menu. Select H1 monitor on the drop-down menu then click '+Add Monitor' to add it to the Monitor's list.

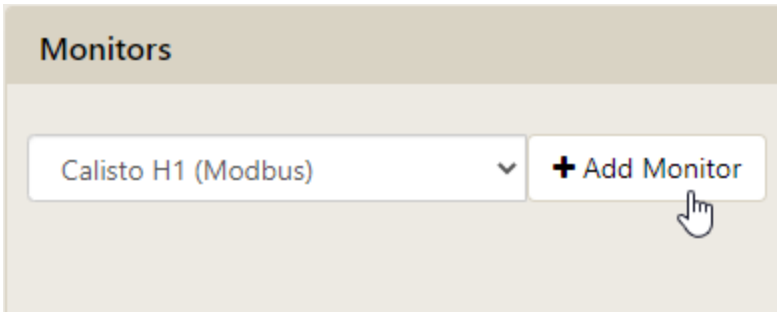

Figure 32 - Adding Calisto H1 Monitor

3. To start editing the monitor, click on the corresponding double arrow under the Channels column.

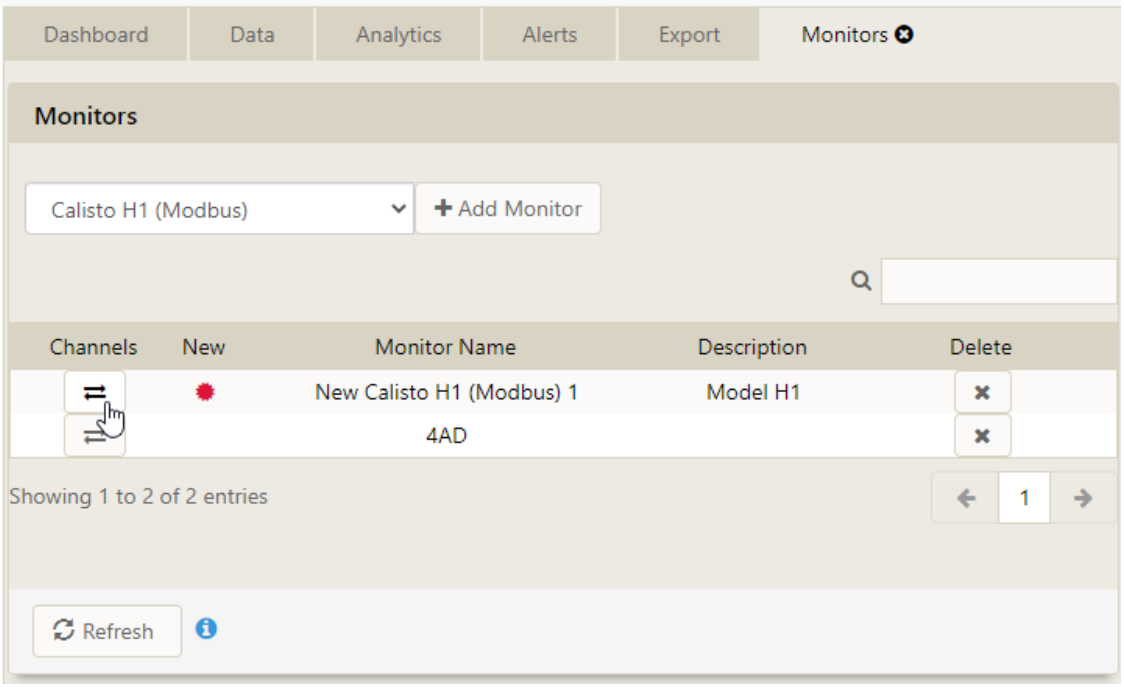

Figure 33 - H1 Monitor instance. Click on Monitor Channels to edit the settings

4. On the H1 monitor configuration page, you can edit the communications settings and assign the asset created to the channels. The channels are entities representing the sensors of the monitor – H2 concentration and oil temperature. When the asset is assigned to the channel, it owns and displays the channel measurements or alerts on the dashboard.

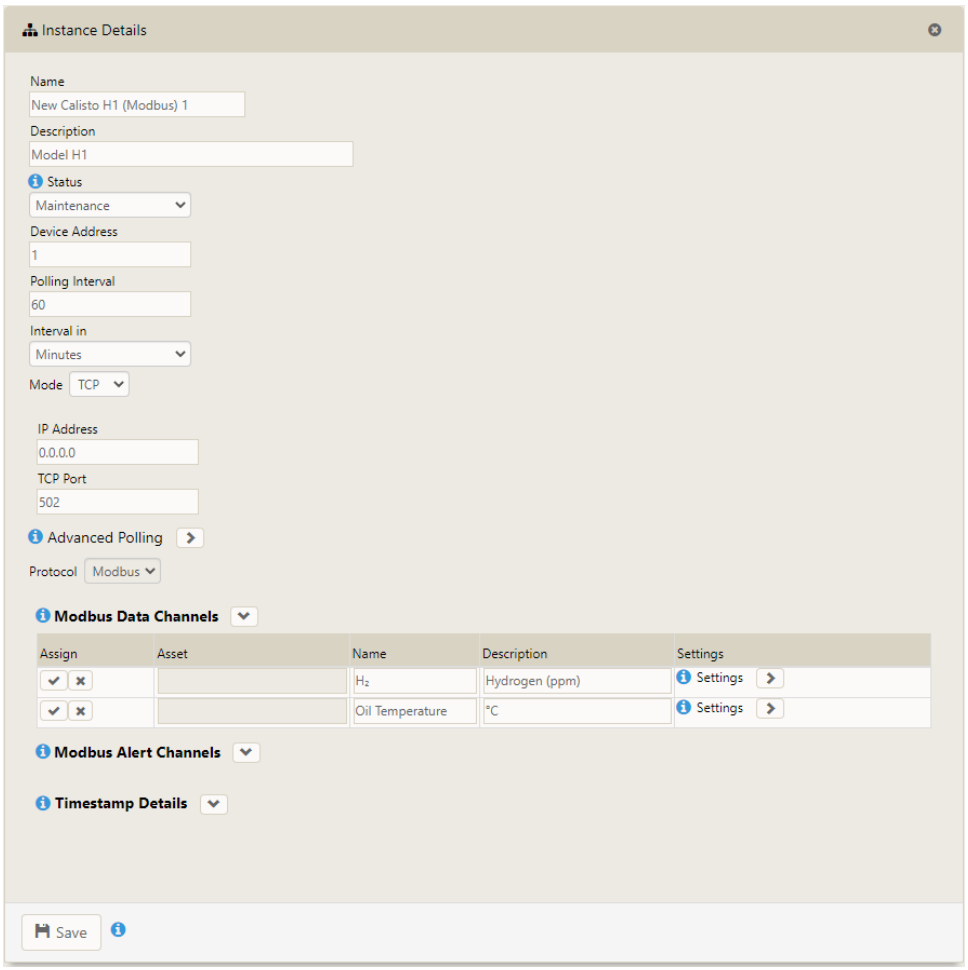

Figure 34 - H1 Monitor Instance

5. Find the asset of interest in the asset tree, then click it to select it. The asset becomes highlighted in blue. Then click the check mark next to channels which you want to associate with the asset. The name of the asset is copied into the Asset field, and the tick box changes color to green.

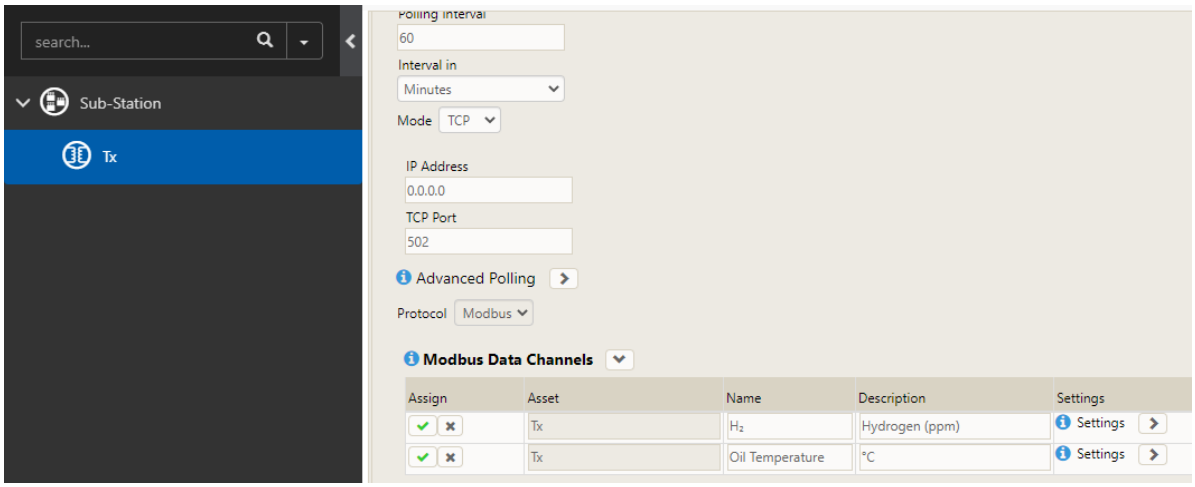

Figure 35 - Assigning the Channels to the Asset

6. The settings of the channels are pre-configured, ready to show scaled measurements and the corresponding unit of measurement.

Commissioning the H1 Monitor

Monitor Field Details	
Name	Enter a suitable name for the monitor.
Description	Model H1
Status	Commissioned: Start collecting data from the monitor; Maintenance: Stop collecting data from the monitor. Previous data collected will continue to be available and visible to the user; Decommissioned: Stop collecting data from the monitor. Previous data collected will not be deleted form the database but will not be visible to the user. Can be reversed back to commissioned or maintenance state
Device Address	Enter the Modbus address programmed on H1.
Polling Interval	The interval at which Calisto N1 receives data from H1
Interval In	Select Interval in seconds or minutes. The interval should be greater than the ability of H1 to produce new measurement. This interval is around 60 minutes or 3600 seconds.

Monitor Field Details	
Mode	Change mode to Serial. Comms only available over serial interface
Serial Interface	Select the RS485 port to which H1 is connected. The serial interface must be set to Master mode so it can be shown on this list. The speed and other parameters of the port must be set to 19200, 8 data bits, 1 stop bits and parity None. Please consult "Configuring Serial Interfaces" on page 74 for more information about setting up the serial interface.

Table 8 H1 Monitor Settings

Click Save in the panel footer. Allow the PRIME application to acknowledge the changes; it is an automatic process and can take up to 3 minutes. Upon successful communication, you will start seeing data on the Dashboard page. Refresh the web browser tab according to the polling rate and latest measured timestamp to see fresh data on the Dashboard.

Note: Line biasing and termination resistor might be required to allow Calisto N1 to pull data from the H1 sensor. Enable the line biasing switch and termination resistor on the respective port that H1 is connected to.

Monitor Configuration - General Steps to Configure Other Monitors

This section describes how to configure other monitors available on the drop-down menu. There are twenty-two ready-to-use monitors available for fast and seamless integration.

Configure the Monitor Instance

1. Click the Gear icon on the top-right of the title bar. Under the Monitor Configuration, click on Monitors.

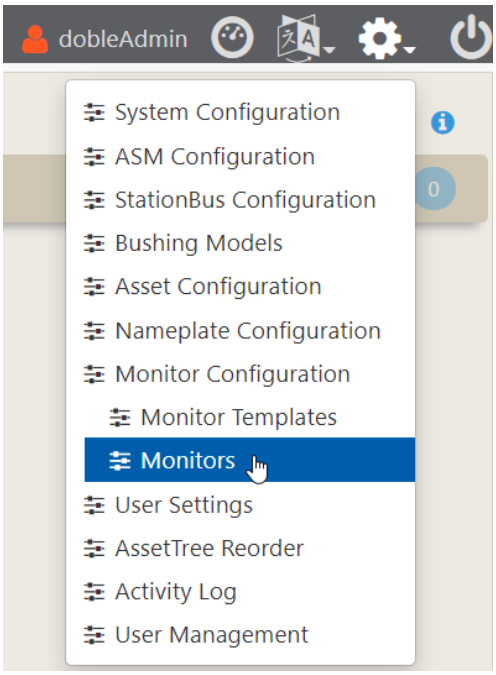

Figure 36 - Monitors option at gear icon

2. The Monitors tab appears in the feature menu. Select the desired monitor on the drop-down menu then click '+Add Monitor' to add it to the Monitor's list.

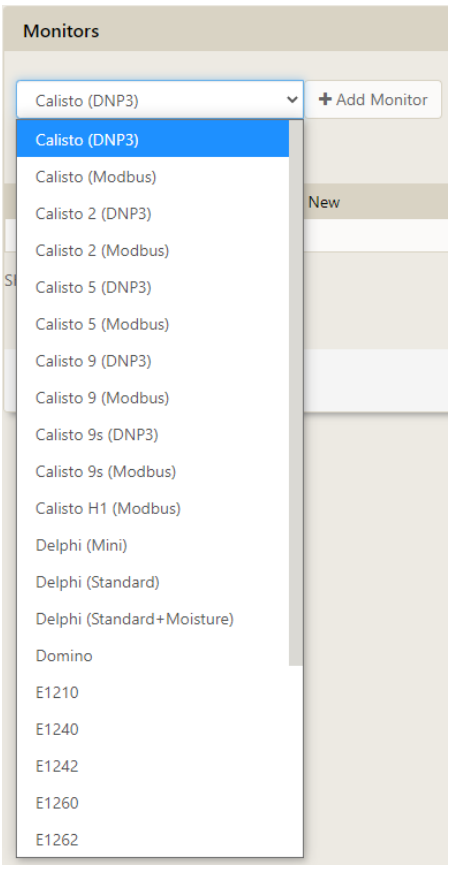

Figure 37 - List of all monitors available. Select a monitor of your choice

3. To start editing the monitor, click on the corresponding double arrow under the Channels column.

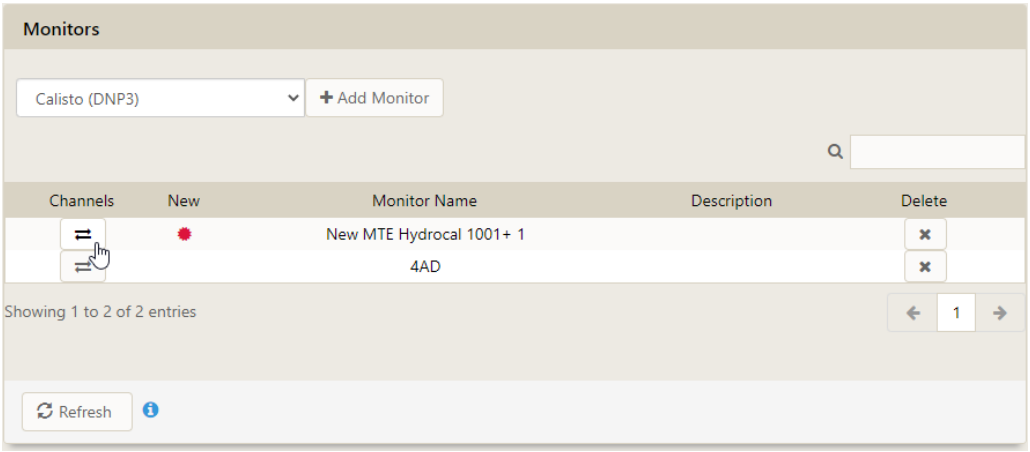

Figure 38 - Monitor instance. Click on Monitor Channels to edit the settings

4. On the monitor configuration page, you can edit the communications settings and assign the asset created to the channels. The channels are entities representing the sensors of the monitor. When the asset is assigned to the channel, it owns and displays the channel measurements or alerts on the dashboard.

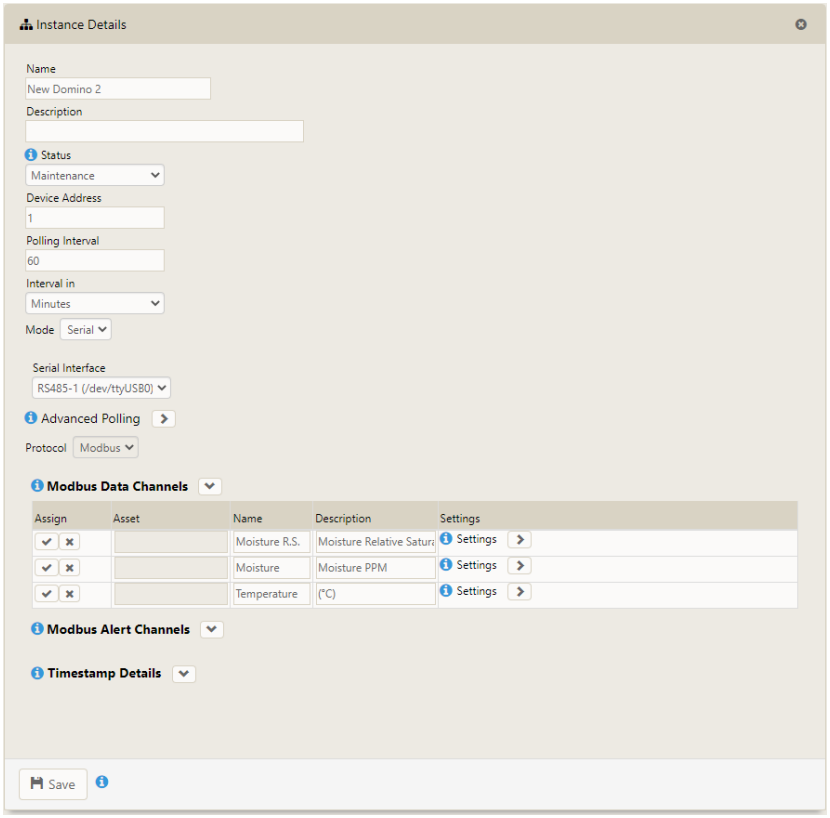

Figure 39 - Example Monitor Instance

5. Find the asset of interest in the asset tree, then click it to select it. The asset becomes highlighted in blue. Then click the check mark next to channels which you want to associate with the asset. The name of the asset is copied into the Asset field, and the tick box changes color to green.

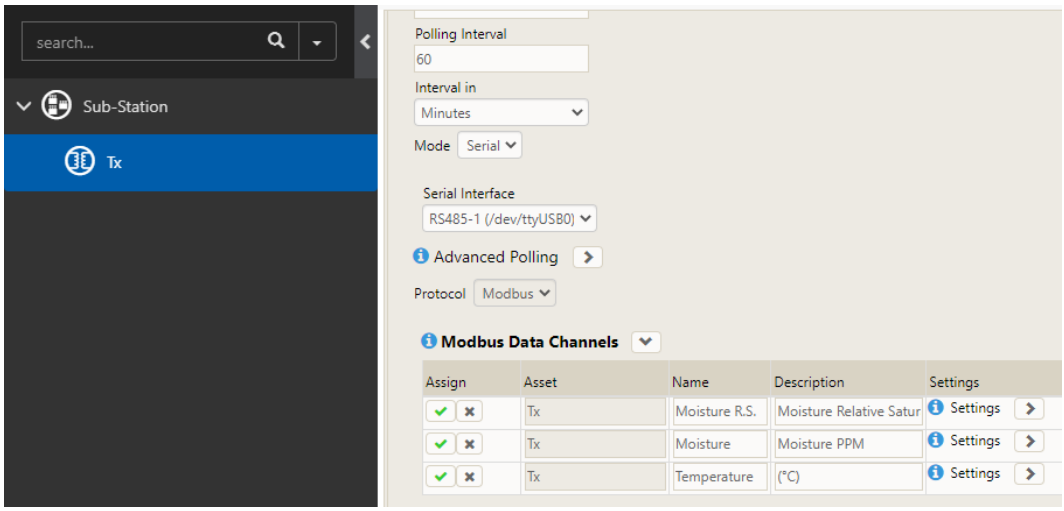

Figure 40 - Assigning Channels to the Asset

6. The settings of the channels are pre-configured, ready to show scaled measurements and its corresponding unit of measurement. No changes can be made to the pre-configured settings.

Commissioning the Monitor

Most of the settings are the same for all monitors apart from the communication mode. Communication mode to monitors is limited to its hardware specification. While some monitors can allow comms over serial and Ethernet, others are limited to only one type of media. Please consult the User Guide of your Monitor to select the appropriate comms mode on the instance.

Name	Enter a suitable name for the monitor.
Description	Description of the monitor model.
Status	Commissioned: Start collecting data from the monitor; Maintenance: Stop collecting data from the monitor. Previous data collected will continue to be available and visible to the user; Decommissioned: Stop collecting data from the monitor. Previous data collected will not be deleted form the database but will not be visible to the user. Can be reversed back to commissioned or maintenance state
Device Address	Enter the Modbus/DNP3 address programmed on monitor. The DNP3 master address is configure on System Configuration -> Comms settings.

Polling Interval	The interval at which Calisto N1 receives data from the monitor.
Interval in	Select Interval in seconds or minutes. The interval should be greater than the ability of you monitor to produce/derive new measurements.
Mode	Select the communication mode, Serial or TCP, according to your monitor's comms configuration. If Serial mode is selected, the options below will change so you can select to which serial RS485 port you monitor is connected up. Whereas if you select TCP mode the options below will change so you can enter the network settings of your monitor.
*Serial Interface	Option only shown when mode is set to Serial. Select the RS485 port to which N1 is connected. The serial interface must be set to Master mode so it can be shown on this list. Please consult "Configuring Serial Interfaces" on page 74 for more information about setting up the serial interface.
*IP address and TCP port	Option only shown when mode is set to TCP. Enter the IP address and Port open on your monitor so Calisto N1 can connect to it over the network.

Table 9 Monitor Comms Settings

Click Save in the panel footer. Allow the PRIME application to acknowledge the changes; it is an automatic process and can take up to 3 minutes. Upon successful communication, you will start seeing data on the Dashboard page. Refresh the web browser tab according to the polling rate and latest measured timestamp to see fresh data on the Dashboard.

Generic Monitor Configuration

This section describes how to create a custom monitor when the device you want to integrate is not available on the Monitor drop-down menu. Creating a custom monitor requires experience in system integration and communication protocols as it's a flexible tool and allow data manipulation. Before starting your custom monitor, setup you monitor to talk either Modbus or DNP3 over RS485 or Ethernet. Get hold of the Modbus register or DNP3 object mapping of the device you want to integrate and select what information you want to send across to N1.

Create the Monitor Template

Monitor template encapsulates the Modbus or DNP3 points of interest. Describe the points in the data and alert channels to reflect the expected configuration of the monitor for a successful polling. At a later stage, the template will be used to create the instance(s) of the monitor by adding the communication settings. To create the template, go to the Gear icon

on the top-right of the title bar. Under the Monitor Configuration, click on Monitor Template.

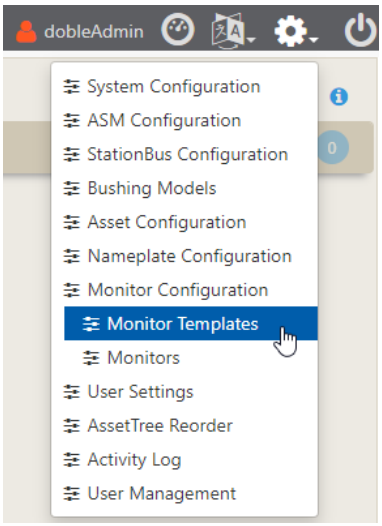

Figure 41 - Monitor Template option at gear icon

The Monitor Template appears in the feature menu. Click '+Create Template' to add a template to the list. Easily manage the templates using the export and delete buttons. Exporting the template to a file allows you to download it to your computer or load to another system. To start editing the template, click on the corresponding double arrow under the Channels column.

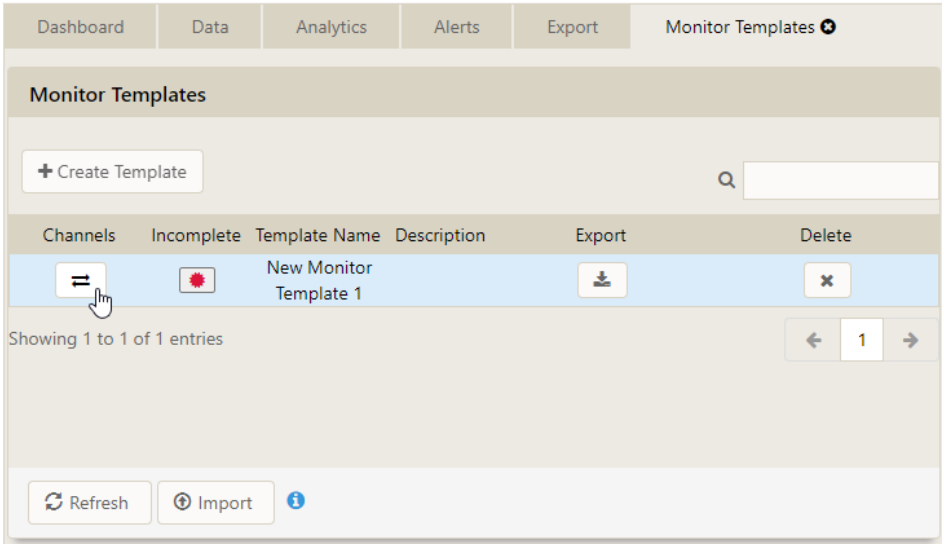

Figure 42 - Click on Channels to edit the template settings

Select the Protocol that you want to configure in the monitor template so the options on the following menus can change accordingly to accommodate the specific protocol settings.

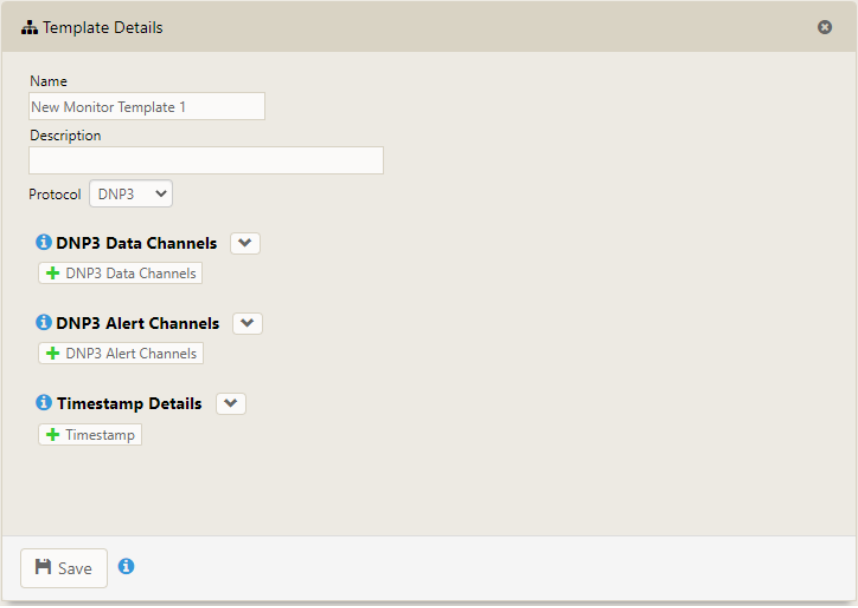

Figure 43 - Monitor template

The template can be broken down into three different types of information: Data channels, Alert Channels and Timestamp details.

Data channels is where you configure measurements and alert points whereas alert channels is where you configure alert points only. Upon successful polling, the measurements and alerts are shown on dashboard page. Moreover, the alert channels will generate system alerts when the measurement or status matches to what was configured in the alert trigger option.

Timestamp details is where you configure timestamp sources. Measurements and alert channels can use system timestamp reference, i.e., data and alerts collected are timestamped as they arrive on PRIME using local time. Alternatively, you can use a remote timestamp, i.e, timestamp from the source of the points in register format. This feature is useful to timestamp data collected from the source and use the source's timestamp when the acquisition actually happened as opposed to timestamp the data when it is recorded on PRIME application after a successful polling.

As there are two different types of data/alert/timestamp channels, Modbus and DNP3, and they share no parameters similarities the following subsections will describe the steps for setting up each type of data channel separately.

Configuring Modbus Channels

1. To create a data channel, click on '+Modbus Data Channels'. The data channel shows the following fields:

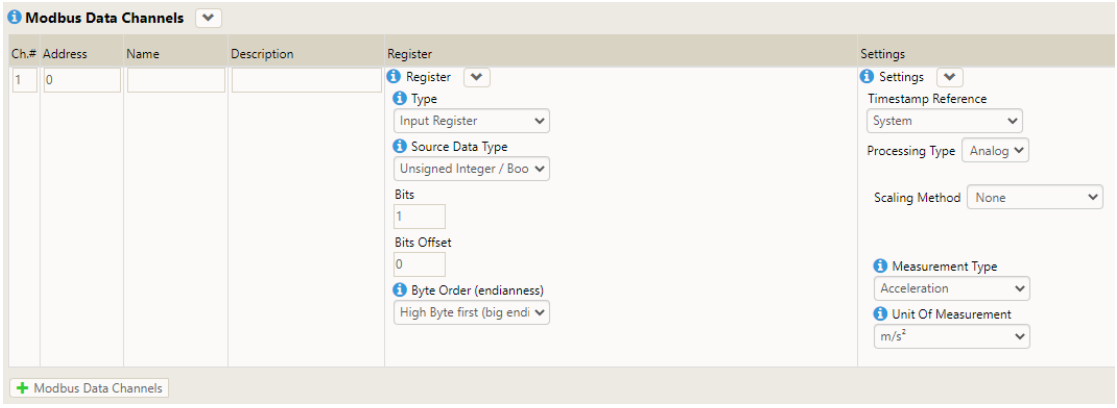

Figure 44 - Monitor template data channel

2. Fill out the fields according to what measurements you want to pull from the monitor.

Ch. #	Unique data channel number
Address	Modbus address of the measurement of interest. If it is not clear whether your monitor documentation refers to register or address, and you are not getting the expected result, try one number up or down.
Name	Enter a name for this channel
Description	Enter a description for this channel (optional)

Register	Type	Select the Function Code supported on the monitor associated to the Modbus register. On PRIME you can select Function Codes 1, 2, 3 and 4
	Source Data Type	Select data type according to function code associated to the Modbus address
	Bits	Number of bits in the register or combined registers representing the value. This field is usually 16 or 32 bits for measurements and 1 bit for binary points
	Bits Offset	Add a bit offset to the register containing the value. The new value is represented by the remaining bits in the register.
	Byte Order (endianness)	Select big-Endian style (the high-order byte is stored first, followed by the low-order byte) or little-Endian style (the low-order byte is stored first, followed by the high-order byte). Usually, big-endian work for most Modbus implementations
Settings	Timestamp Reference	Select system to timestamp fresh data using local time. Use remote timestamp to timestamp fresh data using registers from the monitor containing time and date.
	Processing Type	Select if you want to process the data register as analog value or digital.
	Scaling Method	Enable scaling. Please consult the 4AD Monitor configuration section for more details about scaling methods.
	Measurement Type	Select type of measurement to be associated to this channel.

	Unit of Measurement	Select the appropriate unit of measurement to this channel.

Table 10 Modbus Data Channel Settings

3. Create as many data channels as necessary that you want to be saved on PRIME database.
4. To create an alert channel click on '+Modbus Alert Channels'. The alert channel shows the following fields:

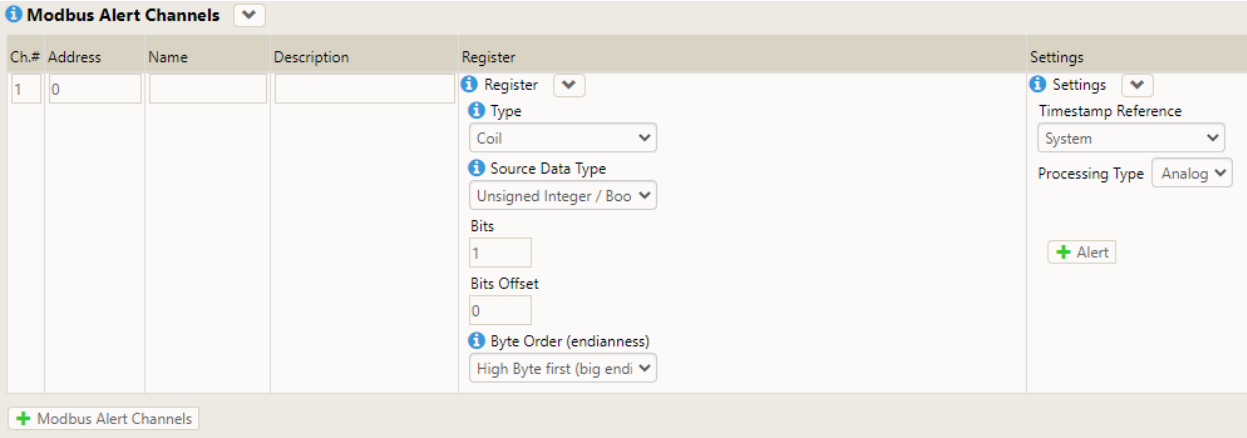

Figure 45 - Monitor template alert channel

Ch. #	Unique Alert Channel Number
Address	Modbus address of the measurement of interest. If it is not clear whether your monitor documentation refers to register or address, and you are not getting the expected result, try one number up or down.
Name	Enter a name for this channel
Description	Enter a description for this channel (optional)

Ch. #		Unique Alert Channel Number
Register	Type	Select the Function Code supported on the monitor associated to the Modbus register. On PRIME you can select Function Codes 1, 2, 3, and 4.
	Source Data Type	Select data type according to function code associated to the Modbus address
	Bits	Number of bits in the register or combined registers representing the value. This field is usually 16 or 32 bits for measurements and 1 bit for binary points
	Bits Offset	Add a bit offset to the register containing the value. The new value is represented by the remaining bits in the register.
	Byte Order (endianness)	Select big-Endian style (the high-order byte is stored first, followed by the low-order byte) or little-Endian style (the low-order byte is stored first, followed by the high-order byte). Usually big-endian work for most Modbus implementations
Settings	Timestamp Reference	Select system to timestamp data using local time as it's saved on the database. Use remote timestamp to timestamp data using registers from the monitor containing time and date.
	Processing Type	Select if you want to process the data register as analog value or digital. Selecting Analog processing type allows you to create a single or several alerts for the same channel. Selecting Binary processing type allows you to create a single alert as the status can be only 0 or 1.
	Alert Value	Enter the value that will trigger the alert
	Alert Type	Assign the severity of the alert
	Alert Message	Assign a custom message to the alert

Table 11 Modbus alert channel settings

5. Create as many alert channels as necessary that you want to be saved on PRIME database.

6. To create a Timestamp details click on '+Timestamp'. The timestamp channel shows the following fields:

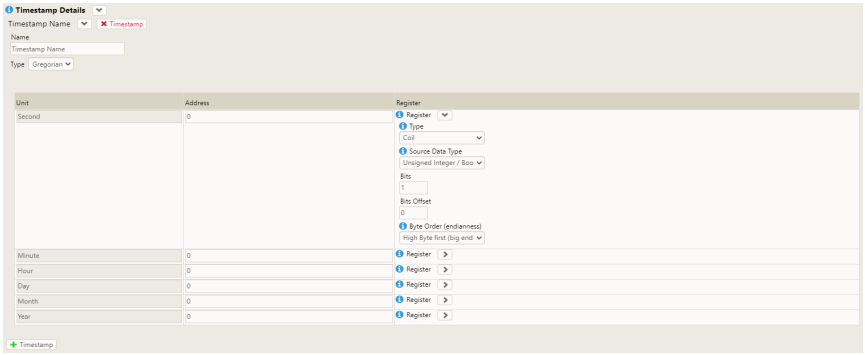

Figure 46 - Monitor template timestamp details

Name		Enter name for the remote timestamp so you can easily identify it in Timestamp Reference field
Unit		Second, Minute, Hour, Day, Month, and Year fields
Address		Enter the address corresponding to the unit being configured
Register	Type	Select the Function Code expected at the monitor associated to the Modbus register. Only Function codes 1, 2, 3 and 4 are implemented, however only function codes 3 and 4 will return a meaningful value
	Source Data Type	Select data type according to function code associated to the Modbus address
	Bits	Number of bits in the register or combined registers representing the value. This field is usually 16 bits
	Bits Offset	Add a bit offset to the register containing the value. The new value is represented by the remaining bits in the register
	Byte Order (endianness)	Select big-Endian style (the high-order byte is stored first, followed by the low-order byte) or little-Endian style (the low-order byte is stored first, followed by the high-order byte). Usually big-endian work for most Modbus implementations

Table 12 Modbus timestamp settings

7. Create as many remote timestamp references as necessary.

Modbus Template Configuration Exercise

Find below some snippets from the Calisto H1 User Guide. Those two tables in the User Guide will provide the information necessary to create the template. On this exercise we will create a template to read H2 ppm and oil temperature.

Note: Calisto H1 monitor driver is already available in the monitor library. The purpose of this exercise is to understand how a Monitor Template is created and how to instantiate it.

Byte	Modbus Parameter	Range	Meaning
1	Slave address	1-247	Unit ID Address
2	Function Code	03	Read Holding Register
3	Starting Address Hi	0x00-0xFF	Holding Register Hi Byte
4	Starting Address Lo	0x00-0xFF	Holding Register Lo Byte
5	Number of registers Hi	0	Limited by Modbus spec V1.1b
6	Number of Registers Lo	1-125	Number of 16-bit registers Lo Byte
7	CRC Low	0x00-0xFF	CRC Low Byte
8	CRC Hi	0x00-0xFF	CRC High Byte

Figure 47 - Modbus Read Request Packet

Register	Parameter	Function	Data Type	Data Range	Access
		Meas-urements			
0	Hydrogen, ppm H2	High word Low word	32-bit bin-ary num-ber	0 to 20,000,000	R
1	Hydrogen, ppm H2	High word Low word	32-bit bin-ary num-ber	0 to 20,000,000	R
2-6	Reserved for future use	Reserved for future use	Reserved for future use	Reserved for future use	Reserved for future use
7	PCB Temperat-ure, Celsius	x100 scale; 100 offset (T=V/100-100)	16-bit bin-ary num-ber	-100 to +200	R
8	Oil Tem-perature, Celsius	x100 scale; 100 offset (T=V/100-100)	16-bit bin-ary num-ber	-100 to +200	R

Figure 48 - Command Register Location

On the Modbus read request packet table we can identify the following:

Register Type	Read Holding Register
Byte Order	Big-Endian

And on the Command Register Locations table we can extract:

Register	Address	Source Data Type	Bits
H2 ppm	0 and 1	Integer	32
Oil temperature	8	Integer	16

Table 13 Modbus map

Also, we will have to apply scale to the oil temperature. The slope intercept form is described in the table as $T = \frac{Value}{100} - 100$, where the temperature is in degrees C and Value is the raw measument. Thus, the scaling constants for the oil temperature are:

Scale	
Multipy	1
Divide	100
Offset	-100

Table 14 Temperature Scale

For more information about scaling please consult "4AD Monitor Configuration" on page 30.

Open the Monitor Templates page. Enter a name for H1 monitor template and select Modbus protocol before filling in the fields. Create two Modbus Data channels, one for each measurement and fill out the fields using the previous tables.

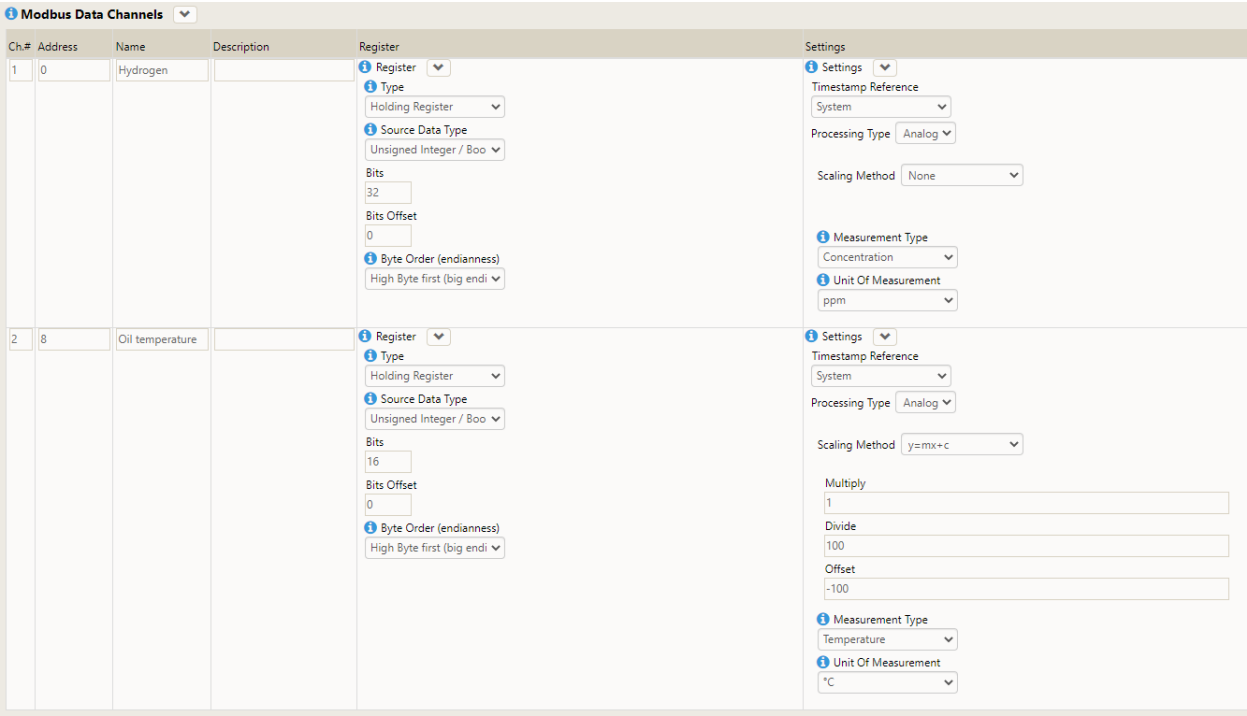

Figure 49 - Fill out the fields using the information from the above tables

Note: An instantiated monitor cannot have its settings changed. Edit the correspondent template, re-instantiate a new monitor, then delete the previous instance. If the monitor has been commissioned and successfully transferred data in, then the instance can no longer be deleted. In this case, set the monitor to 'decommissioned' then re-instantiate a new monitor using the updated template.

After filling out all the information click Save, located in the panel footer. The custom monitor template in now found in the Monitor template list. It's ready to be instantiated for as many Calisto H1 devices connected to the RS485 interface.

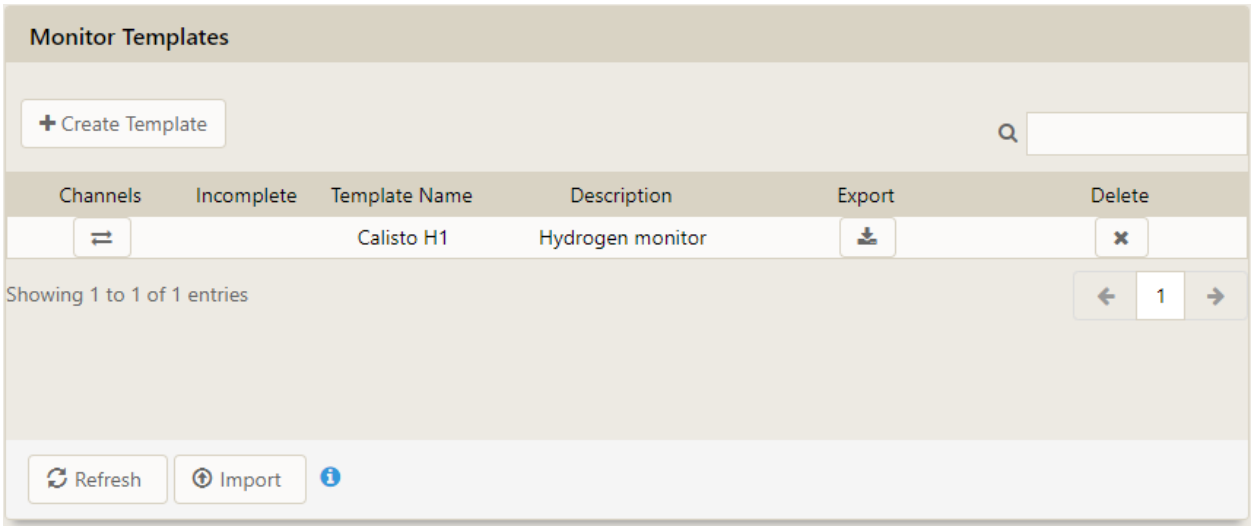

Figure 50 - H1 Monitor Template

To instantiate the template, go to Monitors page, select the custom Calisto H1 monitor template then click +Add Monitor. Make sure that you select the H1 monitor template created, not the official H1 monitor.

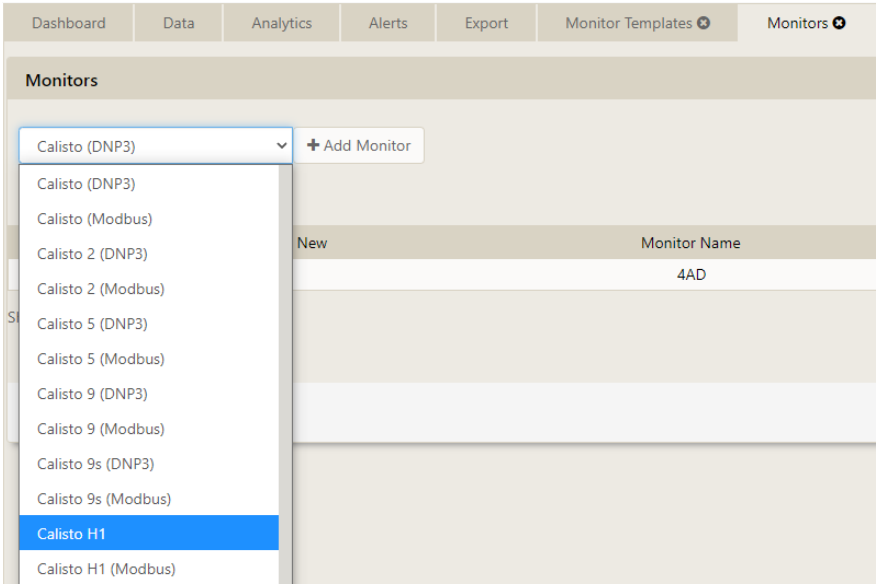

Figure 51 - H1 custom monitor is shown in the monitor drop down list

The monitor instance is shown on the Monitors list. Click on channels to edit the monitor instance settings.

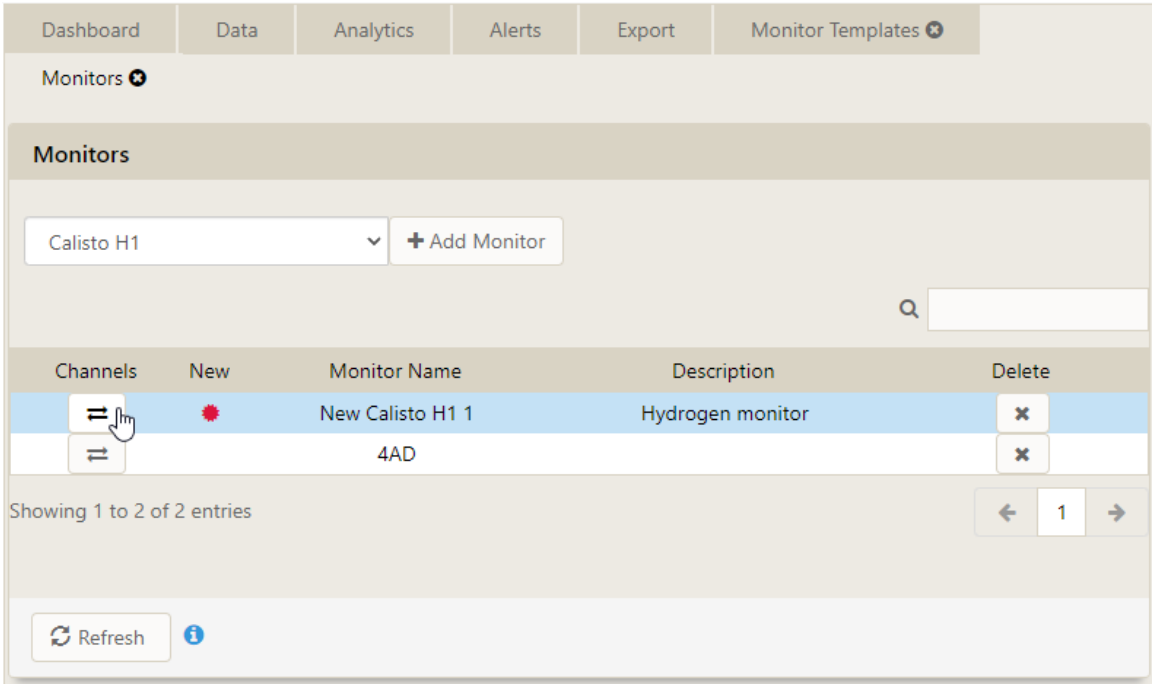

Figure 52 - Custom H1 Monitor Instance

The steps to configure the Instance Details are outlined in "Calisto H1 Monitor Configuration" on page 38. If required, consult the section for further information on how to setup the communication and assign channels to the asset.

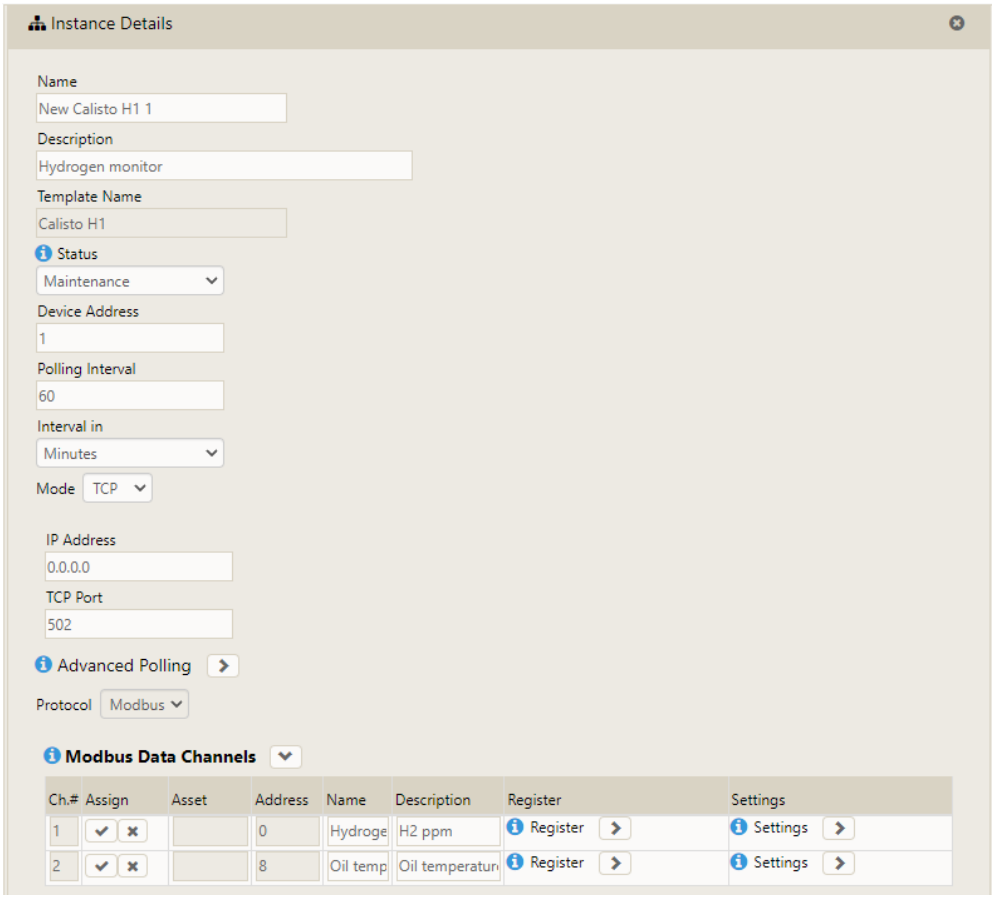

Figure 53 - Custom H1 Monitor Instance Details

Configuring DNP3 Channels

1. To create a data channel click on '+DNP3 Data Channels'. The data channel shows the following fields:

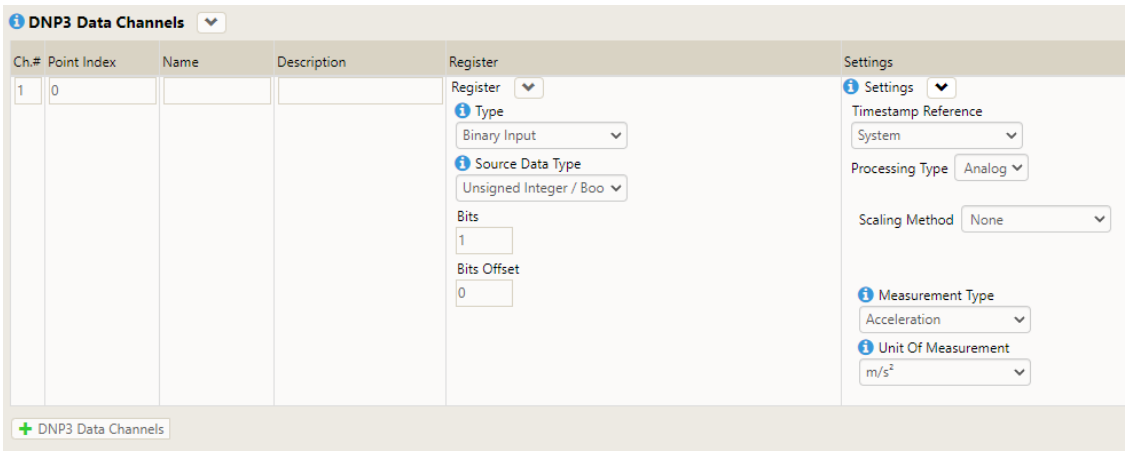

Figure 54 - DNP3 Data Channels

2. Fill out the fields according to what measurements you want to pull from the monitor.

Ch. #	Unique Alert Channel Number
Point Index	In DNP3 terminology, the element numbers are called the point indexes. Indexes are zero-based in DNP3, that is, the lowest element is always identified as zero.
Name	Enter a name for this channel
Description	Enter a description for this channel (optional)

Register	Type	Simply select object types according to the purpose. The options are: Binary Input, Analog Input and Counter Input
	Source Data Type	Select data type according to selected type. The options are: • Unsigned Integer / Boolean • Signed Integer • Float / Double
	Bits	Number of bits in the register or combined registers representing the value. This field is usually 16 or 32 bits for measurements and 1 bit for binary points
	Bits Offset	Add a bit offset to the register containing the value. A new value is represented by the remaining bits in the register.
	Byte Order (endianness)	Add a bit offset to the register containing the value. The new value is represented by the remaining bits in the register.
Settings	Timestamp Reference	Select system to timestamp data using local time as it's saved on the database. Use remote timestamp to timestamp data using registers from the monitor containing time and date.
	Processing Type	Select if you want to process the data register as analog value or digital. Selecting Analog processing type allows you to create a single or several alerts for the same channel. Selecting Binary processing type allows you to create a single alert as the status can be only 0 or 1.
	Scaling Method	Enable scaling. Please consult "4AD Monitor Configuration" on page 30 for more details about scaling methods
	Measurement Type	Select type of measurement to be associated to this channel
	Unit of Measurement	Select the appropriate unit of measurement to this channel.

Table 15 DNP3 data channel settings

3. Create as many data channels as necessary that you want to be saved on PRIME database.
4. To create an alert channel click on '+Modbus Alert Channels'. The alert channel shows the following fields:

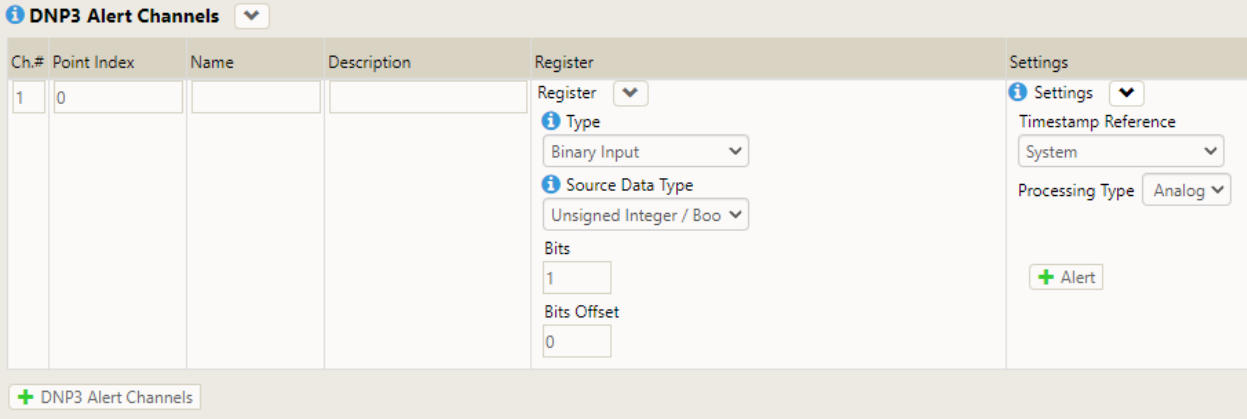

Figure 55 - DNP3 alert channels

Ch. #	Unique Alert Channel Number
Point Index	In DNP3 terminology, the element numbers are called the point indexes. Indexes are zero-based in DNP3, that is, the lowest element is always identified as zero.
Name	Select object types according to the purpose. The options are: Binary Input, Analog Input and Counter Input
Description	Enter a description for this channel (optional)

Register	Type	Select object types according to the purpose. The options are: Binary Input, Analog Input and Counter Input
	Source Data Type	Select data type according to selected type. The options are: • Unsigned Integer / Boolean • Signed Integer • Float / Double
	Bits	Number of bits in the register or combined registers representing the value. This field is usually 16 or 32 bits for measurements and 1 bit for binary points
	Bits Offset	Add a bit offset to the register containing the value. A new value is represented by the remaining bits in the register.
Settings	Timestamp Reference	Select system to timestamp data using local time as it's saved on the database. Use remote timestamp to timestamp data using registers from the monitor containing time and date.
	Processing Type	Select if you want to process the data register as analog value or digital. Selecting Analog processing type allows you to create a single or several alerts for the same channel. Selecting Binary processing type allows you to create a single alert as the status can be only 0 or 1.
	Alert Value	Enter the value that will trigger the alert
	Alert Type	Assign the severity of the alert
	Alert Message	Assign a custom message to the alert

Table 16 DNP3 alert channel settings

5. Create as many alert channels as necessary that you want to be saved on PRIME database.
6. To create a Timestamp details click on '+Timestamp'. The timestamp channel shows the following fields:

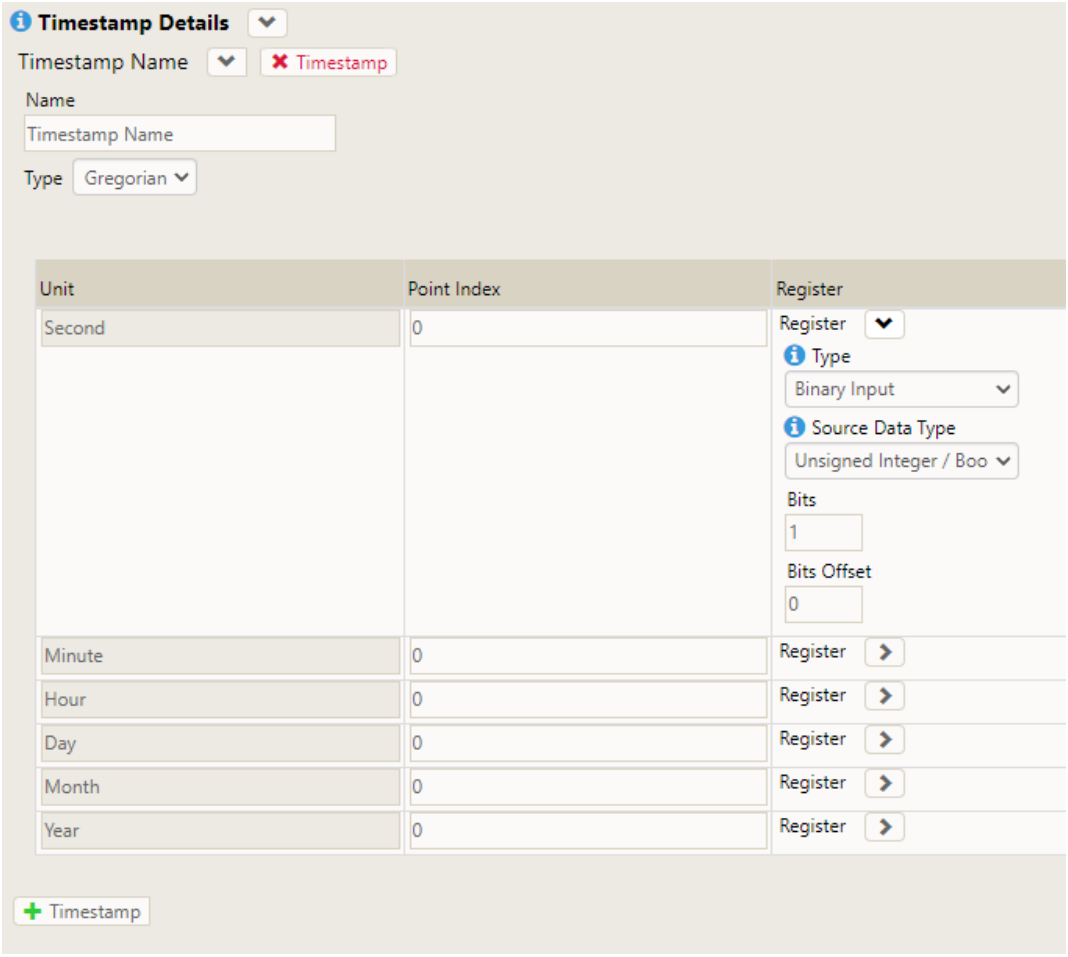

Figure 56 - DNP3 timestamp details

Name	Enter name for the remote timestamp so you can easily identify it in Timestamp Reference field
Unit	Second, Minute, Hour, Day, Month, and Year fields
Address	Enter the address corresponding to the unit being configured

Register	Type	Select object types according to the purpose. The options are: Binary Input, Analog Input and Counter Input
	Source Data Type	Select data type according to selected type. The options are: • Unsigned Integer / Boolean • Signed Integer • Float / Double
	Bits	Number of bits in the register or combined registers representing the value. This field is usually 16.
	Bits Offset	Add a bit offset to the register containing the value. A new value is represented by the remaining bits in the register.

Table 17 DNP3 timestamp settings

7. Create as many remote timestamp references as necessary.

DNP3 Template Configuration Exercise

Find below some snippets from the Calisto C9 DNP3 Device Profile. Those two tables in the DNP3 Device Profile will provide the information necessary to create the template. On this exercise we will create a template to read H2 ppm and CO ppm.

Note: Calisto C9 monitor driver is already available in the monitor library. The purpose of this exercise is to understand how a Monitor Template is created and how to instantiate it.

3.5 ANALOG INPUTS Static (Steady-State) Group Number: 30 Static Frozen Group Number: 31 Event Group Number: 32 Frozen Analog Input Event Group Number: 33 Deadband Group Number: 34	Capabilities (leave tick-boxes blank if this data type is not supported)
3.5.1 Static Variation reported when variation 0 requested or in response to Class polls:	☑ Variation 1 – 32-bit with flag ☐ Variation 2 – 16-bit with flag ☐ Variation 3 – 32-bit without flag ☐ Variation 4 – 16-bit without flag ☐ Variation 5 – single-precision floating point with flag ☐ Variation 6 – double-precision floating point with flag ☐ Based on point Index (add column to table in part 5)

Analog Input points list:

Point Index	Name	Default Class Assigned to Events (1, 2, 3 or none)	Transmitted Value[2]		Scaling[3]		Units	Resolution[4]	Description
			Minimum	Maximum	Multiplier	Offset			
0	H2	none	0 /	200000 /	0.1	0	ppm	0.5	H2 Min. transmitted value when not INIT is 5
1	CO	none	0 /	300000 /	0.1	0	ppm	5	CO Min. transmitted value when not INIT is 100
2	CH4	none	0 /	1000000 /	0.1	0	ppm	0.2	CH4 Min. transmitted value when not INIT is 2

Figure 57 - Calisto C9 input object and list of points details

On the Analog Input capability table we can identify the data type and size:

- Analog Inputs: As per DNP3 specification this object returns a 32-bit integer analog value from an analog input with a range -2^{31} to $+2^{31}-1$, thus it's a 32-bit signed integer.

And on the Analog Input point list table we can extract the point indexes. We can view the required information to proceed in the table below:

Name	Address	Source Data Type	Bits
H2 ppm	0	Signed Integer	32
CO ppm	1	Signed Integer	32

Table 18 DNP3 settings

Also, we will have to apply scale to the measurements. On the Analog Input point list, the multiplier is set to 0.1 therefore the scaling constants on scaling method y=mx+c are:

Scale	
Multiply	1
Divide	10
Offset	0

Table 19 Point Scale

Open Monitor Templates page. Enter a name for C9 monitor template and select DNP3 protocol before filling in the fields. Create two DNP3 Data channels, one for each measurement and fill out the fields using the previous tables.

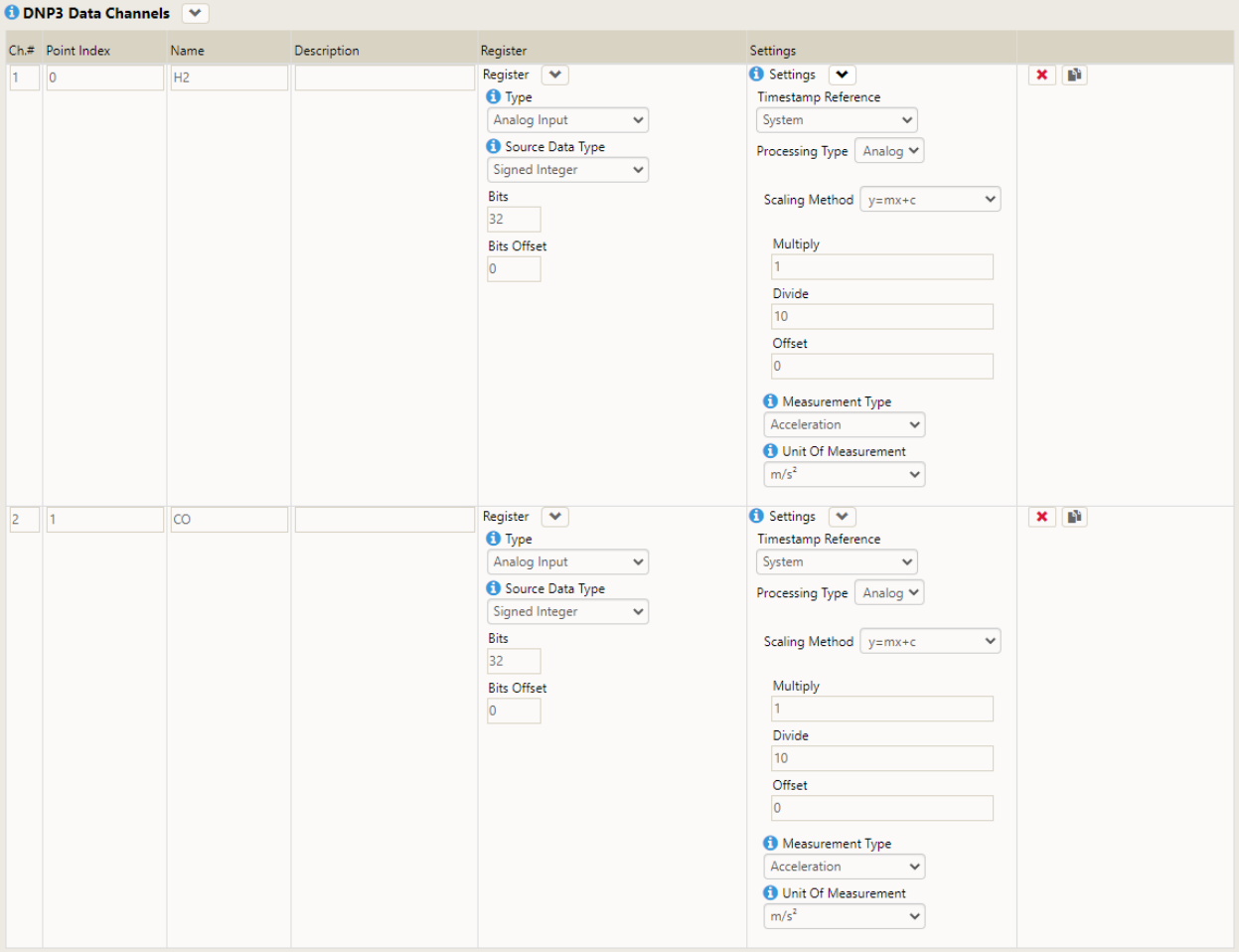

Figure 58 - Fill out the field using the information from above tables

Note: An instantiated monitor cannot have its settings changed. Edit the correspondent template, re-instantiate a new monitor, then delete the previous instance. If the monitor has been commissioned and successfully transferred data in, then the instance can no longer be deleted. In this case, set the monitor to 'decommissioned' then re-instantiate a new monitor using the updated template.

After filling out all the information click Save, located in the panel footer to save the monitor template. The custom monitor template in now found in the Monitor template list.

It's ready to be instantiated for as many Calisto C9 devices connected up to the RS485 interface or LAN.

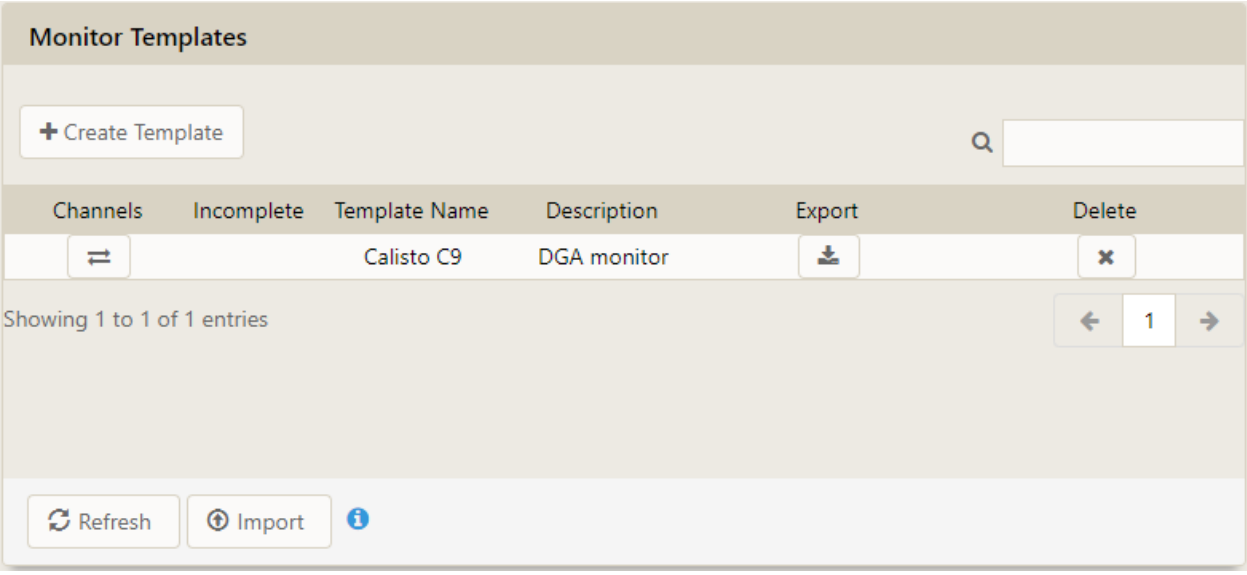

Figure 59 - Custom C9 template

To instantiate the template, go to Monitors page, select the custom Calisto C9 monitor template then click +Add Monitor. Make sure that you select the C9 monitor template created, not the official C9 monitor.

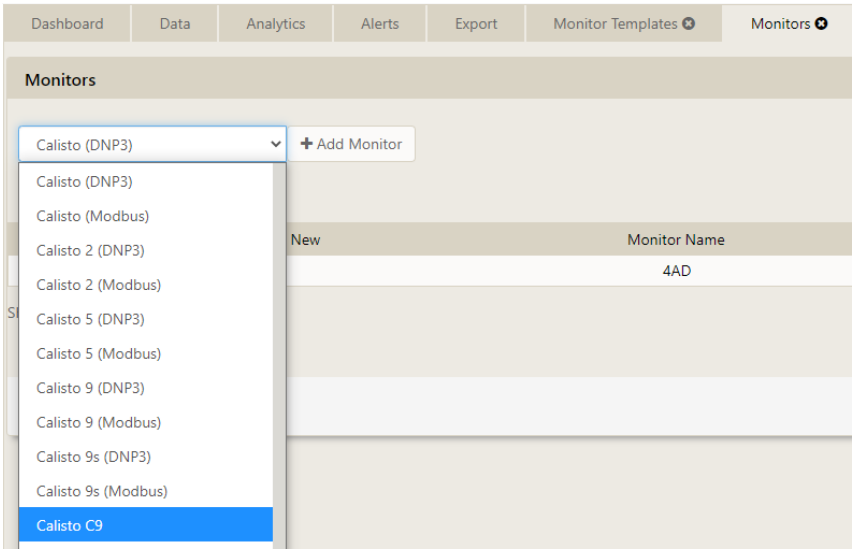

Figure 60 - Custom C9 monitor is shown in the drop down list

The monitor instance is shown on the Monitors list. Click on channels to edit the monitor instance settings.

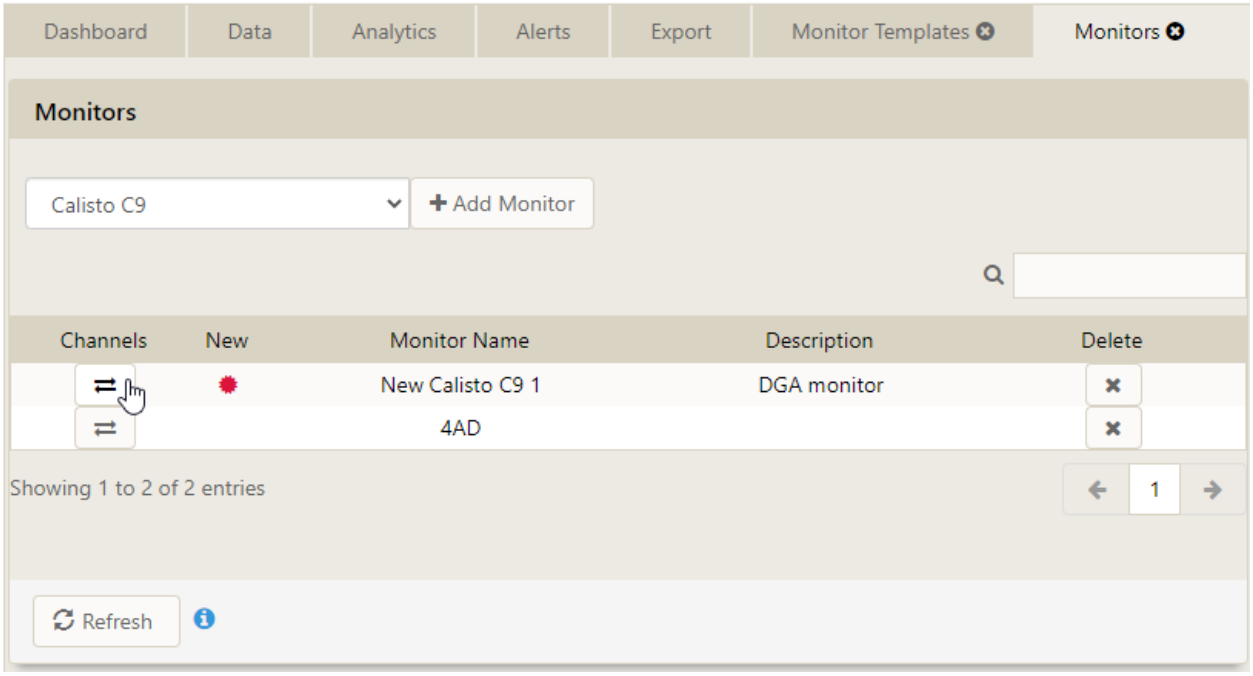

Figure 61 - Custom C9 monitor instance

The steps to configure the Instance Details are detailed in "Monitor Configuration - General Steps to Configure Other Monitors" on page 43. If required, consult the section for further information on how to setup the communication and assign channels to the asset.

7. Network Configuration

Configuring Ethernet Interfaces

Ethernet interfaces allow Calisto N1 to communicate with monitors and supervisory systems. Additional features may also be configured, e.g., security and time reference.

Perform the following steps to edit the Ethernet interfaces.

1. Go to the Gear icon on the top-right of the title bar then click on System Configuration.
2. On the System Configuration tab, click Ethernet Interface. It expands the list to show the two interfaces available.

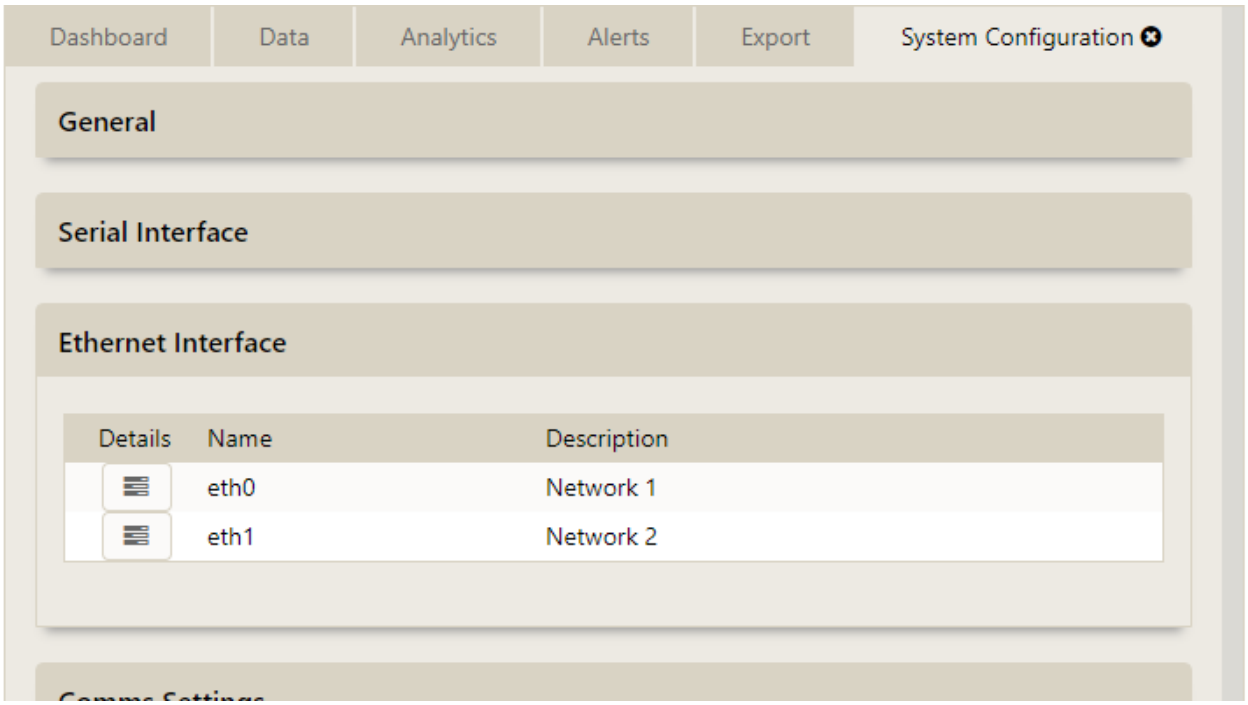

Figure 62 - Two network interfaces are listed in the network configuration

Caution: Both interfaces eth1 and eth0 are accessible from the outside world via the LAN 1/2 ports. Do not configure eth0 and eth1 in the same subnet neither configure the interfaces using the same IP address to avoid connectivity issues.

You can connect to Calisto N1 via either eth0 or eth1. The default IP configuration for each port is shown in the table below.

Interface	IP	Netmask	Gateway
Eth0	192.168.0.19	255.255.255.0	Blank
Eth1	192.168.1.234	255.255.255.0	Blank

Table 20 Default network settings

Caution: A gateway can only be assigned to one interface. Having more than one gateway on the settings might cause connectivity issues.

Note: Make sure the network interface of your PC is set to one of the subnets and use the correct respective IP address to access Calisto N1 over a web browser.

3. Click on details to show the network and firewall settings.

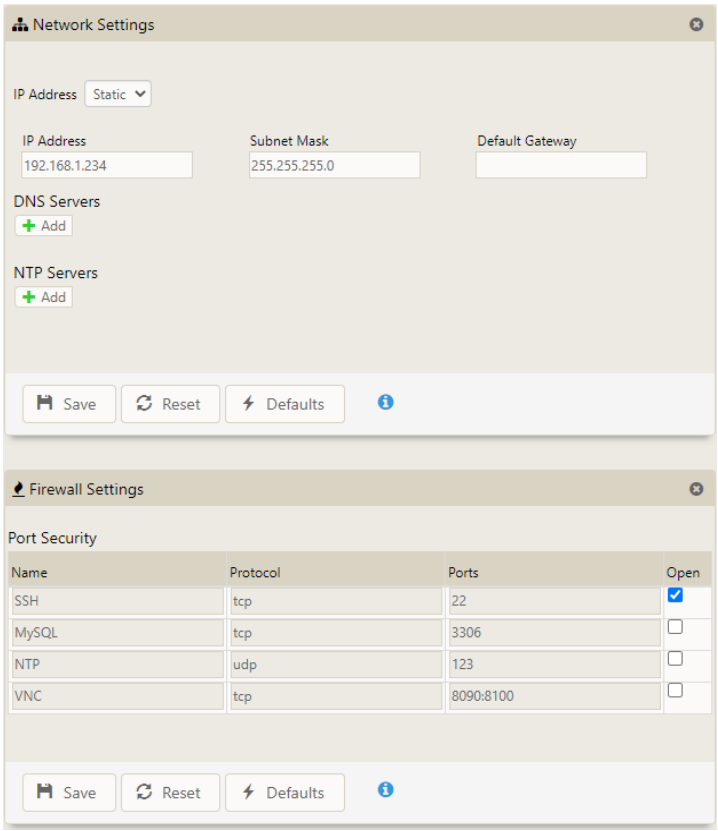

Figure 63 - Eth1 network default static IP and firewall settings

Parameter	Description
IP Address mode	Click the drop-down box to select either Static or DHCP mode. Static mode allows you to enter the IP address of your choice. DHCP mode requires a DHCP server in the network to automatically lease an IP address to the interface
IP Address field	Enter the IP address in this field when Static mode is selected
Subnet Mask field	Enter the subnet mask in this field when Static mode is selected
Default Gateway field	Enter the gateway address in this field when Static mode is selected
DNS Servers	Only add the DNS server if it's required. It's used to resolve names to IP address
NTP Servers	Add an NTP server address to synchronize time to a network time source

Table 21 Ethernet Network Configuration Settings

Port Name	Description
SSH	Allow terminal connection for maintenance purposes
MySQL	Allows database synchronization between Calisto and PRIME devices
NTP	Allows connection from internal boards and external monitors to the internal time server
VNC	Allows VNC connection to the old PD-Guard monitor on PICOS

Table 22 Firewall Settings

Check the open box of the corresponding server to allow clients to connect to the service.

The Network Settings and Firewall Settings have different save buttons. Always click the corresponding save button after editing the settings see Figure 63.

Configuring Serial Interfaces

Serial interfaces allow Calisto N1 to communicate with monitors or supervisory systems using the RS485 interfaces.

The Modbus and DNP3 protocol settings are configurable on 'Serial Interfaces', 'Comms Settings' or even in the Monitor instance depending on the operation mode and protocol used. The table below will help you to identify what section/topic in this document you will relevant information to configure the communication with monitors and SCADA systems.

N1 Operation Mode	Modbus TCP	Modbus serial	DNP3 TCP	DNP3 serial
Master - Collect data from monitors	Monitor instance details	Serial interfaces and Monitor instance details	Comms settings and Monitor instance details	Serial Interfaces, Comms settings and Monitor instance details
Slave/Outstation - Send data to SCADA	Comms settings and StationBus Configuration TCP	Serial interface and StationBus Configuration Serial	Comms settings and StationBus Configuration TCP	Serial interface and StationBus Configuration Serial

Table 23 Serial Interfaces

Perform the following steps to view and edit the serial ports.

1. Click the settings icon at the top-right of the title bar then go to System Configuration.
2. In the System Configuration tab, click Serial Interface.

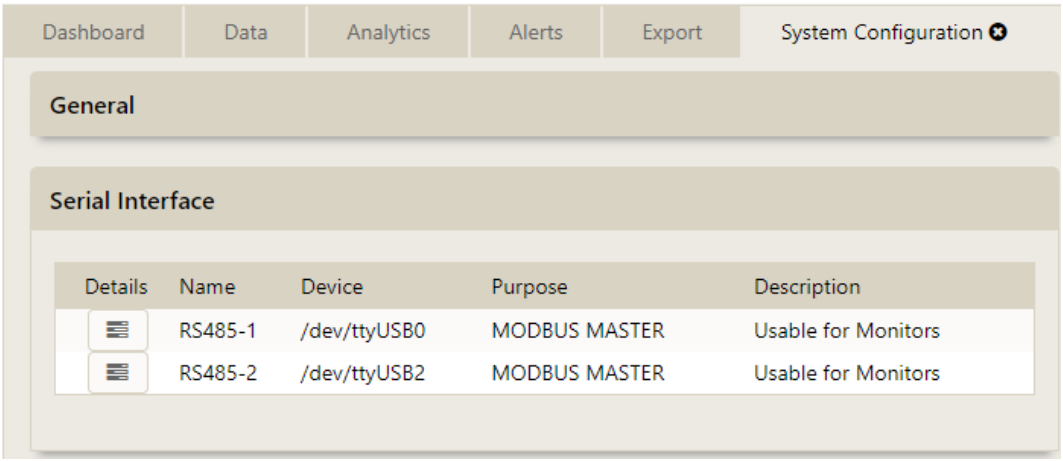

Figure 64 - System Configuration: Serial Interfaces

3. Click Details for the desired port you want to use for communication.

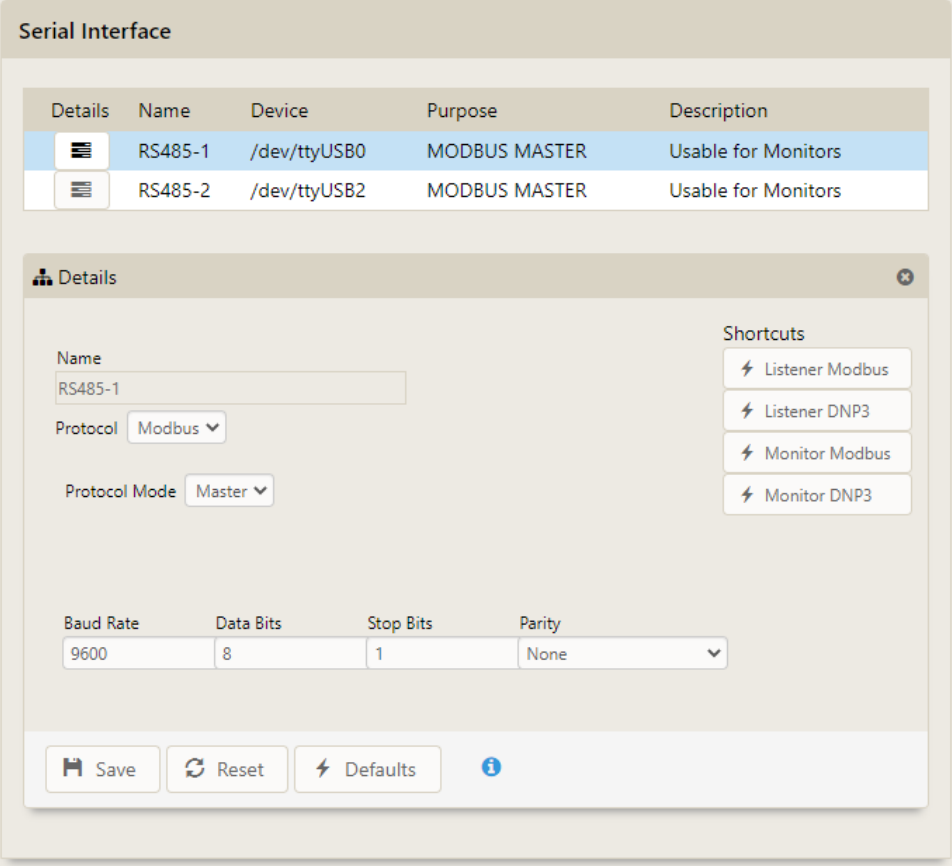

Figure 65 - Serial Interface Configuration Options

4. Select the communication protocol that will be bound to this port and protocol Mode from the drop-down list. Master mode enables the device to pull data from external monitors, e.g., DGA, and remote I/Os. Slave mode allows higher instances, e.g., SCADA systems, to pull data from this device.

> **Note:** When deploying a serial Monitor, set the port in Master mode whereas when configuring a serial StationBus port set it to Slave/oustation mode.

Choose the serial communication parameters, Baud Rate, Data Bits, Stop Bits, and Parity.

5. Select the protocol mode - master or slave/outstation.

   Modbus mode:

   When the port and protocol mode is set to Modbus Master, enter the Modbus address, that was configured on the monitor you want to communicate, in Device Address field located on the respective Monitor instance details. Each monitor instance sharing the same serial port must have a unique Modbus address configured.

For Modbus Slave operation, the Modbus address for the port is entered in the Serial Interface Details. This is the Modbus address that the SCADA uses to interrogate PRIME application, on the configured serial port.

DNP3 mode:

The DNP3 defines two types of endpoints that communicate with one another – a master and an outstation. When the port and protocol mode is set to DNP3 Master, it's mandatory to configure the outstation and master address for successful communication. Enter the DNP3 outstation address of the monitor you want to communicate in Device Address field located on the respective Monitor instance details. Each monitor instance sharing the same serial port must have a unique DNP3 outstation address configured. The DNP3 Master address of PRIME application applies for both DNP3 serial and ethernet communication and is defined in DNP3 Master Address field located in Comms Settings.

For DNP3 outstation operation, the DNP3 address is entered in the Serial Interface Details. This is the DNP3 outstation address that the SCADA will use to interrogate this unit, on the configured serial port. It's not required to enter the same DNP3 master address configured on the SCADA when using outstation mode. Doble's DNP3 implementation ignores the master address in the DNP3 frame request from the SCADA and will successfully respond the SCADA provided that the outstation address matches.

6. Make the appropriate configuration changes and click Save.

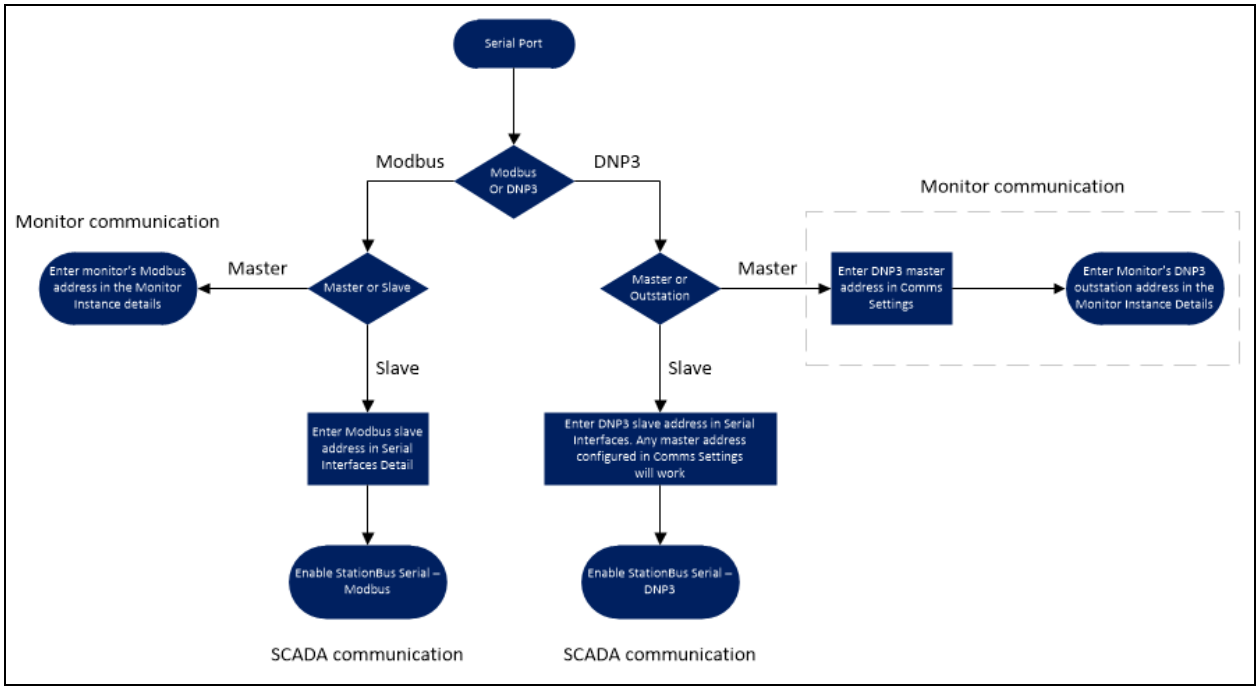

Figure 66 - Monitor and StationBus communication over serial – Configuration flowchart

Comms Settings

On Comms settings you can edit the Modbus and DNP3 protocol address for Monitor and StationBus application. Perform the following steps to edit the Modbus and DNP3 addresses.

1. Click the settings icon on the top-right of the title bar then click System Configuration.
2. In the System Configuration tab, click Comms Settings.

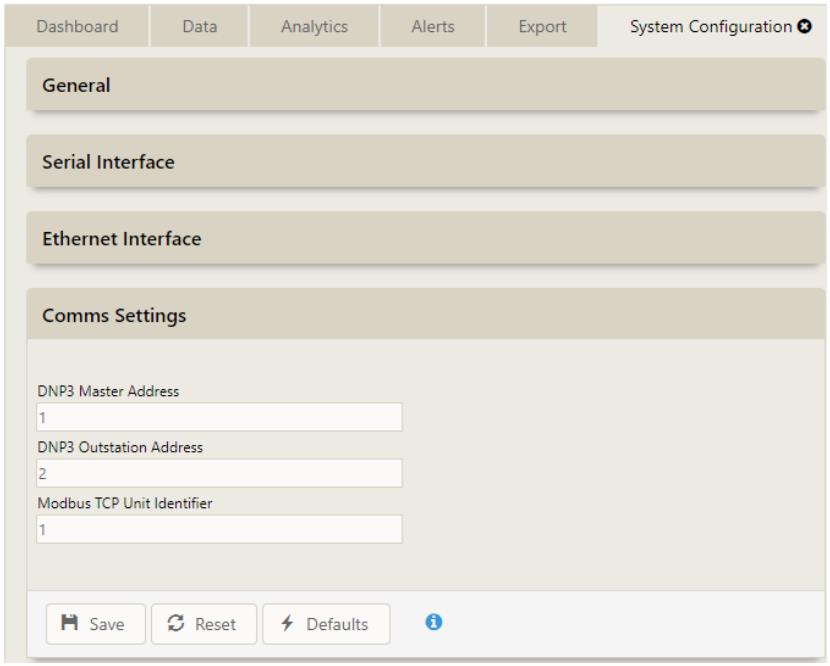

Figure 67 - System configuration: Comms settings

3. Edit the following addressing options as required:
   - DNP3 Master Address - The DNP3 master address is necessary for communication with monitors over:
     - Serial port
     - Ethernet

> **Note:** The DNP3 master address is not required for communication with supervisory systems over DNP3. PRIME application will parse the request from any master address as long as the DNP3 outstation address matches.

   - DNP3 Outstation Address – The DNP3 outstation address is necessary for communication with a supervisory system over:
     - Ethernet

- Modbus TCP Unit Identifier - The Modbus address is necessary for communication with a supervisory system over:
  - Ethernet

4. Click Save after making any changes.

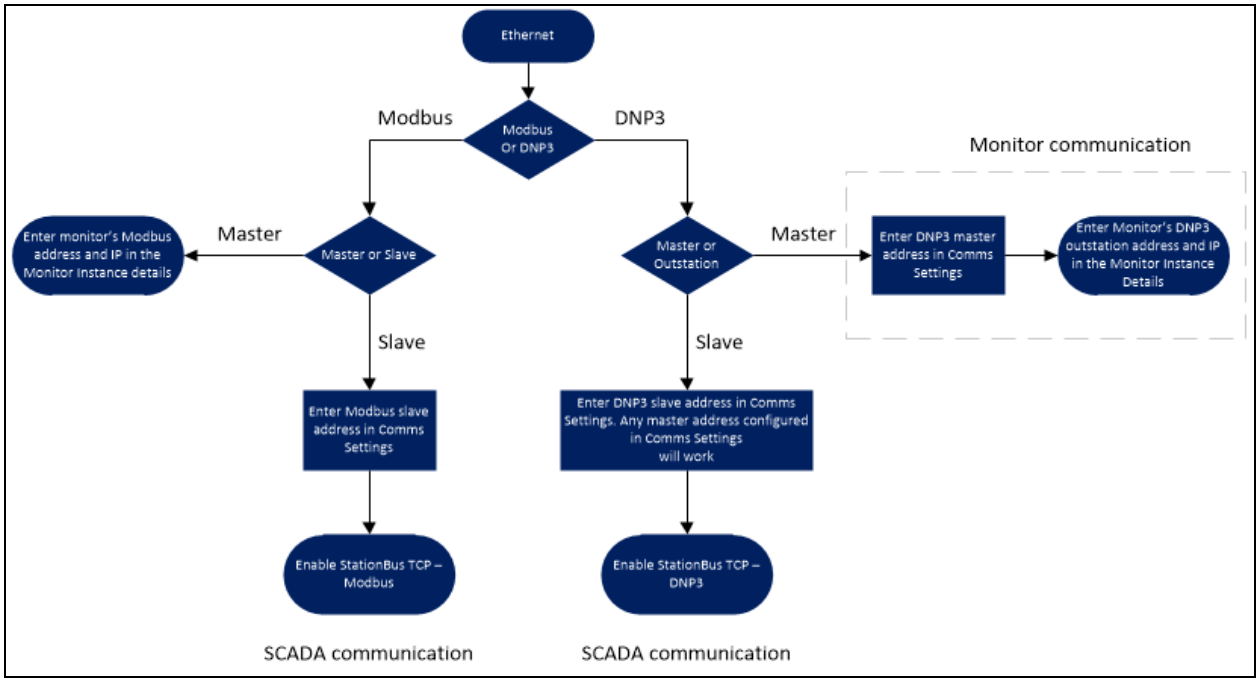

Figure 68 - Monitor and StationBus communication over ethernet – Configuration flow-chart

Refer to "Configuring Serial Interfaces" on page 74 for more information on setting up the DNP3 outstation address and Modbus slave address.

Configuring StationBus

doblePRIME shares data with supervisory systems, e.g. SCADA, DCS and other data aggregators, using Station Bus. Ethernet and Serial interfaces may be configured to provide data via Modbus and DNP3 protocols.

In Station Bus configuration, you can enable the communication protocols to work over TCP and Serial connection, they are handled in different places. Click the TCP|Serial buttons to toggle the interfaces shown in the window.

Perform the following steps to configure the Station Bus.

1. Click the settings gear icon on the top-right of the title bar.
2. Click **Station Bus Configuration**. The figures below shows different the Station Bus Configuration options.

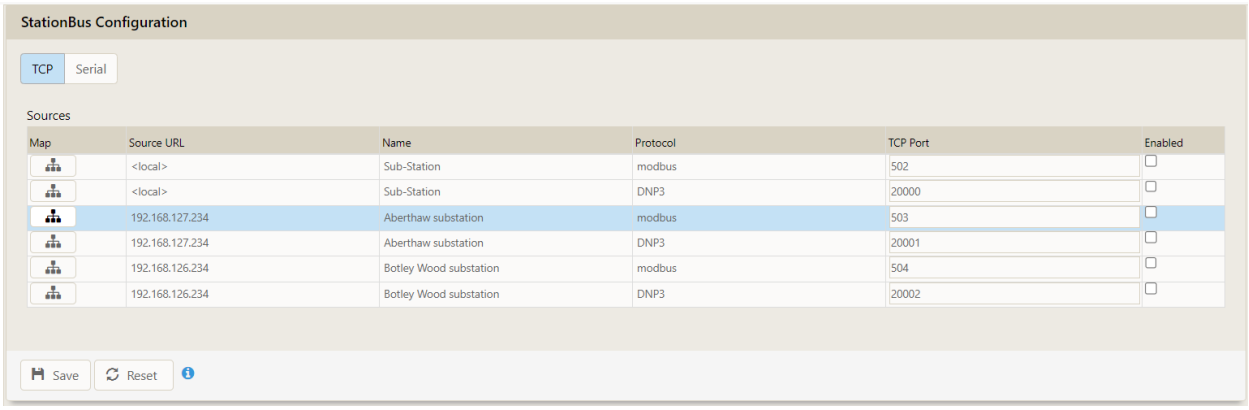

Figure 69 - Station Bus TCP Configuration - Example

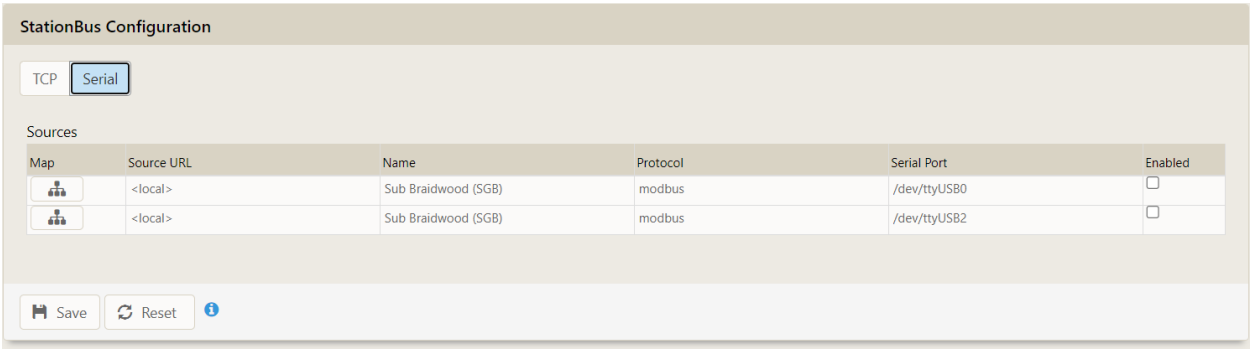

Figure 70 - Station Bus Serial Configuration - Example

Note: Station Bus serial connection requires a serial port to be configured in Modbus Slave or DNP3 Outstation mode. If a communication to a SCADA system over serial is required, refer to "Configuring Serial Interfaces" on page 74 and "Comms Settings" on page 78.

3. Click the respective enable tick box for the interface you want to enable communication with the supervisory system. Multiple instances can be enable for simultaneous communication.

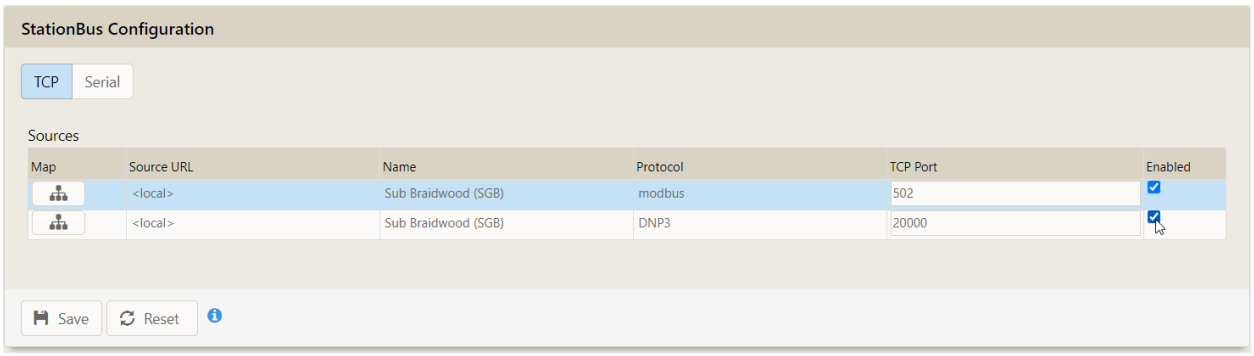

Figure 71 - Enabling StationBus source

4. Click **Save** after the appropriate changes have been made.

For further information about StationBus, please refer to doblePRIME 3.5 User Guide.

8. Operation

Overview

This section gives an overview of the 4AD monitor found inside Calisto N1, explain how the data is collected from monitors and saved into a database for further analysis. The data collection scheme is required the monitors to be configured and set to Commissioned state, please check the Configuration section for more details.

Calisto N1 is a flexible system that allows communication to native and third-parties monitors:

- Prime Interface Gateway - PiG
- Analog and Digital Monitor – 4AD
- Native Monitor – Any read-to use monitor
- Generic Monitor – Any custom-made monitor

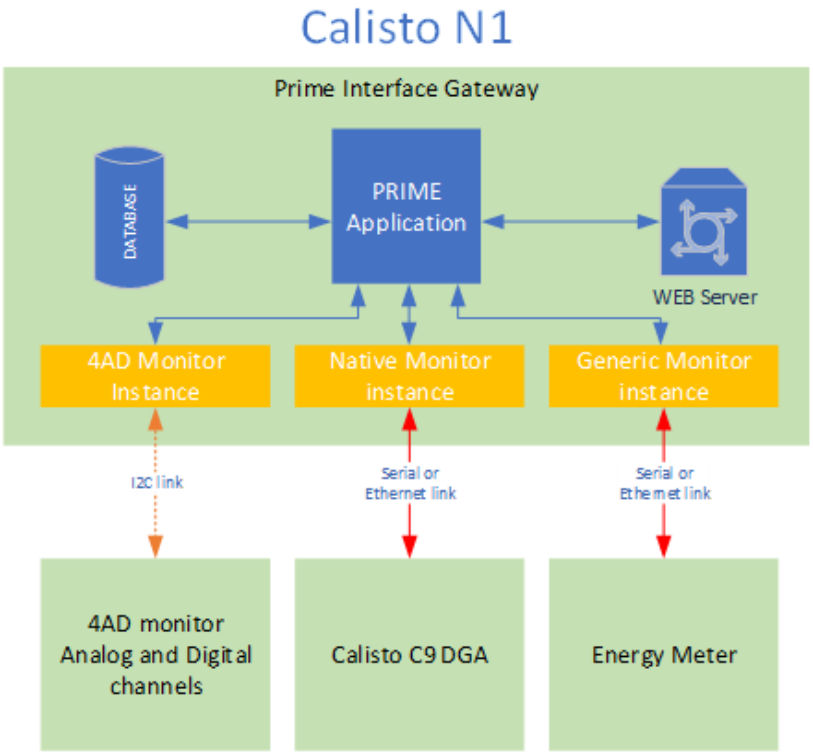

Figure 72 - Internal communication architecture of Calisto N1

The Prime Interface Gateway is the main board which is responsible for running services such as PRIME application, web interface, database management, communication to internal and external monitors, and many others. The process of saving the measurements

from the monitors is based on the polling method. It polls the monitors according to the polling rate entered at each monitor instance. When the monitor responds to the polling, the measurements are saved into the database and timestamped so the data can be trended.

The 4AD monitor is responsible for the acquisition of analog and digital signals. The raw data output from the 4AD ranges from 4000 to 20000 counts corresponding to 4 and 20mA respectively. This monitor can accept a polling rate as fast as 10 seconds for fast acquisition.

Two other types of instances are used to talk to native monitors or generic monitors. Although they are meant for different applications, their internal structure is rather similar as how data is polled and saved to the database.

Results

PRIME Application pulls the data from the monitors, save into the database and present to the user via the web interface. The Dashboard displays the overall health of every asset being monitored in a selected location, such as a substation, and the number of open alerts. Also, there are other tools such as charts, trending, and data tables.

The data shown on the dashboard comes from commissioned monitors and sources.

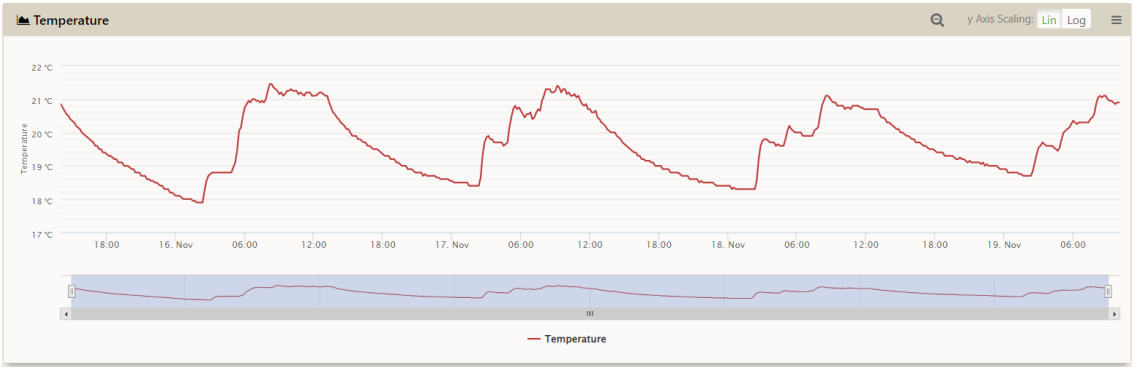

Figure 73 - 4AD monitor trending data

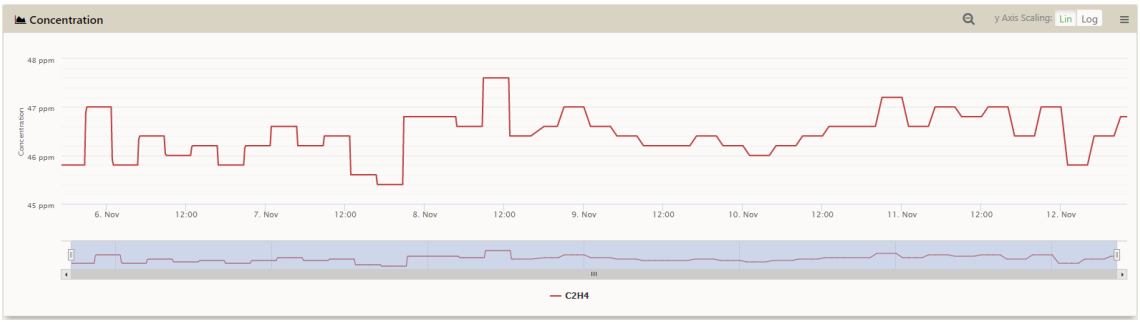

Figure 74 - DGA monitor trending data

Alerts

An “Alert Status” is generated according to the value of a channel on a direct comparison with thresholds, user-configurable levels, which yield three indications: information, warning and action. The overall alert status is computed from the individual channel alerts on the basis of “highest alert wins”, and this is presented on the front panel LEDs and supervisory relays along with a System indication. The System indication operates independently of Info/Warning/Action. The alerts can be viewed in detail in PRIME application, where they are displayed per asset or channels, acknowledge and view alerts.

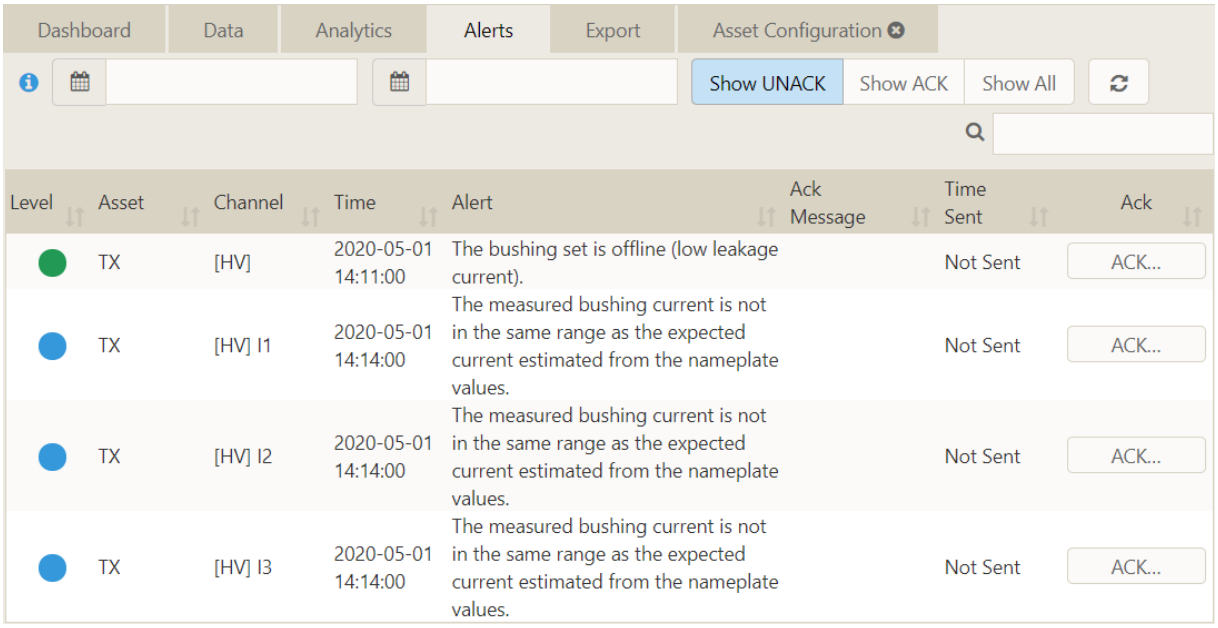

Figure 75 - Alerts tab shows the current and acknowledged alerts

Some native monitors have built-in alert system that can present on PRIME alerts generated on the monitor instrument itself. Generic monitors may have similar functionality, but it requires creating a custom template so that the registers of the alerts of interest are configured correctly.

If alerts have to be overridden or created from scratch, PRIME offers a set of tools named Alert State Machine which you can create alerts when the signal crosses up or down a defined threshold. For more information about viewing the results on PRIME Web Interface, handling alerts, and ASM configuration, please consult the doblePRIME 3.5 User Guide.

9. Wiring Sensors to Calisto N1

Wiring sensors to the 4AD

The following wiring guide explains how to wire analog and digital sensors to the 4AD.

Analog Input Wiring

Caution: Before connecting the wire make sure the sensor output is set to 4-20mA as to not damage the analog input.

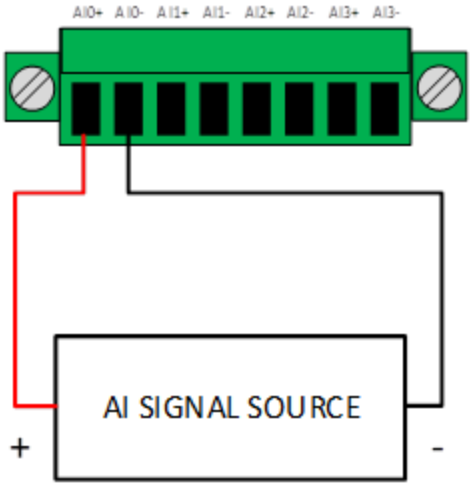

Figure 76 - Wiring a 4-20mA sensor to the analog input

Digital Input Wiring

DI Dry Contact

Operation mode:

- On: Short to GND
- Off: Open circuit

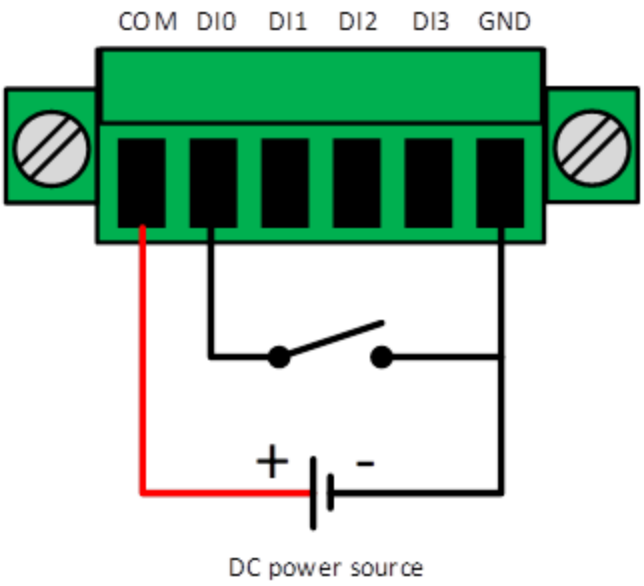

Figure 77 - Wiring a digital input, dry contact sensor

DI Wet Contact (NPN sensor)

Operation mode:

- On: 10 to 30 VDC
- Off: 0 to 3 VDC

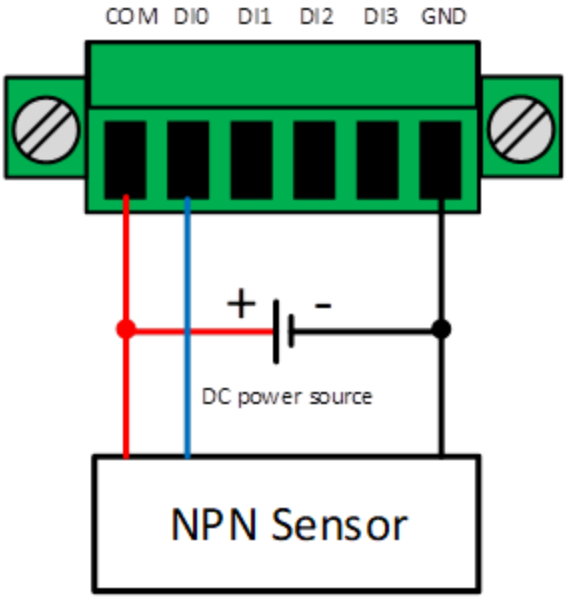

Figure 78 - Wiring a digital input, wet contact NPN sensor

DI Wet Contact (PNP sensor)

Operation mode:

- On: 10 to 30 VDC
- Off: 0 to 3 VDC

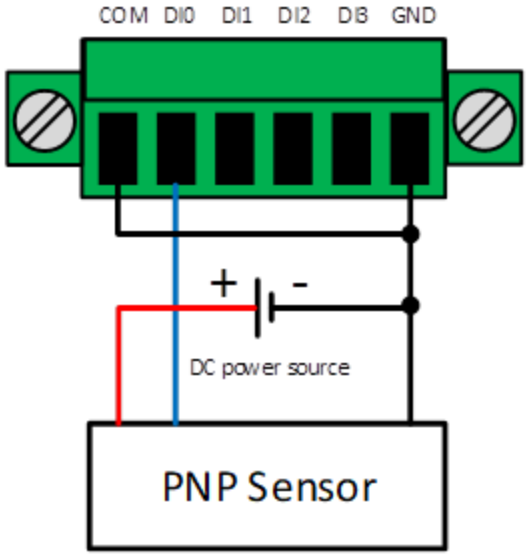

Figure 79 - Wiring a digital input, wet contact PNP sensor

Appendices

A. LEGAL NOTICE

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The meaning of **WARNING** messages used in this material:

A procedure, practice, or condition that could cause bodily injury or death.

Before operation, ensure you have reviewed all the risks associated with the equipment listed in this material and other product materials.

WARNING

If the equipment is used in a manner not specified by the manufacturer, including, without limitation, in connection with abnormal operating conditions, the protection provided by the equipment may be impaired.

WARNING

Do not open the equipment cabinet during rain, snowstorms, or other inclement weather.

WARNING

User must have the capability to continuously monitor for alerts. If this requirement is not met, delayed reaction to alerts may result in otherwise avoidable asset failure that may result in bodily injury or death.

User is responsible for developing and following an appropriate plan for de-energization in the event of potentially unsafe operating conditions. Potentially unsafe operating conditions include, but are not limited to, the results of vandalism, flooding, severe snow and/or ice storms, by which water or contaminants enter into the asset.

WARNING

There may be cases where the monitored asset(s) suddenly fails (between measurements at the normal measurement interval). The user should be aware that online monitoring equipment is not always capable of detecting such rapid (often catastrophic) failures. Asset monitoring is designed to detect incipient, slow-developing faults, but may also be able to

detect more rapidly-developing faults, depending on the specific monitoring device that has been deployed. Other protective devices should be

used in conjunction with monitoring equipment to provide more complete protection for the transformer.

WARNING

If the transformer bushings are replaced, then bushing adaptor circuit integrity checks shall be implemented and the bushing nominal parameters updated before the transformer is returned to service. Refer to the instruction manual. If the bushing is replaced by a mechanically and/or electrically different bushing a new bushing adaptor may be required.

WARNING

If the transformer bushings are subjected to routine maintenance, then the bushing adapter circuit integrity checks should be implemented before the transformer is returned to service. Refer to the IDD, T1 manual.

Liability and guarantee

Doble is not liable for damages that occur due to improper use. Proper use also includes the knowledge of, and compliance with, this material. User changes to the equipment that have not been expressly approved by Doble will result in the loss of guarantee. We reserve the right to modify or improve the designs or specifications of our products at any time without notice.

ALERT SETTINGS

The product is supplied with default settings for alert values. As every installation and operating environment is different due to design, manufacturing tolerances, operating regime, etc., there are no settings that can be applied to every asset. It is the user's responsibility to set appropriate alert values. Alert values must also be routinely reviewed and revised, as appropriate, by user depending on bushing behavior.

Alert value settings for online bushing monitoring should not be based on traditional offline results, including, for example those recommended by the IEEE C57.19.100

Warranty

Equipment Limited Warranty

Doble Engineering Company (DOBLE) warrants the products that it manufactures to be free from defects in material and workmanship for a period of one year from the date shipped from the factory.

During the one year warranty period, DOBLE will repair or replace, at its option, any defective products or components thereof at no additional charge, provided that the product or component is returned, shipping prepaid, to DOBLE. The Purchaser is responsible for insuring any product or component so returned and assumes the risk of loss during shipment. All replaced products and components become the property of DOBLE.

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DOBLE warrants the disks on which the software product is furnished to be free from defects in materials and workmanship under normal use for a period of one hundred and twenty (120) days from the date of shipment from DOBLE.

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DOBLE's entire liability and Purchaser's exclusive remedy shall be:

The replacement of any disks not meeting DOBLE's "limited warranty" which are returned to DOBLE.

If DOBLE is unable to deliver replacement disks which are free from defects in materials and workmanship, Purchaser may terminate this agreement. By returning the software product and all copies thereof in any form and affirming compliance with this requirement in writing, DOBLE will refund the purchase price.

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Some states do not allow the limitation or exclusion of liability for incidental or consequential damages, so the above limitation or exclusion may not apply.

Maintenance

For equipment maintenance, contact:

Doble Engineering Company
123 Felton Street
Marlborough, MA 01752 (USA)
Telephone: 617-926-4900
FAX: 617-926-0528
Email: support@doble.com
Web: www.doble.com

B. Specifications

N1 Base Module		
CPU, Memory, and Buses	**Host CPU**	ARMv8 1.2 GHz
	Memory	1 GB RAM, 32 GB Flash
Storage	32 GB eMMC Flash for application and data storage	
Peripherals	• USB 2.0 • 2x Isolated RS485 (MODBUS, DNP3) • 2 x 10/100 Base T Ethernet (DNP3, MODBUS, HTTP, HTTPS) • Alert LED (Status, Info, Warning, Action) • LDC Display 4x20 and keypad	
Environmental	**Humidity**	0-95% non-condensing
	IP Classification	• IP65 (with cover) • IP40 (without cover)
	Flammability class according with UL94	V2
Temperature	**Operating temperature**	-20°C to +50°C
	Extended temperature	-40°C to +60°C
	Storage temperature	-20°C to +70°C
Mechanical Data	**Height**	300 mm / 11.8 in
	Width	300 mm / 11.8 in
	Depth	132 mm / 5.20 in
	Weight	3.6 kg / 7.9 lbs
	Construction	Polycarbonate
Power Supply	**Input**	115-230 VAC, 50-60 Hz, 0.65 A

Table 24 N1 Specifications

C. Dimensions

Enclosure dimensions:

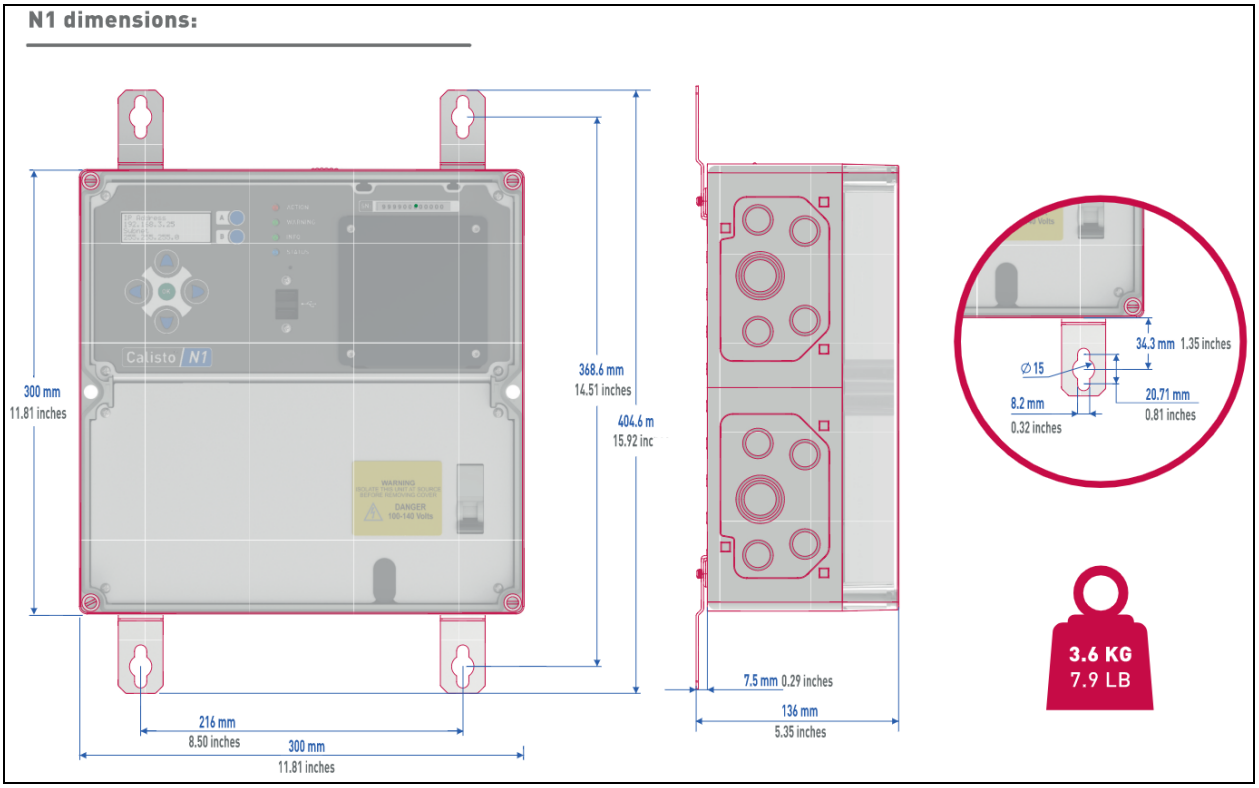


Figure 80 - Enclosure dimensions and specification

D. PICOS Application

Along with the PRIME application, the PICOS application available in the system assists with troubleshooting internal monitors and quickly verifying raw measurements. The PICOS application is a set of scripts that helps you to access the condition of the monitor itself and assist in the commissioning of the system. PICOS is not integrated into PRIME application; thus, no data is exchanged between the two applications. The main application of PICOS is to:

- Troubleshoot internal or external monitors
- Test the front LED (Status Indicator) and supervisory relays
- Test the 4AD card
- Set the date and time of the system
- Control PRIME application
- Purge the database
- Reboot the system

How to Access PICOS

Open a web browser, type the IP address of LAN1 or LAN2 interface and add "/picos" to the URL.

Example: If the unit has the default IP address – 192.168.1.234 – then type "192.168.1.234/picos" in the URL bar. A credential is required to access PICOS.

- Default user: doblePicos
- Password: doblePicos1!

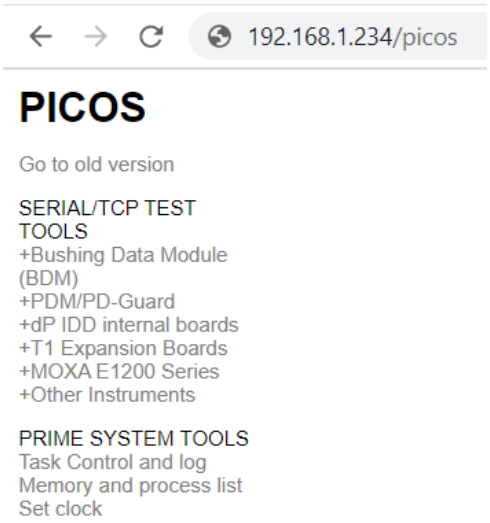


Figure 81 - PICOS menu

Use the menu located at the left-hand side to expand the menus or open the respective pages.

Control of PRIME Application

Click on **Task control and log** to open the page. With this script you have the means to Control the PRIME application to perform:

- Execution of PRIME application
- Reinitialize database
- Reboot the Prime Interface Gateway board

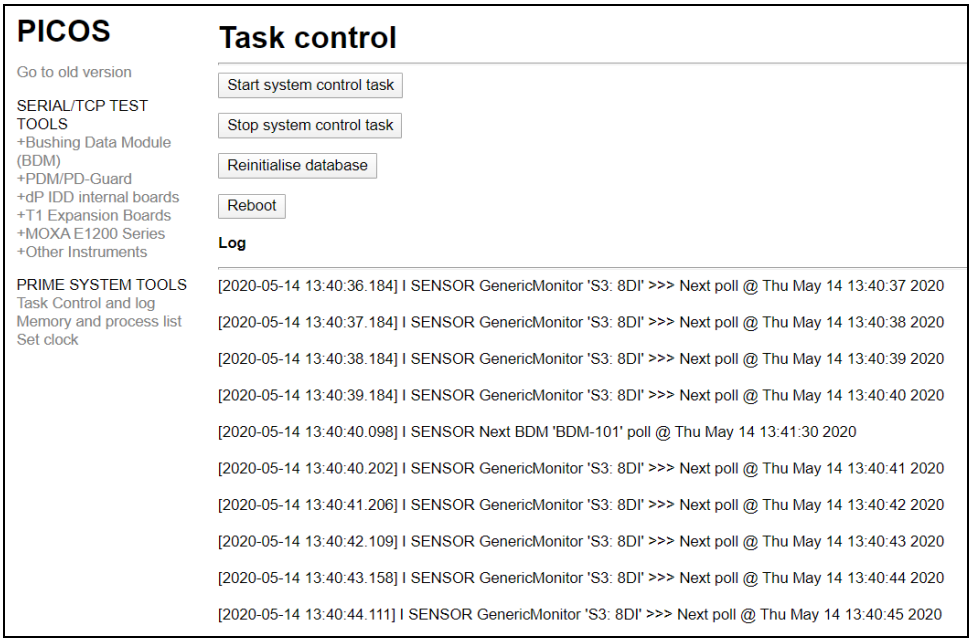


Figure 82 - Control PRIME application from Task Control

Option	Definition
Start/Stop system control task	Stopping PRIME application is required when testing the LED indicator, supervisory relays, and 4AD. During the time PRIME application is not running, data is not pulled from any monitor, and you cannot log into PRIME application.
Reinitialise database	Purge the configuration and database. This deletes all data in the device and frees up memory, and it is not reversible. Use this tool to start the configuration from scratch. This procedure requires a password. Use the password “crm114” to confirm the request.

Option	Definition
Reboot	Reboot PRIME Interface Gateway board. This procedure requires a password. Use the password “crm114” to confirm the request.
Log window	PRIME output system messages on this box to help to troubleshoot the device.

Table 25 Task Control menu definition

Set System Date and Time

Use this script to set the time and date of the system. This clock is used by Calisto N1 to timestamp the measurements.

> **Caution:** The correct way to set up time in the system is to use UTC as reference. Find the timezone on PRIME application to set up the timezone to show your current local time.

Click on Set Clock option under PRIME SYSTEM TOOLS. The current clock is presented on top of the focal panel. Enter new time and date in the fields and click on Set Clock button to submit the changes.

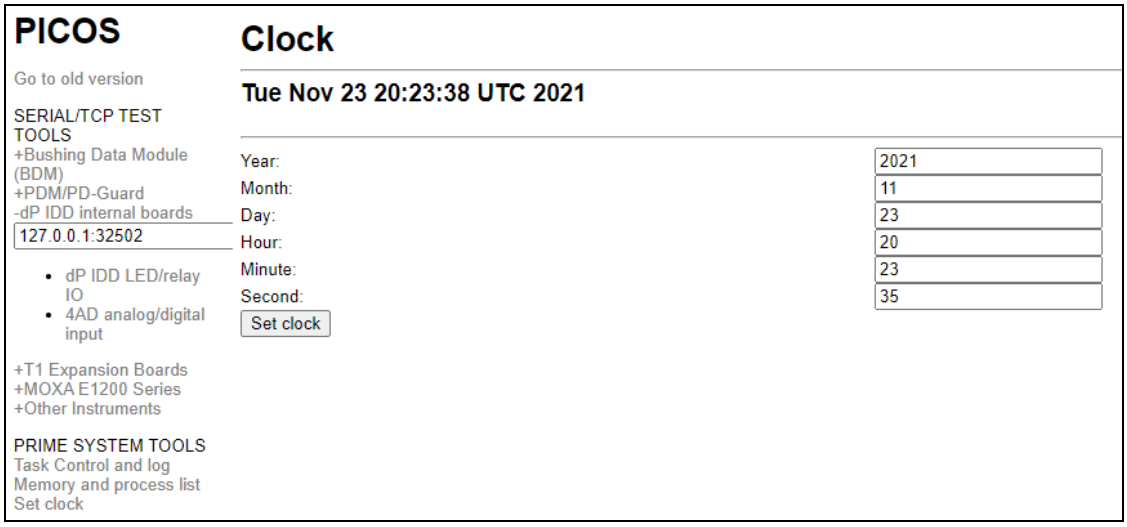


Figure 83 - Setting the time and date of mainboard - Calisto Interface Gateway

Testing the LED Indicator and Supervisory Relays

This script allows you to verify the status of each LED or relay and force a different status.

Note: Before using this tool, make sure SCT is stopped first; otherwise, you will experience connection issues to communicate with the board. See "Control of PRIME Application" on page 97.

Click on dP IDD internal boards to expand the menu then click on dP IDD LED/relay IO.

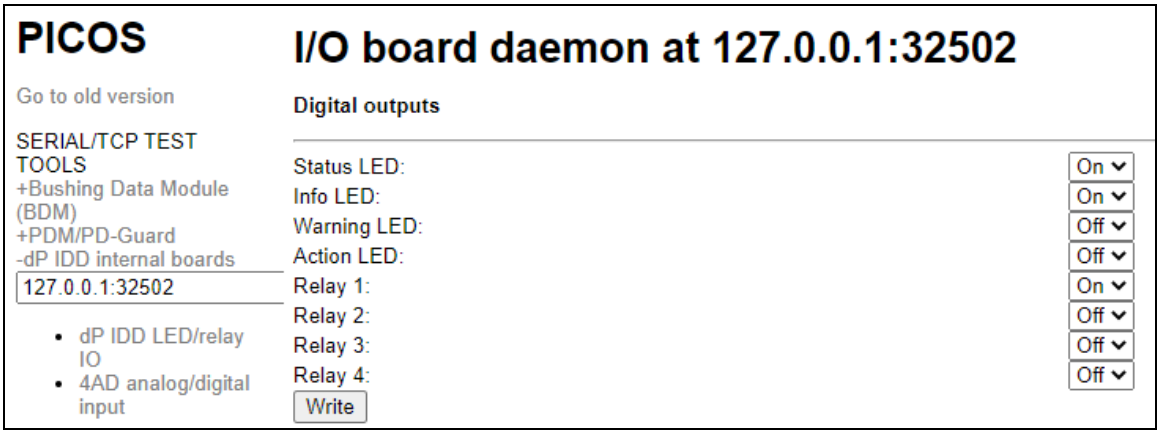


Figure 84 - LED and relay status

The first four digital outputs show the current status of the LEDs. Look at the front LEDs on Calisto N1 to confirm the status on the screen matches the LEDs indication.

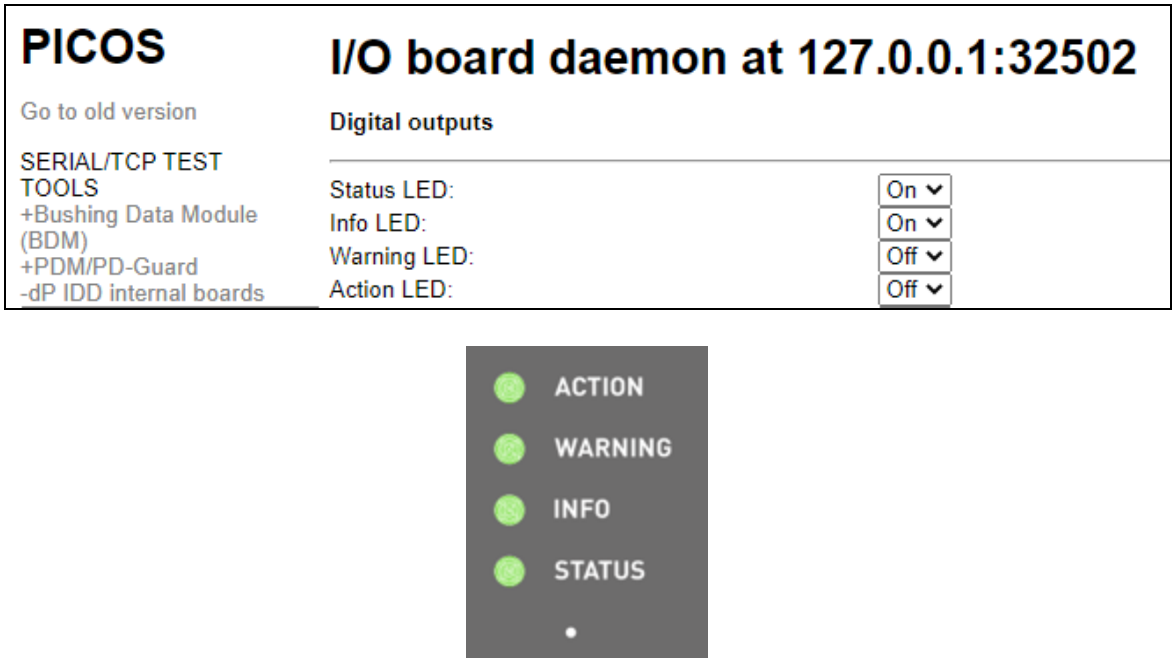


Figure 85 - LED status on PICOS and front LED indicator on the front panel

To change the LED status, click on the drop-down box on the right-hand side of the corresponding LED that you want to test, and toggle the option. Click on the Write button to submit the changes.

The next four digital outputs show the current status of the relays. Test for continuity with a multimeter to verify to verify if the relay contact matches the status seen on the screen.

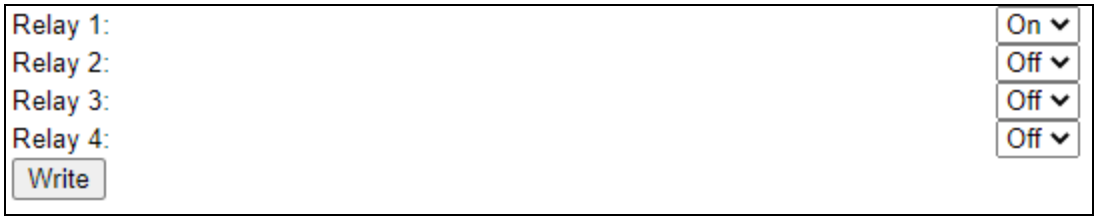


Figure 86 - Use a continuity tester to verify the relay contact status

To change the relay status, click on the drop-down box on the right-hand side of the corresponding relay that you want to test, and toggle the option. Click the Write button to submit the changes.

Testing the 4AD

This script allows you to verify the raw measurements of the analog and digital inputs.

> **Note:** Before using this tool, make sure SCT is stopped first; otherwise, you will experience connection issues to communicate with the board. See "Control of PRIME Application" on page 97.

Click on dP IDD internal boards to expand the menu then click on 4AD analog/digital input.

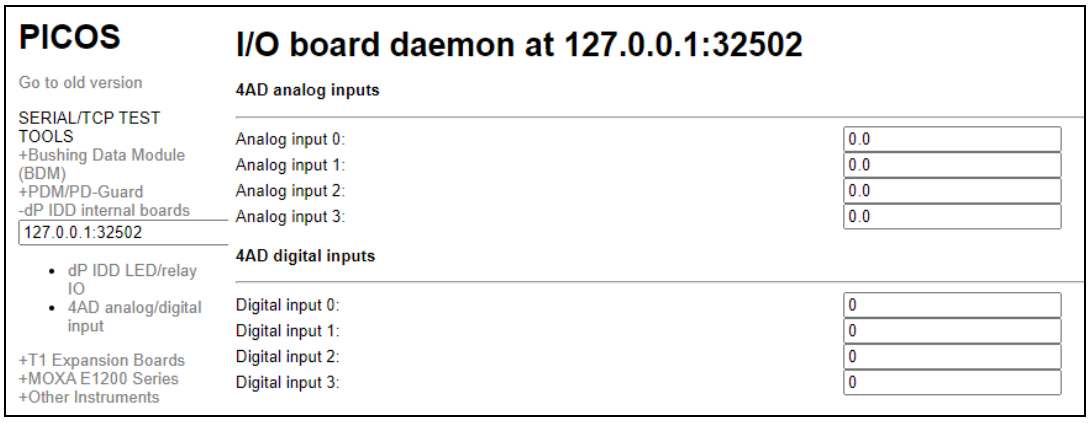


Figure 87 - Testing the 4AD

To test the analog input, wire up the terminal to a 4 to 20mA current loop output signal. When no signal is applied to the input the readout is 0 mA, and when 4mA or 20mA are injected to the input, the respective readout will be 4mA or 20mA.

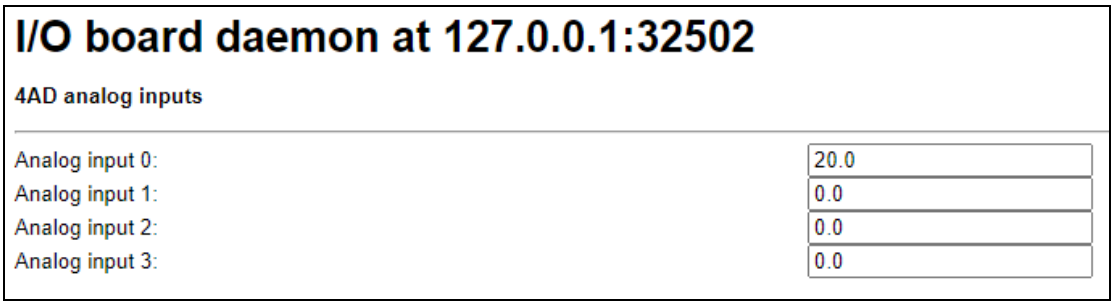


Figure 88 - Injecting 20mA to Analog input 0

See "Analog Input Wiring" on page 85 for more information about wiring up a current loop source to the analog input.

To test the digital input, short circuit the digital input to GND terminal. The status of the digital input should change from 0 (open) to 1 (closed).

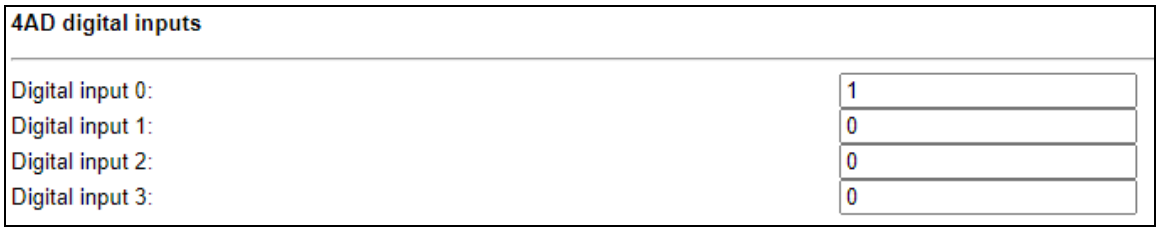


Figure 89 - Closed state simulation to DI0

See "DI Dry Contact" on page 85 for more information about wiring up the digital input.

E. HMI Interface

The HMI - Display and Keypad

The 20x4 characters display located on the front panel allows you to view the latest measurements and unacknowledged alerts without using a PC to connect to Calisto N1. Also, it allows you to view the IP address of the two ethernet interfaces.

Keypad Layout

Figure 90 - Display and Keypad

Key Functions

- Use the keypad to navigate through the menus.
- The Up and Down keys are used to scroll through the menu and sub-menus.
- The Left key is used to return to the menu selection.
- To access a menu option, or change an attribute, press OK.
- To save changes press A
- The B and Right keys have no function assigned.

Menu Layout

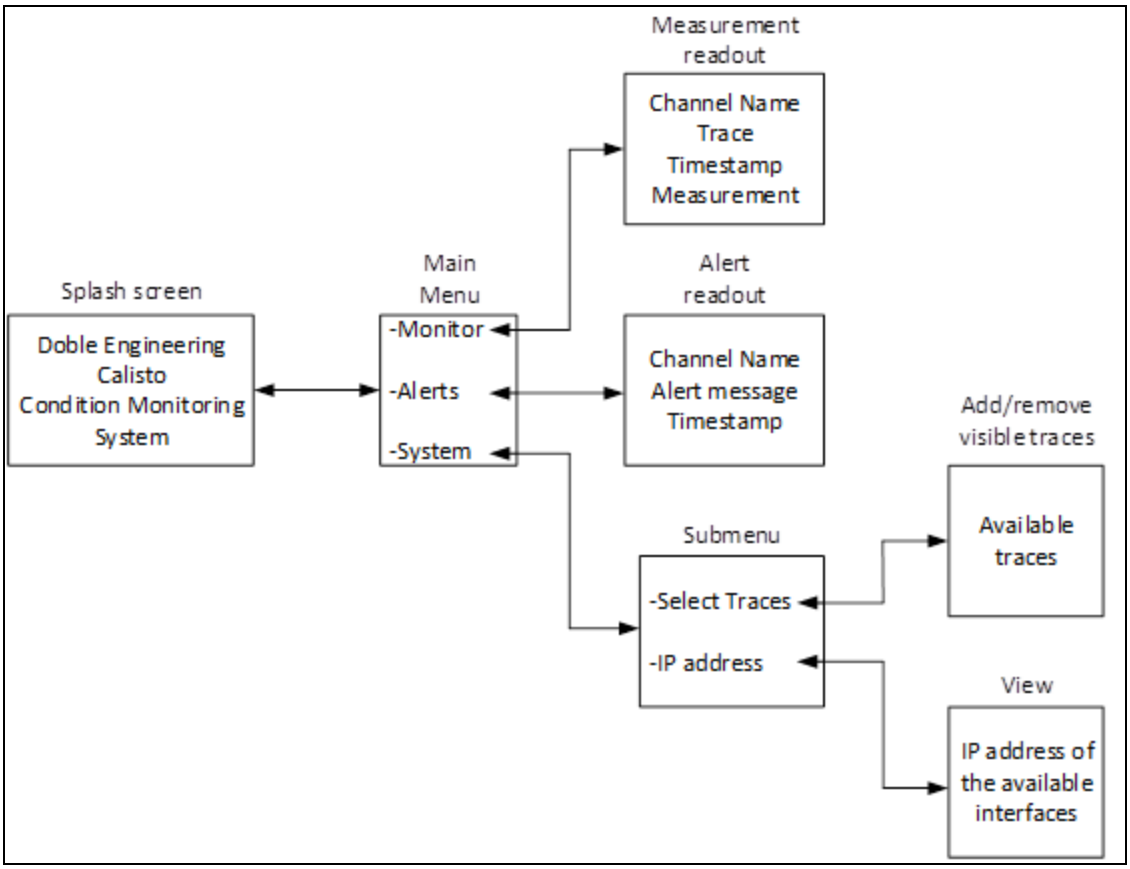


Figure 91 - HMI Menu Structure

- When the display is initiated, it will show the splash screen, that is, just a page showing the name of the device. Press any key to view the main menu. You can return to the splash screen any time from the Main menu, just press Left key to return.
- To view latest measurements, position the cursor on Monitor then press OK. Use Up and Down to scroll through the latest measurements. To return, press the Left key.
- To view unacknowledged alerts, position the cursor on Alerts then press OK. Use Up and Down to scroll through the alerts. To return press the Left Key
- To view System submenu, position the cursor on System then press OK. Use Up and Down to scroll through the submenu. To return press the Left Key.
- In the submenu, to view or edit traces, position the cursor on Select Traces then press OK. Use Up and Down to scroll through the traces. To return press the Left Key. To toggle the view attribute +/-, position the cursor on the trace of interest then press OK. To save the changes press A. To return press the Left Key.
- In the submenu, to view the IP addresses, position the cursor on IP address then press OK. To return press the Left Key.

Monitor Page

The Monitor shows the latest measurements taken by PRIME application. The script will fetch new measurement data from PRIME database every second and update the measurement on the display.

If the trace that you are looking for is not in the list, go to Select Traces paged and check if the corresponding trace attribute is set to viewable (+).

Alerts Page

The Alerts shows the unacknowledged alerts registered by PRIME application. The script will fetch new alerts every time you enter the Alerts page. Alerts cannot be acknowledged via this interface, only via web browser.

Select Traces Page

Traces are entities that correspond to a measurement type, i.e., temperature, leakage current, PAPR, Power factor, etc, and are shown on Monitor page. The list of traces shown on Traces menu will depend on your PRIME configuration. The HMI script reads all the measurements available in the database to extract a list of traces. Thus, the more variety of measurement types you have, the longer that list will be.

To avoid overloading the Monitor list with all possible traces, the script sets an attribute to each possible trace as viewable (+) or not viewable (-) preceding the name of each trace. In that way, the Monitor page will only show traces that precedes with a viewable attribute (+) and hide traces with (-) attribute.

Should you want to toggle the view attribute of a trace, position the select cursor > on the trace of interest then press OK.

After you finish changing the view attributes, press A to save the changes. Wait for the script to update the list of measurements.

If you accidently press Left and leave the page, you can return to Traces page and save the changes previously made. The attribute changes will not be lost by leaving the menu, but they will not take effect until you save them.

After the changes are made and saved, return to Monitor page to view the new list of measurements.

Note: The unit must be power cycled after the configuration is finished on PRIME web interface so the HMI script can read the new structure while the system boots up.

Note: Changes of the attribute are saved to volatile memory. If the system is power cycled, the changes made will be lost.

F. Maintenance - Fuse Replacement

In the event of a fault, the fuses – F1 and F2- can be easily replaced. The fuse terminals are located on the DIN rail next to the Mini Circuit Breaker.

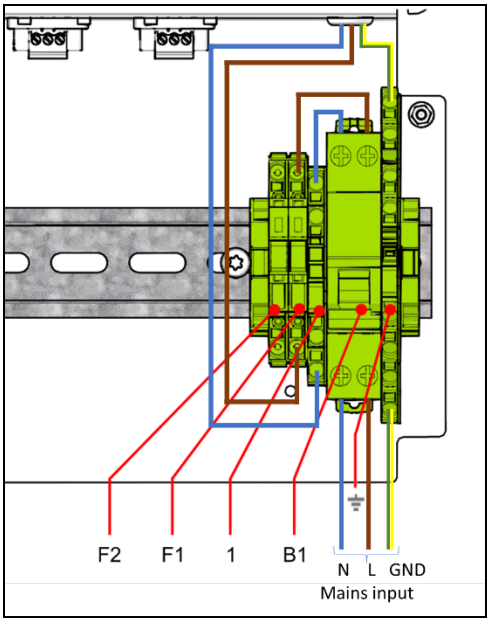


Figure 92 - x DIN Rail Elements

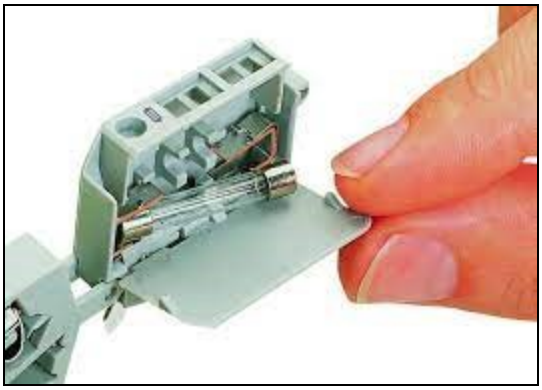
Terminal/Element	Description
F2	Fuse F2, 3.15A slow-blow
F1	Fuse F1, 3.15A slow-blow
1	Neutral Terminal
B1	Mini Circuit Breaker curve C, 6A

Warning: Only authorized and qualified personnel are allowed to service the unit. Risk of electric shock from hazardous live voltages under the cover. Shut off the MCB B1 and isolate this unit at the source before removing the cover to replace the fuses.

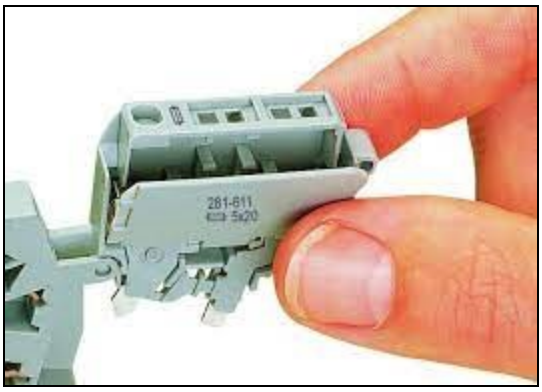
FUSE	Use	Description
F1	Feeed AC power to Calisto N1	3.15A T, 5x20mm time-lag surge withstand glass body cartridge fuse designed to IEC specification.
F2	Feed AC power to additional circuit	3.15A T, 5x20mm time-lag surge withstand glass body cartridge fuse designed to IEC specification.

To replace the fuse, pivot the fuse holder into the locked open position.

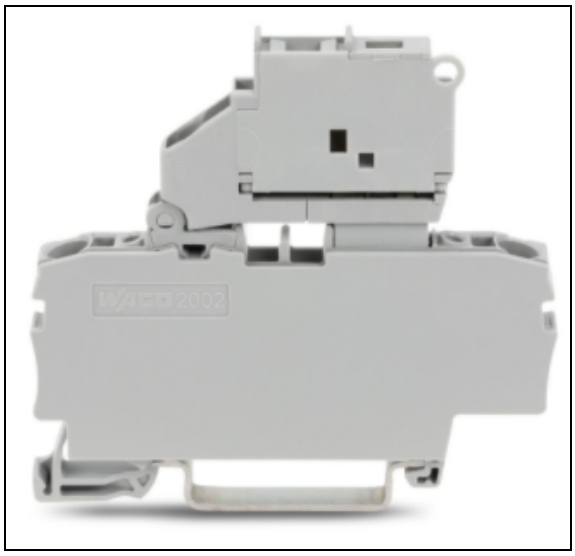
One end of the fuse is automatically ejected from the holder when opening the cover.



Remove the fuse by hand. Insert a new fuse and snap the cover closed.



Pivot the fuse holder into the closed position.



To have the unit back in service put the cover back on to the cable management space and reconnect to the power source. Flip on the mini circuit breaker. The system will initialize, and you will be able to see the menu on the display soon after.

G. Maintenance - RTC Battery Replacement

The RTC battery keeps the clock ticking when the unit is powered off. PRIME software will raise a warning alert to notify you when the battery needs to be replaced.

Use part number 05X-0137-01 to order the battery assembly from Doble (recommended). The battery assembly (05X-0137-01) is a CR2032 battery with a tail and a small PCB board at the other end. Alternatively, you can replace the battery with a BR1225 but it will not last as long as the recommended battery.

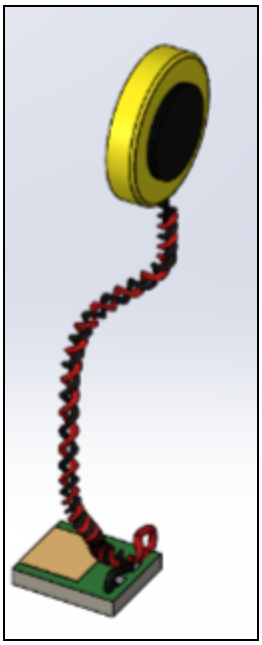


Figure 93 - Battery Assembly, Part Number 05X-0137-01

Disassembling the Unit

Warning: Only authorized and qualified personnel are allowed to service the unit. Risk of electric shock from hazardous live voltages under the cover. Only authorized and qualified personnel are allowed to service the unit. Shut off the MCB B1 and isolate the unit at source before removing the cover.

After the unit is safely disconnected from the mains and free of hazardous live potential, undo the four screws at the corners so you call pull out the chassis from the box.

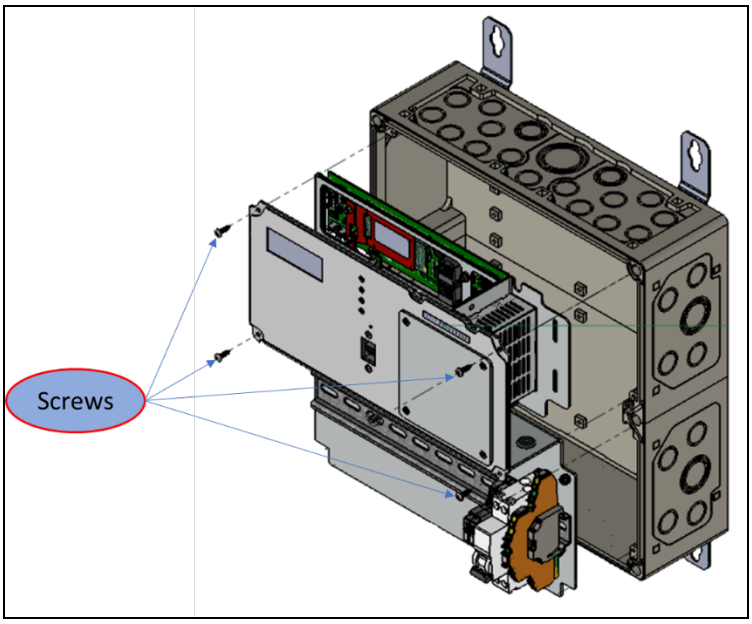


Figure 94 - Screw Location

Flip over the chassis and undo the three nuts to remove Prime Interface Gateway assembly.

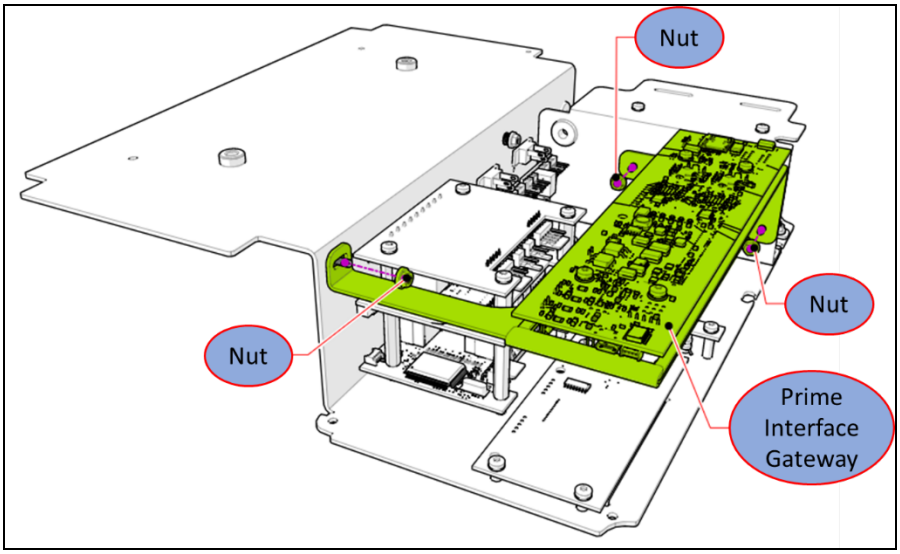


Figure 95 - Prime Interface Gateway Assembly Secured to the Chassis

Locate the battery connected up to Prime Interface Gateway assembly. Note that the PCB end of the battery is inserted in the battery holder.

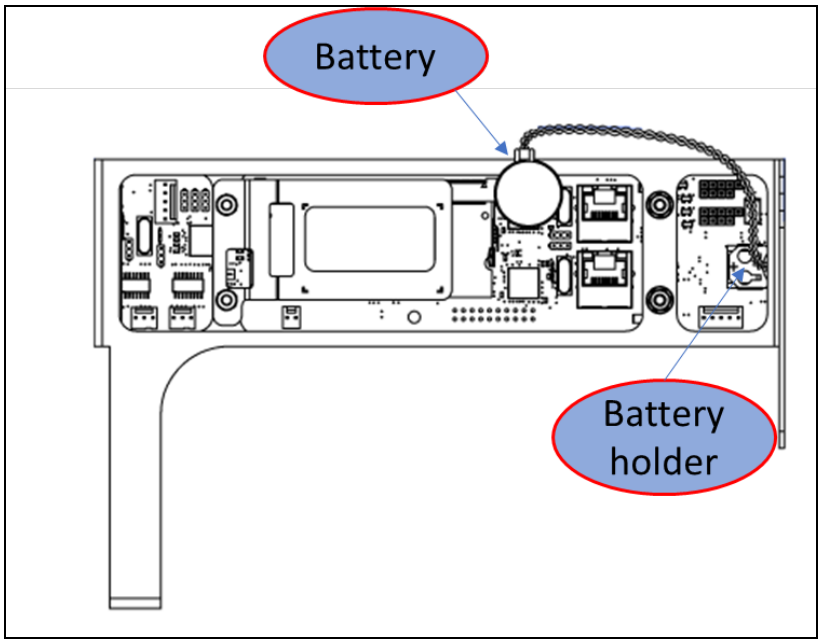


Figure 96 - Prime Interface Gateway Assembly

Remove the small PCB from the battery holder. Insert the PCB of the new battery into the holder. Check the polarity of the board before pushing it in.

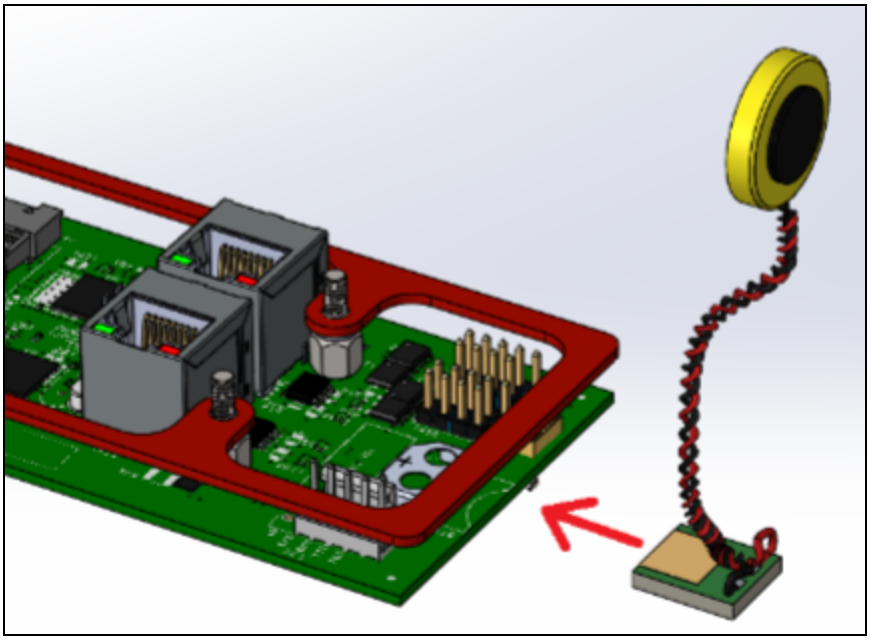


Figure 97 - Check the Polarity Before Pushing PCB Into the Holder

Secure the battery wire inside the frame.

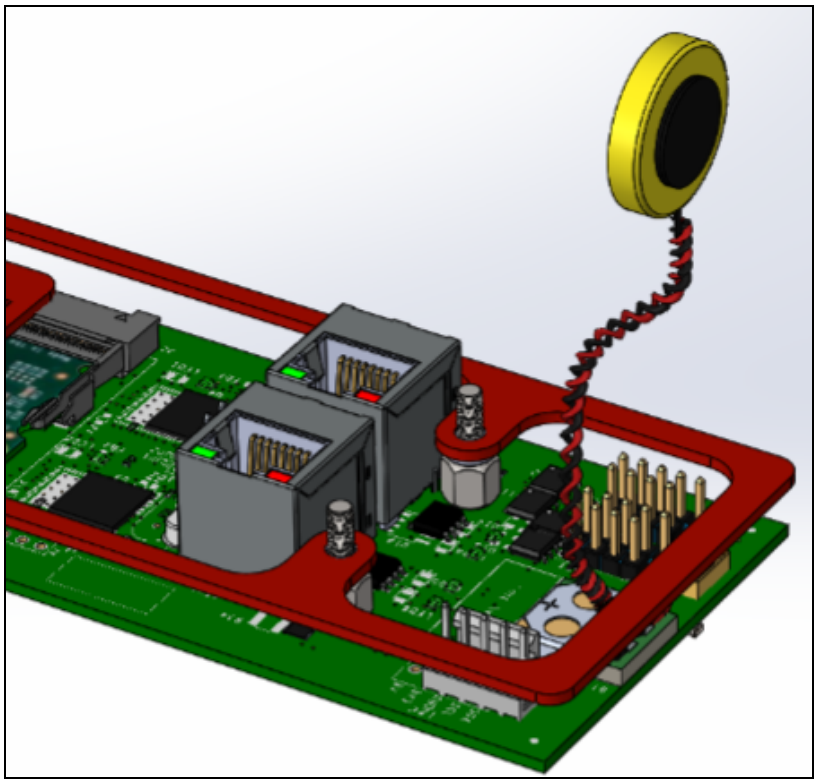


Figure 98 - Arrange the Battery Cable as in this Figure

Reassemble the unit, put the cover back on then power it up. Go to appendix PICOS – Set system date and time to enter the correct time on the unit.