User's Guide

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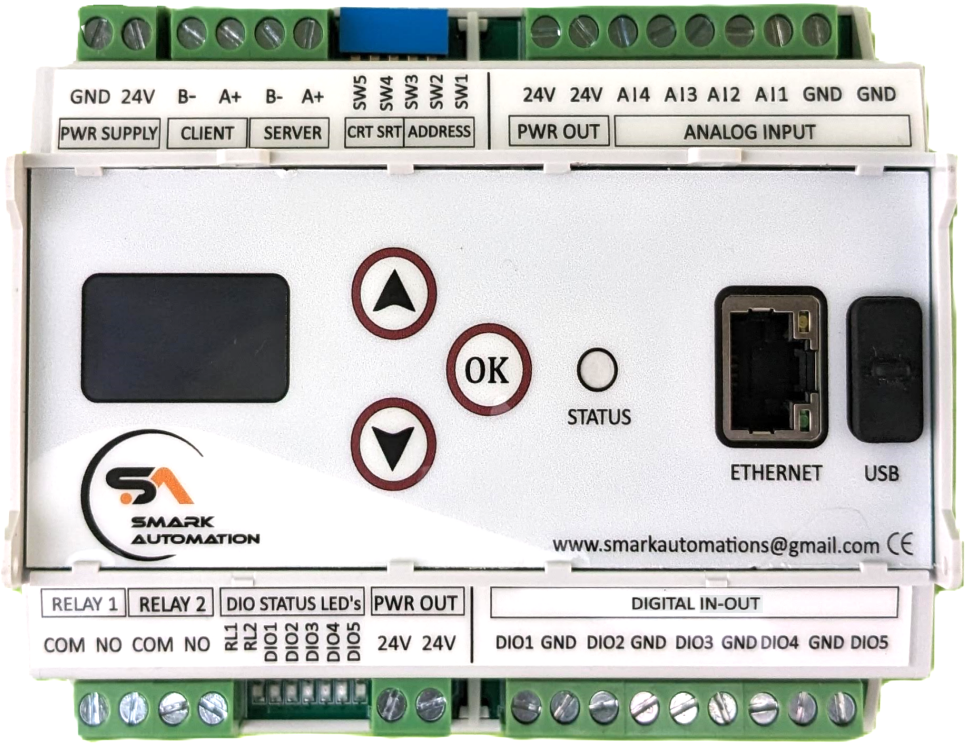


SMPLC-5D4A2R

4-Channel Ethernet Programmable Controller with Embedded Web Server

SPECIFIC WARNINGS

To guarantee the IP protection during the installation, expect to seal the instrument cables (with silicone or foam) after having tightened the cable-gland. Through the installation expect suitable protections to avoid product overheating (eg. a shelter to avoid direct sunlight); similarly for low temperatures. Do not open in case of bad weather conditions (rain, snow, etc). Expect the recurring substitution of the hygroscopic salts. Do not install in small locations and/or without ventilation, with high humidity, in potentially dangerous areas or where the use of explosion proof components is prescribed. Electrical connections on the product must be executed only from qualified and expert personnel, in compliance with actual rules and regulations. For external network powering, the plug at the end of the cord has ground contact; the grounding of the powering is provided from the plug inserted in the socket. The product powering source must be divided from dangerous voltage parts with double insulation and must guarantee an insulation of at least 1000 Vrms. Be sure to have, in the plant, a suitable protection from electric short circuit (for example high sensitivity differential circuit-breaker at the root of the AC/DC power supply unit). Before any maintenance on the product, the powering must be disconnected.

To enable the product protections, expect a connection to the ground plant through a proper green-yellow grounding connector; this connector must be connected to the proper ground clamp (or to any bolt if it is a metal cabinet). Verify periodically rechargeable battery voltage; expect a substitution after roughly 5 years and if the voltage measured on the poles is too low (eg. 10.5V for a battery with nominal voltage 12V) and investigate the causes. Using the product differently from the one expected from the manufacturer can compromise safety conditions. The use of parts other than original spare parts could lead to irregular functioning or even dangerous situations for a person and device.

Contents

1 General Description

1.1 Introduction

The SMPLC-5D4A2R is a versatile and robust device designed to capture, store, and analyse data from a variety of connected sensors. This device is ideal for industries involved in process control, automation, and monitoring. The SMPLC-5D4A2R provides reliable data logging solutions with comprehensive connectivity options and advanced data management capabilities.

The primary purpose of the SMPLC-5D4A2R device is to collect and log data from connected sensors into its memory, offering valuable insights for better understanding and optimization of industrial processes. This device ensures accurate and timely data collection, facilitating improved decision-making, enhanced process control, and efficient troubleshooting. With its advanced features, the SMPLC-5D4A2R supports real-time monitoring, remote access, and easy data retrieval, making it an essential tool for modern industrial applications.

There are four input channel types in the SMPLC-5D4A2R. Analog (voltage/current), Digital IOs, Relay Outputs, and remote channels. Analog sensor channels and Digital IOs are those acquired directly by device through their respective inputs. The remote channels are those acquired through Modbus RTU protocol, operating as master on its RS485 interface.
The analog input channels are configurable for reading voltage/current. These inputs count on the precision of a 24 bit A/D converter with high acquisition speed. Analog signals are averaged for 25 samples over 25ms before saving into the memory. The digital channels can be configured individually as inputs or outputs.

The Ethernet interface allows data download and data access of the inputs and outputs, through services that are already configured. Through a web browser (HTTP), one can visualize the data of the enabled channel, diagnostics and general information of the Device. The SMPLC can also be used to program up to 20 controlling and 15 timer conditions, allowing the triggering of outputs (Control and Timer Conditions are available for the "Conditions Pack" enabled device). All the sensor information of the Data Logger are available in Modbus registers that can be accessed through the Modbus TCP interface or the Modbus RTU interface over RS485 (when operating as slave).

The USB interface is used for connection of a USB flash drive, for data downloading from the logging memory. The USB host can also be used for updating the new firmware of the device.

An exclusive color graphical DISPLAY (Human-Machine Interface - HMI) and 3 navigation keys are provided on the device to configure the device parameters on the go.

1.2 Technical Specifications

The SMPLC-5D4A2R data logger boasts an array of technical features designed to meet the rigorous demands of industrial environments:

1. **Sensor Connectivity**

   Analogue inputs: 4 (0-10V OR (0-20mA or 4-20mA))

2. **Digital Inputs/Outputs**

   5 digital inputs/outputs.

3. **Relay Outputs**

   2 relay outputs.

4. **Real-Time Clock (RTC)**

   Built-in battery backup ensures accurate timekeeping.

5. **Communication Interfaces**

   - **RS485 Interface**
     1. **Modbus Client mode (Master)**
        Device acts as master and can be used to connect extension devices for more data points.
     2. **Modbus Server mode (Slave)**
        Device acts as server and serves the DAS parameters from the logger to SCADA or other modbus master.
   - **Ethernet Interface -** Support following features:
     (a) DHCP
     (b) DNS
     (c) NTP
     (d) MQTT, Port 1883
     (e) Modbus TCP, Port 502
     (f) HTTP, Port 80 - Serves web server

6. **Data Storage**

   1 Gigabit onboard storage capacity, capable of storing data points for more than 2 years (when logging 12 sensors at the interval of 30 second. Changing logging interval or number of sensors will change the logging duration).

7. **User Interface**

   0.96 inch OLED display and 3 navigation keys for setting and selecting device parameters (Human-Machine Interface, HMI).

8. **USB Interface**

   Allows connection of external USB flash drive for data download, with date range selection via the HMI.

9. **Local Web Server**

   Enables monitoring, data download and configuration over Ethernet.

1.3 Installation

1.3.1 Mechanical Installation

The SMPLC Device chassis is designed to be installed on a 35mm DIN rail. Follow these steps for proper installation:

1. **Prepare the Device**

   Pull out the two clamps located on the back of the device, as shown in Fig 1. Make sure to extend them fully, but do not remove them.

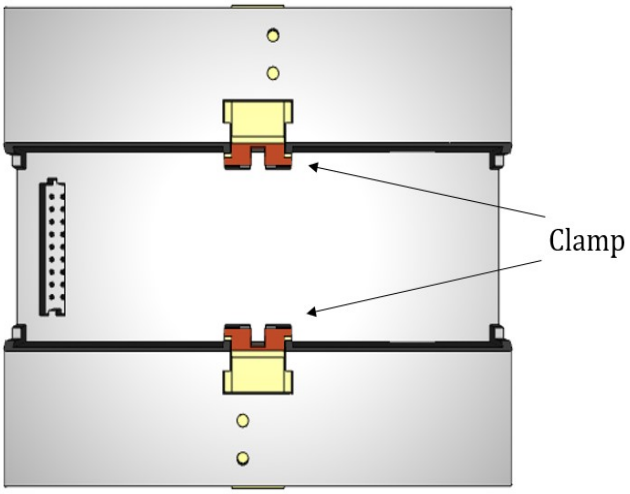


Figure 1: Extending the Clamps

2. **Attach the Device to the Rail**

   Position the SMPLC Device onto the DIN rail as illustrated in Fig 2. Slide the device onto the rail, making sure that the clamps are positioned correctly to secure the device in place.

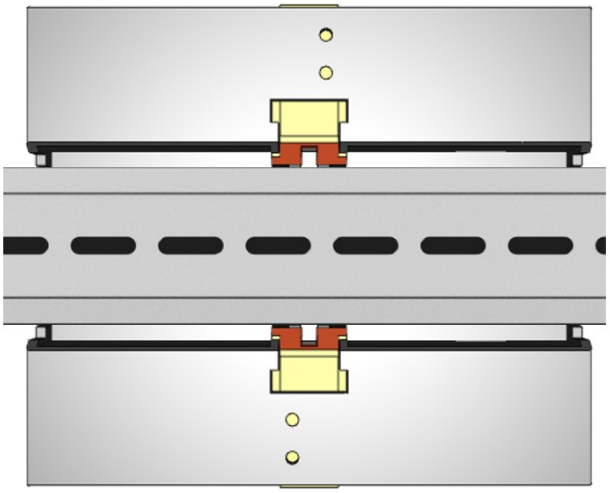


Figure 2: Attaching the Device to the DIN Rail

3. **Secure the Device**

   With the device in position on the rail, push the clamps upward until you hear a distinct double-click sound. This sound confirms that the clamps have engaged and the device is securely mounted on the DIN rail.

1.3.2 Dimensions

The dimensions of the Device, including the attached connector, are illustrated in Fig 3. This figure provides detailed measurements to ensure proper fitting and compatibility with your installation setup. It includes all relevant dimensions, such as length, width, and height, with the connector attached. Please review these measurements carefully to confirm that the device will fit within the designated installation area and to avoid any potential issues during setup.

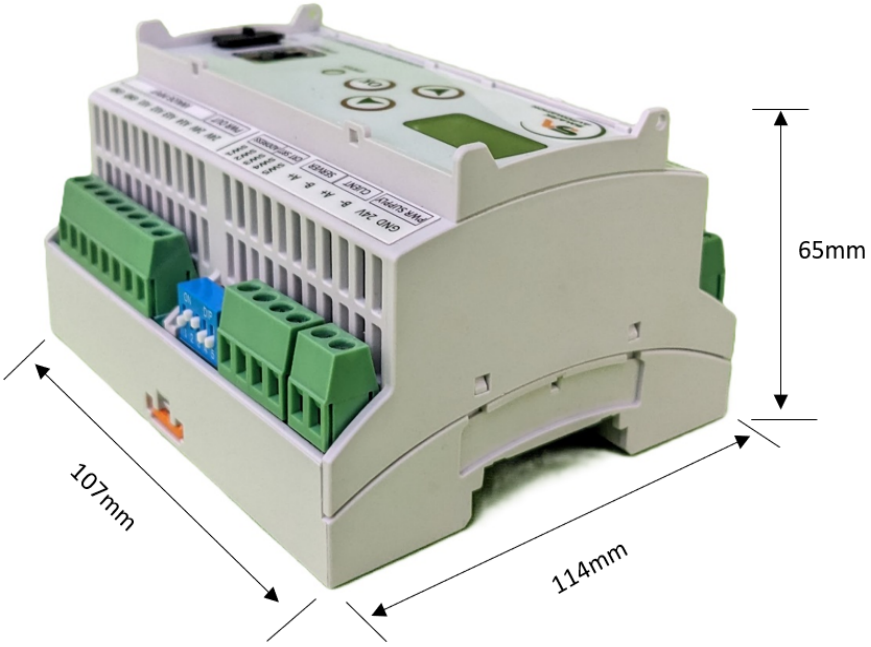


Figure 3: Device Dimensions with Connector Attached

2 Hardware Connection

A SMPLC-5D4A2R is a device used to record and monitor various types of data, such as current, voltage, over time. For accurate and reliable data collection, it's essential to set up the hardware connections correctly. This Section provides a comprehensive overview of the steps required to connect SMPLC-5D4A2R pins to sensors and external devices.

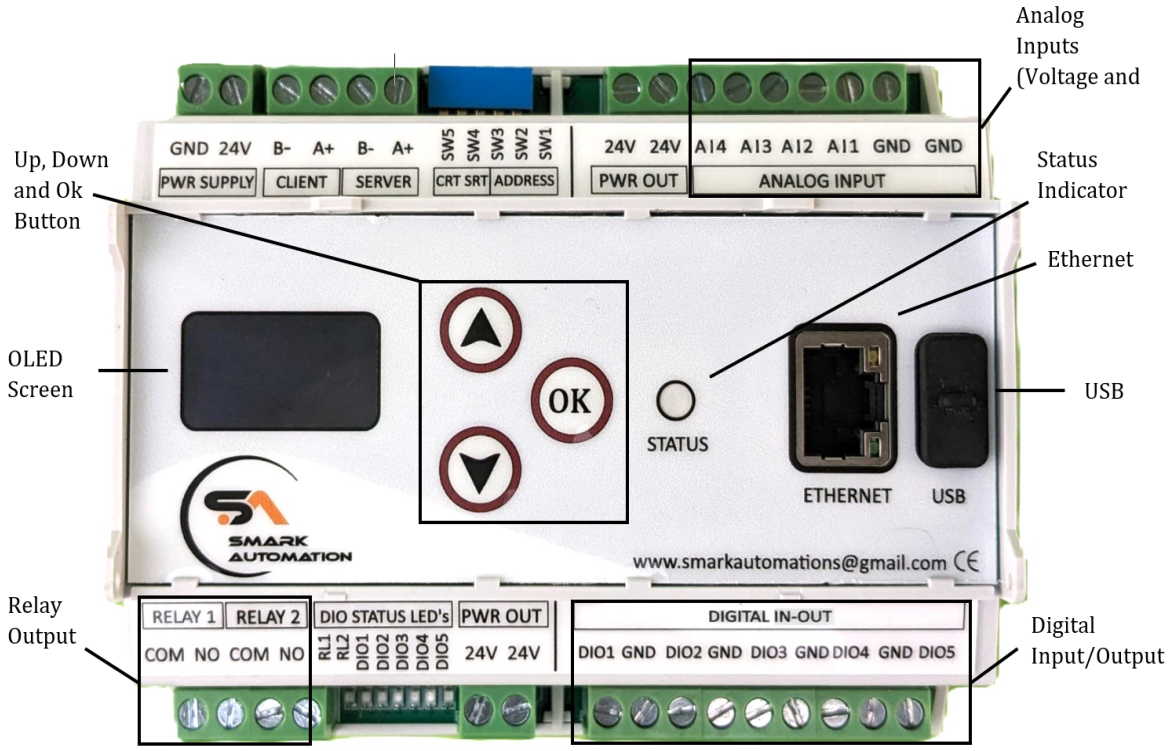


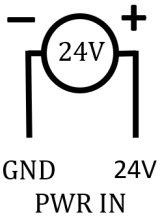
Figure 4: Front View of SMPLC Device

Below are the connectors which are discussed in this section:

1. PWR IN
2. RS-485
3. DIP SW
4. DIO
5. Relay Output
6. Ethernet
7. USB
8. Analog Input Connections
   (a) Voltage Connection
   (b) Current Connection

Note: Check the label on the board to verify the correct polarity.

2.1 PWR IN

	Connect a 24V power supply to the PWR IN pin to power the device. These pins are protected against reverse polarity. It can be powered from two 12V batteries connected in series or from 24V SMPS. If batteries are used, they should be protected against terminal short circuit and should have a proper charging circuit.

	Make sure the polarity is correct and all connections are secure to avoid any power-related issues.

2.2 RS-485

RS-485 connections utilize a 2-wire communication configuration. In a Modbus network, the connections are configured to support both master and slave mode, as discussed below.

Note: To maintain effective RS485 communication and prevent signal reflections, it's crucial to terminate the RS485 line with 120 Ohm resistors at both ends. These resistors ensure that the signal remains clear and reliable. **Do not install termination resistors at any intermediate RS485 nodes. Termination resistor can be enabled from DIP switch as shown in Fig 8.**

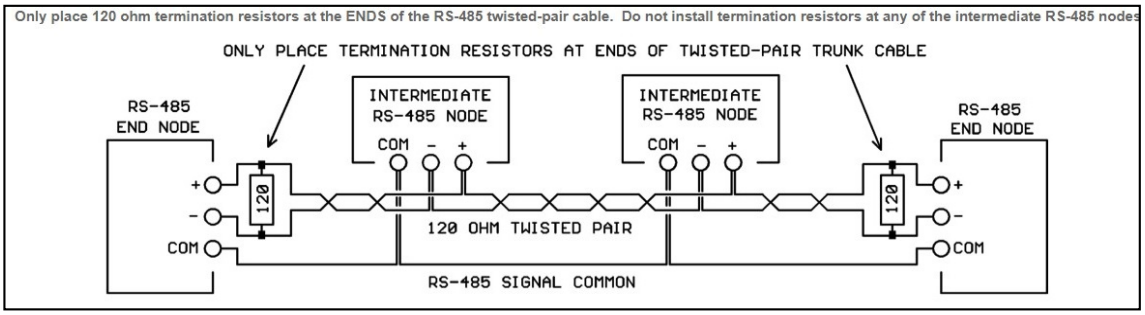


Figure 5: Termination Resistor Connection

- **SMPLC Master(Client) Port**

  In this network setup, a maximum of 6 external devices can be connected to the SMPLC device (Master). The SMPLC device initiates communication by sending commands or requests to slave devices. These devices can be extension devices from SMARK Automations such as SMXT-12D4A or any other device that acts as MODBUS RTU server. In this mode, SMPLC reads data from the connected devices. The data from these connected devices can be saved into SMPLC memory and can be processed to program conditions. The addition of extension device is explained in section 4.6.
  To connect the slave devices to the SMPLC, refer to Fig 6.

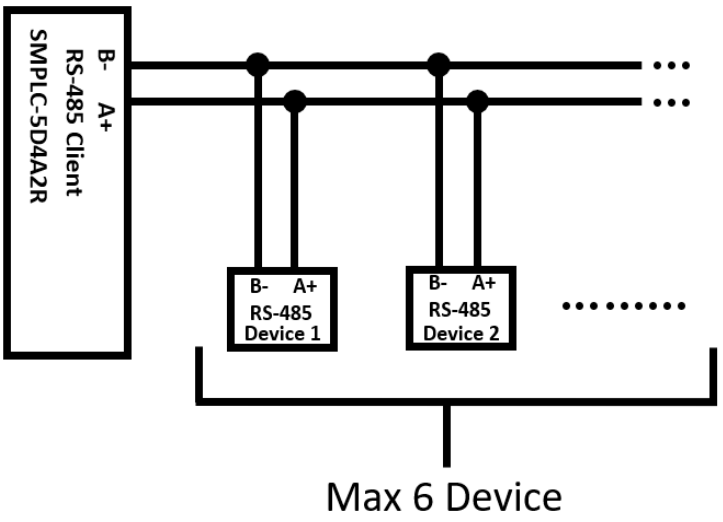


Figure 6: Connection Diagram for SMPLC Device Master

- **SMPLC Slave(Server) Port**

  In an RS-485 Modbus network, an SMPLC device acts as a slave by responding to commands issued by the MODBUS master. It receives requests, performs the required actions, and sends back the appropriate data or status information. Slaves do not initiate communication independently, instead they wait for instructions from the master and respond accordingly. Modbus addresses for the sensors can be found in the section 5.2.
  To connect the SMPLC as a slave, refer to Fig 7.

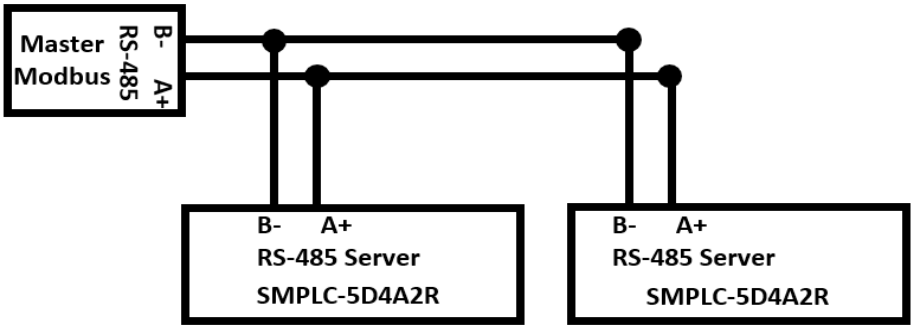


Figure 7: Connection Diagram for SMPLC Device Slave

2.3 DIP SW

A DIP Switch (Dual Inline Package Switch) is a small manual switch commonly used for setting configurations. It consists of a series of tiny mechanical switches that can be toggled on or off to set the Slave Address and to enable or disable the Termination Resistor of a device. Moving a switch down gives "1" and up position gives "0".

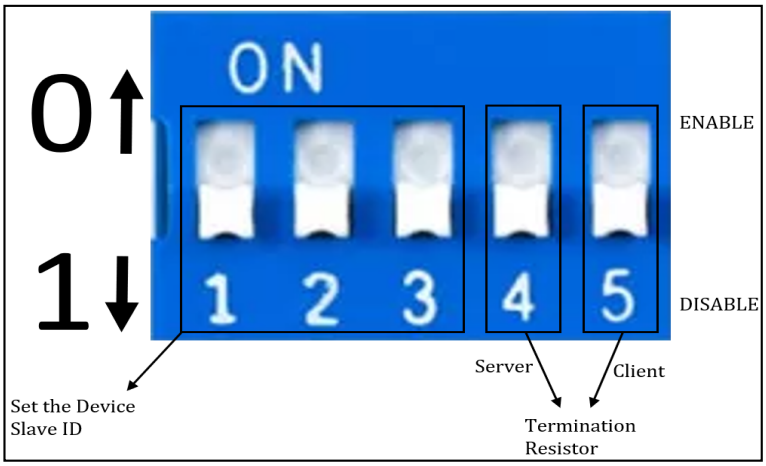


Figure 8: DIP Switch

2.3.1 Configuring Slave ID for SMPLC in Server (Slave) Mode

To set the Slave ID when SMPLC is working in RS485 Server (Slave) mode, adjust the DIP switches according to the configuration in table 1. The Slave ID is determined by the switch positions from right (Switch 3) to left (Switch 1). The address can be set as per the table 1.

Switch 1	Switch 2	Switch 3	Slave ID
0	0	1	1
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	5
1	1	0	6
1	1	1	7

Table 1: Table of Switch Settings and Slave IDs

2.3.2 Configuring Termination Resistor for RS485 Communication

The Termination Resistor Switch used to ensure proper signal integrity over long cable runs. This switch allows users to enable or disable the termination resistor depending on the system's configuration.

Enable (ON): Activates the termination resistor to maintain proper impedance matching, which minimizes signal loss and reflection.

Disable (OFF): Deactivates the termination resistor, used for intermediate devices or when the device is not at the end of the communication line.

There are two DIP switches provided for termination resistor, the left switch is for the server, and the right switch is for the client. It is important to carefully manage the termination resistors in an RS485 network to avoid issues such as data corruption or communication failure. Incorrect configuration may lead to unreliable signal transmission, especially when multiple devices are connected over extended distances.

	To maintain effective RS485 communication and prevent signal reflections, it's crucial to terminate the RS485 line with 120 Ohm resistors at both ends. Do not install termination resistors at any intermediate RS485 nodes.

2.4 DIO

The device features a maximum of 5 Digital Input/Output (DIO) pins. These pins allow for connection of digital sensors, actuators, or other external devices, enabling communication with the system. The DIO pins can be configured as either inputs or outputs depending on the application requirements by user.

Output Configuration: The output pins are configured in sink configuration and cannot drive the voltage. Their connections when configured as output are illustrated in Fig 9.

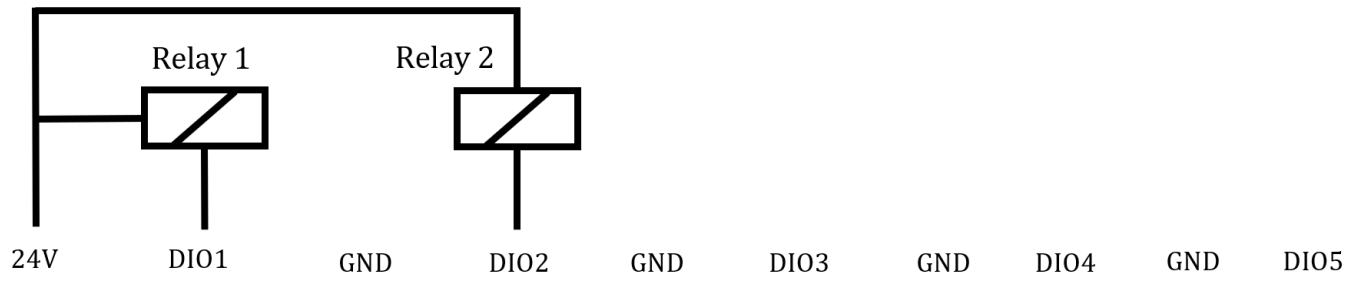


Figure 9: Digital Output Sensor Connection Diagram

Input Configuration: The input pins can be driven either by voltage between 5V-24V or can also sense dry contacts like float switches. Their connections when configured as input are illustrated in Fig 10.

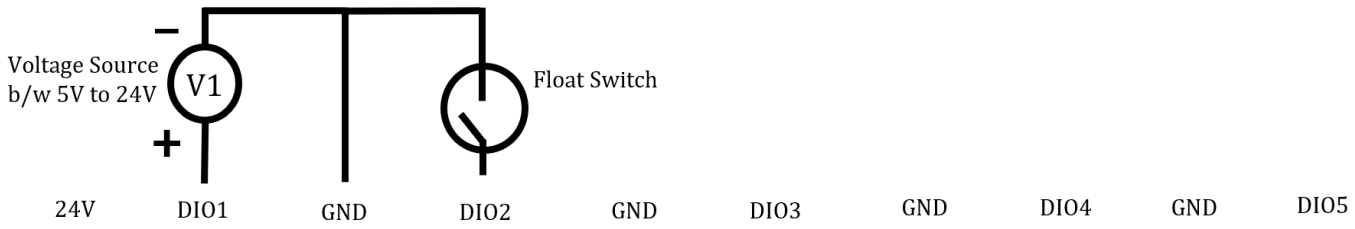


Figure 10: Digital Input Sensor Connection Diagram

2.5 Relay Output

The device offers two relay outputs, each consisting of a COM (Common) terminal and a NO (Normally Open) terminal. This allows the device to control external devices or circuits by switching the relay on or off. Each relay is electrically isolated, which enhances the safety and flexibility of the device. Output configuration for the relay is shown in Fig. 11.

Common (COM): Each relay has its own common terminal (COM), which serves as a shared connection point for the Normally Open (NO) and Normally Closed (NC) contacts. The COM terminal is the starting point for the controlled circuit.

Normally Open (NO): The Normally Open (NO) terminal remains disconnected in the default (off) state. When the relay is activated, the NO terminal closes, allowing current to flow and completing the circuit. This setup is used to control devices that should only be powered when the relay is triggered.

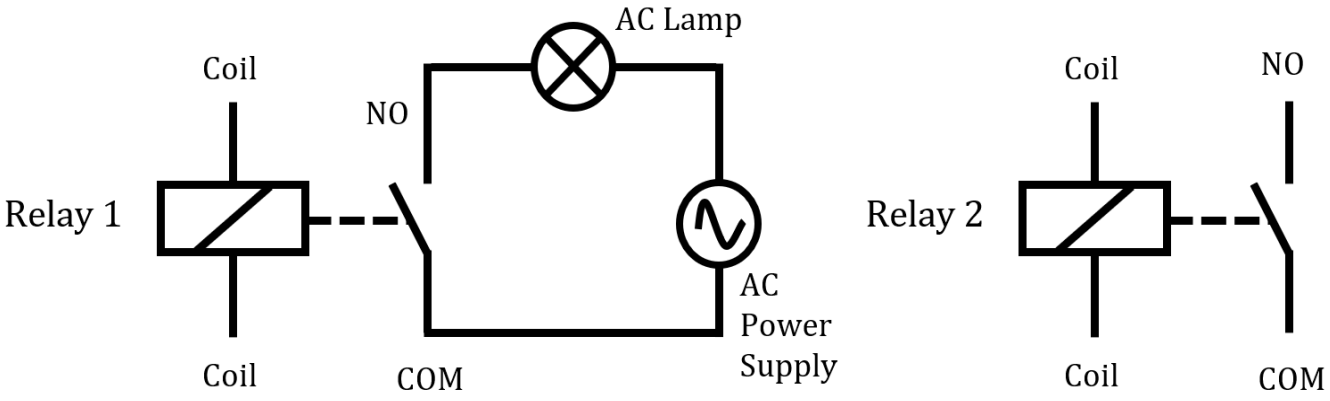


Figure 11: Relay Output Connection Diagram

The DIO Status LEDs, located to the right of the relay output, will turn on or off based on the state of the DIO pins (input/output) and the output state of the relay.

2.6 Ethernet

An Ethernet connector is provided on the device to connect it to the network. The device uses the following protocols for data logging and programming condition tasks:

1. **DHCP (Dynamic Host Configuration Protocol)**

   The device includes a DHCP client that allows it to automatically obtain an IP address from a DHCP server on the network. This enables the device to be easily integrated into a network without manual IP configuration. User can configure DHCP settings either through the OLED interface (refer to section 3.4) or via the web server interface (refer to section 4.5.3).

2. **DNS (Domain Name System)**

   This typically involves how the device uses DNS to resolve domain names into IP addresses for network communication. The device can use DNS to resolve domain names for accessing remote servers.

3. **NTP (Network Time Protocol)**

   The device uses NTP to synchronize its internal clock with an NTP server. This ensures accurate timekeeping. The device can be configured to use either a local NTP server within the network or a global NTP server if internet access is available. Configuration instructions for setting up NTP via the OLED are explained in section 3.1, and setup via the web server is covered in section 4.5.2.

4. **MQTT (Message Queuing Telemetry Transport), Port 1883**

   MQTT is a lightweight messaging protocol designed for efficient communication between devices. The device uses MQTT on port 1883 to exchange data with an MQTT broker, facilitating both sending and receiving messages. All the sensor values can be accessed over MQTT protocol with the following topic. It returns json data as given below.

5. **Modbus TCP, Port 502**

   The device supports the Modbus TCP protocol, which allows for communication with other Modbus-compatible devices over TCP/IP networks using port 502. Modbus TCP enables reading and writing data from/to the device using Modbus commands. Details on the data values and their addresses available through Modbus TCP are listed in section 5.

6. **HTTP (Hypertext Transfer Protocol), Port 80**

   The device includes a web server that operates over HTTP on port 80. This web server provides a user interface for monitoring and configuring the device. Detailed instructions for using the web server for device configuration and monitoring are available in section 4.

2.7 USB

A USB connector is provided to facilitate data transfer from the device. The procedure for downloading data to a USB flash drive is described in section 3.2.

2.8 Analog Channel Connection

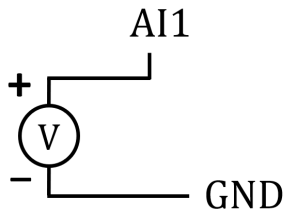
The Analog pins are designed for measuring analog signals, such as those from voltage and current sensors. There are a total of six analog input pins, labeled AI1 to AI6, which can be used for either voltage or current measurements.

- **Voltage/Current Measurement Pin:** Pins AI1 to AI4 support either voltage or current input, but only one sensor type (voltage or current) can be connected to each pin at a time.
- **Pin Tolerances:**
  Voltage Input Range: 0 - 24V
  Current Input Range: 0 - 24mA

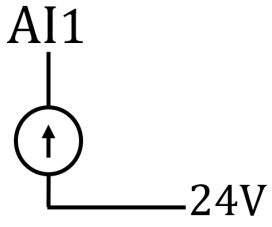
Each pin set is dedicated to its respective measurement type, ensuring accurate and reliable data acquisition for various applications.

	The maximum input voltage must not exceed 24V and the maximum input current must not exceed 24mA. Exceeding these limits could cause damage to the device or result in incorrect measurements.

Voltage(mV/V) Connection:

	Connect the sensors that provide Analog voltage signals to the designated voltage input terminals (e.g., AI1, AI2, etc.). Ensure that the input voltage is within the acceptable range and verify the polarity before making the connection. Refer to the figure shown on the left for connection.

Current(mA) Connection:

	Connect sensors that provide Analog current signals to the current measurement pins (i.e., AI1, AI2, etc). Ensure the input current is within the acceptable range and refer to the figure shown on the left for connection.

3 OLED and its Functionality

An OLED display serves as a User - interface through which user can select and configure various options necessary for the proper functioning of the SMPLC device. This section will guide user through the selection options available on the OLED display.

Once the user connects the sensor (e.g., Analog) and extension devices, turn on the SMPLC device. The OLED display will show the "Smark Automation" along with the device name. Following this, it will display the time and date, along with the logging status, which can be either ON or OFF, as illustrated in Fig 12.

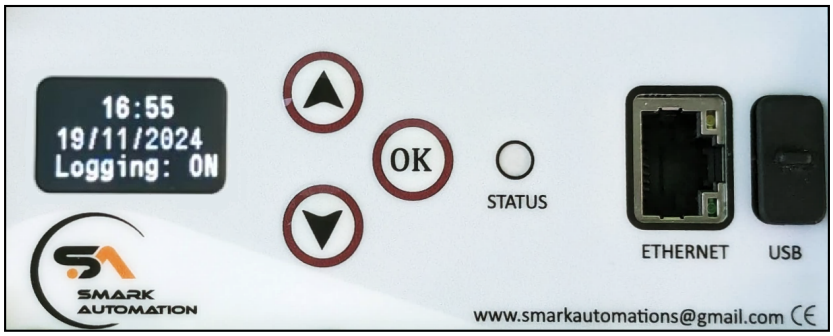


Figure 12: Display Screen of the SMPLC Device

To access the navigation menu of the OLED interface, **press and hold the OK button for 5 seconds**. This action will bring up a menu with various options to configure as shown in Fig 13. The options are:

1. Time
2. USB Logs
3. Show IP
4. Set IP
5. XT COM CONF
6. Update FW
7. Error List
8. Admin

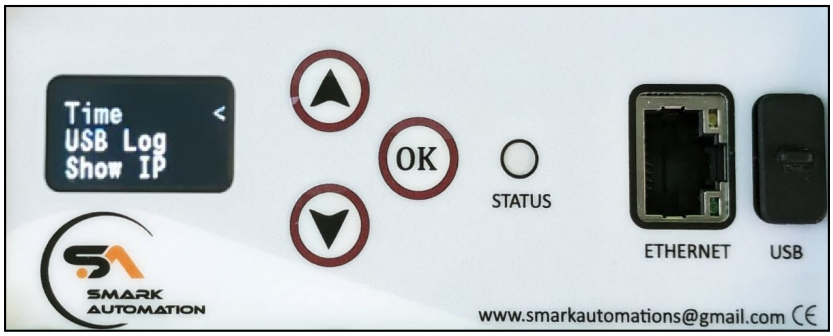


Figure 13: Navigation Menu Option

These options are explained in detail in the further sections of the document. The currently selected option is denoted by "<". Pressing "OK" confirms the selection and enters the chosen menu option, with a 5-second timeout period. If no action is taken within this time frame, the device will return to the menu interface.
To the right of the OK key, the user will find the LED status indicator, which displays the device status:

- **Blinking Blue LED:** A blue LED that blinks on and off at 500-millisecond intervals indicates that data is being copied to the USB.
- **Blinking Green-Yellow LED:** A green-yellow LED that blinks on and off at 500-millisecond intervals signals a network error or lack of internet connection.
- **Blinking Green LED:** A green LED that blinks on and off at 500-millisecond intervals shows that the device is trying to connect to the network.
- **Solid Green LED:** A solid, green LED means the device is operating normally without errors.
- **Blinking Red LED:** A red LED that blinks on and off at 500-millisecond intervals indicates that the extension device is not connected.
- **Solid Red LED:** A solid, red LED signifies that there is no time synchronization with the device or that it has no time.

Note: By clicking the "OK" button, the device will set the option or value the user has selected or entered. To navigate between menus or increase/decrease the numbers, use the up and down arrow keys.

3.1 Time

The Time option allows the user to set or adjust the current time and date on the SMPLC device. Accurate timekeeping is crucial for proper logging and synchronization.

Steps to Configure Time:

1. **Select the Time Option:** Navigate to the "Time" option from the menu using the navigation buttons (i.e. Up and Down Arrow Key) and press the OK button to select it.
2. **Select the Time Option:** On the OLED screen, user will see two options: Config NTP and Set Time as shown in Fig 14. Use the Up and Down Arrow Keys to navigate between numbers and press OK to select and proceed.

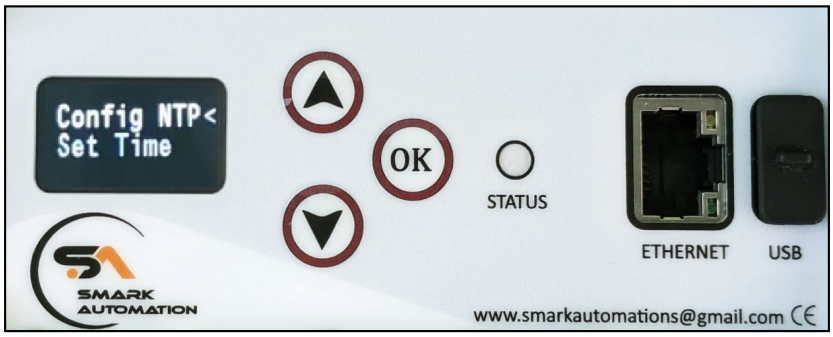


Figure 14: Time Configuration Menu Options

i) **Config NTP:** Config NTP allows user to configure Network Time Protocol (NTP) settings to synchronize the time and date either via the Internet or a local NTP server.

- **Internet NTP:** Select this option to sync with an Internet NTP server. User will need to input the GMT Shift (hour and minute) as shown in Fig 15. After entering the GMT Shift, press OK. A confirmation message will then appear: "Saving Time Config".

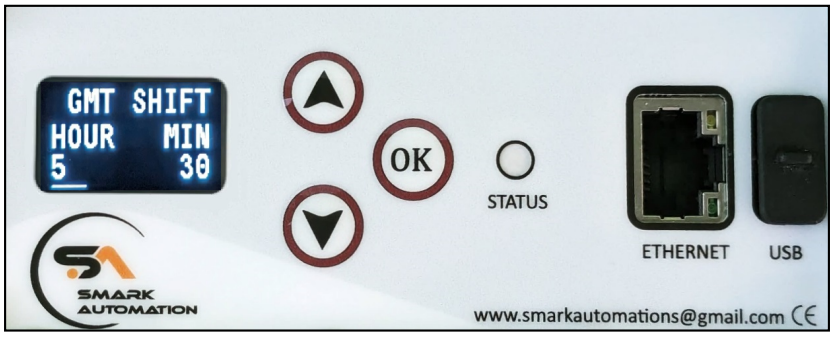


Figure 15: GMT Shift Configuration for Internet NTP

- **Local NTP:** Select this option to sync with a Local NTP server. The user will need to enter the IP address of the Local NTP server. Once the IP address is entered, as shown in Fig 16, the user will be prompted to select the GMT Shift, as chosen for Internet Time. A confirmation message will then appear: "Saving Time Config".

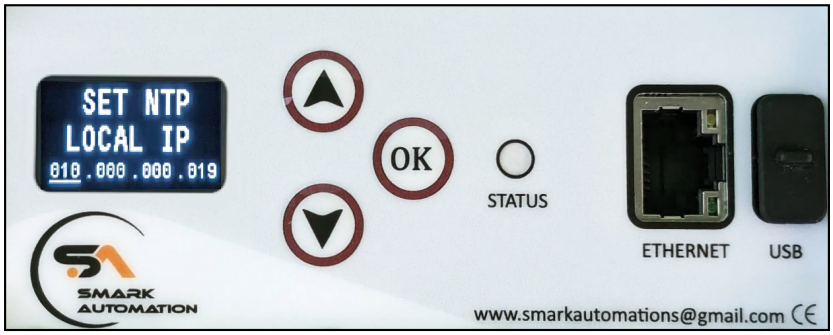


Figure 16: Configuring Local NTP IP

ii) **Set Time:** Select the Set Time option to manually set the time. Follow the below step to set time, date and day:

- **Set time:** The device will prompt the user to enter the hour, minute, and second as shown in Fig 17. Use the up and down arrow keys to adjust the hour, minute, and second. Press OK to confirm selection and move to the next parameter.

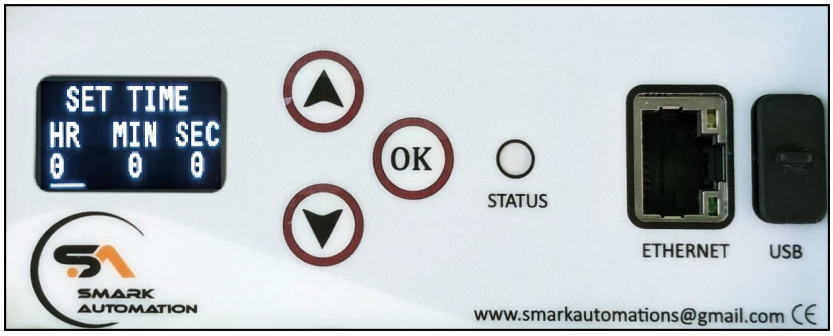


Figure 17: Configuring Time

- **Set date:** User will then be prompted to set the date (date, month, year) as shown in Fig 18. Follow the same procedure as did for setting the time.

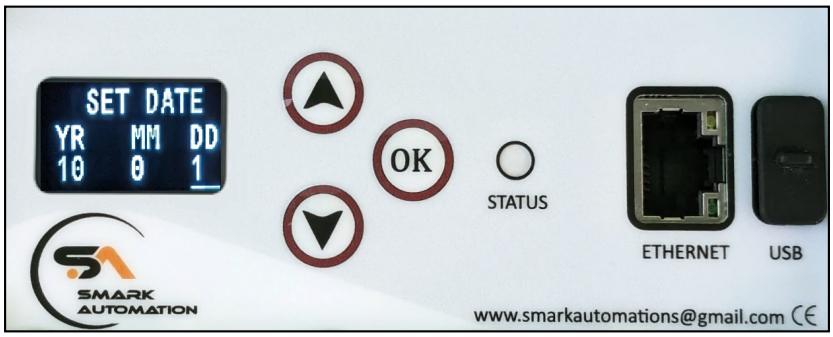


Figure 18: Configuring Date

- **Set Day:** Finally, user will be prompted to enter the day of the week as shown in Fig 19. Adjust using the arrow keys and press OK to confirm.

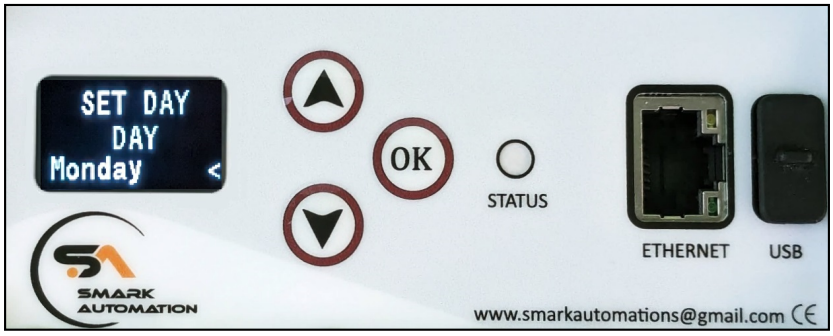


Figure 19: Configuring day

Once user have set the time, date, and day, a confirmation message "Set Time Done" will appear, indicating that all settings have been successfully updated.

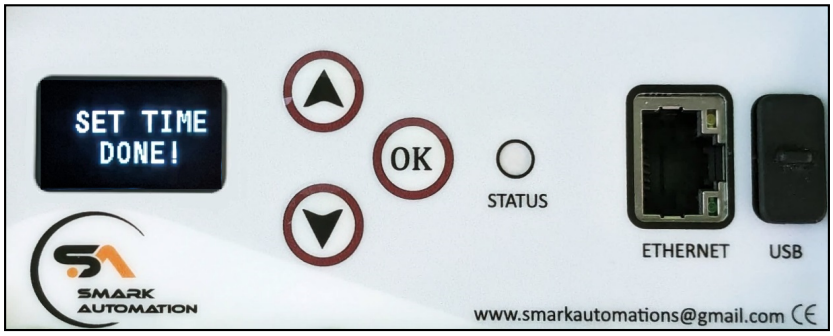


Figure 20: Confirmation message for manually setting the time

3.2 USB Logs

This section explains how to download logs from sensors connected to the device. USB logs allow user to download records related to data from Analog sensors, Temperature sensors and Extension device sensors connected to the system and transferred via USB. Instructions for enabling sensor logging will be discussed in further sections of this document when configuring DAS settings and extension devices.

	Make sure to connect a USB drive with a maximum capacity of 32 GB to the device for downloading logs. USB drives with a capacity larger than 32 GB will not be supported for data logging.

To download the logs, follow these steps:

1. **Connect the USB Drive:** Connect the USB drive to the designated slot on the device.
2. **Navigate to USB Logs:** Access the USB Logs option from the navigation menu.
3. **Enter the Start Date:** After pressing the OK button, user will be prompted to enter the start date (year, month, day), as shown in Fig 21. Fill in all the fields and press OK to proceed to the end date.

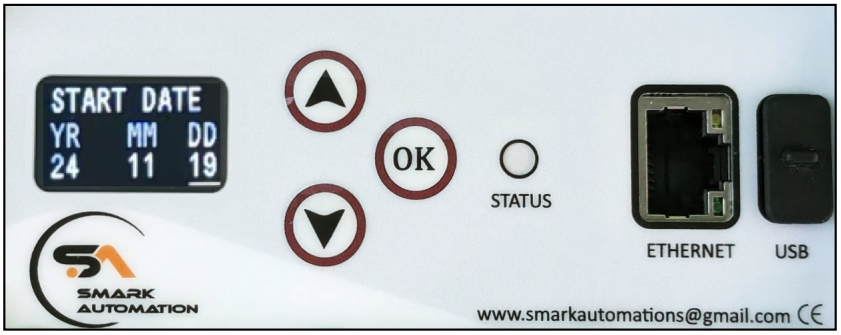


Figure 21: Enter Start Date

4. **Enter the End Date:** For the end date, user can only select dates that are after the start date, with a maximum range of 7 days from the start date. For example, if the start date is set to the 26th, the end date can be selected from the 27th to the 30th or 31st of the same month.

   Once user have selected the end date, press OK. A folder will be created, and an Excel file will be downloaded into that folder. For details on interpreting the Excel file, refer to section 6.

	User can download logs for up to 7 days at a time.

3.3 Show IP

This section explains how to view the IP address of the device. Accessing this information allows the user to determine the network address assigned to the device for communication on the network.

Connect the Ethernet cable to the designated slot on the device. Since the network is configured in DHCP mode, it may take some time to connect. Once connected, the Status Indicator LED will display a solid green colour indicating no error.

To view the IP address and other network details, navigate to the "Show IP" option from the navigation menu. Pressing OK will display the IP address(IP), Gateway (GW), and Subnet (SN) as shown in Fig 22. The IP address displayed here is used to access the local web server. To access the web server, refer to Section 4.1 of the document.

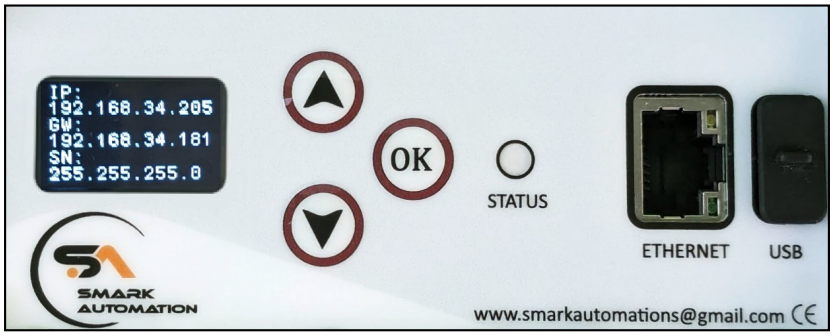


Figure 22: Network Configuration Display

3.4 Set IP

This section explains how to configure device Network Configuration. Choosing between a dynamic or static IP address allows the user to assign a network for more reliable communication.

To Configure the IP, follow these steps:

1. **Access IP Settings:** Navigate to the "Set IP" option from the menu.
2. **Select Network Configuration Type:** User need to choose the type of network configuration for device i.e. either Dynamic or Static as shown in Fig 23. This determines how the device will obtain its IP address and other network settings.

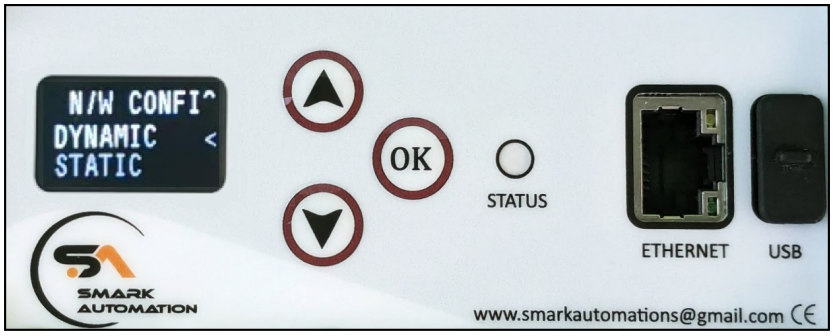


Figure 23: Network Type Configuration

- **Dynamic Configuration:** If "Dynamic" is selected, the device will automatically assigned an IP address and other network settings (such as Gateway and Subnet) from a DHCP (Dynamic Host Configuration Protocol) server on the network. A confirmation message will then appear "DHCP NW Set Restart to Apply".
- **Static IP Configuration:** If "Static" is selected, the user needs to manually enter the IP address, Gateway, and Subnet for the device to configure a fixed IP address.
  1. **Enter IP Address:** The device will first prompt the user to enter the IP address, as shown in Fig 24. Use the up and down arrow keys to adjust each octet of the IP address. Press OK to set the current octet and move to the next one. After setting the fourth octet by pressing OK, the user will be prompted to enter the Subnet.

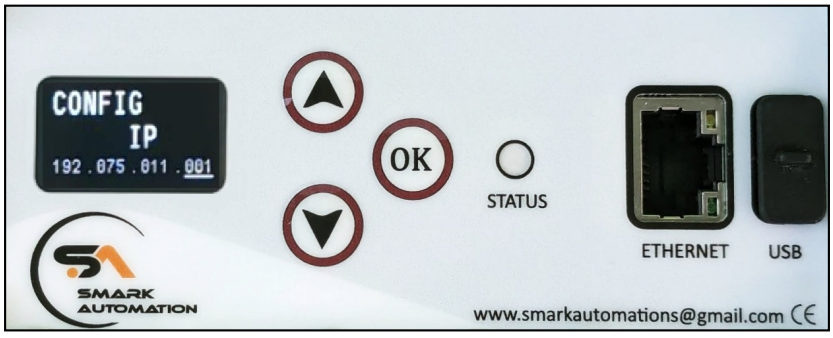


Figure 24: Configuring IP address

  2. **Enter Subnet:** Once the IP address is set, user will be prompted to enter the Subnet, as shown in Fig 25. Follow the same procedure for Configure the IP address to configure the Subnet.

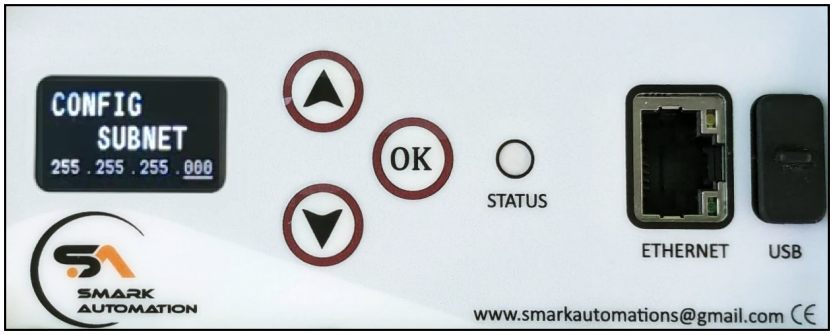


Figure 25: Configuring Subnet

3. **Enter Gateway:** Next, user will be prompted to enter the Gateway, as shown in Fig 26. Once all three parameters are set, a confirmation message will appear: "NW Conf Set Reset Device to Apply".

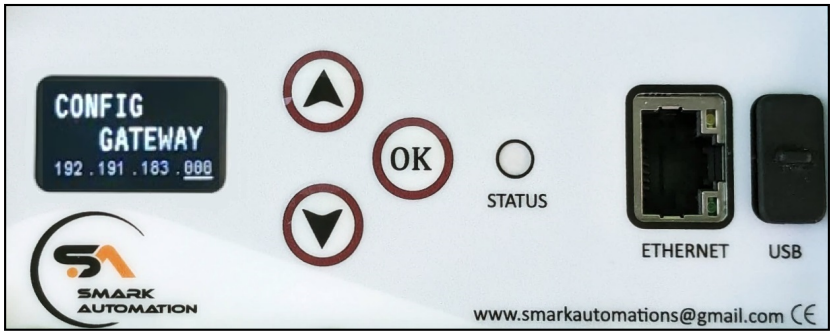


Figure 26: Configuring Gateway

After selecting the network configuration, the user must restart the device to apply the new settings.

Note: Ensure all values are entered correctly to maintain proper network connectivity.

3.5 XT COM CONF

The "XT COM CONF" refers to the client RS485 communication configuration, which connects an external or additional device to the main device. The client RS485 communication configuration enhances the system's capabilities, allowing it to communicate with and log sensor data from the connected sensors. Configuration parameters for XT COM CONF include:

1. **Scan Time:** Set the interval at which the device scans or polls data. This is specified in milliseconds and determines how frequently the device will check for updates or changes.
2. **Baud Rate:** Configure the rate at which data is transmitted between devices. The baud rate is measured in bits per second (bps) and affects the speed of data communication.
3. **Data Bits:** Define the number of data bits in each data frame. Common settings are 7 or 8 data bits.
4. **Stop Bits:** Specify the number of stop bits used to signal the end of a data frame. Common settings are 1 or 2 stop bits.
5. **Parity:** Set the parity checking method to ensure data integrity. Options include:
    - **None:** No parity checking.
    - **Even:** Ensures the number of 1-bits in the data is even.
    - **Odd:** Ensures the number of 1-bits in the data is odd.

To configure the above parameter, follow the below steps:

1. **Access XT COM CONF Menu:** Navigate to the "XT COM CONF" option from the navigation menu. Pressing OK will prompt the user to set the Scan Time as shown in Fig 27.

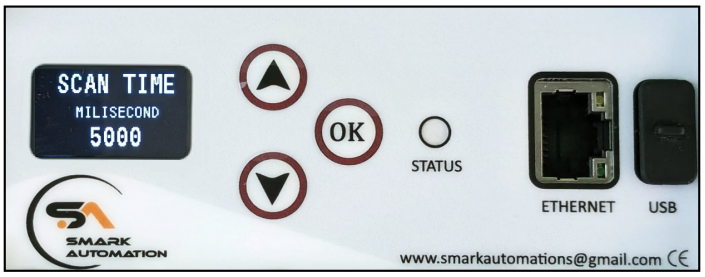


Figure 27: Configuring Scan Time for XT COM CONF

2. **Set Scan Time (ms):** Set the Extension Device Scan Interval, which determines how frequently the main device i.e. SMDAS will check for updates or collect data from connected Extension Devices. The interval can be set between 1000 milliseconds (1 second) and 10000 milliseconds (10 seconds), with the default setting being 5000 milliseconds (5 seconds). Press OK to set the selected scan time and the user will then be prompted to set the Baud rate, as shown in Fig 28.

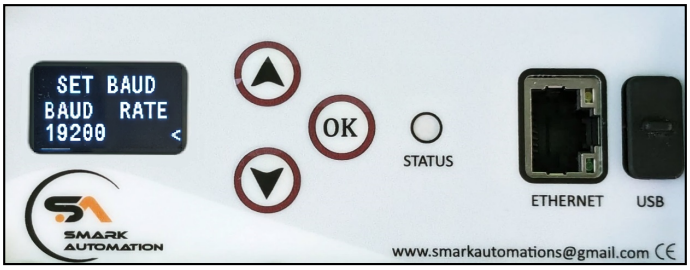


Figure 28: Configuring Baud Rate for XT COM CONF

3. **Select Baud Rate:** Choose the baud rate from the available options. Use the up and down arrow keys to select from the following rates: 4800, 9600, 19200, 57600, and 115200 bits per second (bps) with the default setting being 19200 bps. Press OK to set the selected Baud Rate and the user will then be prompted to set the Data and Stop bit, as shown in Fig 29.

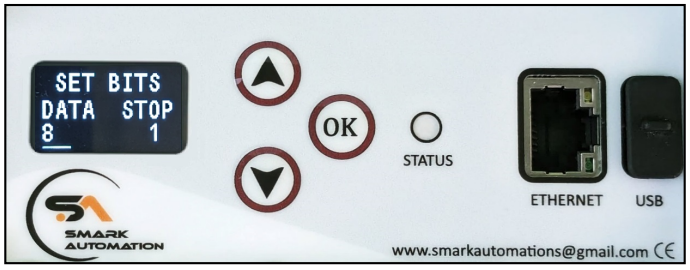


Figure 29: Configuring Data and Stop bit for XT COM CONF

4. **Set Data and Stop Bits:** Configure the number of data bits and stop bits using the up and down arrow keys.

   - **Data Bits:** Set to 8 by default and cannot be changed.
   - **Stop Bits:** The options are 1 or 2, with the default set to 1.

     Press OK to set the selected Data, Stop bits and the user will then be prompted to set the parity, as shown in Fig 30.

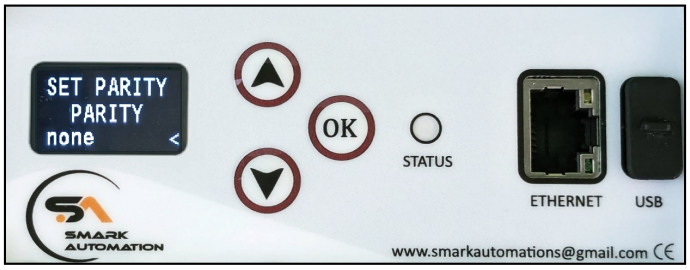


Figure 30: Configuring Parity bit for XT COM CONF

5. **Parity:** Choose the parity from the available options. Use the up and down arrow keys to select from the following rates: none, odd and even with the default setting set to none. Press OK to set the selected Parity bit, a confirmation message will then appear: "Saving XT COM CONF".

3.6 Update FW

Updating the firmware ensures that the device has the latest features, bug fixes, and improvements. Follow these steps to update the firmware:

1. **Connect USB Drive:** Insert the USB drive containing the firmware update into the designated slot on the device.
2. **Access Firmware Update Menu:** Navigate to the "Update FW" option from the menu. Pressing "OK" will initiate the firmware update process. If the USB drive is not connected, an error message stating "NO USB" will be displayed.

3.7 Error List

The Error List provides a summary of any issues or malfunctions that the device has encountered, helping user identify and troubleshoot problems effectively.

To access the Error List, follow this step:

1. **Navigate to Error List Menu:** Go to the "Error List" option from the menu.
2. **View Errors:** Press OK to display the list of errors the device is currently experiencing. If no error is present then it will show No Error msg.

   Possible Errors that may appear in the Error List:

   1. **No Dev Tim:** This error indicates a problem with the device Time. The time is not set for the device which is crucial for data logging.
   2. **XTDev Fail:** This error signifies a failure in connecting or communicating with an extension device (XTDev). Extension devices are additional devices which are connected to enhance the main device functionality.
   3. **Netwrk Err:** This error indicates a network connectivity issue. It suggests that the device is having trouble establishing or maintaining a connection to the network.
   4. **No Intrnet:** This error signifies that the device is unable to connect to the internet. It may be connected to a local network but cannot reach internet resources.
   5. **Memry Full:** This error indicates that the device's memory is full and does not have enough available space to store additional logs.

3.8 Admin

The "Admin" section allows user to manage device settings and security. This includes resetting the device to its initial configuration and changing the device password required to access the "Admin" section.

To access the admin section, follow these steps:

1. **Navigate to Admin:** Select the "Admin" option from the menu.
2. **Enter Device Password:** Press OK to enter the 4-digit device password. **The default password is 0609**. Enter the password to access options for resetting the web credentials and changing the admin section password as shown in Fig 31.

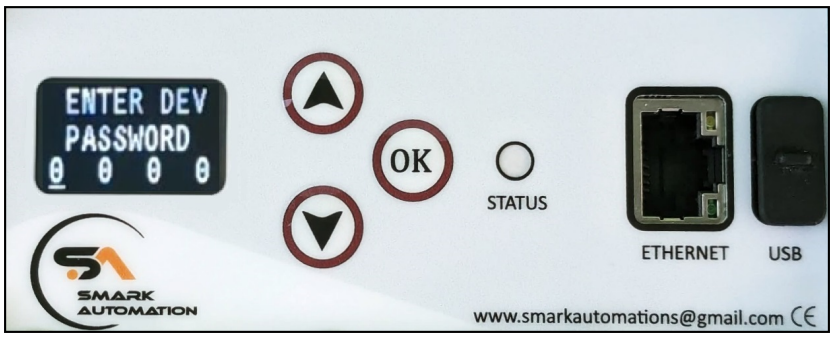


Figure 31: Entering Device Password

3. **Choose an Option:** Two options will appear: "Default" and "Change Pwd" as shown in Fig 32.

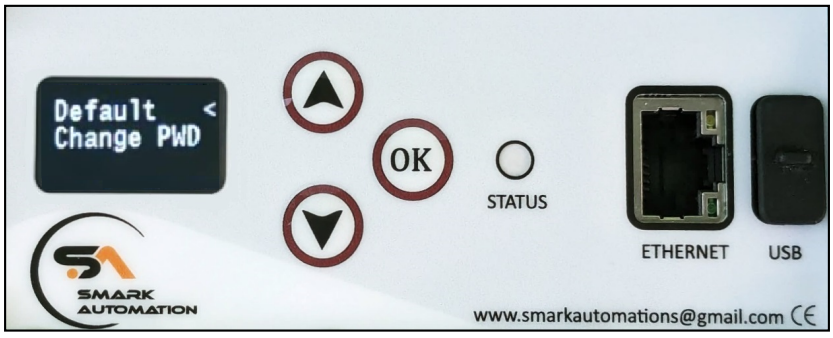


Figure 32: Admin Configuration Menu Option

4. **Select Default:** Selecting "Default", a prompt will appear asking the user to reset the web credentials press OK. After holding OK for 5 seconds, the web credentials will be reset to their default settings. A confirmation message, "Reset Web Credentials" will be displayed, indicating that the credentials have been successfully reset to default.
5. **Select Change Pwd:** Selecting "Change Pwd" will prompt the user to enter a new 4-digit device password. After entering the new password, press OK to set it. A message will appear, "New Dev Password Set" confirming that the new password has been successfully set. The user can then access the "Admin" section using either the default password or the new device password.

4 Local Web Server and its Functionality

A local web server refers to a server hosted on the device itself, accessible within a local network. Unlike web servers hosting publicly, this setup is designed for private use. It allows the device to serve web pages locally over Ethernet, enabling applications such as monitoring, controlling, downloading logs etc within a closed environment.

4.1 Logging into the System

To log into the system, follow these steps:

1. **Connect the Device via Ethernet Cable:** Connect the device to the network using an Ethernet cable and wait until the network connection is established. If the device is configured in DHCP mode, it may take some time to establish a connection to the network.
2. **Check the Device IP Address:** Navigate to the OLED screen menu and select "Show IP" to display the device current IP address. For example, the IP address displayed is 192.168.1.40.
3. **Access the Device via Browser:** Open a web browser(e.g., Google Chrome, Microsoft Edge) on a computer, enter the IP address exactly as shown on the OLED screen into the address bar, and then press Enter to navigate to the device interface. A page will then open, as shown in Fig 33.

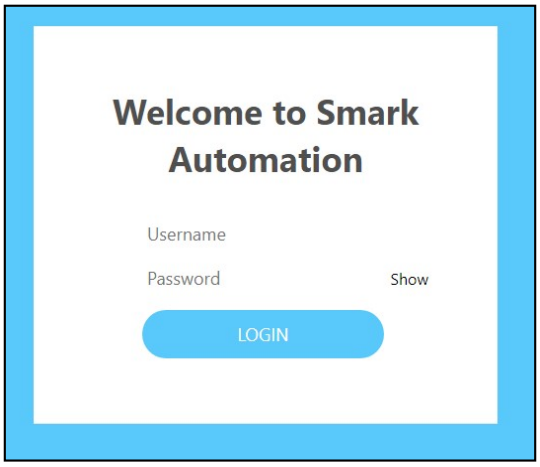


Figure 33: Login Page

4. **Login Information:**

   Enter the following credentials to log into the system:

   Username: admin

   Password: admin

   Click on the LOGIN button to access the device. Upon successful login, a Dashboard page will be displayed confirming access to the device.

4.2 Exploring the Dashboard Page Interface

This section focuses on the dashboard page interface as shown in Fig 34, which is designed to offer user a comprehensive view of device status and sensor data. The key features of the dashboard include:

- **Navigation Menu and Logout Button:** Allows navigation to different pages and facilitates logout.
- **Digital Outputs:** Displays the current state (ON/OFF) of individual pins, providing the operational status of the device.
- **Analog Readings:** Provides real-time values of Analog sensors. This feature facilitates precise monitoring of sensor data, adhering to unit configurations and naming conventions.

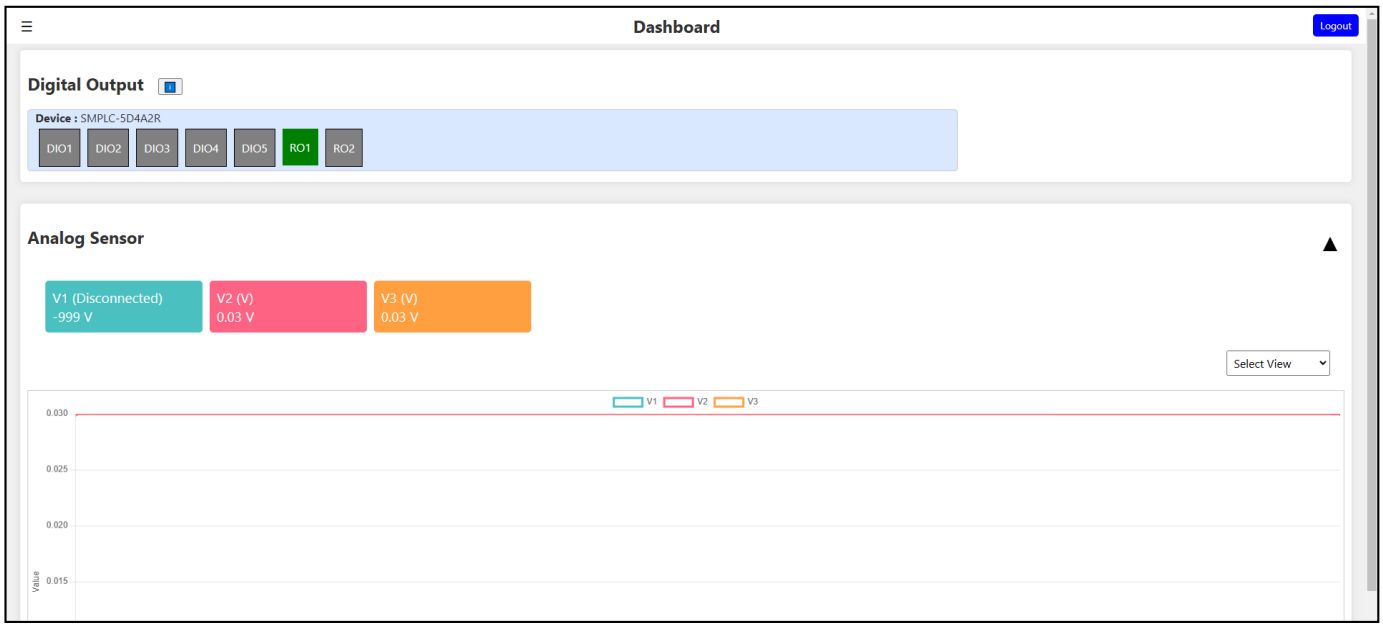


Figure 34: Dashboard Page

4.2.1 Menu and Logout Button

The menu and logout buttons are positioned in the upper corners of the dashboard page as shown in Fig 35, for easy access and consistency across different pages.

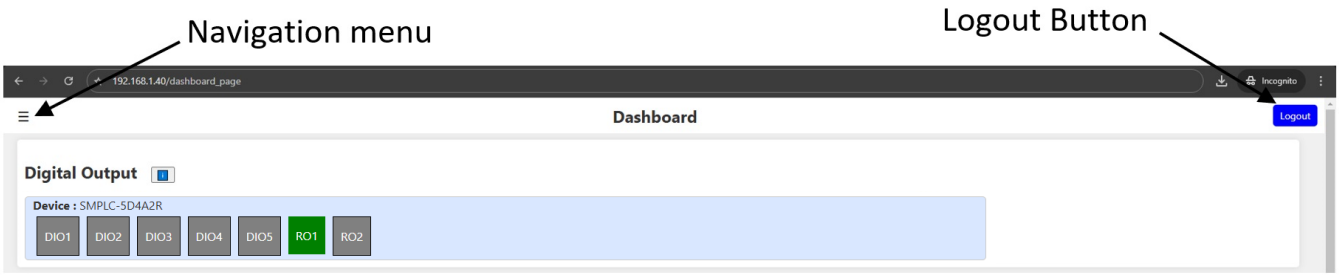


Figure 35: Top Navigation Bar

- **Navigation Menu:** The menu provides options for exploring different device settings. Clicking on the Navigation Menu opens a dropdown list of options, as shown in Fig 36, enabling user to navigate to various pages by selecting them.

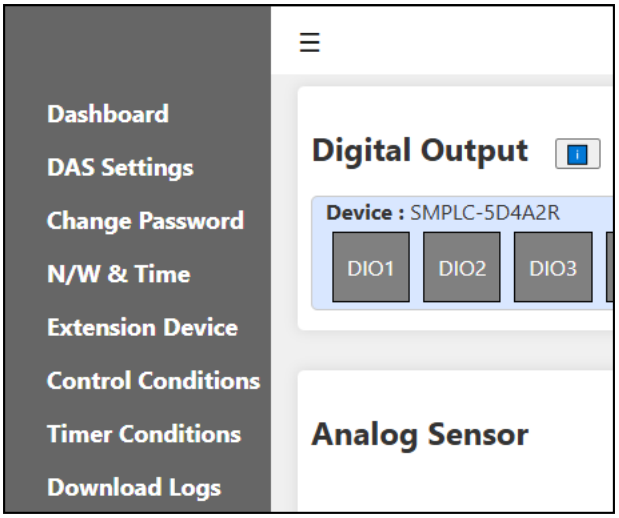


Figure 36: Navigation Menu Options

- **Logout:** This button allows user to securely log out from their current session.

4.2.2 Digital Output, Analog Sensor

Digital Output: The Digital output section represents the status of digital pins along with their respective device name. Each pin is clearly labelled to indicate whether it is currently activated (ON) or deactivated (OFF). Activated (ON) pins are highlighted in green, while deactivated (OFF) pins are shown in grey. For example, in Fig 37, for Device SMPLC-5D4A2R, RO1 is displayed as ON in green, while the others are shown as OFF in grey.

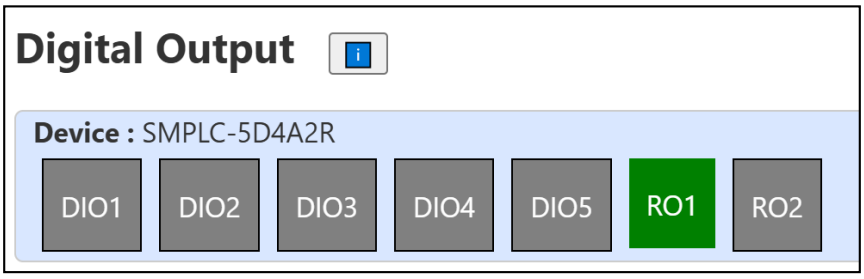


Figure 37: Status of Digital Pins for Device SMPLC-5D4A2R

User can add and configure additional devices, digital and relay pins as required, with detailed instructions provided in further documentation.

Analog Sensor: The Analog sensor section displays live readings captured by the sensors, including their names, units, and corresponding readings shown graphically with the date and time. Figure 38 shows three sensors: one with a "Disconnected" status and the other two with their respective readings and units. The "Disconnected" status appears only when the sensor type is set to 4-20 mA. The sensor type selection is discussed in section 4.4, where DAS settings configuration is covered.

Figure 38: Status of Analog Sensor

User can view readings by hovering over the graph, as demonstrated in Fig 39. Hovering over a specific point will display the reading for that time along with its unit. Additionally, user can hide the plotting of a specific sensor reading by clicking on the coloured box with the sensor name located at the top middle of the graph.

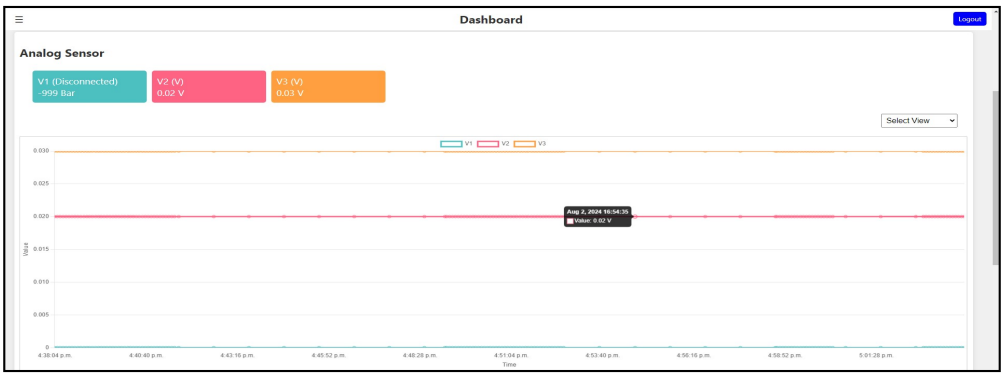


Figure 39: Hovering to View Readings

In the top right corner of the graph, there is a drop-down menu (Fig 40). User can select options from this menu to modify the graph's appearance:

- **Reset View:** Displays the graph from the start of plotting (i.e., when the page was loaded) to the current time.
- **Last 5 Minutes:** Shows data from the last 5 minutes of the plot.
- **Last 10 Minutes:** Shows data from the last 10 minutes of the plot.

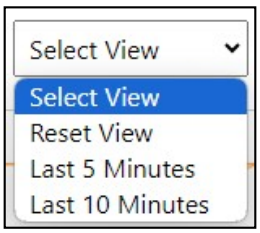


Figure 40: Drop-Down Menu for Graph Appearance

The graph displayed above will only be visible when the PC has an active internet connection. For offline scenarios, it will appear as shown in Fig 41. Even in offline mode, hovering over the graph will display the timestamp, sensor reading, and its unit. However, user will be unable to zoom in or out or access a dropdown to show data for only the last 5 or 10 minutes. Additionally, a checkbox is provided to hide the readings from specific sensors.

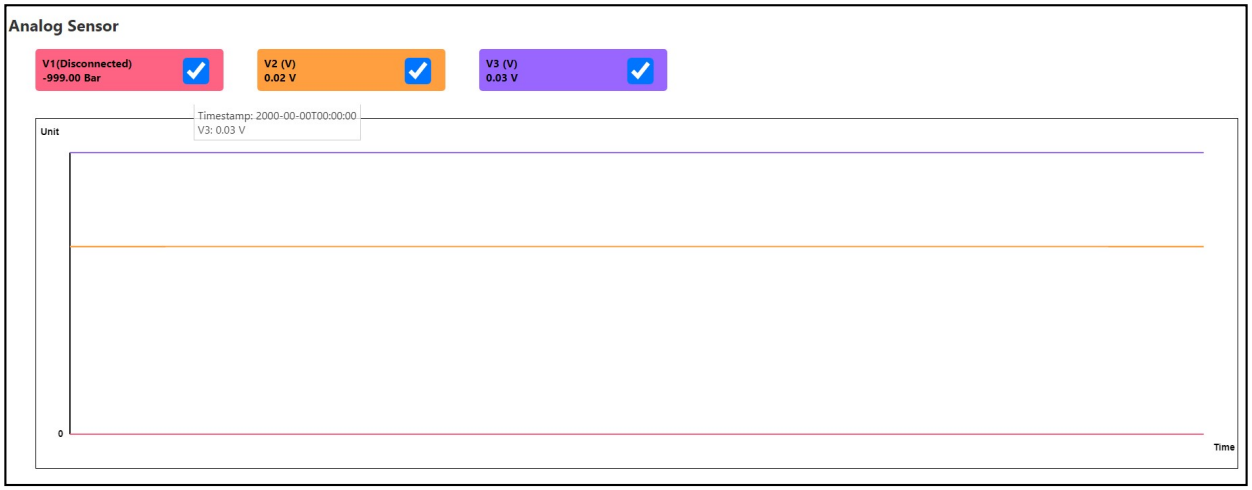


Figure 41: Offline Graph View

	Refreshing the page will erase all readings plotted on the graph, regardless of whether the internet connection is active or not.

4.3 Change Device Password

When a user log in for the first time, user have the option to either update their password for security reasons or retain the current one. To update the password, follow these steps:

1. **Navigate to Page:** Navigate to the "Change Password" page from the navigation menu. The page will open as shown in Fig 42.

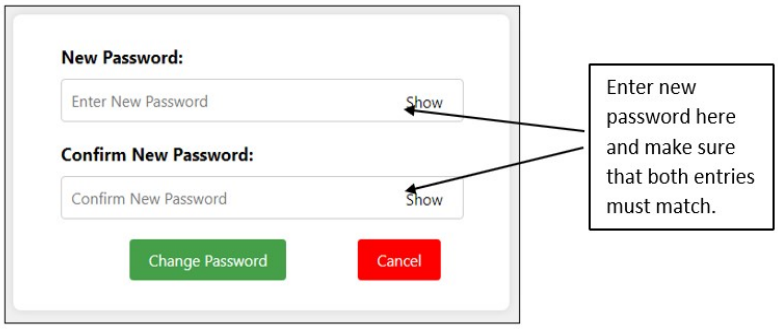


Figure 42: Change Password Page

2. **Enter New Password:** Enter the new password in both the "New Password" and "Confirm New Password" textboxes. Ensure that both passwords match. To view the entered password, click the "Show" button.

3. **Update Password:** Click the "Change Password" button to proceed with the password update.

4. **Confirmation:** After updating, a confirmation message will appear (refer to Fig 43) indicating that the password has been updated successfully. The user will be automatically redirected to the login page to log in using the new credentials. If any other message appears or if the user is not redirected to the login page, follow the instructions provided in that message.

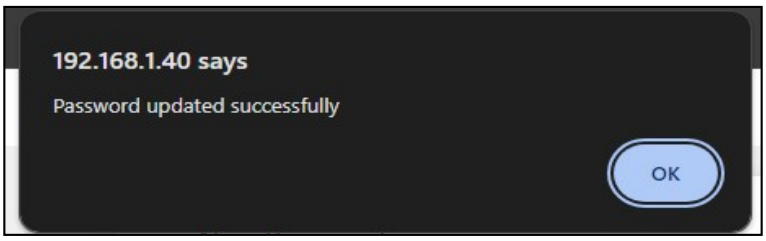


Figure 43: Password Updated Confirmation

4.4 Configure Device Setting

In this section, User will configure the necessary settings for Analog sensors, as well as set up the RS485 communication interface to operate in both server mode. Once user have updated the password and logged in with the new credentials, navigate to the DAS Settings from the Navigation menu. This will open the Settings page (refer to Fig 44), where settings such as data logging intervals, RS485 configurations and settings for Analog sensors can be configured.

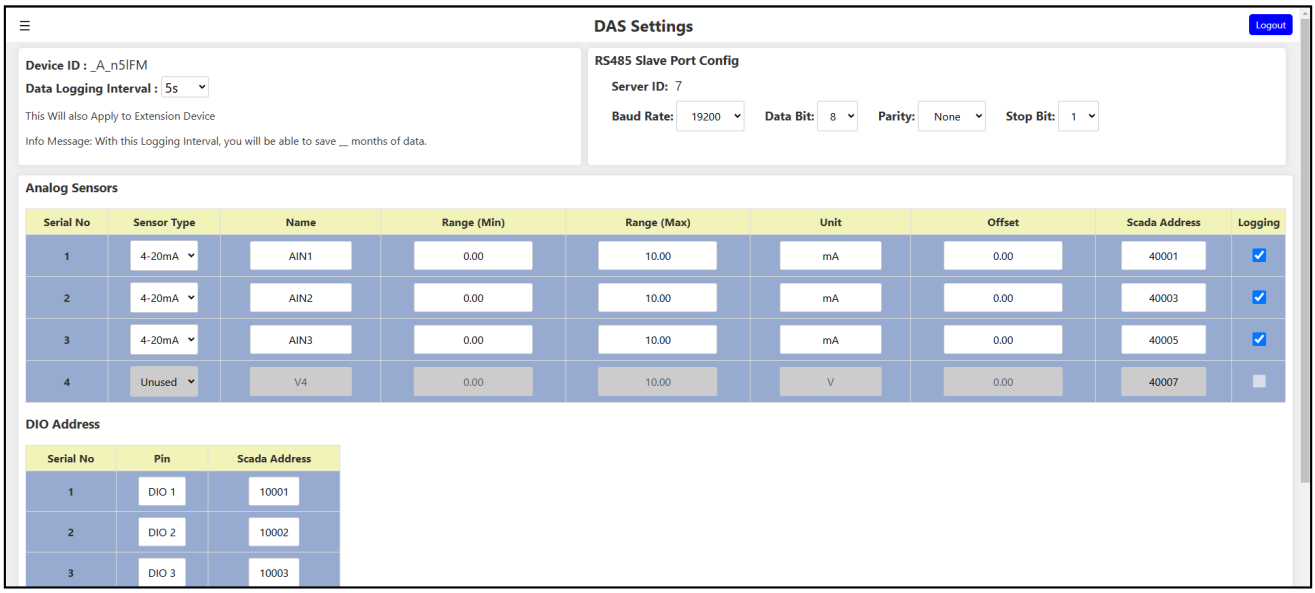


Figure 44: DAS Setting Page

4.4.1 Device ID and Data Logging Interval

Device ID: All devices come with a factory-programmed unique device ID. This ID will be useful when adding the device to our remote monitoring platform, as it ensures that the device can be easily identified and differentiated from other devices within the system.

Data Logging Interval: The data logging interval refers to the time period between successive data recording events or measurements taken by the system. This interval determines how frequently the device records and stores data.
To set the data logging interval, follow these steps:

1. Navigate to the drop-down menu as shown in Fig 45.
2. Choose your preferred option from the available selections.

The selected data logging interval will be applied to both the main device and any connected extension devices. For instructions on adding extension devices, please refer to the section 4.6 of the document.

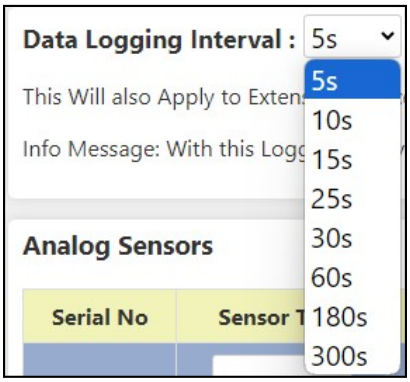


Figure 45: Drop-Down menu for Data Logging Interval

Below is the table showing the number of months of data that can be stored in the device according to the logging interval and the sensors being logged.

Logging Interval	Sensor Set for Logging	Number of Months
5s	4	≈ 16 Months
	2	≈ 29 Months
30s	4	≈ 98 Months
	2	≈ 175 Months
60s	4	≈ 197 Months
	2	≈ 351 Months

Table 2: Data Storage Duration by Logging Interval and Sensor Set

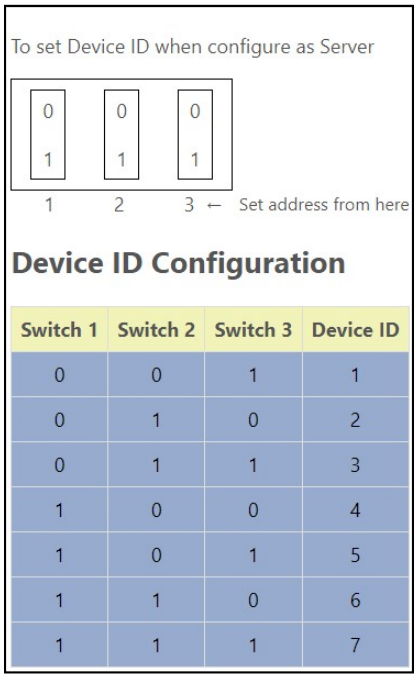
4.4.2 RS485 Configuration

In this section, the user configures the RS485 Server (Slave) Address along with its associated parameters, including Baud Rate, Data Bits, Parity, and Stop Bits, to establish a reliable communication connection. The device has two ports for RS485 communication: Client (Master) and Server (Slave). This section focuses on configuring the Server (Slave) port.

Server (Slave): In this mode, the port is set to Server mode, where the device functions as a slave. It responds to commands and data requests from SCADA systems or other Modbus masters. The device processes incoming data and executes actions based on the instructions received from the master device.

Setting the Slave Address

- The Slave Address is configured by adjusting switches from right (position 3) to left (position 1).
- Move a switch downwards to set it to ON or upwards to set it to OFF.
- Refer to Fig 46 for a combination table illustrating how to set the Slave ID switches.



Device ID Configuration

Switch 1	Switch 2	Switch 3	Device ID
0	0	1	1
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	5
1	1	0	6
1	1	1	7

Figure 46: Slave ID Switch Configuration

Setting RS485 Parameters for Server(Slave)
Once the mode is selected, configuring RS485 parameters is essential to ensure effective communication between devices. To achieve RS485 communication, the following parameters must be configured:

1. **Baud Rate:** The baud rate specifies the speed of data transmission on the RS485 network. The available options in the dropdown are 4800, 9600, 19200, 57600 and 115200 bits per second (bps).

2. **Data Bits:** Data bits specify the number of bits used for each character of data transmission. The standard option provided is 8 bits per character.

3. **Parity:** Parity adds an additional bit to the data character for error detection. The available options in the dropdown are no parity, even parity and odd parity.

4. **Stop Bits:** Stop bits indicate the end of a data character and help synchronize data transmission. The available options in the dropdown are 1 and 2 bits.

Ensure that each parameter is set according to the specific needs of the RS485 network to ensure reliable connection and accurate data transmission between devices.

4.4.3 Configure Analog Sensor

When configuring Analog sensors, it is crucial to accurately record and capture live sensor readings to ensure reliable operation and precise data acquisition. To achieve this, the following parameters need to be identified correctly:

1. **Sensor Type:** This parameter refers to the specific type of sensor that the user has connected to the device. It specifies that only certain types of sensors can be connected to the device.

2. **Range Min and Max:** Define the minimum and maximum values that the sensor can accurately measure. This parameter ensures that readings fall within a specified range to avoid sensor saturation or inaccuracies.

3. **Offset:** This parameter refers to any necessary offset adjustment applied to the sensor readings to correct for systematic errors or to align sensor outputs with expected values.

Once the above parameters are determined, follow the steps below to configure the Analog sensor connected to the AI1 slot of the device. Repeat the same steps for the Analog sensor connected to other slots.

1. **Sensor Type:** Choose the sensor type from the dropdown menu, as illustrated in Fig 47. Selecting "Unused" will disable all parameters for that row.

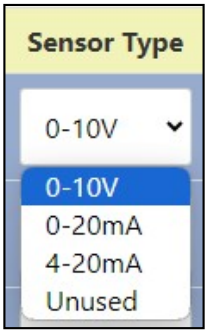


Figure 47: Dropdown Menu for Selecting Analog Sensor Type

2. **Name:** Enter a unique name to identify the sensor. The name should be no longer than 7 characters.

3. **Min and Max Range:** Define the operational range. The minimum range can extend down to -2048, and the maximum range can reach up to 2047. Adjust these values as necessary if the sensor requires a wider range, then update the unit accordingly.

4. **Unit:** Specify the unit of measurement for the sensor data. The unit is limited to 3 characters.

5. **Offset:** The offset is a value added to or subtracted from the raw sensor data to correct or calibrate the readings. Enter the offset value if needed to adjust sensor readings.

6. **SCADA Address:** This unique address is used by the SCADA system, or when the device is configured as a slave, to access real-time analog sensor readings. The user needs to enter the SCADA address of the sensor when requesting from the master device to read or write values into the slave (SMPLC device).This field is not editable, so the address remains fixed.

7. **Logging:** Enable logging to record Analog sensor values for subsequent analysis and historical data retrieval.

After configuring all the Analog sensors, the interface will display as shown in Fig 48. In the image, three sensors are configured with their parameters set, while the remaining three sensors are marked as "Unused." This indicates that only the selected sensor data is displayed and recorded by the device.

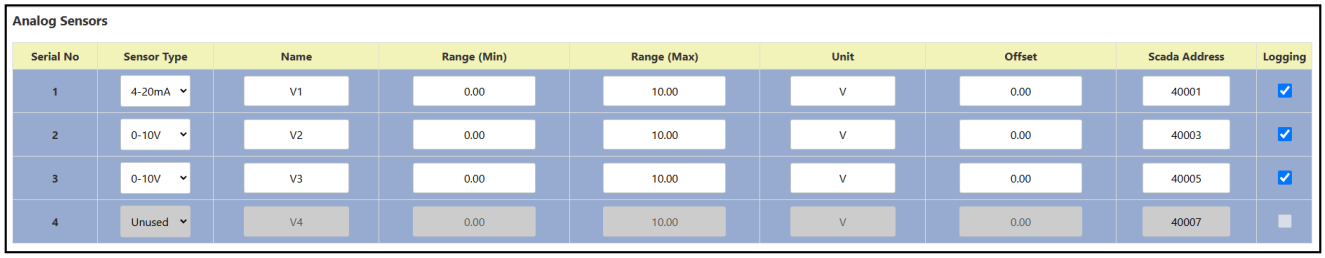


Figure 48: Analog sensor Configuration

Below the Analog Sensor Configuration, the Digital Input/Output (DIO) pins, Relay Output pins, and their respective SCADA addresses are provided. These addresses enable access to the DIO pins through SCADA or a master device.

After configuring all settings, including Data logging interval, RS485 Communication, Analog settings, it's time to save them all by clicking on the Save button located at the bottom right corner of the page. Clicking on it will display a message DAS Setting saved successfully.

4.5 Network and Time Configuration

This section is dedicated to configuring network and time settings, which are essential for the synchronization and reliable operation of the device. In this section, user will configure the following settings:

- Setting up network parameters, such as choosing between Static or DHCP. If Static selected, configuring IP addresses, subnet masks and gateway settings.
- Synchronizing system clocks with network time servers to ensure accurate timestamps and enable precise event logging.

Navigate to the "Network and Time" page from the navigation menu. When the page opens, it will appear as shown in Fig 49, which includes three sections:

1. **Connection Details:** Shows the current connection details i.e. IP address, Subnet, Gateway and MAC ID.
2. **Time Configuration:** Allows setting time manually or synchronizing with NTP (Network Time Protocol).
3. **IP Configuration:** Allows selecting between Static or DHCP for IP address configuration.

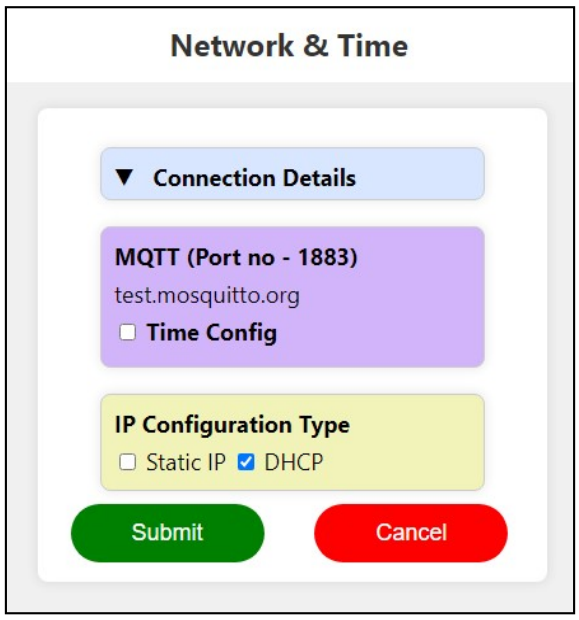


Figure 49: Network and Time Configuration Page

Note: The MQTT server name field is currently non-editable, preventing user from entering a MQTT server name.

4.5.1 Connection Details

The "Connection Details" section provides vital information about the current network configuration of the device. Clicking on Connection Details will display all relevant details as illustrated in Fig 50. This includes:

- **IP Address:** A unique identifier assigned to the device on the network.
- **Subnet:** Defines the range of IP addresses that the device's network belongs to.
- **Gateway:** Specifies the IP address of the gateway device connecting the local network to external networks.
- **MAC ID:** Also referred to as the MAC address, this alphanumeric code uniquely identifies the device's network interface card (NIC).

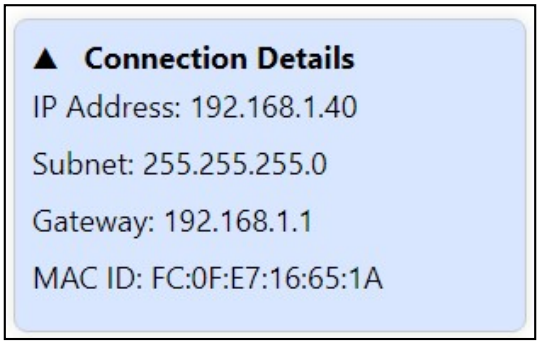


Figure 50: Network Connection Details

4.5.2 Time Configuration

In the "Time Configuration" section, user can manage and synchronize the system clock of the device, which is essential for maintaining accurate timestamps and ensuring precise event logging. Clicking on "Time Config" presents two choices:

1. **Set Time Manually:** Selecting this option allows the user to adjust the device time and date manually according to local requirements. Upon selection, user are prompted to enter their preferred time and date settings, as shown in Fig 51.

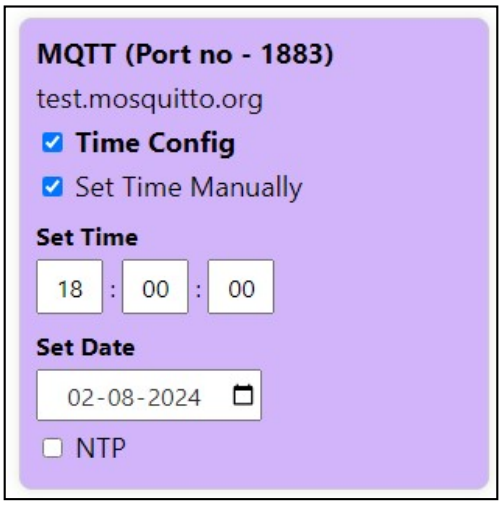


Figure 51: Set Time Manually

2. **NTP (Network Time Protocol):** Selecting this option enables the device clock to synchronize automatically with NTP servers. Upon selection, the user can set the Time Shift (i.e., Time Zone) and choose between a local NTP server by entering local NTP server IP or an Internet NTP server, for which no IP is required, as shown in Fig 52.

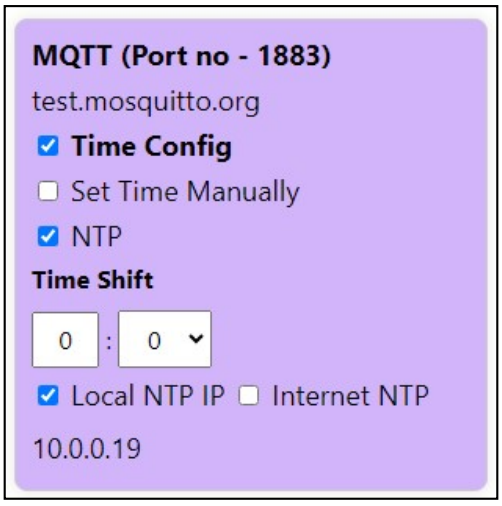


Figure 52: Set NTP Time

4.5.3 IP Configuration

In the "IP Configuration" section, user manage and set the network parameters of the device, which include configuring the IP address, subnet mask and gateway. User have two options to choose from:

1. **Static IP:** Selecting this option allows user to manually assign fixed network settings to ensure consistent connectivity and access. User enter an IP address, subnet mask and gateway according to their specific requirements. It is crucial to enter the correct format for the IP address, subnet mask and gateway. Entering an incorrect format will display an error message on the screen. Refer to Fig 53 for an example of Static IP Configuration.

	We strongly recommend using a static IP address for the device to ensure reliable access to its webserver and to enable a connection to SCADA with a fixed IP address.

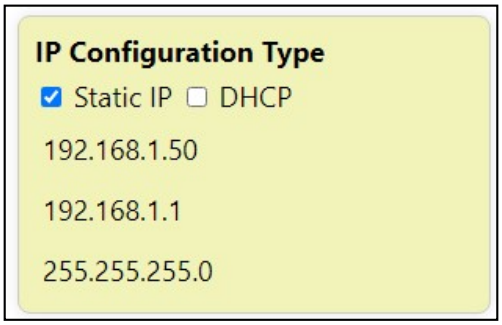


Figure 53: Static IP Configuration

2. **DHCP (Dynamic Host Configuration Protocol):** Selecting this option enables the automatic assignment of IP addresses and network configuration settings by a DHCP server on the network. DHCP is suitable for environments where devices connect automatically and are assigned dynamic IP addresses without manual intervention. This is useful when the user does not want to use the webserver functionality and simply wants to send data to online monitoring.

4.5.4 Saving Network and Time Configuration

After configuring all network and time configuration, click on the "Save" button. A popup window will appear (refer to Fig 54), prompting the user to choose between "Yes" or "No" to restart and connect the device with the new network configuration entered.

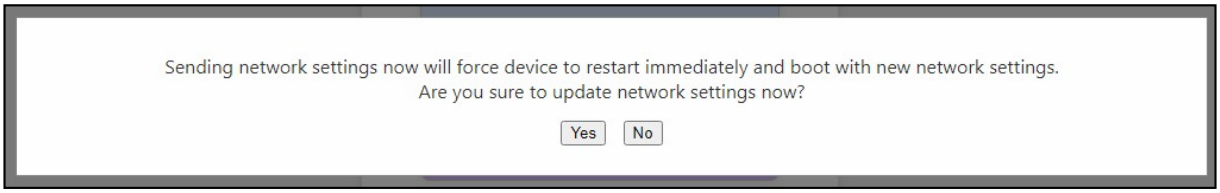


Figure 54: Popup Window

- Selecting "No" will close the popup window without saving the entered network and time configuration.
- Selecting "Yes" will display a page indicating that the device is restarting and connecting to the new network configuration. After the restart, wait until the status indicator displays a solid green LED, confirming a successful network connection. Then, use the updated IP address to access the local web server.

Note: If only the time configuration is modified, a message stating "Time Updated Successfully" will appear and the device will not restart.

4.6 Extension Device

This section explains how to configure Extension Devices, which is used to connect multiple devices to the main device for purposes such as data logging or expanding functionality. In this section, we will configure the following settings:

- **Extension Device Scan Interval:** This setting determines how frequently the main device checks for data from the Extension Devices.
- **Extension Device RS485 Parameter:** This setting determines the configuration of RS485 Client parameters, which is essential to ensure effective communication between devices.
- **Adding an Extension Device:** This process involves integrating additional devices with the main device. This step is essential for expanding the Device functionality or increasing the number of devices being monitored or controlled.
- **Configure the Added Extension Device Settings:** Once an Extension Device is added, the user needs to configure its specific settings to ensure proper operation. This includes adjusting parameters for sensors connected to the Extension Device.

To configure an Extension Device, navigate to the "Extension Device" page from the navigation menu. When the page opens, it will be displayed as shown in Fig 55.

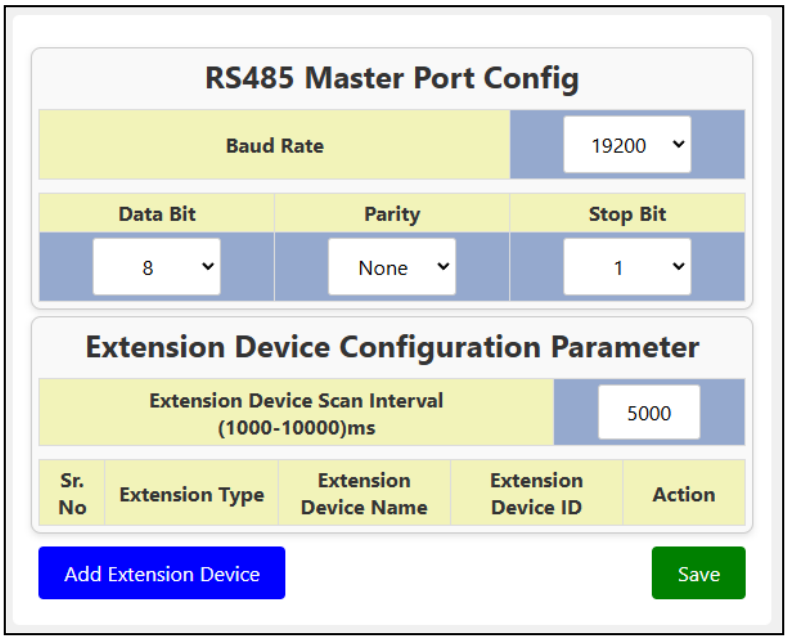


Figure 55: Extension Device page

4.6.1 Extension Device RS485 Parameter:

Configuring RS485 parameters is essential to ensure effective communication between devices. To establish RS485 communication, the following parameters must be configured:

1. **Baud Rate:** The baud rate specifies the speed of data transmission on the RS485 network. The available options in the dropdown are 4800, 9600, 19200, 57600 and 115200 bits per second (bps).
2. **Data Bits:** Data bits specify the number of bits used for each character of data transmission. The standard option provided is 8 bits per character.
3. **Parity:** Parity adds an additional bit to the data character for error detection. The available options in the dropdown are no parity, even parity and odd parity.
4. **Stop Bits:** Stop bits indicate the end of a data character and help synchronize data transmission. The available options in the dropdown are 1 and 2 bits.

Ensure that each parameter is set according to the specific requirements of the RS485 Client network to guarantee a reliable connection and accurate data transmission between devices.

4.6.2 Extension Device Scan Interval

The Extension Device Scan Interval determines how frequently the main device checks for updates or collects data from connected Extension Devices. This interval can be set between 1000 milliseconds (1 second) and 10000 milliseconds (10 seconds). To adjust this setting, enter a value within the specified range as illustrated in Fig 56.

Figure 56: Extension Device Scan Interval

4.6.3 Add Extension Device

To add an Extension Device, follow these steps:

1. **Initiate the Addition Process:** Click on the "Add Extension Device" button. This action will insert a new row into the table displayed on the page, where the user will input the details for the Extension Device. If the user needs to add multiple extension devices, click the button as many times as necessary. Note that a maximum of 6 devices can be added.

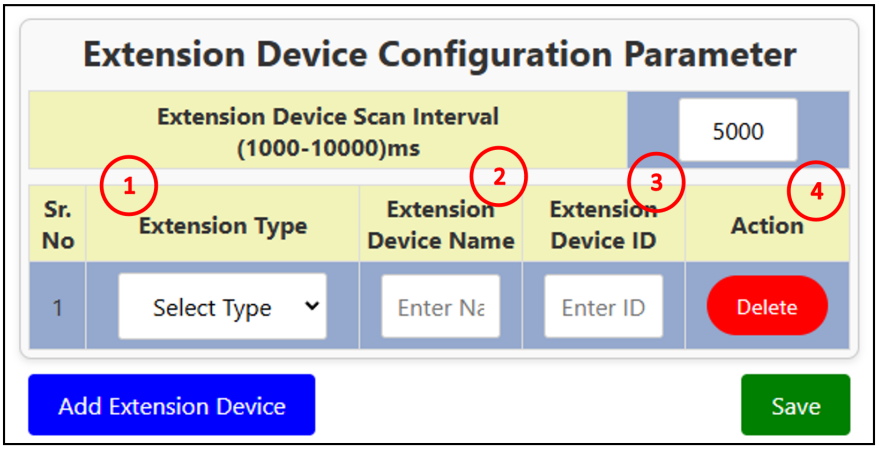


Figure 57: Adding Extension Devices

2. **Enter Device Details:** In the newly added row, input the following details for the Extension Device:

    1. **Extension Type:** Select the type of device from the dropdown menu (e.g., SMXT-12D4A, Custom) as shown in Fig 58. This selection ensures that the system recognizes and configures the specific model or type of the Extension Device.
        - **SMXT-12D4A:** The "SMXT-12D4A" is a device manufactured by Smark Automation. When selected, the system automatically configures the device and recognizes all necessary data points without the need for manual input of datapoints.
        - **Custom:** The "Custom" option allows the user to select a device that is not manufactured by Smark Automation. In this case, the user will need to manually add the required datapoints to ensure that the system can recognize and operate with the custom device correctly. Examples of custom devices include energy meters, flow meters, etc.

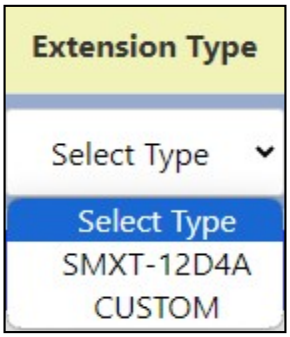


Figure 58: Dropdown Menu for Selecting Extension Type

    2. **Extension Device Name:** Assign a name that clearly describes its function or role for easy identification. The name should not exceed 8 characters.
    3. **Extension Device ID:** Assign a unique ID to the Extension Device to ensure it is properly identified and to avoid conflicts with other Extension devices. This unique ID represents the slave ID set for that particular device. The ID must fall within the following ranges:

SMXT-12D4A Devices: IDs should be between 1 and 7.

Custom Devices: IDs should be between 1 and 9.

4. **Action:** To delete the Extension Device, click on the "Delete" button located in this column. Additionally, after saving the configuration, a "Setting" button will appear below the delete button. Use this "Setting" button to access and modify the settings for that particular Extension Device.

3. **Save the Configuration:** After entering all the necessary details, click the "Save" button. A confirmation message will appear stating "Devices Saved Successfully" indicating that the configuration has been saved.

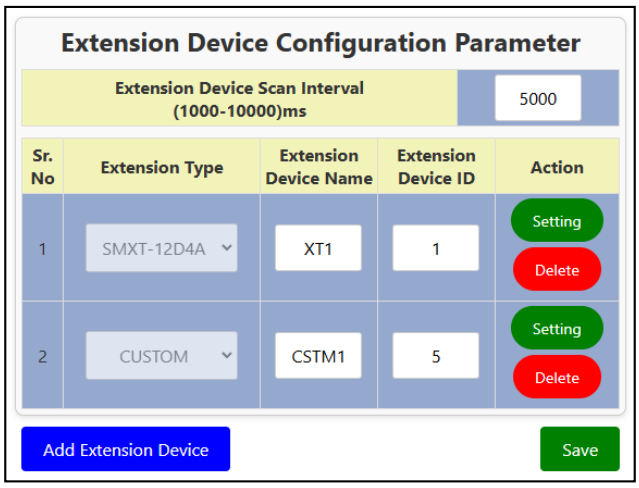


Figure 59: Added Extension Device

4.6.4 Configure Added Extension Device Settings

After adding an Extension Device, the user needs to configure its settings to ensure it operates correctly. Follow these steps to adjust the settings:

1. **Click on the "Settings" Button:** Click on the "Settings" button in the Action column to access the configuration options for the Extension Device. Once the settings page opens, user will see details at the top of the page, including the Device Type, Name, ID and logging interval.

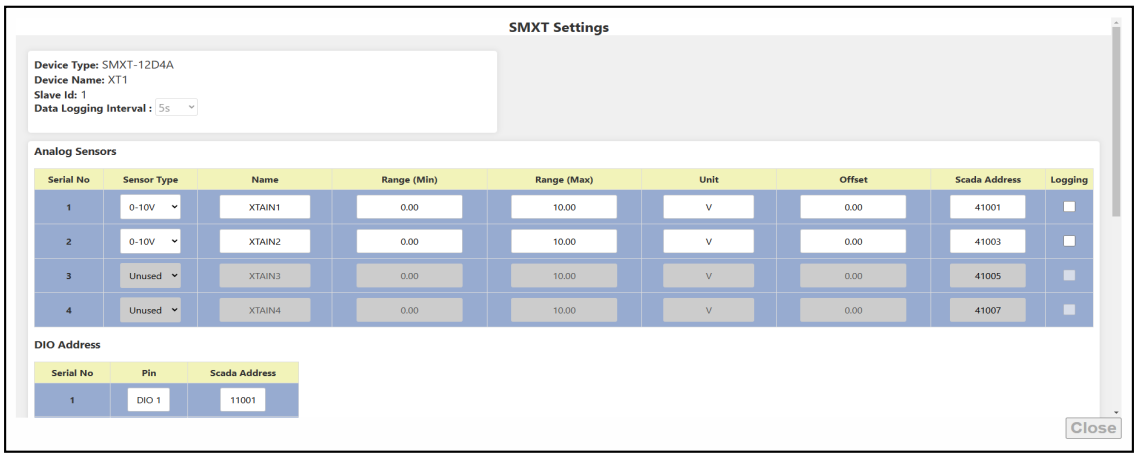


Figure 60: Setting of Device SMXT-12D4A

2. **Configure According to Extension Type:** The configuration process varies depending on the type of Extension Device.

    1. **SMXT-12D4A Device:** For the SMXT device, configuring the extension sensor is similar to configuring DAS Sensors, with the primary difference being that only 4 Analog sensors need to be configured, as illustrated in Fig 60. Additionally, below the Analog sensors, there are 12 digital I/O pins listed with their names and SCADA addresses. For instructions on configuring Analog sensors, refer to the DAS Settings section 4.4.
    2. **Custom Device:** For configuring a Custom Device, user need to manually add each sensor by clicking on "Add Datapoints". Note that a maximum of 15 datapoints can be added.

Figure 61: Custom Device Page

Clicking on Add Datapoint button will insert a new row where user input the following parameters:

1. **Use as I/P:** Enable this option if the datapoint is intended to function as an input. By checking this box, the datapoint will be assigned as an input in the control condition, which can then be used to trigger an output based on the reading of the datapoint.
2. **Name:** Enter a name for the datapoint that describes its function or the type of data it measures. The name should be no longer than 7 characters.
3. **Modbus Register Type:** Select the appropriate Modbus register type from the dropdown menu (as shown in Fig 62), which defines how the sensor data is structured. The options include:
    - **Holding Register:** For read/write data.
    - **Input Register:** For read-only data.
    - **Coil Register:** For binary data or control functions.

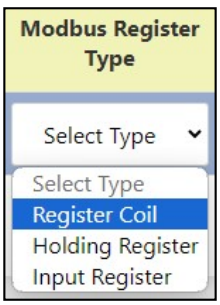


Figure 62: Drop Down menu for Modbus Register Type selection

4. **Modbus Address:** Enter the Modbus register address where the datapoint data is stored. Ensure that to input a 5- or 3-digit address to allow accurate data reading.
5. **Register Length:** The register length is automatically set based on the type of Modbus register. For Holding and Input Registers, the length is 2, while for Coil Registers, the length is 1.
6. **SCADA Address:** This field will automatically assign an address for the SCADA system based on the Modbus address. This address is used to access and display the datapoint data within the SCADA interface. This field is not editable.
7. **Datatype:** Specify the type of data the sensor provides, such as integer or float. The datatype determines how the data is interpreted and presented.
8. **Value:** This field displays the live reading from the sensor, providing real-time data. This field is not editable.
9. **Logging:** Enable this option if wish to record the sensor's data for later analysis and historical data retrieval.
10. **Action:** To remove the sensor, click the "Delete" button in this column. This will remove the sensor from the configuration.

After configuring all the sensors, the interface will display as shown in Fig 63. Additionally, the sensor's live data will appear in the Value column if the custom device is connected to the device. User can also view real-time data for both SMXT and Custom Devices on the dashboard page for comprehensive monitoring and analysis.

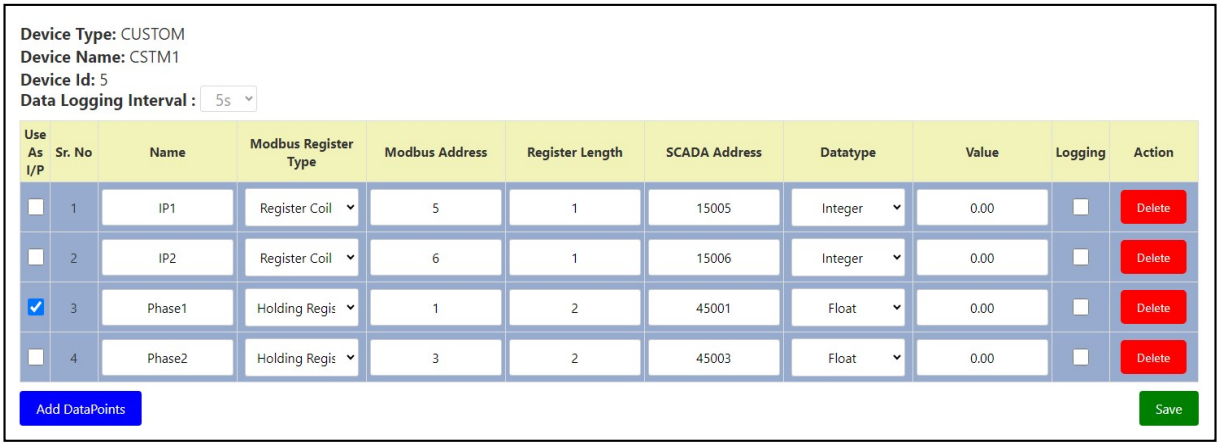


Figure 63: Custom Sensor Configuration

4.7 Control and Timer Conditions

In this section, user will learn how to set up Conditions to manage Digital I/O (DIO) and Analog Output (AO) pins, whether they are connected to the main device or an extension device. These Conditions function similarly to a mini-PLC (Programmable Logic Controller) automating responses based on specific criteria or timing events. This capability enables efficient control and automation of connected devices. In this section, user will configure the following conditions:

- **Control Condition:** Automate device responses based on specific criteria and real-time sensor readings.
- **Timer Condition:** Automate device responses based on elapsed time or scheduled intervals.

4.7.1 Control Condition

A Control Condition allows the user to trigger output actions based on specific control inputs or commands. This type of condition is essential for managing and responding to changes in device states. To access the Control Condition page, select it from the Navigation menu. User will be directed to a page as illustrated in Fig 64. On this page, User need to enter various parameters to automate the device.

Follow these steps to configure a Control condition:

1. **Add a New Condition:** Click the "Add New Condition" button to begin configuring a new condition. Note that user can configure a maximum of 20 conditions.

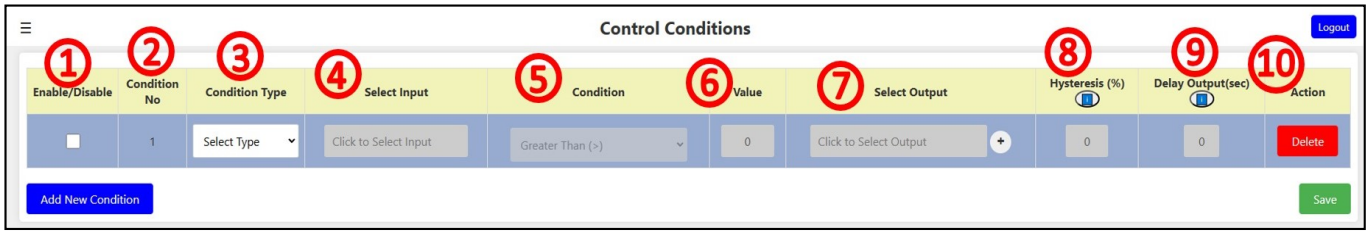


Figure 64: Control Condition Page

2. **Configure the Parameters:**
    1. **Enable/Disable:** Click the "Add New Condition" button to begin configuring a new condition. Note that user can configure a maximum of 20 conditions.
    2. **Condition no:** Each condition is assigned a unique identification number. This helps in organizing and referencing conditions, especially when managing multiple conditions. The number typically reflects the order in which conditions were added. This will automatically get updated when click on Add new condition.
    3. **Condition Type:** This specifies the nature of the condition and determines how the system will interpret and process it. Selecting the "Condition Type" option opens a dropdown menu with various types to choose from, depending on requirements, as shown in Fig 65.

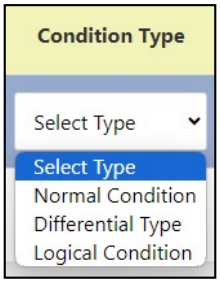


Figure 65: Drop-Down Menu for Condition Type Selection

The available options are as follows, with each one offering a unique method of evaluation:

(a) **Normal Condition:** This is the most straightforward type of condition. It evaluates a set of parameters based on predefined criteria. For example, a normal condition might trigger an action if a temperature reading exceeds a certain value or if a specific sensor input meets a defined threshold.

(b) **Differential Type:** This condition compares the absolute difference between two values or sets of data. It is used when the user needs to assess changes or variations rather than static values.
For example, a differential condition might trigger an action if the difference between two temperature readings exceeds a specified threshold (Compare Value). This type of condition is beneficial for monitoring changes over time.

Note: Since the absolute difference is taken, only positive values will be considered for comparison.

(c) **Logical Condition:** This type involves evaluating conditions based on logical operations. It combines multiple conditions using logical operators such as AND, OR. For example, a logical condition might trigger an action if both a temperature sensor exceeds a certain value and a humidity sensor falls below a certain threshold. This type is useful for complex scenarios requiring multiple criteria to be met simultaneously. Selecting logical will show operator selection below the type as shown in Fig 66.

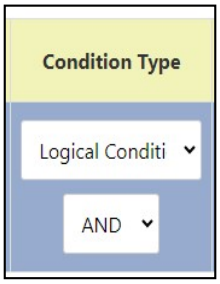


Figure 66: Type and Operator Selection

4. **Select Input:** This parameter enables the choice of the input sensor required for configuring a condition. The number of input selections varies by condition type. For

Normal Conditions, only one sensor selection option is available. For Differential and Logical Conditions, there are two sensor selection options.

Clicking on "Click to Select Input" will open a pop-up window where the user will be prompted to select the device and its respective pin to serve as the input for the condition, as illustrated in Fig 67. In the "Select Device" column, user will see all available devices, including the main device (e.g., SMPLC) and any extension devices configured through the extension page with their Slave ID. In the "Select Pin" column, user will see the pins configured via the settings page.

To select a custom device sensor pin as the input pin for configuring the condition, check the "Use as I/P" checkbox from Extension Device Page. For detailed instructions, refer to the "Extension Device" section. After selecting the device and pin, click the OK button to add the selected parameters.

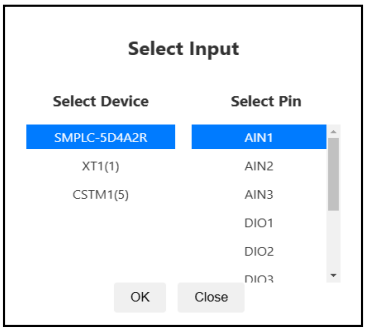


Figure 67: Device and Pin Selection for Configuring Input Sensors

Note: For Logical and Differential Conditions, two input selection boxes are available, and the user must select two input sensors necessary to configure the condition.

5. **Condition/Operator:** This section allows the user to specify the comparison operator to be used on the selected input. Available operators include Greater Than (>), Less Than (<), Greater than or Equal to (>=), Less than or Equal to (<=), Equal to (==), and Not Equal to (!=). These operators determine how the input value will be compared against a specified criterion.
   When DIO pins are selected in the "Select Input" section, only the Equal to (==), and Not Equal to (!=) options will appear in the Condition/Operator column.
6. **Value:** This is the reference value used for comparison against the input. For instance, if the condition type is Normal and involves checking whether a sensor reading exceeds a certain value, the user would enter that threshold value here. If DIO Pins are selected in the "Select Input" section, the Value column will prompt the user to choose between High and Low, as DIO pins only provide binary values (1 or 0).
7. **Select O/P:** This parameter allows the user to select the output or action to be triggered when the condition is met. The available outputs include:
   - **SMPLC or Extension Device DIO:** This option sends a specific signal to turn the device DIO Pins ON or OFF.
   - **Extension Device Analog Output:** This option allows triggering of Analog outputs, enabling more precise control or adjustment.

Note: In this Select O/P, only Smark Devices configured through the Extension page will be displayed. Custom Devices configured via the Extension page will not appear in the "Select Output" options.

Clicking on "Click to Select Output" will open a pop-up window where the user will be prompted to select the device, pin and its output level (i.e., High/Low) for the condition, as shown in Fig 68.

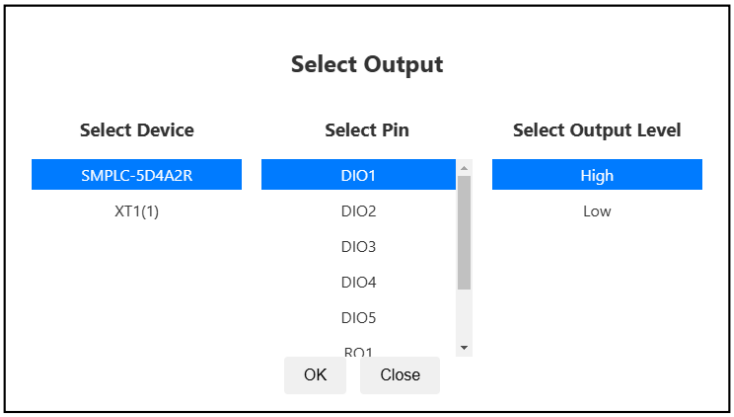


Figure 68: Device, Pin and Output Level Selection for Configuring Output Sensors

In the "Select Device" column, all available devices will be listed, including the main device (e.g., SMPLC) and extension devices configured through the extension page, but excluding Custom Devices. In the "Select Pin" column, user will see the output pins available for triggering. In the "Output Level" column, user will see the options to set the pin to High or Low for DIO pins and a textbox will be provided for entering a voltage value between 0 and 10V if an Analog pin (i.e., Starting with AO) is selected. After selecting the device, pin and level, click the OK button to add the selected parameters. User can add multiple outputs by clicking the plus (+) sign icon next to the output textbox to create additional output textboxes. User can add a maximum of 4 outputs for one condition. For each new output, user must select the device, pin, and level as described above.

Note: Selecting the same pin more than once will result in an error. Ensure each Output pin is unique to avoid conflicts.

8. **Hysteresis:** Hysteresis helps prevent frequent toggling of outputs due to minor fluctuations in the input value around a threshold. By setting a hysteresis value, user define a range within which the input must remain before triggering a change in output, thereby enhancing the stability of the condition evaluation process.

   Note: Hysteresis is expressed as a percentage, so ensure to enter the value accordingly within the range of 0 to 50.

   In Logical conditions where two sensor pins are configured, user need to enter two hysteresis values i.e. one for each pin.
   For Differential conditions, which consider the absolute difference between two sensor values, the hysteresis will be applied to the difference value. Additionally, if Digital

Input/Output (DIO) pins are selected for the input sensor, the pin will simply toggle between states regardless of the hysteresis value entered.

- **With Hysteresis:**
  To prevent unnecessary triggering due to minor fluctuations, set a hysteresis value in percentage. Below are examples of how hysteresis works with different operators
  i) **When input is taken from an Analog Channel or RTD:** Temp1 is taken as the sensor pin with a compare value of 25 and hysteresis of 1%.
  (a) **When "Greater than (>)" condition/operator is taken:**
  – Output will turn on when Temp1 value is greater than 25.
  – Output will turn off when Temp1 value is less than 24.75 (25 - (25 * 1%)).
  (b) **When "Less than (<)" condition/operator is taken:**
  – Output will turn on when Temp1 value is less than 25.
  – Output will turn off when Temp1 value is greater than 25.25 (25 + (25 * 1%)).
  (c) **When "Greater than or Equal to (>=)" condition/operator is taken:**
  – Output will turn on when Temp1 value is greater than or equal to 25.
  – Output will turn off when Temp1 value is less than or equal to 24.75 (25 - (25 * 1%)).
  (d) **When "Less than or Equal to (<=)" condition/operator is taken:**
  – Output will turn on when Temp1 value is less than or equal to 25.
  – Output will turn off when Temp1 value is greater than or equal to 25.25 (25 + (25 * 1%)).
  (e) **When "Equal to (==)" condition/operator is taken:**
  – Output will turn on when Temp1 value is exactly 25.
  – Output will turn off when Temp1 value is greater than 25.25 and less than 24.75.
  (f) **When "Not Equal to (!=)" condition/operator is taken:**
  – Output will turn on when Temp1 value is not equal to 25.
  – Output will turn off when Temp1 value is equal to 25.
  ii) **When input is taken from a DIO:** DIO1 with a compare value of HIGH and hysteresis of 1.50%:
  (a) **When "Equal to (==)" condition/operator is taken:**
  – Output will turn on when DIO1 value is HIGH.
  – Output will turn off when DIO1 value is LOW.
  (b) **When "Not Equal to (!=)" condition/operator is taken:**
  – Output will turn on when DIO1 value is LOW.
  – Output will turn off when DIO1 value is HIGH.
- **Without Hysteresis (i.e., when it is 0%):**
  When hysteresis is set to 0%, the output will stay in its current state (High or Low) regardless of subsequent changes to the input value.

9. **Delay O/p:** This parameter specifies a time delay before the output action is executed after the condition has been met. This delay can help in managing the timing of actions, preventing immediate responses that could be undesirable or unnecessary.

10. **Action:** To delete the Condition, click on the "Delete" button located in this column. This enables them to remove a specific condition with a single click, resulting in the corresponding row being deleted. Through this dedicated deletion feature, user can efficiently eliminate any unwanted conditions.

    To configure additional Control conditions, follow the same steps as described above. For examples and a deeper understanding of conditions, please refer to section 4.7.2.

3. **Save the Condition:** Click the "Save" button located at the bottom right corner to save the control condition in the device memory. A message will then be displayed "Controlling Condition Saved Successfully".

4.7.2 Example to Configure Control condition

Below are some examples of how to configure conditions according to specific requirements.

1. **Normal condition:**

   - **Temperature Control (When input is from an Analog Sensor):**

     Objective: Control the temperature of a room by activating a cooler if the temperature exceeds 28°C (8.50mA). The input temperature sensor is connected to pin AI1 of the SMPLC-5D4A2R, and the output cooler is connected to pin RO1 of the SMPLC-5D4A2R.

     Prerequisites: The room temperature is measured using a RTD (PT100) sensor, which is used to calculate the room temperature. For that Configured pin AI1 with a sensor type of 4-20mA through DAS Setting pg.

     Configuration Steps:

     1. **Enable the Condition:** Check the relevant checkbox.
     2. **Select Condition Type:** Select "Normal Condition" from the dropdown menu.
     3. **Input Device and Pin Selection:** Select device SMPLC-5D4A2R, where the RTD sensor is connected to pin AI1. (For connections, refer to Prerequisites and section 2.8.)
     4. **Condition Setup:** Set the condition to "greater than or equal to (>=)" with a value of 8.50 as cooler needs to ON.
     5. **Output Selection:** Select the cooler connected to pin RO1 of the SMPLC-5D4A2R with a high state.
     6. **Hysteresis Value:** Set to 0.50%.
        Calculation: Adjusted threshold temperature = 8.50 - (8.50 × 0.50 / 100) = 8.50 - 0.0425 = 8.4575mA.
        Behavior: Cooler turns off when the Voltage drops below 2.786V and turns back on when it reaches 8.4575mA.
     7. **Delay Output:** Set to 5 seconds. The cooler will turn ON after a 5-second delay.

     Summary: With this configuration, the cooler activates when the voltage is 2.8V or higher and deactivates when the voltage drops below 2.786V. Additionally, the cooler will turn ON after a 5-second delay.

- **Water Level Control (When input is from DIO):**

  Objective: To Maintain the water level in a tank by controlling the water pump. The input float sensor is connected to pin DIO1 of SMPLC-5D4A2R, and the output pump is controlled via pin RO2 of SMPLC-5D4A2R.

  Configuration Steps:

  1. **Enable the Condition:** Check the relevant checkbox.
  2. **Select Condition Type:** Select "Normal Condition" from the dropdown menu.
  3. **Input Device and Pin Selection:** Select device SMPLC-5D4A2R, where the float sensor is connected to pin DIO1.
  4. **Condition Setup:** Set the condition to "equal to (==)" with a value of "LOW" (indicating the water level is low).
  5. **Output Selection:** Select the pump connected to pin RO2 of SMPLC-5D4A2R with a high state.
  6. **Hysteresis Value:** Set to 1%.
     Behavior: The pump will turn off when the float sensor reads HIGH (indicating sufficient water level).
  7. **Delay Output:** Set to 5 seconds. The pump will turn ON after a 5-second delay.

  Summary: With this configuration, the pump will turn on when the float sensor detects a Low water level and will turn off when the sensor detects a High water level. The 5-second delay ensures that the pump activates with a slight lag to prevent rapid cycling.

2. **Differential condition:**

- **Heat Pump Control:**

  Objective: Activate a heat pump if the temperature difference between flow and return temperatures exceeds 10°C(5.6mA). The flow and return temperature inputs are connected to AI2 and AI3 of SMPLC-5D4A2R, respectively. The output device i.e heat pump, is connected to DIO2 of SMPLC-5D4A2R.

  Prerequisites: The flow and return temperatures are measured using an RTD (PT100) sensor, which calculates the temperature difference between the two sensors to trigger the heat pump. To achieve this, pin AI2 and AI3 is configured with a 4-20mA sensor type through the DAS Setting page.

  Configuration Steps:

  1. **Enable the Condition:** Check the relevant checkbox.
  2. **Select Condition Type:** Select "Differential Condition". Two select input textbox will be added for the condition.
  3. **Device Selection:** Select the device SMPLC-5D4A2R and pins AI2 (flow temp) and AI3 (return temp). (For connections, refer to Prerequisites and section 2.8.)
  4. **Condition Setup:** Set the condition to "greater than or equal to" with a value of 5.6mA.
  5. **Output Selection:** Select the heat pump connected to pin DIO2 of SMPLC-5D4A2R through a relay with High state.

6. **Hysteresis Value:** Set to 1%.
   Calculation: Adjusted threshold temperature difference = 5.6 - (5.6 × 1 / 100) = 5.6 - 0.56 = 5.04mA.
   Behavior: The heat pump will turn off when the pressure difference drops below 5.04mA and turn back on when it reaches 5.6mA.
7. **Delay Output:** Set to 0 seconds. The heat pump will turn on immediately when the condition is met.

Summary: With this setup, the heat pump will activate when the pressure difference between flow and return temperatures is 5.6mA or greater. It will deactivate when the difference falls below 5.04mA. The 0-second delay ensures the heat pump responds instantly to changes in the pressure difference.

3. **Logical condition:**

- **Room Temperature Control (When input is from an Analog Pin):**

  Objective: To Control the heater when room temperature is between 15°C(6.4mA) and 25°C(8mA). The input RTD(PT100) sensor is connected to pin AI1 of the SMPLC-5D4A2R and the output heater is connected to pin DIO3.

  Configuration Steps:

  1. **Enable the Condition:** Check the relevant checkbox.
  2. **Select Condition Type:** Choose "Logical Condition". This will add a input textbox, an operator dropdown, and a hysteresis textbox.
  3. **Device Selection:** Select device SMPLC-5D4A2R with pin AIN1 in both input textboxes.
  4. **Operator Selection:** Choose AND (&&) to ensure both conditions must be true.
  5. **Condition Setup:** First Input: Set to "greater than or equal to (>=)" with a value of 6.4mA.
     Second Input: Set to "less than or equal to (<=)" with a value of 8mA.
  6. **Output Selection:** Choose the heater connected to pin DIO3 of SMPLC-5D4A2R through a relay with High state.
  7. **Hysteresis Value:** Set to 0.20
     First Condition Adjustment: 6.4 - (6.4 × 0.20 / 100) = 6.4 - 0.0128 = 6.3872mA.
     Second Condition Adjustment: 8 + (8 × 0.20 / 100) = 8 + 0.016 = 8.016mA.
     Behavior: Heater turns off when the temperature is below 6.3872mA or above 8.016mA and turns on when the temperature is between the adjusted thresholds i.e. 6.4mA and 8.0mA.
  8. **Delay Output:** Set to 5 seconds to prevent rapid cycling and ensure stable operation.

  Summary: With this configuration, the heater will activate when the temperature is between 6.4mA and 8.0mA and deactivate when it falls below 6.3872mA or exceeds 8.016mA. The 5-second delay helps prevent rapid on/off cycling, ensuring more stable temperature control.

- **Pump Control for Light (When input is from DIO):**

  Objective: Turn on a light if either the water pump or the heat pump is on. The water pump is connected to pin RO2, and the heat pump is connected to pin DIO2. The light is controlled via pin DIO4 of SMPLC-5D4A2R.

  Configuration Steps:

  1. **Enable the Condition:** Check the relevant checkbox.
  2. **Select Condition Type:** Choose "Logical Condition". This will add a input textbox, an operator dropdown, and a hysteresis textbox.
  3. **Device Selection:** Select device XT1(1) with pin RO2 (water pump) and pin DIO2 (heat pump).
  4. **Operator Selection:** Choose "OR (||)" to activate the light if any one of the conditions is true.
  5. **Condition Setup:**
     First Input: Set to "equal to (==)" with a value of "HIGH" for pin RO2.
     Second Input: Set to "equal to (==)" with a value of "HIGH" for pin DIO2.
  6. **Output Selection:** Choose the light connected to pin DIO4 of SMPLC-5D4A2R through a relay with High state.
  7. **Hysteresis Value:** Set to 1%.
     Behavior: The light will turn off when both inputs are LOW (i.e., when neither pump is on).
  8. **Delay Output:** Set to 0 seconds as no delay is required.

  Summary: With this configuration, the light will turn on when either the water pump or the heat pump is on, and it will turn off when neither pump is on.

After configuring the above conditions, the page will appear as shown in Fig 69.

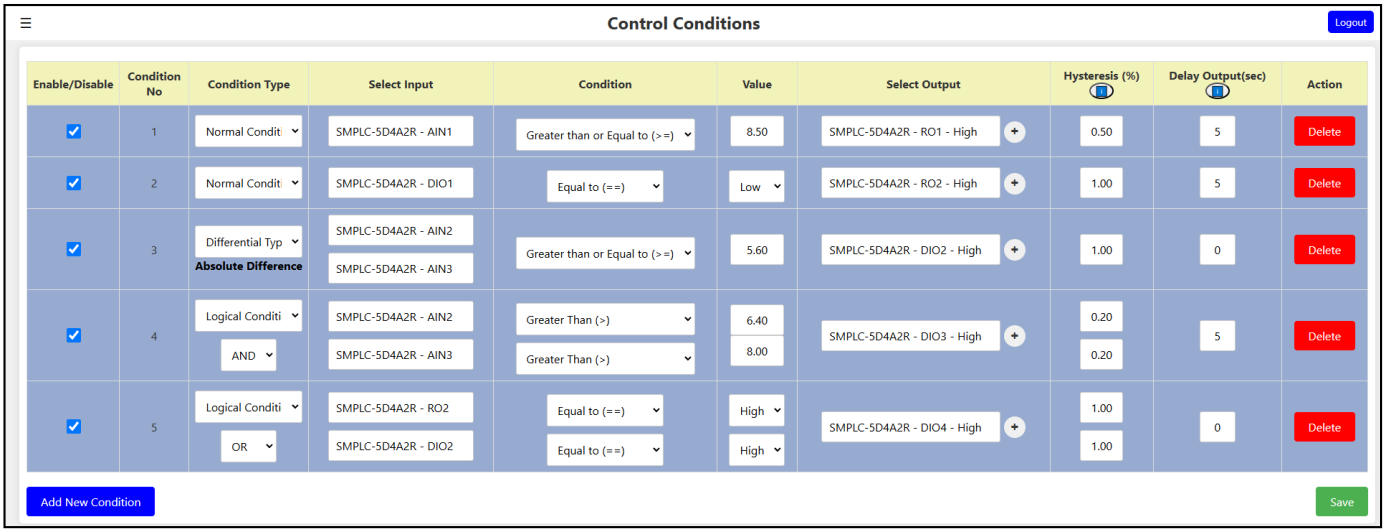


Figure 69: Example of Configured Control Conditions Page

4.7.3 Timer Condition

A Timer Condition allows user to set actions based on elapsed time or specific time intervals. This type of condition is useful for automating tasks that need to occur after a certain duration or at scheduled times.

To access the Timer Condition page, navigate to it from the Navigation menu. User will be directed to a page as illustrated in Fig 70. On this page, user need to enter various parameters to automate the device.

Follow these steps to configure a Timer condition:

1. **Add a New Condition:** Click the "Add Timer Condition" button to begin configuring a new condition. Note that user can configure a maximum of 15 conditions.

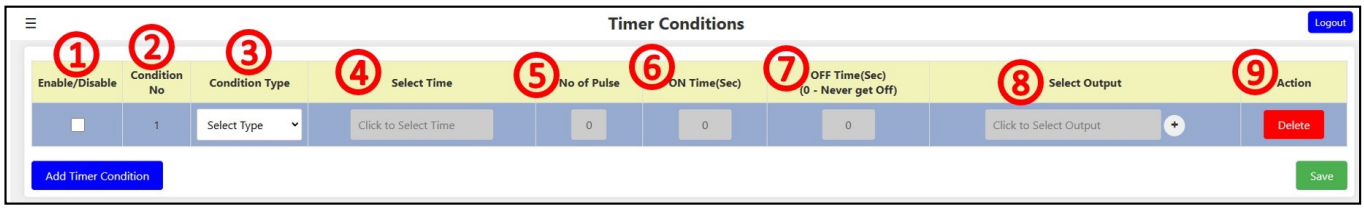


Figure 70: Timer Conditions Page

2. **Configure the Parameters:**

    1. **Enable/Disable:** This option allows the user to activate or deactivate a specific condition. When a condition is enabled, it will be evaluated and may trigger actions based on its parameters. User can only change parameters if the condition is enabled. If a condition is disabled, it will be ignored by the device, allowing it to temporarily suspend it without deleting it.
    2. **Condition no:** Each condition is assigned a unique identification number. This helps in organizing and referencing conditions, especially when managing multiple conditions. The number typically reflects the order in which conditions were added. This will automatically get updated when click on Add new condition.
    3. **Condition Type:** This specifies the nature of the condition and determines how the system will interpret and process it. Selecting the "Condition Type" option opens a dropdown menu with various types to choose from, depending on requirements, as shown in Fig 71.

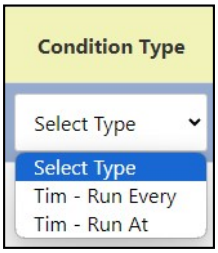


Figure 71: Drop-Down Menu for Timer Condition Type Selection

The available options for scheduling actions are as follows, each offering a unique method of evaluation:

- **Tim – Run Every:** This option enables user to schedule actions to occur at repeating intervals. User can configure the action to trigger every hour or every day depending on their needs. This method is ideal for tasks that require consistent and periodic execution. For example, a task set to run every hour throughout the day.
- **Tim – Run At:** This option allows user to schedule actions to occur at a specific time or on a particular schedule. User can configure the action to run at a fixed time each day, such as 8:00 AM daily or on specific days, such as only on Mondays. This method is useful for tasks that need to be performed at precise time.

4. **Select Time:** This parameter allows the user to specify the time required for configuring a Timer condition. Clicking on "Click to Select Time" will open a pop-up window where user will be prompted to enter the time (i.e., hour, minute, second) in 24-hour format. Additionally, user can select the days of the week by clicking on it. The selected days will be shown in blue, while unselected days will be shown in grey, as shown in Fig 72. After configuring the time and day, click the OK button to save the selected parameters.

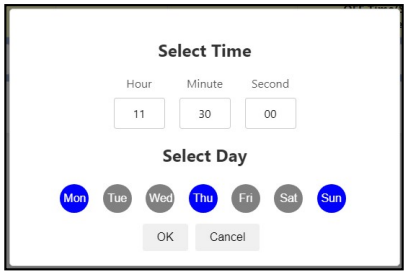


Figure 72: Time and Day Selection for Configuring condition

5. **No of pulse:** A pulse refers to an activation signal sent to an output, involving a cycle of turning the output on and then off. This cycle includes an On Time (when the output is active) and an Off Time (when the output is inactive) and it may be repeated multiple times based on the number of pulses entered. The details of On Time and Off Time will be discussed in a subsequent section.

   Enter the desired number of pulses to determine how many times the output should be activated in the pulse sequence. Entering 0 for the number of pulses will result in the corresponding output not being triggered.

   Note: The range for the number of pulses is from 0 to 100.

6. **On time(sec):** This parameter defines the duration, in seconds, that the output remains active during each pulse. The On Time is the period when the output is turned on. For each pulse cycle, the output will be in its active state for the duration specified by the parameter. The On Time can be adjusted from 0 to 65535 seconds, which is up to a maximum of 18 hours.

   For example, if the On Time is set to 5 seconds, the output will be active for 5 seconds during each pulse cycle before turning off.

7. **Off Time (sec):** This parameter defines the duration, in seconds, that the output remains inactive between pulses. The Off Time is the period when the output is turned off. For each pulse cycle, the output will be inactive for the duration specified

by this parameter before the next pulse begins. The range for Off Time is from 0 to 65535 seconds, which is up to a maximum of 18 hours.

For example, if the Off Time is set to 10 seconds, the output will be off for 10 seconds between each activation. Setting the Off Time to 0 means the output will stay continuously on and will never turn off between pulses.

8. **Select O/P:** This parameter allows the user to select the output or action to be triggered when the condition is met. The available outputs include:

   SMPLC or Extension Device DIO: This option sends a specific signal to turn the device DIO Pins ON or OFF.

   Note: In this Select O/P, only Smark Devices configured through the Extension page will be displayed. Custom Devices configured via the Extension page will not appear in the "Select Output" options.

   Clicking on "Click to Select Output" will open a pop-up window where the user will be prompted to select the device, pin and its output level (i.e., High/Low) for the condition, as shown in Fig 73.

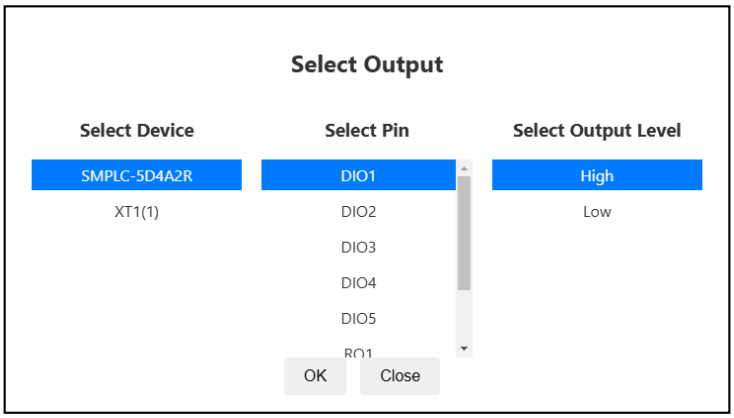


Figure 73: Device, Pin and Output Level Selection for Configuring Output Sensors

In the "Select Device" column, all available devices will be listed, including the main device (e.g., SMPLC) and extension devices configured through the extension page but excluding Custom Devices. In the "Select Pin" column, user will see the output pins available for triggering. In the "Output Level" column, user will see the options to set the pin to High or Low for the DIO pin selected. After selecting the device, pin and level, click the OK button to add the selected parameters.

The previously entered values for pulse, on time and off time will apply to the configured output. To add multiple outputs, click the plus (+) sign icon next to the output textbox to create additional output textboxes, along with corresponding pulse, on time and off time fields. User can add a maximum of 4 outputs for one condition. For each new output, user must select the device, pin and level as described above, and enter the pulse, on time and off time for that particular output.

Note: Selecting the same pin more than once will result in an error. Ensure each Output pin is unique to avoid conflicts.

9. **Action:** To delete the Condition, click on the "Delete" button located in this column. This enables them to remove a specific condition with a single click, resulting in the corresponding row being deleted. Through this dedicated deletion feature, user can efficiently eliminate any unwanted conditions.

   To configure additional Timer conditions, follow the same steps as described above. For examples and a deeper understanding of Timer conditions, please refer to section 4.7.4.

3. **Save the Condition:** Click the "Save" button located at the bottom right corner to save the control condition in the device memory. A message will then be displayed "Timer Condition Saved Successfully".

4.7.4 Example to Configure Timer condition

1. **Tim - Run Every:**

   - **Pump Control:**

     Objective: Control the pump to turn on every 12 hours for 15 minutes. The pump is connected to pin DIO1 of device XT1(1) and should be activated at a high state.

     Configuration Steps:

     1. **Enable the Condition:** Check the relevant checkbox.
     2. **Select Condition Type:** Select "Tim – Run Every" from the dropdown menu.
     3. **Select Time and Day:** Enter 12:00:00 (Hr:Min:Sec) for the interval and select "All Day" to ensure the pump operates every day at the specified interval.
     4. **Enter Pulse:** Set the number of pulses to 1 as the pump should only be triggered once per interval.
     5. **Enter On and Off Time:** Set the on time to 900 seconds (15 minutes) and the off time to 1 second to allow the pump to run for 15 minutes and then turn off momentarily.
     6. **Output Selection:** Select the pump connected to pin DIO1 of XT1(1) through a relay at high state.

     Summary: With this configuration, the pump will turn on every 12 hours for 15 minutes.

2. **Tim - Run At:**

   - **Street Light Control:**

     Objective: Control the street light to turn on at 18:15:00 and turn off at 06:15:00 every day. The street light is connected to a relay through pin DIO2 of XT1(1).

     (a) **Method 1:** Using Two Separate Conditions

     Configuration for Turning On:

     1. **Enable the Condition:** Check the relevant checkbox.
     2. **Select Condition Type:** Select "Tim – Run At" from the dropdown menu.
     3. **Select Time and Day:** Enter 18:15:00 (Hr:Min:Sec) and select "All Day" to operates every day at the specified time.

4. **Enter Pulse:** Set the number of pulses to 1 to ensure the street light turns on only once at the specified time.
5. **Enter On and Off Time:** Set the on time to 1 second and the off time to 0 seconds to keep the street light on continuously once triggered.
6. **Output Selection:** Choose the street light connected to pin DIO1 of XT1(1) through a relay at high state.

Summary: With this configuration, the street light will turn on at 18:15:00.

Configuration for Turning Off:

1. **Enable the Condition:** Check the relevant checkbox.
2. **Select Condition Type:** Choose "Tim – Run At" from the dropdown menu.
3. **Select Time and Day:** Enter 06:15:00 (Hr:Min:Sec) and select "All Day".
4. **Enter Pulse:** Set the number of pulses to 1 to ensure the street light turns off only once at the specified time.
5. **Enter On and Off Time:** Set the on time to 1 second and the off time to 0 seconds to keep the street light off continuously once triggered.
6. **Output Selection:** Choose the street light connected to pin DIO2 of XT1(1) through a relay at low state.

Summary: With this configuration, the street light will turn off at 06:15:00.

(b) **Method 2:** Single Configuration for On and Off

Configuration Steps:

1. **Enable the Condition:** Check the relevant checkbox.
2. **Select Condition Type:** Select "Tim – Run At" from the dropdown menu.
3. **Select Time and Day:** Enter 18:15:00 (Hr:Min:Sec) and select "All Day".
4. **Enter Pulse:** Set the number of pulses to 1 to ensure the street light turns on only once at the specified time.
5. **Enter On and Off Time:** To have the street light on for 12 hours, set the on time to 43200 seconds (12 hours) and the off time to 1 second. This ensures the light turns on at 18:15:00 and off at 06:15:00.
6. **Output Selection:** Select the street light connected to pin DIO2 of XT1(1) through a relay at low state.

Summary: With this configuration, the street light will turn on at 18:15:00 and remain on for 12 hours, and turn off at 06:15:00 the next day.
The Method 2 effectively uses one condition to manage both the on and off time, simplifying the configuration while achieving the desired control of the street light.

After configuring the above conditions, the page will appear as shown in Fig 74.

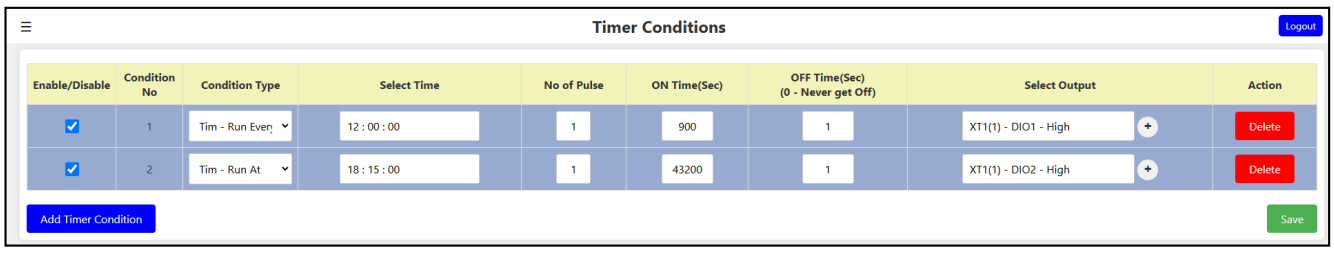


Figure 74: Example of Configured Timer Conditions Page

4.8 Download Logs

This section is dedicated to downloading logs. The Download Logs feature allows user to download log files generated by the device. These logs include sensor readings from both the main device and configured extension devices. Logging settings are managed through the Settings page. User can either enable logging at this stage or verify that logging is already enabled by referring to the Configure Analog and Temperature Sensor section for the SMPLC device and the Configure Added Extension Device Settings section for extension devices.

To Download the logs, select the "Download Logs" option from the navigation menu. The page will appear as illustrated in Fig 75.

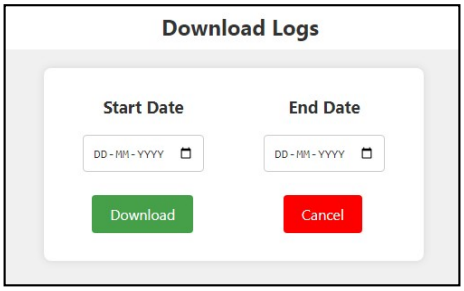


Figure 75: Download Logs Page

To download the logs, user must set the Start Date and End Date fields to define a date range for retrieving log data:

- **Start Date:** Set the beginning date for the log data. Select the desired start date to filter logs from this point onward.
- **End Date:** Set the beginning date for the log data. Select the desired start date to filter logs from this point onward.

After selecting the dates, click the Download button to initiate the process. A save location will be asked to download the SMPLC-5D4A2R Zip file. In some browsers, a warning about an insecure file download may appear, click "Keep" to proceed. After extracting the files from the ZIP archive, logs will be organized into monthly folders, with each folder containing individual .csv files sorted by date as shown in Fig 76. The logs requested are for August 10 and 11, 2024, so only those two files are displayed. For details on interpreting the Excel files, refer to section 6.

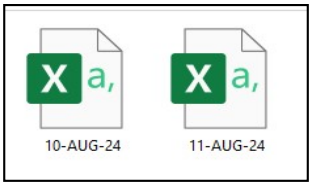


Figure 76: August CSV Files for Dates (10th and 11th)

4.9 Error Page

When a user who has previously logged out or attempts to access a page without logging in, the Device detects the lack of authentication and displays an error page. As shown in Fig 77, the page indicates unauthorized access and includes a blue-highlighted link labelled "here" that prompts the user to log in. This page informs the user that they need to log in to access the requested content.

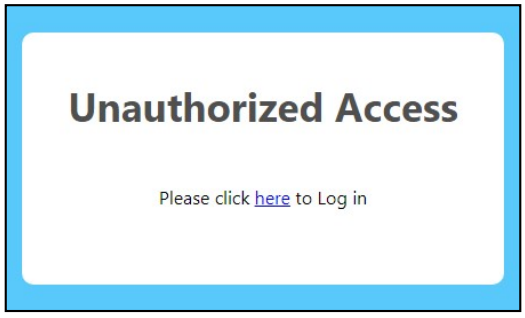


Figure 77: Error Page

5 Testing of MODBUS Communication

5.1 MODBUS TCP/IP

The Modbus TCP/IP communication protocol is a widely utilized method for communicating with controllers. This protocol operates over TCP/IP networks, facilitating efficient data exchange between devices. In this protocol, a client-server model is used, the SMPLC functions as the server in MODBUS TCP protocol, while other devices or systems act as clients.

Follow these steps to set up the connection:

1. **Obtain the IP Address of the Datalogger:** To find the IP address of the datalogger, use the "Show IP" option displayed on the OLED screen, as outlined in section 3.3. Alternatively, user can retrieve the IP address from the web server by referring to section 4.5.3.

2. **Server (Slave) ID:** For MODBUS TCP communication, the SMPLC uses a slave (device) ID of 1.

3. **Set Up the Modbus Client Application:** Enter the IP address and Slave ID into the Modbus client application, such as the Modbus TCP client shown in Fig 78. This setup will enable the application to establish a connection and communicate with the SMPLC server.

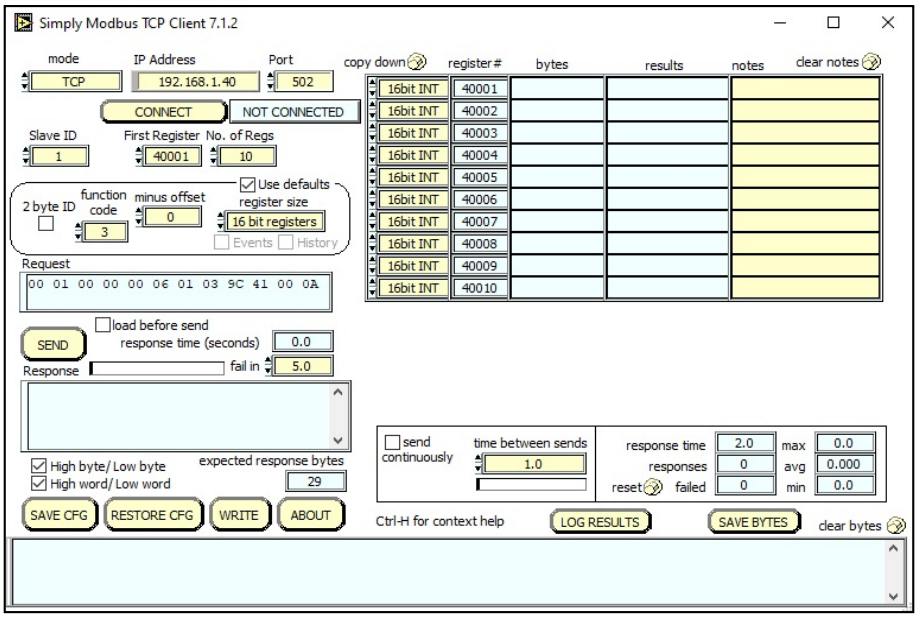


Figure 78: Modbus TCP Client Configuration Interface

4. **Read/Write Data:** To access data for the Analog, Temperature, and Digital Input/Output (DIO) pins of the device, user should refer to the tables below. Additionally, user can check the "SCADA Address" column on the web page for specific pin addresses, as instructed in section 4.4.

5.2 MODBUS Addresses

These addresses are valid for both Modbus TCP and Modbus RTU.

Analog Pins and Addresses:

Pin	Address
AIN1	40001
AIN2	40003
AIN3	40005
AIN4	40007
AIN5	40009
AIN6	40011

Digital Input/Output Pins and Addresses:

Pin	Address
DIO1	10001
DIO2	10002
DIO3	10003
DIO4	10004
DIO5	10005

Relay Output Pins and Addresses:

Pin	Address
RO1	10006
RO2	10007

6 Datalogging

Datalogging is the process of automatically recording data over time. The primary goal of datalogging is to gather accurate and consistent data without manual intervention, enabling detailed analysis and trend observation.

Data can be downloaded from the device in two ways:

1. **Using OLED Display:** Instructions for downloading data via the OLED display will be explained in section 3.2. This method involves navigating through the display menu to export data to a connected device or storage medium like USB stick.
2. **Using Web Server:** Instructions for downloading data via the web server will be explained in section 4.8. This method involves accessing the device's web interface to retrieve data and save it to a computer or other device.

When the device memory is full, it automatically implements a circular logging strategy. This approach ensures that the oldest data is overwritten by the newest entries, allowing for continuous and uninterrupted data recording.

Reading the Excel File:

The downloaded data, saved in an Excel file, will appear as shown in fig 79 (example data from one of the Excel files). Below is a brief overview of how to interpret the information present in the file:

- **Time Column:** The first column in the Excel file represents the timestamp for each data entry. The data is logged according to the interval set by the user in DAS Setting, which in this example is 5 seconds. Therefore, the difference between two consecutive data points is 5 seconds.
- **Sensor Data Columns:** From the second column onwards, the Excel file displays sensor data. Each column represents a different sensor that has been enabled for logging, as configured in the DAS settings. Only the sensors enabled for logging will appear in the file.

	A	B	C	D	E
1	Time	AIN1(mA)	AIN2(mA)	AIN3(mA)	V4(V)
2	06:09:04	0.02	0.03	0.02	0.03
3	06:09:10	0.02	0.03	0.03	0.03
4	06:09:18	0.03	0.03	0.03	0.03
5	06:09:23	0.02	0.03	0.03	0.03
6	06:09:28	0.02	0.03	0.03	0.02
7	06:09:33	0.03	0.03	0.03	0.02
8	06:09:39	0.03	0.03	0.03	0.03
9	06:09:44	0.02	0.03	0.02	0.02
10	06:09:49	0.02	0.03	0.03	0.03
11	06:09:54	0.02	0.03	0.03	0.03
12	06:09:59	0.02	0.04	0.03	0.03

Figure 79: Example of Downloaded Excel file

The term "NC" stands for "Not Connected." This indicates that the sensor or data channel is not connected or not actively providing data at the time of logging. When user see "NC" in the Excel file, it means that no data is available from that sensor for the recorded time period. This could be due to the sensor being disconnected, malfunctioning, or simply not configured for data logging.

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