R-GAS-FLAMMABLE

User Manual

INFRASENSING

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Disclaimers:

This device is **not water-resistant.** Exposure to water, condensation or any form of liquid ingress can result in **malfunction, inaccurate readings, permanent damage, and voiding the warranty**.

Non-condensing operation (definition).
The device must operate only in non-condensing atmospheres. Non-condensing means the ambient dew point stays at least 5°C below the coldest accessible part of the device.

Examples of maximum RH to remain non-condensing:

- 75 °C: ≤ 81% RH (5 °C margin)
- 55 °C: ≤ 78% RH (5 °C)
- 40 °C: ≤ 76% RH (5 °C)

Exposure to condensation (e.g., chamber setups such as 75 °C / 95% RH) is outside the operating specification and may cause malfunction or permanent damage. This use is excluded from warranty coverage.

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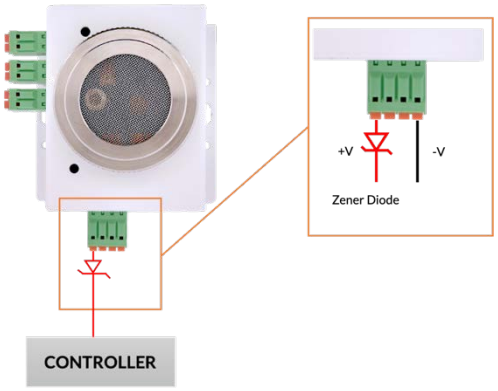
⚠ Power-Supply & Polarity Safety Notice

1. Supplies that can reach 15 – 20 V
   - The 15-20 V band is a protective buffer only; the detector is not intended for continuous operation here.
   - If your supply can rise above 15 V, install a properly-rated Zener diode in the +V line so the voltage presented to the detector is clamped below 14 V.

2. Supplies that can exceed the 24 V rating (24 V ± 10 %)
   - If the power source exceeds the rated voltage (24 V ±10%), a Zener diode must be installed on the +V input terminal block to reduce the voltage to 24 V.
   - Voltages above this limit may damage the methane-detection and relay circuitry.
   - While the calibration-free hydrogen and multi-gas channels are unaffected, over-voltage protection is still strongly recommended.

3. Polarity
   - **Always confirm +V and 0 V** before applying power.
   - Reversed polarity can cause device failure, unpredictable behavior, or safety hazards.



For Zener selection (voltage, wattage, placement) and detailed wiring diagrams, refer to **Section 7.2**.

⚠ Electrical Safety Compliance Notice

To ensure equipment safety and maintain compliance, you must observe to the following wiring and power requirements when interfacing external circuits with the onboard dry-contact relays.

1. Terminal Ratings Limits
   Do not exceed the following electrical limits on the terminal blocks:
   - Maximum Voltage: 30V AC RMS (42.4V Peak) or 60V DC
   - Maximum Current: 2.0 A

2. External Power & Insulation Requirements
   - Power Source Rule: All external circuits connected to these terminals must be powered by a certified SELV (Safety Extra-Low Voltage), PELV (Protected Extra-Low Voltage), or Class 2 power source.
   - Insulation Standard: The external circuit must meet the Functional Insulation / Non-Hazardous Live standard.

3. Electric Shock Protection Note
   The internal relay terminals operate strictly within safe, low-voltage limits. Connecting to them poses no risk of electric shock under normal or single-fault conditions. As long as your external power source stays below 60V DC or 30V AC, the external wiring does not require basic, double, or reinforced shock-protection insulation.

Table of Contents

1 Introduction

The R-GAS-FLAMMABLE detector, developed by InfraSensing, is an advanced, self-calibrating standalone device that doesn't require field calibration. It is designed to monitor flammable gas types in stationary systems.

With a user-settable Slave ID offering 254 combinations and factory calibration, this provides enhanced convenience and reliability.

With a recommendation of one detector per rack for comprehensive monitoring, the R-GAS-FLAMMABLE detector is an indispensable tool for critical facilities. This can be configured to detect different gases based on specific customer needs.

Listed to UL2075 and calibration free flammable gas detector designed to detect the presence and measure the concentration of flammable gases in nonhazardous critical facilities from 0-100% LEL. Patent Pending.

2 All About R-GAS-FLAMMABLE

2.1 Certifications

ETL listed to UL 2075
CSFM-5275
CE and EMC certified
EN50270 certified
EN61010 certified
IEC60068-2-30, IEC 60068-2-6, IEC 61000-4-4, IEC 61000-4-5, IEC 61000-4-6

2.2 Detector Metrics

Internal temperature measurement range	-40°C to 125°C
Internal temperature accuracy	±0.48°C (0.86 °F)
Internal relative humidity measurement range	0 to 100% RH
Internal relative humidity accuracy	2% RH
VOC measurement output range	0-500 VOC Index
VOC repeatability	<±5 VOC index points or % mass volume (m.v.)
Butane (C4H10) accuracy	±5 %LEL
Ethane (C2H6) accuracy	±5 %LEL
Hydrogen (H2) accuracy	±5% LEL
Isobutane (CH3) accuracy	±5 %LEL
Methane (CH4) accuracy	±5 %LEL
Octane (C8H18) accuracy	±12 %LEL
Pentane (C5H12) accuracy	±5 %LEL
Propane (C3H8) accuracy	±6 %LEL
Propylene (C3H6) accuracy	±5 %LEL
Toluene (C7H8) accuracy	±12 %LEL
Xylene (C8H10) accuracy	±12 %LEL

2.3 Technical Specification

Response time (T90)	<30s
Detection Range	0-100 %LEL
Detection method	Spectrometer
Relay outputs	3 (Normally Open)
Relay switching current and voltage	Max. 30 VDC / 250 VAC, max. 2 A / 0.5 A
Input Voltage	12-24V DC ±10%
Power usage	678-1400mW
Protocol	Modbus RTU over RS485
	Integration with BASE-XX over RJ45 (serial data)
Life span	Up to +10 years

2.3.1 Power Usage Table

Voltage	Min Current Rating (A)	Max Current Rating (A)
12	0.054	0.061
12	0.065	0.072
12	0.076	0.083
12	0.088	0.095
24	0.034	0.035
24	0.041	0.042
24	0.048	0.049
24	0.055	0.056

Min Power Usage (mW)	Max Power Usage (mW)
648	732
780	864
912	996
1056	1140
816	0.84
984	1008
1152	1176
1320	1344

Relay 1	Relay 2	Relay 3	Modbus RTU	RJ45
OFF	OFF	OFF	Adds 0.001A	Adds 0.001A
OFF	OFF	ON	Adds 0.001A	Adds 0.001A
OFF	ON	ON	Adds 0.001A	Adds 0.001A
ON	ON	ON	Adds 0.001A	Adds 0.001A
OFF	OFF	OFF	Adds 0.001A	Adds 0.001A
OFF	OFF	ON	Adds 0.001A	Adds 0.001A
OFF	ON	ON	Adds 0.001A	Adds 0.001A
ON	ON	ON	Adds 0.001A	Adds 0.001A

2.4 Environmental Specification

The calibration free component must be kept operating in a non-condensing environment. This means that the dew point temperature should be at least 5°C below device temperature. See section 8.5 Environmental Chamber Testing Policy for damp-heat qualification severities.

For units below firmware 4.41.09 faults may be triggered when the unit operates above an absolute humidity limit of 60g/m3. As of firmware 4.41.09 or higher, the detector's logic is changed when above 60g/m3 so that those faults are no longer triggered.

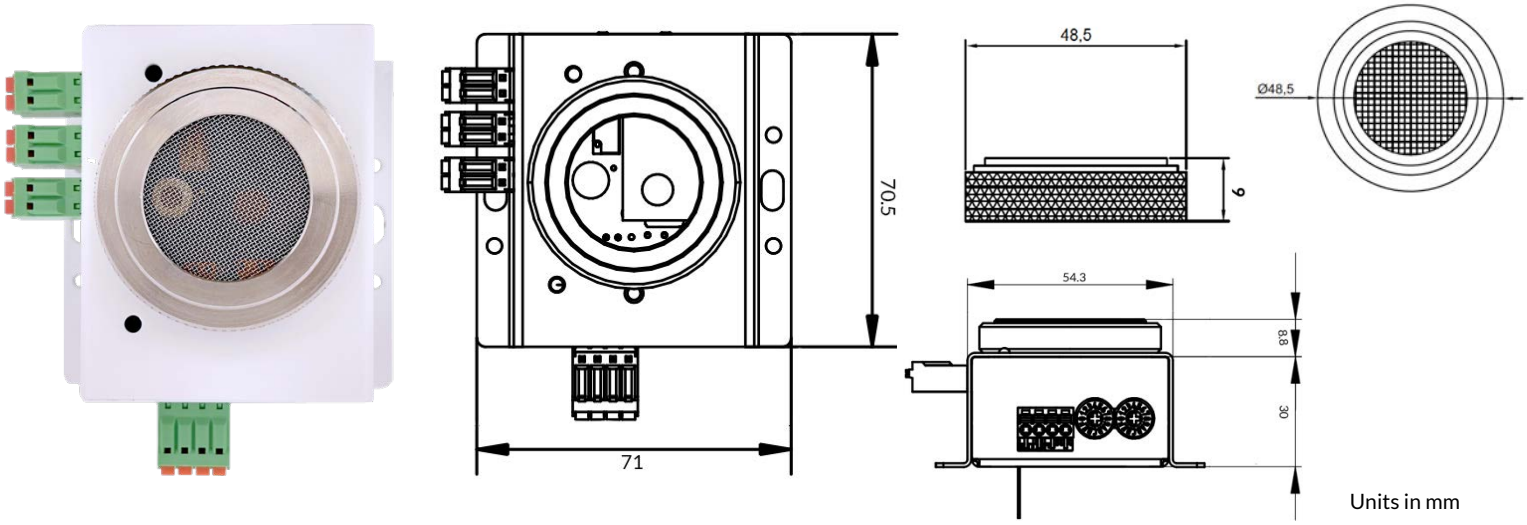
- Calibration-free Multi-Gas Sensing Component

Operating temperature range	-30°C to 75°C (-22°F to 167°F)
Humidity (operating and storage)	Up to 95% RH (non-condensating)
Life span	Up to +10 years

- Methane (CH4) Only Gas Sensing Component

Operating temperature range	-30°C to to 75°C (-22°F to 167°F)
Humidity (operating and storage)	Up to 95% RH (non-condensating)
Life span	Up to 5 years

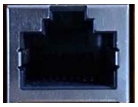
2.5 Physical Specifications



Units in mm

Enclosure	Steel enclosure, industrial grade
Mounting option	0U rack, DIN rail or wall mountable
Dimensions	71mm (2.79") x 70.5mm (2.77") x 30 mm (1.18")
Weight	193g (0.43lb)

2.6 Parts of the R-GAS-FLAMMABLE Detector



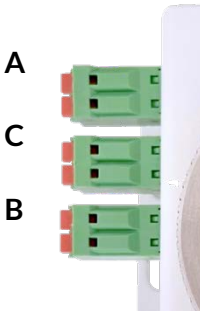
RJ45 Port – This port serves as the communication with the Base Unit

LED - The LED provides signals when the detector is ready for operation and alerts when the detector state is missing, offering users a clear and immediate overview of the detector's operational condition.

LED Status Light:

Warning	**–**	**Amber**
Down	**–**	**Red**
Fault	**–**	**Red**
Normal Condition	**–**	**Green**

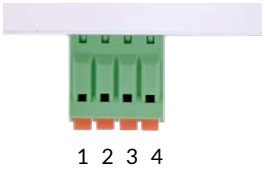
Gas Cap - The gas cap serves as a protective cover for the sensing component, ensuring its durability and safeguarding it from external elements.



Configurable output relays

- A – Relay A - Alarm
- C – Relay C - Fault
- B – Relay B – Alarm

Mounting hole - This allows users to mount the detector according to their preferences, providing flexibility in installation. Please see **section 6.2** for different types of mounting options.



Terminal Block – This block comprises terminals for various connections:

- Terminal 1: 12 to 24V DC power input (+ polarity)
- Terminal 2: (B-) Connection
- Terminal 3: (A+) Connection
- Terminal 4: Ground (GND) (- polarity)

Rotary Encoder – The rotary encoder is a user interface component that can be rotated to input or adjust settings, facilitating user interactions with the detector's configuration. With user settable address out of 254 combinations.

2.7 Error Indications and troubleshooting

2.7.1 LED Status

The LED status indicator provides a quick visual reference for the device's current operating state. It helps user easily identify power status, connectivity, or error conditions through color-coded lights or blinking patters.

For the sensing component such as: VOC, Temp-Hum and CH_4, if the LED status remains in an error condition, any gas events should be addressed first. Then, turn off the device for 5 minutes before powering it back on. If the issue persists, an RMA (Return Merchandise Authorization) should be requested for further evaluation, as the detector may be experiencing a component-related issue.

The detector firmware update process is currently available via our Companion App.

Important Note:

If the LED remains stuck in **Warm-Up** (Blinking – Amber) state during startup, this indicates a potential fault condition and the unit should be considered for repair. In such cases, please proceed with initiating an **RMA (Return Merchandise Authorization)** request.

Note: The LED status feature below is only available starting from firmware version 4.33 and above. Please ensure your device is updated to the appropriate firmware to access this functionality.

	LED Status
EOL (End of Life)	Blinking – RED 30 seconds on/off (overrides everything)
Warm Up	Blinking – AMBER
VOC	Blinking – RED -> AMBER -> PAUSE
Temp Hum	Blinking – RED -> RED -> AMBER -> PAUSE
Multi-gas Sensing Component	Blinking – RED -> AMBER -> RED -> PAUSE
CH4 Gas Sensing Component	Blinking – AMBER -> AMBER -> RED -> PAUSE

Note: The LED status feature below is only available starting from firmware version 4.41.17 and above. Please ensure your device is updated to the appropriate firmware to access this functionality.

	LED Status
Relay Control	Blinking – RED -> YELLOW -> YELLOW
Flash	Blinking – YELLOW -> RED
Condensation Protection Mode	Blinking – RED -> YELLOW -> RED -> RED -> YELLOW

2.7.2 Fault Status

The following values may appear in the Modbus software when an error is detected:

Decimal	Binary	Status
0	b0	OK / Warm Up
2	b1	VOC Fault
4	b2	Temp/Hum Fault
8	b3	Multi-gas sensing fault
16	b4	CH4 fault
64	b6	EOL (End of Life)
128	b7	Relay Control
256	b8	Flash Error
1024	b10	Condensation Protection
2048	b11	Environmental Protection
4096	b12	Gas detection and warm up

For the value **0 (b0)**, which indicates OK/Warm Up status, wait approximately 2 minutes for the detector to fully initialize and transition to the OK state, signaling that it is ready for use.

For values **2–16 (b1–b4)**, if the status does not change, begin by addressing any detected gas events. Afterward, power off the device for 5 minutes before turning it back on. If the issue continues, it may indicate a component-related problem, and an RMA (Return Merchandise Authorization) should be requested for further evaluation.

For the value **64 (b6)**, which indicates EOL (End of Life), the detector must be replaced.

For the value **128 (b7)**, this indicates the operational state of the relay output used for system signaling or fault indication.

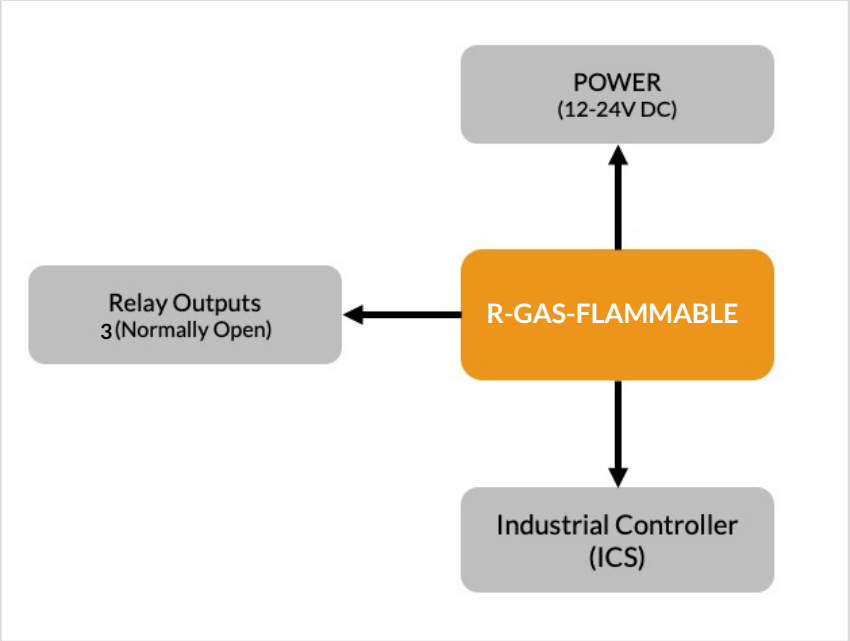
For the value **256 (b8),** this value indicates an issue with the device's internal memory (flash).

For the value **1024 (b10),** this value is activated when condensation is detected, enabling condensation protection mode to prevent detector damage.

For the value **2048 (b11),** this value indicates that the detector is operating in a protective mode because it is outside its defined environmental operating limits

For the value **4096 (b12),** indicates that the device has detected gas while still in the warm-up phase.

3 System Architecture



The core of our system architecture lies in the R-GAS-FLAMMABLE detector, which operates seamlessly on a direct power supply ranging from 12 to 24V DC. This detector, specifically designed for monitoring gas levels, serves as a critical component in our setup. The detector is directly interfaced with an INDUSTRIAL CONTROLLER (ICS) or Modbus Controller, forming a robust connection that facilitates the transfer of real-time data and enables efficient control and monitoring within our industrial environment.

Furthermore, the R-GAS-FLAMMABLE detector enhances its versatility with three normally open relays. These relay outputs contribute to the system's functionality by providing additional control capabilities. This architecture not only ensures reliable power supply and data connectivity but also equips the system with the ability to actuate external devices or processes through the integrated relay outputs, enhancing the overall efficiency and responsiveness of our industrial control setup.

4 CH4 Gas Detection: Cross Sensitivity and Precautionary Measures

Cross-sensitivity occurs when a gas detector responds not only to its target gas but also to other gases in the environment. This characteristic is particularly important to consider when using gas detection systems in environments where multiple gases may be present.

This cross-sensitivity requires careful management to ensure accurate gas detection and system reliability.

Additionally, gas contaminants can impact the performance and longevity of detectors. Below is a list of gas contaminants that should be considered during installation and operation:

- **H_2S** (Hydrogen Sulfide)
- **SOx** (Sulfur Oxides)
- **Cl_2** (Chlorine)
- **HCl** (Hydrogen Chloride)

Here is the list of gases that are cross sensitive to methane (CH_4):

- **Methane** (CH_4)
- **Hydrogen** (H_2)
- **Carbon Monoxide** (CO)
- **Propane** (C_3H_8)
- **Ethylene** (C_2H_4)
- **Ethane** (C_2H_6)
- **Hexane** (C_6H_{14})
- **Benzene** (C_6H_6)
- **Toluene** (C_7H_8)
- **Xylene** (C_6H_4)
- **Ammonia** (NH_3)
- **Hydrogen Sulfide** (H_2S)
- **Acetaldehyde** (C_2H_4O)
- **Formaldehyde** (CH_2O)
- **R-22**
- **R-134a**
- **R-404A**
- **R-410A**

To address this, specific precautions are necessary. By implementing cautions, users can ensure the detector operates effectively, providing reliable and accurate measurements even in challenging conditions.

1. Exposure to silicone vapors – if silicone vapors absorbs onto the detector's surface, the sensing material will be coated, irreversibly inhibiting sensitivity. Avoid exposure where silicone adhesives, hair grooming materials, or silicone rubber/putty may be present.

2. Highly corrosive environment – high density exposure to corrosive materials

3. Contamination by alkaline metals – detector drift may occur when the detector is contaminated by alkaline metals, especially salt water spray.

4. Operation in zero/low oxygen environment – detector require the presence of around 21% (ambient) oxygen in their operating environment in order to function properly. Detectors cannot properly operate in a zero or low oxygen content atmosphere.

5. Excessive exposure to alcohol – if the detector is exposed to high concentrations of alcohol (such as 10,000 ppm or more) for a long period of time, the filter may become saturated.

6. Lighter gas exposure test – consumers often check if detectors are actually sensing gas by exposing them to lighter gas (main component is iso-butane). Because the filter will block iso-butane from reaching the sensing element, this test **cannot** be used with the detector.

5 H2 and other gas flammable detection

Hydrogen (H2) and other flammable gases pose significant safety risks in industrial and commercial settings. Reliable detection systems provide early warnings, and ensuring safety compliance. Below are the list of the flammable gases:

Butane (C4H10) accuracy	±5 %LEL
Ethane (C2H6) accuracy	±5 %LEL
Hydrogen (H2) accuracy	±5% LEL
Isobutane (CH3) accuracy	±5 %LEL
Methane (CH4) accuracy	±5 %LEL
Octane (C8H18) accuracy	±12 %LEL
Pentane (C5H12) accuracy	±5 %LEL
Propane (C3H8) accuracy	±6 %LEL
Propylene (C3H6) accuracy	±5 %LEL
Toluene (C7H8) accuracy	±12 %LEL
Xylene (C8H10) accuracy	±12 %LEL

The H2 and other flammable gas detection is inherently immune to siloxanes and poisoning.

Disclaimer:

If the detector will be subjected to excessively high gas concentrations (≥100% LEL), it is recommend to use the Any Flammable Gas reading instead of the specific target gas.

6 Implementation

In this section, you will gain insights into the practical aspects of deploying our detector technology. We provide detailed information on how the detector are installed, including their integration, testing, and commissioning processes. Additionally, you'll find valuable guidance, ensuring that your team is well-prepared to maximize the detector's capabilities effectively. This section serves as a hands-on guide to put our technology to work in your environment.

6.1 Preparation

Prior to initiating the installation procedure, it is crucial to ensure that you have all the essential materials and devices readily available.

- Devices Needed
  - R-GAS-FLAMMABLE

- Tools Needed
  - RJ45 Cables (Only required if using it as a regular sensor with the Base Unit).
  - Modbus cables
  - Screw driver
  - Screws, bolts and nuts – for mounting purposes

- Things to check
  - Ensure that there is no visible damage on any of the devices
  - Check the functionality of all network cables and ensure that they are free from any defects that could affect the quality of results.
  - Prepare the location or area where you intend to place or install the devices.

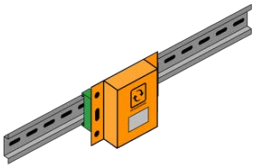
Adhering to these guidelines will contribute to a successful and trouble-free installation process.

6.2 Mounting Installation Guidelines

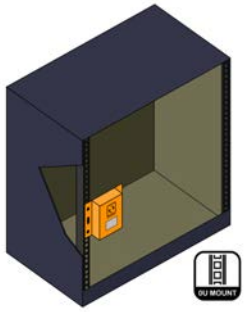
Our sensors and detectors offer flexible mounting solutions, providing you with various options for installation:

Important Note:

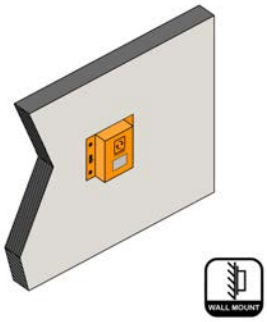
To ensure proper safety and functionality, the unit must be grounded to an earth ground during installation. Connect the grounding wire to one of the enclosure mounting holes, using a screw and washer to secure it firmly and provide a reliable connection. Proper grounding is essential for Electrostatic Discharge (ESD) protection and optimal device performance. Ensure the connection complies with local electrical and safety codes and test it before powering the unit.



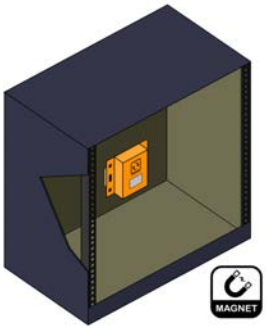
- **DIN Rail**: Ideal for secure, space efficient mounting with compatible enclosures or control panels.



- **0U Rack**: Allows for efficient and organized rack-based installation, conserving valuable rack space.



- **Wall Mount**: Perfect for affixing units to walls, optimizing placement within your environment.

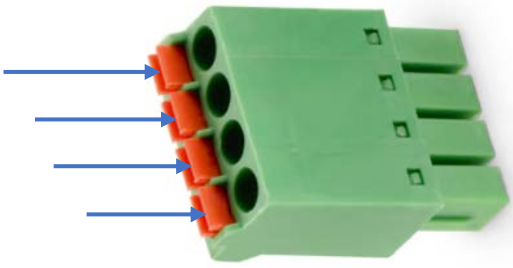


- **Magnetic**: Offers to convenience of magnetic attachment, making it easy to position the components as needed.

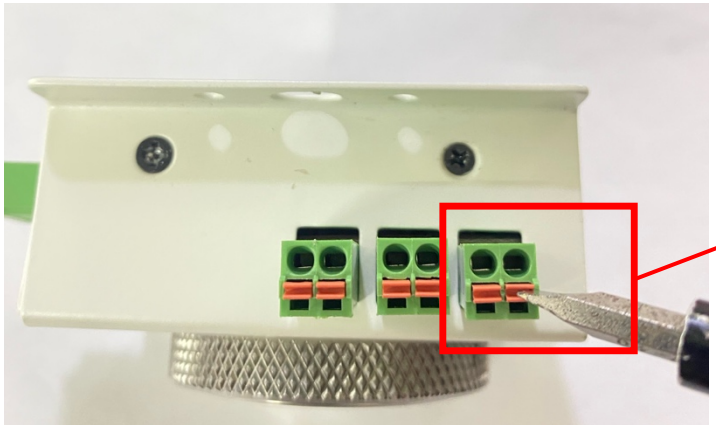
7 Setting up

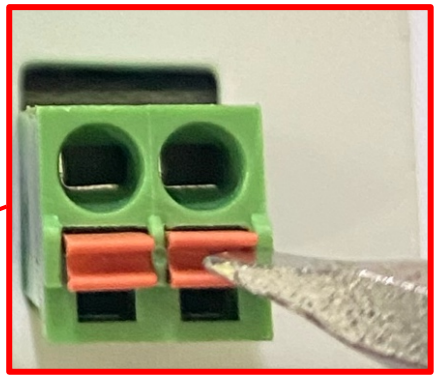
7.1 Securing Wires in Screwless Terminal Blocks

1. Push and hold the orange tab.



You may use your finger or you may also use a precision flat screwdriver to perform this action (as shown the image below). This action opens the contact, creating space for the wire.

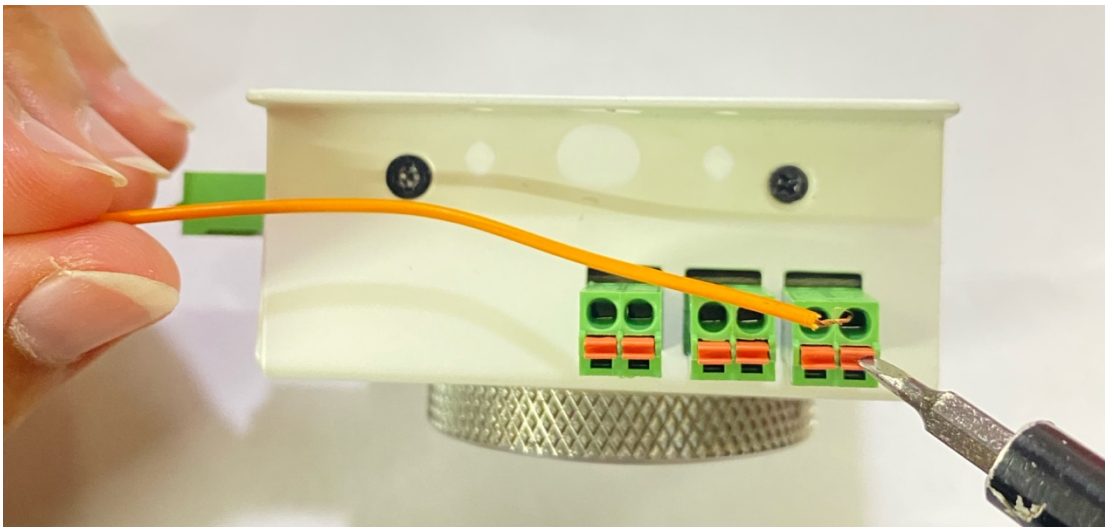




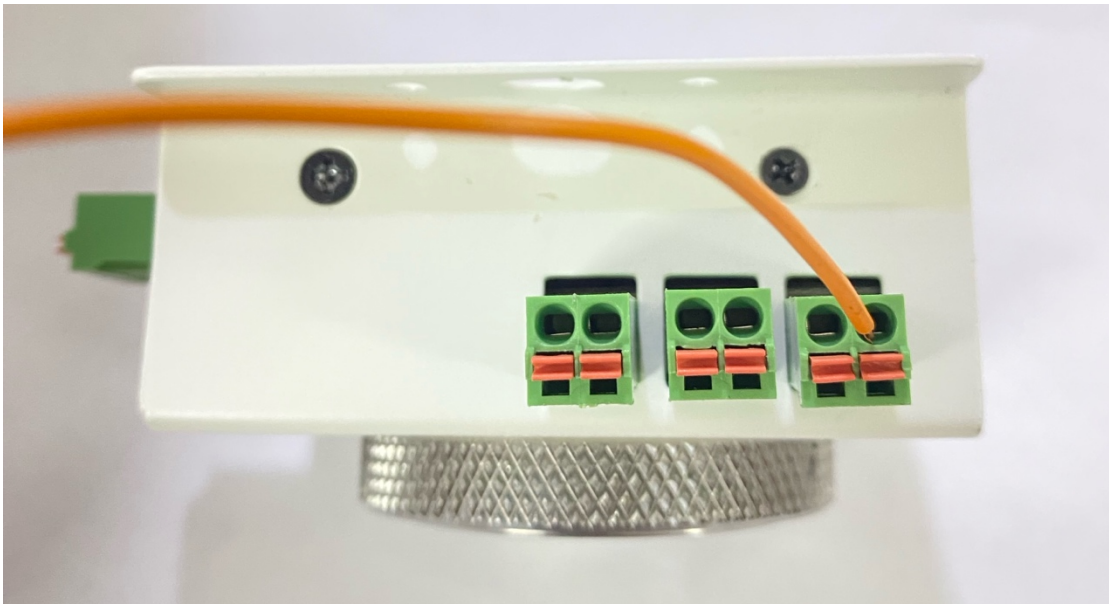
Note:

Push the orange tab towards the terminal

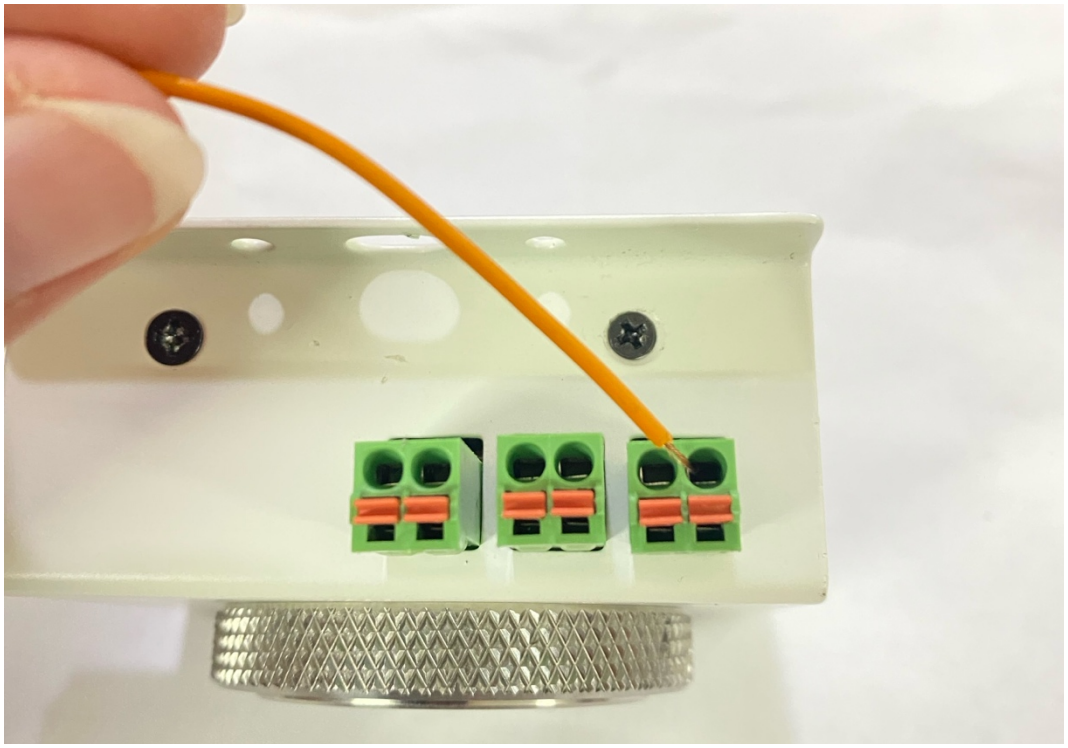
2. While pushing and holding the orange tab, fully insert the stripped end of the wire into the terminal block. Ensure the wire is properly stripped and aligned. You may use a solid wire with a gauge ranging from 16 to 24 AWG for optimal compatibility.



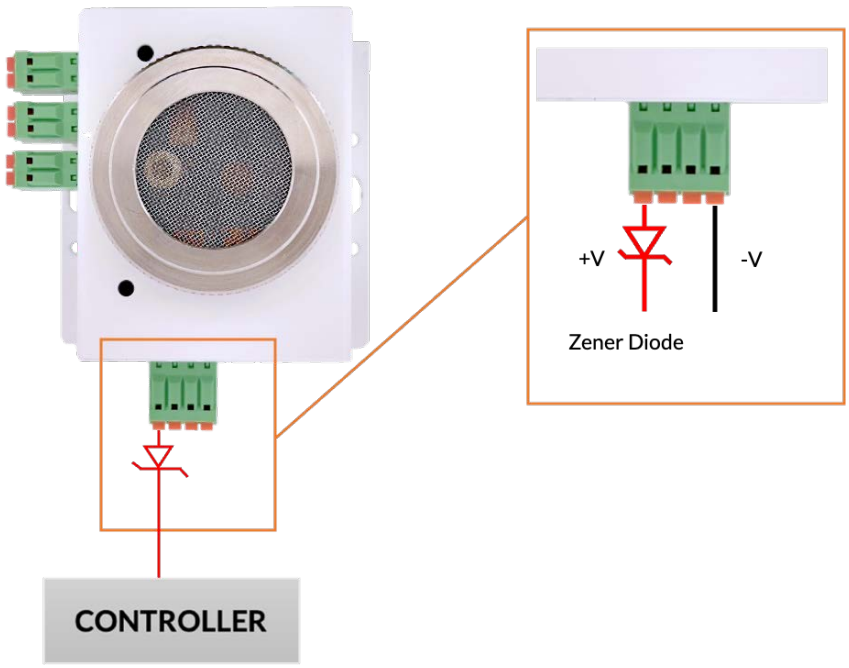
3. Release the orange tab. The spring will secure the wire in place, ensuring a firm connection.



4. Gently tug on the wire to confirm if it is securely held within the terminal block.



7.2 Powering up the R-GAS-FLAMMABLE



⚠ **Disclaimer:**

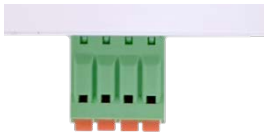
Polarity connection must be strictly observed during installation and operation. **Incorrect polarity may result in damage to the device, malfunction, or safety hazards.** Always verify positive and negative terminals before connecting power.

If the input voltage falls within the 15–20V range, a Zener diode must be used. This is crucial because the detector is designed with a dedicated **safety zone** between 15V and 20V to ensure proper operation and protect internal components. Depending on the operating voltage between 15V-20V we recommend to use a Zener diode to bring the operating voltage below 14v.

If the power source exceeds the rated voltage (24V ±10%) a Zener diode must be installed on the input terminal block (+V) to bring the voltage down to 24V. Exceeding the rated voltage may **damage the methane gas detection and relay components**. However, the calibration-free hydrogen and multi-gas sensing components will not be affected.

For example your power source supplies 27V, a Zener diode part number 625-BZX85C3V3-TAP is required. This is to lower the voltage to 23.7V with ample power dissipation of 1.3W

The R-GAS-FLAMMABLE detector introduces a versatile power-on mechanism with two distinct options. The primary method involves powering it through a direct current (DC) source, accommodating voltages within the range of 12 to 24 volts. This feature ensures compatibility with a variety of DC power systems commonly employed in industrial settings, providing users with a reliable and standard power option for seamless integration into existing infrastructures.



Terminal Block – This block comprises terminals for various connections:

- Terminal 1: 12 to 24V DC power input (+ polarity)
- Terminal 4: Ground (GND) (- polarity)

Note: Please refer to **section 7.1** when inserting wires into the terminal block

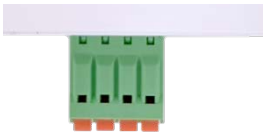
R-GAS-FLAMMABLE can also be powered through the Base Unit, providing a dual-power option that allows users to accommodate the detector to different power sources. This versatile approach ensures ease of use across various applications and operational scenarios.

Important Note:

The device requires a minimum warm-up period of 2 days in a clean environment to ensure accurate readings. It is crucial to allow the detector to complete this warm-up period before relying on its readings for precise and reliable information. After the warm-up period, perform a power cycle to ensure the device operates optimally and provides accurate data.

7.3 Standalone RS485 Connection (Modbus)

Below is the wiring configuration for the terminal block, that connects the detector to your desired platform via RS485



Terminal Block – This block comprises terminals for various connections:

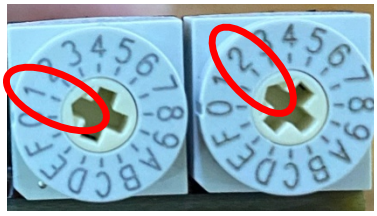
- Terminal 1: 12 to 24V DC power input (+ polarity)
- Terminal 2: (B-) Connection
- Terminal 3: (A+) Connection
- Terminal 4: Ground (GND) (- polarity)

Note: Please refer to **section 7.1** when inserting wires into the terminal block

To set up the Slave ID address please refer to the image below. Please note that there is a pointer which corresponds to the value that it is set to.

Value A	&	Value B	=	Hex Value	→	SLAVE ID

Example:



1	&	2	=	Hex Value	→	12

Important Note:

The combination of **0 and 0** or **F and F** is not functional. Please ensure these configurations are avoided to maintain proper operations.

By default, the rotary switch is set to Hexadecimal (Hex). However, it can be manually converted to Decimal, depending on your preference or system requirements.

7.3.1 Default Modbus Connection Settings

As a standalone device below are the default thresholds and configurations

Parity	None
Baud rate	1200
Stop bit	1

7.3.2 Default Relay Threshold

The relay is triggered based on the gas flammable reading, with the threshold determined by the value of the gas sensing component expressed in percentage Lower Explosive Limit (%LEL).

For newly purchased detectors, the default settings assign Relay A and B threshold values to CH4, and Relay C to the Fault relay. However, you can customize or adjust both the detector type and the threshold values to trigger each relay, using the Modbus table in **Section 7.4** as a reference.

Important Note:

When the Fault Relay is selected, the table below illustrates the relay states for both normal and fault conditions.

Default Relay State	No Fault	Fault Triggered
Default NO	Relay is energized (COM–NO closed)	Relay is de-energized (COM–NO open)
Default NC	Relay is de-energized (COM–NO open)	Relay is energized (COM–NO closed)

It is recommended to configure the Fault Relay as Normally Open (NO). When set to Normally Closed (NC), failures in relay control may go undetected because the relay remains in a closed state and does not change its condition during a fault.

In contrast, when configured as Normally Open (NO), the relay will change state upon detecting a failure, providing a clear and observable indication of a fault condition.

Relay A	25% LEL
Relay B	10% LEL
Relay C	Fault relay

7.3.3 Default Relay State

The default relay state refers to the initial or resting position of a relay when no external power or signal is applied. This state is typically either normally open (NO) or normally closed (NC), indicating whether the relay allows or interrupts the electrical circuit by default. The relays are set to Normally Open (NO) by default. However, users can customize or adjust the relay state to suit the specific application needs. A power cycle is required after applying any changes or updates.

Normally Open	00
Normally Close	01

7.3.4 Relay Delay

Relay delay is the intentional time interval between the activation signal and the actual switching action of the relay.

7.3.5 Relay minimum Running Time

Relay minimum running time refers to the minimum duration the relay remains active starting from the moment it is triggered.

Once the threshold is reached, the relay will continue to operate until it is manually turned off.	-1
After the threshold is reached, the relay will turn off immediately once the conditions return to normal.	00
The relay will activate once the threshold is reached and will continue running for a minimum of XX seconds. For example, if you set the running time to 30 seconds but the conditions have not returned to normal, the relay will keep running until the conditions normalize.	XX seconds

7.4 Modbus Table

Modbus Register Address	Description	Register Type	Data Type	Information		
30001	Fault Status	Read-Only	u16	**Decimal**	**Binary**	**Status**
				1	b0	OK / Warm Up
				2	b1	VOC Fault
				4	b2	Temp/Hum Fault
				8	b3	Multi-gas sensing fault
				16	b4	CH4 fault
				64	b6	EOL (End of Life)
				128	b7	Relay Control
				256	b8	Flash Error
				1024	b10	Condensation Protection
				2048	b11	Environmental Protection
				4096	b12	Gas detection and warm up
30002 to 30003	VOC Reading	Read-Only	32-bit Float (Little Endian | Byte Swap)	In VOC Index		
30004 to 30005	H2 Reading	Read-Only	32-bit Float (Little Endian | Byte Swap)	In %LEL		
30006 to 30007	Internal Temperature Reading	Read-Only	32-bit Float (Little Endian | Byte Swap)	In °C (degree Celsius)		
30008 to 30009	Internal Humidity Reading	Read-Only	32-bit Float (Little Endian | Byte Swap)	In % RH		
30010 to 30011	CH4 Reading	Read-Only	32-bit Float (Little Endian | Byte Swap)	In %LEL		
30013 to 30014	Other Flammable Gas	Read-Only	32-bit Float (Little Endian | Byte Swap)	In %LEL (Excluding H2)		
30016 to 30017	H2 mixture	Read-Only	32-bit Float (Little Endian | Byte Swap)	In % LEL (Available only in Firmware version 4.33 onwards)		
30018 to 30019	Any Flammable Gas	Read-Only	32-bit Float (Little Endian | Byte Swap)	In % LEL (Available only in Firmware version 4.33 onwards)		
30090	Detector status	Read-Only	u16	**Decimal**	**Binary**	**Status**
				1	b0	OK / Warm Up
				2	b1	VOC Fault
				4	b2	Temp/Hum Fault
				8	b3	Multi-gas sensing fault
				16	b4	CH4 fault
				64	b6	EOL (End of Life)
				128	b7	Relay Control
				256	b8	Flash Error
				1024	b10	Condensation Protection
				2048	b11	Environmental Protection
				4096	b12	Gas detection and warm up
				Available only in Firmware version 4.39 onwards		
40001	Modbus Address	Read-Only	u16			
40002	Parity Bit	Read-Write	u16	0 = None, 1 = Odd, 2 = Even		
40003	Baud rate	Read-Write	u16	0 = 1200, 1 = 2400, 2 = 4800, 3 = 9600, 4 = 19200, 5 = 38400		
40004	Stop Bits	Read-Write	u16	0 = 1.5, 1 = 1, 2 = 2		
40005	Relay A Threshold	Read-Write	u16	This is where you set the value to trigger the relay based on the detector you chose on address 40026		

40006	Relay B Threshold	Read-Write	u16	This is where you set the value to trigger the relay based on the detector you chose on address 40027		
40007	Relay A Default State	Read-Write	u16	0 = Normally Open, 1 = Normally Close		
40008	Relay B Default State	Read-Write	u16	0 = Normally Open, 1 = Normally Close		
40009	Relay A Delay	Read-Write	u16	In Seconds		
40010	Relay A min. running time	Read-Write	u16	In seconds; -1 No end 00 – right away		
40011	Relay B Delay	Read-Write	u16	In Seconds		
40012	Relay B min. running time	Read-Write	u16	In seconds; -1 No end 00 – right away		
40022	Relay C Threshold	Read-Write	u16	This is where you set the value to trigger the relay based on the detector you chose on address 40028		
40023	Relay C Default State	Read-Write	u16	0 = Normally Open, 1 = Normally Close		
40024	Relay C Delay	Read-Write	u16	In Seconds		
40025	Relay C min. running time	Read-Write	u16	In seconds; -1 No end 00 – right away		
40026	Relay A - Trigger Source	Read-Write	u16	0 = H2; 1 = Temp; 2 = Hum; 3 = VOC; 4 (Default) = CH4; 5 = Direct control; 6 = Fault Relay; 7 = any gas (H2, CH4 and diff gas concentration); 8 = H2 mixture; 255 = OFF		
40027	Relay B - Trigger Source	Read-Write	u16	0 = H2; 1 = Temp; 2 = Hum; 3 = VOC; 4 (Default) = CH4; 5 = Direct control; 6 = Fault Relay; 7 = any gas (H2, CH4 and diff gas concentration) ; 8 = H2 mixture; 255 = OFF		
40028	Relay C- Trigger Source	Read-Write	u16	0 = H2; 1 = Temp; 2 = Hum; 3 = VOC; 4 = CH4; 5 = Direct control; 6 (Default) = Fault Relay ; 7 = any gas (H2, CH4 and diff gas concentration) ; 8 = H2 mixture; 255 = OFF		
4033	EOL Remaining	Read-Only		Returned time in days till end of the life cycle		
40041	Relay Status	Read-Only	u16	Bit 0 (right most) = Relay A; Bit 1 = Relay B; Bit 2 = Relay C		
40060	Fault Status Setting	Read-Write	u16	**Decimal**	**Binary**	**Settings**
				1	b0	VOC (Default off)
				2	b1	Temp/Hum Component (Default off)
				4	b2	Multi-gas Sensing Component
				8	b3	Methane
				16	b4	When enabled, Methane Fault triggers if both the multi-gas and methane sensing component fail.
				32	b5	Relay Control
				64	b6	Flash error
				512	b9	Condensation Protection
				Available only in Firmware version 4.39 onwards		
1	Relay A	Read-Write		Relay A Status (Optional Trigger to test Relay ON/OFF)		
2	Relay B	Read-Write		Relay B Status (Optional Trigger to test Relay ON/OFF)		
3	Relay C	Read-Write		Relay C Status (Optional Trigger to test Relay ON/OFF)		

NOTE:

To apply changes to the Modbus connection settings, please refer to the following. Note that these changes are only applicable to the following Modbus register addresses (40002, 40003, 40004, 40007, 40008 and 40023).

If you customize the Parity, Baud Rate, or Stop Bits settings, these will need to be set up again. Additionally, a reboot is required if changes are made to the Parity, Baud Rate, or Relay Default State.

The 40041 register represents the relay status using a bitwise value system, where each relay is assigned a specific value equivalent to Relay A = 1, Relay B = 2, and Relay C = 4. When a relay is energized, its corresponding value is added to the total displayed in the Modbus register. For example, a value of 5 (1 + 4) displayed on the register indicates that Relay 1 and Relay 3 are energized, same with the value of 6 (2 + 4) signifies that Relay 2 and Relay 3 are energized.

7.5 Connecting to the Base Unit

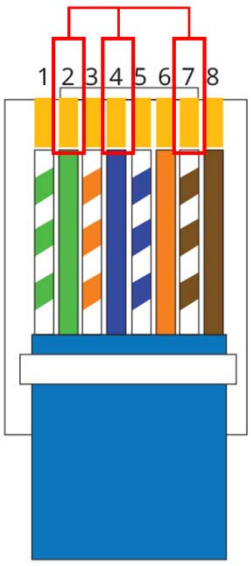
While our unit can operate as a standalone device via RS485 (**section 7.3**), it can also be integrated with our base unit, allowing you to leverage the base unit's various features. The R-GAS-FLAMMABLE detector can be powered directly by the Base Unit and functions as a standard sensor when connected using an RJ45 cable. To ensure optimal performance, please ensure the Base Unit is running the latest firmware version that supports the R-GAS-FLAMMABLE.

For connection setup, please refer to the illustration below. Connect the external sensor probe to the **designated** port at the bottom of the Base Unit using an RJ45-to-RJ45 cable.

For additional details about the Base Unit and its functionality, please check our user manual, specifically on page 11, **section 1.2**: Base Unit Overview https://manuals.infrasensing.info/InfraSensing_Sensors_Platform.pdf

Important Note:

When connecting the R-GAS-FLAMMABLE to both 24V power source and the Base Unit, it is essential to use a modified RJ45 cable to prevent the device from receiving power from the Base Unit.



1. White Green	5. White Blue
2. Green	6. Orange
3. White Orange	7. White Brown
4. Blue	8. Brown

7.6 Setting up VOC Index

The **VOC Index** is a relative air quality indicator that reflects the level of volatile organic compounds (VOCs) in the surrounding environment. Rather than measuring specific gas concentrations in parts per million (ppm), the VOC Index provides a scaled value that represents changes in air quality over time. This makes it especially useful for detecting trends, identifying abnormal conditions, and supporting ventilation or safety responses.

VOCs are commonly emitted from sources such as solvents, cleaning agents, fuels, off-gassing materials, and industrial processes. Elevated VOC levels may indicate poor air quality or potential safety risks. By monitoring the VOC Index, users can gain insight into environmental conditions and respond proactively to maintain safe and healthy spaces.

Please note that these settings can also be adjusted depending on the user's requirements or preferences.

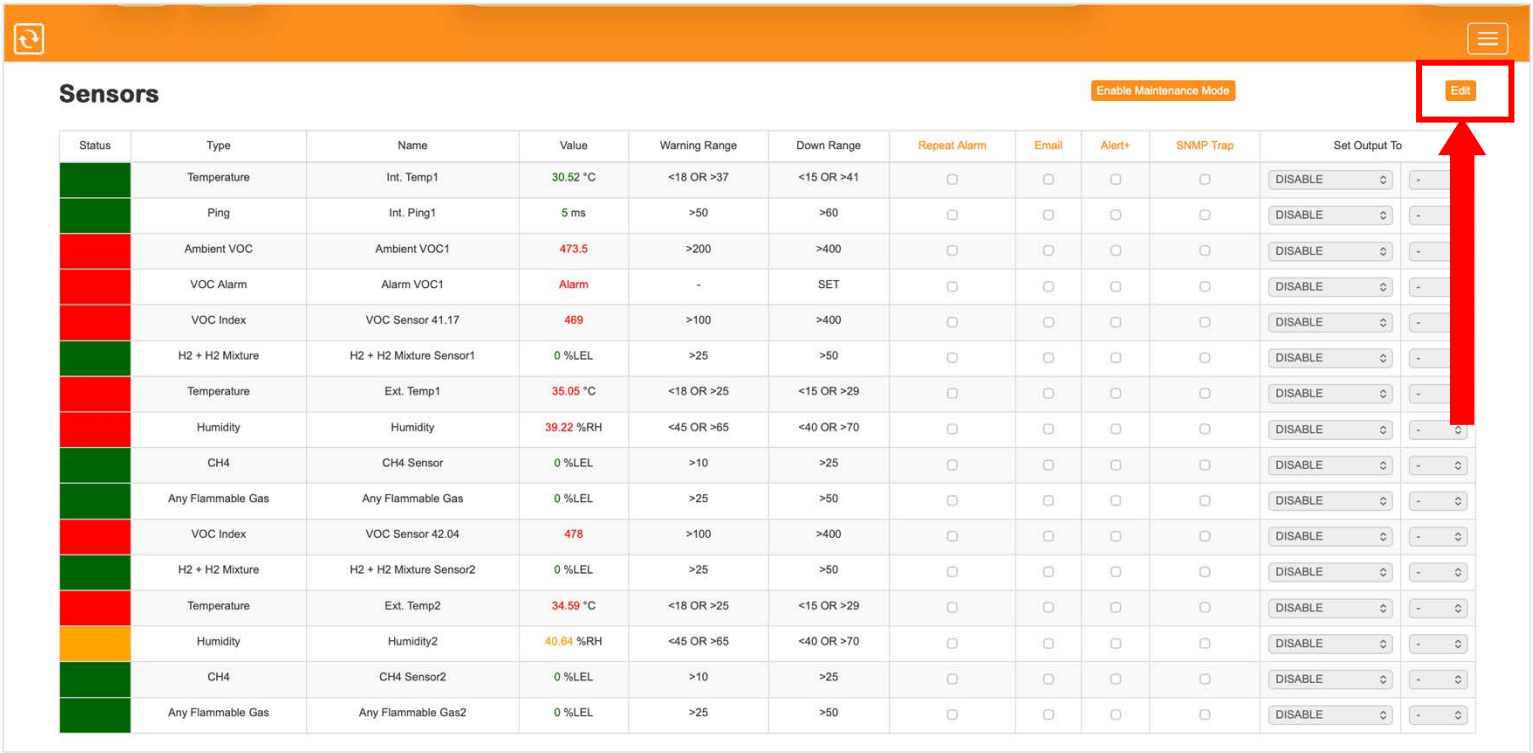
The recommended settings for VOC are:

- Baseline: 100
- Warning: 200
- Down: 400

7.6.1 via Base Unit

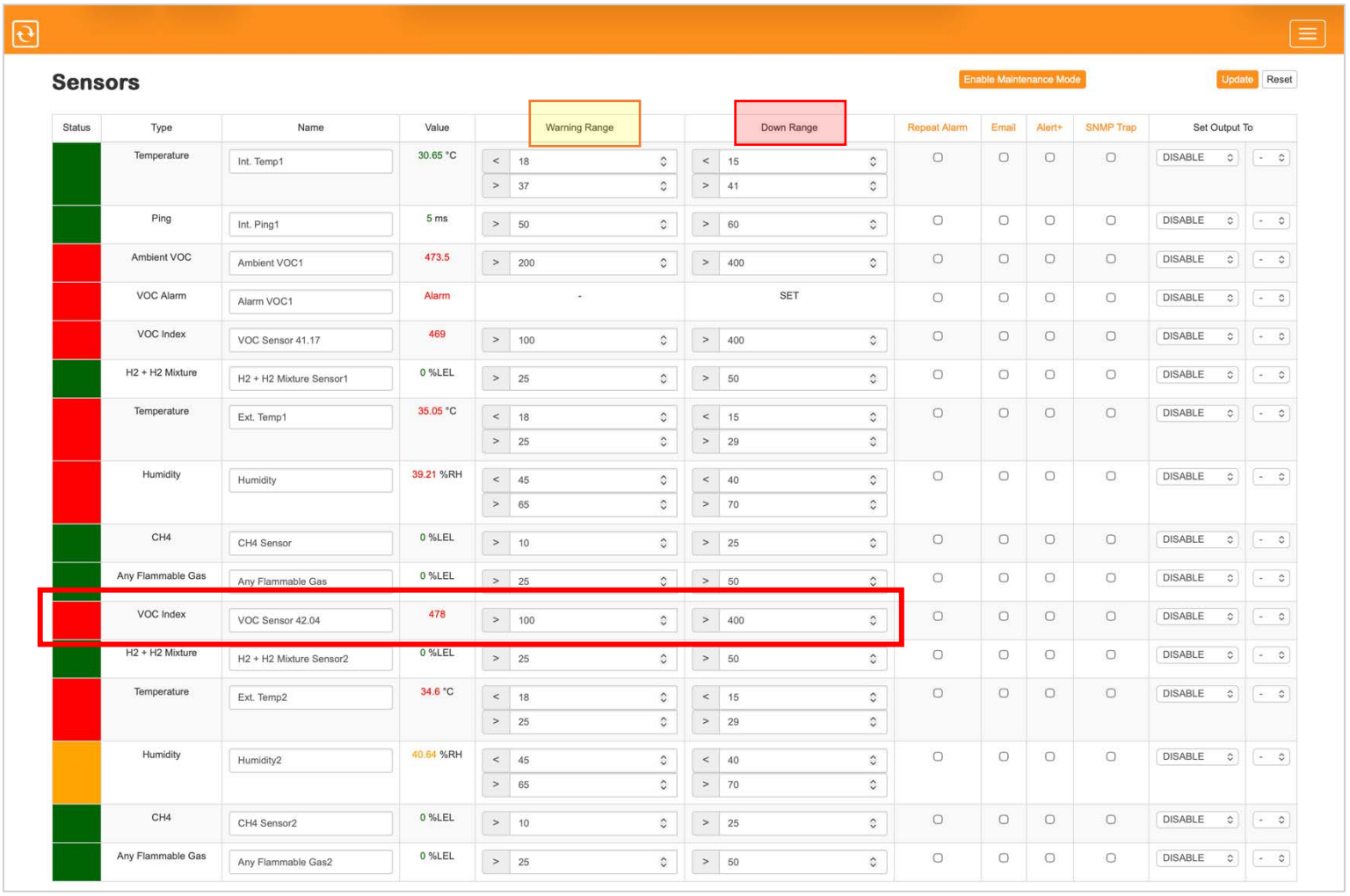
You can adjust or configure the VOC Index when the R-GAS-FLAMMABLE is connected to the Base Unit by accessing the IP address displayed on the Base Unit.

On the **sensor home page**, you will find an **Edit** button at the upper right-hand corner of the page.

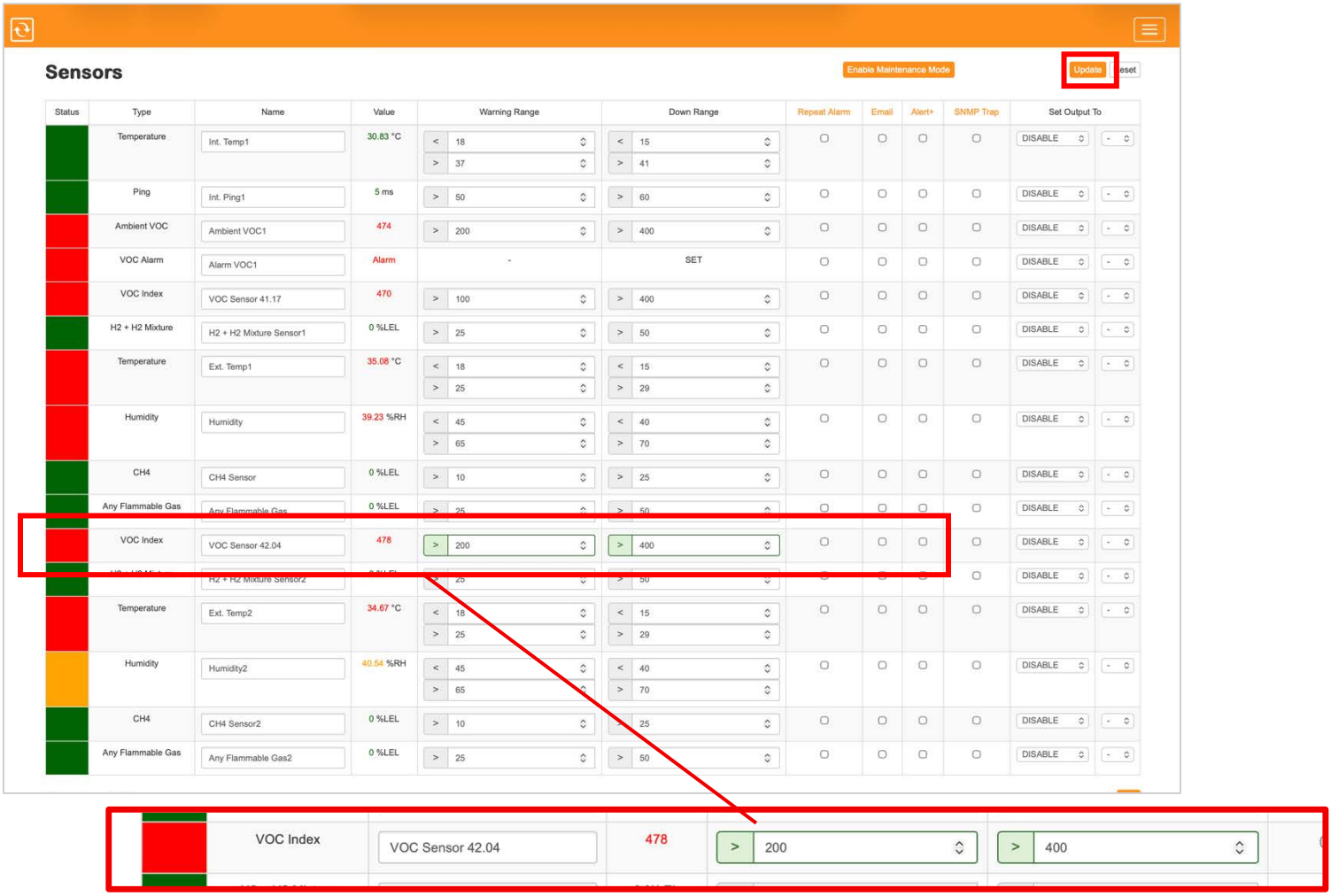


Status	Type	Name	Value	Warning Range	Down Range	Repeat Alarm	Email	Alert+	SNMP Trap	Set Output To	
	Temperature	Int. Temp1	30.52 °C	<18 OR >37	<15 OR >41					DISABLE	-
	Ping	Int. Ping1	5 ms	>50	>60					DISABLE	-
	Ambient VOC	Ambient VOC1	473.5	>200	>400					DISABLE	-
	VOC Alarm	Alarm VOC1	Alarm	-	SET					DISABLE	-
	VOC Index	VOC Sensor 41.17	469	>100	>400					DISABLE	-
	H2 + H2 Mixture	H2 + H2 Mixture Sensor1	0 %LEL	>25	>50					DISABLE	-
	Temperature	Ext. Temp1	35.05 °C	<18 OR >25	<15 OR >29					DISABLE	-
	Humidity	Humidity	39.22 %RH	<45 OR >65	<40 OR >70					DISABLE	-
	CH4	CH4 Sensor	0 %LEL	>10	>25					DISABLE	-
	Any Flammable Gas	Any Flammable Gas	0 %LEL	>25	>50					DISABLE	-
	VOC Index	VOC Sensor 42.04	478	>100	>400					DISABLE	-
	H2 + H2 Mixture	H2 + H2 Mixture Sensor2	0 %LEL	>25	>50					DISABLE	-
	Temperature	Ext. Temp2	34.59 °C	<18 OR >25	<15 OR >29					DISABLE	-
	Humidity	Humidity2	40.64 %RH	<45 OR >65	<40 OR >70					DISABLE	-
	CH4	CH4 Sensor2	0 %LEL	>10	>25					DISABLE	-
	Any Flammable Gas	Any Flammable Gas2	0 %LEL	>25	>50					DISABLE	-

Clicking the **Edit** button enables you to modify the sensor settings, including the **Warning** and **Down** ranges.

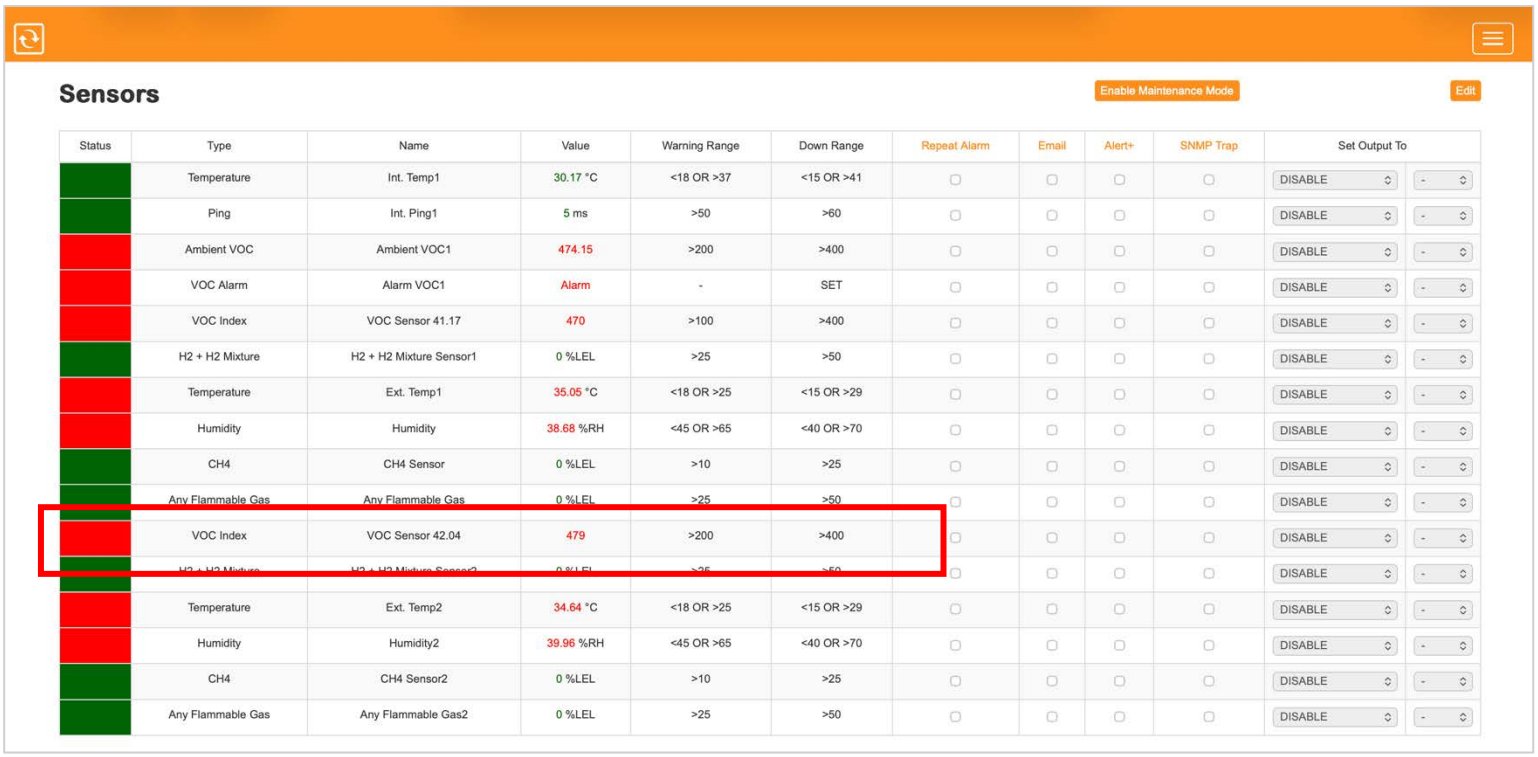


To apply the recommended settings, simply adjust the **Warning** range to 200 and the **Down** range to 400, then click **Update** at the upper right corner of the page.



After clicking Update, a confirmation message will appear once the update is successful. Then, click on Return to Sensor Status.

The applied settings are now visible. These settings are user-configurable and may be modified as needed, based on your specific requirements or preferences.



Status	Type	Name	Value	Warning Range	Down Range	Repeat Alarm	Email	Alert+	SNMP Trap	Set Output To	
	Temperature	Int. Temp1	30.17 °C	<18 OR >37	<15 OR >41					DISABLE	-
	Ping	Int. Ping1	5 ms	>50	>60					DISABLE	-
	Ambient VOC	Ambient VOC1	474.15	>200	>400					DISABLE	-
	VOC Alarm	Alarm VOC1	Alarm	-	SET					DISABLE	-
	VOC Index	VOC Sensor 41.17	470	>100	>400					DISABLE	-
	H2 + H2 Mixture	H2 + H2 Mixture Sensor1	0 %LEL	>25	>50					DISABLE	-
	Temperature	Ext. Temp1	35.05 °C	<18 OR >25	<15 OR >29					DISABLE	-
	Humidity	Humidity	38.68 %RH	<45 OR >65	<40 OR >70					DISABLE	-
	CH4	CH4 Sensor	0 %LEL	>10	>25					DISABLE	-
	Any Flammable Gas	Any Flammable Gas	0 %LEL	>25	>50					DISABLE	-
	VOC Index	VOC Sensor 42.04	479	>200	>400					DISABLE	-
	H2 + H2 Mixture	H2 + H2 Mixture Sensor2	0 %LEL	>25	>50					DISABLE	-
	Temperature	Ext. Temp2	34.64 °C	<18 OR >25	<15 OR >29					DISABLE	-
	Humidity	Humidity2	39.96 %RH	<45 OR >65	<40 OR >70					DISABLE	-
	CH4	CH4 Sensor2	0 %LEL	>10	>25					DISABLE	-
	Any Flammable Gas	Any Flammable Gas2	0 %LEL	>25	>50					DISABLE	-

7.6.2 via Modbus RTU

The VOC Index is a relative air quality indicator that reflects changes in volatile organic compound (VOC) levels over time. Instead of reporting specific gas concentrations, it provides a scaled index value that helps detect trends, abnormal conditions, and potential air quality risks.

Using Modbus RTU, you can monitor the VOC Index and configure relay triggers based on VOC thresholds.

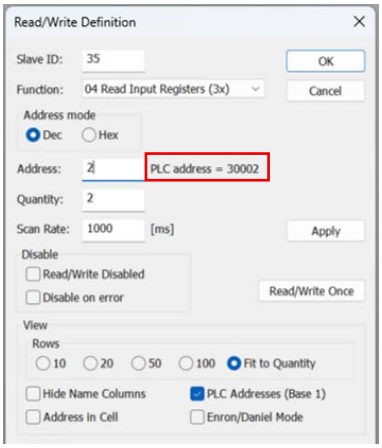
The VOC Index is accessible via the Modbus registers listed below. For this example, Modbus Poll is used as the reference tool; however, you may use any compatible Modbus master software.

(Refer to Section 7.4 – Modbus Table for detailed register information.)

1. The VOC Index register is below:

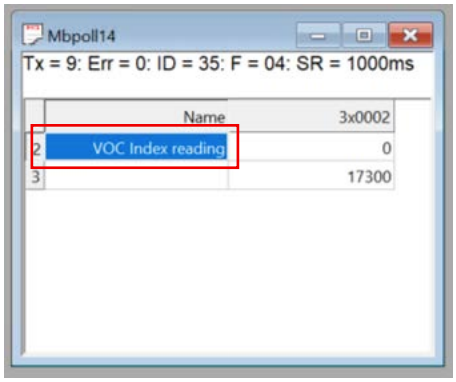
30002 to 30003	VOC Reading	Read-Only	32-bit Float (Little Endian | Byte Swap)	In VOC Index

2. Configure the Read/Write settings and ensure that the PLC address matches exactly with the Modbus register assigned to the VOC index. In this case, start at address 30002 with a quantity of 2.

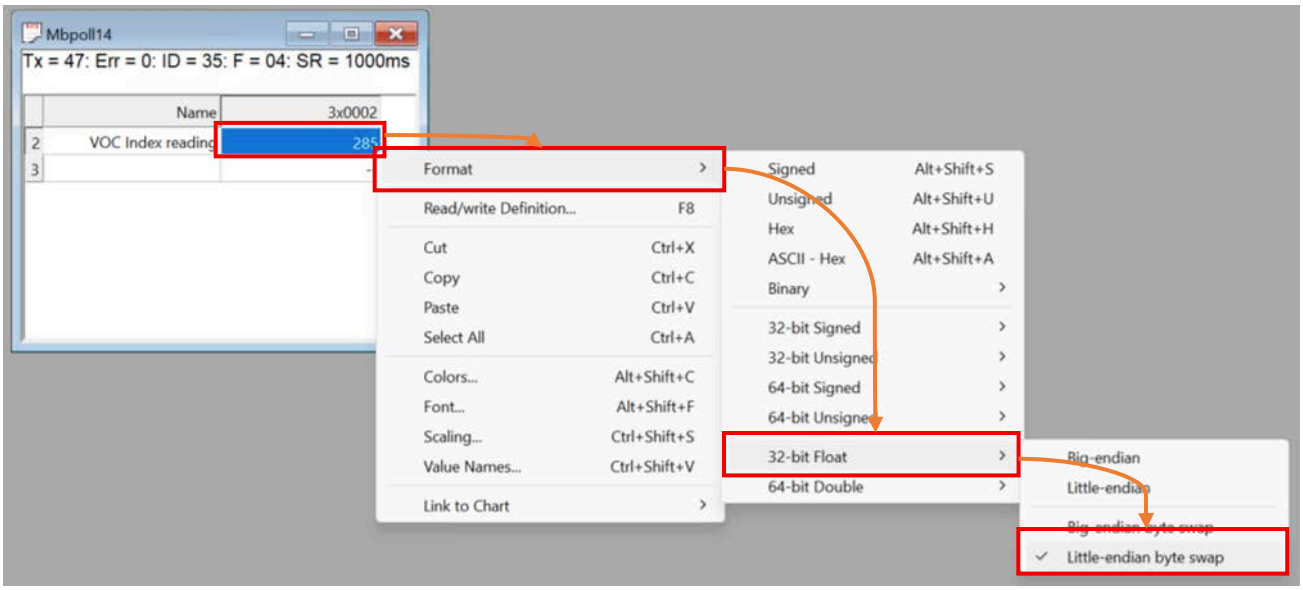


3. Apply the settings and click OK, making sure all other parameters are correct.

4. Assign a name to the register for easy identification.
(we name it as VOC Index reading on the image below)



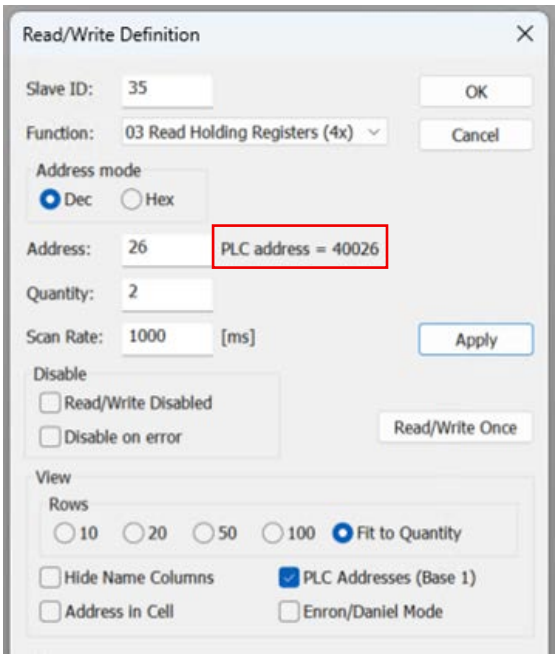
5. Right click the value then set the format to “32-bit Float / Little-endian byte swap”.



6. Now, that we have the VOC Index reading, let us set the Trigger source for relay A and B. Using the Trigger source value below:

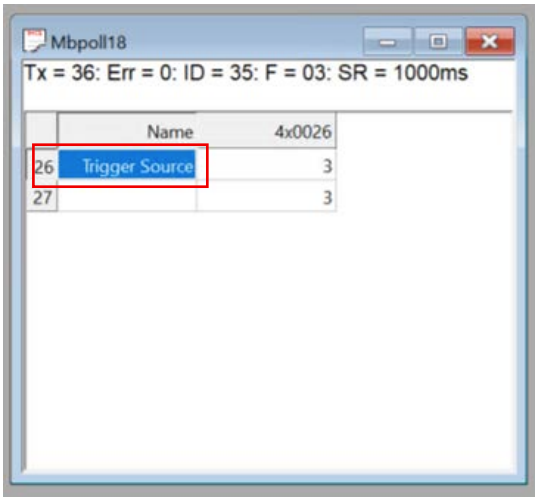
40026	Relay A - Trigger Source	Read-Write	u8	0 = H2; 1 = Temp; 2 = Hum; 3 = VOC; 4 (Default) = CH4; 5 = Direct control; 6 = Fault Relay; 7 = any gas (H2, CH4 and diff gas concentration); 8 = H2 mixture
40027	Relay B - Trigger Source	Read-Write	u8	0 = H2; 1 = Temp; 2 = Hum; 3 = VOC; 4 (Default) = CH4; 5 = Direct control; 6 = Fault Relay; 7 = any gas (H2, CH4 and diff gas concentration) ; 8 = H2 mixture

7. Configure the Read/Write settings and ensure that the PLC address matches exactly with the Modbus register assigned to Trigger source. In this case, start at address 40026 with a quantity of 2.



8. Apply the settings and click OK, making sure all other parameters are correct.

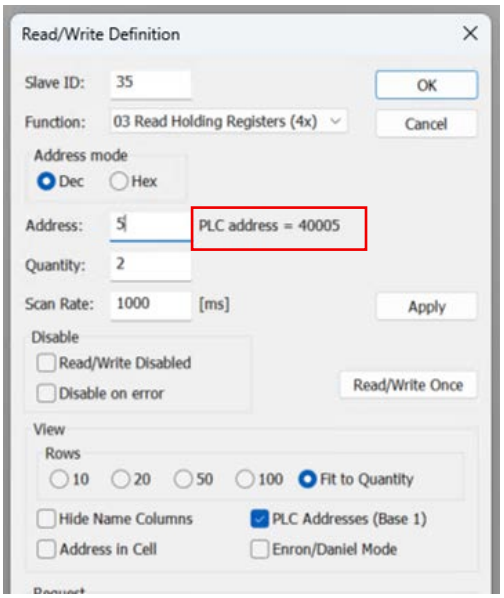
9. Assign a name to the register for easy identification. Our trigger source is coming from 3 = VOC. (we name it as Trigger source on the image below)



10. Now that the trigger source has been set, we can configure the VOC Index threshold.

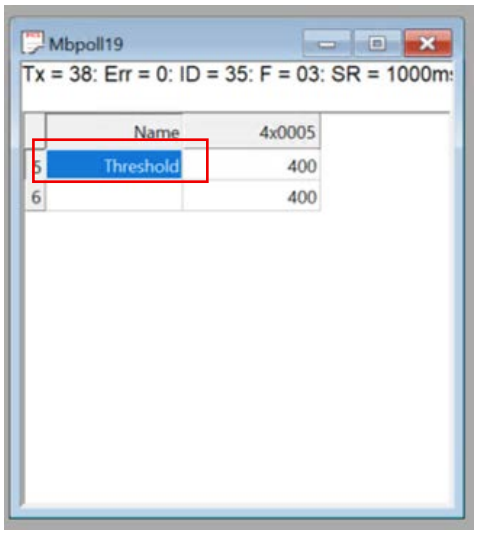
40005	Relay A Threshold	Read-Write	u16	This is where you set the value to trigger the relay based on the sensor you chose on address 40026
40006	Relay B Threshold	Read-Write	u16	This is where you set the value to trigger the relay based on the sensor you chose on address 40027

11. Configure the Read/Write settings and ensure that the PLC address matches exactly with the Modbus register assigned to the Threshold. In this case, start at address 40005 with a quantity of 2.



12. Apply the settings and click OK, making sure all other parameters are correct.

13. Assign a name to the register for easy identification.
    (we name it as Threshold on the image below)

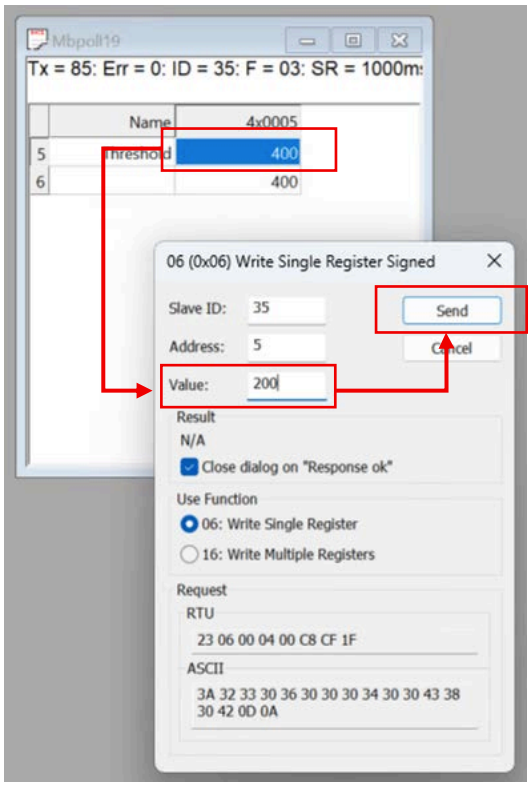


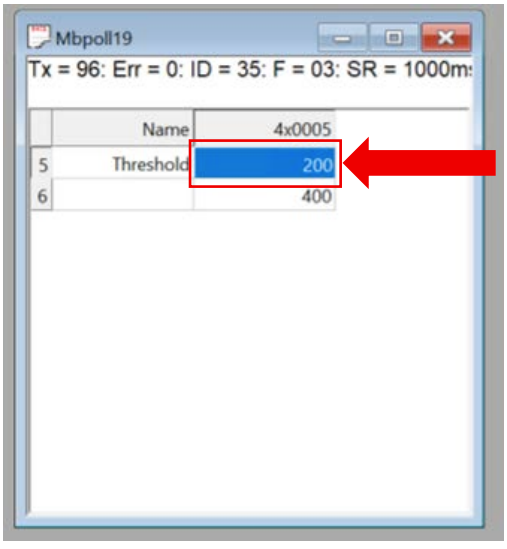
Currently, the thresholds for Relay A and Relay B are set to 400. These values can be adjusted according to your specific requirements. For this example, we will configure:

Relay A: 200 (Warning)
Relay B: 400 (Down)

This allows the system to trigger alerts at different levels based on the set thresholds.

To adjust the Relay A Threshold, simply double-click the value in line 5 (Relay A). A pop-up window will appear, allowing you to enter and save the desired threshold value.



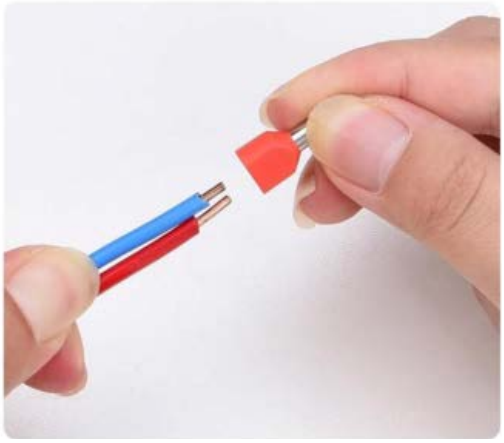


7.7 Connecting R-GAS-FLAMMABLE to Fire Alarm

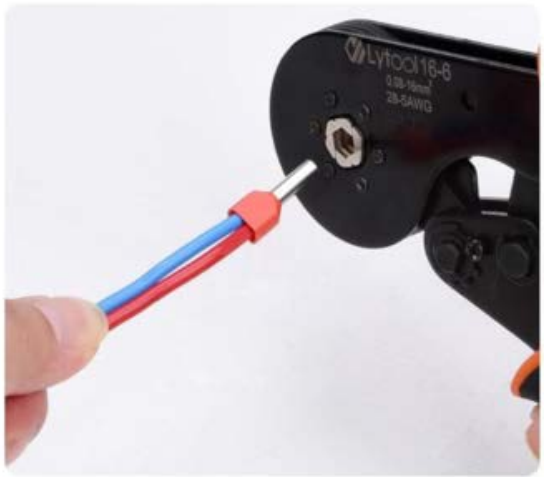
When connecting the R-GAS-FLAMMABLE to two fire alarm wires in a terminal block for a series connection, follow these crimping steps:

1. **Prepare the wires:**
    - Strip the insulation from the ends of the two fire alarm wires to expose the copper conductors. Ensure both wires have the same stripped length for a secure connection.

2. **Insert into the Ferrule:**
    - Take a 16-24 AWG ferrule connector and insert both stripped wire ends into it. Ensure that the wires are fully inserted and aligned properly within the ferrule.



3. **Crimp the Ferrule:**
    - Place the ferrule into the crimping tool, aligning it within the correct slot. Squeeze the crimping tool firmly to secure the connection. The ferrule should now hold both wires tightly.



4. **Verify the Crimped Connection:**

    - Check the crimped ferrule to ensure a secure and solid connection. The wires should not be loose or able to slip out.

5. **Connect to the Terminal Block:**

    - Insert the crimped ferrule into the designated terminal block for the R-GAS-FLAMMABLE.
    - For detailed instructions on properly securing the ferrule in the terminal block, please refer to **Section 7.1**, which provides step-by-step guidance to ensure a secure and reliable connection.

7.8 Connecting R-GAS-FLAMMABLE Detector to your Android Device

The R-GAS-FLAMMABLE detector is designed to provide accurate and reliable monitoring of flammable gases in industrial and energy-critical environments. To simplify configuration and enable real-time access to detector data, we offer a mobile solution through our dedicated Companion App.

Using the AX-USB-RJ45 communication adapter, you can directly connect the R-GAS-FLAMMABLE to any compatible Android device. This allows for convenient on-site configuration, diagnostics, and data viewing-right from your mobile device.

For detailed setup instructions and additional information, please refer to the Prevent-iON User Manual available on our website.

8 Testing

8.1 Periodic Bump Testing

To confirm proper operation and ensure full integration with safety and other systems, periodic bump testing of detectors shall be performed. In the absence of specific code requirements specifying the testing interval, it is recommended to conduct bump testing at least annually out of an abundance of caution. This testing may be conveniently carried out during scheduled fire safety inspections. Additionally, bump testing shall be performed during the initial setup of the system

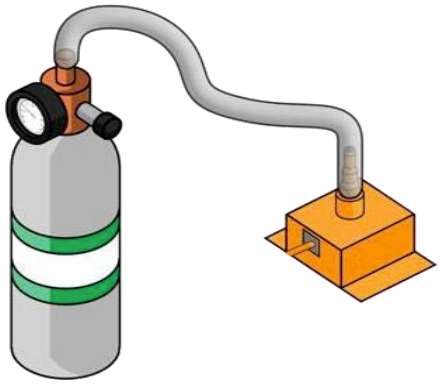
To perform bump testing we recommend the use of calibrated gas cylinders. Such gas cylinders can be sourced from Calgas. For the gas regulator, we utilize a 2.5 LPM regulator from Calgas https://www.calgas.co/6c10

Note:

When a bump test is scheduled, it is **ideal** to perform the firmware update beforehand. Since the smartphone is already connected to the device through the **Prevent-iON Companion App**, the firmware can be conveniently updated prior to testing. This ensures the device operates with the latest firmware version and incorporates the most recent performance and stability improvements.

Required equipment:

- Gas detector
- Gas Bump Adapter (AX-GAS-BUMP)
- Gas tubing (from your local gas supplier)
- Gas valve regulator (300ml/min)
- Gas canister



Procedure:

1. Prepare Workspace:
   - Ensure proper ventilation in the testing area.

2. Prepare the detector:
   - Remove the gas cap from the detector by rotating it counter clockwise.
   - Replace it with the gas bump adapter, rotating it clockwise until secure.

3. Connect tubing:
   - After securely attaching the gas bump adapter to the gas detector, connect one end of the gas tubing to the adapter, and the other end to the gas canister.
   - Finally, connect the gas detector to the controller and wait until warm up time is finish.

4. Secure Gas Cylinder:
   - Ensure that the gas cylinder is securely mounted and in a stable position.

5. Perform the Bump Test:
   - Gradually open the cylinder valve to ensure a controlled flow of gas to the detector. Do not fully open the valve; only open it enough to allow the gas to flow.
   - Allow the gas to flow continuously until the detector registers its presence and triggers a reading
   - Monitor the detector's readings on your monitoring device.

6. Stop Gas Flow:
   - Close the cylinder valve to stop the flow of gas.

7. Verify the Detector Response:
   - Check the detector readings. The values should respond to the gas exposure.
   - Ensure that the detector triggers an alert if configured to do so.
     (Please refer to **section 8.4** Testing via Modbus if a base unit is not present)

8. Maintenance:
   - If the detector passes the bump test, consider it operational.
   - If any issues are identified via the status register during the test, make sure to note what error or value is showing before contacting the manufacturer.

8.2 Bump testing for CH4

It is recommended to use synthetic air containing approximately 20% VOL oxygen, simulating the conditions of a typical natural environment. It is also recommended to preheat for 7 days or at least 2 days prior in doing the bump testing. While there is no specified gas flow rate, it is advised to maintain a low flow rate, gradually open the cylinder valve to ensure a controlled flow of gas to the detector. Do not fully open the valve; only open it enough to allow the gas to flow to ensure optimal performance.

CH4 Gas Cylinder: 50% LEL - 17L steel (Compatible with 6000 Series Multiflow)
https://www.calgas.co/biosystems-54-9079-equivalent

Important note:

Results might differ when using target gas mixed with other gases.

8.3 Bump testing for H2 & other flammable gases

To ensure accurate testing, the background gas should remain consistent throughout the procedure by using zero air or the recommended gas mixtures outlined in the table below. The suggested flow rate for the gas valve regulator is 300 mL/min. Refer to the table below for the recommended gas cylinder mixtures suitable for bump testing.

H2 Gas Cylinder: 50% LEL - 34L steel (Compatible with 6000 Series Multiflow)
https://www.calgas.co/50lel-hydrogen-34l

Important note:

Results might differ when using target gas mixed with other gases.

	Nitrogen	Oxygen	Argon	CO2	Flammable Gas	H2S	CO
"Quad Mix" with 50% LEL (ISO) methane	Balance	0.18	0	0	0.025	25 PPM	100 PPM
"Quad Mix" with 50% LEL (IEC) methane	Balance	0.18	0	0	0.022	25 PPM	100 PPM

	Nitrogen	Oxygen	Argon	CO2	Flammable Gas
Synthetic (dry) air at 50% LEL (ISO) methane	0.7613	0.2043	0.0091	0.0004	0.025
Synthetic (dry) air at 50% LEL (IEC) methane	0.7636	0.2049	0.0091	0.0004	0.022
Synthetic (dry) air at 50% LEL (ISO) pentane	0.7749	0.2079	0.0092	0.0004	0.0075

	Zero air	Flammable gas
50% LEL (ISO) methane	Balance	0.025
50% LEL (IEC) methane	Balance	0.025

Disclaimer:

If the detector will be subjected to excessively high gas concentrations (≥100% LEL), it is recommend to use the Any Flammable Gas reading instead of the specific target gas.

8.4 Testing via Modbus

It is advisable to conduct regular assessments of the gas detector's performance in critical environments. It plays a crucial role in ensuring the dependability, functionality, and security of systems utilizing Modbus communication.

Testing a device via Modbus involves using Modbus commands to read or write data from/to device's registers. Here's a general guide on how to perform Modbus testing manually:

Requirements:

- Modbus Master Device or Software
  - Use a Modbus master device or software to send commands and receive responses
  - Popular Modbus mater software includes Modbus Poll, QMod Master, or any other Modbus testing tool.
- Modbus Cable – It is recommended to use a shielded cable for the Modbus connection.
- R-GAS-FLAMMABLE

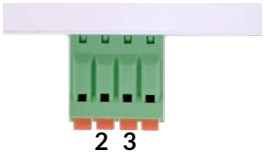
Procedure:

1. Identify device registers:
   - In order to identify the device registers, check the Modbus Table in **section 7.4** to find the specific registers you need to read or write. These registers store important data like detector reading, device status, or control information.

2. Confirm Modbus device address:
   - Every device on a Modbus network has its own unique address. Make sure you know the address of the device you're working with.

3. Check communication settings:
   - Please refer to **section 7.3.1 to 7.4** to find out the communication settings your device uses, like the baud rate, stop bits, and parity.
   - Next step: Set your Modbus master device or software to use the same settings.

4. Connect the Modbus Master:
   - Physically connect your Modbus master (e.g., computer or controller) to the detector via terminal block. Please refer to the image below for reference:



Terminal Block – This block comprises terminals for various connections :

- Terminal 2: (B-) Connection
- Terminal 3: (A+) Connection

Note: Please refer to **section 7.1** when inserting wires into the terminal block

5. Launch Modbus master software:
   - Launch your Modbus master software on your computer and create a new connection to the detector.

6. Configure Connection:
   - Enter the communication parameters (Baud rate, parity , stop bit) in the Modbus master software to establish a connection.
   - For establishing communication between the detector and the Modbus master, set a unique slave ID by adjusting the rotary encoder according to your preference.

- Once the Slave ID is assigned, enter this designated ID into your Modbus Master configuration to establish communication between the detector and the Modbus Master.
- **Note :** The Slave ID on the rotary as showed on the example on **section 7.3** is set to hexadecimal.
- Next, identify the Modbus register address of the detector you want to check. For example, if you're checking the VOC, its address is 30002. Once you have the correct address, enter it into your Modbus master software along with the quantity and scan rate. After configuring these settings, confirm or apply them.
- To retrieve the current detector value, ensure that you also input the correct data type for the detector. Once all settings are applied, you will be able to view the real-time detector values in your Modbus master software.

7. Identify Relay Register:
   - Determine the Modbus register address associated with the relay you want to trigger on the Modbus Slave device.
   - For example, the Modbus register address will be 40007 if you wanted to trigger the Relay A. Please see **section 7.4** for reference.
   - Note: Check if it's a discrete input, coil, or holding register. (these are just different types of data)

8. Write the Modbus Command:
   - In the Modbus master software – find the function code for writing to a discrete output (this allows you to control device like relays).
   - Enter the Modbus Slave ID, register address, and the command value (the value that will trigger the relay)

9. Send Modbus Command:
   - Trigger the relay by sending the configured Modbus command from the Modbus Master to the Modbus Slave device.
   - Monitor the response from the Modbus Slave to ensure successful relay triggering.

10. Verify the Relay State:
    - Check the physical state of the relay on the Modbus Slave device to confirm that it has been triggered.

11. Triggering Relay using gas bump test:
    - Identify the detector value you wish to test during the gas bump procedure. For more details, refer to number 6.
    - Once you've identified the detector, assign it to one of the relays. For example, assign H2 to Relay A threshold. In the Relay A threshold setting, enter 0, since H2 = 0. (please see Modbus table in **section 7.4** for reference)
    - In Modbus address 40005, which corresponds to Relay A's threshold, enter your desired value. For this example, set the threshold to 10% LEL
    - Apply the gas from your canister to the detector (refer to **Section 8.1** for gas bump testing). Observe if the H2 value increases, indicating a successful bump test. When the value exceeds the set threshold, such as 10% LEL, Relay A will be triggered.

8.5 Environmental Chamber Testing Policy

To demonstrate humidity robustness, R-GAS-FLAMMABLE is qualified to IEC 60068-2-30 using a 55 °C high plateau at 93% + 3% RH, Variant 2 cool-down, 6 × 24h cycles (first 2 cycles unpowered; operation verified after recovery). A separate steady dwell is performed at 55 °C / 93-95% RH for 96h.

Note:

The calibration free component must be kept operating in a non-condensing environment. This means that the dew point temperature should be at least 5C below device temperature. For units below firmware 4.41.09 faults may be triggered when the unit operates above an absolute humidity limit of 60g/m3. As of firmware 4.41.09 or higher, the detector's logic is changed when above 60g/m3 so that those faults are no longer triggered.

The +75 °C operating rating applies to dry/non-condensing service. Humidity testing is not performed at 75 °C, and test conditions such as 75 °C / 95% RH are outside the product's operating envelope.

9 Recommended settings for BESS

For BESS applications our target gas is not CH4 but H2 + H2 gas mixtures. By default the detector is configured for CH4 only detection.

Therefore when using the R-GAS-FLAMMABLE inside BESS containers we MUST change the default configuration of the detector to ensure that it detects the target gas and that it operates correctly in outside environments.

Additionally, some sensing components have limited environmental operating ranges, which may lead to unnecessary faults. The R-GAS-FLAMMABLE features multi-gas detection capabilities through detector fusion technology utilizing multiple detection components.

Detector fusion enables us to automatically calibrate the CH4 only gas sensing component and to use different gas sensing mechanisms when one sensing component is outside its environmental envelope.

This guide will show you how to change from the default configuration of CH4 detection to H2 + H2 gas mixture detection for BESS and disable fault alerts to avoid alerts from sensing components when they are used out of their specified range.

The recommended settings for BESS are:

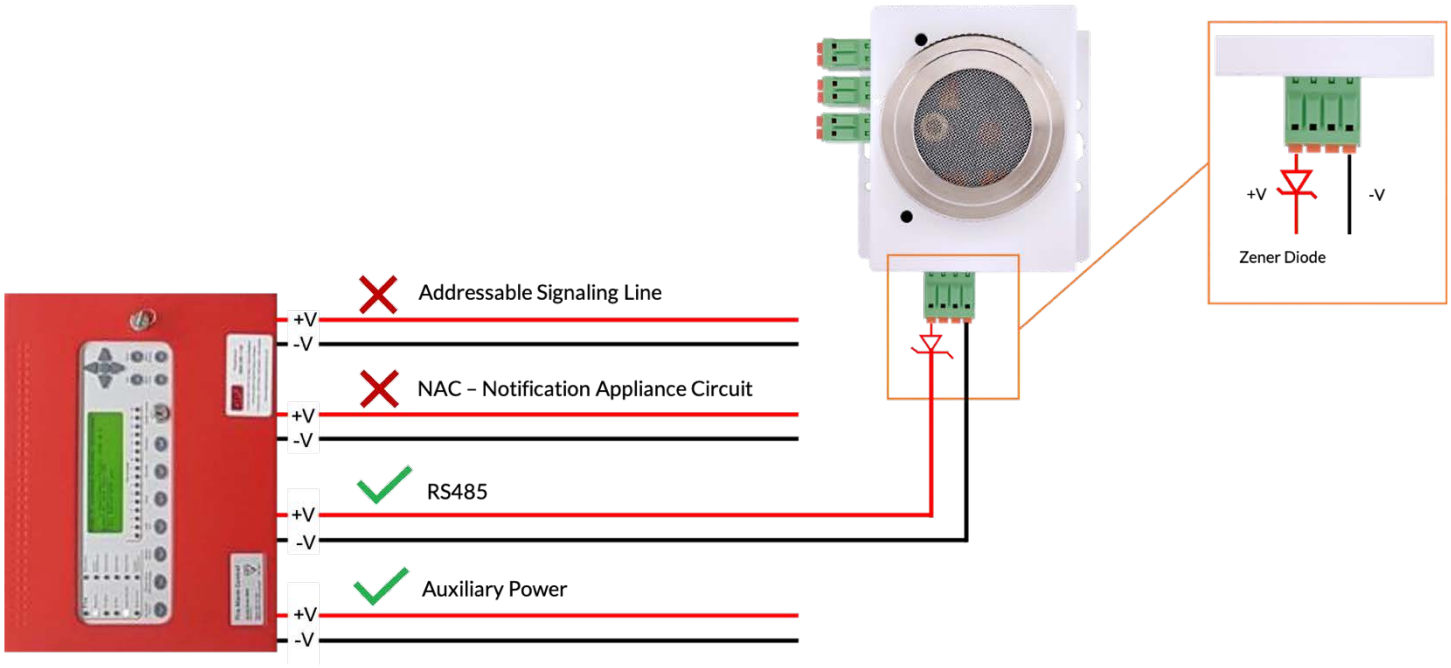
- target gas detection: H2 + H2 mixture
- relays A and B: alert at 10% LEL and at 25% LEL
- fault relay C: alert when multi-gas sensing fails, end of life signal, detected relay failure

10 Application Notes

When connecting the R-GAS-FLAMMABLE into panels please note that it is not compatible with addressable signaling line circuits (SLCs) or notification appliance circuits (NACs), and must not be connected to any addressable device loops.

The detector must be powered from a regulated DC output provided by the fire panel. For example, this may include an RS485 interface or a dedicated auxiliary power output intended for non-addressable devices.

Important: Always ensure the detector is connected with the correct polarity (±). If the supply voltage exceeds 24V DC (±10%), a Zener diode must be installed in series with the positive power line to lower the voltage down.



To keep the relay in the alarm state even after alert levels drop (latching mode), set the "**Relay Running Time**" parameter to "**-1**". Refer to the table below for details.

40010	Relay A min. running time	Read-Write	u16	In seconds; -1 No end 00 – right away
40011	Relay B Delay	Read-Write	u16	In Seconds
40012	Relay B min. running time	Read-Write	u16	In seconds; -1 No end 00 – right away
40022	Relay C Threshold	Read-Write	u16	This is where you set the value to trigger the relay based on the sensor you chose on address 40028
40023	Relay C Default State	Read-Write	u8	0 = Normally Open, 1 = Normally Close
40024	Relay C Delay	Read-Write	u16	In Seconds
40025	Relay C min. running time	Read-Write	u16	In seconds; -1 No end 00 – right away

This can be done via Modbus RTU. Instructions for accessing the registers are provided in **Section 11.1**, using the Modbus addresses listed in the table above.

Should you need to reset the relay triggers it is done by activating Modbus coil address 50, this register resets the relays to default.

50		Read-Write		Reset Relays to Default (ON/OFF or 1/0)

11 Options to Program the detector

There are 2 options to program the detector:

1. Through Modbus RTU , which requires a PC, Modbus RTU software, USB-Serial adapter and 24V power supply to the detector.

2. Using the Prevent-ION Mobile application, This app requires a compatible android phone or tablet (capable of reverse wired charging) and our AX-USB-RJ45 accessory.

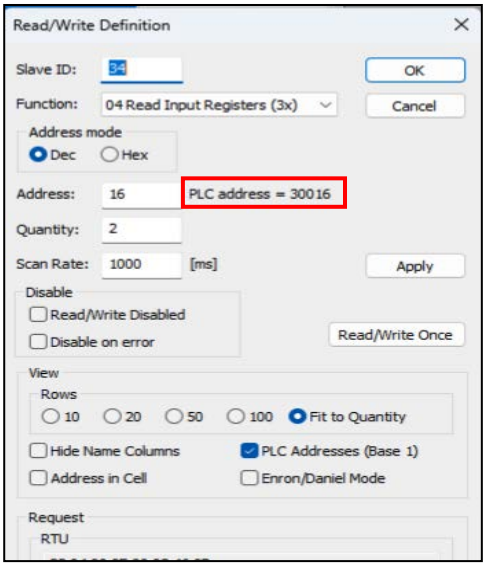
11.1 Configuration for H2 + H2 mixture via Modbus RTU

Below is a step-by-step guide on how to manually add and access the H_2 + gas mixture metrics using your modbus software. For this guide, we'll be demonstrating the process with Modbus Poll software: (https://www.modbustools.com/download/ModbusPollSetup64Bit.exe)

1. The H2 mixture Modbus register is below:

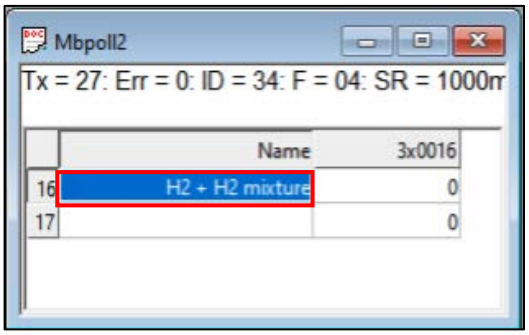
30013 to 30014	Other Flammable Gas	Read-Only	32-bit Float (Little Endian | Byte Swap)	In %LEL (Excluding H2)
30016 to 30017	H2 mixture	Read-Only	32-bit Float (Little Endian | Byte Swap)	In % LEL (Available only in Firmware version 4.33 onwards)
30018 to 30019	Any Flammable Gas	Read-Only	32-bit Float (Little Endian | Byte Swap)	In % LEL (Available only in Firmware version 4.33 onwards)

2. Configure the Read/Write settings and ensure that the PLC address matches exactly with the Modbus register assigned to the H_2 mixture. In this case, start at address 30016 with a quantity of 2.

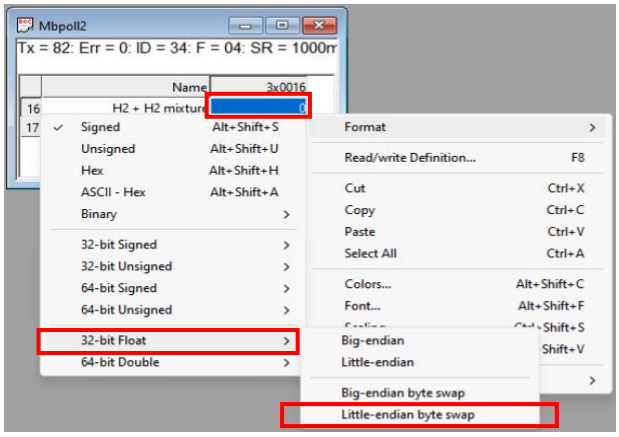


3. Apply the settings and click OK, making sure all other parameters are correct.

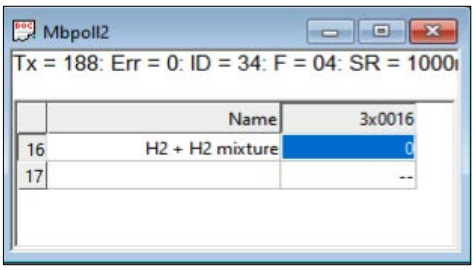
4. Assign a name to the register for easy identification.
(we name it as H2+H2 mixture on the image below)



5. Right click the value then set the format to “32-bit Float / Little-endian byte swap”.



6. Now, when the R-GAS-FLAMMABLE detects H_2 gas mixed with other gases, the corresponding value will be displayed in this section. In this case, the value is 0, as the detector is not currently detecting any H_2 + H_2 mixture. An approximate response time of 10 seconds is required before the detector begins displaying data in the software.



11.1.1 Assigning relay trigger source

We will not set the relay trigger source so that the relays would trigger in an event that H2 + H2 mixture goes beyond elevated values.

40026	Relay A - Trigger Source	Read-Write	u8	0 = H2; 1 = Temp; 2 = Hum; 3 = VOC; 4 (Default) = CH4; 5 = Direct control; 6 = Fault Relay; 7 = any gas (H2, CH4 and diff gas concentration); 8 = H2 mixture
40027	Relay B - Trigger Source	Read-Write	u8	0 = H2; 1 = Temp; 2 = Hum; 3 = VOC; 4 (Default) = CH4; 5 = Direct control; 6 = Fault Relay; 7 = any gas (H2, CH4 and diff gas concentration) ; 8 = H2 mixture
40028	Relay C- Trigger Source	Read-Write	u8	0 = H2; 1 = Temp; 2 = Hum; 3 = VOC; 4 = CH4; 5 = Direct control; 6 (Default) = Fault Relay ; 7 = any gas (H2, CH4 and diff gas concentration) ; 8 = H2 mixture

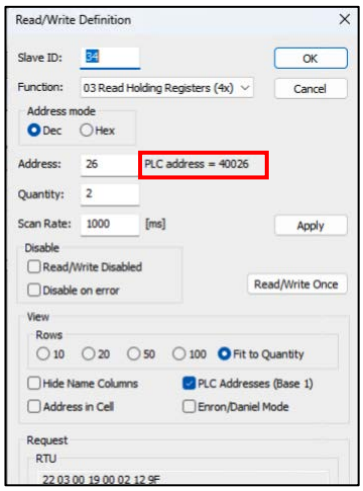
To change or assign the relay trigger source, follow the steps below:
In this application, we'll be assigning the H_2 + gas mixture to trigger both Relay A and Relay B, respectively.

Relay A - H2 + H2 Mixture
Relay B - H2 + H2 Mixture
Relay C - Fault (Default configuration no need to change)

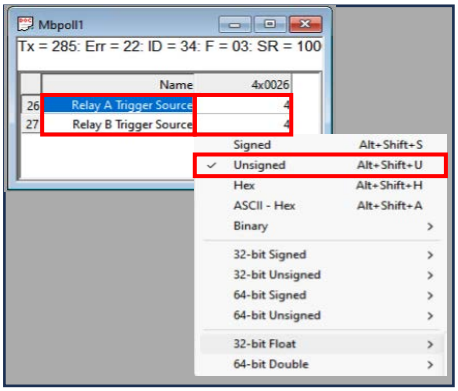
1. Locate the Modbus register for the Relay Trigger Source, as well as the data for the metric you wish to assign. (Modbus address is provided below)

    a. Relay A – Trigger Source : 40026
    b. Relay B – Trigger Source : 40027

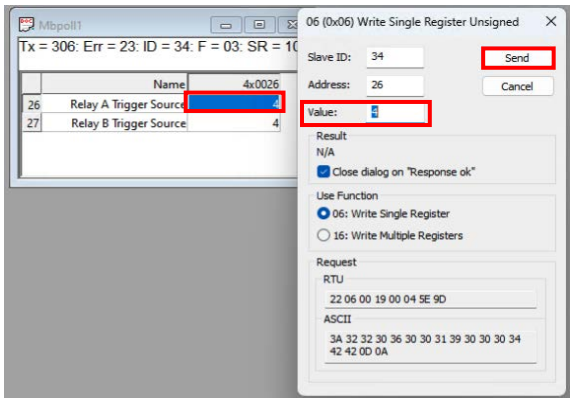
2. Follow the same procedure as in **Section 11.1** to see Relay A and Relay B – Trigger Source using the modbus address stated above (#1)



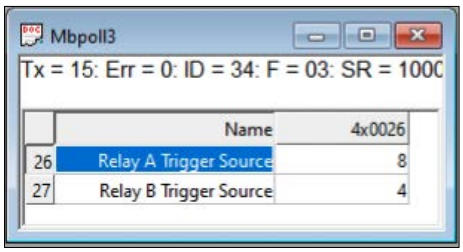
3. Make sure to set the data format to "Unsigned" and assign a name to the register. Please note that the default trigger source, CH_4 (Methane), will be displayed.



4. To change the default trigger source, double-click on the value (please see image below). A “write” section will appear—update the “value” to 8, as 8 corresponds to the H_2 mixture.



5. Click Send to apply the changes. After a few seconds, the value will update from 4 to 8, indicating that Relay A's trigger source is now set to the H_2 mixture.



6. Repeat step 4 and 5 to assign Relay B’s trigger source to the H_2 mixture, we can now set the LEL% threshold for each relay to trigger.

11.1.1.1 Secondary Trigger Source

Starting from firmware version 4.41.18, a new feature called Secondary Trigger Source has been introduced. This feature allows users to configure a secondary trigger source in addition to the primary trigger. With this enhancement, the system can evaluate two independent trigger conditions for relay activation.

The Secondary Trigger Source operates using an **AND logic condition**, meaning both configured trigger sources must meet their defined thresholds for the relay to activate.

Example configuration:

	Trigger source 1	Trigger source 2
Relay A	H2 Mixture	CH4
Relay B	VOC	Humidity
Relay C	Temperature	H2

Example configuration:

Relay	Trigger source 1	Triggered?	Trigger source 2	Triggered?	Result
A	H2 Mixture	YES	CH4	YES	Relay activated
B	VOC	YES	Humidity	NO	Relay not activated

For example, Relay A is activated only when both Trigger Source 1 (H_2) and Trigger Source 2 (CH_4) reach their respective thresholds.

If only one condition is satisfied—such as Trigger Source 1 (VOC) reaching its threshold while Trigger Source 2 (Humidity) does not—Relay B remains **not activated**. This ensures that relay activation occurs strictly when all configured conditions are met.

11.1.2 Assigning relay thresholds

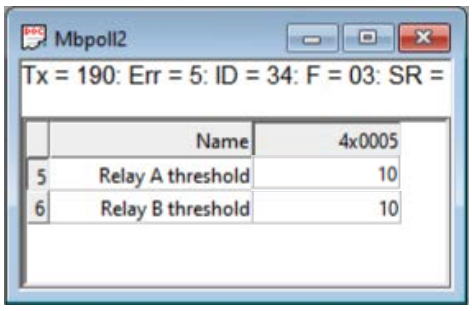
After adding the H_2 mixture and assigning it as the relay trigger source, you can now configure the trigger thresholds based on the LEL% (Lower Explosive Limit) of the H_2 mixture. Below are the modbus register addresses for the Relay A, Relay B and Relay C threshold.

40005	Relay A Threshold	Read-Write	u16	This is where you set the value to trigger the relay based on the sensor you chose on address 40026
40006	Relay B Threshold	Read-Write	u16	This is where you set the value to trigger the relay based on the sensor you chose on address 40027
40022	Relay C Threshold	Read-Write	u16	This is where you set the value to trigger the relay based on the sensor you chose on address 40028

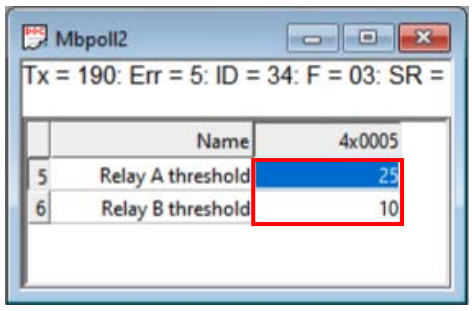
In this example, we'll be configuring thresholds of Relay A and Relay B, respectively.

1. Following the same procedure on **sections 11.1, 11.1.1 and 11.1.2**, add and configure the Read/Write definition, ensuring that the PLC address matches exactly with the Modbus register addresses assigned to Relay A and Relay B thresholds. Be sure to set the data format to "Unsigned."

2. The current values will then be displayed—10 and 10, which are the default LEL% threshold values set for CH_4 (We). The Relay B - 10 represents the warning state, and Relay A - 10 represents the down critical state.

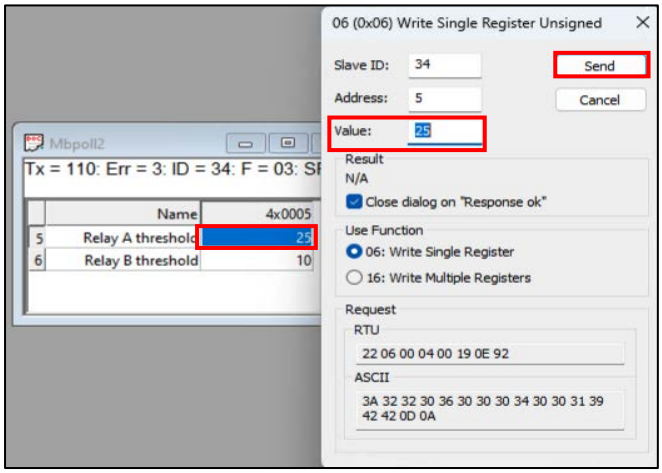


3. When the relay trigger source is set to "8" for the H_2 + H_2 mixture, the default thresholds of 25% LEL and 10% LEL will be automatically displayed.



The 25% LEL H_2 threshold for venting is based on NFPA 69 guidelines.

4. To modify these values, double-click on the Relay threshold entry. Click send after you input 25 on relay A then do the same for relay B but with 10 as its threshold.



Note:

While you are free to modify with your required threshold, our recommendation would be 25% LEL for relay A and 10% LEL for relay B.

11.1.3 Deactivating unnecessary fault triggers.

This configuration aims to remove false alerts. The instructions below will guide us how to turn the fault alert off for methane, VOC and Temperature.

1. The table below shows the address (40060) that we have to access repeating steps from **sections 11.1**.

				Decimal	Binary	Settings
40060	Fault Status Setting	Read-Write	u16	1	b0	VOC (Default off)
				2	b1	Temp/Hum Component (Default off)
				4	b2	Multi-gas Sensing Component
				8	b3	Methane
				16	b4	When enabled, Methane Fault triggers if both the multi-gas and methane sensing component fail.
				32	b5	Relay Control
				64	b6	Flash error
				512	b9	Condensation Protection
				Available only in Firmware version 4.39 onwards		

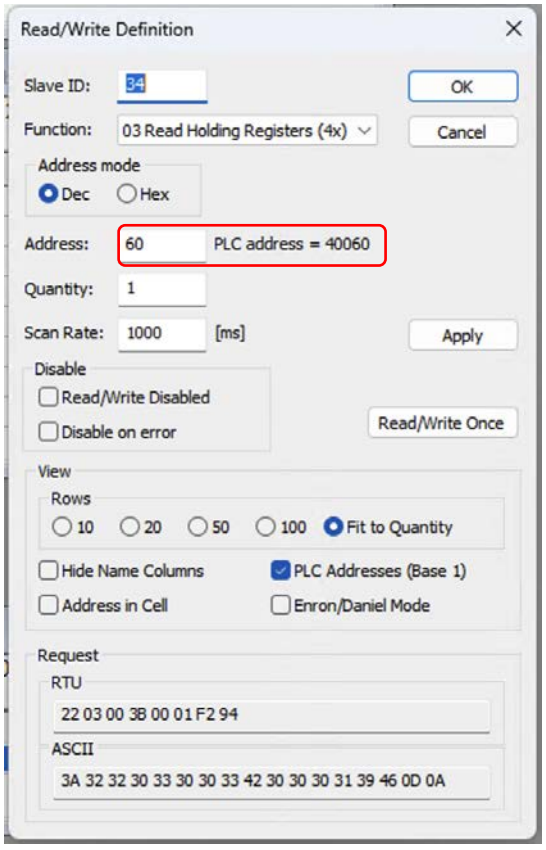
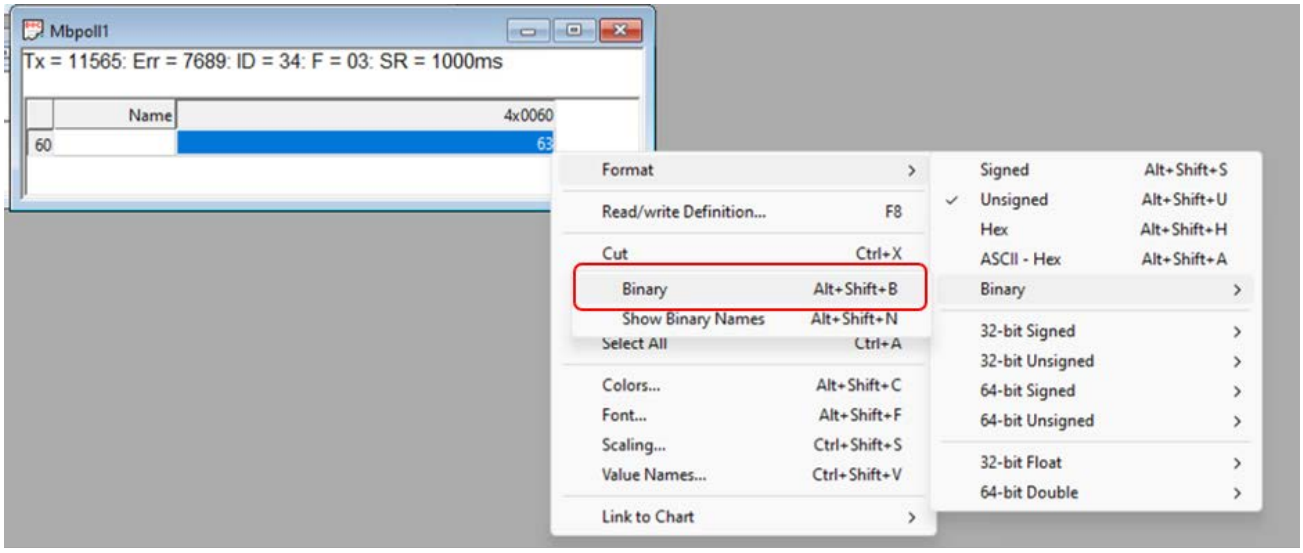


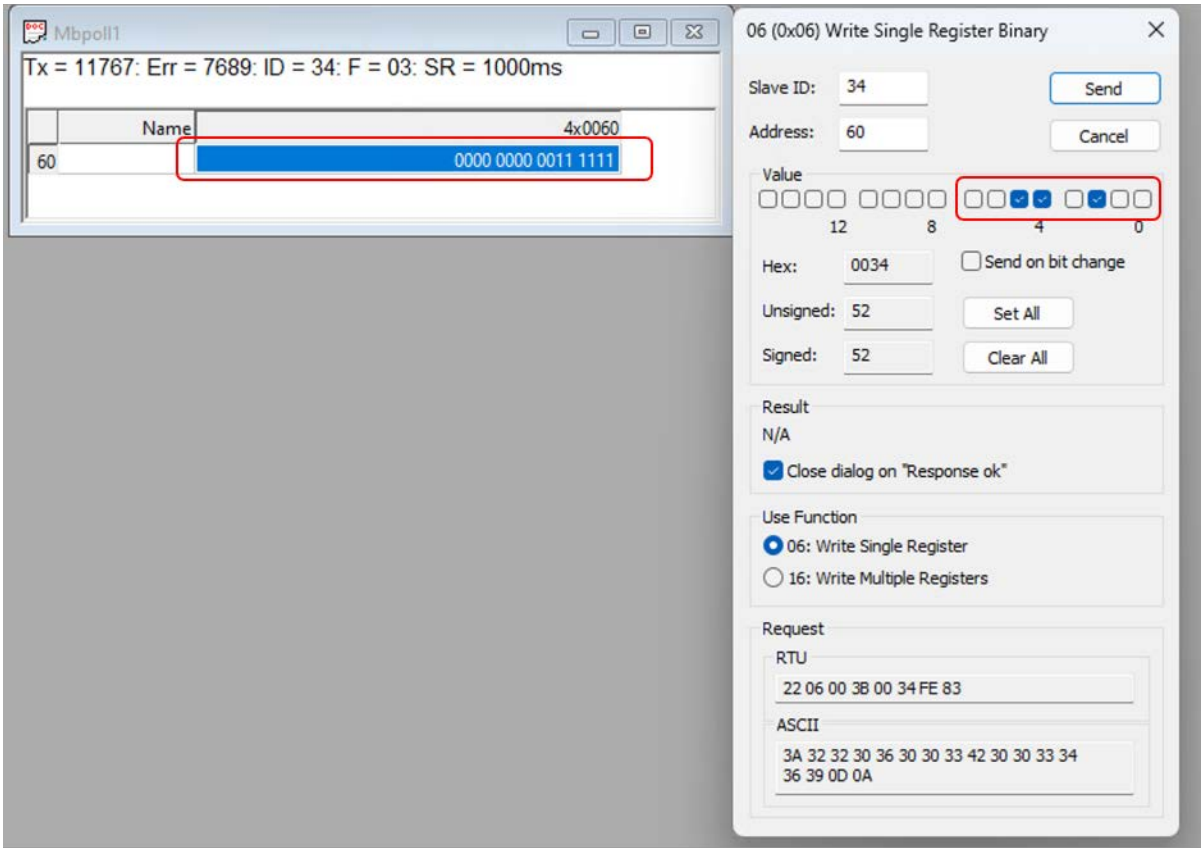
Image shows that we are going to access address 40060

2. As shown in the table under the binary tab for us to deactivate the Fault for Methane only, Temperature and VOC sensing components we will need to deactivate b0 / b1 /b3 respectively.

3. Once we have access to address 40060 , click the value and change it to binary to match the table provided in this section. (Format -> Binary)



4. Once the values are in Binary, double click the value so the option to activate/deactivate each byte appears.

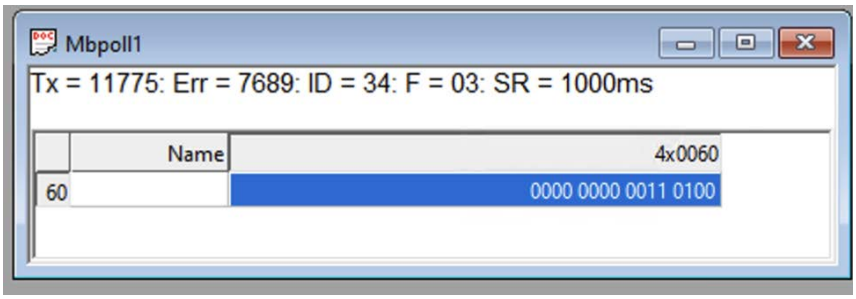


Left side represents the actual value where all Faults are activated (the first byte or “b0” starts at the far right of the binary value)

0011 1111 = this value represents that byte 0 until byte 5 is active (“Active” is represented by the number 1)

The image represents that we deactivated byte b0 / b1 / b3 .

5. Click send to apply, the binary value should look like the image below.
   (We are now all set)



11.2 Configuration using the Android Prevent-iON Application

11.2.1 Settings for H2 + H2 mixture

This guide demonstrates how to assign the H_2 + H_2 gas mixture as a relay trigger source and configure its threshold settings along with deactivating unnecessary fault triggers using the Prevent-iON Mobile Application.

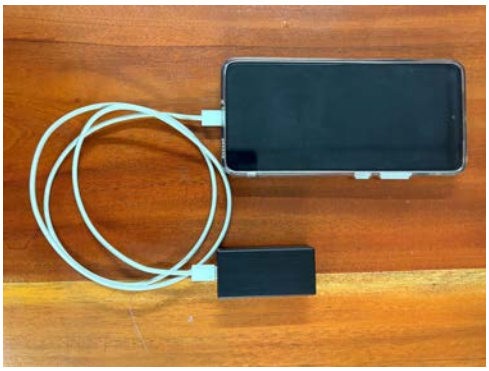
In this example, we will assign the H_2 + H_2 gas mixture as the trigger source for both Relay A and Relay B.

1. Prepare the following required materials:

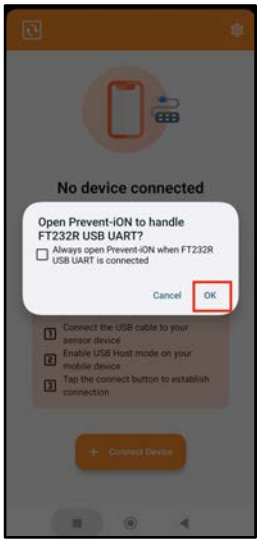
   a. R-GAS-FLAMMABLE
   b. AX-USB-RJ45
   c. A smartphone that supports wired reverse charging
   d. RJ45 Ethernet cable (Cat 5 or higher)
   e. USB Type-C to Type-C cable
   f. Prevent-iON Mobile Application

2. Open the Prevent-iON mobile app.

3. Connect the AX-USB-RJ45 adapter to your Smartphone using the USB Type-C to Type-C cable.

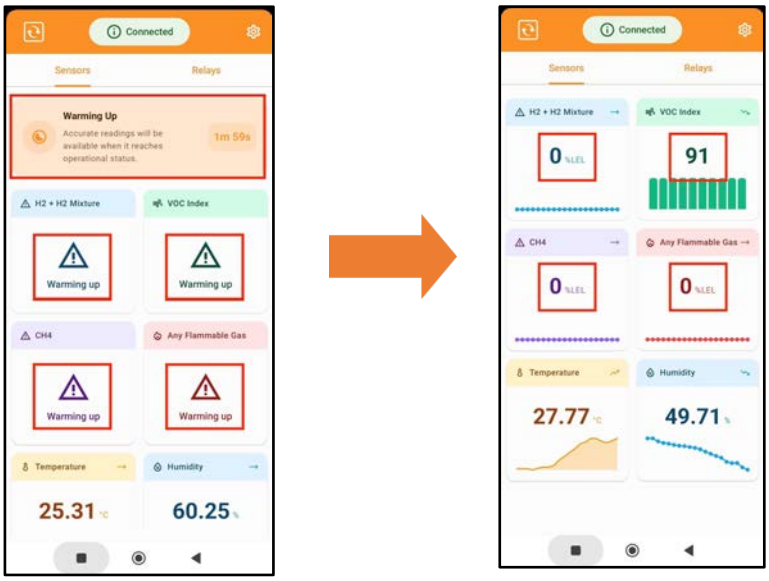


4. Then connect the R-GAS-GAS-FLAMMABLE to the AX-USB-RJ45 using the RJ45 Cable.
5. A notification or prompt will appear from the Prevent-iON Mobile Application, Then Tap “OK”.



6. Tap “Connect Device”.

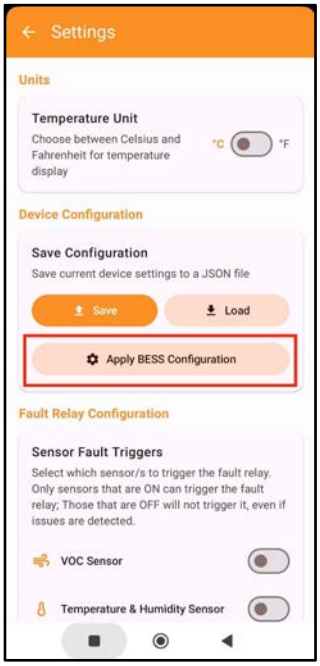
7. The application will display the connected detector metrics and indicate that the detector is “warming up.”



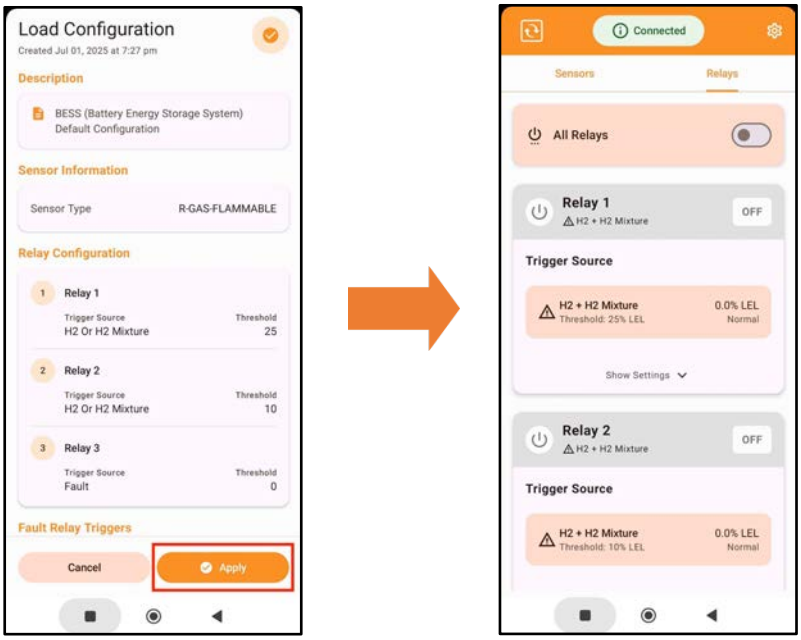
Please allow approximately 2 minutes for the warm-up process to complete. The warm-up is finished once the live detector readings appear and the warming up note disappears, as shown in 2nd image.

8. Click the Gear icon on the upper right.

9. Click the button ”Apply BESS Configuration”.



10. The default values will show, click apply to load it.



This will automatically set the configuration with our recommended set up for H_2 + H_2 mixture.

Relay A - 25% LEL / Relay B - 10% LEL / Relay C - Fault
Deactivated Fault for Methane Only / VOC / Temperature and Humidity