Instruction Manual

Model Ultra IR800

Combustible Gas Detector

GASENSOR TECHNOLOGY

REV: MAN-Ultra IR800-A180528
P/N: GT-TD-MAN.03E

Warranty

GASENSOR TECHNOLOGY PTE. LTD.(hereinafter referred to as GASENSOR) will assume overall responsibilities for use, commissioning, service, maintenance and installation guidance of Ultra IR800 combustible gas detector with measurement range of 0~100%LEL and offer two years warranty from the date of delivery under conditions of normal use and maintenance. All warranties are exclusive of unauthorized product replacement and repair without approval or consent of GASENSOR, product damage as a result of carelessness and improper installation and use of products with original trade mark being torn or replaced.

Important Notes

1. Before using this detector, please read the instruction manual carefully.
2. The detector operation and maintenance must be performed by trained qualified personnel. GASENSOR may provide such training.
3. Install the detector in strict accordance with the user's guide, and comply with the relevant laws, regulations and standards of respective country and enterprise so as to fully protect the safety of employees.
4. To ensure the best operating performance of detector, we suggest our customer to sign a long-term maintenance service contract with GASENSOR or their trained service personnel.

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1.0 Preparing for installation

1.1 System Integrity Test

The safety products of GASENSOR should be handled with care. Their installation, calibration and maintenance shall be conducted according to the respective instruction manual. To ensure the optimum efficiency of instrument operations, GASENSOR recommends that the instruments be maintained in accordance with the given procedure.

1.2 Commissioning the Safety System

Before powering up, the wire connections, terminal connections and stability of the installations should be checked.

After the safety system has been started and gone through the factory specified "warm-up" phase, the signal output transmitted to or received from the equipment shall be within the manufacturer's specified range. The first calibration, verification and testing should be based on factory recommendations and guidance. The system shall be verified by a comprehensive, functional test of all supporting equipment of the safety system. This verification will ensure the system can alert when an alarm condition occurs and fault can be detected when the circuit fails.

1.3 Notes and Warnings

Warning: Some components of the detector may be damaged by static electricity. To avoid electrostatic damage, take special care for system connection and ensure to make contact with the wiring terminal only.

Warning: The detector has been tested and certified for use in hazardous areas. The installation and operation of the detector shall be done according to the user manual and authentication specified in certain certificates. Any modification, improper installation or any operation carried out when the detector is under fault condition or detector configuration is not completed will result in warranty being void.

Warning: Conduit seals or cable gland with gasket joint that is explosion proof rated must be used to ensure that the explosion-proof properties of Ultra IR800 is maintained and to prevent water from entering the system from the conduit or joints at cable glands.

Warning: Ultra IR800 does not contain any user serviceable parts. User shall not attempt to repair Ultra IR800. Repair work can only be carried out by the manufacturer or trained service personnel.

Warning: Damage on the detector housing will result in damages to internal parts or protective seal and endanger the detector's functionality and usability. Never use detector with damaged housing in hazardous environment.

Warning: Ultra IR800 detector can only be used to detect hydrocarbon gas。 The detector cannot be used for detecting hydrogen.

2.0 Overview

2.1 General

Ultra IR800 is a combustible gas detector with measurement range of 0~100%LEL that can be used for continuous measurement of the concentration of flammable gas or vapor in the environment (below the lower explosive limit). It will output a 4 ~ 20mA industrial standard analog signal that is proportional to the percentage concentration (% LEL) of measured gas. The detector may form as part of a detection system via a combustible gas alarm controller, PLC or DCS device to provide gas detection, alarm and monitoring functions.

2.2 Features and Advantages

- ◎ A 32-bit high-performance microprocessor is adopted to provide faster processing speed and larger amount of data processing.
- ◎ Easy zeroing and calibration.
- ◎ Intelligent fault diagnostics functions including event logging of fault, alarm and maintenance events.
- ◎ Multiple output interfaces, including 4 ~ 20 mA output, dual MODBUS and HART communications.
- ◎ Three sets of relay contact output and one set of active contact output.
- ◎ Smart heating technology, eliminating condensation on windows without resulting in high power consumption.
- ◎ Long Life time (more than 5 years), high sensitivity and fast response capability.

2.3 Working Principle and Application

Ultra IR800 is designed to detect gas leak based on the principle of combustible gas is able to absorb specific infrared spectrum. The detector consists of an infrared light source, gold electroplated reflector, dual-wavelength infrared sensors and control circuit (see Figure 1). When there is no combustible gas exists in the environment, the outputs of reference and active filters in dual-wavelength infrared sensor are balanced. Once there is combustible gas in environment, the infrared energy at the active filter is absorbed, this results in the imbalance of measured infrared energy between the reference and active filters, an output signal proportional to the concentration of combustible gas is generated. This signal is then amplified and processed to output a 4-20mA signal that is corresponding to gas concentration.

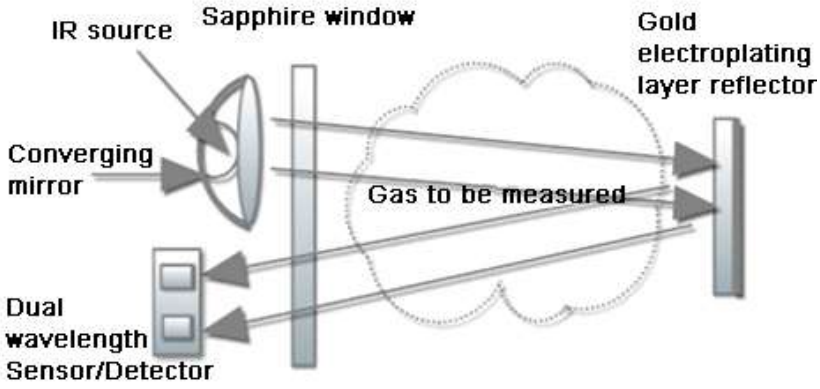

Fig. 1: Diagram of Operation Principle

2.4 Base Unit (With Display)

The Ultra IR800 base unit includes a microprocessor that provides display and control methods for the entire detector device. The base unit (see Figure 2) comes with the following main features:

- Bright LED digital display (outdoor readable);
- MODBUS and HART communications;
- High power relay;
- Easy configuration and calibration;
- Simple on-site connection and wiring

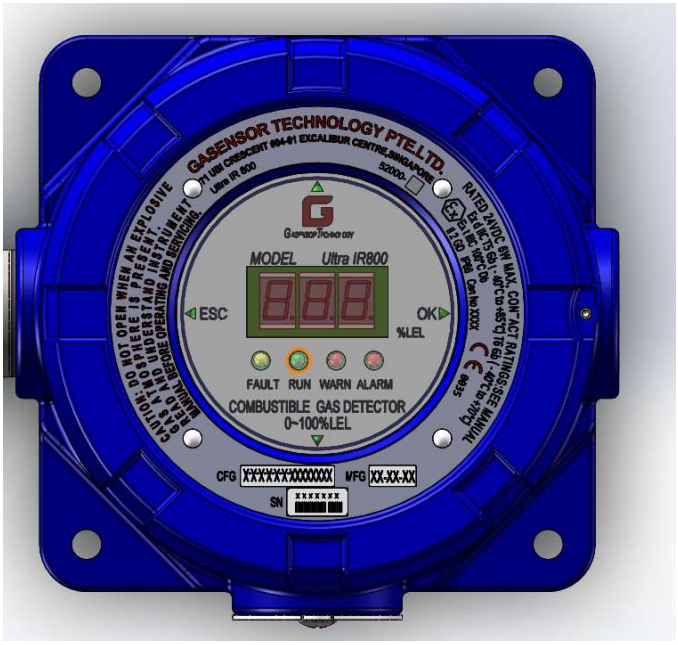

Fig. 2: Base Unit

2.5 Base Unit (Without Display)

According to different user preference, Gasensor provides Ultra IR800 base unit without display as an option (see Figure3).

Fig3: Base Unit (without display)

2.6 Gas Detection Module

The Gas Detection Module housing is made of reinforced stainless steel and provides information to the Base unit via MODBUS communication.

Gas Detection Module (see figure 4) comes with the following features:

- ◎ Gas detection and signal processing circuitry;
- ◎ The connection between base unit and the Gas Detection Module is explosion proof;
- ◎ MODBUS communication between base unit and Gas Detection Module;
- ◎ +24VDC Power supply;
- ◎ Fault monitor

Refer to section7.4 for technical parameters.

Fig 4: Gas Detection Module

3.0 Installation

⚠ Note: Ultra IR800 contains components that may be damaged by static electricity, electrostatic protection should be provided when handling and installing this instrument.

⚠ Note: Recommend to use high-temperature resistant cables. The applicable temperature of the cable shall not be lower than the highest temperature of the application environment.

⚠ Note: Only trained and skilled personnel may carry out detector installation and maintenance. Typical installation steps are listed in the table below. Actual situation may vary depend on different site environment.

Table1: Installation Briefing

No.	Installation Procedure	Section
1	Preparation	3.1 and 3.2
2	Equipment	3.2
3	Ultra IR800 Installation	3.3 and 3.4
4	Installation of cables between Ultra IR800 and control room (including power, 4-20mA, MODBUS)	3.5
5	Ultra IR800 Power Up	3.6

3.1 Unpacking

All detectors supplied by GASENSOR are packed in shockproof boxes to prevent from physical damage. Handle with care when unpacking and check according to enclosed packing list. Please contact GASENSOR if the instrument is damaged or differs from the purchase order.

⚠ **Notes:** Each detector has been calibrated in factory. After the initial installation, it is required to perform zeroing, gas check test and calibration periodically to ensure proper operation. Before zeroing or calibration is carried out, please check if the optical path and the window are clean, these are the most important operations to ensure Ultra IR800 can provide accurate measurement.

3.2 Preparing for Installation

Local or remote installation of the detector should be carried out according to the appropriate installation procedures. The conditions of the gas leakage points and detection sites shall be evaluated before installation. For special detecting requirements the mounting accessories shall be configured accordingly.

3.2.1 Tools Required

Tools required for installing Ultra IR800 detector:

Table 2: Tools Required

Tool	Purpose
2mm Allen wrench	Remove the set screws of the detector Base unit cover
Straight screwdriver Maximum 5mm flat head	Connect wires to the terminals
Adjustable wrench	Connect to conduit and cable gland

3.2.2 Guidelines for Detection Location Selection

There is no universal standard for locating the detector and the optimum location can be different for each application. Before installing, check the installation environment condition. The following guidelines can help to determine proper installation point.

◎ First determine the most likely leak sources and leak accumulation areas. In addition, determining the airflow and wind direction in the protected area, this may help predict gas leak diffusion path;

◎ The detector should be installed in easily accessible place to facilitate periodic security checks, and the Gas Detection Module should be installed horizontally to avoid dust accumulation.

◎ If the gas to be detected is lighter than air, install the detector above the potential gas leak level, and if the gas to be detected is heavier than air, install the detector close to the ground. The detector is usually mounted not less than 30cm above the ground.

◎ Do not install the detector in a position where temperature exceeding its specified operating temperature range, the detector shall be kept away from extreme heat;

◎ The detector shall not be installed in the vicinity of radio transmitters, strong magnetic field, electric field or similar devices;

◎The detector installation location shall be free of strong vibrations;

Special Conditions for Safe Operation:

1. The performance of the combustible gas detector model IR800, as a safety device, is not covered in this certificate.
2. Ambient temperature: -40°C≤Ta≤+70°C or -40°C≤Ta≤+85°C.
3. Warning - DO NOT OPEN THE HOUSING WHEN AN EXPLOSIVE ATMOSPHERE IS PRESENT.
4. When the Ex d enclosure is used, the cable gland is exclude from this certificate, only certified entries shall be used with minimum protection level Gb and Db, protection type Ex d, gas group IIC, minimum IP66.
5. When assembling, operation and maintenance, the operator must follow the requirements of the IEC 60079-14: latest version Explosive atmospheres- Part 14: Electrical installations design, selection and erection, beside of the manufacturer´s operating instructions or its National equivalent.
6. Repair and overhaul shall comply with IEC 60079-19: latest version or its National equivalent.

Note: Both internal and external earthing shall be connected reliably. Ground wire cross-sectional area shall not be less than the phase conductor cross-sectional area level, which is at least 4mm^2.

Warning: If the detector is operating in an environment with temperature lower or higher than the specified operating temperature limit, this may cause unstable readings, false alarm or alarm failure. For more details of environmental requirements, refer to section 7.3.

Note: It is forbidden to paint the detector.

3.3 Installation Overview

Before installation, please refer to section 3.5 for details of wiring termination, section 4.5 for details of calibration instruction.

Once the Ultra IR800 is correctly installed, minimal maintenance is required except for the regular calibration inspection and window cleaning to ensure proper operation. If the detector is affected by abnormal environmental conditions, such as mud stains on the Gas Detection Module, the Gas Detection Module is inadvertently painted, etc., GASENSOR recommends to increase the frequency of detector cleaning and calibration checks.

To ensure best performance, GASENSOR recommends to set up a periodic maintenance schedule. In actual operation, maintenance log shall be kept for each detector.

Maintenance inspection shall include the following items:

- Check if detector installation is proper and secured;
- Check if the detector windows and mirrors are clean and free of oil, water, dust and paint coating;
- Check if cable connection is secured.
- Check if the distribution of all detectors meets the requirements of the factory layout;

Be sure to pay attention to mounting dimensions and outline dimensions during installation.

For more mechanical parameters, see section 3.4.

3.4 Installation Instructions

Install the Ultra IR800 through the bolt holes on the base unit. Remote installation can be used to facilitate easy meter reading.

Notes: For remote installation, an additional explosion-proof junction box is required.

3.4.1 Mounting Dimensions

Mounting dimensions of the detector are shown in Fig.5, Fig.6.

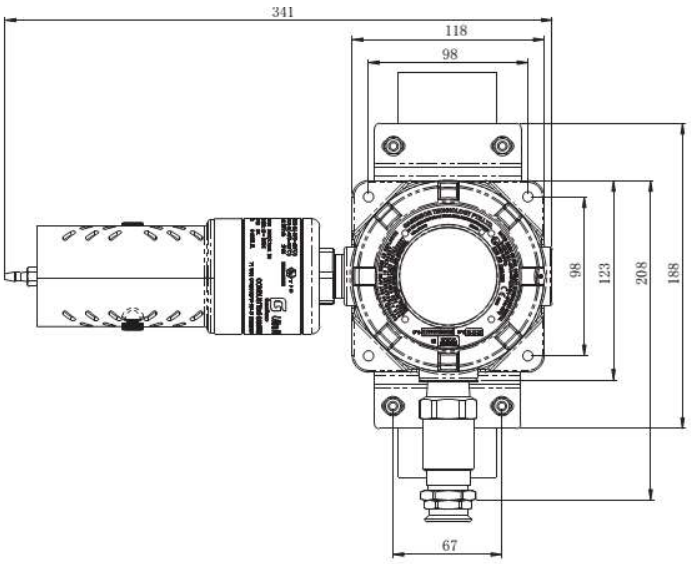

Fig. 5: Wall Mounting（mm）

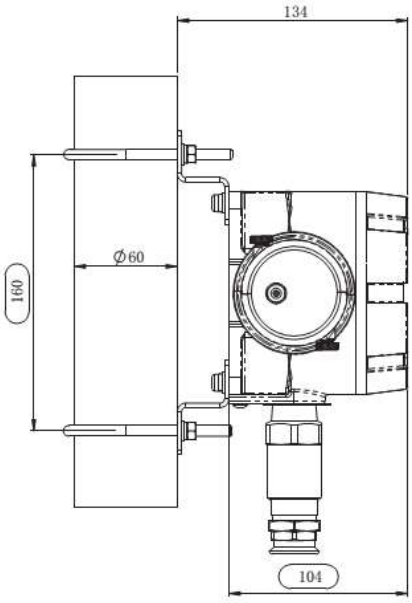

Fig. 6: Standing Column Mounting（mm）

Please read the following section before installation:

Guidelines for Detection Location Selection: Section 3.2.2

Environment Parameter: Section 7.3

Warning: In order to maintain the explosion-proof integrity of the Ultra IR800, explosion-proof conduits must be used for remote installation.

3.5 Wire Connections

3.5.1 Base Unit Wire Connection (With Display)

The layout of detector cable terminals of Ultra IR800 TB1, TB2, TB3 and TB4 are as shown in Figure 7. To ensure safety, the power can be turn on only after all wiring operations, verification are completed. For details, refer to section 3.6.1.

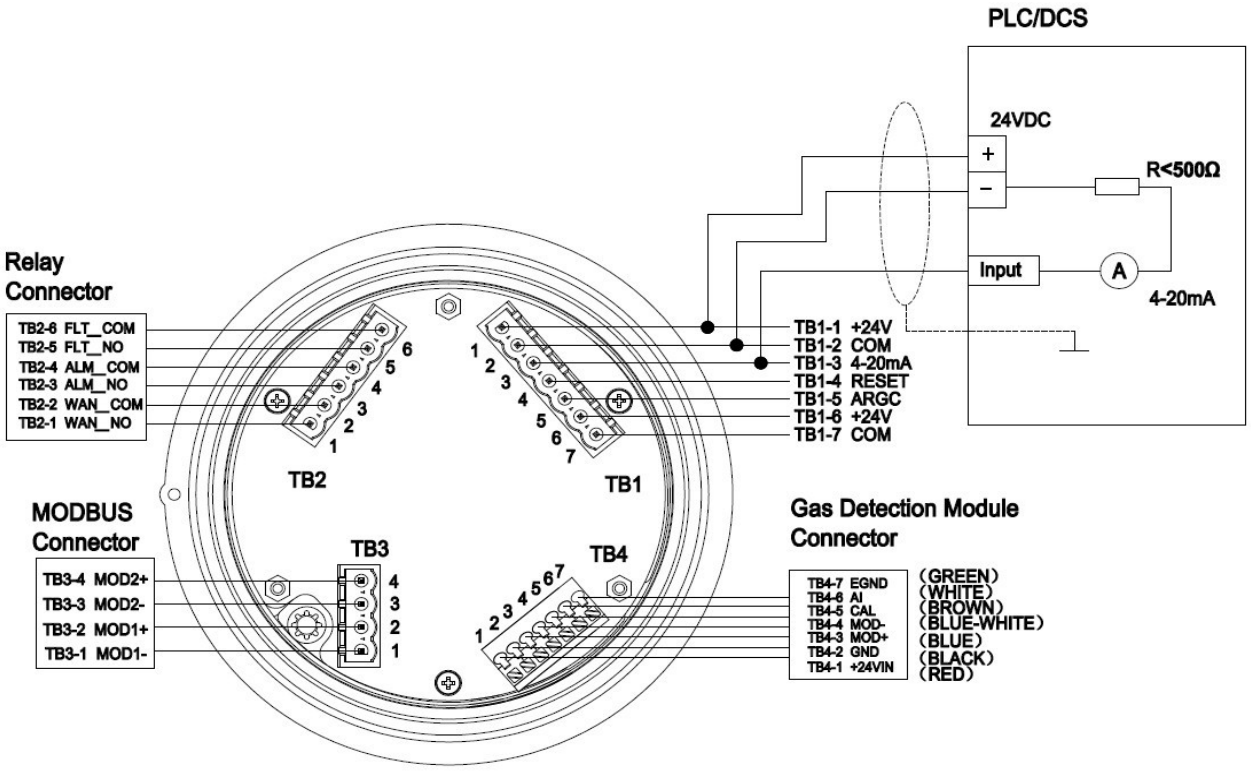

Fig7: Wire Termination (With Display)

Table 3: Wire Termination Description (With Display)

No.	TB1	No.	TB2 (Relay)	No.	TB3 (MODBUS)	No.	TB4 (Gas Detection Module)
1	+24VDC	1	WAN_NO	1	MOD1-	1	+24VDC (red)
2	COM	2	WAN_COM	2	MOD1+	2	GND (black)
3	4-20mA Output	3	ALM_NO	3	MOD2-	3	MOD+(blue)
4	Remote Reset	4	ALM_COM	4	MOD2+	4	MOD- (blue/white)
5	ARGC Remote Calibration	5	FLT_NO			5	CAL(brown)
6	+24VDC	6	FLT_COM			6	AI (white)
7	COM					7	EGND (green)

Note: Avoid contact with the printed circuit board components to prevent electrostatic damage.

All cables must be connected to the corresponding pluggable terminals.

*NO is “Normally Open”, NC is “Normally Close”, WAN is “Warning”, ALM is “Alarm”, FLT is “Fault”

Refer to the following instruction for wire connection of Ultra IR800 base unit terminals (see Figure 7):

1. Loosen the set screw before remove the detector housing cover.
2. Unscrew the knurled screws (see Figure 9), and remove the entire circuit board.
3. Insert flat head screwdriver into terminal plug reed and press down, then open the terminal plug. Gas Detection Module connection details please refer to Section 3.5.3.
4. Insert wire with stripping length of 1.1cm into terminal plug, remove the screwdriver to fasten the wire, gently pull the wire to ensure that it has been firmly locked into the cable terminal plug.

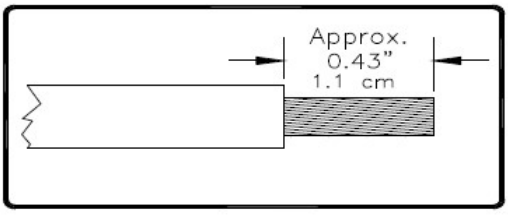

Fig.8: The Length of Stripped Wire

5. Insert the terminal plugs into appropriate terminal sockets, put the circuit board in the housing and tighten the knurled screws. Then tighten the cover and the set screw.

Fig. 9: Positions of Screws

3.5.2 Base Unit Wire Connection (without Display)

The layout of the terminal blocks TB1, TB2 of Ultra IR800 base unit without display is shown in Figure 10. For safety purpose, connect the Ultra IR800 to the DC power ground (TB2-1 or TB2-2) first, then connect the wires between MODBUS and analog device (TB2-5, TB2-6, and TB2-8), and finally connect the +24VDC terminal of the power supply (TB2 -3 or TB2-4). Do not turn on the power until all wiring is completed and verified correctly. See Section 3.6.1.

Wire connection procedure refers to Section 3.5.1.

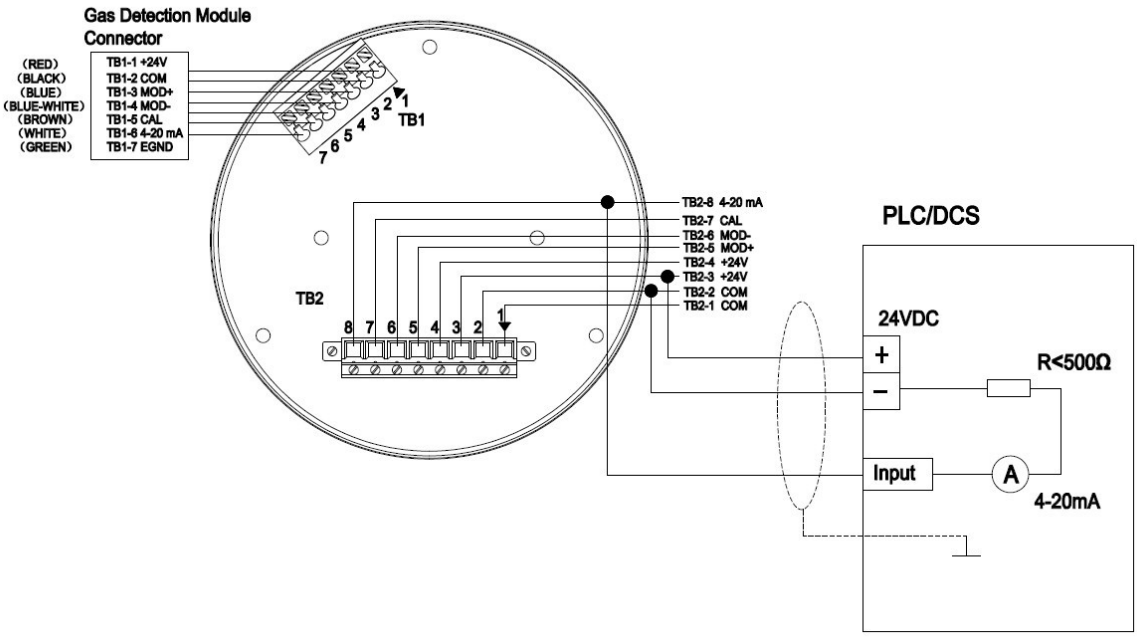

Fig 10: Wire Termination (without display)

Table 4: Wire Termination Description (without display)

No.	1	2	3	4	5	6	7	8
TB1	+24V	COM	MOD+	MOD-	CAL	4-20mA	EGND	
TB2	COM	COM	+24V	+24V	MOD+	MOD-	CAL	4-20mA

3.5.3 Gas Detection Module Wire Connection

The Gas Detection Module has seven wires: red, black, blue, blue and white, white, brown and green. The red wire connects to the positive terminal of the power supply, the black wire connects to the negative terminal of the power supply, the blue wire and blue-white wire are used for RS485 communication, and the white wire is for 4 -20mA output, brown wire for remote calibration and green for chassis ground.

Connect the wires according to following procedure:

1. Ensure that the base unit housing is connected to the chassis ground or to the cable shielded wire, and the cable shielded wire shall be connected to chassis ground in the control room.

Table5: Gas Detection Module Wire Connection

Gas Detection Module Wire	Base Unit	Base Unit (without display)
Red	TB4-1	TB1-1
Black	TB4-2	TB1-2
Blue	TB4-3	TB1-3
Blue-white	TB4-4	TB1-4
Brown	TB4-5	TB1-5
White	TB4-6	TB1-6
Green	TB4-7	TB1-7

Notes: The power line must be disconnected before all other wire connections are completed. The cables should be as short as possible. For acceptable cable length between detector and power source, refer to section 7.4.

To ensure continuous operation and prevent from accidental power off, there is no power switch on the Ultra IR800.

3.5.4 Wire Connection Safety

Warning: According to explosion-proof requirement, the cover of the detector shall not be open when powered on, Otherwise it will violate the hazardous area operating regulations and may cause serious damage to the equipment. Equipment damaged under this condition is not covered in the warranty.

Warning: Ultra IR800 TB1-2 or TB1-7 (base unit with display) and TB2-1 or TB2-2 (base unit without display) shall be connected to DC power ground first before any other connection is made. The device shall be kept at POWER OFF before all wire connections are done.

Warning: Cables shall be kept away from radio transmitters, welding machines, switching power supplies, battery chargers, ignition systems, power generators, and other high frequency, high power conversion equipment.

3.5.5 Relay Terminal Connection (ONLY for Base Unit with Display)

Cable terminal TB2 provides a relay contact for connecting alarm indicator and other related facilities. The function of warning and alarm relay may vary according to energized or de-energized configuration states.

Notes: For Warning and alarm relays, the default setting is de-energized.

When fault relay is set to energized state, the normally closed contact of fault relay will be disconnected after the detector is powered on.

Refer to following table to determining energized and de- energized settings.

Table 6: Energized and De-energized settings of TB2 relay contact

Relay type	TB2 location	De- energized	Energized
Warning	1	Normally Open	Normally Closed
	2	Common	Common
Alarm	3	Normally Open	Normally Closed
	4	Common	Common
Fault	5	Unused: fault relay is in energized state	Normally Closed
	6		Common

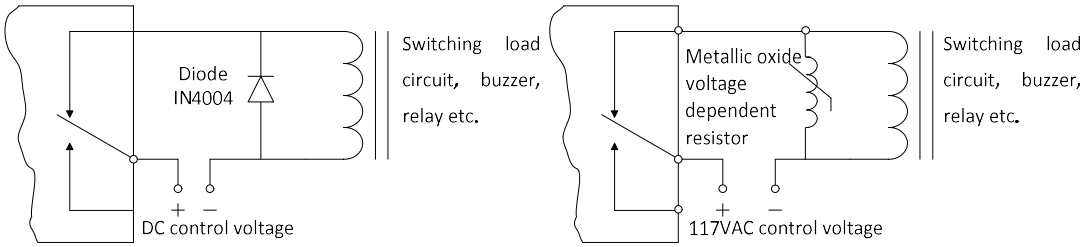

Fig. 11: DC and AC load relay protection

Warning: The relay contacts should have transient suppression and high voltage protection functions.

3.6 Power On and Commissioning

Once the power cable is connected and the alarm relay is installed, the Ultra IR800 is ready to start operate. Before powering on, please read this section carefully.

3.6.1 Verification before Power On

Before powering on the system, please verify the following items:

Table7: Verification Table before Power On

Procedure	Description
1	Verify that the Ultra IR800 is properly installed and ensure that the conduit/cable glands are routed downwards
2	Verify all signaling wires are connected correctly
3	Verify connections between Ultra IR800 Base Unit and Gas Detection Module
4	Verify connections between Ultra IR800 Base Unit and all control room equipment that are connected
5	Ensure the integrity of the Ultra IR800 explosion-proof structure;

6	Verify the power cable connection is correct, voltage supply range is 20~36VDC; when voltage supply is at 18.5VDC or lower, Ultra IR800 shows under voltage error code

3.6.2 Commissioning Procedure

When first start up, the Ultra IR800 will take a short period to stabilize. Ultra IR800 will go through the following steps during this period:

- Base Unit, display, EEPROM self-verification
- Display “rN”, software version
- Display “SU”
- Detector enters monitoring mode, gas concentration value been detected is displayed in the following format:
  - “###” – gas concentration detected by Ultra IR800 in the current environment.
  - If the detector is in fault condition then the corresponding error code will be displayed

3. 7 Maintain Explosion-proof Properties

Ultra IR800 base unit and gas detection module are explosion proof type and can be used in the following hazardous areas:

II 2G Ex db IIC T6 Gb（Ta: -40℃ to +70℃）

II 2G Ex db IIC T5 Gb（Ta: -40℃ to +85℃）

II 2D Ex tb IIIC T100℃ Db IP66

When the detector is powered on, loosened threads on base unit housing cover or gas detection module will result in the explosive-proof rating being reduced.

Each Ultra IR800 base unit housing has three unused NPT3/4″ threaded holes which can be used for following purpose:

· Connecting Ultra IR800 relay switches and wiring conduits to other devices

· Direct connection of gas detection module wiring conduit to alarm relay and control room equipment.

· Unused electrical interface holes must be fitted with plugs provided by GASENSOR.

⚠ **Notes:** During installation, be sure to follow national wiring and installation requirements and use certified cable gland.

When the Ultra IR800 Gas Detection Module is connected to the base unit or to the remote junction box, the Gas Detection Module shall be screwed into the base unit or remote junction box housing and must be rotated more than 5 turns and tightened to ensure the explosion-proof characteristics of the housing.

⚠ **Notes:** Do not wipe the plastic part of the Gas Detection Module with dry cloth to prevent electrostatic

accumulation.

4.0 Operation

This section provides detailed instructions for carrying out startup and configuration works with detector menu systems. MODBUS interface describes another method for running and configuring the detector using the Ultra IR800 MODBUS command.

Warning: To avoid false alarm, please power OFF before maintenance.

4.1 User Menu Structure

Ultra IR800 provides various configurable and optional functions, including user modifiable warning and alarm set points, relay configuration, MODBUS communication and HART communication settings (if HART option is selected in the product configuration). Through selection and configuration of these functions, the detector may operate as an independent device or be connected to respective controller, computer, PLC and DCS based systems. The method to configure these functions with the menu system is described as shown below:

Detailed menu structure of Ultra IR800 is shown as follows,

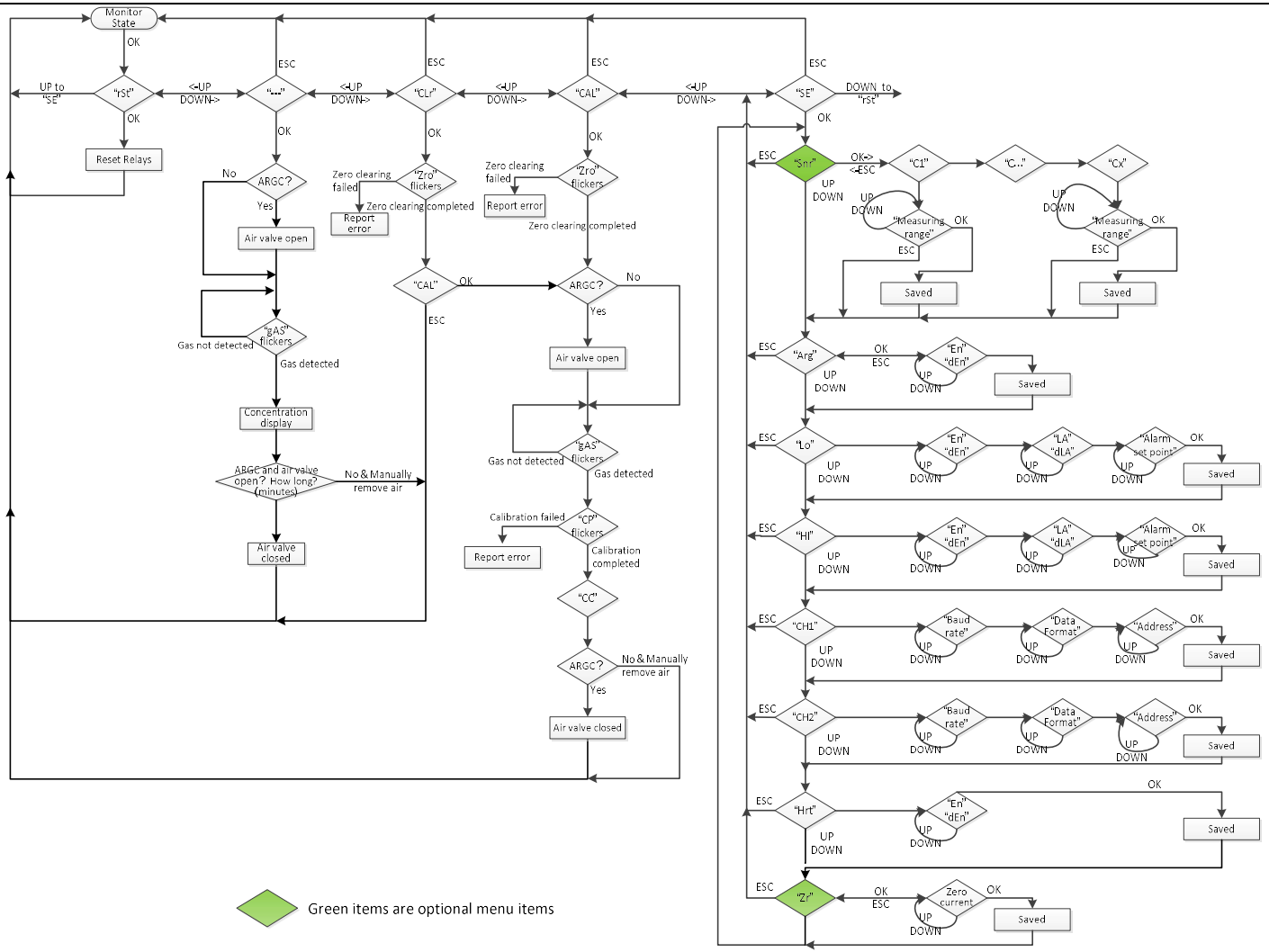

Fig. 12: User Menu Structure

Tip: If the Ultra IR800 is not equipped with relay and MODBUS communication function when ordered, then change in settings of relay and MODBUS will have no effect on operation of the detector.

4.2 Menu Display

4.2.1 Main Menu:

"rSt": reset the relay
"---": gas check
"CLr": separate zero clearing
"CAL": calibration
"SE": setting`

4.2.2 Reset Submenu: (rSt)

When "rSt" is displayed, magnetize the "OK" button to enter Reset status and return to the monitoring interface

4.2.3 Gas Check Submenu: (---)

"gas": flashing, indicates the detector is waiting for inlet of gas
"###": flashing, display the gas concentration

4.2.4 Separate zero clearing Submenu: (CLr)

"Zro": flashing, indicates the system is undergoing zero clearing.
After zero clearing is completed, the instrument displays "CAL" flashing. If magnetize the "OK" button, the instrument will enter calibration mode; if magnetize the "ESC" button, the instrument will return to the monitoring interface. If there is no operation is carried out during the "CAL" state, the instrument will automatically return to the monitoring interface within 30 seconds.

4.2.5 Calibration Submenu: (CAL)

"gAS": flashing, indicates the detector zero clearing is completed and the detector is waiting for gas input
"CP": flashing, indicates the detector is in contact with the gas and calibration ongoing
"CC": flashing, indicates the detector has completed calibration and user shall remove gas supply

4.2.6 Setting Submenu: (SE)

"Snr":
"Sn1": gas type 1
"Sn2": gas type 2
…
"Snx": gas type x
Note: Only for supported product.
"Arg":
"En": remote automatic calibration enabled
"dEn": remote automatic calibration disabled
"Lo"/"Hi": Warning / alarm relay settings

"En": energized
"dEn": de-energized
"LA": latching
"dLA": non-latching
"CH1"/"CH2": Modbus channel 1/ channel 2 settings
Baud rate: "24", "48", "96", "192"
Data formats: "8n1", "8E1", "8o1", "8n2"
"Hrt": HART enabled
"En": enabled
"dEn": disabled

4.3 Startup:

After startup, three 7-segment digital tubes will display "**8.8.8.**" and software version "rN" (N- revision number). Then the detector enters startup mode "SU". After the sensor reaches stable state, the detector enters operation mode and displays the gas concentration currently detected.

4.4 Main Menu

There are four reed switches on the display panels, representing "UP", "Down", "ESC", and "OK" four keys respectively. To configure, use a magnetic wand and get as close as possible to the magnetizing position and remove the magnetic wand after the appropriate indicator light turns on.

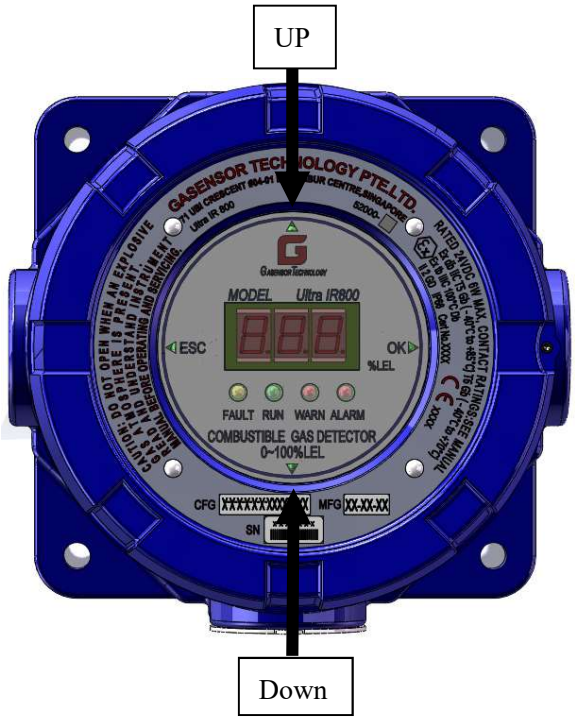

Fig. 13: Magnetic Control Operating Position Plan

Magnetize the “OK” key during the monitoring state to enter the main menu. After entering the main menu, the sequence controlled by “Down” key is shown in the following order:

“rSt”->“---” ->“CLr” ->“CAL” ->“SE” ->“rSt”

The sequence controlled by “Up” key is shown in the following order:

“rSt”->“SE” ->“CAL” ->“CLr” ->“---” ->“rSt”

Apply magnetic wand to “ESC” key to return to the monitoring interface.

Apply magnetic wand to “OK” key to enter the appropriate submenu.

⚠ **Note: If there is no operatione applied to the main menu, the detector will automatically return to the monitoring interface after 15 seconds.**

4.5 Menu Settings:

4.5.1 “Snr” Setting

User can select the gas type from “Sn1” to “Snx” if the detector can measure different gas. Other wise there is no item to select.

4.5.2 “Arg” Setting

The default state of ARGC (remote automatic calibration) is disabled (dEn).

If user installed remote automatic calibration device, the ARGC function can be enabled through the menu or MODBUS communication.

Note: If no remote automatic calibration device is mounted, set ARGC as “dEn”, otherwise the calibration cable will not function.

4.5.3 “Lo” Setting

Users may change settings of the warning relay. Default setup parameters are:

· Non-latching (default)

· De -energized (default)

· 25%FS set point (default)

· Warning relay setting adjustable (**min**: 5%FS, **max**: Alarm relay set point)

·

Under the menu “Lo”, apply magnetic wand to the key “OK” to enter relay energized/de-energized setting, switch menus between “dEn” and “En” through “UP/DOWN” key, apply magnetic wand to the key “OK” to finish setting. Then the detector enters state of relay latching/non-latching settings; switch menus between “dLA” and “LA” through “UP/DOWN” key, apply magnetic wand to the “OK” key to finish setting. After that, the detector enters the state of warning set point setup, the key “Down” is now used for controlling the cursor to switch between hundreds' and tens' digit (current modifying digit flashes); apply magnetic wand to “UP” to increase the set value of current digit by one at each time.

Apply magnetic wand to the key “OK” to save the current “Lo” (Warning) settings and automatically proceed to “Hi” menu.

4.5.4 “Hi” Settings

Users may change settings of the alarm relay. Default setup parameters are:

· Latching (default)

· De-energized (default)

· 50%FS set point (default)

· Alarm relay setting adjustable (**min**: warning relay set point, **max**: 95%FS)

Under the menu “Hi”, apply magnetic wand to the key “OK” to enter relay energized/de-energized setting, switch menus between “dEn” and “En” through “UP/DOWN” key, apply magnetic wand to the key “OK” to finish setting.

Then the detector enters state of relay latching/non-latching settings; switch menus between “dLA” and “LA” through “UP/DOWN” key, apply magnetic wand to the “OK” key to finish setting.

After that, the detector enters the state of alarm set point setup, the key “Down” is now used for controlling the cursor to switch between hundreds' and tens' digit (current modifying digit flashes); apply magnetic wand to “UP” to increase the set value of current digit by one at each time.

Apply magnetic wand to the key “OK” to save the current “Hi” (Alarm) settings and automatically proceed to “CH1” menu.

4.5.5 CH1 and CH2 MODBUS Settings

Tip: For channel 1 and channel 2, the effective address range is 1-247.

CH1 Default settings f:

· address 1

· 9600 baud rate

· 8-N-1

CH2 Default settings:

· address 2

·9600 baud

·8-N-1

Baud rate setting: “UP” and “DOWN” for switching the menu among four baud rates

·“24” stands for: 2400

·“48” stands for: 4800

·“96” stands for: 9600

·“192” stands for: 19200

Supply magnetic wand to “ESC” to return to previous menu, apply magnetic wand to the key “OK”, and the detector will enter data format setting menu.

Data format setting: “UP” and “DOWN” keys are used for switching the menu among four data formats:

·“8n1” stands for: 8-N-1

·“8E1” stands for: 8-E-1

·“8o1” stands for: 8-O-1

·“8n2” stands for: 8-N-2

Apply magnetic wand to “ESC” to return to previous menu, apply magnetic wand to the key “OK”, to enter the communication address setup menu.

Communication address setting: In this menu, the cursor flashes at the highest bit of current address; apply magnetic wand to the key “UP” to increase the value of the address. If the data is increased to greater than 9, it will go back to zero. The key “DOWN” is used to control the cursor to switch among hundreds’, tens’ and ones’ digit, apply magnetic wand to “ESC” to return to previous menu, and apply magnetic wand to “OK” to save the current settings and proceed to submenu under “SE”.

4.5.6 HART Protocol Setting

HART disabled (dEn) by default. If user need to enable or disable Hart function, it shall be set under the menu “Hrt”, apply magnetic wand to the key “OK” to enter Hart function selection menu, “UP”“DOWN” is used to switch between “dEn” and “En”, apply magnetic wand to the key “OK” to save the current settings and proceed to “Zro” menu.

4.5.7 Zr setting

Under the menu “Zr”, apply magnetic wand to the key “OK” and the detector shows current at zero gas concentration.

Apply magnetic wand to the key “DOWN” to reduce the present current at zero gas concentration set value for 0.01 each time, till it reaches 3.91mA;

Apply magnetic wand to the key “UP” to increase the present current at zero gas concentration set value for 0.01 each time, till it reaches 4.15 mA.

Apply magnetic wand to the key “OK” to save the present current set value.

4.5.8 Alarm Relay Reset (ONLY for Base Unit with Display)

If the warning / alarm relay is set to latched, upon detection of the gas concentration drops below the set point, user need to manually reset the relay. There are three ways to reset:

1. To reset the relay via MODBUS interface.
2. Reset the relay through the magnetic switch on the Base unit. Apply magnetic wand to the key “OK” to enter the main menu, select “rSt” submenu, and apply magnetic wand to the key “OK” to complete relay reset.
3. Reset the relay through remote reset input terminal on TB1-4.

4.5.9 Gas Check

1. Under the menu "---", apply magnetic wand to the key "OK" to enter menu "gAS".

2. "gAS" flickers on the display to prompt user to start supply gas

3. After test gas is supplied to the sensor, the detector will show gas concentration value (reading stabilized within 1 minute).

4. When reading is stabilized, gas test is completed. Please remove gas.

When test gas concentration drops to 5%FS or below, the detector will return to normal operation.

Note: Warning, alarm and relay outputs are prohibited at this state.

4.5.10 Separate Zero Clearing Operation

In the main menu, select submenu "CLr", apply magnetic wand to the key "OK" to start system zero clearing. After zero clearing is completed user shall carry out gas calibration, device will wait for 30 seconds for calibration confirmation, if there is no confirmation within 30 seconds, the device returns to monitoring interface. If zero clearing fails, a fault code will be displayed.

⚠ **Note: Warning and alarm outputs are prohibited in this state. Separate zero clearing is only suitable for maintenance purpose. During the actual operation, it is a must to carry out calibration. Separate zero clearing is prohibited during actual operation. GASENSOR accepts no liability for consequences due to separate zero clearing being carried out during actual operation.**

4.5.11 Calibration

1. Under the main menu, select "CAL" submenu, apply magnetic wand to the key "OK" detector enters calibration mode and zeroing procedure starts immediately.

⚠ **Note: During zero reset, make sure that the surrounding air is clean. Otherwise, conduct zero clearing with nitrogen gas.**

2. If "zero clearing" fails, device with display error code F12 (refer to Table 9)

3. If zero clearing is successful, the system enters "gAS" menu. When "gAS" flickers user shall supply calibration gas.

4. Apply calibration gas to the sensor (50% of the full scale of the gas being tested). The displayed content will change from "gAS" to "CP", indicating that the detector has detected calibration gas.

5. After calibration is completed, the displayed content will change from "CP" to "CC" indicating calibration is completed.

6. Remove gas and wait till the detector returns to normal operation state.

The concentration value displayed will gradually decrease to "0". If calibration time-out occurs, the detector will prompt calibration error.

⚠ **Note: Warning and alarm outputs are prohibited in this state.**

4.6 Operation Method (Only for Base Unit without Display)

4.6.1 Calibration

The Ultra IR800 Gas Detection Module is calibrated at the factory and requires periodic calibration. In order to facilitate the user's on-site operation, this module has a calibration function to prepare for on-site personnel calibration needs. In addition, the Gas Detection Module has been designed to eliminate the effects of background gas fluctuations and can be reset onsite.

Calibration Procedure as shown below:

1. Place the magnet at the magnetic supply position (see Figure 13, LED indicator will light up when placed at appropriate position) for about 6 seconds, LED flashes at the frequency of 0.5Hz after the magnet has been removed (LED flashing sequence refer to Figure 14) indicating instrument is zeroing
2. After the zeroing process is completed, the LED will be extinguished immediately after being turned on within 30s (light up duration of 1.8s). If calibration is required, place the magnet to the detector for 6 second the detector will then enter calibration mode (otherwise the detector will return to normal operation state after 30s). The LED indicator will be extinguished quickly after turned on and wait for gas input (LED light up duration of 0.2s).
3. Input 50%LEL calibration gas, after the gas been detected, the LED lights up for 0.8s then turns off for 0.2s.
4. After calibration is completed LED is extinguished quickly after turned on (LED light up duration of 1.8s). Gas Detection Module will be back to normal operation state when gas concentration reduced to below 5%LEL after the calibration gas been removed.

If the gas detection module fails during zero clearing/calibration, the LED will flash at 1Hz. The analog output signal is maintained at 1.5mA during zero clearing/calibration and the analog output signal is 0mA when the Gas Detection Module under fault condition. If the Gas Detection Module has fault during calibration process, the fault can be eliminated by recalibrate.

Note: If the fault can’t be eliminated by recalibrate, please contact GASENSOR. If the detector enters fault mode during operation, please contact GASENSOR.

Fig. 14: Base Unit without display Calibration indicator

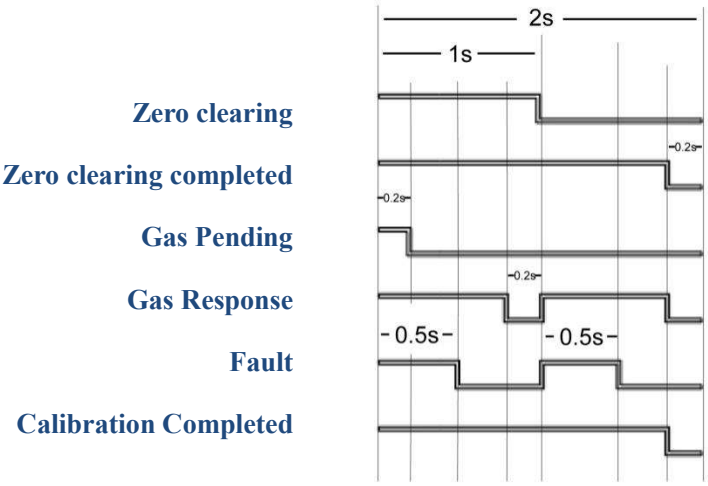

Fig 15: LED Flashing Sequence

5.0 Maintenance

5.1 Routine Inspection

Warning: Before conducting any maintenance of the detector, first disconnect the external devices such as controller, PLC or DCS.

Periodic routine inspections of the detector are necessary to ensure that the external obstacles (such as sludge, snow, or other material) will not block the rain shield and dust cover, and will not affect the equipment's performance.

5.2 Rain Shield and Dust Cover Cleaning

Remove the rain shield and dust cover, clean with soft brush, soap and water, rinse and dry. If damaged or baffle vent is dirty, please replace the rain shield and dust cover.

⚠ **Note: Solvent may cause damage to the rain shield and dust cover.**
If soap and water cannot remove contaminants, please replace the baffle.

5.3 Ultra IR800 Gas Detection Module Lens Cleaning

It is only necessary to clean the detector window lens and the mirror surface when an optical failure is indicated. Use a piece of clean and soft cotton cloth without batting dipped with solution to clean the windows. The windows are not made of glass but of sapphire. Please use designated solvent for cleaning. When cleaning the windows, do not touch the windows or mirror with fingers. The cleaning process is as show as followings:

1. Wet the windows with solution.
2. Wipe the windows with dry and clean window cleaning cloth.
3. Let the window dry completely.
4. Clean the mirror in the same way.

⚠ **Note: Dirty or partially blocked windows will significantly reduce the detection performance of the detector. General cleaning solvents are not applicable. Please use industrial grade ammonia-containing cleaning solvents.**

5.4 Maintenance Calibration

5.4.1 Maintenance Calibration Requirement

The Ultra IR800 Gas Detection Module has undergone a strict power aging assessment and calibration inspection at the factory. After initiating inspection and power up verification to ensure that it is under normal operation state, then the detector is ready for use. Regular gas check or calibration is necessary to ensure the performance and safe use of the instrument. GASENSOR recommends that the Ultra IR800 series shall go through gas check or calibrated every 90 days.

GASENSOR recommends that all gas calibration or maintenance should be documented, including detector readings and related control equipment readings such as DCS or PLC.

Take note of the following before calibration:

1. Make sure the detector is in the clean air or nitrogen air.
2. Detector shall be powered up by one hour at least
3. Use the calibration device provided by GASENSOR for higher calibration or gas check accuracy;
4. The use of a constant valve with larger flow rate can reduce the waiting time for calibration or gas check (a 1.25L/min constant flow valve is recommended);
5. Ensure the validity of the calibration gas type

5.4.2 Calibration Equipment

When calibrating Ultra IR800 series detectors, it is necessary to have a standard gas mixture with a known 50% LEL concentration. GASENSOR recommends using a CA96IR cylinder calibration box (PN: YA901103). Including the following:

1. Gas Calibration Chamber
2. 1.25L/min Constant flow valve
3. Calibration gas tube
4. Magnetic wand
5. 50%LEL Methane (steel cylinder gas)

Note: Reinstall the Rainproof and dustproof cover after calibration.

5.5 Replaceable Parts

List of replaceable parts is as shown in Table 8.

Table 8: List of replaceable parts

No.	Part number	Part name
1	52110	Rainproof and dustproof cover
2	52020	Gas Detection Module
3	52120	Base power panel
4	52130	Base control panel
5	22040	Display panel
6	W701005-3	Cable gland

6.0 Fault Analysis

⚠ **Note:** Repair of components and parts may only be carried out by GASENSOR or engineers authorized by GASENSOR, and repair of circuit board may only be carried out with equipment of GASENSOR. Failure to comply with these regulations will result in the warranty be void.

Note： All Ultra IR800 external alarm connections must be closed or disconnected before performing any check that may cause the detector to enter alarm state**.**

6.1 Fault Code and Maintenance Measures

The detector has firmware with self-diagnostics function and the corresponding fault code display. Thus, fault codes are set in two levels of menus. If fault is detected, the output current signal is set to fault current, the fault relay will be triggered, and the display show the first level fault code “F4”. Under fault conditions, apply magnetic wand to the key “OK”, to display second level fault code. The diagnostic interval time is less than 200ms for critical faults, less than 15 minutes for RAM and less than 2 hours for ROM.

Table 7 lists the faults that Ultra IR800 can detect as well as recommendations for resolving the faults. If troubleshooting is unsuccessful after several attempts, return the detector to GASENSOR or authorized repair service center for repair.

The output current will be set to fault current if any faults occur, the fault current value is described in table 9.

Table 9: Fault Code

Secondary fault code	Fault type	Fault analysis	Solutions
F0**	Base unit ROM fault	Base unit microprocessor ROM fault	• Replace the processor board • Depot repair
F1**	Base unit RAM or EEPROM fault	Base unit microprocessor RAM or EEPROM fault	• Depot repair • Check if any strong interference source is applied to the detector
F2	Low supply voltage	Supply voltage is lower than +18.5VDC	• Check if the supply voltage conform to the requirements of the detector
F3	Reference voltage fault	Internal source reference failure	• Depot repair
F5	Switching value fault	1. Detector reed switch fault 2. Remote calibration line or remote reset line fault (Fault is deemed to have occurred if the switch is closed for more than 2 minutes)	• Depot repair if confirmed to be reed switch fault • Check if remote calibration and remote reset wiring is properly connected

Secondary fault code	Fault type	Fault analysis	Solutions
F10**	Gas Detection Module communication memory fault	1. Gas Detection Module communication fault 2. Gas Detection Module RAM and ROM fault	• Check if the wiring between Gas Detection Module and Base Unit is correct • Depot repair
F11**	Sensor drift	Sensor drift is greater than 10% of the full scale	• Recalibrate • Depot repair if the above method does not resolve fault
F12**	Zero clearing failed	Gas Detection Module cannot complete zero clearing	• Check if zero clearing conditions of the detector are met (environment, zero position gas) • Replace with new sensor • Depot repair
F13**	Calibration failed	Gas Detection Module cannot complete calibration	• Check if the calibration gas meet requirements • Replace with new sensor • Depot repair
F15**	Calibration timed out	During calibration, calibration gas is not provided in a timely manner or such gas is not removed in a timely manner after calibration completed	• Calibrate again according to specified procedures
F16**	Verification timed out	During gas check, gas of specified concentration is not provided or not provided for specified duration	• Resolve fault according to the operation procedures in menu
F17**	GMMEEPROM fault	Gas Detection Module EEPROM fault	• Depot repair
F20**	Optical path is not clean	Light source energy received by the sensor is too weak	• Check if the optical path is blocked • Check if the Gas Detection Module lens and reflector window is clean • Depot repair •
F21**	Light intensity too high	Light source energy received by the sensor is too strong	• Depot repair
F22**	Light intensity sudden change	Light source energy received by the sensor has abnormal sudden change	• Check if any strong interference source is applied to the detector • Depot repair
* Nots: Resistance of the power cable recommended for Ultra IR800 shall be less than 20Ω , loop resistance shall be less than 40Ω(for +24VDC). ** Notes: Faults marked with ** will not be covered by warning or alarm state as their priority rights are higher than those of other faults and for other fault priorities are lower than that of warning or alarm.			

If two or more faults occur simultaneously, the base unit will show fault of higher priority. Priorities of fault codes are as follows:

Table 10: Fault code priority

Priority	Fault	Priority	Fault
1	F0	10	F13
2	F1	11	F15
3	F10	12	F16
4	F17	13	F3
5	F20	14	F2
6	F22	15	F5
7	F11	16	
8	F12	17	
9	F21	18	

7.0 Appendix

7.1 Periodic Check / Calibration

Periodic test and calibration of detector should be carried out according to schedule and procedures specified in user's guide. The test and calibration procedures shall include but not limited to:

- Check zero reading
- Check gas concentration

If the test result exceeds the parameter range specified by GASENSOR, carry out re-calibration or repair.

The check / calibration interval time should be less than 12 months to ensure the PFD (Average Freq' of Dangerous failure) in Table 12.

7.2 Periodic System Integrity Test

System Integrity check **shall be carried out annually** for items below:

- Check all the wiring, terminal connections and installation of integrated safety equipment which includes but not limited to:
  - DC power supply
  - Control module
  - On-site testing equipment
  - Signal and Display equipment
  - Accessories connected with on-site and signal equipment
  - Check the operation status of the safety system by a full functional test of all components and ensure alarm and warning conditions are properly set.
  - Check fault and alarm circuits.

The system integrity interval time should be less than 12 months.

7.3 Technical Parameters

Table 11: Technical parameters

Technical parameters	Description
Sensor type	Pyroelectric infrared radial sensor
Range of measurement and gas type	0~100%LEL CH_4
Alarm set value	Warning: 25%LEL, Alarm: 50%LEL. (default)
Typical lifetime	>5 years (under normal conditions of use)
Warranty period	2 years
Working environment	Temperature: -40℃~+70℃ Humidity 5~100%RH (non-condensing)
Accuracy	±3%LEL (at calibration temperature) ±5%LEL (at -40℃ or 70℃)
Explosive-proof grade	II 2G Ex db IIC T6 Gb（Ta: -40℃to +70℃） II 2G Ex db IIC T5 Gb（Ta: -40℃ to +85℃） II 2D Ex tb IIIC T100℃ Db IP66
Response time (100% full scale gas measuring)	T_{90} <=10S (normal), T_{90} <=5S (fast)
Ambient temperature	-40℃～+70℃ or -40℃～+85℃
Ex standards	IEC 60079 - 0 : 2011 EN 60079 - 0 : 2012 IEC 60079 - 1 : 2014 EN 60079 - 1 : 2014 IEC 60079 - 31 : 2013 EN 60079 - 31 : 2014
Hazardous area classification	Zone 1, Zone 2, Zone 21, Zone 22
Repeatability	±1%FS
Zero drift	≤±5% FS/year
Dimensions	L 341 ×W 208 ×H 104 mm (excluding mounting bracket)

Table 12: Cable Requirements

Cable requirements: 3-wire shielded cable, the maximum distance between detector and 24VDC power source:

AWG	meter
14	1000
16	630
18	400
20	250

Note：These parameters are under 24VDC power supply

7.4 Electrical Characteristics

Table 13: Electrical Characteristics

Technical parameters	Description
Ordinary installation	The maximum distance between detector and power source (rated voltage 24VDC) is 1000 meters
Input power	20~36VDC, rated voltage 24VDC, overall power consumption is below 6W.
Relay capacity (optional)	0.3A@250VAC/2A@30VDC maximum resistance (3x) SPDT－warning, alarm, fault
Output current	Load 500Ω@24VDC Without HART: Signal range: 0-22mA Concentration output range: 4-20 mA Start: 1.5mA Calibration: 1.5 mA Gas check: 1.5mA Setting mode: 1.5 mA Fault: < 1.0 mA Out of range: 21.5 mA Optical Path Fault：2.0±0.2 mA **HART:** Signal range: 3.5-22mA Concentration output range: 4-20 mA Start: 3.5±0.2 mA Zero clearing, calibration and verification: 3.5 ±0.2 mA Fault: 3.5±0.2 mA Out of range: 21.5 ±0.2 mA Setting Mode：3.5mA **HART (compatible mode):** Signal range: 1.25-22mA Concentration range: 4-20 mA Start: <1.0 mA Zero clearing, calibration and verification: 1.5 ±0.2 mA Optical circuit fault: 2.0±0.2 mA Other fault: <1.0mA Detector reset: < 1.0 mA Out of range: 21.5 ±0.2 mA

7.5 Safety Function Information

Table 14: Safety Function Information

Safety Function: To provide the host system signal information of the toxic gas concentration of the LEL set-point using 4-20mA and relay contact outputs. Output currents >=3.8mA and <=20.8mA are normal conditions.			
Summary of IEC 61508-2 Clauses 7.4.2 and 7.4.4		Ultra IR800	**Verdict**
Architectural constraints & Type of product A/B		**HFT=0**	**Type B**
Safe Failure Fraction (SFF)		**94%**	**SIL 2**
Random hardware failures: [h^{-1}]	λ_{DD} λ_{DU}	1.27E-07 4.96E-08	
Random hardware failures: [h^{-1}]	λ_{SD} λ_{SU}	1.29E-07 5.78E-07	
Diagnostic coverage (DC)		72%	
Average Freq' of Dangerous failure (High Demand - PFH)		4.96E-08	**SIL 2**
PFD @ PTI = 8760Hrs MTTR = 8Hrs		**2.19E-04**	**SIL 3**
Hardware safety integrity compliance		Route 1_H	
Systematic safety integrity compliance		**Route 1_S** See report R70008839B	
Systematic Capability (SC1, SC2, SC3, SC4)		**SC2 (HFT:0)** See report R70008839B	
Hardware safety integrity achieved		**SIL 2 low demand, HFT=0 (1oo1) due to SFF SIL 2 high demand, HFT=0**	

In the dangerous undetected failure mode, the output current of Ultra IR800 may be uncertain. To avoid this risk, a period proof test is necessary. The interval time is less than 12 months that is described in 7.1 and 7.2.

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