Wilhelmsen Ships Service

MRD – 4/6 S

Marine Refrigerant Gas Leak Monitor

Installation and Operation Manual

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Section 1. Overview

1.1. General Information

The MRD is the ideal gas detection solution for installations requiring a quality and affordable stand-alone gas detector. It consists of 1 to 6 remote gas sensors connected to and powered by a controller. The controller provides visual, audible, and relay alarms on the detection of gases.

The MRD can be used for:

- detecting refrigerant gases (including NH_3 and CO_2)
- speedy detection of combustible gases
- detection of toxic and VOC gases.

A range of gas detector and sensor enclosures are available for special applications.

The MRD Controller is required. With the MRD, it creates a stand-alone gas detection system and is used to remotely monitor up to six MRD devices. Models are available with 4 and 6 channels. Wiring diagrams are provided later in this manual.

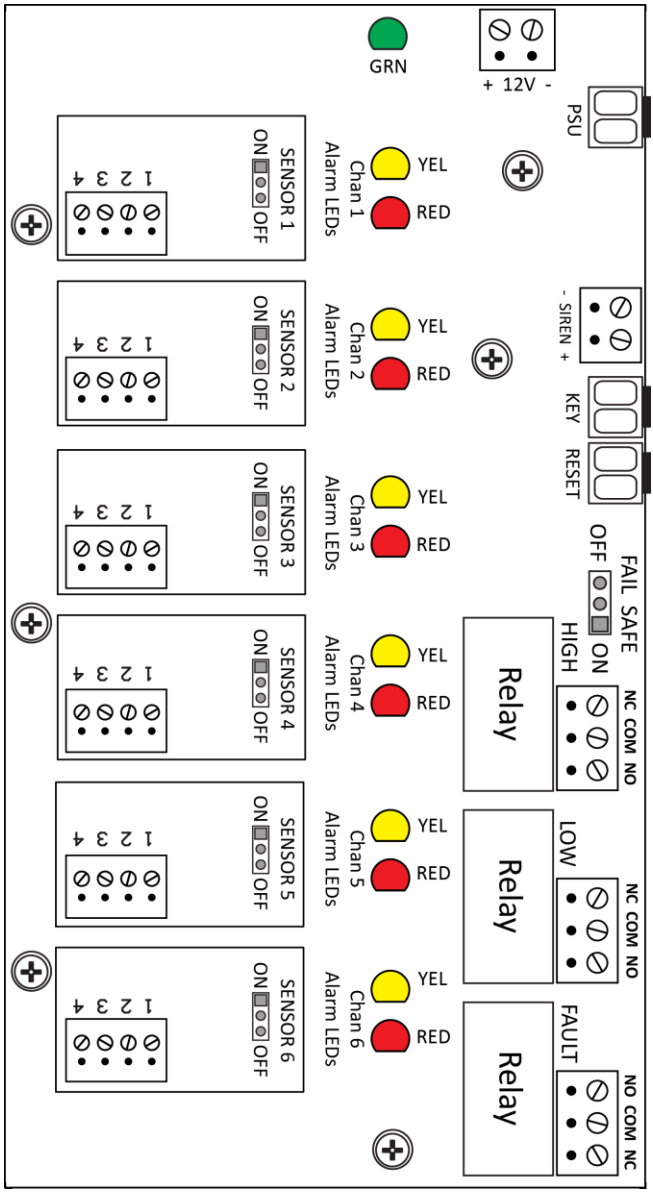

Figure 1. MRD 4- and 6-Channel Controller PCB (Dual Level Alarm)

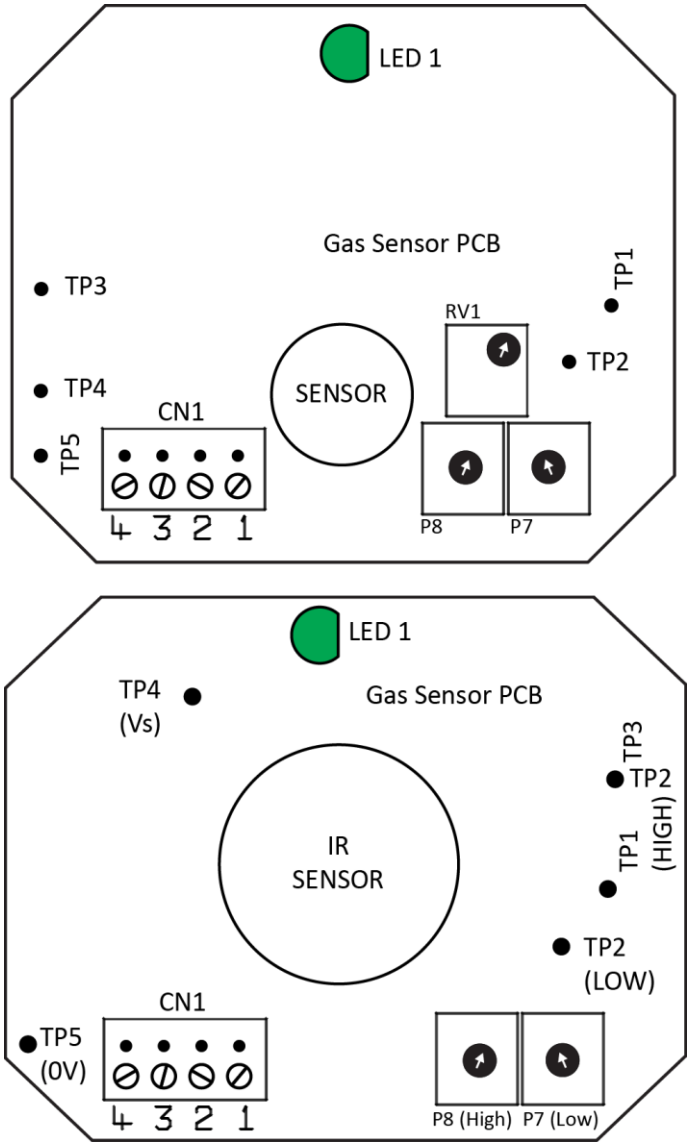

Figure 2. Examples MRD PCBs

1.2. Technical Specifications

Specification	Description
Power Supply	100 - 230 VAC 50 - 60 Hz, or 12 VDC (specified at time of order)
Alarm Silence	Key Switch
Alarm Delay	Preset: 25 sec (low), 30 sec (high)
Power Monitoring LED	Green
Alarm Relay(s)	10 A, 120V/230V
Warm-up Delay	Minimum of 3 minutes
Communications Wiring	4-conductor cable (stranded); 500 ft (152 m) max; 22 AWG; Max 8.8Ω/wire
Approvals	UL/CSA/IEC/EN 61010-1; CE
Sensor Channels	4- and 6-channel systems
Max Power	25 W
Alarm Levels	2 Levels
Audible Alarm (Buzzer)	Internal, intermittent (low), continuous (high)
Alarm Reset	Automatic (low alarm), manual (high alarm)
Visual Alarm LED(s)	Yellow, Red
Fault Indication(s)	Red LED, relay

Specification	Description		
	4- and 6-channel systems		
Std. Enclosure Ratings	MRD: IP41 Controller: IP51		
Dimensions and Weight: Controller	10.3” x 10.4” x 303” 262 x 265 x 84 mm 5.1 lbs / 2.3 kg		
Sensor Dimensions and Weights	**Type/Enclosure**	**Dimensions**	**Weights**
	IP41	3.35” x 5.59” x 2.09” 86 x 142 x 53 mm	6.3 oz 180 g
	IP66	6.89” x 6.5” x 3.29” 175 x 165 x 82 mm	1 lb 6 oz 629 g
	IP66 w/ Exd Remote Head	6.89” x 6.1” x 3.29” 175 x 155 x 82 mm	2 lb 10 oz 1185 g
	IP66 Airflow/ Duct (See Table)	6.89” x 4.9” x 3.29” 175 x 125 x 82 mm	1 lb 4 oz 578 g
	Exd (ATEX only)	5.12” x 6.3” x 3.54” 130 x 160 x 90 mm	9 lb 4 oz 4200 g

NOTE: The hazardous area ***Exd Gas Monitor*** products are designed with individually certified Exd main housing enclosures and certified Exd remote or attached sensor enclosures. The main housing enclosure and its PCB assembly are also Exd certified, but the final **Exd Gas Monitor** assemblies (main enclosure and/or sensor assembly) are not currently Exd certified, but are pending additional testing.

Supported CFM and Duct Sizes for the Duct Mount Housing

Units	Duct Size				
Inches	12 x 12	12 x 24	18 x 18	24 x 24	24 round
Feet	1 x 1	1 x 2	1.5 x 1.5	2 x 2	Pi x 1 x 1
Area (ft^2)	1	2	2.25	4	3.14
CFM	**Ft/min (Based on CFM and Duct Size)**				
2800	2800	n/a	n/a	n/a	n/a
3000	3000	n/a	n/a	n/a	n/a
3400	3400	n/a	n/a	n/a	n/a
3800	3800	n/a	n/a	n/a	n/a
4000	4000	n/a	n/a	n/a	n/a
4400	4400	n/a	n/a	n/a	n/a
4800	4800	n/a	n/a	n/a	n/a
5000	5000	2500	n/a	n/a	n/a
5400	5400	2700	n/a	n/a	n/a
5800	5800	2900	2578	n/a	n/a
6000	6000	3000	2667	n/a	n/a
6400	6400	3200	2844	n/a	n/a
6800	6800	3400	3022	n/a	n/a
7000	7000	3500	3111	n/a	n/a
7400	7400	3700	3289	n/a	n/a
7800	7800	3900	3467	n/a	n/a
8000	8000	4000	3556	n/a	2548
8400	8400	4200	3733	n/a	2675
8800	8800	4400	3911	n/a	2803
9000	9000	4500	4000	n/a	2866
9400	9400	4700	4178	n/a	2994
9800	9800	4900	4356	n/a	3121
10000	10000	5000	4444	2500	3185

Section 2. Placing Sensors

2.1. Installation Warnings

NOTE: This instrument can be equipped with a semiconductor sensor for the detection of refrigerant, combustible and VOC gases. Semiconductor sensors are not gas specific and respond to a variety of other gases including propane exhaust, cleaners, and solvents. Changes in temperature and humidity may also affect the sensor's performance.

WARNING: Explosion hazard! Do not mount the MRD in an area that may contain flammable liquids, vapors, or aerosols. Operation of any electrical equipment in such an environment constitutes a safety hazard.

CAUTION: The MRD contains sensitive electronic components that can be easily damaged. Do not touch nor disturb any of these components.

NOTE: The mounting location of the monitor should allow it to be easily accessible for visual monitoring and servicing.

NOTE: The monitor must be connected by a marked, suitably located and easily reached switch or circuit-breaker as means of disconnection.

NOTE: Connect monitor power and signaling terminals using wiring that complies with local electrical codes or regulations for the intended application.

2.2. General Guidelines

NOTE: The MRD should be installed plumb and level and securely fastened to a rigid mounting surface.

The MRD controller and its sensor(s) should be positioned carefully to avoid mechanical damage (from moving machinery, doors, etc.) and thermal extremes (close to heaters). Units should not be placed unprotected in direct strong drafts/airflows and areas where water or

moisture is present unless an appropriate enclosure is used.

Avoid routing sensor cabling outside of premises, or between buildings via overhead cables. Also, sensor wiring should be kept to a minimum of 20 in (500mm) from the main power supply and telephone cables.

When connecting the main power supply and/or sensor cables ensure a second mechanical fixing is used. Use a cable tie inside the enclosure within 1 in (25mm) of the cable termination.

When power to the unit is switched on, there is a 3-minute delay before the system activates. This allows the sensors to warm up to the correct temperature for gas detection. On a two-alarm unit, the green light on the alarm panel comes on after the delay, indicating that the system is ready. When a unit has been off or stored for a long time the stabilizing period may be longer than 3 minutes. After the 3 minutes has expired, alarms may activate. You may deactivate the siren until stabilization is complete. (Use the key switch on two-alarm units).

Mount the controller using the mounting holes in the base such that the sensor cable terminal blocks are at the bottom of the unit in a convenient position.

Sensors must be located within the appropriate wire lengths from the controller.

In all cases the sensor supplied is designed for maximum sensitivity to a particular gas. However, in certain circumstances false alarms may be caused by the occasional presence of sufficiently high concentrations of other gaseous impurities. Examples of situations where such abnormalities may arise include the following:

- Plant room maintenance activity involving solvent or paint fumes or refrigerant leaks.
- Accidental gas migration in fruit ripening/storage facilities (bananas - ethylene, apples - carbon dioxide).
- Heavy localized exhaust fumes (carbon monoxide, dioxide, propane) from engine-driven forklifts in confined spaces or close to sensors.

A sensor response delay is built in to the system to minimize the possibilities of false alarms.

Section 3. Housing Dimensions

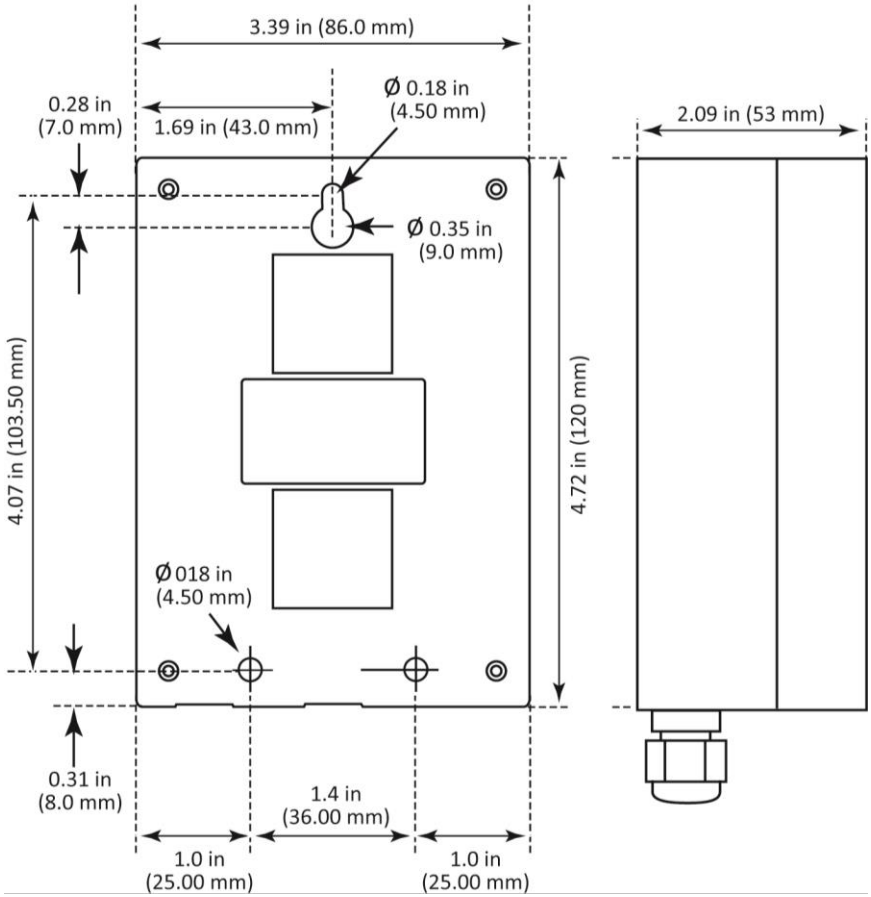

Figure 3. MRD Standard Housing

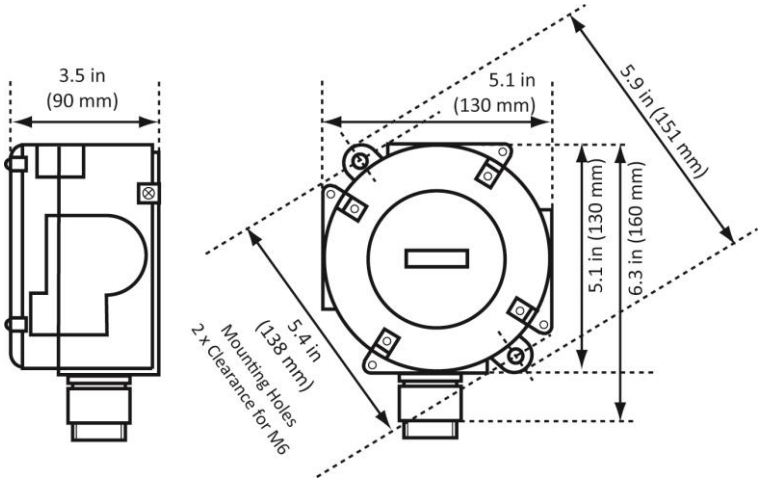

Figure 4. MRD Exd Housing

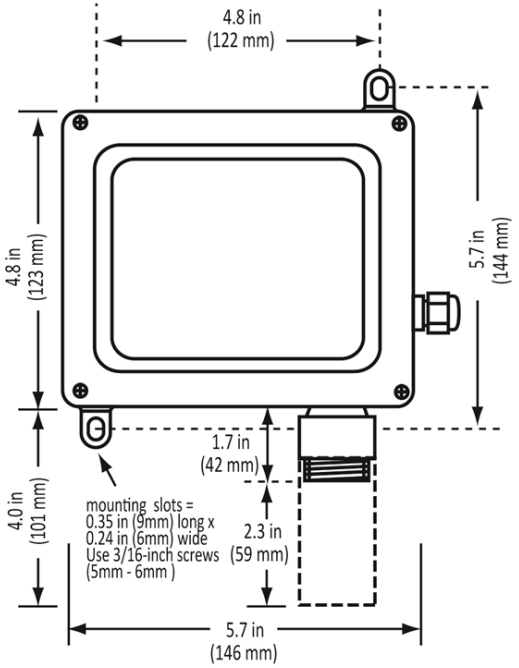

Figure 5. MRD IP66 Housing (with Splash Guard)

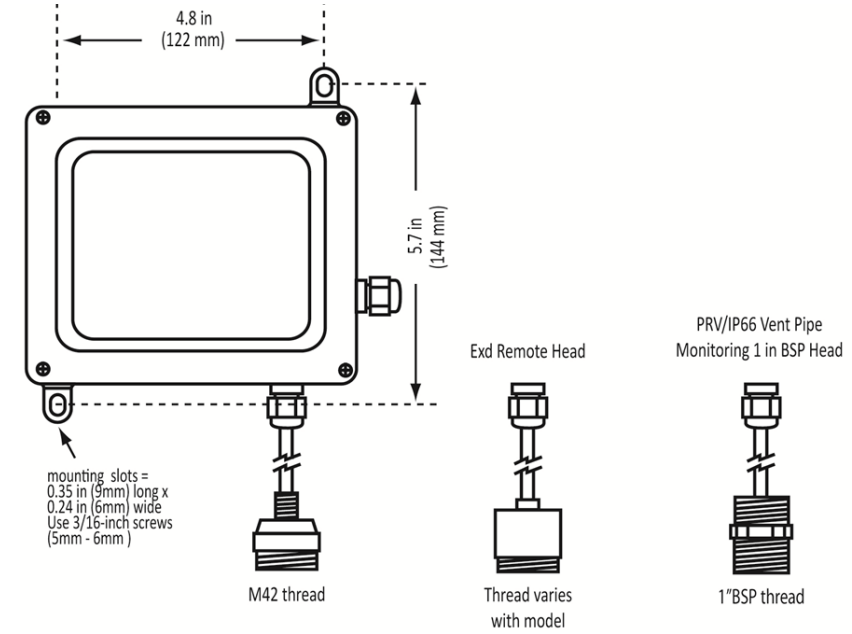

Figure 6. MRD IP66 Housing with Remote Sensor

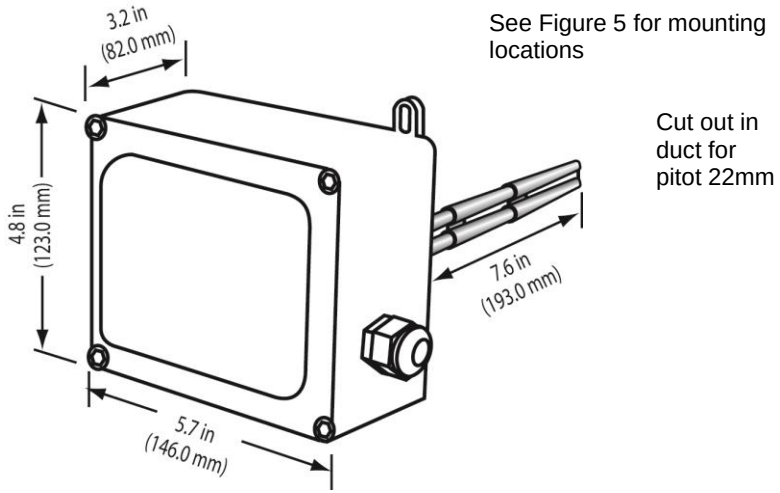

Figure 7. MRD IP66 Housing with Airflow Duct Mount

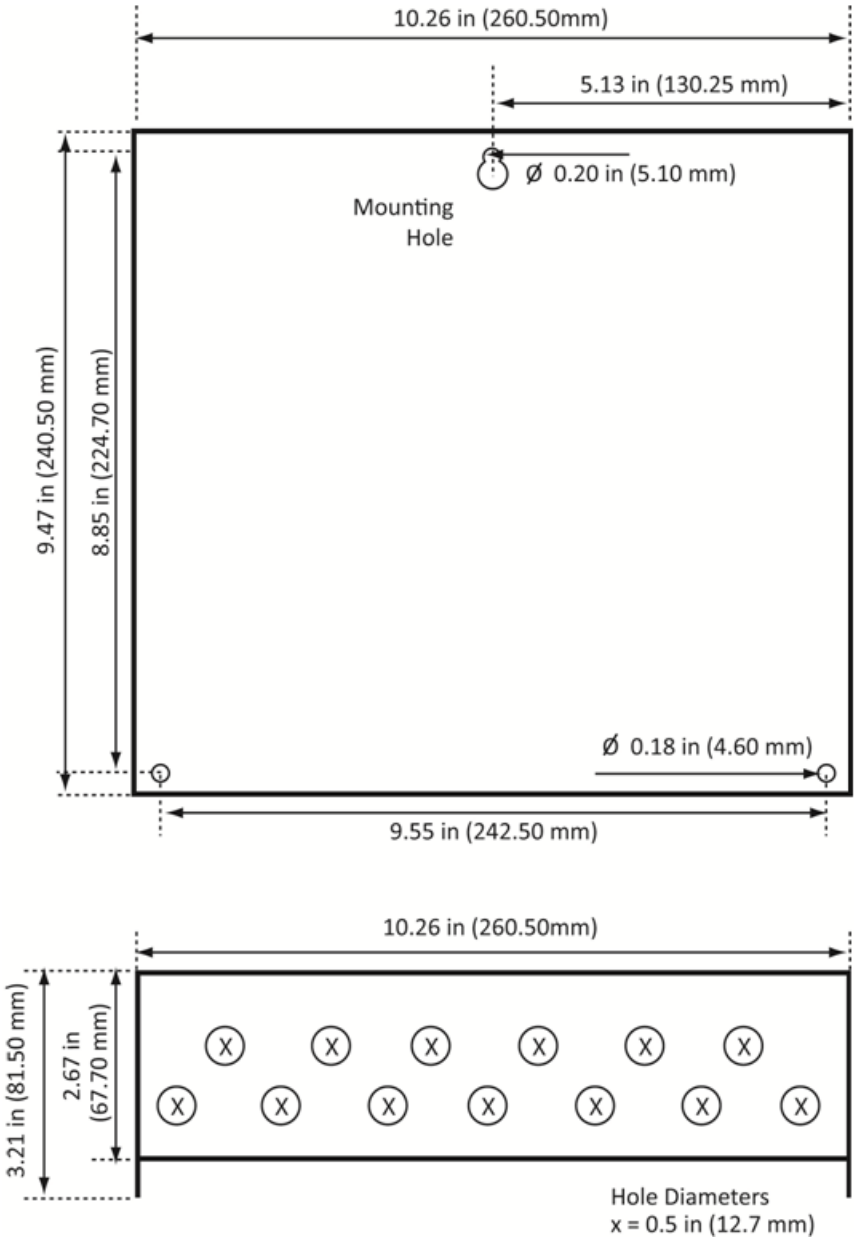

Figure 8. 4- and 6-Sensor Controller Housing

Section 4. Wiring Instructions

4.1. Wiring MRDs

Step	Wiring MRDs
1	Connect a 4-conductor cable (18 AWG recommended) to a terminal block on the MRD controller (CN1, CN2, etc).
2	Route the cable to an MRD.
3	For standard (IP41) MRD housings, remove the lid by: • turning the cable clamp ½ turn counter clockwise to loosen the internal nut • depressing the clip on top of the enclosure to open.
4	Mount the MRD. See Section 3 for dimensions.
5	Connect the other end of the cable to the MRD using terminal block CN1 positions 1,2,3 & 4. (Installation should be such that pin 1 of the MRD controller is connected to pin 1 of the MRD).
6	Close the housing.
7	Repeat above sequence for any/all remaining MRDs.

NOTE: Install a 2200 Ohm resistor between input pins 2 and 3 on any unused channels. If unused channels do NOT have a resistor installed a fault will occur.

IMPORTANT: Ensure that connections 1 to 4 on the sensor connect to their corresponding numbers on the terminal block in the main control unit, otherwise it could cause damage to the MRD.

Maximum Wiring Lengths between MRD and Controller

Requirement	Description
Length:	500 feet maximum
AWG:	22 AWG cable (minimum)
Type:	Stranded 4-wire cable

Resistance:	Max 8.8Ω/wire

NOTE: You may use different cables and longer distances provided the corresponding resistance shown above is not exceeded.

4.2. External Audible Alarm

NOTE: This section applies to the external audible alarm (4-6 channel systems only).

Step	Wiring the External Audible Alarm
1	To install the audible alarm, connect positive (red) lead to the "+" connection of the SIREN terminal.
2	Connect the negative (black) lead to the "-" connection of the SIREN terminal.

4.3. DC Output

NOTE: This section applies to the 12 VDC output (4-6 channel systems only).

Step	Wiring the DC Output
1	The 12 VDC/500 mA output is obtained via the 12V terminal. This output may be wired via the relays to obtain a switching 12 VDC output to drive an external relay or solenoid. **NOTE:** The 12VDC output should not exceed 500 mA.
2	If a switching 12VDC signal is required, connect the "+" of the 12V terminal to the 'COM' terminal of the relay and the device to be switched to either the N/O or N/C terminal (depending on whether a 12V output is required during an alarm condition or while the system is on standby).

Step	Wiring the DC Output
3	The return from the device is connected to "-" on the 12V terminal.

4.4. Relays

All relay outputs are labeled HIGH, LOW and FAULT on the silkscreen. Connect leads to terminal block for Common (COM) and N/O and/or N/C connections as required. Note that relays are rated as 10A @ 120/230 VAC.

NOTE: N/O (normally open) and N/C (normally closed) refer to contact status in standby mode. On a two-alarm system, a high-level alarm condition on any sensor will override a low-level alarm condition on another sensor.

NOTE: The high-level relay may be set for normal or Fail-Safe operation by setting the fail safe jumper on the control unit's printed circuit board.

4.5. Power Connection

Use 3-wire, 20 AWG wire for 230V systems or 3-wire, 18 AWG wire for 120V systems. Connect the main power supply to the MAINS input terminal block.

NOTE: Connection to the main power supply must be made via an approved, readily-accessible, switched and fused plug and socket (or as per local wiring regulations) which should be within 10 feet (3 meters) of the control unit.

NOTE: The main power supply cable should be of an approved type based on local regulations.

NOTE: The blanking plugs for cable entries should only be removed if being replaced by conduit fittings.

NOTE: If replacement of either main power fuse is required, use only a 2A 250V slow fuse (0.79 in/20mm) T2AL250V.

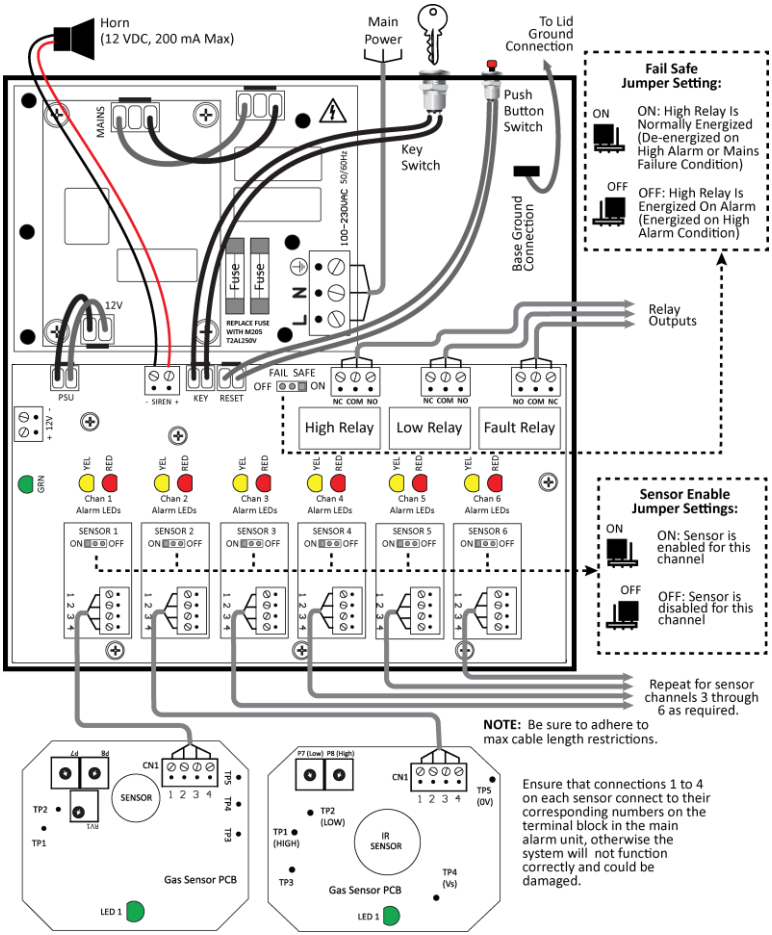

Figure 9. 4- and 6-Sensor, Two-Alarm Installation

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Section 5. Operation and Stabilization

When power to the unit is switched on, the green LED is illuminated, and then there is a 3-minute delay before the system activates. This allows the sensors to warm up to the correct temperature for gas detection.

When a unit has been off or stored for a long time the stabilizing period may be longer than 3 minutes. After the 3 minutes has expired, alarms may activate. You may deactivate the siren using the key switch until stabilization is complete.

After the MRD has been installed in accordance with the installation instructions, the MRD system is ready to monitor the chosen air space and detect gas leaks.

Each of the remote sensors has a green light to indicate that power is present.

To minimize false alarms, the system has a built in delay enforced between the arrival time of gas at the sensor unit, and the time when the alarm occurs. This delay is 20-25 seconds before a low-level alarm, and 25-30 seconds before a high-level alarm.

Operation State	Description
Idle	Only the green light on the panel is on. No gas is present.
Power Interrupted	If the green light is off, power to the unit has been interrupted. Refer to Section 7.
Alarm Conditions	Two-alarm Units: Low Alarm: One of more yellow lights on the panel turn on. The audible alarm operates intermittently, and the low alarm relay operates: this indicates presence of a low level of gas on one or more sensors. High Alarm: One or more red lights on the panel turn on. The audible alarm operates continuously, and the high alarm relay operates: this indicates presence of a high level of gas on one or more of the sensors.
Resetting Alarms	On two-alarm units, low-level alarm conditions will reset automatically when the gas dissipates. High-level alarm conditions require a manual reset (by pressing the reset button). Please note that a high alarm condition can only be reset 30-60 seconds after the gas clears from around the sensors.
Audible Alarm	For the purpose of system maintenance, the audible alarm may be disabled temporarily by using the key switch.
Fault	This indicates a wiring or sensor problem.

Section 6. Functional Tests and Calibration

6.1. Introduction

To comply with the requirements of EN378 and the European F-GAS regulation, sensors must be tested annually. However, local regulations may specify the nature and frequency of this test.

CAUTION: Check local regulations on calibration or testing requirements.

CAUTION: The MRD contains sensitive electronic components that can be easily damaged. Do not touch nor disturb any of these components.

NOTE: The MRD is calibrated at the factory. After installation, a zero adjustment may be required due to differences in environmental conditions.

IMPORTANT: If the MRD is exposed to a large leak it should be tested to ensure correct functionality by electrically resetting the zero setting and carrying out a bump test. See procedures below.

IMPORTANT: The testing and/or calibration of the unit must be carried out by a qualified technician, and must be done in accordance with this manual and in compliance with locally applicable guidelines and regulations.

Suitably qualified operators of the unit should be aware of the regulations and standards set down by the industry/country for the testing or calibration of this unit. This manual is only intended as a guide and, insofar as permitted by law, the manufacturer accepts no responsibility for the calibration, testing, or operation of this unit.

The frequency and nature of testing or calibration may be determined by local regulation or standards.

EN378 and the F-GAS Regulation require an annual check in accordance with the manufacturer's recommendation.

IMPORTANT: Before testing the sensors on-site, the MRD must have been powered up and allowed to stabilize for at least 24 hours. See Section 5.

IMPORTANT: Failure to test or calibrate the unit in accordance with applicable instructions and with industry guidelines may result in serious injury or death. The manufacturer is not liable for any loss, injury, or damage arising from improper testing, incorrect calibration, or inappropriate use of the unit.

IMPORTANT: Wilhelmsen recommends annual checks and gas calibration. Wilhelmsen also recommends sensor replacement every 3 years or as required. Calibration frequency may be extended based on application, but should never exceed 2 years.

IMPORTANT: In applications where life safety is critical, calibration should be done quarterly (every 3 months) or on a more frequent basis. Wilhelmsen is not responsible for setting safety practices and policies. Safe work procedures including calibration policies are best determined by company policy, industry standards, and local codes.

NOTE: For improved accuracy and response, the instrument should be zeroed and calibrated in the environment in which it is being installed.

There are two concepts that need to be differentiated:

Bump Test Exposing the sensor to a gas and observing its response to the gas. The objective is to establish if the sensor is reacting to the gas and all the sensor outputs are working correctly. There are two types of bump test.

- **Quantified:** A known concentration of gas is used.
- **Non-Quantified:** A gas of unknown concentration is used.

Calibration Exposing the sensor to a calibration gas, setting the “zero” or “Standby voltage”, the span/range, and checking/

adjusting all the outputs, to ensure that they are activated at the specified gas concentration.

CAUTION: Before you carry out the bump test or calibration:

- Advise occupants, plant operators, and supervisors.
- Check if the MRD is connected to external systems such as sprinkler systems, plant shut down, external sirens and beacons, ventilation, etc. and disconnect as instructed by the customer.
- Ideally, for bump test or calibration the MRD should be powered up overnight. See Section 5 for more information.

6.2. Electrical Reset

If necessary, reset the Standby and low/high Alarm Threshold Voltages to the factory settings as shown on the calibration label. This is performed on the MRD Sensor PCB.

Electrical reset information is listed on the label on the side of the enclosure and is unique to that sensor.

Tools required:

- A voltmeter (crocodile clips recommended)
- Factory set point electric values (as shown on the rating label)
- Screwdriver (depending on enclosure).

Step	Electrical Reset
1	For semiconductor sensors only, connect a DC voltmeter between TP5 (0V) and TP4 (+V) as shown in Figure 9. Adjust pot RV1.
2	For two-level sensors only, connect your DC voltmeter between TP5 (0V) and TP2 (+V) as shown in Figure 9. Adjust pot P8.

Step	Electrical Reset
3	For high-level alarm voltage, connect your DC voltmeter between TP5 (0V) and TP1 (+V) as shown in Figure 9. Adjust pot P7.

6.3. On-Site Gas Calibration

This section and the next cover calibration using calibration gas cylinders. Wilhelmsen offers a calibration kit that consists of a calibration gas cylinder and a flow regulation valve with flexible non-absorbent tubing and vented calibration hood.

In some cases this option may be expensive relative to sensor exchange because of the cost of visiting a site, calibration gas, etc.

The procedure involves electrical set-up followed by adjustment using calibration gases. Equipment required is as follows:

- Gas cylinder with the appropriate target gas and concentration
- Fixed flow regulator – rate 0.3L/min

NOTE: The sensor delay is approximately 25 seconds and cannot be deactivated

All adjustments are performed on the MRD sensor PCB. The Sensor Standby Voltage and two Alarm Threshold Voltages must be adjusted.

Step	Adjusting the Sensor Standby Voltage (SSV)
1	Connect the voltmeter between TP5 (0V) & TP4 (+Ve) and adjust pot RV1 for 0.3V (on IR units SSV is fixed).

Step	Adjusting the Low Alarm Threshold Voltage (ATV)
2	Monitor the voltage between TP5 (0V) & TP4 (+Ve)/0V and VS on IR units.
3	Apply the low concentration calibration gas to the sensor and wait until the sensor output signal stabilizes. Record this voltage.

Step	Adjusting the Low Alarm Threshold Voltage (ATV)
4	Adjust P8 to the new value. Record and use the new value for subsequent electrical set-ups.

Step	Adjusting the High Alarm Threshold Voltage (ATV)
5	Monitor voltage between TP5 (0V) & TP4 (+Ve)/0V and VS on IR units.
6	Apply the high concentration calibration gas to the sensor and wait until the sensor output signal stabilizes. Record this voltage.
7	Adjust P7 to the new value. Record and use the new value for subsequent electrical set-ups.

CAUTION: The high alarm threshold voltage must be set higher than the low alarm threshold or the unit will not function correctly.

Section 7. Troubleshooting

Symptom	Possible Cause(s)
No lights displayed on panel	• Power failure (check supply) • Tripped circuit breaker or blown fuse on electrical supply • Blown fuse at the electrical supply on the controller PCB board
Red light is on, but no alarm condition is active (i.e., no siren and no relay operation after 3 minutes)	• Make sure the siren has not been deactivated by key switch. • This indicates a wiring or sensor fault (call service provider).
Controller is on, but the MRD is not	• This may indicate a wiring fault between the controller and sensor or a sensor fault. Check power supply to the controller. Check connections between the controller and the sensor to ensure that the wires from positions 1 to 4 on the sensor are connected to the corresponding 1 to 4 connectors on the controller.

NOTE: If false alarms are being triggered by background gases, paint fumes, etc., or extreme humidity or temperature conditions, you may adjust the settings to compensate.

You should adjust the relevant sensor alarm threshold voltage upwards in 0.2 V increments until the condition clears.

To make sure the gas detectors are wired up correctly you can check the voltages at the sensor cable terminal blocks on the controller PCB or sensor PCB using a voltmeter as outlined below in Table 1.

Place the negative probe on terminal position 4 and with the positive on 1, 3, 2, check the values. The readings are lower at the sensor due to power drop in the line.

The terminals should have the values shown in the table below.

You can monitor this as follows:

- Connect voltmeter and monitor voltage between TP5 (0V) and TP4 (+Ve). For IR, monitor between 0V and VS.

Table 1. Connections Correct Values

Position Number	At the Sensor	Controller
1	12V Power Supply	+10V
2	Sensor output, These are approximate, typical internal reference values.	(0=Fault)
		+0.4V
		+1.6V
		+2.8V
3	Approximately 4-5V	+4.8-5V
4	Is the negative side of the power supply	Negative

* *The voltage signal from the sensor will start high and gradually fall (in clean air) to the SSV value shown on the calibration label. IR unit will display 0 Volts until the 2 minute warm-up has finished.*

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