Refrigerant leak detector

Installation and operation manual

Version 1.4

Manufactured for
MITSUBISHI ELECTRIC UK

MITSUBISHI ELECTRIC

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Contents

Safety Precautions

Before installing the unit, make sure you read all the "Safety precautions".

Definition of symbols

Alert	Symbol	Description
Danger		Will result in death or serious injury if not avoided.
Warning		Could potentially result in death of serious injury if not avoided.
Caution		Could potentially result in damage to the product, injury or damage to the environment if not avoided.
Information		Information notes relating to the operation of the product.

 Warning:

Carefully read the labels affixed to the main unit.

 Warning:

- Ask the dealer or an authorised technician to install the unit.
- Improper installation by the user may result in water leakage, electric shock, or fire.
- Use the specified cables for wiring. Make the connections securely so that any outside forces acting on the cables are not applied to the terminals. Inadequate connection and fastening may generate heat and cause a fire.
- Never repair the unit. If the controller must be repaired, consult the dealer.
  If the unit is repaired improperly, electric shock, or fire may result.
- When handling this product, always wear protective equipment. EG: Gloves, full arm protection namely boiler suit, and safety glasses.
  Improper handling may result in injury.
- If refrigerant gas leaks during installation work, ventilate the room.
  If the refrigerant gas comes into contact with a flame, poisonous gases will be released.
- Install the controller according to this Installation Manual.
  If the unit is installed improperly, electric shock, or fire may result.
  Have all electric work done by a licensed electrician according to "Electric Facility Engineering Standard", "Interior Wire Regulations" and the instructions given in this manual and always use a special circuit.
- If the power source capacity is inadequate or electric work is performed improperly, electric shock and fire may result.
  Keep the electric parts away from any water - washing water etc...
  Contact may result in electric shock, fire or smoke.
- After completing installation work, make sure that refrigerant gas is not leaking.
  If the refrigerant gas leaks and is exposed to a fan heater, stove, oven, or other heat source, it may generate noxious gases.
- Do not reconstruct or change the settings of the protection devices. If the pressure switch, thermal switch, or other protection device is shorted or operated forcibly, or parts other than those specified by Mitsubishi Electric are used, fire or explosion may result.

To dispose of this product, consult your dealer. Do not use a leak detection additive.

Precautions for devices that use HCFC and HFC refrigerants


Caution:

- Do not use the existing refrigerant piping.
  The old refrigerant and refrigerator oil in the existing piping contains a large amount of chlorine which may cause the refrigerator oil of the new unit to deteriorate. Use refrigerant piping made of C1220 (CU-DHP) phosphorus deoxidized copper as specified in the JIS H3300" Copper and copper alloy seamless pipes and tubes". In addition, be sure that the inner and outer surfaces of the pipes are clean and free of hazardous sulphur, oxides, dust/dirt, shaving particles, oils, moisture, or any other contaminant.
  Contaminants on the inside of the refrigerant piping may cause the refrigerant residual oil to deteriorate.

- Store the piping to be used during installation indoors and keep both ends of the piping sealed until just before brazing.
  (Store elbows and other joints in a plastic bag.) If dust, dirt, or water enters the refrigerant cycle, deterioration of the oil and compressor problems may result.

- Use ester oil, ether oil or alkylbenzene (small amount) as the refrigerator oil to coat flares and flange connections.
  The refrigerator oil will degrade if it is mixed with a large amount of mineral oil.

- Use liquid refrigerant to fill the system.
  If gas refrigerant is used to seal the system, the composition of the refrigerant in the cylinder will change and performance may drop.

- Do not use a refrigerant other than what is specified..
  If the incorrect refrigerant (R22, etc.) is used, the chlorine in the refrigerant may cause the refrigerator oil to deteriorate.

- Use a vacuum pump with a reverse flow check valve.
  The vacuum pump oil may flow back into the refrigerant cycle and cause the refrigerator oil to deteriorate.
  Do not use the following tools that are used with conventional refrigerants. (Gauge manifold, charge hose, gas leak detector, reverse flow check valve, refrigerant charge base, vacuum gauge, refrigerant recovery equipment.)

- If the conventional refrigerant and refrigerator oil are mixed, the refrigerant may deteriorate.
  If water is mixed in the refrigerant, the refrigerator oil may deteriorate.
  Since HCFC and HFC refrigerants do not contain any chlorine, gas leak detectors for conventional refrigerants will not react to it.

- Do not use a charging cylinder. Using a charging cylinder may cause the refrigerant to deteriorate.
  Be especially careful when managing the tools.

- If dust, dirt, or water gets in the refrigerant cycle, the refrigerant may deteriorate.

Before installation

Caution:

- Do not install the unit where combustible gas may leak.
  If the gas leaks and accumulates around the unit, an explosion may result.
- Ground the unit.
  Do not connect the ground wire to gas or water pipes, lightning rods, or telephone ground lines. Improper grounding may result in electric shock.
- Install the power cable so that tension is not applied to the cable. Tension may cause the cable to break and generate heat which may, in turn, cause fire.
- Install a leak circuit breaker, as required.
  If a leak circuit breaker is not installed, electric shock may result.
- Use power line cables of sufficient current carrying capacity and rating.
  Cables that are too small may leak, generate heat, and cause a fire.
- Use only a circuit breaker and fuse of the specified capacity.
  A fuse or circuit breaker of a larger capacity or a steel or copper wire may result in a general unit failure or fire.
- Be very careful regarding product transportation.
  Two people should be used to carry products of 20kg or more.
- Some products use PP bands for packaging. Do not use any PP bands for a means of transportation.
- Safely dispose of the packing materials.
  Packing materials, such as nails and other metal or wooden parts, may cause stabs or other injuries.
  Tear apart and throw away plastic packaging bags so that children will not play with them - If children play with a plastic bag which has not been torn apart, they face the risk of suffocation.

Before starting a test run

Caution:

- Do not touch the switches with wet fingers.
  Touching a switch with wet fingers can cause electric shock.
- Do not touch the refrigerant pipes during and immediately after operation.
  During and immediately after operation, the refrigerant pipes may be hot or cold, depending on the condition of the refrigerant flowing through the refrigerant piping, compressor, and other refrigerant cycle parts. Your hands may suffer burns or frostbite if you touch the refrigerant pipes.
- Do not operate the air conditioner with the panels and guards removed.
  Rotating, hot, or high-voltage parts can cause injuries.
- Do not turn off the power immediately after stopping operation.
  Always wait at least five minutes before turning off the power. Otherwise, water leakage and other problems may occur.

Disclaimer

Warranty:
All products manufactured on behalf of Mitsubishi Electric UK are warranted against defective materials for a period of three years from the date of delivery to the original purchaser.

Warning:

Mitsubishi Electric UK assumes no liability for damages consequent to the user of this product. We reserve the right to change this manual at any time without notice. The information furnished by us is believed to be accurate and reliable. However, no responsibility is assumed by us for its use, nor for any infringements of patents or other rights of third parties resulting from its use.

1. Overview

This manual outlines the installation and operation of the KSGD refrigerant leak detector.

The KSGD is a stand-alone refrigerant leak detector for air conditioning and refrigeration applications.

The KSGD is available in a number variants – this manual covers all of these variants.

Fig 1 – KSGD detector

1.1 Specification Overview

In the interest of continued product development, the manufacturer reserves the right to make improvements to products with notice or obligation.

Housing	White plastic OR Stainless steel fascia (back box / dry lining box supplied on request – other options available)
Power	12-24V AC or DC
Power usage	Max 2.5VA, 1VA nominal
Relays	1 or 2 – Contact rating 0.5A @ 125VAC / 1A @ 24VDC
Indicators	1 x Tri-colour LED
Sounder	85dB 2300Hz (+/-300Hz)
Screw terminals	5 or 6 x 2.5mm/sq
Size	85 x 85 x 38 mm (30mm behind fascia)
Weight	Approx. 85g (dependant on fascia material)
Refrigerant	R410a, R32 (other gases available on request)
Sensor	Semi-conductor

2. Installation

The KSGD is available with faceplates in white plastic and stainless steel or can be custom finished to suit colour schemes. Irrespective of the faceplate the KSGD will fit into a standard single gang electrical back box.

The minimum depth of the back box is dependent upon the faceplate however all designs will fit into a box 45mm deep enclosure which can be flush mounted into the wall.

Fig-2 shows how the KSGD is to be mounted;

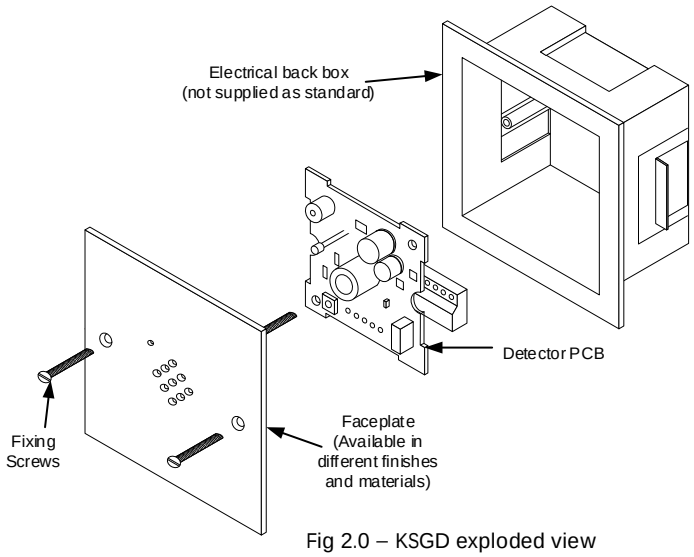

Fig 2.0 – KSGD exploded view

2.1 Locating the sensor

The main considerations when deciding where to locate the KSGD are:-

1. Low level

As HFC refrigerants are heavier than air, the KSGD should be mounted as close as practical to floor level (150mm ~ 250mm above floor level), preferably directly below the air conditioning unit.

2. Accessible for maintenance

The KSGD should be mounted in a position where it can be easily accessed for maintenance and repairs.

3. Minimize possibility of damage

Mount the sensor in a position that minimizes the risk of mechanical damage to the unit.

4. Minimize false alarms

Semi-conductor sensors can be '***poisoned*** by contaminants and after exposure may take considerable time to recover. Solvent paints and silicon mastic are typical contaminants and exposure from these substances must be avoided.

5. Ensure leaks can be detected

Do not mount the sensor next to doors or windows, where fresh air may influence readings.

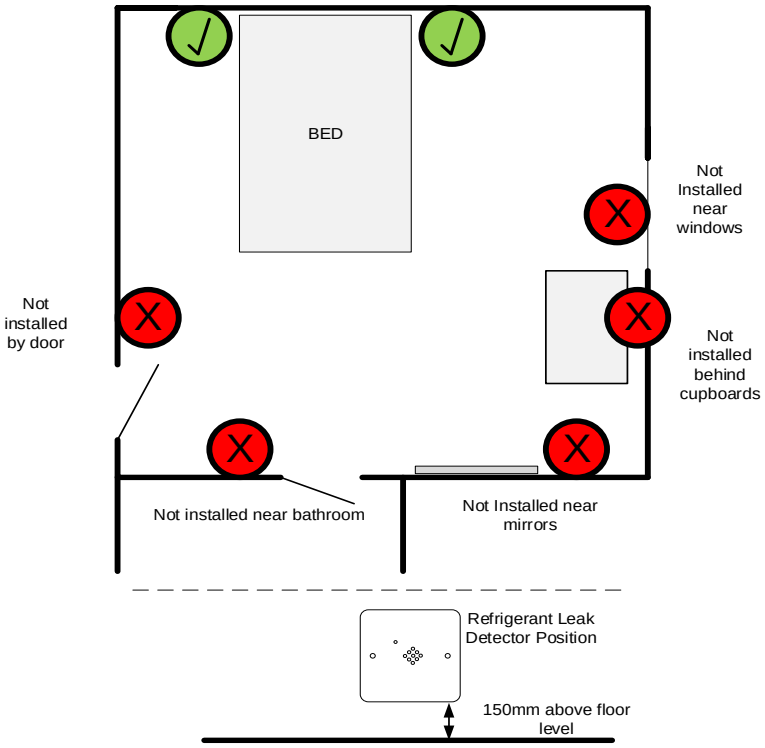

Fig 2.1 – Locating the KSGD

2.2 Electrical connections

The KSGD connections are located on the rear of the detector PCB.

The KSGD will operate from a 12/24 volt AC or DC supply. Start-up current from a 24 volt AC supply is 260mA with steady state of 100mA. A single plug on the PCB accepts all the electrical connections. A small flat bladed screwdriver can be used to prise the plug away from the socket.

Dual relay version;

Pin	Usage	
1	Power (V1)	12 to 24V AC or DC
2	Power (V2)	
3	Relay 1 – (NO1) Normally Open	
4	Relay 1 – (C1) Common	
5	Relay 2 - (NC2) Normally Closed	
6	Relay 2 – (C2) Common	

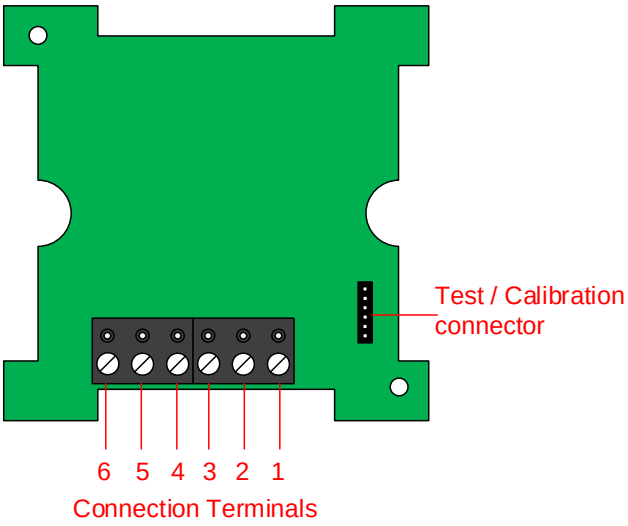

Fig 2.2 – KSGD dual relay version

Single relay version;

Pin	Usage	
1	Power (V1)	12 to 24V AC or DC
2	Power (V2)	
3	Relay – (NO) Normally Open	
4	Relay – (C) Common	
5	Relay – (NC) Normally Closed	

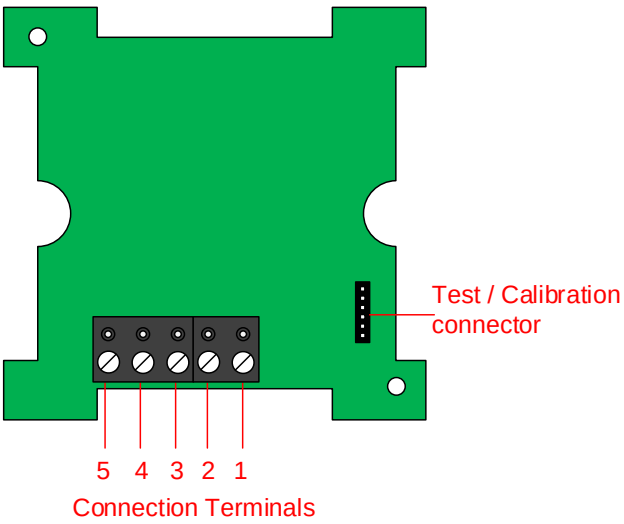

Fig 2.3 – KSGD single relay version

See section 3 for details on the relay operation and functions.

Relay(s) are energized in normal operation, the relay will de-energize if an alarm or fault occurs or if power is not present. The tables above show the relay(s) in the de-energized power removed state.

2.3 Other features

Features such as the sensor and buzzer enable link are located on the front of the detector PCB.

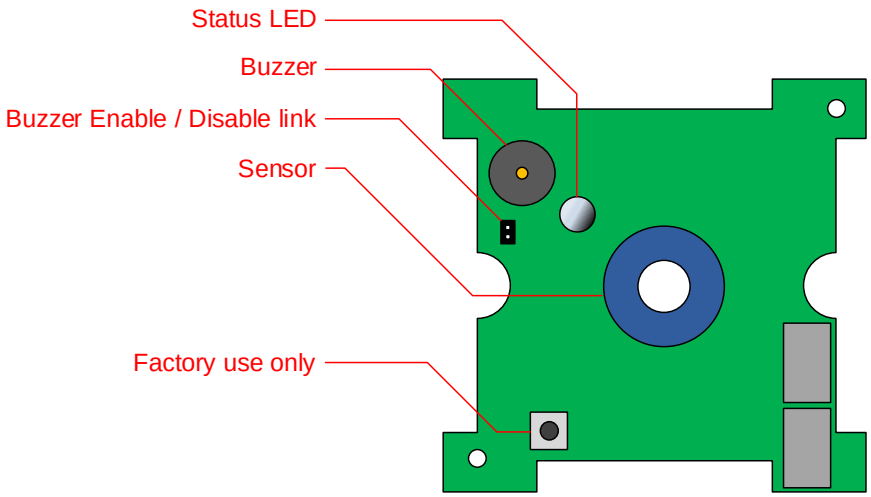

Fig 2.4 – KSGD other features

When the buzzer enable / disable link is fitted, the buzzer will operate when required. Remove this link to disable the buzzer permanently.

3. Operation

When power is applied, a green LED will flash (GREEN/RED) to indicate power "ON". After approximately 5 minutes the green LED will be illuminated permanently and the detector is fully operational. When a refrigerant leak alarm is detected the LED will flash RED/AMBER, the buzzer will sound and the relay(s) will change status. The alarm cannot be acknowledged or muted and the LED/buzzer will indicate an alarm until the refrigerant concentration subsides. In the event of a faulty sensor the LED will flash RED with an AMBER pulse, the relay(s) will change state and the buzzer will pulse once a minute. This action will continue until the fault is rectified.

3.1 Operational matrix

Operating State	**Dual Relay version – Connection terminal states**		**Single Relay version – Connection terminal states**		**LED**	**Buzzer**	**Gv Voltage**
Power removed	**3 & 4**	**5 & 6**	**3 & 4**	**4 & 5**	OFF	OFF	N/A
	OPEN	CLOSED	OPEN	CLOSED			
Warmup (5 minutes)	**3 & 4**	**5 & 6**	**3 & 4**	**4 & 5**	Flashing GREEN>RED (1Hz)	OFF	N/A
	CLOSED	OPEN	CLOSED	OPEN			
Normal operation	**3 & 4**	**5 & 6**	**3 & 4**	**4 & 5**	Constant GREEN	OFF	0.4>1VDC*
		OPEN		OPEN			
Sensor fault	**3 & 4**	**5 & 6**	**3 & 4**	**4 & 5**	RED>OFF (1Hz) 1 x AMBER FLASH PER MINUTE	Pulses once per minute	<0.1VDC
	OPEN	CLOSED	OPEN	CLOSED			
As the gas concentration increases							
Pre-alarm Level 1; Reading> ~500ppm For > 2 seconds	**3 & 4**	**5 & 6**	**3 & 4**	**4 & 5**	Flashing GREEN>OFF (2Hz)	OFF	>2.5VDC
	CLOSED	OPEN	CLOSED	OPEN			
Pre-alarm Level 2; Reading> ~1000ppm For > 2 seconds	**3 & 4**	**5 & 6**	**3 & 4**	**4 & 5**	Flashing RED>OFF (2Hz)	OFF	>3.5VDC
	CLOSED		CLOSED	OPEN			
Low Level Alarm; Reading> ~1000ppm For > 30 minutes	**3 & 4**	**5 & 6**	**3 & 4**	**4 & 5**	Flashing RED>AMBER (2Hz)	Pulses 2Hz	>3.5VDC
	OPEN	CLOSED	OPEN	CLOSED			
High Level Alarm; Reading> ~4000ppm For > 30 seconds	**3 & 4**	**5 & 6**	**3 & 4**	**4 & 5**	Flashing RED>AMBER (4Hz)	Pulses 4Hz	>4.2VDC
	OPEN	CLOSED	OPEN	CLOSED			
After auto reset (gas leak cleared)							
After 60 seconds delay	**3 & 4**	**5 & 6**	**3 & 4**	**4 & 5**	Constant GREEN	OFF	<2.0VDC
	CLOSED	OPEN	CLOSED	OPEN			

*In normal operation in clean air the Gv voltage should be within the range given, however the detector will remain in the normal state until the Gv reaches 2V. If the Gv voltage is greater than 1V, the sensor maybe contaminated or detecting residual refrigerant or contaminant gas / vapor.

PPM Levels quoted are approximate levels expected for R410a refrigerant.

4. Testing

The operation of the detector can be verified in 2 ways – depending on the accuracy required;

4.1 Measuring the Gv

When testing the detector the Gv voltage must be checked using a multi-meter at various points during the test procedure. The Gv voltage is measured on the 6 way test / calibration connector. The location of this connector varies on older variants of the detector, along with the connection terminals. The calibration kit includes a test lead for easy connection and measurement of the Gv.

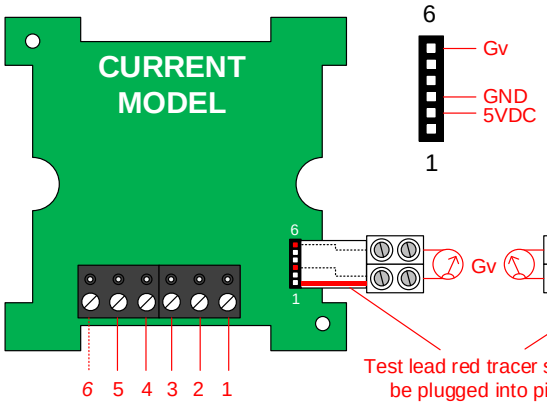

Fig 4.1 – Current model detector Gv voltage

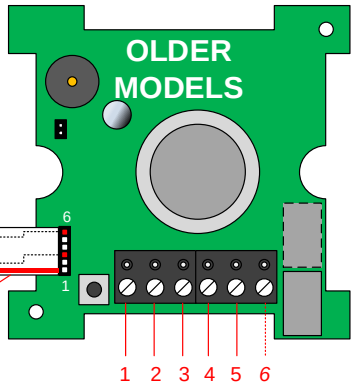

Fig 4.2 – Older model detector Gv voltage

4.1 Bump test procedure

The reactivity of the detector can be verified by performing a "bump" test using propane or butane. This is primarily aimed at verifying the operation of the relay & buzzer – as the propane or butane used is not verification that the sensor can detect refrigerant at the appropriate concentration.

1. Firstly verify *Normal Operation*, using a multi-meter – measure the Gv voltage. The Gv should be between 0.4 VDC and 1 VDC. If the Gv is outside this range the sensor is reacting to refrigerant or a contaminant. The room should be well ventilated to eliminate any potential refrigerant or contaminant and the voltage should subside.

Operating State	Dual Relay version Connection terminal states		Single Relay version Connection terminal states		LED	Buzzer	Gv Voltage
Normal operation	3 & 4	5 & 6	3 & 4	4 & 5	Constant GREEN	OFF	0.4>1VDC
	CLOSED	OPEN	CLOSED	OPEN			

2. Using a small amount of butane or equivalent, spray gas at the sensor for approximately 30 to 40 seconds.

3. The sensor will enter the *High Level Alarm* state.

Operating State	Dual Relay version Connection terminal states		Single Relay version Connection terminal states		LED	Buzzer	Gv Voltage
High Level Alarm Reading> ~4000ppm For > 30 seconds	3 & 4	5 & 6	3 & 4	4 & 5	Flashing RED>AMBER (4Hz)	Pulses 4Hz	>4.2VDC
	OPEN	CLOSED	OPEN	CLOSED			

4. After removing the gas the sensor should recover and return to *Normal Operation.*
It may be necessary to ventilate the room with fresh air for the sensor to recover. The time for the detector to recover will depend upon the concentration of gas detected by the sensor and the time period but is typically less than 5 minutes. It is recommended that the sensor is not subjected to cigarette lighter gas for a prolonged period (>3 minutes) as recovery may become significantly longer.

4.2 Full Operational test procedure

To verify the correct operation of the detector, test gas can be used which is equivalent to the alarm thresholds. Test kits are available.

Fig 4.3 – Calibration test kit

Fig 4.4 – Gas bottle with regulator fitted

1. Fit pressure regulator on to calibrated gas bottle and check the cylinder pressure is above 10 bar.
   The test gas cylinder should be stored at room temperature or allowed to stand at room temperature for at least 4 hours prior to use.
   Ensure the detector is powered up for a minimum of 1 hour before testing.

2. Ensure the detector is in the *Normal operation* state before commencing with tests. Just before conducting tests gently agitate the bottle for 1 to 2 minutes.

Operating State	Dual Relay version Connection terminal states		Single Relay version Connection terminal states		LED	Buzzer	Gv Voltage
Normal operation	**3 & 4**	**5 & 6**	**3 & 4**	**4 & 5**	Constant GREEN	OFF	0.4>1VDC
	CLOSED	OPEN	CLOSED	OPEN			

3. Place the plastic tube directly over the perforation on the cover plate and turn the regulator valve fully anticlockwise to release the test gas. Apply test gas onto the detector.

   As the measured gas level starts to increase, the detector will enter the *Pre-Alarm* states.

Fig 4.5 – Applying gas to the detector

Operating State	Dual Relay version Connection terminal states		Single Relay version Connection terminal states		LED	Buzzer	Gv Voltage
Pre-alarm Level 1; Reading> ~500ppm For > 2 seconds	**3 & 4**	**5 & 6**	**3 & 4**	**4 & 5**	Flashing GREEN>OFF (2Hz)	OFF	>2.5VDC
	CLOSED	OPEN	CLOSED	OPEN			
Pre-alarm Level 2; Reading> ~1000ppm For > 2 seconds	**3 & 4**	**5 & 6**	**3 & 4**	**4 & 5**	Flashing RED>OFF (2Hz)	OFF	>3.5VDC
	CLOSED	OPEN	CLOSED	OPEN			

Once the *Pre-alarm level 2* state is reached, the operation of the detector is proven and unless confirmation of the relay operation is required there is no necessity to continue through the remaining steps – skip to step 5.

If the detector remains in the *Pre-alarm level 2* state continuously for 30 minutes the detector will enter the *Low Alarm Level* condition.

Operating State	Dual Relay version Connection terminal states		Single Relay version Connection terminal states		LED	Buzzer	Gv Voltage
Low Level Alarm; Reading> ~1000ppm For > 30 minutes	**3 & 4**	**5 & 6**	**3 & 4**	**4 & 5**	Flashing RED>AMBER (2Hz)	Pulses 2Hz	>3.5VDC
	OPEN	CLOSED	OPEN	CLOSED			

4. If test gas application is continued the detector will eventually enter the High Level Alarm state.

Operating State	Dual Relay version Connection terminal states		Single Relay version Connection terminal states		LED	Buzzer	Gv Voltage
High Level Alarm Reading> ~4000ppm For > 30 seconds	**3 & 4**	**5 & 6**	**3 & 4**	**4 & 5**	Flashing RED>AMBER (4Hz)	Pulses 4Hz	>4.2VDC
	OPEN	CLOSED	OPEN	CLOSED			

5. Turn off the gas regulator valve and allow clean air to circulate over the sensor and the gas to dissipate. After removing the gas the sensor should recover and return to *Normal Operation.*
   It may be necessary to ventilate the room with fresh air for the sensor to recover. The time for the detector to recover will depend upon the concentration of gas detected by the sensor and the time period but is typically less than 5 minutes. It is recommended that the sensor is not subjected to test gas for a prolonged period (>3 minutes) as recovery may become significantly longer.

Please ensure the regulator is switched off after use and the bottle is stored in a ventilated space.

See section 3.1 for supplementary information of Gv voltages at different operational states.

The detectors relays are normally energized, so the operation can also be tested by isolating power to the detector.

5. Fault finding

Problem	Action
LED Not illuminated	Check power supply
LED Flashing RED>AMBER with interval buzzer – Sensor fault	Check sensor if fitted and seated correctly in sensor socket
LED Flashing RED – Refrigerant leak	Ventilate room and detector should automatically reset
LED Flashing RED>AMBER with buzzer puling (2Hz)	Potential contaminant, Ventilate room, detector will automatically reset.
LED Flashing RED>AMBER with buzzer puling (4Hz)	High level contaminant, Ventilate room. Verify operation of detector.

DO NOT swap the sensor between KSGD units. Each sensor is matched to the PCB and swapping sensors will directly affect the performance of the product.

Revisions

1.4	11/12/2019	First released version - KR

Notes