MACURCO
GAS DETECTION

MG-1 User & Operator Manual

Personal Gas Detection Equipment

MG-1
Portable Multigas Monitor

Issue 1 Apr 2017

CONTENTS

PROLOGUE

MG-1 Overview

Thank you for purchasing the **MG-1**. At **Macurco Gas Detection**, we recognize the need for reliable and robust personal monitors which are sized to be worn and simple to use.

The **MG-1** is a portable monitor capable of detecting up to four gases in a compact and wearable design. Focused on users and fleet managers alike, the **MG-1** offers application-focused solutions giving greater operating time and reduced set up time.

The **MG-1** is classified for use in hazardous areas and gives loud and bright audible and visual alarm indications as well as a vibrate alert. The front mount display is backlit for ease of use, and the simple single button solution makes using and training quick and easy.

Safety Information

- The **MG-1** is a hazardous area certified gas monitor and as such must be operated and maintained in strict accordance with the instructions, warnings and label information included in this manual. The **MG-1** must be operated within the limitations stated.
- Read and Understand all instructions in the operation section of this manual prior to use.
- Before use ensure that the equipment is in good condition, the enclosure is intact and has not been damaged in any way.
- If there is any damage to the equipment, do not use. Contact **Macurco Gas Detection** for repair/replacement.
- Do not disassemble or substitute components as this may impair intrinsic safety and invalidate safety certification.
- Only genuine Macurco replacement parts must be used; substitute components may invalidate certification and warranty of the **MG-1** and accessories. Reference “Service and Maintenance” section for details.
- No live maintenance is permissable.
- Observe all warnings and instructions marked on the unit and within this manual.
- Observe site health and safety procedures for gases being monitored and evacuation procedures.
- Understand the screen display and alarm warnings prior to use.
- If this product is not working properly, read the troubleshooting guide and/or contact **Macurco**. For details reference the ‘Contact **Macurco Gas Detection**’ section of the manual.
- Ensure maintenance, service and calibration is carried out in accordance with the procedures in the manual and only by trained personnel.

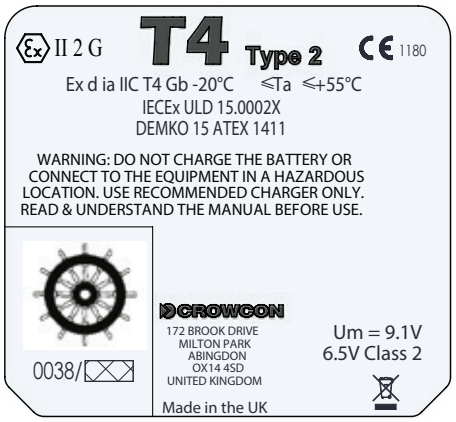
Charging & Communication (Um = 9.1V)

- The **MG-1** rechargeable battery must only be charged in non-hazardous (safe) areas.
- Only connect to the **MG-1** in a safe area for charging or communications.
- The **MG-1** must not be charged or have communication to the device, at ambient temperatures outside the range of 32 to 131°F (0 to +104°C).
- The **MG-1** has been certified and marked Um = 9.1V. Therefore, if charging the **MG-1** via the **MG-1** Charger Cradle or Ten-way Charger only use the **Macurco** supplied AC Adapter. Otherwise this may impair intrinsic safety and invalidate safety certification.

- Alternative charging and communication cable assemblies types “power cable”, “communication cable”, “power and communication cable”, “vehicle power cable”, “cradle power and communications” and “cradle charger” are suitable for use with the **MG-1**.
- Refer to “Power & Communication Cables Technical Data” manual for further details.
- These devices are intended for use in normal atomspheric conditions of temperature -4 to 131°F (-20 to +55°C); pressure 80 kPa (0,8 bar) to 110 kPa (1,1 bar); and air with normal oxygen content, typically 20.9% v/v (volume/volume).
- The **MG-1** ‘Type 2’ (as indicated on the certification label) may be used in Zones 1 and 2, for Group IIA, IIB and IIC gases and vapors and for Temperature Classes T1, T2, T3 and T4 (see Certification label below).

Certification label

The certification marking is as follows:



- The **MG-1** is certified for use in ambient temperatures in the range -4 to +131°F (-20 to +55°C).

IECEx

IEC 60079-0:2011 6th Edition
Electrical apparatus for explosive gas atmospheres Part 0: General requirements

IEC 60079-11:2011 6th Edition
Explosive atmospheres - Part 11: Equipment protection by intrinsic safety “i”

Ex d ia IIC T4 Gb Tamb -4 to 131°F (-20 to +55°C) - T4 Type 2

IECEx ULD 15.0002X

ATEX
EN 60079-0: 2012 + A11:2013
Explosive atmospheres – Part 0: Equipment - General requirements

EN 60079-11:2012
Explosive atmospheres - Part 11: Equipment protection by intrinsic safety “i”

 II 2 G Ex d ia IIC T4 Gb Tamb -20°C to +55°C (T4 Type 2)

DEMKO 15 ATEX 1411

UL
Gas detector use in hazardous locations Class 1 Division 1, Groups A, B, C and D only as to intrinsic safety.

UL 913	Applicable Edition of the UL standard
UL 60079-0:2013	Applicable Edition of the UL standard
UL 60079-11:2013	Applicable Edition of the UL standard

Unpacking

Your **MG-1** will have been inspected and quality checked before it left the manufacturing facility. It will be configured as a standard unit with standard settings as shown in the table below and any changes to suit your specific site requirements can be made utilizing **Portables Pro 2.0** PC Application and the Communications Cable, part number **CH0104**.

MG-1 Standard Configuration Settings:

Alarm levels/type*	**H_2S (Hydrogen Sulfide)** Low Alarm = 10 ppm Rising alarm Latched High Alarm = 15 ppm Rising alarm STEL = 15 ppm TWA = 10 ppm
	CO (Carbon Monoxide) Low Alarm = 35 ppm Rising alarm Latched High Alarm = 200 ppm Rising alarm STEL = 50 ppm TWA = 35 ppm Rising alarm Latched
	O_2 (Oxygen) Low Alarm = 19.5% Vol Falling alarm Latched High Alarm = 23.5% Vol Rising alarm
	LEL (Combustible Gases) Low Alarm = 10% LEL (CH_4) Rising alarm Latched High Alarm = 20% LEL (CH_4) Rising Alarm *(all **MG-1** units are shipped having been calibrated with 2.5% Vol CH_4)*

Calibration Interval	180 days
Bump Test	On, Menu Enabled
Bump Interval	180 days
+ve Safety™	Enabled
Autozero	Confirm Autozero
Lock on calibration due	Disabled
Lock on bump due	Disabled
Home Screen Flipped	Disabled

Box contents

- **MG-1** tested and calibrated
- Quick start guide
- Charging cradle and power supply
- Calibration/bump test plate
- Certificate of Calibration

The following items are optional:

Optional items

T4-CRD	**MG-1** Cradle Charger
T4-TWC	**MG-1** Ten-way Charger
T4-VHL	**MG-1** Vehicle Charger
CH0104	**MG-1** USB Communications Cable and Charger
T4-EXT-F	**MG-1** Sensor Filter Plate
T4-ASP-CAP	**MG-1** Calibration/Bump Test Plate
MG1-FCK	**MG-1** Field Calibration Kit
T4-ASP-KIT	**MG-1** Sampling Kit (includes aspirator plate, hand aspirator and 65 ft. hose)
IT-T4-11Z-ZB-2	**MG-1** I-Test
PC SOFTWARE	Portables Pro 2.1 Software (configuration changes, data logging, calibration)

1. Set-up

1.1 Prior to use

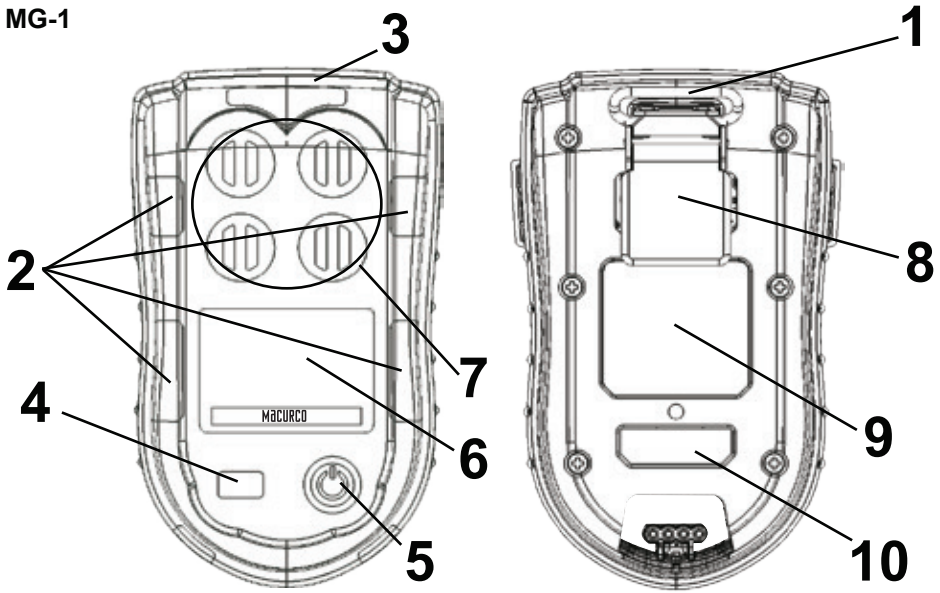
Before use, the **MG-1** should always be checked for any signs of physical damage.

The **MG-1** use a Lithium Ion (Li-ion) battery pack and should arrive with sufficient charge to be used straight out of the box. However, if this is the first time of use, the battery will require charging to attain the full operating time (see Charging & battery indications on page 12).

For battery run times, see the table on page 45.

1.2 MG-1 orientation

Figure 1: **MG-1**

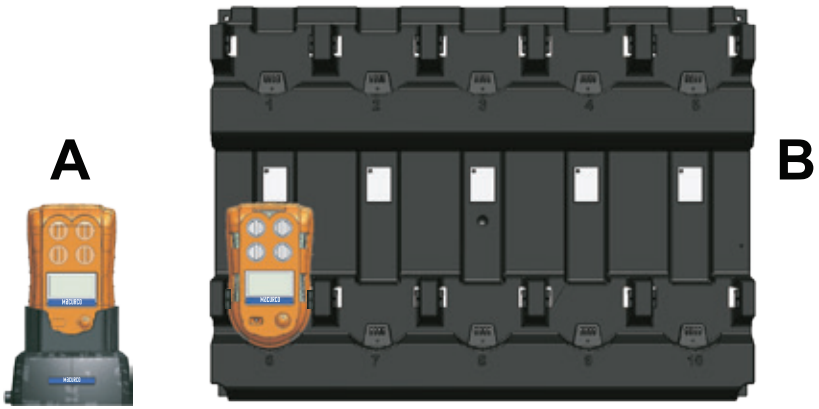


1 D-ring
2 Visual & audible alarms
3 +ve Safety™ indicator
4 Sounder
5 Operator button
6 LCD display
7 Sensor apertures
8 Aligator clip
9 Certification label
10 Serial Number Label

1.3 Charging & battery indications

Charging should only take place in non-hazardous (safe) areas. To charge the **MG-1**, simply plug it into either the desktop charging unit (**A**) or the ten-way charging unit (**B**) (see Figure 2 below). Ensure the **MG-1** fits firmly on to the power connector of whichever chargin unit is used.

Figure 2: Charging options



Referring to Figure 3 below, when the **MG-1** is powered off and placed in a charger, the +ve Safety™ LED will indicate charging status. While the **MG-1** is charging the LED will flash red (**A**), then when fully charged the LED will flash green (**B**).

Figure 3: Charging LED status

The **MG-1** battery icon contains a maximum of three segments and will indicate charging by sequentially filling the battery segments and repeating this process. When fully charged all three segments will be displayed.

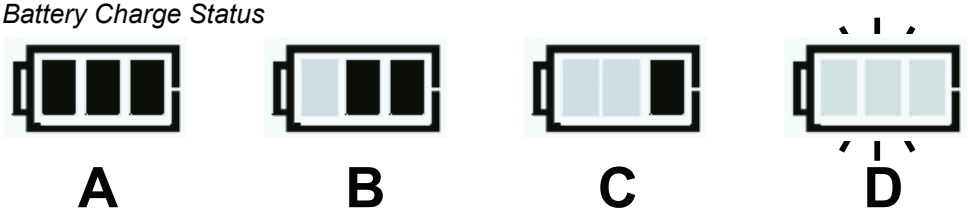
When the **MG-1** is powered up and placed in a charger, the battery icon will indicate charging status but the +ve Safety™ LED will indicate +ve Safety™ status, ***NOT*** charging status.

If the MG-1 is switched on while charging, after approximately 30 minutes of being on charge the **MG-1** will automatically power down and continue charging, showing the battery charging icon in the bottom right of the screen.

While the **MG-1** is not charging the battery icon segments indicate the battery's state of charge. These are only shown when the **MG-1** is not placed in a charger.

When fully charged and all three segments are shown (**A**), the battery typically has a maximum of 18 hours run time* (see Figure 4 below). When the **MG-1** changes from three to two segments (**B**), the battery typicall has a maximum of 12 hours run time. When the **MG-1** changes from two segments to one (**C**), the battery typically has a maximum of eight hours run time. When the battery icon is flashing with no segments (**D**), the battery typical has a maximum of 30 minutes run time before the battery will be depleted.

Figure 4: Battery Charge Status



Should the MG-1 be deep discharged, the charging indication will not be shown until the MG-1 has been charging for one hour and the operator button has been pressed. Store the battery in a fully charged state and recharge at least once every six months.

1.4 Fitting the calibration/bump test plate

The **MG-1** is supplied with a calibration/bump test plate that can be used to carry out a daily bump test or a regular calibration. Place the cap into the groove on the left hand side of the **MG-1** (**A**), ensuring the flat part of the cap faces the bottom of the **MG-1** and the text is the correct way up, then click the right hand side in place (**B**).

Refer to sections 2.8.5 and 2.8.6 for instructions on how bump test and calibrate utilizing the calibration/bump test plate via the **MG-1** menu.

Please note that automated bump testing and calibration of the **MG-1** is also possible via the dedicated **MG-1** I-Test bump and calibration station. Please refer to I-Test User & Operator Manual for further details.

Bump testing and calibration can also be undertaken utilizing the **Portables Pro 2.0** software and the calibration/bump test plate.

Once the gas test is complete, be sure to remove the calibration/bump test plate for general use as this will prevent gas reaching the sensors and may prevent the MG-1 from responding to gas.

The calibration/bump test plate must not be used in a hazardous area and is for safe area use only.

Figure 5: Fitting the calibration/bump test plate

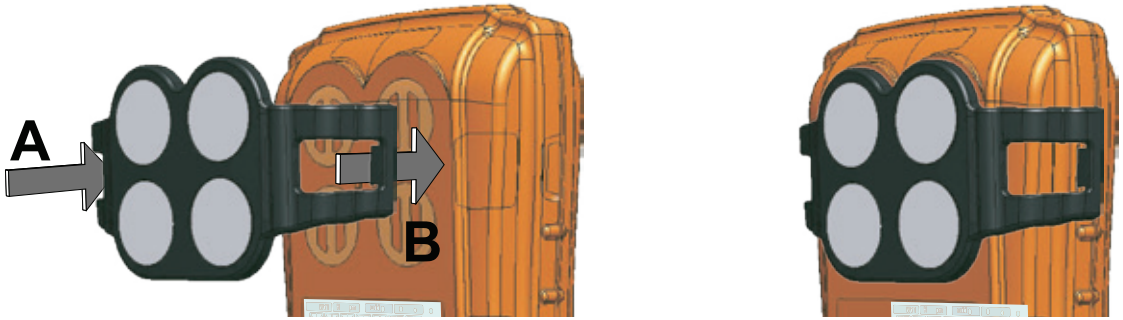
MACURCO GAS DETECTION

1.5 Fitting the external filter plate

The external filter plate is an optional accessory incorporating filters that allows gas to pass through but protect the sensors from dirt and debris. This filter plate will protect the sensors making it easier to maintain the **MG-1**.

Place the filter plate into the groove on the left hand side of the **MG-1** first (**A**), ensuring that the flat part of the plate faces the bottom of the **MG-1**, then click the right hand side in place (**B**).

Figure 6: Fitting the external filter plate



The filter plate is suitable for use in a hazardous area.

The filter plate has been designed to operate with the charging accessories and does not need to be removed when inserting the **MG-1** in to the desktop charger, ten-way charger or the **MG-1** vehicle charger.

The filter plate should be replaced if the filters are damaged by substances that could affect the flow of gas to the sensors, like paints, grease or oils.

1.6 +ve Safety™

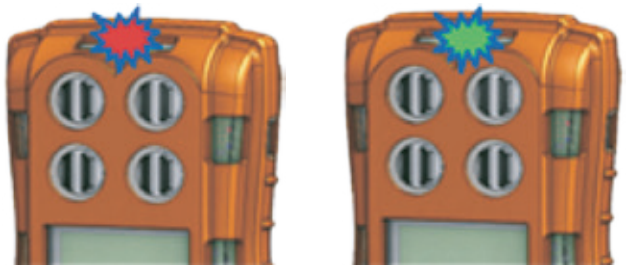
+ve Safety™ is a quick and easy indication of the operating status of the **MG-1**. This status is indicated by a front mounted LED.

When the +ve Safety™ LED is illuminated green, this indicates that the unit is functioning as required and no further action is necessary, such as bump testing or calibration. This enables users and supervisors to easily see that the employee is safe and following work procedures.

When the +ve Safety™ LED is illuminated red, this indicates that one of the following situations has occured and will require user action:

- **Battery is critically low:** The battery has a maximum of 30 minutes run time before it will be completely depleted. This will be accompanied by additional alerts signifying a low battery (see Section 1.3).
- **Bump test is required:** Bump test has failed or exceeded the due date required to meet site procedures. The bump test due date can be reviewed via the information menu (see Section 2.8.2).
- **Calibration is due:** Calibration has failed or exceeded the due date required to meet the site procedure. The calibration due date can be reviewed via the information menu (see Section 2.8.2).
- **MG-1 is in gas alarm:** This could be a high or low gas alarm, or a STEL or TWA alarm. The **MG-1** display will indicate which alarm type has been activated by the relevant icon being displayed on the screen (see section 2.3).
- **MG-1 fault:** The **MG-1** must be reviewed by trained personnel for repair as the **MG-1** has detected an internal fault. An appropriate fault warning will also have been shown on the display.

Figure 7: +ve Safety™ indicators



1.7 Quick view

The configuration details of the **MG-1** can be reviewed even if the **MG-1** is not powered on by momentarily pressing the operator button.

The device will emit an audible beep and the LED's to the right of the display will flash red once. The serial number of the **MG-1** will then be displayed for ten seconds before the unit turns off.

To review all configuration items, the operator button must be pressed to scroll through the available screens. The configuration items that may be displayed are as follows:

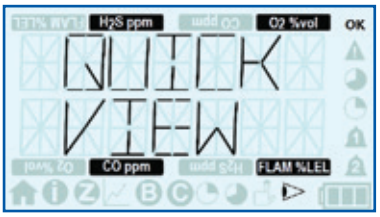
- Serial Number
- Firmware Version
- Configured User
- Sensors configured lower alarm levels (alarm 1)
- Sensors configured upper alarm levels (alarm 2)
- STEL configured alarm levels (CO & H_2S)
- TWA configured alarm levels (CO & H_2S)
- Calibration Due Date
- Bump Due Date
- Instrument Date and Time

The  is shown on all screens indicating that quick view is being accessed.

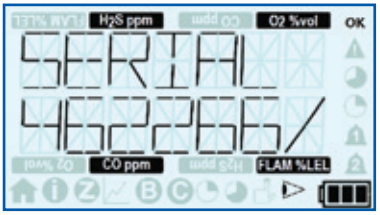
The battery status  is also shown on each screen.

If +ve Safety™ is configured, the +ve Safety™ LED will also illuminate for the duration of the quick view review, showing the status of the instrument (see Section 1.6).

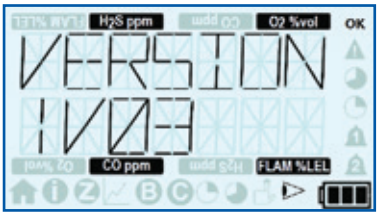
The screen displays the Quick View screen.



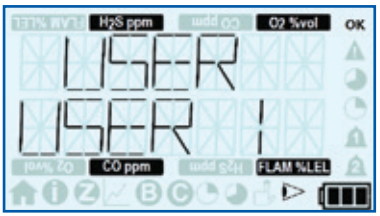
The screen then displays the **MG-1** serial number.



The screen then displays the **MG-1** firmware version.

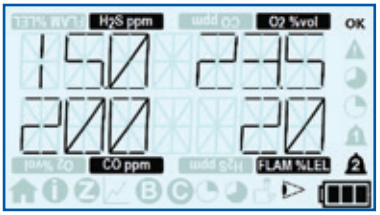


This screen displays the **MG-1**'s configured user name.

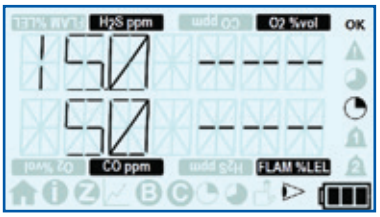


This screen displays the sensors' configured lower alarm levels.

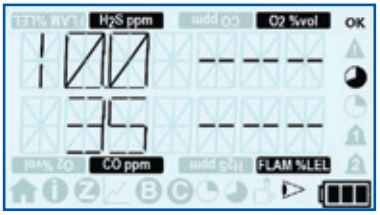
This screen displays the sensors' configured upper alarm levels.



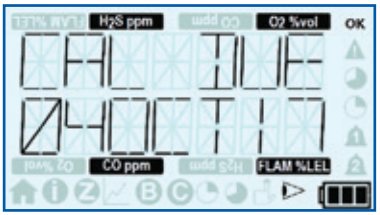
This screen displays the STEL configured alarm levels (see Section 2.3.3).



This screen displays the TWA configured alarm levels (see Section 2.3.4).



This screen displays the date when the **MG-1**'s next calibration is due.



This screen displays the date when the **MG-1**'s next bump test is due.

This screen will only be displayed if bump test is configured via Portables Pro 2.0.

This screen displays the **MG-1**'s current date and time.

2. Operation

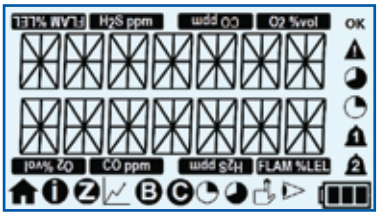
Before turning on the MG-1, ensure that it is in 'clean air' (i.e. outside, in normal air, away from any plant process or suspected gas location). This will allow the MG-1 to be zeroed using clean air as the base point. If the MG-1 is zeroed in contaminated air, a false gas reading can result or the zero could fail.

2.1 Turning on

The MG-1 will not respond to gas until the startup sequence is complete.

In 'clean air', turn on the **MG-1** by holding down the operator button for three short beeps followed by one longer tone. The **MG-1** will warm up and go through a series of automatic processes as follows:

Firstly a test screen will be displayed showing all the possible LCD segments and icons turned on.



If the **MG-1** is turned on within eight hours of being turned off, this screen will be displayed for ten seconds allowing the **MG-1** to retain TWA, STEL and peak readings (see Section 2.3.5).

Simply press the operator button to retain, or do not click the operator button and allow countdown to expire.

The screen then displays the **Macurco Gas Detection** splash screen.

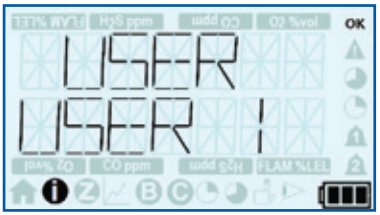
This screen then displays the user's company splash screen/slogan.

This screen will only be displayed if splash screen is configured via Portables Pro 2.0

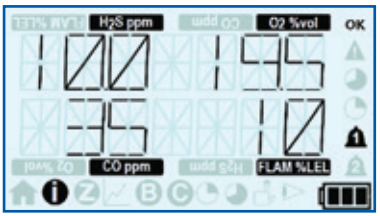
This screen then displays the **MG-1** serial number.

This screen then displays the **MG-1** firmware version.

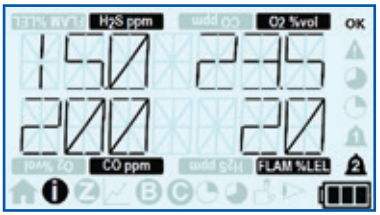
The screen then displays the **MG-1**'s configured user name.



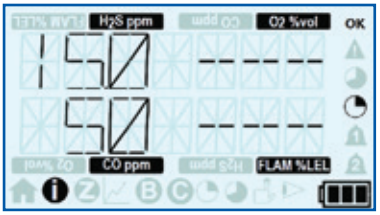
This screen then displays the sensors' configured lower alarm levels.



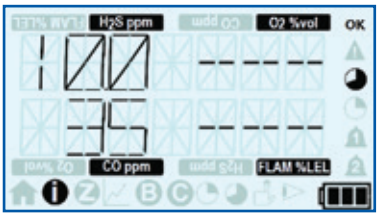
This screen then displays the sensors' configured upper alarm levels.



This screen then displays the STEL configured alarm levels (see Section 2.3.3).



This screen then displays the TWA configured alarm levels.



This screen then displays the date when the **MG-1**'s next calibration is due.

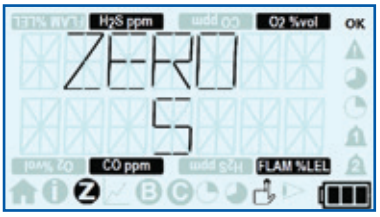
The screen then displays the date when the **MG-1**'s next bump test is due.

This screen will only be displayed if bump test is configured via Portables Pro 2.0.

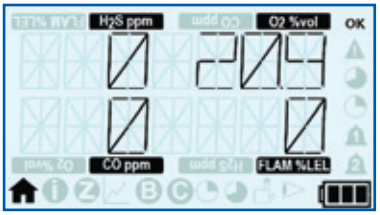
This screen displays the **MG-1**'s current date and time.

If configured to do so, the last screen is the autozero screen.

This will operate as configured via Portables Pro 2.0.



The instrument will then revert to the normal operation 'home screen'.



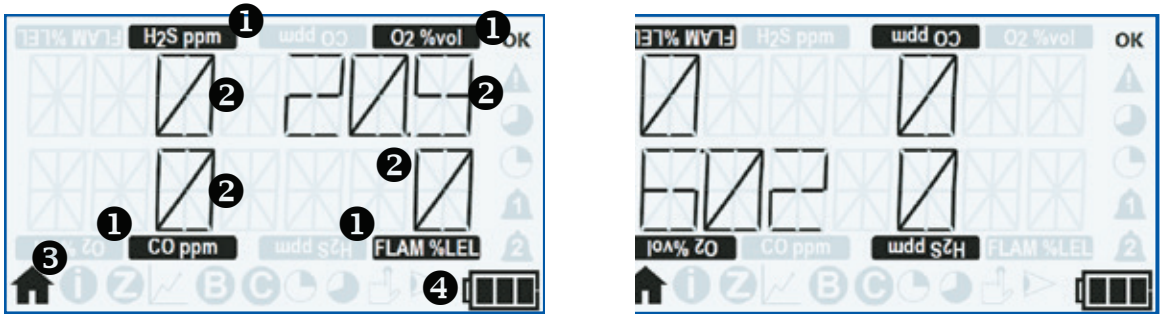
2.2 Home screen

After a successful start up sequence, the screen will display the home screen as shown below (**A**) and (if configured) the +ve Safety™ LED will be illuminated green indicating the **MG-1** is operating correctly.

The image shown is the home screen of a MG-1 fitted with four sensors.

The same screen is also shown in 'home screen flipped' mode (**B**) if this has been configured via **Portables Pro 2.0**.

Figure 8: Display screen after successful start up



❶ Gas type & unit
❷ Gas level
❸ Home screen symbol
❹ Battery Level indicator

2.3 Alarms

The **MG-1** has the following types of alarms:

- Low Battery
- Instantaneous
- Time Weighted Average (TWA)
- Short Term Exposure Limit (STEL)

2.3.1 Low battery alarm

The **MG-1** will indicate a low battery alarm when the battery has a maximum of 30 minutes remaining life.

This warning should be acknowledged immediately by pressing the operator button.

The sounder will then emit an audible double beep every five seconds and the display will flash the battery empty icon .

In addition, if configured to do so (see Section 1.6), the +ve Safety™ LED will change state and illuminate red.

When the low battery alarm is displayed, the operator should finish their current activity and move to a safe area before the 30 minutes battery life expires.

2.3.2 Instantaneous alarm

The **MG-1** will go into alarm immediately if the level of any gas configured to be detected exceeds acceptable limits. A minimum and maximum level is set for oxygen, while the remaining gases will cause an alarm for rising gas levels.

The **MG-1** will indicate an alarm state '**1**' or alarm state '**2**' according to which configured gas level has been exceeded.

When the **MG-1** is in instantaneous alarm the appropriate 'bell' symbol 1 or 2 will flash repeatedly on the screen to indicate which level of alarm has been triggered, the gas type and unit icon will flash to indicate which gas has triggered the alarm, the sounder will emit a tone alarm, LEDs will flash red and blue and the **MG-1** will vibrate.

If +ve Safety™ is configured, the +ve Safety™ LED will also be illuminated red. The LED will return to green when the instantaneous alarm is cleared.

2.3.3 Short term exposure limit alarm (STEL)

For each toxic gas being monitored, the **MG-1** stores information about the gas levels detected to determine the average exposure over a 15 minute running period. If the average levels detected over the defined period of time exceed predetermined levels, the **MG-1** will go into alarm (STEL is not monitored for the duration of a bump test or calibration). The STEL alarm level can be configured via **Portables Pro 2.0**.

In the alarm state, the STEL symbol on the screen will flash indicating the STEL levels have been exceeded, the sounder will emit a tone, alarm LEDs will flash red and blue and the **MG-1** will vibrate.

If +ve Safety™ is configured, the +ve Safety™ LED will also be illuminated red. The LED will return to green when the STEL alarm is cleared.

2.3.4 Time weighted average alarm (TWA)

For each toxic gas being monitored, the **MG-1** stores information about the gas levels detected to determine the average exposure over an eight hour running period. If the average levels detected over the defined period of time exceed predetermined levels, the **MG-1** will go into alarm (TWA is not monitored for the duration of a bump test or calibration). The TWA alarm level can be configured via **Portables Pro 2.0**.

In the alarm state, the TWA symbol on the screen will flash indicating the TWA levels have been exceeded, the sounder will emit a tone, alarm LEDs will flash red and blue and the **MG-1** will vibrate.

If +ve Safety™ is configured, the +ve Safety™ LED will also be illuminated red. The LED will return to green when the TWA alarm is cleared.

2.3.5 TWA Resume function

TWA Resume allows TWA, STEL and peak readings to be retained after the **MG-1** has been switched off for a period of time (i.e. travelling from one job site to the next). This prevents recent toxic exposure history from being lost and the associated risk of the operator exceeding safe exposure levels.

If the **MG-1** is switched off for less than 15 minutes and the TWA resume function is selected (see below), the **MG-1** will retain STEL, TWA and peak gas values when powered back on.

If the **MG-1** is switched off for more than 15 minutes but less than eight hours, and the TWA resume function is selected (see below), the **MG-1** will retain the TWA and peak gas values when powered back on. STEL values will be cleared.

If the **MG-1** is switched off for more than eight hours, the TWA resume function will not be available in the start up sequence. The **MG-1** will clear TWA, STEL and peak gas values when powered on.

The TWA Resume function can be activated during the start up sequence.

Upon start up, following the test screen, if the **MG-1** is switched on within eight hours of being switched off, the screen shown to the right will be displayed for ten seconds allowing the user to 'resume' if required.

Simply click the operator button.

If the **MG-1** is now being used by a new operator and the TWA Resume function is not required, do not click the operator button and allow the countdown to expire. This will reset the STEL, TWA and peak values back to zero.

2.4 Alarm and status icons

The alarm status is represented by the icons shown in the table below:

Icon	Description	Action
OK	Status OK	No action required
⚠	Fault status	Refer to Section 6 for troubleshooting
◔	Long term exposure alarm (TWA)	Follow site procedure
◔	Short term exposure alarm (STEL)	Follow site procedure
1	Alarm 1	Follow site procedure
2	Alarm 2	Follow site procedure

2.5 Accepting and Clearing Alarms

The operation of alarms in terms of how they are cleared is dependent upon the alarm type and the configuration option, which can be changed via **Portables Pro 2.0**.

The options are ‘latched’ and ‘non-latching’ and the functionality is described in the table below.

Alarm 2 cannot be configured and behaves as a latched alarm.

Configuration Setting (Alarm 1 only)	Instantaneous Alarm 1	Instantaneous Alarm 2
Latched	An instantaneous alarm 1 can be cancelled by pressing the operator button but only when the gas level has dropped below the alarm level	An instantaneous alarm 2 can be cancelled by pressing the operator button but only when the gas level has dropped below the alarm level
Non-latching	An instantaneous alarm 1 will not be latched and will return to a non-alarm state without user acceptance once the gas level has dropped below the alarm level	An instantaneous alarm 2 can be cancelled by pressing the operator button but only when the gas level has dropped below the alarm level

Alarm 2 cannot be configured and behaves as a latched alarm.

2.6 Sensors

The **MG-1** is available with the following sensor options:

- Oxygen Sensor (electro-galvanic)
- Carbon Monoxide Sensor (electrochemical)
- Hydrogen Sulfide Sensor (electrochemical)
- Flammable Gases Sensor (pellistor / catalytic bead)

The **MG-1** flammable gas sensor is configured and calibrated at the factory to detect methane.

The MG-1 flammable sensor must only be calibrated with methane.

However, the **MG-1** can be configured to detect other flammable gases. The flammable gas to be detected and the correction factor can be changed in the **MG-1** via **Portables Pro 2.0** PC software.

The table below shows the flammable gases that the **MG-1** (Type 2) can be configured to detect.

Correction factors must only be used if the flammable sensor has been calibrated with methane.

Flammable Gas	Correction Factor	Response Time T90
Hydrogen	0.72	< 10 seconds
Methane	1.00	< 20 seconds
Propane	1.83	< 30 seconds
Butane	1.83	< 30 seconds
Pentane	2.22	< 30 seconds

2.6.1 Oxygen sensor

This sensor is in the form of an electro-galvanic fuel cell, which is an electrical device used to measure the concentration of oxygen gas in the ambient air. The **MG-1** comes default with both higher and lower alarm levels.

2.6.2 Electrochemical sensors

Electrochemical gas sensors measure the volume of a target gas by oxidizing or reducing the target gas at an electrode and measuring the resulting current.

2.6.3 Pellistor sensors

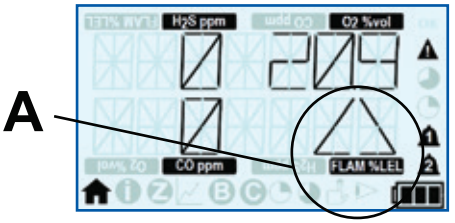
Pellistor sensors (or catalytic beads) are specifically designed to sense explosive gases. The detecting element consists of small “beads” of catalyst-loaded ceramic whose resistance changes in the presence of gas.

2.6.4 Pellistor saver mode

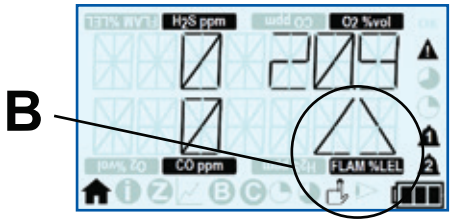
Pellistor sensors can suffer degradation if powered while exposed to flammable gas concentrations greater than 100% LEL, and also if exposed to high levels of H_2S or silicones.

To reduce degradation, the **MG-1** employs a pellistor saver mode. When the flammable gas exceeds the pellistor saver threshold, the detector will turn off the sensor for a minimum period of 200 seconds (**A**).

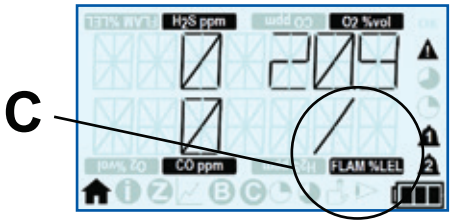
When pellistor saver mode is activated, the user must immediately move to a clean air environment.



After the defined period, the sensor can be re-activated by a single click of the operator button (**B**) once the instrument is in a clean air environment.



After a stabilization time (**C**), if the gas level still exceeds the threshold then the sensor will be turned off and the cycle starts again.



While in saver mode and the subsequent stabilize time, the gas level displayed on the LCD screen will indicate over range. As the sensor has been exposed to a gas level sufficient to cause a sensor over-range, the **MG-1** should be gas tested to ensure no lasting damage has occured.

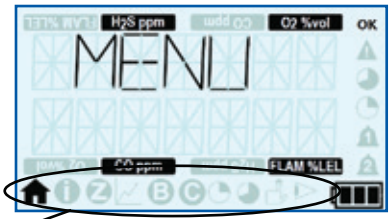
2.7 MG-1 menu icons

The following menu functions on the **MG-1** display can be selected:

Icon	Title	Action
	Home	Return to Home page
	Information	Displays unit status/configuration
	Zero	Performs a sensor zero
	Peak Mode	Displays peak gas readings
	Bump	Performs a bump test
	Calibration	Performs a calibration
	STEL (Short Term Exposure Limit)	Displays the current STEL value
	TWA (Long Term Exposure Limit)	Displays the current TWA value

2.8 Accessing MG-1 menu functions

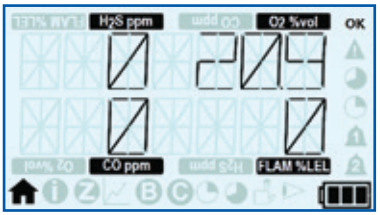
- With the home screen displayed, double click the operator button (**A**) to access the menu functions (**B**).
- Single click the operator button repeatedly to scroll right until the required menu icon is displayed and then double click the operator button to select the function.



- As a safety feature, if gas is detected while in a menu, the **MG-1** will revert back to the home screen to ensure the gas readings are displayed. This will not occur if the **MG-1** was in bump test mode, calibration mode or peak mode.

2.8.1 Home screen

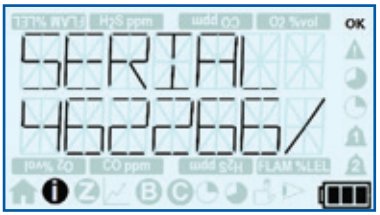
When this icon is selected, the Home screen will be displayed.



2.8.2 Information Screen

- With the home screen displayed, double click the operator button to access the menu functions screen.
- Single click the operator button repeatedly to scroll right until the menu icon is displayed and then double click the operator button to select.

The screen will display the same sequence of screens as when Quick View is selected (see Section 1.7).

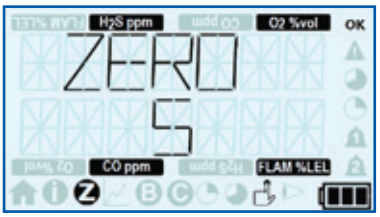


In addition, the information screen will also display any identified fault. This fault will be indicated by a warning icon on the home screen.

Accessing the information screen will provide further details of the identified fault.

2.8.3 Manual zero

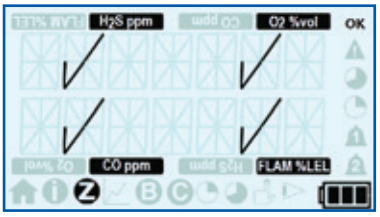
A manual zero should only be carried out in 'clean air'.



The manual zero function allows the **MG-1** to be zeroed at any time.

- With the home screen displayed, double click the operator button to access the menu functions screen.
- Single click the operator button repeatedly to scroll right until the Z menu icon is displayed and then double click the operator button to select.
- The zero countdown screen will then be displayed.
- To perform a manual zero, press the operator button before the countdown finishes.

If the operator button is not pressed before the countdown is complete, the MG-1 will not perform a manual zero and will automatically return to the home screen.



A successful zero of a channel will display a check mark on the screen as shown in image to the right. The **MG-1** will then automatically return to the home screen.

An unsuccessful zero will display a 'X' in the failed channel. The **MG-1** will then automatically return to the home screen.

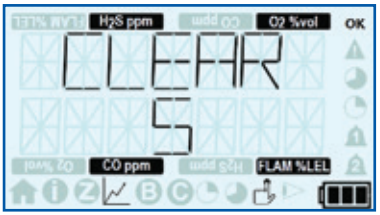
2.8.4 Peak Mode

The peak mode function allows peak gas readings to be viewed at any time.

The peak mode function can also be utilized for pre-entry checks, where the **MG-1** is to be lowered into a confined space.

- With the home screen displayed, double click the operator button to access the menu functions screen.
- Single click the operator button repeatedly to scroll right until the menu icon is displayed and then double click the operator button to select.
- The screen to the right will then be displayed showing the peak readings for each gas.

- After a few seconds, the clear countdown screen will be displayed.
- If you wish to clear the peak levels recorded, press the operator button once.
- If the operator button is not pressed, the display will continue to show the peak readings and the peaks will not be cleared.



Peak readings will continue to be shown until the user exits peak mode.

Peak mode can also be useful during pre-entry checking of a confined space. Peak mode can be selected and the **MG-1** lowered into the area to be checked. When the **MG-1** is subsequently removed, the peak gas readings will be displayed on the screen. Any alarm can be cancelled and the display will continue to indicate the peak gas reading.

To exit the peak mode function, the operator button must be double clicked to return to the menu screen and then double clicked again to return to the home screen.

Ensure that the MG-1 is returned to the home screen after the peak function is no longer required, which will confirm that the MG-1 is displaying current gas readings and not peak values.

Peak readings are cleared to clean air nominal values.

Peak readings are not monitored for the duration of a bump test or calibration.

2.8.5 Bump Test

The MG-1 bump test via menu function must be performed utilizing a quad gas mixture containing CO, H_2S, O_2 and CH_4.

The applied test gas must contain gas concentrations capable of exceeding the configured alarm level 1 for each gas.

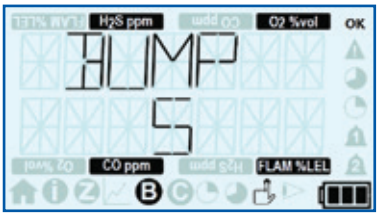
Bump strategy must be enabled for the bump test to operate via the menu function. This can be configured utilizing Portables Pro 2.0.

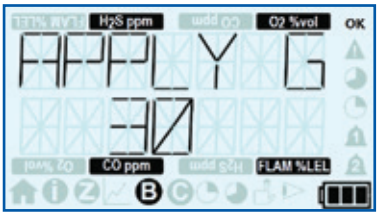
A bump test can also be performed via Portables Pro 2.0 or via I-Test.

If utilizing gas extraction, do not place the extraction outlet closer than 7 in. (20 cm.) to the calibration/bump plate as this may result in an incorrect bump test result.

The bump test function allows the **MG-1** to be bump tested at any time.

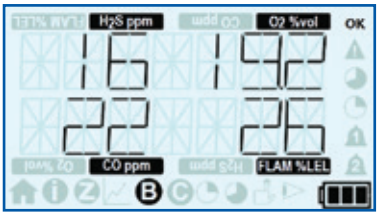
- Ensure the calibration/bump test plate is fitted and the gas supply attached but not providing gas, before selecting the bump test function.
- With the home screen displayed, double click the operator button to access the menu functions screen.
- Single click the operator button repeatedly to scroll right until the Ⓑ menu icon is displayed and then double click the operator button to select.
- The bump test countdown screen will then be displayed.
- To initiate a bump test, press the operator button before the countdown is complete.
- The apply gas countdown screen will then be displayed and the test gas must now be applied.





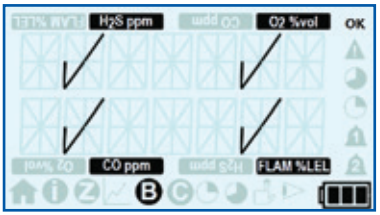
If the operator button is not pressed before the countdown is complete, the MG-1 will not perform a bump test and will automatically return to the home screen.

When the **MG-1** detects the applied test gas, the countdown screen will be replaced with the bump test gas reading screen. This will continue to show the gas readings until the bump test result is displayed.

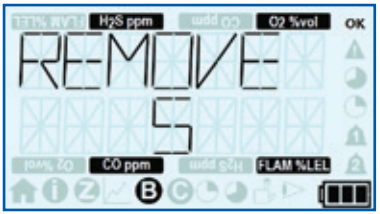


If the test gas is not supplied before the end of the countdown, the bump test will fail. The bump test will be set to due and, if configured, the +ve Safety™ LED will be illuminated red.

- If the bump test is successful, a check mark will be displayed for each gas that passes. If the bump test is unsuccessful, a 'X' will be displayed for each gas that fails.

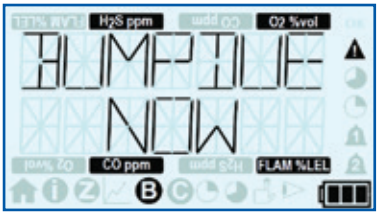


- The remove gas countdown screen will then be displayed. The test gas must be turned off and the bump/calibration plate removed.



- The updated bump test date due screen will be displayed following a successful bump test.

- If the bump test was unsuccessful, the bump due now screen will be displayed. If configured, the +ve Safety™ LED will be illuminated red.



- During the bump test, as gas is applied, the instantaneous alarms will be activated as the gas level exceeds the configured alarm level.
- This will be indicated by the appropriate 'bell' alarm and gas type and unit icon flashing repeatedly. The sounder, LED's and vibrator will be disabled during the bump test.
- A short period after the completion of the bump test, the sounder, LED's and vibrator will be enabled.
- Press the operator button to cancel the alarm.

2.8.6 Calibration

The MG-1 calibration via menu function must be performed utilizing a Macurco quad gas mixture comprised of the following values: CO = 100ppm, H_2S = 15ppm, O_2 = 18%VOL and CH_4 = 50%LEL (2.5%VOL).

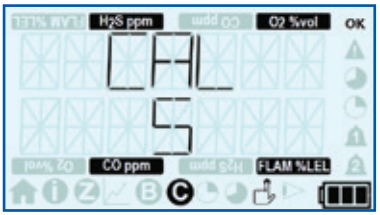
'Allow calibration' must be enabled for the calibration to operate via the menu function. This can be configured utilizing Portables Pro 2.0.

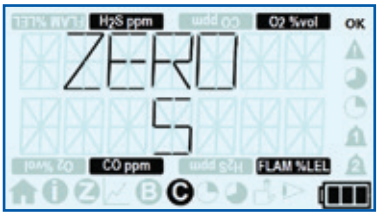
A calibration can also be performed via Portables Pro 2.0 or via I-Test.

If utilizing gas extraction, do not place the extraction outlet closer than 7 in. (20 cm.) to the calibration/bump plate as this may result in an incorrectly calibrated MG-1.

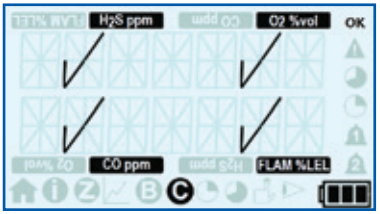
The calibration function allows the **MG-1** to calibrated at any time.

- Before starting, ensure the calibration/bump test plate is not connected and that the instrument is in clean air.
- With the home screen displayed, double click the operator button to access the menu functions screen.
- Single click the operator button repeatedly to scroll right until the C menu icon is displayed and then double click the operator button to select.
- The calibration countdown screen will then be displayed.
- To initiate a calibration, press the operator button before the countdown is complete.
- The zero countdown screen will then be displayed and a zero will be performed when the countdown is complete.

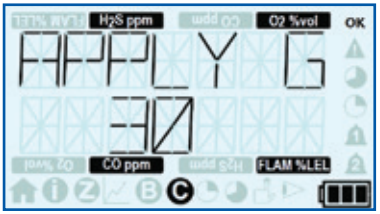




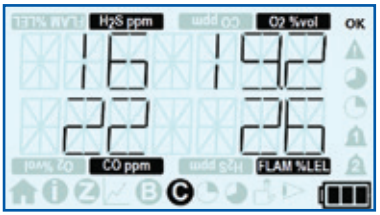
- A successful zero of a channel will display a check mark on the screen.
- If the zero is unsuccessful, a 'X' will be displayed for each gas that fails and the calibration will fail. If configured, the +ve Safety™ LED will be illuminated red.



- If the zero is successful, the apply gas countdown screen will be displayed.
- Fit the calibration/bump test plate and apply the calibration gas.

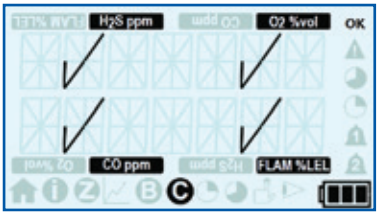


- When the **MG-1** detects the applied test gas, the countdown screen will be replaced with the calibration gas reading screen. This will continue to show the gas readings until the calibration result is displayed.

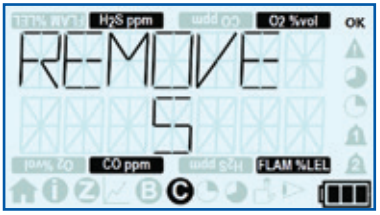


If the test gas is not supplied before the end of the countdown, the calibration will fail and the calibration will be set to due. If configured, the +ve Safety™ LED will be illuminated red.

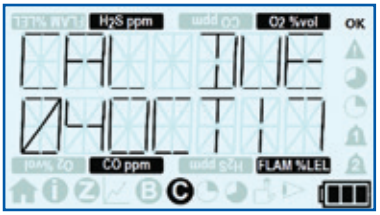
- If the calibration is successful, a check mark will be displayed for each gas that passes. If the calibration is unsuccessful, a 'X' will be displayed for each gas that fails.



- The remove gas countdown screen will then be displayed. The test gas must be turned off and the bump/calibration plate removed.



- If the calibration is successful, the updated calibration due date will be displayed.
- If the calibration is unsuccessful, the **MG-1** will display the calibration due screen. If configured, the +ve Safety™ LED will be illuminated red.
- During the calibration, as gas is applied, the instantaneous alarms will be activated as the gas level exceeds the configured alarm level.



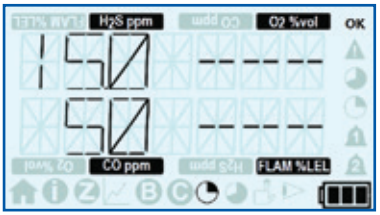
- This will be indicated by the appropriate 'bell' alarm and gas type and unit icon flashing repeatedly. The sounder, LED's and vibrator will be disabled during the calibration.
- A short period after the completion of the calibration, the sounder, LED's and vibrator will be enabled.
- Press the operator button to cancel the alarm.

2.8.7 STEL (Short term exposure limit)

The STEL function allows the current STEL value to be displayed.

For further details on the function of the STEL alarm, refer to Section 2.3.3.

- With the home screen displayed, double click the operator button to access the menu functions screen.
- Single click the operator button repeatedly to scroll right until the menu icon is displayed and then double click the operator button to select.
- The STEL current value screen will then be displayed.
- The **MG-1** will revert back to the home screen automatically after 30 seconds, or the operator button can be double clicked to return to the menu screen and then double clicked again to return to the home screen.

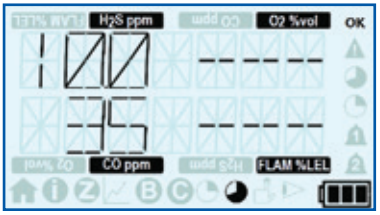


2.8.8 TWA (Time weighted average)

The TWA function allows the current TWA value to be displayed.

For further details on the function of the TWA alarm, refer to Section 2.3.4.

- With the home screen displayed, double click the operator button to access the menu functions screen.
- Single click the operator button repeatedly to scroll right until the menu icon is displayed and then double click the operator button to select.
- The TWA current value screen will then be displayed.
- The **MG-1** will revert back to the home screen automatically after 30 seconds, or the operator button can be double clicked to return to the menu screen and then double clicked again to return to the home screen.



2.8.9 Shutdown

To turn the **MG-1** off, press and hold the operator button. A five second countdown will start. Hold the button down until the countdown has finished and the **MG-1** will shut down. If you release the button before the countdown has finished, the **MG-1** will resume operation. Once off, charge unit if required (see Section 1.3)

The **MG-1** cannot be shutdown if a zero, bump test or calibration is in progress.

2.9 Data Logging

The data log records gas levels for all sensors and has a capacity of 45,000 logs (125 hours @ ten second intervals).

All data logs can be downloaded from the **MG-1** via **Portables Pro 2.0**.

2.10 Event logging

Event logging records significant events occuring during the **MG-1** operation.

The event log has a capacity of at least 1,000 events.

Events include:

- Power On/Off
- Alarm 1 Activation
- Alarm 2 Activation
- STEL Alarm Activation
- TWA Alarm Activation
- Operator Acknowledgments
- Calibration Events/Status
- Bump Test Events/Status
- Zero Events/Status
- Low Battery
- User Change
- Pellistor Saver Mode
- Insert Into I-Test Station
- Time Change/Set
- Event Log Upload
- Faults

2.11 Bump Test

Macurco Gas Detection recommends regular bump tests to confirm sensor operation. This involves applying a known concentration of the correct gas to each sensor to verify sensor response and alarm function. Organizational specific Health and Safety regulations should be adhered to, and a number of flexible and simple solutions are available.

The **MG-1** implements a speedy bump test in which gas is applied to trigger alarm level 1.

The **MG-1** bump strategy can be configured via **Portables Pro 2.0**.

A bump test can be performed on the **MG-1** in one of the following ways:

- Via **MG-1** menu and utilizing the calibration/bump test plate (see Section 2.8.5).
- Via **Portables Pro 2.0** utilizing the calibration/bump test plate.
- Via the I-Test gas station where all testing is fully automated.

  I-Test is an intelligent standalone gas test and calibration solution, suitable for small and large fleet users alike. I-Test offers simple, fully managed testing with data capture and the ability to update configurations.

  Please refer to I-Test User & Operator Manual.

If any channel fails the bump test, the **MG-1** should be calibrated (see Section 2.8.6).

From 11/01/2010, EN60079-29 part 1 has been harmonized under the ATEX directive 94/9/EC. Therefore, to comply with the ATEX directive, portable apparatuses sensing flammable gases should have a functional check with gas before each day of use. Other testing regimes may be employed depending on local circumstances.

2.12 Calibration

Calibration should be carried out if any channel fails a bump test or if the **MG-1** has exceeded its calibration due date.

A calibration can be performed on the **MG-1** in one of the following ways:

- Via **MG-1** menu and utilizing the calibration/bump test plate (see Section 2.8.6).
- Via **Portables Pro 2.0** utilizing the calibration/bump test plate.
- Via the I-Test gas station where all testing is fully automated.

  I-Test is an intelligent standalone gas test and calibration solution, suitable for small and large fleet users alike. I-Test offers simple, fully managed testing with data capture and the ability to update configurations.

  Please refer to I-Test User & Operator Manual.

i **I-Test is suitable for regular periodic calibrations, but Portables Pro 2.0 must be utilized for calibration when sensors or PCB's have been replaced.**

The **MG-1** calibration due dates are automatically updated upon a successful calibration. The factory default interval is set at 180 days.

A calibration should be undertaken with the appropriate **Macurco** supplied gas cylinder or equivalent.

i **The flammable sensor should always be calibrated with methane gas.**

If the calibration fails, this may be indicative of a more serious sensor issue, including the need to replace sensors. The **MG-1** should then be serviced.

2.13 New sensor calibration/service

Servicing and/or installation of a new sensor can only be undertaken by a suitable trained technician using **Portables Pro 2.0** software and the appropriate gas.

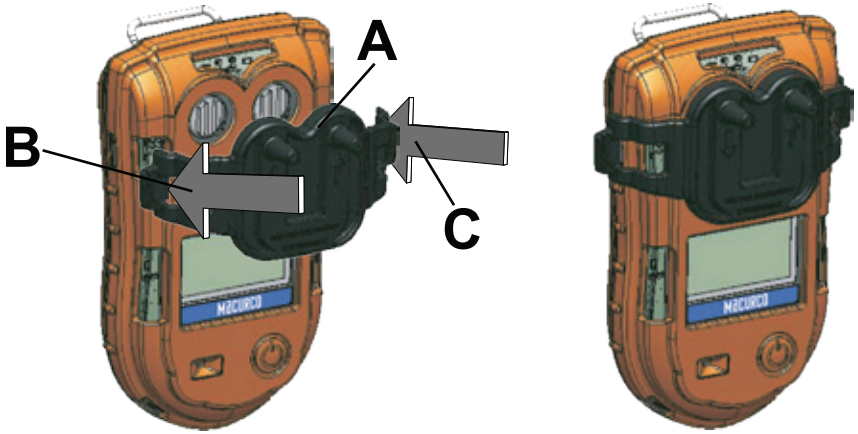
In addition, calibration should be performed as required by local or organizational regulations. In the absence of suitable evidence, such as a field assessment by a competent person, **Macurco** recommends regular service and calibration every six months.

2.14 MG-1 Aspirator Plate

The aspirator plate can be used in scenarios where sampling from an area may be required. This is included in the **T4-ASP-KIT** Sampling Kit, along with the hand aspirator bulb and a 65 ft. sampling hose.

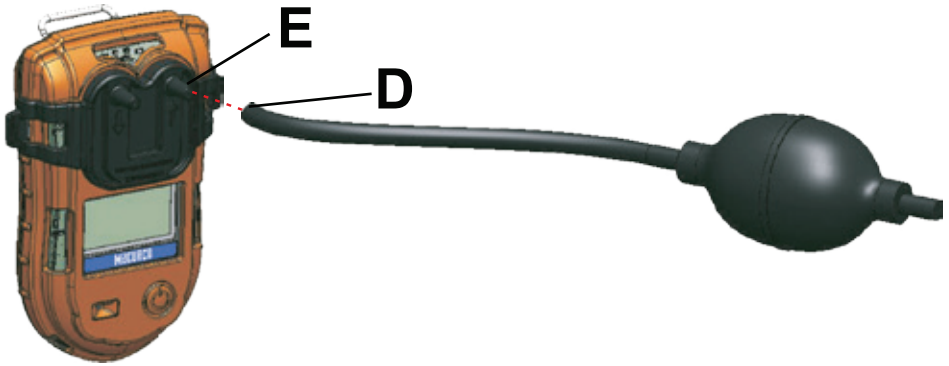
Fit the aspirator plate (**A**) into the groove on the left hand side of the **MG-1** first (**B**), ensuring the flat part of the cap faces the bottom of the **MG-1** and the text is the correct way up, then click the right hand side in place (**C**).

Figure 9: Attaching the Aspirator Plate



The hose end (**D**) of the hand aspirator bulb must then be attached to the aspirator plate port (**E**) on the right hand side (as viewed from the front) adjacent to the arrow head on the aspirator plate.

Figure 10: Attaching the Hand Aspirator



The attachment of the plate should then be checked to ensure a gas tight seal has been achieved. The bulb should be depressed while blocking the adjacent port with a finger. The **MG-1** may at this point indicate an alarm on the O_2 sensor, which is due to the pressure effect on the oxygen sensor. The hand aspirator bulb should not return to the rounded shape if a gas tight seal has been achieved. If the bulb does not return to its normal shape, reposition the aspirator plate and repeat this test.

Allow the O_2 sensor to stabilize before continuing.

The sample hose must then be attached to the aspirator plate on the left hand side (as viewed from the front) adjacent to the base of the arrow on the aspirator plate.

Place the sample tube into the area to be sampled and depress the aspirator bulb. Allow the bulb to return to its rounded shape and then depress the bulb again. Repeat this process to get a constant sample flow to the sensors.

Every depression of the aspirator bulb should pull the sample approximately 10 inches (25 centimeters) up the tube. Therefore, to sample from a 16 foot hose (five meters), at least 20 aspirations will be required. However, a minimum of one minute is recommended to ensure a stable sample is read.

The maximum length allowable for a sample hose is 98 feet (30 meters).

It should be noted that for sample hose lengths greater than 16 feet (five meters), the oxygen sensor may initially go into a falling alarm state for approximately one minute, due to pressure effects, before settling back down to read accurately.

3. Service and maintenance

The **MG-1** is designed to require minimal service and maintenance. As with all electrochemical sensors, however, these will require periodic replacement.

Ensure maintenance, service and calibration are carried out in accordance with the procedures in the manual and only by trained personnel.

For further service or maintenance, contact your local Macurco agent or regional office (see Section 7.2).

4. Specification

Detector type	**MG-1**
Gases*	CO, H_2S, O_2, FLAM LEL Pellistor
Size (d x l x w) (excluding clip)	1.4 x 5.3 x 3.1 in. (35 x 135 x 80 mm)
Weight	9.9 oz (282 g)
Alarms	Audible > 95dB Visual - all angle dual red/blue LEDs Vibrating alert +ve Safety™
Display	Front mount with optional 180 degree flip for ease of view
Data logging	130 hours @ ten second intervals (Approximately 78,000 logs)
Event logging	Alarm, over range, calibration, bump, on/off, TWA (Approximately 3,500 events)
Battery	Rechargeable lithium-ion battery Up to 18 hours runtime Typical charge time 5 ½ hours
Operating temperature	-4°F to +131°F (-20°C to +55°C)†
Storage	-13°F to +149°F (-25°C to +65°C)
Humidity	10 to 95% RH
Ingress protection	Independently tested to IP65 and IP67
Approvals	**IECEx:** Ex d ia IIC T4 Gb Tamb -20°C to +55°C **ATEX:** II 2 G Ex d ia IIC T4 Gb Tamb -20°C to +55°C **UL:** Gas detector use in hazardous locations Class 1 Division 1 Groups A, B, C and D only as to intrinsic safety **Marine Equipment Directive:** LLoyds Certificate Number: MED 1500019
Compliance	CE, FCC and ICES-003 Complies with EMC Directive 2004/108/EC
Communications Interface	Data connection for use with **Portables Pro 2.0** PC Application
Charging options	**MG-1** Cradle Charger (T4-CRD) **MG-1** Ten-Way Charger (T4-TWC) **MG-1** Vehicle Charger (T4-VHL) **MG-1** USB Communications Cable and Charger (CH0104)

† *Sensors may be degraded at the higher temperatures subject to individual sensor specifications*

5. Accessories

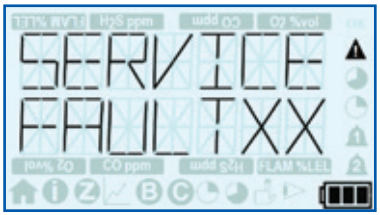
Model Number	Description
T4-CRD	**MG-1** Cradle Charger
T4-TWC	**MG-1** Ten-way Charger
T4-VHL	**MG-1** Vehicle Charger
CH0104	**MG-1** USB Communications Cable and Charger
T4-EXT-F	**MG-1** Sensor Filter Plate
T4-ASP-CAP	**MG-1** Calibration/Bump Test Plate
MG1-FCK	**MG-1** Field Calibration Kit
T4-ASP-KIT	**MG-1** Sampling Kit (includes aspirator plate, hand aspirator and 65 ft. hose)
IT-T4-11Z-ZB-2	**MG-1** I-Test
PC SOFTWARE	Portables Pro 2.1 Software (configuration changes, data logging, calibration)

6. Troubleshooting

6.1 MG-1 Fault / Warning / Information Descriptions

6.1.1 Service Faults

If the **MG-1** detects an internal fault that requires the **MG-1** to be returned for servicing, the 'Service' message (as shown to the right) will be displayed on the screen. 'XX' represents a specific fault ID code.



If the **MG-1** displays a service fault message, the **MG-1** will not operate normally and must be returned to a service center for further investigation and repair. No user intervention possible.

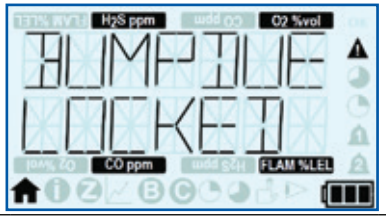
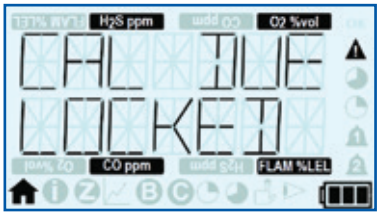
6.1.2 Fault/Warning/Information Messages

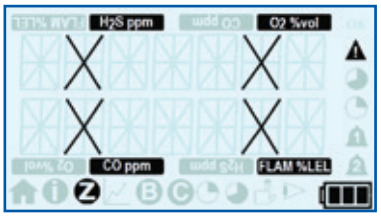
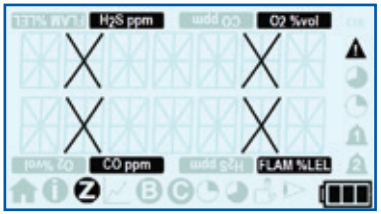
The **MG-1** may indicate a fault or warning that requires user intervention to resolve, or the **MG-1** may provide additional information on instrument status.

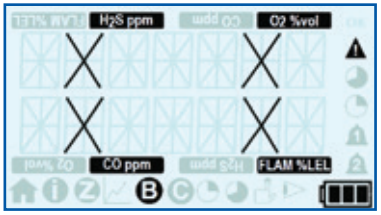
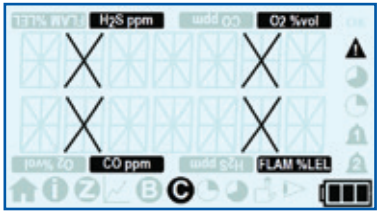
The table below provides further details on these faults, warnings and information messages including the fault message/symptom, the cause and the user action required.

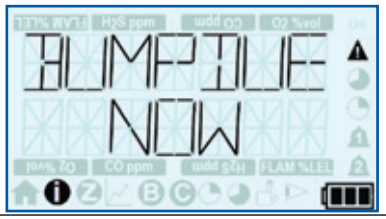
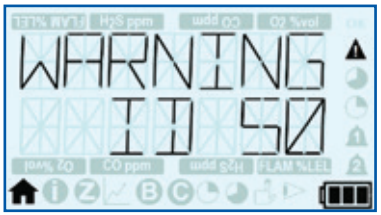
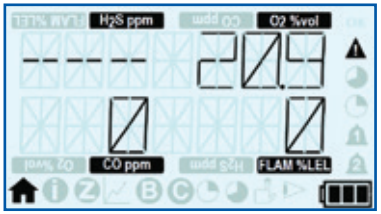
Fault codes as listed in the table below are not displayed in the display message in all cases, but any active fault code can be viewed via the information screen as detailed in Section 2.8.2.

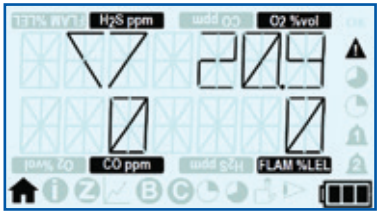
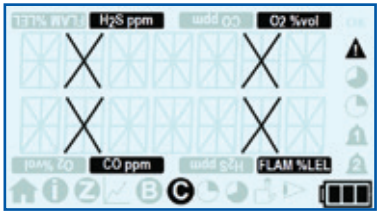
Fault / Warning ID	Warning/Fault	Display Image	Status/Cause	Operator Action
71	"BATTERY LOW" "ID71" The battery icon will also be flashing with no segments.		***Battery Low*** The **MG-1** battery has typically a maximum 30 minutes run time before the battery will be depleted.	Click the operator button to clear the warning. Charge the **MG-1** as soon as possible.
0	"BATTERY EMPTY" "FAULT00" The battery icon will also be flashing with no segments.		***Battery Exhausted*** The **MG-1** battery is exhausted and the **MG-1** will auto shutdown in 15 seconds.	Recharge the **MG-1** battery.

Fault / Warning ID	Warning/Fault	Display Image	Status/Cause	Operator Action
73	"CHARGER SHUTDOWN" "ID 73"		***Charger Shutdown*** The **MG-1** has been placed on charge while the **MG-1** is powered on for a prolonged period. The **MG-1** will auto shutdown after 15 seconds to prevent circuit damage.	If the **MG-1** requires charging, no action required. The **MG-1** will auto switch off and continue charging. If the **MG-1** is removed from the charger, it will not auto switch off and continue operating normally.
21	"TIME LOST" (Displayed during start up)		***Time & Date Lost*** The **MG-1** has detected its internal time and date has been lost.	The **MG-1** time and date **must** be reset to ensure correct operation. This can be reset utilizing **Portables Pro 2.0** or by placing the **MG-1** into I-Test.
74	"BUMPDUE" "LOCKED"		***Bump Locked*** A bump test is due and the **MG-1** is configured to lock on bump due.	Perform a bump test (or a calibration) on the **MG-1** to 'unlock' for normal operation.
25	"CAL DUE" "LOCKED"		***Calibration Locked*** Calibration is due and the **MG-1** is configured to lock on due calibration.	Perform a calibration on the **MG-1** to 'unlock' for normal operation.

Fault / Warning ID	Warning/Fault	Display Image	Status/Cause	Operator Action
	'X' While in 'zero menu'. (The warning ID code for each specific gases is shown in the adjacent column)		***Zero Failure*** Displayed if the result of a sensor zero was a fail. The 'X' indicates which sensor has failed the zero (in the example all gases failed the zero).	Ensure the **MG-1** is in 'clean air' and repeat the zero operation. The **MG-1** must be returned to a service center for further investigation and repair if the zero is not successful when repeated.
26	H_2S			
27	O_2			
28	CO			
29	LEL			
	'X' While in 'autozero function'. (The recorded warning ID code for each specific gases is shown in the adjacent column)		***Autozero Abort*** Displayed if an autozero was aborted due to the **MG-1** detecting gas being present outside acceptable limits. The 'X' indicates which sensor has failed the zero (in the example all gases failed the zero).	Ensure the **MG-1** is in 'clean air' and repeat the zero operation. The **MG-1** must be returned to a service center for further investigation and repair if the zero is not successful when repeated.
42	H_2S			
43	O_2			
44	CO			
45	LEL			

Fault / Warning ID	Warning/Fault	Display Image	Status/Cause	Operator Action
	'X' *While in 'bump menu'.* (The recorded warning ID code for each specific gases is shown in the adjacent column)		***Bump Failure*** Displayed if the result of a bump test was a fail. The 'X' indicates which sensor has failed the bump test (in the example all gases failed the bump test).	Repeat the bump test operation. The **MG-1** must be returned to a service center for further investigation and repair if the bump test is not successful when repeated.
81	H_2S			
82	O_2			
83	CO			
84	LEL			
	'X' *While in 'calibration menu'.* (The recorded warning ID code for each specific gases is shown in the adjacent column)		***Calibration Failure*** Displayed if the result of a sensor calibration was a fail. The 'X' indicates which sensor has failed the calibration (in the example all gases failed the calibration).	Repeat the calibration operation. The **MG-1** must be returned to a service center for further investigation and repair if the calibration is not successful when repeated.
34	H_2S			
35	O_2			
36	CO			
37	LEL			

Fault / Warning ID	Warning/Fault	Display Image	Status/Cause	Operator Action
66	”BUMP DUE” “NOW” (Displayed during start up)		***Bump Test due*** The **MG-1** bump test is overdue.	Perform a bump test on the **MG-1**. This will clear the bump due warning.
67	“CAL DUE” “NOW” (Displayed during start up)		***Calibration Due*** The **MG-1** calibration is overdue.	Perform a calibration on the **MG-1**. This will clear the calibration due warning.
	“WARNING” “ID 50” This will then be followed by the ‘home screen’ displaying: ‘---‘ for the gas in fault. (The fault ID code for the specific gases is shown in the adjacent column)	 	***Hardware Warning*** The **MG-1** has detected a hardware fault with a specific gas channel.	Click the operator button to clear the warning. The **MG-1** must be returned to a service center for further investigation and repair.
50	H_2S			
51	O_2			
52	CO			
53	LEL			

Fault / Warning ID	Warning/Fault	Display Image	Status/Cause	Operator Action
	"WARNING" "ID 58"		***Sensor under range*** Indicates the sensor is reading under range.	Ensure the **MG-1** is in 'clean air' and undertake a zero operation. The **MG-1** must be returned to a service center for further investigation and repair if the message is seen persistently.
	This will then be followed by the 'home screen' displaying "▼" for the gas in under range. (The fault ID code for the specific gases is shown in the adjacent column)			
58	H_2S			
59	O_2			
60	CO			
61	LEL			
	'▲' For the gas in over range. (The fault ID code for the specific gases is shown in the adjacent column)		***Sensor over range*** Indicates that the sensor is reading over range.	Exit hazardous area immediately as over gassing of sensors can cause long term damage. The **MG-1** should be tested to ensure that no lasting damage has occured.
77	H_2S			
78	O_2			
79	CO			
80	LEL			

Fault / Warning ID	Warning/Fault	Display Image	Status/Cause	Operator Action
1	"WARNING" "ID 01"		***Firmware Fault*** The **MG-1** has detected an unexpected internal firmware fault.	Click the operator button to clear the warning. The **MG-1** has recovered to a safe state. The **MG-1** must be returned to a service center for further investigation and repair if the message is seen persistently.
14, 15, 16, 17, 18	"WARNING" "ID 14" (the warning ID shown could be one of the codes in the adjacent column)		***Configuration Failure*** The **MG-1** has detected a configuration read or write failure.	Click the operator button to clear the warning. The **MG-1** has recovered to a safe state. The **MG-1** must be returned to a service center for further investigation and repair if the message is seen persistently.
22, 23	"WARNING" "ID 22" (the warning ID shown could be one of the codes in the adjacent column)		***Logging Fault*** The **MG-1** has detected that it is unable to store data in the data or event log.	Click the operator button to clear the warning. The **MG-1** has recovered to a safe state. The **MG-1** must be returned to a service center for further investigation and repair if the message is seen persistently.

7. Appendices

7.1 Sensor Limitations

The detector is not suitable for use in ambient temperatures above 131°F (55°C) and electrochemical toxic gas sensors may be degraded, reducing life at these temperatures. Water should not be allowed to collect on the sensors as this may impede gas diffusion. Use with care in wet or humid environments where water may condense on the sensors, and check response after use.

Persistent exposure to high levels of toxic gas can shorten the life of toxic sensors. Toxic sensors may also be cross-sensitive to gases other than their specific target gas, and hence the presence of other gases may cause the sensor to respond. If unsure, contact **Macurco Gas Detection**.

Use of high power radio transmitters in close proximity to the detector may exceed RFI immunity levels and cause erroneous indications. If such problems are experienced, remove antennae to a reasonable distance from the detector (e.g. 12 in. or 30 cm).

Standard units detect flammable gases using a catalytic flammable sensor which operates in the presence of oxygen. It is advisable to check the oxygen concentration as well as the flammable gas concentration before entering a confined space. Oxygen levels below 10% will reduce a flammable gas reading.

The performance of catalytic sensors may be permanently degraded if exposed to silicones, sulfur containing gases (such as H_2S), lead or chlorine compounds (including chlorinated hydrocarbons).

7.2 Contact Us

Aerionics, Inc. (dba Macurco Gas Detection)
3601 North St. Paul Avenue
Sioux Falls, South Dakota 57104
Phone: (877) 367-7891
info@aerionicsinc.com

www.macurco.com

Warranty

This equipment leaves the factory fully tested and calibrated. If within the warranty period of two (2) years from date shipped by **Macurco**, the equipment which includes battery and common sensors (see below) is proved to be defective by reason of faulty workmanship or material, we undertake at our option either to repair or replace it free of charge, subject to the conditions below.

Battery Warranty

All batteries degrade in performance over time and usage. For the purpose of this warranty it is considered that two years use equates to 500 full charge / discharge cycles (fully empty to full) and users should expect to see no greater than a 20% decline in run time after either this time or number of cycles, whichever is sooner.

Sensor Warranty

Sensor	Warranty	Expected Life
Oxygen	2 years	2 years
Flammable	2 years	Up to 5 years in air
Carbon monoxide	2 years	>2 years
Hydrogen sulfide	2 years	>2 years

Macurco warrants the **Macurco™ MG-1** will be free from defective materials and workmanship for a period of two (2) years from date shipped by **Macurco**, provided it is maintained and used in accordance with **Macurco** instructions and/or recommendations. If any component becomes defective during the warranty period, it will be replaced or repaired free of charge, if the unit is returned in accordance with the instructions below. This warranty does not apply to units that have been altered or had repair attempted, or that have been subjected to abuse, accidental or otherwise. The above warranty is in lieu of all other express warranties, obligations or liabilities. THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE ARE LIMITED TO A PERIOD OF TWO (2) YEARS FROM THE FACTORY SHIP DATE. **Macurco** shall not be liable for any incidental or consequential damages for breach of this or any other warranty, express or implied, arising out of or related to the use of said gas detector. **Macurco** or its agent's liability shall be limited to replacement or repair as set forth above. Buyer's sole and exclusive remedies are return of the goods and repayment of the price, or repair and replacement of non-conforming goods or parts.

Please contact **Macurco Customer Support** for warranty and technical support inquiries:

Toll Free: (877) 367-7891 **Fax: (512) 524-3415** **Email: info@aerionicsinc.com**