iBRiD® MX6

Multi-gas Monitor

Operation Guide

The Essential Guide for Safety Teams and Instrument Operators

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Contents

Tables and Figures

1 General Information

Certifications

Each MX6 iBrid® is certified by one or more certifying bodies (CBs). The approved uses for which a unit is certified appear on labels affixed to the instrument.

When a new certification is received, it is *not* retroactive to any unit that does not bear the marking on its label.

Instrument certifications at the time of this document's publication are noted below. To determine for which uses a unit is certified, always refer to the unit's labels.

Table 1.1 Hazardous area certifications

Directive or CB	Certification marking
ATEX[a]	Equipment Group and Category II 1 G, Ex ia IIC T4 Ga Equipment Group and Category II 2 G, Ex db ia IIC T4 Gb (with IR sensor) Equipment Group and Category I M1, Ex d ia I Equipment Group and Category I M2, Ex d ia I (with IR sensor) IP64
ANZEx	Ex ia s Zone 0 I Ex ia s Zone 0 IIC T4 IP64
BFE	Permissible for PA Bituminous Underground Mines
China CPC	Metrology Pattern Approval
China Ex	Ex ia d I Ex ia d IIC T4
CSA[b]	Class I, Groups A B C D T4 Ex d ia IIC T4
GOST-R	PB-Ex ia d I X 1 Ex ia d IICT4 X

Table 1.1 Hazardous area certifications

Directive or CB	Certification marking
IECEx[c]	Zone 0 Ex ia IIC T4 Ga Ex ia I
	Zone 1 Ex ia IIC T4 Gb (with IR sensor) Ex db ia I (with IR sensor)
INMETRO	Ex ia IIC T4 Ga Ex db ia IIC T4 Gb (with IR sensor)
KOSHA	Ex d ia IIC T4
MDR	Registration of Plant Design: CH4, O2, CO, H2S, and NO2
MSHA	CFR30, Part 22, methane-air mixture
UL[d]	Class I, Group A B C D T4 Class II, Group F G Class I, Zone 0, AEx ia IIC T4 Class I, Zone 1, AEx ia IIC T4 with IR sensor

[a]The EC type examination certificate is DEMKO 07 ATEX 0626395X; for equipment group and category II 1G; with marking code Ex ia IIC T4 Ga for an ambient temperature range of -20°C to 40°C, with the alkaline battery pack P/N 17131046-3 or -20°C to 55°C with the li-ion battery pack, P/Ns 17131038-1, and 17131038-2. The EC type examination certificate is INERIS 08 ATEX 0026X; for equipment group and category I M1 /M2 with marking code Ex ia d I for an ambient temperature range of -20°C to 40°C, with the alkaline battery pack P/N 17131046-3 or -20°C to 55°C with the li-ion battery pack, P/Ns 17131038-1, and 17131038-2.The EC type examination certificate is INERIS 10 ATEX 0027X; for equipment group and category II 2 G with marking code EN 60079-29-1, and EN 50104.

[b]Certified according to the Canadian Electrical Code for use in Class I, Division 1 Hazardous Locations within an ambient temperature range of -40°C to 40°C for the alkaline battery pack and -40°C to 55°C for the li-ion battery pack. CSA No. 152 certification applies when the instrument is calibrated to 50% LEL CH4, and for a temperature range of 0°C to 40°C. **CAUTION:** Before each day's usage, sensitivity must be tested on a known concentration of pentane or methane equivalent to 25%-50% of full-scale concentration. Accuracy must be within -0% to +20% of actual concentration. Accuracy may be corrected by referring to the zero/calibration section of the instruction manual.

[c]Intrinsically safe for Zone 1 Classified Areas within an ambient temperature range of -20°C to 40°C, with the alkaline battery pack and -20°C to 55°C with the li-ion battery pack.

[d]The MX6 is UL classified only as to intrinsic safety for use in Class I, Division 1, Groups A B C D; T4 and Class II, Groups F, and G and Class I, Zone 0, AEx ia IIC T4 classified locations with the li-ion battery pack P/Ns 17131038-1, and 17131038-2 for T ambient ≤ 55ºC or alkaline battery pack P/N 17131046-3 for T ambient ≤ 40ºC.

Warnings and Cautionary Statements

IMPORTANT: Failure to perform certain procedures or note certain conditions may impair the performance of this product. For maximum safety and optimal performance, read and follow the procedures and conditions listed below.

Table 1.2 Warnings and Cautionary Statements

⚠	**IMPORTANT**: Read and understand this manual before operating.
⚠	**IMPORTANT**: The instrument must be charged before its first use.

Table 1.2 Warnings and Cautionary Statements

⚠ **IMPORTANT**: Be sure to turn off the instrument before (1) servicing the unit or (2) replacing the battery.

⚠ **IMPORTANT**: Battery contacts are exposed on battery packs when they are removed from the instrument. Do not touch the battery contacts and do not stack battery packs on top of each other.

⚠ **WARNING:** Explosion hazard. Only replace batteries in nonhazardous locations. Alkaline battery pack is only approved for use with Duracell MN 1500 or Rayovac LR6 batteries. Do not mix batteries from different manufacturers. Replace all batteries at the same time. When reattaching the battery or Alkaline battery pack, use a torque value of 0.46 newton m (65 ounce-force inch). Do not store instruments with alkaline batteries installed.

⚠ Prior to each day's use, a bump test should be performed. If the instrument does not pass the bump test, a full calibration is recommended.

⚠ Oxygen-deficient atmospheres may cause combustible gas readings to be lower than actual concentrations.

⚠ Oxygen-enriched atmospheres may cause combustible gas readings to be higher than actual concentrations.

⚠ Verify the calibration of the combustible gas sensor after any incident where the combustible gas content has caused the instrument to display an over-range condition.

⚠ Silicone compound vapors or other known contaminants may affect the combustible gas sensor and cause readings of combustible gas to be lower than actual gas concentrations. If the instrument has been used in an area where silicone vapors were present, always calibrate the instrument before next use to ensure accurate measurements.

⚠ Sensor openings and water barriers must be kept clean. Obstruction of the sensor openings or contamination of the water barriers may cause readings to be lower than actual gas concentrations.

⚠ Sudden changes in atmospheric pressure may cause temporary fluctuations in the oxygen reading.

⚠ Charge battery, change pump filter, service unit, and use its communication port only in nonhazardous locations. Not for use in oxygen-enriched atmospheres.

⚠ **WARNING:** Substitution of components may impair intrinsic safety and may cause an unsafe condition.

⚠ **CAUTION:** For safety reasons, this equipment must be operated and serviced by qualified personnel only. Read and understand the instruction manual completely before operating or servicing.

⚠ **CAUTION:** High off-scale readings may indicate explosive concentration.

⚠ **CAUTION:** Any rapid up-scale reading followed by a declining or erratic reading may indicate a gas concentration beyond the upper scale limit which may be hazardous.

⚠ **WARNING:** The use of leather cases can produce inaccurate readings with diffusion (non-aspirated) gas detection instruments for specific monitoring applications. Leather cases should be used ONLY as carrying cases, and NOT for continuous monitoring, with diffusion instruments configured to measure gases **other than** O_2, CO, CO_2, H_2S, and combustible gases (LEL/CH_4).

⚠ **CAUTION:** Remote sampling requires particular attention to ensure accurate gas readings.

Table 1.2 Warnings and Cautionary Statements

⚠ **CAUTION:** Industrial Scientific recommends the “2 & 2 Sampling Rule” when sampling with a motorized pump and tubing, allow for 2 minutes plus 2 seconds per foot of tubing used, prior to recording monitor readings. This allows time for the gas to reach the instrument and for the sensors to react to any gases present. For example, 10 feet (3.05 Meters) of tubing requires 2 minutes and 20 seconds of time to achieve accurate readings.

⚠ **CAUTION:** Industrial Scientific recommends Teflon lined tubing, part number 17154854, be used when sampling for the following gases: Ammonia (NH3), Chlorine (Cl2), Chlorine Dioxide (ClO2), Hydrogen Chloride (HCl), Hydrogen Cyanide (HCN), Nitric Oxide (NO), Nitrogen Dioxide (NO2), Phosphine (PH3), Sulfur Dioxide (SO2), or Photo Ionization Detectors (PIDs) used to detect volatile organic compounds (VOCs) including Benzene (C6H6).

⚠ Contact your service representative immediately if you suspect that the MX6 monitor is working abnormally.

MSHA conditions of use

The following instructions pertain to the use of the MX6 in conjunction with MSHA approval.

MSHA approved for use with the following battery packs only:

(A) Replaceable alkaline battery pack, part number 1713-1046-6, consisting of three each of either of the following 1.5 V battery types: Duracell MN 1500 or Rayovac LR6.

- Do not mix batteries from different manufacturers.
- Replace all batteries at the same time.
- The individual alkaline batteries may be replaced in an area where gas may be present. Do not allow dust to enter the unit when replacing individual batteries.
- The battery pack must be replaced in fresh air only.

(B) Rechargeable lithium-ion battery pack part number 1713-1038-4, or -5, containing two or three 3.6V, 1.8 amp-hour Lithium Batteries.

- The lithium-ion cells are not user-replaceable.
- The lithium-ion pack must be charged in fresh air only.

CAUTION: For compliance determinations required by 30 CFR 75, Subpart D, the monitor must display "CH4" and “%VOL” during the monitor's start-up sequence.

CAUTION: The Model MX6 iBrid Multi-Gas Monitor must be configured to include a catalytic sensor, Model 4L-LEL, P/N 1710-5081, (CH4, 0-5% v/v).

CAUTION: The IR (infrared) methane sensor reading is not to be used for methane concentrations below 5% in air.

CAUTION: The Model MX6 iBrid Multi-Gas Monitor must be calibrated according to the procedure specified in the instruction manual.

CAUTION: In applications requiring MSHA certification, the IR sensor for detecting up to 100% v/v methane-in-air the sensor must be calibrated manually; the DS2 docking station cannot be used to calibrate the IR sensor. The recommended calibration gas for IR methane sensor calibration is 99% volume methane.

CAUTION: When calibrated using methane concentrations less than 5% of volume, reading accuracy of the infrared methane sensor may not be guaranteed to be better than +/-20%.

Key Features

Table 1.3 Key Features Overview

Feature	Description
Audio Indicator	Used for alarms, warnings, and the optional confidence indicator. There are two levels of audio gas alarms based on the frequency of the beeps and the length of delay between beeps. • Low-level (level-1): Low frequency beeps with a long delay • High-level (level-2): High frequency with short delay For all sensors but oxygen, if the gas reading is above the high alarm level, the instrument sustains the high alarm until the gas reading is below the high alarm level, then the instrument switches to the low alarm until the gas reading is below the low alarm level. For the oxygen sensor, a high alarm only is indicated for both oxygen enrichment and depletion.
Vibrating Alarm	Pulsing alarm that is used for limit alarms and as a confidence indicator.
Visual Alarm	Visual alarm LEDs are located on the instrument, above the display screen. There are two levels of visual alarms based on the length of delay between the LED flashes. • Low-level (level-1): LEDs are pulsed with a long delay • High-level (level-2): LEDs are pulsed with a short delay The LCD backlight flashes as part of all alarm sequences, except for the battery low condition. The visual alarm is also used as the confidence indicator which, when enabled, blinks the LEDs once every 30 seconds.
Infrared (I/R) Port	An optical media interface (per IrDA physical layer specification) is located on the bottom of the instrument and is used for infrared (I/R) data transmissions at speeds of 115200 bytes/second.
Clip/Connector	Located on the back of the MX6 for hands-free gas monitoring. A wrist strap is also provided to protect against drops during operation.
Cradles	Three different cradles are available for use with the MX6 multi-gas monitor. • Charger: Charge the internal batteries • Data link: Download data (e.g., events) to a host computer • Charger/Data link: Combination of both
Color LCD	TFT high-resolution, color liquid crystal display.
Menu-Driven User Interface	The user interface is menu-driven and contains the LCD, Navigation Button, Audio Indicator, Vibrating Alarm, and Visual Alarm. The menu system consists of two different menus. The background color of the LCD identifies the current menu. • Operation Menu: white background on LCD • Configuration Menu: yellow background on LCD

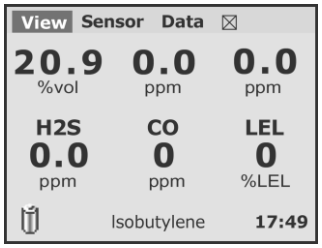
Table 1.3 Key Features Overview

Feature	Description
Security	Access to the Configuration Mode can be protected using a security password. When activated, this password must be entered in order to access and change the parameters within the Configuration Menu.
Alarm Events	Fifteen alarm events for the instrument are recorded into a FIFO queue in nonvolatile memory and are time stamped. An event is recorded any time that the instrument goes into alarm. Event information (which can be downloaded from the instrument) includes instrument serial number, sensor type, sensor serial number, gas type, peak exposure level, alarm duration in minutes and seconds, and date and time that alarm occurred.
Error Events	Fifteen error events for the instrument are recorded into a FIFO queue in nonvolatile memory and are time stamped. An error event is recorded any time that a fault occurs (including pump faults and fault events during the self-test). The information stored for each event includes instrument serial number, fault that occurred, fault error code, date and time stamp, and any pertinent data (i.e., pump current reading).
Data log	Data logging is a feature that allows a variety of system parameters to be recorded at regular intervals (and saved internally) for retrieval (and viewing) at a later date. The data log feature saves the following information: • Alarm Conditions Flagged • Battery Level • Gas Reading • Gas Type • Date • Site ID • Snapshot Enabled/Disabled • STEL • Temperature • Time of Day • TWA • User ID The data log is downloaded when the unit is docked in a compatible docking station and may be accessed through iNet® Control, Docking Station Server Admin Console (DSSAC), and Industrial Scientific Accessory Software.

Note: Data are saved in case of power loss.

Quick Start – Navigating Menus

Table 1.4 Navigating Operation-mode Menus



View			Sensor			Data		
Display ▶	⏻	Numeric Text Graphical Rotate	Zero All	⏻		New Session	⏻	
Battery	⏻		Calibration	⏻		View Data ▶	⏻	Readings Graph TWA Graph TWA Numeric STEL Graph STEL Numeric Event Log Memory Status
Profile	⏻		Bump test	⏻				
Help ▶	⏻	Contact About	Peaks	⏻				
			Sensors ▶	⏻	Sensors 1 - 6[b]			
Configure[a]	⏻		Location	⏻		Comments	⏻	
						Users/Sites ▶	⏻	Set Current User Set Current Site

[a]*Warning:* Only qualified personnel should access and work in configuration mode.

[b]Access tasks, information screens, or settings for individual sensors: Zero, calibration, or bump testing; most recent (or next) calibration, date, and span trends. For PID or LEL sensors, edit unit of measure, RF (PID), or correlation factor (LEL).

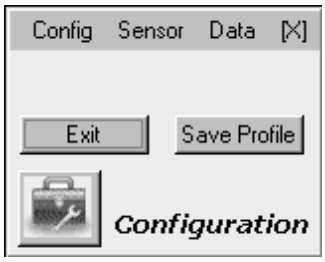
Diagram Key

Begin task
Access settings
Edit setting
View information

Note: Access to each option varies based on the instrument's configured settings.

	Instrument Buttons Key
Any button	Activate backlight.
⏻	Start a task. Confirm or cancel an action. Change an item's status (from on to off, etc.).
▲ or ▼	Navigate menu items or items on a display screen. Enter text or values in a data field.
◀ or ▶	Navigate from menu to menu or navigate items on a display screen. Use as a cursor in a data field.

Table 1.5 Navigating Configuration-mode Menus



Config		
Admin ▶	⏻	Password Clock Language Company Backlight Defaults
Alarms ▶	⏻	Audio Visual Vibrate Latch While Docked Allow Shutdown Confidence ▶
Display ▶	⏻	Time Temp Both (T/T) PID Factor LEL Factor Both (PID/LEL)
Start-up ▶	⏻	User Company Cal Date ▶ Zero Self-test Bump
Profiles ▶	⏻	Set Save ▶ Delete

Sensor		
Sensors ▶	⏻	Sensors 1 – 6[c]
Options ▶	⏻	Field Zero[d] Field Cal[d] Field Bump[d] Field Peaks[d] Cal Date[e] ▶ Cal Overdue[e] Bump Overdue[e] Bump Level[e]
RF List ▶	⏻	Favorite Custom
Location	⏻	

[c]Enable or disable a sensor. Set alarm values (high, low, and STEL) and the TWA time base. Set calibration gas values and properties.

[d]Enable or disable the feature.

[e]Select the calibration due format: date of the next or last (most recent) calibration. Determine instrument behavior when calibration is overdue: automatic shutdown, continued operation, or, continued operation with "cal overdue" user notification. Adjust the bump test criteria.

Data		
Options ▶	⏻	Overwrite Interval Field View View Events
Mode	⏻	
Clear	⏻	
Users ▶	⏻	Set Current Add Delete Field Change
Sites ▶	⏻	Set Current Add Delete Field Change

Diagram Key

Access settings
Edit setting
View information

Note: Access to each option varies based on the instrument's configured settings.

2

Recommended Practices

Procedures

When completed regularly, the procedures defined below help to maintain proper instrument functionality and enhance operator safety.

Configuration. The configuration process allows qualified personnel to review and adjust a unit's settings.

Bump Test (or "functional test"). Bump testing checks for sensor and alarm functionality. The installed sensors are briefly exposed to expected concentrations of calibration gases that are greater than the sensors' low alarm set points. When one or more sensors "pass" the test, they are "functional," and the unit will alarm. Each sensor's "pass" or "fail" result is indicated on the unit's display.

Note: A bump test does not measure for sensor *accuracy* (see "Calibration").

Zero. Zeroing sets each installed sensor to recognize the ambient air as clean air. If the ambient air is not truly clean air, gasses that are present and relevant to the installed sensor types will be measured and displayed as zero. Readings will be inaccurate until the unit is correctly zeroed in truly fresh air or with a zero-air cylinder.

Calibration. All sensors gradually degrade over time. This diminishes a sensor's ability to measure gas concentrations accurately; however, regular calibrations adjust the instrument to compensate for this decline in sensitivity. During calibration, the installed sensors are exposed to expected concentrations of calibration gases and, when needed, the instrument will self-adjust to ensure the accurate measurement and display of detected gas concentrations.

Note: When a sensor has degraded beyond an acceptable level, no further adjustment is possible, and the sensor will no longer pass calibration.

Peak Readings. The instrument stores the highest detected gas readings, the "peak readings" or "peaks". Bump testing and calibration will often register new peak readings. Therefore, the clearing of the peak readings should *follow* each calibration. The instrument operator may also wish to clear the peak readings after a bump test, before a change in location, or after an alarm is addressed and cleared.

Note: The peak readings and the data log readings are stored independently of one another therefore, clearing the peak readings does not affect the data log. Powering the instrument off or changing its battery does not affect the peak readings. These checks and balances help promote operator safety and serve to contain the peak readings in a "black-box" manner. In the event of a gas-related incident, this black-box record can be useful to the safety team or a prospective investigator.

Procedure Frequency

Industrial Scientific Corporation minimum frequency recommendations for each procedure are summarized in the table below. These recommendations are based on field data, safe work procedures, industry best practices, and regulatory standards to enhance worker safety. Industrial Scientific is not responsible for setting customer safety practices and policies. These policies may be affected by the directives and recommendations of regulatory groups, environmental conditions, operating conditions, instrument use patterns and exposure to gas, and other factors.

Table 2.1 Recommended procedure frequency

Procedure	Industrial Scientific Recommended minimum frequency
Configuration	Before first use and as needed thereafter.
Calibration[a]	Before first use and monthly thereafter.
Bump test[b]	Prior to each day's use.

[a]Between regular calibrations, Industrial Scientific also recommends calibration be performed immediately following each of these incidences: the unit falls, is dropped, or experiences another significant impact; is exposed to water; fails a bump test; or has been repeatedly exposed to an over-range (positive or negative) gas concentration. Calibration is also recommended after the installation of a new (or replacement) sensor.

[b]If conditions do not permit daily testing, bump tests may be done less frequently based on company safety policy.

Note: The use of calibration gases not provided by Industrial Scientific may void product warranties and limit potential liability claims.

Biased Sensors

The functionality of biased sensors is dependent on their receipt of continuous power. When their power supply is interrupted, it is their nature to destabilize. This means a biased sensor needs time to restabilize after its power supply is removed or depleted, then restored. Stabilization time varies depending on the sensor type and the length of time it has been without power. Use the information below to support the stability of biased sensors installed in the MX6 iBrid®.

When a biased sensor is in use and the MX6 iBrid displays a *low battery* warning:

- Replace the batteries in the Alkaline battery pack or charge the Extended range Li-ion battery pack.
- Power on the instrument and allow up to 24 hours for the biased sensor to stabilize.

First Use

The MX6 multigas monitor (instrument) is powered by an alkaline or rechargeable Lithium-ion (Li-ion) battery.

The lithium-ion battery packs are charged at the factory; however, some or all of the charge may deplete before the monitor arrives or is unpacked. Industrial Scientific recommends that the monitor be fully charged using an Industrial Scientific compatible charger or docking station; this may require up to eight hours. Note that the LCD on the MX6 shows that the battery is charging.

When fully charged, qualified personnel should configure and calibrate an instrument before first use (see chapters 5 and 6).

Remote Sampling

When sampling with a motorized pump and sampling line, Industrial Scientific recommends the following:

- Choose the tubing type based on the target gases. If the target gases are *known*, use Teflon-lined tubing when sampling for these gases: chlorine (Cl_2), chlorine dioxide (ClO_2), hydrogen chloride (HCl), and volatile organic compounds (VOCs). For other *known* target gases, urethane tubing or Teflon-lined tubing may be used.

  When the target gases are *unknown*, use Teflon-lined tubing.

- Know the length of the sample line as it is a factor in determining sampling time. A sample line may consist of tubing, a probe, or a probe and tubing. It should also have a dust filter–water stop installed at the line's end that will extend into the sample area. Sample-line length is defined as the distance from the dust filter–water stop opening to the point where the line connects to the pump's inlet. Ensure sample-line length does not exceed the pump's maximum draw.

- Before and after each air sample, perform a test of the full sampling line.
  - Block the end of the sampling line at the water-stop opening with your thumb. This should cause a pump-fault alarm.
  - Unblock the water-stop opening. After the alarm cycle completes, the pump should resume normal operation.

  Note: If a pump fault does not occur, check and correct for cracks or other damage, debris, and proper installation in these areas: all sampling line connections, the pump's inlet cap and inlet barrel, and the dust filter-water stop items at the end of the sampling line and inside the pump inlet barrel.

- Based on sample-line length, calculate the minimum time recommended for the air sample to reach the instrument's sensors. As shown below, use a base time of 2 minutes, and add 2 seconds for each 30 cm (1 ') of line length. Watch the display screen for gas readings and, if present, allow them to stabilize to determine the reading.

Table 2.2 Minimum sample time for common sample-line lengths

Sample-line length	Base time (minutes)	+	Sample-line-length factor (seconds)	=	Minimum sample time (mm:ss)
3.05 m (10 ')	2 min	+	(10 x 2 s)	=	02:20
6.10 m (20 ')	2 min	+	(20 x 2 s)	=	02:40
9.14 m (30 ')	2 min	+	(30 x 2 s)	=	03:00
12.10 m (40 ')	2 min	+	(40 x 2 s)	=	03:20
15.24 m (50 ')	2 min	+	(50 x 2 s)	=	03:40
18.29 m (60 ')	2 min	+	(60 x 2 s)	=	04:00
21.34 m (70 ')	2 min	+	(70 x 2 s)	=	04:20
24.38 m (80 ')	2 min	+	(80 x 2 s)	=	04:40
27.43 m (90 ')	2 min	+	(90 x 2 s)	=	05:00
30.48 m (100 ')	2 min	+	(100 x 2 s)	=	05:20

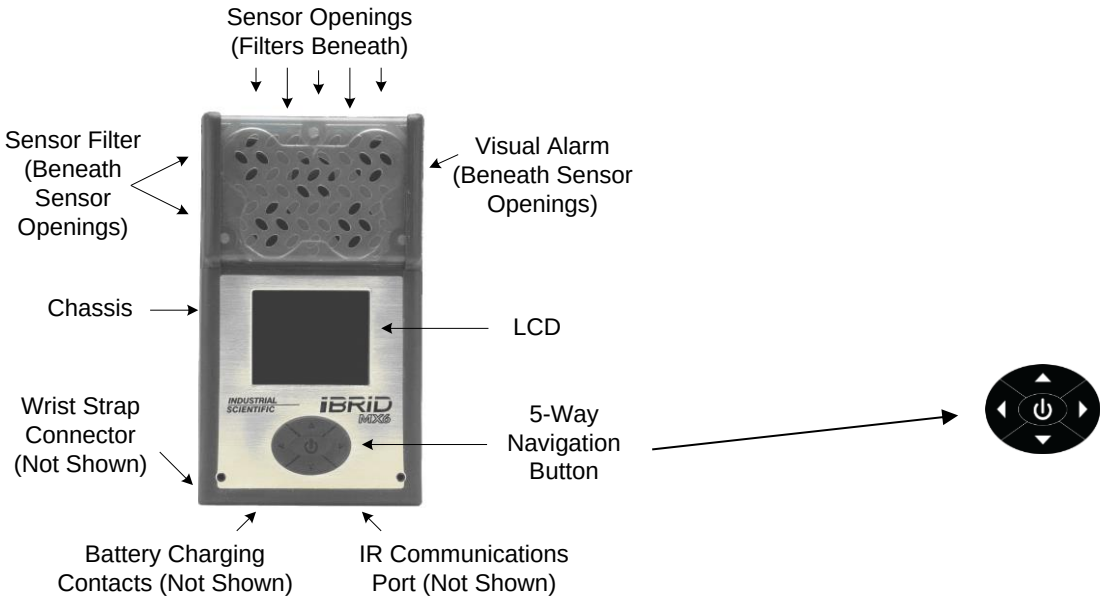
3

Instrument Basics

Hardware Overview

The MX6 multigas monitor is a handheld, “dockable” instrument for personal protection. The five-way navigation button is shown in detail below. The button symbols are used within this document’s instructional text.

Figure 3.1 MX-6 iBrid instrument overview



Power On and Shutdown

Two operation basics are powering on the instrument and shutting it down.

Power on

To power on the MX6 instrument, press and hold ⏻ for at least 3 seconds.

After power on, a series of start-up screens is displayed on the LCD. Start-up screens may vary depending on the unit’s configuration.

If no pump is detected by the unit, the gas-monitoring display screen is activated (see next section).

If the unit detects a pump, it requires the operator-assisted completion of a pump test, a built-in safety measure to ensure the pump is operational.

To complete the pump test, attach the air sampling line* to the pump inlet's nipple. Use a compatible water stop at the other end of the sampling line.

**Note:* The air sampling line may consist of tubing only, probe only, or tubing and probe (in this case, tubing is used to connect the instrument and the probe to allow for moving the probe while holding the instrument steady).

The instrument operator is prompted through the pump-test process by the following display-screen sequence.

No action necessary.

Place your finger over the opening at the end of the sampling line to block the air flow.

Remove your finger from the inlet and press ⏻.

No action necessary.

After a successful pump check, the gas-monitoring display screen is activated.

If no pump fault alarm occurs, there is an issue in the sampling path. Power off the unit. Check and correct for damage, debris, and improper installation in these areas: inlet cap, inlet barrel and dust filter, and the sampling line.

If the unit stays in pump fault, check for an error message on the display screen. For a pump fault error, power off the unit. Check and correct for damage, debris, and improper installation as noted above. If the condition persists, the filter or the tubing may need to be replaced.

Note: The SP6 pump has a nominal flow rate of 300 cc/min (0.3 LPM). A pump fault alarm will occur when the pump senses a vacuum of 30 inches of water.

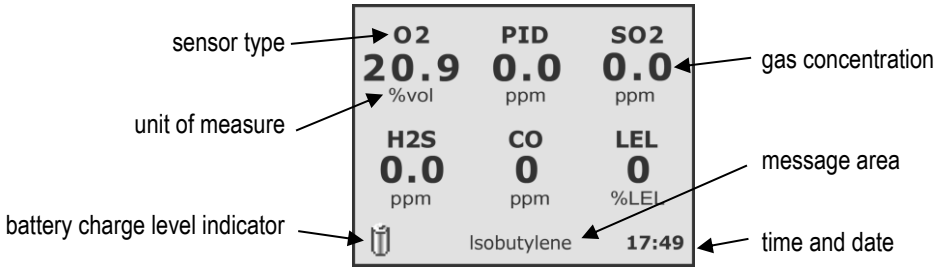
Shutdown

To shut down the instrument, hold ⏻ for more than two seconds. A confirmation screen is displayed to provide for user verification of the shutdown.

Gas-monitoring Display Screen

The gas-monitoring display screen for a six-sensor instrument is reproduced below.

Figure 3.2 Reading the gas-monitoring display screen



Note: The sample gas monitoring display screen is shown here in numeric format. Depending on the unit's configuration, some items may not display or may display differently.

Sensor types and readings are displayed as solid black text during normal operation.

4

Operation

Alarms and Warnings

All monitor alarms and warnings should be taken seriously and responded to according to company policy and guidelines.

During a gas-alarm condition, sensor types are displayed as blinking black text and gas readings are displayed as solid red numerals. Once initiated, a gas-related alarm will remain on while the alarm condition is present. When the detected gas concentration changes, the enabled alarm indicators (visual, audible, and vibration) will change to reflect a new condition. For example, a gas alarm may go from high to low to off as the instrument operator leaves a hazardous area. Likewise, the alarm may go from low to high as a hazardous gas concentration increases.

The alarm latch feature applies to all gas-related alarms. When enabled and the monitor goes into alarm, it will remain in alarm—or "latched"—until the alarm condition no longer exists *and* the monitor user presses the ENTER button for one second.

Note: During over-range conditions, a blinking "OR" is displayed in red as the sensor value. If the alarm is a STEL or TWA, the word "STEL" or "TWA" is shown to indicate the corresponding alarm.

As described below, some events (e.g., pump fault) may be addressed by the instrument operator or a service technician. Other events require instruction from or service by Industrial Scientific.

Table 4.1 Alarm and warning display screens

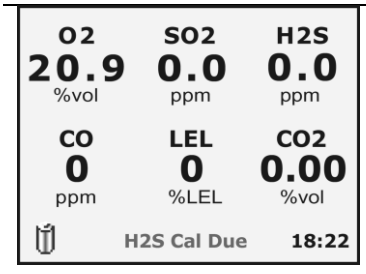
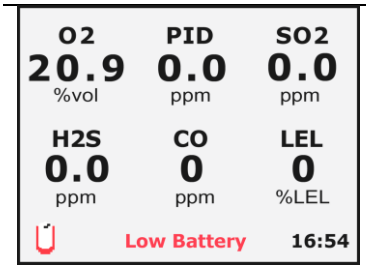
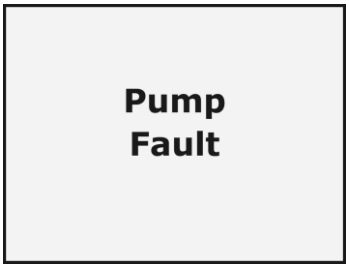
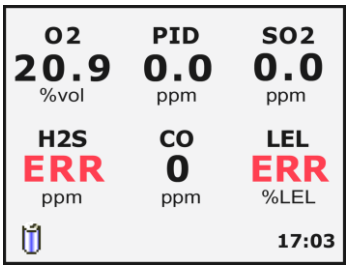
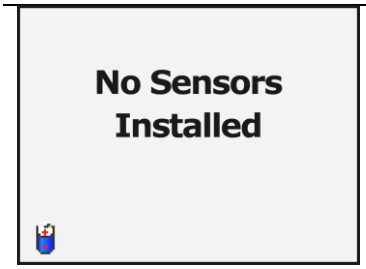
	**Service due warning** When the unit is due for service, a text message appears on the bottom row of the display screen (H2S Calibration Due shown). Respond according to company policy. The unit may be docked for service or the task may be performed manually by qualified personnel (see Chapter 6).

Table 4.1 Alarm and warning display screens

	**Low battery warning** The battery life remaining is less than one hour. When less than 10 minutes remain, the message and icon flash; an audible alarm (when enabled) is also activated. Respond according to company policy.
	**Pump fault alarm** Respond according to company policy. Qualified personnel may power off the unit, then check and correct for damage, debris, and improper installation in these areas: inlet cap, inlet barrel and dust filter, and the sampling line. If the unit remains in pump fault, contact a supervisor or Industrial Scientific.
	**Sensor failure** A data-related function has failed for one or more of the installed sensors. Each failed sensor is indicated by a gas reading of “ERR” and is not operational. Respond according to company policy. Qualified personnel may power off the unit and check the installed sensors for proper installation.
	**No Sensors** The unit does not detect any installed sensors and is not operational. Respond according to company policy. Qualified personnel may power off the unit and check the sensor installations.
	**System Alarm** The unit is not operational. Respond according to company policy. A critical hardware or system fault has occurred and is indicated on screen by a four-digit number, which begins with 3 (3850 shown). Qualified personnel should contact Industrial Scientific for assistance.

Menu System

The *operation-mode menu* is the entry point to any feature. It is activated from the gas-monitoring display screen and has three menu *tabs*.

To activate the menu, start with a powered-on instrument and follow the instruction below.

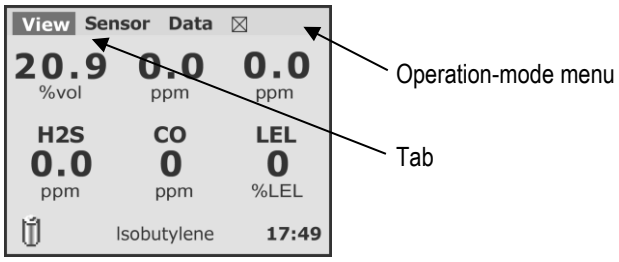
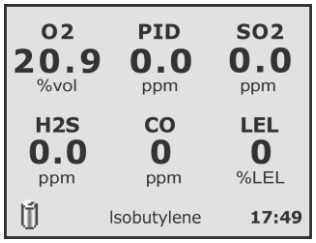
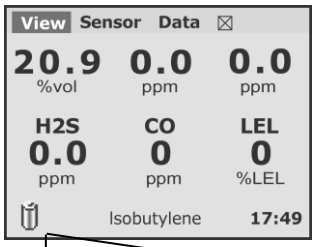
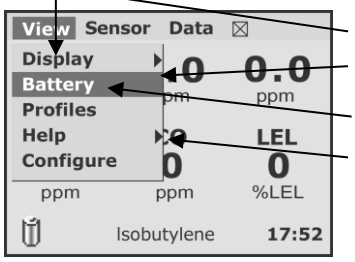


Figure 4.1 Activating the Menu

Instruction	Display Screen	Terminology
If the gas-monitoring screen is not backlit, press ⏻ once to turn on the backlight.		
Press ⏻ again to activate the operation-mode menu. It will appear across the top of the gas-monitoring screen as shown here; the "View" tab is highlighted.		
Press ⏻ to activate the "View" dropdown menu.		Dropdown menu Highlight bar Item Symbol

Navigation

Continuing with the sample screen from above, the instrument operator has already activated the operation-mode menu and the dropdown menu for "View". The keypad is used to navigate as described below.

Figure 4.2 Navigating menus via the Keypad

Navigation

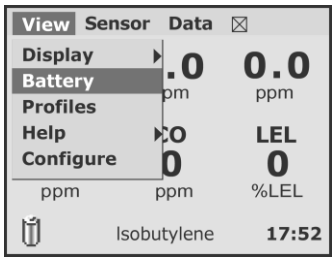
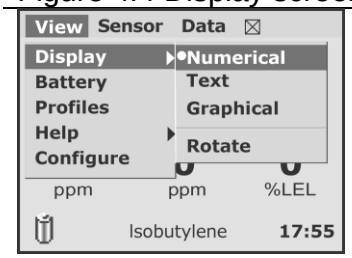
Sample screen	Button press	Result
	⏻	*Activate* the battery information screen.
	▲	Move the highlight bar *up*, from "Battery" to "Display".
	▼	Move the highlight bar *down*, from "Battery" to "Profile".
	◄	Move the highlight bar to the *left* tab, from "View" to "[X]".
	►	Move the highlight bar to the *right* tab, from "View" to "Sensor".

Figure 4.3 Other keypad functions

Button press	Result
Any button	Activate the backlight.
⏻	Start a task.
	Confirm or cancel an action.
	Change an item's status (for example, from on to off).
▲ or ▼	Enter text or values in a data field.
◄ or ►	Use as a cursor within a data field.

As shown below, the "Display" screens contain symbols that indicate navigation options, feature status, or data entry locations.

Figure 4.4 Display screen symbols



Symbol	Meaning
►	Navigation

The "Display" menu item has an additional screen to which the instrument operator can navigate.

Action: Press ⏻ to see the next screen.

● or ✓	Enabled (on)

The screen symbols indicate the following:
- The numeric display style is enabled (on).
- The text and graphical display styles are disabled (off).
- The display screen is set to rotate (for use in environments where a different view is needed).

Actions:

Press ▲ or ▼ to move the highlight bar.

Press ⏻ to enable or disable the highlighted option.

▭ Data entry

Enter text or values in a data field.

Actions:

Press ▲ to increment to the next character (from "a" to "b").

Press ▼ to decrement to the previous character (from "b" to "a").

Press ► to create the next character.

Press ◄ to delete the last character entered

Locating Operation-mode Features

From the menu's three tabs, all features are accessible. Use the navigation instruction from above to activate the menu, and then any tab's dropdown menu. The feature location list (below) shows the dropdown menus and describes the options that are accessible from each menu item.

Figure 4.5 Feature location list

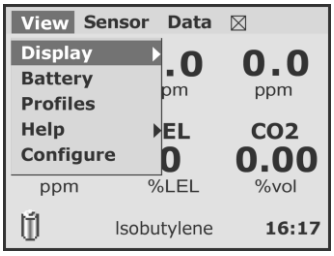
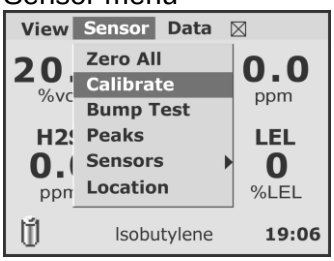
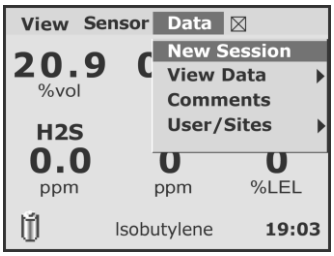
Dropdown menu	Menu item	Accessible options
View menu 	Display	Choose a display style (numeric, text, or graph) for the gas-monitoring screen. Rotate the display 180°.
	Battery	Check the percentage of charge remaining.
	Profiles	Set the instrument (unit) to operate based on the settings of a specific profile.
	Help	Locate Industrial Scientific contact information. View the unit's firmware version.
	Configure	Access the configuration mode**.** *Warning*: Only qualified personnel should access and work in the configuration mode.
Sensor menu 	Zero All	Simultaneously zero all installed sensors. *See also* "Sensors".
	Calibration	Calibrate all installed sensors (with the option to skip any sensor). *See also* "Sensors".
	Bump Test	Bump test all installed sensors (with the option to skip any sensor). *See also* "Sensors".
	Peaks	Simultaneously clear the peak readings for all installed sensors.
	Sensors	Zero, calibrate, or bump test any individual installed sensor. View any sensor's most recent calibration date and its span trends. For a PID or LEL sensor, view its unit of measure along with its RF or correlation factor.
	Location	View a diagram of the installed sensor locations.

Figure 4.5 Feature location list

Dropdown menu	Menu item	Accessible options
Data menu 	New Session	Begin a new data log session.
	View Data	View a graph depicting gas readings for all installed sensors or for an individual sensor. View numeric or graphical displays of TWA or STEL readings for all toxic sensors or for an individual toxic sensor. View details for any of the 15 most recent alarm events.
	Comments	Enter comments to the data log.
	Users/Sites	View or set the current user (or current site).

5

Configuration

Access

Locating Configuration-mode Settings

Access

Using the instructions provided in Chapter 4, qualified personnel can navigate the menu system to enter and work in configuration mode. Menu system terminology is re-introduced below along with configuration-mode access instructions.

Figure 5.1 Entering configuration mode

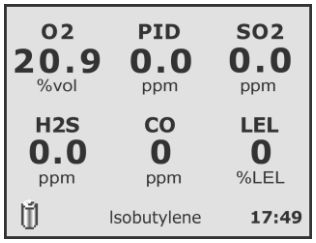
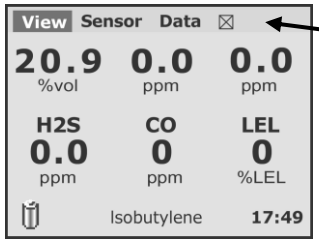
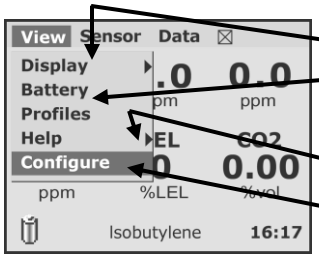
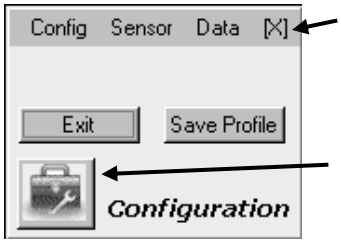
Instruction	Display Screen	Terminology
If the gas-monitoring screen is not backlit, press ⏻ once to turn on the backlight.		
Press ⏻ once to activate the operation-mode menu.		Operation-mode menu
Press ⏻ to activate the "View" dropdown menu. Press ▼ or ▲ to move the highlight bar to "Configure". Press ⏻ to the enter configuration mode. If the unit does *not* have a set password, the user will enter the configuration mode; otherwise, the user will be prompted to enter the configuration-mode password.		Dropdown menu Item Symbol Highlight bar

Figure 5.1 Entering configuration mode

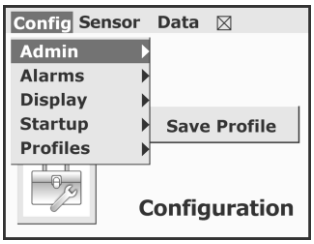
Instruction	Display Screen	Terminology
Press ▼ or ▲ to select a character. Press ► to create the next character, or ◄ to delete the last. Press ⏻ to highlight the password, then ▼ to highlight the "OK" command. Press ⏻.		
The configuration-mode menu will be activated and will appear across the top of the display screen. Press ▲ to move the highlight bar to the "Config" tab. (Press ◄ or ► to highlight another menu tab). Press ⏻ to activate the highlighted tab's dropdown menu.		Configuration-mode menu All configuration-mode screens feature these treatments: Yellow background Tool icon

Note: Passwords are a minimum of three characters and a maximum of 10.

As shown below, display screens contain symbols that indicate navigation options, feature status, or data entry locations.

Figure 5.2 Display screen symbols

Symbol	Meaning
▶	Navigation

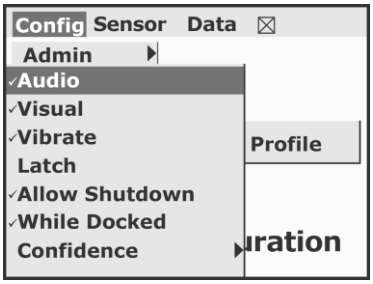


Each menu item has an additional screen to which the safety team member can navigate.

Action: Press ⏻ to see the next screen.

Note: MSHA instruments with the wireless data transfer option enabled from the factory will feataure a "Wireless" item on the config dropdown menu.

● or ✓ Enabled (on)



The symbols shown here indicate the following:

The "Audio", "Visual", and "Vibrate" alarms are enabled (on).

The instrument operator is permitted to shut down the unit while it is in alarm.

The alarms will turn on when the unit is docked.

The alarm "Latch" is disabled (off).

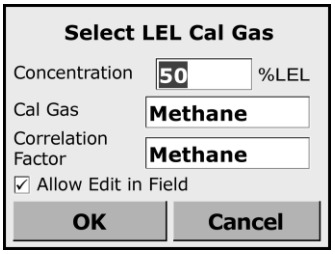
Actions:

Press ▶ to move the highlight bar to the alarm options menu.

Press ▲ or ▼ to move the highlight bar among the alarm options.

Press ⏻ to enable or disable the highlighted option (or access the next screen for the "Confidence" indicator option).

Data entry



Enter text or values in a data field.

Actions:

Press ▶ or ◀ to move the highlight among data fields and buttons.

On a highlighted data field:

Press ▲ (or ▼) to increment (or decrement) the value or to scroll among choices.

Press ⏻ to confirm the value or selection.

Press ▶ or ◀ to move the highlight bar to the next field or button.

Locating Configuration-mode Settings

From the configuration-mode menu, all configurable settings are accessible. The settings location list (below) shows the dropdown menus and describes the options that are accessible from each menu item.

Table 5.1 Settings location list

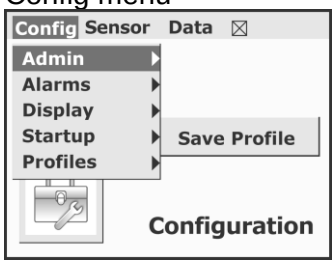
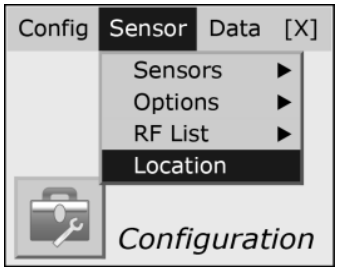
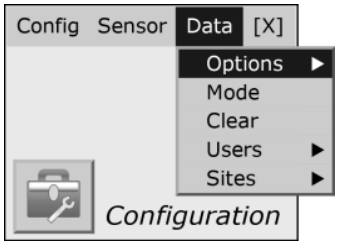
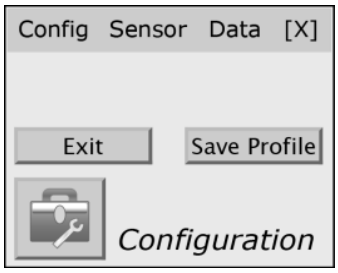
Dropdown menu	Item	Accessible settings
Config menu 	Admin	Edit the settings for the backlight, clock, configuration-mode password, or company name display.
		Choose the display language.
		Reset the instrument to factory default settings.
	Alarms	Enable or disable each of these options: the alarm latching feature and the audio, visual, and vibration alarm indicators*.
		Disallow or allow operator-activated shutdown when the unit is in alarm.
		Disable or enable alarm indicators when the unit is docked.
		Enable the confidence indicator and select the indicator types (audio, visual, or vibrate).
		*It is possible to disable all three alarm indicators. As a precaution, a confirmation screen requires the safety team member to confirm or cancel the action. If confirmed, the operation-mode display will notify the instrument operator, in red type, that all alarm indicators are off (“ALARMS OFF!”).
	Display	Set the gas-monitoring screen to include the time of day, the temperature, or both*.
		Set the gas readings display screen to include the PID RF, LEL correlation factor, or both*.
		*When *both* is selected, the display continuously shows a value, alternating between the two.
	Start-up	Set the unit to prompt the instrument operator, during the start-up sequence, to perform any or all of these tasks: zero, calibration, or bump test.
		Enable or disable the instrument self-test to perform automatically during the start-up sequence.
	Profiles	Enter new profiles, delete profiles, and set the current profile.

Table 5.1 Settings location list

Dropdown menu	Item	Accessible settings
	Wireless	MSHA factory-enabled units only. Choose the interval at which data are wirelessly transmitted. 0 = off Interval value range = 1−300 seconds
Sensor menu 	Sensors	Enable or disable a sensor. Set alarm values (high, low, and STEL) and the TWA time base. Set calibration gas values and properties.
	Options	Enable or disable operation-mode access to these tasks: zero, calibration, clear peaks, and bump test. Choose the display preference for how the unit communicates calibration date information to its user: date of the next or last (most recent) calibration. Determine how the unit will behave when a calibration is overdue. Set the unit for automatic shutdown, continued operation, or continued operation with "cal overdue" notification to the instrument operator. Adjust the criteria (percentage of gas sensed and seconds) required for the unit to pass a bump test.
	RF List	Mark any response factor (RF) as a favorite. Create custom RFs and set the gas type and response factor for each.
	Location	View the unit's sensor location map.
Data menu 	Options	Set the data log recording interval or adjust the TWA time period. Enable or disable operation-mode access to overwrite the data log and view data or events.
	Mode	Choose the data log operation mode: normal, on-alarm, or operator-activated snapshot.
	Clear	Clear the data log of current session data or all data.
	Users	Add or delete users. Set the current user. Enable or disable operation-mode access to change the current user.
	Sites	Add or delete sites. Set the current site. Enable or disable operation-mode access to change the current site.

After changes are made in configuration mode, they can be saved to the instrument profile or to another profile.

Table 5.2 Exiting configuration mode

Dropdown menu	Item	Result
	Exit	Exit and "[x]" exits configuration mode and returns to the gas-monitoring display screen. Changes that have been made in configuration are saved to the instrument profile only; other profiles are not affected.
	Save Profile	Changes that have been made in configuration mode are saved to a specific profile and *not* to the instrument profile. The unit will prompt the safety team member to specify the profile name.

Note: Unless specified otherwise, configuration-mode display screens time out after 90 seconds. When activated, the main configuration screen remains on for five minutes.

Note: If the instrument is still reading gas while in configuration mode, and there is an alarm, the instrument returns to the gas-monitoring display screen.

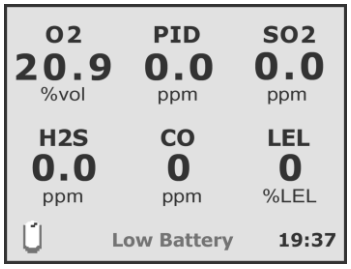
6 Tasks, Diagrams, and Accessories

Power Assessment

The battery icon on the gas-readings display screen visually reflects the current status of the battery life. Depending on the installed LCD, one of two different icons may appear for each charge level.

Table 6.1 Battery icon legend

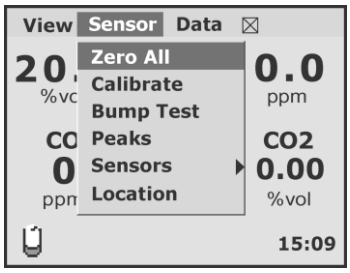
Charge remaining	Icon (color)	Icon (color)
>100%	*(blue)*	*(blue)*
>75%	*(blue)*	*(blue and red)*
>50%	*(blue)*	*(blue and gray)*
>25%	*(blue)*	*(yellow and gray)*
>5%	*(yellow)*	*(red and gray)*



Note: If the battery life remaining is less than one hour, the battery icon flashes on the display and has an audible battery low alarm. If the run time is less than 10 minutes, the instrument alerts the user of impending shutdown by showing "Low Battery" on the lower central part of the display. After being placed on the docking station, the unit's backlight flashes every 5 seconds while it is charging.

Zero

From the operation-mode menu, activate the "Sensor" dropdown menu. Highlight the "Zero All" item and press0. **.** The unit asks the instrument operator to confirm the zero request.

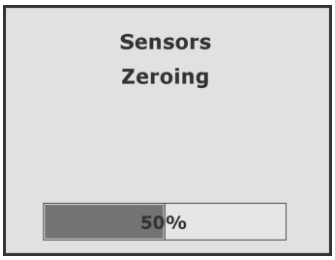


- If "Cancel" is selected, the user is returned to the gas-monitoring display screen and the zeroing is skipped.
- If "OK" is selected, the zeroing of the sensors starts.

If there is a CO_2 sensor present in the instrument, it is zeroed last. Zero air must be applied to zero a CO_2 sensor. The instrument prompts the user to apply zero air. If the user selects "OK", the CO_2 sensor starts zeroing.

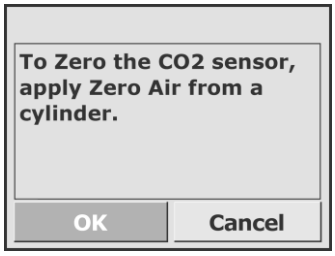
By pressing ◄or► the highlight bar moves from the "OK" button to the "Cancel" button and back again. If the user selects "Cancel", the CO_2 sensor is not zeroed.

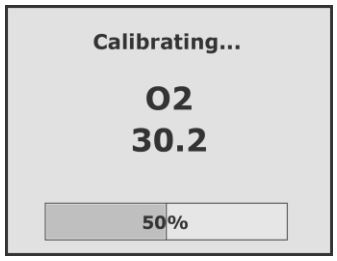
If there is an oxygen sensor installed in the instrument, it is calibrated during the zeroing operation.

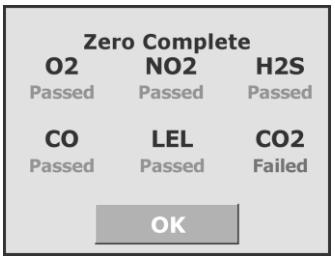


When the zero is finished, the results screen is displayed.

Selecting "OK" returns the instrument to the gas-monitoring screen. If "OK" is not selected, the instrument asks if the user wants to calibrate after a 15 second time-out.



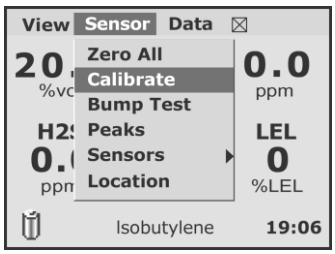


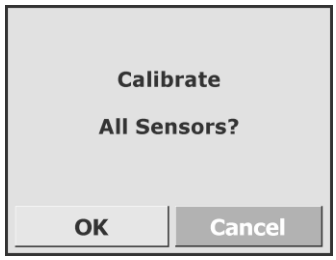


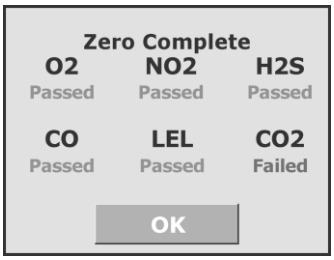
Calibrate

The instrument alarms are deactivated during the calibration to save battery life. If "Calibrate" is selected, the instrument displays the confirmation screen shown below. If "Cancel" is selected, the user is returned to the gas-monitoring display screen.

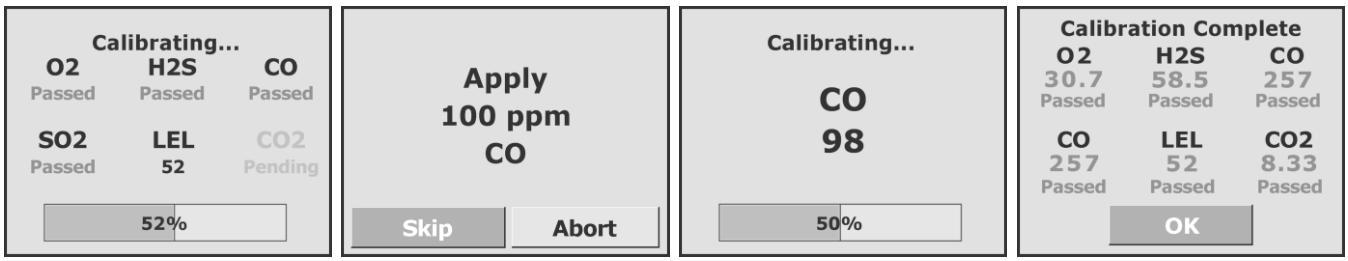
If the user selects "OK", all the installed sensors are zeroed first (following the "Zero All" steps outlined above) and then calibrated. After the zero, the results are shown for 5 seconds and then the calibration of the first sensor begins.







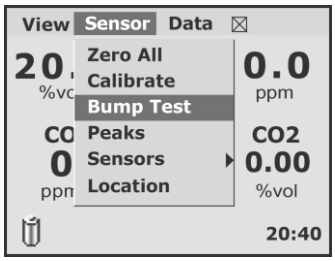
The screen to alert the user to connect gas to the instrument is then shown. Once the sensor starts to read gas, the calibration begins. The user has 5 minutes to apply gas before the calibration times out. Gas should be applied at a flow rate of 0.5 lpm. If the user chooses to "Skip" a sensor, the instrument will move to the next sensor. The "Abort" option aborts the calibration and shows the "Calibration Complete" screen.



When the calibration is finished, the last screen shows the passed, marginal, skipped, and failed sensors, when six sensors are installed.

Bump Test

From the operation-mode menu, activate the “Sensor” dropdown menu. Highlight the “Bump Test” item and press **.**



The unit asks the instrument operator to confirm the bump test request. If “Cancel” is selected, the user is returned to the gas-monitoring display screen. If the user selects “OK”, all the installed sensors are bump tested, starting with the first sensor.

The screen to alert the user to apply gas to the instrument is then shown. The user has a fixed number of seconds to apply gas and select “Start” before the bump times out. If the user selects “Skip”, the bump for this particular sensor is not done. The instrument moves on to the next sensor.

If the user selects “Start”, the bump test is started for this sensor. The sensor must reach a gas reading of 50% or greater (user selectable in configuration menu) of the applied gas (calibration) concentration within 60 seconds (user selectable in configuration menu) to pass. Once the sensor has done so, the word “Pass” is displayed for 3 seconds before the instrument moves on to the next sensor.

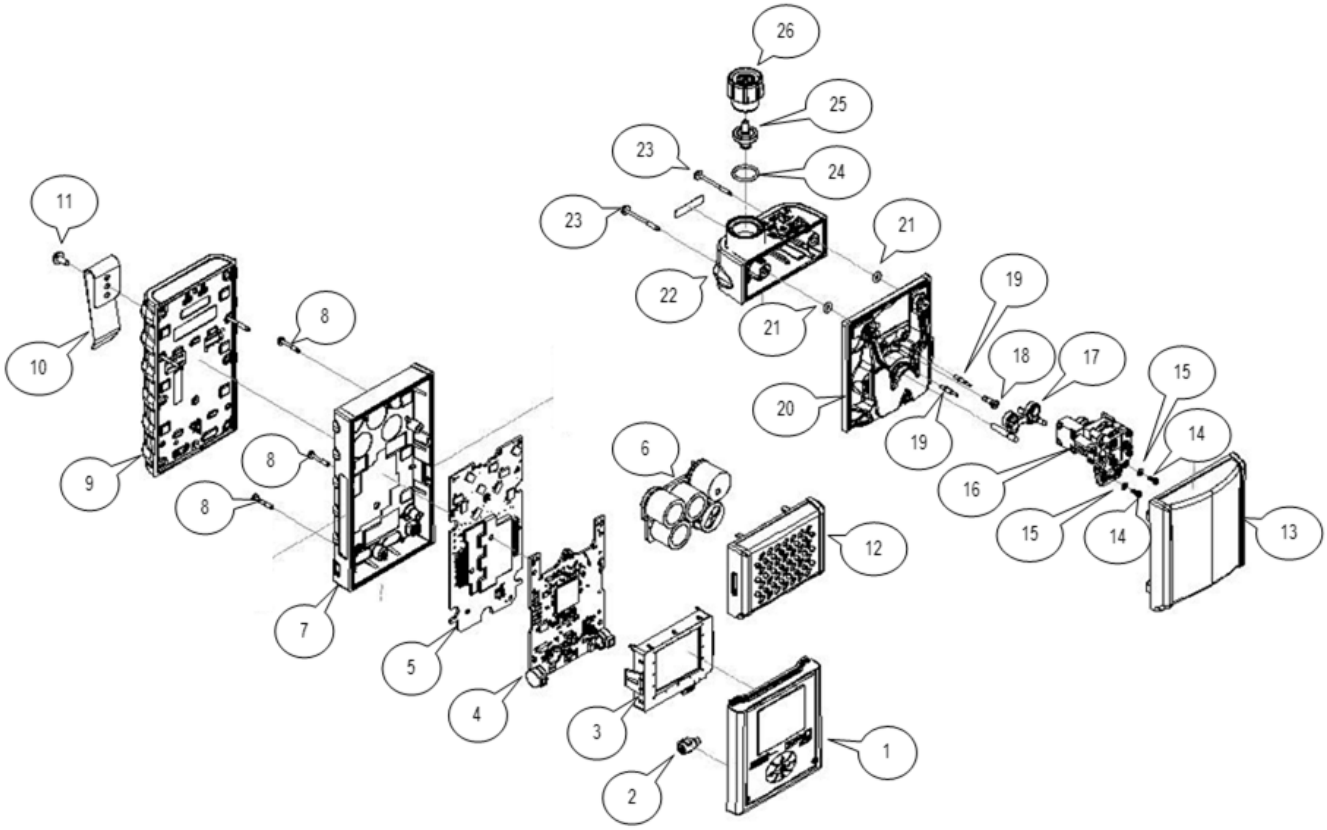
After all the sensors installed in the instrument have been bump tested, a result screen is shown. The user must acknowledge this screen to continue, by selecting the “OK” button.

If all the sensors have passed the bump test, the instrument goes to the gas-monitoring display screen. If any sensor failed the bump test, after viewing and acknowledging the results, the instrument asks the user to continue, or calibrate the failed sensor(s). If the user selects the Cancel button, the sensor is not calibrated, and the instrument moves on to the next sensor in the list. If the user selects “OK”, the failed sensor is calibrated.

If there is more than one sensor that failed the bump test, they are calibrated in order (top row left to right, bottom row left to right on the gas-monitoring display screen), one at a time—each time prompting the user to choose whether to calibrate the sensor or not.

Three-dimensional Diagram

Refer to the three-dimensional diagram for disassembled views of the instrument. Use the diagram number to identify parts, part numbers, and field-replaceable items (see diagram key below).



Items shown in the above diagram, but NOT listed in the table below are not field replaceable.

Key for the MX6 diagram

Table 6.2 MX-6 Field-replaceable parts

Diagram number	Part name	Part number
1	MX6 Case Front	17130964
2	Vibrating Alarm Motor	17127275
5	MX6 Power Manager PCB	17127556
6	MX6 Sensors (see below)	17124975-X
8	Chassis Screw, M2.5 x 16 mm	17128356
9	MX6 Battery Pack (see below)	17131038-X
10	Belt Clip	17127762
11	Belt Clip Screw, T10 torx	17158278
12	Diffusion Cover w/Sensor Water Barrier	17128265

Table 6.2 MX-6 Field-replaceable parts

Diagram number	Part name	Part number
Replacement Sensors		
6	Carbon Monoxide Sensor	17124975-1
6	Hydrogen Sulfide Sensor	17124975-2
6	Oxygen Sensor	17124975-3
6	Nitrogen Dioxide Sensor	17124975-4
6	Sulfur Dioxide Sensor	17124975-5
6	Ammonia Sensor	17124975-6
6	Chlorine Sensor	17124975-7
6	Chlorine Dioxide Sensor	17124975-8
6	Phosphine Sensor	17124975-9
6	Hydrogen Chloride Sensor	17124975-A
6	Hydrogen Cyanide Sensor	17124975-B
6	Hydrogen Sensor	17124975-C
6	Nitric Oxide Sensor	17124975-D
6	Phosphine Sensor (High Range)	17124975-E
6	Carbon Monoxide with Low Hydrogen cross sensitivity Sensor	17124975-G
6	Carbon Monoxide Sensor (High Range)	17124975-H
6	Carbon Monoxide / Hydrogen Sulfide (COSH) Combination Sensor	17124975-J
6	LEL Sensor (Pentane Cal)	17124975-K
6	LEL Sensor (Methane Cal)	17124975-L
6	Methane Sensor (0-5% vol)	17124975-M
6	Infrared Methane Sensor (0-100 % vol)	17124975-N
6	Infrared Methane Sensor (0-100 % LEL)	17124975-S
6	Infrared Hydrocarbon LEL Sensor	17124975-P
6	Infrared Carbon Dioxide Sensor	17124975-Q
6	PID Sensor	17124975-R
MX6 Replacement Battery Packs		
9	Extended Range Battery (UL, CSA, and ATEX)	17131038-2
9	Extended Range Battery (MSHA and AUS)	17131038-5
9	Alkaline Battery Pack (UL, CSA, and ATEX)	17131046-3
9	Alkaline Battery Pack (MSHA)	17131046-6

Table 6.2 MX-6 Field-replaceable parts

Diagram number	Part name	Part number
Pump (SP6)		
25	Dust Filter and Water Stop	17058157
26	Pump Inlet and Filter Cap	17129909
26	Pump Inlet and Filter Cap for use with 6 ' extendable probe	17141581

Accessories

Compatible accessories from Industrial Scientific.

Table 6.3 MX-6 iBrid Accessories

Product	Part Number
Pump	
SP6 Pump	18106765
Docking Stations	
DSX	18109329
Other Accessories	
Charger	18106971
Charger, 12 V	18107011
Charger and Datalink	18107094
Datalink	18107086
Battery Charger, 5-unit	18107136
Truck-mount Charger, hard-wired	18107250
Truck-mount Charger, 12V	18107243

7

Specifications and Warranty

Specifications

Table 7.1 Battery properties

	Run time[a] (hours)	Recharge time[b] (hours)
Extended range Li-ion battery pack		
MX6 iBrid without pump	36	< 8
MX6 iBrid with pump	20	< 8
Alkaline battery pack		
MX6 iBrid without pump	10	not applicable
MX6 iBrid with pump	5	not applicable

[a]Typical run time for fully charged battery operating at room temperature in a unit with CO, O2, LEL (catalytic), and H_2S installed sensors.
[b]The ambient temperature required for charging is 0 – 50 °C (32 – 122 °F).

Table 7.2 Instrument specifications

Warm-up time (includes stabilization time.)	30 seconds; 90 seconds for IR sensors
Temperature range	
Operating	-20 °C to +55 °C (-4 °F to +131 °F)
Storage	-40 °C to +55 °C (-40 °F to +131 °F)
Humidity range	15–95% relative humidity (RH) noncondensing for continuous operation and storage
Pressure range	1 atm ± 0.2 atm for operation and storage
Maximum storage time[a]	Up to 1 year

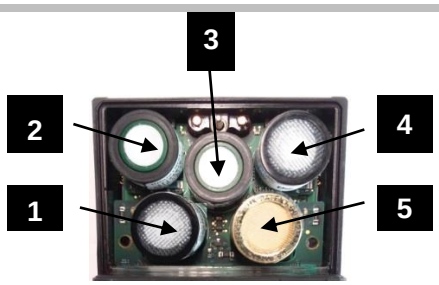
[a]Maximum storage duration is based on the temperature of the storage environment.
Note: Industrial Scientific recommends that infrequently used lithium-ion batteries be fully charged every four months.

Sensor Configuration

Up to five sensors can be installed, each in one or more specific locations. Installing a COSH (CO + H_2S) sensor allows for a sensor configuration that provides gas readings for six gases. To support ingress protection, use a compatible plug in place of any uninstalled sensors.

In addition to the location restrictions for *each* sensor (below), these installation restrictions also apply:

- Install *only* one infrared sensor.
- Install *only* one COSH sensor.



Locations 4 or 5 *only*	
17124975-Q	Infrared Carbon Dioxide (CO_2)
17124975-P	Infrared Hydrocarbon LEL
17124975-N	Infrared Methane (CH_4) [0-100 % vol]
17124975-S	Infrared Methane (CH_4) [0-100 % LEL]
17124975-R	PID

Location 5 *only*	
17124975-L	LEL (Methane - CH_4)
17124975-K	LEL (Pentane - C_5H_{12})
17124975-M	Methane (CH_4) [0-5 % vol]

Any location	
17124975-6	Ammonia (NH_3)
17124975-1	Carbon Monoxide (CO)
17124975-H	Carbon Monoxide (CO), High Range
17124975-7	Chlorine (Cl_2)
17124975-8	Chlorine Dioxide (ClO_2)
17124975-J	COSH: Carbon Monoxide / Hydrogen Sulfide (CO/H_2S)
17124975-C	Hydrogen (H_2)
17124975-A	Hydrogen Chloride (HCl)[a]
17124975-B	Hydrogen Cyanide (HCN)
17124975-2	Hydrogen Sulfide (H_2S)
17124975-G	Carbon Monoxide with Low Hydrogen cross sensitivity (CO/H_2 Low)
17124975-D	Nitric Oxide (NO)[a]
17124975-4	Nitrogen Dioxide (NO_2)
17124975-3	Oxygen (O_2)
17124975-9	Phosphine (PH_3)
17124975-E	Phosphine (PH_3), High Range
17124975-5	Sulfur Dioxide (SO_2)

Figure 7.1 Compatible sensors and installation locations

[a]Biased sensor (see Chapter 2, "Recommended Practices, Biased Sensors").
For more information about each sensor, including its technology (e.g., infrared), see Table 7.3 Sensor Properties and Accuracy.

Sensors

Table 7.3 Sensor Properties and Accuracy

Sensor Name Abbreviation (type)	Properties				Accuracy[c]				
	Measurement		Response time (nominal)		At temperature of calibration		Over full measurement and temperature ranges		
	Range	Resolution	T50	T90	Calibration gas & concentration	Accuracy (subrange)	Temperature range[a]	RH range[a]	Accuracy
Oxygen									
Oxygen O_2 (electrochemical)	0–30 % vol	0.10% vol	6 s	15 s	O_2 20.9% vol	±0.8% vol (0–2.9 vol) ±0.5% vol (3.0–25.0 vol) ±0.8% vol (25.1–30.0 vol)	-20°C to 55°C (-4°F to 131°F)	5–95%	±0.8% vol
Combustibles									
Combustible LEL (catalytic)	0–100% LEL	1% LEL	15 s	35 s	25% LEL Pentane or 50% LEL Methane	±5.0%	-20°C to 55°C (-4°F to 131°F)	15–95%	±15.0%
Combustible LEL (infrared)	0–100% LEL	1% LEL	15 s	35 s	25% LEL Propane	±5.0%	-20°C to 50°C (-4°F to 122°F)	0–95%	±15.0%
Methane CH_4 (infrared)	0–100% LEL	1% LEL	10 s	25 s	50% LEL Methane	±5.0%	-20°C to 50°C (-4°F to 122°F)	0–95%	±15.0%
Methane CH_4 (catalytic)	0–5% vol	0.01% vol	10 s	20 s	2.5% vol Methane	±5.0%	-20°C to 55°C (-4°F to 131°F)	15–95%	±15.0%
Toxics									
Ammonia[b] NH_3 (electrochemical)	0 to 500 ppm	1.00 ppm	21 s	78 s	NH_3 50 ppm	±15.0%	-20°C to 40°C (-4°F to 104°F)	15–95%	±15.0%
Carbon Dioxide CO_2 (infrared)	0–5% vol	0.01% vol	10 s	25 s	CO_2 2.5% vol	±5.0%	-20°C to 50°C (-4°F to 122°F)	0–95%	±15.0%
Carbon Monoxide CO (electrochemical)	0 to 1,500 ppm	1.00 ppm	10 s	20 s	CO 100 ppm	±5.0%	-20°C to 50°C (-4°F to 122°F)	15–90%	±15.0%
Carbon Monoxide (High Range) CO (electrochemical)	0 to 9,999 ppm	1.00 ppm	8 s	19 s	CO 100 ppm	±5.0% (0–1500 ppm) ±15.0% (1501–9999 ppm)	-20°C to 50°C (-4°F to 122°F)	15–90%	±15.0%

Table 7.3 Sensor Properties and Accuracy

Sensor Name Abbreviation (type)	Properties				Accuracy[c]				
	Measurement		Response time (nominal)		At temperature of calibration		Over full measurement and temperature ranges		
	Range	Resolution	T50	T90	Calibration gas & concentration	Accuracy (subrange)	Temperature range[a]	RH range[a]	Accuracy
Carbon Monoxide (Hydrogen Low) CO/H_2 Low (electrochemical)	0 to 1,000 ppm	1.00 ppm	9 s	20 s	CO 100 ppm	±5.0%	-20°C to 50°C (-4°F to 122°F)	15–90%	±15.0%
Carbon Monoxide and Hydrogen Sulfide (COSH) CO/ H_2S (electrochemical)									
CO	0 to 1,500 ppm	1.00 ppm	12 s	30 s	CO 100 ppm	±5.0%	-20°C to 50°C (-4°F to 131°F)	15–90%	±15.0%
H_2S	0 to 500 ppm	0.10 ppm	12 s	30 s	H_2S 25 ppm	±8.0%	-20°C to 55°C (-4°F to 131°F)	15–95%	±15.0%
Chlorine Cl_2 (electrochemical)	0 to 50 ppm	0.10 ppm	6 s	35 s	Cl_2 10 ppm	±10.0% or ±0.2 ppm (0–10.0 ppm), whichever is greater ±15.0% (10.1–50.0 ppm)	-20°C to 40°C (-4°F to 104°F)	15–90%	Varies[d]
Chlorine Dioxide ClO_2 (electrochemical)	0 to 1 ppm	0.01 ppm	7 s	60 s	ClO_2 1 ppm	±10.0% or ±0.05 ppm, whichever is greater	-20°C to 40°C (-4°F to 104°F)	15–95%	±15.0%
Hydrogen H_2 (electrochemical)	0 to 2,000 ppm	1.00 ppm	25 s	65 s	H_2 100 ppm	±6.0%	-20°C to 50°C (-4°F to 122°F)	15–90%	±15.0%
Hydrogen Chloride[b] HCl (electrochemical)	0 to 30 ppm	0.10 ppm	17 s	93 s	HCl 10 ppm	±5.0% or ±0.2 ppm (0–4.0 ppm), whichever is greater -5.0 to +20.0% (4.1–30.0 ppm)	-20°C to 40°C (-4°F to 104°F)	15–95%	±15.0%
Hydrogen Cyanide HCN (electrochemical)	0 to 30 ppm	0.10 ppm	25 s	80 s	HCN 10 ppm	±10.0%	-40°C to 40°C (-40°F to 104°F)	15–90%	±15.0%
Hydrogen Sulfide H_2S (electrochemical)	0 to 500 ppm	0.10 ppm	7 s	20 s	H_2S 25 ppm	±5.0% (0–200 ppm) ±12.0% (201–500 ppm)	-20°C to 50°C (-4°F to 122°F)	15–90%	±15.0%
Nitrogen Dioxide NO_2 (electrochemical)	0 to 150 ppm	0.10 ppm	7 s	18 s	NO_2 25 ppm	±6.0%	-20°C to 50°C (-4°F to 122°F)	15–90%	±15.0%

Table 7.3 Sensor Properties and Accuracy

Sensor Name Abbreviation (type)	Properties				Accuracy[c]				
	Measurement		Response time (nominal)		At temperature of calibration		Over full measurement and temperature ranges		
	Range	Resolution	T50	T90	Calibration gas & concentration	Accuracy (subrange)	Temperature range[a]	RH range[a]	Accuracy
Nitric Oxide[b] NO (electrochemical)	0 to 1,000 ppm	1.00 ppm	7 s	28 s	NO 25 ppm	±10.0%	-20°C to 50°C (-4°F to 122°F)	15–90%	±15.0%
Phosphine PH_3 (electrochemical)	0 to 5 ppm	0.01 ppm	5 s	18 s	PH_3 1 ppm	±6.0% or ±0.1 ppm whichever is greater	-20°C to 40°C (-4°F to 104°F)	20–95%	±15.0%
Phosphine (High range) PH_3 (electrochemical)	0 to 1,000 ppm	1.00 ppm	8 s	40 s	PH_3 5 ppm	±8.0%	-20°C to 50°C (-4°F to 122°F)	15–90%	± 15.0%
Sulfur Dioxide SO_2 (electrochemical)	0 to 150 ppm	0.10 ppm	5 s	20 s	SO_2 10 ppm	±6.0%	-20°C to 50°C (-4°F to 122°F)	15–90%	±15.0%
PID Volatile Organic Compounds (VOC) (10.6 eV photoionization)	0 to 2000 ppm	0.10 ppm	15 s	20 s	Isobutylene 100 ppm	±10.0% (0–800 ppm) ±13.0% (801–1000 ppm) ±23.0% (1001–2000 ppm)	-20°C to 50°C (-4°F to 122°F)	0–90%	±20.0%

[a]During continuous operation.

[b]Sensors may become unstable if the battery is removed from the instrument or after the low battery warning is activated. If either incidence occurs, change the battery (or re-install the existing battery if it has suitable life remaining), then power the monitor ON then OFF, and allow at least 24 hours for the sensors to stabilize.

[c]Apply when the instrument is calibrated using the stated calibration gas and concentration; unless otherwise stated, accuracy is equal to the stated percentage or one unit of resolution, whichever is greater.

[d]For the Cl_2 sensor, accuracy over the "full measurement, temperature, and RH ranges" is based on temperature range: ± 15.0% from -20°C to 40°C (-4°F to 104°F); and ±25.0% from 41°C to 50°C (106°F to 122°F).

Table 7.4 Toxic Gas Sensor Cross-sensitivity

Target Gas	Sensor												
	CO	CO (H2 Low)	H2S	SO2	NO2	Cl2	ClO2	HCN	HCl	PH3	NO	H2	NH3
CO	100	100	1	1	0	0	0	0	0	0	0	20	0
H2S	5	5	100	1	-40	-3	-25	10	300	25	10	20	25
SO2	0	5	5	100	0	0	0	—	40	—	0	0	-40
NO2	-5	5	-25	-165	100	45	—	-70	—	—	30	0	-10
Cl2	-10	0	-20	-25	10	100	60	-20	6	-20	0	0	-50
ClO2	—	—	—	—	—	20	100	—	—	—	—	—	—
HCN	15	—	—	50	1	0	0	100	35	1	0	30	5
HCl	3	—	—	5	0	2	0	0	100	0	15	0	0
PH3	—	—	—	—	—	—	-100	425	300	100	—	—	—
NO	25	40	-0.2	1	5	—	—	-5	—	—	100	30	0
H2	22	3	0.08	0.5	0	0	0	0	0	0	0	100	0
NH3	0	0	0	0	0	0	0	0	0	0	0	0	100

The table above reflects the percentage response provided by the sensor (top row) when exposed to a known concentration of the target gas (column 1).

The numbers were measured under these environmental conditions: 20 °C (68 °F), 50% RH and 1 atm.

The specified cross-interference numbers apply to new sensors only and may vary with time as well as from sensor to sensor.

"—" means no data available.

This table is given as a reference only and is subject to change.

Table 7.5 LEL Data

LEL correlation factors for combustible gases

Sample gas*	LEL (% vol)	LEL correlation factors					
		Calibration gas					
		Butane	Hexane	Hydrogen	Methane	Pentane	Propane
Acetone	2.5%	1.00	0.70	1.70	1.70	0.90	1.10
Acetylene	2.5%	0.70	0.60	1.30	1.30	0.70	0.80
Benzene	1.2%	1.10	0.80	1.90	1.90	1.00	1.20
Butane	1.9%	1.00	0.58	1.78	1.67	0.83	1.03
Ethane	3.0%	0.80	0.60	1.30	1.30	0.70	0.80
Ethanol	3.3%	0.89	0.52	1.59	1.49	0.74	0.92
Ethylene	2.7%	0.80	0.60	1.40	1.30	0.70	0.90
Hexane	1.1%	1.71	1.00	3.04	2.86	1.42	1.77
Hydrogen	4.0%	0.56	0.33	1.00	0.94	0.47	0.58
Isopropanol	2.0%	1.10	0.90	2.00	1.90	1.00	1.20
Methane	5.0%	0.60	0.35	1.06	1.00	0.50	0.62
Methanol	6.0%	0.60	0.50	1.10	1.10	0.60	0.70

Table 7.5 LEL Data

LEL correlation factors for combustible gases

Sample gas*	LEL (% vol)	LEL correlation factors					
		Calibration gas					
		Butane	Hexane	Hydrogen	Methane	Pentane	Propane
Nonane	0.8%	2.22	1.30	3.95	3.71	1.84	2.29
Pentane	1.4%	1.21	0.71	2.15	2.02	1.00	1.25
Propane	2.1%	0.97	0.57	1.72	1.62	0.80	1.00
Styrene	0.9%	1.30	1.00	2.20	2.20	1.10	1.40
Toluene	1.1%	1.53	0.89	2.71	2.55	1.26	1.57
Xylene	1.1%	1.50	1.10	2.60	2.50	1.30	1.60
JP-4	—	—	—	—	—	1.20	—
JP-5	—	—	—	—	—	0.90	—
JP-8	—	—	—	—	—	1.50	—

Note: LEL correlation-factor accuracy may change without notice and is impacted by exposure to sensor inhibitors or poisons, sensor aging, the gas-detection applications and environment, and other factors. Calibrate instruments using the intended target gas when feasible and validate correlation factors as needed.

The table above provides the LEL for select combustible gases*. It also provides correlation factors that help the safety technician and instrument operator determine the actual percentage LEL when the sample gas differs from the gas that was used to calibrate the unit.

For example, if the unit reads 10% LEL in a *pentane* atmosphere, and was calibrated to *methane*, the actual percentage LEL is determined as follows:

1. Locate the table cell where the sample gas (pentane) intersects with the calibration gas (methane).
2. Multiply the cell's value (2.02) by the unit's LEL reading (10%) to calculate the actual concentration of 20.2% LEL.

*The combustible gas list is not a comprehensive list of all combustible gases that can be detected by the MX6. For additional information about combustible gas detection and the MX6, contact the Industrial Scientific Technical Service department.

Warranty

Industrial Scientific Corporation's MX6 iBrid® portable gas monitors are warranted to be free from defects in material and workmanship under normal and proper use and service for as long as the instrument is supported by Industrial Scientific Corporation.

The above warranty does not include sensors, battery packs, and internal pumps, which are warranted to be free from defects in material and workmanship for 24 months from date of shipment, except where otherwise stated in writing in Industrial Scientific literature accompanying the product.

Limitation of Liability

THE WARRANTY SET FORTH ABOVE IS STRICTLY LIMITED TO ITS TERMS AND IS IN LIEU OF ALL OTHER WARRANTIES, GUARANTEES, EXPRESS OR IMPLIED, ARISING BY OPERATION OF LAW, COURSE OF DEALING, USAGE OF TRADE OR OTHERWISE. INDUSTRIAL SCIENTIFIC MAKES NO OTHER WARRANTIES, EITHER EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE.

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