T40 II

Portable Single Gas Monitor

Product Manual

The Essential Guide for Safety Teams and Instrument Operators

INDUSTRIAL SCIENTIFIC

Content

1. Certifications

Directive or CB	Area Classifications	Approved Temperature Range	Standards
IECEx	Ex ia IIC T4 Ga Ex ia I Ma	-40 °C to +50 °C -40 °F to +122 °F	IEC 60079-0:2017 Ed.7.0 IEC 60079-11:2011 Ed.6.0
ATEX	Ex ia IIC T4 Ga Ex ia I Ma	-40 °C to +50 °C -40 °F to +122 °F	EN IEC 60079-0:2018 EN 60079-11:2012
UL	Class I, Division 1, Groups A, B, C, D T4 Class I, Zone 0, AEx ia IIC T4 Ga	-40 °C to +50 °C -40 °F to +122 °F	ANSI/UL 60079-0-2020 Ed.7 ANSI/UL 60079-11-2018 Ed.6 ANSI/UL 913-2019 Ed.8 UL 61010-1 3rd Edition (2012), AMD1: 2018
CSA	Ex ia IIC T4; Class I, Division 1, Groups A, B, C, D T4	-40 °C to +50 °C -40 °F to +122 °F	CAN/CSA C22.2 No. 60079-0:19 CAN/CSA-C22.2 No. 60079-11:14 (r2018) CAN/CSA C22.2 No.61010-1-12, UPD1: 2015, UPD2: 2016, AMD1: 2018
China Ex	Ex ia IIC T4 Ga	-40 °C to +50 °C -40 °F to +122 °F	GB/T 3836.1- 2021 GB/T 3836.4- 2021 GB/T 4208-2017
China MA	Ex ia I Ma	-20 °C to +40 °C -4 °F to +104 °F	MT 703-2008 Q/JT07-2022 GB/T 3836.1-2021 GB/T 3836.4-2021
China CPA	Metrological	-10 °C to +40 °C 14 °F to +104 °F	JJF 1363-2019 JJF 1421-2013

2. Warnings and cautionary statements

⚠ For maximum safety and optimal performance, read and understand the manual before operating or servicing the unit. Failure to perform certain procedures or note certain conditions may impair the performance of this product.

⚠ For safety reasons, this equipment must be operated and serviced by qualified personnel only. Customer site assembly is not recommended, improper disassembly may reduce the performance of the instrument.

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

⚠ DO NOT REPLACE BATTERY WHEN AN EXPLOSIVE ATMOSPHERE IS PRESENT. USE ONLY RAMWAY ER14335 BATTERIES.

⚠ Before use, ensure that the ESD film on the LCD display and label is not damaged or peeling.

⚠ Obstruction of sensor openings–due to dust, dirt, water, or another cause–can inhibit the unit's ability to measure gas concentrations accurately. When this occurs, readings may appear lower than the actual gas concentration. Keep sensor openings clean, dry, and properly exposed to the ambient air.

⚠ Obstructed, contaminated, or damaged sensor water barriers (or their gaskets) can inhibit the unit's ability to measure gas concentrations accurately. When this occurs, readings may appear lower than the actual gas concentration. Contact after-sales service to replace the sensor water barriers and gaskets as needed.

⚠ Service the unit, use its communications port, and change its battery cell only in nonhazardous locations. Not for use in oxygen-enriched atmospheres.

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

3. Product Overview

T40 II single gas monitor is compact, easy to carry and use. It is specially designed to detect the concentration toxic and oxygen gases, and mainly used in Petrochemical industry and coal mine. The monitor can continuously monitor the concentration of harmful gas in the surrounding environment, once the gas concentration reaches the low and high alarm and TWA/STEL alarm preset values, T40 II will produce sound, light and vibration alarms.

3

3.1 Product Specifications

Item	Description		
Display	Segment LCD		
Keypad buttons	Two buttons		
Technology	Electrochemical		
Battery Pack	Replaceable RAMWAY ER14335 3.6 V Primary Lithium-thionyl chloride (Li-SOCl2) battery cell, 1.65AH, 2/3AA. Two-years[a] run time		
Case materials	polycarbonate with a protective rubber over-mold		
Alarms	Visual alarm (two red LEDs). Audible alarm(95 dB). Vibration alarm		
Ranges	Oxygen (O2) 0-30 %VOL	Carbon Monoxide (CO) 0-1000 ppm[b] 0-2000 ppm	Hydrogen Sulfide(H_2S) 0-100 ppm 0-200 ppm 0-500 ppm
Display resolution	0.1 %VOL	1 ppm	0.1 ppm
Calibration gas concentration	20.9 %VOL	100 ppm	25 ppm
Response Time	<10s	<10s	<10s
Dimensions	82 x 60 x 27 mm (3.23 " x 2.36 " x 1.07 ")		
Weight	85 g (3.0 oz.), typical		
Ingress protection	IP66 / IP68		
Operating Temp[c]	-40 °C to +50 °C (-40°F to +122 °F)		
Operating humidity	5 to 95% relative humidity (RH) noncondensing		
Pollution Degree	2		
Maximum use altitude	5000m above sea level		

[a] Depending on operating conditions; the amount of time the unit is in alarm; and the enablement of unit's confidence indicator.
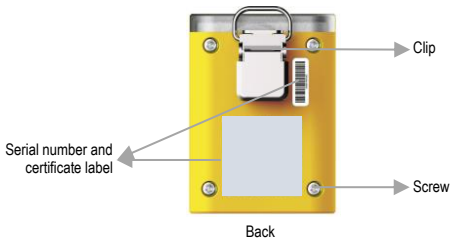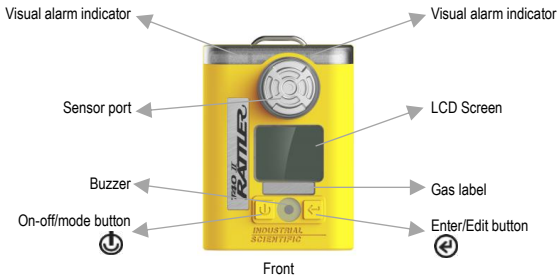
[b] ppm please refer the 4.1 gas unit description.

[c] Operating temperatures below -20°C may cause reduced instrument accuracy and affect display and alarm performance.

T40 II

Visual alarm indicator

Visual alarm indicator

Sensor port

LCD Screen

Buzzer

Gas label

On-off/mode button

Enter/Edit button

Front

Clip

Serial number and certificate label

Screw

Back

Hardware overview

4. Operation and Instructions

The table below list that Industrial Scientific's minimum frequency recommendations for each program. These recommendations are based on site data, safe work procedures, industry best practices and regulatory standards to help ensure worker safety. Users can reduce the frequency of the following procedures as appropriate according to the safety policy of local government or company, Industrial Scientific is not responsible for developing security practices and policies.

Procedure	Recommended minimum frequency
Configuration	Before first use, when there is a change in the installed sensor type, and as otherwise needed.
Calibration	Before first use and at least 6month interval, depending on use and exposure to gas and contamination, such as vibration, drop or sensor replacement, multiple high concentration gas shocks,etc.
Bump test	Prior to each day's use.

4.1 Display Overview

The visual test screen depicted right shows all the indicators that can appear on the display screen. Each indicator is stationary and appears only when relevant to the task being performed.

Display screens, indicators, and abbreviations

Status indicators

✓	Instrument work normally.
!	Instrument failure.
✖	The unit is in configuration mode.

Alarm indicators

◀))	The alarm icon is used in combination with other indicators to communicate a variety of conditions.
◀)) and ▲	High-level gas alarm.
◀)) and ▼	Low-level gas alarm.

6

Symbol	Description
◉)) and STEL	STEL alarm.
◉)) and TWA	TWA alarm
◉)) and $0r$	Positive over-range gas alarm.
◉)) and $-0r$	Negative over-range gas alarm.
⚠	Low-battery alarm.

Process and time-based indicators

Symbol	Description
Ø	The zero icon is used in combination with other indicators to communicate sensor zero information.
🧴	The bump test icon is used in combination with other indicators to communicate bump test information.
🧴	The calibration icon is used in combination with other indicators to communicate calibration information.
⋀	The peak reading is the highest detected gas reading. Always clear the peak reading after calibration.
🕒	A process is in progress. In configuration mode, indicates a time-based setting (e.g. bump test response time).

Gas name and unit-of-measure abbreviations

Abbreviation	Description
CO	Carbon Monoxide (CO)
$H2S$	Hydrogen Sulfide (H2S)
% VOL	Percent by volume refers to a defined amount of the gas in 100 parts of air.
PPM	Parts per million is the unit of measure for CO and H2S,PPM is the volume ratio in describing the gas concentration, 1ppm=10^{-6} equivalent to 1umol/mol.

Other abbreviations

Abbreviation	Description
⌇ lb	Vibration alarm enabled.
STEL	Short-term exposure limit, default time 15minutes. Display variations: "STEL"
TWA	Time-weighted average. default time 8h. Display variations: "TWA"

7

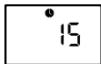## 4.2 Start-up, Shutdown and Always on

Start-up

Press and hold the ⏻ for 3 seconds, the instrument starts to power on. After power on, the instrument automatically enters the visual test, firmware version, 20-second countdown and the second visual test screen, and is accompanied by warning sound and light test. After a short warm-up, it will automatically enter the real-time gas monitoring screen.

Visual test screen	Version	Countdown

Shutdown and always on

Countdown

Press and hold for five seconds.
After a five-second countdown:
The instrument powers off if;
• the always-on feature is disabled or
• the always-on feature is enabled and the security code is set to 000.

Enter security code

If this screen is activated, the shutdown process is security-code protected. To complete shutdown, the user must enter the correct three-digit code.
Value range: 000 to 999

4.3 Configuration mode

Configuration mode can only be accessed during startup, at the 20 second countdown screen, press and hold both buttons simultaneously to enter configuration mode, select alarm and warning related options that maximize safety within the air sampling environment.

When the unit is in configuration mode, the following apply:

- The tool icon (✖) displays in the lower right corner of each screen.
- With successive short presses of the on-off button(⏻), the user can scroll through the configuration loop.
- The enter button (⏎) is used to start the editing process or initiate zero.
- When editing a value, the enter button (⏎) increments the value and the on-off-mode button (⏻) saves the value.

8

- When editing a value, once the last value in the range is reached, the display starts again with the first value.
- When buttons (⏻) is pressed and held more than 1 seconds, the unit leaves configuration mode; it enters operation mode and the home screen is activated.
- Unless otherwise noted, when no button is pressed for 30 seconds, the unit enters operation mode and the home screen is activated.
- Any changes made in configuration mode are automatically saved to the unit and take effect immediately.

Configuration instructions

Buttons or Screen	Button effects or Screen Description
⏻	Saves the currently displayed value or activates the next configuration mode screen.
↩	Increase value or First press activates the value. Continued presses increment the value; hold to speed the increment pace.
✓ ∅ ✗	Initiate zero This screen allows the technician to complete the zero and calibration processes from configuration mode. Note: O2 instrument display initiate calibration (Zero is calibration of O2).
✓ ◀)) H2S 100 ㎨ ✗	Low gas alarm setpoint This screen features the status, low alarm, sensor-type, and configuration icons, with the alarm's current setpoint and unit of measure. Edit the alarm setpoint based on the following: Value range = starts at minumum sensor measurement resolution, ends at the high gas alarm setpoint value. Value increment = sensor measurement resolution
✓ ◀)) H2S 200 ㎨ ✗	High gas alarm setpoint This screen features the status, high alarm, sensor-type, and configuration icons, with the alarm's current setpoint and unit of measure. Edit the alarm setpoint based on the following: Value range = starts at low gas alarm setpoint value, ends at the highest measurement range value of the sensor. Value increment = sensor measurement resolution

9

	TWA alarm setpoint (O2 instrument without this screen) This screen features the status, alarm, sensor-type, configuration, and TWA icons, with the alarm's current setpoint and unit of measure. The alarm setpoint can be edited. Value increment = within the sensor measurement resolution
	STEL alarm setpoint (O2 instrument without this screen) This screen features the status, alarm, sensor type, configuration, and STEL icons, with the current setpoint. The alarm setpoint can be edited. Value increment: sensor measurement resolution
	Calibration gas This screen features the status, sensor-type, configuration, and calibration icons, with the current calibration gas setting in the main area. This setting reflects the concentration of calibration gas that the instrument expects to read when calibrated; it should be edited to match the cylinder's gas concentration. Value range: within the sensor measurement range Value increment: sensor measurement resolution
	Confidence indicator This screen features the status, alarm, and configuration icons, with the selected setting value displayed in the main area. The technician can disable or enable the indicator and choose the indicator type. When enabled, the unit will emit the selected signal every 90 seconds in operation mode. Note: When options 1, 2, or 3 are selected, the expected battery life will be reduced. Values: 0 = disabled 1 = audible chirp enabled 2 = LED flash enabled 3 = audible chirp and LED flash enabled

Operation-mode bump test

This screen features the status, lock, configuration, and bump test icons, with the selected setting value displayed in the main area. The technician can enable or disable this operation mode feature.

When enabled, the instrument operator can bump test the unit from operation mode.

Values:

0 = disabled ,1 = enabled

Bump test percentage

This screen features the status, configuration, and bump test icons, with the current setting value displayed in the main area. The technician can set the percentage of calibration gas to which the unit will respond.

Value range: 50% to 95%

Value increment: 1%

Bump test response-time

This screen features the status, clock, configuration, and bump test icons, with the current setting in seconds displayed in the main area. A sensor passes a bump test when it senses the specified percentage of calibration gas within the specified response time setting.

Value range: 30 to 120 seconds

Value increment: 5 second

Alarm latch

This screen features the status, alarm, lock, and configuration icons, with the current setting displayed in the main area. The technician can enable or disable this operation-mode feature.

When disabled, a unit in alarm will turn off its alarm when the gas reading is no longer at the alarm-producing concentration.

When enabled, a unit in alarm will remain in alarm until it is manually reset. The instrument operator can reset a latched alarm from gas normal reading screen by click ⏎ button.

Values:

0 = disabled ,1 = enabled

|	
	Vibration alarm This screen features the status, alarm, "Vlb", and configuration icons, with the selected setting value displayed in the main area. When enabled, the vibrating alarm will be activated when the unit is in alarm. Values: 0 = disabled ,1 = enabled
	Operation-mode zero (O2 instrument without this screen) This screen features the status, lock, zero, and configuration icons. The technician can enable or disable this operation-mode option. When enabled, the instrument operator can zero the unit from operation mode. Values: 0 = disabled ,1 = enabled
	Operation-mode calibration This screen features the status, lock, configuration, and calibration icons. The technician can enable or disable this operation-mode option. When enabled, the instrument operator can calibrate the unit from operation mode. Values:0 = disabled ,1 = enabled
	Security code This screen features the status, lock, and configuration icons, with the current security code displayed in the main area. The security code controls access to a unit's configuration mode and the ability to power off a unit that is configured for always-on operation. If the security code is set at 000, entry to configuration mode is not security-code protected, and an always-on unit can be powered off without a security code. Any other value will enable the security code. Value range: 000 to 999 Value increment: 1
	Always-on This screen features the status, lock, configuration, and the battery icon. The technician can enable or disable this feature. When enabled, the entry of the unit's security code (if the security code is not 000) will be required to complete the shutdown process. Values: 0 = disabled ,1 = enabled

4.4 Operation mode

In the operation mode, the worker can scroll through the operating mode loop by continuously pressing the Mode button (⏻). The zeroing, calibration, and alarm function test procedures can only be completed if these task settings are enabled for operating mode access。

TWA, STEL (if operating mode access is enabled) and peak readings can also be viewed and cleared. When the reading summary is cleared, CO and H2S value resets to zero.

In operation mode, the following apply:

- Press ⏻ to scroll through the operation-mode loop.
- Press ⏎ to initiate a task or to clear a reading.
- A long press on ⏎ will reset a latched alarm; it does not disable an enabled latch.
- Except where noted, when no button is pressed for 30 seconds, the home screen is activated。

Operation instructions

Buttons or Screen	Button effects or Screen Description
⏻ ⏎	Saves the currently displayed value or activates the next configuration mode screen. Increase value or First press activates the value. Continued presses increment the value; hold to speed the increment pace.
✓ H2S 5.1 ᵖᵖᵐ	Gas monitoring This screen (numeric shown) features the check mark and sensor-type icons, the current gas reading, and unit of measure. The check mark indicates the unit is operational and there are no sensor faults.
✓ ⋀H2S 19.4 ᵖᵖᵐ	Peak reading This screen features the check mark, peak, and sensor-type icons, and the most recent peak reading, Press ⏎ clear the reading then the value reset to 0, For O2 sensor, the reading will be reset to 20.9%vol.
✓ H2S 5.7 ᵖᵖᵐ TWA	TWA reading (O2 instrument without this screen) This screen displays when the TWA reading is enabled in operation-mode. The screen features the check mark, sensor-type, and TWA icons, and the current TWA reading. Press ⏎ clear the reading then the value reset to 0 .

13

|	
✓ H2S 8.1 ᴾᴾᴹ STEL	**STEL reading** (O2 instrument without this screen) This screen displays when the STEL reading is enabled in operation-mode. The screen features the check mark, sensor-type, and STEL icons, and the current STEL reading. Press ⊘ clear the reading then the value reset to 0.
✓ 🖐	**Initiate bump test** This screen displays when operation-mode bump testing is enabled. The screen features the check mark and bump test icons.
✓ ø	**Initiate zero** This screen displays when operation-mode zeroing is enabled. It features the check mark and zero icons. Note: O2 sensor instrument is initiate calibration screen.

4.5 Bump test (or "functional test")

Bump testing is a functional test in which an instrument's installed sensors are to be briefly exposed to (or "bumped" by) calibration gases in concentrations that are greater than the sensors' low-alarm setpoints. This will cause the instrument to go into low alarm and will indicate which sensors pass or fail this basic test for response to gas.

Note:If fails the bump test, please perform a calibration. If failes the calibration, please contact Industrial Sicentific after-sales service.

Bump test instructions

Screen	Screen Description
	Initiate bump test From anywhere in the operation-mode loop, press ⏻ until the initiate bump test screen is activated. Press ⏎ to start the bump test process. Press ⏻ to cancel the bump test.
	Bump test apply gas Once the bump test is started, the apply-gas screen is activated; the expected type and concentration of calibration gas are displayed. For O2 sensor, the apply gas concentration should below low alarm concentration. This screen remains activated for up to 5 minutes as the unit awaits the application of calibration gas.
	Bump test in progress
	Bump test results If fail the bump test, need to calibrate the instrument. If pass the bump test, the home screen will be automatically activated. *note：Close the cylinder and remove the calibration cup after bump test.*

4.6 Zeroing

Zeroing adjusts the sensors' "baseline" readings, which become the points of comparison for subsequent gas readings. It is a prerequisite for calibration. During zeroing, the installed sensors are to be exposed to an air sample from a zero-grade cylinder or ambient air that is known to be clean air. If there are gases in the air sample that are below the lowest alarm level, the instrument will read them as zero; its task is to read the air sample as clean air. The user's task is to ensure the air is clean.

Note: For O2 sensor, Only display calibration screen.

Zeroing instructions

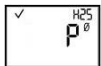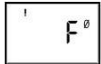| Screen	Screen Description
	Initiate zero From anywhere in the operation-mode loop, press ⏻ until the initiate-zero screen is activated. At the initiate-zero screen, press ⏎ to start the zero process.
	Zero in-progress While the sensors are zeroed, the zero-in-progress screen is activated. *Note：Must be zeroed in fresh air.*
	Zero results After the sensors are zeroed, the zero-results screen is activated, and an audible alert is emitted. If the result is an "F" for fail, press ⏻ to reactivate the initiate-zero screen. Repeat the zero process. If the result is a "P" for pass, press ⏻ to display the initiate-calibration screen. If calibration is not desired, press ⏻ twice or wait approximately 30 seconds to active home screen.

4.7 Calibration

Regular calibrations promote the accurate measurement of gas concentration values. During calibration, an instrument's installed sensors are to be exposed to their set concentrations of calibration gases. Based on the sensors' responses, the instrument will self-adjust to compensate for declining sensor sensitivity, which naturally occurs as the installed sensors are used or "consumed".

Calibration instructions

Screen	Screen Description
	Initiate calibration press 🔵 button at zero results screen to enter the intiate calibration screen, then press 🟢 button to start the calibration. Note: For O2 sensor, press 🟢 button to start calibration without Zeroing.
500ᴘᴹ H2S	Calibration apply gas Once calibration is started, the apply-gas screen is activated; the expected type and concentration of calibration gas are displayed. This screen remains active for up to 5 minutes as the unit awaits the application of calibration gas. To cancel calibration, press 🔵 button.
200ᴘᴹ H2S	Calibration in progress *Note：Need to open the calibration gas cylinder regulator before calibration.*
P F	Calibration results If passes calibration, Result screens are alternately activated and displays the span reserve value. If fails calibration, the audible, visual, and vibrating alarms turn on. Results screens are alternately activated; one indicates the fail results and the other displays the span reserve value. *note：Close the cylinder and remove the calibration cup after calibration.*

17

5. Alarms and Notifications

Alarms notify the instrument operator of danger. Warnings notify of a condition that needs attention.
Take seriously all alarms, warnings, and indicators, and respond to each according to company policy.

Alarms

T40 II gas monitors have alarms of two different intensities, high and low. Alarms are persistent: they
turn off when the alarm-causing event is no longer detected, however, if the instrument's alarm latch is
enabled, an alarm will remain on until the user presses ⏻ to turn it off.

When all alarm signals are on:

- The high alarm features the red lights, with steady sound. It is fast-paced.
- The low alarm is similar to the high alarm, but it is medium-paced.

Note: Signals (visual, audible, and vibration) vary based on instrument settings.

Alarm Level : High

Gas Present (H2S is shown.)

Gas present, over-range alarm

Gas present, negative over-range alarm

Gas present, high alarm

STEL alarm

System alarm

System alarm

Critical low-battery alarm

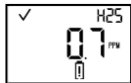### Alarm Level: Low

Gas Present

Gas present, low alarm

TWA alarm

Notifications

Warnings persist until the event is resolved. In some cases, an unresolved warning will become more urgent in frequency. For example, a low-battery warning that is not resolved will change to alarm status indicating a critical low-battery condition.


Low-battery warning

6. Replace the battery

When the battery has 12 to 72 hours left, T40 II display Low-battery warning notification and emit 1 beep, visual and vibration alarm every 1minute. The users need contact Industrial Scientific or qualified person to replace the battery.

1. Using a T10 Torx screwdriver, remove all four screws from the case bottom; set aside the screws.

2. Lift the battery up from its cradle. Dispose of according to company policy.

3. Orient the replacement battery so the positive and negative ends align with the "+" and "-" cradle markings, respectively. Place the new battery into the cradle negative end first. Press down on the battery to secure it in the cradle.
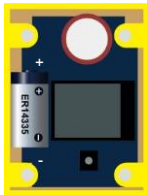
Note:

⚠ Use RAMWAY ER14335 battery only.

⚠ Use Do not replace battery when an explosive atmosphere is present.

⚠ Work on a nonconductive surface in a well-lit area.

⚠ Wear grounding straps to prevent electrostatic discharge (ESD), which can cause damage to the instrument's electronics.

⚠ Be sure to turn off the instrument before servicing the unit or replacing the battery.

7. Warranty Policy

Industrial Scientific Corporation's portable T40 II gas monitors are guaranteed for 2years from the date of shipment, warranted to be free from defects in material and workmanship, under normal and proper use and service.

8. Limitation of Liability

Industrial Scientific makes no other warranties, express or implied, including but not limited to warranties for sale or for special needs.

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