

TMX412 Multi-Gas Monitor



- **Continuous monitoring of up to four gases**
- **Interchangeable toxic gas sensors**
- **One-button auto calibration**
- **Optional datalogging and industrial hygiene functions**
- **Interchangeable battery packs Ni-Cad, Lithium, Alkaline**

Ideal for any environment requiring reliable multi-gas monitoring, the TMX412 is Industrial Scientific's most versatile instrument. Compact and easy to use, the TMX412 delivers peak performance in even the harshest working environments.

The TMX412 simultaneously monitors up to four gases: combustible gases (LEL or methane), oxygen and any one or two of six toxic gases (carbon monoxide, chlorine, chlorine dioxide, hydrogen sulfide, nitrogen dioxide and sulfur dioxide). The instrument automatically recognizes all installed sensors and displays instantaneous readings on the easy-to-read LCD display. The TMX412 is available with an optional datalogging board with

real-time clock that calculates and records STEL and TWA readings (up to 110 hours of data stored). Additional features include: plug-in sensors, RFI protection, audible and visual alarms, easy one-button calibration and peak reading memory. A full line of accessories makes the instrument even more versatile.



SPECIFICATIONS

CASE:	Type 304 Stainless Steel
DIMENSIONS:	4.75" x 2.75" x 2" (121 mm x 70mm x 51 mm)
WEIGHT:	26 oz (738 g)
SENSORS:	Combustible Gases/Methane – Catalytic Diffusion Oxygen and Toxic Gases – Electrochemical
MEASURING RANGES:	<i>Combustible Gases</i> – 0 to 100% LEL in 1% increments <i>Methane</i> – 0 to 5% of volume in 0.1% increments <i>Oxygen</i> – 0 to 30% of volume in 0.1% increments <i>Carbon Monoxide, Hydrogen Sulfide</i> – 0 to 999 ppm in 1 ppm increments <i>Chlorine, Chlorine Dioxide, Nitrogen Dioxide, Sulfur Dioxide</i> – 0.2 to 99.9 ppm in 0.1 ppm increments
POWER SOURCE (RUN TIME):	Rechargeable Ni-Cad Battery Pack (10 hours typical) Replaceable Cell Lithium Battery Pack (18 hours typical) Replaceable 9-volt Alkaline Battery Pack (11 hours typical)
TEMPERATURE RANGE:	-40°F to 122°F (-20°C to 50°C)
HUMIDITY RANGE:	0 to 99% RH (non-condensing)
APPROVALS:	UL and CSA – Class I, Groups A, B, C, D MSHA – Intrinsically safe for Methane/Air mixtures only Australia – EEx ia d IIC T4

The TMX412 comes equipped with a Ni-Cad battery pack installed. To order the unit with Lithium batteries, add an "L" as a suffix to the part number. To order the unit with Alkaline batteries, add an "A" as a suffix to the part number. To order the factory-installed optional datalogging PC board, modify the part number by replacing the second 0 in the four digit suffix with the number 1, and add \$250 USD to the price. Example: 1810-2183-0180. Software disk and cables must be ordered separately.

MOST COMMON INSTRUMENT CONFIGURATIONS (Complete listing in Index, see pages 69 & 70.)

<u>PART NUMBER</u>	<u>DESCRIPTION</u>	<u>PRICE (US Dollars)</u>
1810-2183-0080	LEL, O ₂ , H ₂ S, CO	\$1,770.00
1810-2434-0080	LEL, O ₂ , H ₂ S, CO (Australian version)	\$1,770.00
1810-2183-0090	CH ₄ , O ₂ , H ₂ S, CO	\$1,770.00
1810-2434-0090	CH ₄ , O ₂ , H ₂ S, CO (Australian version)	\$1,770.00
1810-2183-0040	LEL, O ₂ , CO	\$1,560.00
1810-2183-0041	LEL, O ₂ , H ₂ S	\$1,560.00

MAJOR ACCESSORIES

<u>PART NUMBER</u>	<u>DESCRIPTION</u>	<u>PRICE (US Dollars)</u>
1810-2251	Two-Unit Compact Charger, 115V	\$ 59.00
1810-2231	Two-Unit Compact Charger, 230V	\$ 79.00
1810-2558	Two-Unit "Smart" Dual-Rate Charger, 115V	\$ 350.00
1810-2255	Four-Unit "Smart" Dual-Rate Charger, 115V	\$ 410.00
1810-2517	Four-Unit "Smart" Dual-Rate Charger, 230V	\$ 410.00
1704-1872	Spare Battery Pack, Rechargeable Ni-Cad	\$ 90.00
1704-9889	Spare Battery Pack, Replaceable Lithium Cells	\$ 90.00
1706-7174	Spare Battery Pack, Replaceable 9-volt Alkaline	\$ 90.00
1810-2156	SP402 Motorized Sampling Pump	\$ 398.00
1810-2169	SP402 Motorized Sampling Pump (CSA version)	\$ 525.00
1810-2285	Constant-Flow Hand Aspirated Pump for 400 Series	\$ 98.00
1810-3747	103 dB External Alarm	\$ 325.00
1810-2189	Calibration Kit, CO, H ₂ S, O ₂ , Pentane (58 L)	\$ 487.00
1705-6235	TMX Maintenance and Training Video, VHS	\$ 29.95
1706-1011	TMX Maintenance and Training Video, PAL	\$ 29.95
1810-2195	TMX412 Datalogging Software and Cable Kit	\$ 225.00

P/N 1705-0816
REV 10 Printed 1000-5000
Specifications Subject to Change

Multi-Gas Monitor

TMX 412



GUARANTEED.
FOR LIFE.

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FAX 412-788-8353

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Instruction
Manual

OUR MISSION

*Design - Manufacture - Sell:
Highest quality products
for the preservation of
life and property.*

*Provide:
Best customer service
available.*

Dear Valued Customer:

Thank you for buying and using Industrial Scientific's Model TMX412 Multi-Gas Monitor.

Your TMX412 can be relied upon for dependable service, day after day. It has been designed, manufactured, tested and proven under the most scrutinizing conditions possible. With the minimal care and maintenance described in this Instruction Manual, it will provide you with years of reliable monitoring.

I am most concerned that you be pleased with the performance of your TMX412 in the months and years ahead. I urge you to call us with any questions or comments you may have. Often times a phone call and a question can save you hours of frustration. Please never hesitate to contact me at 1-800-DETECTS (338-3287).

All of us at Industrial Scientific appreciate the opportunity to serve you.

Yours very truly,

A handwritten signature in black ink, appearing to read "Kent D. McElhattan". The signature is stylized and cursive.

Kent D. McElhattan
President & CEO
Industrial Scientific Corporation

TABLE OF CONTENTS

1.	WARNINGS AND CAUTIONARY STATEMENTS	3
2.	UNPACKING THE INSTRUMENT	4
3.	TMX412 FEATURES	4
4.	INSTRUMENT OPERATION	8
4.1	Charging the Battery	8
4.2	Turning the TMX412 On and Off	9
4.3	Display Backlight	9
4.4	TMX412 Operating Modes	9
4.4.1	Reading	9
4.4.2	Sensor Configuration	9
4.4.3	Zero	10
4.4.3	Peak	10
4.4.4	Peak Clear	10
4.4.6	Date	10
4.4.7	Cal Date	10
4.4.8	Log Time	10
4.4.9	TWA	10
4.4.10	STEL	10
4.4.11	Hygiene Reset	10
4.5	TMX412 Alarm Indicators	11
4.5.1	Low Alarm	11
4.5.2	High Alarm	11
4.5.3	Over-Range Indication	11
4.5.4	Combustible Gas Over-Range	11
4.5.5	Low Battery Warning	12
4.5.6	Battery Failure	12
4.5.7	Fault Indication	12
5.	CALIBRATING THE TMX412	12
6.	CHANGING INSTRUMENT SETTINGS	15
6.1	Setspan	15
6.2	Alarms	16
6.3	Battery	17
6.4	Code	18
7.	HYGIENE FUNCTIONS	18
7.1	Definition of Terms	18
7.1.1	Data Log	18
7.1.2	Period	18
7.1.3	Logging Session	18
7.1.4	Real Time Clock	18
7.1.5	Log Time Clock	18
7.1.6	Calendar	19
7.1.7	TWA	19
7.1.8	STEL	19
7.2	Principles of Operation	19
7.3	Resetting the Hygiene Functions	19
8.	MAINTENANCE	20
8.1	Cleaning	20
8.2	Changing the Battery	20
8.3	Opening the Instrument for Service	21
8.4	Replacing Water Barriers	21
8.5	Installing or Changing Sensors	21
8.5.1	Toxic Sensor Removal	22
8.5.2	Combustible Sensor Removal	22
8.5.3	Oxygen Sensor Removal	22
8.6	Instrument Reassembly After Service	23
9.	REPLACEMENT PARTS	26
10.	SPECIFICATIONS	27
11.	DEFAULT ALARM SETTINGS	28
12.	TMX412 OPTIONS & ORDERING INFORMATION	29
13.	WARRANTY	30

1. WARNINGS AND CAUTIONARY STATEMENTS

Failure to observe certain procedures or conditions may impair the performance of the instrument. For maximum safety and performance while using the instrument, please read and understand the procedures and conditions outlined below.

- ▲ Oxygen deficient atmospheres may cause readings of combustible gas lower than actual concentrations.
 - ▲ Oxygen enriched atmospheres may cause readings of combustible gas higher than actual concentrations.
 - ▲ Verify calibration of the combustible gas sensor after use where the combustible gas content causes the instrument to latch in the OVER-RANGE alarm condition.
 - ▲ Silicone compound vapors may cause desensitization of the combustible gas sensor and may 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 previously present, always verify the instrument's calibration before next use to ensure accurate measurements.
 - ▲ Sensor aperture areas and water barriers must be kept clean. Obstruction of the sensor aperture areas and/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.
 - ▲ Recharge battery only in a non-hazardous location.
 - ▲ Use the RS-232 port only in a non-hazardous location.
 - ▲ Instrument is tested for intrinsic safety in explosive gas/air (21% oxygen) mixtures only.
- ⚠ CAUTION:** High Over-Range (+OR) combustible gas readings may indicate an explosive concentration of combustible gas.

2. UNPACKING THE INSTRUMENT

The shipping box should contain the following items. Account for each item before discarding the box.

QUANTITY	PART NUMBER	DESCRIPTION
1	1810-2183	TMX412 Multi-Gas Monitor
or 1	1810-2434	TMX412 Multi-Gas Monitor (<i>Australian Version</i>)
1	1705-0816	TMX412 Instruction Manual
1	1705-0745	Keypad Overlay
1	1810-1824	Leather Carrying Case
1	1705-2946	Maintenance Tool
or 1	1705-0278	Maintenance Tool (<i>Australian Version</i>)
1	1704-2839	Calibration Cup
1	1704-4157	Teflon Lined Tygon Tubing

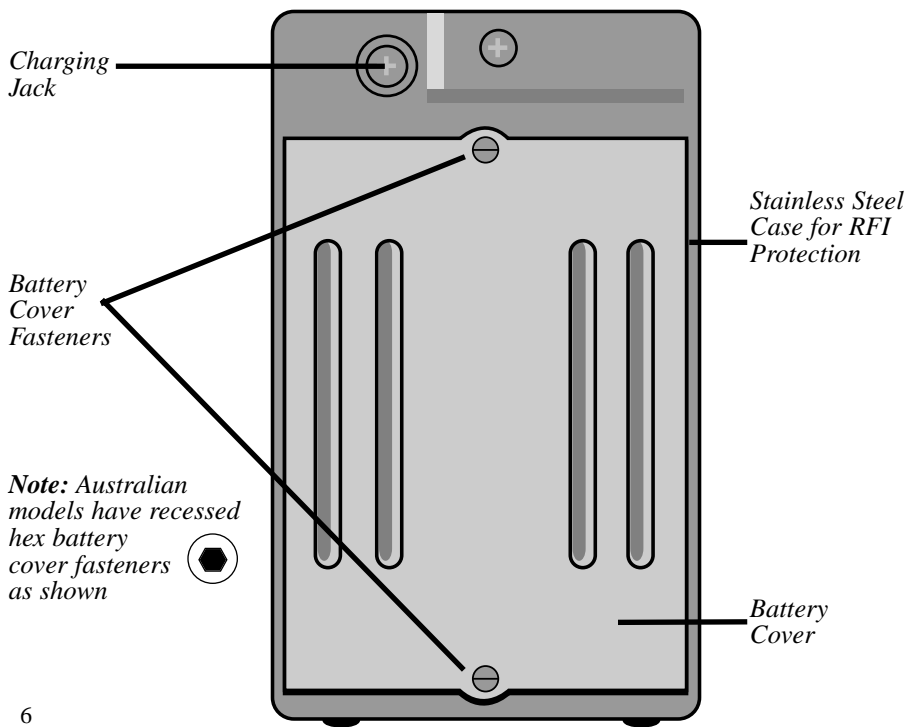
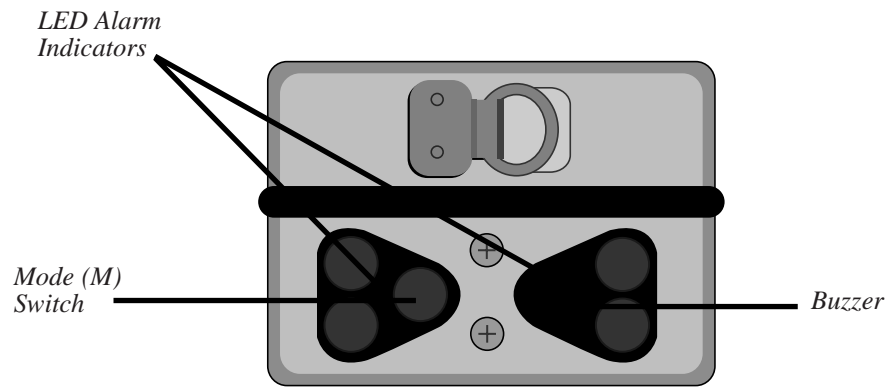
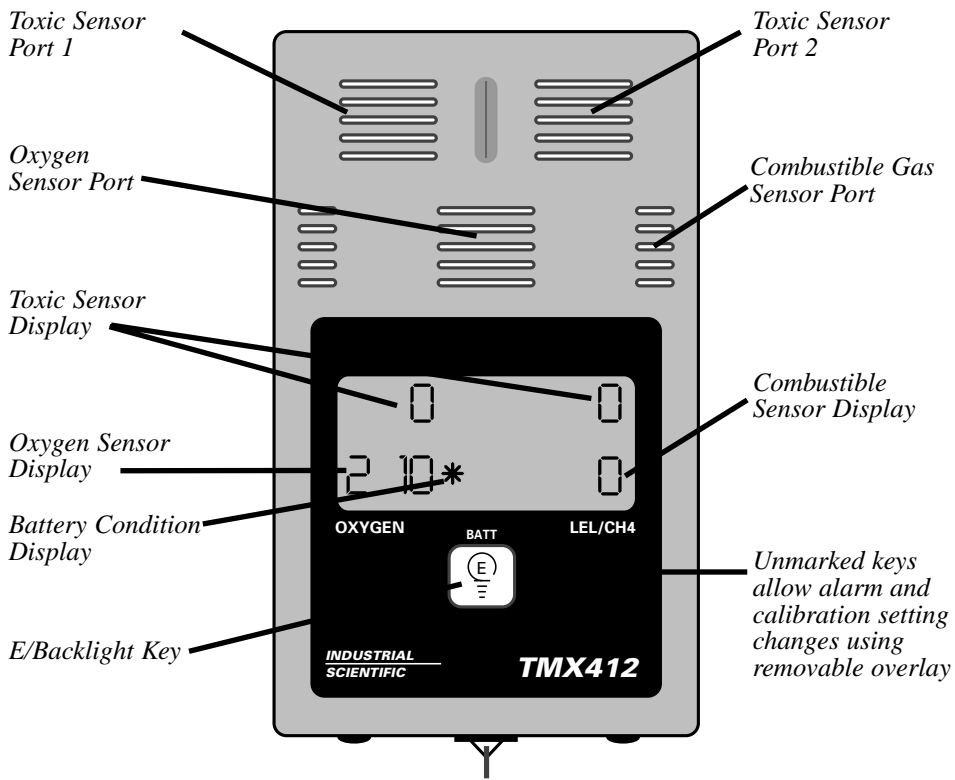
After unpacking, if any listed item is missing, contact either your local distributor of Industrial Scientific products, or call Industrial Scientific Corporation at 1-800-DETECTS (338-3287) in the United States and Canada, or 412-788-4353.

3. TMX412 FEATURES

The Industrial Scientific TMX412 Multi-Gas Monitor may be configured to continuously monitor one, two, three or four gases in any combination of the following:

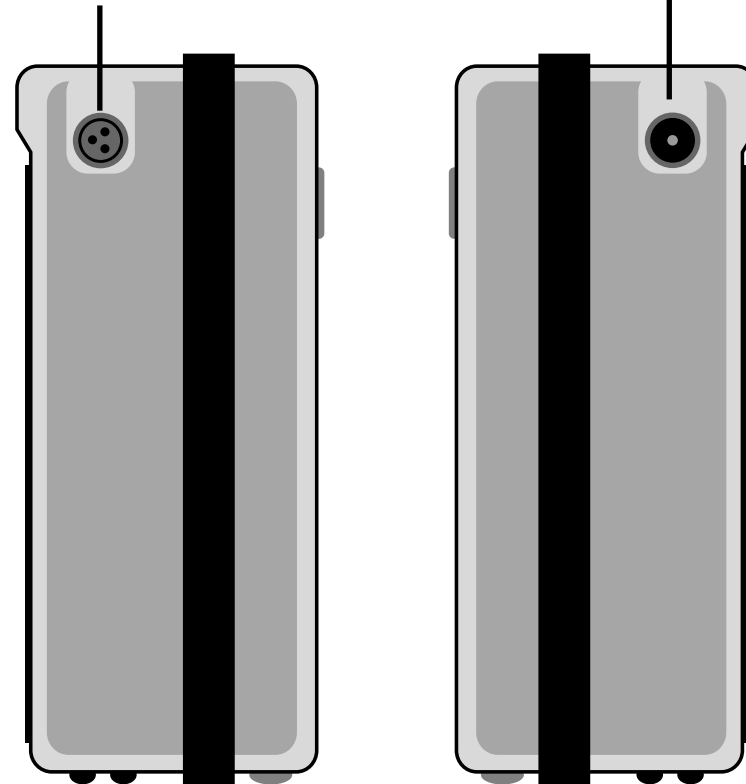
- Oxygen
- Combustible gases (%LEL) or methane (% by volume CH₄). User selects %LEL or %CH₄ prior to calibration.
- Any two of the following toxic gases:
 - Carbon Monoxide
 - Hydrogen Sulfide
 - Sulfur Dioxide
 - Chlorine
 - Nitrogen Dioxide
 - Chlorine Dioxide

- The TMX412 automatically recognizes and displays the sensor configuration when switched on.
- One-Button microprocessor controlled calibration.
- Illuminated display for viewing in low light conditions.
- Round-the-clock monitoring capability using the interchangeable nickel-cadmium rechargeable, disposable lithium, or disposable alkaline battery packs.
- Plug-in sensors that can be changed or replaced without special tools or soldering equipment.
- Audible and visual alarm indicators.
- Optional external audible or vibrating alarms.
- High and low alarms for combustible and toxic gases; enrichment and depletion alarms for oxygen.
- User selectable access code for security of calibration and alarm settings.
- Combustible gas OVER-RANGE protection.
- PEAK reading mode.
- Press and hold power switch to prevent accidental turn on or turn off.
- Hygiene/Data Log option that can be installed by the factory or the customer, to provide short term exposure limit (STEL) and time-weighted average (TWA) readings with data logging.
- The TMX412 is classified as intrinsically safe by the following agencies:
 - Underwriters laboratories (UL).
 - Canadian Standards Association (CSA). *Canadian Standards Association has assessed only the combustible gas portion of this instrument for performance.*
 - Mine Safety and Health Administration (MSHA).
 - Workcover Authority, NSW, Australia.
 - Department of Mineral Resource, NSW, Australia.



RS-232 Jack for Hygiene Downloading

External Alarm Jack



4. INSTRUMENT OPERATION

4.1 CHARGING THE BATTERY



CAUTION: If the TMX412 is using the nickel-cadmium battery pack, fully charge the battery pack prior to use.

NOTE: *The TMX412 must be turned off while charging the battery.*

A single unit compact trickle (10 hour) charger is available for charging the battery in the instrument. In addition to the compact charger, Industrial Scientific offers a full line of chargers with dual rate (4.5 hour) or trickle charging systems in single, dual or four unit configurations. All chargers are capable of charging the battery in or out of the instrument. All dual rate chargers offer the user selectable discharge-before-charge feature to prevent battery memory conditions caused by some repetitive use patterns. Refer to Section 12, Options and Ordering Information, for a complete listing of available chargers.

When charging the battery pack in the instrument, be certain that the instrument is turned off and place it on the battery charger. To charge the battery pack out of the instrument, remove the pack and place it on the charger.

A fully charged battery pack will operate a four-gas configured TMX412 for up to 10 hours. When the instrument is in the normal viewing mode, an eight-segment battery status indicator continuously displays the battery condition. Each segment represents approximately one hour of operating time. When the battery is fully discharged, the display reads BATTERY FAIL and the instrument emits a short beep once a second. Turn off the instrument and recharge the battery pack when BATTERY FAIL appears.

4.2 TURNING THE TMX412 ON AND OFF

- Press and hold the MODE switch. The display will read HOLD and the instrument sounds a short beep approximately once a second.
- Continue holding the MODE switch until the RELEASE screen appears. (Stop here if turning the instrument off.)
- After the instrument is turned ON, the following startup screens will be displayed:

SENSOR CONFIGURATION. The type of sensors installed in the instrument will be displayed.

WARM-UP TIMER. The display will indicate the number of seconds remaining until the instrument begins normal operation.

After the warm-up sequence has been completed, the TMX412 will enter the normal operating mode and will be continuously monitoring all calibrated sensors.

4.3 DISPLAY BACKLIGHT

The display backlight is automatically switched on when the TMX412 is in an alarm condition. To manually activate the backlight when needed, press and release the (E) key. The backlight will illuminate the display for approximately 15 seconds.

4.4 TMX412 OPERATING MODES

The TMX412 offers different operating modes for accessing various instrument features. To scroll through the operating modes, press and release the MODE switch. The operating modes will be accessed in the following sequence:

4.4.1 READING

This is the normal operating mode. The current reading of all sensors is displayed along with the graphical battery charge indicator.

4.4.2 SENSOR CONFIGURATION

This mode will display the type of sensor in the position in which it is installed in the instrument.



4.4.3 ZERO

This mode allows the user to zero the instrument and calibrate all installed sensors. Refer to section 5, Calibrating the TMX412, for instruction on the use of the instrument's automatic zero and calibration functions.



4.4.4 PEAK

This mode will display the highest level of toxic and combustible gas and the lowest level of oxygen measured since the peak readings were last cleared.

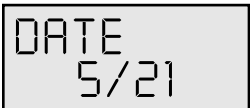
- Press the MODE switch to access the PEAK reading screen.



4.4.5 PEAK CLEAR


This mode will clear all stored peak readings from the TMX412. Press enter (E) to clear the peak readings. The display will return to the PEAK mode and indicate that the peak readings have been reset.

If the TMX412 hygiene option is installed in the instrument, the following operating modes may also be accessed. See Section 7, Hygiene Functions, for further instructions.



4.4.6 DATE

This screen allows the user to see the current date (month/day) set in the instrument.



4.4.7 CAL DATE

This mode allows the user to see the date the unit was last calibrated.




4.4.8 LOG TIME

This mode allows the user to view the current time set in the instrument (RT) and the length of time that data has been logged in the current session (LT).



4.4.9 TWA (Time-Weighted Average)

This mode displays the current time-weighted average exposure of the toxic sensors installed in the instrument.



4.4.10 STEL (Short Term Exposure Limit)

This mode displays the short term average exposure of the toxic sensors installed in the instrument.



4.4.11 HYGIENE RESET

This mode allows the user to reset the hygiene session and the STEL and TWA exposure values.

4.5 TMX412 ALARM INDICATORS

4.5.1 LOW ALARM

When a monitored gas concentration reaches the low level alarm setpoint, the instrument emits a short beep approximately every 1.2 seconds. The four red alarm LEDs and backlight will flash simultaneously. The displayed value of the alarming gas will flash. If the hygiene option is installed, the TWA alarm will mimic the low alarm indicator and the TWA display value in alarm will flash.

4.5.2 HIGH ALARM

When a monitored gas concentration reaches the high alarm level setpoint, the instrument emits a continuous dual tone alarm. As with the low alarm condition, the four red alarm LEDs and backlight will flash simultaneously with the displayed gas value. If the hygiene option is installed, the STEL alarm will mimic the high alarm indicator and the STEL display value in alarm will flash.

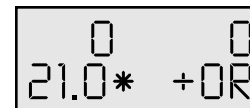
NOTE: *The TMX412 uses the continuous high alarm tone for both low (depletion) and high (enrichment) oxygen alarm conditions.*

4.5.3 OVER-RANGE INDICATION

An over-range condition occurs when a sensor reading exceeds the upper limit of the instrument display range. Over-Range is indicated by +OR in the appropriate sensor display location. With the exception of combustible gas over-range, all over-range conditions will clear automatically when the gas concentration has decreased to a level within the display range of the instrument.

4.5.4 COMBUSTIBLE GAS OVER-RANGE

When the TMX412 detects combustible gases in excess of 100% of LEL or 5% CH₄ by volume, a high alarm condition is latched and +OR is displayed in place of the combustible gas reading. Power is removed from the combustible gas sensor to prevent damage due to the high level of combustible gas.



To clear the combustible gas over-range alarm:

- Exit the hazardous area immediately.
- Press the enter (E) key in clean air.

NOTE: *When the enter (E) key is pressed, the combustible gas level must be less than 100% of LEL or 5% CH₄ to clear the combustible gas over-range condition.*

4.5.5 LOW BATTERY WARNING

When approximately 1 hour of instrument operation energy remains in the battery, the instrument emits a short beep every 15 seconds. In addition, the battery indicator will be replaced by a flashing “B” on the display.

NOTE: *The length of warning time will increase when there is no combustible gas sensor installed in the instrument.*



A rectangular display box showing the text "BATTERY FAIL" in a monospaced font, with "BATTERY" on the top line and "FAIL" on the bottom line.

4.5.6 BATTERY FAILURE

When the battery has insufficient charge to operate the instrument, “BATTERY FAIL” is displayed. The instrument stops monitoring and emits a short beep once every second.

When “BATTERY FAIL” appears, turn off the instrument immediately. Recharge or replace the battery.

4.5.7 FAULT INDICATION

The TMX412 will emit a short beep approximately once a second if a newly installed sensor does not agree with the valid sensor type for that position when the instrument is turned on. The corresponding display position will be blank. This fault indication occurs when a toxic or combustible sensor becomes disconnected or a combustible fault is detected during normal operation. Sensor types become valid only after a successful calibration has been completed.

5. CALIBRATING THE TMX412

The TMX412 is a potential life saving device. Recognizing this fact, Industrial Scientific Corporation recommends that a functional (“bump”) test be performed on every instrument prior to each days use. A functional test is defined as a brief exposure of the monitor to a known concentration of gas(es) for the purpose of verifying sensor and alarm operation and is not intended to be a measure of the accuracy of the instrument.

Industrial Scientific further recommends that a full instrument be performed using a certified concentration(s) of calibration gas(es) monthly to ensure maximum accuracy.

If an instrument fails to operate properly following any functional “bump” test, a full instrument calibration should be performed prior to use.

Calibration will be most accurate when the instrument has been in a stable temperature environment for at least one hour prior to calibrating.

NOTE: *Instrument zero and oxygen span calibration should be performed in clean air containing 20.95% (21%) oxygen. If you are measuring a known combustible gas, use a known %LEL concentration of that gas for span calibration. For general combustible gas measurement, Industrial Scientific Corporation recommends calibrating to pentane in the 15-50% LEL range. The measured LEL concentration of gases other than the calibration gas may not correspond on a one-to-one basis with the monitor reading. Calibration gas flow rate should be between 0.5 and 1.0 liters per minute. Apply CL₂, at a 1.0 liter per minute flow rate. Always use teflon or teflon lined tubing when calibrating Cl₂ or NO₂ sensors.*

The TMX412 utilizes a one-button calibration system. When using multi-component gas cylinders, a full instrument span calibration can be performed in a single step. Multi-component calibration gas cylinders are available for combustible gas/carbon monoxide/hydrogen sulfide configurations.

To calibrate the TMX412:

- From the normal READING mode, press the MODE switch to access the ZERO operating mode.
- Press the (E) key to start the instrument zeroing process. The instrument display will indicate ZEROING.
- When zeroing is complete the instrument display will indicate O2 CAL and will show the current full span value of the oxygen sensor. The oxygen sensor will be spanned to 21.0 in approximately 30 seconds. Oxygen calibration may be aborted at this time by pressing the MODE switch.

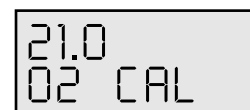
NOTE: *Zeroing the instrument in clean air is preferred, provided that there is no trace of toxic or combustible gas that would cause the instrument to respond. If the air purity is uncertain, use a cylinder of zero grade air to zero the instrument and span the oxygen sensor.*



A rectangular display box showing the text "ZERO" on the top line and "PRESS" on the bottom line.



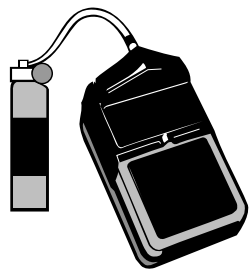
A rectangular display box showing the text "ZEROING" in a monospaced font.



A rectangular display box showing the text "21.0" on the top line and "O2 CAL" on the bottom line.

GO CAL
PRESS

25 LEL
APPLY



- At the completion of the oxygen sensor span operation the instrument will emit a short beep and the display will indicate GO CAL and the message PRESS (E) to CAL will scroll across the bottom of the display. Press (E) to continue calibrating the remaining sensors. Ignoring this message will result in the instrument returning to the normal operating mode in approximately eight seconds.

- When the GO CAL prompt has been acknowledged, the instrument will display the first sensor to be calibrated along with the span gas value. The message APPLY CAL GAS will scroll across the bottom of the display.

NOTE: *APPLY CAL GAS means connect the calibration cup to the appropriate calibration gas cylinder. Place the calibration cup on the instrument as shown. Turn on gas supply.*

- Apply the appropriate concentration of calibration gas. The instrument will wait for three minutes to sense that calibration gas has been applied before aborting and failing calibration. When the instrument senses a concentration greater than 50% of the span gas setting the display will indicate the current full span value for that sensor. The message CAL IN PROCESS will scroll across the bottom of the display.

- When calibration of the sensor has been successfully completed, the instrument will automatically step to the next sensor to be calibrated and the preceding step will be repeated.

- When all sensors have been calibrated successfully the instrument will emit a short beep. The sensor configuration will be shown on the display and sensor identifiers will flash to warn of marginal calibration. Marginal calibration will occur if the sensor full span value is less than 70% of the applied gas concentration. A marginal sensor calibration may be an early warning sign that the sensor will soon need to be replaced.

NOTE: *If the sensor full span value is less than 50% of the applied gas value, the sensor will fail calibration and the instrument will immediately return to the real time READING mode. When failed calibration or low sensitivity is indicated, verify that the calibration cylinder has not emptied or that the cylinder expiration date has not passed.*

- After displaying the sensor configuration, the instrument will automatically return to the real time READING mode.

6. CHANGING INSTRUMENT SETTINGS

Instrument settings, including alarm values, calibration gas concentrations and security code, may only be accessed and changed during the instrument startup sequence.

A keypad overlay is supplied to reveal the location of the hidden keys used for changing instrument settings. Remove the overlay from the protective backing and place it over the instrument faceplate. The clear portion of the overlay will cling to the display window of the faceplate and may be reused.

To access the instrument menus:

- Turn the TMX412 off and back on again.
- When the display shows the warm up timer, press the plus (+) and minus (-) keys simultaneously.

If the instrument security code has been set to a value other than “0”, the CODE screen will be displayed along with the scrolling prompt PRESS (+) OR (-) TO SET (E) TO ENTER. Use the (+) and (-) keys to input the correct security code value and press (E). When the correct code has been entered successfully, the instrument will immediately enter the settings mode.

The settings mode consists of three main functions in the following order:

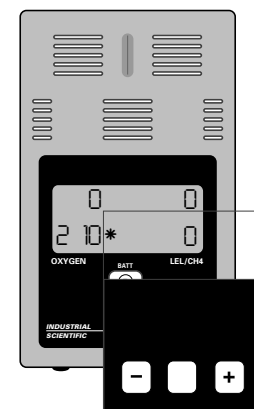
SETSPAN
ALARMS
BATTERY
CODE

The scrolling prompt, PRESS (+) FOR NEXT (E) TO SELECT appears on each screen. Press the (+) to step through the list and (E) to select any of the main functions. Pressing the MODE switch at any one of the main function headings will cause the instrument to return to the normal operating mode.

6.1 SETSPAN

The SETSPAN function allows the user to set the combustible sensor monitoring range to either LEL or CH₄ and to set the calibration gas values for the combustible and toxic sensors.

- Press (E) to enter the SETSPAN function. The display will show LEL along with the prompt PRESS (+) TO CHANGE.



SETSPAN
PRESS

- Press (+) to toggle between LEL and CH₄ combustible sensor span ranges.
- Press MODE to enter the span gas values for all sensors. The display will show the first span value, eg. 25 LEL, along with the prompt PRESS (+) FOR NEXT (E) TO SELECT.

- Press (E) to select the value you wish to change. The display will flash the current span value and will scroll the prompt PRESS (+) or (-) TO SET (E) TO ENTER.
- Press the (+) and (-) minus keys to set the desired span value and (E) to enter the value into memory. Once the value has been entered into memory, it will become the standard span gas value used during instrument calibration.
- Press the MODE switch to return to the SETSPAN function.

6.2 ALARMS

The ALARMS function allows you to set the values for the HI and LOW alarms for each installed sensor. Default alarm settings for each gas are listed in Section 11. If the hygiene/datalogging option is installed, you will also be able to set the STEL and TWA alarm values.

- Press (+) to step from the SETSPAN function to the ALARMS function.
- Press (E) to enter the ALARMS function. The LATCH function will lock the alarm indicators on when a monitored gas concentration reaches the high alarm setpoint. The alarm will reset after the gas concentration has fallen below the alarm setpoint and the user has pressed the (E) key. The display will indicate LATCH along with the scrolling prompt PRESS (+) FOR NEXT (E) TO SELECT.

- Press (E) to select the LATCH function. The display will indicate LATCH along with the prompt PRESS (+) FOR NEXT (E) TO SELECT.
- Press (E) to set the TMX412 high alarm latch as ON or OFF. Press MODE to return to the LATCH screen.

- Press (+) to step to the INSTANT function and set instantaneous alarm values. The display will indicate INSTANT along with the scrolling prompt PRESS (+) FOR NEXT (E) TO SELECT.

- Press (E) to enter the instantaneous alarms function. The display will show the first alarm to be set along with the scrolling prompt PRESS (+) FOR NEXT (E) TO SELECT. The alarm type will be indicated on the display as either high (H) or low (L).
- Press (E) to select the desired alarm to be changed. The display will flash the current alarm value along with the prompt PRESS (+) OR (-) TO SET (E) TO SELECT.
- Press the (+) and (-) keys to set the desired alarm value and (E) to enter the value into memory.
- Press MODE to return to the INSTANT function.
- Press (+) to step to the TWA and STEL alarm functions. The TWA and STEL alarm values are set as previously described.

6.3 BATTERY

The BATTERY option allows the user to select the type of battery installed in the unit. The setting configures the battery indicator to accurately display the discharge rate of the selected battery type.

Change the battery setting as follows:

1. From Setup, access the BATTERY option by pressing the hidden + key until "BATTERY" appears on the display and then press the E key.
2. Press the hidden + key to toggle between battery types. The display will show "NCD/LI" for Ni-Cad or lithium batteries and "ALKALNE" for alkaline batteries.
3. Press the E key to select battery type shown.
4. Press the Mode key twice to return to Reading Mode for normal operation of the instrument.

6.4 CODE

The CODE function allows the user to select a security code to protect calibration and all instrument alarm settings. When the code is set to any value other than “0”, the user will be prompted to enter the proper code prior to entering the settings or calibration modes.

CODE
PRESS

CODE 123
PRESS

- Press (+) to step from the ALARMS function to the CODE function.
- Press (E) to enter the code function. The display will show the current code setting along with the scrolling prompt PRESS (+) OR (-) TO SET (E) TO ENTER.
- Press the (+) and (-) keys to set the code to any value between 0 and 999, and (E) to enter the value into memory.
- Press MODE to return to the CODE function.

7. HYGIENE FUNCTIONS

7.1 DEFINITION OF TERMS

7.1.1 DATA LOG

Record of measured gas concentrations, including time and date, stored in the instruments electronic memory.

7.1.2 PERIOD

The logging time that begins when the instrument is turned on and begins normal operation and lasting until the instrument is turned off.

7.1.3 LOGGING SESSION

One or more periods of normal instrument operation between hygiene function resets.

7.1.4 REAL TIME CLOCK

A clock function in the instrument that maintains the current time.

7.1.5 LOG TIME CLOCK

A clock function in the instrument that monitors the length of time logged during a session.

7.1.6 CALENDAR

A part of the real time clock function that maintains the current date.

7.1.7 TWA (TIME-WEIGHTED AVERAGE)

The accumulated gas exposure averaged over a predetermined time, typically eight hours.

7.1.8 STEL (SHORT TERM EXPOSURE LIMIT)

The accumulated gas exposure value averaged for the proceeding fifteen minutes.

7.2 PRINCIPLES OF OPERATION

If the TMX412 is equipped with the hygiene option, all instantaneous readings of valid installed sensors are sent to the hygiene module. Once every minute, the readings are averaged, the average values are saved to the data log and the TWA and STEL values are calculated for the toxic sensors. The TWA and STEL values are then tested for possible alarm conditions.

The default time base for calculating TWA values is eight hours. However, the time base may be changed to any integer value in the range of one to 40 hours using the optional TMX Hygiene Software and a personal computer.

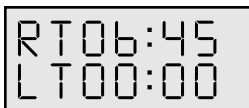
The 130,816 byte memory provides storage capacity for approximately 110 hours of logged data with four sensors installed. The data logging section of the instrument is always powered and a battery backup circuit protects from loss of data for up to 40 minutes during battery changes.

NOTE: *The instrument must be stored on a battery charger when not in use to prevent loss of data due to battery discharge.*

7.3 RESETTING THE HYGIENE FUNCTIONS

NOTE: *If the data logging feature is to be used, ensure the correct date and time information is logged by checking/setting the Real Time Clock and Calendar using the optional TMX Hygiene Software.*

- Press MODE repeatedly to step to the HYGIENE screen.
- Press (E) to reset the hygiene function and begin a new data logging session.



RT 06:45
LT 00:00

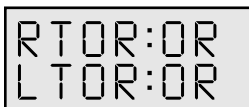
The instrument display will return to the LOG TIME mode and the display will indicate that the log time (LT) will be reset to 00:00. The TWA and STEL values for all toxic sensors will also be reset to zero.



RTOR:OR
LT 00:00

If there is insufficient memory to log approximately 12 hours of data when the hygiene function is reset, the real time clock value will be displayed as RTOR:OR.

When the data memory is full, both the real time and log time will be displayed as OR:OR.



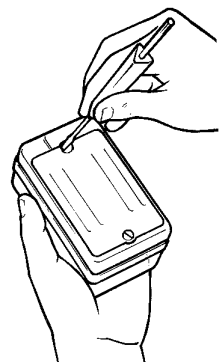
RTOR:OR
LTOR:OR

The data memory may be cleared when full by performing a hygiene reset as described above. All currently stored data will be overwritten. The stored data may be downloaded using the TMX hygiene software.

8 MAINTENANCE

8.1 CLEANING

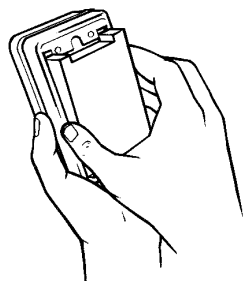
Wipe the outside of the instrument with a soft, clean cloth. Never use solvents or cleaning solutions of any type.



8.2 CHANGING THE BATTERY

To change the TMX412 battery pack:

- Hold the instrument with battery cover facing up.
- Turn the battery cover latches counter-clockwise one quarter of a turn using the maintenance tool supplied to release the cover.
- Gently press down on the bottom of the battery pack to release the top contacts.
- Grasp the battery along the edges and lift out.
- Insert replacement battery, and replace battery cover.
- Turn the latches one quarter turn in the clockwise direction to secure the battery cover.



WARNING: When changing lithium battery cells, replace the cells within the lithium battery pack in a non-hazardous location. Replace the lithium cells with three Duracel DL123A or three Panasonic CR123A or three Sanyo CR123A 3.0 volt lithium battery cells only. Use of another battery may present a risk of fire or explosion.

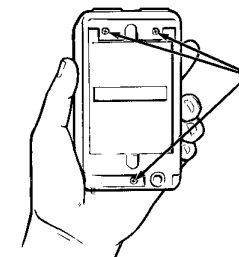
WARNING: Lithium battery cells may explode if mistreated. Do not recharge, disassemble, or dispose of in fire. Do not charge the replaceable lithium battery pack either while it is installed in, or removed from the instrument.

WARNING: The 1704-9889 replaceable lithium battery pack is not approved for use in applications or areas requiring MSHA approval.

WARNING: Australian TMX412, p/n 1810-2434, is to be used with Nicad battery pack p/n 1705-4735 only.

8.3 OPENING THE INSTRUMENT FOR SERVICE

- Remove the battery cover and battery.
- Remove the three screws that hold the instrument case halves together.
- Grasp the bottom half of the instrument with one hand. Using the other hand, lift the top until it clears the sensors. Then place it face down next to the instrument. Use care not to damage the flex cable connecting the case top to the main circuit board.



8.4 REPLACING WATER BARRIERS

When the sensor water barrier becomes clogged or damaged, it is necessary to replace them.

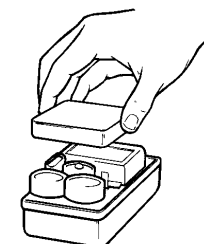
To replace the water barrier:

- Lift the water barrier and filter screen from inside the top case half and remove.
- Place the new water barrier and filter screen in the top case half.



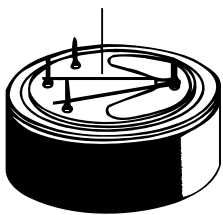
8.5 INSTALLING OR CHANGING SENSORS

- Open the instrument as described.
- Carefully remove the sensor shroud by lifting it straight up.



NOTE: *The TMX412 must be calibrated whenever a sensor is installed or replaced. All installed sensor types are shown on the Sensor Configuration screen during instrument start-up. However, a fault condition will be indicated if the instrument has not been calibrated for any of the installed sensor types. When a new oxygen sensor is installed, allow 15 minutes for it to stabilize before attempting calibration. If the toxic sensor is replaced with a different type or the combustible sensor is reconfigured, the alarm settings must be changed to reflect the appropriate alarm settings for the sensor installed.*

Shorting Wire

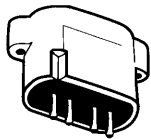


8.5.1 TOXIC SENSOR REMOVAL/REPLACEMENT

- To remove the toxic sensor, grasp the sensor and lift it straight up. Use care to avoid bending the sensor pins.

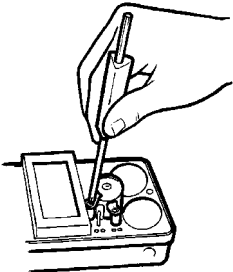
WARNING: *When removing the toxic sensor for storage, connect a shorting wire to the two pins as shown.*

- New sensors are shipped with a shorting wire attached. **Remove the shorting wire from the new sensor.**
- Immediately install the sensor in the instrument. Never apply pressure to the area inside of the black O-Ring seal at the top of the sensor.



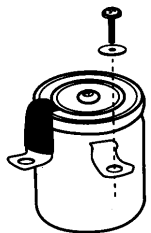
8.5.2 COMBUSTIBLE SENSOR REMOVAL/REPLACEMENT

- To remove the combustible sensor, grasp the sensor and lift it straight up.
- When installing the combustible sensor, align the notch on the sensor body with the polarizing pin on the sensor board.



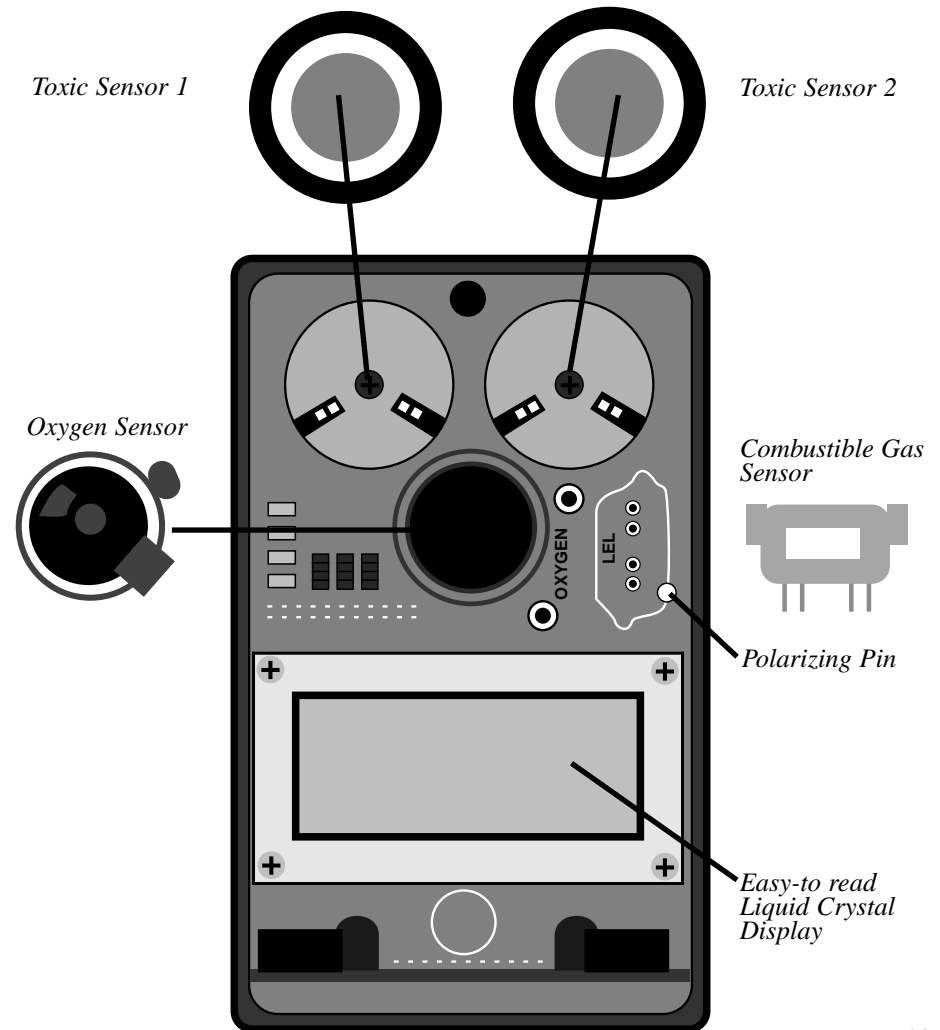
8.5.3 OXYGEN SENSOR REMOVAL/REPLACEMENT

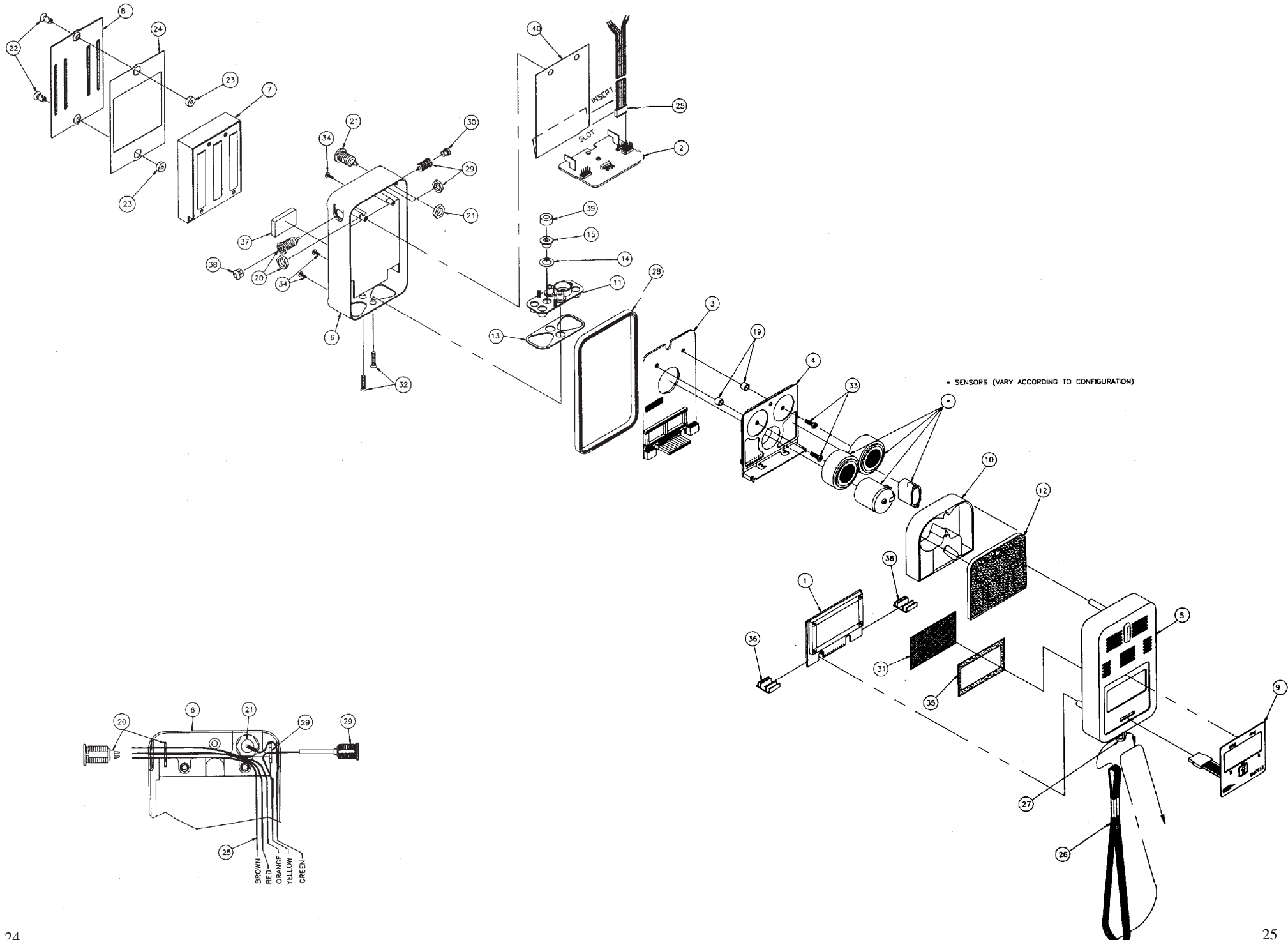
- Remove the two mounting screws and nylon washers using the maintenance tool or small Phillips screwdriver.
- Bend the two mounting tabs out as shown before installing the new sensor.



8.6 INSTRUMENT REASSEMBLY AFTER SERVICE

- Reassemble the instrument by aligning the two posts with the corresponding openings in the circuit board. Gently fit the instrument case halves together, making certain that the gasket is properly seated, and the flex cable is not pinched between the buzzer and the instrument case top.
- Replace and tighten the three retaining screws until they are firmly seated. Do not overtighten.
- Replace the battery and battery cover.





9. REPLACEMENT PARTS

The following items numbers refer to the exploded view drawing on pages 24 and 25.

ITEM	PART NUMBER	DESCRIPTION (QTY)
1	1704-2680	Display P.C. Board Assembly (1)
or	1705-4222	Display P.C. Board Assembly (1) <i>(Australian Version Only)</i>
2	1705-0660	Alarm P.C. Board Assembly (1)
or	1705-4214	Alarm P.C. Board Assembly (1) <i>(Australian Version Only)</i>
3	1705-0759	Main P.C. Board Assembly (1)
4	1705-0857	Sensor P.C. Board Assembly (1)
5	1705-0753	Case Top Assembly (1)
6	1703-8654	Case Bottom Assembly (1)
7	1704-1872	Nicad Battery Pack (1)
or	1705-4735	Nicad Battery Pack (1) <i>(Australian Version Only)</i>
8	1703-7169	Battery Case Cover (1)
9	1705-0661	Keypad/Faceplate (1)
10	1703-6930	Sensor Shroud (1)
11	1703-7045	Alarm Bezel (1)
12		Sensor Barrier/Seal (1), consists of:
	1705-0479	Sensor Membrane
	1707-8635	Sensor Gasket
13	1703-8118	Alarm Bezel Gasket (1)
14	1703-8746	Mode Button Seal (1)
15	1704-8927	Mode Button (1)
19	1703-7235	Circuit Board Spacer (2)
20	1703-8134	Receptacle, 3 Contact (1)
21	1704-2151	Charging Jack (1)
22	1703-9660	Dzus Stud (2)
or	1705-2827	Dzus Stud (2) <i>(Australian Version Only)</i>
23	1704-2722	Stud Seal (2)
24	1704-4017	Battery Cover Gasket (1)
25	1704-1823	5 Conductor Cable (1)
26	1704-9876	Instrument Strap (1)
27	1704-7994	Split D-Ring (1)
28	1703-1782	RFI Case Gasket (1)
29	1702-8374	External Alarm Jack (1)
30	1702-9273	Hole plug (1)
31	1705-0295	RFI Screen (1)
32	1704-4249	Screw, FHCR 4-40 x .47 SST (2)
33	1703-3689	Screw, PHCR 4-40 x .25 SST (2)
34	1704-2219	Screw, FHCR 4-40 x .38 SST (3)
35	1704-9736	Conductive Tape, RF Screen (1)
36	1705-0776	Circuit Board Support (2)
37	1704-3308	Battery Spacer (1)
38	1704-4066	Data Port Plug (1)
39	1704-6764	Mode Switch Spacer
40	1704-9685	Main Board Insulator

10. SPECIFICATIONS

CASE:	Stainless Steel
DIMENSIONS:	4.75"L x 2.75"W x 2"H (121 X 70 X 51 mm)
WEIGHT:	26 ounces (738 grams)
SENSORS:	Combustible Gases and Methane-Catalytic Oxygen and Toxic Gases-Electrochemical
MEASURING RANGE:	
LEL (Combustible Gases)	0 to 100% in 1% increments
CH ₄ (Methane)	0 to 5% of volume in 0.1% increments
O ₂ (Oxygen)	0 to 30% of volume in 0.1% increments
CO (Carbon Monoxide)	0 to 999 PPM (parts per million) in 1 PPM increments
H ₂ S (Hydrogen Sulfide)	0 to 999 PPM (parts per million) in 1 PPM increments
SO ₂ (Sulfur Dioxide)	0.2 to 99.9 PPM (parts per million) in 0.1 PPM increments
NO ₂ (Nitrogen Dioxide)	0.2 to 99.9 PPM (parts per million) in 0.1 PPM increments
Cl ₂ (Chlorine)	0.2 to 99.9 PPM (parts per million) in 0.1 PPM increments
ClO ₂ (Chlorine Dioxide)	0 to 99.9 PPM (parts per million) in 0.1 PPM increments
POWER SOURCE:	Rechargeable, replaceable nickel-cadmium battery pack, replaceable cell lithium battery pack or 9-volt alkaline battery packs
BATTERY LIFE:	With Combustible Sensor 10 hours (Nicad) Without Combustible Sensor 10 days (Nicad)
READOUT:	Alpha-Numeric Liquid Crystal Display
TEMPERATURE RANGE:	Continuous Operation — -20°C to 50°C (-4°F to 122°F)

Intermittent Operation (Up to 8 hours) —

Carbon Monoxide	-20°C to 55°C (-4°F to 131°F)
Chlorine	-20°C to 55°C (-4°F to 131°F)
Hydrogen Sulfide	-40°C to 50°C (-40°F to 122°F)
Nitrogen Dioxide	-20°C to 55°C (-4°F to 131°F)
Oxygen	-20°C to 55°C (-4°F to 131°F)
Sulfur Dioxide	-20°C to 55°C (-4°F to 131°F)
Chlorine Dioxide	-20°C to 50°C (-4°F to 122°F)

HUMIDITY RANGE: 15% to 90% RH (Continuous Operation)
(Non Condensing) 0% to 99% RH (Intermittent Operation)

STORAGE TEMPERATURE: 0°C to 20°C (32°F to 68°F)

11. DEFAULT ALARM SETTINGS

GAS	LOW ALARM	HIGH ALARM
O ₂	19.5%	23.5%
LEL	10%	20%
CH ₄	1.0%	1.5%
CO	35 PPM	70 PPM
H ₂ S	10 PPM	20 PPM
SO ₂	2.0 PPM	4.0 PPM
NO ₂	3.0 PPM	6.0 PPM
Cl ₂	0.5 PPM	1.0 PPM
ClO ₂	0.3 PPM	1.0 PPM

12. TMX412 OPTIONS & ORDERING INFORMATION

PART NUMBER	DESCRIPTION (QTY)
1704-1856	Combustible Sensor
1702-3516	Oxygen Sensor
1704-1898	Hydrogen Sulfide Sensor
1704-1880	Carbon Monoxide Sensor
1707-3271	Chlorine Sensor
1704-1922	Nitrogen Dioxide Sensor
1704-1906	Sulfur Dioxide Sensor
1706-7174	Replaceable 9-volt Alkaline Battery Pack (includes 2)
1810-2252	115 VAC Compact Economy Charger
1810-2251	115 VAC Two Unit Compact Charger
1810-2558	115 VAC Two Unit Dual Rate Charger
1810-2255	115 VAC Four Unit Dual Rate Charger
1810-2517	230 VAC Four Unit Dual Rate Charger
1810-2566	230 VAC Four Unit Dual Rate Charger
1810-2756	230 VAC Two Unit Compact Charger (<i>Australian Version</i>)
1810-2231	230 VAC Two Unit Compact Charger
1810-1972	230 VAC One Unit Dual Rate Charger
1810-2145	12 VDC One Unit Compact Charger
1810-1915	12 VDC Two Unit Dual Rate Charger
1810-2156	SP402 Sampling Pump with hose (UL)
1810-2169*	SP402 Sampling Pump with hose (CSA)
1810-2285	Constant Flow Hand Pump with Hose
1810-1386	Stainless Steel Extendible Probe - 6ft.
1810-1428	Polycarbonate Probe
1704-1872	Rechargeable Nicad Battery Pack
1704-4735	Rechargeable Nicad Battery Pack (<i>Australian Version</i>)
1707-4204	Chlorine Dioxide Sensor
1704-9889	Replaceable Lithium Battery Pack (includes 3)
1704-7747	Replacement Lithium Battery Cell
1810-1824	Leather Carrying Case for TMX412
1810-2161	Leather Combination Carrying Case for SP402/TMX412
1810-2177	Leather Handle for 1810-2161 Carrying Case
1810-4240	Nylon Carrying Case for TMX412
1810-4109	Nylon Combination Carrying Case for TMX412/SP402
1810-3747	External Audible/Visual Alarm (103 db)
1810-2146*	Vibrating Alarm
1810-2187	Cylinder Cal. Gas, H ₂ S, CO, Pentane, Oxygen
1810-1576	Cylinder, Cal. Gas, Carbon Monoxide, Pentane and Oxygen
1810-2165	Cylinder, Cal. Gas, Carbon Monoxide, Methane and Oxygen
1810-1584	Cylinder, Cal. Gas, Zero Air
1810-2222	Cylinder, Cal. Gas, 5 PPM Sulfur Dioxide
1810-1758	Cylinder, Cal. Gas, 10 PPM Chlorine
1810-2219	Cylinder, Cal. Gas, 5 PPM Nitrogen Dioxide
1810-1766	Flow Regulator with Pressure Gauge, for all cylinders except Ammonia
1704-4157	Teflon Lined Tygon Tubing (24")
1704-2839	Calibration Cup

13. WARRANTY

Industrial Scientific portable gas monitoring instruments are warranted to be free from defects in material and workmanship for as long as the instrument is in service.

The above warranty does not include sensors, battery packs, internal pumps or filters, all of which are warranted to be free from defects in material and workmanship for eighteen months from the date of shipment, or one year from the date of first use, whichever occurs first, except where otherwise stated in writing in Industrial Scientific literature accompanying the product.

All other Industrial Scientific products are warranted to be free from defects in material and workmanship for a period of eighteen (18) months from the date of shipment, or one (1) year from the date of first use, whichever occurs first, except where otherwise stated in writing in Industrial Scientific literature accompanying the product.

LIMITATION OF LIABILITY

INDUSTRIAL SCIENTIFIC MAKES NO OTHER WARRANTIES, EITHER EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE.

SHOULD THE PRODUCT FAIL TO CONFORM TO THE ABOVE WARRANTY, BUYER'S ONLY REMEDY AND INDUSTRIAL SCIENTIFIC'S ONLY OBLIGATION SHALL BE, AT INDUSTRIAL SCIENTIFIC'S SOLE OPTION, REPLACEMENT OR REPAIR OF SUCH NON-CONFORMING GOODS OR REFUND OF THE ORIGINAL PURCHASE PRICE OF THE NON-CONFORMING GOODS. IN NO EVENT WILL INDUSTRIAL SCIENTIFIC BE LIABLE FOR ANY OTHER SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING LOSS OF PROFIT OR LOSS OF USE, ARISING OUT OF THE SALE, MANUFACTURE OR USE OF ANY PRODUCTS SOLD HEREUNDER WHETHER SUCH CLAIM IS PLEADED IN CONTRACT OR IN TORT, INCLUDING STRICT LIABILITY IN TORT.

It shall be an express condition to Industrial Scientific's warranty that all products be carefully inspected for damage by Buyer upon receipt, be properly calibrated for Buyer's particular use, and be used, repaired, and maintained in strict accordance with the instructions set forth in Industrial Scientific's product literature. Repair or maintenance by non-qualified personnel will invalidate the warranty, as will the use of non-approved consumables or spare parts. As with any other sophisticated product, it is essential and a condition of Industrial Scientific's warranty that all personnel using the products be fully acquainted with their use, capabilities and limitations as set forth in the applicable product literature.

Buyer acknowledges that it alone has determined the intended purpose and suitability of the goods purchased. It is expressly agreed by the parties that any technical or other advice given by Industrial Scientific with respect to the use of the goods or services is given without charge and at Buyer's risk; therefore, Industrial Scientific assumes no obligations or liability for the advice given or results obtained.