User Guide

ALTAIR io 4

Gas Detection Wearable

MSA
The Safety Company

MSA - The Safety Company
1000 Cranberry Woods Drive
Cranberry Township, PA 16066
USA
Phone 1-800-MSA-2222
Fax 1-800-967-0398

For your local MSA contacts, please go to our website www.MSAsafety.com

Contents

1   Safety Notices

1.1   General Notices

- For Declaration of Conformity, please visit the product page on MSAsafety.com.

- This product incorporates Bluetooth wireless technology.

- Alternative use or use outside manufacturer specifications will be considered non-compliance. This also applies to unauthorized alterations of the product and to commissioning work that has not been carried out by MSA or authorized persons.

- Use of any charger other than the charger supplied with the device or sold by MSA for use with the ALTAIR io 4 may damage or improperly charge the battery.

⚠ WARNING!

- Cellular connectivity is dependent upon signal availability and strength of the wireless service(s) necessary to maintain the communication link. Loss of cellular connectivity will prevent remote communication of alerts and other data from the device to the Grid as well as from the Grid to the device. Low signal strength will delay remote communication of alerts and other data from the device to the Grid as well as from the Grid to the device. Take appropriate precautions in the event of a loss of cellular connectivity or low signal strength.

- When cellular connectivity is restored, data from the time period without cellular connectivity is transmitted to the cloud before the device begins communicating current alerts and data to the Grid. This may result in a delay between when cellular connectivity is restored and when the device can be monitored on the Grid.

Failure to follow these warnings can result in serious personal injury or death.

1.2   Liability

MSA accepts no liability in cases where the device has been misused, used inappropriately or not used as intended. MSA accepts no liability in cases where damage or injury is caused by wear and tear, neglect or failure to carry out inspection and maintenance procedures. The selection and use of the device are the exclusive responsibility of the employer and/or individual operator. Warranties and guarantees made by MSA with respect to the device are voided, if it is not used, serviced or maintained in accordance with the instructions in this manual.

The selection and use of this product must be under the direction of a qualified safety professional who has carefully evaluated the specific hazards of the jobsite where it will be used and who is completely familiar with the product and its limitations. The selection and use of this product and its incorporation into the safety scheme of the jobsite is the exclusive responsibility of the employer.

Changes and modifications not expressly approved by the manufacturer will void the user's authority to operate the equipment.

Follow all relevant national regulations applicable in country of use.

1.3   Before You Start

⚠ WARNING!

Carefully review the following safety limitations and precautions before placing this device in service. Do not alter or modify the device.

Failure to follow this warning can result in serious personal injury or death.

Before getting started with the ALTAIR io 4, there are several things to know. Please read this user guide carefully before using the device. The device will perform as designed only if it is used and maintained in accordance with the manufacturer's instruction. Otherwise, it could fail to perform as designed and persons who rely on this device for their safety could sustain serious personal injury or death. In addition to manufacturer instructions, applicable national regulations should be considered for safe use.

1.3.1 General Warnings and Precautions

⚠ WARNING!
- Use the device only to detect gases/vapors for which a sensor is installed.
- Do not use the device to detect combustible dusts or mists.
- Do not open the device in an explosive atmosphere.
- Do not use the device if:
  - the function test is unsuccessful,
  - the device is damaged,
  - a competent servicing/maintenance has not been completed, or
  - genuine MSA spare parts have not been used.
- If the device is subjected to physical shock, the device must pass calibration before continuing use.
- Charging the device in a hazardous environment poses a risk of explosion. Do not charge the device in a hazardous area.
- Do not use silicone-type lubricants when assembling the detector, and do not allow silicone vapors to be drawn into the flow system while in operation. Silicone can desensitize the combustible gas sensor, thereby giving erroneously low readings.

Failure to follow this warning can result in serious personal injury or death.

1.3.2 Functional Check

Before each day's use, check the function of the device. To power on the device to check its functionality, refer to the Power On and Off section. Once the device is powered on, the display will activate and the device will complete a start-up sequence, during which you should observe proper function of the:

- Display
- Alert LEDs
- Horn
- Vibration

1.3.3 Gas Measurement

Combustible Gas

Do not use the device to test for combustible gases in atmospheres containing vapors from liquids with a high flash point [above 38 °C (100 °F)], as this may result in erroneously low readings.

CSA requires (per CAN/CSA-C22.2 No. 60079-29-1) that combustible sensor sensitivity be tested before each day's use on a known concentration of methane equivalent to 25 to 50 % of full-scale concentration. Accuracy must be within 0 to +20 % of actual.

When the combustible gas sensor reading reaches its maximum range, the device enters a locked alarm state to protect the sensor, the sensor shuts down, and the user interface displays "overrange" in the combustible sensor tile. This state can be reset by turning the device off and on in a fresh-air environment. Keep the device in the fresh air environment until sensor readings have stabilized and then zero the sensors.

⚠ WARNING!

The minimum concentration of a combustible gas in air that can ignite is defined as the Lower Explosive Limit (LEL). A combustible gas reading of "overrange" indicates that the atmosphere is above 100% LEL and an explosion hazard exists.

Do not use the device for prolonged periods in an atmosphere containing a concentration of fuel or solvent vapors that may be greater than 10% LEL. Move away from the hazardous area immediately.

Failure to follow this warning can result in serious personal injury or death.

1.3.4　Physical Shock

If the device is subjected to a physical shock, complete the steps in Calibration.

1.3.5　Sensors

- Do not block sensor openings as this may cause inaccurate readings.
- Do not press on the face of the sensors, as this may damage them and cause erroneous readings.
- Do not use compressed air to clean the sensor holes, as the pressure may damage the sensors.

Allow sufficient time for device to display accurate reading. Response times vary based on the type of sensor being utilized.

NOTE: While the device can detect up to 30% oxygen in ambient air, it is approved for use only up to 21% oxygen in hazardous locations.

1.3.6　Battery

Use only battery chargers made available by MSA for use with this device; other chargers may damage the battery pack and the device. As the battery pack ages, there will be a reduction in usable device runtime.

1.3.7　Environmental Conditions

General

⚠ WARNING!

- Do not use the device to test for combustible or toxic gases in the following atmospheres as this may result in erroneous readings:
  - Reducing atmospheres
  - Furnace stacks
  - Inert environments
  - Atmospheres containing combustible airborne mists/dusts.
- Do not use the device to test for toxic gases in oxygen-deficient (<19.5 % vol) or oxygen-rich (>20.8 % vol) atmospheres, as this may result in erroneous readings.
- Do not use the device to test for combustible gases in atmospheres <10% vol oxygen, as this may result in erroneous readings.

- Use the device only to detect gases/vapors for which a sensor is installed.

Failure to follow these warnings can result in serious personal injury or death.

Many environmental factors may affect the sensor readings, including changes in atmospheric pressure, humidity and temperature. Pressure and humidity changes also affect the amount of oxygen present in the atmosphere.

Pressure

If pressure changes rapidly (e.g., stepping through airlock), the oxygen sensor reading may temporarily shift and possibly cause the device to go into alarm. While the percentage of oxygen may remain at or near 20.8 Vol %, the total amount of oxygen present in the atmosphere available for respiration may become a hazard if the overall pressure is reduced by a significant degree.

It is recommended that an oxygen calibration be performed at the temperature and pressure of use. Ensure that the device is in known fresh air before performing a calibration.

Humidity

If humidity changes by any significant degree (e.g., going from a dry, air conditioned environment to outdoor, moisture laden air), oxygen readings can be reduced by up to 0.5 %, due to water vapor in the air displacing oxygen.

The oxygen sensor has a special filter to reduce the effects of humidity changes on oxygen readings. This effect will not be noticed immediately, but slowly impacts oxygen readings over several hours.

Temperature

The sensors have built-in temperature compensation. However, if temperature shifts dramatically, the sensor reading may shift. Zero the device at the work site temperature to minimize the effect of temperature changes.

1.3.8 Storage

When not in use, store the device in a safe, dry place between 18 °C (64 °F) and 30 °C (86 °F).

⚠ WARNING!

Do not store the device where silicone vapors are present or in the presence of silicone components, lubricants, cleaners or other substances containing silicone. Silicone can desensitize the combustible gas sensor, thereby giving erroneously low readings. Calibrate the detector upon removal from storage and prior to use.

Failure to follow this warning can result in serious personal injury or death.

2   Welcome

The ALTAIR io 4 is a Gas Detection Wearable capable of monitoring ambient air with enhanced safety features to help protect the user. It is for use by trained and qualified personnel. It can be configured to include up to 3 sensors, which can detect up to 4 gases including:

- Combustible gases and certain combustible vapors
- Oxygen-deficient and oxygen-rich atmospheres
- Specific toxic gases for which a sensor is installed
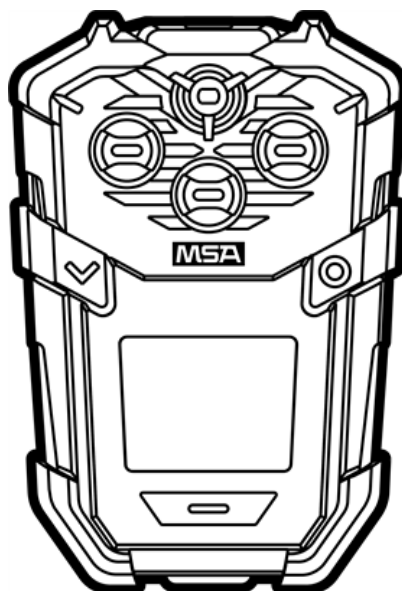
2.1   ALTAIR io 4 Design

The ALTAIR io 4 was designed to simplify and improve your gas detection experience. The device leverages cellular connectivity to assist with gas detection and other safety features. ALTAIR io 4 design features include:

- Every device is powered by integrated cellular connectivity.
- Grid, a cloud-based industrial safety software platform, is a deeply integrated and necessary part of the ALTAIR io 4 experience.
- Device data is streamed to the cloud and accessible from your Grid account.
- Configuration of 1, 10 or 10,000 devices can be done with the click of a button through Grid and each device's cellular connection—anywhere in the world.
- MSA id dramatically simplifies device assignment.

2.2   Grid Introduction

Grid is a cloud-based industrial safety software platform. Every ALTAIR io 4 includes and requires a Grid account because it's an integral part of the experience. All device access, configuration, software updates, and enhanced safety services are provided through your account. Additionally, as a software-as-a-service (SaaS) platform, Grid is continually delivering new features, enhancements, and updates. Some of what you can accomplish with Grid includes:

- Activate and add devices to your Grid fleet.
- Access factory calibration certificates.
- Access warranty information.

- Create, edit and apply over-the-air ALTAIR io 4 configuration to a single device or groups of devices.
- Access any ALTAIR io 4 device data logs in your Grid account.
- Create and assign MSA id Tags through the Grid mobile app.
- Manage your fleet with the Grid Fleet Manager service.
- Monitor your fleet in near-real time with the Grid Live Monitor service.
- Access and push over-the-air firmware updates to your entire fleet.

⚠️ **WARNING!**

- The MSA Grid is not a replacement for worker response to local alarms from their personal safety devices. The MSA Grid is a supplement to a defined safety program for the use of personal safety devices.
- Cellular connectivity is dependent upon signal availability and strength of the wireless service(s) necessary to maintain the communication link. Loss of cellular connectivity will prevent remote communication of alerts and other data from the device to the Grid as well as from the Grid to the device. Low signal strength will delay remote communication of alerts and other data from the device to the Grid as well as from the Grid to the device. Take appropriate precautions in the event of a loss of cellular connectivity or low signal strength.
- When cellular connectivity is restored, data from the time period without cellular connectivity is transmitted to the cloud before the device begins communicating current alerts and data to the Grid. This may result in a delay between when cellular connectivity is restored and when the device can be monitored on the Grid.

Failure to follow these warnings can result in serious personal injury or death.

2.3 ALTAIR io DOCK Introduction

ALTAIR io DOCK is a rugged automated test system that simplifies bump testing and calibration via its plug and play design. Simply place the ALTAIR io 4 into the cradle and let the device do the work. It tells Dock what test it needs to run and starts it automatically. Once complete, the Dock indicates the test results to allow the user to interpret and move forward with their work based on the results.

2.4 MSA id Introduction

Replacing paper-based processes, MSA id provides a comprehensive solution to digitally assign a device by tapping it to an MSA id Tag, and digitally return a device by simply plugging it into the ALTAIR io CHARGE.

2.5 MSA id Tags Introduction

MSA id Tags are RFID tags that can be assigned to each worker. By tapping an ALTAIR io 4 to an MSA id tag, the device is now assigned. Every ALTAIR io 4 includes one MSA id Tag.

2.6 ALTAIR io CHARGE Introduction

ALTAIR io CHARGE simplifies and organizes the charging and device return experience with its 5-port design. Simply plug the device into a port, and it will be digitally returned and begin to charge for the next use.

3 Getting Started

3.1 Overview

3.1.1 Device Management with Grid

Device management is done entirely through your included MSA Grid account, over-the-air via the device's cellular connection. To get started, please set up your account and download the Grid Mobile App from the App Store or Google Play Store.
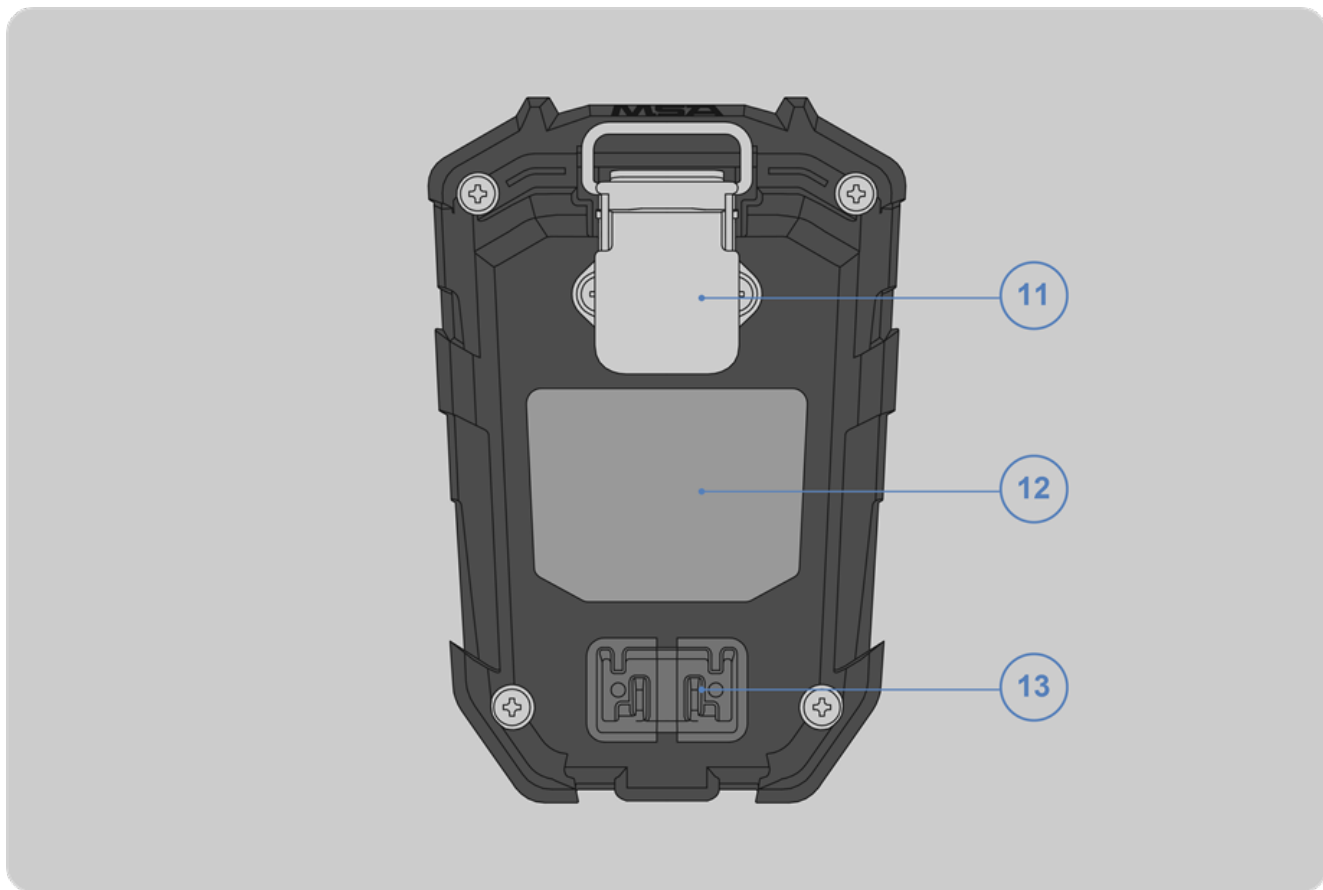
3.1.2 In the Box

- ALTAIR io 4 Gas Detection Wearable
- Quick-Start Guide with Certifications
- MSA id Tag
- USB Power Cable
- USB Power Adapters
- Calibration Cap

3.1.3 Hardware Overview

01	Left and Right LEDs	06	Right Navigation Button
02	Left Navigation Button	07	LCD Display
03	Safe LED	08	Alert Button
04	Audible Horn	09	MSA id Tag
05	Sensor Inlets	10	Calibration Clip

11	Stainless Steel Clip
12	Product Label
13	Magnetic Charging Interface

3.1.4   Home Screen
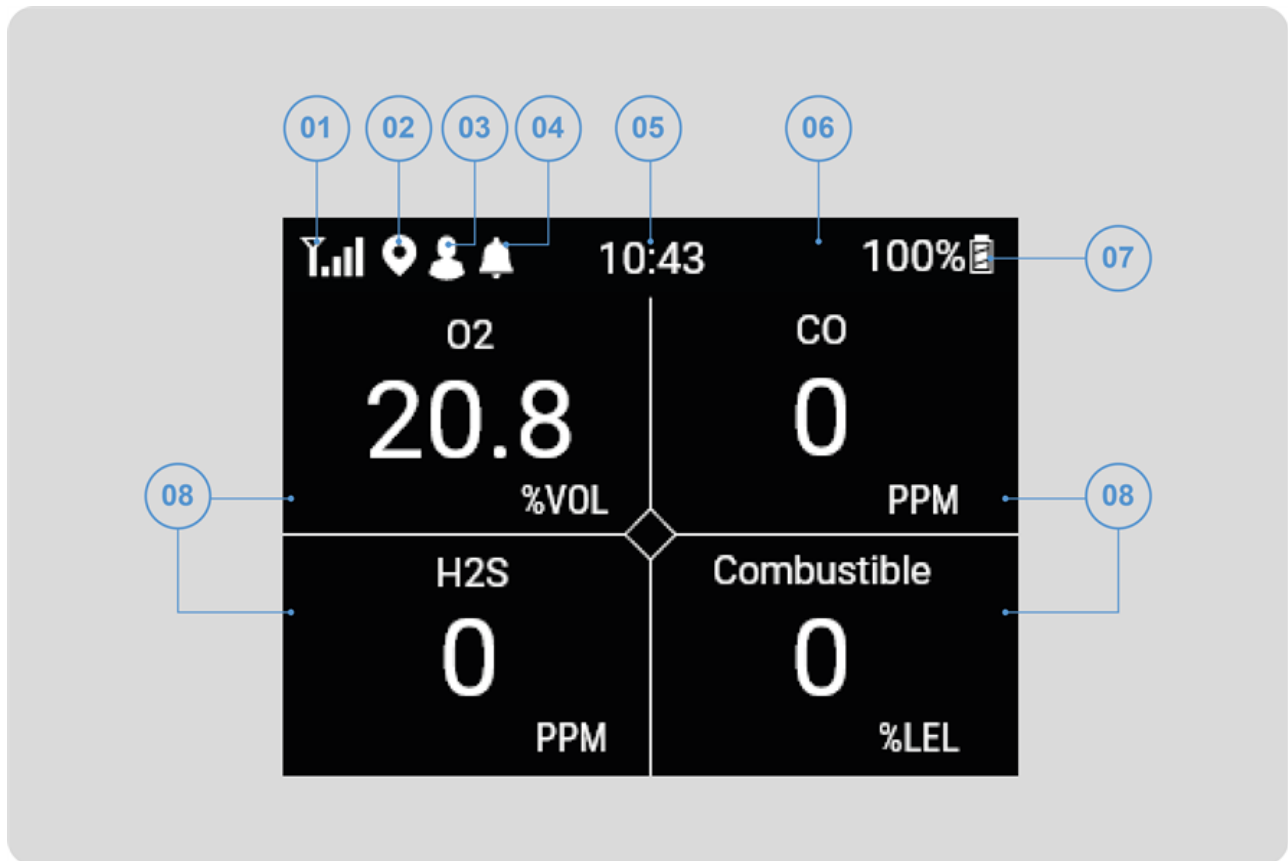
01	Cellular Connection	05	Time
02	GPS Location	06	Status Bar
03	Device Assigned	07	Battery Life
04	Notification	08	Gas Measurement Tiles

3.2   Commissioning

Commissioning devices is the process of adding assets to your Grid account and activating their cellular connectivity. Typically, devices are commissioned to the appropriate Grid account automatically at order fulfillment. However, if automatic commissioning is not performed, your Grid account can be used to complete this setup.

3.3   Operation

3.3.1   Power On and Off

To power on the device:

1. Press and hold the right navigation button for 1 second.
2. The device will proceed to the startup sequence.

The startup sequence includes the following:

- ○ Introduction screens
- ○ Self-testing
- ○ Sensor alert setpoints
- ○ Bump test and calibration information
- ○ Fresh Air Baseline (if enabled)
- ○ Lock-outs (if enabled and active)

NOTE: During power on, the device performs a self-test. This self-test ensures properly functioning display, audible horn, LEDs and vibration.

To power off the device:

1. Press and hold the right navigation button for 1 second.
2. To confirm power off, select the right navigation button on the next screen.

3.3.2   Navigation

1. To access the device menu, press the left navigation button.
2. To navigate the device menu, press the left navigation button.
3. To select a device menu option, press the left navigation button until the option is highlighted and then press the right navigation button.
4. To acknowledge an alert, press the Alert button.
5. To activate the emergency alarm, hold the Alert button for 3 seconds.

3.3.3   Safe LED

The Safe LED is used to indicate the device is safe and operational. If the device is operational, compliant, and without any active alerts, the Safe LED will slowly pulse green to intuitively communicate this to the user.

3.3.4 Charging

1. Plug the charging cable into the power source.
2. Attach the device to the magnetic charging contacts.

Status	Indicator
Charging	Static red Safe LED
Fully Charged	Static green Safe LED
Charging Error	Flashing red Safe LED
Software Update in Progress	Flashing yellow Safe LED

During periods of non-use, the charger may remain connected to the device

Allow very hot or cold devices to stabilize for one hour at room temperature before attempting to charge. Minimum and maximum ambient temperature to charge the device is 0 °C (32 °F) and 40 °C (104 °F) respectively. For best results, charge device at room temperature of 23 °C (73 °F).

Charging may be interrupted when ambient temperature moves outside of the charging temperature. In this case, the device will show an error. To resolve the error, remove the device from the charger and cease charging until the ambient temperature is within the approved temperature range of 0 °C (32 °F) to 40 °C (104 °F).

3.3.5 Battery Care

Actual battery run-time will vary depending on cellular coverage, GPS coverage, ambient temperature, usage, active alerts, acknowledgment delay of alerts, location changes, RFID reading, gas readings, device navigation, battery age, and battery cycles.

In temperatures below -20° C, use caution operating the instrument, as battery runtime may be diminished and alarm functionality may be affected near the end of battery life. Regularly observe the Safe LED to confirm that the device is operational. To reduce the impact on battery runtime and alarm functionality:

- Use a fully charged battery.
- Prior to use, power device on in room temperature environment.
- Alternate operation between cold temperature and room temperature environments.

Low Battery Level Notification

⚠ WARNING!

If Low Battery Level notification activates while using the device, leave the area immediately. The end of battery life is approaching.

Failure to follow this warning can result in serious personal injury or death.

A Low Battery Notification indicates that a nominal 1 hour is remaining before the battery's charge is depleted.

> ℹ The duration of remaining device operation during a Low Battery Level notification depends on several variables, including cellular coverage, GPS coverage, ambient temperature, usage, active alerts, acknowledgment delay of alerts, location changes, RFID reading, gas readings, device navigation, battery age, and battery cycles.

When the device goes into Low Battery Level notification:

- the current battery life percentage is indicated
- audible pattern sounds
- LED pattern occurs
- status bar UI shows low battery
- device LED continues to breathe yellow every 4 seconds
- device continues to show low battery notification.

Shutdown Sequence

⚠ WARNING!

If a Critical Battery Alarm activates or a Shutdown Sequence occurs while using the device, leave the area immediately. The device no longer has enough power to indicate potential hazards.

Failure to follow this warning can result in serious personal injury or death.

In a Shutdown Sequence:

- the device will power down with an LED pattern, a vibration, and an audible alert
- the Safe LED will stop breathing yellow.

If the device shuts down due to battery depletion while in use:

1. Leave any hazardous location immediately.

2. Recharge the battery.

ⓘ Allow very hot or cold devices to stabilize for one hour at room temperature before attempting to charge.

3.3.6   Viewing Device Information

1. Open the Main menu and select **Device info**.

2. Select one of the following menu options:

   ○ Calibration info: View dates for the latest and upcoming calibration and bump tests.

     ▪ Upcoming calibration dates are determined by the Grid-configured settings.

   ○ Sensor alert levels: View gas levels for each warning or alarm.

   ○ About: View important information such as the owner name, Device ID, software version and serial numbers.

   ○ Exit: Return to the previous menu.

3.4   Bump Test and Calibration

3.4.1   Bump Test

A bump test quickly confirms that the gas sensors are functioning. Perform a full calibration to ensure accuracy.

There are two methods to perform a bump test on the ALTAIR io 4:

- Automatically through the ALTAIR io DOCK
- Manually using proper calibration gas, regulator, tubing, and a calibration cap.

Bump test frequency is often stipulated by national or corporate regulations; however, bump testing before each day's use is generally the accepted best safety practice. Perform a bump test more frequently if the device is subjected to physical shock or high levels of contaminants.

> ⚠ **WARNING!**
>
> - Perform the bump test per the instructions in this user guide. Do not continue operation of a detector that is not able to pass a bump test.
> - Perform a bump test more frequently if the tested atmosphere contains the following materials, which may desensitize the combustible gas sensor and cause erroneous readings:
>
>   ○ Organic silicones
>
>   ○ Silicates
>
>   ○ Lead-containing compounds
>
>   ○ Hydrogen sulphide exposures over 200 ppm or exposures over 50 ppm for one minute.
>
> **Failure to follow these warnings can result in serious personal injury or death.**

If the device fails the bump test, perform a calibration to check sensor accuracy per the Calibration section before using the device.

ALTAIR io DOCK Bump Test

To perform the automatic bump test:

1. Insert the device with the display facing the ALTAIR io DOCK Test Stand until it clicks.
2. The appropriate test runs automatically based on the Grid-configured settings and indicates bump test results upon completion.
3. Remove the ALTAIR io 4 by pressing the gray release button.

Manual Bump Test

The manual bump test requires the following equipment:

*   Proper, Unexpired Calibration Gas Cylinder
*   0.25 liters/min. Flow Regulator
*   1/8" ID Superthane Ester Tubing
*   Calibration Cap

To perform the manual bump test:

1. Verify the gas concentrations displayed match calibration gas cylinder.
2. Navigate to the bump test menu option.
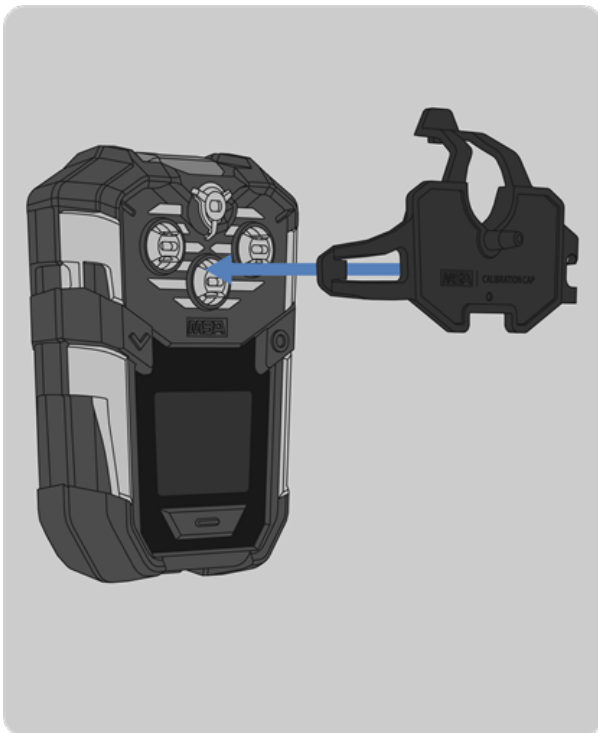
3. Install the calibration cap.
    a. Insert the tab on the calibration cap into the left slot on the device.
    b. Press the calibration cap until it seats onto the device.
    c. Press both the top and right tab down onto the device until they snap into place.
    d. Ensure the calibration cap is properly seated.
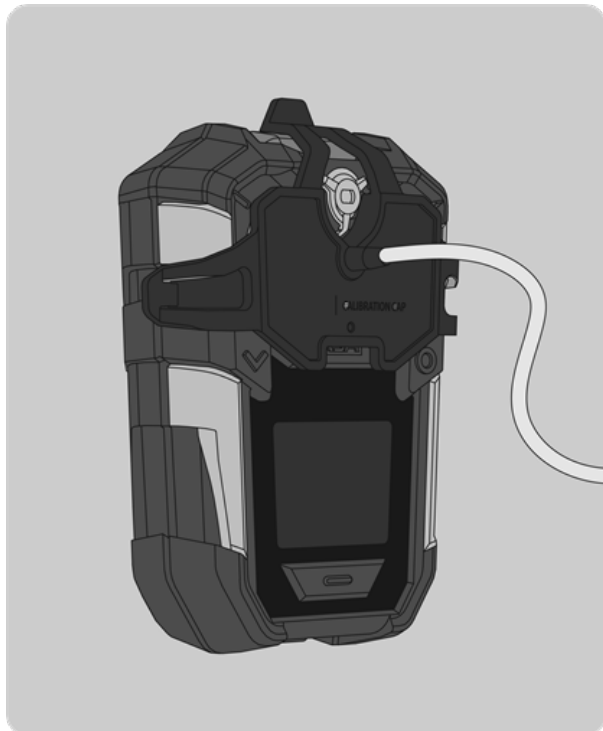
e. Connect one end of the tubing to the calibration cap.

f. Connect the other end of the tubing to the gas regulator.

4. Select **Start** to begin the bump test.

5. Open the pressure reducer valve on the calibration gas cylinder.

6. The device will display the bump test results.

7. Close the valve after bump testing.

8. Remove the calibration cap.

3.4.2   Calibration

There are two methods to perform a calibration on the ALTAIR io 4

- Automatically through the ALTAIR io DOCK
- Manually using proper calibration gas, regulator, tubing, and a calibration cap

Manual calibration must be performed using a flow regulator with a flow set to 0.25 liters per minute.

MSA recommends calibration at least every six months; however, many countries and/or organizations have their own calibration guidelines. The ALTAIR io 4 calibration interval can be configured to adapt to these requirements.

During zero calibration, the O_2 sensor is also span calibrated to 20.8% O_2 fresh air, adjusting the calibration curve as needed. During span calibration, the O_2 sensor's accuracy is checked against a known oxygen gas concentration without adjusting the calibration curve.

The calibration procedure adjusts the span value for any sensor that passes the calibration test; sensor span values that fail calibration are left unchanged. Since residual gas may be present, the device may briefly go into an exposure alarm after the calibration sequence is completed.

If a sensor is nearing its end of life, the device will communicate a notification to the user after a successful calibration.

If a calibration is unsuccessful for two subsequent calibrations, the device will communicate an end of sensor life warning to the user. Note that a span calibration can fail for many reasons other than a sensor at the end of its life. If a span calibration failure occurs, factors such as remaining gas in the calibration gas cylinder, gas expiration date, security of the calibration cap, etc. should be verified, and a calibration should be repeated prior to replacing the sensor.

NOTE: Live LEL readings displayed during calibration are indicative of calibrated values and are not necessarily indicative of the true LEL of calibration gas being applied. For example, if using 2.5% volume methane to calibrate to a general combustible reading, live readings during calibration will indicate a 100% LEL reading, even though calibration gas being used is only 57% LEL.

⚠ WARNING!

Perform a calibration per the instructions in this user guide. Do not continue operation of a detector that is not able to pass calibration.

Failure to follow this warning can result in serious personal injury or death.

ALTAIR io DOCK Calibration

1. Insert the device into the ALTAIR io DOCK Test Stand until it clicks.
2. The appropriate test runs automatically based on Grid-configured settings and indicates the calibration results upon completion.
3. Remove the ALTAIR io 4 by pressing the gray release button.

Manual Calibration

The manual calibration test requires the following equipment:

- Proper, Unexpired Calibration Gas Cylinder
- 0.25 liters/min. Flow Regulator
- 1/8" ID Superthane Ester Tubing
- Calibration Cap

To perform the manual calibration test:

1. Verify the gas concentrations displayed match the calibration gas cylinder.
2. Navigate to the calibration menu option.
3. On the Zero Sensors screen, select **Start** when in fresh air.

4. Assemble the calibration kit and install the calibration cap on the device:

    a. Insert the tab on the calibration cap into the left slot on the device.

    b. Press the calibration cap until it seats onto the device.

    c. Press both the top and right tab down onto the device until they snap into place.

    d. Ensure the calibration cap is properly seated.
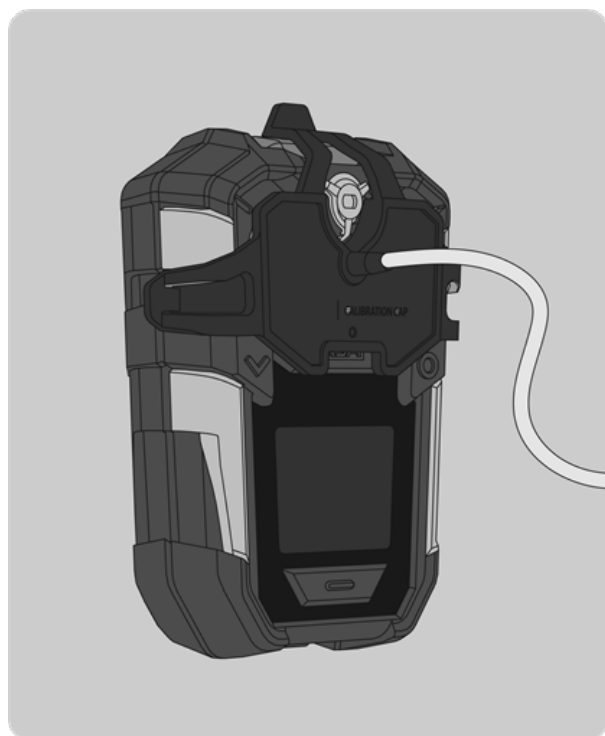
    e. Connect one end of the tubing to the calibration cap.

    f. Connect the other end of the tubing to the gas regulator (supplied in calibration kit).

5. Select **Next**.

6. Open the pressure reducer valve on the calibration gas cylinder.

7. The device will display the calibration results upon completion.

8. Close the valve after calibration.

9. Remove the calibration cap.

3.4.3 Fresh Air Baseline

⚠️ **WARNING!**

Do not activate Fresh Air Baseline unless you are certain you are in fresh, uncontaminated air; otherwise, inaccurate readings can occur which can falsely indicate that a hazardous atmosphere is safe.

If you have any doubts as to the quality of the surrounding air, do not use the Fresh Air Baseline feature. Do not use Fresh Air Baseline as a substitute for daily calibration checks. The calibration check is required to verify span accuracy.

Failure to follow this warning can result in serious personal injury or death.

The device has the ability to run a Fresh Air Baseline as part of its start-up sequence. This will baseline the sensors at zero (or 20.8% for oxygen) as long as the current sensor readings are within safe thresholds determined by the device. Fresh Air Baseline can be configured in Grid to run automatically, require user input to execute, or be turned off.

3.4.4 Zero Sensors

⚠️ **WARNING!**

Do not activate zero sensors unless you are certain you are in fresh, uncontaminated air; otherwise, inaccurate readings can occur which can falsely indicate that a hazardous atmosphere is safe.

If you have any doubts as to the quality of the surrounding air, do not use the zero sensors feature. Do not use zero sensors as a substitute for daily calibration checks. The calibration check is required to verify span accuracy.

Failure to follow this warning can result in serious personal injury or death.

Zero sensors will calibrate the zero readings (or 20.8% volume for oxygen) of the device. Zero sensors can be accessed from the device's menu. Zero sensors allows for wider sensor tolerances than a Fresh Air Baseline when it is performed.

To zero the sensors:

1. Navigate to the Zero Sensors menu option.
2. Confirm you are in fresh air.
3. Press **Start**.

4 Features

4.1 Alerts

The ALTAIR io 4 has three types of alerts that are used to notify the wearer of the device and those in its vicinity:

- Notifications: indicate action that needs to be taken soon.
- Warnings: indicate a heightened state of awareness and action may be required.
- Alarms: indicate the highest state of awareness and the user must immediately leave the area being monitored.

These alerts are used to communicate increasing levels of urgency.

Each alert type has three styles in addition to being communicated through the device display:

- Audible—through the ALTAIR io 4 horn.
- Vibrational—through the ALTAIR io 4 vibrational motor.
- Visual—through the ALTAIR io 4 LEDs.

> ⚠ **WARNING!**
>
> If a gas exposure alert or battery level alert of any type activates while using the device, leave the area immediately.
> **Failure to follow this warning can result in serious personal injury or death.**

4.1.1 Notifications

Notifications are used to indicate action that may need to be taken soon or to alert the wearer of contextual information. Notifications should be used to drive proactive compliance and maintenance. Notifications can be acknowledged by pressing the Alert button. If the alert is not acknowledged, it will be visible in the Notification screen. Alerts remain in the Notification screen until they are no longer considered active.

> ⚠ **WARNING!**
>
> If Low Battery Level notification activates while using the device, leave the area immediately. The end of battery life is approaching.
> **Failure to follow this warning can result in serious personal injury or death.**

Notification Delivery

Delivery Type	Description
Safe LED	Green flash
Audible	Casual Ringtone
Vibration	Casual Vibration
User Interface	Backlight illuminates and display communicates relevant notification in status bar

Notification Types

Notification Type	Description	Post-Acknowledgement Safe LED
Bump Test Due Now	Grid-configured bump test interval has expired.	Breathing Yellow
Calibration Due Now	Grid-configured calibration interval has expired.	Breathing Yellow
Replace Sensor Soon*	Sensor should be replaced soon but continues to be functional.	Breathing Green
Replace Sensor Now*	Sensor should be replaced now. Triggered by two consecutive failed calibrations.	Breathing Yellow
Cellular Disconnected	Cellular has been disconnected for greater than the Grid-configured threshold time.	Breathing Yellow
Low Battery Level	Battery level is < 5%.	Breathing Yellow
Device Configuration Update	Device has received an updated configuration from Grid.	Breathing Green

Notification Type	Description	Post-Acknowledgement Safe LED
*Indicates that the device detects a loss of sensor sensitivity during calibration. In addition to true loss of sensor sensitivity, the device may issue these notifications if calibration gas is expired, misapplied or not used during the span calibration. Ensure the quality of the calibration gas delivery system. Proper recalibration may remove these notifications.		

Viewing Active Notifications

1. Press the left navigation button twice.
2. Navigate to the notifications menu up.
3. Press the **Right navigation** button.

4.1.2   Warnings

Warnings are used to indicate a heightened state of awareness and action may be required. Warnings can be acknowledged by pressing the Alert button.

Warning Delivery

Delivery Type	Description	
360° LEDs	Medium Intensity Yellow LED Pattern	
Audible	Medium Intensity Ringtone	
Vibration	Medium Intensity Vibration	
User Interface	Backlight illuminates and display communicates relevant warning in status bar and gas measurement tile, if applicable.	

Warning Types	Description
Gas Warnings	
Low Gas Exposure Warning	Measurement greater than the warning threshold.
O_2 Enrichment Warning	Measurement greater than the warning threshold.
O_2 Deficiency Warning	Measurement less than warning threshold.
Underrange Warning	Measurement is below the underrange threshold of the sensor for greater than one minute.
Enhanced Safety Warnings	
Motion Detection Check-In	No detected movement within the configured threshold time.
Maintenance Warnings	
Invalid Tag Read	An invalid tag was used to assign the device.

4.1.3 Alarms

Alarms are used to indicate the highest state of awareness and action may be required. Alarms can be acknowledged by pressing the Alert button.

> ⚠️ **WARNING!**
>
> - If an alarm is triggered while using the device, leave the area immediately.
> - If the STEL alarm activates, leave the contaminated area immediately; the ambient gas concentration has reached the preset STEL alarm level. Failure to follow this warning will cause over-exposure to toxic gases.
> - If the TWA alarm activates, leave the contaminated area immediately; the ambient gas concentration has reached the preset TWA alarm level. Failure to follow this warning will cause over-exposure to toxic gases.
> - If Critical Battery Level alarm activates or Shutdown Sequence occurs while using the device, leave the area immediately. The device no longer has enough power to indicate potential hazards.
> - If a Sensor Error alarm activates while using the device, leave the area immediately as the device will be unable to utilize the effected sensor.
>
> **Failure to follow these warnings can result in serious personal injury or death.**

Alarm Delivery

Delivery Type	Description
360° LEDs	High Intensity Red LED Pattern
Audible	High Intensity Tone
Vibration	High Intensity Vibration
User Interface	Backlight illuminates and display communicates relevant warning in status bar and gas measurement tile, if applicable.

Alarm Types	Description
Gas Alarms	
High Gas Exposure	Measurement greater than the alarm threshold.
O_2 Enrichment	Measurement greater than the alarm threshold.
O_2 Deficiency	Measurement less than the alarm threshold.
Short-Term Exposure Limit (STEL)	Short-term exposure greater than the alarm threshold.
Time-Weighted Average (TWA)	Time-weighted average greater than the alarm threshold.
Overrange	Measurement greater than the sensor range.
Enhanced Safety Alarms	
Emergency	Manually activated by pressing Alert button for 3 seconds.

Alarm Types	Description
Evacuation	Alarm remotely activated from Grid.
Motion Detection - No Check-In	Motion Detection Check-In not acknowledged.
Maintenance Alarms	
Critical Battery Level	Battery level has less than 10 minutes remaining.
Sensor Error	Sensor is not properly installed or is not functional.

4.2   Gas Detection

4.2.1   Time-Weighted Average (TWA)

The device can monitor the time-weighted average (TWA) of exposure to toxic gases which calculates the average exposure since the device was turned on or since the TWA calculation was reset.

The current TWA exposure calculation can be viewed and reset through the device menu and can be configured through Grid to calculate using two different methods: Rolling Window and Cumulative Average.

NOTE: Power cycling the device will reset the time-weighted average calculation

Rolling Window

When Rolling Window is selected, the TWA is calculated based off the exposure during most recent configured shift length. This is OSHA's typically recommended TWA calculation.

Example Calculation

- Device powered on for 12 hours
- 4 hours of exposure at 50 ppm in hours 0 – 4
- 4 hours of exposure of 0 ppm in hours 4 - 8
- 4 hours of exposure at 50 ppm in hours 8 – 12
- 8 hour shift length selected

$$\frac{(4 hours * 0ppm) + (4 hours * 50ppm)}{8 hours} = 25ppm$$

Cumulative Average

When cumulative average is selected, the TWA is calculated based off the exposure during the entire time the device has been on without power cycling while dividing by the configured shift length, regardless of how long the device is powered on. This is the ACGIH / EH40 typically recommended TWA calculation.

Example Calculation

- Device powered on for 12 hours
- 4 hours of exposure at 50 ppm in hours 0 – 4
- 4 hours of exposure of 0 ppm in hours 4 - 8

- 4 hours of exposure at 50 ppm in hours 8 - 12
- 8 hour shift length selected

$$\frac{(4hours * 50ppm) + (4hours * 0ppm) + (4hours * 50ppm)}{8hours} = 50ppm$$

4.2.2 Short-Term Exposure

The device can monitor the short-term exposure of toxic gases which calculates the average exposure over the most recent 15 minute period since the device was turned on or since the short-term exposure calculation was reset.

The current short-term exposure calculation can be viewed and reset through the device menu.

NOTE: Power cycling the device will reset the short-term exposure calculation

Example Calculation

- 15 minutes of exposure at 35 ppm:

$$\frac{15minutes * 35ppm}{15minutes} = 35ppm$$

- 10 minutes of exposure at 35 ppm and 5 minutes of exposure at 5 ppm:

$$\frac{(10minutes * 35ppm) + (5minutes * 5ppm)}{15minutes} = 25ppm$$

4.2.3 Reading Adjustment Factor

Adjustment factors provide the ability to provide gas readings to a target gas that may differ from gas used for calibration. The ALTAIR io 4 simplifies the use of adjustment factors through its device configuration.

To utilize adjustment factors:

1. Calibrate the ALTAIR io 4 to Methane (CH_4).
2. Select a *Custom Combustible Conversion* in the device configuration.
3. Enter applicable adjustment factor found in the table below.

ALTAIR io 4 Adjustment Factors		
Calibration Gas	**Target Gas**	**Adjustment Factor**
Methane	Methane	0.99
	Butane	1.74
	Propane	1.72
	Pentane	1.84
	Hydrogen	1.06

Adjustment Factors were calculated by calibrating an ALTAIR io 4 to 1.45% Methane (CH_4) and measuring the response to a known concentration of the relevant target gas found in the table. The response to the target gas was divided by the response to Methane.

Response Notes

1. Some compounds may reduce the sensitivity of the combustible gas sensor by poisoning or inhibiting the catalytic action or by polymerizing on the catalytic surface.
2. These conversion factors should be used only if the target gas is known.
3. These conversion factors are typical. Individual units may vary by ±25 % from these values.
4. The results are intended for guidance only. For the most accurate measurements, a device should be calibrated using the target gas.

4.3   Device Compliance

4.3.1   Bump Test Lock-Out

To promote compliance with bump test requirements, the device can be configured to not enter standard measurement mode until the device has been bump tested per the Grid-configured schedule. In the lock-out state, a reminder notification will sound every 15 seconds, flash the Safe LED, and vibrate. Once a bump test is complete, the device will fully turn on.

4.3.2   Calibration Lock-Out

To promote compliance with calibration requirements, the device can be configured to not enter standard measurement mode until the device has been calibrated per the Grid-configured schedule. In the lock-out state, a reminder notification will sound every 15 seconds, flash the Safe LED, and vibrate. Once a calibration is complete, the device will fully turn on.

4.3.3   Device Assignment Lock-Out

To promote device assignment to worker, the device can be configured to not enter standard measurement mode until the device has been assigned to an MSA id Tag. In the lock-out state, a reminder notification will sound every 15 seconds, flash the Safe LED, and vibrate. Once the device has been assigned, the device will fully turn on.

4.4   Enhanced Safety Features

4.4.1   Motion Detection

The device can monitor worker movement if enabled through Grid. If the device detects no movement beyond the Grid-configured threshold, the device will warn the user to check-in with the Alert button.

If the warning is not acknowledged within the configured acknowledgment threshold, the device will escalate into alarm.

4.4.2   Worker Emergency

The device can be put into emergency alarm on command by pressing the Alert button for 3 seconds.

4.4.3   Remote Evacuation

Through Grid, devices can be remotely notified to evacuate. When activated from Grid, devices will enter alarm state. See Alerts for more information.

4.5   Device Configuration Profile

The ALTAIR io 4 is highly configurable to meet the needs of your safety program. Device configuration profiles can be created, selected, and saved through your Grid account. These configuration profiles can be applied and kept in sync with desired devices directly through Grid's web application or through the mobile app. When a configuration profile is pushed to selected devices, the new configuration is immediately applied if powered on with a cellular connection, or if powered off it will be applied at next power on with a cellular connection.

4.6　　　Device Precision Configuration

Through the Grid mobile app, a configuration profile can be selected and applied to a subset of chosen devices that you have on hand to configure. This work flow is advantageous for easily configuring select devices with physical interaction.

4.7　　　Data Storage

The device sends all data including geo-tagged events, alerts, and readings to its commissioned Grid account where it is accessible.

4.8　　　MSA id

MSA id allows users to digitally assign and return devices, providing visibility into who is using which device and tying all device data to the user. MSA id can be managed through your Grid account.

4.8.1　　MSA id Tags

With the use of personal-issued MSA id Tags, the ALTAIR io 4 can be digitally assigned to worker personnel – providing historical and up-to-date digital transparency.

4.8.2　　Assigning an MSA id Tag to a Worker

To assign an MSA id Tag to a user, use your Grid account.

NOTE: A mobile device equipped with an RFID reader is required.

4.8.3　　Assigning an ALTAIR io 4 to an MSA id Tag

To assign device to MSA id Tag, tap the front display of the device to MSA id tag

4.8.4　　Returning an Assigned ALTAIR io 4

To return a device, insert the device into the ALTAIR io CHARGE. The device will be authenticated, making sure the ALTAIR io CHARGE is assigned to the same Grid account as the device, and then automatically returned.

4.9　　　ALTAIR io CHARGE

ALTAIR io CHARGE simplifies and organizes the charging and device return experience with its 5-port design. Plug the device into a port and it will be digitally returned and begin charging for the next use.

4.9.1　　Commissioning your ALTAIR io CHARGE

The ALTAIR io CHARGE will charge devices normally without commissioning. However, to utilize MSA id, it will need to be commissioned to your account. Use the Grid mobile app to complete this step.

4.10　　Over-the-Air Updates

The ALTAIR io 4 supports over-the-air software updates that will be pushed out over time, delivering new functionality, features, and optimization to your device. Once a software update is available, you will be notified through your Grid account. You can choose when this update is delivered and select the devices it is delivered to. Once you release this software update, the associated devices will download and install the software updates at the beginning of their next charging cycle with a cellular connection.

It is recommended that all software updates be made as soon as possible.

> ⚠️ **WARNING!**
>
> If a software update is identified as critical, required, important or otherwise necessary for continued safe use of the product, the update must be installed on all devices within the time frame stipulated in communications from MSA or at the next charging cycle, whichever is earlier.
>
> **Failure to follow this warning can result in serious personal injury or death.**

> *NOTICE*
>
> - To avoid disruption, the device will only download and install software updates while charging. If the device is removed from the charger before the download and installation is complete, the update is halted and the last firmware version will be utilized.
>
> - The device checks for an available software update at the beginning of each charging cycle, and does not check again. If a software update is released while a device is in the midst of charging, it will not download and install on this device until it checks for this update at the beginning of its next charging cycle.
>
> - MSA MAKES NO WARRANTY OF ANY KIND THAT ANY UPDATE WILL MEET USER'S OR ANY PERSON'S REQUIREMENTS, ACHIEVE ANY INTENDED RESULT, BE COMPATIBLE OR WORK WITH ANY SOFTWARE, SYSTEM, OR OTHER SERVICES, OR BE SECURE, ACCURATE, COMPLETE, FREE OF HARMFUL CODE, OR ERROR FREE.

5   Device Care

5.1   Maintenance

> ⚠️ **WARNING!**
>
> - Repair or alteration of the device beyond the procedures described in this user guide or by anyone other than a person authorized by MSA, could cause the unit to fail to perform properly. Use only genuine MSA replacement parts when performing any maintenance procedures on the device. Substitution of components can seriously impair performance, alter intrinsic safety characteristics or void agency approvals.
>
> - This device contains electrostatically sensitive components. Do not open or repair the device without using the appropriate electrostatic discharge (ESD) protection. Electrostatic discharge can damage sensitive components and result in erroneous gas readings or inability to detect a gas event. The warranty does not cover damage caused by electrostatic discharge.
>
> - Opening the device and replacing components in a hazardous environment poses a risk of explosion. Do not open the device or replace components in a hazardous area.
>
> - Remove and install all components carefully, ensuring that the components are not damaged. Otherwise device intrinsic safety may be adversely affected, wrong readings could occur, and persons relying on the device for their safety could sustain serious personal injury or death.
>
> - Perform a calibration after performing maintenance on the device.
>
> **Failure to follow these warnings can result in serious personal injury or death.**

5.1.1   Cleaning

Routine Cleaning

Clean the exterior of the device regularly using only a damp cloth. Do not use cleaning agents, as many contain silicone or alcohol, which can damage the sensors.

Dust and Dirt Exposure

Use a dry, soft bristled brush to remove any dust or dirt that has accumulated on the device, especially at the sensor openings. If there is a buildup of dust or dirt particles remaining in the sensor area after brushing, use a vacuum to remove remaining particles, but maintain at least a 1/2 inch (1.3 cm) distance from the gas detector.

Water Exposure

If the apparatus is exposed to water, turn the device sensor side down and gently shake water off the sensor area. Any remaining water can be removed with a clean dry cloth.

5.1.2   Sensor Change

> **⚠ WARNING!**
> - Handle combustible and toxic gas sensors carefully, the electrochemical version is a sealed unit which contains a corrosive electrolyte. Leaked electrolyte can come into contact with skin, eyes, or clothes, and cause burns. If contact with the electrolyte does occur, immediately rinse the area with a large quantity of water. If contact with the eyes occurs, rinse thoroughly with water for 15 minutes and consult a doctor.
> - Do not install a leaking sensor in the sensing head assembly. The leaking sensor must be disposed of in accordance with local, state and federal laws.
> - Calibration is required after a sensor is installed; otherwise, the device will not perform as expected.
>
> **Failure to follow these warnings can result in serious personal injury or death.**

This section will provide a brief description on how to change the sensor in the ALTAIR io 4 Gas Detection Wearable.

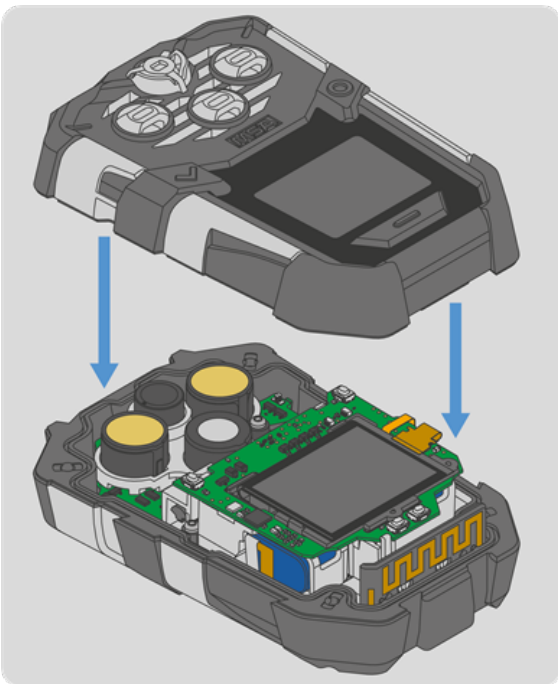**Tools Required:**

- Phillips head #1 torque screwdriver
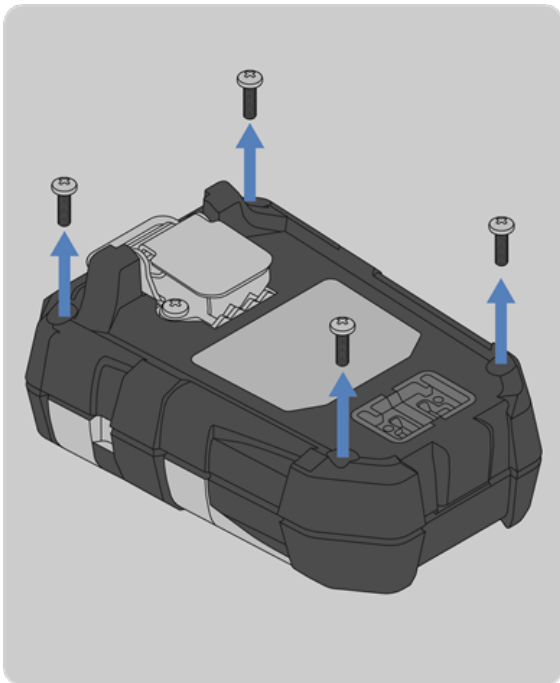
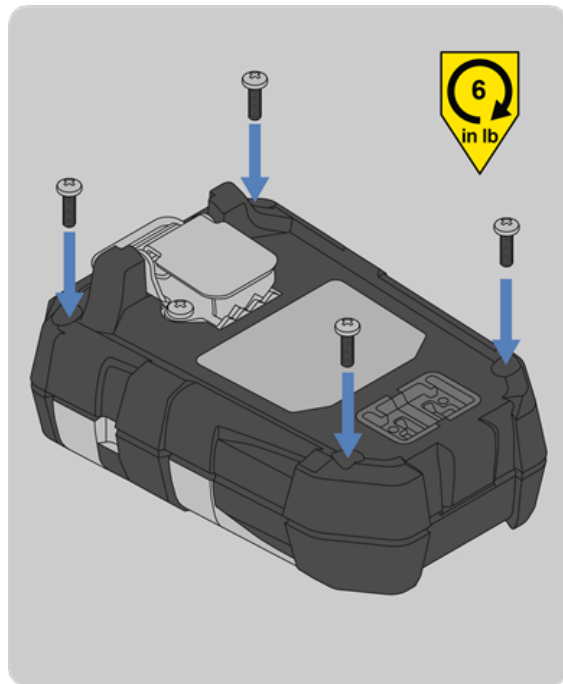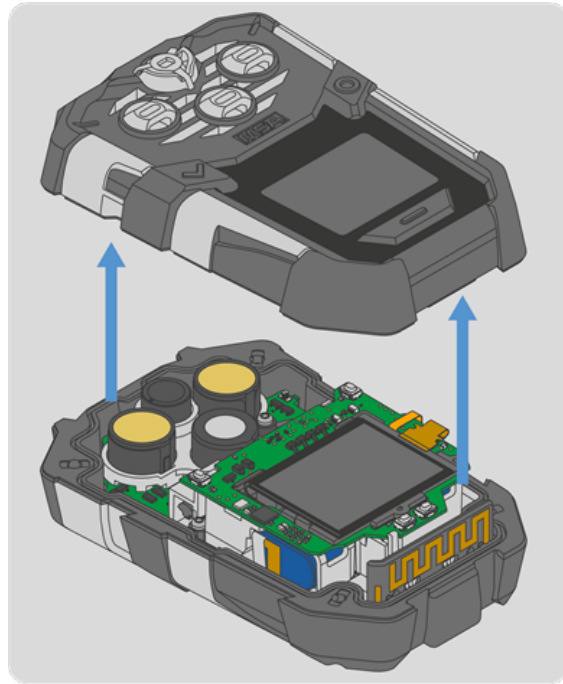1. Remove the four external screws with a Phillips head #1 screwdriver.
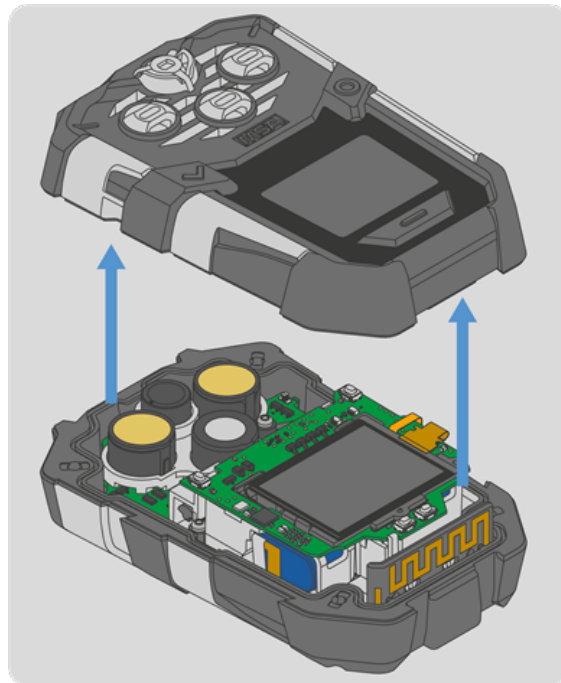

2. Remove the front housing and attached sensor gasket.

NOTE: The horn may stick to the gasket when the front housing is removed. If this occurs, see Step 4 of Horn Change to reinstall the horn.
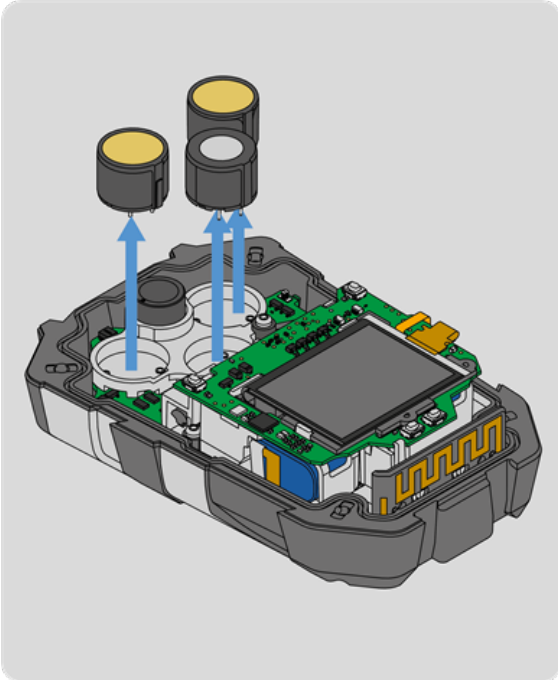
3. Remove the sensor(s) you plan on replacing by pulling it up and clear of the bracket.
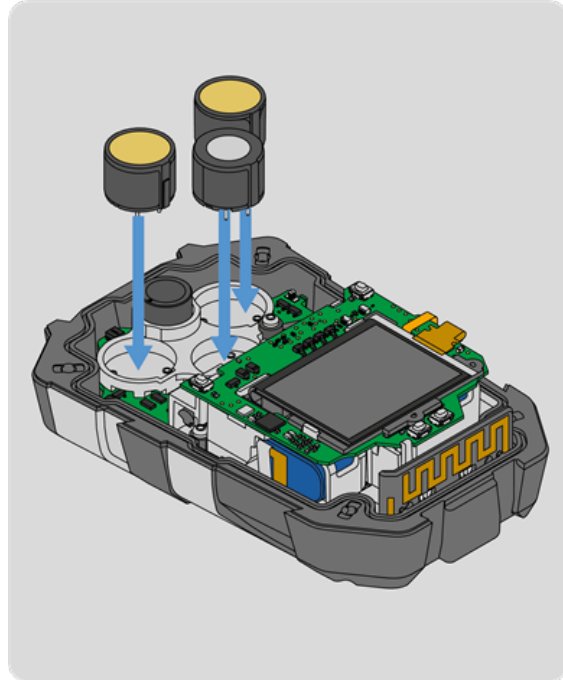
4. Install the replacement sensor(s) by pushing it down into the clear bracket.

NOTE: Make sure to align the keying feature of the sensor with the keying slot in the clear bracket. Be careful not to break the sensor pins by forcing the sensor into the clear bracket.
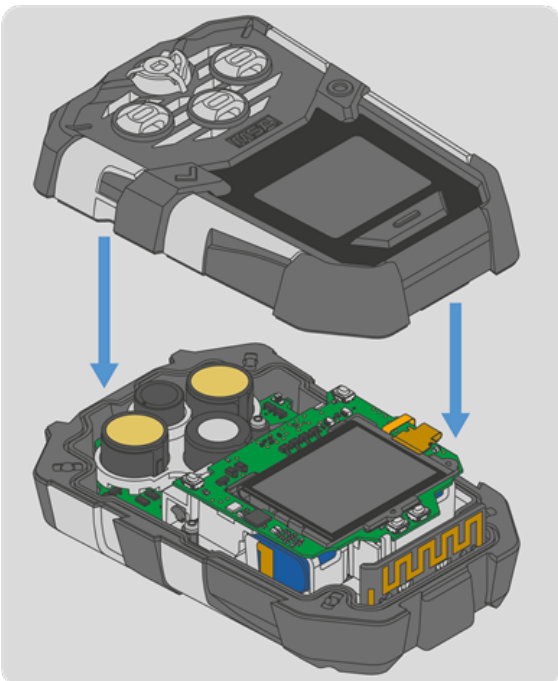
5. Install the front housing.
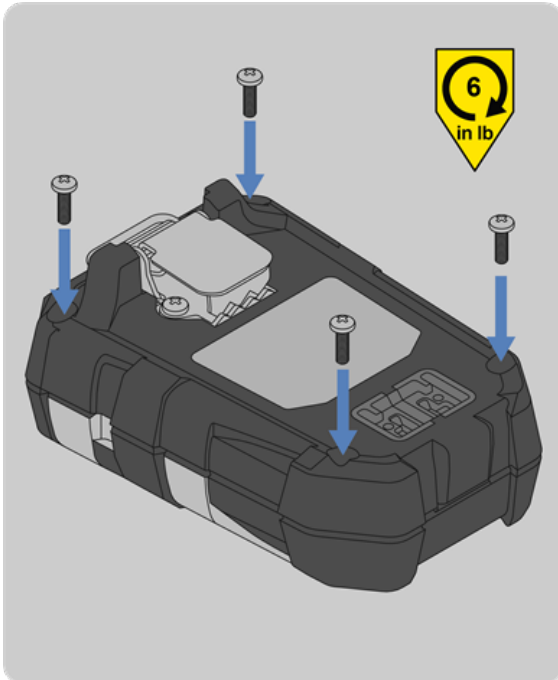
6. Install the four external screws with a Phillips head #1 torque screwdriver. Torque to 6 in-lbs (0.68 N-m).

7. Calibrate the device after sensors have stabilized.

> ℹ️ Allow sensors to stabilize at room temperature for at least 30 minutes before calibration.

5.1.3 Clip Replacement

This section will briefly describe how to replace the clip on the ALTAIR io 4 Gas Detection Wearable.

Tools Required:

• Phillips head #1 torque screwdriver

1. Open the clip as shown.
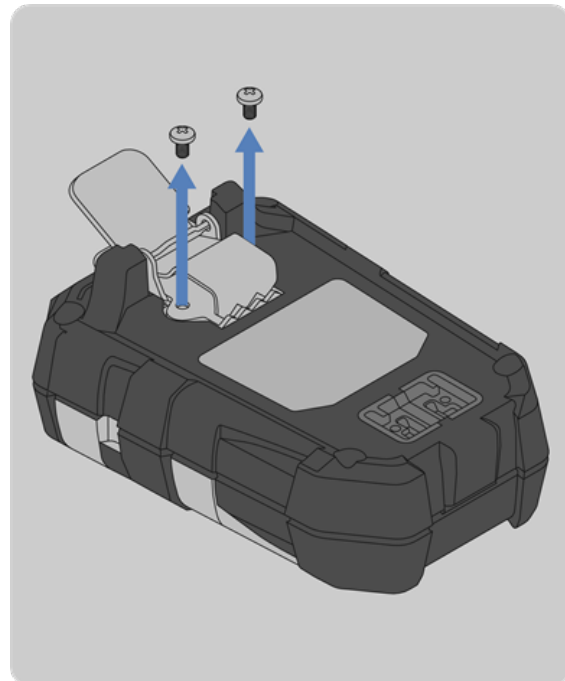
2. Remove the two screws with a Phillips head #1
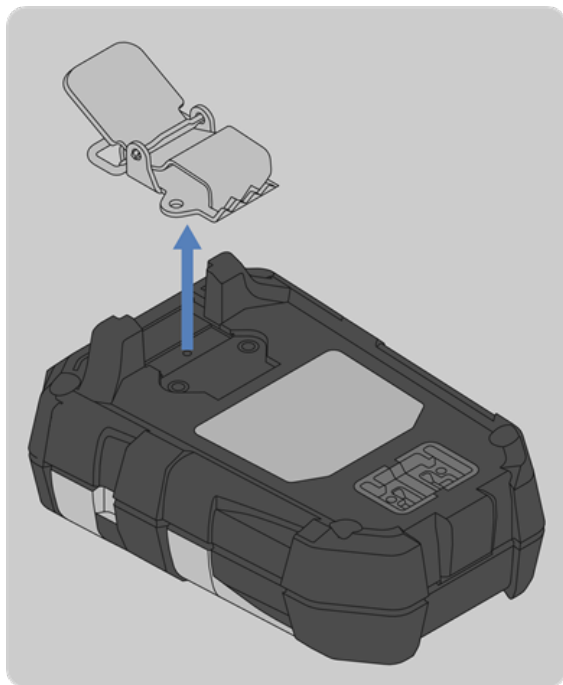
screwdriver.

3. Remove the clip from the back housing.
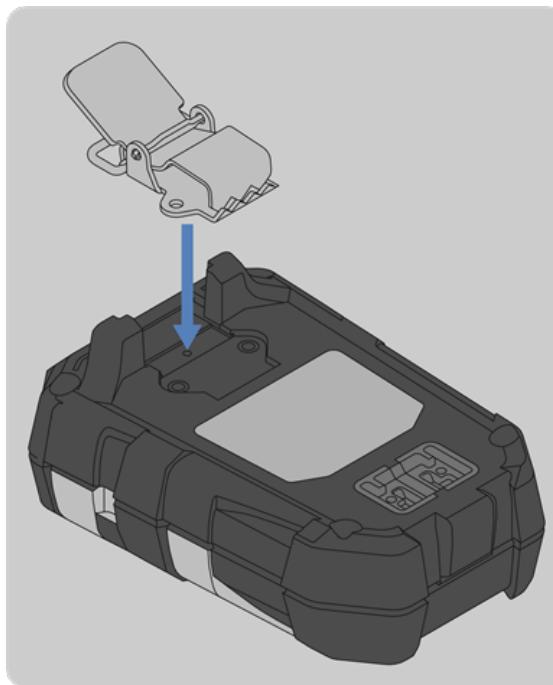
4. Place the replacement clip on the back housing.
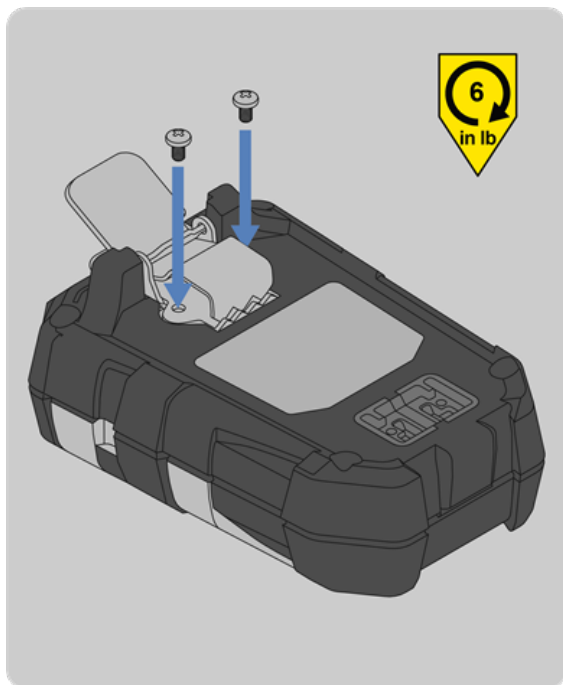
5. Install the two screws with a Phillips head #1 torque screwdriver. Torque to 6 in-lbs (0.68 N-m).

5.1.4 Front Housing Replacement

This section will briefly describe how to replace the front housing for the ALTAIR io 4 Gas Detection Wearable.
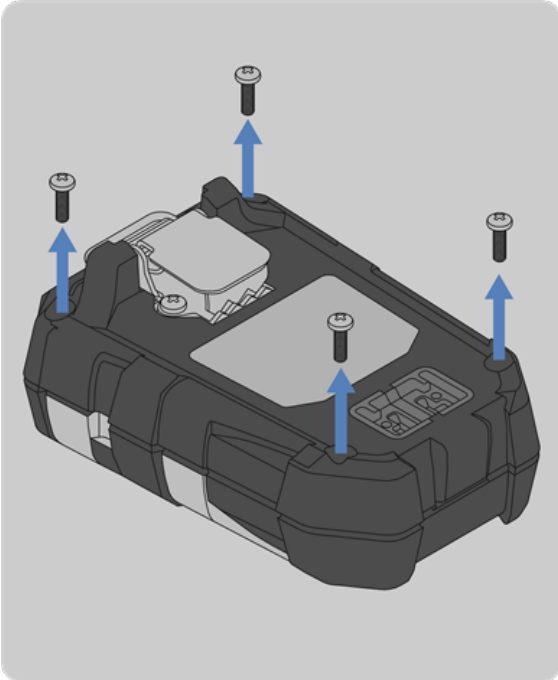
Tools Required:

- Phillips head #1 torque screwdriver

1. Remove the four external screws with a Phillips head #1 screwdriver.
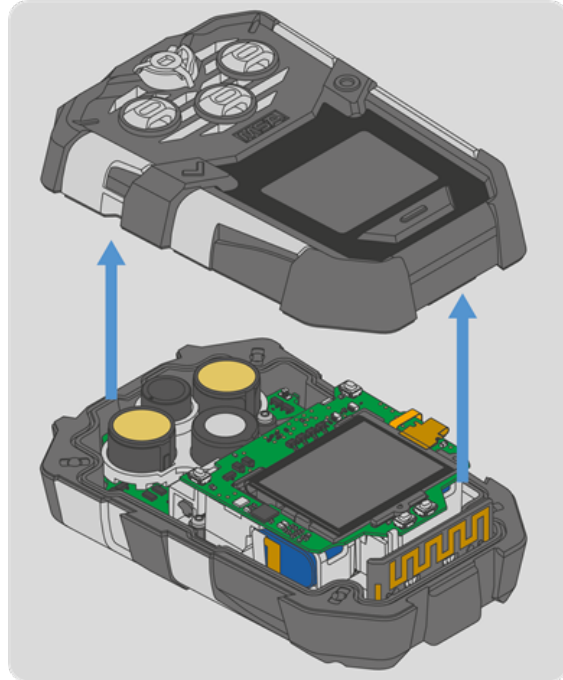
2. Remove the front housing and sensor gasket.

NOTE: The horn or sensors may stick to the gasket when the front housing is removed. If this occurs, see Step 4 of Horn Change to reinstall the horn or Step 4 of Sensor Change to reinstall the sensor.

3. Install the new front housing and sensor gasket.

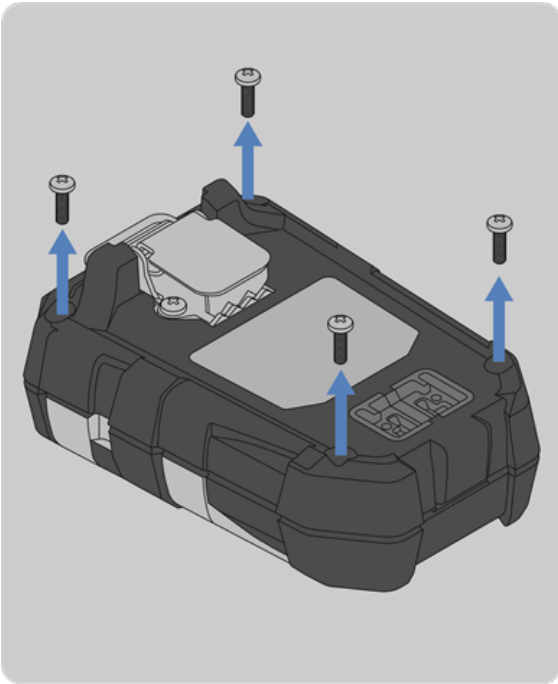4. Install the four external screws with a Phillips head #1 torque screwdriver. Torque to 6 in-lbs (0.68 N-m).

5. Calibrate the device per the instructions in the ALTAIR io 4 User Guide.

5.1.5   Horn Change

This section will provide a brief description on how to change the horn in the ALTAIR io 4 Gas Detection Wearable.

Tools Required:

- Phillips head #1 torque screwdriver
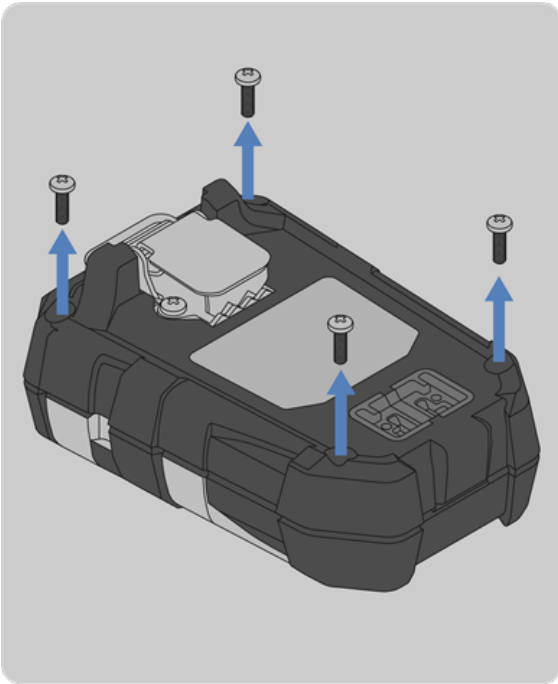
1. Remove the four external screws with a Phillips head #1 screwdriver.

2. Remove the front housing casing and attached sensor gasket.

NOTE: The sensors may stick to the gasket when the front housing is removed. If this occurs, see Step 4 of Sensor Change to reinstall the sensor.

3. Remove the sensor gasket from the front housing.

4. Install the new sensor gasket into the front housing.
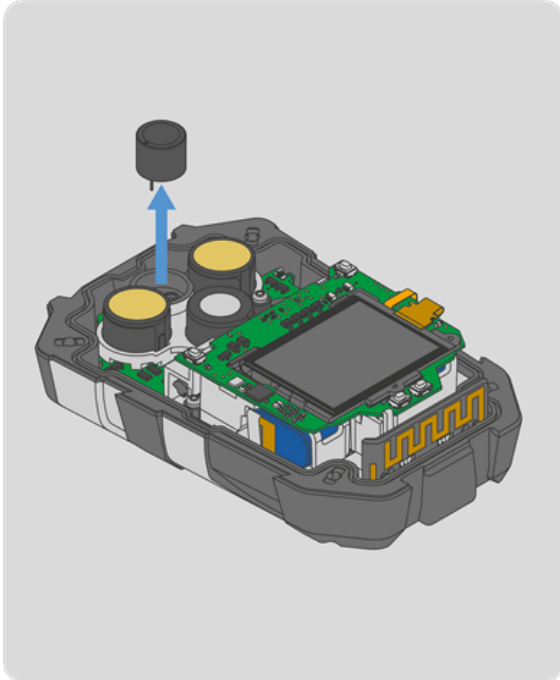
5. Remove the horn by pulling it up and out of the clear bracket.
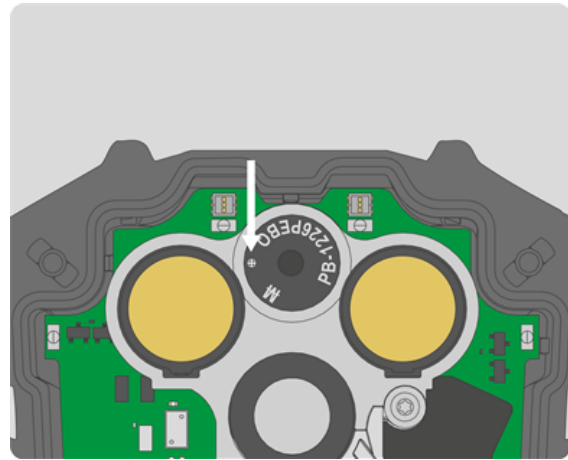
6. Install the replacement horn by pushing it down into the clear bracket.

NOTE: Make sure to align the two pins with the two receptacles. Install the horn so the text on the top surface of the horn is aligned as shown in the graphic.
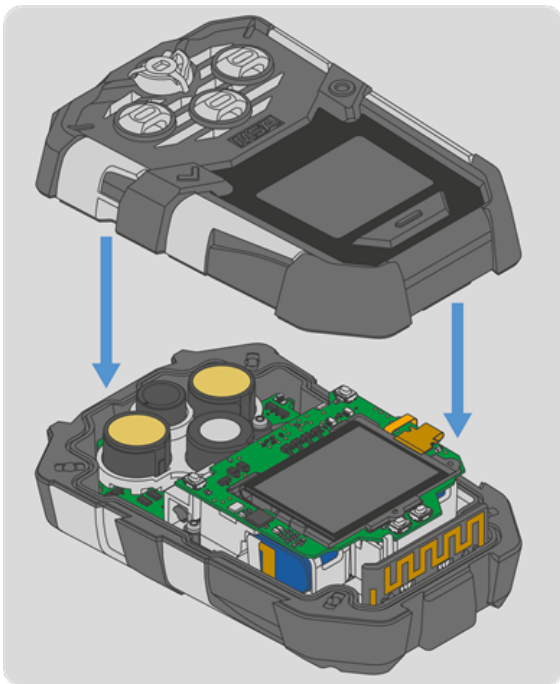
7. Install the front housing.
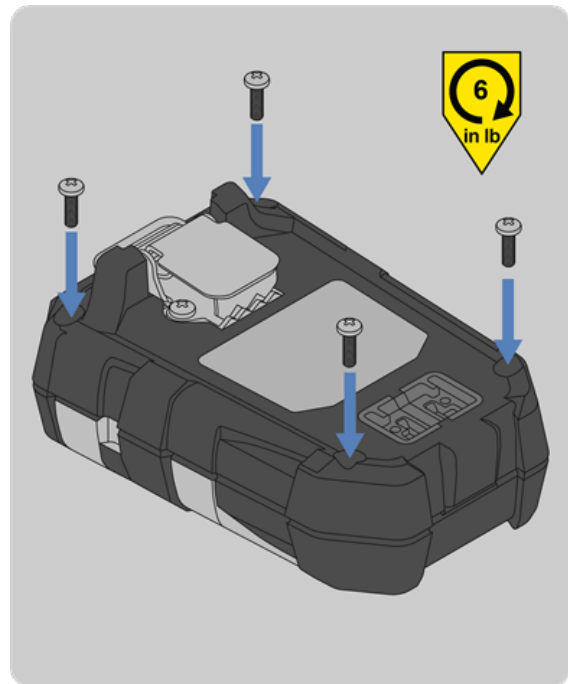
8. Install the four external screws with a Phillips head #1 torque screwdriver. Torque to 6 in-lbs (0.68 N-m).

9. Calibrate the device per the instructions in the ALTAIR io 4 User Guide.

5.1.6   Display Replacement

This section will briefly describe how to replace the display on the ALTAIR io 4 Gas Detection Wearable.

Tools Required:

• Phillips head #1 torque screwdriver

1. Remove the four external screws with a Phillips head #1 screwdriver.
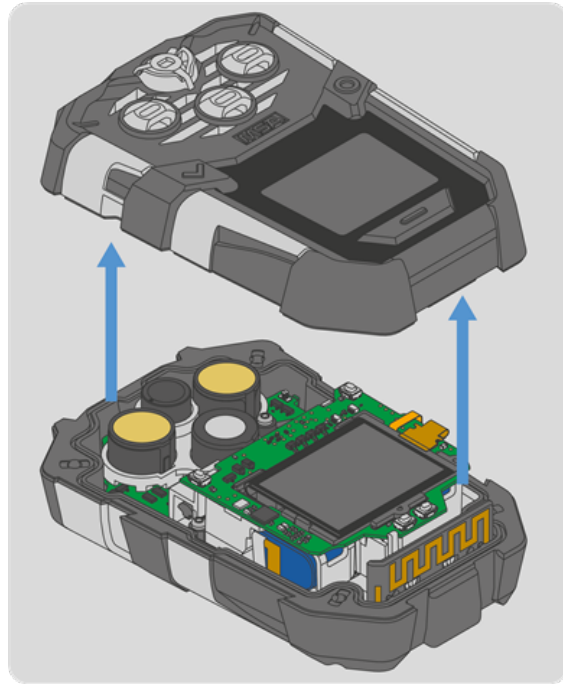
2. Remove the front housing and attached sensor gasket.

NOTE: The horn or sensors may stick to the gasket when the front housing is removed. If this occurs, see Step 4 of Horn Change to reinstall the horn or Step 4 of Sensor Change to reinstall the sensor.
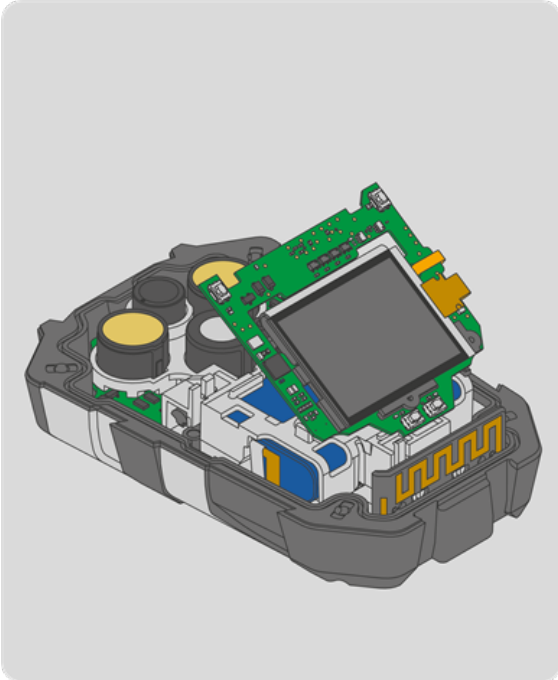
3. Remove the display PCBA and display assembly by lifting it up as shown below.
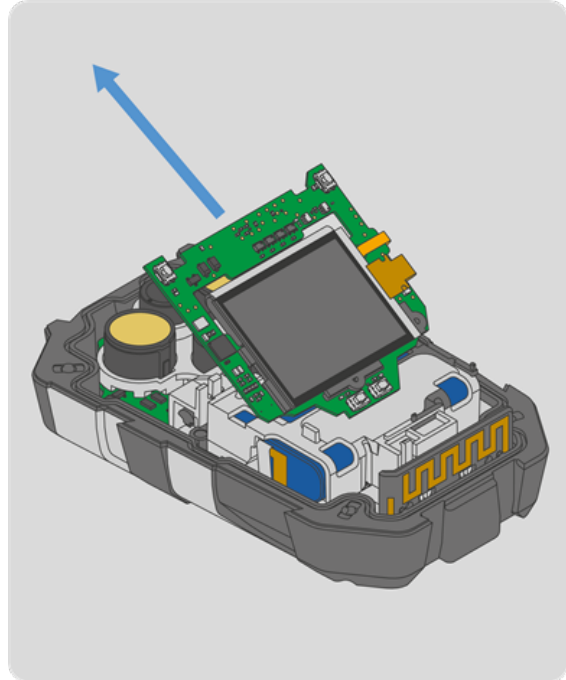
4. Lift the display PCBA and display assembly away from the main board at the angle shown. Discard according to local regulations.
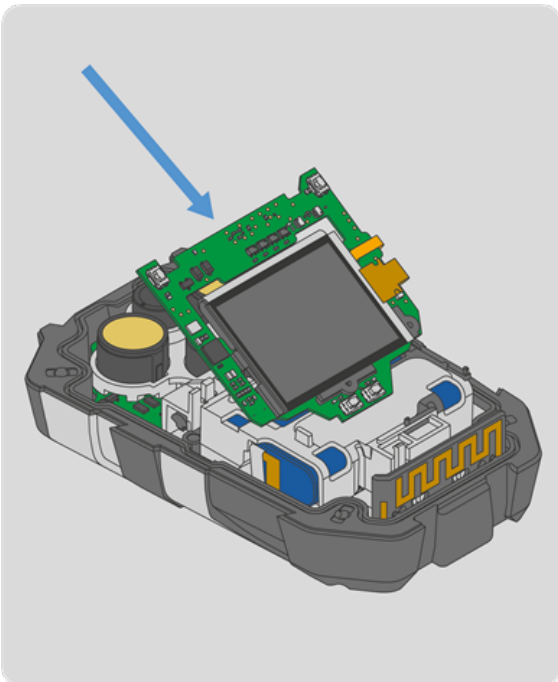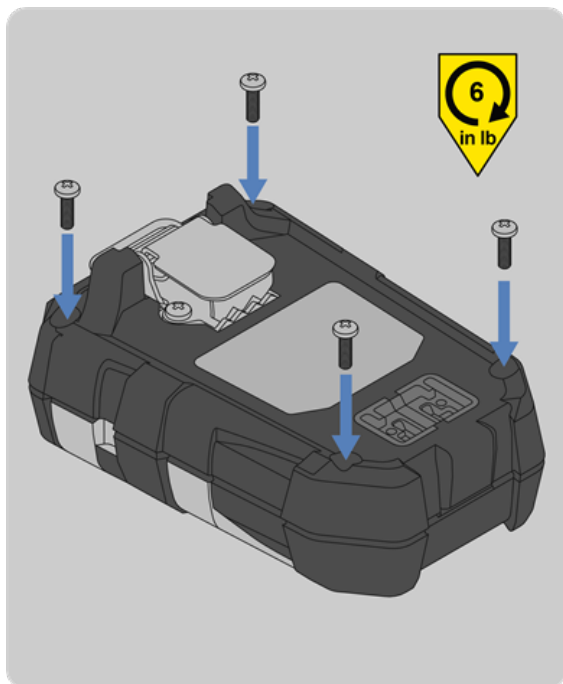

5. Take the new display PCBA and display assembly , and insert the bottom left edge under the snap fit on the battery holder. Push the display PCBA down to engage the board to board connector.
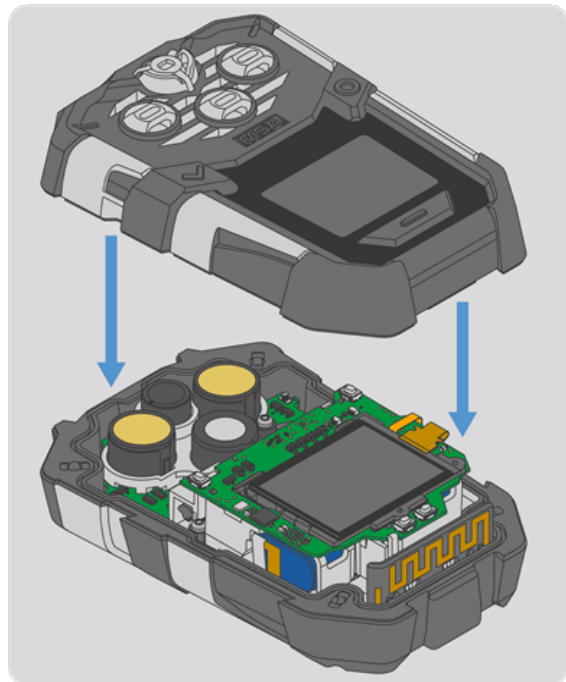
6. Install the front housing.

NOTE: Make sure the board to board connector is properly aligned.

7. Install the four external screws with a Phillips head #1 torque screwdriver. Torque to 6 in-lbs (0.68 N-m).

8. Calibrate the device per the instructions in the ALTAIR io 4 User Guide.
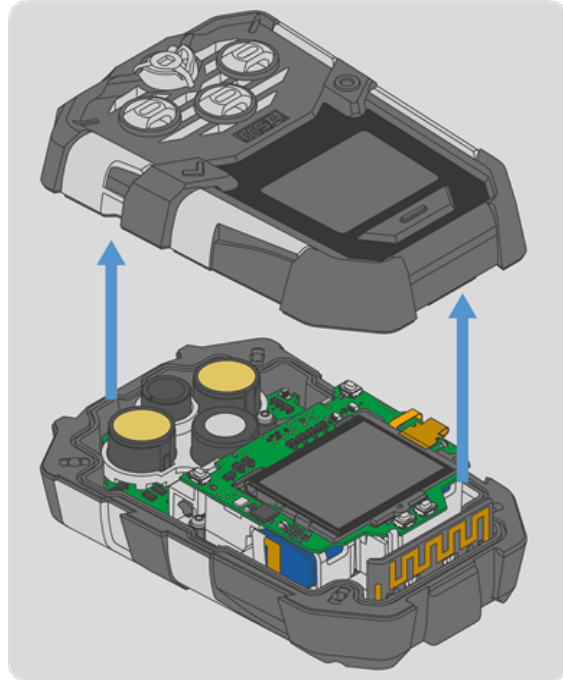
5.1.7   Back Housing Replacement

This section will briefly describe how to replace the back housing on the ALTAIR io 4 Gas Detection Wearable.

Tools Required:

- Phillips head #1 torque screwdriver
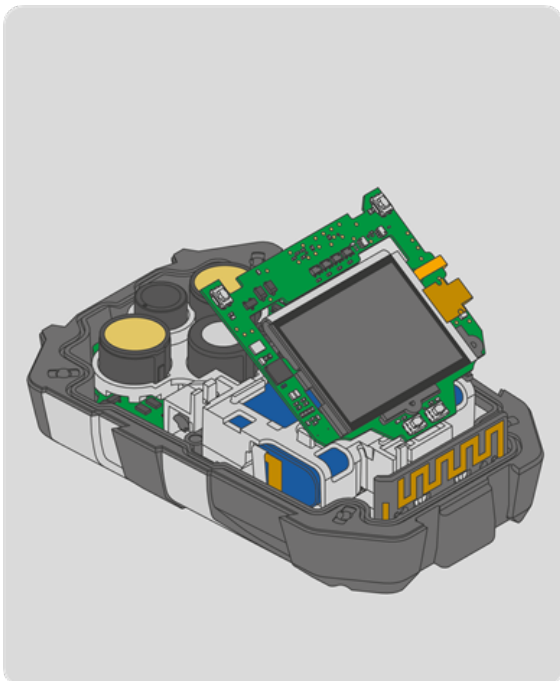- Torx T6 torque screwdriver
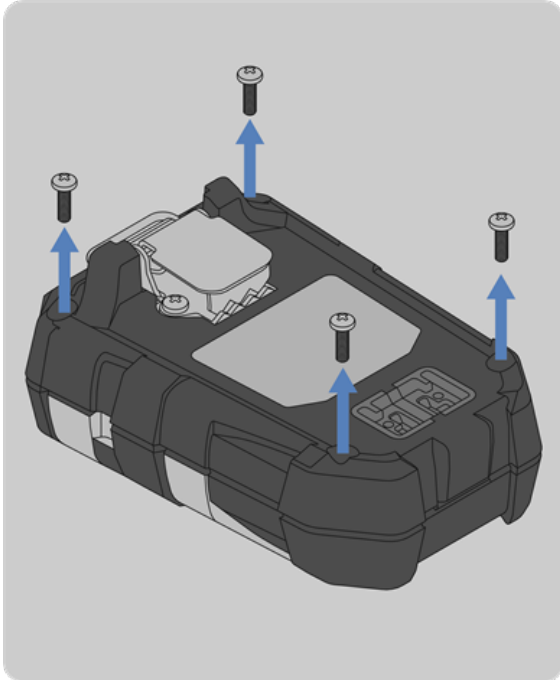
1. Remove the four external screws with a Phillips head #1 screwdriver.

2. Remove the front housing and attached sensor gasket.

NOTE: The horn or sensors may stick to the gasket when the front housing is removed. If this occurs, see Step 4 of Horn Change to reinstall the horn or Step 4 of Sensor Change to reinstall the sensor.
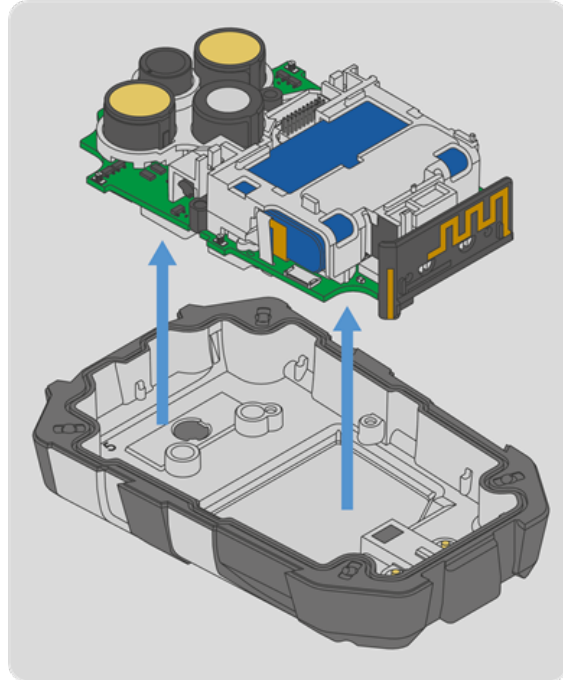

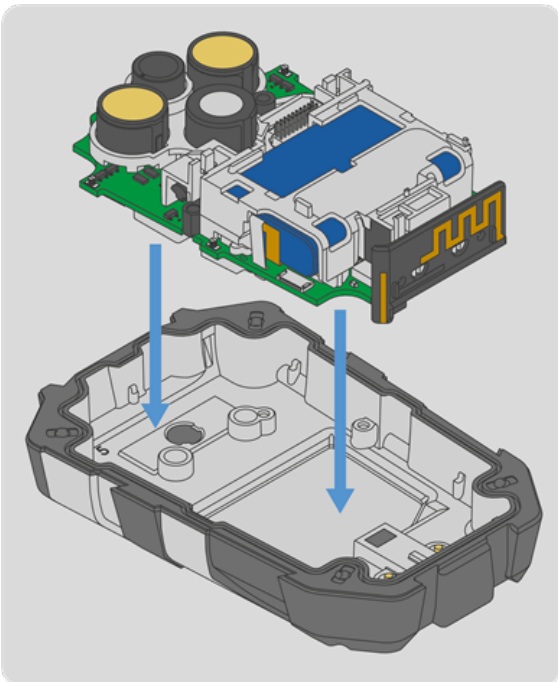3. Remove the display PCBA and display assembly by lifting it up.
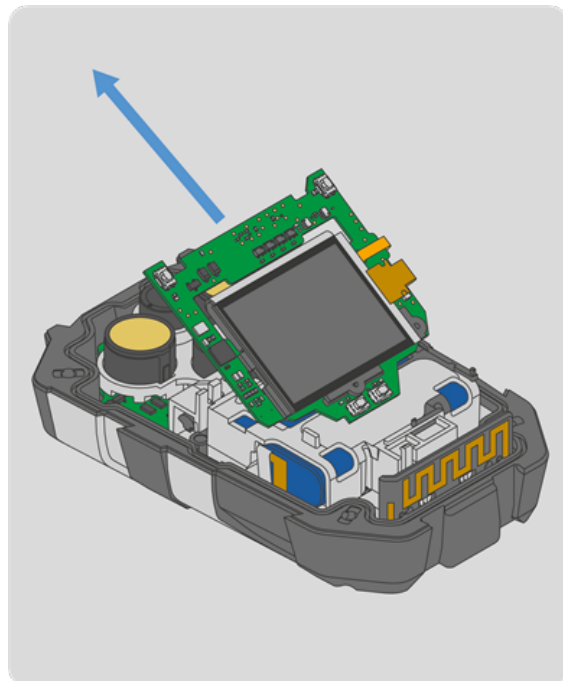
4. Lift the display PCBA and display assembly away from the main board at the angle shown.
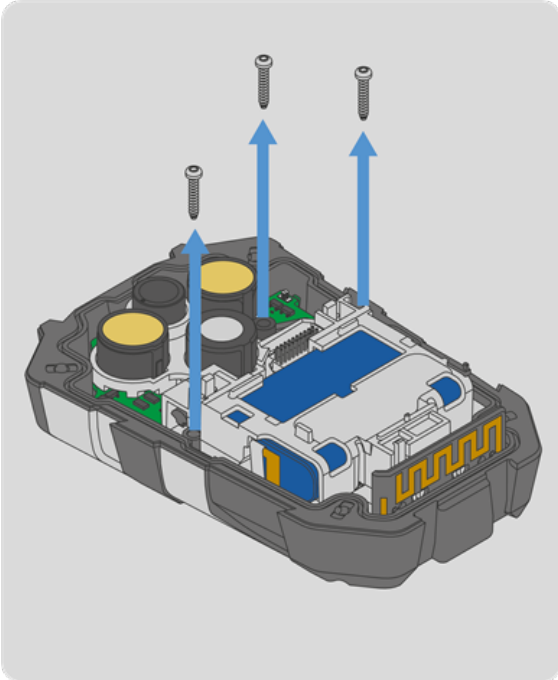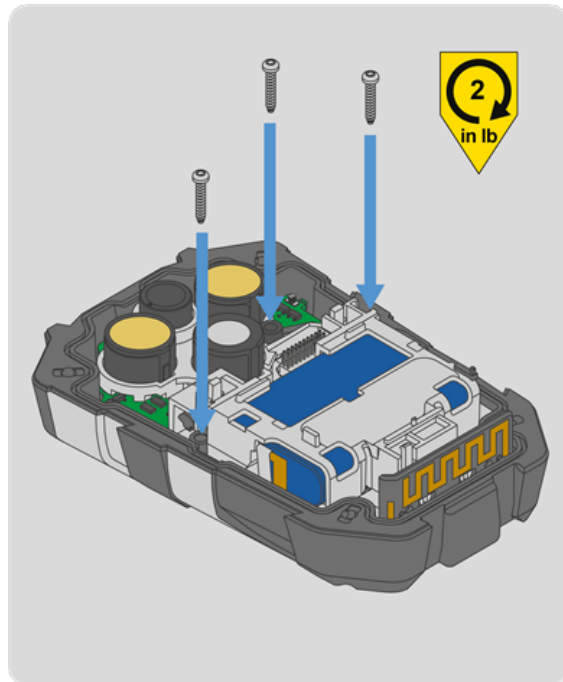
5. Remove the three internal screws with a Torx T6 screwdriver.
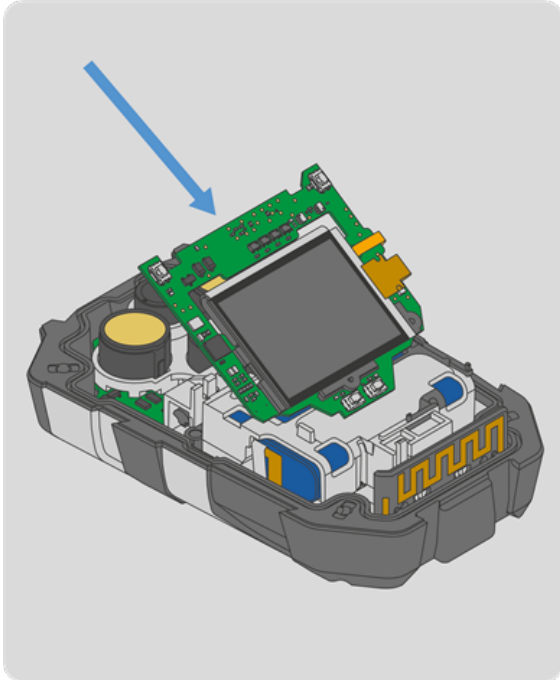

6. Lift the clear bracket and mainboard out of the back housing. Discard the back housing according to local regulations.

7. Install the main board into the replacement back housing.

8. Install the three replacement internal screws with a Torx T6 torque screwdriver. Torque to 2 in-lbs (0.23 N-m).

9. Take the display PCBA and display assembly, and insert the bottom left edge under the snap fit on the battery holder. Push the display PCBA down to engage the board to board connector.

NOTE: Make sure the board to board connector is properly aligned.
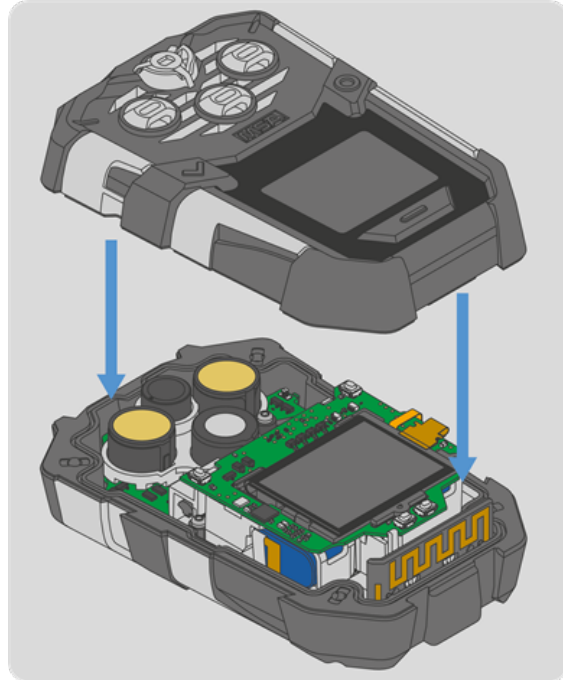
10. Install the front housing.
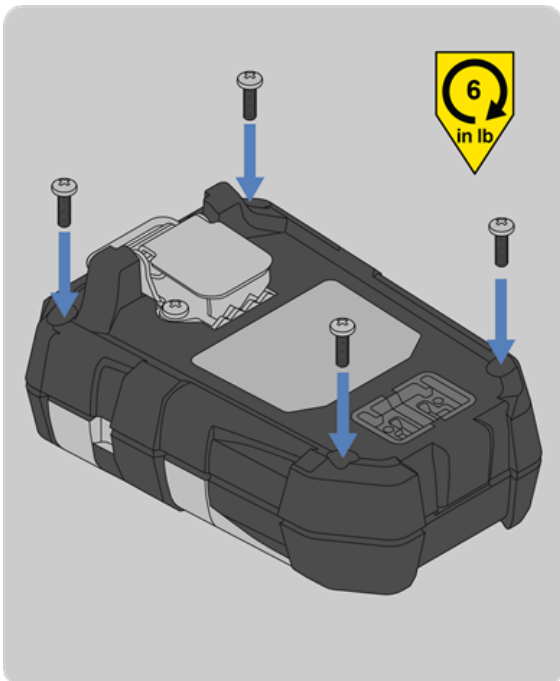
11. Install the four replacement screws with a Phillips head #1 torque screwdriver. Torque to 6 in-lbs (0.68 N-m).

12. Calibrate the device per the instructions in the ALTAIR io 4 User Guide.

6   Troubleshooting   48

There may be instances where your ALTAIR io 4 screen displays an error message. If this occurs, take the following troubleshooting steps:

1. Follow the troubleshooting prompts on the screen as they appear.

2. If the troubleshooting steps do not resolve the error, contact MSA:

MSA - The Safety Company

1000 Cranberry Woods Drive

Cranberry Township, PA 16066

USA

Phone 1-800-MSA-2222

Fax 1-800-967-0398

For local MSA contacts, please visit us at **MSAsafety.com**

7   Learn More

7.1   Replacement Parts

Replacement part numbers and information can be found on thethe MSA website under the ALTAIR io 4 product page's technical information.

7.2   Disposal and Recycling

Dispose the device and batteries in accordance with local health and safety regulations.

7.3   Warranty

The warranties made by MSA with respect to the product are voided if the product is not used and serviced in accordance with the instructions in this manual. Protect yourself and others by following them. We encourage our customers to contact MSA regarding this equipment prior to use or for any additional information relative to use or repairs.

Item	Warranty Period
Chassis and electronics	MSA warrants that this product will be free from mechanical defects and faulty workmanship for the term of the MSA+ subscription agreement.
All sensors (unless otherwise specified)	MSA warrants that this product will be free from mechanical defects and faulty workmanship for the term of the MSA+ subscription agreement.

This warranty does not cover filters, fuses, etc. Certain other accessories not specifically listed here may have different warranty periods. This warranty is valid only if the product is maintained and used in accordance with Seller's instructions and/or recommendations.

The Seller shall be released from all obligations under this warranty in the event repairs or modifications are made by persons other than its own or authorized service personnel or if the warranty claim results from physical abuse or misuse of the product. No agent, employee or representative of the Seller has any authority to bind the Seller to any affirmation, representation or warranty concerning this product.

Seller makes no warranty concerning components or accessories not manufactured by the Seller, but will pass on to the Purchaser all warranties of manufacturers of such components.

THIS WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY, AND IS STRICTLY LIMITED TO THE TERMS HEREOF. SELLER SPECIFICALLY DISCLAIMS ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE, TITLE, AND NON-INFRINGEMENT, AND ALL WARRANTIES ARISING FROM COURSE OF DEALING, USAGE, OR TRADE PRACTICE. SELLER MAKES NO WARRANTY OF ANY KIND THAT THE PRODUCT OR ANY SOFTWARE THEREIN OR USED IN CONNECTION WITH THE PRODUCT WILL MEET PURCHASER'S OR ANY OTHER PERSON'S REQUIREMENTS, OPERATE WITHOUT INTERRUPTION, ACHIEVE ANY INTENDED RESULT, BE COMPATIBLE OR WORK WITH ANY SOFTWARE, SYSTEM OR OTHER SERVICES, OR BE SECURE, ACCURATE, COMPLETE, FREE OF HARMFUL CODE, OR ERROR FREE.

Exclusive Remedy

It is expressly agreed that Purchaser's sole and exclusive remedy for breach of the above warranty, for any tortious conduct of Seller, or for any other cause of action, shall be the repair or replacement at Seller's option (including replacement with upgraded equipment at Seller's discretion), of any equipment or parts thereof, which after examination by Seller is proven to be other than as warranted. Replacement equipment and/or parts per the previous sentence will be provided at no cost to

Purchaser, F.O.B. Seller's Plant. Failure of Seller to successfully replace any nonconforming equipment or parts shall not cause the remedy established hereby to fail of its essential purpose or later any limitation of liability found herein.

Exclusion of Consequential Damage

PURCHASER SPECIFICALLY UNDERSTANDS AND AGREES THAT UNDER NO CIRCUMSTANCES WILL SELLER BE LIABLE TO PURCHASER FOR ECONOMIC, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LOSSES OF ANY KIND WHATSOEVER, INCLUDING BUT NOT LIMITED TO, LOSS OF ANTICIPATED PROFITS AND ANY OTHER LOSS CAUSED BY REASON OF NONOPERATION OF THE GOODS. THIS EXCLUSION IS APPLICABLE TO CLAIMS FOR BREACH OF WARRANTY, TORTIOUS CONDUCT OR ANY OTHER CAUSE OF ACTION AGAINST SELLER.