

# ORION™

## Non-Linear Junction Detector User Manual



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## CASE CONTENTS



1. **ORION 2.4 GHz Antenna\*** - *if purchased*
2. **ORION 900 MHz Antenna\*** - *if purchased*
3. **ORION Handle\*** - *with thumb screws*
4. **Second Harmonic Test Tag** - *semi-conductor*
5. **Third Harmonic Test Tag** - *corrosive*
6. **2 Lithium-Ion Batteries**
7. **Headphones**
8. **15V Power Adapter**

### 9. Power Cords

10. **6 ft. USB Cable** - *Type A to Mini-B for software updates*

### 11. Lithium-Ion Smart Battery Charger

\*Both antenna heads included only with a Deluxe purchase. Handle may be keypad or touch screen depending on model selection. Packaging may vary.



## Non-Linear Junction Detector

The ORION is available in different models: ORION 2.4 and ORION 900. Packaging, transmit power, and frequency ranges may vary depending on the model purchased.

Antenna(s)	Transmit Power	FCC and IC* Compliant	Public Safety & Security CE Compliant	Commercial CE Compliant
<b>ORION 2.4</b>				
	3.3 watt	Yes	Yes	Yes**
<b>ORION 900</b>				
	800 milliwatt	No	Yes	Yes
	1.4 watt	Yes	Yes	No
	3.2 watt	No	Yes	No

\*US Federal Communications Commission (FCC) and Industry Canada (IC)

\*\* Requires unit to be in "Europe-CE" mode

This manual contains proprietary information intended solely for use with the ORION Non-Linear Junction Detector.

This document is intended to provide guidance and instruction on using the ORION Non-Linear Junction Detector for finding hidden electronic devices. The overall effectiveness of this product, and of any surveillance countermeasure, is dependent on the threat level and the user's ability to properly utilize the appropriate equipment.

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Regularly scheduled courses are taught monthly; visit REI's website ([www.reiusa.net](http://www.reiusa.net)) or contact REI ([sales@reiusa.net](mailto:sales@reiusa.net)) for training dates.

### OWNER'S RECORD

The Serial Number of each ORION is located on the bottom of the unit near the battery compartment door. Each head is also serialized. Please record these numbers and refer to them whenever you contact your dealer or Research Electronics International concerning this product. Note: Removal or alteration of the serial number automatically voids all warranties of this product.

SERIAL NUMBERS: \_\_\_\_\_

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**WARNING: It is the responsibility of the user to comply with the appropriate radio communication laws of the country in which the ORION is being used.**

The ORION 2.4 and ORION 900 FCC comply with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

The ORION 2.4 and ORION 900 FCC comply with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Les modèles ORION 2.4 et ORION 900 FCC sont conformes à Industrie Canada exempts de licence(s) standard RSS. Son utilisation est soumise aux deux conditions suivantes: (1) cet appareil ne peut pas provoquer d'interférences et (2) cet appareil doit accepter Toute interférence, y compris les interférences qui peuvent causer un mauvais fonctionnement du dispositif.

Para O Brasil:

No Homologação	Modelo
08148-23-15728	Orion 2.4
08152-23-15728	Orion 900

Information contained in this manual including product operation and specifications is subject to change without notice.

Any product or brand names contained in this manual are used only for identification purposes and are trademarks or registered trademarks of their respective holders.

Patents Pending



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# PRECAUTIONS

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## PRECAUTIONS

### ORION

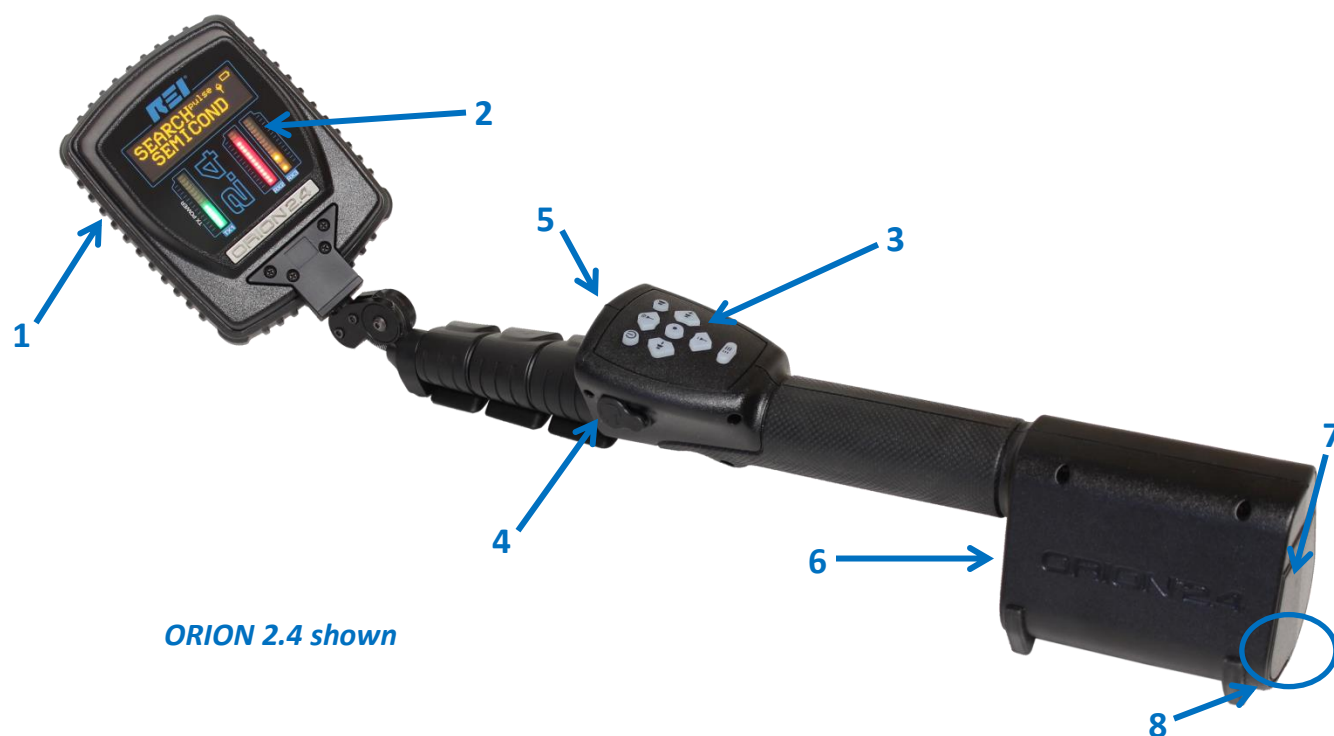
- CAUTION: Any changes or modifications not expressly approved by REI could void the user's authority to operate the equipment.
- The ORION is for professional use only.
- The ORION is capable of emitting radio signals. It is the responsibility of the user to practice good safety procedures. In doing so, you should take the following precautions:
  - Do not point the antenna at a person's eyes or head.
  - Maintain a distance of at least 28 cm between the antenna and the body of the user or nearby persons
  - Do not leave the antenna in close proximity to any part of the body for more than 5 minutes.
  - Do not use near flammable fluids or explosives or in any area where the use of radio communications equipment is prohibited.
  - Do not use in close proximity to any person fitted with a heart pacemaker, heart defibrillator, or any other life support device.
- For your own safety do not use the ORION if:
  - The ORION cables or its plugs become frayed or otherwise damaged.
  - The ORION housing is cracked or otherwise damaged.
  - You suspect that the unit requires servicing
- Only use REI approved power sources, batteries, chargers, and accessories. The supplied power supply is REI #UNT345-1530. The supplied battery pack is RRC Power Solutions Lithium Ion Rechargeable Battery pack Model #RRC2040, rated 11.25V, 2950mAh, 33.2Wh. The supplied real-time clock battery is a CR2032 coin cell battery with the following specifications: 3V nominal voltage, 225mAh nominal capacity, -30°C to 60°C operating temp
- The ORION should not be used for normal operation while charging a battery in the ORION unit. To return to normal operation, disconnect the AC power supply.
- There are no serviceable parts inside. Contact your dealer or Research Electronics International, LLC for repairs. Opening the unit will void the warranty.
- For your own safety do not use the AC power battery charger if:
  - The battery charger cables or its plugs become frayed or otherwise damaged.
  - The battery charger housing is cracked or otherwise damaged.
  - The battery charger is exposed to rain, liquid or excessive moisture.

### Lithium-Ion Batteries

- CAUTION: RISK OF EXPLOSION IF BATTERY IS REPLACED BY AN INCORRECT TYPE. DISPOSE OF USED BATTERIES ACCORDING TO THE INSTRUCTIONS.
- For your own safety do not use any ORION battery if:
  - The battery case is cracked or otherwise damaged.
  - The battery is excessively hot or warm for any reason.
- Avoid shorting the battery, immersing in water, or exposing to fire. Also, avoid excessive physical shock or vibration.
- Only use the specified REI battery chargers or products to charge REI batteries
- There are no serviceable parts inside the battery. Contact your dealer or Research Electronics International, LLC for repairs. Opening or puncturing the unit can be dangerous and may result in injury.
- Using the Lithium-Ion batteries in a manner not specified by this user's guide may override the equipment's built-in protection mechanisms.
- Keep out of the reach of children.
- Dispose of Lithium-Ion batteries in accordance with local regulations.

## Equipment Description

### Overview



*ORION 2.4 shown*

1. **ANTENNA** – located on opposite side of head display
2. **HEAD DISPLAY** – LED Bar graphs for indicating Transmit Power level, 2<sup>nd</sup> & 3<sup>rd</sup> Harmonic levels and a small informational display for indicating status and displaying the menu.
3. **KEYPAD** – used for controlling the ORION
4. **HEADPHONE JACK** – for connection of headphones to monitor audio from the unit
5. **USB CONNECTOR** – used for connecting to a PC for software updates
6. **SPEAKER** – used to monitor audio from the unit
7. **POWER INPUT** (*under battery door*) – for connecting AC adapter for charging (only use REI supplied AC Adapter)
8. **BATTERY DOOR / BATTERY DOOR LATCH** – conceals battery compartment



## Keypad



1. **POWER** – Press to Power on. Press and hold while the unit is on to Power off. A tap of the power button while the unit is on allows for quick selection of the Transmit Power Mode (Auto or Manual)
2. **AUDIO** – Press and hold to Mute and Unmute the speaker or headphones. A tap of the audio button allows for quick selection of the audio alerts.
3. **TRANSMIT POWER INCREASE / UP ARROW** – Increases Auto Transmit Power maximum or Manual Transmit Power level depending on current Transmit Power mode (Auto or Manual). When a menu or menu item is on the screen, this button acts as a navigational control.
4. **TRANSMIT POWER DECREASE / DOWN ARROW** – Decreases Auto Transmit Power maximum or Manual Transmit Power level depending on current Transmit Power mode (Auto or Manual). When a menu or menu item is on the screen, this button acts as a navigational control.
5. **VOLUME DOWN / LEFT ARROW** – Decreases the volume. When a menu or menu item is on the screen, this button acts as a navigational control.
6. **VOLUME UP / RIGHT ARROW** – Increases the volume. When a menu or menu item is on the screen, this button acts as a navigational control.
7. **SET** – When a menu is on the screen, this button sets the currently active menu item. With no menu on the screen, this button can be used to adjust the transmit frequency (see page 13). Press and hold this button to turn on or off the flashlight.
8. **MENU** – Displays the Top Menu. If a menu is displayed, this button exits the Menu.

## SET-UP & BASIC OPERATION

The ORION has been designed for quick and easy deployment. Depending on your application, some adjustments to the default setting may need to be made.

### Battery Usage

Lithium-ion rechargeable batteries have been included with your unit.



To insert or switch out a new battery:

1. While pressing the latch on the bottom of the grip housing unit, raise the battery door at the rear of the unit.
2. Slide the battery into the battery slot observing proper contact alignment until it latches into place.
3. Close the battery door.

The ORION has a built-in battery charger. To charge the battery in the unit:

1. While pressing the latch on the bottom of the grip housing unit, raise the battery door at the rear of the unit.
2. With the battery already inserted in the unit, connect the provided AC power supply to the jack located just above the battery slot and to an AC source. The battery will begin charging. Charging is automatic; it will stop when the battery is fully charged. The OLED display on the head indicates the battery charge status during charging.

Note: The ORION should not be used for normal operation while charging a battery in the ORION unit. To return to normal operation, disconnect the AC power supply.

Note: To keep the battery in good working condition, it should be removed from the ORION for long term storage of 90 days or more. Even when powered off, the operating system of the ORION continues to use a low stand-by current that in some cases could cause a deep discharge and possible damage to the battery, preventing a normal recharge.

## Real Time Clock Battery

An internal CR2032 coin cell battery provides power for the real time clock function. The Real Time Clock (RTC) battery should provide years of service. In the event that the clock on the ORION stops functioning or user settings are no longer saved, the Real Time Clock battery will need to be replaced.

To replace the Real Time Clock battery:

- 1) Open the battery door and remove the product's Lithium Ion Battery.
- 2) Remove the Phillips head screw in the panel above the battery compartment.
- 3) Slide the battery tray that rests above the battery compartment out of the unit. Do not disconnect the cable attached to the circuit board.
- 4) Locate the CR2032 battery on the right side of the battery tray circuit board.
- 5) Remove the old CR2032 battery from the battery clip and replace with a new CR2032 battery. Observe the battery polarity marking on the holder clip when replacing the battery; the positive (+) side should be facing up, away from the circuit board.
- 6) Replace the battery tray and secure with the Phillips head screw. Be careful not to pinch the attached cable while positioning the battery tray. Do not force the battery tray – the tray rests along plastic ridges in the side of the battery compartment. If positioned correctly, it should slide easily into place.

Note: The provided internal coin cell is a CR2032 battery with the following specifications: 3V nominal voltage, 225 mAh nominal capacity, -30°C to 60°C operating temperature.





### Connecting the ORION head

The ORION is provided with a quick release head for easily removing or connecting the head to the pole/grip handle. The ORION 900 is stored in the case with the head separated from the pole/grip handle. To connect the ORION head to the pole/grip handle:

1. Locate the triangular plate on the pole/grip handle with the captured thumb screws
2. Align the triangular plate on the pole/grip handle with the triangular recess on the selected ORION head
3. Hand tighten the thumb screws to secure the head to the pole/grip handle

Note: Always power off the ORION before removing the head. Undefined behavior may result from failure to do so.

### Procedure

When the ORION is turned on, it scans the Transmit, 2<sup>nd</sup> Harmonic, and 3<sup>rd</sup> Harmonic spectrums and automatically selects a quiet frequency avoiding any interference. The operator may also manually select frequencies. Two test tags are included with the ORION. One is a semiconductor diode to simulate an electronic device. The second is a steel wool pack, to simulate a corrosive metal-to-metal junction. These tags can be used to verify the proper operation of the ORION.

There are two basic procedures to using any Non-Linear Junction Detector:

1. Detecting a non-linear junction and
2. Discriminating between electronics and false detection

The ORION can be configured multiple ways to aid in these two processes.

## Basic ORION Functions

### Power On/Off

To Power on or off the unit:

1. With the unit off, press and release the Power button to turn the unit on.
2. With the unit on, press and *hold* the Power button to turn the unit off.

### Operation/Menu Item: Transmit Power Level

The Transmit Power Level may need to be adjusted depending on several factors, including the target or detection range.

To manually adjust the Transmit Power Level:

1. Repeatedly press the Up Arrow button to increase the transmit power. The TX1 Green Bar graph will increase corresponding to the increase in transmit power. The OLED Display above the bar graphs will display the numerical value of the transmit power level.
2. Repeatedly press the Down Arrow button to decrease the transmit power. The TX1 Green Bar graph will decrease corresponding to the decrease in transmit power. The OLED Display above the bar graphs will display the numerical value of the transmit power level.

*Note: Whenever a menu is on the screen, the Up Arrow and Down Arrow serve as navigation keys for the menu. To adjust the Transmit Power Level, confirm that no menu is displayed. To exit a menu, press the Menu button again or wait about 10 seconds for the menu to time out.*

### Auto / Manual Transmit

The ORION can be operated in either auto transmit mode or manual transmit mode. In auto transmit mode, the transmit power will automatically reduce whenever the receiver becomes saturated. In Manual transmit mode, the transmit power remains at the same level unless it is manually changed.




To toggle between Auto Transmit mode and Manual Transmit Mode:

1. With the unit powered on, briefly press and release the Power button. The Transmit Power Mode Sub-Menu will be displayed.
2. Select the desired mode, "Manual" or "Auto", from the sub-menu.

### Frequency Adjust

In order to detect electronic devices, the ORION transmits a signal and then looks for reflections of this signal at harmonic frequencies (see the Appendix for additional detail on how the ORION works).

To adjust the transmit frequency:

1. With no menu on the screen, press the Set button . The OLED screen will display a frequency adjust menu.
2. Press the left or right arrow buttons,  or , to adjust the transmit frequency.

*Note: Even with no menu on screen, if a "SEMICONDUCTOR" or "CORROSIVE" alert is displayed on screen, it will hide the frequency adjust menu.*

*Note: The frequency cannot be adjusted on the ORION 900 800mW model - it transmits only on a single frequency, 869.525 MHz.*

The transmit frequency can also be adjusted using the menu, which will allow you to monitor the ambient environment to select a quiet channel (see page 20).

### Volume Level

In addition to bar graphs and the OLED display, which give visual cues whenever a hidden electronic target is detected, the ORION also has several operation modes, which give different audio cues whenever targets are detected. For details on these operation modes, see the appropriate sections later in this User's Manual. These audio cues can be received either through the provided speaker on the unit or through headphones.

To adjust the audio level of the ORION:

1. Repeatedly press the Right Arrow button to increase the volume. The OLED screen will display the volume level as it increases.
2. Repeatedly press the Left Arrow button to decrease the volume. The OLED screen will display the volume level as it decreases.

*Note: Whenever a menu is on the screen, the Left Arrow and Right Arrow serve as navigation keys for the menu. To adjust the Volume Level, confirm that no menu is displayed. To exit a menu, press the Menu button again or wait about 10 seconds for the menu to time out.*

### Volume Mute

To quickly mute the volume level:

1. Press and hold the Audio button until the audio silences.
2. Press and hold the Audio button again to return to the previous volume level.

## Adjusting the Menu Items

The ORION can be configured for multiple situations. The majority of settings changes are handled through the menu.

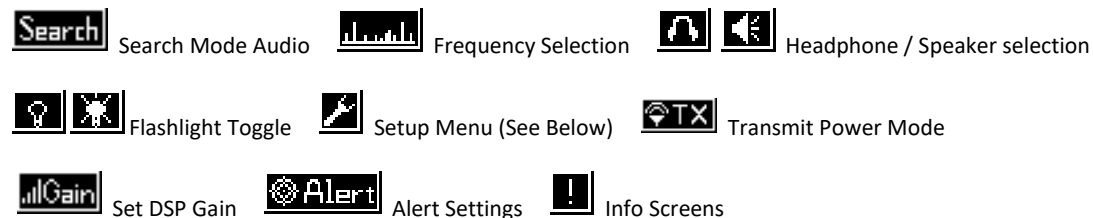
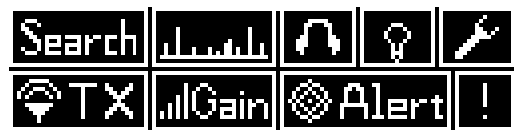
To adjust menu items:

1. Press the MENU button. The Main Menu will appear.
2. Press the Left or Right Arrow to begin scrolling through the Main Menu Items.
3. To enter one of the Main Menu Items, press the Set button when that Menu Item is highlighted.

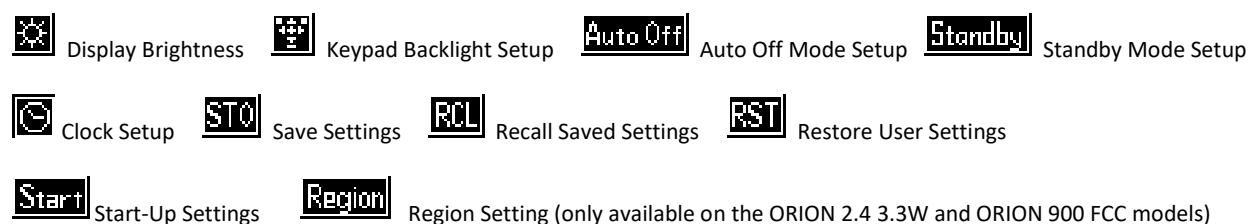
Depending on the Menu Item selected, a configuration change may happen immediately or the user may be presented with a Sub-menu with additional options. See the following sections for details.

## Menu Structure

### MAIN MENU



### SETUP MENU





## Quick Access Buttons

### POWER Button:

Tap – To change the Transmit Power Mode (Manual or Auto), tap the POWER button while the unit is powered on. Select "Manual" or "Auto" from the sub-menu that appears.

Press & Hold – To power down the unit, press & hold the POWER button while the unit is powered on

### AUDIO Button:

Tap – To change the Audio operating mode, tap the AUDIO button.

Press & Hold – To mute the volume, press & hold the AUDIO Button until the audio silences.  
Press & hold the AUDIO button again to return to the previous volume level

### SET (⊙) Button

Tap - To change the transmit frequency, tap the SET button (⊙). Press the left or right buttons, **←** or **→**, to adjust the frequency.

Press & Hold – To toggle the flashlight on and off, press & hold the SET button (⊙)

### MENU Button

Press & Hold – To scan the frequency spectrum to automatically find and select a quiet channel for use, press & hold the MENU button.

## Menu Items / Operations

### Search Mode Audio: Tone

Purpose: To provide an audible component to target detection. The type of tone heard can be selected using the Tone Alert Type Setting (see below).

Access: Menu > **Search** > **Tone** > ⊙ (*press set button*)

Quick Access: Press the Audio button to quickly access the Search Mode Audio Sub-menu

### Tone Alert Type: 2<sup>nd</sup> Only

Purpose: With the Tone Alert Type set to 2<sup>nd</sup> only, an audible, synthetic tone is heard only when the received 2<sup>nd</sup> harmonic signal level surpasses the set trip level. As the 2<sup>nd</sup> harmonic signal level increases, the frequency of the synthetic tone will increase. Note: In addition to setting the Tone



Alert Type, the search mode audio must be set to "Tone" and the Volume must be up to hear the alert tone.

Access: Menu >  >  >  >  (press set button)

### **Tone Alert Type: 3<sup>rd</sup> Only**

Purpose: With the Tone Alert Type set to 3<sup>rd</sup> only, an audible, synthetic tone is heard only when the received 3<sup>rd</sup> harmonic signal level surpasses the set trip level. As the 3<sup>rd</sup> harmonic signal level increases, the frequency of the synthetic tone will increase. Note: In addition to setting the Tone Alert Type, the search mode audio must be set to "Tone" and the Volume must be up to hear the alert tone.

Access: Menu >  >  >  >  (press set button)



### **Tone Alert Type: 2<sup>nd</sup> & 3<sup>rd</sup>**

Purpose: With the Tone Alert Type set to 2<sup>nd</sup> & 3<sup>rd</sup>, an audible, synthetic tone is heard whenever the received 2<sup>nd</sup> harmonic signal or 3<sup>rd</sup> harmonic signal level surpasses the set trip level. As the signal level increases, the frequency of the synthetic tone will increase. Note: In addition to setting the Tone Alert Type, the search mode audio must be set to "Tone" and the Volume must be up to hear the alert tone.

Access: Menu >  >  >  >  (press set button)

### **Tone Alert Type: 2<sup>nd</sup> & distinctive 3<sup>rd</sup>**

Purpose: With the Tone Alert Type set to 2<sup>nd</sup> & distinctive 3<sup>rd</sup>, an audible, synthetic tone is heard whenever the received 2<sup>nd</sup> harmonic signal level surpasses the set trip level. As the 2<sup>nd</sup> harmonic signal level increases, the frequency of the synthetic tone will increase. If the received 3<sup>rd</sup> harmonic signal level becomes higher than the received 2<sup>nd</sup> harmonic signal level, a lower frequency tone representing the 3<sup>rd</sup> harmonic will be heard alternating (or warbling) with the 2<sup>nd</sup> harmonic tone.

Access: Menu >  >  >  >  (press set button)

### Audio: Listen 2<sup>nd</sup> AM

**Purpose:** Provides an alternate audible response. The received 2<sup>nd</sup> harmonic signal is AM demodulated and output through the speakers or headphones

**Access:** Menu > **Search** > **2nd AM** >  (press set button)

**Quick Access:** Press the Audio button to quickly access the Search Mode Audio Sub-menu

**Note:** This mode is not available on the ORION 900 800 mW model.

### Audio: Listen 2<sup>nd</sup> FM

**Purpose:** Provides an alternate audible response. The received 2<sup>nd</sup> harmonic signal is FM demodulated and output through the speakers or headphones

**Access:** Menu > **Search** > **2nd FM** >  (press set button)

**Quick Access:** Press the Audio button to quickly access the Search Mode Audio Sub-menu

**Note:** This mode is not available on the ORION 900 800 mW model.

### Audio: Listen 3<sup>rd</sup> AM

**Purpose:** Provides an alternate audible response. The received 3<sup>rd</sup> harmonic signal is AM demodulated and output through the speakers or headphones

**Access:** Menu > **Search** > **3rd AM** >  (press set button)

**Quick Access:** Press the Audio button to quickly access the Search Mode Audio Sub-menu

**Note:** This mode is not available on the ORION 900 800 mW model.

### Audio: Listen 3<sup>rd</sup> FM

**Purpose:** Provides an alternate audible response. The received 3<sup>rd</sup> harmonic signal is FM demodulated and output through the speakers or headphones

**Access:** Menu >  >  >  (press set button)

**Quick Access:** Press the Audio button to quickly access the Search Mode Audio Sub-menu

**Note:** This mode is not available on the ORION 900 800 mW model.

### Gain Level


**Purpose:** Sets the level of digital signal processing integration that is used to process the received signals.



**Access:** Menu >  > select desired Gain Level

**Range:** Low, Medium, High

### Auto/Manual Transmit Power



**Purpose:** To adjust the transmit power level and to switch between automatic and manual transmit modes. In auto-transmit mode, the transmit power will automatically reduce whenever the receiver becomes saturated. In auto transmit mode, the set transmit power level is indicated by a blinking LED in the Tx Power bar graph. In Manual transmit mode, the transmit power remains at the same level unless it is manually changed.

**Menu Access:** Menu >  > select desired Transmit Power mode

**Quick Access:** Press the Up or Down Arrow ( or ) with no menu on the screen to adjust the Transmit Power Level. Tap the POWER button to get quick access to the Transmit power mode sub-menu.



**Range:** Auto or Manual, 0 to 100%

### Manual Frequency Adjust

- Purpose:** This mode scans and displays the Transmit, 2<sup>nd</sup> Harmonic, & 3<sup>rd</sup> Harmonic spectrums allowing the user to manually select a quiet channel for operation.
- Menu Access:** Menu >  >  > Press the Set Button (⊙) to scan the ambient frequency and manually adjust the frequency or Press the Menu button to set the ORION to Manual Frequency Mode without running a scan.
- Operation:** When Freq Scan mode is first entered, the Transmit Frequency bandwidth is shown. Press the Up ↑ or Down ↓ arrow to change the bandwidth to the 2<sup>nd</sup> Harmonic or 3<sup>rd</sup> Harmonic bandwidth. The selected bandwidth is displayed on the left side of the screen. Press the Left ← or Right → arrow to move the cursor to a quiet frequency. Press the set button ⊙ to change the transmit frequency of the ORION to the cursor frequency.

*Note: On the ORION 900 800mW model, the frequency cannot be adjusted - it transmits only on a single frequency, 869.525 MHz. Frequency scan mode is available however to show the RF spectrum surrounding the transmit frequency, the 2<sup>nd</sup> harmonic, and the 3<sup>rd</sup> harmonic.*

### Auto Frequency Mode

- Purpose:** When enabled, the unit will scan the frequency spectrums of the transmitter, 2<sup>nd</sup> harmonic, and 3<sup>rd</sup> harmonic to find and select a quiet channel for use, avoiding any interference to and from other devices. The ORION also performs this operation on power-up as well.
- Menu Access:** Menu >  >  > Press the Set Button (⊙) to run the Auto Scan or Press the Menu button to set the ORION to Auto Frequency Mode without running a scan.
- Quick Access:** Press and hold the MENU button to perform an Auto Frequency Scan.

### Alert: Trip Level

- Purpose:** To set a trip level for the alert tones, the vibration feedback, and target indicators (“SEMICOND” or “CORROSIVE”). The trip level is indicated by blinking LEDs on the RX2 and RX3 bar graphs.

Menu Access: Menu >  >  > ↑ or ↓ to adjust Trip Level

Range: 0%, 5%, 10%, 15%, 20%, 25%, 30%, 35%, 40%, 45%, 50%

### Vibrate Setup




Purpose: To enable or disable vibrator/haptic feedback

Access: Menu >  >  > select desired vibrate level

Range: Off, Short, Long




### Speaker: Headphones Only

Purpose: To shut the speaker on the ORION off and operate with headphones only. In this configuration, the speaker will remain OFF regardless of whether headphones are plugged in or not.




Access: Menu > If  icon is present, select it. The unit will toggle to Headphones Only mode and the  icon will be displayed in the Main Menu. If the  icon is present, the unit is already in Headphones Only mode.

### Speaker: Headphones or Speaker



Purpose: To allow operation of the ORION with either the headphones or the built-in speaker. When no headphones are connected, audio will be heard from the built-in speaker. When headphones are connected, the built-in speaker will automatically shut off and audio will be heard through the connected headphones.

Access: Menu > If  icon is present, select it. The unit will toggle to Headphones or Speaker mode and the  icon will be displayed in the Main Menu. If the  icon is present, the unit is already in Headphones Only mode.



### Flashlight Setup

- Purpose: Toggles the flashlight on the head on/off
- Access: Menu >  >  (press set button)
- Quick Access: Press and hold the set button () to toggle the flashlight on and off




### Display Brightness

- Purpose: To adjust the brightness of the OLED character display and LED Bar Graphs.
- Access: Menu >  >  > select desired brightness setting
- Range: Low, Medium, High





### Keypad Backlight Setup

- Purpose: To configure keypad backlight
- Access: Menu >  >  > select desired setting
- Range: Off, On, Momentary





### Standby Mode Setup

- Purpose: To configure Standby Mode. This feature will automatically put the unit into a low-power state after a predetermined period of inactivity. Full operation returns when unit is picked up or handled.
- Access: Menu >  > **Standby** > Press  or  to adjust timeout
- Range: Disabled, 1 2, 3, 4, or 5 minutes










### Auto Off Mode Setup

- Purpose: To configure Auto Off Mode. This feature will automatically shut off the unit after a predetermined period of inactivity. Power Up operation (pressing the power button) is required to return to full operation.
- Access: Menu >  >  > Press  or  to adjust timeout
- Range: Disabled, 5, 10, 15, 20, or 30 minutes







### Show Clock

- Purpose: To display the current time and date
- Access: Menu >  >  >  >  (press set button)  
To exit this screen, press any key
- Display: Current time and date

### Set Clock

- Purpose: To set the current time and date
- Access: Menu >  >  >  >  (press set button)  
Press Left or Right Arrow ( ) to select h, m, s, M, D, Y  
Press the Up or Down Arrow ( ) to change the selected item  
Press the set button () to complete the change and exit the set clock screen

### Save/Recall User Settings

- Purpose: For saving the current configuration for recall at a later time.
- Access: To Save current settings - Menu >  >  >  (press set button)  
To Recall saved settings - Menu >  >  >  (press set button)

### Restore User Settings


**Purpose:** Anytime that the ORION is shut down, it saves any user settings that have been changed to memory. The next time the unit is powered on, it will recall these saved settings. However at any time the original factory user settings can be restored.


**Access:** Menu >  >  >  (press set button)

### Start-Up Settings

**Purpose:** The Start Up settings allow the user to determine the configuration that the ORION will boot up in.

**Access:** Menu >  >  > Select Start Up Settings

**Range:** Last Settings : The ORION will boot up with the same settings as the last power down

Saved Settings : The ORION will always boot up with the Saved User settings (see above).



## Region Setting

**Purpose:** The Region Setting is only available on the ORION 2.4 3.3W and ORION 900 FCC models and allows the unit to comply with appropriate regulatory restrictions in specific regions. Note: Operation in a mode other than FCC/IC may result in reduced performance. The table below lists the max transmit power and the frequency range for each of the selections in this menu.

**Access:** Menu >  > **Region** >  or  to change the country.

**Range:** FCC/IC, Europe-CE, Austria, Bulgaria, France, Germany, Hungary, Italy, Liechtenstein, Lithuania, Portugal, Slovenia, Switzerland, Japan

### ORION 2.4 3.3W

Region/Country Setting	Max Transmit Power	Frequency Range (GHz)
FCC/IC	3.3W	2.404 - 2.472
Europe - CE	500 mW	2.447 - 2.453
REI recommends the Europe - CE setting for countries subject to CE regulation. However, prior to EU Radio Equipment Directive (RED) adoption, the following Region/Country settings were included to satisfy R&TTE legislation, and remain in the model.		
Austria	100 mW	2.404 - 2.472
Bulgaria	3.3W	2.446 - 2.454
France	10 mW	2.404 - 2.472
Germany*	25 mW	2.404 - 2.472
Hungary	10 mW	2.404 - 2.472
Italy	10 mW	2.404 - 2.472
Liechtenstein	10 mW	2.404 - 2.472
Lithuania	10 mW	2.404 - 2.472
Portugal	10 mW	2.404 - 2.472
Slovenia	10 mW	2.404 - 2.472
Switzerland	10 mW	2.404 - 2.472
Japan	10 mW	2.404 - 2.472

\* The operator violates German law if the unit is operated with a higher power than permitted. Fine regulation of TKG §148 and §149 could apply. Units shipped into Germany will be preset with the German Country setting.



### ORION 900 FCC

Region Setting	Max Transmit Power	Frequency Range (MHz)
USA - FCC	1.4W	905 - 925
Brazil	1.4W	918 - 925



## APPENDIX

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### Battery Status

- Purpose: To display current battery status to the customer
- Access: Menu >  >  > Ⓢ (*press set button*)  
To see additional information press the Up or Down Arrow (↑↓).  
To exit this screen, press the set button (Ⓢ) again.
- Display: Current battery status.

### Display REI Information / System IDs

- Purpose: To display general information about REI & the ORION and internal component information.
- Access: Menu >  >  > Ⓢ (*press set button*)  
To see additional information press the Up or Down Arrow (↑↓).  
To exit this screen, press the set button (Ⓢ) again.

# SPECIFICATIONS

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## Specifications

### TRANSMITTER

**Frequency Bands:** 2.404 GHz – 2.472 GHz center (ORION 2.4 3.3W)

840 MHz - 960 MHz center (ORION 900 3.2W)

905 MHz - 925 MHz center (ORION 900 1.4W)

869.525 MHz (ORION 900 800 mW)

**Transmit Channels:** Manual or Auto selection

**Transmit Power:** 3.3 W EIRP (ORION 2.4 3.3W)

3.2 W EIRP (ORION 900 3.2W)

1.4 W EIRP (ORION 900 1.4W)

800 mW EIRP (ORION 900 800 mW)

**Power Control:** Manual or Auto control

**Detection Modulation:** Digital 1.25 MHz BW

### RECEIVER

**Simultaneous 2<sup>nd</sup> & 3<sup>rd</sup> harmonic receive**

**Digitally Correlated**

**Frequency Bands:**

**ORION 2.4 3.3 W:** Transmit Band (2.404 GHz – 2.472 GHz); Second Harmonic (4.808 GHz – 4.944 GHz); Third Harmonic (7.212 GHz – 7.416 GHz)

**ORION 900 3.2W:** Transmit Band (840 MHz - 960 MHz); Second Harmonic (1680 MHz - 1920 MHz); Third Harmonic (2520 MHz - 2880 MHz)

**ORION 900 1.4W:** Transmit Band (905 MHz - 925 MHz); Second Harmonic (1810 MHz - 1850 MHz); Third Harmonic (2715 MHz - 2775 MHz)

**ORION 900 800 mW:** Transmit Frequency (869.525 MHz); Second Harmonic (1739.05 MHz); Third Harmonic (2608.575 MHz)

**Sensitivity (ORION 2.4 3.3W):** -140 dBm for both harmonics

**Sensitivity (ORION 900 Models):** -130 dBm for both harmonics

### DISPLAY

**Antenna-Mounted Display**

**Bar Graph Display** for transmit power level, 2<sup>nd</sup> harmonic level, 3<sup>rd</sup> harmonic level, data field display, for other information (operation mode, low battery, volume, DSP gain, etc.)

### MECHANICAL

**Extension Lengths:** 16-51 in (40.6 - 129.5 cm)

**Case Dimensions:** 6.25 in x 14.9 in x 18.5 in (15.9 cm x 37.8 cm x 47.0 cm)

**ORION 2.4 Dim:** 22.4 in x 3.75 in x 3 in (57 cm x 9 cm x 7.5 cm)

**ORION 900 Dim:** 23 in x 3.75 in x 3 in (58.4 cm x 9 cm x 7.5 cm)

**Overall Extended Length:** 58 in (147 cm)

**ORION 2.4 Weight w/ Battery:** 2.8 lbs (1.3 kg)

**ORION 900 Weight with Battery:** 3.4 lbs (1.5 kg)

**Case Weight including ORION 2.4 & Accessories:** 11.6 lbs (5.2 kg)

**Case Weight including ORION 900 & Accessories:** 12.2 lbs (5.5 kg)

# SPECIFICATIONS

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## MAIN BATTERY

**Input AC:** 100 - 240 V, 50 – 60 Hz

**Run Time:** >8 hours per battery (typical)

**Charge Time:** 2.5 hours per battery (typical)

**Batteries:** Lithium-Ion Rechargeable Battery (2 included)

The supplied battery pack: RRC Power Solutions Lithium Ion Rechargeable Battery pack Model #RRC2040, rated 11.25V, 2950mAh, 33.2Wh.

## THERMAL

**Operating Temperature:** -10 to 53°C

**Battery Charging Temperature:** 5 to 37°C

**Storage Temperature:** -20 to 60°C

*Note: extended storage at temperatures above 40 °C could degrade battery & OLED display performance and life.*



*ORION 900 1.4W & ORION 900 3.2W are CE marked for Public Safety & Security*

*ORION 2.4 3.3W and ORION 900 800 mW are CE marked for commercial availability*

*Product specifications and descriptions subject to change without notice.*

## APPENDIX

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### APPENDIX

The ORION 2.4, designed and built by the engineers at Research Electronics International, is the latest advancement in Non-Linear Junction Evaluation. The ORION 2.4 can be used to locate electronic devices whether in furniture, walls, ceiling fixtures or elsewhere. The ORION 2.4 detects semiconductor junctions, to alert in the presence of electronics.

It is important to note that due to the variations in electronic circuitry, the unit will respond differently to different electronic circuits. Therefore, the manufacturer makes no guarantee about the performance of the unit when attempting to detect hidden electronic devices.

### Background Theory

The ORION 2.4 radiates RF energy at frequency  $f_0$  and receives energy at  $2f_0$  &  $3f_0$ . When the radiated signal at  $f_0$  encounters a non-linear junction, some of the energy is re-radiated back at  $f_0, 2f_0, 3f_0, \dots$ . It is the non-linear characteristic of the junction that generates  $2f_0, 3f_0, \dots$  (the 2<sup>nd</sup> & 3<sup>rd</sup> harmonics respectively). By observing the presence of returned signals at  $2f_0, 3f_0$ , the user can detect the presence of a non-linear junction.

Now consider a basic diode; the simplest form of an electronic non-linear junction.

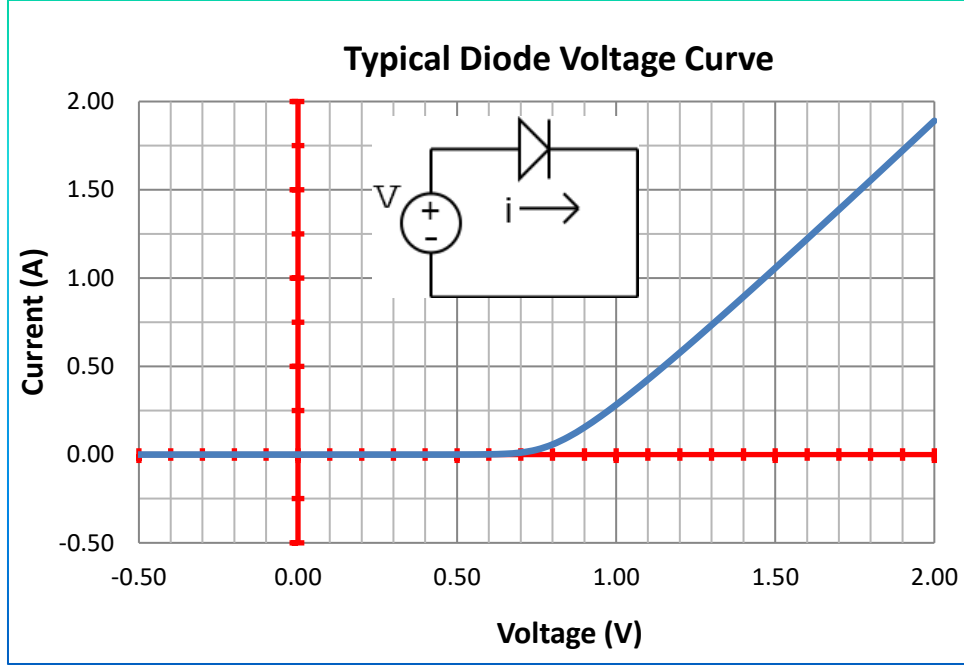
$$i = I_s \left[ e^{qv/kT} - 1 \right]$$

Eq. 1

Where  $i$  is the current of the signal,  $I_s$  the leakage current,  $q$  equals the electron charge,  $v$  is the voltage,  $K$  equals Boltzmann's constant, and  $T$  is the temperature in Kelvins.

A plot of this equation for a typical diode looks something like the following:

## APPENDIX



If we approximate Eq. 1 near the origin using Taylor Series,

$$i = I_s \left[ \frac{vq}{kT} + \frac{\left(\frac{vq}{kT}\right)^2}{2} + \frac{\left(\frac{vq}{kT}\right)^3}{6} + \dots \right] \quad \text{Eq. 2}$$

For small signals across the diodes terminals, we can reduce this to the first three terms,

$$i \sim I_s \left[ \frac{vq}{kT} + \frac{\left(\frac{vq}{kT}\right)^2}{2} + \frac{\left(\frac{vq}{kT}\right)^3}{6} \right] \quad \text{Eq. 3}$$

In Eq. 3, the second term is responsible for generating the 2<sup>nd</sup> harmonic and the third term is responsible for generating the 3<sup>rd</sup> harmonic.

Electronic devices typically have many different non-linear junctions (diodes, transistors, etc.) linked by wires or printed circuit board traces. Therefore energy can be radiated in and out of the device through complex paths. Typically the 2<sup>nd</sup> harmonic signal is stronger than the 3<sup>rd</sup> harmonic signal. However, some circuits can re-radiate strong 3<sup>rd</sup> harmonic signals.

Other situations can also produce harmonic signals. Two dissimilar metals, joined or touching, and corroded metals return harmonic signals (passive intermodulation). These we will refer to as false junctions (Sometimes called “rusty bolt effect” or “environmental diodes”).

The junctions in electronic devices and those in false junctions are quite different. The junctions in electronic devices are well defined, but those created by false junctions are not as well defined or as

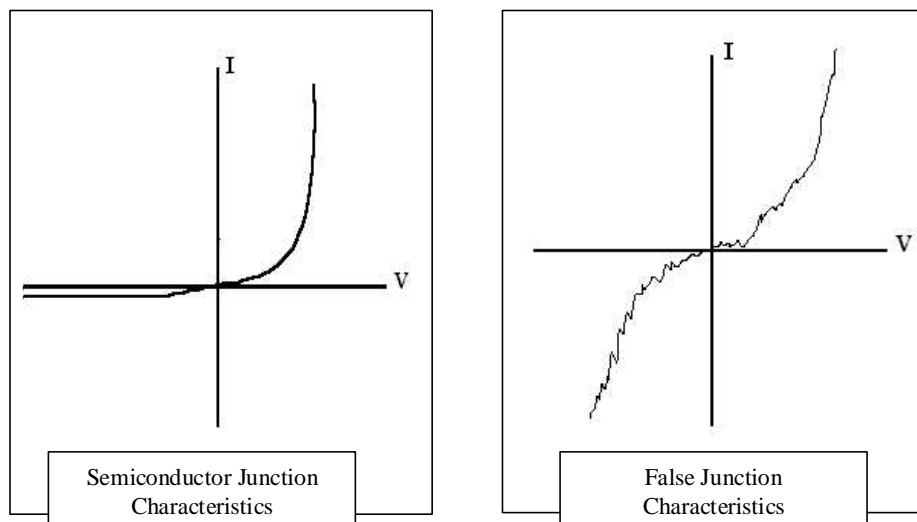
## APPENDIX

clean a physical junction. Imagine two perfect cubes joined—this would be a junction found in electronic devices. False junctions are more like two irregularly shaped items touching in places, but not in a smooth, regular pattern.



[http://en.wikipedia.org/wiki/File:Rust\\_Bolt.JPG](http://en.wikipedia.org/wiki/File:Rust_Bolt.JPG)

Although there are various different types of semiconductor junctions (PN, PIN, JFET, MOSFET, etc.), they all produce clean, predictable junction characteristics. For the junctions found in electronic devices, this equation produces a predictable, but unsymmetrical curve. False junctions produce a less regular curve, one that is noisy and unpredictable, yet they are typically symmetrical: their curve is mirrored for negative values. The current/voltage characteristics are illustrated below.



## APPENDIX

This level of regularity in the junction results in differences in the harmonic signals. When the ORION 2.4 radiates a signal that is returned by the junction in electronics, it results in a strong 2<sup>nd</sup> harmonic signal and a weak 3<sup>rd</sup> harmonic. A false junction returns a very weak 2<sup>nd</sup> harmonic and a strong 3<sup>rd</sup>.



ORION 2.4 COMPARISON OF HARMONIC LEVELS

(A – Semiconductor, B – False Junction; Bargraphs on the right are the 2<sup>nd</sup> and 3<sup>rd</sup> harmonic levels)

As mentioned earlier, some semiconductor circuits re-radiate a strong third harmonic signal. For example with two diodes connected back to back (see below), the shape of the voltage curve resembles the symmetry of a false junction and produces a stronger third harmonic than does a single diode.

