ORION™ HX

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

ORION™ HX

Non-Linear Junction Detector

The ORION HX is available in several different models: ORION 2.4 HX, ORION 900 HX, and ORION Deluxe. 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
ORION 2.4 HX				
	3.3 watt (FCC)	Yes	Yes	Yes**
	6.6 watt (G)	No	Yes	No
ORION 900 HX				
	800 milliwatt	No	Yes	Yes
	1.4 watt (FCC)	Yes	Yes	No
	3.2 watt (G)	No	Yes	No
ORION HX Deluxe				
	3.3 watt/1.4 watt (FCC)	Yes	Yes	No
	6.6 watt/3.2 watt (G)	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 HX Non-Linear Junction Detector.

This document is intended to provide guidance and instruction on using the ORION HX 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 operate the appropriate equipment.

REI offers the world's largest commercially available Technical Security training facility. Training courses include classroom instruction and hands-on exercises where students perform sweep exercises in "live" environments utilizing "target rich" project rooms. The progressive course curriculum is designed for the beginner or the seasoned Technical Security Technician.

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

OWNER'S RECORD

The Serial Number of each ORION HX 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 it 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: _____

Revision 2.9

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REI products are designed and intended for legal commercial applications, however because laws and regulations vary from state to state and country to country, it is the sole responsibility of the purchaser and user/operator to check and comply with all applicable laws and regulations for the possession and operation of this equipment before and after making a purchase.

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

The ORION 2.4 HX FCC and ORION HX 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 HX FCC and ORION 900 HX 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 HX FCC et ORION HX 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 HX
08152-23-15728	Orion 900 HX

The ORION 2.4 HX G and the ORION 900 HX G are authorized for use only by agencies, persons, and entities not restricted by US Federal Communications Commission (FCC) or Industry Canada.

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

ORION HX

- CAUTION: Any changes or modifications not expressly approved by REI could void the user's authority to operate the equipment.
- The ORION HX is for professional use only.
- The ORION HX is capable of emitting radio frequencies. 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 #UIB345-15. 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 device. 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

1. **ANTENNA** – located on opposite side of head display
2. **HEAD DISPLAY** – LED Bar graphs for indicating Transmit Power level, 2nd & 3rd Harmonic levels and a small OLED informational display for indicating status and displaying the menu.
3. **TOUCHSCREEN DISPLAY** – used for controlling the ORION HX and monitoring its operation
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. **MICRO SD CARD** – used for saving screen shots or user settings
7. **POWER BUTTON** – Press to power on. Press and hold while the unit is on to power off.
8. **SPEAKER** – used to monitor audio from the unit
9. **POWER INPUT** *(under battery door)* – for connecting AC adapter for charging (only use REI supplied AC Adapter)
10. **BATTERY DOOR / BATTERY DOOR LATCH** – conceals battery compartment

ORION 2.4 HX shown

Ports

1. **USB Connector** – connect to a PC for software updates
2. **MICRO SD CARD Slot** – save screenshots or user settings

SET-UP & BASIC OPERATION

The ORION HX 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 HX 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 device 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 device for long-term storage of 90 days or more. Even when powered off, the operating system of the ORION unit 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 unit 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 HX head

The ORION is provided with a quick-release head. This is useful if the ORION Deluxe package has been purchased which includes an ORION 2.4 head and an ORION 900 head with one pole/grip handle. The ORION 900 and the ORION Deluxe units are stored in the case with the head separated from 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 device is turned on, it scans the Transmit, 2nd Harmonic, and 3rd 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 device. 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 unit.

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

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

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

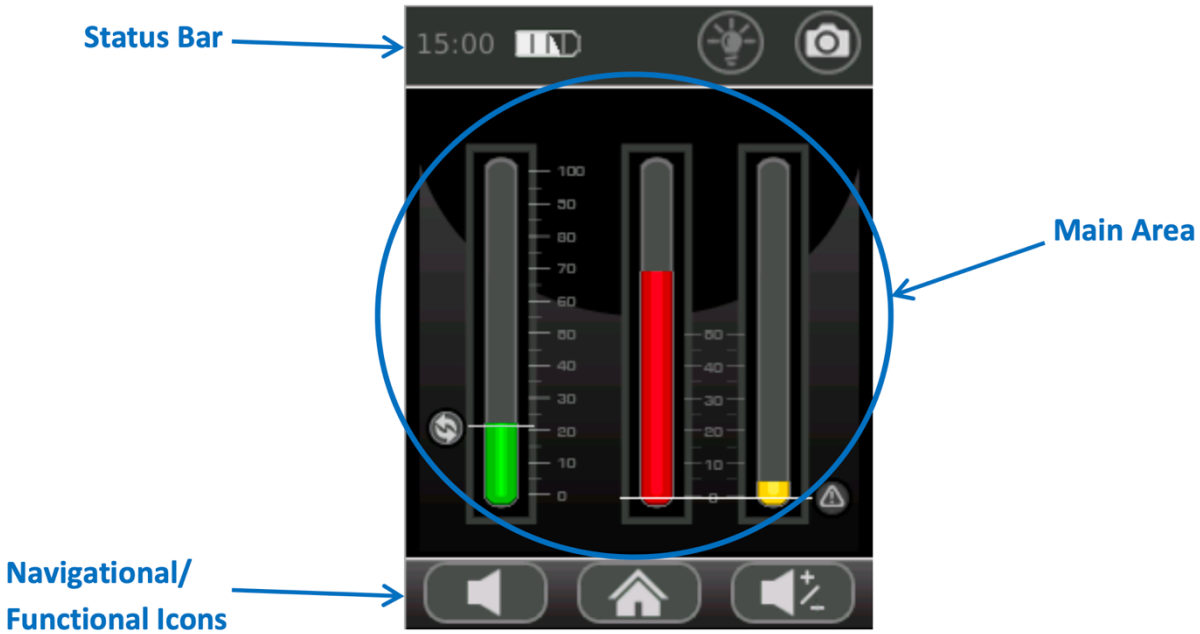
Display Screens

Display Screen Layout

Status Bar – This area of each screen contains status icons indicating the current condition of the ORION unit. Tapping the camera icon in the status bar will take a screenshot and save it to a micro SD card.

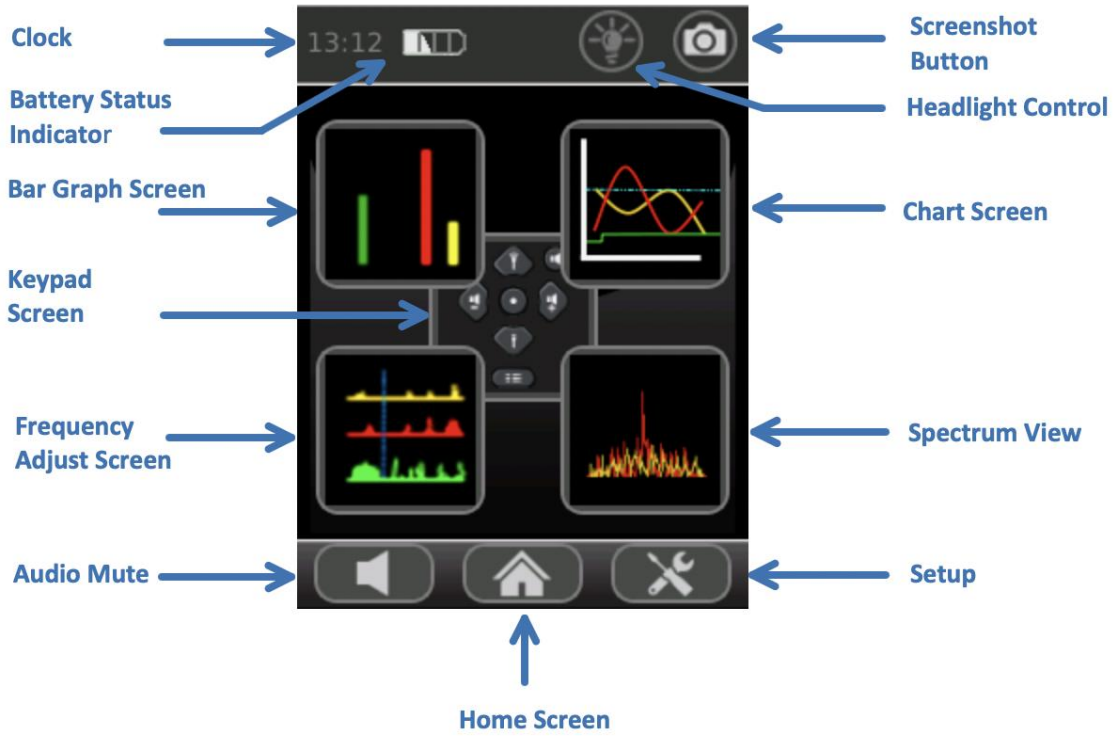
Main Area – The content of this area will vary depending on which screen is currently selected.

Navigational/Function Icons – The icons in this area also vary depending on which screen is currently selected. They will typically aid with navigating to another screen or will provide quick access to typically used functions.



Home Screen

By default, the Home Screen is the initial screen shown after the ORION unit is powered on. The Home Screen allows for quick navigation to any of the main operational modes. The diagram below details what functions are accessible when the various icons are tapped on the screen.



Battery Status Indicator – This indicates the charging level of the battery. This indicator is common to all the display screens.

Screenshot – Tapping this icon captures a screenshot of the current display and saves it to the inserted microSD card. For additional details regarding the screenshot feature, see page 30.

Clock – This indicator displays the current time. This indicator is common to all the display screens. For instructions on setting the clock, see page 25.

Headlight Control – Tapping this icon will toggle the headlamp off and on.

Bar Graph Screen – Tapping this icon will take the user to the Bar Graph Screen (see page 15).

Chart Screen – Tapping this icon will take the user to the Chart Screen (see page 17).

Keypad Screen – Allows for an alternate method of making adjustments to the ORION unit (see page 27)

Frequency Adjust Screen – Tapping this icon will take the user to the Frequency Adjust Screen (see page 17).

Spectrum View – Tapping this icon will take the user to the Spectrum View Screen (see page 19). Note: Spectrum View is not available in all models.

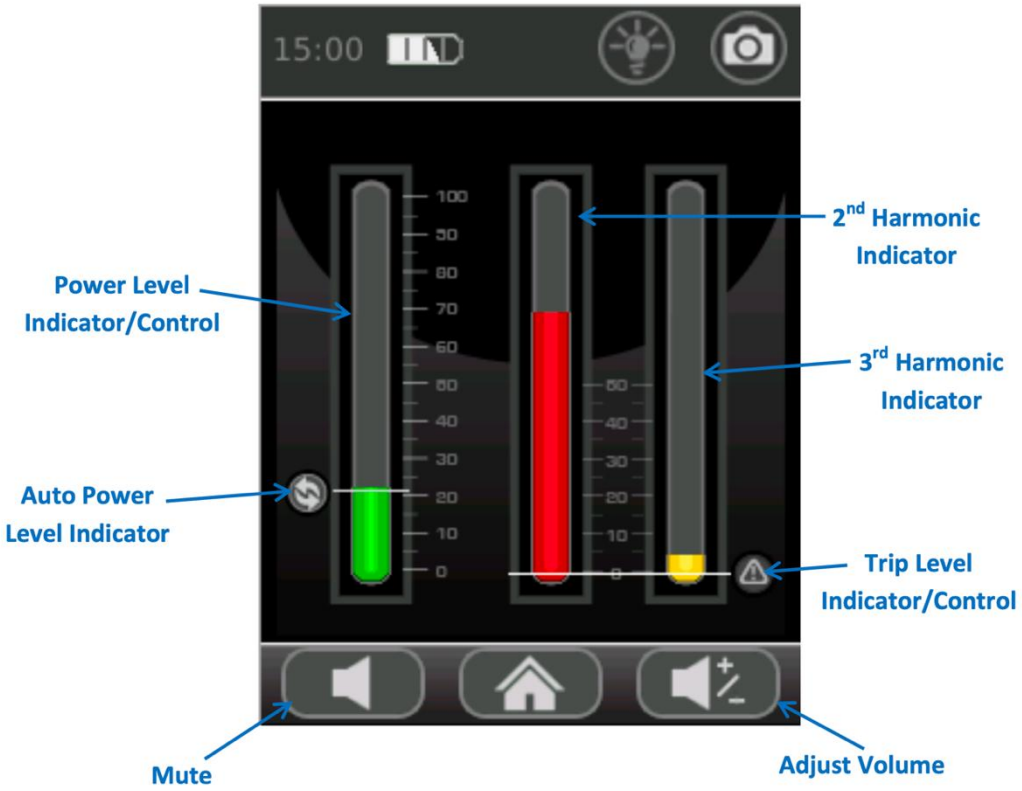
Audio Mute – Tapping this icon will mute the audio. Tapping this icon a second time will unmute the audio.

Home Screen – This icon is common to all the display screens. It returns the user to the Home Screen. When the user is already on the Home Screen, this button has no function.

Setup – Tapping this icon will access the device

Bar Graph Screen

The bar graph screen replicates the indicators that are found on the head of the device.



Power Level Indicator/Control – To increase the transmit power level, tap on the top half of the Power Level Indicator. The green bar graph will increase corresponding to the increase in transmit power. To decrease the transmit power level, tap on the bottom half of the Power Level Indicator. The green bar graph will decrease corresponding to the decrease in transmit power.

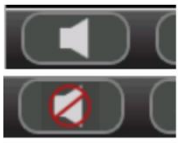
Auto Power Level Indicator – The Auto Power Level Indicator is shown on the Bar Graph Screen, whenever the device is operated in auto transmit mode. The device can be operated in either auto transmit mode or manual transmit mode. In auto transmit mode, the transmit power will automatically reduce whenever the receiver becomes saturated. In manual transmit mode, the transmit power remains at the same level unless it is manually changed. The Auto Power Level Indicator indicates the set maximum transmit power level. If the receiver becomes saturated, for example, due to a target, the actual power level, indicated by the green bar, will decrease, but the Auto Power Level Indicator will stay at the same level to indicate the max power level. If the unit is in auto transmit mode, adjusting the transmit power level will also adjust the auto power level. To toggle between auto and manual transmit modes, quickly press the power button.

2nd Harmonic Indicator – The 2nd & 3rd harmonic indicators help to discriminate between electronic devices and false junctions. For electronic devices, the 2nd harmonic level will be higher than the 3rd harmonic level.

3rd Harmonic Indicator – The 2nd & 3rd harmonic indicators help to discriminate between electronic devices and false junctions. For false junctions, the 3rd harmonic level will be higher than the 2nd harmonic level. For additional information regarding the theory behind the ORION's operation, see the Appendix (page **Error! Bookmark not defined.**).

Trip Level Indicator/Control – To set a trip level for the alert tone, the vibration feedback, and target indicators ("SEMICOND" or "CORROSIVE"). To increase the trip level, tap the top half of the 2nd or 3rd harmonic indicator. To decrease the trip level, tap the bottom half of the 2nd or 3rd harmonic indicator. The trip level can be adjusted from 0% to 50% in 5% intervals.

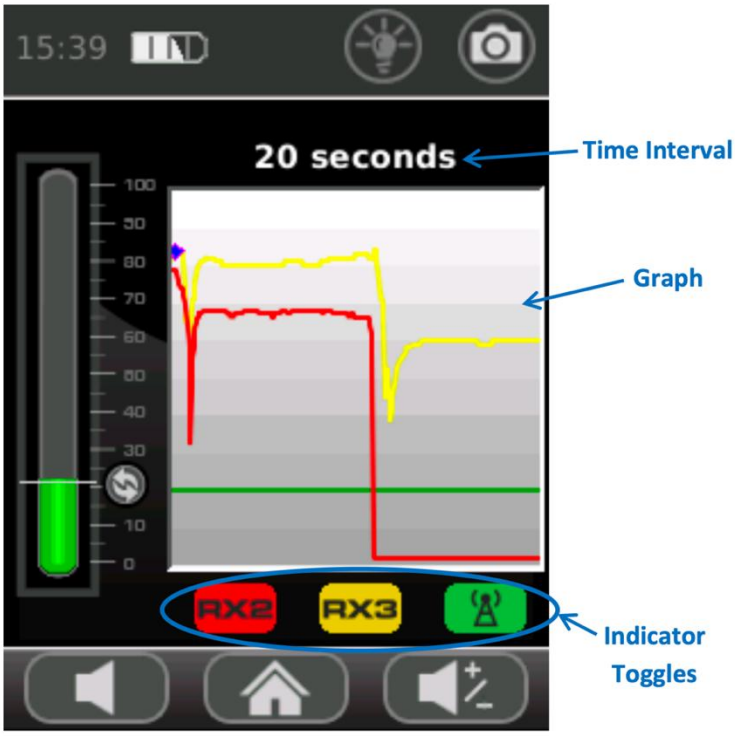
Mute – Tap this icon to mute the audio. The appearance of the icon will change to indicate that the audio has been muted. Tap the icon again to unmute the audio.



Adjust Volume – Tap this icon to adjust the volume level. After tapping, the Adjust Volume icon will change to Increase Volume and the Mute icon will change to Decrease Volume. The icons will change back to their original state after a few seconds if there is no activity.

Chart Screen

The chart screen provides a time-based history of the transmit power level, 2nd harmonic level, and 3rd harmonic level.



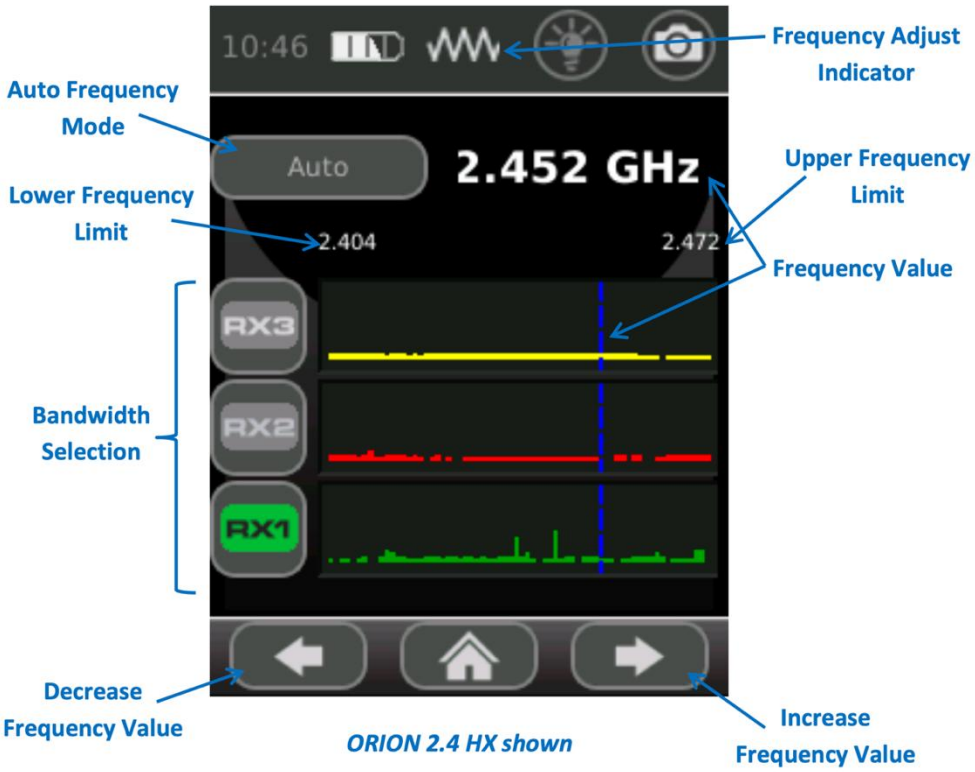
Time Interval – The time interval is the amount of time represented by the horizontal span of the graph. To select a different time interval, tap anywhere on the graph. Selecting a larger time increment will allow more data to be shown on the graph at one time. The range of available values for the time interval is 10s, 20s, 30s, and 1m.

Graph – The graph represents a time-based history of the transmit power level, 2nd harmonic level, and 3rd harmonic level. The green trace represents the transmit power level. The red trace represents the 2nd harmonic level. The yellow trace represents the 3rd harmonic level.

Indicator Toggles – The display of the individual traces in the graph can be toggled off or on. To toggle a trace off or on, tap the corresponding indicator toggle. For example, to hide the transmit power level trace in the graph, tap the green indicator toggle. The indicator toggle will turn grey indicating that the corresponding trace is hidden. To display the trace, tap the indicator toggle again.

Frequency Adjust Screen

The frequency adjust screen provides a view of the ambient RF environment allowing the user to select a quiet channel for the transmit frequency.



ORION 2.4 HX shown

Frequency Adjust Indicator – The waveform symbol indicates that the ORION is in frequency adjust mode. The transmit power level is turned off in frequency adjust mode.

Auto Frequency Mode – When enabled, the unit will scan the frequency spectrums of the transmitter, 2nd harmonic, and 3rd harmonic to find and select a quiet channel for use, avoiding any interference to and from other devices. If this mode is enabled, the unit will also perform this operation on power up as well. Note: Auto Frequency Mode is not available for all models.

Frequency Value – This is the value of the transmit frequency. The frequency is represented in numerical form at the top of the screen. A blue dashed cursor also represents the transmit frequency value in the spectrum graph in the middle of the screen. Note: the ORION does not transmit when the unit is in this mode so that it can monitor the ambient RF environment, but this value represents what the transmit frequency will be when this screen is exited and the unit is operating. The frequency value can be adjusted in several ways. The frequency value can be automatically determined by tapping the Auto Frequency Mode button. It can be manually selected by clicking within the ambient RF graphs. Fine adjustment can be done by tapping the "Decrease Frequency Value" or "Increase Frequency Value" buttons at the bottom of the screen. Note: The frequency cannot be adjusted on the ORION 900 HX Commercial CE compliant model - it transmits only on a single frequency, 869.525 MHz.

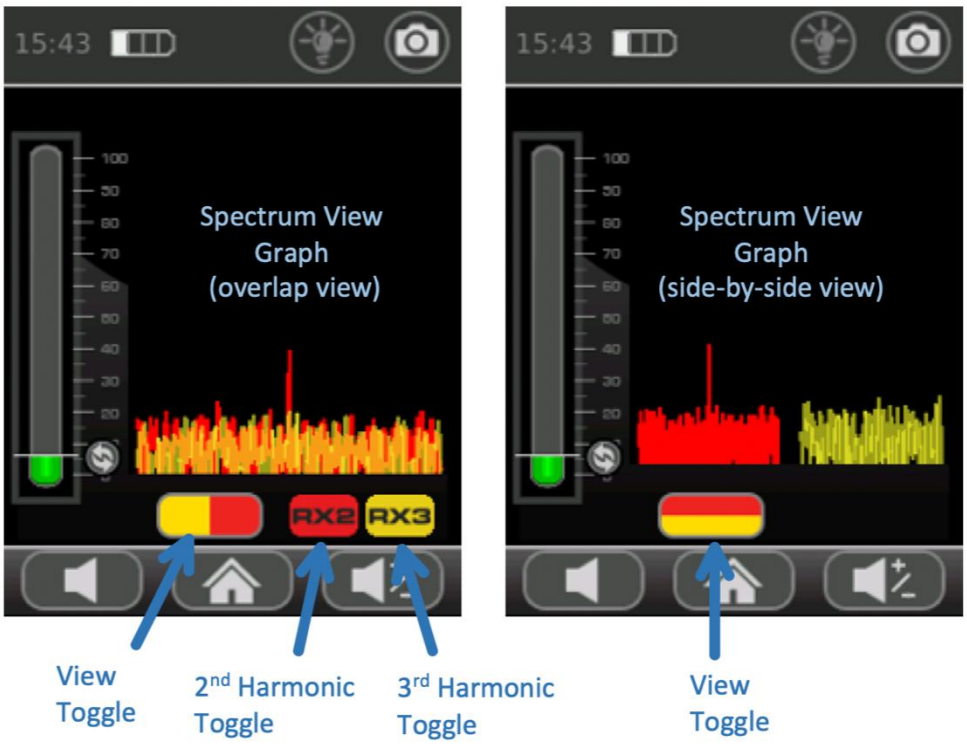
Bandwidth Selection – The RF graphs in the center of the screen display the ambient RF environment. Only one of the graphs can be active at a time. To select which graph is active, tap the corresponding

icon on the left side of the screen. Monitoring the RF environment allows a quiet frequency to be selected, one that avoids interference from other RF sources, such as Wi-Fi or Bluetooth.

Frequency Limits – The Upper and Lower Frequency Limits show the range of the currently selected bandwidth.

Spectrum View Screen

The Spectrum View screen provides an alternate view of the 2nd and 3rd harmonic receive levels. Spectrum View provides an FFT-based spectral representation of the 2nd and 3rd harmonic receivers. This view may actually indicate a hit on the 2nd or 3rd harmonic before it registers on the bar graphs. Note: The Spectrum View feature is not available on all models.



Spectrum View Graph – The red trace graph represents the 2nd harmonic; the yellow trace represents the 3rd harmonic.

View Toggle – This button toggles between the overlap view and the side-by-side view.

2nd Harmonic Toggle – This button toggles the display of the 2nd harmonic trace. It is only available in overlap view.

3rd Harmonic Toggle – This button toggles the display of the 3rd harmonic trace. It is only available in side-by-side view.

Setup

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

To scroll through the three different setup screens, use the arrow keys at the bottom of the screen.

To make adjustments to one of the setup items, tap the corresponding button.

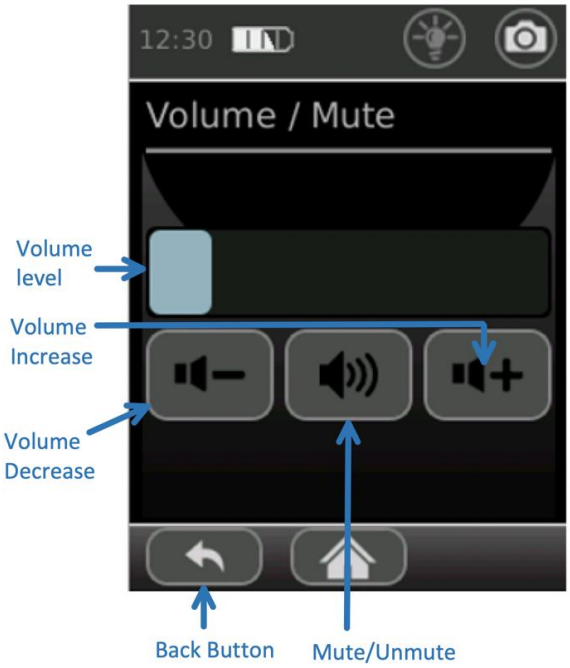
Note: The Freq Mode setting, which is shown on the first setup screen, is not available for all models.

Note: The Region setting, which is shown on the third setup screen, is only available for the ORION 2.4 HX FCC and the ORION 900 HX FCC models.

Volume

The volume adjustment allows control of the volume level of the audio cues that are heard through the provided speaker on the unit or through headphones.

Press BACK to return to the setup screen menu after making adjustments.



Audio Mode

The audio mode menu provides configurations for the audible response of the ORION.

Type

Tone – In this mode, synthetic tones will be used to indicate when the 2nd or 3rd harmonic level has exceeded the trip level. The tone style can be configured using the setup menu (see page 23). The trip level can be adjusted on the Bar Graph Screen (see page 15).

RX2 - AM – The received 2nd harmonic signal is AM demodulated and output through the speakers or headphones.

RX2 - FM – The received 2nd harmonic signal is FM demodulated and output through the speakers or headphones.

RX3 - AM – The received 3rd harmonic signal is AM demodulated and output through the speakers or headphones.

RX3 - FM – The received 3rd harmonic signal is FM demodulated and output through the speakers or headphones.

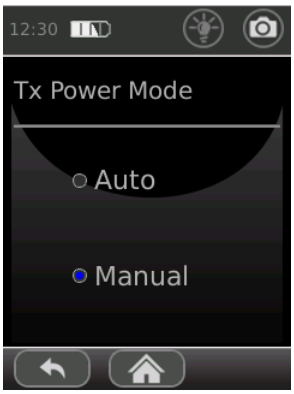
Note: RX2 - AM, RX2 - FM, RX3 - AM, and RX3 - FM are not available in all models.

Source

HP Only – This setting shuts the speaker on the ORION off and audio cues are heard through the headphones only. In this configuration, the speaker will remain OFF regardless of whether headphones are plugged in or not.

Speaker/HP – This setting allows 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.

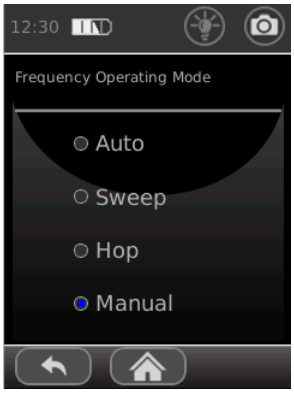
Tx Power Mode



Auto – In auto transmit power mode, the transmit power will automatically reduce whenever the receiver becomes saturated. In auto transmit mode, the set transmit power level is indicated by the Auto Power Level Indicator on the Bar Graph Screen (see page 15) and on the Chart Screen (see page 17). On the head display, the set transmit power level is indicated by a blinking LED in the Tx Power bar graph.

Manual – In manual transmit power mode, the transmit power remains at the same level unless it is manually changed.

Freq Mode



Auto – In auto frequency mode, each time that the unit is powered up, it will scan the frequency spectrums of the transmitter, 2nd harmonic, and 3rd harmonic to find and select a quiet channel for use, avoiding any interference to and from other devices. An auto-frequency scan can be initiated at any time from the Frequency Adjust Screen (see page 17).

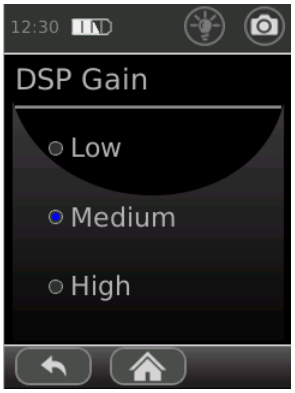
Sweep – In Sweep frequency mode, the ORION will continuously change the transmit frequency, sweeping sequentially through each channel of its range. Sweep mode is only available in the ORION 2.4 HX G and ORION 900 HX G models.

Hop – In Hop frequency mode, the ORION will continuously change the transmit frequency, randomly selecting channels throughout its range. Hop mode is only available in the ORION 2.4 HX G and ORION 900 HX G models.

Manual – In manual frequency mode, the transmit frequency will not change unless manually changed. The transmit frequency can be changed from the Frequency Adjust Screen (see page 17).

Note: The Freq Mode option is not available in all models.

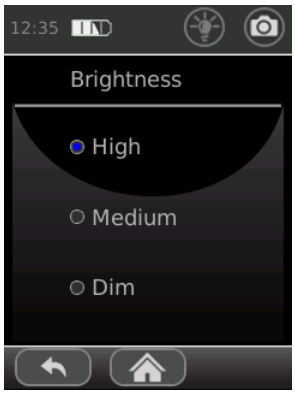
DSP Gain Level



This setting configures the level of digital signal processing integration that is used to process the received signals. Sensitivity increases as the DSP Gain is increased from Low to High.

Brightness

This setting adjusts the brightness of the OLED screen and the LED Bar Graphs on the head display and the Touch Screen display. There are three available brightness settings: Dim, Medium, High.



Tone Style

Four different styles are available for the Tone Alerts. Note: In addition to setting the Tone Style, the Audio Type from the Audio Mode Menu (see page 21) must be set to "Tone" and the volume must be up to hear the alert tone.

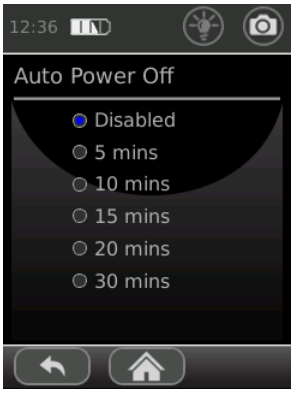
2nd Only – With this Tone Style, an audible, synthetic tone is heard only when the received 2nd harmonic signal level surpasses the set trip level. As the 2nd harmonic signal level increases, the frequency of the synthetic tone will increase.

3rd Only – With this Tone Style, an audible, synthetic tone is heard only when the received 3rd harmonic signal level surpasses the set trip level. As the 3rd harmonic signal level increases, the frequency of the synthetic tone will increase.

2nd/3rd Same – With this tone style, an audible, synthetic tone is heard whenever the received 2nd harmonic signal or 3rd harmonic signal level surpasses the set trip level. As the signal level increases, the frequency of the synthetic tone will increase.

2nd/3rd Diff – With this tone style, an audible, synthetic tone is heard whenever the received 2nd harmonic signal level surpasses the trip level. As the 2nd harmonic signal level increases, the frequency of the synthetic tone will increase. If the received 3rd harmonic signal level becomes higher than the received 2nd harmonic signal level, a lower frequency tone representing the 3rd harmonic will be heard alternating (or warbling) with the 2nd harmonic tone.

Auto Power Off



This feature will automatically shut off the unit after a predetermined period of inactivity. A power up operation (pressing the power button) is required to return to full operation.

To enable this feature, select one of the time durations listed to determine how long the unit must be inactive before shutting off. The available durations are: 5, 10, 15, 20, & 30 minutes.

To disable this feature, select "Disabled".

Haptic Style

In addition to visual and audio cues, the ORION will also provide haptic (vibrator) cues whenever the 2nd or 3rd harmonic levels exceed the trip levels. The trip level can be adjusted on the Bar Graph Screen (see page 15).

Mode

On - Both – with this setting, the unit will vibrate whenever the 2nd or 3rd harmonic levels exceed the set trip level or whenever the user interacts with the touch screen.

On - Target – with this setting, the unit will only vibrate whenever the 2nd or 3rd harmonic levels exceed the set trip level.

On - Touch – with this setting, the unit will only vibrate whenever the user interacts with the touch screen.

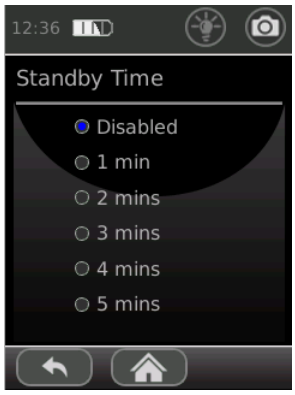
Off – with this setting, the unit will not provide any haptic feedback.

Length

Short – vibration feedback will be set to short pulses.

Long – vibration feedback will be set to longer pulses.

Standby Time

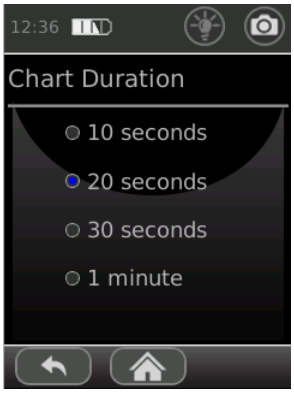


This menu configures Standby Mode. This feature will automatically put the unit into a low-power state after a predetermined period of inactivity. Full operation returns when the unit is picked up or handled.

To enable this feature, select one of the time durations listed to determine how long the unit must be inactive before going into Standby Mode. The available durations are: 1, 2, 3, 4, & 5 minutes.
To disable this feature, select "Disabled".

Chart Duration

This menu configures the displayed duration of the chart on the chart screen.

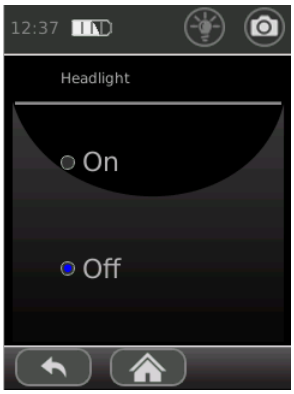


The available ranges for chart duration are: 10 seconds, 20 seconds, 30 seconds, & 1 minute.

Chart duration can also be configured from the Chart Screen (see page 17).

Headlight

This menu toggles the headlight on and off.



The headlight can also be toggled on/off from the headlight control that appears in the status bar of each screen (see Page 14)

Date/Time

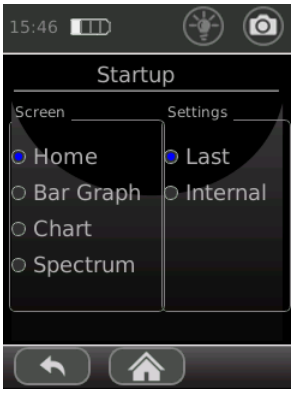
This menu is for setting the current date and time.

The time is displayed in the status bar of each screen.

The date and time is also displayed on any screen captures that are saved with the ORION.

Startup

This menu allows the user to determine the configuration that the ORION will boot up in.



Screen

The screen selection configures which screen is shown first whenever the unit is powered up. There are four available choices for initial screen: Home, Bar Graph, Chart, & Spectrum.

Settings

Last – The ORION will boot up with the same settings as the last power down

Internal – The ORION will always boot up with the user settings saved to the internal profile (see below)

User Settings

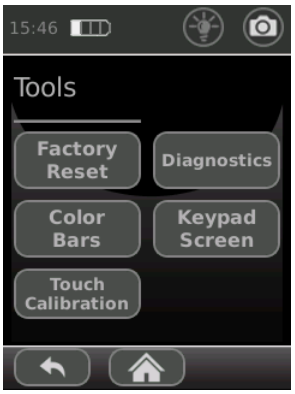
After setting up the configurable items on the ORION (Audio Mode, Tx Power Mode, Freq Mode, Brightness, Tone Style, etc.), the unit can save this configuration for recall at a later time. Using a micro SD storage device, up to 7 different configurations can be saved.

Any saved configurations *or* profiles show up in the Saved Profile List. To scroll through the saved profiles in the list, tap the left or right arrows on the screen. Once the name of the saved profile is displayed on the screen, press the Load Settings button to load those settings to the ORION. If SD Card profiles have been saved to a micro SD card, then that specific micro SD card must be inserted in the ORION to recall those profiles.

To save the current configuration, press the "Save As…" button. From the dialog box that appears, select one of the listed profiles. Select "OK". Note: If the selected profile already has a saved configuration, that configuration will be overwritten with the new configuration. The SD Card profiles are only available if a Micro SD card is inserted in the unit.

Tools

This menu contains additional tools for the ORION HX.



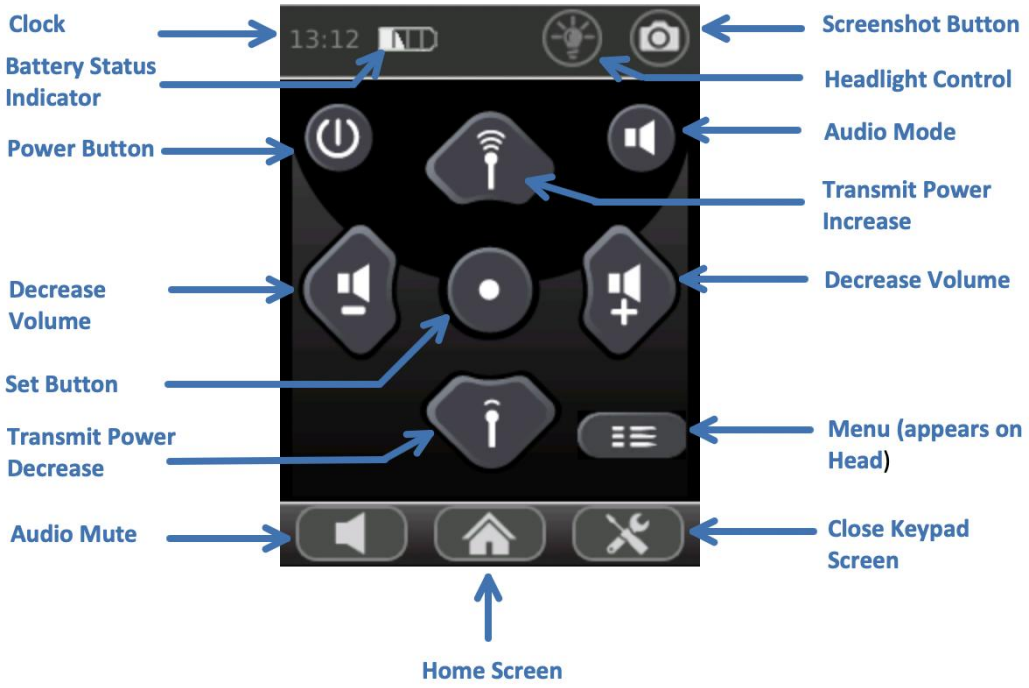
Factory Reset – Original factory user settings can be restored to the unit using the Factory Reset button.

Touch Calibration – In order to properly align the touch screen to the display, it may be necessary to calibrate the touch screen. After selecting the Touch Calibration button, follow the on-screen instructions.

Color Bars – Displays a set of Color Bars for Touch Screen display evaluation.

Diagnostics – Performs diagnostic communication tests and displays the results.

Keypad Screen – Allows for an alternate method of making adjustments to the ORION unit.



Info

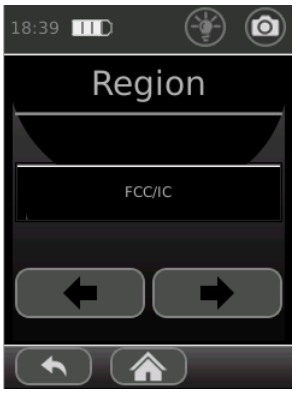
This menu displays general information about REI, software versions, and battery status.

To access the information included, select the tabs across the top of the screen.

Region

This Region setting is only available for the ORION 2.4 HX FCC model and ORION 900 HX FCC model 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 tables below list the max transmit power and the frequency range for each of the selections in this menu.



ORION 2.4 HX FCC

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

* Note: 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.

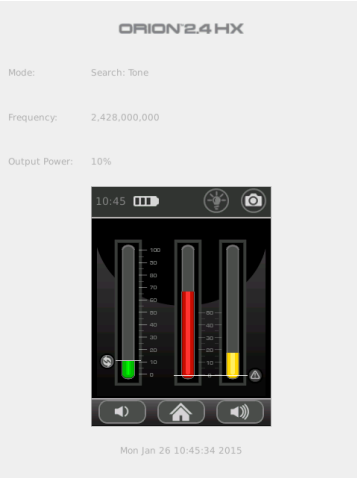
ORION 900 HX FCC

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

Additional Features

Screenshot

To assist in report-writing, the ORION provides the ability to capture screenshots from the display. Screenshots are stored as PNG files and are saved to an inserted micro SD card. To use this function, insert a micro SD card into the micro SD card slot near the top of the touch screen display. Then tap the screenshot icon that appears in the status bar on any screen. If successful, the message "Save Complete" will briefly appear in the status bar area. In addition to the captured screenshot, the saved image file also has additional information such as the date/time, mode, frequency, & power level.



Specifications

TRANSMITTER

Frequency Bands*: 2.404 GHz – 2.472 GHz center (ORION 2.4 HX models)
840 MHz – 960 MHz center (ORION 900 HX G model)
905 MHz – 925 MHz center (ORION 900 HX FCC model)
Transmit Channels: Manual or Auto selection, more than 60 available
Maximum Transmit Power*: 6.6 W EIRP (ORION 2.4 HX G)
3.3 W EIRP (ORION 2.4 HX FCC)
3.2 W EIRP (ORION 900 HX G)
1.4 W EIRP (ORION 900 HX FCC)
Power Control: Manual or Auto control
Detection Modulation: Digital 1.25 MHz BW

RECEIVER

Simultaneous 2nd & 3rd harmonic receive
Digitally Correlated
Frequency Bands (ORION 2.4 HX): Transmit Band (2.404 GHz – 2.472 GHz); Second Harmonic (4.808 GHz – 4.944 GHz); Third Harmonic (7.212 GHz – 7.416 GHz)
Frequency Bands (ORION 900 HX G): Transmit Band (840 MHz – 960 MHz); Second Harmonic (1680 MHz – 1920 MHz); Third Harmonic (2520 MHz –2880 MHz)
Frequency Bands (ORION 900 HX FCC): Transmit Band (905 MHz – 925 MHz); Second Harmonic (1810 MHz - 1850 MHz); Third Harmonic (2715 MHz – 2775 MHz)
Sensitivity (ORION 2.4 HX): –140 dBm for both harmonics
Sensitivity (ORION 900 HX): – 130 dBm for both harmonics

DISPLAY

Handle-Mounted Touch Screen Controller Display
Antenna-Mounted Display

Bar Graph Display for transmit power level, 2nd harmonic level, 3rd 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: 3 lbs (1.4 kg)
ORION 900 Weight with Battery: 3.6 lbs (1.6 kg)
Case Weight including ORION 2.4 HX & Accessories: 12 lbs (5.4 kg)
Case Weight including ORION 900 HX & Accessories: 12.6 lbs (5.7 kg)
Case Weight including ORION HX Deluxe & Accessories: 12.9 lbs (5.9 kg)

MAIN BATTERY

Input AC: 100 – 240 V, 50 – 60 Hz
Run Time: >4 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 50°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.

CE

ORION 2.4 HX G, ORION 900 HX G, and ORION 900 HX FCC are CE marked for Public Safety & Security
ORION 2.4 HX FCC and ORION 900 HX 800 mW are CE marked for commercial availability

Product specifications and descriptions subject to change without notice.

**The frequency bands and maximum transmit power of the ORION 900 HX Commercial CE compliant model are limited due to CE RED regulations.*

APPENDIX

The ORION, designed and built by the engineers at Research Electronics International, is the latest advancement in Non-Linear Junction Evaluation. The ORION can be used to locate electronic devices, whether in furniture, walls, ceiling fixtures, or elsewhere. The ORION 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 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, $2f_0$, $3f_0$, ... It is the non-linear characteristic of the junction that generates $2f_0$, $3f_0$, ... (the 2nd & 3rd 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.

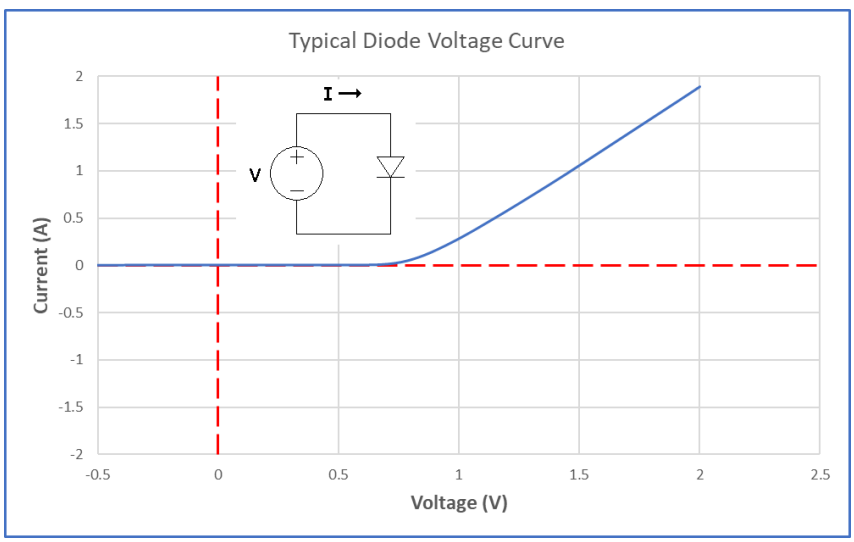
Now consider a basic diode — the simplest form of an electronic non-linear junction.

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

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 Kelvin.

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



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

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

For small signals across the diode's terminals, we can reduce this to the first three terms,

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

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

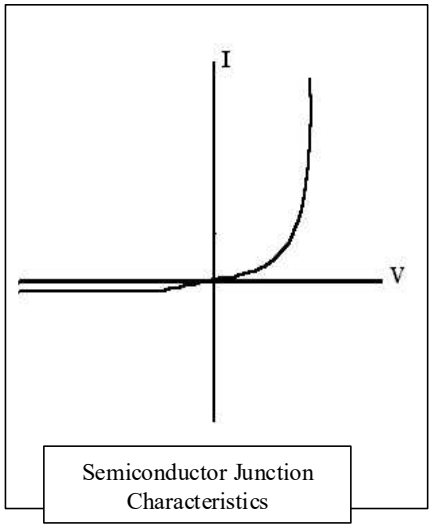
Electronic devices typically have many different non-linear junctions (diodes, transistors, etc.) linked by wires or printed circuit board traces. Therefore, energy can be radiated in and out of the device through complex paths. Typically, the 2nd harmonic signal is stronger than the 3rd harmonic signal.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

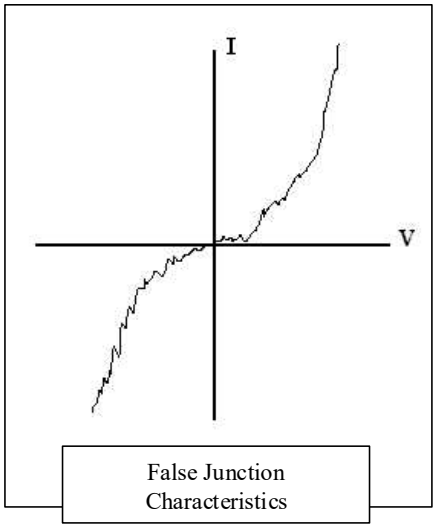
Other situations can also produce harmonic signals. Two dissimilar metals joined or touching, and corroded metals return harmonic signals (passive intermodulation). These we will refer to as false junctions (Sometimes called "rusty bolt effect" or "environmental diodes").

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 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

Although there are various 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.





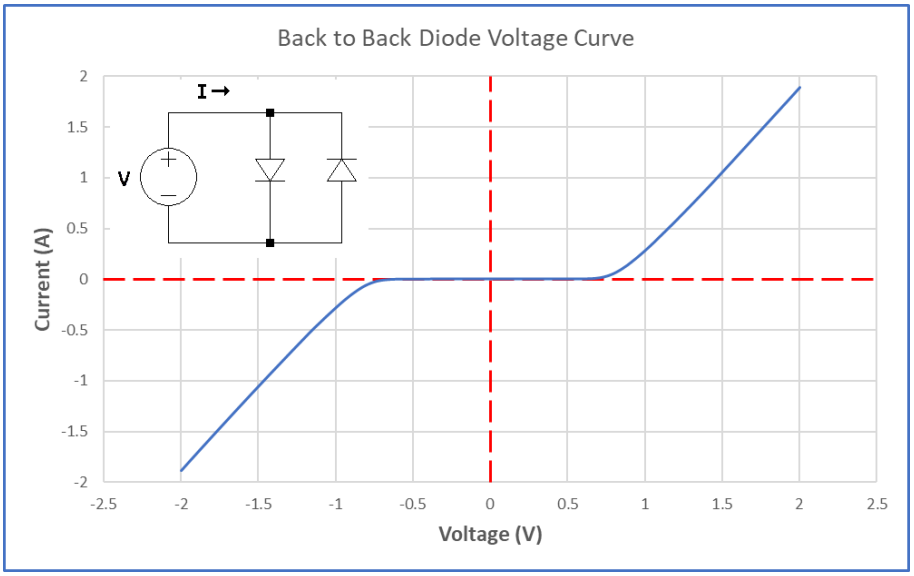
This level of regularity in the junction results in differences in the harmonic signals. When the ORION radiates a signal that is returned by the junction in electronics, it results in a strong 2nd harmonic signal and a weak 3rd harmonic. A false junction returns a very weak 2nd harmonic and a strong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

A

B

ORION COMPARISON OF HARMONIC LEVELS
(A – Semiconductor, B – False Junction; Bar graphs on the right are the 2nd and 3rd 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.



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ORION HX is based in part on the work of Qt 4.8.

The source code for Qt 4.8 SDK is available from Nokia here: http://download.qt.io/archive/qt/4.8/4.8.0/qt-everywhere-opensource-src-4.8.0.zip
It is also available on request from Research Electronics International.

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Version 1.0, January 1, 2003

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Version 2.1, February 1999

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When a program is linked with a library, whether statically or using a shared library, the combination of the two is legally speaking a combined work, a derivative of the original library. The ordinary General Public License therefore permits such linking only if the entire combination fits its criteria of freedom. The Lesser General Public License permits more lax criteria for linking other code with the library.

We call this license the "Lesser" General Public License because it does Less to protect the user's freedom than the ordinary General Public License. It also provides other free software developers Less of an advantage over competing non-free programs. These disadvantages are the reason we use the ordinary General Public License for many libraries. However, the Lesser license provides advantages in certain special circumstances.

For example, on rare occasions, there may be a special need to encourage the widest possible use of a certain library, so that it becomes a de-facto standard. To achieve this, non-free programs must be allowed to use the library. A more frequent case is that a free library does the same job as widely used non-free libraries. In this case, there is little to gain by limiting the free library to free software only, so we use the Lesser General Public License.

In other cases, permission to use a particular library in non-free programs enables a greater number of people to use a large body of free software. For example, permission to use the GNU C Library in non-free programs enables many more people to use the whole GNU operating system, as well as its variant, the GNU/Linux operating system.

Although the Lesser General Public License is Less protective of the users' freedom, it does ensure that the user of a program that is linked with the Library has the freedom and the wherewithal to run that program using a modified version of the Library.

The precise terms and conditions for copying, distribution and modification follow. Pay close attention to the difference between a "work based on the library" and a "work that uses the library". The former contains code derived from the library, whereas the latter must be combined with the library in order to run.

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A "library" means a collection of software functions and/or data prepared so as to be conveniently linked with application programs (which use some of those functions and data) to form executables.

The "Library", below, refers to any such software library or work which has been distributed under these terms. A "work based on the Library" means either the Library or any derivative work under copyright law: that is to say, a work containing the Library or a portion of it, either verbatim or with modifications and/or translated straightforwardly into another language. (Hereinafter, translation is included without limitation in the term "modification".)

"Source code" for a work means the preferred form of the work for making modifications to it. For a library, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the library.

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d) If a facility in the modified Library refers to a function or a table of data to be supplied by an application program that uses the facility, other than as an argument passed when the facility is invoked, then you must make a good faith effort to ensure that, in the event an application does not supply such function or table, the facility still operates, and performs whatever part of its purpose remains meaningful.

(For example, a function in a library to compute square roots has a purpose that is entirely well-defined independent of the application. Therefore, Subsection 2d requires that any application-supplied function or table used by this function must be optional: if the application does not supply it, the square root function must still compute square roots.)

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Thus, it is not the intent of this section to claim rights or contest your rights to work written entirely by you; rather, the intent is to exercise the right to control the distribution of derivative or collective works based on the Library.

In addition, mere aggregation of another work not based on the Library with the Library (or with a work based on the Library) on a volume of a storage or distribution medium does not bring the other work under the scope of this License.

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This option is useful when you wish to copy part of the code of the Library into a program that is not a library.

4. You may copy and distribute the Library (or a portion or derivative of it, under Section 2) in object code or executable form under the terms of Sections 1 and 2 above provided that you accompany it with the complete corresponding machine-readable source code, which must be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange.

If distribution of object code is made by offering access to copy from a designated place, then offering equivalent access to copy the source code from the same place satisfies the requirement to distribute the source code, even though third parties are not compelled to copy the source along with the object code.

5. A program that contains no derivative of any portion of the Library, but is designed to work with the Library by being compiled or linked with it, is called a "work that uses the Library". Such a work, in isolation, is not a derivative work of the Library, and therefore falls outside the scope of this License.

However, linking a "work that uses the Library" with the Library creates an executable that is a derivative of the Library (because it contains portions of the Library), rather than a "work that uses the library". The executable is therefore covered by this License. Section 6 states terms for distribution of such executables.

When a "work that uses the Library" uses material from a header file that is part of the Library, the object code for the work may be a derivative work of the Library even though the source code is not. Whether this is true is especially significant if the work can be linked without the Library, or if the work is itself a library. The threshold for this to be true is not precisely defined by law.

If such an object file uses only numerical parameters, data structure layouts and accessors, and small macros and small inline functions (ten lines or less in length), then the use of the object file is unrestricted, regardless of whether it is legally a derivative work. (Executables containing this object code plus portions of the Library will still fall under Section 6.)

Otherwise, if the work is a derivative of the Library, you may distribute the object code for the work under the terms of Section 6. Any executables containing that work also fall under Section 6, whether or not they are linked directly with the Library itself.

6. As an exception to the Sections above, you may also combine or link a "work that uses the Library" with the Library to produce a work containing portions of the Library, and distribute that work under terms of your choice, provided that the terms permit modification of the work for the customer's own use and reverse engineering for debugging such modifications.

You must give prominent notice with each copy of the work that the Library is used in it and that the Library and its use are covered by this License. You must supply a copy of this License. If the work during execution displays copyright notices, you must include the copyright notice for the Library among them, as well as a reference directing the user to the copy of this License. Also, you must do one of these things:

a) Accompany the work with the complete corresponding machine-readable source code for the Library including whatever changes were used in the work (which must be distributed under Sections 1 and 2 above); and, if the work is an executable linked with the Library, with the complete machine-readable "work that uses the Library", as object code and/or source code, so that the user can modify the Library and then relink to produce a modified executable containing the modified Library. (It is understood that the user who changes the contents of definitions files in the Library will not necessarily be able to recompile the application to use the modified definitions.)

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c) Accompany the work with a written offer, valid for at least three years, to give the same user the materials specified in Subsection 6a, above, for a charge no more than the cost of performing this distribution.

d) If distribution of the work is made by offering access to copy from a designated place, offer equivalent access to copy the above specified materials from the same place.

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It may happen that this requirement contradicts the license restrictions of other proprietary libraries that do not normally accompany the operating system. Such a contradiction means you cannot use both them and the Library together in an executable that you distribute.

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