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## Revision History

Date	Revision Number	Changed By	Description
07.24.2020	v.1.0	Mark Bloechl	Completed Document
07.28.2020	v.1.1	Paul	Updated Pictures

### 1. AirFinder 3.0 System Overview

AirFinder 3.0 asset tracking tags work with the AirFinder 3.0 Precise Location Service, to provide location

coordinates in 3 dimensions with approximately 1m accuracy.

The AirFinder Precise Location Service consists of the following hardware components:

- AirFinder Location Beacon (LB) or Location Beacons (LBs)
- AirFinder Access Point (AP) or Access Points (APs) (also referred to as Aggregators)
- AirFinder Gateway (GW) or Gateways (GWs)

Location Beacons (LBs) provide the input data for the AirFinder Precise Location Service.

Location Beacons rapidly broadcast short data packets at 2.45GHz; these broadcast packets are called beacon messages. These beacon messages are transmitted multiple times per second, and the on-air time of each beacon is very short - measured in microseconds.

AirFinder asset tracking tags scan for Location Beacon advertisement messages, calculate their location, connect to an Access Point, and transmit that location.

AirFinder Access Points support 2.4 GHz Radio Access network using a proprietary protocol referred to as XLE, for AirFinder 3.0 Devices. AirFinder Access Points (APs) are installed at a facility in a configuration to provide complete and redundant XLE network coverage for Devices. APs, like Location Beacons, broadcast a frequent and periodic beacon message; however, the AP beacon message is different than the Location Beacon message. These AP beacons are also heard by AirFinder asset tracking tags, but not used by the tags in the standard location algorithm. An AirFinder tag scans for available APs and attempts connection to the first one it detects. In almost all cases, the asset tag will receive beacon messages from multiple APs in any location within a facility.

When an AP receives an uplink message from an asset tracking AF3.0 tag (i.e. a location update message with the tag's xyz coordinates in meters referenced to a pre-defined origin on a scale accurate floor plan), it transmits this message to an AirFinder Gateway. APs use an FCC-certified over-the-air-protocol called Symphony Link™, which operates in the 902-928 MHz frequency band, to communicate with Gateways. Link Labs is the creator of the Symphony Link Protocol and the AirFinder Gateways.

Like APs, Gateways are installed at a site to provide comprehensive and redundant Symphony Link coverage. This Symphony Link Network is an Internet of Things (IoT) network service layer for all Access Points. Access Points communicate Alert messages to Gateways. When a Gateway receives a message from an Access Point, it acknowledges to the Access Point that the message was received.

Access Points have several other functions, in addition to aggregating up-link messages from AF3 asset tracking tags. Location Beacons also periodically connect to Access Points to send a heartbeat (i.e. "still alive") message. This short heartbeat message contains the LB MAC ID and also the current voltage of the batteries of the LB. Access Points also regularly send their own heartbeat message to Gateways, indicating that the Access Point is connected and functioning properly. AF3 asset tracking tags also transmit a heartbeat message periodically.

If, or when, the configuration of Location Beacons or Staff Alert Devices need to be changed, the configuration change will be transmitted from the AirFinder Precise Location Service Platform through a Gateway down to the Access Points. Location Beacons and AF3 Asset tracking tags connect to Access Points when transmitting their heartbeat message, and check for a mailbox message at that time to determine if there are new configuration settings to download. If there are, then the LB or Device, updates

its settings.

AirFinder Gateways aggregate and transmit AF3 asset tracking tag up-link messages, as well as any other traffic from Location Beacons, and Access Points to the AirFinder Precise Location Service cloud platform. Gateways are connected to the Internet via an IoT (LTE) network connection. In some rare cases, the Gateway may have an Internet connection via a LAN or other backhaul method.

Any messages to AF3 Asset tracking tags or other infrastructure coming from the AirFinder Platform are transmitted via that cloud to the on-site Gateways. Gateways then pass on the messages, as required by each message type, to individual hardware or categories of hardware.

#### AF3 Tag location update event:

The AF3 location update process is outlined below:

1. Tag scans for all available LBs
2. Tag generates 'target' LB list, then resumes scanning
3. When the Tag detects a beacon message from one of the targeted LBs, it replies to request a ranging sequence. The reply occurs on a random channel chosen by the LB and indicated in the beacon message.
4. After receiving the Tag's range request message, the LB responds with an acknowledgement on a different channel, chosen by the Tag.
5. In response, the Tag transmits a ranging start message to the LB. Both Tag and LB then hop to the first channel in the agreed-upon, randomized hop map.
6. The Tag transmits a ~40us long CW tone. Precisely 80us later, the LB replies with a ~40us CW tone at the same frequency.
7. The Tag and LB hop to the next frequency in the map and repeat the prior step.
8. When all hops are complete, the Tag and LB proceed to the randomly selected data transfer channel.
9. The LB transmits IQ samples collected during the Tag's transmission in a 2Mbps burst up to 1ms in length.
10. The Tag acknowledges the IQ samples, and the over-the-air portion of the location update is complete.

After the Tag has acquired the LBs IQ samples, it performs a sequence of calculations to estimate the range to the LB. This entire ranging process lasts 13 -- 40ms, depending on the number of hops in the selected hop map. After acquiring a sufficient number of ranges (generally 4-6), the tag performs a trilateration based on the known beacon locations (xyz coordinates advertised by the location beacon) to estimate its own position.

## **2. AirFinder Power Cradle DC Power (WF-402D)**

### **a. Hardware Verification**

- Remove AirFinder Power Cradle DC Power (WF-402B) from packaging.
- Visibly inspect front and back of unit (see Images 23 and 24 below)
  - If not damaged, proceed to the next step.

- If the unit has visible damage, do not install. Instead, immediately put unit aside and RMA.



Image 1: Front view of Power Cradle DC Power with Access Point attached

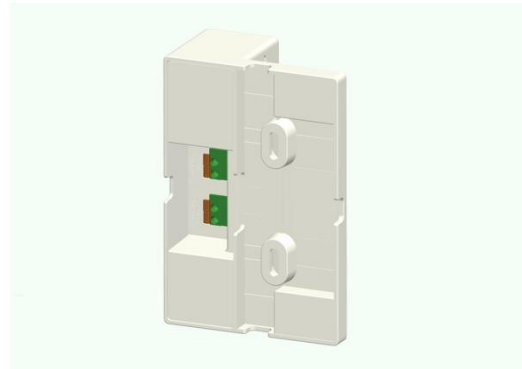


Image 2: Rear view of Power Cradle DC Power with Access Point attached

- Identify location for installing Power Cradle DC Power.
  - Verify that Power Cradle DC Power can be installed in the location.
- Screw Power Cradle DC Power into wall or other surface.
- Attach power supply to Power Cradle DC Power.
- Attached Location Beacon or Access Point to Power Cradle DC Power.
  - If Location Beacon or Access Point powers normally, see above, then the Power Cradle DC Power has been successfully installed.

b. Power and Reset on Power Cradle DC Power

- Power
  - When power is connected to Power Cradle DC Power, LED lights solid for 5 minutes.
  - After 5 minutes, the LED turns off.
- Reset
  - If the Power Cradle DC Power needs to be reset, then remove external power from the unit.
  - Wait 1 minute.
  - Reattached power supply.
  - Validate power conditions above.

### 3. AirFinder Access Point (WF-402AP)

- a. Hardware Verification
- i. Remove AirFinder Access Point (WF-402AP) from packaging.
  - ii. Visibly inspect front and back of unit (see Figures 13 and 14 below)
    1. If not damaged, proceed to the next step.
  - iii. If the unit has visible damage, do not install. Instead, immediately put unit aside and RMA.

**Figure 1:**  
Front view of Access Point attached to Power Cradle AC Power



**Figure 2:**  
Rear view of Access Point attached to Power Cradle AC Power



- iv. Locate power outlet that already has installed a functioning Power Cradle AC Power or a Location Beach AC Power.
- v. Slide attaching pegs of Access Point into slots of Power Cradle AC Power or a Location Beach AC Power.
- vi. See Figures 15 and 16 for verification of proper installation of Access Point.
- vii. Verify proper functioning of Access Point by observing proper LED behavior of unit according to the Power and Reset Conditions described below in b.
- viii. After verification of the proper functioning of Access Point, then the Access Point has been properly installed.

Figure 3: Front view of AP attached to Power Cradle and wall transformer



Figure 4: Side view of Access Point attached to Power Cradle AC Power



## b. Power and Reset Conditions on Access Point

- LED Behavior when Access Point is powered
  - See Image 17 for view of the Access Point LEDs.
  - LED Labeled "SL" Success
    - LED starts blinking when power is applied (or after a reset).
  - Lights solid for 5 minutes when SL backhaul is successfully acquired (i.e. registration through completed; ready to flow data).
    - After 5 minutes, LED shuts off.
  - LED Labeled "SL" Failure
    - If no SL Gateway is found after full scan process, transition to slow blink for up to 5 minutes
      - After 5 minutes, LED shuts off.
    - Access Point will periodically attempt to find a gateway. When AP attempts another scan / registration process, the LED starts blinking again (as above)
- LED Labeled "AF"
  - LED blinks when AirFinder messages over BLE are being received / transmitted. This function is enabled as long as LED is active.
  - When LED "SL" is shut off, LED "AF" will also be shut off.
  -
- Reset
  - To reset the Access Point, simply remove the device from the Power Cradle AC Power or the Location Beacon AC Power and then reconnect to power.

Image 3: Access Point





- To remove the Access Point from the Power Cradle AC Power or the Location Beacon AC Power, access the underside of the combined unit to release the attaching clip.
- Acquire a ballpoint pen or paperclip.
- Find the slot underneath the Access Point. Insert the pen or paperclip into the circular opening.
- While keeping the pen or paperclip inserted, pull the paperclip or pen gently away from the Power Cradle AC Power or the Location Beacon AC Power. This releases the attaching clip without breaking the Access Point or attachment.
- After detaching the Access Point, reattach it.
- When successfully reset, the device will return to the initial LED Behavior laid out above (“LED Behavior when unit is powered”)

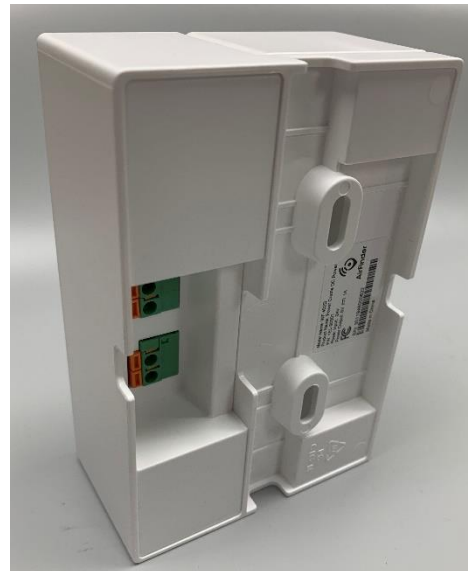
#### 4. AirFinder 3.0 Location Beacon (WF-402A)

- a. Hardware Verification
  - i. Remove AirFinder Location Beacon (WF-402A) from packaging.
  - ii. Visibly inspect front and back of unit (see Figures 13 and 14 below)
    1. If not damaged, proceed to the next step.
  - iii. If the unit has visible damage, do not install. Instead, immediately put unit aside and RMA.

Figure 1: LB IN DC POWER CRADLE



Figure 2: REPLACE WITH PIC OF LB IN DC POWER CRADLE



- iv. Slide attaching pegs of LB into slots of DC Power Cradle.
- v. See Figures 15 and 16 for verification of proper installation of Location Beacon.
- vi. Verify proper functioning of LB by observing proper LED behavior of unit according to the Power and Reset Conditions described below in b.
- vii. After verification of the proper functioning of LB, then the LB has been properly installed.

### c. Power and Reset Conditions on Location Beacon

- LED Behavior when Location Beacon is powered
  - No LEDs will light for approximately 15 seconds
  - The LED labeled 'SL' will light solid for 60 seconds
  - If an AF3 AP is detected, the SL LED will then blink at a roughly 2Hz rate
  - Otherwise, the LED will turn off until an AP is detected
- Reset
  - To reset the Location Beacon, either:
    - Insert a paperclip into the hole marked 'reset'
    - Cycle power to the device (e.g. by unplugging it, waiting for several seconds, then plugging it back in)

## 5. ETL Warnings (English and French)

1. For connection to a supply not in the U.S.A., use an attachment plug adapter of the proper configuration for the power outlet, if needed.

Pour la connexion à une alimentation pas aux Etats-Unis, utilisez un adaptateur de fixation de la configuration correcte pour la prise d'alimentation, si nécessaire.

2. Caution: Risk of Electric Shock. Grounding continuity must be maintained.

Attention: RISQUE DE CHOC ÉLECTRIQUE. La continuité de la mise à la terre doit être maintenue.

3. For indoor use only.

POUR UNE UTILISATION EN INTÉRIEUR.

4. Please check prior use, if output voltage and current of the power supply is suitable for the product.

Se il vous plaît vérifier avant l'utilisation, si la tension de sortie et le courant de l'alimentation est adapté au produit.

5. For information technology equipment use only.

Pour l'utilisation des équipements de technologie d'information seulement.

6. The plug is used as disconnect device. The socket-outlet shall be installed near the equipment and shall be easily accessible.

La prise est utilisée comme dispositif de déconnexion. La prise de courant doit être installée près de l'équipement et doit être facilement accessible.

7. The cover may under no circumstances be opened. If the cover is damaged, then the power supply may no longer be used.

Le couvercle peut en aucun cas être ouvert. Si le couvercle est endommagé, l'alimentation ne peut plus être utilisé.

8. Children should be supervised to ensure that they do not play with the appliance.

Les enfants doivent être surveillés pour s'assurer qu'ils ne jouent pas avec l'appareil.

## 6. FCC Warning

### **Federal Communications Commission (FCC) Interference Statement**

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generate, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

Reorient or relocate the receiving antenna.

Increase the separation between the equipment and receiver.

Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

Consult the dealer or an experienced radio/TV technician for help.

This device complies 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.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

### **RF exposure warning**

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.

## IC Radiation Exposure Statement for Canada

This device complies with Industry Canada licence-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.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

User manuals for transmitters equipped with detachable antennas shall also contain the following notice in a conspicuous location:

This radio transmitter (identify the device by certification number, or model number if Category II) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Le présent émetteur radio (identifier le dispositif par son numéro de certification ou son numéro de modèle s'il fait partie du matériel de catégorie I) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

### IMPORTANT NOTE:

Radiation Exposure Statement:

This equipment complies with “Industry Canada RSS-102 for radiation exposure limits set forth for an uncontrolled environment”.

Déclaration d'exposition aux radiations:

Cet équipement est conforme aux limites d'exposition aux rayonnements IC établies pour un environnement non contrôlé.

### **Industry Canada – Emissions compliance statement**

This Class B digital apparatus complies with Canadian ICES-003.

Avis de Conformité à la Réglementation d' Industrie Canada. Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.