FREEWAVE

WC30i – Axis Wireless

Angle Sensor

User & Reference Manual

The FreeWave® WC30i-AXIS Wireless Angle Sensor is an Intrinsically Safe wireless Inclinometer used for Hatch, Pump Jack, and Angle monitoring:

- Hatch Detection reporting – Closed, Cracked, Open (Hatch Mode).

- Pump Jack Status reporting - Running/Not Running (Pump Jack Mode)

- Angle reporting – X/Y Axis Tilt Angles (Angle Mode)

- Easy to install

- Internal long-life battery, 5+ years of operation

- Sends data to a FreeWave Gateway

- AES 128bit Encryption

- Pushbutton zeroing

- Report on state change

The products described in this manual can fail in a variety of modes due to misuse, age, or malfunction and is not designed or intended for used in systems requiring fail-safe performance, including life safety systems. Systems with the products must be designed to prevent personal injury and property damage during product operation and in the event of product failure.

FreeWave Technologies, Inc. warrants the FreeWave WC30i-AXIS Wireless Angle Sensor (Product) that you have purchased against defects in materials and manufacturing for a period of three years from the date of shipment, depending on model number. In the event of a Product failure due to materials or workmanship, FreeWave will, at its discretion, repair or replace the Product. For evaluation of Warranty coverage, return the Product to FreeWave upon receiving a Return Material Authorization (RMA). The replacement product will remain under warranty for 90 days or the remainder of the original product warranty period, whichever is longer.

IN NO EVENT WILL FREEWAVE TECHNOLOGIES, INC., ITS SUPPLIERS, OR ITS LICENSORS BE LIABLE FOR ANY DAMAGES ARISING FROM THE USE OF OR INABILITY TO USE THIS PRODUCT. THIS INCLUDES BUSINESS INTERRUPTION, LOSS OF BUSINESS INFORMATION, INABILITY TO ACCESS OR SEND COMMUNICATION OR DATA, PERSONAL INJURY OR DAMAGE, OR OTHER LOSS WHICH MAY ARISE FROM THE USE OF THIS PRODUCT. THE WARRANTY IS EXCLUSIVE AND ALL OTHER WARRANTIES EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE ARE EXPRESSLY DISCLAIMED.

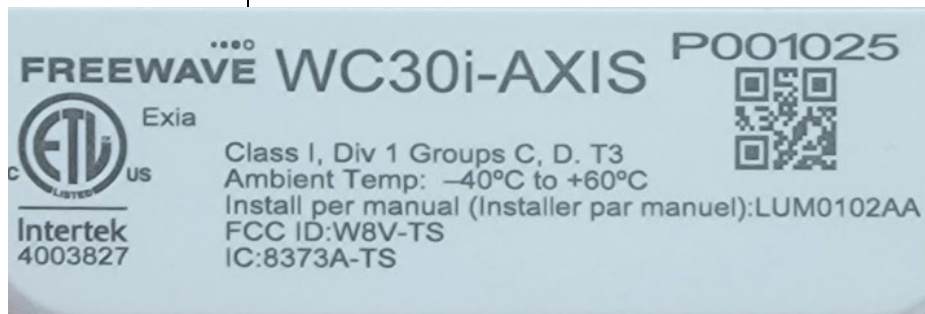FreeWave's Warranty does **not apply** in the following circumstances:
1. If Product repair, adjustments, or parts replacements are required due to accident, neglect, or undue physical, electrical, or electromagnetic stress.
2. If Product is used outside of FreeWave specifications as stated in the Product's data sheet.
3. If Product has been modified, repaired, or altered by Customer unless FreeWave specifically authorized such alterations in each instance in writing.

FreeWave Technologies, Inc. 5395 Pearl Parkway, Suite 100
Boulder, CO 80301
303-381-9200
Toll Free: 1-866-923-6168
Fax: 303-786-9948
www.freewave.com

|	
Enclosure Size	3.5" wide × 3.1" tall × 2.3" deep
Power Source	Internal AA IS Lithium battery pack
Temperature Rating	Operating range: -40°C to +80°C C1D1 certified operating range: -40°C to +60°C
Radio	40mW, 902-928MHz Ism Band, FHSS radio, internal antenna
Compliance	Class I, Division 1 groups C and D. EXia = Intrinsically Safe Apparatus. Radio FCC and IC certified.
Standards	Intrinsically Safe Apparatus and Associated Apparatus for Use In Class 1, 2, 3, Division 1, Hazardous (Classified) Locations [UL 913:2013 Ed.8+R:16Oct2015] Intrinsically Safe And Non-Incendive Equipment For Use In Hazardous Locations (R2016) [CSAC22.2#157:1992 Ed.3+G1;U2]
Resolution Reporting	<0.1 degree
Frequency	Hatch Detection and Pump Jack Mode: Sends data every 10 minutes or immediately after a state changes. Angle Mode: User configurable 15 seconds to 2 hours

FREEWAVE WC30i-AXIS P001025

ETL Intertek 4003827

Exia
Class I, Div 1 Groups C, D. T3
Ambient Temp: –40°C to +60°C
Install per manual (Installer par manuel):LUM0102AA
FCC ID:W8V-TS
IC:8373A-TS

 WARNING: Use of this equipment in a manner not specified by the manufacturer may impair the protection provided by the equipment.

 WARNING: The use of any parts not supplied by the manufacturer violates the safety rating of the equipment.

Connections and Components
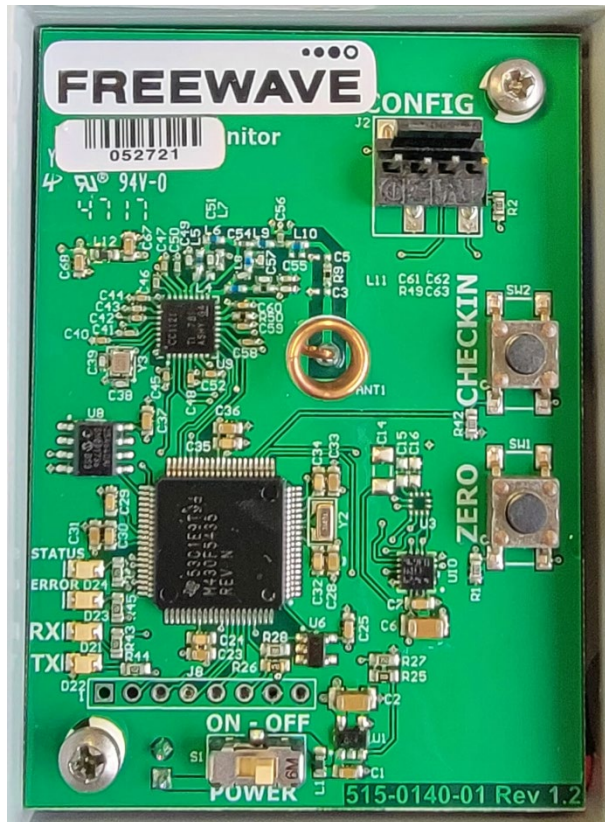
Radio LEDs

- The Radio TX LED (green) flashes each time a radio packet is sent. This LED will blink rapidly while searching for the radio network.
- The Radio RX LED (red) blinks on each received radio packet.

Status LEDs

- The Active LED (green) will blink at boot up and will blink quickly when the sensor is being read.
- The ERROR LED (red) will blink to indicate an error condition.

Zero Button

- The Zero button allows the sensor to be zeroed when the unit is installed, and the hatch is in the closed position. This is only used in Hatch and Angle modes.

Check-in Button

- If this button is pressed the WC30i-AXIS Wireless Angle Sensor will take a sensor reading and send the data to the gateway.

The WC30i-AXIS Wireless Angle Sensor must be configured for correct operation before being fielded. The configurable items include:

- Modes (Hatch, Pump Jack, Angle)

- Modbus ID

- Network Selection

All settings are made using the FreeWave Toolkit PC application and FreeWave 4-pin USB cable (Serial-4PIN).

WARNING: Perform the steps in this section (Setup) in a safe location only.

Using the FreeWave Toolkit

The FreeWave Toolkit application can be downloaded at https://support.freewave.com/. After installation, launch the software and the main toolkit window will open:
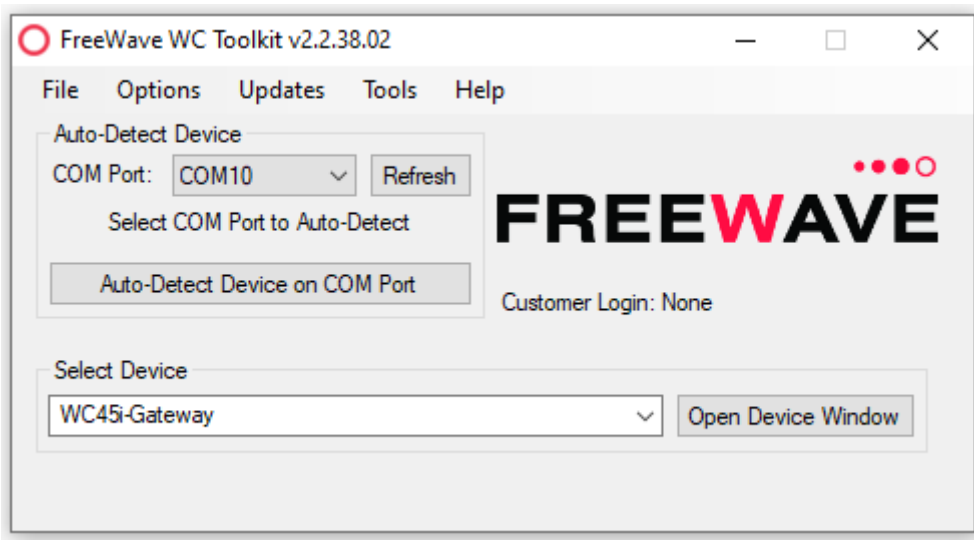
Select the COM port associated and click "Auto-Detect Device on COM Port" This will open the device configuration window, where all device settings can be configured.
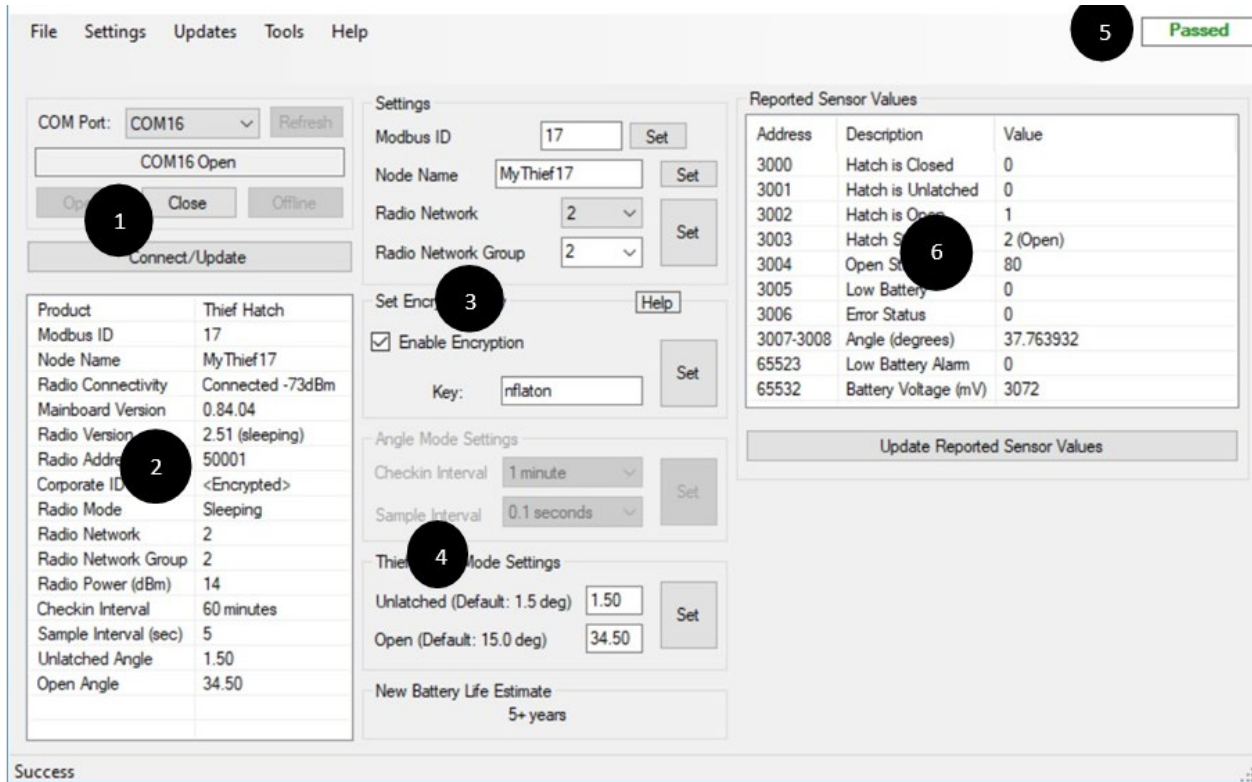
1	COM Settings	
2	Node Information	
3	Configurable node settings	
4	Mode Specific Settings	
5	Command successfully passed to node (displays fail if unsuccessful)	
6	Current readings	

The default operation mode for the WC30i-AXIS Wireless Angle Sensor is "Hatch Detection Mode". When the WC30i-AXIS Wireless Angle Sensor is to be used for Pump Jack or Angle monitoring, the mode must be changed.

- Hatch Detection Mode: The device monitors the state of a hatch and reports it as closed, unlatched (angle exceeds 1.5°) or open (angle exceeds 15°).
- Pump Jack Mode: The device monitors the state of a pump jack and reports whether it is running or not.
- Angle Mode: The device reports the average, minimum and maximum X and Y axis angles over the reporting interval along with a data distinguishing sequence number.

From the 'Settings' menu, select 'Set Mode', then select either 'Hatch', 'Pump Jack Mode' or 'Angle Mode'. Note that the device Modbus register map changes with the configured mode setting.

Network Setting

The network is set using the FreeWave Toolkit. The network, network group, and corporate ID or encryption settings must match those of the gateway (and other nodes) for them to communicate.
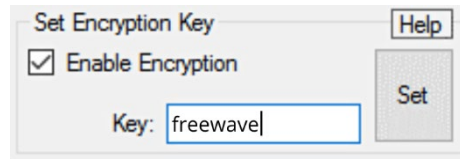

Encryption

It is possible to encrypt over-the-air transmissions to prevent tampering. Encryption keys replace the Corporate ID system, so it is important that all devices connected to a Gateway have the same encryption key as well as network and network group number.

To set up a device to use encryption, click the checkbox labeled **Enable Encryption** inside the **Set Corporate ID** box:

The encryption key box. For more details, click the Help button.

The box will then change into a **Set Encryption Key** box, and it will prompt instead for the encryption key you would like to use. Note that keys may not contain spaces or angle brackets. Enter it and then press **Set**. This will cause the Sentinel to drop its network, and can only attempt to join networks that use the same encryption key. If you are setting up a new network, you will need to set the encryption key on all of your devices. If you are adding a Sentinel to a legacy network, you can simply set the Corporate ID without clicking the Enable Encryption box, and it will remain compatible with the older system.

It is also possible to hide your encryption key, so it cannot be read. This is the most secure option, but if you forget your key, there is no way to recover it – you will have to reset the key on every device on its network. To enable this option, select **Set Encryption Key Unrecoverable** under the **Settings** menu.

Hatch Detection Mode Settings

The unlatched angle and open angle thresholds may be changed.
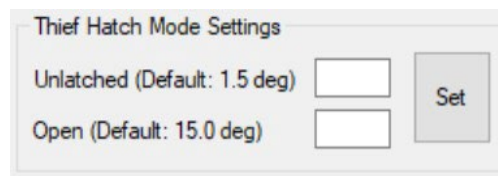
Angle Mode Settings

The check-in interval sets the reporting frequency which is also the time period over which readings are averaged. The check-in interval defaults to 60 seconds. The available intervals are:

- 15 seconds
- 1 minute
- 2 minutes
- 5 minutes
- 10 minutes
- 30 minutes
- 60 minutes
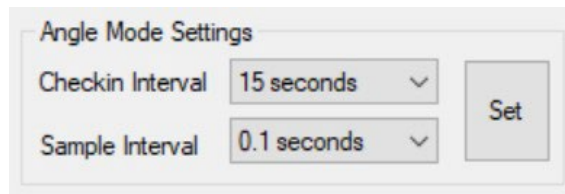
The sample interval sets the data rate at which readings are taken. The sample interval defaults to 0.1 seconds. The available intervals are:

- 0.1 seconds
- 0.2 seconds
- 0.5 seconds
- 1 second

The angle range is +/-90° from the point at which the sensor was zeroed. If an out-of-range angle is detected, the error status is set. To indicate an error occurred in the reporting period, the device reports 360° as the average angle and 360° for the angle range that was exceeded (e.g., if there was a reading during the reporting period of 125°, both the average angle and the maximum angle will be set to 360°).

Hatch Detection and Pump Jack Modes

The sensor technology used does not require a specific orientation for installation, the device can be installed in any orientation or angle.

A suitable bracket must be used to adapt the WC30i-AXIS Wireless Angle Sensor to a hatch cover or to the arm of a pump jack. The drawing below shows the dimension of the mounting holes available.
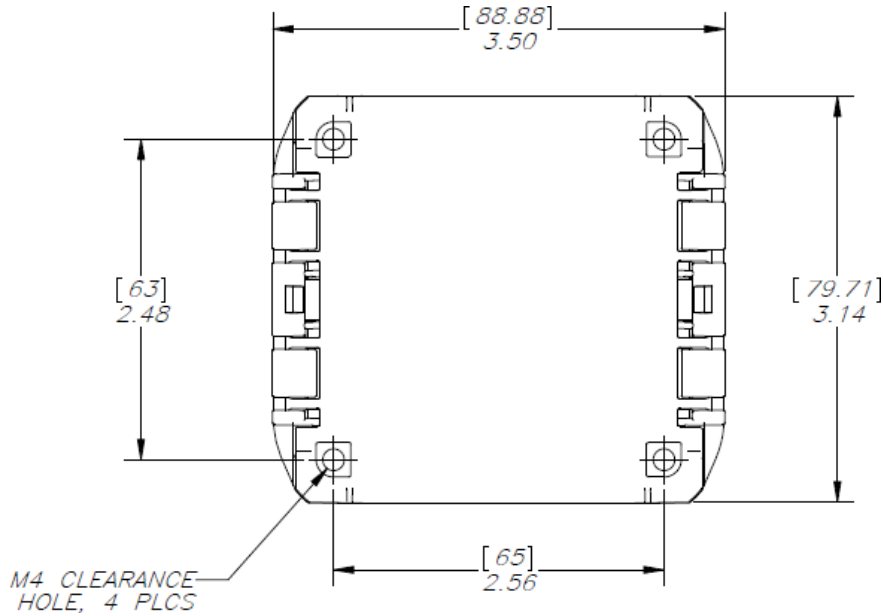
Angle Mode

The device must be mounted flat on a horizontal surface with the label facing up.
Note that the X and Y angles reported by the device are parallel to the X and Y axis of the enclosure
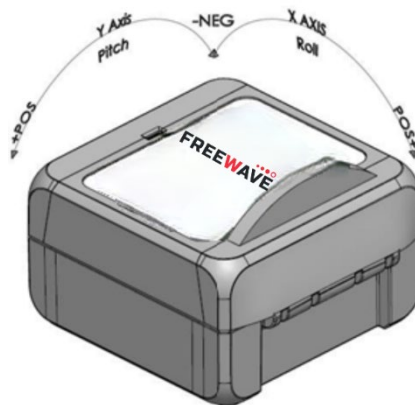
WARNING: The WC30i-AXIS Wireless Angle Sensor must be securely mounted such that it cannot sustain a fall. Failure to do this may impact the safety rating of the device.

WARNING: The WC30i-AXIS Wireless Angle Sensor must be mounted in a location free of high vibrations. Over time vibrations can damage it or the battery pack, which could impair its safety ratings. Do not mount directly to continuous vibrating equipment such as pumps or compressors.

Sensor Zeroing – Hatch and Angle Modes Only

Once the monitor has been secured, its angle sensor must be calibrated. In Hatch mode, the hatch must be fully closed and latched before zeroing. Press and hold the ZERO button for about 2 seconds (until the green status LED turns on), then release. Wait approx. 5 seconds for the sensor to go through its internal calibration and zeroing process. If successful, the green status LED will blink 3 times. If the calibration fails (due to movement), the red status LED will blink 3 times, if this happens the zero process must be done again.

The WC30i-AXIS Wireless Angle Sensor sends data to a FreeWave Telemetry Modbus Gateway, available at the gateway in registers where it can then be read by a Modbus RTU.This data is accessible at the same Modbus ID that was configured for the Wave Contact

Thief Hatch Mode

Register Number	Register Address (Offset)	Description
43001	3000	Hatch Closed State. 1=Closed, 0=Not closed
43002	3001	Hatch Unlatched State. 1=Unlatched, 0=Not unlatched
43003	3002	Hatch Open State. 1=Open, 0=Not Open
43004	3003	Hatch State. 0=Closed, 1=Unlatched, 2=Open
43005	3004	Hatch Open Count.Total number of hatch openings
43006	3005	Low Battery Alarm. 1=Low battery
43007	3006	Error Status. 0=no errors, 1=sensor error
43008-43009	3007-3008	Measured Angle (32Bit Float)

Pump Jack Mode

Register Number	Register Address (Offset)	Description
43001	3000	Pump Jack Status. 1=Running, 0=Not Running
43002	3001	Error Status. 0=no errors, 1=sensor error

Angle Mode

Register Number	Register Address (Offset)	Description
43001	3000-3001	X-Axis Angle Avg
43003	3002-3003	X-Axis Angle Min
43005	3004-3005	X-Axis Angle Max
43007	3006-3007	Y-Axis Angle Avg
43009	3008-3009	Y-Axis Angle Min
43011	3010-3011	Y-Axis Angle Max
43013	3012	Sequence Number (0 to 65,535)
43014	3013	Error Status (0=No Error, 2=Zeroing Error, 4=X Angle Error, 8=Y Angle Error, 12=X and Y Angle Errors)

Register Number	Register Address (Offset)	Description
49987	9986 or 65523	Low Battery Alarm. 1=Low battery
49988	9987 or 65524	Major revision number for the mainboard
49989	9988 or 65525	Minor revision number for the mainboard
49990	9989 or 65526	Major revision number for the radio
49991	9990 or 65527	Minor revision number for the radio
49992	9991 or 65528	High 16 bits of SFTS node address
49993	9992 or 65529	Low 16 bits of SFTS node address (the radio ID)
49994	9993 or 65530	Modbus ID readback
49995	9994 or 65531	Received signal strength of last packet from the device (Signed INT)
49996	9995 or 65532	Battery voltage of the device, in millivolts
49997	9996 or 65533	Minutes until this device will time out, unless new data is received
49998	9997 or 65534	Number of registers cached for this device
49999	9998 or 65535	Device type. 57= Hatch Mode, 61=Pump Jack Mode, 67=Angle Mode

Internal Lithium Battery Replacement

Battery Packs can be changed with the node in place.

1. Open the cover from the enclosure.
2. Switch the power switch to the OFF position.
3. Remove the two screws that hold the PCB in place
4. Unplug the battery from the PCB, by depressing the locking clip on the connector.
5. Install the new battery pack
6. Connect the battery to the PCB battery connector.
7. Reinstall the PCB assembly.

WARNING: Use of any battery other than the FreeWave part number WC-BAT-3AA-IS will impair the protection provided by the equipment.

The outside of the enclosure may be cleaned with water, mild soap, and a damp cloth as needed. High-pressure washing is not recommended.

WARNING: Electrostatic Discharge Hazard! Care must be taken to avoid the potential of creating a charge on the enclosure or antenna. Do not wipe with a dry cloth. Do not brush against the enclosure with clothing or gloves.

Configuration /Debug

Debug and configuration information is available if a connection is made via the debug port on the main board. USB to 4-pin serial cable must be used for this interface.

WARNING: Only connect to the debug port in a safe area! Ensure that the maximum voltage applied to the configuration port is less than 5 VDC!

Technical Support
FREEWAVE Technologies Inc.
Get Support: https://support.freewave.com/
Hours: 8am-5pm MDT

Revision History

Changes or modifications not expressly approved by FreeWave could void the user's authority to operate the equipment.

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.

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 generates, 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 to 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 has been designed to operate with a permanently soldered antenna. No other antenna may be used.

To comply with FCC's and IC's RF radiation exposure requirements, the antenna(s) used for this transmitter must be installed such that a minimum separation distance of 20cm is always maintained between the radiator (antenna) & user's/nearby person's body and must not be co-located or operating in conjunction with any other antenna or transmitter.

This device complies with Industry Canada's license-exempt RSSs. 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.

Revision	Date	Changes/Updates
1.0	02/01/23	Initial release