

Rescue Repeater - Technical Manual

Product Line: Punch Rescue Emergency Alert System

Device Covered: Rescue Repeater v1.4

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Manufacturer: GHH Innovations

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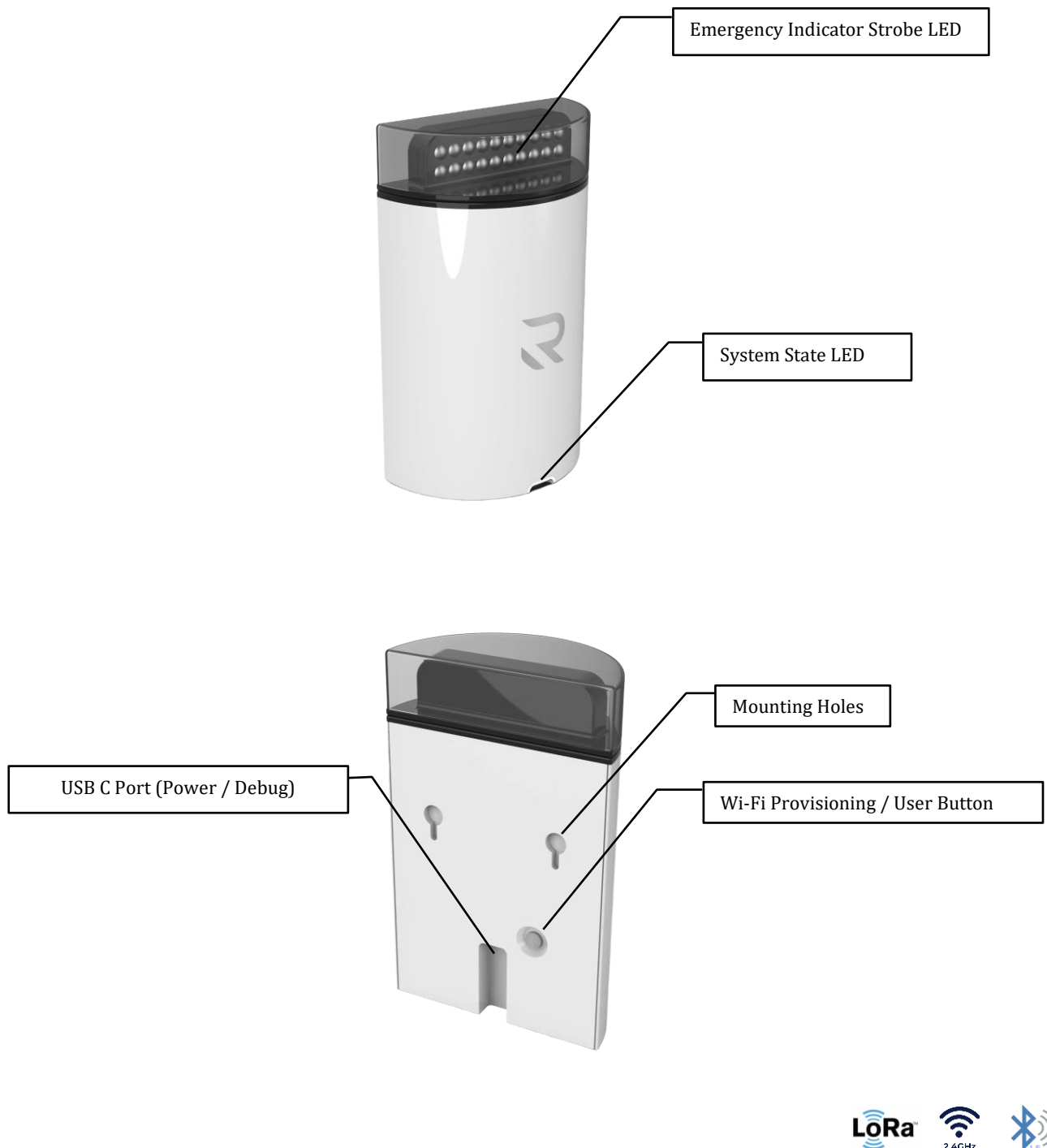
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1. Introduction

The **Rescue Repeater** is a fixed infrastructure device within the Punch Rescue Emergency Alert System. It functions as a communication relay, localization receiver, and backend gateway for wearable Rescue Cards (Lanyards).

The Rescue Repeater integrates **Wi-Fi, LoRa, and BLE radio technologies** to ensure reliable emergency event detection, localization, and forwarding.



2. Functional Description

The Rescue Repeater performs the following primary functions:

- **Emergency Alert Reception (LoRa)**
Listens for LoRa emergency alert frames transmitted by Rescue Cards (Lanyards) and forwards received alerts to the backend system or neighboring devices.
 - **BLE Proximity and Localization**
Continuously scans for BLE beacon advertisements transmitted by Rescue Cards.
Received signal strength (RSSI) data is reported to the backend to assist in determining the approximate location or proximity of the Rescue Card.
 - **Backend Communication (Wi-Fi / MQTT)**
Uses Wi-Fi connectivity to communicate with the backend system via MQTT for:
 - Alert publishing
 - Heartbeat reporting
 - Configuration management
 - OTA firmware updates
-

2.1. Power and Backup Operation

The Rescue Repeater is designed for continuous operation and resilience during power interruptions.

- **Primary Power Source:**
USB-C interface connected to an external power adapter
 - Input Voltage: **5 VDC, 1.2A (max).**
- **Battery Backup:**
Integrated rechargeable battery providing **up to 36 Hrs of operation** during external power loss.

Battery charging is managed internally when external power is available.

3. Technical Details

3.1. Processing and Control

- **Main Controller:** ESP32-S3-MINI-1-N8 series MCU
 - **Architecture:** 32-bit microcontroller with integrated Wi-Fi and Bluetooth Low Energy, 512Kb Ram with 8MB external SPI flash.
 - **Function:**
 - System control
 - Radio coordination (LoRa, BLE, Wi-Fi)
 - Backend communication (MQTT)
 - Power management and monitoring
-

3.2. Wireless Communication

3.2.1. LoRa Radio

- **LoRa Module:** Dual LoRa-E5HF modules (Independent Tx and Rx Operation).
- **Antenna:** PCB trace antenna x2
- **Operating Params:**
 - Frequency: 915 MHz (ISM band)
 - Spreading Factor: SF7
 - Bandwidth: 250 kHz
- **Functionality:**
 - Emergency alert reception from Rescue Cards and Confirmation Feedback.
 - LoRa-based communication with Rescue Base Stations within the Punch Rescue system



3.2.2. Bluetooth Low Energy (BLE)

- **BLE Standard:** Bluetooth Low Energy (integrated with ESP32-S3)
- **Role:**
 - Passive scanning of BLE beacon advertisements
 - Collection of RSSI data for proximity and location inference.
 - Connect with Mobile App.
- **Connection Mode:** Connectable and non-connectable advertisement reception.



3.2.3 Wi-Fi

- **Wi-Fi Standard:** IEEE 802.11 b/g/n (2.4 GHz)
- **Purpose:**
 - Backend communication via MQTT
 - OTA firmware updates
 - Device configuration and monitoring



3.2. Power Supply and Management

- **Primary Input:**
 - USB Type-C connector
 - Max Current: **1.2 A**
 - Maximum power device draws **5~6 W**.
 - Recommended Power Supply: **5VDC, 2A (10W)**
 - **Battery Backup:**
 - Integrated rechargeable battery
 - Supports up to **36 hours of operation** during power outage (typical usage)
 - **Power Management Features:**
 - DC-DC buck and boost converters
 - Battery charging and protection circuitry
 - Resettable fuse.
-

3.4. Indicators and User Interface

- **Status Indicators:**
 - Multi-color RGB LED for system state indication (on Bottom of the Device)
 - **Alert Indicator:**
 - High-visibility strobe LED (On Top of the device)
 - Configurable patterns and colors via backend
 - **User Controls:**
 - Tactile switches for local control, test mode, or reset functions
-

3.5. Interfaces and Connectivity

- **USB Interface:**
 - USB Type-C for power input and service/debug (if enabled)
 - **Internal Connectors:**
 - Board-to-wire connectors for peripherals, LEDs, Battery.
 - **Antenna Interfaces:**
 - PCB trace inverted-F antennas for sub-GHz LoRa operation
-

3.6. Protection and Reliability

- **ESD Protection:**
 - Dedicated ESD protection devices on external interfaces
- **Battery Polarity Protection:**
 - Resettable fuse on power input.

3.7. Recommended Operating Environment (°F)

- Operating Temperature: 32 °F to 104 °F
- Humidity: 10% to 90% RH (non-condensing)
- Installation Type: Indoor, fixed installation

Device performance outside this range is not guaranteed.

4. Operation Guide

4.1. Power-Up Procedure

1. Power Adapter Requirement

Use a certified external power adapter with the following rating:

- Input: 120 VAC, 60 Hz
- Output: 5 VDC, 2 A

2. Connect Power

- Insert the USB Type-C cable into the USB-C port on the Rescue Repeater.
- Plug the power adapter into a wall socket.

3. Device Startup

- Upon applying power, the device will automatically power on.
- The status LED located at the bottom of the device will illuminate **Blue**.

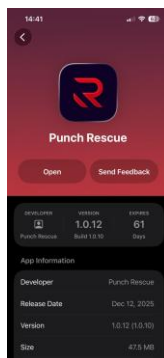
4. Startup Indication

- **Blue** LED indicates:
 - Device is powered ON
 - Device is not provisioned
 - Device is not connected to any Wi-Fi network

This state confirms that the hardware is operating correctly and ready for Wi-Fi provisioning.

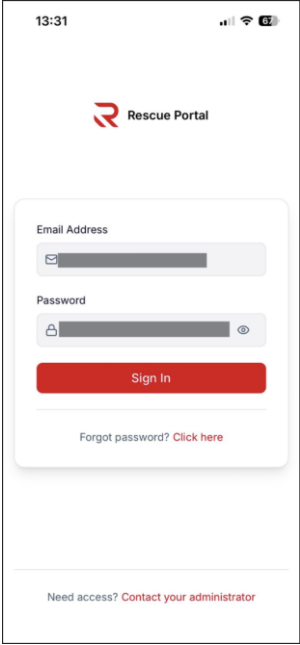
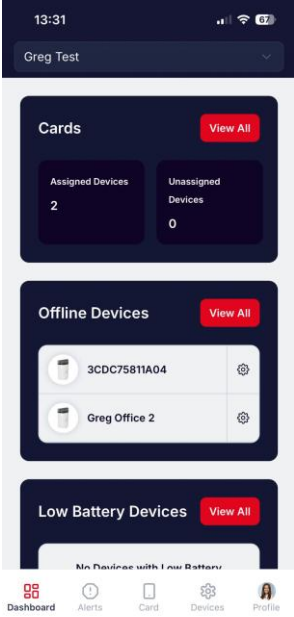
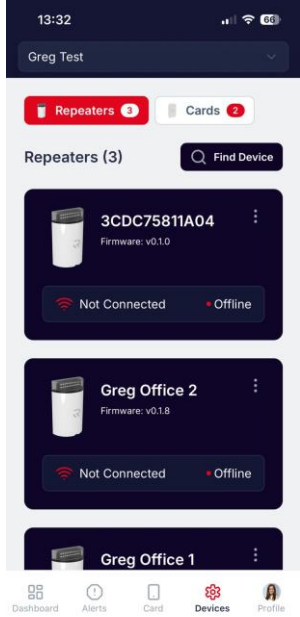
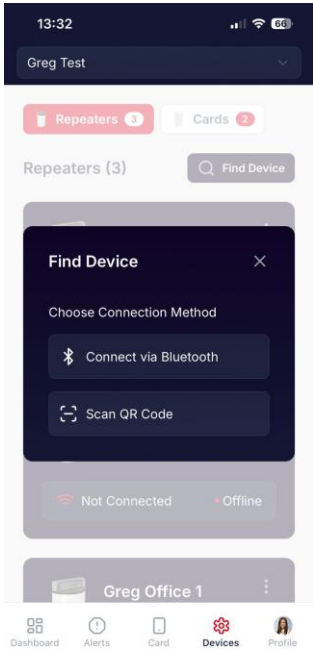
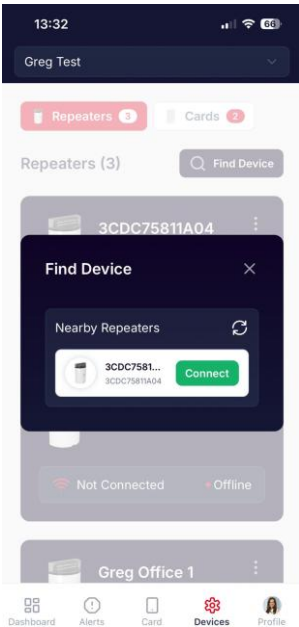
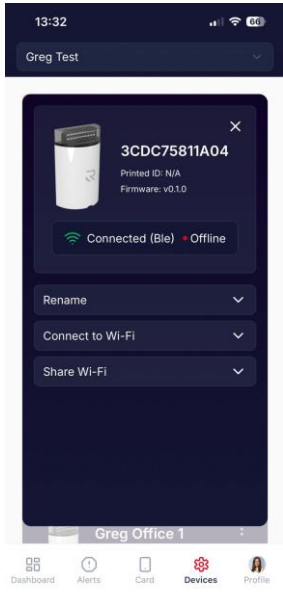
4.2. Wi-Fi Provisioning

1. Install “Punch Rescue” application on your mobile on your iOS device.

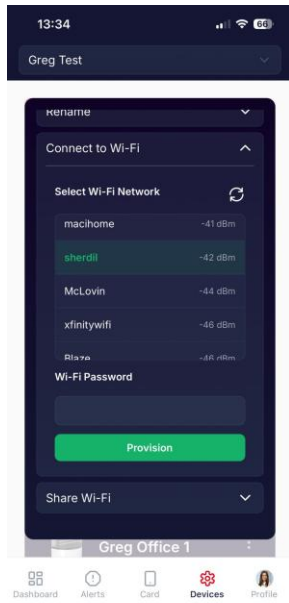


4.2.1 Application Interface for Registering your “new device” and Wi-Fi Provisioning:

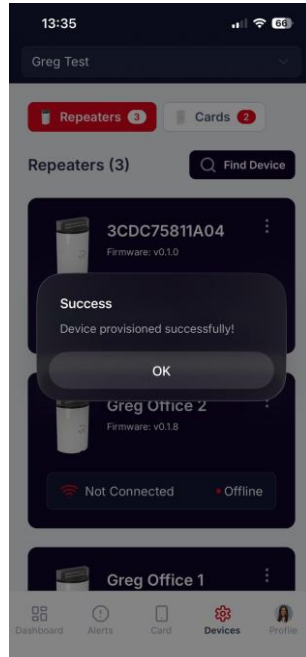
1. Power Up the device.
2. Device Status LED will turn **“Blue”** once device is up and running.

1. Open the App and Login with your Rescue Portal credential. 	2. This is the Rescue Dashboard. Open Devices Tab at Bottom. 	3. All registered devices can be seen here in this list. Now Tap on Find Device. 
4. Select “Connect via Bluetooth”. 	5. List of nearby repeater devices in provision mode will appear here. Select “Connect”. 	5. Now repeater is connected to App over BLE. It can be provisioned, renamed as per user needs. Select “Connect to Wi-Fi”. 

6. It will look for available Wi-Fi networks. Select your network, enter **"Wi-Fi Password"** and hit **"Provision"**.



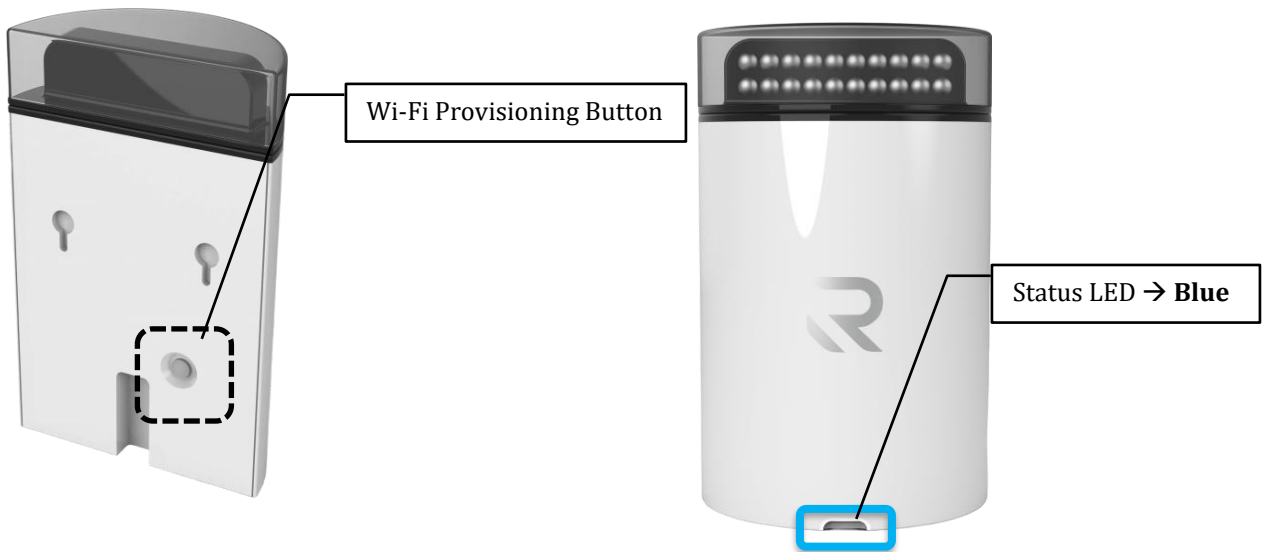
7. Wait for **Success** popup window.



8. Device is Successfully connected with Wi-Fi. Status Indicator on device itself will turn **Green**.

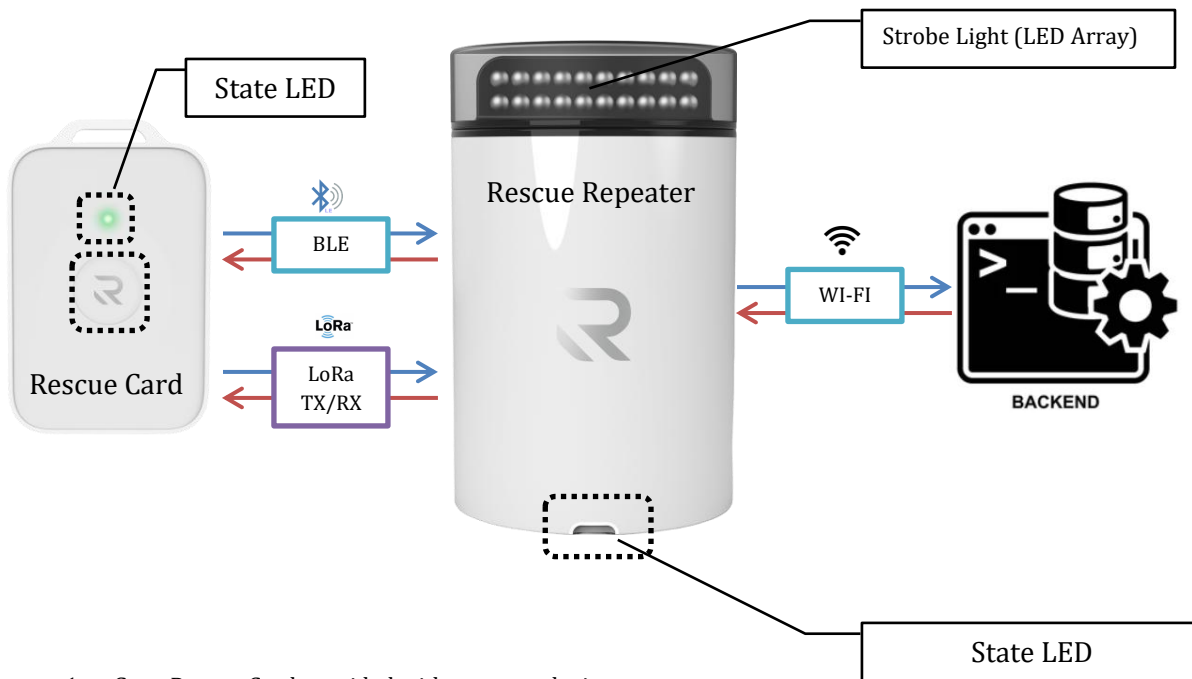


- If device is not showing up in the list, make sure device is in provisioning mode, if not double press the **"Provisioning Button"** on the back of the device.



4.3 Testing the Device:

Repeater device works in conjunction with Rescue Card (Lanyard).



1. Get a Rescue Card provided with repeater device.
2. Power it up by inserting Batteries (2xCR2032) Battery.
3. Press the button at the center of the device **3 times**.
4. Strobe Light (LED Array) will start blinking immediately.
5. State LED on the CARD will turn **Amber**.
6. This shows repeaters device is working as expected.

5. Maintenance and Care

The Rescue Repeater is designed as a **maintenance-free device** under normal operating conditions. No routine user service or calibration is required.

5.1. Routine Maintenance

- No periodic maintenance is required.
- The device contains **no user-serviceable parts**.
- Firmware updates are performed **remotely via OTA** when required.

5.2. Battery Pack

- The internal backup battery is **not user replaceable**.
- Battery charging occurs automatically when external power is present.
- If backup duration degrades over time, pack replacement is recommended.

5.3. Inspection

Periodic visual inspection is recommended to ensure:

- Power cable is securely connected
- Enclosure is intact with no visible damage
- Mounting hardware is secure

5.4. Service and Repairs

- Do **not** open the enclosure. It's not a DIY thing.
- All repairs must be performed by **authorized service personnel** only.

6 Troubleshooting

The Rescue Repeater is a sealed device and **must not be opened by users**.

All internal servicing and repairs shall be performed **only by qualified technicians**.

6.1 General Guidance

If the device is **not operating as intended**, users should perform only the following basic checks:

- Verify the power adapter is securely plugged into the wall socket
- Ensure the USB-C cable is properly connected to the device
- Confirm the wall outlet is providing power
- Observe the state LED behavior

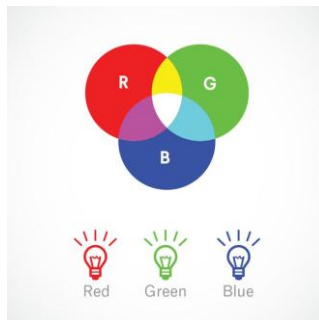
No further user troubleshooting is permitted.

6.2 Status Indicator LED

State LED Indicator Explained.

State	Description	State LED	RED	GREEN	BLUE
STATE_INITIALIZING	System is offline	Blue	off	off	on
STATE_PROVISIONING	Repeater is in provisioning mode	Aqua	off	on	on
STATE_WIFI_CONNECTING	Device is trying to connect to a WiFi network	Yellow	on	on	off
STATE_WIFI_CONNECTED	WiFi is connected and device is waiting for connection with MQTT	Green	off	on	off
STATE_MQTT_CONNECTED	MQTT is connected	White	on	on	on
STATE_ALERT	An alert is active	Red	off	on	off
Invalid State ???	Internal State Error	Violet	on	off	on

LED Color Mix.



6.3 Common Issues

Issue	Possible Cause	User Action
Device does not power ON	No power from adapter or outlet	Check power adapter and outlet
No backend connection	Wi-Fi credentials incorrect	Contact support
No alerts received	Network or radio issue	Contact support
Unexpected LED behavior	Firmware or system fault	Contact support

6.3 Restricted Access Notice

- The enclosure **must not be opened** by the user
 - No internal components are user-serviceable
 - Opening the device may Cause permanent damage.
-

6.4 Technical Support

If the device continues to malfunction:

Users must contact authorized technical support:

 **Support Email:** <mailto:support@punchrescue.com>

Please provide:

- Device serial number or MAC address
- Description of the issue
- LED status and behavior
- Installation environment details.

7. Safety Instructions

The Rescue Repeater contains an **internal lithium-ion (Li-ion) rechargeable battery**. Failure to follow these instructions may result in injury, damage, or reduced product life.

7.1 General Safety

- Use **only the specified power adapter** (5V DC).
 - Do **not** attempt to open, modify, or repair the device.
 - The enclosure must only be opened by **qualified service personnel**.
 - Do not expose the device to:
 - Excessive heat
 - Open flames
 - Direct sunlight for extended periods
 - Water or high humidity beyond rated limits
-

7.2 Battery Safety

- The internal battery is **not user-replaceable**.
 - Do **not**:
 - Short-circuit the battery terminals
 - Puncture, crush, or deform the device
 - Immerse in water
 - Stop using the device immediately if:
 - It becomes unusually hot
 - Emits odor or smoke
 - Shows visible swelling or deformation
-

7.3 Charging Safety

- Charge the device **only through the USB-C port**.
- Do not use damaged cables or adapters.
- Do not charge the device:
 - Near flammable materials
 - In extreme temperatures

7.4 Environmental Conditions

- Operate the device only within the **specified temperature range**.
- Do not store the device in:
 - Vehicles under direct sunlight
 - Freezing environments

7.5 Disposal and Recycling

- Do **not** dispose of the device in household waste.
- Li-ion batteries must be disposed of in accordance with:
 - Local regulations.

FCC Statement

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.

Note: 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 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 or more 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.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Radiation Exposure Statement

This device complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

This device must operate with a minimum distance of 20 cm between the radiator and user body.