R.O.D. (Radio Operations Deployment) Box



Functionality:

The ROD Box is a simple kit that keeps radios charged, cool and dry for up to 80+ hours in the shade and 55+ hours in direct high intensity sunlight. It is made to mount on existing infrastructure or strap to trees, poles or any available structure while holding whatever tactical or commercial radio is needed. If multiple electronics are utilized inside, instead of charging all separately, the only thing that needs to be hot-swapped is the BB-2590 battery.

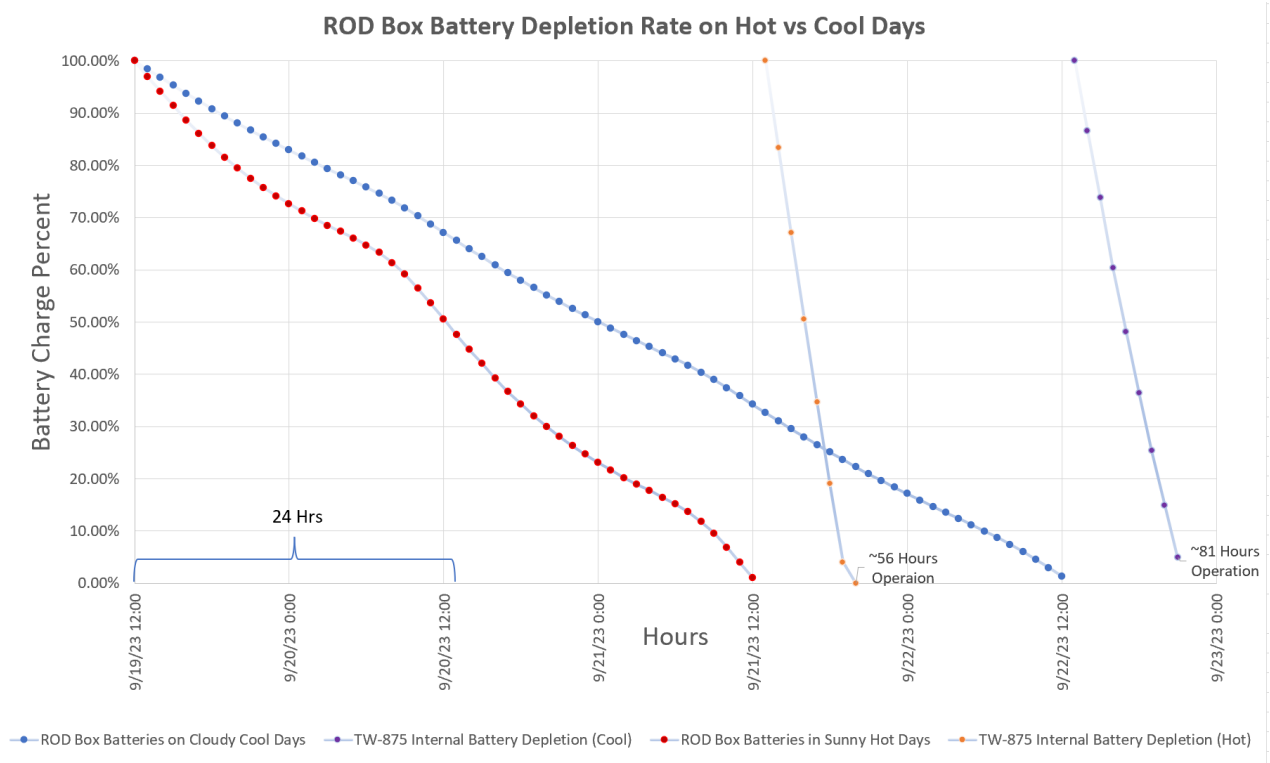
Current versions allow for any radio that can fit inside to fit into a custom mount, and then slide and clip securely into a universal attachment inside the box. Currently supported are TW-875, TW-950, GoTenna, and an EUD for ATAK visibility or other status monitoring. The most recent version can power an EUD, GoTenna, and a larger radio at the same time.



Testing and Data:

The ROD Box has been employed on Oahu, Hawaii for 5 weeks total, supporting mesh networks for 2 courses of Jungle School at Lightning Academy. Previously all 15 radios had to be brought in to charge daily before being set up again early the following morning before exercises would commence. They were exposed to all civilians who could enter the National Preserve and were directly exposed to constant rain, high humidity, hot sun and the highest UV index in the US. ROD boxes can go 3 days without any upkeep, can be strapped to higher elevations if desired for network health, and they're locked in place to deter tampering.

On average, 1.3% battery drain per hour was logged with 20+ datapoints, though direct sunlight on hot days does drain the battery faster, lasting 2 days. It's a simple system, designed for repair while keeping the important components safe, and has already shown durability to protect both the BB-2590 batteries and TW-875 radios through 20-30 foot drops during some unforeseen mast collapses. Wiring can be replaced quickly with snap in connectors, though the only structures that fractured were some printed components designed to be replaced, dampening the fall for the other (more expensive) internal components.



Simulated Battery Depletion rate (first the bb-2590 depletes in the box, then the TW-875's internal battery does) Based off Event Data. Battery depletion increases as the temperature rises during sunlight hours.

Actual Data:

- 48 Hrs operation Sept. 13-15, 80-90+ °F days with high Sun exposure:
    - 11 checked (some we moved and put out at different times).
        - Average Radio battery: 100%.
        - Average bb-2590 battery: 38% including Masts, 45% discluding Masts.
    - Mast ROD Boxes were the outliers below the average battery remaining:
        - Average Radio battery: 100%.
        - Average bb-2590 battery: 5% (Higher heat in the sun reduces battery life).
    - Sun caused surface temperatures of 120+ °F in the sun on dark surfaces. ROD Boxes are light colored and internally cooled, both lowering internal temperature.
- 66 Hrs operation Sept. 18-21, 70-80 °F On and off precipitation and wind:
    - 10 checked (some left out for the Culminating Exercise):
        - Average Radio battery: 100%.
        - Average bb-2590 battery: 12%.
        - No large difference in Mast vs. Tree mounted boxes (most likely) because of cool weather, winds and rain lowering heat.
        - The first Mast put up did drain the bb-2590 completely and the TW-875 down to 54%.
            - Timestamped at ~72hrs at takedown.
            - Highest Utilized Node in the network (since it was outputting data to the TOC 24/7).
- 73 Hrs operation Sept. 18-21, 70-80 °F On and off precipitation and wind:
    - 3 collected (the last few brought in after the Culminating Exercise).
    - All TW-875 batteries still at 100%, BB-2590 Batteries basically depleted.

Design Characteristics:

Version 1 (Left) and Version 2 (Right)

This is a summarized Operation and Technical overview:

- Design Breakdown:
  - Weight: 4.5lbs (2.025kg) without radio/battery, 8.5lbs with TW-875 and bb-2950
  - Cost for making 1: $300/ea (+93 if 3D prints are outsourced)
  - Cost for making 17: $183/ea (+93 if 3D prints are outsourced)
  - Protects $10,000+ worth of equipment
  - Ingress Protection Rating: IP55
  - Construction Time: 6 hours /ea
    - Albeit with non-optimal equipment, working on cutting this in half.
  - Container: Pelican 1200 Protector Box (interior 9.3"x7.1"x4.1")
    - TNC and SMA connections external from top face. Can include N, HN, or BNC as needed.
- New version improvements:
  - Holds TW-875 (or TW-950), EUD and GoTenna while charging all, can operate and charge any combination of them.
  - Lighter than the original.
  - Better cable management.
  - Better airflow and more durable components.
  - New Radio Attachment interface:
    - Can fit any radio (that will fit between the box and the battery) with an adapter made for the radio.

        - Breaks less often than the original (haven't seen one break yet, though there's always next time. They're replaceable anyways.
- Operation:
    - Radio mounted to the underside of the case lid with access to all buttons and controls. The mount is made to slide in and click.
    - Wires going from antenna connections on TW-875 to screw into adapters going through the lid of the pelican. Options for antennas on the side face or top face, depending on situation and mounting situation.
    - BB-2590 battery in bottom, quick access to replace battery.
    - Antennas fit in side (at least for TW-radios), depending on antenna size.
    - Desiccants under the main insert to reduce internal humidity, have to be replaced every once and a while but not critical to operation, suggested for storage.
    - The main switch controls fan and power and battery charging, each component does have to be individually turned on before operation.
- Equipment Requirements:
    - A Radio with Antennas.
    - A charging cable for the radio (currently the charging cable must have a bb-2590 male termination, though because these can be purchased, adapters can be made.
    - BB-2590 battery. The most energy dense, high capacity, widely used and available battery on the market that I've seen.
- Heat Management:
    - Perforations on left and right semi-hidden under the pelican lip allow air to flow, with the fan and printed insert shape directing air over the battery and radio.
    - Water resistant filter that covers the ventilation holes.
- Waterproofing:
    - The enclosure is resistant to water and dust entering, rating IP55 on the ingress protection scale. This means resistance to direct streams of water or dust without impacting operation. I've taken precautions to protect the most in-danger parts, like the main battery. The only boxes that showed any leakage at all were up for 66 hours in the rain in completely exposed positions, and there was no effect to operation or equipment by design.

Fabrication and Price Scaling:

Currently I'm producing these and can provide the purchase list. After testing I've made many small efficiency improvements, though that makes constructing one of these from scratch take an estimated 6 hours. I'm working to reduce this with better tools and components I need to modify less after purchase, hopefully cutting the time in half. Additionally, component assembly could be done by a 3rd party company, increasing the price but essentially automating the product.

The price coincides with economies of scale; The more components ordered at once to have more manufactured, the cheaper each one becomes to make. Outsourcing prints adds cost as well but also reduces our effort, factoring this in purchasing the required components for manufacturing 1 box is $400, but $275 while making 17, and down to $183 each if the components are ordered for 17, and we print out components ourselves whenever we need a new one.

The only testing that has not been done is functional time while powering the main radio, GoTenna, and EUD simultaneously. The math suggests instead of the 55-80 hour functional time (depending on environmental conditions), it would be reduced to 40-55 hours while charging everything at once, which is still a very useful increase. This does not include the internal batteries of the components, so it would last longer. Also, more components on-board means the utility of only having to replace the one BB-2590 battery is greatly increased, instead of removing each component and requiring individual charging.

Seeing as this is the second version and I predict new use cases, the printed insert can be modified fairly easily to change and add functionality.