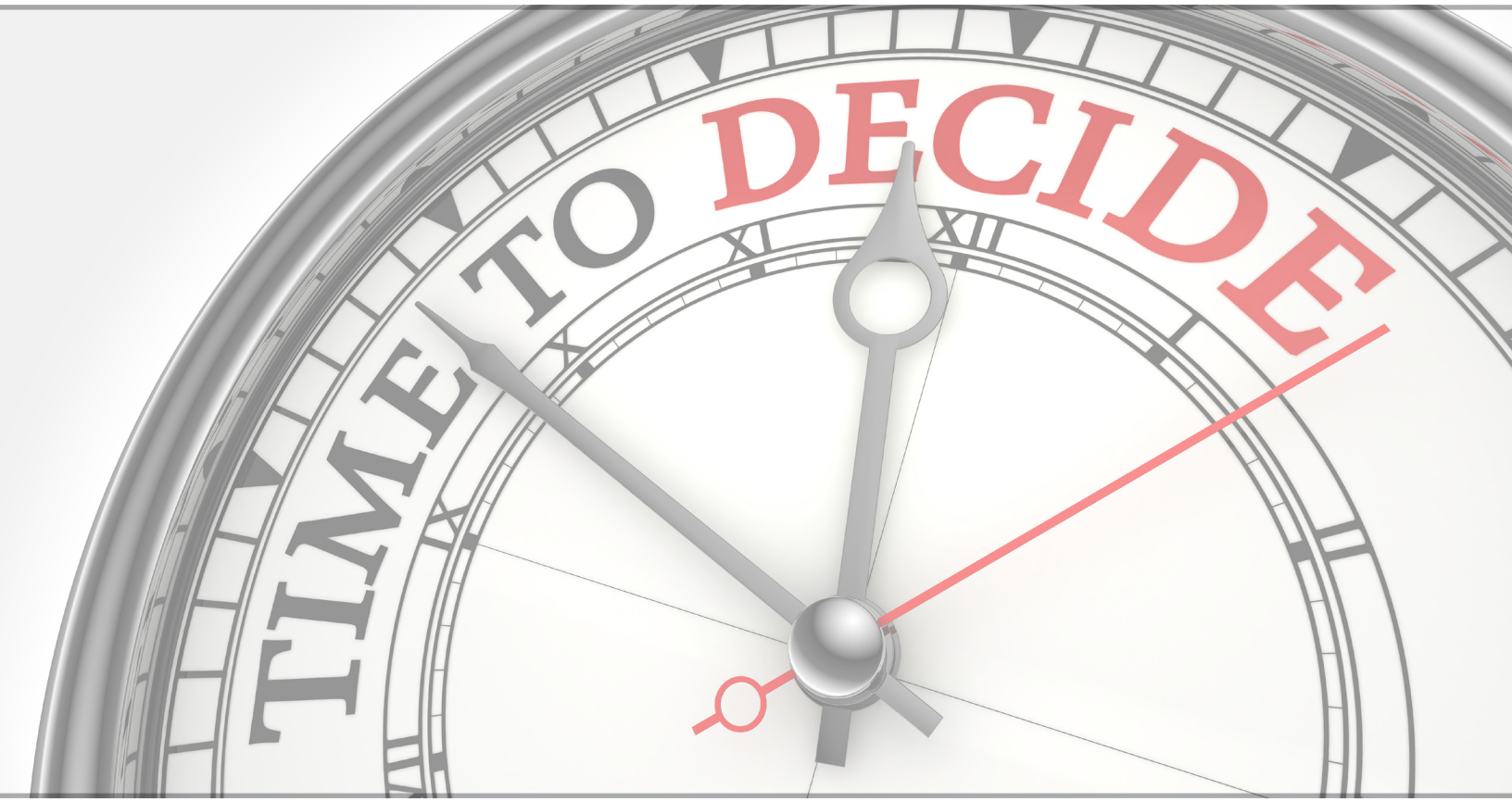
ULTRALIFE®

Whitepaper June 2018



Lithium Coin Cells or ULTRALIFE® Thin Cells

Are today's coin cells struggling to meet the demands of modern wireless applications where a new set of performance attributes are required?

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"When devices must operate 24/7, most portable IoT device manufacturers return to the battery"

The chatter surrounding the Internet of Things (IoT) speaks volumes about the interconnection of smart devices but not so much as to how they should be powered. For IoT devices which are designed to exist 'off grid' they must source their electrical energy from somewhere, whether that be a traditional battery, or one of many energy harvesting techniques such as solar or kinetic scavenging.

For long term reliability, when devices must operate 24/7, most portable IoT device manufacturers return to the battery as the most reliable, cost effective solution when it comes to supplying electrical energy.

Lithium Manganese Dioxide batteries offer the most attractive mix of performance attributes due to their high voltage (3V), long shelf life (10 years), wide availability and relatively low cost.

When electronic devices must be made slim it is the Lithium coin cells (also known as button cells) which have been the mainstay of low power electronic devices from wrist watches to calculators since their inception in the 1970's. However, today's coin cells are struggling to meet the demands of modern wireless applications where a new set of performance attributes are required.

COIN CELLS

Lithium coin cells range in capacity from 10mAh to 1000mAh and are ideal for applications which operate at or around room temperature where the discharge current is low and constant, with few peak demands.

Due to their relatively high internal resistance, coin cells have difficulty providing high pulses of current (such as RF transmission pulses) and low temperature operation (<0°C) can range from poor to non-existent.

Coin cells do however have the advantage that they are available in many standard sizes and from multiple manufacturers. They are easily replaced if a suitable cell holder is used or can be permanently installed into devices using PCB solder pins making them ideal for memory backup applications.

ULTRALIFE® Thin Cells

The need for batteries that can provide higher discharge currents across a wider temperature range, whilst still providing a slim form factor has led to the development of ULTRALIFE® Lithium Thin Cells.

Thin Cells are an evolution of ULTRALIFE's cylindrical Lithium Manganese technology and offer cell thickness down to 1.2mm and with footprints up to 305mm x 305mm. The technology allows for continuous discharge current of up to ten times that of a coin cell of the same capacity.

Thin Cells offer superior performance to coin cells due to their wider effective operating temperature range and superior discharge rate capability which makes them ideal for embedded IoT applications or any application where a product must be slim and where coin cells fail to deliver.

Discharge Performance

The following charts compare the discharge performance of an ULTRALIFE® CP124920 Thin Cell to CR2025 coin cells from three different Tier-1 manufacturers.

All four cells have a rated capacity of between 160mAh and 165mAh. The discharge test was conducted at a constant resistance of 1kΩ which resulted in a load of between 2.0mA and 2.8mA. Three test temperatures of +20°C (room temperature), -10°C (low temperature) and +60°C (high temperature) were used.

Room Temperature (Fig. 1)

The three coin cells exhibit similar performance delivering between 135mAh and 154mAh. The Ultralife® Thin cell delivers more than its rated capacity at 173mAh and because it operates at a higher voltage, the delivered energy (the area under the curve) is superior to that of the coin cells.

Low Temperature (Fig. 2)

The growth of internal resistance caused by the low temperature is evident in this test with all cells having a suppressed discharge voltage and reduced capacity. However, it is the Ultralife® Thin Cell that has the highest voltage and twice the capacity of the best performing coin cell.

High Temperature (Fig. 3)

The discharge voltage and capacity of all cells is much improved at elevated temperatures as the discharge chemical reactions operate far more efficiently. However, it is still the Ultralife® Thin Cell that provides the highest voltage and capacity of the group.

High Rate (Fig. 4)

This test demonstrates the performance advantage of the ULTRALIFE® Thin Cells over the coin cells when subjected to a high rate discharge. The test uses a 65Ω constant resistance load which discharges the cells at between 31mA and 43mA. The test was conducted at room temperature (+20°C). The superior discharge capability of the ULTRALIFE® Thin Cell is clearly shown in this test. In real life applications it is more common for high current pulses to be very short and inter-spaced with very low background current consumption but this test demonstrates that under high load, the ULTRALIFE® Thin Cell is far more capable than the coin cells which have a far higher internal resistance.

Removable vs. Embedded

Coin cells can be either fitted with PCB pins and permanently soldered into a device or they can be placed into a cell holder making them user replaceable. ULTRALIFE® Thin Cells are ideal for permanently embedding into devices or can be factory fitted into a plastic carrier enabling them to be swapped out by the user. Even with a carrier option, the OEM must create a supply chain for replacement as Thin Cells supplied in carrier are not available through retail channels.

Attribute Comparison

The table below compares coin cells and ULTRALIFE® Thin Cells across ten performance attributes. For low drain devices requiring a user replaceable battery it is coin cells which provide the best option. When a custom cell size is required, discharge rates are high or when low temperature performance is required, ULTRALIFE® Thin cells are an attractive proposition and should be considered by IoT device manufacturers as the power source for their next device.

ATTRIBUTE	COIN CELL	ULTRALIFE THIN CELL
Shelf Life	✓✓	✓✓
Ease of (user) replacement	✓	✗
Slim Profile	✓	✓✓
Large footprint capable	✗	✓✓
Aftermarket availability	✓✓	✗
Low temperature performance	✗	✓
High rate performance	✗	✓
Safety	✓	✓
Custom size availability	✗✗	✓✓
Cost	✓✓	✓

✓✓ Very Good ✓ Good ✗ Poor ✗✗ Very Poor

Figures

Figure 1 - Comparison Between 165mAh Ultralife LiMnO2 Thin Cell and Coin Cells (Typical Performance at +20°C under 1kΩ Resistive Load)

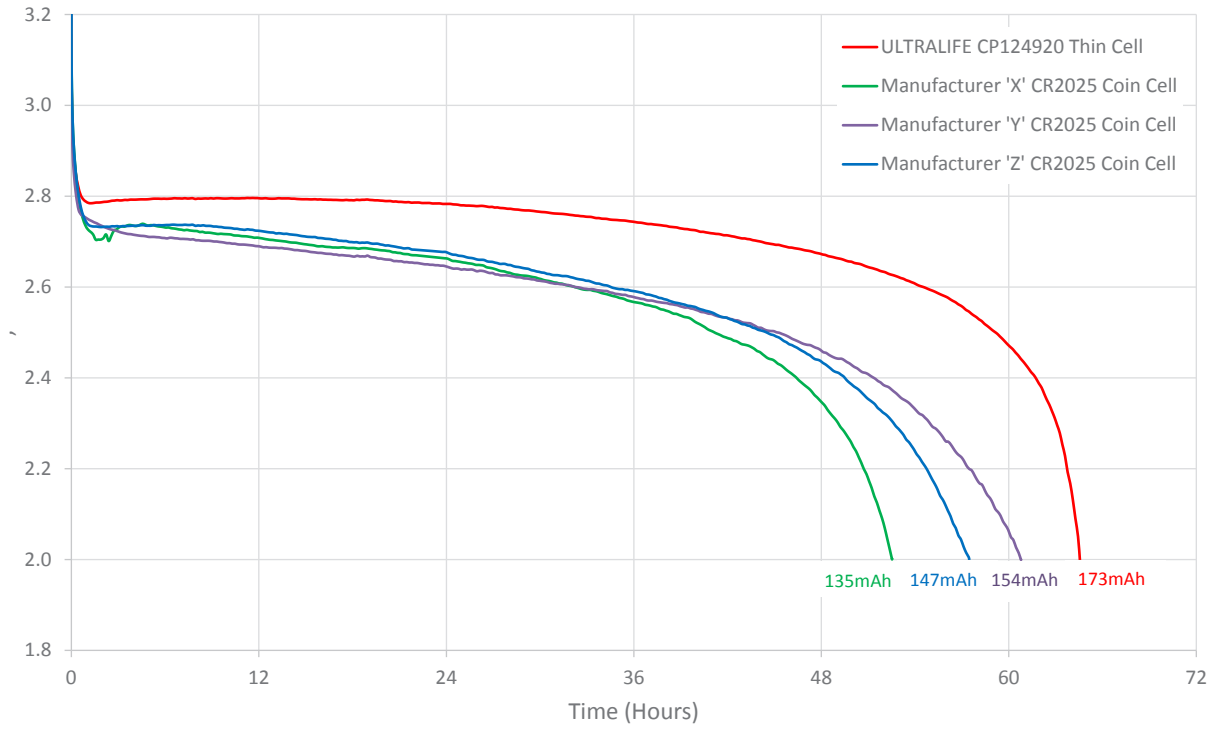


Figure 2 - Comparison Between 165mAh Ultralife LiMnO2 Thin Cell and Coin Cells (Typical Performance at -10°C under 1kΩ Resistive Load)

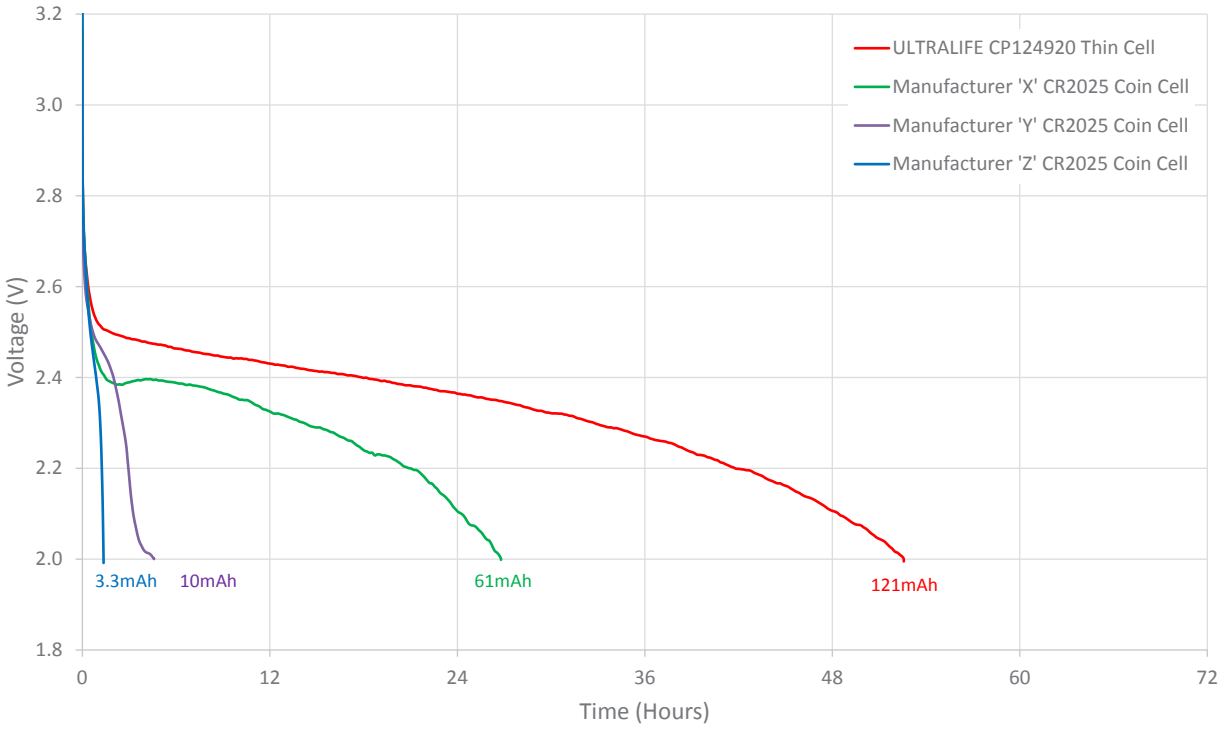


Figure 3 - Comparison Between 165mAh Ultralife LiMnO2 Thin Cell and Coin Cells (Typical Performance at +60°C under 1kΩ Resistive Load)

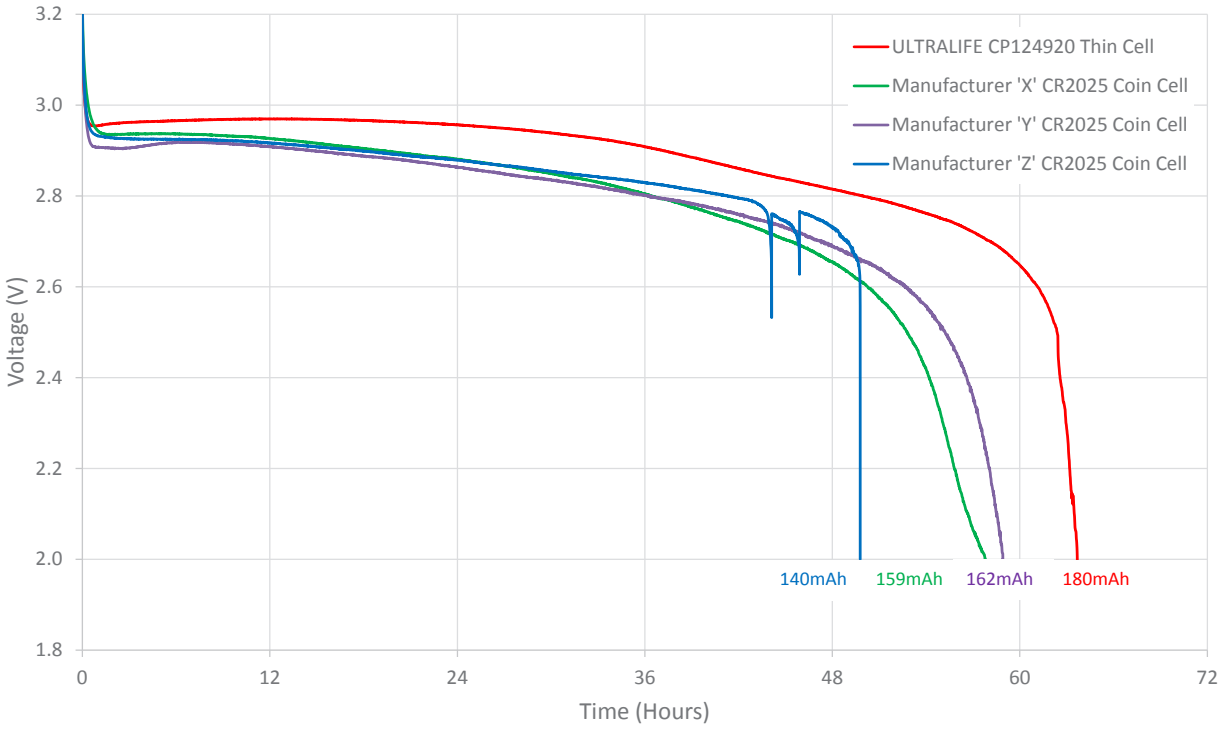
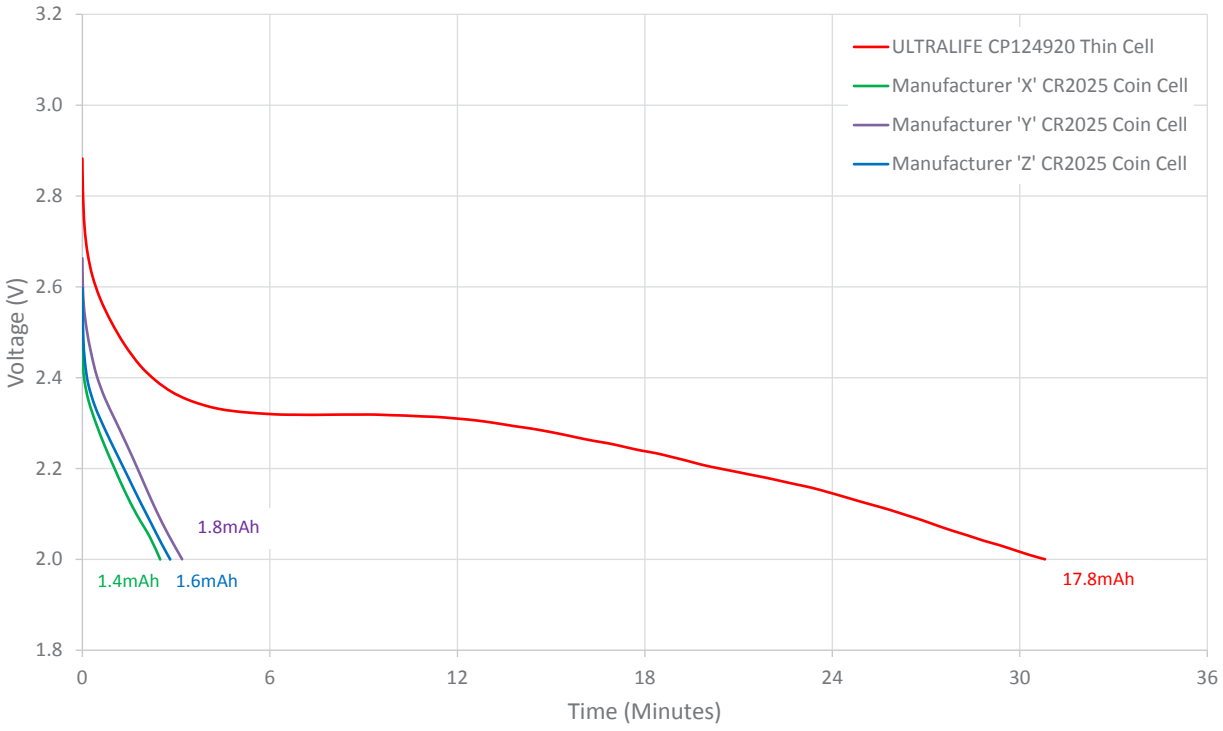


Figure 4 - Comparison Between 165mAh Ultralife LiMnO2 Thin Cell and Coin Cells (Typical Performance at +20°C under 65Ω Resistive Load)



ULTRALIFE BATTERY & ENERGY PRODUCTS

2000 Technology Parkway
Newark
New York 14513
United States

TEL 800-332-5000 (USA & Canada)
TEL +1-315-332-7100
EMAIL sales@ultralifecorp.com
WEB www.ultralifecorp.com

THIN CELL

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