Thionyl Chloride Product Line
Application Guide

Cylindrical Format

$LiSOCl_2$

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1. About Ultralife® Lithium Thionyl Chloide Batteries

1.1 History

Ultralife Corporation has been providing the safest, highest quality Lithium batteries worldwide for over 20 years. Ultralife Corporation has an extensive product line across many Lithium battery chemistries. Our leading edge technologies offer the safest, highest energy densities available. Ultralife continues to invest in research and development to enhance current products and deliver new product advancements to the commercial marketplace.

1.2 Advantages

Ultralife Lithium Thionyl Chloride cells have some of the highest energy density and performance characteristics of all Lithium based battery chemistries. Lithium Thionyl Chloride cells offer excellent temperature characteristics, a flat discharge curve, and a hermetically sealed stainless steel container for long term shelf life. The passivation layer that occurs on all Lithium Thionyl Chloride cells allows for long storage periods with minimal loss in overall cell capacity, making it a perfect choice for long term backup and remote metering applications.

1.3 Characteristics

- High Operational Safety (UL certified)
- High Cell Voltage (3.6V)
- Wide Temperature of operation
- Low Self Discharge
- High Energy Density
- High Reliability
- Resistance to corrosion with Stainless case
- Non Flammable Electrolyte
- Inorganic Electrolyte
- Non Pressurized System
- Electrolyte is Corrosive

1.4 Part Numbers

The Thionyl Chloride Cell product line from Ultralife has the following part number schema.

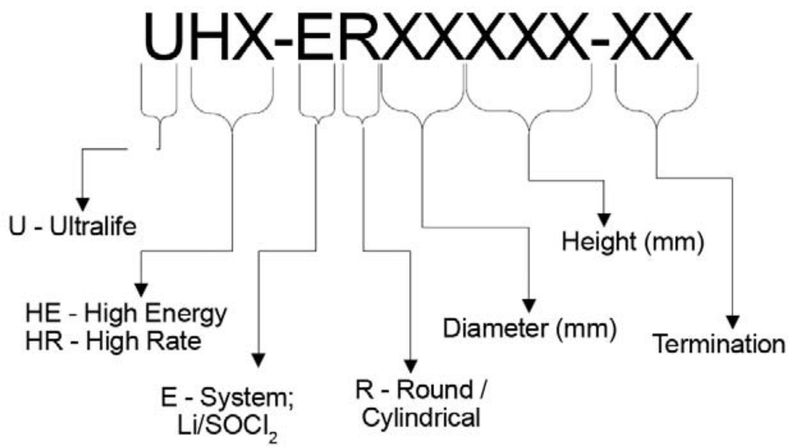


Figure 1: Part Number Schema

1.5 Type Indentification

The high energy version (UHE) of a cell is recognized by a label that has a black band on the negative side of the cell label. The high rate version (UHR) of a cell is recognized by a black band on the negative side of the cell and a red band on the positive side of the cell. See examples in figure 2 below.

Figure 2: Product Identification

2. Cell Designs

2.1 Bobbin Designs (UHE Types)

A Bobbin cell design is utilized in applications where high energy and low discharge rates are required. Due to the low surface area between the anode and cathode materials, the rate capability is limited.

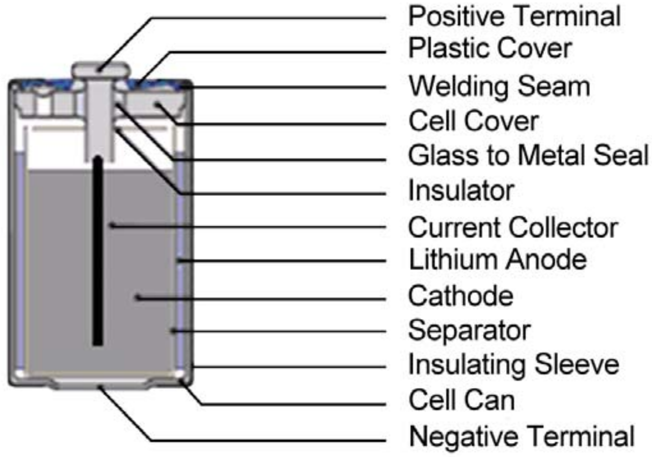


Figure 3: Bobbin Construction

2.2 Spiral Wound (UHR Types)

A spiral cell design is utilized when high discharge rates are required. The spiral design allows for large surface areas between the anode and the cathode materials, increasing ionic transfer between the electrodes, resulting in higher rate discharge capability.

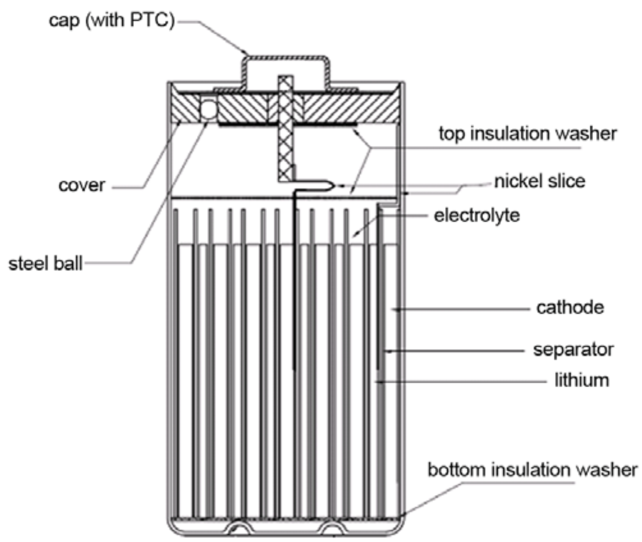


Figure 4: Spiral Wound Construction

3. Applications / Markets

3.1 Remote Metering

- Utility Meters: Water, Gas, Electric
- Automatic Meter Readers
- Industrial meters / valves

3.2 Safety / Security

- Alarm systems
- Safe / Door Lockers
- Detectors

3.3 Remote Monitoring

- RFID
- Asset Tracking / GPS Systems
- Personnel ID systems
- Patient Monitoring / Biotelemetry
- Seismic Monitoring
- High Voltage Line Fault Detectors

3.4 Automotive Power

- Navigational Systems
- Automotive sensors
- Taximeters
- Toll Pass Applications

3.5 Backup Power

- Memory Backup
- Encryption Keys

3.6 Industrial / Consumer

- Clocks / Timers
- Weather Stations
- Telemetry Equipment
- Vending Machines

4. Design Notes

4.1 Transient Minimum Voltage (TMV)

Due to a passivation layer over the Lithium surface, the resistance of the cell will be temporarily increased, resulting in an initial voltage drop during initiation of discharge. The lowest voltage due to these phenomena is referred to as transient minimum voltage. This minimum voltage will be further reduced as temperature decreases and discharge rate increases.

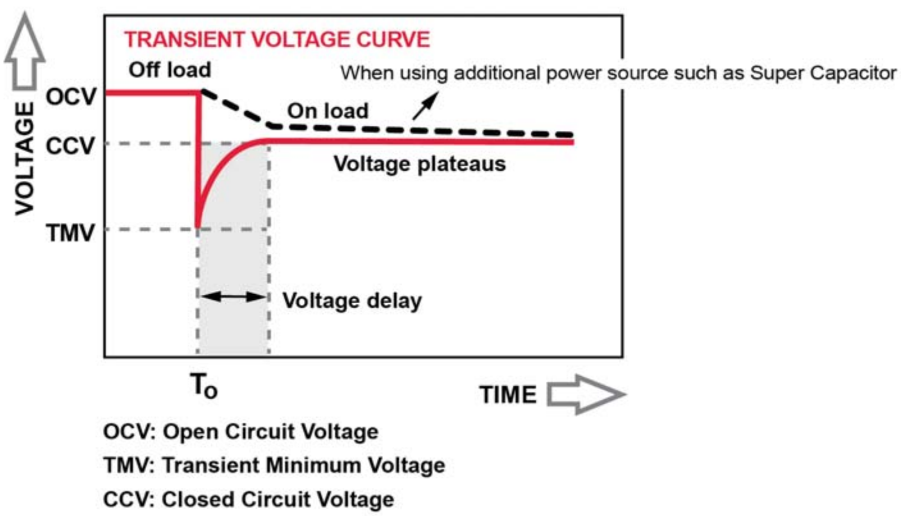
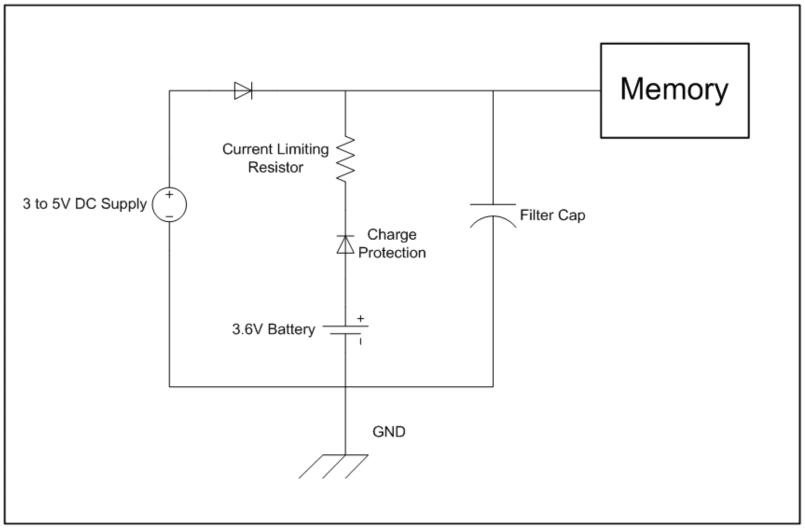


Figure 5: Transient Minimum Voltage

4.2 Backup Power Application

A typical application of Lithium Thionyl Chloride cells is to provide memory or microcontroller backup power in the event of a power failure or rechargeable battery depletion. A typical design circuit is provided in figure 6. Note that a current limiting resistor and series diodes (two for redundancy) are typically required to comply with safety requirements under most compliance certifications (UL, IEC, etc.). Please refer to your required safety recognition specification for additional information.



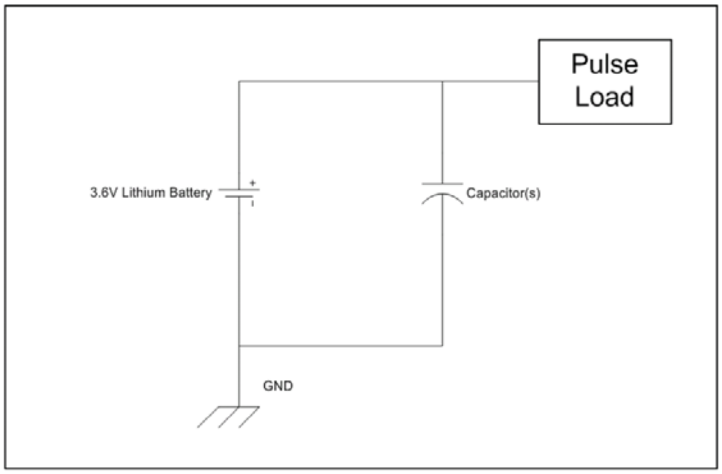
Typical Circuit Design for Backup Power

Figure 6: Backup Power Circuit Design

4.3 Pulse Load Applications

A typical pulse load design is included in figure 7. This type of circuit would be prevalent in applications such as remote wireless meters, toll pass, or similar applications. With the passivation layer build up that occurs over time in Lithium Chloride it is suggested that a capacitor of appropriate size be combined with the battery in parallel.

The capacitor will provide the high pulse current that is required for short periods of time to the circuit that the high resistance passivation film will prevent the cell from providing. This capacitor could be electrolytic, polymer film, a super capacitor, or ultra capacitors as the circuit requires.



Typical Circuit Design for Low Duty Cycle Pulse Application

Figure 7: Pulse Power Circuit Design

The formula for sizing the capacitor is:

$C= VW / R \times t / \Delta V$

Where:

- C = Capacitor
- VW = Working Voltage
- R = RL + RC
  - (RL = Resistance of Circuit Load V/ Pulse Current)
  - (RC = Internal Resistance of Chosen Capacitor in milliohms)
- t = Backup Time
- ΔV = Maximum Voltage Drop Allowed in Circuit

Typically a capacitor will be sized at least 2 times the required value to account for the varying environmental factors and capacitor life aging. There will be some leakage current through the capacitor and that current should be accounted for when choosing the proper size cell for your application. This leakage current will vary based on the environmental conditions so be certain to factor in temperature extremes when determining proper cell size.

5. Design Support

5.1 Battery Pack Assembly

Battery pack assembly should be completed by experienced and qualified battery manufacturers. Battery packs should be carefully constructed and fully tested to comply with all necessary regulations prior to shipment, installation, or use in any application or device. For custom pack assemblies please contact Ultralife Corporation for design assistance and manufacturing options.

5.2 Cell Orientation

Cell orientation during use may affect performance in the larger cell sizes (C, D), as the electrolyte may be distributed in a manner that reduces capacity. Consult Ultralife if there are questions about your specific application. Typical Orientations are below in figure 3.

Figure 8: Cell Orientation

5.3 Terminations

Various cell terminals can be provided to facilitate cell mounting installation in the end use application. Tabs can be provided to mount cells to printed circuit boards by soldering. Custom wire harnesses can be provided to allow for easy replacement in end use applications. Please contact Ultralife for additional information on termination options.

5.4 Soldering

5.4.1 Hand Soldering

- Only skilled personnel should attempt to solder
- Wear all required personal protective gear
- Do not solder directly to the cell, solder to termination tab only
- Finish solder operation within 5 second time period
- Allow solder to fully cool prior to next solder operation
- Use proper heat sink practices when soldering to prevent cell heating

5.4.2 Wave Soldering

- Do not Expose cells directly to solder bath
- Keep solder bath temperature below 280ºC
- Solder time should be less than 5 seconds
- Do not overheat battery during soldering

6. General

6.1 Shipment

Many Lithium metal batteries are regulated and require specific compliance and testing prior to shipping. Please visit the Ultralife Corporation website for guidance on shipping information and links to requirements.

6.2 Safety

- Do not solder directly to the cell or cell body
- Do not disassemble or open cells or expose contents to water
- Do not heat cells above recommended temperatures and dwell times
- Do not short circuit
- See MSDS for additional information

6.3 Disposal

Cells should be disposed of in accordance with all applicable local, state, federal or international regulations. Cells should be fully discharged prior to disposal if possible. Cells should be insulated prior to disposal to prevent inadvertent short circuits.

6.5 Legal

This document is provided as general guidance in utilizing and designing Ultralife Thionyl Chloride cells in various applications. Designs of multiple cells in series or parallel must be tested and certified with all local, state, federal, and international laws and regulations.

This document in no way replaces sound design practices and/or absolves the user of responsibility to comply with the necessary laws and regulations.

6.5 Contact Information

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