THE PULSE OF PROGRESS

LITHIUM COIN CELLS

JAUCH DEVELOPS

WHITEPAPER

CONTENT

1. Introduction and Advantages of Coin Cells

Coin Cells (also called Button Cells) are small, flat, and typically single-use batteries designed to deliver a steady 3.0 V (for Lithium systems) in a very compact form factor. Their thin profile, long shelf life, low self-discharge, and reliable leak resistance make them the power source of choice for countless compact electronics.

Coin Cells play a pivotal role in the ongoing miniaturization of electronic devices. Their compact shape allows them to be integrated easily into increasingly smaller gadgets, supporting the development of advanced technologies where space efficiency is essential. Despite their diminutive size, Coin Cells offer exceptional reliability, delivering a steady power supply crucial for applications that require consistent performance. This unique combination of a small footprint and dependable operation makes Coin Cells particularly well suited for wearables, medical patches, and other devices.

The importance of Coin Cells in today's technology landscape stems from several key factors:

- **Miniaturization** is a major driver, as modern wearables, sensors, asset tags, and medical patches require ultra-compact batteries that do not compromise on power.
- **Long service life** is critical for devices like memory backups or remote sensors, where maintenance-free operation over several years is often necessary due to their hard-to-reach locations.
- **Reliability**, as Coin Cells provide stable voltage and predictable behavior essential for accurate sensing, real-time clock and memory retention, and other low-power electronics. In addition, standardized sizes such as the CR2032, along with versatile mounting options ranging from holders to welded tabs or pins, streamline both integration and manufacturing processes for device designers.

Within Lithium Coin Cells, Li/MnO_2 (the CR series, such as CR2032) is the most widely used chemistry. Zooming out to all Coin/Button Cells (including non-lithium chemistries), Silver Oxide (SR) still dominates watches, while Zinc-Air leads traditional hearing aid cells.

1.1 Naming Standard

According to the IEC 60086 battery naming standard, all primary Lithium Manganese Dioxide Coin Cells (Li/MnO_2) use the prefix CR.

The IEC code defines:

- C = Lithium battery with Manganese Dioxide (MnO_2) cathode
- R = Round cell (coin or cylindrical)

Other Coin Cell chemistries use different prefixes:

- BR – Lithium Carbon Monofluoride (Li/CF_X)
- ML – Rechargeable Lithium Manganese Oxide
- VL – Lithium Vanadium Oxide
- SR – Silver Oxide (non-lithium)

1.2 Li/MnO_2 (CR) Coin Cells

Li/MnO_2 (CR) Coin Cells are compact, lightweight primary batteries with a nominal voltage of 3.0 V. They offer stable performance across a broad operating temperature range and excellent shelf life. Compared with lithium systems using liquid cathodes ($LiSO_2$, $LiSOCl_2$, $LiSO_2Cl_2$), Li/MnO_2 cells typically exhibit lower anode passivation, which helps prevent initial voltage delay (a voltage dip at the start of a load).

They are available in many standard sizes (e.g., CR2016, CR2032, CR2450) and can be used in battery holders or supplied with welded solder tabs/pins for PCB mounting.

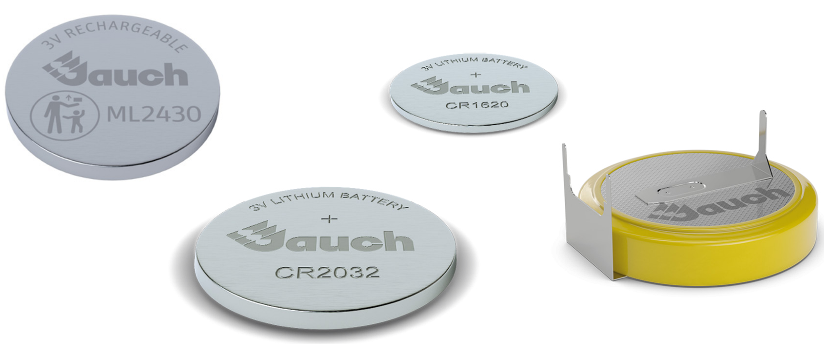


Figure 1: Lithium Coin Cell from Jauch

1.3 Advantages

- **Market prevalence:** Li/MnO_2 is the most common consumer-grade primary Lithium chemistry, accounting for more sales than other Li primary systems combined; CR2032 is the single most ubiquitous size in modern electronics.
- **Suitable voltage for electronics (3.0 V):** Perfect for MCUs, logic circuits, RTC, BLE bursts, etc., without needing boost circuitry.
- **Low self-discharge & long shelf life:** Typically ≈1%/year at 23 °C.
- **Shelf life:** Up to ~7 years when stored at or below 23 °C in unopened, original packaging; smaller formats may trend lower, larger formats higher.
- **Wide temperature range and robust construction:** Broad operating ranges and anti-leak designs make them a safe, general-purpose choice.
- **Standardization & supply depth:** A mature ecosystem of sizes (CR2016/2025/2032/2450/2477, etc.), holders, and tabbed versions simplifies design and sourcing.

In a nutshell: for Lithium Coin Cells, CR-series hits the best balance of voltage, pulse capability, cost, and availability – hence why so many products are designed around CR-cells.

2. Structure and operating principle of Coin Cells

The mechanical design of a Coin Cell is based on a two-part metal housing consisting of a lid and a cup, which simultaneously form the electrical terminals. The lid typically serves as the negative terminal (anode side), while the cup represents the positive terminal (cathode side). The active material of the electrodes is designed with a planar structure to maximize the available reaction surface while maintaining a minimal overall height. A microporous separator is positioned between the anode and cathode, providing electrical insulation while allowing ionic charge transport. Sealing of the cell is achieved via polymer-based gaskets or insulating rings, which must be both chemically resistant and mechanically robust.

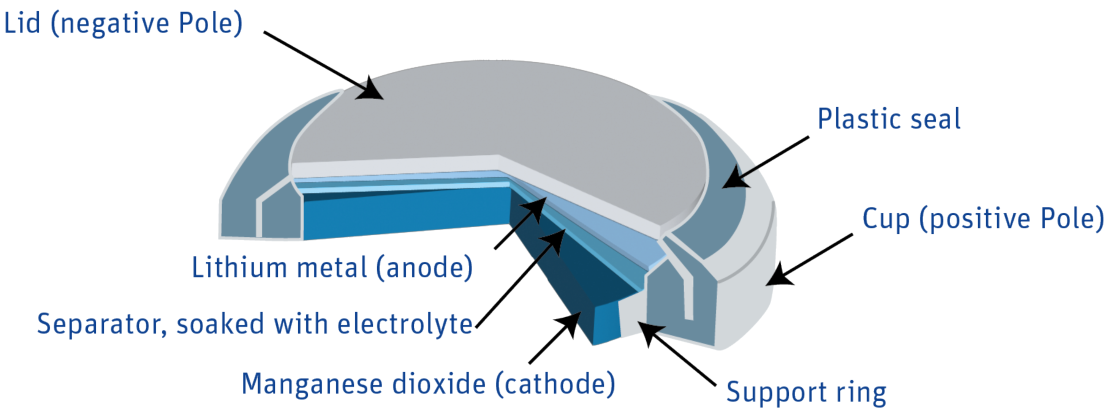


Figure 2: Structure of a CR Cell

Material selection is critical to the electrical and chemical performance of a Coin Cell. In CR batteries, metallic Lithium is used as the anode, enabling a high electrochemical potential difference and, thus, a high cell voltage. Manganese Dioxide is used as the cathode material. The electrolyte is formulated to provide high conductivity while maintaining low reactivity with the electrode materials.

The electrochemical operation of a Coin Cell is based on a galvanic cell in which a spontaneous redox reaction occurs during discharge. Oxidation takes place at the anode, releasing electrons. These electrons flow through the external circuit to the cathode, where they are consumed in a reduction reaction. At the same time, ions migrate within the cell through the electrolyte to ensure charge balance between the electrodes. The cell voltage results from the difference in the electrochemical potentials of the two electrode materials and remains stable over a large portion of the discharge in high-quality Coin Cells.

Different chemical systems of Coin Cells exhibit specific discharge characteristics. Lithium Coin Cells provide high energy density and low self-discharge, making them particularly suitable for long-term applications with operating lifetimes of several years.

Another key aspect is the thermal and mechanical behavior of the Coin Cell. Temperature changes affect both the reaction kinetics and the internal resistance of the cell. CR Coin Cells can typically be operated within a temperature range of -30 °C to +85 °C. At low temperatures, ion mobility in the electrolyte decreases, resulting in reduced performance. In contrast, high temperatures accelerate aging processes and may shorten service life. This must be considered when calculating the expected battery life. Mechanical stresses such as vibration or shock must be compensated for through a robust housing design and stable electrode fixation, particularly in automotive or industrial applications.

In principle, the relationship between temperature and the progress of chemical processes follows the RGT (reaction rate–temperature) rule. As a rule of thumb, a +10 °C increase approximately doubles the reaction rate.

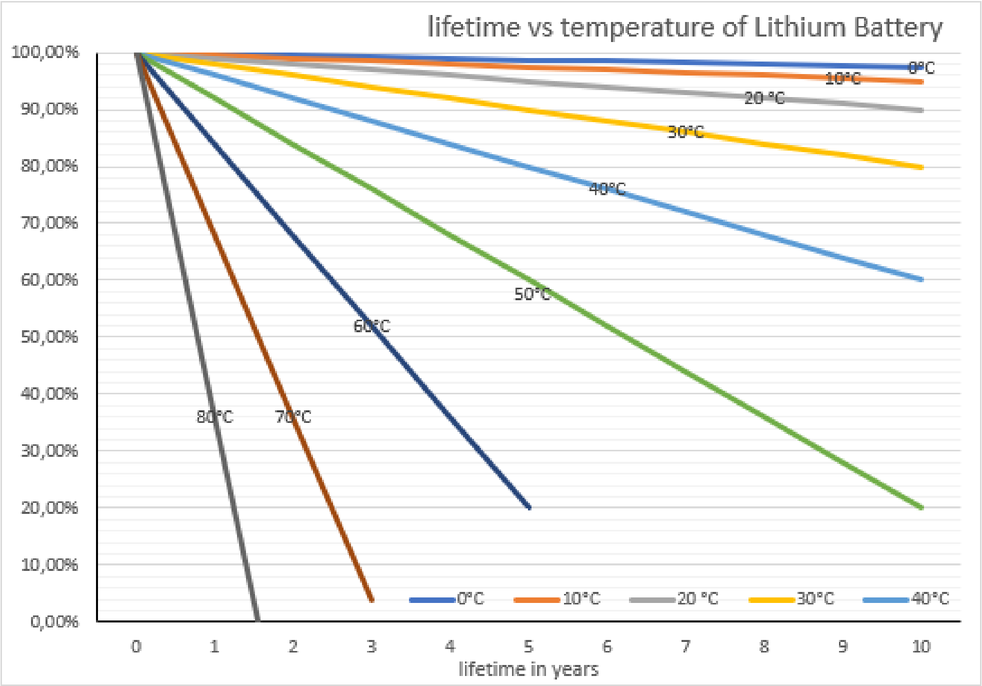


Figure 3: Temperature impact on the lifetime of Lithium Batteries

Design tip

Actual shelf life depends on the exact cell design, seal system, electrolyte formulation, and storage temperature/humidity. Always verify with the specific cell's datasheet.

- **Temperature (dominant):** Keep cells near room temperature; heat accelerates side reactions and raises internal resistance. Avoid prolonged storage above ~30 °C. Exposure to temperatures around ~70 °C can significantly increase resistance and accelerate ageing.

- **Humidity & environment:** Avoid prolonged exposure to extreme relative humidity. Store cells in their original packaging. Watch for condensation when moving cells from cold storage to warmer environments.

- **Cell design (seal, electrolyte, process control):** Different sealing systems and electrolyte formulations lead to varying leakage currents, passivation behavior, and thus different shelf life specifications across brands and sizes.

- **Size effects:** Smaller cells (e.g., CR1025/CR1216) are often specified with a ~5 years shelf life; while mainstream sizes (e.g., CR2032/CR2450) commonly reach up to ~10 years – due to a mix of capacity, geometry, and sealing characteristics.

CR-Batteries at a glance:

Key electrical characteristics:
- Nominal Voltage: 3.0 V (fresh OCV typically ≥ 3.0 V at 20 °C – 25 °C)
- Operating Temperature: Typically –30 °C to +85 °C (application-dependent)
- Primary / Non rechargeable: Do not recharge.

Shelf Life & Self Discharge
- Self Discharge: Typically < 1% per year at 23 °C, depending on size, chemistry formulation, and storage conditions.
- Typical Shelf Life at ≤ 23 °C (unloaded, in original packaging):
    - Smaller diameters (~10 – 12 mm): up to ~5 years
    - Larger diameters (~16 – 24 mm): up to ~10 years
- Voltage Stability: Good voltage retention during storage thanks to the stability of Li/MnO_2 chemistry and low-leakage design.

2.1 Open Circuit Voltage (OCV) vs. Closed Circuit Voltage (CCV)

OCV (open circuit voltage) refers to the terminal voltage of a Battery or Coin Cell when no load is connected and therefore, no current flows. It represents a measure of the electrochemical equilibrium of the cell and depends directly on the electrode materials and the chemical system used. OCV is commonly used to estimate the state of charge, as the voltage changes with increasing discharge. For Coin Cells, the OCV is typically measured after a defined rest period to minimize polarization effects and ensure reproducible values. Fresh Li/MnO_2 Coin Cells typically exhibit an open-circuit voltage of approximately 3.0 – 3.2 V at room temperature. Under standard conditions, the OCV of new cells is above 3.0 V, although minor batch-to-batch and device-related variations may occur.

CCV (closed circuit voltage), in contrast, describes the terminal voltage of a Battery under load, meaning while the cell is delivering current to a connected device. This voltage is always lower than the OCV, as it is affected by internal resistance as well as electrochemical and ohmic losses. The difference between OCV and CCV increases with higher current load and is particularly relevant for Coin Cells due to their comparatively high internal resistance. CCV is therefore a critical parameter for real-world application performance, especially under pulse or peak load conditions.

The following relationship applies: as soon as a load draws a current I, the terminal voltage decreases due to the internal resistance R_int:
$V_{Load} \approx V_{OCV} - I \cdot R_{int}$

- Low, steady loads (e.g., a few µA up to several hundred µA)→ the delivered voltage remains close to the OCV, enabling nearly full utilization of the capacity
- Pulsed loads (e.g., several tens to hundreds of mA for wireless transmission) → lead to temporary voltage drops. If the voltage falls below the minimum operating voltage of the device, the system may fail (“brown-out”) unless appropriate countermeasures are implemented

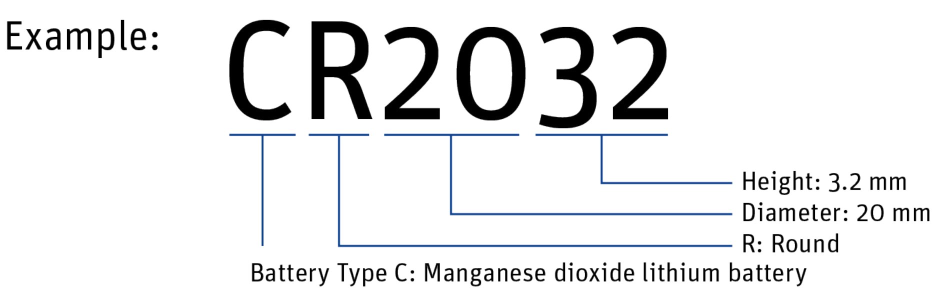
Design tip (pulse management)

- Add a reservoir capacitor (low ESR) across the supply rails to support pulse current.
- Consider derating for low temperatures, as R_{int} increases in the cold, leading to greater pulse-induced voltage sag.
- Validate performance with application-specific pulse profiles (peak current, duration, and repetition rate).

3. Characteristics of Coin Cells

Standard Lithium Coin Cells

Standard Lithium Coin Cells of the CR type are based on Lithium Manganese Dioxide (Li/MnO_2) chemistry and provide a stable nominal voltage of 3.0 V with very low self-discharge. They offer a capacity range of 25 mAh to 1,000 mAh, with diameters from 10 mm to 30 mm and heights from 1.6 mm to 7.7 mm, and are designed for a wide operating temperature range of –30 °C to +85 °C. These cells are optimized for long-life, low-power electronics and are ideally suited for applications requiring a compact power source with high reliability and extended operating lifetime.



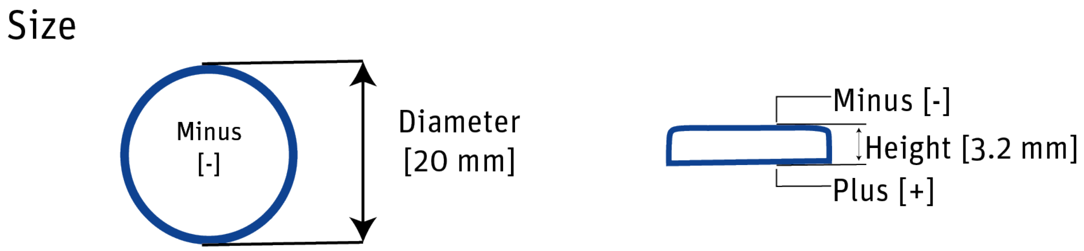


Figure 4: Example: CR2032 Jauch (IB) | Jauch MAT: 245785

3.1 Product portfolio

MODEL	VOLTAGE (V)	CAPACITY (mAh)	DIAMETER (mm)	HEIGHT (mm)	WEIGHT (g)
CR1025	3.0	30	10.0	2.5	0.7
CR1216	3.0	25	12.5	1.6	0.7
CR1220	3.0	38	12.5	2.0	0.8
CR1225	3.0	50	12.5	2.5	0.9
CR1616	3.0	50	16.5	1.6	1.2
CR1620	3.0	70	16.0	2.0	1.3
CR1632	3.0	140	16.0	3.2	2.0
CR2016	3.0	80	20.0	1.6	2.0
CR2025	3.0	150	20.0	2.5	2.6
CR2032	3.0	245	20.0	3.2	3.2
CR2320	3.0	130	23.0	2.0	3.0
CR2325	3.0	190	23.0	2.5	3.3
CR2330	3.0	260	23.0	3.0	4.0
CR2335	3.0	300	23.0	3.5	4.3
CR2354	3.0	560	23.0	5.4	6.9
CR2430	3.0	270	24.5	3.0	4.5
CR2450	3.0	620	24.5	5.0	6.9
CR2477	3.0	1.000	24.5	7.7	10.5
CR3032	3.0	500	30.0	3.2	6.8

* All models have a temperature range of -30°C to +85°C
Table 1:Standard CR Cells (Li/MnO_2) from the Jauch Quartz GmbH portfolio

High-Temperature Lithium Coin Cells

High-Temperature Lithium Coin Cells of the CR HT series are based on optimized Lithium Manganese Dioxide (Li/MnO_2) chemistry and are designed for an extended operating temperature range of –40 °C to +125 °C. With capacity levels ranging from 120 mAh to 550 mAh and diameters between 16 mm and 24.5 mm, these cells deliver a stable 3.0 V supply even under thermally demanding conditions. These cells are specifically engineered for applications requiring reliable, long-term performance in extreme environments – including industrial sensing, automotive modules (e.g., TPMS/ETC), and high-temperature IoT systems.

MODEL	VOLTAGE (V)	CAPACITY (mAh)	DIAMETER (mm)	HEIGHT(mm)
CR1632JHT	3.0	120	16.0	3.2
CR2032JHT	3.0	200	20.0	3.2
CR2050JHT	3.0	350	20.0	5.0
CR2450JHT	3.0	550	24.0	5.0

* All models have a temperature range of -40°C to +125°C

Table 2: High Temperature CR Cells (Li/MnO_2) from the Jauch Quartz GmbH portfolio

Lithium Coin Cells for specific applications - Examples ESL (Electronic Shelf Labels)

The Lithium Coin Cell for Electronic Shelf Labels (ESL) is based on Lithium Manganese Dioxide (Li/MnO_2) technology and are optimized for energy-efficient operation of digital price tags. With a capacity of 620 mAh, a nominal voltage of 3.0 V, and an operating temperature range of –30 °C to +85 °C, they ensure a stable power supply for frequent wireless updates while maintaining extremely low standby currents. The CR2450 ESL form factor provides high energy density and extended replacement intervals – making it ideal for large-scale ESL infrastructures in retail environments or similar applications that require multi-year operation without battery replacement.

MODEL	VOLTAGE (V)	CAPACITY (mAh)	DIAMETER (mm)	HEIGHT (mm)	WEIGHT (g)
CR2450 ESL	3.0	620	24.5	5.0	6.9

*All models have a temperature range of -20°C to +70°C

Tabee 3: Application Specific CR Cells (Li/MnO_2) from the Jauch Quartz GmbH portfolio. Example: ESL Electronic Shelf Labels (digital price tags)

Rechargeable Coin Cells

Rechargeable Lithium Manganese Dioxide Coin Cells of the ML series combine a stable 3.0 V nominal voltage with the ability to undergo multiple charge/discharge cycles, making them ideally suited for long-life, low-power applications with intermittent energy demand. With capacity ranging from 18 mAh to 100 mAh, diameters from 12.5 mm to 24.5 mm, and an operating temperature range of –20 °C to +70 °C, ML Cells provide a compact, rechargeable energy source for systems requiring energy buffering or periodic recharging. Typical applications include RTC backup functions, energy buffering for intermittently operated IoT modules, and small electronic devices with occasional recharge requirements.

MODEL	VOLTAGE (V)	CAPACITY (mAh)	HEIGHT (mm)	DIAMETER (mm)
ML1220	3.0	18	2.0	12.5
ML2020	3.0	40	2.0	20.0
ML2032	3.0	65	3.2	20.0
ML2430	3.0	100	3.0	24.5

Table 4:ML - Rechargeable Li/MnO_2 Cell from the Jauch Quartz GmbH portfolio

Low Temperature Coin Cells

Low Temperature CR Cells (Li/MnO_2): are designed for operation down to −55 °C. They are well suited for Cold Chain applications such as temperature loggers, asset trackers, and sensors used in refrigerated or deep-freeze logistics environments. *By request only.*

Matrix of Tabbed Lithium Coin Cells

This matrix is a quick-reference guide to help you select the right tab configuration for your device and assembly process. It brings together the most common options for tabbed Lithium Coin Cells – mounting orientation (horizontal or vertical), lead style (2-pin, 3-pin, SMD gull wing, through-hole).

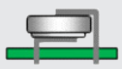
MOUNTING TYPE	MOUNTING DIRECTION	DESCRIPTION	TAB SPEC			
			Description			
Trough-hole	Horizontal assembly	H 	H2 Two Pins	H2B Two Pins	H3 Three Pins	H3B Three Pins
Trough-hole	Vertical assembly	V 	V2 Two Pins	V2B Two Pins	V3 Three Pins	V3B Three Pins
Surface Mounting	SMD assembly	SM 	SM Tabs on each side	SMB Both tabs on one side		

Table 5: Examples of Tabbed Lithium Coin Cells options

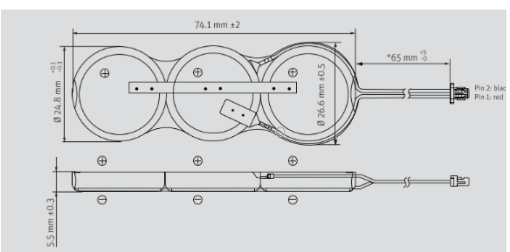


Figure 5: Customized example: CR 2450J 1s3P

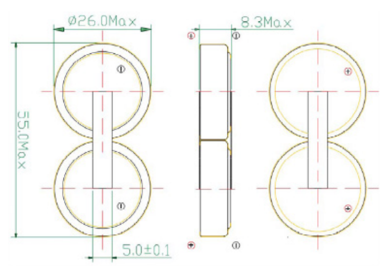


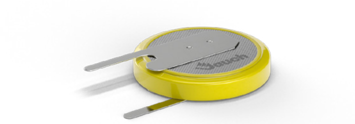
Figure 6: Customized example: CR 2450J 1s2P

Coin Cell with Tabs

These tables present a concise overview of our available Coin Cells with tabs. Each entry lists the cell size, tab style (2-pin, 3-pin, SMD or through hole), and mounting orientation (horizontal or vertical). Use these tables to match your PCB footprint, height constraints, and assembly method; if a variant isn't shown, custom tab configurations are available on request.

Vertical mounting:

with 2 Pins, through-hole mounting



V2 Type

with 3 Pins, through-hole mounting

V3 Type

MODEL	VOLTAGE (V)	CAPACITY (mAh)	DIAMETER (mm)	HEIGHT (mm)	CONFIGURATION
CR1025 V2	3.0	30	10.0	2.5	2 pins vertical / through hole mounting
CR1220 V2	3.0	40	12.5	2.0	2 pins vertical / through hole mounting
CR2032 V2	3.0	240	20.0	3.2	2 pins vertical / through hole mounting
CR2032 V3	3.0	240	20.0	3.2	3 pins vertical / through hole mounting
CR2450 V3	3.0	610	24.5	5.0	3 pins vertical / through hole mounting
CR2477 V3	3.0	1.000	24.5	7.7	3 pins vertical / through hole mounting

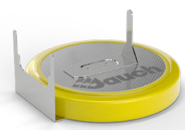
Table 6: Standard CR Cells (Li/MnO_2) vertical tab options from the Jauch Quartz GmbH portfolio

Horizontal Mounting:

with 2 Pins

H2-Type

with 3 Pins



H3-Type

MODEL	VOLTAGE (V)	CAPACITY (mAh)	DIAMETER (mm)	HEIGHT (mm)	CONFIGURATION
CR1225 H2	3.	48	12.5	2.5	2 pins horizontal/ through hole mounting
CR1632 H2	3.0	135	16.0	3.2	2 pins horizontal/ through hole mounting
CR1632 H2B	3.0	135	16.0	3.2	2 pins horizontal/ through hole mounting
CR2032 H2	3.0	240	20.0	3.2	2 pins horizontal/ through hole mounting
CR2032 H2B	3.0	240	20.0	3.2	2 pins horizontal/ through hole mounting
CR2032 H3	3.0	240	20.0	3.2	3 pins horizontal/ through hole mounting
CR2032 H3B	3.0	240	20.0	3.2	3 pins horizontal/ through hole mounting
CR2450 H3	3.0	610	24.5	5.0	3 pins horizontal/ through hole mounting
CR2450 H3B	3.0	610	24.5	5.0	3 pins horizontal/ through hole mounting
CR2477 H2B	3.0	1.000	24.5	7.7	2 pins horizontal/ through hole mounting

Table 7: Standard CR Cells (Li/MnO_2) horizontal tab options from the Jauch Quartz GmbH portfolio

Horizontal Mounting:

SMD-Mounting with 2 Pins

SMD-Type

MODEL	VOLTAGE (V)	CAPACITY (mAh)	DIAMETER (mm)	HEIGHT (mm)	CONFIGURATION
CR1216SM	3.0	30	12.0	1.6	Surface Mounting
CR1220SM	3.0	40	12.5	2.0	Surface Mounting
CR1225SM	3.0	48	12.5	2.5	Surface Mounting
CR1620SM	3.0	75	16.0	2.0	Surface Mounting
CR1632SM	3.0	135	16.0	3.2	Surface Mounting
CR2016SM	3.0	85	20.0	1.6	Surface Mounting
CR2025SM	3.0	165	20.0	2.5	Surface Mounting
CR2032SM	3.0	240	20.0	3.2	Surface Mounting
CR2430SM	3.0	320	24.5	3.0	Surface Mounting
CR2450SM	3.0	610	24.5	5.0	Surface Mounting
CR2477SM	3.0	1.000	24.5	7.7	Surface Mounting

Table 8: Standard CR Cells (Li/MnO_2) SMD tab options from the Jauch Quartz GmbH portfolio

4. Electrical & Temperature performance

4.1 Reverse Current, Short-Circuit Behavior & Environmental Robustness of Coin Cells

Reverse (Backfeed) Current – Protecting Primary Cells:

Primary Lithium Coin Cells must never be recharged. Whenever a Coin Cell is connected to a system that also has an external power source (e.g., USB, mains adapter, energy harvester, supercapacitor, etc.), the design must prevent any current flowing from the system back into the cell.

Common protection approaches

- Two low-leakage silicon diodes in series: Minimize reverse leakage; the series configuration provides an extra safety margin.
- One low-leakage blocking diode + series resistor: The resistor limits any residual recharge current into the cell.
- Ideal-diode MOSFET stage: Provides very low forward loss and nA-level reverse leakage when properly chosen, useful when every µA matters.
- Avoid Schottky diodes for backfeed blocking unless you have verified their reverse leakage across temperature – they typically leak more than silicon diodes, especially above room temperature.

Short-Circuits – What to Expect & How to Test:

A short-circuit (even brief) can depolarize the electrodes and increase internal resistance. After removing the short, the open-circuit voltage recovers slowly; measuring the battery during recovery can falsely suggest a defect.

- Avoid intentional short circuits during development and production.
- Expect capacity loss and elevated impedance after severe or repeated short circuits.
- Use a ≥ 10 MΩ instrument for OCV checks and allow a rest period (e.g., 30–120 minutes at room temperature) before evaluation.
- Manufacturing note: Only cells specifically rated for soldering/reflow (e.g., SMD/high-temperature variants, or pre-tabbed cells) should undergo those processes. Standard loose cells are not intended for direct soldering.

Environmental & Mechanical Robustness

Modern CR Coin Cells use corrosion resistant steel cans, high-integrity crimp seals (or equivalent), and organic electrolytes with low creep, yielding excellent leakage resistance and reliable performance in any orientation.

Quality programs typically include accelerated stress tests such as:

- High-temperature storage
- High-temperature/high humidity storage
- Thermal cycling and vibration (per product family standards)

As always, verify operating temperature and storage limits in the specific cell datasheet – standard CR types are typically qualified around −30 °C to +85 °C, while specialized high temperature CR versions exist for harsher environments (e.g., −40 °C to +125 °C, depending on the part).

> **NOTE:** Consider increased self-discharge at higher temperature; important for capacity calculation for expected lifetime.

Design Tip

√ Validate pulse loads (closed-circuit voltage at the cold corner)

√ Enforce no-charge conditions for primary cells in both hardware and firmware

√ Document measurement procedures (rest time, instrument impedance, etc.)

4.2 Passivation phenomena

Lithium Reactivity, Electrolytes, and Passivation in Primary Coin Cells:

Elemental Lithium is highly reactive and will readily interact with moisture, oxygen, and many solvent systems. For years this reactivity limited practical battery designs because metallic Lithium tended to attack common electrolytes. Broad commercial adoption became feasible once aprotic organic electroly-tes were introduced in the 1980s, which enable the formation of a protective interphase on the Lithium surface.

The solid-electrolyte interphase SEI

When a Lithium metal anode first meets a compatible organic electrolyte, the surface undergoes a controlled reaction that forms a thin, ion-conductive, solid-electrolyte interphase (SEI).

- This film blocks further parasitic reactions between electrolyte and Lithium while still allowing Li^+ transport.
- The SEI's mechanical integrity and chemical composition are critical to long-term stability, shelf life, and the voltage profile under load.

What determines a good SEI?

- Electrolyte recipe: Solvent blend, Lithium salt, and additives
- Cell design and manufacturing conditions: Moisture control, electrode surface state, and sealing quality.
- Initial conditioning ("formation"): Many manufacturers apply a controlled, shallow discharge – only a small percentage of theoretical capacity – to create a uniform, resilient SEI before shipment. The exact parameters are tailored to the chemistry and size.

Behavior of Li/MnO_2 (CR) vs. Other Primary Lithium Systems

In Lithium Manganese Dioxide (Li/MnO_2, "CR") Coin Cells, once the SEI is properly established during production, its thickness and properties remain comparatively stable over typical storage periods – even after long room-temperature storage or brief exposures to elevated temperature within specification. As a result, CR Cells generally maintain good pulse capability without special conditioning by the end user.

By contrast, several liquid-cathode primary systems (e.g., $LiSO_2$, $LiSOCl_2$, $LiSO_2Cl_2$) are more prone to progressive passivation during storage, especially after exposure to high-temperatures. This thicker surface layer can temporarily raise internal resistance and cause a "voltage delay" when a high pulse is demanded immediately after idle storage. In those chemistries, designers sometimes apply a continuous micro-load or a brief pre-step in application to reduce the initial impedance before critical pulses. For CR systems, such precautions are typically unnecessary.

Practical Implications for Design & Validation

- **Pulse performance:** Verify loaded voltage at the lowest operating temperature and after end-of-life conditioning. For CR Cells, expect stable first-pulse behavior when stored within specification.
- **Shelf life vs. temperature:** Keep storage within the manufacturer's limits to minimize side reactions. Elevated temperatures accelerate electrolyte/Lithium interactions in all systems.
- **Incoming inspection:** Monitor open-circuit voltage, impedance (if available), and visual seal integrity; avoid moisture exposure.
- **No "reviving" primary cells:** Heating or charging primary Lithium Cells is unsafe and can damage the SEI, compromising safety and performance.
- **Document formation assumptions:** If your qualification plan depends on immediate high-pulse performance, confirm the cell's factory formation process with the supplier and replicate worst-case storage before testing.

Bottom line: A well-formed SEI is the cornerstone of long shelf life and reliable pulse performance in primary Lithium Cells. Li/MnO_2 (CR) Coin Cells are engineered so that their passivation state remains stable over time, whereas certain liquid-cathode systems may require pre-loading strategies to overcome voltage delay after storage.

5. Typical packing options for Coin Cell Batteries

Below are our standard packaging formats for Coin Cells. Each option supports efficient handling and safe transport, with clear lot and date codes.

Industrial Bulk – Multi-Cell Plastic Trays

Figure 7: Industrial Bulk (IB) – multi cell plastic tray

Packaging code: IB

- **Description:** Factory/OEM format with cells placed in dedicated cavities to prevent contact. Trays are stacked and shrink wrapped for stability and efficient line-side loading.

- **Counts:** Tray and carton quantities depend on the cell size and height.

Secure, Child-Resistant Blister Pack

Figure 8: Secure Blister (SB)

Packaging code: SB

- **Description:** Tamper resistant blister packaging that requires tools or scissors to open. Designed to help prevent child access while ensuring long shelf life in retail or service channels.

- **Compliance note:** Aligns with child resistance requirements defined in IEC 60086-4 and, for the U.S. market, the Poison Prevention Packaging Act (16 CFR 1700.15) and Reese's Law labeling rules.

Trays for Tabbed/Pinned Cells (PCB Mount)

- **Description:** Reinforced trays or sleeves for cells with pre welded solder tabs or pins. The packaging maintains lead planarity, protects terminals, and supports both vertical and horizontal orientations (including SMD ready variants).

6. Notes on Handling, Safety and Transport

6.1 Soldering Guidelines for Coin Cells with Tabs/Pins

General Principles

- Only solder tabbed or pinned versions. Do not attempt to solder directly to the can or cap of a Coin Cell; tabs are factory spot-welded for this purpose.
- Keep the soldering heat localized to the tab or pin. Avoid touching the battery body with the soldering iron.
- Use a temperature-controlled station and keep dwell time short: ≤ 350 °C and ≤ 5 s per joint in the tab's solder area is a good upper limit. Allow a brief cool down between joints.

Hand Soldering (Through Hole / Tab Leads)

- Pre-tin the PCB pad and the tab end, then complete the joint quickly to minimize heat transfer into the cell.
- Do not bend tabs at the weld point. If forming is necessary, keep bends away from the weld and use a generous radius.
- Prefer no-clean, halide-free flux (e.g., ROLO). Avoid acidic/activated fluxes and aggressive cleaning that might wick solvents under the cell's seal.
- If possible, use a small heat shunt on the lead to limit heat conduction.

Reflow Soldering – Not Permitted for Primary Coin Cells

- Do not use reflow on primary Lithium Coin Cells (e.g., CR/BR). Reflow temperatures can soften the gasket and compromise the seal, risking leakage, venting, or ignition, and degrading performance.
- Only proceed with reflow if the manufacturer explicitly specifies a reflow-capable Coin Cell (rare, typically certain rechargeable coin chemistries). Otherwise, reflow is prohibited.

Wave Soldering (Pinned Cells Only)

- When the two terminals pass the wave, a brief short may occur via the solder. This is typically < 5 s and causes negligible capacity loss.
- After such a short, the open-circuit voltage usually rebound immediately to > 2.5 V, with full recovery to the pre-process value potentially taking hours to days. Keep this in mind when performing electrical checks immediately after soldering – the cell is generally stabilizing, not defective.
- Control the cell surface temperature during the wave; keep the battery below ~85 °C. Use fixtures/orientation to minimize thermal load and avoid multiple back-to-back passes without cooling.

Additional Recommendations

- Monitor temperature at the battery can, not just at the iron or the wave.
- Avoid ultrasonic cleaning and do not immerse the cell during board wash.
- Don't apply mechanical pressure or clamping loads to the cell body during assembly.
- Keep conformal coating away from safety vents/seals; follow the cell manufacturer's keep-out regions.
- For line qualification, document solder tip temperature, dwell, flux type, preheat profile, and measured cell temperature to ensure process repeatability.

6.2 Safety Guidelines for Lithium Coin Cells

Handling Instructions – Preventing Accidental Discharge

- Work on non-conductive surfaces. Do not place cells on conductive or semi-conductive materials (e.g., many ESD/antistatic mats, metallized bags, or metal trays).
- Remove cells one at a time. Keep batteries in their original trays until use; do not pour or "tip out" trays.
- Avoid cell-to-cell contact. When handling loose parts, ensure cells cannot touch each other. For tabbed cells, insulate the tabs (e.g., with Kapton® or PVC tape) until soldering or assembly.

6.3 General Safety & Precautions

1. Keep out of reach of children: Coin Cells pose a serious ingestion hazard. If swallowed or inserted, seek immediate medical attention.

2. Child-resistant product design: Battery compartments in consumer products should be secured (tool-openable or requiring two simultaneous actions) and clearly labeled.

3. No charging of primary cells: Design circuits to prevent charging or reverse charging of primary Lithium Coin Cells (use blocking diodes or equivalent isolation).

4. Observe correct polarity: Insert cells matching the (+/−) markings; include reverse-polarity protection where feasible.

5. Do not heat, crush, puncture, or disassemble. Never incinerate.

6. Replace as a set: Do not mix new and used cells, different chemistries, grades, or brands in one device.

7. Prevent short circuits: Keep cells away from metal objects and tools; do not store loose cells in bulk.

8. No direct soldering to the can: Only solder tabbed or pinned versions. Keep heat localized with short dwell times (e.g., ≤ 350 °C for ≤ 5 s at the tab).

9. Temperature & environment: Avoid high temperatures, moisture, and direct sunlight.

10. Insulate tabs for disposal/transport: Wrap solder tags or leads to prevent accidental contact.

11. Welding cautions. Improper spot-welding can damage internal components.

12. No reflow soldering for primary Coin Cells. Reflow temperatures can deform gaskets and lead to leakage or venting.

Storage & Transport

- Store in original packaging in a cool, dry place (typ. 0–30 °C, moderate RH). Avoid condensation.
- FIFO (first-in, first-out) to maintain freshness; verify open circuit voltage (OCV) and visual condition at incoming inspection.
- Transport only in packaging that prevents short circuits and complies with applicable Lithium-metal shipping regulations (e.g., UN 38.3 tested cells; IATA/ICAO, IMDG, ADR as applicable).

Preventing Quality Issues – Practical Tips

- **Incoming inspection:** Check lot and date code, OCV within specification, and absence of dents, corrosion, or seal damage.
- **Process control:** Record soldering temperature, dwell, flux type, and measured cell surface temperature during line qualification.
- **Cleaning:** Do not immerse cells or expose them to ultrasonic cleaning. Keep solvents away from the cell seal and safety vents.
- **Post-assembly checks:** Allow cells to thermally stabilize before voltage or pulse tests. After any brief process short (e.g., during wave soldering of pinned cells), OCV typically recovers quickly; full recovery to initial OCV may take longer – this alone does not indicate a defect.

Incident Response & End-of-Life

- If leakage occurs: Avoid contact with skin and eyes; use appropriate PPE and rinse affected areas with water. Leaking cells need to be disposed of properly.
- Recycling/Disposal: Follow local regulations. Insulate terminals before disposal and route cells to approved recycling streams.

! **In short:** keep cells isolated from conductive surfaces, handle one at a time, never short or heat them, only solder via tabs with controlled heat, and design products to prevent charging and child access.

7. Typical Applications

CR Coin Cells (Lithium Manganese Dioxide) are widely used in a broad range of modern applications that require compact form factors, high energy density, and long-term stable electrical performance. With a nominal voltage of 3.0 V, low self-discharge, and reliable performance in both low- and high-impedance load scenarios, they are ideally suited for long-life, low-power electronics. The following application areas highlight the technical versatility of this Battery type.

IoT Devices and Connected Sensor Nodes

In the Internet of Things environment, Coin Cells are integrated into compact sensing and communication modules that often operate continuously for several years. Typical electrical profiles include extremely low standby currents in the microampere range, combined with short-duration pulse currents for wireless transmissions (e.g., BLE packets in the tens of milliamps range). CR Coin Cells provide a stable voltage supply throughout the entire discharge curve. Applications include environmental and motion detectors, door and window sensors, mini-beacons, smart labels, and consumption or usage loggers.

Wearables and Medical Devices

Wearables and medical applications require power sources with high reliability, predictable discharge behavior, and low weight. CR Coin Cells meet these requirements with robust cell chemistry, stable output voltage, and a wide operating temperature range suitable for both daily use and medical environments. Typical devices include digital thermometers, blood glucose monitoring systems, portable diagnostic modules, and compact fitness and activity sensors. Voltage stability is maintained even under recurring measurement cycles and short pulse loads.

Automotive Smart Keys and Sensor Systems

Electronic vehicle keys place high demands on temperature resistance, pulse capability, and long-term reliability. Smart Keys typically operate with very low standby currents but generate short bursts of higher pulse loads for RF transmission. CR Coin Cells reliably support these load profiles and maintain stable pulse performance even at low ambient temperatures.
Additionally, specialized variants are used in automotive sensor and monitoring units where compact size and reliable voltage delivery are critical.

Industrial Sensor Nodes and Smart Home Devices

In industrial environments, Coin Cells are used in wireless sensors, switches, and monitoring units that must operate maintenance-free for years. The low self-discharge of Li/MnO_2 Cells enables long standby times, while the mechanically robust metal housing and temperature resistance ensure reliable operation even under demanding environmental conditions.
Applications include vibration and condition monitoring, wireless control and switching modules, humidity or leakage sensors, and compact Smart Home devices.

Asset Tracking (BLE, RFID, GPS Mini Trackers)

Tracking systems require extremely compact energy sources capable of delivering stable performance over long periods. CR Coin Cells offer a high energy density, a flat discharge curve, and the ability to supply recurring pulse currents for wireless communication. This makes them ideal for BLE beacons, RFID tags, and miniature GPS systems. Their robust design ensures reliable operation under temperature fluctuations and mechanical stress in mobile use cases, enabling multi-year autonomous operation in logistics and industrial environments.

Animal Identification and Access Systems

Electronic animal identification and access control systems require compact, durable, and temperature-resistant power solutions. CR Coin Cells are used in electronic animal ID transponders, smart collar systems, activity trackers, and automated access mechanisms such as pet doors. Their stable voltage profile and low self-discharge ensure dependable performance even under irregular load conditions or outdoor use.

Watches, Toys, and Conventional Consumer Devices

Many consumer devices require extremely low continuous currents combined with very long operating lifetimes and high reliability. CR Coin Cells deliver consistent energy over years in applications such as wristwatches, calculators, small toys, remote controls, and LED-based devices. They are also used as backup Batteries in computer motherboards for real-time clocks (RTC) and BIOS memory, where they maintain a nearly constant voltage even under very low load conditions.

8. Battery Technology at Jauch

Founded in 1954, Jauch Quartz GmbH has been active in the battery industry since 1976. The company has increasingly specialized in Lithium Battery technology and has continuously expanded its product portfolio in this area.
Whether standard batteries or application-specific developments - Jauch has a wide range of primary Lithium Batteries and rechargeable battery systems. Many of the products are available directly from stock.

In-House Test and Certification Center

Jauch's new test and certification center in Villingen-Schwenningen supports companies in the safe market launch of Lithium Batteries. In the new test laboratory, cells and batteries can be comprehensively tested and certified - either directly or in cooperation with renowned, accredited test laboratories to meet standards such as UL, PSE, KC and CCC.
In addition to individual tests, Jauch conducts all assessments required for the United Nations transport test UN38.3, as well as for IEC 62133, the key safety standard for rechargeable batteries issued by the International Electrotechnical Commission (IEC). These comprehensive testing and certification services provide companies with a reliable foundation for marketing their products globally.

Quality and Environmental Standards

Jauch is certified to DIN EN ISO 9001:2015 and the company's environmental management system is certified to ISO 14001. As a result, its Batteries and Battery packs meet the highest international production and quality standards. All products comply with RoHS and REACH regulations and are free from lead and conflict minerals.

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