Panasonic ENERGY
Energy that changes the future.

High-Temperature-Resistant Coin Type Lithium Primary Batteries for IoT Applications

In recent years, developed countries have been facing increasingly severe labor shortages due to declining birthrates and population aging. This challenge is particularly pronounced in industries that require demanding on-site work, such as factories and plants, construction, logistics, and infrastructure maintenance. To address these issues, the digital transformation of field operations through IoT is progressing. With advances in communication, cloud technologies, and AI, continuous monitoring with sensors and data-driven predictive maintenance enables high productivity even with a smaller workforce.

1. Challenges of Weather Resistance in Industrial IoT Devices

Industrial IoT devices are precision instruments and therefore require not only waterproofing and dust protection but also robust resistance to high and low ambient temperatures and sudden temperature fluctuations. In addition, as device functionality increases, processing loads rise, leading to greater heat generation from electronic components. Combined with continued device miniaturization, this trapped heat can compromise operational stability. As a result, device designs must withstand both external temperature variations and internal heat buildup.

2.Use Cases Requiring Weather Resistance in Industrial IoT Devices

2-1. IoT Devices for Outdoor Infrastructure Monitoring

To address the aging of social infrastructure, such as bridges, roads, dams, and water pipelines, the adoption of strain and vibration sensors to detect structural degradation is increasing. In the area of natural disaster mitigation, accelerometers and tilt sensors used for landslide detection are also gaining attention. These sensors require wide temperature tolerance to ensure stable operation under harsh environmental conditions, including direct sunlight in extreme heat and freezing temperatures. Additionally, strong waterproofing and moisture resistance are essential to withstand rain, humidity, and other exposure to the elements.

Figure 1. Example Use Cases: Strain and Vibration Sensors for Bridges, Vibration Sensors for Water Pipelines, and Landslide Monitoring Sensors

2-2. IoT Devices for Plant Equipment Monitoring

In power generation, chemical, and steel plants, equipment such as turbines, furnaces, boilers, and piping operate at high temperatures. As a safer alternative to hazardous visual inspections, wireless sensors that measure temperature, vibration, and flow rate are increasingly being utilized. Since these sensors are often installed directly on the equipment being monitored, they must operate reliably even under high-temperature conditions.

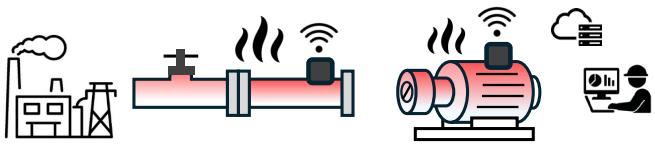

Figure 2. Example Applications of IoT Sensors Mounted on Pipes and Power Generation Turbines

2-3. IoT Devices for Cold-Chain Logistics

In cold-chain logistics for pharmaceuticals, food products, and other temperature-sensitive goods, GPS trackers play an important role in tracking locations, while temperature sensors are essential for monitoring cargo conditions. These sensors must exhibit high reliability, capable of stable operation over extended periods in low-temperature environments and under repeated exposure to large temperature differentials, such as when moving between freezers and ambient outdoor air.

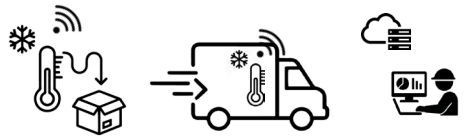

Figure 3. Example Applications of IoT Sensors in Cold-Chain Logistics

2-4. Other Applications Beyond IoT

Coin-type batteries are used on printed circuit boards (PCBs) in servers and in automotive ADAS/AD systems to retain time data when the main power supply is turned off. In recent years, the rapid expansion of AI has driven the need for increasingly high processing loads on PCBs, making heat generation a critical issue. As a result, coin batteries mounted on these boards must offer high reliability, maintaining stable performance over long periods, even under elevated temperatures.

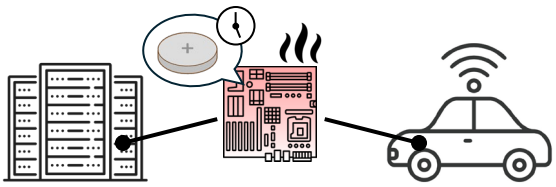

Figure 4. Coin-Type Battery Used for Time-Data Backup on a Motherboard

3. Panasonic Energy's High-Temperature-Resistant Coin-Type Batteries

Panasonic Energy offers a wide lineup of coin-type batteries designed for IoT applications. In addition to standard models (operating temperature range: –30°C to 85°C), the portfolio includes high temperature resistant types (–40°C to 125°C) that can operate reliably across a broad range of environmental conditions, regardless of installation location or seasonal variations.

Table 1. Lineup of Panasonic Energy CR Lithium Coin Primary Batteries

Type	Model	Normal Capacity (mAh)	Continuous Standard Load (mA)	Dia. (mm)	Height (mm)	Approx. Weight (g)	Operating Temp. (℃)
Standard	CR1025	30	0.1	10.0	2.5	0.6	-30~85
	CR1216	25		12.5	1.6	0.7	
	CR1220	35			2.0	0.9	
	CR1616	55		16.0	1.6	1.0	
	CR1620	75			2.0	1.3	
	CR1632	140			3.2	1.9	
	CR2012	55		20.0	1.2	1.4	
	CR2016	90			1.6	1.6	
	CR2025	165	0.2		2.5	2.3	
	CR2032	225			3.2	2.8	
	CR2330	265		23.0	3.0	3.7	
	CR2354	560			5.4	5.7	
	CR2412	100		24.5	1.2	2.0	
	CR2450	620			5.0	6.2	
	CR2477	1000			7.7	10.5	
	CR3032	500		30.0	3.2	6.9	
High-Temperature (Wide Temperature range)	CR2032A	210	0.2	20.0	3.2	3.0	-40~125
	CR2032B						-40~120
	CR2050A	345			5.0	4.1	-40~125
	CR2050B2						-40~120
	CR2450A	550	0.4	24.5		6.2	-40~125
	CR2450B	560					-40~105

Figures 5 and 6 present the high-temperature test results for a standard CR coin cell and our high-temperature-resistant model. The standard battery exhibits a rapid increase in internal resistance and a sharp drop in voltage within several tens of hours after storage begins at 125 °C, making continued use difficult. In contrast, our product maintains stable operation for more than approximately 200 hours, with minimal changes in both resistance and voltage.

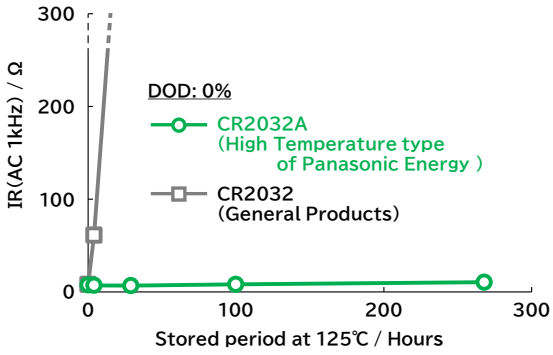

Figure 5. Changes in Internal Resistance During the 125 °C Storage Test for the Standard Model and Our High-Temperature-Resistant Battery

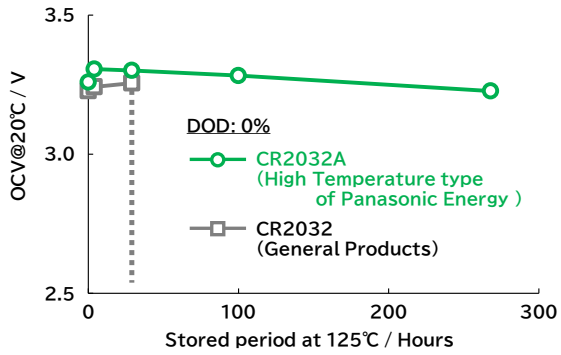

Figure 6. Changes in Voltage During the 125 ℃ Storage Test for the Standard Model and Our High-Temperature-Resistant Battery

A typical CR coin cell deteriorates under high-temperature conditions due to gas generation inside the battery. In contrast, our high-temperature-resistant model employs proprietary technologies that suppress gas formation within the cell, enabling stable operation even in harsh environments. Figure 7 shows the pulse-discharge characteristics of a standard CR coin cell and our high-temperature-resistant battery at −20 ℃. Owing to a proprietary anode formulation, our product maintains a stable voltage comparable to that at room temperature, even at a depth of discharge of 80%, outperforming the standard model.

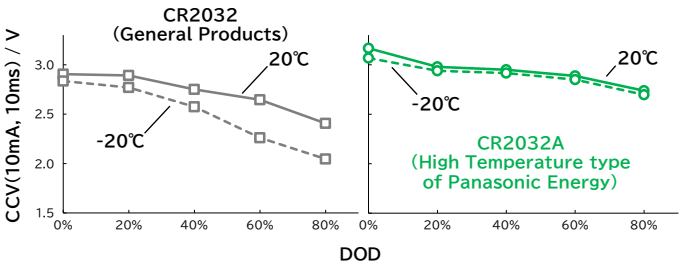

Figure 7. Pulse-Discharge Characteristics at Room Temperature and Low Temperatures

As shown above, our high-temperature-resistant battery delivers outstanding reliability across a wide temperature range. In addition, its advanced sealing technology provides superior humidity resistance, making it an optimal power source for IoT devices operating in harsh environments.

4. Globally Stable Supply Chain

Panasonic Energy operates multiple production and material-procurement sites for battery materials, cells, and battery packs, enabling us to supply products reliably over extended periods through an efficient and stable global supply chain. Furthermore, with sales offices located worldwide, we can engage in detailed, locally based communication with our customers. Panasonic Energy supports convenient, comfortable daily living through consumer batteries and contributes to social infrastructure across diverse sectors—as well as to the automotive industry, including EV applications —thereby helping to realize a sustainable society in which enriched lifestyles and environmental responsibility coexist harmoniously.

■ If you have any questions about this document, please contact the following:
Global Network for Business - Business - Panasonic Energy Co., Ltd.

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