



# Smart Energy Partner



FDK group, as a Smart Energy Partner, assemble advanced technologies, would like our customers to best utilize electric energy in a safe and efficient manner, and contribute to materialization and development of sustainable society.



# Technology System Diagram

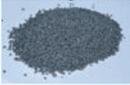
## Ceramic and powder technology



Hydrogen storage alloys



Grinded toners



Magnetic material

## Battery technology



Lithium batteries



Alkaline batteries

Ni-MH batteries

## Electronics technology



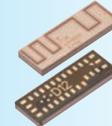
System power supplies



Power supplies

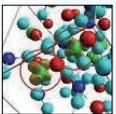


Sensors

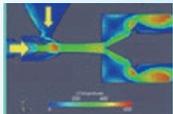


Small resin packaged modules

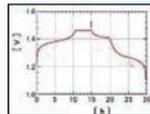
## Apply CAE to all tiers



Material



Powder process



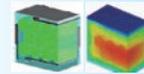
Prediction of battery charge/discharge characteristics



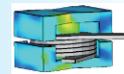
Battery sealing process



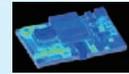
Power supply module  
Thermal and fluid flow analysis



Electricity storage module  
Thermal and fluid flow analysis

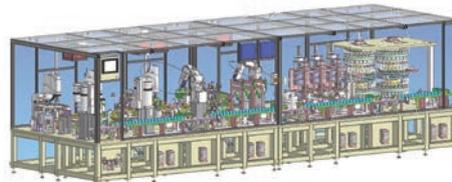


Core magnetic field  
Heat generation



Thermal and fluid flow analysis  
Thermal and fluid implementation

## Applied to manufacturing and inspection equipment



Factory automation equipment

# Japan/Overseas facilities



### BAOTOU FDK CO., LTD. (China)

Manufacture/Development

Battery materials, Rare earth alloys, Magnetic materials



### Takasaki Plant (Gunma Prefecture)

Manufacture/Development

Ni-MH batteries, Battery system



### Tottori Plant (Tottori Prefecture)

Manufacture/Development

Lithium batteries



### Kosai Plant (Shizuoka Prefecture)

Manufacture/Development

Customized modules, Power supplies, Grinded toners, All-solid-state batteries, Next generation batteries (Development only)



### FUCHI ELECTRONICS CO., LTD. (Taiwan)

Manufacture/Development

Customized modules



### Washizu Plant (Shizuoka Prefecture)

Manufacture/Development

Alkaline batteries



### FDK ENGINEERING CO., LTD. (Shizuoka Prefecture)

Manufacture/Development

Facilities & Equipment

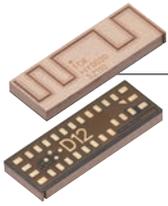


### XIAMEN FDK CORPORATION (China)

Manufacture

Customized modules, Power supplies, Ni-MH & Lithium battery packs assembly

# FDK Table of Contents



## ELECTRONIC MODULES

P 5

We provide high-quality products that meet our customers' needs with a one-stop solution, from design, development, parts procurement to mounting and assembly inspection, and follow-through service.

- Bluetooth® Low Energy Modules . . . . . P 7
- Microwave 24GHz Motion Detector Modules . . . . . P 9
- EMS/ODM Custom Modules . . . . . P11



## POWER SYSTEMS

P13

FDK provide solutions by customized and system power supply. We support customers improvement of competitiveness with our products that exceed performance and quality compared with general purpose power supply.

- Customized Power Supplies · System Power Supplies . . . . . P15



## Ni-MH BATTERIES

P17

Ni-MH batteries are a type of rechargeable battery. FDK Ni-MH batteries feature stable discharge voltage, high current discharge, are resistant to over-charge and over-discharge, and have excellent safety.



## LITHIUM BATTERIES

P27

Taking advantage of lithium metal's high capacity per unit mass in the negative electrode material, FDK's technology realizes a highly reliable and long-lasting power supply solution over a wide range of temperature conditions.



## ALKALINE BATTERIES

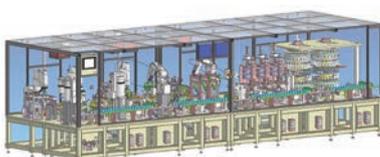
P37

Primary batteries with excellent power and long-lasting performance. Long duration for high power consumption equipment. FDK Alkaline batteries meet everyone's needs for various equipment with high reliability.



### JAPAN Quality

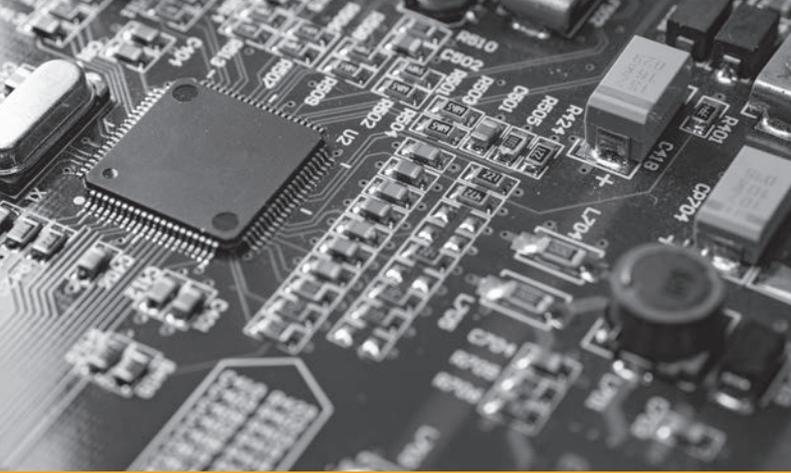
FDK is proud of its battery performance. All our batteries are manufactured using advanced technology from Japan and meet the highest quality standards. We are committed to delivering the safest and most reliable batteries in the world.



## FDK ENGINEERING

P43

FDK Engineering provides total support for our customers' equipment and machinery needs for automated production line, streamlining and automation, from design to manufacturing and final adjustments.



# ELECTRONIC MODULES

## Japan/Overseas facilities



**Kosai Plant (Shizuoka Prefecture)**  
 Manufacture/Development  
 Customized modules, Power supplies, Grinded toners, All-solid-state batteries, Next generation batteries (Development only)

**FUCHI ELECTRONICS CO., LTD. (Taiwan)**  
 Manufacture/Development  
 Customized modules

**XIAMEN FDK CORPORATION (China)**  
 Manufacture  
 Customized modules, Power supplies, Ni-MH & Lithium battery packs assembly

Designing, developing, and manufacturing various modules featuring high functionality, high density, small size, and light weight based on design technology (circuits, CAD), mounting technology, evaluation and analysis technology

## Solutions required for modules



### FDK's Technologies

#### Design

##### Circuit

- Analog circuit technologies
- Power circuit technologies
- High frequency and radio circuit technologies
- Wireless communication, sensing and antenna circuit technologies

##### Circuit board artwork design

- Rigid boards (Multilayer, Thin Plate)
- Flexible printed circuits
- Rigid flexible printed wiring boards

##### Printed circuit board assembly

- High-density mounting technologies (SMT)
- BGA small narrow pitch parts
- DIP parts
- Underfill applications
- Moisture-Proof surface coatings

#### Structure

- Resin packaging technologies
- Shielded resin packaging technologies

#### Manufacturing

- Process design technologies
- Metal mask designs
- Production of dedicated testing equipment
- Various jig designs

#### Evaluation analysis

- Antenna and radio device evaluation technologies
- CAE simulation
- Stress analysis
- SEM, EDAX analysis



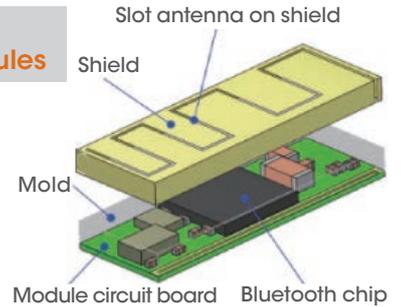
# World's smallest\*<sup>1</sup> Bluetooth® Low Energy modules with slot antenna on shielded package technology

## Three strengths of the FDK Bluetooth Low Energy modules

### 1 World's smallest all-in-one Bluetooth Low Energy modules

Dimensions: 3.5 x 10.0 x 1.0mm  
World's smallest Bluetooth Low Energy modules with three built-in features:

- 32 MHz crystal unit for main clock
- 32.768 kHz crystal unit for low power
- Passive component for power supply



### 2 The "slot antenna on shielded package" technology achieved the world's smallest occupied area on printed circuit boards

Featuring the world's smallest occupied PCB area among Bluetooth Low Energy modules. No large Keep Out Area is required, and the occupied PCB area is less than half that of conventional Bluetooth low energy modules.

#### Conventional Bluetooth Low Energy Modules

Since an antenna is placed on a module board, there is a Keep Out Area.

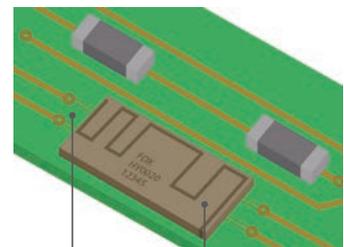


#### FDK Bluetooth Low Energy Modules

Being able to utilize the rest of the area effectively by placing the antenna on the package.



### 3 No prohibited wiring areas around the board makes flexibility of designing boards.



It is possible to wire around the module, on the inner layer, and back side.

\*Some of the area under the module is a Keep Out Area.

Bluetooth module

## Utilizing our module's characteristics of ultra small and light.

#### Data transfer

Sports (Motion analysis)  
Fitness (Exercise management)  
Computer peripheral devices and accessories (Behavior management)  
Health care



#### Location services

Tracker (Location management)  
Smart lock (Security management)



#### Device network

Network lighting (Operation control)  
Monitoring (Operation management)  
Electronic shelf tag (Operation management)  
FA facilities (Condition management)



Sensor data

New value

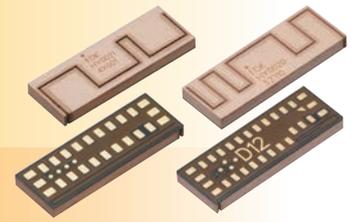
Big data

AI/Machine learning

AI

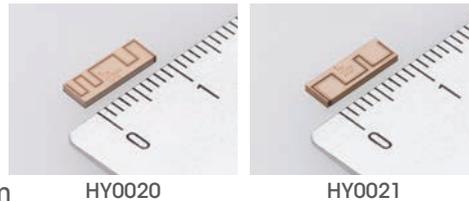
# Bluetooth® Low Energy Modules

World's smallest\*<sup>※1</sup> Bluetooth Low Energy module with slot antenna on shielded package technology



## Features

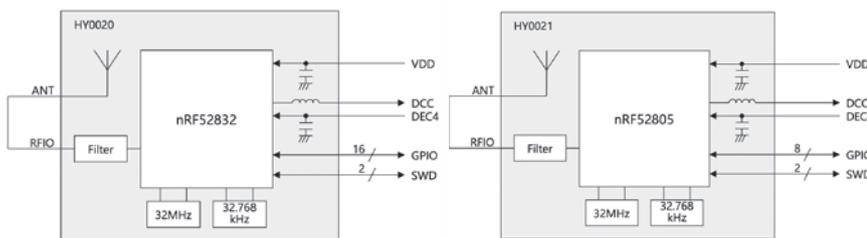
- Slot Antenna on Shielded Package
- Ultra-small module with slot antenna built into shielded package
- A large Keep Out Area is not required. Realizing world's smallest occupied PCB area.
- Bluetooth v5.4
  - Low energy 2Mbps
  - Maximum power: +4dBm
  - Sensitivity: -94dBm (1Mbps)
- Built-in LDO, DC/DC circuit
- Dimensions: 3.5 x 10.0 x 1.0mm
- Easy for PCB design based on maximum patterning flexibility
- Various certifications have been obtained



## Applications

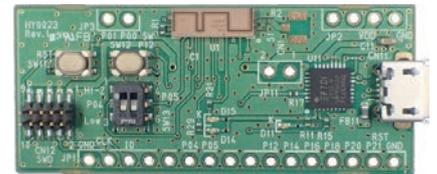
- Wearables
- Health care
- Remote controllers
- IoT
- Beacons
- Computer peripherals

## Block diagrams



## Evaluation boards

Please utilize these boards for the modules' characteristics and software development.



## Specifications

Product name	HY0020	HY0021
Bluetooth version	v5.4	v5.4
Built-in Bluetooth IC	Nordic nRF52832	Nordic nRF52805
CPU	Arm® Cortex®-M4 with FPU	Arm Cortex-M4
Memory	512KB Flash / 64KB RAM	192KB Flash / 24KB RAM
Number of GPIOs	16 (NFC, SPI, I2C, I2S, UART, PDM, QDEC, ADC)	8 (SPI, I2C, UART, QDEC, ADC)
High-speed clock (32MHz)	Built-in	Built-in
Low-speed clock (32.768kHz)	Built-in	Built-in
Operating Temperature range (°C)	-40 to +85	-40 to +85
Operating voltage range (V)	1.7 to 3.6	1.7 to 3.6
Dimensions (mm)	3.5 × 10.0 × 1.0	3.5 × 10.0 × 1.0
Package	29-Pin LGA	24-Pin LGA
Certification/qualification	Japan (MIC) U.S.A. (FCC) Canada (ISED) (ETSI EN300 328 V2.2.2) Bluetooth	Japan (MIC) U.S.A. (FCC) Canada (ISED) (ETSI EN300 328 V2.2.2) Bluetooth

\*1Our company research as of March 13, 2025

•FDK Corporation designs, manufactures and sells these modules under license of Slot Antenna on Shielded Package technology patented by Toshiba Corporation.

•The Bluetooth® word mark and logos are registered trademarks owned by Bluetooth SIG, Inc.

•Arm and Cortex are registered trademarks of Arm Limited (or its subsidiaries) in the US and/or elsewhere.

# Microwave 24GHz Motion Detector Modules

Can only be used in Japan



Doppler sensor using 24 GHz microwave  
Small, low height, Japan Radio Law Construction Design Certified

## Features

Can detect even through shielding such as resin, wood, glass, etc.  
Detectable even in high temperature environment.  
It is possible to discriminate the traveling direction (moving direction) and speed of the object.

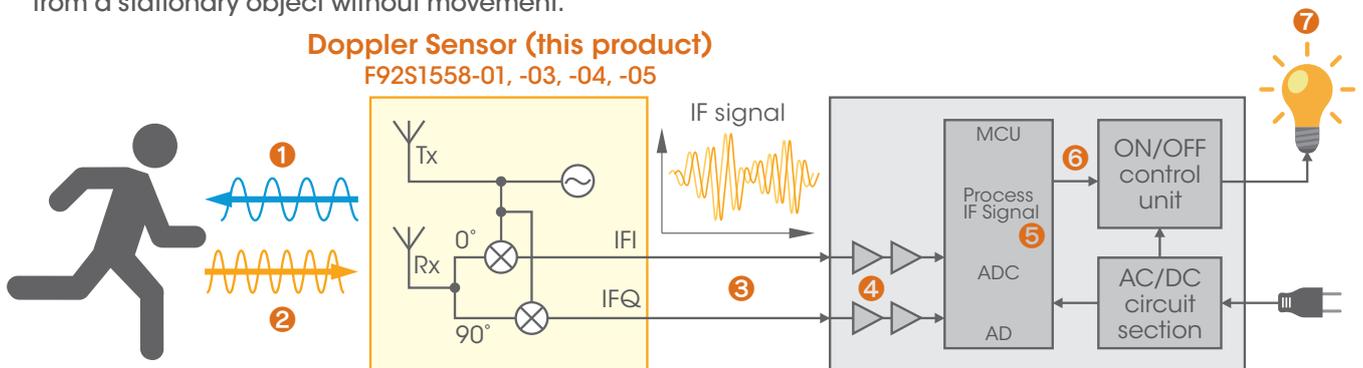
## Applications

- Automatic lighting
- Automatic doors
- Security devices
- Speed measurement systems
- Other equipment using motion sensors

## Example of use: A light with a motion sensor

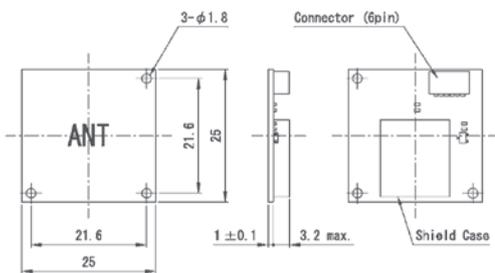
### Flow to detection

- 1 Sensing module emits 24 GHz radio wave
- 2 Receives radio waves reflected by a moving object
  - The strength of the reflected wave varies depending on the size and reflectivity of the object, as well as the distance to it.
- 3 Outputs IF signal corresponding to received reflected wave
  - Outputs an IF signal proportional to the strength of the received reflected wave.
  - IF signal is not output when reflected wave is received from a stationary object without movement.
- 4 Amplifies the IF signal to the desired magnitude
- 5 IF signal is processed in MCU
  - A threshold is set. Motion is detected when the IF signal level exceeds it.
- 6 Sends an ON signal from the MCU to the ON/OFF control unit
- 7 A light turns on



\*We also handle development and production of control boards.

## Outlines



Pin No.	Name	Description
1	VCC	Power supply 3.3V
2	IFQ	IFQ signal output
3	GND	Ground
4	IFI	IFI signal output
5	TX_ON	Output ON/OFF
6	Vctrl	Oscillator ON/OFF

## Specifications

Product name	F92S1558-01	F92S1558-05	F92S1558-03, 04
Transmission frequency	24.05 ~ 24.25GHz		
Detection method	Doppler method		
Antenna	4x1 Array Antenna	2x1 Array Antenna	1x1 Antenna
Transmission level (EIRP)	12.67dBm typ.	9.40dBm typ.	5.17dBm typ.
Power supply voltage	DC 3.3V		
Consumption current	46mA typ./55mA max.		
Operating temperature range	-40 ~ +85°C		
Dimensions	25mm × 25mm × 4mm		
Connector	Join Tech A1024WRA-S-06PNLNT1T00R	J.S.T. Mfg. SM06B-SHJH-TF(HF)	-03 J.S.T. Mfg. SM06B-SHJH-TF(HF) -04 Join Tech A1024WRA-S-06PNLNT1T00R

## Precautions when using the Bluetooth module and the Motion Detector Module

1. Our company strives to improve the quality and reliability of its products, but generally, semiconductor and storage products may malfunction or fail. When you use this product, it is your responsibility to carry out the necessary safety design for your hardware, software, and system (hereinafter referred to as the "Customer Product") to ensure that any malfunction or failure of this product will not cause injury to human life, body, or property. When designing your product, please review and follow the latest SPEC and technical data(Documentation, specifications, data sheets, application notes, etc.). In addition, when using product data, technical details, programs, algorithms, and other application circuit examples contained in these materials, please thoroughly evaluate the product with the customer's product and determine whether it is applicable at the customer's own risk.
2. This product is not intended for use in equipment that requires a particularly high level of quality and reliability, or in equipment whose failure or malfunction is likely to harm human life or body, cause enormous property damage, or have a serious impact on society (hereinafter referred to as "Specific Use"), and its suitability for Specific Use is not guaranteed. Specific applications include, but are not limited to, nuclear-related equipment, aerospace equipment, medical equipment, automotive and transportation equipment, train and marine equipment, traffic signal equipment, combustion and explosion control equipment, various safety-related equipment, lifting equipment, power equipment and financial equipment. Our company assumes no responsibility if this product is used for a specific purpose. If you wish to use this product for a specific purpose, please contact our company.
3. This product must be used within our company warranty as to maximum rating, operating voltage range and other conditions. Our company shall not be liable for any failure or accident caused by use exceeding the guaranteed value. In addition, even if the product is used within the warranty value, take system measures such as failsafe to prevent serious damage to human life, body or property due to a failure of the product.
4. This product is not designed for use in the following special environments. If you wish to use this product in these special environments, please contact our company.
  - (1) In liquids such as water, oil, chemicals, and organic solvents
  - (2) Exposure to direct sunlight, outdoors, in dust
  - (3) In a corrosive gas atmosphere
  - (4) Areas subject to unusually high temperatures, low temperatures, or high humidity
  - (5) Location close to heat generating equipment
  - (6) Place of strong magnetism
  - (7) Locations where the product may be exposed to dew condensation or freezing
  - (8) Environment exposed to radiation and cosmic rays
5. Do not disassemble, analyze, reverse engineer, modify, adapt or reproduce this product.
6. You may not use this product in products whose manufacture, use or sale is prohibited by laws, regulations and orders in Japan and abroad.
7. This product emits radio waves. Please check details and follow regional regulations.

# EMS/ODM Custom Modules

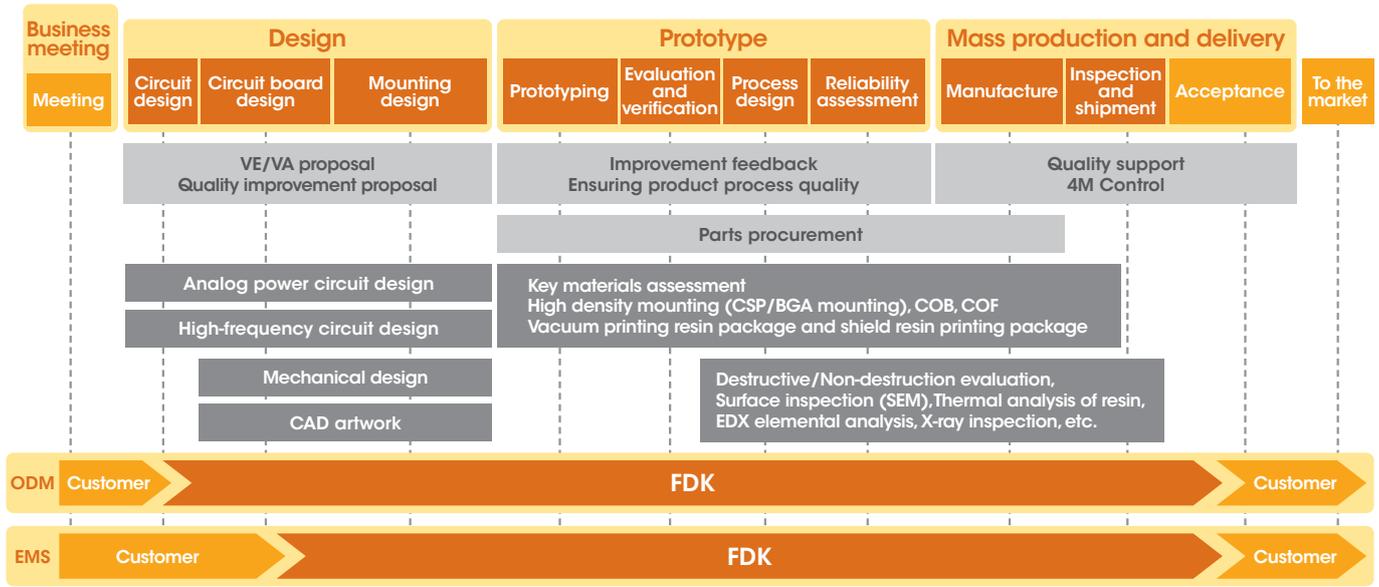
High-density mounting technology realizes compact and highly functional modules

Support from development/design to manufacturing of electronic devices. FDK provides total solutions to support your requirements.

Realization of product development and commercialization based on design (circuits, CAD), mounting, evaluation and analysis technologies.

Development of application products centered on "small and lightweight," "wireless," and "sensing."

Provide products and modules which are high-density, high-quality, high-value-added products according to technology-proposal-based design and development from the design stage.



## Technical proposal-based design and development Design technologies embodies your requests

- **Analog power circuit design** Mobility, Battery control, Security, Display control, etc.
- **High frequency circuit design** Communication module, Sensing module, Wireless module, Antenna technology
- **Mechanical design** Metal housing, Resin housing
- **CAD artwork design** Rigid circuit board (2-layer/Multi-layer/Build-up/Latest circuit board), FPC, aluminum substrate, etc.

## Realization of cutting-edge technologies and processes Evaluation and analysis technologies

- **Materials, methods, and structural technologies** Key materials assessment, High-density mounting (CSP/BGA mounting), COB, COF
- **Vacuum printing resin package and shield resin printing package**
- **Evaluation, Analysis technology** Destruction/Non-destructive evaluation, Surface inspection (SEM), Thermal analysis of resin, EDX elemental analysis, X-ray inspection, etc.
- **Global production system** 3 production sites :Kosai plant, FUCHI ELECTRONICS, and XIAMEN FDK (FUCHI ELECTRONICS and XIAMEN FDK hold ISO/IATF 16949 certification.)

### Resin package modules

- Contributing to space saving and weight reduction through miniaturization
- Achieving high-quality void-free resin sealing packages by vacuum printing methods.
- Achieving differentiation advantage through functional integration and commonality with built-in peripheral circuits
- Surface mountable modules



### Cost reduction proposal

- Suggest circuits and component replacements

### For total cost reduction by modularization

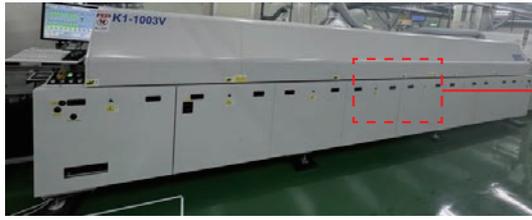
- Reduction of development effort through consolidation and commonality
- Total cost reduction by pitch conversion in modularization
- Reducing product certification costs and design evaluation time through module certification

## Production lines

We provide high-quality products that meet the needs of customers by establishing an automated integrated line from component mounting to various post-process.



SMT line



Vacuum type reflow oven



Inside the vacuum area



Testing-resin coating-curing integrated production line



Vacuum printing encapsulation systems



Automatic dicing saw



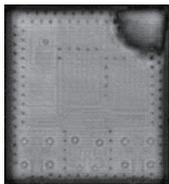
PCB separator



Underfill jet coating-curing integrated production line

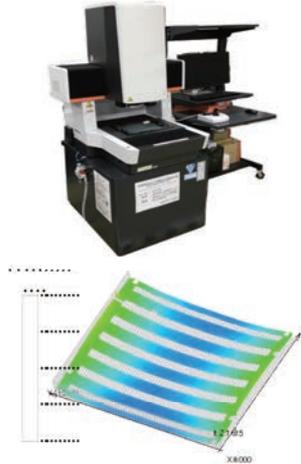
## Evaluation equipment

### Scanning acoustic tomography (SAT)



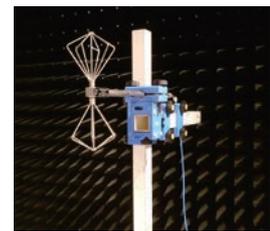
Observation of internal delamination of bare chips

### CNC vision measuring system

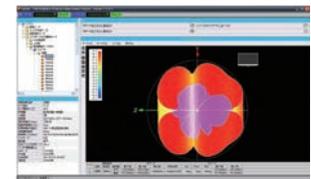


Warp analysis of printed circuit boards

### Antenna evaluation facility

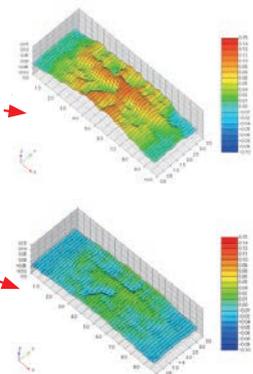
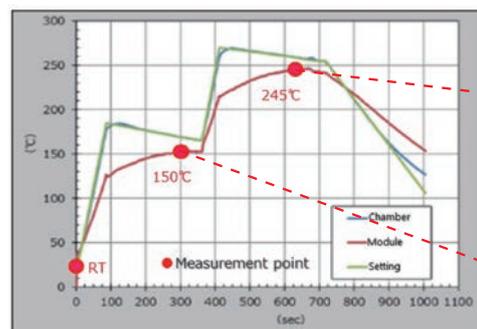


Anechoic chamber



Software for antenna evaluation

## Coplanarity measuring module

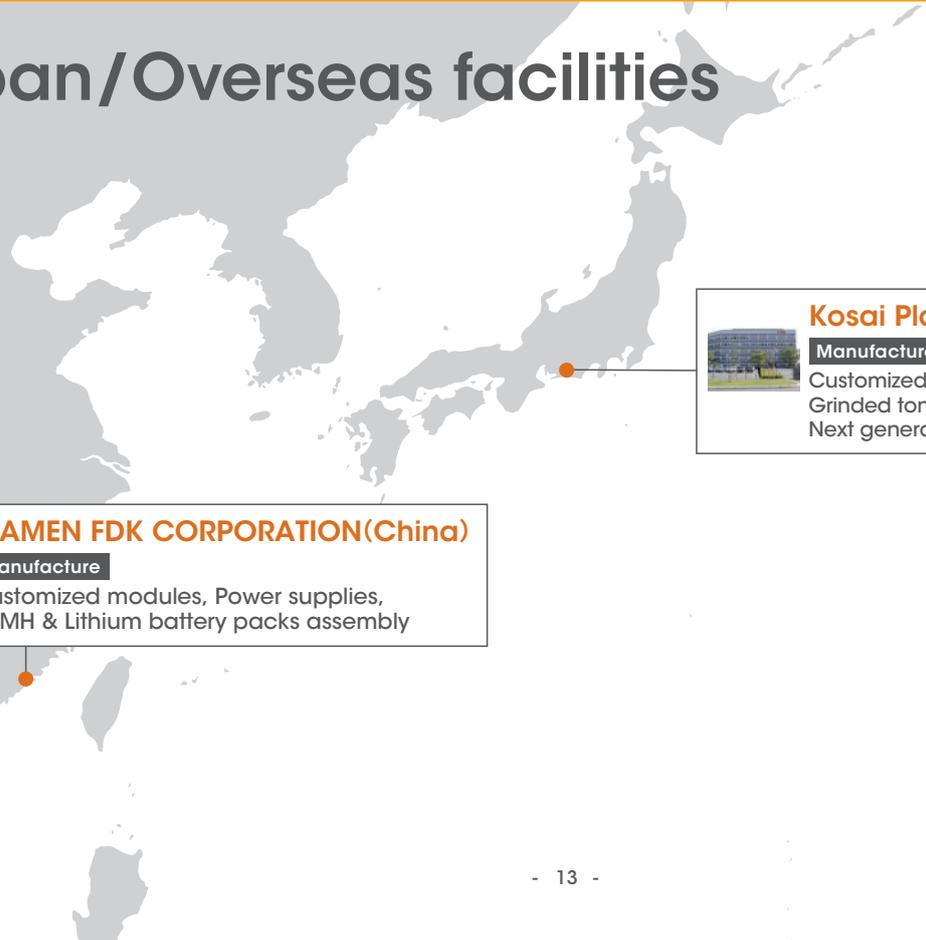


Warpage evaluation during reflow of module products



# POWER SYSTEMS

## Japan/Overseas facilities

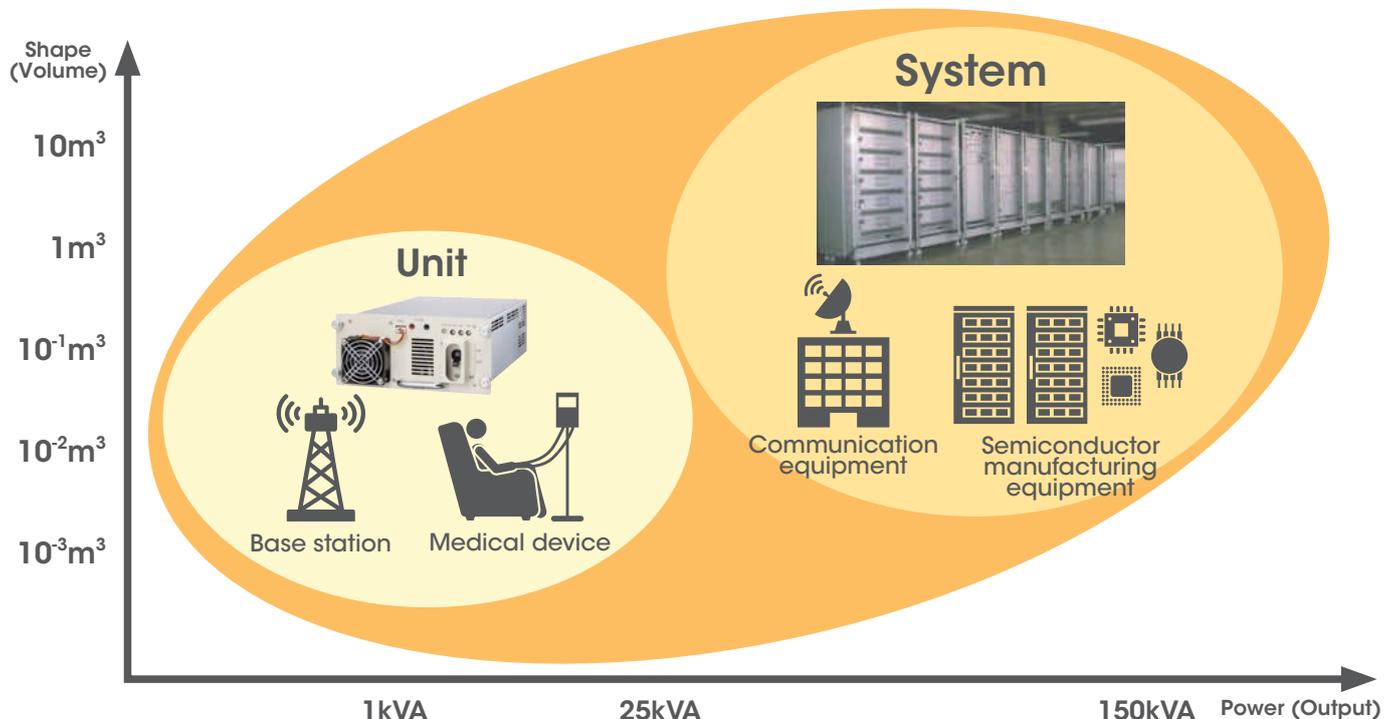


**XIAMEN FDK CORPORATION(China)**  
**Manufacture**  
 Customized modules, Power supplies,  
 Ni-MH & Lithium battery packs assembly

**Kosai Plant(Shizuoka Prefecture)**  
**Manufacture/Development**  
 Customized modules, Power supplies,  
 Grinded toners, All-solid-state batteries,  
 Next generation batteries (Development only)

Development and manufacture of custom power supplies that meet customer requirements, from high-precision power supplies for semiconductor manufacturing equipment to high-reliability power supplies for medical use.

## From small power supplies to large power systems



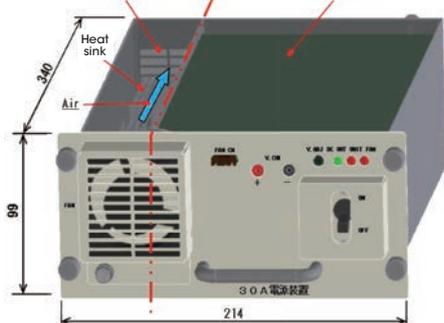
Types of Power Supplies	AC/DC Power Supply	DC/DC Power Supply	Motor Driver	Power System
Input	AC 100V/AC 200V 1 Phase/3 Phase	~ 400V	~ 400V	AC 200V 3 Phase
Output voltage	1V ~ 400V	1V ~ 400V	-400V ~+ 400V	DC Power/Driver
Output power	100VA ~ 25kVA	100VA ~ 25kVA	~ 10kVA	~ 150kVA

### Features

- Stable power supply with long lifespan design - Design life of 15 years or more.
- Improve cost efficiency through the adoption of the latest high-efficiency converters.
- Corrosion resistance achieved through environmentally considered cooling separation structure.
- Increased flexibility in system design with parallel redundant operation functionality.
- Enhanced safety and maintainability with high-reliability design.
- Customized 19 inch rack mounting available in the lineup.

Forced air cooling area  
Heat-generating components

Natural cooling area  
Heat dissipation to the housing



Cooling Separation Structure (48 V 30 A Power Supply)  
(This exterior is an image)

### Product example

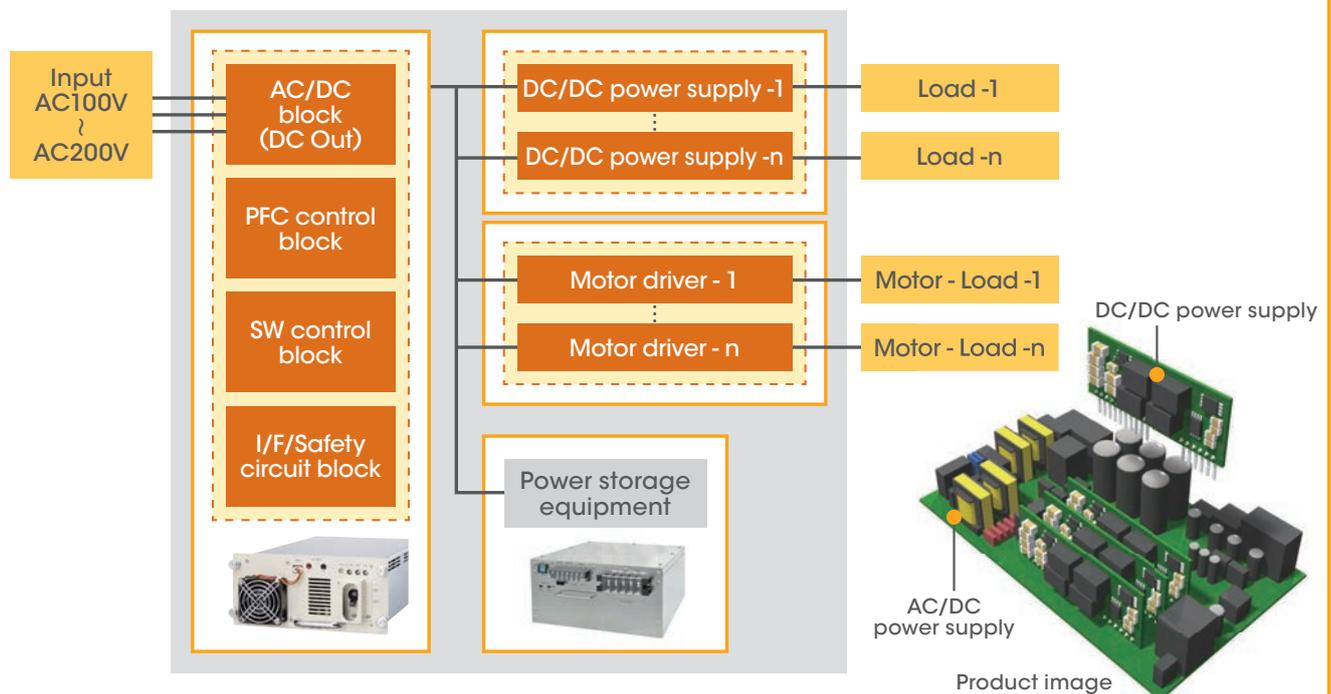
	PJA921-60 48V 30A Power supply	PJA922-60 48V 50A Power supply
Product name		
Input	AC 100V 1 Phase AC 200V 1 Phase/3 Phase	AC 200V 1 Phase/3 Phase
Output voltage (Switching method)	DC+40.8~+55.2V	DC+40.8~+55.2V
Output current (maximum)	30A	50A
Dimensions (mm)	W214×D340×H99	W214×D340×H148
Efficiency	90% or more(AC200V)	90% or more(AC200V)
Temperature range Humidity range	-10~+45°C 45~90%	-10~+45°C 45~90%
Specifications	Temporary power shutdown hold-up time Protection circuit  Withstand voltage Lightning surge tolerance Radiation/conduction Disturbance Cooling system	20msec or more Output overvoltage protection Output overcurrent protection Internal temperature anomaly protection 2000V between 1 and -2 cycles VCCI Class A compliance Forced air cooling

Based on customer requests, FDK develops, designs and manufactures power supplies that meet various standards.

## Five core technologies for

### Flexible and scalable technologies

Based our expertise on high-efficiency and low-noise circuit design, various power supply devices that support power control, and drive technologies that supports motor loads, we can offer solutions to meet the diverse needs of customers.



- When a motor is driven, it is required to reduce the influence of interference between motor operations, and we have various technologies to drive the motor such as synchronous operation, phase shift, and supply line switching control.
- For power supply applications with high output voltage and high capacity exceeding the safety voltage, we use our original circuit technologies to achieve the conversion control including safety.

### Composite rack (system) design technologies

**Large rack design technologies with efficient heat circulation function that enables multiple power supply units to be mounted and monitoring functions**

- We provide optimal mechanical designs considering strength performances, assembly workability and costs in a virtual space based on 3D models.
- We maintain the same high quality even during mass production, by providing an integrated service from rack designs to manufacturing and delivery.



## Various standards

- SEMI Standard (Semiconductor manufacturing equipment)
- IEC60601-1 (Medical electrical equipment)
- IEC61000-4 (Immunity)
- EC62368 (Electrical safety standard)
- CISPR (EMC)

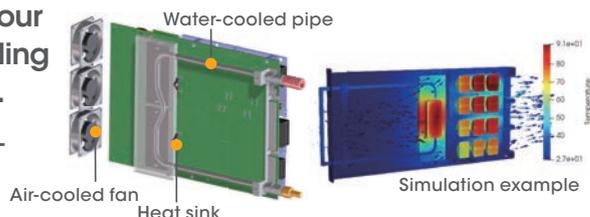
# custom power supplies

## Heat treatment technologies

### Cooling technologies for high-capacity power control

Offering a wide range of cooling methods to suit your equipment, e.g. natural air cooling, forced air cooling using fans, and water-cooling using cooling water.

- By performing fluid thermal analysis simulation using in-house supercomputers, fluid and thermal verification is virtually performed at the design stage prior to manufacturing.
- Shortening development leadtime.



Water cooling enables e.g. semiconductor elements to cool precisely efficiently and reduces the size of heat sinks by half. Exhaust heat can also be easily emitted.

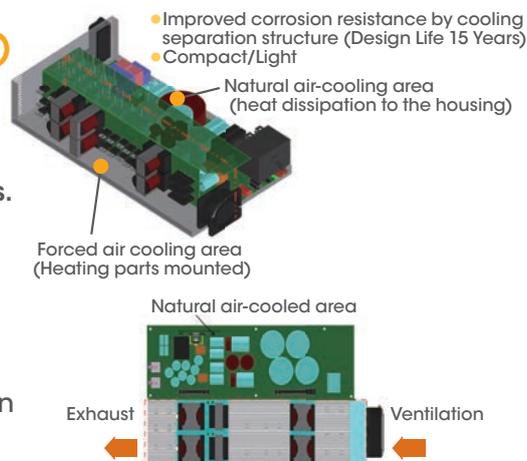
## Environmentally friendly technologies

### Technologies to protect quality in harsh environments (condensation, corrosion, dust)

Fan-forced air cooling is commonly used to miniaturize products and extend their lifespan. However, in harsh environments e.g. high humidity, it can sometimes affect the reliability of internal board patterns and semiconductor leads.

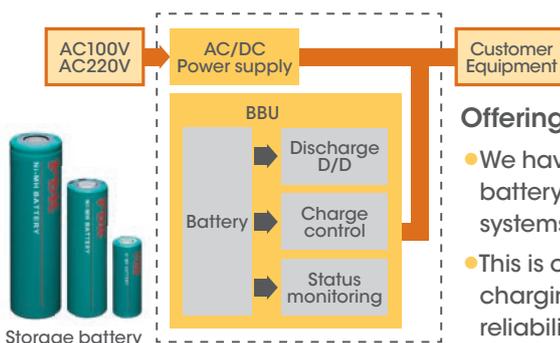
(It can cause corrosion when extremely fine wiring patterns such as control ICs are continuously exposed to moist wind.)

- For products designed for high-humidity environments, moisture-resistant coating treatments for circuit patterns can be applied.
- For the product uses in harsh environments, the separation structure technology following on the right enables us to maintain compactness by forced air cooling while providing more reliability.



By completely separating the heating and control units, corrosion resistance is achieved by protecting the patterned area from moisture-laden air.

## Battery control and monitoring technologies



### Optimal control of the entire backup system, including batteries

Offering the best battery and battery system to meet your needs

- We have extensive experience in both battery and custom-designed battery systems. We design and produce batteries and battery systems with safety and reliability for each application.
- This is our unique system that features such as optimal control of charging and discharging, battery diagnostic that ensure high reliability, and battery life prediction.



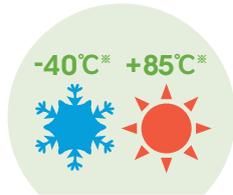
# Ni-MH BATTERIES



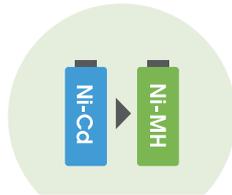
FDK Ni-MH batteries are resistant to over-charge and over-discharge, have excellent safety, and can be easily transported. In addition, Ni-MH batteries are easy to recycle because they contain a high nickel content.



Rechargeable and environmentally friendly



Usable in a wide temperature range



Best for replacing Ni-Cd batteries due to longer life



High recyclability



Easy to transport

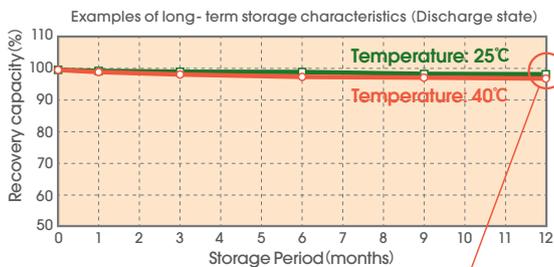
\* Limited to high durability type for in-vehicle applications.

## Features of FDK Ni-MH batteries

### FDK original technologies

#### Positive electrode material

Nickel hydroxide coated with a highly conductive cobalt compound

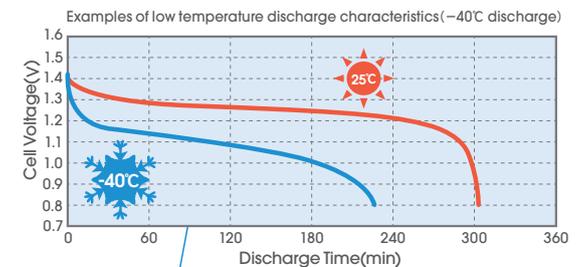


Low capacity loss after long storage

Model: HR-AAULT Charge: 1000mA (-ΔV=10mV) Rest: 1hour  
Discharge: 1000mA (E.V.=1.00V)  
Ambient Temperature: 25°C

#### Negative electrode material

Super lattice hydrogen absorbing alloy



Can be used even at -40°C depending on usage conditions

Model: HR-AAUTEW Charge: 460mA (-ΔV=10mV) Ambient Temperature: 25°C  
Rest: 3hours Discharge: 92mA (E.V.=0.80V)  
Ambient Temperature: -40°C

## Applications for FDK Ni-MH batteries

FDK's line-up of Ni-MH batteries offer an exceptional solution for your energy needs, and can be used in a wide variety of applications to enhance performance while extending runtime.

	High Durability for In-Vehicle Applications	High Durability	High-Rate Discharge	Standard	Dry Cell Compatible
1 Security	dashboard cameras SVT-tracking	security cameras ATM			
2 Transportation		reefer containers railroad crossing security equipment	electric bikes		
3 Emergency		emergency lights			
4 Medical & health care		bedside monitors	electric wheelchairs nursing lifts		automatic blood pressure monitors
5 Lighting		street light solar systems		external camera flashes	flashlights
6 Home appliances				electric shavers	wireless mice remote controllers
7 Information	eCall T-Box	UPS, base stations		wireless devices audio equipment	wireless keyboards transceivers
8 Construction		lift landing devices			

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FDK Ni-MH batteries have a wide operating temperature range (-40 to +85°C) for in-vehicle applications. They work especially well in low temperatures, making them ideal for cold regions.

Wide operating temperature range

[Standard Ni-MH Battery]

0 to +50°C

-40 to +85°C<sup>※1</sup>

## High Durability Ni-MH Batteries for In-Vehicle Applications

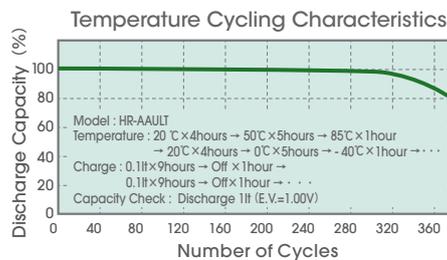
The high durability model for in-vehicle applications allows a long life providing continuous usage over a wide temperature range.



### Features

#### • Usable in a wide temperature range

The high durability model for in-vehicle applications can be used in a wide temperature range (-40°C to +85°C) as is required for in-vehicle applications. The battery life is also significantly longer than the standard Ni-MH battery. In addition, these batteries utilize a safe, water-based electrolyte and thus are suitable for in-vehicle applications.



### Applications

- eCall, T-Box, tracking, etc.



### Specifications

Model	HR-2/3AAAUT	HR-AAAUTEW	HR-AAUTEWM Standard Type	HR-AAUTEW Low-temp. Discharge Type	HR-AATEZ Long Life Type	HR-AATEX Low-temp. Discharge Type	HR-4/3FAUT	
Nominal Voltage	1.2V	1.2V	1.2V	1.2V	1.2V	1.2V	1.2V	
Typical Capacity <sup>※2</sup>	220mAh	500mAh	1100mAh	1100mAh	1200mAh	1300mAh	3700mAh	
Minimum Capacity <sup>※3</sup>	200mAh	460mAh	1000mAh	1000mAh	1100mAh	1100mAh	3500mAh	
Quick-Charge <sup>※4</sup>	Current	220mA	500mA	1100mA	1100mA	1200mA	1300mA	3000mA
	Time	1.1h	1.1h	1.1h	1.1h	1.1h	1.1h	1.3h
Dimensions (incl.tube) <sup>※5</sup>	Diameter	10.5mm	10.5mm	14.2mm	14.2mm	14.35mm	14.35mm	18.0mm
	Height	30.0mm	44.5mm	50.0mm	50.0mm	50.0mm	50.0mm	67.5mm
Approx. Weight	8g	12g	27g	27g	27g	27g	58g	

※1: Battery capacity and life may be reduced at extreme temperatures. Please contact us for details. ※2: Typical capacity when being discharged at 0.2It until the voltage reaches to 1.00V within 1 hour after a single cell being charged for 16 hours at 0.1It. ※3: Minimum capacity when being discharged at 0.2It until the voltage reaches to 1.00V within 1 hour after a single cell being charged for 16 hours at 0.1It. ※4: Consult FDK according to conditions of use. ※5: Including heat shrink tube.

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# High Durability Ni-MH Batteries

Long life / high reliability.



## Features

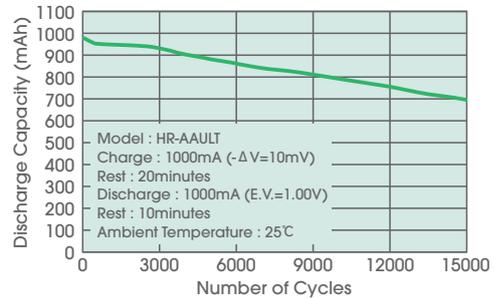
### • Long life

Excellent battery life in repeated charge/discharge conditions. Suitable for nickel cadmium battery replacement (for emergency lights, emergency exit lights, and security equipment), for solar power generation, and wind power generation batteries.

## Applications

- Suitable for emergency lights, emergency exit lights, security equipment, communication base stations, medical equipment, ATMs, POSs, smart meters, road studs (cat's eyes), and various kinds of backup power supply.
- High durability Ni-MH batteries meet the MT/MU classifications defined in IEC 61951-2<sup>※1</sup>.
- They can also achieve excellent battery life via intermittent or timer charging methods for maintaining charge after main charging.

Charge / Discharge Cycle Characteristics



※2 : The seal is issued by the Japan Electric Association (JEA) Battery Equipment Certification Committee. This seal indicates that the product complies with applicable regulations and technical standards, including the Fire Service Act.

## Specifications

Model	HR-2/3AAAUTU <sup>※2</sup> MU Grade Type	HR-AAAUTU <sup>※2</sup> MU Grade Type	HR-AAULTU <sup>※2</sup> MU Grade Type	HR-AAULT <sup>※2</sup>	HR-AATU MU Grade Type	
Nominal Voltage	1.2V	1.2V	1.2V	1.2V	1.2V	
Typical Capacity <sup>※3</sup>	220mAh	500mAh	780mAh	1050mAh	1280mAh	
Minimum Capacity <sup>※4</sup>	200mAh	460mAh	700mAh	1000mAh	1200mAh	
Quick-Charge <sup>※5</sup>	Current	220mA	500mA	780mA	1050mA	1280mA
	Time	1.1h	1.1h	1.1h	1.1h	1.1h
Dimensions (incl.tube) <sup>※6</sup>	Diameter	10.5mm	10.5mm	14.2mm	14.2mm	14.35mm
	Height	30.0mm	44.5mm	49.0mm	49.0mm	50.0mm
Approx. Weight	8g	13g	20g	25g	26g	

Model	HR-AAUT	HR-4/5FAUPT <sup>※2</sup>	HR-AUT	HR-5/4SCUT <sup>※2</sup>	HR-4/3FAUT	
Nominal Voltage	1.2V	1.2V	1.2V	1.2V	1.2V	
Typical Capacity <sup>※3</sup>	1580mAh	1650mAh	2200mAh	3250mAh	3700mAh	
Minimum Capacity <sup>※4</sup>	1500mAh	1500mAh	2000mAh	3000mAh	3500mAh	
Quick-Charge <sup>※5</sup>	Current	1580mA	1650mA	2200mA	3250mA	3000mA
	Time	1.1h	1.1h	1.1h	1.1h	1.3h
Dimensions (incl.tube) <sup>※6</sup>	Diameter	14.2mm	18.1mm <sup>※7</sup>	17.0mm	23.0mm	18.0mm
	Height	50.0mm	43.2mm <sup>※7</sup>	50.0mm	50.0mm	67.5mm
Approx. Weight	26g	37g	37g	69g	58g	

※1: Compliance with IEC 61951-2 MT/MU classifications does not guarantee. ※3: Typical capacity when being discharged at 0.2It until the voltage reaches to 1.00V within 1 hour after a single cell being charged for 16 hours at 0.1It. ※4: Minimum capacity when being discharged at 0.2It until the voltage reaches to 1.00V within 1 hour after a single cell being charged for 16 hours at 0.1It. ※5: Consult FDK according to conditions of use. ※6: Including heat shrink tube. ※7: Including paper tube / heat shrink tube.

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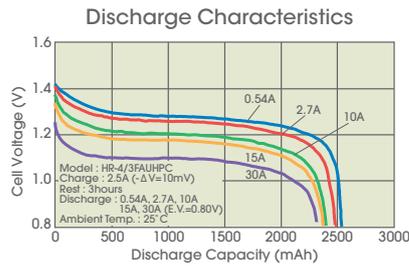
# High-Rate Discharge Ni-MH Batteries



Suitable for high drain use with stable voltage.

## Features

- **Superior high-rate discharge characteristics**  
FDK's original electrode manufacturing process, coupled with specialized current collectors minimize internal impedance, which in turn enables high-rate discharging and secures a stable discharge voltage.



## Applications

- Electric tools, nursing lifts, electric motor applications, etc.



## Specifications

Model	HR-4/5FAUP	HR-4/3FAUHPC	HR-SCU	HR-4/3FAUPC	HR-4/3FAUP	
Nominal Voltage	1.2V	1.2V	1.2V	1.2V	1.2V	
Typical Capacity <sup>※1</sup>	1950mAh	2700mAh	3000mAh	3200mAh	4000mAh	
Minimum Capacity <sup>※2</sup>	1800mAh	2500mAh	2700mAh	3050mAh	3750mAh	
Quick-Charge <sup>※3</sup>	Current	1950mA	2700mA	3200mA	4000mA	
	Time	1.1h	1.1h	1.1h	1.1h	1.1h
Dimensions (incl.tube) <sup>※4</sup>	Diameter	18.1mm <sup>※5</sup>	18.1mm <sup>※5</sup>	23.0mm	18.1mm <sup>※5</sup>	18.1mm <sup>※5</sup>
	Height	43.2mm <sup>※5</sup>	67.0mm <sup>※5</sup>	43.5mm	67.0mm <sup>※5</sup>	67.0mm <sup>※5</sup>
Approx. Weight	39g	57g	59g	60g	59g	

※1: Typical capacity when a single cell is discharged at 0.2It after being charged at 0.1It for 16 hours. ※2: Minimum capacity when a single cell is discharged at 0.2It after being charged at 0.1It for 16 hours. ※3: Consult FDK according to conditions of use. ※4: Including heat shrink tube. ※5: Including paper tube / heat shrink tube.

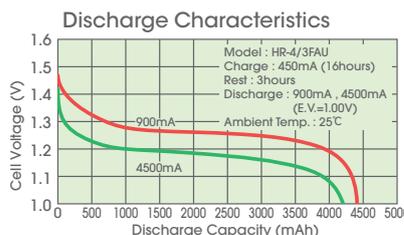
# Standard Ni-MH Batteries



Suitable for long time use.

## Features

- **High energy density**  
Standard Ni-MH batteries achieve a high energy density by using exclusively developed materials and construction. Standard Ni-MH batteries can allow for an extended run time in various applications.



## Applications

- Audio / video equipment, information / communication devices, lighting equipment, measuring instruments, home appliances, toys, etc.



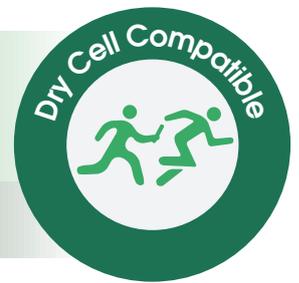
## Specifications

Model	HR-AAAUC Long Life Type	HR-AAUC Long Life Type	HR-AAUE	HR-AAU	HR-4/5AU	HR-AUE	HR-4/3AU	HR-4/3FAU
Nominal Voltage	1.2V	1.2V	1.2V	1.2V	1.2V	1.2V	1.2V	1.2V
Typical Capacity <sup>※1</sup>	700mAh	1200mAh	1400mAh	1650mAh	2150mAh	2700mAh	4000mAh	4500mAh
Minimum Capacity <sup>※2</sup>	650mAh	1100mAh	1250mAh	1500mAh	1950mAh	2450mAh	3600mAh	4100mAh
Quick-Charge <sup>※3</sup>	Current	700mA	1200mA	1400mA	1650mA	2150mA	3000mA	3000mA
	Time	1.1h	1.1h	1.1h	1.1h	1.1h	1.4h	1.6h
Dimensions (incl.tube) <sup>※4</sup>	Diameter	10.5mm	14.2mm	14.2mm	14.2mm	17.0mm	17.0mm	18.0mm
	Height	44.5mm	50.0mm	50.0mm	50.0mm	43.0mm	50.0mm	67.5mm
Approx. Weight	12g	22g	25g	27g	33g	39g	53g	59g

※1: Typical capacity when being discharged at 0.2It until the voltage reaches to 1.00V within 1 hour after a single cell being charged for 16 hours at 0.1It. ※2: Minimum capacity when being discharged at 0.2It until the voltage reaches to 1.00V within 1 hour after a single cell being charged for 16 hours at 0.1It. ※3: Consult FDK according to conditions of use. ※4: Including heat shrink tube.

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# Dry Cell Compatible Ni-MH Batteries

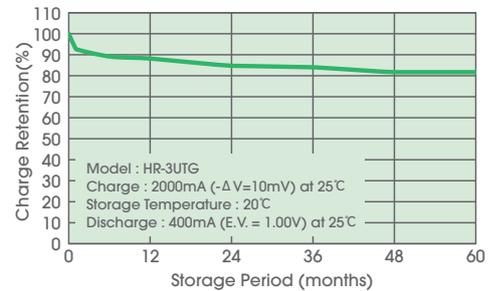


Rechargeable consumer batteries that can save resources.

## Features

- Dry cell compatible form factor**  
 Dry cell compatible Ni-MH batteries can be used in most equipment that use dry cells.
- Cost effectiveness**  
 Economical batteries with less waste due to being rechargeable unlike a dry cell.
- Low self-discharge**  
 Ready to use after purchasing, can be stored as emergency supplies.

Self-Discharge Characteristics



## Applications

- For automatic blood pressure monitors, remote controllers, wireless mice, flashlights, transceivers, wireless keyboards, etc.
- Dry cell compatible Ni-MH batteries can also be used for business purposes other than those listed above.
- It is necessary to confirm the application and battery usage conditions to sell dry cell compatible Ni-MH batteries. Please contact us for more details.



## Specifications

Model	HR-4UQ	HR-4UTG Long Life Type	HR-4UTG	HR-4UTGX	HR-3UQ	HR-3UTG Long Life Type	HR-3UTG	HR-3UTGX
Nominal Voltage	1.2V	1.2V	1.2V	1.2V	1.2V	1.2V	1.2V	1.2V
Typical Capacity <sup>※1</sup>	600mAh	800mAh	800mAh	1000mAh	1000mAh	2000mAh	2000mAh	2620mAh
Minimum Capacity <sup>※2</sup>	550mAh	750mAh	750mAh	930mAh	950mAh	1900mAh	1900mAh	2500mAh
Quick-Charge <sup>※3</sup>	Current	600mA	800mA	800mA	1000mA	1000mA	2000mA	2620mA
	Time	1.1h	1.1h	1.1h	1.1h	1.1h	1.1h	1.1h
Dimensions (incl.tube) <sup>※4</sup>	Diameter	10.5mm	10.5mm	10.5mm	10.5mm	14.2mm	14.35mm	14.5mm
	Height	44.5mm	44.5mm	44.5mm	44.5mm	50.4mm	50.4mm	50.4mm
Approx. Weight	11g	13g	13g	13g	19g	27g	27g	32g

※1: Typical capacity when being discharged at 0.2It until the voltage reaches to 1.00V within 1 hour after a single cell being charged for 16 hours at 0.1It. ※2: Minimum capacity when being discharged at 0.2It until the voltage reaches to 1.00V within 1 hour after a single cell being charged for 16 hours at 0.1It. ※3: Consult FDk according to conditions of use. ※4: Including label / heat shrink tube.

# Battery Pack, Battery System

FDK provides options for battery packs and battery systems depending on the requirements of each application.

When battery cells are used in equipment, most instances are as battery packs or battery systems. FDK has a wealth of experience with battery packs, as well as both custom designed and standard battery systems. We design and manufacture with consideration of battery safety and reliability for each application.

- Battery pack (assembly of multiple cells)
- Battery system (assembly of multiple cells with BMS that controls charge and discharge)
  - ↳ Custom designed battery system
  - ↳ Standard battery system

## Incorporating Battery Packs

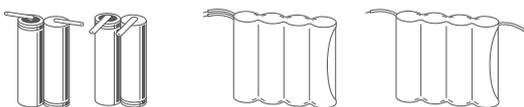
### Standard Configuration

When using battery cells, in equipment, battery model, number of cells and shape will differ depending on rated power, space and usage conditions of equipment.

#### ● Connection shape

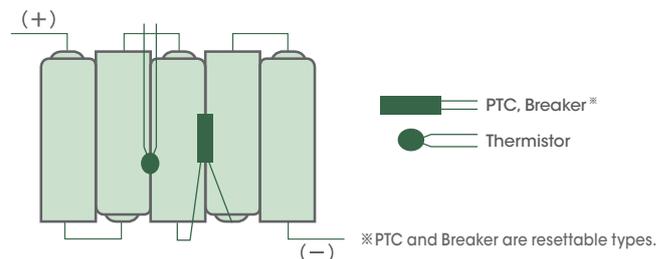


#### ● Terminal direction



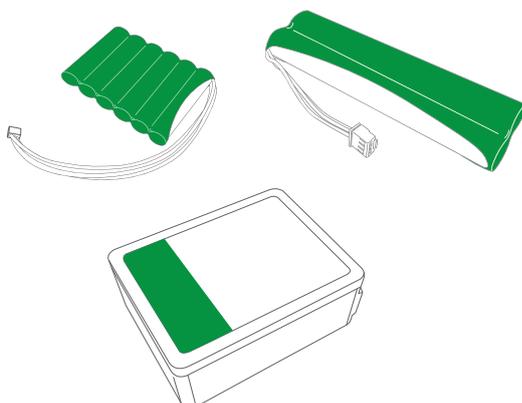
### Safety Device

When designing an assembled battery, it is necessary to install a safety device in case of charger failure and external short circuit. FDK recommends that the following parts are built into the assembled battery.



### Example of Battery Pack Shapes

FDK can produce battery packs with various shapes according to usage. Our cases can be made from heat shrink tubing, resin, metal, etc. Please consult us regarding the electrical wiring and terminal types.



### Usage of Battery Packs

Our products are used in various applications such as in-vehicle applications, emergency lights, home-use, etc. Please contact us about the usage of applications, ambient temperature, charge and discharge conditions, etc.



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# Battery System

FDK saves our customers' development resources by providing batteries with control functions according to the application.

Our battery packs include a battery management system (BMS) that controls charging and discharging. This brings out the best performance of Ni-MH batteries and contributes to improving the function of our customers' products while reducing development time.

## Battery Management System

FDK's BMS is an original system that has functions to control charge and discharge as well as diagnose and predict battery life, etc.

### Battery Management

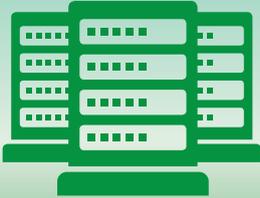
- **Charge/discharge control:**  
Prevents over-charge and discharge, and minimizes battery performance degradation
- **Self-diagnosis function:**  
Diagnosis of charge circuit and discharge circuits  
High reliability (internal resistance and self-discharge rate) through battery diagnostics
- **Lifetime prediction function(Options):**  
Capable of predicting battery lifetime through usage and environmental history and giving advanced notice

### Examples of Custom Control Functions

- ① Low temperature charge control function for cold regions
- ② Lifetime prediction function to reduce the number of battery replacements
- ③ Charge control function with built-in charge circuit

## Custom Designed Battery Systems

Our battery system is suitable for many applications requiring high reliability such as medical equipment, infrastructure, and information equipment.

<p><b>Data centers</b></p> <p>Servers DC12V 280W output</p> 	<p>Medical equipment</p> <p>DC12V 70W output</p> 	<p>Lift automatic landings</p> <p>DC48V 1kW output</p> 
<p>Disaster response vending machines</p> <p>DC48V 450W output</p> 	<p>Base stations</p> <p>DC48V 2kW output</p> 	

## Standard Battery System

We offer a standard battery system with DC24V input and output.

<b>Model</b>	<p>BBUS-122024-02</p> 
Output Voltage	DC24V
Capacity	1100Wh
Output current	30A
Dimensions	W 300mm D 422mm H 150mm
Approx. Weight	25kg
Applications	<p>Power supply backup for railway signal equipment, and surveillance cameras.</p> 

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# Ni-MH Battery Chargers for 10 series / 20 series Battery Packs

- ✓ Designed to charge 10 -20 series Ni-MH battery pack.  
※Please contact us if you have a request in regards to other series.
- ✓ Offers most suitable charge control.
- ✓ Includes refresh discharge function.
- ✓ Includes overcharging and overheating prevention function.



Item	FIC10M-FDK01	FIC20M-FDK01
Rating Output Voltage	10 series : DC14V	20 series : DC28V
Charging Current	1650mA (Constant Current)	
Charging Time	Approx. 2 hours (Capacity : 3200mAh) Approx. 2.5 hours (Capacity : 4000mAh)	
Charging Control	-ΔV, battery temperature detection, timer	
Refresh Discharge	Approx. 9 hours (Capacity : 3200mAh) Approx.11 hours (Capacity : 4000mAh)	
Input	AC100~240V 50-60Hz 57-76VA	AC100~240V 50-60Hz 103-130VA
Indicators	Charging : Red light, Fully charged : Green light, Refreshing : Orange light, Error : Blinking red light	
Safety Approval	Please contact us	PSE
Dimensions	170(L) X 95(W) X 59(H) mm	
Approx. Weight	600g	
Operating Temperature	0°C to +40°C	
Storage Temperature	-20°C to +60°C	

## Charging Methods

Charging Method	Constant current charging					
	Main charging				Maintenance charging	
	Quick charging			Low rate charging	Pulse current charging	Intermittent charging
	Peak voltage control charging	dT/dt control charging	-ΔV control charging	Timer control charging		
Overview						
V : Battery voltage I : Charge current T : Battery temperature	Terminate charging by detecting battery peak voltage.	Terminate charging by detecting battery temperature rate.	Terminate charging by detecting specified battery voltage drop after peak voltage.	Terminate charging by counting elapsed time.	Charging by pulse current to compensate self-discharge after main charging to keep fully charged state.	Charging intermittently after main charging to return to fully charged state. (Factor of recharging: battery voltage, elapsed time)
Charging Time	1~2h	1~2h	1~2h	11~12h	—	—
Charging Current <sup>*1</sup>	0.5~1.0It	0.5~1.0It	0.5~1.0It	0.1It	1/20~1.0It (Avg.1/500It)	1/20~1.0It
Standard Type	◎	◎	◎	○	◎	◎
High Durability Type	◎	◎	◎	—	○	○
High-Rate Discharge Type	◎	◎	◎	—	○	○
Dry Cell Compatible Type	◎	○	◎	○ <sup>*2</sup>	—	○

◎ Recommended : Suitable to exhibit battery performance. ○ Available : Can be used depending on the specification of equipment.

- 1It(A) = Rated capacity [Ah] / 1 [h]
- Proper charging method and charging condition are depending on the specification/usage of equipment or structure of battery pack. Please contact us for details.
- If your device supports a charge rate of 0.1It or more, please note that the overcharge performance and temperature rise conditions will differ depending on your battery type. Please contact us before deciding on specifications.

● When a large number of cells, a high capacity battery, or a battery assembly that does not dissipate heat effectively is used, abnormal heat generation may occur even if the charging current is less than 0.1It.

\*1 Charging current is just a reference, please contact us for details.

\*2 Some charging methods should not be applied to dry cell compatible batteries regardless of equipment specification. Please contact us for details.

The contents of this catalogue are not guaranteed.

# Ni-MH Batteries Handling Precautions for Safe Use

Carefully read these instructions before using Ni-MH batteries for the first time.

For your safety and that of your customers, observe all cautionary information provided in this manual. Save this manual for future reference.

The following information is intended to highlight potential safety hazards that can be associated with the misuse, misapplication or damage of Ni-MH batteries. Please carefully evaluate the information in this section when using Ni-MH batteries (single cells or assembled batteries) or when using or manufacturing equipment incorporating Ni-MH batteries. This catalogue is not a substitute for independent evaluation of equipment incorporating Ni-MH batteries. Customers incorporating Ni-MH batteries into their equipment must assure that their completed product has been properly designed, manufactured and tested. End users of equipment incorporating Ni-MH batteries should also be provided with sufficient warnings and instructions on their safe operation. As appropriate, some or all of the following warnings and information should be incorporated into the instruction manual accompanying your equipment.

Batteries of this type are not sold to individual customers. If you wish to replace the battery in your device, please contact the store where you purchased it or the device manufacturer.

## **⚠ DANGER**

- Failure to carefully observe the following procedures and precautions can result in leakage of battery fluid (electrolyte), heat generation, bursting, fire and serious personal injury.
  - Never dispose of Ni-MH batteries in a fire or heat them. Doing so may melt the insulation, damage the gas release vents or protective devices, ignite hydrogen gas, and cause leakage of battery fluid (electrolyte), heat generation, bursting and fire.
  - Do not connect the ⊕ (positive) and ⊖ (negative) terminals of Ni-MH batteries together with electrically conductive materials, including lead wires. Do not transport or store Ni-MH batteries with their terminals uncovered or in contact with a metal object (such as a necklace) or other conductive material. Doing so may cause short circuit, which would result in excessive current flow and possibly cause leakage of battery fluid, heat generation, bursting and fire. When carrying or storing batteries, use an appropriate case.
  - Only charge Ni-MH batteries using chargers that satisfy FDK's specifications. Only charge batteries under the conditions specified by FDK. Failure to follow proper charging procedures may cause excessive current flow, loss of control during charging, leakage of battery fluid, heat generation, bursting and fire.
  - Never disassemble Ni-MH batteries. Doing so may cause an internal or external short circuit or result in exposed material of battery reacting chemically with the air. It may also cause heat generation, bursting and fire. Also, this is dangerous as it may cause exposure to alkaline fluid.
  - Never modify or reconstruct Ni-MH batteries. Protective devices to prevent danger are built into batteries (single cells or assembled batteries). If these are damaged, excessive current flow may cause loss of control during charging or discharging of the battery, leakage of battery fluid, heat generation, bursting and fire.
  - Never solder lead wires directly on to Ni-MH batteries. The heat of the soldering operation may melt the insulation, damage the gas release vents or protective devices, cause leakage of battery fluid, heat generation, bursting and fire.
  - The ⊕ (positive) and ⊖ (negative) terminals of Ni-MH batteries are predetermined. Do not force the terminal connection to a charger or equipment. If the terminals cannot be easily connected to the charger or equipment, check if the ⊕ and ⊖ terminals are correctly positioned. If the terminals are reversed, during charging the battery may be discharged rather than charged. Furthermore, reversed connections may cause abnormal chemical reaction in the battery, the flow of abnormal currents, leakage of battery fluid, heat generation, bursting and fire.
  - The gas release vent which releases internal gas is located in the ⊕ positive terminal of the Ni-MH batteries. For this reason, never deform this section or cover or obstruct its gas release structure. If this section is deformed or covered or obstructed, the gas release vent will not function properly, possibly causing leakage of battery fluid, heat generation, bursting and fire.
  - Do not directly connect Ni-MH batteries to a direct power source or the cigarette lighter socket in a car. High voltage may cause excessive current flow, leakage of battery fluid, heat generation, bursting and fire.
  - Do not use Ni-MH batteries in any equipment other than those specified by FDK. Depending on the equipment being used, doing so may cause abnormal current flow, leakage of battery fluid, heat generation, bursting and fire.
- Ni-MH batteries contain a strong colorless alkaline solution (electrolyte). Alkaline solution is extremely corrosive and will cause skin damage. If any fluid from Ni-MH batteries comes in contact with a user's eyes, they should immediately flush their eyes and wash them thoroughly with clean water from a tap or another source and consult a doctor immediately. Strong alkaline solution can damage eyes and lead to permanent loss of eyesight.
- When Ni-MH batteries are to be incorporated in equipment or housed within a case, avoid airtight structures as this may lead to the equipment or case being damaged or may be harmful to users.
- Please contact us before using Ni-MH batteries in waterproof housing or cases. This may lead to the accumulation of gases from the battery which can ignite and cause rupturing.

## **⚠ WARNING**

- Do not apply water, seawater or other oxidizing reagents to Ni-MH batteries, as this can cause rust and heat generation. If a battery becomes rusted, the gas release vent may no longer operate, and can result in bursting.
- Do not connect more than 21 Ni-MH batteries in series, as this may cause electrical shocks, leakage of battery fluid and heat generation.
- Keep Ni-MH batteries or the equipment out of the reach of infants and small children, in order to avoid them swallowing batteries. In the event the batteries are swallowed, consult a doctor immediately.
- Do not charge or use Ni-MH batteries with the ⊕ and ⊖ terminals reversed. Charging batteries with the terminals reversed may discharge rather than charge the batteries, or it may cause abnormal chemical reaction in the batteries. Using batteries with the terminals reversed may discharge with of abnormal current, leakage of battery fluid, heat generation, bursting and fire.
- Do not over-charge Ni-MH batteries by exceeding the predetermined charging period specified by the battery charger's instructions or indicator. If Ni-MH batteries are not fully charged after the battery charger's predetermined charging period has elapsed, stop the charging process. Prolonged charging may cause leakage of battery fluid, heat generation, bursting. Be sure to handle recharged batteries carefully as they may be hot.
- Do not use Ni-MH batteries if the outer tube/label is scratched or damaged. Doing so will expose the battery to the risk of a short circuit, and may cause leakage of battery fluid, heat generation, bursting and fire.

- Do not remove the outer tube from a battery or damage it. Doing so will expose the battery to the risk of a short circuit, and may cause leakage of battery fluid, heat generation, bursting and fire.
- If Ni-MH batteries leak fluid, change color, change shape, or change in any other way, do not use them, otherwise they may cause heat generation, bursting and fire.
- Ni-MH batteries contain strong colorless alkaline solution (electrolyte). If the skin or clothing comes in contact with fluid from a Ni-MH batteries. Battery fluid can irritate the skin thoroughly wash the area immediately with clean water from the tap or another source.
- When transporting Ni-MH batteries, pack them carefully so that the batteries inside the case are not moved.

## **⚠ CAUTION**

- Do not strike or drop Ni-MH batteries. Sharp impacts or concussions to Ni-MH batteries may cause leakage of battery fluid, heat generation, bursting and fire.
- Store Ni-MH batteries out of the reach of infants and small children. When charging or using a battery, do not let infants or small children remove the battery from the charger or the equipment being used.
- Children should not use Ni-MH batteries unless they have been carefully instructed on the contents of this instruction manual and their parents or guardians have confirmed that the children understand and appreciate the proper usage and safety hazards presented by the batteries.
- Do not charge Ni-MH batteries if they have been cooled to 0°C or below. Doing so may cause leakage of battery fluid, impair performance or shorten operating life of Ni-MH batteries.
- Do not use or store Ni-MH batteries at high temperature, such as in strong direct sunlight, in cars during hot weather, or directly in front of a heater. This may cause leakage of battery fluid. It could also impair performance and shorten battery life of Ni-MH batteries.
- Do not use old and new batteries mixed together, or batteries at different charge levels. Do not use Ni-MH batteries mixed together with a dry cell or other battery of a different capacity, type, or brand name. This may cause leakage of battery fluid and heat generation.
- When more than two batteries are to be used together, charge them simultaneously prior to use. If they are not charged at the same time, it could cause leakage of battery fluid and heat generation.
- For the recommended charging method for Ni-MH batteries, read the battery charger's instruction manual carefully.
- Do not place or cover flammable materials on the battery while charging or discharging the Ni-MH batteries. It may cause leakage of battery fluid, heat generation, bursting and fire.
- If Ni-MH batteries do not perform or function well with certain subject, refer to the instruction manual or warnings of the subject equipment.
- Do not charge Ni-MH batteries beyond the recommended time described in the instruction manual for the charger or equipment. Overcharging causes leakage of battery fluid, heat generation, bursting and fire. It could also impair performance and shorten battery life of Ni-MH batteries.
- After long term storage, there is a possibility that a battery cannot be fully charged. In order to fully charge it, charge and discharge the battery a few times.
- Be sure to turn off the equipment after use of Ni-MH batteries, as this may result in leakage of battery fluid.
- After they have been removed from equipment, store Ni-MH batteries in a dry place and within the recommended storage temperature range. This will help preserve the batteries' performance and durability and to minimize the possibility of leakage of battery fluid or corrosion. (For the indicated storage temperature range, refer to the rating table of this catalogue. FDK recommends a temperature range from -20 to 30 °C for longer battery life.)
- Before using Ni-MH batteries, be sure to read the instruction manual and all precautions carefully, then store the manual and precautions carefully to use as reference when the need arises. If you have specific questions about the instruction manual or the precautions, contact FDK at the location listed on the last page of this catalogue.
- If corrosion, heat generation or other abnormalities with new Ni-MH batteries are detected, immediately stop using them and return them to the store or FDK that they were purchased from.
- If the Ni-MH battery terminals become dirty, clean them with a soft dry cloth prior to use. Dirt on the terminals can result in poor contact with the equipment, loss of power, or inability to charge.
- When incorporating Ni-MH batteries into their equipment or case, use materials with alkali resistance for the contact point and terminal of the battery. (Copper-containing materials can cause rust and corrosion problems.)
- Batteries have a limited lifetime. Even in the same equipment, the battery life varies depending on the ambient temperature during operation and number of charge/discharge cycles. Therefore, if the operating time of a Ni-MH battery becomes much shorter than its initial operating time, even after recharging, it is most likely near the end of its battery life and should be replaced with a new battery.
- Remove Ni-MH batteries from your device if it will not be used for an extended period of time, as this may result in leakage of battery fluid. Also, be sure to turn off your device after using Ni-MH batteries.
- Ni-MH batteries should be charged after first purchase or having not been used for a long period of time.

### **Battery Regulation (EU) 2023/1542**

As of August 18, 2024, the display of the CE mark has been mandatory under the European Battery Regulation. Batteries must comply with the specific requirements applicable to each category to bear the CE mark. If you plan to ship products to the European market, please contact us for further information.



# LITHIUM BATTERIES



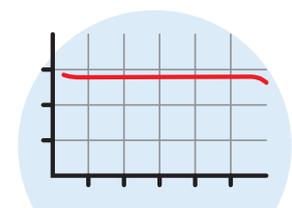
# Strong Lineup of Cylindrical, Thin and Coin types. Made-in-Japan Quality and Reliability.

FDK's technology adds long-term reliability to lithium batteries' original features such as high energy density and superior shelf life. No toxic substances restricted by the RoHS Directive are used in FDK's environmentally-conscious lithium batteries.

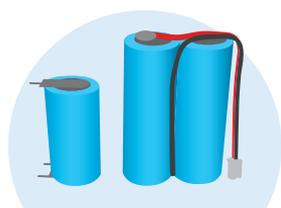


## FDK's Lithium Battery Advantages

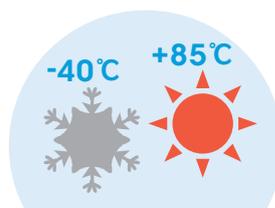
A variety of shapes and sizes make your application design easy. Stable and long-lasting power supply under a wide range of temperature conditions.



Stable discharge current



High flexibility for application design



Wide range of operating temperatures  
-40°C to +85°C<sup>※1</sup>

※1 In the case of cylindrical-type



Extended usage  
20 years<sup>※2</sup>

※2 In the case of CR17500EP and CR17500EX. Expected life at room temperature. Expected life varies depending on usage and environment.

## Typical Uses of Lithium Batteries

Reliable power sources for a wide range of applications from every corner of society



[cards, thin modules]



- cards with dynamic code display
- beacon modules
- electronic tags

[utility meters]



- gas meters
- electricity meters
- water meters
- HCAs

[home security]



- fire alarms
- gas alarms
- electronic locks

[medical devices]



- medical patches
- AEDs
- memory backup
- surgical powered tools

[in-vehicle equipment]



- eCall
- dashboard cameras
- keyless entry

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# Stable performance and long life Long-term reliability proven in the market Best fit for smart meter solutions

## Advantage ① Long-lasting reliability (※)

Optimized material design and laser-sealing ensure extended long life. This supports your application operating just as you would expect.

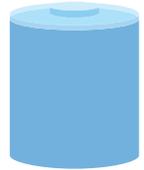
**10 years** → **20 years**

(※) Period varies depending on the model, usage and environment.

## Advantage ② Excellent capacity retention

Very low self-discharge rate (0.5% per year at room temperature) means at least 95% or more capacity is retained after 10-year storage.

Capacity **95%** (10 years at RT)



## Advantage ③ Wide operating temperature range (※)

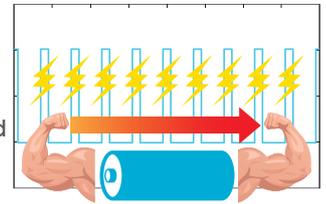
Non-aqueous electrolyte does not freeze easily. This supports your application's operation across a wide temperature range.



(※) Consult with FDK when using batteries at temperatures exceeding -20°C to +60°C (-4°F to +140°F) range.

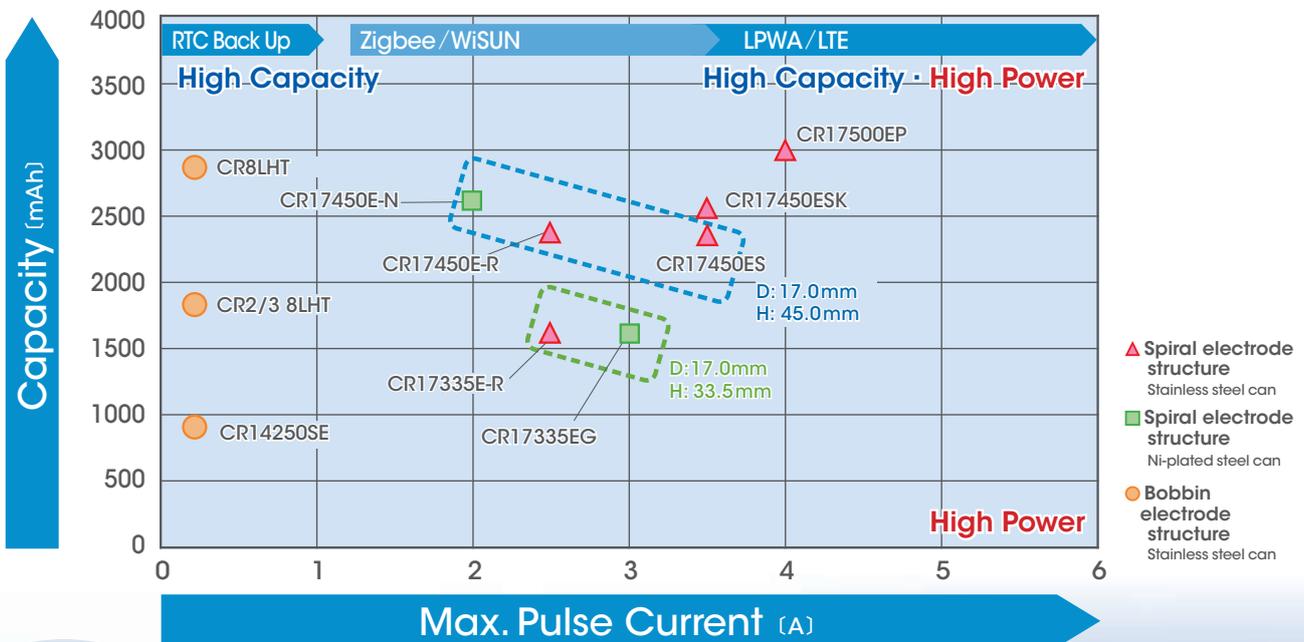
## Advantage ④ Long lasting (※) high discharge current over a long period

Spiral electrode structure and optimized electrolyte composition supply power for high demanding applications such as repeated radio communication and emergency valve shut-off operation.



(※) Period varies depending on the model, usage and environment.

## Supporting the various needs of meters with a combination of high power and high capacity.



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# Cylindrical-type Primary Lithium Batteries - High Power

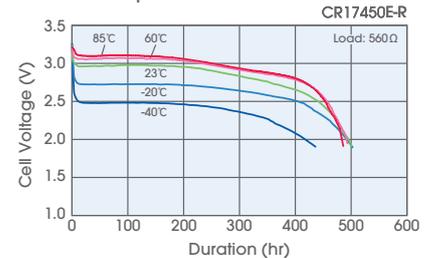
Utilizes a spiral electrode structure to provide a high discharge current. Laser sealing ensures an extended lifetime.



## Features

- Spiral electrode structure ensures high-rate current discharge.
- Low self-discharge rate and long life.  
Self-discharge rate: less than 0.5% per year at room temperature.
- Usable over a wide temperature range  
Operational temperature range : -40°C to +85°C (-40°F to +185°F)  
Consult with FDK when using batteries at temperatures exceeding -20°C to +60°C (-4°F to +140°F) range.
- UL recognition (File No. MH13421) 

Temperature Characteristics



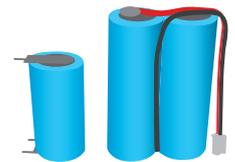
## Applications

- Gas, electricity, and water meters
- Fire and gas alarms
- In-vehicle applications  
(ETCs, eCall systems, etc)
- Security equipment
- Communication equipment



## Others

- Please use tabs or connectors when connecting these batteries to applications.



## Specifications

Model	CR17335E-R	CR17335E-G	CR17450E-R	CR17450E-S	CR17450E-N	CR17450ESK	CR17500EP	CR17500EX
In accordance with IEC standard nomenclature	17335	17335	17450	17450	17450	17E450	17E500	17E500
Nominal Voltage	3V	3V	3V	3V	3V	3V	3V	3V
Nominal Capacity <sup>#1</sup>	1600mAh	1600mAh	2400mAh	2400mAh	2600mAh	2600mAh	3000mAh	3500mAh
Standard Discharge Current	5mA	5mA	5mA	5mA	5mA	5mA	5mA	5mA
Max. Pulse Current <sup>#2</sup>	2500mA	3000mA	2500mA	3500mA	2000mA	3500mA	4000mA	3000mA
Dimensions	Diameter	17.0mm	17.0mm	17.0mm	17.0mm	17.4mm	17.4mm	17.4mm
	Height	33.5mm	33.5mm	45.0mm	45.0mm	45.0mm	50.0mm	50.0mm
Approx. Weight	17g	17g	23g	23g	23g	24g	28g	28g

※Expected life at room temperature : CR17500EP and CR17500EX 20 years, other models 10 years.

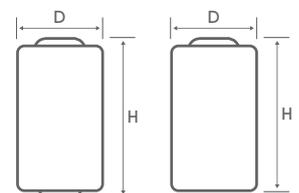
Expected life is reference only and is not intended to imply any guarantee or warranty. Actual life depends on condition of use.

※Consult with FDK when considering connection method and multiple-cell configuration.

※CR17335E-G and CR17450E-N have the outer can made of nickel plated steel.

※1 Nominal capacity is determined at an end voltage of 2.0V when the battery is allowed to discharge at a standard current level at +23°C.

※2 Current value for obtaining 1.0V cell voltage when pulse is applied for 15 seconds at 50% discharge depth (50% of the nominal capacity) at +23°C.



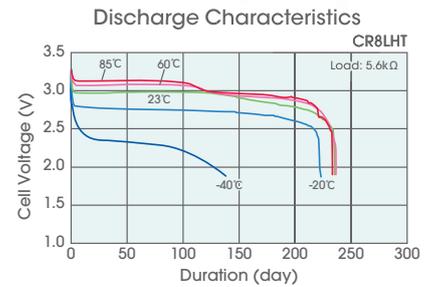
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# Cylindrical-type Primary Lithium Batteries - High Capacity

Utilizes a unique bobbin electrode structure to provide high capacity.

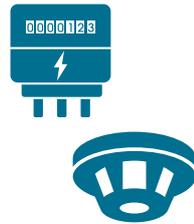
## Features

- Bobbin electrode structure ensures high-capacity performance.
- Low self-discharge rate and long life.  
Self-discharge rate : less than 0.5% per year at room temperature.
- Usable over a wide temperature range.  
Operational temperature range : -40°C to +85°C (-40°F to +185°F)  
Consult with FDK when using batteries at temperatures exceeding -20°C to +60°C (-4°F to +140°F) range.
- UL recognition (File No. MH13421) 



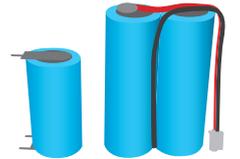
## Applications

- Electricity and water meters
- Fire alarms
- Memory backup power source



## Others

- Please use tabs or connectors when connecting these batteries to applications.



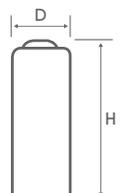
## Specifications

Model	CR14250SE	CR14250SEK	CR2/3 8-L	CR2/3 8LHT	CR8-LHC	CR8LHT
In accordance with IEC standard nomenclature	14250	14250	17335	17335	17450	17450
Nominal Voltage	3V	3V	3V	3V	3V	3V
Nominal Capacity <sup>※1</sup>	850mAh	920mAh	1900mAh	1800mAh	3000mAh	2850mAh
Standard Discharge Current	0.5mA	0.5mA	0.5mA	0.5mA	0.5mA	0.5mA
Dimensions	Diameter	14.5mm	14.5mm	17.0mm	17.0mm	17.0mm
	Height	25.0mm	25.0mm	33.5mm	33.5mm	45.0mm
Approx. Weight	9g	9g	16g	16g	23g	23g

※Expected life is 10 years at room temperature.

Expected life is reference only and is not intended to imply any guarantee or warranty. Actual life depends on condition of use.

※Consult with FDK when considering connection method and multiple-cell configuration.



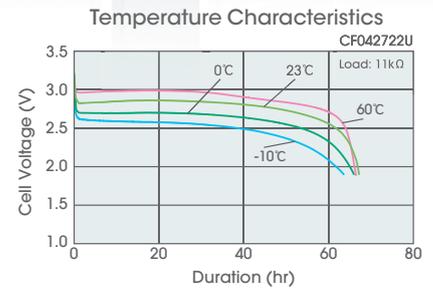
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# Thin-type Primary Lithium Batteries

For overall thickness and weight reduction in devices.

## Features

- Low self-discharge rate and long life.  
Self-discharge rate: less than 3% per year at room temperature.
- Usable over wide temperature range.  
Operational temperature range : -10°C to +60°C (+14°F to +140°F)
- UL recognition (File No. MH13421) 



## Applications

- Credit cards with dynamic code display
- Card type security systems
- Electronic tags
- Gift cards
- Medical patches



## Others

- Can be connected via thermal compression bonding.
- Consult with FDK when using multiple Thin-type batteries.
- ISO/IEC 10373-1 Supports bending tests
- For curved surface applications



## Specifications

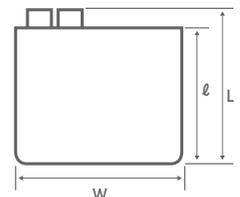
Model	CF042223	CF042722U	CF042039	CF052722U	CF052039	
Nominal Voltage	3V	3V	3V	3V	3V	
Nominal Capacity <sup>※1</sup>	12mAh	15mAh	25mAh	22mAh	35mAh	
Standard Discharge Current	0.25mA	0.25mA	0.25mA	0.25mA	0.25mA	
Dimensions	Length	L : 27.0mm (ℓ : 24.0mm)	L : 25.5mm (ℓ : 22.5mm)	L : 42.5mm (ℓ : 39.5mm)	L : 25.5mm (ℓ : 22.5mm)	L : 42.5mm (ℓ : 39.5mm)
	Width	23.0mm	27.5mm	20.5mm	27.5mm	20.5mm
	Thickness	0.45mm	0.45mm	0.45mm	0.55mm	0.55mm
Approx. Weight	0.4g	0.4g	0.5g	0.5g	0.6g	

※Expected life is 5 years at room temperature.

Expected life is reference only and is not intended to imply any guarantee or warranty. Actual life depends on condition of use.

※Consult with FDK about installation method.

※1 Nominal capacity is determined at an end voltage of 2.0V when the battery is allowed to discharge at a standard current level at +23°C.



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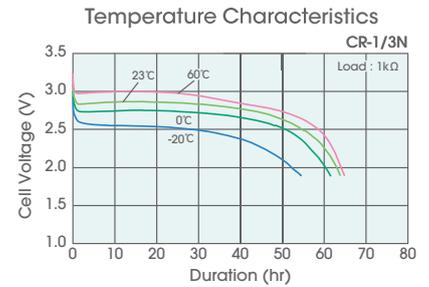
# Coin-type Primary Lithium Batteries

Manganese dioxide for the positive electrode material and lithium for the negative electrode material



## Features

- Low self-discharge rate and long life.  
Self-discharge rate : Approx. 1% per year at room temperature.
- Usable over wide temperature range.  
Operational temperature range: -20°C to +60°C (-4°F to +140°F) (CR-1/3N, 2CR-1/3N)  
-20°C to +70°C (-4°F to +158°F) (other models)
- UL recognition (File No. MH13421) 
- Adopting pictograms to prevent accidental ingestion by infants: CR2016, CR2025, CR2032  
(IEC 60086-4: KEEP OUT REACH OF CHILDREN) 



## Applications

- Electronic notebooks
- Electronic automobile keys (keyless entry)
- LED-related devices
- Memory backup power source



## Others

- Available with secondary processing (multiple cells, tabs, connectors, etc) in accordance with use.
- Nickel-plated phosphor bronze or stainless steel should be used for battery contact terminal materials. To ensure stable contact conditions, contact pressure of several newtons is recommended when attaching.

## Specifications

Model	CR2016	CR2025	CR2032	CR-1/3N	2CR-1/3N	
In accordance with IEC standard nomenclature	CR2016	CR2025	CR2032	CR11108	2CR13252	
Nominal Voltage	3V	3V	3V	3V	6V	
Nominal Capacity <sup>※1</sup>	90mAh	170mAh	240mAh	160mAh	160mAh	
Standard Discharge Current	0.2mA	0.2mA	0.2mA	2.7mA	2.7mA	
Dimensions	Diameter	20.0mm	20.0mm	20.0mm	11.6mm	13.0mm
	Height	1.6mm	2.5mm	3.2mm	10.8mm	25.2mm
Approx. Weight	1.7g	2.5g	3.0g	3.3g	9.1g	

※Expected life is 5 years at room temperature.

Expected life is reference only and is not intended to imply any guarantee or warranty. Actual life depends on condition of use.

※Consult with FDK when considering connection method and multiple-cell configuration.

※1 Nominal capacity is determined at an end voltage of 2.0V (4.0V for 2CR-1/3N) when the battery is allowed to discharge at a standard current level at +23°C.



The contents of this catalogue are not guaranteed.

# Coin-type Rechargeable Lithium Batteries

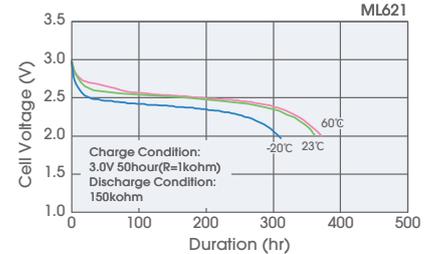
Manganese composite oxide for the positive electrode material and lithium aluminium alloy for the negative electrode material.



## Features

- Compatible with reflow soldering (Max. 260°C) (ML614R)
- Stable operating voltage of 2.5V.
- Capable of being charged at 2.8V.
- Low self-discharge rate and long life  
Self-discharge rate: Approx. 2% per year at room temperature.
- Usable over a wide temperature range.  
Operational temperature range : -20°C to +60°C (-4°F to +140°F)
- UL recognition (File No. MH13421) 

Temperature Characteristics



## Applications

- Security cameras
- Dashboard cameras
- Keyless entry
- GPS
- Backup power source for RTC



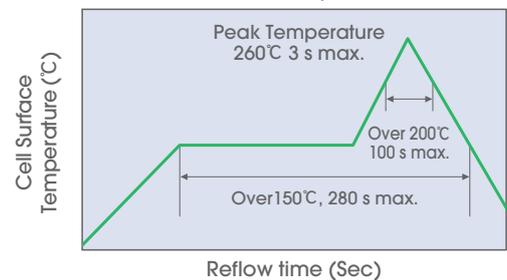
## Others

- Available with secondary tab processing in accordance with use.
- ML614R is only available with dedicated tab only.
- Nickel-plated phosphor bronze or stainless steel should be used for battery contact terminal materials. To ensure stable contact conditions, contact pressure of several newtons is recommended when attaching.

## Specifications

Model	ML614	ML621	ML614R (ML614R-TT31)
Nominal Voltage	3V	3V	3V
Nominal Capacity <sup>*1</sup>	3.4mAh	5.8mAh	2.5mAh
Standard Charge/Discharge Current	0.015mA	0.015mA	0.005mA
Max. Pulse Current <sup>*2</sup>	1.5mA	1.5mA	-
Charge/Discharge Cycle Characteristics	300 (Discharge depth of 20%)		300 (Discharge depth of 10%)
Charging Method	Constant voltage charge 2.8~3.25V		2.8~3.1V
Dimensions	Diameter	6.8mm	6.8mm
	Height	1.4mm	2.1mm
Approx. Weight	0.16g	0.22g	0.19g
for Reflow Soldering	-	-	○

Recommended reflow pattern for ML614R



※Expected life is 5 years at room temperature.

Expected life is reference only and is not intended to imply any guarantee or warranty. Actual life depends on condition of use.

※Consult with FDK when considering connection method and multiple-cell configuration.

※1 Nominal capacity is determined at an end voltage of 2.0V when the battery is allowed to discharge at a standard current level at +23°C.

※2 Current value for obtaining 2.0V cell voltage when pulse is applied for 15 seconds at 50% discharge depth (50% of the nominal capacity) at +23°C.

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# Lithium batteries Handling Precautions for Safe Use

Lithium batteries contain combustible materials such as lithium metal, lithium alloy and organic solvent. Improper handling can lead to leakage, heat generation, explosion or fire. To prevent accidents, pay sufficient attention to the following precautions. Also refer to them when you are describing in your instruction manual how to handle lithium batteries used in your application.

These batteries are not available for sale to individual customers. If you wish to replace the battery in your device, please contact the store where you purchased the device or the device manufacturer.

## ●Thin-type primary and coin-type primary/rechargeable lithium batteries

### ⚠ WARNING

- 1. Do not charge (Primary batteries: CF and CR series).**  
When the battery is charged, gas is generated inside and it raises internal pressure, resulting in leakage, heat generation, explosion or fire.
- 2. Do not charge with unspecified conditions (Rechargeable batteries: ML series)**  
Doing so may generate gas inside the battery, resulting in leakage, heat generation, explosion or fire.
- 3. Keep batteries out of the reach of children**  
In case of ingestion of a cell or battery, seek medical assistance promptly. Swallowing coin cells or batteries can cause chemical burns, perforation of soft tissue, and in severe cases can cause death. They need to be removed immediately if swallowed.
- 4. Do not throw batteries into fire. Do not heat or disassemble batteries.**  
Doing so may damage insulation, which can lead to leakage, heat generation, explosion or fire.
- 5. Do not use the battery with the ⊕ and ⊖ terminals reversed.**  
Doing so may cause the battery to leak, overheat, rupture, or catch fire due to abnormal reactions during charging or short circuit.
- 6. If leaked liquid gets in the eyes, it can cause eye injury.**  
Wash the eye(s) with clean water and receive medical care immediately.
- 7. If leaked liquid gets into the mouth, rinse the mouth well and consult with a doctor immediately.**
- 8. Do not connect the ⊕ and ⊖ of the battery with a wire, etc., and do not carry or store the battery with metal necklaces, hairpins, etc., as this may cause the batteries to short-circuit, resulting in excessive current flow and battery leakage, overheating, rupture, or fire.**
- 9. If this battery is leaking or has a strange odor, keep it away from fire immediately as the leaked electrolyte may ignite.**
- 10. Do not solder directly on the battery.**  
Doing so may damage insulation, which can lead to leakage, heat generation, explosion or fire.
- 11. Make sure to insulate battery terminals with vinyl tape when disposing of or storing them to avoid short circuit.**  
Putting batteries together disorderly or in contact with metal objects may cause short-circuit, resulting in leakage, heat generation, explosion or fire.
- 12. Do not use new and used batteries together. Do not use different types of batteries together.**  
Difference in their characteristics may cause leakage, heat generation, explosion or fire.
- 13. Do not stick batteries on the skin.**  
Doing so may cause skin injury.

### ⚠ CAUTION

- 1. Do not drop the battery, give it a strong shock, or deform it.**  
Doing so may cause leakage, heat generation, explosion or fire.
- 2. Avoid contact with water.**  
Doing so may cause leakage, heat generation, explosion or fire.
- 3. Make sure to insert batteries in the application so that the positive ⊕ and negative ⊖ terminals may not come into contact with metal parts of the application.**
- 4. Read the application's instruction manual and precautions carefully before use.**  
The specifications or performance of these batteries may not match some usages or types of application.
- 5. Store and use the batteries away from direct sunlight, high temperature and high humidity**  
Otherwise, it can lead to leakage, heat generation, explosion or fire. If stored or used in such environment, batteries may suffer from deteriorated performance and life.
- 6. Do not use the batteries if you notice heat generation, deformation or other abnormal situations while using or storing them.**  
These can lead to leakage, heat generation or explosion.
- 7. For proper disposal of batteries, refer to local regulations.**

## ●Cylindrical-type primary lithium batteries

### ⚠ WARNING

- 1. Do not charge.**  
When the battery is charged, gas is generated inside and it raises internal pressure, resulting in leakage, heat generation, explosion or fire.
- 2. Do not use batteries for unspecified purposes.**  
Different terminal structure may suffer from contact failure. Differences in specifications may damage the battery or application, which can lead to leakage, heat generation, explosion or fire.
- 3. Do not throw batteries into fire. Do not heat or disassemble batteries.**  
Doing so may damage insulation, which can lead to leakage, heat generation, explosion or fire.
- 4. Do not insert batteries with the positive ⊕ and negative ⊖ polarities reversed.**  
Make sure the polarities are in the right position when inserting the batteries into the application. When using 3 or more batteries, the application may operate even though one of the batteries is improperly inserted but this may cause leakage, heat generation, explosion or fire.
- 5. If leaked liquid gets in the eyes, it can cause eye injury.**  
Wash the eye(s) with clean water and receive medical care immediately.
- 6. If leaked liquid gets into the mouth, rinse the mouth well and consult with a doctor immediately.**
- 7. Do not connect the (+) and (-) of the battery with a wire, etc., and do not carry or store the battery with metal necklaces, hairpins, etc., as this may cause the batteries to short-circuit, resulting in excessive current flow and battery leakage, overheating, rupture, or fire.**  
Difference in their characteristics may cause leakage, heat generation, explosion or fire.
- 8. If this battery is leaking or has a strange odor, keep it away from fire immediately as the leaked electrolyte may ignite.**
- 9. Do not use new and used batteries together. Do not use different types of batteries together.**  
If the positive ⊕ and negative ⊖ terminals come into contact with metal objects, short circuit occurs and excessive current flows at once resulting in leakage, heat generation, explosion or fire. When carrying or storing the batteries, avoid direct contact with metal objects such as bracelets or key chains by putting them in a separate container.
- 10. Do not solder directly on the battery.**  
Doing so may damage insulation, which can lead to leakage, heat generation, explosion or fire.
- 11. Do not remove or damage the outer label of the battery.**  
Doing so may cause the battery to short-circuit, resulting in leakage, overheating, rupture, or fire.
- 12. Do not drop the battery, give it a strong shock, or deform it.**  
Doing so may cause the battery to leak, overheat, explode, or catch fire.
- 13. Do not deform the battery in any way.**  
Doing so may damage insulation or gas release vent resulting in leakage, heat generation, explosion or fire.
- 14. Make sure to insulate battery terminals with vinyl tape when disposing of or storing them to avoid short circuit.**  
Putting batteries together disorderly or in contact with metal objects may cause short-circuit, resulting in leakage, heat generation, explosion or fire.

### ⚠ CAUTION

- 1. Do not use or leave the batteries exposed to heat such as a front of window in direct sunlight or inside a car under sunlight.**  
Doing so may cause leakage, heat generation, explosion or fire.
- 2. Avoid contact with water.**  
Doing so may cause leakage, heat generation, explosion or fire.
- 3. Read the application's instruction manual and precautions carefully before use.**  
The specifications or performance of these batteries may not match some usages or types of application.
- 4. Remove batteries from the application if you do not use it for a long time.**
- 5. Store and use the batteries away from direct sunlight, high temperature and high humidity.**  
Otherwise, it can lead to leakage, heat generation, explosion or fire. If stored or used in such environment, batteries may suffer from deteriorated performance and life.
- 6. Do not use the batteries if you notice heat generation, deformation or other abnormal situations while using or storing them.**  
It can lead to leakage, heat generation or explosion.
- 7. Check batteries inside emergency-use applications periodically.**  
Applications may not work properly in emergency due to batteries' deterioration, or may be damaged by leakage.
- 8. For proper disposal of batteries, refer to local regulations.**

# Requests Regarding Quality Assurance and Ensuring Safety

When considering the following please contact FDK beforehand to ensure quality and safety standards:

- |   |  |
|---|--|
| <ul style="list-style-type: none"><li>① Connecting batteries in series or in parallel on circuits.</li><li>② Molding batteries with resin.</li><li>③ Welding terminals onto batteries.</li><li>④ Cleaning or welding by means of ultrasonic.</li><li>⑤ Setting the battery life for your application.</li></ul> | <ul style="list-style-type: none"><li>⑥ Using the batteries for medical devices.</li><li>⑦ Using other power supply on the same circuit with thin-, coin- and cylindrical-type primary lithium batteries.</li><li>⑧ Using contact method such as battery holder for thin- and cylindrical-type primary lithium batteries and coin-type rechargeable lithium batteries.</li></ul> |
|---|--|

## Notes on Transportation

Lithium metal batteries are classified as Class 9 dangerous goods in the United Nations Recommendations, and given UN numbers UN3090 and UN3091. All the relevant requirements of UN Recommendations as well as other related regulations such as IATA Dangerous Goods Regulation (IATA-DGR) and International Maritime Dangerous Code (IMDG-Code) shall be met for transportation of lithium metal batteries as described below. Please note that air transportation regulations for lithium batteries will be amended irregularly as required and that it is important to refer to the latest IATA-DGR (64th edition).

### Special Notes Regarding FDK Lithium Batteries

- All of our lithium batteries are categorized as lithium metal batteries from a transportation regulation perspective.
- Our lithium batteries and shipping packages meet the requirements of subsection 38.3, Part III, UN Manual of Test and Criteria.
- If you need a certificate for transportation, please contact our department through your purchasing channel.
- If you pack lithium batteries for shipping, please note that you will be responsible for related tests and certificates.
- Some countries, regions, or shipping agents may set their own rules of transportation, so please contact them in advance.

### Air transportation of our lithium batteries

#### 1. Transporting of batteries (UN3090)

Lithium metal batteries are classified into two categories based on Packing Instruction 968 of the IATA Dangerous Goods Regulations (IATA-DGR) as follows. Lithium metal batteries are permitted to be transported by cargo aircraft only.

##### • Transporting as Section I A

Cells containing more than 1g of lithium or batteries (battery packs) containing more than 2g of lithium are applicable to Section IA, and it is permitted to transport them as Class 9 Dangerous Goods when they comply with all requirements<sup>※1</sup> of the transport conditions of Section IA.

#### 2. Transporting as Packed with equipment or Contained in equipment (UN3091)

If lithium content of cells is no more than 1g or total lithium content of batteries is no more than 2g, they are applicable to Section II and permitted for transport as exempted Class 9 Dangerous Goods when they comply with all requirements<sup>※1</sup> of the transport conditions of Section II. If the lithium content is over the aforementioned values, they are applicable to Section I and permitted for transport as Class 9 Dangerous Goods when they comply with all requirements<sup>※1</sup> of the transport conditions of Section I.

※1: For more detailed information of transport conditions, please refer to IATA-DGR 64th edition

### Maritime transportation of our lithium batteries

#### 1. Transporting as batteries (UN3090) and, Packed with equipment / Contained in equipment (UN3091)

Lithium metal batteries and, lithium metal batteries packed with equipment or contained in equipment are classified into two categories according to the International Maritime Dangerous Goods Code (IMDG-Code) as follows.

##### • Transporting as Dangerous Goods

Cells containing more than 1g of lithium or batteries (battery packs) containing more than 2g of lithium are applicable to Class 9 Dangerous Goods, and it is permitted to transport as Class 9 Dangerous Goods when they comply with all requirements<sup>※2</sup> of the transport conditions of Special provisions 230 (Packing instruction 903).

##### • Transporting as exempted Dangerous Goods

Cells containing no more than 1g of lithium or batteries (battery packs) containing no more than 2g of lithium are applicable to exempted Class 9 Dangerous Goods, and it is permitted to transport them without using a Class 9 Dangerous Goods container (packing group II) when they comply with all requirements<sup>※2</sup> of the transport conditions of Special provisions 188.

※2: For more detailed information of transport conditions, please refer to the latest version of IMDG-Code.

## Notes on Environmental Regulations <sup>※</sup> Information as of June 2023

In line with the increasing awareness of the need to protect the global environment, unified environmental regulations such as RoHS, WEEE or REACH in EU countries and various local regulations in other countries have been established. In EU countries the RoHS Directive is not applied to batteries used in Electrical and Electronic Equipment (EEE), whereas the Battery Directive (2006/66/EC) is applied. Batteries are subject to the WEEE Directive while they are mounted in EEE. Please note that regulations applicable to batteries are different from those for EEE. For further information, please consult with FDK. Our lithium batteries do not contain mercury, lead, cadmium, hexavalent chromium or other hazardous materials. However, lithium batteries contain flammable substances such as lithium metal and organic electrolyte, and safety requirements for lithium batteries may be set by local governments. Please confirm your local rules and regulations when you dispose of lithium batteries.

### Certificate of Conformity to Battery Directive

We hereby certify that our lithium batteries delivered to you conform to Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators (referred to as the "Battery Directive"). According to the Directive, the following restricted substances and labeling requirement are set down and our batteries conform to these requirements. In addition, easy removal of batteries from the application is also set down in the Directive, therefore your taking into consideration this requirement in the design stage of your applications is appreciated.

#### 1. Restricted substances (Article 4)

Batteries containing the following substances with more than the designated content by weight are required to be placed on EU market:  
Mercury: 5ppm / Cadmium: 20ppm

#### 2. Labeling (Article 21)

A mark meaning separate waste collection should be placed on all batteries and accumulators in EU member states. We put marks on the body of the battery for cylindrical and prismatic batteries, or on the packaging for small batteries such as coin-type batteries.

#### 3. Easy removal of waste batteries (Article 11)

Manufacturers shall design products in such a way that waste batteries can be readily removed. This requirement is deemed to comply with in such cases where batteries can be removed by end-users or independent qualified professionals.

### Response to RoHS 2 Directive

#### 1. Basic view

The recital 14 of RoHS 2 Directive explicitly states the following:  
"This Directive should apply without prejudice to Union legislation on safety and health requirements and specific Union waste management legislation, in particular Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and Regulation (EC) No 850/2004." This means the Battery Directive has precedence over the RoHS 2 Directive for batteries and accumulators. Therefore, we are not in a position to submit a certificate or an agreement for batteries and accumulators regarding conformity with the RoHS 2 Directive. We appreciate your understanding.

#### 2. Restricted substances

RoHS 2 Directive regulates the restriction of maximum concentration value by weight in homogeneous materials<sup>※</sup> of electrical and electronic equipment (EEE) in Annex II as shown below. ※ homogeneous materials means uniform composition that cannot be disjointed or separated into different materials by mechanical actions such as unscrewing, cutting, crushing, grinding and abrasive processes.

i. Mercury 0.1% / ii. Lead 0.1% / iii. Cadmium 0.01% / iv. Cr+6 0.1% / v. PBBs 0.1% / vi. PBDEs 0.1% / vii. DEHP 0.1% / viii. BBP 0.1% / ix. DBP 0.1% / x. DIBP 0.1%

Since RoHS 2 Directive does not apply to batteries and accumulators as aforementioned, the restriction of use of the above 10 materials is not applicable to our batteries. However, our lithium batteries do not contain any of these 10 materials, so we can deliver an analysis report for our batteries simply as a certificate of non-use. The rule about homogeneous materials described in article 3 (20) of RoHS 2 Directive is not applicable to batteries and accumulators, so we provide data analysis reporting based on battery weight.

### Regarding the Battery Regulation (EU) 2023/1542

All of our batteries comply with the Battery Regulation (EU) 2023/1542.<sup>※1</sup>

To indicate compliance with the Battery Regulation (EU) 2023/1542, we put the CE mark on the body or packaging of our batteries.<sup>※2</sup>

※1 Only the requirements applicable as of August 2024.

※2 Except for some batteries not intended for the European market.

For further details regarding compliance with the Battery Regulation, please contact us.

### Correlation between Battery Directive and WEEE/RoHS Directive

If you are concerned about the correlation between Battery Directive (applied to batteries and accumulators) and the WEEE/RoHS Directives (also known as EU environmental regulations), we would like to introduce the website of the Battery Association of Japan (BAJ), where you can find BAJ's official view on this matter. <https://www.baj.or.jp/battery/recycle/recycle09.html>

### Response to REACH Regulation

#### 1. Is it necessary to register a battery in accordance with the REACH Regulation?

Batteries are categorized as "articles" by REACH. Articles 7 (1) and 7 (5) of the REACH Regulation state that a producer or an importer of articles should register to the agency any substance contained in those articles, if both the following conditions are met:

- a) The substance is intended to be released under normal or reasonably foreseeable conditions of use, and
- b) The total weight of the substance contained in the article(s) exceeds one ton per producer or importer per year.

Batteries are not such articles that contain substances that are intended to be released, but rather batteries are intended to supply electricity generated by an internal chemical reaction of the positive and negative electrodes. Therefore condition a) is not applicable and there is no obligation to register to the agency. For this reason, we cannot submit a certificate or an agreement for batteries in regard to compliance with the REACH Regulation. We appreciate your understanding.

#### 2. Our obligation to the REACH Regulation

(1) Duty to communicate information on substances in articles

Article 33 states "Any supplier of an article containing a substance meeting the criteria in Article 57 and identified in accordance with Article 59(1) in a concentration above 0.1 % weight by weight (w/w) shall provide the recipient of the article with sufficient information, available to the supplier, to allow safe use of the article including, as a minimum, the name of that substance."

(2) Duty of compliance with restricted substances

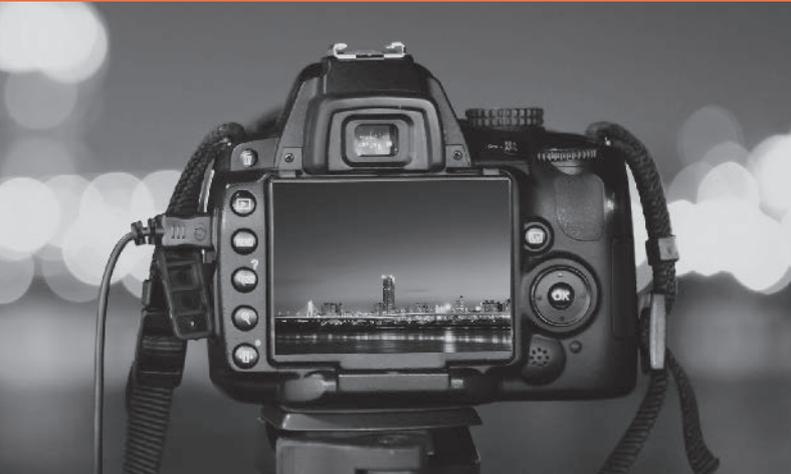
Article 67 states "A substance on its own, in a preparation or in an article, for which Annex XVII contains a restriction shall not be manufactured, placed on the market or used unless it complies with the conditions of that restriction." We comply with these requirements.

### Response to SVHC Candidates

SVHC candidates can become subject to authorization and as a result, it is important to be aware of the most recent situation. We always monitor relevant information such as news releases from ECHA and carefully check whether newly announced SVHC candidate substances are contained in our components or not. Confirmation from our suppliers can take multiple days, so we would appreciate your understanding in case our response to any queries is delayed. Please feel free to contact our sales representatives for requests about SVHC candidate list.



# ALKALINE BATTERIES



# These alkaline batteries are long lasting, easy to use, and safe.

Alkaline batteries perform a critical function in devices used throughout our lives. With high power and long duration delivering optimal performance in support of various devices, our batteries are proudly made in Japan according to the highest quality standards.



WASHIZU Plant

## Usable temperature range of FDK's alkaline batteries



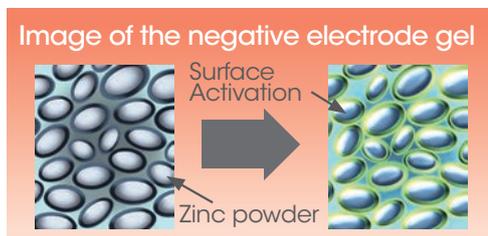
※ Usable temperature range depends on condition of use, please contact us.

## Features of FDK's alkaline batteries FDK's original technologies

With FDK's unique technologies, we have achieved improvements in discharge performance, storage performance, and leak resistance.

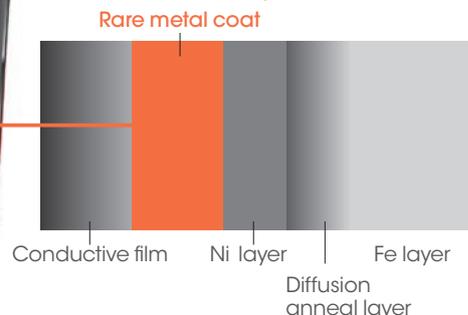
### Passivation block technologies

By adopting this technology, we have enhanced the reaction efficiency of zinc at the end of discharge, improving light to moderate load and continuous discharge performance.



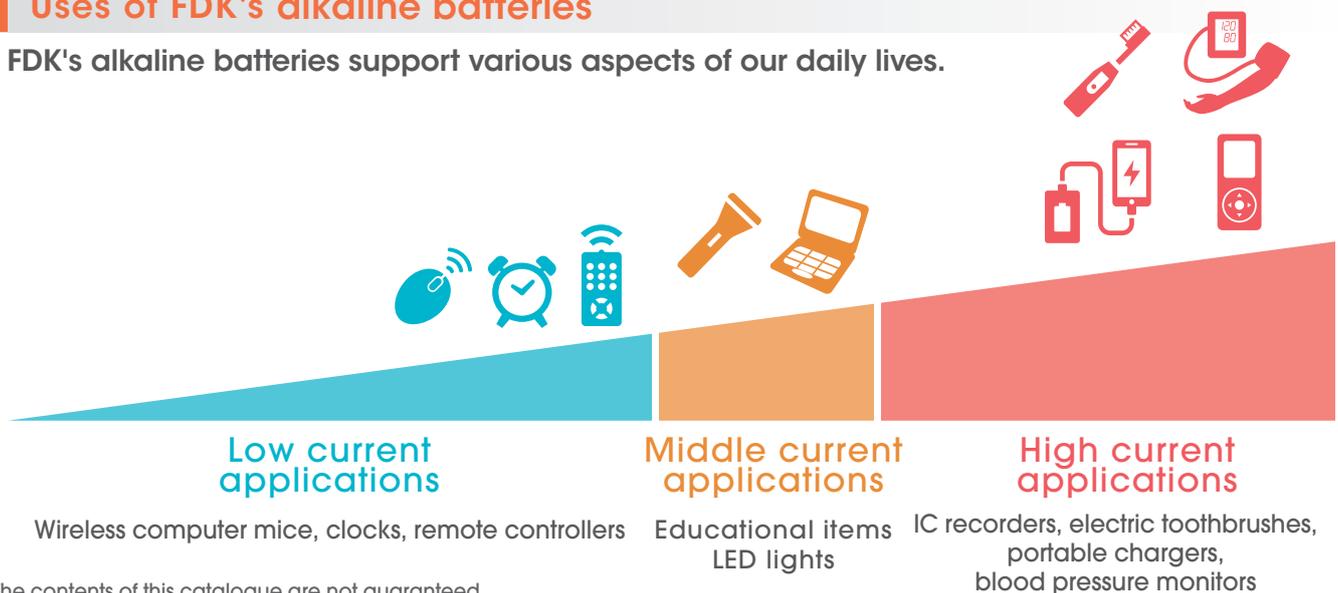
### Adoption of rare metal coating

By adopting a rare metal coating between the conductive film and the nickel-plated layer, internal resistance increase due to oxidation is prevented, and the dissolution of Fe from the battery internals, which could cause leakage, is suppressed.



## Uses of FDK's alkaline batteries

FDK's alkaline batteries support various aspects of our daily lives.



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# Alkaline Batteries - Premium

Best Performance for All Devices.



## Features

A high-performance alkaline battery engineered for longer life and superior high current performance.

**10 years storage**  
\*1

**One-year warranty**

**Leakage protection**  
\*2

\*1."Expiration of a recommended usage period" is indicated on the battery body of the cell. It is recommended to use the batteries within this period.  
\*2.Unique technology sealing structure (D, C size), improved corrosion resistance of cathode can, gasket made of special material (AAA, AA size)

## Applications

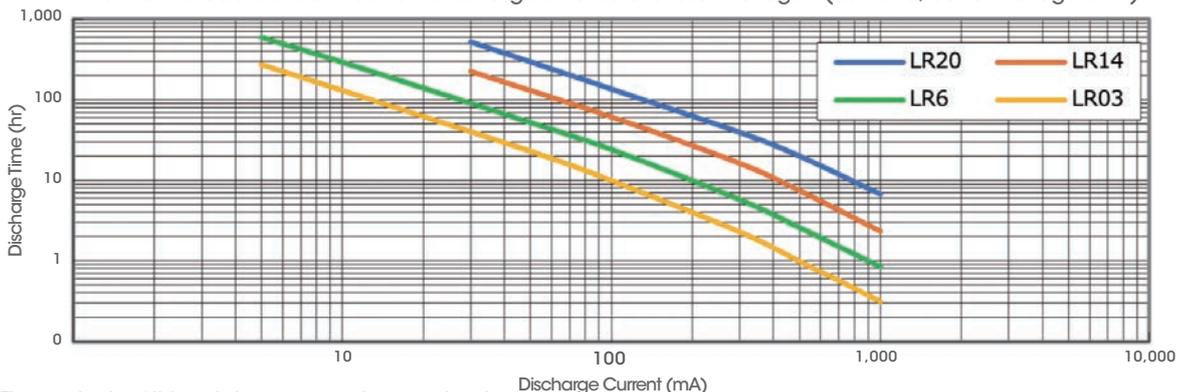
- digital still cameras, electric shavers, LED lanterns, gaming devices, electronic dictionaries, LED flashlights, portable chargers, IC recorders, electric toothbrushes, remote controllers, wireless computer mice, clocks



## Technical data & discharging times

Model		LR20 Premium	LR14 Premium	LR6 Premium	LR03 Premium
Nominal Voltage		1.5V	1.5V	1.5V	1.5V
Outer Dimensions	Height	60.9mm	49.6mm	50.1mm	44.2mm
	Diameter	33.0mm	25.6mm	14.1mm	10.3mm

Premium Grade Constant Current Discharge Characteristics off Voltage (20 ± 2° C, Cut-off Voltage 0.9V)



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# Alkaline Batteries - High Power

Great for High Drain Devices.



## Features

A high-performance alkaline battery with enhanced high current performance.

**5 years storage**  
\*1

**One-year warranty**

**Leakage protection**  
\*2

\*1."Expiration of a recommended usage period" is indicated on the battery body of the cell. It is recommended to use the batteries within this period.  
\*2.Unique technology sealing structure (D, C size), improved corrosion resistance of cathode can, gasket made of special material (AAA, AA size)

## Applications

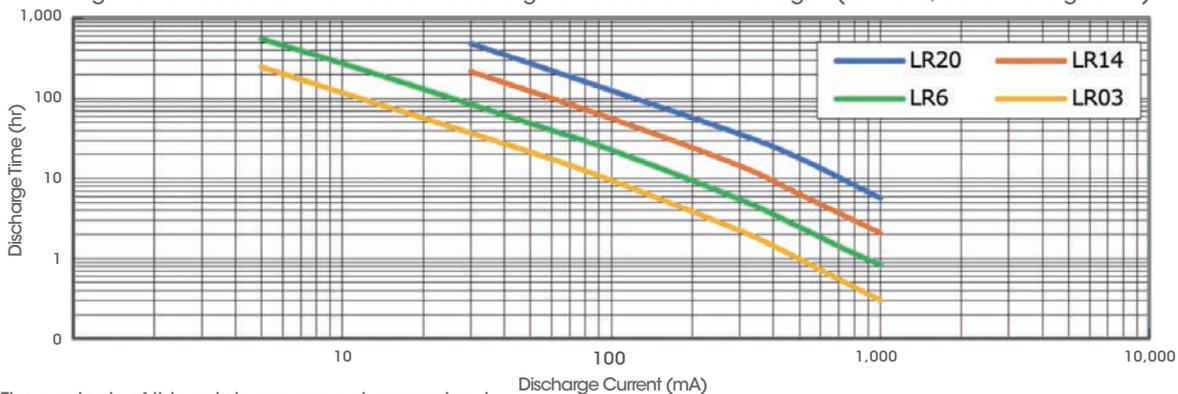
- digital still cameras, electric shavers, LED lanterns, gaming devices, electronic dictionaries, LED flashlights, portable chargers, IC recorders, electric toothbrushes



## Technical data & discharging times

Model		LR20 High Power	LR14 High Power	LR6 High Power	LR03 High Power
Nominal Voltage		1.5V	1.5V	1.5V	1.5V
Outer Dimensions	Height	60.9mm	49.6mm	50.1mm	44.2mm
	Diameter	33.0mm	25.6mm	14.1mm	10.3mm

High Power Grade Constant Current Discharge Characteristics off Voltage (20 ± 2° C, Cut-off Voltage 0.9V)



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# Alkaline Batteries - Long Life

Power for Everyday Life.



## Features

Providing the best value for everyday-use applications.

**5 years storage**  
\*1

**One-year warranty**

**Leakage protection**  
\*2

1. "Expiration of a recommended usage period" is indicated on the battery body of the cell. It is recommended to use the batteries within this period.  
\*2. Unique technology sealing structure (D, C size), improved corrosion resistance of cathode can, gasket made of special material (AAA, AA size)

## Applications

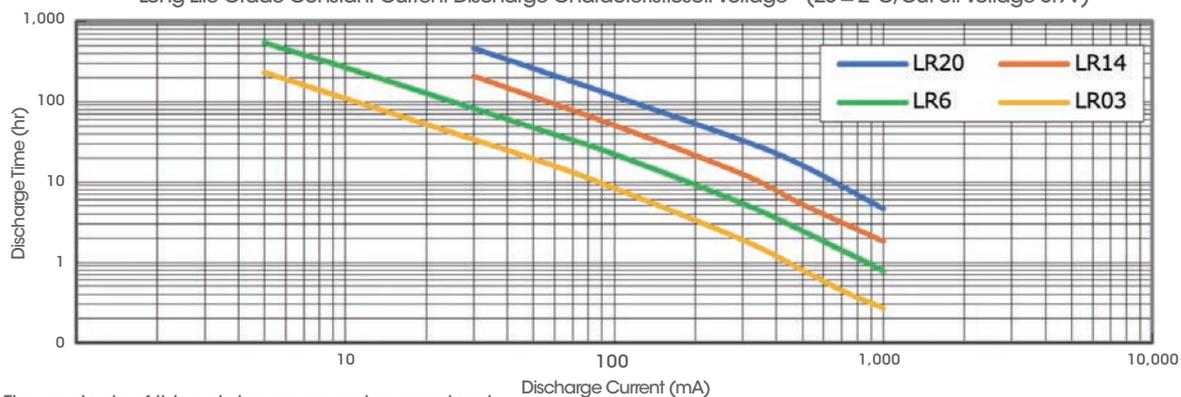
• remote controllers, wireless computer mice, clocks, educational items



## Technical data & discharging times

Model		LR20 Long Life	LR14 Long Life	LR6 Long Life	LR03 Long Life
Nominal Voltage		1.5V	1.5V	1.5V	1.5V
Outer Dimensions	Height	60.9mm	49.6mm	50.1mm	44.2mm
	Diameter	33.0mm	25.6mm	14.1mm	10.3mm

Long Life Grade Constant Current Discharge Characteristics of Voltage (20 ± 2° C, Cut-off Voltage 0.9V)



The contents of this catalogue are not guaranteed.

# Alkaline Batteries Handling Precautions for Safe Use

Alkaline batteries are a safe and reliable power source when used correctly. However, if mishandled, the batteries may leak, overheat, or even rupture. Therefore, please pay attention to the following precautions.

## ⚠ WARNING

- In case of such an emergency where the solution gets into the eye, wash immediately with plenty of water and receive medical treatment from a doctor.
- Keep the batteries out of reach of infants and young children. If a battery is swallowed, consult a doctor immediately.
- Do not dispose of batteries in fire. When batteries are disposed of in fire, the heat build-up may cause explosion.
- Do not use the battery with the positive (+) and negative (-) terminals reversed. Batteries which are incorrectly placed into equipment may short-circuit, or be charged. This can result in a rapid temperature rise and venting leading to leakage and explosion.
- If you lick the alkaline battery solution, rinse your mouth immediately and consult a doctor.
- If the alkaline battery solution comes into contact with your skin or clothing, it may cause skin damage. Immediately rinse it off with plenty of clean water, such as tap water.
- Do not connect the positive (+) and negative (-) terminals of the battery with a wire or carry or store the battery together with metal objects such as necklaces or hairpins. This may cause a short circuit, allowing excessive current to flow, which could lead to leakage, overheating, or rupture of the battery.
- Do not mix new batteries with used or old batteries, or batteries of different brands or types. Due to differences in their characteristics, there is a risk of leakage, overheating, or even rupture of the batteries.
- This battery is not designed for recharging. Charging it could damage the insulation or internal structure, potentially causing the battery to leak, overheat, or rupture.
- Please remove and dispose of the depleted battery from the device immediately. Leaving a used-up battery connected to the device for an extended period may cause gas buildup, which could lead to battery leakage, overheating, rupture, or damage to the device.
- If you are not using the device for an extended period, please remove the battery. Gas buildup from the battery may cause leakage or damage the device.

## ⚠ CAUTION

- Do not peel off or damage the battery's outer label. Doing so may cause a short circuit, potentially leading to leakage, overheating, or rupture.
- Do not subject the battery to impact by dropping or throwing it. This could cause the battery to leak, overheat, or rupture.
- Do not deform the battery. Damage to the insulation or gas vent could cause the battery to leak, overheat, or rupture.
- When using the battery in a device with a fully sealed structure, please follow the instructions in the device's user manual.
- Do not directly solder batteries. When a battery is directly soldered, it may be damaged by heat. This may result in leakage, explosion, etc.
- Do not use or leave the battery in high-temperature places, such as under direct sunlight or inside a car on a hot day. This may cause the battery to leak, overheat, or rupture.
- When storing or disposing of the battery, please insulate the terminals with tape or similar material. Mixing the battery with other batteries or metal objects may cause leakage, overheating, or rupture.
- If you notice any unusual signs such as heat generation, deformation, or damage to the outer label during use or storage of the battery, please stop using it. There is a risk of leakage, overheating, or rupture.
- Do not wet the battery with water or other liquids. This may cause the battery to overheat or lead to corrosion on the battery terminals.
- Batteries may not be compatible with the specifications or performance requirements of certain devices. Please follow the instructions and precautions in the device's manual to ensure the correct use of the appropriate battery for your device.
- Use and store the battery in a place away from direct sunlight, high temperatures, and high humidity. Exposure to such conditions may cause the battery to leak and could also reduce its performance and lifespan.
- Please regularly check the batteries in emergency devices or those used for emergency purposes. If the device is not maintained, the device may become unusable when needed, or the battery leakage may damage the device.
- This battery can be disposed of as general non-burnable waste. However, if there are any local regulations, please follow those rules for disposal.
- Additionally, certain batteries, such as 9V rectangular batteries, may pose a risk of external short circuits due to their terminal shape, so when disposing of the battery, please insulate the terminals with tape or similar materials.

## Precautions during handling, transportation, display, storage, and disposal

### 1. Avoid rough handling of battery cartons.

Rough handling of battery cartons may lead to battery damage and impaired electrical performance and may result in leakage, explosion or heat generation.

### 2. Batteries shall be stored in well-ventilated, dry and cool conditions.

Storage at high temperature and high humidity leads to deterioration of the battery performance and electrolyte leakage. For normal storage, the temperature should be between +10°C and +25°C and never exceed +30°C. Extreme humidity (over 95% RH for example) for sustained periods should be avoided since this is detrimental to both batteries and packaging. Batteries should not be stored near radiators, boilers or in direct sunlight.

### 3. Battery cartons should not be stacked in multiple layers (or should not exceed a specified height).

The batteries inside the lower compartment of the packaging box may become deformed and leak.

### 4. When batteries are stored in warehouses or displayed in storefronts, they should not be exposed to direct sunlight or rain water for extended periods.

Exposure to high temperature may increase performance deterioration and risk of electrolyte leakage. If batteries get wet, their insulation resistance decreases, increasing the risk of self-discharge and generation of rust.

### 5. Do not mix unpackaged batteries so as to avoid mechanical damage and/or short-circuit of each other.

When batteries are mixed together, external short circuit may occur, possibly resulting in physical damage, heat generation, leakage and/or explosion. To avoid these possible hazards, batteries should be kept in their packaging until use.

### 6. In transportation, display, and storage, please follow the first-in, first-out principle and ensure that the inventory does not remain for an extended period.

## Battery compartment guidelines

### 1. Technical Liaison

It is recommended that companies producing battery-powered equipment should maintain close liaison with the battery industry. The capabilities of existing batteries should be taken into account at design inception. Whenever possible, the battery type selected should be one included in IEC 60086-2. The equipment should be permanently marked with the IEC designation, grade and size of battery which will give optimum performance.

### 2. Battery Compartment

- a) Battery compartments should be easily accessible. Design compartments so that batteries are easily inserted and do not fall out. The dimensions and design of compartments and contacts should be such that batteries complying with this standard will be accepted. In particular, the equipment designer should not ignore the tolerances given in this standard, even if a national standard or a battery manufacturer calls for smaller battery tolerances.
- b) The design of the negative contact should make allowance for any recess of the battery terminal.
- c) Equipment intended for use by children should have battery compartments which are tamper-proof.
- d) Clearly indicate the type of battery to use, the correct polarity alignment and directions for insertion.
- e) Use the shape and/or the dimensions of the positive and negative battery terminals in compartment designs to prevent the reverse connection of batteries. Positive and negative battery contacts should be visibly different in form to avoid confusion when inserting batteries.
- f) Battery compartments should be electrically insulated from the electric circuit and positioned so as to minimize possible

damage and/or risk of injury. Only the battery terminals should physically contact the electric circuit. Care should be taken in the choice of materials and the design of contacts to ensure that effective electrical contact is made and maintained under conditions of use even with batteries at the extremes of dimensions permitted by this standard. Battery and equipment terminals should be of compatible material and low electrical resistance.

g) Battery compartments with parallel connections are not recommended since a wrongly placed battery will result in charging conditions.

h) Although batteries are very much improved regarding their resistance to leakage, it can still occur occasionally. When the battery compartment cannot be completely isolated from the equipment, it should be positioned so as to minimize possible damage.

i) The battery compartment shall be clearly and permanently marked to show the correct orientation of the batteries. The reversed placement of one battery in a set, which may result in battery leakage and/or explosion and/or fire. To minimize this hazard, battery compartments should be designed so that a reversed battery will result in no electrical circuit.

j) The associated circuitry should not make physical contact with any part of the battery except at the surfaces intended for this purpose.

k) Designers are strongly advised to refer to IEC 60086-5 for comprehensive safety considerations.

### 3. Voltage cut-off

In order to prevent leakage resulting from a battery being driven into reverse, the equipment voltage cut-off shall not be below the battery manufacturers' recommendation.

## Notes on Environmental Regulations

### Certificate of Conformity to Battery Directive

We hereby certify that our alkaline batteries delivered to you conform to Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators (referred to as the "Battery Directive"). According to the Directive, the following restricted substances and labeling requirements are set down and our batteries conform to these requirements. In addition, easy removal of batteries from the applications is also set down in the Directive, therefore your taking into consideration this requirement in the design stage of your application is appreciated.

#### 1. Restricted substances (Article 4)

Batteries containing the following substances with more than the designated content by weight are prohibited to be placed on EU market:  
Mercury: 5ppm  
Cadmium: 20ppm

#### 2. Labeling (Article 21)

A mark meaning separate waste collection should be placed on all batteries and accumulators in EU member states. We put marks on the body of the battery for cylindrical and prismatic batteries, or on the packaging for small batteries such as coin-type batteries.

#### 3. Easy removal of waste batteries (Article 11)

Manufacturers shall design products in such a way that waste batteries can be readily removed. This requirement is deemed to comply with in such cases where batteries can be removed by end-users or independent qualified professionals.

## Response to RoHS 2 Directive

### 1. Basic view

The recital 14 of RoHS 2 Directive explicitly states the following:

"This Directive should apply without prejudice to Union legislation on safety and health requirements and specific Union waste management legislation, in particular Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and Regulation (EC) No 850/2004. This means the Battery Directive has precedence over the RoHS 2 Directive for batteries and accumulators. Therefore, we are not in a position to submit a certificate or an agreement for batteries and accumulators regarding conformity with the RoHS 2 Directive. We appreciate your understanding."

### 2. Restricted substances

RoHS 2 Directive regulates the restriction of maximum concentration value by weight in homogeneous materials\* of electrical and electronic equipment (EEE) in Annex II as shown below.

\*Homogeneous materials means uniform composition that cannot be disjoined or separated into different materials by mechanical actions such as unscrewing, cutting, crushing, grinding and abrasive processes.

- i. Mercury 0.1%
- ii. Lead 0.1%
- iii. Cadmium 0.01%
- iv. Cr+6 0.1%
- v. PBBs 0.1%
- vi. PBDEs 0.1%
- vii. DEHP 0.1%
- viii. BBP 0.1%
- ix. DBP 0.1%
- X. DIBP 0.1%

Since RoHS 2 Directive does not apply to batteries and accumulators as aforementioned, the restriction of use of the above 10

materials is not applicable to our batteries. However, our alkaline batteries do not contain any of these 10 materials, so we can deliver an analysis report for our batteries simply as a certificate of non-use. The rule about homogenous materials described in article 3 (20) of RoHS 2 Directive is not applicable to batteries and accumulators, so we provide data analysis reporting based on battery weight.

## Regarding the Battery Regulation (EU) 2023/1542

All of our batteries comply with the Battery Regulation (EU) 2023/1542.<sup>\*\*1</sup>

To indicate compliance with the Battery Regulation (EU) 2023/1542, we put the CE mark on the body or packaging of our batteries.<sup>\*\*2</sup>

※1 Only the requirements applicable as of August 2024.

※2 Except for some batteries not intended for the European market.

For further details regarding compliance with the Battery Regulation, please contact us.

## Correlation between Battery Directive and WEEE/RoHS Directive

If you are concerned about the correlation between the Battery Directive (applied to batteries and accumulators) and the WEEE/RoHS Directives (also known as EU environmental regulations), we would like to introduce the website of the Battery Association of Japan (BAJ), where you can find BAJ's official view on this matter.

<https://www.baj.or.jp/battery/recycle/recycle09.html>

## Response to REACH Regulation

### 1. Is it necessary to register a battery in accordance with the REACH Regulation?

Batteries are categorized as "articles" by REACH. Articles 7 (1) and 7 (5) of the REACH Regulation state that a producer or an importer of articles should register to the agency any substance contained in those articles, if both the following conditions are met:

- a) The substance is intended to be released under normal or reasonably foreseeable conditions of use, and
  - b) The total weight of the substance contained in the article(s) exceeds one ton per producer or importer per year.
- Batteries are not such articles that contain substances that are intended to be released, but rather batteries are intended to supply electricity generated by an internal chemical reaction of the positive and negative electrodes. Therefore condition a) is not applicable and there is no obligation to register to the agency. For this reason, we cannot submit a certificate or an agreement for batteries in regards to compliance with the REACH Regulation. We appreciate your understanding.

### 2. Our obligation to the REACH Regulation

(1) Duty to communicate information on substances in articles

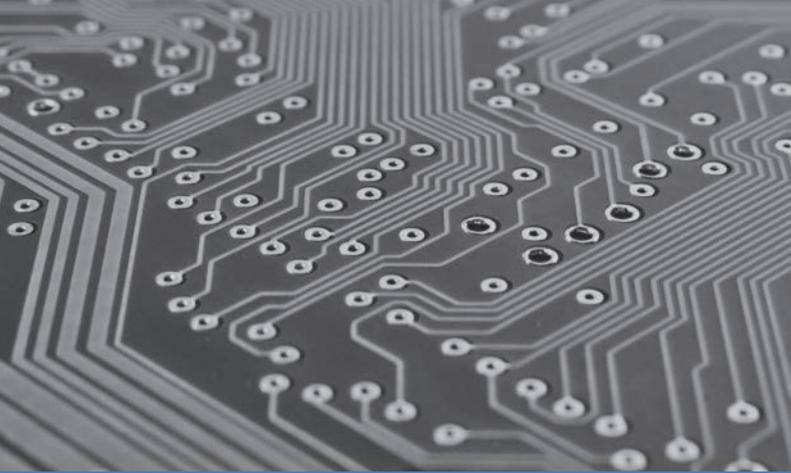
Article 33 states "Any supplier of an article containing a substance meeting the criteria in Article 57 and identified in accordance with Article 59(1) in a concentration above 0.1% weight by weight (w/w) shall provide the recipient of the article with sufficient information, available to the supplier to allow safe use of the article including, as a minimum, the name of that substance."

(2) Duty of compliance with restricted substances

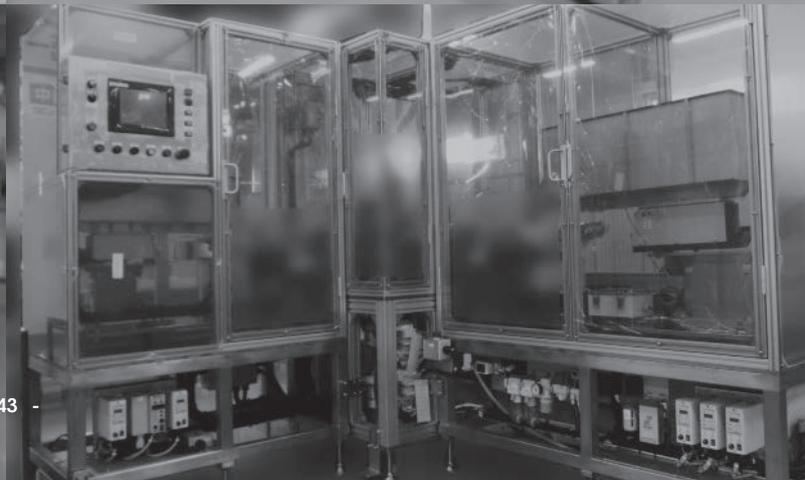
Article 67 states "A substance on its own, in a preparation or in an article, for which Annex XVII contains a restriction shall not be manufactured, placed on the market or used unless it complies with the conditions of that restriction." We shall comply with these requirements.

## Response to SVHC Candidates

SVHC candidates can become subject to authorization and as a result, it is important to be aware of the most recent situation. We always monitor relevant information such as news releases from ECHA and carefully check whether newly announced SVHC candidate substances are contained in our components or not. Confirmation from our suppliers can take multiple days, so we would appreciate your understanding in case our response to any queries is delayed. Please feel free to contact our sales representatives for requests about SVHC candidate list.



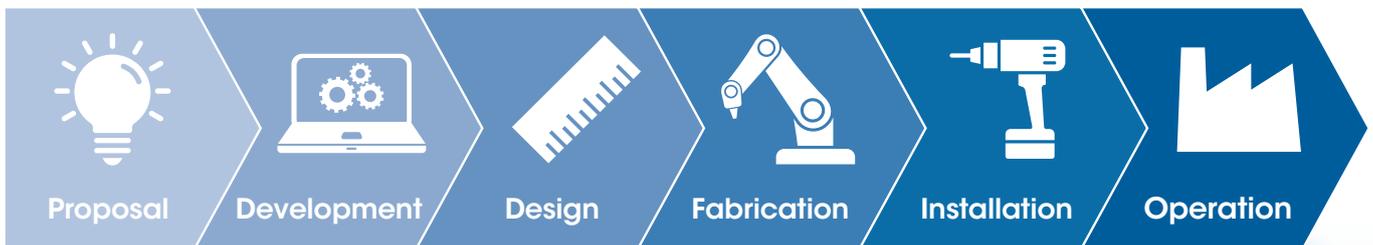
# FDK ENGINEERING



# We provide solutions to your requirements

We provide fully customized FA equipment

FDK Engineering provides total comprehensive support for customized machinery. Production efficiency can be improved through automation and FDK Engineering can provide total support from machinery design, manufacturing, and operation.



## To the Production Engineering Department,



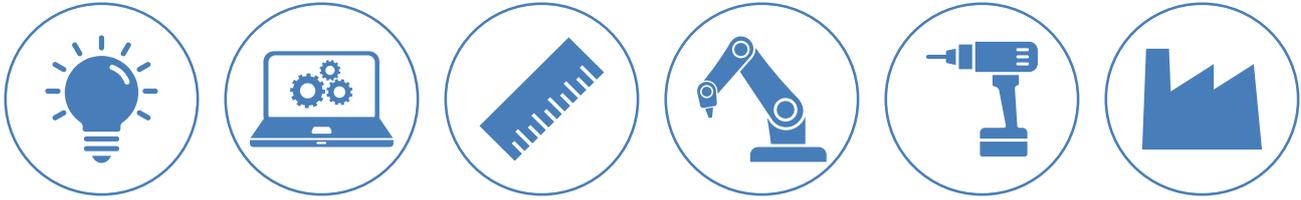
If you are having trouble deciding on the specifications for your new equipment, please contact us. We can provide you with a comprehensive proposal, including finalizing the specifications.

**SOLUTION**

## FDK Engineering offers innovative solutions to support your needs!

# Fully customized FA equipment

We provide **comprehensive support** from proposal to design, manufacturing, and operation.



Proposal

Development

Design

Fabrication

Installation

Operation

- Conceptual proposal
- Proposal for improved equipment configuration
- Providing equipment estimates based on 'I want to do this!' feedback

- Experimental and verification development
- 3D design (ICAD)
- Design considerate of safety and operability
- Custom program design
- Image processing (AI integration available)
- Traceability system

- Precise assembly
- Flexible support until stable operation
- Expedited parts processing
- Overseas supervision support
- Export documentation support
- Compliance with international standards (CE, UL)
- Capability to support medical validation

- ISO 9001 certified
- Proposals for improvement
- Post-delivery modification support
- Expedited response to unexpected troubles

## Production system

We have two assembly zones and produce equipment according to their specific characteristics.

### Assembly Area Floor Overview – Building No.1

- Dimensions: 45m×16m
- Note: Dedicated production zones available for individual customer isolation.



### Assembly Area Floor Overview – Building No.2

- Dimensions: 50m×18m
- Note: Dedicated production zones available for individual customer isolation.

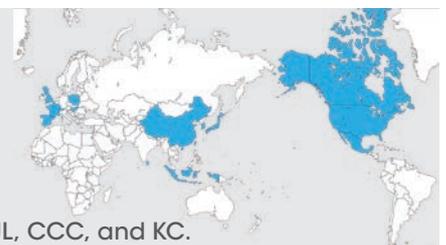


## Overseas Support

We have experiences and know-how in assisting with the startup of equipment at our customers' overseas factories. Our services include export management, document translation, and dispatching technical engineers.

## Compliance with Standards

We have experience in complying with international standards such as CE, UL, CCC, and KC.



## FA equipment installation results and applications

Category	Applications	
Automotive-related Equipment	Engine-related	Engine component assembly machines (spark plug/valve lifter), fuel injection nozzle inspection machines, rocker arm assembly machines
	Drivetrain-related	Transmission component assembly machines, clutch assembly machines, sealant dispensing equipment, ECT sensor assembly machines
	Brake Systems	ABS solenoid valve assembly line, ABS pump assembly line
	Body & Others	Collision detection sensor assembly machines, motor assembly machines, LED lamp assembly machines
Battery-related Equipment	Alkaline dry battery assembly line, lithium battery assembly line, in-vehicle lithium-ion battery assembly machines, can exterior inspection machines	
Electronics-related Equipment	Exhaust gas sensor inspection & assembly machines, industrial washing machines, seat peeling machines	
Medical, Food, and Others	IV bag assembly machines, printing inspection machines, paper & thread winding machines for Baumkuchen baking rod, imaging solution filling machines	

## Company Profile

### FDK ENGINEERING CO., LTD.

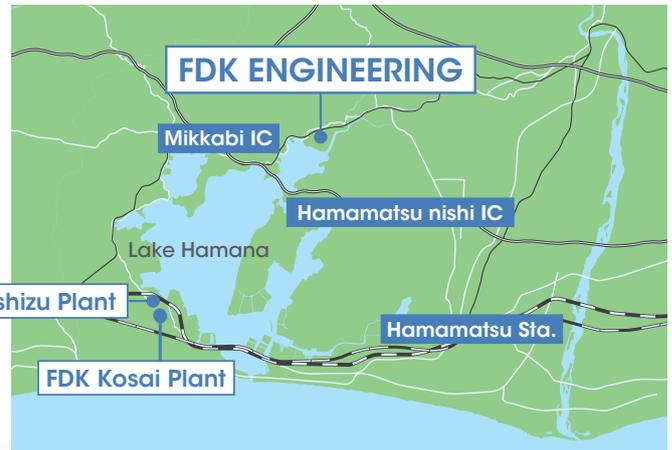
Established	1990.9.1
Capital	490 million yen
Business	

Design, Manufacturing, Installation, and Adjustment of FA Equipment

- Automotive-related Equipment
- Battery-related Equipment
- Electronics-related Equipment
- Medical-related Equipment
- Image Inspection Equipment

Authorization	Certifications and Licenses
	<ul style="list-style-type: none"> <li>● General construction (Machine and equipment installation work)</li> <li>● ISO 9001 ● ISO 14001</li> </ul>

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HP	<a href="https://www.fdk.co.jp/fdk-eng/">https://www.fdk.co.jp/fdk-eng/</a> (in Japanese)
Mail Address	eg_info@fdk.co.jp



Scan for Website



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