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Application guide

Accelerating EV charging infrastructure

muRata
INNOVATOR IN ELECTRONICS

Expanding EV Market

Are you keeping pace with the ever-evolving market?

The growth of electric vehicle sales has created a substantial demand for high-quality automotive electronics, needed to fulfill the expanding car sales and charging infrastructure.

With rising global emissions and concerns over the security of oil supplies, the demand for electric vehicles is set to increase further.

As EV technology rapidly evolves, if mass adoption is to prove viable, the surrounding infrastructure must keep pace with developments by providing reliable, consistent, and faster charging performance.



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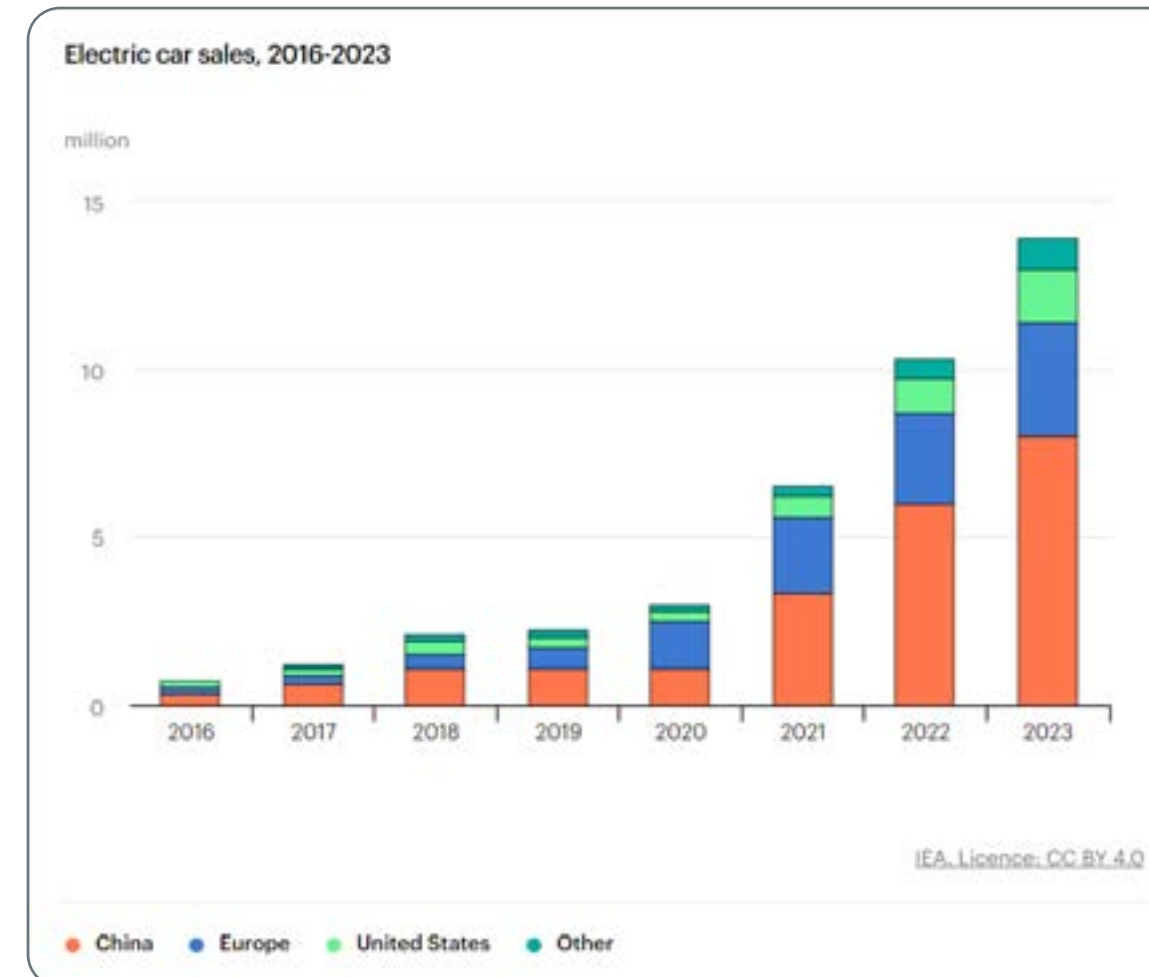
EV Market Overview

The EV market is seeing exponential growth

The Institute of Economic Affairs (IEA) found that the share of EVs in total car sales has more than tripled in the past three years – increasing from around 4% in 2020 to 14% in 2022. This strong growth is expected to continue for the foreseeable future, with market analysts such as Statista, projecting a compound annual growth rate (CAGR) of 10.07% between 2023 to 2028.

Seen by many consumers, governments, and industry leaders as a key component in combating climate change, there are widespread national policies and incentives to help continue the growth of EVs and their supporting infrastructure. The EU has set a 2035 target to ban the sale of new internal combustion engine (ICE) powered vehicles, while both the United States and China have placed significant investment in EV production to bolster sales.

 www.iea.org: [Link](#) www.statista.com: [Link](#)



Currently, China holds the majority share of new EV registrations at 60% in 2022, with the EU and United States ranking as the second and third largest markets. Norway leads in terms of market share with 80% of all their new vehicles sales coming from EVs. The total global sales of electric vehicles exceeded 10 million in 2022, and it is anticipated that this will grow to 14 million in 2023, indicating a 35% year-on-year growth.

Standalone Fact: Statista states that the electric vehicle market is projected to reach a value of UD\$561.3bn in 2023, up from UD\$176.1bn in 2020. This pattern of growth is expected to continue with a projected market value of UD\$744.7bn expected by 2026. This is up from UD\$44.7bn ten years earlier in 2016.

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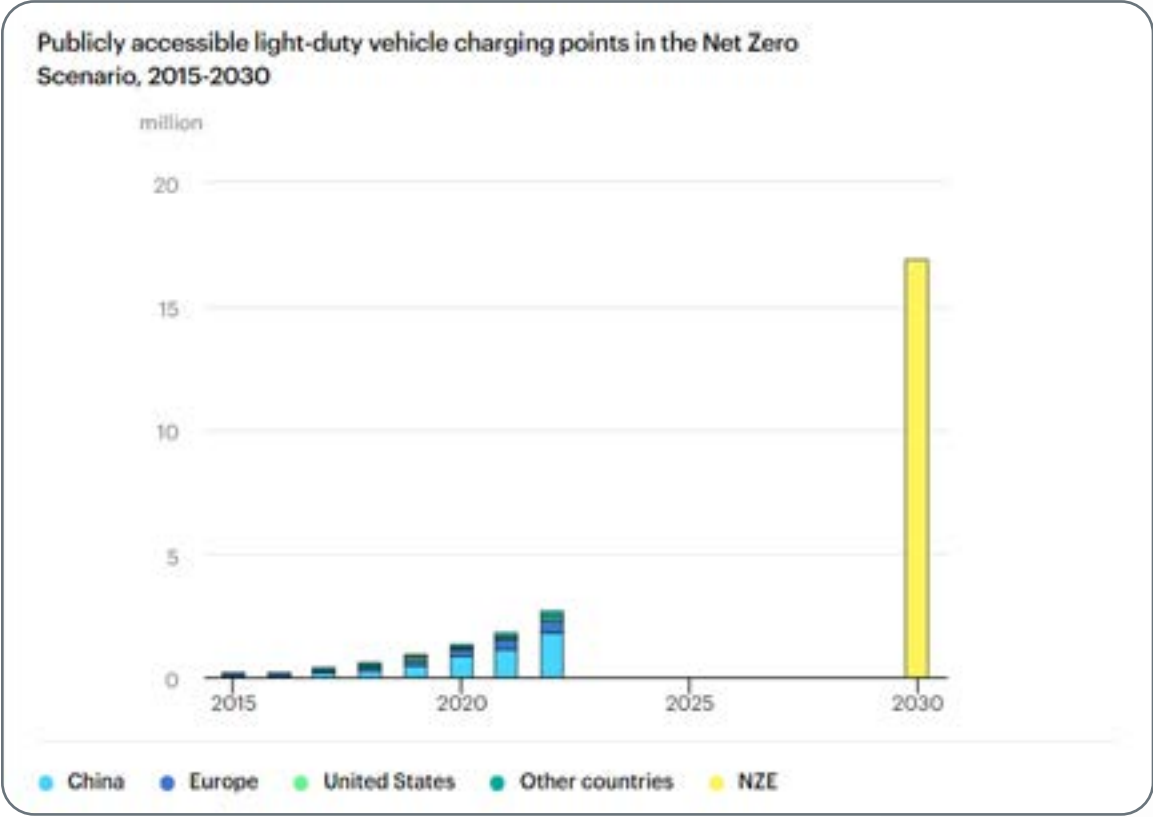
On the Charge

A look at EV charging market trends

While the overall success and continued growth of the EV market is dependent on a number of factors, the availability and performance of the supporting charging network is arguably the most important one. Although home chargers are currently meeting most of the demand, there is a growing need for publicly accessible stations to match the convenience of refueling ICE powered vehicles. Public infrastructure is crucial for EV adoption, especially in dense urban areas with limited home access.

As the number of EVs increases globally, there is a corresponding decrease in the ratio of charging points per vehicle. In order to sustain the growth of EV sales, it is imperative to meet the demand for charging by providing accessible and affordable infrastructure, whether this is through private options at homes or workplaces, or through the availability of publicly accessible stations.

 www.iea.org: [Link](#) [Link2](#)



Growing Charging Network – In 2022, a further 900,000 public charging stations were added, expanding the global infrastructure to 2.7million. While this represents a 55% increase compared to 2021, further work is needed to keep up with demand and many countries are looking to rapidly expand their infrastructure. To align with targets needed to reach global Net Zero by 2050 (as set by the Paris Agreement), the global EV charging network will need to grow to 16.9 million stations by 2030.

Infrastructure Evolution – As well as standard recharging stations for electric Light-Duty Vehicles (LDVs), global infrastructure will need to increase in performance to provide fast charging to improve the consumer experience and reduce range anxiety and waiting times at service stations. Equally Heavy-Duty Vehicle (HDV) charging networks are practically non-existent, and even existing fast 350kW stations may



not be adequate for HDVs. Several studies propose chargers of up to 1MW to recharge an electric truck within a typical 30-45 minute stop.

Increasing Performance – In 2022, the number of fast chargers increased by 330,000 with 90% installed in China alone, bringing their total stock to 760,000. Within the EU there were 70,000 fast chargers and, in the US the total is 28,000. Fast charging networks can remove significant barriers which prevents many consumers from moving to EVs from ICE powered vehicles.

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Removing EV Charging Barriers

Reliable and high-performance charging networks are underpinned by high-quality components

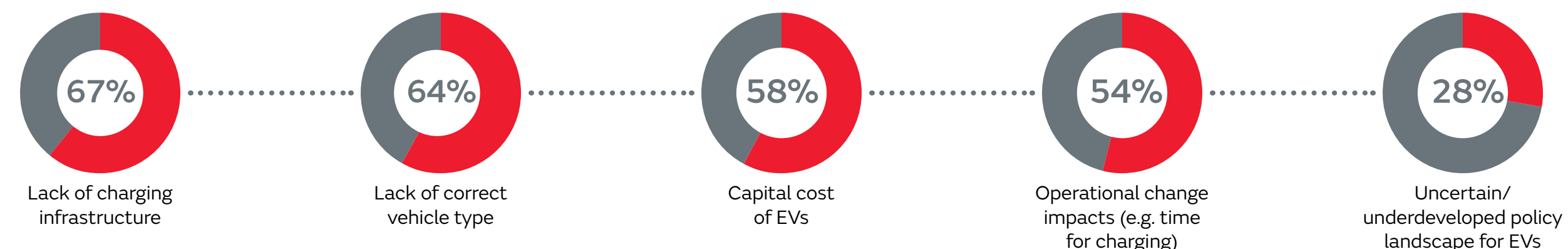
EV100 is a global initiative looking to help companies switch their owned and contracted fleets to electric vehicles by 2030. In their 2021 member's Progress and Insight Report, 67% of all respondents listed a lack of charging infrastructure as a major barrier for EV adoption. With a further 54% stating recharging times as another significant issue. While this is a glimpse into the commercial world, the consumer market is sending the same message, with supporting infrastructure often stated as a primary barrier for EV adoption.

To increase the rate of commercial and consumer EV adoption, infrastructure coverage needs to grow, chargers must increase in performance and improve reliability. In one US research report, it was found that 25% of all EV owners surveyed reported having major

issues with nonfunctional or broken stations, with network communication often being the primary cause. While in the UK only 20% of chargers are fast or ultra-fast devices, lagging behind consumer and commercial expectations.

Resolving all three issues is possible in part through correct electronic component selection. Murata's products are designed to help manufacturers create higher performing solutions at lower prices, propagating the growth of fast charging networks. Furthermore, Murata's solutions are extensively tested, trusted and inherently robust. From thermistors to conductivity modules, designers of EV charging solutions can be sure Murata solutions will provide reliable performance for years to come.

Top 5 Barriers To EV Adoption



 www.zap-map.com: [Link](#) www.arxiv.org: [Link](#) www.theclimategroup.org: [Link](#)

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Murata & Sustainability

The move towards carbon neutral starts at manufacturing

‘Keihakutansho’, which means ‘light, thin, short and small’ in Japanese, has been a core principle of Murata since our inception in 1944. It is the very embodiment of efficiency and sits alongside our company slogan ‘Innovator in Electronics’. These philosophies apply to all of our EV charging products, from our DC-DC converters to our Micro batteries. We continually look for ways to miniaturize and increase the efficiency of our solutions.

At Murata, we are committed to sustainability. Our efforts go beyond supporting the automotive industry’s aim of achieving carbon neutrality with our wide range of highly optimized products. Aligning with the United Nations Sustainability and Development Goals (SDGs), we are committed across all of our solutions and business groups to reduce material waste and conserve power through miniaturization and heightened efficiency.

 www.corporate.murata.com: [Link](#) [Link2](#) [Link3](#)

Murata encompasses many climate change and sustainability initiatives, partnerships and working groups into its core business practices. From our executive membership in the Japan Climate Leaders’ Partnership (JCLP) to our continuous responses to the Carbon Disclosure Project (CDP) climate change questionnaires, we are always exploring how our business and products can help the world become more sustainable. With such scrutiny applied to our own working practices, our customers can be sure that our EV charging infrastructure solutions lead the way in terms of efficiency and design optimization.

Standalone Fact: In December 2020, Murata joined RE100, which aims to change the power used in business activities to 100% renewable electricity by 2050. Kanazu Murata Manufacturing is the first of Murata’s facilities to achieve “100% renewable energy” and the facility includes an innovative carport with 383kW solar panels on the roof.



Kanazu Murata Manufacturing



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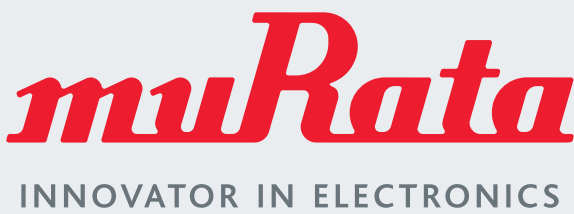
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Content Guide

Within this application guide, we will explore a carefully curated selection of Murata’s cutting-edge DC-DC transformers, connectivity modules, Crystal units, thermistors, piezoelectrics and micro batteries.

Providing a detailed look at how their reliable design and innovative features can help to accelerate your next automotive charging design.

To discover our entire electrified automotive range or to contact your local Murata representative, please visit our website [here](#).

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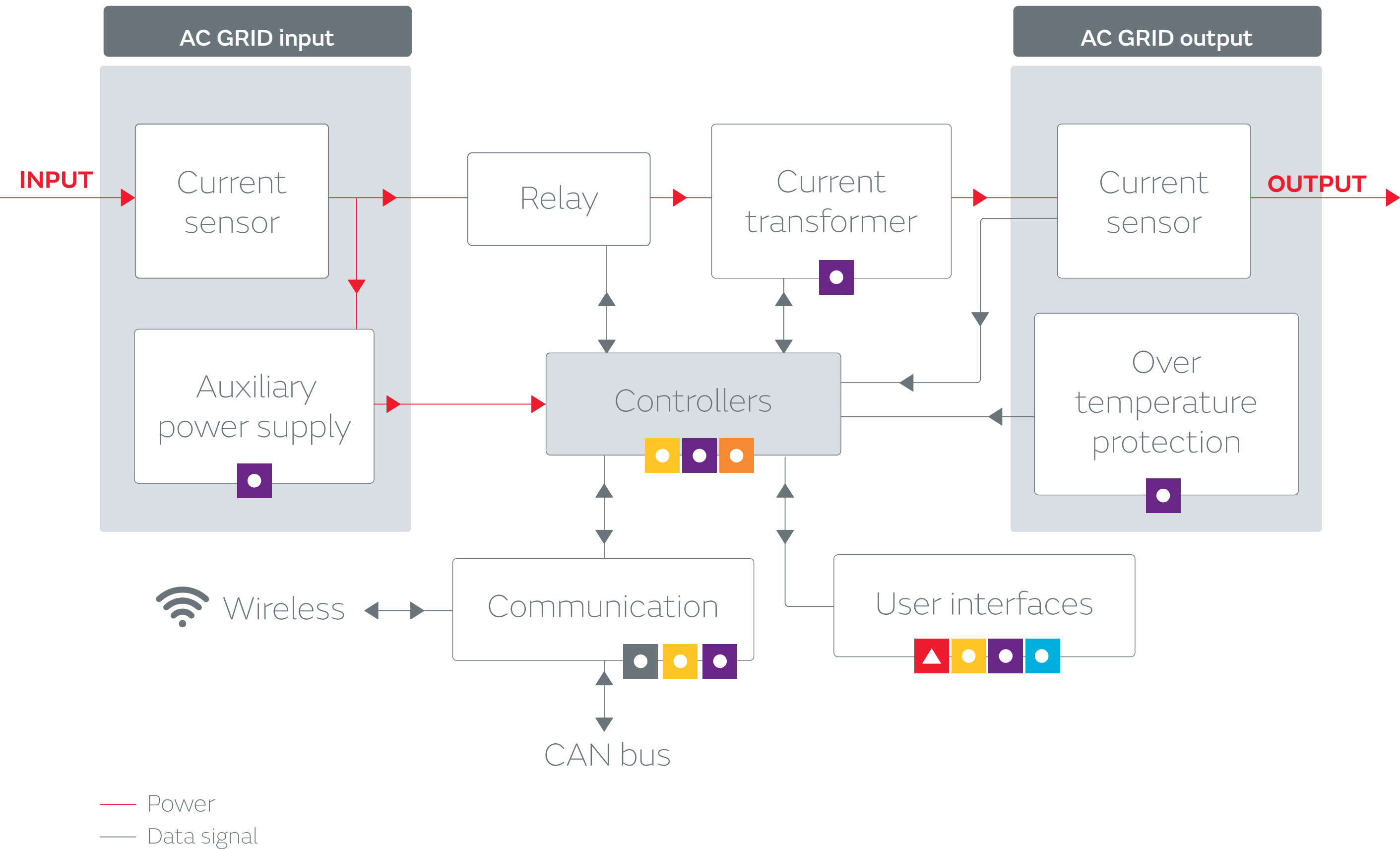


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AC Charger

Block diagram



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▲ NX* series	Power Products
● Long & Short Range	Connectivity Modules
● Crystal Units	Timing Devices
● NTC Thermistor	Sensors
● Piezoelectric Sounders	Sound Components
● CR Batteries	Micro Batteries

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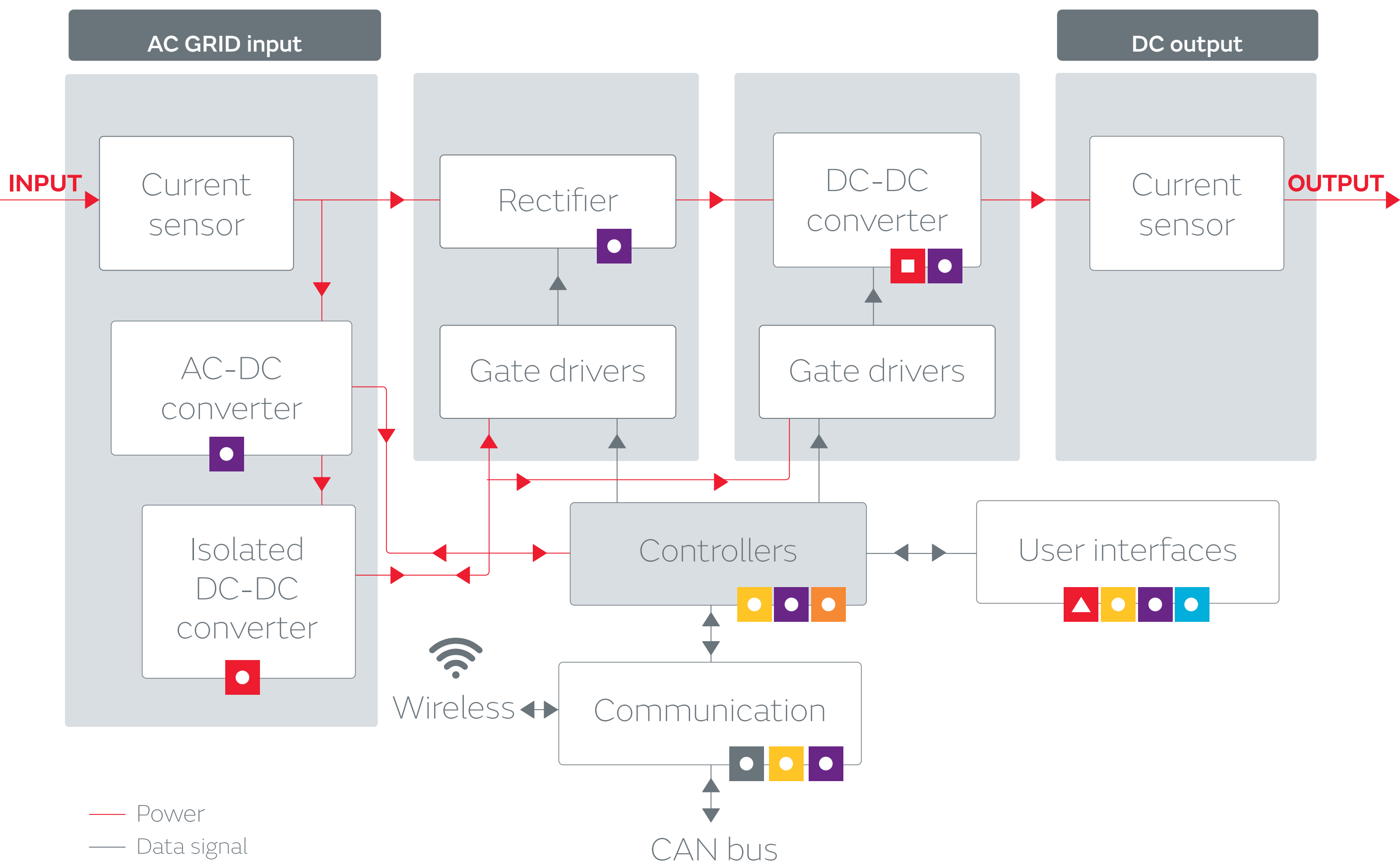
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DC Charger

Block diagram



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Murata innovation

● MG* series	▲ NX* series	■ HPHF Transformer
● Long & Short Range		
● Crystal Units		
● NTC Thermistor		
● Piezoelectric Sounders		
● CR Batteries		

- Power Products
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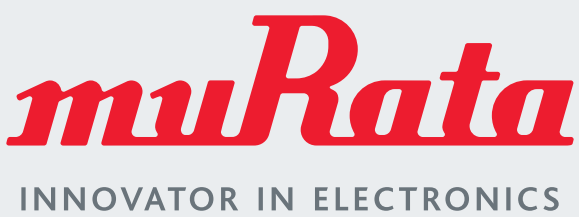
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Power Products

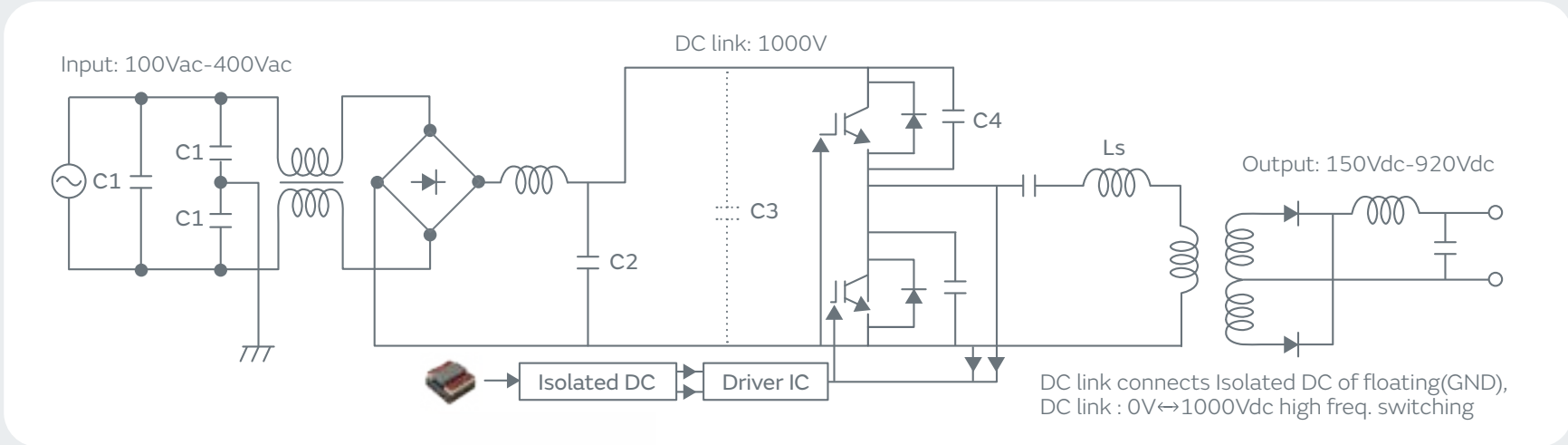
MG* series (1-6W) Isolated DC-DC converter for gate drivers

Murata’s range of DC-DC converters for gate drive power feature the high isolation and dv/dt requirements characteristics and performance needed by modern EV charging infrastructure.

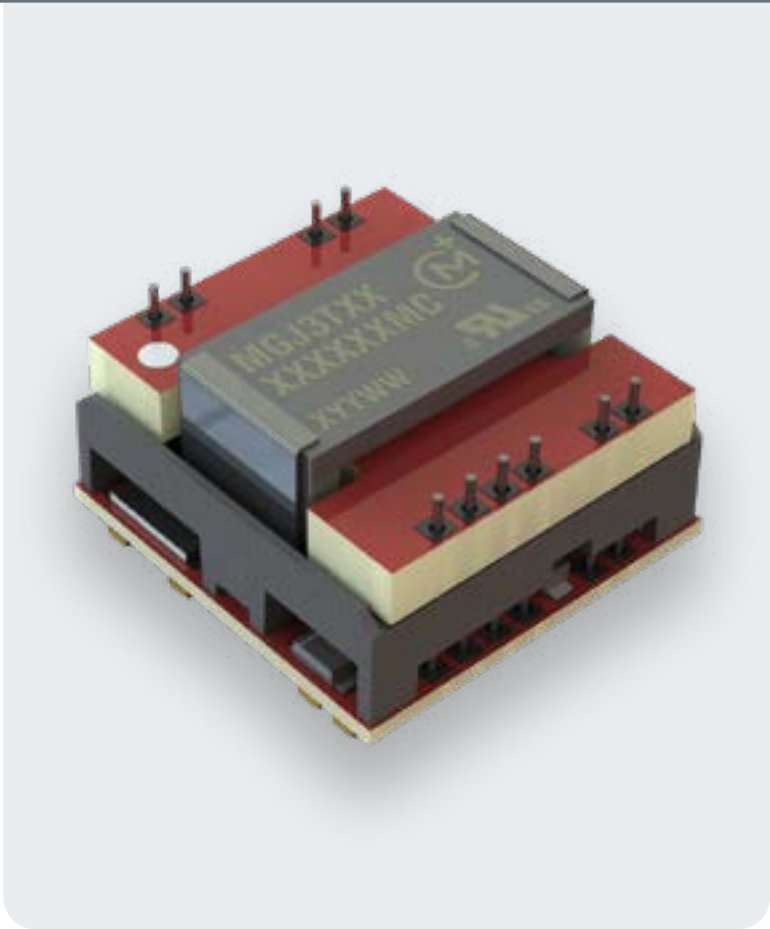
Designed for powering ‘high side’ and ‘low side’ gate drive circuits typically used in electric motors and inverters, a choice of output voltages are available, allowing for optimum drive levels and best system efficiency. Continuous barrier withstand voltages range from 1.1kVDC to 3kVDC and output powers between 1W to 6W, with the industrial grade temperature rating, EMI performance and construction ensuring a long service life and reliability within EV charging systems.

Features

- Optimized (bipolar) output voltages for MOS, IGBT, SiC & GaN gate drives
- Ultra-low isolation capacitance
- High continuous barrier withstand voltage
- Characterized partial discharge performance
- High dv/dt immunity



	MGN 1W	MGJ 1-2W	MGJ 3-6W
Isolation capacitance	2.5pF	≤ 4pF	15pF
Continuous barrier withstand voltage	1.1kVDC	3kVDC	3kVDC
Characterized CMTI	>200kV/μs	>200kV/μs	>100kV/μs
Isolation (up to)	3KVAC	5.7kVDC	10.2kVDC
Operating temp.	-40 up to 105°C	-40 up to 105°C	-40 up to 105°C
Insulation	UL62368 Reinforced (pending)	UL60950 Reinforced	UL60950 Reinforced



- Power Products
- MG* series
 - NX* series
 - High Power High Frequency

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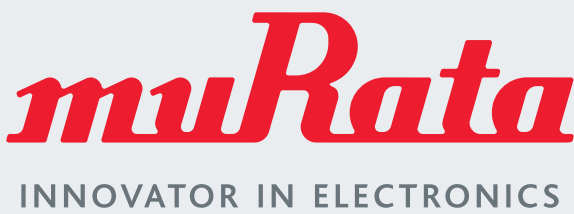
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Power Products

NXE & NXJ series Isolated DC-DC

Delivering increased performance, reducing packaging considerations, and accelerating time to market, Murata’s cost-effective isolated DC-DC converters feature a highly optimized design in elegant low-profile packaging.

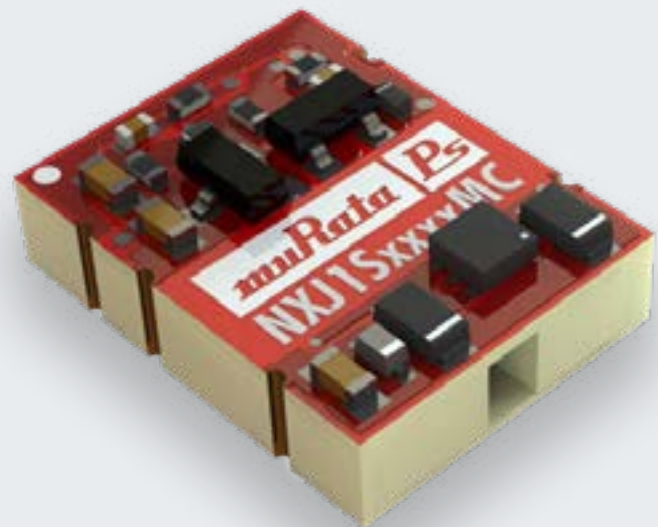
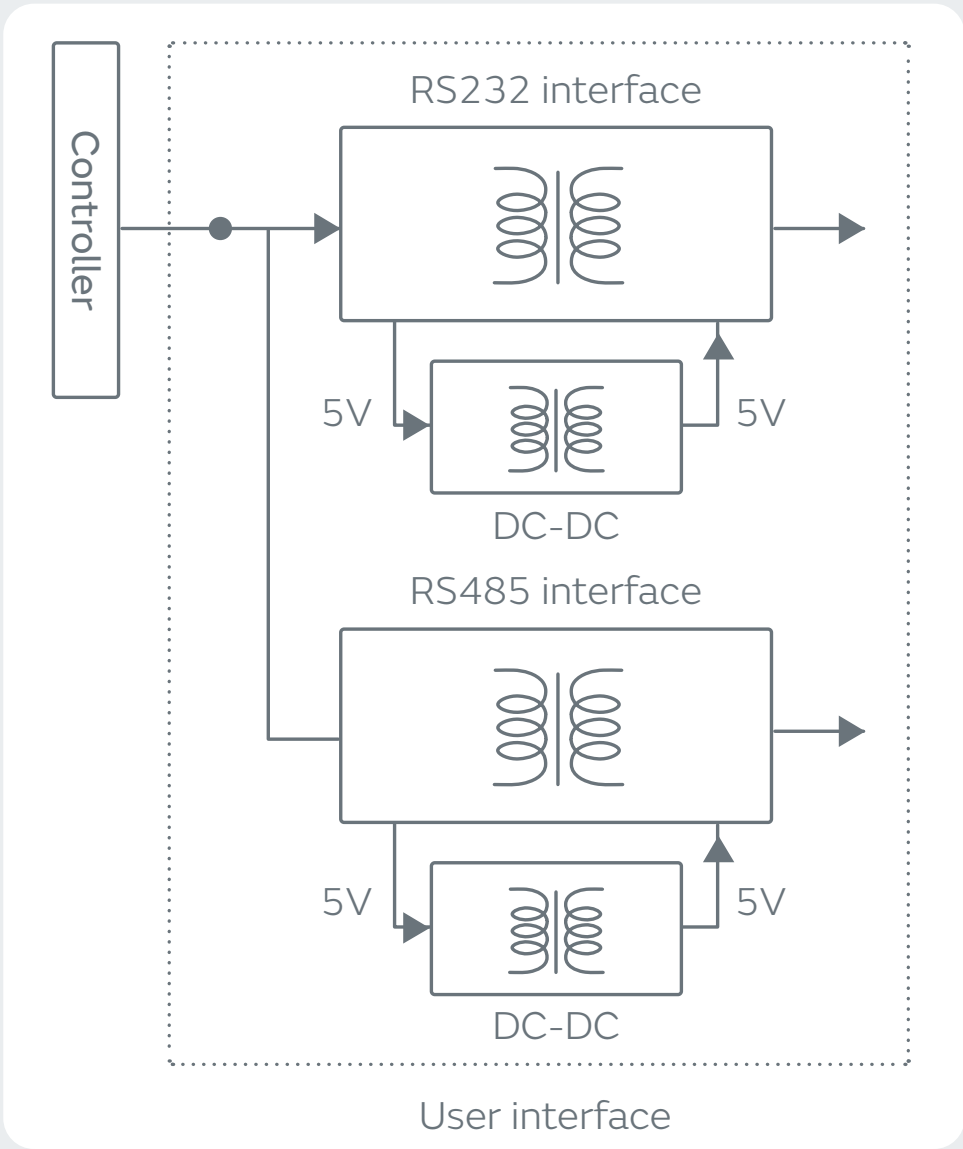
The NXE1 and NCJ1 series advanced automated manufacturing processes, providing increased product reliability and repeatability of performance. All models in the family utilize an industry standard footprint allowing for easy integration into existing EV charging systems, while the wide range of voltage options with isolate test voltages up to 5.2kVDC meet the technical requirements.

Features

- 1W & 2W versions
- Lowest profile isolated converters
- Highest isolation for footprint size (up to 5.2kVDC)
- Allows peak reflow temperature of 260°C as per J-STD-020
- Operating temperature -40 up to +110°C
- UL60950 Approval



	NXE1	NXE2	NXJ1	NXJ2
Vin	3,3,5	5,12	3,3,5,12	5,12,24
Vout:	3,3,5	5,12,15	3,3,5,12,15	5,12,15
Wattage:	1W	2W	1W	2W
Isolation test voltage:	3kVDC	3kVDC	4.2kVDC	5.2kVDC
Operating Temp:	-40 up to 110°C			
Safety:	ANSI/AAMI ES60601-1, UL60950			
	1 MOOP	1 MOOP	1 MOOP	1 MOOP & 2 MOOP



Power Products

- MG* series
- ▲ NX* series
- High Power High Frequency

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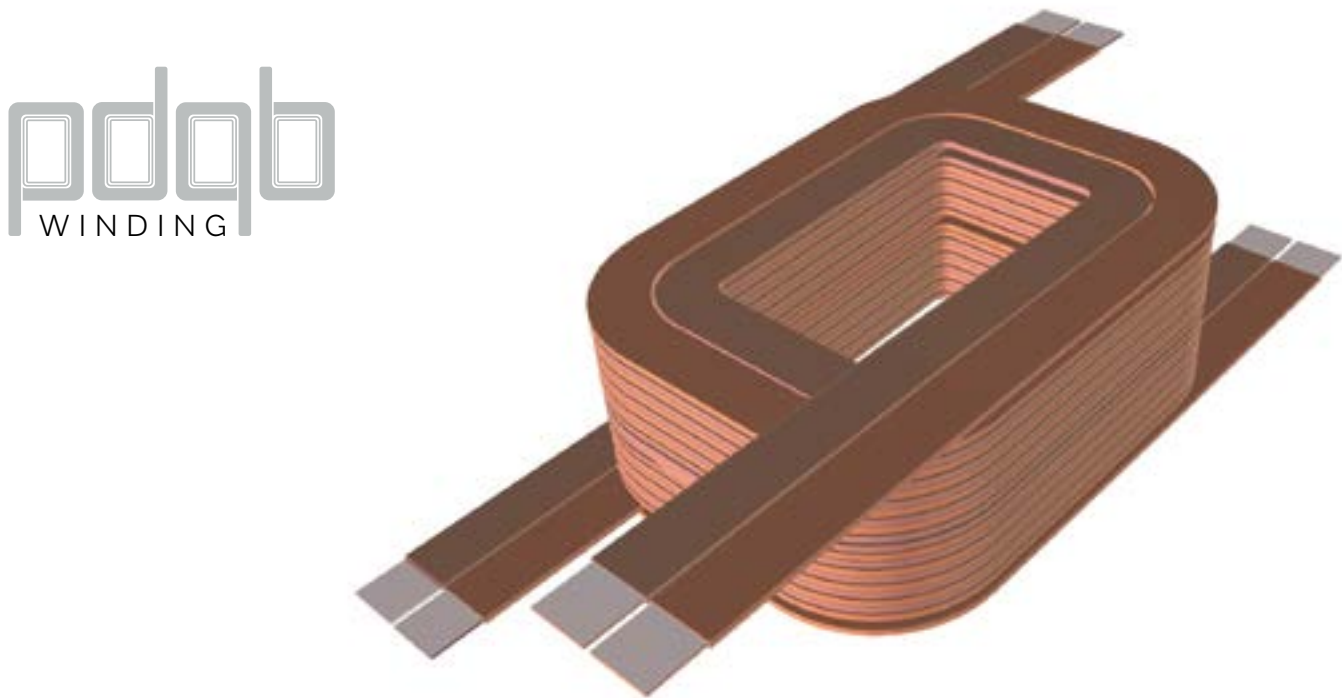


Power Products

High Power High Frequency Transformer for DC-DC converter

Murata’s patented pdqb winding technology pushes the boundaries of power conversion with efficiencies greater than 99.5% available, allowing EV electronic designers to deliver a new generation of optimized charging solutions.

This breakthrough technology practically eliminates proximity effects whilst mitigating the effects of inter-winding capacitance and other losses, allowing for higher frequencies at a higher power and in smaller packages. As a scalable solution, Murata’s pdqb transformers are available in power ratings from 30kW to 400kW, covering the full scope of slow, fast and Ultra-fast EV charging stations.

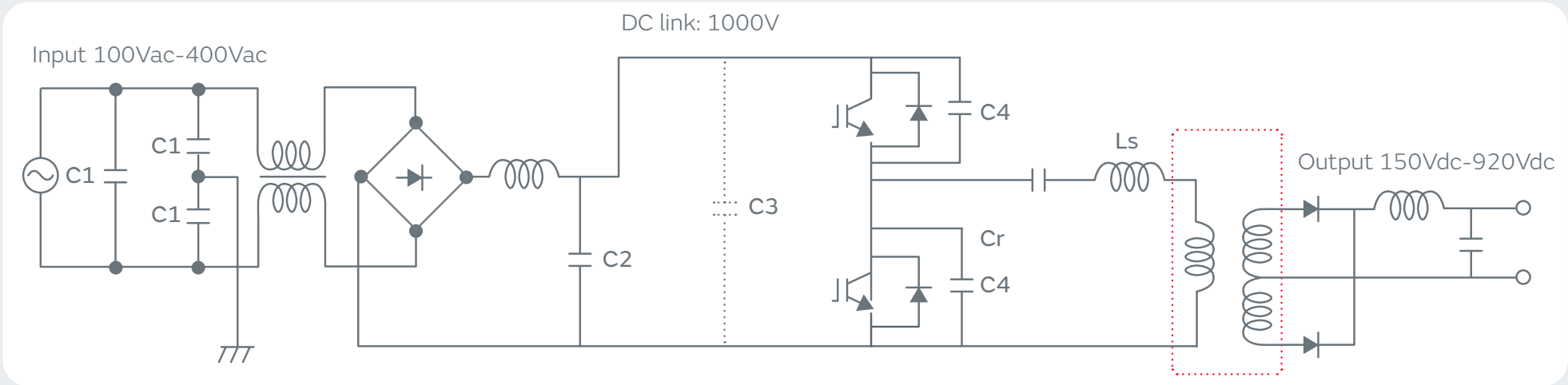


Features

- Fully customized transformers
- Compact size Ex.: 25cm*18cm*20cm (100kW, 200kHz)
- Efficiency: >99.5% achieved by proprietary pdqb winding technology
- Power rating: 30kW to 400kW
- Frequency: 20kHz to 250kHz
- Isolation: up to 6kV
- Vin: 50V to 1100V
- Vout: 50V to 1100V
- Turns ratio: 1:1 to 10:1



Power Products	
●	MG* series
▲	NX* series
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Connectivity Modules

Long Range and Short Range

From the world’s smallest Cat. M1/NB-IoT module to our co-developed by Embedded Artists M.2 evaluation boards, Murata provides a comprehensive range of connectivity solutions designed to speed up development and deliver high-performance and reliable operation.

The modules follow Murata’s ethos of miniaturization and efficiency, and feature incredibly low energy requirements in compact packaging. All the latest wireless protocols are supported from short range Wi-Fi 6 and UWB to long range NB-IoT and GNSS communication. With Murata’s modules, engineers can be sure that any charging infrastructure remains connected and operational for years to come.

Features

- Broad product line-up
- Strong partnerships IC vendors
- Multiple production locations
- 100% Pre-tested
- Certified modules
- FAE support (Global and Local)
- Online support & Forum
- RF simulation & design support

Easy evaluation using [Embedded Artist M.2 boards](#)



Long Range [Cat. M1/NB-IoT](#)

- Features:**
- Cat. M1/NB-IoT
 - Small size
 - GPS/GNSS
 - Supporting global regulation and major worldwide carriers



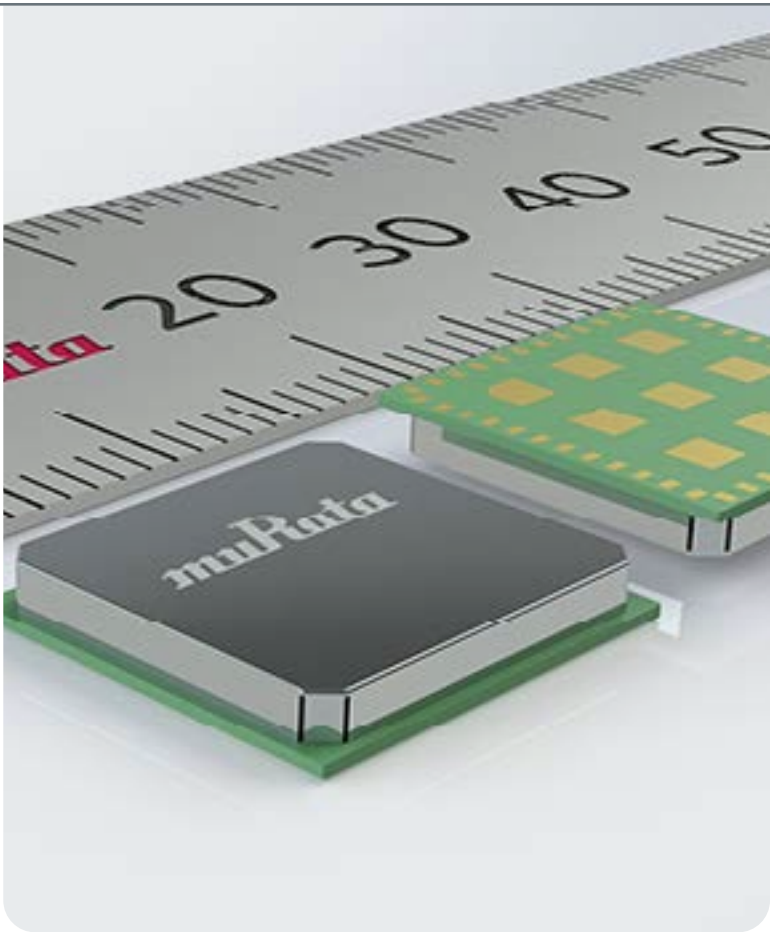
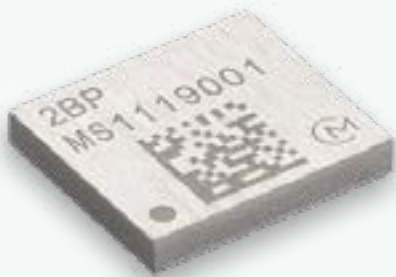
Short Range [Wi-Fi / Bluetooth](#)

- Features:**
- WiFi 4, 5, 6, 6e and 7 (UD) + BT/BLE and 802.15.4



Short Range [UWB](#)

- Features:**
- Contactless presence detection
 - High Security
 - Precise Distance & AoA measuring



Connectivity Modules

- Long Range and Short Range

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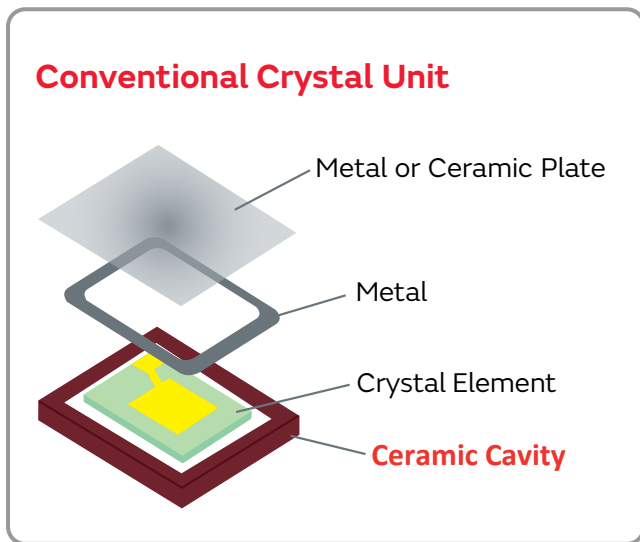


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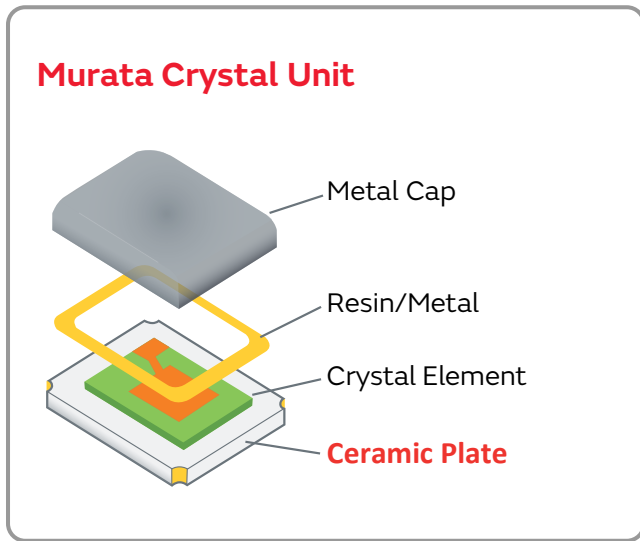
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Murata’s crystal units are made of high stability piezoelectric quartz crystal that function as a mechanical resonator.

Often used to generate clock signals, they provide essential timing for ICs and circuitry across the controllers, communication modules and user interfaces found within EV charging infrastructure. Murata’s automotive grade crystal units deliver high-quality performance in compact packaging. With their unique construction that enables greater manufacturing simplicity, higher production output and lower cost.



Ceramic cavity plate designs used in conventional Crystal Units are both complex and expensive



The unique metal cap and planar ceramic plate construction has a proven track record, increases our production output and reduces costs

Features

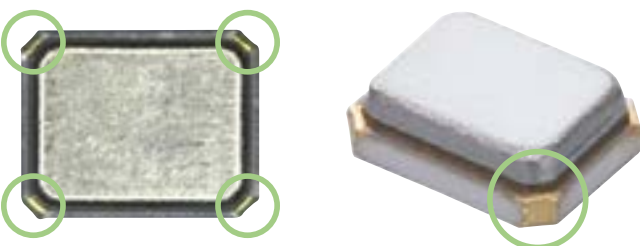
- Frequency range: 20 to 50MHz
- Component size: 2.0x1.6mm
- [Supporting your robust designs through patented and innovative technology](#)
- Realizing stable supply for your products
- [Providing evaluation support service, IC matching](#)
- Automotive grade available

AEC-Q200

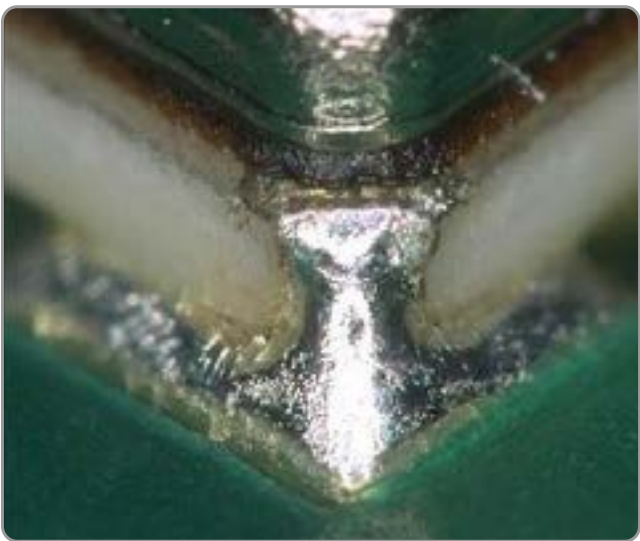
RoHS

Lead free

(Only automotive grade)



Corner cut-off design



Murata Crystals have corner electrodes for checking the solder condition in the soldering process



Timing Devices

● Crystal Units

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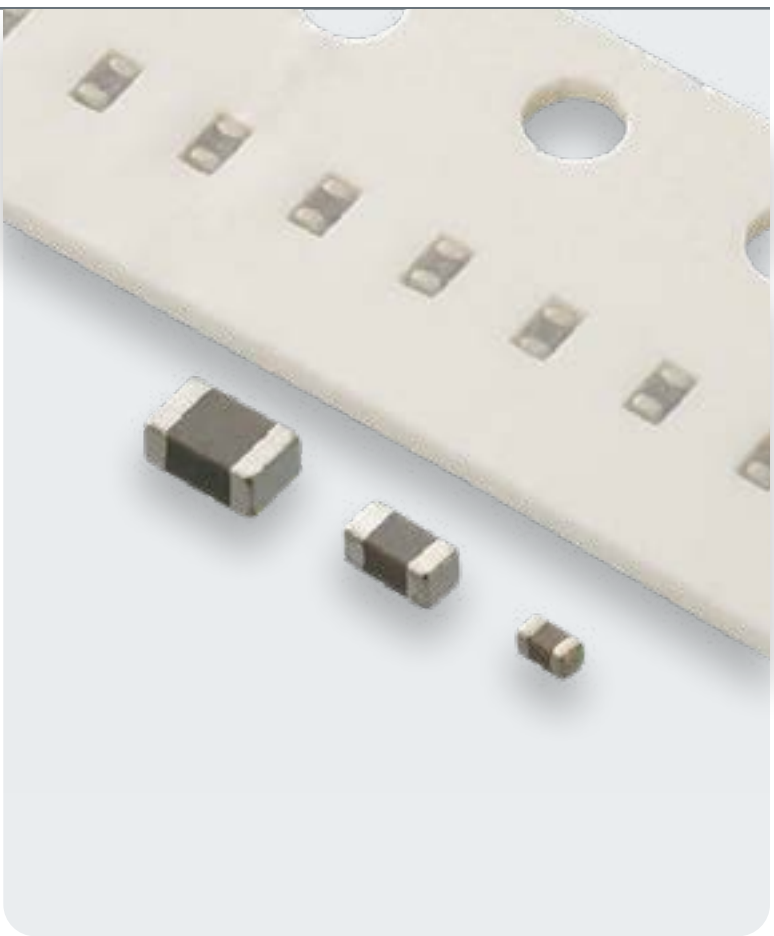
NTC Thermistor

As a world-leading manufacturer of PTC NTC thermistors, Murata consistently meets the automotive market’s expectations for high quality, best value, top-class service and reliable delivery.

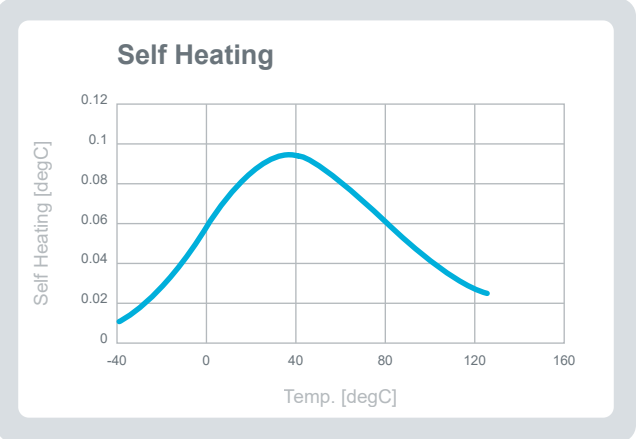
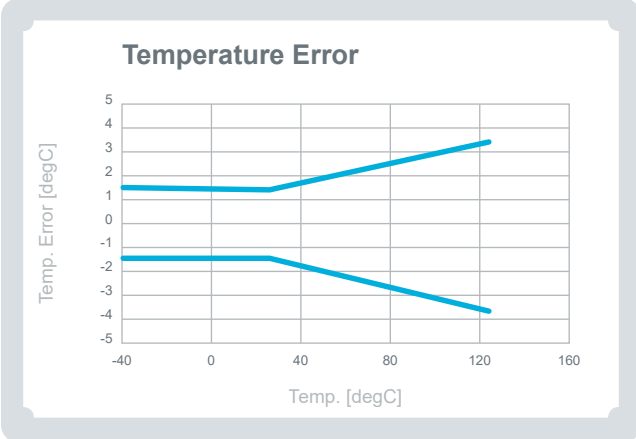
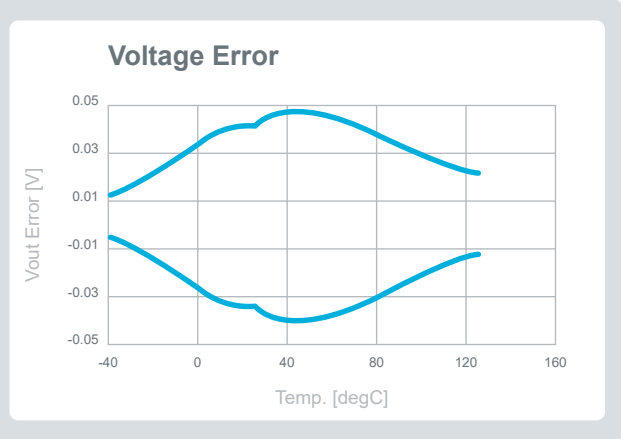
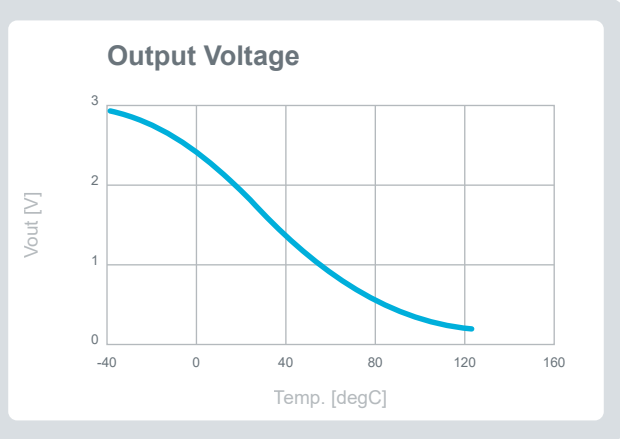
Murata’s NTC thermistors deliver excellent precision and thermal response and are available in a range of packaging designs. They provide simple integration into a wide range of EV systems where they can be used for functions such as inrush current suppression and temperature compensation.

Features

- Multiple size lineup; 0603, 0402, and 0201 inches
- Available for wider R25 accuracy variation; 5%, 2%, and 1%
- Automotive grade available
- Supporting safe design even for tough environmental conditions
- Murata’s N°1 market share ensures a reliable supply chain
- Available for design support tool in Murata website



Example of Simulation data



Sensors

● NTC Thermistor

Product search: [Link](#) Performance simulator: [Link](#)

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Sound Components

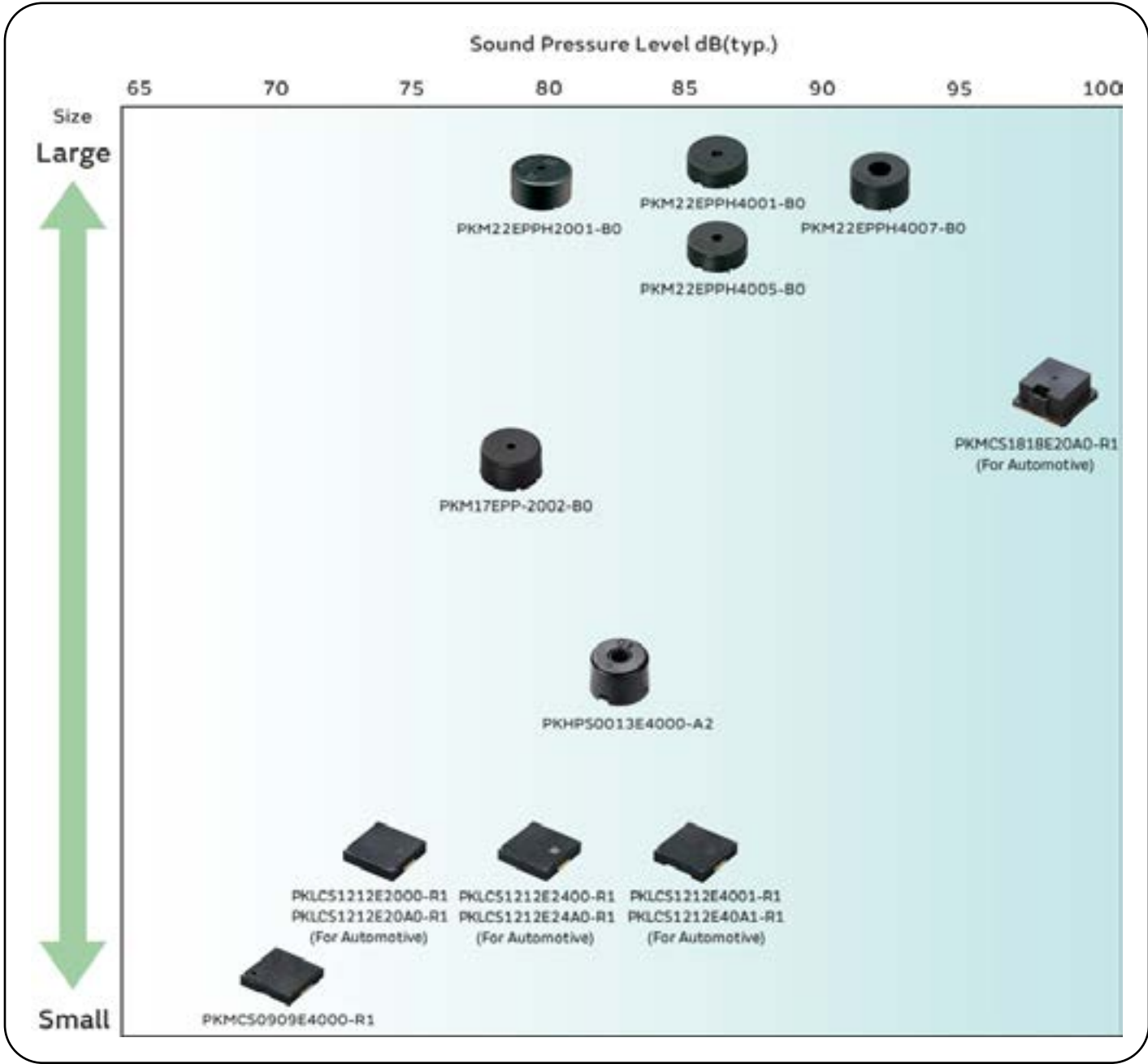
Piezoelectric Sounders

Murata’s high-quality piezoelectric sounders are components which generate monotone sound suitable for providing systems with audible indication without the need for built-in oscillation circuits.

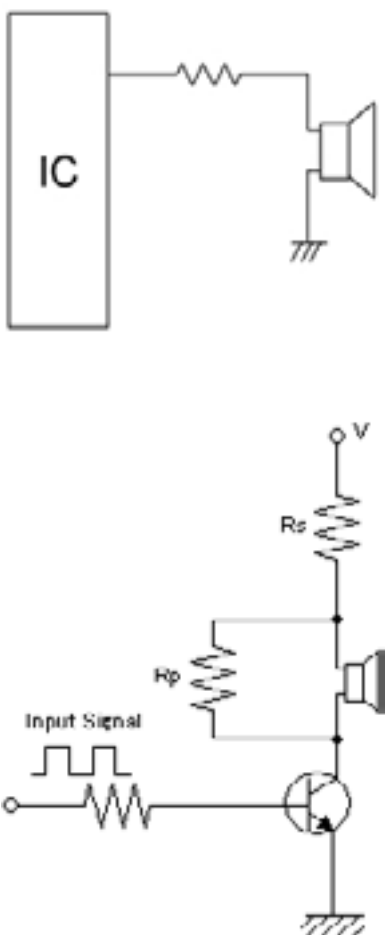
Within EV charging infrastructure they are ideal for providing feedback in user interfaces, and come in SMD packaging, which is optimal for small, high-density mounting and pin type packaging, which can be used for general purposes.

Features

- Lightweight with no internal magnet
- Low current consumption
- Available for sounding with multiple frequencies
- [Wide selection of sizes and loudness](#)



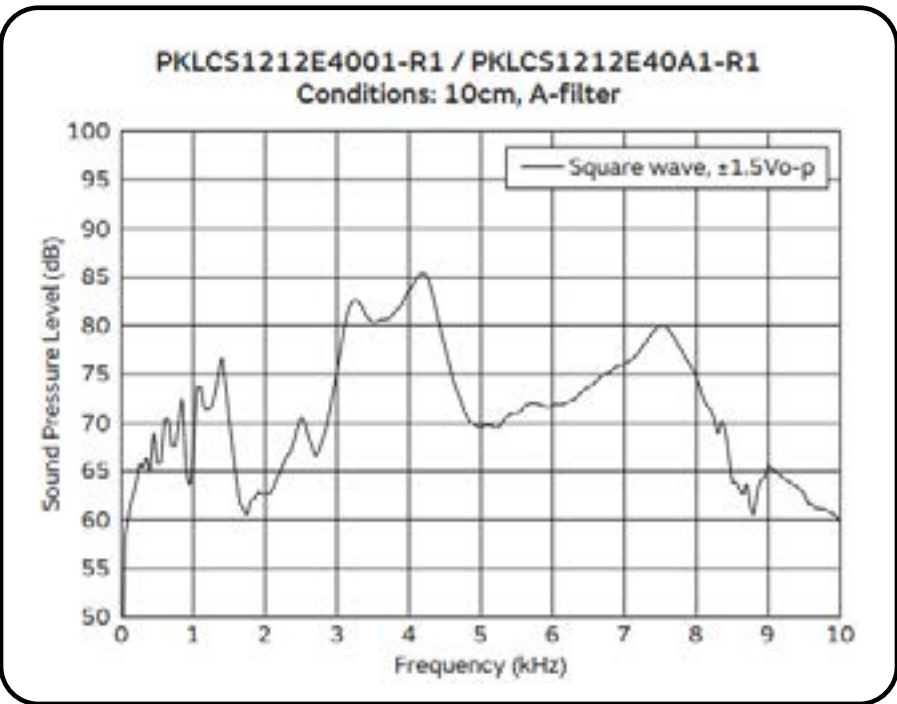
EASY TO DESIGN:



Magnet Free

Simple drive circuit

No cavity housing required



Sound Components

- Piezoelectric Sounders

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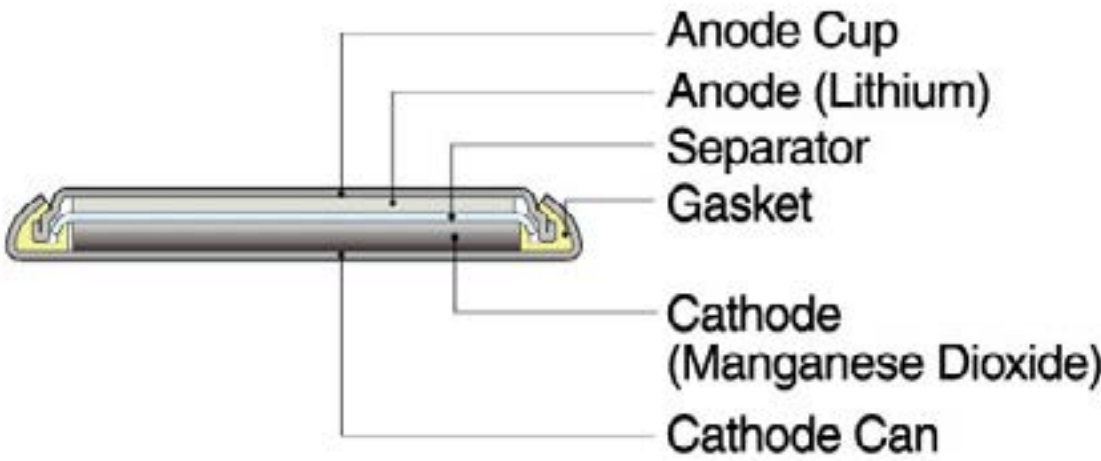


Micro Batteries

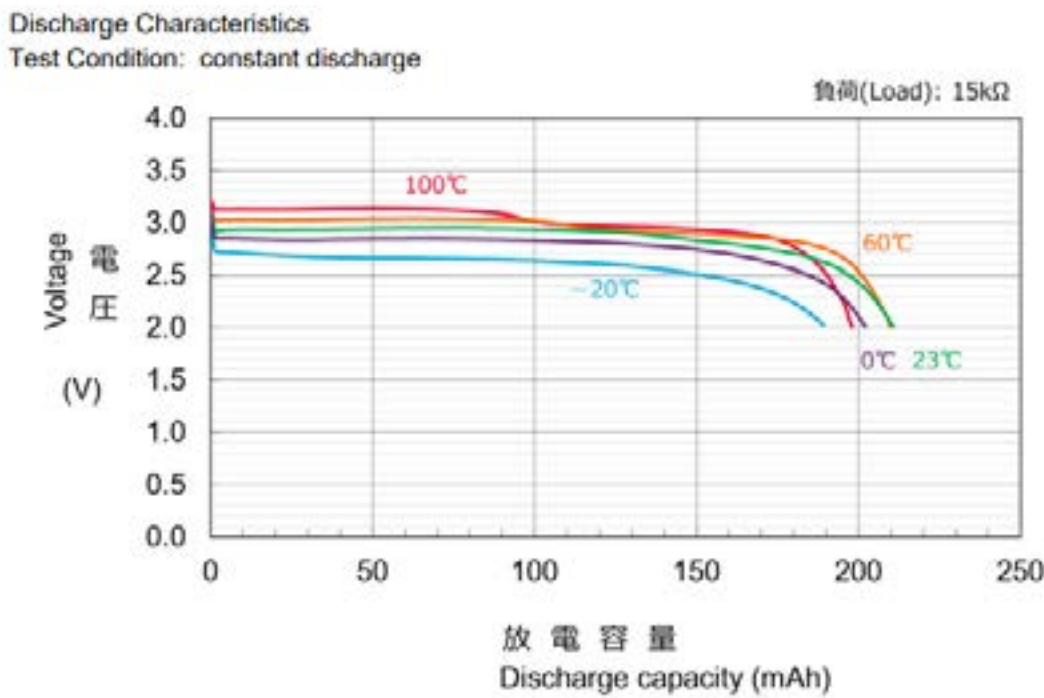
CR Coin Lithium Batteries

Murata offers a wide range of primary micro-batteries with high performance and reliability, built off over 40 years of technology development and manufacturing expertise.

Within EVs DC and AC charging circuitry, they can provide vital backup power for controller and connectivity module's memory. Murata's wide range of cost-effective and reliable CR Coin batteries even include heat-resistant designs.



CR2032W Performance



Features

- Long life, ideal for RTC and memory back-up
- High reliability: Outstanding temperature range
- Stable discharge characteristics

Type	Extended Temperature	Heat Resistant
Operating Temp.	-40°C to +85°C	-40°C to +125°C
Model (Nominal Capacity)	CR2477X (1000mAh)	CR2032W (210mAh)



Lightweight, High Voltage and High Energy Density:

The 3V battery voltage is almost double that of normal alkaline or manganese batteries



Excellent Discharge Characteristics:

Voltage characteristics remain stable even for a long period of discharge



High Quality and Reliability:

40 years of manufacturing experience

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1 Export Control

For customers outside Japan:

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For products which are controlled items subject to the “Foreign Exchange and Foreign Trade Law” of Japan, the export license specified by the law is required for export.

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- ① Aircraft equipment
- ② Aerospace equipment
- ③ Undersea equipment
- ④ Power plant equipment
- ⑤ Medical equipment
- ⑥ Transportation equipment (vehicles, trains, ships, etc.)
- ⑦ Traffic signal equipment
- ⑧ Disaster prevention / crime prevention equipment
- ⑨ Data-processing equipment
- ⑩ Application of similar complexity and/or reliability requirements to the applications listed above

3 Product specifications in this catalog are as of March 2020. They are subject to change or our products in it may be discontinued without advance notice. Please check with our sales representatives or product engineers before ordering. If there are any questions, please contact our sales representatives or product engineers.

4 Please read rating and **CAUTION** (for storage, operating, rating, soldering, mounting and handling) in this catalog to prevent smoking and/or burning, etc.

5 This catalog has only typical specifications. Therefore, please approve our product specifications or transact the approval sheet for product specifications before ordering.

6 Please note that unless otherwise specified, we shall assume no responsibility whatsoever for any conflict or dispute that may occur in connection with the effect of our and/or a third party’s intellectual property rights and other related rights in consideration of your use of our products and/or information described or contained in our catalogs. In this connection, no representation shall be made to the effect that any third parties are authorized to use the rights mentioned above under licenses without our consent.

7 No ozone depleting substances (ODS) under the Montreal Protocol are used in our manufacturing process.



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