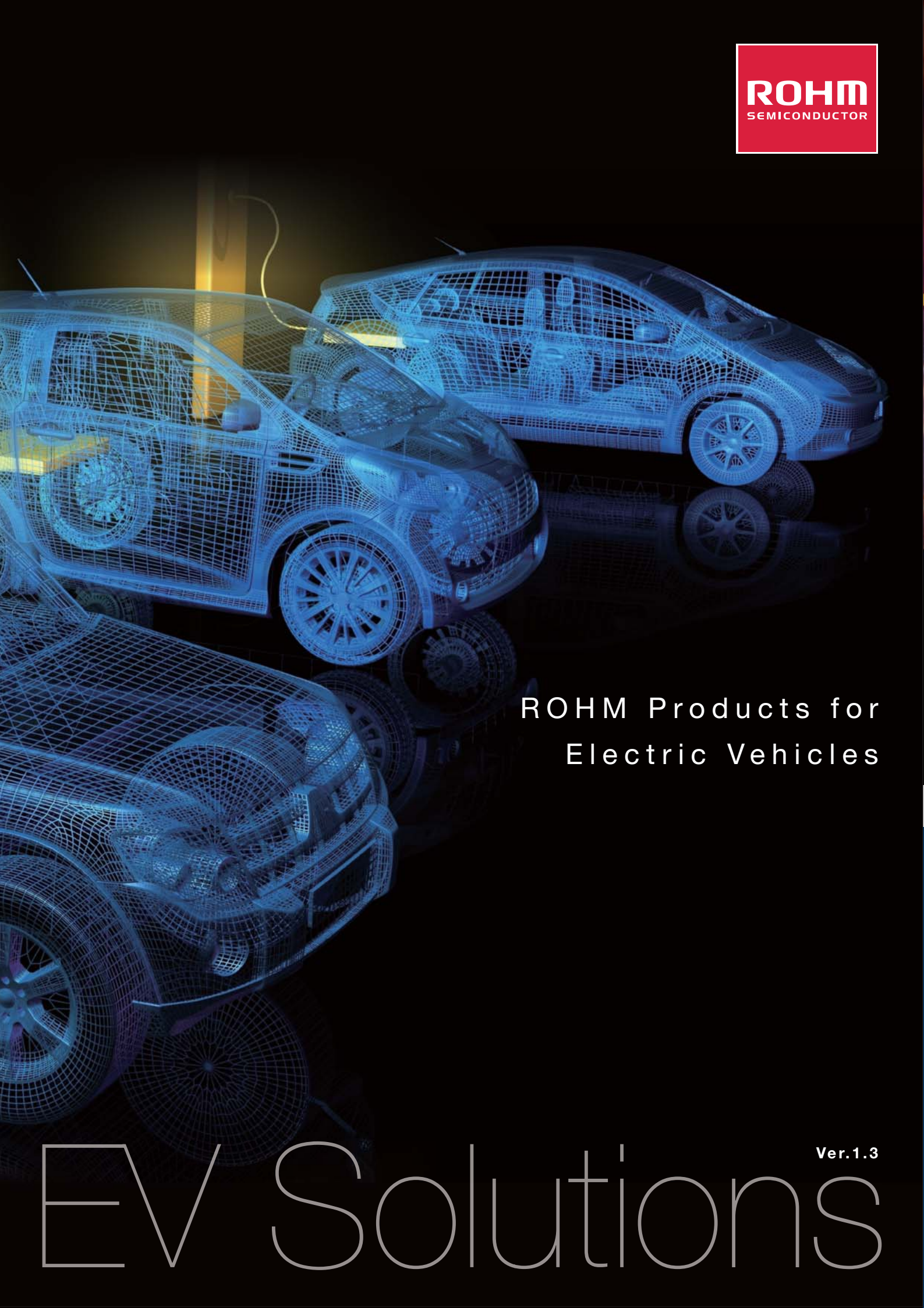


ROHM Products for
Electric Vehicles

EV Solutions

Ver.1.3

SiC devices hold the key in the electric vehicle performance

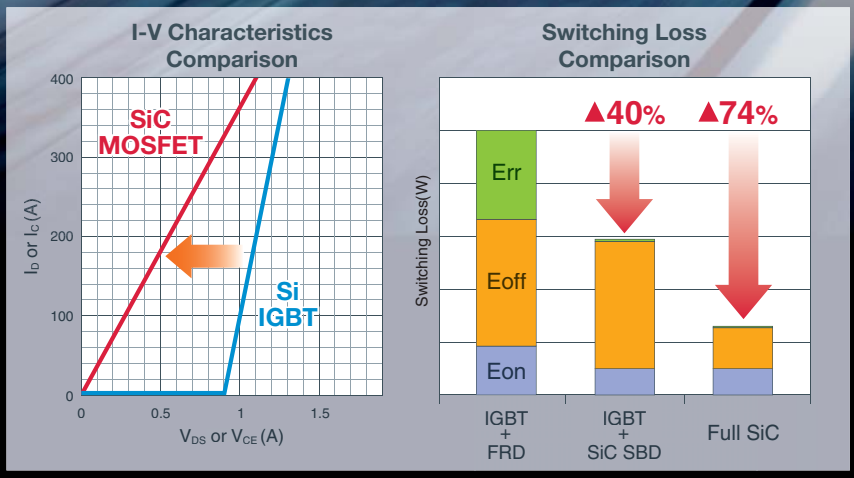
SiC devices are being increasingly adopted - primarily in DC/DC converters and onboard chargers for electric vehicles. This is due to their superior voltage resistance and loss characteristics which make them ideal for next-generation applications.

SiC Device Performance

Perhaps the biggest challenge for electric vehicles is maximizing cruising distance given the limited battery power.
To this end, it is important to increase electricity costs in lieu of fuel economy. SiC devices are considered key in achieving this goal.
Their superior physical characteristics as a semiconductor material make it possible to exceed the limits of Si devices and provide greater performance in electric vehicles.

Advantages of SiC devices

- Reduced conduction loss
- Lower switching loss
- Supports higher voltages and frequencies



ROHM's Approach to

Dedicated EV units require higher reliability and lower power consumption in a smaller form factor.
ROHM supplies power devices such as SiC and IGBTs together with gate driver ICs designed to drive them.
ROHM also offers a broad lineup of general-purpose products, from power supply ICs optimized for peripheral circuitry and discretes (transistors/diodes) to current detection shunt resistors.

ROHM Solutions

High Voltage
SiC, IGBT

+

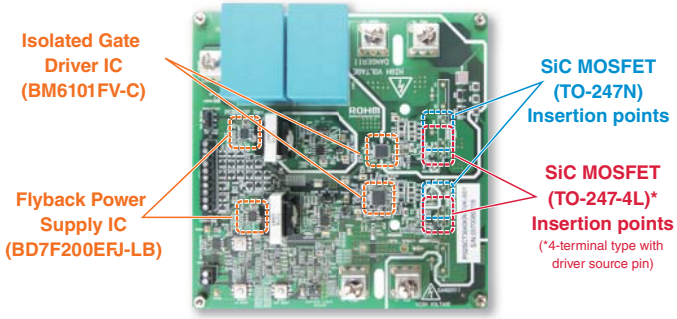
Isolation Technology
Gate Driver ICs

+

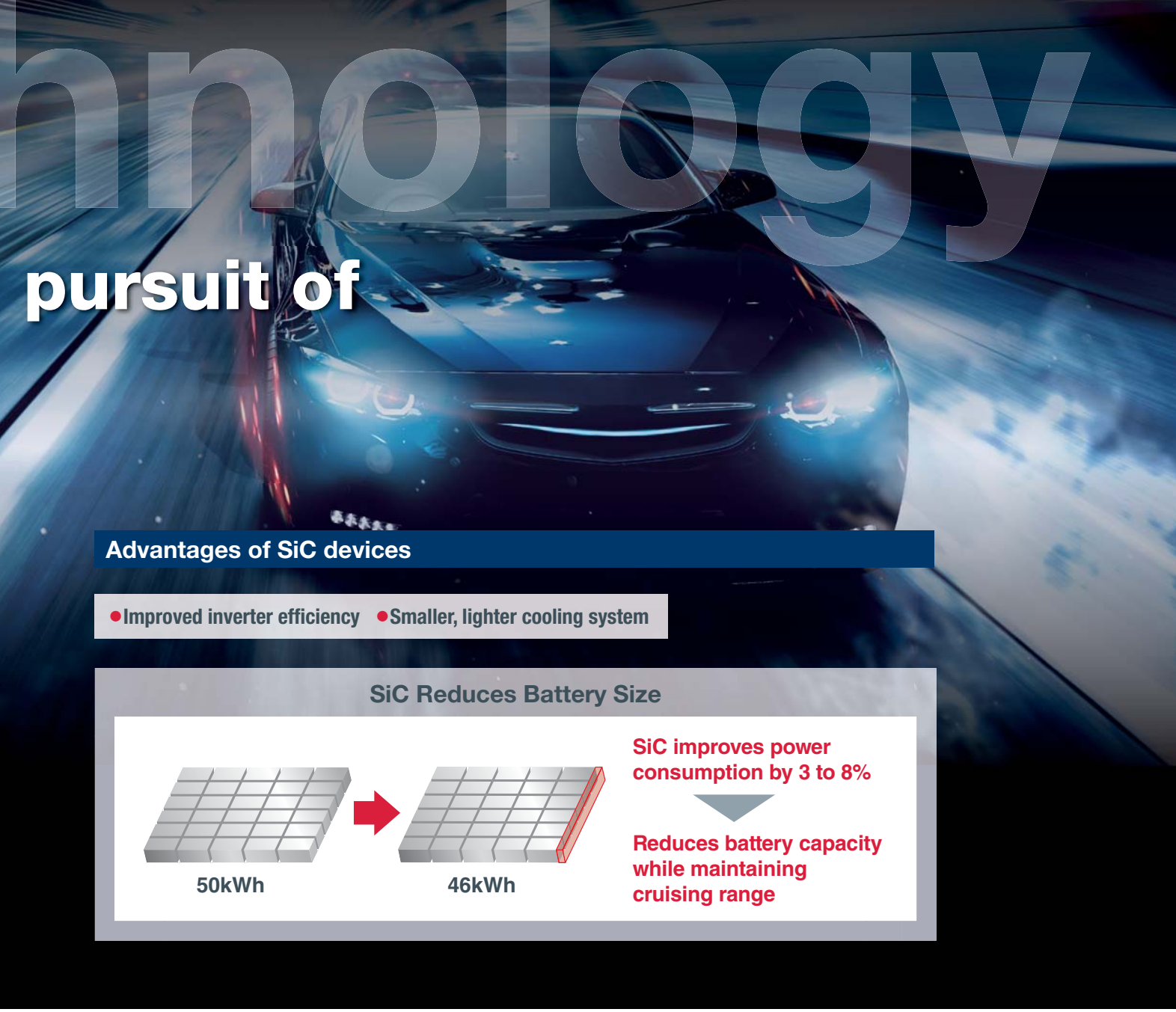
General-Purpose
Power Supply ICs/Motor Driver/ Transistor/Diode/Shunt Resistor, etc.

Topics — New SiC MOSFET Evaluation Board

ROHM's solution board includes a control power supply, multiple protection functions, and gate drive circuit optimized for the latest SiC MOSFETs.



P02SCT3040KR-EVK-001



nology pursuit of

Advantages of SiC devices

- Improved inverter efficiency
- Smaller, lighter cooling system

SiC Reduces Battery Size

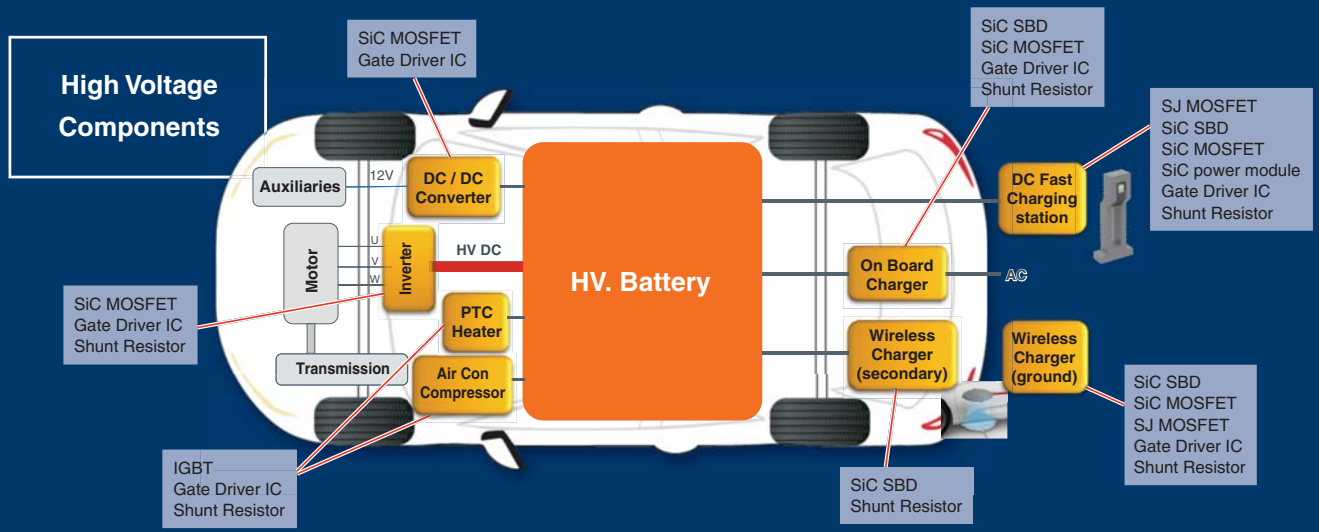
50kWh 46kWh

SiC improves power consumption by 3 to 8%

Reduces battery capacity while maintaining cruising range

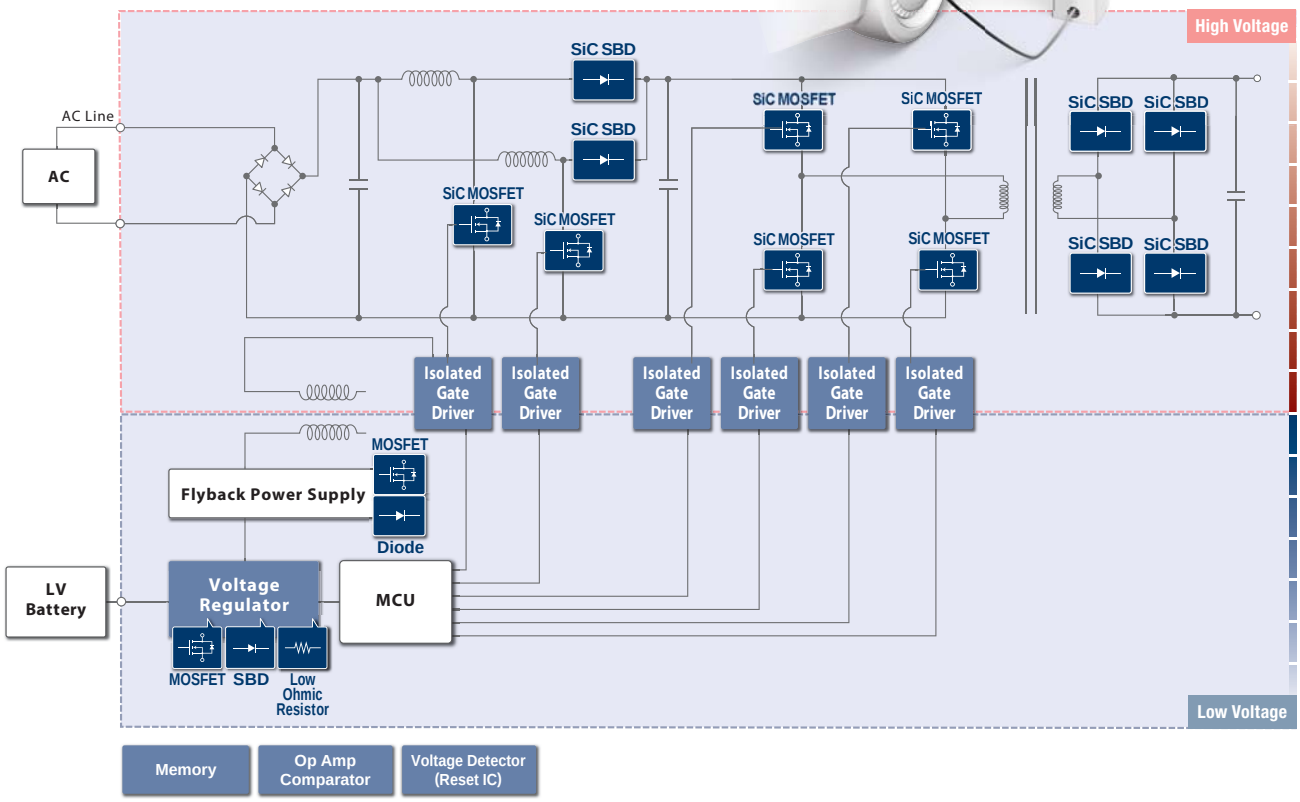
Dedicated EV Blocks

ROHM is focused on a variety of applications for electric vehicles, including the main inverter, onboard charger, and DC/DC converter. And going forward, in response to emerging trends such as greater miniaturization due to higher frequency drive, larger battery voltages, and improved set efficiency, the adoption of SiC devices is expected to only increase. ROHM achieves superior quality and s table supply through a vertically integrated production system, from raw materials to finished products.



ON-BOARD CHARGER

On-board chargers consist of AC/DC converters that convert an AC voltage (100V to 240V) to a DC voltage in order to charge the high voltage battery. To ensure worldwide compatibility, the permissible input voltage for many on-board chargers ranges from 85V to 265V. And to meet market needs for shorter charge times, the voltage specified under fast charging standards is increased, along with battery voltage. As a result, on-board chargers tend to have higher permissible input voltage, promoting the use of SiC not only for the internal diodes, but MOSFETs as well.



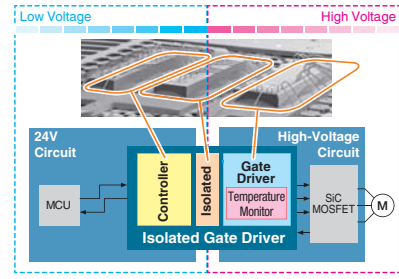
Gate Drivers

2,500Vrms Isolated Gate Drivers

BM61S40RFV-C
BM61S41RFV-C
BM61M41RFV-C

ROHM gate drivers integrate an isolated gate driver element that leverages the latest BiC-DMOS processes along with original on-chip transformer technology.
This makes it possible to achieve the smallest package size in the industry*, contributing to system miniaturization. In addition, our gate drivers incorporate protection elements and meet automotive quality requirements while providing higher noise immunity, lower current consumption, shorter delay time, and superior temperature characteristics compared to conventional photocoupler types to improve system reliability and reduce design load.

All-in-One Isolated Gate Drivers



Industry's Smallest*
Reduces size by 40% vs conventional products

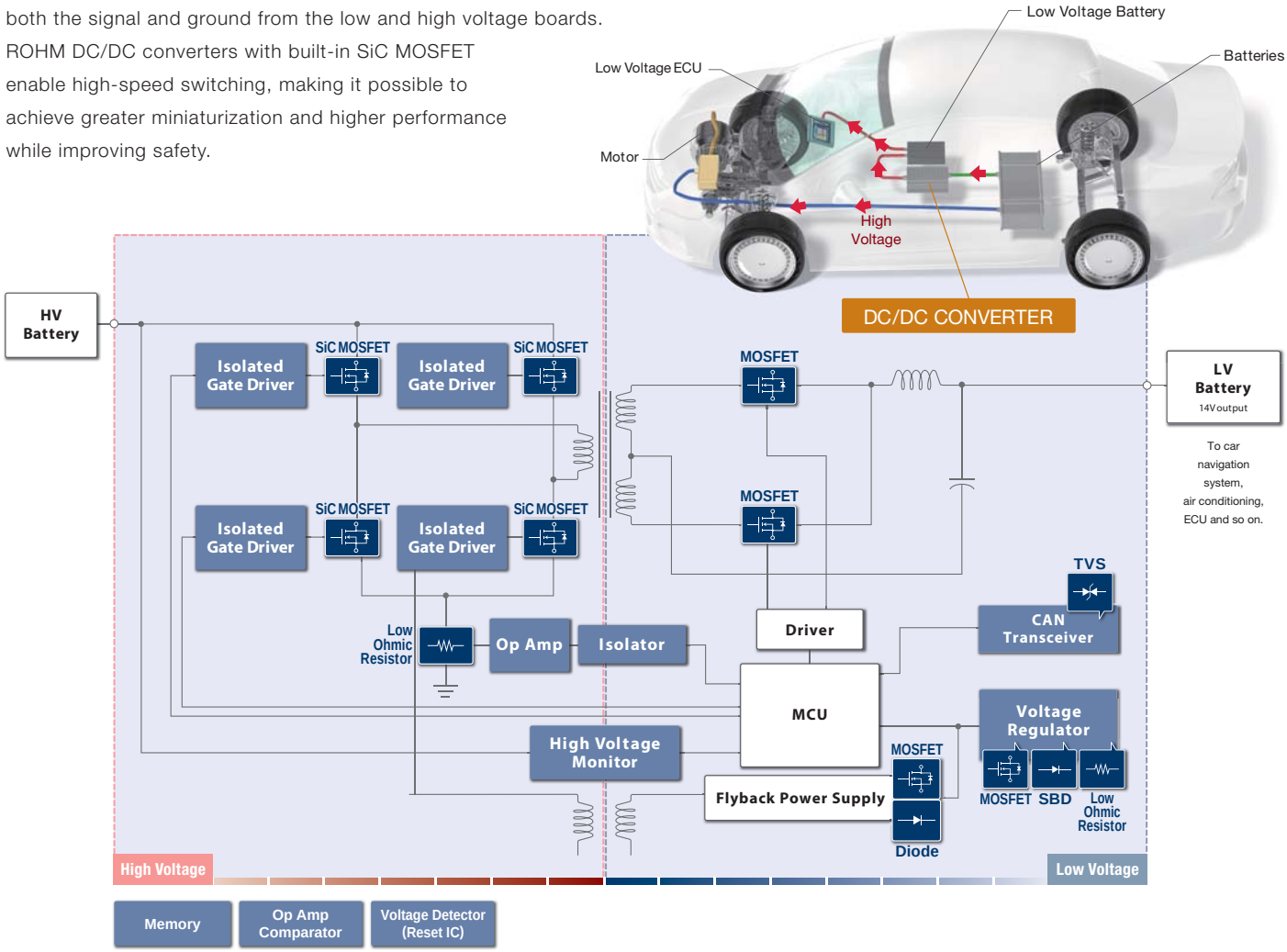
High Speed
65ns delay time

Low Current Consumption
22% lower current consumption
over 0.9mA photocouplers

*ROHM October 2019 study

DC/DC CONVERTER

In EVs the engine is replaced by a high voltage battery and motor.
The DC/DC converter switches power elements and utilizes a transformer to convert the high battery voltage to a lower voltage.
To protect low voltage electronic circuits, it is necessary to electrically isolate both the signal and ground from the low and high voltage boards.
ROHM DC/DC converters with built-in SiC MOSFET enable high-speed switching, making it possible to achieve greater miniaturization and higher performance while improving safety.



IGBTs Isolated Gate Bipolar Transistor

RGS series

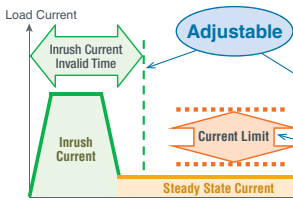
ROHM IGBTs contribute to greater energy savings and efficiency in a wide range of high voltage high current applications.
Original trench gate structure and thin wafer technology are used to achieve low switching loss and $V_{CE(sat)}$. This makes the AEC-Q101 qualified RGS series ideal for a variety of EV systems, including the electric compressor.

IPDs 2ch High Side Intelligent Power Devices

BV2HC045EFU-C
BV2HD045EFU-C

The role of fuses and relays is beginning to change. IPDs are increasingly being used as replacements due to the greater safety and security they provide. ROHM IPDs are not only ideal for replacing fuses and relays, they contribute to functional safety of the entire system through multi-current control and error flag operation.

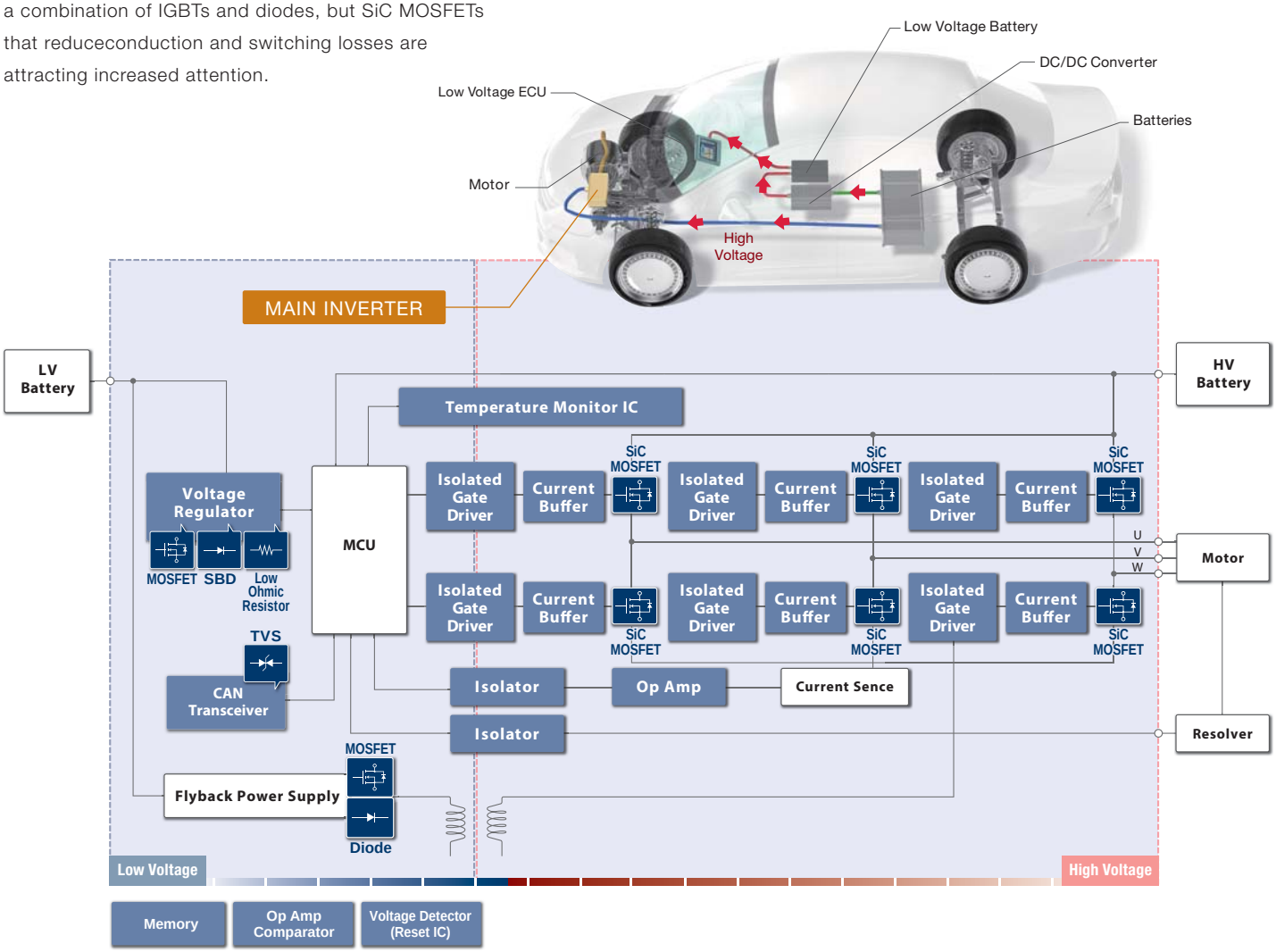
Multi-Current Control F



Dedicated EV Blocks

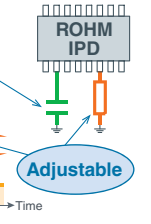
MAIN INVERTER

The main inverter converts DC voltage supplied by the battery into 3-phase AC voltage for driving the motor. Conventional power devices for inverters typically utilize a combination of IGBTs and diodes, but SiC MOSFETs that reduceconduction and switching losses are attracting increased attention.



ts for EV ECUs

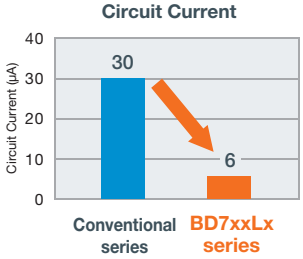
Function



LDOs Single Output Low Saturation Regulators

BD4xxM5 series
BD4xxM5W series
BD7xxLx series
BD800M5

Along with greater functionality and accuracy in automotive blocks, ICs that can supply stable power to MCUs and sensors are being increasingly demanded. In response, ROHM offers linear regulators strong against external noise and battery fluctuations. We also offer a broad lineup of class-leading automotive-grade quiescent current regulators that contributes to greater energy savings and enables users to select the ideal product based on application requirements.

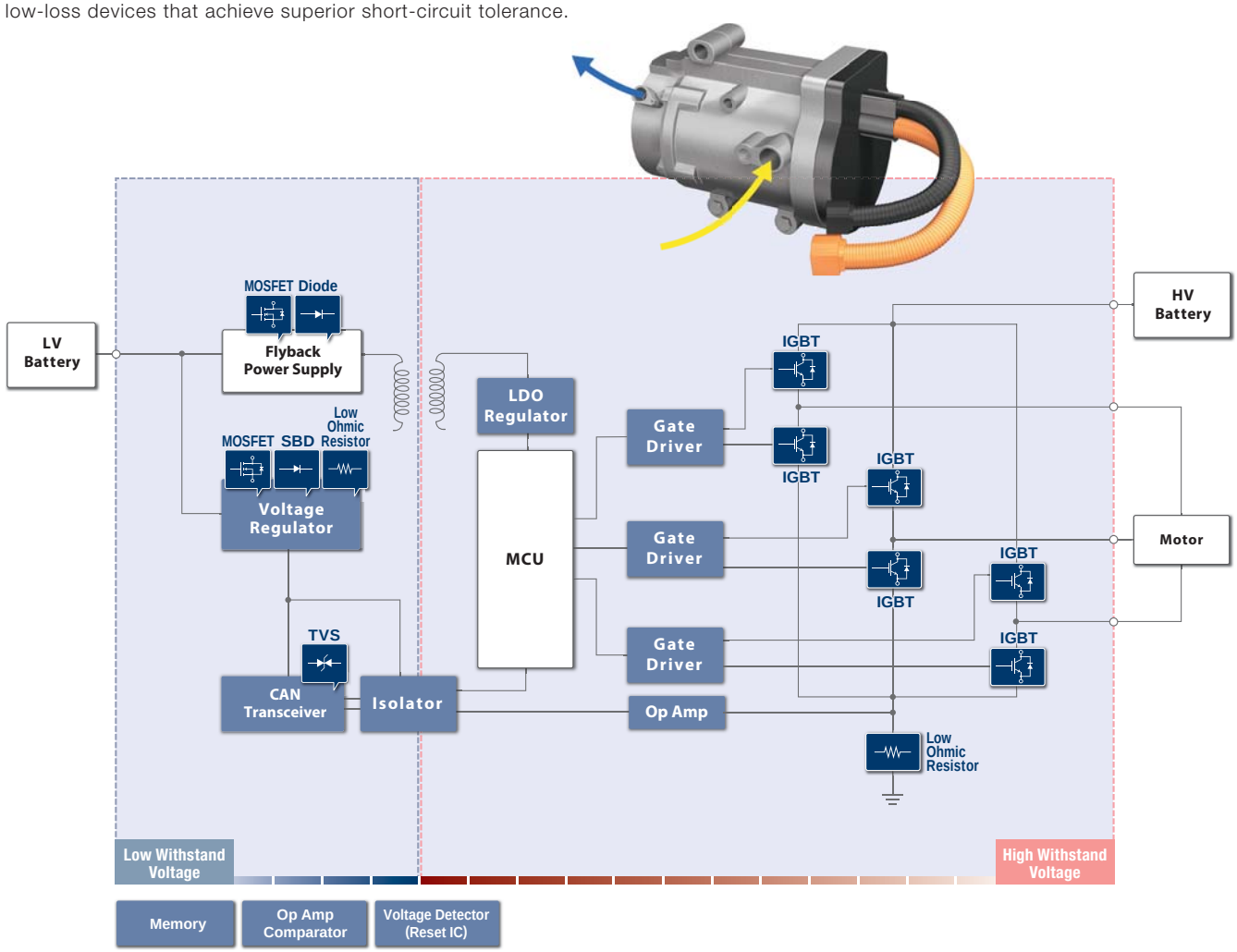


SHUNT

PSR series

ELECTRIC COMPRESSOR

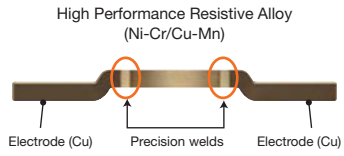
In EVs, the AC compressor is electric.
High voltage is used to increase motor efficiency, and for inverters that control rotation as well, high voltage, along with high reliability and high efficiency, are important factors. ROHM IGBTs for electric compressors are low-loss devices that achieve superior short-circuit tolerance.



RESISTORs

Features such as high power handling capability and ultra-low resistance are ideal for current detection in high power automotive blocks. High precision welding technology utilized between the resistive element and electrodes allows ROHM's PSR series to deliver excellent temperature coefficient of resistance (TCR) - even in the low-ohmic region.

High power achieved by combining precision welding echnology with a high-performance alloy



SCHOTTKY BARRIER DIODEs

Low V_F series
Ultra-low I_R series

The broad lineup consists of both low V_F and I_R types that allow users to select the ideal product based on set requirements.

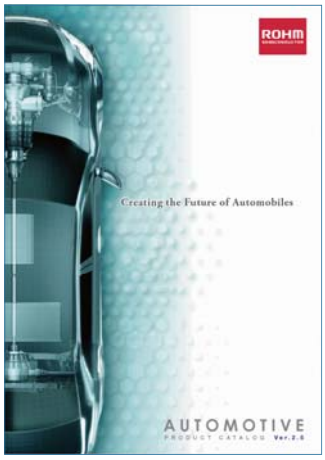
MOSFETs

40V series
60V series
100V series

ROHM offers a wide range of MOSFETs that support a variety of motor and drive applications, including low ON resistance models developed utilizing the latest processes.

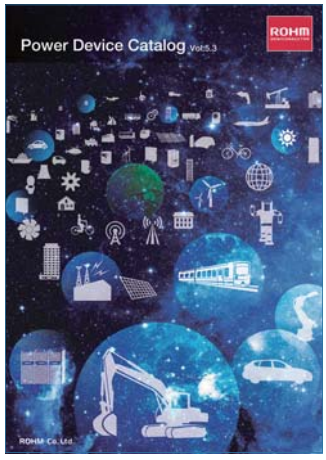
ROHM Automotive Catalogs

Automotive and Power Device Catalogs are available in addition to this brochure.



Automotive Catalog

Includes detailed information on the ROHM Group's broad range of automotive products.
We offer an extensive lineup of automotive-grade products and solutions that support the continuing electronification and evolution of today's and next-generation vehicles.



Power Device Catalog

Introduces ROHM's industry-leading products for power applications.
Also included are high voltage, high efficiency devices utilizing SiC.
Please refer to our next-generation Eco Devices that contribute to greater energy savings and reduced CO_2 emissions.

Creating a safer, more secure automotive society

Acquired development process certification under automotive functional safety standard ISO26262 ~Supports device development with the highest level of safety (ASIL-D)~

ROHM has built a dedicated line for automotive products and performs development that complies with quality management system (IATF 16949) and electronic product reliability (AEC-Q100/101/102) standards. And in 2018 ROHM obtained ISO26262 development process certification (a functional safety standard for automotive applications) from 3rd party certification organization TUV Rheinland (Germany). This allows ROHM's automotive device development process to support the highest safety requirements (ASIL-D). Going forward, ROHM will contribute to greater safety and security in the automotive industry by continuing to apply its ISO 26262 certified development process to products such as power supply and timing controller ICs that require functional safety.

ROHM Sales Offices Contact us for further information about the products.

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Atlanta	+1-770-754-5972	**France**	+33 (0) 1 40 60 87 30	**Shenzhen**	+86-755-8307-3008	**Yokohama**	+81-45-476-2121
Boston	+1-781-565-1138	**United Kingdom**	+44-1-908-272400	**Hong Kong**	+852-2740-6262		
Chicago	+1-847-368-1006	**Finland**	+358-400-726 124	**Taiwan**	+886-2-2500-6956		
Detroit	+1-248-348-9920	**Spain**	+34-9375-24320	**Singapore**	+65-6436-5100		
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