



ROHM Power Management IC
Technology

Nano Pulse Control™
Nano Energy™

Nano Series

2 Cutting-Edge Technologies from the Leader in Analog Power

Nano Pulse Control™

Nano Energy™

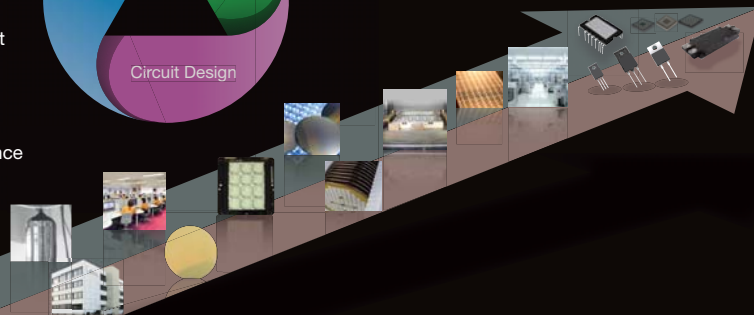
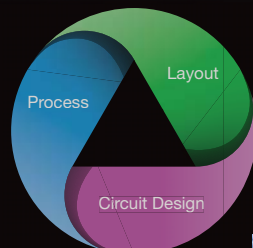


ROHM's Advanced Development Project

In 2014 ROHM's IC Product Development Team launched a bold new project. Power supply ICs occupy an important position within ROHM's broad portfolio of products, and ROHM cultivates technologies based on product development to improve performance based on application requirements.

For this project we used our vertically integrated production system to pursue not only circuit and layout design, but also process technology that links technology with products.

Two nano technologies were born from the market leader with extensive experience and track record in the development of power supply ICs, utilizing the best engineers from within the ROHM Group eager to take on new challenges.



Nano technologies that achieve industry-leading* step-down ratio with ultra-low current consumption

ROHM developed two advanced technologies that achieve the highest specifications in the industry on the order of nano (10^{-9}). The first is ultra-fast pulse control technology, dubbed 'Nano Pulse Control'. Integrating this technology in the BD9V100MUF enables a switching ON time of just 9ns. This makes it possible to achieve an unprecedented step-down ratio of 24:1 in a DC/DC converter with built-in MOSFET. For example, in 48V mild hybrid vehicles that are currently being introduced, mainly in Europe, step-down operation from 48V to 3.3V is demanded to support ECUs (Engine Control Units). Until now, however, it was necessary to first step down to an intermediate voltage (i.e. 12V), requiring 2 chips, but using ROHM's Nano

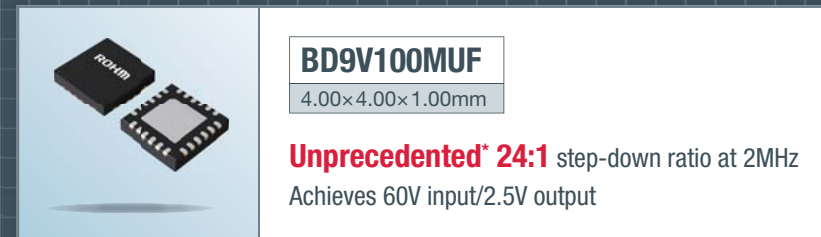
Pulse Control enables direct step-down from 48V to 3.3V with a single IC, reducing the number of parts along with mounting area.

The second technology, Nano Energy, dramatically reduces power consumption in power supply ICs. This technology is used in the BD70522GUL to achieve the world's lowest* current consumption of 180nA, allowing the IC to be driven for up to 10 years on a single coin battery - a key demand for the IoT industry. Battery drive time is doubled compared to standard products at no load (standby), prolonging battery life and contributing to greater miniaturization.

Convert high voltages to low voltages using a single IC. Achieve simpler, more compact systems.

Nano Pulse Control™

[Ultra-High-Speed Control Technology]



Development Background

The proliferation of hybrid and electric vehicles in response to the growing need to curb CO₂ emissions on a global scale has brought attention (particularly in Europe) to mild hybrid vehicles that provide better cost performance than full hybrids. Mild hybrid systems utilize a 48V lithium ion battery to deliver greater efficiency over conventional 12V power supplies. However, the many ECUs used in many vehicle systems demand lower drive voltages, typically 3.3V

but as low as 2.5V.

To convert 48V to 3.3V at 2MHz (to prevent interference with the AM radio band) conventional solutions employ 2 stages (2 chips), the first to step-down to an intermediate voltage such as 12V. In 48V systems it is also necessary support step-down operation from a maximum voltage of 60V to 2.5V, requiring an extremely high step-down ratio of 24:1 when using a single chip.

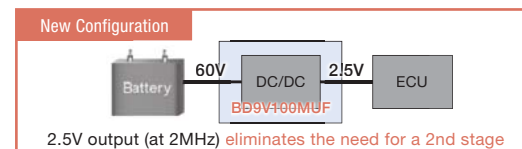
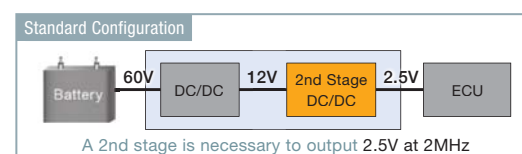
Technology Development and Commercialization

At ROHM, we challenged ourselves with the extremely high goal of developing ultra-high-speed pulse control technology (Nano Pulse Control) for monolithic (single-chip) DC/DC converters. As a result, we were able to reduce the switching ON time to an unprecedented 9ns, the smallest in the world and a breakthrough accomplishment considering that the typical ON time is around 120ns. Another major benefit of this technology is stable control at extremely

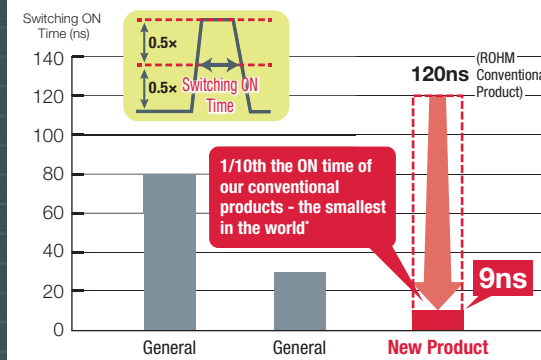
narrow pulse widths.

Development involved breaking from convention by leveraging proprietary analog design technology and power supply process expertise along with our vertically integrated production system. As a result, step-down operation from 60V to 2.5V is achieved through the BD9V100MUF monolithic buck DC/DC converter with integrated MOSFET.

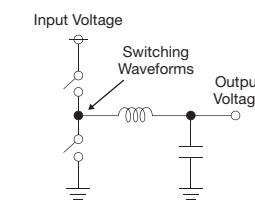
Advantage of a High Step-Down Ratio



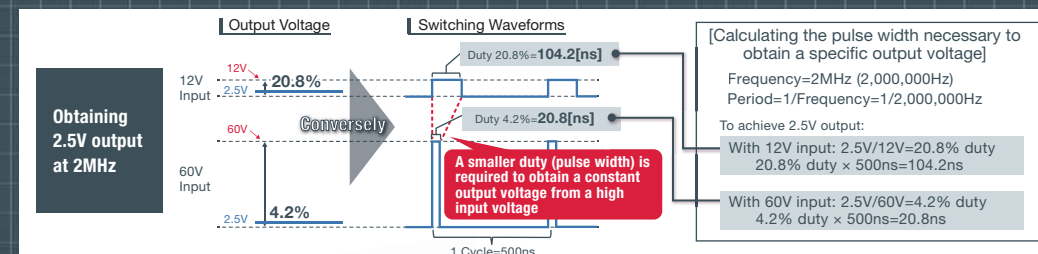
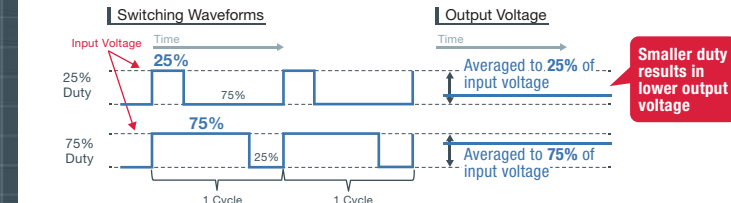
Advantages of Nano Pulse Control



DC/DC Converter Circuit Diagram



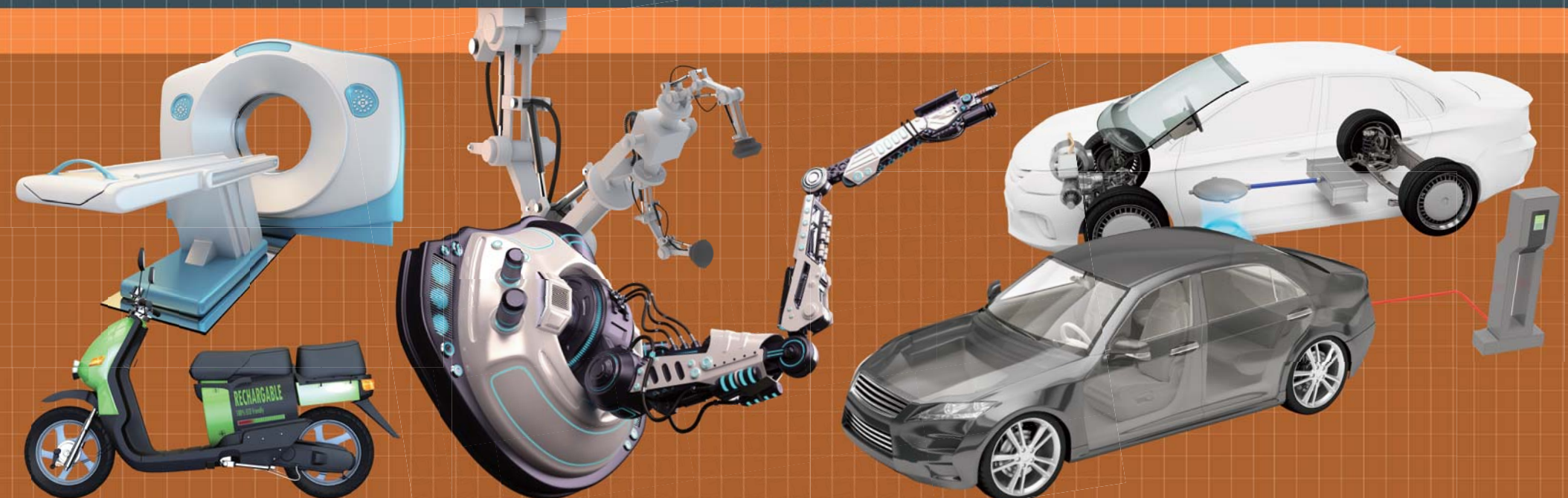
DC/DC Converter Operating Principle (The smaller the duty the smaller the output voltage)



A world of possibilities

Developing a DC/DC capable of stepping down from 60V to 2.5V on a single chip significantly reduces the number of parts compared to conventional 2-chip systems. In particular, at higher frequencies it becomes possible to greatly reduce the size of the coil. This will allow users to simplify system design, reduce application size, and at the same time decrease costs. For example, minimizing the size and costs of 48V power supply systems used for mild hybrid cars, industrial robots, and base station sub-power supplies is expected to contribute to the advancement of society.


In addition to the BD9V100MUF, ROHM will continue to develop products incorporating Nano Pulse Control to meet customer demands.



Enables long-term drive in battery-equipped devices

Nano EnergyTM

[Ultra-low-current technology]



BD70522GUL
1.76×1.56×0.57mm
Lowest* current consumption in the world: 180nA
Provides twice the battery life of conventional products

Development Background

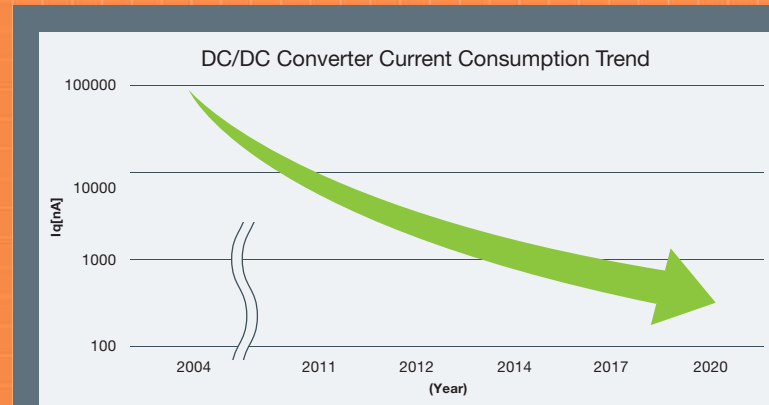
In the electronic equipment field, in addition to the increasing functionality of smartphones and widespread use of wearables, the introduction of IoT devices that can operate and communicate wirelessly between devices without human intervention is attracting attention. In many cases these devices are driven by batteries, making it necessary to reduce power consumption. And although improving design and securing space for integrating new functions are progressing, miniaturization is also an important factor, leading to smaller drive

batteries, but there is a large number of devices where maintenance (i.e. changing batteries) cannot be carried out regularly, especially in the IoT field, driving the demand to enable long-term operation (10 years) on a single coin battery.
In response to these market trends and themes, ROHM began developing technologies to significantly reduce IC power consumption. At the start, the lowest current consumption in the industry for power supply ICs was 360nA. This provided a baseline for our efforts.

Technology Development and Commercialization

When simply considering reducing current consumption, the first option is to raise the resistance value of the circuit, but this can lead to problems such as element current leakage, increased sensitivity to noise, and reduced response speed. In response, ROHM developed Nano Energy, a breakthrough technology that decreases current consumption during ultra-light loads while minimizing the ensuing trade-off. The result is a current consumption of 180nA, the smallest in the world*.

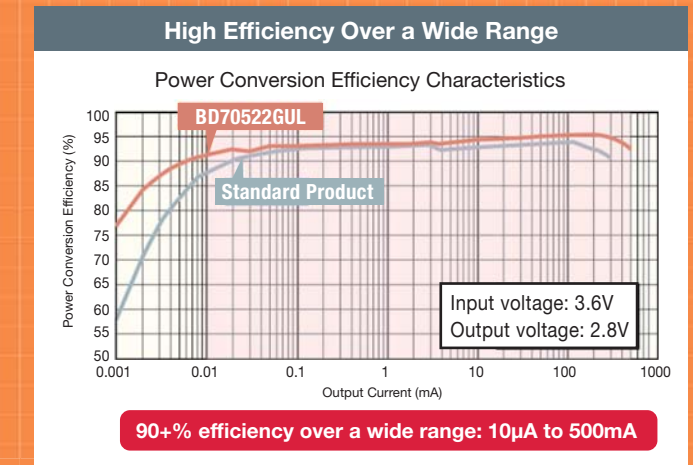
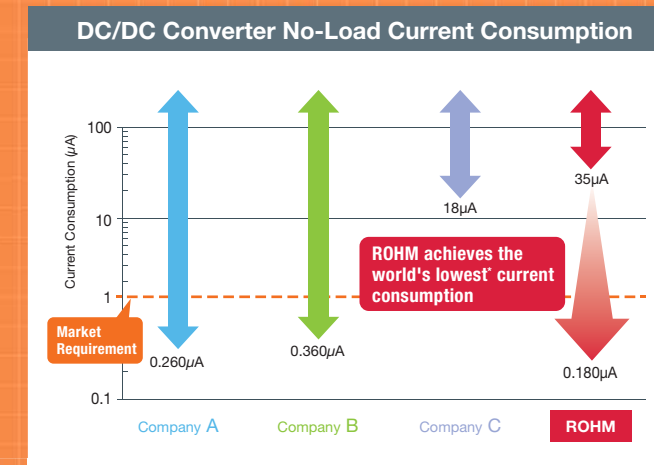
This technology was used to develop the BD70522GUL DC/DC converter, which delivers twice the battery drive time of conventional products at no-load (standby). In addition, high 90% power efficiency is enabled in the widest current range in the industry: 10μA to 500mA. ROHM was able to achieve these characteristics by leveraging proprietary circuit design, layout, and process technologies with its original vertically integrated production system.



Key Demand for the IoT Industry

10 years drive from
a single coin battery

Current consumption
on the order of
nA or less required



A world of possibilities

Dramatic reductions in the power consumption of power supply ICs in the IoT field has brought about a demand to achieve 10-year drive on a single coin battery. This allows for a reduction in the amount of labor and costs required for device maintenance by enabling long-term drive with small batteries even in wearables that are becoming increasingly compact and multifunctional.

In addition, it will be possible to continue operation even in extremely low-power environments, such as energy harvesting systems that generate small amounts of electricity from light, heat, and vibration (which is expected to see increased adoption in a variety of fields).

At ROHM, Nano Energy will be used as a core technology to expand its lineup of power supply ICs to meet a range of customer requirements. At the same time, we plan on promoting the use of PMICs (Power Management ICs).



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