Solving Power Supply Issues with ROHM’s Nano Series of Leading-Edge Power Supply Technologies
ROHM Key Technologies

Power Technology
Contributing to the creation of new value and solving social issues through the development of innovative power devices

Analog Technology
Contributing to meeting system needs by continuing to refine advanced analog technologies

Sample Power Solution

Low Voltage
12V Battery Board
- Power Management Power Supply IC
- MCU
- Isolated Gate Driver IC
- MOSFET Diode Chip Resistor
- Shunt Resistor

High Voltage
Battery Board
- Power Semiconductor
- Gate Driver
- Isolator
- Controller
Analog technology cultivated over many years results in more intelligent devices that consume less power.

Maximizing the performance of power semiconductors

Intelligent power-saving drive

Unprecedented noise immunity solves noise issues

Driver ICs

Power Management
Power Supply ICs

Op Amps / Comparators

Nano Power Supply Technologies

Promoting elemental Nano technologies in a variety of applications
Power Supply IC Requirements

**Solutions that Applications Require**
- Power saving (longer application life)
- High power compatibility
- Increased functionality (including greater miniaturization)
- Safety functions

**Solutions that Power Supply ICs Can Provide**
- High power conversion efficiency, low current consumption
- Higher withstand voltage, large current support
- High integration, fewer peripheral components/greater miniaturization
- Protection functions, long-term operation (high reliability)
What is Nano Power Supply Technology?

Nano power supply technologies were developed by combining advanced analog expertise covering circuit design, processes, and layout utilizing ROHM’s vertically integrated production system.

Creating quality in the development process
Circuit Design: Element characteristics, power fluctuations, signal level, etc.
Layout: Circuit layout, pairing, signal interference, etc.

Creating quality in the production process
Wafer: Element shape, element materials, wiring materials, etc.
Package: Heat dissipation characteristics, frame materials, wiring materials, etc.

A Vertically Integrated Production System
Combining 3 analog technologies to achieve high efficiency and stable power control

These technologies are being deployed in ASSPs (Application Specific Standard Products)
Nano Power Supply Technologies

3 technologies solve current market needs of power supply systems

- **Higher voltages and frequencies**
  - Enables direct step-down from 60V to 2.5V
  - Ultra-high-speed pulse control technology
  - **Nano Pulse Control™**

- **Lower current consumption**
  - Enables 10-year drive on a single coin battery
  - Ultra-low current consumption technology
  - **Nano Energy™**

- **Greater miniaturization • Reduced design load**
  - Eliminates stability issues related to capacitance
  - Ultra-stable control technology
  - **Nano Cap™**

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48V System Requirements

- **Current**
  - Forklifts DC48V (Pb)
  - Base Station Backup Power Supplies DC48V (Pb)
  - DC48V Industrial Robots

- **Wide range of 48V applications in the industrial equipment sector**

- **Future**
  - 12VDC HEVs (Li, Pb)
  - Switching to 48V vehicle power supplies

**Expanding 48V Systems: The Need for Higher Withstand Voltages and Higher Frequency Operation**

**Target**

- Power supplies for 48V battery systems in mild hybrid EVs
  - European manufacturers are leading the development to achieve CO2 reduction targets
  - The motors and batteries are smaller than conventional HEV systems, improving cruising range

**Market Trend for 48V Mild Hybrid Vehicles**

- *48V market only

**What is a 48V Hybrid System?**

- **Conventional HEV System**
  - 250V HEV Motor
  - Battery
  - Voltage Converter Module
  - 12V

- **48V Mild Hybrid System**
  - 48V HEV Motor
  - Battery
  - Power Supply

**Power supply ICs are required to output a low output voltage from a high input voltage**
Nano Pulse Control® Technology

Proprietary method enables stable voltage control even with extremely short switching ON time (which has been difficult to achieve in the past)

Achieves the world’s smallest* ON time of 9ns

*ROHM Sept. 2017 study

For example, 1V can be directly output from 48V input (f=2MHz)
Nano Pulse Control® Technology

Existing Configuration

- Battery
- 48V
- SWREG 12V
- Secondary SWREG
- MCU/DDR 3.3V/1.2V

Cannot output 1.2V or 3.3V from 48V input (f=2MHz)
Requires a secondary SW regulator

Solution size: 47mm x 25mm
1175mm²

New Structure

- Battery
- 48V
- SWREG
- MCU/DDR 3.3V/1.2V

1.2V and 3.3V output possible from 48V input (f=2MHz)
Secondary SW regulator not needed

Solution size: 18mm x 20mm
360mm²

1 Chip

Inductor size

6mm² ⇒ 2.4mm²

Reduced 70%

Nano Pulse Control™

Single-chip solution contributes to greater space savings

*1: NRS6028T(15uH) idc=1.6A
NRH2412T(2.2uH) idc=1.7A
## Proliferation of Compact High-Performance Systems: The Need for Lower Current Consumption

### Key Point

Power supply ICs featuring even lower current consumption

### Development Trends

#### Wearable Market

- Improved safety
- Greater miniaturization
- Longer life

Requires a low consumption power supply IC

#### Automotive Market

- Proliferation of EVs/HEVs
- Idle stop
- Increasing number of functions that operate when parked

### Lithium Battery

New Battery Type

Nano Energy™

Nano Energy®

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Nano Energy™ Technology

Features of the BD70522GUL with Nano Energy™

Achieves ultra-low 180nA current consumption

Current Consumption

- Class-leading low current consumption: 180nA

Efficiency (VIN=3.6V, VOUT=3.3V)

- Achieves a max. efficiency of 90% at 10µA load current
- Significantly reduces standby loss

Achieves fast response to load fluctuations at ultra-light loads

Load Fluctuation (VIN=3.6V, VOUT=3.3V)

- VOUT: 500mV/div
- Load: 200mA/div

- Load: 0mA ⇔ 500mA
- Load: 30mA ⇔ 500mA

Ensures even faster response at light loads

*ROHM Survey
**Constant Demand of Power Supply ICs: The Need to Reduce the Number of Peripheral Components**

### Solutions that Applications Require
- Power saving (longer application life)
- High power compatibility
- Increased functionality (including greater miniaturization)
- Safety functions

### Solutions that Power Supply ICs Can Provide
- High power conversion efficiency, low current consumption
- Higher withstand voltage, large current support
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- Protection functions, long-term operation (high reliability)

**Relationship Between the Power Supply IC and System (i.e. MCU)**

Power supply ICs need to be able to simply reduce the number of capacitors
Nano Cap™ Technology

Nano Cap™ Achieves Ultra-Stable Control

- Achieves ultra-stable operation with a voltage fluctuation of ±5% even with 1/10th the capacitance.
Eliminating the output capacitor solves capacitance issues in a variety of applications
Latest Power Supply IC Technologies
“ROHM Nano”

**Nano Pulse Control™**

Enables direct step-down from 60V to 2.5V

**Ultra-high-speed pulse control technology**

- Switching Time (ns)
  - Standard Technology: 80ns
  - Nano: 9ns
  - Co. A: 30ns
  - Co. B: 30ns
  - ROHM: 9ns

**Nano Energy™**

Provides 10-year drive on a single coin battery

**Ultra-low current consumption technology**

- Current Consumption (nA)
  - Standard Technology: 360nA
  - Nano: 180nA
  - Co. A: 260nA
  - Co. B: 260nA
  - ROHM: 180nA

**Nano Cap™**

Eliminates stability issues related to capacitance

**Ultra-stable control technology**

- Voltage Fluctuation (%)
  - Market Requirement: 5%
  - ROHM: 15.6%
  - Co. A: 14.0%
  - Co. B: 3.6%

Solves issues by promoting adoption in power supply and other analog ICs
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