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

Opening a world of possibilities with ROHM power and analog 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
  - Controller
  - Isolator
  - Gate Driver
  - MOSFET
  - Diode
  - Chip Resistor
  - Shunt Resistor

- **High Voltage** Battery Board
  - Power Semiconductor
  - Isolated Gate Driver IC
  - Shunt Resistor
Analog technology cultivated over many years results in more intelligent devices that consume less power.

- Maximizing the performance of power semiconductors: Driver ICs
- Intelligent power-saving drive: Power Management, Power Supply ICs
- Unprecedented noise immunity solves noise issues: Op Amps / Comparators

Nano Power Supply Technologies

Promoting elemental Nano technologies in a variety of applications: AC, TVs, Refrigerators, Speakers, Vacuum Cleaners, PCS, Automotive, Mobile Devices.
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)
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.

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

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

Fewer external parts · Greater miniaturization
Achieves industry-leading voltage fluctuation regardless of capacitance
Ultra-stable control technology

Nano Pulse Control™
Nano Energy™
Nano Cap™

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

**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

**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
- 250V Battery
- Voltage Converter Module

- 12V

- ECU

- 3.3V

48V Mild Hybrid System

- 48V HEV Motor
- 48V Battery
- Power Supply

- 3.3V

- ECU

- 3.3V

**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)

*ROHM Sept. 2017 study

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

For example, 1V can be directly output from 48V input (f=2MHz)

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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

Reduced 70%

Inductor size:

- 6mm² ⇒ 2.4mm²

*1: NRB6028T(15uH) idc=1.6A
NRH2412T(2.2uH) idc=1.7A

Single-chip solution contributes to greater space savings
Proliferation of Compact High-Performance Systems: The Need for Lower Current Consumption

Key Point
Power supply ICs featuring even lower current consumption

Wearable Market

- Li-ion Battery
- New Battery Type
- Requires a low consumption power supply IC

Development Trends
- Improved safety
- Greater miniaturization
- Longer life

Automotive Market

- Alarm System
  - Functions that operate when parked
  - Backup operation even when the display is OFF
- Keyless
  - Functions that operate when parked
- Car Navigation
  - Memory backup requires a power supply

Development Trends
- Proliferation of EVs/HEVs
  - Low power consumption is required to improve fuel economy
- Idle stop
  - Stops the engine when the vehicle stops, with the battery providing the necessary power
- Increasing number of functions that operate when parked
  - Power supplied by battery may cause battery drain
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

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

Achieves fast response to load fluctuations at ultra-light loads

Ensures even faster response at light loads

Achieves ultra-low 180nA current consumption

Load: 0mA ⇔ 500mA

Load: 30mA ⇔ 500mA

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

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

- Power Supply IC: Switching Regulator, Linear Regulator, etc.
- MCU, etc.

Capacitor Required for the Power Supply IC

Capacitor Required for the MCU

Power supply ICs need to be able to simply reduce the number of capacitors
Nanotechnology Achieves Ultra-Stable Control

- At Conventional Output Capacitance: 1μF
  - Nano Cap Equipped Product: ±50mV
  - Conventional Product: ±370mV
- At Nano Cap Output Capacitance: 100nF
  - Nano Cap Equipped Product: ±180mV
  - Conventional Product: ±780mV

Max. Voltage Fluctuation

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Conditions: 5V output voltage, 50mA load current fluctuation

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**

- Standard Technology: 80ns
- Nano Power Supply: 9ns

**Nano Energy™**

Provides 10-year drive on a single coin battery

- **Ultra-low current consumption technology**

- Standard Technology: 360nA
- Nano Power Supply: 180nA

**Nano Cap™**

Achieves industry-leading voltage fluctuation regardless of capacitance

- **Ultra-stable control technology**

- Standard Technology: 15.6%
- Nano Power Supply: 3.6%

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