ROHM SEMICONDUCTOR

ROHM's Automotive
Semiconductor
Switches

IPD Intelligent
Power
Device

ROHM semiconductor switches provide greater reliability, safety and longer life

IPD : Intelligent Power Device

The emergence of self-driving cars and vehicles equipped with ADAS (Advanced Driver Assistance Systems) following improved safety countermeasures related to human life increases the importance of safety and reliability in electronic circuits. At the same time, there is a need for electronic systems to more reliably detect abnormalities to further improve vehicle safety. One way is to review the role of the power supply path which provides the source of operation in electronic circuits. In addition to responding to abnormalities, there is also a demand to ensure safety beforehand by treating all behavior levels that differ from the norm as abnormal while extending the life and durability of the circuit itself.
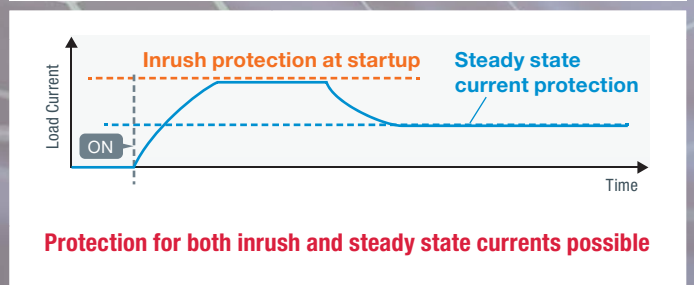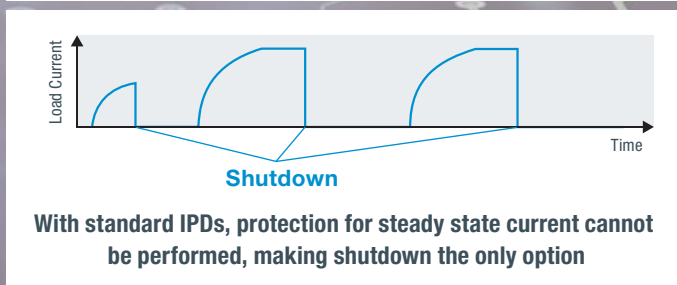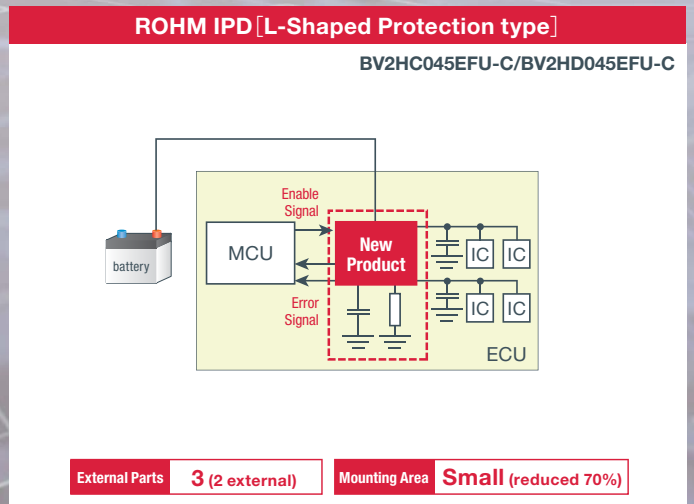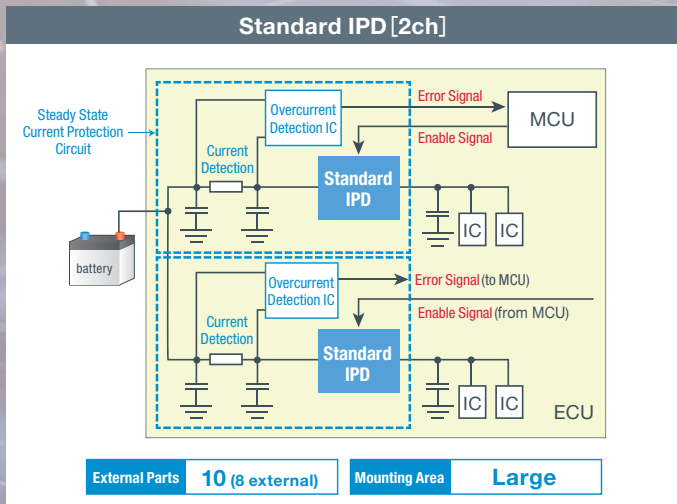
POINT ▶ **Prevents circuit blackout even during unexpected current abnormalities**

Until now, circuit protection entails the use of an MCU to judge the error signal detected by the overcurrent detection IC before transmitting it to the IPD as an enable signal to initiate shutdown or repeated shutdown/restart operation. However, this can result in unstable circuit operation or malfunction. In constrast, ROHM's new IPDs provide protection functionality without an MCU and are capable of supplying the minimum current during protection operation, allowing the circuit to operate while generating an error signal. This makes it possible to make emergency calls during circuit operation in the event of non-fatal abnormalities.

What's more, circuit blackouts can be avoided when the mechanical load increases due to aging or unexpected increases in parasitic capacitance. In addition, independent operation is enabled without going through an MCU, reducing the number of components required and improving reliability.
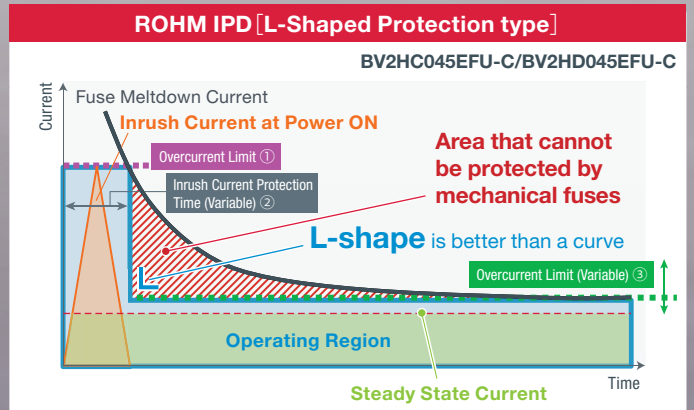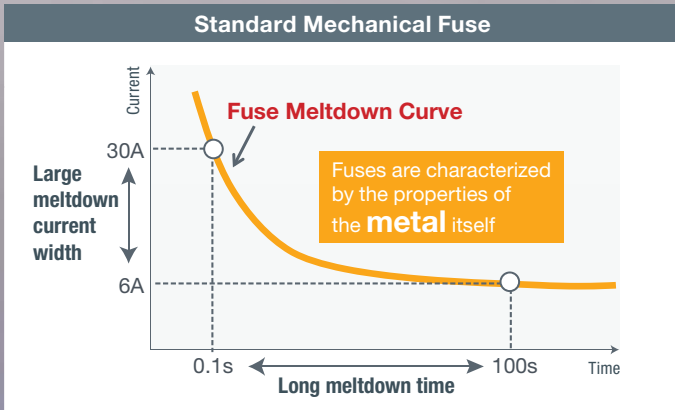
Operation Comparison (After Overcurrent Detection)

Standard IPD [2ch]	ROHM IPD [L-Shaped Protection type]
	BV2HC045EFU-C/BV2HD045EFU-C

Standard IPD [2ch]:
Steady State Current Protection Circuit — Current Detection — Overcurrent Detection IC — Error Signal → MCU — Enable Signal — Standard IPD — IC IC
battery — Current Detection — Overcurrent Detection IC — Error Signal (to MCU) — Enable Signal (from MCU) — Standard IPD — IC IC — ECU

External Parts	**10** (8 external)	Mounting Area	**Large**

ROHM IPD [L-Shaped Protection type]:
battery — MCU — Enable Signal — New Product — Error Signal — IC IC / IC IC — ECU

External Parts	**3** (2 external)	Mounting Area	**Small** (reduced 70%)

Load Current vs Time (Standard IPD) — Shutdown

With standard IPDs, protection for steady state current cannot be performed, making shutdown the only option

Load Current vs Time (ROHM IPD) — Inrush protection at startup / Steady state current protection — ON

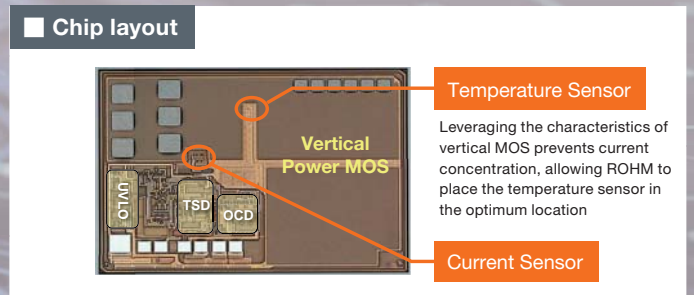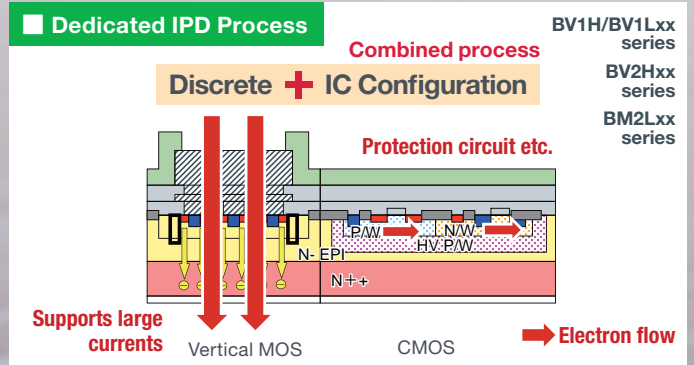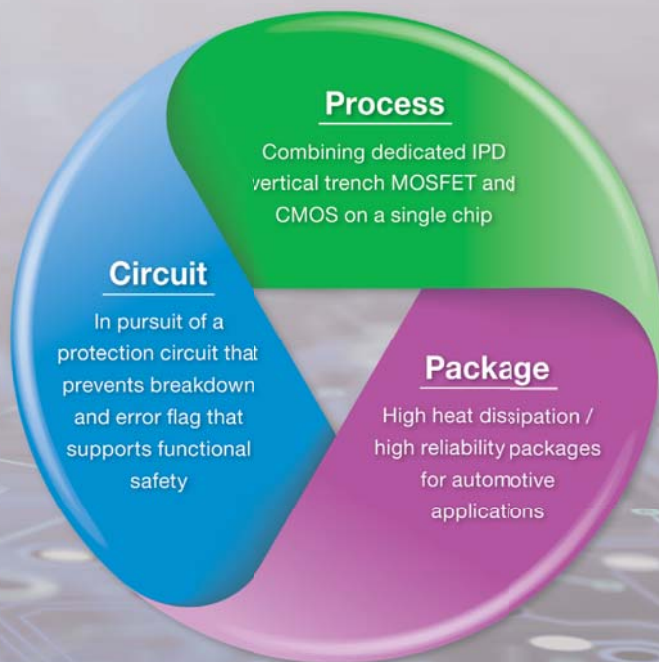**Protection for both inrush and steady state currents possible**

POINT ▶ Protects even in areas impossible to cover with fuses

Standard fuses are designed with a certain margin against short-circuits and inrush current during power ON to prevent erroneous cutoff.
In contrast, ROHM's new IPDs are capable of both protecting against inrush current and masking the inrush current region, enabling high accuracy detection of even slight current abnormalities during steady state operation.
Also, since the minimum current can be supplied instead of shutting down operation immediately after an abnormality occurs, they can be used for preventive maintenance by detecting abnormalities during circuit operation.
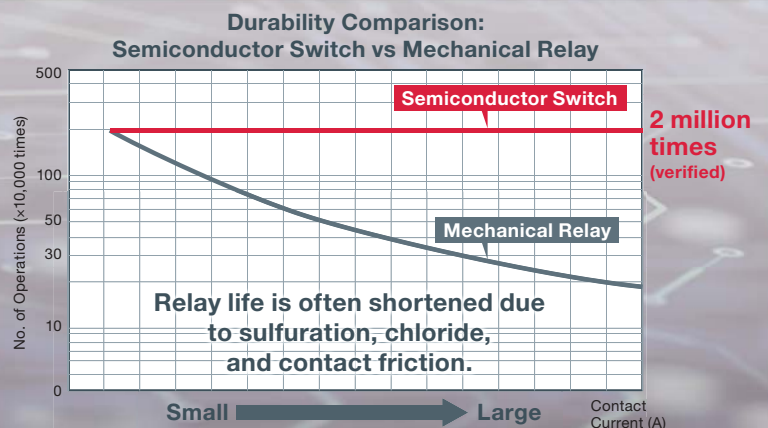
Standard Mechanical Fuse

Fuse Meltdown Curve

Current

30A

Large meltdown current width

6A

Fuses are characterized by the properties of the **metal** itself

0.1s ◄── Long meltdown time ──► 100s

Time

ROHM IPD [L-Shaped Protection type]

BV2HC045EFU-C/BV2HD045EFU-C

Current

Fuse Meltdown Current

Inrush Current at Power ON

Overcurrent Limit ①

Inrush Current Protection Time (Variable) ②

Area that cannot be protected by mechanical fuses

L-shape is better than a curve

Overcurrent Limit (Variable) ③

Operating Region

Steady State Current

Time

POINT ▶ Utilizes the latest power semiconductor technologies

Process
Combining dedicated IPD vertical trench MOSFET and CMOS on a single chip

Circuit
In pursuit of a protection circuit that prevents breakdown and error flag that supports functional safety

Package
High heat dissipation / high reliability packages for automotive applications

■ Dedicated IPD Process

BV1H/BV1Lxx series
BV2Hxx series
BM2Lxx series

Combined process

Discrete + IC Configuration

Protection circuit etc.

P/W N/W HV P/W
N- EPI
N++

Supports large currents

Vertical MOS   CMOS   ➡ Electron flow

■ Chip layout

Temperature Sensor

Leveraging the characteristics of vertical MOS prevents current concentration, allowing ROHM to place the temperature sensor in the optimum location

Vertical Power MOS

UVLO   TSD   OCD

Current Sensor

POINT ▶ IPD switches deliver dozens of times longer life than conventional relays

ROHM's IPD power switch block features a discrete high current structure capable of covering areas that can only be switched using relays.
In addition, the life of semiconductor switches exceeds one million times.
This ensures worry-free use, unlike mechanical relays which are susceptible to contact failure due to aging, gases, or carbides.

**Durability Comparison:
Semiconductor Switch vs Mechanical Relay**

No. of Operations (×10,000 times)

500

Semiconductor Switch

2 million times (verified)

100

50

30

Mechanical Relay

10

Relay life is often shortened due to sulfuration, chloride, and contact friction.

0

Small ──► Large

Contact Current (A)

IPD (Intelligent Power Device)

High Side Switches

L-Shape Protection Smart High Side Switches

Part No.	Voltage Range (V)	V_{DS} (Max) (V)	ch	Iocp (Min) (A)	ON Resistance (Typ) (mΩ)	TSD	Package	Automotive-Grade AEC-Q100
New BV2HC045EFU-C	6.0 to 19.0	41	2	21	45	Off-latch	HSSOP-C16	YES
New BV2HD045EFU-C	6.0 to 28.0	41	2	21	45	Self-restart	HSSOP-C16	YES

Smart High Side Switches

Part No.	Voltage Range (V)	V_{DS} (Max) (V)	ch	Iocp (Min) (A)	ON Resistance (Typ) (mΩ)	TSD	Package	Automotive-Grade AEC-Q100
BV1HD090FJ-C	4.5 to 36.0	45.0	1	2.7	90	Self-restart	SOP-J8	YES
BD1HC500EFJ-C	4.0 to 18.0	44.5	1	0.8	500	Off-latch	HTSOP-J8	YES
BD1HC500FVM-C	4.0 to 18.0	44.5	1	0.8	500	Off-latch	MSOP8	YES
BD1HC500HFN-C	4.0 to 18.0	44.5	1	0.8	500	Off-latch	HSON8	YES
BD1HD500EFJ-C	4.0 to 18.0	44.5	1	0.8	500	Self-restart	HTSOP-J8	YES
BD1HD500FVM-C	4.0 to 18.0	44.5	1	0.8	500	Self-restart	MSOP8	YES
BD1HD500HFN-C	4.0 to 18.0	44.5	1	0.8	500	Self-restart	HSON8	YES

Low Side Switches

Smart Low Side Switches

Part No.	Voltage Range (V)	V_{DS} (Max) (V)	ch	Iocp (Min) (A)	ON Resistance (Typ) (mΩ)	TSD	Package	Automotive-Grade AEC-Q100
New BV1LB010FPJ-C	3.5 to 5.5	38	1	42	10	Self-restart	TO252-J3	YES
BV1LB028FPJ-C	3.0 to 5.5	42	1	30	28	Self-restart	TO252-J3	YES
BV1LB045FPJ-C	3.0 to 5.5	42	1	18	45	Self-restart	TO252-J3	YES
BV1LB085FJ-C	3.0 to 5.5	42	1	13	85	Self-restart	SOP-J8	YES
BV1LC105FJ-C	3.0 to 5.5	42	1	3	105	Self-restart	SOP-J8	YES
BV1LB150FJ-C	3.0 to 5.5	42	1	6.5	150	Self-restart	SOP-J8	YES
BV1LB300FJ-C	3.0 to 5.5	42	1	1.7	300	Self-restart	SOP-J8	YES
BV1LC300FJ-C	3.0 to 5.5	42	1	1.7	350	Self-restart	SOP-J8	YES
BD1LB500EFJ-C	3.5 to 5.5	42	1	0.8	350	Self-restart	HTSOP-J8	YES
BD1LB500FVM-C	3.5 to 5.5	42	1	0.8	350	Self-restart	MSOP8	YES
BM2LC105FJ-C	3.0 to 5.5	42	2	3	105	Self-restart	SOP-J8	YES
BM2LC120FJ-C	3.0 to 5.5	42	2	3	120	Self-restart	SOP-J8	YES
BM2LB110FJ-C	3.0 to 5.5	42	2	2.5	120	Self-restart	SOP-J8	YES
BM2LB150FJ-C	3.0 to 5.5	42	2	6.5	150	Self-restart	SOP-J8	YES
BM2LB300FJ-C	3.0 to 5.5	42	2	1.7	300	Self-restart	SOP-J8	YES
BM2LC300FJ-C	3.0 to 5.5	42	2	1.7	350	Self-restart	SOP-J8	YES
BD8LB600FS-C	3.0 to 5.5(Digital)/ 4.0 to 5.5(Analog)	45	8	1	600	Self-restart	SSOP-A24	YES
BD8LA700EFV-C	3.0 to 5.5(Digital)/ 4.0 to 5.5(Analog)	45	8	0.5	700	Off-latch	HTSSOP-B24	YES