Automotive LED Drivers Selection Guide

Ver.2.3

ROHM SEMICONDUCTOR

Creating the future of Automobiles

Automotive

ROHM Co.,Ltd.

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*Before using the product(s) please verify the numerical values, data, and functions listed in the latest datasheet.

Pickup Application Configuration Examples

Application	Type	LED Driver
FRONT		
High/Low Beam, DRL, Fog, Position		
Multiple LEDs	Simple Drive	BD18351EFV-M(P.5) ☆BD18353EFV-M/MUF-M(P.6)
Few LEDs High Current Load 	Simple Drive	☆BD18394EFV-M/MUF-M(P.3) ☆BD18391/5EFV-M(P.4) BD1834x-M series(P.11-12)
	Corresponds to ADB	☆BD18394EFV-M/MUF-M(P.3) ☆BD18391/5EFV-M(P.4) Under Planning
Few LEDs Low Current Load 	Small Size	☆BD18336NUF-M(P.13)
	Controller type	BD1834x-M series(P.11-12)
	Internal MOSFET	BD837x-M series(P.14)
Turn lamp		
Sequential Turn 	Without MCU	BD18351EFV-M(P.5) ☆BD18353EFV-M/MUF-M(P.6) ☆BD18362EFV-M(P.8)
	With MCU	☆BD18394EFV-M/MUF-M(P.3) ☆BD18391/5EFV-M(P.4) Under Planning
		BD18337EFV-M(P.9-10) BD18347EFV-M(P.9-10) Nch MOSFET
Rear/Side		
Conventional Turn 	Controller	BD1834x-M series(P.11-12)
	Internal MOSFET/ 4ch	BD18337EFV-M(P.9-10) BD18347EFV-M(P.9-10)
Rear lamp		
Tail/Stop 	Small Size	☆BD18336NUF-M(P.13)
	Controller	BD18340FV-M(P.11)
	Internal MOSFET/ 4ch	BD18337EFV-M(P.9-10) BD18347EFV-M(P.9-10)
	Internal MOSFET/ 1ch	BD837x-M series(P.14)

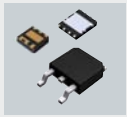
Discrete

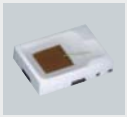
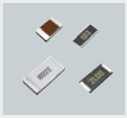
Buck converter
MOSFET: RSx/RD3 series(P.17)
Diode: RBR/RBxx8 series(P.18)

Buck-Boost converter
MOSFET: RSx/RD3 series(P.17)
Diode: RBR/RBxx8 series(P.18)

Matrix SW/ADB
MOSFET: RSx/RSD series(P.17)
Diode: RBR/RBxx8 series(P.18)
Shunt Resistor: LTR series(P.19)
Chip Resistor: SFR series(P.20)

Linear Driver
PNP Transistor: 2SAR573(P.17)
MOSFET: RJU003N03(P.17)
LED: PSL030x series(P.17)
Chip Resistor: SFR series(P.20)

Appearance
<MOSFETs>

<Diodes>

<LEDs>

<Chip Resistors>


Buck LED Driver
Boost, Buck-Boost LED Driver
Matrix SW LED Controller
Linear type LED Driver
☆: Under Development

*Before using the Products, please verify the numerical values, data, and functions listed in the latest datasheet.

Pickup LED Driver Lineup for Automotive Lamps

LED channel & number	20mA	130mA	500mA	800mA	1A	2 to 6A
Long chain 6 to 15 LEDs	**BD18351EFV-M**(Boost, Buck-Boost) ☆**BD18353EFV-M/MUF-M**(Boost, Buck-Boost) ☆**BD18312MUF-M**(1ch Boost+2ch Buck) **Front light**		☆**BD18391EFV-M** 1ch Buck Integrated FET(1A)		☆**BD18395 EFV-M** 1ch Buck Integrated FET(2A)	☆**BD18394 EFV-M/MUF-M** 1ch Buck Controller **Front light (LED/Laser)**
Multi channels 3 to 6 LEDs						
Multi channels 1 to 3 LEDs	**BD1834x series**(Controller) ☆**BD18336NUF-M**(Small PKG/1ch) ☆**BD18347EFV-M/BD18337EFV-M**(FET/4ch) **RCL/DRL/Turn/CL/Fog/High low beam**					
One channel 1 to 3 LEDs	**BD837x series** (Integrated FET/up to 500mA) **RCL/DRL/Turn/CL/Fog**					

Buck LED Driver | **Boost, Buck-Boost LED Driver** | **Linear LED Driver** | ☆: Under Development

Under Development

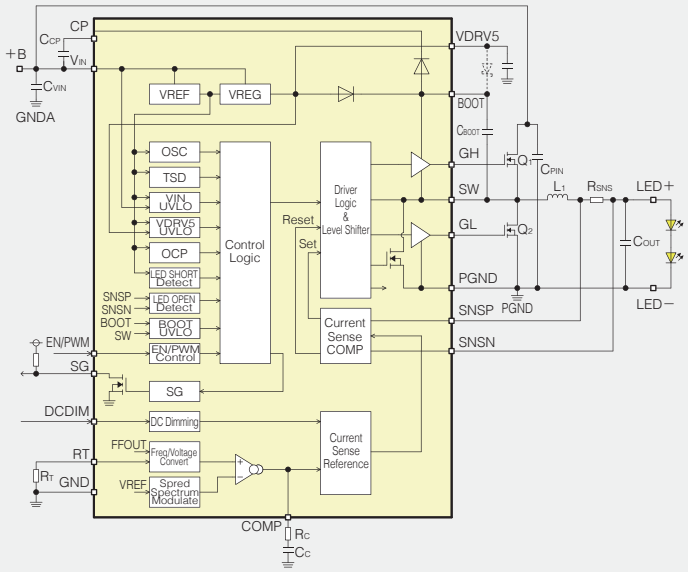
Buck LED Drivers featuring Fixed Switching Frequency Control

BD18394EFV-M/BD18394MUF-M

Key Features

- Synchronous rectification buck LED drivers
- Hysteresis function
- Operating voltage range: 5.0V to 70V
- LED voltage range: 2.0V to 60V
- Switching frequency: 100kHz to 500kHz
- **Fixed switching frequency control**
- **Spread spectrum function**
- High-side LED current detection function
- PWM/DC dimming function
- Supports matrix drive
- LED open/short detection function
- UVLO, TSD, OCP functions

Block Diagram



Target Applications

- High/Low Beam
- Tail-Stop Lamp, DRL
- Position/Turn Lamp

Package

HTSSOP-B16

W(Typ)	×	D(Typ)	×	H(Max)
5.00mm	×	6.40mm	×	1.00mm

VQFN24FV4040

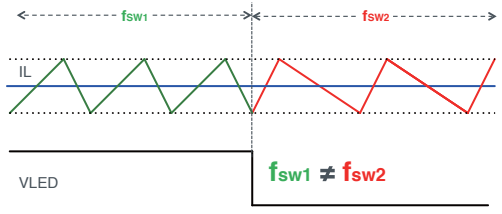
W(Typ)	×	D(Typ)	×	H(Max)
4.00mm	×	4.00mm	×	1.00mm

Advantages of EMC Countermeasures(Fixed Switching Frequency Control)

- Fixed switching frequency control addresses automotive EMC standards such as CISPR25 by focusing on switching frequency fluctuations that are issues of OFF time control.
- In addition, combining with a spread spectrum function ensures sufficient margin for automotive EMC standards.
- Hysteresis control provides faster response when changing the number of LEDs compared with current mode.

OFF Time Control

- Constant ripple control amplitude
- Switching frequency fluctuation
  → **Problem for EMC countermeasures**

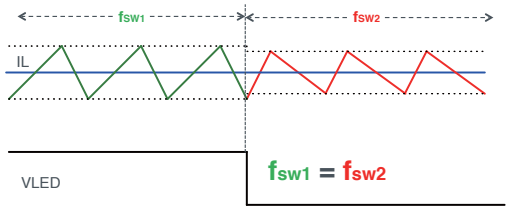


Response	Good
Frequency Stabilization	Dependant on input/ output conditions

- Hysteresis control ensures good response. However, the switching frequency will vary depending on the input/output conditions.

Fixed Switching Frequency Control

- The ripple current amplitude will fluctuate
- Switching frequency is constant.
  → **Facilitates EMC countermeasures**



Response	Good
Frequency Stabilization	Fixed

- Constant Switching frequency simplifies filter selection.
- Combining with spread spectrum contributes a compact filter size.
- Hysteresis control ensures good response.

Under Development

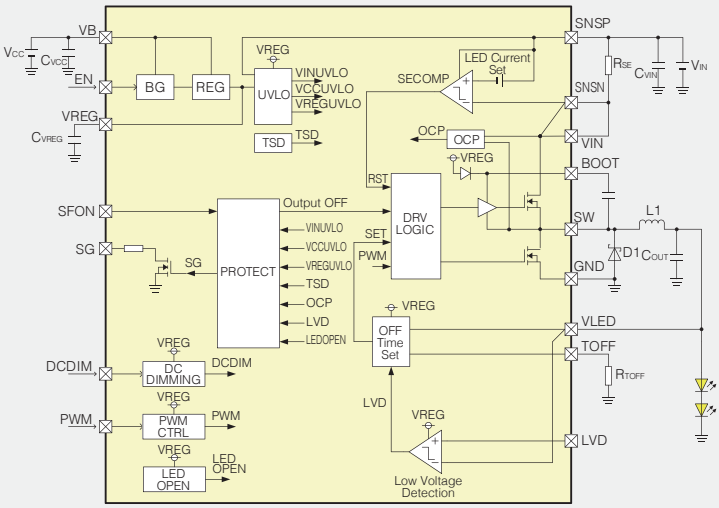
Buck LED Drivers featuring OFF time control (built-in switch FET)

BD18391EFV-M/BD18395EFV-M

Key Features

- Buck LED drivers with **built-in FET featuring OFF time control**
- Hysteresis control
- Operating voltage range: 4.5V to 70V
- LED voltage range: 0V to 60V
- LED current setting range:
  0.1A to 1.0A(BD18391EFV)
  0.2A to 2.0A(BD18395EFV)
- Switching frequency: 25kHz to 1MHz
- Standby current: 0μA(Typ)
- Output ON resistance: 0.17Ω(Typ)
- **PWM/DC dimming function**
- **Supports matrix drive**
  (output capacitance: less than10nF)
- **High-side LED current detection function**
- LED open/short detection function
- UVLO, TSD, OCP functions

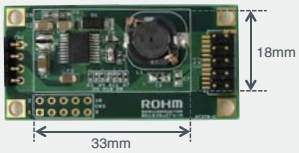
Block Diagram



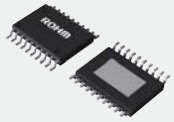
Target Applications

- High/Low Beam
- Tail-Stop Lamp, DRL
- Position/Turn Lamp

<Layout Example>



Package



HTSSOP-B20

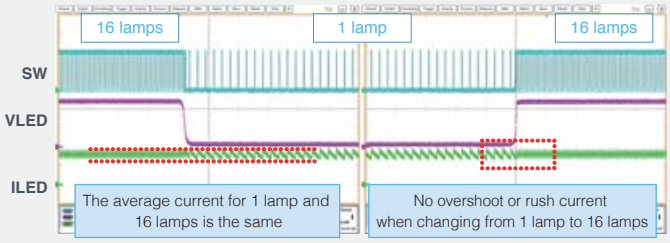
W(Typ)	×	D(Typ)	×	H(Max)
6.50mm	×	6.40mm	×	1.00mm

OFF Time Control

● LED drivers that light up multiple LEDs through matrix control, such as ADB and dynamic indicators, require fast response, reduced LED rush current, and minimal fluctuation in the average current when changing the number of LEDs.
OFF time control keeps the LED current ripple constant by detecting LED peak current with comparator and fixed OFF time control of buck converter.
The above requirements are realized because no phase compensation is necessary and output CAP can be minimized.

Sample Waveforms When Changing the Number of LEDs(BD18391EFV-M)

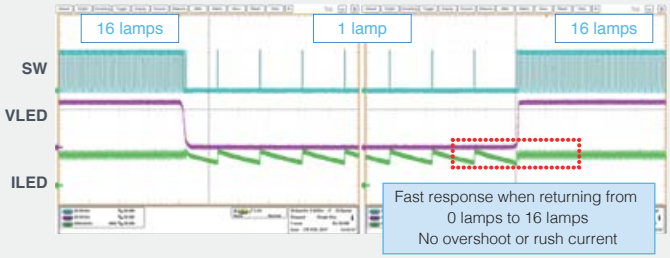
No. of LEDs
16 lamps⇒1 lamp



<Condition>
SW: 30V/div@DC
VLED: 20V/div@DC
ILED: 200mA/div@DC
Time: 50μsec./div

The LED voltage and current are immediately stabilized when changing the number of LEDs

No. of LEDs
16 lamps⇒0 lamp



Fast return even when all LEDs are OFF

New Products

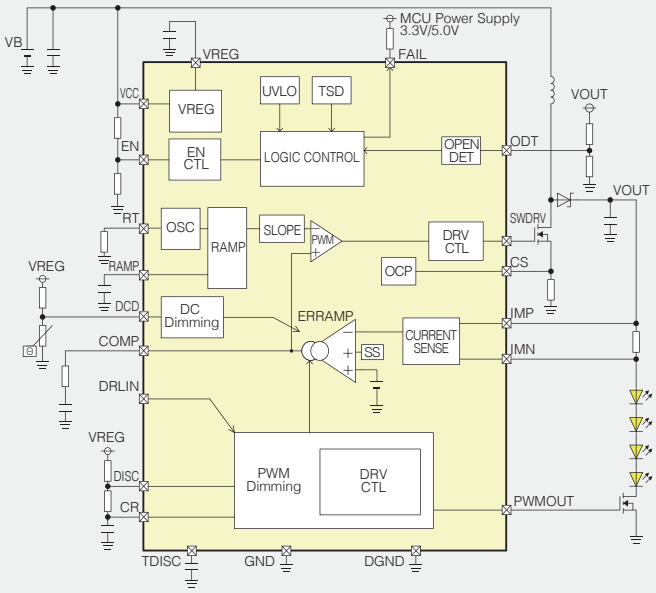
Boost LED Driver

BD18351EFV-M

Key Features

- 1ch boost LED driver
- Operating voltage range: 4.5 to 65V
- Boost voltage range: 6.0 to 65V
- High accuracy power supply: 2.5V±3%
- LED current accuracy: ±3%(−40℃ to +125℃)
- Switching frequency: 200kHz to 700kHz
- **PWM/DC dimming function**
- **Built-in PWM generator**
- **High-side LED current detection function**
- **Spread spectrum function**
- LED open/short protection function
- UVLO, TSD, OCP functions
- Self-diagnostic function(FAIL)

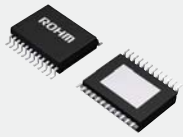
Block Diagram



Target Applications

- High/Low Beam
- Tail-Stop Lamp, DRL
- Position/Turn Lamp

Package



HTSSOP-B24

W(Typ)	×	D(Typ)	×	H(Max)
7.80mm	×	7.60mm	×	1.00mm

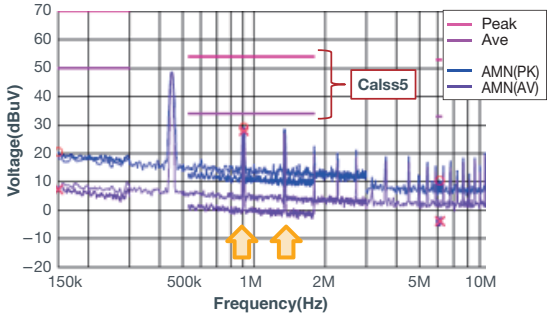
Spread Spectrum Function

- Spread spectrum(spread spectrum clock generator) is a function that mitigates noise concentration at a certain frequency(switching frequency and its harmonics) by intentionally modulating the switching frequency. It is effective in reducing the peak noise.
- The EMC level required for automotive applications is expected to become more stringent in the future following the continued electrification of vehicles and adoption of ADAS/Autonomous driving, but adding a spread spectrum function provides a better margin against automotive EMI standards such as CISPR25. This is why it is possible to decrease the size of the input filter block by optimization of filter components.

CISPR25/Conduction Emission Test Comparison

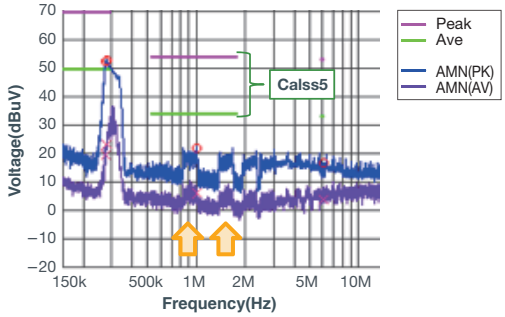
- Comparison of noise measurement result with π type filter constants required to meet CISPR25/Class 5 (8 white LED in series, ILED=300mA)

Conventional Product(without Spread Spectrum)



[π Type Filter Constants] Inductor: 4.7μH, Capacitor: 220μF

BD18351EFV-M(with Spread Spectrum)



[π Type Filter Constants] Inductor: 2.2μH, Capacitor: 10μF

The spread spectrum function makes it possible to reduce the input filter constants to comply with the CISPR25 standard

Under Development

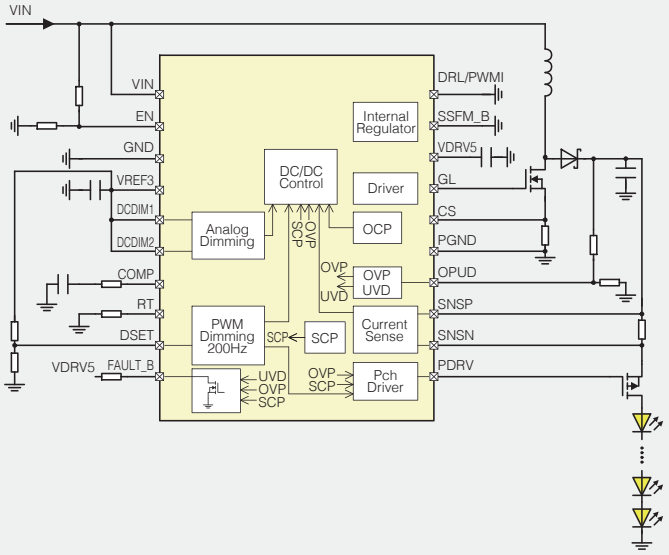
Boost LED Drivers

BD18353EFV-M/BD18353MUF-M

Key Features

- 1ch boost LED driver
- Operating voltage range: 5.0V to 65V
- Boost voltage range: up to 60V
- LED current accuracy: ±3%(–40℃ to +125℃)
- Switching frequency: 100kHz to 2.2MHz(T.B.D)
- **PWM/DC dimming function**
- **2-system DC dimming function**
- **Built-in PWM generator(200Hz)**
- **High-side LED current detection function**
- **Integrated Pch MOSFET driver for PWM dimming**
- **Spread spectrum function**
- **Hiccup timer**
- LED open/short protection function
- UVLO, UVD, OVP, OCP, TSD functions
- Diagnostic function(FAULT_B)

Block Diagram

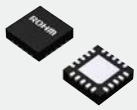


Target Applications

- High/Low Beam
- Tail-Stop Lamp, DRL
- Position/Turn Lamp

Package

HTSSOP-B20
W(Typ) × D(Typ) × H(Max)
6.50mm × 6.40mm × 1.00mm



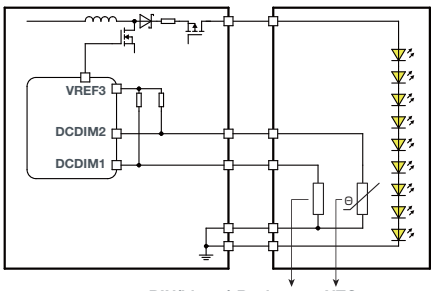
VQFN20FV3535
W(Typ) × D(Typ) × H(Max)
3.50mm × 3.50mm × 1.00mm

2-System DC Dimming Function

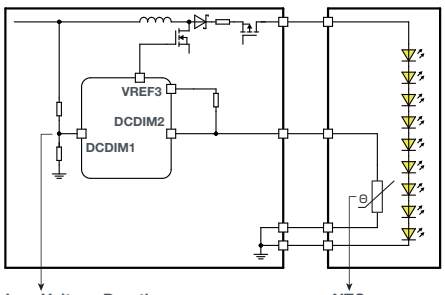
- The BD18353EFV-M and BD18353MUF-M each have 2 DC dimming terminals(DCDIM1 and DCDIM2)

Configuration Example	DCDIM1	DCDIM2
1	BIN resistor	Thermal derating(NTC)
2	Analog input from MCU	Thermal derating(NTC)
3	Analog input from resistor dividing	Thermal derating(NTC)
4	MCU control	Unused

Configuration Example 1



Configuration Example 3



Under Development

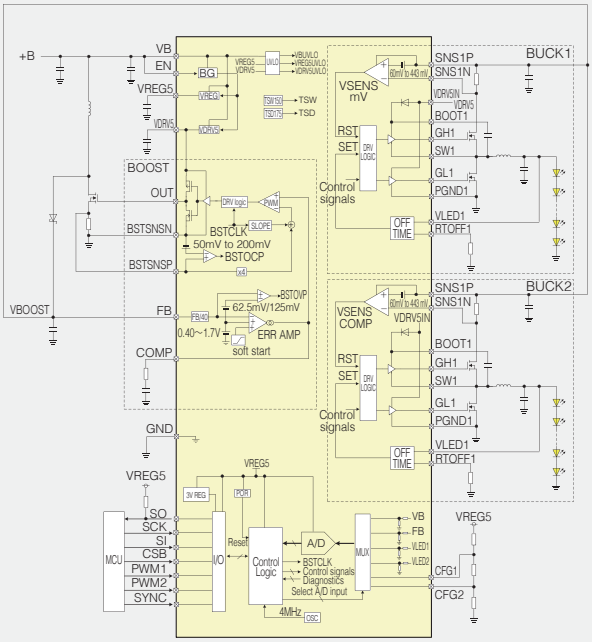
1ch Boost + 2ch Buck LED Driver

BD18312MUF-M

Key Features

- **1ch boost power supply + 2ch buck LED driver**
  Boost block: Current mode DC/DC controller
  Buck block: Buck LED driver featuring OFF time control
- Operating voltage range: 5.5V to 50V
- LED voltage range: 2.5V to 62V
- LED settable current range: Depends on external FET
- Switching frequency: 63kHz to 500kHz(Boost)
  : 25kHz to 1MHz(Buck)
- Standby current: 0μA(Typ)
- **PWM/DC dimming function**
- **Supports matrix drive**(output capacitance≤10nF)
- **High-side LED current detection function**
- **Limp home function**
- **Peak current correction function**
- LED open/short protection function
- UVLO, TSD, OCP functions

Block Diagram



Target Applications

- ADB
- High/Low Beam
- Tail-Stop Lamp, DRL
- Position/Turn Lamp

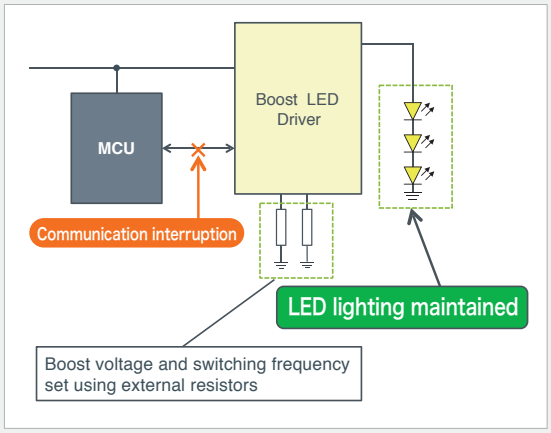
Package

VQFN40FV6060

W(Typ)	× D(Typ)	× H(Max)
6.00mm	× 6.00mm	× 1.00mm

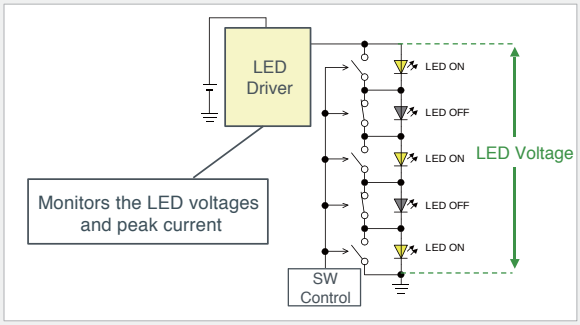
Limp Home Function

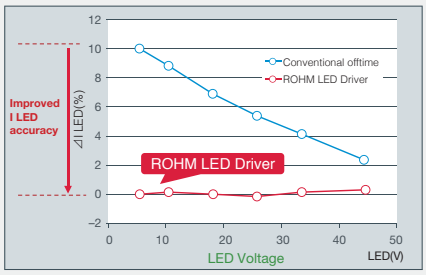
When communication between the LED driver IC and MCU is interrupted, the BD18312MUF-M detects an error via SPI and enters Limp Home mode.
Limp-home mode first reads the BIN(Binary) resistors which is external using the A/D converter. The boost output voltage and frequency can be set by these external BIN resistors, and BD18312MUF-M maintains LED lighting operation on these settings.



Peak Current Correction Function

During ADB operation, the LED voltage fluctuates dynamically, causing variations in the LED current. The BD18312MUF-M can correct these LED current fluctuations using a **peak current correction function**.





Under Development

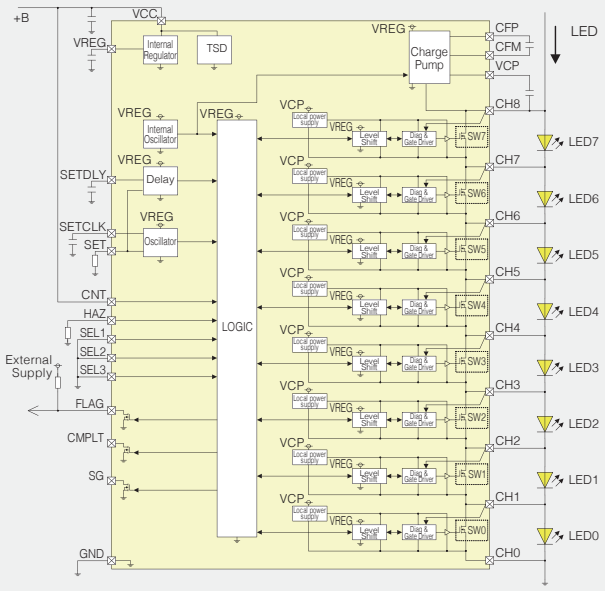
Matrix LED Controller with Built-in Pattern

BD18362EFV-M

Key Features

- 8ch Matrix LED controller
- Input voltage range: 5.5V to 60V
- LED voltage range: 0V to 48V
- Max LED current: 1.0A
- Built-in MOSFET(Ron=230mΩ)
- Standalone mode(no MCU)
- Sequential lighting pattern built-in
- Internal sequential lighting time setting function
- All lights ON function
- 2 LEDs can be connected to each switch
- LED open/short detection
- UVLO, TSD functions

Block Diagram

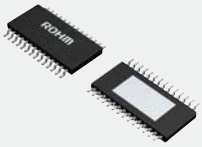


Target Applications

- Dynamic Indicator

Enables optimized design of dynamic Indicator

Package

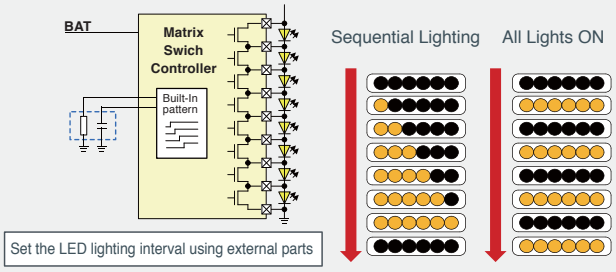


HTSSOP-B28

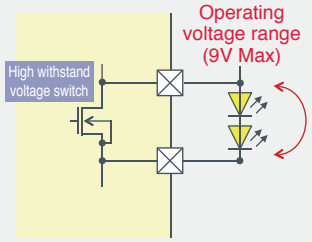
W(Typ) × D(Typ) × H(Max)

9.70mm × 6.40mm × 1.00mm

Built-in Lighting Pattern Facilitates Design



Connect 2 LEDs to Each Channel



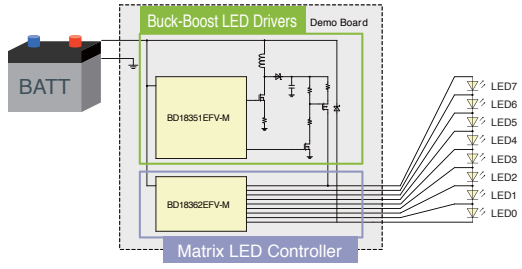
High voltage switches of BD18362EFV-M can handle up to 9V, so that 2 series of LED can be connected.
2 chips in 1 package type of LED can be connected, too.

*The guaranteed operating range is 9V/ch

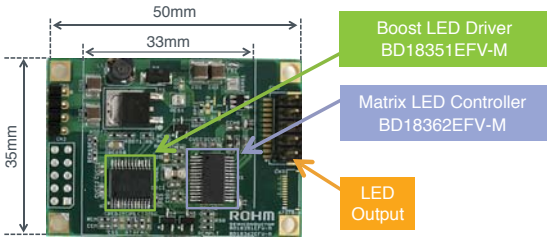
Dynamic Indicator Solution Without an MCU

Sequential control is easily achieved by combining ROHM's buck-boost LED driver(BD18351EFV-M) with a matrix LED controller.

Buck-Boost LED Driver + Matrix LED Controller Configuration



Evaluation Board



New Products

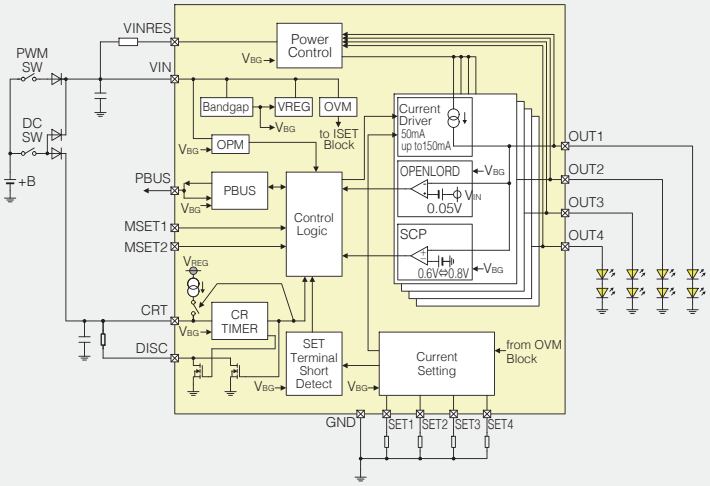
4ch Linear LED Drivers

BD18337EFV-M/BD18347EFV-M

Key Features

- 4ch linear LED drivers with built-in FET
- Operating voltage range: 5.5V to 20V
- Max output current: 150mA/ch(Total: 500mA)
- Output current accuracy: ±5%(Ta=−40℃ to +125℃)
- **Power Shift function**
- **License lamp mode**
- **LED open detection mask function**
  BD18337: 11.0V(Typ)
  BD18347: 7.65V(Typ)
- LED open/output short detection function
- Overvoltage mute function: V_{IN}>20V(Min)
- **PBUS function**
- TSD/UVLO
- UVLO, TSD functions

Block Diagram



Target Applications

- Rear Lamps
- Position/DRL
- Fog
- Turn

Package

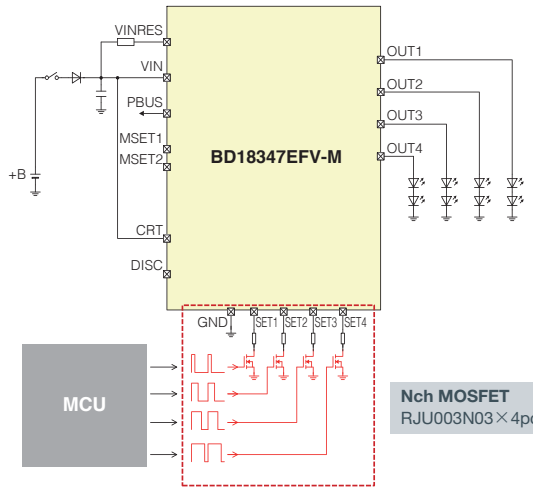
HTSSOP-B16

W(Typ) × D(Typ) × H(Max)
5.00mm × 6.40mm × 1.00mm

Individual PWM Dimming

● With BD18337EFV-M and BD18347EFV-M, individual PWM dimming can be done by connecting an Nch MOSFET to each channel. The delay time for the PWM signal when using external MOSFETs is shown in the figure of Measurement Conditions at the lower right.

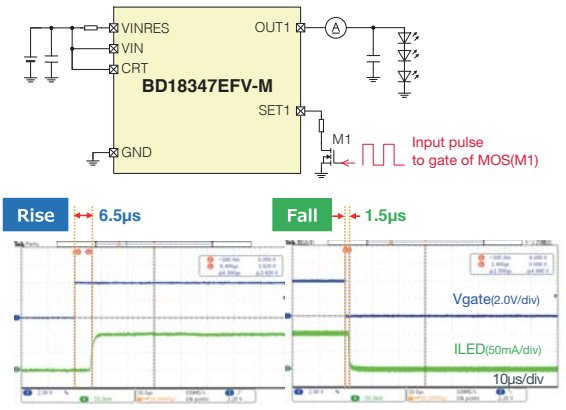
Configuration Example



Nch MOSFET
RJU003N03×4pcs

Measurement Results

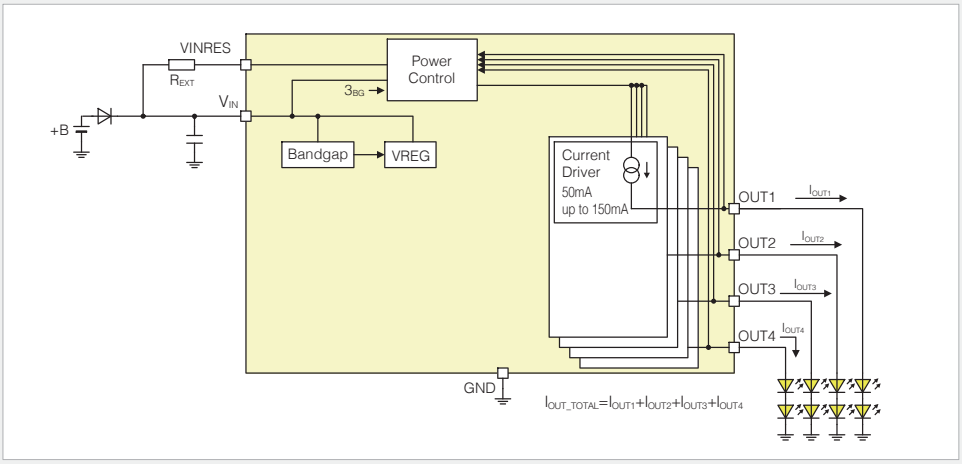
V_{IN}=13V, Output current: 100mA Ta=25˚C
Output capacitor: 0.047μF, LED: 3Strings(Color: Red)



Combining with an MCU supports applications such as dynamic Indicators

Power Shift Function

● Power shift function simplifies thermal design of LED driver board by adding external resister.
With conventional linear LED drivers, thermal design is difficult in high power applications due to the constraints for permissible package power loss.
In contrast, BD18337EFV-M and BD18347EFV-M dissipates the power ,which is consumed internally with conventional linear LED driver, externally with resistor(R_{EXT}) added between V_{IN} and VINRES. Thus IC temperature increase is minimized.
The voltage between VINRES pin and OUT1-4 pins are controlled to be less than 2.0V.

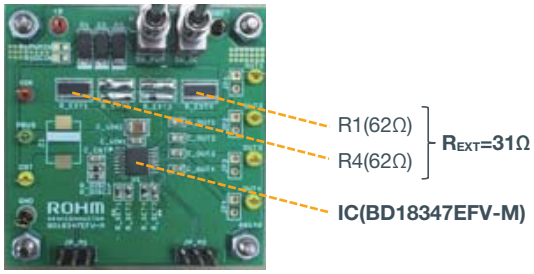


Adding a resistor simplifies thermal design and contributes to lower total cost by reducing the number of LED drivers

Actual Effects

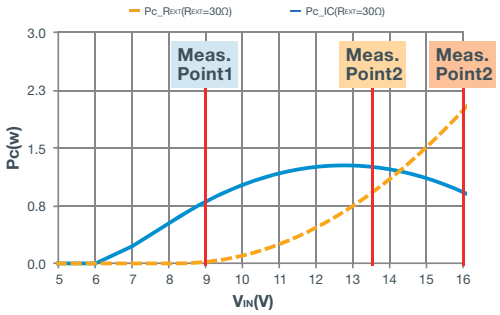
Measurement Conditions

+B=9V/13.5V/16V, I_{LED}=75mA/CH(Total: 300mA), V_{LED}=6.25V



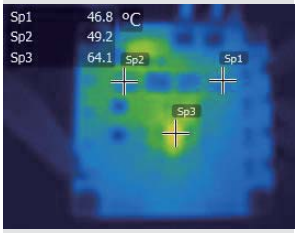
Loss Curves(Ideal Curves)

V_{IN} vs Pc(IC, R_{EXT}), I_{OUT} TOTAL=300mA, V_{LED} = 6.25V, R_{EXT}=31Ω



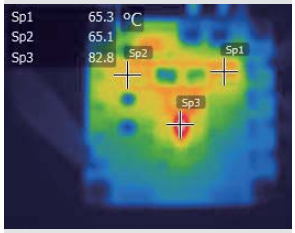
Measurement Results

Meas. Point1: +B=9V



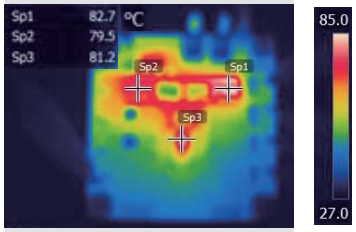
IC Temp. : 64.1˚C
R1 Temp. : 49.2˚C
R4 Temp. : 46.8˚C

Meas. Point2: +B=13.5V



IC Temp. : 82.8˚C
R1 Temp. : 65.1˚C
R4 Temp. : 65.3˚C

Meas. Point3: +B=16V



IC Temp. : 81.2˚C
R1 Temp. : 79.5˚C
R4 Temp. : 82.7˚C

External resistor reduces IC heat generation

New Products

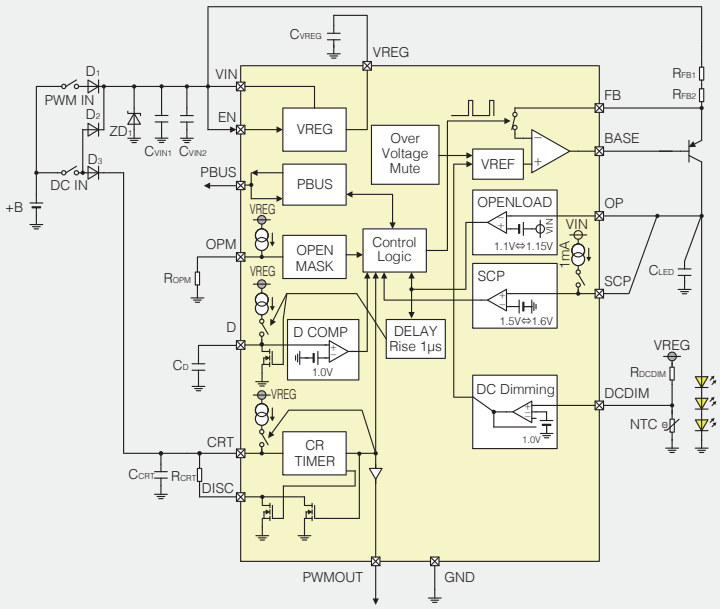
Linear LED Controllers

BD18340FV-M/BD18341FV-M/BD18342FV-M
BD18343FV-M/ New BD18345EFV-M

Key Features

- Linear LED controllers
- Operating voltage range: 4.5V to19V
- Reference voltage(5V) output: ±3%(Ta=25℃ to 125℃)
- FB terminal voltage accuracy: ±3%(Ta=25℃ to 125℃)
- **Standby current: 0μA(Typ)**
- **PWM dimming function**
- **DC dimming function** (BD18340, 18341, 18345 only)
- **PWMOUT synchronization signal output function** (BD18340, 18341, 18345 only)
- **LED open detection mask function(Variable voltage)**
- LED open/output short detection function
- Overvoltage mute function: 20V(Min)
- **PBUS function**
- UVLO, TSD functions

Block Diagram

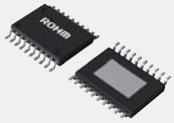


Target Applications

- Rear Lamps
- Position/DRL
- Fog
- Turn

Package

SSOP-B16(Other than BD18345)
W(Typ) × D(Typ) × H(Max)
5.00mm × 6.40mm × 1.00mm



HTSSOP-B20(BD18345)
W(Typ) × D(Typ) × H(Max)
6.50mm × 6.40mm × 1.00mm

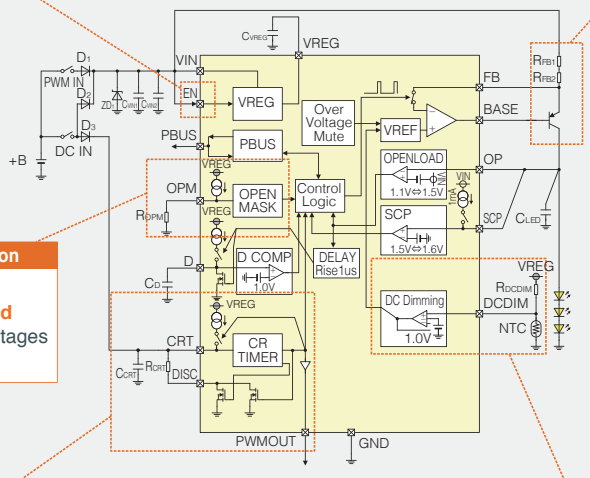
Multiple Built-In Functions

Standby Function

Standby current: 0μA(Typ)

LED open detection mask function

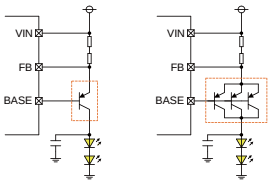
The LED open detection **mask voltage can be changed** based on the number of LED stages (variable voltage)



Controller Type

Support for both low and high current applications(1.0A Max) is achieved by simply changing the number of external PNP transistors

• Low Current • High Current



- **Contributes to IC consolidation (common design)**
- **Reduces system costs (compared with built-in switch types)**

CR Timer with PWM Signal External Output Function

The built-in CR timer eliminates the need to input a PWM signal from a timer IC or MCU(except BD18343) and the internally generated PWM signal **can be externally output, facilitating synchronous control** (BD18340, BD18341, and BD18345 only)

Temperature Derating Possible

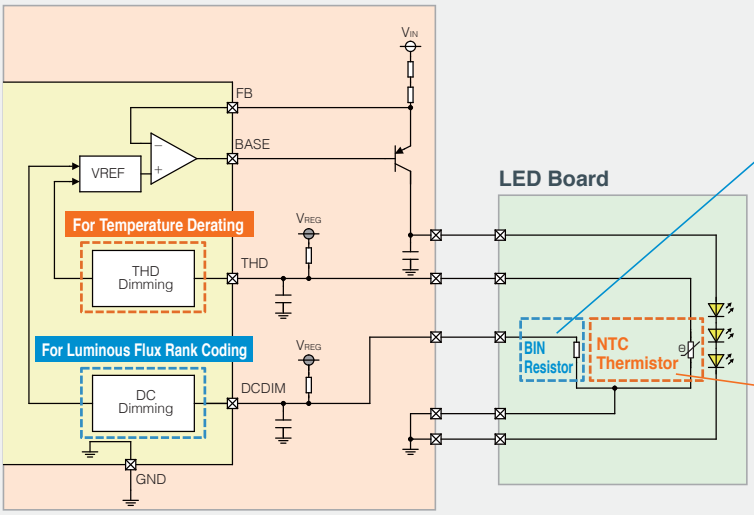
Luminous flux BIN setting and temperature derating is **possible with NTC thermistor so that constant voltage Zener is not needed.** (BD18340, BD18341, and BD18345 only)

New Products BD18345EFV-M with Enhanced DC Dimming Function

BD18345EFV-M

BD18345EFV-M with Enhanced DC Dimming Function

- The number of DC dimming functions was **expanded from 1 system in conventional models**(BD18340/BD18341) to **2 systems** in the BD18345
- **Achieves both** LED coding and temperature derating functionality
- DC dimming accuracy **improved to ±3%**(DCDIM pin)



Eliminates the needs to change resistor on the control board for different luminous flux ranks

DCDIM pin for DC dimming

Select a BIN resistor on the LED board corresponding to the LED luminous flux rank.
The voltage to DCDIM will vary depending on BIN resistor so that voltage of FB pin will be adjusted automatically.

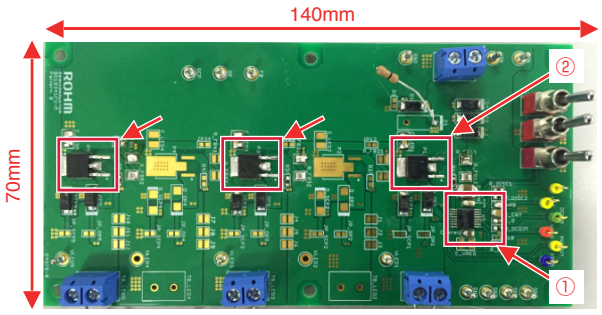
Ensuring high reliability by reducing LED degradation.

THD Pin For Temperature Derating

Connect an NTC thermistor. (The voltage of THD pin is resistor divided voltage from V_{REG})
Following a rise in temperature of the LED board, the resistance value of the thermistor decreases along with the THD pin voltage.
The output current can be derated based on the THD pin voltage.

Reference Boards

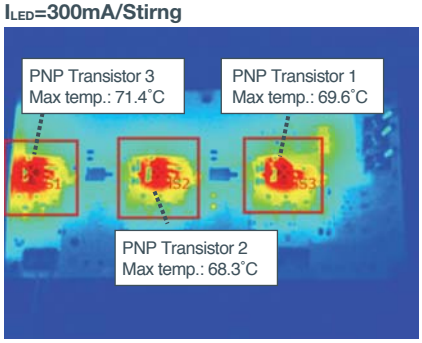
3-System



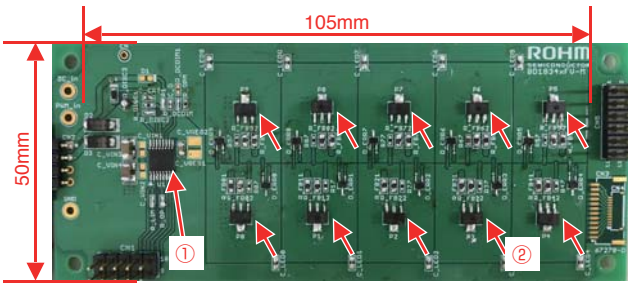
(Substrate: FR4 4-layer with 1oz. copper foil)

①BD18341FV-M, ②2SAR573DFHG

I_{LED}=300mA/Stirng



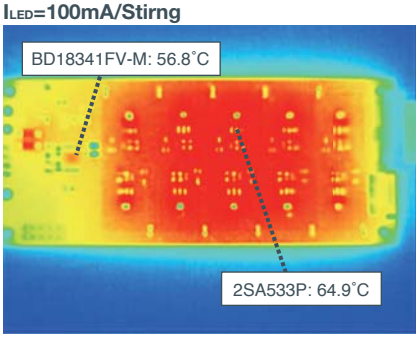
10-System



(Substrate: FR4 4-layer with 1oz. copper foil)

①BD18341FV-M, ②2SAR533P

I_{LED}=100mA/Stirng



Under Development

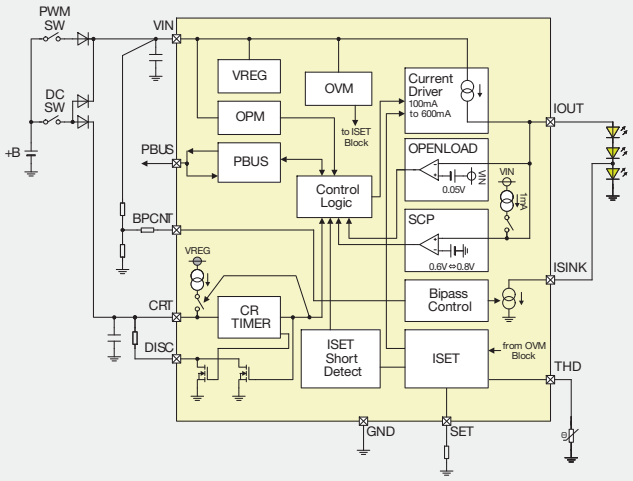
Ultra-Compact Linear LED Driver

BD18336NUF-M

Key Features

- Linear LED driver with built-in FET
- Operating voltage range: 5.5V to 20V
- Max output current: 400mA(DC), 600mA(50% duty)
- Output current accuracy: ±5%(240mA to 600mA) Tj=−40°C to +150°C
- **LED current bypass control during input voltage drops**
- **PWM dimming function**: 1% to 100%(@200Hz)
- **Output current derating function**
- **LED open detection mask function: 11V(Typ)**
- LED open/output short detection
- ISET pin short protection
- Overvoltage mute function: 16V(Min)
- **PBUS function**
- UVLO, TSD functions

Block Diagram



Target Applications

- Socket LED
- Rear Lamps
- Position/DRL
- Fog
- Turn

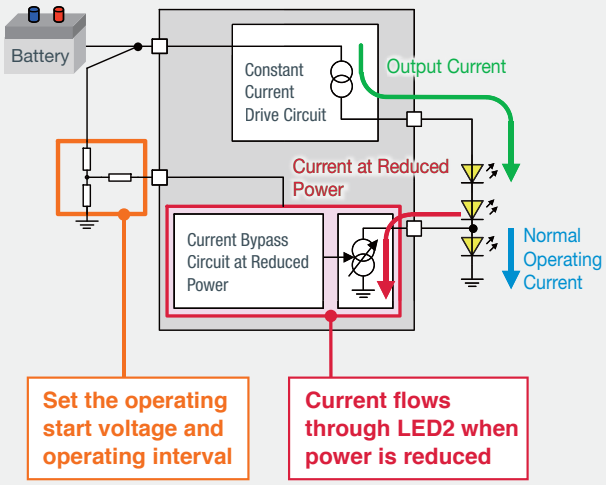
Package

VSON10FV3030

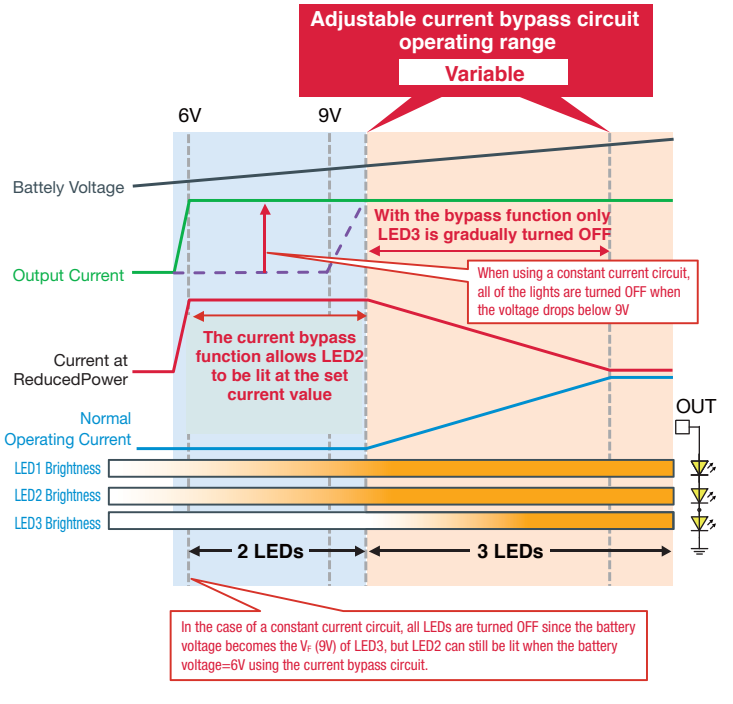
W(Typ)	×	D(Typ)	×	H(Max)
3.00mm	×	3.00mm	×	1.00mm

Current Bypass Function During Input Voltage Drops

The BD18336NUF-M can maintain lighting by dimming LED1 at the lowest stage even in the V_F of LED3 (approx. 9V) is greater than V_{IN} due to the LED current bypass function when the input voltage drops.



Introducing a current bypass function makes it possible to light the LEDs over the entire battery voltage range: 9V to 16V



Pickup

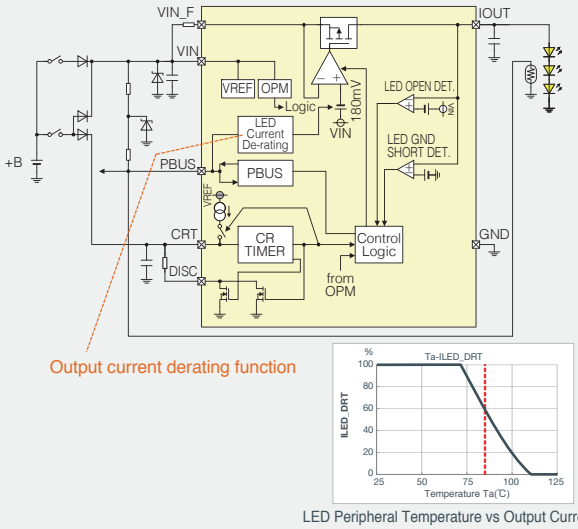
Linear LED Drivers with Built-in FET

BD83732HFP-M/BD83733HFP-M

Key Features

- Linear LED driver with built-in FET
- Operating voltage range: 4.5V to 42V
- Max output current: 500mA
- Output current accuracy: ±3%(Ta=25℃)
- **PWM dimming function**
  (PWM dimming range: 0.4% to 100%@200Hz)
- **Output current derating function**
- **LED open detection mask function(during reduced power)**
  BD83732: 7.6V(Typ)
  BD83733: 11.0V(Typ)
- LED open/short detection function
- **PBUS function**
- TSD protection function

Block Diagram



LED Peripheral Temperature vs Output Current ILED

Target Applications

- Rear Lamps
- Fog
- Position/DRL
- Turn

Package

HRP7

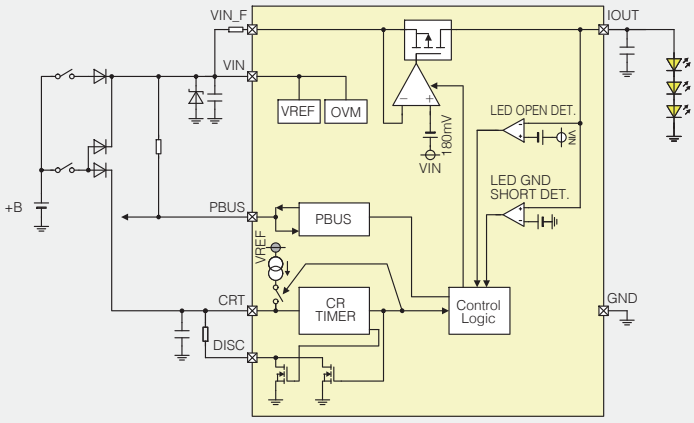
W(Typ)	×	D(Typ)	×	H(Max)
9.395mm	×	10.540mm	×	2.005mm

BD8374HFP-M/BD8374EFJ-M

Key Features

- Linear LED driver with built-in FET
- Operating voltage range: 4.5V to 42V
- Max output current: 500mA
- Output current accuracy: ±3%(Ta=25℃)
- **PWM dimming function**
  (PWM dimming range: 0.4% to 100%@200Hz)
- LED open/short detection function
- Overvoltage mute function: 27V(Min)
- **PBUS function**
- TSD protection function

Block Diagram



Target Applications

- Rear Lamps
- Fog
- Position/DRL
- Turn

Package

HRP7

W(Typ)	×	D(Typ)	×	H(Max)
9.395mm	×	10.540mm	×	2.005mm

HTSOP-J8

W(Typ)	×	D(Typ)	×	H(Max)
4.90mm	×	6.00mm	×	1.00mm

Pickup Linear LED Drivers Lineup

BD1834x-M series/BD837x-M series

BD1834x-M series

Part Number	Channel Number (ch)	Operating Voltage Range (V)	Absolute Maximum Rating (V)	Drive Current	Dimmer mode		PWM OUT	Package
					PWM CRT	DC		
BD18340FV-M	1 to 10	4.5 to 19	70	Depend on External Transistor (Total: 1000mA)	✓	✓ ±5%	✓	SSOP-B16
BD18341FV-M	1 to 10	4.5 to 19	70		✓	✓ ±13%	✓	SSOP-B16
BD18342FV-M	1 to 10	4.5 to 19	70		✓	–	–	SSOP-B16
BD18343FV-M	1 to 10	4.5 to 19	70		Only External Input	–	–	SSOP-B16
New **BD18345EFV-M**	1	4.5 to 19	70		✓	2port ±3%	✓	HTSSOP-B20
☆**BD18336NUF-M**	1	5.5 to 20	42	400mA(DC) 600mA(50% Duty)	✓	✓	–	VSON10FV3030
New **BD18347EFV-M/** New **BD18337EFV-M**	4	5.5 to 20	40	150mA/ch (Total: 450mA)	✓	–	–	HTSSOP-B16

☆: Under Development

BD837x-M series

Part Number	channel Number (ch)	Operating Voltage Range (V)	Absolute Maximum Rating (V)	Drive Current (mA)	Dimmer mode		PWM OUT	Package
					PWM CRT	DC		
BD8372HFP-M/ BD8372EFJ-M	1	5.5 to 40	50	200	–	High Current Low Current	–	HRP7/ HTSOP-J8
BD8374HFP-M/ BD8374EFJ-M	1	4.5 to 42	50	500	✓	–	–	HRP7/ HTSOP-J8
BD83732HFP-M/ BD83733HFP-M	1	4.5 to 42	50	500	✓	✓	–	HRP7

Pickup PBUS Function

Patent Registered
Japan : JP 5636241
US : US8754592
China : CN102431486A

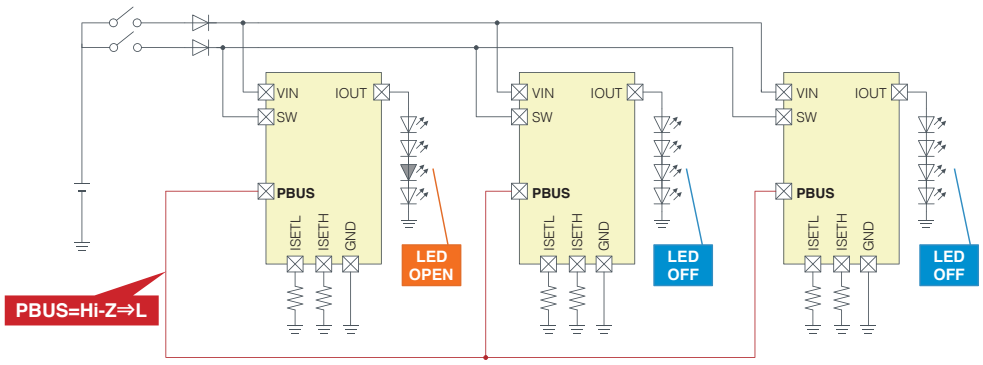
BD1834x-M series/BD837x-M series

PBUS Function

● **Basic Patent: PBUS Function**

The PBUS(Protect BUS) function automatically determines IC master or slave when detecting LED disconnection or IC output ground fault in multi-channel LED drive circuit that drive multiple LEDs and turns OFF all channels at once(all off).
Each model in the BD1834x-M and BD837x-M series is equipped with this function as standard.

BD1834x-M series Circuit Example

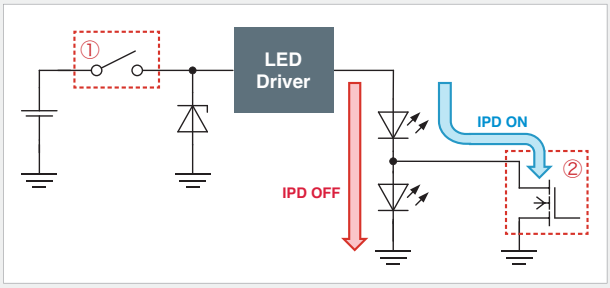


PROTECT BUS
Connecting the PBUS terminal between ICs makes it possible to detect a single lamp break or ground fault and turn all lamps OFF at once.

IPD(Intelligent Power Device)

Key Features

■ ROHM offers an enhanced lineup of IPD integrating MOSFET protection functions in 1ch/2ch/8ch series



(Automotive Lamp Application Example)

① Replaces mechanical relays and fuses

② Replaces FETs used for high/low beam switching and lighting control

◆ Replaces FETs adopted for resistive rear lamp switching

Lineup

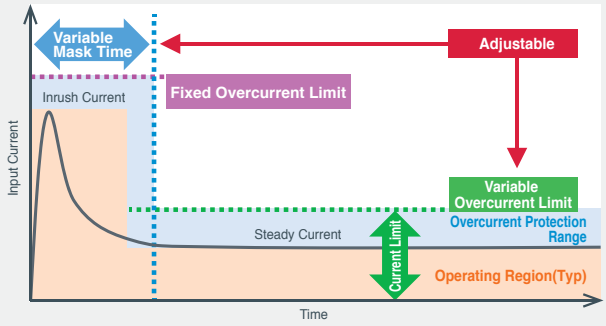
HSON8	MSOP8	HSON-A8	SOP-J8	HTSOP-J8	TO252-J3	HSSOP-C16	HTSSOP-B24	SSOP-A24
								
2.9mm×3.0mm×0.6mm	2.9mm×4.0mm×0.9mm	3.5mm×4.65mm×1.0mm	4.9mm×6.0mm×1.0mm	4.9mm×6.0mm×1.0mm	6.6mm×10.1mm×2.3mm	4.9mm×6.0mm×1.7mm	7.8mm×7.6mm×1.0mm	10.0mm×7.8mm×1.8mm

	No. of Ch	Part No.	Voltage Range (V)	VDS (Max) (V)	Overcurrent Detection (Min) (A)	ON Resistance (Typ) (mΩ)	TSD	Functions: Error Flag Output	Functions: Current Sense	Functions: Variable Overcurrent Detection	Functions: Overcurrent Mask Time Setting	Error Flag Output: Overheat Detection	Error Flag Output: Overcurrent Detection	Error Flag Output: Load Open Detection	Error Flag Output: Load Open Detection	Package: HSON8(HFN)	Package: MSOP8(FVM)	Package: HSON-A8(HFS)	Package: SOP-J8(FJ)	Package: HTSOP-J8(EFJ)	Package: TO252-J3(FPJ)	Package: HSSOP-C16(EFU)	Package: HTSSOP-B24(EFV)	Package: SSOP-A24(FS)
High-Side Switches	1	☆BV1HF045EFJ-C	6.0 to 28.0	45	21	45	Self-restart	✓	–	–	–	✓	✓	✓	✓	–	–	–	–	✓	–	–	–	–
	1	☆BV1HJ045EFJ-C	6.0 to 28.0	45	5	45	Self-restart	✓	–	–	–	✓	✓	✓	✓	–	–	–	–	✓	–	–	–	–
	1	BV1HD090FJ-C	4.5 to 36.0	45	2.7	90	Self-restart	✓	–	–	–	✓	✓*2	✓	–	–	–	–	✓	–	–	–	–	–
	1	☆BV1HN090FJ-C	4.5 to 36.0	45	4	90	Self-restart	✓	–	–	–	✓	✓	✓	–	–	–	–	✓	–	–	–	–	–
	1	BD1HC500□□□-C*1	4.0 to 18.0	44.5	0.8	500	Off-latch	✓	–	–	–	✓	✓*2	✓	–	✓	✓	–	–	✓	–	–	–	–
	1	BD1HD500□□□-C*1	4.0 to 18.0	44.5	0.8	500	Self-restart	✓	–	–	–	✓	✓*2	✓	–	✓	✓	–	–	✓	–	–	–	–
	1	☆BV1HB045EFJ-C	6.0 to 28.0	45	21	45	Self-restart	✓	✓	–	–	✓	✓	✓	–	–	–	–	–	✓	–	–	–	–
	2	New BV2HC045EFU-C	6.0 to 19.0	41	Fix(21A)& Adj(1 to 10A)	45	Off-latch	✓	–	✓	✓	✓	✓	✓	–	–	–	–	–	–	–	✓	–	–
	2	New BV2HD045EFU-C	6.0 to 28.0	41	Fix(21A)& Adj(1 to 10A)	45	Self-restart	✓	–	✓	✓	✓	✓	✓	–	–	–	–	–	–	–	✓	–	–
	2	☆BV2HD070EFU-C	6.0 to 28.0	41	Fix(21A)& Adj(0.5 to 7A)	70	Self-restart	✓	–	✓	✓	✓	✓	✓	–	–	–	–	–	–	–	✓	–	–
Low-Side Switches	1	New BV1LB010FPJ-C	3.0 to 5.5	42	42	10	Self-restart	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	–	–	–
	1	BV1LB028FPJ-C	3.0 to 5.5	42	30	28	Self-restart	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	–	–	–
	1	BV1LB045FPJ-C	3.0 to 5.5	42	18	45	Self-restart	–	–	–	–	–	–	–	–	–	–	–	–	–	✓	–	–	–
	1	BV1LB085FJ-C*1	3.0 to 5.5	42	13	85	Self-restart	–	–	–	–	–	–	–	–	–	–	–	✓	–	–	–	–	–
	1	BV1LB150FJ-C*1	3.0 to 5.5	42	6.5	150	Self-restart	–	–	–	–	–	–	–	–	–	–	–	✓	–	–	–	–	–
	1	BV1LB300FJ-C*1	3.0 to 5.5	42	1.7	300	Self-restart	–	–	–	–	–	–	–	–	–	–	–	✓	–	–	–	–	–
	1	BD1LB500□□□-C*1	3.0 to 5.5	42	0.8	350	Self-restart	–	–	–	–	–	–	–	–	–	✓	–	–	✓	–	–	–	–
	1	☆BV1LC085EFJ-C	3.0 to 5.5	42	5	85	Self-restart	✓	–	–	–	✓	✓	✓	–	–	–	–	–	✓	–	–	–	–
	1	BV1LC105FJ-C	3.0 to 5.5	42	3	105	Self-restart	✓	–	–	–	✓	✓	✓	–	–	–	–	✓	–	–	–	–	–
	1	BV1LC150EFJ-C	3.0 to 5.5	42	3.5	150	Self-restart	✓	–	–	–	✓	✓	✓	–	–	–	–	–	✓	–	–	–	–
	1	BV1LC300FJ-C*1	3.0 to 5.5	42	1.7	350	Self-restart	✓	–	–	–	✓	✓	✓	–	–	–	–	✓	–	–	–	–	–
	2	BM2LB150FJ-C	3.0 to 5.5	42	6.5	150	Self-restart	–	–	–	–	–	–	–	–	–	–	–	✓	–	–	–	–	–
	2	BM2LB110FJ-C	3.0 to 5.5	42	2.5	120	Self-restart	–	–	–	–	–	–	–	–	–	–	–	✓	–	–	–	–	–
	2	BM2LB300FJ-C	3.0 to 5.5	42	1.7	300	Self-restart	–	–	–	–	–	–	–	–	–	–	–	✓	–	–	–	–	–
	2	BM2LC105FJ-C	3.0 to 5.5	42	3	105	Self-restart	✓	–	–	–	✓	✓	✓	–	–	–	–	✓	–	–	–	–	–
	2	BM2LC300FJ-C	3.0 to 5.5	42	1.7	350	Self-restart	✓	–	–	–	✓	✓	✓	–	–	–	–	✓	–	–	–	–	–
	8	BD8LB600FS-C	3.0 to 5.5(Digital) 4.0 to 5.5(Analog)	45	1	600	Self-restart	✓	–	–	–	✓	✓	✓	–	–	–	–	–	–	–	–	–	✓
	8	BD8LA700EFV-C	3.0 to 5.5(Digital) 4.0 to 5.5(Analog)	45	0.5	700	Off-latch	✓	–	–	–	✓	✓	✓	–	–	–	–	–	–	–	–	✓	–

☆: Under Development *1: The □□□ in the part number are reserved for the package code. Refer to the package columns at the right side of the table. *2: Hiccup type

BV2Hx045EFU-C series Overcurrent Protection Operation

■ Variable overcurrent limit and mask time **make it easy to adjust current protection conditions depending on the load conditions.**



Fixed Overcurrent Limit

Fixed value of the IC

Variable Overcurrent Limit

Unlike fixed overcurrent limit methods for IC protection, abnormal current is detected and limited during steady-state operation. This limit can be adjusted based on load characteristics using an external resistor(functions after the mask time ends)

Variable Mask Time

Mask time prevents erroneous detection of inrush current to the capacitive load as abnormal current during steady-state operation. It can be varied based on load characteristics via external capacitor

MOSFETs/Bipolar Transistors for Automotive LED Drivers

Nch MOSFET for BD18394EFV-M

Package	Part No.	Absolute Maximum Ratings			$R_{DS}(on)$ Typ(mΩ)	Qg Typ (nC)	Ciss Typ (pF)
		V_{DSS}(V)	I_D(A)	V_{GS}(V)	V_{GS}=10V	V_{GS}=4.5V	V_{GS}=20V
DFN2020	**RF9G120BH**	40	12	±20	17.5	9.1	520
HSMT8	**AG109DGQ4**	40	27	±20	9.4	21	1,170

Pch MOSFET for BD18353EFV/MUF-M

Package	Part No.	Absolute Maximum Ratings			$R_{DS}(on)$ Typ(mΩ)	Qg Typ (nC)	Ciss Typ (pF)
		V_{DSS}(V)	I_D(A)	V_{GS}(V)	V_{GS}=10V	V_{GS}=5V	V_{GS}=10V
SOT-346T (TSMT3)	**RSR015P06**	−60	−1.5	±20	200	10*1	500
SOT-457T (TSMT6)	**RSQ015P10**	−100	−1.5	±20	350	17	950*2

*1: V_{GS}=10V *2: V_{GS}=25V

Nch MOSFET for BD18353EFV/MUF-M

Package	Part No.	Absolute Maximum Ratings			$R_{DS}(on)$ Typ(mΩ)	Qg Typ (nC)	Ciss Typ (pF)
		V_{DSS}(V)	I_D(A)	V_{GS}(V)	V_{GS}=4.5V	V_{GS}=5V	V_{GS}=10V
SOT-323 (UMT3)	**RJU003N03**	30	0.3	±12	800	—	24

PNP Transistors for the BD1834x series

Package	Part No.	Absolute Maximum Ratings		h_{FE}
		V_{CEO}(V)	I_C(A)	
SOT-89 (MPT3)	**2SAR533P**	−50	−3	180～450
TO-252 〈DPAK〉	**2SAR573D3**	−50	−3	180～450
	2SAR583D3		−7	

Nch MOSFET

Single Type

Package	Part No.	Absolute Maximum Ratings			$R_{DS}(on)$ Typ(mΩ)	Qg Typ (nC)	Ciss Typ (pF)
		V_{DSS}(V)	I_D(A)	V_{GS}(V)	V_{GS}=10V	V_{GS}=5V	V_{GS}=10V
SOT-346T (TSMT3)	**RSR025N05**	45	2.5	±20	70	3.6	260
	RSR030N06	60	3	±20	60	5	380
	RSR020N06		2	±20	120	2.7	180
	RSR010N10	100	1	±20	370	3.5	140
SOT-457T (TSMT6)	**RVQ040N05**	45	4	±21	38	6.3	530
	RSQ035N06	60	3.5	±20	50	6.5	430
	RSQ015N06		1.5	±20	210	2	110
SOT-89(MPT3)	**RHP020N06**	60	2	±20	150	7*1	140
SOP8	**RSS070N05**	45	7	±20	18	12	1000
	RSS065N06	60	6.5	±20	24	11	900
TO-252 〈D-PAK〉	**RD3L080SN**	60	8	±20	57	9.4*1	380
	RD3L050SN		5	±20	78	8*1	290
	RD3P050SN	100	5	±20	135	14*1	530*2

Dual Type(Nch+Nch)

Package	Part No.	Absolute Maximum Ratings			$R_{DS}(on)$ Typ(mΩ)	Qg Typ (nC)	Ciss Typ (pF)
		V_{DSS}(V)	I_D(A)	V_{GS}(V)	V_{GS}=10V	V_{GS}=5V	V_{GS}=10V
SOP8	**SP8K24**	45	6	±20	18	15.4	1400
	SP8K22		4.5	±20	33	6.8	550
	SP8K33	60	5	±20	34	8	620
	SP8K32		4.5	±20	46	7	500
	SP8K31		3.5	±20	85	3.7	250
	SP8K41	80	3.4	±20	90	6.6	600
	SP8K52	100	3	±20	120	8.5	610*2

*1: V_{GS}=10V *2: V_{GS}=25V

Note1: This page contains a partial except of ROHM's broad lineup and typical characteristics
Please refer to ROHM's website for the complete lineup and detailed product characteristics, or contact a ROHM sales representative.
Note2: Indicates the JEDEC package type. ( ): ROHM Package, 〈 〉: GENERAL Code.

DFN2020WF-L7	SOT-323(UMT3)	SOT-346T(TSMT3)	SOT-457T(TSMT6)	(HSMT8)	SOT-89(MPT3)	SOP8	TO-252〈D-PAK〉
							
2.0mm×2.0mm×0.6mm	2.0mm×2.1mm×0.9mm	2.9mm×2.8mm×1.0mm	2.9mm×2.8mm×1.0mm	3.3mm×3.3mm×0.8mm	4.5mm×4.0mm×1.5mm	5.0mm×6.0mm×1.75mm	9.5mm×6.5mm×2.3mm

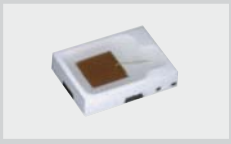
Under development High Output High Heat Dissipation Chip LEDs

PSL030x series

PSLED series

(2.75mm×2.0mm t=0.7mm)

Color Lineup **Red**



Emitting Color	Part No.	Forward Current I_FMax(mA) (Ta=25˚C)	Measured Current I_F(mA)	Electrical・Optical Characteristics			
				Forward Voltage V_F(V)	Dominant Wavelength λ_D(nm)	Luminous Flux ΦV(lm)	Thermal Resistance (˚C/W)
				Typ	Typ	Typ	Typ
Red	☆PSL0301U2T	250	140	2.4	618	26*	19
	☆PSL0304U21T	1,000	350	2.3	618	70	10
	☆PSL0304U22T	1,000	700	2.6	618	120*	10

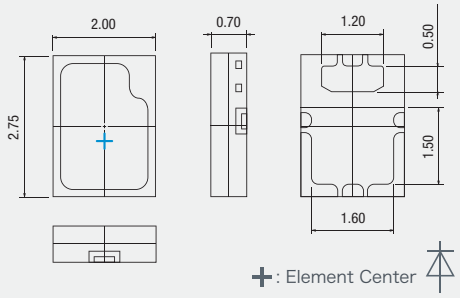
☆: Please note that the specifications may change for products under development.

Key Features

- **Compact・High output・High heat dissipation**
- High reliability
- Automotive-grade(AEC-Q102 qualified)

Dimensions

(unit : mm)



Concept

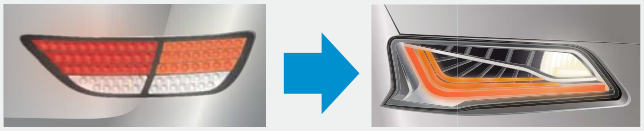
Develop compact high power LEDs optimized for a variety of stop lamps, from conventional point light source types to the latest uniform light sources featuring advanced design aesthetics

⇒ **Adopts a high luminance chip structure**

⇒ **Facilitates designs utilizing products with different brightnesses by unifying package types**

Performance

Supports the continuing diversification of stop lamp designs



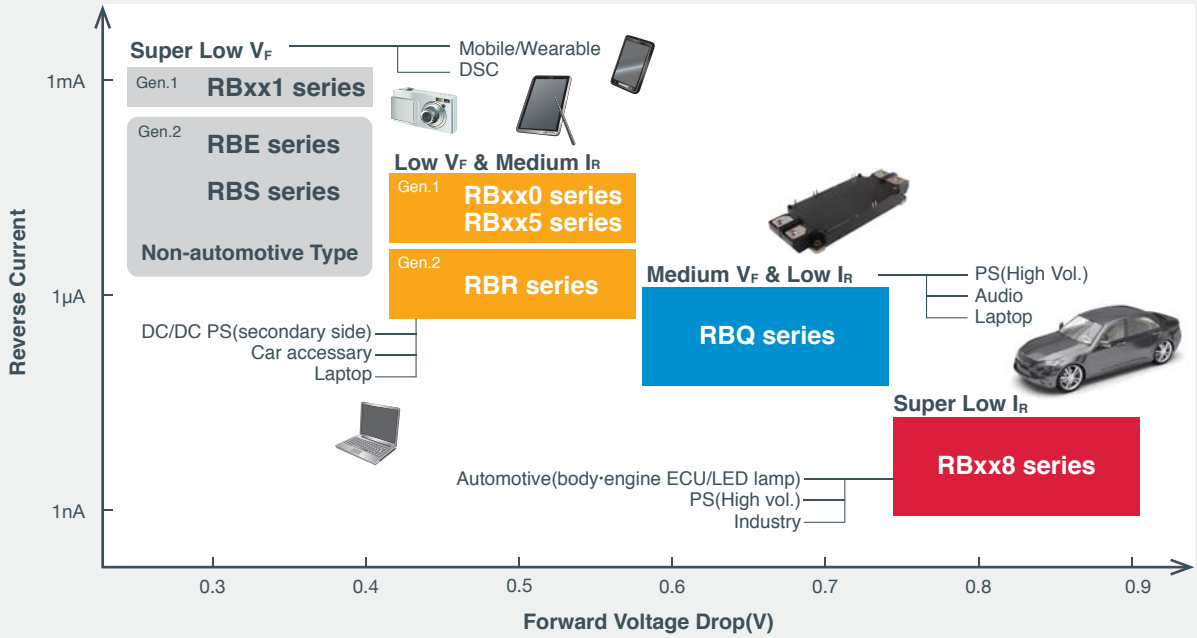
Design Aligning LEDs Side-by-Side(Point Light Source) (No. of LEDs: Many)

Design Combining LEDs with a Light Guide(Uniform Light Source) (No. of LEDs: Few)

Schottky Barrier Diodes for Automotive LED Drivers

Key Features

■ Lineup of all 3 series of automotive grade products from low V_F to ultra-low-I_R types



Package

■ High heat dissipation packages that contribute to thinner, smaller set are currently under development

(PMDE)	SOD-123FL(PMDU)	SOD-128(PMDTM)	TO-277	TO-252〈DPAK〉
New			Under Development	
				
2.5mm×1.3mm×0.95mm	3.5mm×1.6mm×0.8mm	4.7mm×2.5mm×0.95mm	6.5mm×4.3mm×1.1mm *Scheduled for mass Production in July 2020	10.0mm×6.5mm×2.2mm

RBxx8 series/Ultra Low I_R Type

Package	Part No.	Absolute Maximum Ratings		Electrical Characteristic (Tj = 25°C)			
		V_R(V)	Io(A)	V_F Max (V)	I_F(A)	I_R Max (μA)	V_R(V)
(PMDE)	☆RB168VWM-40	40	1	0.69	1	0.5	40
	☆RB168VWM-60	60	1	0.76	1	0.5	60
	☆RB168VWM100	100	1	0.84	1	0.3	100
SOD-123FL (PMDU)	RB168MM-40	40	1	0.65	1	0.55	40
	RB068MM-40		2	0.725	2	0.55	
	RB168MM-60	60	1	0.68	1	1.5	60
	RB068MM-60		2	0.765	2	1.5	
	RB168MM100	100	1	0.81	1	0.4	100
	RB068MM100		2	0.87	2	0.4	
SOD-128 (PMDTM)	RB168LAM-40	40	1	0.69	1	0.5	40
	RB068LAM-40		2	0.69	2	1.0	
	RB058LAM-40		3	0.69	3	2.5	
	RB088LAM-40		5	0.71	5	3.6	
	RB168LAM-60	60	1	0.68	1	1.5	60
	RB068LAM-60		2	0.68	2	2.0	
	RB058LAM-60		3	0.64	3	4.0	
	RB088LAM-60		5	0.71	5	4.0	
	RB168LAM100	100	1	0.81	1	0.4	100
	RB068LAM100		2	0.81	2	1.5	
	RB058LAM100		3	0.81	3	3.0	
	RB088LAM100		5	0.87	5	3.0	
TO-252 〈DPAK〉	RB075BM40S	40	5	0.75	5	5	40
	RB098BM-40		6	0.77	3	1.5	
	RB088BM-40		10	0.77	5	3.0	
	RB098BM-60	60	6	0.83	3	1.5	60
	RB088BM-60		10	0.83	5	3.0	
	RB098BM100	100	6	0.77	3	3.0	100
	RB088BM100		10	0.87	5	5.0	
	RB088BM200	200	10	0.88	5	7.0	200
	RB218BM200		20	0.88	10	10.0	

RBR series/Low V_F Type

Package	Part No.	Absolute Maximum Ratings		Electrical Characteristic (Tj = 25°C)			
		V_R(V)	Io(A)	V_F Max (V)	I_F(A)	I_R Max (μA)	V_R(V)
(PMDE)	☆RBR1VWM40A	40	1	0.52	1	50	40
	☆RBR2VWM40A		2	0.62	2	50	
	☆RBR1VWM60A	60	1	0.53	1	75	60
	☆RBR2VWM60A		2	0.65	2	75	
SOD-123FL (PMDU)	RBR1MM40A	40	1	0.52	1	50	40
	RBR2MM40A		2	0.62	2	50	
	RBR3MM40A		3	0.62	3	80	
	RBR1MM60A	60	1	0.53	1	75	60
	RBR2MM60A		2	0.65	2	75	
	RBR3MM60A		3	0.66	3	100	
SOD-128 (PMDTM)	RBR1LAM40A	40	1	0.52	1	50	40
	RBR2LAM40A		2	0.55	2	80	
	RBR3LAM40A		3	0.69	3	50	
	RBR5LAM40A		5	0.53	5	200	
	RBR1LAM60A	60	1	0.53	1	75	60
	RBR2LAM60A		2	0.65	2	75	
	RBR3LAM60A		3	0.66	3	100	
	RBR5LAM60A		5	0.55	5	250	
TO-252 〈DPAK〉	RBR10BM40A	40	10	0.62	5	120	40
	RBR15BM40A		15	0.55	7.5	240	
	RBR20BM40A		20	0.55	10	360	
	RBR10BM60A	60	10	0.65	5	200	60
	RBR15BM60A		15	0.58	7.5	400	
	RBR20BM60A		20	0.59	10	600	

☆: Under Development
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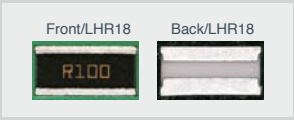
New Products Wide Terminal/High Power Chip Resistors(1220 to 2550 size)

LHR18, LTR10/18/50

LHR series
LHR18(1632 size)

LTR series
LTR10(1220 size)
LTR18(1632 size)
LTR50(2550 size)

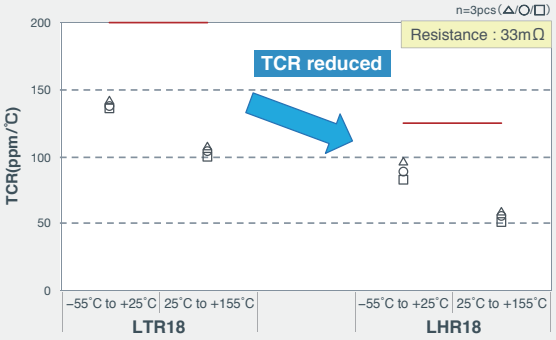


Key Features

- Wide terminal configuration improves heat dissipation to the substrate
- Superior junction reliability against temperature cycling
- Higher TCR accuracy through pattern optimization(LHR18)

Concept

Pattern optimization further improves TCR accuracy

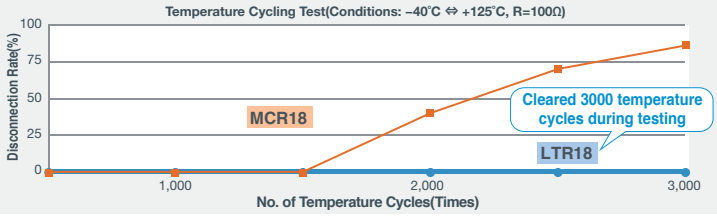


Spec

Type	Size mm(inch)	Rated Power (W)	Tolerance	Resistance Range	Temperature Coefficient of Resistance(ppm/˚C)	Operating Temp (˚C)
New LHR18	1632 (0612)	1.25	F(±1.0%) J(±5.0%)	33mΩ to 39mΩ	0 to 125	–55 to +155
				47mΩ to 270mΩ	0 to 100	
				300mΩ to 1Ω	0 to 75	
LTR10	1220 (0508)	0.5	F(±1.0%) J(±5.0%)	47mΩ to 9.1Ω	±150	
		0.25	D(±0.5%)	10Ω to 1MΩ	±100	
			F(±1%)	1Ω to 1MΩ	±100	
			J(±5%)	1Ω to 1MΩ	±200	
LTR18	1632 (0612)	1.0	F(±1%) J(±5%)	10mΩ to 18mΩ	0 to 300	
				20mΩ to 47mΩ	0 to 200	
				51mΩ to 470mΩ	0 to 150	
				510mΩ to 1.0Ω	±100	
		0.75	D(±0.5%)	10Ω to 1MΩ	±100	
			F(±1%)	1Ω to 1MΩ	±100	
			J(±5%)	1Ω to 1MΩ	±200	
LTR50	2550 (1020)	New 2.0	F(±1%) J(±5%)	10mΩ to 18mΩ	0 to 300	
				20mΩ to 47mΩ	0 to 200	
				51mΩ to 91mΩ	0 to 150	
				100mΩ to 910mΩ	±100	
		1.0	D(±0.5%)	10Ω to 1MΩ	±100	
			F(±1%)	1Ω to 1MΩ	±100	
			J(±5%)	1Ω to 1MΩ	±200	

Perfomance

Superior junction reliability against temperature cycling



New Products High Power Anti-Surge Chip Resistors(1005 to 3225 size)

SDR03/10, ESR01/03/10/18/25

SDR series
SDR03(1608 size)
SDR10(2012 size)

ESR series
ESR01(1005 size)
ESR03(1608 size)
ESR10(2012 size)
ESR18(3216 size)
ESR25(3225 size)

Key Features

- Proprietary element technology improves surge resistance
- Guaranteed electrostatic breakdown voltage 2kV to 5kV (EIAJ4701-1 Human Body Model)

Spec

Type	Size mm(inch)	Rated Power (W)	Tolerance	Resistance Range	Temperature Coefficient of Resistance(ppm/˚C)	Operating Temp (˚C)
SDR03	1608 (0603)	0.3	D(±0.5%)	10Ω to 1MΩ(E24/96)	±100	–55 to +155
			F(±1.0%)	1Ω to 9.76Ω(E24/96)	±200	
				10Ω to 10MΩ(E24/96)	±100	
			J(±5.0%)	1Ω to 10MΩ(E24)	±200	
New SDR10	2012 (0805)	0.5	D(±0.5%)	10Ω to 1MΩ(E24/96)	±100	
			F(±1.0%)	1Ω to 10MΩ(E24/96)	±100	
			J(±5.0%)	1Ω to 10MΩ(E24)	±200	
ESR01	1005 (0402)	0.2	F(±1%)	10Ω to 976kΩ(E24/96)	±100	
				1MΩ to 2.2MΩ(E24)		
			J (±5%)	1Ω to 9.1Ω(E24)	±500/–250	
				10Ω to 10MΩ(E24)	±200	
ESR03	1608 (0603)	0.25	D(±0.5%)	10Ω to 1MΩ(E24/96)	±100	
			F(±1%)	1Ω to 9.76Ω(E24/96)	±200	
				10Ω to 10MΩ(E24/96)	±100	
			J(±5%)	1Ω to 1MΩ(E24)	±200	
ESR10	2012 (0805)	0.4	D(±0.5%)	10Ω to 1MΩ(E24/96)	±100	
			F(±1%)	1Ω to 10MΩ(E24/96)	±100	
			J(±5%)	1Ω to 30MΩ(E24)	±200	
ESR18	3216 (1206)	0.5	D(±0.5%)	10Ω to 1MΩ(E24/96)	±100	
			F(±1%)	1Ω to 10MΩ(E24/96)	±100	
			J(±5%)	1Ω to 15MΩ(E24)	±200	
ESR25	3225 (1210)	0.66	D(±0.5%)	10Ω to 1MΩ(E24/96)	±100	
			F(±1%)	1Ω to 10MΩ(E24/96)	±100	
			J(±5%)	1Ω to 10MΩ(E24)	±200	

Rated Power List

Class-leading power lineup contributes to system miniaturization

Size mm \ Series	MCR series Standard Type	ESR series Surge Resistance Type	SDR series High Surge Resistance Type	LTR series High Power Wide Terminal Type	LTR Low Ohmic series High Power Wide Terminal Type	LHR series High Power Low TCR Wide Terminal Type
1005	0.063W	0.2W	–	–	–	–
1608	0.1W	0.25W	0.3W	–	–	–
2012(1220)	0.125W	0.4W	0.5W	0.25W	0.5W	–
3216(1632)	0.25W	0.5W	–	0.75W	1.0W	1.25W
3225	0.25W	0.66W	–	–	–	–
5025(2550)	0.5W	–	–	1.0W	2.0W	–

*LTR Low Ohmic series: 10mΩ to 1Ω, LTR series: 1Ω or more *The size in the ( ) indicates the size of the wide terminal type.

New Products Anti-Sulfuration Chip Resistors(1005 to 3225 size)

SFR01/03/10/18/25

SFR series

SFR01(1005 size)
SFR03(1608 size)
SFR10(2012 size)
SFR18(3216 size)
SFR25(3225 size)

Key Features

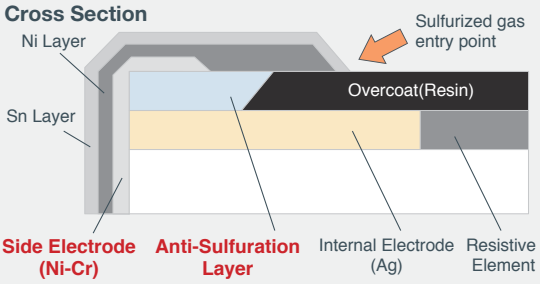
- Lineup offered in the 1005 to 3225 sizes
- **Improved sulfuration resistance (compared with ROHM's conventional products)**

Concept

Provides a stable supply of products that deliver anti-sulfuration performance

⇒ **Add a sulfurization-resistant layer** to the inner electrode

⇒ **Utilize a Ni-Cr metal strong against corrosion** for the side electrodes



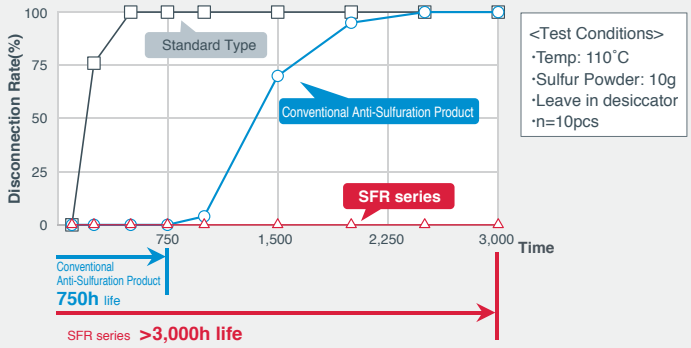
Spec

Type	Size mm(inch)	Rated Power	Tolerance	Resistance Range (Ω)	Temperature Coefficient of Resistance(ppm/℃)	Operating Temp (℃)
SFR01	1005 (0402)	0.063W	±5%	1 to 9.1(E24)	+500/−250	−55 to +155
				10 to 10M(E24)	±200	
			±1%	10 to 2.2M(E24/96)	±100	
SFR03	1608 (0603)	0.1W	±5%	1 to 9.1(E24)	±400	
				10 to 10M(E24)	±200	
			±1%	10 to 10M(E24/96)	±100	
SFR10	2012 (0805)	0.125W	±5%	1 to 9.1(E24)	±400	
				10 to 10M(E24)	±200	
			±1%	10 to 2.2M(E24/96)	±100	
New SFR18	3216 (1206)	0.25W	±5%	1 to 9.1(E24)	±400	
				10 to 10M(E24)	±200	
			±1%	10 to 2.2M(E24/96)	±100	
New SFR25	3225 (1210)	0.5W	±5%	1 to 1M(E24)	±200	
			±1%	10 to 1M(E24/96)	±100	

Note: E24: Standard products/E96: Custom products

Performance

■ Disconnection rate during sulfuration testing



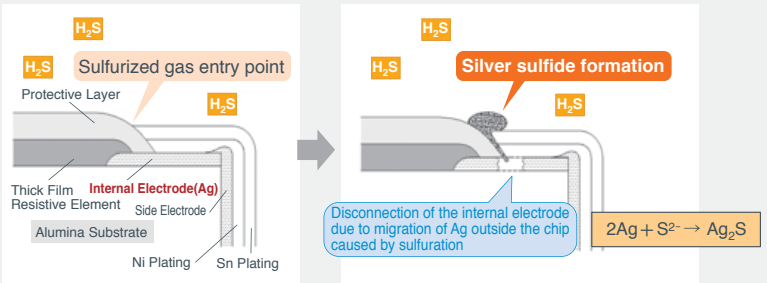
Tech Tips Chip Resistor Sulfuration

SFR01/03/10/18/25

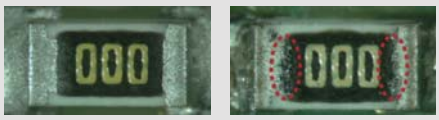
Disconnection Due to Sulfuration

Sulfur particles are generally present in the air in various forms, such as automotive exhaust gases and sulfur gas in hot springs. These sulfur components are adsorbed on metallic surfaces and gradually react with the metal itself. Silver(Ag) is typically used for the internal electrode in thick-film chip resistors, and when sulfur components in the gas enters the gap between the protective layer and plating, silver migrates and reacts, gradually forming silver sulfide(Ag_2S) as shown in the below figure for 'Sulfuration Mechanism'. As a result, the internal electrode may become disconnected, causing an open circuit within the resistor. This phenomenon is referred to as disconnection due to sulfuration of the chip resistance. The SFR series adopts a sulfuration-resistant layer on the internal electrode, preventing sulfur erosion.

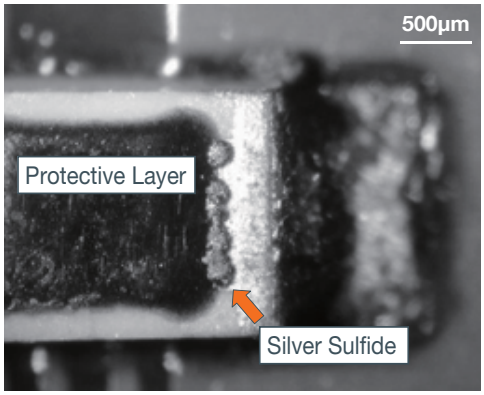
Sulfuration Mechanism



● External appearance of standard chip resistors



● Enlarged photo of sulfurized chip resistor



Tech Tips Noise Characteristics and Immunity

What are noise characteristics?

EMC
⇒ Electromagnetic Compatibility

Refers to the ability to maintain performance even if disturbed by other equipment without interfering with external systems. It is called electromagnetic compatibility due to the need to ensure normal device operation without mutual electromagnetic interference, classified as EMI and EMS , below.

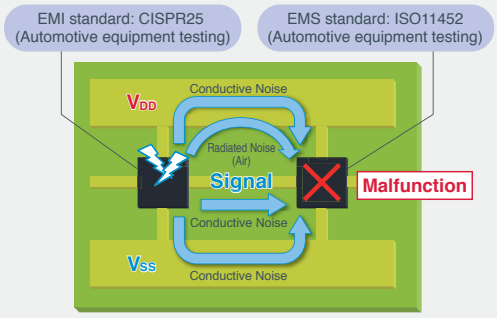
EMI
⇒ Electromagnetic Interference(Emission)

EMI refers to noise generated by the target IC that can interfere with the operation of surrounding ICs and systems. Since EMI may cause peripheral IC and/or systems to malfunction, delicate circuit design is necessary to prevent this phenomenon from occurring.

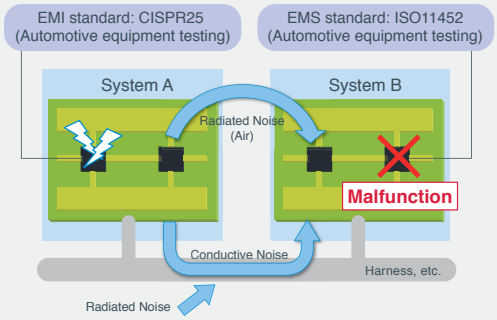
EMS
⇒ Electromagnetic Susceptibility(Immunity)

EMS is the tendency(ability/tolerance) for equipment to malfunction in the presence of external noise. If sufficient tolerance cannot be secured, the circuit may malfunction or fail to operate, so a robust circuit design is necessary.

EMC Issues on the Same Board



EMC Issues from Outside the Board



Possible issues with improper PCB layout

The following issues may occur if the PCB layout of the LED driver is inappropriate

⇒ **Low EMC and PI performance**

⇒ **Deterioration in light intensity (i.e. LED current accuracy)**

⇒ **LED fluctuation due to unstable operation (oscillation, switching waveform breakdown, etc.)**

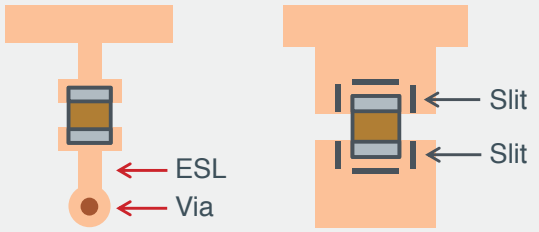
PCB Design Checklist

Designing a proper PCB layout

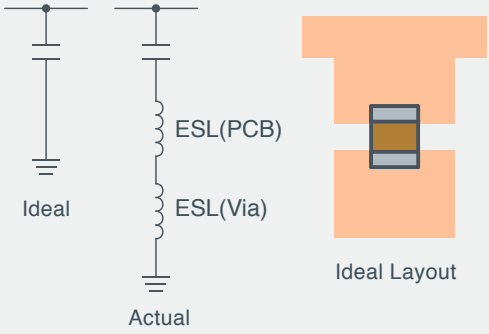
1. Make the power line as short and wide as possible.
2. Keep the MOSFET-diode-capacitor loop short to minimize the AC current path.
3. Place the oscillation frequency determination resistor RT close to the GND pin(reference GND).
4. Place the decoupling capacitor used for constant voltage within the IC as close to the IC pin as possible.
5. Keep the feedback line of the current detection resistor far from noise sources such as switching lines.
   ⇒ In the case of double-sided mounting, place the power products on the same side as the IC and other components on the backside as an effective countermeasure. At this time do not let the feedback line pass under the inductor.
6. Separating the power GND(SBD, input/output capacitor GND) from the reference GND(RT, GND) will minimize the effects of switching noise. Make them common to the GND plane.
7. Please refrain from using thermal relief as much as possible.
   ⇒ The high frequency characteristics will degrade.

Precautions Regarding Thermal Relief

Be careful regarding the layout of the capacitor used as a noise countermeasure



With the above layout(thermal relief), since the ESL component of the PCB is added, the resonant frequency moves to the lower frequency side according to the previous equation and the desired noise removal effect cannot be obtained.



Tech Tips Heat Resistance and Thermal Characteristics

Definitions •Applications •Formulas

■ These definitions conform to JEDEC standard JESD51

Symbol	Definition	Applications	Formula
θ_{JA}	The thermal resistance between the junction temperature Tj and ambient temperature Ta when the package is mounted on a PCB	Comparing the heat dissipation performance among packages of different shapes	$\theta_{JA} = (Tj–Ta) \div P$
Ψ_{JT}	The thermal characteristics parameter between the junction temperature Tj and the temperature of the center of the upper surface of the package T_T.	Estimating junction temperature	$\Psi_{JT} = (Tj–T_T) \div P$
$\theta_{JC\text{-}TOP}$	The thermal resistance between the junction temperature Tj and temperature of the top surface of the package $T_{C\text{-}TOP}$. The heat dissipation path is only on the top surface; the others are adiabatic.	Used for simulations using the 2-resistance model	$\theta_{JC\text{-}TOP} = (Tj–T_{C\text{-}TOP}) \div P$
$\theta_{JC\text{-}BOT}$	The thermal resistance between the junction temperature Tj and the temperature of the bottom surface of the package $T_{C\text{-}BOT}$. The heat dissipation path is only on the bottom surface; the others are adiabatic.	Used to estimate the junction temperature, since when the heat dissipation metal at the bottom of the package is exposed, most of the heat flows only through the package bottom.	$\theta_{JC\text{-}BOT} = (Tj–T_{C\text{-}BOT}) \div P$

Note 1: $\theta JA/\Psi_{JT}$ is the value when mounted on a JEDEC board. Note 2: Conventionally, the value provided as θ_{JC} is Ψ_{JT} in this definition.

Illustrations for Each Definition

JEDEC(JESD51) reference

■ θ_{JA}: Thermal resistance between the junction and the ambient environment

*Heat dissipation through multiple thermal paths

■ Ψ_{JT}: Thermal characteristics between the junction and the center of the top surface of the package

*Heat conduction(with heat dissipation) other than at the top surface of the package

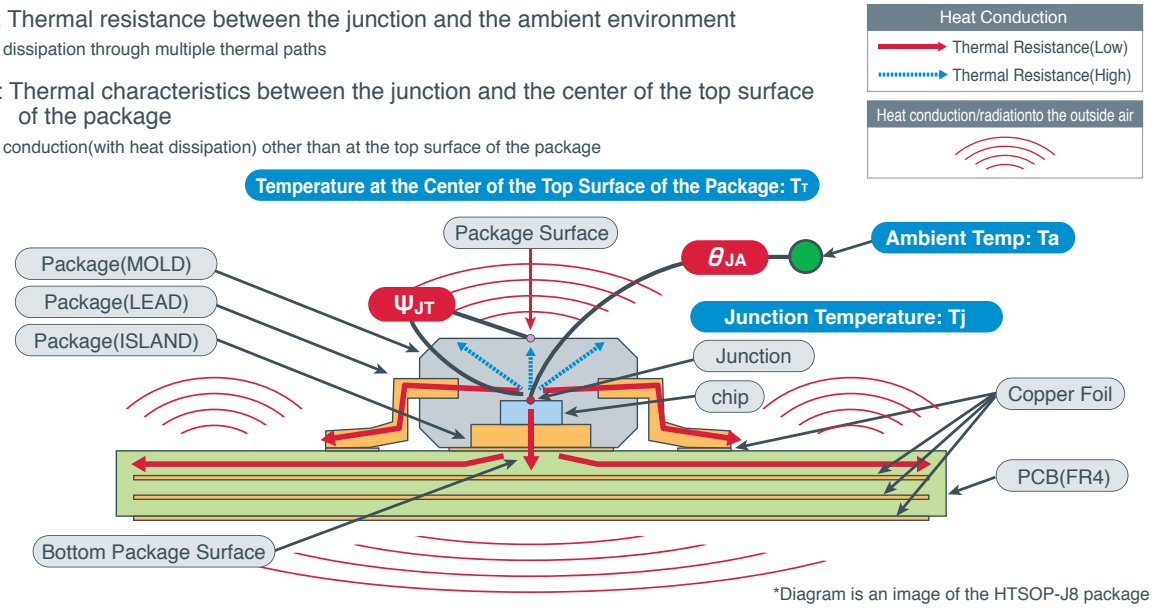
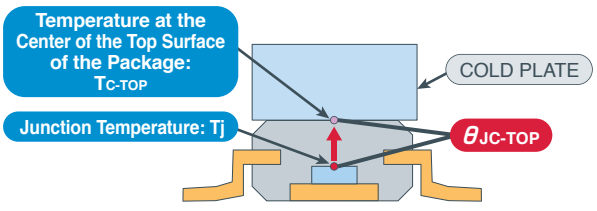


*Diagram is an image of the HTSOP-J8 package

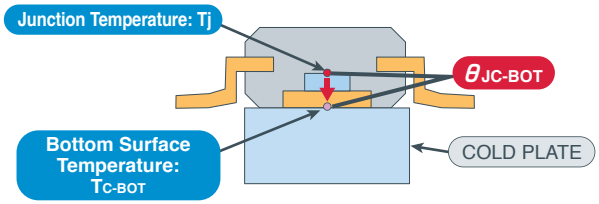
■ $\theta_{JC\text{-}TOP}$: Thermal resistance between the junction and the top surface of the package

*Heat is dissipated only at the top surface of the package; the others are adiabatic.



■ $\theta_{JC\text{-}BOT}$: Thermal resistance between the junction and the bottom surface of the package

*Heat is dissipated only at the bottom surface of the package; the others are adiabatic.



Support System for EMC/Thermal treatment

EMC Countermeasure

Market Background

■ The increasing number of ECUs and continuing miniaturization (higher frequency) is increasing the number of cases where the internal noise interference worsens.

⇒ **Increased risk of malfunction due to noise**

⇒ **Greater risk of generating noise which can cause malfunctions to surrounding equipment**

■ Also, upon further investigation the following can be expected.

⇒ **With the continuing proliferation of ADAS and automated driving, it has become imperative to prevent malfunctions and control failures due to external noise.**

⇒ **Eliminating metal body (shield) and reducing body weight to minimize environmental load**

EMC countermeasure technology is becoming more important

ROHM EMC Countermeasure Support System

■ **Established an anechoic chamber** (at the Shin-Yokohama Technology Center)

■ **Recommendations on application countermeasures designed to** clear the CISPR25 Class 5 requirements

anechoic chamber

Note: A fee may be charged depending on the type of support.

Automotive EMC Test Standard

■ Applicable EMC standards

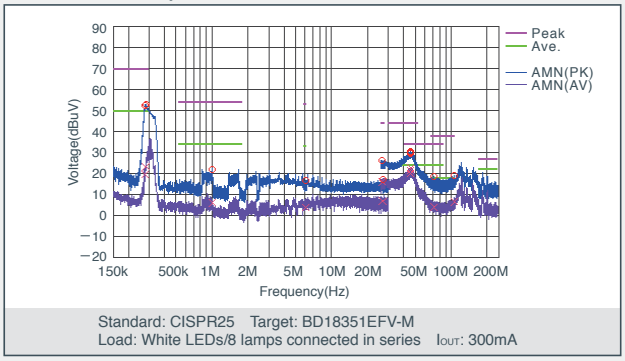
Automotive Emission Test

Test Method	Standard	Frequency
Radiated Emission	CISPR25 Class5	150kHz to 1GHz
Conducted Emission	CISPR25 Class5	150kHz to 108MHz

Automotive Immunity Test

Test Method	Standard	Frequency	Max
BCI Immunity	ISO11452-4	100kHz to 2.1GHz	200mA *≦400MHz: 300mA
Transient Immunity	ISO7637-2/3/5	Pulse 1/2a/2b/3a/3b/4/5a/5b	
Radiated Immunity	ISO11452-2	80MHz to 3GHz	200V/m
	Radar pulse	1.2 to 1.4GHz	300V/m
		3.1 to 4.2GHz	
Near field Antenna Immunity	Custom SPEC	800MHz to 2.4GHz	up to15W
TEM CELL Immunity	ISO11452-3	1MHz to 400MHz	200W

Measurement Example



Standard: CISPR25 Target: BD18351EFV-M
Load: White LEDs/8 lamps connected in series I_{OUT}: 300mA

Thermal Countermeasure

- **Validate thermal designs before PCB ordering by performing simulations that include board patterns**
- **In the event of thermal issues, we can suggest improvements through actual measurements and simulations**

Market Background

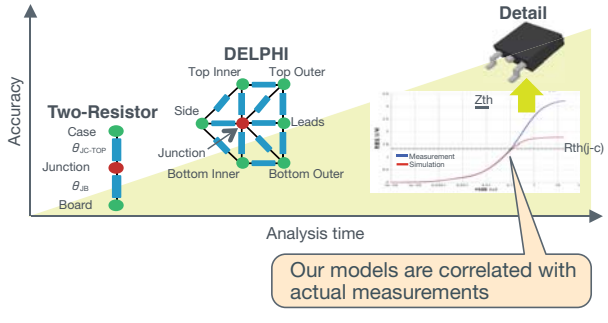
■ The number of cases where the thermal environment for parts is worsening has increased due to mechanical integration and mounting in engine compartments

⇒ **Increases the risk of a reduction in the quality and life of electronic components**

Heat dissipation design technology is becoming more important

Thermal Simulation Support Case Study

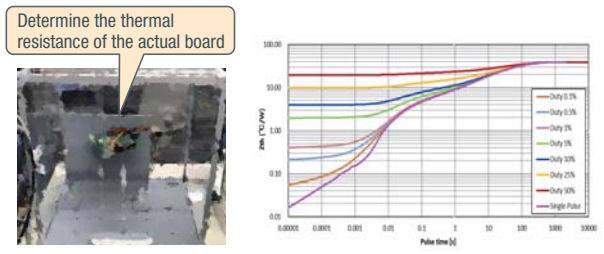
■ Provided to customers that perform thermal simulations in-house



Note: A fee may be charged depending on the type of support.

Thermal Resistance Measurement On the Customer's Board

■ Prototyping, evaluating mass-produced boards, thermal resistance measurement

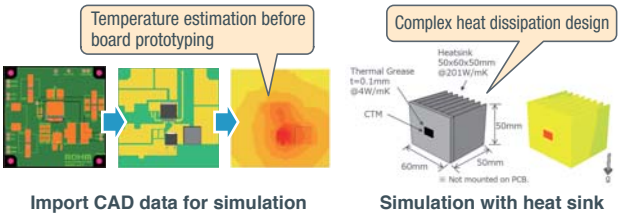


Environment **Measurement result**

Thermal Simulation with the Customer's Board/ Heat Dissipation Environment

■ Utilize borrowed board data

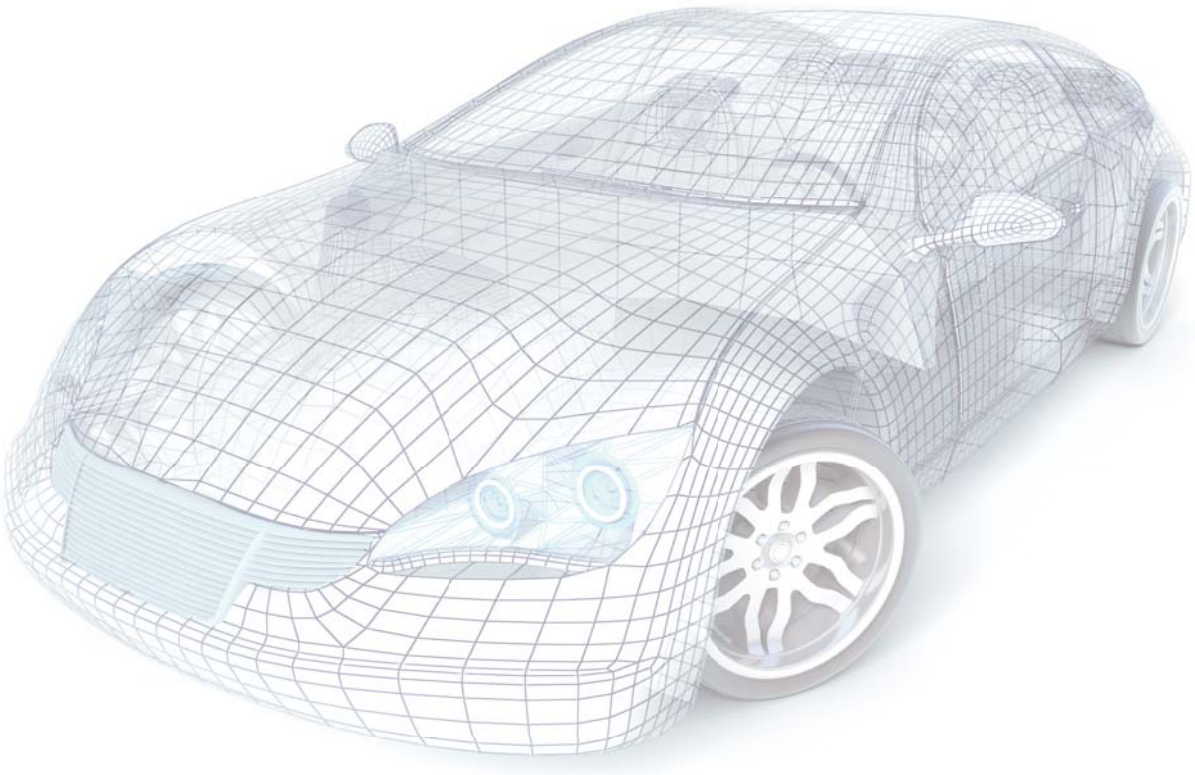
■ Use borrowed heat sink information



Import CAD data for simulation **Simulation with heat sink**

ROHM Manufacturing

Throughout its history cars have continued to evolve in response to the growing awareness for safety, comfort, and the environment, in step towards continued electrification.
In the course of this progress, autonomous driving and smart cities will soon be realized with the advent of next-generation vehicles.
ROHM contributes to the evolution and advancement of the automotive sector and next-generation cars by taking a quality-first approach to manufacturing and ensuring long-term, stable supply of products.



Achieving High Quality and Stable Supply Through a Vertically Integrated Production System

ROHM's vertically integrated production system is the result of its commitment to 'Quality First'.
The ROHM Group carries out manufacturing, sales and service - from design and development to wafer fabrication - in-house and continually works on initiatives to improve quality in all processes.

Commitment to Raw Materials

Wafer production from silicon ingot pulling

Raw silicon

In-House Photo Mask

Pursuing high quality through consistent quality control from IC chip design layout to photo mask production

SiCrystal
A ROHM Group Company

SiCrystal, a German-based SiC single crystal wafer manufacturer, became a member of the ROHM Group in 2009.German S 2C single crystal wafer maker SiCrystal became a ROHM Group Company in 2009

High Quality

Achieving high quality in every process

ROHM continually pursues 'Quality First' as a corporate objective. Through our vertically integrated production system the Group implements production, sales, and service - including design, development, and wafer fabrication - and are working on initiatives to improve quality in all processes. At the same time, excellent traceability is achieved through a system that ensures worry-free use of our products by customers.

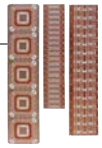
Stable Supply

Utilizing the Group's collective power to fulfill supply responsibilities

The ROHM Group is tasked with supplying products that meet market demands. By managing the manufacturing process in-house using our vertically integrated production system, we are able to create a system that is less susceptible to external factors compared with general fabless and foundry manufacturers. We have established a BCM(Business Continuity Management) system that involves securing appropriate inventory and carrying out multi-site production, and endeavor to ensure a stable supply to customers.

In-house dies and lead frames

To ensure quality, all dies for lead frame punching, lead frames, and even molds are produced in-house.

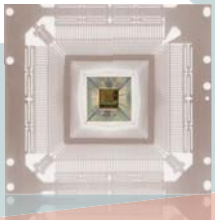


Cutting-edge packages

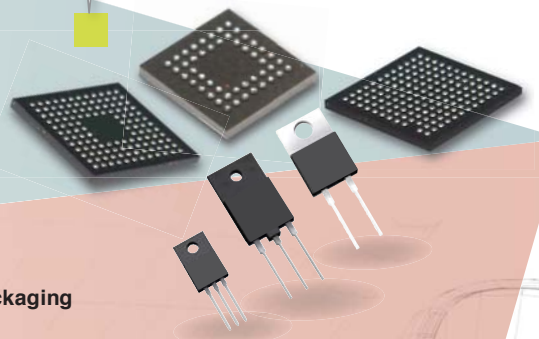
Broad package lineup(i.e. CSP, BGA, COF, COC, stacked package) supports the latest assembly technologies.

Frame & Dies

Assembly Line



Packaging



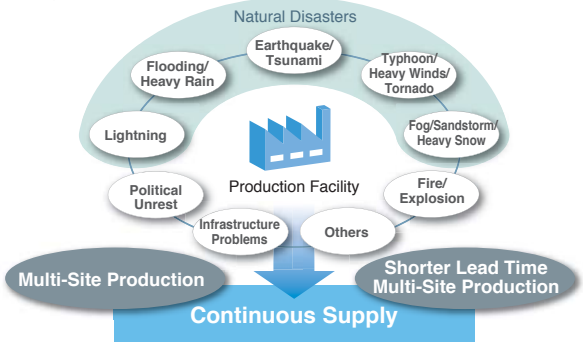
In-House Production System

All production equipment were developed completely in-house, making it possible to flexibly and precisely meet customer needs.

All production systems developed in-house

BCM System

ROHM continues to strengthen its BCM system by performing diagnosis based on risk verification at all production sites.



Approach for Automotive-Grade Products

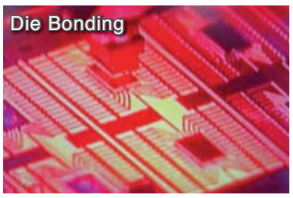
ROHM establishes 'Quality First' as a corporate objective, pursues innovative,
high quality manufacturing, and provides greater peace of mind through guaranteed delivery times.
ROHM implements a variety of initiatives to ensure high reliability.

Initiative Example

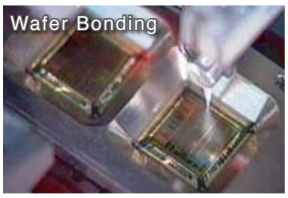
Real-time quality checks

From silicon ingot pulling and wafer fabrication to testing, final assembly, and shipment, ROHM adopted a screening method to check the workmanship at each process.

ROHM original real-time quality checks — Real Time Work & Check



Check the workmanship at the same time as performing die bonding

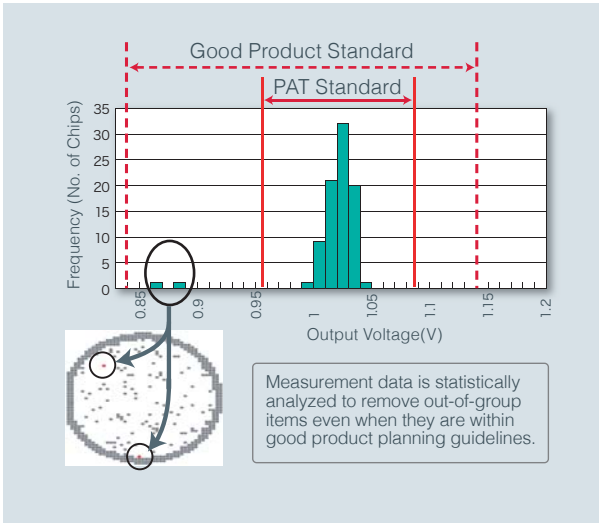


Check the quality at the same time as performing die bonding

Introducing the PAT System(Conforming to AEC Guidelines)

The PAT system statistically analyzes measurement data and removes out-of-group items even when they are within good product standards. With this method even when a product is determined to be non-defective and within the standard at the time of shipment, if it is out-of-group within the lot distribution it is removed as having the potential of being defective. This allows ROHM to act out of an abundance of caution to prevent the shipment of defective products.

PAT System PAT: Part Average Testing (Parts Averaging Test)



Dedicated automotive product line

Automotive products are manufactured on dedicated lines by certified operators who have passed special tests. Utilizing dedicated Machine and Man results in a higher grade manufacturing environment.

Line division and 4M differentiation

The basic elements of ROHM's approach to quality **4M**···**M**an **M**achine **M**aterial **M**ethod

All automotive-grade products are manufactured on HR(High Reliability) lines separate from general products.

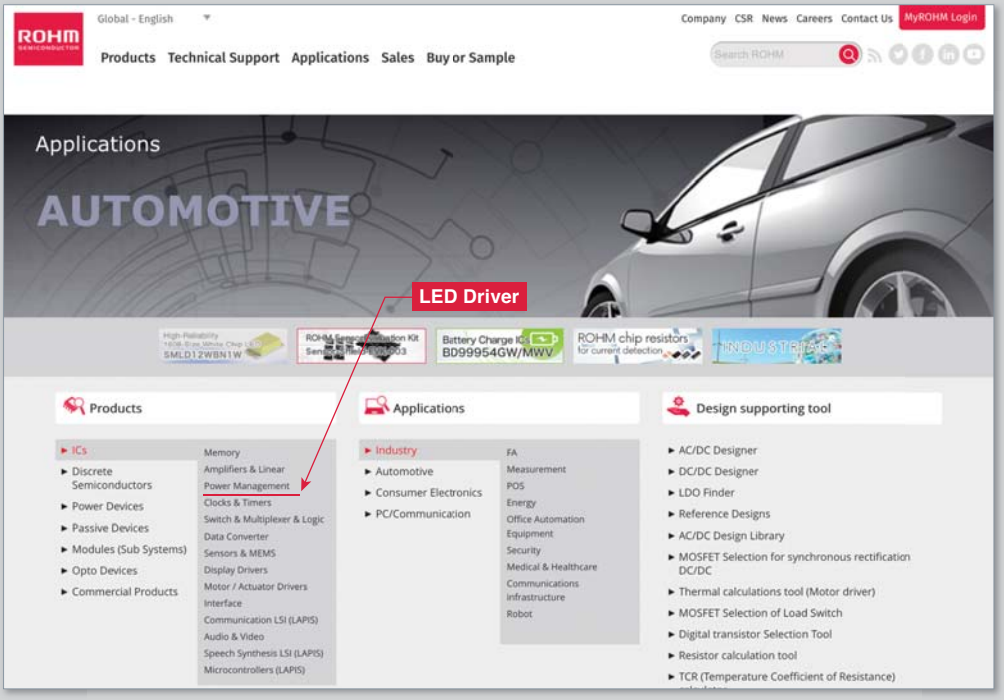
Certification armband

Initiative Overview(IC Case)

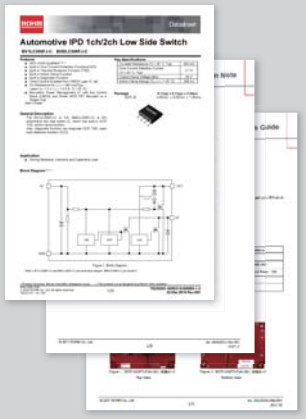
Model Design	Model Test Design	Model Qualification Testing
Robust design with multiple protection circuits/improved damage resistance/easier testability/characteristics limit evaluation	High/normal/low temperature measurement of all chips, HV stress testing, PAT system introduction	Based on JEITA. JEDEC,AEC-Q100/AEC-Q101/AEC-Q200 compliance · Long-term reliability testing · Life prediction based on WLR data · Electrostatic breakdown test
Wafer Process Management	**Assembly Process Management**	**Traceability, keep samples, in-process defect analysis, etc.**
SPC management/Real-time monitoring/Defect inspection of all chips	Real-time Work & Check at main processing point (s)/Quality guarantee (i.e. internal X-ray inspection, reflow screening)/4M establishment	Important Security Applications All keep samples from all lots are stored for 10 years/In-process defective product analysis(all lots), etc.

Guide to ROHM's Website https://www.rohm.com

Please visit ROHM's website for product lineups for each category



■ Datasheets, application notes, reference designs, Spice models, and other materials are available.



■ ROHM's website provides technical information useful for designers, focused on basic knowledge on products and seminar information.

Tech Web
https://micro.rohm.com/en/techweb

DEVICE PLUS
https://www.deviceplus.com

Electronics Basics
https://www.rohm.com/electronics-basics

Home Page Design Support Content List

Item	Overview	
Selection Guide (This Catalog)	A guidebook that simplifies IC selection. Product pickups and sample solutions are provided.	
Datasheet	Contains the most important information provided to customers on ROHM products. Functional characteristics, conditions, and applicable ranges built into the products are listed, along with the scope of warranty. Also provided is application information, including the required external parts, in order to ensure stable operation and maximize performance.	
Application Note Example	Switching Type	Capacitor Calculation for Buck Converter ICs Considerations for Multilayer Ceramic Capacitor Used for Buck Converters Inductor Calculation for Buck Converter ICs Considerations for Power Inductors Used for Buck Converters Quick Reference Table for Setting the Output Voltage of Buck Converter ICs PCB Layout Method for Buck Converters Snubber Circuit for Buck Converter ICs Buck Converter Efficiency Calculating Power Loss(Synchronous Rectification Type)
	Linear Type	Reverse Voltage Protection for Linear Regulators Output Voltage Setting Resistance Table for Linear Regulator ICs Linear Regulator Power Supply ON/OFF Characteristics Simple Stability Experiments for Linear Regulators Thermal Resistance Data of Automotive Linear Regulators
	General	Phase Margin Measurement Method Using a Frequency Characteristics Analyzer(FRA) Regarding Thermal Resistance About Thermal Resistance and Thermal Characteristics of IC Packages
SPICE Models	SPICE models are offered that can be used in PSpice simulations. However, since the files are encrypted for security purposes, they are executable only with PSpice	
Basic Information	Package Information	Implementation specifications, resistance to whiskers
	Package Information Environmental Data	REACH Substances of Very High Concern(SVHC) non-use certificate, UL94 flame retardant class ELV, RoHS Directive certificates of compliance
	Reliability Information	Report on reliability test results
	Individual Product Data	List of production facilities
	Export-Related Information	Regarding the Export Trade Control Order and US Export Regulations
Support Page	Provides new product information, evaluation boards, and videos	
Technology Information Site Tech Web	Acquire basic knowledge on power supply ICs Archive site on the latest topics on power supply ICs ideal for engineers - TECH INFO	

ROHM Group Locations (Japan)

Sales Offices

Kyoto	Nagoya	Sendai
Tokyo	Matsumoto	Takasaki
Yokohama	Nishi-Tokyo	Utsunomiya

R&D Centers

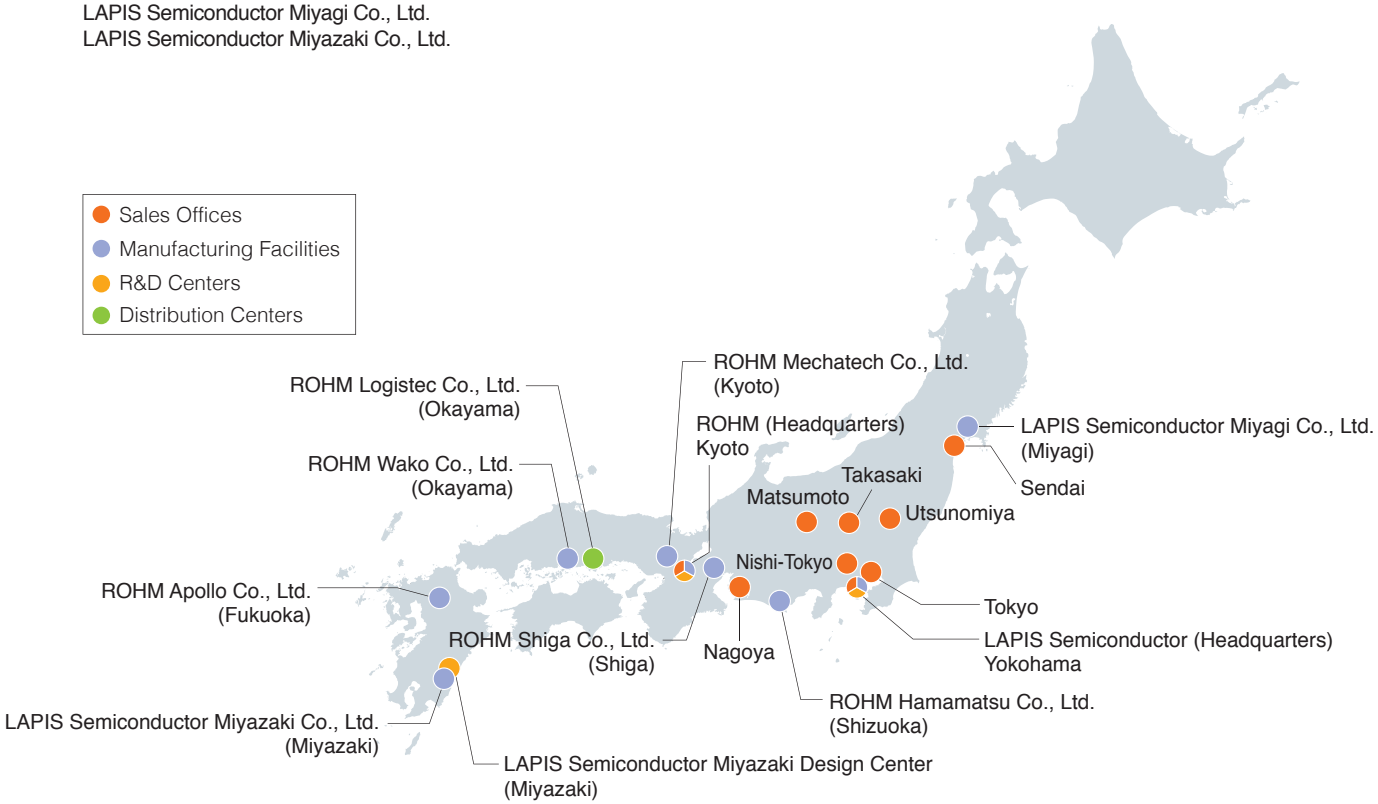
Kyoto Technology Center (Head Office)
Kyoto Technology Center (Kyoto Ekimae)
Yokohama Technology Center
LAPIS Semiconductor Co., Ltd.(Shin-Yokohama)
LAPIS Semiconductor Miyazaki Design Center

Manufacturing Facilities

ROHM Co., Ltd.
ROHM Shiga Co., Ltd.
ROHM Hamamatsu Co., Ltd.
ROHM Wako Co., Ltd.
ROHM Apollo Co., Ltd.
ROHM Mechatech Co., Ltd.
LAPIS Semiconductor Co., Ltd.
LAPIS Semiconductor Miyagi Co., Ltd.
LAPIS Semiconductor Miyazaki Co., Ltd.

Distribution Centers

ROHM Logistec Co., Ltd.



ROHM Group Locations (Global)

Sales Offices

ASIA	ROHM Semiconductor Korea Corporation
	ROHM Semiconductor Trading (Dalian) Co., Ltd.
	ROHM Semiconductor Trading (Beijing) Co., Ltd.
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	ROHM Semiconductor (Shenzhen) Co., Ltd.
	ROHM Semiconductor Hong Kong Co., Ltd.
	ROHM Semiconductor Taiwan Co., Ltd.
	ROHM Semiconductor Singapore Pte. Ltd.
	ROHM Semiconductor Philippines Corporation
	ROHM Semiconductor (Thailand) Co., Ltd.
	ROHM Semiconductor Malaysia Sdn. Bhd.
	ROHM Semiconductor India Pvt. Ltd.
AMERICA	ROHM Semiconductor U.S.A., LLC
EUROPE	ROHM Semiconductor GmbH

R&D Centers

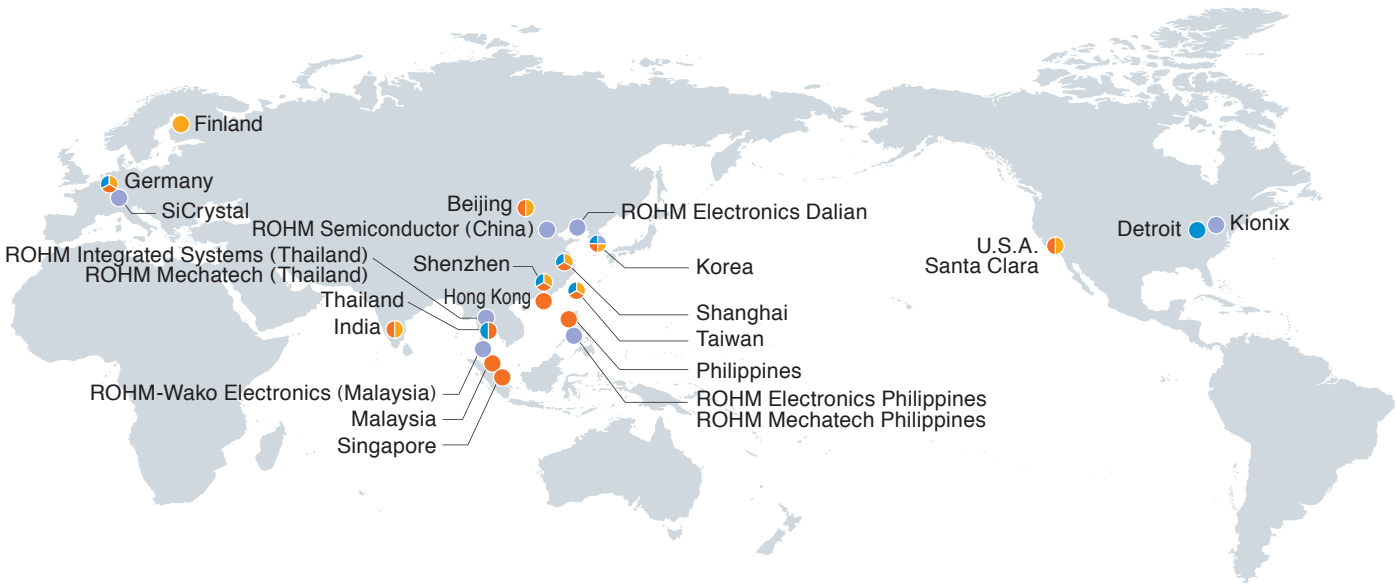
ASIA	Korea Design Center
	Beijing Design Center
	Shanghai Design Center
	Shenzhen Design Center
	Taiwan Design Center
	India Design Center
AMERICA	America Design Center (Santa Clara)
EUROPE	Europe Design Center
	Finland Software Development Center

Manufacturing Facilities

ASIA	ROHM Korea Corporation
	ROHM Electronics Philippines, Inc.
	ROHM Integrated Systems (Thailand) Co., Ltd.
	ROHM Semiconductor (China) Co., Ltd.
	ROHM Electronics Dalian Co., Ltd.
	ROHM-Wako Electronics (Malaysia) Sdn. Bhd.
	ROHM Mechatech Philippines, Inc.
	ROHM Mechatech (Thailand) Co., Ltd.
AMERICA	Kionix, Inc.
EUROPE	SiCrystal GmbH

QA Centers

ASIA	Korea QA Center
	Shanghai QA Center
	Shenzhen QA Center
	Taiwan QA Center
	Thailand QA Center
AMERICA	America QA Center
EUROPE	Europe QA Center



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