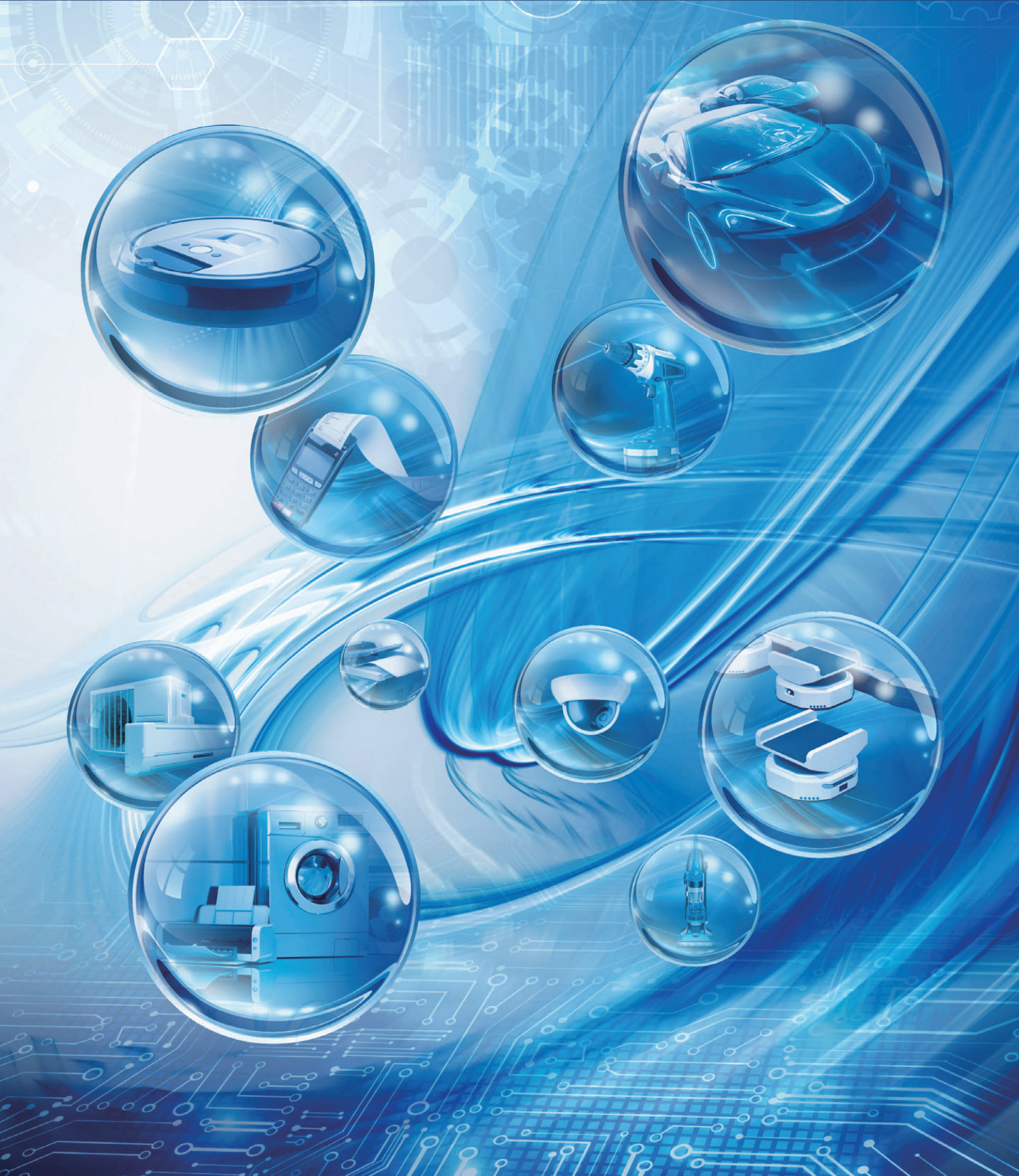


Motor Driver ICs and peripheral parts



# Motor Drivers Ver.13.1



# Motor Drivers

Four characteristics are required for motor drivers

## ■ High Reliability

ROHM is further strengthening the internal protection capabilities of its motor drivers, such as by integrating functions that prevent malfunctions due to voltage drop and protecting the IC from abnormal voltages and currents. We are also implementing a current limiting function that controls the motor current at startup, during forced stops, and when locked. In addition, function pins are provided that output fault conditions to an external host processor, ensuring a greater level of safety.

**High  
Reliability**

## ■ Silent Operation / Low Vibration

Regarding optimization of the drive waveforms with respect to noise and vibration during motor operation, ROHM proposes commutation drive technologies optimized for the wide range of magnetic circuits of motors in various applications and fields, for example by utilizing current attenuation methods (decay technology) in stepper motor drivers, fan motor driver soft start technology, and commutation width technology (120°/150°/sine wave) ideal for brushless DC motor drivers.

**Silence**

## ■ Low Power Consumption / High Efficiency

To further reduce motor power consumption, we will continue to develop high efficiency low consumption power devices and driver technologies. For example, by using an automatic angle adjustment function to pursue high efficiency and low power consumption across a wide range of rotational speeds, from low to high.

**High  
Efficiency**

## ■ Control / Convenience

ROHM offers solutions that maximize the hardware implementation of high efficiency drive control algorithms for motors that make it easy for engineers to use. Examples include sensorless position control technology, digital motor rotation control technology, and high accuracy positioning control technology required for actuators. Also, taking into account the compatibility of our product lineups, we are working to improve convenience by considering package pin designs that eliminate the need to change the pattern of the motor drive control substrate even when the load specifications change during motor development.

**Control**



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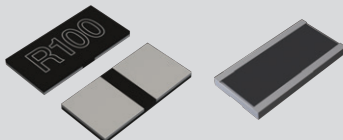
# Motor Driver Selection

Application Voltage	Motor Driver	Output Current	1.0A	2.0A	
3.3V 5V	Brushed DC Motor Drivers <a href="#">▶ P.09</a>	0.5A	2.0A		
	Stepper Motor Drivers <a href="#">▶ P.11</a>	0.8A			
	Single-Phase Brushless DC Motor Drivers <a href="#">▶ P.13</a>	0.6A	1.0A		
	3-Phase Brushless DC Motor Drivers <a href="#">▶ P.17</a>	0.7A			
12V	Brushed DC Motor Drivers <a href="#">▶ P.09</a>	0.5A			
	Stepper Motor Drivers <a href="#">▶ P.11</a>	0.8A	2.2A		
	Single-Phase Brushless DC Motor Drivers <a href="#">▶ P.13</a>	0.8A	1.8A		
	3-Phase Brushless DC Motor Drivers <a href="#">▶ P.15</a> <a href="#">▶ P.17</a>	1.0A			
24V 36V 48V	Brushed DC Motor Drivers <a href="#">▶ P.09</a>	0.5A			
	Stepper Motor Drivers <a href="#">▶ P.11</a>	0.8A			
	Single-Phase Brushless DC Motor Drivers <a href="#">▶ P.13</a>	0.9A			
	3-Phase Brushless DC Motor Drivers <a href="#">▶ P.15</a> <a href="#">▶ P.17</a>	1.5A			
	Gate Driver + Power Device <a href="#">▶ P.21</a>				
250V 600V	High Voltage 3-Phase Brushless DC Motor Drivers <a href="#">▶ P.19</a>	1.5A			
	IPMs (Intelligent Power Modules) <a href="#">▶ P.20</a>				
	Power Device <a href="#">▶ P.21</a>				

## Shunt Resistors

[▶ P.25](#)

Introducing shunt resistors used in motor drive systems to detect motor drive current



## Solutions Board

[▶ P.26](#)

Introducing solution boards that combine controllers, MOSFETs, and power supplies



## Automotive Motor Drive

Introducing ROHM drivers that satisfy automotive reliability requirements

- Brushed DC Motor Drivers
- Stepper Motor Drivers
- 3-Phase Brushless DC Motor Drivers
- 3-Phase Gate Drivers





ers **P.27**

**Low Voltage DC Motor Drivers** **P.31**

Introducing low voltage motor drivers (i.e. lens drivers for cameras)

**Selection by Application** **P.33**

Introduces the use of motor drivers in a variety of sets, from home appliances such as AC and washing machines to AGVs (Automatic Guided Vehicles) and power tools

# Motor Driver Quick Search

## Brushed DC Motor Drivers

P.09

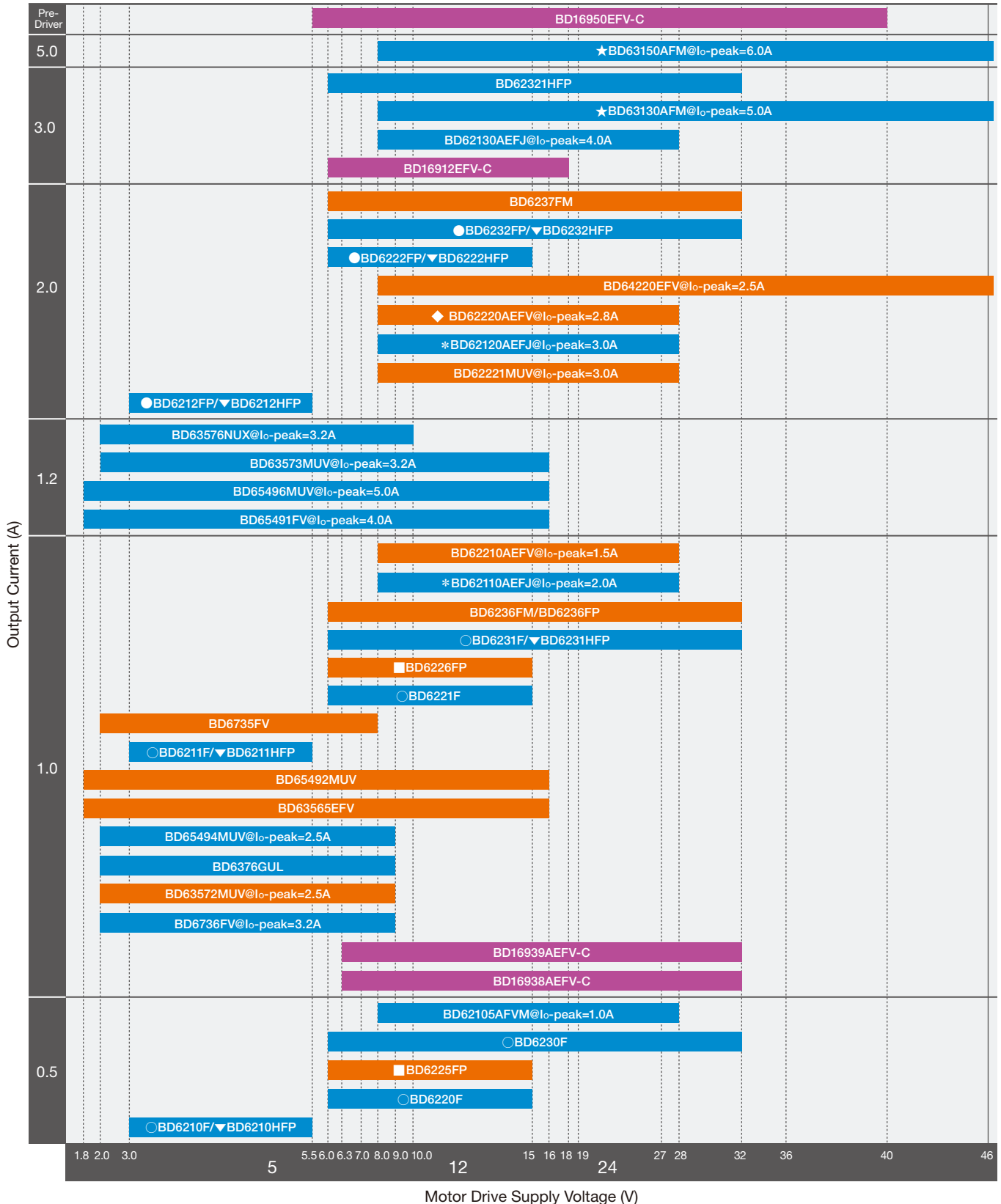
P.27 (For Automotive Use)

1ch Brushed Motor Drivers

2ch Brushed Motor Drivers

Automotive Brushed Motor Drivers

Models with the same symbol in front of the part number indicate pin-compatible products. The peak output current is indicated after the @ mark.

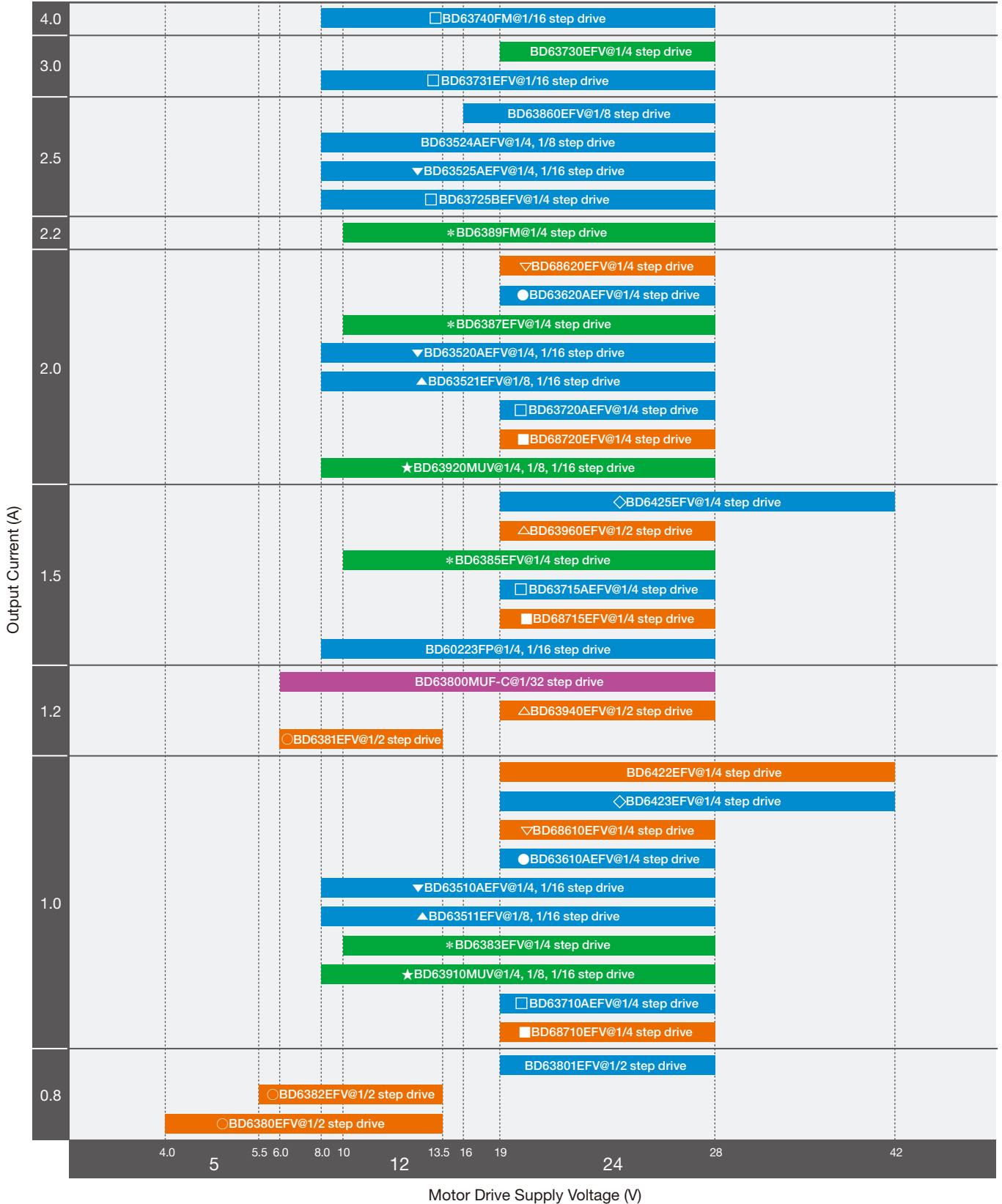


# Stepper Motor Drivers

▶ P.11 ▶ P.27 (For Automotive Use)

CLK-IN      PARA-IN      Selectable CLK-IN/PARA-IN      For Automotive Use

Models with the same symbol in front of the part number indicate function-compatible products. The drive method is indicated after the @ mark.



# Motor Driver Quick Search

## Single-Phase Brushless DC Motor Drivers

▶ P.13

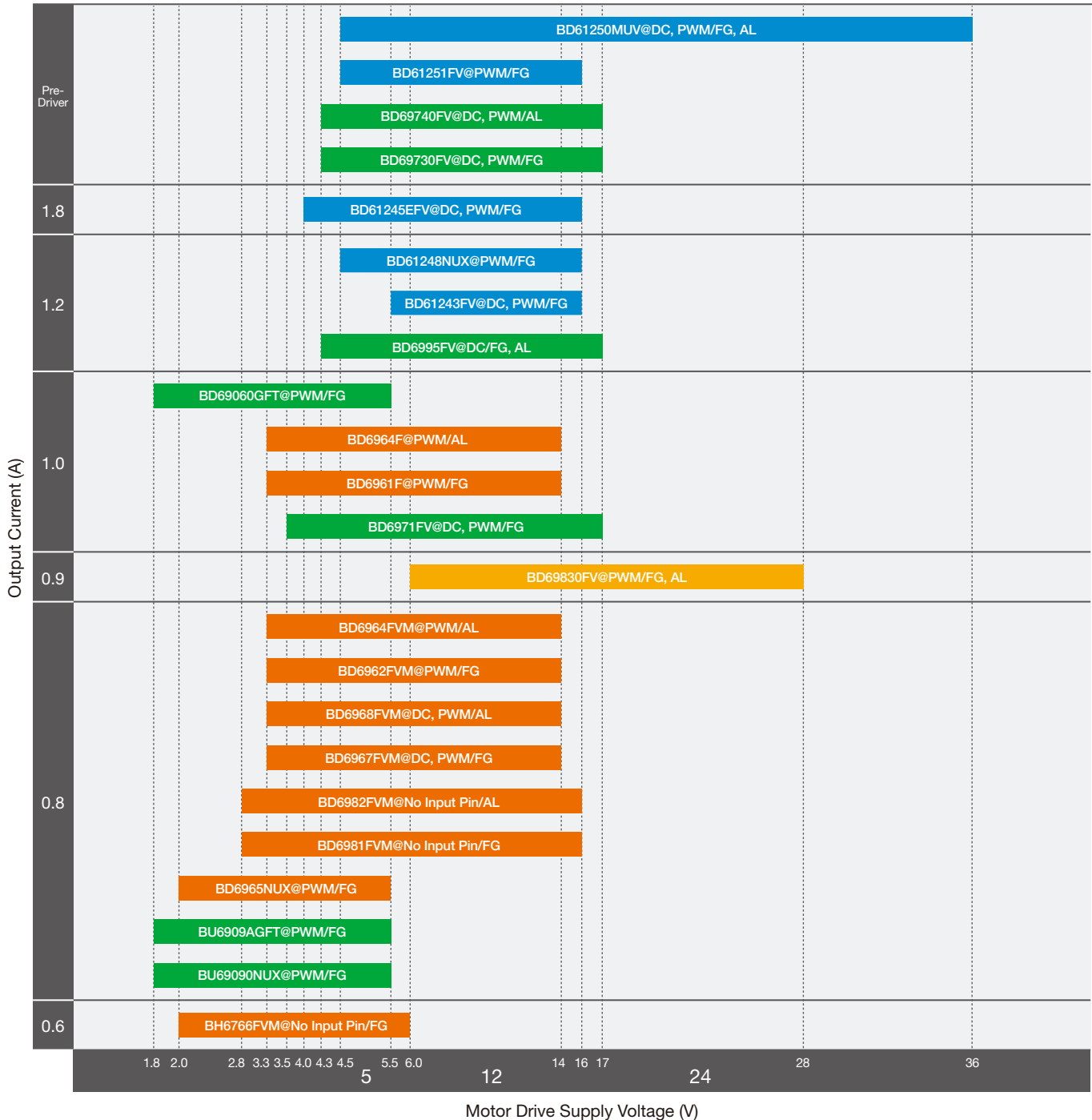
Sine Wave

BTL

PWM Soft Switching

Switching

The speed control input signal (DC, PWM, No Terminal (no speed control terminal))/External output signal pin (FG, AL) are indicated after the @ mark.





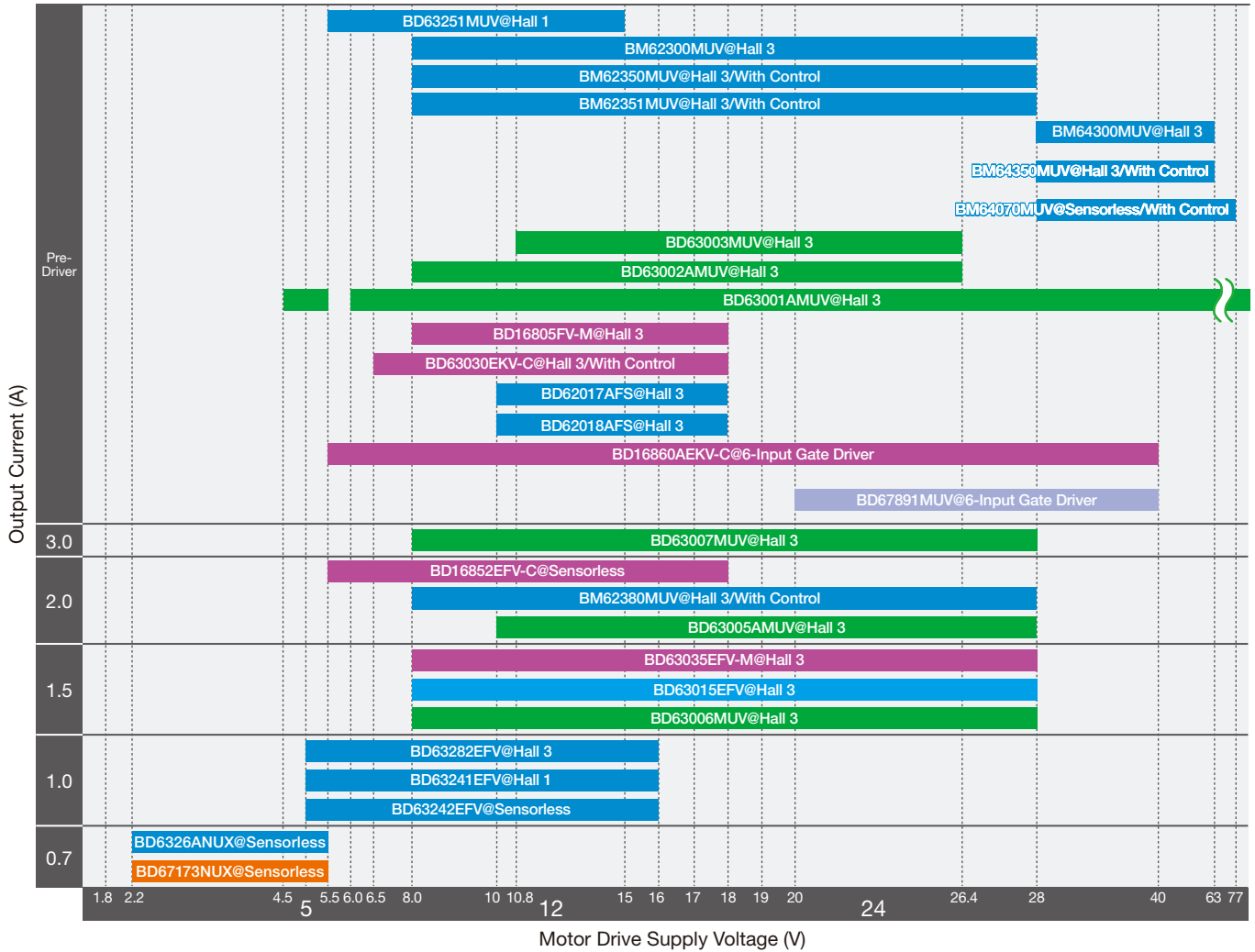
# 3-Phase Brushless DC Motor Drivers

P.15

P.27 (For Automotive Use)

Sine Wave
150°
120°
(For Automotive Use)
Gate Driver

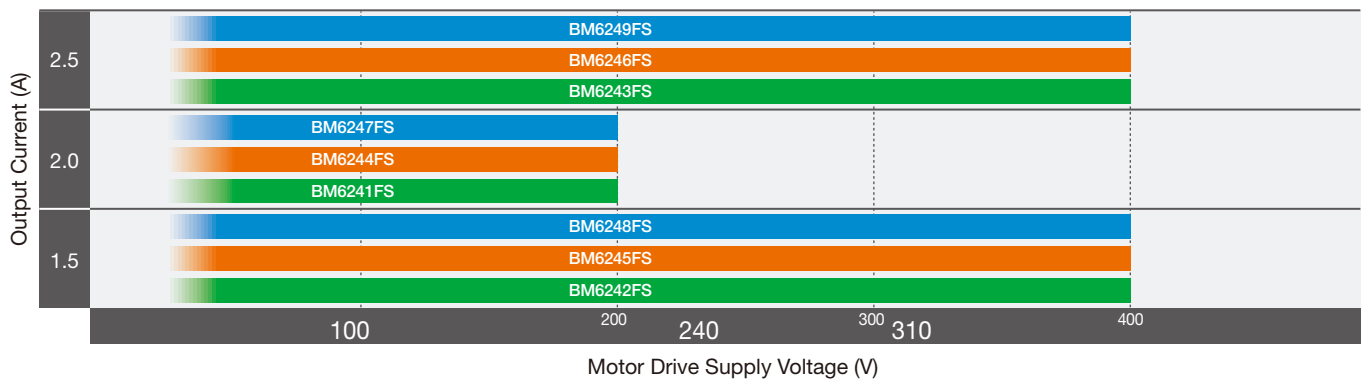
The Hall sensor type/control is indicated after the @ mark (none if not specified).



# High Voltage 3-Phase Brushless DC Motor Drivers

P.19

Sine Wave
120°/150° Switching
6-Input



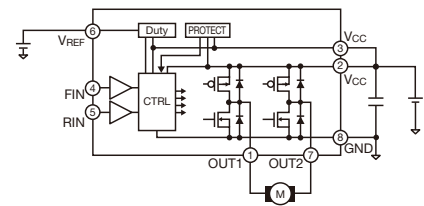
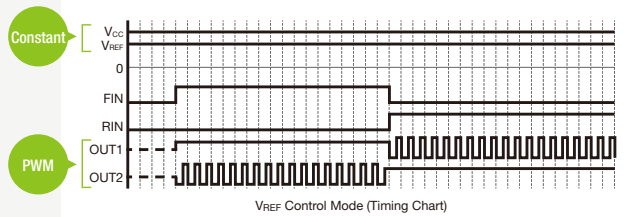
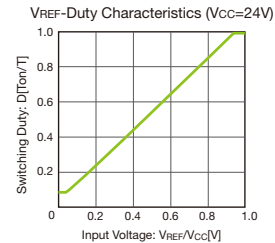
# Brushed DC Motor Drivers (Refer to P.27 for automotive products)

ROHM brush DC motor drivers are reversible drivers that operate brush motors using an H-bridge circuit and include functions such as forward/reverse, brake, and PWM drive. These high efficiency, high reliability motor drivers are offered in a range of voltages, currents, and package types—including pin-compatible models.



## VREF Control Function (VREFPWM)

PWM drive at the output stage is enabled by supplying a DC voltage to the VREF pin.  
 Changing the PWM ON duty based on the supplied DC voltage value makes it possible to control motor speed. This method (PWM duty control) results in lower power consumption compared with controlling the voltage supplied to the motor.  
 The relationship between the VREF pin supplied voltage and output switching duty is shown in the graph at right.  
 During switching operation, the L side output performs switching based on duty. ("L" ↔ "Hi-Z")



## Product Lineups with the Same Pin Layout

Models with the same pin layout are offered for 1A, 2A, and 3A, making it possible to respond to sudden changes in current by simply replacing the driver without modifying the board pattern.

### Compact series (HTSOP-J8)

Part No.	Supply Voltage (V)	Output Current [Peak] (A)
BD62110AEFJ	8.0 to 28.0	1.0 [2.0]
BD62120AEFJ		2.0 [3.0]
BD62130AEFJ		3.0 [4.0]

### Current Limiting series

Part No.	Supply Voltage (V)	Output Current [Peak] (A)
BD62210AEFV	8.0 to 28.0	1.0 [1.5]
BD62220AEFV		2.0 [2.8]

### High Voltage series

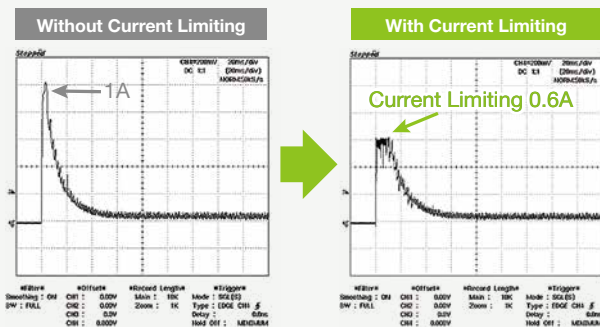
Part No.	Supply Voltage (V)	Output Current [Peak] (A)
BD63130AFM	8.0 to 46.2	3.0 [5.0]
BD63150AFM		5.0 [6.0]



## Current Limiting Function

A current limiting function is built in. This function limits inrush current during startup. (The current is set by the voltage supplied to the output current detection resistor and VREF terminal.) This function also allows use as a constant current control stepper motor driver.

### Output Current Waveforms During Startup



## Supports High-Speed Drive BD65491FV, BD65496MUV, BD65494MUV, BD65492MUV, BD63576NUX, BD63572MUV, etc.

In these products, shortening the turn ON and turn OFF times increases the maximum operating frequency at the output stage, making it ideal for applications requiring high-speed drive.

	Logic Input Frequency (kHz) (Max)	Turn ON (ns) (Typ)	Turn OFF (ns) (Typ)	Comments
BD65491FV	500	150	50	Turn ON/OFF time can be switched in 4 steps
BD65496MUV	500	150	50	Turn ON/OFF time can be switched in 4 steps
BD65494MUV	200	200	60	3mm × 3mm package (VQFN016V3030)
BD65492MUV	500	200	80	2ch
BD63576NUX	500	240	60	1ch, 2mm × 2mm package (VSON008X2020)
BD63572MUV	1,000	45	45	2ch, 3.5mm × 3.5mm package (VQFN20PV3535)

# Brushed DC Motor Driver Lineup

## 3.3V/5V Applications

Part No.	Supply Voltage (V)	Output Current (A) [Peak Current (A)]	ch	VREF PWM	Current Limiting	Supports High-Speed Drive	Output ON Resistance (Ω)	Package
BD6210F	3.0 to 5.5	0.5	1	✓	—	—	1	SOP8
BD6210HFP	3.0 to 5.5	0.5	1	✓	—	—	1	HRP7
BD6211F	3.0 to 5.5	1.0	1	✓	—	—	1	SOP8
BD6211HFP	3.0 to 5.5	1.0	1	✓	—	—	1	HRP7
BD65494MUV	2.0 to 9.0	1.0 [2.5*1]	1	—	—	✓	0.55	VQFN016V3030
BD6376GUL	2.0 to 9.0	1.0	1	—	—	✓	0.45	VCSP50L1
BD6736FV	2.0 to 9.0	1.0 [3.2*2]	1	—	—	—	0.35	SSOP-B20
BD6735FV	2.0 to 8.0	1.0	2	—	—	—	1	SSOP-B20
BD63572MUV	2.0 to 9.0	1.0 [2.5*1]	2	—	—	✓	0.4	VQFN20PV3535
BD63576NUX	2.0 to 10.0	1.2 [3.2*3]	1	—	—	✓	0.55	VSON008X2020
BD6212FP	3.0 to 5.5	2.0	1	✓	—	—	0.5	HSOP25
BD6212HFP	3.0 to 5.5	2.0	1	✓	—	—	0.5	HRP7

\*1: Pulse width  $t_w=100\text{ms}$ , Duty  $\leq 10\%$  of pulse \*2: Pulse width  $t_w=100\text{ms}$  \*3: Pulse width  $t_w=100\text{ms}$ , Duty  $<5\%$  of pulse

## 3.3V/5V/12V Applications

Part No.	Supply Voltage (V)	Output Current (A) [Peak Current (A)]	ch	VREF PWM	Current Limiting	Supports High-Speed Drive	Output ON Resistance (Ω)	Package
BD65492MUV	1.8 to 16.0	1.0	2	—	—	✓	0.9	VQFN024V4040
BD63565EFV	1.8 to 16.0	1.0	2	—	—	✓	0.9	HTSSOP-B20
BD65496MUV	1.8 to 16.0	1.2 [5.0*1]	1	—	—	✓	0.35	VQFN024V4040
BD65491FV	1.8 to 16.0	1.2 [4.0*1]	1	—	—	✓	0.35	SSOP-B16
BD63573NUV	2.0 to 16.0	1.2 [3.2*2]	1	—	—	✓	0.38	VSON010V3030

\*1: Pulse width  $t_w=100\text{ms}$ , Duty  $\leq 5\%$  of pulse \*2: Pulse width  $t_w=100\text{ms}$ , Duty  $\leq 20\%$  of pulse

## 12V Application

Part No.	Supply Voltage (V)	Output Current (A) [Peak Current (A)]	ch	VREF PWM	Current Limiting	Supports High-Speed Drive	Output ON Resistance (Ω)	Package
BD6220F	6.0 to 15.0	0.5	1	✓	—	—	1.5	SOP8
BD6225FP	6.0 to 15.0	0.5	2	✓	—	—	1.5	HSOP25
BD6221F	6.0 to 15.0	1.0	1	✓	—	—	1.5	SOP8
BD6226FP	6.0 to 15.0	1.0	2	✓	—	—	1.5	HSOP25
BD6222FP	6.0 to 15.0	2.0	1	✓	—	—	1	HSOP25
BD6222HFP	6.0 to 15.0	2.0	1	✓	—	—	1	HRP7

## 12V/24V Applications

Part No.	Supply Voltage (V)	Output Current (A) [Peak Current (A)]	ch	VREF PWM	Current Limiting	Supports High-Speed Drive	Output ON Resistance (Ω)	Package
BD62105AFVM	8.0 to 28.0	0.5 [1.0*1]	1	—	—	—	1.8	MSOP8
BD6230F	6.0 to 32.0	0.5	1	✓	—	—	1.5	SOP8
BD62110AEFJ	8.0 to 28.0	1.0 [2.0*1]	1	—	—	—	1.8	HTSOP-J8
BD6231F	6.0 to 32.0	1.0	1	✓	—	—	1.5	SOP8
BD6231HFP	6.0 to 32.0	1.0	1	✓	—	—	1.5	HRP7
BD62210AEFV	8.0 to 28.0	1.0 [1.5*1]	2	—	✓	—	1.9	HTSSOP-B28
BD6236FP	6.0 to 32.0	1.0	2	✓	—	—	1.5	HSOP25
BD6236FM	6.0 to 32.0	1.0	2	✓	—	—	1.5	HSOP-M28
BD6232FP	6.0 to 32.0	2.0	1	✓	—	—	1	HSOP25
BD6232HFP	6.0 to 32.0	2.0	1	✓	—	—	1	HRP7
BD62120AEFJ	8.0 to 28.0	2.0 [3.0*1]	1	—	—	—	0.65	HTSOP-J8
BD6237FM	6.0 to 32.0	2.0	2	✓	—	—	1	HSOP-M28
BD62220AEFV	8.0 to 28.0	2.0 [2.8*1]	2	—	✓	—	0.65	HTSSOP-B20
BD62221MUV	8.0 to 28.0	2.0 [3.0]	2	—	✓	—	0.55	VQFN0325050
BD62321HFP	6.0 to 32.0	3.0	1	—	—	—	1	HRP7
BD62130AEFJ	8.0 to 28.0	3.0 [4.0*1]	1	—	—	—	0.35	HTSOP-J8

\*1: Pulse width  $t_w \leq 1\text{ms}$ , Duty 20% of pulse

## 12V/24V/36V Applications

Part No.	Supply Voltage (V)	Output Current (A) [Peak Current (A)]	ch	VREF PWM	Current Limiting	Supports High-Speed Drive	Output ON Resistance (Ω)	Package
BD64220EFV	8.0 to 46.2	2.0 [2.5*1]	2	—	✓	—	0.65	HTSSOP-B28
BD63130AFM	8.0 to 46.2	3.0 [5.0]	1	—	✓	—	0.55	HSOP-M36
BD63150AFM	8.0 to 46.2	5.0 [6.0*1]	1	—	✓	—	0.3	HSOP-M36

\*1: Pulse width  $t_w \leq 1\text{ms}$ , Duty 20% of pulse

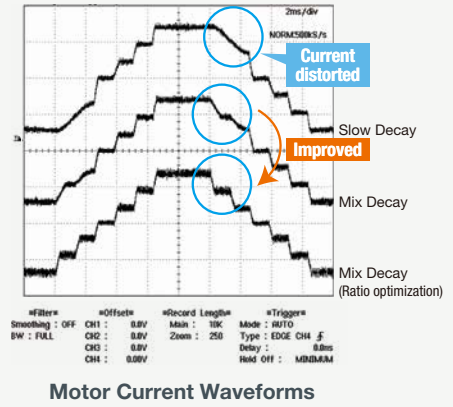
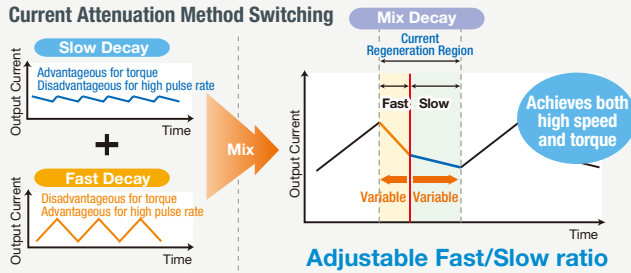
# Stepper Motor Drivers (Refer to P.27 for automotive products)

ROHM high efficiency, high reliability CLK-/PARA-IN stepper motor drivers are available in a range of interfaces, voltages, currents. Pin- and function-compatible models are offered as well.



## Mix Decay Function

When the motor current decays, the followability of the current will worsen depending on the current regeneration mode (Slow/Fast Decay), causing vibration and noise. As a countermeasure, a Mix Decay function is built in that externally adjusts the ratio of Slow Decay and Fast Decay during current attenuation.



## Product Lines with the Same Pin Layout

Five models with the same pin layout are offered in output currents from 1A to 3A, making it possible to support sudden changes in current by simply replacing the driver without modifying the board pattern.

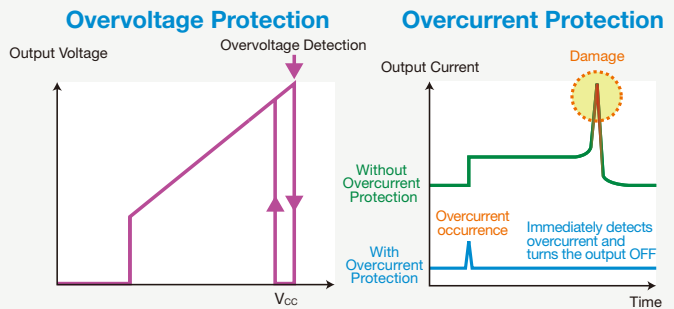
Part No.	Output Current (A)	Excitation Method	Package
BD63710AEFV	1	Full, 1/2, 1/4	HTSSOP-B28
BD63715AEFV	1.5	Full, 1/2, 1/4	
BD63720AEFV	2	Full, 1/2, 1/4	
BD63725BEFV	2.5	Full, 1/2, 1/4	
BD63731EFV	3	Full, 1/2, 1/4, 1/8*, 1/16*	

\*Pin 11 which is a mode switching terminal in the BD63731EFV is an NC terminal in other products.



## Multiple Protection Circuits

- When overvoltage is supplied to the power supply pin the output stage is turned OFF to prevent breakdown (Overvoltage protection)
- Output fault tolerance (overcurrent protection) Prevents damage even when the output pin is shorted to the power supply or ground



## Stepper Motor Driver – Drive Methods

Excitation Method	Single Phase Excitation	2 Phase Excitation Full Step	1-2 Phase Excitation Half Step	W1-2 Phase Excitation Quarter Step	2W1-2 Phase Excitation Eighth Step	4W1-2 Phase Excitation Sixteenth Step
Structural Overview Excitation Overview						
Features	· Small torque · Long vibration convergence time · Normally not used	· Large torque · Short vibration convergence time	· 1/2 step angle · Requires output current control	· 1/4 step angle · Requires output current control	· 1/8 step angle · Requires output current control	· 1/16 step angle · Requires output current control
Waveforms INA VREF VOUT IOUT						

# Stepper Motor Driver Lineup

## 5V Application

Part No.	Supply Voltage (V)		Output Current (A)	Control Input Signal	Drive	Decay			Function compatible*	Output ON Resistance (Ω)	Package
	Control Block	Output Block				Slow	Fast	Mix			
<b>BD6380EFV</b>	2.5 to 5.5	4.0 to 13.5	0.8	PARA	1/2	✓	—	—	J	1.2	HTSSOP-B24

\*Models with the same letter are function compatible

## 12V Application

Part No.	Supply Voltage (V)		Output Current (A)	Control Input Signal	Drive	Decay			Function compatible*	Output ON Resistance (Ω)	Package
	Control Block	Output Block				Slow	Fast	Mix			
<b>BD6382EFV</b>	3.0 to 5.5	5.5 to 13.5	0.8	PARA	1/2	✓	—	—	J	1.2	HTSSOP-B24
<b>BD6381EFV</b>	2.5 to 5.5	6.0 to 13.5	1.2	PARA	1/2	✓	—	—	J	1.0	HTSSOP-B24

\*Models with the same letter are function compatible

## 12V/24V Applications

Part No.	Supply Voltage (V)	Output Current (A)	Control Input Signal	Drive	Decay			Function compatible*	Output ON Resistance (Ω)	Package
					Slow	Fast	Mix			
<b>BD6383EFV</b>	10.0 to 28.0	1.0	CLK/PARA	1/4	✓	✓	✓	A	1.5	HTSSOP-B40
<b>BD6385EFV</b>	10.0 to 28.0	1.5	CLK/PARA	1/4	✓	✓	✓	A	1.0	HTSSOP-B40
<b>BD6387EFV</b>	10.0 to 28.0	2.0	CLK/PARA	1/4	✓	✓	✓	A	0.8	HTSSOP-B40
<b>BD6389FM</b>	10.0 to 28.0	2.2	CLK/PARA	1/4	✓	✓	✓	A	0.7	HSOP-M36
<b>BD63910MUV</b>	8.0 to 28.0	1.0	CLK/PARA	1/16	✓	✓	✓	L	1.3	VQFN028V5050
<b>BD63510AEFV</b>	8.0 to 28.0	1.0	CLK	1/16	✓	✓	✓	B	1.75	HTSSOP-B28
<b>BD63511EFV</b>	8.0 to 28.0	1.0	CLK	1/16	✓	✓	✓	C	1.75	HTSSOP-B28
<b>BD60223FP</b>	8.0 to 28.0	1.5	CLK	1/16	✓	✓	✓	—	0.55	HSOP25
<b>BD63920MUV</b>	8.0 to 28.0	2.0	CLK/PARA	1/16	✓	✓	✓	L	0.49	VQFN028V5050
<b>BD63520AEFV</b>	8.0 to 28.0	2.0	CLK	1/16	✓	✓	✓	B	0.65	HTSSOP-B28
<b>BD63521EFV</b>	8.0 to 28.0	2.0	CLK	1/16	✓	✓	✓	C	0.65	HTSSOP-B28
<b>BD63725BEFV</b>	8.0 to 28.0	2.5	CLK	1/4	✓	✓	✓	H	0.35	HTSSOP-B28
<b>BD63525AEFV</b>	8.0 to 28.0	2.5	CLK	1/16	✓	✓	✓	B	0.35	HTSSOP-B28
<b>BD63524AEFV</b>	8.0 to 28.0	2.5	CLK	1/8	✓	✓	✓	—	0.35	HTSSOP-B28
<b>New</b> <b>BD63731EFV</b>	8.0 to 28.0	3.0	CLK	1/16	✓	✓	✓	H	0.28	HTSSOP-B28
<b>New</b> <b>BD63740FM</b>	8.0 to 28.0	4.0	CLK	1/16	✓	✓	✓	H	0.28	HSOP-M36

\*Models with the same letter are function compatible

## 24V Application

Part No.	Supply Voltage (V)	Output Current (A)	Control Input Signal	Drive	Decay			Function compatible*	Output ON Resistance (Ω)	Package
					Slow	Fast	Mix			
<b>BD63801EFV</b>	19.0 to 28.0	0.8	CLK	1/2	✓	—	—	—	2.8	HTSSOP-B24
<b>BD68610EFV</b>	19.0 to 28.0	1.0	PARA	1/4	✓	✓	✓	E	1.8	HTSSOP-B20
<b>BD68710EFV</b>	19.0 to 28.0	1.0	PARA	1/4	✓	✓	✓	F	1.2	HTSSOP-B28
<b>BD63610AEFV</b>	19.0 to 28.0	1.0	CLK	1/4	✓	—	—	G	1.8	HTSSOP-B20
<b>BD63710AEFV</b>	19.0 to 28.0	1.0	CLK	1/4	✓	✓	✓	H	1.2	HTSSOP-B28
<b>BD63940EFV</b>	19.0 to 28.0	1.2	PARA	1/2	✓	—	—	K	1.4	HTSSOP-B24
<b>BD68715EFV</b>	19.0 to 28.0	1.5	PARA	1/4	✓	✓	✓	F	0.95	HTSSOP-B28
<b>BD63715AEFV</b>	19.0 to 28.0	1.5	CLK	1/4	✓	✓	✓	H	0.95	HTSSOP-B28
<b>BD63960EFV</b>	19.0 to 28.0	1.5	PARA	1/2	✓	—	—	K	1.1	HTSSOP-B24
<b>BD68620EFV</b>	19.0 to 28.0	2.0	PARA	1/4	✓	✓	✓	E	0.95	HTSSOP-B24
<b>BD68720EFV</b>	19.0 to 28.0	2.0	PARA	1/4	✓	✓	✓	F	0.65	HTSSOP-B28
<b>BD63620AEFV</b>	19.0 to 28.0	2.0	CLK	1/4	✓	✓	✓	G	0.95	HTSSOP-B24
<b>BD63720AEFV</b>	19.0 to 28.0	2.0	CLK	1/4	✓	✓	✓	H	0.65	HTSSOP-B28
<b>BD63860EFV</b>	16.0 to 28.0	2.5	CLK	1/8	✓	✓	✓	—	0.8	HTSSOP-B28
<b>BD63730EFV</b>	19.0 to 28.0	3.0	CLK/PARA	1/4	✓	✓	✓	—	0.4	HTSSOP-B54

\*Models with the same letter are function compatible

## 24V/36V Applications

Part No.	Supply Voltage (V)	Output Current (A)	Control Input Signal	Drive	Decay			Function compatible*	Output ON Resistance (Ω)	Package
					Slow	Fast	Mix			
<b>BD6422EFV</b>	19.0 to 42.0	1.0	PARA	1/4	✓	✓	✓	—	2.0	HTSSOP-B24
<b>BD6423EFV</b>	19.0 to 42.0	1.0	CLK	1/4	✓	✓	✓	I	2.0	HTSSOP-B24
<b>BD6425EFV</b>	19.0 to 42.0	1.5	CLK	1/4	✓	✓	✓	I	1.1	HTSSOP-B28

\*Models with the same letter are function compatible

# Single-Phase Brushless DC Motor Drivers

ROHM's single-phase brushless DC motor drivers support control technologies and various drive methods required for silent, high efficiency operation, making them ideal for applications such as fan motors. A broad lineup is offered in a range of voltages and currents.

## Operating Waveform Comparison of Different Drive Methods

	Switching Drive	BTL Drive	PWM Soft Switching Drive	Sinusoidal Drive
Drive Waveforms				
Motor Efficiency	Better	Good	Better	Better
Low Noise	Good	Better	Better	Excellent

Silence

### Sinusoidal Drive

**Conventional**

OUT1  
OUT2  
FG  
Icoil

Current distortion

**Sinusoidal Drive**

OUT1  
OUT2  
FG  
Icoil

Hall signals are used to generate PWM soft switching waveforms. The PWM soft switching interval cannot be freely adjusted due to the effects of the temperature characteristics of the Hall signal. In addition, the coil signal will become distorted and noise will increase.

The coil current waveform can be adjusted by the voltage supplied to the PWM soft switching interval setting terminal. This helps to minimize current distortion and noise.

High Efficiency

### Advance/Delay Angle Control Drive

BD61250MUV

**Advance Angle Setting**

Advance Angle ←

**Delay Angle Setting**

→ Delay Angle

To obtain the maximum torque, the phase of the driver output signal with respect to the Hall signal should be adjusted so that the phases of the magnet (rotor) and coil current are at 90°. (Can be set from 22.5° on the advance angle side to 22.5° on the delay angle side)

Control

### Wind Loss Correction

BD61250MUV, BD6995FV, BD61245EFV

**Motor Rotational Speed vs PWM Input Duty**

Rotational Speed vs PWM Input Duty

➔

**Motor Rotational Speed vs PWM Input Duty**

Rotational Speed vs PWM Input Duty

Increased motor rotational speed linearity vs input duty

ADJ pin adjustment

Optimizing the setting of the ADJ pin makes it possible to improve the linearity of motor rotational speed (vs. PWM input duty) and increase speed setting accuracy.

Control

### I/O Slope Setting

BD61243FV, BD61250MUV, BD61245EFV

OUT1, 2 Output ON Duty (%) vs PWM Input ON Duty (%)

SLOPE=0.5, SLOPE=2, Slope origin

This function enables convenient adjustment of the motor rotational speed and PWM input duty. The slope of the IC output duty and PWM speed control signal to the motor can be varied between 0.5 and 2.0.

Control

### Improved Back Electromotive Force Jump

BD6995FV, BD61243FV, BD61245EFV

**Conventional Drive Method**

Output voltage jump

**New Drive Method**

Output voltage jumps that occur during rotational speed changes are minimized, such as when the forward/reverse idle power supply is turned ON, the torque input suddenly changes, or during lock detection/recovery.

High Efficiency

### Standby Function

This function reduces standby power consumption when the motor is stopped. Setting the PWM signal duty to 0% switches the IC to standby mode.

# Single-Phase Brushless DC Motor Driver Lineup

## 3.3V/5V (Drivers)

Part No.	Supply Voltage (V)	Output Current (A)	Drive Method				Speed Control Input Signal		Min Speed Setting	Advance/Delay Angle Setting	Standby Function	Current Control Function	FG/AL*	Hall Bias (V)	Package
			Switching	BTL	PWM Soft SW	Sine Wave	DC	PWM							
BH6766FVM	2.0 to 6.0	0.6	—	✓	—	—	—	—	—	—	—	—	FG	1.3	MSOP8
BU6909AGFT	1.8 to 5.5	0.8	—	—	✓	—	—	✓	—	—	✓	—	FG	Built in	TSSOF6
BU69090NUX	1.8 to 5.5	0.8	—	—	✓	—	—	✓	—	—	✓	—	FG	Built in	VSON008X2030
BD6965NUX	2.0 to 5.5	0.8	—	✓	—	—	—	✓	—	—	✓	—	FG	—	VSON008X2030
<b>New</b> BD69060GFT	1.8 to 5.5	1.0	—	—	✓	—	—	✓	—	—	✓	—	FG	Built in	TSSOF6

\* FG: Rotational speed output terminal, AL: Alarm signal output terminal

## 3.3V/5V/12V/24V (Drivers)

Part No.	Supply Voltage (V)	Output Current (A)	Drive Method				Speed Control Input Signal		Min Speed Setting	Advance/Delay Angle Setting	Standby Function	Current Control Function	FG/AL*	Hall Bias (V)	Package
			Switching	BTL	PWM Soft SW	Sine Wave	DC	PWM							
BD6981FVM	2.8 to 16.0	0.8	—	✓	—	—	—	—	—	—	—	—	FG	1.2	MSOP8
BD6982FVM	2.8 to 16.0	0.8	—	✓	—	—	—	—	—	—	—	—	AL	1.2	MSOP8
BD6967FVM	3.3 to 14.0	0.8	—	✓	—	—	✓	✓	—	—	—	—	FG	1.2	MSOP10
BD6968FVM	3.3 to 14.0	0.8	—	✓	—	—	✓	✓	—	—	—	—	AL	1.2	MSOP10
BD6962FVM	3.3 to 14.0	0.8	—	✓	—	—	—	✓	—	—	—	—	FG	—	MSOP8
BD6964FVM	3.3 to 14.0	0.8	—	✓	—	—	—	✓	—	—	—	—	AL	—	MSOP8
BD69830FV	6.0 to 28.0	0.9	✓	—	—	—	—	✓	—	—	—	—	FG/AL	1.2	SSOP-B14
BD6971FV	3.5 to 17.0	1.0	—	—	✓	—	✓	✓	✓	—	—	—	FG	1.3	SSOP-B14
BD6961F	3.3 to 14.0	1.0	—	✓	—	—	—	✓	—	—	—	—	FG	—	SOP8
BD6964F	3.3 to 14.0	1.0	—	✓	—	—	—	✓	—	—	—	—	AL	—	SOP8
BD6995FV	4.3 to 17.0	1.2	—	—	✓	—	✓	—	✓	—	—	—	FG/AL	1.25	SSOP-B16
<b>New</b> BD61248NUX	4.5 to 16.0	1.2	—	—	—	✓	—	✓	—	—	—	—	FG	—	VSON010X3030
BD61243FV	5.5 to 16.0	1.2	—	—	—	✓	✓	✓	✓	—	—	—	FG	—	SSOP-B14
BD61245EFV	4.0 to 16.0	1.8	—	—	—	✓	✓	✓	✓	—	—	—	FG	—	HTSSOP-B16

\* FG: Rotational speed output terminal, AL: Alarm signal output terminal

## 12V/24V (Predrivers) (External MOSFET: N+P)

Part No.	Supply Voltage (V)	Output Current (A) High-Side/ Low-Side*	Drive Method				Speed Control Input Signal		Min Speed Setting	Advance/Delay Angle Setting	Standby Function	Current Control Function	FG/AL*2	Hall Bias (V)	Package	
			Switching	BTL	PWM Soft SW	Sine Wave	DC	PWM								
BD69730FV	4.3 to 17.0	-9/±10	—	—	✓	—	✓	✓	—	—	—	—	✓	FG	1.26	SSOP-B16
BD69740FV	4.3 to 17.0	-9/±10	—	—	✓	—	✓	✓	—	—	—	—	✓	AL	1.26	SSOP-B16
BD61251FV	4.5 to 16.0	±10/±10	—	—	—	✓	—	✓	—	—	—	—	✓	FG	—	SSOP-B16
BD61250MUV	4.5 to 36.0	±10/±10	—	—	—	✓	✓	✓	✓	✓	✓	—	✓	FG/AL	—	VQFN024V4040

\*1: Reference values (high-side FET gate drive current/low-side FET gate drive current)

\*2: FG: Rotational speed output terminal, AL: Alarm signal output terminal

# MOSFET Lineup (When Using a Predriver)

Polarity (ch)	Part No.	V <sub>DS</sub> (V)		I <sub>D</sub> (A)		R <sub>DS(on)</sub> Typ V <sub>GS</sub> =10V		R <sub>DS(on)</sub> Typ (mΩ) V <sub>GS</sub> =4.5V		Package	Size (mm)	P <sub>o</sub> (W)
		Nch	Pch	Nch	Pch	Nch	Pch	Nch	Pch			
N+P	HP8M51	100	100	4.5*1	-4.5*1	120	210	130	230	(HSOP8) Symmetry Dual	5.0×6.0×1.0	7*1
	SH8M51	100	-100	3	-2.5	120	210	130	230	(SOP8)	5.0×6.0×1.75	2
	QS8M51	100	-100	2	-1.5	240	350	250	380	(TSMT8)	2.8×3.0×0.85	1.5
	SH8M41	80	-80	3.4	-2.6	90	165	110	220	(SOP8)	5.0×6.0×1.75	2
	HP8M31	60	-60	8.5*1	-8.5*1	46	50	52	55	(HSOP8) Symmetry Dual	5.0×6.0×1.0	7*1
	<b>New</b> SH8MC5	60	-60	6.5	-7	25	27	33	29	(SOP8)	5.0×6.0×1.75	2
	SH8M31	60	-60	4.5	-4.5	46	50	52	55			
	<b>New</b> QH8MC5	60	-60	3	-3.5	70	71	100	79	(TSMT8)	2.8×3.0×0.85	1.5
	QS8M31	60	-60	3	-2	80	150	93	180			
	<b>New</b> SH8MB5	40	-40	8.5	-8	14.9	13.9	18.2	16.5	(SOP8)	5.0×6.0×1.75	2
	<b>New</b> QH8MB5	40	-40	4.5	-5	34	33	44	41	(TSMT8)	2.8×3.0×0.85	1.5
	HP8MA2	30	-30	18*1	-15*1	7.5	13.2	11.7	21	(HSOP8) Symmetry Dual	5.0×6.0×1.0	7*1
	SH8MA4	30	-30	9*1	-8.5*1	16.5	23	22.2	32	(SOP8)	5.0×6.0×1.75	3*1
	SH8MA3	30	-30	7*1	-6*1	23	40	42	60			
	SH8MA2	30	-30	4.5*1	-4.5*1	57	63	88	89			
	QH8MA4	30	-30	9*1	-8*1	12.3	22	18.2	31			
QH8MA3	30	-30	7*1	-5.5*1	22	37	35	55	(TSMT8)	2.8×3.0×0.85	2.5*1	
QH8MA2	30	-30	4.5	-3	25	55	40	80				
UT6MA2	30	-30	4	-4	37	55	59	80	(HUM2020L8) Dual (DFN2020-8D)	2.0×2.0×0.6	2	

\*1: Pw ≤ 1s

Note: Indicates the JEDEC package notation. ( ): ROHM Package, ( ): General Code.

# 3-Phase Brushless DC Motor Drivers (120° Commutation)

(Refer to P.29 for automotive products)

ROHM 3-phase brushless DC motor drivers (120° commutation) are compatible with motors equipped with Hall sensors. Single-chip driver and predriver types are offered, which we propose together with power devices for the output stage.

## 120°/150°/Sine Wave Commutation Drive

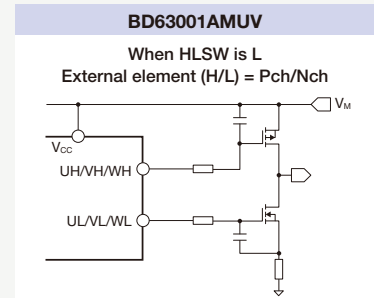
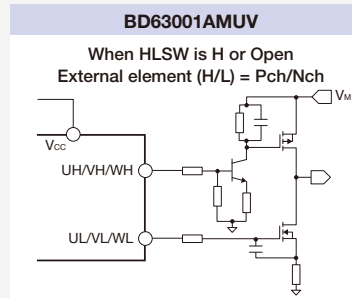
	120° Commutation Drive	150° Commutation Drive	Sine Wave Commutation Drive
Current Waveform			
Motor Efficiency			Good →
Switching Efficiency	Good ←		
Control Characteristics	Easy ←		
Noise			Good →
Torque Ripple			Good →



### Predriver + Power Element Supports a Wide Drive Voltage Range

BD63001AMUV

The BD63001AMUV features predriver specifications for driving external MOSFETs. The  $V_M$  voltage can be raised with respect to the  $V_{CC}$  voltage to support a wide range of drive voltages. Also, when using  $V_{CC}=V_M$ , the number of external parts can be reduced by setting the logic of the UH/VH/WH pin that drives the external high side element through the HLSW pin.

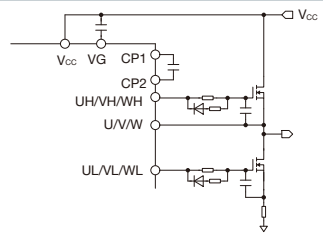


### Constant Current Driver Reduces the Number of Parts

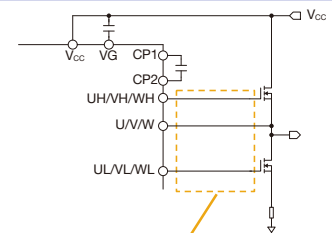
BD63003MUV

The BD63003MUV eliminates the need for external parts used to adjust the slew rate of each phase by switching from the standard inverter gate voltage drive type to constant current drive.

#### Standard Inverter Type (i.e. BD63002AMUV)



#### Constant Current Drive Type (BD63003MUV)



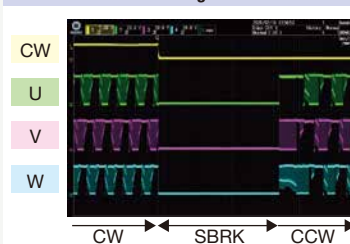
### Selecting the Brake Function When Switching the Direction of Rotation

BD63003MUV

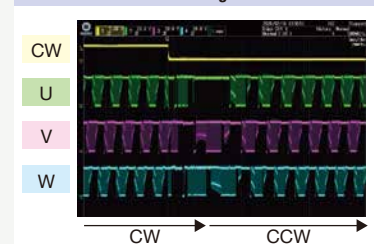
The BD63003MUV can be set with or without Short Brake (SBRK) when switching the direction of rotation. Without SBRK, the time until switching the rotation direction can be shortened vs with SBRK. (Note: Pay attention to the rated current of the external FET, as large current can flow during reverse rotation.)

SBRK Selection: BD63003MUV  
Without SBRK: BD63007MUV  
With SBRK: BD63001AMUV, BD63002AMUV,  
BD63005AMUV, BD63006MUV

#### With SBRK when switching the rotation direction



#### Without SBRK when switching the rotation direction





# 3-Phase Brushless DC Motor Driver Lineup

## 12V/24V (Single-Chip Drivers)

Part No.	Operating Voltage Range (V)	Output Current (A) [Peak Current (A)]	Sensor Type	FG Signal Output	Hall Bias (V)	Motor Lock Protection	Speed Control Input Signal	Brake function when switching the direction of rotation	Current Control Function	Package
<b>BD63006MUUV</b>	8.0 to 28.0	1.5	Hall 3*2	✓	5	✓	DirectPWM	✓	✓	VQFN024V4040
<b>BD63005AMUV</b>	10.0 to 28.0	2.0 [3.5*1]	Hall 3*2	✓	5	✓	DirectPWM	✓	✓	VQFN040V6060
<b>BD63007MUUV</b>	8.0 to 28.0	3.0 [5.0*1]	Hall 3*2	✓	5	✓	DirectPWM	—	✓	VQFN040V6060

\*1: Pulse width  $t_w \leq 1\text{ms}$ , Duty=20% of pulse \*2: Supports Hall elements and Hall ICs

## 12V/24V (Predrivers)

Part No.	Operating Voltage Range (V)	Output Current (mA)*1 (source/sink)	Sensor Type	FG Signal Output	Hall Bias (V)	Motor Lock Protection	Speed Control Input Signal	Brake function when switching the direction of rotation	Current Control Function	External FET	Package
<b>BD63001AMUV</b>	6.0 to 28.0	200/~200*2	Hall 3*4	✓	5	✓	DC/DirectPWM	✓	✓	N+P	VQFN024V4040
<b>New</b> <b>BD63002AMUV</b>	8.0 to 26.4	High-Side (100/~50)*3 Low-Side (50/~100)	Hall 3*4	✓	5	✓	DirectPWM	✓	✓	N+N	VQFN028V5050
<b>BD63003MUUV</b>	10.8 to 26.4	63/~136	Hall 3*4	✓	5	✓	DirectPWM	selectable	✓	N+N	VQFN032V5050

\*1: Reference value \*2: Pulse width  $t_w < 1\mu\text{s}$ , 50Hz \*3: Pulse width  $t_w \leq 1\mu\text{s}$  \*4: Supports Hall elements and Hall ICs

## 3-Phase Gate Driver

Part No.	Supply Voltage (V) (Motor/control blocks)	Output Current (mA)*1 (source/sink)	Input Method	FG Signal Output	Hall Bias (V)	Motor Lock Protection	Speed Control Input Signal	Current Control Function	External FET	Package
<b>BD7891MUUV</b>	20 to 40/2.5 to 5.5	50/~50	6-Input	✓	—	—	DirectPWM	✓	N+P	VQFN32V5050

\*1: Reference value

# MOSFET Lineup (When Using a Predriver)

Polarity (ch)	Part No.	V <sub>DSS</sub> (V)	I <sub>D</sub> (A)	R <sub>DS(on)</sub> Typ (mΩ)		Package	Size (mm)	P <sub>D</sub> (W)				
				V <sub>GS</sub> =10V	V <sub>GS</sub> =4.5V							
N+N	<b>QH8K51</b>	100	2	240	250	(TSMT8)	2.8×3.0×0.85	1.5				
	<b>SH8K52</b>	100	3	120	135	(SOP8)	5.0×6.0×1.75	2				
	<b>SH8K41</b>	80	3.4	90	110			2				
	<b>SH8K39</b>	60	13*1	15	20			5.8*1				
	<b>New</b> <b>SH8KC6</b>	60	6.5	25	33			2				
	☆ <b>SH8KC7</b>	60	10	10.7	13.5	(TSMT8)	2.8×3.0×0.85	2				
	<b>New</b> <b>QH8KC6</b>	60	5.5	23	31			1.5				
	<b>New</b> <b>QH8KC5</b>	60	3	70	100			1.5				
	<b>New</b> <b>UT6KC5</b>	60	3.5	73	104			(HUML2020L8) Dual (DFN2020-8D)	2.0×2.0×0.6	2		
	☆ <b>SH8KB7</b>	40	12.5	7.7	8.7	(SOP8)	5.0×6.0×1.75	2				
	<b>New</b> <b>SH8KB6</b>	40	8.5	14.9	18.2			2				
	<b>SH8K26</b>	40	6*1	27	35			2*1				
	<b>New</b> <b>QH8KB6</b>	40	8	13.7	16.4			1.5				
	<b>New</b> <b>QH8KB5</b>	40	4.5	34	44	(TSMT8)	2.8×3.0×0.85	1.5				
	<b>New</b> <b>UT6KB5</b>	40	5	37	48	(HUML2020L8) Dual (DFN2020-8D)	2.0×2.0×0.6	2				
	<b>SH8KA7</b>	30	15*1	7.1	8.3	(SOP8)	5.0×6.0×1.75	4.6*1				
	<b>SH8KA4</b>	30	9*1	16.5	22.2			3*1				
	<b>SH8KA2</b>	30	8*1	23	34			2.8*1				
	<b>SH8K12</b>	30	6*1	30	40			2				
	<b>SH8KA1</b>	30	4.5*1	54	84			2.7*1				
<b>SH8K11</b>	30	3.5	70	90	2							
<b>QH8KA3</b>	30	9*1	12.3	18.2	2.6*1							
<b>QH8KA2</b>	30	4.5	25	40	(TSMT8)			2.8×3.0×0.85	1.5			
<b>QH8KA1</b>	30	4.5*1	56	86	2.4*1							
Polarity (ch)	Part No.	V <sub>DSS</sub> (V)		I <sub>D</sub> (A)		R <sub>DS(on)</sub> Typ (mΩ) V <sub>GS</sub> =10V		R <sub>DS(on)</sub> Typ (mΩ) V <sub>GS</sub> =4.5V		Package	Size (mm)	P <sub>D</sub> (W)
		Nch	Pch	Nch	Pch	Nch	Pch	Nch	Pch			
N+P	<b>HP8M51</b>	100	-100	4.5*1	-4.5*1	120	210	130	230	(HSOP8) Symmetry Dual	5.0×6.0×1.0	7*1
	<b>SH8M51</b>	100	-100	3	-2.5	120	210	130	230	(SOP8)	5.0×6.0×1.75	2
	<b>QS8M51</b>	100	-100	2	-1.5	240	350	250	380	(TSMT8)	2.8×3.0×0.85	1.5
	<b>SH8M41</b>	80	-80	3.4	-2.6	90	165	110	220	(SOP8)	5.0×6.0×1.75	2
	<b>HP8M31</b>	60	-60	8.5*1	-8.5*1	46	50	52	55	(HSOP8) Symmetry Dual	5.0×6.0×1.0	7*1
	<b>New</b> <b>SH8MC5</b>	60	-60	6.5	-7	25	27	33	29	(SOP8)	5.0×6.0×1.75	2
	<b>SH8M31</b>	60	-60	4.5	-4.5	46	50	52	55			2
	<b>New</b> <b>QH8MC5</b>	60	-60	3	-3.5	70	71	100	79	(TSMT8)	2.8×3.0×0.85	1.5
	<b>QS8M31</b>	60	-60	3	-2	80	150	93	180	(TSMT8)	2.8×3.0×0.85	1.5
	<b>New</b> <b>SH8MB5</b>	40	-40	8.5	-8	14.9	13.9	18.2	16.5	(SOP8)	5.0×6.0×1.75	2
	<b>New</b> <b>QH8MB5</b>	40	-40	4.5	-5	34	33	44	41	(TSMT8)	2.8×3.0×0.85	1.5
	<b>HP8MA2</b>	30	-30	18*1	-15*1	7.5	13.2	11.7	21	(HSOP8) Symmetry Dual	5.0×6.0×1.0	7*1
	<b>SH8MA4</b>	30	-30	9*1	-8.5*1	16.5	23	22.2	32	(SOP8)	5.0×6.0×1.75	3*1
	<b>SH8MA3</b>	30	-30	7*1	-6*1	23	40	42	60			2.8*1
	<b>SH8MA2</b>	30	-30	4.5*1	-4.5*1	57	63	88	89			2.7*1
	<b>QH8MA4</b>	30	-30	9*1	-8*1	12.3	22	18.2	31			2.6*1
	<b>QH8MA3</b>	30	-30	7*1	-5.5*1	22	37	35	55	(TSMT8)	2.8×3.0×0.85	2.5*1
	<b>QH8MA2</b>	30	-30	4.5	-3	25	55	40	80	(HUML2020L8) Dual (DFN2020-8D)	2.0×2.0×0.6	1.5
<b>UT6MA2</b>	30	-30	4	-4	37	55	59	80	2			

\*1: PW ≤ 1s

☆: Under Development

Note: Indicates the JEDEC package notation. ( ): ROHM Package, ( ): General Code.

# 3-Phase Brushless DC Motor Drivers (Sine Wave Commutation)

(Refer to P.29 for automotive products)

ROHM's 3-phase brushless DC motor drivers (sine wave/150° commutation) are compatible with both sensorless motors and motors equipped with Hall sensors. In addition to 3.3V, 5V, 12V, and 24V products, 48V power supplies are also supported, including models with a built-in speed control function.

### Control

#### 100V Gate Driver, Built-in Power Supply

ROHM 48V drivers integrate a gate driver and power supply that reduces the number of components along with board area, simplifying board design considerably.

**Conventional Structure:** MCU, LDO (bDCDC), Gate Driver, Gate Driver, Gate Driver.

**ROHM Product:** MCU, Build-in LDO, Control Block, Analog Block, Integrating the Gate Driver.

### Silence

#### Sine Wave Drive Method Startup

Adopts sine wave drive to achieve low noise from startup to normal rotation

Target Models: BM62xxxMUV series, BM64xxxMUV series, BD63241FV, BD63242EFV, BD63282EFV, BD63251MUV

### High Efficiency

#### Advance Angle Control Function

BD63241FV, BD63242EFV, BD63282EFV, BD63251MUV, BM623xxMUV series, BM643xxMUV series

To maximize motor efficiency it is necessary to obtain maximum torque by setting the phases of the magnetic fields of the magnet (rotor) and coil (winding) to 90°. This enables control of the phase of the driver output signal relative to the Hall signal.

■ Multiplying the phase induced voltage with the phase current results in the phase torque. The negative part of the multiplication operation becomes the negative torque.

← The phase of the phase supplied voltage advances. The induced voltage matches the current phase.

### Control

#### Function Adjustment via Internal Non-volatile Memory

BM62380MUV, BM62350MUV, BM62351MUV, BM64350MUV, BM64070MUV

Internal non-volatile memory, combined with a debugging communication function, enable adjustment of speed control and other characteristics for each motor product.

### Control

#### Built-in Slew Rate Adjustment Function Reduces the Number of External Parts

BM64070MUV

The BM64070MUV includes a resistor-based slew rate adjustment function that eliminates the need for a slew rate function configured with external components at the output stage. This results in fewer external components.

(Rx4 + Dix2 + Cx2) eliminates 3-phase components

# 3-Phase Brushless DC Motor Driver Lineup

## 3.3V/5V (Single-Chip Drivers)

Part No.	Operating Voltage Range (V)	Output Current (A)	Commutation Method	Sensor Type	Lead Angle Setting	FG Signal Output	Hall Bias (V)	Motor Lock Protection	Speed Control Input Signal	Internal Speed Feedback	Current Control Function	Package
<b>BD67173NUX</b>	2.2 to 5.5	0.7	150°	Sensorless	-	✓	-	✓	DirectPWM	-	-	VSON010X3030
<b>BD6326ANUX</b>	2.2 to 5.5	0.7	Sine Wave	Sensorless	-	✓	-	✓	DirectPWM	-	-	VSON010X3030

## 12V (Single-Chip Drivers)

Part No.	Operating Voltage Range (V)	Output Current (A)	Commutation Method	Sensor Type	Lead Angle Setting	FG Signal Output	Hall Bias (V)	Motor Lock Protection	Speed Control Input Signal	Internal Speed Feedback	Current Control Function	Package
<b>BD63282EFV</b>	5.0 to 16.0	1.0	Sine Wave	Hall 3*	✓	✓	5	✓	DC/DirectPWM	-	✓	HTSSOP-B20
<b>BD63241FV</b>	5.0 to 16.0	1.0	Sine Wave	Hall 1*	✓	✓	1.25	✓	DirectPWM	-	✓	SSOP-B16
<b>BD63242EFV</b>	5.0 to 16.0	1.0	Sine Wave	Sensorless	✓	✓	-	✓	DirectPWM	-	✓	HTSSOP-B16

\*Supports Hall elements and Hall ICs

## 12V/24V (Single-Chip Drivers)

Part No.	Operating Voltage Range (V)	Output Current (A)	Commutation Method	Sensor Type	Lead Angle Setting	FG Signal Output	Hall Bias (V)	Motor Lock Protection	Speed Control Input Signal	Internal Speed Feedback	Current Control Function	Package
<b>BD63015EFV</b>	8.0 to 28.0	1.5	Sine Wave	Hall 3*	-	✓	5	✓	DC	-	✓	HTSSOP-B20
☆ <b>BM62380MUV</b>	8.0 to 28.0	2.0	Sine Wave	Hall 3*	✓	✓	5	✓	DirectPWM	✓	✓	VQFN040V6060

\*Supports Hall elements and Hall ICs

☆: Under Development

## 12V (Predriver)

Part No.	Operating Voltage Range (V)	Output Current (mA)** (source/sink)	Commutation Method	Sensor Type	Lead Angle Setting	FG Signal Output	Hall Bias (V)	Motor Lock Protection	Speed Control Input Signal	Internal Speed Feedback	Current Control Function	External FET	Package
<b>BD63251MUV</b>	5.5 to 15.0	10/-10	Sine Wave	Hall 1* <sup>2</sup>	✓	✓	1.25	✓	DC/DirectPWM	-	✓	N+P	VQFN024V4040

\*1: Reference values \*2: Supports Hall elements and Hall ICs

## 12V/24V (Predrivers)

Part No.	Operating Voltage Range (V)	Output Current (mA)** (source/sink)	Commutation Method	Sensor Type	Lead Angle Setting	FG Signal Output	Hall Bias (V)	Motor Lock Protection	Speed Control Input Signal	Internal Speed Feedback	Current Control Function	External FET	Package
<b>BM62300MUV</b>	8.0 to 28.0	150/-150	Sine Wave	Hall 3* <sup>2</sup>	✓	✓	5	✓	DirectPWM	-	✓	N+N	VQFN032V5050
☆ <b>BM62350MUV</b>	8.0 to 28.0	150/-150	Sine Wave	Hall 3* <sup>2</sup>	✓	✓	5	✓	DirectPWM	✓	✓	N+N	VQFN032V5050
☆ <b>BM62351MUV</b>	8.0 to 28.0	150/-150	Sine Wave	Hall 3* <sup>2</sup>	✓	✓	5	✓	CLKIN	✓	✓	N+N	VQFN032V5050

\*1: Reference value, Pulse width tws 1μs, Dutys10% of pulse \*2: Supports Hall elements and Hall ICs

☆: Under Development

## 48V (Predrivers)

Part No.	Operating Voltage Range (V)	Output Current (mA)** (source/sink)	Commutation Method	Sensor Type	Lead Angle Setting	FG Signal Output	Hall Bias (V)	Motor Lock Protection	Speed Control Input Signal	Internal Speed Feedback	Current Control Function	External FET	Package
<b>BM64300MUV</b>	28.0 to 63.0	100/-100	Sine Wave	Hall 3* <sup>3</sup>	✓	✓	5	✓	DirectPWM	-	✓	N+N	VQFN040V6060
☆ <b>BM64350MUV</b>	28.0 to 63.0	100/-100	Sine Wave	Hall 3* <sup>3</sup>	✓	✓	5	✓	DirectPWM	✓	✓	N+N	VQFN040V6060
<b>BM64070MUV</b>	28.0 to 77.0	100/-100 <sup>2</sup>	Sine Wave	Sensorless	✓	✓	5	✓	DirectPWM	✓	✓	N+N	VQFN040V6060

\*1: Reference value, Pulse width tws 1μs, Dutys10% of pulse \*2: Can be set in 4 stages \*3: Supports Hall elements and Hall ICs

☆: Under Development

# MOSFET Lineup (When Using a Predriver)

Polarity (ch)	Part No.	V <sub>BSS</sub> (V)		I <sub>D</sub> (A)		R <sub>DS(on)</sub> Typ (mΩ)		Package	Size (mm)	P <sub>D</sub> (W)		
		Nch	Pch	Nch	Pch	V <sub>GS</sub> =10	V <sub>GS</sub> =4.5					
N+N	<b>QH8K51</b>	100	-	2	-	240	250	(TSM8)	2.8×3.0×0.85	1.5		
	<b>SH8K52</b>	100	-	3	-	120	135					
	<b>SH8K41</b>	80	-	3.4	-	90	110					
	<b>SH8K39</b>	60	-	13* <sup>1</sup>	-	15	20	(SOP8)	5.0×6.0×1.75	5.8* <sup>1</sup>		
	<b>SH8K39</b>	60	-	13* <sup>1</sup>	-	15	20					
	<b>SH8K39</b>	60	-	13* <sup>1</sup>	-	15	20					
	<b>New SH8KC6</b>	60	-	6.5	-	25	33			2		
	☆ <b>SH8KC7</b>	60	-	10	-	10.7	13.5			2		
	<b>New QH8KC6</b>	60	-	5.5	-	23	31	(TSM8)	2.8×3.0×0.85	1.5		
	<b>New QH8KC5</b>	60	-	3	-	70	100					
	<b>New UT6KC5</b>	60	-	3.5	-	73	104	DFN2020-8D (HUML2020L8 Dual)	2.0×2.0×0.6	2		
	☆ <b>SH8KB7</b>	40	-	12.5	-	7.7	8.7					
	<b>New SH8KB6</b>	40	-	8.5	-	14.9	18.2	(SOP8)	5.0×6.0×1.75	2		
	<b>SH8K26</b>	40	-	6* <sup>1</sup>	-	27	35					
	<b>New QH8KB6</b>	40	-	8	-	13.7	16.4	(TSM8)	2.8×3.0×0.85	1.5		
	<b>New QH8KB5</b>	40	-	4.5	-	34	44					
	<b>New UT6KB5</b>	40	-	5	-	37	48	DFN2020-8D (HUML2020L8 Dual)	2.0×2.0×0.6	2		
	<b>SH8KA7</b>	30	-	15* <sup>1</sup>	-	7.1	8.3					
	<b>SH8KA4</b>	30	-	9* <sup>1</sup>	-	16.5	22.2			4.6* <sup>1</sup>		
	<b>SH8KA2</b>	30	-	8* <sup>1</sup>	-	23	34	(SOP8)	5.0×6.0×1.75	3* <sup>1</sup>		
	<b>SH8K12</b>	30	-	6* <sup>1</sup>	-	30	40					
<b>SH8KA1</b>	30	-	4.5* <sup>1</sup>	-	54	84						
<b>SH8K11</b>	30	-	3.5	-	70	90						
<b>QH8KA3</b>	30	-	9* <sup>1</sup>	-	12.3	18.2			2.8* <sup>1</sup>			
<b>QH8KA2</b>	30	-	4.5	-	25	40	(TSM8)	2.8×3.0×0.85	1.5			
<b>QH8KA1</b>	30	-	4.5* <sup>1</sup>	-	56	86						
N+P	<b>HP8M51</b>	V <sub>BSS</sub> (V)		I <sub>D</sub> (A)		R <sub>DS(on)</sub> Typ (mΩ) V <sub>GS</sub> =10V		R <sub>DS(on)</sub> Typ (mΩ) V <sub>GS</sub> =4.5V		Package	Size (mm)	P <sub>D</sub> (W)
		Nch	Pch	Nch	Pch	Nch	Pch	Nch	Pch			
	<b>SH8M51</b>	100	-100	4.5* <sup>1</sup>	-4.5* <sup>1</sup>	120	210	130	230	(HSOP8) Symmetry Dual	5.0×6.0×1.0	7* <sup>1</sup>
	<b>SH8M51</b>	100	-100	3	-2.5	120	210	130	230	(SOP8)		
	<b>QS8M51</b>	100	-100	2	-1.5	240	350	250	380	(TSM8)	2.8×3.0×0.85	1.5
	<b>SH8M41</b>	80	-80	3.4	-2.6	90	165	110	220	(SOP8)		
	<b>HP8M31</b>	60	-60	8.5* <sup>1</sup>	-8.5* <sup>1</sup>	46	50	52	55	(HSOP8) Symmetry Dual	5.0×6.0×1.0	7* <sup>1</sup>
	<b>New SH8MC5</b>	60	-60	6.5	-7.0	25	27	33	29	(SOP8)		
	<b>SH8M31</b>	60	-60	4.5	-4.5	46	50	52	55	(SOP8)	5.0×6.0×1.75	2
	<b>New QH8MC5</b>	60	-60	3.0	-3.5	70	71	100	79	(TSM8)		
	<b>QS8M31</b>	60	-60	3	-2	80	150	93	180	(TSM8)	2.8×3.0×0.85	1.5
	<b>New SH8MB5</b>	40	-40	8.5	-8.0	14.9	13.9	18.2	16.5	(SOP8)		
	<b>New QH8MB5</b>	40	-40	4.5	-5	34	33	44	41	(TSM8)	2.8×3.0×0.85	1.5
	<b>HP8MA2</b>	30	-30	18* <sup>1</sup>	-15* <sup>1</sup>	7.5	13.2	11.7	21	(HSOP8) Symmetry Dual		5.0×6.0×1.0
	<b>SH8MA4</b>	30	-30	9* <sup>1</sup>	-8.5* <sup>1</sup>	16.5	23	22.2	32			
	<b>SH8MA3</b>	30	-30	7* <sup>1</sup>	-6* <sup>1</sup>	23	40	42	60	(SOP8)	5.0×6.0×1.75	2.8* <sup>1</sup>
	<b>SH8MA2</b>	30	-30	4.5* <sup>1</sup>	-4.5* <sup>1</sup>	57	63	88	89			
	<b>SH8MA2</b>	30	-30	9* <sup>1</sup>	-8* <sup>1</sup>	12.3	22	18.2	31			
	<b>QH8MA3</b>	30	-30	7* <sup>1</sup>	-5.5* <sup>1</sup>	22	37	35	55	(TSM8)	2.8×3.0×0.85	2.5* <sup>1</sup>
	<b>QH8MA2</b>	30	-30	4.5	-3	25	55	40	80			
	<b>UT6MA2</b>	30	-30	4	-4	37	55	59	80	(HUML2020L8) Dual <DFN2020-8D>	2.0×2.0×0.6	2

\*1: PWs1s

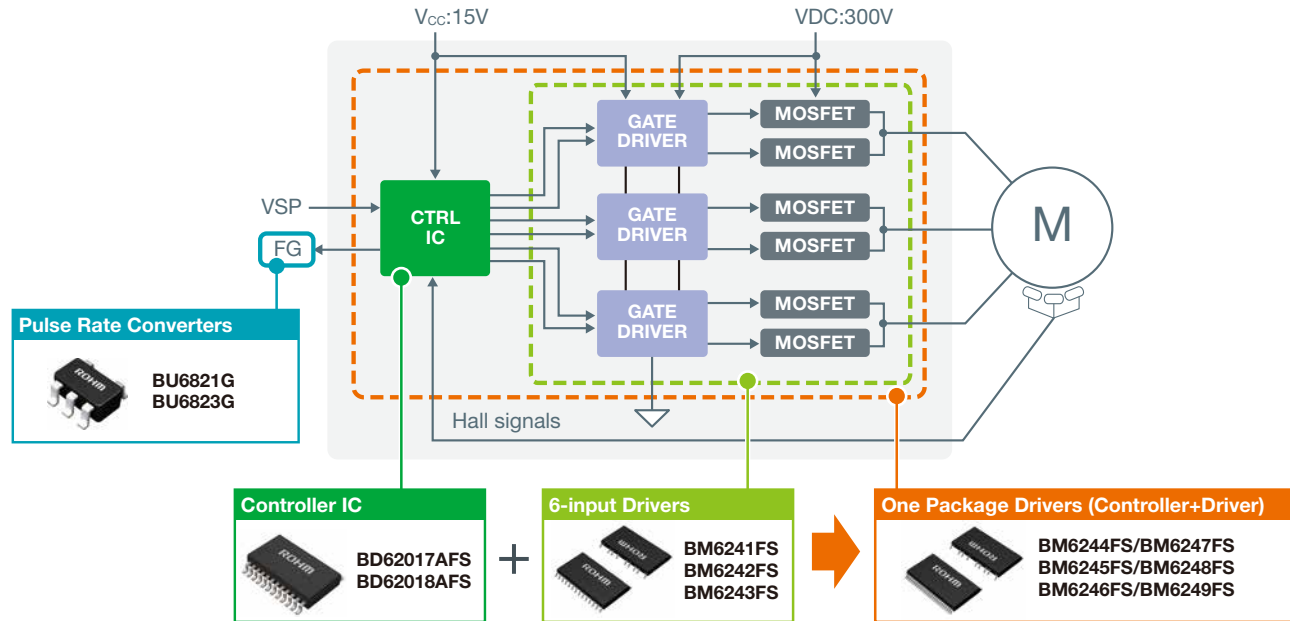
Note: Indicates the JEDEC package notation. ( ): ROHM Package, ( ): General Code.

☆: Under Development

# High Voltage 3-Phase Brushless DC Motor Drivers

ROHM high voltage 3-phase brushless DC motor drivers are compatible with motors equipped with Hall sensors (Hall elements/Hall ICs). The broad lineup supports different voltages (250V/600V withstand), commutation angles (120°/150°/180° (sine wave)), and currents (1.5A to 2.5A). Ideal for home appliances such as air conditioners/purifiers and fan motors.

## Brushless DC Motor: Block Diagram



## High Voltage 3-Phase Brushless DC Motor Driver Lineup

### High Voltage 3-Phase Brushless DC Motor Drivers 6-Input Type

Part No.	Control Method	Withstand Voltage (V)	Output Current (A)	Output ON Resistance (Ω) (Typ)	Diode Forward Voltage (V)	Package
<b>BM6241FS</b>	6-Input	250	2.0	0.9	0.9	SSOP-A54_23
<b>BM6242FS</b>	6-Input	600	1.5	2.7	1.1	SSOP-A54_23
<b>BM6243FS</b>	6-Input	600	2.5	1.7	1.1	SSOP-A54_23

Protection functions: UVLO (Under Voltage Lock Out), TSD (Thermal Shutdown), OCP (Over Current Protection), Fault Output

### High Voltage 3-Phase Brushless DC Motor Drivers Built-in Control Type

Part No.	Commutation Method	Withstand Voltage (V)	Output Current (A)	Output ON Resistance (Ω) (Typ)	Diode Forward Voltage (V)	Phase Control Range (deg.)	Package
<b>BM6244FS</b>	120°/150° Commutation	250	2.0	0.9	0.9	0 to +30	SSOP-A54_36A
<b>BM6245FS</b>	120°/150° Commutation	600	1.5	2.7	1.1	0 to +30	SSOP-A54_36A
<b>BM6246FS</b>	120°/150° Commutation	600	2.5	1.7	1.1	0 to +30	SSOP-A54_36A
<b>BM6247FS</b>	Sine Wave Commutation	250	2.0	0.9	0.9	0 to +40	SSOP-A54_36A
<b>BM6248FS</b>	Sine Wave Commutation	600	1.5	2.7	1.1	0 to +40	SSOP-A54_36A
<b>BM6249FS</b>	Sine Wave Commutation	600	2.5	1.7	1.1	0 to +40	SSOP-A54_36A

Protection functions: UVLO (Under Voltage Lock Out), TSD (Thermal Shutdown), CLL (Current Limiting Function), OCP (Over Current Protection), MLP (Motor Lockout Protection), Hall Input Abnormality Detection Function, Fault Output

### 3-Phase Brushless DC Motor Controllers

Part No.	Commutation Method	Supply Voltage (V)	Control Voltage Input Range (V)	No. of FG Output Pulses (Pulse/rev)	FG Signal Conversion Ratio	Phase Control Range (deg.)	Package
<b>BD62017AFS</b>	Sine Wave Commutation	10.0 to 18.0	2.1 to 5.4	4 or 12 <sup>2</sup>	15 : 12	0 to +40	SSOP-A24
<b>BD62018AFS</b>	Sine Wave Commutation	10.0 to 18.0	2.1 to 5.4	4 or 12 <sup>1</sup>	12 : 12	0 to +40	SSOP-A24

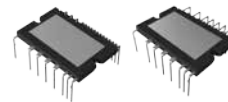
\*1: For 8-pole motors \*2: For 10-pole motors

### Pulse Rate Converters

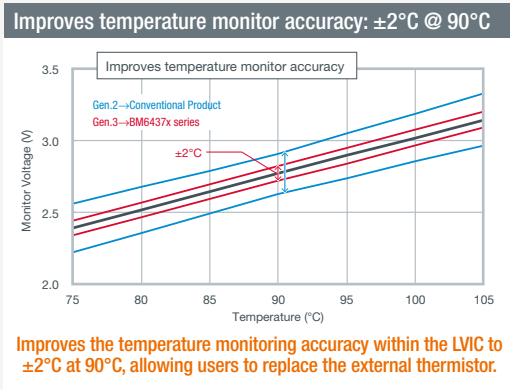
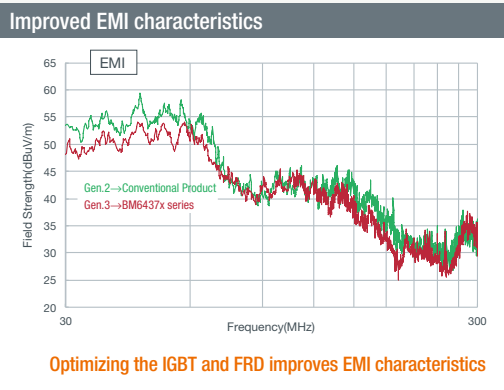
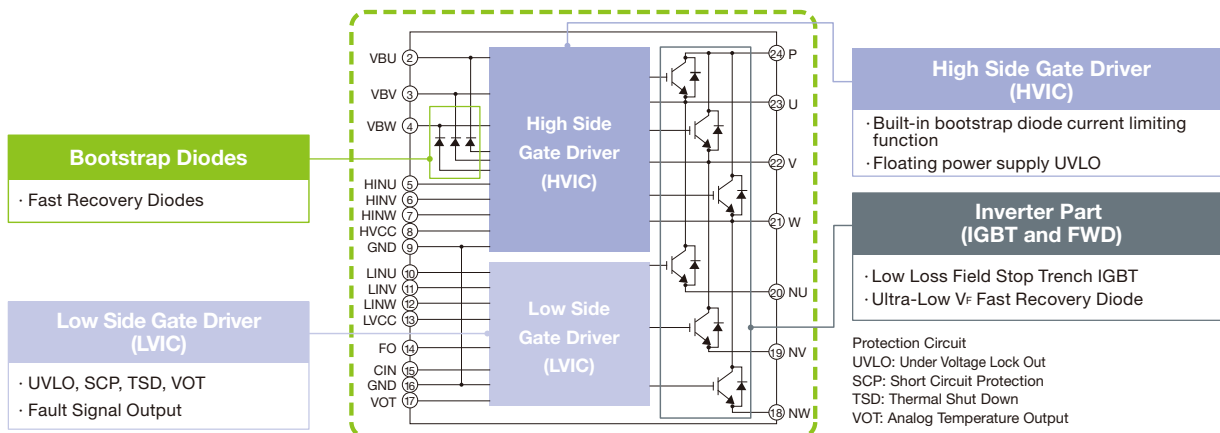
Part No.	Supply Voltage (V)	Circuit Current (mA)	Input Frequency Range (kHz)	Conversion Ratio (Input:Output)	Package
<b>BU6821G</b>	4.5 to 5.5	0.5	0.005 to 5	15 : 12	SSOP5
<b>BU6823G</b>	4.5 to 5.5	0.5	0.005 to 5	21 : 12	SSOP5

# IPM (Intelligent Power Modules)

ROHM IPMs integrate a high efficiency control circuit in original high voltage low loss power devices to maximize performance. The lineup includes both IGBT and MOSFET types for the output stage.



## Module Configuration (IGBT IPM)



## IPM (Intelligent Power Modules) Lineup

IGBT-IPM							
Part No.	$V_{CES}$ (V)	$I_C$ (A)	$V_{CESAT}$ (V)	PWM Input Frequency (kHz)	Isolation Voltage*1 (Vrms)	Temperature Protection Function*2	Package
<b>New</b> BM64374S-VA	600	15	1.80	up to 20	1,500	TSD/VOT	HSDIP25
<b>New</b> BM64375S-VA	600	20	1.70	up to 20	1,500	TSD/VOT	HSDIP25
<b>New</b> BM64377S-VA	600	30	1.70	up to 20	1,500	TSD/VOT	HSDIP25
<b>New</b> BM64378S-VA	600	35	1.50	up to 20	1,500	TSD/VOT	HSDIP25

\*1: AC60Hz, 1 min., supports 2500Vrms when using a convex heat sink \*2: TSD: Thermal shutdown, VOT: Analog temperature output

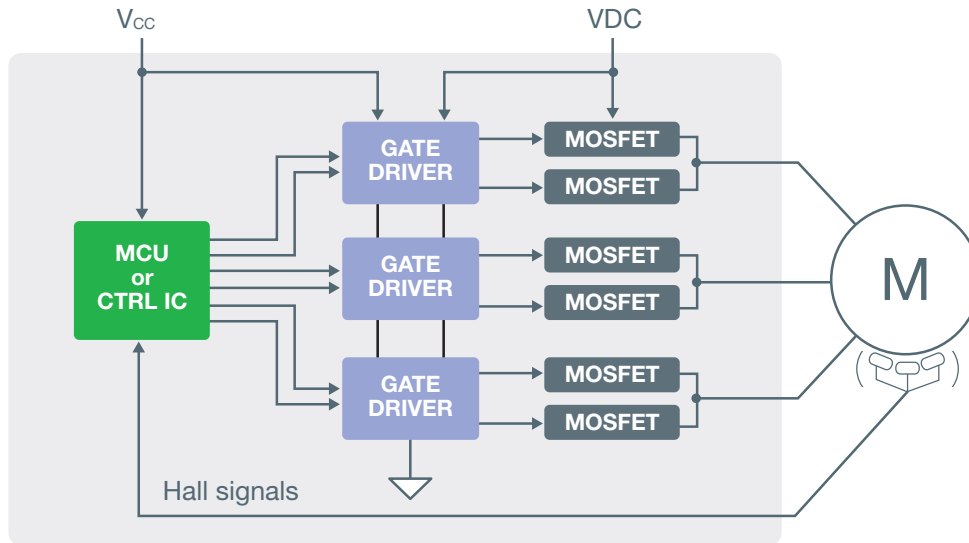
MOS-IPM							
Part No.	$V_{DSS}$ (V)	$I_D$ (A)	$R_{on}$ (m $\Omega$ )	Recommended Switching Frequency (kHz)	Isolation Voltage*1 (Vrms)	Temperature Protection Function*2	Package
BM65364S-VA	600	15	120	up to 20	1,500	TSD	HSDIP25
BM65364S-VC	600	15	120	up to 20	1,500	TSD	HSDIP25VC

\*1: AC60Hz, 1 min., supports 2500Vrms when using a convex heat sink \*2: TSD: Thermal shutdown, VOT: Analog temperature output

# Gate Driver + Power Device

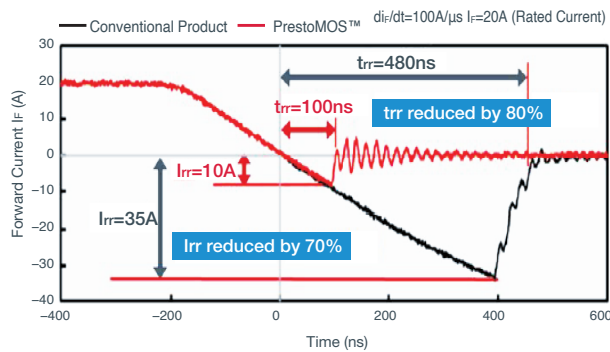
ROHM offers high side/low side gate drivers that utilize the bootstrap method. High performance MOSFETs and IGBTs are also available that contribute to greater system energy savings and efficiency.

## Brushless DC Motor: Block Diagram



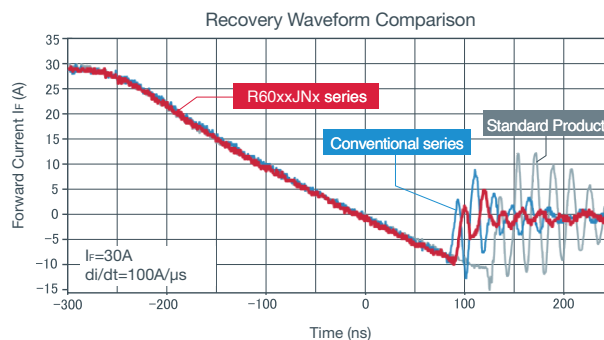
## Recovery Characteristics Suitable for Motor Drive R60xxJN series

### Reverse recovery time ( $t_{rr}$ ) reduced 80%



Significantly improves recovery time and recovery current vs conventional MOSFETs  
Reduces switching loss and improves regenerative characteristics

### Improves soft recovery characteristics



Improved recovery characteristics over our conventional series  
results in lower noise in motor systems

# Gate Drivers Lineup

## Gate Drivers for Power Devices

Part No.	ch	V <sub>CC</sub> (V)	High Side Floating Voltage (V)	Output Current (A) source/sink	Delay Time (ns) (Turn-on) / (Turn-off)	Boot Diode	Operating Temperature (°C)	Package
<b>New</b> BD2320EFJ-LA	2	7.5 to 14.5	100	3.5/-4.5	27/29	✓	-40 to +125	HTSOP-J8
<b>New</b> BD2310G	1*1	4.5 to 18*2	—	4.0/-4.0	15/15	—	-40 to +125	SSOP5

\* 1: Low side \*2: Gate Driver Voltage Range

# MOSFET Lineup

Refer to P.23 for product details

## 600V Withstand Voltage Fast Recovery PrestoMOS™ Super Junction MOSFETs: R60xxJN series

Part No.	V <sub>DSS</sub> (V)	I <sub>D</sub> (A)	R <sub>DS(on)</sub> (Ω) V <sub>GS</sub> =15V	Q <sub>g</sub> (nC) V <sub>GS</sub> =15V	t <sub>r</sub> (ns)	Package
<b>R60xxJND3 series</b>	600	4 to 14	0.3 to 1.10	10.5 to 32	45 to 75	TO-252 (DPAK)
<b>R60xxJNJ series</b>	600	4 to 20	0.18 to 1.10	10.5 to 45	45 to 85	TO-263S (LPTS) [SC-83] (D2PAK)
<b>R60xxJNZ series</b>	600	20 to 50	0.064 to 0.18	45 to 120	85 to 120	TO-3PF
<b>R60xxJNX series</b>	600	4 to 30	0.11 to 1.10	10.5 to 74	45 to 100	(TO-220FM) (TO-220FP)
<b>R60xxJNZ4 series</b>	600	20 to 70	0.045 to 0.18	45 to 165	85 to 135	TO-247AD (TO-247)

Note: Indicates the JEDEC package notation. ( ) denotes ROHM package type, [ ] JEITA code, ( ) General code.

## 40V/60V/100V MOSFET series

Part No.	V <sub>DSS</sub> (V)	I <sub>D</sub> (A)	R <sub>DS(on)</sub> (mΩ) Typ	Package
<b>RF4xxxxBG series</b>	40, 60	7.0 to 10	10.9 to 21	(HUML2020L8) Single (DFN2020-8S)
<b>RQ7xxxxBG series</b>	40, 60	5.5 to 8	12.7 to 23	(TSMT8)
<b>RQ3xxxxGN series</b>	40, 60	27 to 39	5.1 to 10.3	(HSMT8)
<b>RS1xxxxGN series</b>	40, 60, 100	27 to 39	1.9 to 9.3	(HSOP8 Single)
<b>RD3xxxxBG series</b>	40, 60, 100	35 to 70	2.1 to 8.5	TO-252 (DPAK)
<b>RJ1xxxxGN series</b>	40, 60, 100	80 to 120	2.1 to 5.3	TO-263AB (LPTL)
<b>RSJxxxN10 series</b>	100	30 to 65	6.5 to 33	TO-263S (LPTS) [SC-83] (D2PAK)
☆ <b>RX3xxxxBG series</b>	40, 60	70 to 180	1.0 to 3.2	TO-220AB

Note: Indicates the JEDEC package notation. ( ) denotes ROHM package type, [ ] JEITA code, ( ) General code.

☆: Under Development

# IGBT Lineup

Refer to P.24 for product details

## 650V/1200V IGBTs: RGT/RGS series

Part No.	V <sub>CES</sub> (V)	I <sub>C</sub> (A)	V <sub>CE(sat)</sub> (V)	t <sub>r</sub> (ns)	C <sub>ies</sub> (pF)	C <sub>res</sub> (pF)	FRD		Package
							V <sub>F</sub> (V)	t <sub>r</sub> (ns)	
							Typ	Typ	
<b>RGTxxBM65D series</b>	650	4 to 8	1.65	71 to 95	220 to 450	4.5 to 8	1.40 to 1.45	40 to 42	TO-252
<b>RGTxxNS65D series</b>	650	4 to 25	1.65	60 to 104	220 to 1400	4.5 to 22	1.40 to 1.50	40 to 58	TO-263S (LPDS) /TO-262
<b>RGTxxNL65D series</b>	650	4 to 25	1.65	60 to 104	220 to 1400	4.5 to 22	1.40 to 1.50	40 to 58	TO-263L (LPDL)
☆ <b>RGSxxNL65D series</b>	650	15 to 30	1.65	91 to 100	TBD	TBD	1.45, 1.50	93 to 115	TO-263L (LPDL)
<b>RGTxxTM65D series</b>	650	3 to 13	1.65	60 to 104	220 to 1400	4.5 to 22	1.40 to 1.50	40 to 58	TO-220NFM
<b>RGTxxTS65D series</b>	650	20 to 50	1.65	55 to 62	1070 to 2770	18 to 43	1.35 to 1.45	54 to 58	TO-247N
<b>RGSxxTS65D series</b>	650	30 to 75	1.65, 1.7	90 to 101	980 to 2324	13 to 23	1.45	98, 112	TO-247N
<b>RGSxxTS65E series</b>	650	50, 75	1.65, 1.7	90, 91	1570 to 2324	23	1.45	109, 113	TO-247N
<b>RGSxxTSX2D series</b>	1200	25 to 40	1.7	128 to 227	1272 to 2820	8 to 25	1.65	157 to 198	TO-247N

Note: Indicates the JEDEC package notation. ( ) denotes ROHM package type.

☆: Under Development

\*PrestoMOS™ is a trademark or registered trademark of ROHM Co., Ltd.

# Detailed Power Device Lineup

## MOSFET Lineup

### Fast Recovery Super Junction MOSFET PrestoMOS™ R60xxJNx series

Part No.	V <sub>DSS</sub> (V)	I <sub>D</sub> (A)	R <sub>DS(on)</sub> (Ω) V <sub>GS</sub> =15V	Q <sub>g</sub> (nC) V <sub>GS</sub> =15V	t <sub>rr</sub> (ns)	Package
R6004JND3	600	4	1.10	10.5	45	TO-252 (DPAK)
R6006JND3		6	0.72	15.5	58	
R6007JND3		7	0.60	17.5	60	
R6009JND3		9	0.45	22	65	
R6004JNJ	600	4	1.10	10.5	45	TO-263S (LPTS) [SC-83] (D2PAK)
R6006JNJ		6	0.72	15.5	58	
R6007JNJ		7	0.60	17.5	60	
R6009JNJ		9	0.45	22	65	
R6012JNJ		12	0.30	28	70	
R6018JNJ		18	0.22	42	80	
R6020JNJ		20	0.18	45	85	
<b>New</b> R6020JNZ	600	20	0.18	45	85	(TO-3PF)
<b>New</b> R6025JNZ		25	0.14	57	90	
<b>New</b> R6030JNZ		30	0.11	74	100	
<b>New</b> R6050JNZ		50	0.064	120	120	
R6004JNX	600	4	1.10	10.5	45	(TO-220FM) (TO-220FP)
R6006JNX		6	0.72	15.5	58	
R6007JNX		7	0.60	17.5	60	
R6009JNX		9	0.45	22	65	
R6012JNX		12	0.30	28	70	
R6018JNX		18	0.22	42	80	
R6020JNX		20	0.18	45	85	
R6025JNX		25	0.14	57	90	
<b>New</b> R6030JNX		30	0.11	74	100	
<b>New</b> R6020JNZ4	600	20	0.18	45	85	TO-247AD (TO-247)
<b>New</b> R6025JNZ4		25	0.14	57	90	
<b>New</b> R6030JNZ4		30	0.11	74	100	
<b>New</b> R6042JNZ4		42	0.08	100	110	
<b>New</b> R6050JNZ4		50	0.064	120	120	
<b>New</b> R6070JNZ4		70	0.045	165	135	

Note: Indicates the JEDEC package notation. ( ) denotes ROHM package type, [ ] JEITA code, ( ) General code.

### 40V/60V/100V MOSFET series

Part No.	V <sub>DSS</sub> (V)	I <sub>D</sub> (A)	R <sub>DS(on)</sub> Typ (mΩ) V <sub>GS</sub> =10V	Q <sub>g</sub> (nC) V <sub>GS</sub> =4.5V	Package
<b>New</b> RF4G100BG	40	10	10.9	4.6	(HUML2020L8) Single (DFN2020-8S)
<b>New</b> RF4L070BG	60	7	21	4.6	
<b>New</b> RQ7G080BG	40	8	12.7	4.6	(TSMT8)
<b>New</b> RQ7L055BG	60	5.5	23	4.6	
RQ3G150GN	40	39	5.1	11.6	(HSMT8)
RQ3G100GN	40	27	11	4.3	
RQ3L090GN	60	30	10.3	13	
RS1G300GN	40	80	1.9	28.6	
RS1G180GN	40	57	5	19.5*	(HSOP8 Single)
RS1G120MN	40	34	11.6	9.4*	
RS1L180GN	60	68	4.2	34	
RS1L120GN	60	36	9.3	14	
RS1P600BE	100	60	7.5	33*	
☆RD3G07BBG	40	70	2.2	60	
☆RD3G03BBG	40	35	4.7	19.8	
☆RD3L07BBG	60	70	3.5	44	
☆RD3L03BBG	60	35	8.9	14.5	
RD3P08BBD	100	80*	8.6	37*	
RD3P200SN	100	20	33	55*	
RJ1G12BGN	40	120	1.38	165*	TO-263AB (LPTL)
RJ1G08CGN	40	80	4.2	15.7	
RJ1L12BGN	60	120	2.1	175*	
RJ1L06CGN	60	80	5.3	27	
RJ1P12BBD	100	120	3.8	91.5*	
RSJ650N10	100	65	6.5	260*	
RSJ301N10	100	30	33	60*	
☆RX3G18BBG	40	180	1.0	230	TO-220AB
☆RX3G07BBG	40	70	2.2	60	
☆RX3L18BBG	60	180	1.4	170	
☆RX3L07BBG	60	70	3.5	44	

\*V<sub>DSS</sub>=10V

Note: Indicates the JEDEC package notation. ( ) denotes ROHM package type, [ ] JEITA code, ( ) General code.

☆: Under Development



# IGBT Lineup

## IGBT RGT series / RGS series

Part No.	V <sub>CE(S)</sub> (V)	I <sub>C</sub> (A)		V <sub>CE(sat)</sub> (V)		t <sub>r</sub> (ns)		C <sub>ies</sub> (pF)		C <sub>res</sub> (pF)		FRD				Package
		25 °C	100 °C	Typ	I <sub>C</sub> (A)	Typ	I <sub>C</sub> (A)	Typ	V <sub>CE</sub> (V)	Typ	I <sub>F</sub> (A)	V <sub>F</sub> (V)		t <sub>rr</sub> (ns)		
												Typ	I <sub>F</sub> (A)	Typ	I <sub>F</sub> (A)	
<b>RGT8BM65D</b>	650	8	4	1.65	4	71	4	220	30	4.5	30	1.45	4	40	4	TO-252
<b>RGT16BM65D</b>	650	16	8	1.65	8	95	8	450		8		1.40	8	42	8	
<b>RGT8NS65D</b>	650	8	4	1.65	4	71	4	220	30	4.5	30	1.45	4	40	4	TO-263S (LPDS)/ TO-262
<b>RGT16NS65D</b>	650	16	8	1.65	8	95	8	450		8		1.40	8	42	8	
<b>RGT20NS65D</b>	650	20	10	1.65	10	104	10	610		9		1.40	8	42	8	
<b>RGT30NS65D</b>	650	30	15	1.65	15	75	15	780		13		1.50	15	55	15	
<b>RGT40NS65D</b>	650	40	20	1.65	20	60	20	1070		18		1.45	20	58	20	
<b>RGT50NS65D</b>	650	48	25	1.65	25	65	25	1400		22		1.45	20	58	20	
<b>RGT8NL65D</b>	650	8	4	1.65	4	71	4	220		4.5		1.45	4	40	4	
<b>RGT16NL65D</b>	650	16	8	1.65	8	95	8	450	8	1.40	8	42	8			
<b>RGT20NL65D</b>	650	20	10	1.65	10	104	10	610	9	1.40	8	42	8			
<b>RGT30NL65D</b>	650	30	15	1.65	15	75	15	780	13	1.50	15	55	15			
<b>RGT40NL65D</b>	650	40	20	1.65	20	60	20	1070	18	1.45	20	58	20			
<b>RGT50NL65D</b>	650	48	25	1.65	25	65	25	1400	22	1.45	20	58	20			
☆ <b>RGS30NL65D</b>	650	30	15	1.65	15	98	15	TBD	TBD	1.45	15	115	15			
☆ <b>RGS40NL65D</b>	650	40	20	1.65	20	100	20	TBD	TBD	1.45	20	93	20			
☆ <b>RGS50NL65D</b>	650	50	25	1.65	25	97	25	TBD	TBD	1.50	25	95	25			
☆ <b>RGS60NL65D</b>	650	56	30	1.65	30	91	30	TBD	TBD	1.50	25	95	25			
<b>RGT8TM65D</b>	650	5	3	1.65	4	71	4	220	30	4.5	30	1.45	4	40	4	TO-220NFM
<b>RGT16TM65D</b>	650	9	5	1.65	8	95	8	450		8		1.40	8	42	8	
<b>RGT20TM65D</b>	650	10	6	1.65	10	104	10	610		9		1.40	8	42	8	
<b>RGT30TM65D</b>	650	14	8	1.65	15	75	15	780		13		1.50	15	55	15	
<b>RGT40TM65D</b>	650	17	10	1.65	20	60	20	1070		18		1.45	20	58	20	
<b>RGT50TM65D</b>	650	21	13	1.65	25	65	25	1400		22		1.45	20	58	20	
<b>RGT40TS65D</b>	650	40	20	1.65	20	60	20	1070		18		1.45	20	58	20	
<b>RGT50TS65D</b>	650	48	25	1.65	25	65	25	1400	22	1.45	20	58	20			
<b>RGT60TS65D</b>	650	55	30	1.65	30	60	30	1730	29	1.35	20	58	20			
<b>RGT80TS65D</b>	650	70	40	1.65	40	55	40	2210	36	1.35	20	58	20			
<b>RGT00TS65D</b>	650	85	50	1.65	50	62	50	2770	43	1.45	30	54	30			
<b>RGS60TS65D</b>	650	56	30	1.65	30	101	30	980	13	1.45	30	98	30			
<b>RGS80TS65D</b>	650	73	40	1.65	40	96	40	1240	16	1.45	30	98	30			
<b>RGS00TS65D</b>	650	88	50	1.65	50	91	50	1570	23	1.45	30	98	30			
<b>RGS00TS65E</b>	650	88	50	1.65	50	91	50	1570	23	1.45	50	113	50			
<b>New</b> <b>RGSX5TS65D</b>	650	114	75	1.70	75	90	75	2324	23	1.45	50	113	50			
<b>New</b> <b>RGSX5TS65E</b>	650	114	75	1.70	75	90	75	2324	23	1.45	75	109	75			
<b>RGS30TSX2D</b>	1200	30	15	1.70	15	128	15	1272	30	8	30	1.65	15	157	15	
<b>RGS50TSX2D</b>	1200	50	25	1.70	25	205	25	2095		12		1.65	25	182	25	
<b>RGS80TSX2D</b>	1200	80	40	1.70	40	227	40	2820		25		1.65	40	198	40	

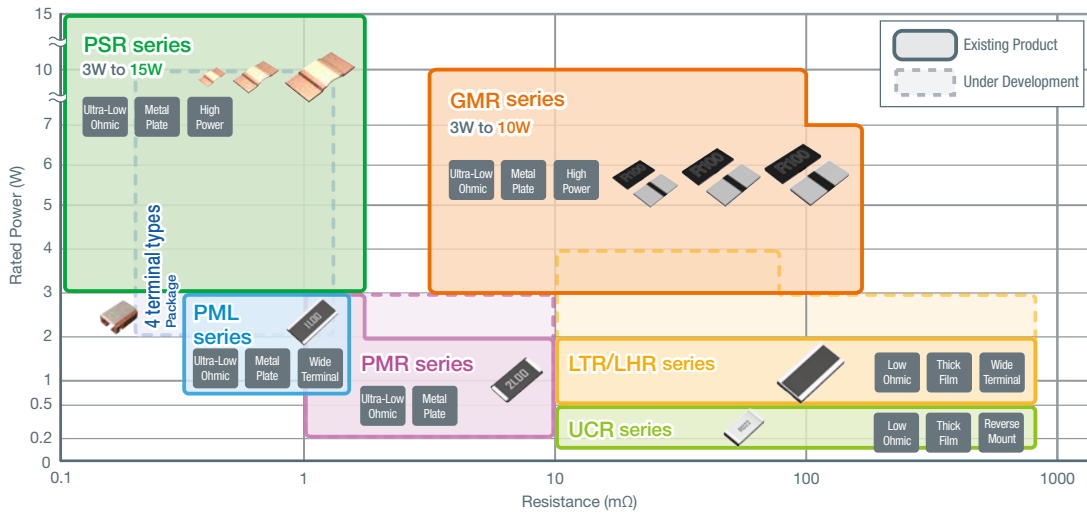
Note: Indicates the JEDEC package notation. ( ) denotes ROHM package type.

☆: Under Development

# Shunt Resistors

ROHM shunt resistors supports a variety of applications, from mobile devices such as smartphones to automotive and industrial systems requiring extreme reliability. Both the GMR series of metal plate shunt resistors that utilize a new structure to achieve high rated power, along with the wide terminal thick-film LTR series, are suitable for automotive and industrial motor applications that demand high reliability.

## Shunt Resistor Lineup



### Improves System Reliability GMR series

For shunt resistors used in the industrial equipment market, greater importance is being placed on safety, stability, and reliability. ROHM's GMR series contributes to improved system reliability by optimizing heat dissipation design to minimize temperature rise and improve current detection accuracy.

### Improved Joint Reliability LTR series

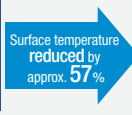
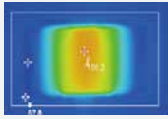
Configuring the terminals on the long sides shortens the distance between terminals, reducing mechanical stress on the solder joints. This improves junction reliability during temperature changes.

### Reduces Surface Temperature Rise

#### Surface Temperature Comparison at 2W (Ta=25°C)

Conventional Product (5025 Size)

GMR50 (5025 Size)



150°C at 2W

65°C at 2W

Surface temperature reduced by approx. 57%. Optimized electrode structure and resistive element design significantly reduce heat generation.

	MCR series (Standard Product)	LTR series Wide Terminal
Terminal Configuration		
Effects of PCB Expansion/Contraction	Junction mechanical stress <b>Large</b>	Junction mechanical stress <b>Small</b>

## Shunt Resistor Lineup

### High Power Metal Plate Shunt Resistors: GMR series

Part No.	Size Code mm (inch)	Rated Power (Rated Terminal Temp.)	Resistance Tolerance	Temperature Coefficient of Resistance*1 (ppm/°C)	Resistance Range	Operating Temp. (°C)	Automotive-Grade AEC-Q200
<b>New</b> GMR50	5025 (2010)	4W (90°C), 3W (110°C)	F (±1%)	0 to +25 ±25	5mΩ 10mΩ to 220mΩ (E24 series)*2	-65 to +170	YES
<b>New</b> GMR100	6432 (2512)	7W (70°C), 5W (110°C)	F (±1%)	0 to +25 ±20	5mΩ 10mΩ to 220mΩ (E24 series)*2		YES
<b>New</b> GMR320	7142 (2817)	10W (70°C), 7W (110°C)	F (±1%)	0 to +25 ±25	5mΩ 10mΩ to 100mΩ (E24 series)*2		YES

\*1: (+20°C to +60°C) \*2: The development schedule may vary depending on the resistance value. Please inquire.

### High Power Wide Terminal Thick Film Resistors: LTR Low Ohmic series

Part No.	Size Code mm (inch)	Rated Power TC=70°C	Resistance Tolerance	Temperature Coefficient of Resistance (ppm/°C)	Resistance	Operating Temp. (°C)	Automotive-Grade AEC-Q200
LTR10	1220 (0508)	0.5W	J (±5%) F (±1%)	±150	47mΩ to 9.1Ω (E24 series)	-55 to +155	YES
LTR18	1632 (0612)	1W	J (±5%) F (±1%)	0 to 300 0 to 200 0 to 150 ±100	10mΩ to 18mΩ (E24 series) 20mΩ to 47mΩ (E24 series) 51mΩ to 470mΩ (E24 series) 510mΩ to 1Ω (E24 series)		YES
LTR50	2550 (1020)	2W	J (±5%) F (±1%)	0 to 300 0 to 200 0 to 150 ±100	10mΩ to 18mΩ (E24 series) 20mΩ to 47mΩ (E24 series) 51mΩ to 91mΩ (E24 series) 100mΩ to 910mΩ (E24 series)		YES
LTR100	3264 (1225)	2W ☆ 3W	J (±5%) F (±1%) J (±5%) F (±1%)	±200 0 to 150 0 to 100 0 to 300 0 to 200 0 to 150	100mΩ to 910mΩ (E24 series) 100mΩ to 200mΩ (E24 series) 220mΩ to 910mΩ (E24 series) 10mΩ to 18mΩ (E24 series) 20mΩ to 47mΩ (E24 series) 51mΩ to 91mΩ (E24 series)		YES

☆: Under Development

# Motor Driver Solutions Board

We propose a combination controller + power stage for driving high wattage motors that cannot be achieved using a driver with built-in drive stage. This board is designed to easily connect to and drive DC brushless motors.


## Medium Current Output

Easily drive 3-phase brushless DC motors by connecting the board to the motor, supplying power, and inputting a control signal. Three commutation types are offered: sine wave, 150°, and 120°, and for 120° commutation users can select 3 power packages depending on the motor output.

### Sample Block Diagram


### Sample Board Appearance

**RMS332ND-010**



65mm×80mm

**BM64300MUV-EVK-001**



60mm×68mm

Board Part No.	Input DC Voltage (V)	Max Output Current*1 (A)	Mountable MOS Package	Commutation Method	Sensor Type	Controller IC
RMS332SD-011	6 to 18	6*2	SOP8	3-Phase 120°	Hall 3	BD63001AMUV
RMS332SD-012	15 to 28	10*2	TO-252/TO-263/HSOP8	3-Phase 120°	Hall 3	BD63001AMUV
RMS332ND-010	15 to 28	30*2	TO-220	3-Phase 120°	Hall 3	BD63001AMUV
RMS338ND-003	15 to 28	30*2	TO-252/HSOP8	3-Phase Sine Wave/3-Phase 150°	Hall 3	BD6201xAFS
RMS335ND-007	15 to 28	30*2	TO-220	3-Phase Sine Wave/3-Phase 150°	Hall 3	BD6201xAFS
RMS318ND-002	15 to 28	30*2	TO-252/HSOP8	3-Phase Sine Wave	Hall 1	BD63251MUV
BM64300MUV-EVK-001	28 to 63	8*2	TO-252/HSOP8	3-Phase Sine Wave	Hall 3	BM64300MUV

\*1: Max output current (Reference current. Set by derating from the rated value.) \*2: Since the power stage uses discrete MOSFETs, this is the MOSFET current capacity.

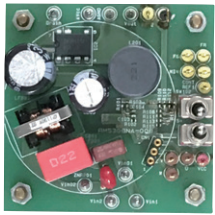
## AC Power Supply Motor Drive Solution

Mounting an AC/DC motor driver on a single board makes it possible to drive brushless DC motors by connecting to an AC power supply. Allows users to replace AC motors with DC motors.

### Sample Block Diagram (Example of RMS338NA-005)

### Sample Board Appearance

**RMS308NA-008**



55mm×55mm

Board Part No.	Input AC Voltage (V)	Motor DC Voltage (V)	Max Output Current*1 (A)	Mountable MOS Package	Motor Type	Commutation Method	Sensor Type	Controller IC
RMS308NA-008	90 to 264	10.4 to 13.2	1.0	—	12V Sensorless 3-Phase Brushless	3-Phase Sine Wave	Sensorless	BD63242EFV
RMS338NA-005	90 to 264	127 to 373*2	4.0*3	TO-252/TO-263	High Voltage 3-Phase Brushless	3-Phase Sine Wave/3-Phase 150°	Hall 3	BD6201xAFS
RMS118NA-009	90 to 264	127 to 373*2	4.0*3	TO-252/TO-263	High Voltage Single-Phase Brushless	Single-Phase Sine Wave	Hall 1	BD61250MUV

\*1: Max output current (Reference current. Set by derating from the rated value.)

\*2: Depends on the input AC voltage \*3: Since the power stage uses discrete MOSFETs, this is the MOSFET current capacity.

# Low Voltage DC Motor Drivers

## Brushed DC Motor Drivers, Stepper Motor Drivers

ROHM automotive brushed DC motor drivers featuring multiple channels that make it possible to drive several motors with a single driver. Pre-drivers are also available for driving motors at high currents. Stepper motor drivers reduce the number of external parts by eliminating the need for an external position sensor necessary for accurate position control.

### Body System

Stepper Motor Driver

LED Head Light adjustment

☆ **BD63800MUF-C**

### Body System

Brushed DC Motor Driver

HVAC Damper & Door Mirror

**New** **BD16939AEFV-C** (6ch Half+SPI)

**New** **BD16938AEFV-C** (8ch Half+SPI)

**BD16912EFV-C** (1ch Full)

### Powertrain System

Brushed DC Motor Driver

Valve

**BD16912EFV-C** (1ch Full)



### Powertrain System

Stepper Motor Driver

Valve

☆ **BD63800MUF-C**

### Infotainment System

Stepper Motor Driver

HUD Window Shield

☆ **BD63800MUF-C**

### Body System

Brushed DC Motor Pre-Driver

Power Window, Power Seat, Sunroof, Rear-gate

**BD16950EFV-C** (Pre-Driver)

### Infotainment System

Brushed DC Motor Driver

HUD Combiner, LD Projector, etc

**BD16912EFV-C** (1ch Full)

### Powertrain System

Brushed DC Motor Pre-Driver

4-Wheel Torque Distribution System

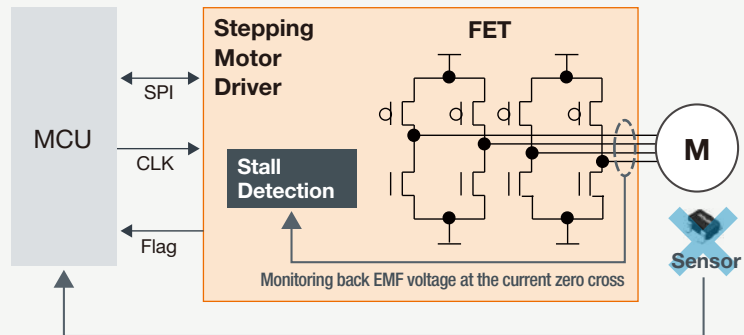
**BD16950EFV-C** (Pre-Driver)

☆: Under Development

## STALL Detection Function (Enables Monitoring of Motor Status Without an External Sensor) BD63800MUF-C



Since stepper motors are used in position control applications, high accuracy motor control is required. Conventionally, to detect STALL it was necessary to detect the motor position, angle, and speed using an external sensor such as an encoder, but the BD63800MUF-C can prevent motor malfunction by detecting STALL conditions from motor back EMF voltage and sending an error signal to the MCU.



## Brush DC Motor Driver (H-bridge Type) Usage Method BD16912EFV-C, BD16939AEFV-C, BD16938AEFV-C



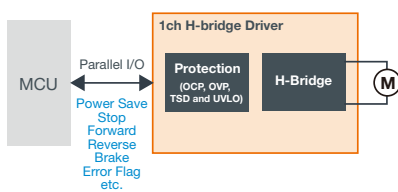
Multichannel brush motor drivers (H-bridge type) are products that drive motors by controlling multiple drivers using only one control signal (SPI communication). This makes it possible to reduce the number of signal lines along with the external parts.

Part No.	Output Channels	No. of Drivable Motors							Drive conditions marked with ○ (◎ indicates no drive conditions)	Application Examples
		1	2	3	4	5	6	7		
<b>BD16912EFV-C</b>	1ch	◎								HVAC Damper, Valve, HUD Combiner, LD Projector, etc.
<b>BD16939AEFV-C</b>	3ch (Half 6ch)			◎	○	○			○ Do not drive more than 4 motors simultaneously	
<b>BD16938AEFV-C</b>	4ch (Half 8ch)				◎	○	○	○	○ Do not drive more than 5 motors simultaneously	

### 1ch Usage Example

(BD16912EFV-C)

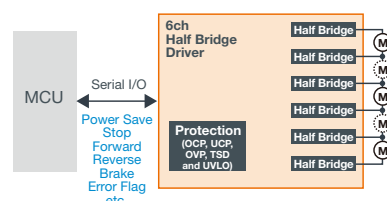
Below is an example of a 1ch application.



### 3ch (Half 6ch) Usage Example

(BD16939AEFV-C)

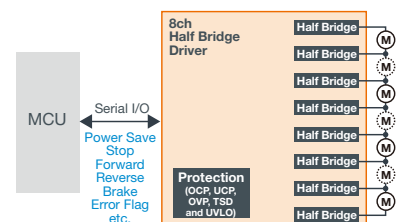
Below is an example of a 3ch (half 6ch) application. 4-5 motors can be driven, provided that 3 are not driven at the same time.



### 4ch (Half 8ch) Usage Example

(BD16938AEFV-C)

Below is an example of a 4ch (half 8ch) application. 4-7 motors can be driven with 1 driver, provided that more than 5 are not driven at the same time.

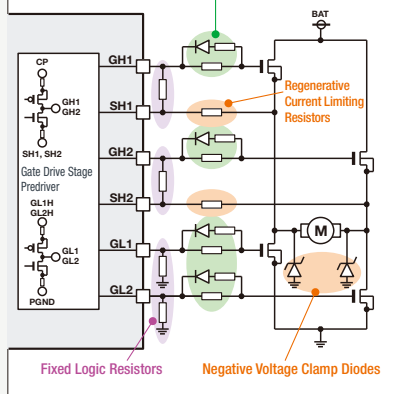


Control

Optimizing the efficiency and EMI characteristics via SPI communication (vs conventional methods using external components) contributes to improved design efficiency and ECU miniaturization by reducing the number of parts required.

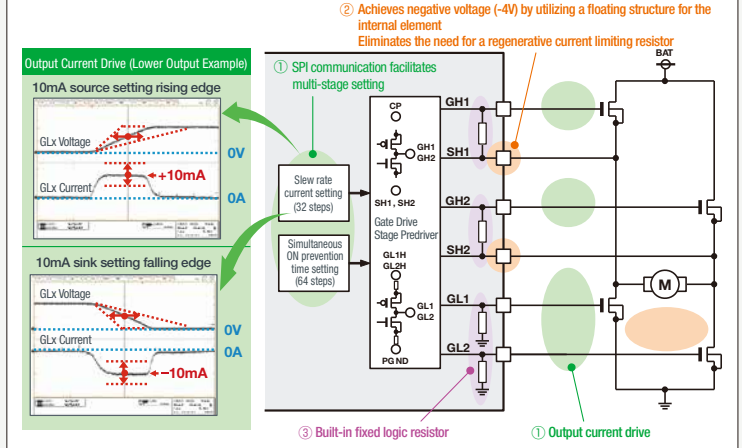
Setting via External Components (Conventional)

Slew Rate/Simultaneous ON Prevention Setting Resistors and Diodes (Needs to be adjusted and re-mounted every time the FET is changed)



\*1: 31-step output slew rate setting: 1mA to 31mA output current (in 1mA steps) \*2: 64-step simultaneous ON prevention time setting: 0.25µs to 92µs prevention time

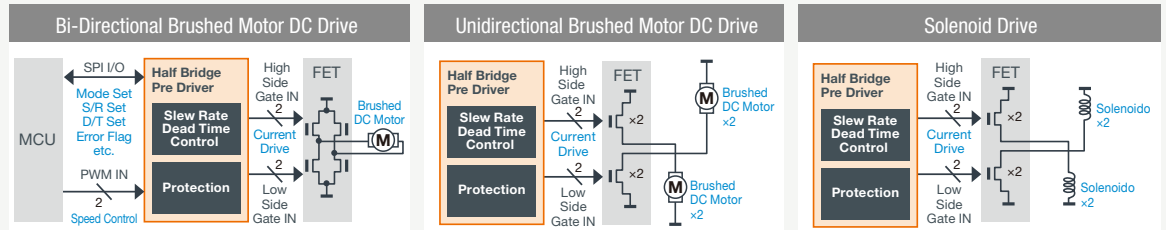
Setting via SPI



Independently Control Up to 4 Motors and/or Solenoids

Control

Independent control supports a variety of drive systems



Automotive Brushed Motor Driver Lineup

Drivers

Part No.	Output Channels (ch)	Withstand Voltage (V)	Supply Voltage (V)	Output Current (A)	Motor Mode Setting Signal <sup>*1</sup>	Protection Functions <sup>*2</sup>	Error Flag	Operating Temperature (°C)	Package	Automotive-Grade AEC-Q100
<b>New</b> BD16939AEFV-C	3 (Half 6ch)	40	6.3 to 32.0	1	SPI	OC <sub>P</sub> , UC <sub>P</sub> , OV <sub>P</sub> , TSD, UVLO, TW	OC <sub>P</sub> , UC <sub>P</sub> , OV <sub>P</sub> , TSD, UVLO, TW	-40 to +125	HTSSOP-B28	Grade 1
<b>New</b> BD16938AEFV-C	4 (Half 8ch)	40	6.3 to 32.0	1	SPI	OC <sub>P</sub> , UC <sub>P</sub> , OV <sub>P</sub> , TSD, UVLO, TW	OC <sub>P</sub> , UC <sub>P</sub> , OV <sub>P</sub> , TSD, UVLO, TW	-40 to +125	HTSSOP-B20	Grade 1
BD16912EFV-C	1	40	6.0 to 18.0	3	Parallel 2 Inputs	OC <sub>P</sub> , OV <sub>P</sub> , TSD, UVLO, TW	OC <sub>P</sub> , OV <sub>P</sub> , TW	-40 to +125	HTSSOP-B20	Grade 1

\*1: Forward, reverse, idle, brake \*2: OC<sub>P</sub>: Over Current Protection, UC<sub>P</sub>: Under Current Protection, OV<sub>P</sub>: Over Voltage Protection, TSD: Thermal Shutdown, UVLO: Under Voltage Lock Out, TW: Thermal Warning

Pre-driver (External MOSFET: N+N)

Part No.	Output Channels (ch)	Withstand Voltage (V)	Supply Voltage (V)	Output Current <sup>*1</sup> (mA)	Motor Mode Setting Signal <sup>*3</sup>	Speed Control Input Signal	Protection Functions <sup>*1</sup>	Error Flag	Operating Temperature (°C)	Package	Automotive-Grade AEC-Q100
BD16950EFV-C	1 (Half 2ch)	40	5.5 to 40.0	1 to 31 <sup>*2</sup>	SPI	Direct PWM	OC <sub>P</sub> , OV <sub>P</sub> , TSD, UVLO, TW, UVP	OC <sub>P</sub> , OV <sub>P</sub> , TSD, UVLO, TW, UVP	-40 to +125	HTSSOP-B24	Grade 1

\*1: Reference values \*2: Can be set in 31 steps \*3: Forward, reverse, idle, brake

\*4: OC<sub>P</sub>: Over Current Protection, OV<sub>P</sub>: Over Voltage Protection, TSD: Thermal Shutdown, UVLO: Under Voltage Lock Out, TW: Thermal Warning, UVP: Under Voltage Protection of Drain Terminal

Automotive Stepper Motor Driver Lineup

Driver

Part No.	Withstand Voltage (V)	Supply Voltage (V)	Output Current (A) [Peak Current (A)]	Control Input Signal	Drive	Decay	Output ON Resistance (Ω)	Package	Automotive-Grade AEC-Q100
☆BD63800MUF-C	40	6 to 28	1.2 [1.35 <sup>*1</sup> ]	CLK/SPI	1/32	✓ <sup>*2</sup>	0.75	VQFN32FBV050	Grade 1

\*1: Pulse width tw<1ms, Duty 20% of pulse \*2: Selectable Slow, Fast, Mix, Auto

☆: Under Development

Automotive MOSFET Lineup (Nch)

Part No.	ch	BV <sub>oss</sub> (V)	I <sub>D</sub> (A)	R <sub>DS(on)</sub> Typ (mΩ)		R <sub>DS(on)</sub> Max (mΩ)		Q <sub>g</sub> (nC) V <sub>GS</sub> =10V	C <sub>iss</sub> (pF)	Package
				V <sub>GS</sub> =10V	V <sub>GS</sub> =4.5V	V <sub>GS</sub> =10V	V <sub>GS</sub> =4.5V			
☆AG073DGS4	N	40	120	1.8	2.2	2.3	3	98	5500	HPLF5060
☆AG070DGS4	N	40	120	2.2	3	3	4	80	4000	HPLF5060
☆AG004DGD3	N	40	80	2.5	2.9	3.3	4	105	5800	TO-252
☆AG086DGD3	N	40	80	3.5	4.3	4.6	5.9	51	2900	
☆AG087DGD3	N	40	80	4.5	5.7	6	7.9	36	2000	

☆: Under Development

# Automotive Motor Drivers

## 3-Phase Brushless DC Motor Drivers, 3-Phase Gate Drivers

ROHM's 3-phase brushless DC motor drivers are available in Hall sensor, sensorless, and gate driver versions to support a variety of specifications.

### Body System

3-Phase Brushless DC Motor Driver

HVAC Blower & Battery Cooling Fan

**BD16805FV-M** (Pre-Driver)

**BD63030EKV-C** (Pre-Driver)

### Body System

3-Phase Brushless DC Motor Driver

Seat Fan

**BD63035EFV-M** (Driver)



### Powertrain System

3-Phase Gate Driver

Integrated Starter Generator etc.

☆ **BD16860AEKV-C** (Gate Driver)

### Powertrain System

3-Phase Brushless DC Motor Driver

Electric Fuel Pump, Oil Pump, Water Pump

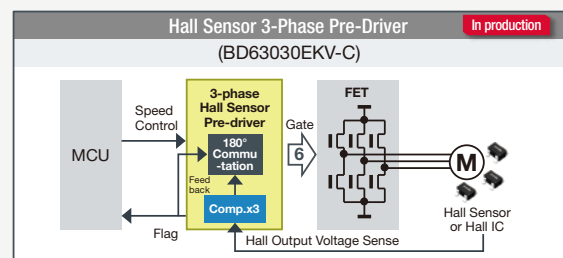
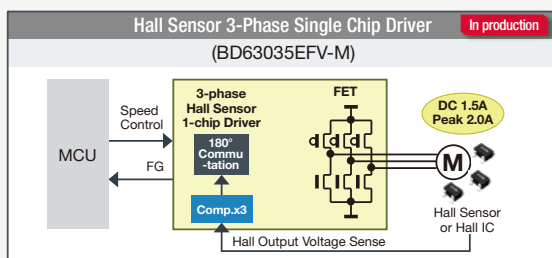
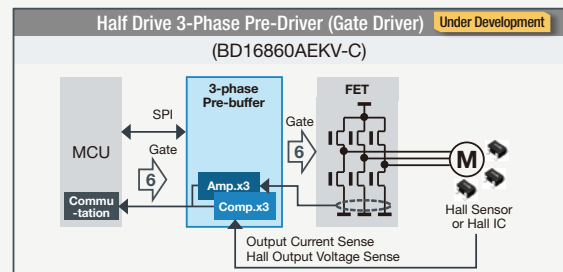
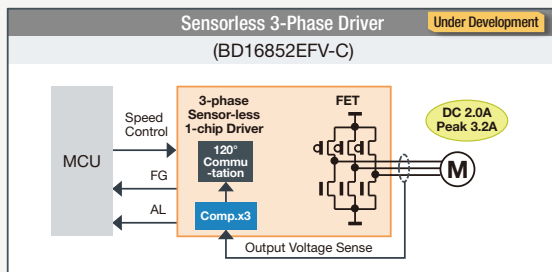
☆ **BD16852EFV-C** (Driver)

☆: Under Development

## 3-Phase Brushless DC Motor Drivers Compatible with 4 Drive Specifications

The following 4 types of 3-phase brushless DC motor drivers are available for different specifications (i.e. Hall sensor/driver/pre-driver).

### Control

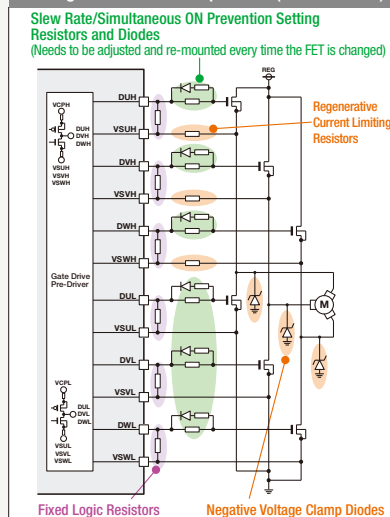


## Set the Pre-driver Output Current and Simultaneous ON Prevention Time in Multiple Stages via SPI Communication BD16860AEKV-C

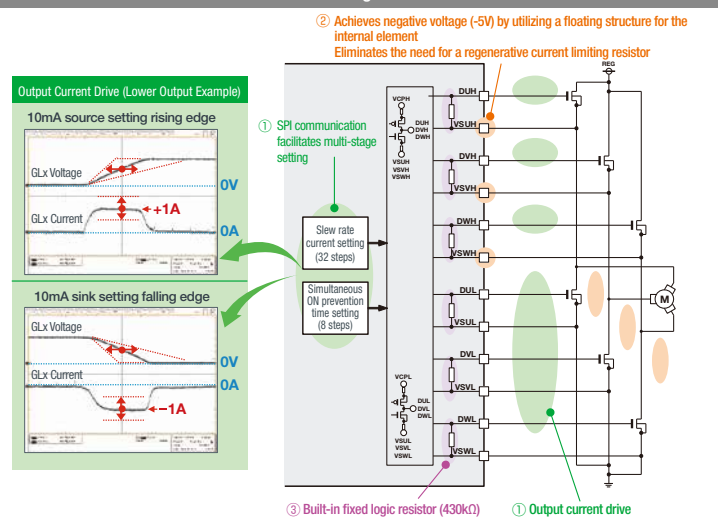
Previously, optimizing the efficiency and EMI characteristics were performed using external components, but by setting the gate driver current capability via SPI communication, the number of parts can be reduced, achieving improved design efficiency and ECU miniaturization.

### Control

### Setting via External Components (Conventional)



### Setting via SPI

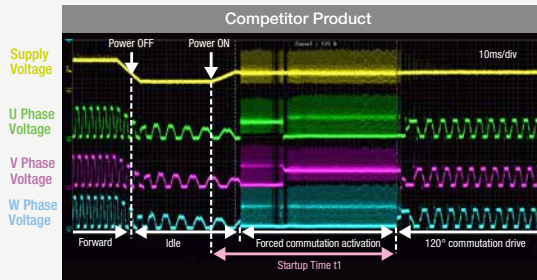




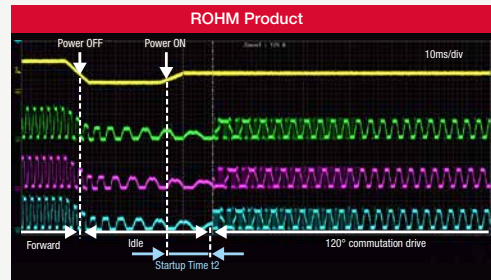
Startup Sequence

Startup time is one of the most important characteristics of sensorless motor drivers. The startup sequence of the BD16852EFV-C determines the initial state of the motor and transitions to the appropriate startup method. Based on results comparing startup from a normal idle state, the startup time during cranking tests can be reduced by approx. 20% over competitor products.

Startup Comparison from a Normal Idle State (ISO7637-2 Pulse 4 Cranking Test)

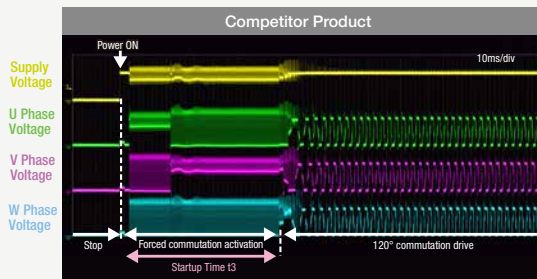


Even when restarting from a momentary power failure, the system starts up after an inherent forced commutation cycle (Startup Time t1)

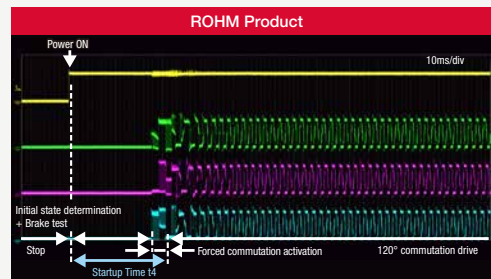


When normal idle is determined at restart (the induced voltage is detected normally), the system starts up immediately (Startup Time t2)

Startup comparison from a stopped state



Perform forced commutation (single-phase excitation x 2) for a certain period of time before transitioning to 120° commutation drive (Startup Time t3)



Immediately transitions to 120° commutation drive once induced voltage is detected during forced commutation (Startup Time t4)

3-Phase Brushless DC Motor Driver Lineup

Drivers

Part No.	Withstand Voltage (V)	Supply Voltage (V)	Output Current (A) [Peak Current (A)]	Commutation Method	Sensor Type	FG/AL*1	Hall Bias (V)	Motor Lock Protection	Speed Control Input Signal	Current Control Function	Operating Temperature (°C)	Package	Automotive-Grade AEC-Q100
BD63035EFV-M	36	8.0 to 28.0	1.5 [2.0*3]	Sine Wave	Hall 3*2	FG	5	✓	DC	✓	-40 to +105	HTSSOP-B20	Grade 2
☆BD16852EFV-C	40	5.5 to 18.0	2.0 [3.2*4]	120°	Sensorless	FG/AL	-	✓	DC	✓	-40 to +125	HTSSOP-B28	Grade 1

\*1: FG: Rotation speed output terminal, AL: Alarm signal output terminal \*2: Supports Hall elements and Hall ICs \*3: Pulse width tws≤1ms, Duty 20% of pulse ☆: Under Development  
\*4: Upper value of current limit setting

Pre-drivers (External MOSFET: N+N)

Part No.	Withstand Voltage (V)	Supply Voltage (V)	Commutation Method	Sensor Type	Lead Angle Setting	FG/AL*3	Hall Bias (V)	Motor Lock Protection	Speed Control Input Signal	Operating Temperature (°C)	Package	Automotive-Grade AEC-Q100
BD16805FV-M	60	8.0 to 18.0	Sine Wave	Hall 3*1	Fixed from 0-30°	FG/AL	5.5	✓	DC/Direct PWM	-40 to +115	SSOP-B40	Grade 2
BD63030EKV-C	50	6.5 to 18.0	Sine Wave	Hall 3*2	Linked to speed command from 0-30°	FG/AL*4	5.0	✓	DC/Direct PWM (with rotational speed feedback control)	-40 to +125	HTQFP64AV	Grade 1

\*1: Supports only Hall elements \*2: Supports Hall elements and Hall ICs \*3: FG: Rotation output terminal, AL: Alarm signal output terminal  
\*4: FG signal is normally output at the output terminal, AL signal is output during abnormalities

Gate Driver (External MOSFET: N+N)

Part No.	Withstand Voltage (V)	Supply Voltage (V)	Output Current *1 (mA)	Input	Simultaneous ON prevention time (μs)	Protection Functions*4	Error Flag	Operating Temperature (°C)	Package	Automotive-Grade AEC-Q100
☆BD16860AEKV-C	60	5.5 to 40	1.2 to 1,060*2	6-Input	up to 3.6*3	OCP, OVP, UVLO, TSD, WDT	OCP, OVP, UVLO, TSD	-40 to +125	HTQFP64AV	Grade 1

\*1: Reference values \*2: Can be set in 32 steps \*3: Can be set in 8 steps ☆: Under Development  
\*4: OCP:Over Current Protection, OVP: Over Voltage Protection, UVLO: Under Voltage Lock Out, TSD: Thermal Shut Down, WDT: Watch Dog timer

Automotive MOSFET Lineup (Nch)

Part No.	ch	BV <sub>oss</sub> (V)	I <sub>o</sub> (A)	R <sub>DS(on)</sub> Typ (mΩ)		R <sub>DS(on)</sub> Max (mΩ)		Q <sub>g</sub> (nC)	C <sub>iss</sub> (pF)	Package
				V <sub>GS</sub> =10V	V <sub>GS</sub> =4.5V	V <sub>GS</sub> =10V	V <sub>GS</sub> =4.5V	V <sub>GS</sub> =10V		
☆AG073DGS4	N	40	120	1.8	2.2	2.3	3	98	5500	HPLF5060
☆AG070DGS4	N	40	120	2.2	3	3	4	80	4000	HPLF5060
☆AG004DGD3	N	40	80	2.5	2.9	3.3	4	105	5800	TO-252
☆AG086DGD3	N	40	80	3.5	4.3	4.6	5.9	51	2900	
☆AG087DGD3	N	40	80	4.5	5.7	6	7.9	36	2000	

☆: Under Development

# Low Voltage DC Motor Drivers

DC motor drivers recommended for low voltage drive. Capable of driving motors in low voltage applications including camera lens drivers, system lens drivers, surveillance cameras, and POS.

## Portable POS

Low Voltage DC Motor Driver Lineup [▶ P.32](#)



### Paper Transport

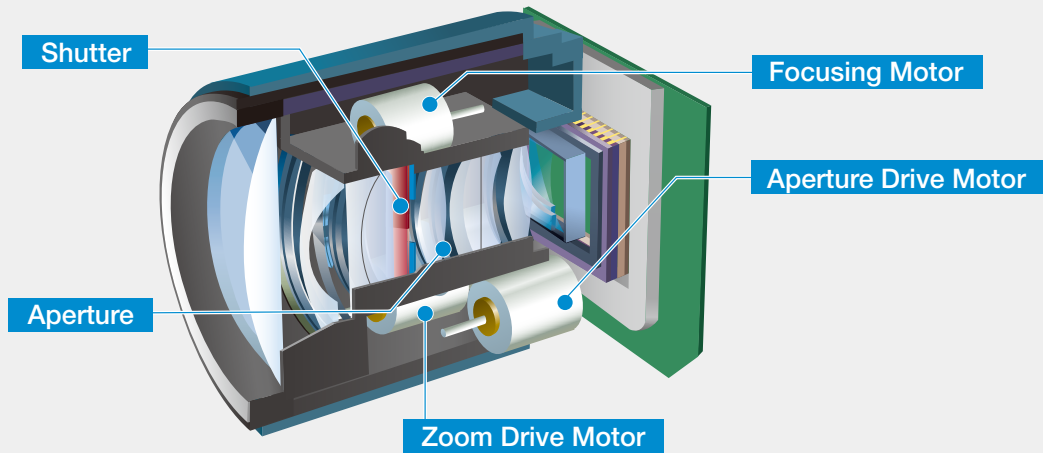
Brushed DC Motor Drivers [▶ P.09](#)

Stepper Motor Drivers [▶ P.11](#)

## Camera Lens

Low Voltage DC Motor Driver Lineup [▶ P.32](#)

Camera Lens Driver Lineup [▶ P.32](#)



### Shutter

### Focusing Motor

### Aperture Drive Motor

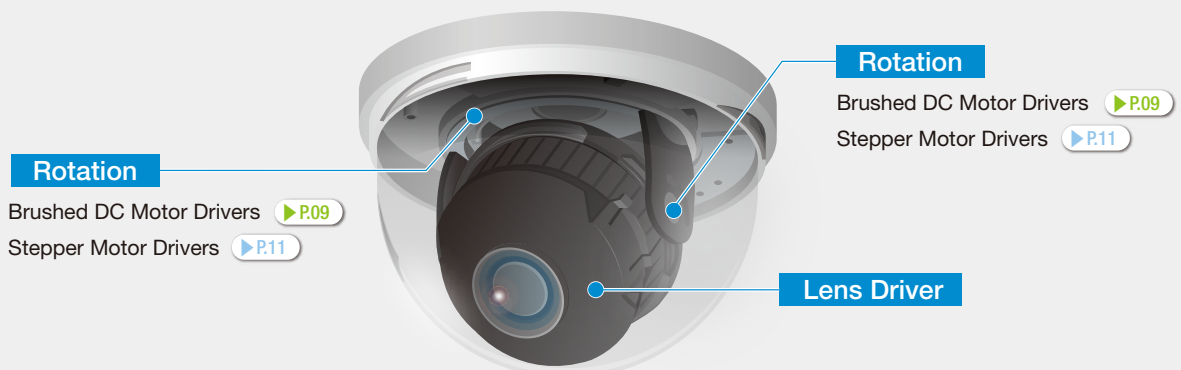
### Aperture

### Zoom Drive Motor

## Surveillance Cameras

Low Voltage DC Motor Driver Lineup [▶ P.32](#)

Camera Lens Driver Lineup [▶ P.32](#)



### Rotation

### Rotation

### Lens Driver

Brushed DC Motor Drivers [▶ P.09](#)

Stepper Motor Drivers [▶ P.11](#)

Brushed DC Motor Drivers [▶ P.09](#)

Stepper Motor Drivers [▶ P.11](#)



# Low Voltage DC Motor Driver Lineup

## 1ch/2ch Low Voltage Brushed Motor Drivers

Part No.	No. of Channels (ch)	Supply Voltage (V)	Max Driver Output Current (A)	ON Resistance (Ω)	Turn ON Time (ns)	Turn OFF Time (ns)	Control Input Frequency (kHz) Max	Package (mm)
BD65492MUV	2	1.8 to 16.0	1.0	0.9	200 (Includes 80ns through-current prevention OFF time)	80	500	VQFN024V4040 (4.0x4.0) H=1.0Max
BD63565EFV	2	1.8 to 16.0	1.0	0.9	200 (Includes 80ns through-current prevention OFF time)	80	500	HTSSOP-B20 (6.5x6.4) H=1.0Max
BD65491FV	1	1.8 to 16.0	1.2 Peak 4.0	0.35	150 (Includes 80ns through-current prevention OFF time)	50	500	SSOP-B16 (6.5x5.0) H=1.25Max
BD65496MUV	1	1.8 to 16.0	1.2 Peak 5.0	0.35	150 (Includes 80ns through-current prevention OFF time)	50	500	VQFN024V4040 (4.0x4.0) H=1.0Max
BD6735FV	2	2.0 to 8.0	1.0	1.0	300 (Includes 90ns through-current prevention OFF time)	100	100	SSOP-B20 (6.5x6.4) H=1.25Max
BD6376GUL	1	2.0 to 9.0	1.0	0.45	200 (Includes 80ns through-current prevention OFF time)	60	200	VCSP50L1 (1.6x1.6) H=0.55Max
BD63572MUV	2	2.0 to 9.0	1.0 Peak 2.5	0.4	45 (Includes 17ns through-current prevention OFF time)	45	1000	VQFN20PV3535 (3.5x3.5) H=1.0
BD65494MUV	1	2.0 to 9.0	1.0 Peak 2.5	0.55	200 (Includes 80ns through-current prevention OFF time)	60	200	VQFN016V3030 (3.0x3.0) H=1.0Max
BD6736FV	1	2.0 to 9.0	1.0 Peak 3.2	0.35	1000 (Includes 800ns through-current prevention OFF time)	100	100	SSOP-B20 (6.5x6.4) H=1.25Max
BD63576NUX	1	2.0 to 10.0	1.0 Peak 3.2	0.55	240 (Includes 140ns through-current prevention OFF time)	60	500	VSON008X2020 (2x2) H=0.6
BD63573NUV	1	2.0 to 16.0	1.2 Peak 3.2	0.35	250 (Includes 80ns through-current prevention OFF time)	80	500	VSON010V3030 (3.0x3.0) H=1.0Max
BD65499MUV	1	4.0 to 27.0	0.5 Peak 2.0	0.6	150 (Includes 80ns through-current prevention OFF time)	50	300	VQFN028V5050 (5.0x5.0) H=1.0Max

# Camera Lens Driver Lineup

## 5ch Camera System Lens Driver

Part No.	Supply Voltage (V)	Max Driver Output Current (A)	Actuator-Specific Drive Examples (Drive Motor, Drive System, Output ON Resistance (Ω))				Input I/F	Reference Voltage Output for Constant Current Setting (V)	Package (mm)
			AF	Zoom	Iris	Shutter			
BD6758KN	2.5 to 5.5	0.8	e.g. STM (1, 2ch) FULL ON 1.2	DCM (3ch) FULL ON 1.2	DCM or VCM (4ch) FULL ON 1.2	VCM (5ch) Constant Current 1.0	Parallel	1.2 (±3%)	VQFN36 (6.2x6.2)H=0.95Max

## 6ch Camera System Lens Drivers

Part No.	Supply Voltage (V)	Max Driver Output Current (A)	Actuator-Specific Drive Examples (Drive Motor, Drive System, Output ON Resistance (Ω))					Input I/F	Reference Voltage Output for Constant Current Setting (V)	Package (mm)
			AF	Zoom	Iris	Shutter	Barrier			
BD6373GW	2.5 to 5.5	0.8	e.g. STM (1, 2ch) FULL ON 1.2	STM (3, 4ch) FULL ON 1.2	DCM or VCM (5ch) FULL ON 1.2	VCM (6ch) FULL ON 1.2	—	Parallel	—	UCSP75M2 (2.6x2.6) H=0.85Max
BD6753KV	4.5 to 10.5 (1, 2ch) 2.0 to 10.5 (ch3 to 6)	0.8	e.g. STM (1, 2ch) FULL ON 1.2	STM (3, 4ch) FULL ON 1.2	DCM or VCM (5ch) PWM (±3%) 1.2	VCM (6ch) PWM (±3%) 1.2	—	Parallel + Serial	0.9 (±10%)	VQFP48C (9.0x9.0) H=1.60Max

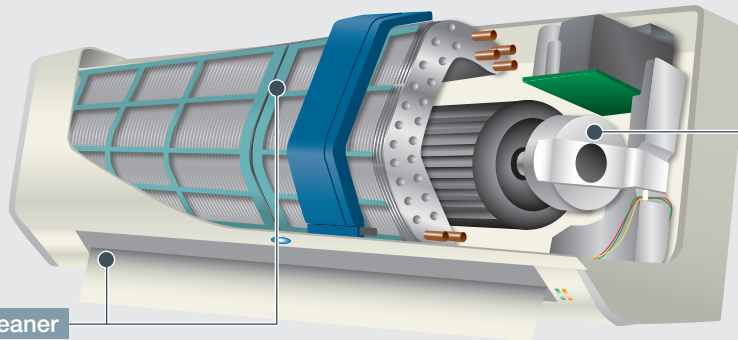
## System Lens Drivers for μ-Step Cameras

Part No.	Supply Voltage (V)	Max Driver Output Current (A)	Actuator-Specific Drive Examples (Drive Motor, Drive System, Output ON Resistance (Ω))					Package (mm)	
			AF	Zoom	Iris	Shutter	Other		
BU24020GU	2.7 to 3.6 (Logic) 2.7 to 5.5 (Driver)	0.5	e.g. 1	STM (1, 2ch) μ-step (class-D) 1.5	STM (3, 4ch) μ-step (class-D) 1.5	—	—	—	VCSP85H2 (2.6x2.6) H=1.0Max
			e.g. 2	STM (1, 2ch) μ-step (class-D) 1.5	DCM (3ch) FULL ON (PWM) 1.5	VCM (4ch) FULL ON (PWM) 1.5	—	—	
BU24033GW	1.62 to 3.6 (lo) 2.7 to 3.6 (Logic) 2.7 to 5.5 (Driver)	0.5/0.6	e.g. 1	STM (1, 2ch) μ-step (class-D) 1.5	STM (3, 4ch) μ-step (class-D) 1.5	VCM (5ch) FULL ON (PWM) 1.0	VCM (6ch) Constant Current 1.0	—	UCSP75M3 (3.0x3.0) H=0.85Max
			e.g. 2	STM (1, 2ch) μ-step (class-D) 1.5	FULL ON (PWM+Speed Control) 1.0	VCM (3ch) FULL ON (PWM) 1.5	VCM (6ch) Constant Current 1.0	DCM (4ch) FULL ON (PWM) 1.5	
BU24035GW	2.7 to 3.6 (Logic) 2.7 to 5.5 (Driver)	0.5/0.6	e.g. 1	STM (1, 2ch) μ-step (class-D) 1.5	DCM (5ch) FULL ON (PWM+Speed Control) 1.0	STM (3, 4ch) μ-step (class-D) 1.5	VCM (6ch) Constant Current 1.0	—	UCSP75M3 (3.1x3.1) H=0.85Max
			e.g. 2	STM (1, 2ch) μ-step (class-D) 1.5	FULL ON (PWM+Speed Control) 1.5	VCM (5ch) FULL ON (PWM)/Constant Current 1.0	VCM (6ch) Constant Current 1.0	VCM (4ch) FULL ON (PWM) 1.5	
BU24036MWW	2.7 to 3.6 (Logic) 2.7 to 5.5 (Driver)	0.5/0.6	e.g. 1	STM (1, 2ch) μ-step (class-D) 2.0	DCM (5ch) FULL ON (PWM+Speed Control) 1.0	STM (3, 4ch) μ-step (class-D) 1.5	VCM (6ch) Constant Current 1.0	—	UQFN040V5050 (5.0x5.0) H=1.00Max
			e.g. 2	STM (1, 2ch) μ-step (class-D) 2.0	DCM (3ch) FULL ON (PWM+Speed Control) 1.5	VCM (5ch) FULL ON (PWM)/Constant Current 1.0	VCM (6ch) Constant Current 1.0	VCM (4ch) FULL ON (PWM) 1.5	
BU24038GW	2.7 to 3.6 (Logic) 2.7 to 5.5 (Driver)	0.5	e.g. 1	STM (1, 2ch) μ-step (class-D) 1.5	STM (3, 4ch) μ-step (class-D) 1.5	STM (5, 6ch) μ-step (class-D) 1.5	VCM (8ch) FULL ON (PWM) 1.5	VCM (9ch) Constant Current 1.0	UCSP75M3 (3.8x3.8) H=0.85Max
			e.g. 2	STM (1, 2ch) μ-step (class-D) 1.5	STM (5, 6ch) μ-step (class-D) 1.5	VCM (3ch) FULL ON (PWM) 1.5	VCM (4ch) FULL ON (PWM) 1.5	VCM (9ch) Constant Current 1.0	

STM: Stepper Motor, DCM: DC Motor, VCM: Voice Coil Motor (These actuator-specific drive examples are typical examples, and usage in other applications can be considered.)  
Input I/F: 3-wire serial, μ-step resolution: 1024

# Selection by Application

## Air Conditioners



**Indoor Fan**

High Voltage 3-Phase  
Brushless DC Motor Drivers

▶ **P.19**

**Louver/Filter Cleaner**

Brushed DC Motor Drivers

▶ **P.09**

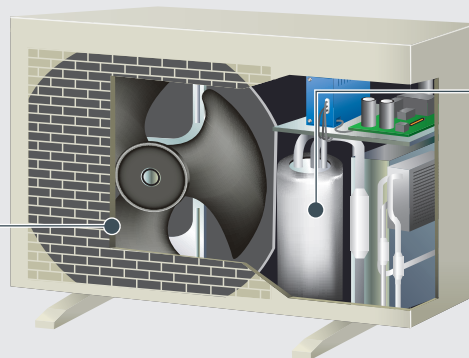
Stepper Motor Drivers

▶ **P.11**

**Outdoor Fan**

High Voltage 3-Phase  
Brushless DC Motor Drivers

▶ **P.19**



**Compressor**

IPMs  
(Intelligent Power Modules)

▶ **P.20**

Power Device

▶ **P.21**

## Refrigerators

**Automatic Ice Maker**

Brushed DC Motor Drivers

▶ **P.09**

Stepper Motor Drivers

▶ **P.11**

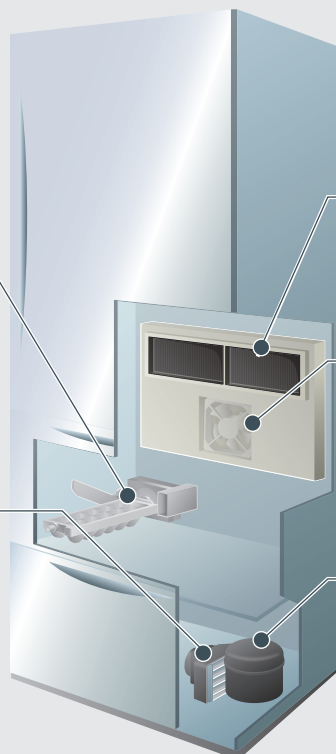
**Fan**

Single-Phase Brushless  
DC Motor Drivers

▶ **P.13**

3-Phase Brushless  
DC Motor Drivers

▶ **P.15** ▶ **P.17**



**Damper**

Brushed DC Motor Drivers

▶ **P.09**

Stepper Motor Drivers

▶ **P.11**

**Fan**

Single-Phase Brushless  
DC Motor Drivers

▶ **P.13**

3-Phase Brushless  
DC Motor Drivers

▶ **P.15**

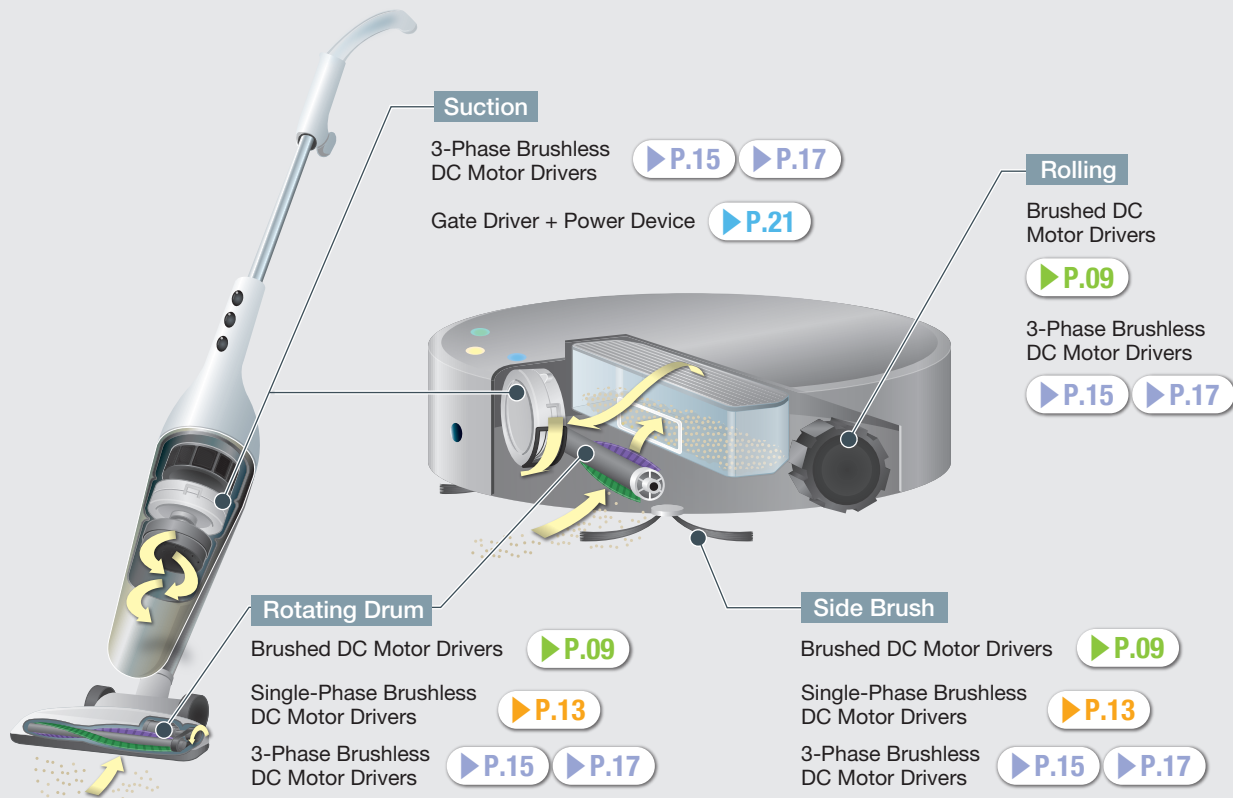
▶ **P.17**

**Compressor**

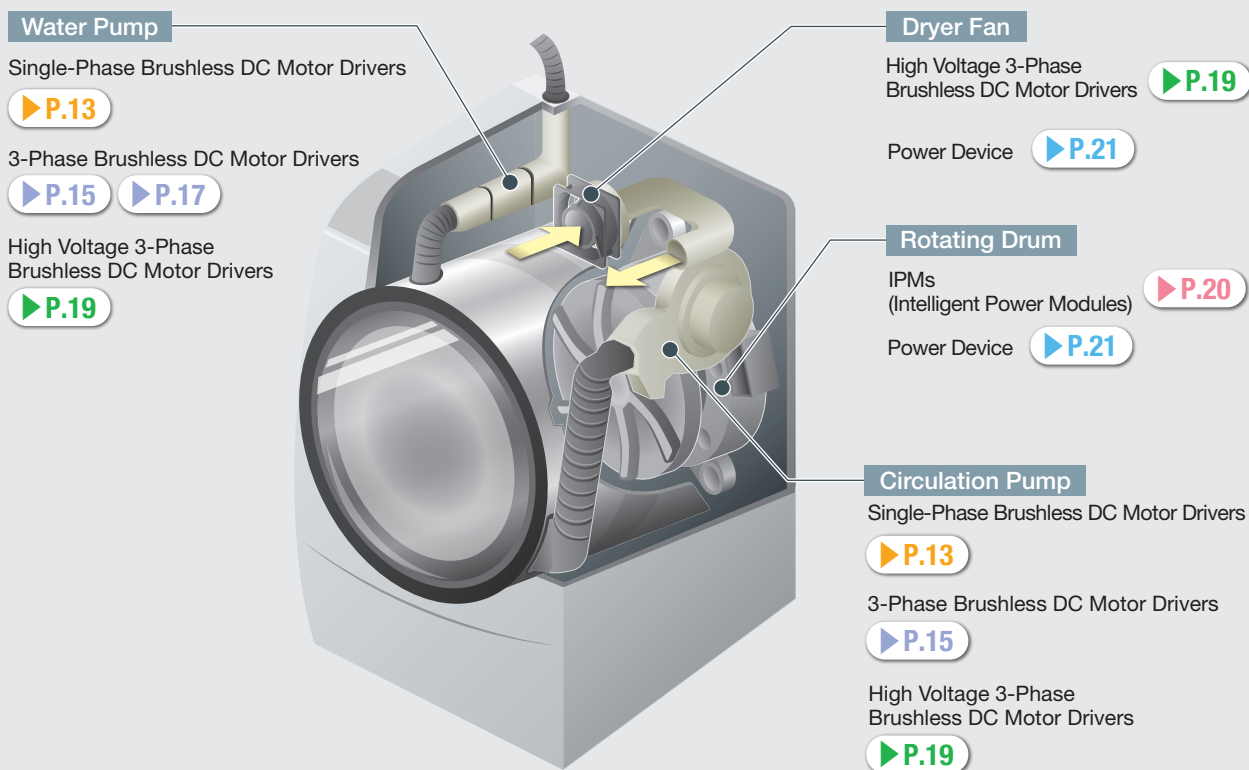
Power Device

▶ **P.21**

## Vacuum Cleaners

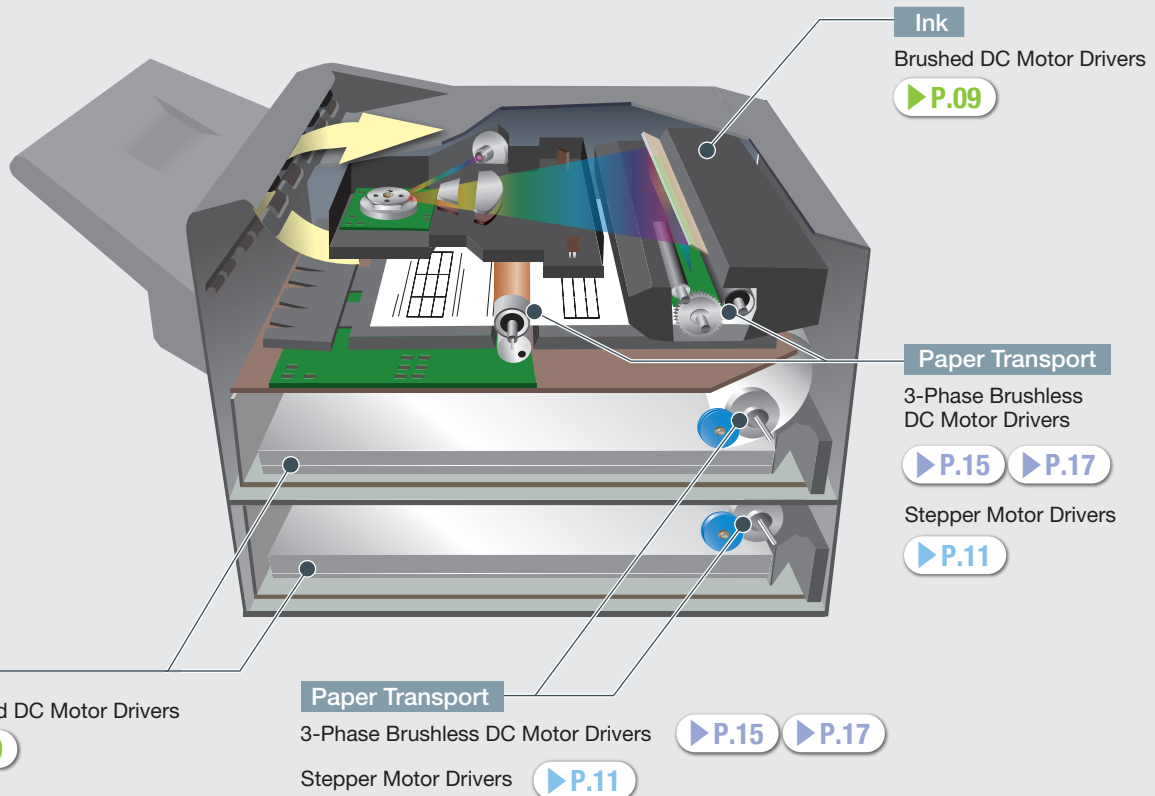


## Washing Machines

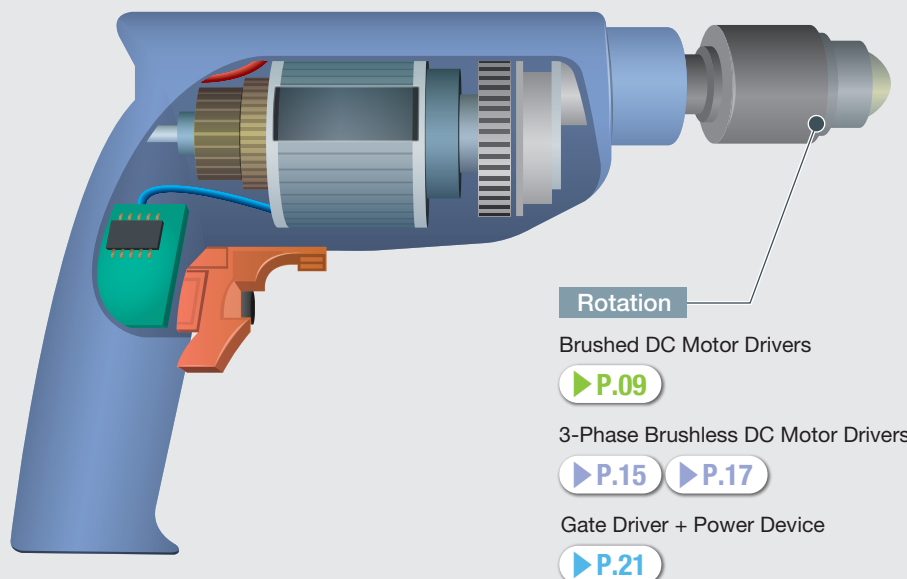


# Selection by Application

## Printers

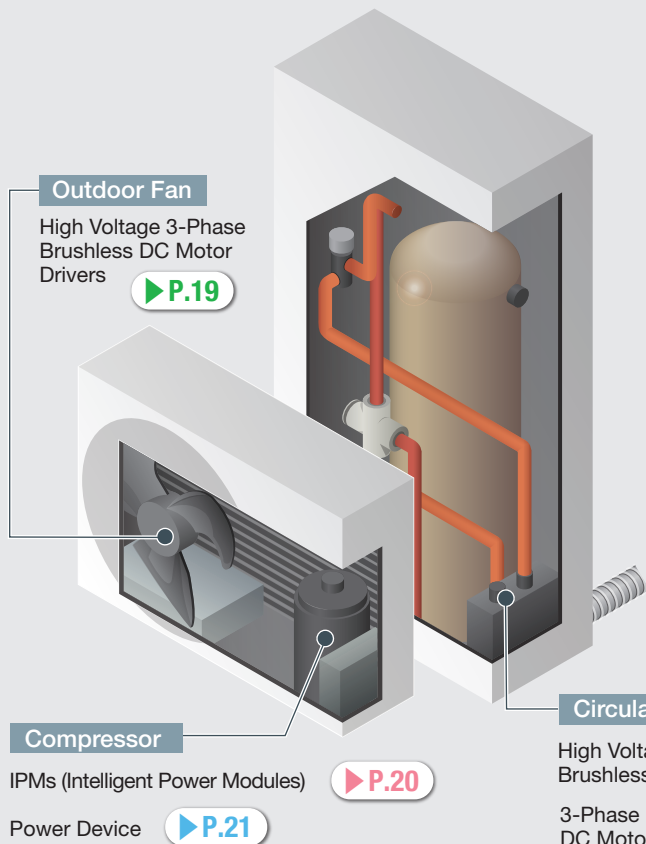


## Power Tools

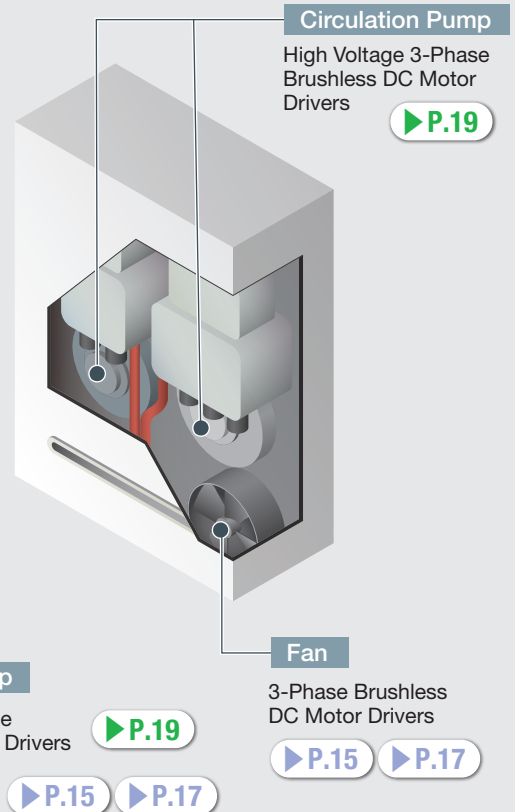


## Water Heaters

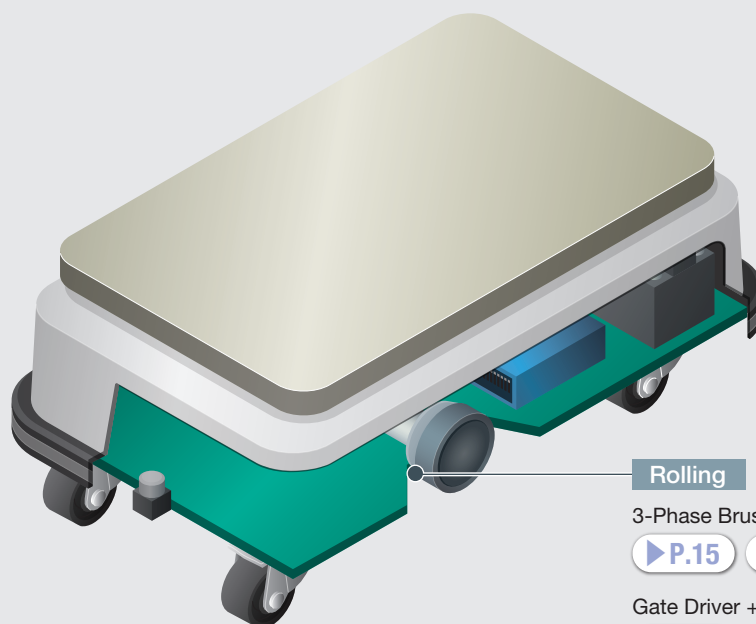
### Hot Water Supply



### Instantaneous



## Mobility (AGV)



### Rolling

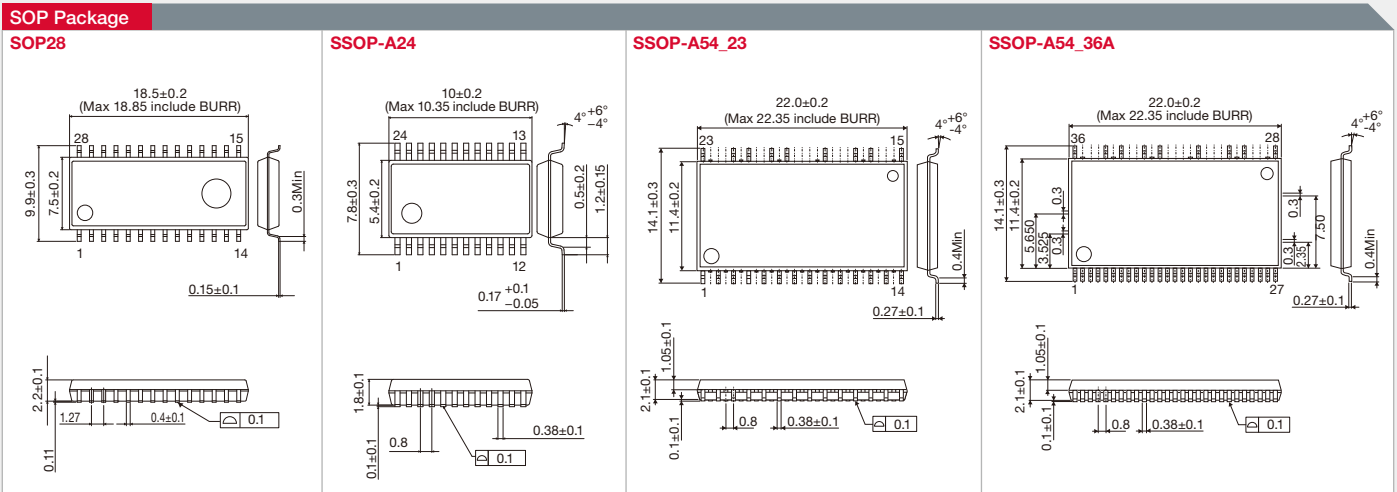
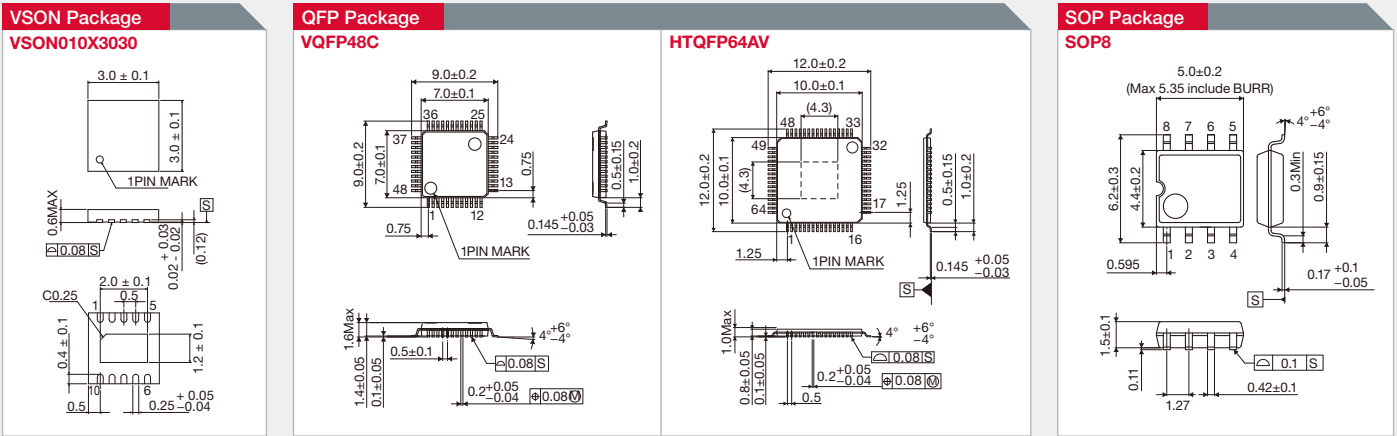
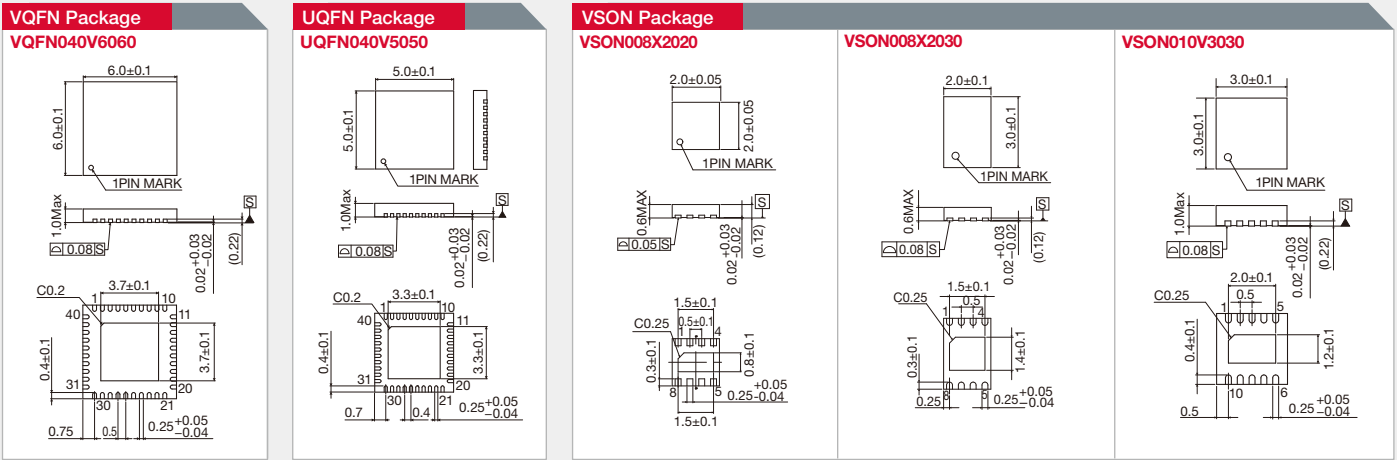
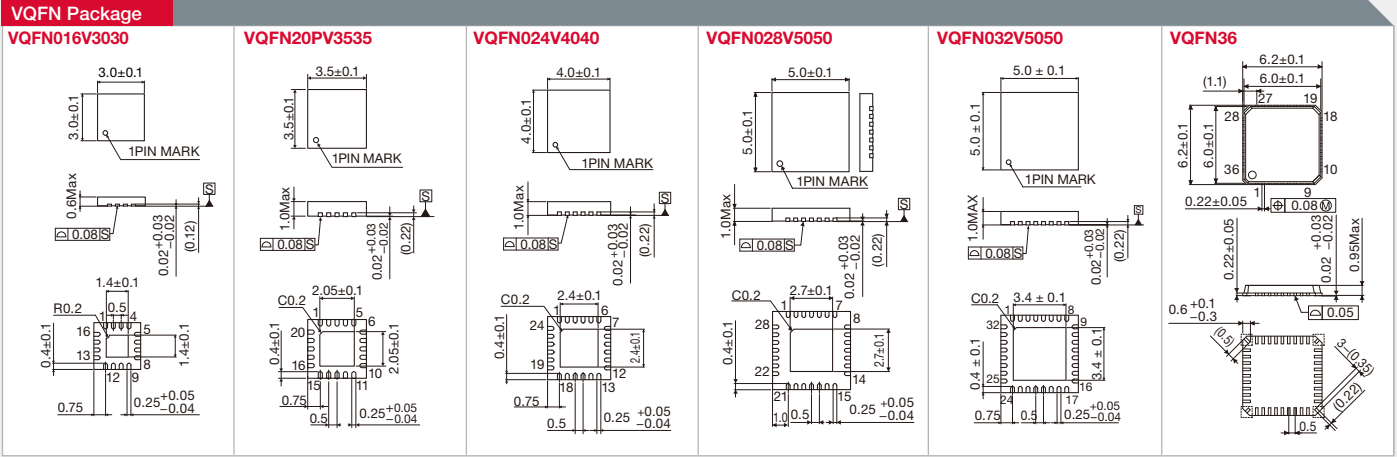
3-Phase Brushless DC Motor Drivers

▶ P.15 ▶ P.17

Gate Driver + Power Device

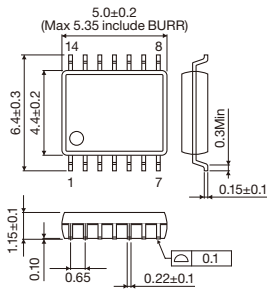
▶ P.21

# Package List (Unit: mm)

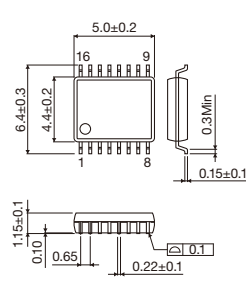


**SOP Package**

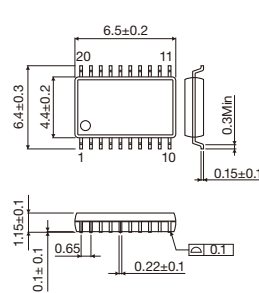
**SSOP-B14**



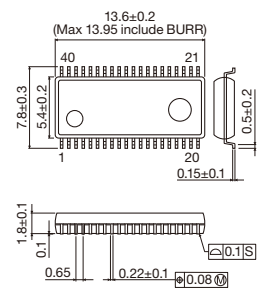
**SSOP-B16**



**SSOP-B20**

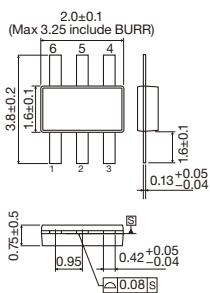


**SSOP-B40**



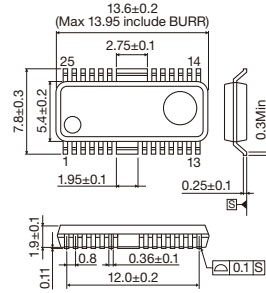
**SOP Package**

**TSSOP6**

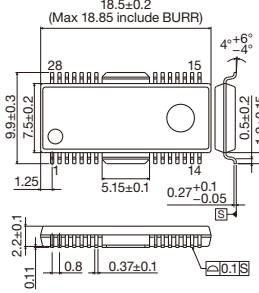


**HSOP Package**

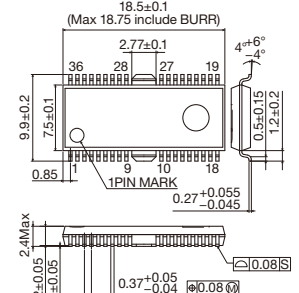
**HSOP25**



**HSOP-M28**

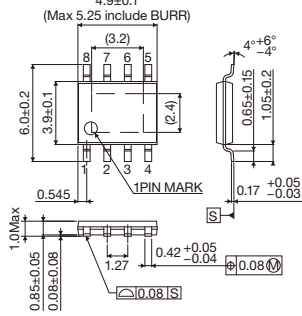


**HSOP-M36**

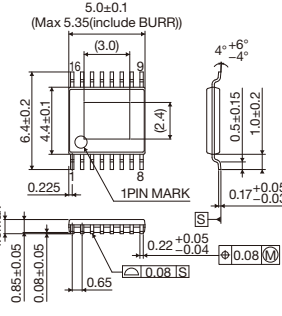


**HSOP Package**

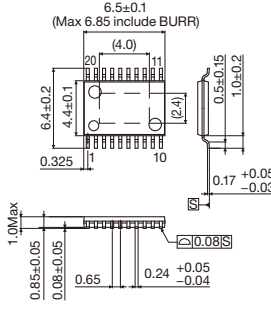
**HTSOP-J8**



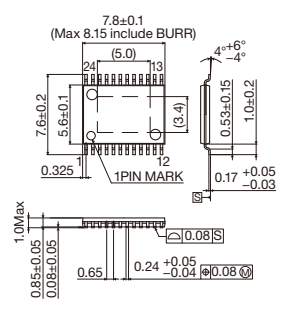
**HTSSOP-B16**



**HTSSOP-B20**

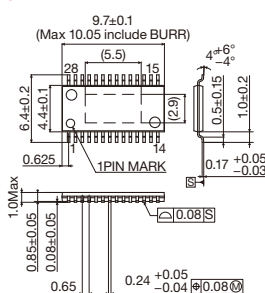


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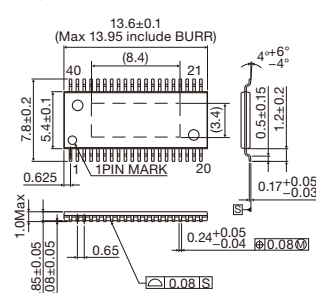


**HSOP Package**

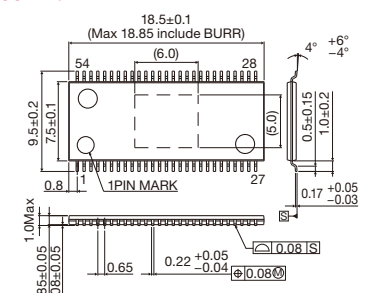
**HTSSOP-B28**



**HTSSOP-B40**

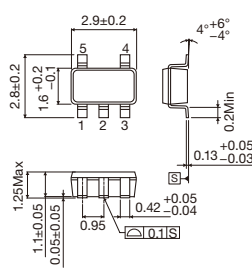


**HTSSOP-B54**

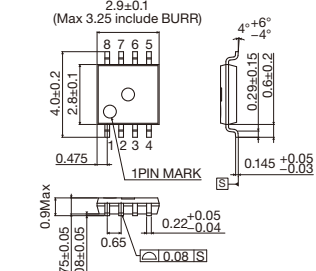


**Small Package**

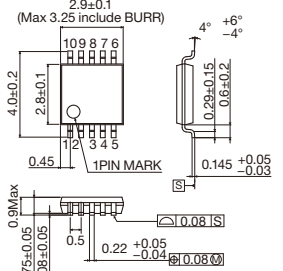
**SSOPs**



**MSOP8**



**MSOP10**

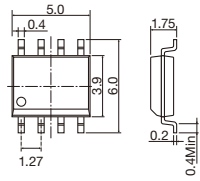




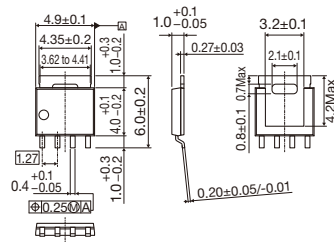


**MOSFET Package**

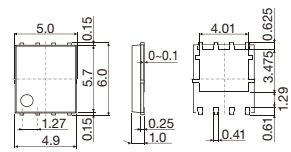
(SOP8)



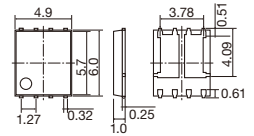
**HPLF5060**



(HSOP8 Single)

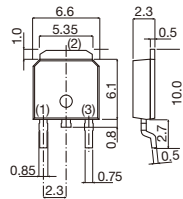


(HSOP8 Symmetry Dual)

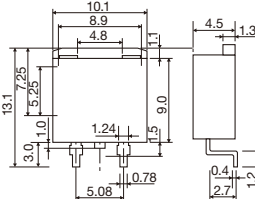


**MOSFET Package**

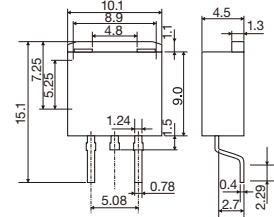
TO-252\*1(DPAK)



TO-263S(LPTS)  
(SC-83)(D2PAK)

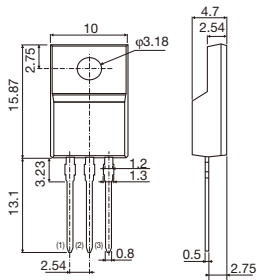


TO-263AB(LPTL)

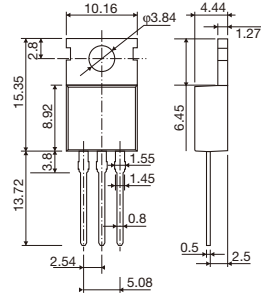


**MOSFET Package**

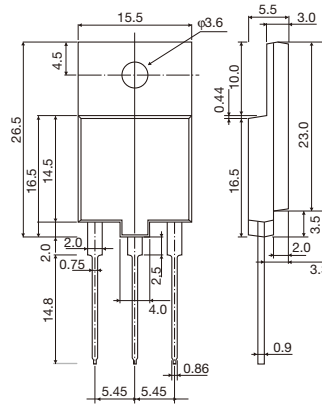
(TO-220FM)\*2(TO-220FP)



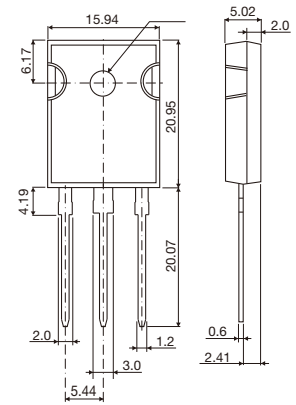
TO-220AB



(TO-3PF)



TO-247AD(TO-247)



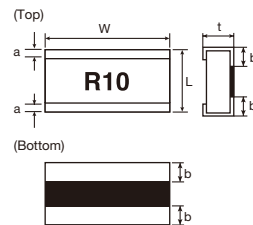
Note1: \*1 Taping code: TL1 Note2: \*2 Packing code: C7 G Note 3: Please refer to the specifications for the dimensions.

**LTR series Resistors**

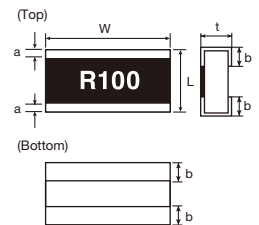
External Dimensions (Unit: mm)

Part No.	Size Code mm (inch)	L	W	t	a	b
LTR10	1220 (0508)	1.2±0.1	2.0±0.1	0.55±0.1	0.3±0.2	0.35±0.2
LTR18	1632 (0612)	1.6±0.1	3.2±0.1	0.58±0.1	0.5±0.2	0.5±0.2
LTR50	2550 (1020)	2.5±0.15	5.0±0.15	0.58±0.15	0.38±0.2	0.9±0.2
LTR100	3264 (1225)	3.2±0.15	6.4±0.15	0.55±0.15	0.4±0.25	1.13±0.25

LTR10



LHR18/LTR50 (Marking Code)  
LTR18/LTR100 (No Marking Code)

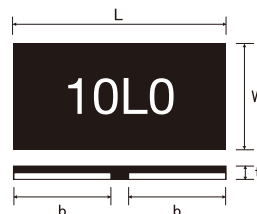


**GMR series Resistors**

External Dimensions (Unit: mm)

Part No.	Size Code mm (inch)	L	W	t	b
GMR50	5025 (2010)	5.00±0.25	2.50±0.25	0.40±0.15	2.05±0.25
GMR100	6432 (2512)	6.40±0.25	3.20±0.25	0.40±0.15	2.75±0.25
GMR320	7142 (2817)	7.10±0.25	4.20±0.25	0.40±0.15	3.10±0.25

GMR50/100/320



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AG073DGS4	P.28, P.30	BD63565EFV	P.5, P.32	BM62380MUV	P.18	R6006JNJ	P.23	RG78NL65D	P.24
AG086DGD3	P.28, P.30	BD63572MUV	P.5, P.32	BM6241FS	P.20	R6006JNX	P.23	RG78NS65D	P.24
AG087DGD3	P.28, P.30	BD63573NUV	P.5, P.32	BM6242FS	P.20	R6007JND3	P.23	RG78TM65D	P.24
BD16805FV-M	P.30	BD63576NUX	P.5, P.32	BM6243FS	P.20	R6007JNJ	P.23	RJ1G08CGN	P.23
BD16852EFV-C	P.30	BD63610AEFV	P.12	BM6244FS	P.20	R6007JNX	P.23	RJ1G12BGN	P.23
BD16860AEKV-C	P.30	BD63620AEFV	P.12	BM6245FS	P.20	R6009JND3	P.23	RJ1L06CGN	P.23
BD16912EFV-C	P.28	BD63710AEFV	P.12	BM6246FS	P.20	R6009JNJ	P.23	RJ1L12BGN	P.23
BD16939AEFV-C	P.28	BD63715AEFV	P.12	BM6247FS	P.20	R6009JNX	P.23	RJ1P12BBD	P.23
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BD61248NUX	P.14	BD63800MUF-C	P.28	BM63375S-VC	P.20	R6020JNZ4	P.23	RMS338NA-005	P.26
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BD6222HFP	P.5	BD65492MUV	P.5, P.32	BU24038GW	P.32	RGS00TS65E	P.24	SH8K12	P.16, P.18
BD6225FP	P.5	BD65494MUV	P.5, P.32	BU6821G	P.20	RGS30NL65D	P.24	SH8K26	P.16, P.18
BD6226FP	P.5	BD65496MUV	P.5, P.32	BU6823G	P.20	RGS30TSX2D	P.24	SH8K39	P.16, P.18
BD6230F	P.5	BD65499MUV	P.32	BU69090NUX	P.14	RGS40NL65D	P.24	SH8K41	P.16, P.18
BD6231F	P.5	BD67173NUX	P.18	BU6909AGFT	P.14	RGS50NL65D	P.24	SH8K52	P.16, P.18
BD6231HFP	P.5	BD6735FV	P.5, P.32	GMR100	P.25	RGS50TSX2D	P.24	SH8KA1	P.16, P.18
BD62321HFP	P.5	BD6736FV	P.5, P.32	GMR320	P.25	RGS60NL65D	P.24	SH8KA2	P.16, P.18
BD6232FP	P.5	BD6753KV	P.32	GMR50	P.25	RGS60TS65D	P.24	SH8KA4	P.16, P.18
BD6232HFP	P.5	BD6758KN	P.32	HP8M31	P.14, P.16, P.18	RGS80TS65D	P.24	SH8KA7	P.16, P.18
BD6236FM	P.5	BD67891MUV	P.16	HP8M51	P.14, P.16, P.18	RGS80TSX2D	P.24	SH8KB6	P.16, P.18
BD6236FP	P.5	BD68610EFV	P.12	HP8MA2	P.14, P.16, P.18	RGSX5TS65D	P.24	SH8KB7	P.16, P.18
BD6237FM	P.5	BD68620EFV	P.12	LTR10	P.25	RGSX5TS65E	P.24	SH8KC6	P.16, P.18
BD63001AMUV	P.16	BD68710EFV	P.12	LTR100	P.25	RG700TS65D	P.24	SH8KC7	P.16, P.18
BD63002AMUV	P.16	BD68715EFV	P.12	LTR18	P.25	RGT16BM65D	P.24	SH8M31	P.14, P.16, P.18
BD63003MUV	P.16	BD68720EFV	P.12	LTR50	P.25	RGT16NL65D	P.24	SH8M41	P.14, P.16, P.18
BD63005AMUV	P.16	BD69060GFT	P.14	QH8K51	P.16, P.18	RGT16NS65D	P.24	SH8M51	P.14, P.16, P.18
BD63006MUV	P.16	BD6961F	P.14	QH8KA1	P.16, P.18	RGT16TM65D	P.24	SH8MA2	P.14, P.16, P.18
BD63007MUV	P.16	BD6962FVM	P.14	QH8KA2	P.16, P.18	RGT20NL65D	P.24	SH8MA3	P.14, P.16, P.18
BD63015EFV	P.18	BD6964F	P.14	QH8KA3	P.16, P.18	RGT20NS65D	P.24	SH8MA4	P.14, P.16, P.18
BD63030EKV-C	P.30	BD6964FVM	P.14	QH8KB5	P.16, P.18	RGT20TM65D	P.24	SH8MB5	P.14, P.16, P.18
BD63035EFV-M	P.30	BD6965NUX	P.14	QH8KB6	P.16, P.18	RGT30NL65D	P.24	SH8MC5	P.14, P.16, P.18
BD63130AFM	P.5	BD6967FVM	P.14	QH8KC5	P.16, P.18	RGT30NS65D	P.24	UT6KB5	P.16, P.18
BD63150AFM	P.5	BD6968FVM	P.14	QH8KC6	P.16, P.18	RGT30TM65D	P.24	UT6KC5	P.16, P.18
BD63241FV	P.18	BD6971FV	P.14	QH8MA2	P.14, P.16, P.18	RGT40NL65D	P.24	UT6MA2	P.14, P.16, P.18
BD63242EFV	P.18	BD69730FV	P.14	QH8MA3	P.14, P.16, P.18	RGT40NS65D	P.24		
BD63251MUV	P.18	BD69740FV	P.14	QH8MA4	P.14, P.16, P.18	RGT40TM65D	P.24		
BD6326ANUX	P.18	BD6981FVM	P.14	QH8MA5	P.14, P.16, P.18	RGT40TS65D	P.24		
BD63282EFV	P.18	BD6982FVM	P.14	QH8MC5	P.14, P.16, P.18	RGT50NL65D	P.24		
BD63510AEFV	P.12	BD69830FV	P.14	QS8M31	P.14, P.16, P.18	RGT50NS65D	P.24		
BD63511EFV	P.12	BD6995FV	P.14	QS8M51	P.14, P.16, P.18	RGT50TM65D	P.24		
BD63520AEFV	P.12	BH6766FVM	P.14	R6004JND3	P.23	RGT50TS65D	P.24		
BD63521EFV	P.12	BM62300MUV	P.18	R6004JNJ	P.23	RGT60TS65D	P.24		

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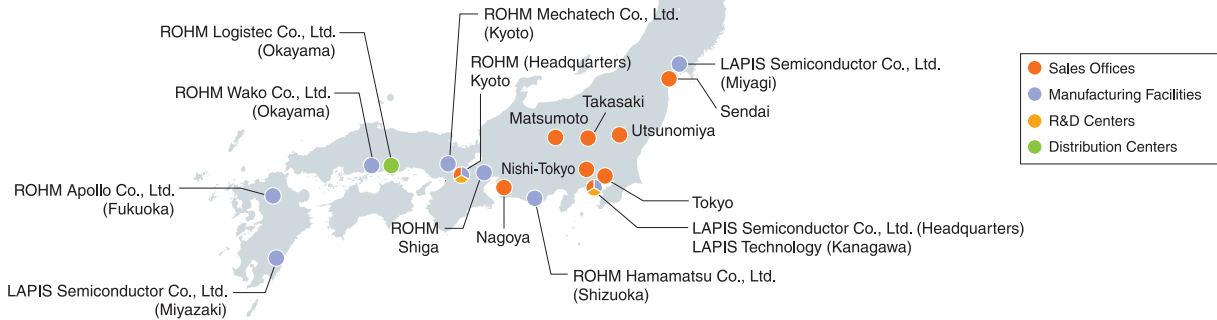
ROHM Co., Ltd.      LAPIS Semiconductor Co., Ltd.  
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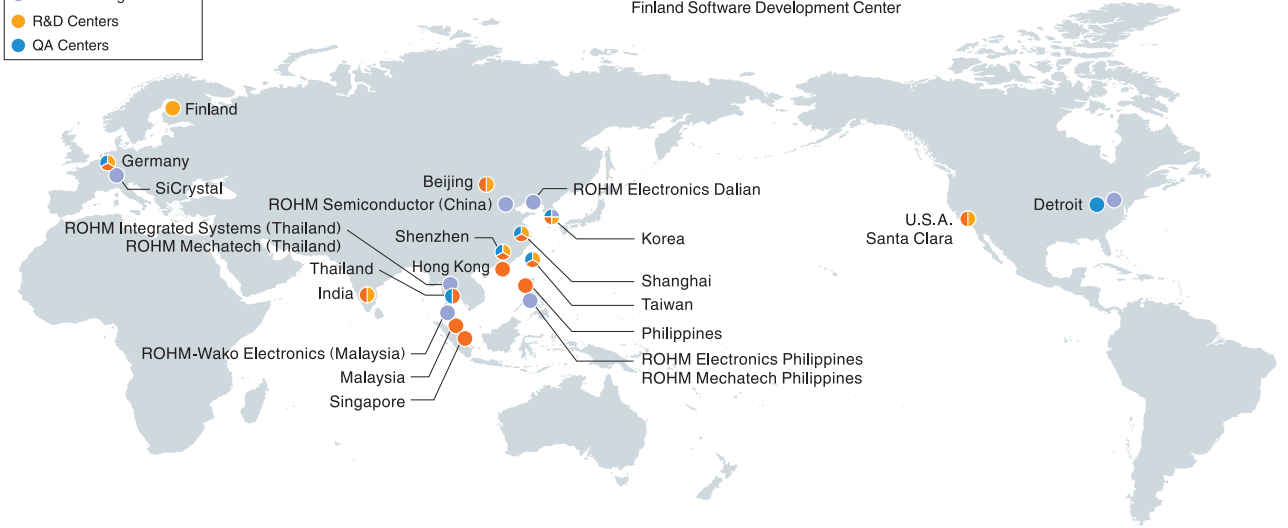
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<b>France</b>	+33 (0) 1 40 60 87 30	<b>Shenzhen</b>	+86-755-8307-3008	<b>Yokohama</b>	+81-45-476-2121

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**ROHM Co., Ltd.**

21 Saiin Mizosaki-cho, Ukyo-ku,  
Kyoto 615-8585 Japan  
TEL : +81-75-311-2121 FAX : +81-75-315-0172

[www.rohm.com](http://www.rohm.com)

