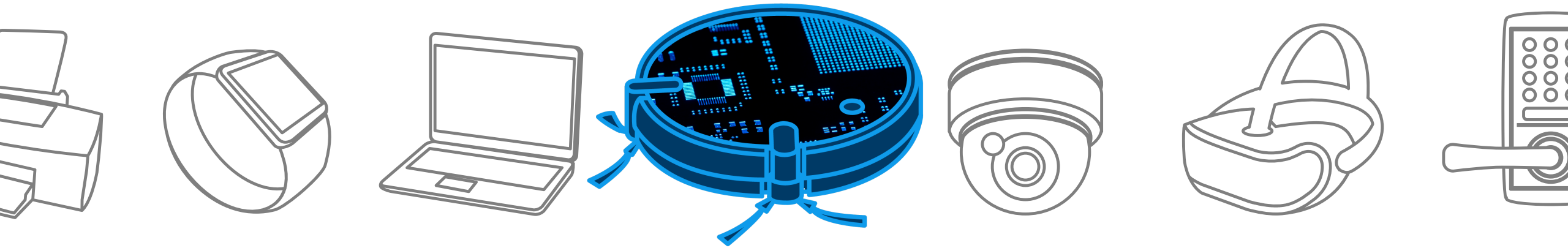
TOSHIBA

R23

Robot Cleaner

Solution Proposal by Toshiba



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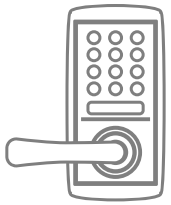

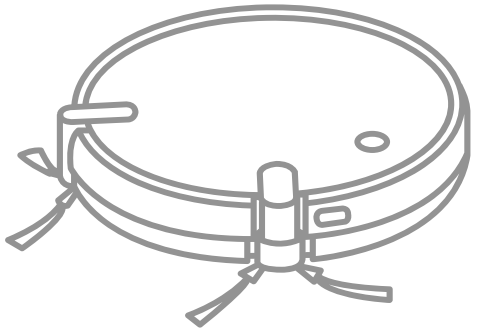

Toshiba Electronic Devices & Storage Corporation provides comprehensive device solutions to customers developing new products by applying its thorough understanding of the systems acquired through the analysis of basic product designs.

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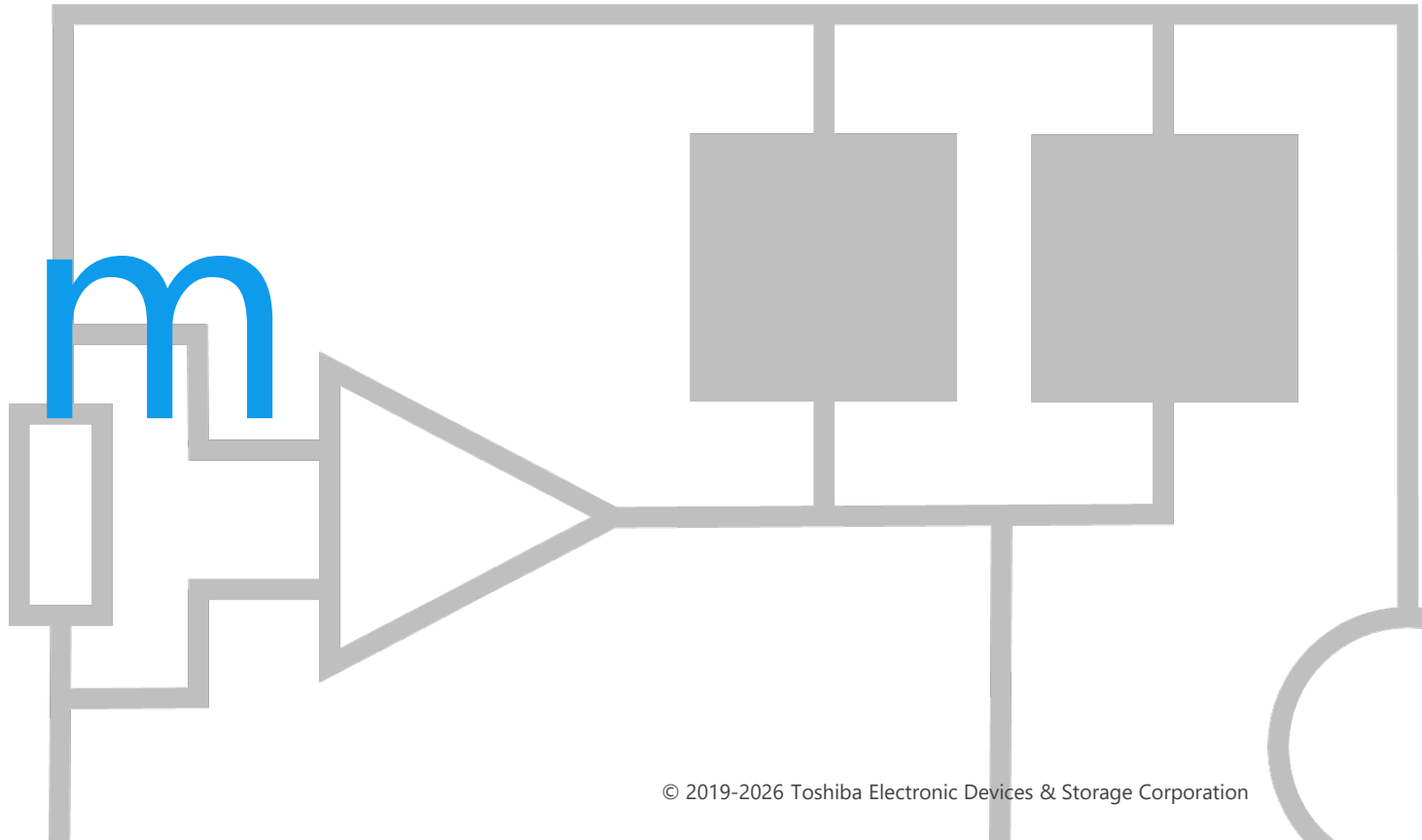
Block Diagram



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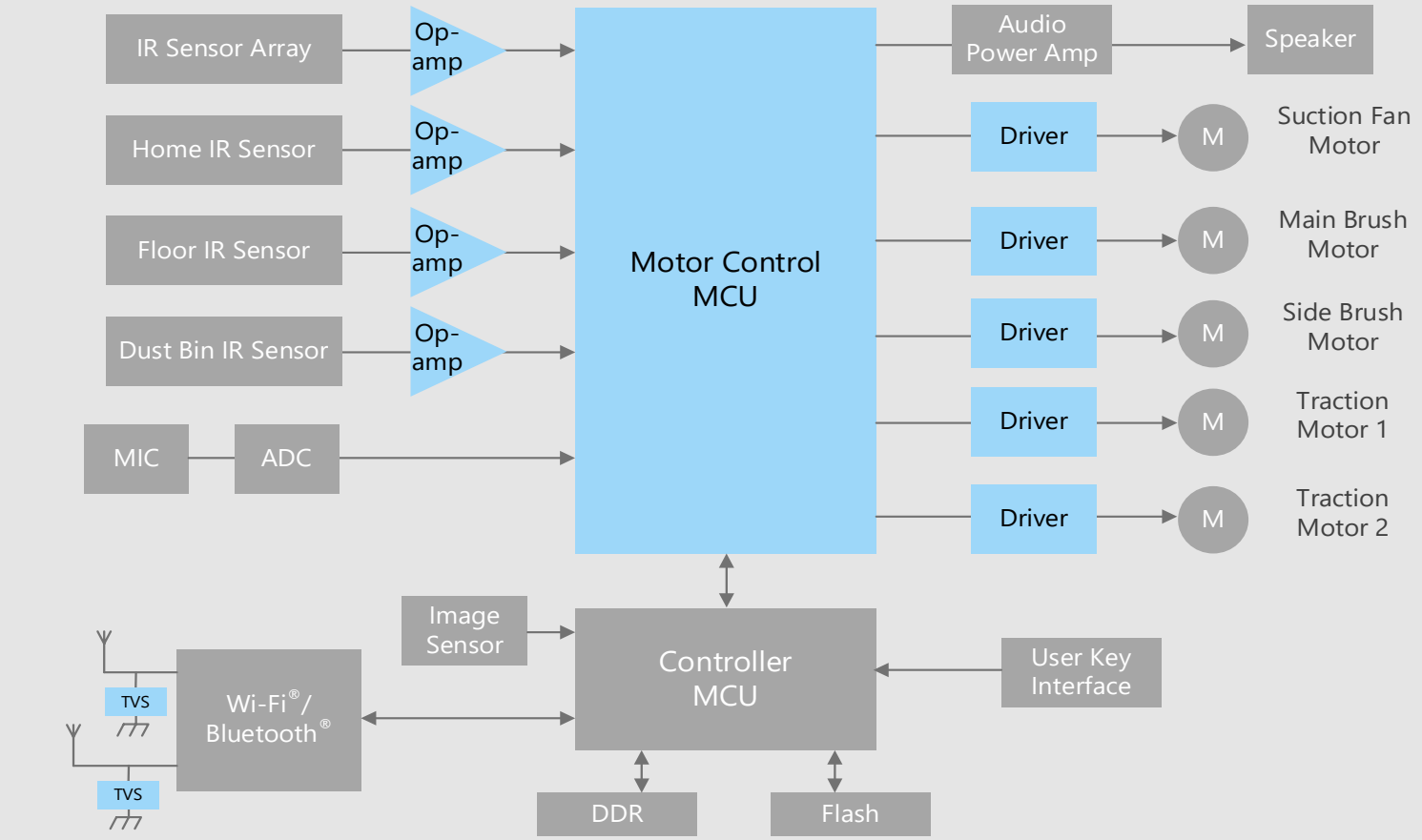
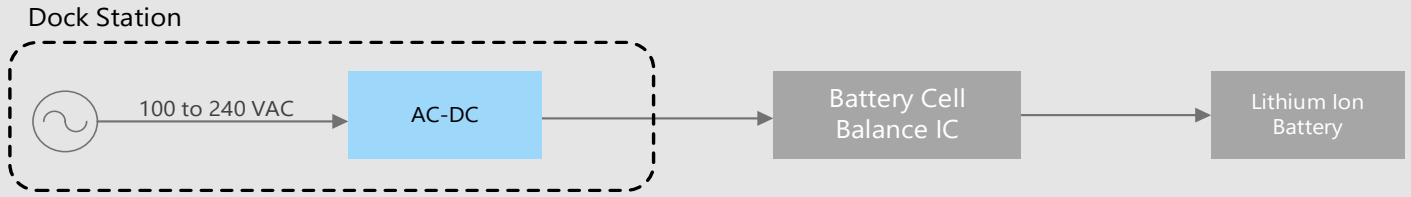
Robot Cleaner　Overall block diagram





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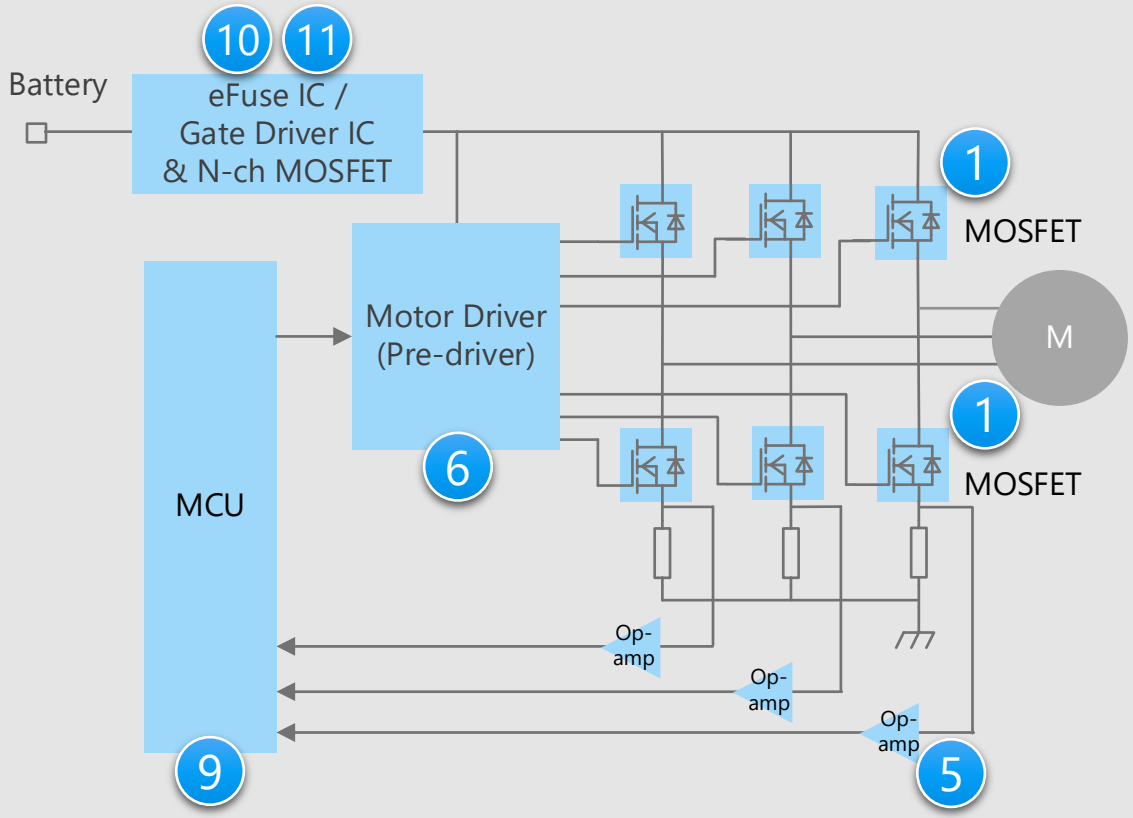
Robot Cleaner　Detail of motor drive circuit (1)

Brushless DC motor drive circuit

Motor Driver (Pre-driver) + MOSFET type



* Click on the number in the circuit diagram to jump to the detailed description page

Criteria for device selection

- It is required to select the product with a current rating that is suitable for the motor rating.
- It is required to select suitable motor driver (pre-driver) for the rating of the switching device to be driven.
- Operational amplifiers with low noise are suitable for the sensor block.
- With the increasing current density of small surface mount components, it is necessary to design a heat dissipation that takes the reliability into account.

Proposals from Toshiba

- **Realize a set with low power consumption by low on-resistance** 1
  U-MOS Series N-ch MOSFET
- **Amplify the detected weak signal with low noise** 5
  Low noise operational amplifier
- **Easy motor drive** 6
  Brushless DC motor driver (pre-driver)
- **Easy software development using general purpose CPU cores** 9
  MCU
- **Built-in protection function against short circuit, over current, over voltage, etc.** 10
  Electronic fuse (eFuse IC)
- **Small package and built-in over voltage protection function** 11
  N-ch MOSFET gate driver IC

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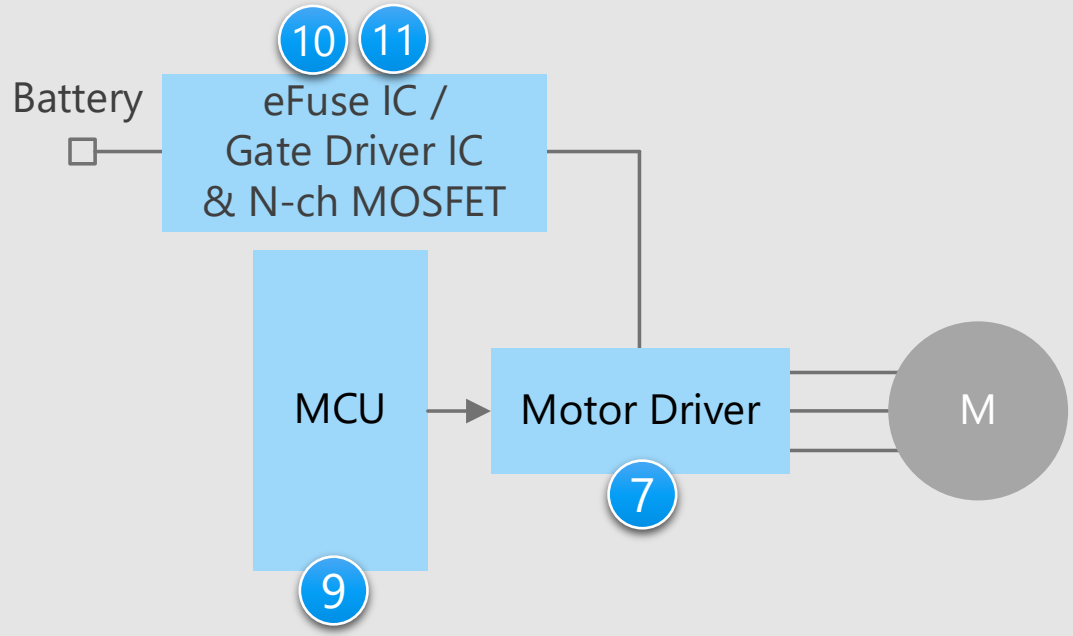
Robot Cleaner　Detail of motor drive circuit (2)

Brushless DC motor drive circuit

Motor Driver type



Criteria for device selection

- To select the product with a current rating that is suitable for the motor rating.
- With the increasing current density of small surface mount components, it is necessary to design a heat dissipation that takes the reliability into account.

Proposals from Toshiba

- **Easy motor drive** 7
  Brushless DC motor driver
- **Easy software development using general purpose CPU cores** 9
  MCU
- **Built-in protection function against short circuit, over current, over voltage, etc.** 10
  Electronic fuse (eFuse IC)
- **Small package and built-in over voltage protection function** 11
  N-ch MOSFET gate driver IC

* Click on the number in the circuit diagram to jump to the detailed description page

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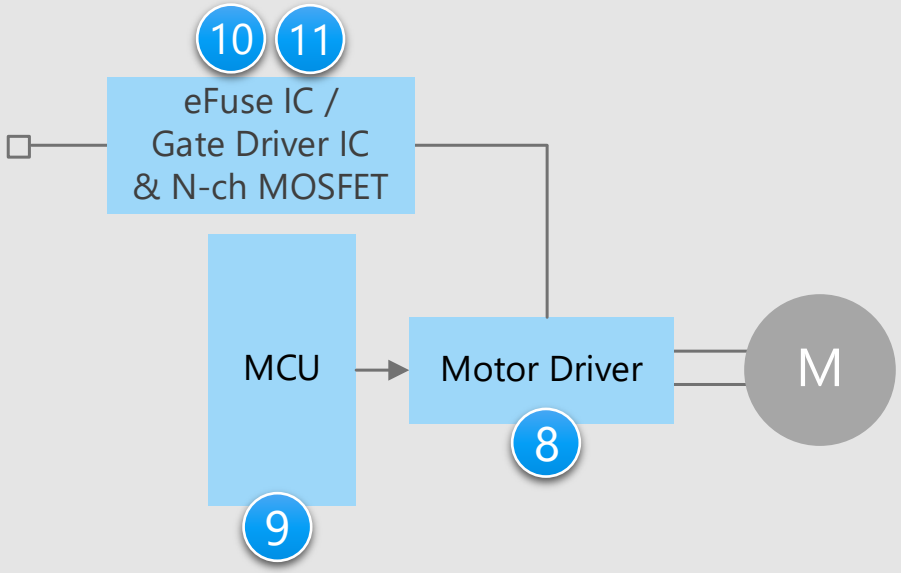
Robot Cleaner　Detail of motor drive circuit (3)

Brushed DC motor drive circuit

Motor Driver type



* Click on the number in the circuit diagram to jump to the detailed description page

Criteria for device selection

- It is required to select the product with a current rating that is suitable for the motor rating.
- With the increasing current density of small surface mount components, it is necessary to design a heat dissipation that takes the reliability into account.

Proposals from Toshiba

- **Easy motor drive** 8
  Brushed DC motor driver
- **Easy software development using general purpose CPU cores** 9
  MCU
- **Built-in protection function against short circuit, over current, over voltage, etc.** 10
  Electronic fuse (eFuse IC)
- **Small package and built-in over voltage protection function** 11
  N-ch MOSFET gate driver IC

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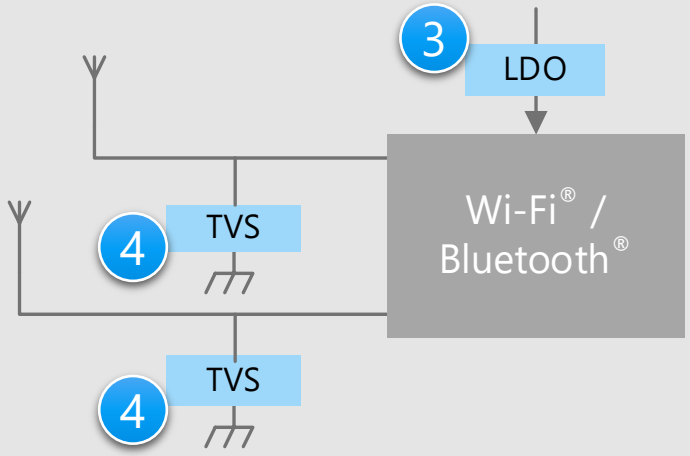
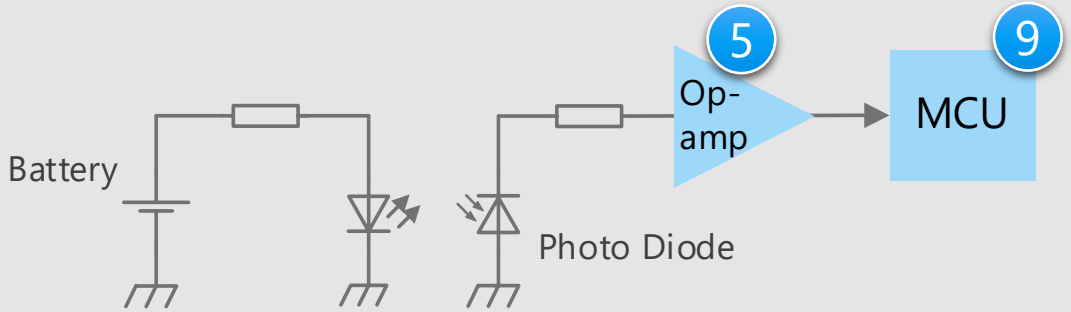
Robot Cleaner　Detail of RF and sensor unit

Wi-Fi®/Bluetooth® circuit



Infrared sensor circuit



* Click on the number in the circuit diagram to jump to the detailed description page

Criteria for device selection

- Power Supply Rejection Ratio (PSRR) is a key characteristic for wireless systems.
- Wi-Fi® system requires high current power supply.
- A small Transient Voltage Suppressor (TVS) with low C_t is suitable for Electro Static Discharge (ESD) protection without attenuating the antenna signal.
- Operational amplifiers with low noise are suitable for the sensor block.

Proposals from Toshiba

- **Realize noise-resistant power supply** 3
  Small surface mount LDO regulator
- **Absorb Electro Static Discharge (ESD) from antennas and prevent malfunction of the circuit** 4
  TVS diode
- **Amplify the detected weak signal with low noise** 5
  Low noise operational amplifier
- **Easy software development using general purpose CPU cores** 9
  MCU

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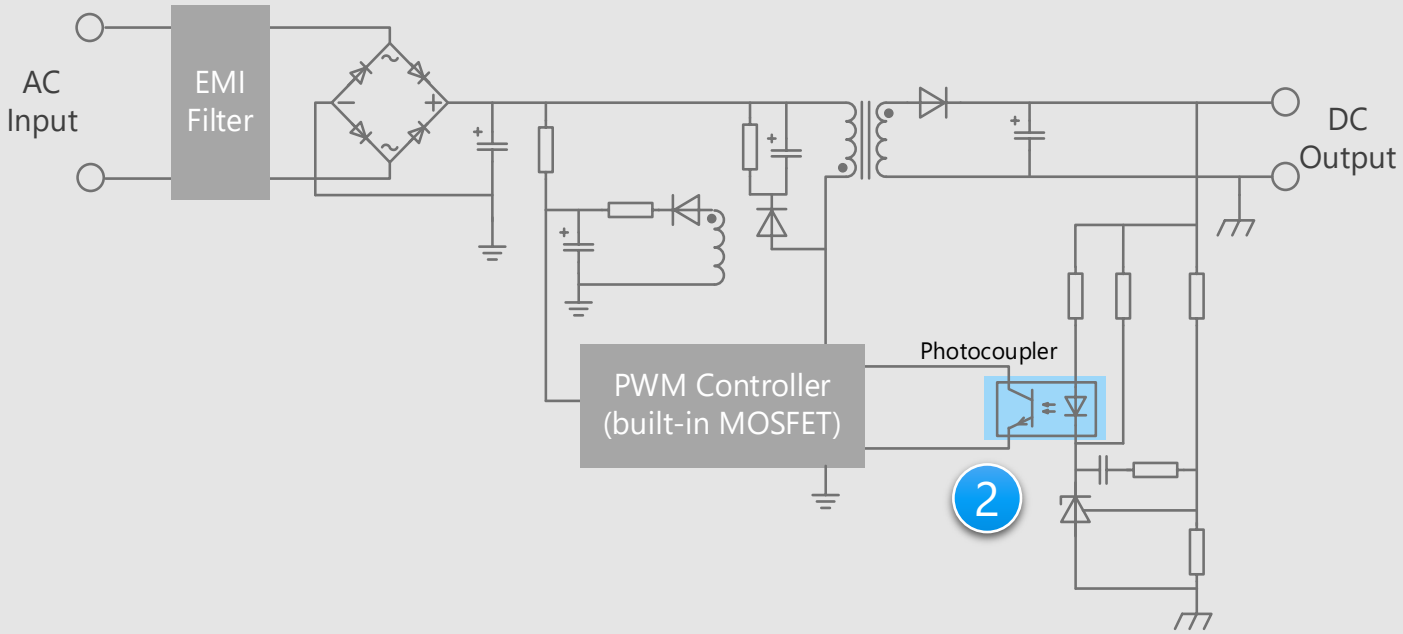
Robot Cleaner　Detail of power supply unit of dock station

Flyback AC-DC circuit



* Click on the number in the circuit diagram to jump to the detailed description page

Criteria for device selection

- A transistor output photocoupler with high current transfer ratio is suitable for the power supply feedback circuit.
- Small package products contribute to the reduction of circuit board area.

Proposal from Toshiba

- **High current transfer ratio and high temperature operation makes easy to design.**
  Transistor output photocoupler 2

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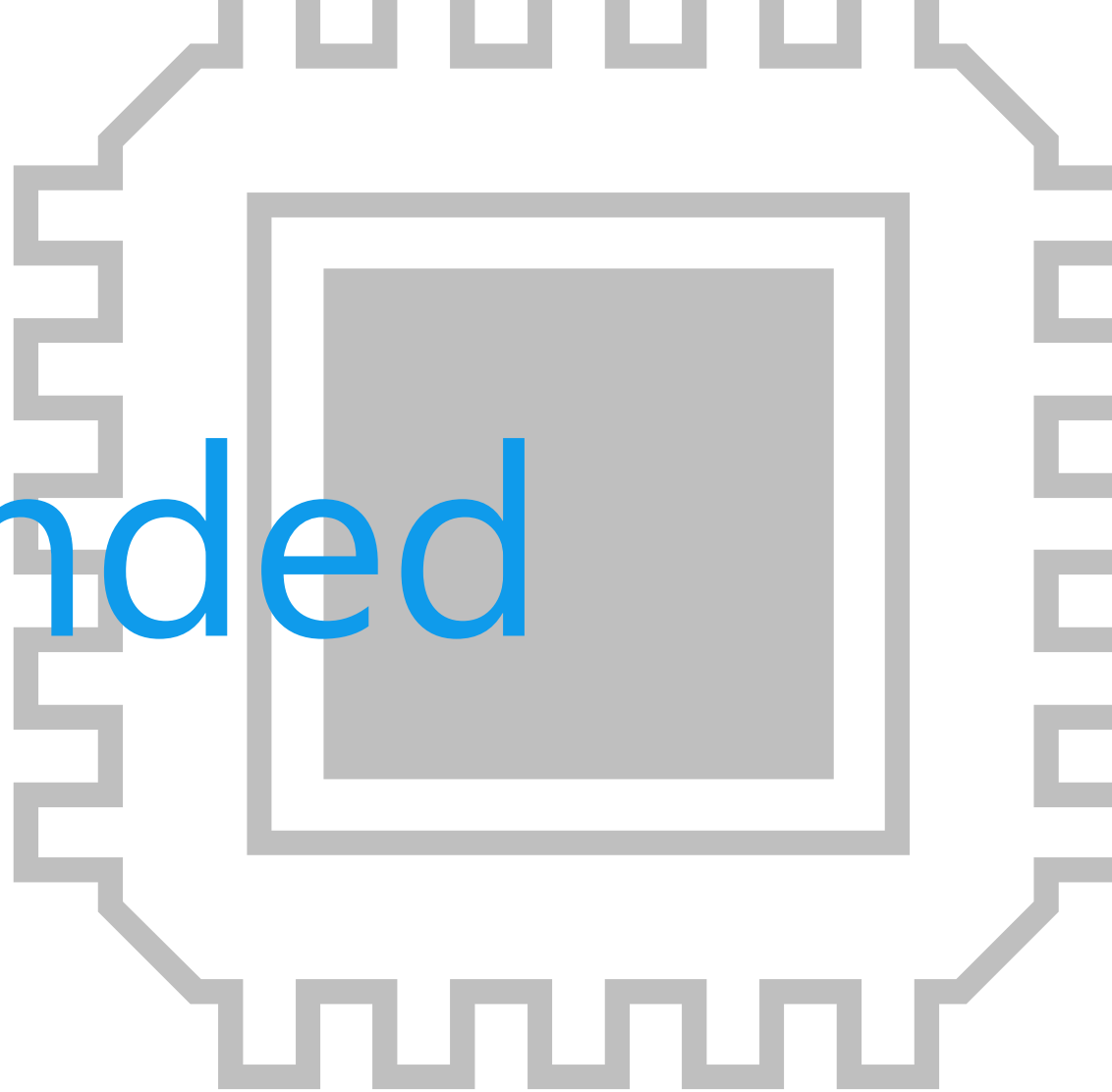
Recommended Devices



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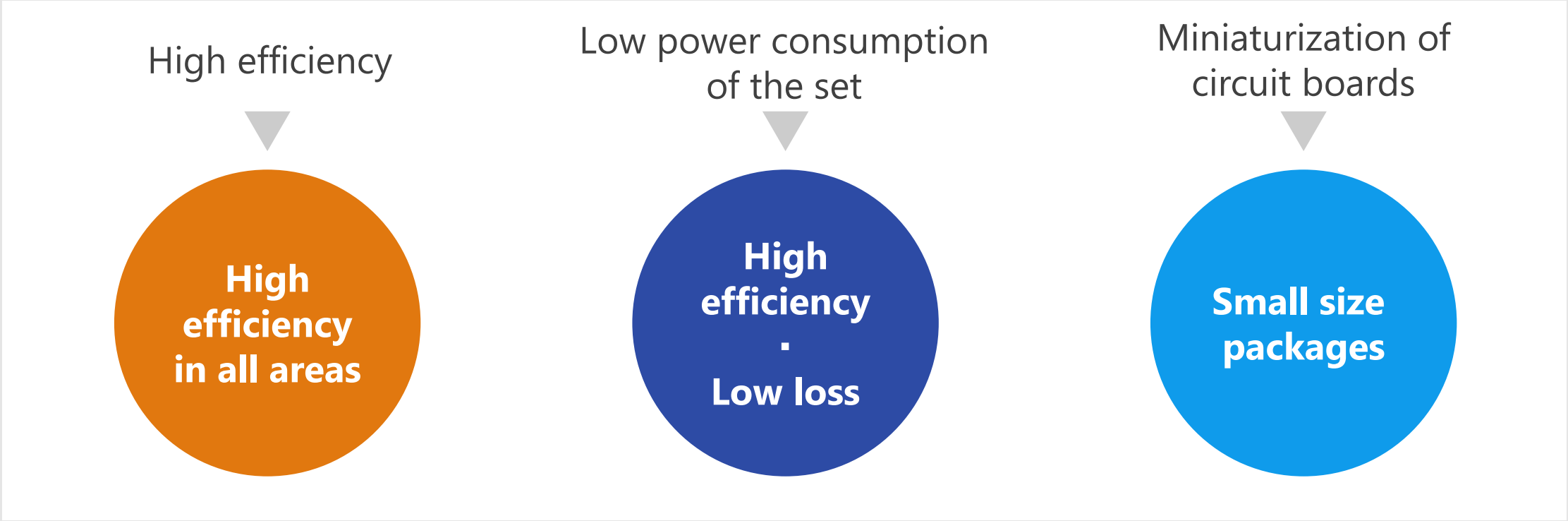
Device solutions to address customer needs

As described above, in the design of robot cleaner, **“High efficiency “**, **“Low power consumption of the set”** and **“Miniaturization of circuit boards”** are important factors. Toshiba’s proposals are based on these three solution perspectives.



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Device solutions to address customer needs

	High efficiency in all areas	High efficiency · Low loss	Small size packages
1 U-MOS Series N-ch MOSFET	●	●	●
2 Transistor output photocoupler	●		●
3 Small surface mount LDO regulator	●	●	●
4 TVS diode		●	●
5 Low noise operational amplifier			●
6 Brushless DC motor driver (pre-driver)	●	●	●
7 Brushless DC motor driver	●	●	●
8 Brushed DC motor driver	●	●	●
9 MCU		●	●

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Device solutions to address customer needs

	High efficiency in all areas	High efficiency · Low loss	Small size packages
10 Electronic fuse (eFuse IC)	●	●	●
11 N-ch MOSFET gate driver IC		●	●

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1a U-MOS Series N-ch MOSFET

TPN5R203PL / TPN7R006PL / TPHR7404PU

High efficiency in all areas | High efficiency · Low loss | Small size packages

Value provided

Low on-resistance products are available in the lineup. Improvement of trade-off characteristics between on-resistance and capacitance contributes to energy saving.

1 Low on-resistance

Low on-resistance contributes to reducing heat generation and power consumption.

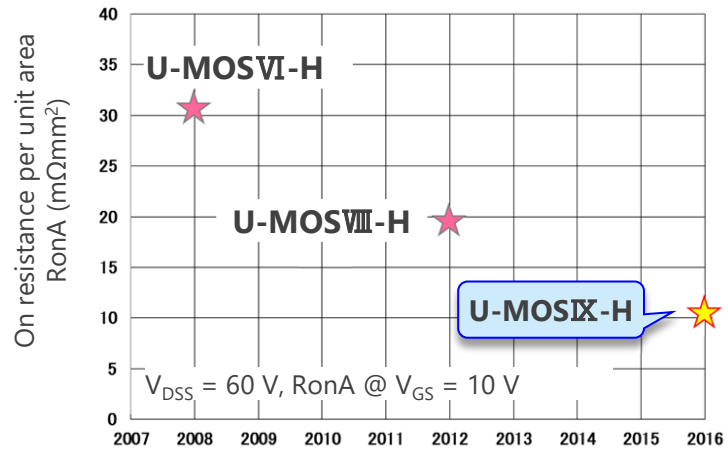
2 Small total gate charge

Small total gate charge reduces the performance required for driving the MOSFET, thereby improving the switching characteristics.

3 High speed switching

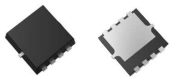
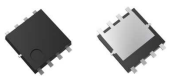
Reducing switching loss by high speed operation contributes to improving efficiency.

RonA reduction trend of N-ch MOSFET



[Note] Toshiba internal comparison

Lineup

Part number		TPN5R203PL	TPN7R006PL	TPHR7404PU
Package		TSON Advance 		SOP Advance 
V_{DSS} [V]		30	60	40
I_D [A]		36 (76*)	54 (76*)	150 (400*)
$R_{DS(ON)}$ [mΩ] @V_{GS} = 10 V	Typ.	3.9	5.4	0.51
	Max	5.2	7.0	0.74
Polarity		N-ch	N-ch	N-ch
Generation		U-MOSⅨ-H	U-MOSⅨ-H	U-MOSⅨ-H

*: Silicon limit

◆Return to Block Diagram TOP

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1b U-MOS Series N-ch MOSFET (80 V)

TPH2R408QM / TPM1R908QM / TPN12008QM / TPN19008QM / TK5R1P08QM / TK6R9P08QM

High efficiency in all areas | High efficiency - Low loss | Small size packages

Value provided

Lineup of low on-resistance products is provided. Improvement of trade-off characteristics between on-resistance and capacitance contributes to higher efficiency of power supply.

1 Low on-resistance

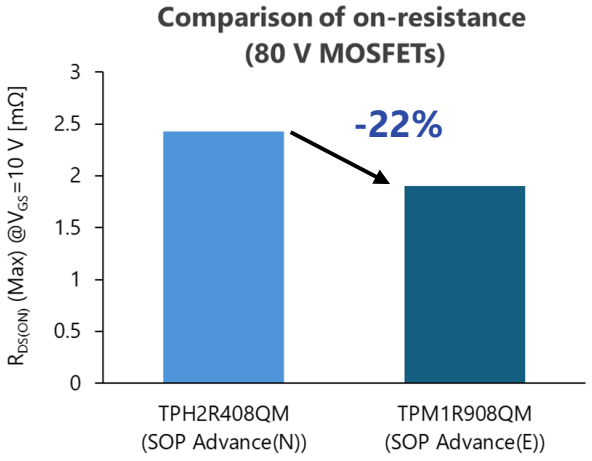
$R_{DS(ON)}$ is low. It makes heat generation and power consumption low.
$R_{DS(ON)}$ has been reduced by 22% compared to Toshiba's existing 80 V MOSFETs. [Note]

2 Small gate input charge

Small gate input charge reduces the performance required for driving the MOSFET. It contributes to improving switching characteristics.

3 High speed switching

Reducing switching loss through high speed operation contributes to higher power supply efficiency.



[Note] Toshiba internal comparison

Lineup

Part number		TPH2R408QM	TPM1R908QM	TPN12008QM	TPN19008QM	TK5R1P08QM	TK6R9P08QM
Package		SOP Advance(N)	SOP Advance(E)	TSON Advance		DPAK	
V_{DSS} [V]		80	80	80	80	80	80
I_D [A]		120 (200*)	238	26 (60*)	34 (38*)	84 (105*)	62 (83*)
$R_{DS(ON)}$ [mΩ] @V_{GS} = 10 V	Typ.	1.90	1.5	9.6	14.7	4.2	5.5
	Max	2.43	1.9	12.3	19.0	5.1	6.9
Polarity		N-ch	N-ch	N-ch	N-ch	N-ch	N-ch
Generation		U-MOSX-H	U-MOSX-H	U-MOSX-H	U-MOSX-H	U-MOSX-H	U-MOSX-H

*: Silicon limit

◆Return to Block Diagram TOP

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2 Transistor output photocoupler
TLP383

High efficiency in all areas | Low loss | Small size packages

Value provided

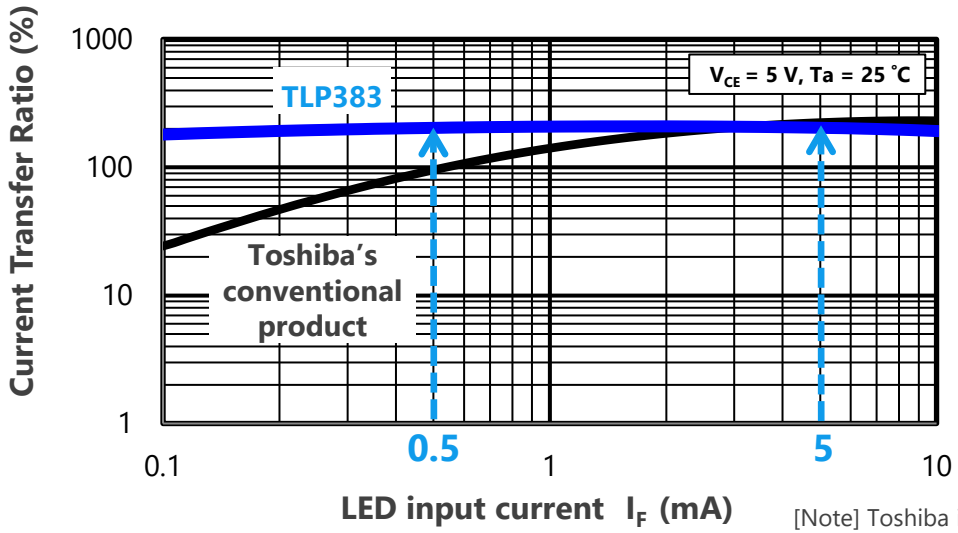
High current transfer ratio (CTR) is realized even in the low input current range (I_F=0.5 mA).

1 High current transfer ratio

Phototransistor and InGaAs infrared light emitting diode are optically coupled. Highly isolated photocouplers realize higher CTR than Toshiba's existing product (TLP385) in low input current range (@ I_F = 0.5 mA).

2 The operating temperature range is extended to 125 °C

It is designed to operate under severe conditions of ambient temperature environment.



[Note] Toshiba internal comparison

Lineup

Part number	TLP383
Package	4pin SO6L
I_C/I_F [%] @I_F = 0.5 mA, 5 mA	50 to 600
t_{off} (Typ.) [μs] @I_F = 1.6 mA	28
BV_S [Vrms]	5000
T_{opr} [°C]	-55 to 125

◆Return to Block Diagram TOP

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3 Small surface mount LDO regulator

TCR15AG / TCR8BM / TCR5FM / TCR5RG / TCR3RM / TCR3U / TCR3LM / TCR3D / TCR3EM / TCR1HF Series

High efficiency in all areas

High efficiency · Low loss

Small size packages

Value provided

Wide lineup from general purpose type to WCSP (Wafer Level Chip Size Package) type are provided. Contribute to realize a stable power supply.

1 Low dropout voltage

Low dropout voltage characteristic has been realized by the originally developed process.

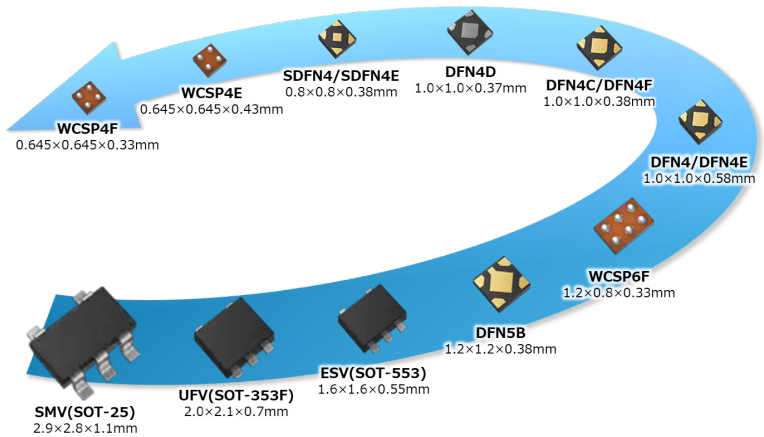
2 High PSRR Low output noise voltage

Many product series that realize both high PSRR (Power Supply Rejection Ratio) and low output noise voltage characteristics are provided. They are suitable for stable power supply for analog circuit.

3 Low current consumption

$I_{B(ON)}$ of 0.34 μA (typ.) @I_{OUT} = 0 mA, V_{OUT} ≦ 1.5 V is realized by utilizing CMOS process and unique circuit technology. (TCR3U Series)

Rich package lineup



Lineup

Part number	TCR15AG Series	TCR8BM Series	TCR5FM Series	TCR5RG Series	TCR3RM Series	TCR3U Series	TCR3LM Series	TCR3D Series	TCR3EM Series	TCR1HF Series
Features	Low dropout voltage High PSRR		High PSRR Low noise Low current consumption			Low current consumption		Standard type		36 V Input voltage
I_{OUT} (Max) [A]	1.5	0.8	0.5		0.3					0.15
PSRR (Typ.) [dB] @f = 1 kHz	95	98	91	100	100	70	-	72	68	70
I_B (Typ.) [μA]	25	20	10	7	7	0.34	1	86	35	170

◆Return to Block Diagram TOP

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4 TVS diode

DF2B5M4SL / DF2B6M4SL / DF2B6M4BSL

High efficiency in all areas | High efficiency · Low loss | Small size packages

Value provided

This absorbs static electricity (ESD) from external terminals, prevents circuit malfunction and protects devices.

1 High ESD pulse absorption performance

Improved ESD absorption compared to Toshiba's existing products. (50 % reduction in operating resistance)
For some products, both low operating resistance and low capacitance are realized and ensures high signal protection performance and signal quality.

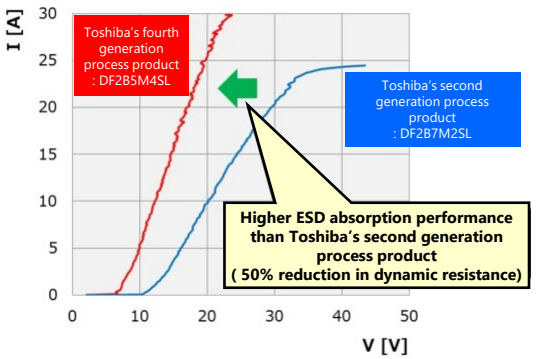
2 Suppress ESD energy by low clamp voltage

Protect the connected circuits and devices using Toshiba own technology.

3 Suitable for high density mounting

A variety of small size packages are available.

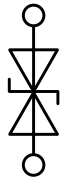
ESD Pulse Absorption Performance
(Toshiba internal comparison)



Unidirectional

Suitable for paths such as logic signals. There are lineups of 1in1, 2in1, 4in1, 5in1, 7in1.

Bidirectional



Suitable for paths with both polar signals such as audio signals.

Lineup

Part number	DF2B5M4SL	DF2B6M4SL	DF2B6M4BSL
Package	SL2	Top view Bottom view	
V_{ESD} [kV]	±20	±20	±8
V_{RWM} (Max) [V]	3.6	5.5	5.5
C_t (Typ.) [pF]	0.2	0.2	0.12
R_{DYN} (Typ.) [Ω]	0.5	0.5	1.05

[Note] This product is an ESD protection diode and cannot be used for purposes other than ESD protection.

◆Return to Block Diagram TOP

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5 Low noise operational amplifier

TC75S67TU

High efficiency in all areas | High efficiency · Low loss | Small size packages

Value provided

Small signals detected by various sensors can be amplified with very low noise.

1 Low noise
V_{NI} = 6.0 [nV/√Hz] (Typ.) @f = 1 kHz

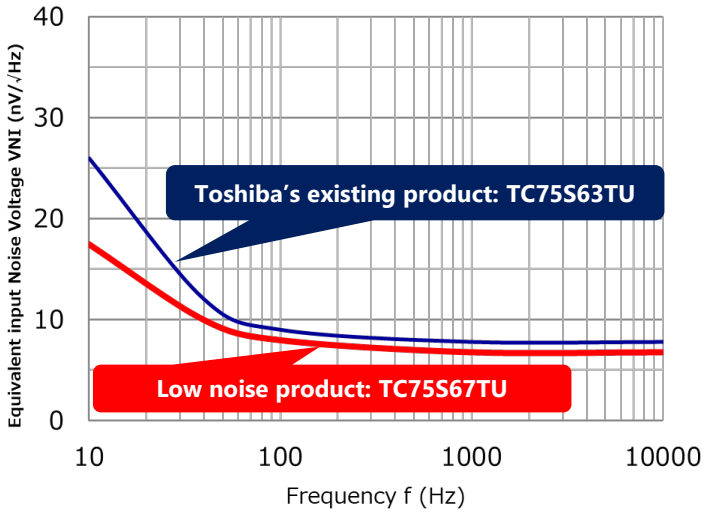
Small signals detected by various sensors [Note] can be amplify with low noise using CMOS operational amplifier by optimizing the processing. We achieved low input equivalent noise voltage.

[Note] Sensor types: vibration detection sensor, shock sensor, accelerometer, pressure sensor, infrared sensor, temperature sensor, etc.

2 Low current consumption
I_{DD} = 430 [µA] (Typ.)

Low current consumption characteristics are realized by using the CMOS process.

Noise characteristics
(Toshiba internal comparison)



Lineup

Part number	TC75S67TU
Package	UFV
$V_{DD,SS}$ (Max) [V]	±2.75
$V_{DD,SS}$ (Min) [V]	±1.1
I_{DD} (Typ.) [µA]	430
V_{NI} [nV/√Hz] (Typ.) @f = 1 kHz	6.0

◆Return to Block Diagram TOP

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6 Brushless DC motor driver (pre-driver)

TC78B009FTG / TC78B011FTG

High efficiency in all areas

High efficiency · Low loss

Small size packages

Value provided

Sensorless type three-phase brushless DC motor driver. It controls motor rotation speed by changing the PWM [Note] duty cycle.

[Note] Pulse Width Modulation

1 Sensorless

Driving brushless DC motor without hall sensors by the commutation signal control based on the back-EMF voltage in each phase of the coil. It contributes to reduce system BOM cost.

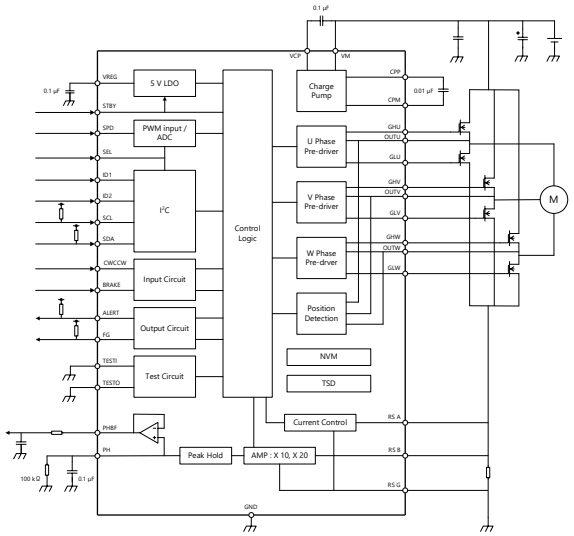
2 Low noise & low vibration

Soft switching and sine wave drive are built in. These contribute to low noise and vibration reduction of motor drive by smooth current waveform. (TC78B011FTG)

3 Abnormality detection functions

Abnormality detection functions such as Over current detection (ISD) , Overheat detection (TSD) and Low voltage detection (UVLO) are built in for stable motor driving.

TC78B009/011FTG



Lineup

Part number	TC78B009FTG	TC78B011FTG
Supply voltage * [V]	30	
Control	Sensorless square wave	Sensorless sine wave
Features & Others	N-ch MOSFETs drive pre-driver Built-in closed loop speed control with adjustable speed curve Serial interface (I^2C) for various settings Standby mode CW/CCW control	
Package	WQFN36	

*: Absolute maximum rating

◆Return to Block Diagram TOP

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7 Brushless DC motor driver

TB67B001FTG

High efficiency in all areas

High efficiency · Low loss

Small size packages

Value provided

Sensorless type three-phase brushless DC motor driver. It controls motor rotation speed by changing the PWM [Note] duty cycle.

[Note] Pulse Width Modulation

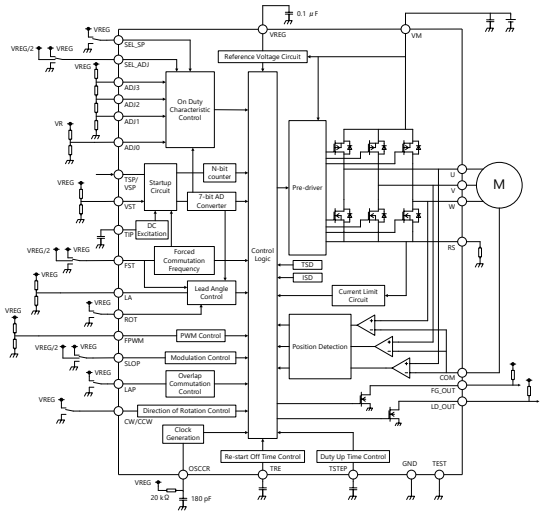
1 Sensorless

Driving brushless DC motor without hall sensors by the commutation signal control based on the back-EMF voltage in each phase of the coil. It contributes to reduce system BOM cost.

2 Abnormality detection functions

Abnormality detection functions such as
Over current detection (ISD), Overheat detection (TSD) and Low voltage detection (UVLO) are built in for stable motor driving.

TB67B001FTG



Lineup

Part number	TB67B001FTG
Supply voltage * [V]	25
Control	Sensorless square wave
Features & Others	Output current * : 3A Output PWM duty adjustment Lead angle control Rotation pulse signal output Forced commutation frequency control Selectable PWM frequency
Package	VQFN36

*: Absolute maximum ratings

◆Return to Block Diagram TOP

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8a 1ch brushed DC motor driver

TB67H450AFNG / TB67H451AFNG

High efficiency in all areas | High efficiency · Low loss | Small size packages

Value provided

High voltage and low power consumption have been achieved by BiCD process. Simple single channel version.

1 High voltage (50 V)

Maximum rating of the output voltage is improved from 40 to 50 V to allow margin for air discharge test, etc.

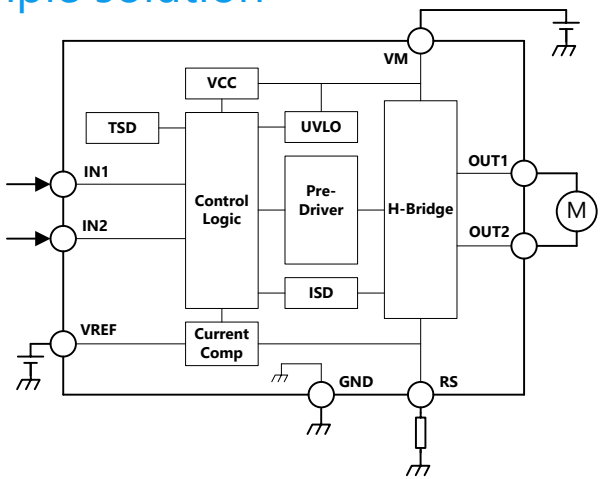
2 Wide operation voltage range

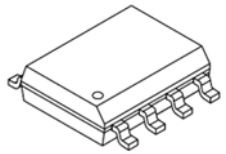
Wide motor power supply voltage operating range from 4.5 to 44 V supports battery drive applications.

3 Highly compatible package

Adopting HSOP8 package compatible with competitor's products or Toshiba's existing products.

■Simple solution





P-HSOP8-0405-1.27-002
(4.9 x 6.0 mm)

Lineup

Part number		TB67H450AFNG	TB67H451AFNG
Motor type		Brushed DC motor	
Maximum ratings	Motor output voltage [V]	50	
	Motor output current [A]	3.5	
Motor power supply voltage operating range [V]		4.5 to 44	
Output on-resistance (H+L) (Typ.) [Ω]		0.6	
Output circuit		1 circuit	
Control interface		1 mode	
Phase mode		2-phase, 1-2 phase excitation	
Abnormality detection function		Overheat (TSD), over current (ISD), low voltage (UVLO)	

◆Return to Block Diagram TOP

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8b 2ch brushed DC motor driver

TB67H401FTG / TB67H420FTG

High efficiency in all areas | High efficiency · Low loss | Small size packages

Value provided

High voltage, high current and low power consumption have been achieved by BiCD process. 2ch version adopted Toshiba's original current detection.

1 High voltage (50 V) / High current

Maximum rating of the output voltage is improved from 40 to 50 V to allow margin for air discharge test etc.
TB67H420 can handle an absolute output maximum current of 9 A.

2 Toshiba's original current detection

TB67H401FTG can feedback current detection signal to controller such as MCU by the current limiter output.
TB67H420FTG realizes the constant current PWM [Note 1] without detection resistors by ACDS [Note 2] function.

3 Three selectable drive modes

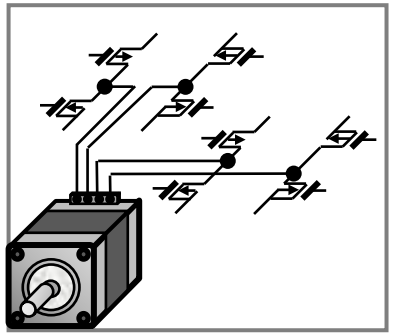
The H-bridge combination can be tailored according to the type of motor and the required current capacity as: (1) single stepper drive, (2) dual brush drive, and (3) high current, single brush drive.

[Note 1] Pulse Width Modulation

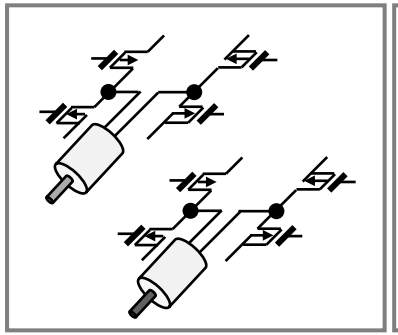
[Note 2] Advanced Current Detection System

■Three selectable drive modes

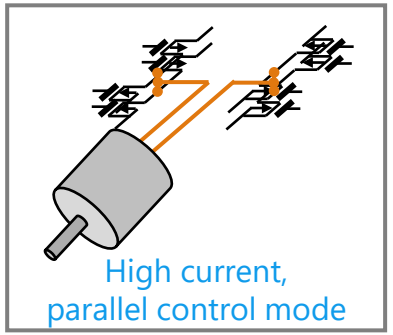
(1) Single stepper



(2) Dual brush



(3) High current, single brush



High current, parallel control mode

Lineup

Part number	TB67H401FTG	TB67H420FTG
Motor type	Brushed DC motor	
Motor output voltage [V]	50	
Motor output current [A]	6.0 (Single H-bridge mode)	9.0 (Single H-bridge mode)
Output on-resistance [Ω]	0.25	0.17
Output circuit	2 circuits	
Control impedance	4 modes	
Step resolution/excitation mode	1/1, 1/2 step (2-phase, 1-2 phase excitation)	
Error detection	Overheating (TSD), over current (ISD), low voltage monitoring (POR)	
Package	QFN48	

◆Return to Block Diagram TOP

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9 MCU

TXZ+™ 4A Series M4K Group / TX04 Series M470 Group / TX03 Series M370 Group

High efficiency in all areas | High efficiency · Low loss | Small size packages

Value provided

System cost reduction, higher efficiency and less development work.

1 Equipped with motor control co-processor

Toshiba's original co-processor vector engine (VE) for motor control reduces CPU load and allows control of multiple motors and peripherals. [Note 1]

2 Equipped with motor control circuit

A variety of three-phase PWM [Note 2] waveforms and AD converters enable highly efficient, low noise control. The Advanced Encoder (A-ENC) reduces the load of CPU process in detecting the position performed for each PWM.

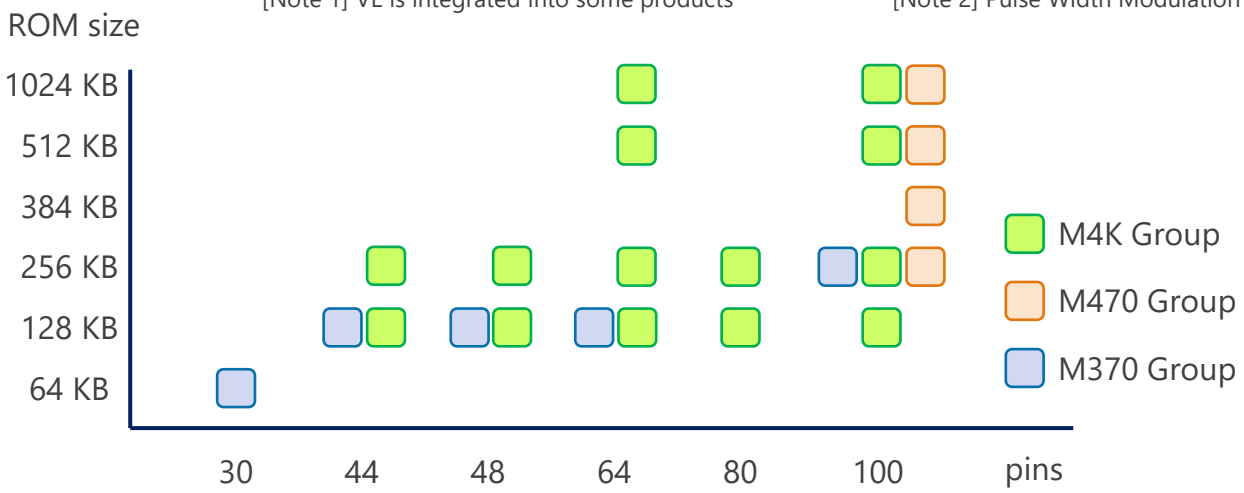
3 Provide development support tools

Third party evaluation boards and sample programs that can be used to shorten the development time are provided. Toshiba has also offered new, simple, versatile motor control software development kits (MCU Motor Studio). [Note 3]

[Note 1] VE is integrated into some products

[Note 2] Pulse Width Modulation

[Note 3] MCU Motor Studio supports some products and will expand in TXZ+™ family.



Lineup

Series	Group	Function
TXZ+™ 4A Series	M4K Group	Arm® Cortex®-M4, Max. 160 MHz operation 4.5 to 5.5 V, 3motor control (Max), Data Flash
TX04 Series	M470 Group	Arm® Cortex®-M4, Max. 160 MHz operation 4.5 to 5.5 V, 2motor control (Max)
TX03 Series	M370 Group	Arm® Cortex®-M3, 80 MHz operation 4.5 to 5.5 V, 2motor control (Max)

◆Return to Block Diagram TOP

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10a Electronic fuse (eFuse IC)

TCKE8 Series / TCKE7 Series

High efficiency in all areas | High efficiency · Low loss | Small size packages

Value provided

Electronic fuse (eFuse IC) can be used repeatedly to protect circuits from abnormal conditions such as over current and over voltage.

1 Can be used repeatedly

When over current flows through the electronic fuse (eFuse IC), the internal detection circuit operates and switches off the internal MOSFET. Unlike conventional fuses, eFuse IC can be used repeatedly.

2 IEC 62368-1 certified

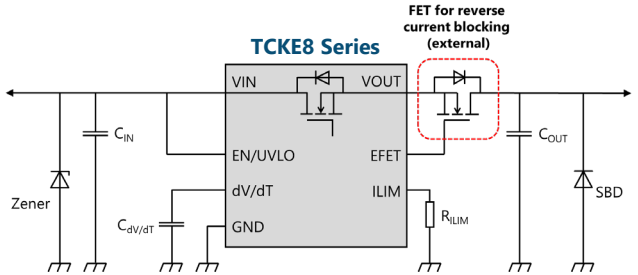
Toshiba's eFuse ICs are certified to the international safety standard IEC 62368-1 (G9: Integrated circuit (IC) current limiters) and contribute to robust protection and simplification of circuit design.

3 Rich protection functions

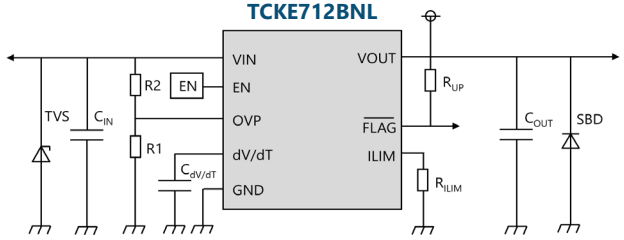
TCKE8 Series: short circuit protection, over current protection, over current clamp function, over voltage clamp function, thermal shutdown, inrush current suppression, backflow prevention (optional), etc.

TCKE7 Series: short circuit protection, over current protection, over voltage protection, thermal shutdown, FLAG signal output, backflow prevention (built-in), etc.

Example of peripheral circuit for TCKE8 Series



Example of peripheral circuit for TCKE7 Series



Lineup

Part number	TCKE800NA/NL	TCKE805NA/NL	TCKE812NA/NL	TCKE712BNL
Package	WSON10B 3.0 x 3.0 x 0.75 mm Top view Bottom view			WSON10 3.0 x 3.0 x 0.75 mm
V_{IN} [V]	4.4 to 18.0			4.4 to 13.2
R_{ON} (Typ.) [mΩ]	28			53
Fault response	NA: Auto-retry NL: Latched (external signal control)			Latched (external signal control)
V_{OVC} (Typ.) [V]	-	6.04	15.1	Adjustable

◆Return to Block Diagram TOP

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Electronic fuse (eFuse IC)

TCKE9 Series

High efficiency in all areas | High efficiency · Low loss | Small size packages

Value provided

Electronic fuse (eFuse IC) can be used repeatedly to protect circuits from abnormal conditions such as over current and over voltage.

1 Can be used repeatedly

When over current flows through the electronic fuse (eFuse IC), the internal detection circuit operates and switches off the internal MOSFET. Unlike conventional fuses, eFuse IC can be used repeatedly.

2 Product selection is possible according to usage

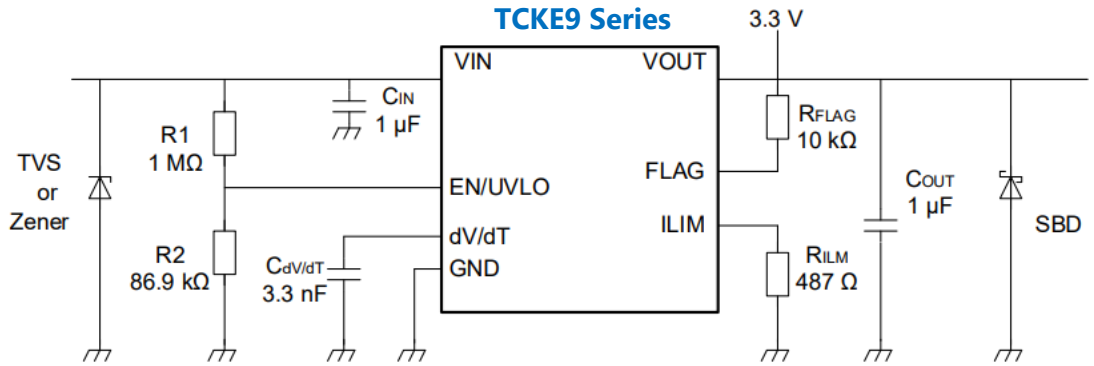
Suitable product with suitable failure response can be selected according to usage.

NA: Auto-retry type
QNA: Auto-retry with quick output discharge type
NL: Latched type

3 Rich protection functions

TCKE9 Series feature many protection functions such as adjustable over current limit, short circuit protection, over voltage clamp, adjustable slew rate control, adjustable under voltage Protection, and thermal shutdown.

Example of peripheral circuit for TCKE9 Series



Lineup

Part number	TCKE903NA/NL/QNA	TCKE905ANA/NL/QNA	TCKE912NA/NL	TCKE920NA/NL
Package	WSON8 2.0 x 2.0 x 0.75 mm	Top view	Bottom view	
V_{IN} [V]	2.7 to 23			
R_{ON} (Typ.) [mΩ]	34			
Fault response	NA: Auto-retry (QNA: with quick output discharge), NL: Latched			
V_{OVC} (Typ.) [V]	3.87	5.7	13.7	22.2

◆Return to Block Diagram TOP

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Electronic fuse (eFuse IC)

TCKE6 Series

High efficiency in all areas | High efficiency · Low loss | Small size packages

Value provided

Electronic fuse (eFuse IC) can be used repeatedly to protect circuits from abnormal conditions such as over current and over voltage.

1 Can be used repeatedly

When over current flows through the electronic fuse (eFuse IC), the internal detection circuit operates and switches off the internal MOSFET. Unlike conventional fuses, eFuse IC can be used repeatedly.

2 Product selection is possible according to usage

Suitable product can be selected according to usage.

FLAG function: TCKE601RA/RL

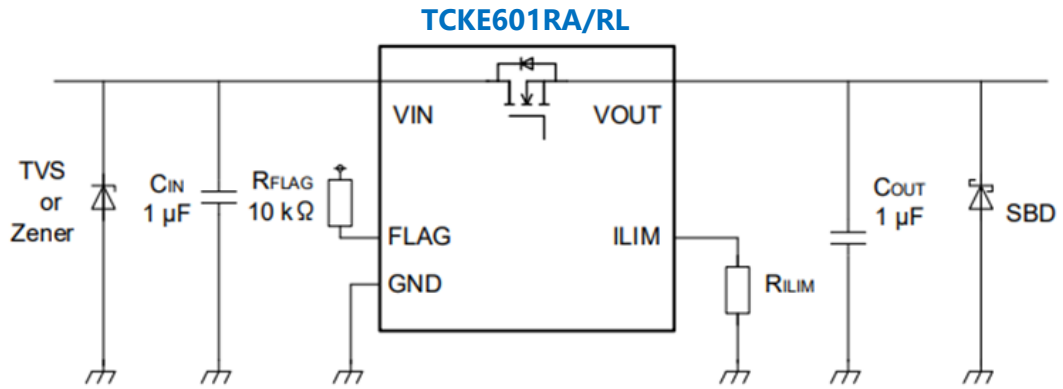
MODE function (selectable recovery mode): TCKE602

EN (enable) function: TCKE603RA/RL

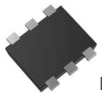
3 Rich protection functions

TCKE6 Series feature many protection functions such as adjustable over current limit, short circuit protection, under voltage protection, and thermal shutdown.

Example of peripheral circuit for TCKE601RA/RL



Lineup

Part number	TCKE601RA	TCKE601RL	TCKE602RM	TCKE603RA	TCKE603RL
Package	TSOP6F Top view  Bottom view				
V_{IN} [V]	4.4 to 30				
R_{ON} (Typ.) [mΩ]	52				
Function	FLAG		MODE	EN	
Fault response	Auto-retry	Latched	Selectable type	Auto-retry	Latched

◆Return to Block Diagram TOP

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11 N-ch MOSFET gate driver IC

TCK4xx series

High efficiency in all areas | High efficiency · Low loss | Small size packages

Value provided

It is N-ch MOSFET gate driver IC with OVP [Note 1] function. It contributes to reduction of power consumption and miniaturization of load switch circuit.

[Note 1] OVP: Over Voltage Protection

1 Three types of N-ch MOSFET can be driven

The following types of MOSFET can be driven:
TCK40xG: Single high side connection
Common source connection
TCK42xG: Single high side connection
Common drain connection

2 Wide operating voltage range and various OVLO [Note 2] threshold voltage

Operating voltage V_{opr}: 2.7 to 28 V
Maximum input voltage: 40 V
V_{IN_OVLO} [Note 3] lineups suitable for 5 to 24V power supply line.

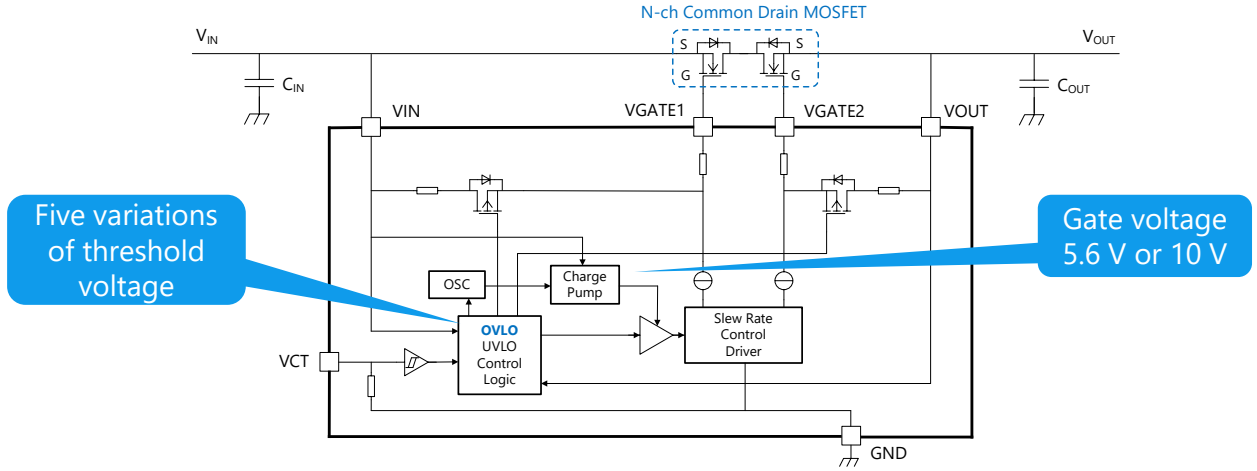
[Note 2] OVLO: Over Voltage Lock Out
[Note 3] V_{IN_OVLO}: V_{IN} OVLO threshold

3 Small size packages

It contributes to reduction of the mounting area and miniaturization of the circuit board :

WCSP6E: 1.2 x 0.8 mm, t: 0.55 mm
WCSP6G: 1.2 x 0.8 mm, t: 0.35 mm

Circuit example of TCK42xG with N-ch common drain connection MOSFET



Lineup

Part number	V_{IN_OVLO} Min / Max [V]	V_{GS} Typ. / Max [V]	N-ch MOSFET type can be driven	Package
TCK401G	Over 28	Max 10 (V_{IN} ≥ 12 V)	Single high side Common Source	WCSP6E
TCK402G				
TCK420G	26.50 / 28.50	10 / 11 (V_{IN} ≥ 5 V)	Single high side Common Drain	WCSP6G
TCK421G	22.34 / 24.05			
TCK422G	13.61 / 14.91			
TCK423G	13.61 / 14.91	5.6 / 6.3		
TCK424G	10.35 / 11.47			
TCK425G	5.76 / 6.87			

◆Return to Block Diagram TOP

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