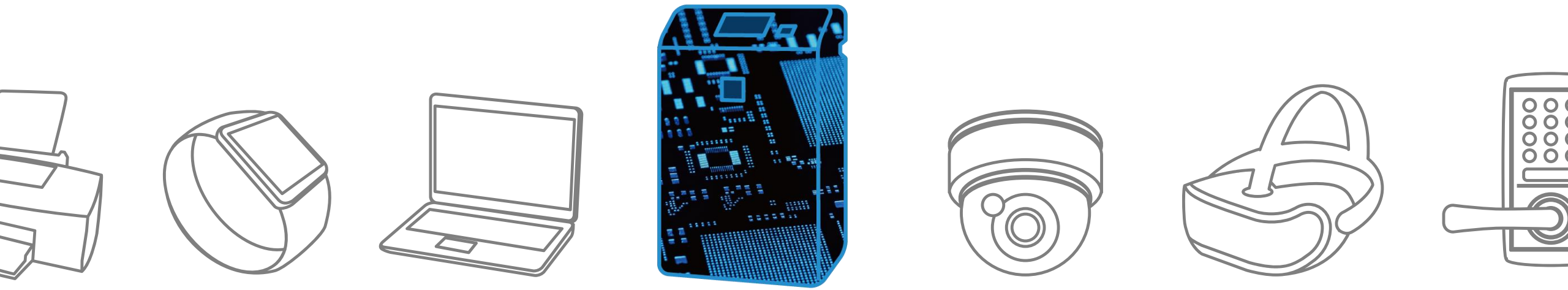
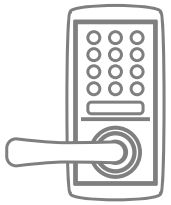
TOSHIBA

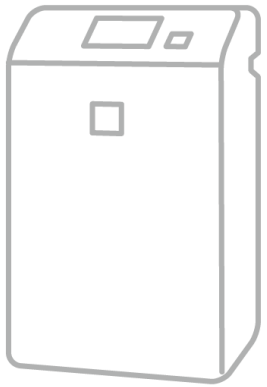
R22

Air Cleaner

Solution Proposal by Toshiba

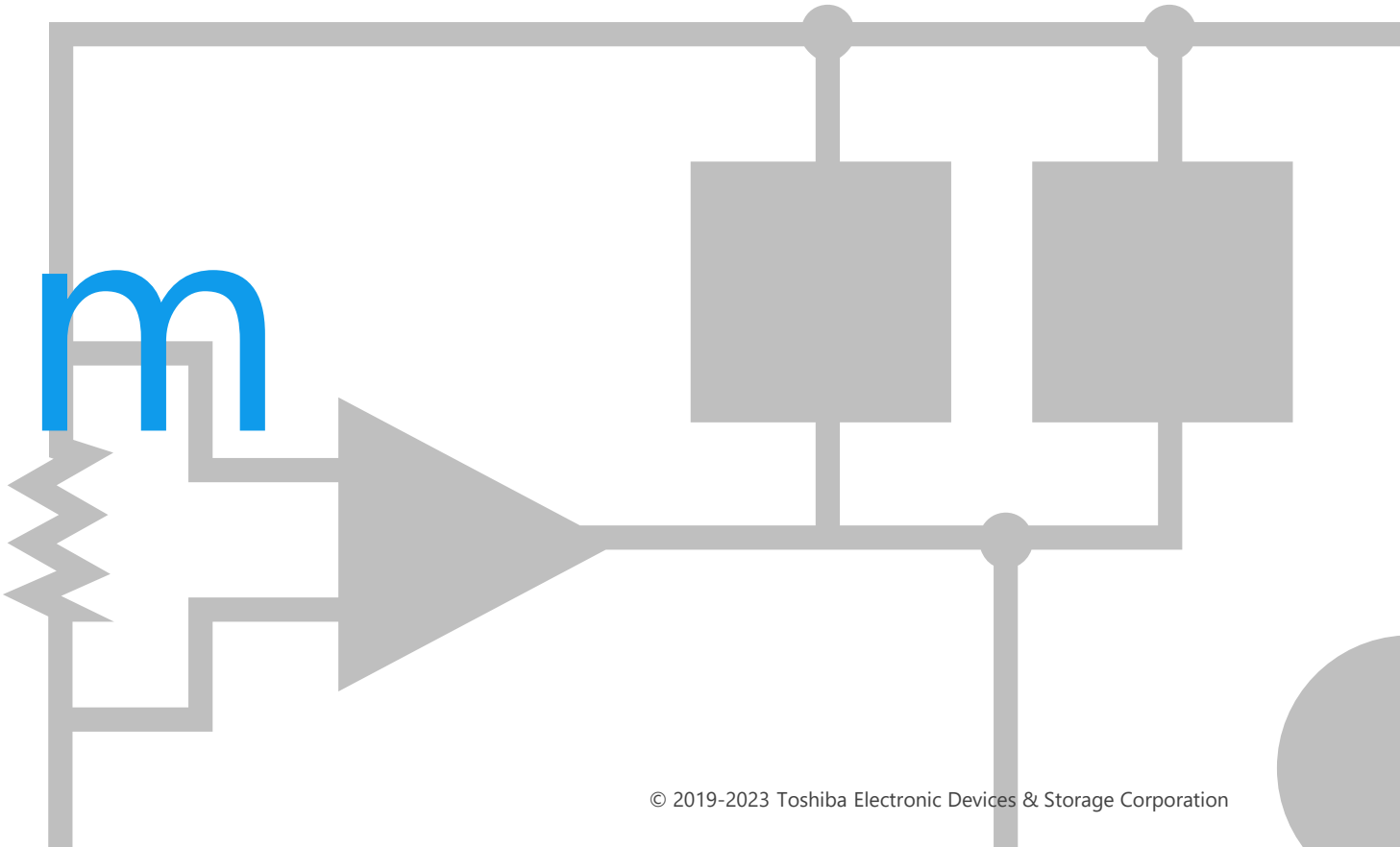




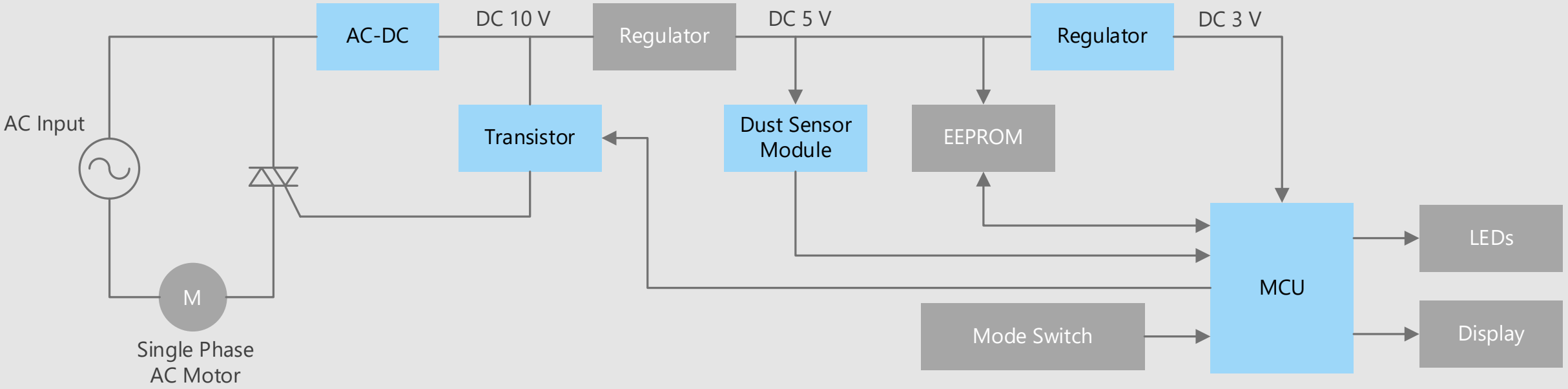


Toshiba Electronic Devices & Storage Corporation provides comprehensive device solutions to customers developing new products by applying its thorough understanding of the systems acquired through the analysis of basic product designs.

Block Diagram

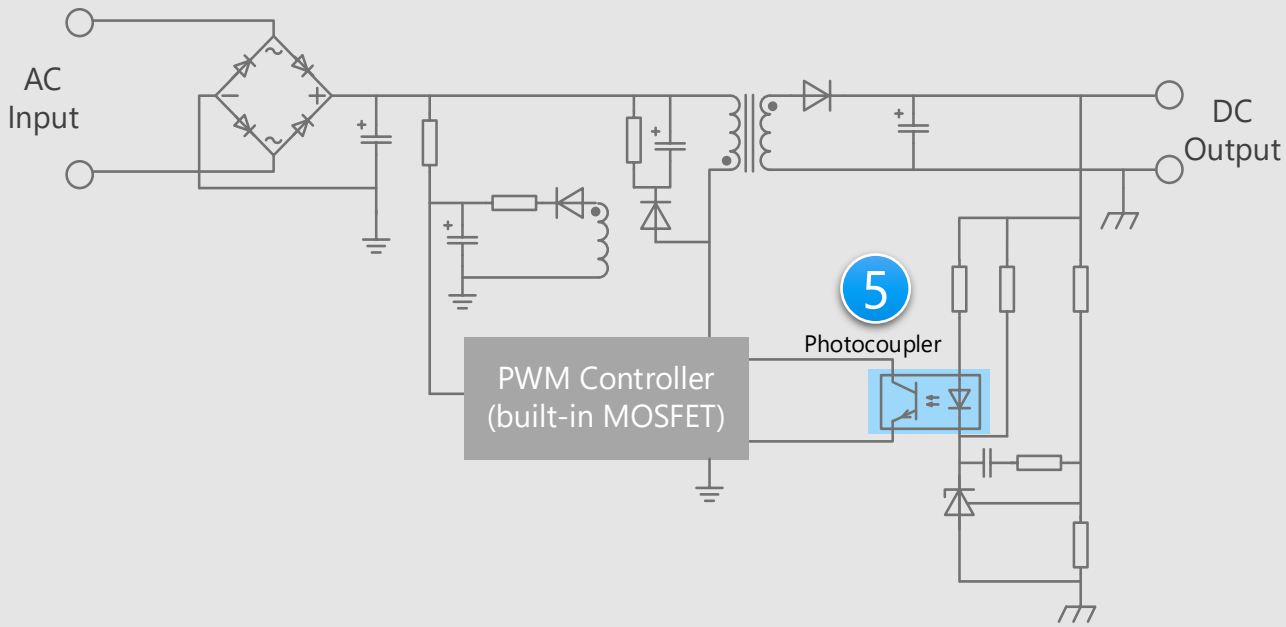


Air Cleaner　Overall block diagram



Air Cleaner　Detail of power supply unit

Flyback type AC-DC converter circuit



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

Criteria for device selection

- A photocoupler with high current transfer ratio in the low input current range contributes to high power supply efficiency.
- Small package products contribute to the reduction of circuit board area.

Proposals from Toshiba

- **High current transfer ratio and high temperature operation are realized**
  Transistor output photocoupler

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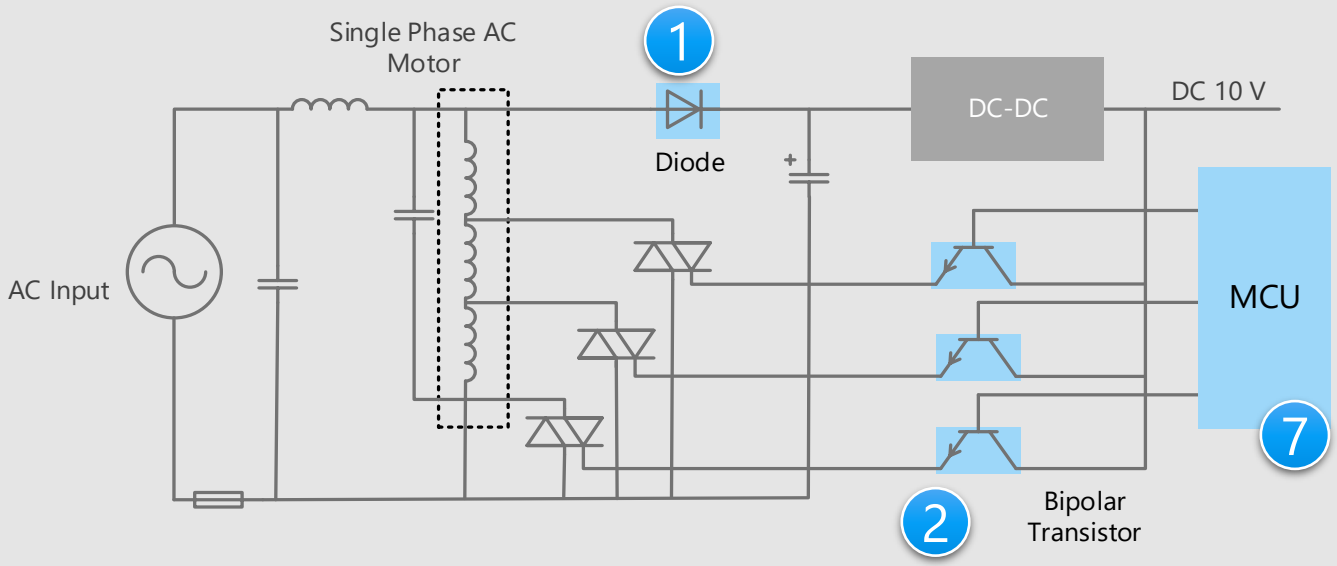
Air Cleaner　Detail of main motor unit (1)

Main motor drive unit (When AC motor is used)



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

Criteria for device selection

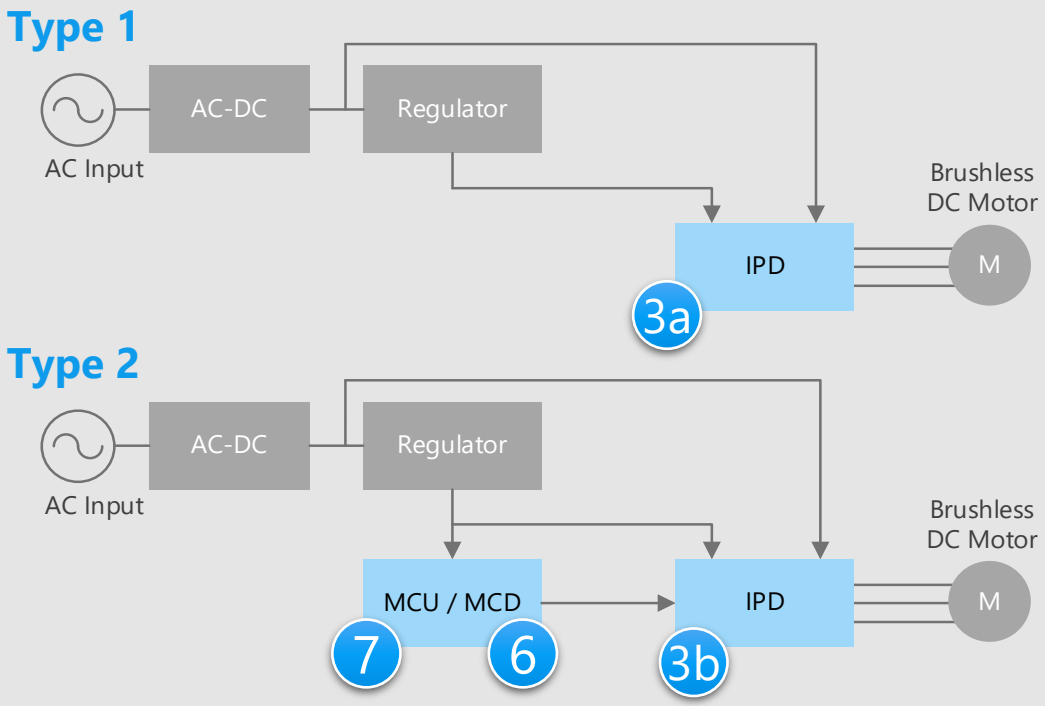
- Small package products contribute to the reduction of circuit board area.
- Stable motor driving can be realized by using bipolar transistors, which have higher ESD tolerance than MOSFET.

Proposals from Toshiba

- **Suitable for rectification**
  Rectifier diode
- **Suitable for use in small current switches**
  Bipolar transistor
- **System control at low power consumption with analog interfaces**
  MCU TMPM036FWFG / TMPM037FWUG

Air Cleaner　Detail of main motor unit (2)

Main motor drive unit
(When brushless DC motor is used)



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

Criteria for device selection

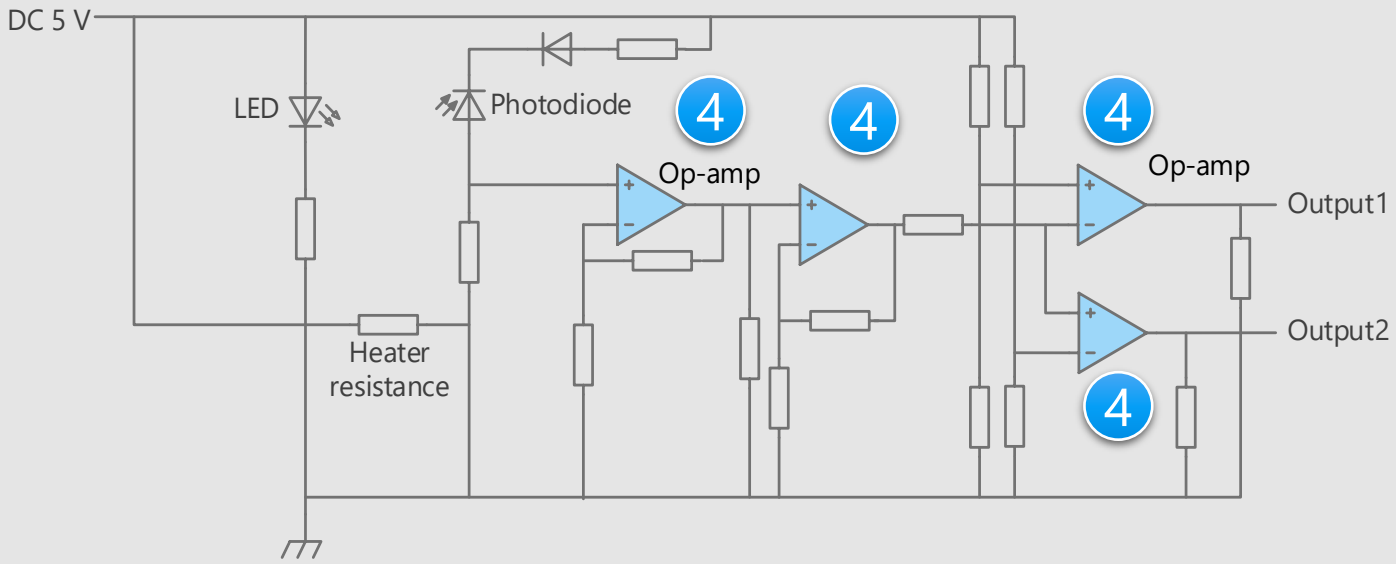
- The use of IPD enables direct variable speed driving of brushless DC motors.
- Brushless DC motor controller allows easy control of three-phase brushless DC motor using inverter control.
- Small package products contribute to the reduction of circuit board area.

Proposals from Toshiba

- **High voltage motor can be driven** 3a 3b
  High voltage IPD
- **Easy motor control** 6
  Brushless DC motor controller IC
- **System control at low power consumption with analog interfaces** 7
  MCU TMPM036FWFG / TMPM037FWUG

Air Cleaner　Detail of dust sensor unit

Dust sensor section



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

Criteria for device selection

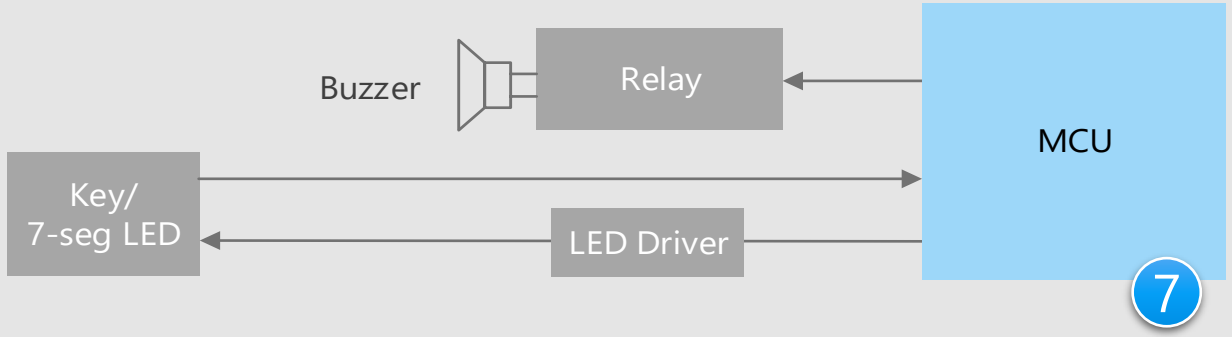
- Small package products contribute to the reduction of circuit board area.
- Low noise operational amplifiers are suitable for high precision sensing.

Proposals from Toshiba

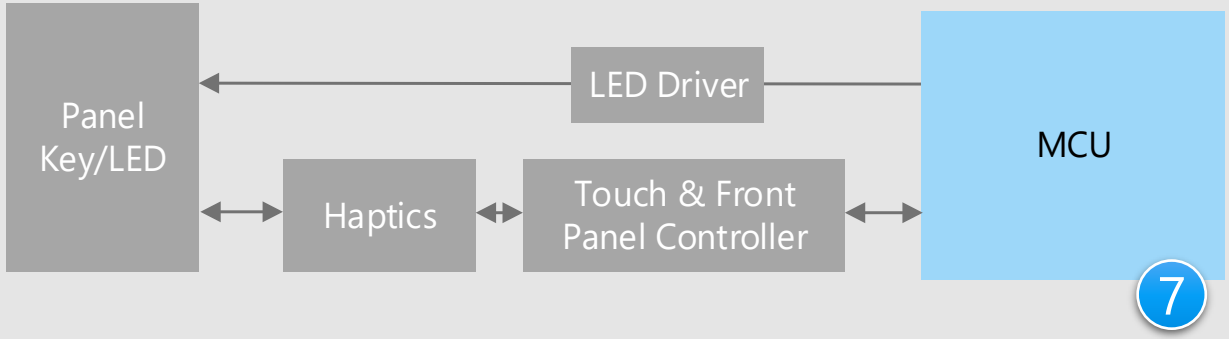
- **Amplify the detected very small signal with low noise**
  Low current consumption op-amp / Low noise op-amp　4

Air Cleaner　Detail of operation unit

Operation unit (Example of Key/LED)



Operation unit (Example of touch panel)



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

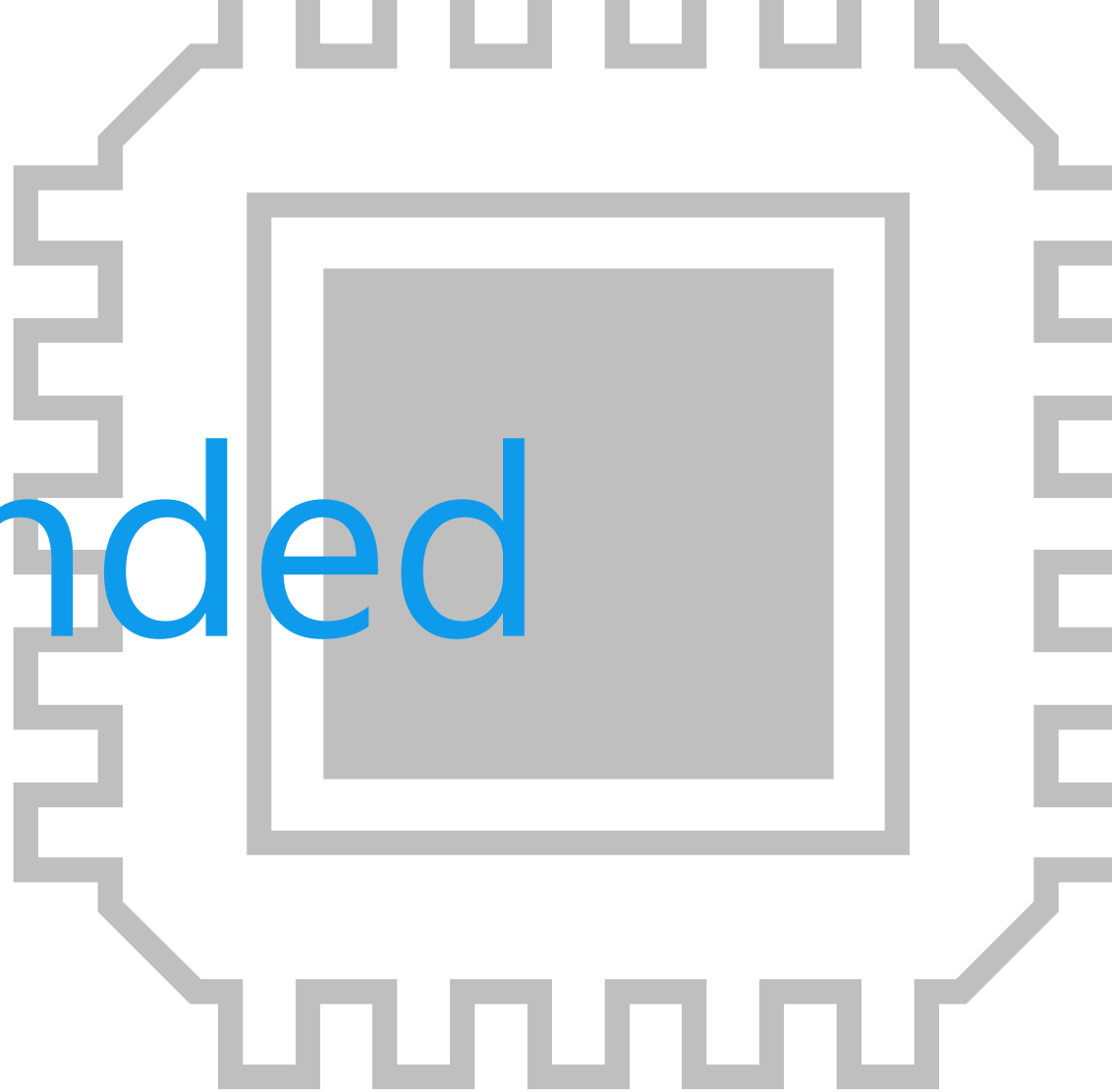
Criteria for device selection

- An MCU which has analog interfaces with low power consumption is suitable for monitoring of various sensors and system control.

Proposals from Toshiba

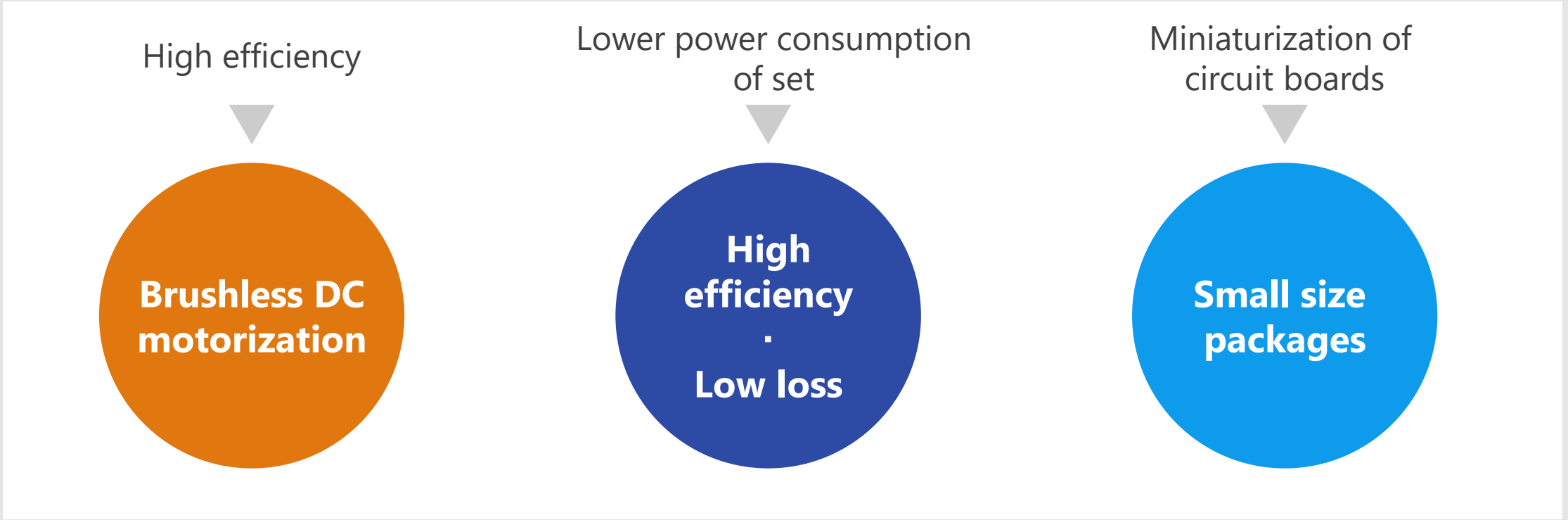
- **System control at low power consumption with analog interfaces**
  MCU TMPM036FWFG / TMPM037FWUG 7

Recommended Devices



Device solutions to address customer needs

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



Device solutions to address customer needs

	Brushless DC motorization	High efficiency · Low loss	Small size packages
1 Rectifier diode		●	●
2 Bipolar transistor		●	●
3a 3b High voltage IPD	●	●	●
4 Low current consumption op-amp / Low noise op-amp		●	●
5 Transistor output photocoupler		●	●
6 Brushless DC motor controller IC	●	●	●
7 MCU TMPM036FWFG / TMPM037FWUG		●	●

1 Rectifier diode
CMG06A

Brushless DC motorization | High efficiency · Low loss | Small size packages

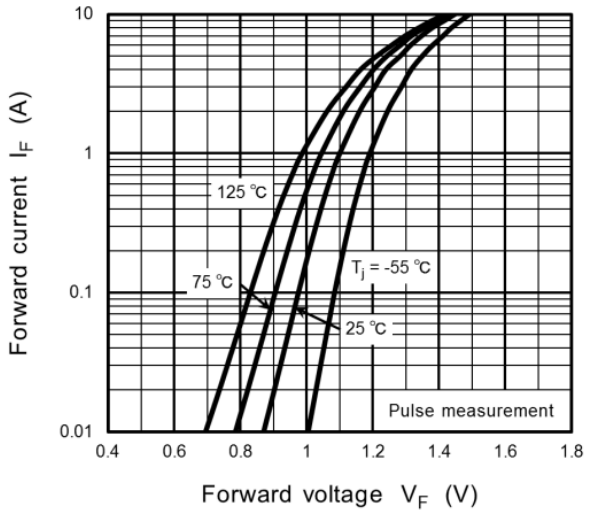
Value provided

Wide range of products are provided, mainly small package that is suitable for high density assembly.

1 Surface mount / small package

The use of M-FLAT™ packages contributes to the reduction of height and space saving of equipment compared to previous lead type devices [Note] .

[Note] Comparison with Toshiba's products



CMG06A
forward characteristic

2 Wide product lineup

A lineup of repetitive peak reverse voltages of 200 to 1000 V and average forward current of 0.5 to 3 A is available, enabling the selection of devices according to requirements.

Lineup

Part number	CMG06A
Package	M-FLAT™ 
$I_{F(AV)}$ [A]	1
V_{RRM} [V]	600

◆Return to Block Diagram TOP

2 Bipolar transistor

2SC6026CT

Brushless DC motorization | High efficiency · Low loss | Small size packages

Value provided

With wide product lineup, Toshiba provides products that meet the needs of customers.

1 Wide package lineup

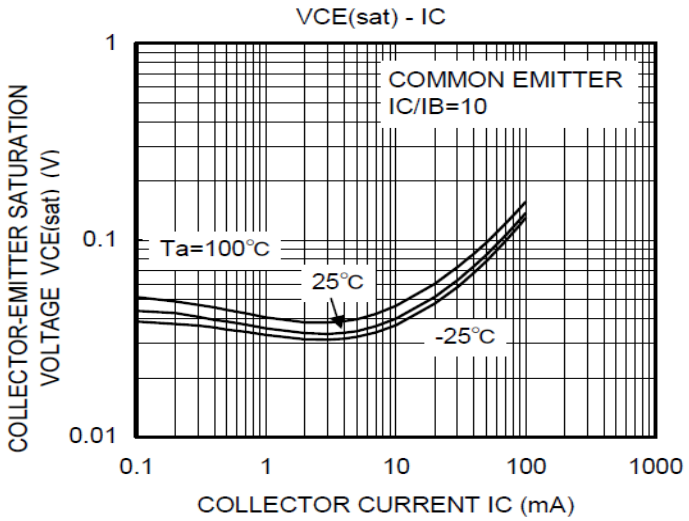
A large number of packages, such as flat lead and leadless, are available, allowing to choose products that suit circuit boards of the set.

2 Low collector-emitter saturation voltage

The low saturation voltage between the collector and emitter realize lower power consumption.

3 High ESD resistance

In applications where static electricity is likely to occur, such as air cleaners, bipolar transistors with higher ESD resistance than MOSFET are needed.



Lineup

Part number	2SC6026CT
Type	NPN
Package	CST3 
V_{CEO} [V]	50
I_C [mA]	100

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3a High voltage IPD

TPD4162F

Brushless DC motorization | High efficiency · Low loss | Small size packages

Value provided

This product optimizes for brushless DC motor driving and has the functions required for motor driving into one package.

1 Contributing to low power consumption

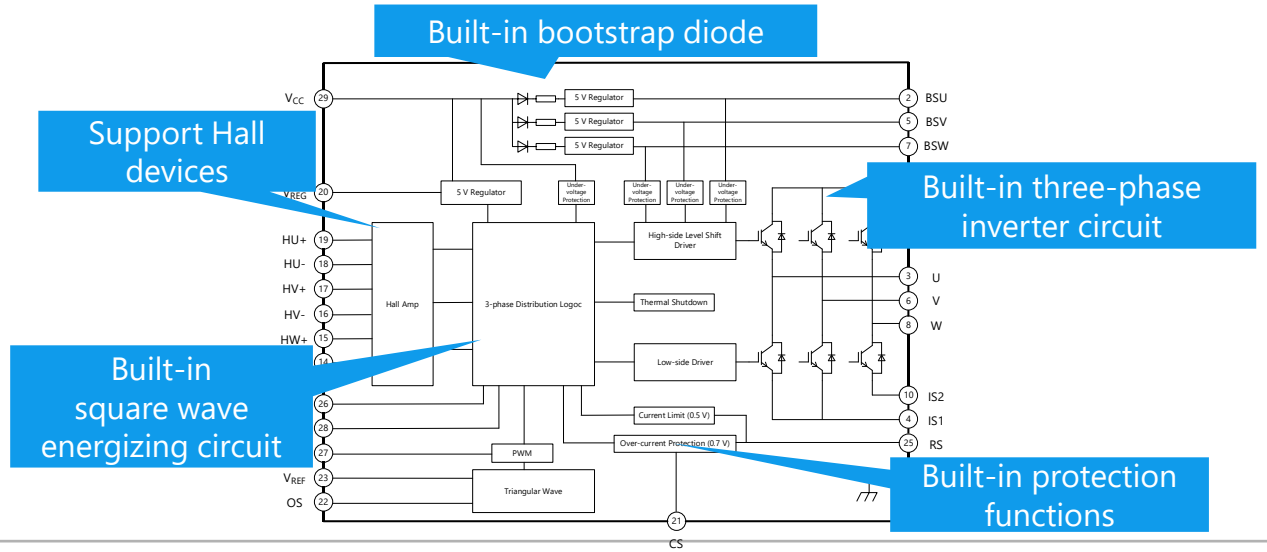
The power consumption can be reduced by replacing from the AC motor to a brushless DC motor.

2 Contributing to reducing the number of parts

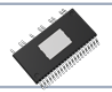
Built-in functions and protection functions required for inverter operation can reduce the number of parts.

3 Contributing to reduction of circuit board area

The use of small surface mount packages contributes to the reduction of circuit board area.



Lineup

Part number	TPD4162F
Package	P-HSSOP31-0918-0.80-002 
V_{BB} [V]	600
I_{out} [A]	0.7
V_{CC} (Max) [V]	17.5
Protective function	Current limitation, overcurrent protection, thermal shutdown, under voltage protection

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3b High voltage IPD

TPD4204F / TPD4163F / TPD4163K / TPD4164F / TPD4164K

Brushless DC motorization | High efficiency · Low loss | Small size packages

Value provided

A brushless DC motor driver with a built-in MOSFET can be driven at a variable speed by control signals from the MCU.

1 Built-in circuit required to drive the motor

It contains a level shifting high side driver, low side driver and MOSFETs or IGBTs.

TPD4204F: MOSFET output

TPD4163F/TPD4163K/TPD4164F/TPD4164K: IGBT output

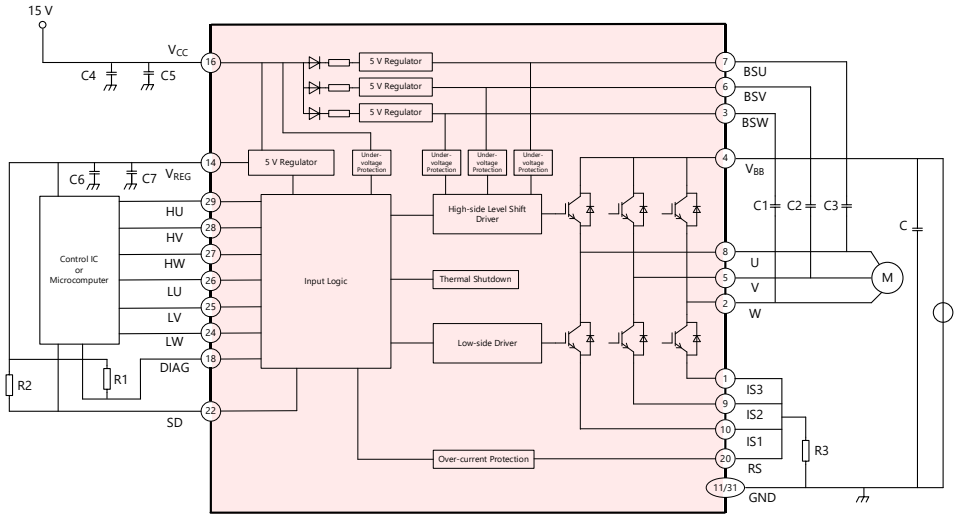
2 Motor drive terminals and control terminals are separated

High voltage and large current terminals and the control terminals are separated on both sides of the package, thereby eliminating the complexity of wiring.

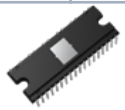
3 Various protection functions

Over current and under voltage protection, shutdown and thermal shutdown functions are available.

TPD4163F Application Circuit Example



Lineup

Part number	TPD4204F	TPD4163F	TPD4164F	TPD4163K	TPD4164K
Package	 P-SSOP30-1120-1.00-001	 P-HSSOP31-0918-0.80-002		 P-HDIP30-1233-1.78-001	
V_{BB} [V]	600				
I_{out} [A]	2.5	1.0	2.0	1.0	2.0
V_{CC} [V]	13.5 to 16.5				

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4 Low current consumption op-amp / Low noise op-amp

TC75S102F / TC75S67TU

Brushless DC motorization | High efficiency · Low loss | Small size packages

Value provided

Lineup includes low current consumption type that contributes to low power consumption and a low noise type that maximizes the performance of high performance sensors.

1 Low voltage operation

We have a lineup of low power supply voltage-driven operational amplifiers using CMOS process for low power supply voltage-driven wearable equipment.

2 Low current consumption

(TC75S102F) I_{DD} = 0.27 [µA] (Typ.)

CMOS processes have been used to achieve lower current consumption. This contributes to lower power consumption and longer life of wearable equipment.

3 Low noise (TC75S67TU)

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

This CMOS operational amplifier can amplify minute signals detected by various sensors [Note] with low noises. By optimizing the process, the equivalent input noise voltage has been reduced.

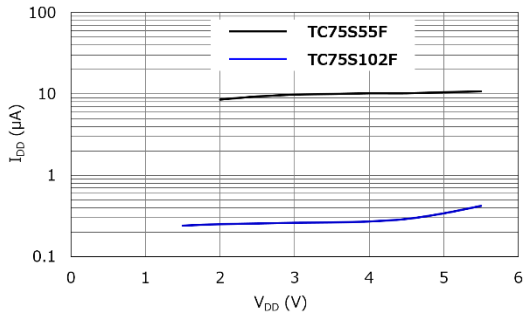
[Note] Sensor types: vibration, shock, acceleration, pressure, infrared, temperature, etc.

TC75S102F

Current Consumption Characteristic

(Toshiba internal comparison)

Low current consumption product TC75S102F

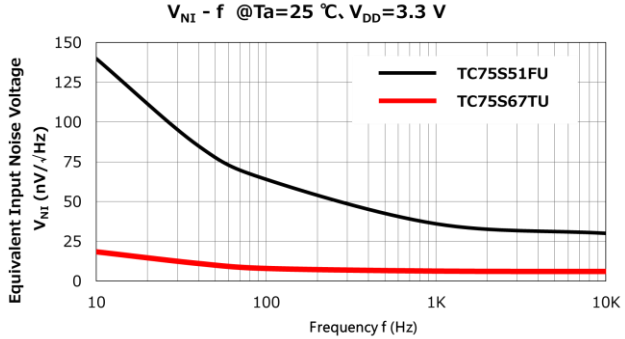


TC75S67TU

Noise Characteristic

(Toshiba internal comparison)

Reduce 1/f noise (10 Hz) by 86 % from our normal products



Lineup

Part number	TC75S102F	TC75S67TU
Package	SMV 	UFV 
V_{DD} - V_{SS} [V]	1.5 to 5.5	2.2 to 5.5
V_{IO} (Max) [mV]	1.3	3
CMV_{IN} (Max) [V]	V_{DD}	1.4 (@V_{DD} = 2.5 V)
I_{DD} (Typ. / Max) [µA]	0.27 / 0.46 (@V_{DD} = 1.5 V)	430 / 700 (@V_{DD} = 2.5 V)
V_{NI} (Typ.) [nV/√Hz] @f = 1 kHz	-	6

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5 Transistor output photocoupler

TLP383 / TLP293 / TLP385

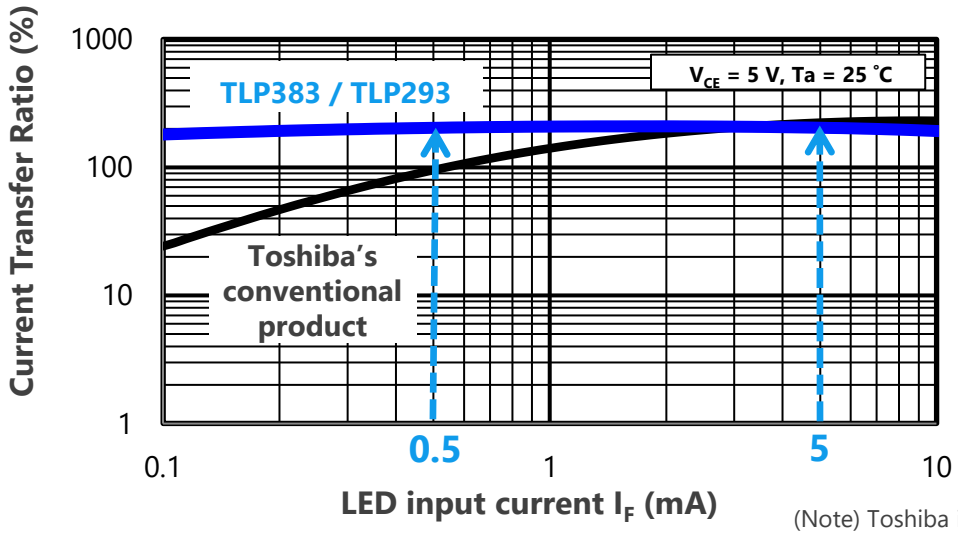
Brushless DC motorization | High efficiency · Low loss | Small size packages

Value provided

High CTR (Current Transfer Ratio) is realized even in low input current range (I_F = 0.5 mA).

1 High current transfer ratio

The TLP383 and TLP293 is a high isolation photocoupler that optically couples a phototransistor and high output infrared LED. Compared to Toshiba's conventional products (TLP385), higher CTR (Current Transfer Ratio) in low input current range (@I_F = 0.5 mA) is realized.



(Note) Toshiba internal comparison

2 High temperature operation

The TLP383 and TLP293 are designed to operate even under severe ambient temperature conditions.

Lineup

Part number	TLP383	TLP293	TLP385
Package	4pin SO6L 	SO4 	4pin SO6L 
BV_S [Vrms]	5000	3750	5000
T_{opr} [°C]	-55 to 125	-55 to 125	-55 to 110

◆Return to Block Diagram TOP

6 Brushless DC motor controller IC

TB6584FNG / TB6584AFNG / TB6586AFG

Brushless DC motorization | High efficiency · Low loss | Small size packages

Value provided

By using IPD externally to the controller, high voltage and high current brushless DC motor drive is realized.

1 Efficient motor control using auto lead angle control

In addition to fixed angle control using voltage input (32 steps), auto lead angle control using current feedback is possible.

2 Motor control with low noise and low vibration

Sine wave drive system with smooth current waveforms contributes to lower motor noise and vibration compared to conventional square wave drive system [Note].

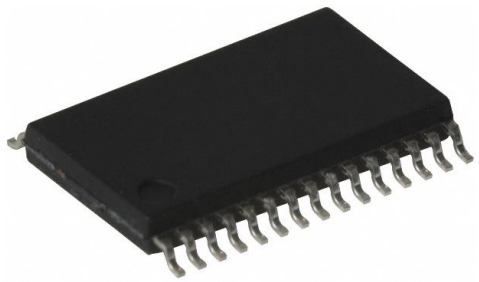
(TB6584FNG, TB6584AFNG)

3 Full development support

Third party evaluation boards and PSpice® data can be provided to support customer development and design.

[Note] Comparison with Toshiba products

TB6584FNG, TB6584AFNG



Package: SSOP30-P-300-0.65 (10.2 x 7.6 x 1.6 mm)

Lineup

Part number	TB6584FNG	TB6584AFNG	TB6586AFG
V_{CC} [V]	6 to 16.5		6.5 to 16.5
I_{OUT} [A]	0.002		0.003
Drive mode	Sine wave drive		Square wave drive
Features	Lead angle control: Auto phase control (current feedback) Sensor input: Hall device/Hall IC compatible Internal regulator: 5 V, 30 mA (Max) Error detection: Overcurrent protection, position signal error, low voltage		Lead angle control: External input Sensor input: Hall device/Hall IC compatible Internal regulator: 5 V, 35 mA (Max) Error detection: Overcurrent protection, position signal error, low voltage

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7 MCU

TX00 Series M030 Group TMPM036FWFG / TMPM037FWUG

Brushless DC motorization | High efficiency · Low loss | Small size packages

Value provided

It contributes to system cost down, high efficiency system and development efficiency improvement.

1 Built-in Arm® Cortex®-M0 CPU core

Built-in Arm Cortex-M0 core with Arm® Thumb® instruction set improves energy efficiency. Various development tool and their partners allow users many options.

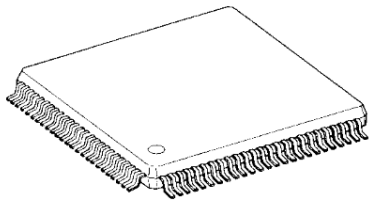
2 Suitable for sensing analog signal

Built-in multichannel AD converter executes sensing data processing efficiently at low cost.

3 Small package and low power consumption

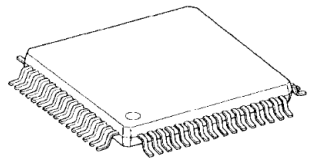
Cortex-M0 and Toshiba original NANO FLASH™ technology bring to the small package and low power consumption. They contribute to reduce circuit board area and power consumption.

TMPM036FWFG



Package:
LQFP100-P-1414-0.50H

TMPM037FWUG



Package:
LQFP64-P-1010-0.50E

Lineup

Part number	TMPM036FWFG	TMPM037FWUG
Maximum operation frequency	20 MHz	20 MHz
Instruction ROM	128 KB	128 KB
RAM	16 KB	16 KB
Timer	14ch	10ch
UART / SIO	6	5
I^2C	2	1
AD converter	8ch (10bit)	8ch (10bit)

◆Return to Block Diagram TOP

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