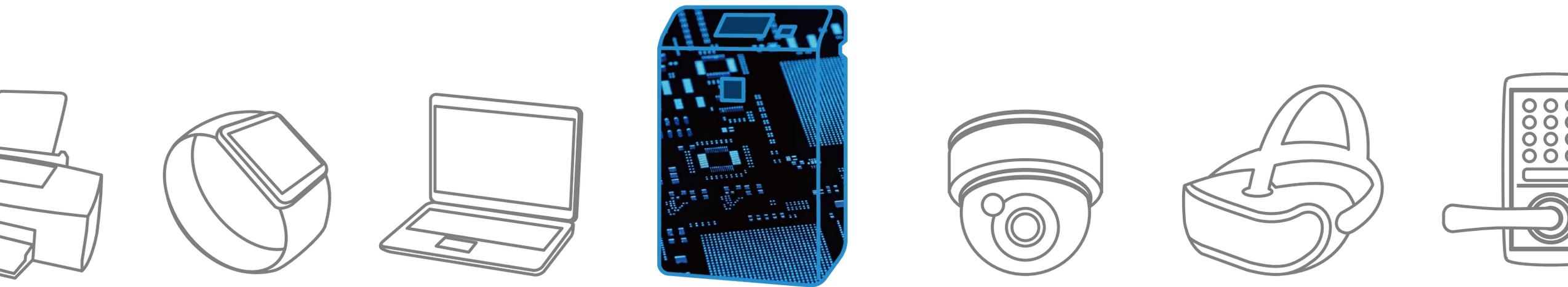
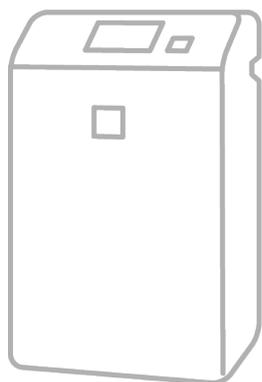
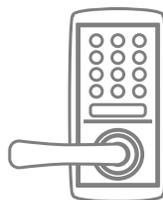


Air Cleaner

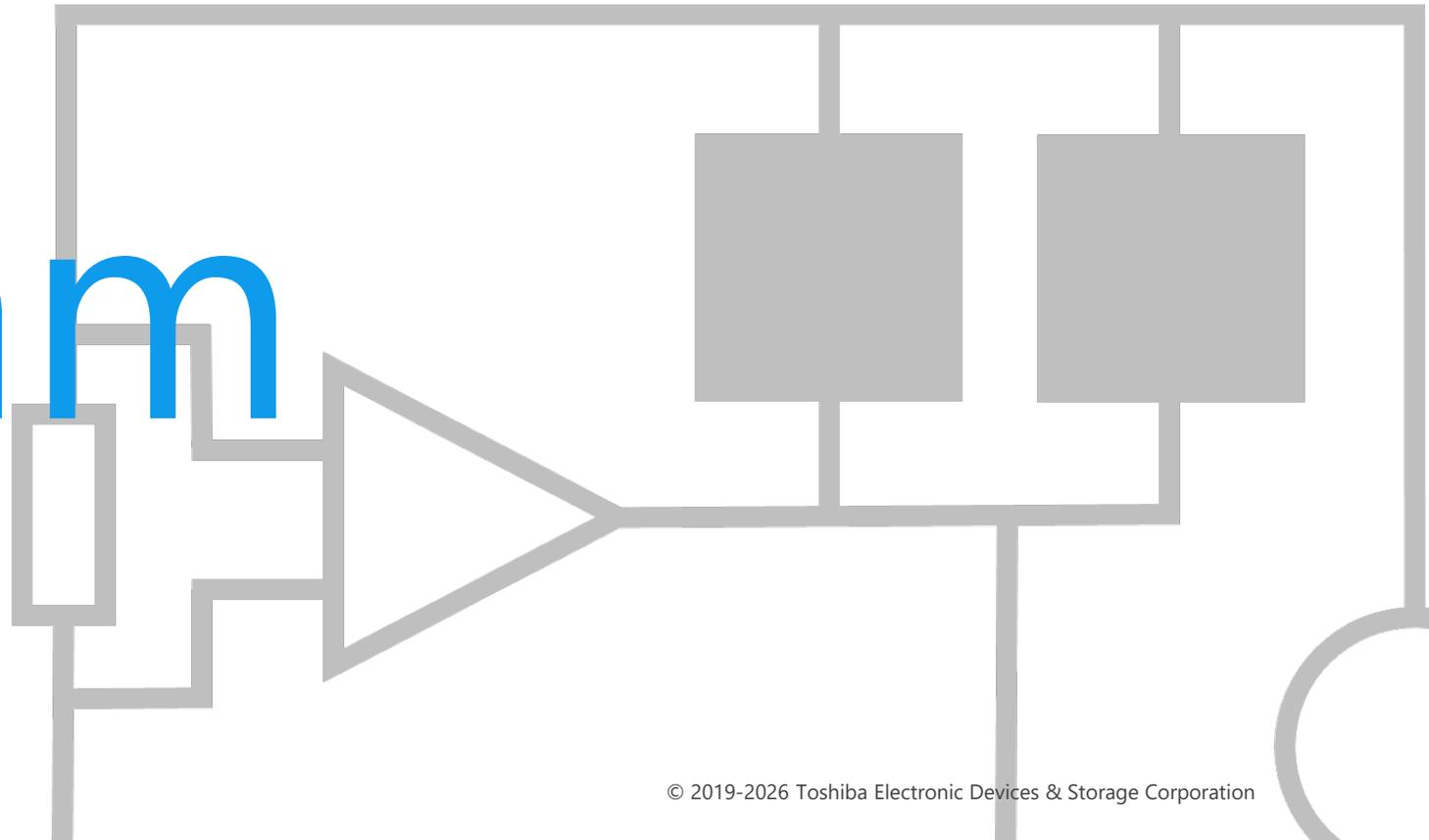
Solution Proposal by Toshiba



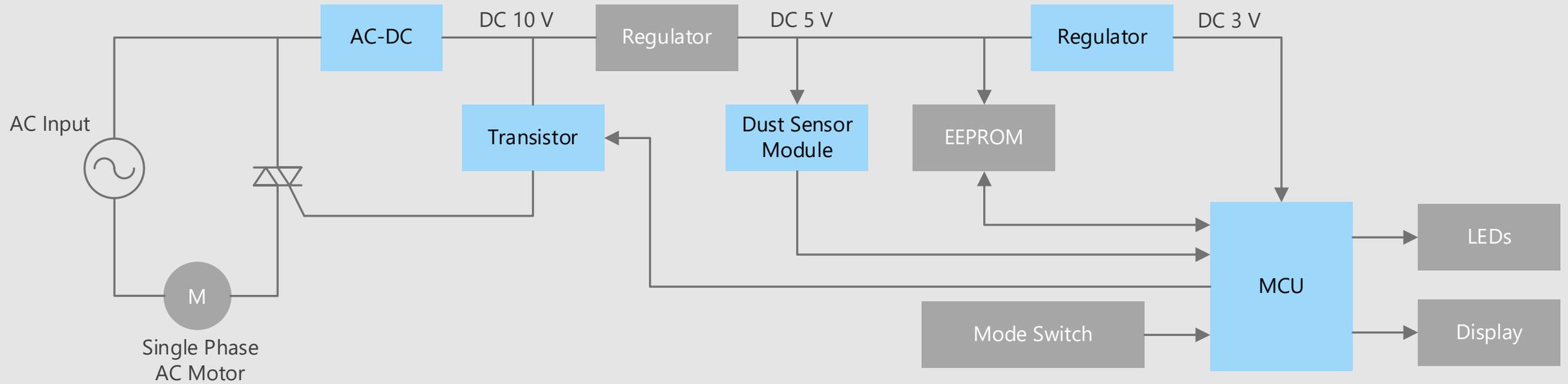


Toshiba Electronic Devices & Storage Corporation provides comprehensive device solutions to customers developing new products by applying its thorough understanding of the systems acquired through the analysis of basic product designs.

Block Diagram

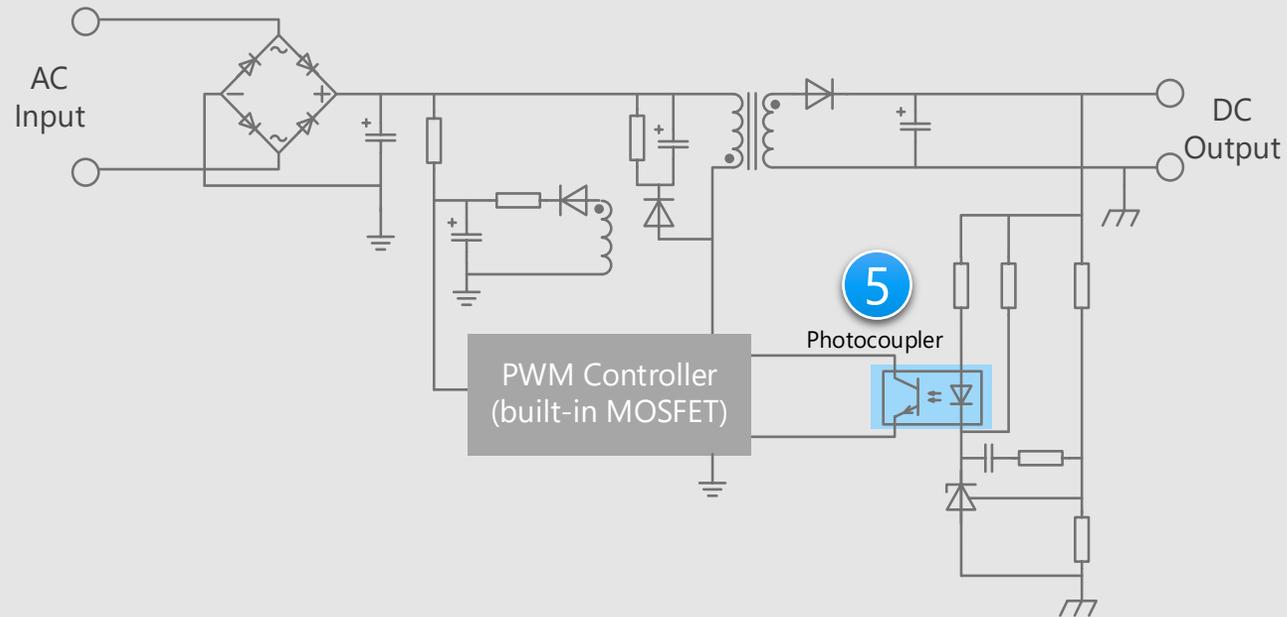


Air Cleaner Overall block diagram



* Using AC motor for main motor

Flyback type AC-DC converter circuit



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.

Proposal from Toshiba

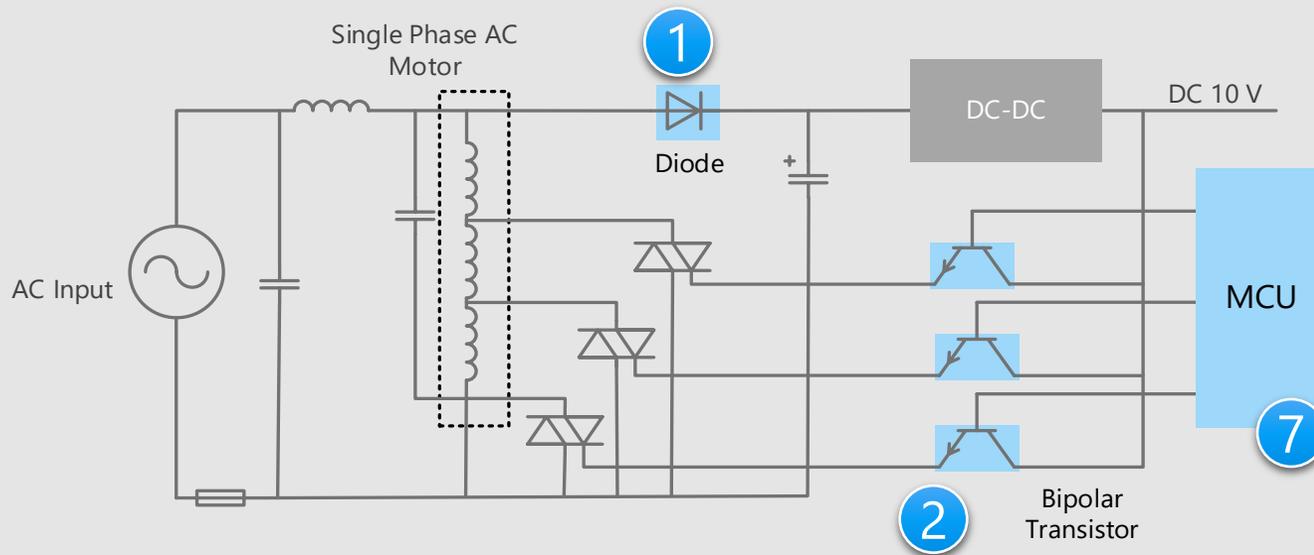
- **High current transfer ratio and high temperature operation are realized**
Transistor output photocoupler

5

* [Click the number in the circuit diagram to jump to the detailed description page](#)

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.

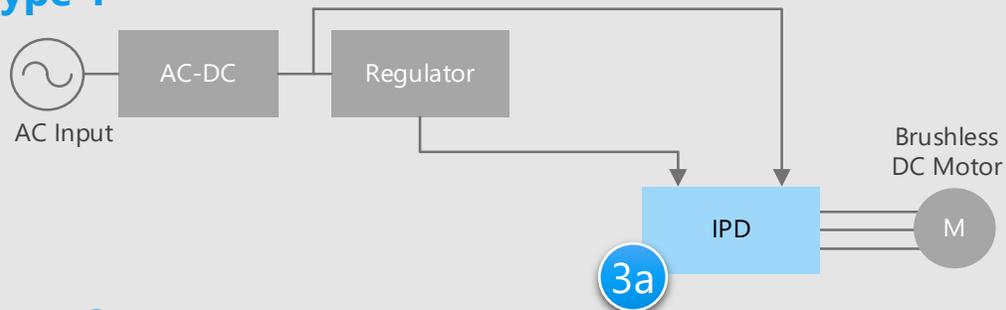
Proposals from Toshiba

- **Suitable for rectification**
Rectifier diode (1)
- **Suitable for use in small current switches**
Bipolar transistor (2)
- **System control at low power consumption with analog interfaces**
MCU TMPM036FWFG / TMPM037FWUG (7)

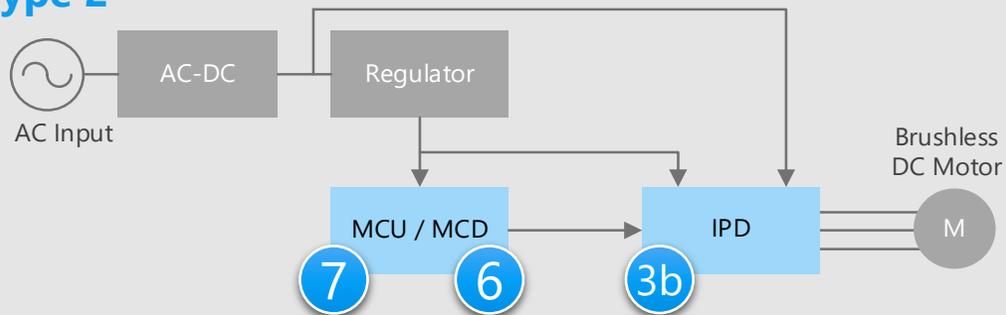
Air Cleaner Detail of main motor unit (2)

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

Type 1



Type 2



Criteria for device selection

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

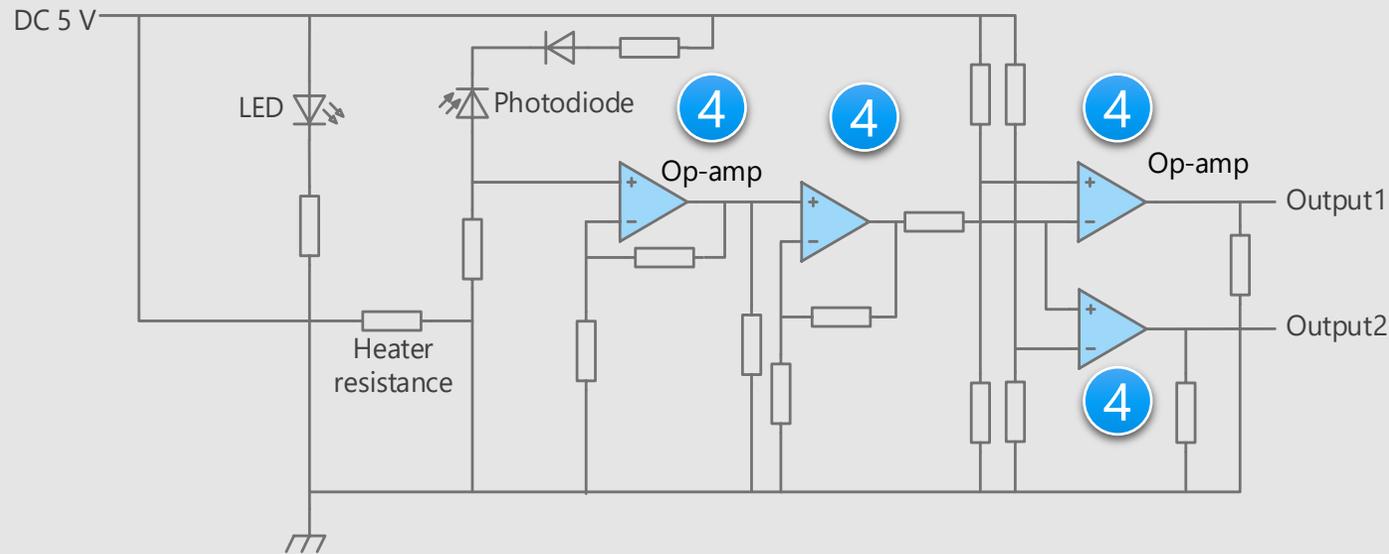
Proposals from Toshiba

- **High voltage motor can be driven**
High voltage IPD 3a 3b
- **Easy motor control**
Brushless DC motor driver 6
- **System control at low power consumption with analog interfaces**
MCU TPM036FWFG / TPM037FWUG 7

* [Click the number in the circuit diagram to jump to the detailed description page](#)

Air Cleaner Detail of dust sensor unit

Dust sensor section



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.

Proposal from Toshiba

- **Amplify the detected very small signal with low noise**

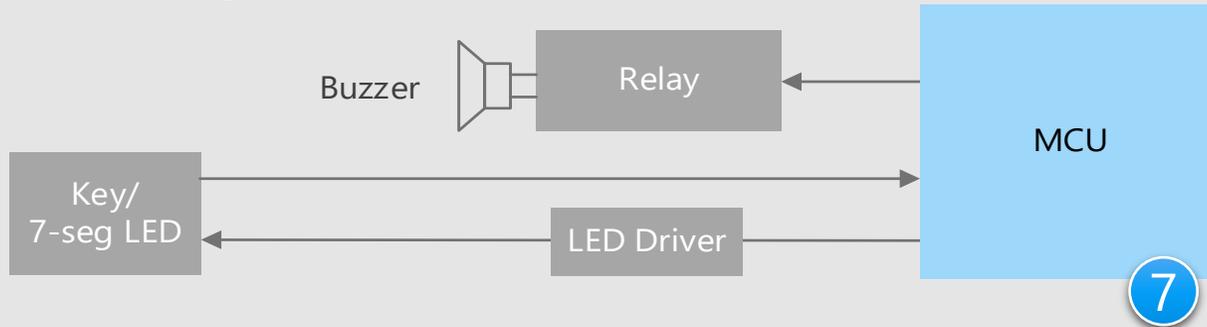
Low current consumption op-amp /
Low noise op-amp

4

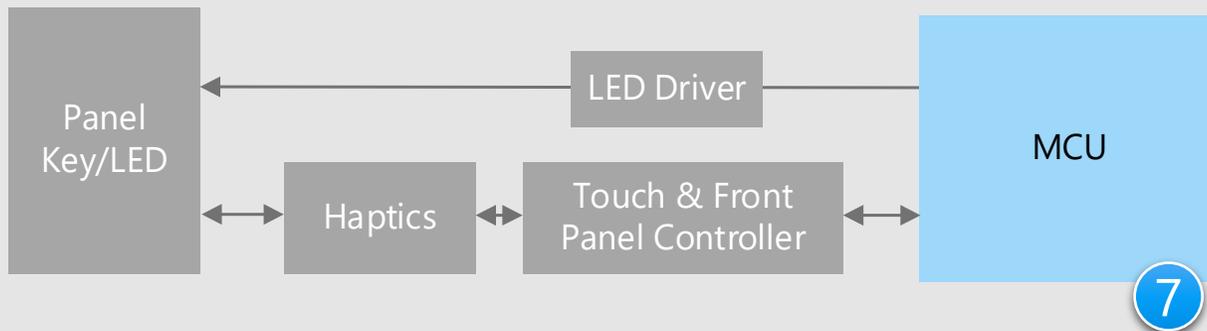
* [Click the number in the circuit diagram to jump to the detailed description page](#)

Air Cleaner Detail of operation unit

Operation unit (Example of Key/LED)



Operation unit (Example of touch panel)



Criteria for device selection

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

Proposal from Toshiba

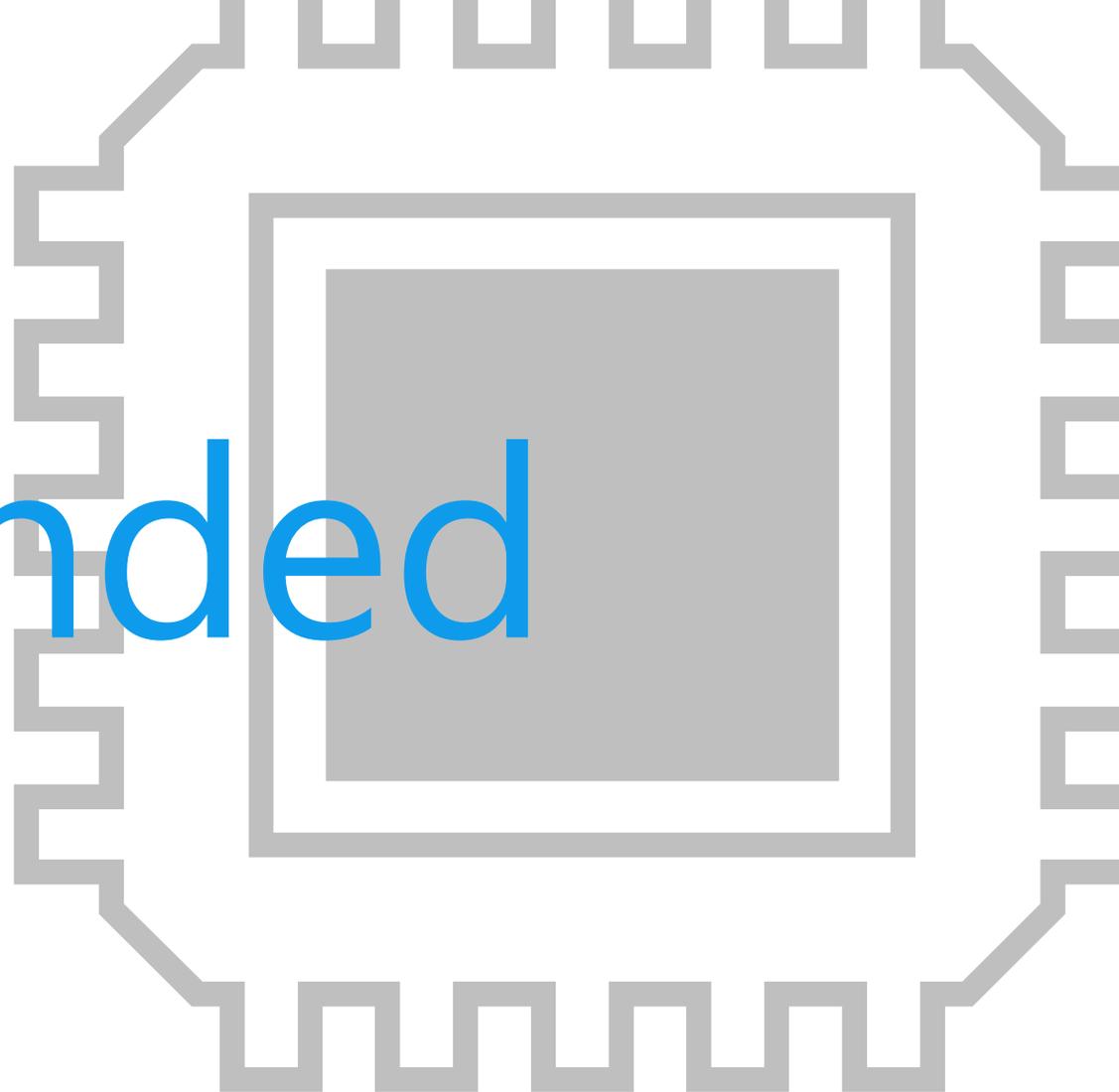
- **System control at low power consumption with analog interfaces**

MCU TPM036FWFG / TPM037FWUG

7

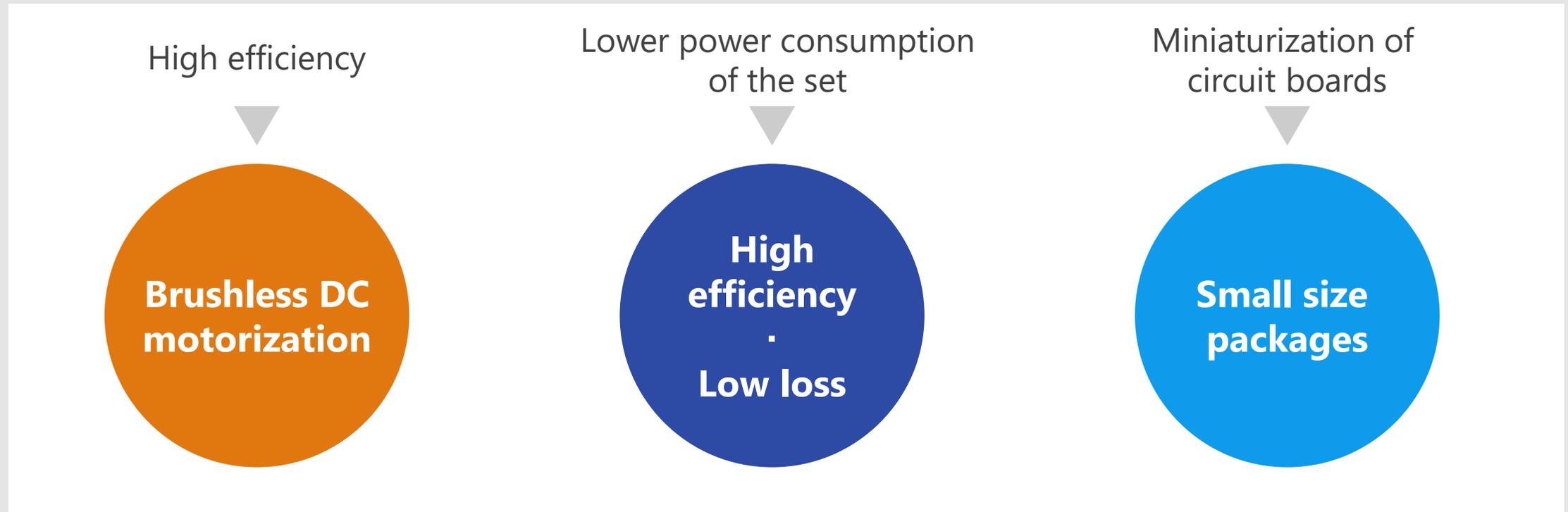
* Click the number in the circuit diagram to jump to the detailed description page.

Recommended Devices



Device solutions to address customer needs

As described above, in the design of Air 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.



Device solutions to address customer needs

Brushless DC motorization

High efficiency
-
Low loss

Small size packages

	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 driver	●	●	●
7 MCU TPM036FWFG / TPM037FWUG		●	●

Value provided

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

1 Surface mount / small package

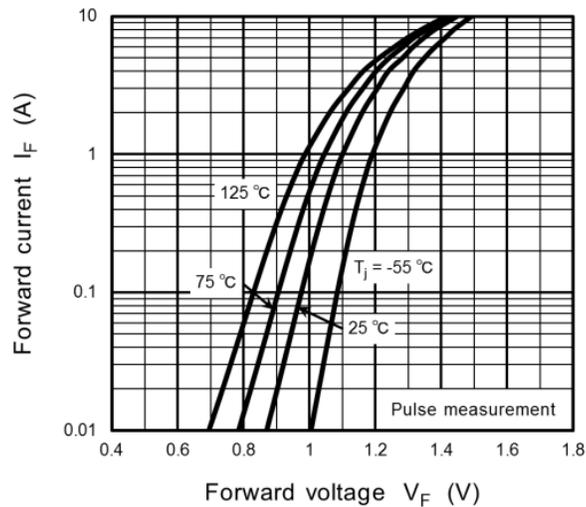
The use of M-FLAT™ packages contributes to the reduction of height and space saving of equipment compared to previous lead type devices [Note].

[Note] Comparison with Toshiba's products

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.

CMG06A
An example of forward characteristic



Lineup

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

[Return to Block Diagram TOP](#)

Value provided

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

1 Wide package lineup

Many type 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

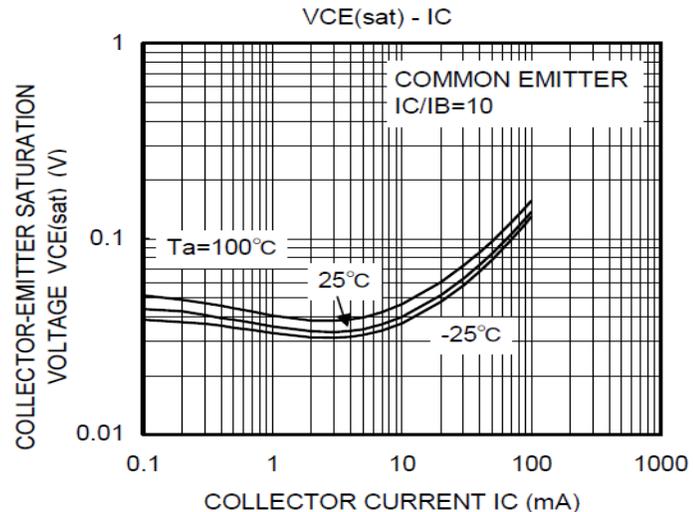
The low saturation voltage between the collector and emitter realizes lower power consumption.

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.

2SC6026CT

An example of $V_{CE(sat)} - I_C$ characteristic



Lineup

Part number	2SC6026CT	
Polarity	NPN	
Package	CST3	 Top view  Bottom view
V_{CEO} [V]	50	
I_C [mA]	100	

[Return to Block Diagram TOP](#)

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

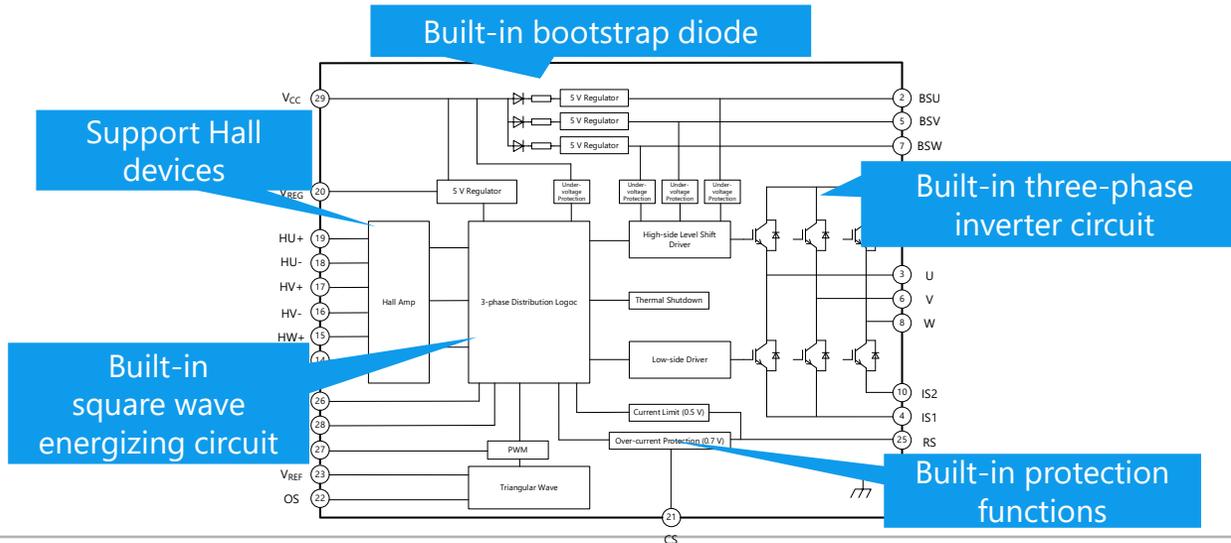
The power consumption can be reduced by replacing the AC motor with a brushless DC motor.

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
Protection function	Current limitation, overcurrent protection, thermal shutdown, under voltage protection

[Return to Block Diagram TOP](#)

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

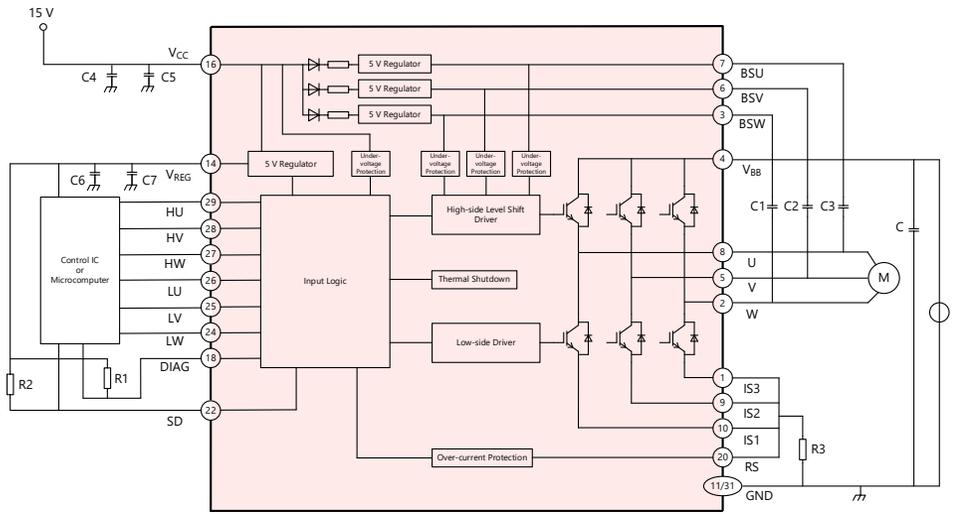
2 Motor drive terminals and control terminals are separated

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	
Absolute maximum ratings	V_{BB} [V]	600			
	I_{out} [A]	2.5	1.0	2.0	1.0
Operating Ranges	V_{CC} [V]	13.5 to 16.5			

[Return to Block Diagram TOP](#)

Value provided

Lineup includes low current consumption type that contributes to low power consumption of the set 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 circuit.

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 of equipment.

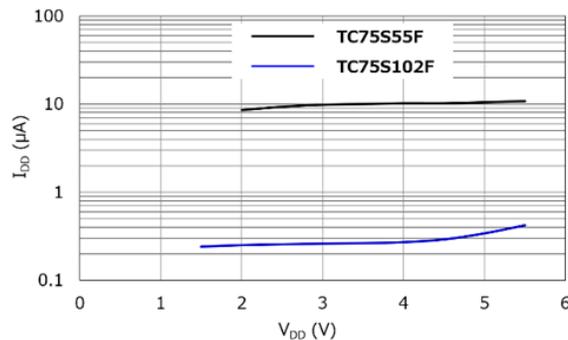
3 Low noise (TC75S67TU) $V_{NI} = 6.0$ [$\text{nV}/\sqrt{\text{Hz}}$] (Typ.) @ $f = 1$ kHz

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

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

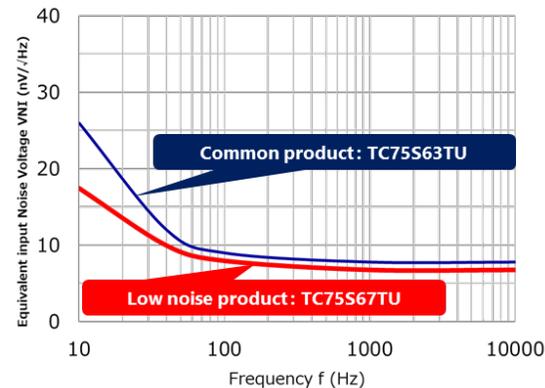
TC75S102F

Current Consumption Characteristic
(Toshiba internal comparison)



TC75S67TU

Noise Characteristic
(Toshiba internal comparison)



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.) [$\text{nV}/\sqrt{\text{Hz}}$] @ $f = 1$ kHz	-	6

[Return to Block Diagram TOP](#)

5 Transistor output photocoupler

TLP383 / TLP293 / TLP385

Brushless DC motorization

High efficiency
Low loss

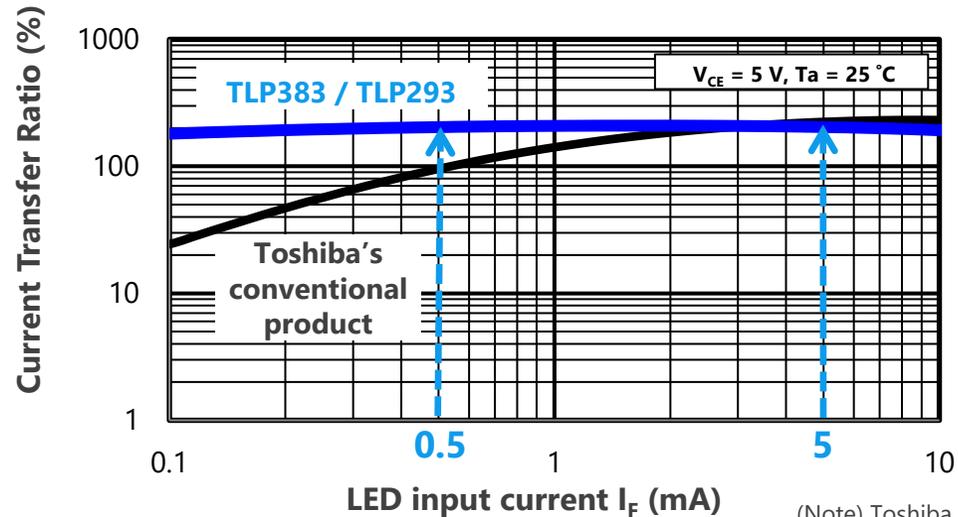
Small size packages

Value provided

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

1 High current transfer ratio

The TLP383 and TLP293 are high isolation photocouplers that optically couple a phototransistor and high output infrared LED. Compared to Toshiba's conventional products (TLP385), higher CTR (Current Transfer Ratio) in low input current range (@ $I_F = 0.5 \text{ mA}$) 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} [$^\circ\text{C}$]	-55 to 125	-55 to 125	-55 to 110

[Return to Block Diagram TOP](#)

Value provided

High-voltage, high-current brushless DC motors can be driven by combining a motor driver with an IPD.

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)

[Note] Comparison with Toshiba products

3 Full development support

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

TB6584FNG, TB6584AFNG



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

Lineup

Part number	TB6584FNG	TB6584AFNG	TB6586AFG
Absolute maximum ratings	V _{CC} [V]	18	18
	I _{OUT} [A]	0.002	0.003
Operating Ranges	V _{CC} [V]	6 to 16.5	6.5 to 16.5
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

[Return to Block Diagram TOP](#)

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 Thumb instruction set improves energy efficiency. Various development tools and their partners allow users many options.

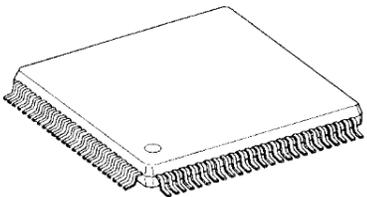
2 Suitable for sensing analog signal

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

3 Small package and low power consumption

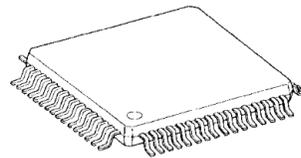
Cortex-M0 and Toshiba's original NANO FLASH™ technology enable the small package and low power consumption. They contribute to reducing circuit board area and power consumption.

TPM036FWFG



Package:
LQFP100-P-1414-0.50H

TPM037FWUG



Package:
LQFP64-P-1010-0.50E

Lineup

Part number	TPM036FWFG	TPM037FWUG
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 ² C	2	1
AD converter	8ch (10bit)	8ch (10bit)

[Return to Block Diagram TOP](#)

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