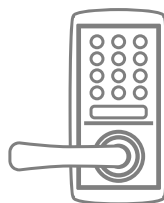


Warm Water Bidet

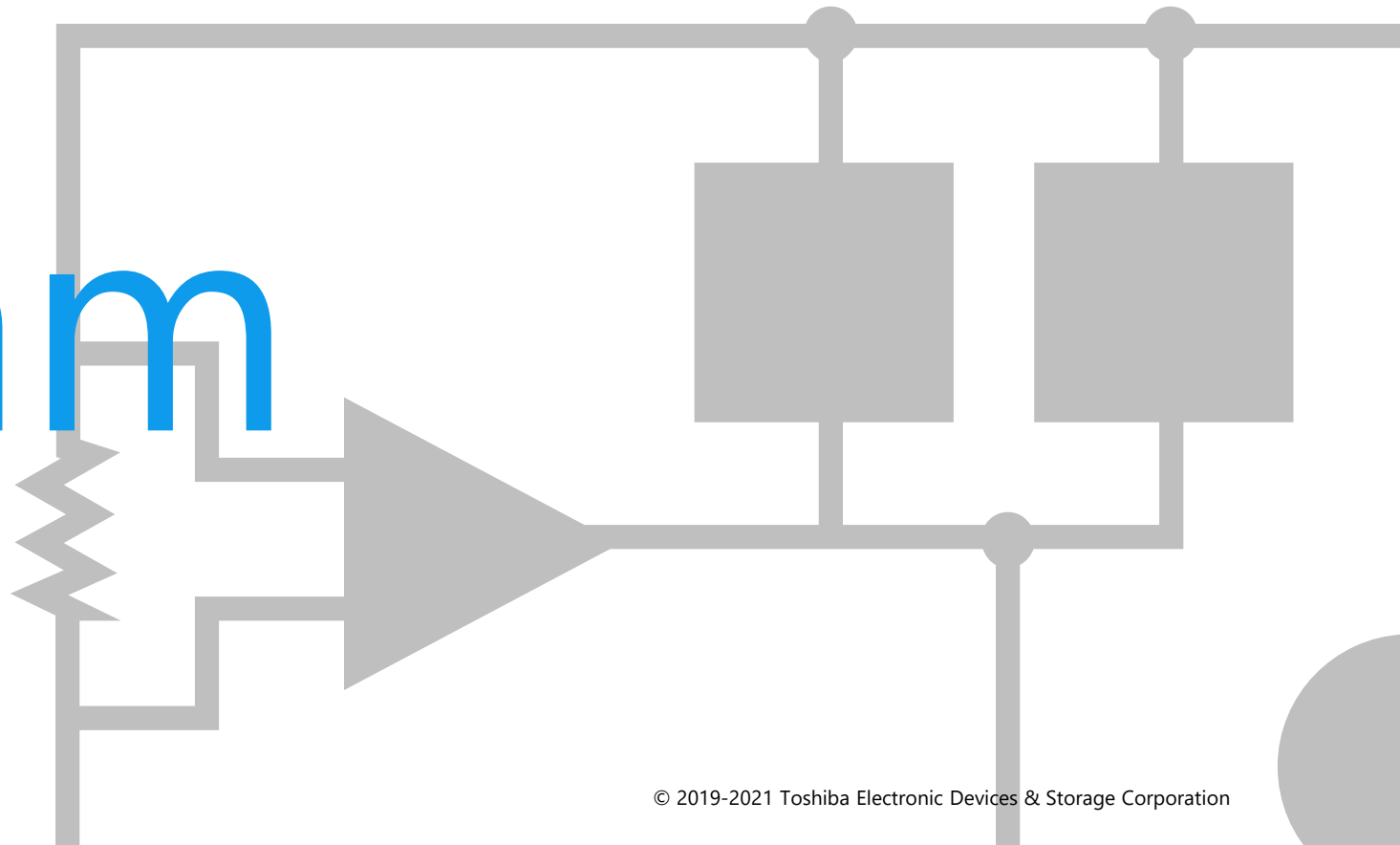
Solution Proposal by Toshiba



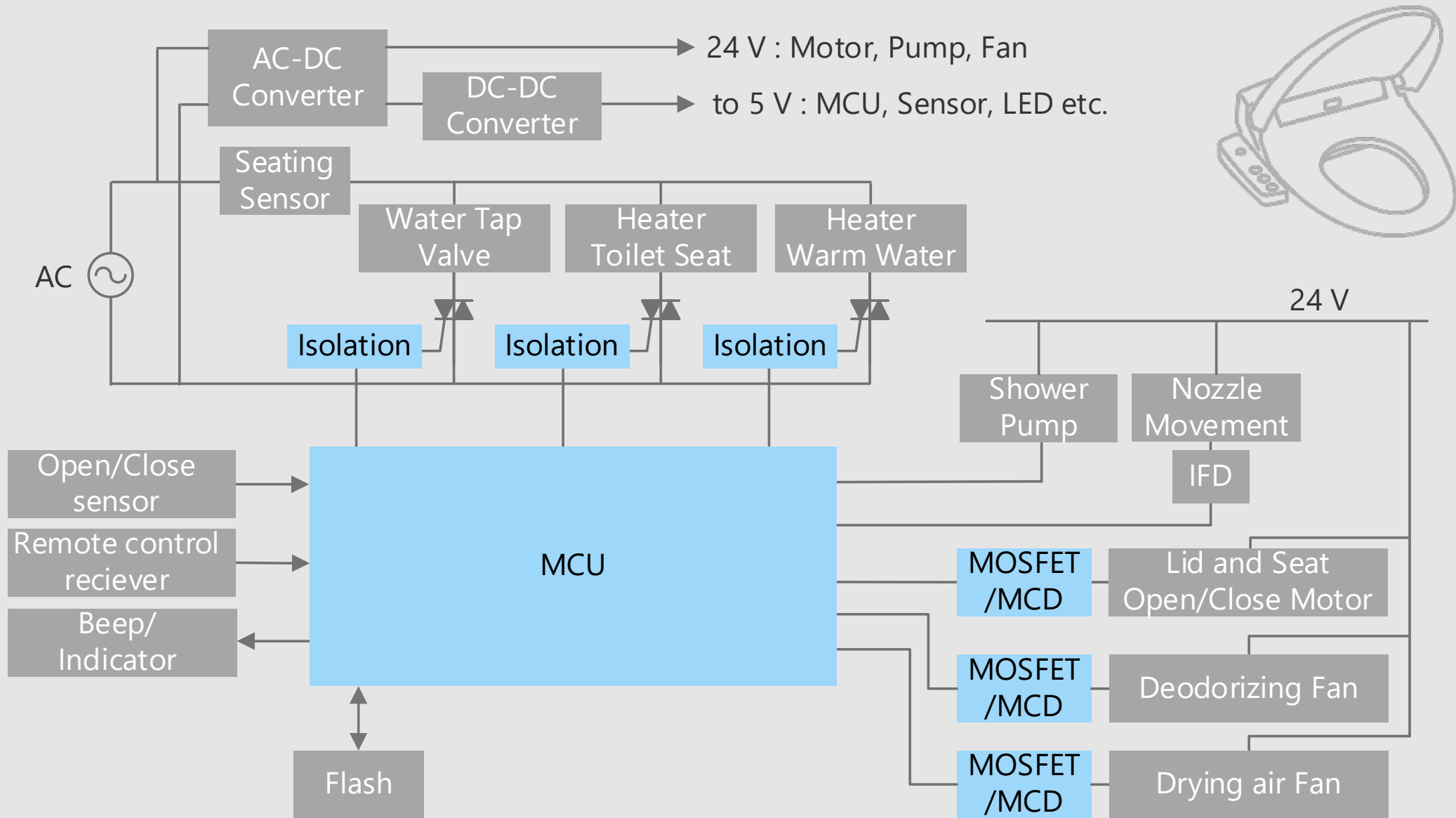


Toshiba Electronic Devices & Storage Corporation provides comprehensive device solutions to customers developing new products by applying its thorough understanding of the systems acquired through the analysis of basic product designs.

Block Diagram

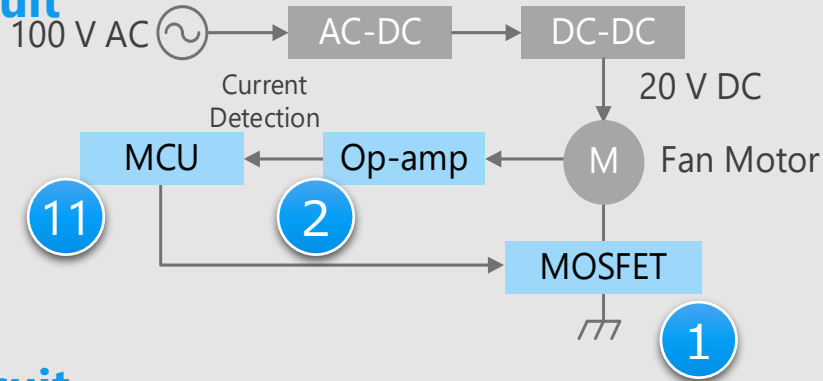


Warm Water Bidet Overall block diagram

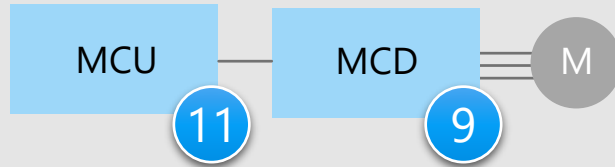


Warm Water Bidet Details of fan motor drive / LED drive

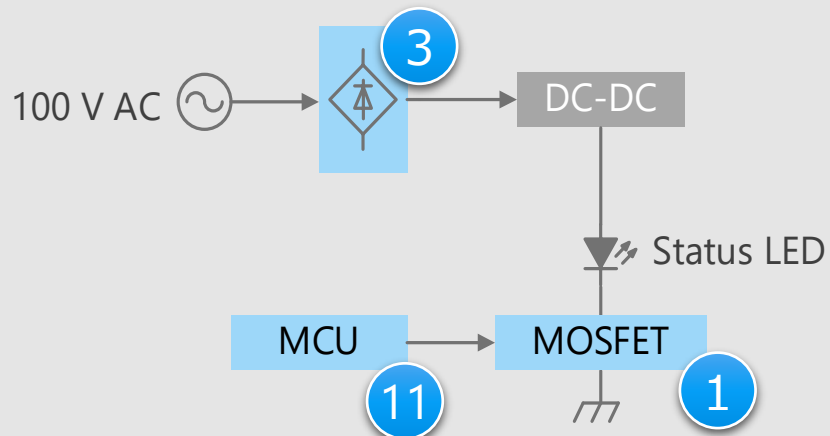
Fan motor drive circuit



Fan motor drive circuit (With MCD)



LED driving circuit



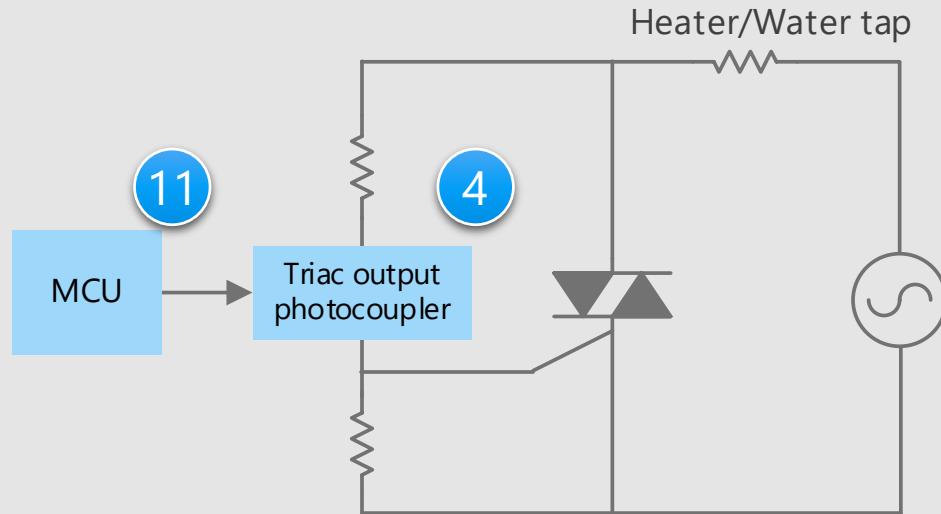
Criteria for device selection

- Low on-resistance characteristic contributes to low loss of the set.
- Use of small package enables to reduce the circuit board area.
- An operational amplifier is used to amplify signals such as current sensing.

Proposals from Toshiba

- **Low on-resistance realizes a set with low power consumption**
Semi-power MOSFET
- **Operational amplifier with integrated phase compensation circuit**
General purpose operational amplifier
- **Small surface mount package suitable for high density mounting**
Rectifier diode
- **Motor controller with MOSFET that can easily drive brushless motor**
Brushless DC motor driver IC (w/MOSFET)
- **Built-in analog input interface at low power consumption and efficient software development**
MCU

Heater/Water tap control circuit



Criteria for device selection

- A triac output photocoupler is suitable to control AC load.

Proposals from Toshiba

- **Efficient control of AC load is realized.**

Triac output photocoupler

4

- **Built-in analog input interface at low power consumption and efficient software development**

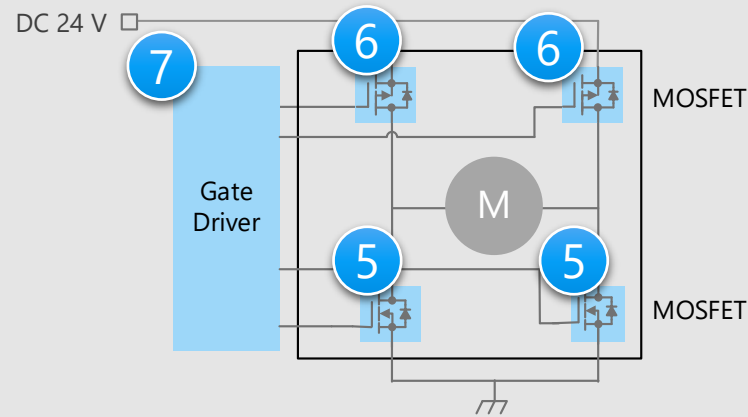
MCU

11

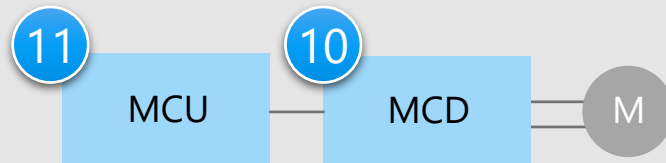
※ Click on the number in the circuit diagram to jump to the detailed description page

Warm Water Bidet Details of lid and seat open/close motor drive unit

Lid and seat open/close brush motor drive circuit



Lid and seat open/close brush motor drive circuit (With MCD)



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

Criteria for device selection

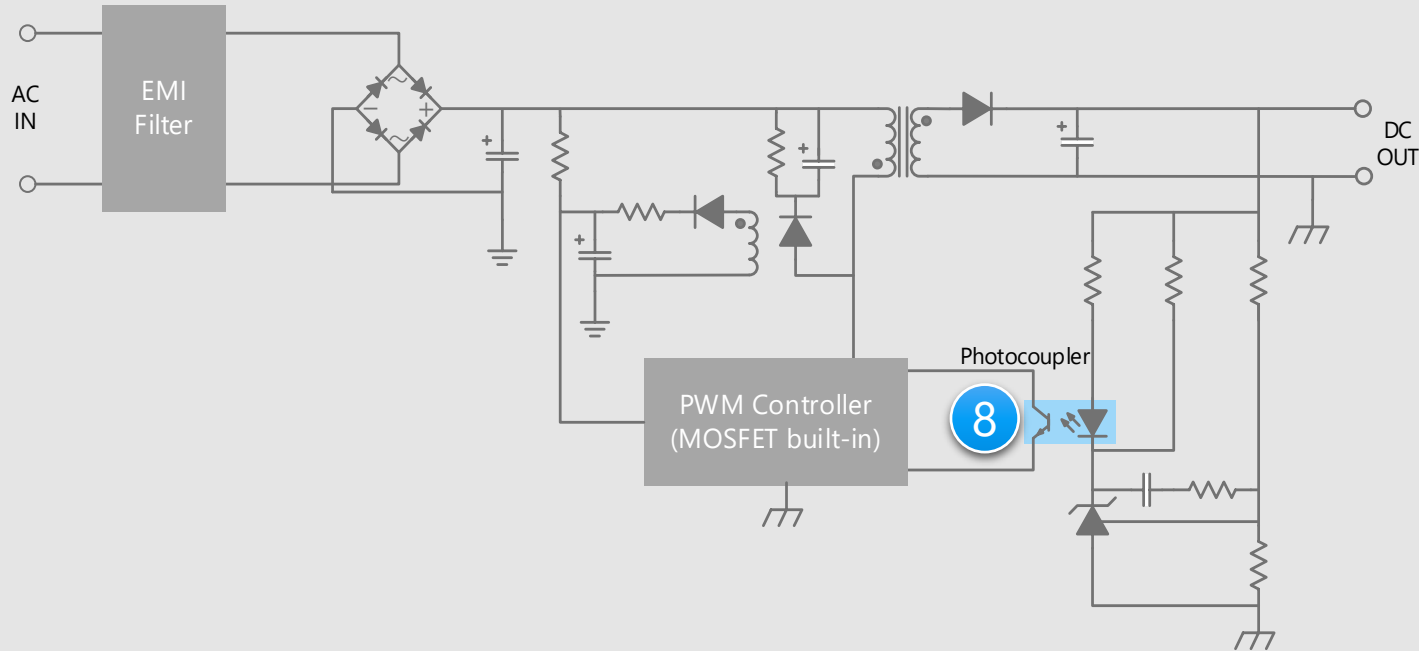
- To select the product with a current rating that is optimal for the motor rating.
- To select optimal predriver for the rating of the switching element to be driven.
- With the increasing current density of small surface mount components, it is necessary to design a heat dissipation that takes into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

Proposals from Toshiba

- **Realize low power consumption of the set with low on-resistance** 5
U-MOS Series N-ch MOSFET
- **Realize low power consumption of the set with low on-resistance** 6
U-MOS Series P-ch MOSFET
- **Realize full-bridge drive circuit** 7
Intelligent power device (IPD)
- **Low power drive using BiCD process** 10
Brushed DC motor driver IC
- **Built-in analog input interface at low power consumption and efficient software development** 11
MCU

Warm Water Bidet Details of power supply unit

Flyback AC-DC circuits



Criteria for device selection

- Contribute to high power supply efficiency by realizing high conversion efficiency even in the low input current range.
- Circuit board area can be reduced by using compact package products.

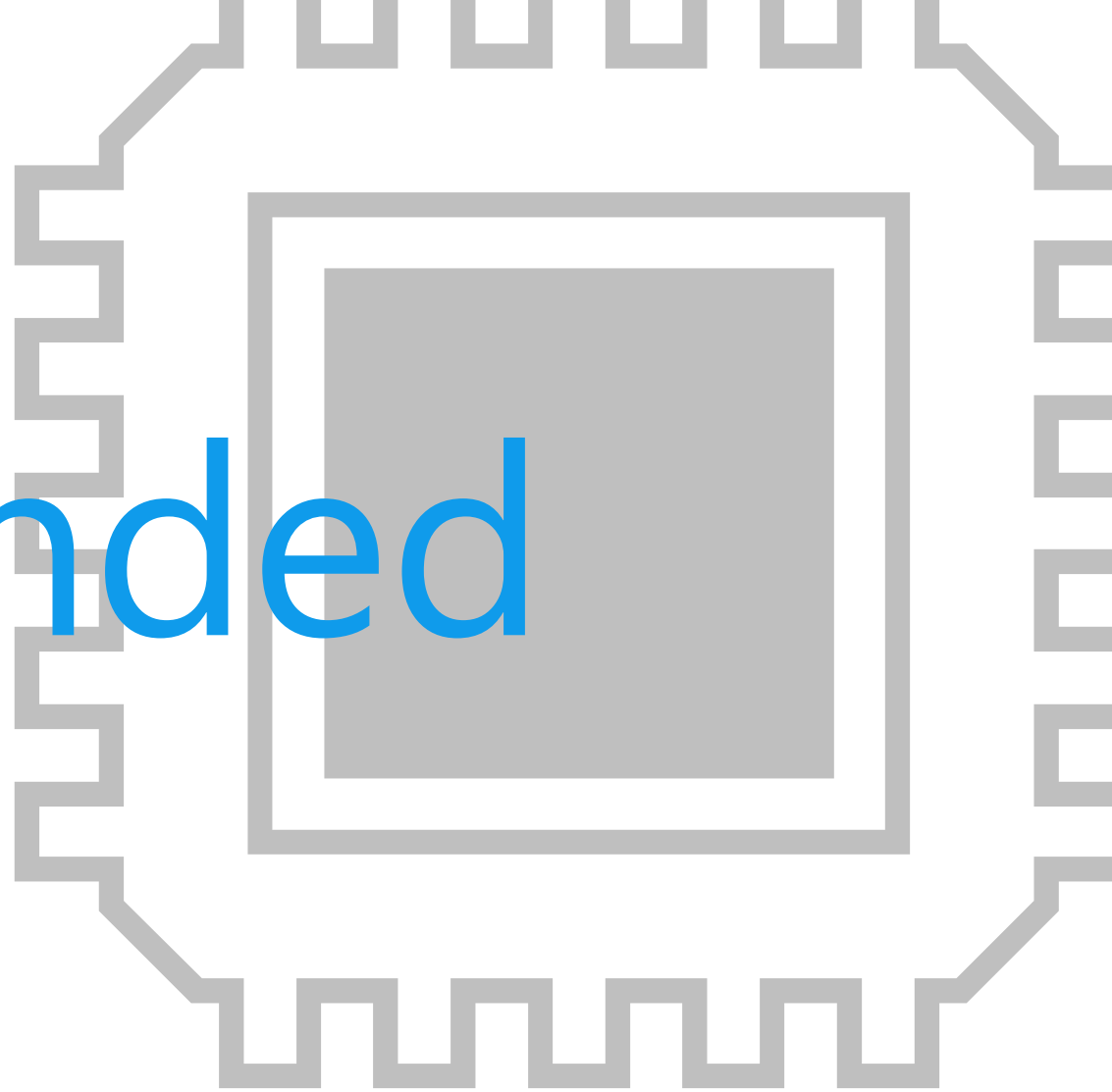
Proposal from Toshiba

- **Photocoupler with excellent environmental resistance**
Transistor output photocoupler

8

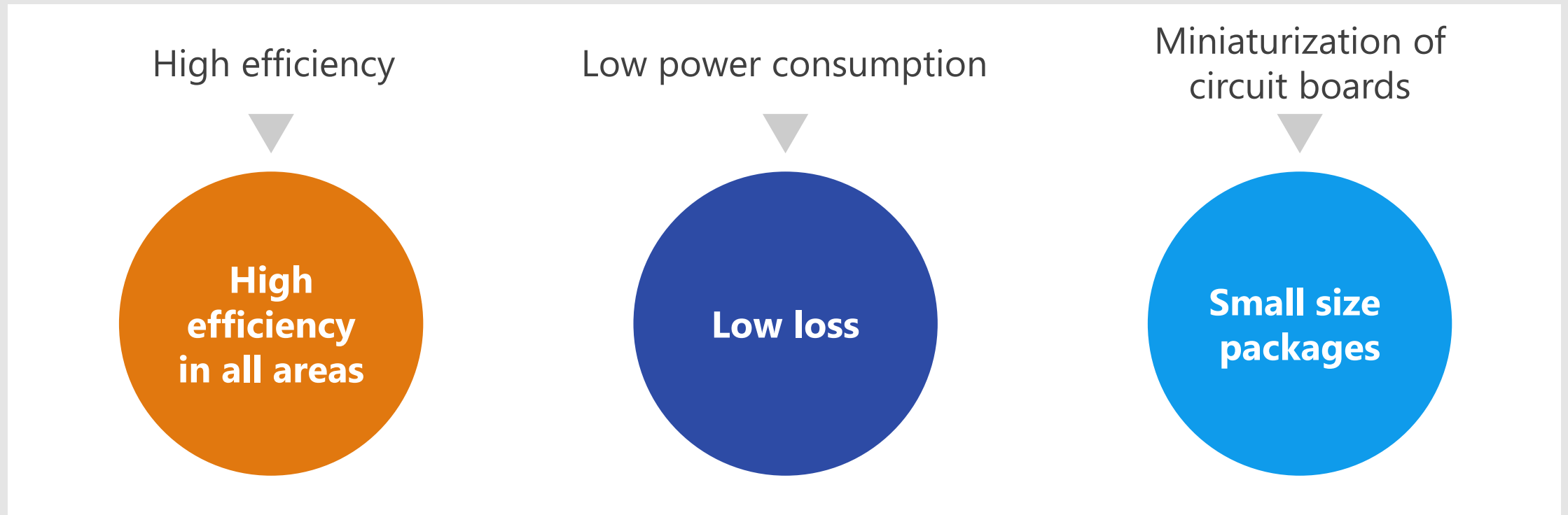
※ Click on the number in the circuit diagram to jump to the detailed description page

Recommended Devices



Device solutions to address customer needs

As described above, in the design of warm water bidet, “**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

High efficiency
in all areas

Low loss

Small size
packages

	High efficiency in all areas	Low loss	Small size packages
① Semi-power MOSFET		●	●
② General purpose operational amplifier	●		●
③ Rectifier diode	●	●	
④ Triac output photocoupler	●	●	●
⑤ U-MOS Series N-ch MOSFET	●	●	●
⑥ U-MOS Series P-ch MOSFET	●	●	●
⑦ Intelligent power device (IPD)	●	●	●
⑧ Transistor output photocoupler	●		●
⑨ Brushless DC motor driver IC	●	●	●
⑩ Brushed DC motor driver IC	●	●	●
⑪ MCU	●	●	●

Value provided

U-MOS series MOSFET contributes to energy saving and miniaturization by improving the trade-off characteristics between on-resistance and capacitance.

1 Low on-resistance

By keeping the drain-source on-resistance low, heat generation and power consumption can be reduced and contributes to miniaturization.

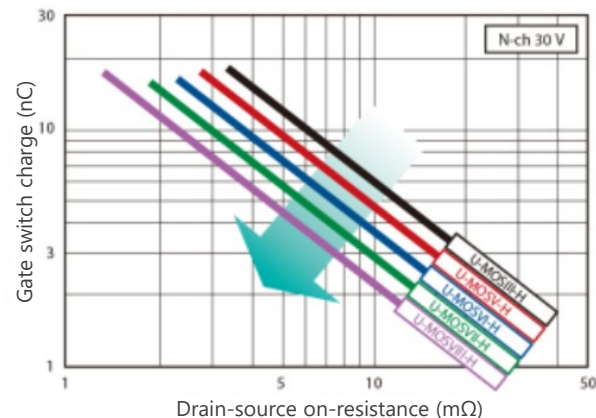
2 Small gate input charge

Reducing gate input charge needed for driving MOSFET improves switching characteristic.

3 Fast switching speed


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

Trade-off characteristics of on-resistance and gate input charge



(Note: Toshiba internal comparison)

Line up

Part number	SSM3K56MFV	SSM6N56FE
Package	VESM 	ES6 
V_{DSS} [V]	20	20
I_D [A]	0.8	0.8
$R_{DS(ON)}$ [Ω] @ $V_{GS} = 10$ V	Typ.	0.186
	Max	0.235
Polarity	N-ch	N-ch \times 2
Generation	U-MOSVII-H	U-MOSVII-H

[◆Return to Block Diagram TOP](#)

2 General purpose operational amplifier

TC75S51FU / TC75S103F

High efficiency in all areas

Low loss

Small size packages

Value provided

CMOS single operation amplifier with a built-in phase compensator, low voltage drive, and low current power supply.

1 Low voltage operation is possible.

Compared with bipolar general purpose operational amplifiers, low voltage operation is possible. [Note]

$$V_{DD} = \pm 0.75 \text{ to } \pm 3.5 \text{ V or } 1.5 \text{ to } 7 \text{ V}$$

2 Low current power supply $I_{DD}=60 \text{ } [\mu\text{A}] \text{ (Typ.)}$

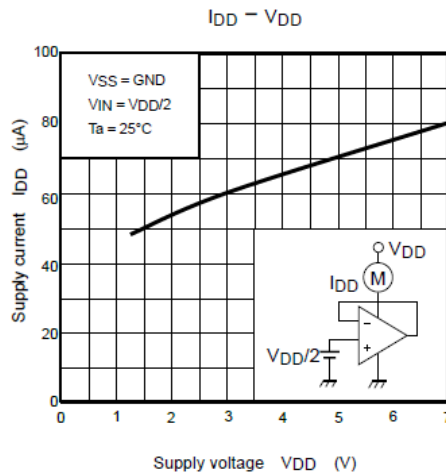
The low current power supply characteristics of CMOS processes contribute to extend the battery life of small IoT devices. [Note]

3 Built-in phase compensator circuit



Because the phase compensation circuit is built-in, there is no need for any external device.

Note: Comparison with our bipolar process operational amplifier

TC75S51FU
Characteristics chart



Line up

Part number	TC75S51FU	TC75S103F
Package	USV 	SMV 
$V_{DD} - V_{SS}$ [V]	1.5 to 7.0	1.8 to 5.5
I_{DD} (Typ. / Max) [μA]	60 / 200 (@ $V_{DD}=3.0 \text{ V}$)	100 / 165 (@ $V_{DD}=3.3 \text{ V}$)
f_T (Typ.) [MHz]	0.6	0.36
Input, Output Full Range		✓

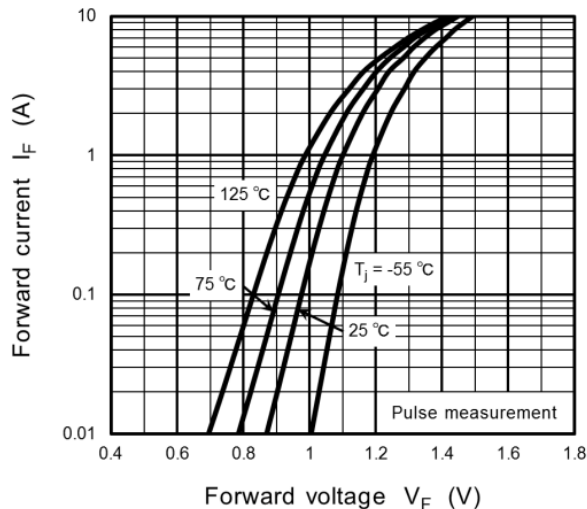
[Return to Block Diagram TOP](#)

Value provided

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

1 Surface mount / compact package

Surface mounting: Adopting M-FLAT™ package which is lower in height compared to Toshiba conventional lead type contributes to the space saving of the equipment.



•CMG06A forward characteristic

2 Wide product line-up


Wide product line-up

Reverse voltage : 200 to 1000 V

Average forward current : 0.5 to 3 A

Suitable product can be selected according to requirements.

Line up

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

[◆Return to Block Diagram TOP](#)

4 Triac output photocoupler

TLP267J / TLP3052A

High efficiency in all areas

Low loss

Small size packages

Value provided

This photocoupler consists of a non zero crossing photo triac, optically coupled to a infrared light emitting diode.

1 Non zero cross type

This photocoupler is suitable for the case where the operation time is short and phase control is necessary.

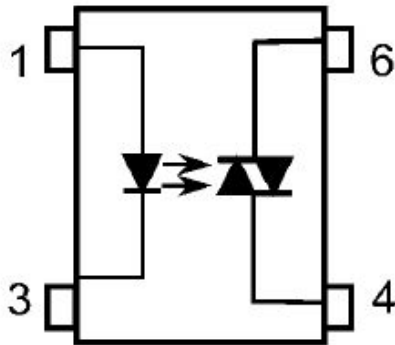
2 Switching characteristic

It has excellent features such as high speed, low noise and silence.

3 Miniaturization of mounting area

4pin SO6 packages have a size of 3.7 x 7.0 x 2.1 mm.

TLP267J
Internal connection





UL-approved : UL1577, File No. E67349

cUL-approved: CSA Component Acceptance Service No.5A File No.E67349

VDE-approved: EN60747-5-5, EN60065 or EN60950-1 (Note)

(Note) When a VDE approved type is needed, please designate the Option (V4).

Line up

Part Number	TLP267J	TLP3052A
Package	SO6 	5pin DIP6 
V_{DRM} (Max) [V]	600	600
BV_S (Min) [Vrms]	3750	5000
T_{opr} [°C]	-40 to 100	-40 to 100
Feature	Non-zero-voltage turn-on	

[◆Return to Block Diagram TOP](#)

Value provided

Contribute to energy saving and miniaturization by realizing lineup of low on-resistance type and trade-off characteristics of on-resistance between capacitance

1 Low on-resistance

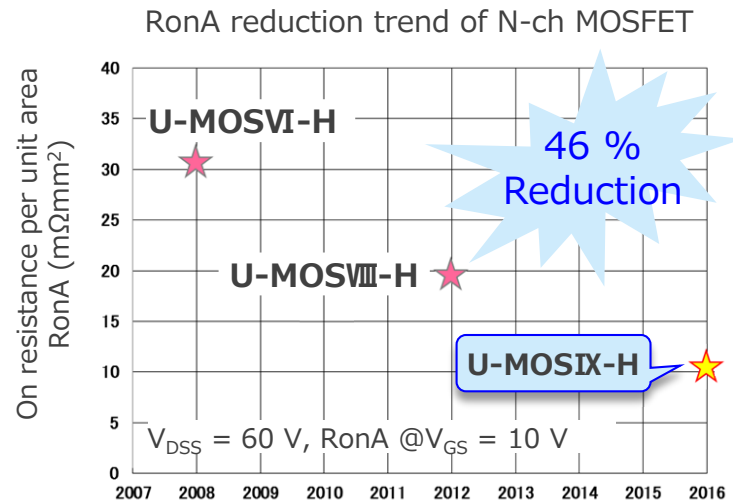
By reducing on-resistance between drain and source, heat generation and power consumption can be kept low, and it can contribute to miniaturization.

2 Small total gate charge

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



3 Fast switching speed

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



(Note: Toshiba internal comparison)

Line up

Part number	TPH2R903PL	TPH3R003PL	TPH4R803PL	TPN2R903PL	TPN5R203PL	
Package	SOP Advance 			TSON Advance 		
V_{DSS} (Max) [V]	30	30	30	30	30	
I_D (Max) [A]	70 (124*)	88 (134*)	48 (90*)	70 (122*)	38 (76*)	
$R_{DS(ON)}$ [mΩ] @ $V_{GS} = 10 \text{ V}$	Typ.	2.1	2.2	3.6	2.1	3.9
	Max	2.9	3.0	4.8	2.9	5.2
Polarity	N-ch	N-ch	N-ch	N-ch	N-ch	
Generation	U-MOSIX-H	U-MOSIX-H	U-MOSIX-H	U-MOSIX-H	U-MOSIX-H	

* : Silicon limit

[◆Return to Block Diagram TOP](#)

Value provided

Contribute to energy saving and miniaturization by realizing lineup of low on-resistance type and trade-off characteristics of on-resistance between capacitance

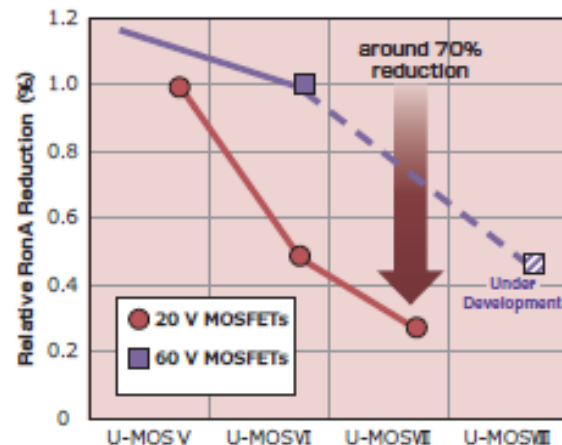
1 Low on-resistance

By reducing on-resistance between drain and source, heat generation and power consumption can be kept low, and it can contribute to miniaturization.

2 Small total gate charge


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

RonA reduction trend of P-ch MOSFET



(Note: Toshiba internal comparison)

Line up

Part number	TPCA8120	
Package	SOP Advance	
V_{DSS} [V]	-30	
I_D [A]	-45	
$R_{DS(ON)}$ [mΩ] @ $V_{GS} = -10$ V	Typ.	2.4
	Max	3.0
Polarity	P-ch	
Generation	U-MOSVI	

[Return to Block Diagram TOP](#)

Value provided

A gate driver with half-bridge output, which can be driven with a large current (± 500 mA maximum).

1 Half-bridge type

It is a half-bridge type gate driver and is suitable for high-side P-ch type and low-side N-ch type power MOSFET driving.

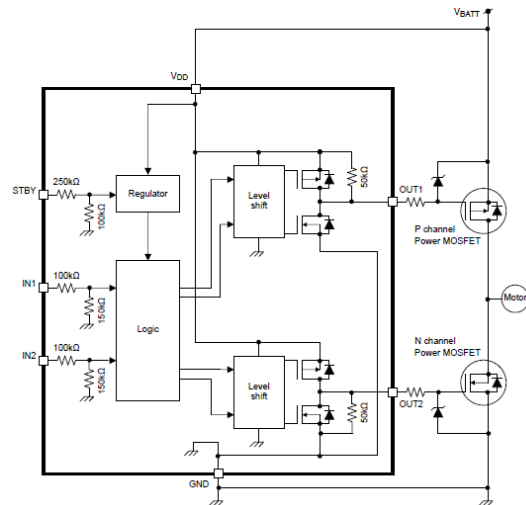
2 Can be driven with a large current

The output current rating of ± 500 mA is secured, and high current driving is possible.

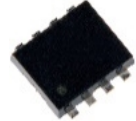
3 Compact package

It is packaged in the compact PS-8 package.
Dimensions of PS-8 : 2.8 x 2.9 x 0.8 mm

Internal block diagram and an example of application circuit of TPD7211F



Line up

Part number	TPD7211F
Package	PS-8 
$V_{DD(opr)}$ [V]	5 to 18
I_{OUT} [mA]	± 500
T_{opr} [°C]	-40 to 125

[Return to Block Diagram TOP](#)

Value provided

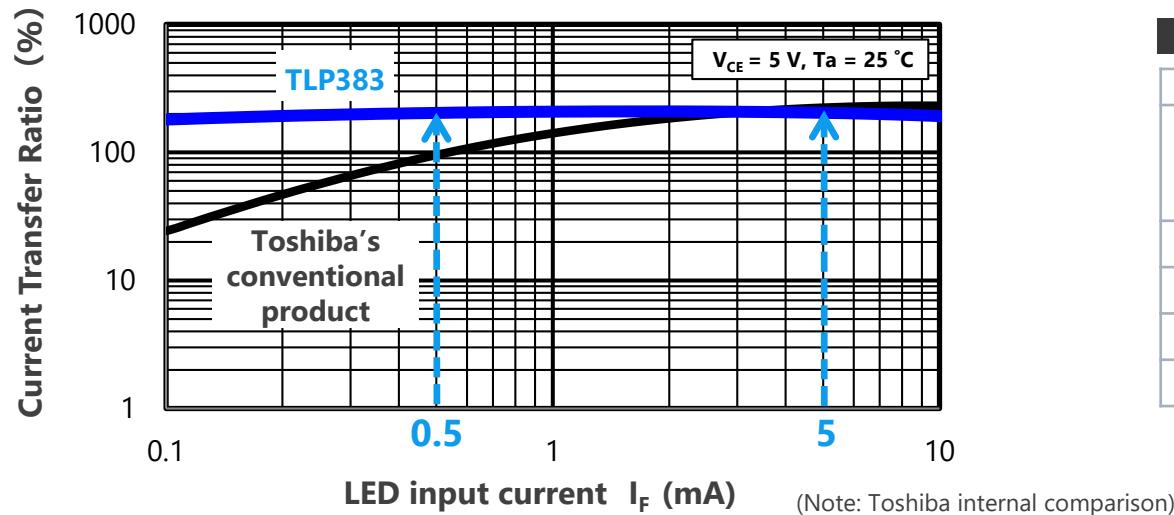
High current transfer ratio is realized even in the low input current range ($I_F = 0.5 \text{ mA}$).

1 High current transfer ratio


Phototransistor and InGaAs infrared light emitting diode are optically coupled. Highly isolated photocouplers realize higher CTR than Toshiba's conventional products in low input current range (@ $I_F = 0.5 \text{ mA}$).

2 The operating temperature range is extended to 125 °C

It is designed to operate under severe conditions of ambient temperature environment, such as inverters, robots, machinery, and high output power supplies.



Line up

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

[Return to Block Diagram TOP](#)

Value provided

Simple fan motor drive with low noise & low vibration.**1 Suitable for small Fan motor**

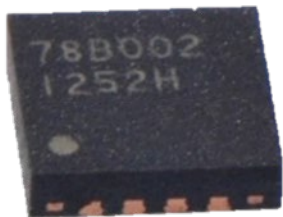
It is a single phase full-wave driver and suitable for small brushless DC Fan motor.

2 Low noise & low vibration

Smooth waveform by soft switching drive realizes low noise and low vibration.

3 Small package

Small QFN16 package with high heat dissipation.



WQFN16 Package (3 mm x 3 mm x 0.75 mm)

Line up

Part number	TC78B002FNG	TC78B002FTG
Power supply voltage	5.5 to 16 V	
Output current	1.5 A (Max)	
Drive type	Single phase full wave drive	
Features & Others	PWM control Soft switching drive Quick start Hall bias circuit Error detection: Current limit, Thermal shutdown	

[◆Return to Block Diagram TOP](#)



Value provided

Toshiba's proprietary technology eliminates the need for phase adjustment and achieves high efficiency for a wide range of rotation speeds.

1 High efficiency is achieved for a wide range of rotation speeds

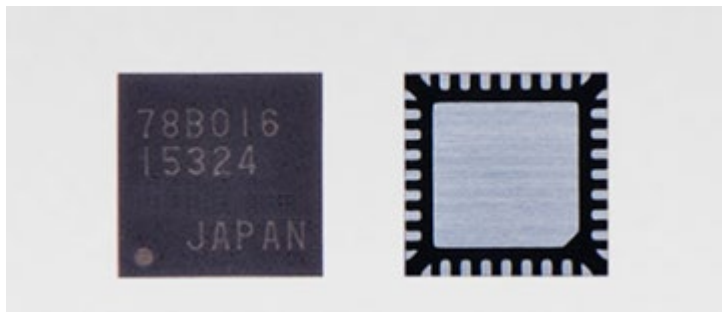
With the ability to adjust the phase of the voltage and current individually for different types of motors with a simple setting, a high efficiency drive is realized.

2 Motor control with low noise, and low vibration

The use of a sinusoidal drive system featuring a smooth current waveform contributes to the low noise and low vibration of the motor, as compared to Toshiba's square wave drive system.

3 Low loss, Low heat

Since the output on-resistance is a small 0.23 Ω (Typ.), the power loss of the IC itself during operation can be kept low.



WQFN36 package (5 mm x 5 mm x 0.8 mm)

Line up

Part number	TC78B016FTG
Power supply voltage	6 to 30 V (operating range)
Output current	3 A (operating range)
Drive system	Sine wave drive system
Other/Features	Phase control : Optimum phase control of voltage and current Hall device / Hall IC compatible Speed control input: PWM signal/ analog voltage input Exception detection function: Overheating detection, overcurrent detection, motor lock detection Output ON-resistance (sum of top and bottom): 0.23 Ω (Typ.)

[◆Return to Block Diagram TOP](#)

Value provided

Adoption of BiCD process enables high withstand voltage, large current and low power consumption drive.

1 High withstand voltage (50 V) / High current

In order to allow margin for air discharge test etc., the withstand voltage of the output is increased from 40 V to 50 V. The TB67H400A can handle an absolute output maximum current of 8 A.

2 DIP package available

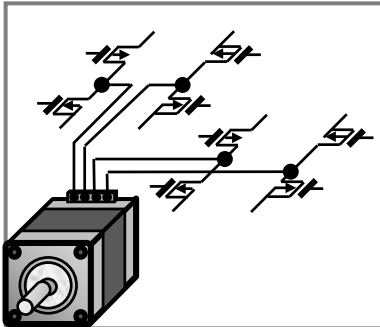
A lineup of products compatible with self-insertion DIP packages, required for basic amusement systems, are available to meet all needs.

3 3 selectable drive modes

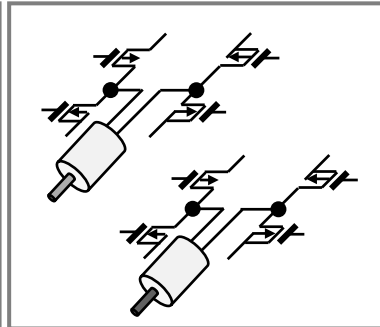
The H-bridge combination can be tailored according to the type of motor and the required current capacity as: (1) single stepper drive, (2) dual brush drive, and (3) high current, single-brush drive.

■ 3 selectable drive modes

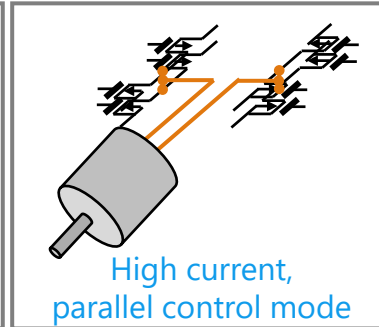
① Single stepper



② Dual brush



③ High current, single brush



Line up

Model	TB67H400A	TB67H410	TB67H450A	TB67H451A
Motor type	Brushed DC motor			
Output withstand voltage	50 V			
Output current	8.0 A (Large mode)	5.0 A (Large mode)	3.5 A	3.5 A
Output On resistance	0.25 Ω	0.4 Ω	0.3 Ω	0.3 Ω
Output circuit	1 circuit (large current drive mode)		1 circuit	1 circuit
Control impedance	4 modes			
Step resolution/excitation mode	1/1, 1/2 step (2-phase, 1-2 phase excitation)			
Error detection	overheating, overcurrent, low voltage monitoring			
Package	QFN48 / HTSSOP48 / HZIP25 / SDIP24	QFN48 / SDIP24	HSOP8	HSOP8

[◆Return to Block Diagram TOP](#)

Value provided

Built-in 50 % duty control function in UART, compatible with Home Bus System (HBS).**1 Built-in Arm® Cortex®-M3
CPU core**

TMPM381FWFG and TMPM383FSUG implement Cortex-M3 core with 40 MHz maximum operation frequency. Various development tool and their partners allow users many options.

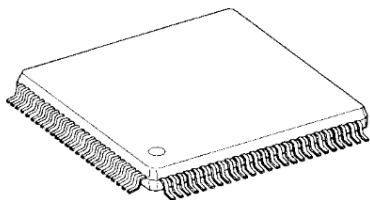
2 Compatible with HBS

UART function is equipped with 50 % duty control function and is compatible with HBS. A control system composed of HBS can be easily constructed using centralized management systems or thermostats.

**3 Small package and very low
power consumption**

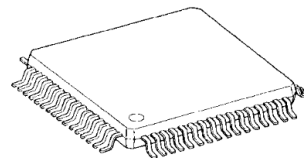
TMPM381FWFG and TMPM383FSUG execute sensing data monitoring and processing efficiently by combining built-in analog function such as ADC and CPU system. The original NANOFLASH™ is possible to rewrite at high speed. It reduces user software development time period.

TMPM381FWFG



LQFP100

TMPM383FSUG



LQFP64

Line up

Part number	TMPM381FWFG	TMPM383FSUG
Maximum operation frequency	40 MHz	40 MHz
Instruction ROM	128 KB	64 KB
RAM	10 KB	8 KB
Timer	16bit x 8ch	16bit x 8ch
UART / SIO	3ch	2ch
UART(50 % duty)	1ch	1ch
ADC	18ch (12bit)	10ch (12bit)

[◆Return to Block Diagram TOP](#)

If you are interested in these products and have questions or comments about any of them, please do not hesitate to contact us below:

Contact address: <https://toshiba.semicon-storage.com/ap-en/contact.html>



Terms of use

This terms of use is made between Toshiba Electronic Devices and Storage Corporation ("We") and customers who use documents and data that are consulted to design electronics applications on which our semiconductor devices are mounted ("this Reference Design"). Customers shall comply with this terms of use. Please note that it is assumed that customers agree to any and all this terms of use if customers download this Reference Design. We may, at its sole and exclusive discretion, change, alter, modify, add, and/or remove any part of this terms of use at any time without any prior notice. We may terminate this terms of use at any time and for any reason. Upon termination of this terms of use, customers shall destroy this Reference Design. In the event of any breach thereof by customers, customers shall destroy this Reference Design, and furnish us a written confirmation to prove such destruction.

1. Restrictions on usage

- 1.This Reference Design is provided solely as reference data for designing electronics applications. Customers shall not use this Reference Design for any other purpose, including without limitation, verification of reliability.
- 2.This Reference Design is for customer's own use and not for sale, lease or other transfer.
- 3.Customers shall not use this Reference Design for evaluation in high or low temperature, high humidity, or high electromagnetic environments.
- 4.This Reference Design shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable laws or regulations.

2. Limitations

- 1.We reserve the right to make changes to this Reference Design without notice.
- 2.This Reference Design should be treated as a reference only. We are not responsible for any incorrect or incomplete data and information.
- 3.Semiconductor devices can malfunction or fail. When designing electronics applications by referring to this Reference Design, customers are responsible for complying with safety standards and for providing adequate designs and safeguards for their hardware, software and systems which minimize risk and avoid situations in which a malfunction or failure of semiconductor devices could cause loss of human life, bodily injury or damage to property, including data loss or corruption. Customers must also refer to and comply with the latest versions of all relevant our information, including without limitation, specifications, data sheets and application notes for semiconductor devices, as well as the precautions and conditions set forth in the "Semiconductor Reliability Handbook".
- 4.When designing electronics applications by referring to this Reference Design, customers must evaluate the whole system adequately. Customers are solely responsible for all aspects of their own product design or applications. WE ASSUME NO LIABILITY FOR CUSTOMERS' PRODUCT DESIGN OR APPLICATIONS.
- 5.No responsibility is assumed by us for any infringement of patents or any other intellectual property rights of third parties that may result from the use of this Reference Design. No license to any intellectual property right is granted by this terms of use, whether express or implied, by estoppel or otherwise.
- 6.THIS REFERENCE DESIGN IS PROVIDED "AS IS". WE (a) ASSUME NO LIABILITY WHATSOEVER, INCLUDING WITHOUT LIMITATION, INDIRECT, CONSEQUENTIAL, SPECIAL, OR INCIDENTAL DAMAGES OR LOSS, INCLUDING WITHOUT LIMITATION, LOSS OF PROFITS, LOSS OF OPPORTUNITIES, BUSINESS INTERRUPTION AND LOSS OF DATA, AND (b) DISCLAIM ANY AND ALL EXPRESS OR IMPLIED WARRANTIES AND CONDITIONS RELATED TO THIS REFERENCE DESIGN, INCLUDING WARRANTIES OR CONDITIONS OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, ACCURACY OF INFORMATION, OR NONINFRINGEMENT.

3. Export Control

Customers shall not use or otherwise make available this Reference Design for any military purposes, including without limitation, for the design, development, use, stockpiling or manufacturing of nuclear, chemical, or biological weapons or missile technology products (mass destruction weapons). This Reference Design may be controlled under the applicable export laws and regulations including, without limitation, the Japanese Foreign Exchange and Foreign Trade Law and the U.S. Export Administration Regulations. Export and re-export of this Reference Design are strictly prohibited except in compliance with all applicable export laws and regulations.

4. Governing Laws

This terms of use shall be governed and construed by laws of Japan.

RESTRICTIONS ON PRODUCT USE

- Toshiba Electronic Devices & Storage Corporation, and its subsidiaries and affiliates (collectively "TOSHIBA"), reserve the right to make changes to the information in this document, and related hardware, software and systems (collectively "Product") without notice.
- This document and any information herein may not be reproduced without prior written permission from TOSHIBA. Even with TOSHIBA's written permission, reproduction is permissible only if reproduction is without alteration/omission.
- Though TOSHIBA works continually to improve Product's quality and reliability, Product can malfunction or fail. Customers are responsible for complying with safety standards and for providing adequate designs and safeguards for their hardware, software and systems which minimize risk and avoid situations in which a malfunction or failure of Product could cause loss of human life, bodily injury or damage to property, including data loss or corruption. Before customers use the Product, create designs including the Product, or incorporate the Product into their own applications, customers must also refer to and comply with (a) the latest versions of all relevant TOSHIBA information, including without limitation, this document, the specifications, the data sheets and application notes for Product and the precautions and conditions set forth in the "TOSHIBA Semiconductor Reliability Handbook" and (b) the instructions for the application with which the Product will be used with or for. Customers are solely responsible for all aspects of their own product design or applications, including but not limited to (a) determining the appropriateness of the use of this Product in such design or applications; (b) evaluating and determining the applicability of any information contained in this document, or in charts, diagrams, programs, algorithms, sample application circuits, or any other referenced documents; and (c) validating all operating parameters for such designs and applications. **TOSHIBA ASSUMES NO LIABILITY FOR CUSTOMERS' PRODUCT DESIGN OR APPLICATIONS..**
- **PRODUCT IS NEITHER INTENDED NOR WARRANTED FOR USE IN EQUIPMENTS OR SYSTEMS THAT REQUIRE EXTRAORDINARILY HIGH LEVELS OF QUALITY AND/OR RELIABILITY, AND/OR A MALFUNCTION OR FAILURE OF WHICH MAY CAUSE LOSS OF HUMAN LIFE, BODILY INJURY, SERIOUS PROPERTY DAMAGE AND/OR SERIOUS PUBLIC IMPACT ("UNINTENDED USE").** Except for specific applications as expressly stated in this document, Unintended Use includes, without limitation, equipment used in nuclear facilities, equipment used in the aerospace industry, lifesaving and/or life supporting medical equipment, equipment used for automobiles, trains, ships and other transportation, traffic signaling equipment, equipment used to control combustions or explosions, safety devices, elevators and escalators, and devices related to power plant. **IF YOU USE PRODUCT FOR UNINTENDED USE, TOSHIBA ASSUMES NO LIABILITY FOR PRODUCT.** For details, please contact your TOSHIBA sales representative or contact us via our website.
- Do not disassemble, analyze, reverse-engineer, alter, modify, translate or copy Product, whether in whole or in part.
- Product shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable laws or regulations.
- The information contained herein is presented only as guidance for Product use. No responsibility is assumed by TOSHIBA for any infringement of patents or any other intellectual property rights of third parties that may result from the use of Product. No license to any intellectual property right is granted by this document, whether express or implied, by estoppel or otherwise.
- **ABSENT A WRITTEN SIGNED AGREEMENT, EXCEPT AS PROVIDED IN THE RELEVANT TERMS AND CONDITIONS OF SALE FOR PRODUCT, AND TO THE MAXIMUM EXTENT ALLOWABLE BY LAW, TOSHIBA (1) ASSUMES NO LIABILITY WHATSOEVER, INCLUDING WITHOUT LIMITATION, INDIRECT, CONSEQUENTIAL, SPECIAL, OR INCIDENTAL DAMAGES OR LOSS, INCLUDING WITHOUT LIMITATION, LOSS OF PROFITS, LOSS OF OPPORTUNITIES, BUSINESS INTERRUPTION AND LOSS OF DATA, AND (2) DISCLAIMS ANY AND ALL EXPRESS OR IMPLIED WARRANTIES AND CONDITIONS RELATED TO SALE, USE OF PRODUCT, OR INFORMATION, INCLUDING WARRANTIES OR CONDITIONS OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, ACCURACY OF INFORMATION, OR NONINFRINGEMENT.**
- Product may include products using GaAs (Gallium Arsenide). GaAs is harmful to humans if consumed or absorbed, whether in the form of dust or vapor. Handle with care and do not break, cut, crush, grind, dissolve chemically or otherwise expose GaAs in Product.
- Do not use or otherwise make available Product or related software or technology for any military purposes, including without limitation, for the design, development, use, stockpiling or manufacturing of nuclear, chemical, or biological weapons or missile technology products (mass destruction weapons). Product and related software and technology may be controlled under the applicable export laws and regulations including, without limitation, the Japanese Foreign Exchange and Foreign Trade Law and the U.S. Export Administration Regulations. Export and re-export of Product or related software or technology are strictly prohibited except in compliance with all applicable export laws and regulations.
- Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product. Please use Product in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. **TOSHIBA ASSUMES NO LIABILITY FOR DAMAGES OR LOSSES OCCURRING AS A RESULT OF NONCOMPLIANCE WITH APPLICABLE LAWS AND REGULATIONS.**

TOSHIBA

* Arm and Cortex are registered trademarks of Arm Limited (or its subsidiaries) in the US and/or elsewhere.

* M-FLAT™ and NANOFLASH™ are trademarks of Toshiba Electronic Devices & Storage Corporation.

* All other company names, product names, and service names may be trademarks of their respective companies.