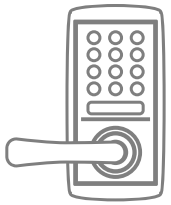
TOSHIBA

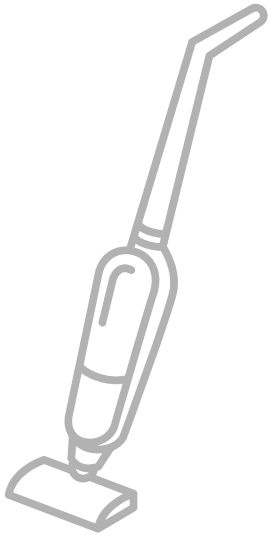
R22

Cordless Cleaner

Solution Proposal by Toshiba

© 2019-2025 Toshiba Electronic Devices & Storage Corporation

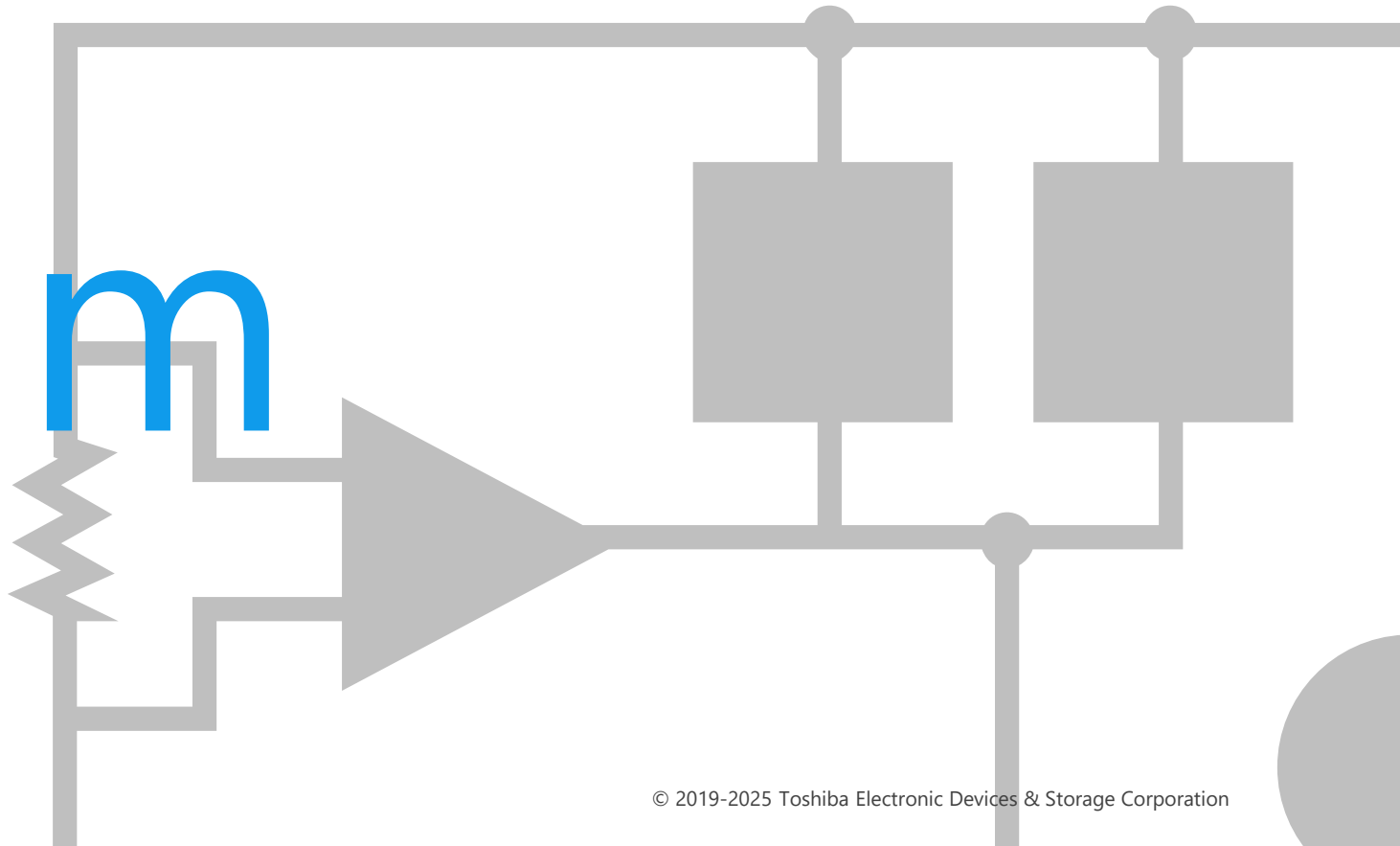




Toshiba Electronic Devices & Storage Corporation provides comprehensive device solutions to customers developing new products by applying its thorough understanding of the systems acquired through the analysis of basic product designs.

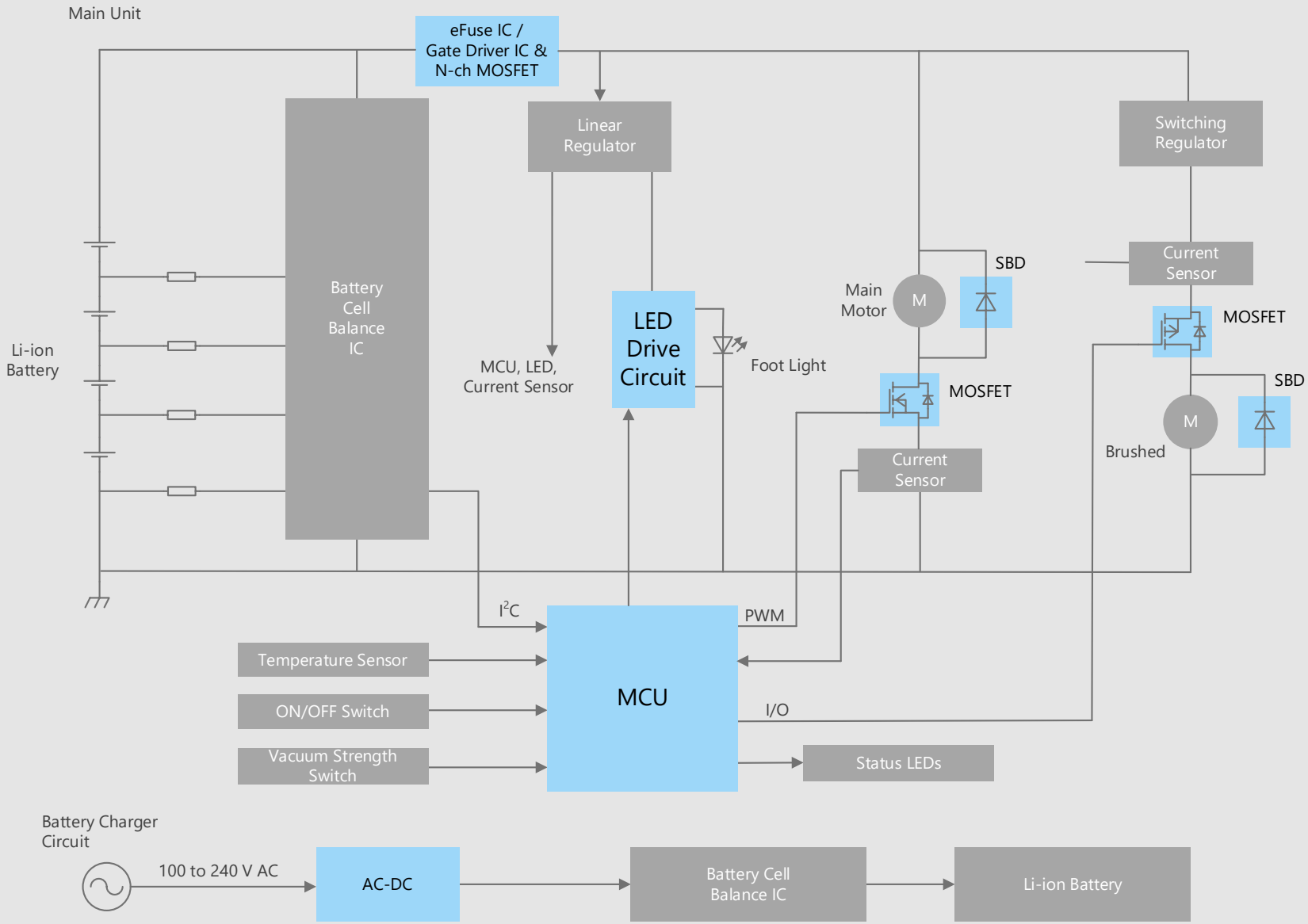
© 2019-2025 Toshiba Electronic Devices & Storage Corporation

Block Diagram



© 2019-2025 Toshiba Electronic Devices & Storage Corporation

Cordless Cleaner　Overall block diagram

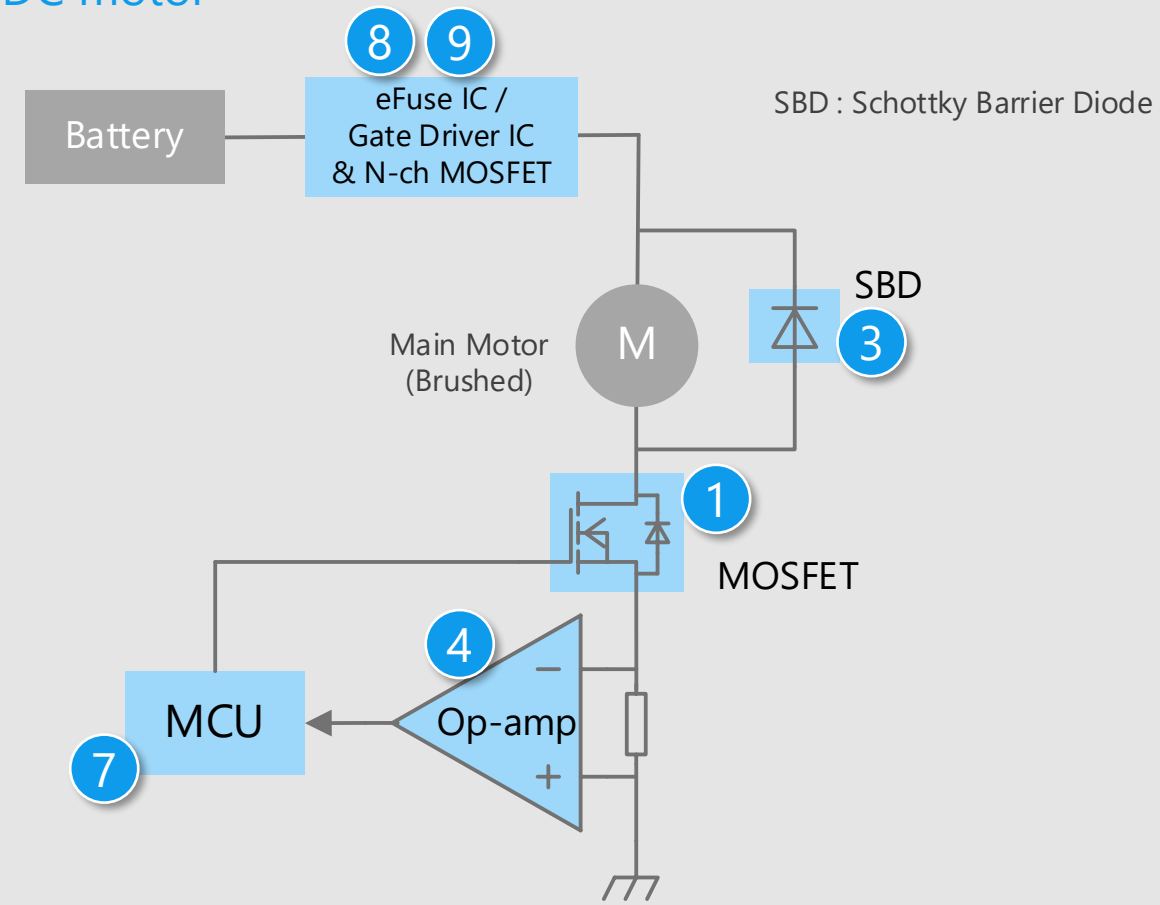


© 2019-2025 Toshiba Electronic Devices & Storage Corporation

Cordless Cleaner　Detail of motor drive circuit (1)

Main motor drive circuit

Brushed DC motor



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

Criteria for device selection

- Motor loss can be reduced by using small package products with good heat dissipation and high speed switching.
- Small package products contribute to the reduction of circuit board area.
- High precision current detection is possible by an operational amplifier with small input offset voltage.

Proposal from Toshiba

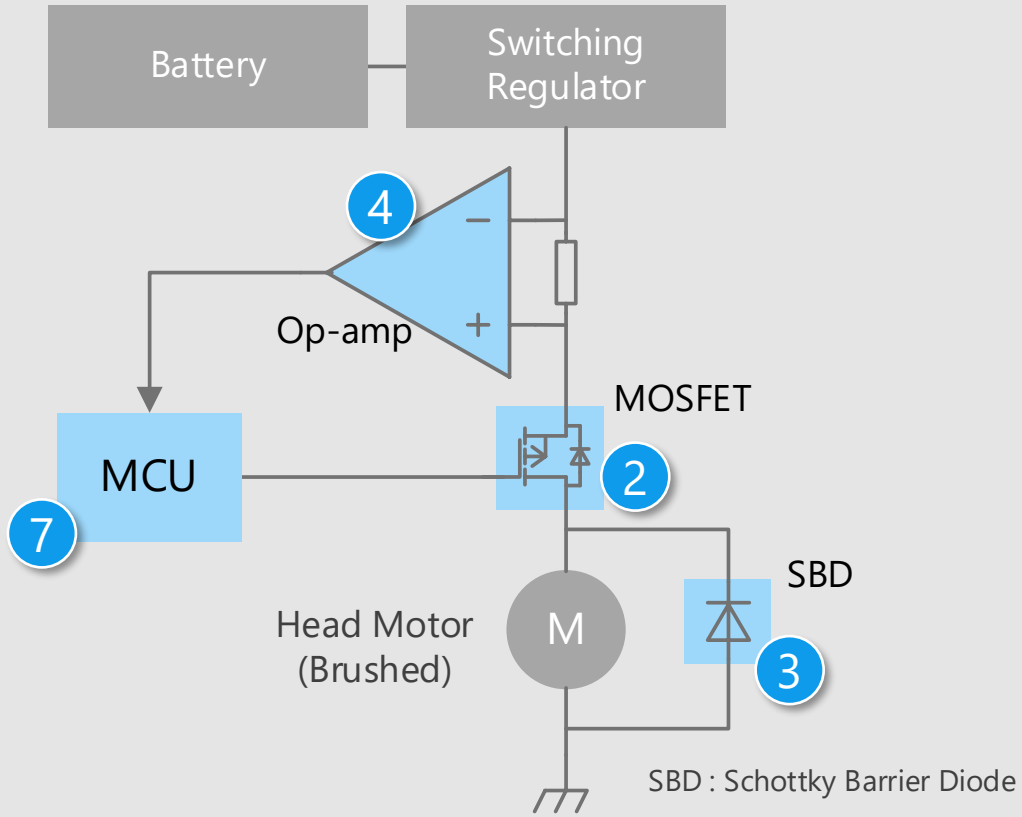
- **Realize the set with low power consumption by low on-resistance**
  U-MOS Series N-ch MOSFET　1
- **Strong against surge current**
  Schottky barrier diode　3
- **Realize low voltage drive and low current consumption by built-in phase compensation circuit**
  CMOS operational amplifier　4
- **Built-in ADCs, timers and 3-phase PWM output. Execute system control with low power consumption**
  MCU　7
- **Built-in protection function against short circuit, over current, over voltage, etc.**
  Electronic fuse (eFuse IC)　8
- **Small package and built-in over voltage protection function**
  N-ch MOSFET gate driver IC　9

© 2019-2025 Toshiba Electronic Devices & Storage Corporation

Cordless Cleaner　Detail of motor drive circuit (2)

Head motor drive circuit

Brushed DC motor



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

Criteria for device selection

- Motor loss can be reduced by using small package products with good heat dissipation and high speed switching.
- Small package products contribute to the reduction of circuit board area.
- High precision current detection is possible by an operational amplifier with small input offset voltage.

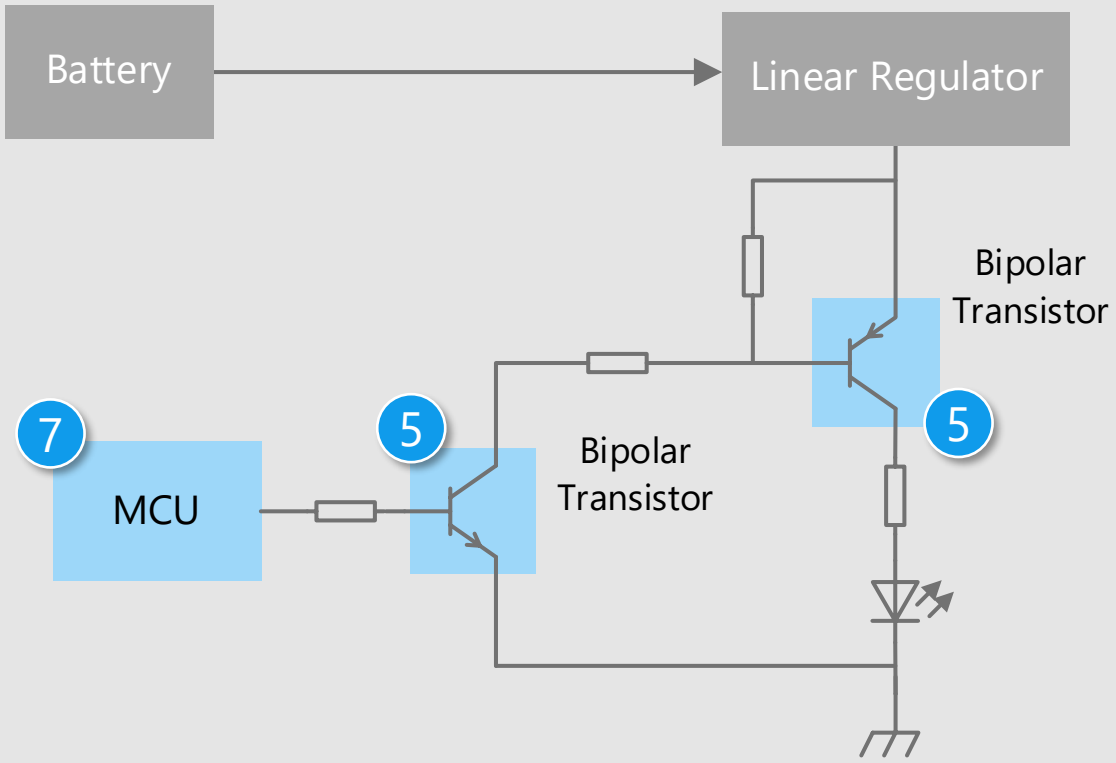
Proposal from Toshiba

- **Realize the set with low power consumption by low on-resistance**
  U-MOS Series P-ch MOSFET　2
- **Strong against surge current**
  Schottky barrier diode　3
- **Realize low voltage drive and low current consumption by built-in phase compensation circuit**
  CMOS operational amplifier　4
- **Built-in ADCs, timers and 3-phase PWM output. Execute system control with low power consumption**
  MCU　7

© 2019-2025 Toshiba Electronic Devices & Storage Corporation

Cordless Cleaner　Detail of LED drive circuit

LED drive circuit for lighting



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

Criteria for device selection

- Transistors with small package and low collector-emitter saturation voltage are required.
- Small package products contribute to the reduction of circuit board area.

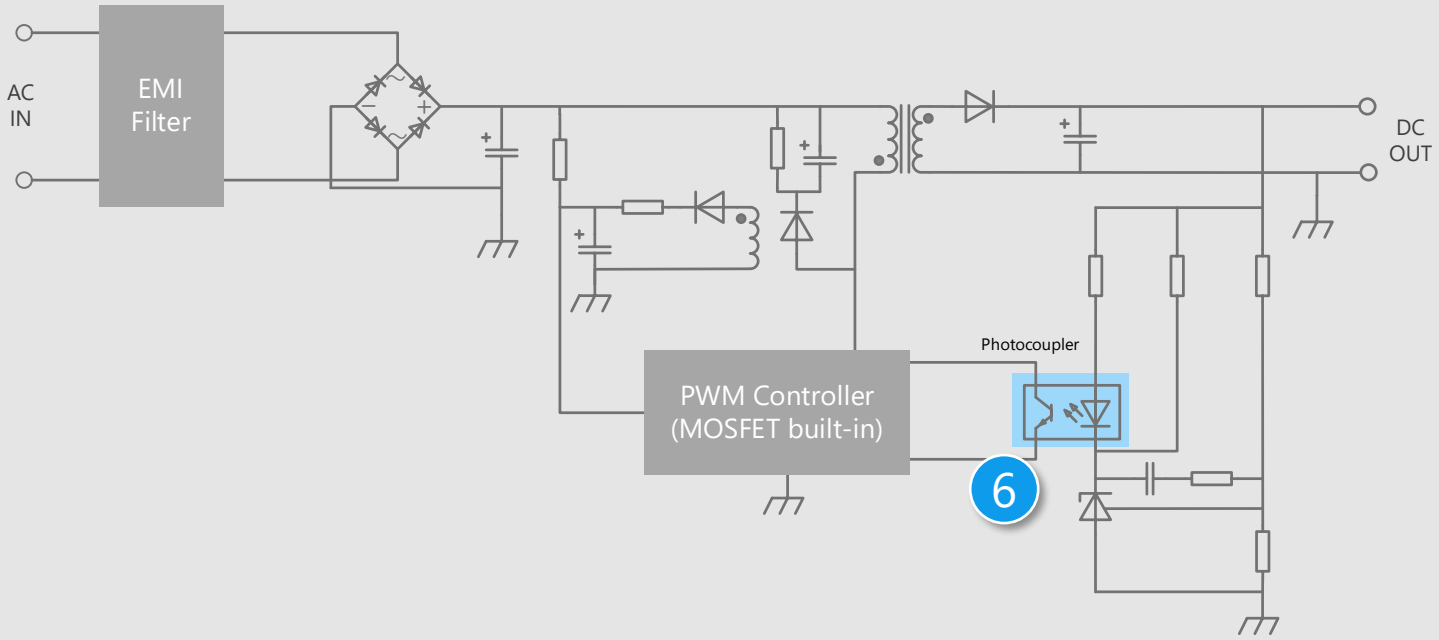
Proposal from Toshiba

- **High voltage and high h_{FE}**
  Small surface mount bipolar transistor 5
- **Built-in ADCs, timers and 3-phase PWM output. Execute system control with low power consumption**
  MCU 7

© 2019-2025 Toshiba Electronic Devices & Storage Corporation

Cordless Cleaner　Detail of power supply line

Flyback AC-DC circuits



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

Criteria for device selection

- Contribute to high power supply efficiency by using photocouplers with high current transfer ratio even in the low input current range.
- Small package products contribute to the reduction of circuit board area.

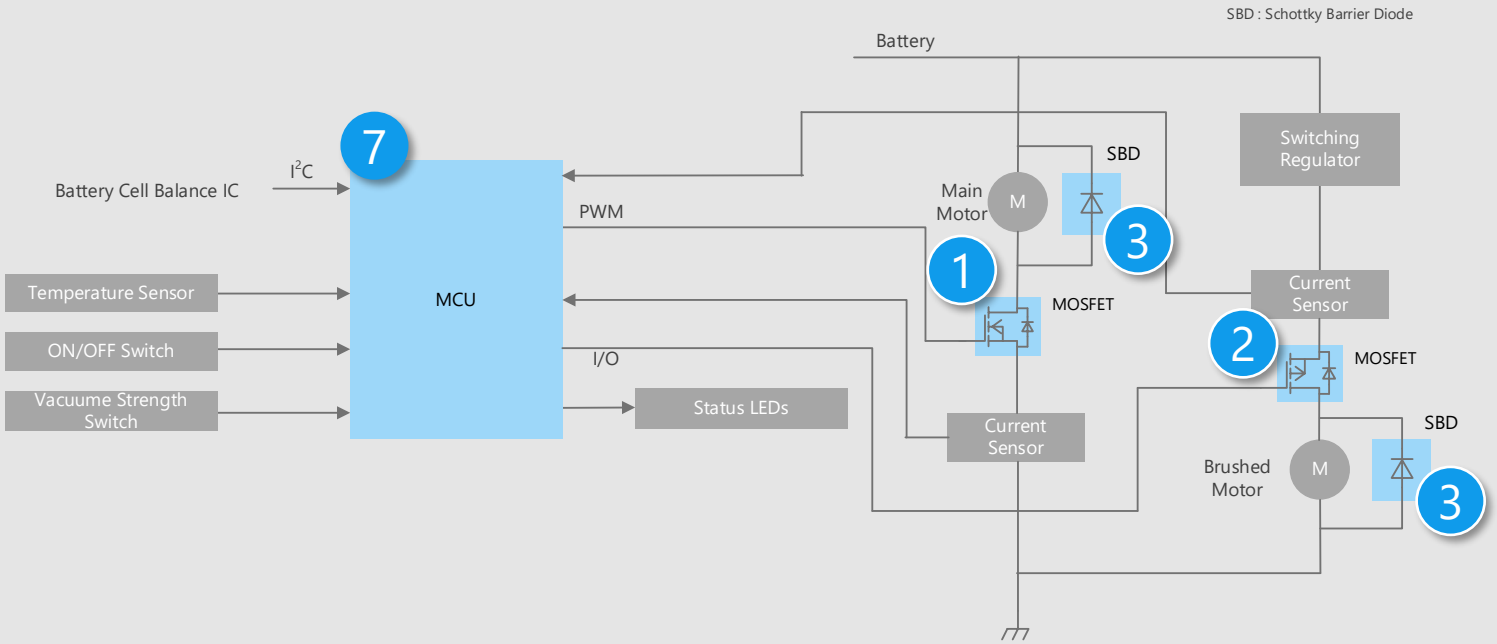
Proposal from Toshiba

- **Photocoupler with excellent environmental resistance**
  Transistor output photocoupler　6

© 2019-2025 Toshiba Electronic Devices & Storage Corporation

Cordless Cleaner　Detail of main control section

Main control circuit



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

Criteria for device selection

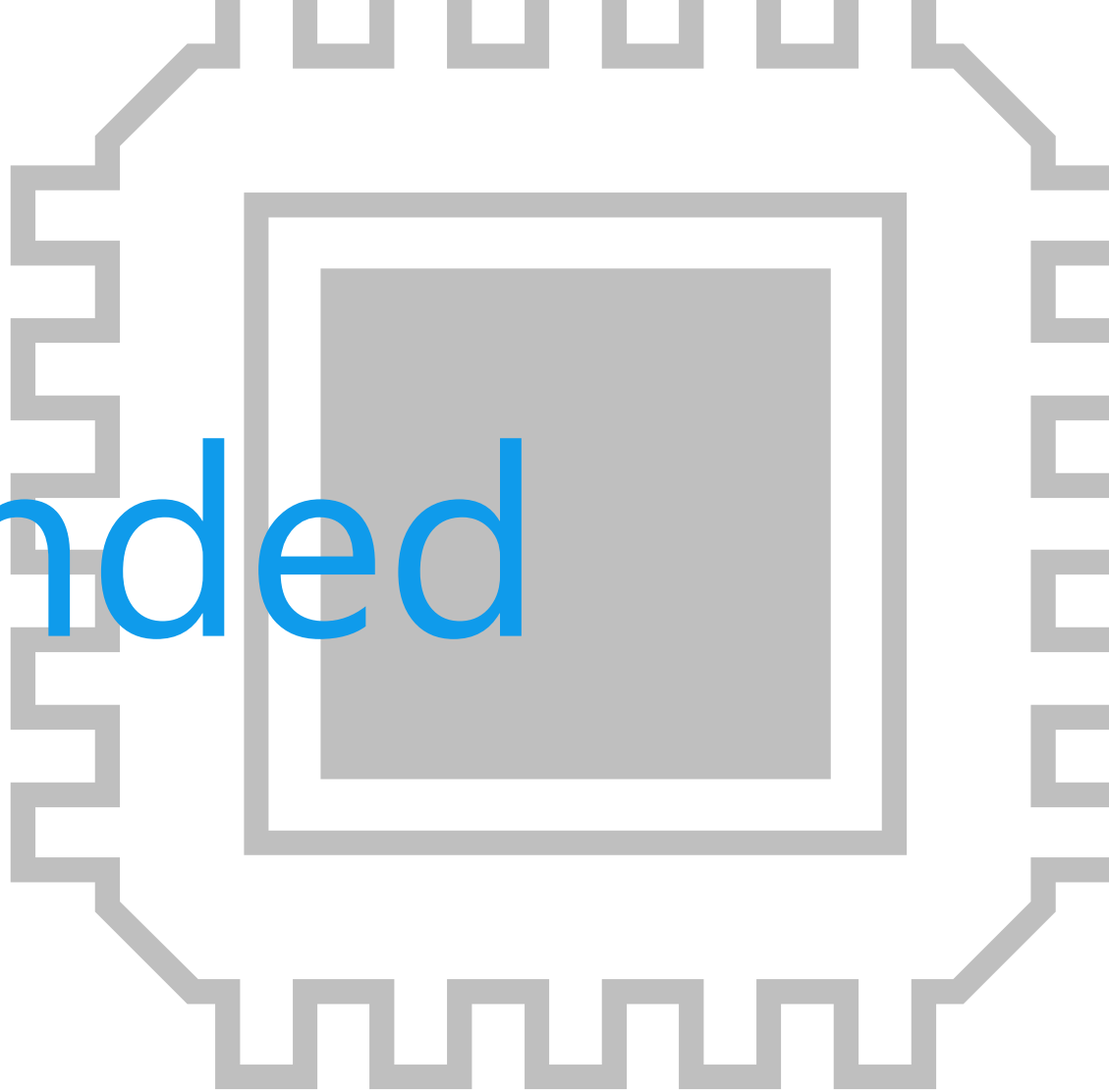
- Motor loss can be reduced by using small package products with good heat dissipation and high speed switching.
- Small package products contribute to the reduction of circuit board area.
- An MCU is required to control motors in main and brush parts at the same time.
- For system control, an MCU with monitoring various sensors such as current, temperature and light is required.

Proposal from Toshiba

- **Realize low power consumption by low on-resistance** 1
  U-MOS Series N-ch MOSFET
  U-MOS Series P-ch MOSFET 2
- **Strong against surge current**
  Schottky barrier diode 3
- **Built-in ADCs, timers and 3-phase PWM output. Execute system control with low power consumption**
  MCU 7

© 2019-2025 Toshiba Electronic Devices & Storage Corporation

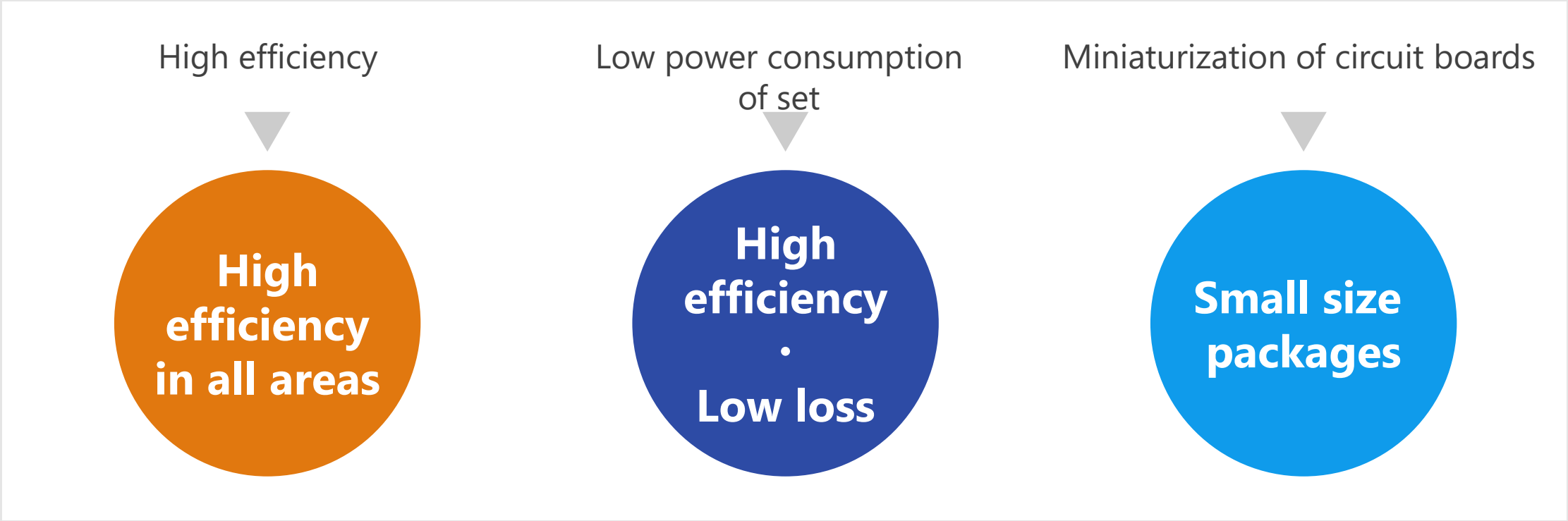
Recommended Devices



© 2019-2025 Toshiba Electronic Devices & Storage Corporation

Device solutions to address customer needs

As described above, in the design of cordless 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.



© 2019-2025 Toshiba Electronic Devices & Storage Corporation

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 U-MOS Series P-ch MOSFET	●	●	●
3 Schottky barrier diode	●		●
4 CMOS operational amplifier	●	●	●
5 Small surface mount bipolar transistor			●
6 Transistor output photocoupler	●		●
7 MCU	●		●
8 Electronic fuse (eFuse IC)	●	●	●
9 N-ch MOSFET gate driver IC		●	●

© 2019-2025 Toshiba Electronic Devices & Storage Corporation

1 U-MOS Series N-ch MOSFET

TPH7R006PL / TPH4R008QM / TPH2R408QM / TPN7R006PL / TPN8R408QM / TK5R1P08QM / TK6R9P08QM

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

Value provided

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

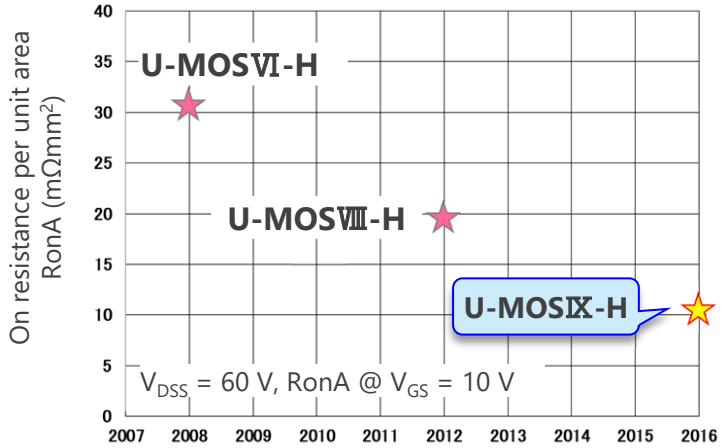
2 Small total gate charge

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.

RonA reduction trend of N-ch MOSFET



(Note: Toshiba internal comparison)

Lineup

Part number		TPH7R006PL	TPH4R008QM	TPH2R408QM	TPN7R006PL	TPN8R408QM	TK5R1P08QM	TK6R9P08QM
Package		SOP Advance	SOP Advance(N)		TSON Advance		DPAK	
V_{DSS} [V]		60	80	80	60	80	80	80
I_D [A]		60 (79*)	86 (140*)	120 (200*)	54 (76*)	32 (77*)	84 (105*)	62 (83*)
$R_{DS(ON)}$ [mΩ] @V_{GS} = 10 V	Typ.	5.4	3.1	1.9	5.4	6.5	4.2	5.5
	Max	7.0	4	2.43	7.0	8.4	5.1	6.9
Polarity		N-ch	N-ch	N-ch	N-ch	N-ch	N-ch	N-ch
Generation		U-MOSⅨ-H	U-MOSⅩ-H	U-MOSⅩ-H	U-MOSⅨ-H	U-MOSⅩ-H	U-MOSⅩ-H	U-MOSⅩ-H

* : Silicon limit

◆Return to Block Diagram TOP

© 2019-2025 Toshiba Electronic Devices & Storage Corporation

2 U-MOS Series P-ch MOSFET

TPCA8120

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

Value provided

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

1 Low on-resistance

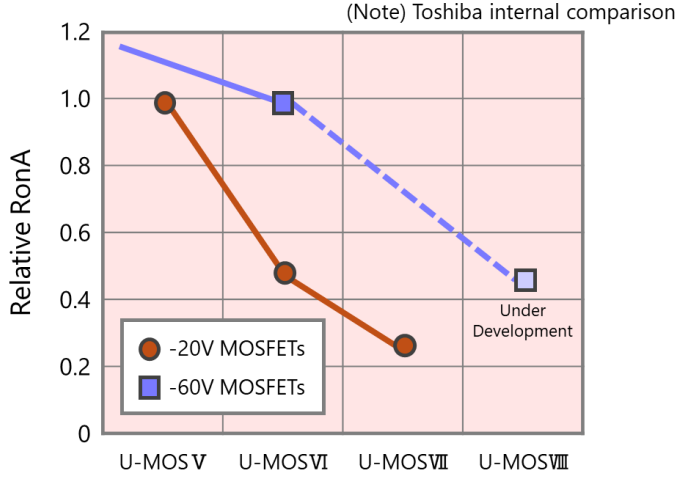
By reducing on-resistance between drain and source, heat generation and power consumption can be kept low, and it can contribute to miniaturization.

2 Small total gate charge

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

RonA reduction of P-ch MOSFET

(Note) Toshiba internal comparison



Lineup

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

© 2019-2025 Toshiba Electronic Devices & Storage Corporation

3 Schottky barrier diode
CMS05 / CMS15

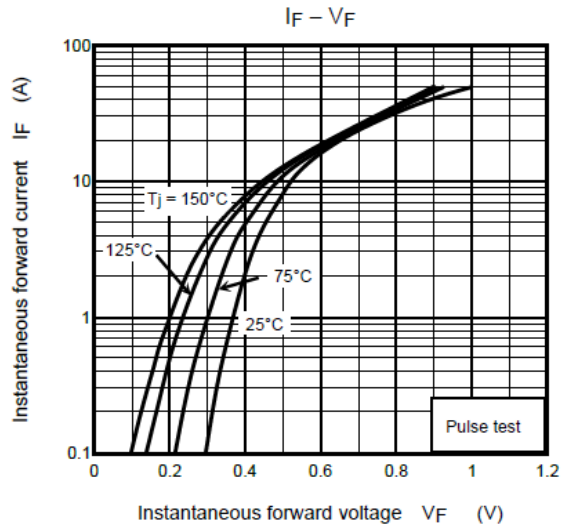
High efficiency in all areas | High efficiency · Low loss | Small size packages

Value provided

We are expanding lineup of small packages that are suitable for high density mounting.

1 Small surface mount package

Adopting M-FLAT™ package, contribute lower height and space saving of equipment compared with Toshiba conventional lead type.



CMS05
Forward characteristic

2 Extensive product lineup

Extensive product lineup
Reverse voltage : up to 60 V /
Average forward current : up to 5 A
It is possible to choose suitable product according to specification of set.

Lineup

Part number	CMS05	CMS15
Package	M-FLAT™	M-FLAT™
$I_{F(AV)}$ [A]	5	3
V_{RRM} [V]	30	60
V_{FM} (Typ.) [V]	0.43	0.55

◆Return to Block Diagram TOP

© 2019-2025 Toshiba Electronic Devices & Storage Corporation

4 CMOS operational amplifier

TC75S55F / TC75S55FU

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

Value provided

Low voltage driving and low current consumption compared with bipolar type, contributing to the flexibility and low loss in device design.

1 Low voltage operation

CMOS processes enable low voltage operation compared to Toshiba bipolar operational amplifier.

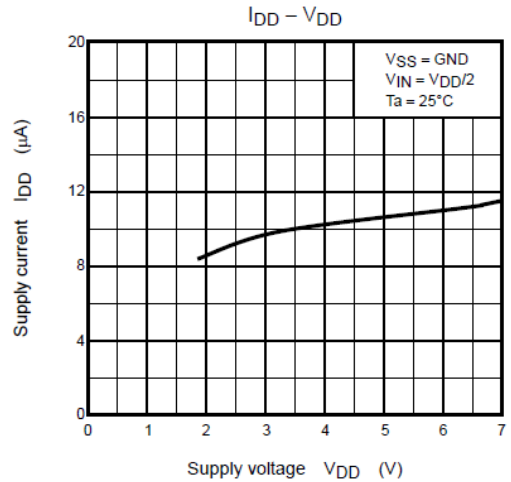
2 Low current consumption

Low current consumption characteristics of CMOS processes contribute to extending the battery life of small IoT equipment.

Note: Comparison with Toshiba's bipolar process operational amplifier

3 Built-in phase compensation circuit

Eliminating the need for external components, CMOS operational amplifier contributes to reduction in the number of parts and size of equipment.



TC75S55F
I_{DD} = 10 μA (Typ.)
@ V_{DD} = 3 V

Low current consumption design compared with bipolar operational amplifier
(Supply current of Toshiba's bipolar process products : I_{CC}=400 [μA] (Typ.))

Lineup

Part number	TC75S55F	TC75S55FU
Package	SMV	USV
V_{DD} [V]	1.8 to 7 ±0.9 to ±3.5	1.8 to 7 ±0.9 to ±3.5
I_{DD} (Typ.) [μA]	10	10
f_T (Typ.) [MHz]	0.16	0.16

◆Return to Block Diagram TOP

© 2019-2025 Toshiba Electronic Devices & Storage Corporation

5 Small surface mount bipolar transistor

2SC2712 / 2SA1162 / TBC847 / TBC857 / HN1B01FU

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

Value provided

Through our extensive product lineup, we provide products that meet the needs of customers.

1 Various package lineups

Many types of package, such as flat lead type and leadless type, are available. It is possible to choose the product that suit customer's circuit board.

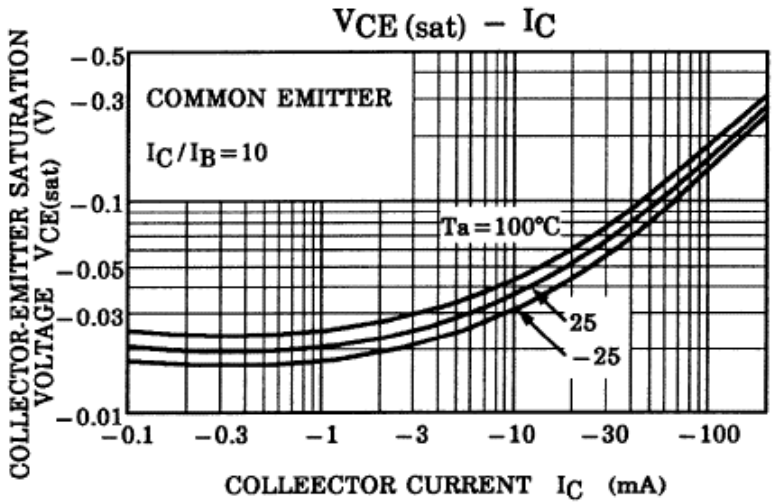
2 Low collector-emitter saturation voltage

Low power consumption is realized by low collector-emitter saturation voltage.

3 High ESD resistance

In applications where static electricity is easily generated, such as in vacuum cleaners, bipolar transistors with higher ESD resistance than MOSFET[Note] are helpful.

［Note］Comparison with Toshiba products



2SA1162

Lineup

Part number				
	NPN	2SC2712	TBC847	HN1B01FU (NPN+PNP)
	PNP	2SA1162	TBC857	
Package		S-Mini	SOT23	US6
$\lvert V_{CEO} \rvert$ [V]		50	50	50
$\lvert I_C \rvert$ [mA]		150	150	150

◆Return to Block Diagram TOP

© 2019-2025 Toshiba Electronic Devices & Storage Corporation

6 Transistor output photocoupler
TLP383

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

Value provided

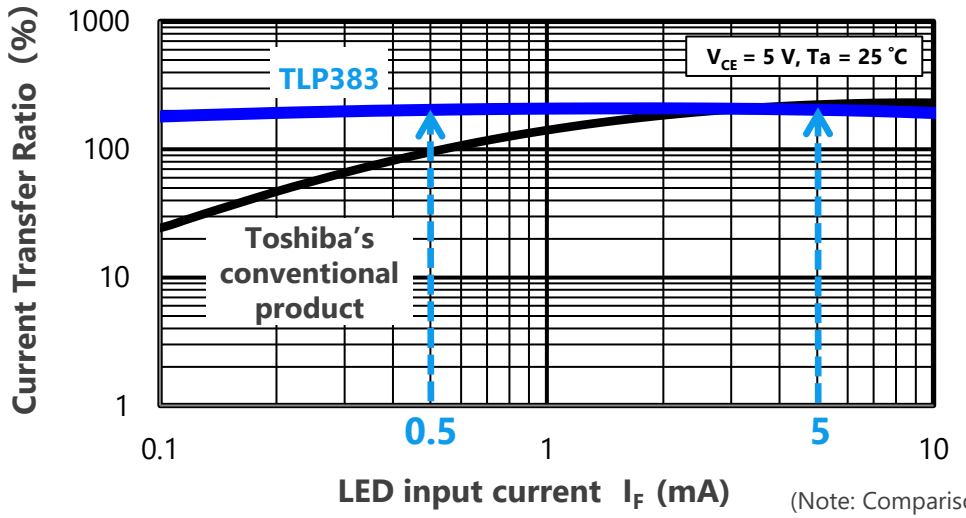
High current transfer ratio is realized even in the low input current range (I_F=0.5 mA).

1 High current transfer ratio

Phototransistor and InGaAs infrared light emitting diode are optically coupled. Highly isolated photocouplers realize higher CTR than Toshiba's conventional products 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: Comparison with conventional Toshiba products)

Lineup

Part number		TLP383
Package		4pin SO6L
I_C/I_F [%]	@I_F = 0.5 mA, V_{CE} = 5 V	50 to 600
	@I_F = 5 mA, V_{CE} = 5 V	
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

© 2019-2025 Toshiba Electronic Devices & Storage Corporation

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.

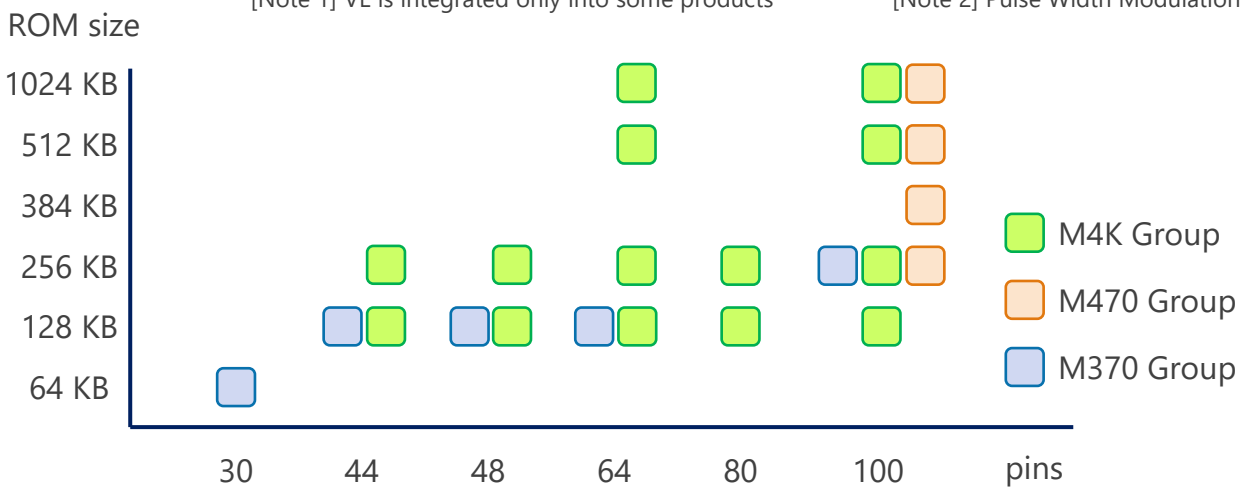
3 Provide development support tools

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

[Note 1] VE is integrated only into some products

[Note 2] Pulse Width Modulation

[Note 3] MCU Motor Studio supports only 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

© 2019-2025 Toshiba Electronic Devices & Storage Corporation

8 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 overcurrent and overvoltage.

1 Can be used repeatedly

When overcurrent flows through the electronic fuse (eFuse IC), the internal detection circuit operates and switches off the internal MOSFET. It is not destroyed by a single overcurrent and can be used repeatedly.

2 IEC 62368-1 certified

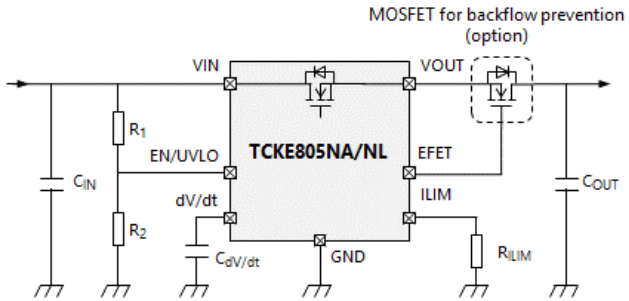
Toshiba's eFuse ICs are certified to the international safety standard IEC 62368-1 (G9: Integrated circuit (IC) current limiters) and contribute to robust protection and simplification of circuit design.

3 Rich protection functions

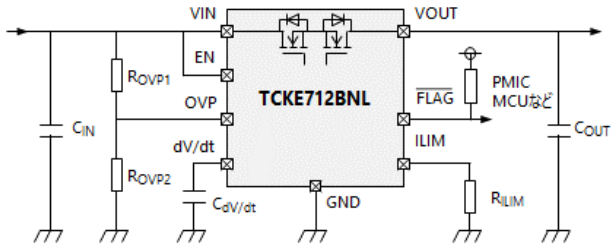
TCKE8 Series: Short-circuit protection, overcurrent protection, overcurrent clamp function, overvoltage clamp function, thermal shut down, inrush current suppression, backflow prevention (optional), etc.

TCKE7 Series: Short-circuit protection, overcurrent protection, overvoltage protection, thermal shut down, FLAG signal output, backflow prevention (built-in), etc.

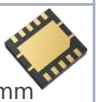
Reference circuit example of TCKE8 Series



Reference circuit example of TCKE7 Series



Lineup

Part number	TCKE800NA/NL	TCKE805NA/NL	TCKE812NA/NL	TCKE712BNL
Package	WSON10B 3.0 x 3.0 x 0.75 mm			WSON10 3.0 x 3.0 x 0.75 mm 
V_{IN} [V]	4.4 to 18			4.4 to 13.2
R_{ON} (Typ.) [mΩ]	28			53
Return function	NA: Automatic return NL: Latch type (external signal control)			Latch type (external signal control)
V_{OVC} (Typ.) [V]	-	6.04	15.1	Adjustable

◆Return to Block Diagram TOP

© 2019-2025 Toshiba Electronic Devices & Storage Corporation

9 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 miniaturization and reduction of power loss of load switch circuit.

[Note 1] OVP : Over Voltage Protection

1 3 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 24 V power supply line.

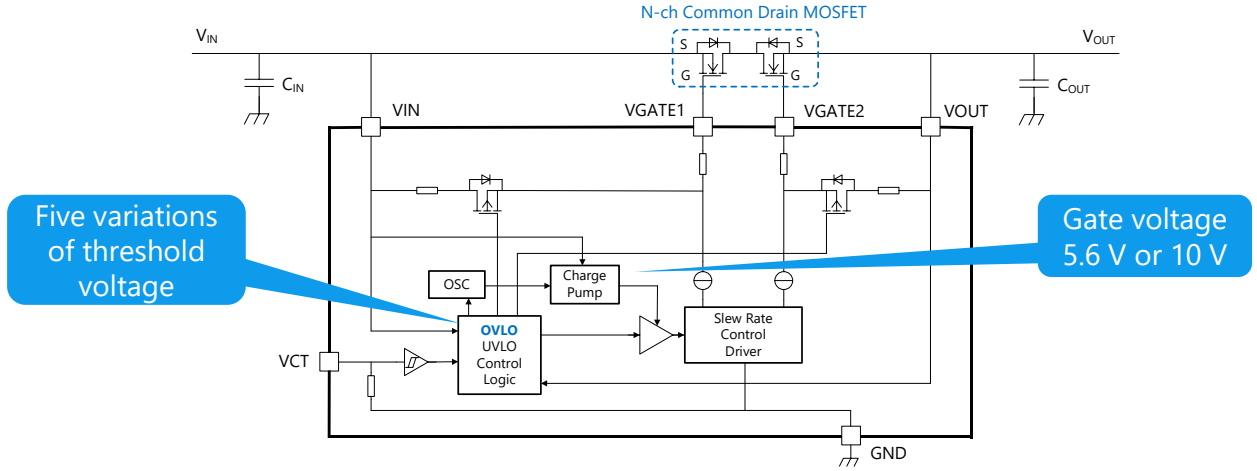
[Note 2] OVLO : Over Voltage Lock Out
[Note 3] V_{IN_OVLO} : V_{IN} OVLO threshold

3 Small 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

© 2019-2025 Toshiba Electronic Devices & Storage Corporation

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

© 2019-2025 Toshiba Electronic Devices & Storage Corporation

Terms of use

This terms of use is made between Toshiba Electronic Devices and Storage Corporation (“We”) and Customer who downloads or uses this Reference Design. Customer shall comply with this terms of use. This Reference Design means all documents and data in order to design electronics applications on which our semiconductor device is embedded.

Section 1. Restrictions on usage
1. This Reference Design is provided solely as reference data for designing electronics applications. Customer shall not use this Reference Design for any other purpose, including without limitation, verification of reliability.
2. Customer shall not use this Reference Design for sale, lease or other transfer.
3. Customer 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 product or system whose manufacture, use, or sale is prohibited under any applicable laws or regulations.

Section 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, Customer is 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. Customer 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. Designing electronics applications by referring to this Reference Design, Customer must evaluate the whole system sufficiently. Customer is solely responsible for applying this Reference Design to Customer's own product design or applications. WE ASSUME NO LIABILITY FOR CUSTOMER'S PRODUCT DESIGN OR APPLICATIONS.
5. WE SHALL NOT BE RESPONSIBLE 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 WITHOUT LIMITATION, WARRANTIES OR CONDITIONS OF FUNCTION AND WORKING, WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, ACCURACY OF INFORMATION, OR NONINFRINGEMENT.

Section 3. Terms and Termination
It is assumed that Customer agrees to any and all this terms of use if Customer downloads or uses 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 without any cause. Upon termination of this terms of use, Customer shall eliminate this Reference Design. Furthermore, upon our request, Customer shall submit to us a written confirmation to prove elimination of this Reference Design.

Section 4. Export Control
Customer 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 Act and the U.S. Export Administration Regulations. Export and re-export of this Reference Design is strictly prohibited except in compliance with all applicable export laws and regulations.

Section 5. Governing Laws
This terms of use shall be governed and construed by laws of Japan, without reference to conflict of law principle.

Section 6. Jurisdiction
Unless otherwise specified, Tokyo District Court in Tokyo, Japan shall be exclusively the court of first jurisdiction for all disputes under this terms of use.

© 2019-2025 Toshiba Electronic Devices & Storage Corporation

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.**

© 2019-2025 Toshiba Electronic Devices & Storage Corporation

TOSHIBA

* Arm and Cortex are registered trademarks of Arm Limited (or its subsidiaries) in the US and/or elsewhere.
* M-FLAT™ and TXZ+™ are trademarks of Toshiba Electronic Devices & Storage Corporation.
* All other company names, product names, and service names may be trademarks of their respective companies.