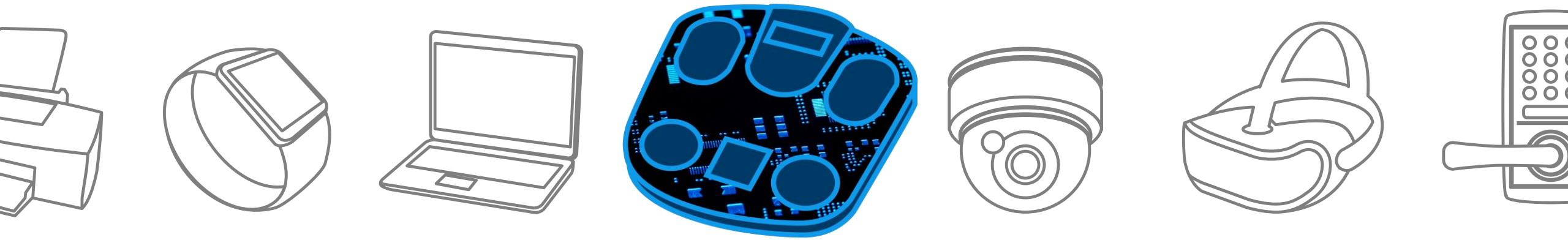
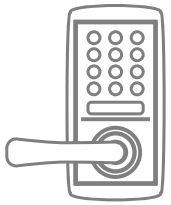
TOSHIBA

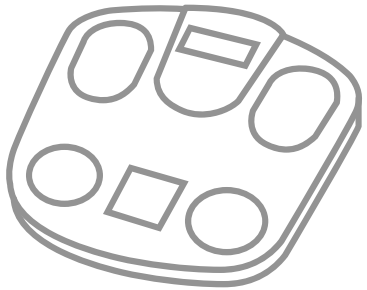
R21

Body Composition Analyzer

Solution Proposal by Toshiba

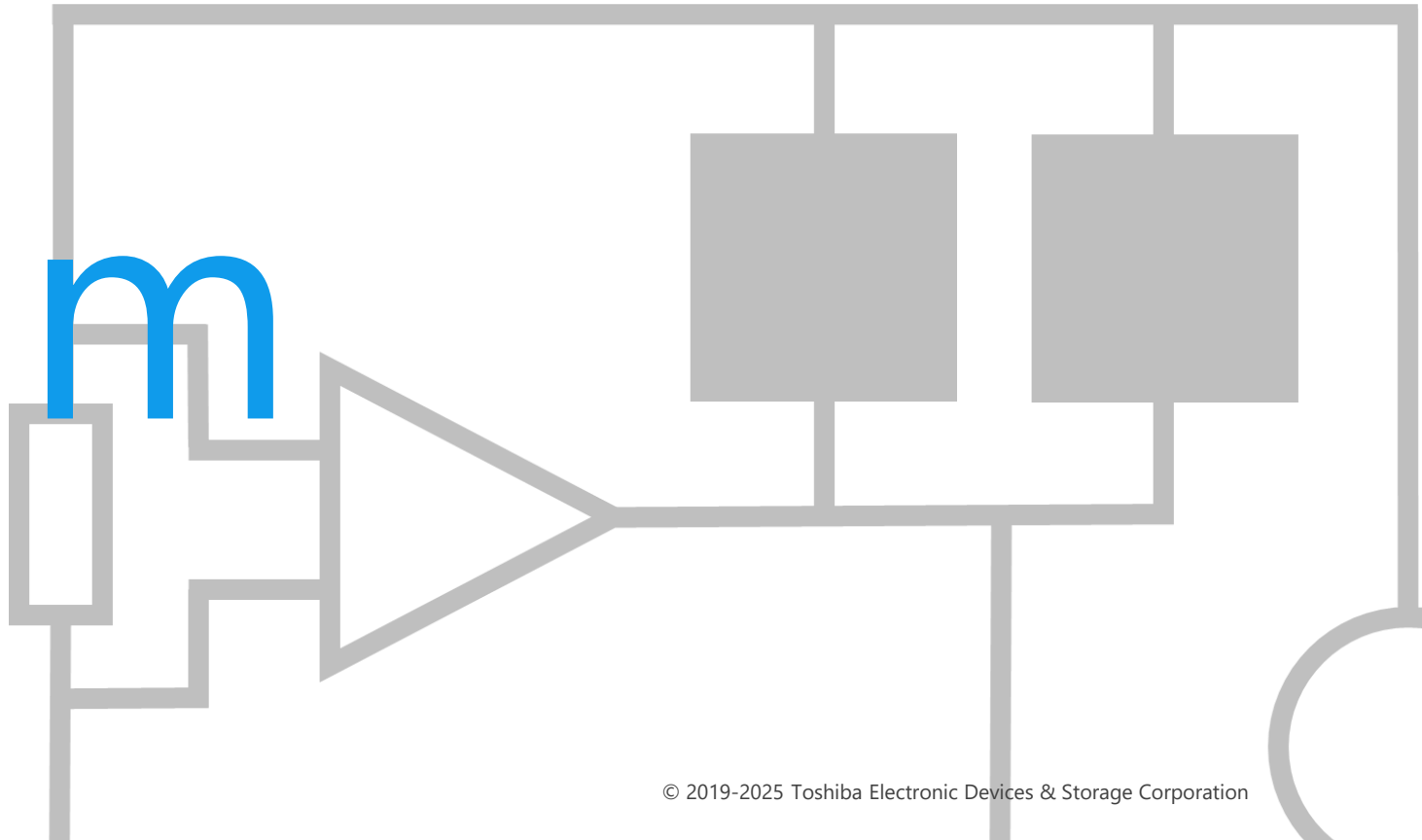




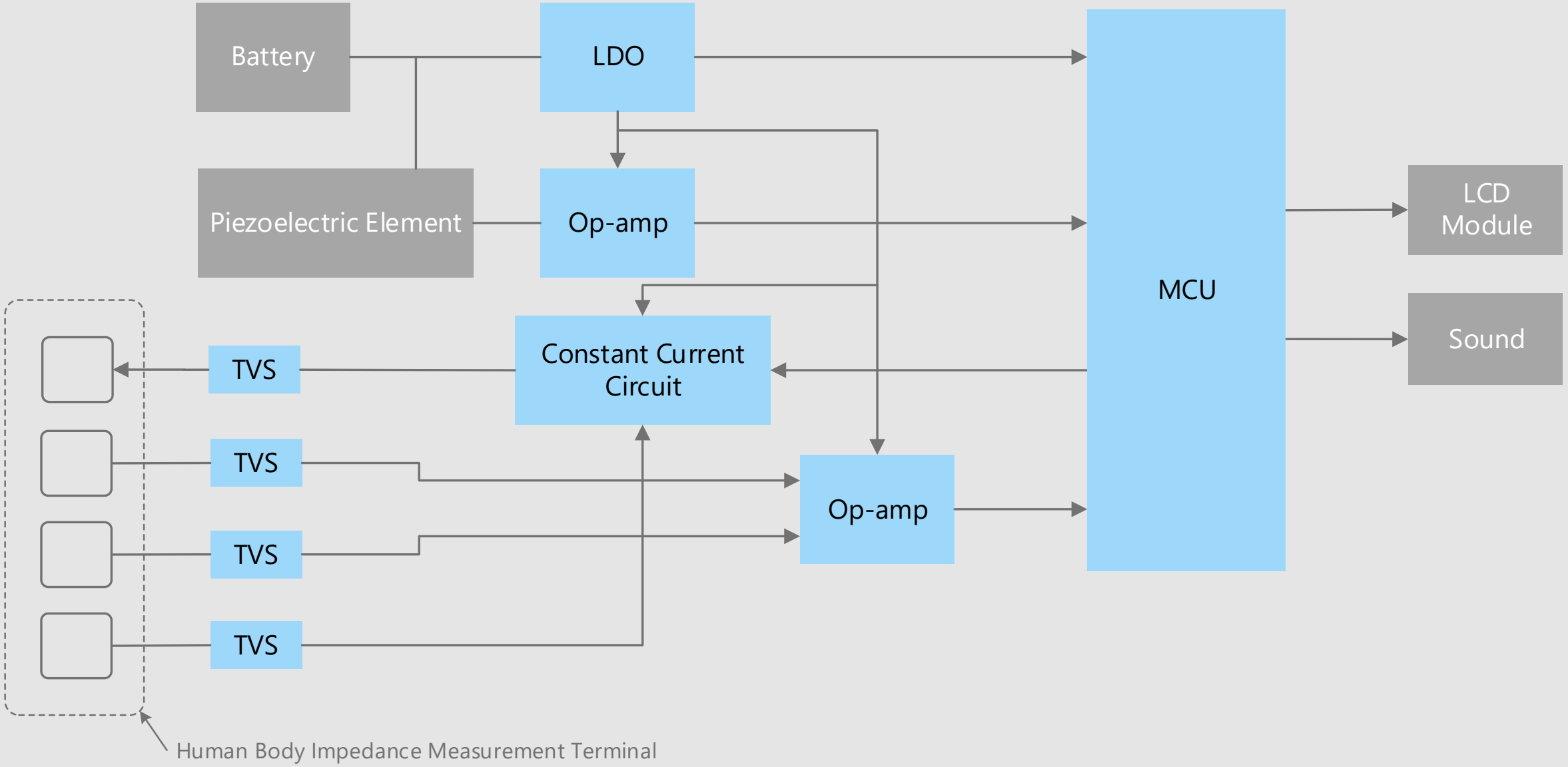


Toshiba Electronic Devices & Storage Corporation provides comprehensive device solutions to customers developing new products by applying its thorough understanding of the systems acquired through the analysis of basic product designs.

Block Diagram

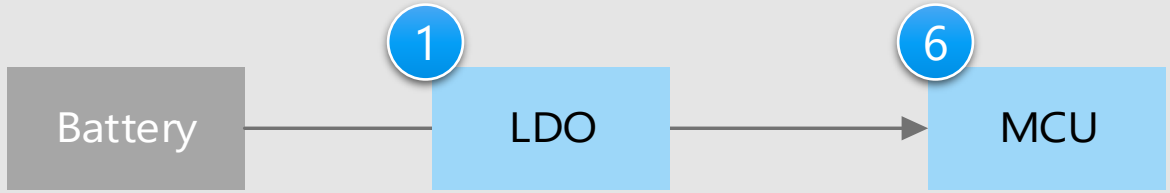


Body Composition Analyzer　Overall block diagram

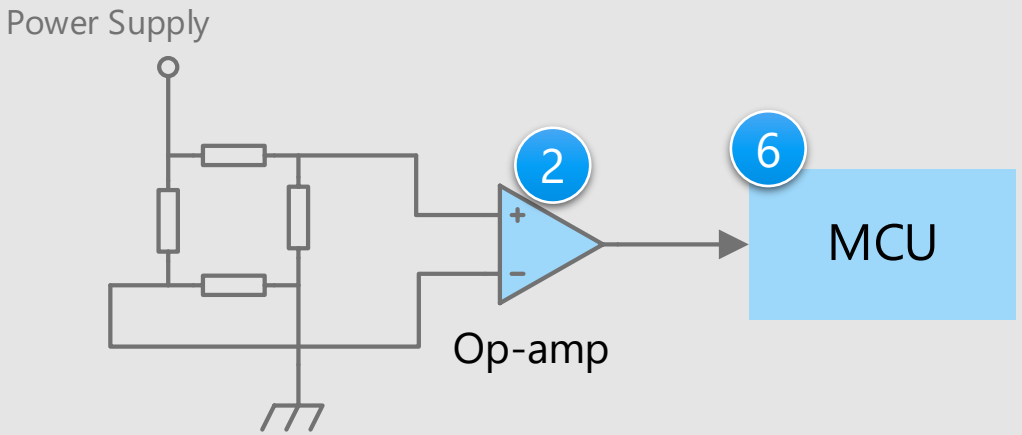


Body Composition Analyzer　Details of analog signal line (1)

Power supply



Piezoelectric element



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

Criteria for device selection

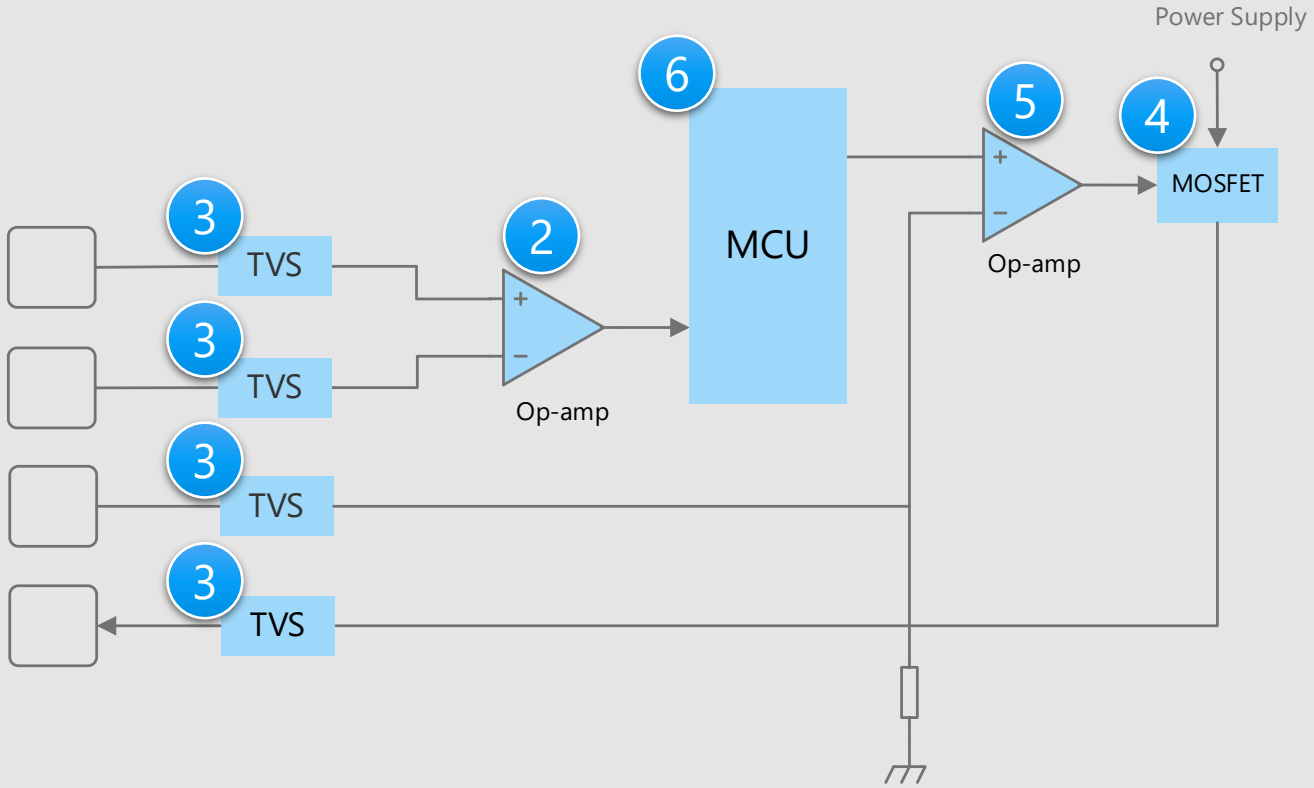
- PSRR (Power Supply Rejection Ratio) is a key characteristic for power supply of microcontroller.
- The circuit board area can be reduced by using small package products.

Proposals from Toshiba

- **Supply the power with low noise** 1
  Small surface mount LDO regulator
- **Amplify the detected weak signal with low noise** 2
  Low noise operational amplifier
- **Built-in analog input interface for sensing, low power consumption and efficient software development** 6
  MCU

Body Composition Analyzer　Details of analog signal line (2)

Human body impedance measurement



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

Criteria for device selection

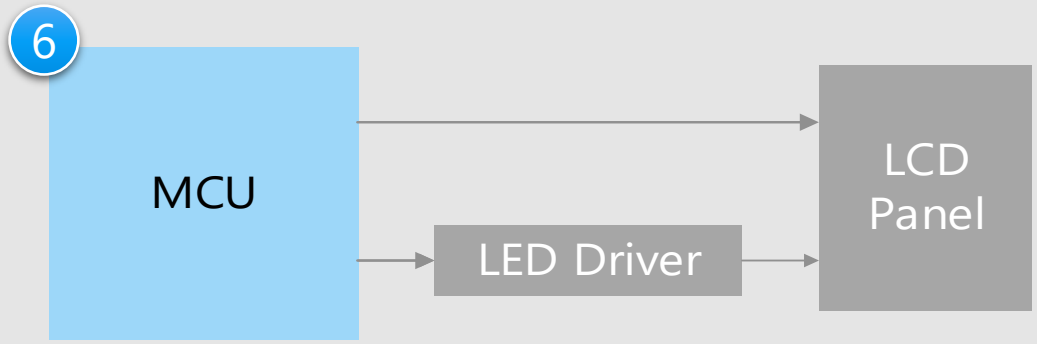
- It is necessary to protect devices against surge voltage such an Electrostatic Discharge (ESD) from external terminals.
- Low noise operational amplifiers are required to improve measurement accuracy.

Proposals from Toshiba

- **Amplify the detected small signal with low noise**
  Low noise operational amplifier　2
- **Absorb ESD from external terminals to prevent circuit malfunction and device breakdown**
  TVS diode　3
- **Realize a set with low power consumption by low on-resistance**
  Small signal MOSFET　4
- **Amplify the detected small signal**
  Low current consumption operational amplifier　5
- **Built-in analog input interface for sensing, low power consumption and efficient software development**
  MCU　6

Body Composition Analyzer　Details of Main operation unit

Panel display system



Criteria for device selection

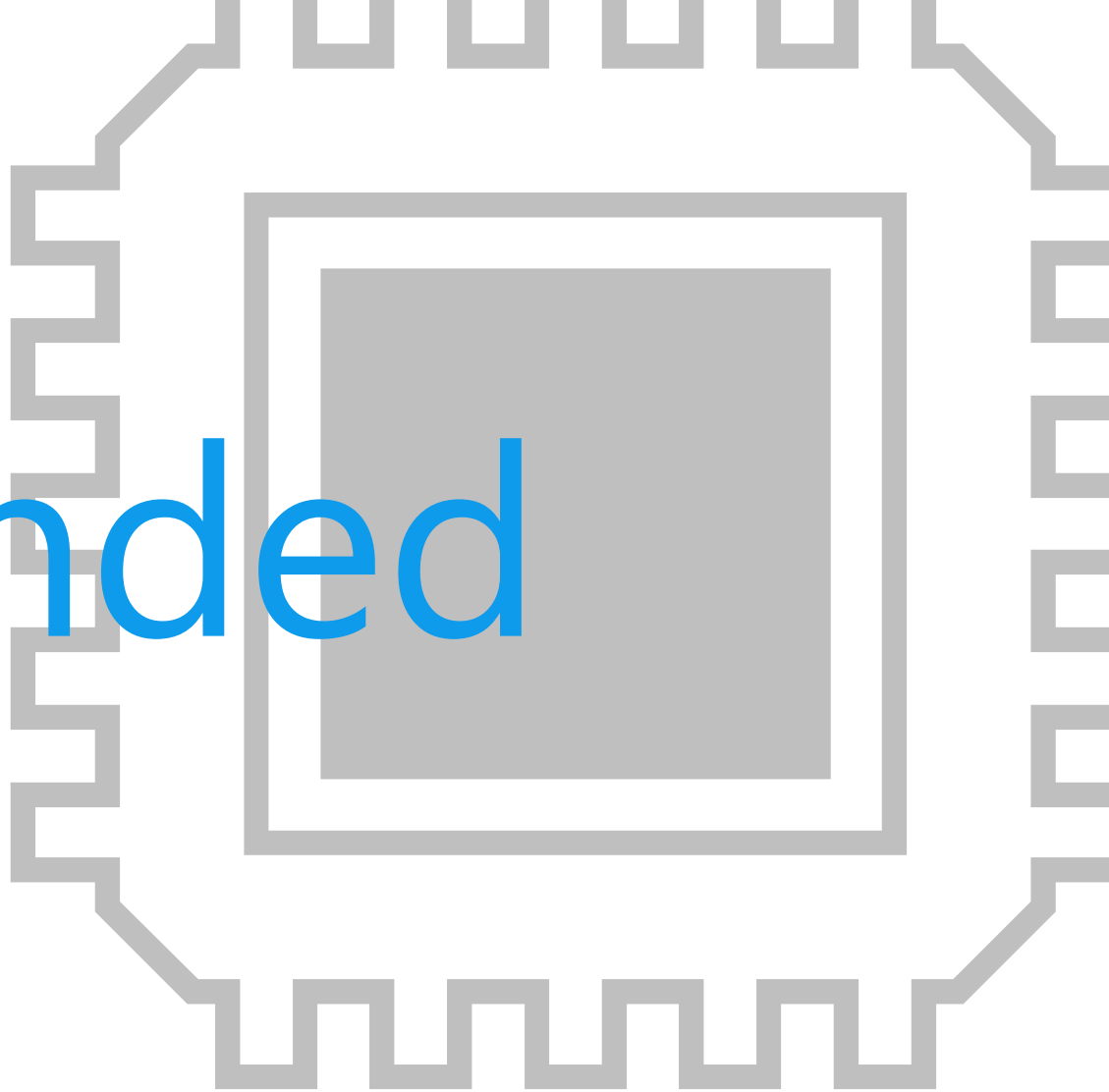
- Data processing of various sensing data and its analyzation within very short period.

Proposal from Toshiba

- **Built-in analog input interface for sensing, low power consumption and efficient software development**
  MCU 6

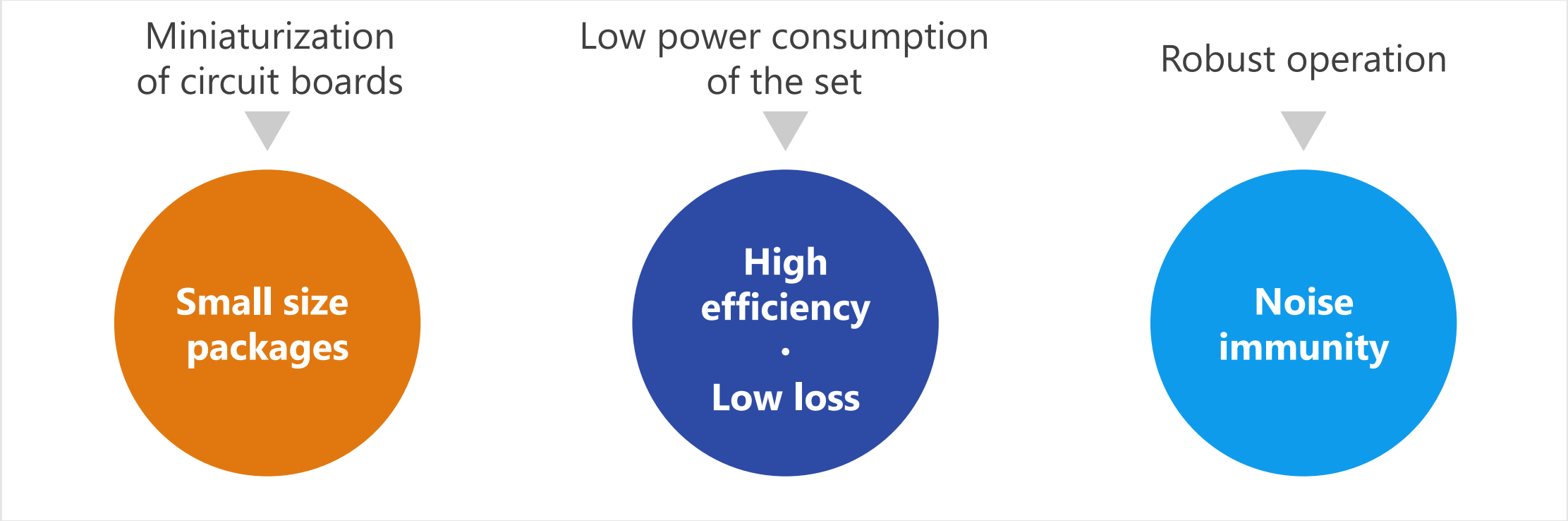
* Click the number in the circuit diagram to jump to the detailed description page

Recommended Devices



Device solutions to address customer needs

As described above, in the design of body composition analyzer, **“Miniaturization of circuit boards“**, **“Low power consumption of the set”** and **“Robust operation”** are important factors. Toshiba’s proposals are based on these three solution perspectives.



Device solutions to address customer needs

	Small size packages	High efficiency · Low loss	Noise immunity
① Small surface mount LDO regulator	●	●	●
② Low noise operational amplifier	●	●	
③ TVS diode	●	●	●
④ Small signal MOSFET	●	●	
⑤ Low current consumption operational amplifier	●	●	
⑥ MCU	●	●	

1 Small surface mount LDO regulator

TCR15AG / TCR13AG / TCR8BM / TCR5BM / TCR5RG / TCR3RM / TCR3U / TCR2L / TAR5 Series

Small size packages | High efficiency · Low loss | Noise immunity

Value provided

Wide lineup from general purpose type to small package type are provided. Contribute to realize a stable power supply not affected by fluctuation of battery.

1 Low dropout voltage

The originally developed the latest generation process significantly improved the dropout voltage characteristics.

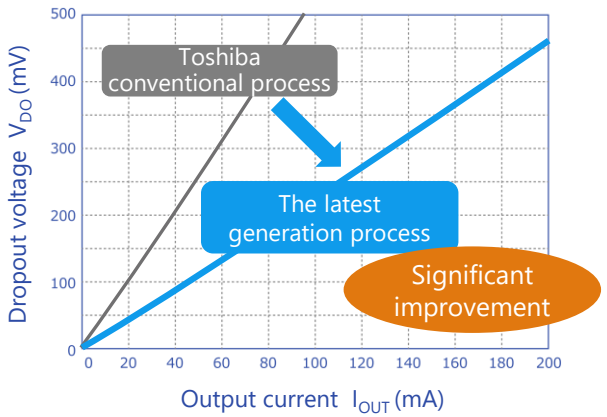
2 High PSRR Low output noise voltage

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

3 Low current consumption

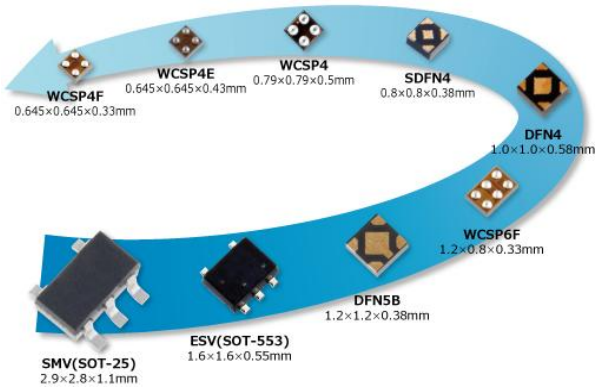
0.34 μA of $I_{B(ON)}$ is realized by utilizing CMOS process and unique circuit technology.
(TCR3U Series)

Low dropout voltage



(Note) Toshiba internal comparison

Rich package lineup



Lineup

Part number	TCR15AG Series	TCR13AG Series	TCR8BM Series	TCR5BM Series	TCR5RG Series	TCR3RM Series	TCR3U Series	TCR2L Series	TAR5 Series
Features	Low dropout voltage High PSRR				High PSRR Low noise Low current consumption		Low current consumption		15 V Input voltage Bipolar type
I_{OUT} (Max) [A]	1.5	1.3	0.8	0.5		0.3		0.2	
PSRR (Typ.) [dB] @f = 1 kHz	95	90	98	98	100	100	70	-	70
I_B (Typ.) [μA]	25	56	20	19	7	7	0.34	1	170

◆Return to Block Diagram TOP

2 Low noise operational amplifier
TC75S67TU

Small size packages | High efficiency · Low loss | Noise immunity

Value provided

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

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

Very small signals detected by various sensors [Note 1] can be amplified with low noise using CMOS operational amplifier by optimizing the processing. We achieved low input equivalent noise voltage.

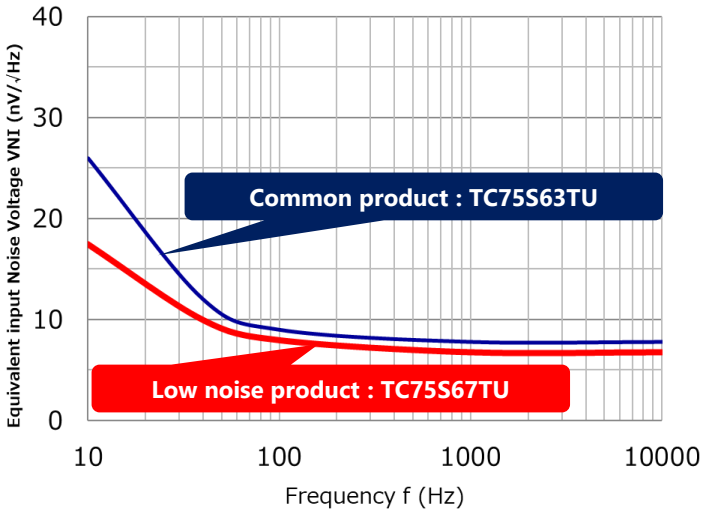
[Note 1] Sensor types: vibration detection sensor, shock sensor, accelerometer, pressure sensor, infrared sensor, and temperature sensor, etc.

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

The low current consumption characteristics of CMOS processing contributes to the extension of battery life of the compact IoT devices [Note 2].

[Note 2] Compared with Toshiba's operational amplifier using bipolar processing.

Noise characteristics
(Toshiba internal comparison)



Lineup

Part number	TC75S67TU
Package	UFV 
$V_{DD,SS}$ (Max) [V]	±2.75
$V_{DD,SS}$ (Min) [V]	±1.1
I_{DD} (Max) [μA]	700
V_{NI} (Typ.) [nV/√Hz] @f = 1 kHz	6

◆Return to Block Diagram TOP

3 TVS diode
DF2B7AFU

Small size packages | High efficiency · Low loss | Noise immunity

Value provided

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

1 Improved ESD absorption

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

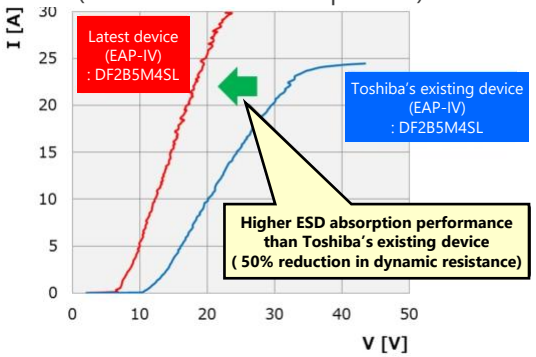
2 Suppress ESD energy by low clamp voltage

Protect the connected circuits and devices using Toshiba own technology.

3 Suitable for high-density mounting

A variety of compact packages are available.

ESD Pulse Absorption Performance
(Toshiba internal comparison)



Unidirectional

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

Bidirectional

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

Lineup

Part number	DF2B7AFU
Package	USC 
V_{ESD} (Max) [kV]	±30
V_{RWM} (Max) [V]	5.5
C_t (Max) [pF]	10.0
R_{DYN} (Typ.) [Ω]	0.2

◆Return to Block Diagram TOP

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

4 Small signal MOSFET

SSM3K15AMFV

Small size packages | High efficiency · Low loss | Noise immunity

Value provided

Suitable for the load switch with partial power-down and greatly contributes to miniaturization.

1 Low voltage drive

Drive at V_{GS} = 2.5 V.

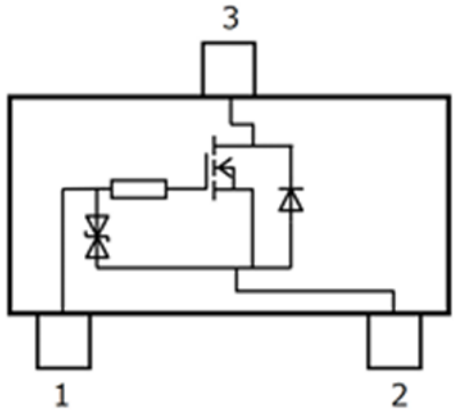
2 Low on-resistance

By reducing on-resistance between the source and drain, heat generation and power consumption can be kept low.

3 Small package

Small SOT-723 / VESM type package.

SSM3K15AMFV
Internal connection



1: Gate
2: Source
3: Drain

Lineup

Part number		SSM3K15AMFV
Package		VESM
V_{DSS} (Max) [V]		30
I_D (Max) [mA]		100
$R_{DS(ON)}$ [Ω] @V_{GS} = 2.5 V	Typ.	3.5
	Max	6.0
Polarity		N-ch

◆Return to Block Diagram TOP

5 Low current consumption operational amplifier

TC75S102F / TC75S103F

Small size packages | High efficiency · Low loss | Noise immunity

Value provided

The offered lineups of operational amplifiers with low current consumption contribute to lower power consumption.

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 body composition analyzer.

2 Low current consumption 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 I/O full range (I/O Rail to Rail)

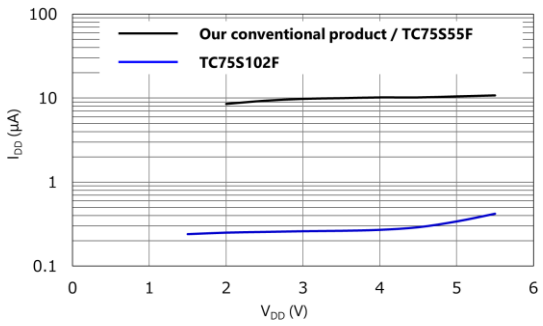
It is possible to amplify and process a wide range of input signals from GND voltage to power supply voltage at low power supply voltage.

TC75S102F

Current Consumption Characteristic

(Toshiba internal comparison)

Low current consumption product TC75S102F



Lineup

Part number	TC75S102F	TC75S103F
Package	SMV 	SMV 
V_{DD} - V_{SS} (Max) [V]	1.5 to 5.5	1.8 to 5.5
V_{IO} (Max) [mV]	1.3	1.5
CMV_{IN} (Max) [V]	V_{DD}	V_{DD}
I_{DD} (Typ. / Max) [µA]	0.27 / 0.46 (@V_{DD} = 1.5 V)	100 / 165 (@V_{DD} = 1.8 V)
f_T (Typ.) [kHz]	0.5	300

◆Return to Block Diagram TOP

Value provided

Contribute to system and development efficiency improvement.

1 Built-in Arm® Cortex®-M0 CPU core

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

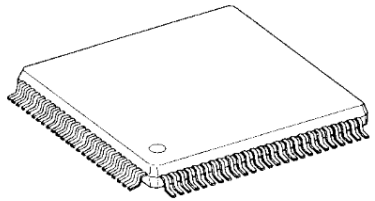
2 Suitable for sensing analog signal

Built-in multi-channel ADC and CPU system executes sensing data processing efficiently.

3 Small package and very low power consumption

Cortex-M0 and Toshiba original NANOFLASH™ technology bring to the small package and low power consumption.
They contribute to reduction of footprint area and power consumption.

TMPM061FWFG



LQFP100-P-1414-0.50G

Lineup

Part number	TMPM061FWFG
Maximum operation frequency	16 MHz
Instruction ROM	128 KB
RAM	8 KB
Timer	9ch
UART/SIO	4ch
ADC	1ch (10bits), 3ch (24bits)
LCDD	40 seg x 4 com

◆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 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.

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.**