

# Human Sensor

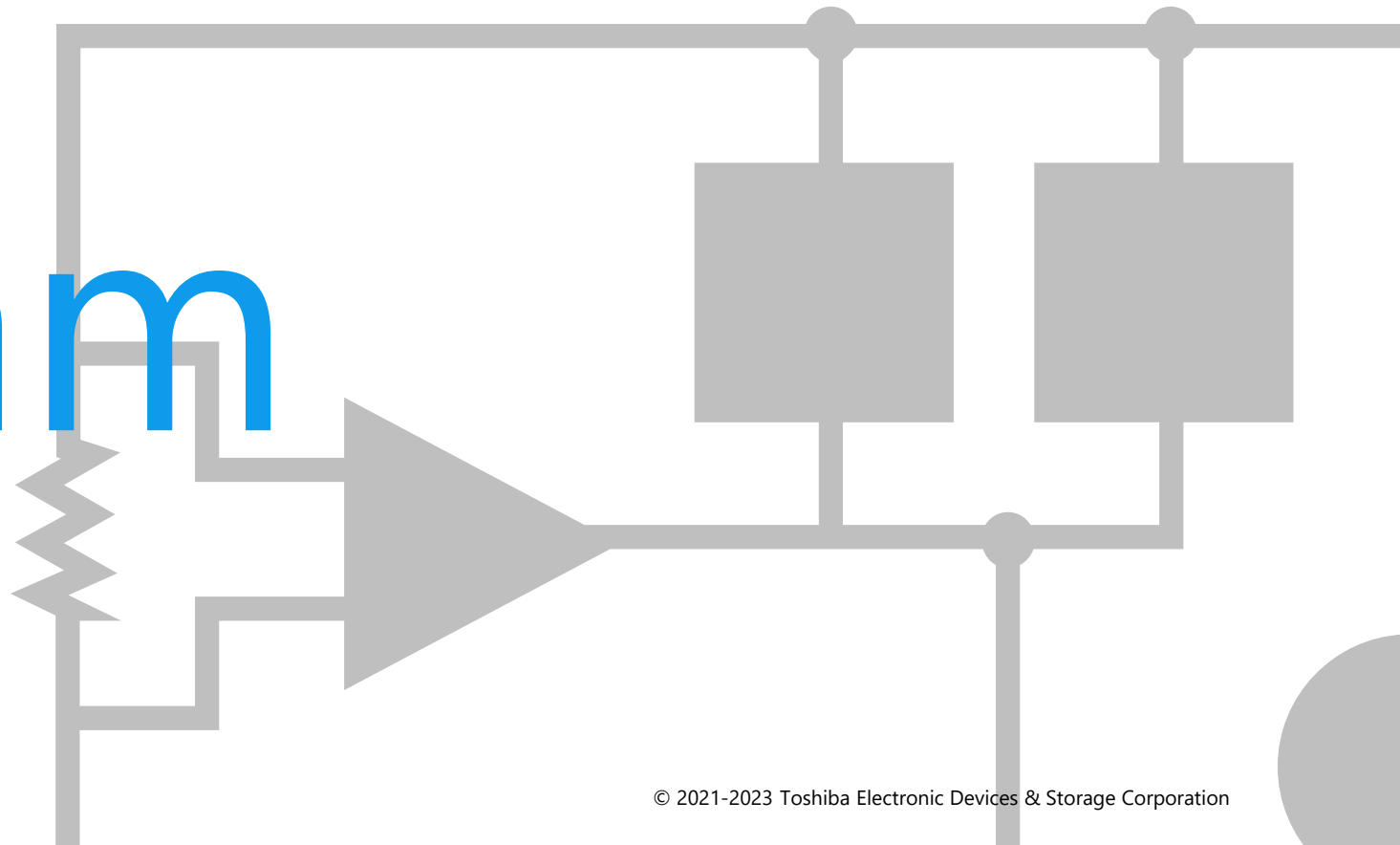
Solution Proposal by Toshiba



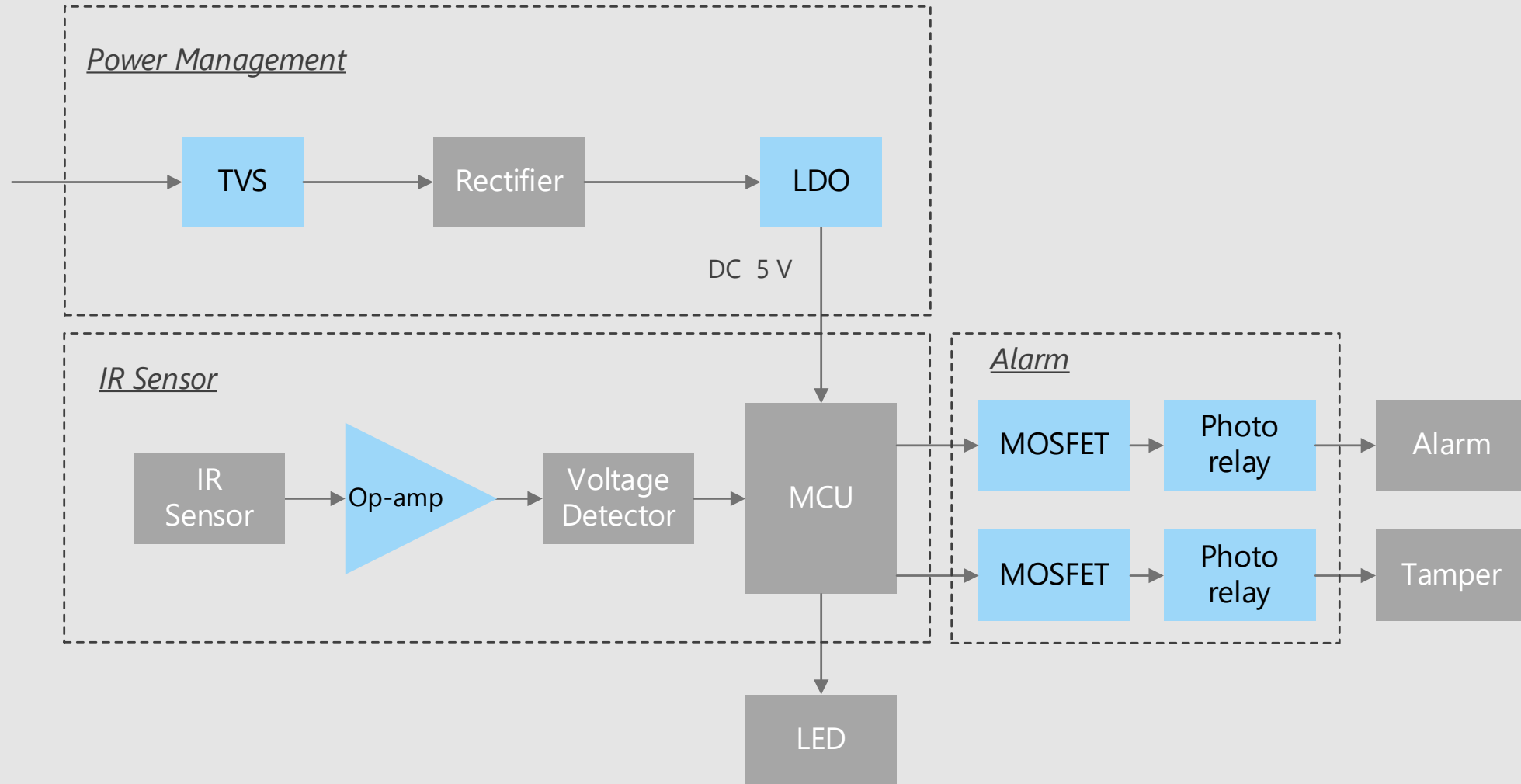


Toshiba Electronic Devices & Storage Corporation provides comprehensive device solutions to customers developing new products by applying its thorough understanding of the systems acquired through the analysis of basic product designs.

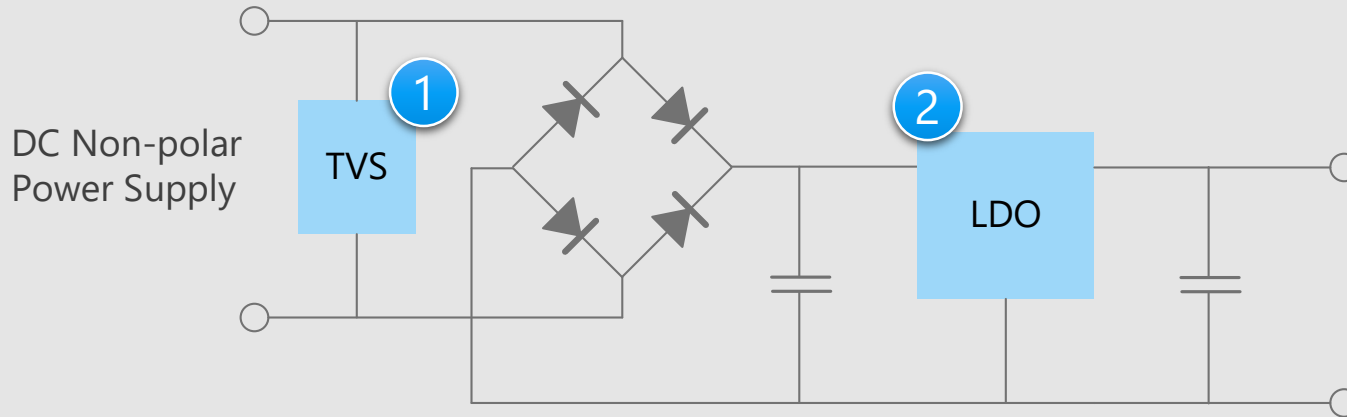
# Block Diagram



# Human Sensor Overall block diagram



## An example of power supply circuit



## Criteria for device selection

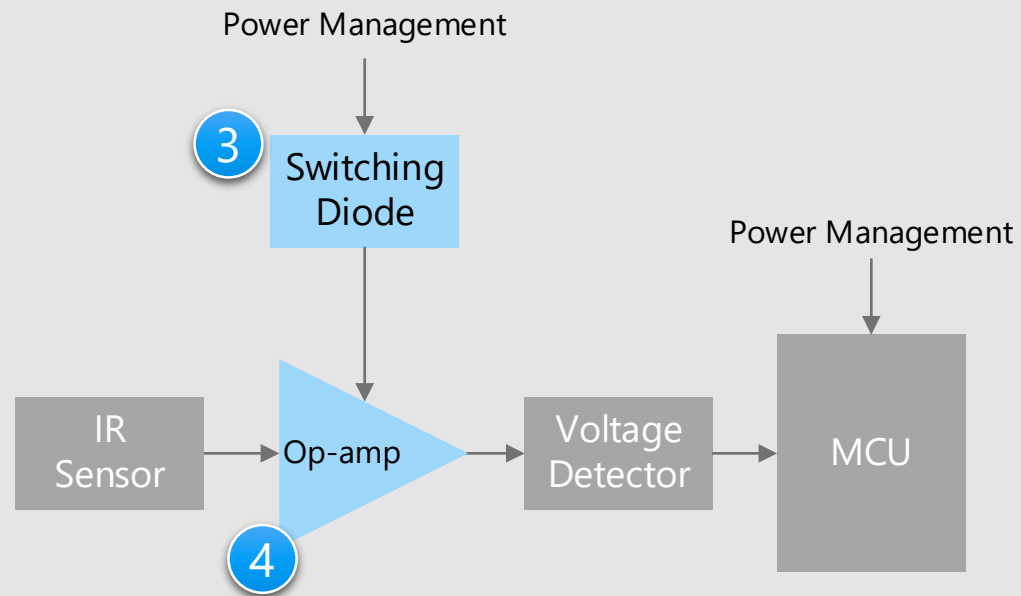
- Highly ESD resistant and reliable system design is possible.
- The board area can be reduced by adopting a small package product.

## Proposal from Toshiba

- **Realizes high ESD tolerance and space saving.**  
TVS diode 1
- **Space saving and low dropout voltage.**  
Small surface mount LDO regulator 2

\* Click on the numbers in the circuit diagram to jump to the detailed descriptions page

## An example of sensor circuit



\* Click on the numbers in the circuit diagram to jump to the detailed descriptions page

## Criteria for device selection

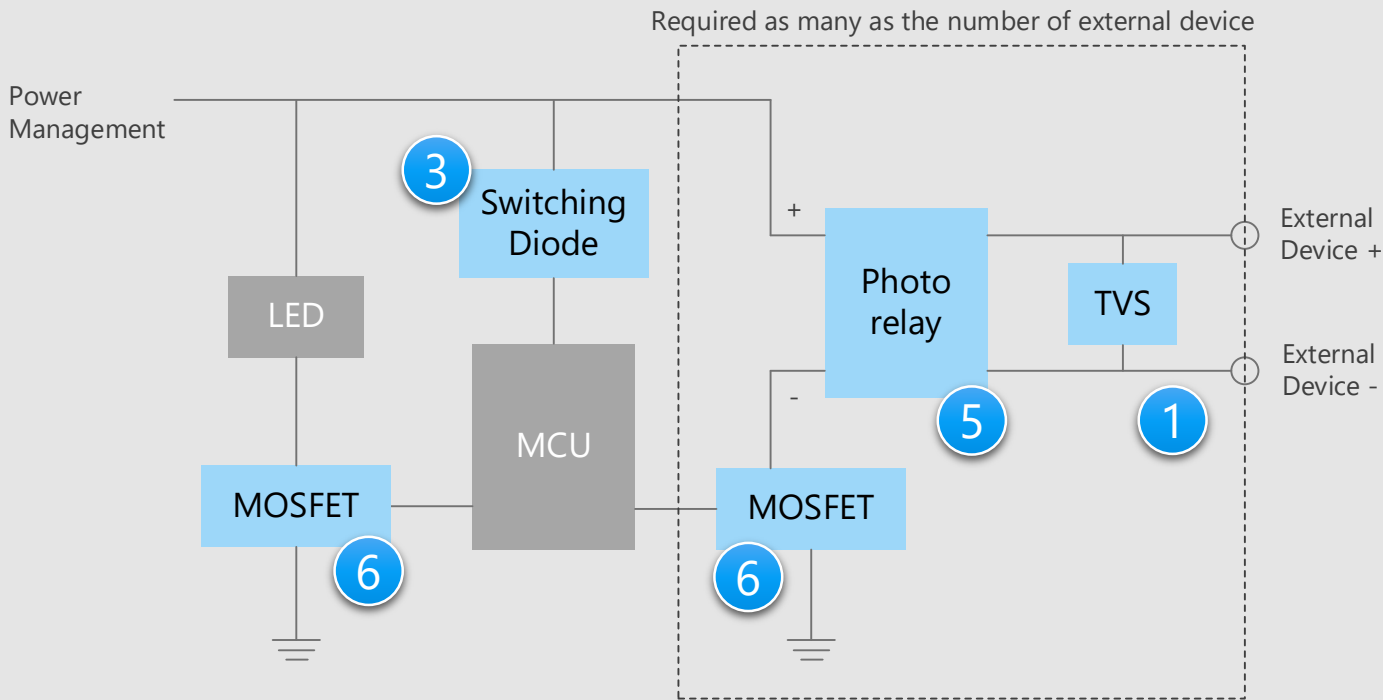
- High-speed switching characteristic supports high frequency operation.
- Low power consumption is realized by operating at low voltage / current consumption.
- An operational amplifier with low offset characteristics and low noise characteristics is required for high-precision sensing.

## Proposal from Toshiba

- **High speed switching**  
Switching diode 3
- **Low noise operational amplifier with low  $V_{IO}$**   
Low current consumption op-amp /  
Low noise op-amp 4

# Human Sensor    Detail of alarm circuit

## An example of alarm circuit



\* [Click on the numbers in the circuit diagram to jump to the detailed descriptions page](#)

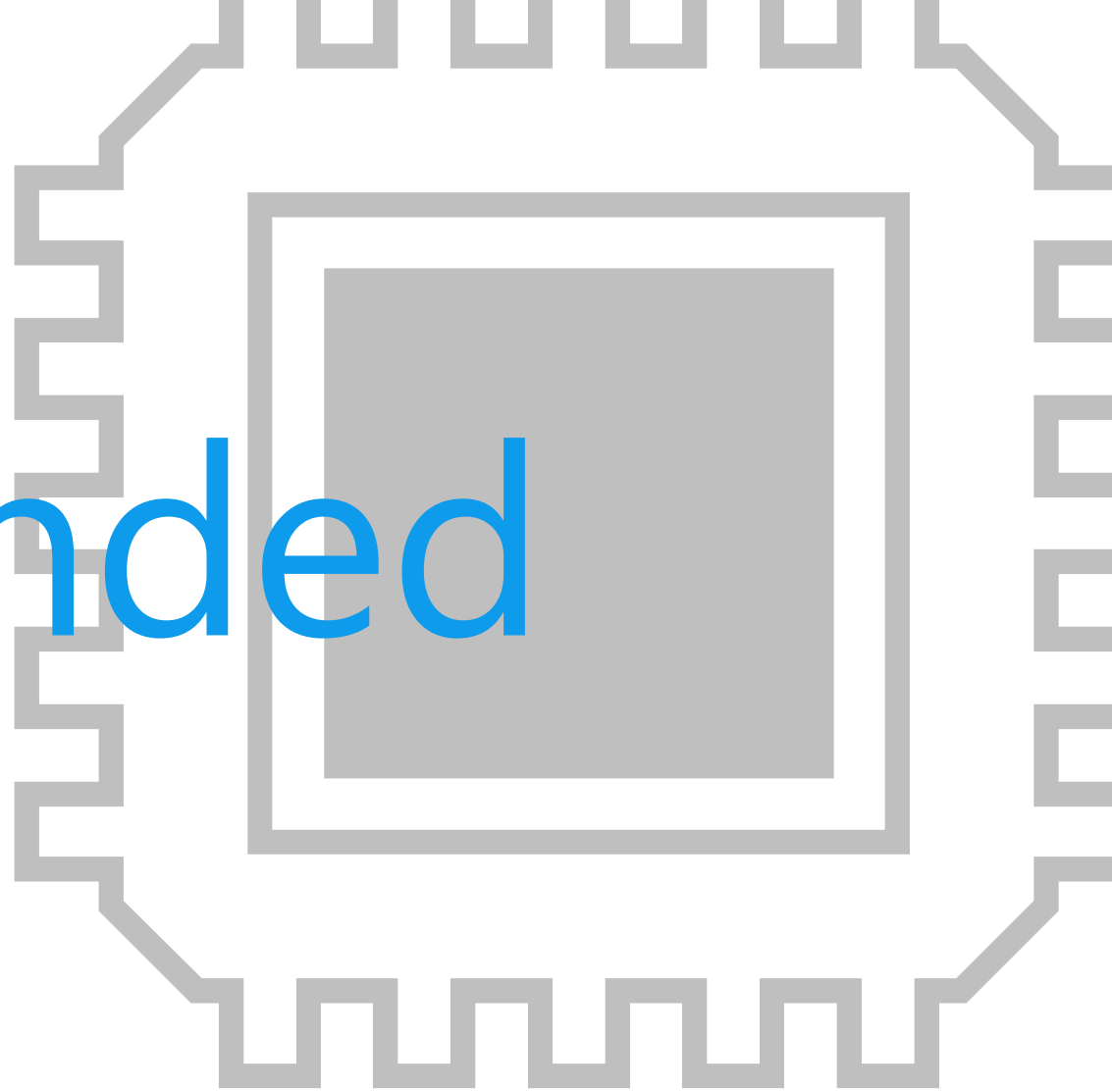
## Criteria for device selection

- By using a photorelay instead of a mechanical relay, the life limit due to wear or welding of the contact portion is eliminated, enabling a longer life and quieter operation.
- In addition, the board area can be reduced by adopting a small package product.

## Proposal from Toshiba

- **Realizes high ESD tolerance and space saving.** 1  
TVS diode
- **High speed switching** 3  
Switching diode
- **Suitable for replacement of mechanical relays.** 5  
Photorelay
- **A MOSFET that can be driven at low voltages.** 6  
Small signal MOSFET

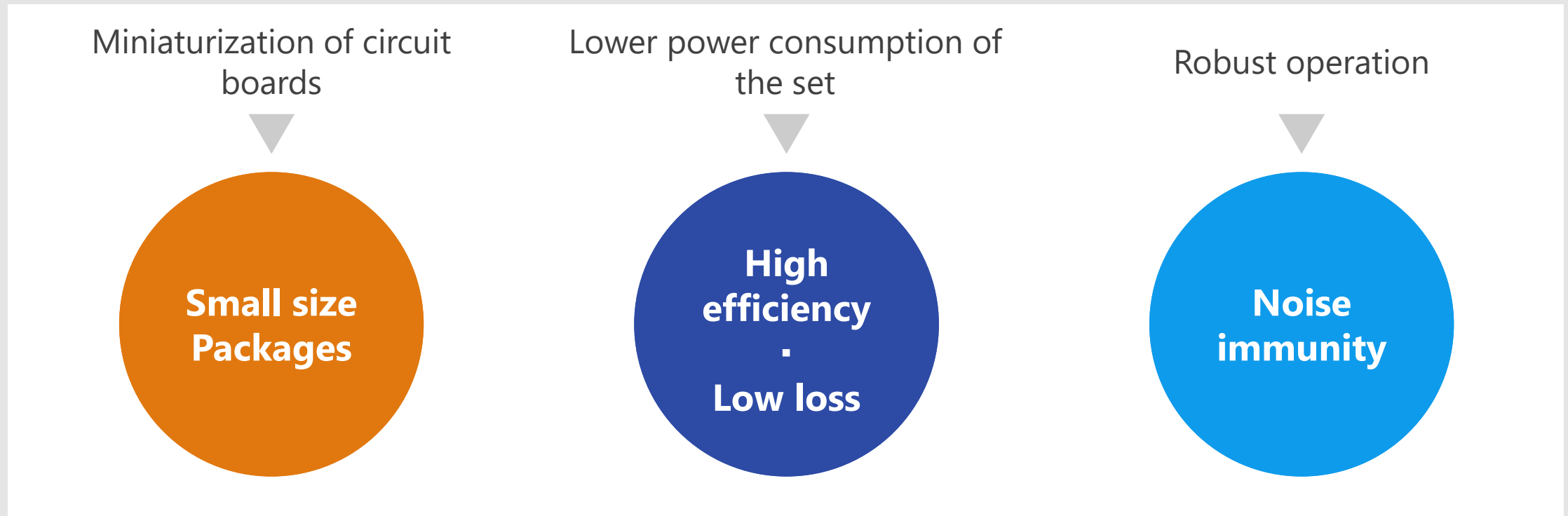
# Recommended Devices





# Device solutions to address customer needs

As described above, in the design of human sensor, "**Miniaturization of circuit boards**", "**Low power consumption of sets**" 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 TVS diode  | ● |   | ● |
| ② Small surface mount LDO regulator                    | ● | ● | ● |
| ③ Switching diode                                      | ● |   |   |
| ④ Low current consumption op-amp /<br>Low noise op-amp | ● | ● |   |
| ⑤ Photorelay   | ● | ● | ● |
| ⑥ Small signal MOSFET                                  | ● | ● |   |

Value provided

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

## 1 Improved ESD pulse absorption

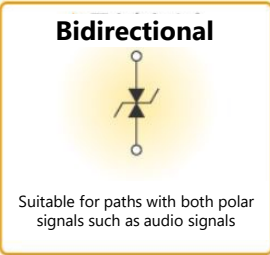
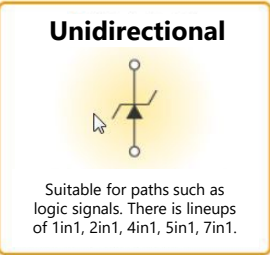
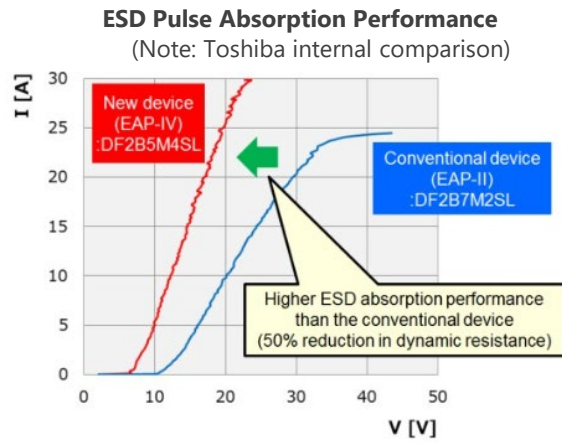
Improved ESD absorption compared to our conventional products. (50 % reduction in operating resistance)  
For some products, both low operating resistance and low capacitance are realized and ensures high signal protection performance and signal quality.

## 2 Suppress ESD energy by low clamp voltage



Steadily protect the connected circuits/devices using proprietary technology.

## 3 Suitable for high-density mounting

A variety of compact packages are available.



### Lineup

| Part number                   | DF2B29FU      | DF2S23P2FU  | DF2S23P2CTC   |
|-------------------------------|---------------|---|---|
| Package                       | SOD-323 (USC) |  | SOD-963 (CST2C)  |
| $V_{ESD}$ [kV]                | ±25           | ±30   |   |
| $V_{RWM}$ (Max) [V]           | ±24           | 21  |   |
| $C_t$ (Typ.) [pF]             | 9             | 160   |   |
| $R_{DYN}$ (Typ.) [ $\Omega$ ] | 1.1           | 0.13  |   |

Note : This product is designed for ESD protection purpose and cannot be used for purposes other than ESD protection.

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# 2 Small surface mount LDO regulator

TAR5S50U / TAR5S50 / TAR5SB50

Small size packages

High efficiency  
·  
Low loss

Noise immunity

Value provided

Wide line up 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

Dropout characteristics have been greatly improved by the newly developed process.(50 % improvement : Toshiba comparison)

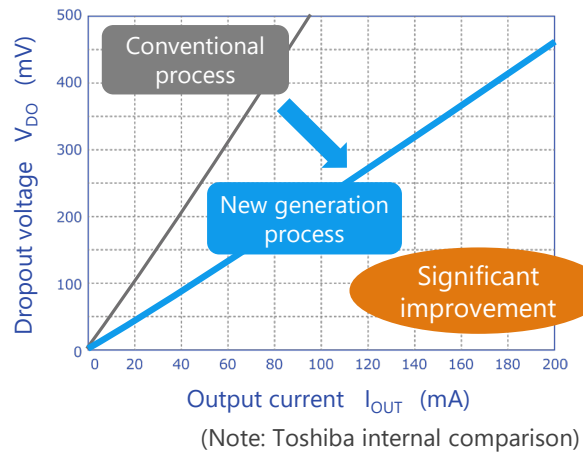
## 2 High PSRR

With a high PSRR (Power Supply Rejection Ratio), ripple is efficiently removed.

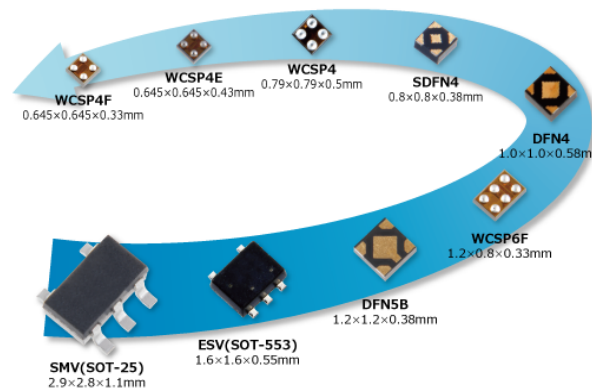
## 3 Can be used with ceramic capacitors

With improved dropout characteristics, it is now possible to use ceramic capacitors for external capacitor functions.



### Low dropout voltage



### Rich package line up



### Lineup

| Part number                   | TAR5S50U   | TAR5S50  | TAR5SB50 |
|-------------------------------|--|--|----------|
| Package                       | SOT-353F (UFV)  | SOT-25 (SMV)  |          |
| $V_{IN}$ [V]                  | 2.4 to 15  |  |          |
| $I_{OUT}$ (Max) [mA]          | 200  |  |          |
| $V_{DO}$ (Typ.) [mV]          | 130  |  |          |
| PSRR (Typ.) [dB]              | 70   |  |          |
| $I_{B(ON)}$ (Typ.) [ $\mu$ A] | 170  |  |          |

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# 3 Switching diode

1SS181 / 1SS184 / 1SS352 / 1SS387 / 1SS302A

Small size packages

High efficiency  
Low loss

Noise immunity

Value provided

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

## 1 Surface mount / compact package

Adopting S-mini / USC / ESC / USM package which is lower in height compared to the conventional lead type contributes to the space saving of the equipment.

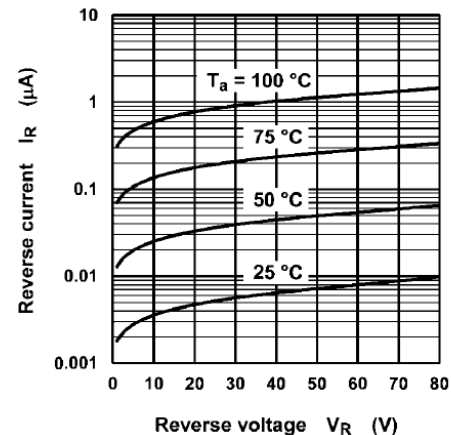
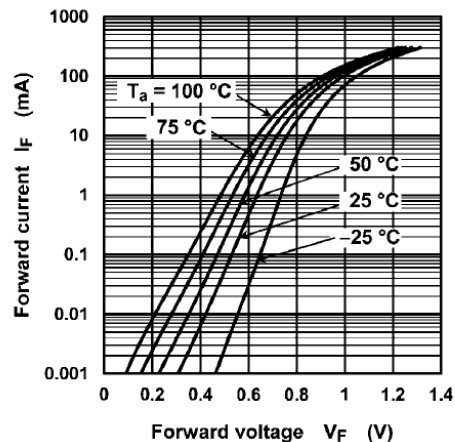
## 2 Wide product line up (1)

Reverse voltage : 20 to 100 V  
Average forward current : 100 mA  
Suitable product can be selected according to requirements.





## 3 Wide product line up (2)

For protection of inductive load of mechanical relay, diodes with low voltage and small package are also provided.

Examples of 1SS302A's characteristics



Lineup

| Part number      | 1SS181  | 1SS184 | 1SS352   | 1SS387   | 1SS302A  |
|------------------|---|--------|--|--|--|
| Package          |  S-Mini |        |  USC |  ESC |  USM |
| $I_O$ (Max) [mA] | 100   | 100    | 100  | 100  | 100  |
| $V_R$ (Max) [V]  | 80  | 80     | 80   | 80   | 80   |

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Value provided

## Low current consumption type and low noise type operational amplifiers maximize the performance of system.

### 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 equipment.

### 2 Low current consumption (TC75S102F) $I_{DD} = 0.27$ [μA] (Typ.)

CMOS processes have been used to achieve lower current consumption. This contributes to lower power consumption.

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

This CMOS operational amplifier can amplify minute signals detected by various sensors [1] with very low noises. By optimizing the process, we have achieved the industry's top-level [2] low equivalent input noise voltage.

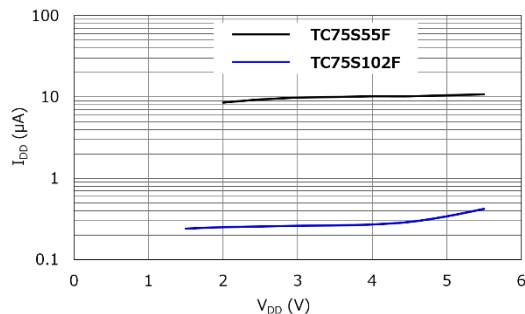
[Note 1] Sensor types: vibration, shock, acceleration, pressure, infrared, temperature, etc.

[Note 2] As of May 2017

#### TC75S102F

Current Consumption Characteristic  
(Note: Toshiba internal comparison)

Low current consumption product TC75S102F

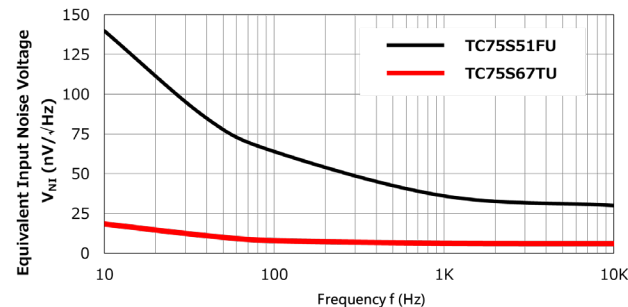


#### TC75S67TU



Noise Characteristic  
(Note: Toshiba internal comparison)

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

$V_{NI} - f$  @Ta=25 °C, V<sub>DD</sub>=3.3 V



#### Lineup

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

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Value provided

Photorelays are composed of infrared light emitting diodes that are optically coupled to photo MOSFETs, are resistant to noise, and low current consumption, suitable for use in motion detectors.

### 1 Low on-resistance $R_{ON}$

Low on-resistance  $R_{ON}$  contributes to realize low power consumption of set.

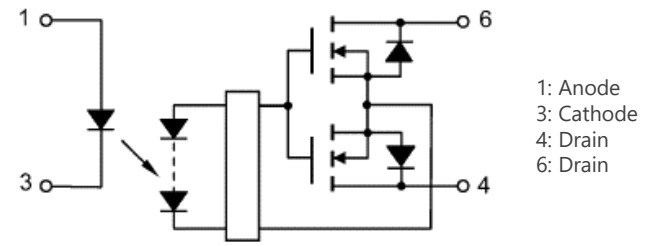
### 2 Low trigger current $I_{FT}$

The trigger current  $I_{FT}$  of TLP171A is 0.2 mA (Max).  
Low  $I_{FT}$  contributes to design with low drive current.

### 3 Many types of package

Many types of package for reducing of size of set and improving freedom of design are provided.

TLP170AM  
Internal circuit



Safety standard  
All 4 parts  
UL-recognized: UL1577, File No.E67349  
cUL-recognized: CSA Component Acceptance Service No.5A File No.E67349  
VDE-approved: EN 60747-5-5

only for TLP240A  
UL-recognized: UL 508, File No.E499232  
CQC-approved: GB4943.1, GB8898  
VDE-approved: EN 62368-1

| Lineup                      |          |           |         |         |
|-----------------------------|----------|-----------|---------|---------|
| Part number                 | TLP170AM | TLP171A   | TLP240A | TLP241B |
| Package                     | 4pin SO6 | 2.54 SOP4 | DIP4    |         |
| $I_{ON}$ (Max) [A]          | 0.7      | 0.4       | 0.5     | 2.0     |
| $V_{OFF}$ (Max) [V]         | 60       | 60        | 60      | 100     |
| $R_{ON}$ (Max) [ $\Omega$ ] | 0.3      | 2         | 2       | 0.2     |
| $I_{FT}$ (Max) [mA]         | 1        | 0.2       | 3       | 3       |
| $BV_S$ (Min) [Vrms]         | 3750     | 1500      | 5000    | 5000    |

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# 6 Small signal MOSFET

SSM3K15ACTC / SSM3K16CTC / SSM3K35AFS / SSM3K35AMFV

Small size packages

High efficiency  
·  
Low loss

Noise immunity

Value provided

Suitable for high speed switching and greatly contributes to miniaturization.

## 1 Low voltage operation

Drive at low  $V_{GS}$

SSM3K15ACTC / SSM3K16CTC : 1.5 V drive

SSM3K35AFS / SSM3K35AMFV : 1.2 V drive

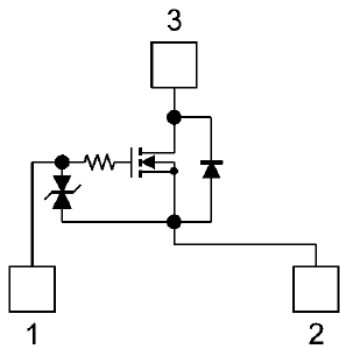
## 2 Low on-resistance

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

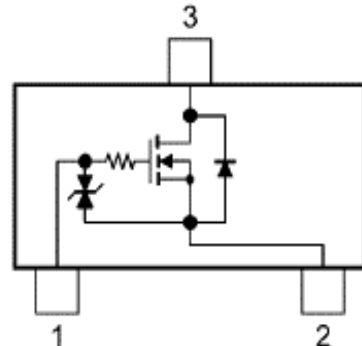
## 3 Small size packages

Products with small size package such as CST3C, SSM and VESM are provided.

SSM3K15ACTC / SSM3K16CTC  
Internal circuit diagram






SSM3K35AFS / SSM3K35AMFV  
Internal circuit diagram



1: Gate  
2: Source  
3: Drain

### Lineup

| Part number   | SSM3K15ACTC  | SSM3K16CTC | SSM3K35AFS   | SSM3K35AMFV   |
|---|--|------------|--|---|
| Package   | CST3C  |            | SSM  | VESM  |
| Polarity  | N-ch   | N-ch       | N-ch   | N-ch  |
| $V_{DSS}$ [V]   | 30   | 20         | 20   | 20  |
| $I_D$ [mA]  | 100  | 200        | 250  | 250   |
| $R_{DS(ON)}$ (Max) [ $\Omega$ ]<br>@ $V_{GS} = 2.5$ V | 6  | 3          | 1.6  | 1.6   |

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