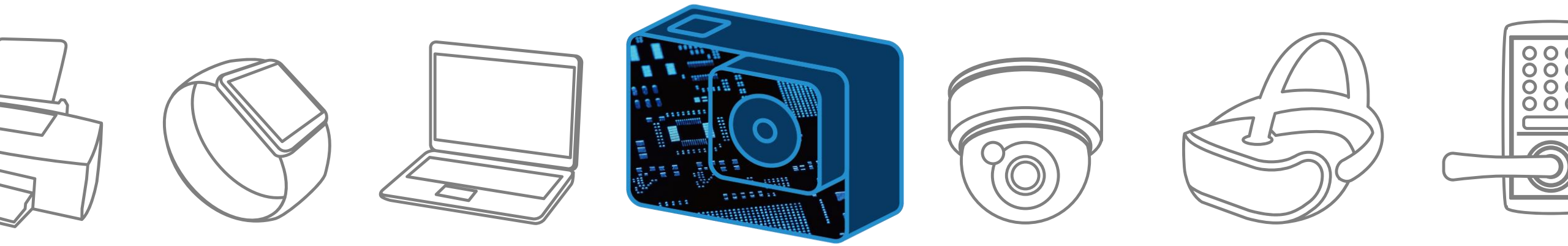
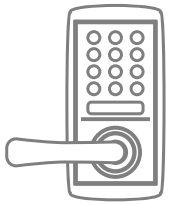
TOSHIBA

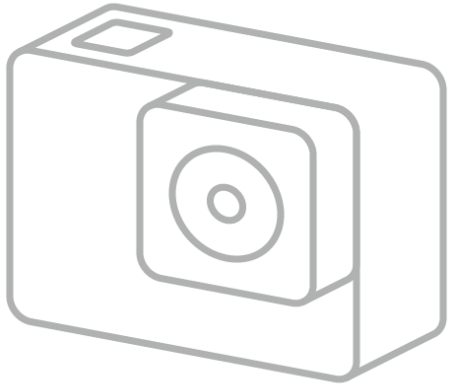
R22

# Action Camera

## Solution Proposal by Toshiba

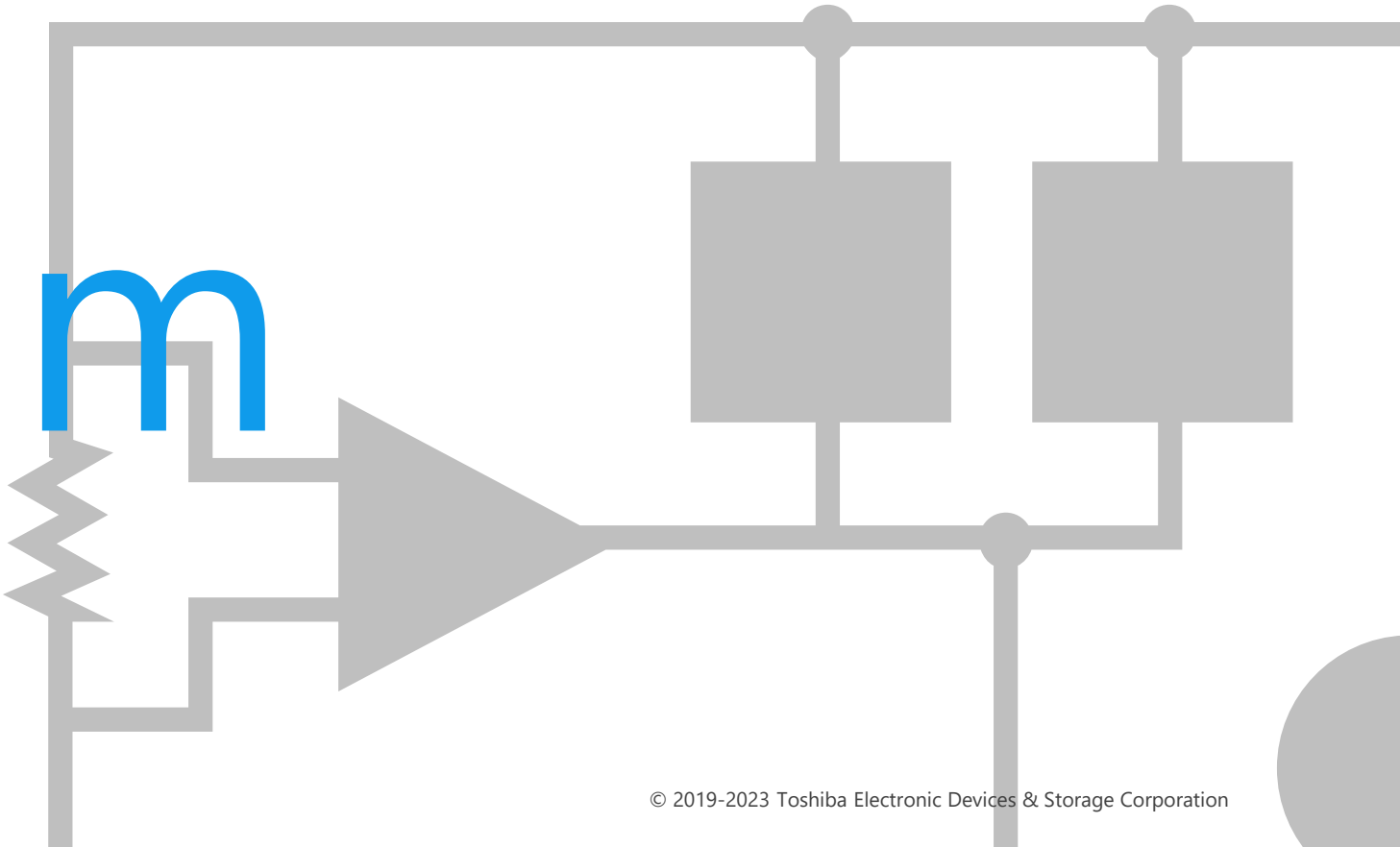




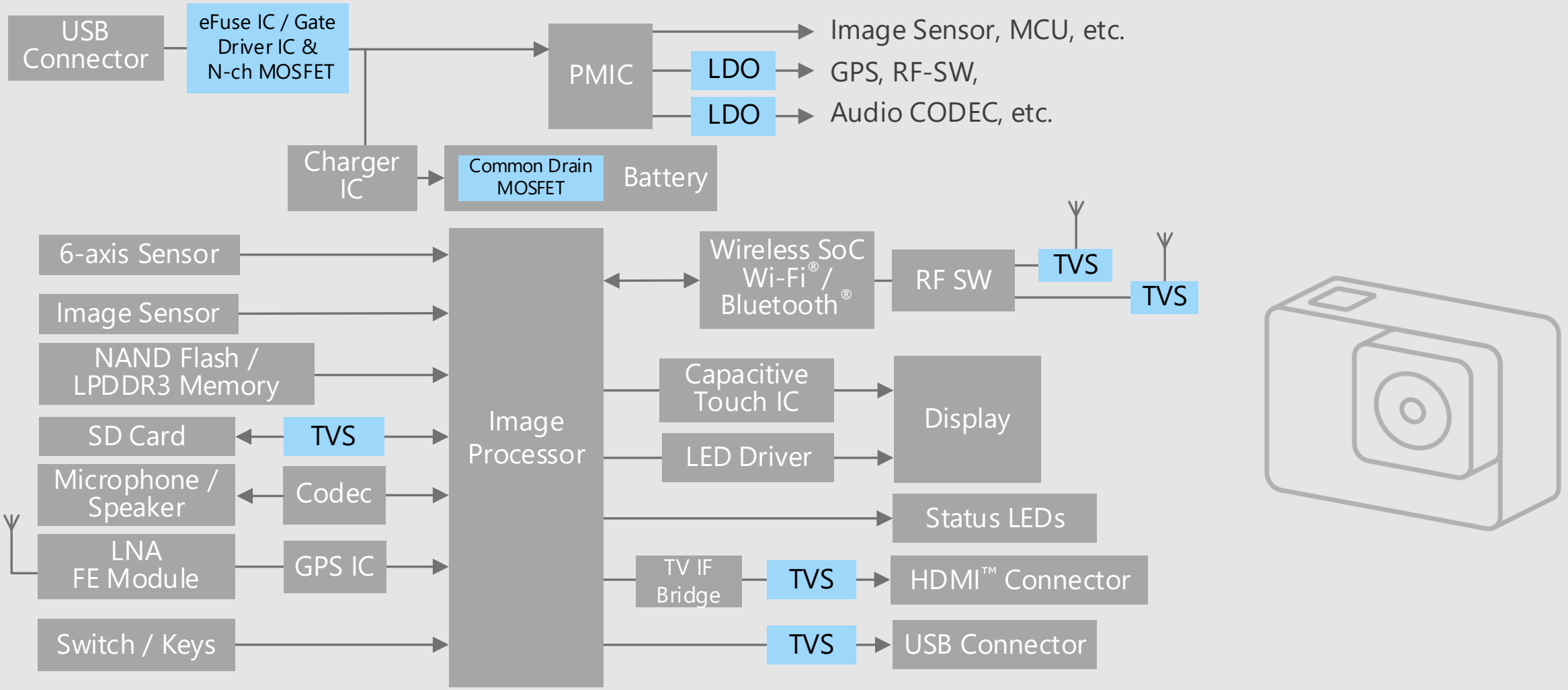


Toshiba Electronic Devices & Storage Corporation provides comprehensive device solutions to customers developing new products by applying its thorough understanding of the systems acquired through the analysis of basic product designs.

# Block Diagram

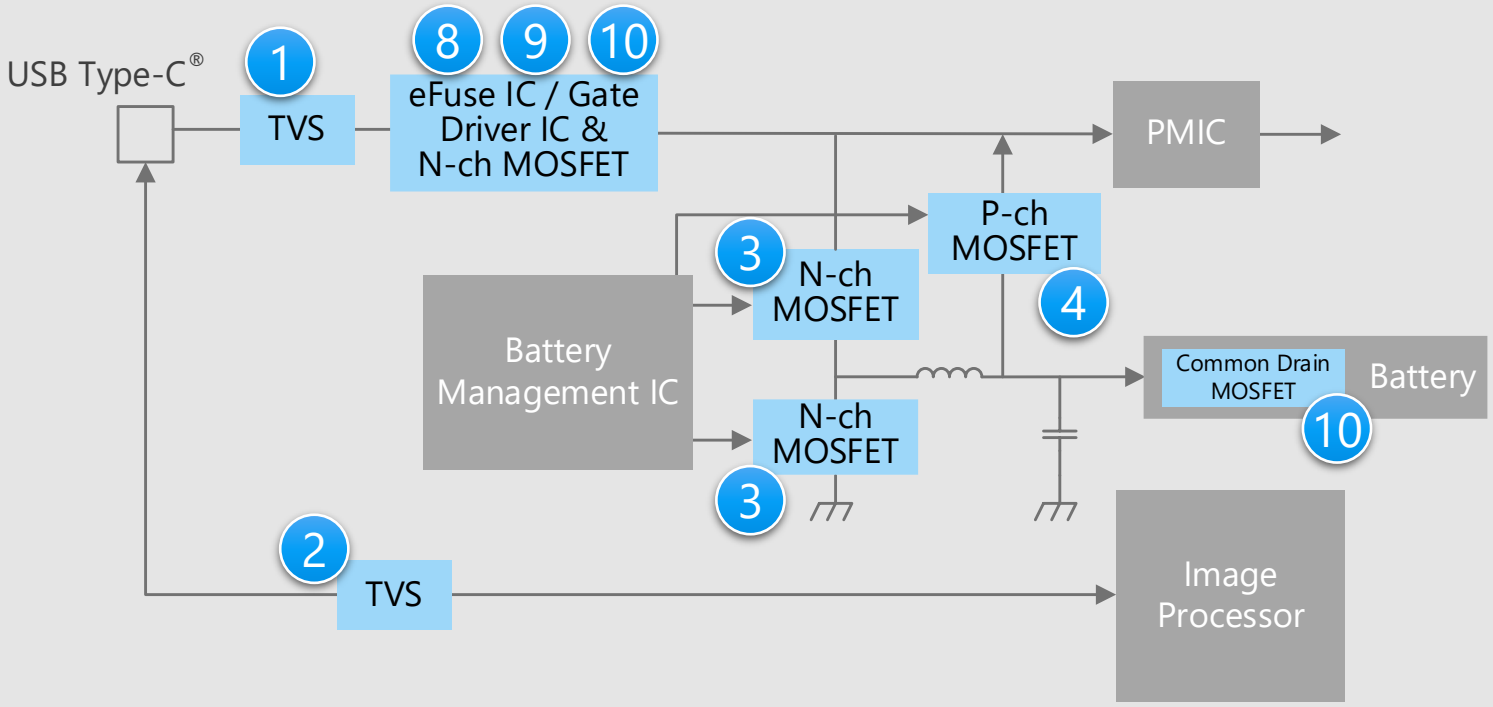


# Action Camera　Overall block diagram



# Action Camera　Detail of USB connector peripheral unit

## Battery and USB unit




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

## Criteria for device selection

- Lower capacity type TVS diodes are suitable for ESD protection of data lines because they have a small effect on high speed signal transmission.
- MOSFETs with low on-resistance are suitable for the control of USB and battery powered supply circuits.
- Small package products contribute to the reduction of circuit board area.

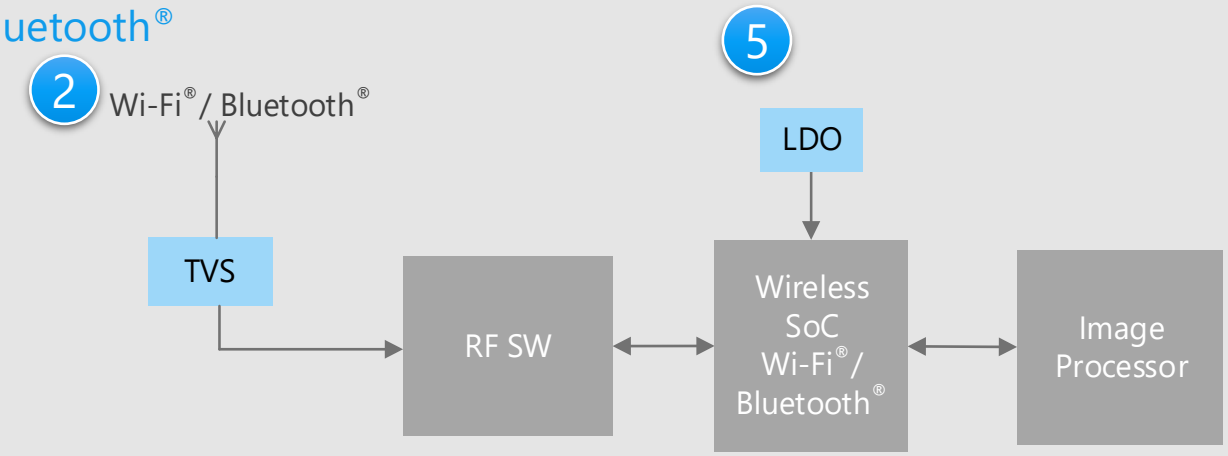
## Proposals from Toshiba

- **Small package and high ESD resistance** 1
  TVS diode
  Low capacitance TVS diode 2
- **Small package and low on-resistance**
  Small signal MOSFET (N-ch) 3
  Small signal MOSFET (P-ch) 4
- **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
- **Low on-resistance and small package**
  N-ch common drain MOSFET 10

# Action Camera　Detail of RF unit

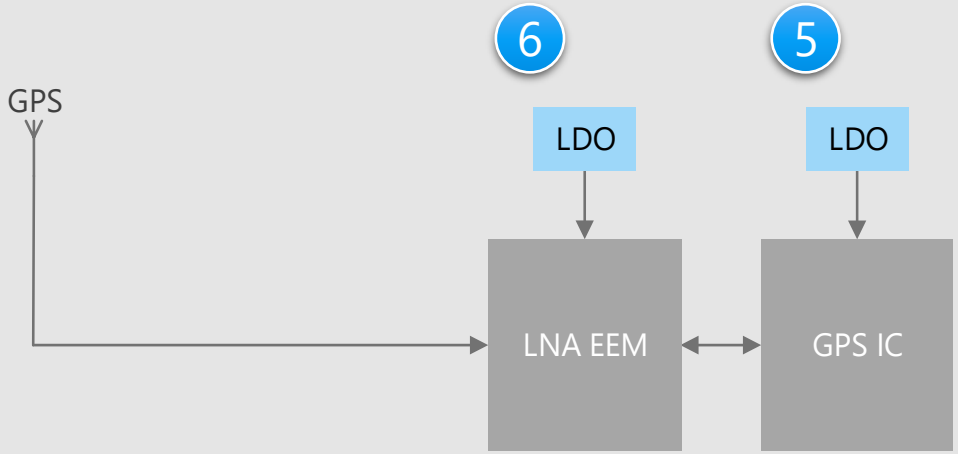
## RF unit

Wi-Fi®/ Bluetooth®




## RF unit

GPS




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

## Criteria for device selection

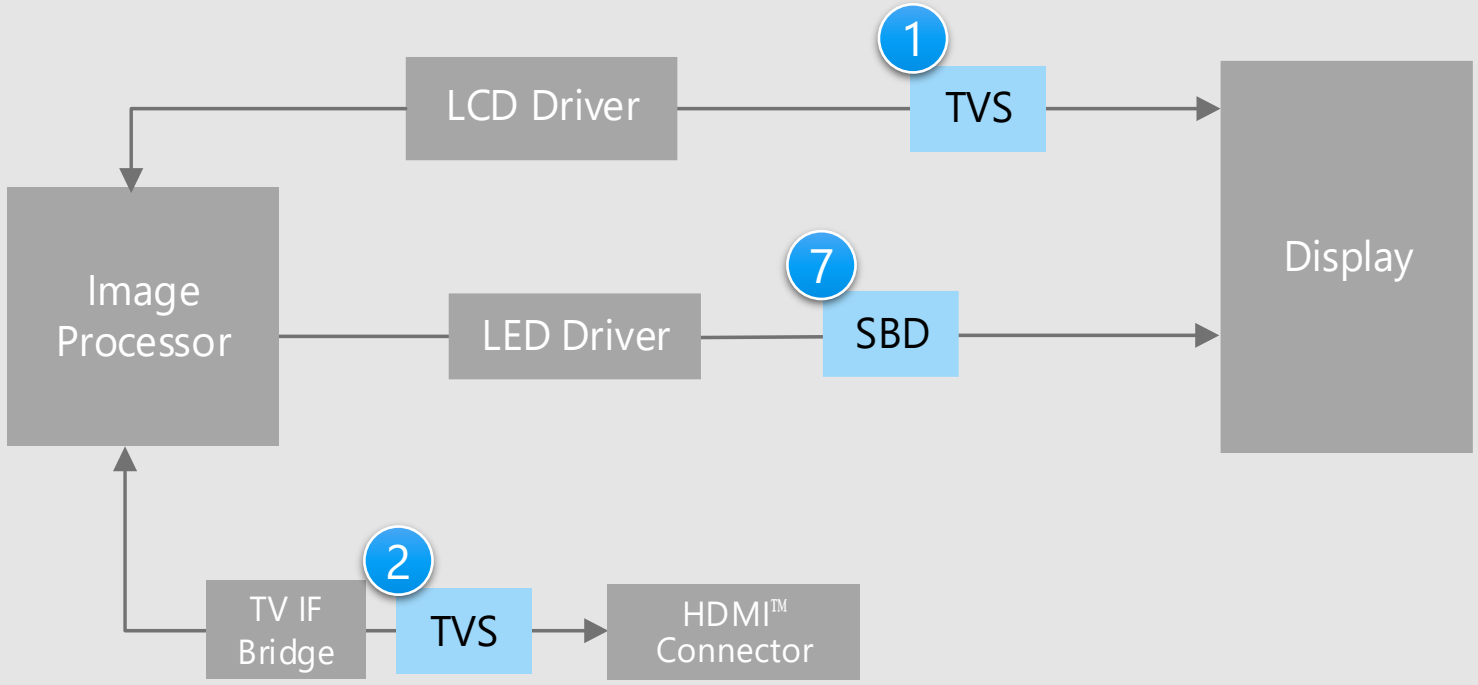
- Lower capacity type TVS diodes are suitable for ESD protection from antennas because they have a small effect on RF signal transmission.
- LDO regulators with low dropout characteristics are suitable for efficient voltage conversion.
- Small package products contribute to the reduction of circuit board area.

## Proposals from Toshiba

- **Small package and high ESD resistance**
  Low capacitance TVS diode 2
- **Small package and low dropout characteristics**
  High current LDO regulator 5
  Low current LDO regulator 6

# Action Camera　Detail of display peripheral unit

## Display unit




SBD : Schottky barrier diode

<u>* Click on the number in the circuit diagram to jump to the detailed description page</u>

## Criteria for device selection

- By using a Schottky barrier diode with low $V_F$ and low $I_R$ , the power consumption of the set can be reduced.
- Lower capacity type TVS diodes are suitable for ESD protection in data lines because they have a small effect on high speed signal transmission.
- Small package products contribute to the reduction of circuit board area.

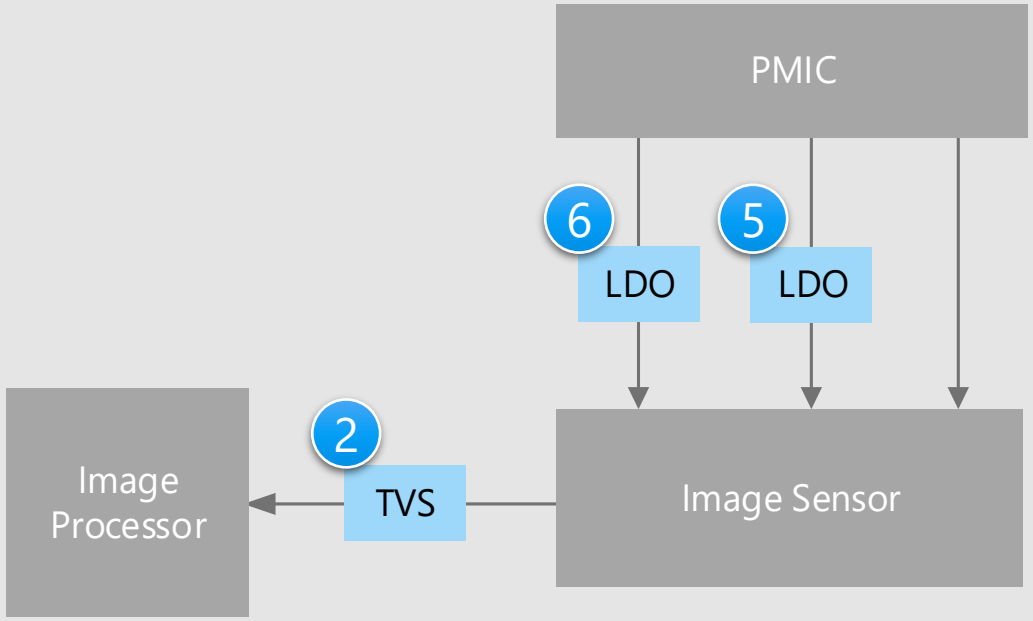
## Proposals from Toshiba

- **Small package and high ESD resistance**
  TVS diode
  Low capacitance TVS diode
- **Small package and low $V_F$ characteristics**
  Schottky barrier diode

1
2
7

# Action Camera　Detail of camera peripheral unit

## Camera unit




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

## Criteria for device selection

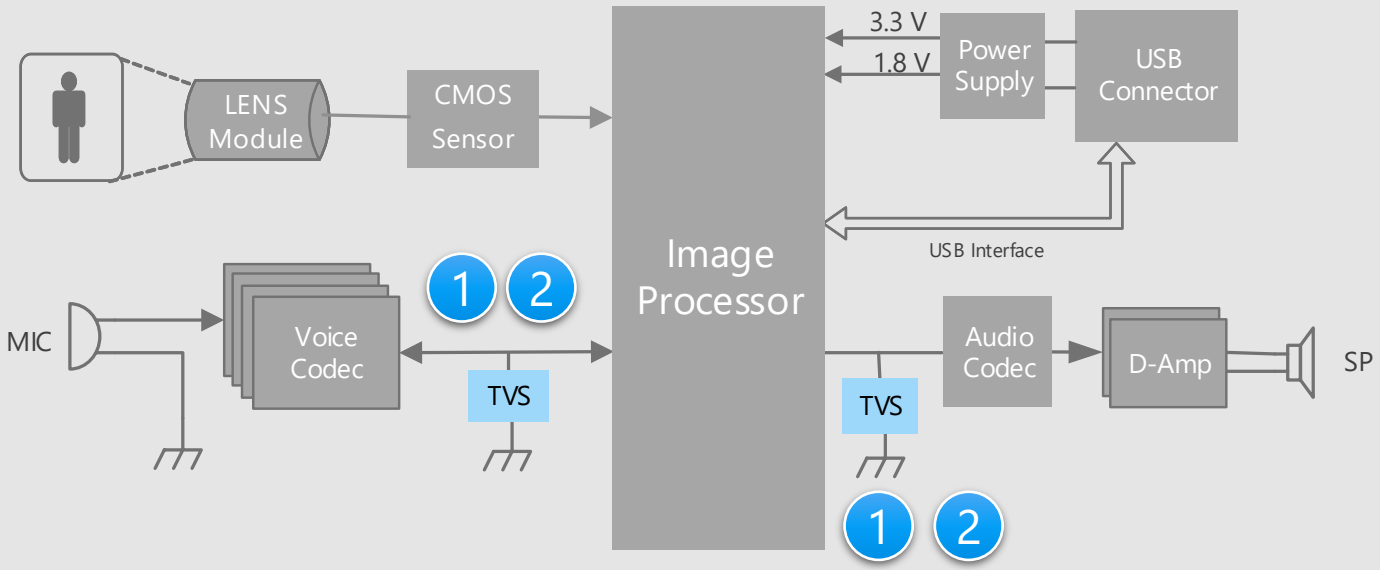
- LDO regulators with low dropout characteristics are suitable for efficient voltage conversion.
- Lower capacity type TVS diodes are suitable for ESD protection in data lines because they have a small effect on high speed signal transmission.
- Small package products contribute to the reduction of circuit board area.

## Proposals from Toshiba

- **Small package and high ESD resistance**
  Low capacitance TVS diode 2
- **Small package and low drop-out characteristics**
  High current LDO regulator 5
  Low current LDO regulator 6

# Action Camera　Detail of camera motion unit

## Image processing unit




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

## Criteria for device selection

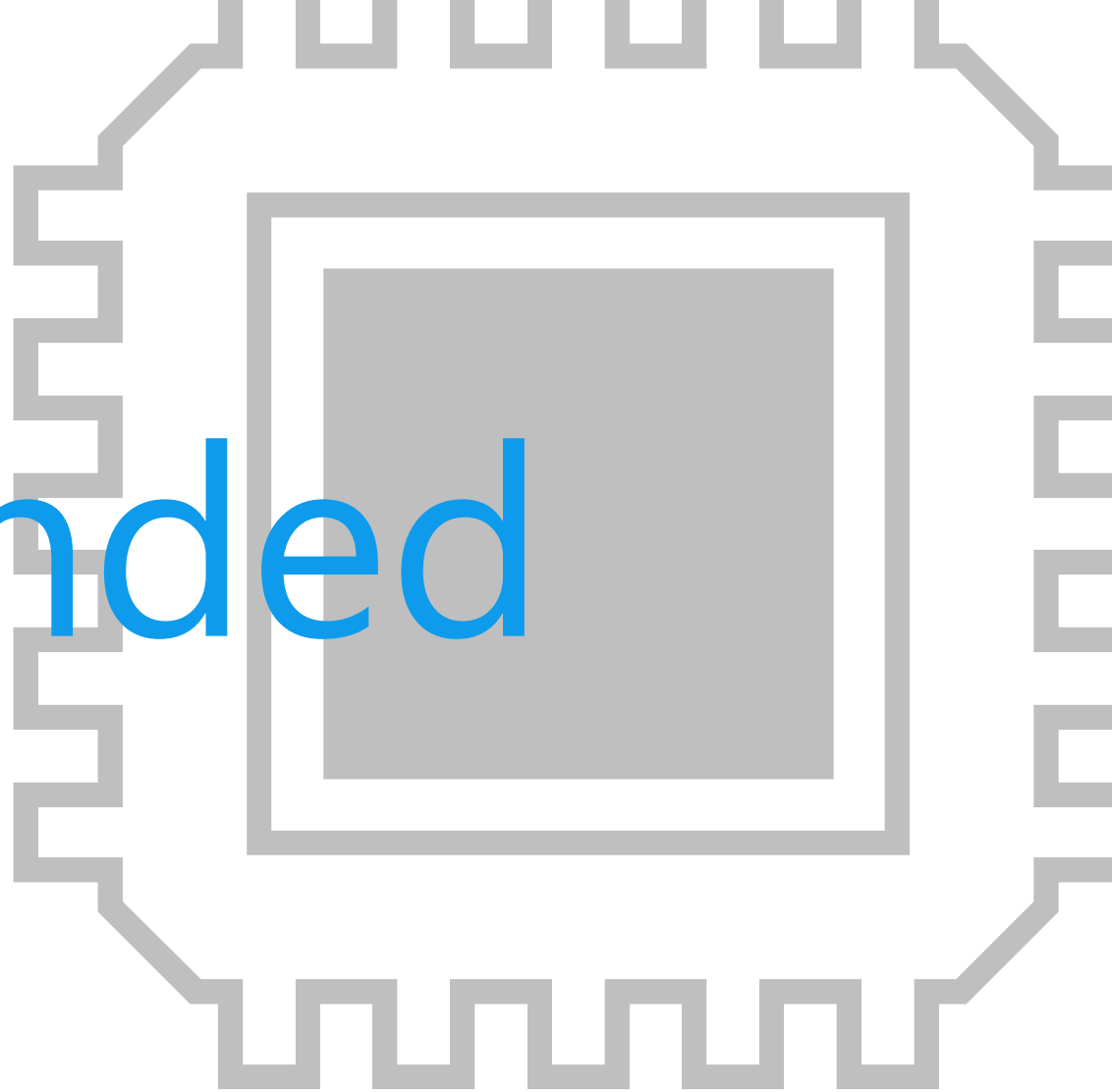
- Lower capacity type TVS diodes are suitable for ESD protection in data lines because they have a small effect on high speed signal transmission.

## Proposals from Toshiba

- **Small package and high ESD resistance**
  TVS diode
  Low capacitance TVS diode

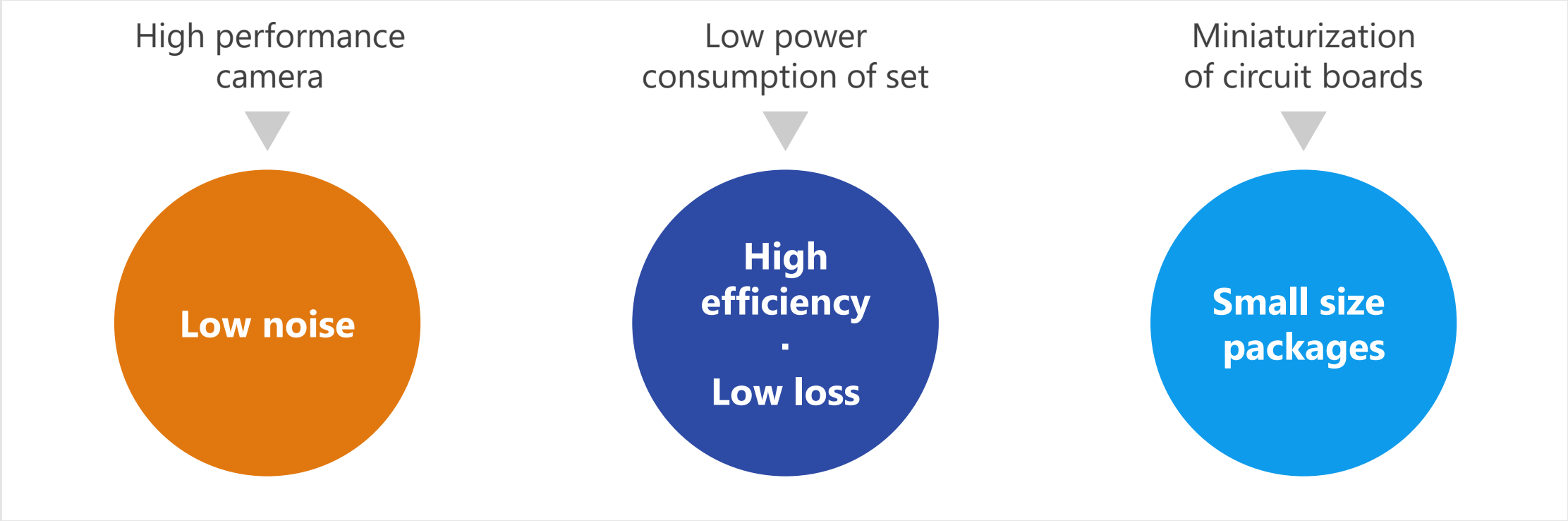
1
2

# Recommended Devices

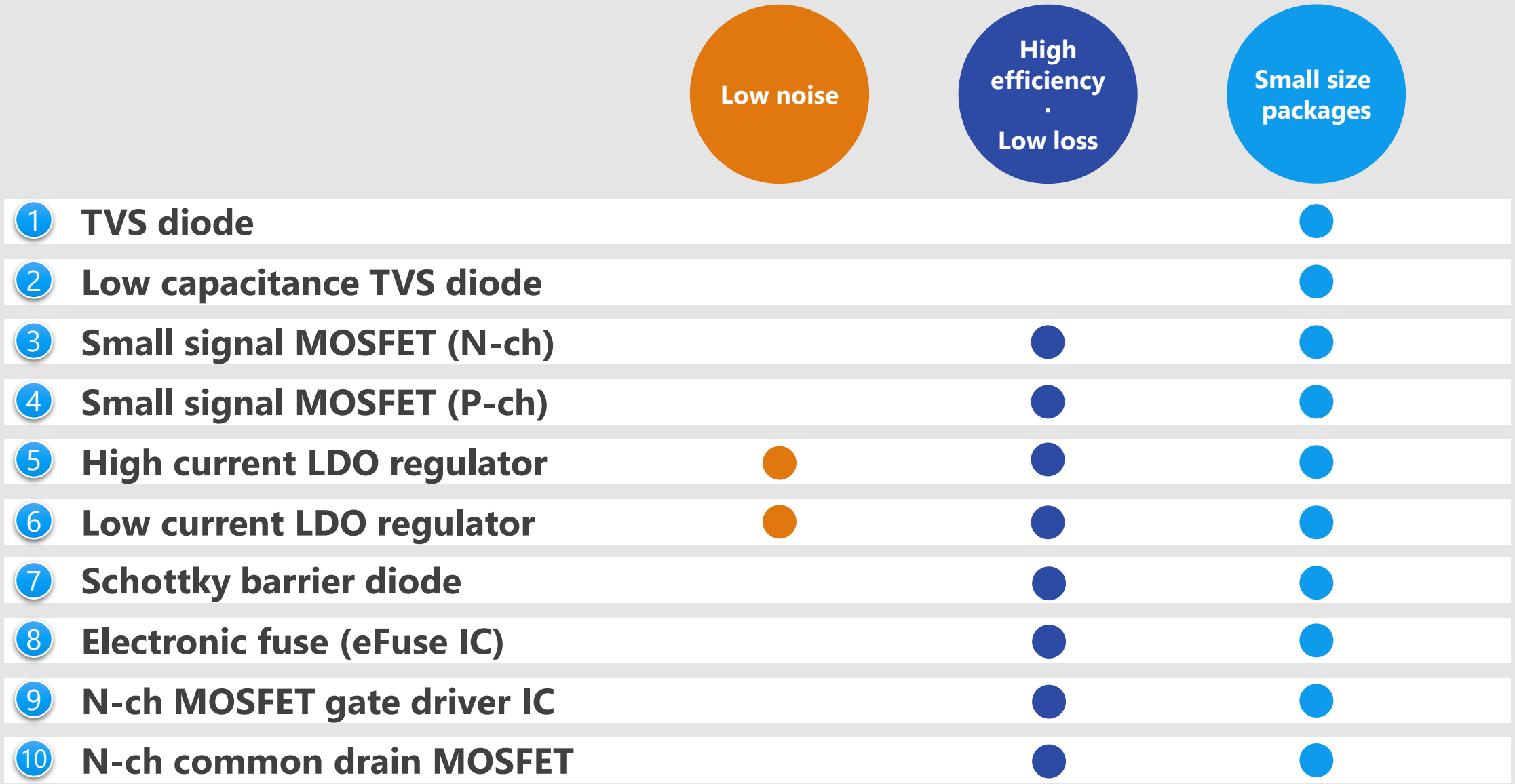


# Device solutions to address customer needs

As described above, in the design of action camera, **“High performance camera”**, **“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



# 1 TVS diode

## DF2B7BSL / DF2S23P2CTC

Low noise | High efficiency · Low loss | Small size packages

Value provided

**This absorbs static electricity from external terminals, prevents circuit malfunction and protects devices.**

### 1 High ESD pulse absorption performance

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.

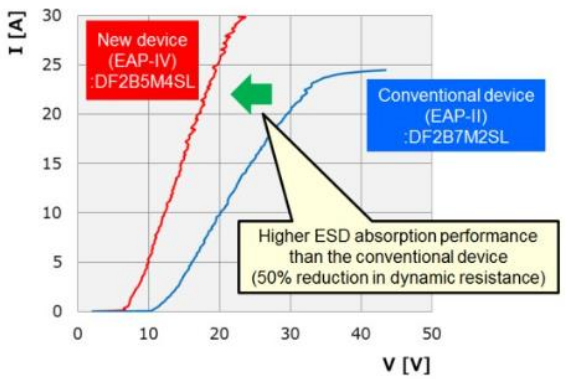
### 2 Suppress ESD energy by low clamp voltage

Protect the connected circuits and devices using Toshiba own technology.

### 3 Suitable for high density mounting

A variety of small packages are available.

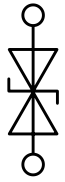
**ESD Pulse Absorption Performance (Toshiba internal comparison)**




**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 | DF2B7BSL | DF2S23P2CTC |
|---|---|---|
| Package | SL2  | CST2C  |
| $V_{ESD}$ [kV] | ±30 | ±30 |
| $V_{RWM}$ (Max) [V] | 5.5 | 21 |
| $C_t$ (Typ.) [pF] | 12 | 160 |
| $R_{DYN}$ (Typ.) [Ω] | 0.2 | 0.13 |

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

◆Return to Block Diagram TOP

# 2 Low capacitance TVS diode

## DF2B6M4BSL / DF2B5M4ASL / DF2B6M4ASL / DF2B6M4SL

Low noise | High efficiency · Low loss | Small size packages

Value provided

**Low capacitance TVS diode has a small effect on the signal transmission of data line. It prevents circuit malfunction and protects the device.**

### 1 High ESD pulse absorption performance

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.

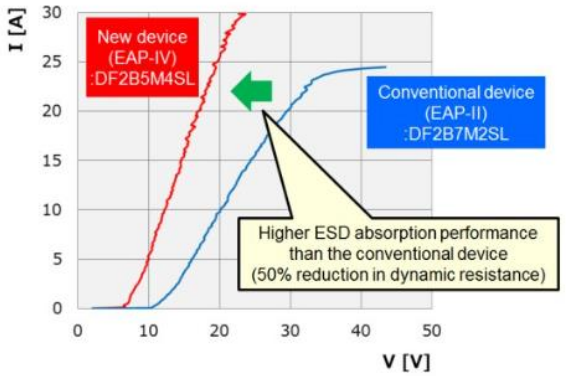
### 2 Suppress ESD energy by low clamp voltage

Protect the connected circuits and devices using Toshiba own technology.

### 3 Suitable for high density mounting

A variety of small packages are available.

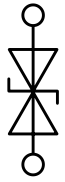
**ESD Pulse Absorption Performance (Toshiba internal comparison)**




**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 | DF2B6M4BSL | DF2B5M4ASL | DF2B6M4ASL | DF2B6M4SL |
|---|---|---|---|---|
| Package | SL2 | SL2 | SL2 | SL2 |
| $V_{ESD}$ [kV] | ±8 | ±16 | ±15 | ±20 |
| $V_{RWM}$ (Max) [V] | 5.5 | 3.6 | 5.5 | 5.5 |
| $C_t$ (Typ.) [pF] | 0.12 | 0.15 | 0.15 | 0.2 |
| $R_{DYN}$ (Typ.) [Ω] | 1.05 | 0.7 | 0.7 | 0.5 |

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

◆Return to Block Diagram TOP

# 3 Small signal MOSFET (N-ch)

## SSM6K513NU / SSM6N55NU

Low noise | High efficiency · Low loss | Small size packages

Value provided

**It is suitable for power management switches and others. Therefore, contributes to miniaturization of sets.**

### 1 Low voltage operation

Operates down to $V_{GS}$ = 4.5 V.

### 2 Low on-resistance

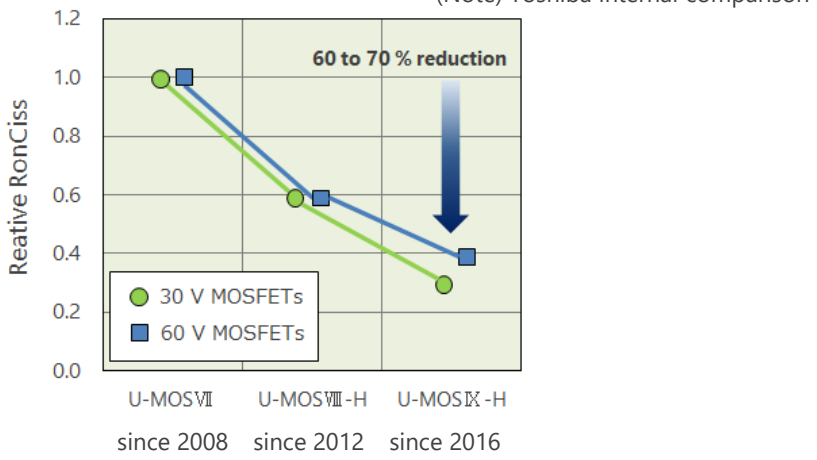
By reducing on-resistance between the drain and source, heat generation and power consumption can be kept low.

### 3 Small package

Sealed in SOT-1220 (2.0 x 2.0 mm) package.

RonCiss reduction of N-ch MOSFET

(Note) Toshiba internal comparison




Lineup

| Part number | | SSM6K513NU | SSM6N55NU |
|---|---|---|---|
| Package | | UDFN6B (SOT-1220) | UDFN6 (SOT-1118) |
| $V_{DSS}$ [V] | | 30 | 30 |
| $I_D$ [A] | | 15 | 4 |
| $R_{DS(ON)}$ [mΩ] @$V_{GS}$ = 4.5 V | Typ. | 8.0 | 48 |
| | Max | 12 | 64 |
| Polarity | | N-ch | N-ch x 2 |

◆Return to Block Diagram TOP

# 4 Small signal MOSFET (P-ch)

## SSM6J507NU

Low noise | High efficiency · Low loss | Small size packages

Value provided

**It is suitable for power management switches and others. Therefore, contributes to miniaturization of sets.**

### 1 Low voltage operation

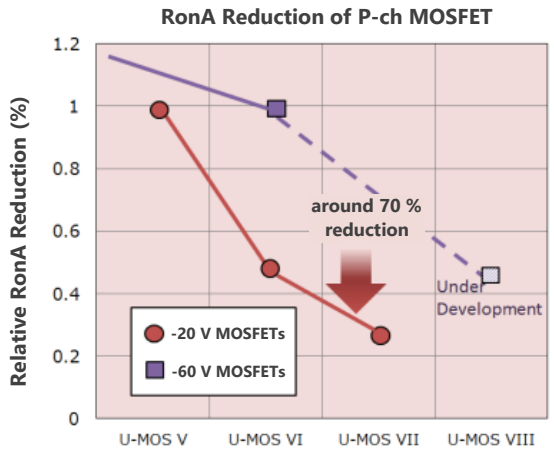
Operates down to $V_{GS}$ = -4.5 V.

### 2 Low on-resistance

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

### 3 Small package

Sealed in SOT-1220 (2.0 x 2.0 mm) package.




(Note: Toshiba internal comparison)

Lineup

| Part number | | SSM6J507NU |
|---|---|---|
| Package | | UDFN6B (SOT-1220) |
| $V_{DSS}$ [V] | | -30 |
| $I_D$ [A] | | -10 |
| $R_{DS(ON)}$ [mΩ] @$V_{GS}$ = -4.5 V | Typ. | 19 |
| | Max | 28 |
| Polarity | | P-ch |

◆Return to Block Diagram TOP

# 5 High current LDO regulator

## TCR15AG Series / TCR5BM Series / TCR5RG Series

Low noise | High efficiency · Low loss | Small size packages

Value provided

**This LDO eliminates the switching noise generated in the power supply circuit and provides a power supply with less output voltage fluctuation.**

### 1 High PSRR

Toshiba's LDO regulator has high PSRR (Power Supply Rejection Ratio) characteristic. Stable power supply is realized by removing switching noise generated in the circuit.

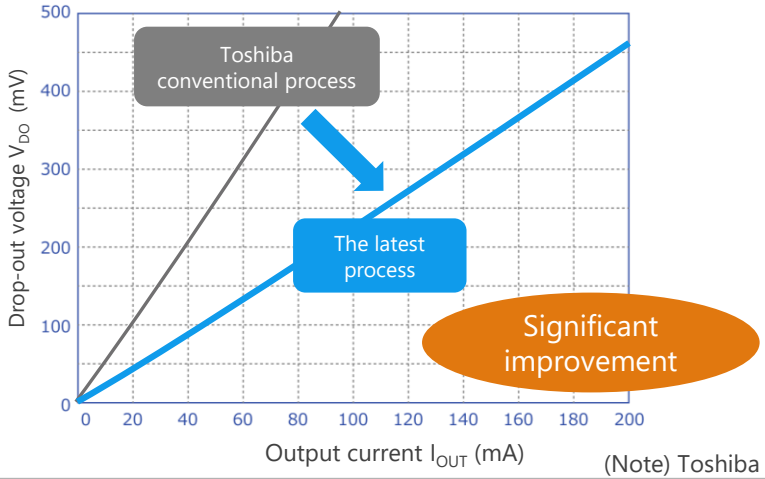
### 2 Low dropout voltage

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

### 3 Suitable for high density mounting

A variety of small packages are available.

Low dropout voltage




(Note) Toshiba internal comparison with TCR3U series.

Lineup

| Part number | TCR15AG Series | TCR5BM Series | TCR5RG Series |
|---|---|---|---|
| Package | WCSP6F | DFN5B | WCSP4F |
| $I_{OUT}$ (Max) [A] | 1.5 | 0.5 | 0.5 |
| $V_{DO}$ (Typ.) [mV] | 120 @$I_{OUT}$ = 1.5 A | 100 @$I_{OUT}$ = 500 mA | 150 (TCR5RG28A) @$I_{OUT}$ = 500 mA |
| PSRR (Typ.) [dB] @f = 1 kHz | 95 | 98 | 100 |
| $I_{BIAS(ON)}$ / $I_B$ (Typ.) [μA] | 25 | 19 | 7 |

◆Return to Block Diagram TOP

# 6 Low current LDO regulator

## TCR3RM Series / TCR3UM Series / TCR3UG Series / TCR3DG Series

Low noise | High efficiency · Low loss | Small size packages

Value provided

**This LDO eliminates the switching noise generated in the power supply circuit and provides a power supply with less output voltage fluctuation.**

### 1 High PSRR

Toshiba's LDO regulator has high PSRR (Power Supply Rejection Ratio) characteristic. Stable power supply is realized by removing switching noise generated in the circuit.

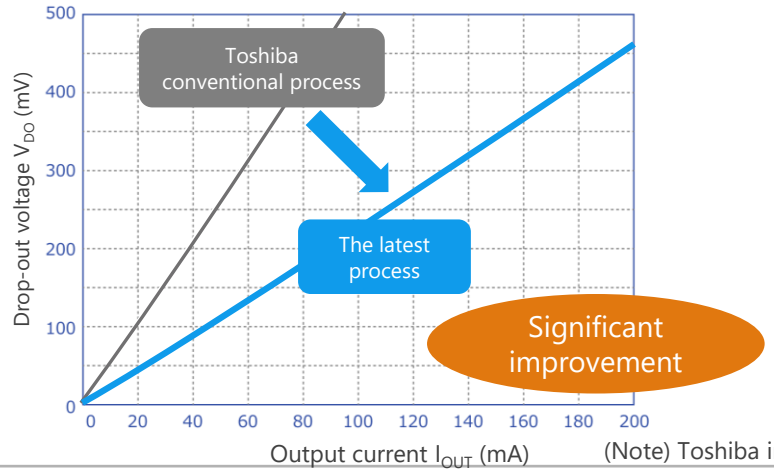
### 2 Low dropout voltage

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

### 3 Suitable for high density mounting

A variety of small packages are available.

Low dropout voltage




(Note) Toshiba internal comparison with TCR3U series.

Lineup

| Part number | TCR3RM Series | TCR3UM Series | TCR3UG Series | TCR3DG Series |
|---|---|---|---|---|
| Package | DFN4C/ DFN4F | DFN4/ DFN4E | WCSP4F | WCSP4E |
| $I_{OUT}$ (Max) [A] | 0.3 | 0.3 | 0.3 | 0.3 |
| $V_{DO}$ (Typ.) [mV] @$I_{OUT}$ = 300 mA | 98 (TCR3RM45A) | 196 (TCR3UM33A) | 140 (TCR3UG33A/ TCR3UG33B) | 195 |
| PSRR (Typ.) [dB] @f = 1 kHz | 100 | 70 | 70 | 70 |
| $I_{BIAS(ON)}$ / $I_B$ (Typ.) [μA] | 7 | 0.34 | 0.34 | 65 (TCR3DG18) |

◆Return to Block Diagram TOP

# 7 Schottky barrier diode

## DSR01S30SL / CLS10F40

Low noise | High efficiency · Low loss | Small size packages

Value provided

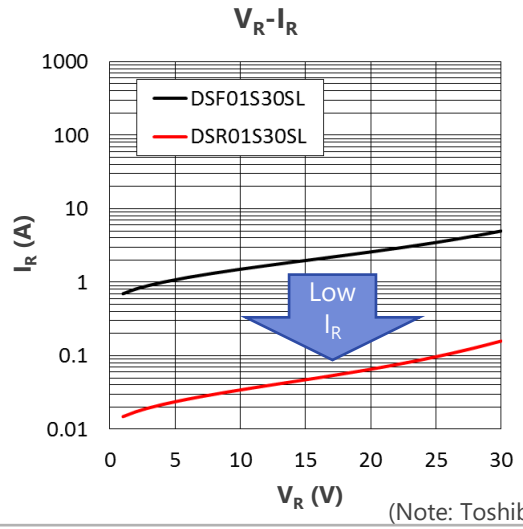
**low $V_F$ and low $I_R$ characteristics have been realized and contributes to improved circuit efficiency.**

## 1 Low $V_F$ and low $I_R$ characteristics

Low $V_F$ and low $I_R$ characteristics compared to our conventional products have been realized.
When used in rectification applications, the circuit efficiency can be further improved.

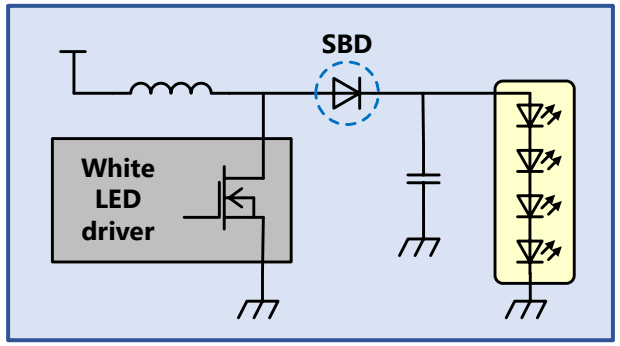
## 2 Suitable for high density mounting

A variety of small packages are available.




(Note: Toshiba internal comparison)

**e.g., LCD back light of up converter circuit**




Lineup

| Part number | DSR01S30SL | CLS10F40 |
|---|---|---|
| Package | SL2 | CL2E |
| $V_R$ [V] | 30 | 40 |
| $I_O$ [A] | 0.1 | 1 |
| $V_F$ (Max) [V] | 0.62 @$I_F$ = 0.1 A | 0.57 @$I_F$ = 1 A |
| $I_R$ (Max) [μA] | 0.7 @$V_R$ = 30 V | 25 @$V_R$ = 40 V |

◆Return to Block Diagram TOP

# 8 Electronic fuse (eFuse IC)

## TCKE8 Series / TCKE7 Series

Low noise | 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

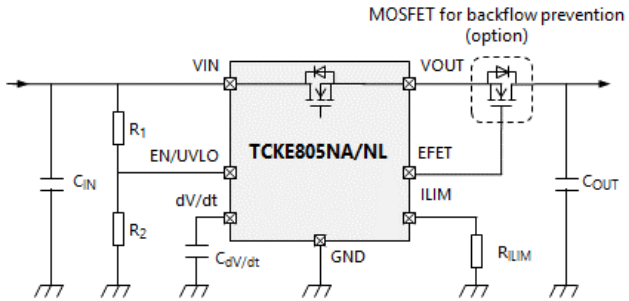
Toshiba's eFuse ICs are certified to the international safety standard IEC 62368-1 (G9: Integrated circuit (IC) current limiters) and contribute to robust protection and simplification of circuit design.

### 3 Rich protection functions

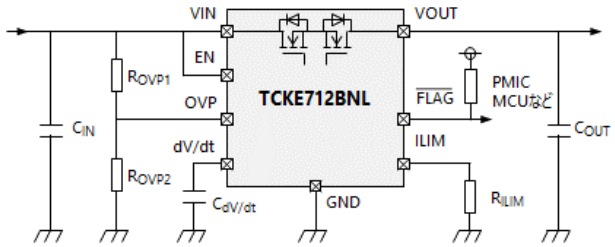
TCKE8 Series: Short-circuit protection, overcurrent protection, overcurrent clamp function, overvoltage clamp function, thermal shut down, inrush current suppression, backflow prevention (optional), etc.

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

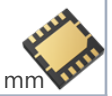
**Reference circuit example of TCKE8 Series**




**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

# 9 N-ch MOSFET gate driver IC

## TCK4xx Series

Low noise | 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 reduction of power consumption and miniaturization of load switch circuit.**

[Note 1] OVP: Over Voltage Protection

### 1 Three 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 24V power supply line.

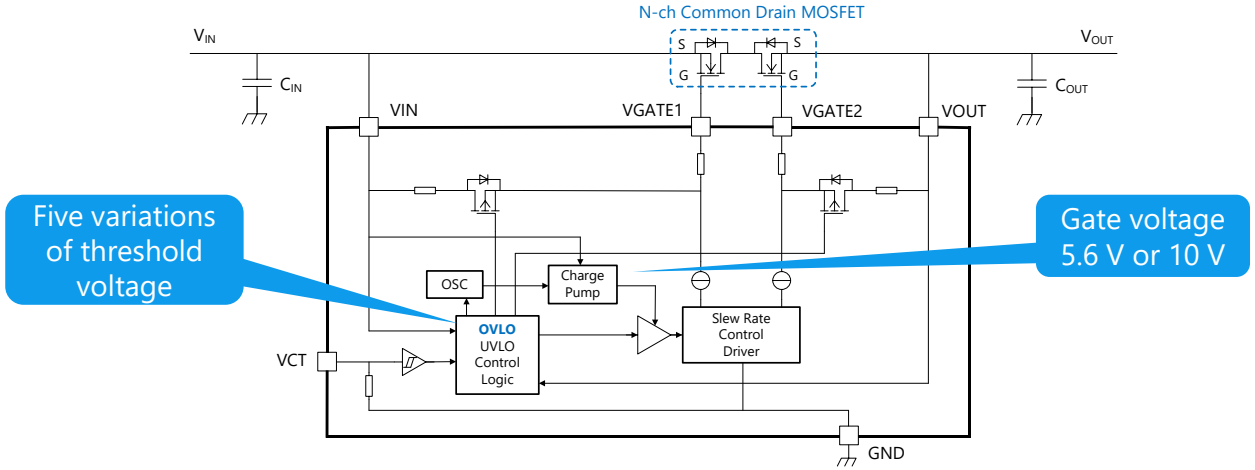
[Note 2] OVLO: Over Voltage Lock Out
[Note 3] $V_{IN\_OVLO}$: $V_{IN}$ OVLO threshold

### 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

# 10 N-ch common drain MOSFET

## SSMxN9 Series

Low noise | High efficiency · Low loss | Small size packages

Value provided

**This is low on-resistance MOSFET with small and thin package. It contributes to suppressing heat generation during charging and discharging, as well as to reducing the size of set.**

### 1 Low on-state resistance

Low on-resistance is achieved by applying a low resistance diffusion process.
This contributes to suppression of heat generation.

### 2 Small and thin package

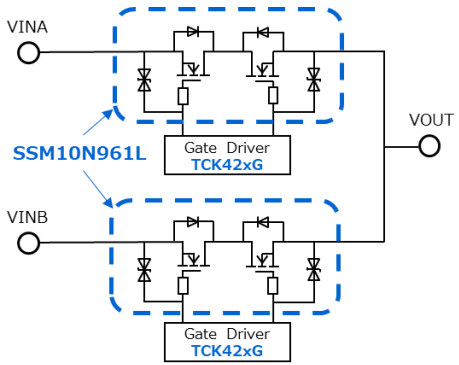
While in a dual configuration, it is a small and thin chipLGA package products.
This contributes to miniaturization of set.

### 3 Low gate-source leakage current

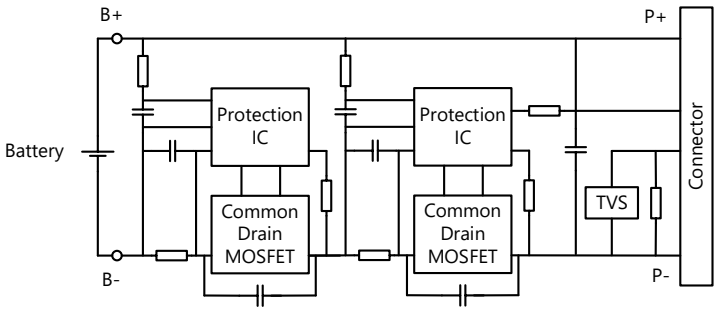
Low gate-source leakage current characteristics enable low standby power and contribute to long term operation of battery used sets.

## Examples of common drain MOSFET application

### Power multiplexer




### Li-ion battery protection circuit




## Lineup

| Part number | SSM14N956L | SSM10N954L | SSM6N951L | SSM10N961L |
|---|---|---|---|---|
| Package | TCSPED-302701 | TCSPAC-153001 | TCSP6A-172101 | TCSPAG-341501 |
| Source-source voltage $V_{SSS}$ [V] | 12 | | | 30 |
| Gate-source voltage $V_{GSS}$ [V] | ±8 | | | ±20 |
| Source current (DC) $I_S$ [A] | 20.0 | 13.5 | 8.0 | 14.0 |
| $R_{SS(ON)}$ (Typ.) [mΩ] @$V_{GS}$ = 3.8 V | 1.1 | 2.2 | 4.6 | - |
| $R_{SS(ON)}$ (Typ.) [mΩ] @$V_{GS}$ = 10 V | - | - | - | 9.9 |

◆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:

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