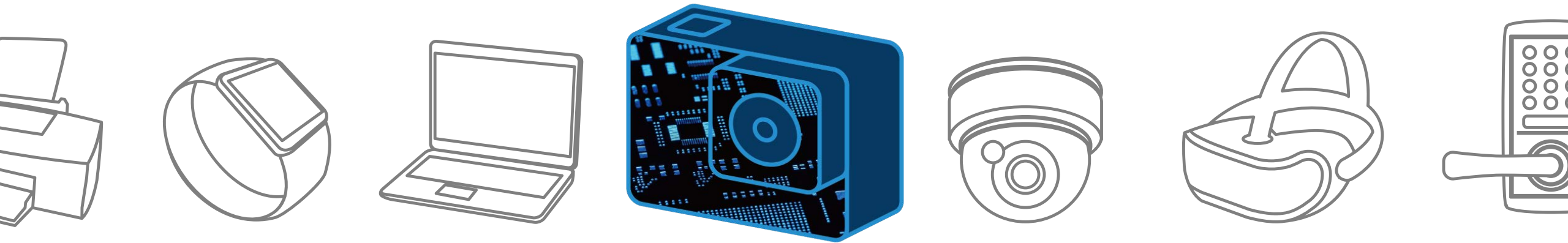
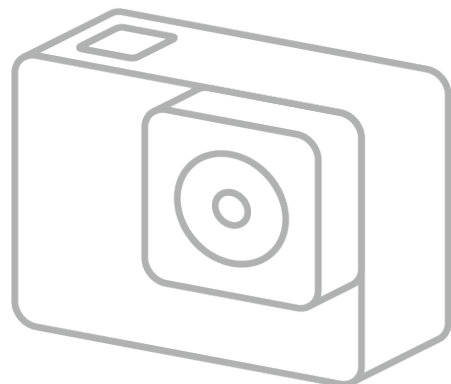


Action Camera

Solution Proposal by Toshiba

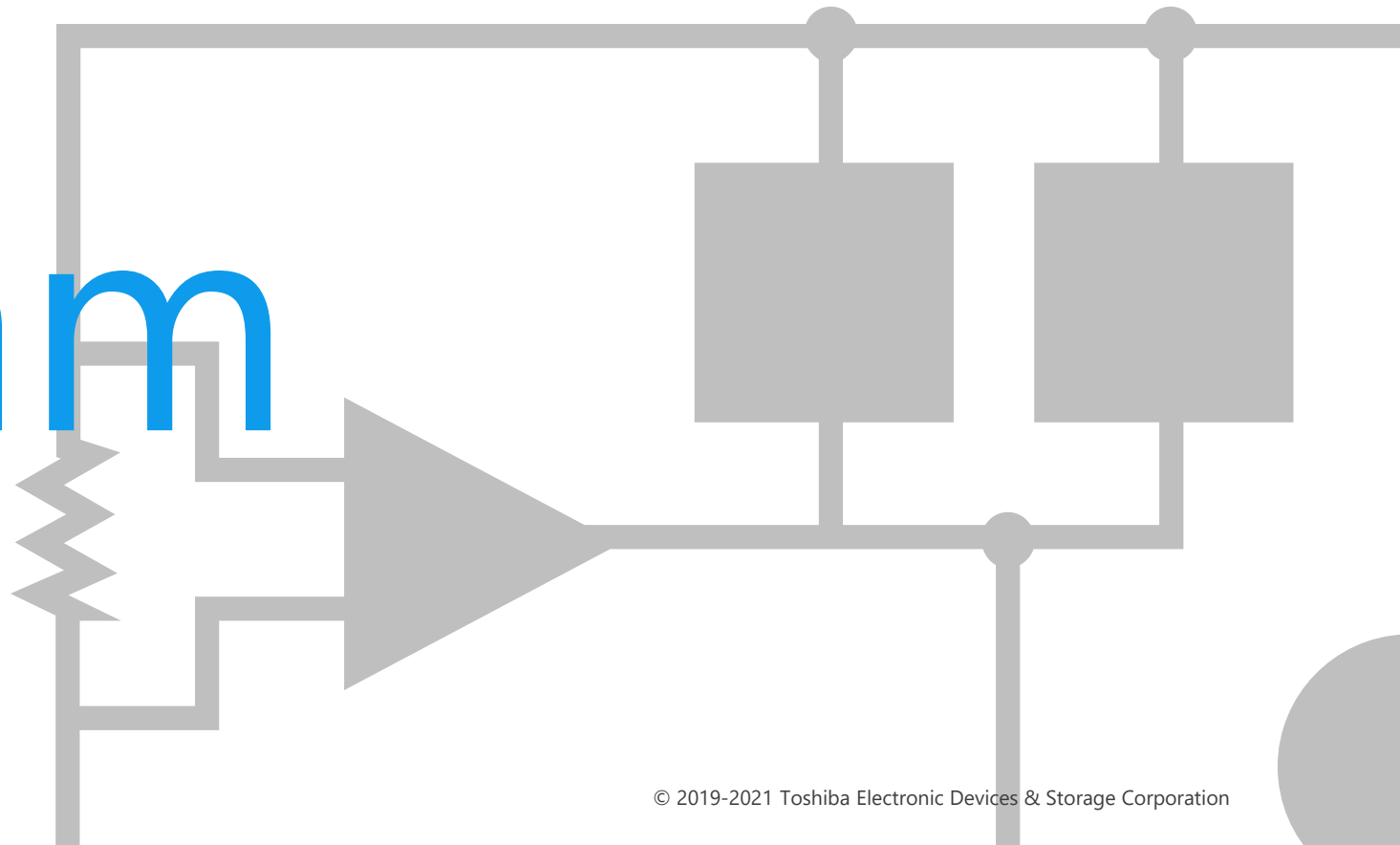




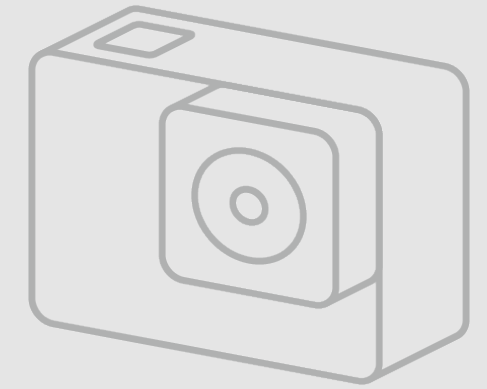
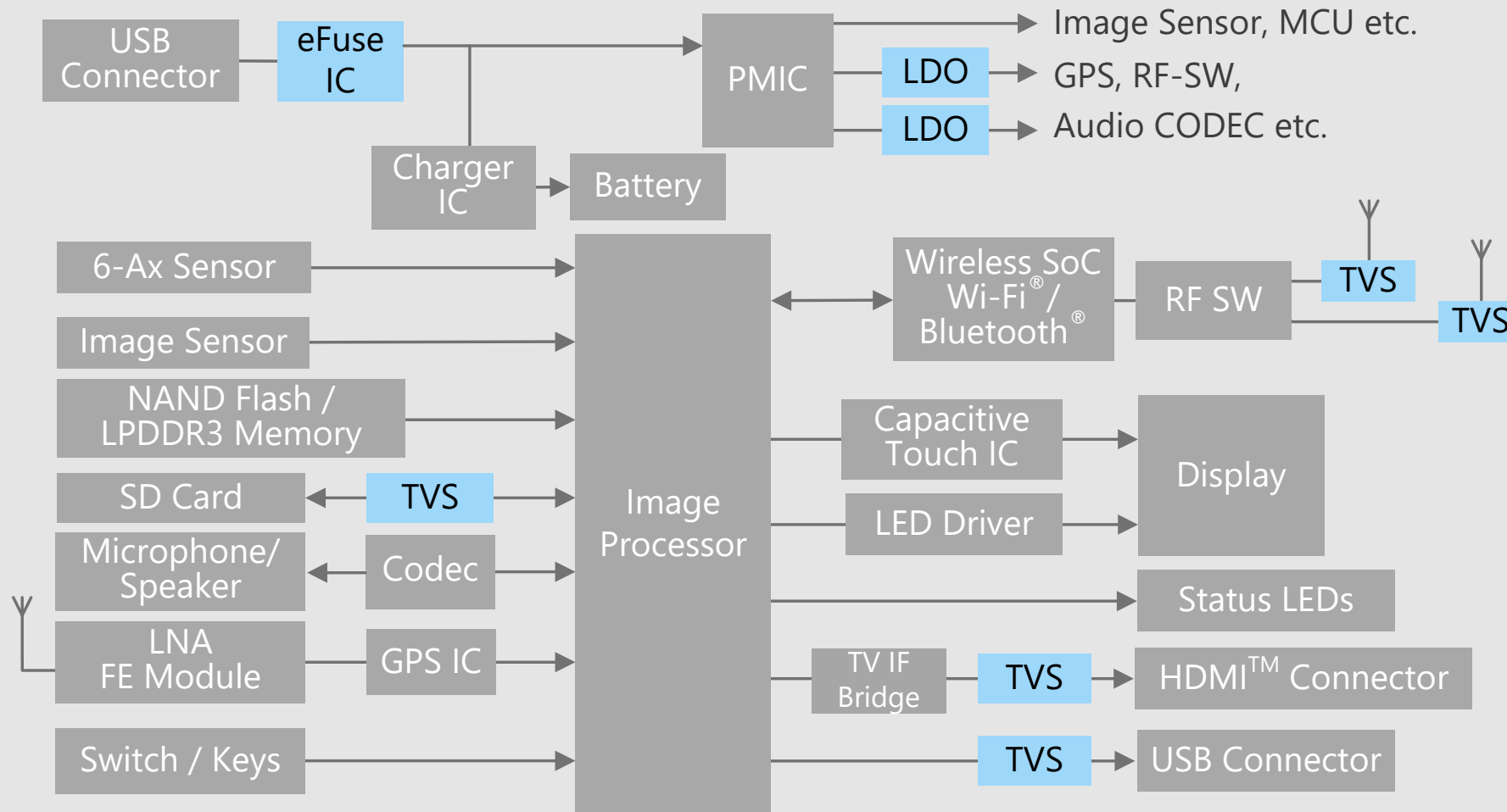
Toshiba Electronic Devices & Storage Corporation provides comprehensive device solutions to customers developing new products by applying its thorough understanding of the systems acquired through the analysis of basic product designs.



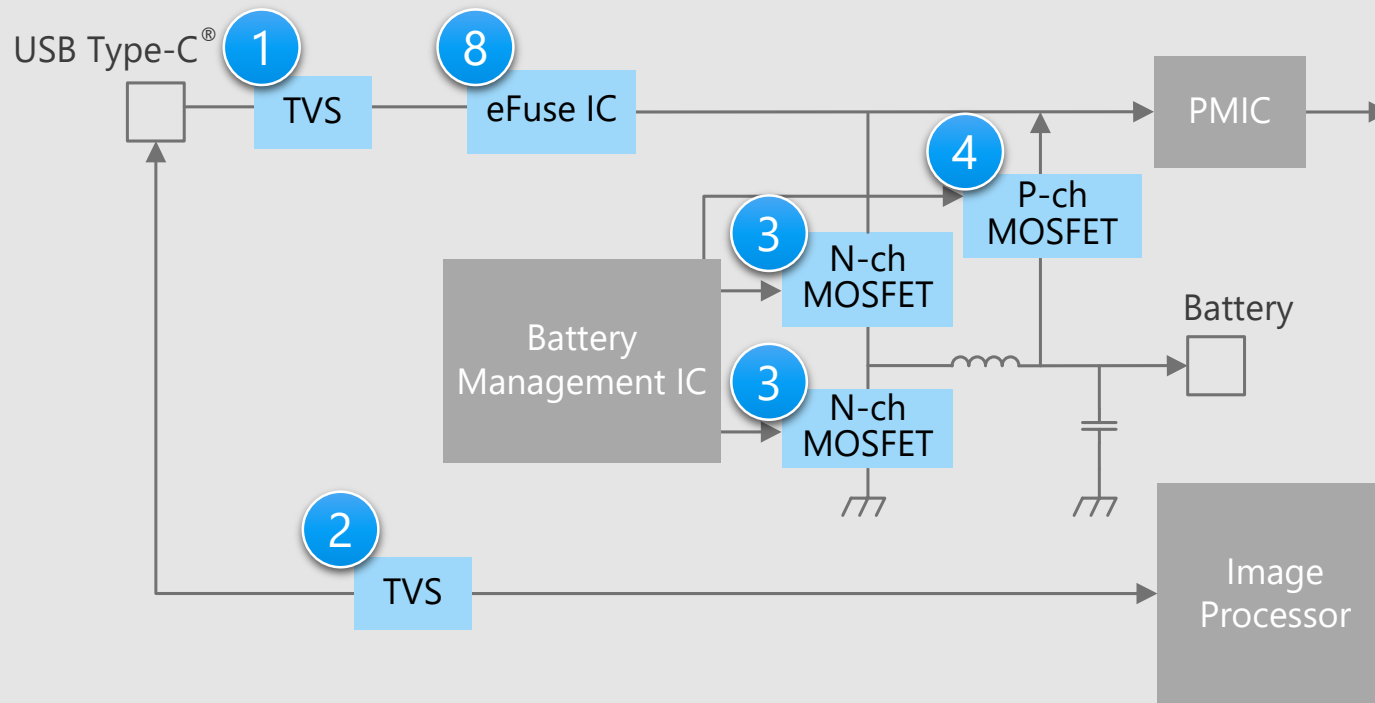
Block Diagram



Action Camera Overall block diagram



Battery and USB unit



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

Criteria for device selection

- Since the power line is susceptible to induced lightning, ESD protection devices are required to have higher tolerances.
- Lower capacitance ESD protection device is required not to affect the transmission of high speed signals on data lines.
- Lower on-resistance MOSFET is required to improve energy efficiency.
- Circuit board area can be reduced by adopting compact package products.

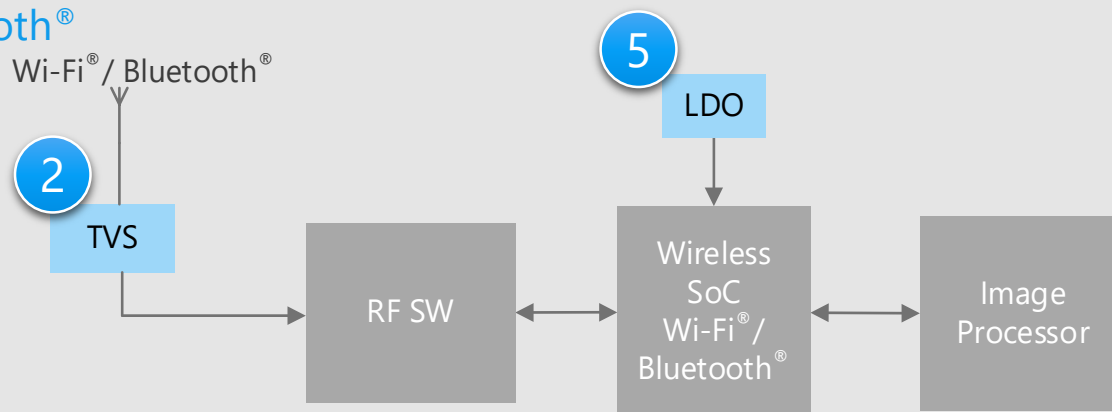
Proposals from Toshiba

- **TVS diode with compact package and high ESD tolerance** (1)
Standard capacitance TVS diode
- **TVS diode with compact package and low capacitance** (2)
Low capacitance TVS diode
- **MOSFET with compact package and low on-resistance** (3)
Small signal MOSFET (N-ch)
- **MOSFET with compact package and low on-resistance** (4)
Small signal MOSFET (P-ch)
- **Robust protection function** (8)
Electronic fuse (eFuse IC)

Action Camera Detail of RF unit

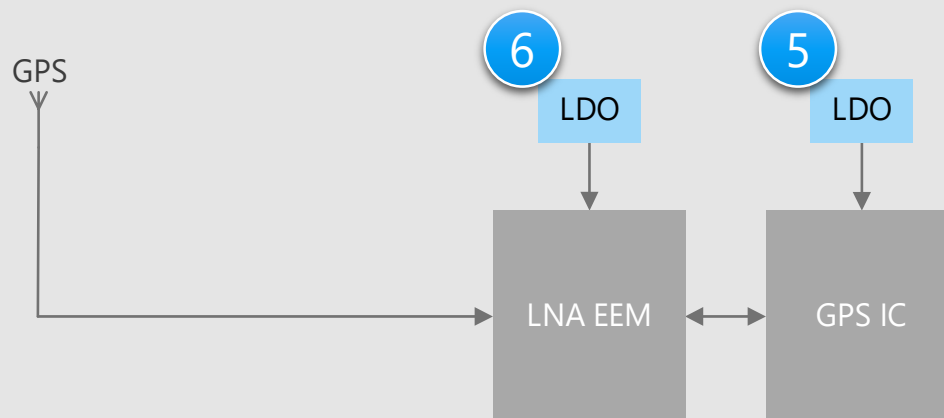
RF unit

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 capacitance ESD protection devices are required not to affect the transmission of high speed signals from antenna.
- LDO regulator having a high current driving capability for transmitting Wi-Fi® / Bluetooth® and having a low drop-out characteristic is required for efficient voltage conversion.
- To realize compact size and efficient voltage conversion, Low drop-out characteristic is required to LDO regulator.
- Compact packages can reduce the circuit board area.

Proposals from Toshiba

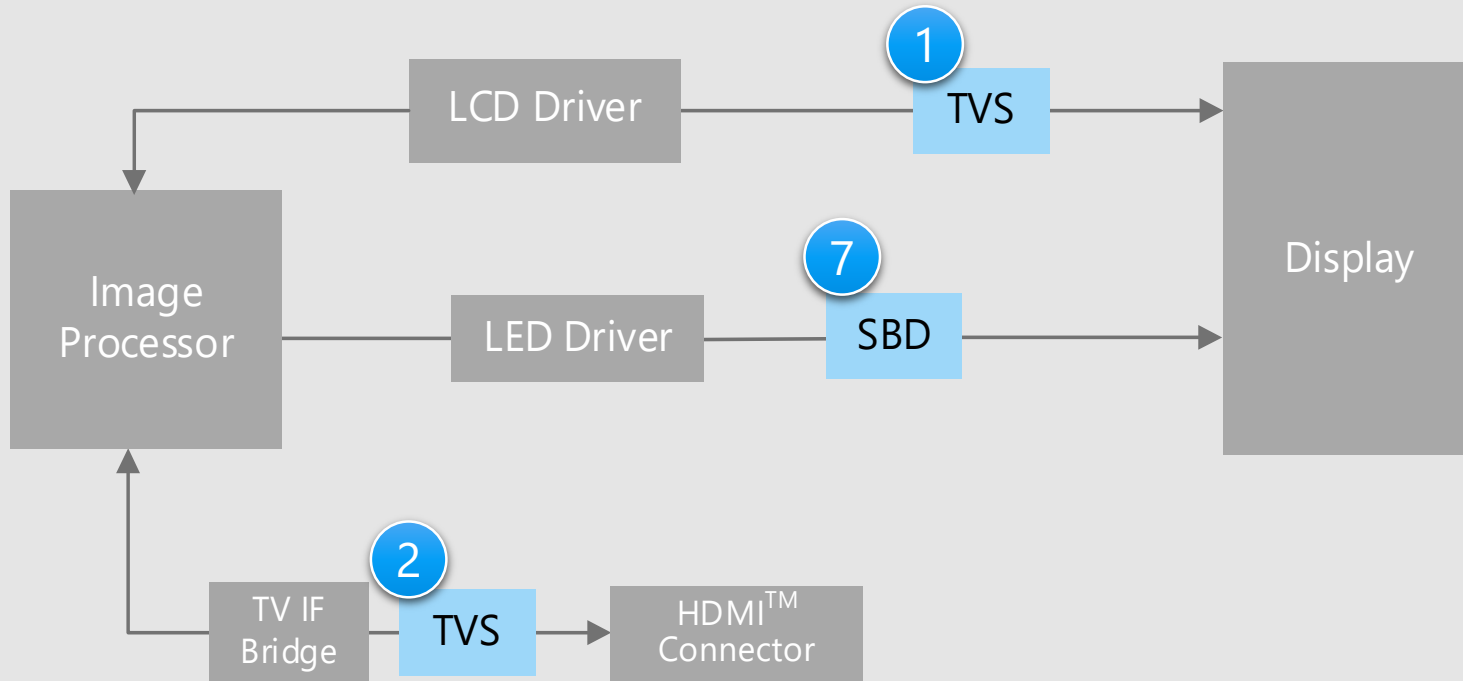
- **TVS diode with compact package and low capacitance**
Low capacitance TVS diode
- **LDO regulator with compact package and capable of applying a large current**
High current LDO regulator
- **LDO Regulator with compact package and low drop-out characteristics**
Small current LDO regulator

2

5

6

Display unit



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

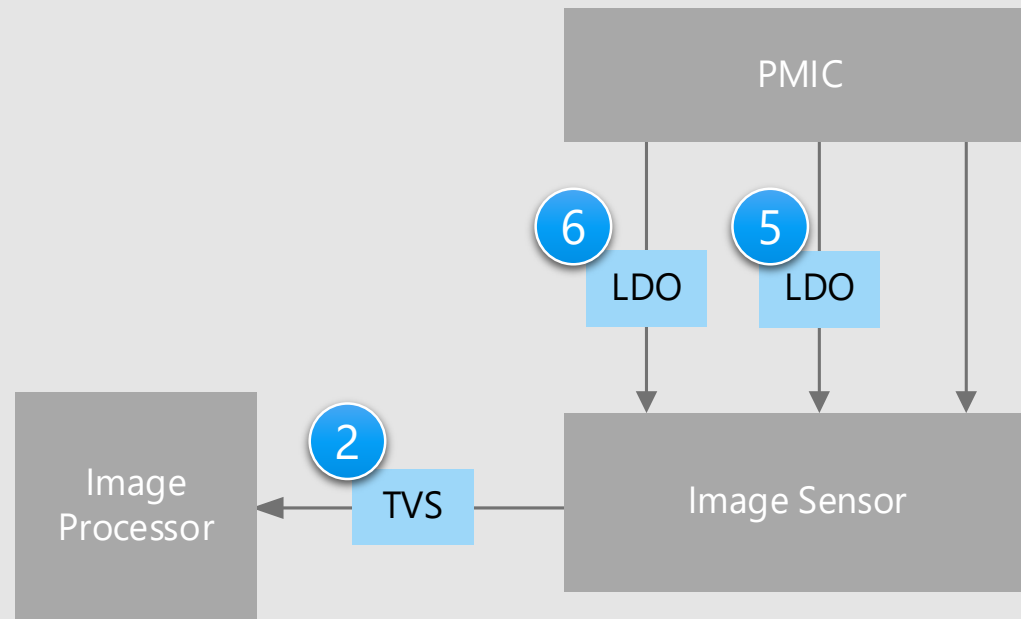
Criteria for device selection

- Low V_F characteristics are required for efficient power supply.
- Lower capacitance ESD protection device is required not to affect the transmission of high speed signals on the data lines.
- Compact packages can reduce the circuit board area

Proposals from Toshiba

- **TVS diode with compact package and high ESD tolerance**
Standard capacitance TVS diode 1
- **TVS diode with compact package and low capacitance**
Low capacitance TVS diode 2
- **SBD with compact package and low V_F characteristics**
Schottky barrier diode (SBD) 7

Camera unit



Criteria for device selection

- LDO regulator with low current consumption and low drop-out characteristics is required to last battery long.
- LDO regulator with low drop-out characteristic is required to realize large current drive capability and efficient voltage conversion.
- Lower capacitance ESD protection device is required not to affect the transmission of high speed signals on a data line.
- Circuit board area can be reduced by adopting compact packages.

Proposals from Toshiba

- **TVS diode with compact package and high ESD tolerance**
Low capacitance TVS diode
- **LDO regulator with compact package and capable of applying a large current**
High current LDO regulator
- **LDO Regulator with compact package and low drop-out characteristics**
Small current LDO regulator

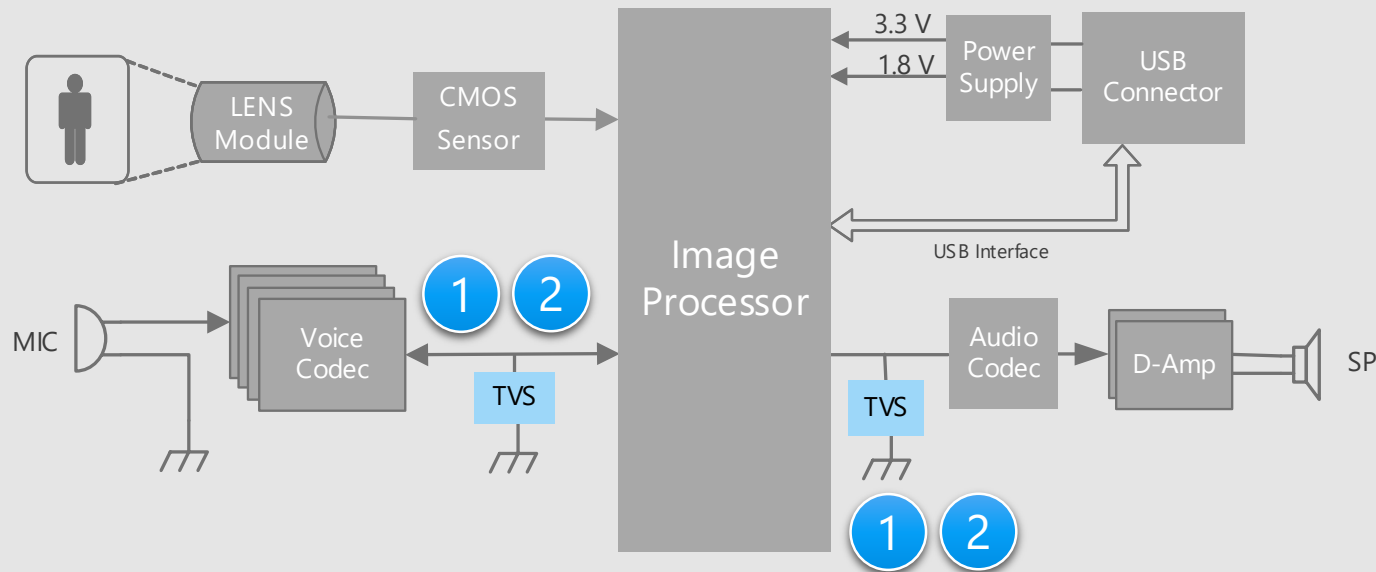
2

5

6

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

Camera motion unit



Criteria for device selection

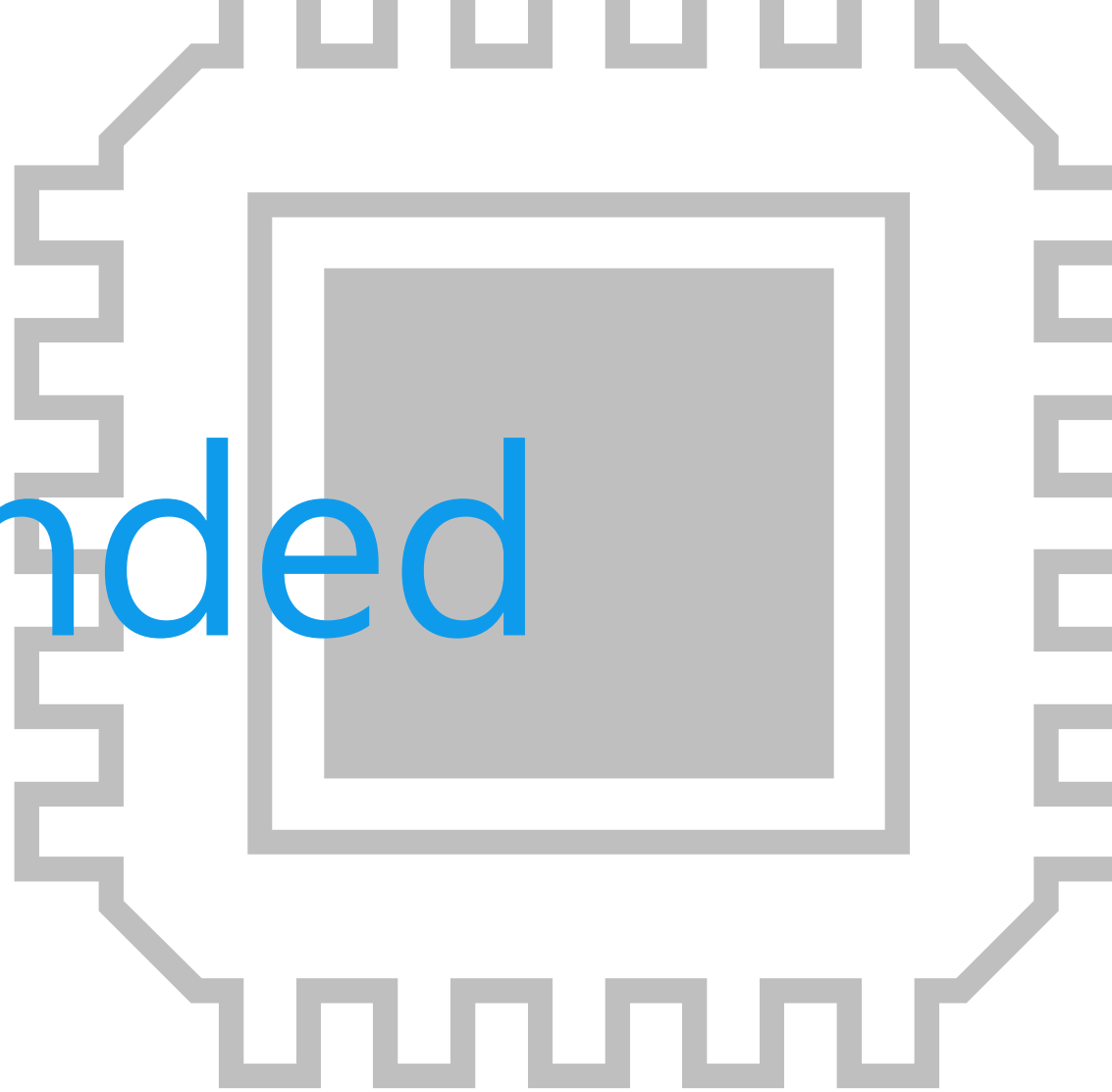
- Lower capacitance ESD protection device is required not to affect the transmission of high speed signals on data lines.

Proposals from Toshiba

- **TVS diode with compact package and high ESD tolerance**
Standard capacitance TVS diode 1
- **TVS diode with compact package and low capacitance**
Low capacitance TVS diode 2

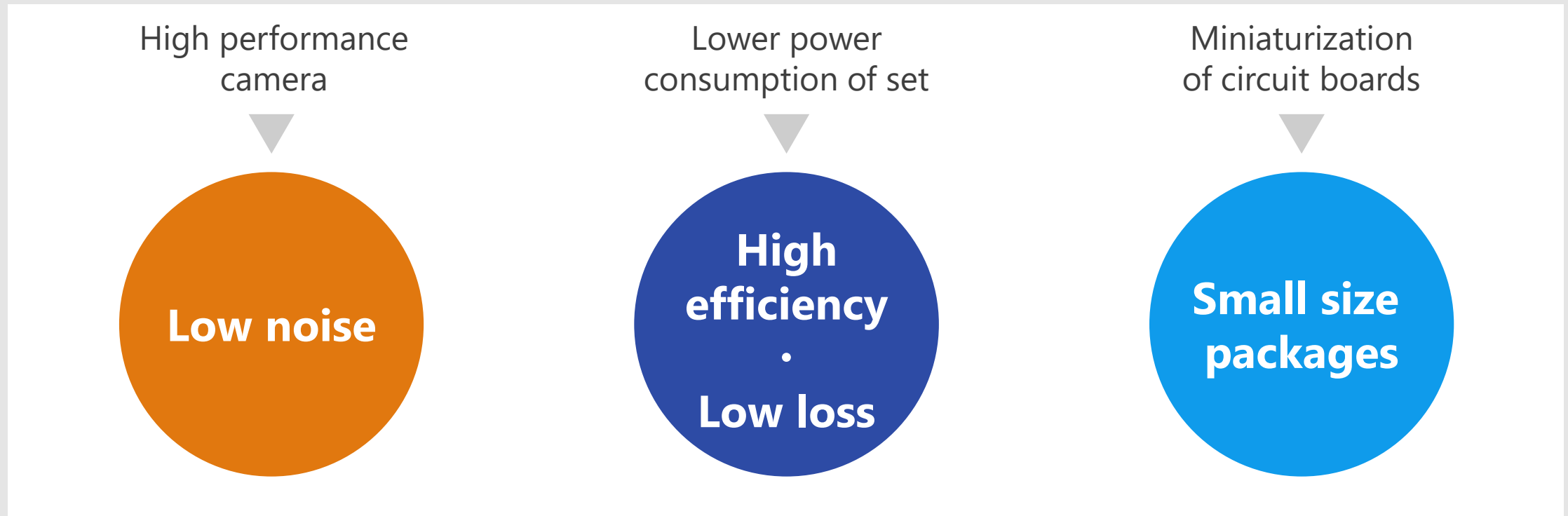
✂ Click the number in the circuit diagram to jump to the detailed description page

Recommended Devices



Device solutions to address customer needs

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



	Low noise	High efficiency · Low loss	Small size packages
① Standard capacitance TVS diode			●
② Low capacitance TVS diode			●
③ Small signal MOSFET (N-ch)		●	●
④ Small signal MOSFET (P-ch)		●	●
⑤ High current LDO regulator	●	●	●
⑥ Small current LDO regulator	●	●	●
⑦ Schottky barrier diode (SBD)		●	●
⑧ Electronic fuse (eFuse IC)		●	●

1 Standard capacitance TVS diode

DF2B7ASL / DF2S14P1CT

Low noise

High efficiency
Low loss

Small size packages

Value provided

TVS diode absorbs static electricity (ESD) and surge from external terminals and is suitable for preventing circuit malfunction and device protection.

1 High ESD pulse absorption performance

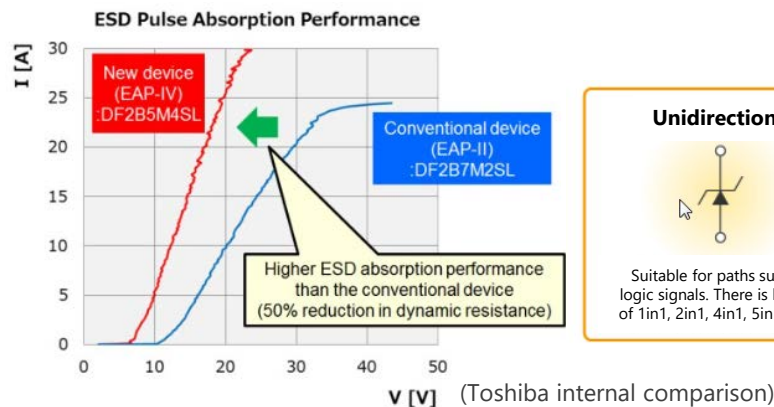
For some products, both low operating resistance and low capacitance are realized, and ensures high signal protection performance and signal quality.

2 Suppress ESD energy by low clamp voltage

TVS diodes steadily protect connected circuits/devices by adopting proprietary technology.

3 Suitable for high-density mounting

A variety of compact packages are available.



Unidirectional



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

Bidirectional



Suitable for paths with both polar signals such as audio signals

Line up

Part number	DF2B7ASL	DF2S14P1CT
Package	SL2 	CST2 
V_{ESD} (Max) [kV]	± 30	± 30
V_{RWM} (Max) [V]	5.5	12.6
C_t (Typ.) [pF]	8.5	40
R_{DYN} (Typ.) [Ω]	0.2	0.5

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

[◆Return to Block Diagram TOP](#)

Value provided

This TVS diode has low capacitance that does not affect the transmission of high speed signals on data lines, and is suitable for preventing circuit malfunctions and protecting devices.

1 High ESD pulse absorption performance

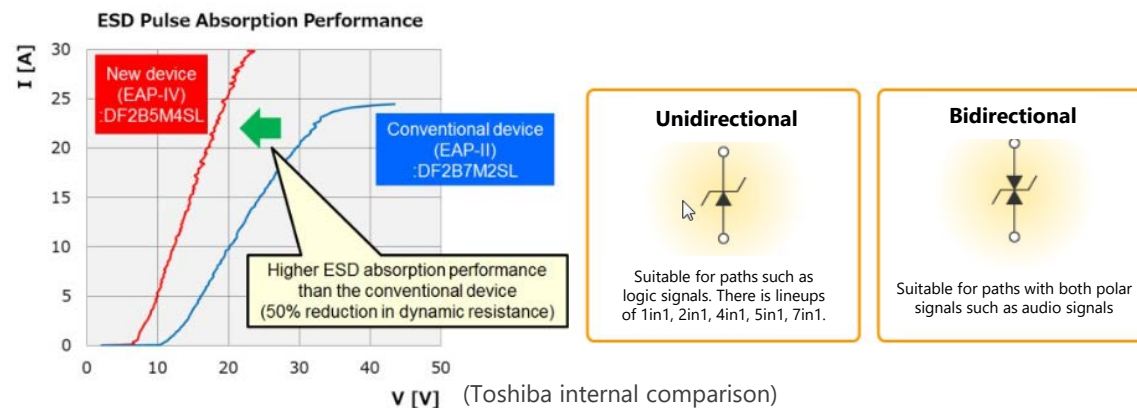
For some products, both low operating resistance and low capacitance are realized, and ensures high signal protection performance and signal quality.

2 Suppress ESD energy by low clamp voltage




TVS diodes steadily protect connected circuits/devices by adopting proprietary technology.

3 Suitable for high-density mounting

A variety of compact packages are available.



Line up

Part number	DF2B5M4ASL	DF2B6M4ASL	DF2B6M4SL
Package	SL2 	SL2 	SL2 
V_{ESD} (Max) [kV]	±16	±15	±20
V_{RWM} (Max) [V]	3.6	5.5	5.5
C_t (Typ.) [pF]	0.15	0.15	0.2
R_{DYN} (Typ.) [Ω]	0.7	0.7	0.5

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

[◆Return to Block Diagram TOP](#)

Value provided

It is suitable for power management switches, etc., and greatly contributes to miniaturization of sets.

1 Low voltage drive

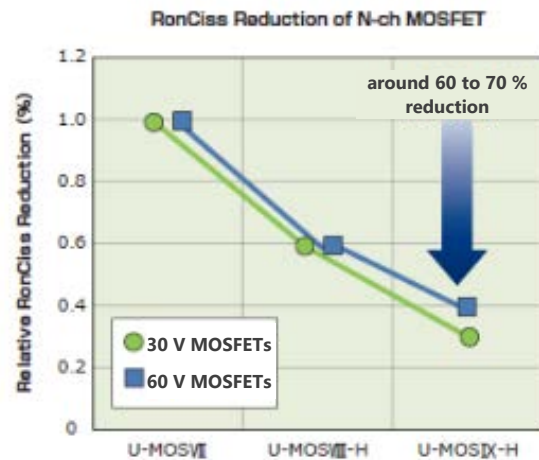
Drive at $V_{DS} = 4.5 \text{ V}$.

2 Low on-resistance



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

3 Compact package

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



(Note: Toshiba internal comparison)

Line up		
Part number	SSM6K513NU	SSM6N55NU
Package	UDFN6B 	UDFN6B 
V_{DSS} [V]	30	30
I_D [A]	15	4
$R_{DS(ON)}$ [mΩ] @ $V_{GS} = 4.5 \text{ V}$	Typ.	8.0
	Max	12
Polarity	N-ch	N-ch x 2

[Return to Block Diagram TOP](#)

Value provided

It is suitable for power management switches, etc., and greatly contributes to miniaturization of sets.

1 Low voltage drive

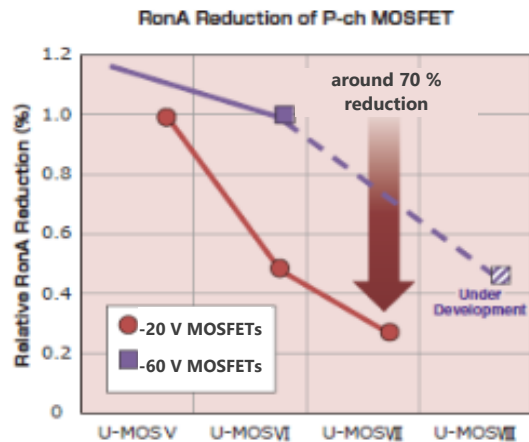
Drive at $V_{DS} = 4.5$ V.

2 Low on-resistance


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

3 Compact package

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



(Note: Toshiba internal comparison)

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

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5 High current LDO regulator

TCR15AG Series / TCR5BM Series / TCR5RG Series



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

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

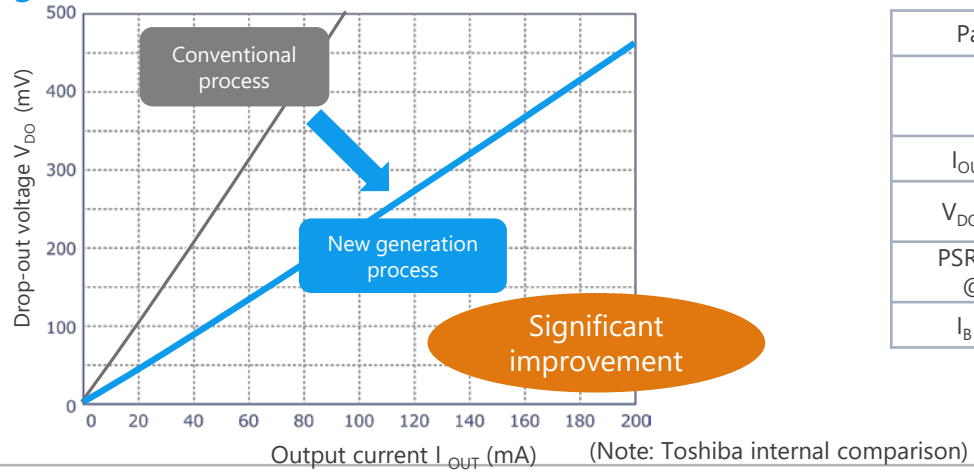
2 Low loss (low dropout)

The heat generated by the circuit can be minimized since our LDO regulator minimizes the losses generated by the circuit.

3 Suitable for high-density mounting

A variety of compact packages are available.

Low dropout voltage



Line up

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 @ $I_{OUT} = 500$ mA
PSRR (Typ.) [dB] @ $f = 1$ kHz	95	98	100
I_B (Typ.) [μ A]	25	19	7

[Return to Block Diagram TOP](#)

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

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

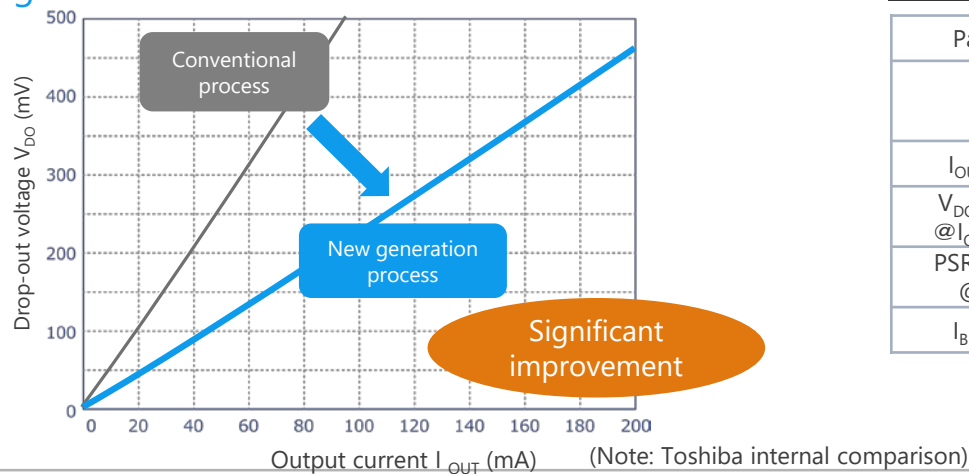
2 Low loss (low dropout)

The heat generated by the circuit can be minimized since our LDO regulator minimizes the losses generated by the circuit.





3 Suitable for high-density mounting

A variety of compact packages are available.

Low dropout voltage



Line up

Part number	TCR3RM Series	TCR3UM Series	TCR3UG Series	TCR3DG Series
Package	DFN4C 	DFN4 	WCSP4F 	WCSP4E 
I_{OUT} (Max) [A]	0.3	0.3	0.3	0.3
V_{DO} (Typ.) [mV] @ $I_{OUT} = 300$ mA	98	196	140	195
PSRR (Typ.) [dB] @ $f = 1$ kHz	100	70	70	70
I_B (Typ.) [μ A]	7	0.34	0.34	65

[◆Return to Block Diagram TOP](#)

Value provided

low V_F and low I_R characteristics were realized and contributes to improved circuit-efficiency.

1 Low V_F characteristics

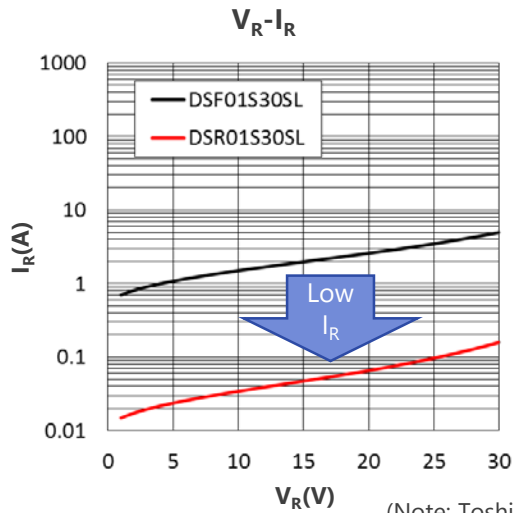
Low V_F characteristics compared to our conventional products was realized. When used in backflow prevention applications, the circuit efficiency can be further improved.

2 Low I_R characteristics

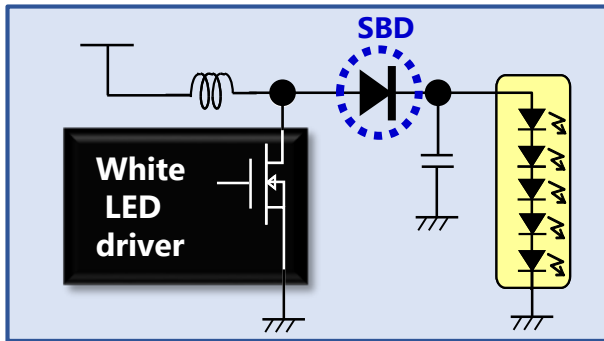
Low I_R characteristics compared to conventional products was realized. When used in backflow prevention applications, the circuit efficiency can be further improved.

3 Suitable for high-density mounting

A variety of compact packages are available.



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



Line up

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

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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 IEC62368-1 certified

Toshiba's eFuse ICs are certified to the international safety standard IEC62368-1 (G9: Integrated circuit (IC) current limiters) and contribute to robust protection and simplification of circuit design.

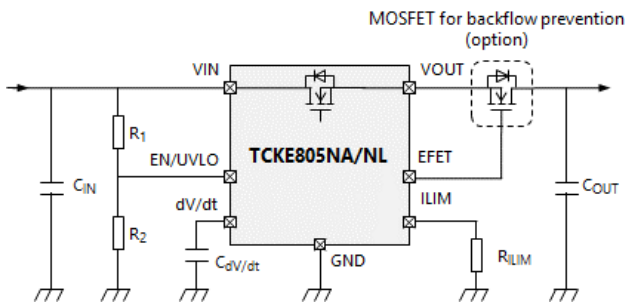
Note: TCKE712BNL is scheduled to be certified in Sep. 2021.

3 Rich protection functions

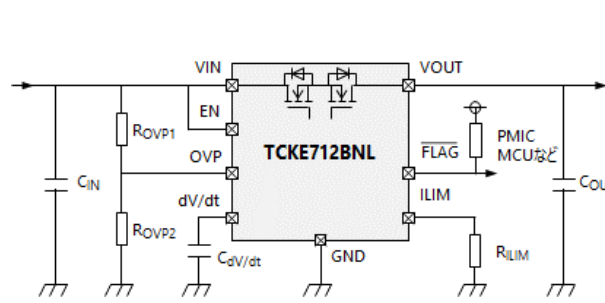
TCKE8 Series: short-circuit protection, overcurrent protection, overcurrent clamp function, overvoltage clamp function, thermal shut down, inrush current suppression, backflow prevention (optional), etc.

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



Line up

Part number	TCKE800NA/NL	TCKE805NA/NL	TCKE812NA/NL	TCKE712BNL
Package	WSO10B 3.0 x 3.0 x 0.75 mm			WSO10 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	15.0	Adjustable

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