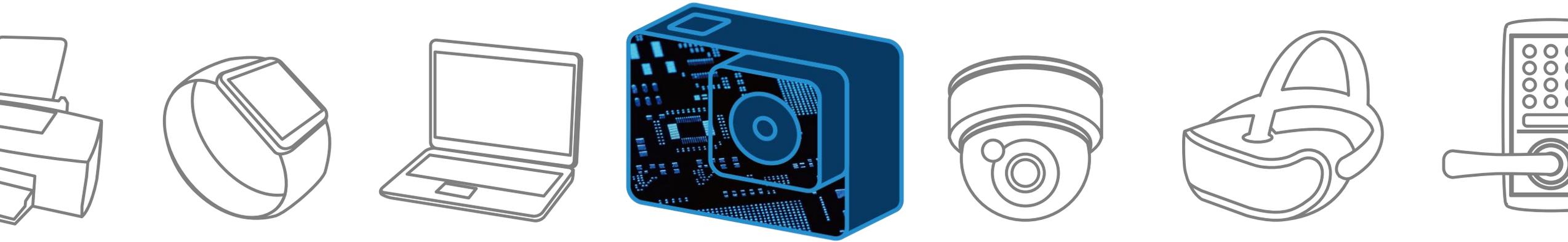
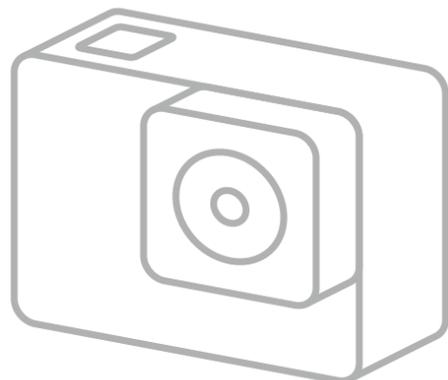
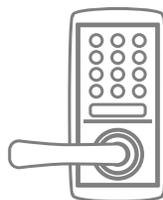


Action Camera

Solution Proposal by Toshiba

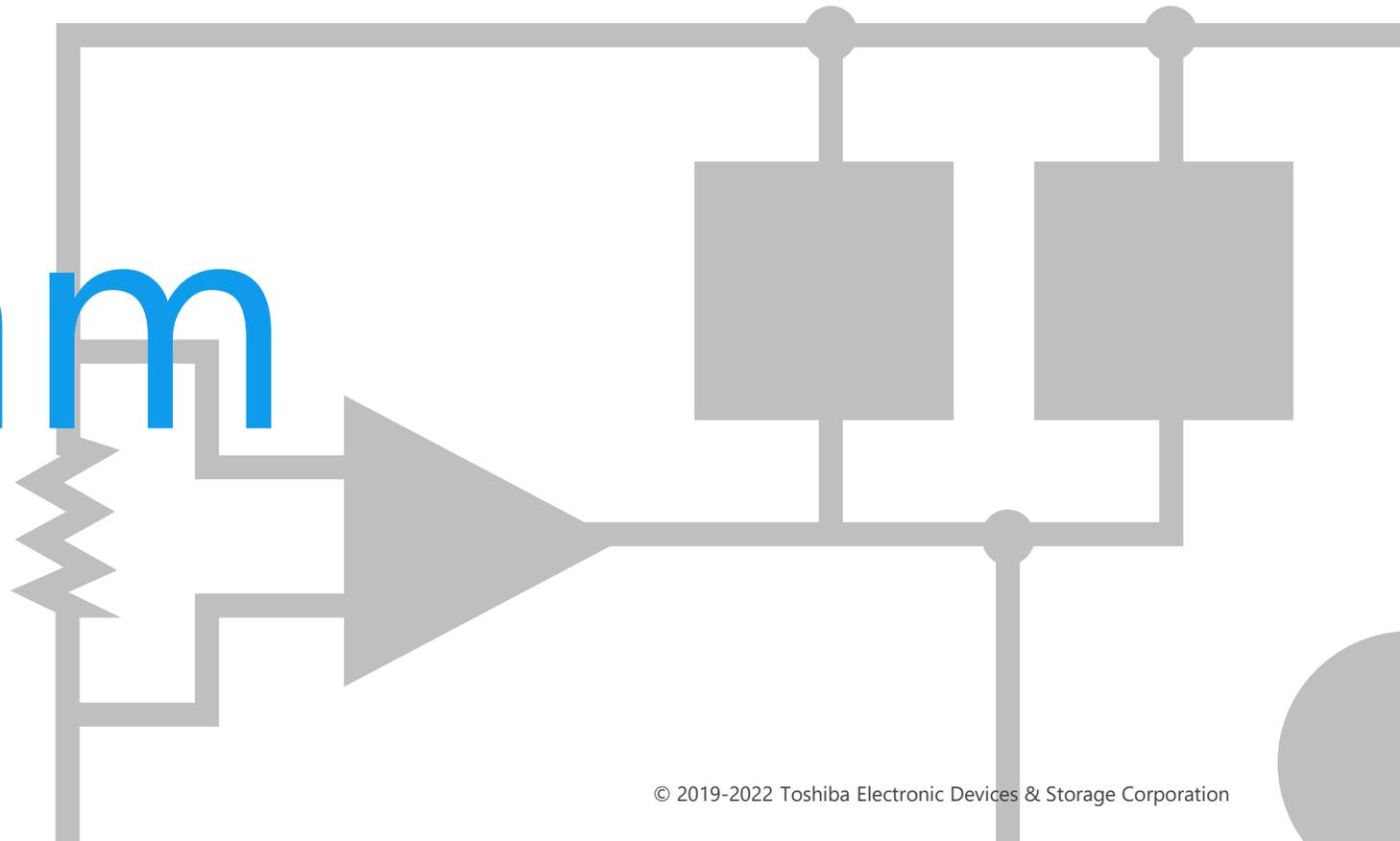




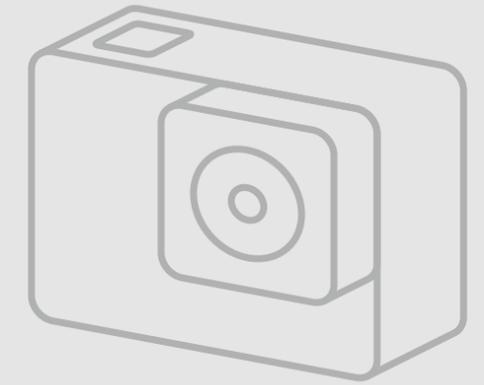
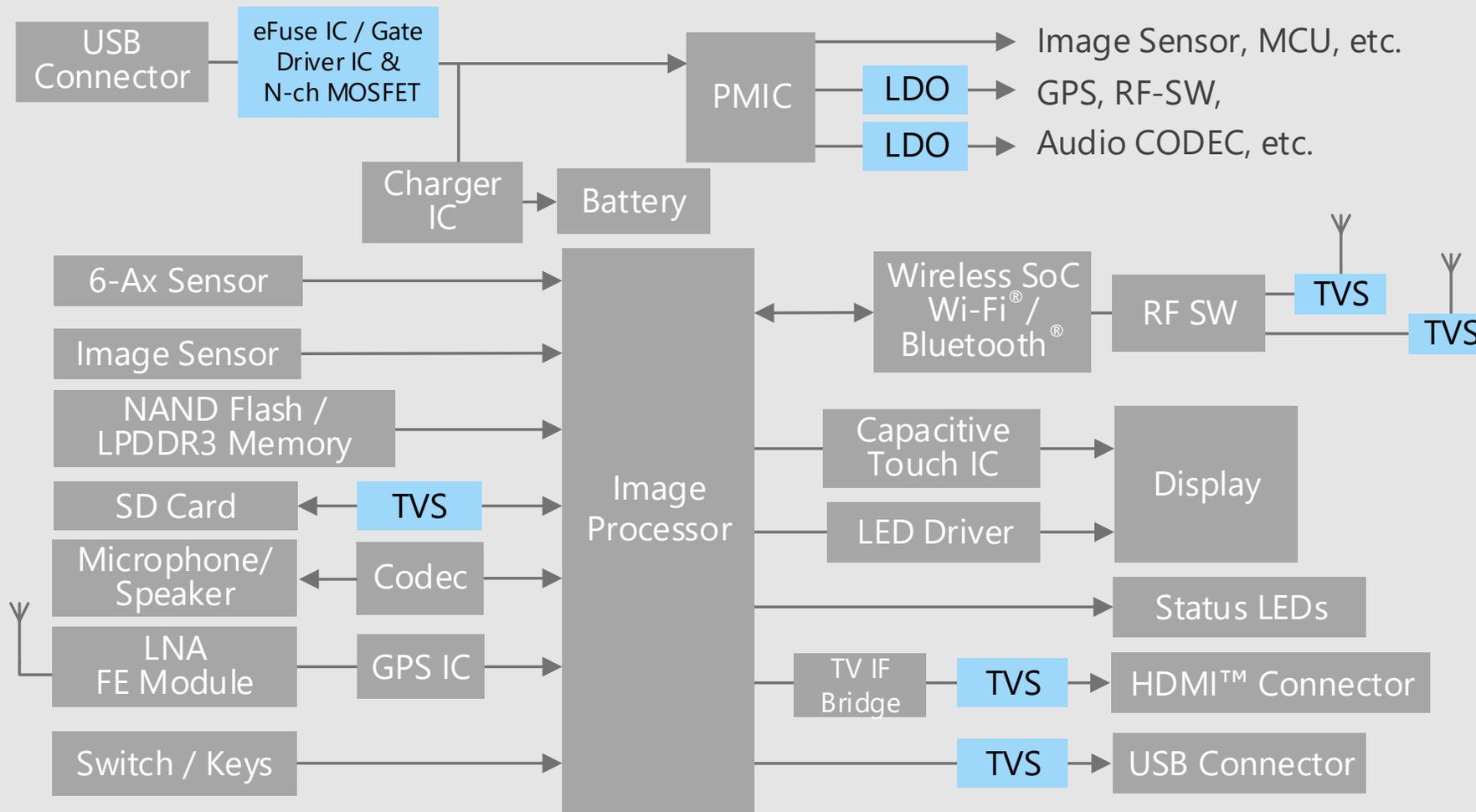
Toshiba Electronic Devices & Storage Corporation provides comprehensive device solutions to customers developing new products by applying its thorough understanding of the systems acquired through the analysis of basic product designs.



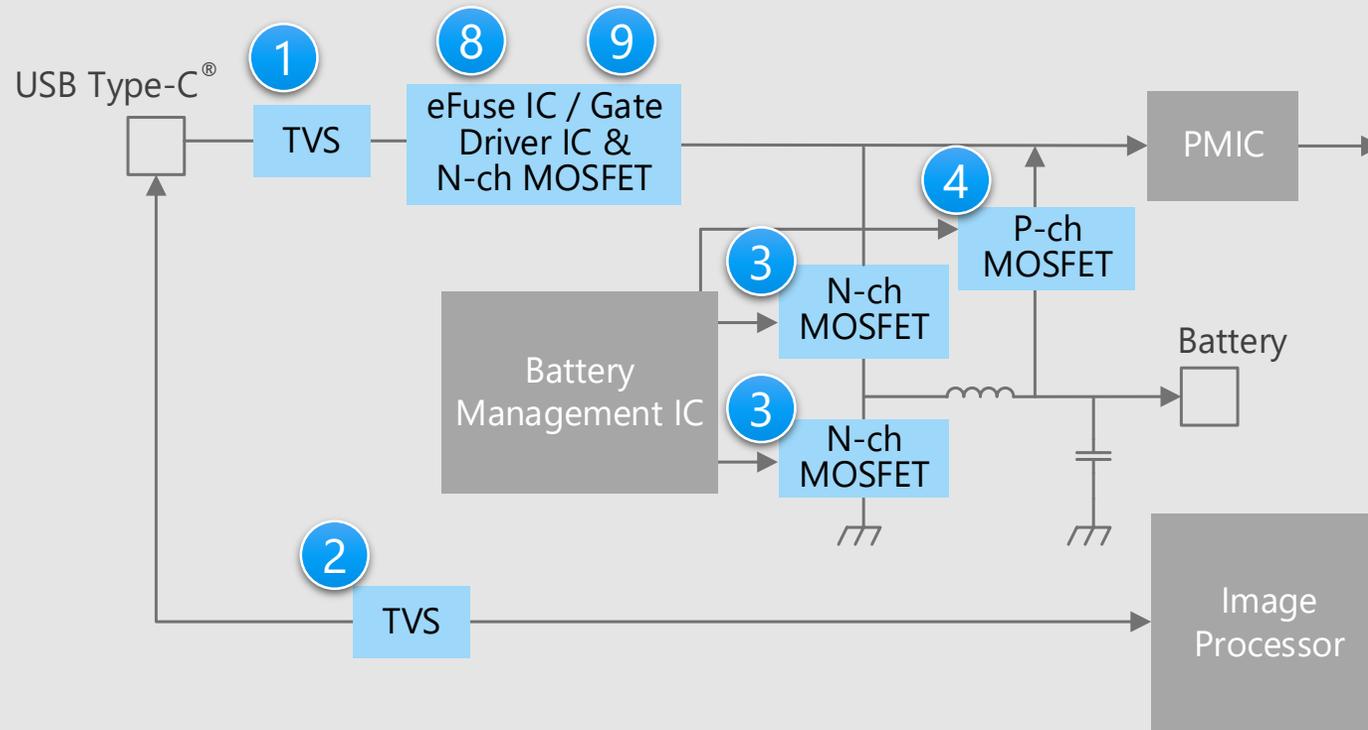
Block Diagram



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

- 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 tolerance**
TVS diode
- **Small package and low on-resistance**
Small signal MOSFET (N-ch)
Small signal MOSFET (P-ch)
- **Built-in protection function against short circuit, over current, over voltage, etc.**
Electronic fuse (eFuse IC)
- **Small package and built-in over voltage protection function**
N-ch MOSFET gate driver IC

1

2

3

4

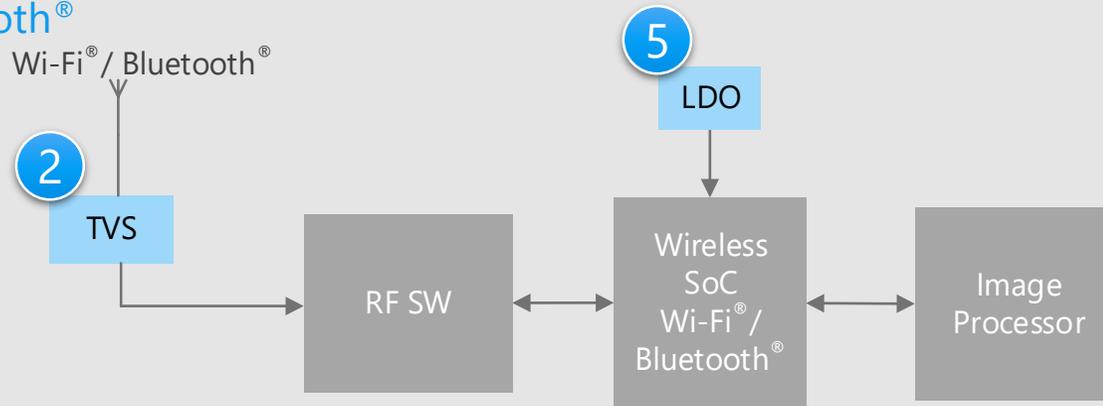
8

9

Action Camera Detail of RF unit

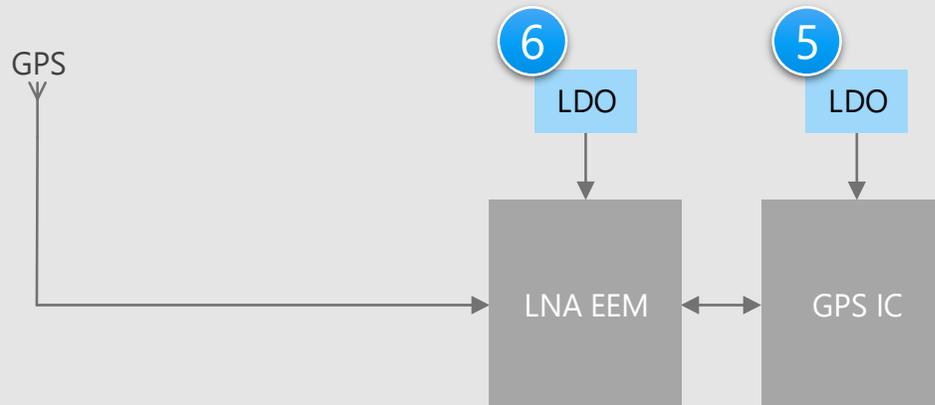
RF unit

Wi-Fi®/ Bluetooth®



RF unit

GPS



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

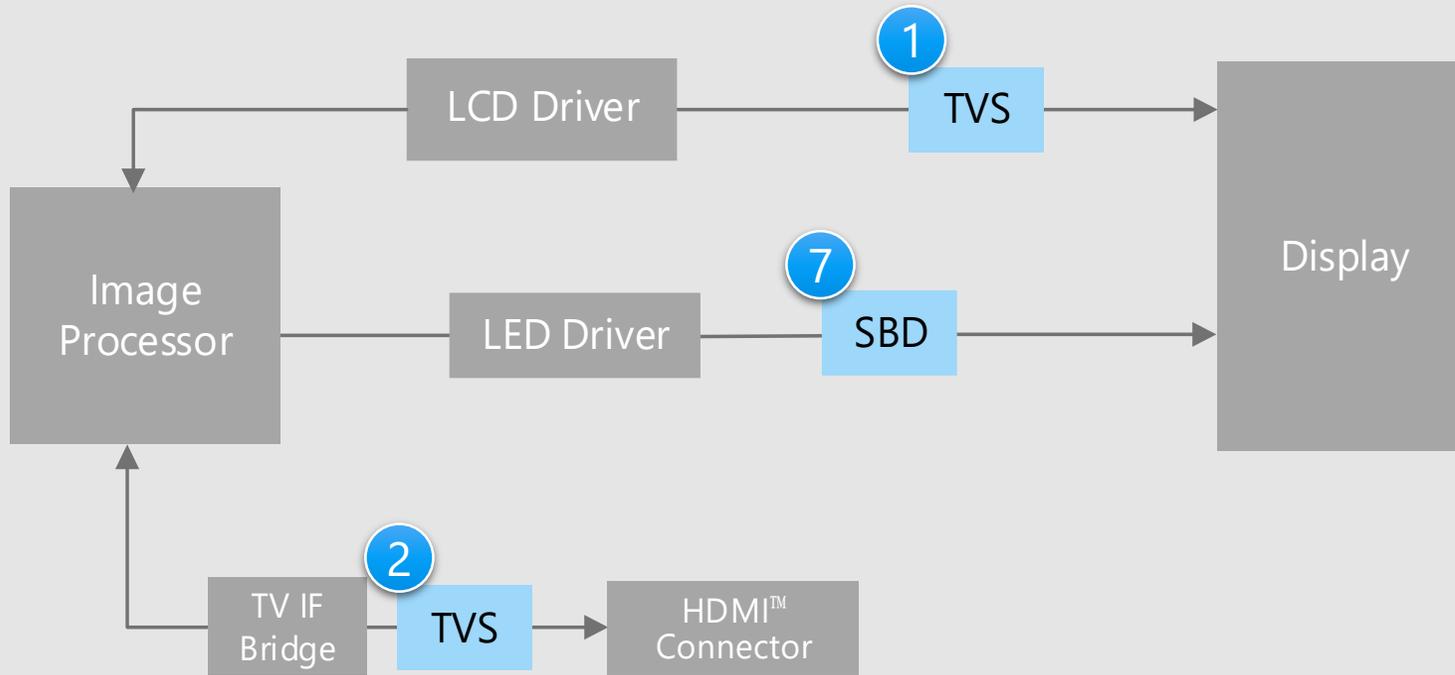
Criteria for device selection

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

Display unit



SBD : Schottky barrier diode

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 tolerance**
 - TVS diode
 - Low capacitance TVS diode
- **Small package and low V_F characteristics**
 - Schottky barrier diode

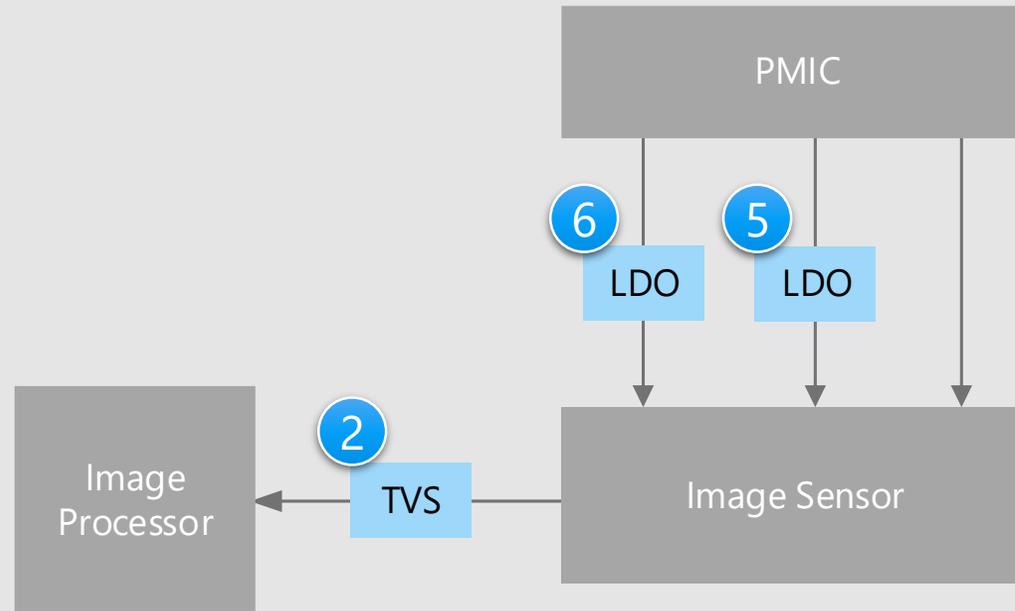
1

2

7

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

Camera unit



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 tolerance**
Low capacitance TVS diode
- **Small package and low drop-out characteristics**
High current LDO regulator
Low current LDO regulator

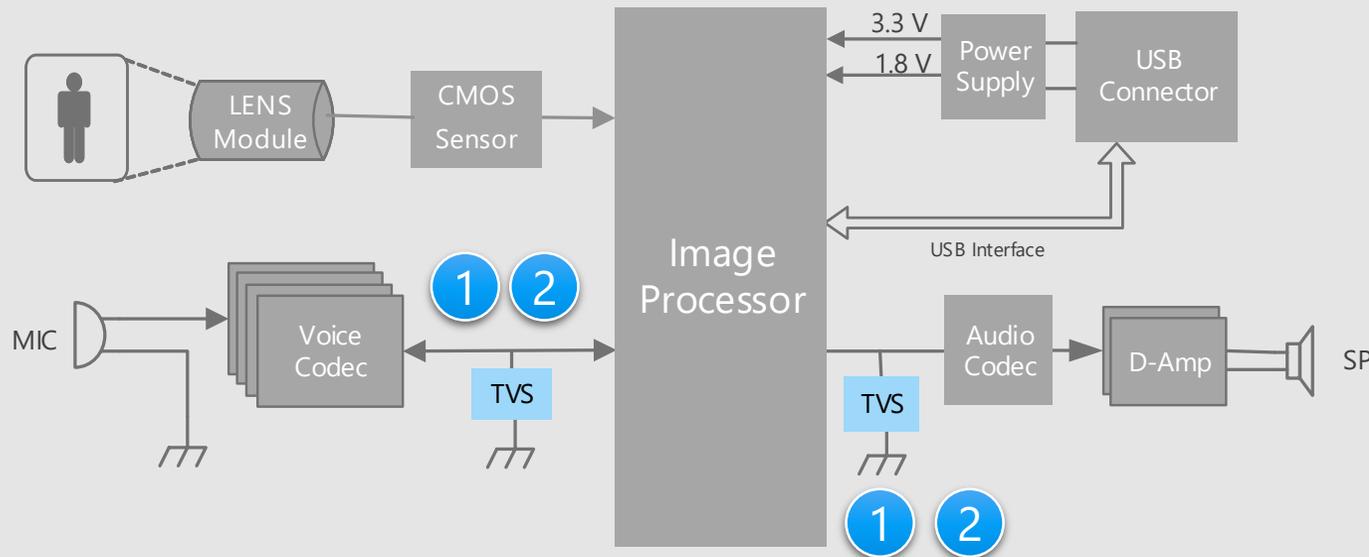
2

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

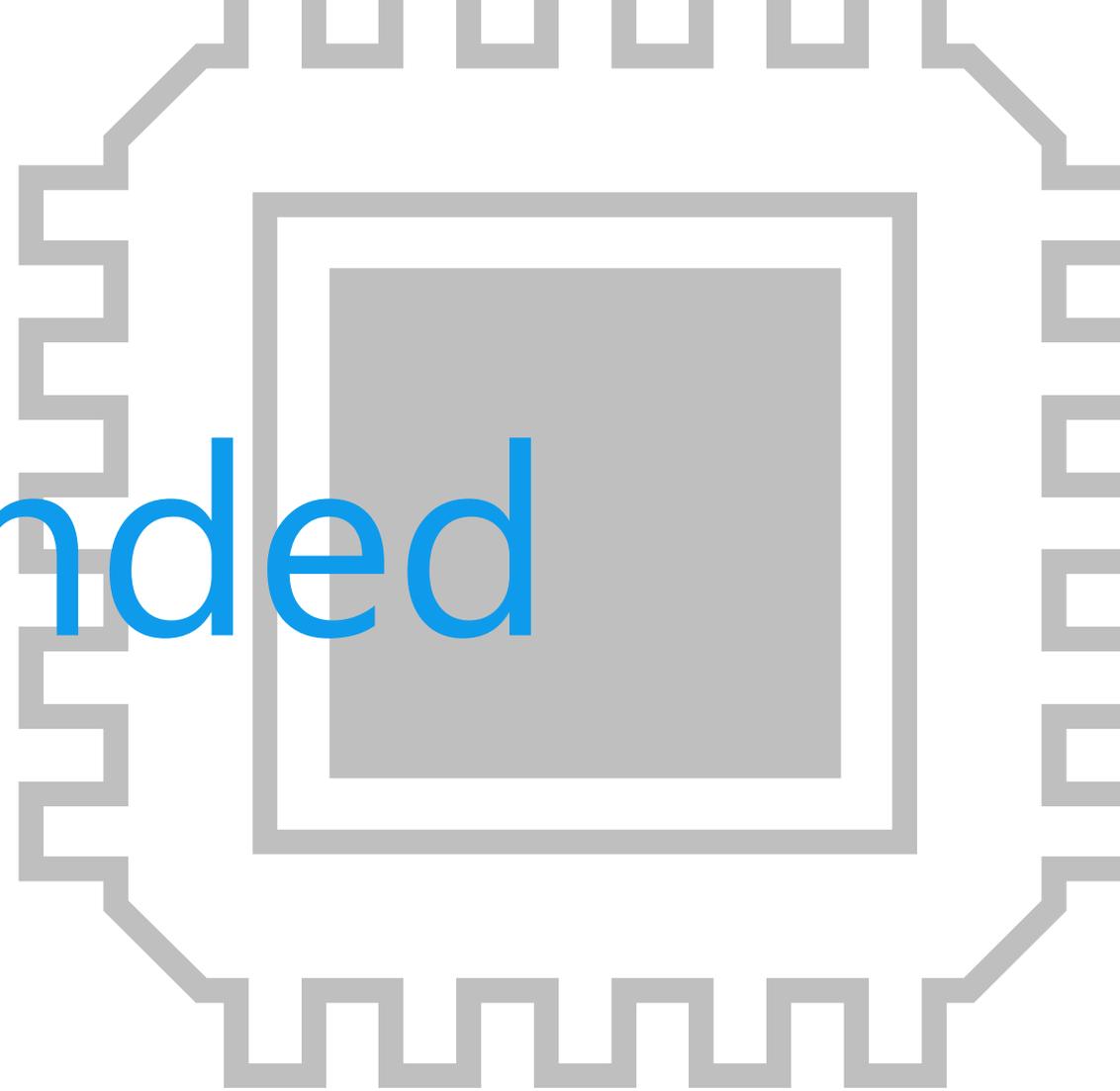
Proposals from Toshiba

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



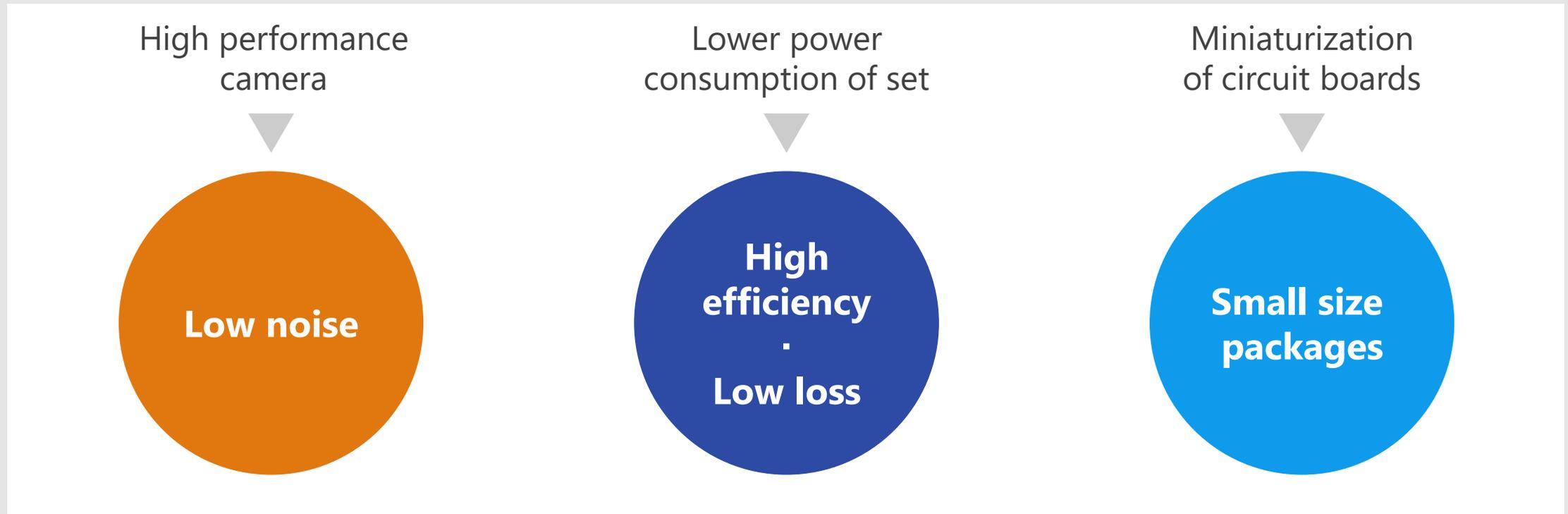
✂ Click the number in the circuit diagram to jump to the detailed description page

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	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	Low current LDO regulator	●	●	●
7	Schottky barrier diode		●	●
8	Electronic fuse (eFuse IC)		●	●
9	N-ch MOSFET gate driver IC		●	●

Value provided

TVS diode absorbs static electricity (ESD) and surge from external terminals to prevent circuit malfunction and protect 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.

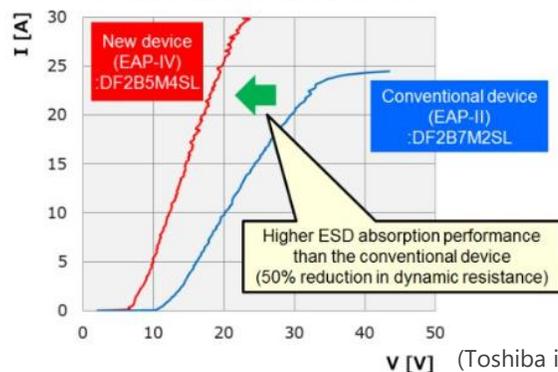
2 Suppress ESD energy by low clamp voltage

Protect the connected circuits/devices using Toshiba own technology.

3 Suitable for high density mounting

A variety of small packages are available.

ESD Pulse Absorption Performance



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

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 designed for ESD protection purpose and cannot be used for purposes other than ESD protection.

[◆Return to Block Diagram TOP](#)

Value provided

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

1 High ESD pulse absorption performance

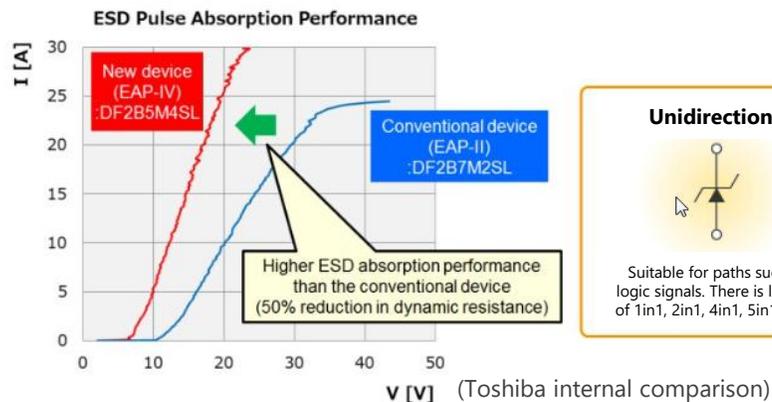
Improved ESD absorption compared to our conventional products. (50 % reduction in operating resistance) For some products, both low operating resistance and low capacitance are realized and ensures high signal protection performance and signal quality.

2 Suppress ESD energy by low clamp voltage

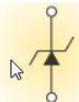
Protect the connected circuits/devices using Toshiba own technology.

3 Suitable for high density mounting

A variety of small 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

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 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 and others. Therefore, contributes to miniaturization of sets.

1 Low voltage operation

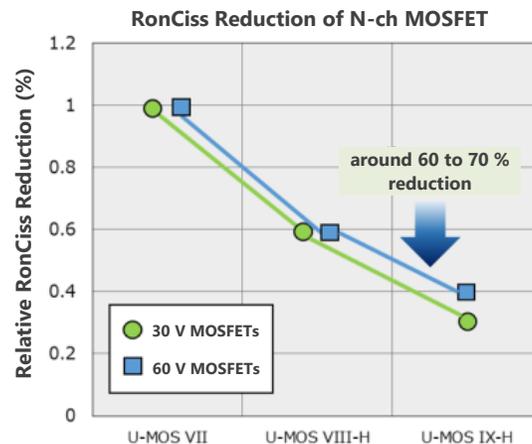
Operates down to $V_{GS} = 4.5\text{ V}$.

2 Low on-resistance

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

3 Small package

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



(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
$R_{DS(ON)}$ [m Ω] @ $V_{GS} = 4.5\text{ V}$	Typ.	48
	Max	64
Polarity	N-ch	N-ch x 2

[Return to Block Diagram TOP](#)

Value provided

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

1 Low voltage operation

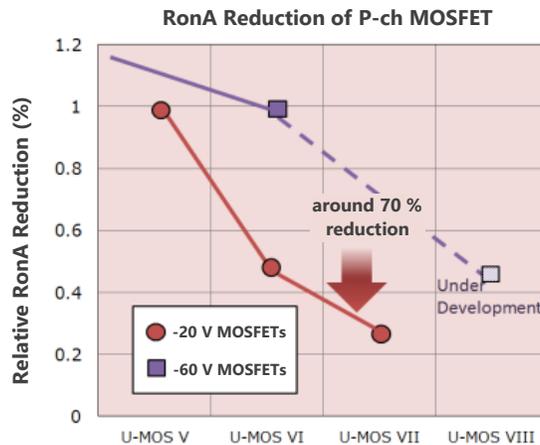
Operates down to $V_{GS} = -4.5$ V.

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	

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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

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.

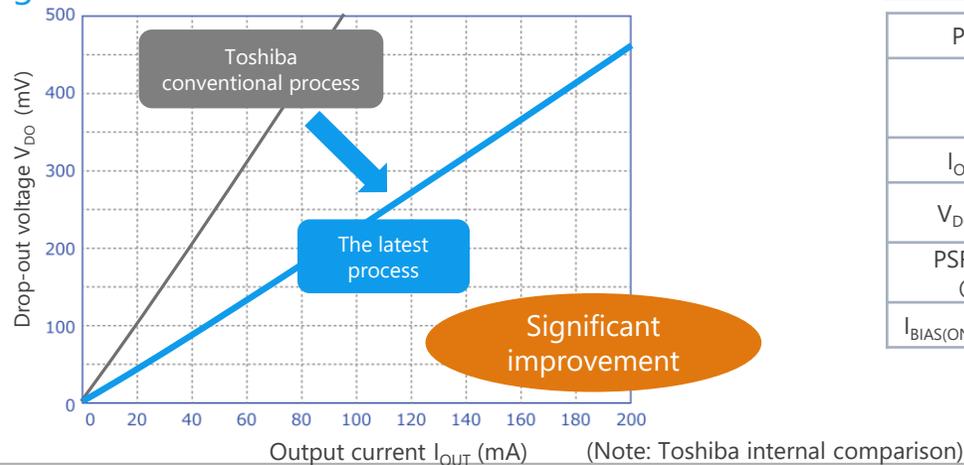
2 Low dropout voltage

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



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.) [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

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.

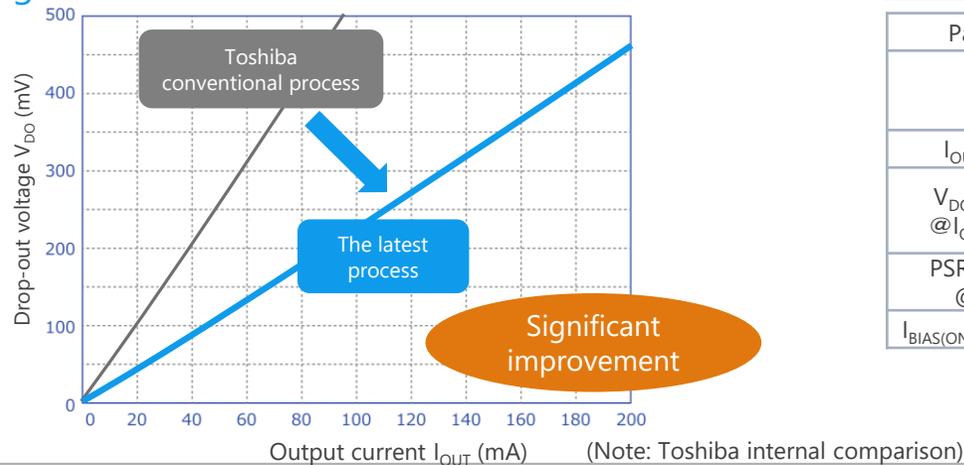
2 Low dropout voltage

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



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.) [μ A]	7	0.34	0.34	65 (TCR3DG18)

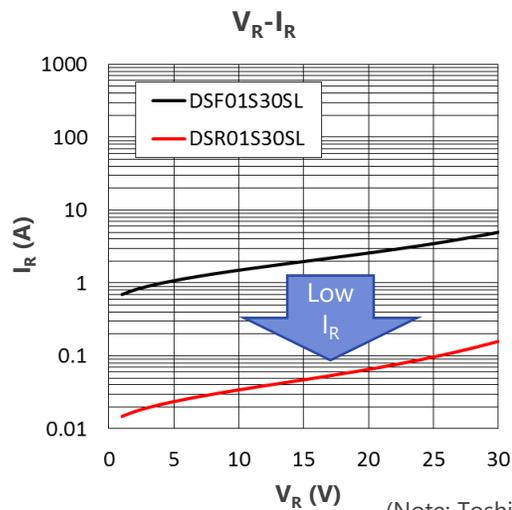
[Return to Block Diagram TOP](#)

Value provided

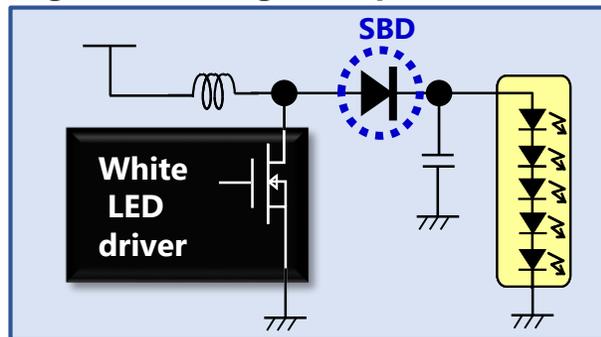
low V_F and low I_R characteristics have been realized and contributes to improved circuit efficiency.

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.



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



(Note: Toshiba internal comparison)

2 Suitable for high density mounting

A variety of small packages are available.

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) [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 IEC 62368-1 certified

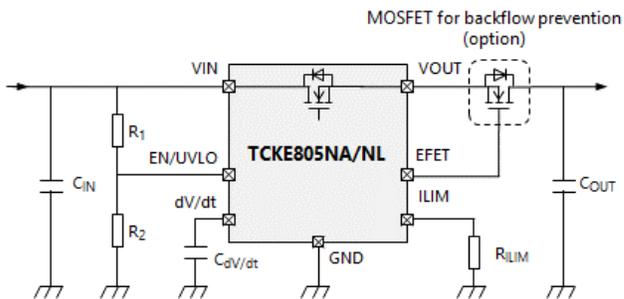
Toshiba's eFuse ICs are certified to the international safety standard IEC 62368-1 (G9: Integrated circuit (IC) current limiters) and contribute to robust protection and simplification of circuit design.

3 Rich protection functions

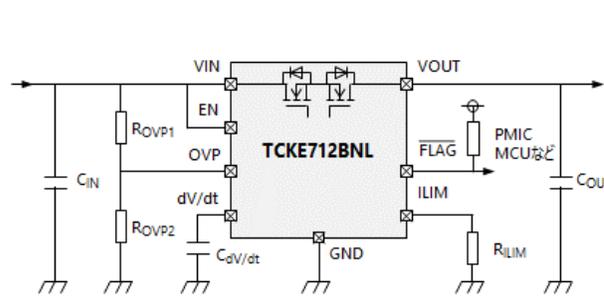
TCKE8 Series: short-circuit protection, overcurrent protection, overcurrent clamp function, overvoltage clamp function, thermal shut down, inrush current suppression, backflow prevention (optional), etc.

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	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	15.1	Adjustable

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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.

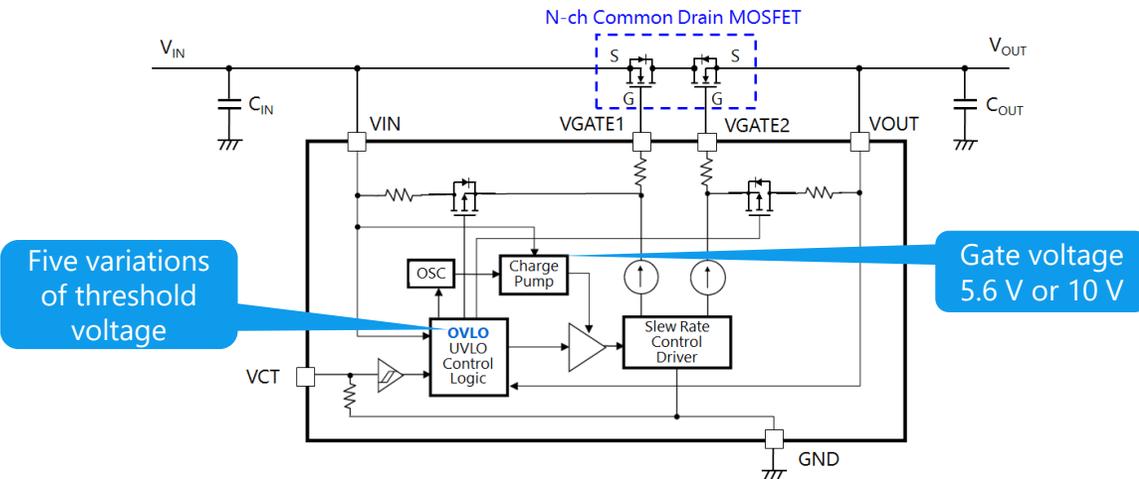
[Note 2] OVLO : Over Voltage Lock Out
 [Note 3] V_{IN_OVLO} : V_{IN} OVLO threshold

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



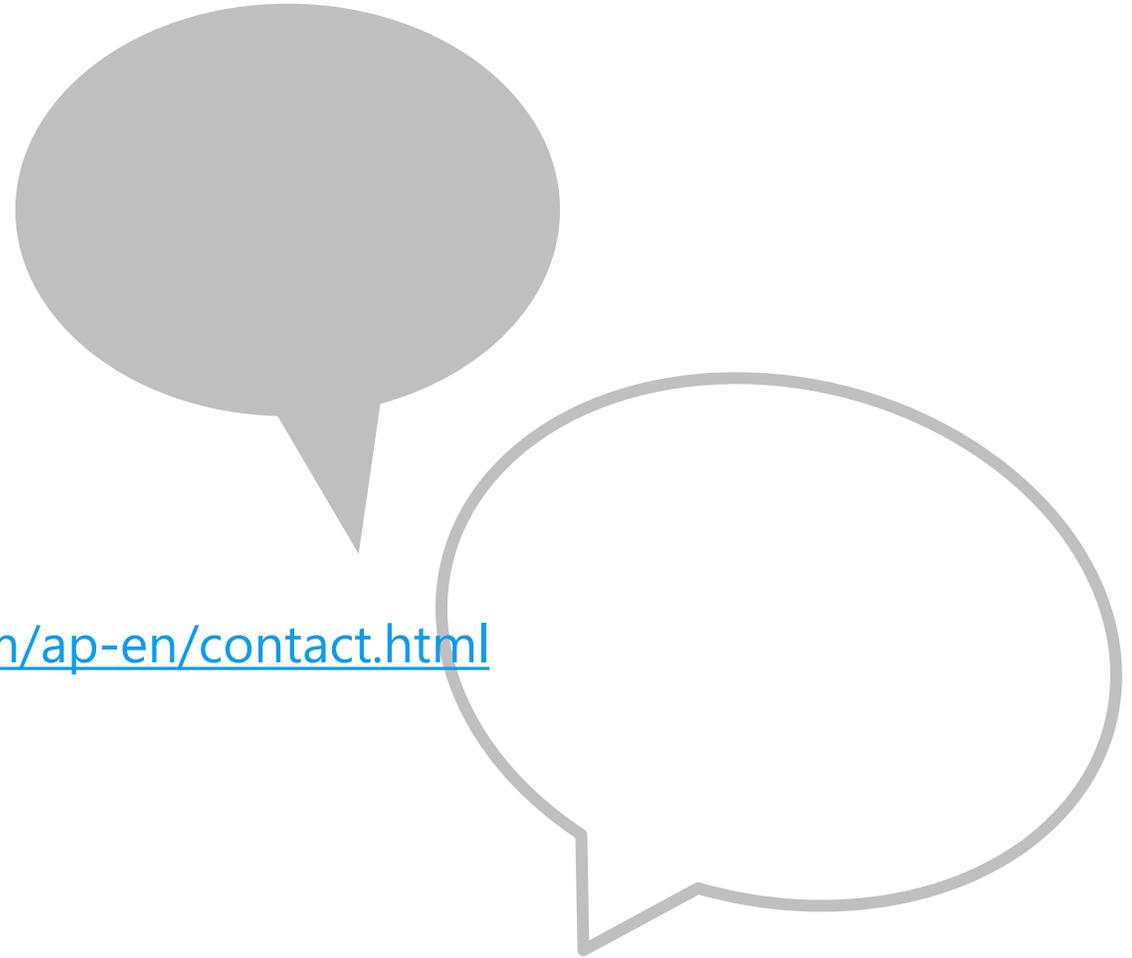
Lineup

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 ($V_{IN} \geq 12$ V)	Single high side	WCSP6E 
TCK402G			Common Source	
TCK420G	26.50 / 28.50	10 / 11 ($V_{IN} \geq 5$ 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			

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