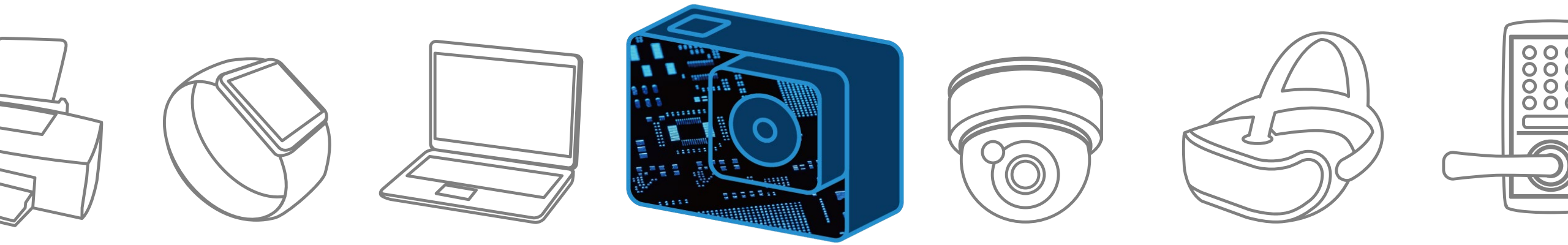
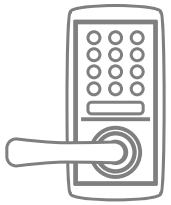
TOSHIBA

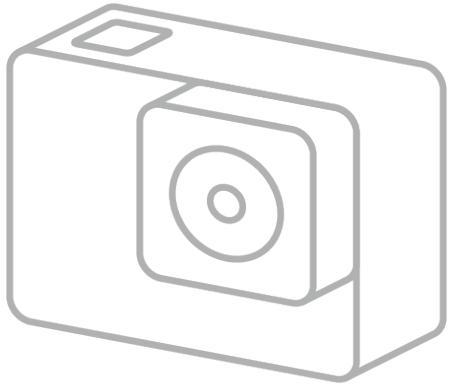
R24

Action Camera

Solution Proposal by Toshiba

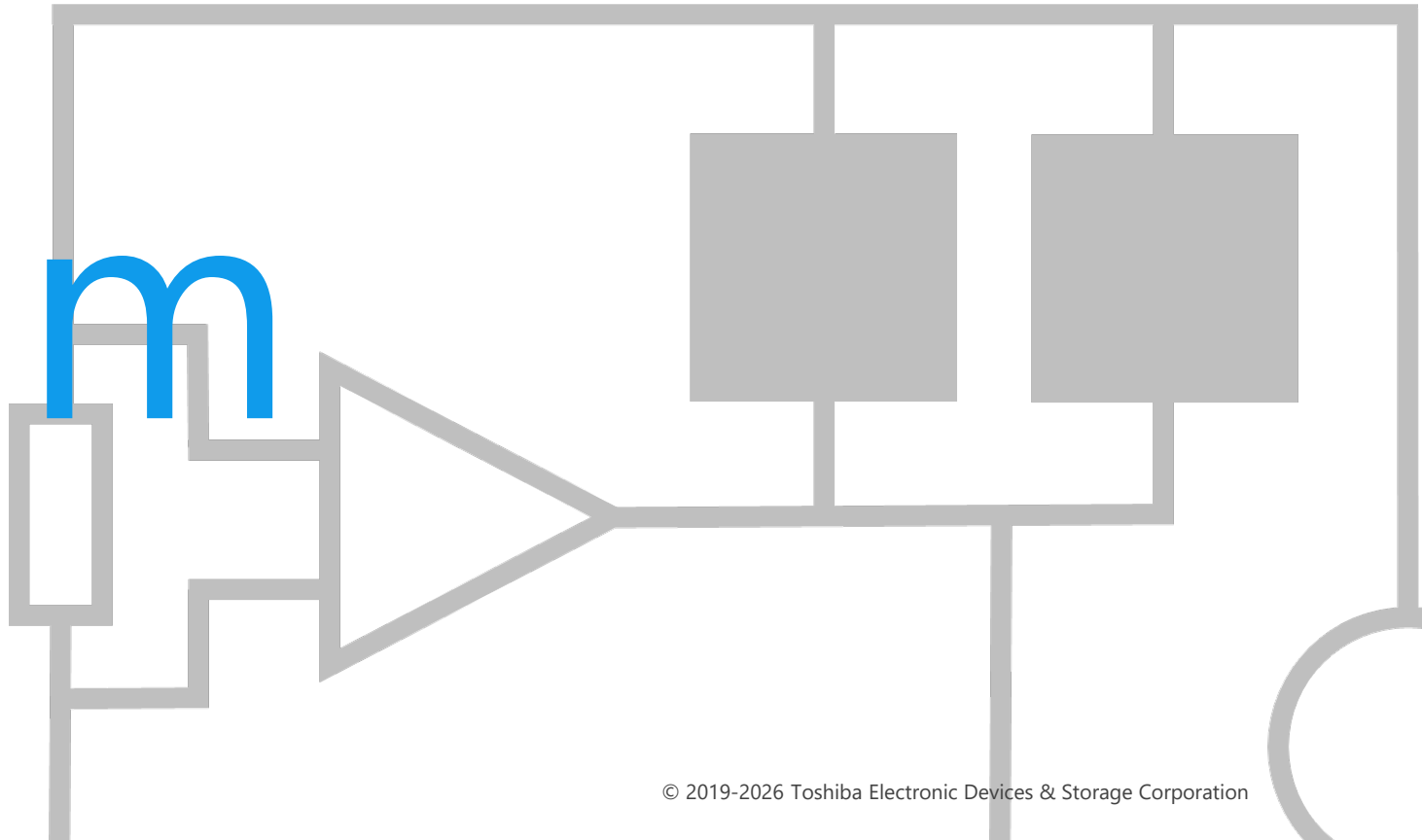




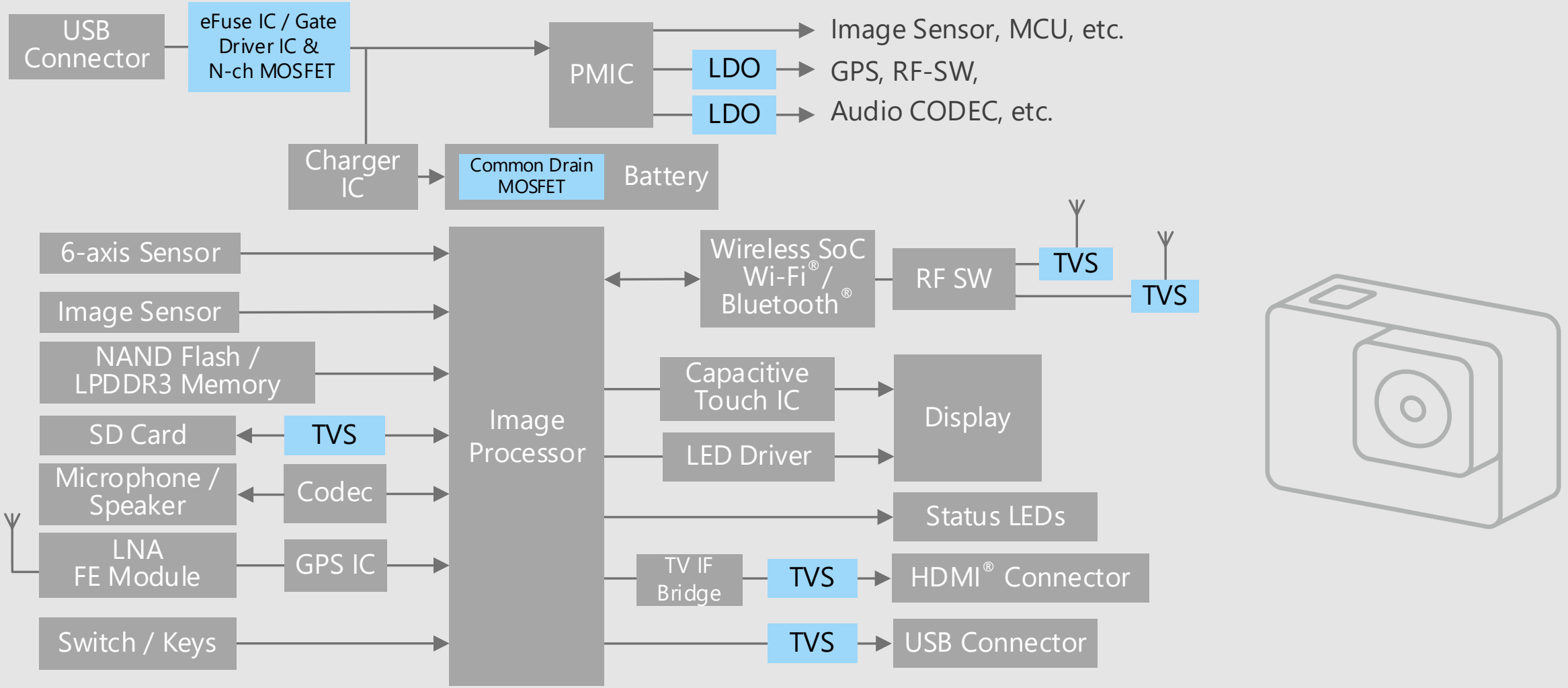


Toshiba Electronic Devices & Storage Corporation provides comprehensive device solutions to customers developing new products by applying its thorough understanding of the systems acquired through the analysis of basic product designs.

Block Diagram

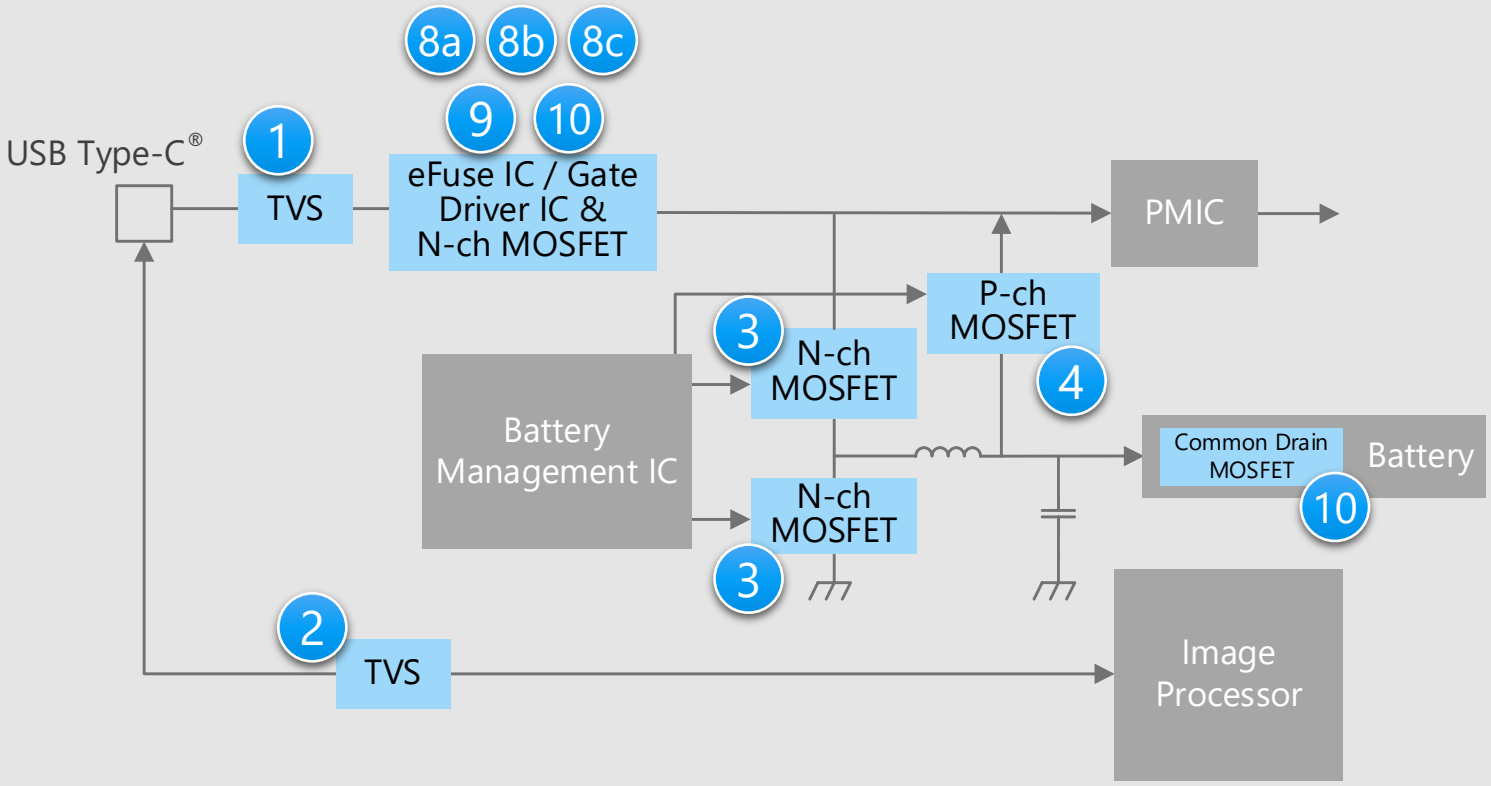


Action Camera　Overall block diagram



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.

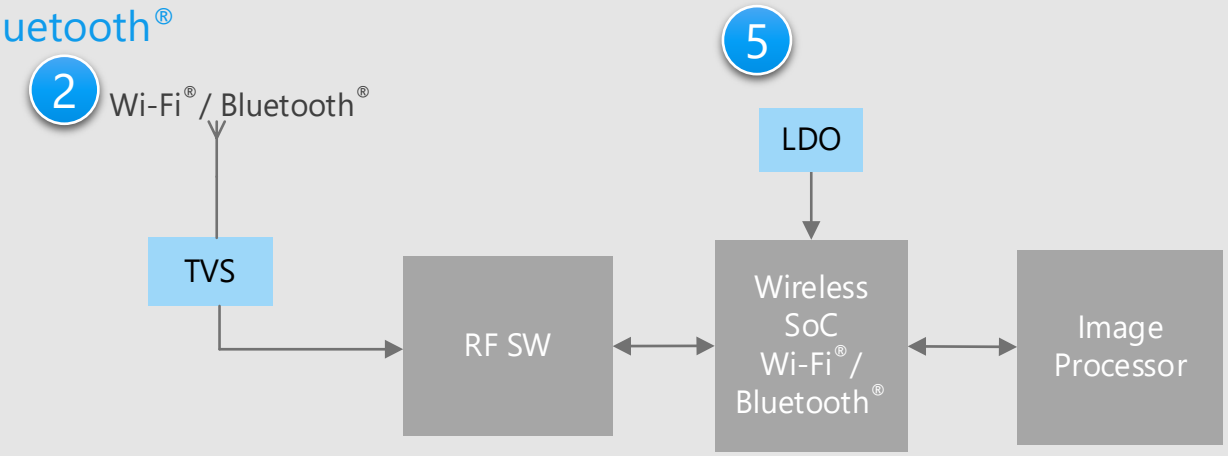
Proposals from Toshiba

- **Small package and high ESD resistance** (1, 2)
  TVS diode
  Low capacitance TVS diode
- **Small package and low on-resistance** (3, 4)
  Small signal MOSFET (N-ch)
  Small signal MOSFET (P-ch)
- **Built-in protection function against short circuit, over current, over voltage, etc.** (8a, 8b, 8c)
  Electronic fuse (eFuse IC)
- **Small package and built-in over voltage protection function** (9)
  N-ch MOSFET gate driver IC
- **Low on-resistance and small package** (10)
  N-ch common drain MOSFET

Action Camera　Detail of RF unit

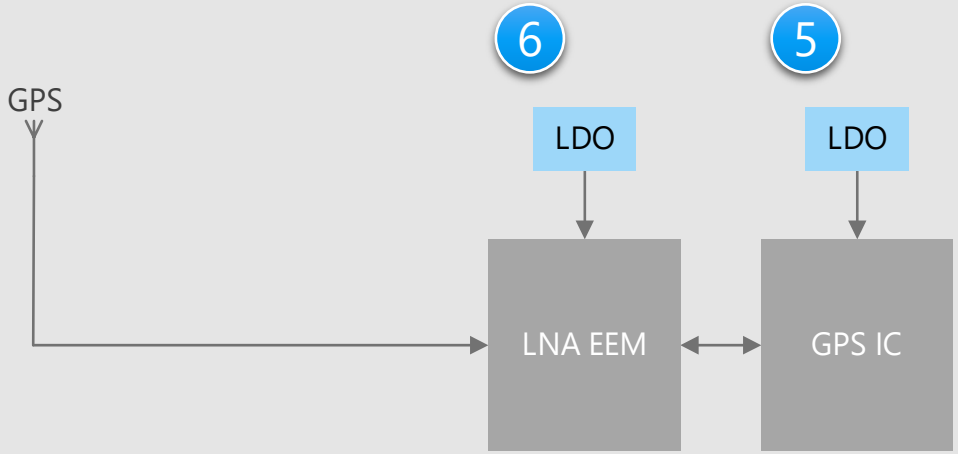
RF unit

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

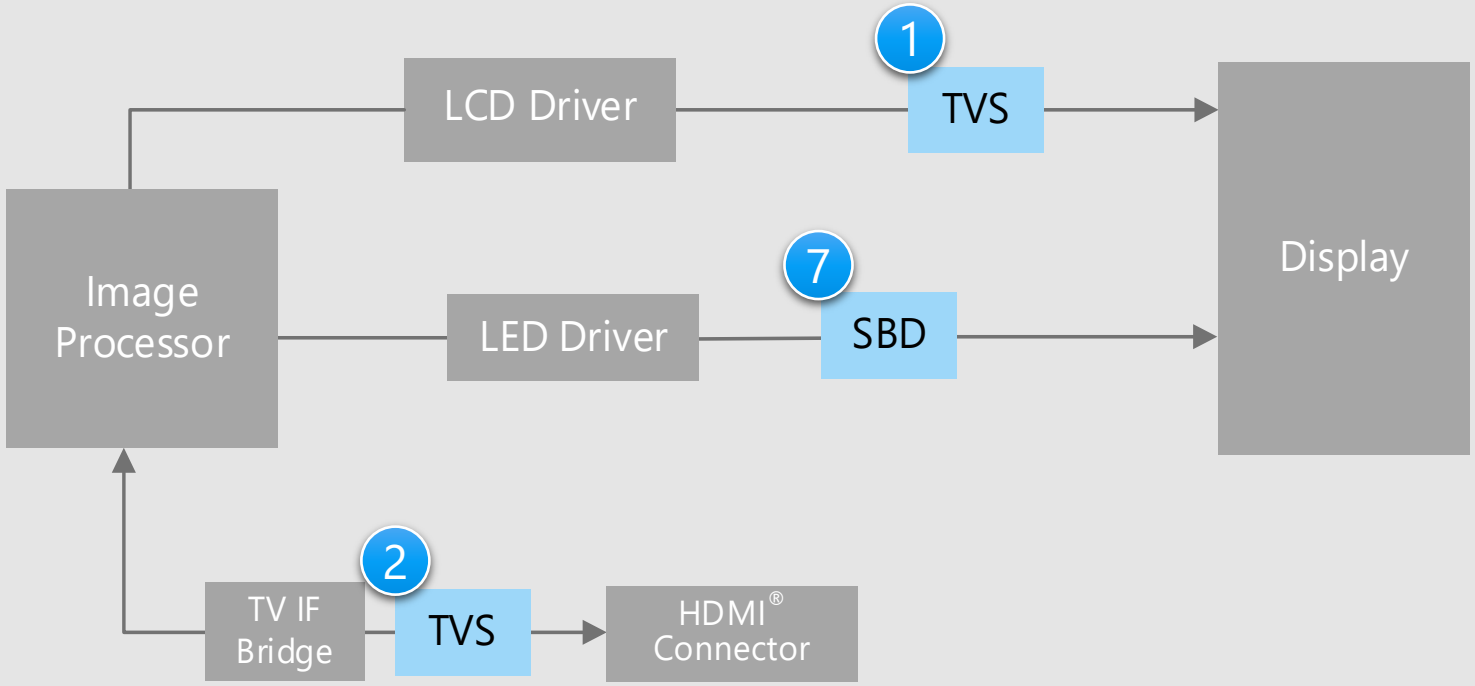
- Lower capacity type TVS diodes are suitable for ESD protection from antennas because they have a small effect on RF signal transmission.
- LDO regulators with low dropout characteristics are suitable for efficient voltage conversion.
- Small package products contribute to the reduction of circuit board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

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

Criteria for device selection

- A Schottky barrier diode with low V_F and low I_R contributes to reducing the power consumption of the set.
- 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.

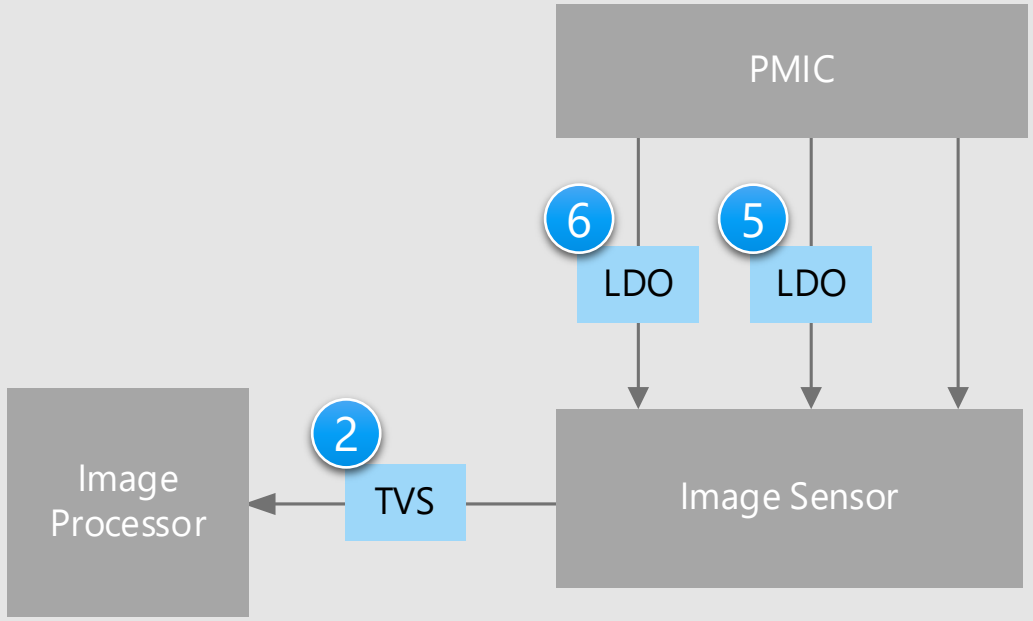
Proposals from Toshiba

- **Small package and high ESD resistance**
  TVS diode
  Low capacitance TVS diode
- **Small package, low V_F and low I_R 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

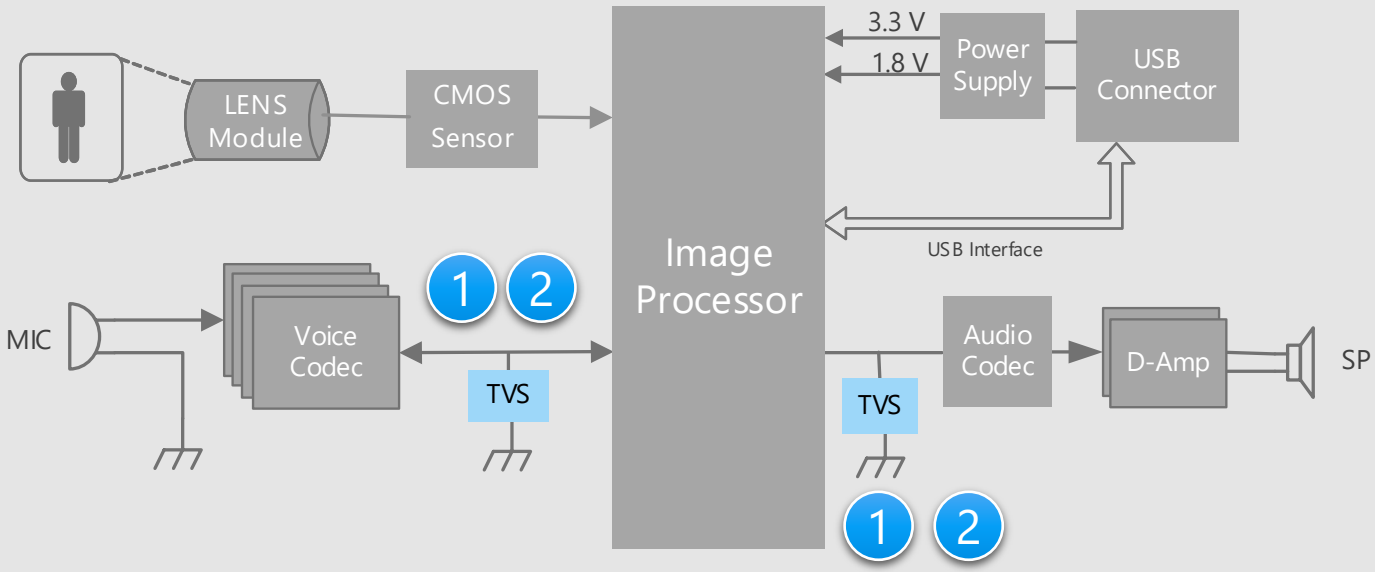
- LDO regulators with low dropout characteristics are suitable for efficient voltage conversion.
- Lower capacity type TVS diodes are suitable for ESD protection in data lines because they have a small effect on high speed signal transmission.
- Small package products contribute to the reduction of circuit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

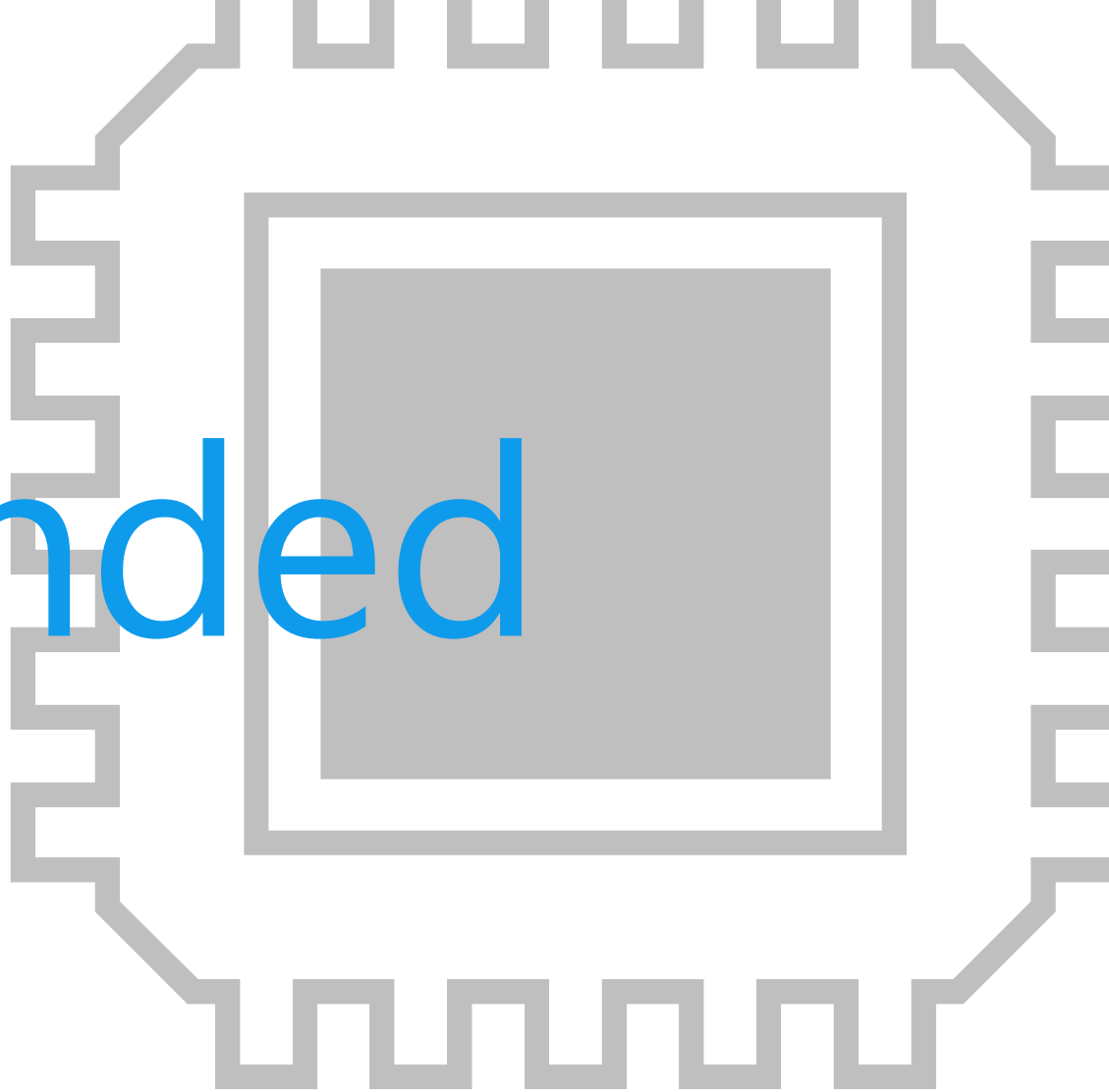
- Lower capacity type TVS diodes are suitable for ESD protection in data lines because they have a small effect on high speed signal transmission.

Proposals from Toshiba

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

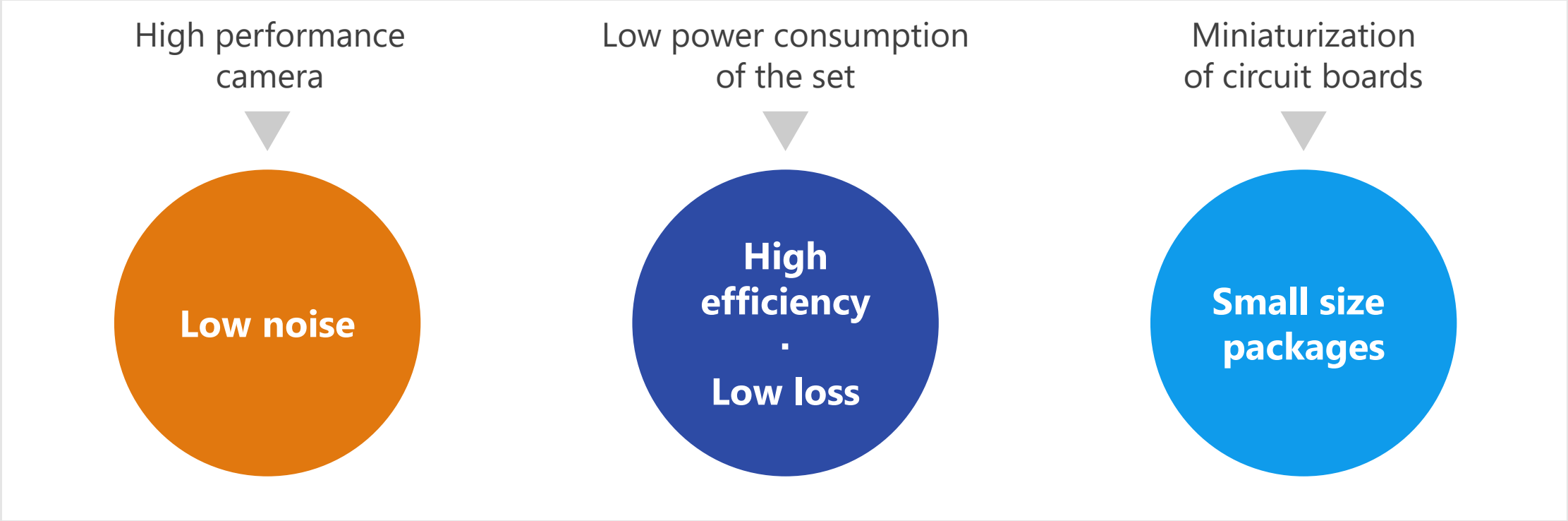
1
2

Recommended Devices

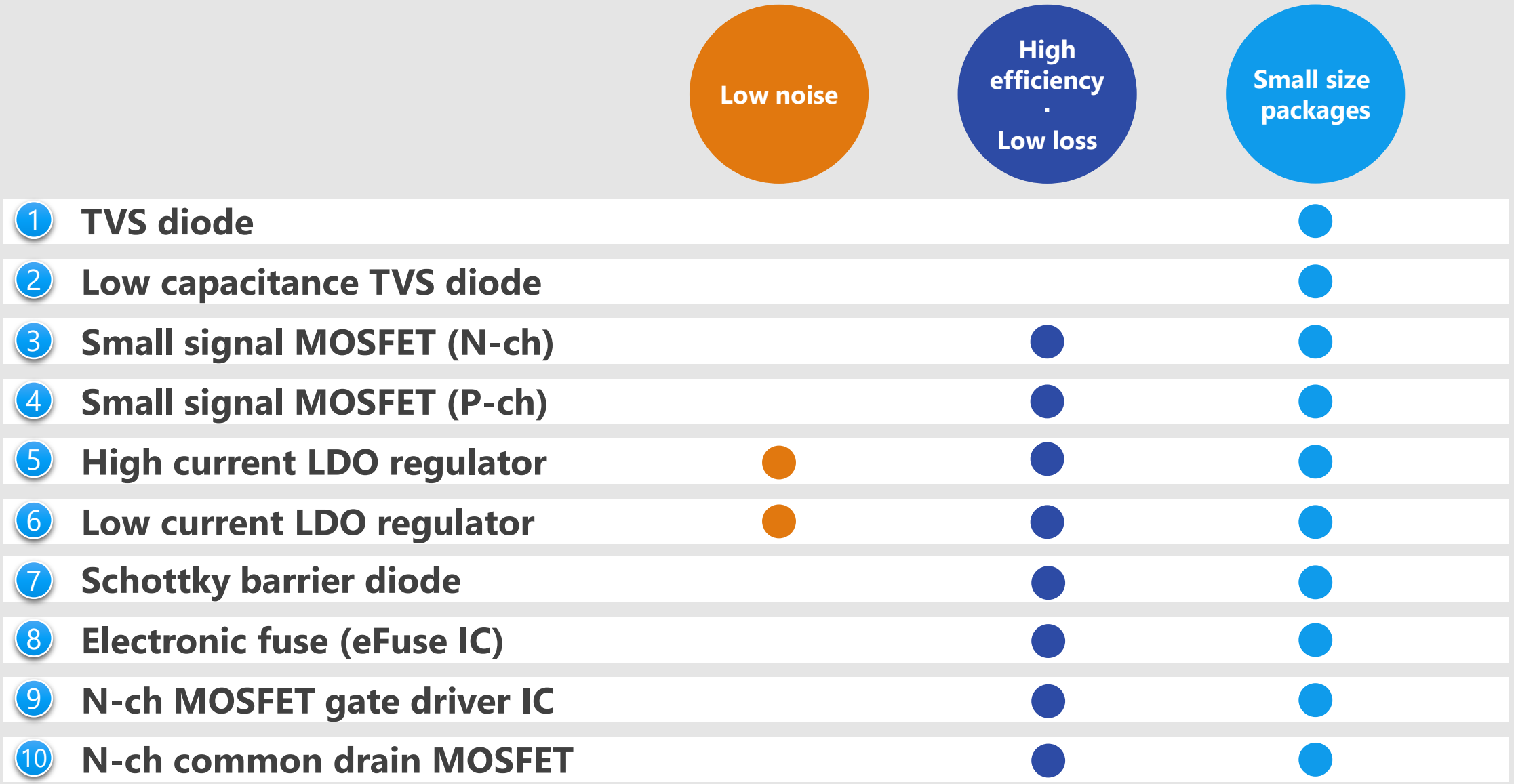


Device solutions to address customer needs

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

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

Value provided

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

1 High ESD pulse absorption performance

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 ensures high signal protection performance and signal quality.

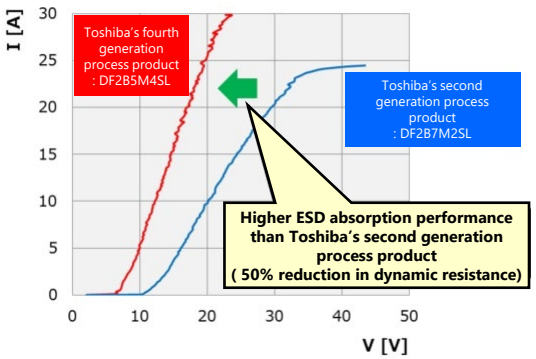
2 Suppress ESD energy by low clamp voltage

Protect the connected circuits and devices using Toshiba own technology.

3 Suitable for high density mounting

A variety of small size packages are available.

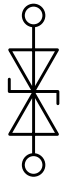
ESD Pulse Absorption Performance
(Toshiba internal comparison)



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
Package	SL2  Top view  Bottom view
V_{ESD} [kV]	±30
V_{RWM} (Max) [V]	5.5
C_t (Typ.) [pF]	12
R_{DYN} (Typ.) [Ω]	0.2

(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 Toshiba's existing 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.

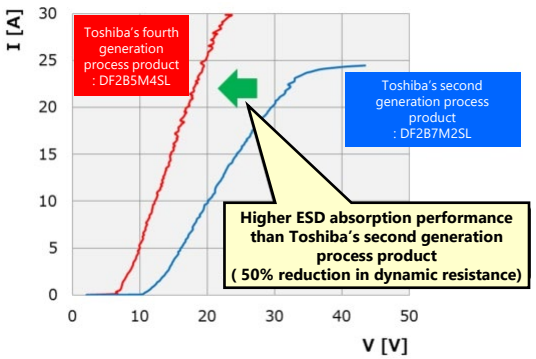
2 Suppress ESD energy by low clamp voltage

Protect the connected circuits and devices using Toshiba own technology.

3 Suitable for high density mounting

A variety of small size packages are available.

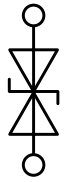
ESD Pulse Absorption Performance
(Toshiba internal comparison)



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	 Top view	 Bottom view	
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 driving voltage

Operates down to V_{GS} = 4.5 V.

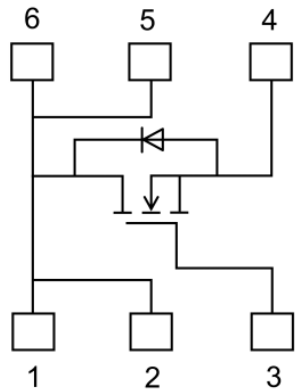
2 Low on-resistance

The drain-source on-resistance is low, as a result heat generation and power consumption can be kept low.

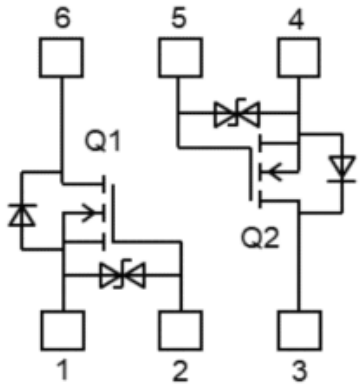
3 Small size package

Sealed in SOT-1220 (2.0 x 2.0 mm), SOT-1118 (2.0 x 2.0 mm) small size package.

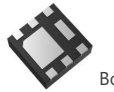
Internal circuit of SSM6K513NU



Internal circuit of SSM6N55NU



Lineup

Part number		SSM6K513NU	SSM6N55NU
Package		UDFN6B (SOT-1220)  Bottom view	UDFN6 (SOT-1118)  Bottom view
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 driving voltage

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

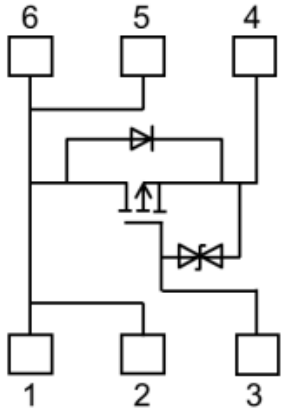
2 Low on-resistance

The drain-source on-resistance is low, as a result heat generation and power consumption can be kept low.

3 Small size package

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

Internal circuit of SSM6J507NU



Lineup

Part number		SSM6J507NU
Package		UDFN6B (SOT-1220)  Top view  Bottom view
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.

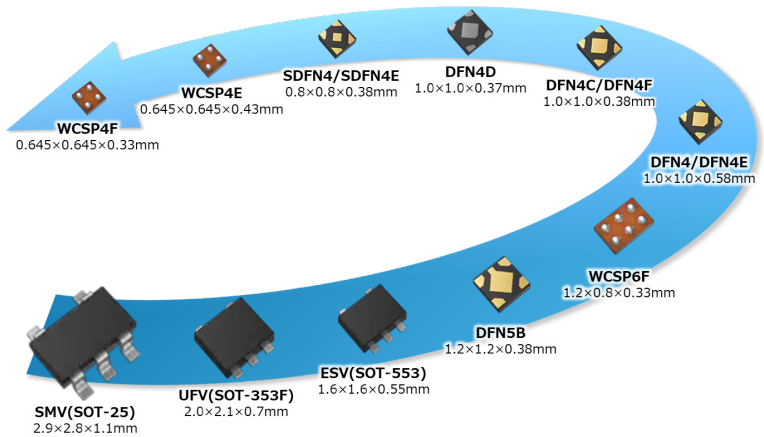
2 Low dropout voltage

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

3 Suitable for high density mounting

A variety of small size packages are available.

Rich package lineup



Lineup

Part number	TCR15AG Series	TCR5BM Series	TCR5RG Series
Package	WCSP6F  Bottom view	DFN5B  Bottom view	WCSP4F  Bottom view
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.

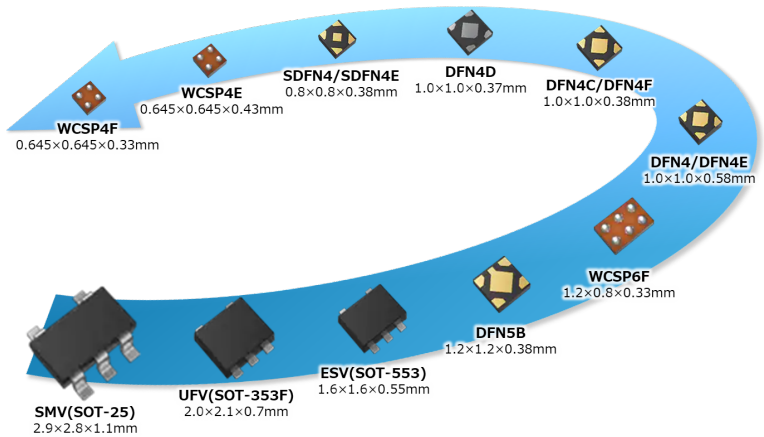
2 Low dropout voltage

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

3 Suitable for high density mounting

A variety of small size packages are available.

Rich package lineup



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

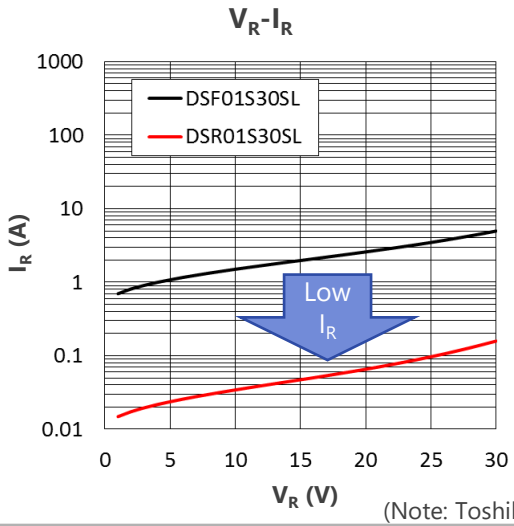
low V_F and low I_R characteristics have been realized and contributes to improved circuit efficiency.

1 Low V_F and low I_R

Low V_F and low I_R characteristics compared to Toshiba's existing products have been realized.
When used in rectification applications, the circuit efficiency can be further improved.

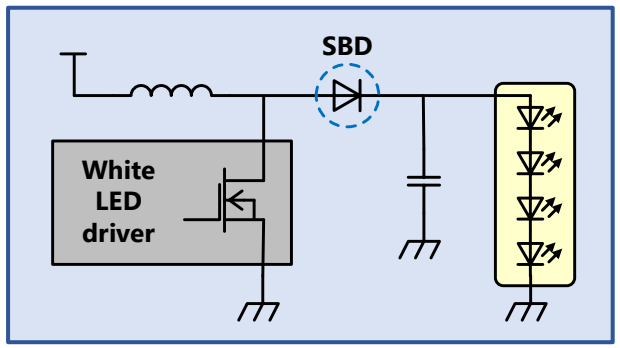
2 Suitable for high density mounting

A variety of small size packages are available.



(Note: Toshiba internal comparison)

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



Lineup

Part number	DSR01S30SL	CLS10F40
Package	SL2  Top view  Bottom view	CL2E  Top view  Bottom view
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

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

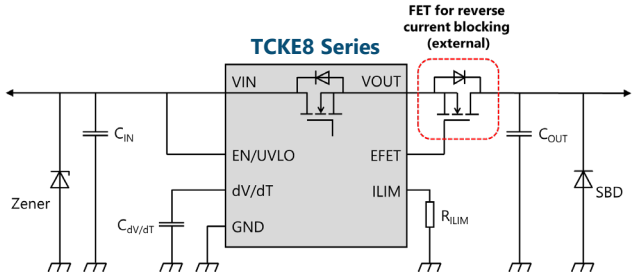
Toshiba's eFuse ICs are certified to the international safety standard IEC 62368-1 (G9: Integrated circuit (IC) current limiters) and contribute to robust protection and simplification of circuit design.

3 Rich protection functions

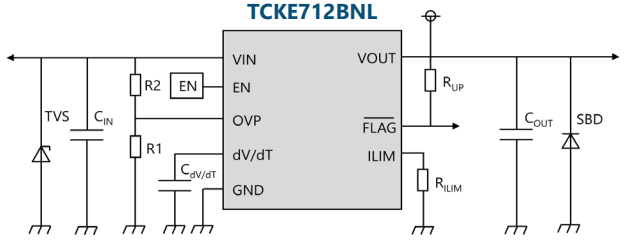
TCKE8 Series: short-circuit protection, overcurrent protection, overcurrent clamp function, overvoltage clamp function, thermal shutdown, inrush current suppression, backflow prevention (optional), etc.

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

Example of peripheral circuit for TCKE8 Series



Example of peripheral circuit for TCKE7 Series



Lineup

Part number	TCKE800NA/NL	TCKE805NA/NL	TCKE812NA/NL	TCKE712BNL
Package	WSON10B 3.0 x 3.0 x 0.75 mm  Top view  Bottom view			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
Fault response	NA: Auto-retry NL: Latched (external signal control)			Latched (external signal control)
V_{OVC} (Typ.) [V]	-	6.04	15.1	Adjustable

◆Return to Block Diagram TOP

8b Electronic fuse (eFuse IC)

TCKE9 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 Product selection is possible according to usage

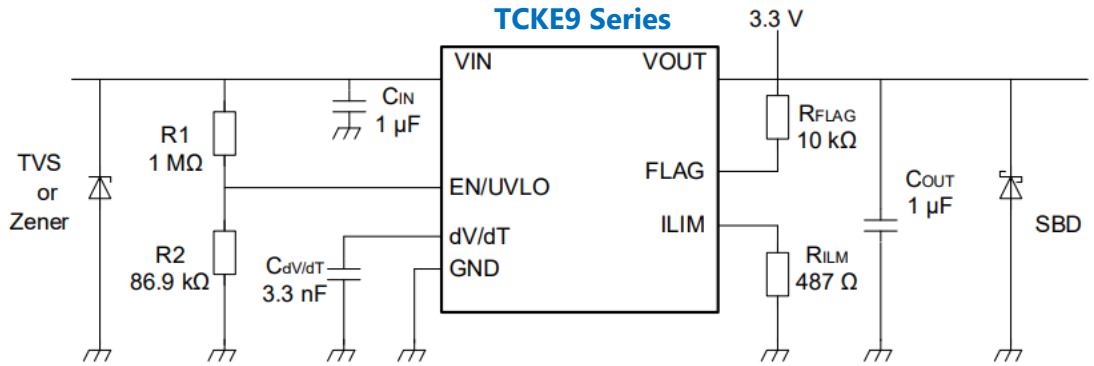
Suitable product with suitable failure response can be selected according to usage.

NA: Auto-retry type
QNA: Auto-retry with quick output discharge type
NL: Latched type

3 Rich protection functions

TCKE9 Series feature many protection functions such as adjustable over current limit, short circuit protection, over voltage clamp, adjustable slew rate control, adjustable under voltage Protection, and thermal shutdown.

Example of peripheral circuit for TCKE9 Series



Lineup

Part number	TCKE903NA/NL/QNA	TCKE905ANA/NL/QNA	TCKE912NA/NL	TCKE920NA/NL
Package	WSON8 2.0 x 2.0 x 0.75 mm	 Top view	 Bottom view	
V_{IN} [V]	2.7 to 23			
R_{ON} (Typ.) [mΩ]	34			
Fault response	NA: Auto-retry (QNA: with quick output discharge), NL: Latched			
V_{OVC} (Typ.) [V]	3.87	5.7	13.7	22.2

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Electronic fuse (eFuse IC)

TCKE6 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 Product selection is possible according to usage

Suitable product can be selected according to usage.

FLAG function: TCKE601RA/RL

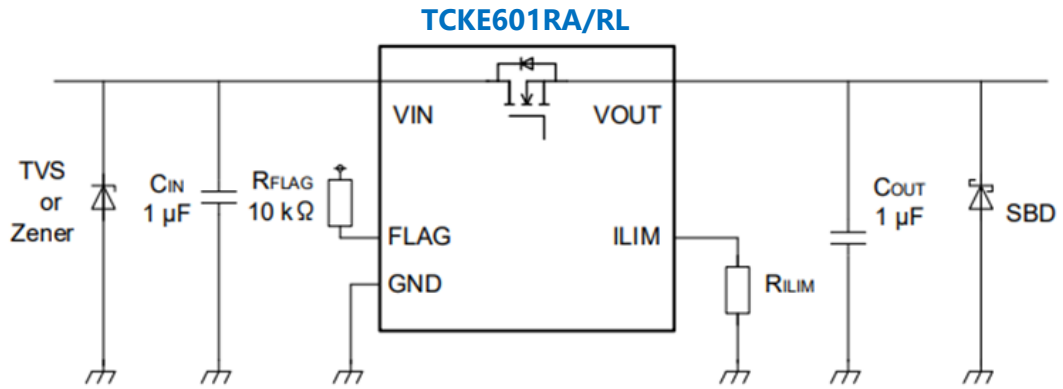
MODE function (selectable recovery mode): TCKE602

EN (enable) function: TCKE603RA/RL

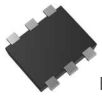
3 Rich protection functions

TCKE6 Series feature many protection functions such as adjustable over current limit, short circuit protection, under voltage protection, and thermal shutdown.

Example of peripheral circuit for TCKE601RA/RL



Lineup

Part number	TCKE601RA	TCKE601RL	TCKE602RM	TCKE603RA	TCKE603RL
Package	TSOP6F  Top view  Bottom view				
V_{IN} [V]	4.4 to 30				
R_{ON} (Typ.) [mΩ]	52				
Function	FLAG		MODE	EN	
Fault response	Auto-retry	Latched	Selectable type	Auto-retry	Latched

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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.

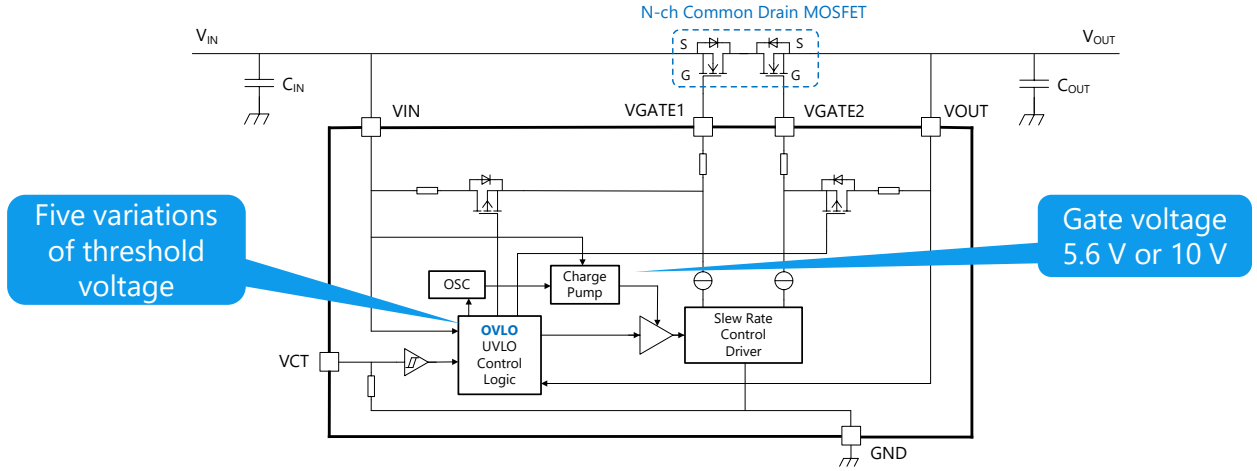
[Note 2] OVLO: Over Voltage Lock Out
[Note 3] V_{IN_OVLO}: V_{IN} OVLO threshold

3 Small size 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			

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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 process.
This contributes to suppression of heat generation.

2 Small and thin package

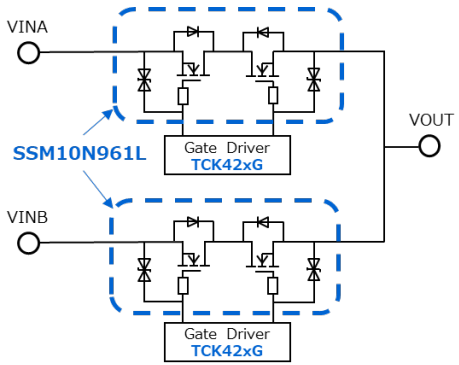
While in a dual configuration, it is a small and thin chipLGA package products.
This contributes to miniaturization of set.

3 Low gate-source leakage current

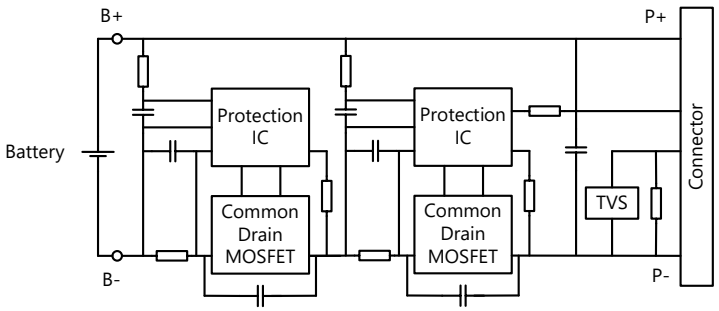
Low gate-source leakage current characteristics enable low standby power and contribute to long term operation of battery used sets.

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

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