TOSHIBA

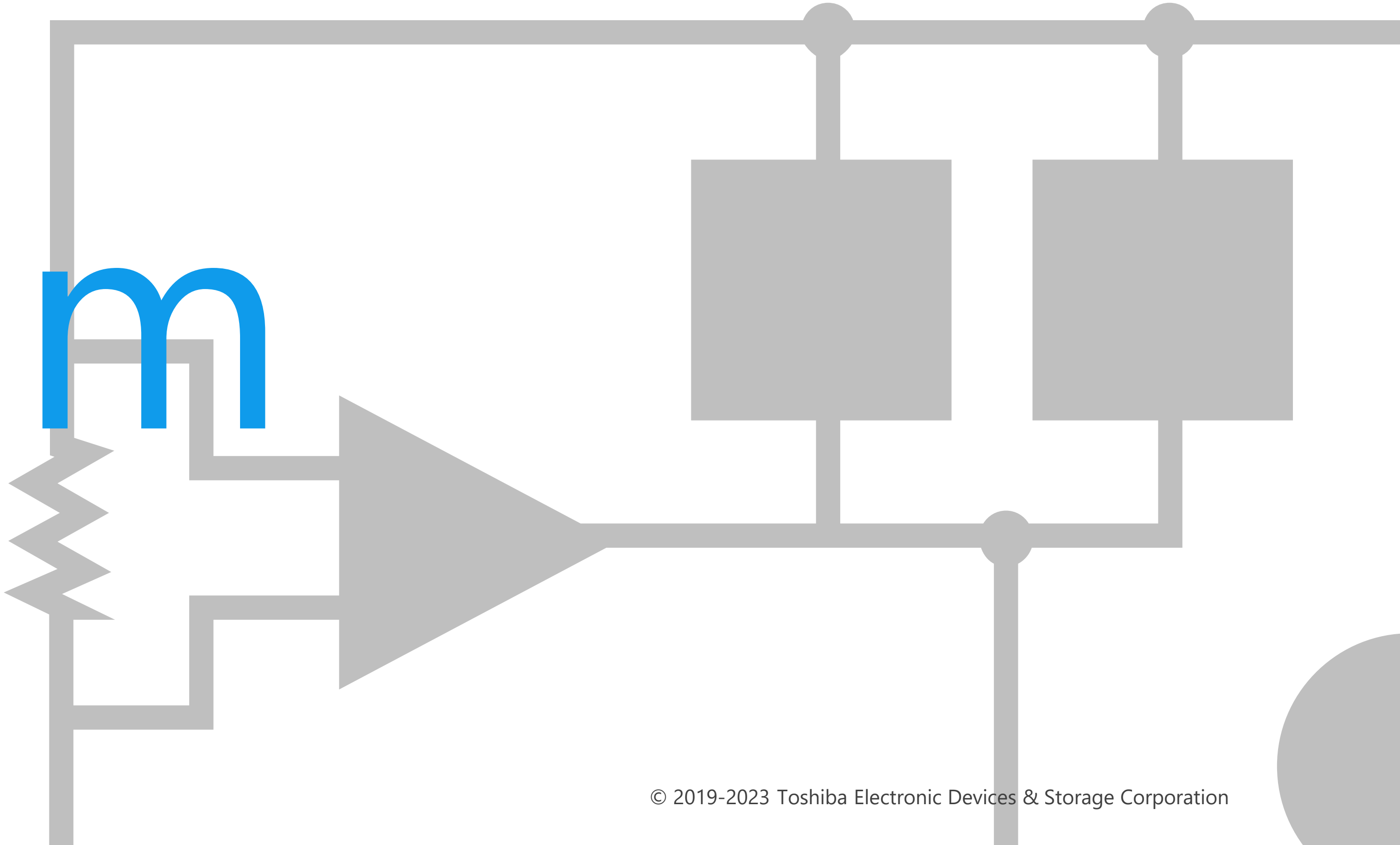
R21.1

Wireless Earbuds

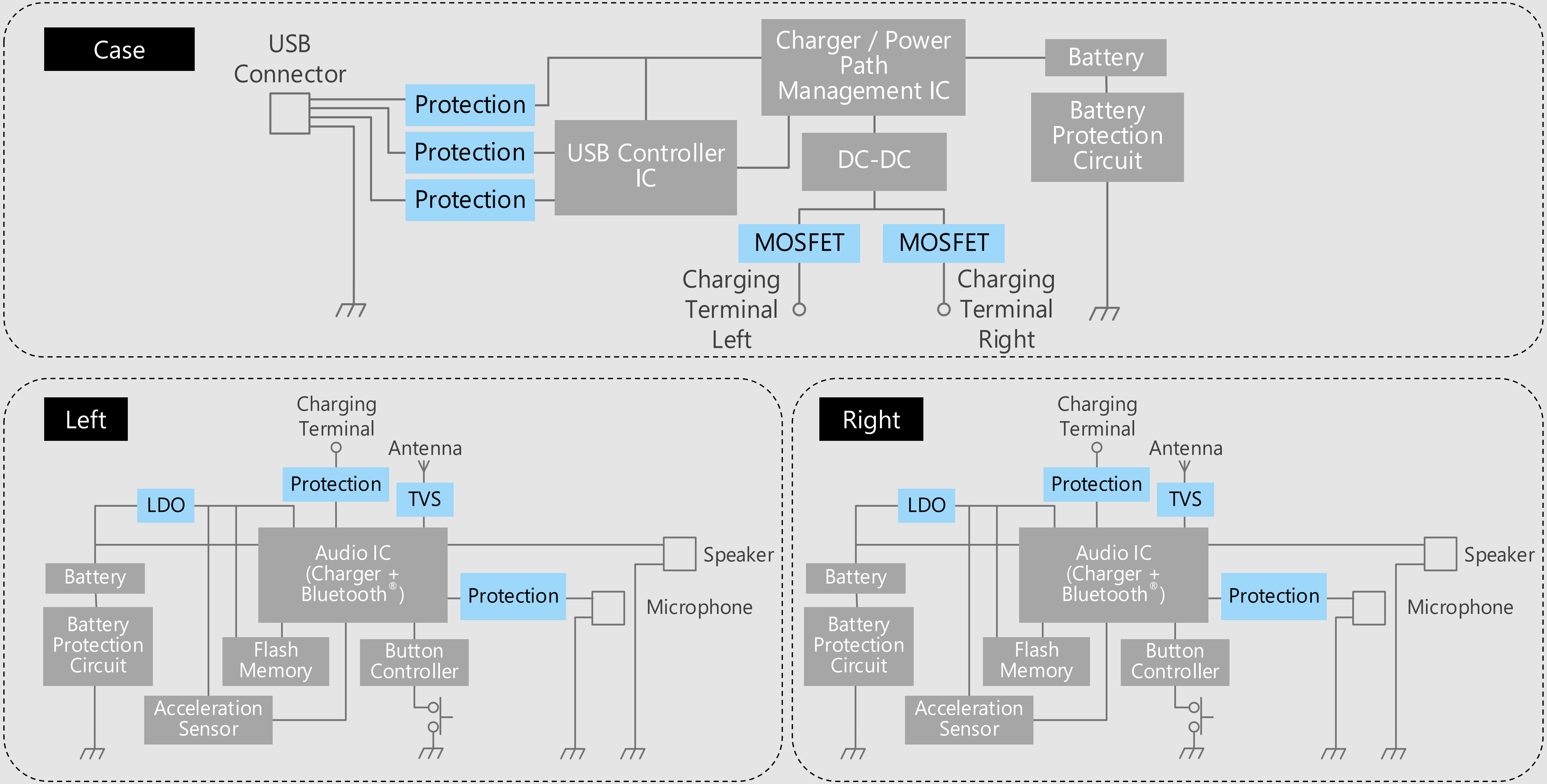
Solution Proposal by Toshiba

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



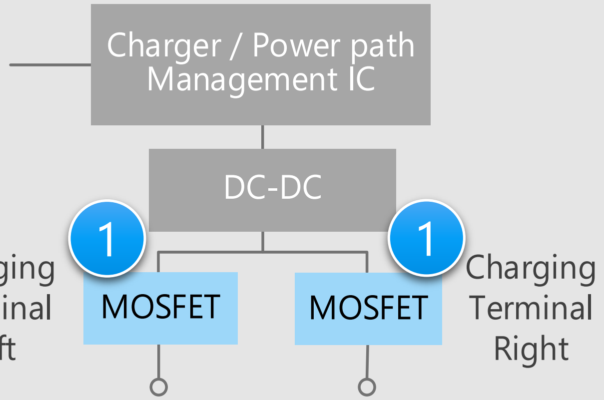
Wireless Earbuds　Overall block diagram



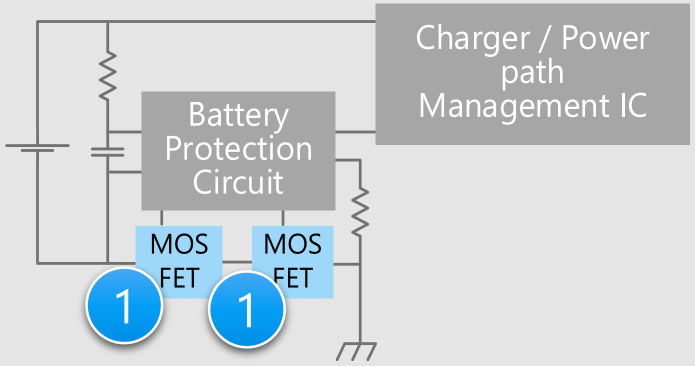
Wireless Earbuds　Detail of earbuds case

Power supply lines

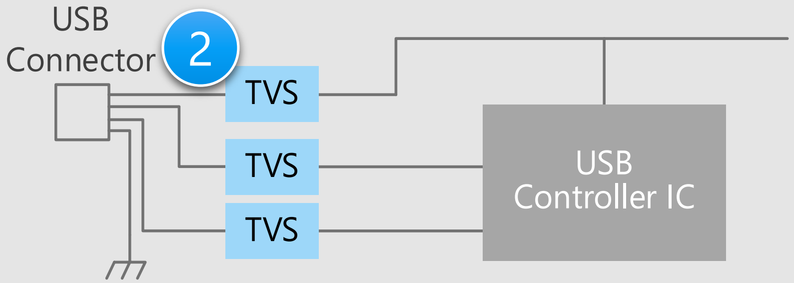
Load switch



Battery management



External connector



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

Criteria for device selection

- MOSFET that can be driven at low voltage and prepared low on-resistance is suitable for load switch.
- Small package products contribute to the reduction of circuit board area.
- A compact TVS diode is suitable for ESD protection.

Proposals from Toshiba

- **Realize a set with low power consumption by low on-resistance**

  Small signal MOSFET 1
- **TVS diode that prepared compact size and rich lineup of capacitance**

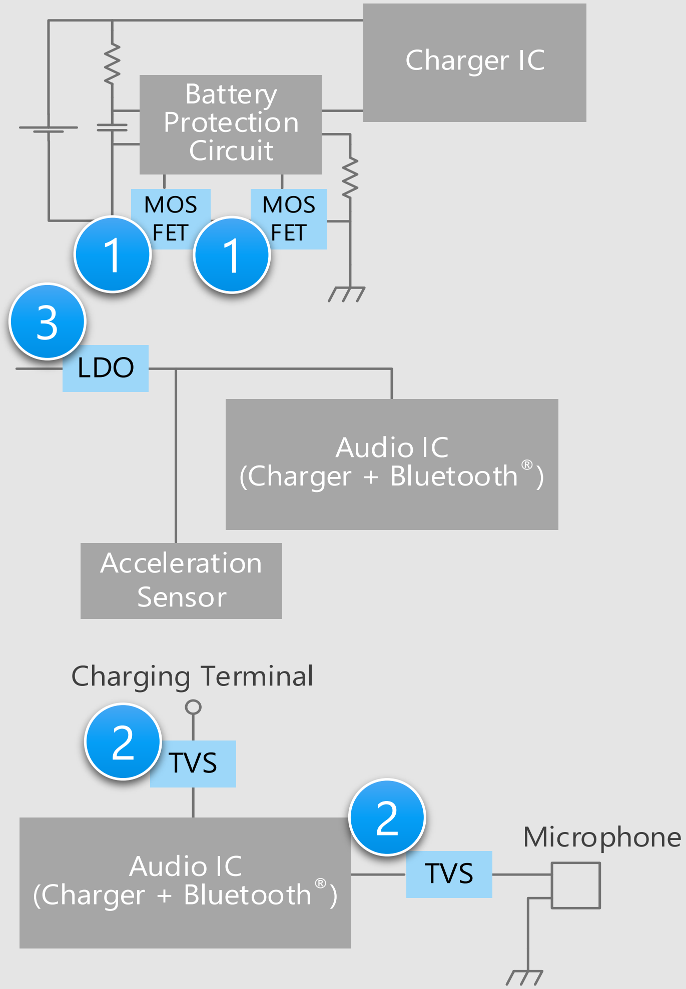
  TVS diode 2

Wireless Earbuds　Detail of earbuds

Battery management

Power supply circuit

Circuit protection



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

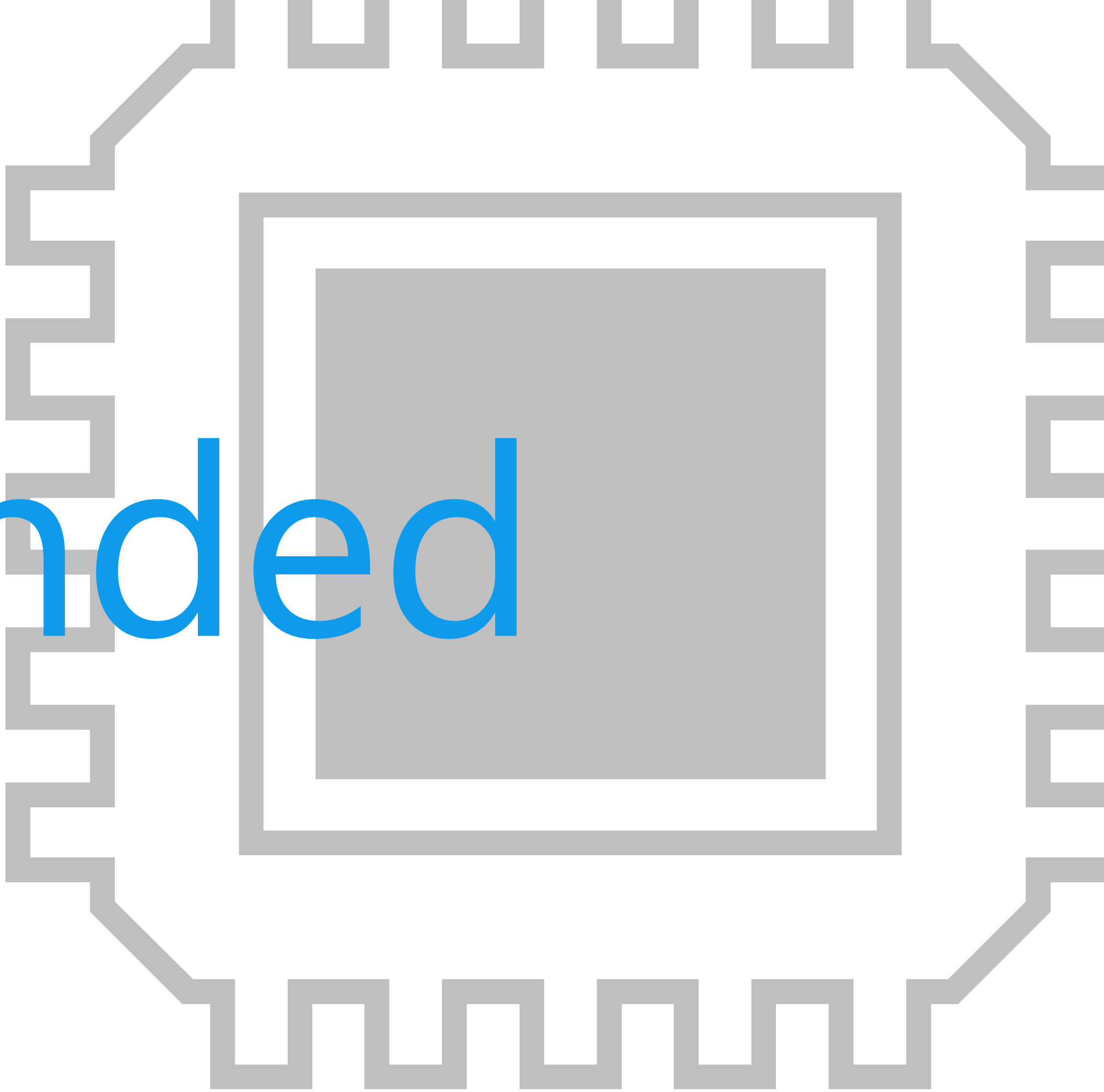
Criteria for device selection

- Small package products contribute to the reduction of circuit board area.
- MOSFET that can be driven at low voltage and prepared low on-resistance is suitable for battery management.
- PSRR (Power Supply Rejection Ratio) of LDO regulator is an important parameter for wireless system.
- A compact TVS diode is suitable for ESD protection.

Proposals from Toshiba

- **Realize a set with low power consumption by low voltage drive and low on-resistance**
  Small signal MOSFET ①
- **TVS diode that prepared compact size and rich lineup of capacitance**
  TVS diode ②
- **Provide small and low noise power supply**
  Small surface mount LDO regulator ③

Recommended Devices



Device solutions to address customer needs

As described above, in the design of wireless earbuds, **“Miniaturization of circuit boards”**, **“Low power consumption of set”** and **“High reliability”** are important factors. Toshiba’s proposals are based on these three solution perspectives.

Miniaturization of circuit boards

▼

Small size packages

Low power consumption of set

▼

High efficiency
·
Low loss

High reliability

▼

Protection from Surge/ESD

Device solutions to address customer needs

	Small size packages	High efficiency · Low loss	Protection from Surge/ESD
① **Small signal MOSFET**	●	●	
② **TVS diode**	●		●
③ **Small surface mount LDO regulator**	●	●	

1 Small signal MOSFET

SSM6N951L / SSM6N56FE / SSM6N61NU / SSM3K56ACT

Small size packages

High efficiency · Low loss

Protection from Surge/ESD

Value provided

Contribute to miniaturization and low power consumption of the set by low on-resistance and 2in1 package.

1 Low on-resistance

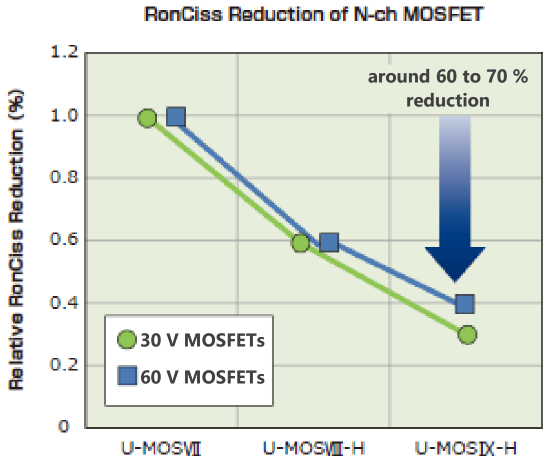
Heat dissipation and power consumption can be reduced by low drain-source on-resistance.

2 Low voltage drive

Power consumption of the set can be reduced by low voltage drive.

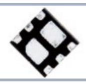
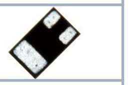
3 Small size package

Various packages, including ES6 packages (2in1), are available.



(Note: Toshiba internal comparison)

Lineup

Part number		SSM6N951L	SSM6N56FE	SSM6N61NU	SSM3K56ACT
Package		TCSP6A -172101 	ES6 	UDFN6 	CST3 
Polarity		N-ch x 2 (Drain Common)	N-ch x 2	N-ch x 2	N-ch
$V_{DSS,}$ / V_{SSS} [V]		12	20	20	20
I_D / I_S [A]		8	0.8	4	1.4
$R_{DS(ON)}$ / $R_{SS(ON)}$ [mΩ] @V_{GS} = 2.5 V	Typ.	5.5	230	31	230
	Max	10	300	45	300

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2 TVS diode

DF2B6USL / DF2B6M4BSL / DF2B7BSL

Small size packages

High efficiency · Low loss

Protection from Surge/ESD

Value provided

Absorbs static electricity (ESD) 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

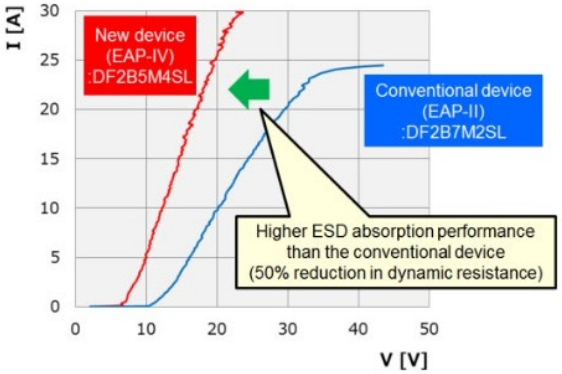
Protect the connected circuits/devices using Toshiba own technology.

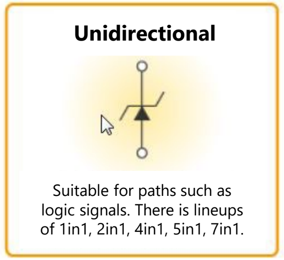
3 Suitable for high density mounting

Another below table, a variety of compact packages are available.

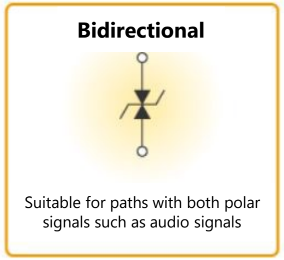
ESD Pulse Absorption Performance

(NOTE: Toshiba internal comparison)





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



Suitable for paths with both polar signals such as audio signals

Lineup

Part number	DF2B6USL	DF2B6M4BSL	DF2B7BSL
Package	SL2 		
V_{ESD} [kV]	±10	±8	±30
V_{RWM} (Max) [V]	5.5	5.5	5.5
C_t (Typ.) [pF]	1.5	0.12	12
R_{DYN} (Typ.) [Ω]	0.25	1.05	0.2
Purpose	For signal lines	For signal lines	For signal / power supply lines

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

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3 Small surface mount LDO regulator

TCR5BM Series / TCR5RG Series / TCR3UG Series / TCR2EN Series

Small size packages

High efficiency · Low loss

Protection from Surge/ESD

Value provided

LDO regulator capable of low power and long life operation with low output voltage fluctuation by eliminating switching noise.

1 High PSRR

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

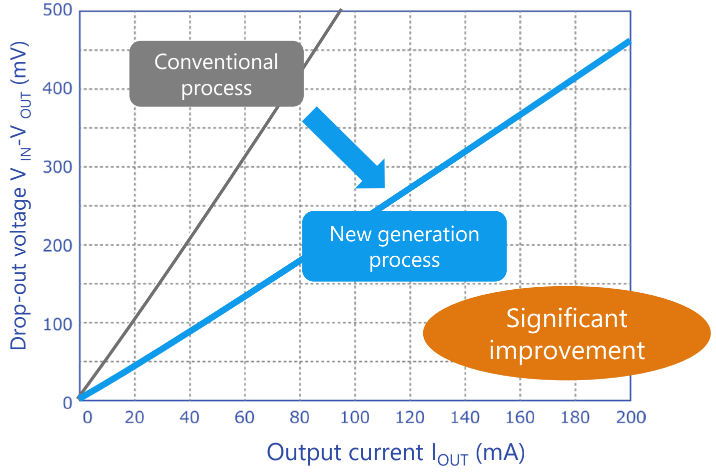
2 Low loss (low dropout)

Toshiba's LDO regulator has low loss characteristic and contributes to the suppression of heat generated in the circuit.

3 Suitable for high density mounting

Various packages are available.

Example of dropout voltage characteristic



(Note: Toshiba internal comparison)

Lineup

Part number	TCR5BM Series	TCR5RG Series	TCR3UG Series	TCR2EN Series
Package	DFN5B 	WCSP4F 		SDFN4 
I_{OUT} (Max) [A]	0.5	0.5	0.3	0.2
V_{DO} (Typ.) [mV]	100 @I_{OUT} = 500 mA	150 @I_{OUT} = 500 mA	140 @I_{OUT} = 300 mA	160 @I_{OUT} = 150 mA
PSRR (Typ.) [dB] @f=1 kHz	98	100	70	73
I_B (Typ.) [μA]	19	7	0.34	35

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