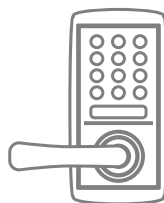


Wireless Earphones

Solution Proposal by Toshiba

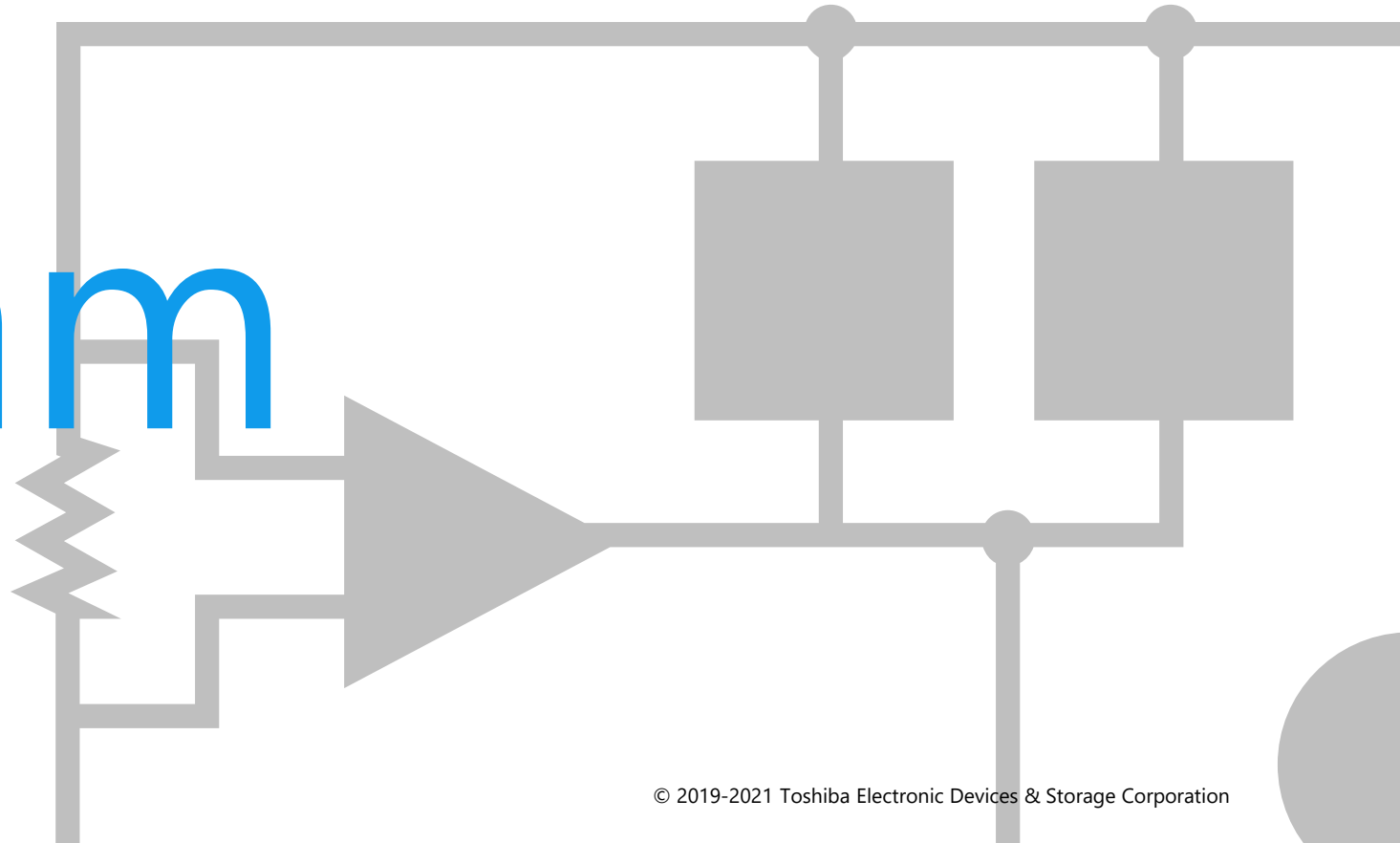




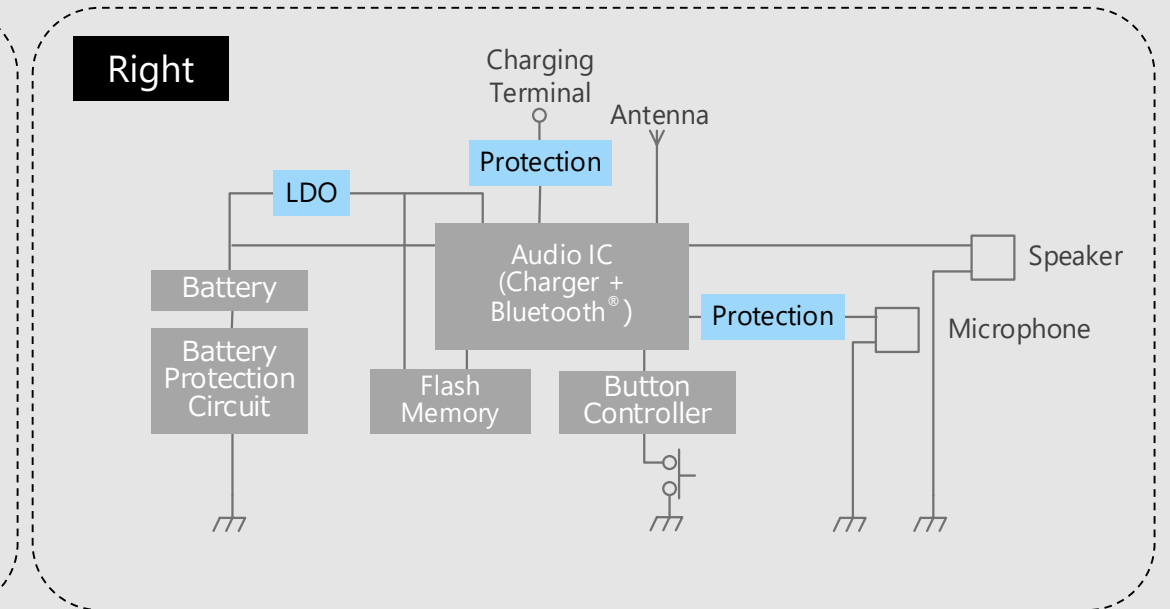
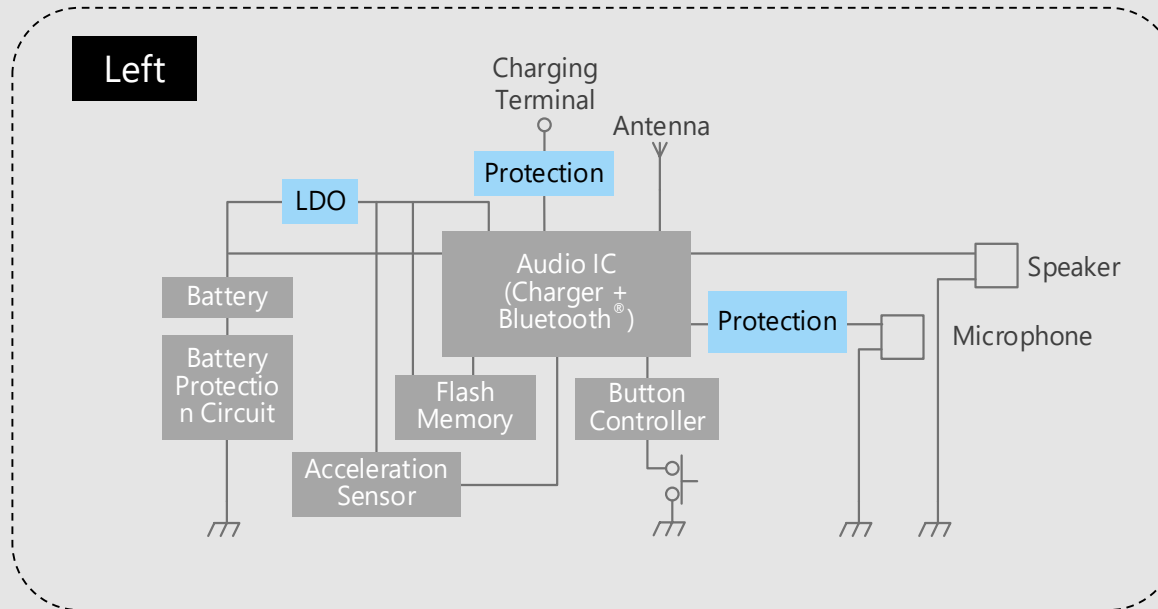
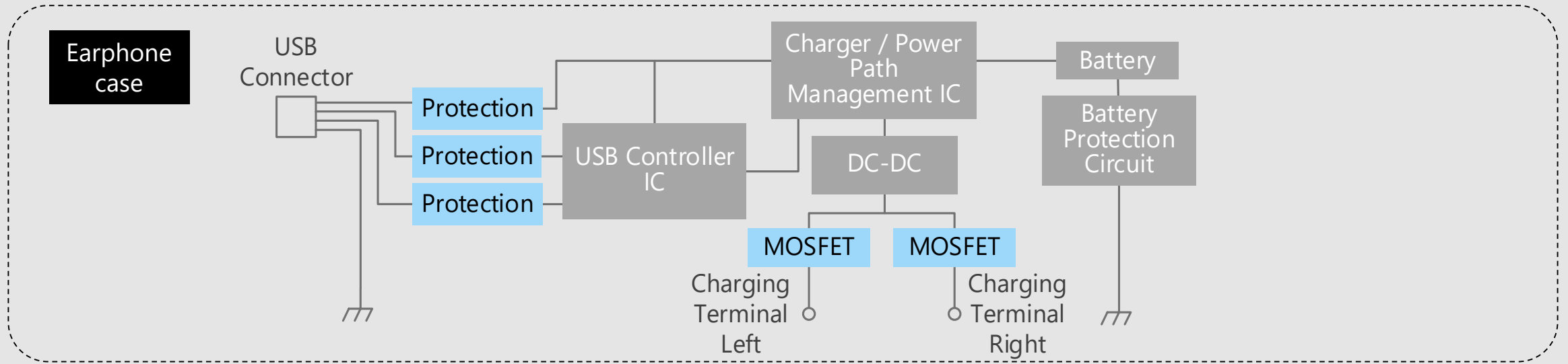
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Block Diagram



Wireless Earphone Overall block diagram

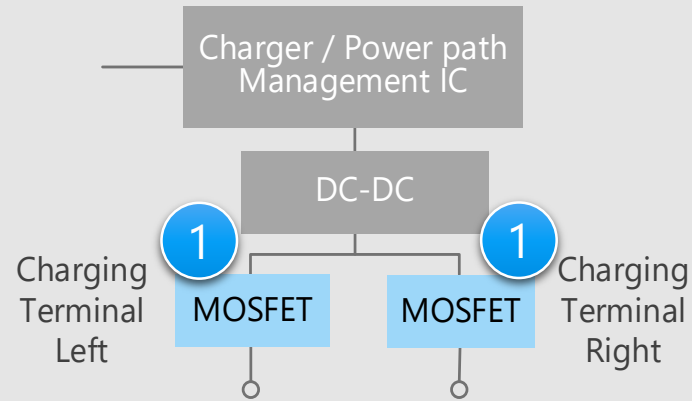


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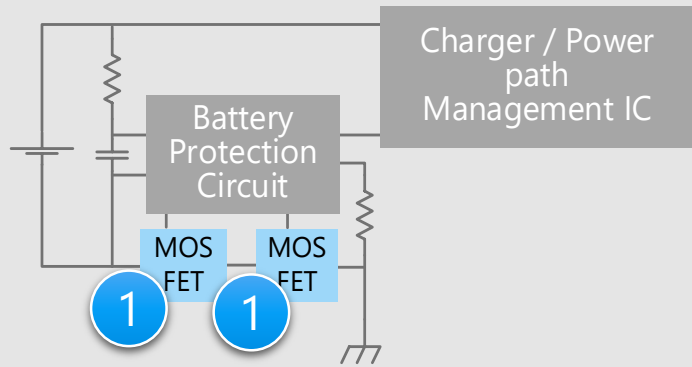
Wireless Earphone Detail of earphone case

Power supply lines

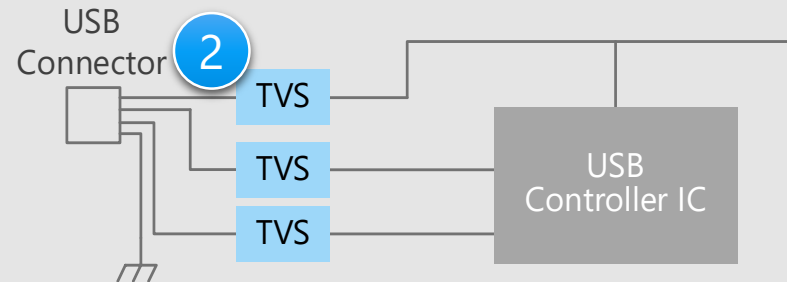
Load switch



Battery management



External connector



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

Criteria for device selection

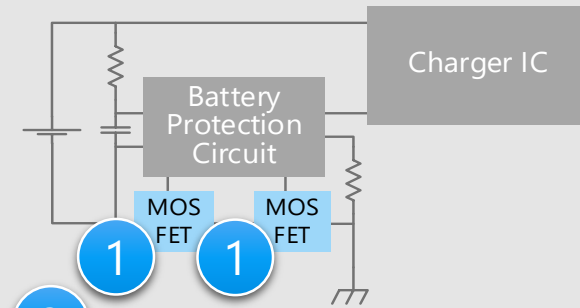
- To improve energy-efficiency, a MOSFET with lower on-resistance is required.
- The circuit board area can be reduced by adopting a compact package product.
- Low-voltage operation suitable for battery operation is required.
- It is necessary to absorb ESD entering from external terminals and protect the circuit.

Proposals from Toshiba

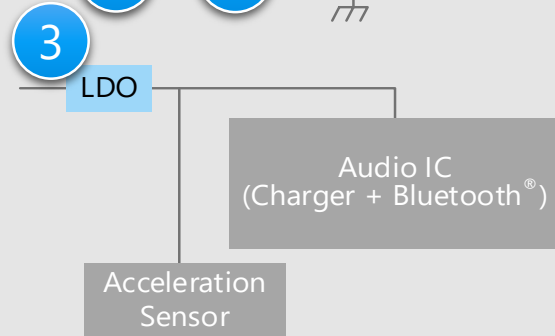
- **Small signal MOSFET with low on-resistance and efficient heat dissipation** 1
Small signal MOSFET
- **TVS diode that realizes compact size and low capacitance** 2
TVS diode

Wireless Earphone Detail of earphone

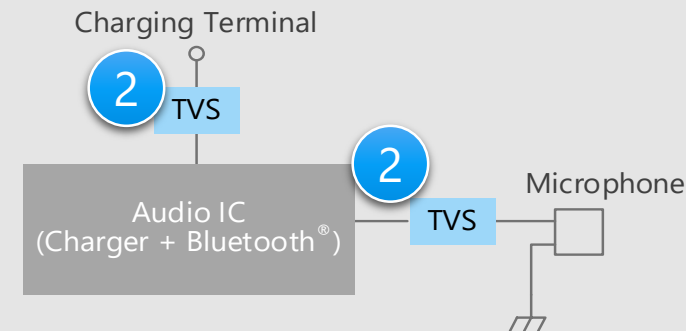
Battery management



Power supply circuit



Circuit protection



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

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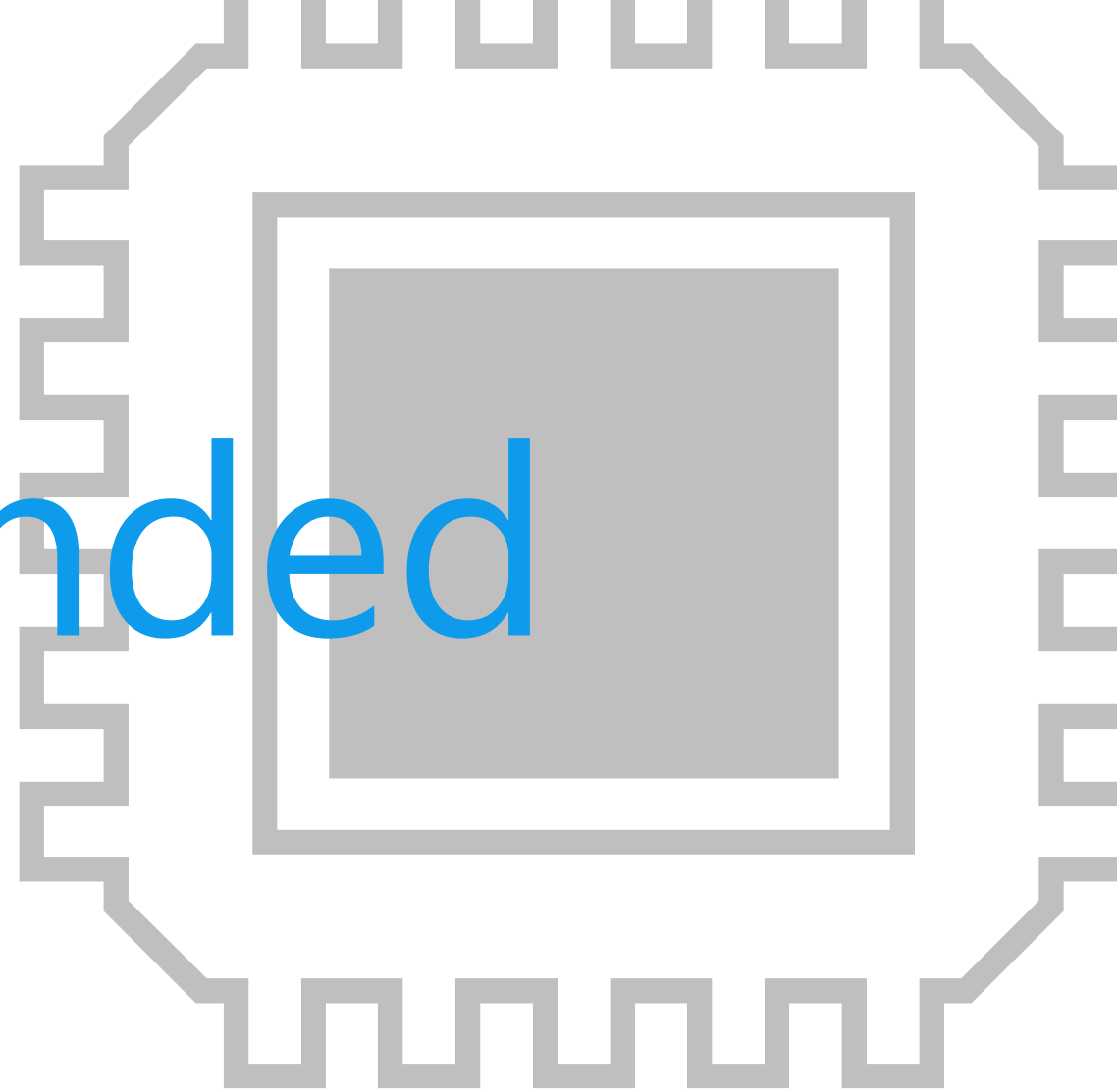
Criteria for device selection

- The circuit board area can be reduced by adopting a compact package product.
- To improve energy-efficiency, a MOSFET with lower on-resistance is required.
- In order to perform voltage conversion in a compact and efficient manner, an LDO regulator having a low dropout characteristic is required.
- A compact, standard capacitance type TVS diode is suitable for ESD protection.

Proposals from Toshiba

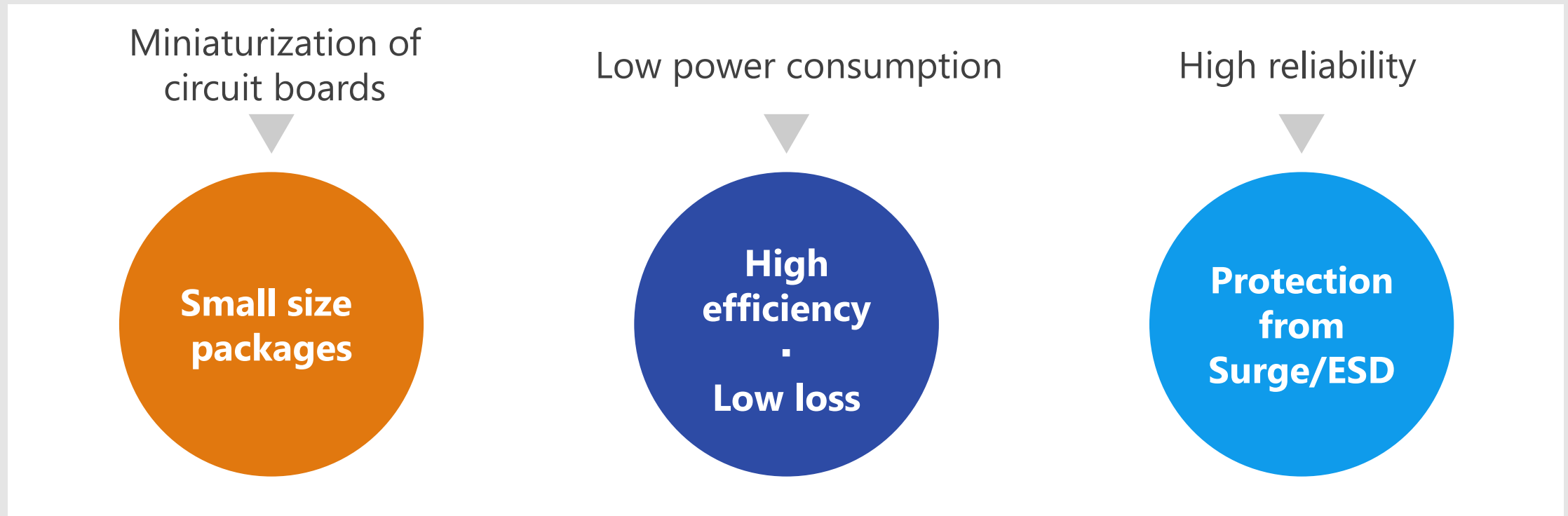
- **Small signal MOSFET with low on-resistance and efficient heat dissipation**
Small signal MOSFET 1
- **TVS diode that realizes compact size and low capacitance**
TVS diode 2
- **Small LDO regulator capable of applying a large current**
Small surface mount LDO regulator 3

Recommended Devices



Device solutions to address customer needs

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



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	●	●	

Value provided

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

1 Low on-resistance

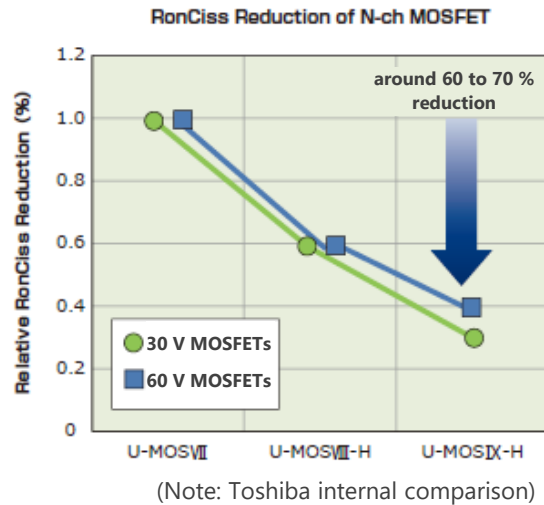
Heat dissipation and power consumption can be reduced by low drain-source on-resistance.

2 Low voltage drive

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

3 Small size package

Wide variety of package lineups, including ES6 packages (2in1), are provided.



Line up

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
V_{DSS} / V_{SSS} [V]	12	20	20	20
I_D / I_S [A]	8	0.8	4	14
$R_{DS(ON)} / R_{SS(ON)}$ [mΩ] @ $V_{GS} = 4.5$ V	Typ.	4.4	186	186
	Max	5.1	235	235

[Return to Block Diagram TOP](#)

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 Reduce ESD energy by low clamp voltage

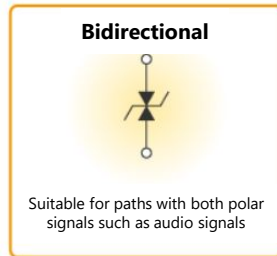
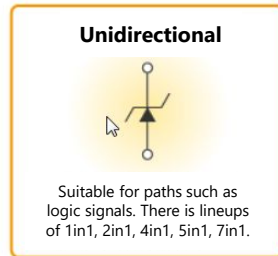
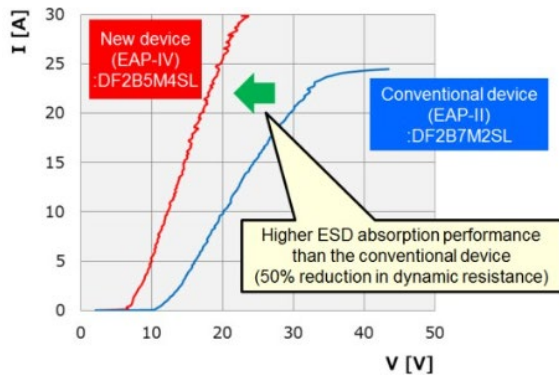
Steadily protect the connected circuits/devices using proprietary technology.

3 Suitable for high-density mounting

A variety of small size packages are available.

ESD Pulse Absorption Performance

(NOTE: Toshiba internal comparison)



Line up

Part number	DF2B6USL	DF2B7ASL	DF2S6P1CT
Package	SL2	SL2	CST2
V_{ESD} [kV]	±10	±30	±30
V_{RWM} (Max) [V]	1.5	5.5	5.5
C_t (Typ.) [pF]	1.5	8.5	90
R_{dyn} (Typ.) [Ω]	0.25	0.2	0.23
Use	For signal lines	For signal / power supply line	For power supply lines

(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 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

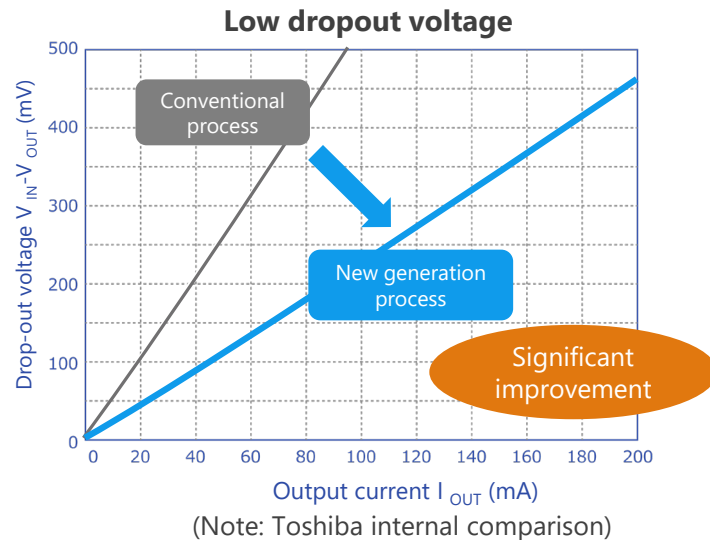
Our LDO regulator high PSRR (Power Supply Rejection Ratio) characteristic. Stable power supply is realized by removing switching noise generated in the circuit.




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

A variety of small size packages are available.



Line up				
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.) [μ A]	19	7	0.34	35

[Return to Block Diagram TOP](#)

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