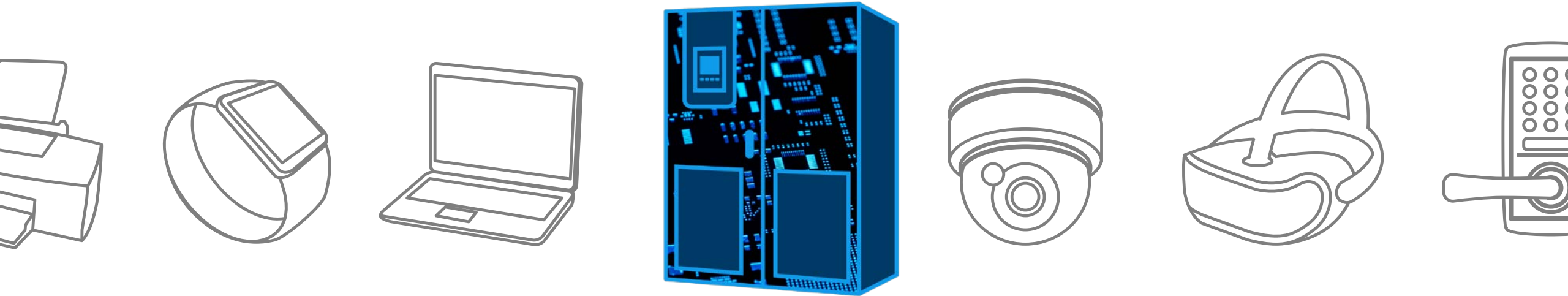


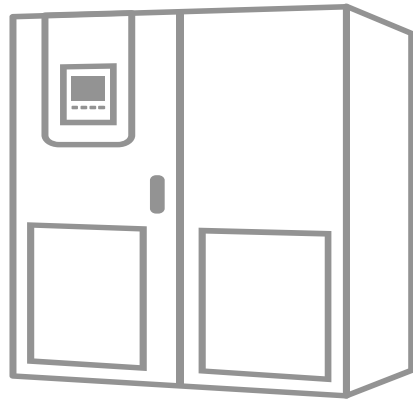
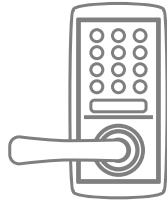
TOSHIBA

Uninterruptible Power Supply

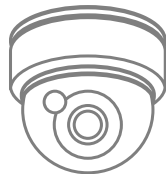
Solution Proposal by Toshiba

R20

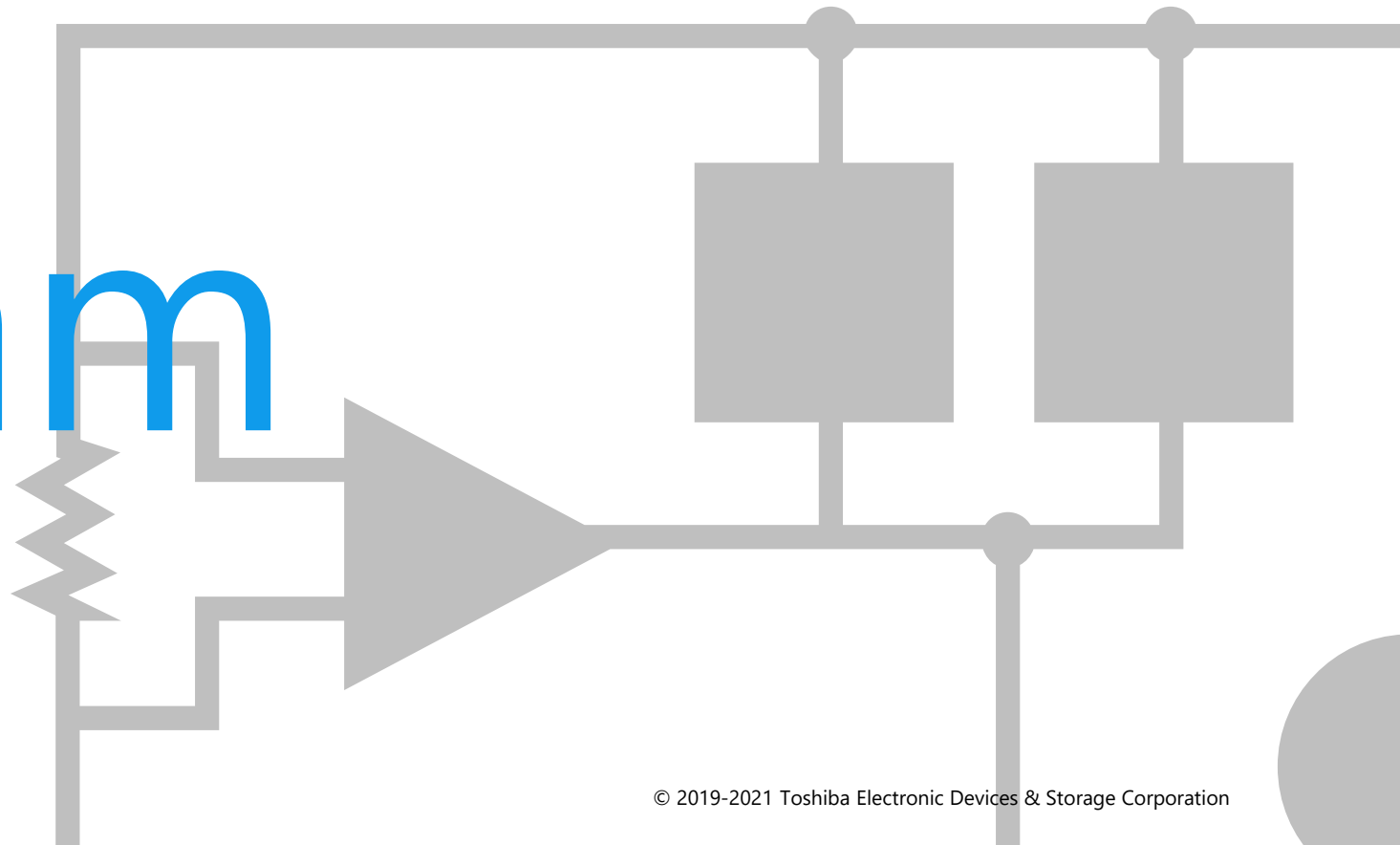




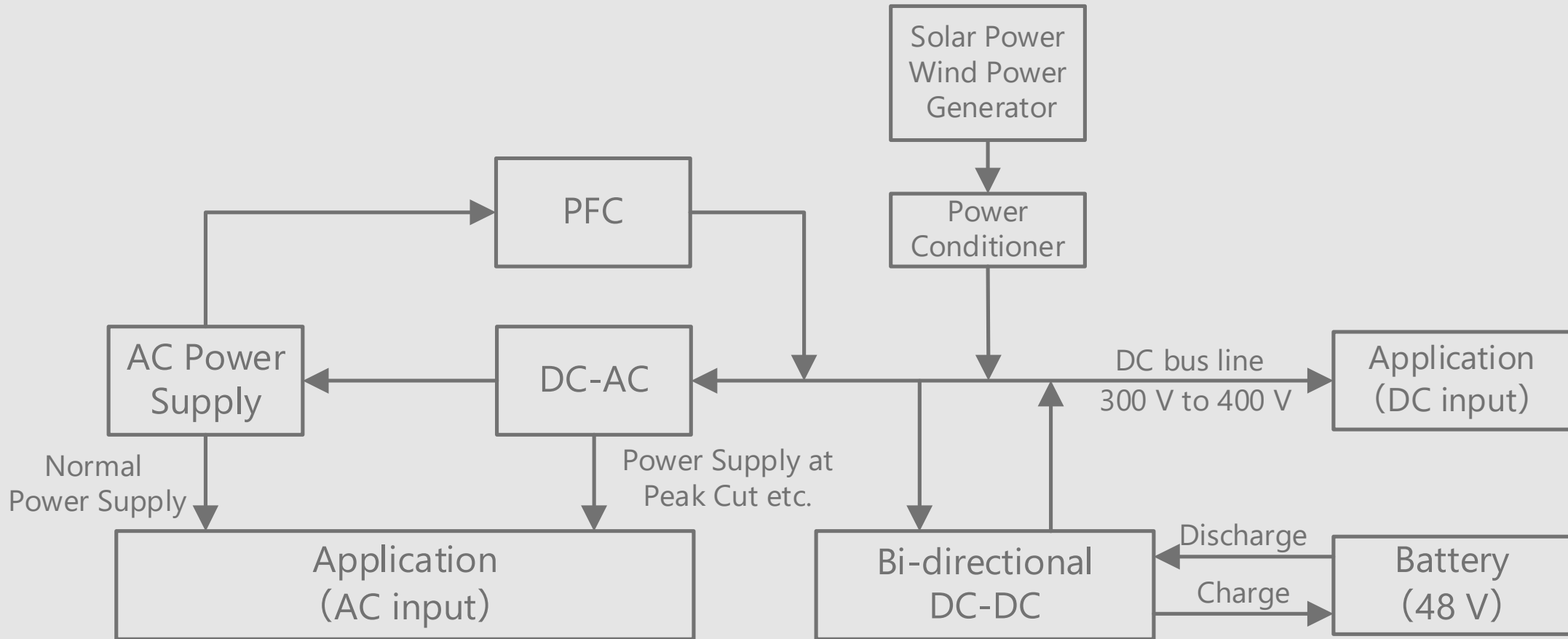
Toshiba Electronic Devices & Storage Corporation provides comprehensive device solutions to customers developing new products by applying its thorough understanding of the systems acquired through the analysis of basic product designs.



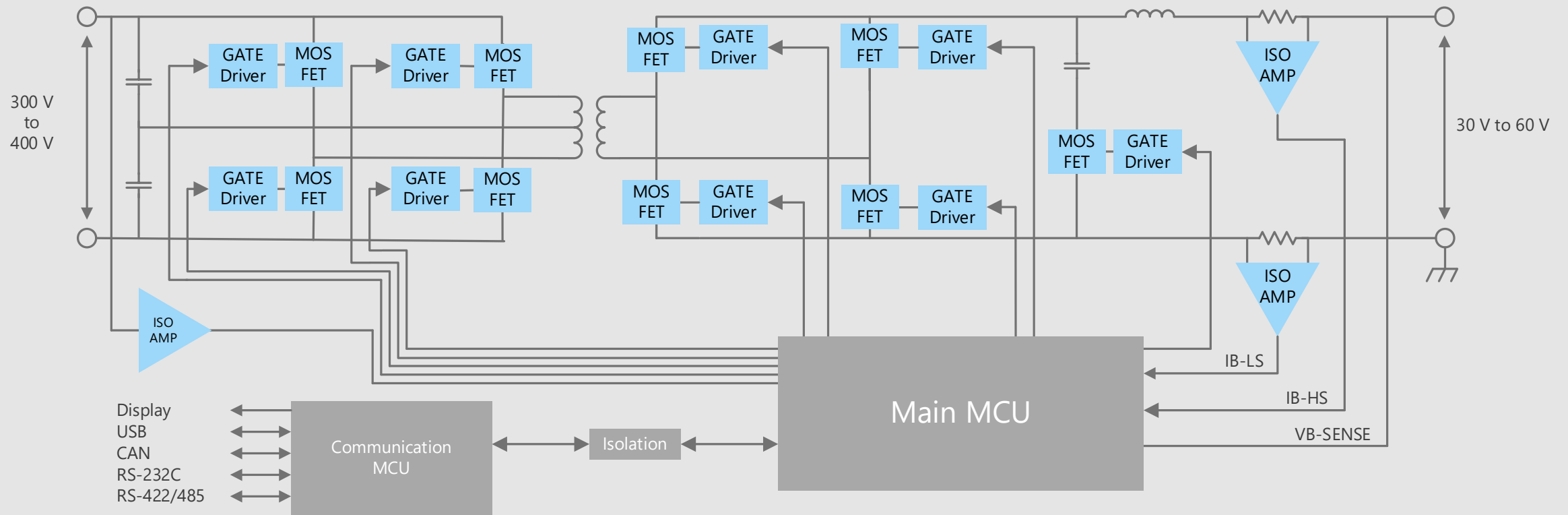
Block Diagram



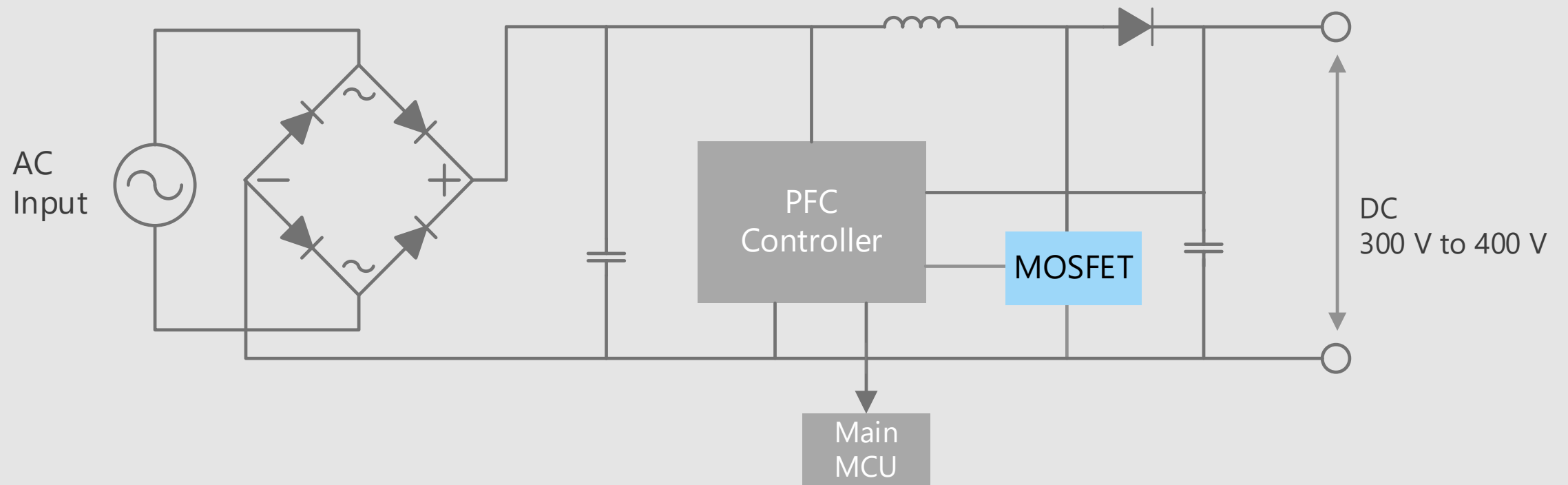
UPS Overall block diagram of standard system (power supply)



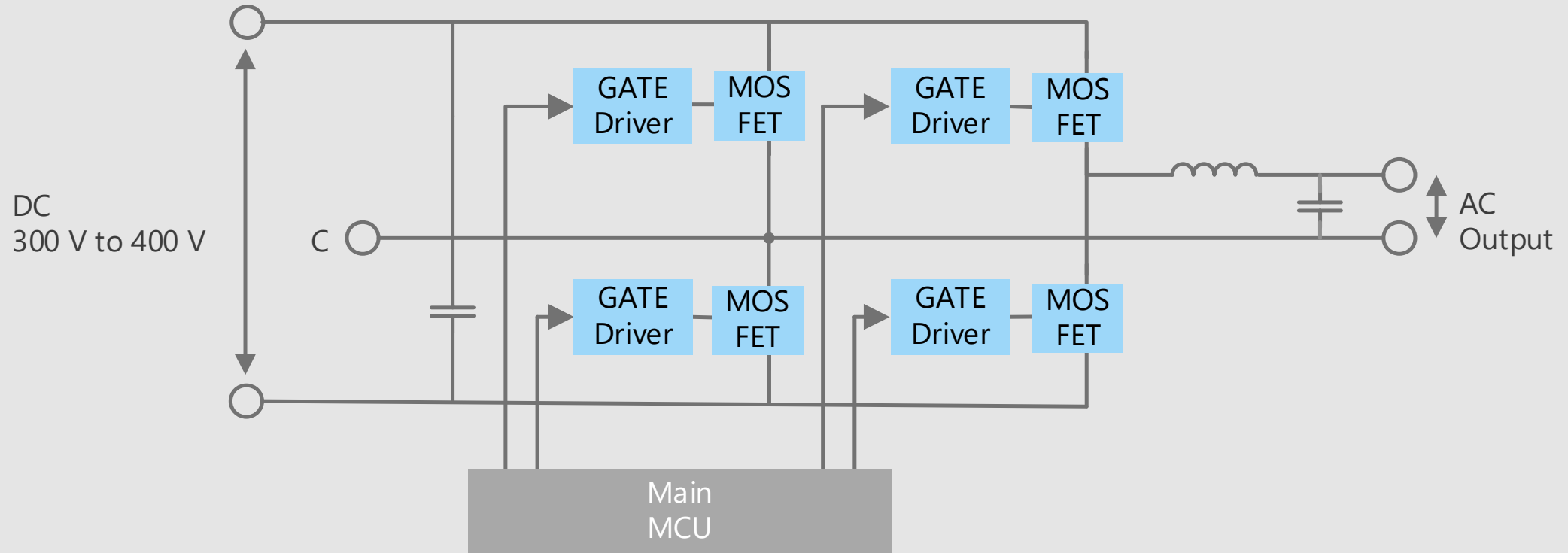
UPS Overall block diagram of interactive DC-DC



UPS Overall block diagram of PFC converter



UPS Overall block diagram of DC-AC inverter



USB block Protection circuit



RS-232 block Protection circuit



Display block Protection circuit



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

Criteria for device selection

- To protect the USB signal line, it is necessary to use a TVS diode with a low capacitance between terminals.
- Low-dynamic resistivity (R_{DYN}) is a key feature that determines the protective tolerance.
- It is important to protect not only the exterior but also the interior of the set.

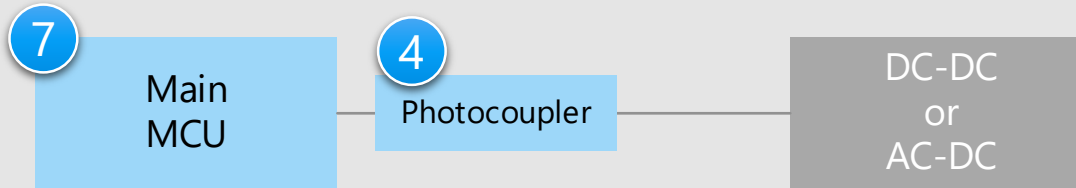
Proposals from Toshiba

- **The absorbs static electricity (ESD) and prevents circuit malfunction and device breakdown.**
TVS diode

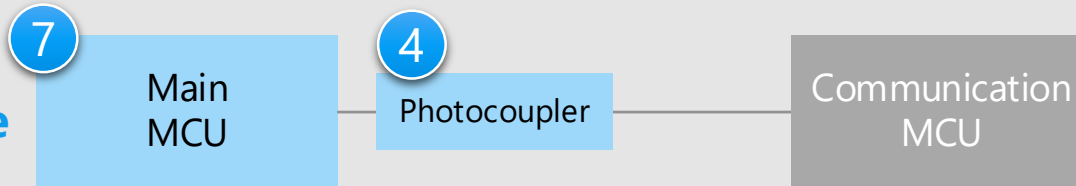
1

UPS Detail of insulating part

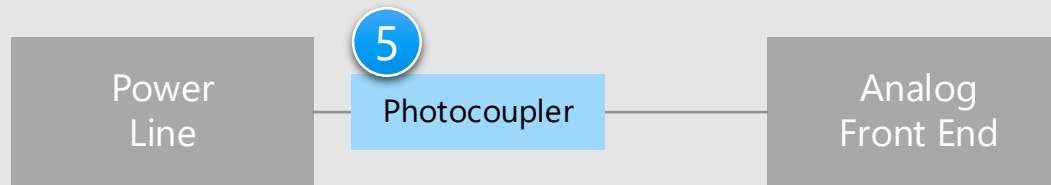
DC-DC – MCU DC signal transmission line



Digital signal Transmission line



Analog signal Transmission line



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

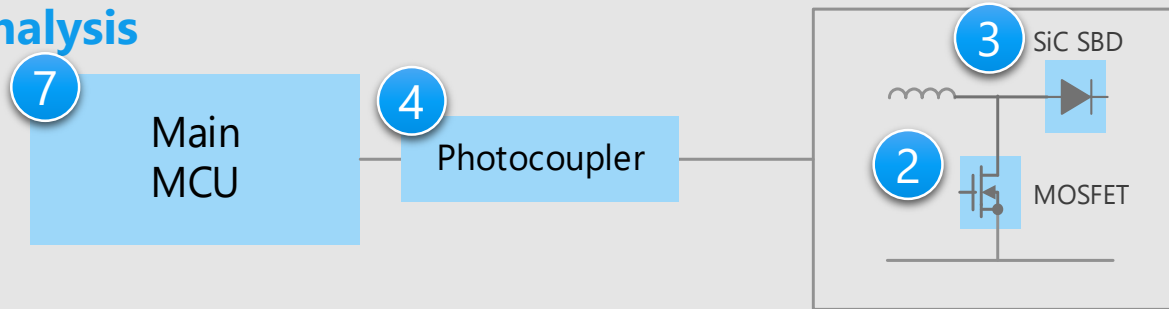
Criteria for device selection

- It is necessary to isolate the DC-DC converter and the control MCU.
- It is also necessary to isolate the MCU for control and the MCU for communication from each other.
- Protection against high voltage is required to protect the IC used internally.

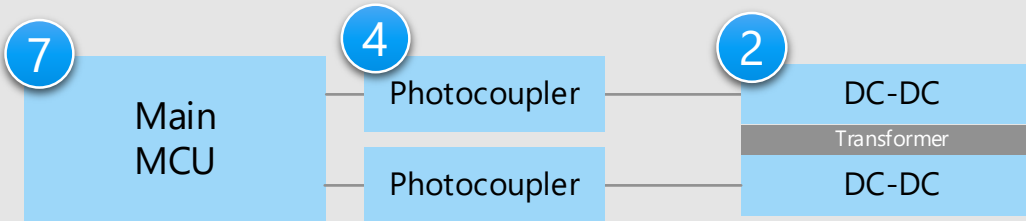
Proposals from Toshiba

- **Photocoupler with excellent environmental resistance** 4
IC output photocoupler
- **Photocoupler suitable for analog signal transmission** 5
Isolation amplifier
- **Major interface standards support** 7
MCU

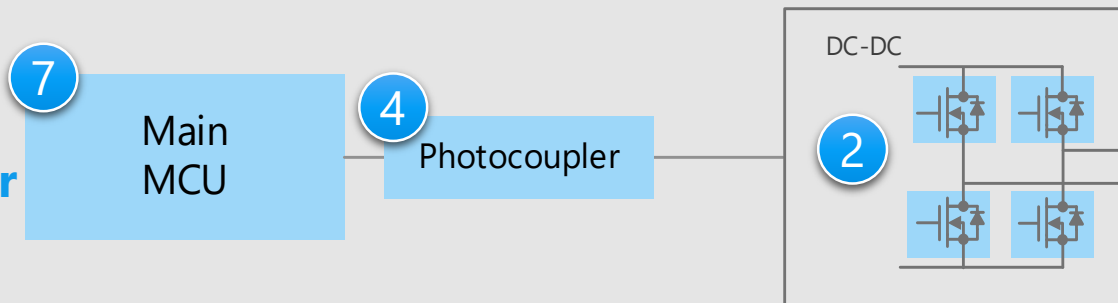
The motion analysis



For power supply DC-DC converter



For output DC-DC converter



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

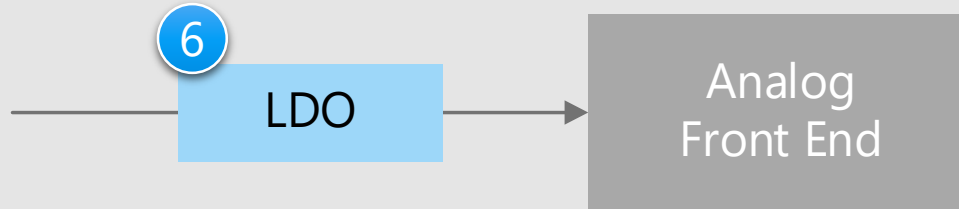
Criteria for device selection

- A high-voltage (normal 600V) MOSFET with high-speed recovery diodes is used for PFCs and DC-DC converters.
- SiC type Schottky barrier diodes are suitable for PFC circuits.
- Both high-voltage MOSFET and low-voltage MOSFET are used for power DC-DC converters.

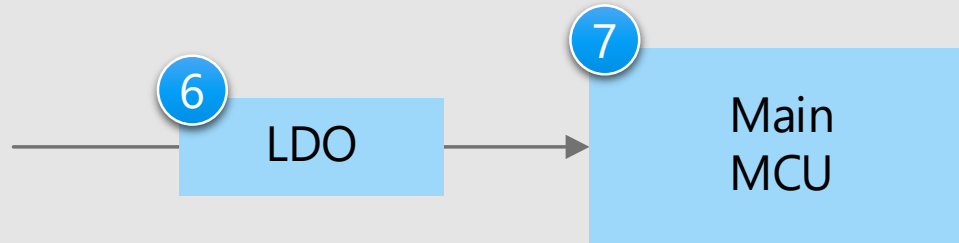
Proposals from Toshiba

- **Suitable for high-efficiency power supply switching**
 - DTMOS Series MOSFET (2)
 - U-MOS Series MOSFET (2)
- **Strong with efficiency figure of merit and surge current**
 - SiC Schottky barrier diode (3)
- **Photocoupler with excellent environmental resistance**
 - IC output photocoupler (4)
- **Built-in 3-phase PWM output for inverter control**
 - MCU (7)

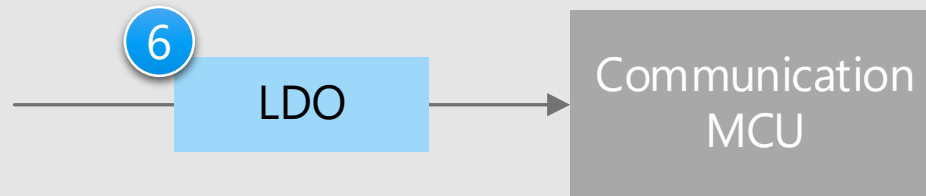
The motion analysis



For power supply DC-DC converter



For output DC-DC converter



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

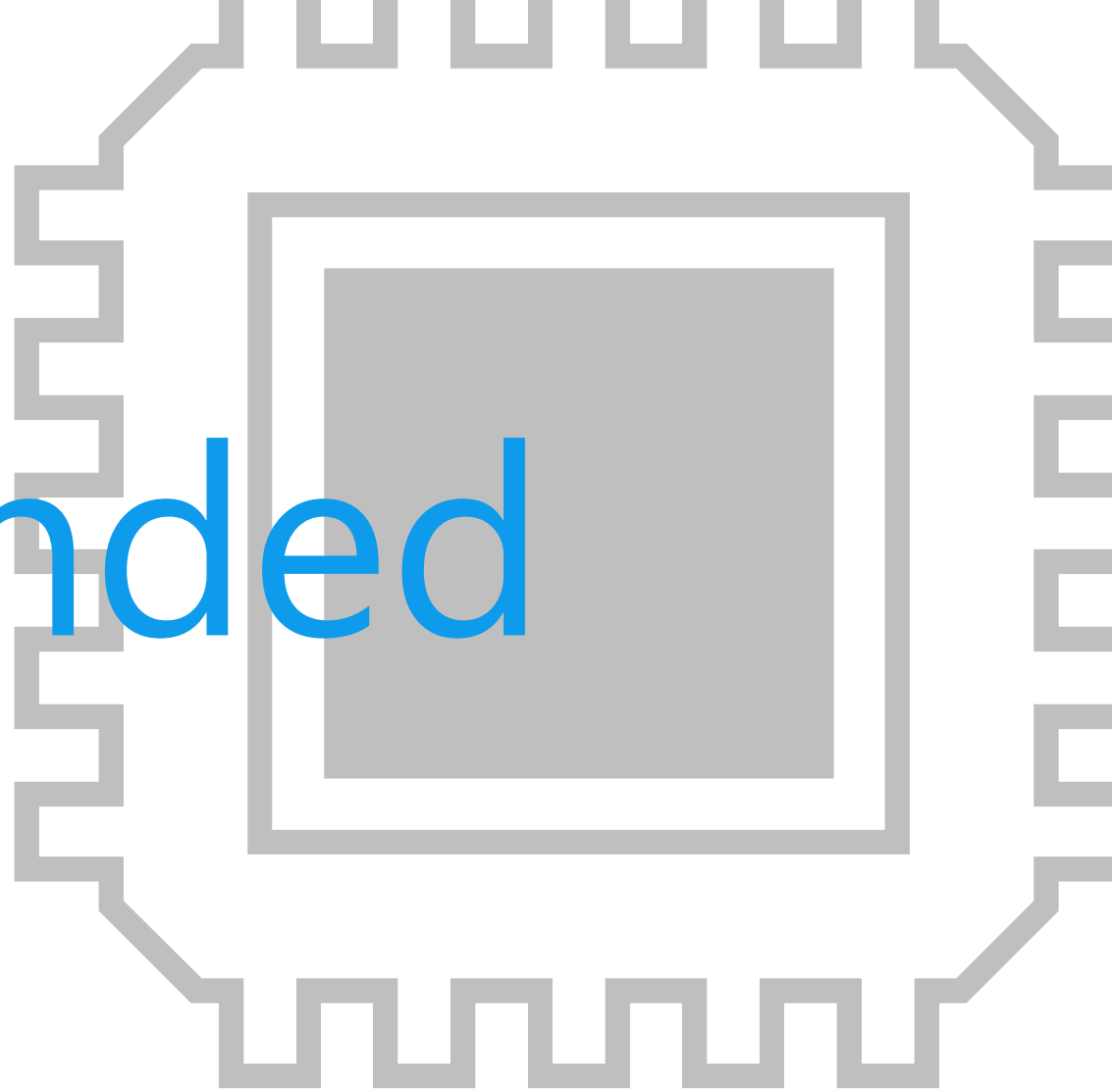
Criteria for device selection

- PSRR features are key features of radio systems.
- MIMO systems require a power supply that can supply large currents.
- New WiGig systems also require a power supply that can supply large currents.

Proposals from Toshiba

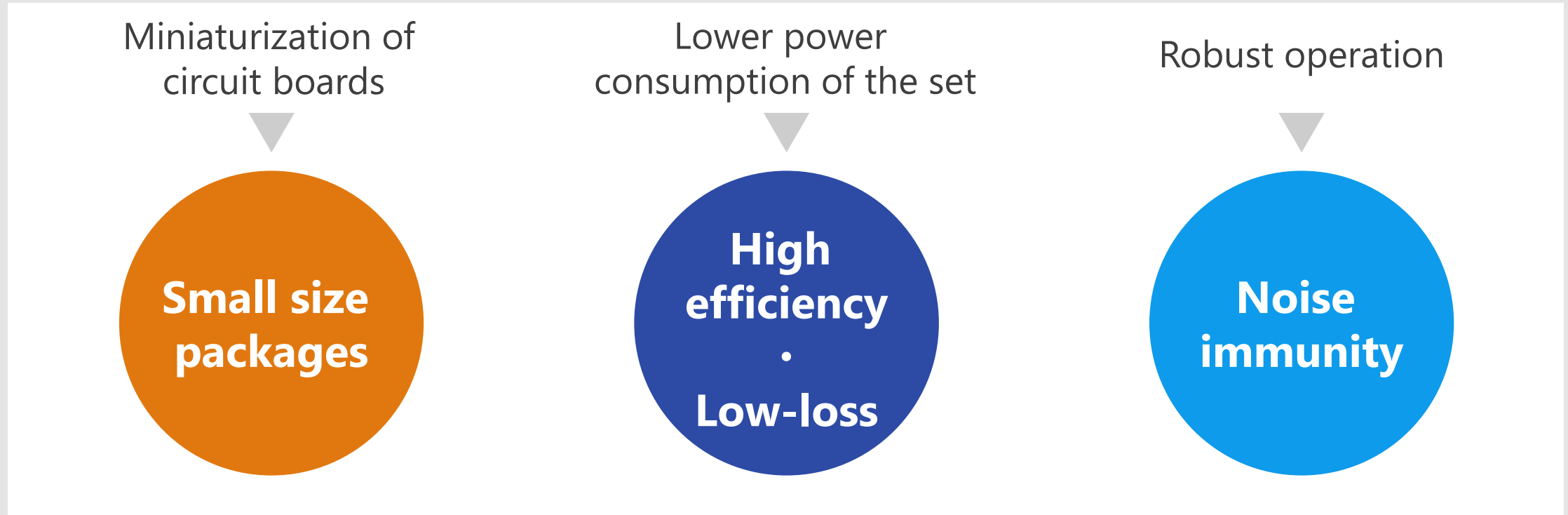
- **Compact surface mounting that is resistant to power supply noise**
Small surface mount LDO regulator 6
- **Built-in 3-phase PWM output for inverter control**
MCU 7

Recommended Devices



Device Solutions to Solve Customer Problems

As described above, in the design of a UPS, "**Miniaturization of circuit boards**", "**Low power consumption of sets**" and "**Robust operation**" are important factors. Toshiba's proposals are based on these three solution perspectives.



Device Solutions to Solve Customer Problems

Small size packages

High efficiency
·
Low-loss

Noise immunity

① TVS diode	●		●
② DTMOS Series MOSFET U-MOS Series MOSFET	●	●	●
③ SiC Schottky barrier diode	●	●	●
④ IC output photocoupler	●	●	●
⑤ Isolation amplifier	●	●	●
⑥ Small surface mount LDO regulator	●	●	●
⑦ MCU	●	●	

Value provided

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

1 Improved ESD pulse absorption

Improved ESD absorption compared to 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.

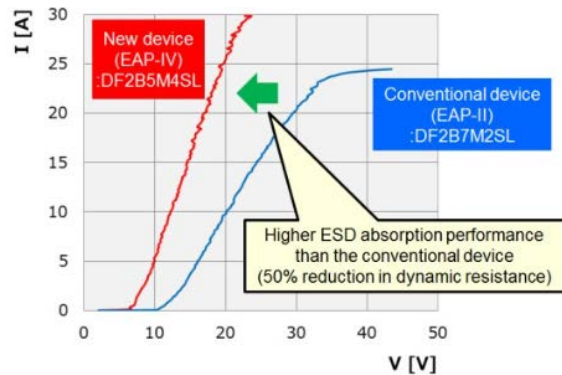
2 Suppress ESD energy by low clamp voltage

Steadily protect the connected circuits/devices using proprietary technology.

3 Suitable for high-density mounting

A variety of compact packages are available.

ESD Pulse Absorption Performance (Toshiba internal comparison)



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	DF2B6M4SL	DF2B20M4SL	DF2B5PCT	DF2B7PCT	DFS2S14P2CTC
Package	SL2 		CST2 		CST2C 
V_{ESD} [kV]	±20	±15	±30	±30	±30
V_{RWM} (Max) [V]	5.5	18.5	3.6	5.5	12.6
C_t (Typ.) [pF]	0.2	0.2	41	45	270
R_{DYN} (Typ.) [Ω]	0.5	0.2	0.1	0.1	0.08
Purpose	Signal line protection		Power line protection		

(NOTE) : This product is designed for ESD protection purpose and cannot be used for purposes other than ESD protection (including but not limited to voltage regulation applications).

[Return to Block Diagram TOP](#)

Value provided

DTMOS series contribute to achieve higher efficiency by $R_{DS(on)} \times Q_{gd}$ improvement1 $R_{DS(on)} \times Q_{gd}$ improvement

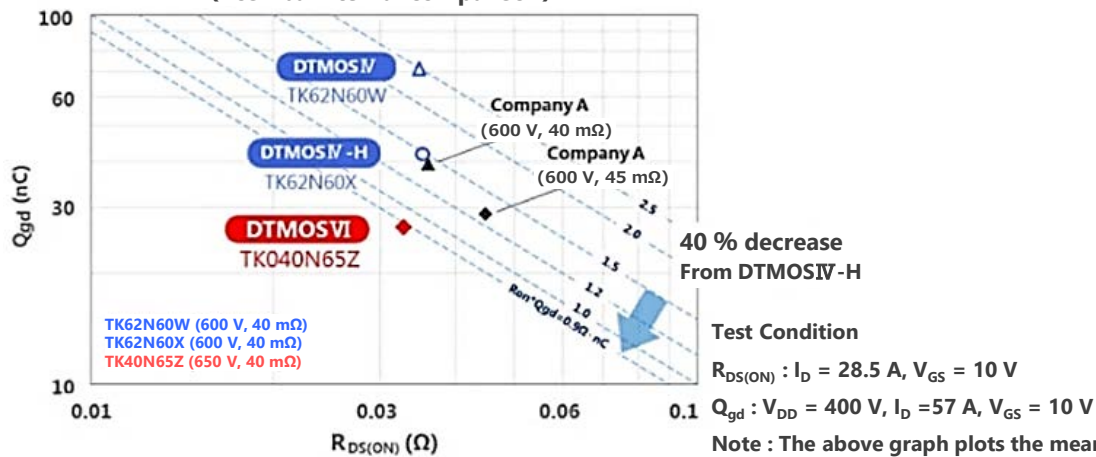
In the DTMOSVI series, the $R_{DS(ON)} \times Q_{gd}$ is reduced by approximately 40 % compared with the conventional DTMOSIV-H series product by optimizing the gate design and processes.

2 Body diode reverse recovery characteristics



Fast Recovery body diode type based on DTMOSIV series, which make more efficient.
(DTMOSIV, High-speed Recovery Diode Type)

3 Enhancement type

This is an enhancement type that is easy to handle.

Comparisons of figures of merit
(Toshiba internal comparison)

Line up

Part number	TK25A60X	TK16A60W5	TK110A65Z	TK190A65Z	TK110U65Z	TK190U65Z	
Package	TO-220SIS 			TOLL 			
V_{DSS} [V]	600	600	650	650	650	650	
I_D [A]	25	16	24	15	24	15	
$R_{DS(ON)}$ [Ω] @ $V_{GS} = 10 \text{ V}$	Typ.	0.105	0.18	0.092	0.158	0.086	0.149
	Max	0.125	0.23	0.11	0.19	0.11	0.19
Polarity	N-ch	N-ch	N-ch	N-ch	N-ch	N-ch	
Generation	DTMOSIV-H	DTMOSIV	DTMOSVI	DTMOSVI	DTMOSVI	DTMOSVI	

[◆Return to Block Diagram TOP](#)

Value provided

Contribution to energy saving with the latest technology and wide variety of lineup

1 High Efficiency

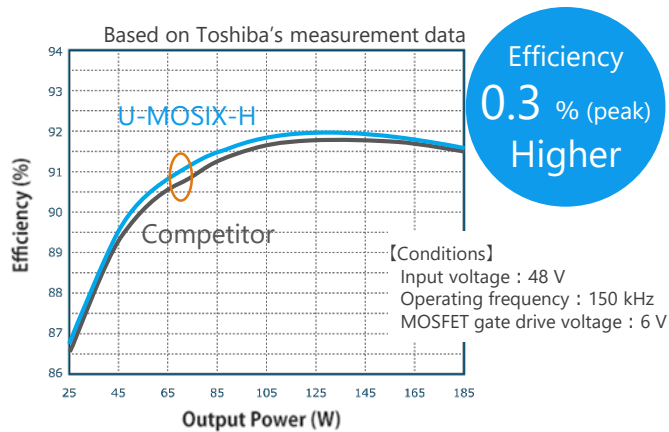
- Low on-resistance ($R_{DS(ON)}$) achieved by fine integration.
- Improved trade off between $R_{DS(ON)}$ and Q_g, Q_{sw}, Q_{oss} .

2 Wide variety of Lineup

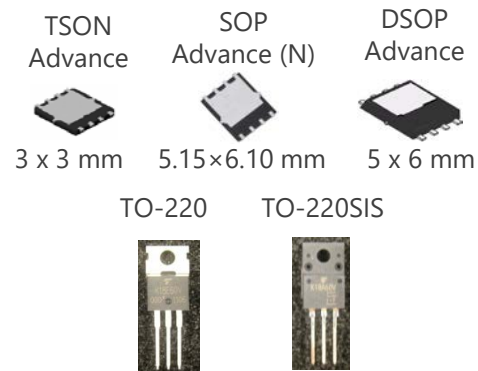
- Voltage Lineup from 20 V to 250 V.
- Wide variety of packages.

3 Ease of Design




- Low V_{DS} spike and ringing by parasitic snubber.
- High avalanche capability.



Efficiency comparison in the case of full-bridge DC-DC converter



Wide variety of packages

Line up					
Part number	TPN19008QM	TPH4R008QM	TPH2R408QM	TK100E10N1	
Package	TSON Advance 	SOP Advance(N) 		TO-220 	
V_{DS} [V]	80	80	80	100	
I_D [A]	34 (38*)	86 (140*)	120 (200*)	100 (207*)	
$R_{DS(ON)}$ [Ω] @ $V_{GS} = 10$ V	Typ.	0.0147	0.0031	0.0019	0.0028
	Max	0.019	0.004	0.00243	0.0034
Polarity	N-ch	N-ch	N-ch	N-ch	
Generation	U-MOSX-H	U-MOSX-H	U-MOSX-H	U-MOSVIII-H	

* : Silicon limit

[Return to Block Diagram TOP](#)

Value provided

Can be applied to power factor correction circuits and a wide range of power supply control applications, and greatly contributes to miniaturization.

1 High surge tolerance

The surge peak forward current $I_{FSM} = 97\text{ A (Max)}$ (TRS12E65F). Surge current is increased around 2 times of the first generation by using improved JBS (Junction Barrier Schottky) structure.

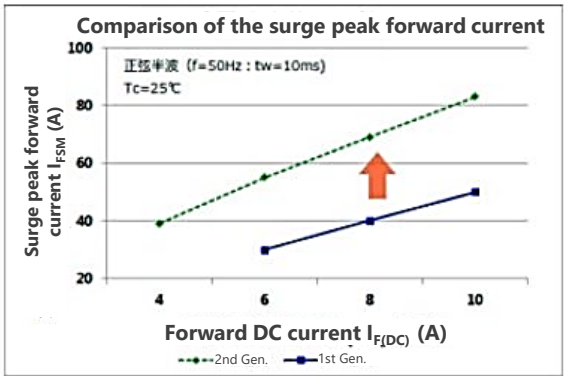
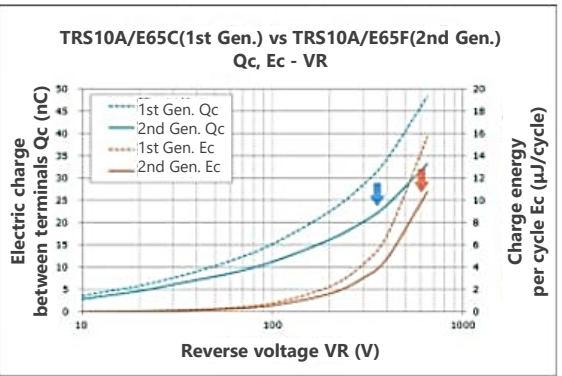
2 Second-generation chip design

The figure of merit ($V_F \times Q_C$) (Note1) is improved by 30 % and the surge peak forward current (I_{FSM}) is improved, thereby contributing to higher efficiency of the power supply.

3 Small package




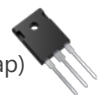
Provided in TO-220 through-hole type package.

Comparison between Toshiba's first and second generation products



Note1: The $V_F \times Q_C$: (product of forward voltage and total charge) is an index representing the loss performance of the SiC SBD. When comparing the products with the same current rating, the smaller the index, the lower the loss.

Line up

Part number	TRS4A65F	TRS4E65F	TRS12E65F	TRS12N65FB	TRS16N65FB	TRS20N65FB	TRS24N65FB
Package	 TO-220F-2L	 TO-220-2L	 TO-220-2L	 TO-247 (Center tap)			
V_{RRM} [V]	650	650	650	650	650	650	650
$I_{F(DC)}$ [A]	4	4	12	6 / 12 *	8 / 16 *	10 / 20 *	12 / 24 *
I_{FSM} [A]	37	39	97	52 / 104 *	65 / 130 *	79 / 158	92 / 184 *
V_F (Typ.) [V]	1.45 @ $I_F = 4\text{ A}$	1.45 @ $I_F = 4\text{ A}$	1.45 @ $I_F = 12\text{ A}$	1.45 @ $I_F = 6\text{ A}$	1.45 @ $I_F = 8\text{ A}$	1.45 @ $I_F = 10\text{ A}$	1.45 @ $I_F = 12\text{ A}$

* : Per Leg / Both Legs

[Return to Block Diagram TOP](#)

Value provided

Combines an infrared light-emitting diode with high optical output and an integrated circuit light-receiving IC chip with high gain and high speed.

1 High noise immunity

The products have internal faraday shield that provides a guaranteed common-mode transient immunity.

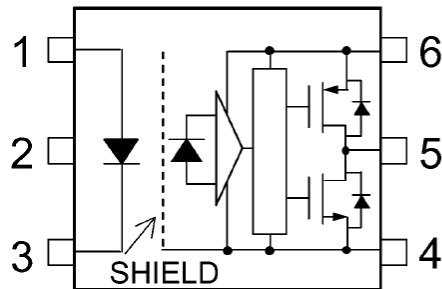
2 High isolation voltage

The isolation voltage BV_S is 5000 [Vrms] (Min).

3 Ambient temperature of 125 °C is guaranteed

The products are designed to operate even under severe ambient temperature conditions, such as inverters, robots, machinery, and high-output power supplies. (For TLP2761/2768A)

Internal circuit configuration (TLP5754)



- 1: Anode
- 2: N.C.
- 3: Cathode
- 4: GND
- 5: V_O (Output)
- 6: V_{CC}

UL-approved: UL1577, File No.E67349

cUL-approved: CSA Component Acceptance Service No.5A File No.E67349

VDE-approved: EN60747-5-5, EN60065, EN60950-1, EN 62368-1 (Note 1)

Note 1: When a VDE approved type is needed, please designate the Option (D4).

Line up

Part number	TLP5214	TLP5231	TLP5754	TLP2761	TLP2768A
Package	SO16L 	SO16L 	SO6L 	SO6L 	SO6L 
BV_S (Min) [Vrms]	5000	5000	5000	5000	5000
T_{opr} [°C]	-40 to 110	-40 to 110	-40 to 110	-40 to 125	-40 to 125
Output type	IC output	IC output	Totem-pole output	Totem-pole output	Open collector output

[◆Return to Block Diagram TOP](#)

Value provided

This is suitable isolation amplifier for current / voltage detection of motors and inverters.

1 High insulation capacity

This optical coupling type isolation amplifier has a high-precision $\Delta\Sigma$ AD conversion circuit on the input side and a high-precision DA conversion circuit on the output side.

2 Support for common mode

Common-mode transient elimination is provided with CMTI = 15 kV/ μ s (Min).

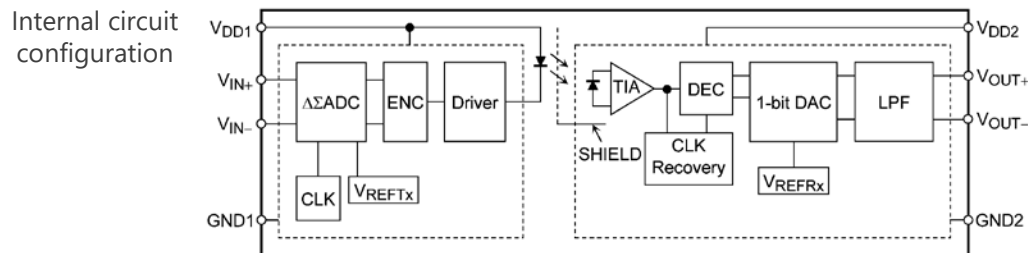
3 5 V system power supply voltages

Input power supply voltage

$$V_{DD1} = 4.5 \text{ V to } 5.5 \text{ V}$$

Output Power Supply Voltage

$$V_{DD2} = 3.0 \text{ V to } 5.5 \text{ V}$$



Note: A 0.1- μ F bypass capacitor must be connected between 1 and 4 pins and between 5 and 8 pins.

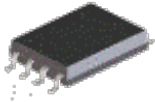
UL-approved: UL1577, File No.E67349

cUL-approved: CSA Component Acceptance Service No.5A File No.E67349

VDE-approved: EN60747-5-5, EN60065, EN60950-1, EN 62368-1 (Note 1)

Note 1: When a VDE approved type is needed, please designate the Option (D4).

Line up

Part number	TLP7820
Package	SO8L 
BV_S (Min) [Vrms]	5000
T_{opr} [$^{\circ}$ C]	-40 to 105
CMTI (Min) [kV/ μ s]	15

[Return to Block Diagram TOP](#)

Value provided

Wide line up from general-purpose type to small package type are provided. Contribute to realize a stable power supply not affected by fluctuation of battery.

1 Low dropout voltage

The newly developed new-generation process significantly improved the drop-out voltage characteristics.

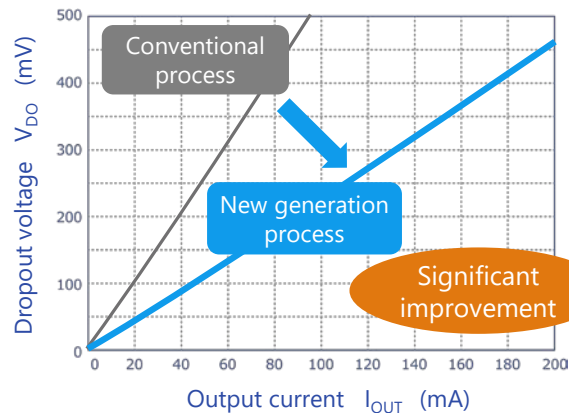
2 High PSRR Low output noise voltage

Many product series that realize both high PSRR (Power Supply Rejection Ratio) and low output noise voltage characteristics are provided. They are suitable for stable power supply for analog circuit.

3 Low current consumption

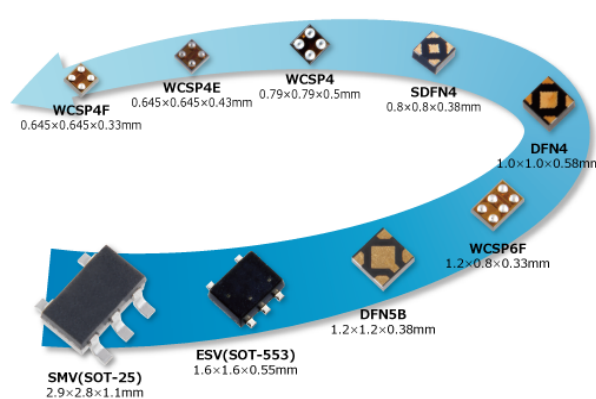
0.34 μA of $I_{B(ON)}$ is realized by utilizing CMOS process and unique circuit technology.

Low dropout voltage



Note: Toshiba internal comparison

Rich package line up



Line up

Part number	TCR15AG Series	TCR13AG Series	TCR8BM Series	TCR5BM Series	TCR5RG Series	TCR3RM Series	TCR3U Series	TCR2L Series	TAR5 Series
Features	Low dropout voltage High PSRR				High PSRR Low noise Low current consumption		Low current consumption		15V Input voltage Bipolar type
I_{OUT} (Max) [A]	1.5	1.3	0.8	0.5		0.3		0.2	
PSRR (Typ.) [dB] @f=1 kHz	95	90	98	98	100	100	70	-	70
I_B (Typ.) [μA]	25	52	20	19	7	7	0.34	1	170

[Return to Block Diagram TOP](#)

Value provided

Built-in 3-phase PWM and Ethernet function execute inverter control and internal system communication at low power consumption**1 Built-in Arm® Cortex®-M3
CPU core**

TMPM369 implements Cortex-M3 core with 80 MHz maximum operation frequency. Various development tool and their partners allow users many options.

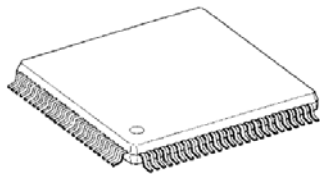
2 3-phase PWM output

TMPM369 has 2ch of 3-phase PWM output in it. It is suitable for controlling inverter system. The original NANOFLASH™ is possible to rewrite at high-speed. It reduces user software development time period.

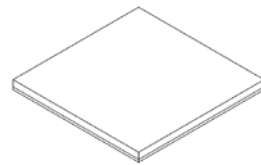
**3 Various communication
interfaces**

TMPM369 supports various communication standards. They can construct internal system communication easily.

TMPM369FDG

LQFP144
(20 mm x 20 mm)

TMPM369FDXBG

TFBGA177
(11 mm x 11 mm)

Line up

Part number	TMPM369FDG/FDXBG
Maximum operation frequency	80 MHz
Instruction ROM	512 KB
RAM	128 KB
3-phase PWM output	2ch
Ethernet MAC	1ch
USB2.0	Host 1ch, Device 1ch
CAN, UART	1ch, 4ch

[◆Return to Block Diagram TOP](#)

If you are interested in these products and have questions or comments about any of them, please do not hesitate to contact us below:

Contact address: <https://toshiba.semicon-storage.com/ap-en/contact.html>



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