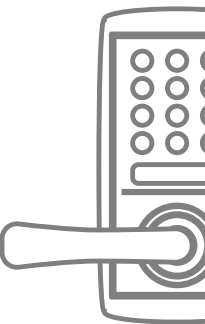
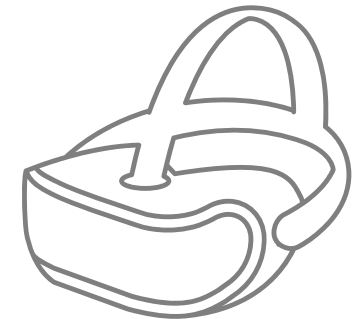
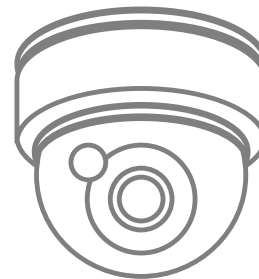
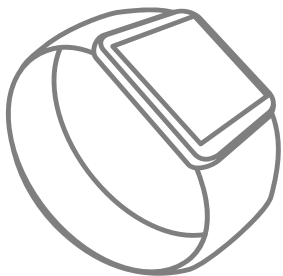
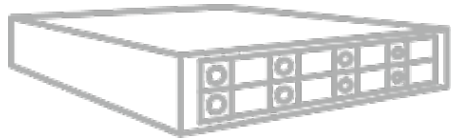
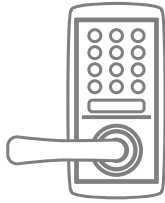
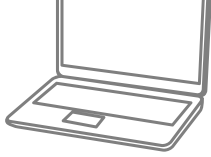


Server

Solution Proposal by Toshiba

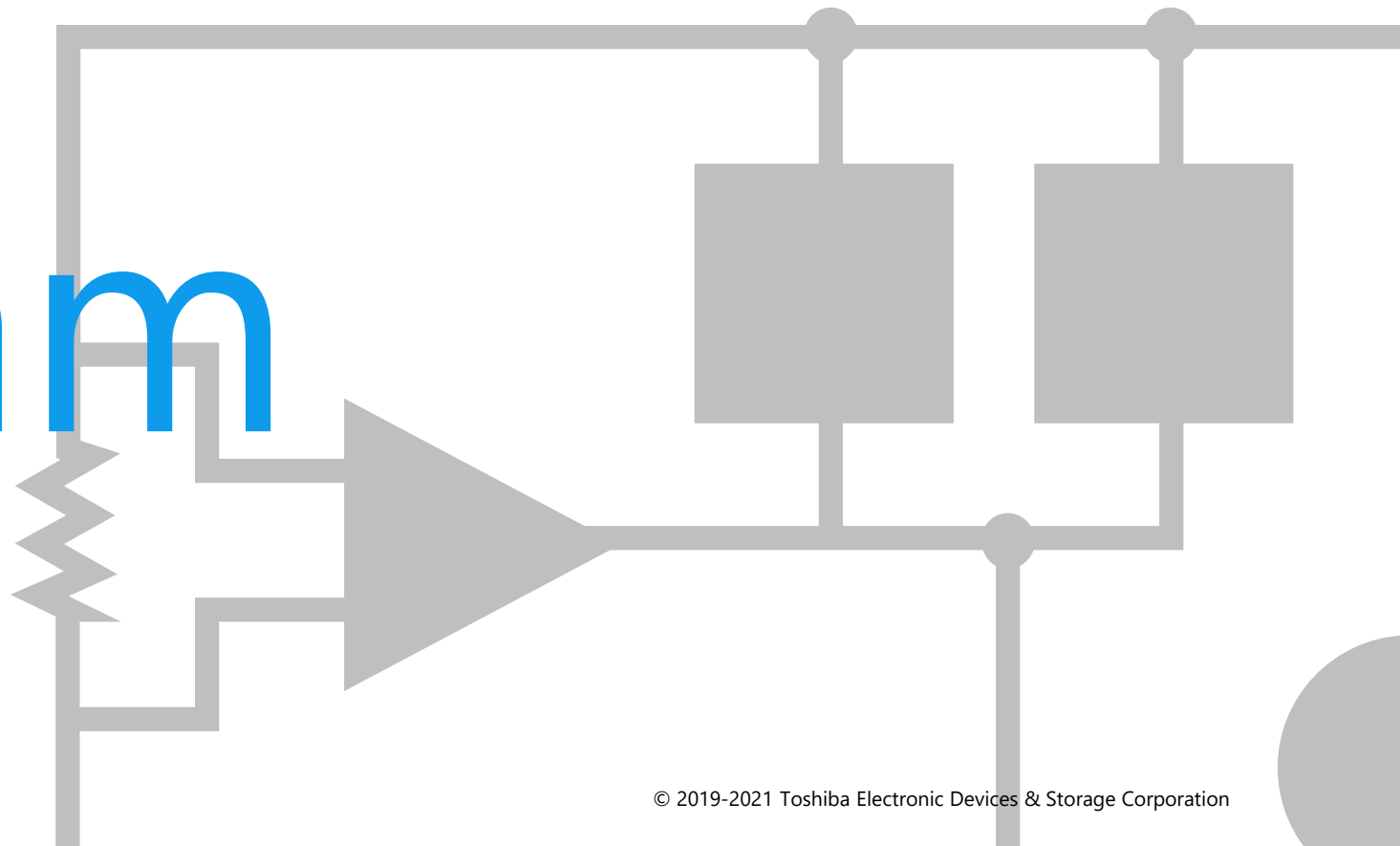




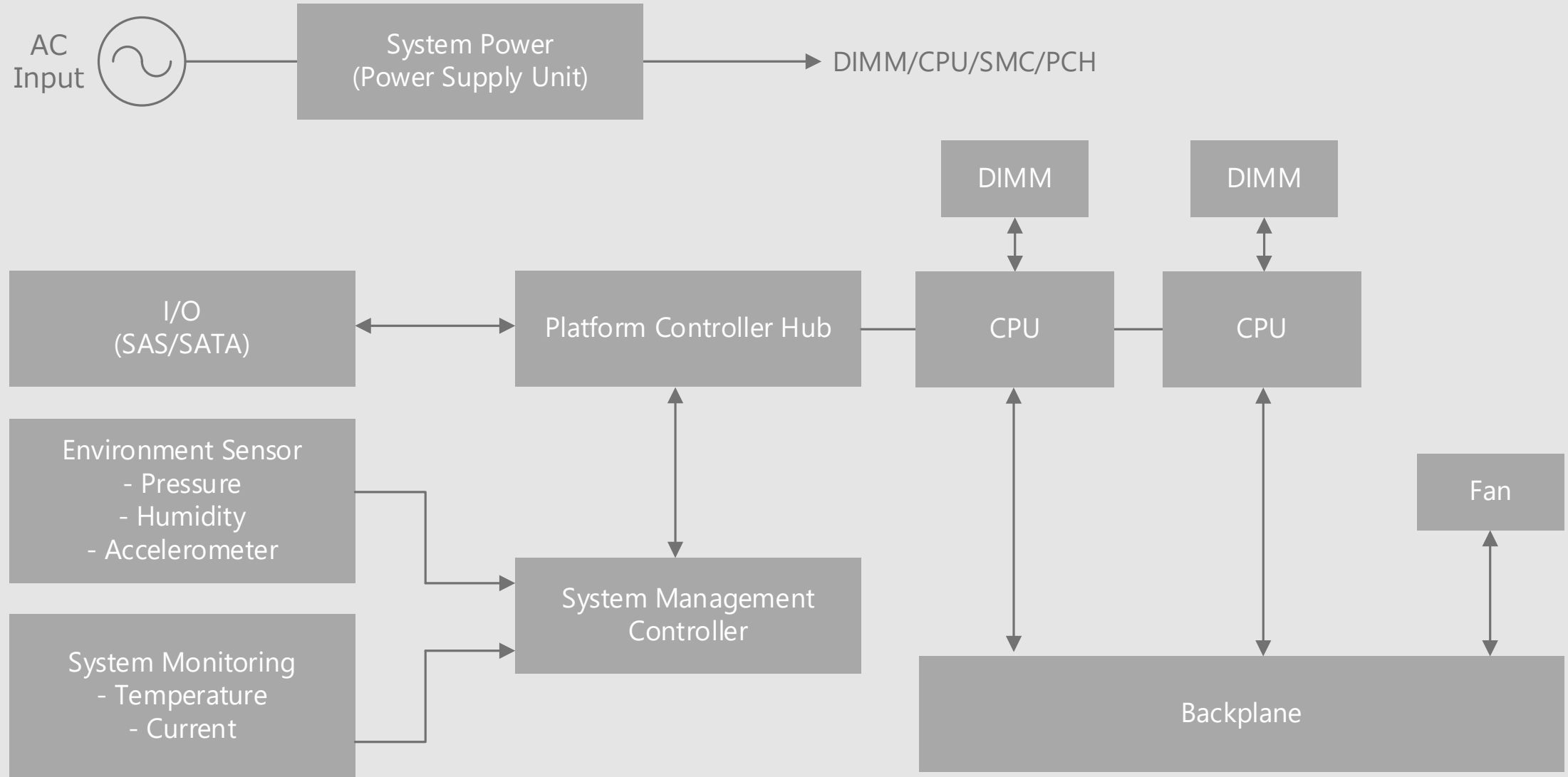
Toshiba Electronic Devices & Storage Corporation provides comprehensive device solutions to customers developing new products by applying its thorough understanding of the systems acquired through the analysis of basic product designs.



Block Diagram



Server Overall block diagram

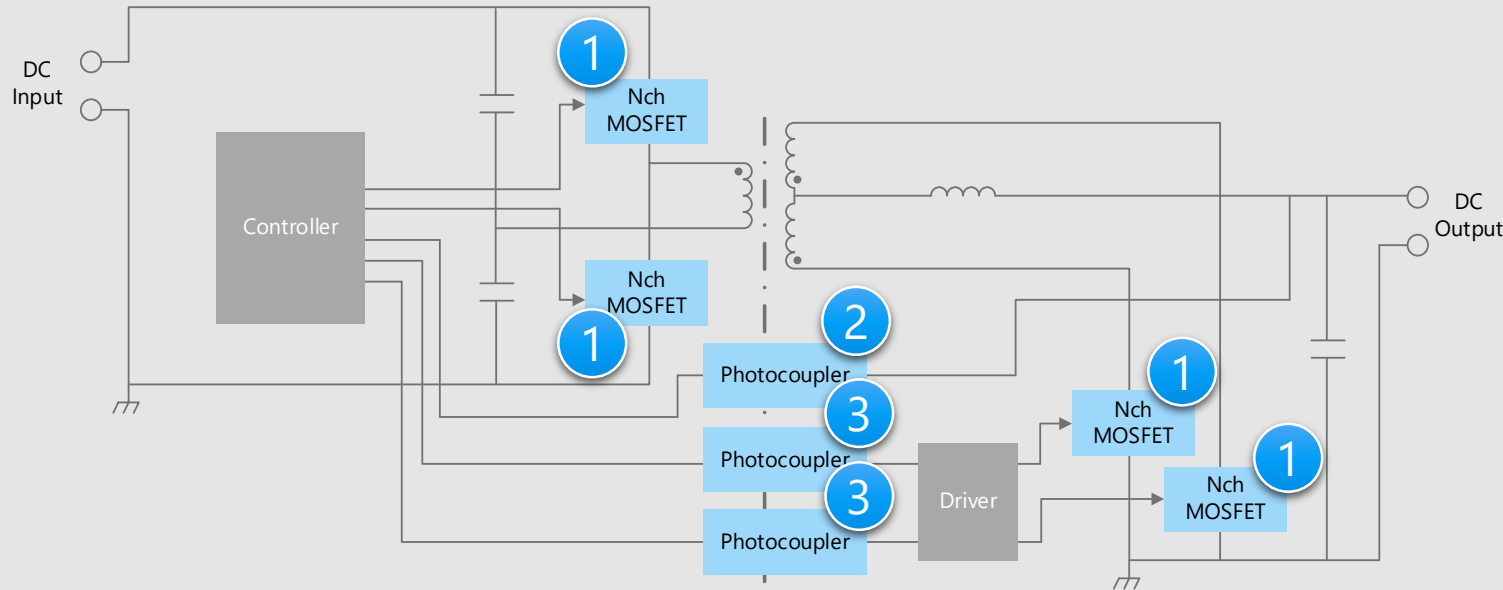


Server Detail of the Server Power Supply Circuit (1)

DC-DC converters for 48 V systems

Power supply for 1.2 V and 100 A output isolated DC-DC converters

($V_{IN(DC)} = 40$ to 59.5 V, $V_{OUT} = 1.2$ V, $I_{OUT} = 100$ A)



Reference Design from here →

[Click Here](#)

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

Device selection points

- A MOSFET having a high voltage and a low on-resistance is suitable for the PFC circuit of the DC-DC power supply.
- A transistor output photocoupler is typically used for feeding back voltages to the primary in the DC-DC power supply.
- The IC output coupler is used for signal isolation.

Proposals from Toshiba

- **Suitable for high-voltage power supply switching**

U-MOS Series power MOSFET

- **Photocoupler with excellent environmental resistance**

Transistor output photocoupler

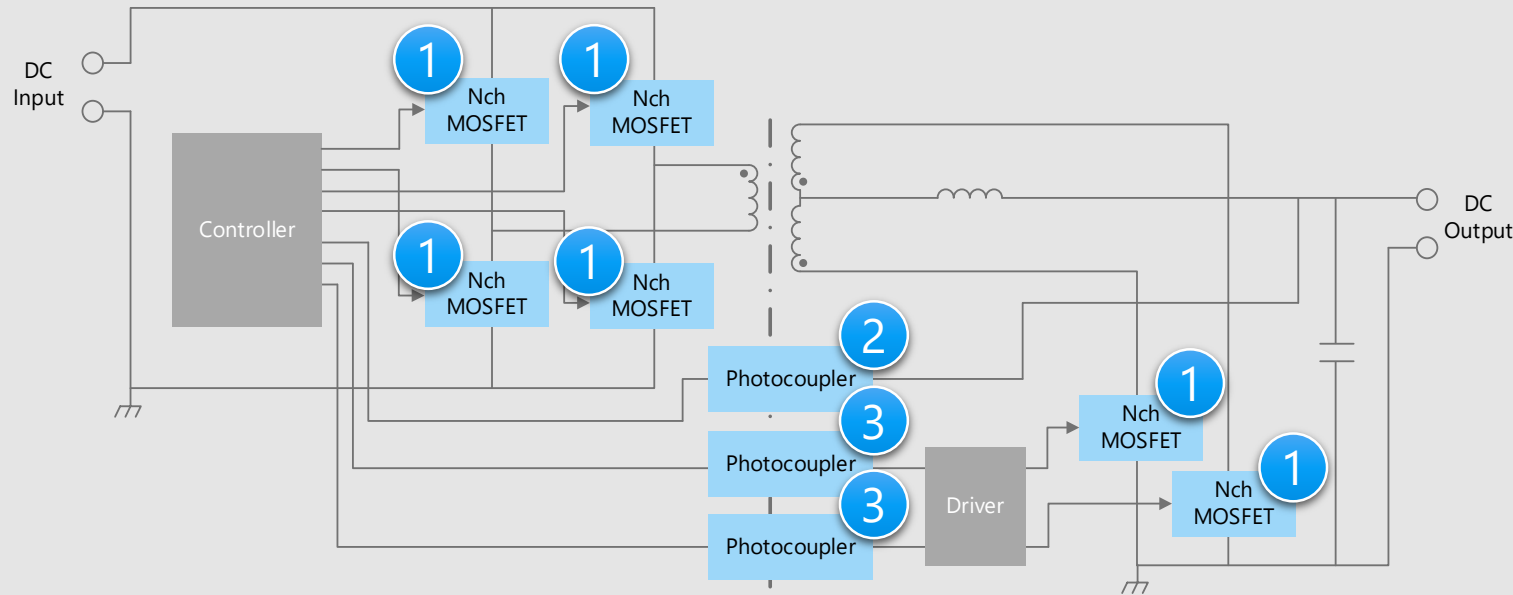
IC output photocoupler

Server Detail of the Server Power Supply Circuit (2)

DC-DC converters for 48 V systems

300 W Isolated DC-DC Converters Power Supply

($V_{IN(DC)} = 36 \text{ to } 75 \text{ V}$, $V_{OUT} = 12.0 \text{ V}$, $I_{OUT} = 25 \text{ A}$)



Reference Design from here →

[Click Here](#)

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

Device selection points

- A MOSFET having a high voltage and a low on-resistance is suitable for the PFC circuit of the DC-DC power supply.
- A transistor output photocoupler is typically used for feeding back voltages to the primary in the DC-DC power supply.
- The IC output coupler is used for signal isolation.

Proposals from Toshiba

- **Suitable for high-efficiency power supply switching**

U-MOS Series power MOSFET

- **Photocoupler with excellent environmental resistance**

Transistor output photocoupler

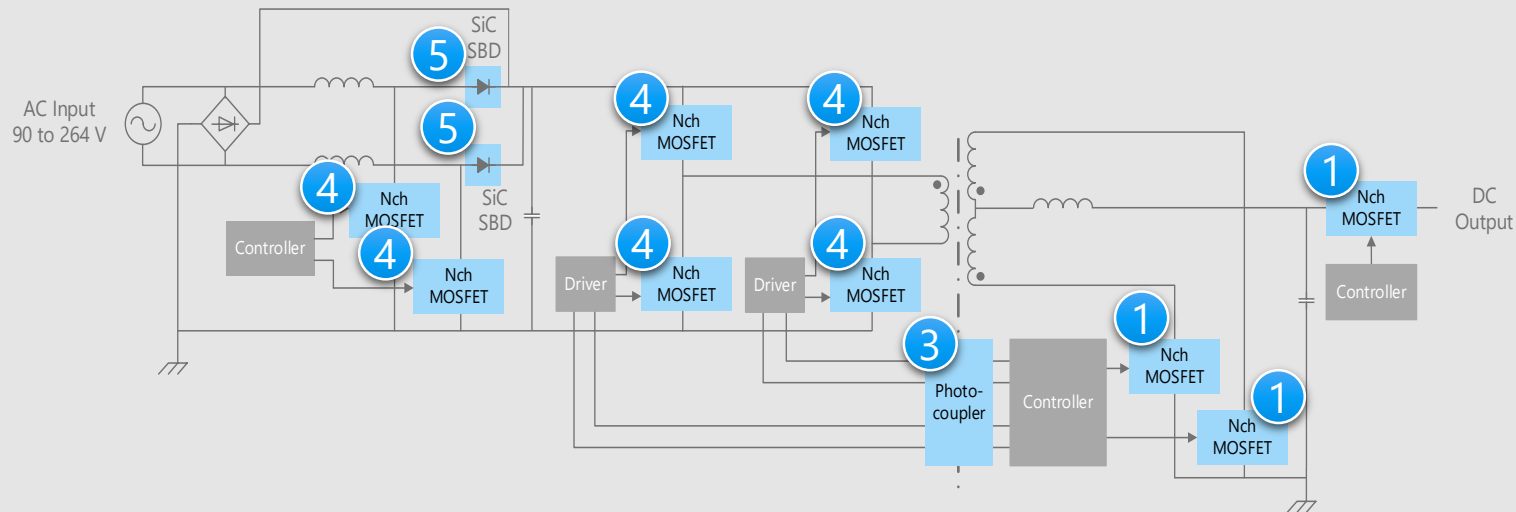
IC output photocoupler

Server Detail of the Server Power Supply Circuit (3)

AC-DC converters for 12 V systems (bridgeless PFCs)

1.6 kW power supply

($V_{IN(AC)} = 90 \text{ to } 264 \text{ V}$, $V_{OUT} = 12.0 \text{ V}$, $I_{OUT} = 66.7 \text{ A} / 133 \text{ A}$)



Reference Model of the power supply circuit from here →

[Click Here](#)

Reference Design of PFC Circuit from here →

[Click Here](#)

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

Device selection points

- A MOSFET having a high voltage and a low on-resistance is suitable for the PFC circuit of the AC-DC power supply.
- A transistor output photocoupler is typically used for feeding back voltages to the primary in the AC-DC power supply.
- The IC output coupler is used for signal isolation.

Proposals from Toshiba

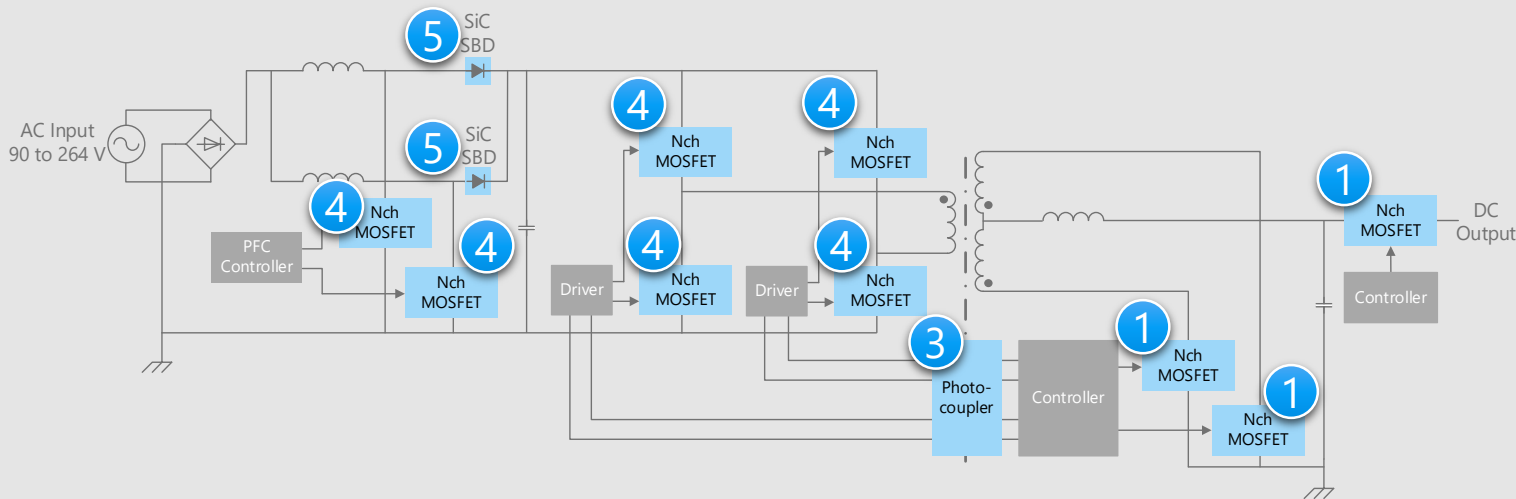
- **Suitable for high-efficiency power supply switching**
U-MOS Series power MOSFET 1
- **Photocoupler with excellent environmental resistance**
IC output photocoupler 3
- **Suitable for high-voltage power supply switching**
DTMOS Series power MOSFET 4
- **Preferred for high efficiency and miniaturization of power sources**
SiC Schottky barrier diode 5

Server Detail of the Server Power Supply Circuit (4)

AC-DC converters for 12 V systems (interleaved PFCs)

1.6 kW power supply

($V_{IN(AC)} = 90 \text{ to } 264 \text{ V}$, $V_{OUT} = 12.0 \text{ V}$, $I_{OUT} = 66.7 \text{ A} / 133 \text{ A}$)



Reference Model of the power supply circuit from here →

[Click Here](#)

Reference Design of PFC Circuit from here →

[Click Here](#)

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

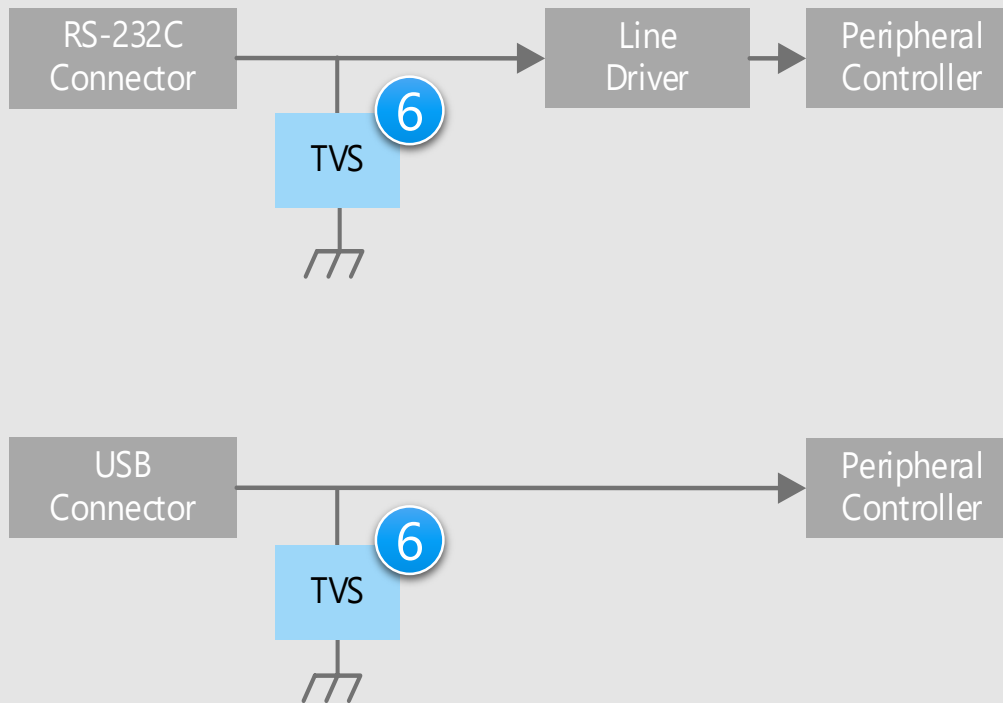
Device selection points

- A MOSFET having a high voltage and a low on-resistance is suitable for the PFC circuit of the AC-DC power supply.
- A transistor output photocoupler is typically used for feeding back voltages to the primary in the AC-DC power supply.
- The IC output coupler is used for signal isolation.

Proposals from Toshiba

- **Suitable for high-efficiency power supply switching**
U-MOS Series power MOSFET 1
- **Photocoupler with excellent environmental resistance**
IC output photocoupler 3
- **Suitable for high-voltage power supply switching**
DTMOS Series power MOSFET 4
- **Preferred for high efficiency and miniaturization of power sources**
SiC Schottky barrier diode 5

Peripheral interface



Device selection points

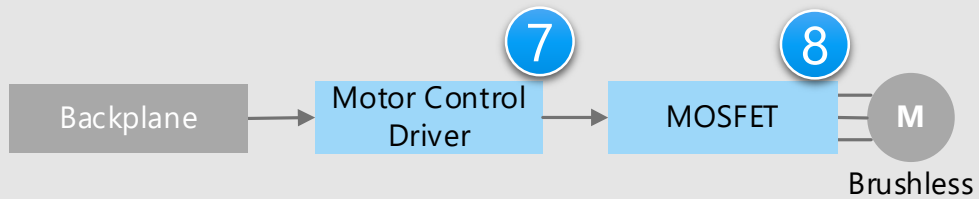
- To improve the reliability of the set, ESD protection is required for connectors that may come into contact with the human body.
- Small, low-Ct TVS diodes are suitable for ESD protection.

Proposals from Toshiba

- **Absorb static electricity (ESD) from external terminals to prevent malfunction of the circuit.**
- TVS diode

6

Fan unit



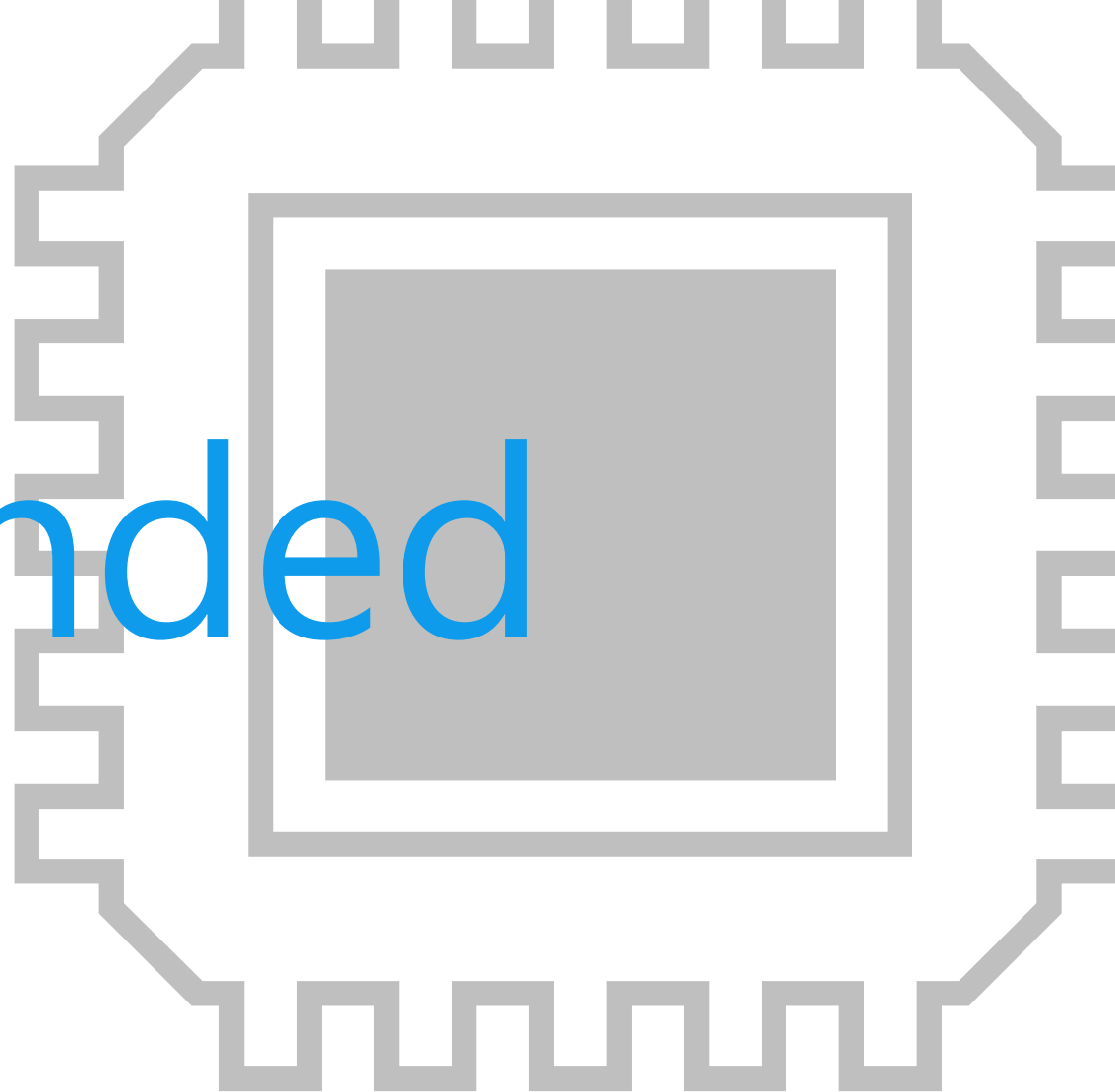
Device selection points

- Using brushless motor drivers, 3-phase brushless motors can be easily controlled

Proposals from Toshiba

- **Very easy control of motors**
Three-phase brushless DC motor driver IC (7)
- **Suitable for switching**
Semi-power MOSFET (8)

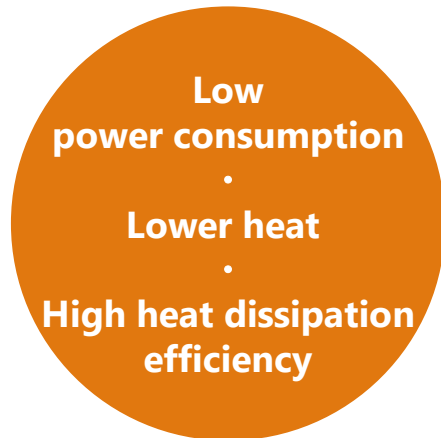
Recommended Devices



Device Solutions to Solve Customer Problems

As described above, in the design of the server system, "**Low power consumption and low heat generation**", "**Improved set reliability**" and "**Miniaturization of circuit boards**" are important factors. Toshiba's proposals are based on these three solution perspectives.

Low power consumption and
low heat generation



Improved set reliability



Miniaturization of
circuit boards



Device Solutions to Solve Customer Problems

Low
power consumption
•
Lower heat
•
High heat dissipation
efficiency

Noise
immunity

Small size
packages

①	U-MOS Series power MOSFET	●		●
②	Transistor output photocoupler		●	●
③	IC output photocoupler		●	●
④	DTMOS Series power MOSFET	●		●
⑤	SiC Schottky barrier diode	●		●
⑥	TVS diode		●	●
⑦	Three-phase brushless DC motor driver IC	●		●
⑧	Semi-power MOSFET	●		●

Value provided

Low $R_{DS(ON)}$ and high heat dissipation characteristics reduce the temperature of application.

1 Low on-resistance

Low $R_{DS(ON)}$ characteristics makes heat generation and power consumption small. Our $R_{DS(ON)}$ lineup starts from 0.36 m Ω .

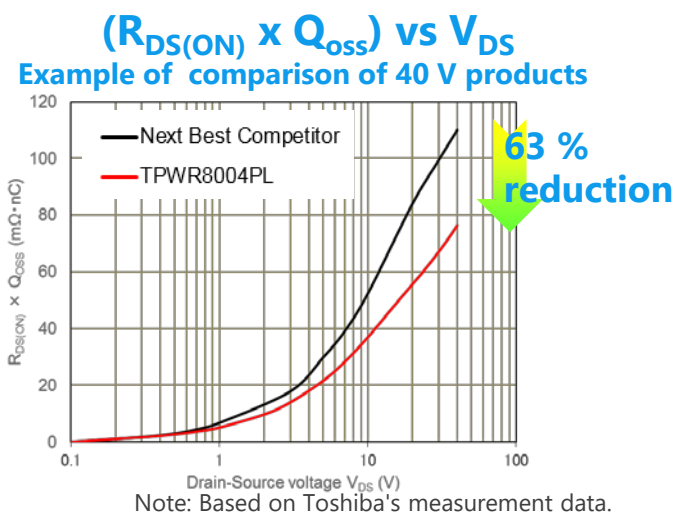
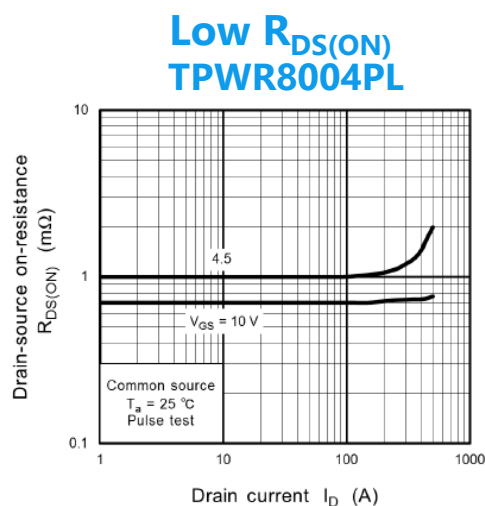
2 Small output charge Q_{oss}

The Q_{oss} is small and contributes to the reduction of power loss. The $R_{DS(ON)} \times Q_{oss}$ has been reduced by 63 % compared to that of the latest competitor's 40 V products. ^{Note1}




3 Wide variety of packages

Toshiba have a double-sided cooling package (DSOP Advance) with same footprint as SOP Advance. Wide package lineup for many kinds of applications.

Note1: As of Nov. 2017, products with the same rating, based on Toshiba's measurement data.



Line up

Part number	TPWR8004PL	TPHR7404PU	TPH1R306PL	TPH3R70APL
Package	DSOP Advance 	SOP Advance 	SOP Advance(N) 	
V_{DS} [V]	40	40	60	100
I_D [A]	150 (340*)	150 (400*)	100 (260*)	90 (150*)
$R_{DS(ON)}$ [m Ω] @ $V_{GS} = 10$ V	Typ.	0.65	0.51	1.0
	Max	0.80	0.74	1.34
Polarity	N-ch	N-ch	N-ch	N-ch
Generation	U-MOSIX-H	U-MOSIX-H	U-MOSIX-H	U-MOSIX-H

* : Silicon limit

[Return to Block Diagram TOP](#)

Value provided

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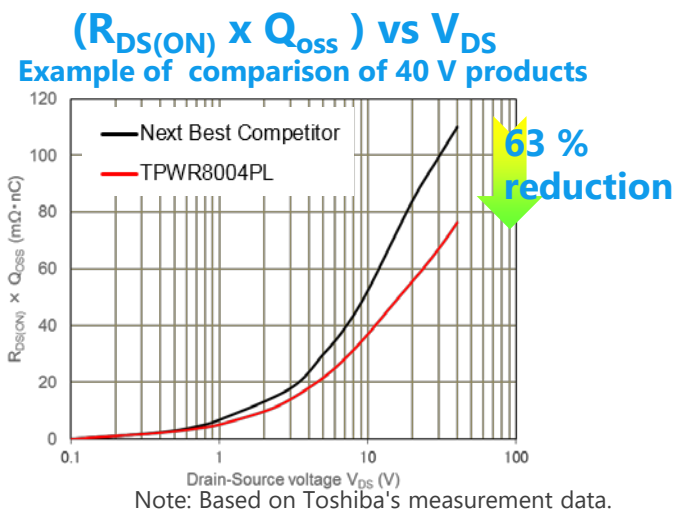
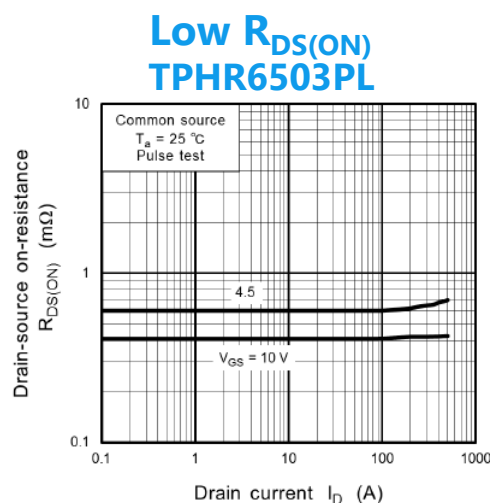
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Note1: As of Nov. 2017, products with the same rating, based on Toshiba's measurement data.



Line up

Part number	TPHR6503PL	TPHR9203PL	TPHR9003NC
Package	SOP Advance(N)		SOP Advance 
V_{DS} [V]	30	30	30
I_D [A]	150 (393*)	150 (280*)	60 (220*)
$R_{DS(ON)}$ [mΩ] @ $V_{GS} = 10\text{ V}$	Typ.	0.41	0.61
	Max	0.65	0.92
Polarity	N-ch	N-ch	N-ch
Generation	U-MOSIX-H	U-MOSIX-H	U-MOSVIII-H

* : Silicon limit

[Return to Block Diagram TOP](#)

Value provided

Low $R_{DS(ON)}$ and high heat dissipation characteristics reduce the temperature of application.

1 Low on-resistance

Low $R_{DS(ON)}$ characteristics makes heat generation and power consumption small. Our $R_{DS(ON)}$ lineup starts from 0.36 mΩ.

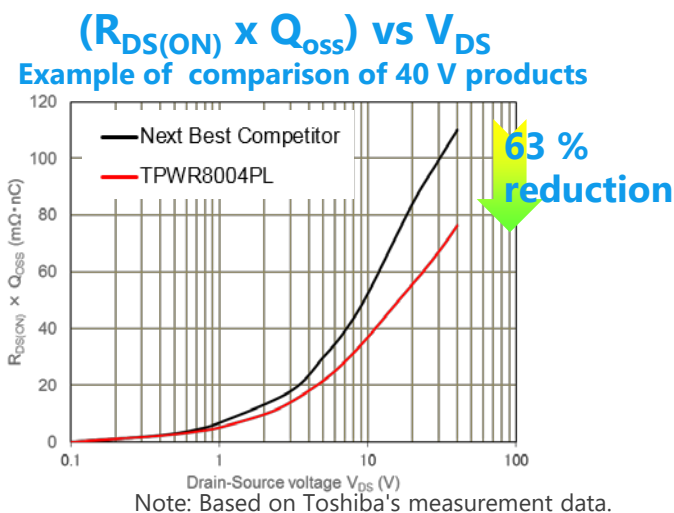
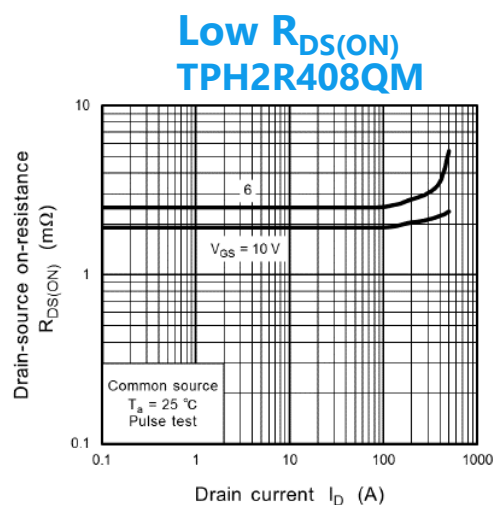
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Line up

Part number	TPH2R408QM	TPH4R008QM	TPN8R408QM	TPN12008QM	TPN19008QM	TK5R1P08QM	TK6R9P08QM	
Package	SOP Advance(N) 		TSOP Advance 			DPAK 		
V _{DSS} [V]	80	80	80	80	80	80	80	
I _D [A]	120 (200*)	86 (140*)	32 (77*)	26 (60*)	34 (38*)	84 (105*)	62 (83*)	
R _{DS(ON)} [mΩ] @V _{GS} = 10 V	Typ.	1.9	3.1	6.5	9.6	14.7	4.2	5.5
	Max	2.43	4	8.4	12.3	19	5.1	6.9
Polarity	N-ch	N-ch	N-ch	N-ch	N-ch	N-ch	N-ch	
Generation	U-MOSX-H	U-MOSX-H	U-MOSX-H	U-MOSX-H	U-MOSX-H	U-MOSX-H	U-MOSX-H	

* : Silicon limit

[Return to Block Diagram TOP](#)

Value provided

Contributing to the reduction of the board footprint area and the elimination of equipment maintenance by improving reliability.

1 High current transfer ratio

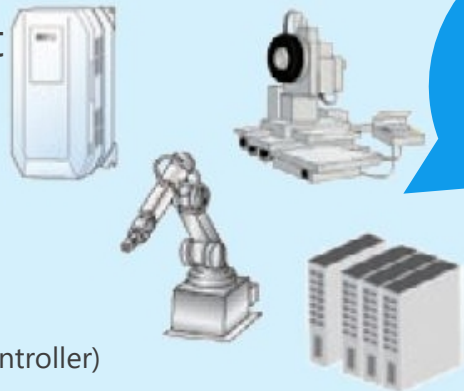
These are photo couplers of high isolation type that consists of a phototransistor optically coupled to an infrared LED. It achieves high current transfer ratio.

2 Wide operating temperature range

It is designed to operate even under severe ambient temperature conditions, such as inverters, robots, machinery, and high-output power supplies.

Industrial equipment

General-purpose inverter
Servo amplifier
Robot
Machine Tool
High-output power supply
Security equipment
Semiconductor tester
PLC (Programmable Logic Controller)



High level of
isolation and
noise
blocking

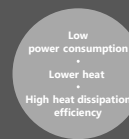
Line up

Part number	TLP383	TLP291(SE)
Package	4pin SO6L 	SO4 
BV_S (Min) [Vrms]	5000	3750
T_{opr} [°C]	-55 to 125	-55 to 110

[◆Return to Block Diagram TOP](#)

3 IC output photocoupler

TLP2767 / TLP2370



Value provided

Photocoupler that consists of an infrared light-emitting diode and an integrated photodetector with high gain and high speed.

1 High speed

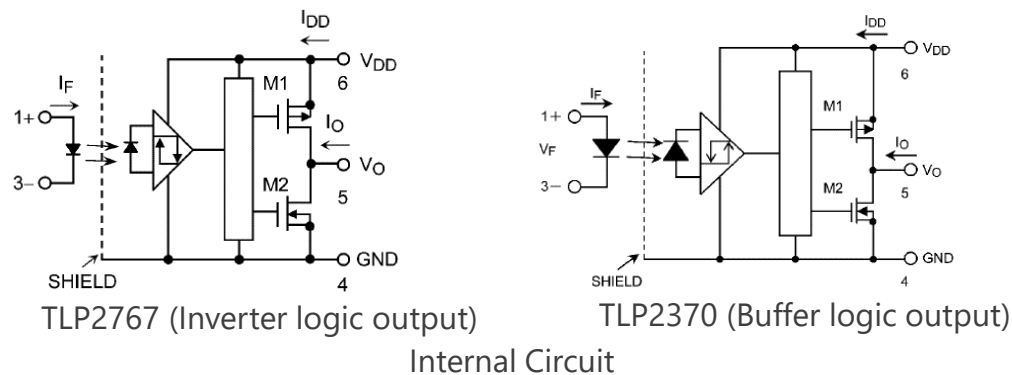
The propagation delay is 20 ns (Max) for TLP2767 and 60 ns (Max) for TLP2370. Margin design becomes easier than general phototransistor couplers.

2 Operating temperature is expanded to 125 °C

It is designed to operate even under severe ambient temperature conditions, such as inverters, robots, machinery, and high-output power supplies.

3 Wide range of power supply voltages 2.7 to 5.5 V

The products can be used even in systems in which 3.3 V and 5.0 V are mixed, thereby possible to standardize components.



Line up

Part number	TLP2767	TLP2370
Package	SO6L 	SO6 (5pin) 
V_{CC} [V]	2.7 to 5.5	2.7 to 5.5
I_{CC} (Max) [mA]	2.5	0.4
T_{pd} (Max) [ns]	20	60
BV_S (Min) [Vrms]	5000	3750
T_{opr} [°C]	-40 to 125	-40 to 125

[◆Return to Block Diagram TOP](#)

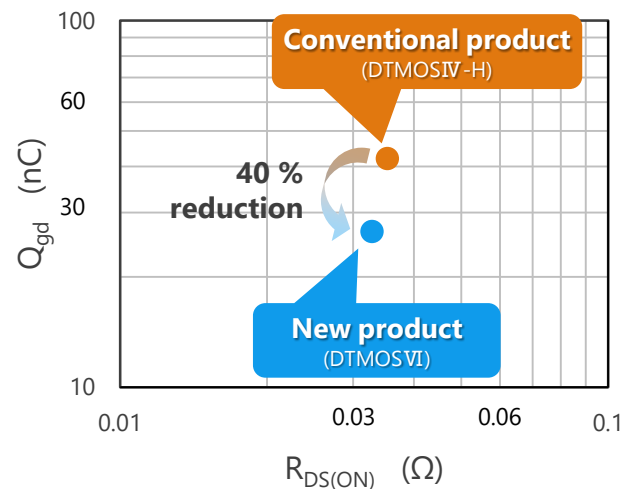
Value provided

The $R_{DS(ON)} \times Q_{gd}$ is reduced by 40 % (compared with Toshiba's conventional products) to improve power efficiency, and contributing to miniaturization of the set.

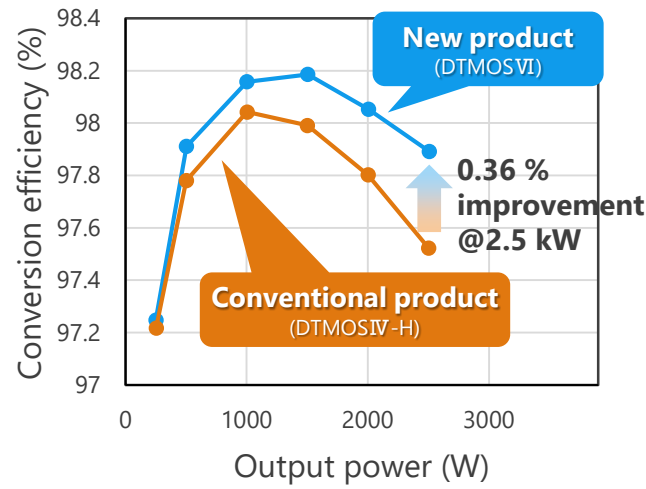
1 $R_{DS(ON)} \times Q_{gd}$ 40 % reduction

The $R_{DS(ON)} \times Q_{gd}$ of figure of merit has been reduced by 40 % with gate design and process optimization.

(Comparison of DTMOSIV-H Products: Toshiba internal comparison)



(Note: Toshiba internal comparison)








(Note: Toshiba internal comparison)

2 Various package lineup

Various package lineup from the TO-247-4L package with Kelvin terminal to thin SMD package (DFN 8x8) with package thickness 0.85 mm.

Line up

Part number	TK040N65Z	TK040Z65Z	TK090A65Z	TK099V65Z	TK090U65Z
Package	TO-247 	TO-247-4L 	TO-220SIS 	DFN 8x8 	TOLL 
V_{DS} [V]	650	650	650	650	650
I_D [A]	57	57	30	30	30
$R_{DS(ON)}$ [Ω] @ $V_{GS} = 10$ V	Typ.	0.033	0.033	0.075	0.080
	Max	0.040	0.040	0.090	0.099
Polarity	N-ch	N-ch	N-ch	N-ch	N-ch
Generation	DTMOSVI	DTMOSVI	DTMOSVI	DTMOSVI	DTMOSVI

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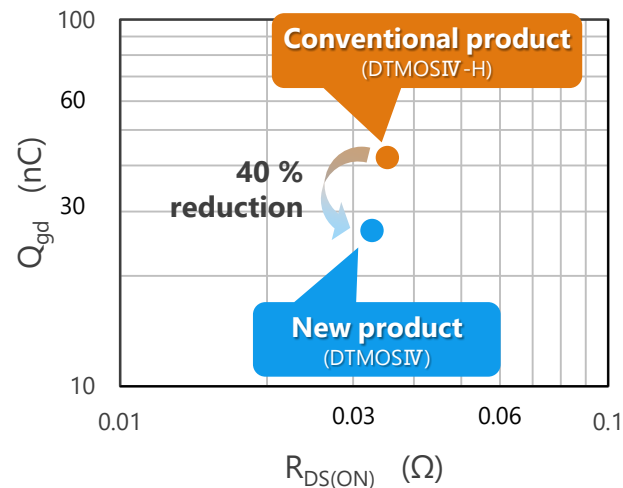
Value provided

The $R_{DS(ON)} \times Q_{gd}$ is reduced by 40 % (compared with Toshiba's conventional products) to improve power efficiency, and contributing to miniaturization of the set.

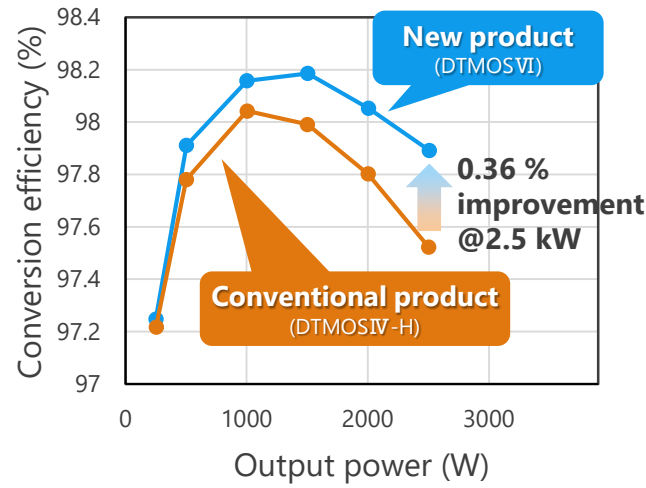
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(Comparison of DTMOSIV-H Products: Toshiba internal comparison)



(Note: Toshiba internal comparison)



(Note: Toshiba internal comparison)

2 Various package lineup

Various package lineup from the TO-247-4L package with Kelvin terminal to thin SMD package (DFN 8x8) with package thickness 0.85 mm.

Line up

Part number	TK110N65Z	TK110Z65Z	TK110A65Z	TK125V65Z	TK110U65Z	TK155U65Z
Package	TO-247	TO-247-4L	TO-220SIS	DFN 8x8	TOLL	
V_{DS} [V]	650	650	650	650	650	650
I_D [A]	24	24	24	24	24	18
$R_{DS(ON)}$ [Ω] @ $V_{GS} = 10$ V	Typ. 0.092	0.092	0.092	0.105	0.086	0.122
	Max 0.11	0.11	0.11	0.125	0.11	0.155
Polarity	N-ch	N-ch	N-ch	N-ch	N-ch	N-ch
Generation	DTMOSVI	DTMOSVI	DTMOSVI	DTMOSVI	DTMOSVI	DTMOSVI

[Return to Block Diagram TOP](#)

Value provided

Applicable to PFC circuits or a wide range of power supply applications, and greatly contributes to miniaturization.

1 High surge current capability

The surge current (I_{FSM}) is improved than 1st Gen. product.
 $I_{FSM} = 97$ [A] (Max) (TRS12E65F)
 Surge current is increased around 2 times of the first generation by using improved JBS (Junction Barrier Schottky) structure.

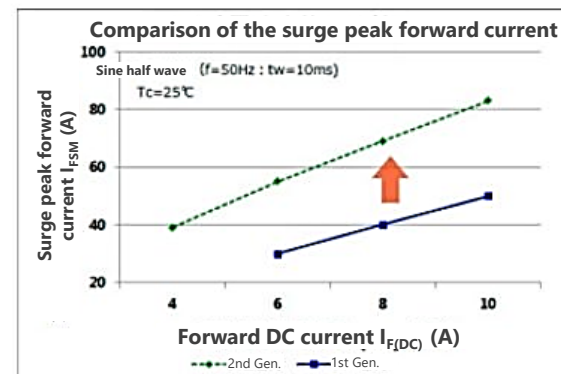
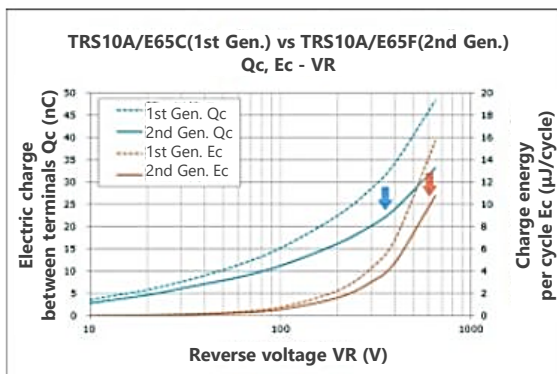
2 Second-generation chip design

The figure of merit ($V_F \times Q_C$) ^{Note1} is improved by 30 % than 1st gen. product.

3 Small package



Provided in TO-220F-2L through-hole type package.

Comparison between Toshiba's 1st and 2nd 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	TRS8E65F	TRS12E65F	TRS12N65FB	TRS16N65FB	TRS20N65FB	TRS24N65FB
Package	TO-220-2L 	TO-247 (Center tap) 				
V_{RRM} [V]	650	650	650	650	650	650
$I_{F(DC)}$ [A]	8	12	6 / 12 *	8 / 16 *	10 / 20 *	12 / 24 *
I_{FSM} [A]	69	97	52 / 104 *	65 / 130 *	79 / 158 *	92 / 184 *
V_F (Typ.) [V]	1.2 @ $I_F = 4$ A	1.45 @ $I_F = 12$ A	1.45 @ $I_F = 6$ A	1.45 @ $I_F = 8$ A	1.45 @ $I_F = 10$ A	1.45 @ $I_F = 12$ A

* : Per Leg / Both Legs

[Return to Block Diagram TOP](#)

Value provided

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

1 Improved ESD 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.

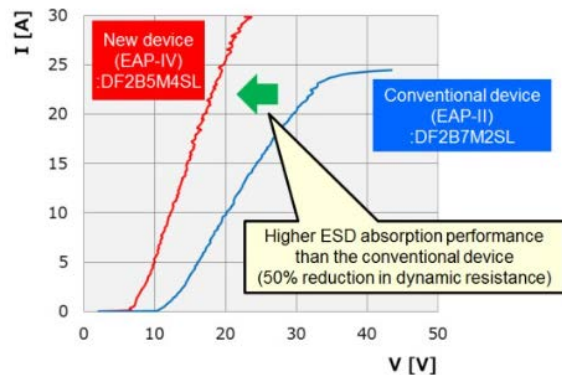
2 Suppress ESD energy by low clamp voltage

Steadily protect the connected circuits/devices using proprietary technology.

3 Optimal 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	DF2B7ASL	DF2B5M4SL	DF2B6M4SL
Package	SL2 		
V_{ESD} [kV]	± 30	± 20	± 20
V_{RWM} (Max) [V]	5.5	3.6	5.5
C_t (Typ.) [pF]	8.5	0.2	0.2
R_{DYN} (Typ.) [Ω]	0.2	0.5	0.5
Purpose	Power line protection	Signal 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

1 hall sine wave PWM control driver for 3-phase brushless DC motor. It is suitable for controlling server fans.

1 1 hall phase difference detection circuit

Monitoring 1 hall component output voltage and controlling a motor. Possible to reduce motor unit BOM cost.

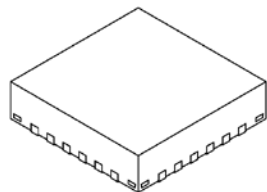
2 Closed loop speed control

Configurable speed curve by setting built-in NVM without an external MCU. It contributes motor unit BOM cost.

3 Small package

VQFN24 and WQFN36 is suitable for limited foot print area.

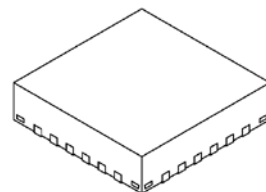
TC78B025FTG / TC78B027FTG



VQFN24

(4 mm x 4 mm x 1 mm)

TC78B009FTG



WQFN36

(5 mm x 5 mm x 0.8 mm)

Line up

Part number	TC78B025FTG	TC78B027FTG	TC78B009FTG
Operation voltage [V]	4.5 to 16	5 to 16	5.5 to 27
Drive type	Sine wave PWM drive		PWM drive
Others	1 hole component input position detection		Sensorless
	Closed loop speed control function, Configurable speed curve		
	Stand by mode		
	Soft start		
Package	Built-in driver (3.5 A (Max))		Built-in pre driver for Nch FET drive
	VQFN24		WQFN36

[◆Return to Block Diagram TOP](#)

Value provided

Low on-resistance, small and high power dissipation packages contributes to miniaturization and low power consumption of the systems.

1 Low loss (reduced chip resistance)

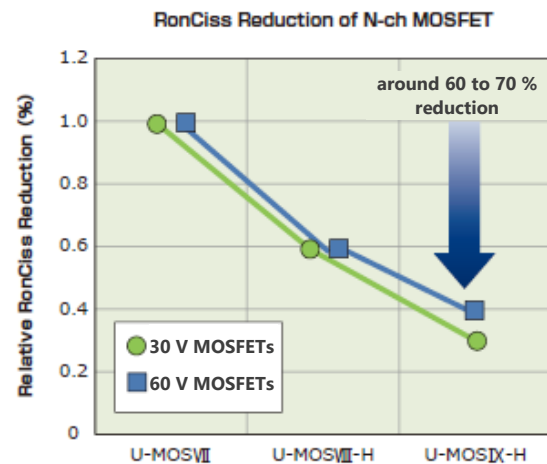
Using low chip resistance technology to contribute to reduced power consumption systems.

2 Small and high heat-dissipating package

Small and high heat-dissipating packages (UDFN6B, SOT-23F) contributes to space saving during mounting.



3 Low voltage drive

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



(Note: Toshiba internal comparison)

Line up

Part number		SSM6K341NU	SSM3K341R
Package		UDFN6B 	SOT-23F 
$V_{DS(DC)}$ [V]		60	60
I_D [A]		6	6
$R_{DS(ON)}$ [mΩ] @ $V_{GS} = 4.5$ V	Typ.	36	36
	Max	51	51
Polarity		N-ch	N-ch

[Return to Block Diagram TOP](#)

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