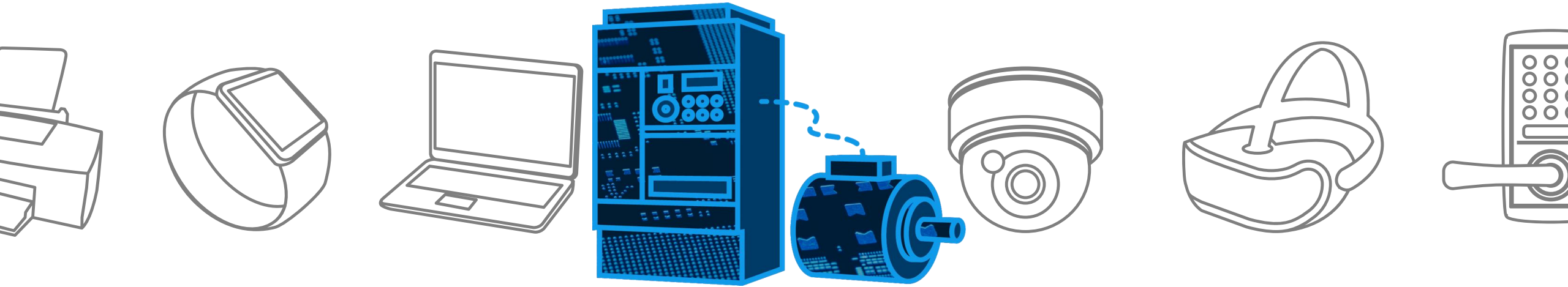
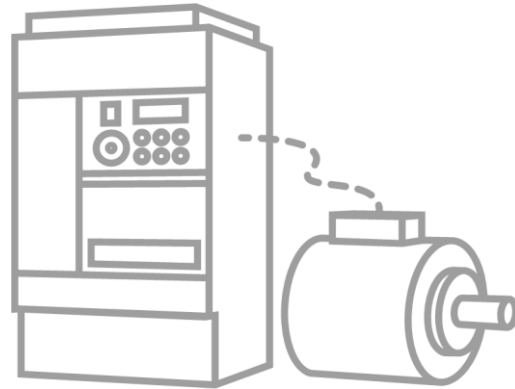
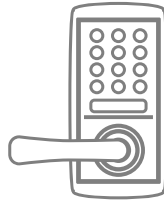


Inverter/Servo

Solution Proposal by Toshiba

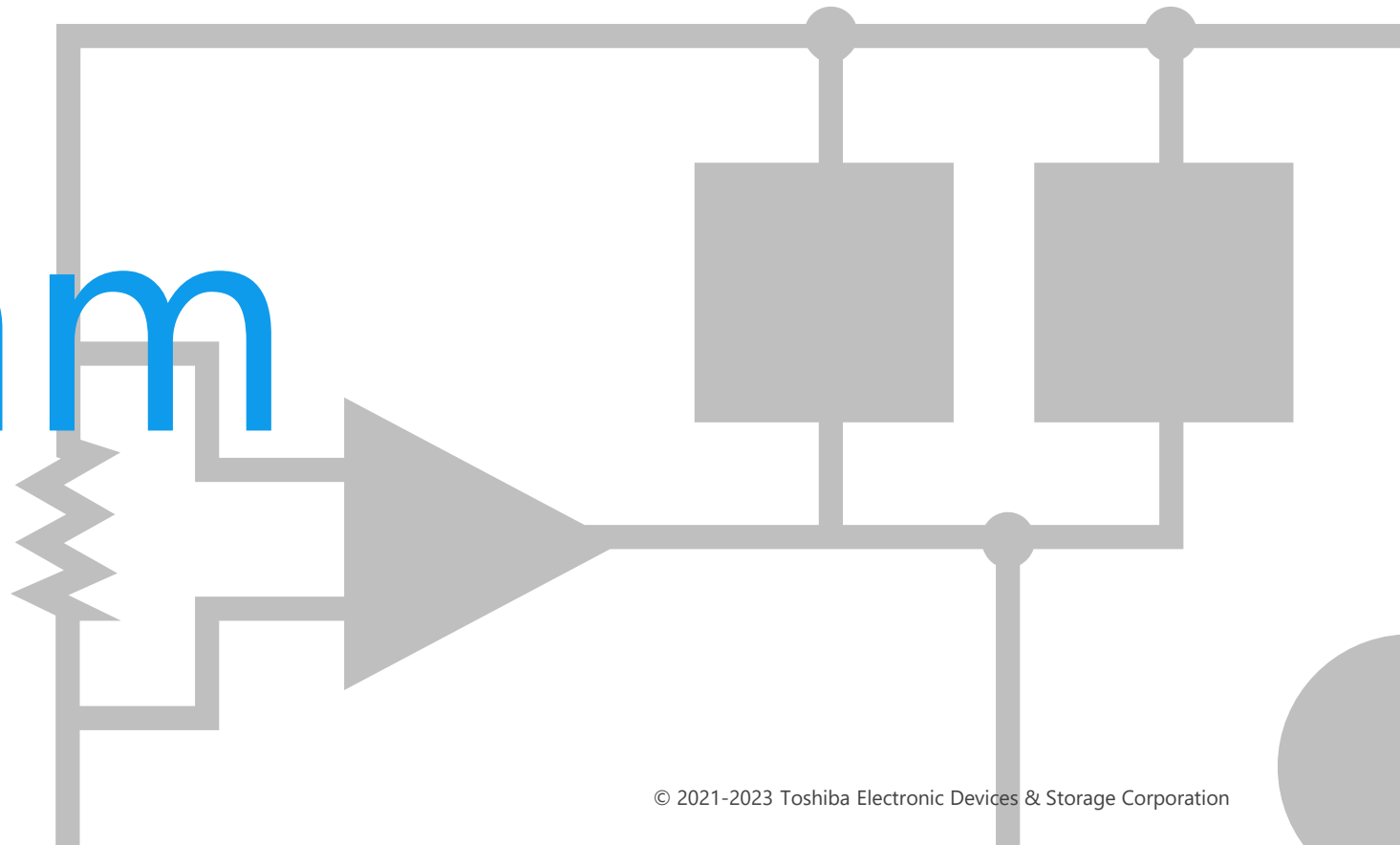




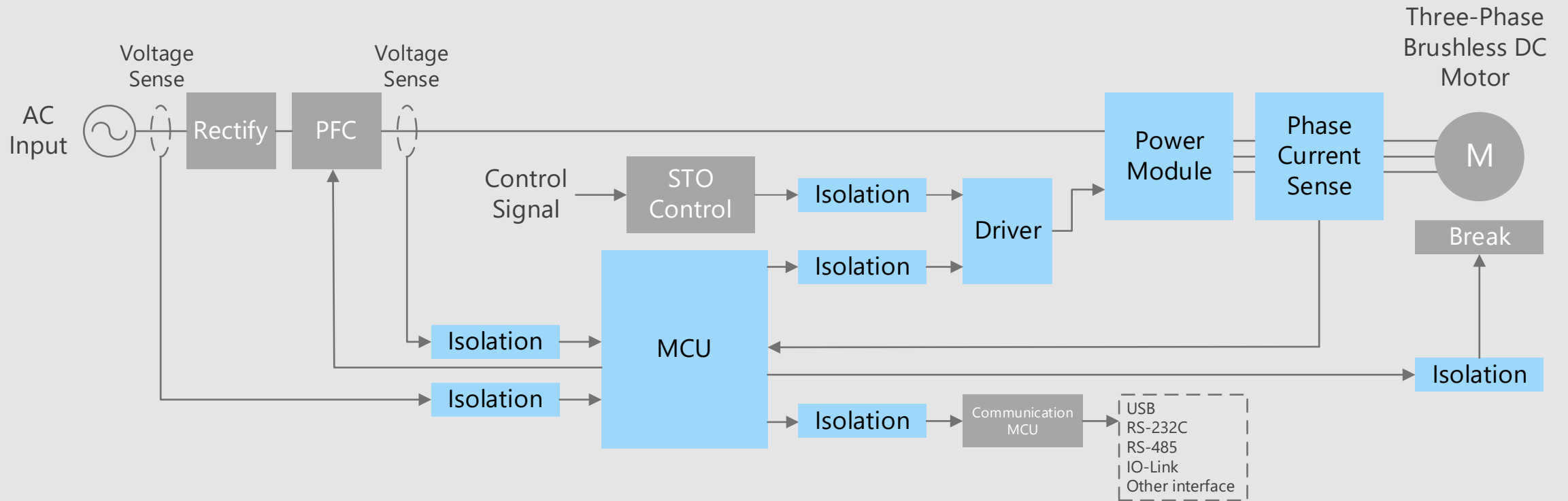
Toshiba Electronic Devices & Storage Corporation provides comprehensive device solutions to customers developing new products by applying its thorough understanding of the systems acquired through the analysis of basic product designs.



Block Diagram

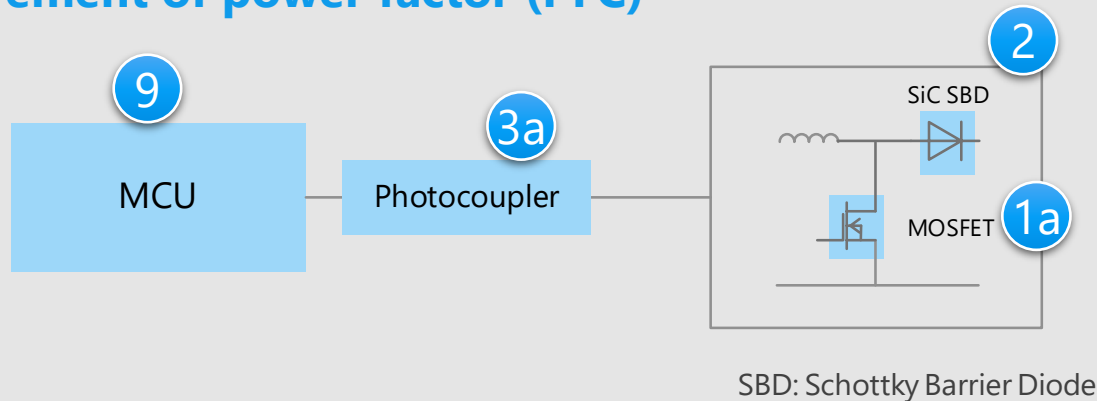


Inverter/Servo Overall block diagram

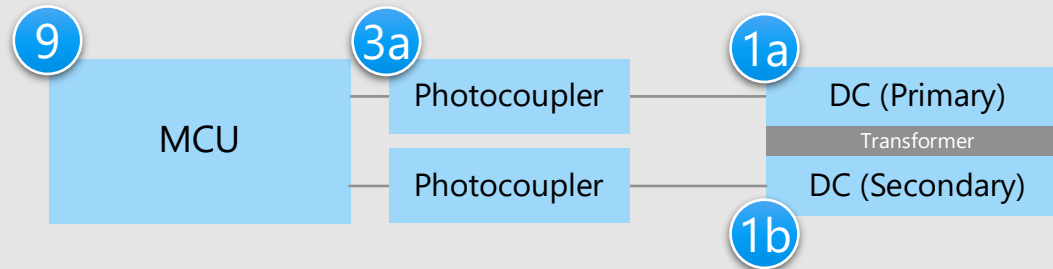


Inverter/Servo Detail of power supply circuit

Improvement of power factor (PFC)



DC-DC converter



Criteria for device selection

- A high voltage MOSFET with high speed recovery diodes is suitable for DC-DC converters.
- SiC type Schottky barrier diodes are suitable for PFC circuits.

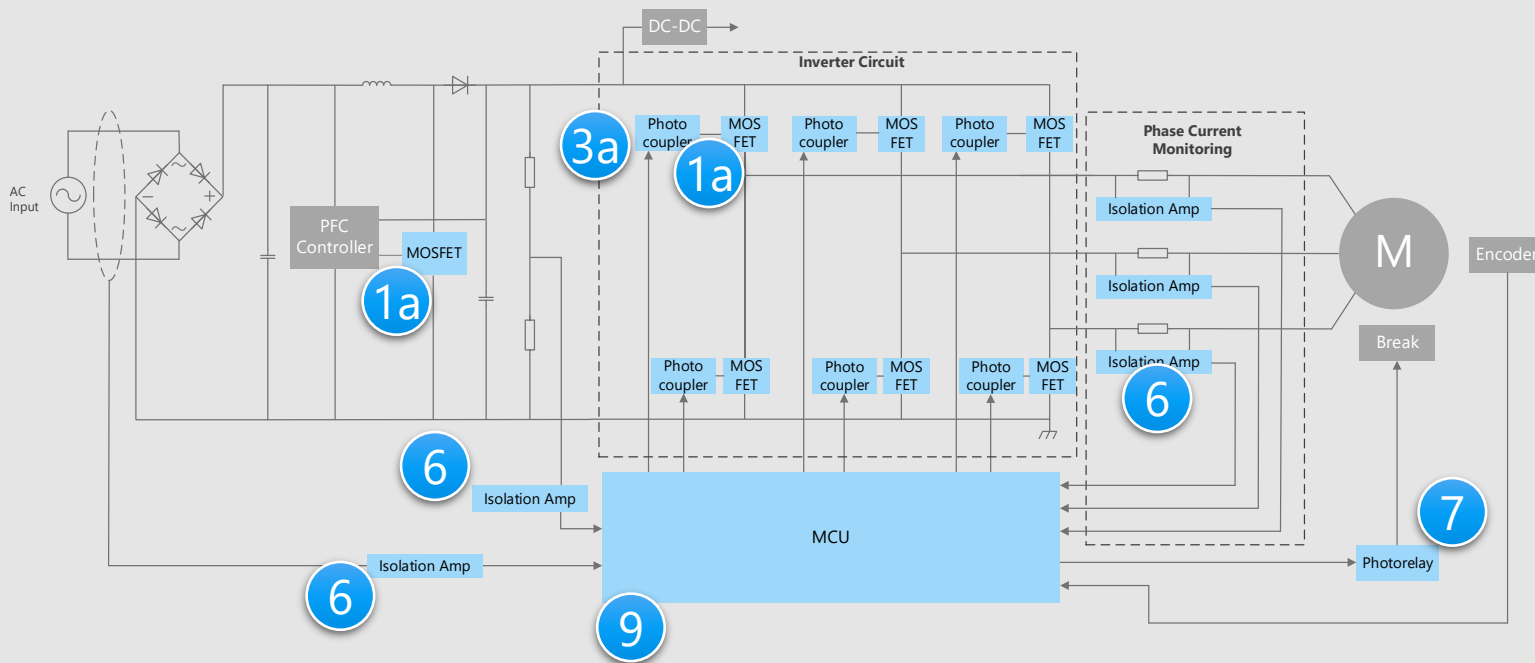
Proposals from Toshiba

- **Suitable for high efficiency power supply switching** (1a)
 - DTMOS Series MOSFET (1b)
 - U-MOS Series MOSFET (1b)
- **Small $V_F \times Q_C$ and high surge current capability** (2)
 - SiC Schottky barrier diode (2)
- **Photocoupler that is resistant to noise and can operate at high temperature** (3a)
 - Gate driver photocoupler (for MOSFET/IPM driving) (3a)
- **Easy software development using general purpose CPU cores** (9)
 - MCU M4K Group / M470 Group / M370 Group (9)

* Click on the numbers in the circuit diagram to jump to the detailed descriptions page

Inverter/Servo Detail of motor driving circuit (1)

Motor driving circuit (with MOSFETs)



Criteria for device selection

- The use of photocouplers and photorelays realizes the signal transmission between the systems with different voltage levels, and suppress the noise influences.
- The use of photorelays instead of mechanical relays eliminates the life limitation caused by contact wear and welding at the contact points, enabling long life and quieter operation.

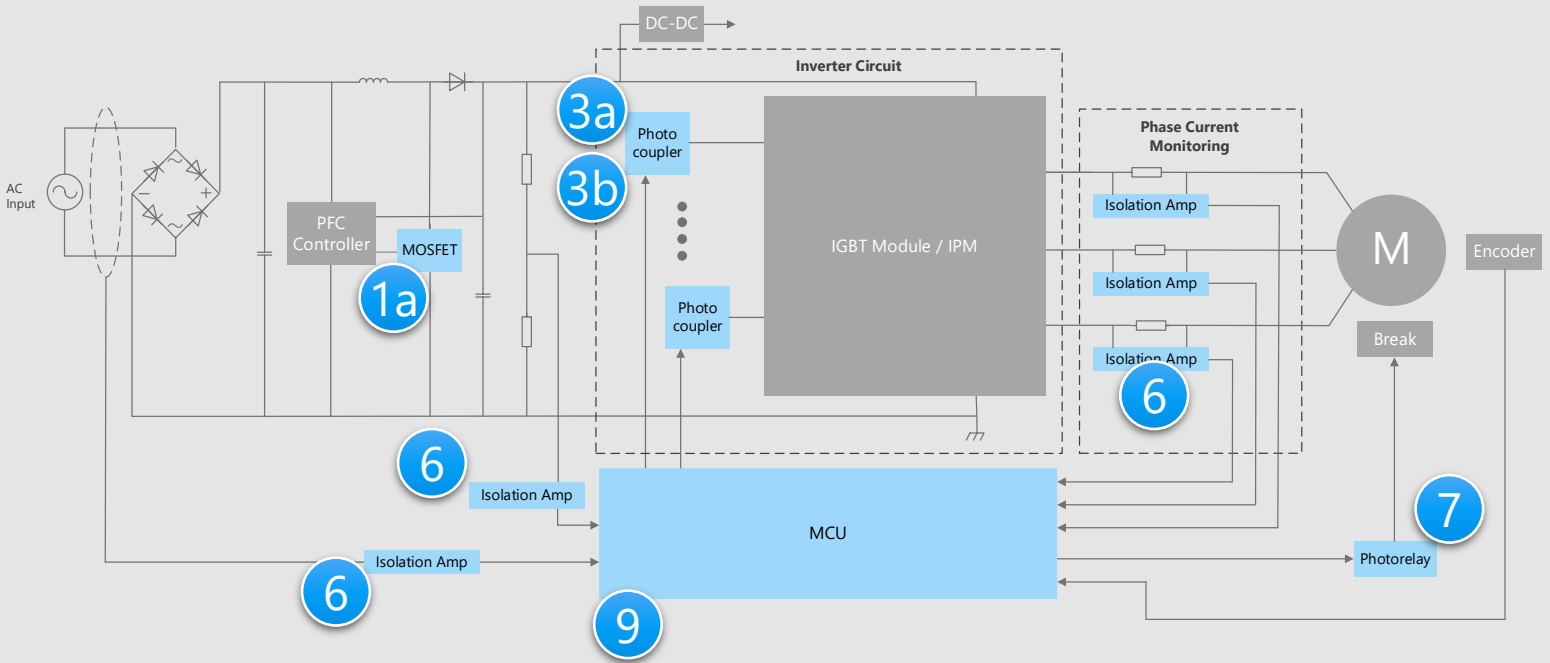
Proposals from Toshiba

- **Suitable for high efficiency power supply switching**
DTMOS Series MOSFET 1a
- **Photocoupler that is resistant to noise and can operate at high temperature**
Gate driver photocoupler (for MOSFET/IPM driving) 3a
- **Isolation amplifiers suitable for current and voltage detection circuits**
Isolation amplifier 6
- **Photorelays suitable for replacing mechanical relays**
Photorelay 7
- **Easy software development using general purpose CPU cores**
MCU M4K Group / M470 Group / M370 Group 9

* Click on the numbers in the circuit diagram to jump to the detailed descriptions page

Inverter/Servo Detail of motor driving circuit (2)

Motor driving circuit (with IGBT Module/IPM)



Criteria for device selection

- The use of photocouplers and photorelays realizes the signal transmission between the systems with different voltage levels, and suppress the noise influences.
- The use of photorelays instead of mechanical relays eliminates the life limitation caused by contact wear and welding at the contact points, enabling long life and quieter operation.

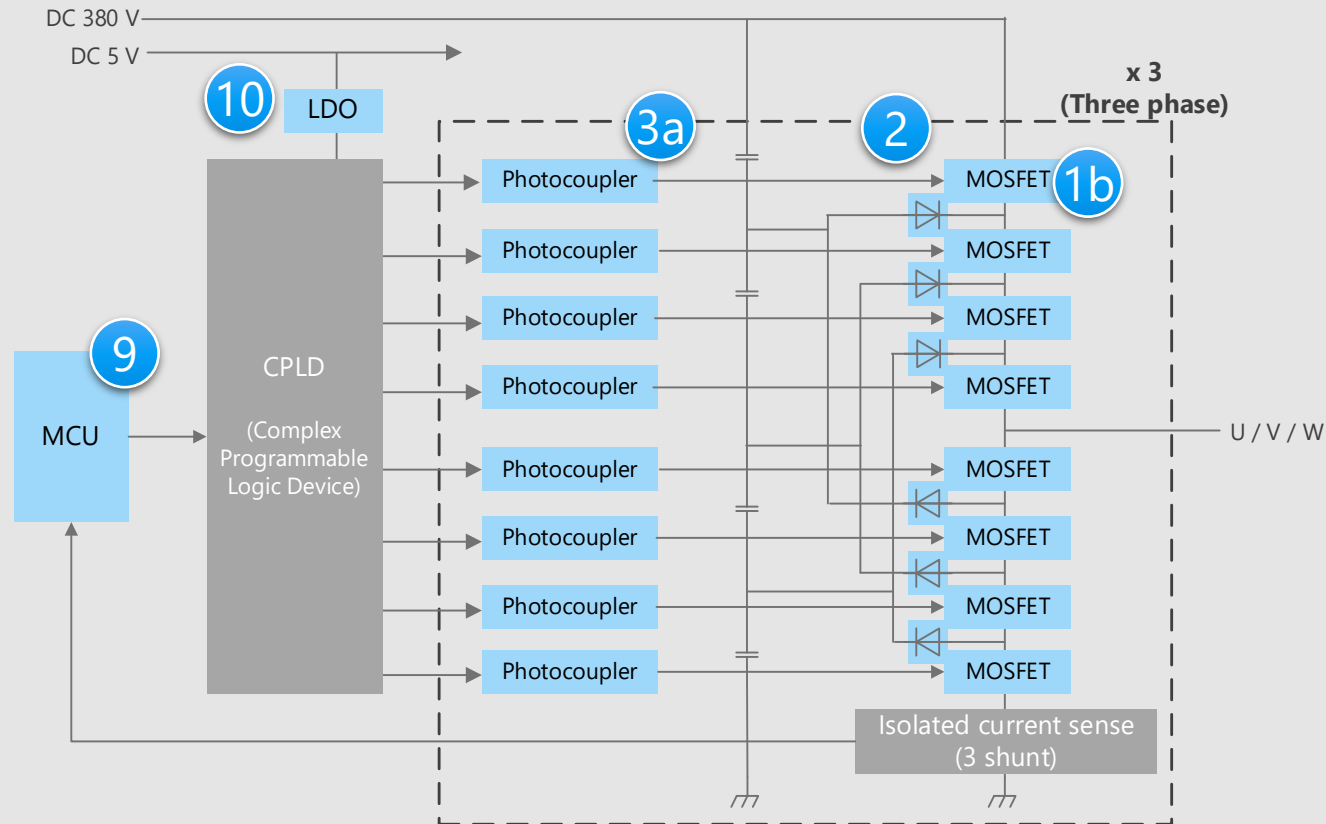
Proposals from Toshiba

- **Suitable for high efficiency power supply switching**
DTMOS Series MOSFET
- **Photocouplers that are resistant to noise and can operate at high temperature**
Gate driver photocoupler (for MOSFET/IPM driving)
Gate driver photocoupler (for IGBT driving)
- **Isolation amplifiers suitable for current and voltage detection circuits**
Isolation amplifier
- **Photorelays suitable for replacing mechanical relays**
Photorelay
- **Easy software development using general purpose CPU cores**
MCU M4K Group / M470 Group / M370 Group

- 1a
- 3a
- 3b
- 6
- 7
- 9

* Click on the numbers in the circuit diagram to jump to the detailed descriptions page

Multi-level motor driving circuit (with MOSFETs)



Criteria for device selection

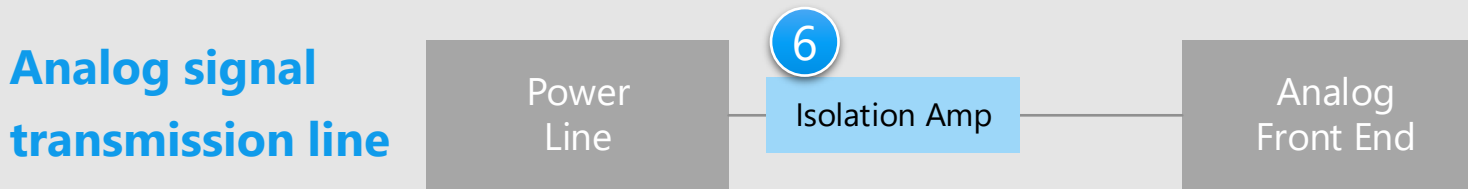
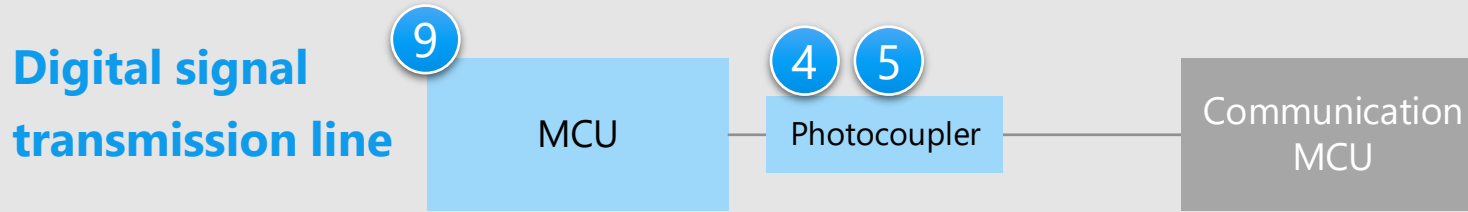
- In a multi-level motor driving circuit, switching devices with low voltage and low on-resistance can be used, enabling efficient power conversion.
- The use of photocouplers and photorelays realizes the signal transmission between the systems with different voltage levels, and suppress the noise influences.

Proposals from Toshiba

- **Suitable for high efficiency power supply switching**
U-MOS Series MOSFET
- **Small $V_F \times Q_C$ and high surge current capability**
SiC Schottky barrier diode
- **Photocoupler that is resistant to noise and can operate at high temperature**
Gate driver photocoupler (for MOSFET/IPM driving)
- **Easy software development using general purpose CPU cores**
MCU M4K Group / M470 Group / M370 Group
- **Supply the power with low noise**
Small surface mount LDO regulator



* Click on the numbers in the circuit diagram to jump to the detailed descriptions page



Criteria for device selection

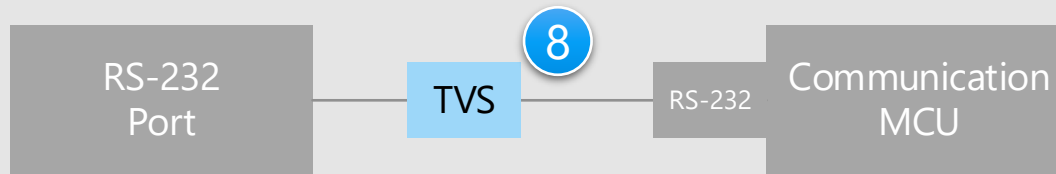
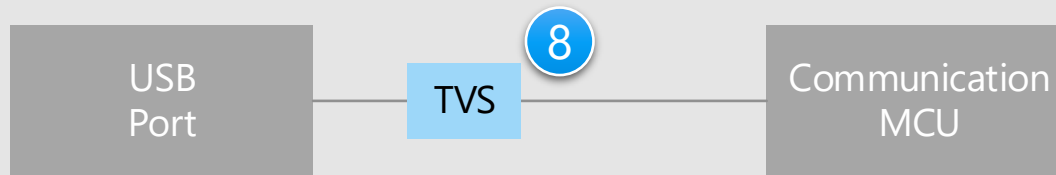
- Photocouplers are suitable for isolation in digital signal transmission lines.
- Isolation amplifiers are suitable for isolation between the high voltage circuit and various detection circuits.

Proposals from Toshiba

- **Photocouplers that are resistant to noise and can operate at high temperature** 4
Photocoupler for high speed communication
Transistor output photocoupler 5
- **Isolation amplifiers suitable for current and voltage detection circuits** 6
Isolation amplifier
- **Easy software development using general purpose CPU cores** 9
MCU M4K Group / M470 Group / M370 Group

* [Click on the numbers in the circuit diagram to jump to the detailed descriptions page](#)

Interface circuits



Criteria for device selection

- TVS diode with a low capacitance is suitable for ESD protecting the USB signal line.

Proposal from Toshiba

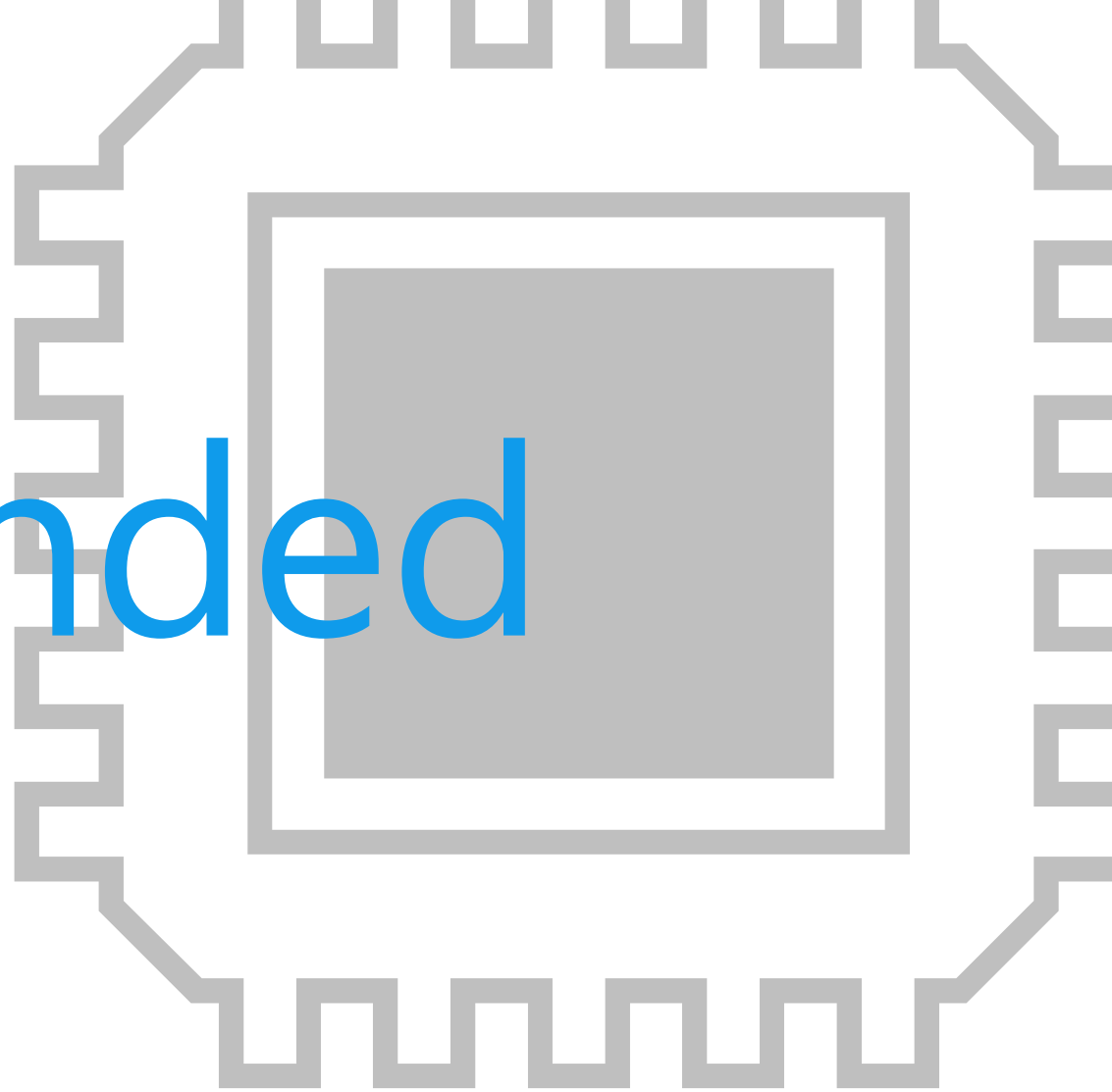
- **Prevent circuit malfunctions and protect devices by absorbing electrostatic discharge from external terminals**

TVS diode

8

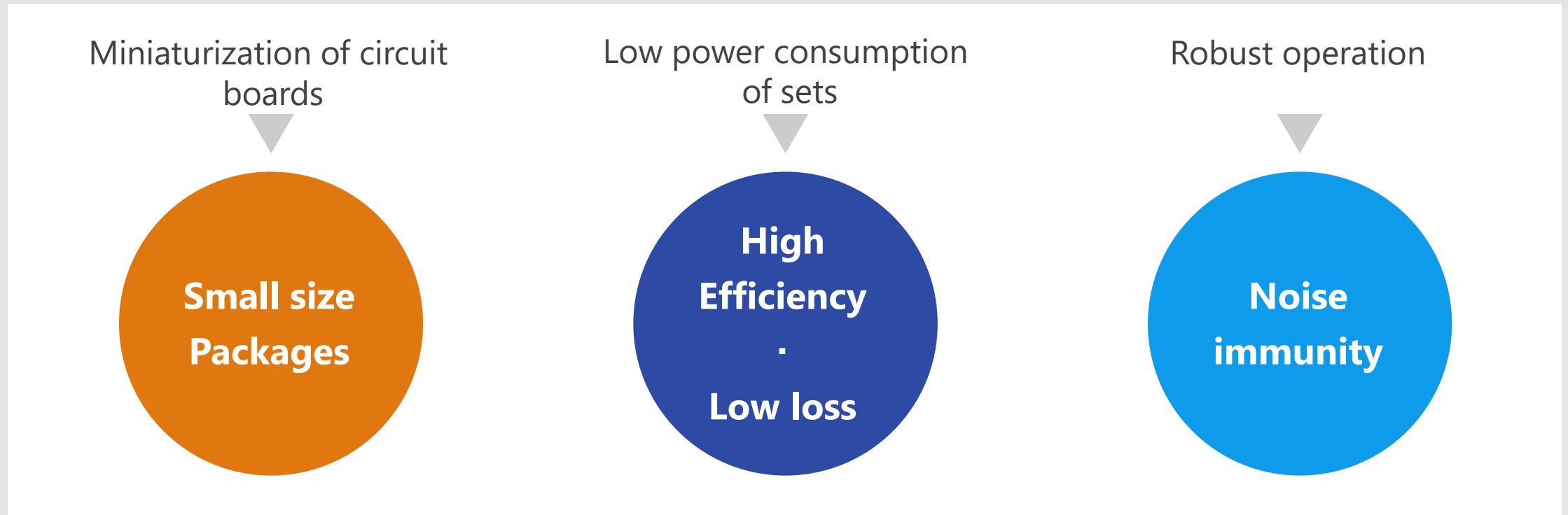
* Click on the numbers in the circuit diagram to jump to the detailed descriptions page

Recommended Devices



Device solutions to address customer needs

As described above, in the design of inverter/servo system, "**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 address customer needs

Small size packages

High Efficiency
·
Low loss

Noise immunity

1a	DTMOS Series MOSFET	●	●	●
1b	U-MOS Series MOSFET	●	●	●
2	SiC Schottky barrier diode	●	●	●
3a	Gate driver photocoupler (for MOSFET/IPM driving)	●	●	●
3b	Gate driver photocoupler (for IGBT driving)	●	●	●
4	Photocoupler for high speed communication	●	●	●
5	Transistor output photocoupler	●	●	●
6	Isolation amplifier	●	●	●
7	Photorelay	●	●	●

Device solutions to address customer needs

Small size packages

High Efficiency
·
Low loss

Noise immunity

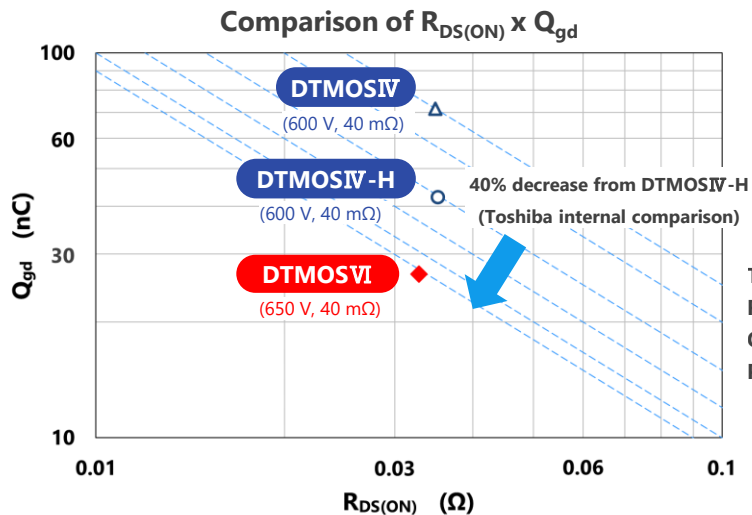
8	TVS diode	●		●
9	MCU M4K Group / M470 Group / M370 Group	●	●	
10	Small surface mount LDO regulator	●	●	●

Value provided

DTMOS series contribute to provide highly efficient power supply by improving $R_{DS(on)} \times Q_{gd}$.

1 $R_{DS(on)} \times Q_{gd}$ improvement

In the DTMOSVI series, the $R_{DS(on)} \times Q_{gd}$ is reduced by approximately 40 % compared with Toshiba's conventional DTMOSIV-H series product by optimizing the gate structure design and processes. (Based on Toshiba's measurement data as of March, 2023)





Test Condition
 $R_{DS(on)}$: $I_D = 28.5 \text{ A}, V_{GS} = 10 \text{ V}$
 Q_{gd} : $V_{DD} = 400 \text{ V}, I_D = 57 \text{ A}, V_{GS} = 10 \text{ V}$
 Plots the mean of the measured values.
 (Based on Toshiba's measurement data as of March, 2023)

2 Body diode reverse recovery characteristics

High speed body diode reduces recovery loss and contributes to higher efficiency of power supply. (TK16A60W5)

Lineup

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	15.8	24	15	24	15
$R_{DS(on)}$ [Ω] @ V _{GS} = 10 V	Typ.	0.105	0.18	0.092	0.158	0.086
	Max	0.125	0.23	0.11	0.19	0.11
Polarity	N-ch	N-ch	N-ch	N-ch	N-ch	N-ch
Generation	DTMOSIV-H	DTMOSIV(HSD)	DTMOSVI	DTMOSVI	DTMOSVI	DTMOSVI

[Return to Block Diagram TOP](#)

Value provided

Contribution to energy saving and efficiency increasing with wide variety of lineup and easy design.

1 High efficiency

Low on-resistance ($R_{DS(ON)}$) achieved by fine integration process.

Trade off between $R_{DS(ON)}$ and Q_{gr} , Q_{swr} , Q_{oss} have been improved by optimization of cell structure.

2 Wide variety of lineup

Voltage from 20 to 250 V are lined up. Wide variety of packages from surface mount type to through hole type are provided.




3 Easy to design

Low V_{DS} spike and ringing have been realized by parasitic snubber. High avalanche capability.



Wide variety of packages

Lineup

Part number	TPN19008QM	TPH2R408QM	TPH4R008QM	TPH9R00CQ5
Package	TSON Advance 	SOP Advance 	SOP Advance(N) 	SOP Advance / SOP Advance(N)
V_{DSS} [V]	80	80	80	150
I_D [A]	34 (38*)	120 (200*)	86 (140*)	64 (108*)
$R_{DS(ON)}$ [Ω] @ $V_{GS} = 10$ V	Typ.	0.0147	0.0019	0.0031
	Max	0.019	0.00243	0.004
Polarity	N-ch	N-ch	N-ch	N-ch
Generation	U-MOSX-H	U-MOSX-H	U-MOSX-H	U-MOSX-H

*: Silicon limit

[Return to Block Diagram TOP](#)

Value provided

Contribution to energy saving and efficiency increasing with wide variety of lineup and easy design.

1 High efficiency

Low on-resistance ($R_{DS(ON)}$) achieved by fine integration process.
Trade off between $R_{DS(ON)}$ and Q_{gr} , Q_{swr} , Q_{oss} have been improved by optimization of cell structure.

2 Wide variety of lineup

Voltage from 20 to 250 V are lined up.
Wide variety of packages from surface mount type to through hole type are provided.



3 Easy to design

Low V_{DS} spike and ringing have been realized by parasitic snubber.
High avalanche capability.



Wide variety of packages

Lineup

Part number	TK2R4A08QM	TK2R4E08QM	TK100E10N1	
Package	TO-220SIS 	TO-220 		
V_{DSS} [V]	80	80	100	
I_D [A]	100 (116*)	120 (290*)	100 (207*)	
$R_{DS(ON)}$ [Ω] @ $V_{GS} = 10$ V	Typ.	0.00188	0.00197	0.0028
	Max	0.00244	0.00244	0.0034
Polarity	N-ch	N-ch	N-ch	
Generation	U-MOSX-H	U-MOSX-H	U-MOSVIII-H	

*: Silicon limit

[Return to Block Diagram TOP](#)

Value provided

SiC SBDs [Note1] with low loss and high efficiency are realized by adopting new metal and optimizing device design.

[Note1] SBD: Schottky barrier diode

1 Low forward voltage (V_F)

For the new products, new metal and thin wafer technology are introduced. $V_F = 1.2$ V (Typ.) is realized as compared with $V_F = 1.45$ V (Typ.) of our existing products. V_F is reduced by about 17%.

2 Improvement of power supply efficiency

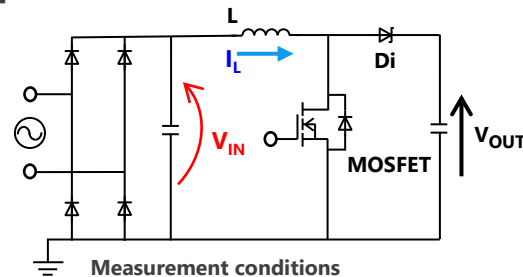
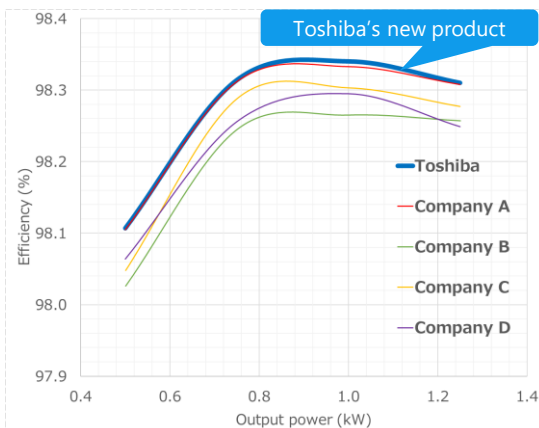
Compared with our existing products, the trade off of $V_F \times Q_C$ [Note2] of the new products have improved. About 0.1% of conversion efficiency improvement have also achieved under 800 W output condition in our test.

[Note2] 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.

3 Expansion of package series

In addition to the existing package series, DFN8x8 surface mount package type has prepared. It contributes to miniaturization and high power density of equipment.

Comparison between Toshiba's new product and competitor products







Measurement conditions

$V_{IN} = 200$ V AC
 $V_{OUT} = 400$ V DC
 $f = 65$ kHz
 MOSFET: TK040Z65Z
 MOSFET external gate resistance = 4.7Ω
 $T_a = 25$ °C

(Toshiba internal comparison, as of November 2021)

Lineup

Part number	TRS12A65F	TRS24N65FB	TRS2E65H *	TRS12E65H *	TRS4V65H *	TRS12V65H *
Package	 TO-220F-2L	 TO-247 (Center tap)	 TO-220-2L		 DFN8x8	
V_{RRM} [V]	650	650	650	650	650	650
$I_{F(DC)}$ [A]	12	12 / 24 **	2	12	4	12
I_{FSM} [A]	92	92 / 184 **	19	74	28	60
V_F (Typ.) [V]	1.45 @ $I_F = 12$ A	1.45 @ $I_F = 12$ A	1.2 @ $I_F = 2$ A	1.2 @ $I_F = 12$ A	1.2 @ $I_F = 4$ A	1.2 @ $I_F = 12$ A

*: New product

**: Per Leg / Both Legs

[Return to Block Diagram TOP](#)

[Note 1] IPM: Intelligent Power Module

Value provided

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

1 High noise immunity

Light receiving IC has internal Faraday shield that provides high CMTI (Common Mode Transient Immunity).

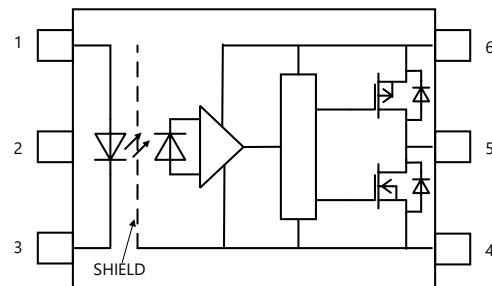
2 High isolation voltage

The isolation voltage BVS is 5000 [Vrms].
(BVS = 3750 [Vrms] for TLP152)

3 High temperature operation

The products are designed to operate even under severe ambient temperature conditions, such as inverters, robots and machinery, etc.

Internal circuit configuration (TLP5774H)



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

UL-recognized UL1577, File No.E67349



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

VDE-recognized EN60747-5-5, EN62368-1 [Note 2]

CQC-recognized GB4943.1, GB8898

[Note 2] When a VDE approved type is needed, please designate the Option (D4).

Lineup

Part number	TLP152	TLP5774H	TLP2745	TLP2719
Package	5pin SO6 	SO6L 		
Application	MOSFET driving		IPM driving	
CMTI (Min) [kV/μs]	±20	±35	±30	±10
T _{opr} [°C]	-40 to 100	-40 to 125	-40 to 110	-40 to 100
Propagation delay time (Max) [ns]	190	150	120	2000
Overcurrent protection	-	-	-	-

[◆Return to Block Diagram TOP](#)

Value provided

High isolation by opto-coupling solution and characteristics suitable for gate driving help to simplify circuit design.

1 High noise immunity

Light receiving IC has internal Faraday shield that provides high CMTI (Common Mode Transient Immunity).

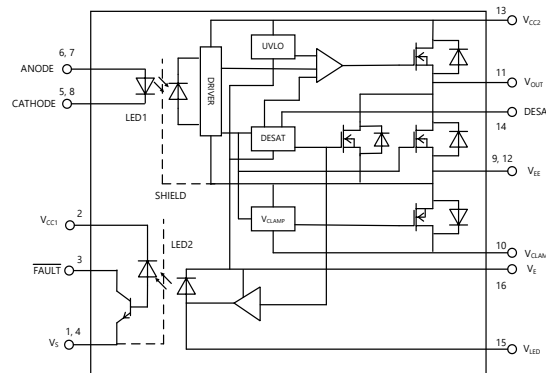
2 High temperature operation

The products are designed to operate even under severe ambient temperature conditions, such as inverters, robots and machinery, etc.

3 Wide output current ratings lineup

Wide product lineup suitable for both gate drive and pre gate drive enables to choose product suitable for each driving.
The products with built-in overcurrent protection function are also provided.

Internal circuit configuration (TLP5212)



UL-recognized UL1577, File No.E67349

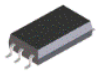
cUL-recognized CSA Component Acceptance Service No.5A File No.E67349

VDE-recognized EN60747-5-5, EN62368-1 (TLP5212 approved only for EN60747-5-5) [Note]

CQC-recognized GB4943.1, GB8898

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

Lineup

Part number	TLP5214A	TLP5212	TLP5222	TLP5231	TLP5754H	TLP5705H
Package	SO16L 				SO6L 	
CMTI (Min) [kV/μs]	±35	±25		±35	±50	
T _{opr} [°C]	-40 to 110				-40 to 125	
Peak output current [A]	±4.0	±2.5		±4.0	±5.0	
Overcurrent protection	✓				-	

[Return to Block Diagram TOP](#)

Value provided

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

1 High noise immunity

Light receiving IC has internal Faraday shield that provides high CMTI (Common Mode Transient Immunity).

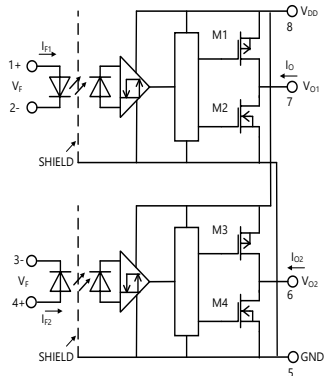
2 High isolation voltage

The isolation voltage BV_S is 5000 [Vrms].

3 High temperature operation

The products are designed to operate even under severe ambient temperature conditions, such as inverters, robots and machinery, etc. (-40 to 125 °C)

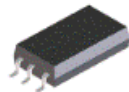
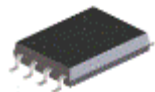
Internal circuit configuration (TLP2210)



- 1: Anode 1
- 2: Cathode 1
- 3: Cathode 2
- 4: Anode 2
- 5: GND
- 6: $V_O 2$ (output 2)
- 7: $V_O 1$ (output 1)
- 8: V_{DD}

UL-recognized UL1577, File No.E67349
 cUL-recognized CSA Component Acceptance Service No.5A File No.E67349
 VDE-recognized EN60747-5-5, EN62368-1 [Note]
 CQC-recognized GB4943.1, GB8898

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

Lineup						
Part number	TLP2710	TLP2761	TLP2770	TLP2210	TLP2261	TLP2270
Package	SO6L 			SO8L(LF4) 		
Channel	1			2		
Data rate [Mbps]	5	15	20	5	15	20
T_{opr} [°C]	-40 to 125	-40 to 125	-40 to 125	-40 to 125	-40 to 125	-40 to 125

[Return to Block Diagram TOP](#)

5 Transistor output photocoupler

TLP383 / TLP293 / TLP385

Small size packages

High efficiency
Low loss

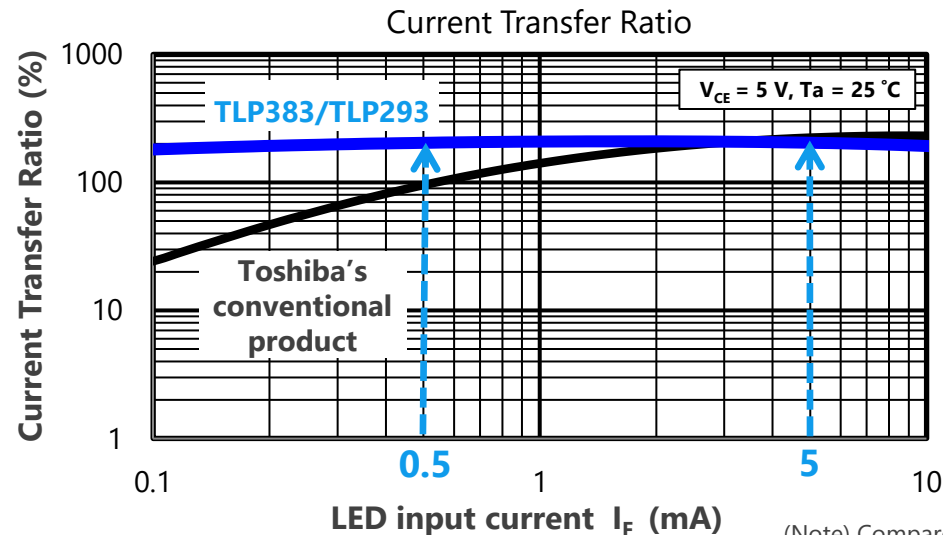
Noise immunity

Value provided

High CTR (Current Transfer Ratio) is realized even in low input current range ($I_F = 0.5 \text{ mA}$).

1 High current transfer ratio

The TLP383 and TLP293 are high isolation photocouplers that optically couple a phototransistor and high output infrared LED. Compared to Toshiba's conventional products (TLP385), higher CTR (Current Transfer Ratio) in low input current range (@ $I_F = 0.5 \text{ mA}$) is realized.






(Note) Compared with Toshiba conventional products

2 High temperature operation

The products are designed to operate even under severe ambient temperature conditions, such as inverters, robots and machinery, etc.

Lineup

Part number	TLP383	TLP293	TLP385
Package	4pin SO6L 	SO4 	4pin SO6L 
BV_S [Vrms]	5000	3750	5000
T_{opr} [$^\circ\text{C}$]	-55 to 125	-55 to 125	-55 to 110

[Return to Block Diagram TOP](#)

Value provided

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

1 High isolation performance

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 immunity is provided with CMTI [Note 1] = 15 kV/ μ s (Min).

[Note 1] CMTI: Common Mode Transient Immunity

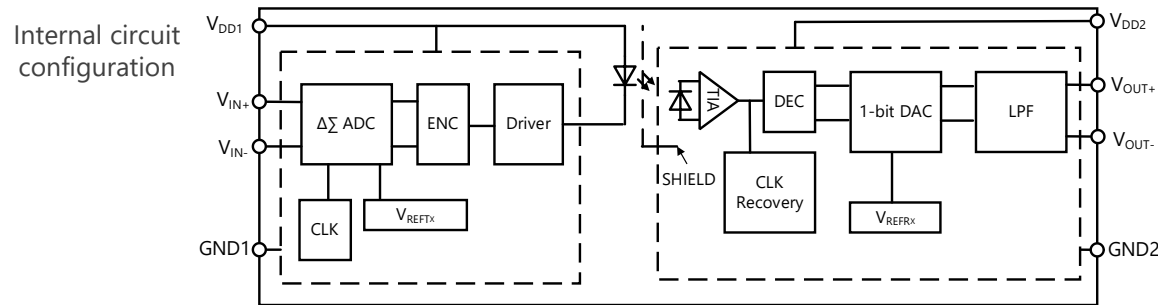
3 5 V system power supply voltages

Input power supply voltage

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

Output power supply voltage

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



[Note 1] Bypass capacitor of 0.1 μ F 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: EN 60747-5-5, EN 62368-1 [Note 2]

[Note 2] When a VDE approved type is needed, please designate the Option (D4).

Lineup

Part number	TLP7820
Package	SO8L(LF4) 
BV _S [Vrms]	5000
T _{opr} [°C]	-40 to 105
CMTI (Min) [kV/ μ s]	15

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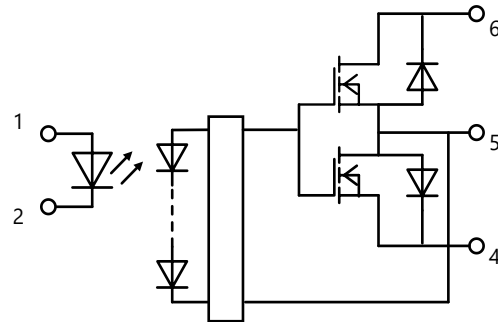
Value provided

Photorelay consists of an infrared light emitting diode optically coupled to a photo-MOSFET and is suitable for replacing mechanical relays.

1 Low on-resistance

On-resistance $R_{ON} = 0.05 \Omega$ (Max)
(TLP3547: A connection) [Note 1]

TLP3545A
Internal equivalent circuit



Safety Standards

UL approved: UL1577, File No.E67349

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

UL-recognized: UL 508, File No.E499232 [Note 2]

VDE-approved: EN 60747-5-5 [Note 3]

[Note 2] Please refer Absolute Maximum Ratings (UL-recognized UL 508) for UL 508 products.

[Note 3] When a VDE approved type is needed, please designate the Option (D4).

2 Wide current range

Wide range of allowed ON current I_{ON} ,
suitable for power line control.





$I_{ON} = 5.0 \text{ A}$ (Max)
(TLP3547: A connection) [Note 1]

[Note 1] Please refer to the technical data sheet for connection.

3 Lineup of package and isolation voltage

The lineup of isolation voltage and package for freedom of design are provided.

Lineup

Part number	TLP3122A	TLP170AM	TLP3545A	TLP3547	TLP240A	TLP241B
Package	4pin SO6 	DIP6 	DIP8 	DIP4 		
I_{ON} [A]	1.4	0.7	4.0	5.0	0.5	2.0
V_{OFF} [V]	60	60	60	60	60	100
R_{ON} (Max) [Ω]	0.25	0.3	0.06	0.05	2.0	0.2
BV_S [Vrms]	3750	3750	2500	2500	5000	5000

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Value provided

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

1 High ESD pulse absorption performance

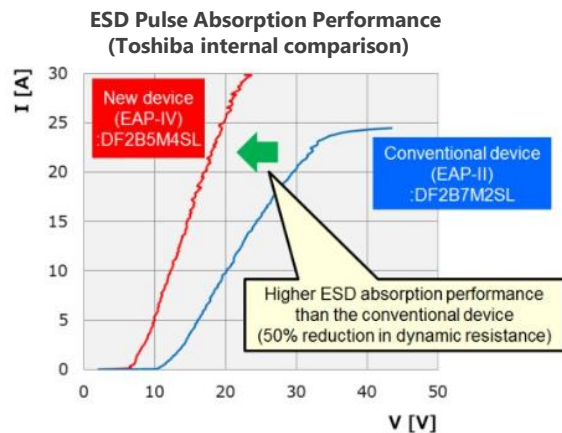
Improved ESD absorption compared to our conventional products. (50 % reduction in operating resistance) For some products, both low operating resistance and low capacitance are realized and ensures high signal protection performance and signal quality.

2 Suppress ESD energy by low clamp voltage

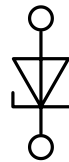
Protect the connected circuits and devices using proprietary technology.

3 Suitable for high density mounting

A variety of small packages are available.



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

Lineup

Part number	DF2B6M4BSL	DF2B20M4SL	DF2B5PCT	DF2B7PCT	DFS2S14P2CTC
Package	SL2 		CST2 		CST2C 
V_{ESD} [kV]	±8	±15	±30	±30	±30
V_{RWM} (Max) [V]	5.5	18.5	3.6	5.5	12.6
C_t (Typ.) [pF]	0.12	0.2	41	45	270
R_{DYN} (Typ.) [Ω]	1.05	0.2	0.1	0.1	0.08
Purpose	Signal line protection		Power line protection		

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

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Value provided

System cost reduction, higher efficiency and less development work.

1 Equipped with motor control co-processor

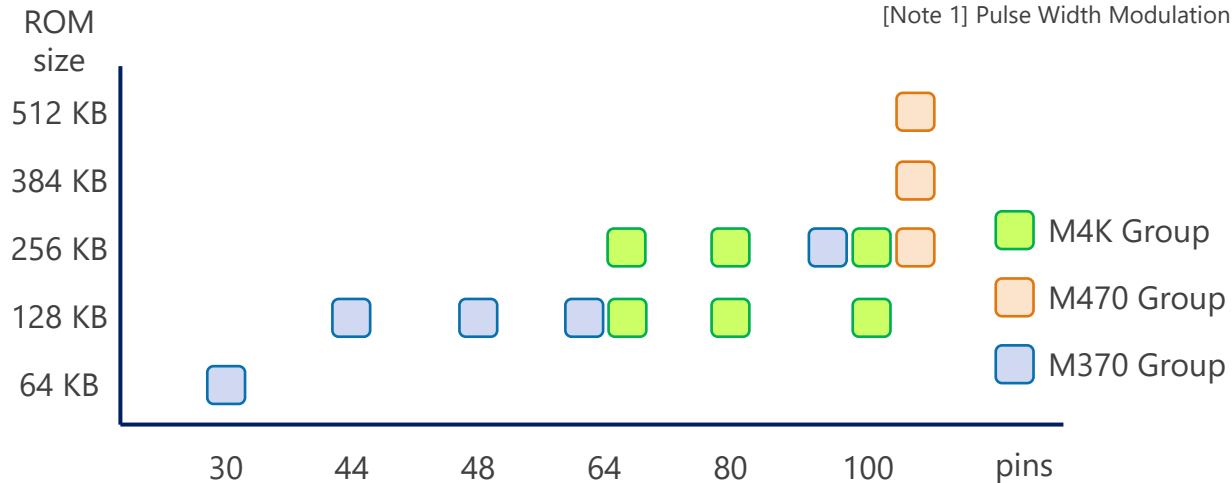
Toshiba's original co-processor vector engine (VE) for motor control reduces CPU load and allows control of multiple motors and peripherals.

2 Equipped with motor control circuit

A variety of three-phase PWM ^[Note 1] waveforms and AD converters enable highly efficient, low noise control. The Advanced Encoder (A-ENC) reduces the load of CPU process in detecting the position performed for each PWM.

3 Provide development support tools

Third party evaluation boards and sample programs that can be used to shorten the development time are provided. Toshiba has begun offering a new, simple, versatile motor control software development kit (MCU Motor Studio). ^[Note 2]



[Note 1] Pulse Width Modulation

[Note 2] For M4K group and will gradually expand for TXZ+™ series products.

Lineup		
Series	Group	Function
TXZ+™ 4A Series	M4K Group	Arm® Cortex®-M4, 160 MHz operation 4.5 to 5.5 V, 3motor control (Max), Data Flash
TX04 Series	M470 Group	Arm® Cortex®-M4, 120 MHz operation 4.5 to 5.5 V, 2motor control (Max)
TX03 Series	M370 Group	Arm® Cortex®-M3, 80 MHz operation 4.5 to 5.5 V, 2motor control (Max)

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10 Small surface mount LDO regulator

TCR15AG / TCR13AG / TCR8BM / TCR5BM / TCR5RG / TCR3RM / TCR3U / TCR2L / TAR5 Series

Small size packages

High efficiency
Low loss

Noise immunity

Value provided

Wide lineup 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 originally developed latest process significantly improved the dropout voltage characteristics.

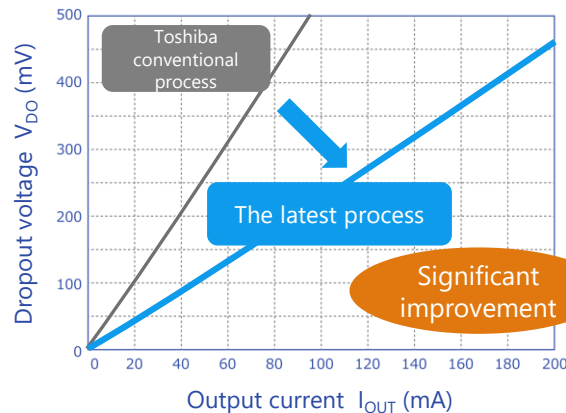
2 High PSRR Low output noise voltage

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

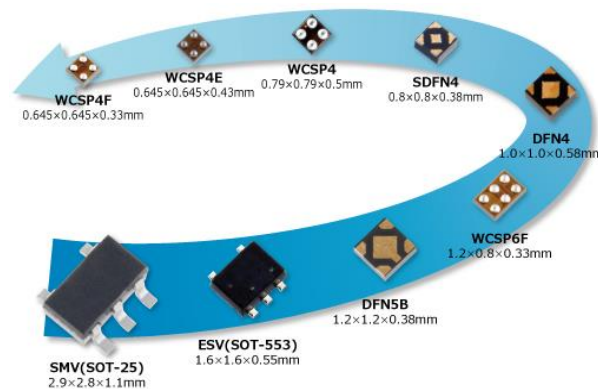
0.34 μA of $I_{B(ON)}$ is realized by utilizing CMOS process and unique circuit technology.
(TCR3U Series)

Low dropout voltage



(Note) Toshiba internal comparison

Rich package lineup



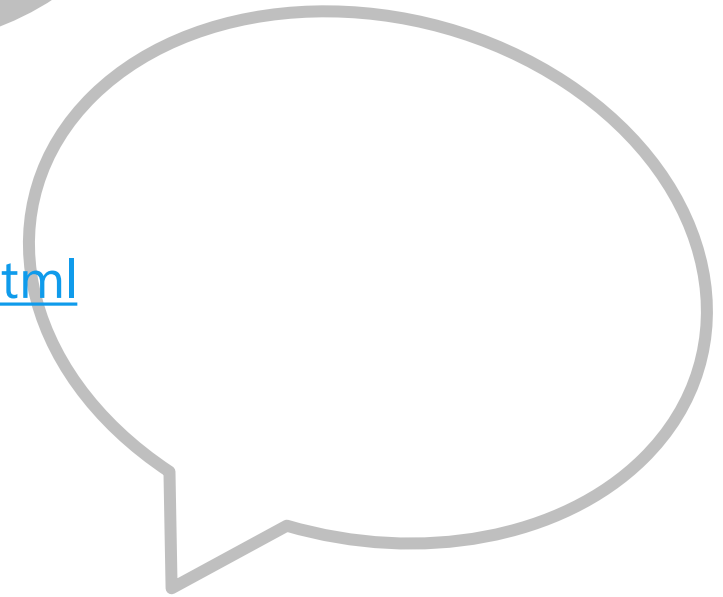
Lineup

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		15 V 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	56	20	19	7	7	0.34	1	170

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