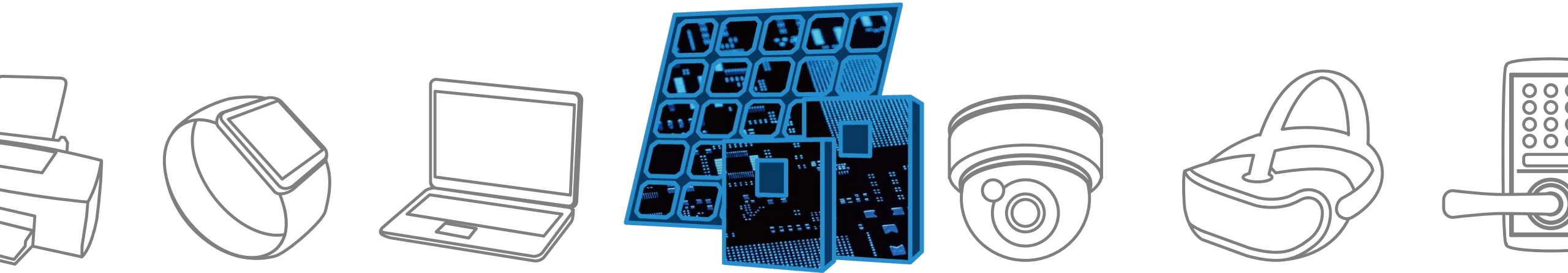


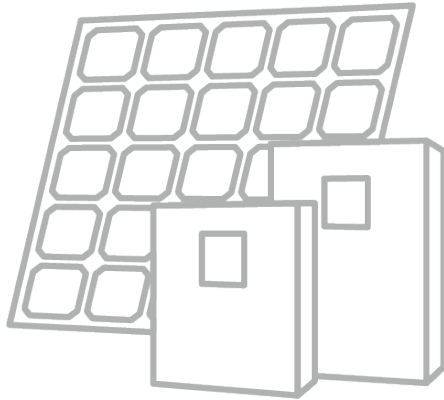
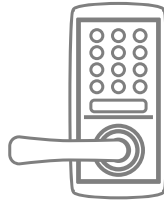
TOSHIBA

Mega-solar Inverters

Solution Proposal by Toshiba

R20

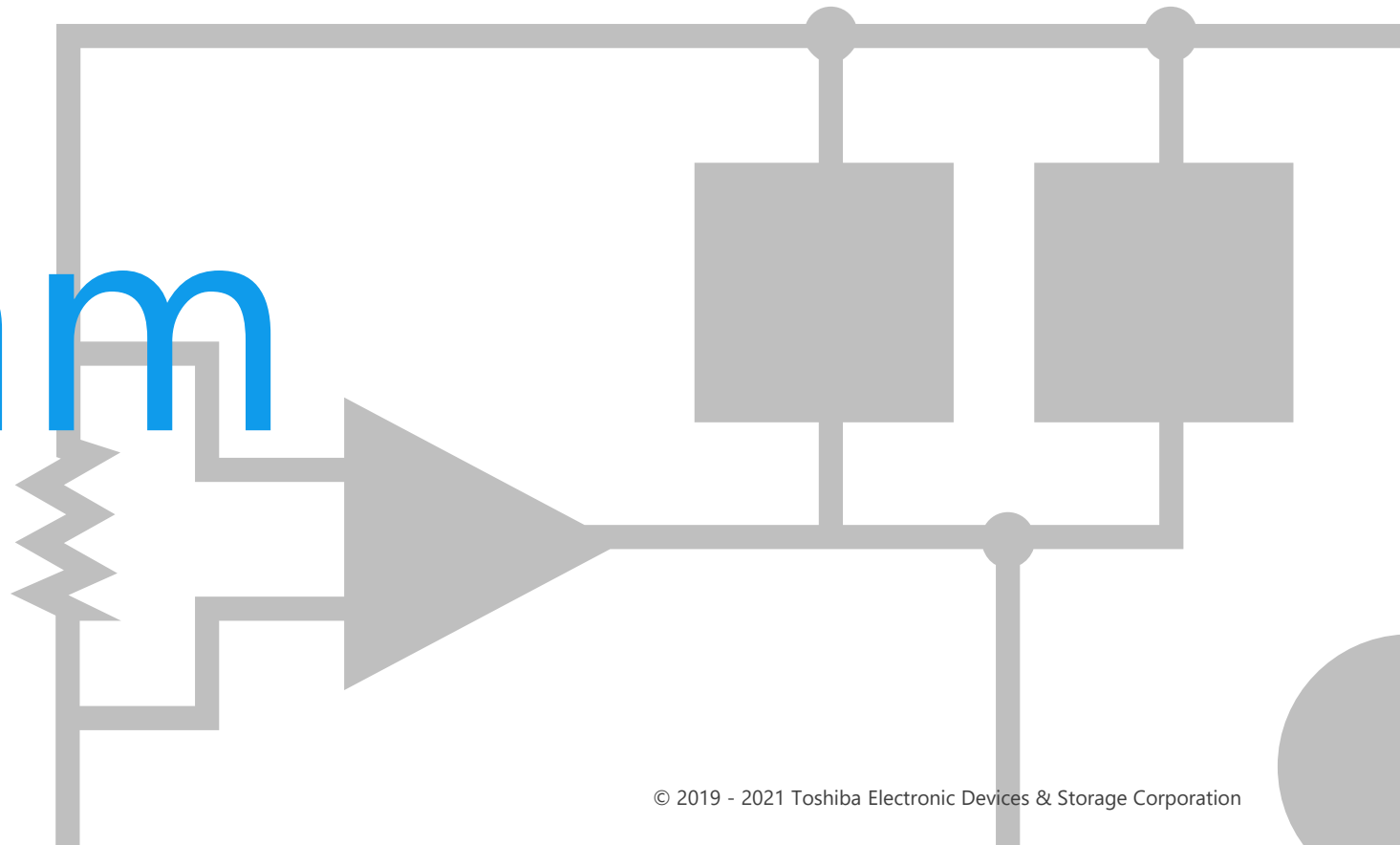




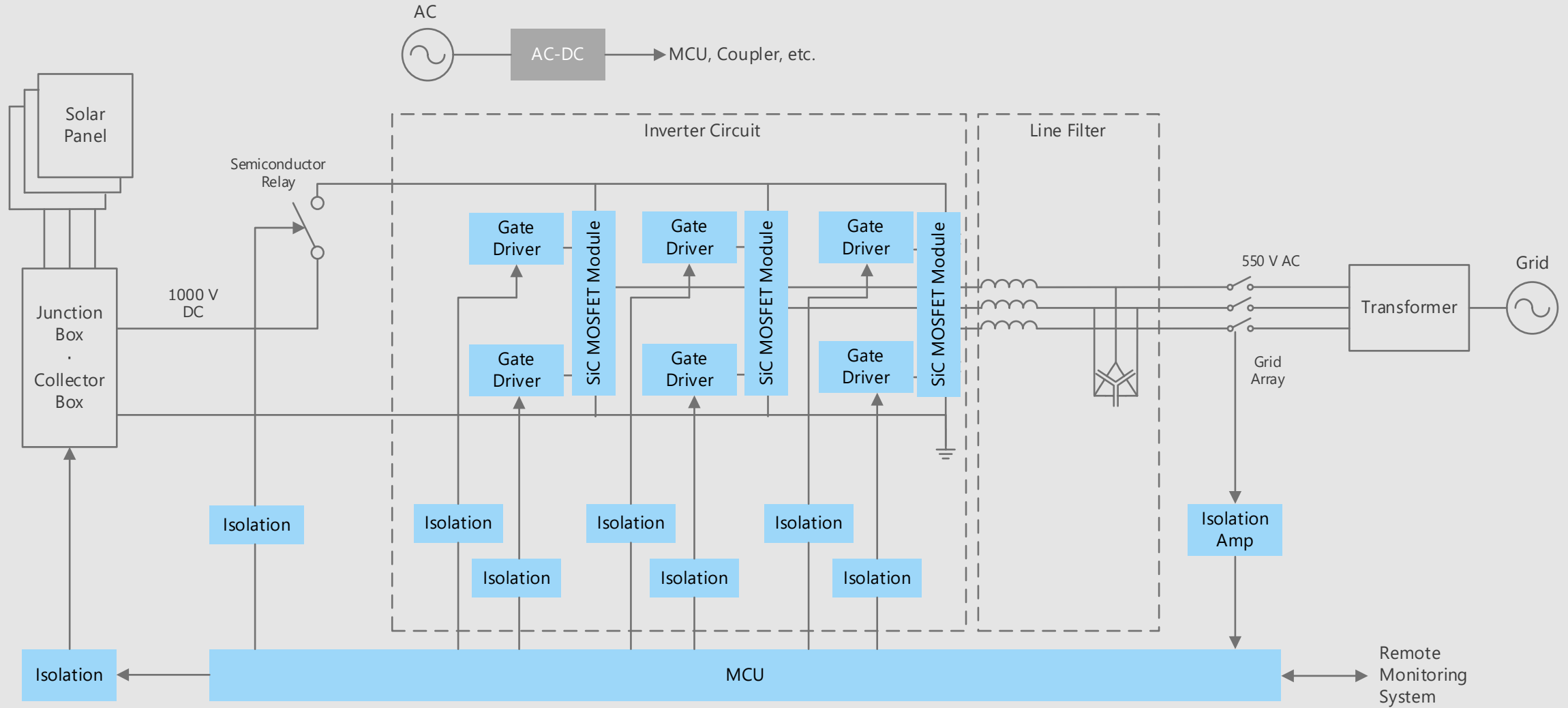
Toshiba Electronic Devices & Storage Corporation provides comprehensive device solutions to customers developing new products by applying its thorough understanding of the systems acquired through the analysis of basic product designs.



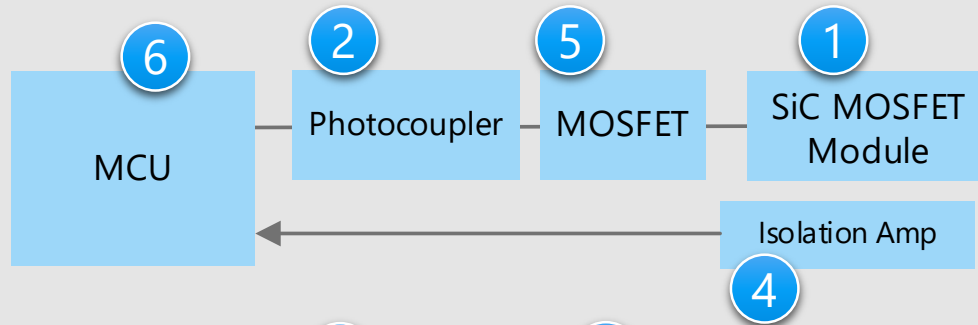
Block Diagram



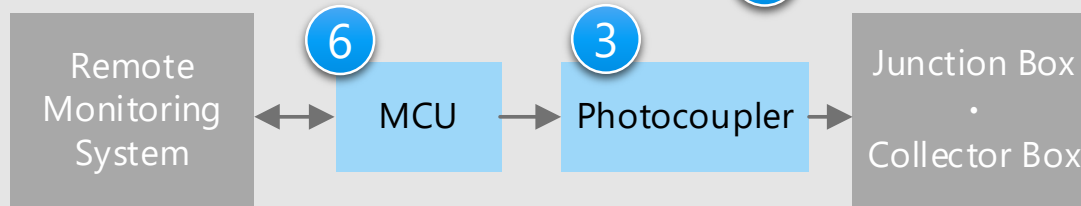
Mega-solar Inverters Overall block diagram



Inverter circuit



Monitor peripheral circuit



Microcomputer peripheral circuit



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

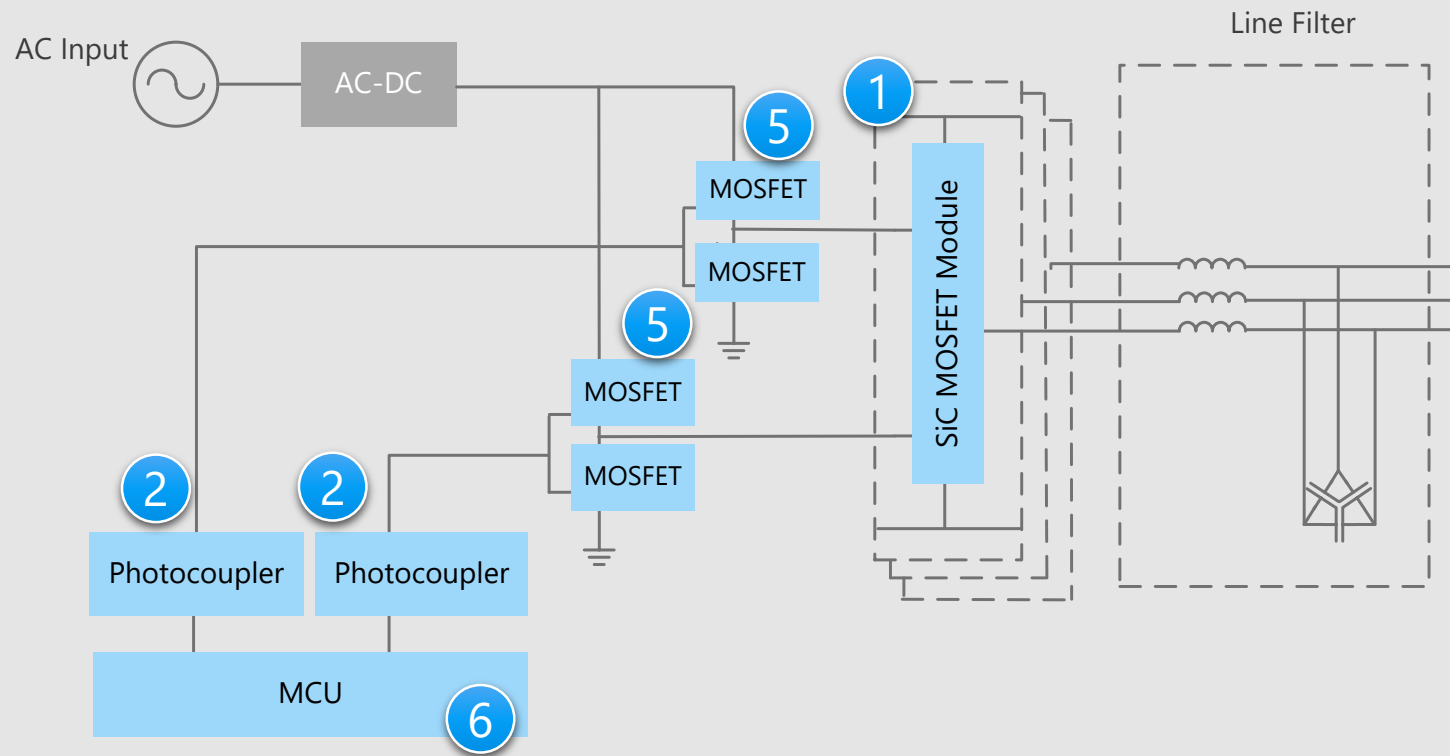
Criteria for device selection

- SiC MOSFET is suitable for high speed switching. For 1000 V DC two-level inverters, SiC MOSFET with $V_{DSS}=1700$ V are suitable.
- The use of isolating device is effective for the control of high voltage systems.
- Inverter control at each sub system and communication with a cloud are required.

Proposals from Toshiba

- **High speed switching** ①
SiC MOSFET module (under development)
- **Photocoupler having excellent environmental resistance** ②
IC output photocoupler for IGBT/MOSFET driving
- **Photocoupler having excellent environmental resistance** ③
IC output photocoupler for high speed transmission
- **Both high precision and high isolation have realized by built-in $\Delta\Sigma$ /D converter** ④
Isolation amplifier
- **Both P-ch and N-ch MOSFETs are assembled in one package** ⑤
Power MOSFET
- **Built-in 3-phase PWM and Ethernet function is suitable for controlling mega solar system** ⑥
MCU

Inverter gate drive circuit



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

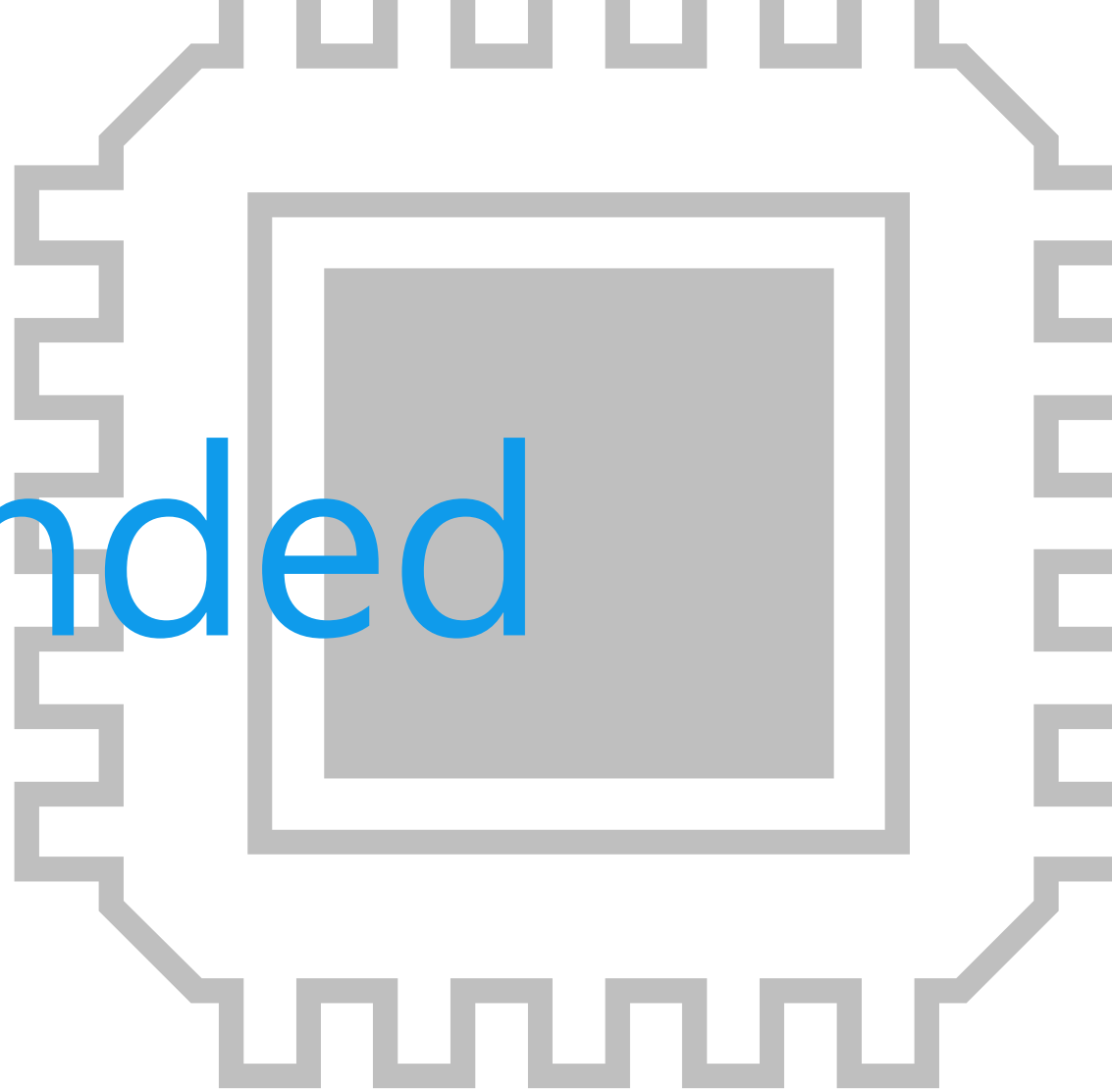
Criteria for device selection

- Large current is required to drive the gates of the power MOSFET.
- For high speed switching, MOSFETs with low input capacity are suitable.
- Mounting area on the circuit board can be reduced by adopting compact packages.

Proposals from Toshiba

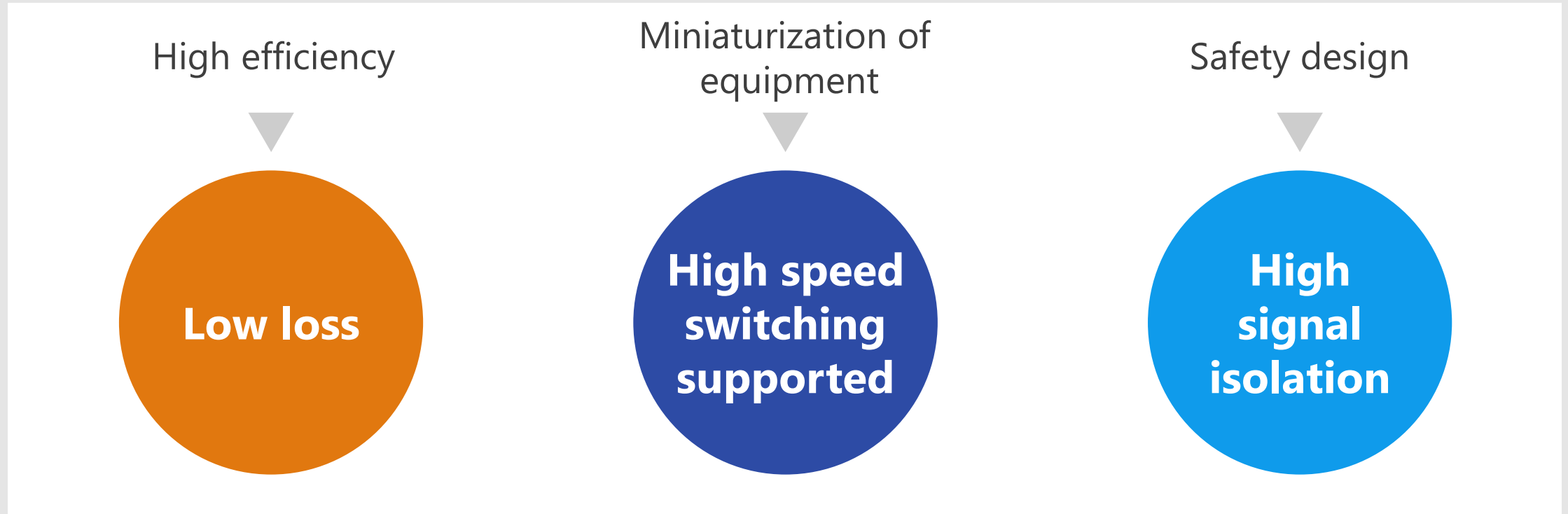
- **High speed switching** 1
SiC MOSFET module (under development)
- **Photocoupler having excellent environmental resistance** 2
IC output photocoupler for IGBT/MOSFET driving
- **Both P-ch and N-ch MOSFETs are assembled in one package** 5
Power MOSFET
- **Built-in 3-phase PWM and Ethernet function is suitable for controlling mega solar system** 6
MCU

Recommended Devices



Device solutions to address customer needs

As described above, in the design of mega-solar inverter, “**High efficiency**”, “**Miniaturization of equipment**” and “**Safety design**” are important factors. Toshiba’s proposals are based on these three solution perspectives.



Device solutions to address customer needs

Low loss

High speed switching supported

High signal isolation

① SiC MOSFET module	●	●	
② IC output photocoupler for IGBT/MOSFET driving			●
③ IC output photocoupler for high speed transmission		●	●
④ Isolation amplifier			●
⑤ Power MOSFET	●	●	
⑥ MCU	●		

Value provided

High voltage/low loss SiC MOSFET module contributes to more efficient and compact equipment.

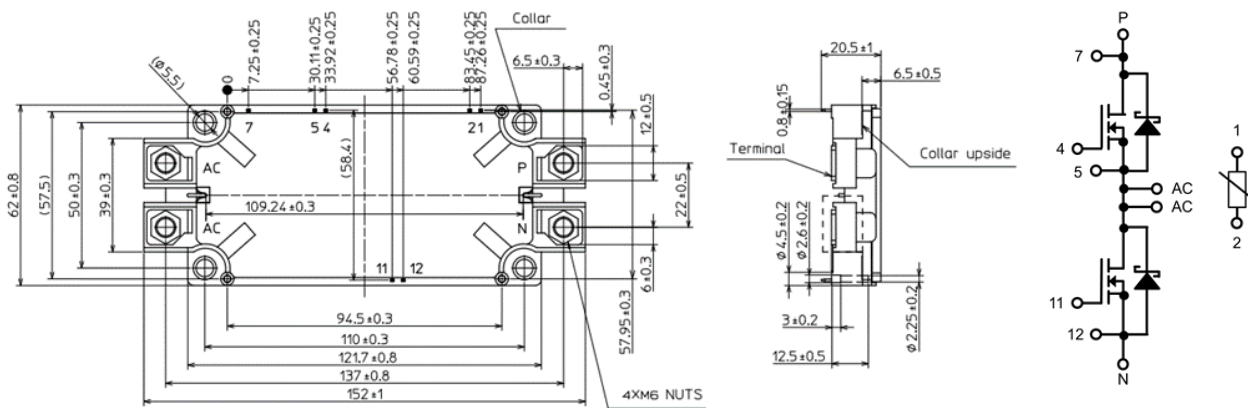
1 High voltage/low loss SiC MOSFET

A high voltage SiC MOSFET with reduced conduction and switching losses is installed.

2 Easy to connect 2-in-1 module

Two MOSFETs are assembled in one package. This half bridge modular configuration with a standard package reduces system design cost.

Package and equivalent circuit



Line up

Part number	MG400V2YMS3
V_{BSS} [V]	1700
I_D [A]	400
$V_{DS(on)sense}$ (Typ.) [V] @ $I_D=400$ A, $V_{GS}=20$ V, $T_{ch}=25$ °C	1.1
Polarity	N-ch

[Return to Block Diagram TOP](#)

2 IC output photocoupler for IGBT/MOSFET driving

TLP5772

Low loss

High speed switching supported

High signal isolation

Value provided

This photocoupler optically couples an infrared light emitting diode with high optical output power and an integrated circuit light-receiving IC chip with high gain and high speed.

1 Compact package

Package size of TLP5772 is 50 % smaller than Toshiba conventional DIP8 package in terms of mounting area, and it comply with reinforced isolation class of international safety standards.

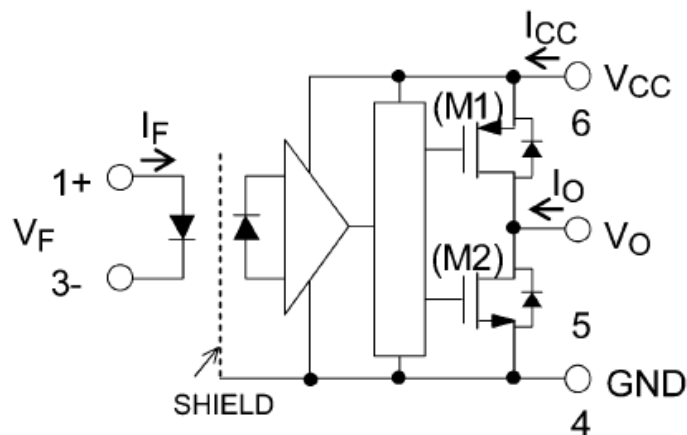
2 Common mode transient immunity (CMTI) of 35 kV/μs

By providing a shield between input and output, high instantaneous common mode rejection of ± 35 kV/μs has realized and noise resistance between input and output is excellent.


3 Direct drive by microcomputer

The low input type allows bufferless direct drive by the microcomputer. And a rail-to-rail output allows stable operation of the system and good switching characteristics.

Internal circuit configuration



Line up

Part number	TLP5772
Package	SO6L 
BV_S (Min) [Vrms]	5000
I_{FLH} (Max) [mA]	2
$CM_{H/L}$ (Min) [kV/μs]	± 35

[Return to Block Diagram TOP](#)

Value provided

This photocoupler optically couples an infrared light emitting diode with high optical output power and an integrated circuit light-receiving IC chip with high gain and high speed.

1 Supports 3.3 V power supply

This photocoupler operates with power supply voltage from 2.7 V to 5.5 V. Therefore, it can be used in mixed voltage system such as 3.3 V / 5 V.

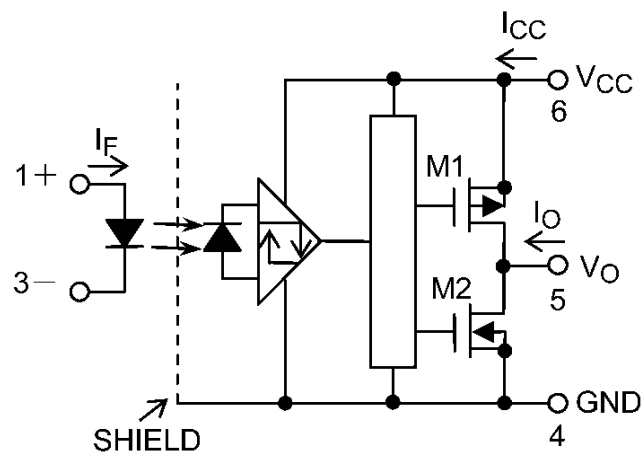
2 Operation at ambient temperature of 125 °C

This photocoupler is designed to operate under severe conditions of ambient temperature environment, such as an inverter, a robot, a machine tool and a high output power supply.


3 Direct drive by microcomputer

The low input type allows bufferless direct drive by the microcomputer. It is also a rail-to-rail output that allows for stable operation of the system and good switching characteristics.

Internal circuit configuration



Line up

Part number	TLP2761
Package	SO6L 
BV_S (Min) [Vrms]	5000
T_{opr} [°C]	-40 to 125
Output interface	totem-pole (Inverter)

[Return to Block Diagram TOP](#)

Value provided

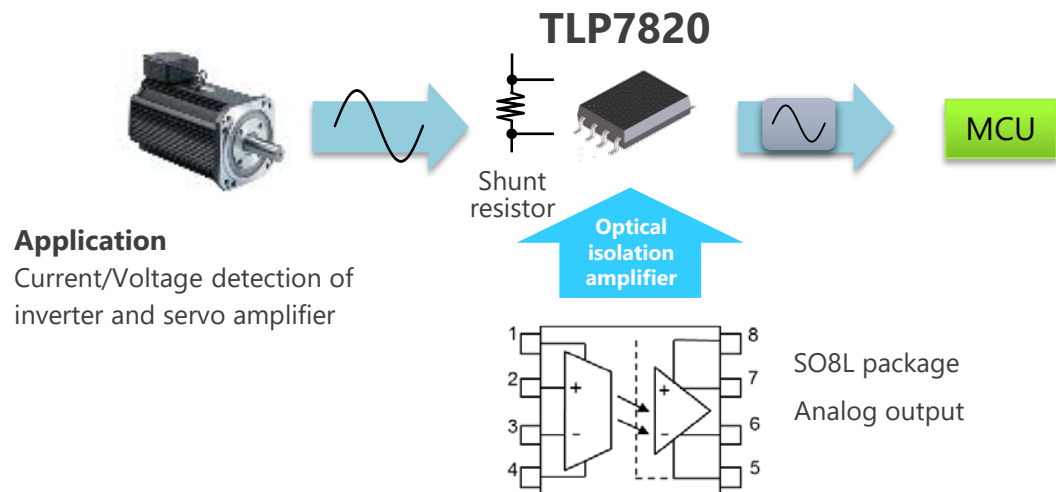
High precision and excellent isolation performance have realized with built-in $\Delta\Sigma$ A/D converter circuit. These enable accurate current/voltage detection.

1 Reduction of input side supply current

By introducing original digital modulation-and-demodulation technology, the input voltage dependency of primary side supply current is improved. The maximum circuit current is reduced by this, and it contributes to primary side power supply designs and the low power consumption design of application.

2 Adoption of a new SO8L thin package

By adopting new thin package SO8L with height of 2.3 mm, TLP7820 is thinner* than the existing equivalent products of other company and contributes to reduction of mounting space in applications. (* Based on Toshiba's measurement data)



Line up

Part number	TLP7820
Package height [mm]	2.3
Gain accuracy (Rank B) [%]	±0.5
T_{opr} [°C]	-40 to 105
V_{OS} (Typ.) [mV]	0.9
I_{DD1} (Max) [mA]	12
CMTI (Min) [kV/ μ s]	±15

[Return to Block Diagram TOP](#)

Value provided

Both P-channel and N-channel MOSFETs with low on-resistance are assembled in one small package (2-in-1 type). Contributes reduction of heat generation and mounting area.

1 Low on-resistance

By keeping the on-resistance between the drain and source low, heat generation and power consumption can be kept low.

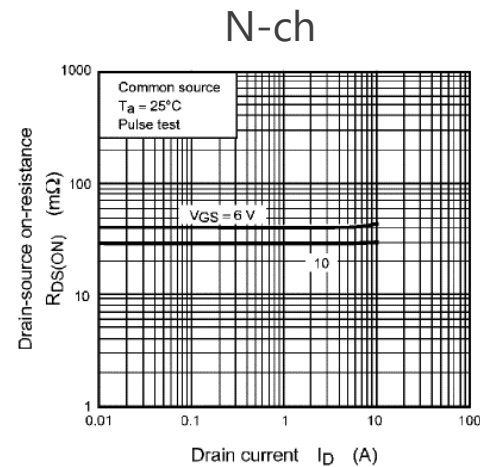
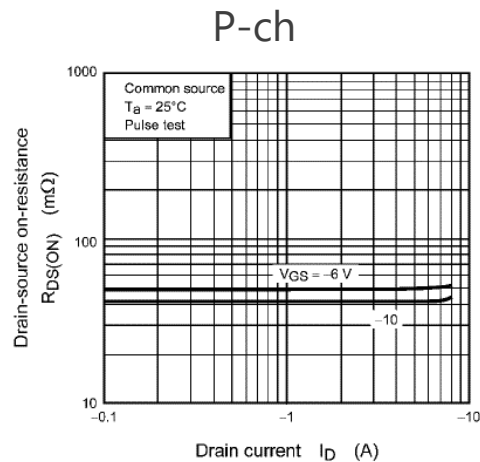
2 2-in-1 type

P-channel and N-channel MOSFETs are assembled in one package. Suitable for P-channel and N-channel push-pull circuit.


3 Compact package

Product lineup includes small and thin packages, contributing to the reduction of mounting area.

Low on-resistance



Line up

Part number		TPCP8407	
Package		PS-8 	
Polarity		P-ch	N-ch
V_{DSS} [V]		-40	40
I_D [A]		-4	5
$R_{DS(ON)}$ [mΩ]		Typ.	Max
@ $V_{GS} = +10$ V (N-ch)			
@ $V_{GS} = -10$ V (P-ch)		56.8	36.3

[Return to Block Diagram TOP](#)

Value provided

Built-in 3-phase PWM and Ethernet function execute inverter control and communication to a cloud 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.

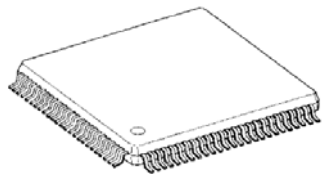
2 3-phase PWM output

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

3 Various communication interfaces

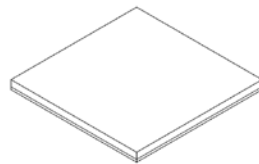
TMPM369 supports major communication interfaces except Ethernet such as USB, CAN, UART and SPI. User can construct a communication system easily with a cloud.

TMPM369FDG



LQFP144
(20 mm x 20 mm)

TMPM369FDXBG



TFBGA177
(11 mm x 11 mm)

Line up

Part number	TMPM369FDG / TMPM369FDXBG
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

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