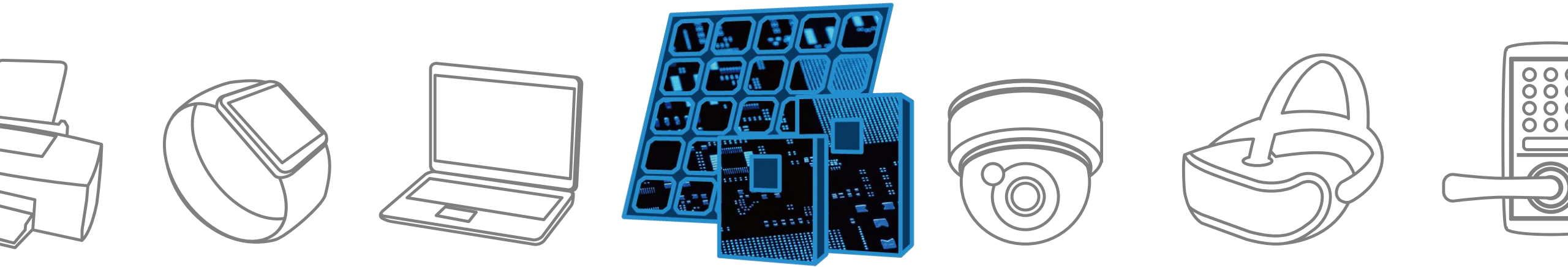


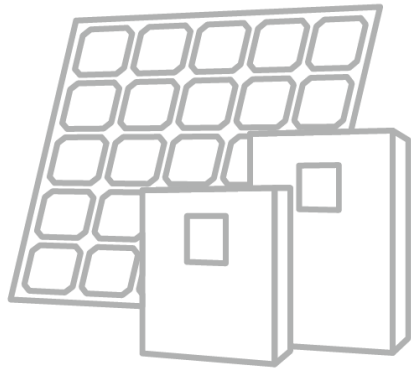
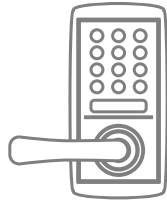
**TOSHIBA**

# PV Inverter for Household Use

Solution Proposal by Toshiba

R22

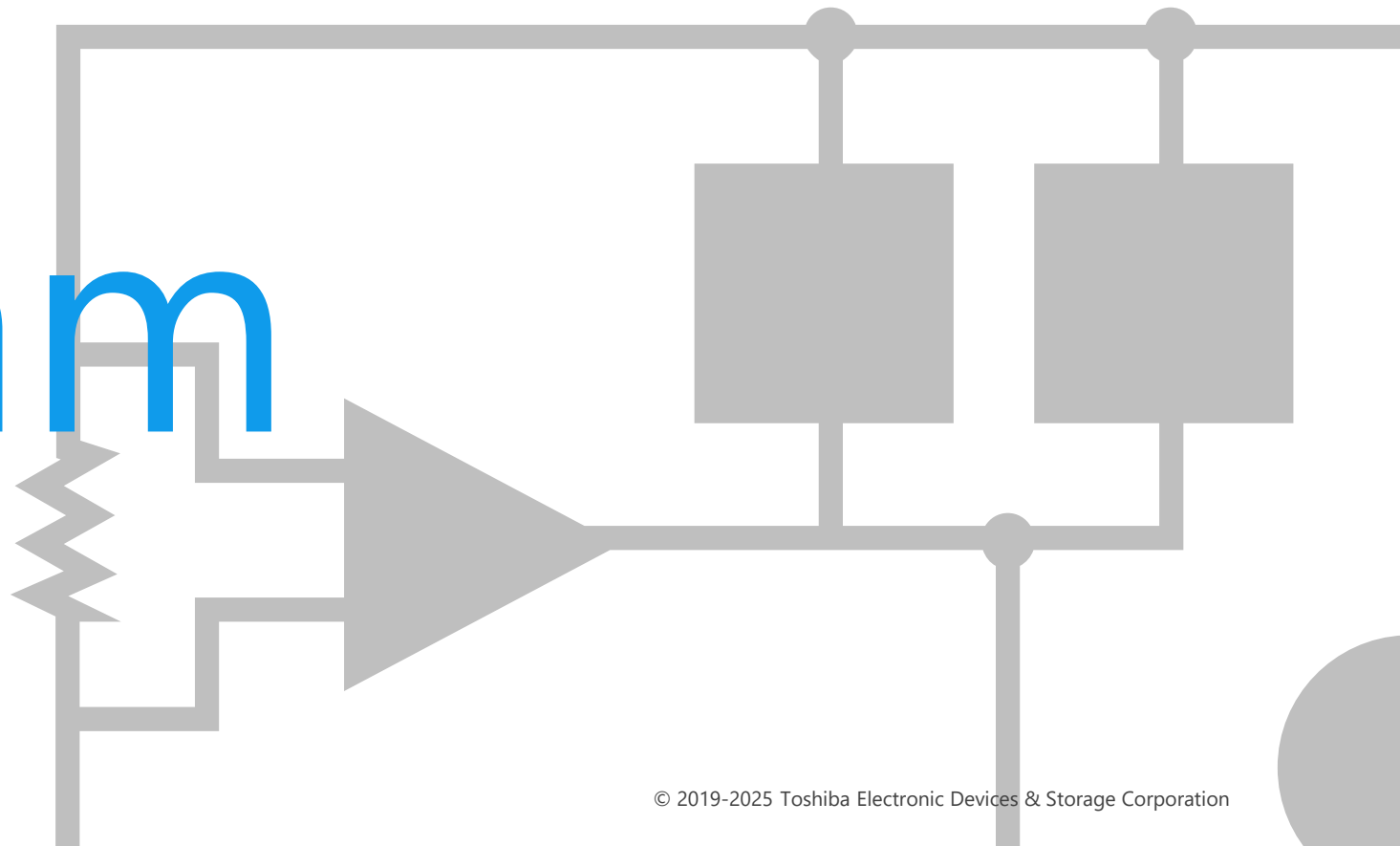




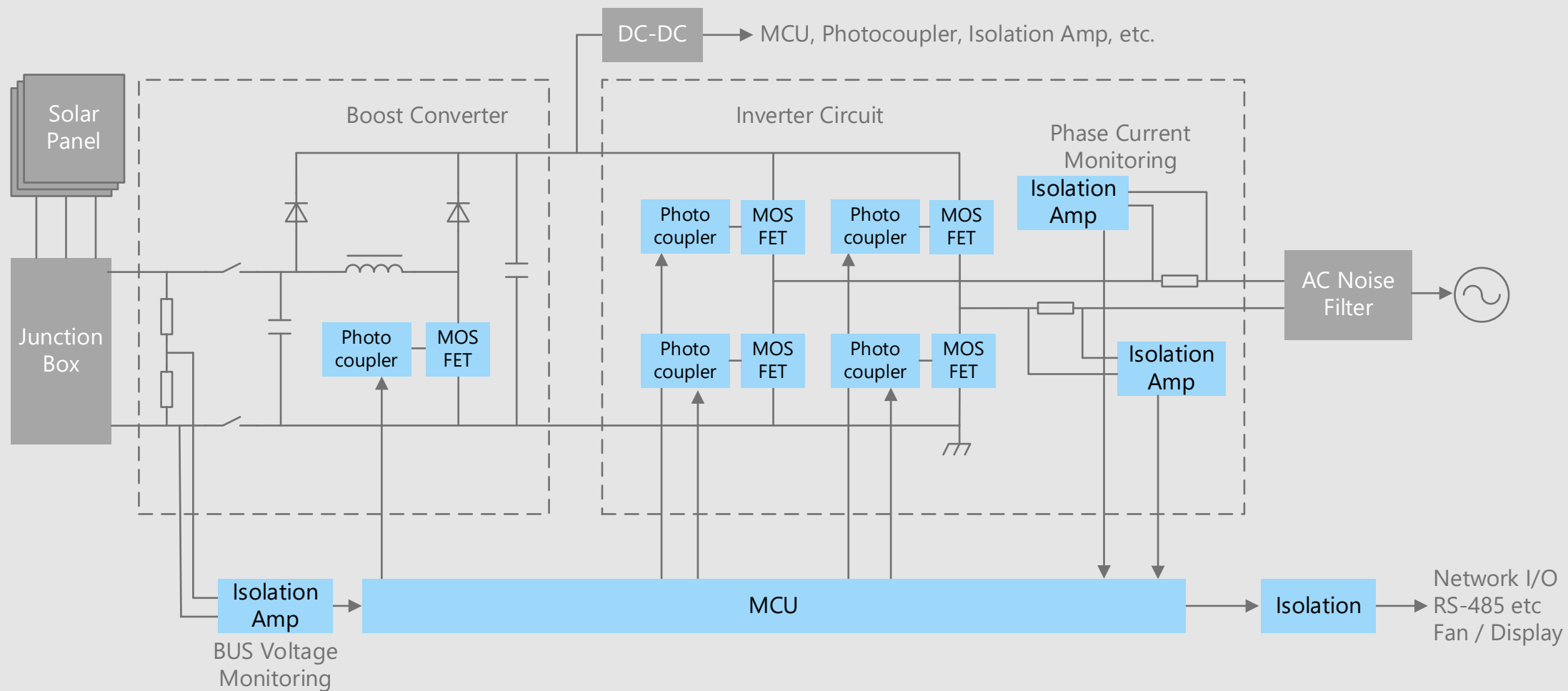
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# Block Diagram

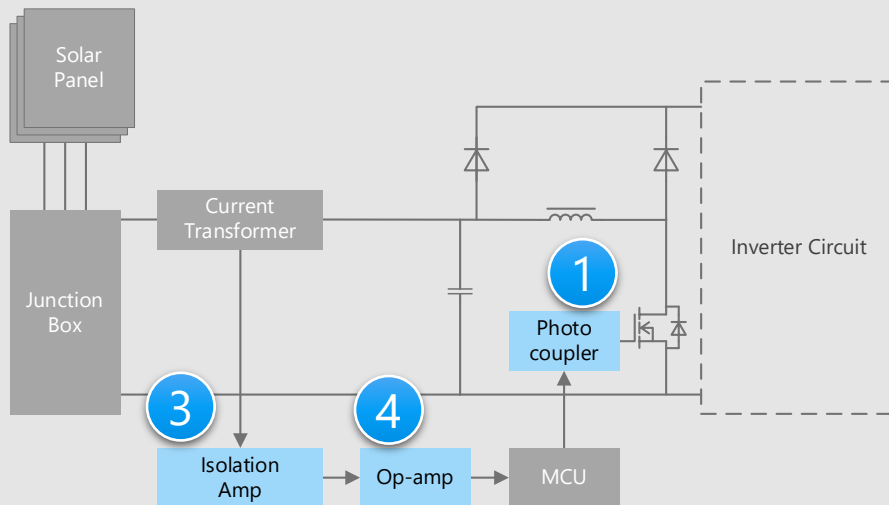


# PV Inverter for Household Use Overall block diagram

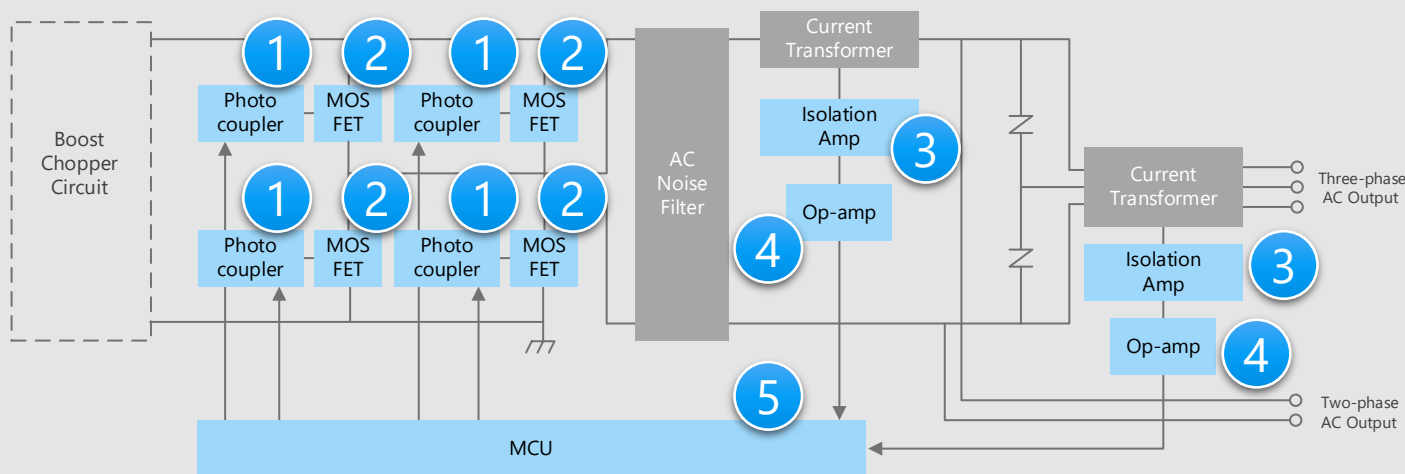


# PV Inverter for Household Use    Details of power supply unit

## Boost converter circuit



## Inverter circuit



## Criteria for device selection

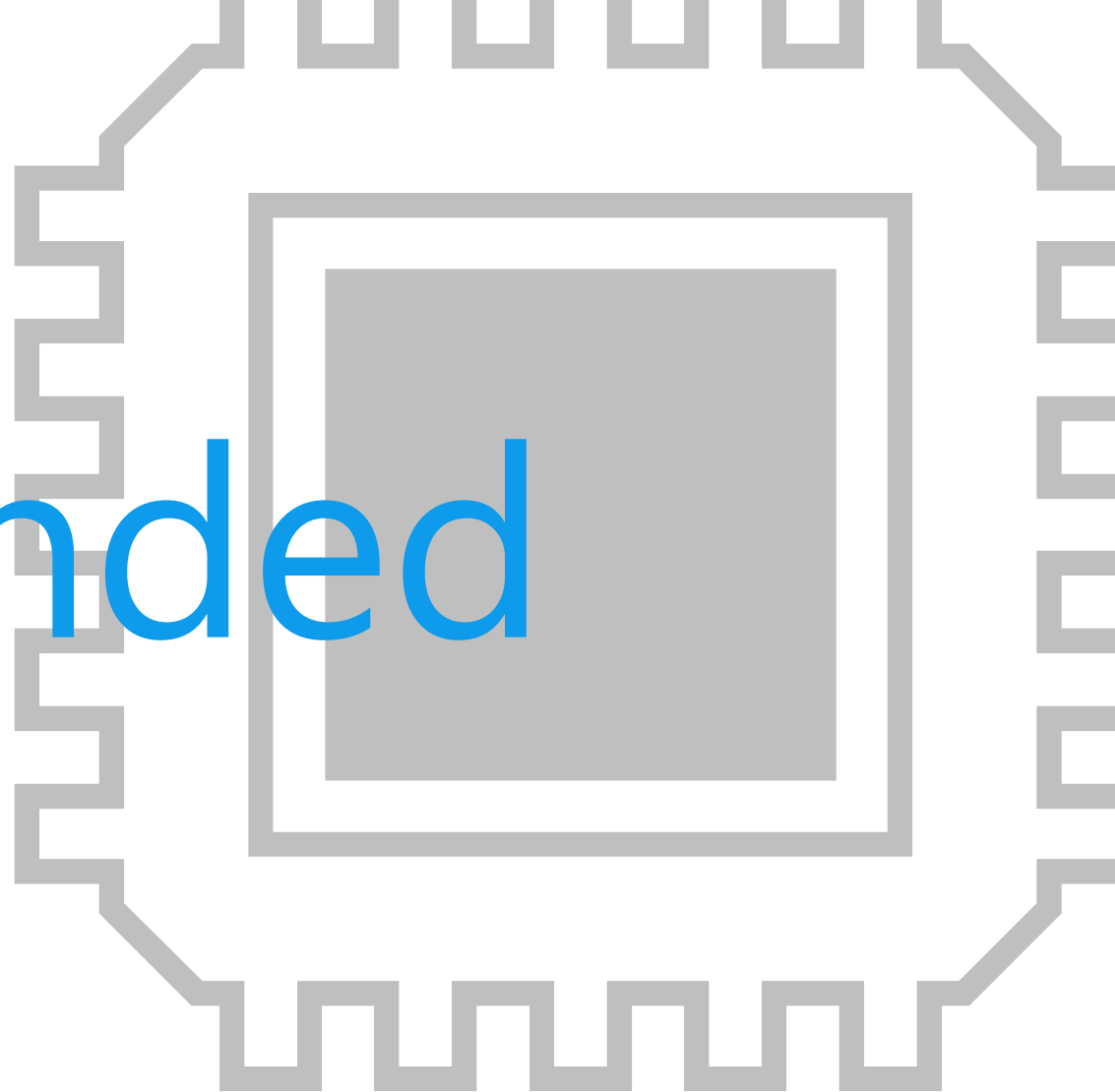
- IC output photocoupler capable of high speed PWM signal transmission is suitable for controlling converters and inverters.
- MOSFET with a good balance between on-resistance and switching speed is suitable for increasing the efficiency of the inverter.
- Isolation amplifier is suitable for detecting signals with different reference potentials.
- Low noise operational amplifier is suitable for high accuracy signal amplification.

## Proposals from Toshiba

- **Photocoupler that is resistant to noise and can operate at high temperature**  
IC output photocoupler
- **Low on-resistance and high speed switching MOSFET**  
DTMOS Series MOSFET
- **Low power consumption and high accuracy control in a small package**  
Isolation amplifier
- **Amplify the detected weak signal with low noise**  
Low noise operational amplifier
- **Built-in three-phase PWM is suitable for controlling inverter system**  
MCU M380 Group

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

# Recommended Devices



# Device solutions to address customer needs

As described above, in the design of PV inverter for household use, **“Enhancement of safety of set”, “High efficiency”** and **“Miniaturization of circuit boards”** are important factors. Toshiba’s proposals are based on these three solution perspectives.



# Device solutions to address customer needs

	Safety	Low loss	Small size packages
① IC output photocoupler	●		●
② DTMOS Series MOSFET		●	●
③ Isolation amplifier	●	●	●
④ Low noise operational amplifier		●	●
⑤ MCU M380 Group		●	●



Value provided

This is the photocoupler that coupled an infrared light emitting diode with high output power and a light receiving IC chip with high gain and high speed.

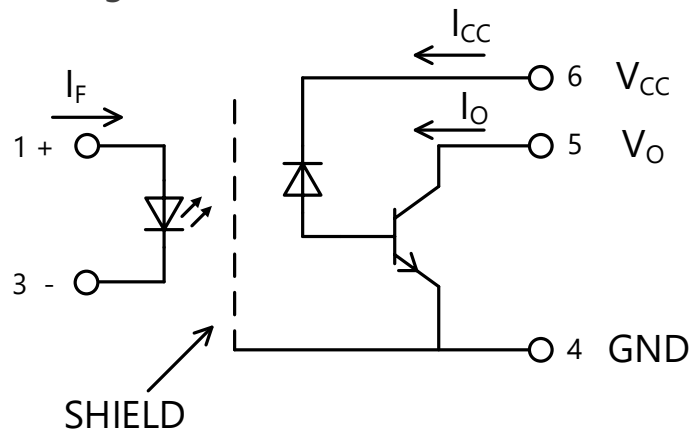
## 1 Common mode transient immunity (CMTI) of 10 [kV/ $\mu$ s]

This photocoupler has CMTI capability of 10 kV/ $\mu$ s or more by providing shield between input and output of the photocoupler.


## 2 High speed

IC output photocouplers transmit PWM signals, which requires high speed operation.

Internal circuit configuration



### Lineup

Part number	TLP2719
Package	SO6L 
BV <sub>S</sub> [Vrms]	5000
Data transfer rate (Typ.) [Mbps]	1
CM <sub>Hr</sub> , CM <sub>L</sub> (Min) [kV/ $\mu$ s]	$\pm 10$

[◆ Return to Block Diagram Top](#)

Value provided

**The built-in various protective functions make it easy to design the gate drive circuit.**

## 1 Protective functions

Various protective functions <sup>[Note]</sup> including an overcurrent detection by monitoring collector voltage are built in.

[Note] Gate signal soft turn off, fault feedback function

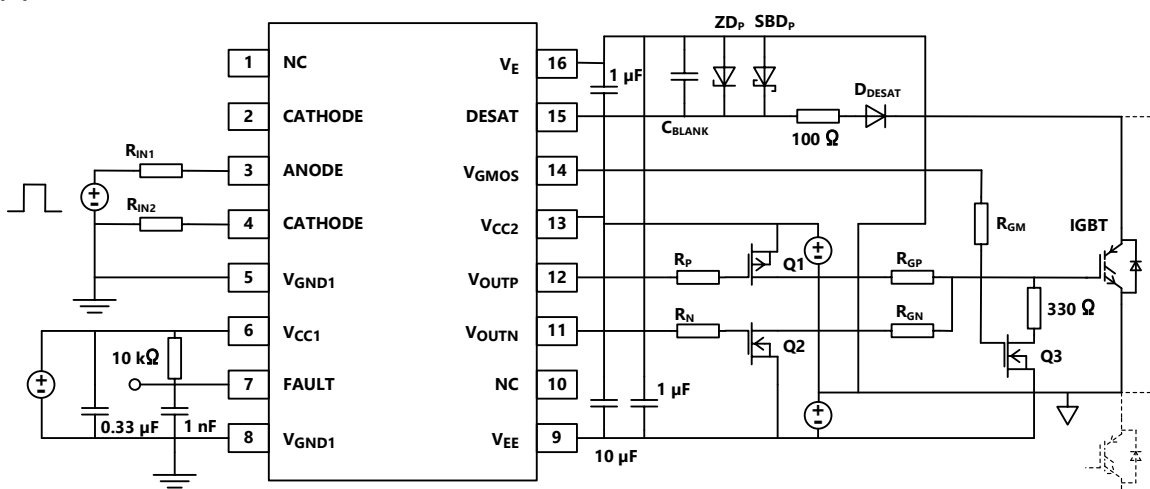
## 2 Rail-to-rail output

TLP5231, TLP5214 and TLP5214A generate a full-swing voltage output signal and contribute to low power consumption.




### 3 High temperature of 110 °C (ambient) operation

These photocouplers are designed to operate under severe ambient temperature conditions.

## Application Circuit (TLP5231)



## Lineup

Part number	TLP5231	TLP5214	TLP5214A
Package	SO16L 	SO16L 	SO16L 
$I_{OP}$ (Max) [A]	±2.5	±4.0	±4.0
$t_{pHL}/t_{pLH}$ (Max) [ns]	300	150	150
$BV_S$ [Vrms]	5000	5000	5000
$T_{opr}$ [°C]	-40 to 110	-40 to 110	-40 to 110
$V_{CC2} - V_{EE}$ [V]	21.5 to 30	15 to 30	15 to 30
$I_{FHL}(I_{FLH})$ (Max) [mA]	3.5	6	6
DESAT Filter	✓	-	✓

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Value provided

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

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

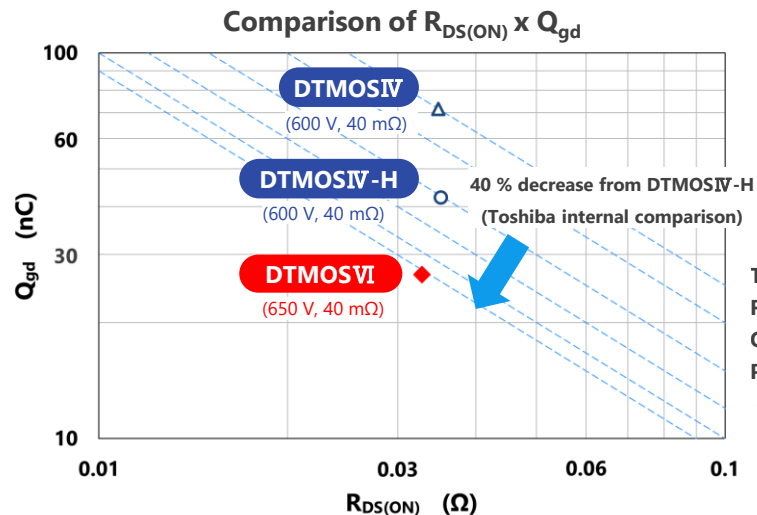
In the DTMOSVI series, the  $R_{DS(ON)} \times Q_{gd}$  is reduced by approximately 40 % compared with our conventional DTMOSIV-H series product by optimizing the gate design and processes.

## 2 Enhancement type

This is an enhancement type that is easy to handle.

## 3 Various packages

Wide package lineup:  
from through hole type to small surface mount type with high heat dissipating.



### 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)

### Lineup

Part number	TK090E65Z	TK090U65Z	TK090A65Z	TK090N65Z	TK090Z65Z
Package	 TO-220	 TOLL	 TO-220SIS	 TO-247	 TO-247-4L
$V_{DS}$ [V]	650	650	650	650	650
$I_D$ [A]	30	30	30	30	30
$R_{DS(ON)}$ [Ω] @ $V_{GS} = 10 \text{ V}$	Typ.	0.075	0.07	0.075	0.075
	Max	0.09	0.09	0.09	0.09
Polarity	N-ch	N-ch	N-ch	N-ch	N-ch
Generation	DTMOSVI	DTMOSVI	DTMOSVI	DTMOSVI	DTMOSVI

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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/ $\mu$ s (Min).

[Note 1] CMTI: Common Mode Transient Immunity

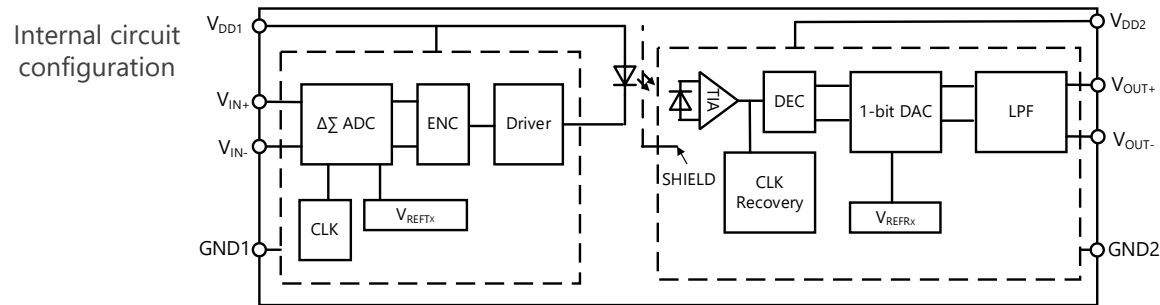
## 3 5 V system power supply voltages

Input power supply voltage

$V_{DD1}$  = 4.5 to 5.5 V

Output power supply voltage

$V_{DD2}$  = 3.0 to 5.5 V



[Note 1] Bypass capacitor of 0.1  $\mu$ 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/ $\mu$ s]	15

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Value provided

Very small signals detected by various sensors can be amplified with very low noise.

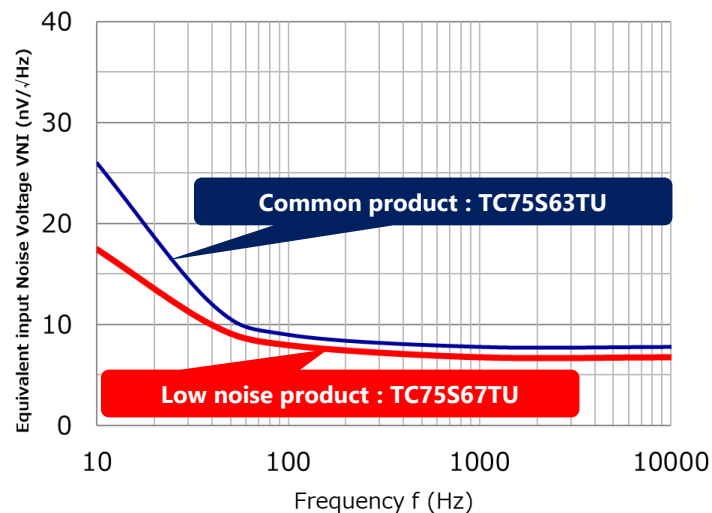
## 1 Low noise $V_{NI} = 6.0 \text{ [nV}/\sqrt{\text{Hz}}] \text{ (Typ.) @} f = 1 \text{ kHz}$

Small signals detected by various sensors <sup>[Note]</sup> can be amplified with low noise using CMOS operational amplifier. Low input equivalent noise voltage has been achieved by optimizing the processing.

[Note] Sensor types: vibration detection sensor, shock sensor, accelerometer, pressure sensor, infrared sensor, temperature sensor, etc.

### Noise characteristics


(Toshiba internal comparison)



## 2 Low current consumption $I_{DD} = 430 \text{ [}\mu\text{A]} \text{ (Typ.)}$

Low current consumption characteristics are realized by using the CMOS process.

### Lineup

Part number	TC75S67TU
Package	UFV 
$V_{DD,SS} \text{ (Max) [V]}$	$\pm 2.75$
$V_{DD,SS} \text{ (Min) [V]}$	$\pm 1.1$
$I_{DD} \text{ (Typ.) [}\mu\text{A]}$	430
$V_{NI} \text{ (Typ.) [nV}/\sqrt{\text{Hz}}] \text{ @} f = 1 \text{ kHz}$	6

[Return to Block Diagram Top](#)

Value provided

**Toshiba original oscillation frequency detector (OFD) can be utilized for abnormal operation detection of system.**

## 1 Built-in Arm® Cortex®-M3 CPU core

TMPM381/383 implements Cortex-M3 core with 40 MHz maximum operation frequency. Various development tool and their partners allow users many options.

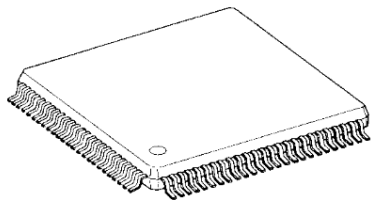
## 2 System cost down and development efficiency improvement

TMPM381/383 executes system monitoring efficiently by using built-in AD converter. The original NANO FLASH™ is possible to rewrite at high speed. It reduces user software development time period.

## 3 Built-in oscillation frequency detector

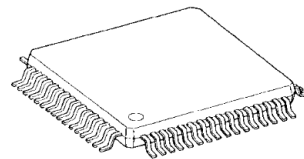
TMPM381/383 implements Toshiba original oscillation frequency detector (OFD) which detects abnormal oscillation at the hardware level. This function can be utilized for abnormal operation detection of system.

TMPM381FWFG



LQFP100-P-1414-0.50H

TMPM383FSUG



LQFP64-P-1010-0.50E

### Lineup

Part number	TMPM381FWFG	TMPM383FSUG
Maximum operation frequency	40 MHz	40 MHz
Instruction ROM	128 KB	64 KB
RAM	10 KB	8 KB
Timer	16bit x 8ch	16bit x 8ch
UART / SIO	3ch	2ch
Full UART	1ch	1ch
AD converter	18ch (12bit)	10ch (12bit)
IO Port	83 ports	47 ports

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