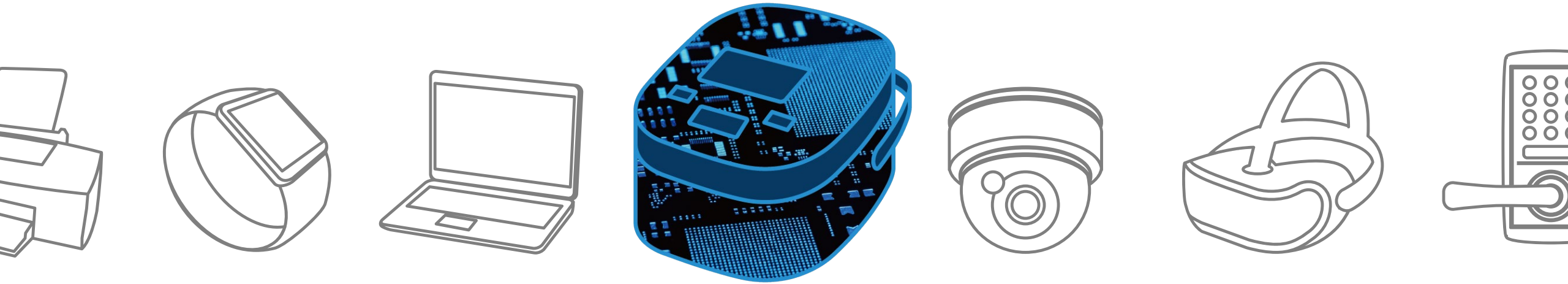
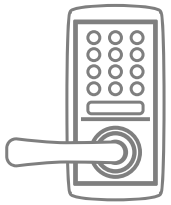
TOSHIBA

R21

IH Rice Cooker

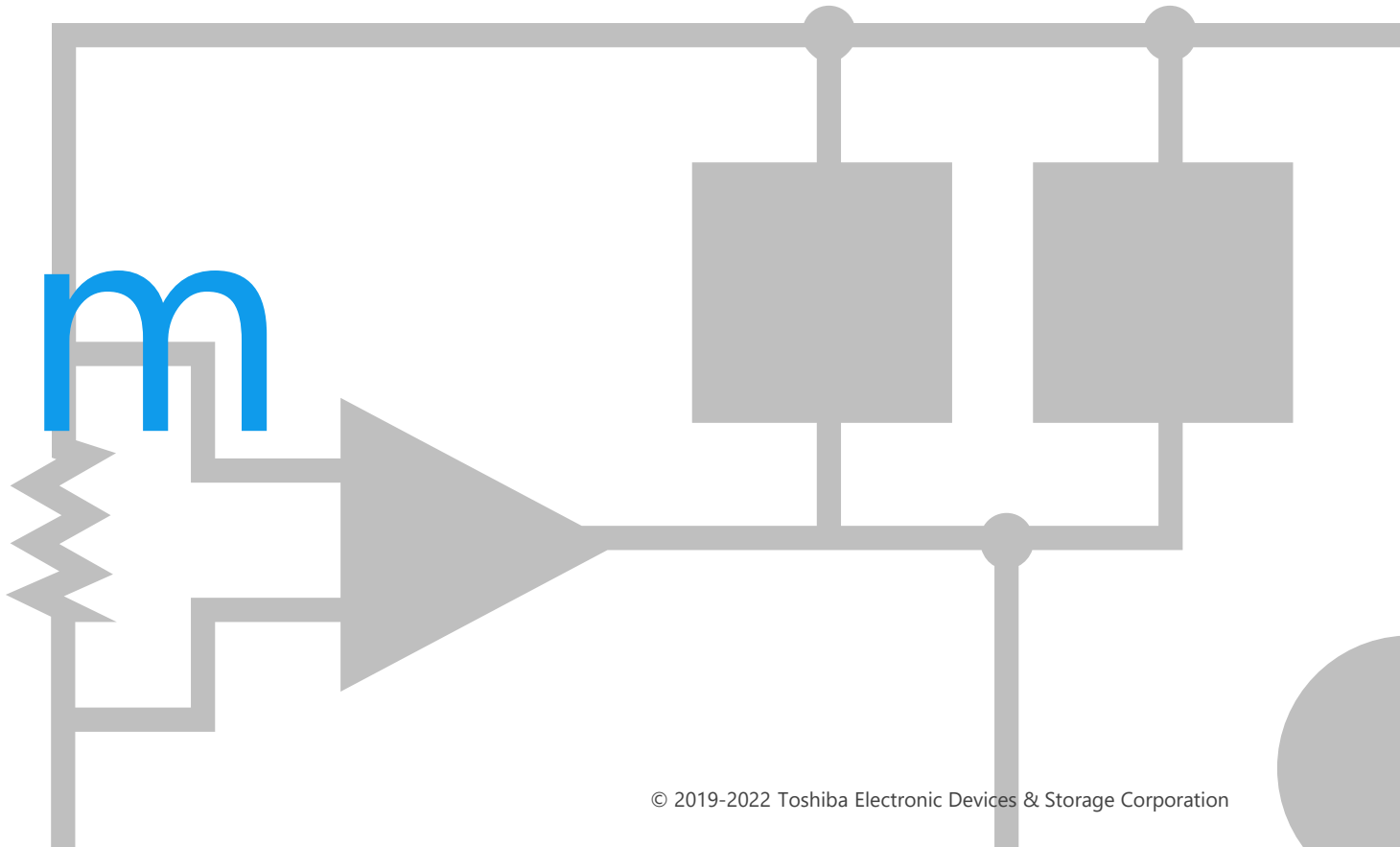
Solution Proposal by Toshiba



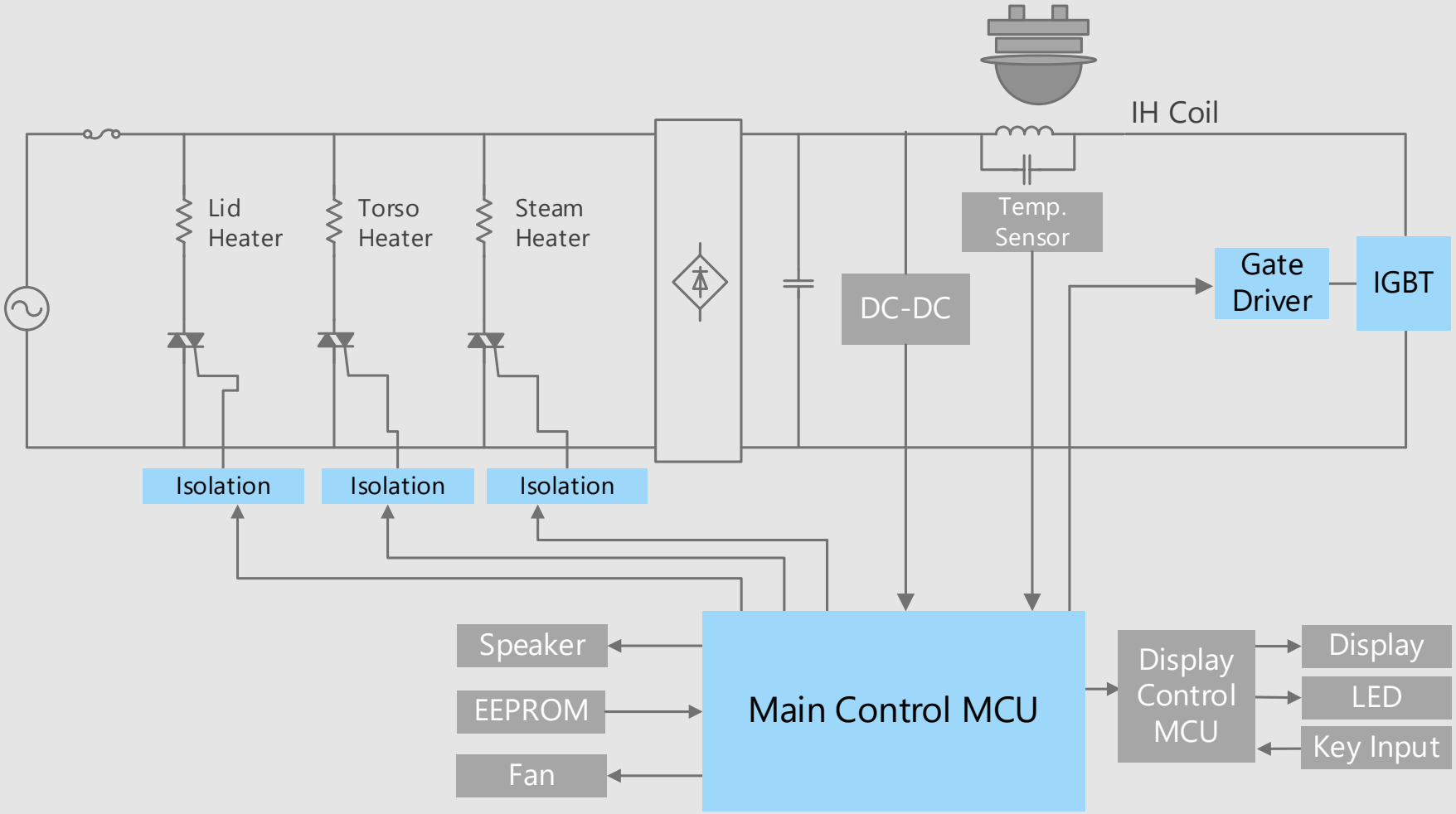


Toshiba Electronic Devices & Storage Corporation provides comprehensive device solutions to customers developing new products by applying its thorough understanding of the systems acquired through the analysis of basic product designs.

Block Diagram

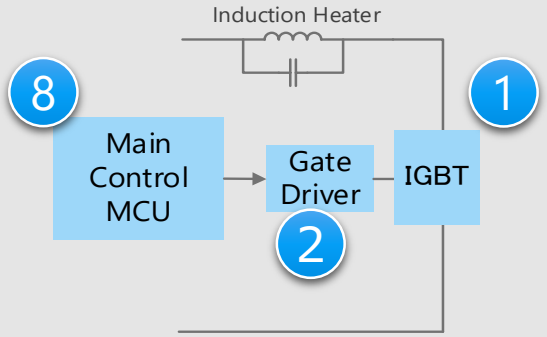


IH Rice Cooker　Overall block diagram

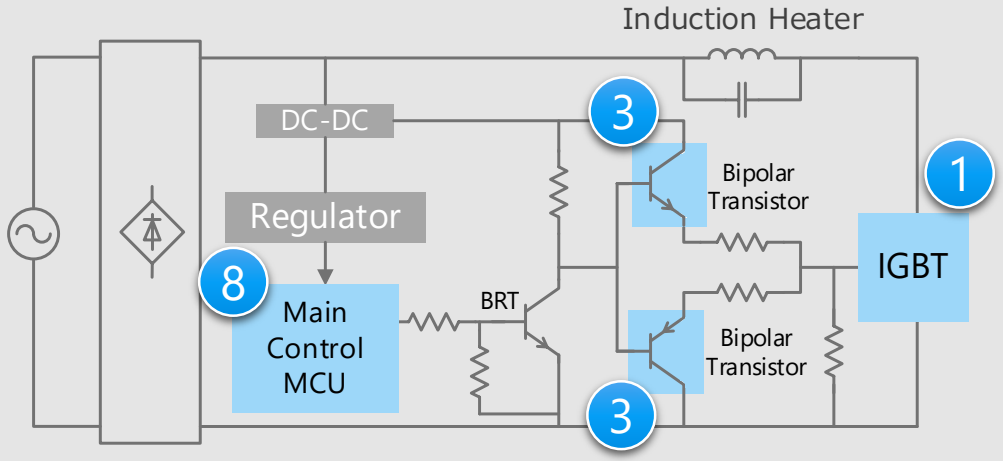


IH Rice Cooker　Detail of IH coil drive unit

IH coil drive circuit (using gate driver coupler)



IH coil drive circuit (using discrete components)



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

Criteria for device selection

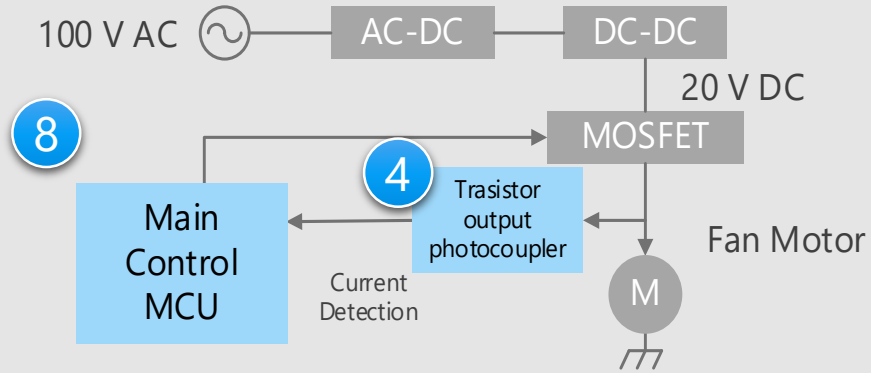
- High speed switching and low saturation voltage characteristics are required for IGBT.
- Small package products contribute to the reduction of circuit board area.
- Rail-to-Rail output, low voltage driving and low current consumption are required for gate driver to realize low power consumption of the set.
- System control requires a MCU for sensor monitoring, high speed data processing and various heaters.

Proposals from Toshiba

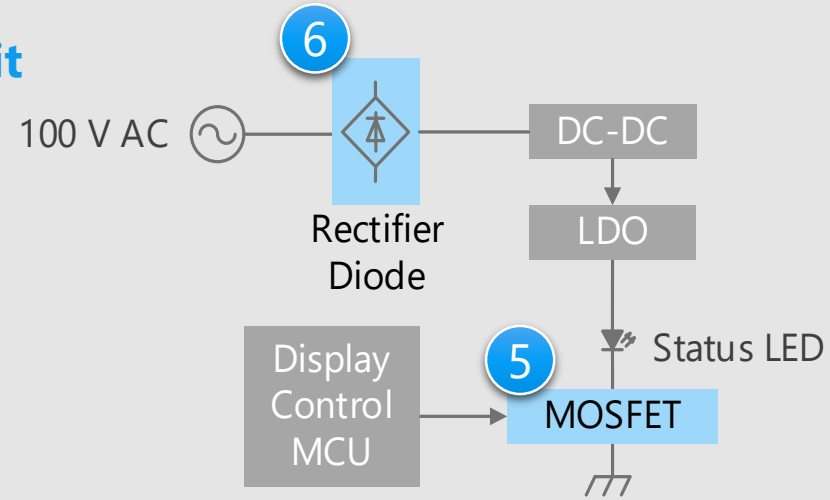
- **High speed and high efficiency switching are realized**
  Discrete IGBT　1
- **High efficiency due to rail-to-rail characteristics**
  IGBT gate driver coupler　2
- **Contribute to reduction of switching loss**
  Bipolar transistor for IGBT gate drive　3
- **High efficient processing of multiple input and output data**
  Main control MCU　8

IH Rice Cooker　Detail of fan motor drive / LED drive unit

Fan motor drive circuit



LED driving circuit



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

Criteria for device selection

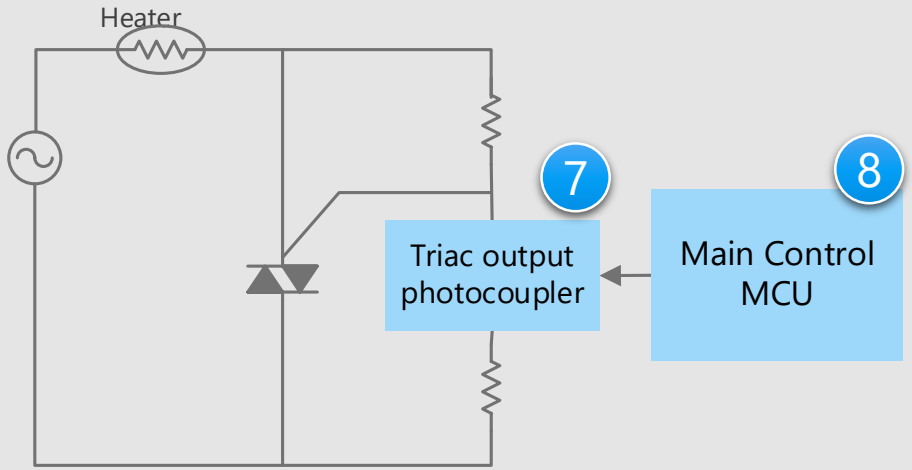
- MOSFET with low on-resistance characteristic contributes to low loss of the set.
- Small package products contribute to the reduction of circuit board area.
- System control requires a MCU for sensor monitoring, high speed data processing and various heaters.

Proposals from Toshiba

- **High current transfer ratio and high temperature operation makes easy to design.**
  Transistor output photocoupler　4
- **Low on-resistance realizes a set with low power consumption**
  U-MOS Series MOSFET　5
- **Small surface mount package suitable for high density mounting**
  Rectifier diode　6
- **High efficient processing of multiple input and output data**
  Main control MCU　8

IH Rice Cooker　Detail of heater control unit

Heater control circuit



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

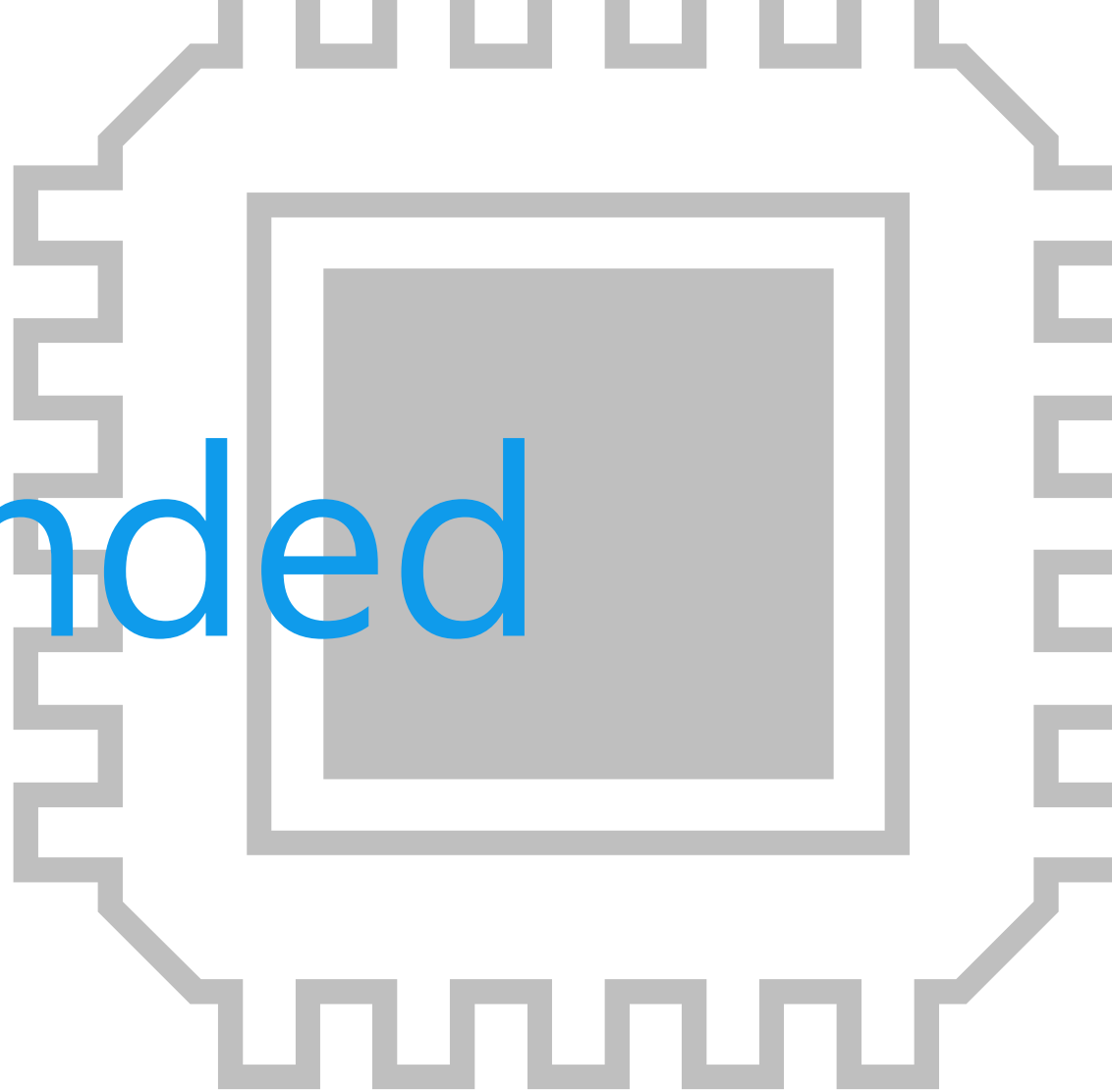
Criteria for device selection

- A triac output photocoupler is suitable to control AC load.
- System control requires a MCU for sensor monitoring, high speed data processing and various heaters.

Proposals from Toshiba

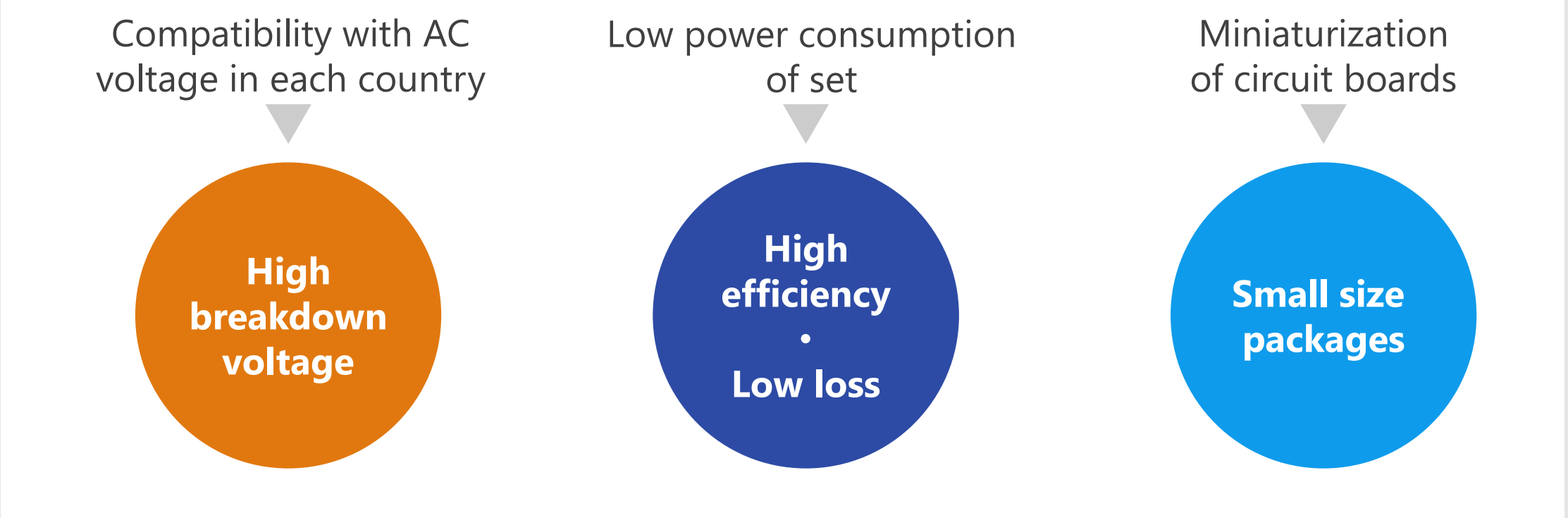
- **Efficient control of AC load is realized.**
  Triac output photocoupler 7
- **High efficient processing of multiple input and output data**
  Main control MCU 8

Recommended Devices



Device solutions to address customer needs

As described above, in order to design IH Rice Cooker, **“Compatibility with AC voltage in each country”**, **“Low power consumption of set”** and **“Miniaturization of circuit boards”** are important factors. Toshiba’s proposals are based on these three solution perspectives.



Device solutions to address customer needs

	High breakdown voltage	High efficiency • Low loss	Small size packages
1 Discrete IGBT	●	●	
2 IGBT gate driver coupler	●	●	●
3 Bipolar transistor for IGBT gate drive		●	●
4 Transistor output photocoupler		●	●
5 U-MOS Series MOSFET		●	●
6 Rectifier diode	●	●	●
7 Triac output photocoupler	●	●	●
8 Main control MCU		●	●

1 Discrete IGBT

GT50N324 / GT30J110SRA / GT20N135SRA / GT30N135SRA

High breakdown voltage | High efficiency • Low loss | Small size packages

Value provided

High speed switching and low saturation voltage characteristics contribute to high efficiency.

1 High speed switching

Reducing switching loss through high speed operation contributes to higher inverter efficiency.

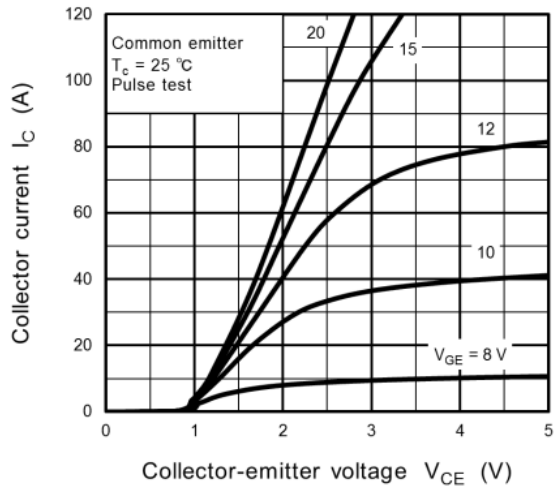
2 Low saturation voltage

Saturation voltage is kept low while realizing high speed switching.

3 Enhancement type

Enhancement type is easy to handle because no collector current flows when no gate voltage is applied.

GT30J110SRA
Characteristics Curves



Lineup

Part number	GT50N324	GT30J110SRA	GT20N135SRA	GT30N135SRA
Package	TO-3P(N)		TO-247	
V_{CES} [V]	1000	1100	1350	1350
t_f (Typ.) [μs]	0.11 @I_C = 60 A	0.17 @I_C = 60 A	0.25 @I_C = 40 A	0.25 @I_C = 60 A
$V_{CE(sat)}$ (Typ.) [V]	1.9 @I_C = 60 A	2.15 @I_C = 60 A	2.0 @I_C = 40 A	2.15 @I_C = 60 A

◆Return to Block Diagram TOP

2a IGBT gate driver coupler

TLP5771H / TLP5772H / TLP5774H / TLP5751H / TLP5752H / TLP5754H

High breakdown voltage | High efficiency · Low loss | Small size packages

Value provided

Rail-to-rail output enables stable operation of the system and reduction of conduction losses.

1 Rail-to-rail output

This product generates a full swing voltage output signal and contributes to low power consumption.

2 Small package

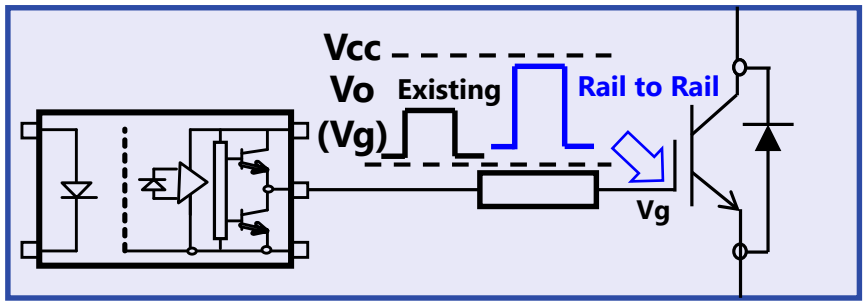
This driver couplers are 50 % smaller than the 8-pin DIP package [Note] and meets the reinforced insulation class requirements of international safety standards.

3 Operational ambient temperature range 125 °C

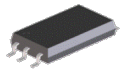
These driver couplers are designed to operate under severe ambient temperature conditions.

[Note] Comparison with Toshiba products

Rail-to-rail output



Lineup

Part number	TLP5771H	TLP5772H	TLP5774H	TLP5751H	TLP5752H	TLP5754H
Package	SO6L 					
I_{op} (Max) [A]	±1	±2.5	±4	±1	±2.5	±4
t_{pHL} , t_{pLH} (Max) [ns]	150	150	150	150	150	150
BV_S [V_{rms}]	5000	5000	5000	5000	5000	5000
T_{opr} [°C]	-40 to 125	-40 to 125	-40 to 125	-40 to 125	-40 to 125	-40 to 125
V_{cc} [V]	10 to 30	10 to 30	10 to 30	15 to 30	15 to 30	15 to 30
I_{FLH} (Max) [mA]	2	2	2	4	4	4

◆Return to Block Diagram TOP

2b IGBT gate driver coupler

TLP5231 (Smart Gate Driver Coupler)

High breakdown voltage | High efficiency · Low loss | Small size packages

Value provided

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

1 Protective Functions

TLP5231 delivers various built-in functions [Note], including an overcurrent detection by monitoring collector voltage.

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

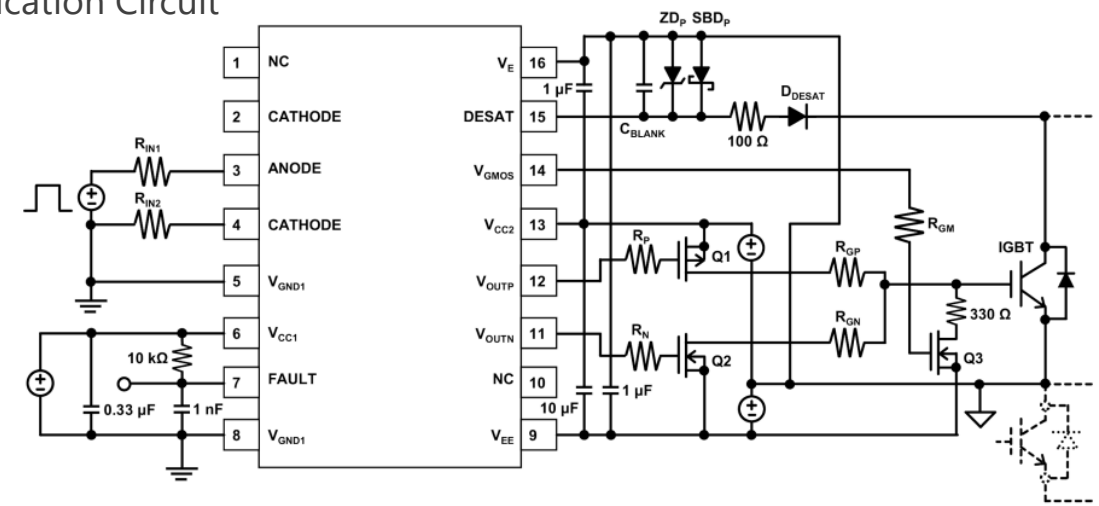
2 Rail-to-rail output

TLP5231 generates a full swing voltage output signal and contributes to low power consumption.

3 Operational ambient temperature range 110 °C

TLP5231 is designed to operate under severe ambient temperature conditions.

Application Circuit



Lineup

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

◆Return to Block Diagram TOP

3 Bipolar transistor for IGBT gate drive

HN4B101J / HN4B102J / TPCP8901 / TPCP8902

High breakdown voltage | High efficiency · Low loss | Small size packages

Value provided

High speed switching characteristics and high h_{FE} performance enable the system to have higher frequencies and lower losses.

1 High speed switching operation

These transistors have high speed switching characteristic suitable for high frequency equipment.

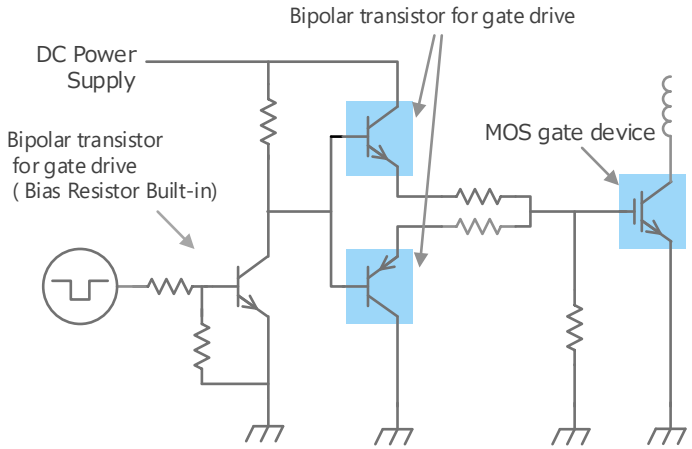
2 High DC current gain (h_{FE})

Maximum rating of collector current and DC current gain are improved for larger IGBT gate capacity.

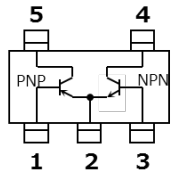
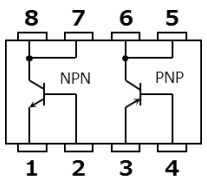
3 Compact and thin package

Both PNP and NPN type are mounted on one small surface mount package to reduce mounting area.
Emitter terminals of PS-8 package is independent, so it is easy to set the gate resistance ON and OFF.

Example of IGBT gate drive circuit



Lineup

Part number	HN4B101J	HN4B102J	TPCP8901	TPCP8902
Package	SMV		PS-8	
Internal structure (Top View)				
V_{CEO} (PNP/NPN) [V]	-30 / 30	-30 / 30	-50 / 50	-30 / 30
I_{CP} (PNP/NPN) [A]	-5 / 5	-8 / 8	-5 / 5	-8 / 8

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4 Transistor output photocoupler

TLP183 / TLP185(SE

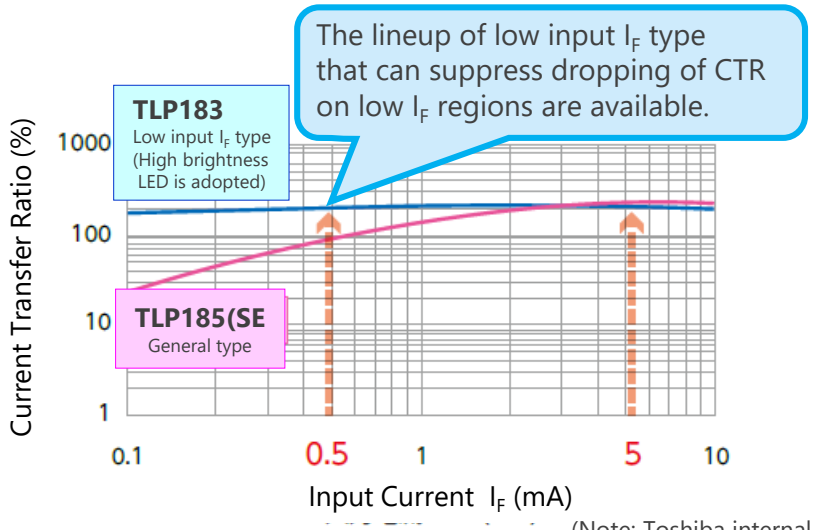
High breakdown voltage | High efficiency · Low loss | Small size packages

Value provided

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

1 High current transfer ratio

TLP183 is a high-isolation photocoupler that optically couples a phototransistor and high output infrared LED. Compared to TLP185(SE (Toshiba's conventional product), high CTR (Current Transfer Ratio) in low input current range (@ I_F = 0.5 mA) is realized.



(Note: Toshiba internal comparison)

2 Wide operating temperature range

It is designed to operate even under severe ambient temperature conditions.

Lineup

Part number	TLP183	TLP185(SE
Package	4pin SO6 	4pin SO6 
BV_S [Vrms]	3750	3750
T_{opr} [°C]	-55 to 125	-55 to 110

◆Return to Block Diagram TOP

5 U-MOS Series MOSFET

SSM3K56MFV / SSM6N56FE

High breakdown voltage | High efficiency • Low loss | Small size packages

Value provided

U-MOS series MOSFET contributes to energy saving and miniaturization by improving the trade-off characteristics between on-resistance and capacitance.

1 Low on-resistance

By keeping the drain-source on-resistance low, heat generation and power consumption can be reduced and contributes to miniaturization.

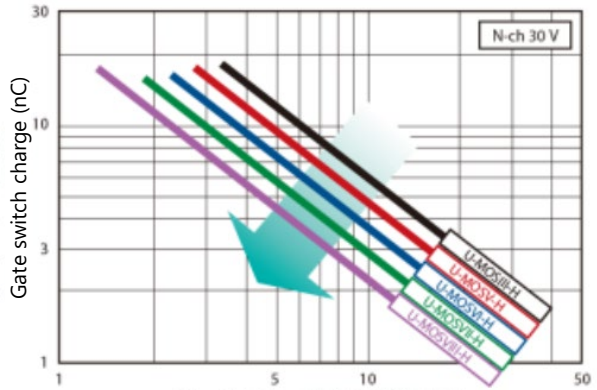
2 Small gate input charge

Switching characteristics are improved by reducing the amount of gate input charge.

3 Fast switching speed

Reducing switching loss by high speed operation contributes to higher efficiency.

Trade-off characteristics of on-resistance and gate input charge



(Note: Toshiba internal comparison)

Lineup

Part number		SSM3K56MFV	SSM6N56FE
Package		VESM 	ES6 
V_{DSS} [V]		20	20
I_D [A]		0.8	0.8
$R_{DS(ON)}$ [Ω] @V_{GS} = 4.5 V	Typ.	0.186	0.186
	Max	0.235	0.235
Polarity		N-ch	N-ch × 2

◆Return to Block Diagram TOP

6 Rectifier diode
CMG06A

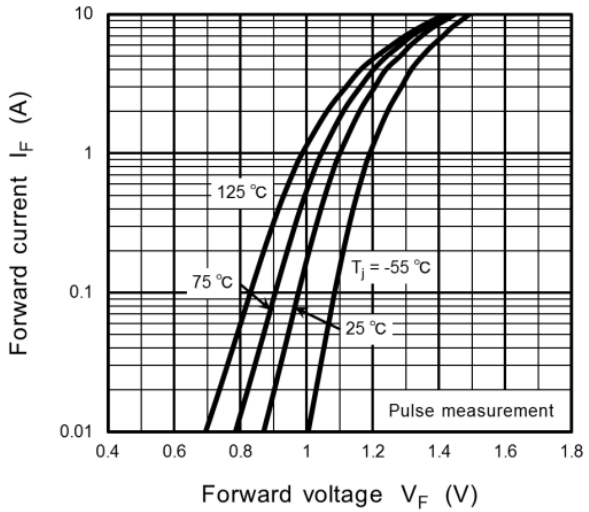
High breakdown voltage | High efficiency • Low loss | Small size packages

Value provided

Wide range of products are provided, mainly compact package that is suitable for high density assembly.

1 Surface mount / small package

Adopting M-FLAT™ package which is lower in height compared to the conventional lead type contributes to the space saving of the equipment.



CMG06A
forward characteristic

2 Wide product lineup

Repetitive peak reverse voltage : 200 to 1000 V
Average forward current : 0.5 to 3 A
Suitable product can be selected according to requirements.

Lineup

Part number	CMG06A
Package	M-FLAT™ 
$I_{F(AV)}$ [A]	1
V_{RRM} [V]	600

◆Return to Block Diagram TOP

7 Triac output photocoupler

TLP267J / TLP3052A

High breakdown voltage

High efficiency · Low loss

Small size packages

Value provided

This photocoupler consists of a non zero crossing photo triac, optically coupled to a infrared light emitting diode.

1 Non zero cross type

This photocoupler is suitable for the case where the operation time is short and phase control is necessary.

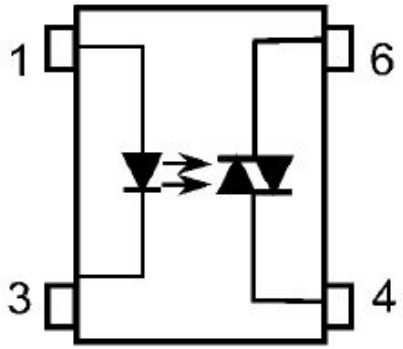
2 Switching characteristic

It has excellent features such as high speed, low noise and silence.

3 Miniaturization of mounting area

4pin SO6 packages have a size of 3.7 x 7.0 x 2.1 mm. (TLP267J)

TLP267J
Internal connection



UL-approved : UL1577, File No. E67349
cUL-approved: CSA Component Acceptance Service No.5A File No.E67349
VDE-approved: EN60747-5-5, EN62368-1 (Note)
(Note) When a VDE approved type is needed, please designate the Option (V4).

Lineup

Part number	TLP267J	TLP3052A
Package	4pin SO6 	5pin DIP6 
V_{DRM} [V]	600	600
BV_S [Vrms]	3750	5000
T_{opr} [°C]	-40 to 100	-40 to 100
Type	Non-zero-voltage turn-on	

◆Return to Block Diagram TOP

8 Main control MCU

TX03 Series M380 Group TMPM383FSUG

High breakdown voltage | High efficiency • Low loss | Small size packages

Value provided

System control at low power consumption by various timers and AD converters.

1 Built-in Arm® Cortex®-M3 CPU core

TMPM383FSUG implements Cortex-M3 core with 40 MHz maximum operation frequency. Various development tool and their partners allow users many options.

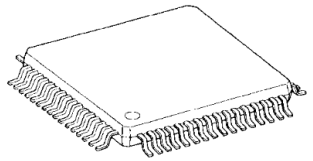
2 System cost down and development efficiency improvement

Multi-channel AD converters and timers enable efficient monitoring and motoring of various parts of the system. The Toshiba original NANOFLASH™ is possible to rewrite at high speed. It reduces user software development time period.

3 Small size package and low power consumption

TMPM383FSUG supports low power consumption library and stand by function. These contribute to reduce low power consumption. The package is small LQFP64.

TMPM383FSUG



LQFP64

Lineup

Part number	TMPM383FSUG
Maximum operation frequency	40 MHz
Instruction ROM	64 KB
RAM	8 KB
Thumb®-2 Instruction set	Available
Timer	16bit x 8ch
I^2C	1ch
AD converter	10ch (12bit)

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