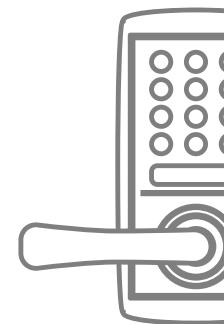
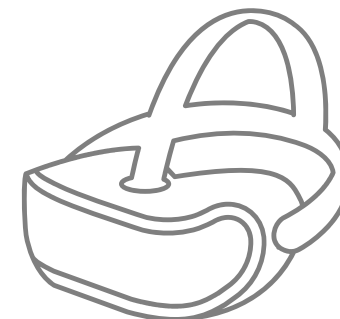
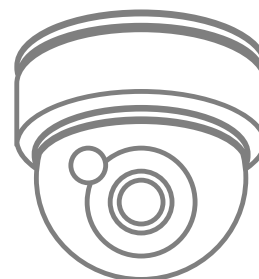
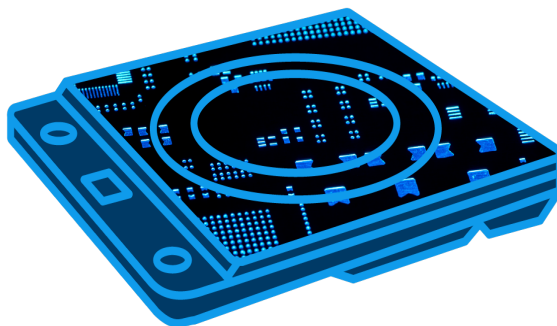
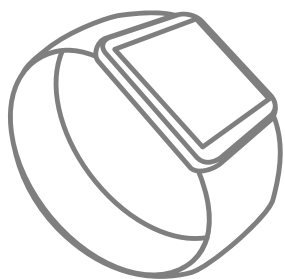
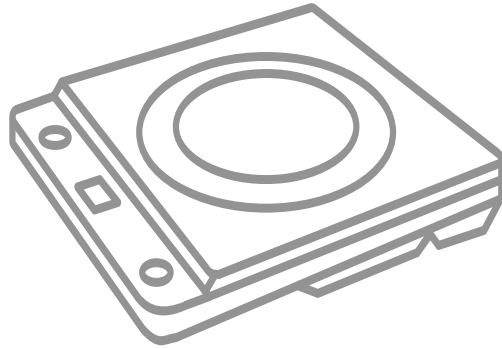
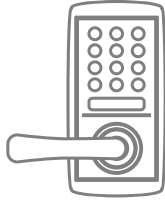
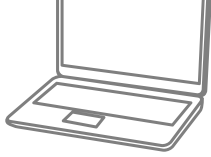


IH Cooking Heater

Solution Proposal by Toshiba

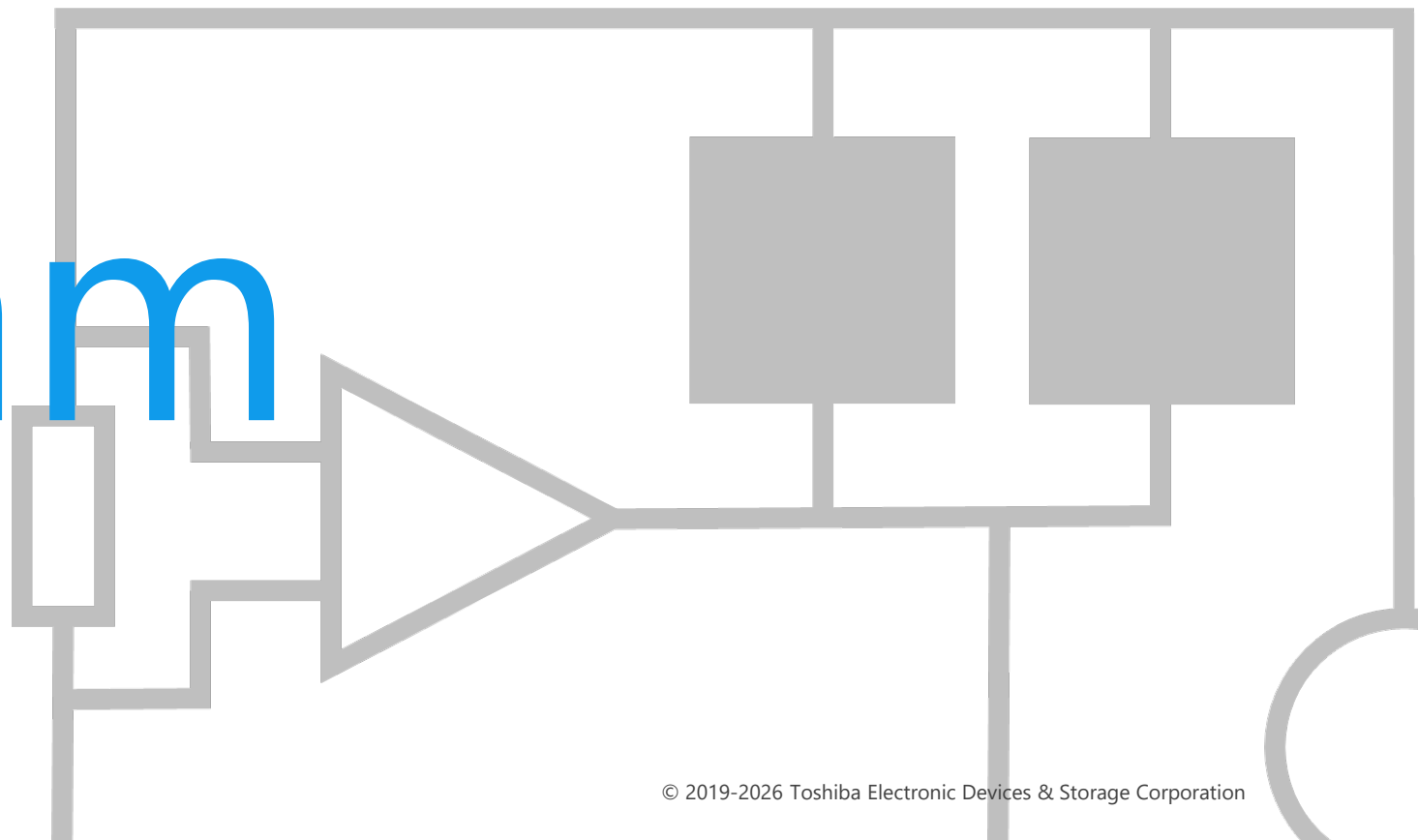




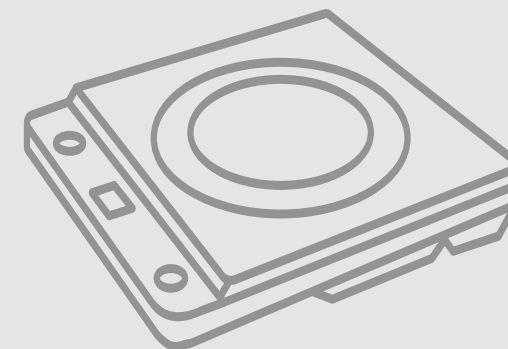
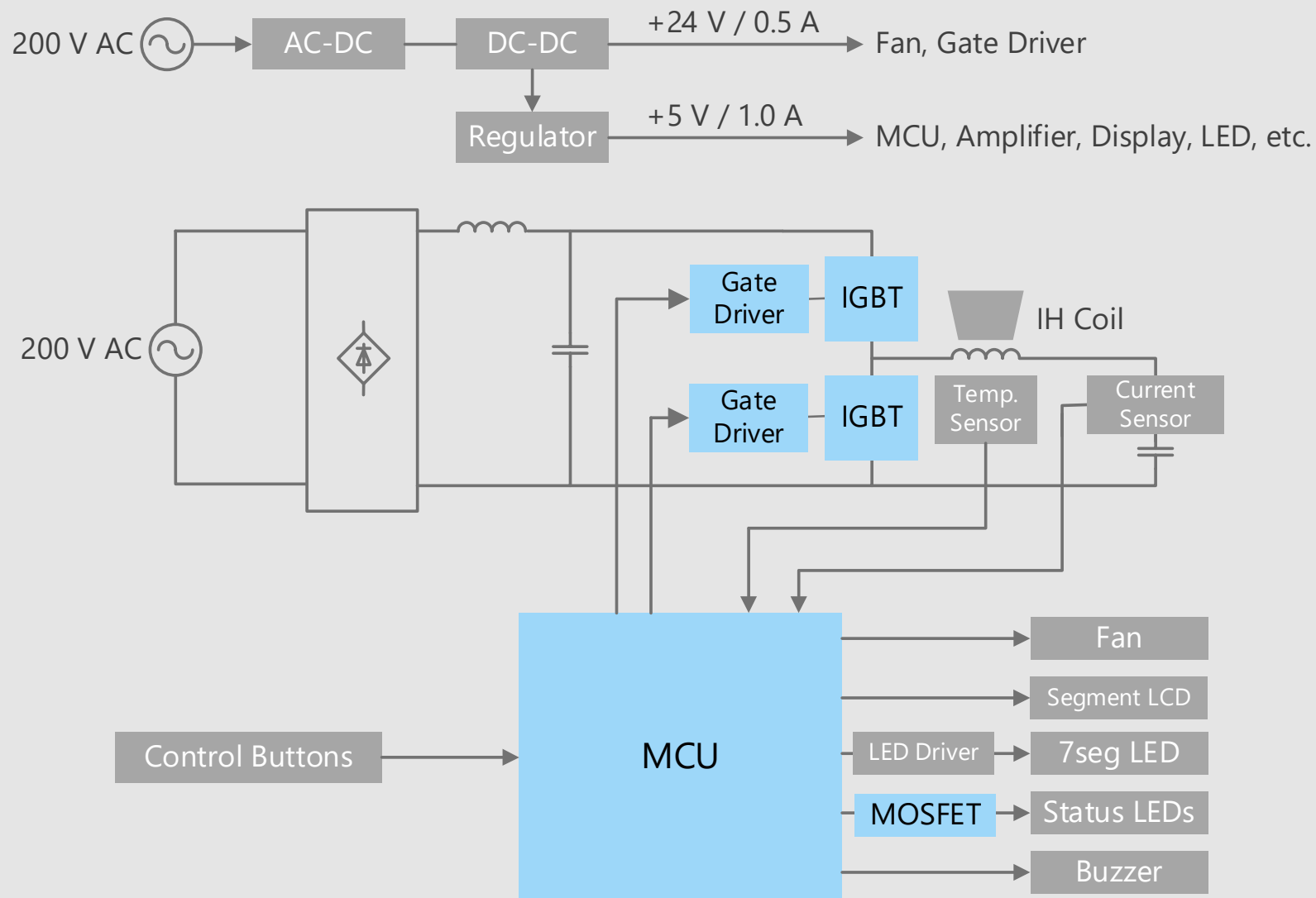
Toshiba Electronic Devices & Storage Corporation provides comprehensive device solutions to customers developing new products by applying its thorough understanding of the systems acquired through the analysis of basic product designs.



Block Diagram



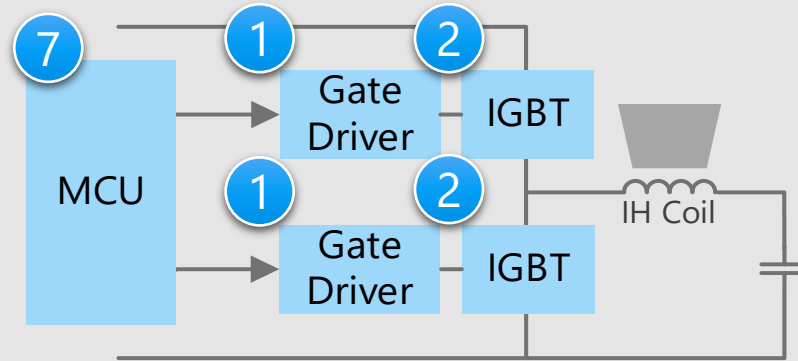
IH Cooking Heater Overall block diagram



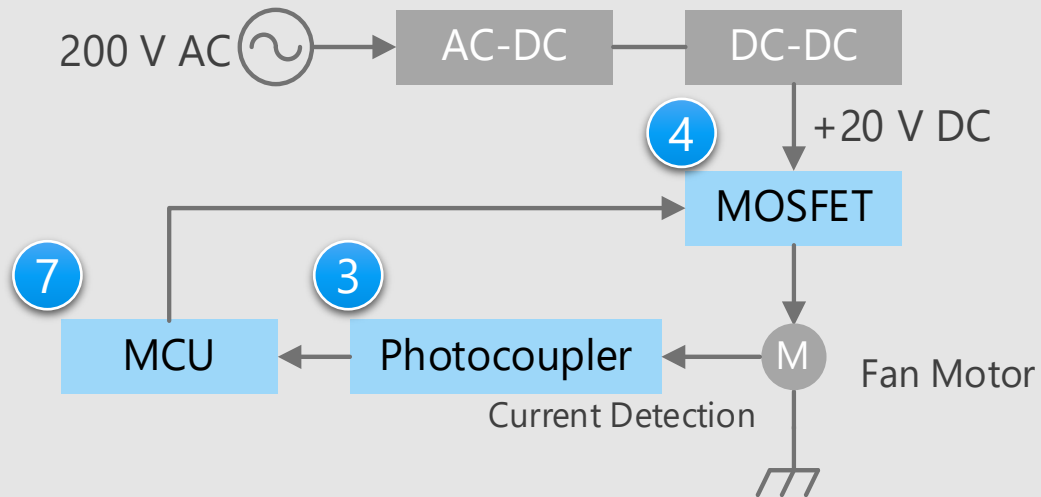
IH Cooking Heater Detail of IH coil drive / fan motor drive

IH coil drive circuit

Current resonance circuit



Brushless DC motor drive circuit



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

Criteria for device selection

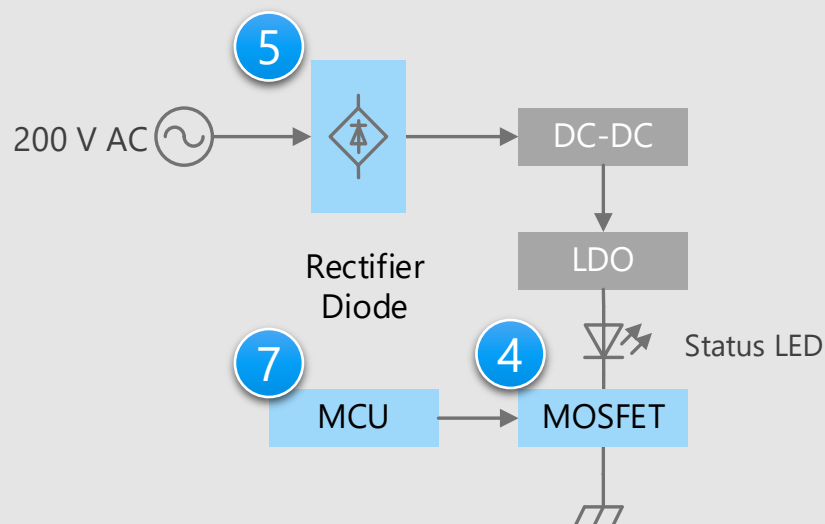
- High speed switching and low saturation voltage characteristics are required for IGBT.
- Rail-to-Rail output, low voltage driving and low current consumption are required for gate driver to realize low power consumption of the set.
- Monitoring sensor, high speed data processing and heater control are required for efficient system control.

Proposals from Toshiba

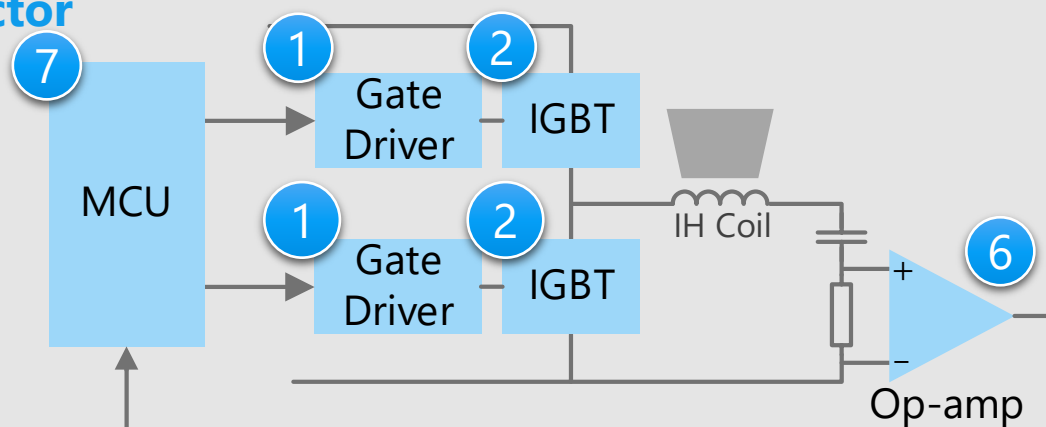
- **High efficiency due to rail-to-rail characteristics is realized**
IGBT gate driver coupler
- **High speed and high efficiency switching are realized**
Discrete IGBT
- **High current transfer ratio and high temperature operation are realized**
Transistor output photocoupler
- **Realize a set with low power consumption by low on-resistance**
U-MOS Series MOSFET
- **PWM control with multifunctional timer and A-PMD**
MCU M3H Group

IH Cooking Heater Detail of LED drive / current detector

LED drive circuit



Current detector



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

Criteria for device selection

- Low on-resistance characteristic contributes to low loss of the set.
- Error detection of equipment is enabled by monitoring the current of the system power supply. The use of an operational amplifier which have low voltage operation, low current consumption and low offset voltage leads to high precision monitoring and low power consumption.
- Monitoring sensor, high speed data processing and heater control are required for efficient system control.

Proposals from Toshiba

- **High efficiency due to rail-to-rail characteristics is realized**
IGBT gate driver coupler
- **High speed and high efficiency switching are realized**
Discrete IGBT
- **Realize a set with low power consumption by low on-resistance**
U-MOS Series MOSFET
- **Small surface mount package suitable for high density mounting**
Rectifier diode
- **Isolated transmission of the current detection signal**
Isolation amplifier
- **Built-in AD converter with the monitoring function**
MCU M3H Group

IH Cooking Heater Detail of display and operation section

Display and operation section



Criteria for device selection

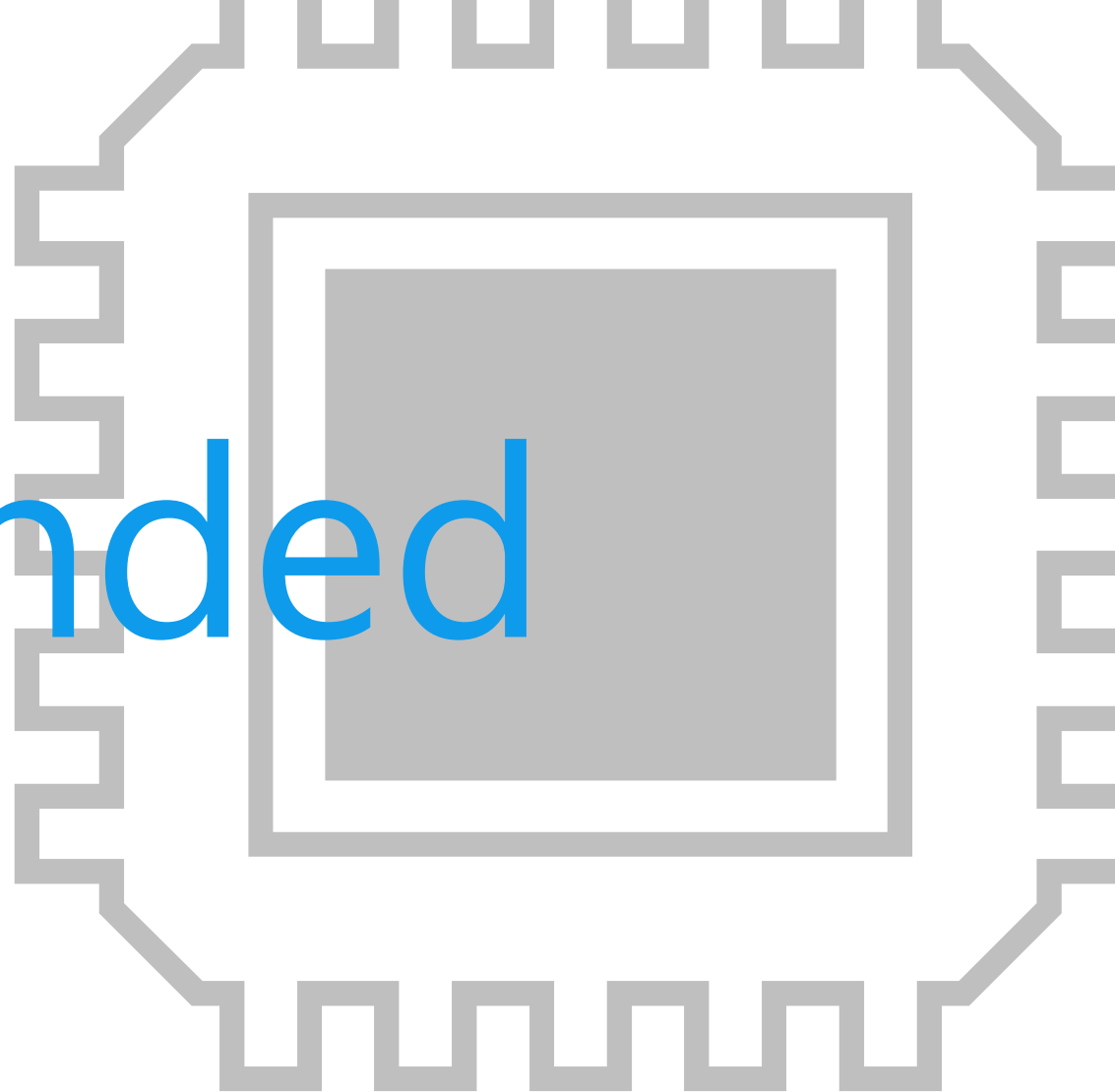
- Low on-resistance characteristic contributes to low loss of the set.
- The use of MCU with built-in external component functions reduces board BOM costs.

Proposals from Toshiba

- **Realize a set with low power consumption by low on-resistance**
U-MOS Series MOSFET 4
- **Built-in LCD display control circuit (DLCD) for non-bias driving system**
MCU M3H Group 7

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

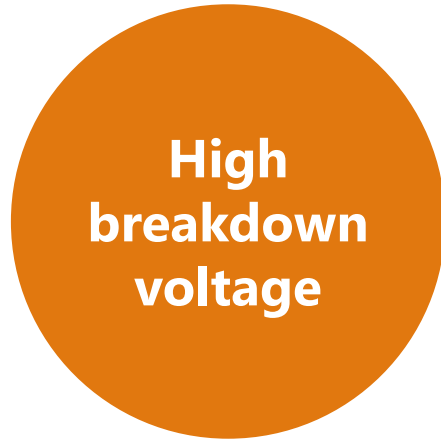
Recommended Devices



Device Solutions to address customer needs

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

Compatibility with AC voltage
in each country



Low power consumption
of the set



Miniaturization
of circuit boards



Device Solutions to address customer needs

	High breakdown voltage	High efficiency · Low loss	Small size packages
① IGBT gate driver coupler	●	●	●
② Discrete IGBT	●	●	
③ Transistor output photocoupler		●	●
④ U-MOS Series MOSFET		●	●
⑤ Rectifier diode	●	●	●
⑥ Isolation amplifier		●	●
⑦ MCU M3H Group		●	●

Value provided

Rail-to-Rail output enables the system to operate stably and reduce conduction losses.

1 Rail-to-Rail output

These driver couplers generate a full swing voltage output signal and contribute to low power consumption.

2 Small size package

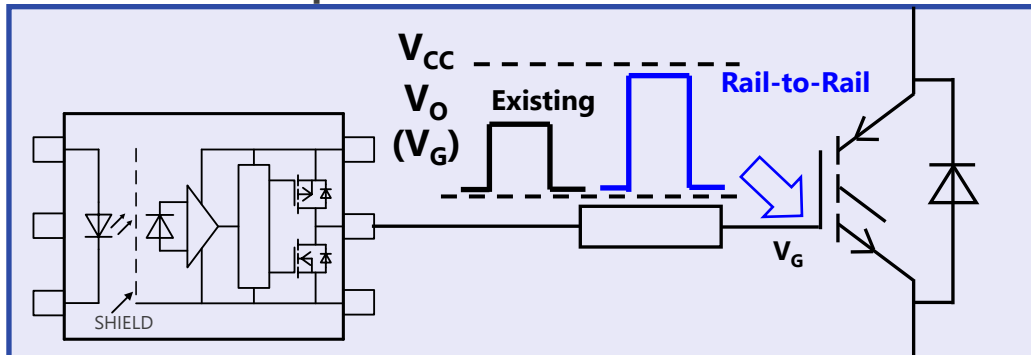
These driver couplers are 50 % smaller than the DIP8 package ^[Note 1] and meet the reinforced insulation class requirements of international safety standards.

[Note 1] Comparison with Toshiba products

3 Operational ambient temperature range 125 °C

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

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					
BV _S [Vrms]	5000					
T _{opr} [°C]	-40 to 125					
V _{CC} [V]	10 to 30			15 to 30		
I _{FIH} (Max) [mA]	2			4		

[◆Return to Block Diagram TOP](#)

Value provided

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

1 Built-in 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

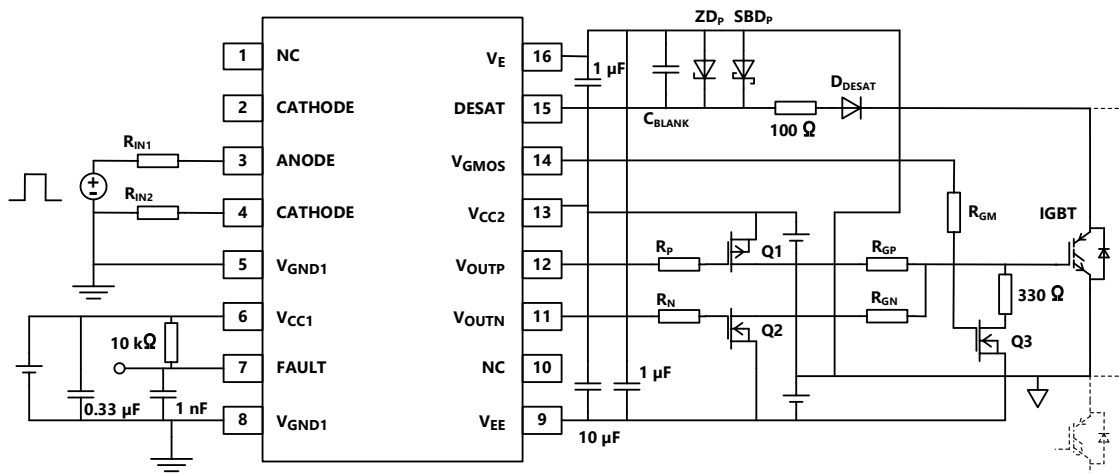
2 Rail-to-Rail output

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.

Example 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](#)

Value provided

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

1 High speed switching

Reducing switching loss through high speed operation contributes to higher power supply efficiency of the set.

2 Low saturation voltage

Saturation voltage is kept low while realizing high speed switching.

3 Built-in FWD (Free Wheeling Diode)

An RC (Reverse Conducting) structure that integrates an IGBT and FWD in a single chip has been adopted. ^[Note] The FWD is connected in inverse parallel to the IGBT, commutating the load current generated by back electromotive force generated in inductive loads (coils) in the reverse direction of the IGBT, thereby protecting the IGBT.

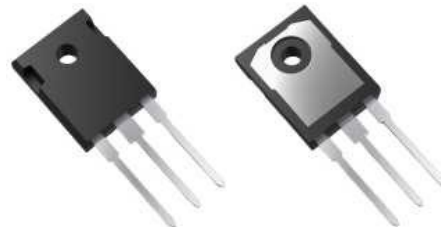
[Note] Except GT50J123

TO-3P(N)



Top view

TO-247



Top view

Bottom view

Lineup

Part number		GT50J123	GT30J65MRB	GT30J110SRA	GT20N135SRA	GT30N135SRA
Built-in FWD		-	✓ (RC structure)			
Absolute maximum ratings	I _C [A]	59	60	60	40	60
	V _{CES} [V]	600	650	1100	1350	1350
t _f (Typ.) [μs]		0.04 @I _C = 30 A	0.04 @I _C = 15 A	0.17 @I _C = 60 A	0.25 @I _C = 40 A	0.25 @I _C = 60 A
V _{CE(sat)} (Typ.) [V]		1.90 @I _C = 50 A	1.40 @I _C = 30 A (Pulse)	2.15 @I _C = 60 A (Pulse)	2.00 @I _C = 40 A (Pulse)	2.15 @I _C = 60 A (Pulse)
Package		TO-3P(N)			TO-247	

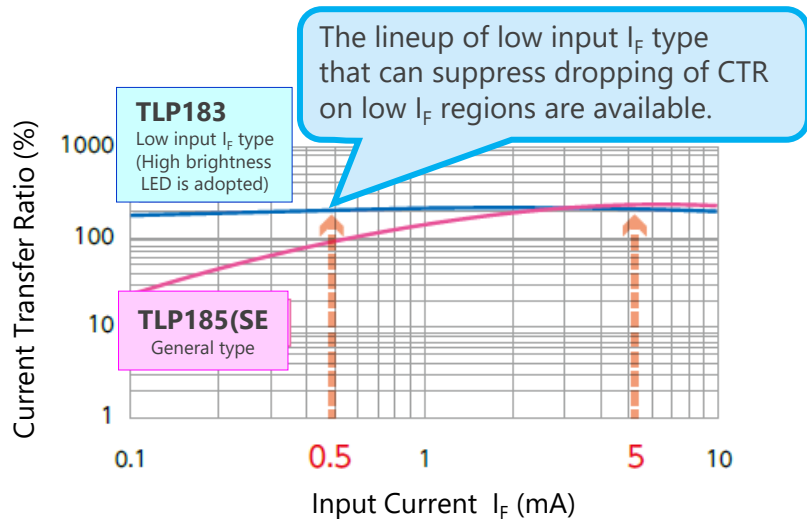
[◆Return to Block Diagram TOP](#)

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

TLP183 is a high-isolation photocoupler that optically couples a phototransistor and high output infrared LED. Compared to TLP185(SE (Toshiba's existing product), high CTR (Current Transfer Ratio) in low input current range (@ $I_F = 0.5 \text{ mA}$) 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	
BV _S [Vrms]	3750	
T _{opr} [°C]	-55 to 125	-55 to 110

[◆Return to Block Diagram TOP](#)

Value provided

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

1 Low on-resistance

The drain-source on-resistance is low. Heat generation and power consumption can be reduced.

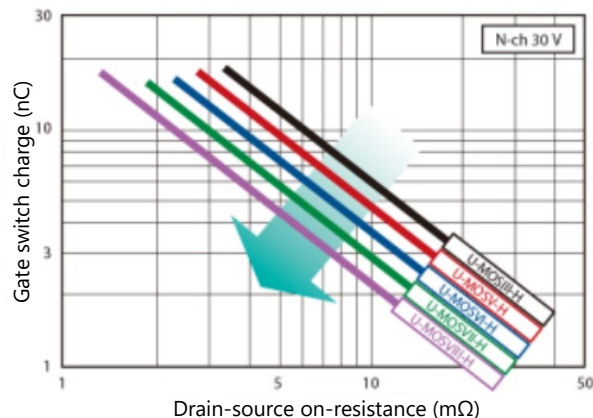
2 Small gate input charge

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

3 High speed switching

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_{DS} [V]	20	
I_D [A]	0.8	
$R_{DS(ON)}$ [Ω] @ $V_{GS} = 4.5$ V	Typ.	0.186
	Max	0.235
Polarity	N-ch	N-ch x 2

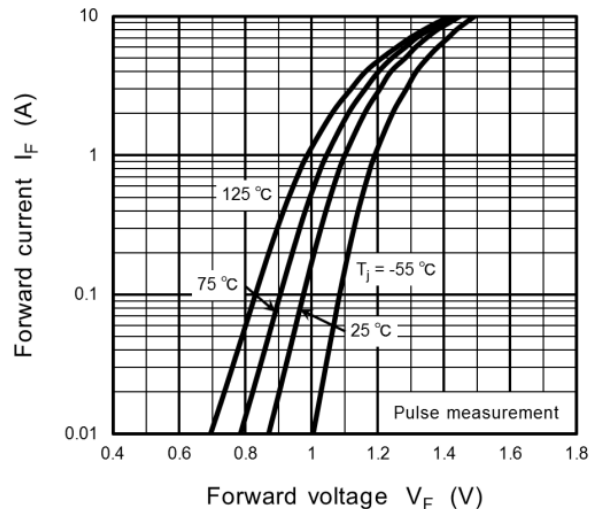
[◆Return to Block Diagram TOP](#)

Value provided

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

1 Small size surface mount package

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



CMG06A
forward characteristic

2 Wide product lineup

Repetitive peak reverse voltage: 200 to 600 V

Average forward current: 0.5 to 3 A

Suitable product can be selected according to requirements.

Lineup

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

[◆Return to Block Diagram TOP](#)

Value provided

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

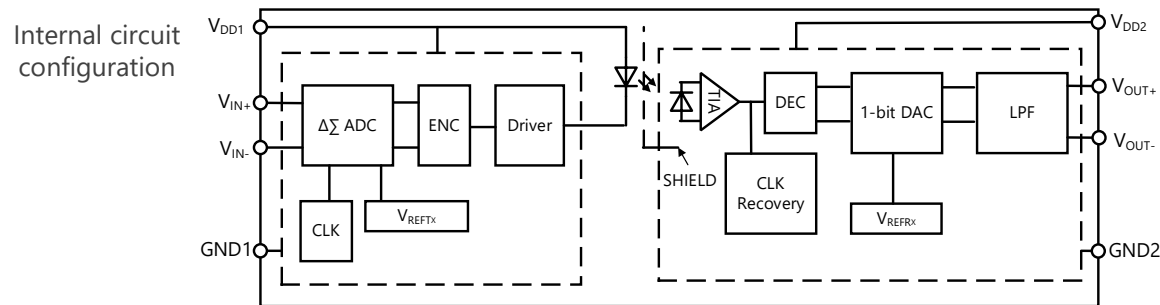
3 5 V system power supply voltages

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

[Return to Block Diagram TOP](#)

Value provided

AD converters, timers, and PWM ^[Note 1] output circuits are built in. The system-control runs at low power.

[Note 1] Pulse Width Modulation

1 Built-in Arm® Cortex®-M3 CPU core

The product lineup is equipped with Arm Cortex-M3 core (maximum operation frequency of 120 MHz). Various development tools and their partners allow users many options.

2 Enhancement of system functionality

Built-in multifunctional timers and A-PMD ^[Note 2] control circuit generate PWM. AD converters with monitoring capabilities are also built in. They provide efficient monitoring and IH control of the various parts of the system. It also has an LCD indicator control circuit. This enables direct drive of the liquid crystal panel ^[Note 3].

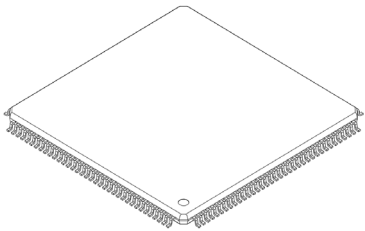
[Note 2] Advanced Programmable Motor Control Circuit

[Note 3] Excluding M3HL series.

3 Low power consumption, small size package

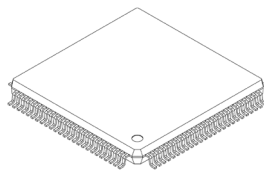
Several low power modes are available to support low power consumption. Package lineup of LQFP144 from small LQFP64 is provided.

TMPM3HQF10BFG
TMPM3HQFDAFG



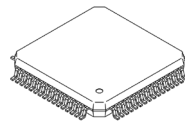
P-LQFP144-2020-0.50-002
(22.0 x 22.0 x 1.7 mm)

TMPM3HNF10BFG
TMPM3HNFDAFG



P-LQFP100-1414-0.50-002
(16.0 x 16.0 x 1.7 mm)

TMPM3HLF10BUG
TMPM3HLFDAUG



P-LQFP64-1010-0.50-003
(12.0 x 12.0 x 1.7 mm)

Lineup

Part number	M3H (2)	TMPM3HQF10BFG	TMPM3HNF10BFG	TMPM3HLF10BUG
	M3H (1)	TMPM3HQFD/Z/Y/AFG	TMPM3HNFD/Z/Y/AFG	TMPM3HLFD/Z/Y/AUG
Operating frequency (Max)		120 MHz		
ROM (flash)	M3H (2)	1024 KB (512 KB x 2 area, compatible with FOTA*)		
	M3H (1)	512 / 384 / 256 KB		
RAM	M3H (2)	130 KB (with parity)		
	M3H (1)	66 KB (with parity)		
Timer		32bit x 8ch (16bit x 16ch)		
AD converter		21ch (12bit)	17ch (12bit)	12ch (12bit)
Serial communication		UART: 8ch, I ² C: 4ch, TSPI: 5ch	UART: 8ch, I ² C: 3ch, TSPI: 4ch	UART: 7ch, I ² C: 2ch, TSPI: 1ch
Package		P-LQFP144-2020-0.50-002	P-LQFP100-1414-0.50-002	P-LQFP64-1010-0.50-003

* Firmware update Over The Air

[◆Return to Block Diagram TOP](#)

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