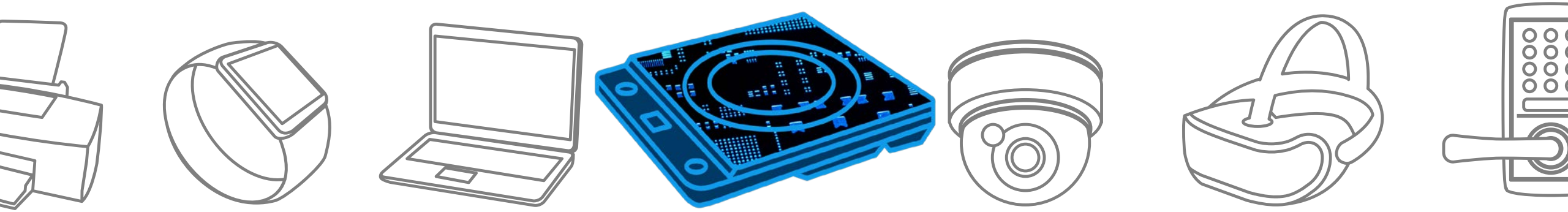
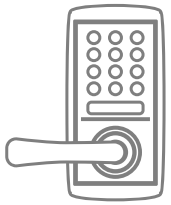
TOSHIBA

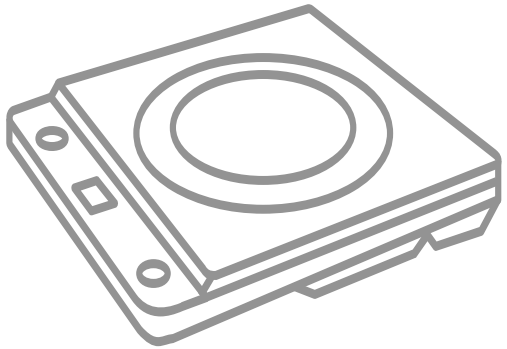
R20

IH Cooking Heater

Solution Proposal by Toshiba

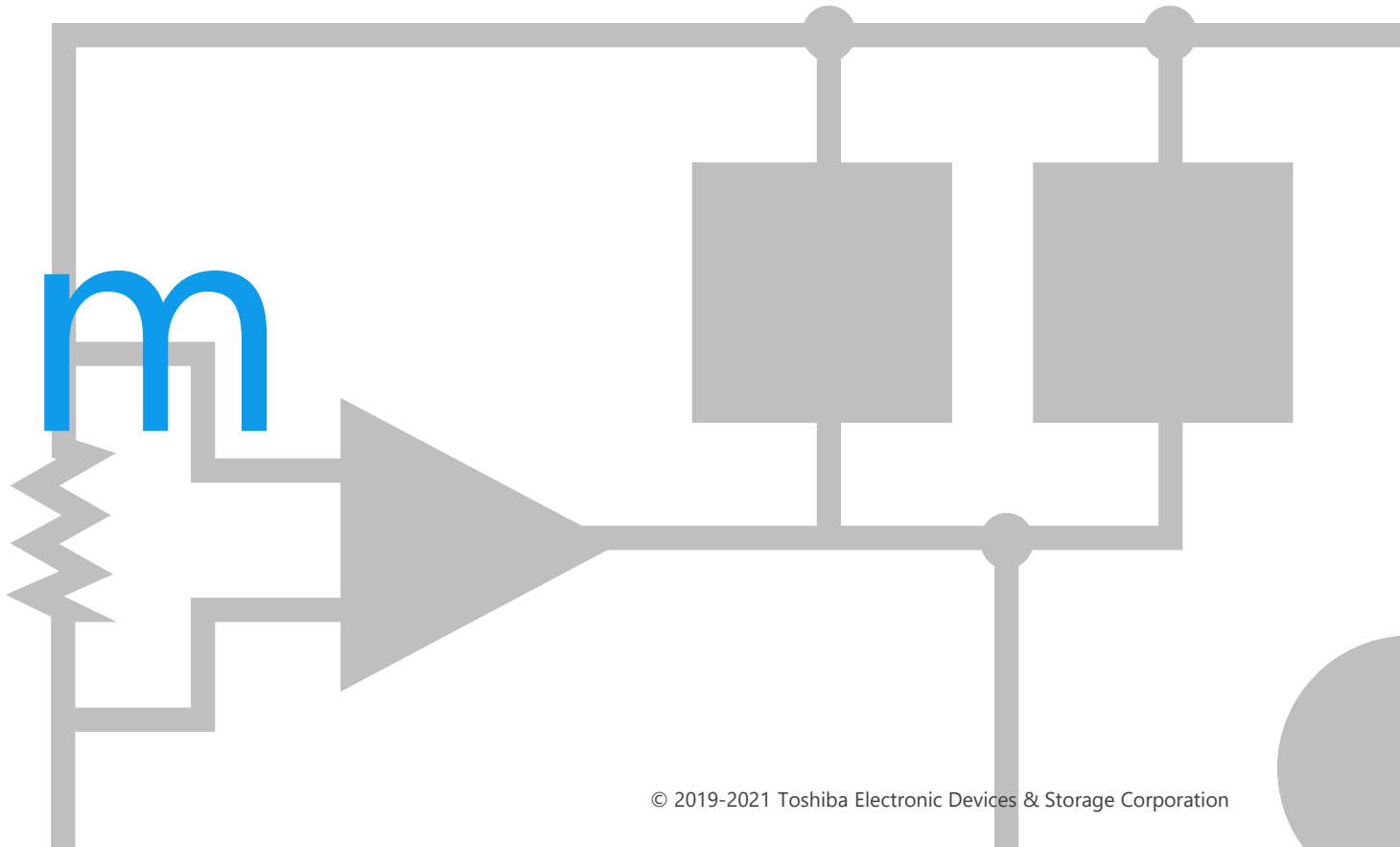




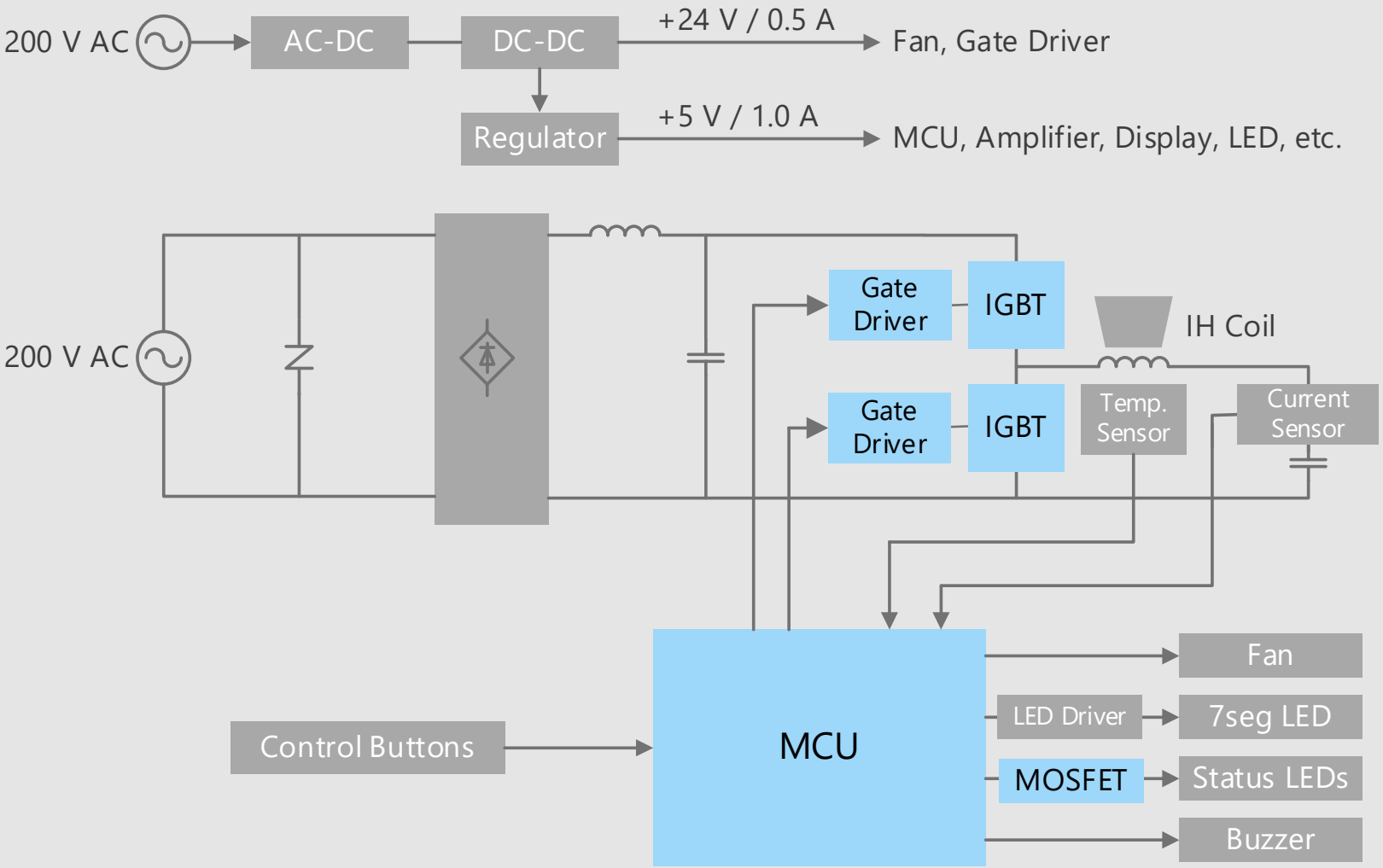


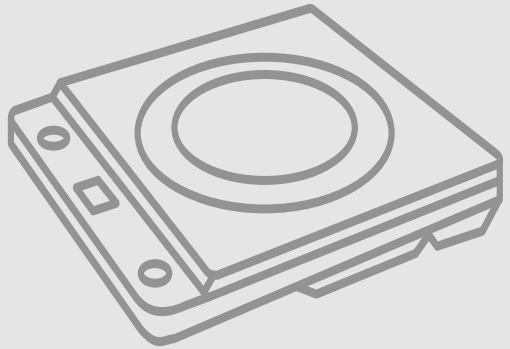
Toshiba Electronic Devices & Storage Corporation provides comprehensive device solutions to customers developing new products by applying its thorough understanding of the systems acquired through the analysis of basic product designs.

Block Diagram



IH Cooking Heater　Overall block diagram

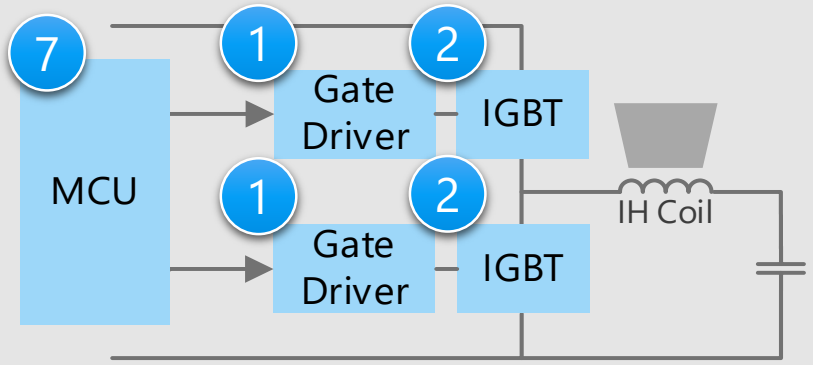




IH Cooking Heater　Detail of IH coil drive / fan motor drive

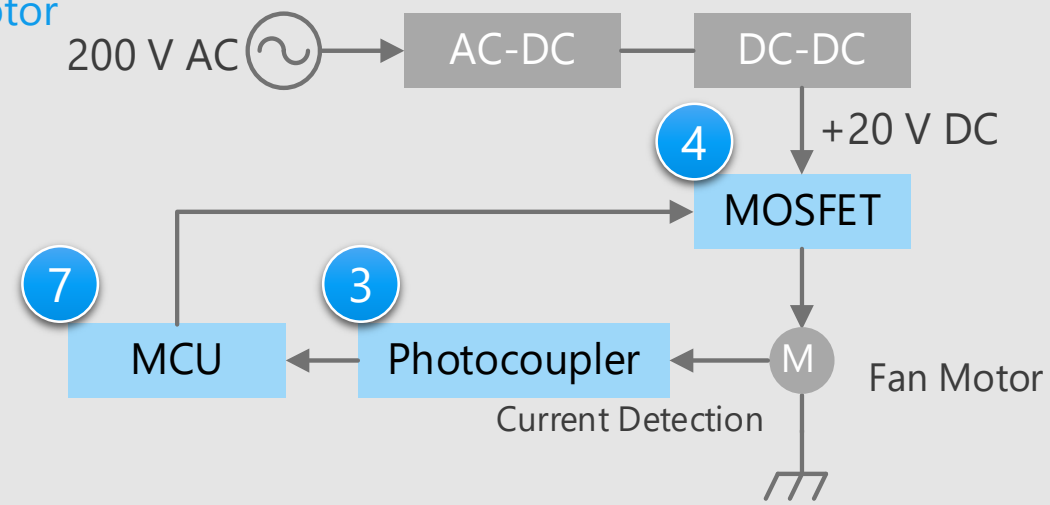
IH coil drive circuit

Current resonance circuit



Brushed DC motor drive circuit

Brushed DC motor



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

Criteria for device selection

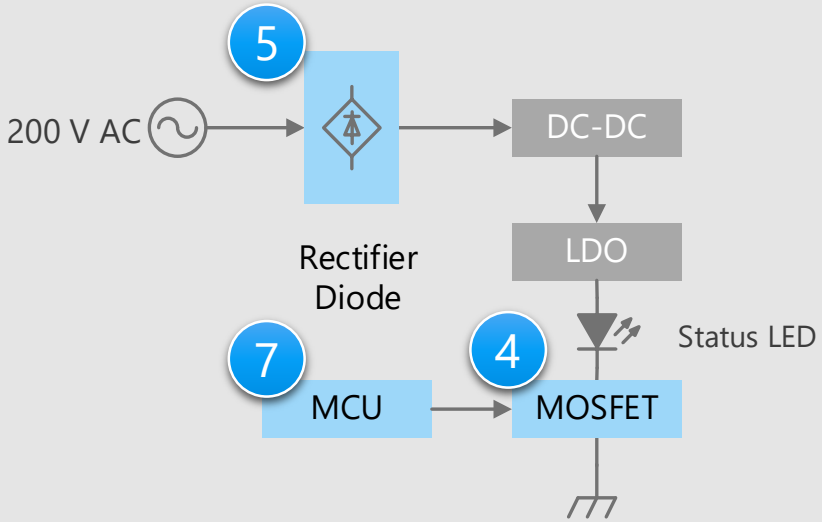
- Fast switching and low saturation voltage characteristics are required for IGBT.
- Use of small package enables to reduce the circuit board area.
- Rail-to-Rail output, low voltage driving and low current consumption are required for gate driver to realize low power consumption of the set.
- Monitoring sensor, high speed data processing and heater control are needed for efficient system control.

Proposals from Toshiba

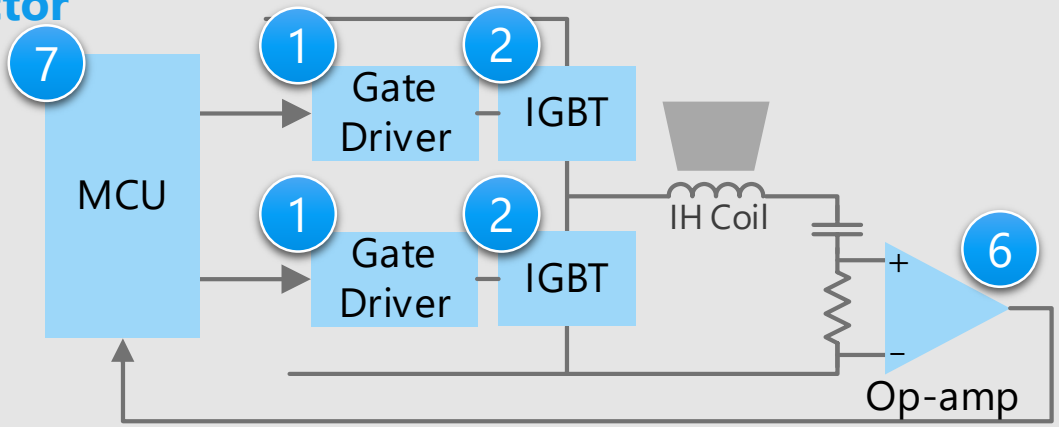
- **Higher efficiency is realized** 1
  IGBT gate driver coupler
- **Fast and high efficiency switching are realized** 2
  Silicon N-channel discrete IGBT
- **High current transfer ratio and high temperature operation makes easy to design.** 3
  Transistor output photocoupler
- **Low on-resistance realizes a set with low power consumption** 4
  U-MOS Series MOSFET
- **High efficient processing of a few input and output data** 7
  MCU

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

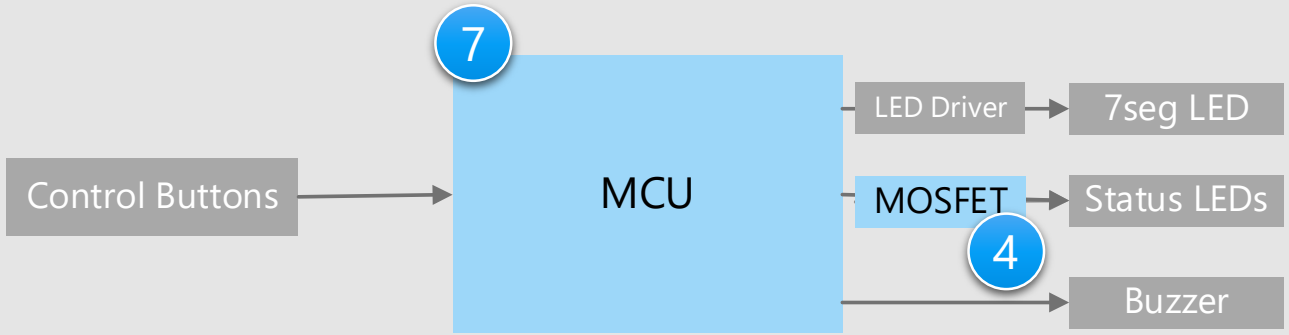
- Low on-resistance characteristic contributes to low loss of the set.
- Error detection of equipment is enabled by monitoring the current of the system power supply. The use of an operational amplifier which have low voltage operation, low current consumption and low offset voltage leads to high precision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

Proposals from Toshiba

- **Higher efficiency is realized** 1
  IGBT gate driver coupler
- **Fast and high efficiency switching are realized** 2
  Silicon N-channel discrete IGBT
- **Low on-resistance characteristic contributes to low loss of the set.** 4
  U-MOS Series MOSFET
- **Small surface mount package suitable for high density mounting** 5
  Rectifier diode
- **Isolated transmission of the current detection signal** 6
  Isolation amplifier
- **High efficient processing of a few input and output data** 7
  MCU

IH Cooking Heater　Detail of display and operation section

Display and operation section



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

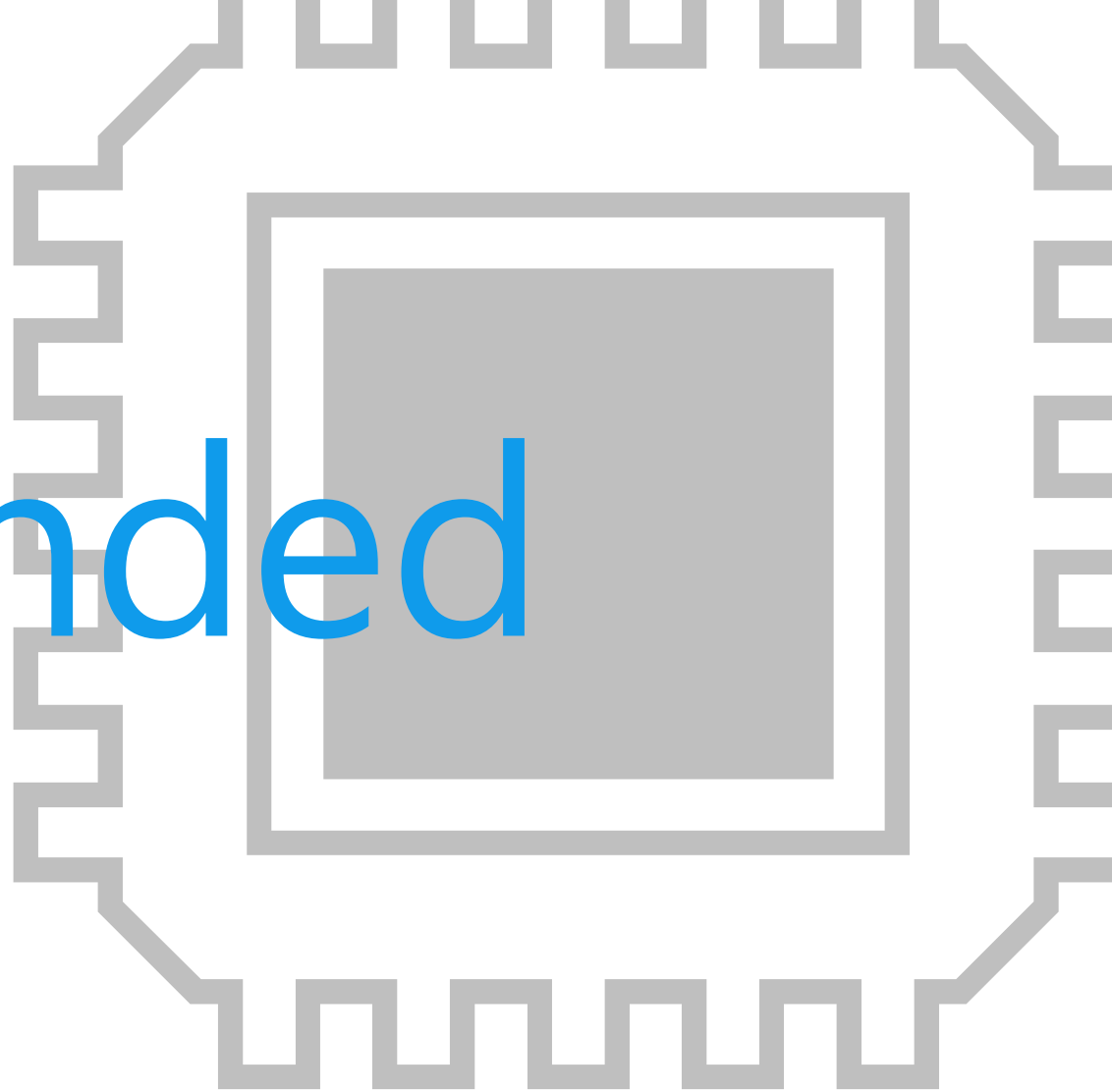
Criteria for device selection

- Low on-resistance characteristic contributes to low loss of the set.
- Monitoring sensor, high speed data processing and heater control are needed for efficient system control.

Proposals from Toshiba

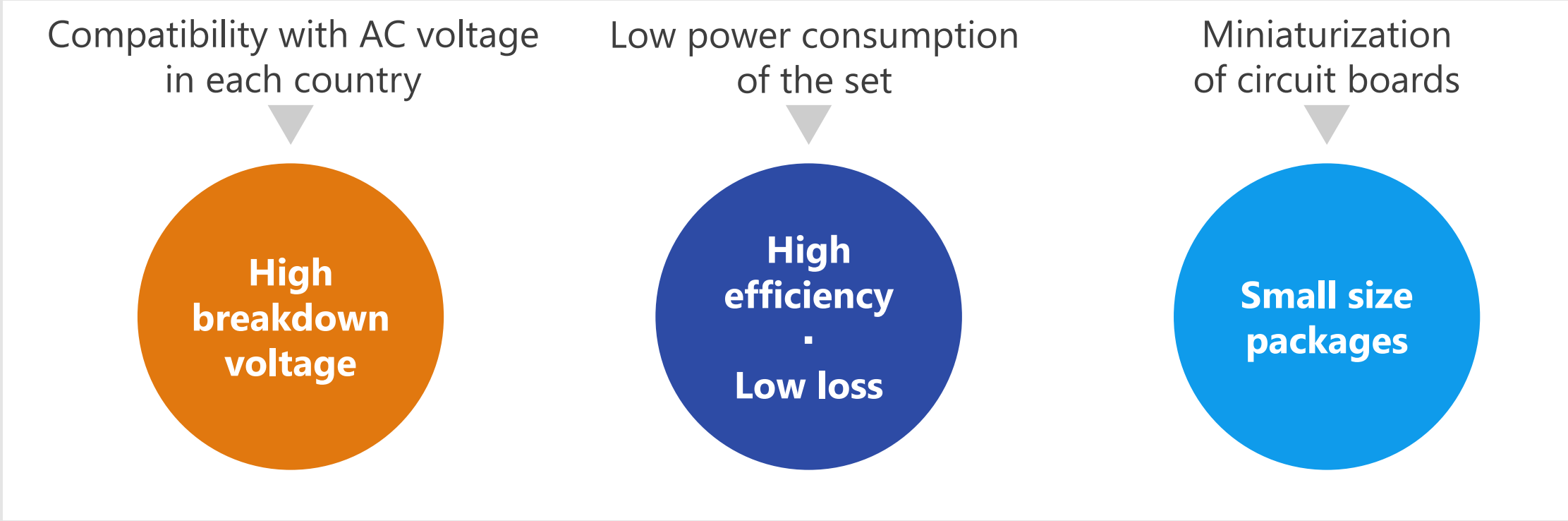
- **Low on-resistance characteristic contributes to low loss of the set.**
  U-MOS Series MOSFET　4
- **High efficient processing of a few input and output data**
  MCU　7

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 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 IGBT gate driver coupler	●	●	●
2 Silicon N-channel discrete IGBT	●	●	
3 Transistor output photocoupler		●	●
4 U-MOS Series MOSFET		●	●
5 Rectifier diode	●	●	●
6 Isolation amplifier		●	●
7 MCU		●	●

1a 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 the system to operate safely and reduce conduction losses.

1 Rail-to-rail output

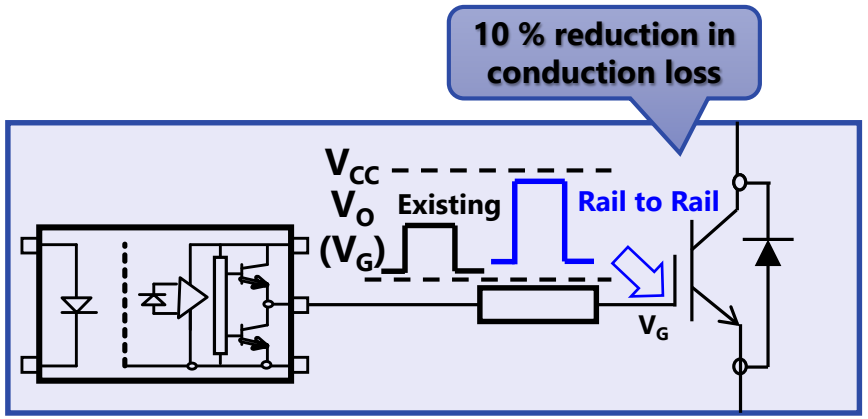
TLP577X and TLP575X generates a full-swing voltage output signal and contributes to low power consumption.

2 Small package

The mounting area of SO6L package is 50 % smaller than that of Toshiba conventional DIP8. And these gate driver coupler comply with reinforced insulation class of overseas safety standards.

3 Operating temperature is expanded to 125 °C

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



Note: Comparison with the case of using Toshiba's TLP5701/5702.

Line up

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

◆Return to Block Diagram TOP

1b 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

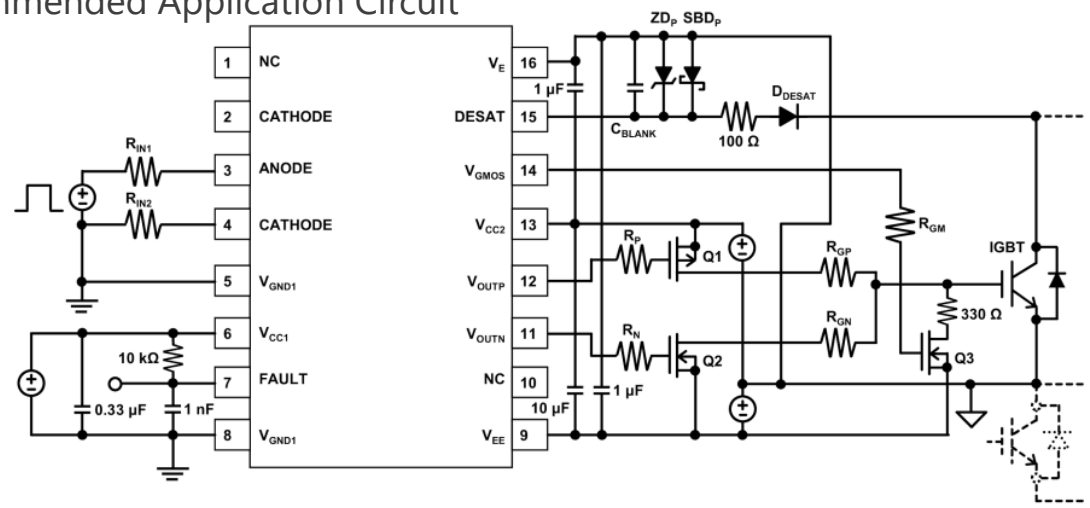
2 Rail-to-rail output

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

3 Operating temperature is expanded to 110 °C

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

Recommended Application Circuit



Line up

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

2 Silicon N-channel discrete IGBT

GT50JR21 / GT50JR22

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

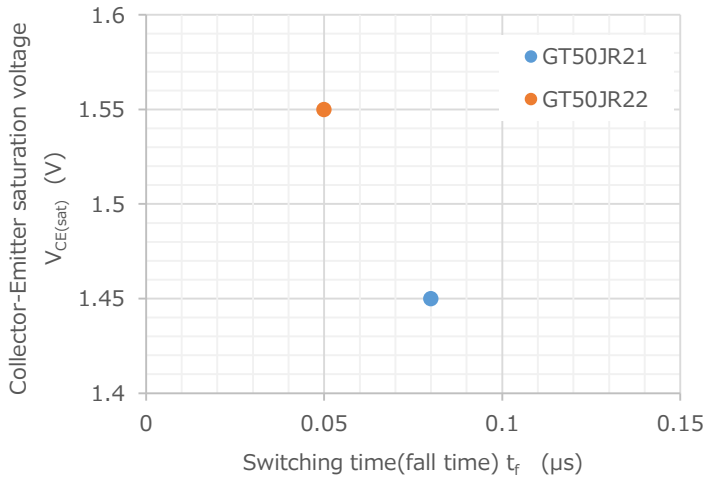
Reducing switching loss through high speed operation contributes to higher power supply efficiency.

2 Low saturation voltage

Saturation voltage is kept low while realizing high speed switching.

3 Line up

For more suitable design, Low saturation voltage type (GT50JR21) and fast switching type (GT50JR22) are selectable.



(Note: Toshiba internal comparison)

Line up

Part Number	GT50JR21	GT50JR22
Package	TO-3P(N)	
t_f (Typ.) [μs] @I_C = 50 A, Ta = 25 °C	0.08	0.05
$V_{CE(sat)}$ (Typ.) [V] @I_C = 50 A, Ta = 25 °C	1.45	1.55

◆Return to Block Diagram TOP

3 Transistor output photocoupler

TLP183 / TLP185(SE

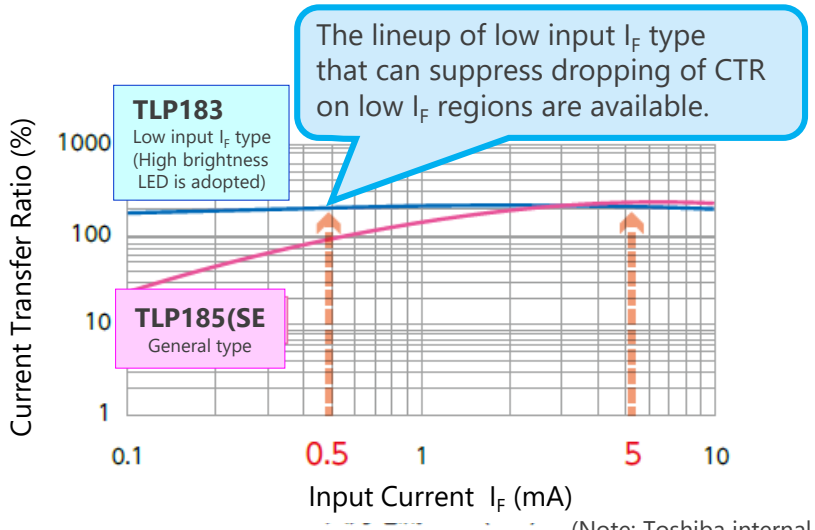
High breakdown voltage | High efficiency · Low loss | Small size packages

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

Phototransistor and GaAs/InGaAs infrared light emitting diode are optically coupled. TLP183 is highly isolated photocoupler that is realized higher CTR than Toshiba's conventional product (TLP185(SE) in low input current range (@ I_F = 0.5 mA).



(Note: Toshiba internal comparison)

2 Wide operating temperature range

It is designed to operate even under severe ambient temperature conditions, such as inverter equipment, robots, machine tools and high-output power supplies.

Line up

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

◆Return to Block Diagram TOP

4 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.

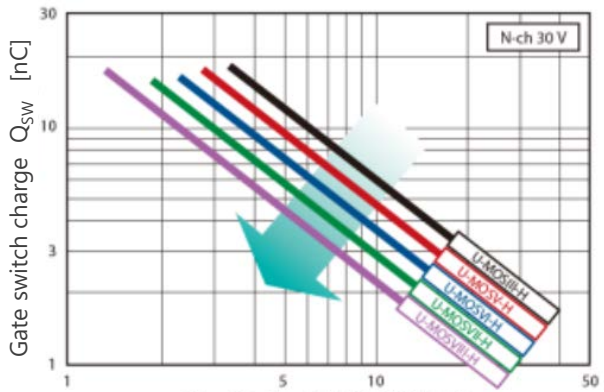
2 Small gate input charge

Reducing gate input charge needed for driving MOSFET improves switching characteristic.

3 Fast switching speed

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

Trade-off characteristics of on-resistance



(Note: Toshiba internal comparison)

Line up

Part number		SSM3K56MFV	SSM6N56FE
Polarity		N-ch	N-ch × 2
Package		VESM 	ES6 
V_{DSS} [V]		20	20
I_D [A]		0.8	0.8
$R_{DS(ON)}$ [Ω] @V_{GS} = 10 V	Typ.	0.186	0.360
	Max	0.235	0.840

◆Return to Block Diagram TOP

5 Rectifier diode
CMG06A

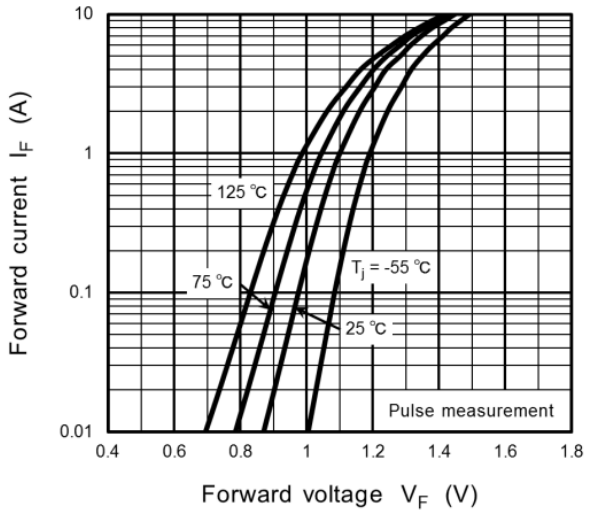
High breakdown voltage | High efficiency · Low loss | Small size packages

Value provided

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

1 Surface mount / compact package

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



・CMG06A
forward characteristic

2 Wide product line-up

Wide product line-up
- Reverse voltage : 200 to 1000 V
- Average forward current : 0.5 to 3 A

Suitable product can be selected according to requirements.

Line up

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

◆Return to Block Diagram TOP

6 Isolation amplifier
TLP7820

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

Value provided

Isolation amplifier with low current consumption and compact package enables highly accurate current detection.

1 Low current consumption

Introduction of new digital modulation technology has reduced current consumption due to input voltage dependence.

2 Small package

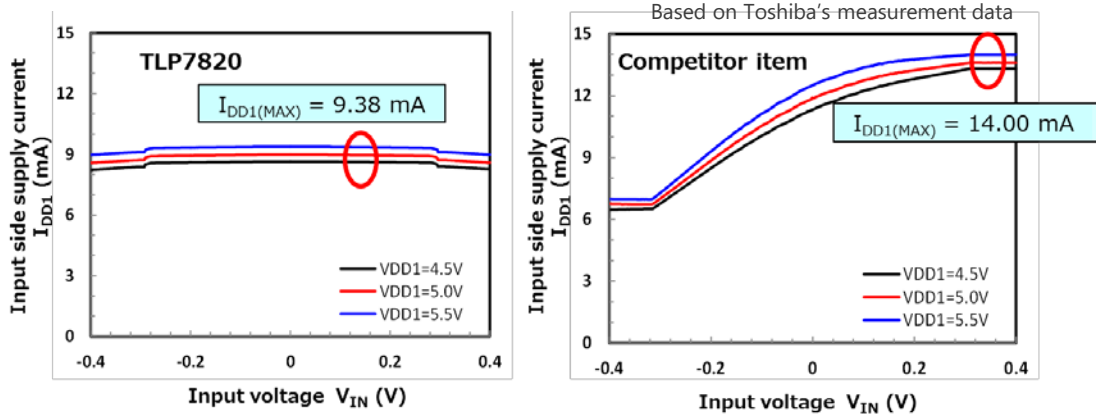
Compact SO8L package contributes reducing mounting area.

3 High accuracy

This optical coupling type isolation amplifier uses ΔΣ A/D convertor with a high precision on the input side and D/A convertor with a high precision on the output side.

Current consumption characteristics

Based on Toshiba's measurement data



Line up

Part number	TLP7820
Package	SO8L(LF4) 
Gain accuracy [%]	±0.5 / ±1.0 / ±3.0 (rank selection)
$\|dG/dT_a\|$ (Typ.) [V/V/°C]	0.00012
NL_{200} (Typ.) [%]	0.02
V_{OS} (Typ.) [mV]	0.9
I_{DD1} (Typ.) [mA]	8.6
I_{DD2} (Typ.) [mA]	6.2

◆Return to Block Diagram TOP

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

Value provided

System control at low power consumption by using built-in timers and ADCs

1 Built-in Arm® Cortex® -M3 CPU core

TMPM383FSUG implements Cortex-M3 core with 80 MHz maximum operation frequency. Various development tool and their partners allow users many options.

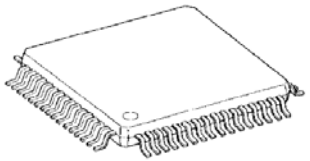
2 System cost down and development efficiency improvement

TMPM383FSUG executes sensing data monitoring and processing efficiently by combining built-in analog function such as ADC, and CPU system. The 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

Line up

Part number	TMPM383FSUG
Maximum operation frequency	40 MHz
Instruction ROM	64 KB
RAM	8 KB
Thumb-2 Instruction set	Available
Timer	16bit x 8ch
I2C	1ch
ADC	10ch (10bit)

◆Return to Block Diagram TOP

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