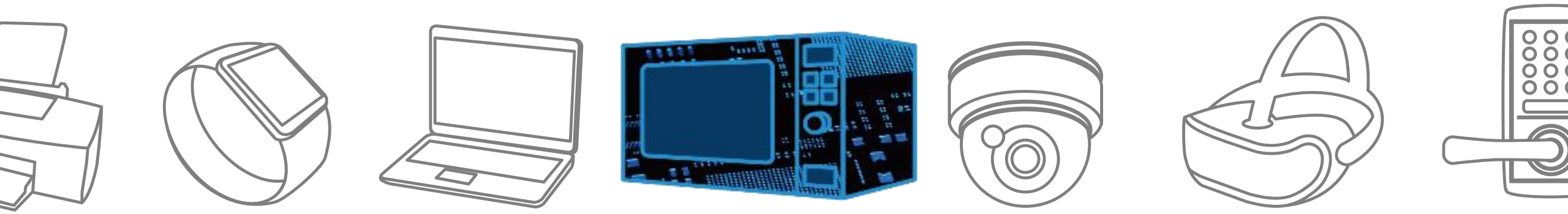
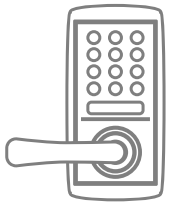
TOSHIBA

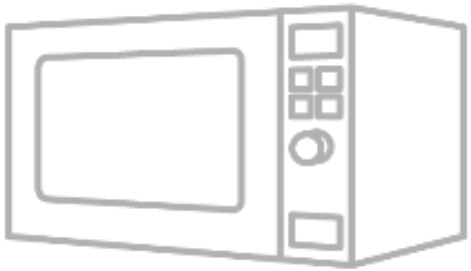
R22

Microwave Oven

Solution Proposal by Toshiba

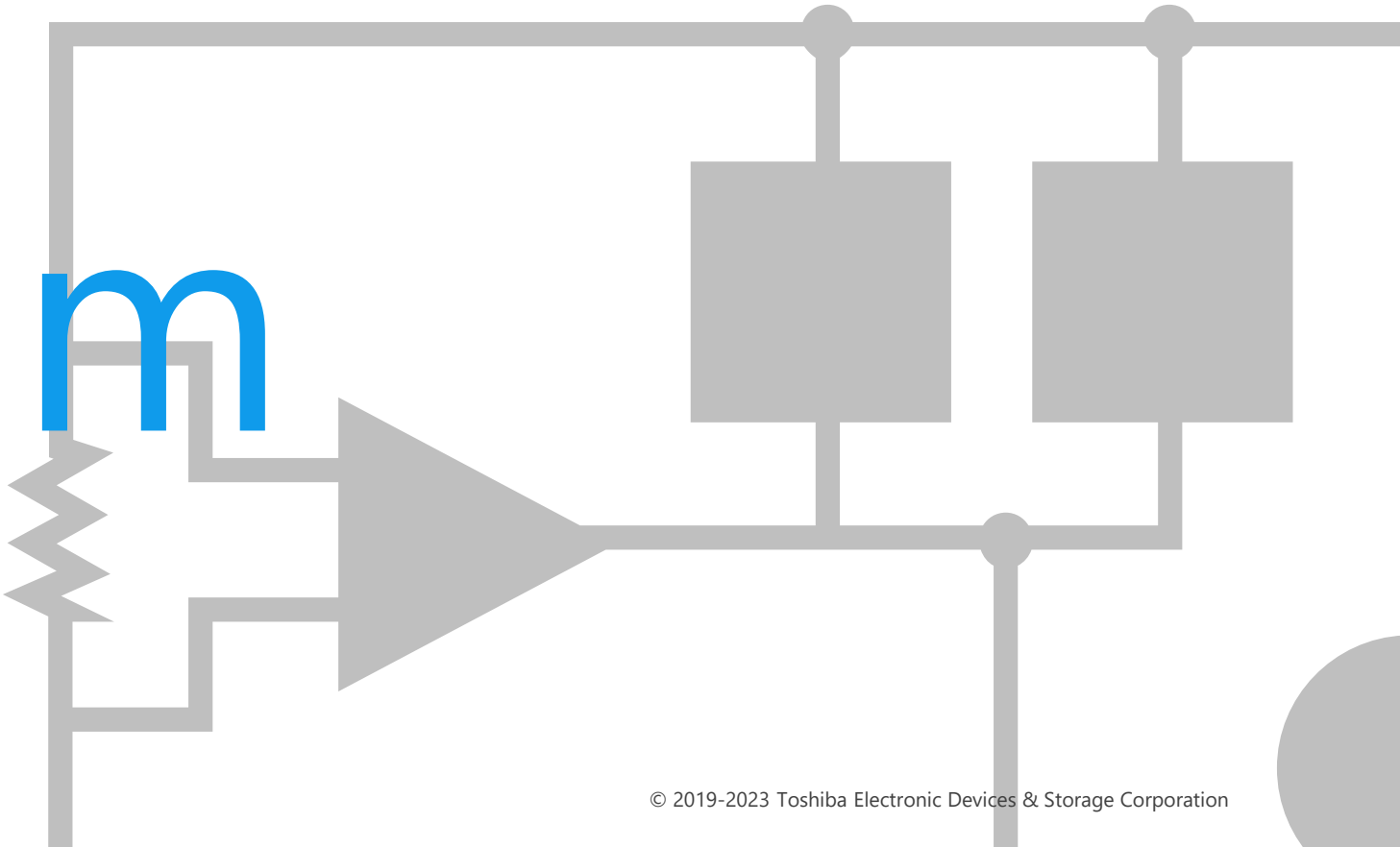




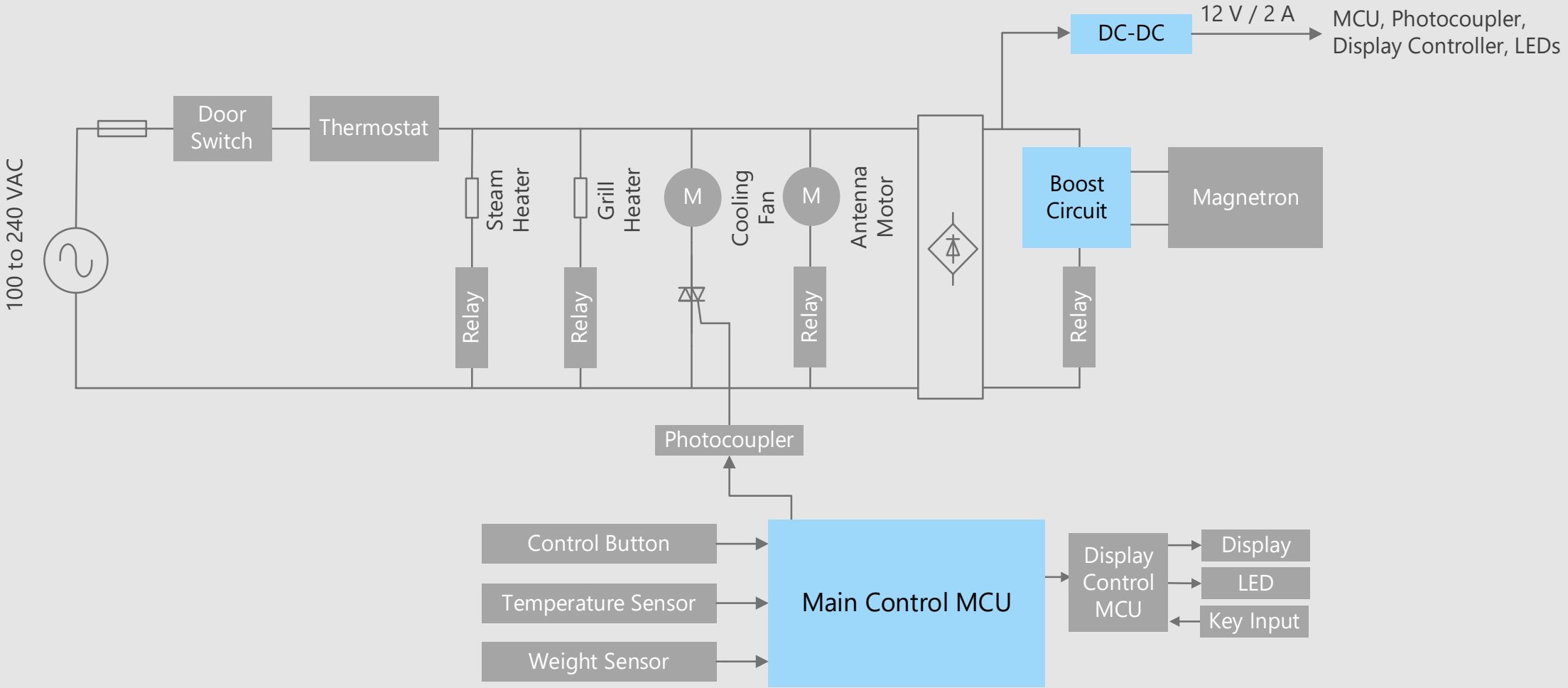


Toshiba Electronic Devices & Storage Corporation provides comprehensive device solutions to customers developing new products by applying its thorough understanding of the systems acquired through the analysis of basic product designs.

Block Diagram

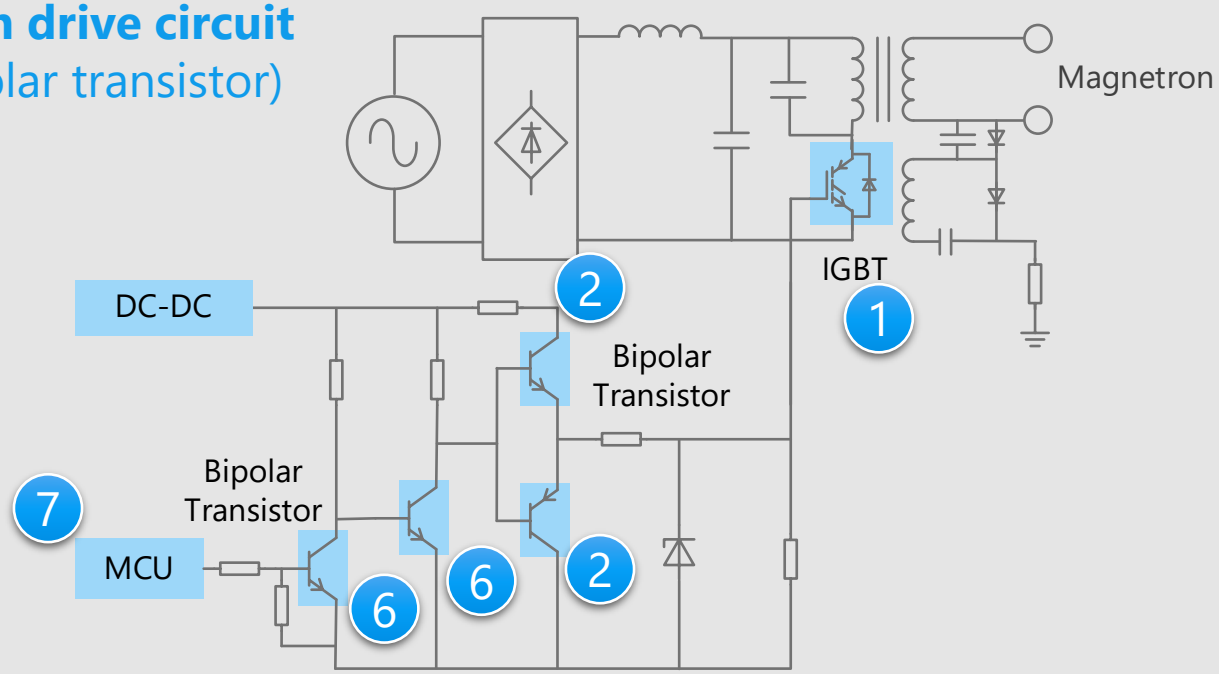


Microwave Oven　Overall block diagram

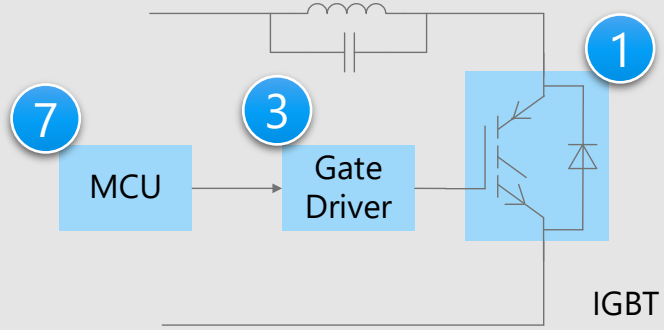


Microwave Oven　Details of magnetron drive circuit

Magnetron drive circuit
(Using bipolar transistor)



Magnetron drive circuit
(Using gate driver coupler)



<u>* Click on the numbers in the circuit diagram to jump to the detailed descriptions page</u>

Criteria for device selection

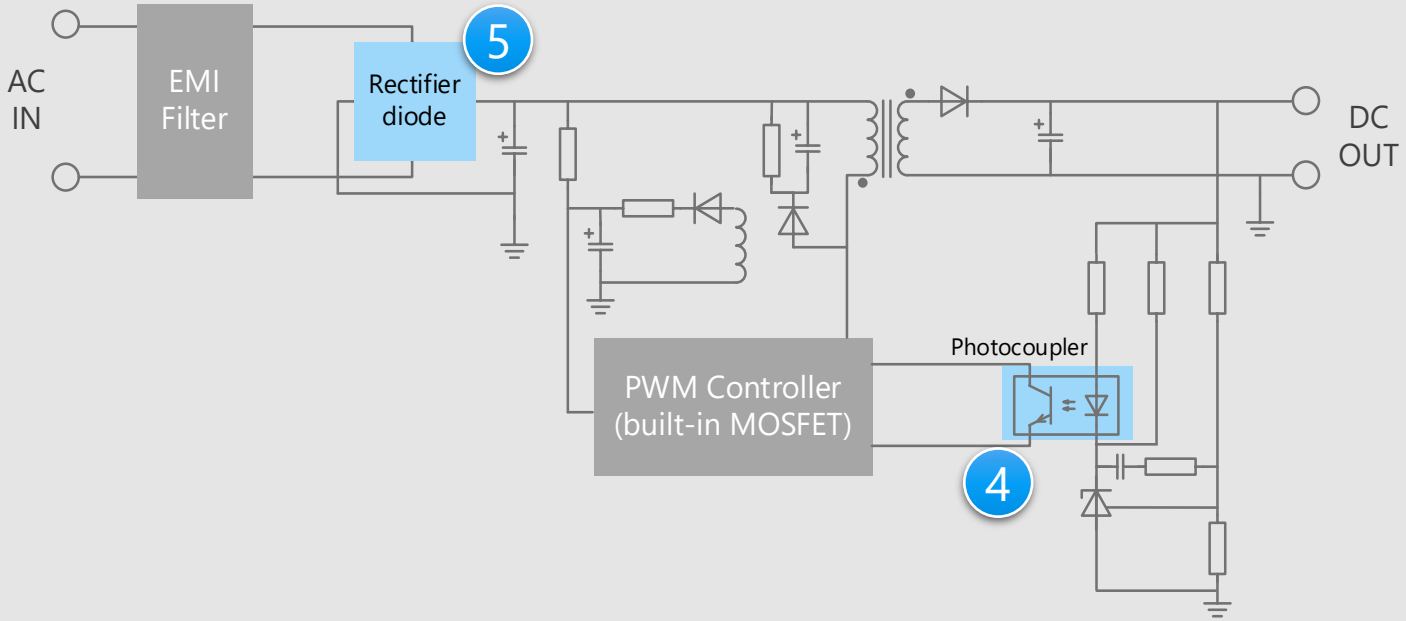
- Both high speed switching and low saturation voltage are required for IGBT.
- Small package products contribute to the reduction of circuit board area.
- Rail to Rail, low input current and low current consumption characteristics are required for gate driver to reduce power consumption.
- System control requires an MCU that can process data from various sensors at high speed.

Proposals from Toshiba

- **High efficiency with high speed switching and low saturation voltage** 1
  Discrete IGBT
- **Contribute to loss reduction by high speed switching and high h_{FE}** 2
  Bipolar transistor for IGBT gate drive
- **High efficiency due to Rail to Rail characteristics** 3
  IGBT gate driver coupler
- **High voltage and high h_{FE}** 6
  Bipolar transistor
- **High efficient processing of multiple input and output data** 7
  MCU

Microwave Oven　Details of power supply circuit

Flyback type AC-DC converter



* Click on the numbers in the circuit diagram to jump to the detailed descriptions page

Criteria for device selection

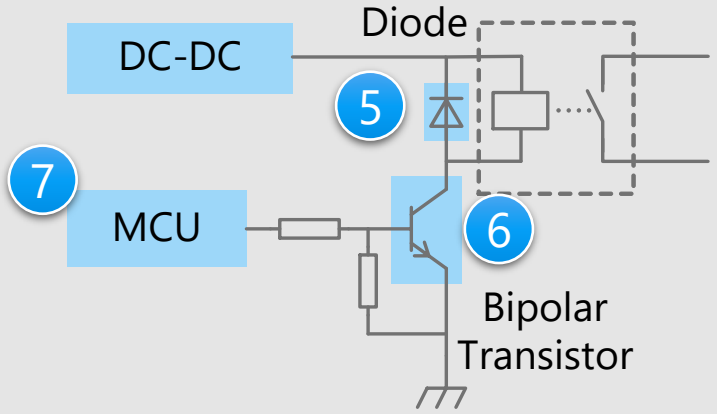
- Photocoupler with high current transfer ratio even in the low input current range contributes to higher power supply efficiency.
- Small package products contribute to the reduction of circuit board area.

Proposals from Toshiba

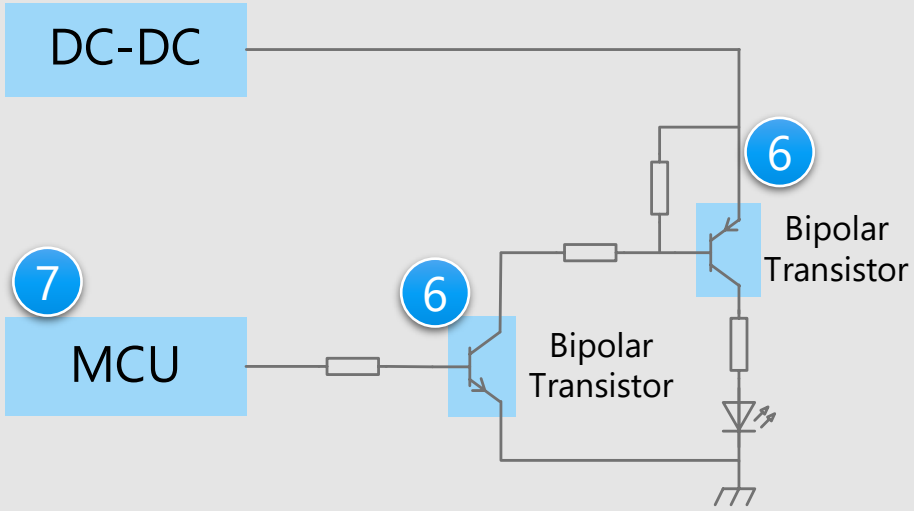
- **High current transfer ratio and high temperature operation make easy to design.**
  Transistor output photocoupler 4
- **Small surface mount package suitable for high density mounting**
  Rectifier diode 5

Microwave Oven　Details of Relay / LED drive

Relay drive circuit



LED drive circuit



* Click on the numbers in the circuit diagram to jump to the detailed descriptions page

Criteria for device selection

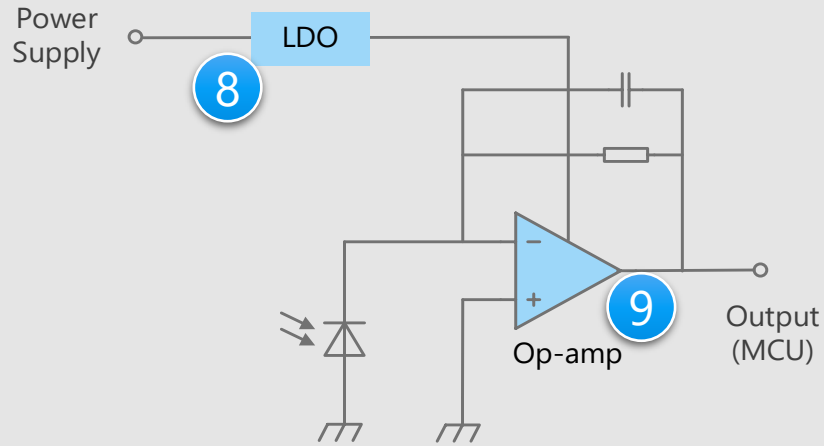
- The use of a bipolar transistor with a low collector-emitter saturation voltage $V_{CE(sat)}$ has an advantage in power utilization efficiency.
- Small package products contribute to the reduction of circuit board area.
- System control requires an MCU that can process data from various sensors at high speed.

Proposals from Toshiba

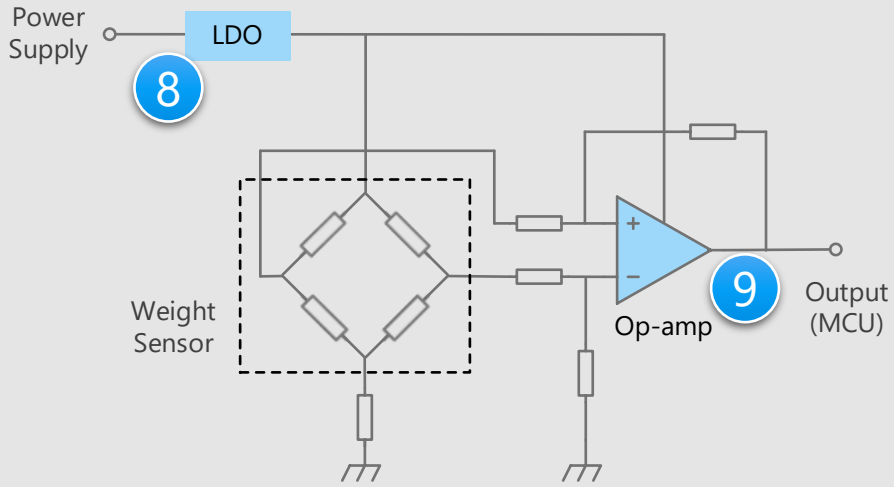
- **Small surface mount package suitable for high density mounting**
  Rectifier diode　5
- **Low $V_{CE(sat)}$**
  Bipolar transistor　6
- **High efficient processing of multiple input and output data**
  MCU　7

Microwave Oven　Details of sensor input unit

Temperature sensor circuit



Weight sensor circuit



* Click on the numbers in the circuit diagram to jump to the detailed descriptions page

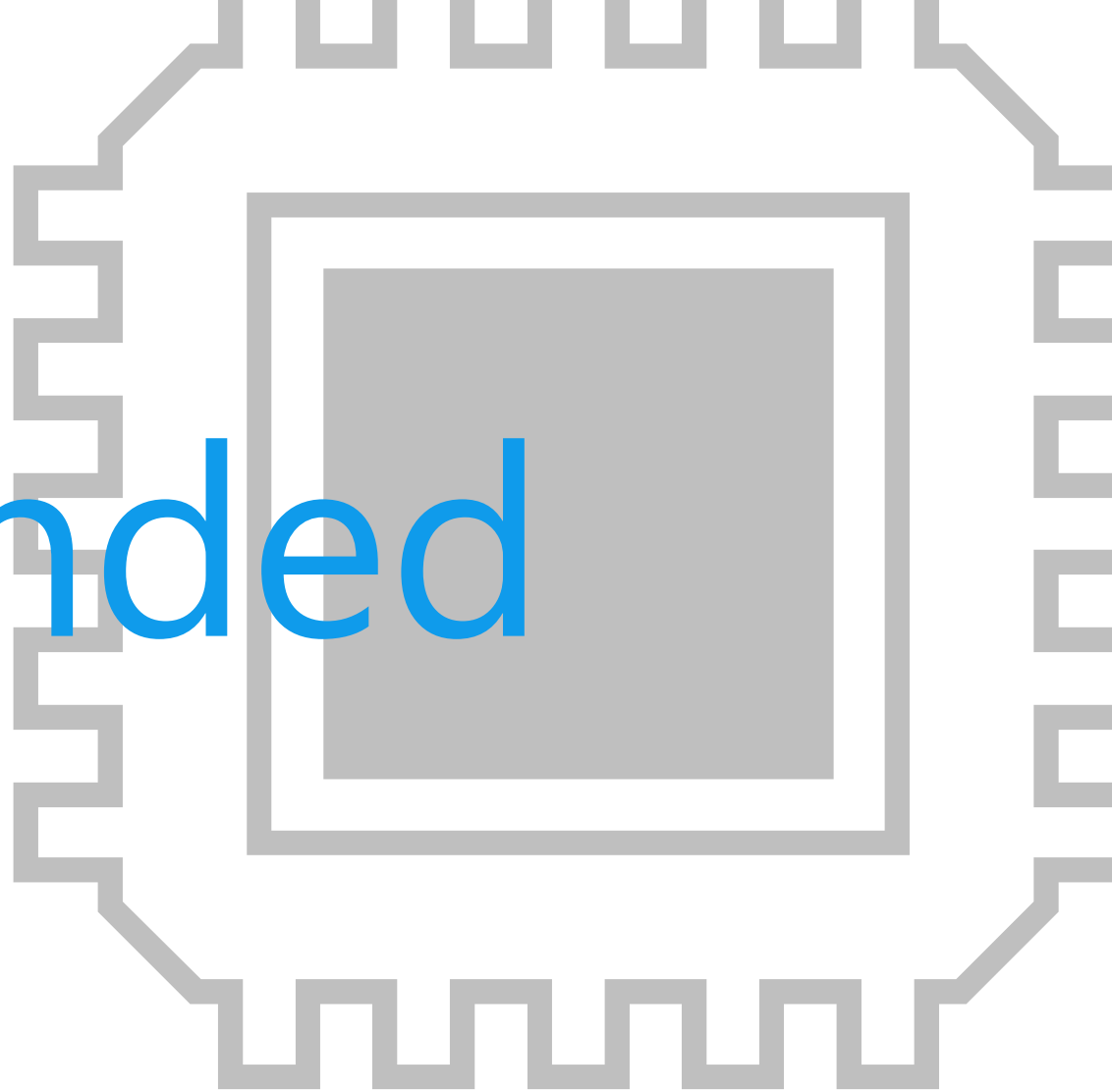
Criteria for device selection

- PSRR (Power Supply Rejection Ratio) of LDO regulator is an important parameter for sensor modules.
- The operational amplifier should be low current consumption or low noise device.
- Small package products contribute to the reduction of circuit board area.

Proposals from Toshiba

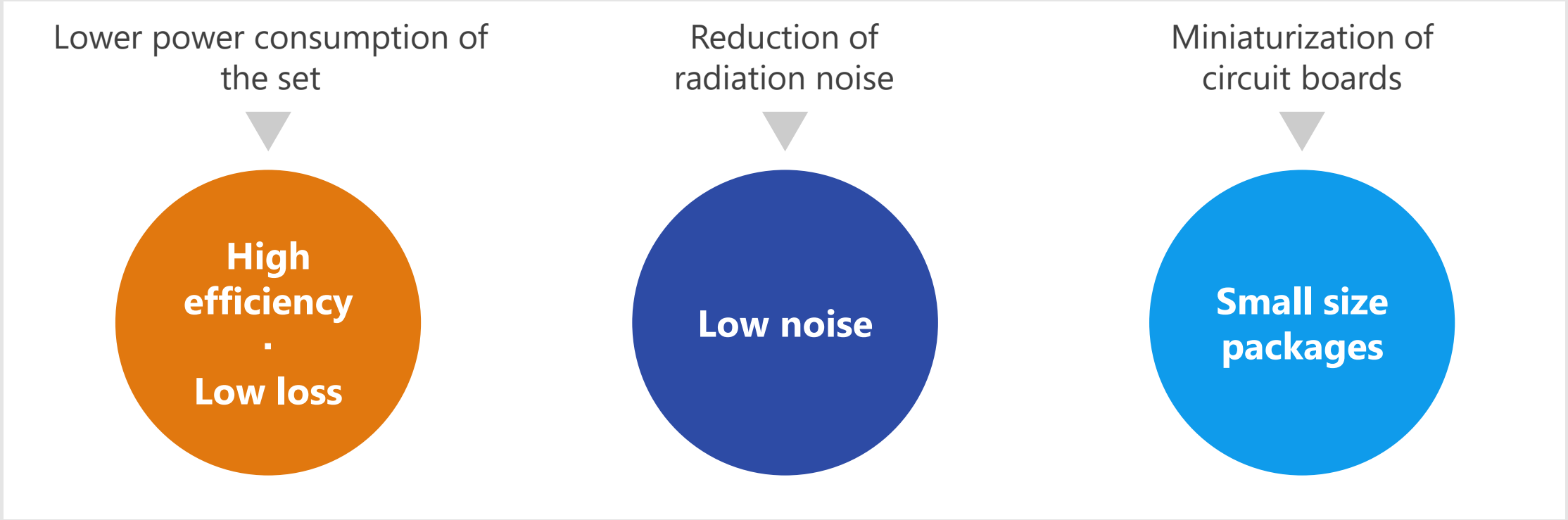
- **Supply the power with low noise** 8
  Small surface mount LDO regulator
- **Amplification of detected very small signal with low noise** 9
  Low current consumption op-amp / Low noise op-amp

Recommended Devices



Device solutions to address customer needs

As described above, in the design of microwave oven, **“Lower power consumption of the set"**, **"Reduction of radiation noise"** and **"Miniaturization of the boards"** are important factors. Toshiba's proposals are based on these three solutions perspectives.



Device solutions to address customer needs

	High efficiency · Low loss	Low noise	Small size packages
1 Discrete IGBT	●	●	
2 Bipolar transistor for IGBT gate drive	●		●
3 IGBT gate driver coupler	●		●
4 Transistor output photocoupler	●		●
5 Rectifier diode			●
6 Bipolar transistor			●
7 MCU	●		●
8 Small surface mount LDO regulator	●		●
9 Low current consumption op-amp / Low noise op-amp	●		●

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.

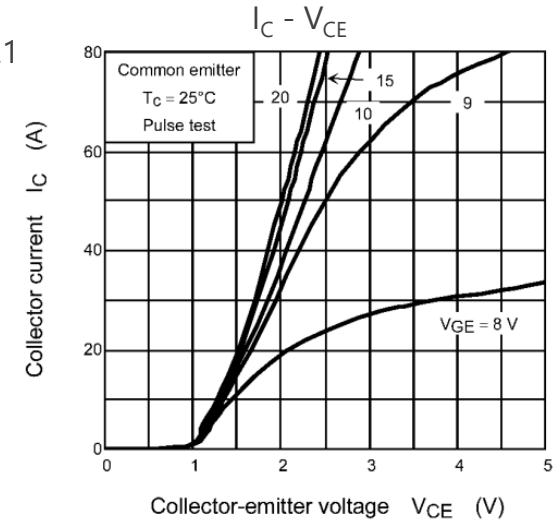
2 Low saturation voltage

Saturation voltage is kept low while realizing high speed switching.

3 Enhancement type

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

GT40QR21



Lineup

Part number	GT40QR21	GT30J110SRA	GT30N135SRA
Package	TO-3P(N) 	TO-3P(N) 	TO-247 
V_{CES} [V]	1200	1100	1350
t_f (Typ.) [µs]	0.20 @I_C = 40 A	0.17 @I_C = 60 A	0.25 @I_C = 60 A
$V_{CE(sat)}$ (Typ.) [V]	1.9 @I_C = 40 A	2.15 @I_C = 60 A	2.15 @I_C = 60 A

◆Return to Block Diagram TOP

2 Bipolar transistor for IGBT gate drive

HN4B101J / HN4B102J / TPCP8901 / TPCP8902

High efficiency · Low loss | Low noise | 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

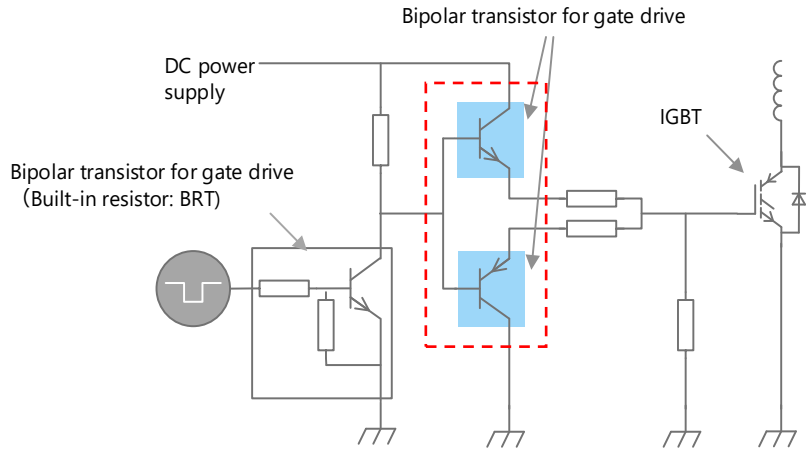
These transistors have high speed switching characteristic suitable for high frequency equipment.

2 High DC current gain (h_{FE})

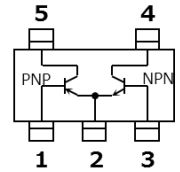
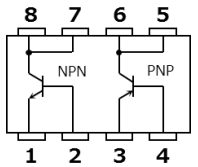
Maximum rating of collector current and DC current gain is improved for larger IGBT gate capacitance.

3 Small 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 divide the gate resistance ON/OFF.



Lineup

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

◆Return to Block Diagram TOP

3a IGBT gate driver coupler

TLP5771H / TLP5772H / TLP5774H / TLP5751H / TLP5752H / TLP5754H

High efficiency · Low loss | Low noise | Small size packages

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.

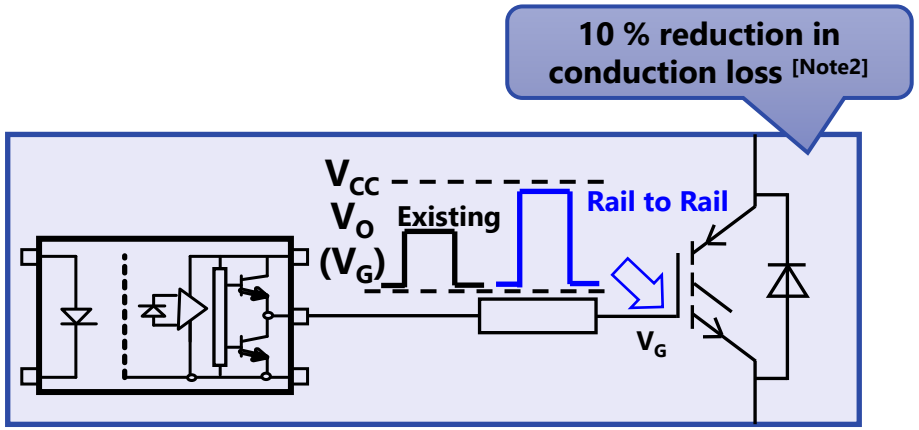
2 Small package

These driver couplers are 50 % smaller than the 8-pin DIP package [Note1] and meet the reinforced insulation class requirements of international safety standards.

3 Operational ambient temperature range 125 °C

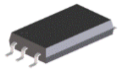
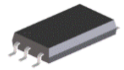
These driver couplers are designed to operate under severe ambient temperature conditions.

[Note1] Comparison with Toshiba products



[Note2] Comparison with conventional Toshiba products

Lineup

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

IGBT gate driver coupler

TLP5231 (Smart Gate Driver Coupler)

High efficiency · Low loss | Low noise | 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

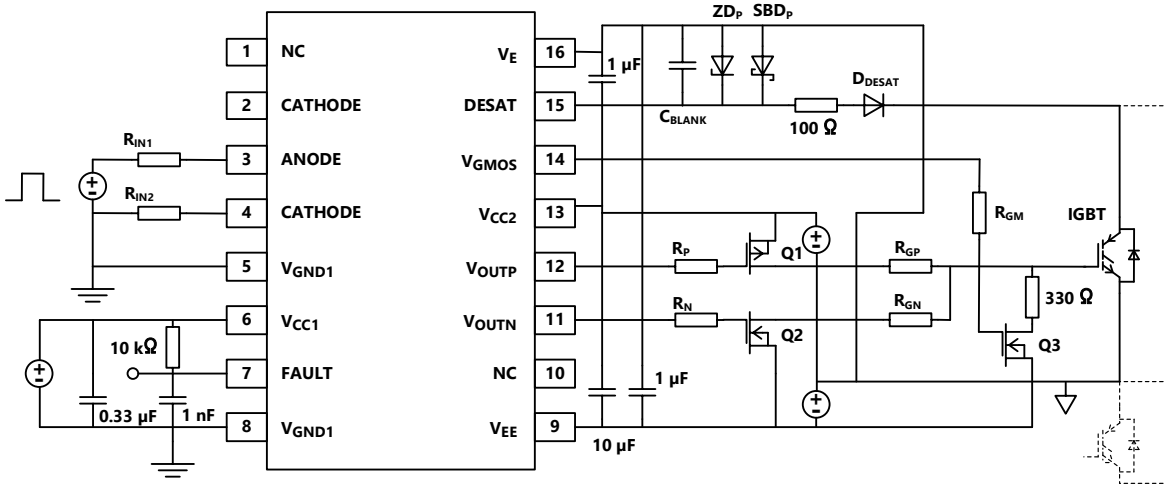
2 Rail to Rail output

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.

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

4 Transistor output photocoupler

TLP383 / TLP293 / TLP385

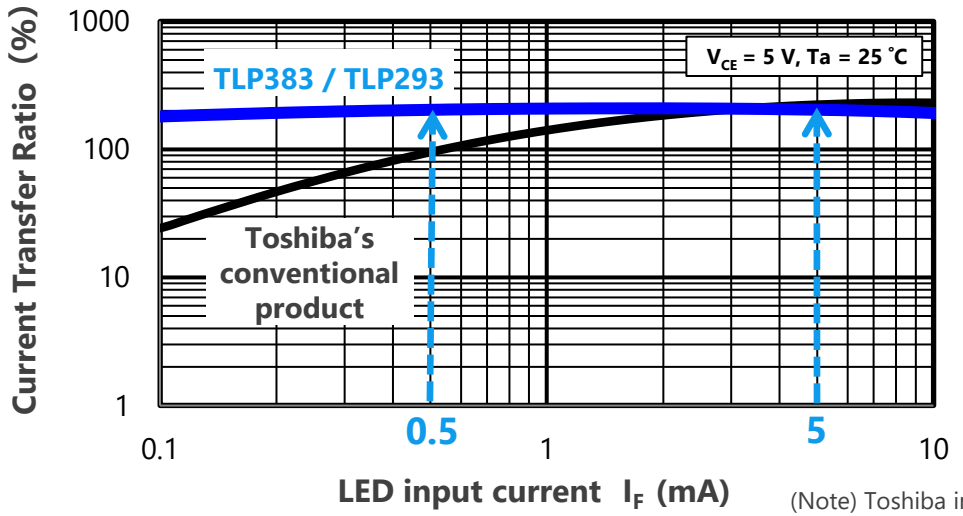
High efficiency · Low loss | Low noise | Small size packages

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

The TLP383 and TLP293 are high-isolation photocouplers that optically couple a phototransistor and high output infrared LED. Compared to Toshiba's conventional product (TLP385), higher CTR (Current Transfer Ratio) in low input current range (@IF = 0.5 mA) is realized.



(Note) Toshiba internal comparison

2 High temperature operation

The TLP383 and TLP293 are designed to operate even under severe ambient temperature conditions.

Lineup

Part number	TLP383	TLP293	TLP385
Package	4pin SO6L 	SO4 	4pin SO6L 
BV_S [Vrms]	5000	3750	5000
T_{opr} [°C]	-55 to 125	-55 to 125	-55 to 110

◆Return to Block Diagram TOP

5 Rectifier diode
CMG06A / 1SS352

High efficiency · Low loss | Low noise | Small size packages

Value provided

Various products are provided, mainly small 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 [Note] contributes to the space saving of the equipment.

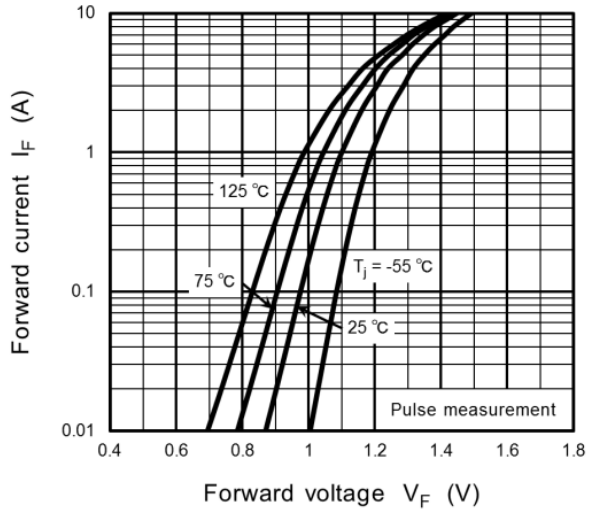
2 Wide product lineup (1)

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

3 Wide product lineup (2)

We also offer a lineup of low voltage, small package diodes to protect the inductive loads of mechanical relays.

[Note] Comparison with our products



・CMG06A
forward characteristic

Lineup

Part number	CMG06A	1SS352
Package	M-FLAT™ 	USC 
$I_{F(AV)}$ [A]	1	0.1 (for I_O)
V_{RRM} [V]	600	80 (for V_R)

◆Return to Block Diagram TOP

6 Bipolar transistor

TMBT3906 / TMBT3904 / 2SC4116

High efficiency · Low loss | Low noise | Small size packages

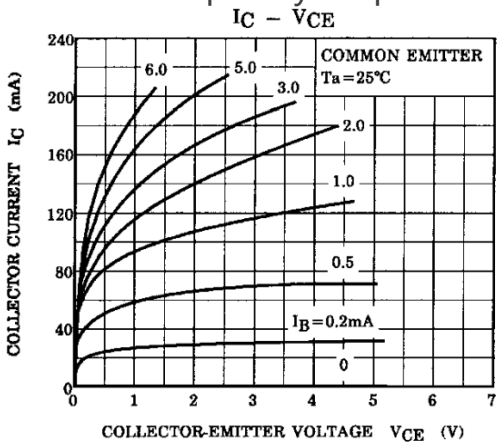
Value provided

Various products are provided for radio frequency applications, power supply applications and other.

1 High voltage

High voltage allows for large loads and instantaneous voltage changes.

High voltage and high current, suitable for low frequency amplification



(TMBT3904: Max)
High breakdown voltage: V_{CEO} = 50 V
Large current: I_C = 200 mA

2 Large current

It covers a wide range of applications, from high frequency applications to power supply applications, and is particularly suitable for applications requiring current capacity.

Lineup

Part number	TMBT3906	TMBT3904	2SC4116
Package	SOT23 	SOT23 	USM 
V_{CEO} [V]	-50	50	50
I_C [mA]	-200	200	150
$V_{CE(sat)}$ (Max) [V]	-0.25	0.2	0.25
h_{FE}	100 to 300	100 to 300	70 to 700
Polarity	PNP	NPN	NPN

◆Return to Block Diagram TOP

Value provided

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

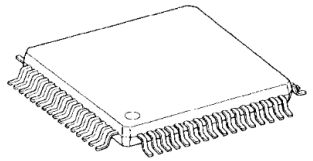
2 System cost down and development efficiency improvement

Multi-channel ADCs and timers enable efficient monitoring and motoring of various parts of the system. Toshiba's 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-P-1010-0.50E

Lineup

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

◆Return to Block Diagram TOP

8 Small surface mount LDO regulator

TCR15AG / TCR13AG / TCR8BM / TCR5BM / TCR5RG / TCR3RM / TCR3U / TCR2L / TAR5 Series

High efficiency · Low loss | Low noise | Small size packages

Value provided

Wide lineup from general purpose type to small package type are provided.
Contribute to realize a stable power supply not affected by fluctuation of battery.

1 Low dropout voltage

The originally developed latest process significantly improved the dropout voltage characteristics.

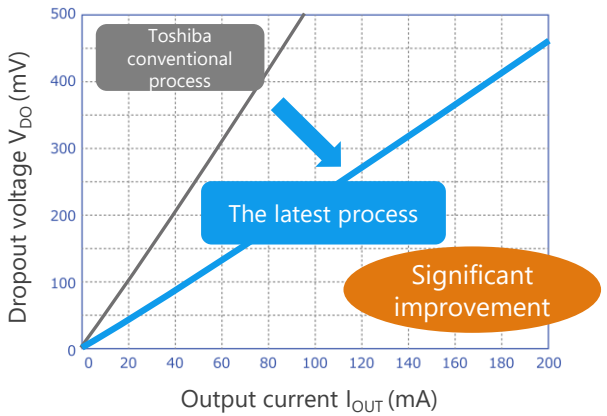
2 High PSRR Low output noise voltage

Many product series that realize both high PSRR (Power Supply Rejection Ratio) and low output noise voltage characteristics are provided. They are suitable for stable power supply for analog circuit.

3 Low current consumption

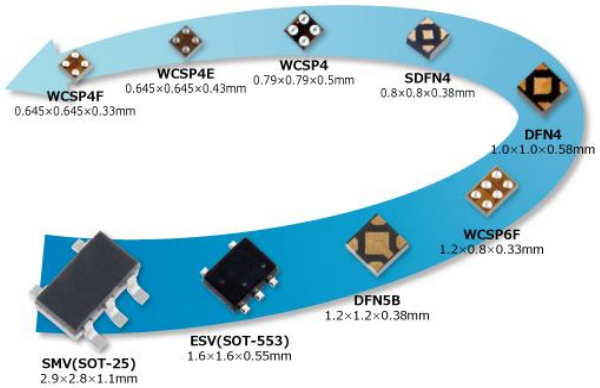
0.34 μA of $I_{B(ON)}$ is realized by utilizing CMOS process and unique circuit technology.
(TCR3U Series)

Low dropout voltage



(Note) Toshiba internal comparison

Rich package lineup



Lineup

Part number	TCR15AG Series	TCR13AG Series	TCR8BM Series	TCR5BM Series	TCR5RG Series	TCR3RM Series	TCR3U Series	TCR2L Series	TAR5 Series
Features	Low dropout voltage High PSRR				High PSRR Low noise Low current consumption		Low current consumption		15 V Input voltage Bipolar type
I_{OUT} (Max) [A]	1.5	1.3	0.8	0.5		0.3		0.2	
PSRR (Typ.) [dB] @f = 1 kHz	95	90	98	98	100	100	70	-	70
I_B (Typ.) [μA]	25	56	20	19	7	7	0.34	1	170

◆Return to Block Diagram TOP

9 Low current consumption op-amp / Low noise op-amp

TC75S102F / TC75S67TU

High efficiency · Low loss | Low noise | Small size packages

Value provided

Low current consumption type and low noise type operational amplifiers maximize the performance of system.

1 Low voltage operation

We have a lineup of low power supply voltage-driven operational amplifiers using CMOS process for low power supply voltage-driven wearable equipment.

2 Low current consumption (TC75S102F) I_{DD} = 0.27 [µA] (Typ.)

CMOS processes have been used to achieve lower current consumption. This contributes to lower power consumption of wearable equipment.

3 Low noise (TC75S67TU) V_{NI} = 6.0 [nV/√Hz] (Typ.) @f = 1 kHz

This CMOS operational amplifier can amplify minute signals detected by various sensors [Note] with very low noises. By optimizing the process, the equivalent input noise voltage has been reduced.

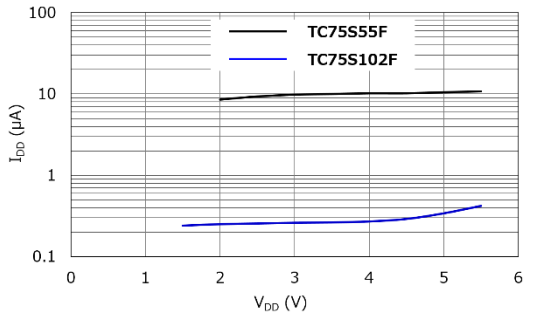
[Note] Sensor types: vibration, shock, acceleration, pressure, infrared, temperature, etc.

TC75S102F

Current Consumption Characteristic

(Toshiba internal comparison)

Low current consumption product TC75S102F



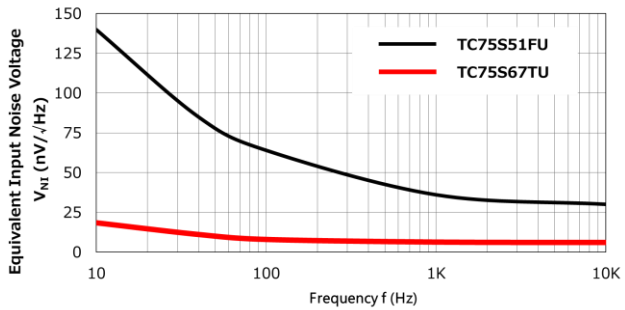
TC75S67TU

Noise Characteristic

(Toshiba internal comparison)

Reduce 1/f noise (10 Hz) by 86 % from our normal products

V_{NI} - f @Ta=25 ℃, V_{DD}=3.3 V



Lineup

Part number	TC75S102F	TC75S67TU
Package	SMV 	UFV 
V_{DD} - V_{SS} [V]	1.5 to 5.5	2.2 to 5.5
V_{IO} (Max) [mV]	1.3	3
CMV_{IN} (Max) [V]	V_{DD}	1.4 (@V_{DD} = 2.5 V)
I_{DD} (Typ. / Max) [µA]	0.27 / 0.46 (@V_{DD} = 1.5 V)	430 / 700 (@V_{DD} = 2.5 V)
V_{NI} (Typ.) [nV/√Hz] @f = 1 kHz	-	6

◆Return to Block Diagram TOP

If you are interested in these products and have questions or comments about any of them, please do not hesitate to contact us below:

Contact address: https://toshiba.semicon-storage.com/ap-en/contact.html

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