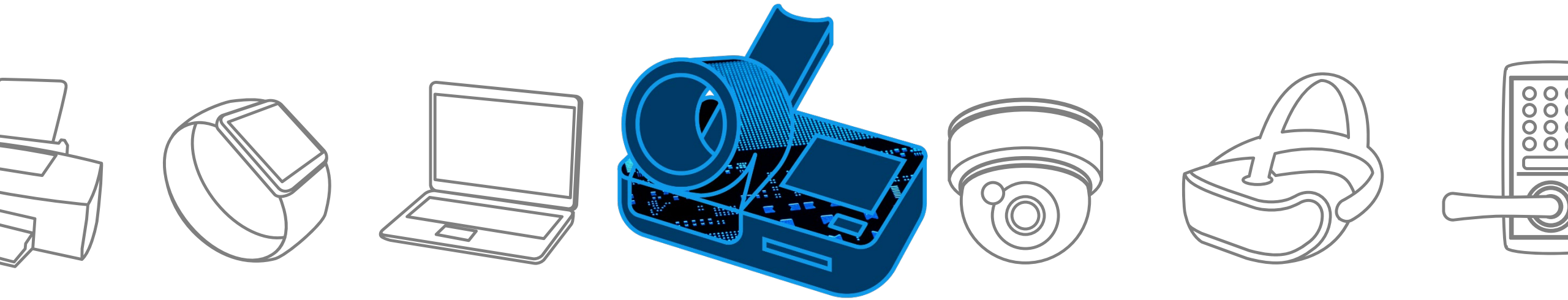
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R22

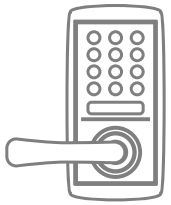
Electronic Sphygmomanometer

Solution Proposal by Toshiba



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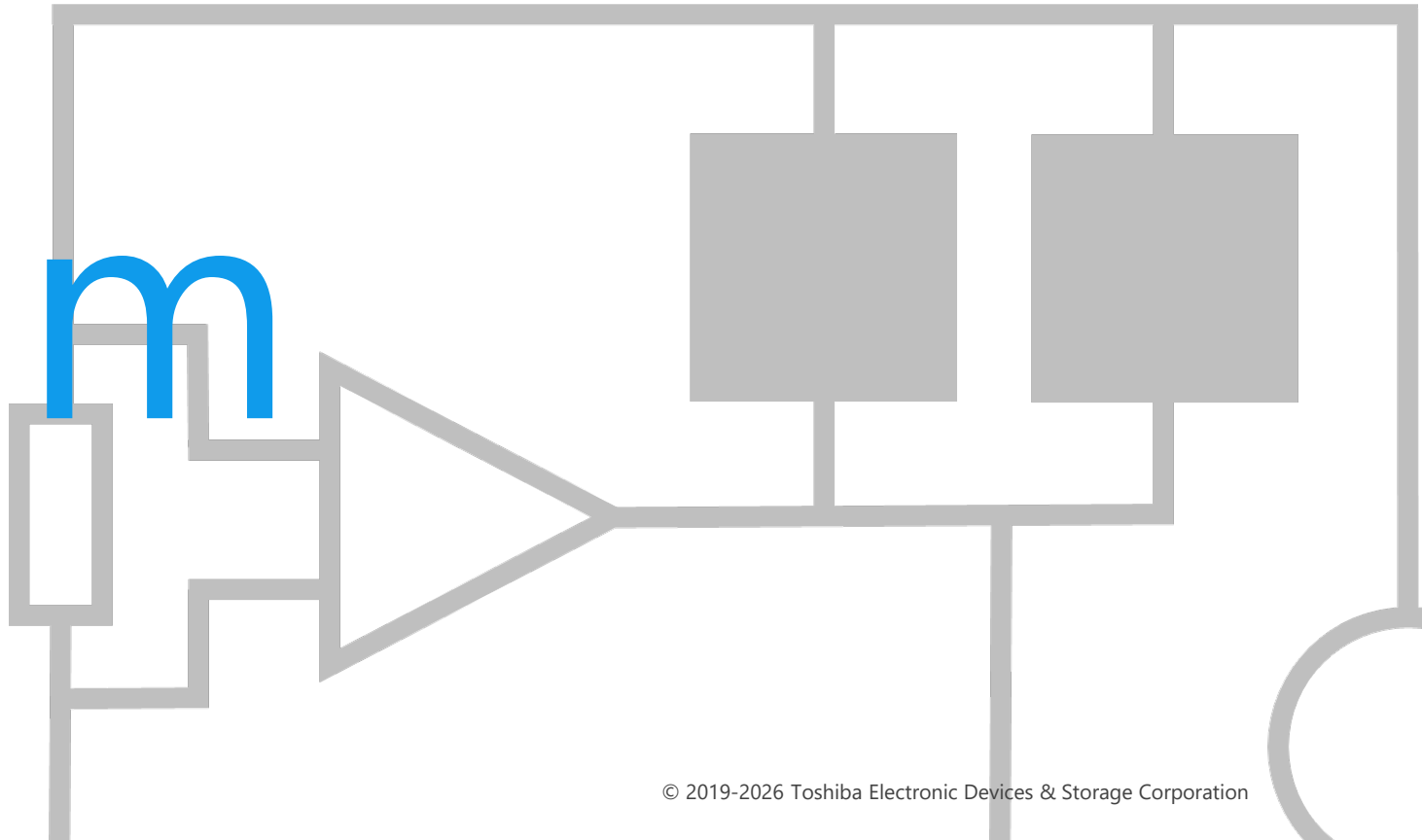
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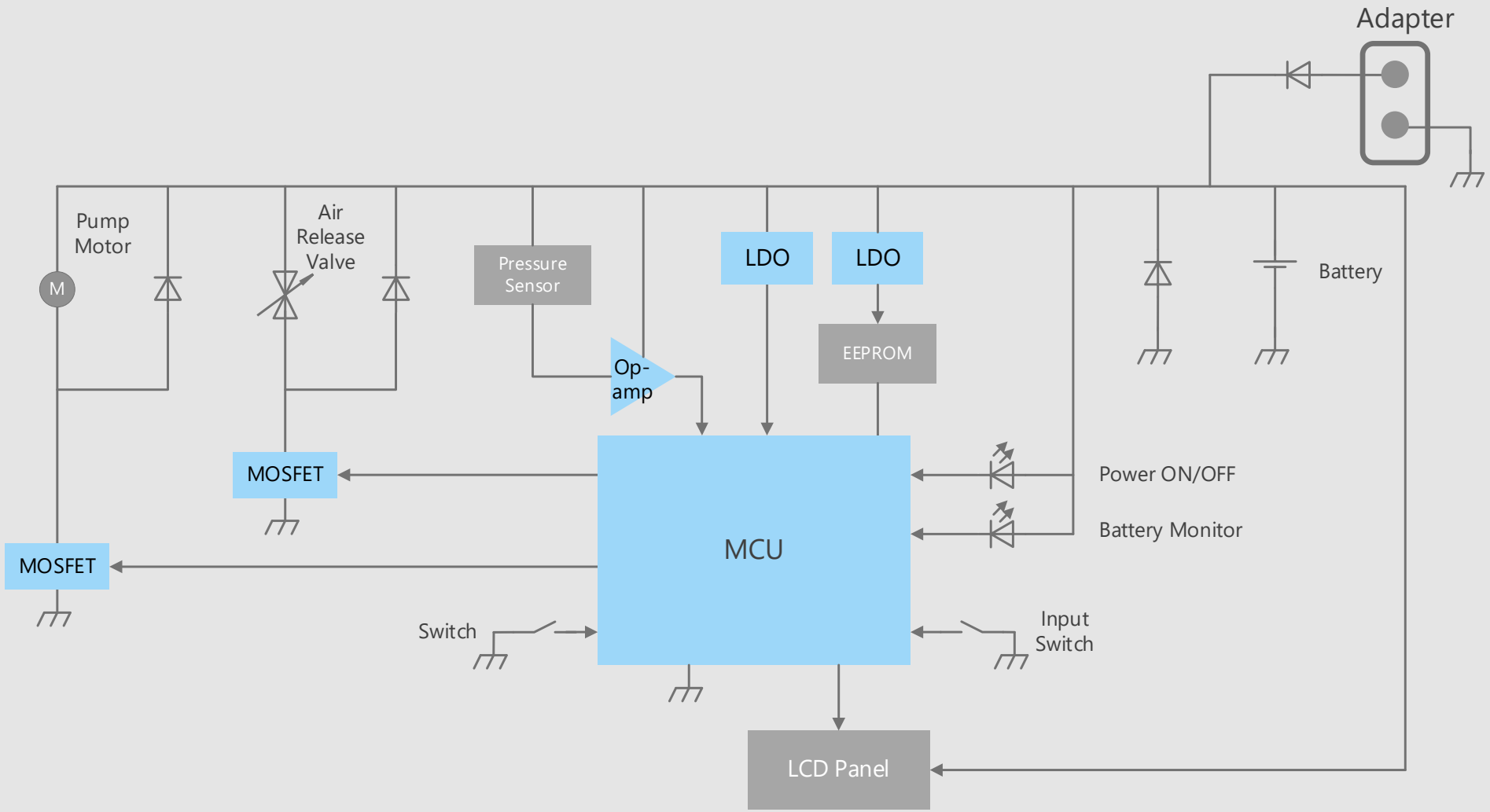
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Block Diagram



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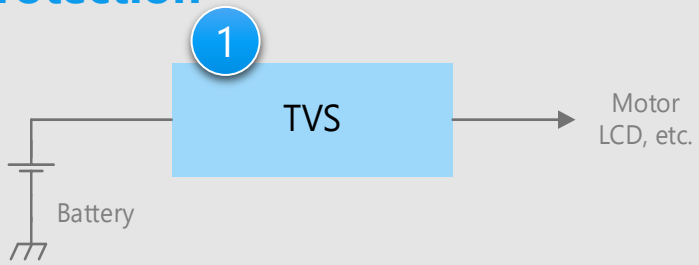
Electronic Sphygmomanometer　Overall block diagram



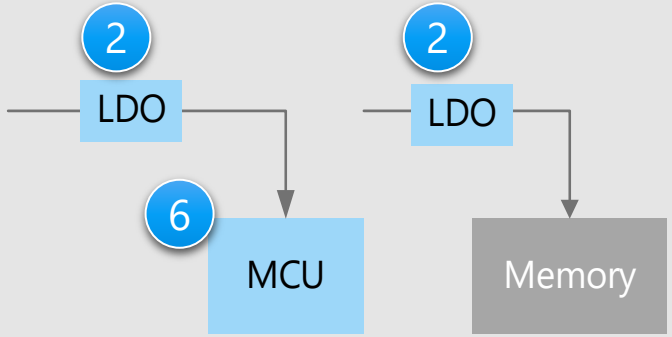
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Electronic Sphygmomanometer　Detail of power supply circuits

Surge voltage protection



Control MCU power supply



Constant voltage supply circuit



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

Device selection points

- The power line from the AC adapter must be protected against surge voltage.
- PSRR is a key characteristic of MCU.
- A backflow prevention measure is necessary between the battery and the AC adapter.

Proposals from Toshiba

- **Static electricity (ESD) from external terminals is absorbed to prevent circuit malfunction and device breakdown**
  TVS diode (1)
- **Supply the power with low noise**
  Small surface mount LDO regulator (2)
- **Low forward voltage and strong against surge current**
  Schottky barrier diode (3)
- **MCU with built-in LCD driver / controller**
  MCU TLCS™-870/C1 Series (6)

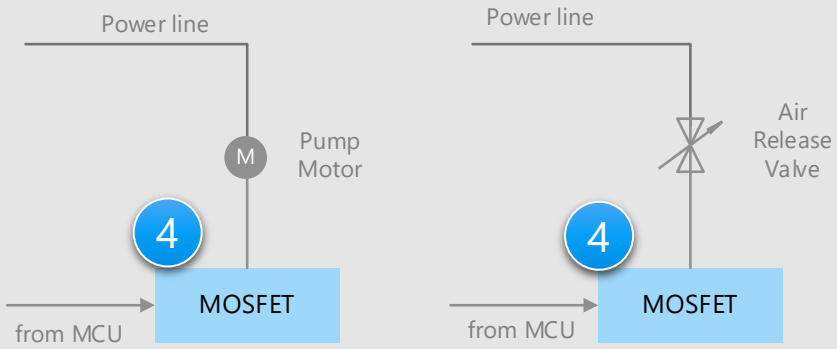
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Electronic Sphygmomanometer　Detail of motor drive circuits

Motor protection



Motor control



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

Device selection points

- Protection against flyback current from the motor is required.
- A small size and low on-resistance MOSFET is used to control the motors.

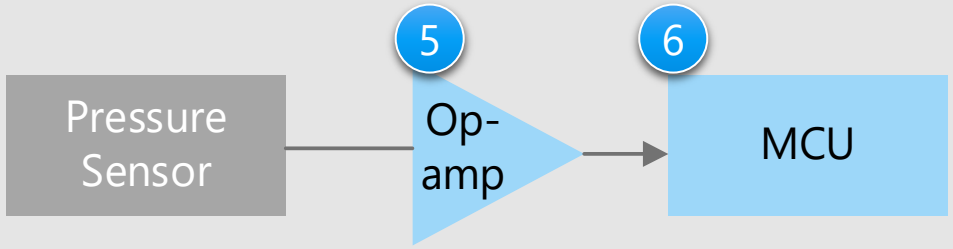
Proposals from Toshiba

- **Low forward voltage and strong against surge current**
  Schottky barrier diode　3
- **Contribute to reduction of power consumption by low on-resistance**
  Small signal MOSFET　4

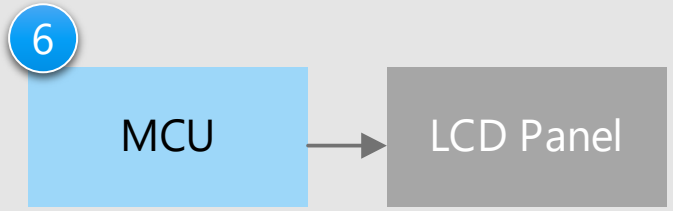
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Electronic Sphygmomanometer　Detail of sensor signal detection circuit

Pressure sensor



LCD driver / controller



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

Device selection points

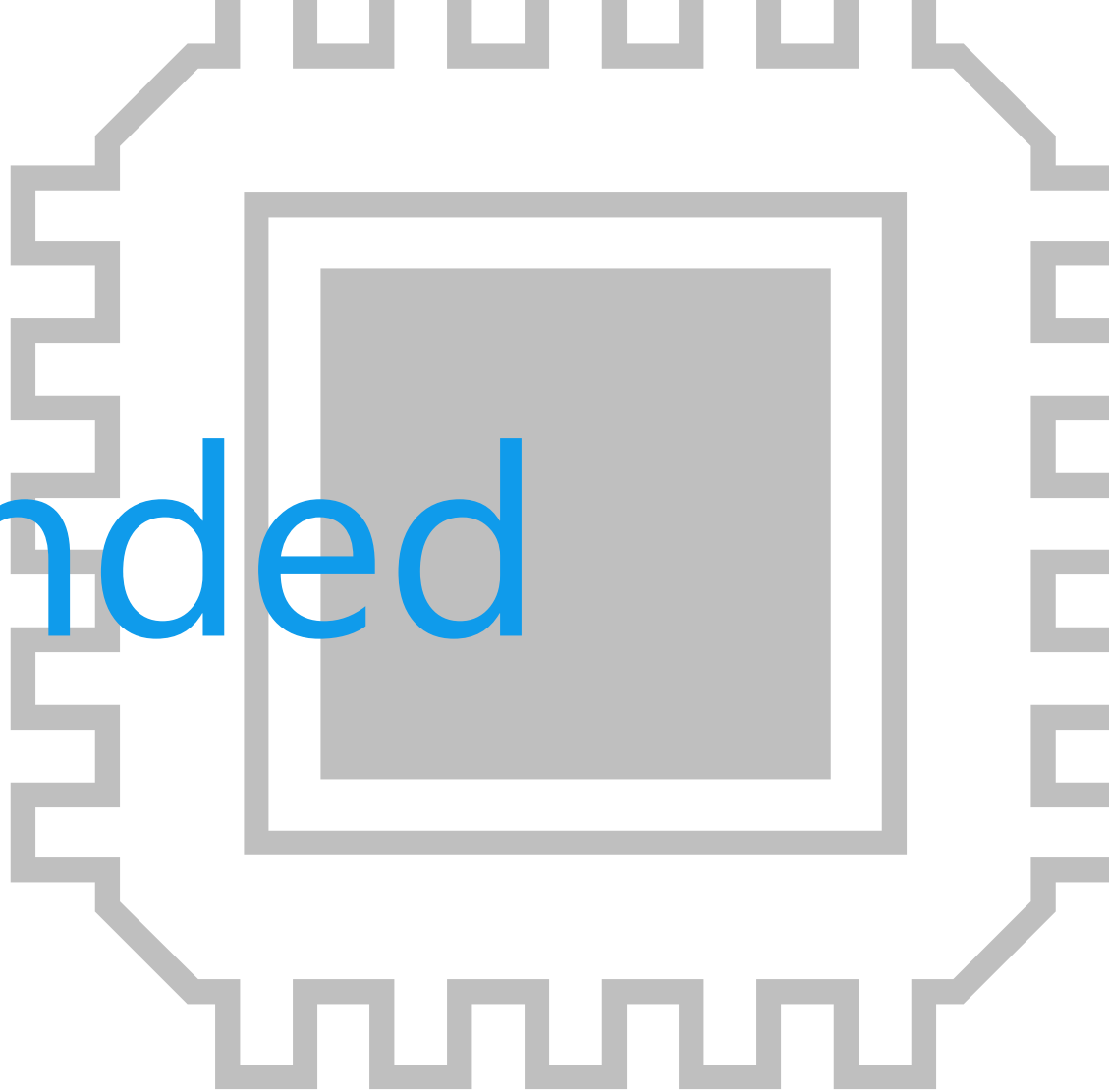
- It is important to select an operational amplifier with characteristics that correspond to the voltage and current levels of output from the sensor.
- Small size package products contribute to the reduction of circuit board area.

Proposals from Toshiba

- **Amplify the detected small signal with low noise**
  Low noise operational amplifier 5
- **MCU with built-in LCD driver / controller**
  MCU TLCS™-870/C1 Series 6

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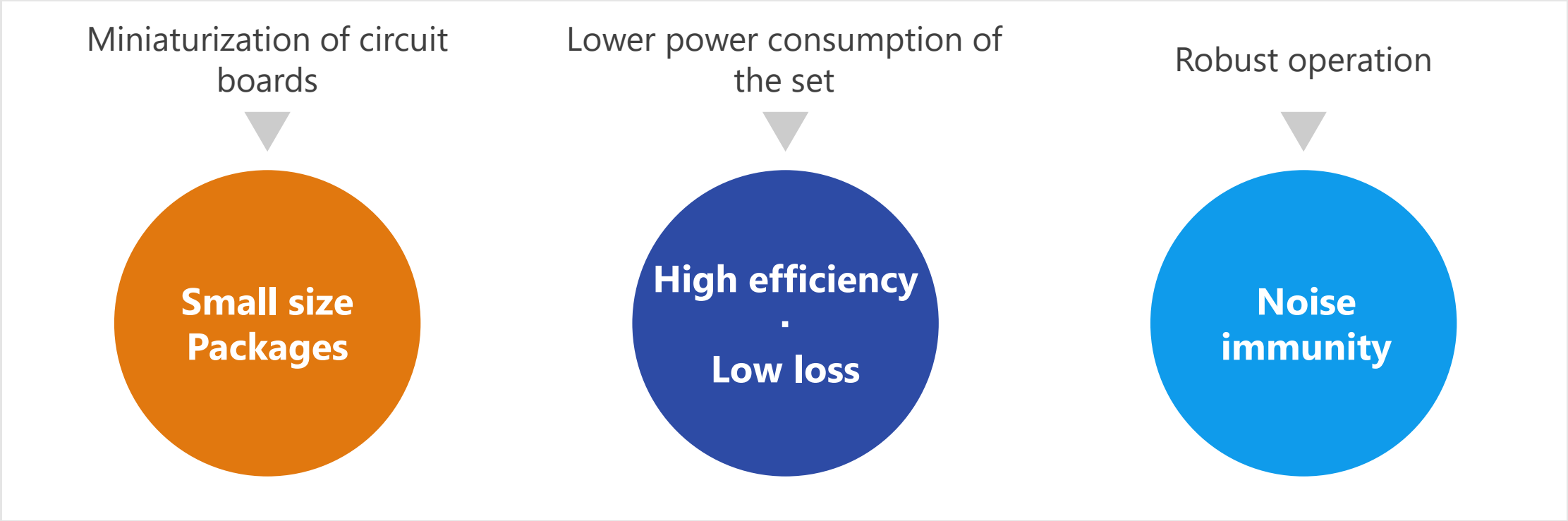
Recommended Devices



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Device Solutions to address customer needs

As described above, in the design of Electronic Sphygmomanometer, **"Miniaturization of circuit boards"**, **"Low power consumption of the set"** and **"Robust operation"** are important factors. Toshiba's proposals are based on these three solution perspectives.



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Device Solutions to address customer needs

	Small size packages	High efficiency · Low loss	Noise immunity
① TVS diode	●		●
② Small surface mount LDO regulator	●	●	●
③ Schottky barrier diode	●	●	●
④ Small signal MOSFET	●	●	
⑤ Low noise operational amplifier	●		
⑥ MCU TLCS™-870/C1 Series		●	

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1 TVS diode

DF2B7ASL / DF2B20M4SL / DF2B5PCT / DF2B7PCT / DF2B7AFU

Small size packages | High efficiency · Low loss | Noise immunity

Value provided

TVS diode absorbs static electricity (ESD) from external terminals, prevents circuit malfunction and protects devices.

1 High ESD pulse absorption performance

Improved ESD absorption compared to Toshiba's existing products. (50 % reduction in dynamic resistance)
For some products, both low operating resistance and low capacitance are realized and ensures high signal protection performance and signal quality.

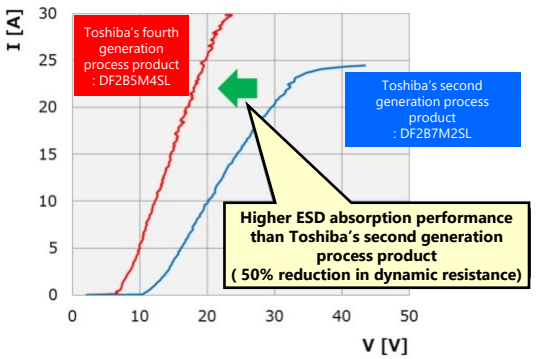
2 Suppress ESD energy by low clamp voltage

Protect the connected circuits and devices using Toshiba own technology.

3 Suitable for high density mounting

A variety of small size packages are available.

ESD Pulse Absorption Performance
(Toshiba internal comparison)

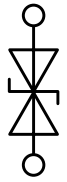


Unidirectional



Suitable for paths such as logic signals. There are lineups of 1in1, 2in1, 4in1, 5in1, 7in1.

Bidirectional



Suitable for paths with both polar signals such as audio signals.

Lineup

Part number	DF2B7ASL	DF2B20M4SL	DF2B5PCT	DF2B7PCT	DF2B7AFU
Package	SOD-962 (SL2)  Top view  Bottom view		SOD-882 (CST2)  Top view  Bottom view		SOD-323 (USC) 
V_{ESD} [kV]	±30	±15	±30	±30	±30
V_{RWM} (Max) [V]	5.5	18.5	3.6	5.5	5.5
C_t (Typ.) [pF]	8.5	0.2	41	45	8.5
R_{DYN} (Typ.) [Ω]	0.2	0.2	0.1	0.1	0.2

[Note] This product is an ESD protection diode and cannot be used for purposes other than ESD protection.

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2 Small surface mount LDO regulator

TCR15AG / TCR8BM / TCR5FM / TCR5RG / TCR3RM / TCR3U / TCR3LM / TCR3D / TCR3EM / TCR1HF Series

Small size packages | High efficiency · Low loss | Noise immunity

Value provided

Wide lineup from general purpose type to WCSP (Wafer Level Chip Size Package) type are provided. Contribute to realize a stable power supply.

1 Low dropout voltage

Low dropout voltage characteristic has been realized by the originally developed process.

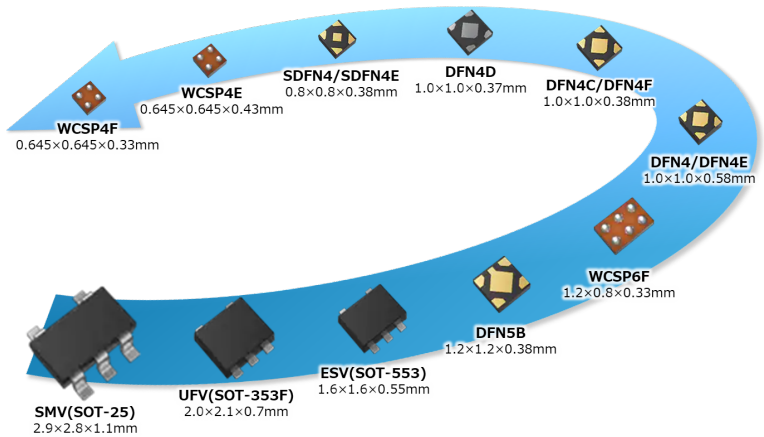
2 High PSRR Low output noise voltage

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

$I_{B(ON)}$ of 0.34 μA (typ.) @I_{OUT} = 0 mA, V_{OUT} ≦ 1.5 V is realized by utilizing CMOS process and unique circuit technology. (TCR3U Series)

Rich package lineup



Lineup

Part number	TCR15AG Series	TCR8BM Series	TCR5FM Series	TCR5RG Series	TCR3RM Series	TCR3U Series	TCR3LM Series	TCR3D Series	TCR3EM Series	TCR1HF Series
Features	Low dropout voltage High PSRR		High PSRR Low noise Low current consumption			Low current consumption		Standard type		36 V Input voltage
I_{OUT} (Max) [A]	1.5	0.8	0.5		0.3					0.15
PSRR (Typ.) [dB] @f = 1 kHz	95	98	91	100	100	70	-	72	68	70
I_B (Typ.) [μA]	25	20	10	7	7	0.34	1	86	35	170

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3 Schottky barrier diode

CUS10S40 / CUHS15F40 / CUS10F30 / 1SS424

Small size packages | High efficiency · Low loss | Noise immunity

Value provided

Low loss allows it to be applied to various applications, and contributes to miniaturization.

1 Low forward voltage

It is suitable for Backflow prevention with low power loss by low forward voltage.

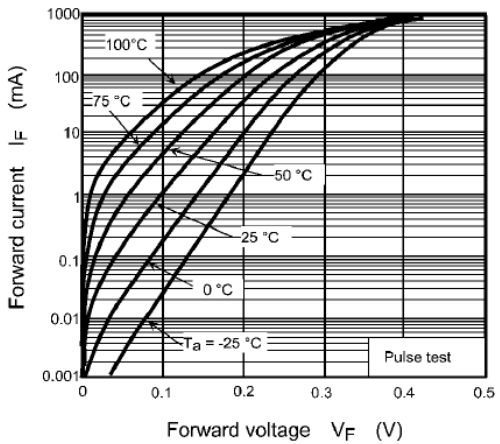
2 High reverse voltage

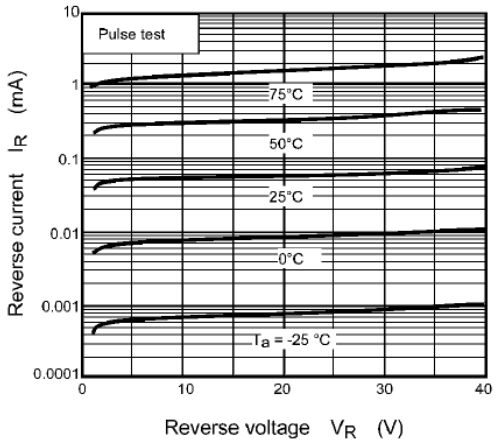
The maximum reverse voltage V_R is 40 V. (CUS10S40 and CUHS15F40)

3 Small size package

Small size package is suitable for high-density mounting.

CUS10S40 Characteristics Curves





Lineup

Part number	CUS10S40	CUHS15F40	CUS10F30	1SS424
Package	SOD-323 (USC) 	SOD-323HE (US2H) 	SOD-323 (USC) 	SOD-523 (ESC) 
I_O (Max) [A]	1.0	1.5	1.0	0.2
V_R (Max) [V]	40	40	30	20
V_F (Typ.) [V]	0.45	0.49	0.43	0.42

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4 Small signal MOSFET

SSM3K324R / SSM3K35AMFV

Small size packages | High efficiency · Low loss | Noise immunity

Value provided

Suitable for power management switches and contributes to miniaturization.

1 Low voltage drive

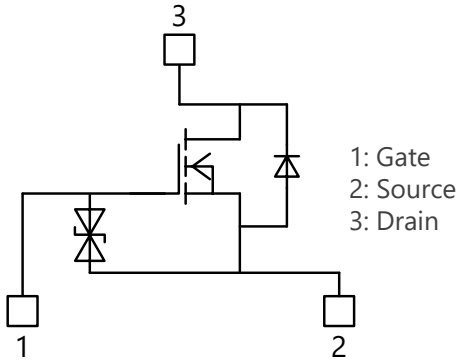
This MOSFET operates at a low voltage of V_{GS} = 1.8 V.

2 Low on-resistance

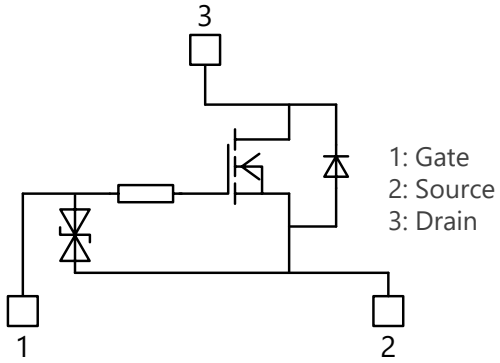
The on-resistance between the drain and source is low.

Heat generation and power consumption can be reduced.

SSM3K324R Internal connection



SSM3K35AMFV Internal connection



Lineup

Part number	SSM3K324R	SSM3K35AMFV
Package	SOT-23F  Top view  Bottom view	SOT-723 (VESM)  Top view  Bottom view
V_{DSS} [V]	30	20
I_D [A]	4.0	0.25
$R_{DS(ON)}$ (Max) [Ω] @V_{GS} = 1.8 V	0.109	2.4
Polarity	N-ch	

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5 Low noise operational amplifier

TC75S67TU

Small size packages | High efficiency · Low loss | Noise immunity

Value provided

Small signals detected by various sensors can be amplified with low noise.

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

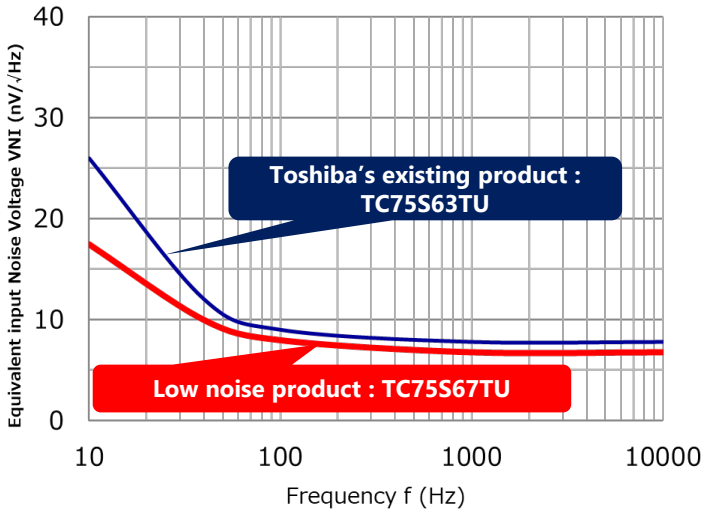
Small signals detected by various sensors [Note] are amplified with low noise using CMOS operational amplifier. Low input equivalent noise voltage has been achieved by optimizing the processing.

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

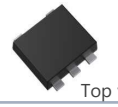
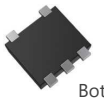
2 Low current consumption
I_{DD} = 430 µA (Typ.)

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

Noise characteristics
(Toshiba internal comparison)



Lineup

Part number	TC75S67TU
Package	SOT-353F (UFV)  Top view  Bottom view
$V_{DD,SS}$ (Max) [V]	±2.75
$V_{DD,SS}$ (Min) [V]	±1.1
I_{DD} (Typ.) [µA]	430
V_{NI} (Typ.) [nV/√Hz] @f = 1 kHz	6.0

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Value provided

Toshiba original CPU core 8bit microcontroller equipped with a large capacity 124 KB flash memory and LCD driver.

1 Toshiba Original CPU Core TLCS™-870/C1 Series

TLCS™-870/C1 series of 8bit MCUs realizes processing capability comparable to that of 16bit MCUs [Note] and achieves high-speed processing at low internal clock frequencies by operating one instruction cycle in a single clock cycle.

[Note] TLCS™-870/C1 series has 16bit general purpose registers and can also execute 16bit operation/transfer instructions.

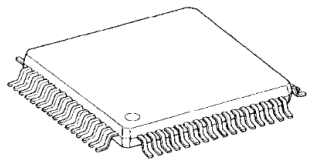
2 Built-in LCD driver / controller

TMP89FW20AUG and TMP89FW24AFG have a built-in LCD driver / controller and can directly drive a segment LCD. 1/4, 1/3, 1/2 duty and static drive can be selected. They also have a built-in bleeder resistor for LCD power supply voltage.

3 Reduction of system cost and development load

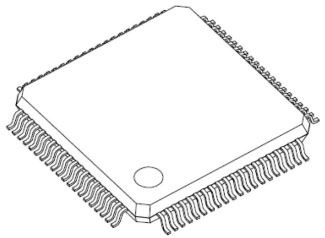
TMP89FW20AUG and TMP89FW24AFG have a built-in high-frequency oscillation circuit (10 MHz (typ.)) and can reduce system cost.
In addition, the software development period can be shortened by a built-in Toshiba NANO FLASH™ memory, which allows high-speed rewriting of programs.

TMP89FW20AUG



Package
LQFP64-P-1010-0.50E
(10 x 10 mm)

TMP89FW24AFG



Package
LQFP80-P-1212-0.50F
(12 x 12 mm)

Lineup

Part number	TMP89FW20AUG	TMP89FW24AFG
Maximum operation frequency	16 MHz	16 MHz
Instruction ROM	124 KB	124 KB
RAM	3 KB	3 KB
Timer	16bit x 2ch 10bit x 1ch 8bit x 4ch	16bit x 2ch 10bit x 1ch 8bit x 4ch
UART	3ch	3ch
LCD driver/controller	32 seg x 4 com	40 seg x 4 com
AD converter	8ch (10bit)	8ch (10bit)

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