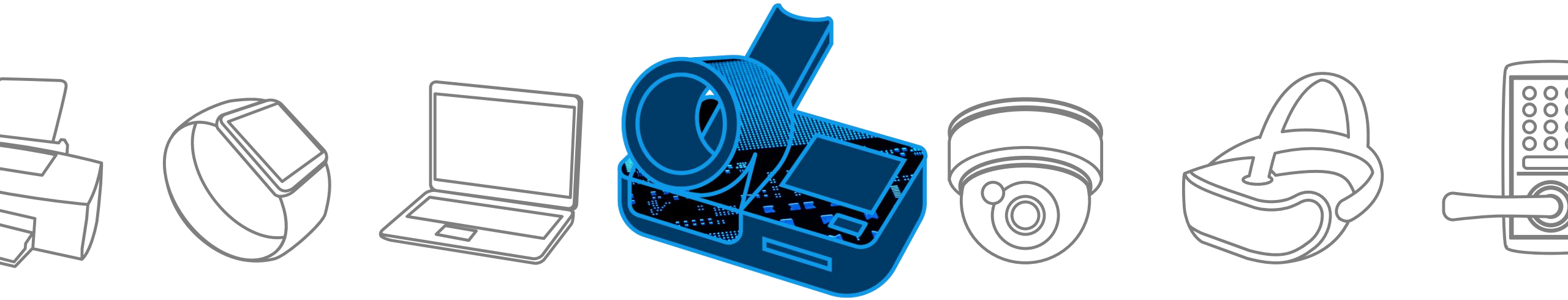


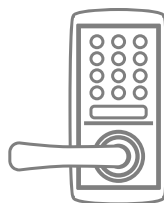
**TOSHIBA**

# Electronic Sphygmomanometer

R21

**Solution Proposal by Toshiba**

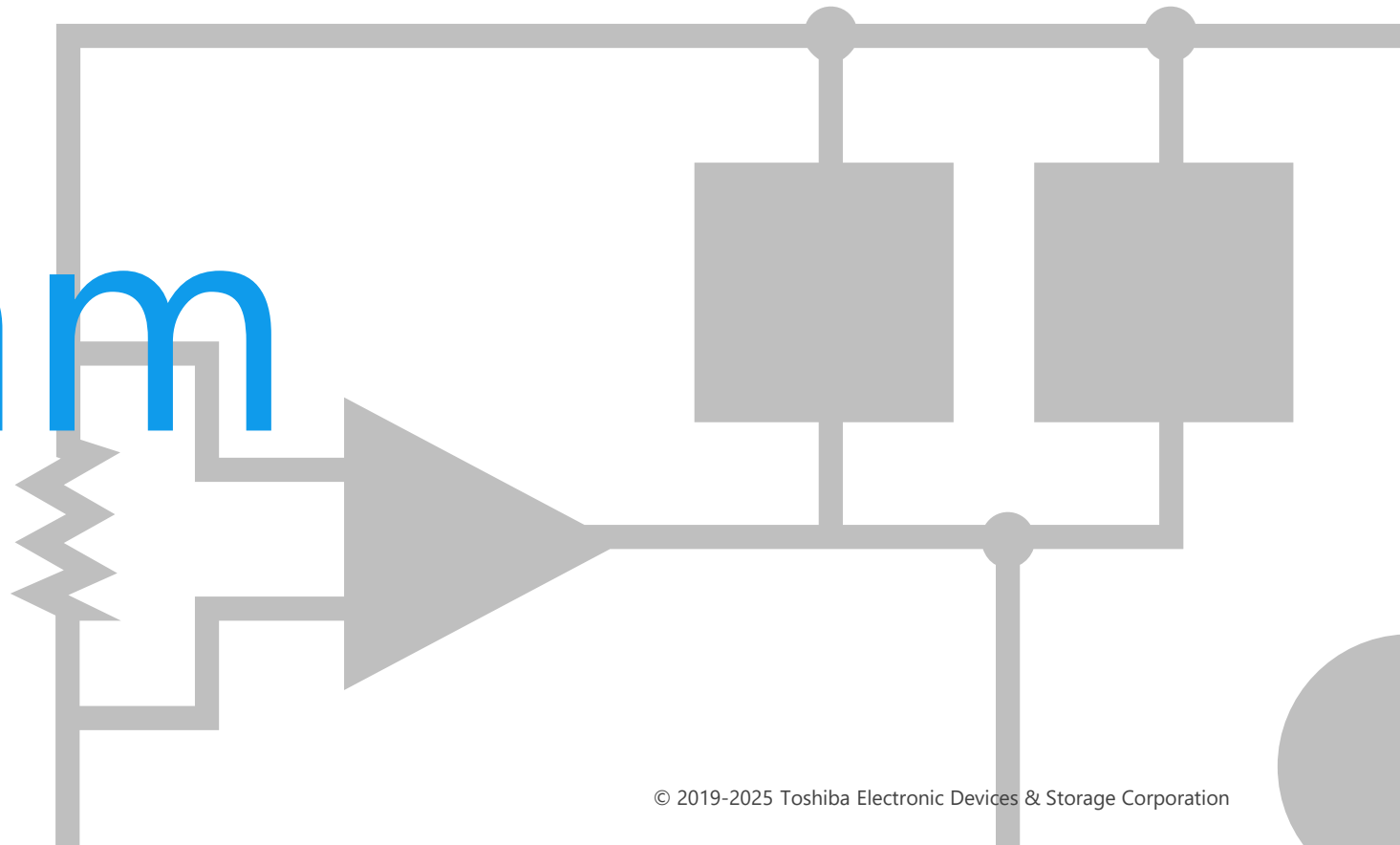




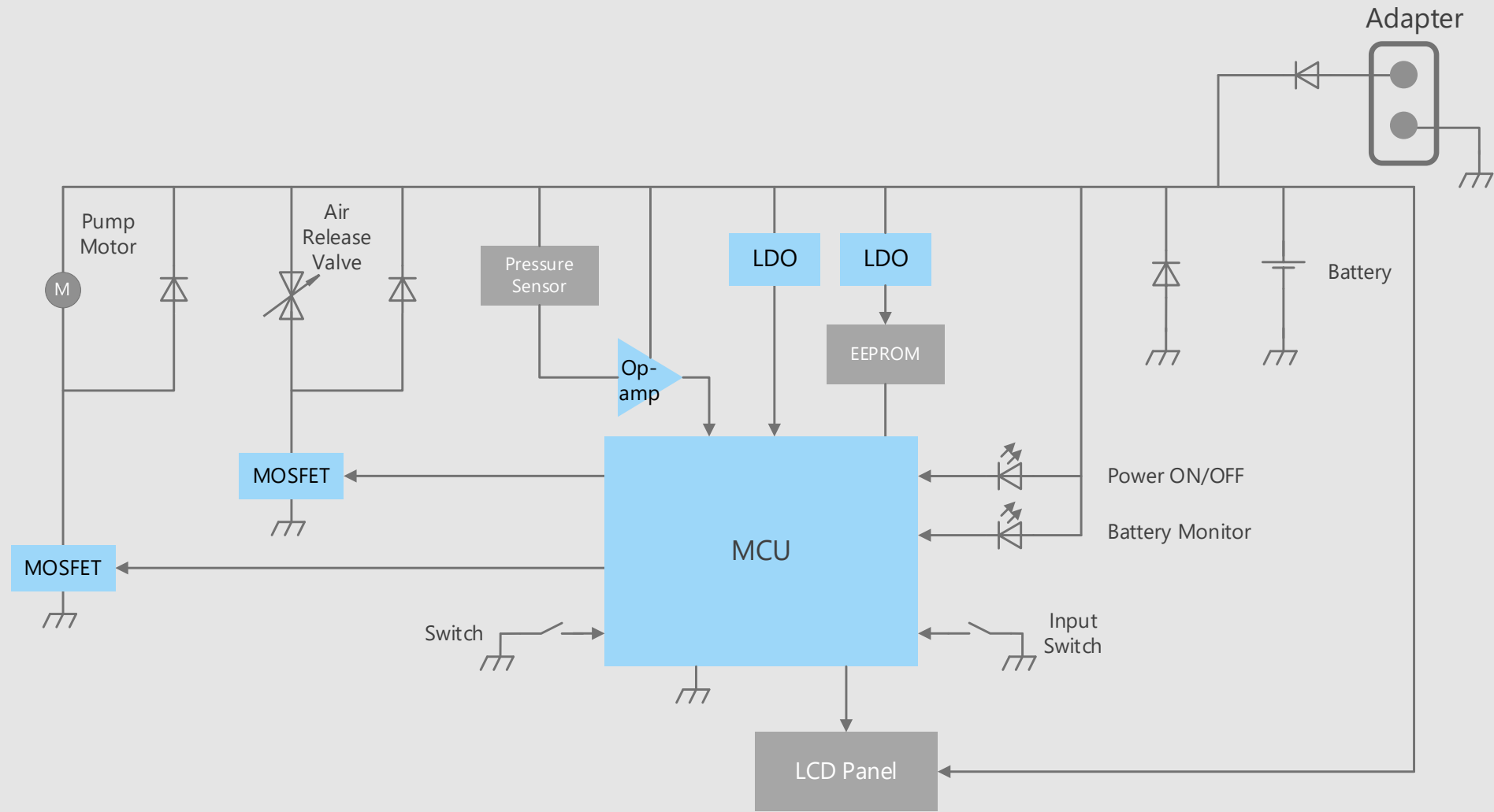
Toshiba Electronic Devices & Storage Corporation provides comprehensive device solutions to customers developing new products by applying its thorough understanding of the systems acquired through the analysis of basic product designs.



# Block Diagram

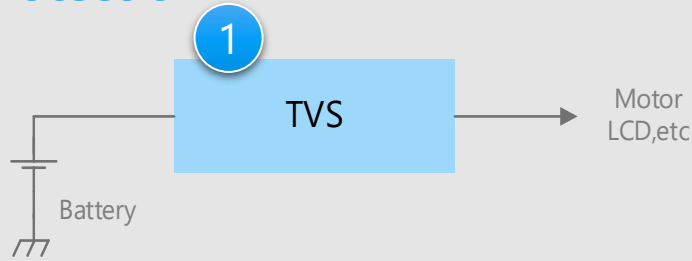


# Electronic Sphygmomanometer Overall block diagram

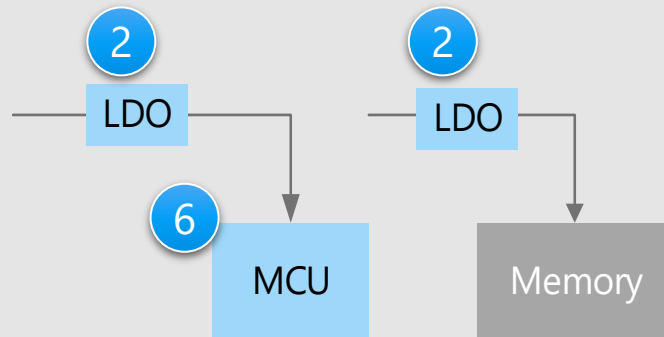


# Electronic Sphygmomanometer    Detail of power supply circuits

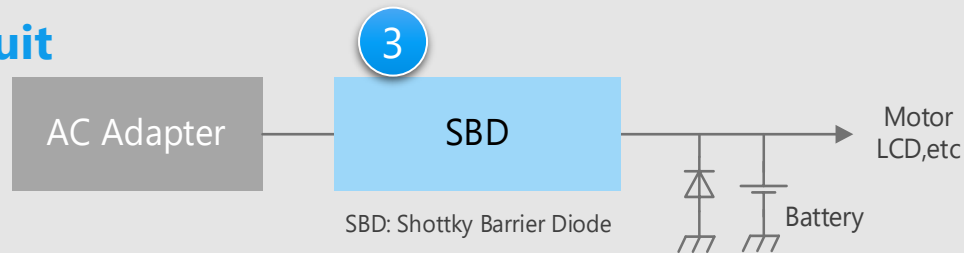
## Surge voltage protection



## 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 feature of MCU.
- A backflow prevention measure is necessary between the battery and the AC adapter.

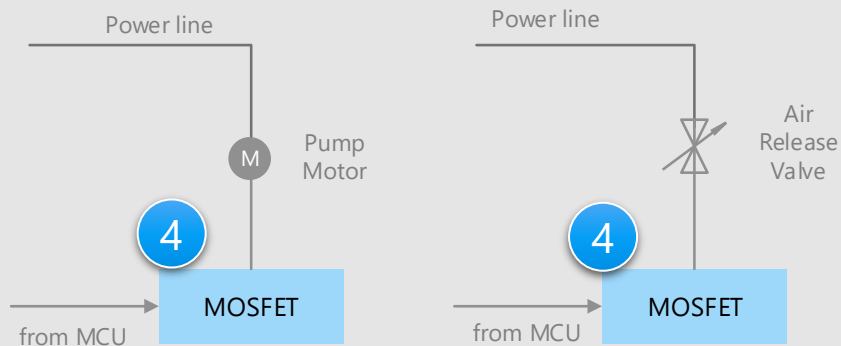
## Proposals from Toshiba

- **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 / Strong against surge current**  
Schottky barrier diode 3
- **Built-in LCD driver / controller CPU**  
MCU 6

## Motor protection



## Motor control



## Device selection points

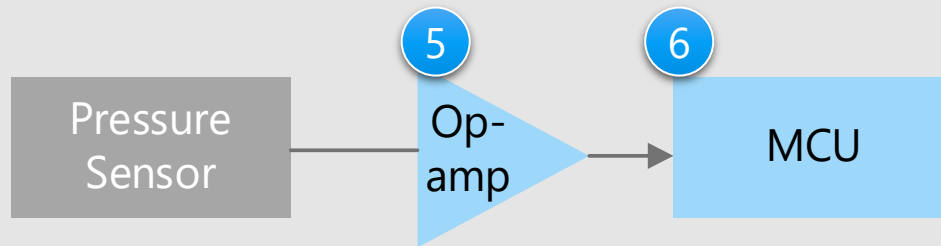
- A small, low on-resistance MOSFET is used to control the motors.
- Protection against flyback current by the motor is necessary.

## Proposals from Toshiba

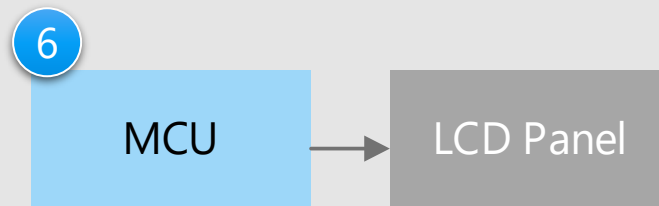
- **Low forward voltage / Strong against surge current** 3  
Schottky barrier diode
- **Setting of low power consumption with low on-resistance** 4  
Small signal MOSFET

\* [Click on the numbers in the circuit diagram to jump to the detailed descriptions page](#)

## Pressure sensor



## LCD driver / controller



## Device selection points

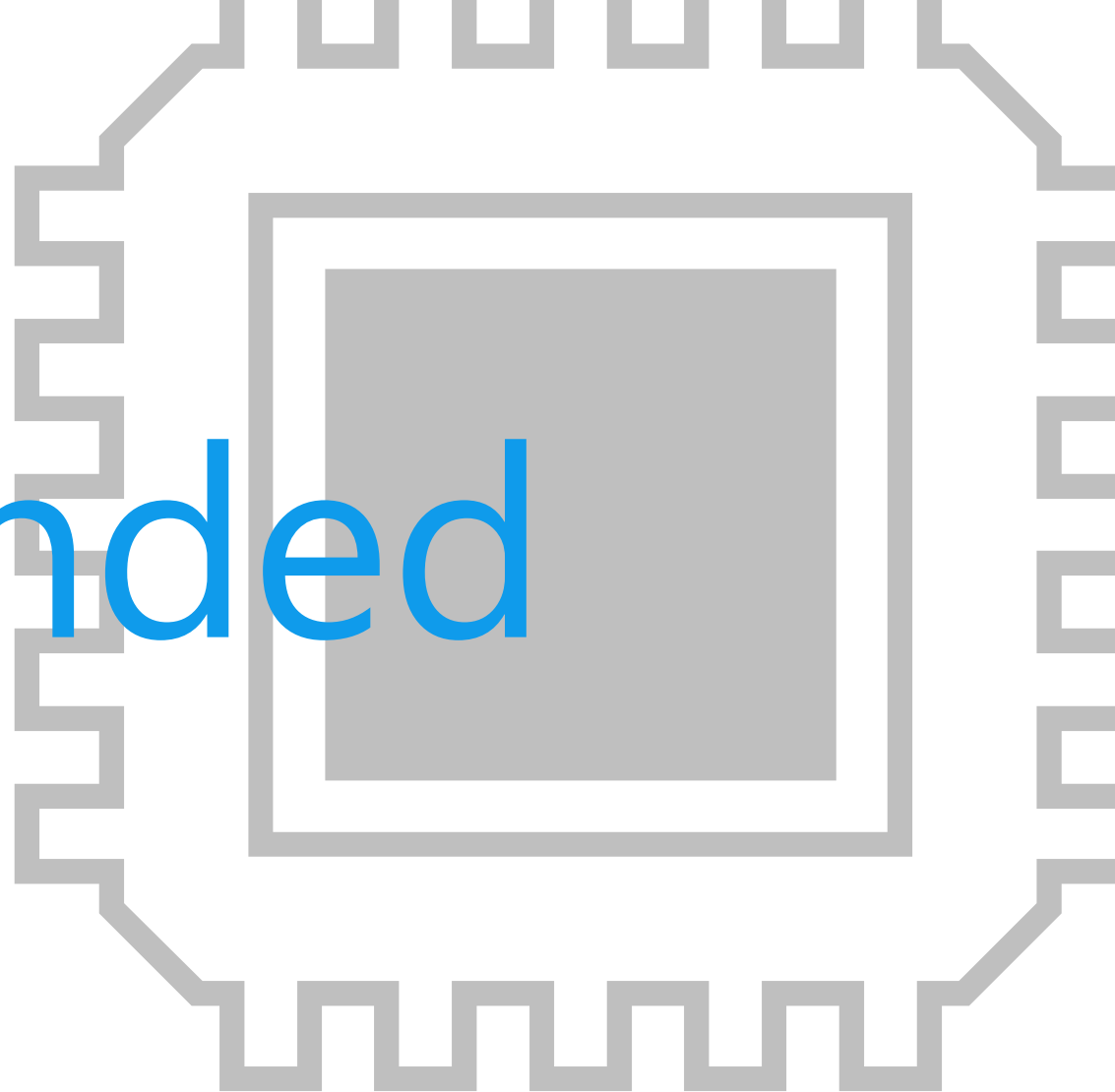
- The voltage and current supplied are important for selecting the operational amplifier.
- Small package products contribute to the reduction of circuit board area.

## Proposals from Toshiba

- **Amplify the detected small signal with low noise.** 5  
Low noise operational amplifier
- **Built-in LCD driver / controller CPU** 6  
MCU

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

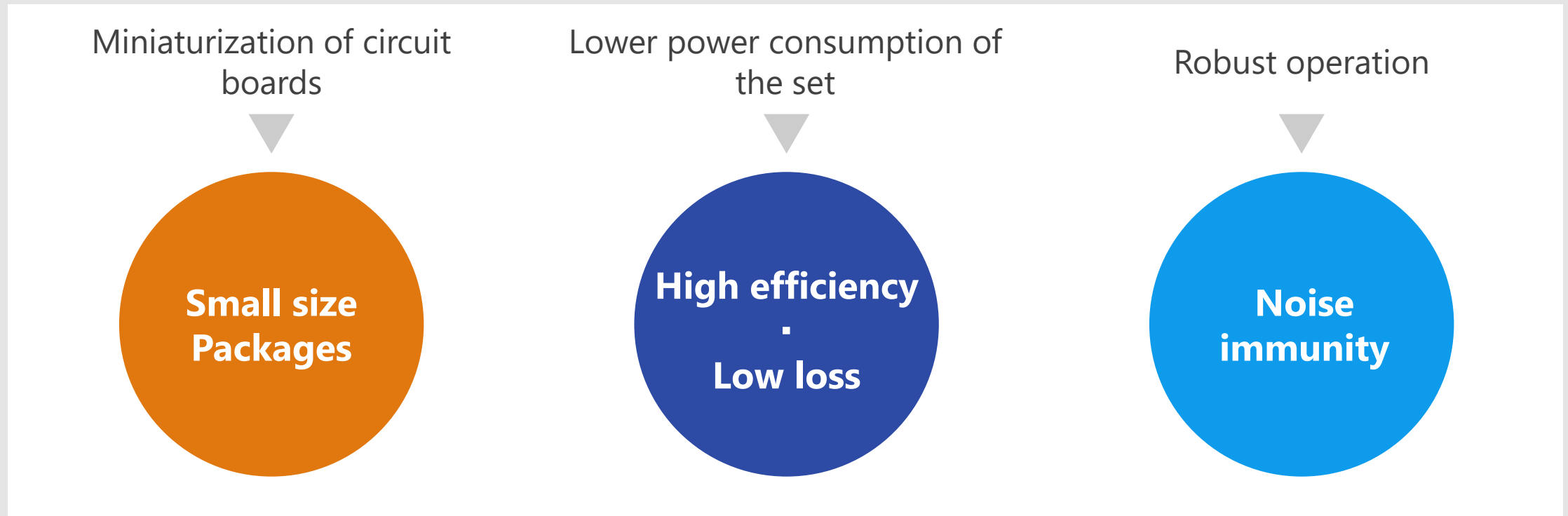
# Recommended Devices





# 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.



# 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		●	

Value provided

## Absorbs static electricity (ESD) from external terminals, prevents circuit malfunction, and protects devices.

### 1 Improved ESD absorption

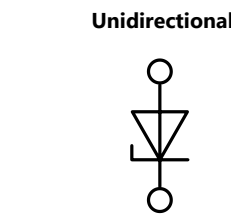
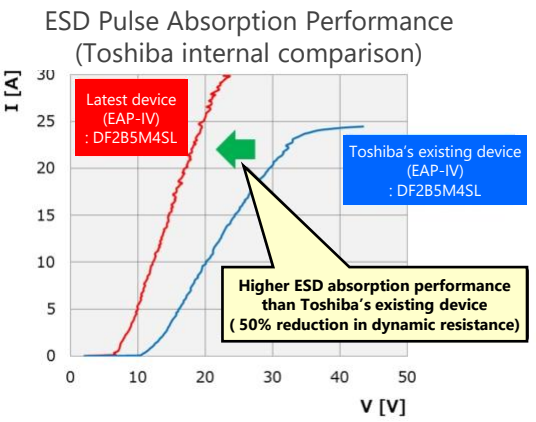
Improved ESD absorption compared to Toshiba's existing products. (50 % reduction in operating resistance)  
For some products, both low operating resistance and low capacitance are realized and ensures high signal protection performance and signal quality.

### 2 Suppress ESD energy by low clamp voltage

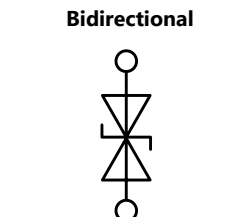
Steadily protect the connected circuits/devices using proprietary technology.

### 3 Suitable for high-density mounting

A variety of compact packages are available.





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



Suitable for paths with both polar signals such as audio signals

### Lineup

Part number	DF2B7ASL	DF2B20M4SL	DF2B5PCT	DF2B7PCT	DF2B7AFU
Package	SL2 		CST2 		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.) [ $\Omega$ ]	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.

[Return to Block Diagram TOP](#)

# 2 Small surface mount LDO regulator

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

Small size packages

High efficiency  
Low loss

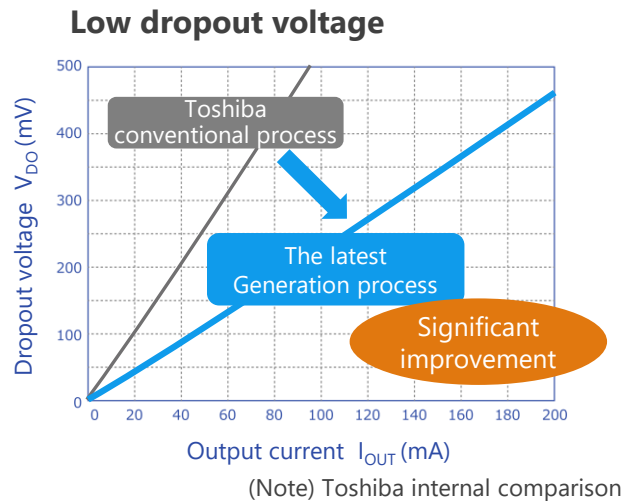
Noise immunity

Value provided

Wide line up 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 the latest generation process significantly improved the dropout voltage characteristics.



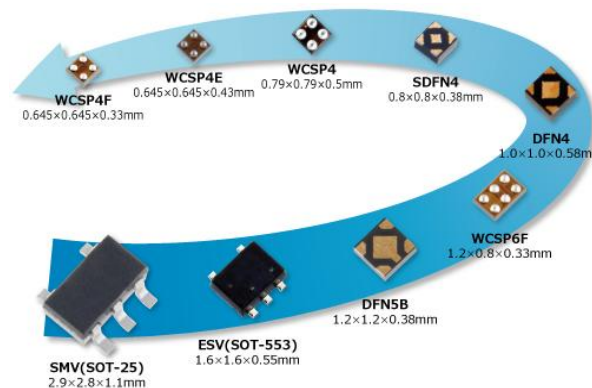
## 2 High PSRR Low output noise voltage

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  $\mu\text{A}$  of  $I_{B(ON)}$  is realized by utilizing CMOS process and unique circuit technology. (TCR3U Series)

### 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		15V 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.) [ $\mu\text{A}$ ]	25	56	20	19	7	7	0.34	1	170

[Return to Block Diagram TOP](#)

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.

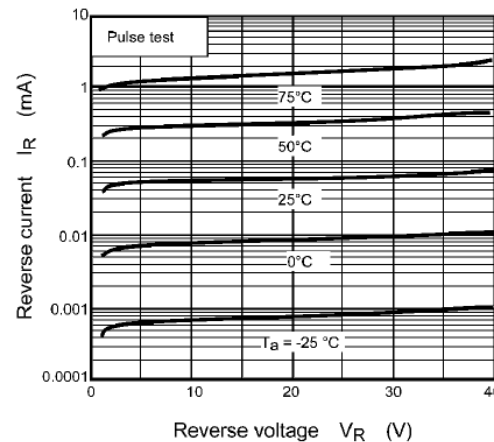
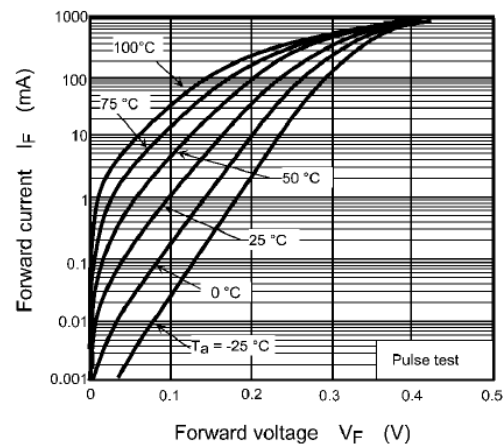
## 2 Be resistant to reverse voltage

The reverse voltage  $V_R$  can be applied up to 40 V.

## 3 Small package

Small package is suitable for high-density mounting.

CUS10S40 Characteristics Curves



Lineup

Part number	CUS10S40	CUHS15F40	CUS10F30	1SS424
Package	USC 	US2H 	USC 	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

[Return to Block Diagram TOP](#)

Value provided

Suitable for power management switches and contributes to miniaturization.

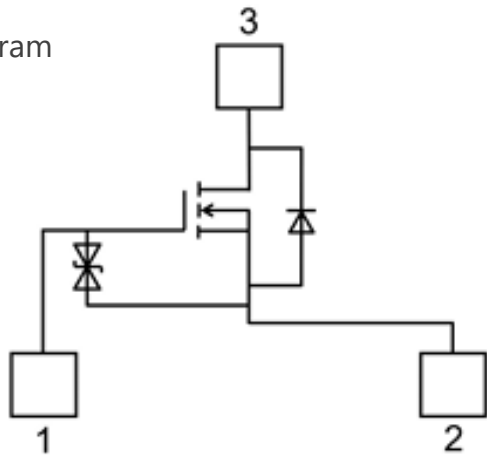
## 1 Low voltage drive



Operates down to  $V_{GS} = 1.8$  V.

## 2 Low on-resistance

Heat generation and power consumption can be kept low by keeping the on-resistance between the drain and source low.

SSM3K324R  
Internal connection diagram



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

[Return to Block Diagram TOP](#)

# 5 Low noise operational amplifier

## TC75S67TU

Small size packages

High efficiency  
·  
Low loss

Noise immunity

Value provided

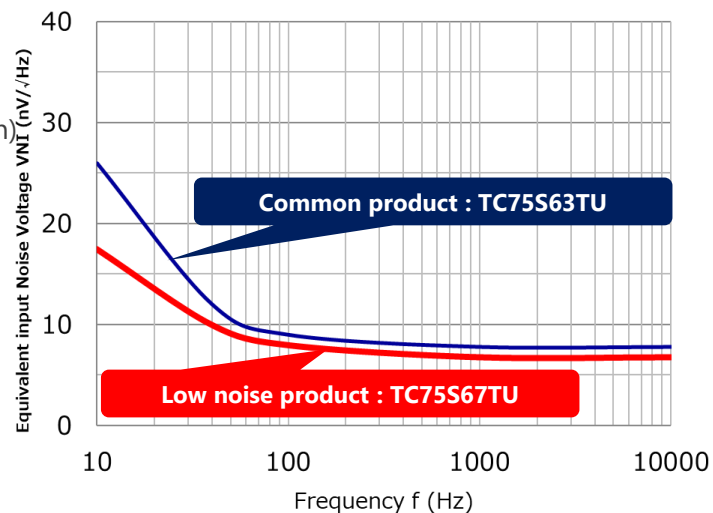
Small signals detected by various sensors can be amplified with very low noise.

**1 Low noise**  
 $V_{NI} = 6.0 \text{ [nV}/\sqrt{\text{Hz}}] \text{ (Typ.) @ } f = 1 \text{ kHz}$

Small signals detected by various sensors [Note] can be 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.


Noise characteristics  
 (Toshiba internal comparison)



**2 Low current consumption**  
 $I_{DD} = 430 \text{ [}\mu\text{A]} \text{ (Typ.)}$

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

### Lineup

Part number	TC75S67TU
Package	UFV 
$V_{DD,SS} \text{ (Max) [V]}$	$\pm 2.75$
$V_{DD,SS} \text{ (Min) [V]}$	$\pm 1.1$
$I_{DD} \text{ (Typ.) [}\mu\text{A]}$	430
$V_{NI} \text{ [nV}/\sqrt{\text{Hz}}] \text{ (Typ.) @ } f = 1 \text{ kHz}$	6

[Return to Block Diagram TOP](#)

## Value provided

**Toshiba original CPU core 8-bit 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 equivalent to 16bit MCUs, and achieves high-speed processing at low internal clock frequencies by operating one instruction cycle in a single clock cycle.

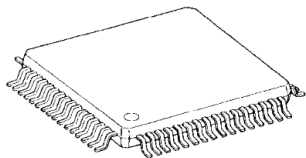
### 2 Built-in LCD driver / controller

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

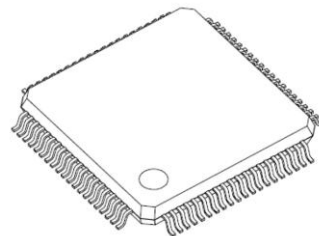
TMP89FW20AUG and TMP89FW24AFG have a built-in high-frequency oscillation circuit (Typ.:10 MHz) and can reduce system cost. In addition, the software development period can be shortened by a built-in Toshiba NANOFLASH™ memory, which allows high-speed rewriting of programs.

TMP89FW20AUG



LQFP64

TMP89FW24AFG



LQFP80

## 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
LCDD	32 SEG x 4 COM	40 SEG x 4 COM
ADC	8ch (10bit)	8ch (10bit)

[◆Return to Block Diagram TOP](#)



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