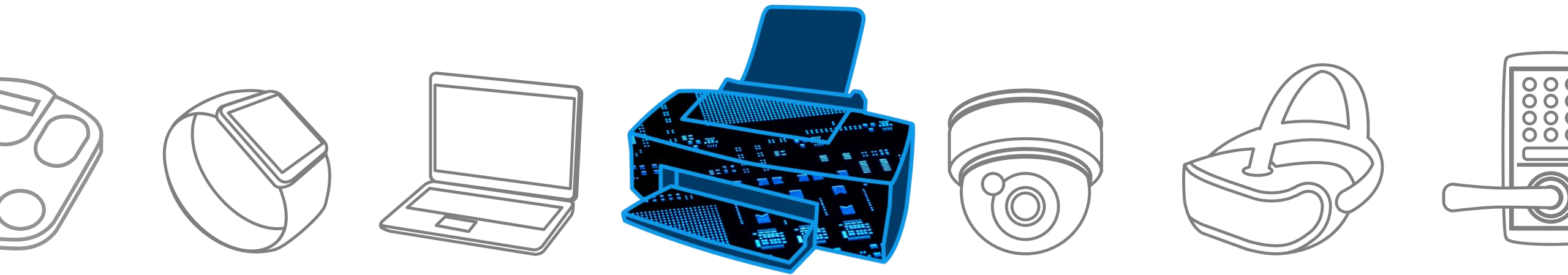
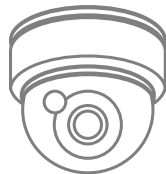
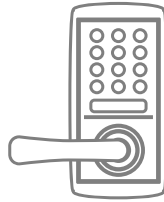


Inkjet Printer

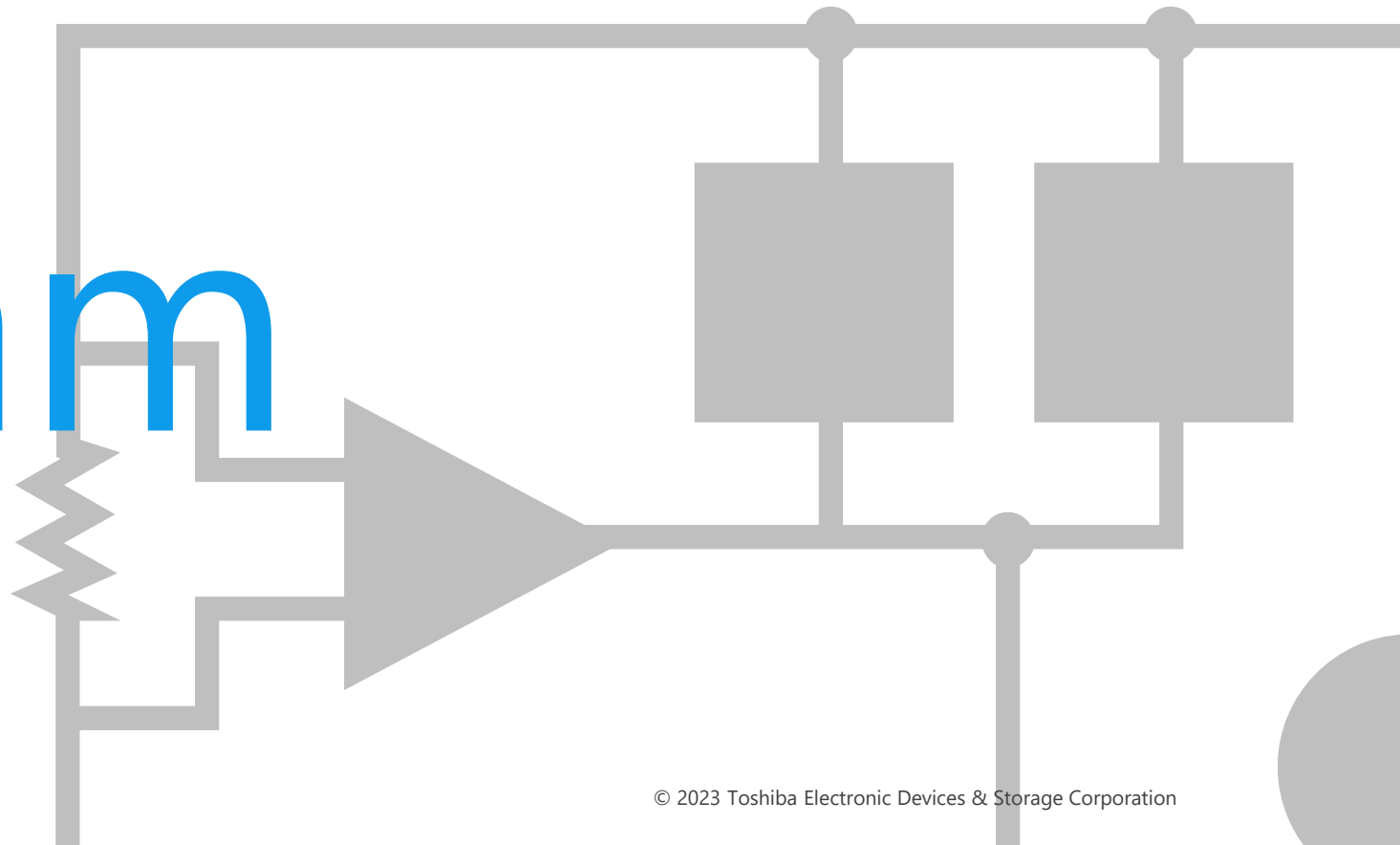
Solution Proposal by Toshiba



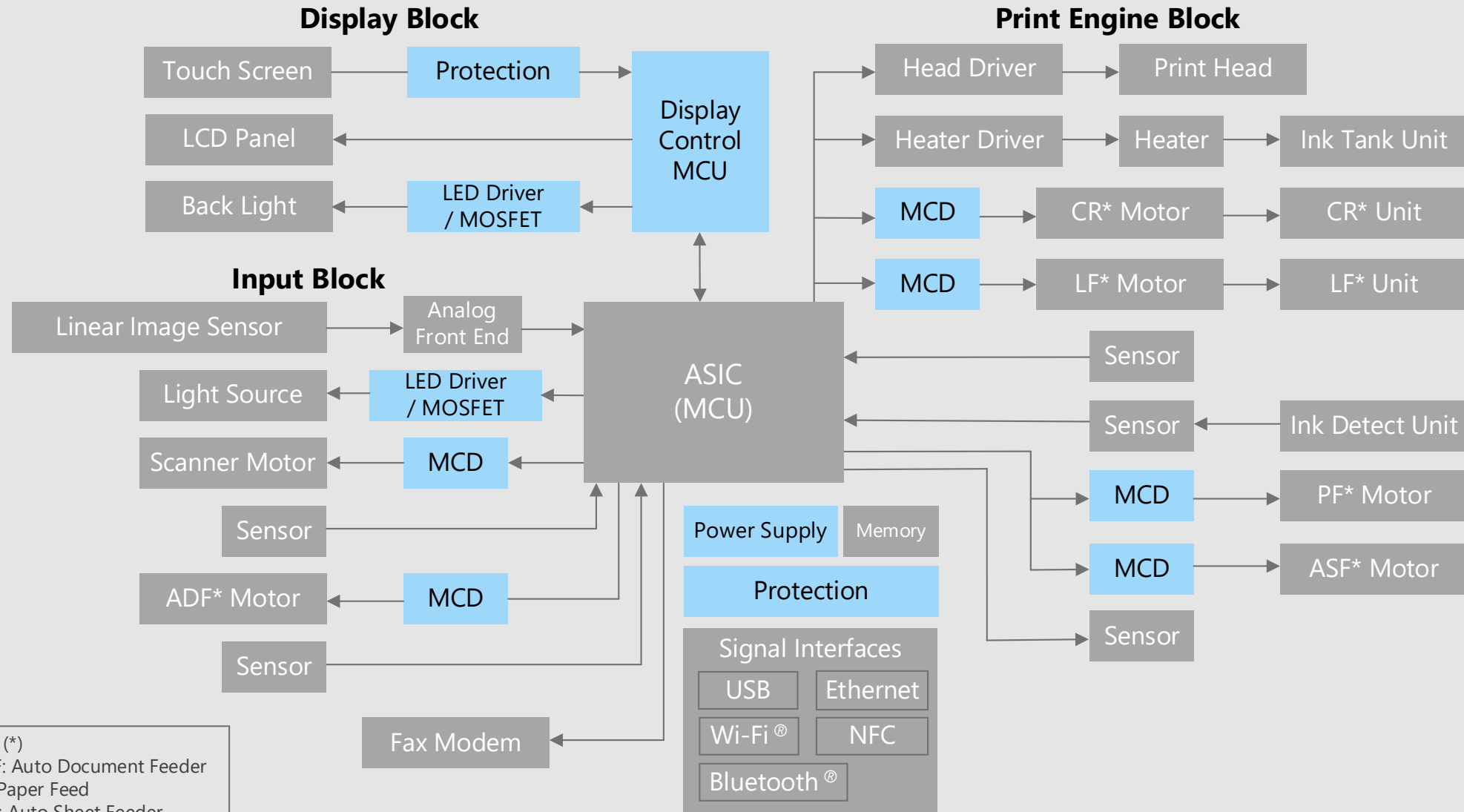


Toshiba Electronic Devices & Storage Corporation provides comprehensive device solutions to customers developing new products by applying its thorough understanding of the systems acquired through the analysis of basic product designs.

Block Diagram



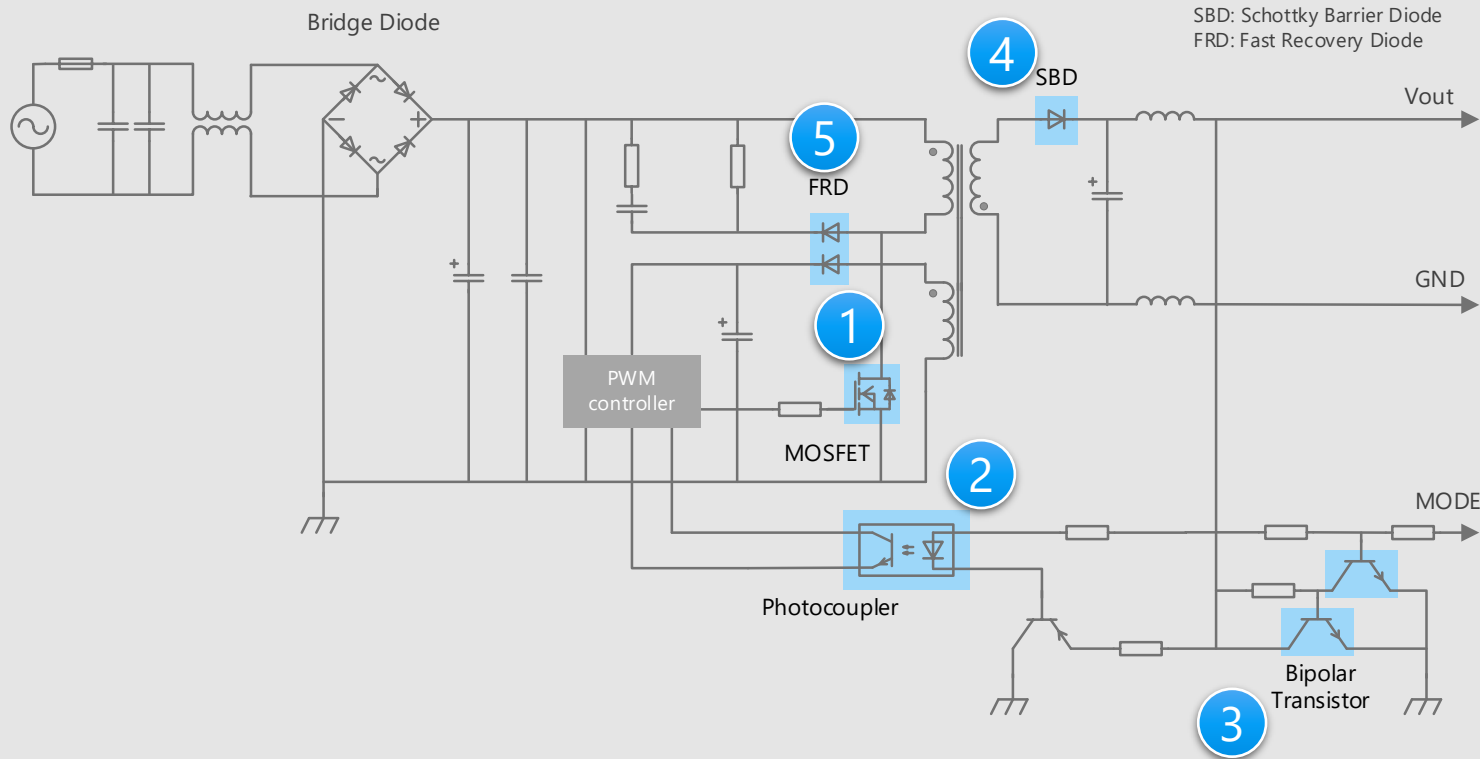
Inkjet Printer Overall block diagram



Note (*)
 ADF: Auto Document Feeder
 PF: Paper Feed
 ASF: Auto Sheet Feeder
 CR: Carriage Return
 LF: Line Feed

Inkjet Printer Detail of the power supply circuit

Power supply circuit



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

Criteria for device selection

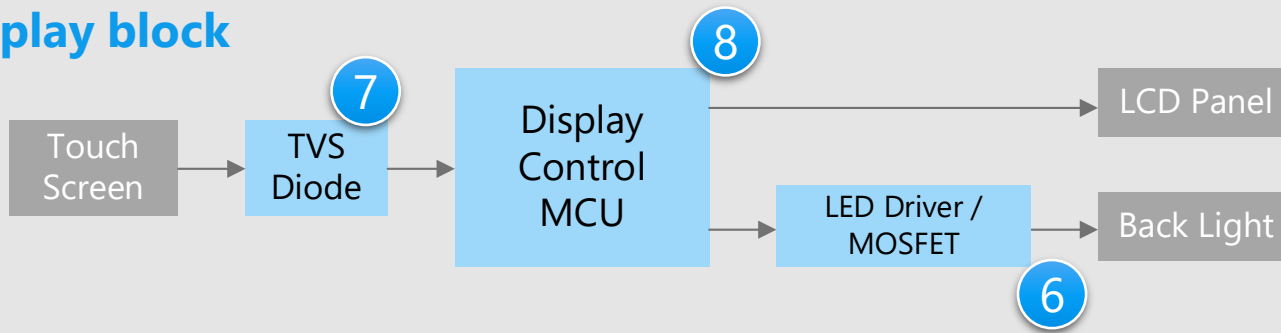
- Transistor output photocoupler is suitable for isolation of feedback signal from the secondary side.
- By using a MOSFET with low on-resistance and high heat dissipation efficiency, a set having low heat generation and low power consumption is realized.
- Small package products contribute to the reduction of circuit board area.

Proposals from Toshiba

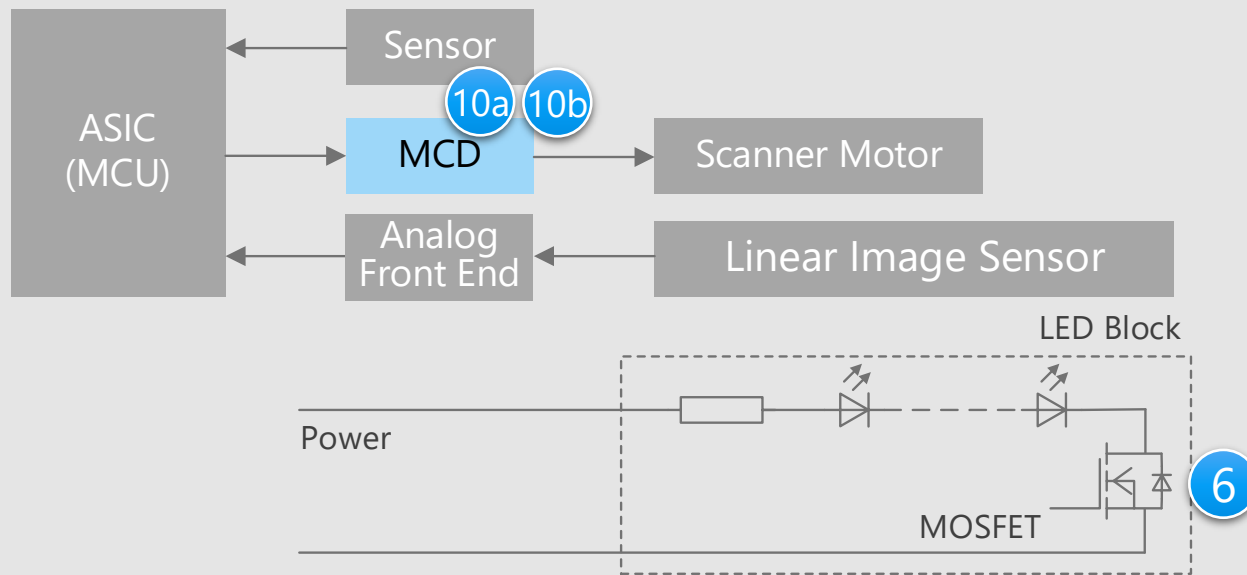
- **Suitable for high efficiency power supply switching**
π-MOS Series MOSFET 1
- **Photocoupler with excellent environmental resistance**
Transistor output photocoupler 2
- **For high speed switching and compact surface mounting**
Bipolar transistor 3
- **High speed, low loss**
Schottky barrier diode 4
- **High reverse voltage and short reverse recovery time**
Fast recovery diode 5

Inkjet Printer Detail of display / scanner block

Display block



Scanner block



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

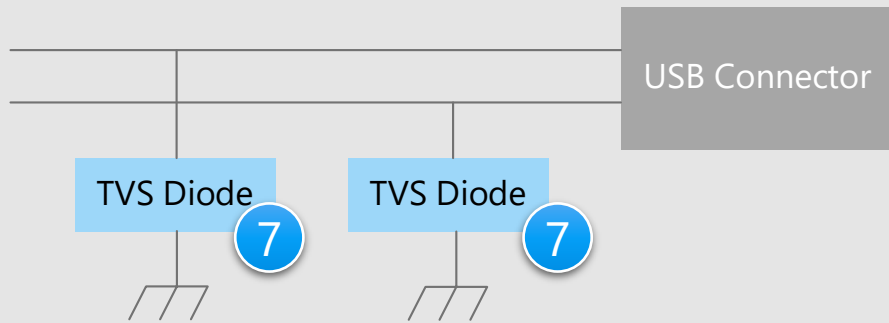
Criteria for device selection

- Small package products contribute to the reduction of circuit board area.
- TVS diodes are suitable for absorbing the static electricity from external terminals to prevent circuit malfunction and device breakdown.
- Document scanning requires fine control of the light source.

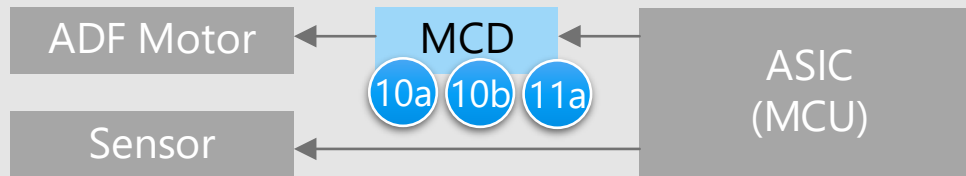
Proposals from Toshiba

- **Realizes low on-resistance and low power consumption set**
Small signal MOSFET 6
- **High speed signal line protection with low capacitance characteristics**
TVS diode 7
- **All in one chip with a built-in LCD driver**
MCU TPM061FWFG 8
- **High precision current control for a scanner**
Stepping motor driver 10a 10b

USB circuit



ADF block



Criteria for device selection

- Small package products contribute to the reduction of circuit board area.
- TVS diodes are suitable for absorbing the static electricity from external terminals to prevent circuit malfunction and device breakdown.
- Document feeding requires fine control.

Proposals from Toshiba

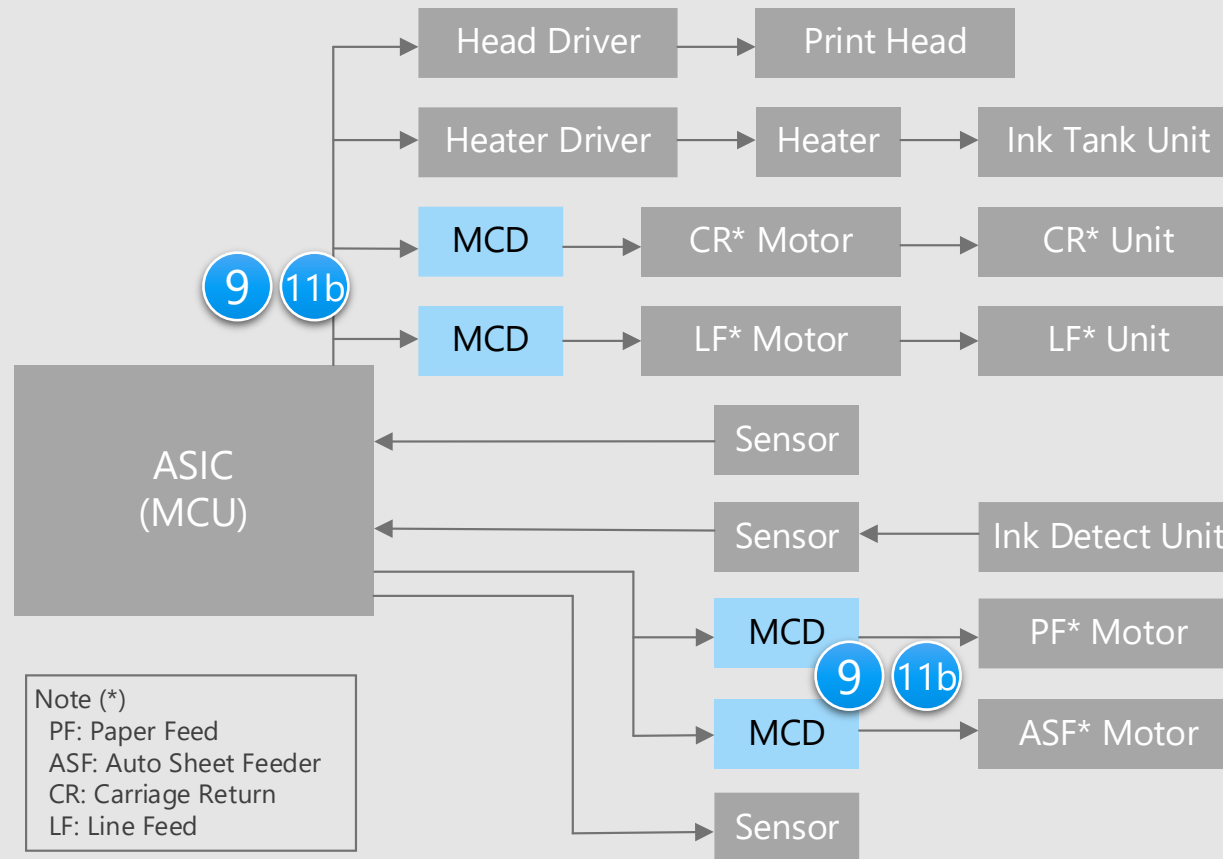
- **High speed signal line protection with low capacitance characteristics**
TVS diode
- **High precision current control for ADF**
Stepping motor driver
Brushed DC motor driver



* [Click the number in the circuit diagram to jump to the detailed description page](#)

Inkjet Printer Detail of print engine block

Print engine block



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

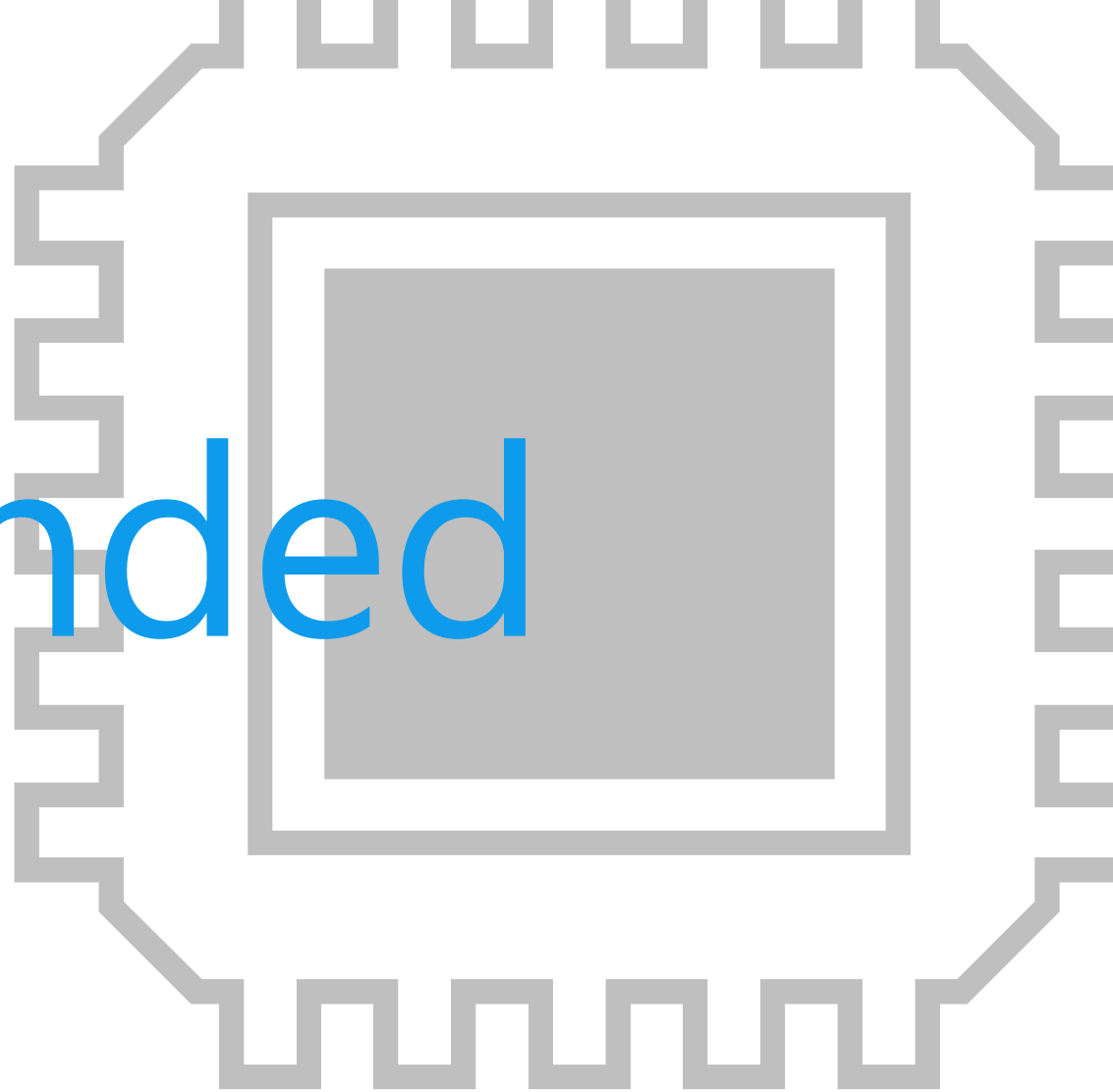
Criteria for device selection

- Feeding printing a document and a paper requires high precision paper position control.

Proposals from Toshiba

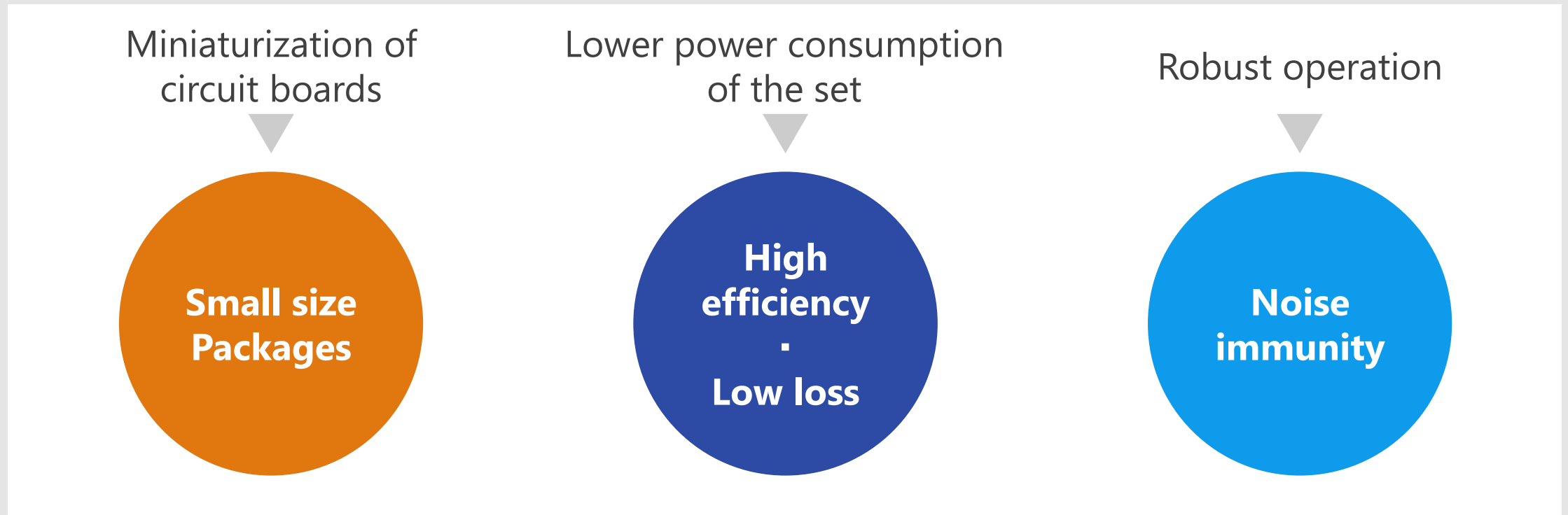
- **Positioning sorter and sheet with high accuracy**
Stepping motor driver with a built-in AGC
Brushed DC motor driver

Recommended Devices



Device solutions to address customer needs

As described above, in the design of Inkjet Printer, "**Miniaturization of circuit boards**", "**Low power consumption of 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

	Small size Packages	High efficiency · Low loss	Noise immunity
① π-MOS Series MOSFET	●	●	
② Transistor output photocoupler	●	●	●
③ Bipolar transistor	●	●	
④ Schottky barrier diode	●	●	●
⑤ Fast recovery diode	●	●	
⑥ Small signal MOSFET	●	●	
⑦ TVS diode	●		●
⑧ MCU <small>TMPM061FWFG</small>	●	●	
⑨ Stepping motor driver with a built-in AGC	●	●	
⑩a ⑩b Stepping motor driver	●	●	
⑪a ⑪b Brushed DC motor driver	●	●	

Value provided

This MOSFET is suitable for switching regulators and is easy to handle and contributes to miniaturization.

1 Low on-resistance

By keeping the on-resistance between the drain and source low, heat generation and power consumption can be kept low.

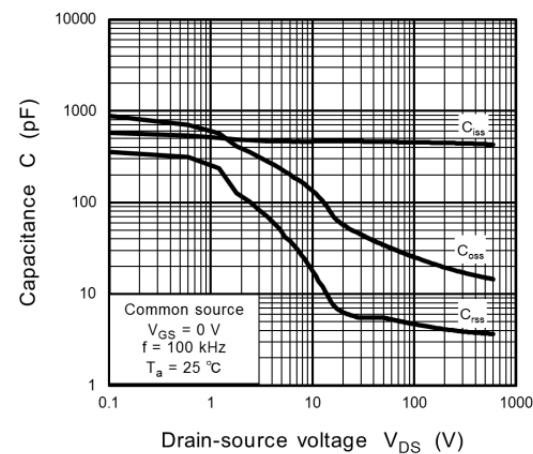
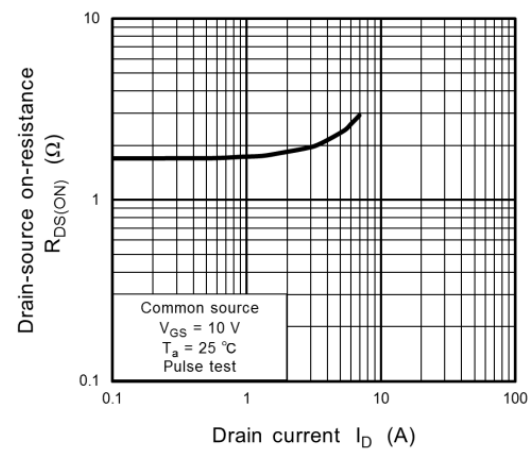
2 Low leakage current

Drain cut-off current $I_{DSS} = 10 \mu\text{A}$ (Max)
($V_{DS} = 600 \text{ V}$)


3 Enhancement type

It is easy to handle because it is an enhancement type in which no collector current flows when no gate voltage is applied.

TK2K2A60F Characteristics Curves



Lineup

Part number	TK2K2A60F	
Package	TO-220SIS	
V_{DSS} [V]	600	
I_D [A]	3.5	
C_{iss} (Typ.) [pF]	450	
$R_{DS(ON)}$ [Ω]	Typ.	1.82
	Max	2.2
Polarity	N-ch	

[Return to Block Diagram TOP](#)

2 Transistor output photocoupler

TLP383 / TLP385 / TLP387 / TLP388

Small size Packages

High efficiency
Low loss

Noise immunity

Value provided

Reduction in required circuit board area and improving reliability enabling maintenance-free operation.

1 High isolation voltage is realized even using compact and thin package

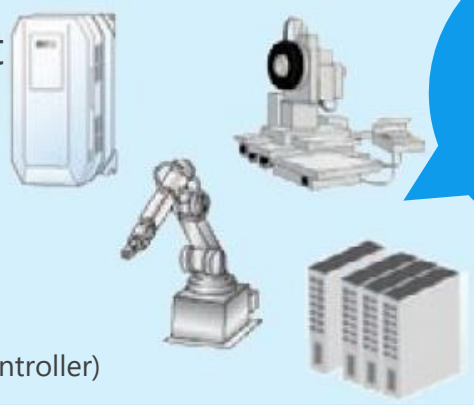
It is a highly isolated photocoupler that phototransistors and infrared light emitting diodes are optically coupled, and achieved a high isolation voltage of 5000 Vrms. In addition, since the SO6L package is smaller and thinner than Toshiba standard DIP package, high density mounting is possible.

2 Operating temperature is expanded to 110 °C or 125 °C

It is designed to operate even under severe ambient temperature conditions, such as inverters, robots, machinery and high output power supplies.


Industrial equipment

- General purpose inverter
- Servo amplifier
- Robot
- Machine Tool
- High output power supply
- Security equipment
- Semiconductor tester
- PLC (Programmable Logic Controller)
- MFP (Multi Function Printer)



High level of isolation and noise blocking

Lineup

Part number	TLP383	TLP385	TLP387	TLP388
Package	4pin SO6L 			
V _{CEO} [V]	80	80	300	350
BV _S [Vrms]	5000	5000	5000	5000
T _{opr} [°C]	-55 to 125	-55 to 110	-55 to 110	-55 to 125

[Return to Block Diagram TOP](#)

Value provided

It is suitable for low frequency and low noise applications and covers a wide range of applications.

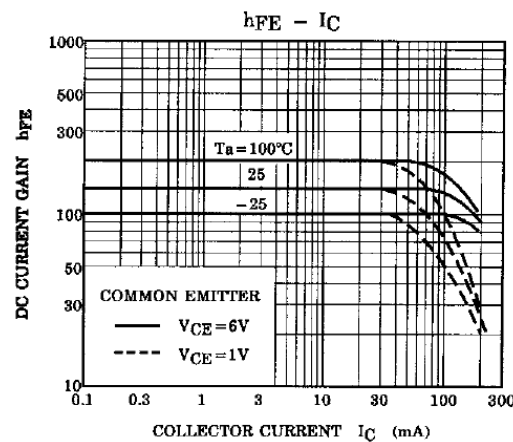
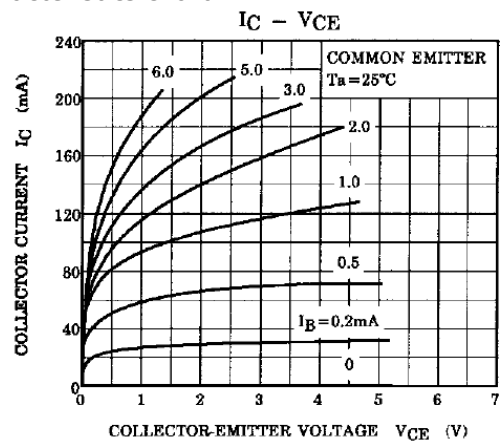
1 High voltage

High voltage allows for large loads and instantaneous voltage changes.


2 Large current (rated collector current)

It covers a wide range of applications, from low frequency applications to power supply applications.

TMBT3904
Characteristics chart



Lineup

Part number	TMBT3904
Package	SOT23 
V _{CEO} [V]	50
I _C [mA]	200
V _{CE(sat)} (Max) [V]	0.3 @ I _C = 50 mA, I _B = 5 mA
h _{FE}	100 to 300 @ V _{CE} = 1 V, I _C = 10 mA
Polarity	NPN

[Return to Block Diagram TOP](#)

4 Schottky barrier diode

CMS15 / CUHS20F60

Small size
Packages

High
efficiency
·
Low loss

Noise
immunity

Value provided

It is suitable for high frequency rectification of switching power supplies and contributes to miniaturization.

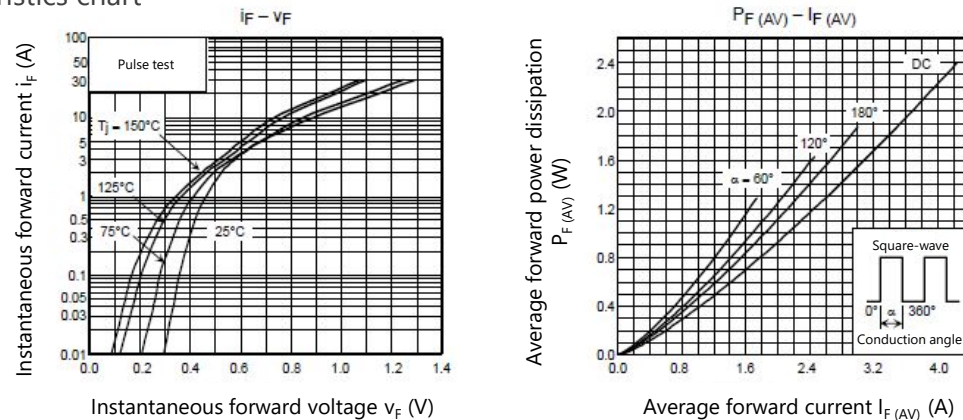
1 High speed switching

It is suitable for high speed switching applications.



2 Small package

This small package is suitable for high density mounting.

CMS15
Characteristics chart



Lineup

Part number	CMS15	CUHS20F60
Package	 M-FLAT™	 US2H
V_{RRM} / V_R [V]	60	60
$I_{F(AV)} / I_O$ [A]	3.0	2.0
V_{FM} / V_F (Max) [V]	0.58 @ $I_{FM} = 3.0$ A	0.59 @ $I_F = 2.0$ A
C_j (Typ.) [pF]	102	300

[Return to Block Diagram TOP](#)

5 Fast recovery diode

CRF03A

Small size
Packages

High
efficiency
·
Low loss

Noise
immunity

Value provided

This is a silicon diffusion matching type high frequency rectifier diode. Contributes to high efficiency and miniaturization of power supplies.

1 High reverse voltage

Repetitive peak reverse voltage (V_{RRM}) is high.
(CRF03A: Rated 600 V)

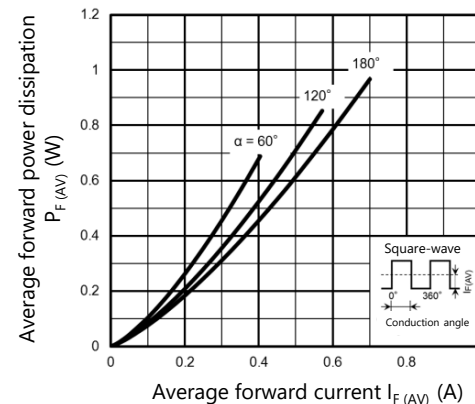
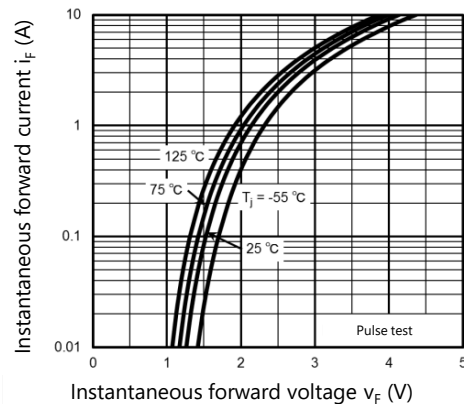
2 Fast reverse recovery time

The reverse recovery time (t_{rr}) is fast and is suitable for high speed operation.
(CRF03A: Up to 100 ns)


3 Small package

This small package is suitable for high density mounting.

CRF03A
Characteristics chart



Lineup

Part number	CRF03A
Package	S-FLAT™ 
V_{RRM} [V]	600
$I_{F(AV)}$ [A]	0.7
V_{FM} (Max) [V]	2.0 @ $I_{FM} = 0.7$ A
I_{RRM} (Max) [μ A]	50

[Return to Block Diagram TOP](#)

Value provided

It is suitable for high speed switches and contributes to miniaturization.

1 Low voltage operation

Operate down to $|V_{GS}| = 1.2\text{ V}$.

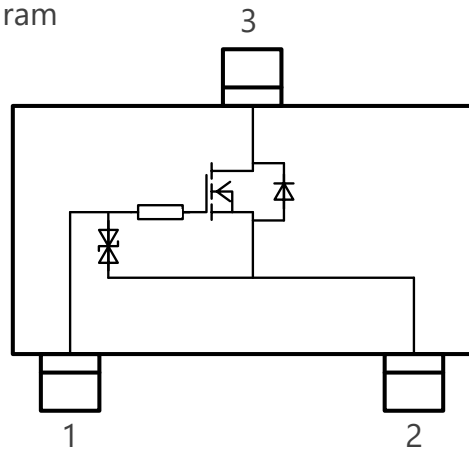
2 Low on-resistance

By keeping the on-resistance between the drain and source low, heat generation and power consumption can be kept low.

3 Wide package lineup

In addition to SSM packages, we have CST3C packages, VESM packages, ES6 packages and US6 packages.

SSM3K35FS
Internal connection diagram



Lineup					
Part number	SSM3K35FS	SSM3K35AFS	SSM3J35FS	SSM3J35AFS	
Package	SSM	SSM	SSM	SSM	
V_{DSS} [V]	20	20	-20	-20	
I_D [A]	0.18	0.25	-0.1	-0.25	
$R_{DS(ON)}$ [Ω] @ $ V_{GS} = 2.5\text{ V}$	Typ.	2	1.1	5.6	1.5
	Max	4	1.6	11	2.1
Polarity	N-ch	N-ch	P-ch	P-ch	

[Return to Block Diagram TOP](#)

Value provided

This absorbs static electricity from external terminals, prevents circuit malfunction and protects devices.

1 Improved ESD pulse absorption

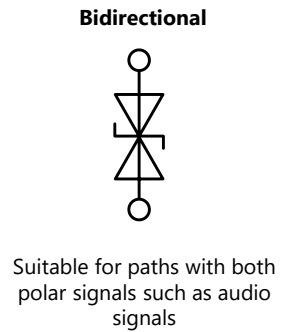
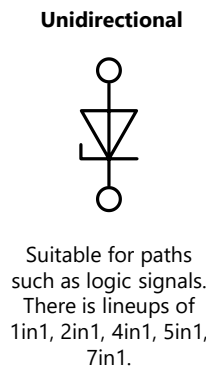
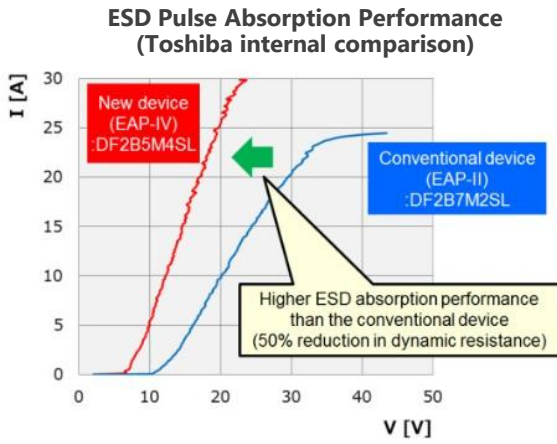
We have improved the absorbency of ESD compared to Toshiba conventional products (50 % reduction in operating resistance). It achieves both low operating resistance and low capacitance, and ensures high signal protection performance and signal quality.

2 Suppress ESD energy by low clamp voltage

TVS diodes protect connected circuits and devices by adopting proprietary technology.

3 Suitable for high density mounting

Small size package is suitable for high density mounting.



Lineup					
Part number	DF2B5M4ASL	DF2B6M4ASL	DF2B6USL	DF6D6UFE	DF2B6M4BSL
Package	SL2	SL2	SL2	ES6	SL2
V_{ESD} [kV]	±16	±15	±10	±10	±8
V_{RWM} (Max) [V]	3.6	5.5	5.5	5.5	5.5
C_t (Typ.) [pF]	0.15	0.15	1.5	1.5	0.12
R_{DYN} (Typ.) [Ω]	0.7	0.7	0.25	0.25	1.05

(NOTE) This product is an ESD protection diode and cannot be used for purposes other than ESD protection.

[Return to Block Diagram TOP](#)

Value provided

System cost down, high efficiency system, development efficiency improvement

1 Built-in Arm® Cortex®-M0 CPU core

Built-in Arm Cortex-M0 core with Thumb® instruction set improves energy efficiency. Various development tool and their partners allow users many options.

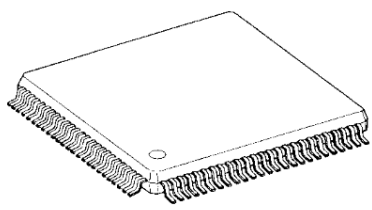
2 Suitable for sensing analog signal

Built-in multichannel AD converter and CPU system executes sensing data processing efficiently at low cost.

3 Small package and low power consumption

Cortex-M0 and original NANOFFLASH™ technology bring to the small package and low power consumption. They contribute to reduction of board area and power consumption.

TMPM061FWFG



Package: LQFP100-P-1414-0.50G

Lineup

Part number	TMPM061FWFG
Maximum operation frequency	16 MHz
Instruction ROM	128 KB
RAM	8 KB
Timer	9ch
UART/SIO	4ch
AD converter	2ch (10bit), 3ch (24bit)
LCDD	40 seg x 4 com

[Return to Block Diagram TOP](#)

Value provided

Motor current is optimized in real time by using built-in AGC (Active Gain Control).

1 High voltage (50 V)

The maximum rated voltage of these products is 50 V, it can be used in a supply of 12 to 36 V with sufficient margin.

2 Step-out prevention and high efficiency control using AGC

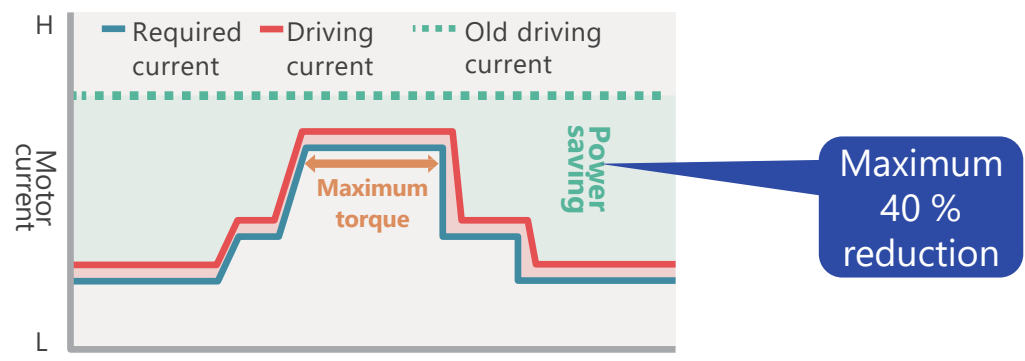
By detecting the motor load torque with just the driver IC and automatically optimizing the current according to the drive condition, step-out avoidance and highly efficient motor control are possible.

3 ADMD (Advanced Dynamic Mixed Decay) realizes high-efficiency operation at high rpm.

Toshiba's original ADMD technology tracks input current more closely than the conventional mixed decay mode ^[Note 1], making highly efficient motor control possible at high rpm.

[Note 1] Comparison with our products

Active Gain Control



[Note 2] Toshiba internal comparison

Lineup			
Part number		TB67S128FTG	TB67S289FTG
Absolute maximum ratings	Output voltage [V]	50	
	Output current [A]	5.0	3.0
Output ON-resistance (H+L) (Typ.) [Ω]		0.25	0.4
Control interface		Clock / Serial	Clock
Step		1/1, 1/2, 1/4, 1/8, 1/16, 1/32, 1/64, 1/128	1/1, 1/2, 1/4, 1/8, 1/16, 1/32
Features		ADMD (high efficiency control)	ACDS (without current sense resistor)
Error detection function		Thermal shutdown (TSD), over current detection (ISD), power-on-reset (POR), motor load open (OPD)	
Package		P-VQFN64-0909-0.50-006	P-VQFN48-0707-0.50-004

[Return to Block Diagram TOP](#)

Value provided

The maximum voltage rating of 40 V. Standard stepping motor drivers with a small package

1 High voltage and current

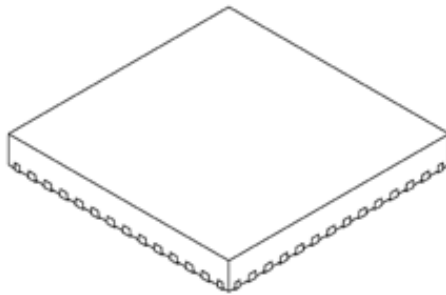
The maximum rated voltage of these products is 40 V, and the maximum rated current is 2 or 2.8 A. Low on-resistance contributes low power consumption and low heat.

2 Small size and high heat dissipation

The package uses a high heat dissipation QFN with an E-Pad on the bottom. Heat is dissipated by connecting the E-Pad part to the board GND. It also contributes to the reduction of board area.

3 Error detection functions

Over current detection (ISD), thermal shutdown (TSD) and power on reset (POR) are available for safe motor driving.



Package: P-WQFN36-0606-0.50-002
(6 x 6 mm)

Lineup

Part number		TB67S511FTAG	TB67S512FTAG	TB67S521FTAG	TB67S522FTAG
Absolute maximum ratings	Output voltage [V]	40			
	Output current [A]	2.0		2.8	
Output ON-resistance (H+L) (Typ.) [Ω]		0.8		0.53	
Driving type		PWM constant current drive			
Excitation mode		full, half and quarter step resolutions			
Control interface		Phase	Clock	Phase	Clock
Error detection function		Thermal shut down (TSD), over current (ISD), power on reset (POR)			
Package		P-WQFN36-0606-0.50-002			

[◆Return to Block Diagram TOP](#)

Value provided

The maximum voltage rating of 40 V. Standard stepping motor drivers with a small package

1 High voltage and current

The maximum rated voltage of these products is 40 V, and the maximum rated current is 2 or 1.5 A. Low on-resistance contributes low power consumption and low heat.

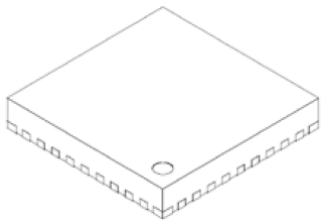
2 Small size and high heat dissipation

The package uses a high heat dissipation QFN with an E-Pad on the bottom. Heat is dissipated by connecting the E-Pad part to the board GND. It also contributes to the reduction of board area.

3 Error detection functions

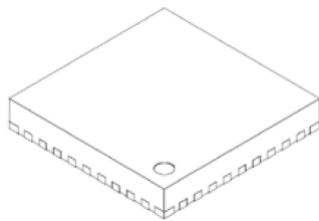
Over current detection (ISD), thermal shut down (TSD) and under voltage lockout (UVLO) are available for safe motor driving.

TB67S539FTG



Package: P-VQFN32-0505-0.50-004
(5 x 5 mm)

TB67S549FTG



Package: P-VQFN24-0404-0.50-004
(4 x 4 mm)

Lineup

Part number		TB67S539FTG	TB67S549FTG
Absolute maximum ratings	Output voltage [V]	40	40
	Output current [A]	2.0	1.5
Output ON-resistance (H+L) (Typ.) [Ω]		0.8	1.2
Driving type		PWM constant current drive	
Excitation mode		full, half, quarter, 1/8, 1/16 and 1/32 step resolutions	
Control interface		Clock	
Error detection function		Thermal shut down (TSD), over current (ISD), low voltage (UVLO)	
Package		P-VQFN32-0505-0.50-004	P-VQFN24-0404-0.50-004

[◆Return to Block Diagram TOP](#)

Value provided

High voltage, high current and low power consumption with BiCD process. Simple single channel version.

1 High voltage (50 V)/ High current

Maximum rating of the output voltage is improved from 40 to 50 V to allow margin for air discharge test, etc.

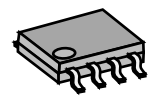
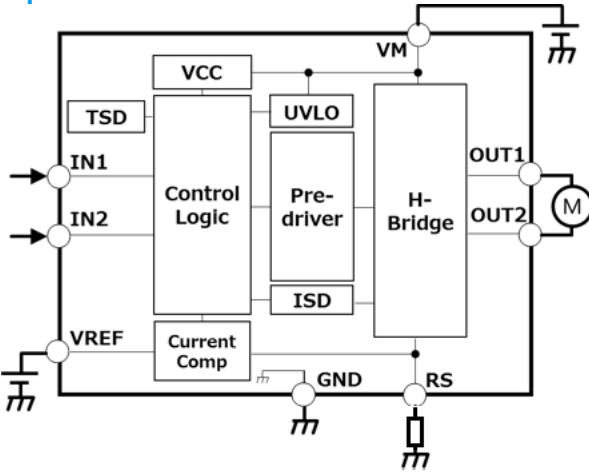
2 Wide operation voltage range

Wide power supply voltage range from 4.5 to 44 V supports battery driven applications.

3 Mature package

Adopting HSOP8 package compatible with competitor's products or Toshiba conventional products.

Simple solution



P-HSOP8-0405-1.27-002
(4.9 x 6.0 mm)

Lineup		
Part number	TB67H450AFNG	TB67H451AFNG
Motor type	Brushed DC motor	
Absolute maximum ratings	Output voltage [V]	50
	Output current [A]	3.5
Output ON-resistance (H+L) (Typ.) [Ω]	0.6	
Output circuit	1ch	
Error detection function	Thermal shut down (TSD), over current (ISD), low voltage (UVLO)	
Package	P-HSOP8-0405-1.27-002	

[Return to Block Diagram TOP](#)

Value provided

High voltage, high current with BiCD process. More selection supports higher current driving.

1 High voltage (50 V)/ High current

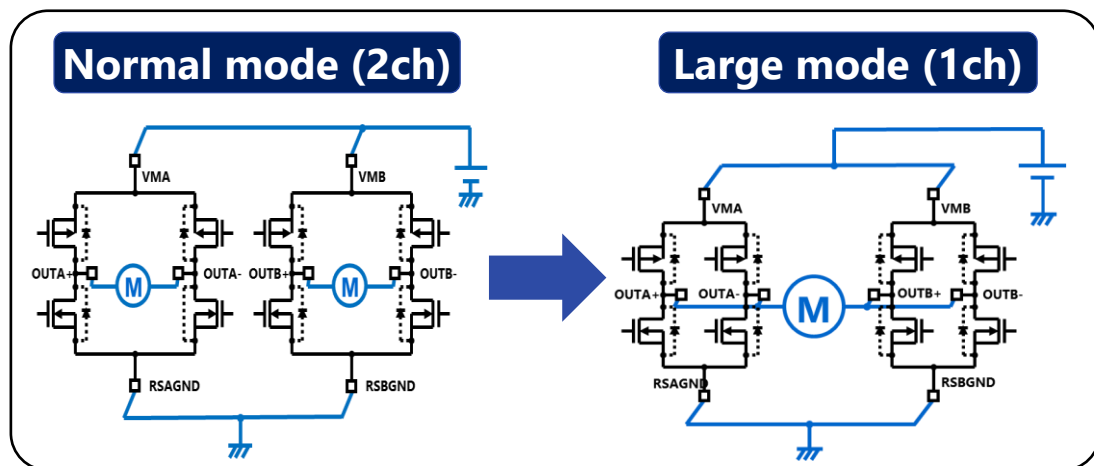
Maximum rating of the output voltage is improved from 40 to 50 V to allow margin for air discharge test, etc.

2 Wide operation voltage range

Wide operation voltage range from 10 to 47 V supports battery driven applications.

3 High current drive

Built-in 2ch of H-bridge circuit can drive two brushed DC motors or a single brushed motor by using large mode which obtains two times current.



Lineup

Part number		TB67H400AFTG	TB67H410FTG	TB67H420FTG
Motor type		Brushed DC motor		
Absolute maximum ratings	Output voltage [V]	50		
	Output current (Normal) [A]	4.0	2.5	4.5
	Output current (Large) [A]	8.0	5.0	9.0
Output ON-resistance (Normal) (H+L) [Ω]		0.49	0.8	0.33
Error detection function		TSD, ISD, POR*		TSD, ISD, POR, OPD*
Package		P-WQFN48-0707-0.50-003		P-VQFN48-0707-0.50-004

* Thermal shutdown (TSD), over current detection (ISD), power-on-reset (POR), motor load open (OPD)

[Return to Block Diagram TOP](#)

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