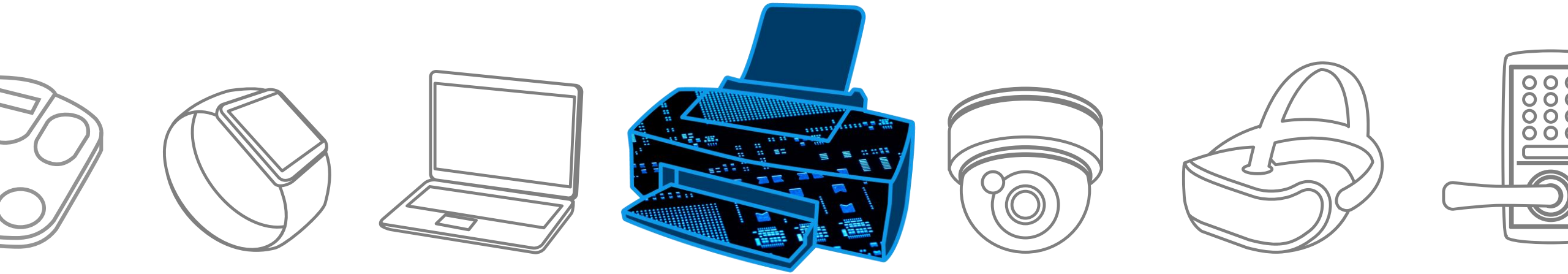
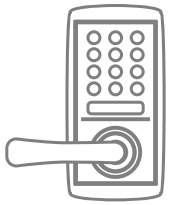
TOSHIBA

R2

Inkjet Printer

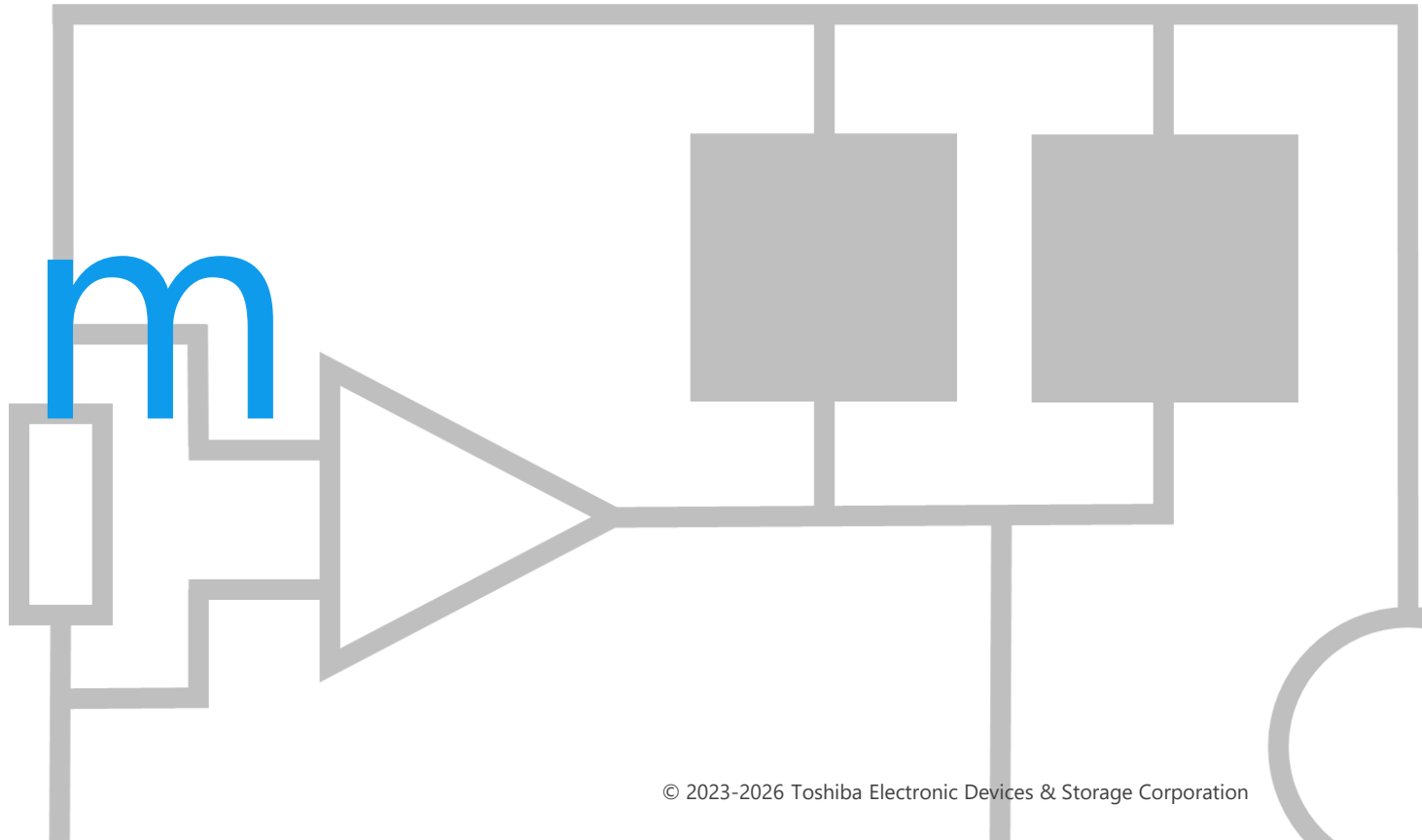
Solution Proposal by Toshiba



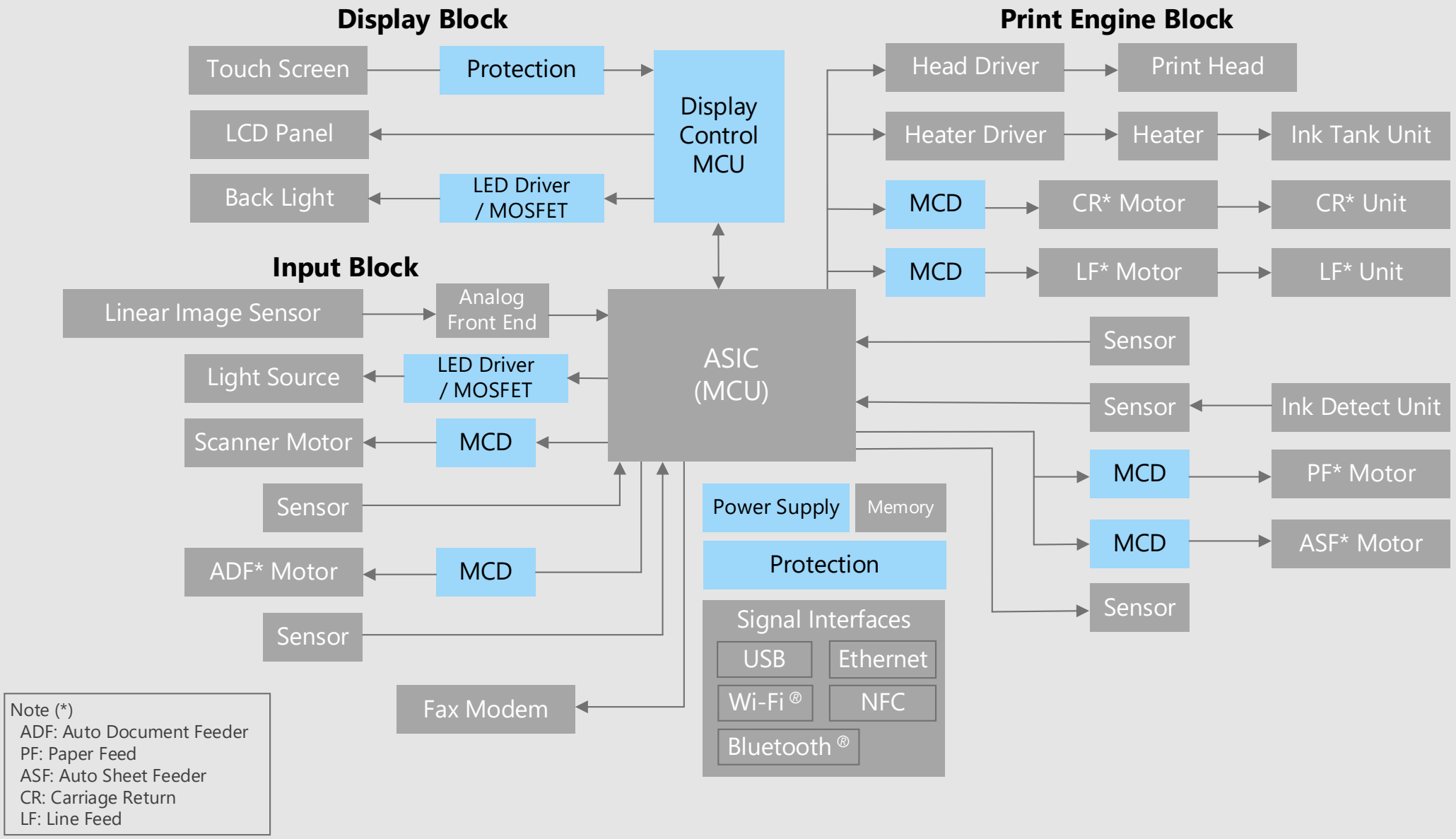


Toshiba Electronic Devices & Storage Corporation provides comprehensive device solutions to customers developing new products by applying its thorough understanding of the systems acquired through the analysis of basic product designs.

Block Diagram

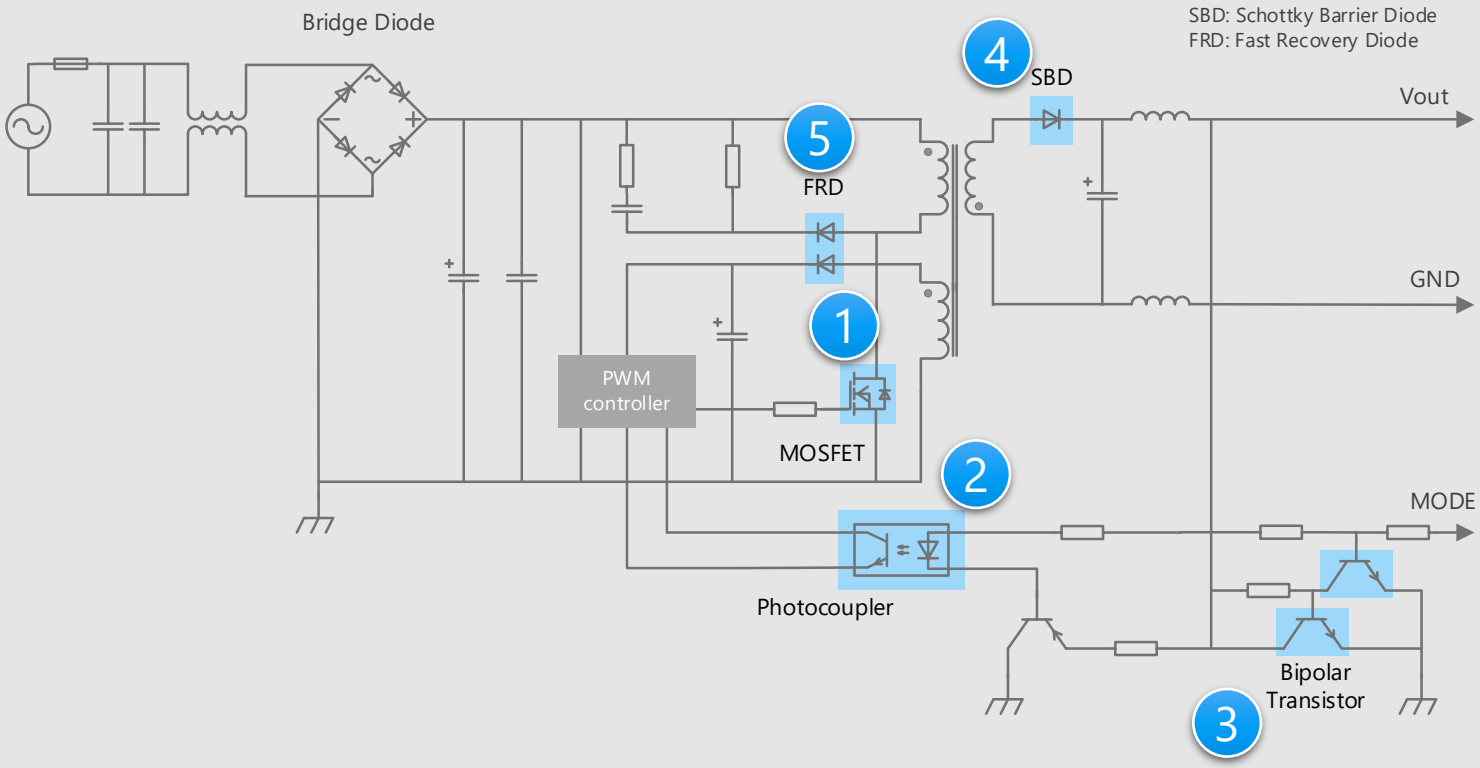


Inkjet Printer　Overall block diagram



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

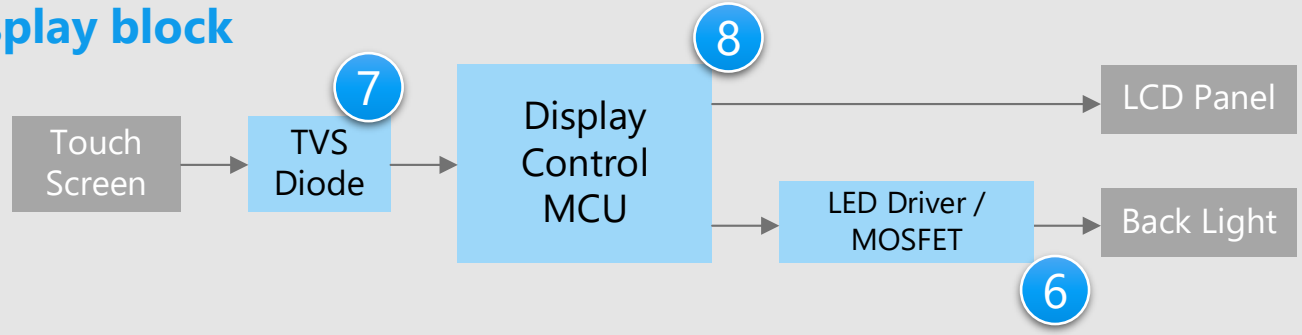
- Transistor output photocoupler is suitable for isolation of feedback signal from the secondary side.
- By using a MOSFET with low on-resistance and high heat dissipation efficiency, a set having low heat generation and low power consumption is realized.
- Small package products contribute to the reduction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

Proposals from Toshiba

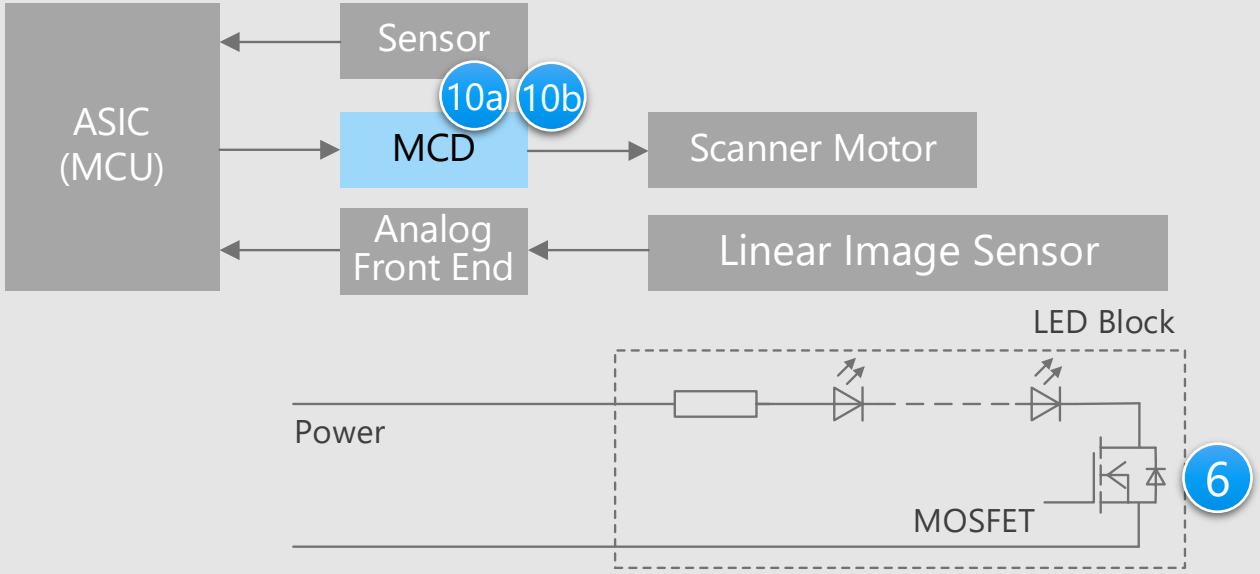
- **Suitable for high efficiency power supply switching** 1
  π-MOS Series MOSFET
- **Photocoupler with excellent environmental resistance** 2
  Transistor output photocoupler
- **For high speed switching and compact surface mounting** 3
  Bipolar transistor
- **High speed, low loss** 4
  Schottky barrier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

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

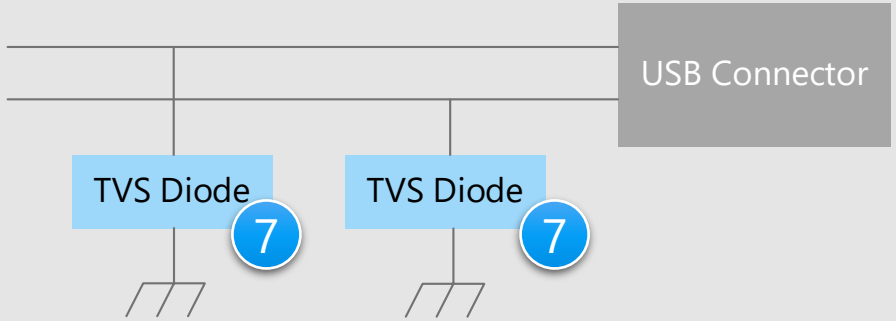
- Small package products contribute to the reduction of circuit board area.
- TVS diodes are suitable for absorbing the static electricity (ESD) from external terminals to prevent circuit malfunction and device breakdown.
- Document scanning requires fine control of the light source.

Proposals from Toshiba

- **Realizes low on-resistance and low power consumption set** 6
  Small signal MOSFET
- **High speed signal line protection with low capacitance characteristics** 7
  TVS diode
- **All in one chip with a built-in LCD driver** 8
  MCU TMPM061FWFG
- **High precision current control for a scanner** 10a 10b
  Stepping motor driver

Inkjet Printer　Detail of USB / ADF block

USB circuit



ADF (Auto Document Feeder) 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 (ESD) from external terminals to prevent circuit malfunction and device breakdown.
- Document feeding requires fine control.

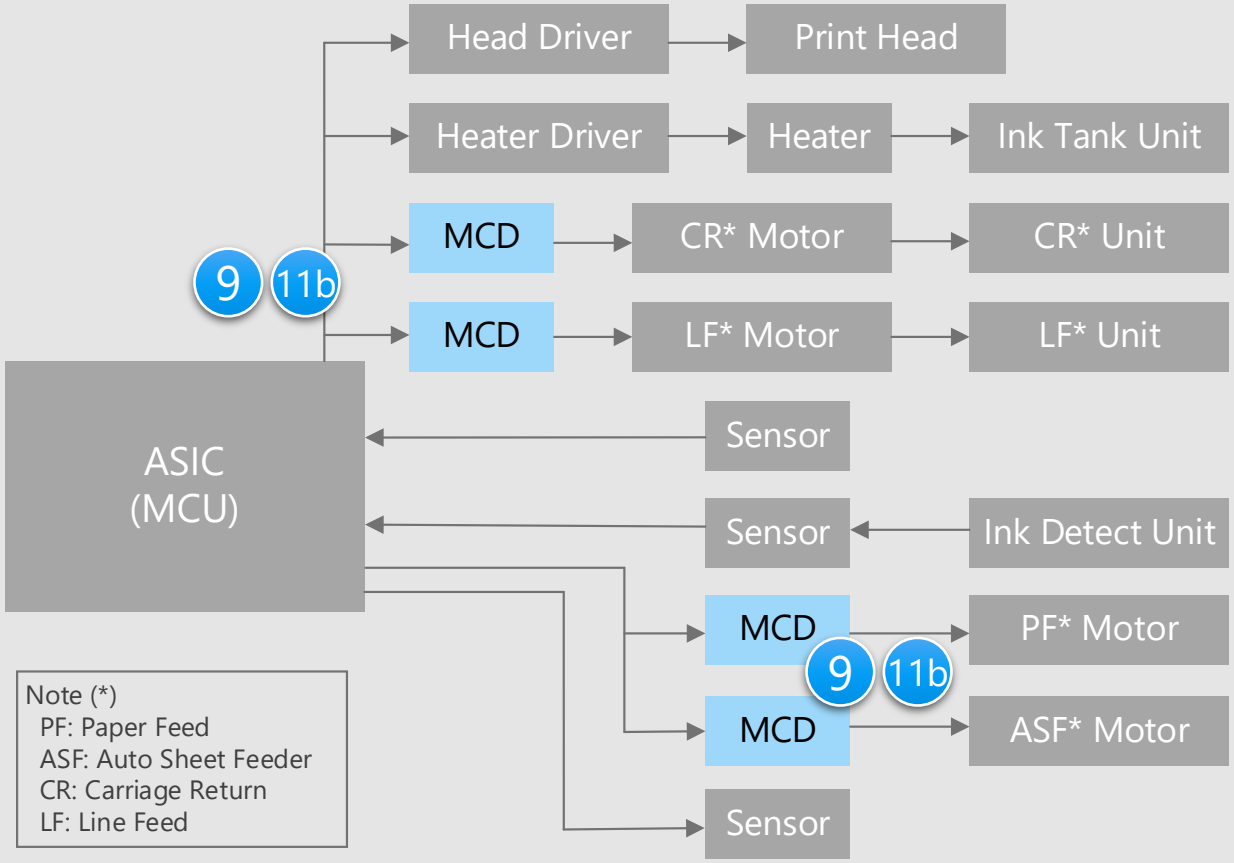
Proposals from Toshiba

- **High speed signal line protection with low capacitance characteristics**
  TVS diode
- **High precision current control for ADF**
  Stepping motor driver
  1ch Brushed DC motor driver

7
10a 10b
11a

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

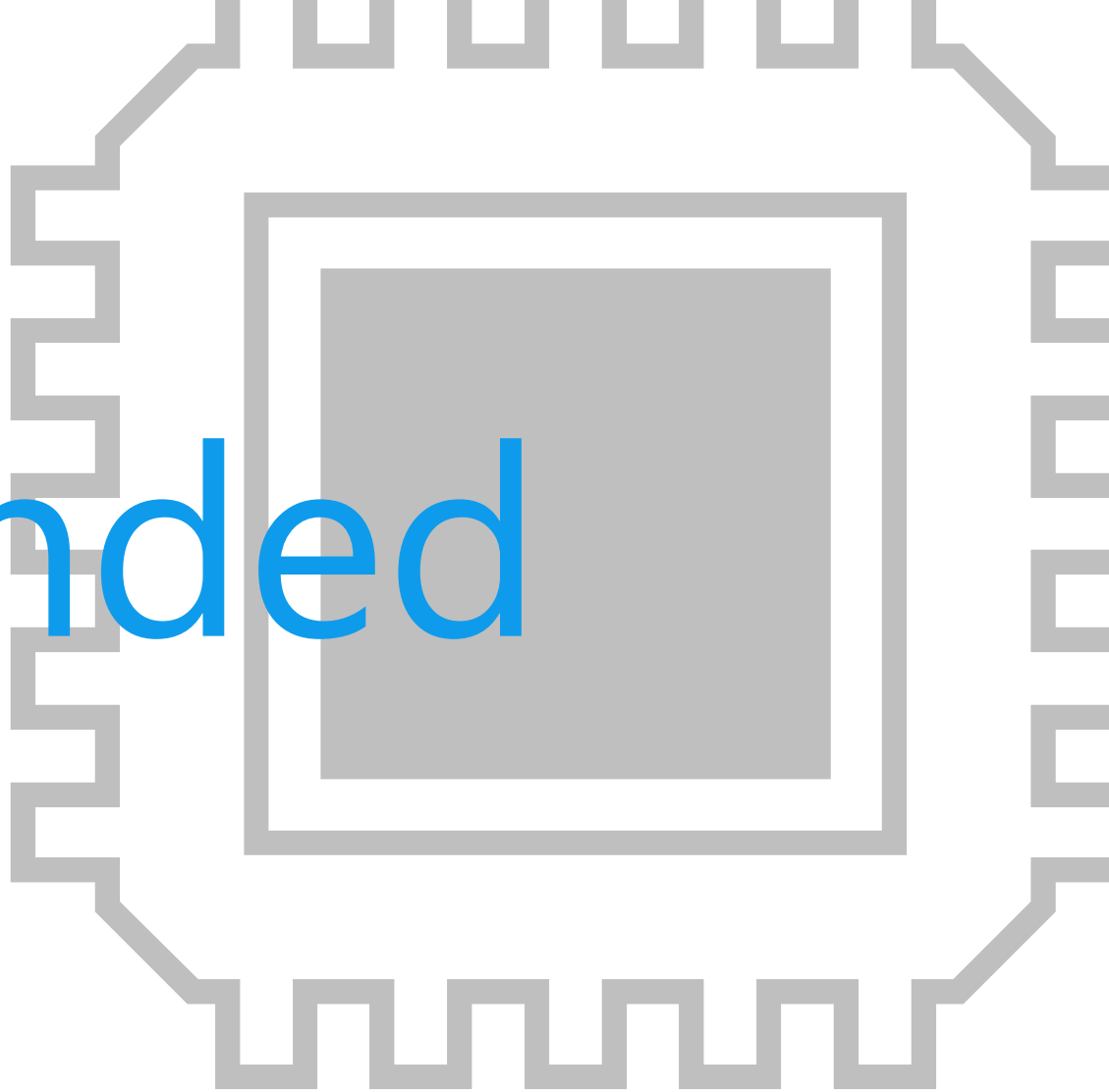
- Feeding printing a document and a paper requires high precision paper position control.

Proposals from Toshiba

- **Positioning sorter and sheet with high accuracy**
  Stepping motor driver with a built-in AGC 2ch Brushed DC motor driver

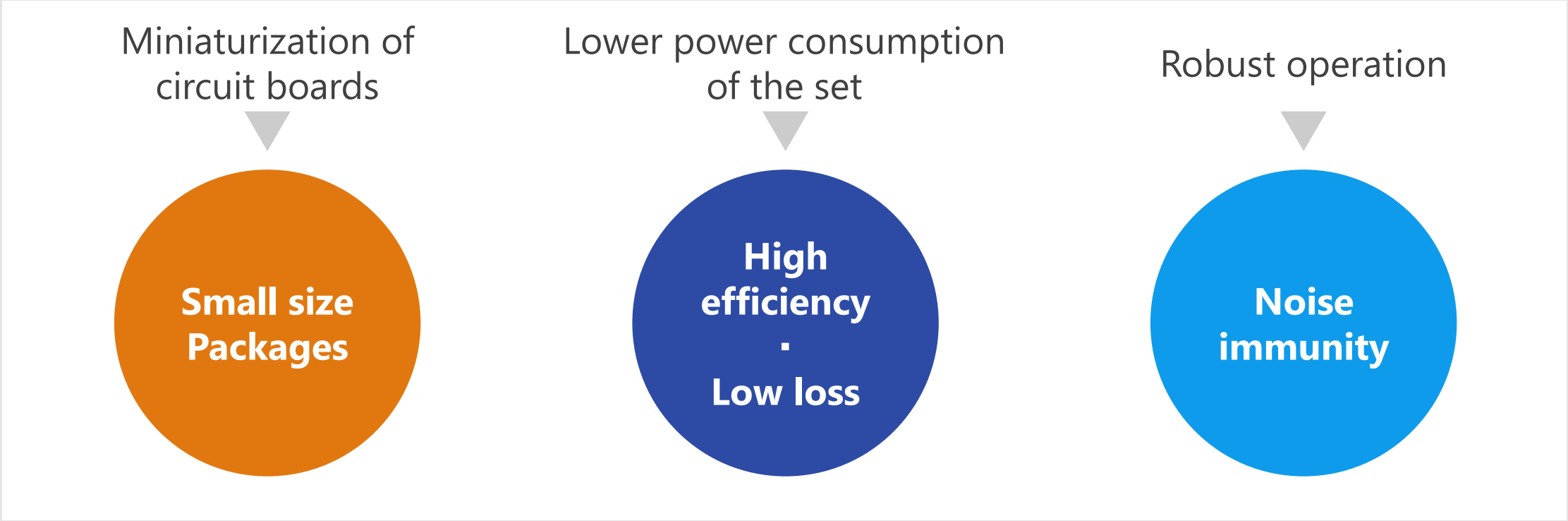
9
11b

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 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 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 TMPM061FWFG	●	●	
9 Stepping motor driver with a built-in AGC	●	●	
10a 10b Stepping motor driver	●	●	
11a 11b Brushed DC motor driver	●	●	

1 π-MOS Series MOSFET

TK2K2A60F

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

Value provided

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

1 Low on-resistance

The on-resistance between the drain and source is low, as a result heat generation and power consumption can be kept low.

2 Low leakage current

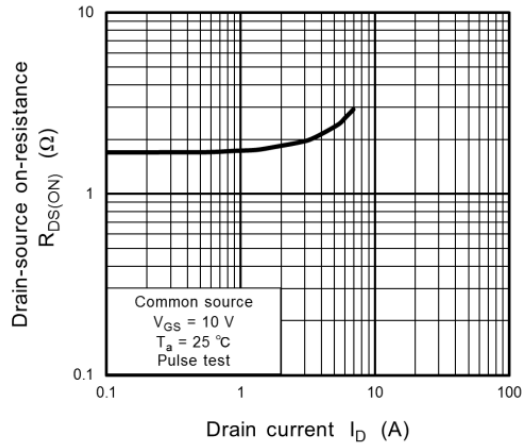
Drain cut-off current:

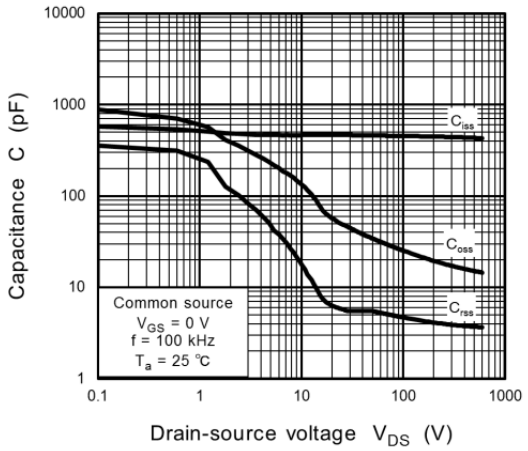
I_{DSS} = 10 μA (Max) @V_{DS} = 600 V

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

These photocoupler have advantages such as 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

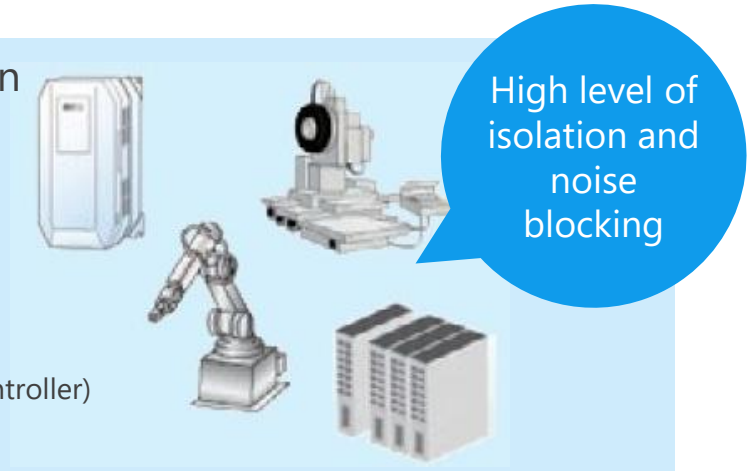
It is a highly isolated photocoupler that phototransistors and infrared light emitting diodes are optically coupled, and achieved a high isolation voltage of 5000 Vrms. In addition, since the SO6L package is smaller and thinner than Toshiba standard DIP package, high density mounting is possible.

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

It is designed to operate even under severe ambient temperature conditions.

Examples of application

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



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

3 Bipolar transistor

TMBT3904

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

Value provided

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

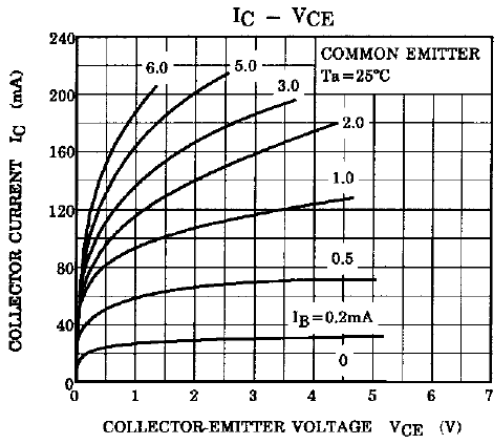
1 High voltage

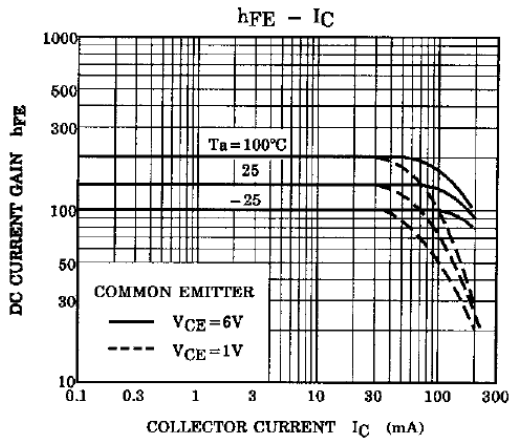
High voltage allows for large loads and instantaneous voltage changes.

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.

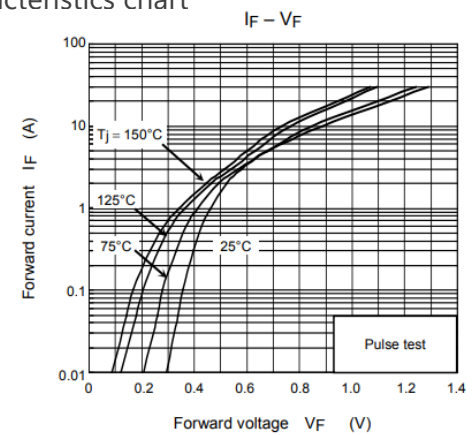
1 High speed switching

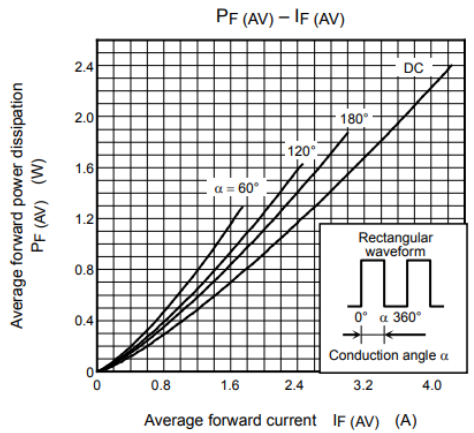
It is suitable for high speed switching applications.

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

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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)

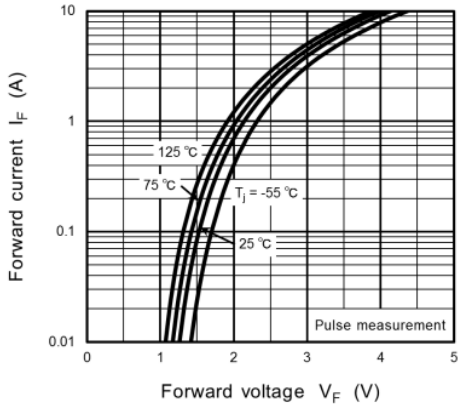
2 Fast reverse recovery time

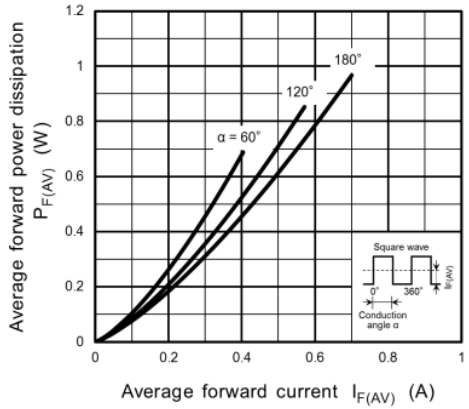
The reverse recovery time (t_{rr}) is fast and is suitable for high speed operation.
(CRF03A: Up to 100 ns)

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) [μA]	50

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6 Small signal MOSFET

SSM3K35FS / SSM3K35AFS / SSM3J35FS / SSM3J35AFS

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

Value provided

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

1 Low voltage operation

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

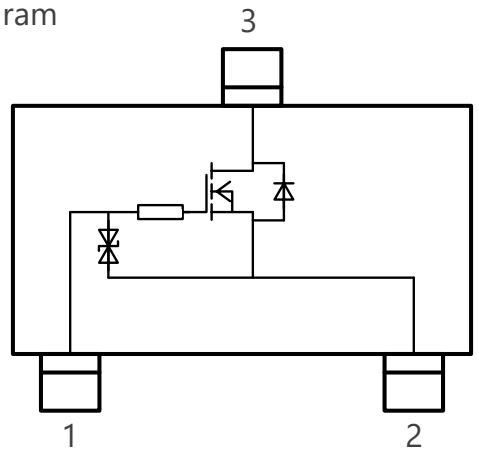
2 Low on-resistance

The on-resistance between the drain and source is low, as a result 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 			
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 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

7 TVS diode

DF2B5M4ASL / DF2B6M4ASL / DF2B6USL / DF6D6UFE / DF2B6M4BSL

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

Value provided

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

1 Improved ESD pulse 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.

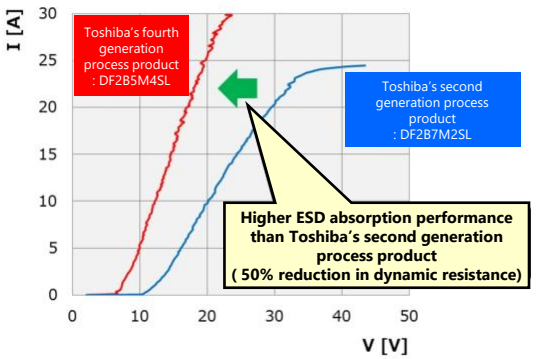
2 Suppress ESD energy by low clamp voltage

Protect the connected circuits and devices using Toshiba own technology.

3 Suitable for high density mounting

A variety of small packages are available.

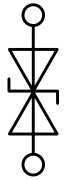
ESD Pulse Absorption Performance
(Toshiba internal comparison)



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	DF2B5M4ASL	DF2B6M4ASL	DF2B6USL	DF6D6UFE	DF2B6M4BSL
Package	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.

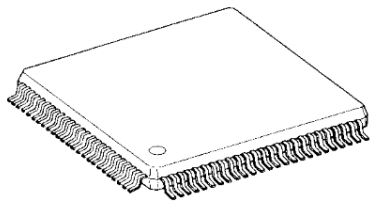
2 Suitable for sensing analog signal

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 Toshiba original NANOFLASH™ 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

9 Stepping motor driver with a built-in AGC

TB67S128FTG / TB67S289FTG

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

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

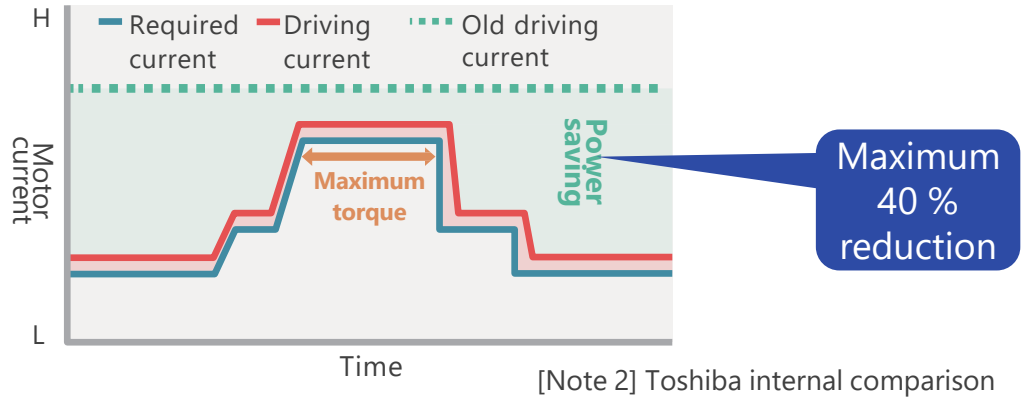
By detecting the motor load torque with just the driver IC and automatically optimizing the current according to the drive condition, step-out avoidance and highly efficient motor control are possible.

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		AGC, ADMD, ACDS (Advanced Current Detection System)	
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

Stepping motor driver

TB67S511FTAG / TB67S512FTAG / TB67S521FTAG / TB67S522FTAG

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

Value provided

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

1 High voltage and current

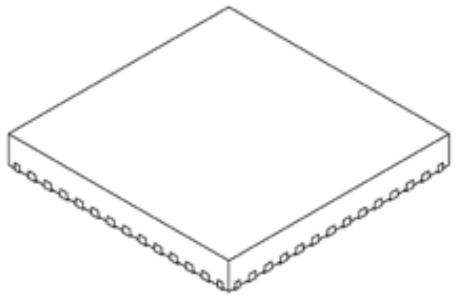
The maximum rated voltage of these products is 40 V, and the maximum rated current is 2 or 2.8 A. Low on-resistance contributes low power consumption and low heat.

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

10b Stepping motor driver

TB67S539FTG / TB67S549FTG

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

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.

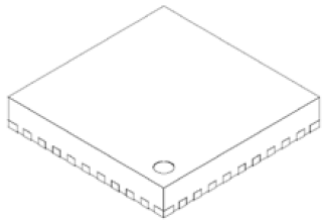
2 Small size and high heat dissipation

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

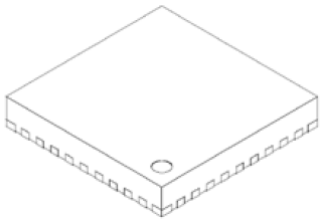
Over current detection (ISD), thermal shut down (TSD) and under voltage lockout (UVLO) are available for safe motor driving.

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

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11a 1ch brushed DC motor driver

TB67H450AFNG / TB67H451AFNG

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

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.

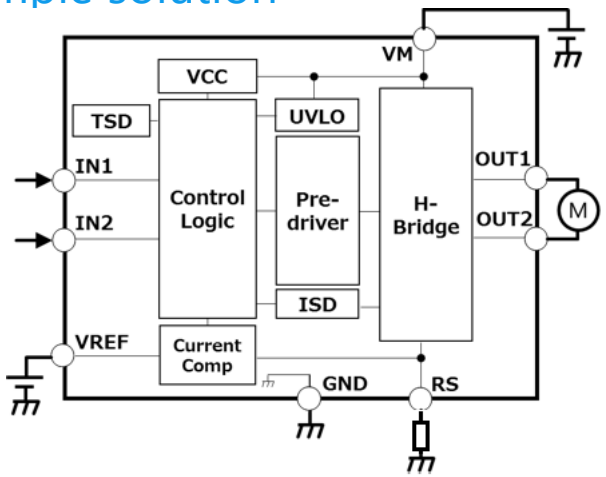
2 Wide operation voltage range

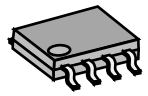
Wide power supply voltage range from 4.5 to 44 V supports battery driven applications.

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	

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11b 2ch brushed DC motor driver

TB67H400AFTG / TB67H410FTG / TB67H420FTG

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

Value provided

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

1 High voltage (50 V)

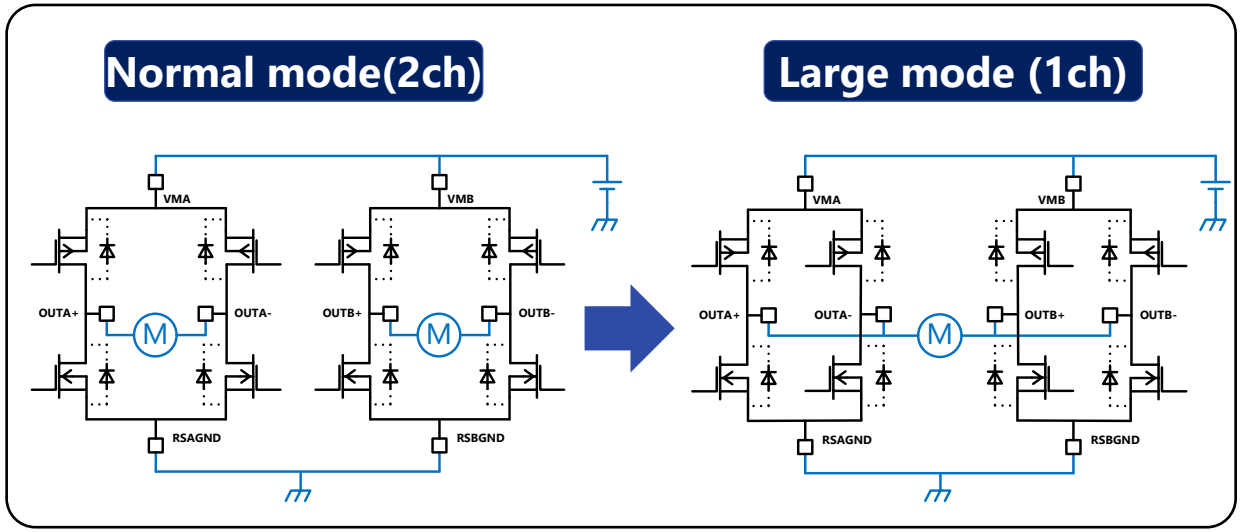
Maximum rating of the output voltage is improved from 40 to 50 V to allow margin for air discharge test, etc.

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)

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

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