TBD62789APG

Usage considerations

Function of transistor array

There are various kinds of transistor arrays depending on their functions.

- Input active level

There are two types. The TBD62789APG is high active type.

Type	Description	TBD62789APG
High active	Output is ON by inputting ”H” level to input pin	Available
Low active	Output is ON by inputting ”L” level to input pin	—

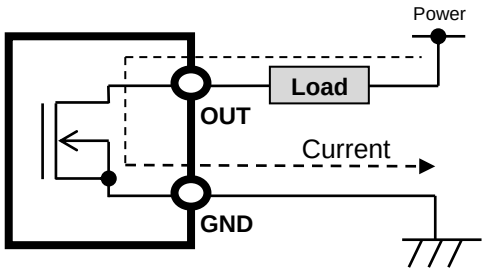
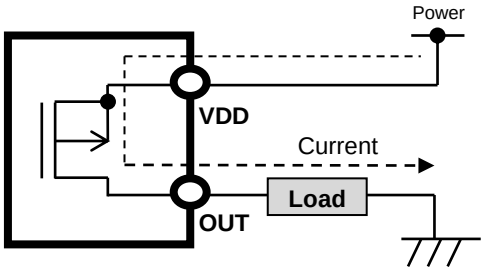
- Output clamp diode

There are two types. The TBD62789APG is built-in type.

Type	Description	TBD62789APG
Built-in	Optimal for driving the motor, the relay, and the solenoid. (Capable of driving the LED and the level shift circuit.)	—
Non Built-in	Optimal for driving the LED and the level shift circuit. (External diodes are required to drive the motor, the relay, and the solenoid.)	Available

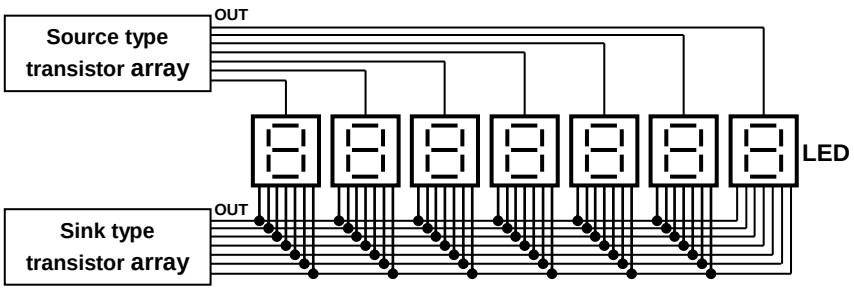
- Output current system

There are two types. The TBD62789APG is source type. Connecting point of each load is different.

Type	Description	TBD62789APG
Sink type	Output of current sink type (output pull) 	—
Source type	Output of current source type (output push) 	Available

Application example

Dynamic drive control is available by combining transistor arrays of the sink type and the source type.



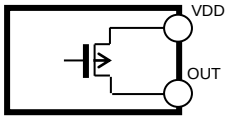
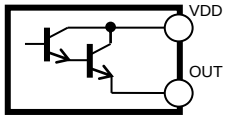
- Construction of input circuit

There are two types. The TBD62789APG has the data storage function.

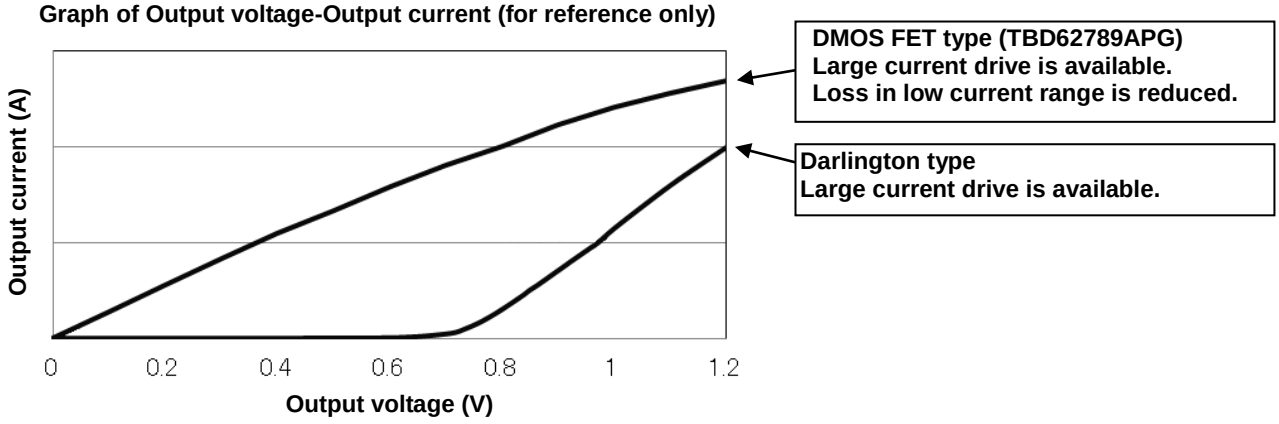
Type	Description	TBD62789APG
Data storage type	Built in D-type flip flop: Holding input data is available.	Available
Without data storage function	Input data storage function is not built in.	—

- Construction of output circuit

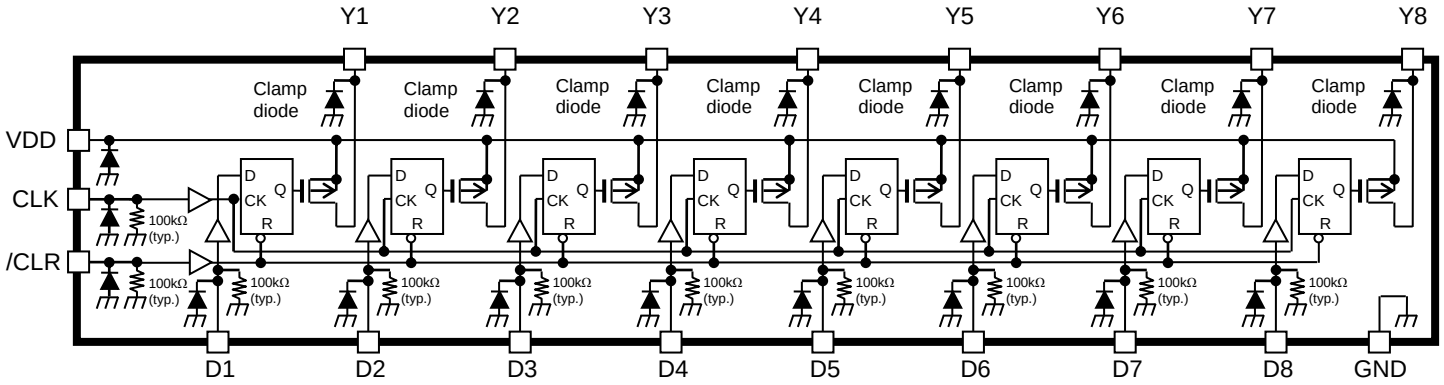
There are two types. The TBD62789APG is DMOS FET type.

Type	Description	TBD62789APG
DMOS FET type	 **Features** **Large current drive is available.** **Loss in low current range is reduced.**	Available
Bipolar transistor Darlington type	 **Features** **Large current drive is available.**	—

Characteristics graph for reference (features of each type)



Basic circuit



The basic circuit diagrams may be simplified or some parts of them may be omitted for explanatory purposes.

Function table

INPUT			OUTPUT: Y
/CLR	CLK	D	
L	X	X	Z (OFF)
H	↑	L	Z (OFF)
H	↑	H	H (ON)
H	L	X	Y0
H	↓	X	Y0
H	H	X	Y0

↑: Change from ”L” to ”H”.
↓: Change from ”H” to L”
H: High level
Z: High impedance (OFF)
X: Don’t care
Y0: Y level just before input conditions shown in the table are fixed.

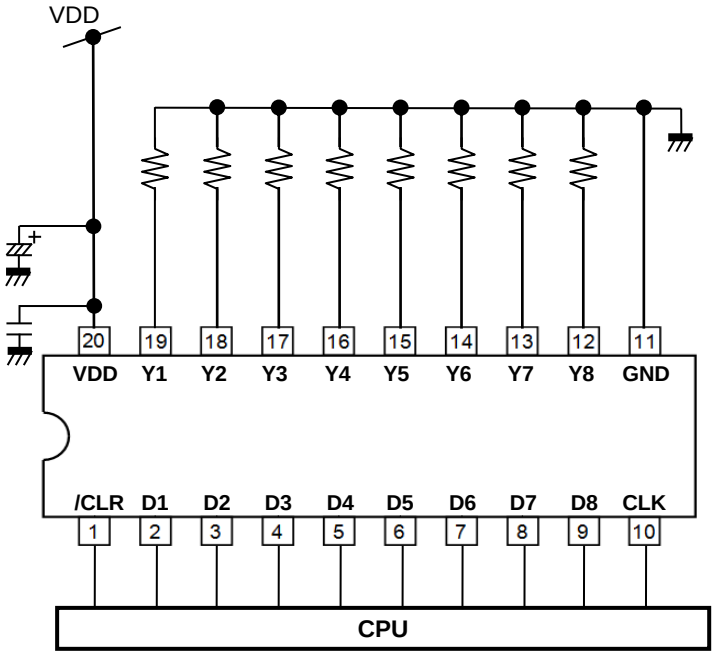
- Usage considerations

Unused channel pins are recommended to be treated as follows;

Pin	Connection treatments
D1, D2, D3, D4, D5, D6, D7 and ,D8	Input pins are treated to be pulled down and outputs are turned off during open state. Connecting input pins to the GND pin is recommended to prevent IC malfunctions occurred by noise.
Y1, Y2, Y3, Y4, Y5, Y6, Y7, and Y8	For output pins, VDD connection is recommended. Furthermore, when using in strong noise environment, GND connection may be better because noise immunity including ESD surge may be improved depending on wiring. For design, the comparison evaluation is recommended.

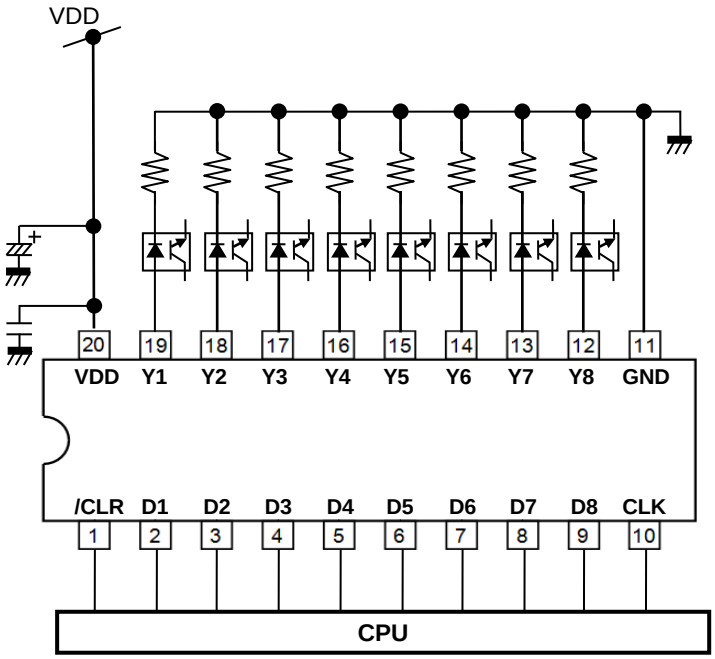
Example of Application Circuit

- Resistive load drive



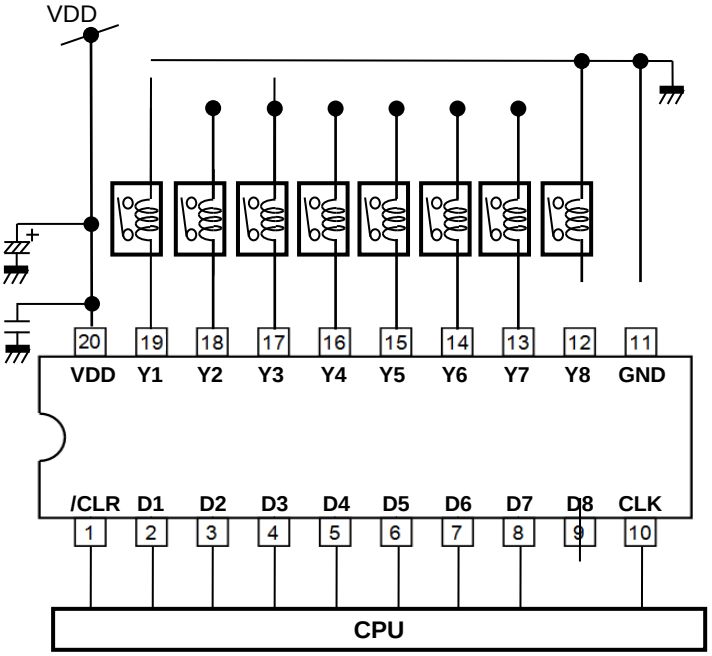
For voltage stabilization and noise rejection, please connect a stacked ceramic capacitor (0.01 μF to 1 μF) or an electrolytic capacitor (10 μF to 100 μF) to VDD line. The capacitor is recommended to be connected as close to the IC as possible.

- Photo coupler drive



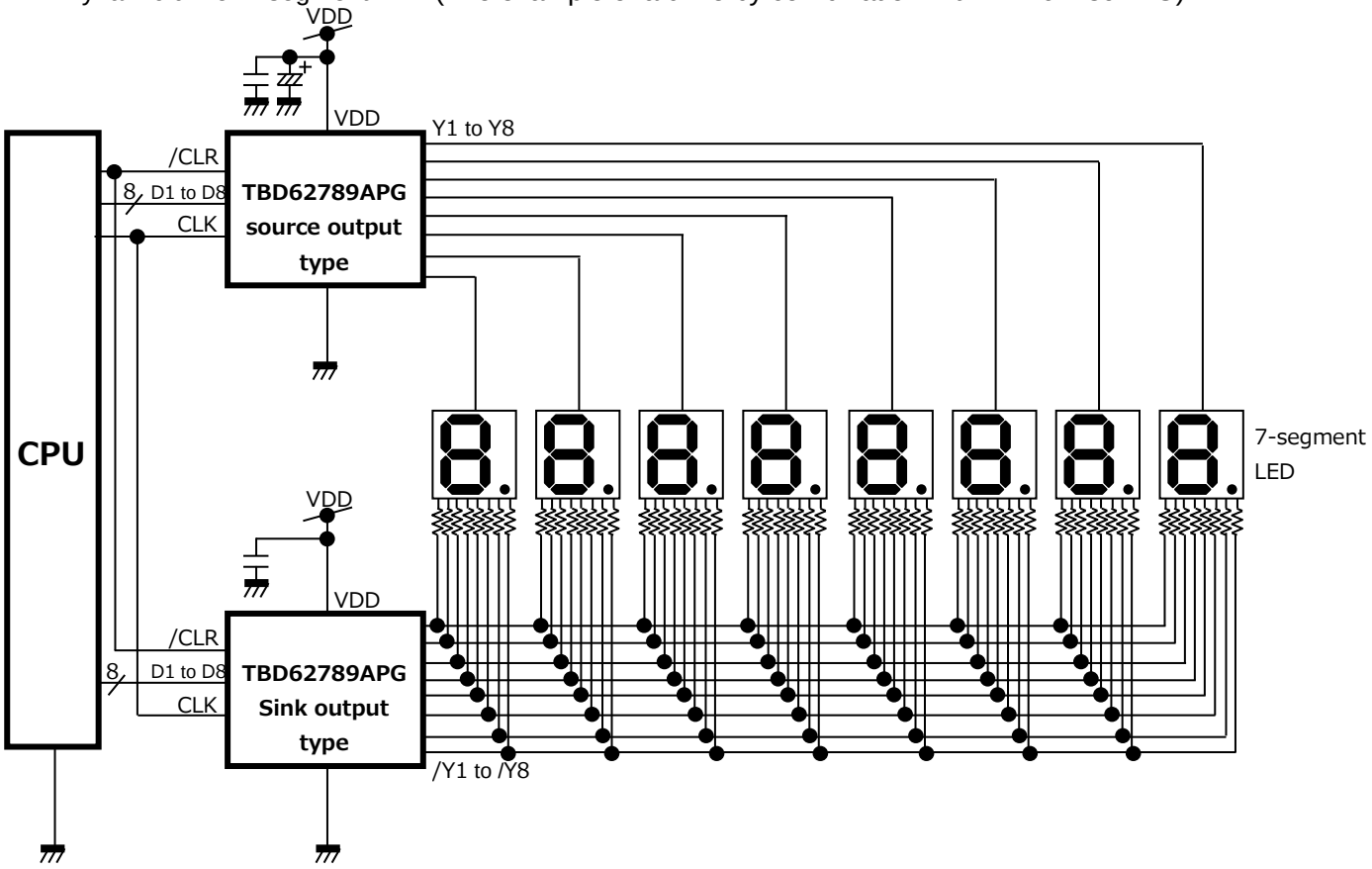
For voltage stabilization and noise rejection, please connect a stacked ceramic capacitor (0.01 μF to 1 μF) or an electrolytic capacitor (10 μF to 100 μF) to VDD line. The capacitor is recommended to be connected as close to the IC as possible.

- Relay drive



For voltage stabilization and noise rejection, please connect a stacked ceramic capacitor (0.01 μF to 1 μF) or an electrolytic capacitor (10 μF to 100 μF) to VDD line. The capacitor is recommended to be connected as close to the IC as possible.

- Dynamic drive: 7-segment LED (The example of a drive by combination with TBD62789APG)

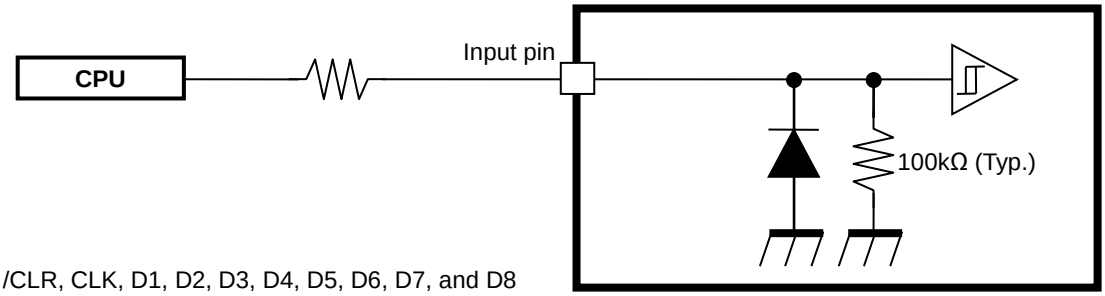


For voltage stabilization and noise rejection, please connect a stacked ceramic capacitor (0.01 μF to 1 μF) or an electrolytic capacitor (10 μF to 100 μF) to VDD line. The capacitor is recommended to be connected as close to the IC as possible.

Noise suppression (including ESD surge)

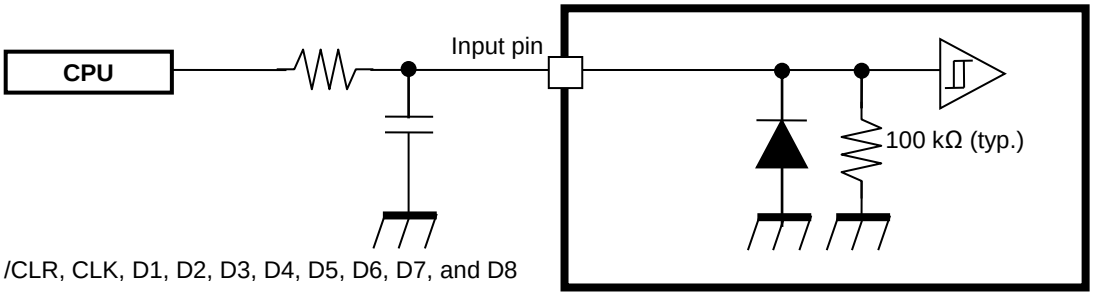
When the input and output pins of the IC have a noise, which includes ESD surge, IC malfunctions and breakdown may occur.
Generally, noise immunity, including surge, can be improved by connecting the resistor series, CR filter, and ESD protection diode to the input pins and connecting ESD protection diode to the output pins.

(Ex.) Connecting resistor series to the input pin



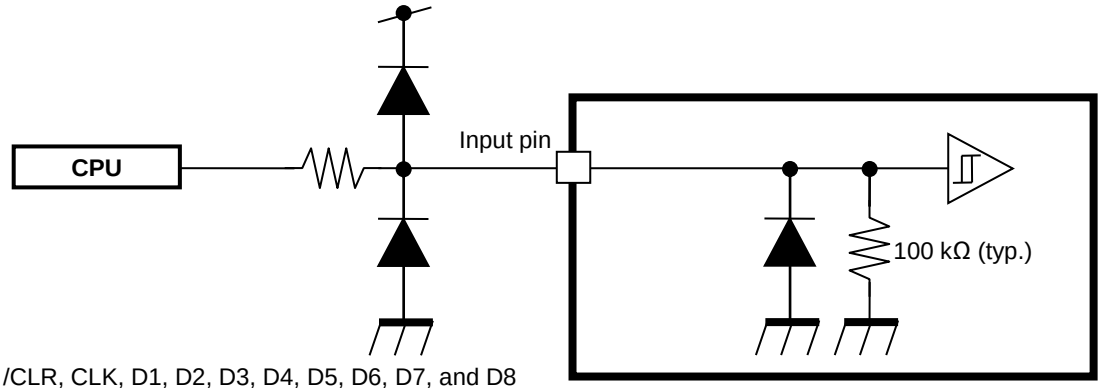
Input pins: /CLR, CLK, D1, D2, D3, D4, D5, D6, D7, and D8

(Ex.) Connecting CR filter to the input pin



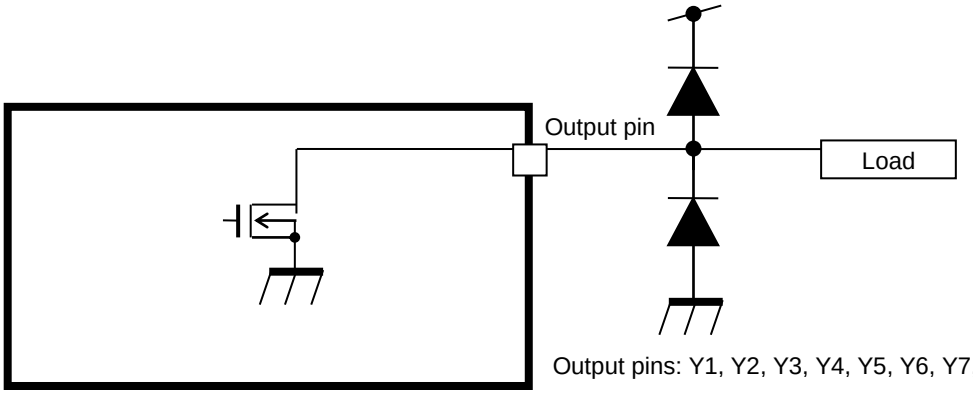
Input pins: /CLR, CLK, D1, D2, D3, D4, D5, D6, D7, and D8

(Ex.) Connecting ESD protection diode to the input pin



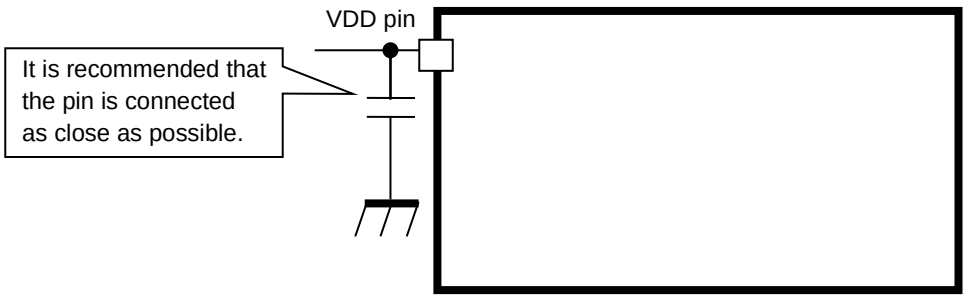
Input pins: /CLR, CLK, D1, D2, D3, D4, D5, D6, D7, and D8

(Ex.) Connecting ESD protection diode to the output pin



Output pins: Y1, Y2, Y3, Y4, Y5, Y6, Y7, and Y8

(Ex.) Connecting a stacked ceramic capacitor to nearby VDD pin



Loss calculation of the IC

In using the IC, take enough margins for each configuration by referring to the PD-Ta graph after calculating the loss of the IC according to below formula.
Under the conditions in PD-Ta graph, the drive current can be configured up to 400 mA per one channel.

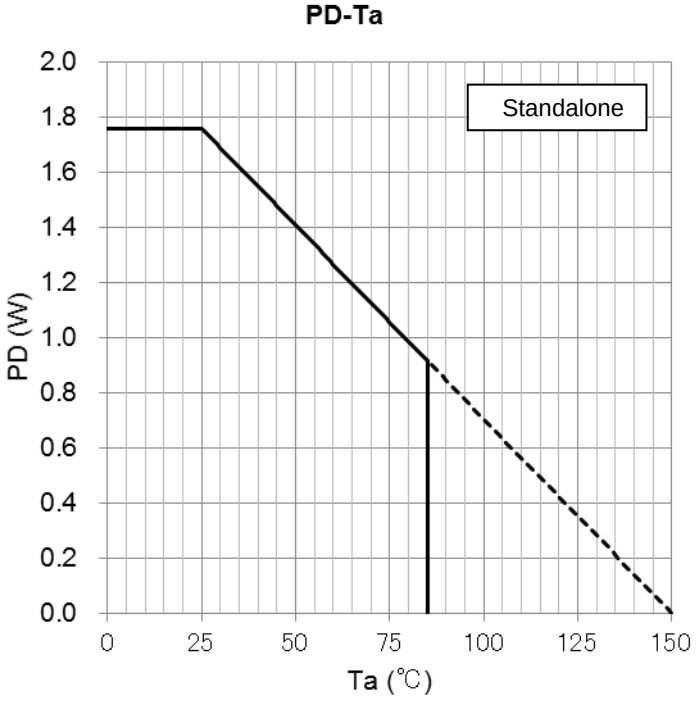
- **Loss calculation**

・Output
Pout(W) = IOUT(A) × IOUT(A) × RON(Ω) × ONDuty × number of driving channels
・Input
Pin(W) = IIN(A) × VIN(V) × ONDuty × number of driving channels
・VDD
Pvdd(W) = ICC(A) × VDD(V) × ONDuty ×number of driving channels
・Total
PD(W) = Pout(W)+ Pin(W)+ Pvdd(W)

*** RON, IIN, and ICC: Please refer to the electrical characteristics in the data sheet.**
*** ONDuty: Please adopt ON term / cycle.**
However, when ONterm is 25 ms or more, please adopt value of 1 for ONDuty.

- **PD-Ta graph**

Conditions: Absolute maximum rating of the junction temperature (Tj) is 150°C.



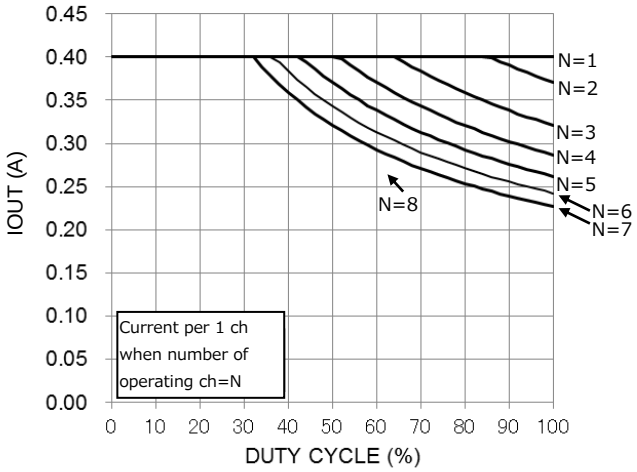
- **Package thermal resistance**

Rth(j-a) =71°C (Standalone)

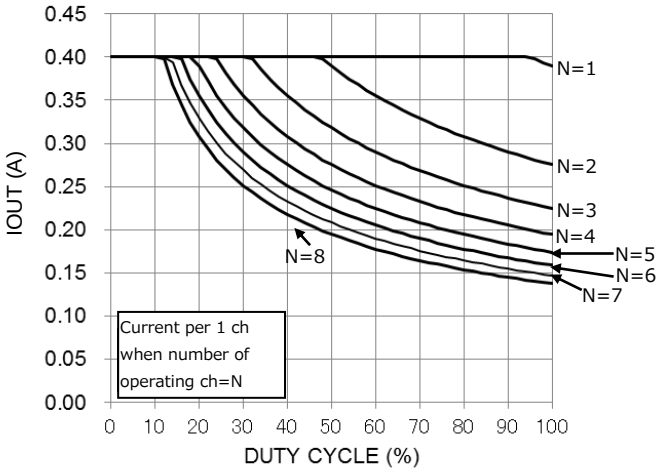
Reference data

* The data is for reference, not guaranteed.

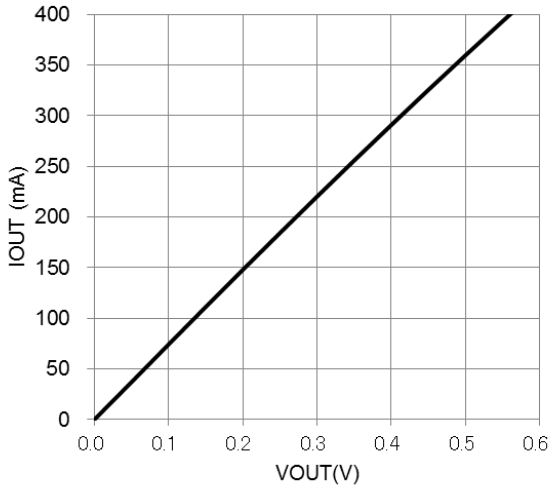
IOUT-DUTY CYCLE
TBD62789APG alone
Tj Tj=120°C,Ta=25°C, Pulse width: 25 ms or less



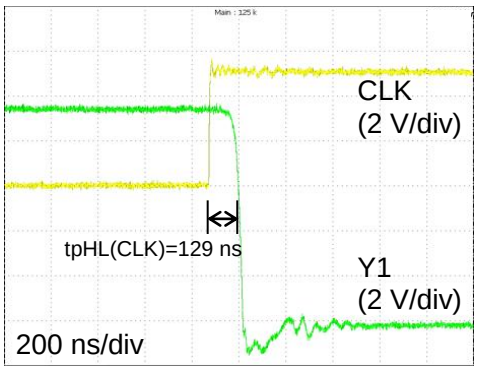
IOUT-DUTY CYCLE
TBD62789APG alone
Tj=120°C,Ta=85°C, Pulse width: 25 ms or less



VOUT - IOUT
TBD62789APG
VDD=4.5V,Ta=25℃

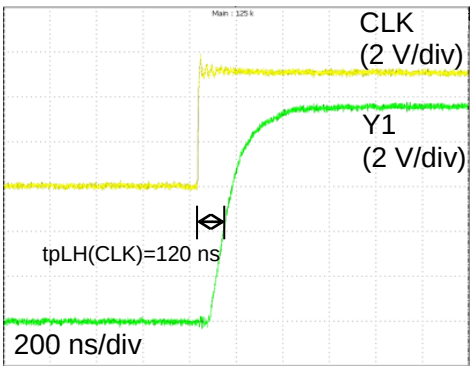


Output switching waveform (output=ON)



Test conditions: VDD=10 V, output load capacity=15 pF, output load resistance=25 Ω

Output switching waveform (Output=OFF)



Test conditions: VDD=10 V, output load capacity=15 pF, output load resistance=25 Ω

Notes on Contents

1. Pin Connection Diagrams
The pin connection diagrams may be simplified or some parts of them may be omitted for explanatory purposes.

2. Basic Circuits
The basic circuit diagrams may be simplified or some parts of them may be omitted for explanatory purposes.

3. Test Circuits
The test circuit diagrams may be simplified or some parts of them may be omitted for explanatory purposes.

4. Timing Charts
Timing charts may be simplified or some parts of them may be omitted for explanatory purposes.

IC Usage Considerations
Notes on handling of ICs

[1] The absolute maximum ratings of a semiconductor device are a set of ratings that must not be exceeded, even for a moment. Do not exceed any of these ratings.
Exceeding the rating(s) may cause the device breakdown, damage or deterioration, and may result injury by explosion or combustion.

[2] Do not insert devices in the wrong orientation or incorrectly.
Make sure that the positive and negative terminals of power supplies are connected properly.
Otherwise, the current or power consumption may exceed the absolute maximum rating, and exceeding the rating(s) may cause the device breakdown, damage or deterioration, and may result injury by explosion or combustion.
In addition, do not use any device that is applied the current with inserting in the wrong orientation or incorrectly even just one time.

[3] Use an appropriate power supply fuse to ensure that a large current does not continuously flow in case of over current and/or IC failure. The IC will fully break down when used under conditions that exceed its absolute maximum ratings, when the wiring is routed improperly or when an abnormal pulse noise occurs from the wiring or load, causing a large current to continuously flow and the breakdown can lead smoke or ignition. To minimize the effects of the flow of a large current in case of breakdown, appropriate settings, such as fuse capacity, fusing time and insertion circuit location, are required.

[4] If your design includes an inductive load such as a motor coil, incorporate a protection circuit into the design to prevent device malfunction or breakdown caused by the current resulting from the inrush current at power ON or the negative current resulting from the back electromotive force at power OFF. IC breakdown may cause injury, smoke or ignition.
Use a stable power supply with ICs with built-in protection functions. If the power supply is unstable, the protection function may not operate, causing IC breakdown. IC breakdown may cause injury, smoke or ignition.

[5] Carefully select external components (such as inputs and negative feedback capacitors) and load components (such as speakers), for example, power amp and regulator.
If there is a large amount of leakage current such as input or negative feedback condenser, the IC output DC voltage will increase. If this output voltage is connected to a speaker with low input withstand voltage, overcurrent or IC failure can cause smoke or ignition. (The over current can cause smoke or ignition from the IC itself.) In particular, please pay attention when using a Bridge Tied Load (BTL) connection type IC that inputs output DC voltage to a speaker directly.

Points to remember on handling of ICs

Heat Radiation Design

In using an IC with large current flow such as power amp, regulator or driver, please design the device so that heat is appropriately radiated, not to exceed the specified junction temperature (T_j) at any time and condition. These ICs generate heat even during normal use. An inadequate IC heat radiation design can lead to decrease in IC life, deterioration of IC characteristics or IC breakdown. In addition, please design the device taking into considerate the effect of IC heat radiation with peripheral components.

Back-EMF

When a motor rotates in the reverse direction, stops or slows down abruptly, a current flow back to the motor's power supply due to the effect of back-EMF. If the current sink capability of the power supply is small, the device's motor power supply and output pins might be exposed to conditions beyond absolute maximum ratings. To avoid this problem, take the effect of back-EMF into consideration in system design.

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