TBD62786A series

Usage considerations

8ch-low active source type DMOS transistor array for level shift circuits, inductive loads such as motors and relays, and LEDs.
TBD62786A series are low active version of TBD62783A series. V_{CC} is 0 V and the IC can operate with negative voltage for inputs and GND.

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Function of transistor array

There are various kinds of transistor arrays according to their functions.

●Input active level

There are two types. The TBD62786A series are low active type.

Type	Description	TBD62786A
High active	Output is ON by inputting ”H” level to input pin.	–
Low active	Output is ON by inputting ”L” level to input pin.	✓

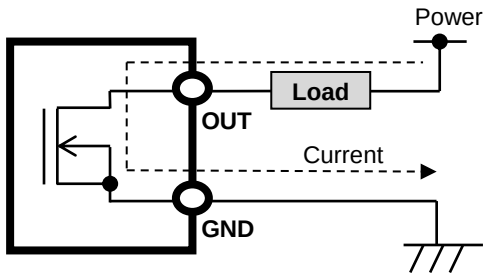
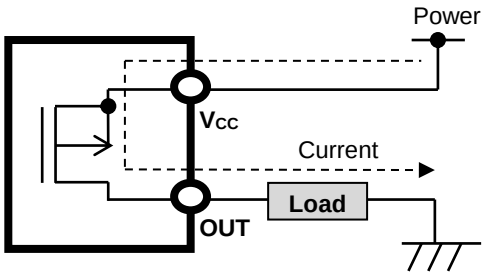
●Output clamp diode

There are two types. The TBD62786A series are built-in type.

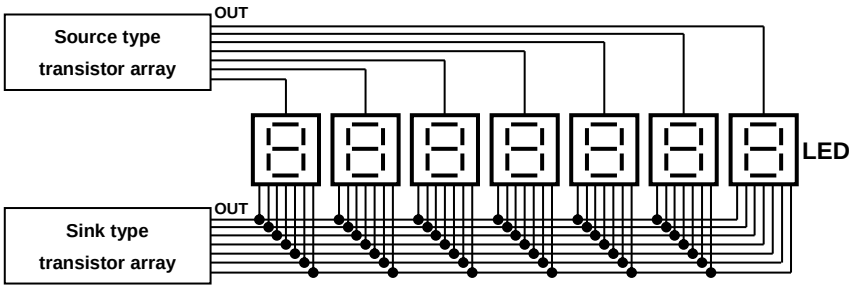
Type	Description	TBD62786A
Built-in	Optimal for driving motors, relays, and solenoids. (Capable of driving LEDs and level shift circuits.)	✓
Non-built-in	Optimal for driving LEDs and level shift circuits. (External diodes are required to drive motors, relays, and solenoids.)	–

●Output current system

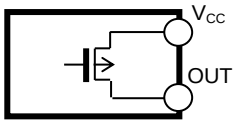
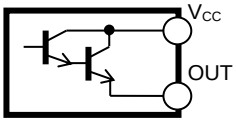
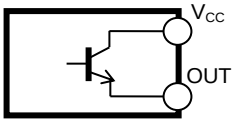
There are two types. The TBD62786A series are source type. Connecting point of each load is different.

Type	Description	TBD62786A
Sink type	Output of current sink type (output pull) 	–
Source type	Output of current source type (output push) 	✓

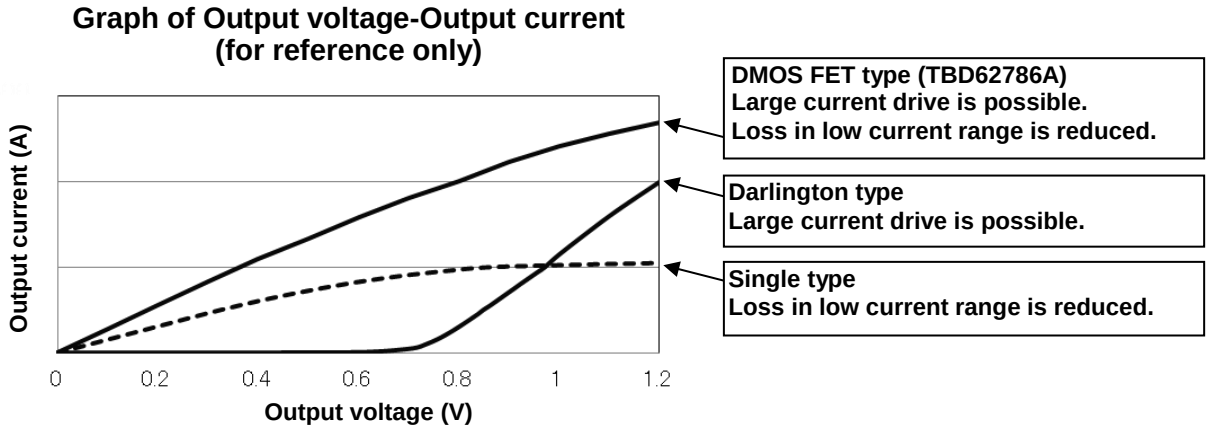
Dynamic drive control is possible by combining transistor arrays of the sink type and the source type.



●Construction of output circuit
There are three types. The TBD62786A series are DMOS FET type.

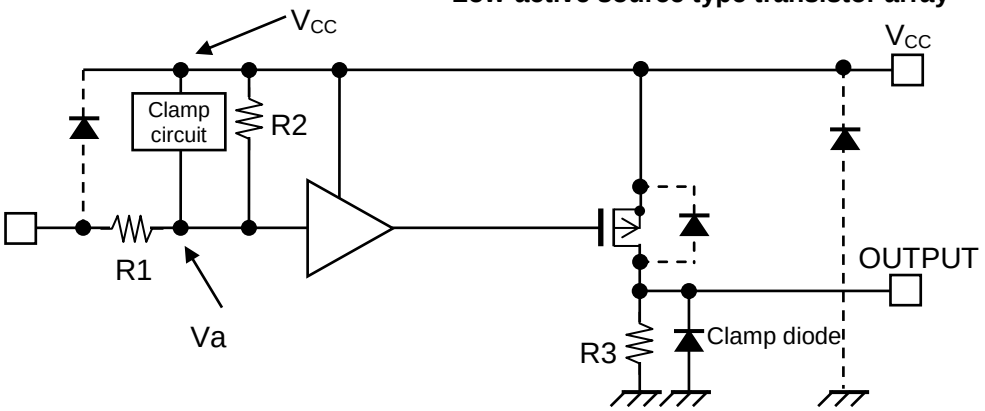
Type	Description	TBD62786A
DMOS FET type	 **Features** **Large current drive is possible.** **Loss in low current range is reduced.**	✓
Bipolar transistor Darlington type	 **Features** **Large current drive is possible.**	–
Bipolar transistor Single type	 **Features** **Loss in low current range is reduced.**	–

Characteristics graph of each type (for reference only)



Basic circuit

***Low-active source type transistor array**



*Constant number of internal resistance: R1=320.5 kΩ (typ.), R2=300 kΩ (typ.)
*The accuracy of the internal resistance is ±30 % (reference value).
*The clamp circuit controls the upper limit of the voltage difference between V_{CC} and Va. The upper limit is about 4 V.

Above basic circuit diagram may be omitted or simplified for explanatory purposes.

●Control of output ON/OFF

Outputs of the TBD62786A series are constructed by DMOS FET. ON/OFF of output is controlled according to the applied voltage of the input pin.

Product	V_{IN}(ON)	V_{IN}(OFF)
TBD62786A series	-30 V to -2.8 V@V_{CC}=0 V	-1.2 V to 0 V@V_{CC}=0 V

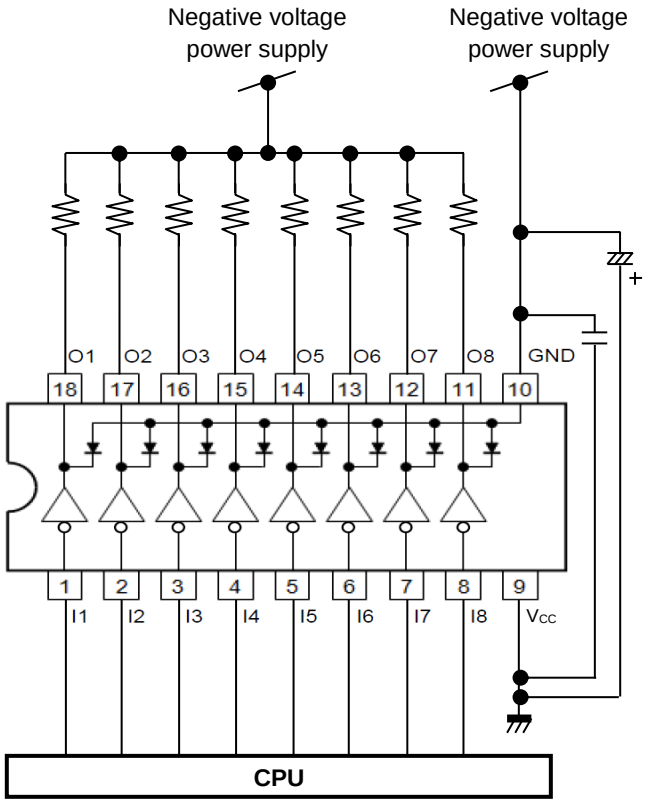
●Treatments for unused pins

Unused channel pins are recommended to be treated as follows;

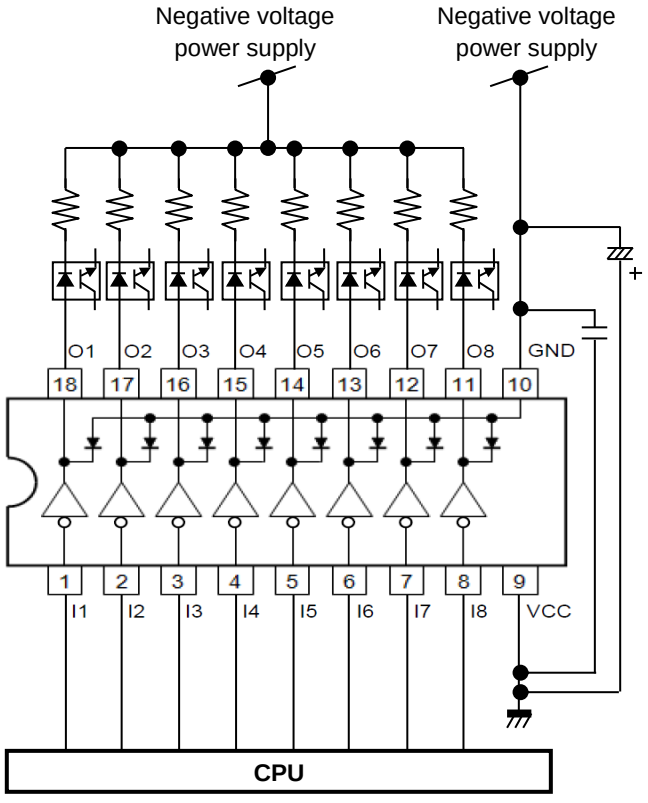
Pin	Connection treatments
I1, I2, I3, I4, I5, I6, I7, and I8	Input pins are pulled up and outputs are turned off during open state. Connecting input pins to the V_{CC} pin is recommended to prevent IC malfunctions due to noise.
O1, O2, O3, O4, O5, O6, O7, and O8	Open state or GND connection is recommended. When the IC is used under high noise intensity, connecting to GND may have the higher noise tolerance (including ESD surge) than the open state according to the wiring state. Therefore, in designing, it is recommended to compare the noise tolerance between them.

Application circuit example

● Resistive load drive



●Photo coupler drive

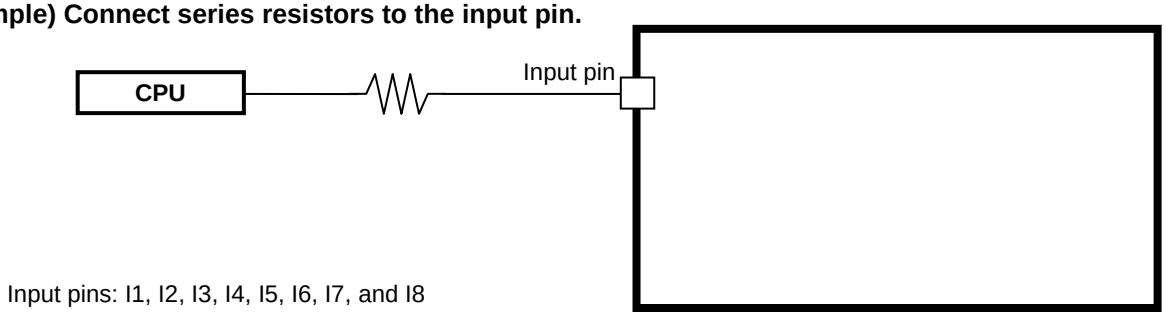


For voltage stabilization and noise rejection, please connect a stacked ceramic capacitor (0.01 μF to 1 μF) or an electrolytic capacitor (10 μF to 100 μF) to V_{CC} line. The capacitor is recommended to be connected as close to the IC as possible.

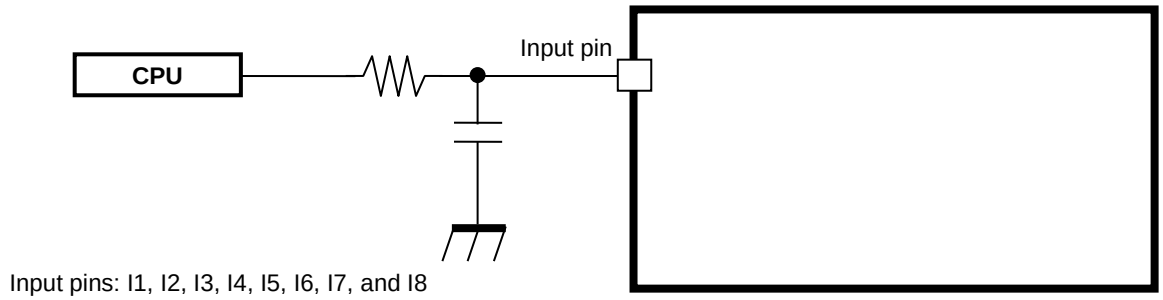
Noise reduction (including ESD surge measurement)

When a noise (including ESD surge) is applied on the input and output pins of the IC, the IC or other components will be damaged or fail.
Generally, noise (including ESD surge) tolerance is improved by connecting series resistors, a CR filter, and an ESD protection diode to the input pins, by connecting an ESD protection diode to the output pins, and by connecting a multilayer ceramic capacitor close to V_{CC} pin.

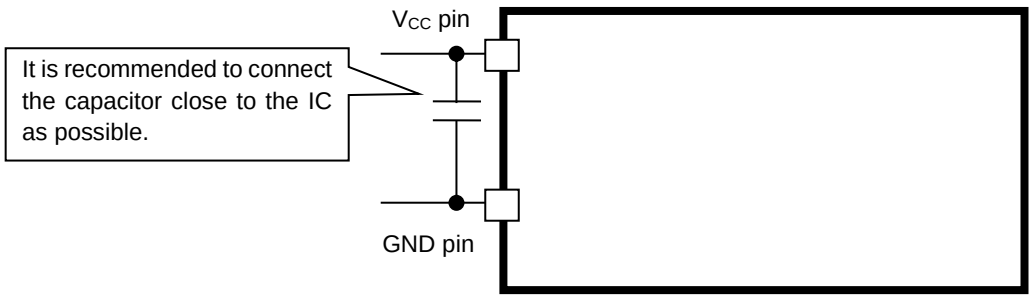
(Example) Connect series resistors to the input pin.



(Example)Connect a CR filter to the input pin.



(Example) Connect a multilayer ceramic capacitor close to V_{CC} pin.



Loss calculation of the IC

In using the IC, take enough margins for each configuration by calculating the loss of the IC from below formula and by referring to the P_D-T_a graph.

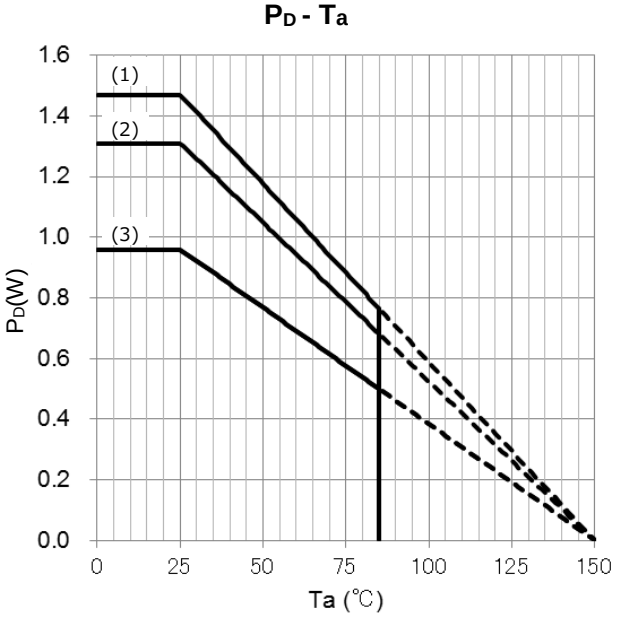
●Loss calculation

- Output block
  Pout(W) = I_{OUT}(A) × I_{OUT}(A) × R_{ON}(Ω) × ONDuty × number of driving channels
- Input block
  Pin(W) = I_{IN}(A) × V_{IN}(V) × ONDuty × number of driving channels
- V_{CC}
  Pvcc(W) = I_{CC}(A) × V_{CC}(V) × number of driving channels
- Whole IC
  PD(W) = Pout(W)+ Pin(W)+ Pvcc(W)

*R_{ON}, I_{CC}, and IIN: Please refer to 'Electrical characteristics' in the data sheet.
*ONDuty: Please adopt ON term/cycle. However, when ON term is 25 ms or more, please adopt 'ONDuty=1'.

●P_D-T_a graph

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



(1)APG type alone

(2)When mounted on AFWG type
(75 × 114 × 1.6 mm, Cu area 20 %, single-side glass epoxy)

(3)When mounted on AFNG type,
(50 × 50 × 1.6 mm, Cu area 40 %, single-side glass epoxy)

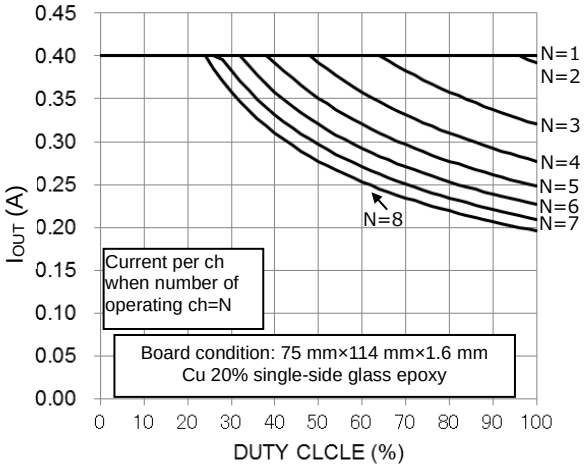
●Package thermal resistance (for reference only)

PG type	:Rth(j-a) = 85 °C/W (standalone)
FNG type	: Rth(j-a) = 130 °C/W (when mounted on 50 × 50 × 1.6 mm, Cu area 40 %, single-side glass epoxy)
FWG type	: Rth(j-a) = 95 °C/W (when mounted on 75 × 114 × 1.6 mm, Cu area 20 %, single-side glass epoxy)

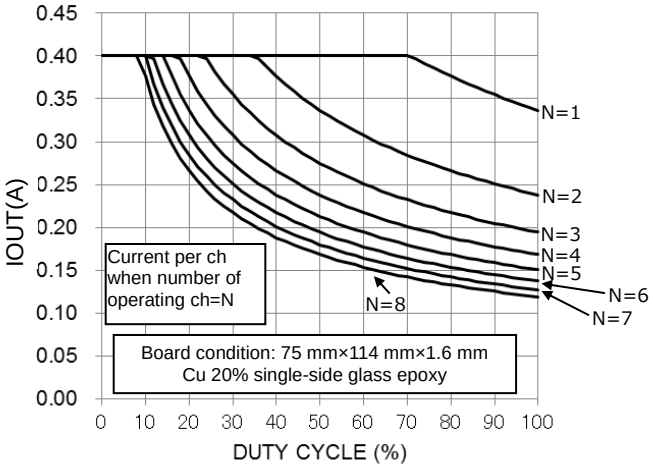
Reference data

* The data is for reference, not guaranteed.

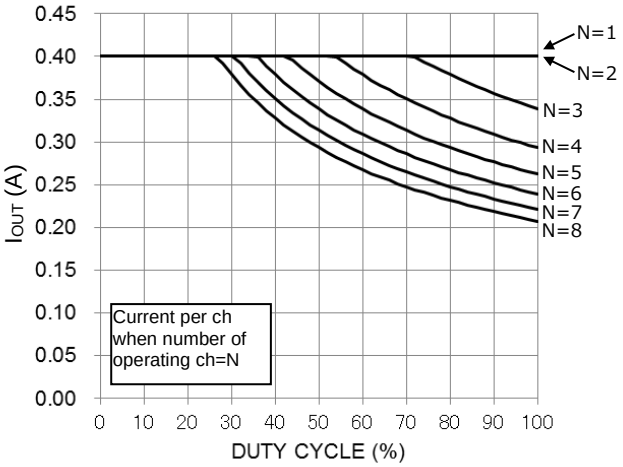
I_{OUT} - DUTY CYCLE
Mounted on the board of TBD62786AFWG
Tj=120℃,Ta=25℃, VCC=5V pulse width: 25ms or less



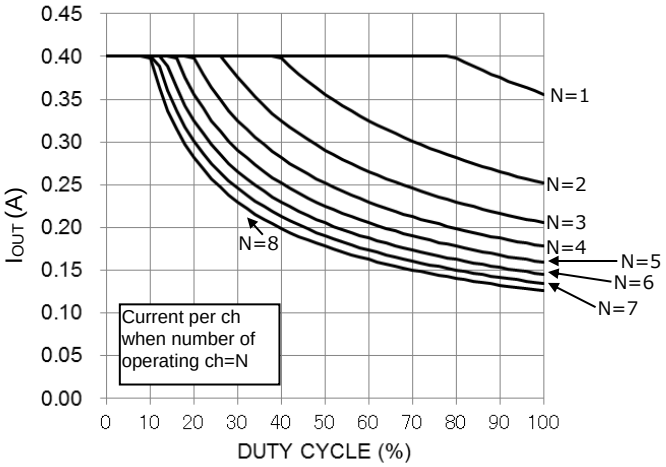
I_{OUT} - DUTY CYCLE
Mounted on the board of TBD62786AFWG
Tj=120℃,Ta=85℃, VCC=5V, pulse width: 25ms or less



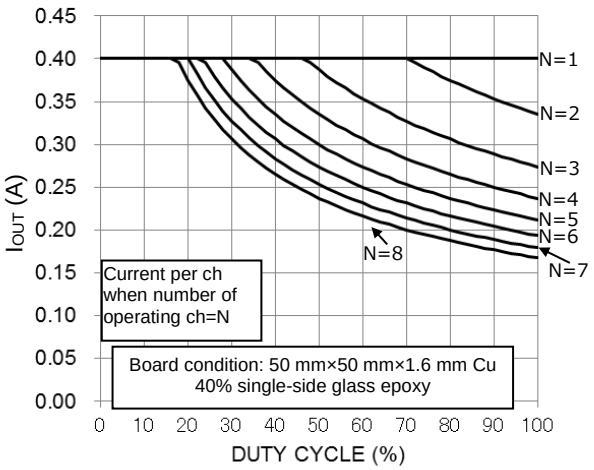
I_{OUT} - DUTY CYCLE
Mounted on the board of TBD62786APG
Tj=120 °C,Ta=25 °C, VCC=5 V pulse width: 25 ms or less



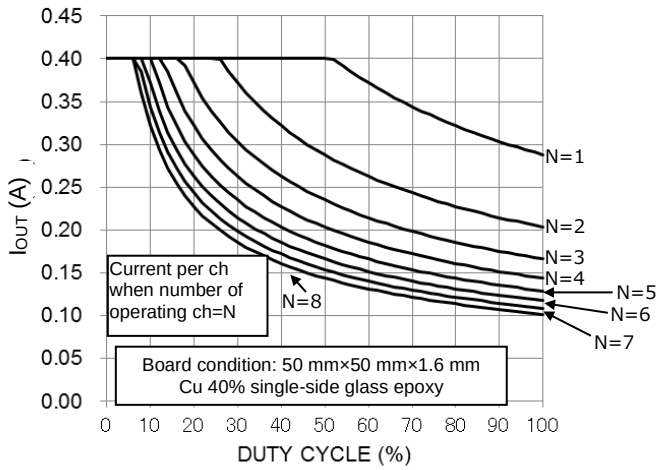
I_{OUT} - DUTY CYCLE
Mounted on the board of TBD62786APG
Tj=120 °C,Ta=85 °C, VCC=5 V, pulse width: 25 ms or less



I_{OUT} - DUTY CYCLE
Mounted on the board of TBD62786AFNG
Tj=120 °C,Ta=25 °C, VCC=5 V pulse width: 25 ms or less



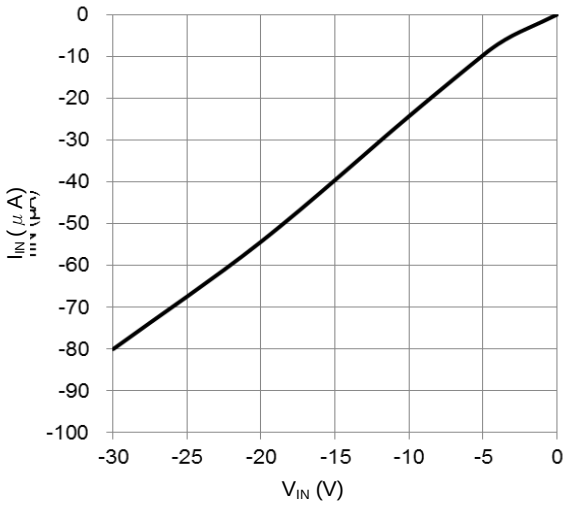
I_{OUT} - DUTY CYCLE
Mounted on the board of TBD62786AFNG
Tj=120 °C,Ta=85 °C, VCC=5 V, pulse width: 25 ms or less



* The data is for reference, not guaranteed.

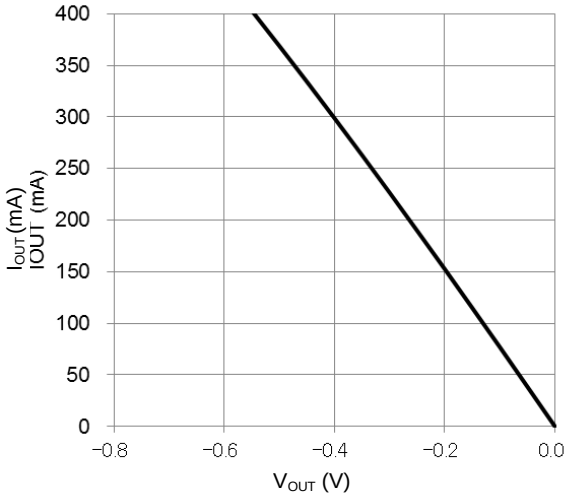
V_{IN} - I_{IN} I

Ta = 25 °C,V_{CC} = 0 V,GND = -5 V



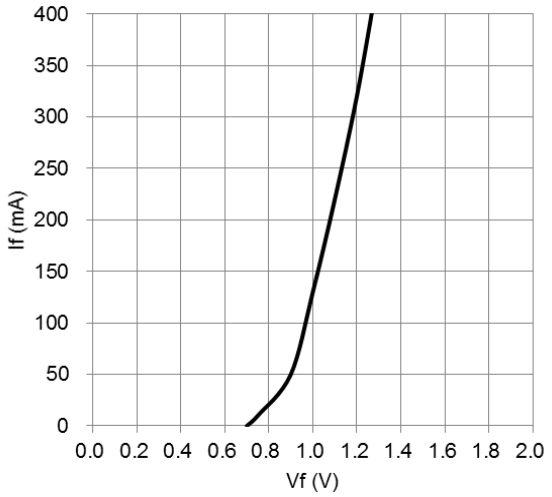
V_{OUT} - I_{OUT} T

Ta = 25 °C,V_{IN} = 0 V, V_{CC} = 0 V



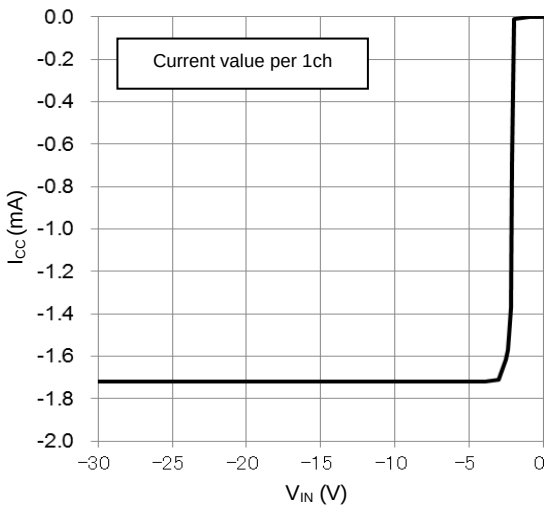
Vf - If

Ta = 25 °C



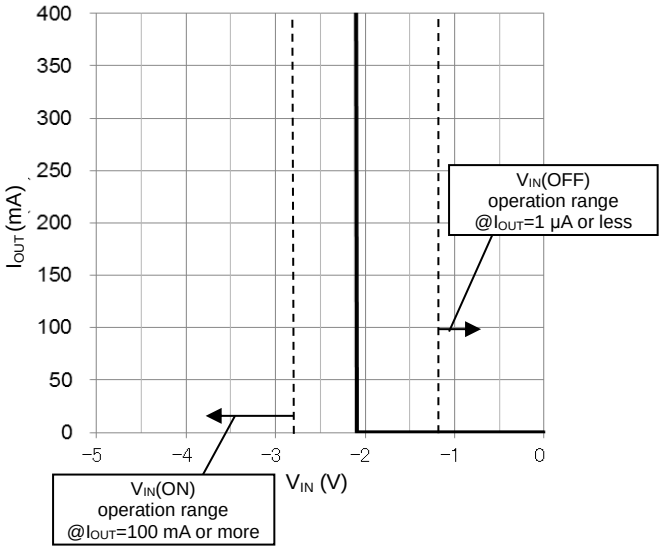
V_{IN} - I_{CC}

Ta = 25 °C,V_{CC} = 0 V, GND = -5 V, Output OPEN



V_{IN} - I_{OUT}

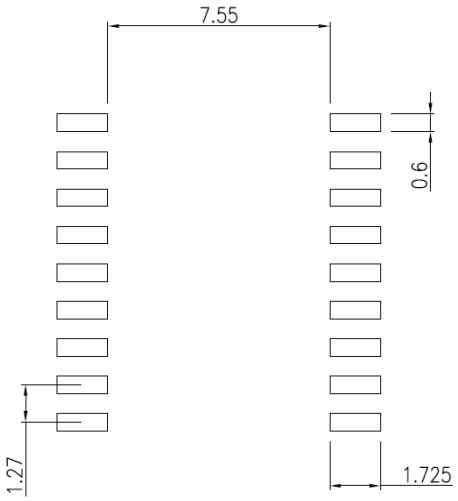
Ta = 25 °C,V_{CC} = 0 V, GND = -5 V



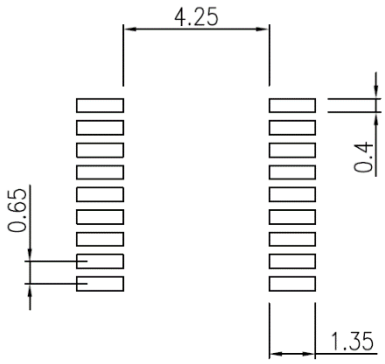
Land pattern dimension (for reference only)

Unit: mm

TBD62786AFWG



TBD62786AFNG



The land pattern dimensions shown above are provided for reference purposes only, and are not guaranteed for mass production.

In determining the size of mounting board, design the most appropriate pattern by considering the solder bridge, the solder connecting strength, the pattern accuracy in making board, and the mounting accuracy of the IC board.

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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