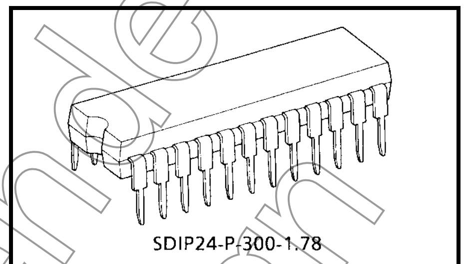
TOSHIBA BIPOLAR DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

# TD62708NG

## 8CH HIGH CURRENT SOURCE DRIVER

The TD62708NG is comprised of eight source current output stages and $\overline{\text{ENABLE}}$ inputs which can gate the outputs.
TD62708N features a large output source current of 1.8 A and minimized output voltage change vs output current change.
These features make the device optimum for driving the matrix of ink jet printer print heads, LEDs, and the scan side of resistor matrixes.
Before using this device, note the thermal conditions for usage.
The suffix (G) appended to the part number represents a Lead (Pb)-Free product.

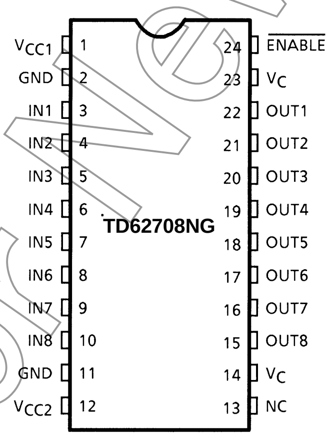



Weight: 1.2 g (typ.)

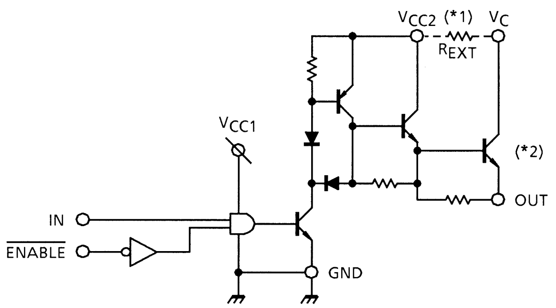
## Features

- Input terminal : High active
- $\overline{\text{Enable}}$ terminal : Low input output active mode
- Output current : $I_{OUT}$ = 1.8 A (MAX)
- A little change of output voltage
  : $\Delta V_{OH1} \le 0.45$ V
  (at $I_{OH}$ = 0.18 A~1.44 A)
- Package type : DIP24N
- Input compatible with TTL, 5 V CMOS

## Pin Connection (top view)



## Schematics (each driver)



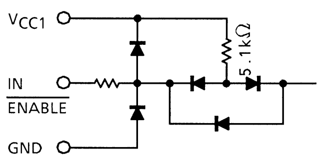

FUNCTION

| IN | $\overline{\text{ENABLE}}$ | OUT |
|---|---|---|
| H | L | ON |
| L | L | OFF |
| Don't Care | H | OFF |

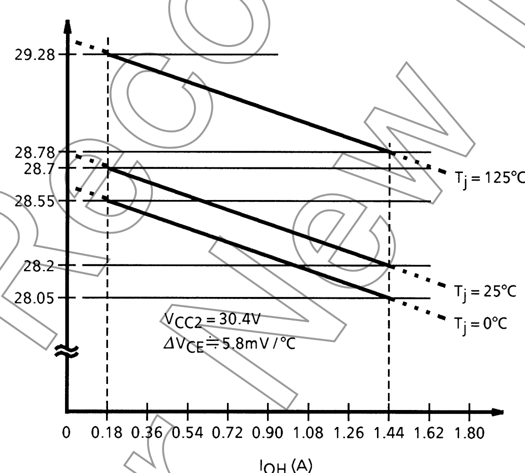
* 1: For normal use, connect $V_{CC2}$ and $V_C$.
For applications whose thermal conditions are more demanding, TOSHIBA recommends an external resistor ($R_{EXT}$ : approx. 0.9 Ω / 2W) be connected between $V_{CC2}$ and $V_C$.

* 2: When connecting an external resistor between $BV_{CC2}$ and $V_C$, to avoid parasitic sub currents, set the voltage between $V_C$ and OUT as 0.3 V or more.
Set the external resistor value so that the voltage between $V_C$ and OUT is 0.3 V or more at the maximum temperature of the operating temperature range.

## Input Circuit : IN, $\overline{\text{ENABLE}}$




Note: Since the states of the input pins (pins 3 to 10) are the same as those at high-level input, set the pins for unused channels to GND.




- Output voltage (Temperature characteristic)
  Output Voltage ($V_{OH}$) has a Temperature Characteristic of 5.8 mV / °C, care must be taken to keep Junction Temp ($T_j$) within safety Limits.

## Absolute Maximum Ratings (Ta = 25°C)

| CHARACTERISTIC | SYMBOL | RATING | UNIT |
|---|---|---|---|
| Supply Voltage 1 | $V_{CC1}$ | −0.5~7.0 | V |
| Supply Voltage 2 | $V_{CC2}$ | −0.5~40 | |
| Output Current | $I_{OUT}$ | 1.8 (Note) | A |
| Input Voltage | $V_{IN}$ | −0.5~7.0 | V |
| Input Current | $I_{IN}$ | ±4.0 | mA |
| Power Dissipation | $P_D$ | 1.78 | W |
| Janction Temperature | $T_j$ | 150 | °C |
| Operating Temperature | $T_{opr}$ | −40~85 | °C |
| Storage Temperature | $T_{stg}$ | −55~150 | °C |

Note 1: 1.8 A / ch (32 μs, Duty ≤ 76%), Each Channel should not be switched on at same time.
Note 2: When mounting the device on the PC board, and the temperature exceeds 25°C, derate to 14.2 mW / °C.

## Recommended Operating Conditions

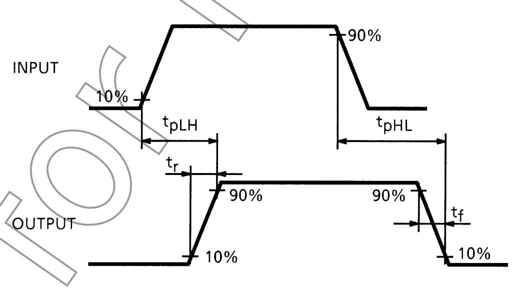
| CHARACTERISTIC | SYMBOL | CONDITION | MIN | TYP. | MAX | UNIT |
|---|---|---|---|---|---|---|
| Supply Voltage 1 | $V_{CC1}$ | — | 4.5 | 5.0 | 5.5 | V |
| Supply Voltage 2 | $V_{CC2}$ | — | — | — | 30 | |
| Output Current | $I_{OH}$ (Note) | — | — | — | 1.44 | A |
| Input Voltage | $V_{IN}$ (H) | $V_{IN}$ = H, $V_{CC1}$ = 5.0 V | 2.4 | — | $V_{CC}$ | V |
| | $V_{IN}$ (L) | $V_{IN}$ = L, $V_{CC1}$ = 5.0 V | 0 | — | 0.4 | V |
| | $V_{EN}$ (H) | $V_{EN}$ = H, $V_{CC1}$ = 5.0 V | 2.4 | — | $V_{CC}$ | V |
| | $V_{EN}$ (L) | $V_{EN}$ = L, $V_{CC1}$ = 5.0 V | 0 | — | 0.4 | V |
| Operating Temperature | $T_{opr}$ | — | 0 | — | 70 | °C |

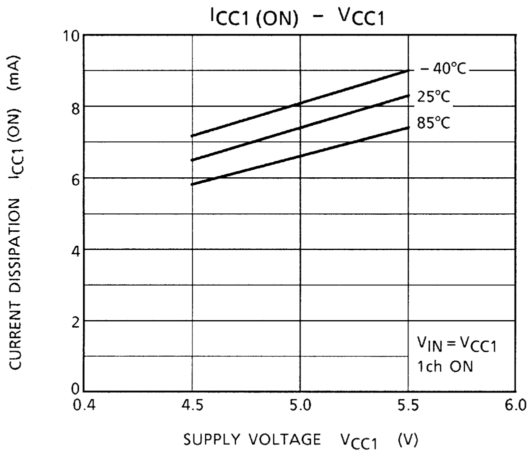
Note: Each Channel should not be switched on at same time.

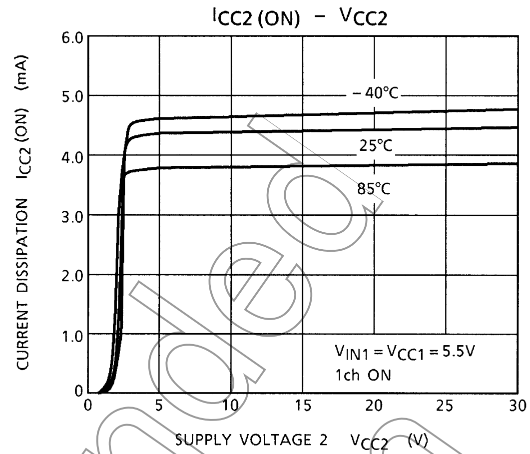
## Electrical Characteristics (Ta = 0~70°C)

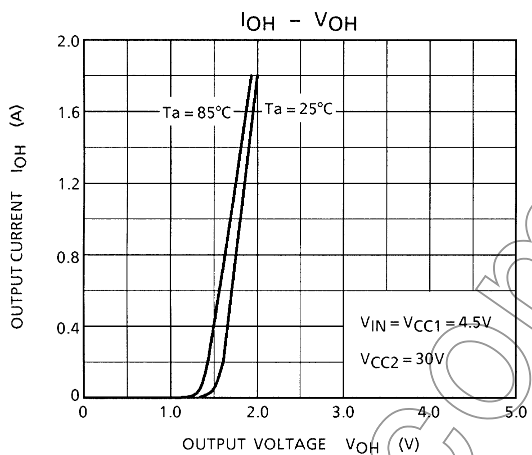
| CHARACTERISTIC | SYMBOL | TEST CIR-CUIT | TEST CONDITION | MIN | TYP. | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| Leakage Current | $I_{L1}$ | — | $V_{CC1}$ = 7.0 V, IN = L, EN = H | — | — | 100 | μA |
| | $I_{L2}$ | | $V_{CC2}$ = 30 V, IN = L, EN = H | — | — | 100 | |
| | $I_{L3}$ | | $V_C$ = 30 V, IN = L, EN = H | — | — | 100 | |
| Input Current | $I_{IN1}$ | — | $V_{CC1}$ = 5.0 V, $V_{IN}$ = 5.0 V | — | 0 | 10 | μA |
| | $I_{IN2}$ | | $V_{CC1}$ = 5.0 V, $V_{IN}$ = 0 V | 0.55 | 0.8 | 1.1 | mA |
| | $I_{EN1}$ | | $V_{CC1}$ = 5.0 V, $V_{EN}$ = 5.0 V | — | 0 | 10 | μA |
| | $I_{EN2}$ | | $V_{CC1}$ = 5.0 V, $V_{EN}$ = 0 V | 0.55 | 0.8 | 1.1 | mA |
| Input Voltage | $V_{INH}$ | — | $V_{CC1}$ = 5.0 V | 2.0 | — | $V_{CC}$ +0.4 | V |
| | $V_{INL}$ | | $V_{CC1}$ = 5.0 V | GND −0.4 | — | 0.8 | |
| | $V_{ENH}$ | | $V_{CC1}$ = 5.0 V | 2.0 | — | $V_{CC}$ +0.4 | |
| | $V_{ENL}$ | | $V_{CC1}$ = 5.0 V | GND −0.4 | — | 0.8 | |
| Output Voltage | $V_{OH1}$ | — | $I_{OH}$ = 1.44 A, $V_{CC2}$ = 30 V | 27.0 | 27.5 | — | V |
| | $V_{OH2}$ | | $I_{OH}$ = 0.18 A, $V_{CC2}$ = 30 V | 27.5 | 28.0 | — | |
| Change Of Output Voltage | $\Delta V_{OH1}$ | — | $V_{OH1} - V_{OH2}$ ($T_j$ = 25°C) | — | 0.3 | 0.45 | V |
| Output Voltage Temperature Characteristic | $\Delta V_{CE2}$ | — | $V_{OH}$ ($T_j$ = 105°C) − $V_{OH}$ ($T_j$ = 25°C) $I_{OH}$ = 0.18 A | — | 0.5 | — | V |
| Propagation Delay Time | $t_{pLH1}$ | — | $V_{CC1}$ = $V_{IN}$ = 4.5 V, $V_{CC2}$ = 30 V, $I_{OUT}$ = 0.18 A | — | 0.1 | 1.0 | μs |
| | $t_{pLH2}$ | | $I_{OUT}$ = 1.44 A | — | 0.2 | 1.0 | |
| | $t_{pHL1}$ | | $I_{OUT}$ = 0.18 A | — | 1.0 | 3.5 | |
| | $t_{pHL2}$ | | $I_{OUT}$ = 1.44 A | — | 1.5 | 3.5 | |
| Rise Time | $t_{r1}$ | — | $V_{CC1}$ = $V_{IN}$ = 4.5 V, $V_{CC2}$ = 30 V, $I_{OUT}$ = 0.18 A | — | 0.05 | 0.5 | |
| | $t_{r2}$ | | $I_{OUT}$ = 1.44 A | — | 0.1 | 0.5 | |
| Fall Time | $t_{f1}$ | | $I_{OUT}$ = 0.18 A | — | 0.3 | 2.0 | |
| | $t_{f2}$ | | $I_{OUT}$ = 1.44 A | — | 0.3 | 2.0 | |

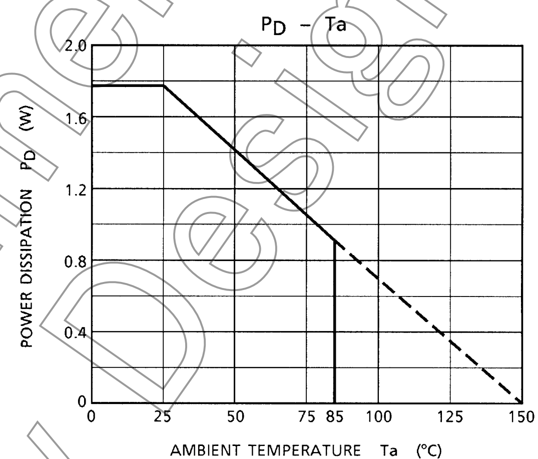
## Ac Test Circuit




ICC1 (ON) – VCC1
CURRENT DISSIPATION ICC1 (ON) (mA)
SUPPLY VOLTAGE VCC1 (V)
– 40°C
25°C
85°C
VIN = VCC1
1ch ON


ICC2 (ON) – VCC2
CURRENT DISSIPATION ICC2 (ON) (mA)
SUPPLY VOLTAGE 2 VCC2 (V)
– 40°C
25°C
85°C
VIN1 = VCC1 = 5.5V
1ch ON


IOH – VOH
OUTPUT CURRENT IOH (A)
OUTPUT VOLTAGE VOH (V)
Ta = 85°C
Ta = 25°C
VIN = VCC1 = 4.5V
VCC2 = 30V


PD – Ta
POWER DISSIPATION PD (W)
AMBIENT TEMPERATURE Ta (°C)

- Thermal calculation

  Where, power dissipation = ($V_{CC1}$ × $I_{CC1}$) + ($V_{CC2}$ × $I_{CC2}$ × ch × Duty) + ($V_{OH}$ × $I_{OH}$ × ch × Duty) and the transient thermal resistance of DIP24N (R + h) = 70°C / W, the junction temperature (Tj) is :

  $T_{j\,(MAX)} \geq (P_D \times R + h) + Ta\,(MAX)$ …………… expression (A)

| |
|---|
| Conditions: $V_{CC1}$ = 5 V ($I_{CC1}$ = approx. 8 mA), $V_{CC2}$ = 30 V ($I_{CC2}$ = approx. 5 mA), 1ch on<br>$V_{OH}$ = approx. 2.0 V, $I_{OH}$ = 1.44 A,<br>$T_{j\,(MAX)}$ = 120°C, ambient temperature (MAX) : Ta = 70°C |

(1) When $V_{CC2}$ and $V_C$ are connected:
Due to expression (a), for designs without cooling fins, duty = approx. 20% is required, as the following calculation shows :

$P_D$ = (5 V × 8 mA) + (30 V × 5 mA × 1ch × 0.2) + (2.0 V × 1.44 A × 1ch × 0.2)
= 40 mW + 30 mW + 576 mW
= 646 mW

$T_{j\,(MAX)} \geq$ (646 mW × 70°C / W) + 70°C = approx. 115°C …………… OK

(2) When an external resistor ($R_{EXT}$ = 0.9 Ω) is connected between $V_{CC2}$ and $V_C$ :
Change the above condition :

$V_{OH}$ = 2.0 V − (0.9 Ω × 1.44 A)
= 0.7 V

$P_D$ when substituted in expression (a) :

$P_D$ = (5 V × 8 mA) + (30 V × 5 mA × 1 × 0.2) + (0.7 V × 1.44 A × 1 × 0.2)
= 40 mW + 30 mW + 202 mW
= 272 mW

$T_{j\,(MAX)} \geq$ (272 mW × 70°C / W) + 70°C = approx. 89°C
when $T_{j\,(MAX)}$ = 120°C

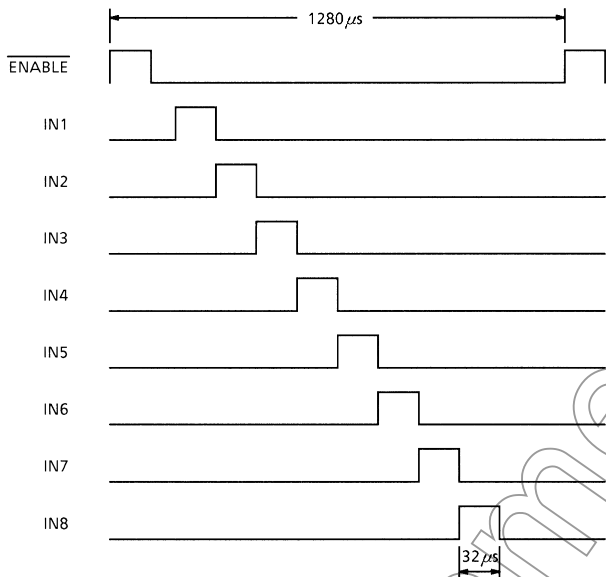
.
. (calculation omitted)
.

Duty can be approx. 58%.

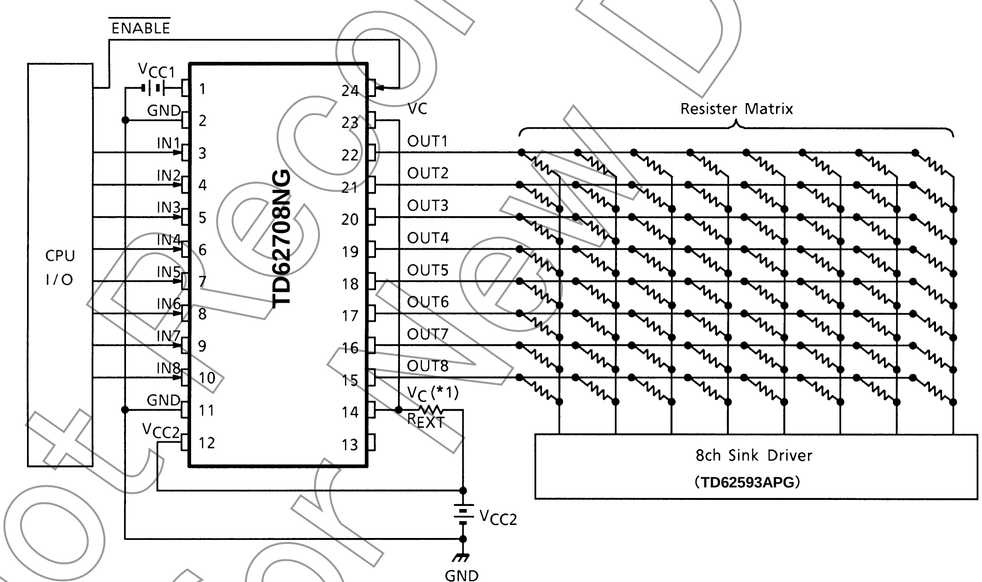
- Duty (when duty = 20%)

  Condition : pulse width = 32 μs (cycle = 1280 μs)

  Duty = (32 μs × 8ch) ÷1280 μs = 20%




## Application Circuit



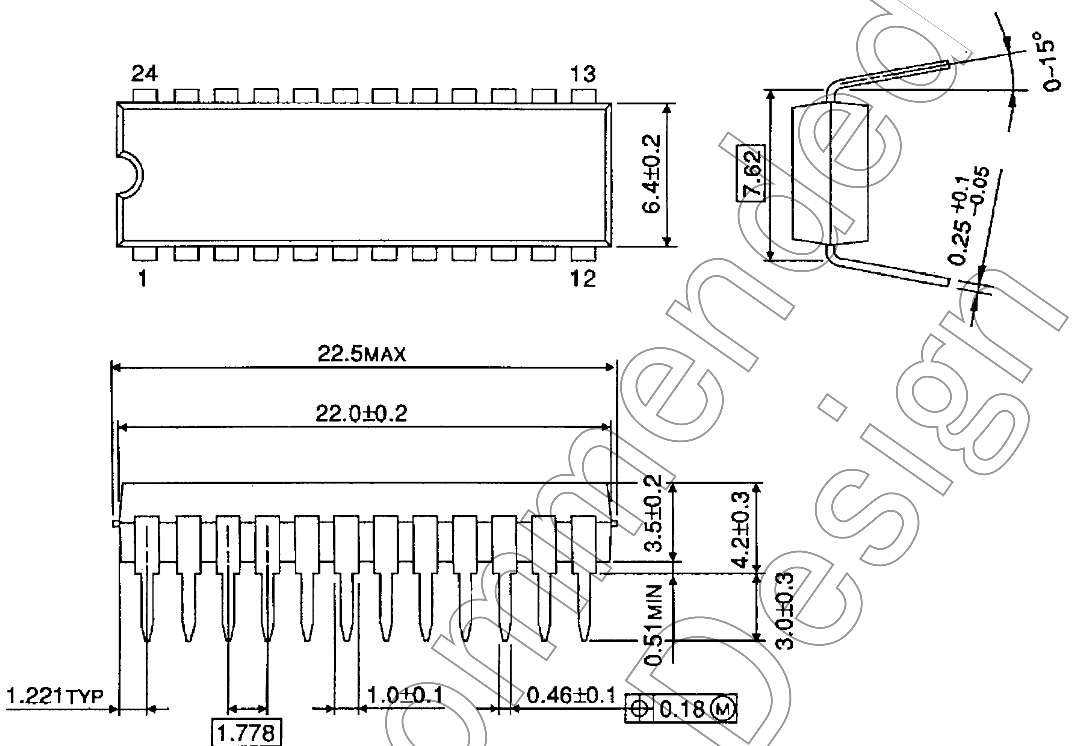

Note 1: TOSHIBA recommends external resistor $R_{EXT}$ (approx. 0.9 Ω / 2W) be connected between $V_{CC2}$ and $V_C$.

## Precautions for Using

This IC does not include built-in protection circuits for excess current or overvoltage.
If this IC is subjected to excess current or overvoltage, it may be destroyed.
Hence, the utmost care must be taken when systems which incorporate this IC are designed.
Utmost care is necessary in the design of the output line, $V_{CC}$ ($V_{CC1}$, $V_{CC2}$, $V_C$) and GND line since IC may be destroyed due to short−circuit between outputs, air contamination fault, or fault by improper grounding.

## Package Dimensions

SDIP24-P-300-1.78 Unit : mm




Weight: 1.2 g (typ.)

## Notes on Contents

### 1. Equivalent Circuits

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

### 2. Application Circuits

The application circuits shown in this document are provided for reference purposes only.
Thorough evaluation is required, especially at the mass production design stage.
Toshiba does not grant any license to any industrial property rights by providing these examples of application circuits.

## 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) 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.

(3) 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.

(4) 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.

(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

(1) 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 (Tj) 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.

(2) 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.

About solderability, following conditions were confirmed

- Solderability

(1) Use of Sn-37Pb solder Bath
- · solder bath temperature = 230°C
- · dipping time = 5 seconds
- · the number of times = once
- · use of R-type flux

(2) Use of Sn-3.0Ag-0.5Cu solder Bath
- · solder bath temperature = 245°C
- · dipping time = 5 seconds
- · the number of times = once
- · use of R-type flux