

TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

TA8276HQ

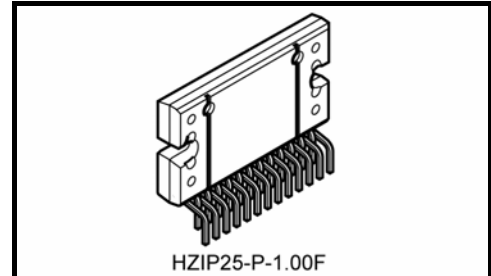
Max Power 35 W BTL × 4 ch Audio Power IC

The TA8276HQ is 4 ch BTL audio power amplifier for car audio application.

This IC can generate more high power: $POUTMAX = 35\text{ W}$ as it is included the pure complementary PNP and NPN transistor output stage.

It is designed low distortion ratio for 4 ch BTL audio power amplifier, built-in stand-by function, muting function, output clipping detection and diagnosis circuit which can detect output to VCC/GND short and over voltage input mode.

Additionally, the AUX amplifier and various kind of protector for car audio use are built-in.



Weight: 7.7 g (typ.)

Features

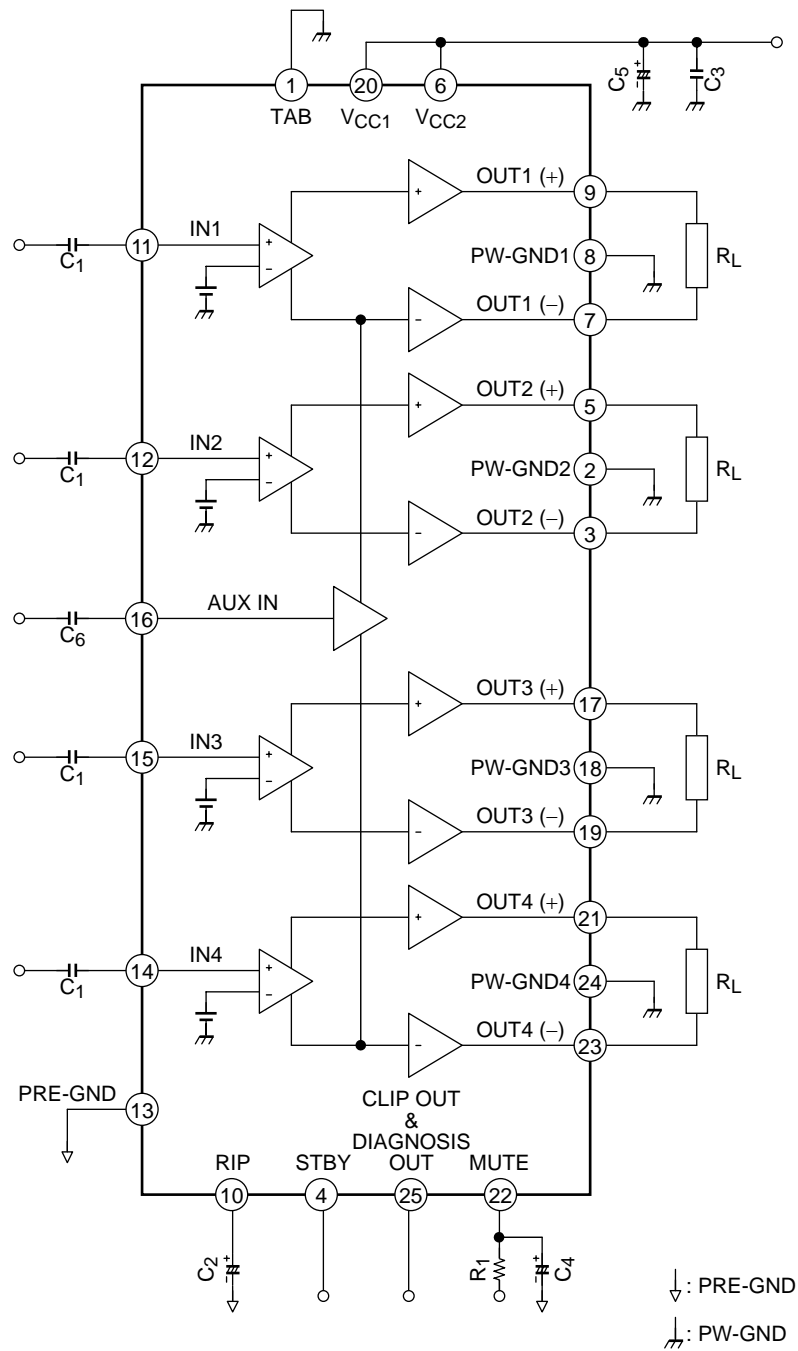
- High power: $POUTMAX (1) = 35\text{ W}$ (typ.)
 $(VCC = 14.4\text{ V}, f = 1\text{ kHz}, JEITA\text{ max}, R_L = 4\ \Omega)$
 : $POUTMAX (2) = 31\text{ W}$ (typ.)
 $(VCC = 13.7\text{ V}, f = 1\text{ kHz}, JEITA\text{ max}, R_L = 4\ \Omega)$
 : $POUT (1) = 23\text{ W}$ (typ.)
 $(VCC = 14.4\text{ V}, f = 1\text{ kHz}, THD = 10\%, R_L = 4\ \Omega)$
 : $POUT (2) = 20\text{ W}$ (typ.)
 $(VCC = 13.2\text{ V}, f = 1\text{ kHz}, THD = 10\%, R_L = 4\ \Omega)$
- Built-in output clipping detection and diagnosis circuit (pin 25)
- Low distortion ratio: $THD = 0.02\%$ (typ.)
 $(VCC = 13.2\text{ V}, f = 1\text{ kHz}, POUT = 5\text{ W}, R_L = 4\ \Omega)$
- Low noise: $V_{NO} = 0.10\text{ mVrms}$ (typ.)
 1. $(VCC = 13.2\text{ V}, R_g = 0\ \Omega, G_V = 26\text{ dB}, BW = 20\text{ Hz}\sim 20\text{ kHz})$
- Built-in stand-by switch (pin 4)
- Built-in muting function (pin 22)
- Built-in AUX amplifier from single input to 2 channels output (pin 16)
- Built-in various protection circuit
 : Thermal shut down, over voltage, out to GND, out to VCC, out to out short, speaker burned
- Operating supply voltage: $VCC_{(opr)} = 9\sim 18\text{ V}$

Note 1: Install the product correctly. Otherwise, it may result in break down, damage and/or degradation to the product or equipment.

Note 2: These protection functions are intended to avoid some output short circuits or other abnormal conditions temporarily. These protect functions do not warrant to prevent the IC from being damaged.

- In case of the product would be operated with exceeded guaranteed operating ranges, these protection features may not operate and some output short circuits may result in the IC being damaged.

Block Diagram



Note3: Some of the functional blocks, circuits, or constants in the block diagram may be omitted or simplified for explanatory purpose.

Caution and Application Method
(Description is made only on the single channel.)

1. Voltage Gain Adjustment

This IC has no NF (negative feedback) terminals. Therefore, the voltage gain can't adjusted, but it makes the device a space and total costs saver.

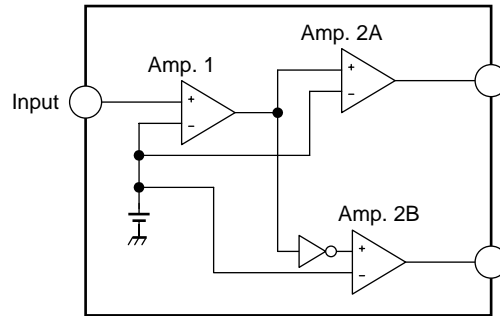


Figure 1 Block Diagram

The voltage gain of Amp.1: $G_{V1} = 0 \text{ dB}$

The voltage gain of Amp.2A, B: $G_{V2} = 20 \text{ dB}$

The voltage gain of BLT Connection: $G_V \text{ (BTL)} = 6 \text{ dB}$

Therefore, the total voltage gain is decided by expression below.

$$G_V = G_{V1} + G_{V2} + G_V \text{ (BTL)} = 0 + 20 + 6 = 26 \text{ dB}$$

2. Stand-by SW Function (pin 4)

By means of controlling pin 4 (stand-by terminal) to high and low, the power supply can be set to ON and OFF. The threshold voltage of pin 4 is set at about $3V_{BE}$ (typ.), and the power supply current is about $2 \mu\text{A}$ (typ.) at the stand-by state.

Control Voltage of pin 4: V_{SB}

| Stand-by | Power | V_{SB} (V) |
|----------|-------|-----------------|
| ON | OFF | 0~1.5 |
| OFF | ON | $3 \sim V_{CC}$ |

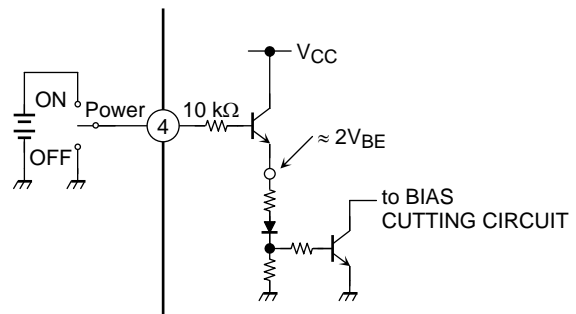


Figure 2 With pin 4 set to High, Power is turned ON

Adjustage of Stand-by SW

- (1) Since V_{CC} can directly be controlled to ON or OFF by the microcomputer, the switching relay can be omitted.
- (2) Since the control current is microscopic, the switching relay of small current capacity is satisfactory for switching

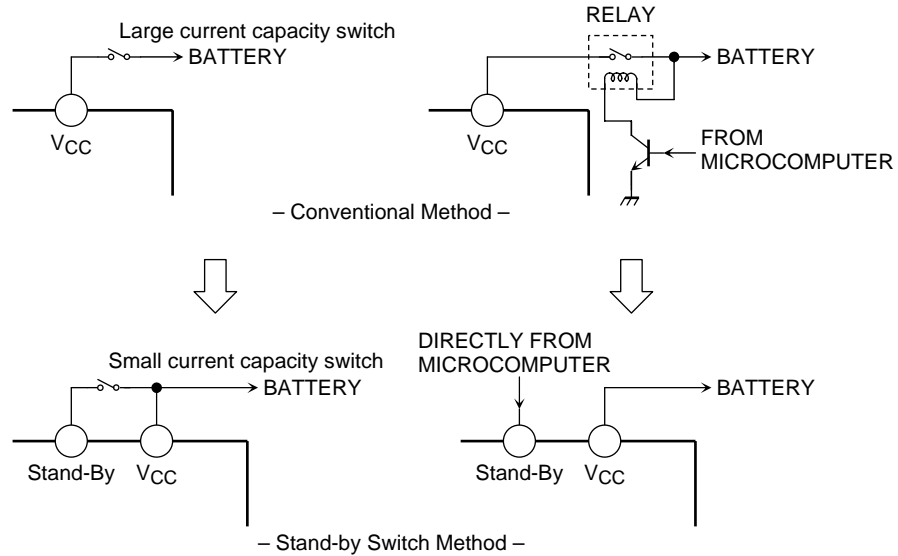


Figure 3

3. Muting Function (pin 22)

By means of controlling pin 22 less than 0.5 V, it can make the audio muting condition.

The muting time constant is decided by R_1 and C_4 and these parts is related the pop noise at power ON/OFF.

The series resistance; R_1 must be set up less than 10 k Ω to get enough muting attenuation.

The muting function have to be controlled by a transistor, FET and μ -COM port which has $I_{MUTE} > 250 \mu A$ ability.

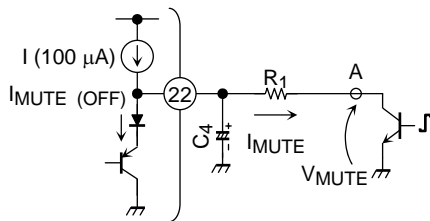
Pin 22 terminal voltage has the temperature characteristics of 4.6 V (low temperature) to 3.2 V (high temperature).

Therefore, it is need to design with attention as using the microcontroller of which operating voltage is less than 5 V.

Terminal 22 may not be pulled up and shall be controlled by OPEN/LOW.

When it is obliged to do, it must be pulled up via diode, because it has to defend flowing reverse current to internal circuit of pin 22.

<Recommended Application>



<Application for pulled up>

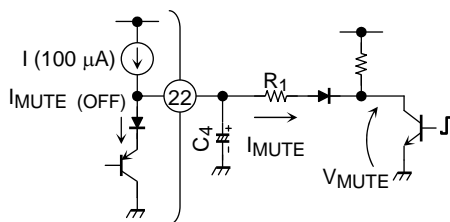


Figure 4 Muting Function

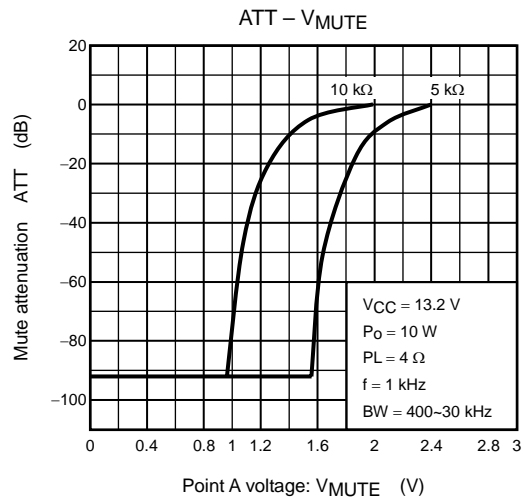


Figure 5 Mute Attenuation – V_{MUTE} (V)

4. AUX Input (pin 16)

The pin 16 is for input terminal of AUX amplifier.

The total gain is 0 dB by using of AUX amplifier.

Therefore, the μ -COM can directly drive the AUX amplifier.

BEEP sound or voice synthesizer signal can be input to pin 16 directly.

When AUX function is not used, this pin must be connected to PRE-GND (pin 13) via a capacitor.

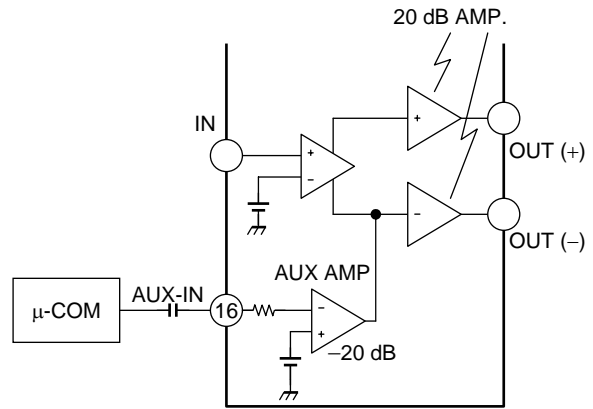


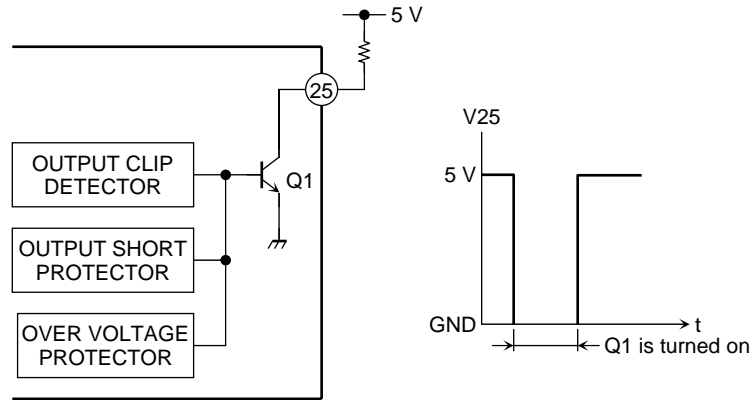
Figure 6 AUX Input

5. Diagnosis Output (pin 25)

This diagnosis output terminal of pin 25 has open collector output structure on chip as shown in Figure 7. In case diagnosis circuit that detect unusual case is operated, NPN Tr. (Q1) is turned on.

It is possible to protect all the system of apparatus as well as power IC protection.

In case of being unused this function, use this IC as open-connection on pin 25.



pin 25: Open collector output (active low)

Figure 7 Self Diagnosis Output

5.1 In Case of Shorting Output to V_{CC}/GND or Over Voltage Power Supplied

NPN Tr. (Q1) is turned on.

Threshold of over voltage protection: V_{CC} = 22 V (typ.)

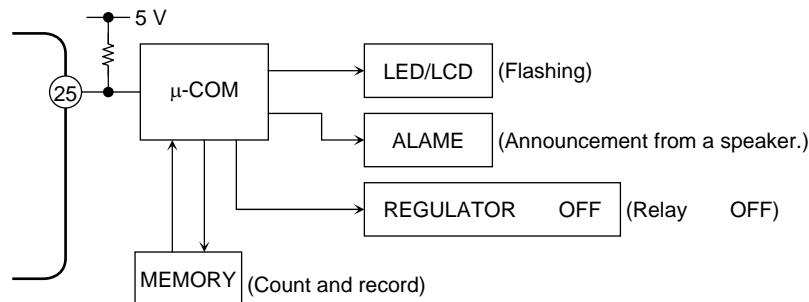


Figure 8 Application 1

5.2 In Case of Shorting Output to Output

NPN Tr. (Q1) is turned on and off in response to the input signal voltage.

5.3 Prevention of speaker burning accident (In Case of Rare Short Circuit of Speaker)

When the direct current resistance between OUT + and OUT - terminal becomes 1 Ω or less and output current over 4 A flows, this IC makes a protection circuit operate and suppresses the current into a speaker. This system makes the burning accident of the speaker prevent as below mechanism.

<The guess mechanism of a burning accident of the speaker>

Abnormal output offset voltage (voltage between OUT + and OUT -) over 4 V is made by the external circuit failure.(Note 4)



The speaker impedance becomes 1 Ω or less as it is in a rare short circuit condition.



The current more than 4 A flows into the speaker and the speaker is burned.

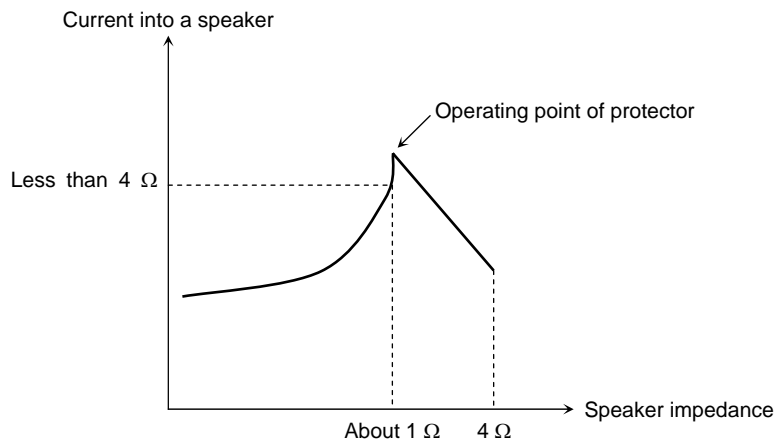


Figure 9

Note 4: It is appeared by biased input DC voltage (for example, large leakage of the input capacitor, short-circuit between copper patterns of PCB.)

5.4 Applications

When output terminals short-circuit to V_{CC} or GND, the voltage of 25pin is fixed to “L”.

And when shorting OUT + to OUT -, “L” and “H” are switched according to an input signal.

Therefore, it is possible to judge how the power IC condition is if a micro-controller detects the 25pin voltage that is smoothed out with LPF.

It is recommend that the threshold voltage (V_{th}) is set up as higher as possible because output level of LPF is changed according to an input signal.

(for example, V_{th} is set up to 4 V if 25pin is pulled up to 5 V line.)

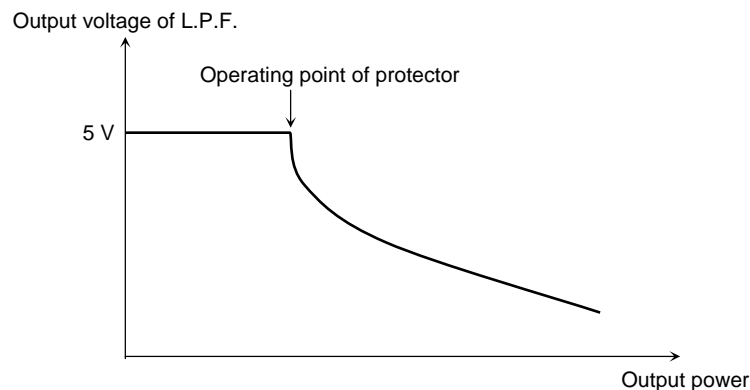


Figure 10

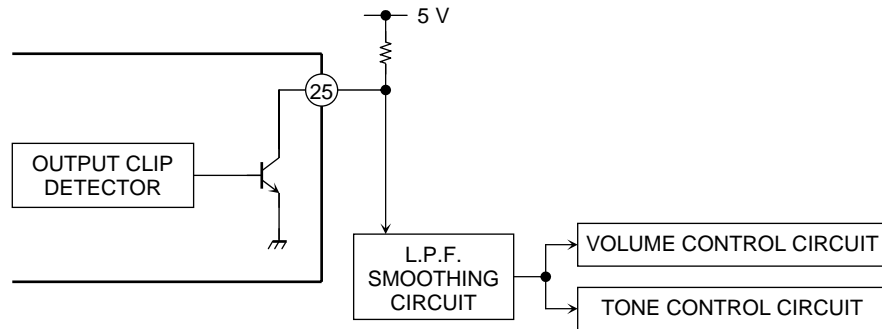
6. Output Clip Detection Function (pin 25)

The output clip detection terminal of pin 25 has the open collector output structure on chip as shown in Figure 11. In case that the output waveform is clipping, the clip detection circuit is operated and NPN Tr. is turned on.

It is possible to improve the audio quality with controlling the volume, tone control circuit through L.P.F. smoothing circuit as shown in Figure 11.

In case of being unused this function, use this IC as open connection on pin 25.

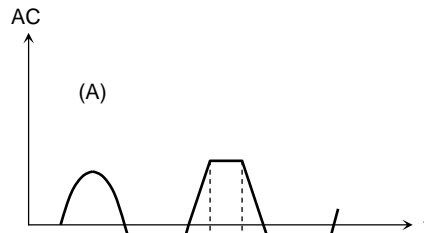
(Application)



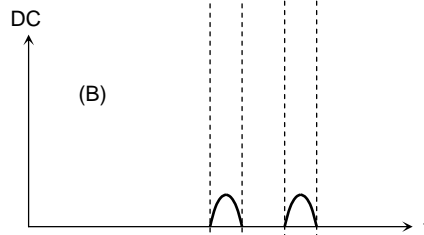
pin 25: Open collector output (active low)

Figure 11

(A) Output (AC wave form)



(B) Clip Detector Circuit (internal)



(C) Clip Detector Terminal (pin 25)

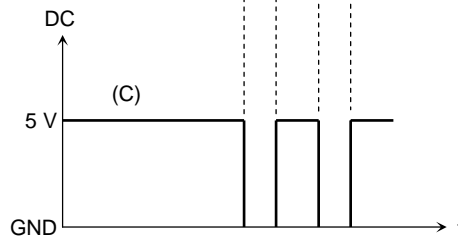


Figure 12 Clip Detection

Maximum Ratings (Ta = 25°C)

| Characteristics | Symbol | Rating | Unit |
|-----------------------------|-------------------------|---------|------|
| Peak supply voltage (0.2 s) | V _{CC} (surge) | 50 | V |
| DC supply voltage | V _{CC} (DC) | 25 | V |
| Operation supply voltage | V _{CC} (opr) | 18 | V |
| Output current (peak) | I _O (peak) | 9 | A |
| Power dissipation | P _D (Note 5) | 125 | W |
| Operation temperature | T _{opr} | -40~85 | °C |
| Storage temperature | T _{stg} | -55~150 | °C |

Note 5: Package thermal resistance $\theta_{j-T} = 1^{\circ}\text{C/W}$ (typ.)
(Ta = 25°C, with infinite heat sink)

The absolute maximum ratings of a semiconductor device are a set of specified parameter values, which must not be exceeded during operation, even for an instant. If any of these rating would be exceeded during operation, the device electrical characteristics may be irreparably altered and the reliability and lifetime of the device can no longer be guaranteed. Moreover, these operations with exceeded ratings may cause break down, damage and/or degradation to any other equipment. Applications using the device should be designed such that each maximum rating will never be exceeded in any operating conditions. Before using, creating and/or producing designs, refer to and comply with the precautions and conditions set forth in this documents.

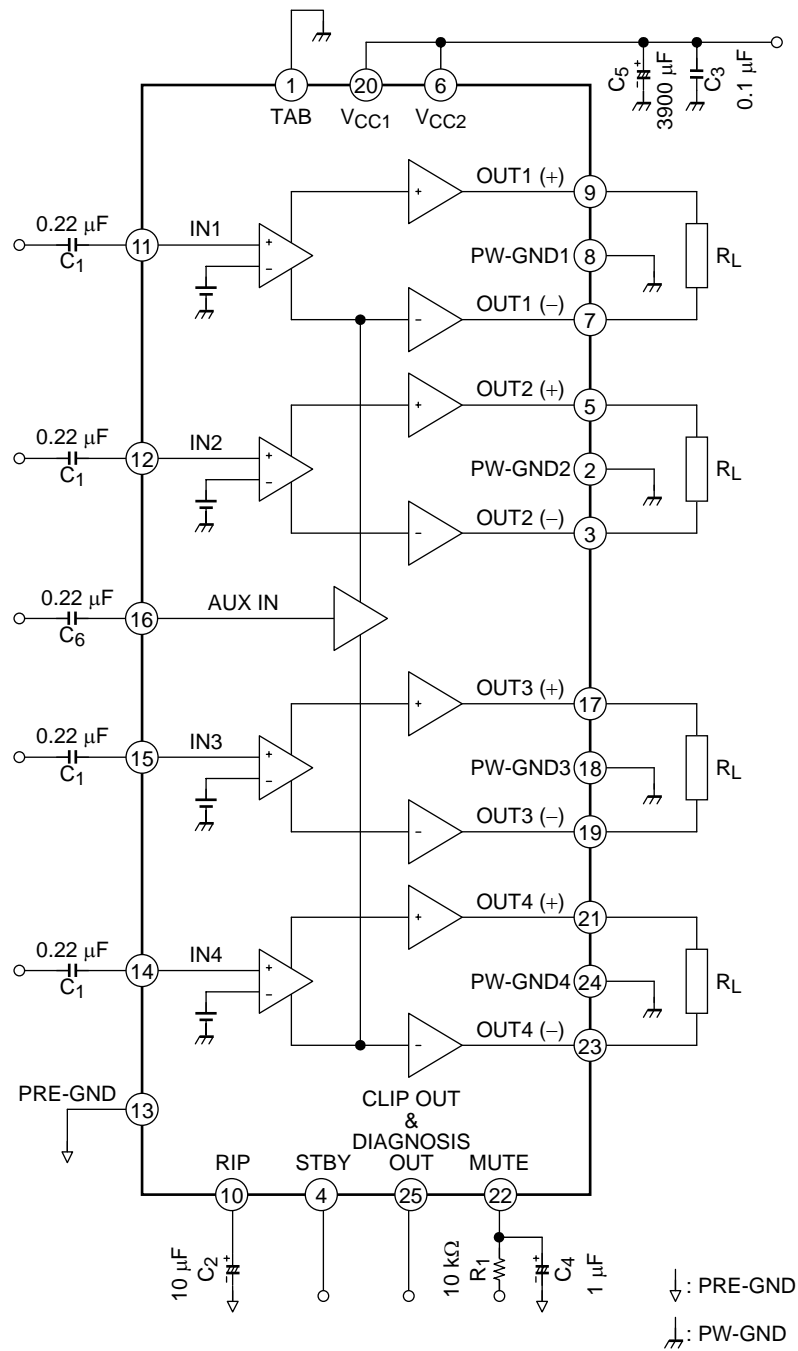
Electrical Characteristics

(unless otherwise specified, V_{CC} = 13.2 V, f = 1 kHz, R_L = 4 Ω, Ta = 25°C)

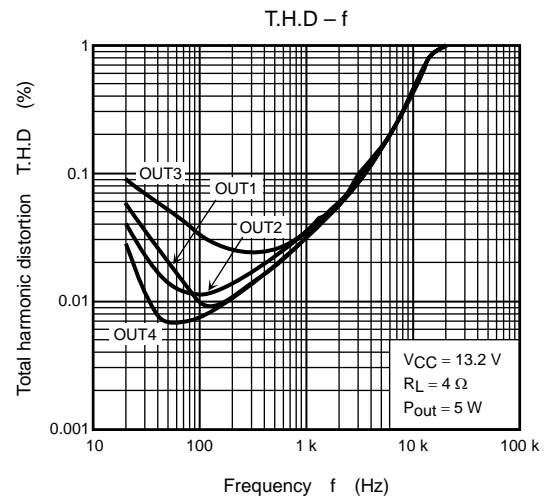
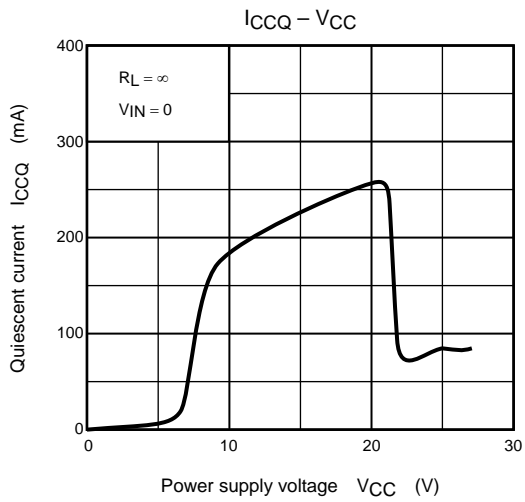
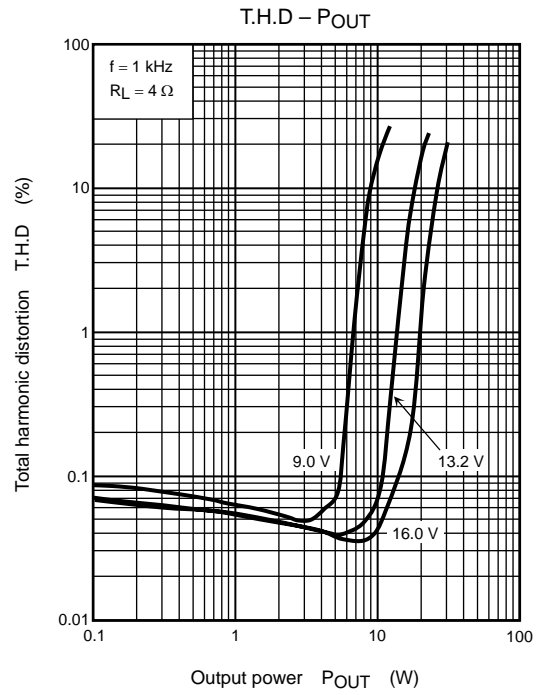
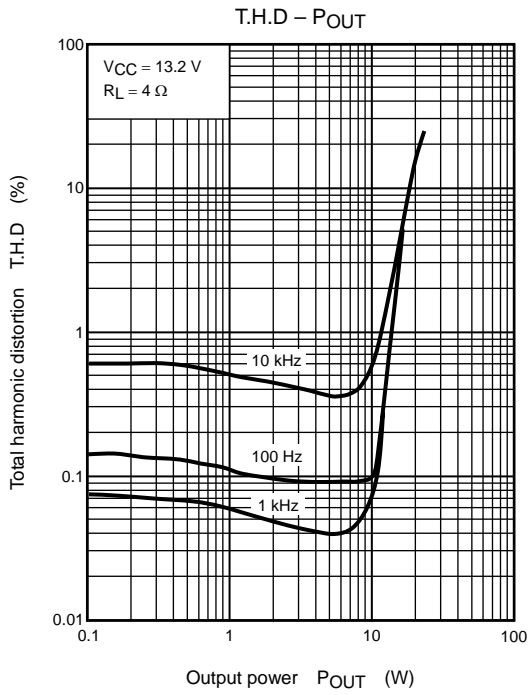
| Characteristics | Symbol | Test Circuit | Test Condition | Min | Typ. | Max | Unit |
|-------------------------------|--------------------------|--------------|--|------|------|-----------------|-------------------|
| Quiescent current | I _{CCQ} | — | V _{IN} = 0 | — | 200 | 400 | mA |
| Output power | P _{OUT} MAX (1) | — | V _{CC} = 14.4 V, max Power | — | 35 | — | W |
| | P _{OUT} MAX (2) | — | V _{CC} = 13.7 V, max Power | — | 31 | — | |
| | P _{OUT} (1) | — | V _{CC} = 14.4 V, THD = 10% | — | 23 | — | |
| | P _{OUT} (2) | — | THD = 10% | 17 | 20 | — | |
| Total harmonic distortion | THD | — | P _{OUT} = 5 W | — | 0.02 | 0.2 | % |
| Voltage gain | G _V | — | V _{OUT} = 0.775 V _{rms} (0 dBm) | 24 | 26 | 28 | dB |
| Voltage gain ratio | ΔG _V | — | V _{OUT} = 0.775 V _{rms} (0 dBm) | -1.0 | 0 | 1.0 | |
| Output noise voltage | V _{NO} (1) | — | R _g = 0 Ω, DIN45405 | — | 0.12 | — | mV _{rms} |
| | V _{NO} (2) | — | R _g = 0 Ω, BW = 20 Hz~20 kHz | — | 0.10 | 0.35 | |
| Ripple rejection ratio | R.R. | — | f _{rip} = 100 Hz, R _g = 620 Ω V _{rip} = 0.775 V _{rms} (0 dBm) | 40 | 50 | — | dB |
| Cross talk | C.T. | — | R _g = 620 Ω V _{OUT} = 0.775 V _{rms} (0 dBm) | — | 65 | — | dB |
| Output offset voltage | V _{OFFSET} | — | — | -150 | 0 | 150 | mV |
| Input resistance | R _{IN} | — | — | — | 90 | — | kΩ |
| Stand-by current | I _{SB} | — | Stand-by condition | — | 2 | 10 | μA |
| Stand-by control voltage | V _{SB} H | — | Power: ON | 3.0 | — | V _{CC} | V |
| | V _{SB} L | — | Power: OFF | 0 | — | 1.5 | |
| Mute control voltage (Note 2) | V _M H | — | Mute: OFF | Open | | | — |
| | V _M L | — | Mute: ON, R ₁ = 10 kΩ | 0 | — | 0.5 | V |
| Mute attenuation | ATT M | — | Mute: ON, V _{OUT} = 7.75 V _{rms} (20 dBm) at Mute: OFF. | 80 | 90 | — | dB |

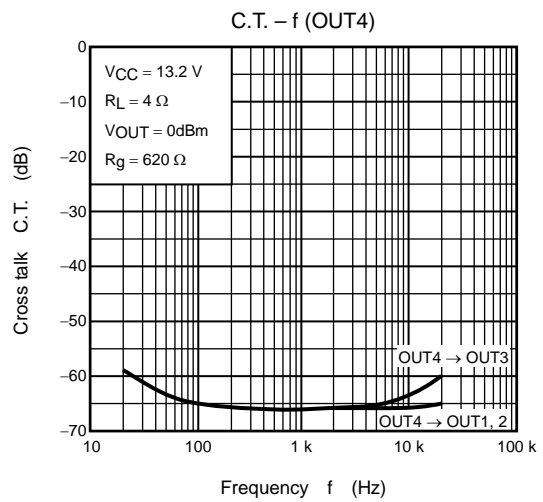
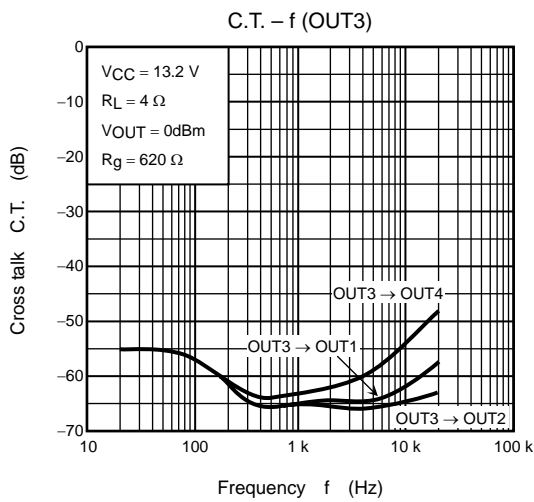
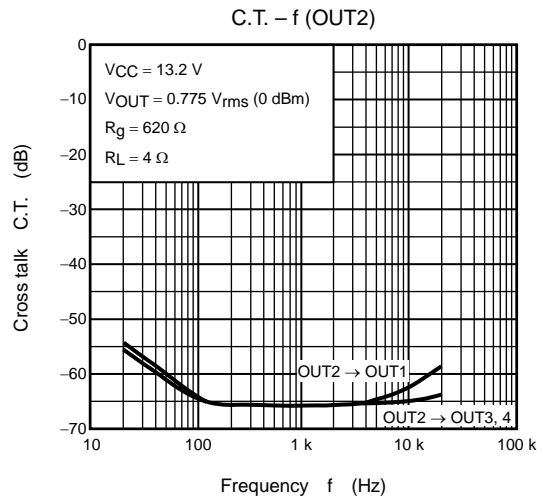
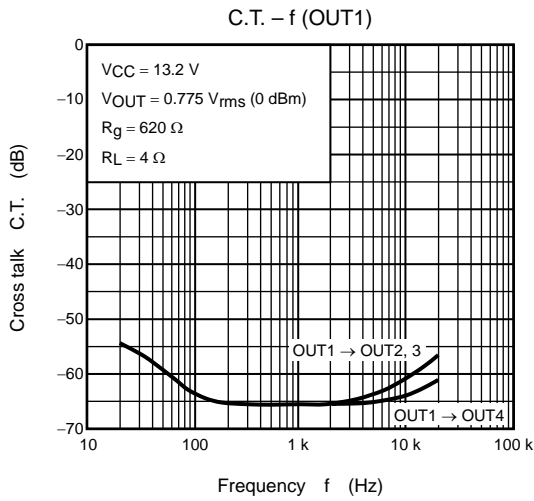
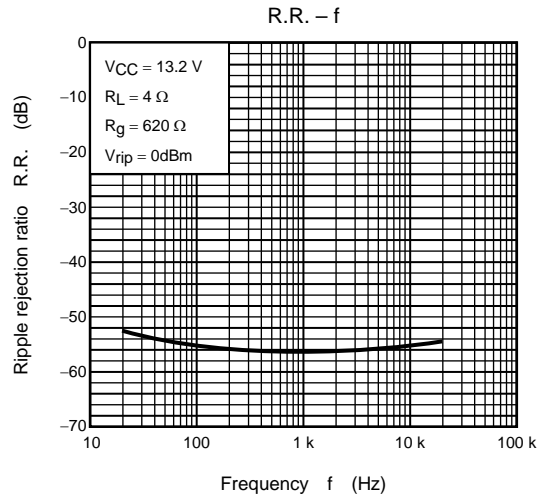
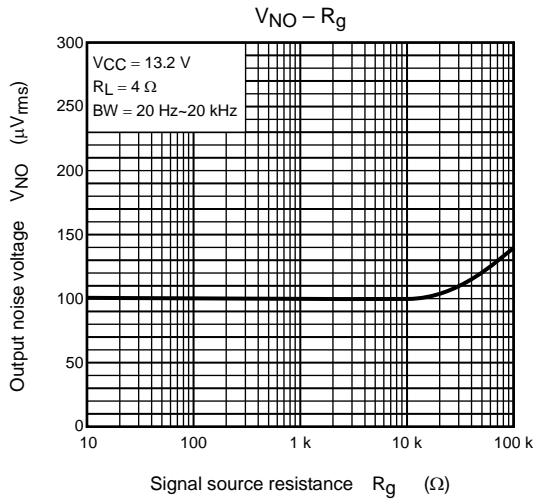
Note 2: Muting function have to be controlled by open and low logic, which logic is a transistor, FET and μ-COM port of I_{MUTE} > 250 μA ability. This means than the mute control terminal : pin 22 must not be pulled-up.

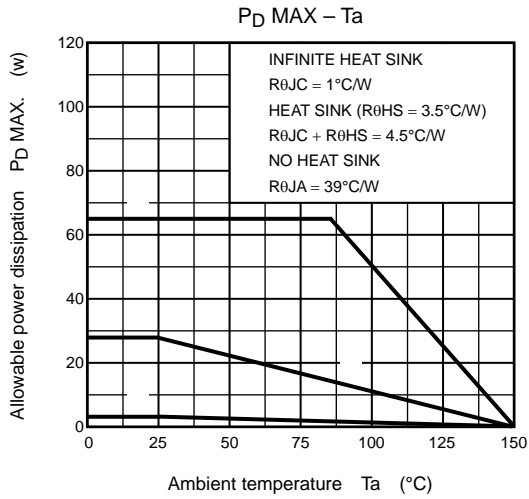
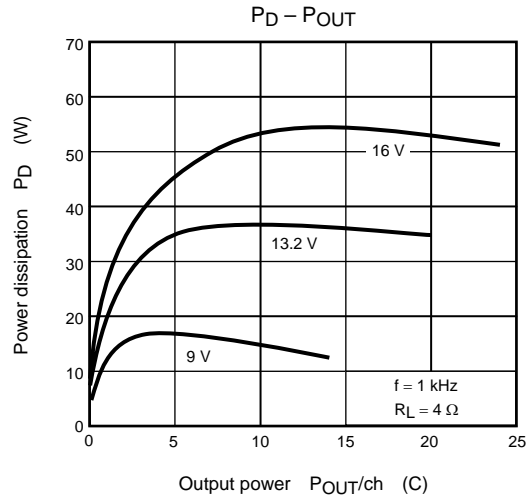
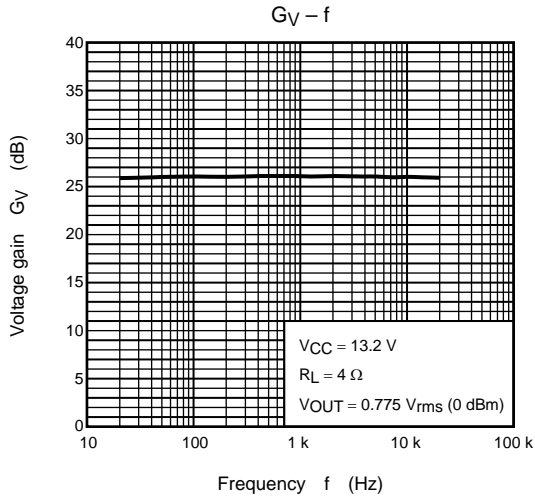
Test Circuit



Components in the test circuits are only used to obtain and confirm the device characteristics.
 These components and circuits do not warrant to prevent the application equipment from malfunction or failure.



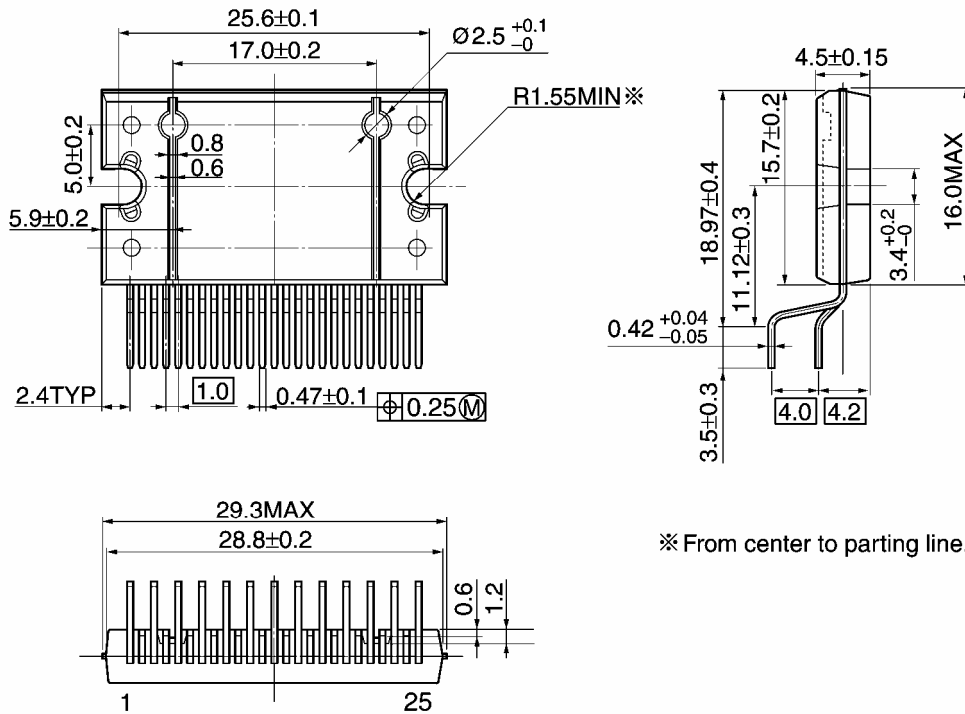




Package Dimensions

HZIP25-P-1.00F

Unit: mm



※ From center to parting line.

Weight: 7.7 g (typ.)

About solderability, following conditions were confirmed

- Solderability

- (1) Use of Sn-63Pb 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

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