TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

TA8273HQ

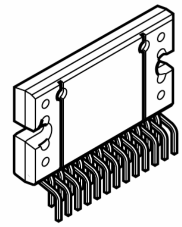
Max Power 47 W BTL × 4 ch Audio Power IC

The TA8273HQ is 4 ch BTL audio power amplifier for car audio application.

This IC can generate more high power: $P_{OUT}MAX$ = 47 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, and diagnosis circuit which can detect output to V_{CC}/GND short, output offset voltage and over voltage input mode.

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



HZIP25-P-1.00F

Weight: 7.7 g (typ.)

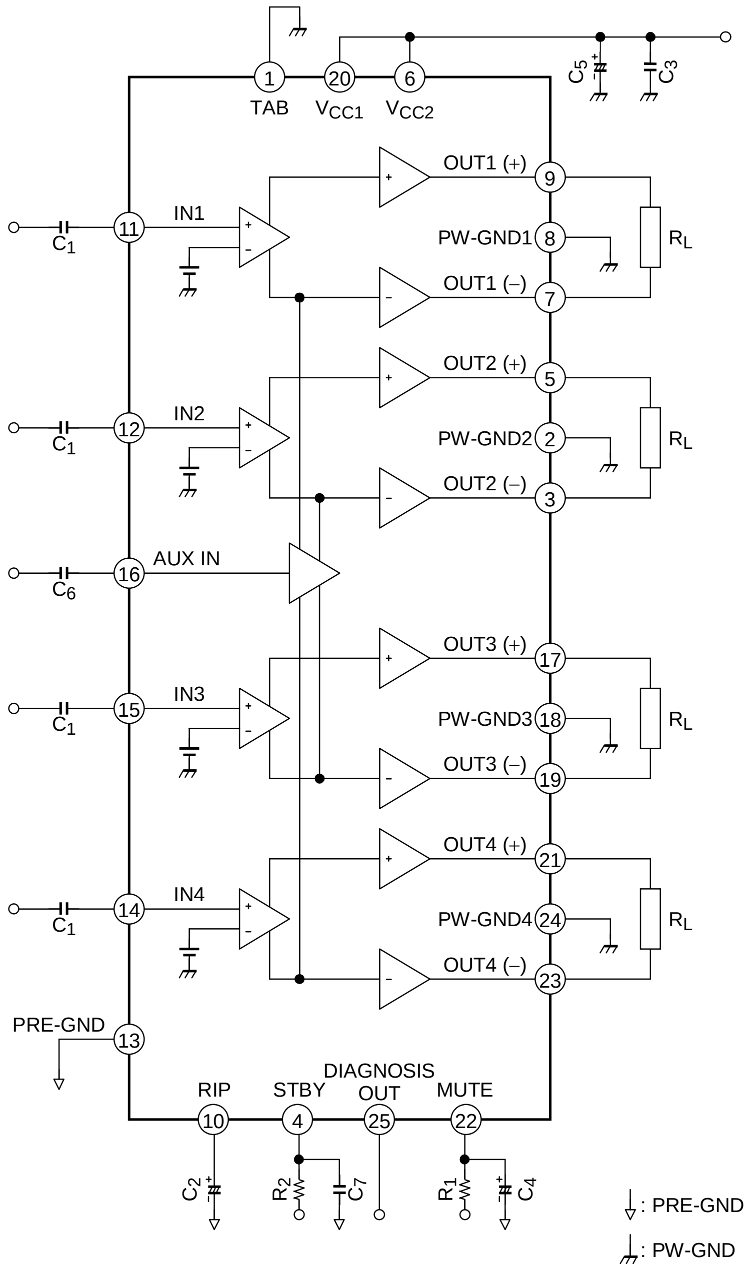
Features

- High power: $P_{OUT}MAX$ (1) = 47 W (typ.)
  (V_{CC} = 14.4 V, f = 1 kHz, JEITA max, R_L = 4 Ω)
  : $P_{OUT}MAX$ (2) = 43 W (typ.)
  (V_{CC} = 13.7 V, f = 1 kHz, JEITA max, R_L = 4 Ω)
  : P_{OUT} (1) = 29 W (typ.)
  (V_{CC} = 14.4 V, f = 1 kHz, THD = 10%, R_L = 4 Ω)
  : P_{OUT} (2) = 25 W (typ.)
  (V_{CC} = 13.2 V, f = 1 kHz, THD = 10%, R_L = 4 Ω)
- Built-in diagnosis circuit (pin 25)
- Low distortion ratio: THD = 0.02% (typ.)
  (V_{CC} = 13.2 V, f = 1 kHz, P_{OUT} = 5 W, R_L = 4 Ω)
- Low noise: V_{NO} = 0.10 mVrms (typ.)
  (V_{CC} = 13.2 V, R_g = 0 Ω, G_V = 27dB, BW = 20 Hz~20 kHz)
- Built-in stand-by switch function (pin 4)
- Built-in muting function (pin 22)
- Built-in AUX amplifier from single input to 4 channels output (pin 16)
- Built-in various protection circuit
  : Thermal shut down, over voltage, out to GND, out to V_{CC}, out to out short
- Operating supply voltage: $V_{CC\ (opr)}$ = 9~16 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.

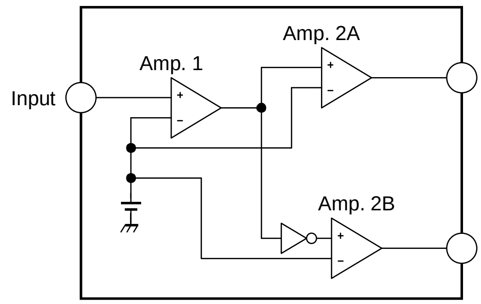


Figure 1 Block Diagram

The voltage gain of Amp.1 : $G_{V1} = 1dB$
The voltage gain of Amp.2A, B : $G_{V2} = 20dB$
The voltage gain of BLT Connection : $G_{V\ (BTL)} = 6dB$

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

$G_V = G_{V1} + G_{V2} + G_{V\ (BTL)} = 1 + 20 + 6 = 27dB$

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 μA (typ.) at the stand-by state.

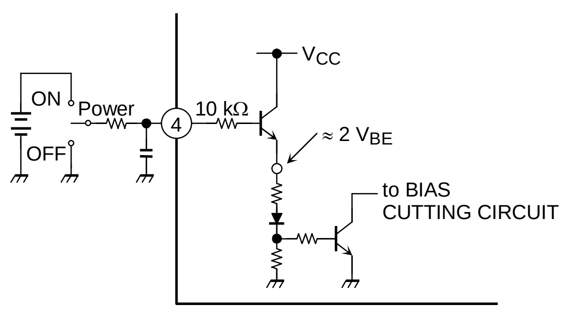


Figure 2 With pin 4 set to High, Power is turned ON

Control Voltage of pin 4: V_{SB}

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

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

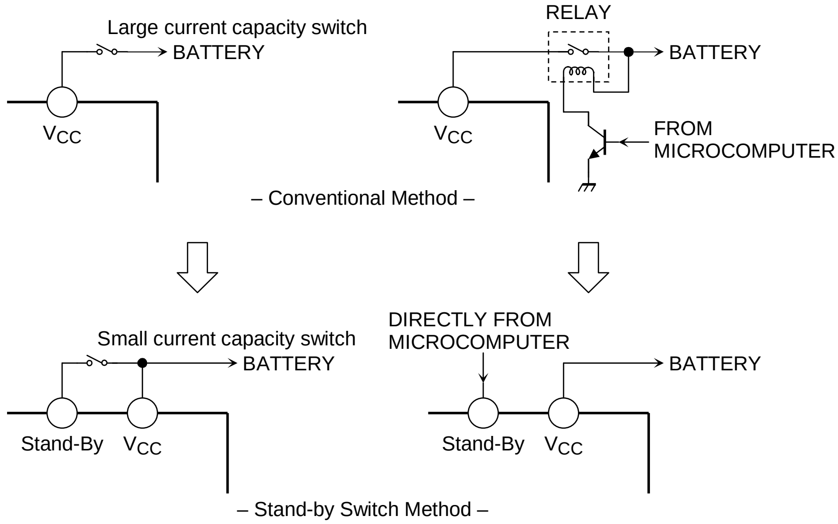


Figure 3

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; R1 must be set up less than 10 kΩ 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 μA ability.

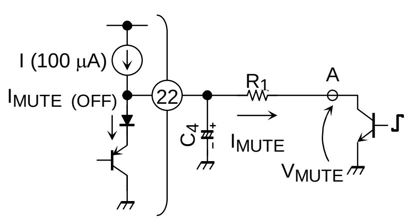
Pin 22 terminal voltage has the temperature characteristics of 4.6 V (low temperature) to 3.2 V (high temperature).

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

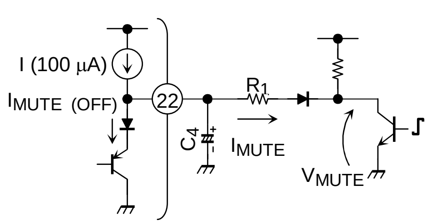
Terminal 22 may not be pulled up and shall be controlled by OPEN/LOW.

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>



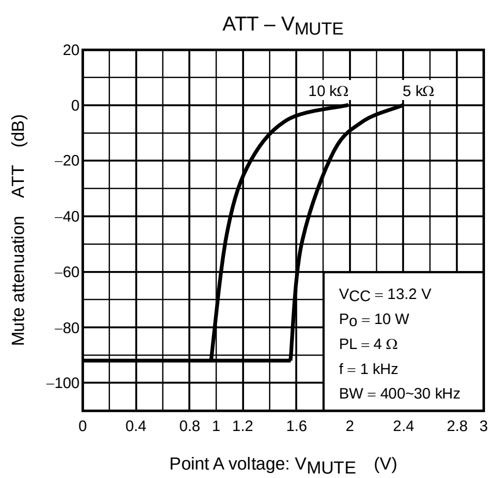


Figure 4 Muting Function **Figure 5 Mute Attenuation – V_{MUTE} (V)**

4. AUX Input (pin 16)

The pin 16 is for input terminal of AUX amplifier.

The total gain is 0dB 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.

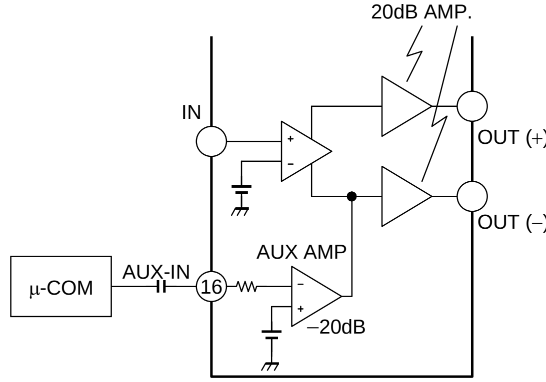
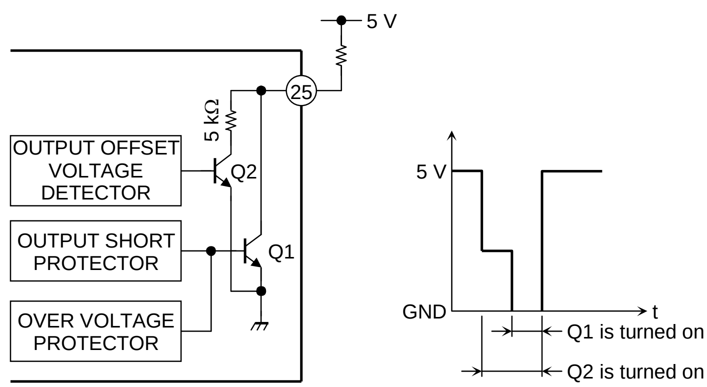


Figure 6 AUX Input

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 transistor (Q1) or (Q2) 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 transistor (Q1) is turned on.

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

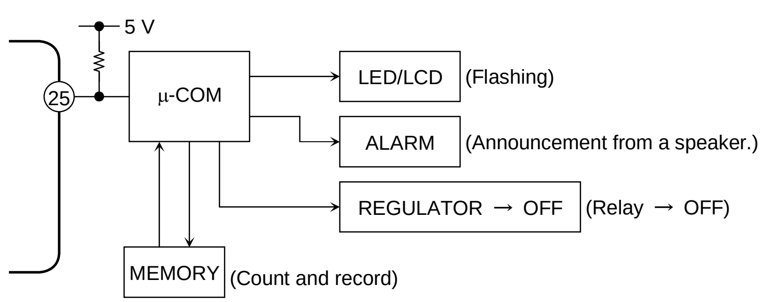


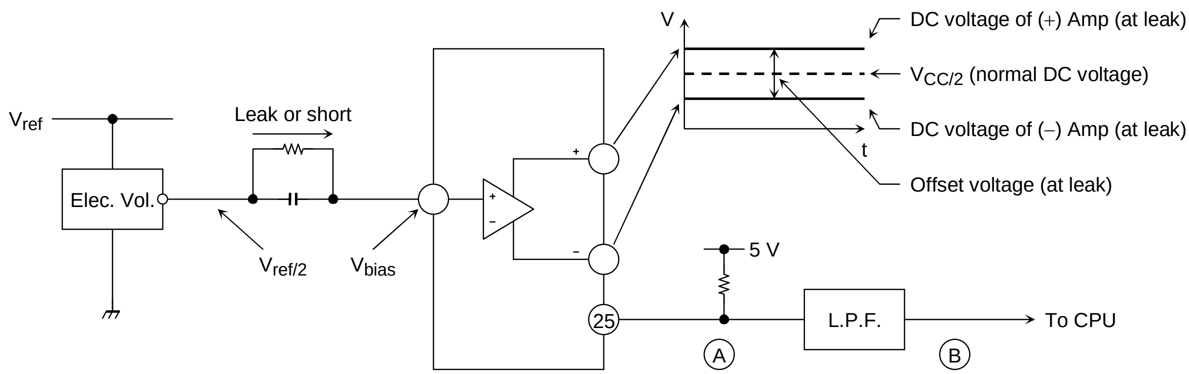
Figure 8 Application 1

5.2 In Case of Shorting Output to Output

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

5.3 In Case of Appearing Output Offset Voltage by Generating a Large Leakage Current on the Input Capacitor etc.

NPN transistor (Q2) is turned on while the inverted output voltage level become less than the threshold level of output offset voltage detector.



*: It is possible to detect the abnormal output offset which is appeared by the large leakage of the input capacitor at $V_{ref/2} > V_{bias}$ (about 1.4 V)

Figure 9 Application and Detection Mechanism

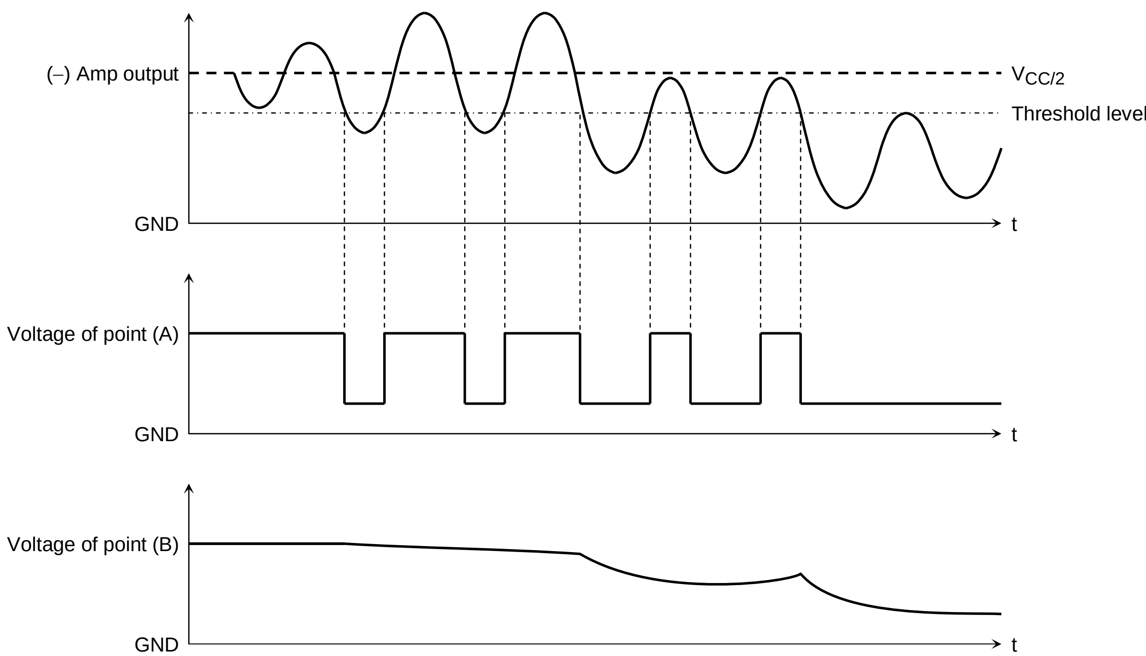


Figure 10 Wave Form

Absolute 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	$V_{CC\ (opr)}$	16	V
Output current (peak)	$I_{O\ (peak)}$	9	A
Power dissipation	P_D (Note4)	125	W
Operation temperature	T_{opr}	−40~85	°C
Storage temperature	T_{stg}	−55~150	°C

Note4 : Package thermal resistance θj-T = 1°C/W (typ.)
(Ta = 25°C, with infinite heat sink)

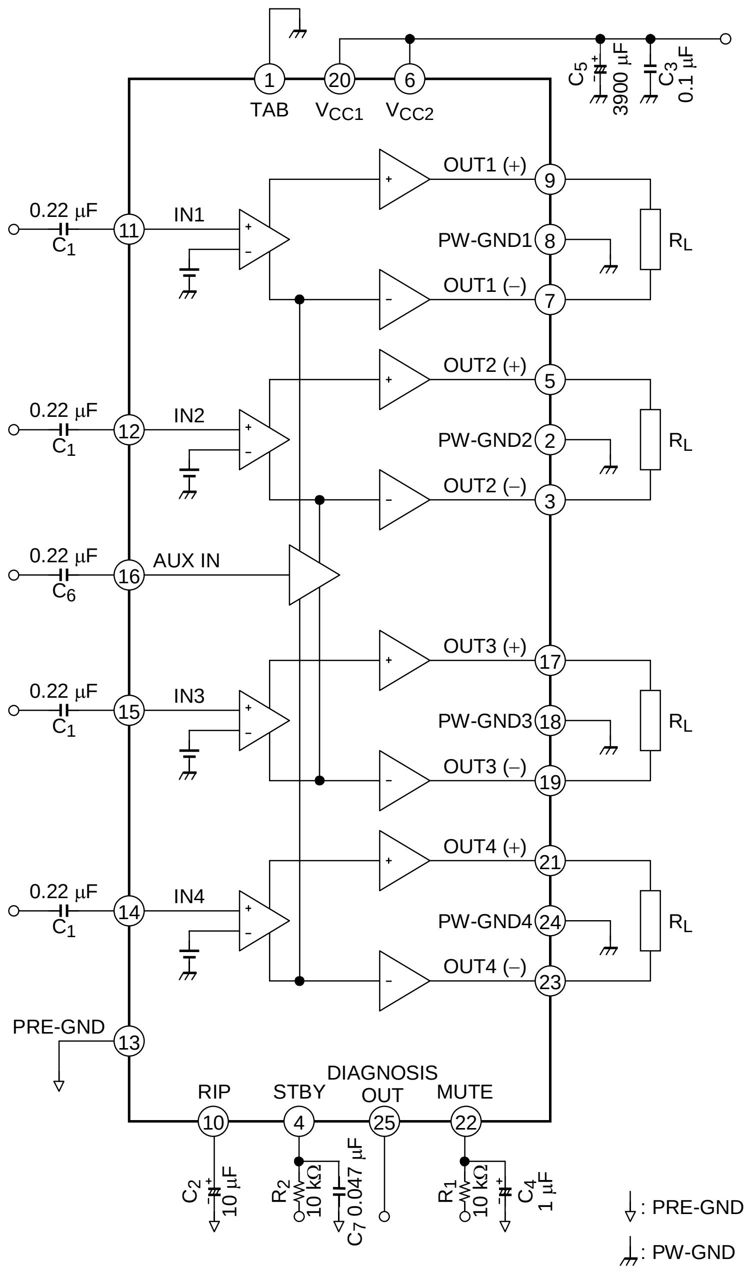
The absolute maximum ratings of a semiconductor device are a set of specified parameter values, which must not be exceeded during operation, even for an instant. If any of these rating would be exceeded during operation, the device electrical characteristics may be irreparably altered and the reliability 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 absolute 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)

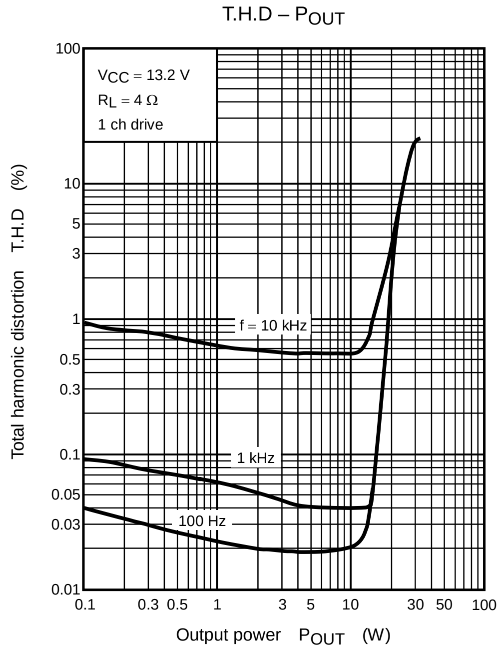
Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Quiescent current	I_{CCQ}	—	V_{IN} = 0	—	200	400	mA
Output power	P_{OUT} MAX (1)	—	V_{CC} = 14.4 V, max Power	—	47	—	W
	P_{OUT} MAX (2)	—	V_{CC} = 13.7 V, max Power	—	43	—	
	P_{OUT} (1)	—	V_{CC} = 14.4 V, THD = 10%	—	29	—	
	P_{OUT} (2)	—	THD = 10%	23	25	—	
Total harmonic distortion	THD	—	P_{OUT} = 5 W	—	0.02	0.2	%
Voltage gain	G_V	—	V_{OUT} = 0.775 Vrms (0dBm)	25	27	29	dB
Voltage gain ratio	ΔG_V	—	V_{OUT} = 0.775 Vrms (0dBm)	−1.0	0	1.0	
Output noise voltage	V_{NO} (1)	—	Rg = 0 Ω, DIN45405	—	0.12	—	mVrms
	V_{NO} (2)	—	Rg = 0 Ω, BW = 20 Hz~20 kHz	—	0.10	0.35	
Ripple rejection ratio	R.R.	—	f_{rip} = 100 Hz, Rg = 620 Ω V_{rip} = 0.775 Vrms (0dBm)	40	50	—	dB
Cross talk	C.T.	—	Rg = 620 Ω V_{OUT} = 0.775 Vrms (0dBm)	—	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 (Note5)	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 Vrms (20dBm) at Mute: OFF.	80	90	—	dB

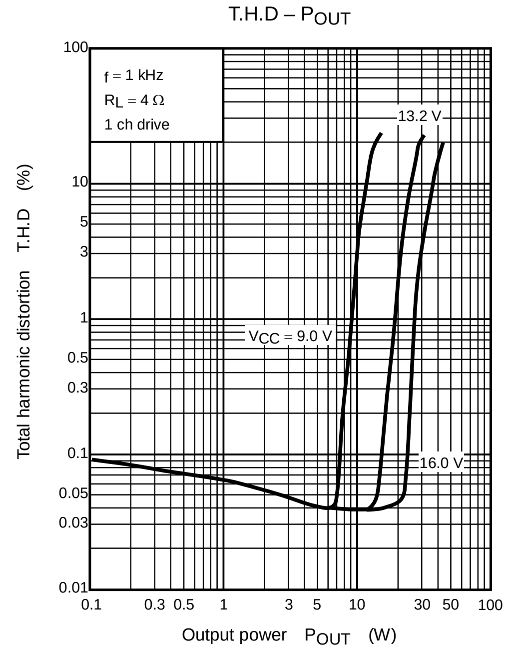
Note 5: Muting function have to be controlled by open and low logic, which logic is a transistor, FET and μ-COM port of I_{MUTE} > 250 μA ability.This means than the mute control terminal : pin 22 must not be pulled-up.

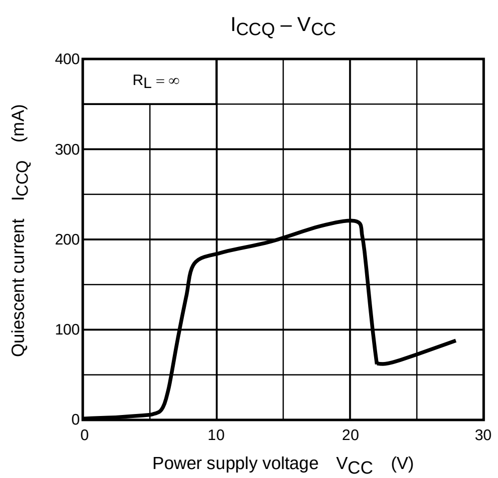
Test Circuit

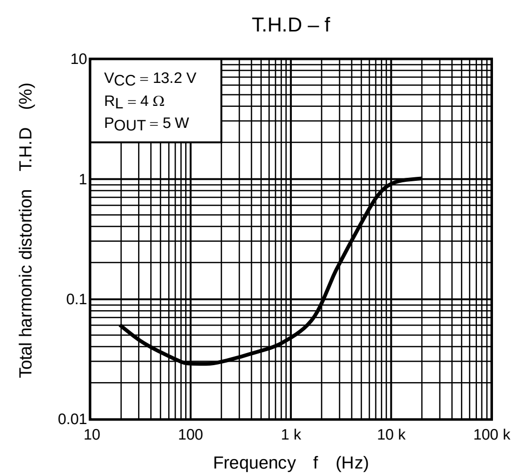


Components in the test circuits are only used to obtain and confirm the device characteristics.
These components and circuits do not warrant to prevent the application equipment from malfunction or failure.

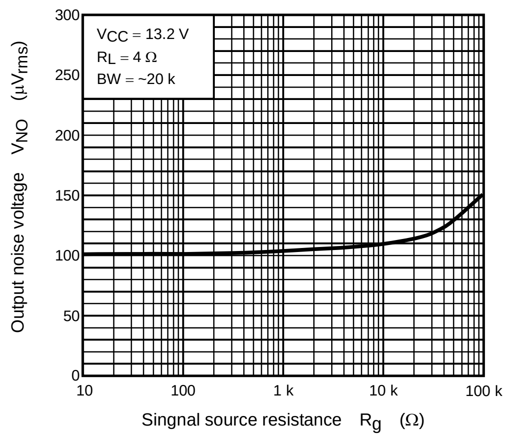

T.H.D – POUT
VCC = 13.2 V
RL = 4 Ω
1 ch drive
f = 10 kHz
1 kHz
100 Hz
Total harmonic distortion T.H.D (%)
Output power POUT (W)
100
10
5
3
1
0.5
0.3
0.1
0.05
0.03
0.01
0.1
0.3
0.5
1
3
5
10
30
50
100


T.H.D – POUT
f = 1 kHz
RL = 4 Ω
1 ch drive
13.2 V
VCC = 9.0 V
16.0 V
Total harmonic distortion T.H.D (%)
Output power POUT (W)
100
10
5
3
1
0.5
0.3
0.1
0.05
0.03
0.01
0.1
0.3
0.5
1
3
5
10
30
50
100

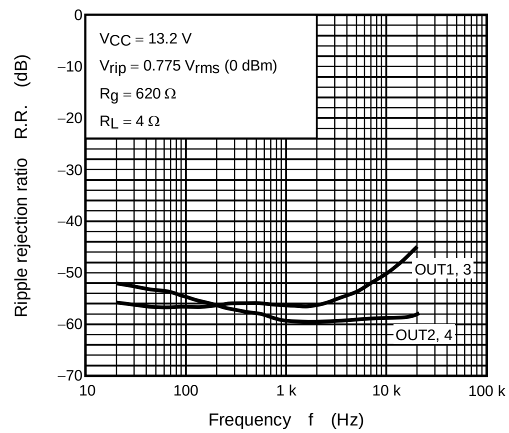

ICCQ – VCC
RL = ∞
Quiescent current ICCQ (mA)
Power supply voltage VCC (V)
400
300
200
100
0
0
10
20
30


T.H.D – f
VCC = 13.2 V
RL = 4 Ω
POUT = 5 W
Total harmonic distortion T.H.D (%)
Frequency f (Hz)
10
1
0.1
0.01
10
100
1 k
10 k
100 k

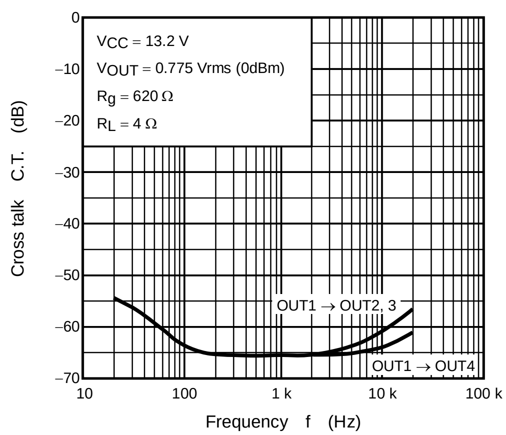
V_{NO} – R_g



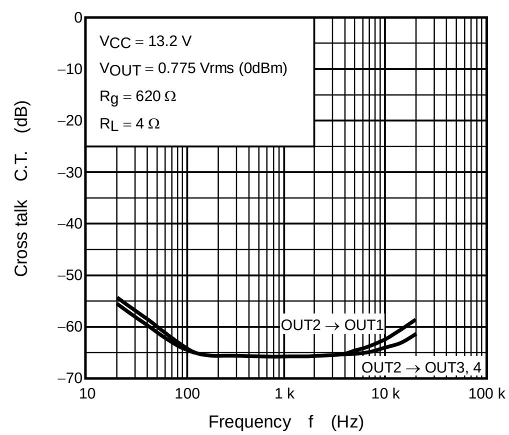
R.R. – f



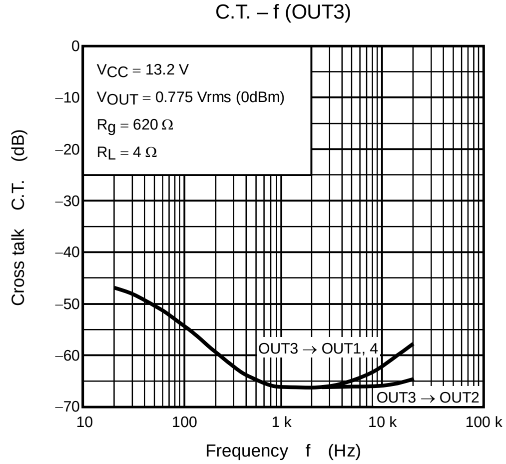
C.T. – f (OUT1)



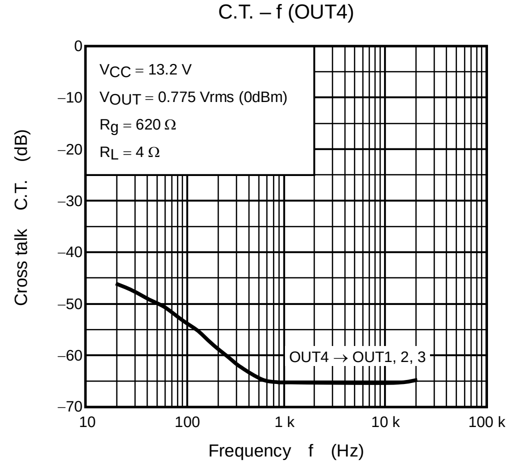
C.T. – f (OUT2)



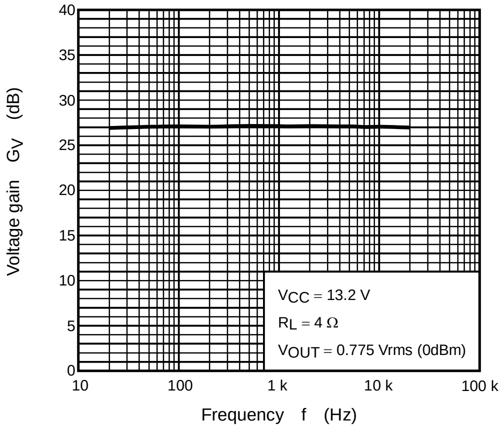
C.T. – f (OUT3)



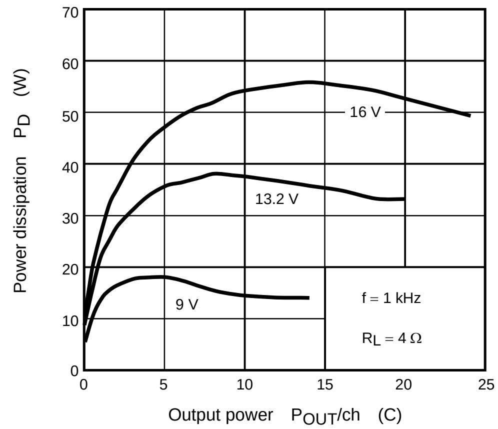
C.T. – f (OUT4)



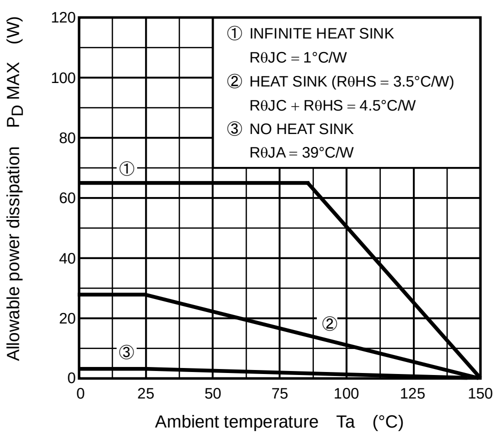
$G_V – f$



$P_D – P_{OUT}$

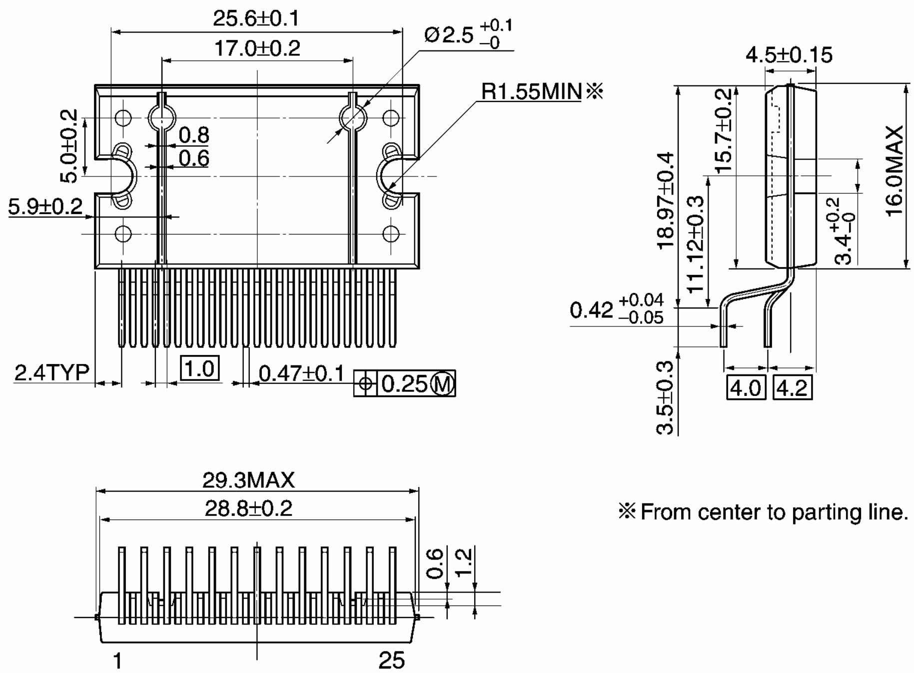


P_D MAX – Ta



Package Dimensions

HZIP25-P-1.00F Unit: mm



Weight: 7.7 g (typ.)

- 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.

- 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. For details on how to connect a protection circuit such as a current limiting resistor or back electromotive force adsorption diode, refer to individual IC datasheets or the IC databook. 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.

- 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.

- Over current Protection Circuit
  Over current protection circuits (referred to as current limiter circuits) do not necessarily protect ICs under all circumstances. If the Over current protection circuits operate against the over current, clear the over current status immediately. Depending on the method of use and usage conditions, such as exceeding absolute maximum ratings can cause the over current protection circuit to not operate properly or IC breakdown before operation. In addition, depending on the method of use and usage conditions, if over current continues to flow for a long time after operation, the IC may generate heat resulting in breakdown.

- Thermal Shutdown Circuit
  Thermal shutdown circuits do not necessarily protect ICs under all circumstances. If the Thermal shutdown circuits operate against the over temperature, clear the heat generation status immediately. Depending on the method of use and usage conditions, such as exceeding absolute maximum ratings can cause the thermal shutdown circuit to not operate properly or IC breakdown before operation.

- Heat Radiation Design
  When 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.

- Installation to Heat Sink
  Please install the power IC to the heat sink not to apply excessive mechanical stress to the IC. Excessive mechanical stress can lead to package cracks, resulting in a reduction in reliability or breakdown of internal IC chip. In addition, depending on the IC, the use of silicon rubber may be prohibited. Check whether the use of silicon rubber is prohibited for the IC you intend to use, or not. For details of power IC heat radiation design and heat sink installation, refer to individual technical datasheets or IC databooks.

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  The product is often the final stage (the external output stage) of a circuit. Substandard performance or malfunction of the destination device to which the circuit supplies output may cause damage to the circuit or to the product. 030619_R

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