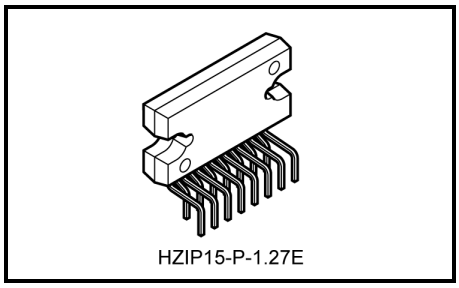
TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

TA8254BHQ

Max Power 45 W BTL × 2 ch Audio Power IC

The TA8254BHQ is BTL stereo audio power amplifier for car audio application, especially for 2 Ω load impedance.

It is built-in Stand-by Function, Muting Function, diagnosis circuit output clipping detector and various kind of protections.

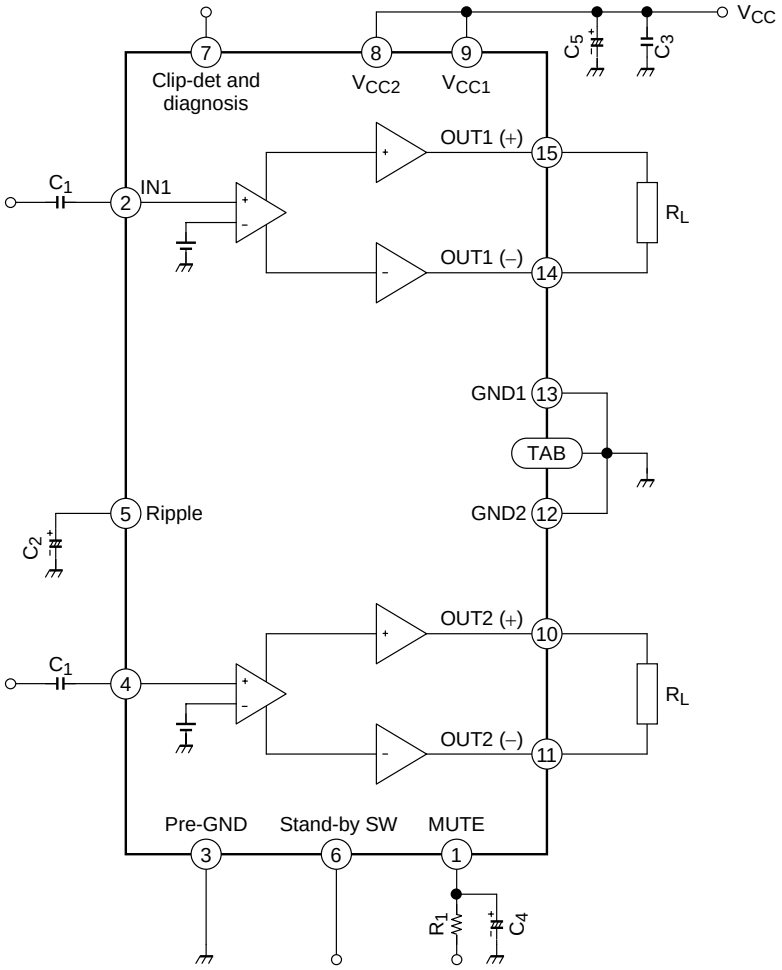


Weight: 4.0 g (typ.)

Features

- High power
  : P_{OUT} (1) = 45 W (typ.) /channel
  (V_{CC} = 14.4 V, f = 1 kHz, THD = 10%, R_L = 2 Ω)
  : P_{OUT} (2) = 35 W (typ.) /channel
  (V_{CC} = 13.2 V, f = 1 kHz, THD = 10%, R_L = 2 Ω)
  : P_{OUT} (3) = 21 W (typ.) /channel
  (V_{CC} = 13.2 V, f = 1 kHz, THD = 10%, R_L = 4 Ω)
- Low distortion ratio
  : THD = 0.02% (typ.)
  (V_{CC} = 13.2 V, f = 1 kHz, P_{OUT} = 10 W, R_L = 4 Ω)
- Low noise
  : V_{NO} = 0.10 mVrms (typ.)
  (V_{CC} = 13.2 V, R_L = 4 Ω, R_g = 0 Ω, BW = 20 Hz to 20 kHz)
- Built-in stand-by function
  : (with pin set at LOW, power is turned OFF) I_{SB} = 1 μA (typ.)
- Built-in output clipping detection and diagnosis circuit
  : (open collector (active LOW))
- Built-in various protection circuits
  : Thermal shut down, over voltage, OUT → V_{CC} short, OUT → GND short and OUT-OUT short.
- Operating supply voltage: V_{CC} (opr) = 9 to 18 V

Block Diagram



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.

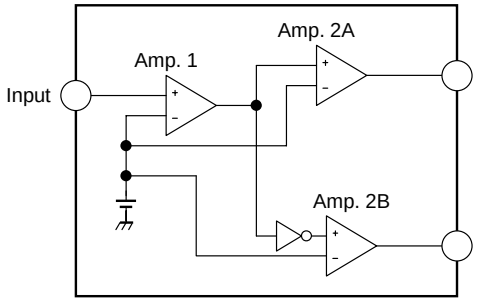


Figure 1 Block Diagram

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

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

2. Stand-by SW Function (pin 6)

By means of controlling pin 6 (stand-by terminal) to High and Low, the power supply can be set to ON and OFF.

The threshold voltage of pin 6 is set at about 3 V_{BE} (typ.), and the Power Supply current is about 1 μA (typ.) at the stand-by state.

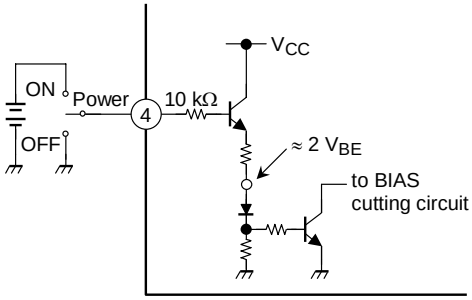


Figure 2 With Pin 6 Set to High, Power is Turned ON

Control Voltage of Pin 6: V_{SB}

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

Adjustable with 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

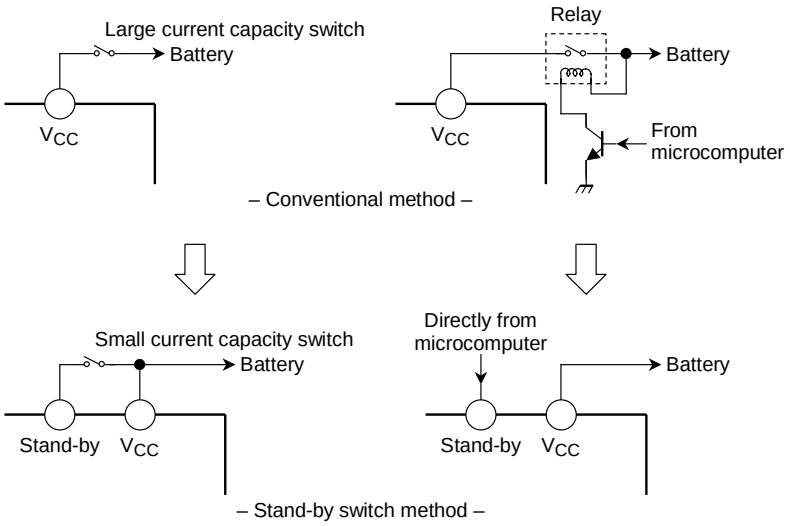


Figure 3 Stand-by Switch

3. Muting Function (pin 1)

By means of controlling pin 1 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 15 kΩ, we recommend 10 kΩ.

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

pin 1 must not be pulled up and it shall be controlled by OPEN/LOW.

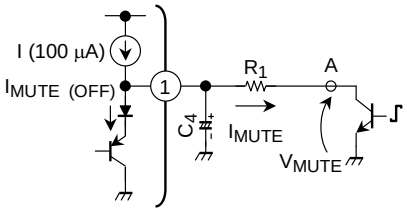


Figure 4 Muting Function

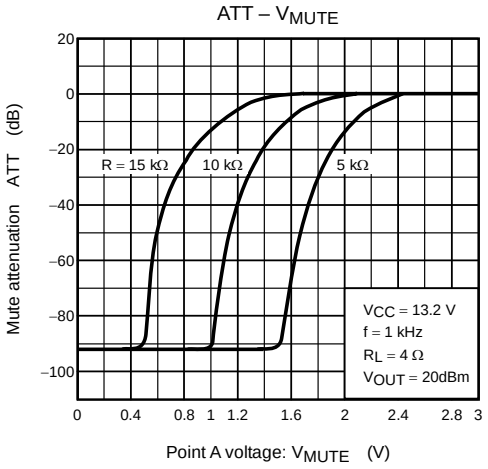


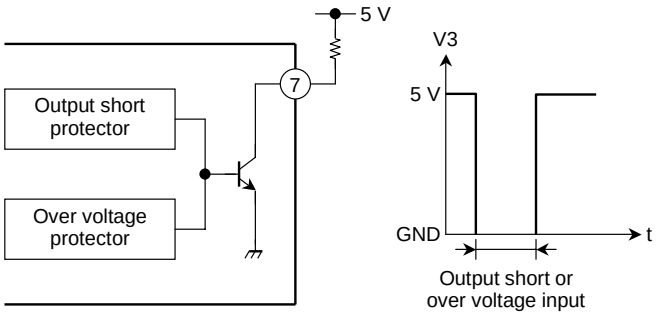
Figure 5 Mute Attenuation – V_{MUTE} (V)

4. Diagnosis Output (pin 7)

The diagnosis output terminal of pin 7 has open collector output structure on chip as shown in Figure 6.

In unusual case that output terminal of Power Amp. is condition of output to V_{CC} or output to GND short and over voltage input mode, 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 7.



Pin 7: Open collector output (active low)

Figure 6 Self Diagnosis Output

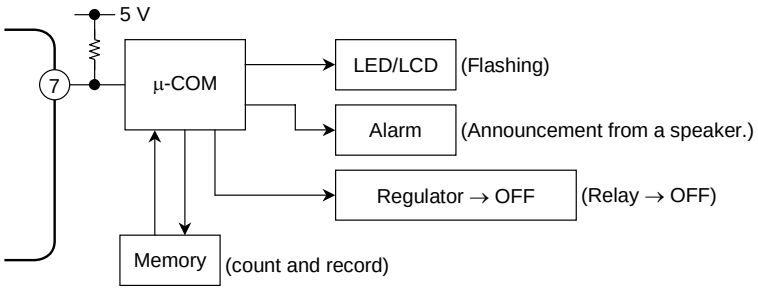


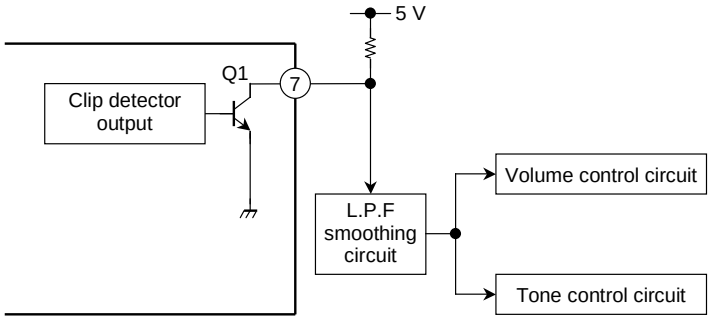
Figure 7 Application 1

5. Output Clip Detection Function (pin 7)

The output clip detection terminal of pin 7 has the open collector output structure on chip as shown in Figure 8. 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 8.

In case of being unused this function, use this IC as open connection on pin 7.



Pin 7: Open collector output (active low)

Figure 8 Application 2

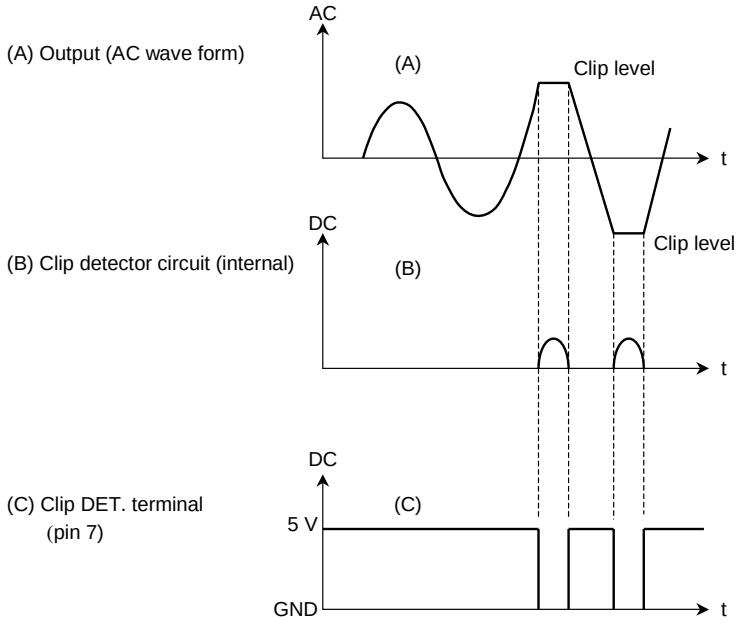


Figure 9 Clip Detection

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)	18	V
Output current (peak)	$I_{O\ (peak)}$	9	A
Power dissipation	P_D (Note 1)	83	W
Operation temperature	T_{opr}	−40 to 85	°C
Storage temperature	T_{stg}	−55 to 150	°C

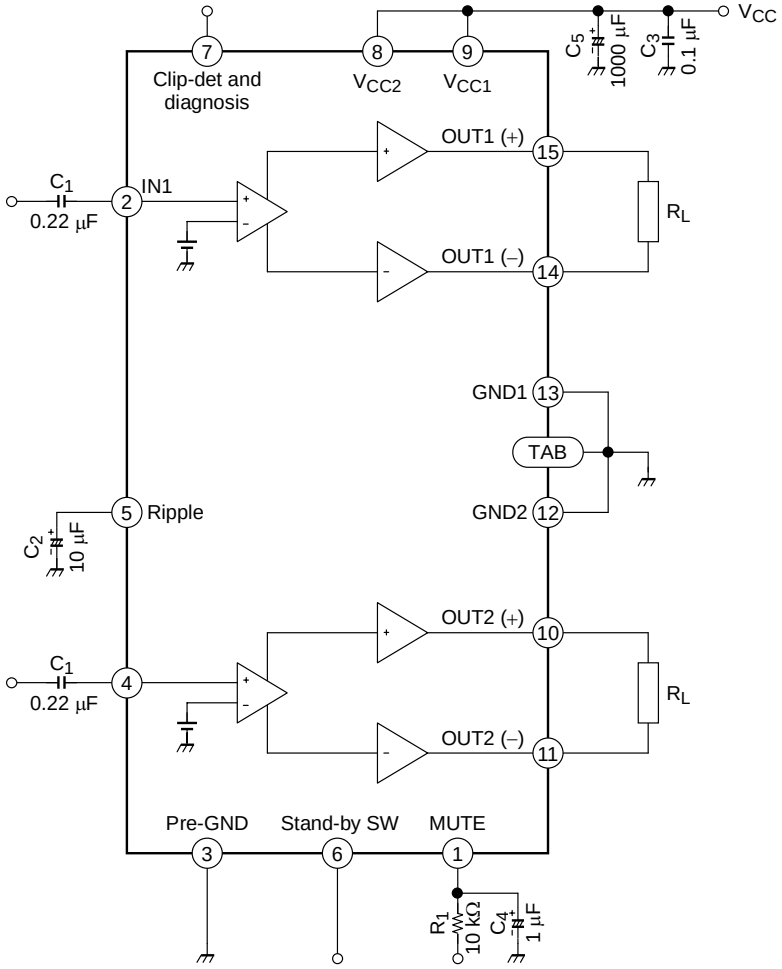
Note 1: Package thermal resistance $\theta_{j\text{-}T}$ = 1°C/W (typ.)
(Ta = 25°C, with infinite heat sink)

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

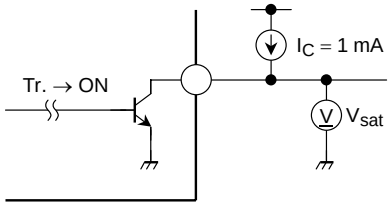
Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Quiescent current	I_{CCQ}	—	V_{IN} = 0	—	120	250	mA
Output power	P_{OUT} (1)	—	V_{CC} = 14.4 V, R_L = 2 Ω THD = 10%	40	45	—	W
	P_{OUT} (2)	—	R_L = 2 Ω, THD = 10%	—	35	—	
	P_{OUT} (3)	—	THD = 10%	19	21	—	
Total harmonic distortion	THD	—	P_{OUT} = 10 W	—	0.02	0.2	%
Voltage gain	G_V	—	—	24	26	28	dB
Voltage gain ratio	ΔG_V	—	—	−1.0	0	1.0	dB
Output noise voltage	V_{NO}	—	Rg = 0 Ω, BW = 20 Hz~20 kHz	—	0.10	0.35	mVrms
Ripple rejection ratio	R.R.	—	f_{ripple} = 100 Hz, Rg = 600 Ω	40	55	—	dB
Input resistance	R_{IN}	—	—	—	90	—	kΩ
Output offset voltage	V_{OFFSET}	—	V_{IN} = 0	−150	0	150	mV
Current at stand-by state	I_{SB}	—	—	—	1	10	μA
Cross talk	C.T.	—	Rg = 600 Ω V_{OUT} = 0.775 Vrms (0dBm)	—	75	—	dB
Stand-by control voltage	V_{SB}	—	Stand-by → OFF (Power → ON)	3.0	—	V_{CC}	V
Diagnosis out saturation voltage	V_{sat}	—	I_C = 1 mA	—	100	—	mV
Mute control voltage (Note 2)	V_M H	—	Mute: OFF	Open			V
	V_M L	—	Mute: ON,	0	—	1.5	
Mute attenuation	ATT M	—	Mute: ON, V_{OUT} = 7.75 Vrms (20dBm) at Mute: OFF	—	85	—	dB

Note 2: Muting function must be controlled by open and low logic.
This means that the mute control terminal: pin 1 must not be pulled up.

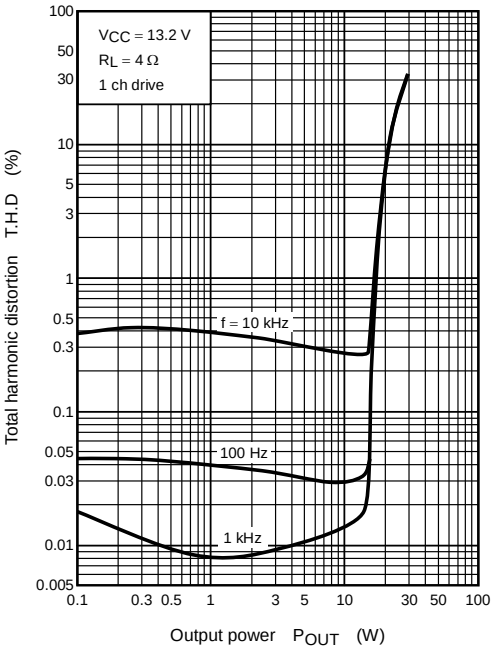
Test Circuit



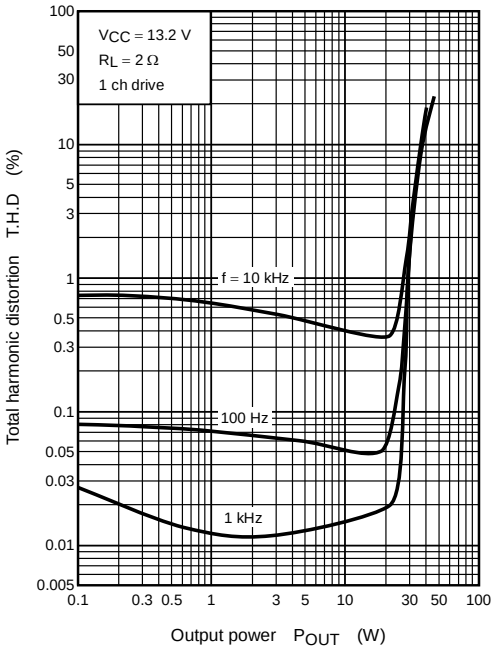
Diagnosis Out Test Circuit



T.H.D – P_{OUT}



T.H.D – P_{OUT}



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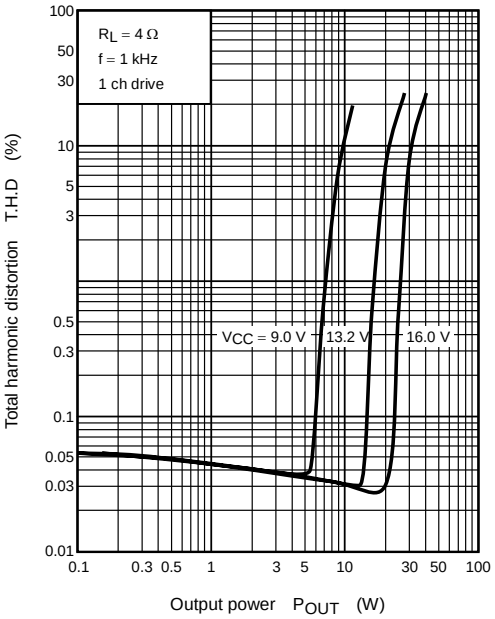
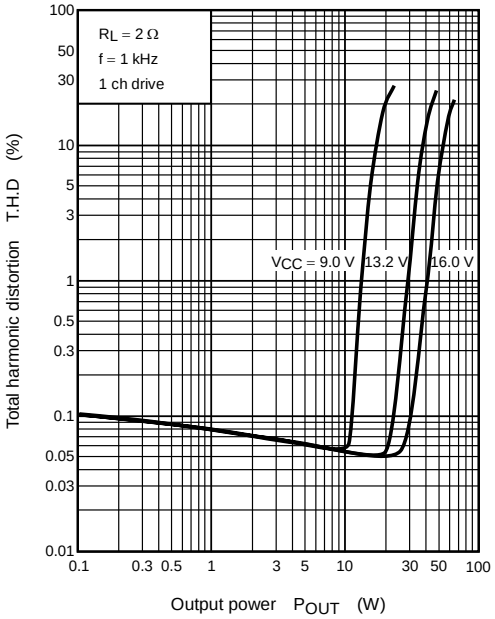
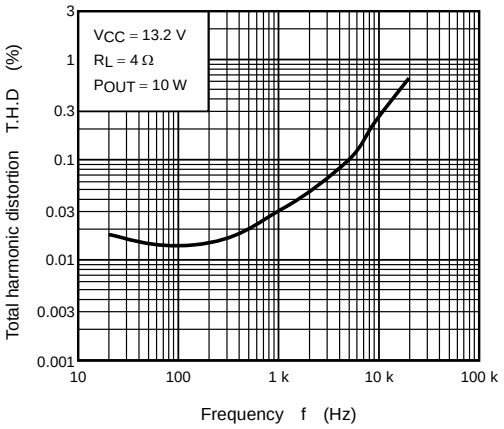


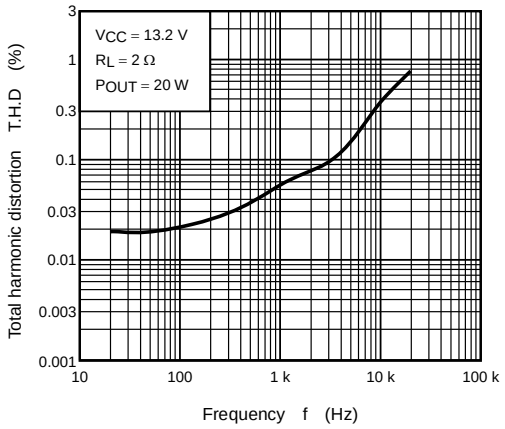
T.H.D – P_{OUT}



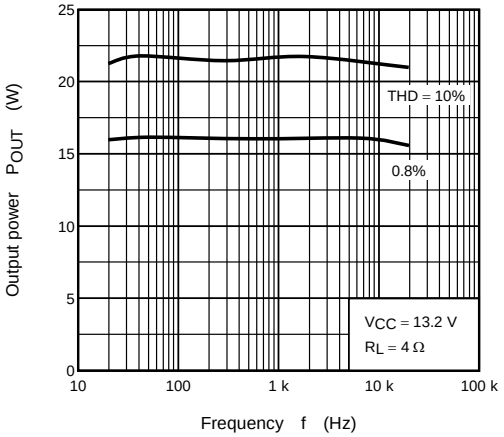
T.H.D – f



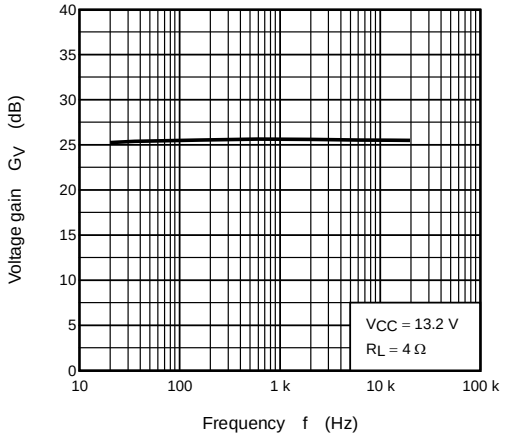
T.H.D – f



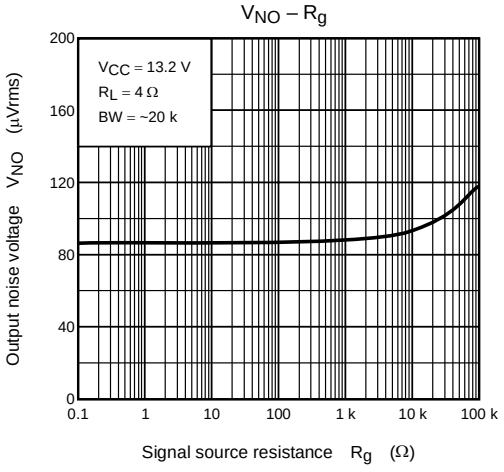
P_{OUT} – f



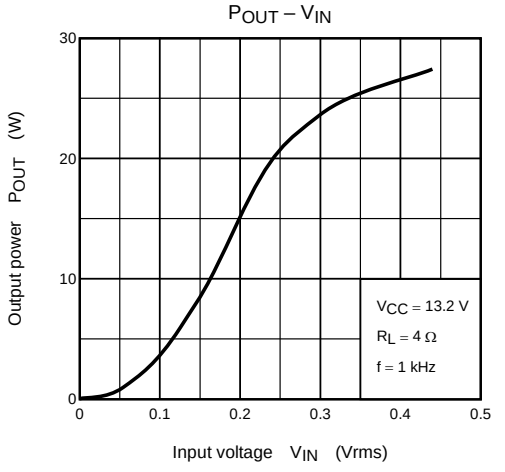
G_V – f



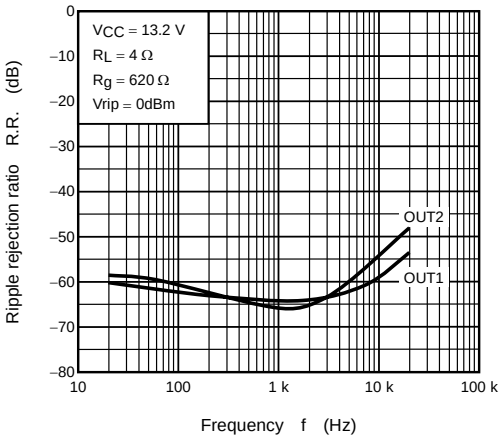
V_{NO} – R_g



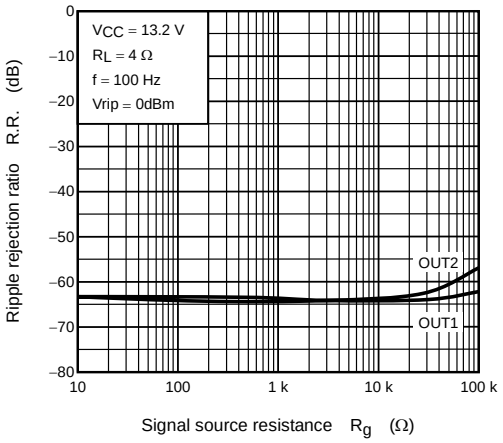
P_{OUT} – V_{IN}



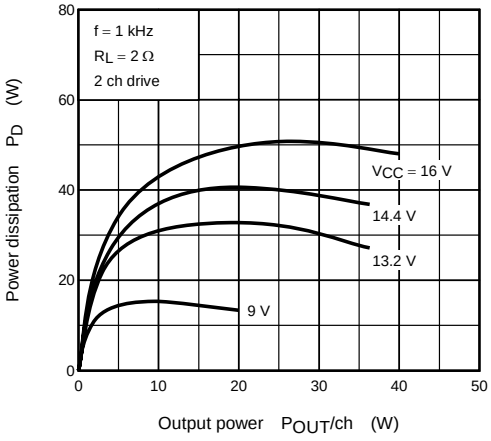
R.R. – f



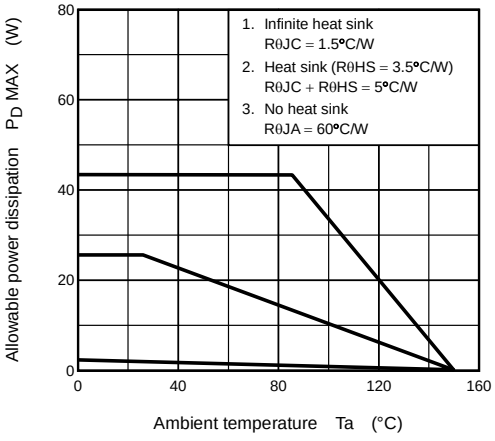
R.R. – R_g



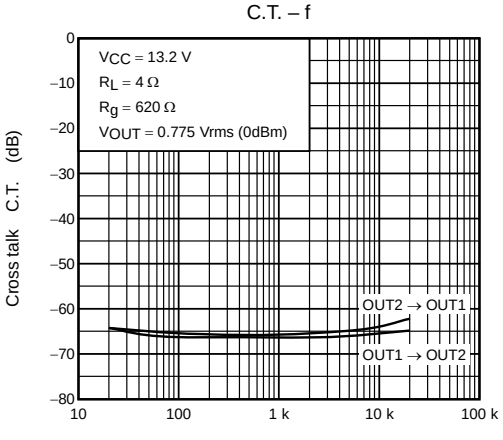
P_D – P_{OUT}



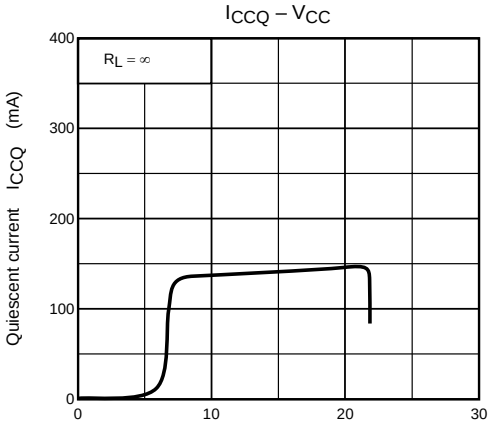
P_D MAX – Ta



C.T. – f

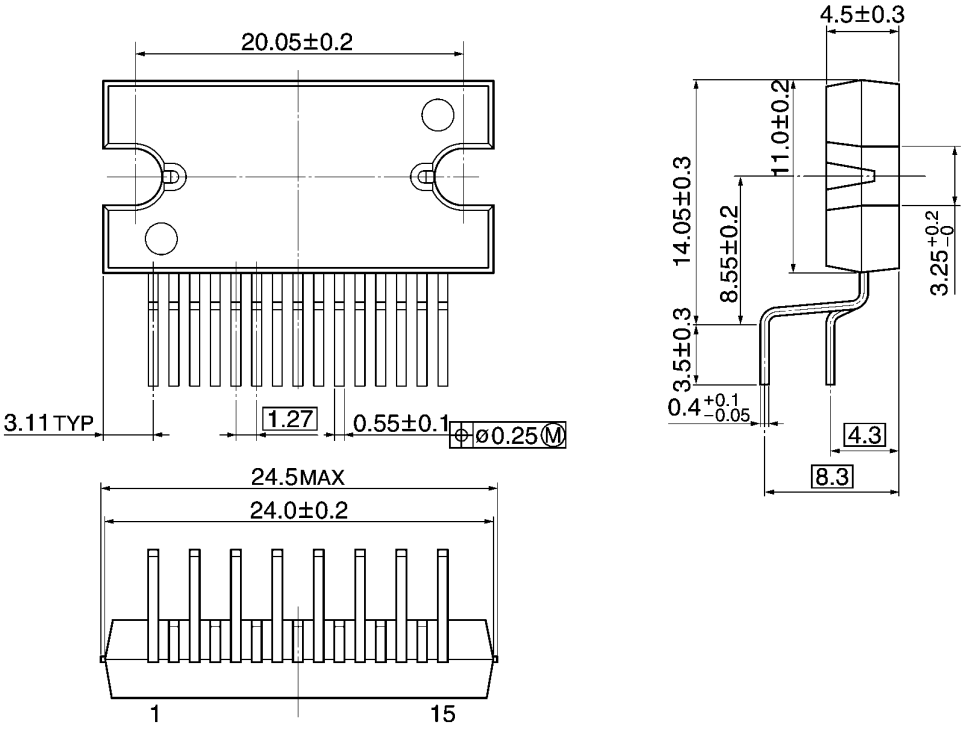


I_{CCQ} – V_{CC}



Package Dimensions

HZIP15-P-1.27E Unit: mm



Weight: 4.0 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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  In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the "Handling Guide for Semiconductor Devices," or "TOSHIBA Semiconductor Reliability Handbook" etc. 021023_A
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- The products described in this document are subject to the foreign exchange and foreign trade laws. 021023_E

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