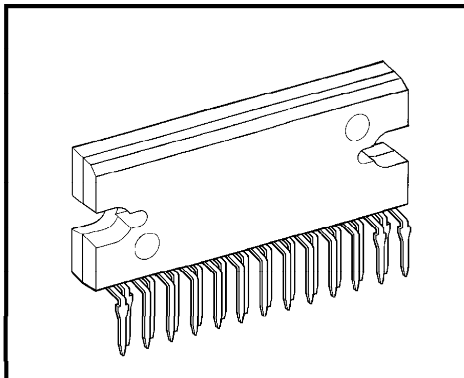
TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

TA8251AH

MAX POWER 30W BTL × 4CH AUDIO POWER IC

The TA8251AH is 4ch BTL audio power amplifier for consumer application.
It is designed low distortion ratio for 4ch BTL audio power amplifier, built-in Stand-by Function, Muting Function and Junction Temperature Detection Circuit.
Additionally, the AUX. amplifier is built-in, it can make the beep signal etc. output to 2 channels (OUT1 and 4).
It contains various kind of protectors for car audio.



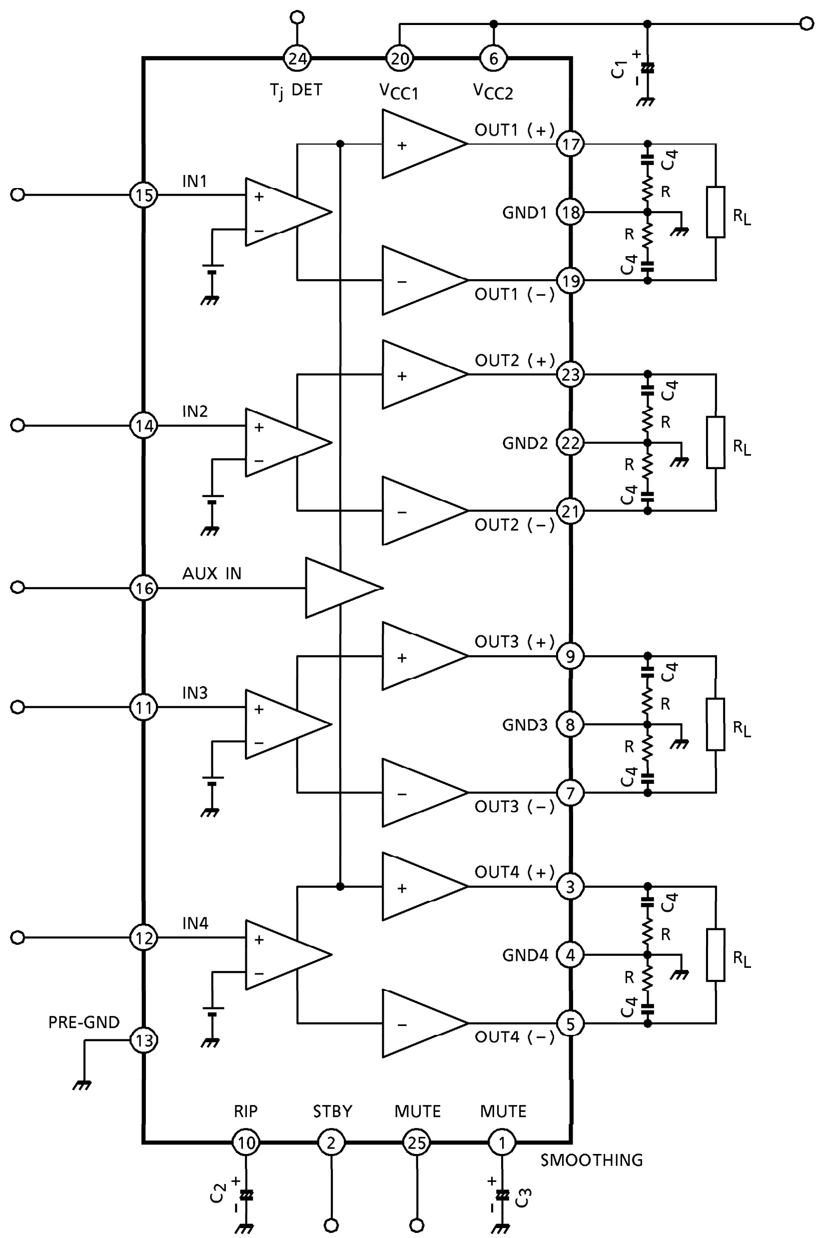
HZIP25-P-1.27C

Weight : 9.8g (Typ.)

FEATURES

- High power
  - : P_{OUT} (MAX) = 30W (Typ.)
    (V_{CC} = 13.7V, f = 1kHz, R_L = 4Ω)
  - : P_{OUT} (1) = 21W (Typ.)
    (V_{CC} = 14.4V, f = 1kHz, THD = 10%, R_L = 4Ω)
  - : P_{OUT} (2) = 18W (Typ.)
    (V_{CC} = 13.2V, f = 1kHz, THD = 10%, R_L = 4Ω)
- Low distortion ratio
  - : THD = 0.02% (Typ.)
    (V_{CC} = 13.2V, f = 1kHz, P_{OUT} = 3W, R_L = 4Ω)
- Low noise
  - : V_{NO} = 0.10mV_{rms} (Typ.)
    (V_{CC} = 13.2V, R_g = 0Ω, G_V = 34dB, BW = 20~20kHz)
- Built-in stand-by switch function (Pin②)
- Built-in muting function (Pin①, ㉕)
- Built-in AUX. amplifier from single input to 2 channels output (Pin⑯)
- Built-in junction temperature detection circuit (Pin㉔)
  - : Pin㉔ DC voltage rises at about +10mV / °C in proportion to junction temperature.
- Built-in various protection circuit
  - : Thermal shut down, over voltage, out to GND, out to V_{CC}, out to out short
- Operating supply voltage
  - : $V_{CC\ (opr)}$ = 9~18V

BLOCK DIAGRAM

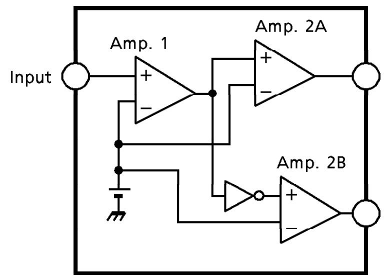


CAUTION AND APPLICATION METHOD

(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.



(Fig.1) Block diagram

The voltage gain of Amp. 1 : $G_{V1} = 0dB$
The voltage gain of Amp. 2A, B : $G_{V2} = 28dB$
The voltage gain of BLT Connection : $G_{V\,(BTL)} = 6dB$

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

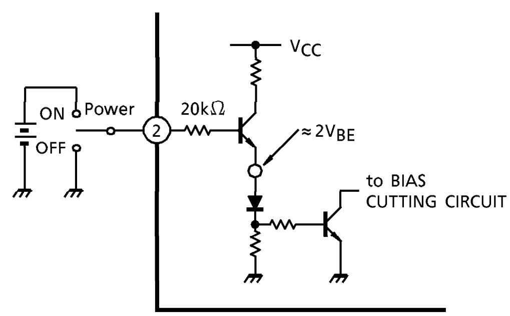
$$G_V = G_{V1} + G_{V2} + G_{V\,(BTL)} = 0 + 28 + 6 = 34dB$$

2. Stand-by SW function

   By means of controlling pin② (Stand-by terminal) to High and Low, the power supply can be set to ON and OFF. The threshold voltage of pin② is set at about 3V (Typ.), and the Power Supply current is about 100μA (Typ.) at the stand-by state.

Control Voltage of pin② : $V_{(SB)}$

STAND-BY	POWER	$V_{(SB)}$ (V)
ON	OFF	0~2
OFF	ON	3~V_{CC}

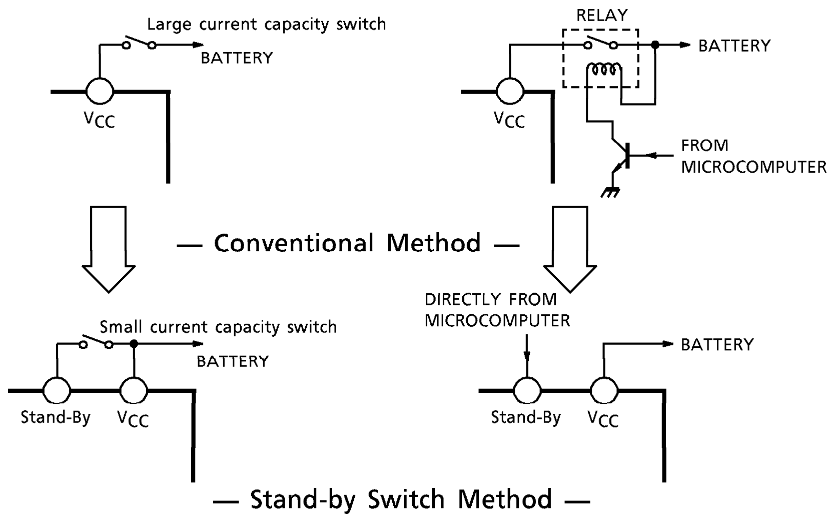


(Fig.2) With pin② set to High, Power is turned ON

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



3. Preventive measure against oscillation

For preventing the oscillation, it is advisable to use C_4, the condenser of polyester film having small characteristic fluctuation of the temperature and the frequency.
The resistance R to be series applied to C_4 is effective for phase correction of high frequency, and improves the oscillation allowance.

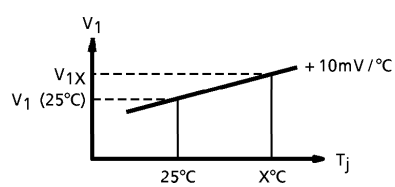
(1) Capacity value and the kind of condenser
(2) Layout of printed board

4. Junction temperature detecting pin㉔

Using temperature characteristic of a band gap circuit and in proportion to junction temperature, pin㉔ DC voltage : V_2 rises at about $+10mV/°C$ temperature characteristic. So, the relation between V_2 at $T_j = 25°C$ and V_{2x} at $T_j = x°C$ is decided by the following expression :

$$T\ (x°C) = \frac{V_{2x} - V_2\ (25°C)}{10mV/°C} + 25\ (°C)$$

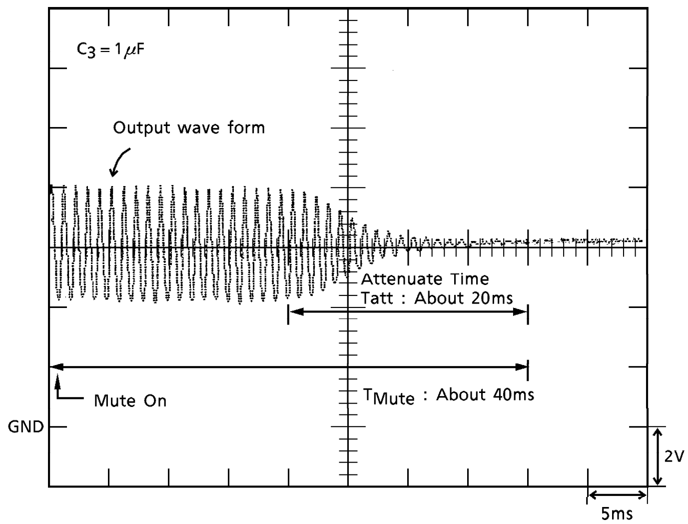
In deciding a heat sink size, a junction temperature can be easily made clear by measuring voltage at this pin while a backside temperature of IC was so far measured using a thermocouple type thermometer.



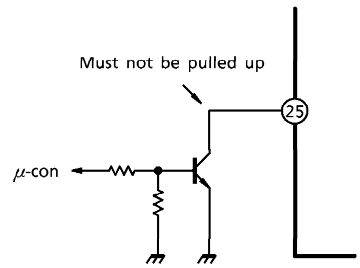
(Fig.3)

5. Muting function : pin①, pin㉕

By means of controlling pin㉕ (Mute control terminal) less than about 1.5V, it can make the IC muting condition as below. However, pin㉕ must not be connected to a certain voltage, for example, V_{CC}, V_{DD}, V_{ref},…etc. In other words, pin㉕ is inhibited to be pulled up, for instance fig.5 application.



(Fig.4) Output wave form at Muting Condition

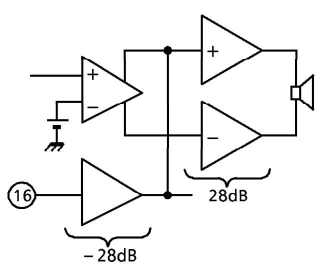


(Fig.5) Mute control

The attenuation by the muting function is 70dB (Typ.). This muting is very smooth attenuating by the time constant of pin① : smoothing.
Therefore, this function is suitable to the audio muting. The time for attenuation : Tatt is adjustable by changing the capacitance of C_3. But the Tatt may influence the popping noise level. So, please decide the time of Tatt by testing on the units.

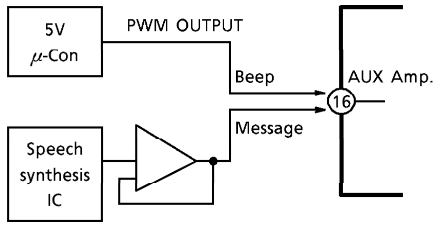
6. AUX. amplifier : pin⑯

The pin⑯ is for input terminal of AUX. amplifier.
The total gain is 0dB by using of AUX. amplifier.



(Fig.6) AUX. amplifier

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



(Fig.7) The application of AUX. amplifier

The amplified signal from pin⑯ is out to the OUT1 and 4.

7. Cross talk

The cross talk characteristics of the IC is not good between OUT1 and 2, OUT3 and 4.
So we recommend to use by below method.

OUT1, 2	L-ch (or R-ch)
OUT3, 4	R-ch (or L-ch)

And, please refer to below table in case of applying the AUX. IN because it is out to OUT 1 and 4.

ex)

OUT1	Front	L-ch (or R-ch)	AUX. OUT
OUT2	Rear		—
OUT3	Rear	R-ch (or L-ch)	—
OUT4	Front		AUX. OUT

MAXIMUM RATING (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Peak Supply Voltage (0.2s)	$V_{CC\ (surge)}$	50	V
DC Supply Voltage	$V_{CC\ (DC)}$	25	V
Operating Supply Voltage	$V_{CC\ (opr)}$	18	V
Output Current (peak)	$I_{o\ (peak)}$	9	A
Power Dissipation	P_D (*)	83	W
Operating Temperature	T_{opr}	−40~85	°C
Storage Temperature	T_{stg}	−55~150	°C

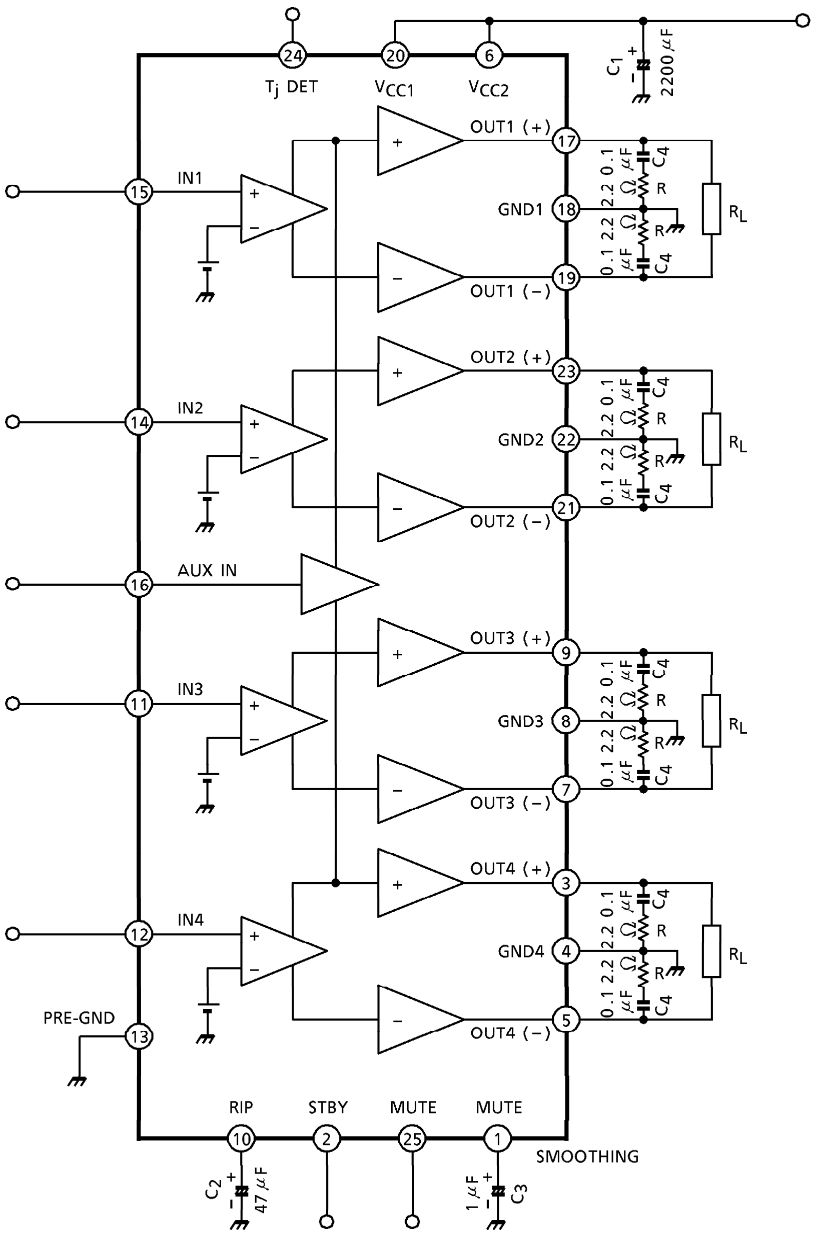
(*) Package thermal resistance $\theta_{j\text{-}T}$ = 1.5°C / W (Typ.)
(Ta = 25°C, with infinite heat sink)

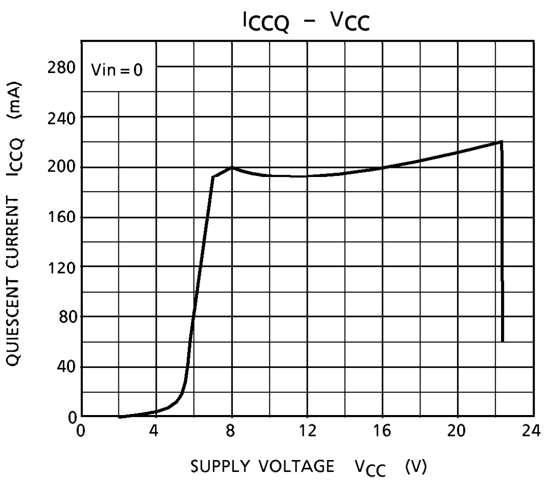
ELECTRICAL CHARACTERISTICS (Unless otherwise specified V_{CC} = 13.2V, f = 1kHz, R_L = 4Ω, Ta = 25°C)

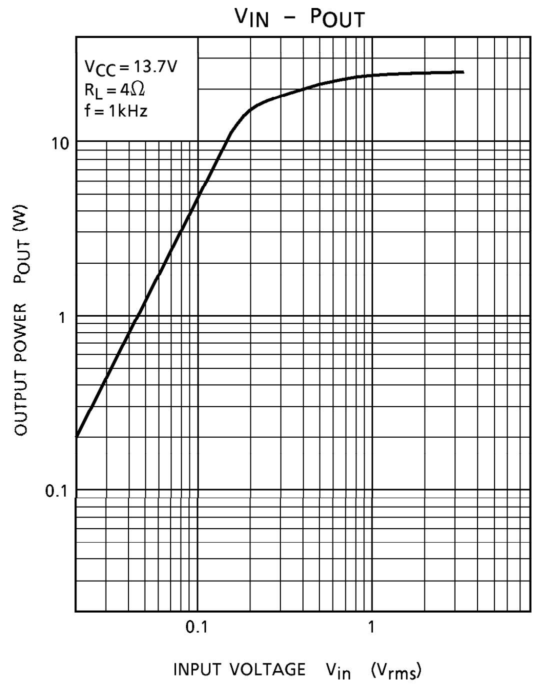
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Quiescent Current	I_{CCQ}	—	V_{IN} = 0	—	200	400	mA
Output Power	P_{OUT} (MAX)	—	V_{CC} = 13.7V, MAX power	—	30	—	W
	P_{OUT} (1)	—	V_{CC} = 14.4V, THD = 10%	—	21	—	
	P_{OUT} (2)	—	THD = 10%	16	18	—	
Total Harmonic Distortion	THD	—	P_{OUT} = 3W	—	0.02	0.2	%
Voltage Gain	G_V	—	V_{OUT} = 0.775V_{rms} (0dBm)	32	34	36	dB
Voltage Gain Ratio	ΔG_V	—	V_{OUT} = 0.775V_{rms} (0dBm)	−1.0	0	1.0	dB
Output Noise Voltage	$V_{NO\ (1)}$	—	R_g = 0Ω, DIN45405	—	0.12	—	mV_{rms}
	$V_{NO\ (2)}$	—	R_g = 0Ω, BW = 20Hz~20kHz	—	0.10	0.35	mV_{rms}
Ripple Rejection Ratio	R.R.	—	f_{rip} = 100Hz, R_g = 620Ω V_{rip} = 0.775V_{rms} (0dBm)	40	55	—	dB
Cross Talk	C.T.	—	R_g = 620Ω, V_{OUT} = 0.775V_{rms} (0dBm)	—	75	—	dB
Output Offset Voltage	V_{OFFSET}	—	—	−300	0	+300	mV
Input Resistance	R_{IN}	—	—	—	30	—	kΩ
Stand-by Current	I_{SB}	—	Stand-by condition	—	100	150	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 (*)	V_M H	—	Mute : off	OPEN			V
	V_M L	—	Mute : on	0	—	1.5	
Mute Attenuation	ATT M	—	Mute : on	—	70	—	dB

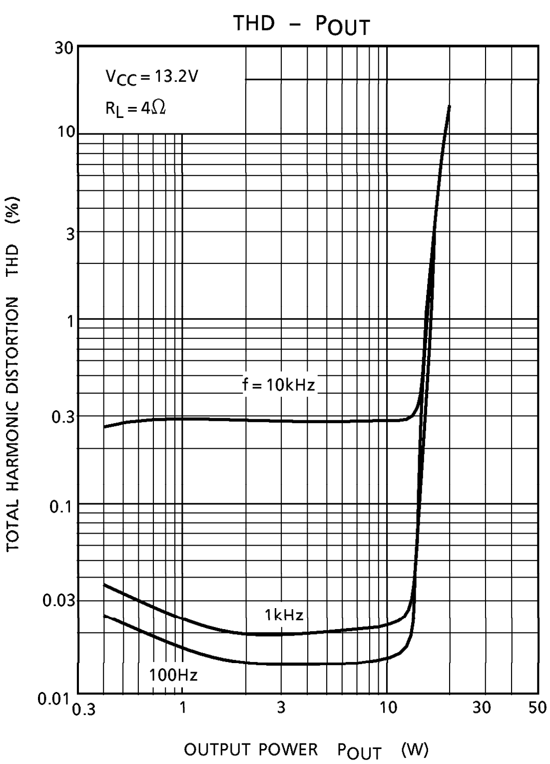
(*) Muting function must be controlled by open and Low Logic.
This means that the mute control terminal : pin㉕ must not be pulled up.

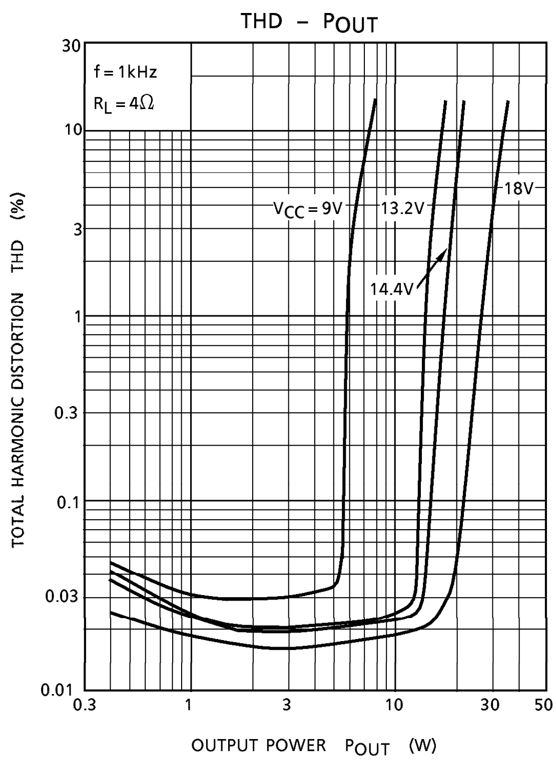
TEST CIRCUIT
($G_V = 34dB$)

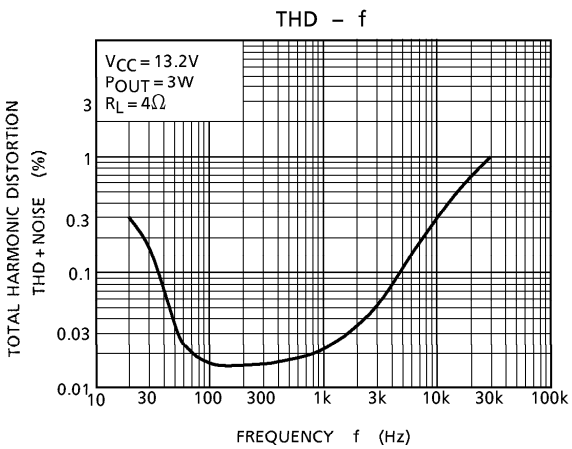


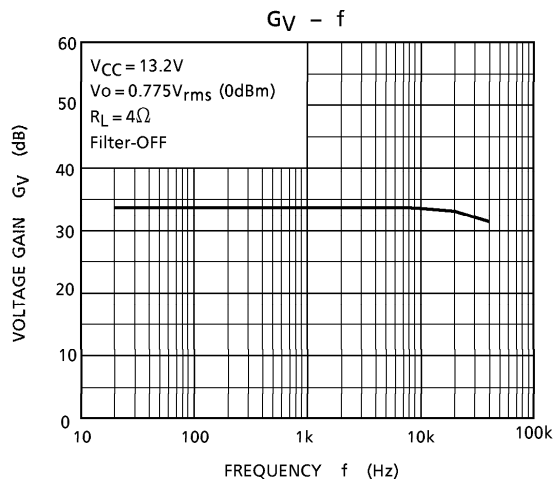

ICCQ – VCC
Vin = 0
QUIESCENT CURRENT ICCQ (mA)
SUPPLY VOLTAGE VCC (V)
0
40
80
120
160
200
240
280
4
8
12
16
20
24

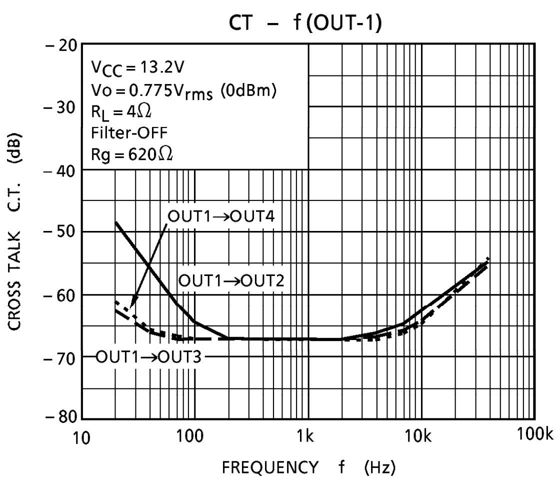

VIN – POUT
VCC = 13.7V
RL = 4Ω
f = 1kHz
OUTPUT POWER POUT (W)
INPUT VOLTAGE Vin (Vrms)
10
1
0.1

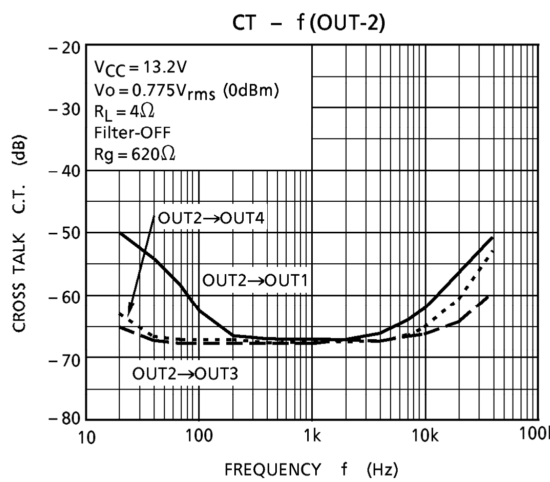

THD – POUT
VCC = 13.2V
RL = 4Ω
f = 10kHz
1kHz
100Hz
TOTAL HARMONIC DISTORTION THD (%)
OUTPUT POWER POUT (W)
30
10
3
1
0.3
0.1
0.03
0.01
50

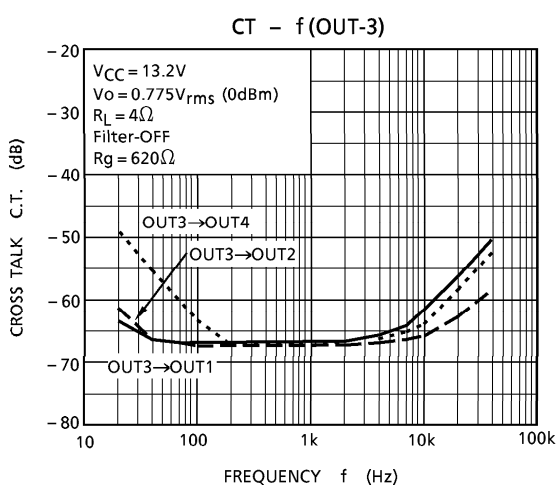

THD – POUT
f = 1kHz
RL = 4Ω
VCC = 9V
13.2V
14.4V
18V
TOTAL HARMONIC DISTORTION THD (%)
OUTPUT POWER POUT (W)

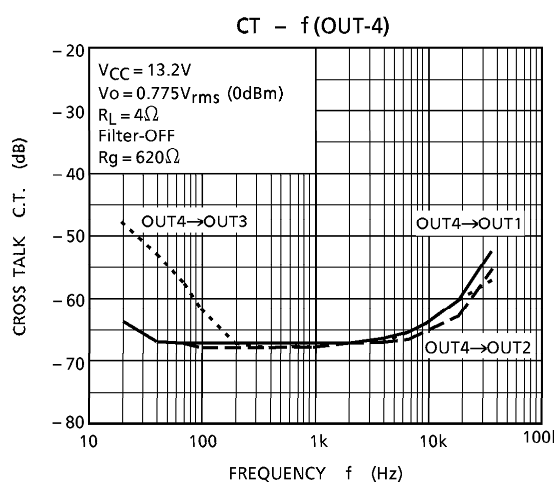

THD – f
VCC = 13.2V
POUT = 3W
RL = 4Ω
TOTAL HARMONIC DISTORTION THD + NOISE (%)
FREQUENCY f (Hz)


GV – f
VCC = 13.2V
Vo = 0.775Vrms (0dBm)
RL = 4Ω
Filter-OFF
VOLTAGE GAIN GV (dB)
FREQUENCY f (Hz)

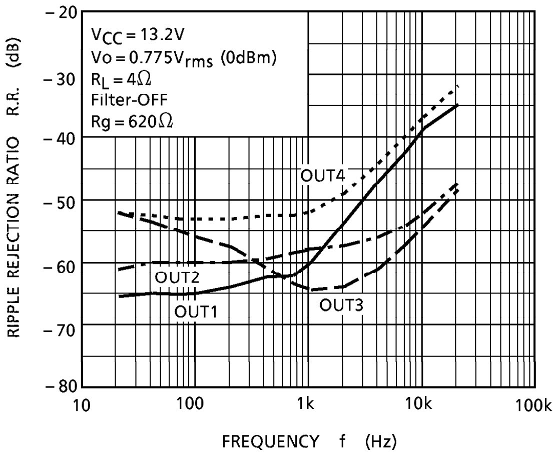

CT – f (OUT-1)
VCC = 13.2V
Vo = 0.775Vrms (0dBm)
RL = 4Ω
Filter-OFF
Rg = 620Ω
OUT1→OUT4
OUT1→OUT2
OUT1→OUT3
CROSS TALK C.T. (dB)
FREQUENCY f (Hz)


CT – f (OUT-2)
VCC = 13.2V
Vo = 0.775Vrms (0dBm)
RL = 4Ω
Filter-OFF
Rg = 620Ω
OUT2→OUT4
OUT2→OUT1
OUT2→OUT3
CROSS TALK C.T. (dB)
FREQUENCY f (Hz)

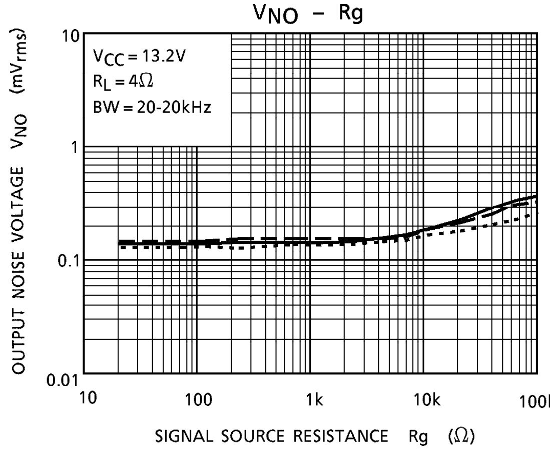

CT – f (OUT-3)
VCC = 13.2V
Vo = 0.775Vrms (0dBm)
RL = 4Ω
Filter-OFF
Rg = 620Ω
OUT3→OUT4
OUT3→OUT2
OUT3→OUT1
CROSS TALK C.T. (dB)
FREQUENCY f (Hz)


CT – f (OUT-4)
VCC = 13.2V
Vo = 0.775Vrms (0dBm)
RL = 4Ω
Filter-OFF
Rg = 620Ω
OUT4→OUT3
OUT4→OUT1
OUT4→OUT2
CROSS TALK C.T. (dB)
FREQUENCY f (Hz)

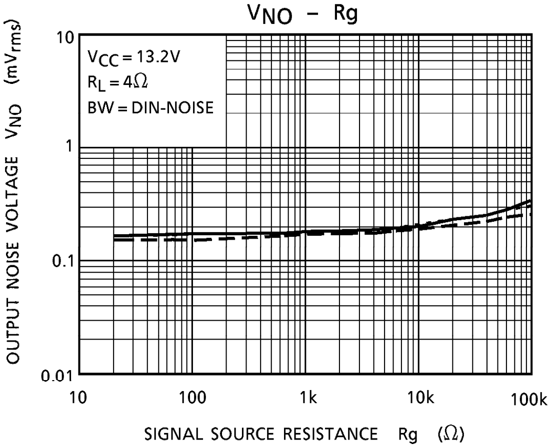
RR – f



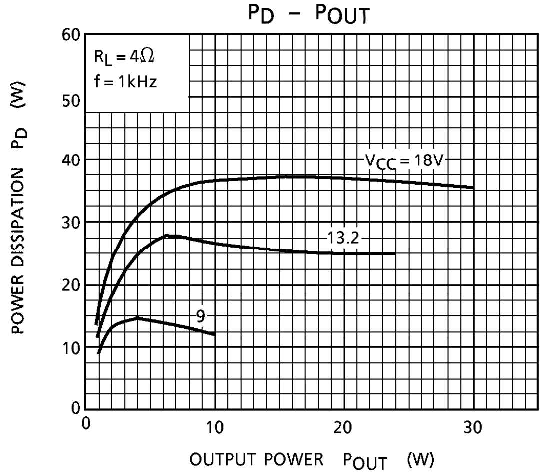
V_{NO} – Rg



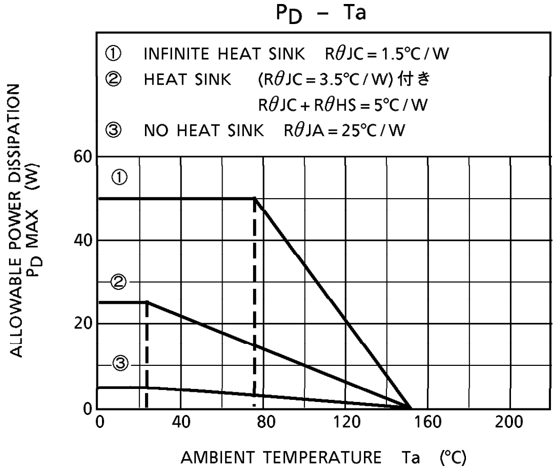
V_{NO} – Rg



P_D – P_{OUT}



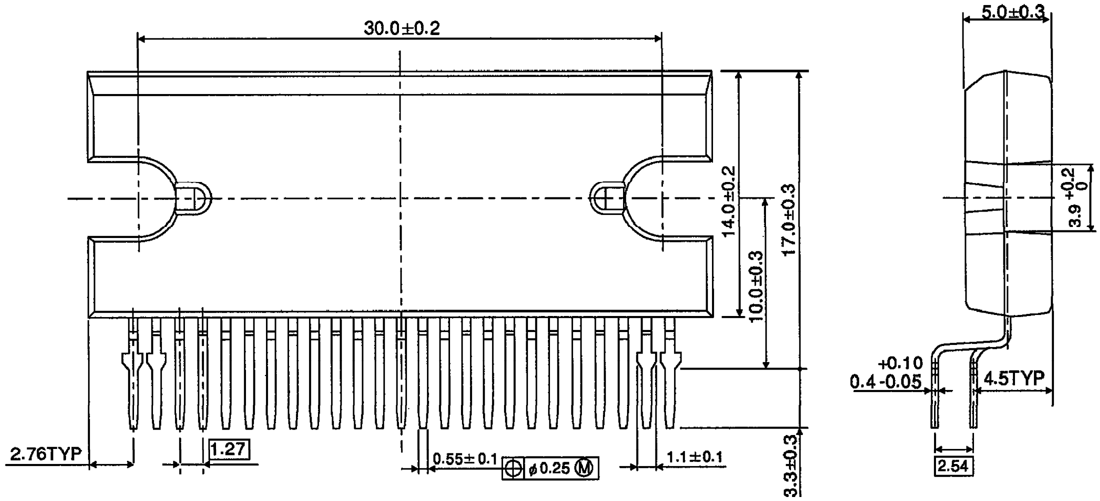
P_D – Ta

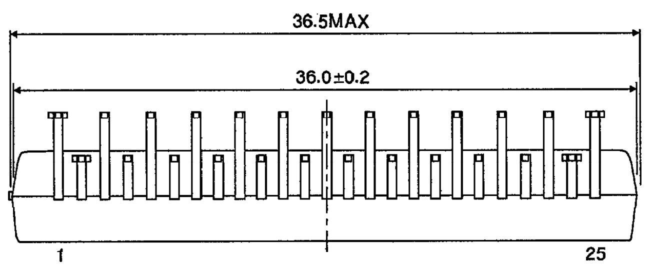


OUTLINE DRAWING

HZIP25-P-1.27C

Unit : mm





Weight : 9.8g (Typ.)