# HA13150A

## 21 W × 4-Channel BTL Power IC

HITACHI

ADE-207-107
1st. Edition

### Description

HA13150A is a four-channel BTL amplifier IC designed for car audio, featuring high output and low distortion, and applicable to digital audio equipment. It provides 21 W output per channel, with a 14.4 V power supply and at 10% distortion.

### Functions

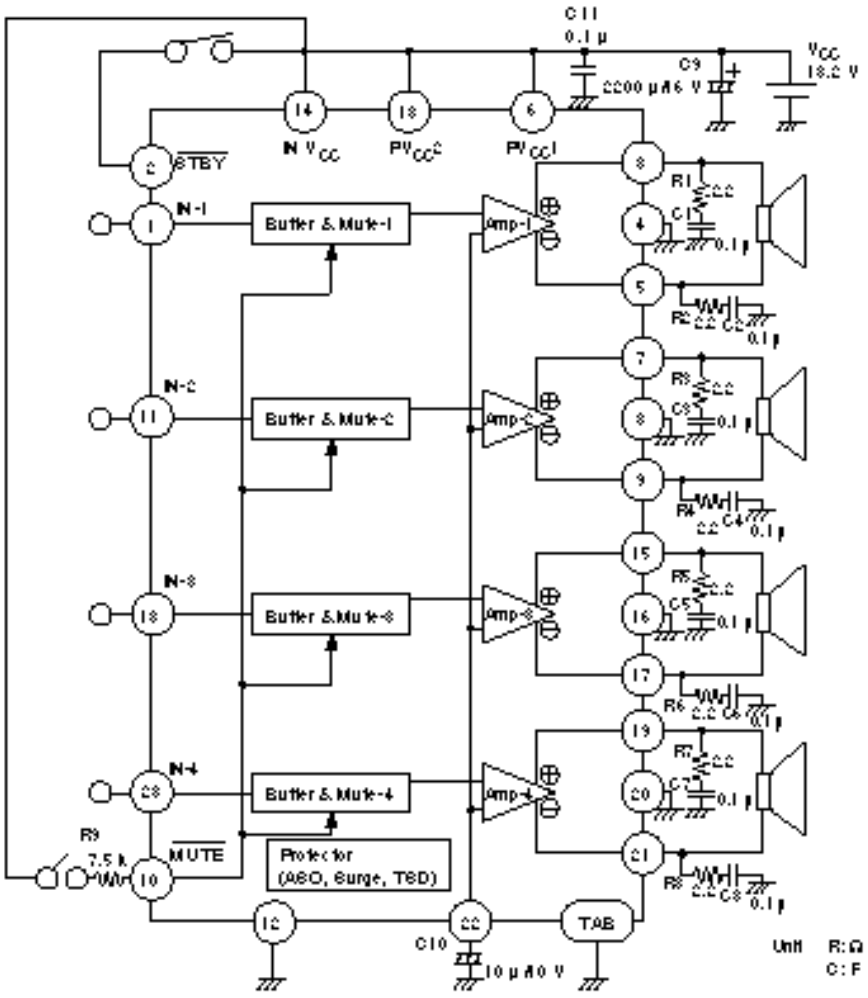
- Built-in standby circuit
- Built-in muting circuit
- Built-in protection circuits (surge, TSD, and ASO)

### Features

- Requires few external parts
- Low distortion (total harmonic distortion = 0.01% at 3 W)
- Low noise (at Rg = 620 Ω, noise is 0.15 mV (muting off) or 0.1 mV (muting on))
- Popping noise minimized
- Highly reliable current-limiting ASO protector keeps speakers safe from all kinds of trouble. Reliability is further enhanced by a fast-acting thermal shutdown protection circuit with on/off hysteresis.

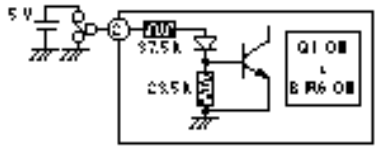
Hitachi semiconductor

## Block Diagram

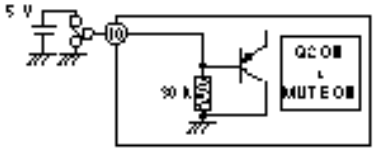



' C1 to C8 should be polyester film capacitors with no secondary resonance (non-inductive), to assure stable operation.

Notes: 1. Standby
Power is turned on when a signal of 3.5 V or 0.05 mA is impressed at pin 2. When pin 2 is open or connected to GND, standby is turned on (output off).




2. Muting
Muting is turned off (output on) when a signal of 3.5 V or 0.1 mA is impressed at pin 10.
When pin 10 is open or connected to GND, muting is turned on (output off).

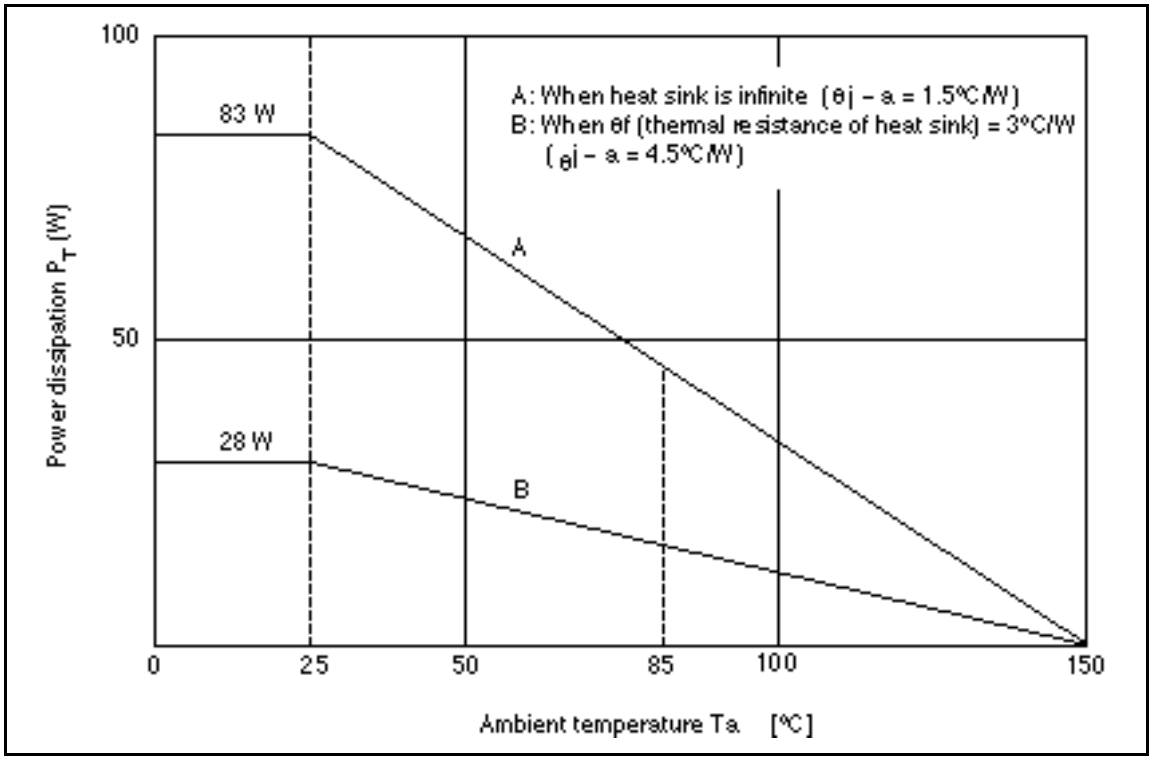



**Absolute Maximum Ratings** (Ta = 25°C)

| Item | Symbol | Rating | Unit | Remarks |
|---|---|---|---|---|

| | | | |
|---|---|---|---|
| Operating supply voltage | $V_{CC}$ | 18 | V |
| Supply voltage when no signal *1 | $V_{CC}$ (DC) | 26 | V |
| Peak supply voltage *2 | $V_{CC}$ (PEAK) | 50 | V |
| Output current *3 | $I_O$ (PEAK) | 4 | A |
| Power dissipation *4 | $P_T$ | 83 | W |
| Junction temperature | Tj | 150 | °C |
| Operating temperature | Topr | –30 to +85 | °C |
| Storage temperature | Tstg | –55 to +125 | °C |

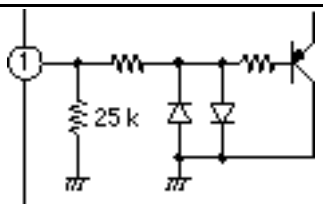
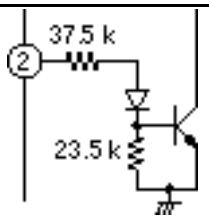
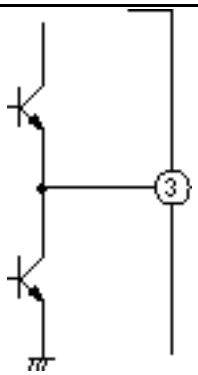
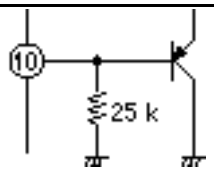
Notes: 1. Tolerance within 30 seconds
2. Tolerance in surge pulse waveform
3. Value per 1 channel
4. Value when attached on the infinite heat sink plate at Ta = 25°C.
The derating carve is as shown in the graph below.



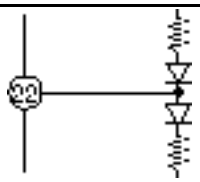
**Electrical Characteristics** ($V_{CC}$ = 13.2 V, f = 1 kHz, $R_L$ = 4 Ω, Rg = 620 Ω, Ta = 25°C)

| Item | Symbol | Min | Typ | Max | Unit | Test Conditions |
|---|---|---|---|---|---|---|
| Current when no signal | Iq1 | — | 240 | — | mA | Vin = 0 |
| Output offset voltage | ΔVq | –250 | 0 | +250 | mV | |
| Gain | Gv | 30.5 | 32 | 33.5 | dB | |
| Gain difference between channels | ΔGv | –1.5 | 0 | +1.5 | dB | |
| Rated output power | Po | — | 18 | — | W | $V_{CC}$ = 13.2 V<br>$R_L$ = 4 Ω, THD = 10% |
| Max output power | Pomax | — | 30 | — | | $V_{CC}$ = 13.7 V<br>$R_L$ = 4 Ω, THD = Max |
| Total harmonic distortion | T.H.D | — | 0.01 | — | % | Po = 3 W |
| Output noise voltage | WBN | — | 0.15 | 0.5 | mVrms | Rg = 0 Ω<br>BW = 20 to 20 kHz |
| Ripple rejection | SVR | — | 55 | — | dB | Rg = 600 Ω<br>f = 120 Hz |
| Channel crosstalk | C.T | — | 70 | — | dB | Rg = 600 Ω<br>Vout = 0 dBm |
| Input impedance | Rin | — | 25 | — | kΩ | |
| Standby current | Iq2 | — | — | 200 | μA | |
| Standby control voltage (high) | $V_{STH}$ | 3.5 | — | $V_{CC}$ | V | |
| Standby control voltage (low) | $V_{STL}$ | 0 | — | 1.5 | V | |
| Muting control voltage (high) | $V_{MH}$ | 3.5 | — | $V_{CC}$ | V | |
| Muting control voltage (low) | $V_{ML}$ | 0 | — | 1.5 | V | |
| Muting attenuation | $A_{TTM}$ | — | 70 | — | dB | Vout = 0 dBm |

## Pin Explanation

| Pin No. | Symbol | Functions | Input Impedance | DC Voltage | Equivalence Circuit |
|---|---|---|---|---|---|
| 1 | IN1 | CH1 INPUT | 25 kΩ (Typ) | 0 V |  |
| 11 | IN2 | CH2 INPUT | | | |
| 13 | IN3 | CH3 INPUT | | | |
| 23 | IN4 | CH4 INPUT | | | |
| 2 | STBY | Standby control | 90 kΩ (at Trs. cutoff) | — |  |
| 3 | OUT1 (+) | CH1 OUTPUT | — | $V_{CC}/2$ |  |
| 5 | OUT1 (–) | | | | |
| 7 | OUT2 (+) | CH2 OUTPUT | | | |
| 9 | OUT2 (–) | | | | |
| 15 | OUT3 (+) | CH3 OUTPUT | | | |
| 17 | OUT3 (–) | | | | |
| 19 | OUT4 (+) | CH4 OUTPUT | | | |
| 21 | OUT4 (–) | | | | |
| 10 | MUTE | Muting control | 25 kΩ (Typ) | — |  |

## Pin Explanation (cont)

| Pin No. | Symbol | Functions | Input Impedance | DC Voltage | Equivalence Circuit |
|---|---|---|---|---|---|
| 22 | RIPPLE | Bias stability | — | $V_{CC}/2$ |  |
| 6 | $PV_{CC}1$ | Power of output stage | — | $V_{CC}$ | — |
| 18 | $PV_{CC}2$ | | | | |
| 14 | $INV_{CC}$ | Power of input stage | — | $V_{CC}$ | — |
| 4 | CH1 GND | CH1 power GND | — | — | — |
| 8 | CH2 GND | CH2 power GND | | | |
| 16 | CH3 GND | CH3 power GND | | | |
| 20 | CH4 GND | CH4 power GND | | | |
| 12 | IN GND | Input signal GND | — | — | — |

## Point of Application Board Design

1. Notes on Application board's pattern design

· For increasing stability, the connected line of $V_{CC}$ and OUTGND is better to be made wider and lower impedance.

· For increasing stability, it is better to place the capacitor between $V_{CC}$ and GND (0.1 µF) close to IC.

· For increasing stability, it is better to place C1 to C8 and R1 to R8, which are for stopping oscillation, close to IC.

· It is better to place the grounding of resistor (Rg), between input line and ground, close to INGND (Pin 12) because if OUTGND is connected to the line between Rg and INGND, THD will become worse due to current from OUTGND.

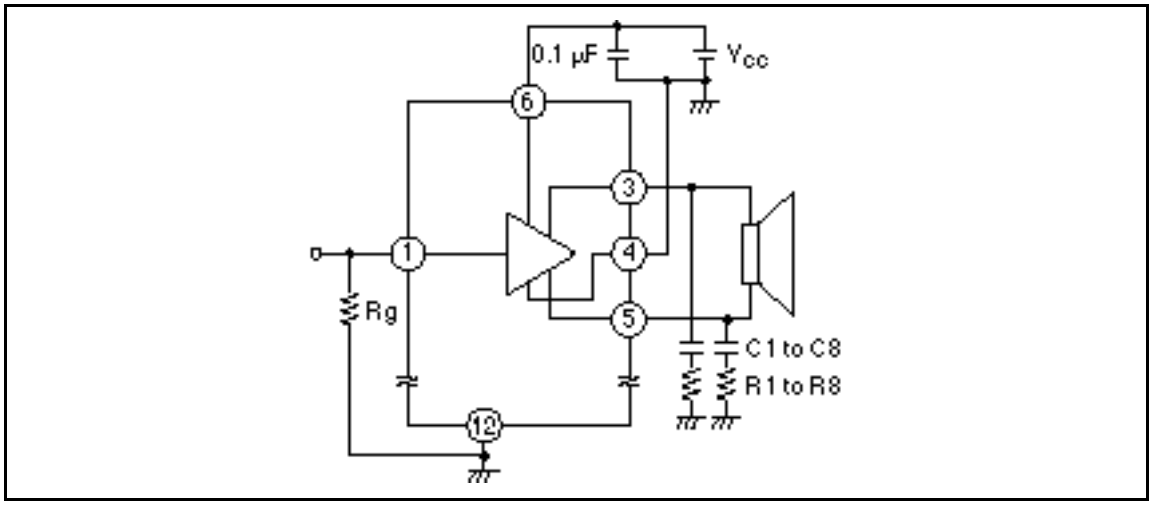



**Figure 1 Notes on Application Board's Pattern Design**

2. How to reduce the popping noise by Muting circuit

   At normal operating circuit, Muting circuit operates at high speed under 1 µs.

   In case popping noise becomes a problem, it is possible to reduce the popping noise by connecting capacitor, which determines the switching time constant, between pin 10 and GND. (Following figure 2)

   We recommend value of capacitor greater then 1 µF.

   Also transitional popping noise can be reduced sharply by muting before $V_{CC}$ and Standby are ON/OFF.

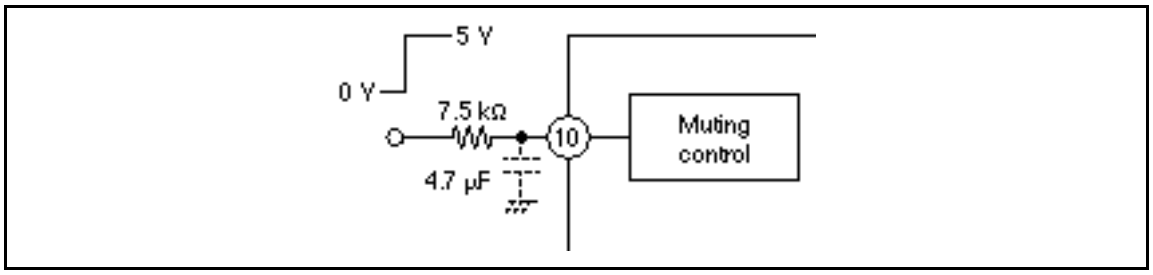
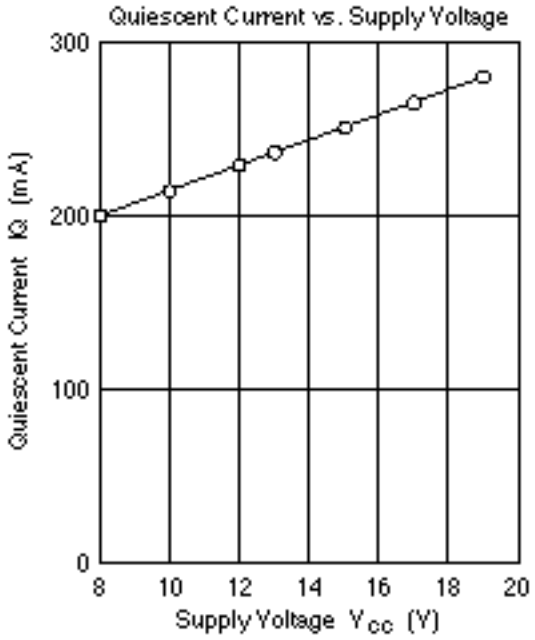
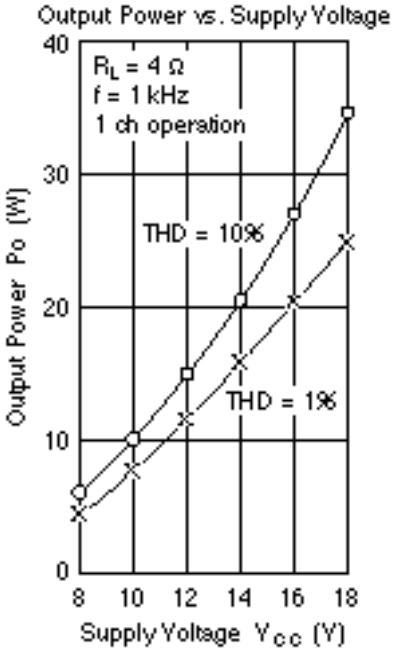


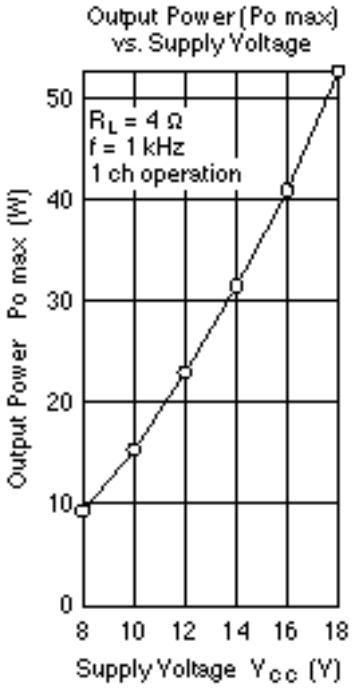

**Figure 2 How to use Muting Circuit**

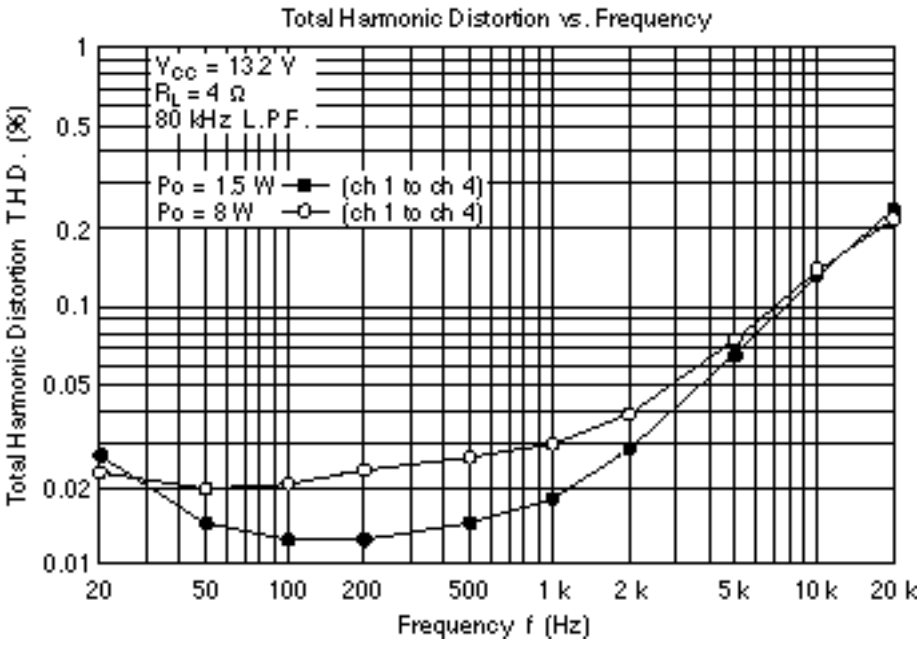
**Table 1 Muting ON/OFF Time**

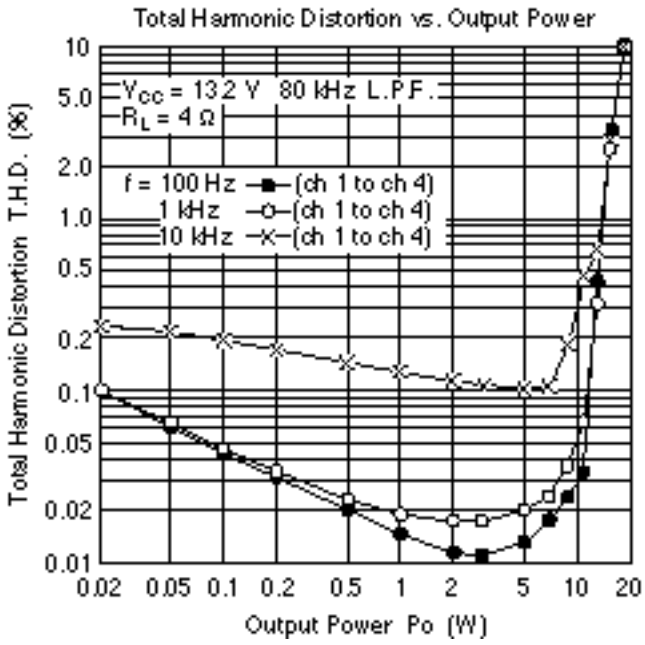
| C (µF) | ON Time | OFF Time |
|---|---|---|
| nothing | under 1 µs | under 1 µs |
| 0.47 | 2 ms | 2 ms |
| 4.7 | 19 ms | 19 ms |

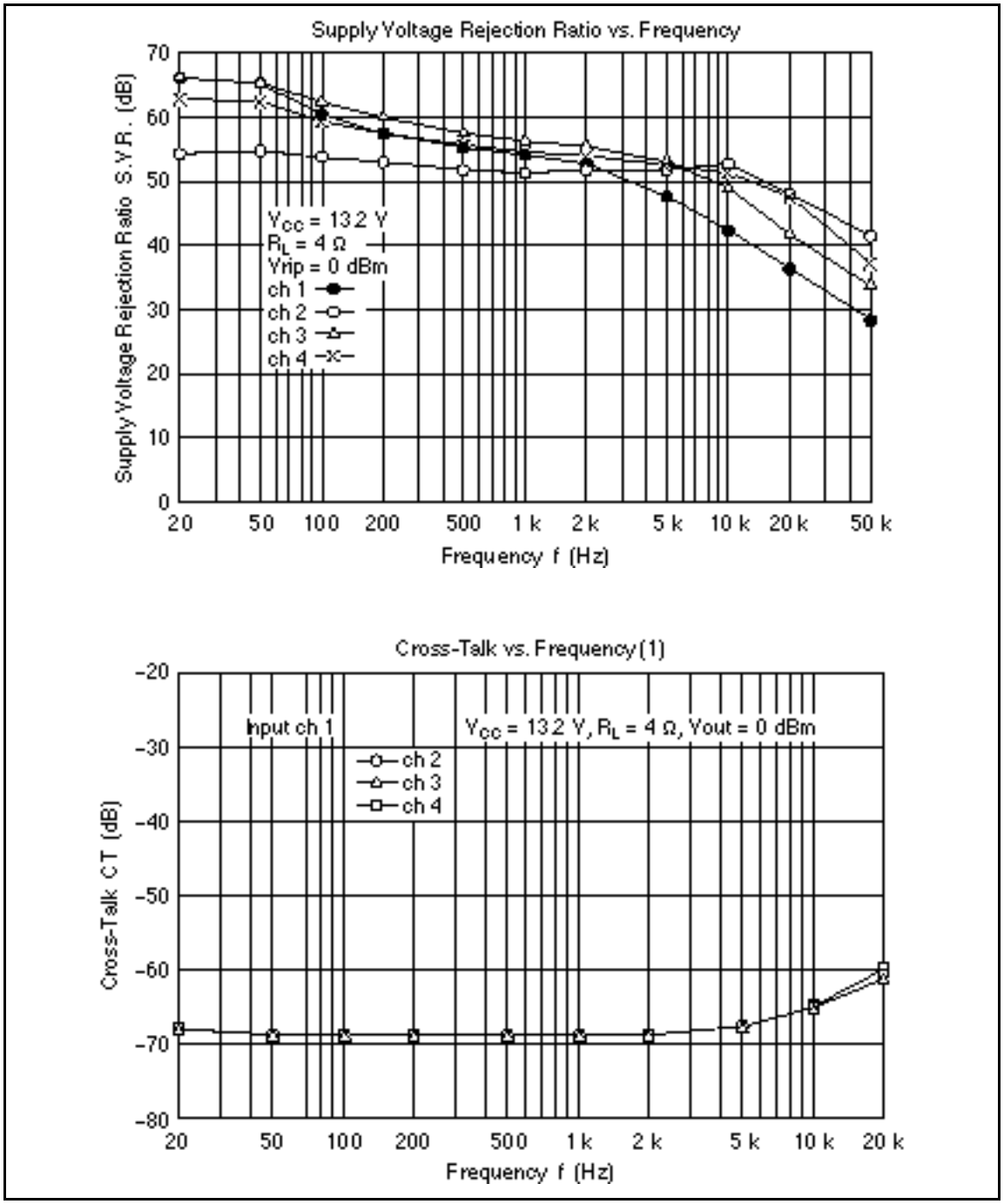

Quiescent Current vs. Supply Voltage
Quiescent Current IQ (mA)
300
200
100
0
8
10
12
14
16
18
20
Supply Voltage Vcc (V)


Output Power vs. Supply Voltage
RL = 4 Ω
f = 1 kHz
1 ch operation
THD = 10%
THD = 1%
Output Power Po (W)
40
30
20
10
0
8
10
12
14
16
18
Supply Voltage Vcc (V)

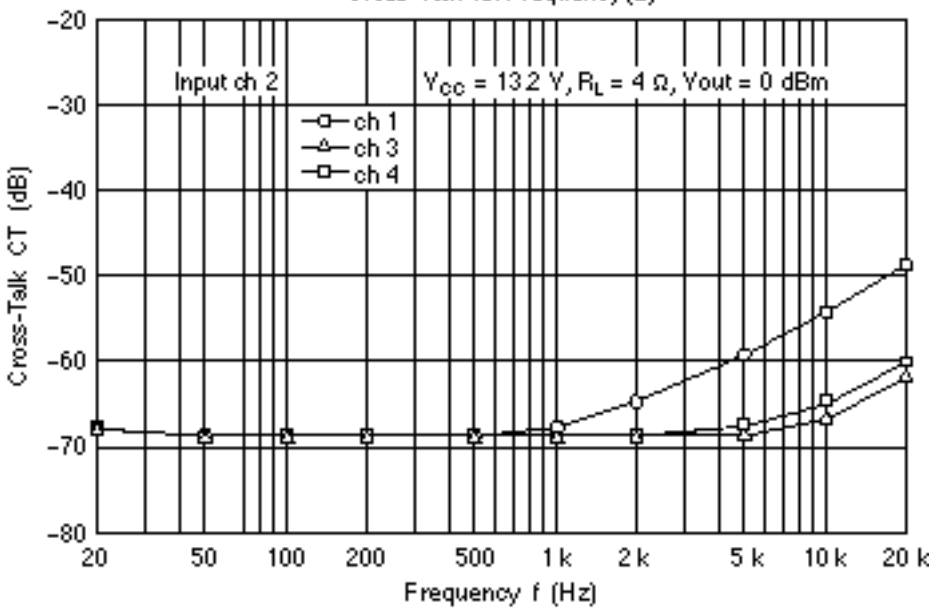

Output Power (Po max)
vs. Supply Voltage
RL = 4 Ω
f = 1 kHz
1 ch operation
Output Power Po max (W)
50
40
30
20
10
0
8
10
12
14
16
18
Supply Voltage Vcc (V)


Total Harmonic Distortion vs. Frequency
Vcc = 13.2 V
RL = 4 Ω
80 kHz L.P.F.
Po = 1.5 W (ch 1 to ch 4)
Po = 8 W (ch 1 to ch 4)
Total Harmonic Distortion T.H.D. (%)
1
0.5
0.2
0.1
0.05
0.02
0.01
20
50
100
200
500
1 k
2 k
5 k
10 k
20 k
Frequency f (Hz)

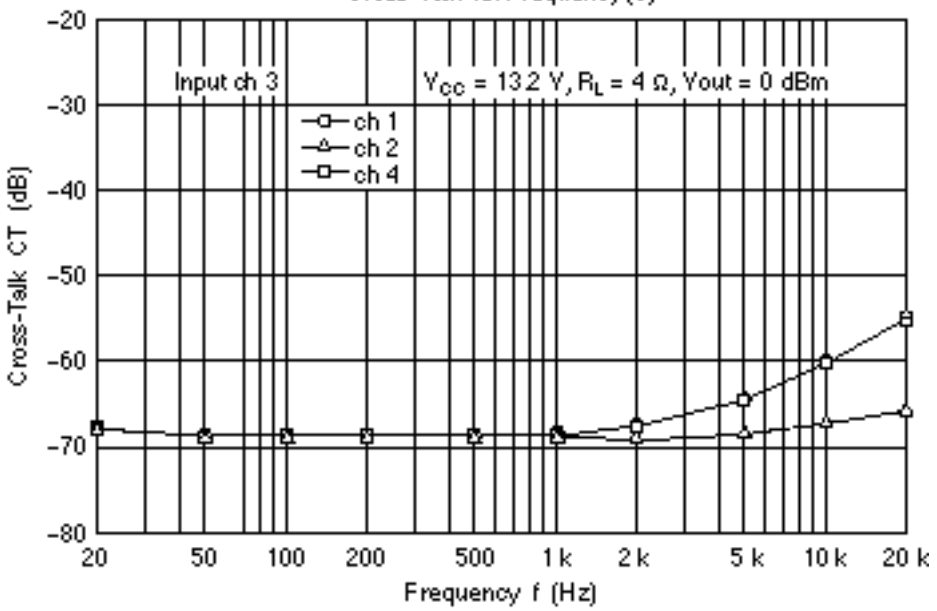

Total Harmonic Distortion vs. Output Power
Vcc = 13.2 V 80 kHz L.P.F.
RL = 4 Ω
f = 100 Hz (ch 1 to ch 4)
1 kHz (ch 1 to ch 4)
10 kHz (ch 1 to ch 4)
Total Harmonic Distortion T.H.D. (%)
10
5.0
2.0
1.0
0.5
0.2
0.1
0.05
0.02
0.01
0.02
0.05
0.1
0.2
0.5
1
2
5
10
20
Output Power Po (W)

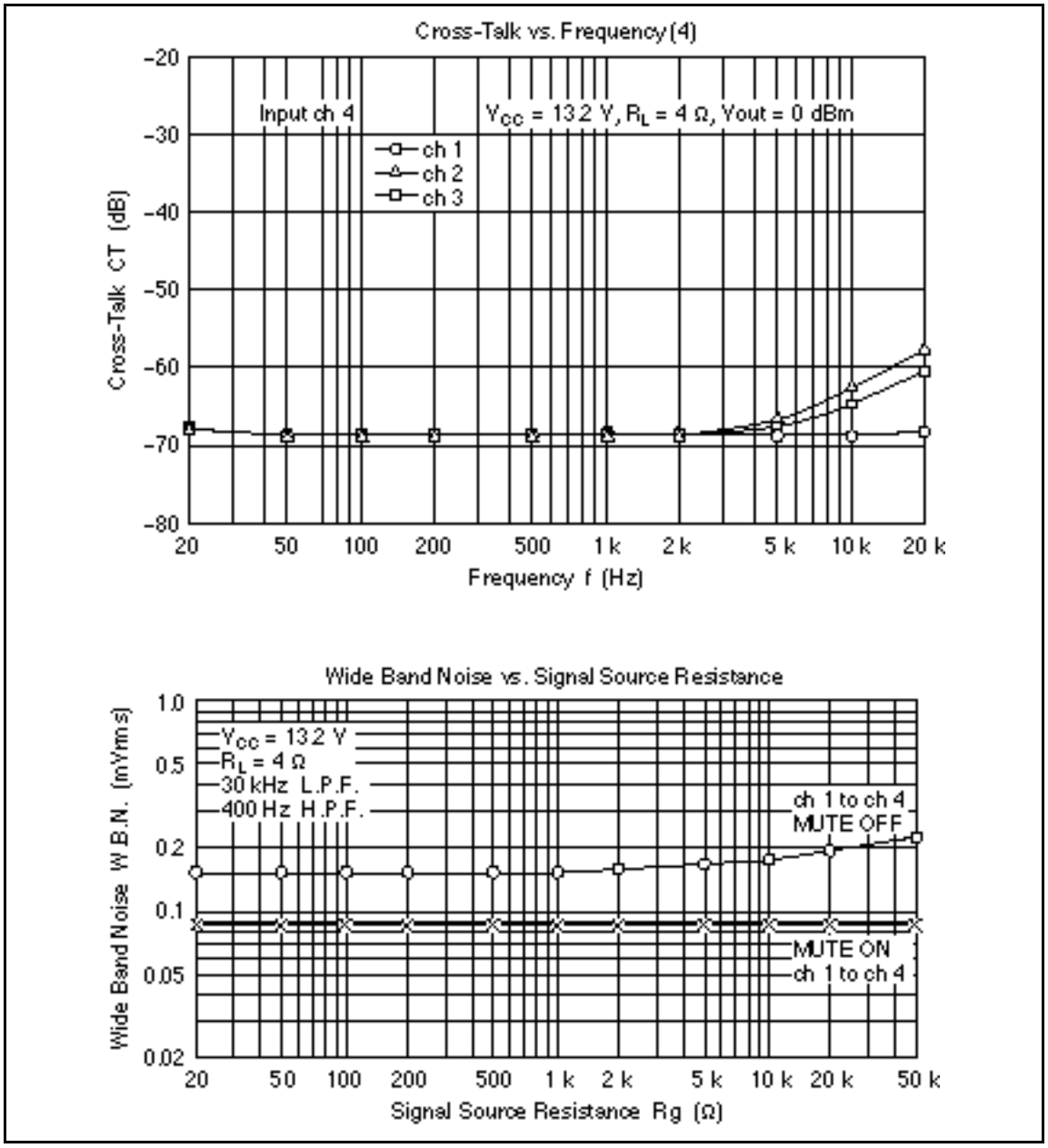

Supply Voltage Rejection Ratio vs. Frequency
Supply Voltage Rejection Ratio S.V.R. (dB)
70
60
50
40
30
20
10
0
20
50
100
200
500
1 k
2 k
5 k
10 k
20 k
50 k
Frequency f (Hz)
Vcc = 13.2 V
RL = 4 Ω
Vrip = 0 dBm
ch 1
ch 2
ch 3
ch 4
Cross-Talk vs. Frequency (1)
Cross-Talk CT (dB)
-20
-30
-40
-50
-60
-70
-80
20
50
100
200
500
1 k
2 k
5 k
10 k
20 k
Frequency f (Hz)
Input ch 1
Vcc = 13.2 V, RL = 4 Ω, Vout = 0 dBm
ch 2
ch 3
ch 4

Cross-Talk vs. Frequency (2)

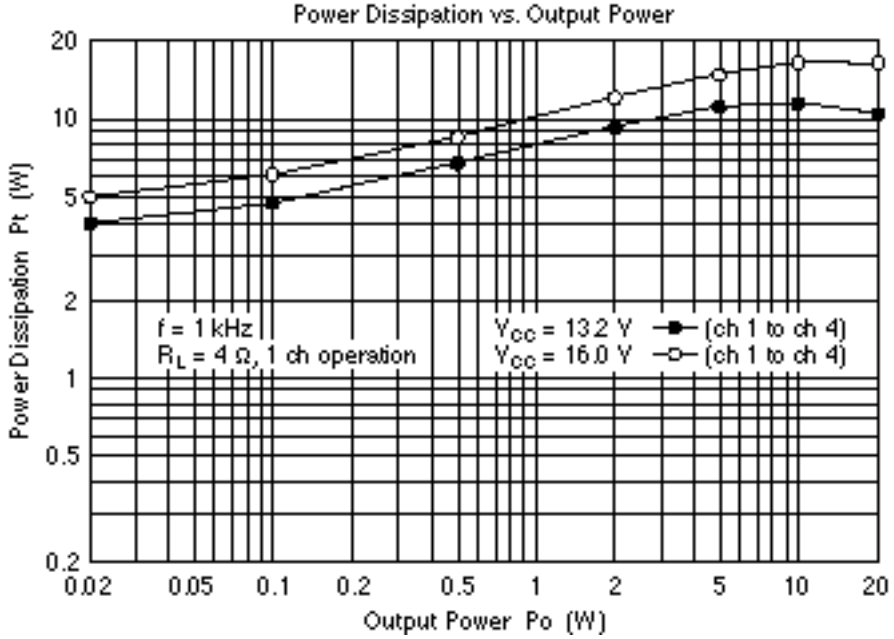



Cross-Talk vs. Frequency (3)

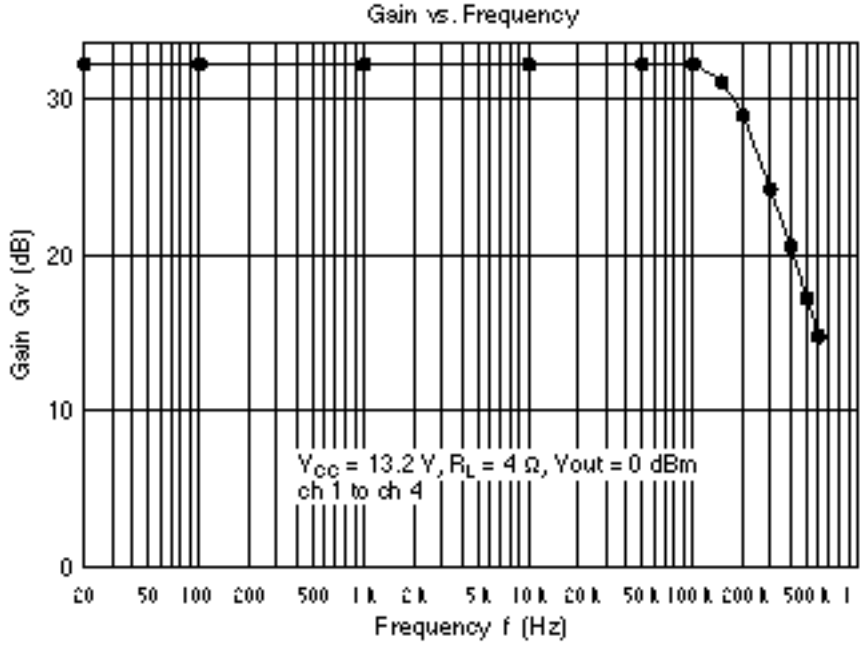



Cross-Talk vs. Frequency (4)
Input ch 4
$V_{CC}$ = 13.2 V, $R_L$ = 4 Ω, Vout = 0 dBm
ch 1
ch 2
ch 3
Cross-Talk CT (dB)
-20
-30
-40
-50
-60
-70
-80
20
50
100
200
500
1 k
2 k
5 k
10 k
20 k
Frequency f (Hz)
Wide Band Noise vs. Signal Source Resistance
$V_{CC}$ = 13.2 V
$R_L$ = 4 Ω
30 kHz L.P.F.
400 Hz H.P.F.
ch 1 to ch 4
MUTE OFF
MUTE ON
ch 1 to ch 4
Wide Band Noise W.B.N. (mVrms)
1.0
0.5
0.2
0.1
0.05
0.02
20
50
100
200
500
1 k
2 k
5 k
10 k
20 k
50 k
Signal Source Resistance Rg (Ω)

Power Dissipation vs. Output Power




Gain vs. Frequency



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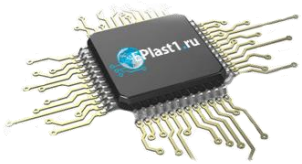


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