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

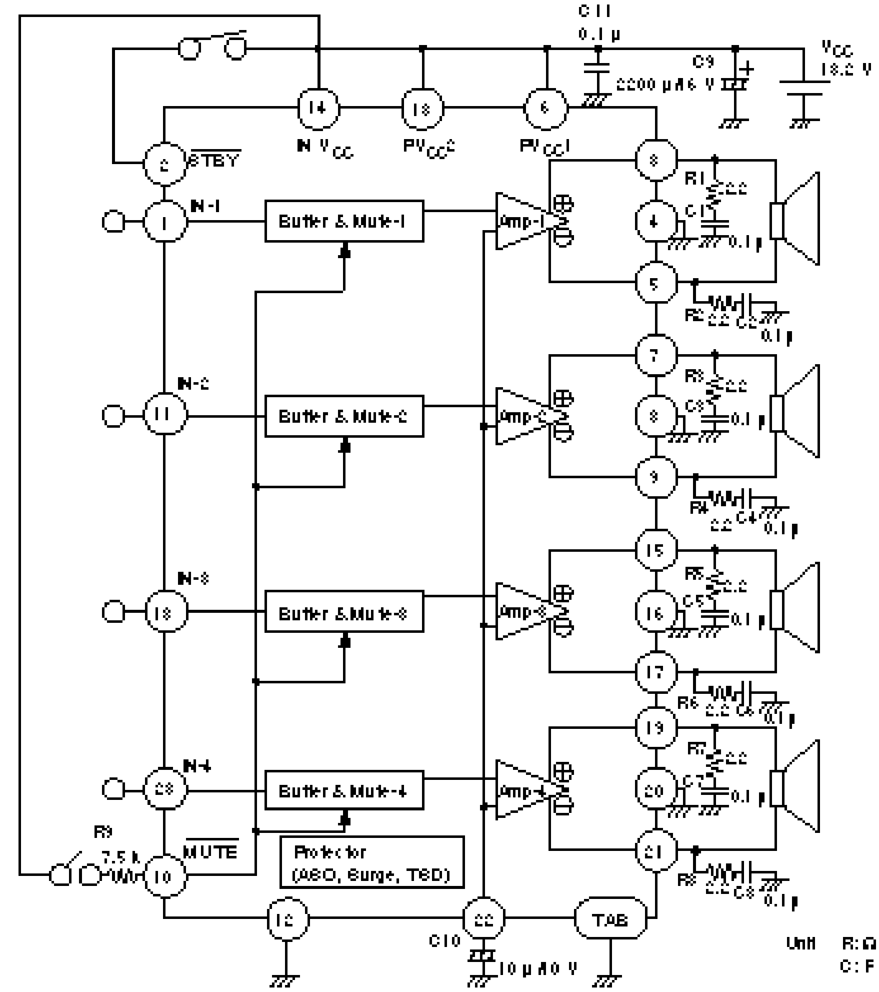
- Built-in standby circuit
- Built-in muting circuit
- Built-in protection circuits (surge, TSD, and ASO)

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.

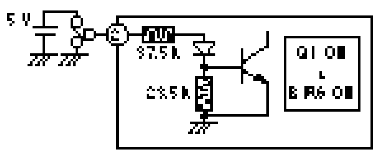
Hitachi semiconductor

Block Diagram

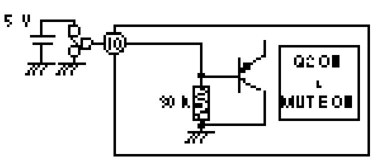


* C1 to C8 should be polyester film capacitors with no secondary resonance (non-inductive), to assure stable operation.

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 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).

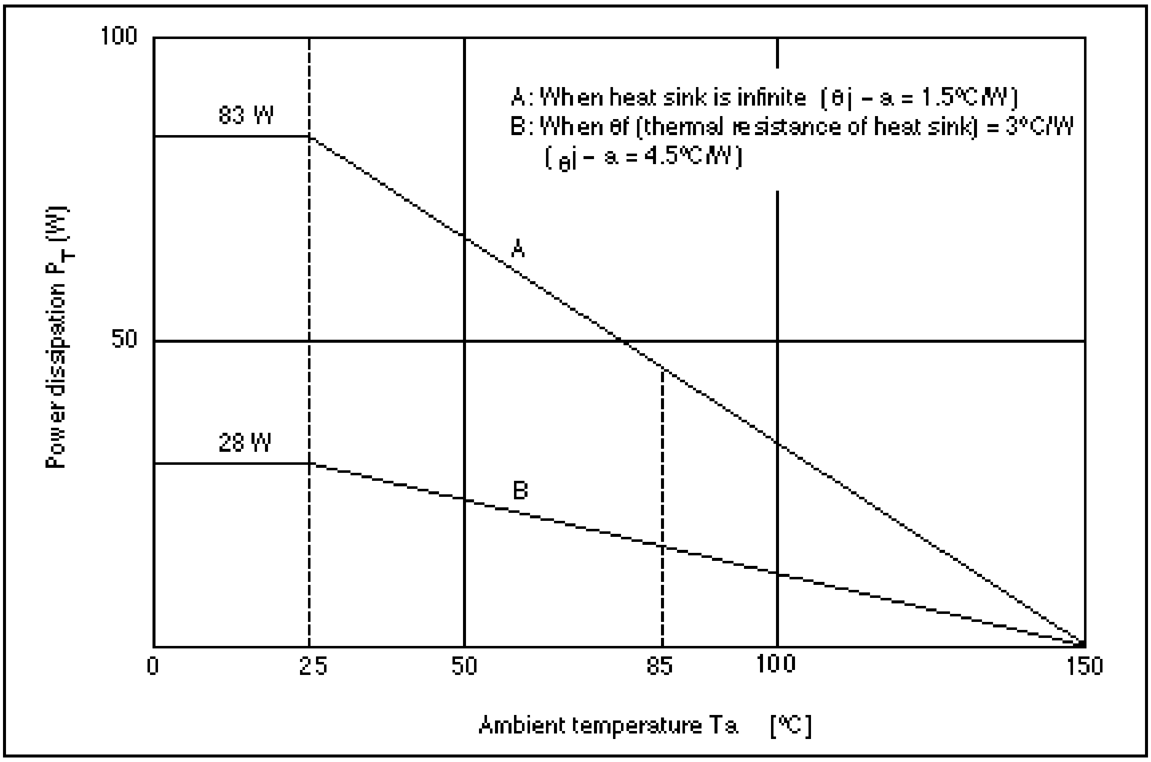


Absolute Maximum Ratings (Ta = 25°C)

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

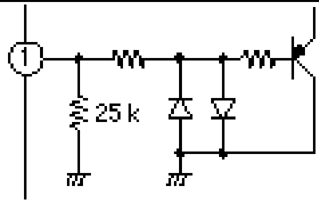
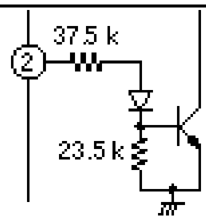
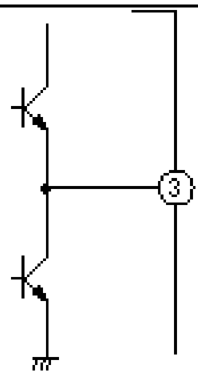
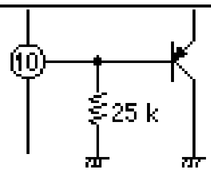
Notes: 1. Tolerance within 30 seconds
2. Tolerance in surge pulse waveform
3. Value per 1 channel
4. Value when attached on the infinite heat sink plate at Ta = 25°C.
The derating carve is as shown in the graph below.



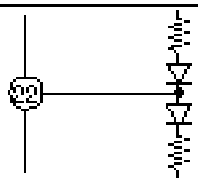
Electrical Characteristics (V_{CC} = 13.2 V, f = 1 kHz, R_L = 4 Ω, Rg = 620 Ω, Ta = 25°C)

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 R_L = 4 Ω, THD = 10%
Max output power	Pomax	—	30	—		V_{CC} = 13.7 V 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 BW = 20 to 20 kHz
Ripple rejection	SVR	—	55	—	dB	Rg = 600 Ω f = 120 Hz
Channel crosstalk	C.T	—	70	—	dB	Rg = 600 Ω 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.

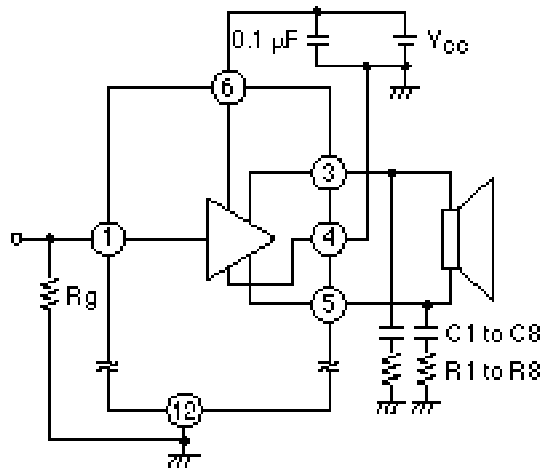


Figure 1 Notes on Application Board's Pattern Design

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.

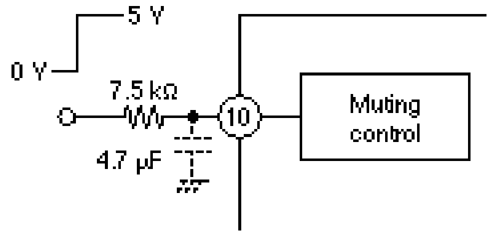
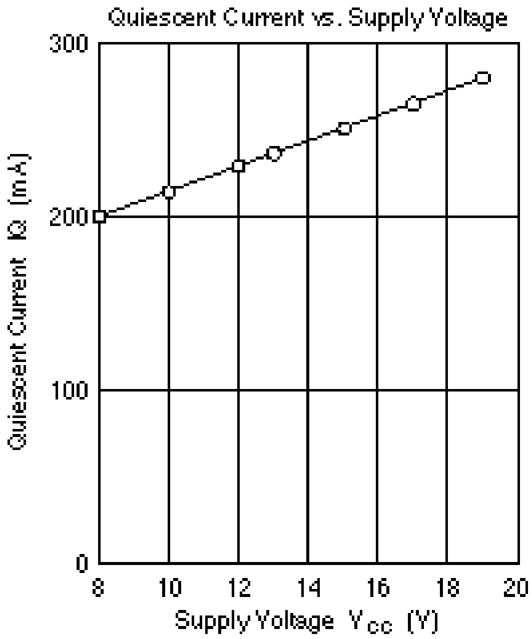
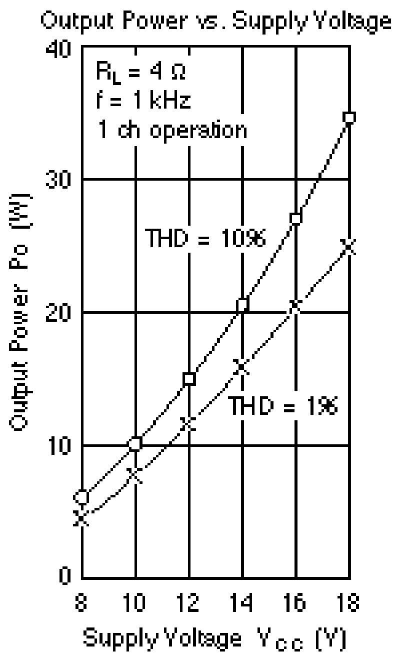


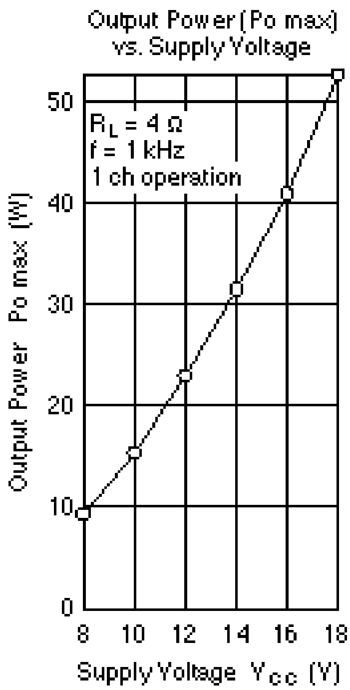
Figure 2 How to use Muting Circuit

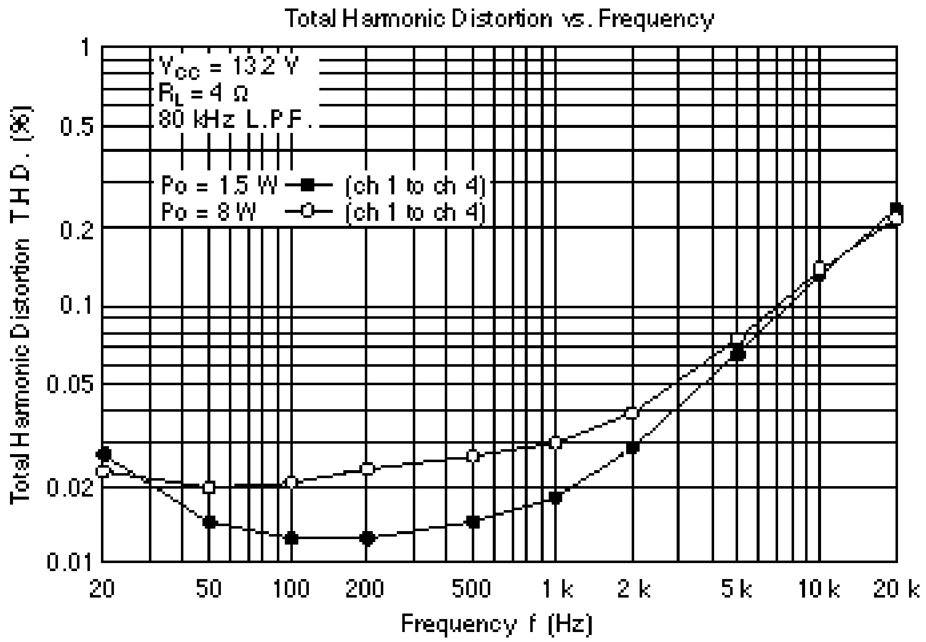
Table 1 Muting ON/OFF Time

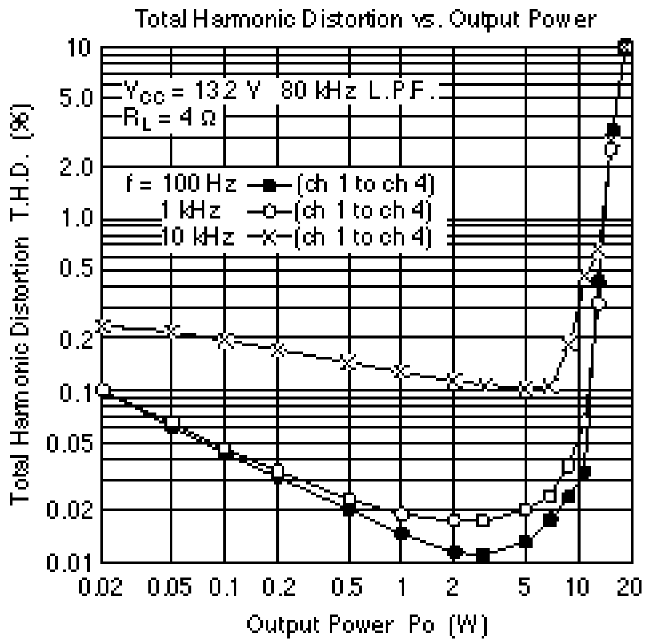
C (µF)	ON Time	OFF Time
nothing	under 1 µs	under 1 µs
0.47	2 ms	2 ms
4.7	19 ms	19 ms

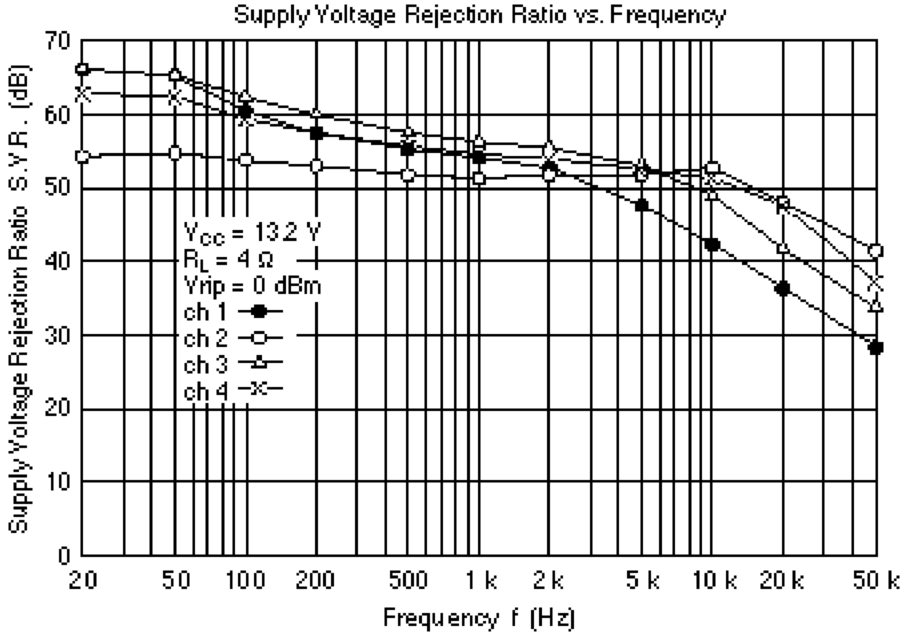

Quiescent Current vs. Supply Voltage
Quiescent Current IQ (mA)
300
200
100
0
8
10
12
14
16
18
20
Supply Voltage Vcc (V)

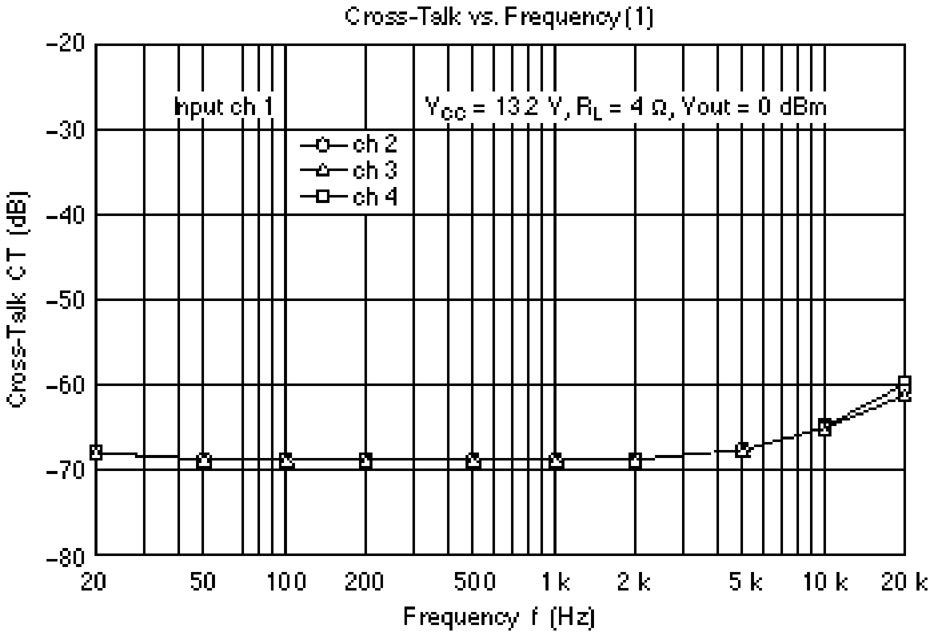

Output Power vs. Supply Voltage
RL = 4 Ω
f = 1 kHz
1 ch operation
THD = 10%
THD = 1%
Output Power Po (W)
40
30
20
10
0
8
10
12
14
16
18
Supply Voltage Vcc (V)

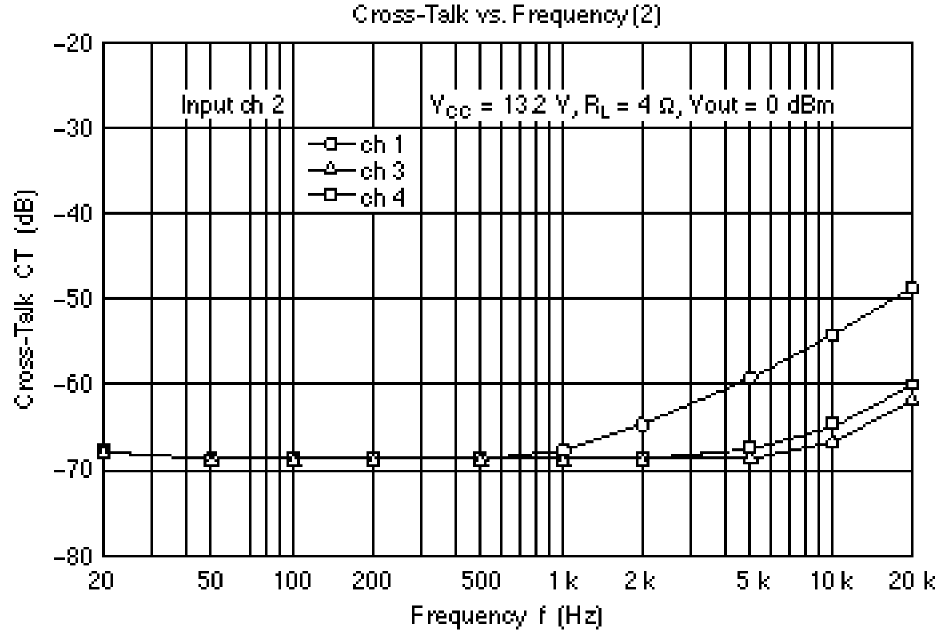

Output Power (Po max)
vs. Supply Voltage
RL = 4 Ω
f = 1 kHz
1 ch operation
Output Power Po max (W)
50
40
30
20
10
0
8
10
12
14
16
18
Supply Voltage Vcc (V)

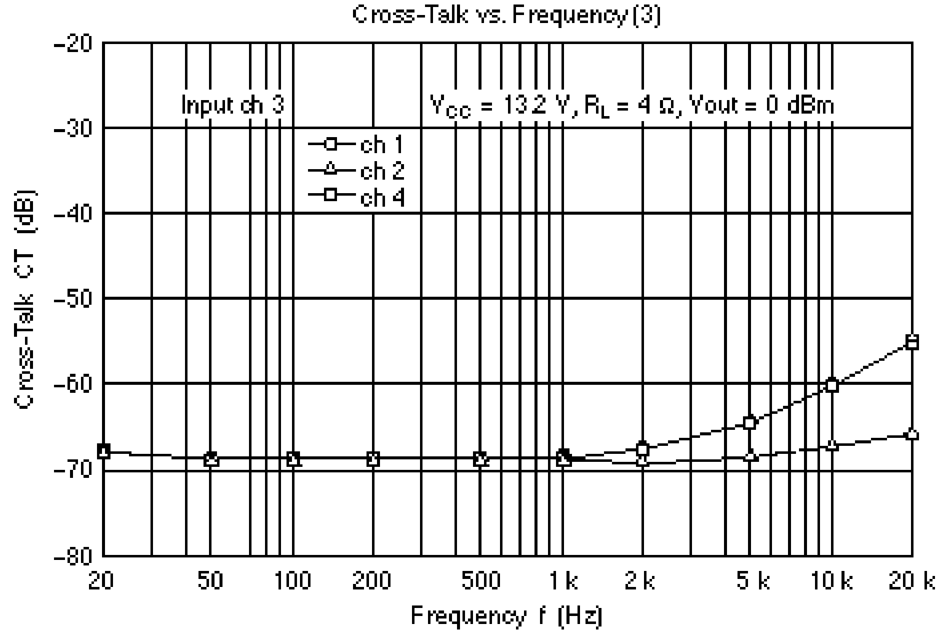

Total Harmonic Distortion vs. Frequency
Vcc = 13.2 V
RL = 4 Ω
80 kHz L.P.F.
Po = 1.5 W (ch 1 to ch 4)
Po = 8 W (ch 1 to ch 4)
Total Harmonic Distortion T.H.D. (%)
1
0.5
0.2
0.1
0.05
0.02
0.01
20
50
100
200
500
1 k
2 k
5 k
10 k
20 k
Frequency f (Hz)

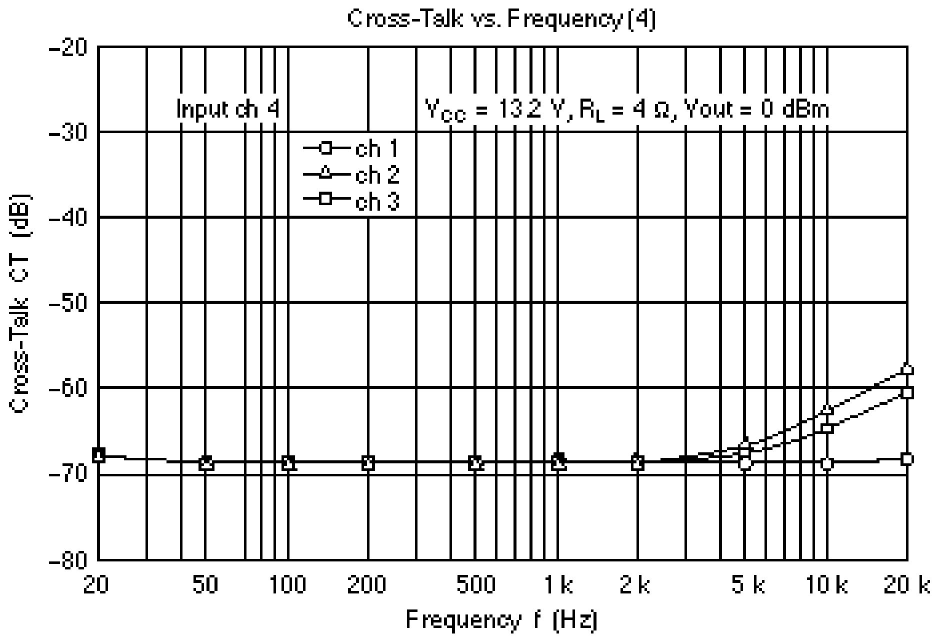

Total Harmonic Distortion vs. Output Power
Vcc = 13.2 V 80 kHz L.P.F.
RL = 4 Ω
f = 100 Hz (ch 1 to ch 4)
1 kHz (ch 1 to ch 4)
10 kHz (ch 1 to ch 4)
Total Harmonic Distortion T.H.D. (%)
10
5.0
2.0
1.0
0.5
0.2
0.1
0.05
0.02
0.01
0.02
0.05
0.1
0.2
0.5
1
2
5
10
20
Output Power Po (W)

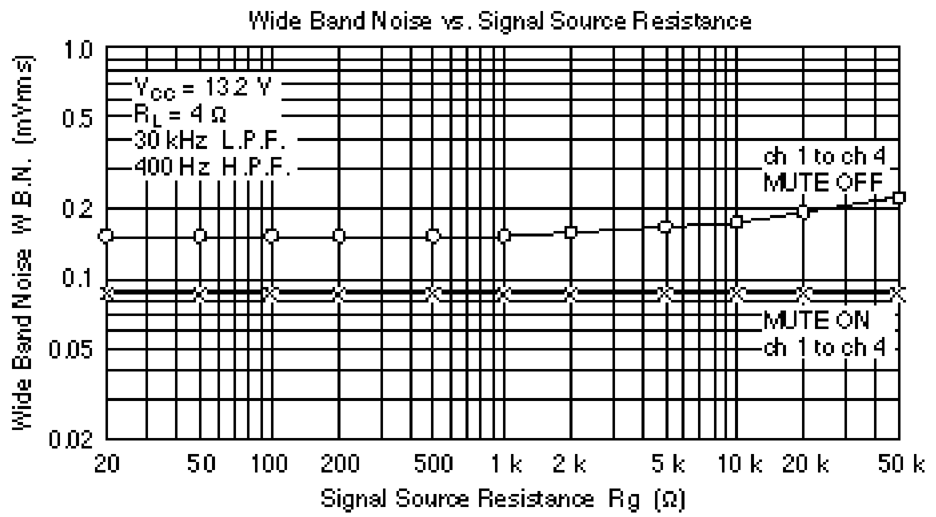

Supply Voltage Rejection Ratio vs. Frequency
Supply Voltage Rejection Ratio S.V.R. (dB)
Frequency f (Hz)
VCC = 13.2 V
RL = 4 Ω
Vrip = 0 dBm
ch 1
ch 2
ch 3
ch 4
70
60
50
40
30
20
10
0
20
50
100
200
500
1 k
2 k
5 k
10 k
20 k
50 k

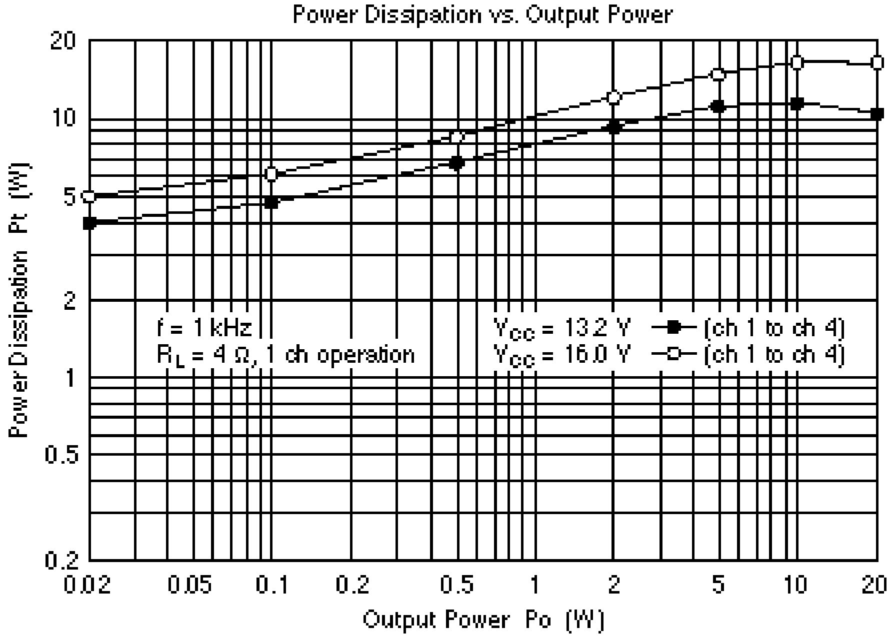

Cross-Talk vs. Frequency (1)
Cross-Talk CT (dB)
Frequency f (Hz)
Input ch 1
VCC = 13.2 V, RL = 4 Ω, Vout = 0 dBm
ch 2
ch 3
ch 4
−20
−30
−40
−50
−60
−70
−80
20
50
100
200
500
1 k
2 k
5 k
10 k
20 k

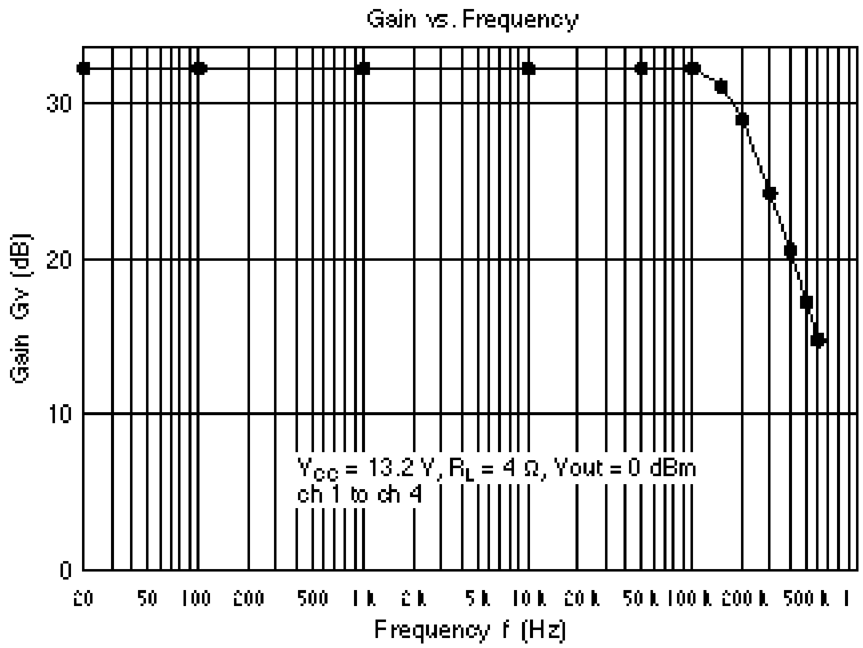

Cross-Talk vs. Frequency (2)
Input ch 2
V_{CC} = 13.2 V, R_L = 4 Ω, Vout = 0 dBm
ch 1
ch 3
ch 4
Cross-Talk CT (dB)
−20
−30
−40
−50
−60
−70
−80
20
50
100
200
500
1 k
2 k
5 k
10 k
20 k
Frequency f (Hz)


Cross-Talk vs. Frequency (3)
Input ch 3
V_{CC} = 13.2 V, R_L = 4 Ω, Vout = 0 dBm
ch 1
ch 2
ch 4
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)


Cross-Talk vs. Frequency (4)
Input ch 4
VCC = 13.2 V, RL = 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
VCC = 13.2 V
RL = 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
20
10
5
2
1
0.5
0.2
0.02
0.05
0.1
0.2
0.5
1
2
5
10
20
Output Power Po (W)
Power Dissipation Pt (W)
f = 1 kHz
RL = 4 Ω, 1 ch operation
VCC = 13.2 V (ch 1 to ch 4)
VCC = 16.0 V (ch 1 to ch 4)


Gain vs. Frequency
30
20
10
0
Gain Gv (dB)
VCC = 13.2 V, RL = 4 Ω, Vout = 0 dBm
ch 1 to ch 4
20
50
100
200
500
1 k
2 k
5 k
10 k
20 k
50 k
100 k
200 k
500 k
1
Frequency f (Hz)

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