HA13151, HA13152

14 W × 4-Channel BTL Power IC

HITACHI

ADE-207-116
1st. Edition

Description

The HA13151/HA13152 are high output and low distortion 4 ch BTL power IC designed for digital car audio.

At 13.2 V to 4 Ω load, this power IC provides output power 14 W with 10% distortion.

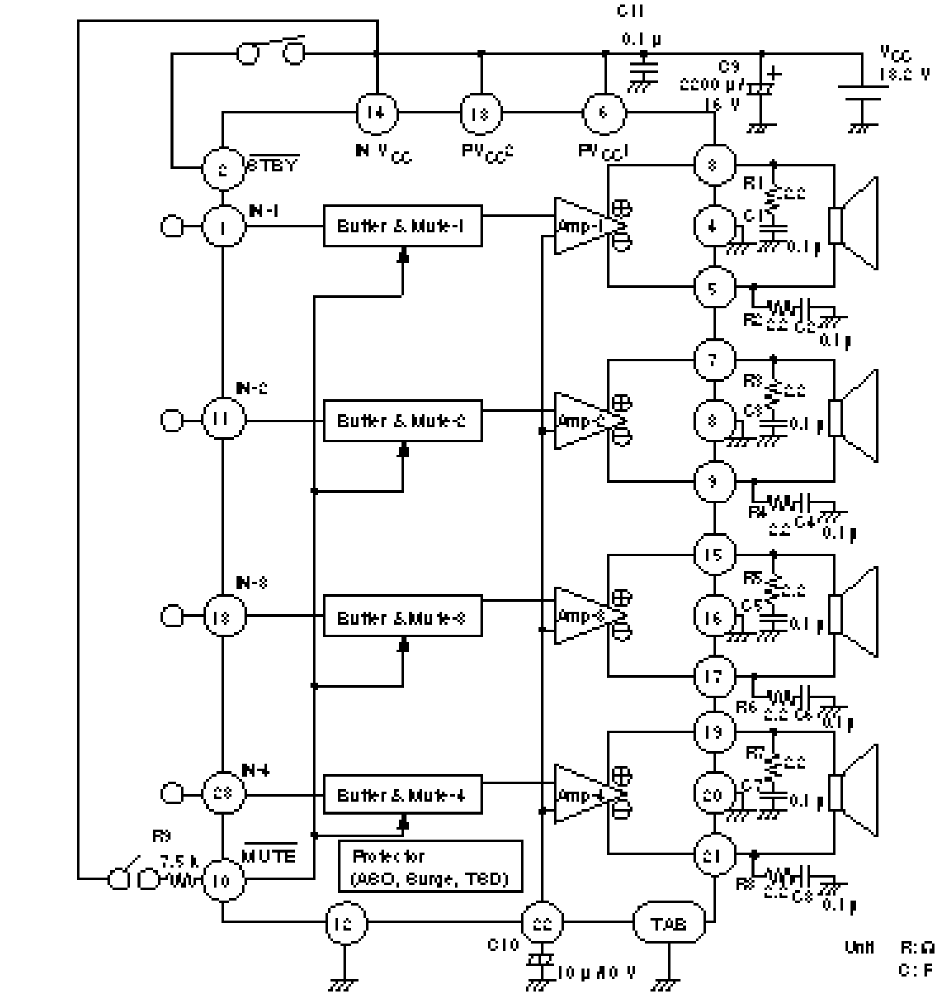
Functions

- 4 ch BTL power amplifiers
- Built-in standby circuit
- Built-in muting circuit
- Built-in protection circuit (surge, T.S.D, and ASO)

Features

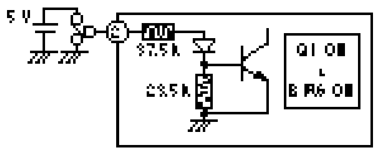
- Few external parts lead to compact set-area possibility
- Popping noise minimized
- Low output noise
- Built-in high reliability protection circuit

Block Diagram

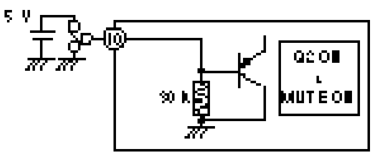


* C1 to C8 should be polyester film capacitors with no secondary resonance (non-inductive), to assure stable operation.

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).

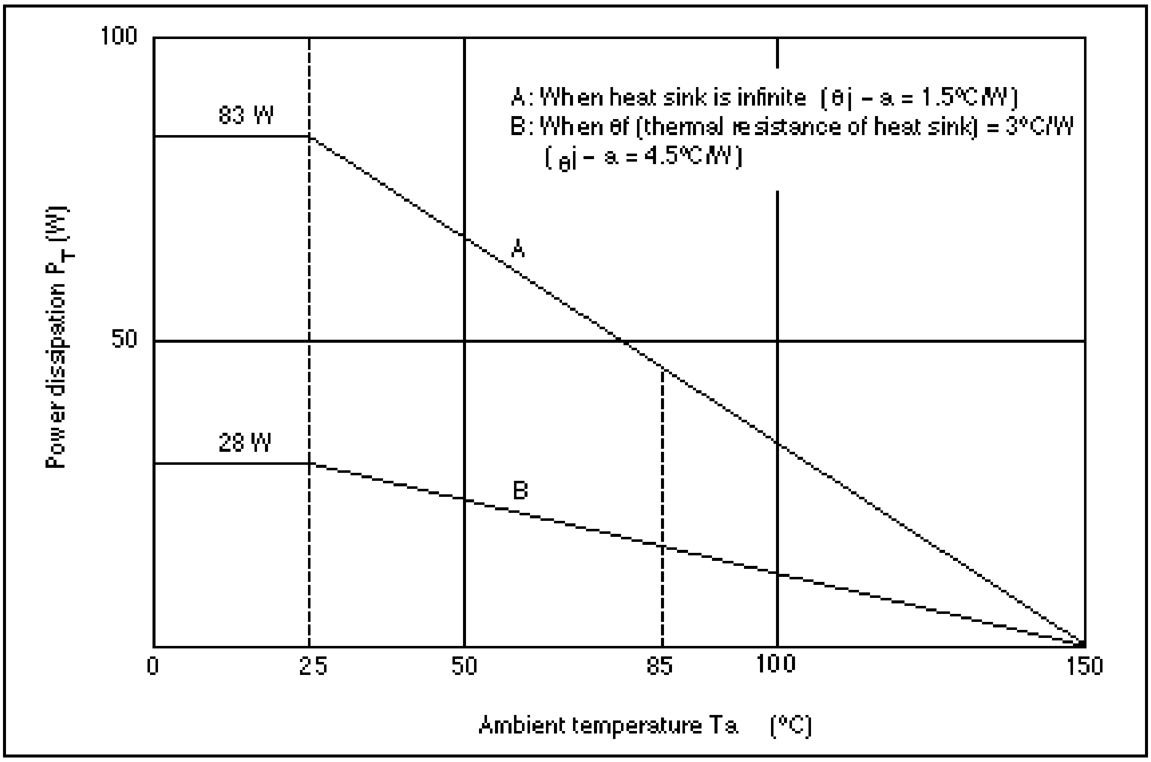


Absolute Maximum Ratings (Ta = 25°C)

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)	3	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 = 600 Ω, Ta = 25°C)

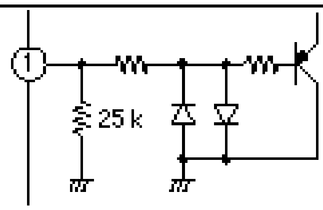
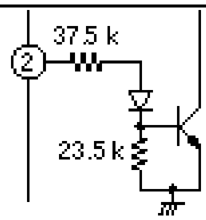
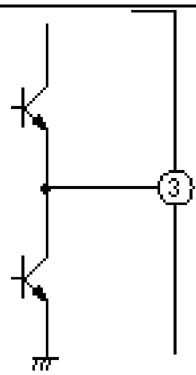
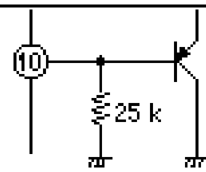
HA13151

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Quiescent current	I_Q1	—	270	—	mA	Vin = 0
Output offset voltage	ΔV_Q	–300	0	+300	mV	
Gain	G_V	30.5	32	33.5	dB	
Gain difference between channels	ΔG_V	–1.5	0	+1.5	dB	
Rated output power	Po	—	14	—	W	V_{CC} = 13.2 V THD = 10%, R_L = 4 Ω
Max output power	Pomax	—	22	—	W	V_{CC} = 13.7 V THD = Max, R_L = 4 Ω
Total harmonic distortion	T.H.D.	—	0.05	—	%	Po = 3 W
Output noise voltage	WBN	—	0.15	—	mVrms	Rg = 0 Ω BW = 20 to 20 kHz
Ripple rejection	SVR	—	55	—	dB	Rg = 600 Ω, f = 120 Hz
Channel cross talk	C.T.	—	70	—	dB	Rg = 600 Ω Vout = 0 dBm
Input impedance	Rin	—	25	—	kΩ	
Standby current	I_Q2	—	—	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	ATTM	—	70	—	dB	Vout = 0 dBm

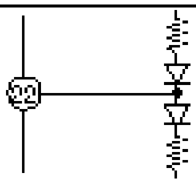
HA13152

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Quiescent current	I_Q1	—	270	—	mA	Vin = 0
Output offset voltage	ΔV_Q	–300	0	+300	mV	
Gain	G_V	38.5	40	41.5	dB	
Gain difference between channels	ΔG_V	–1.5	0	+1.5	dB	
Rated output power	Po	—	14	—	W	V_{CC} = 13.2 V THD = 10%, R_L = 4 Ω
Max output power	Pomax	—	22	—	W	V_{CC} = 13.7 V THD = Max, R_L = 4 Ω
Total harmonic distortion	T.H.D.	—	0.05	—	%	Po = 3%
Output noise voltage	WBN	—	0.25	—	mVrms	Rg = 0 Ω BW = 20 to 20 kHz
Ripple rejection	SVR	—	45	—	dB	Rg = 600 Ω, f = 120 Hz
Channel cross talk	C.T.	—	60	—	dB	Rg = 600 Ω Vout = 0 dBm
Input impedance	Rin	—	25	—	kΩ	
Standby current	I_Q2	—	—	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	ATTM	—	60	—	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.

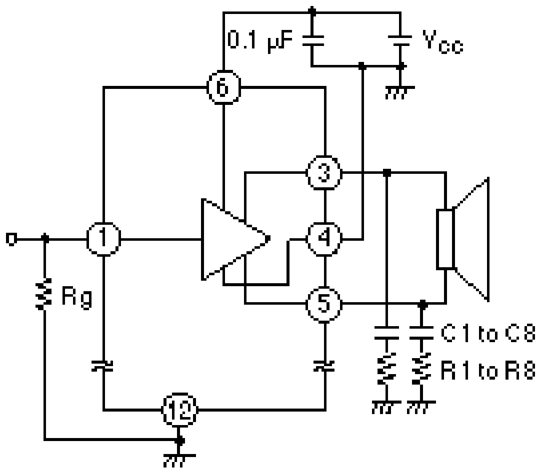


Figure 1 Notes on Application Board's Pattern Design

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.

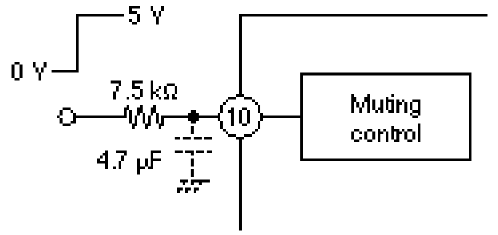
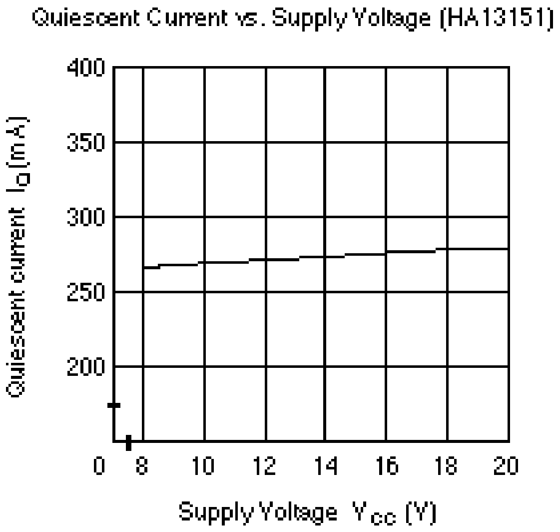
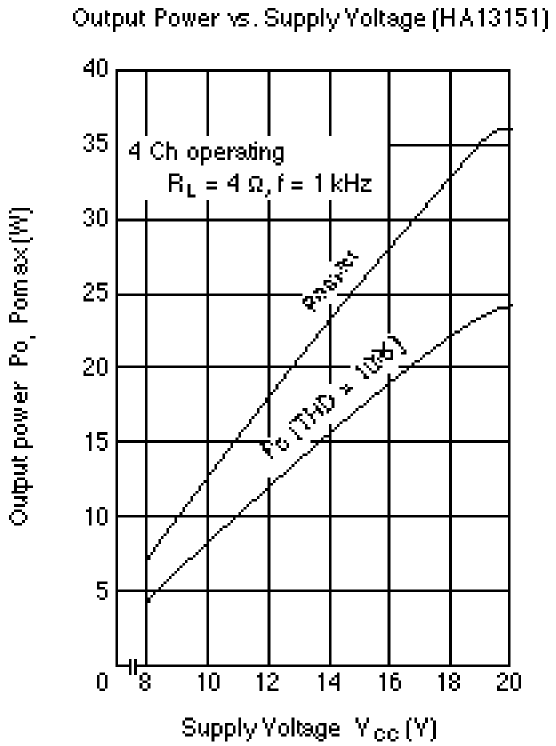


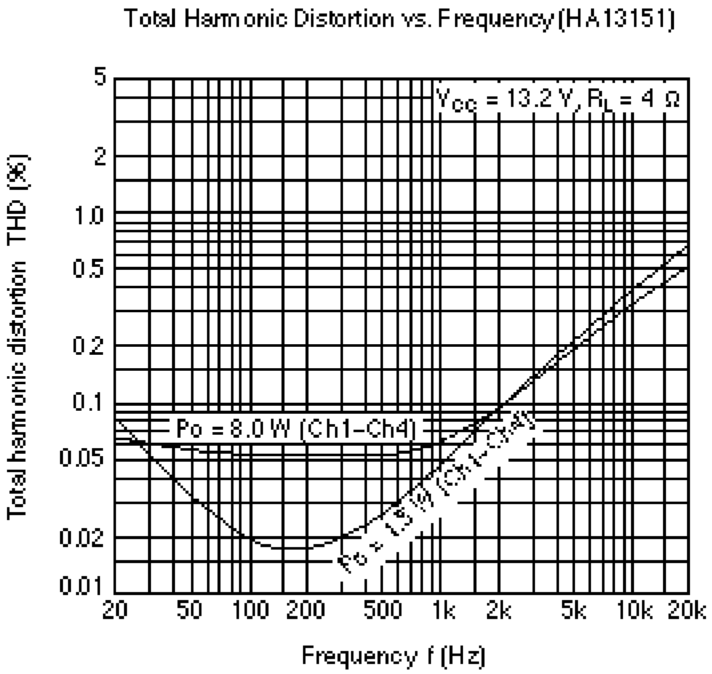
Figure 2 How to use Muting Circuit

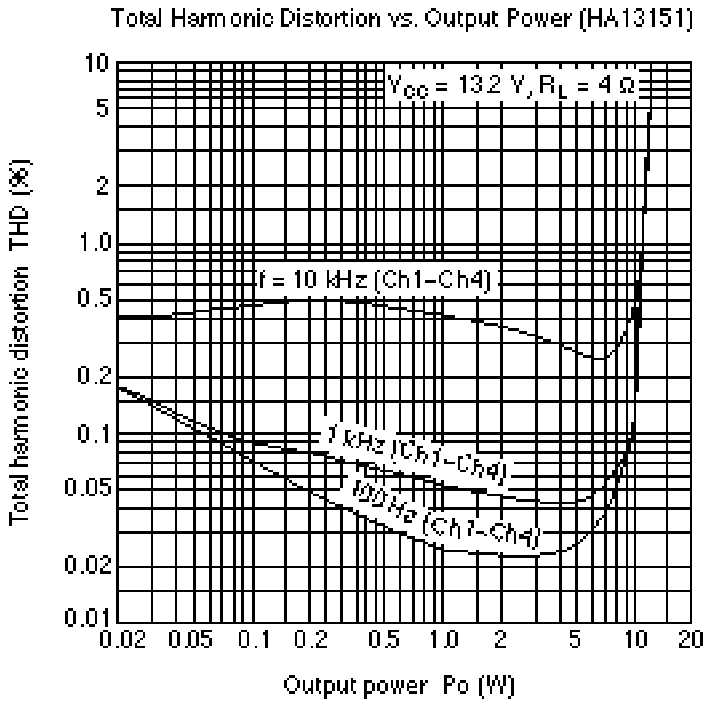
Table 1 Muting ON/OFF Time

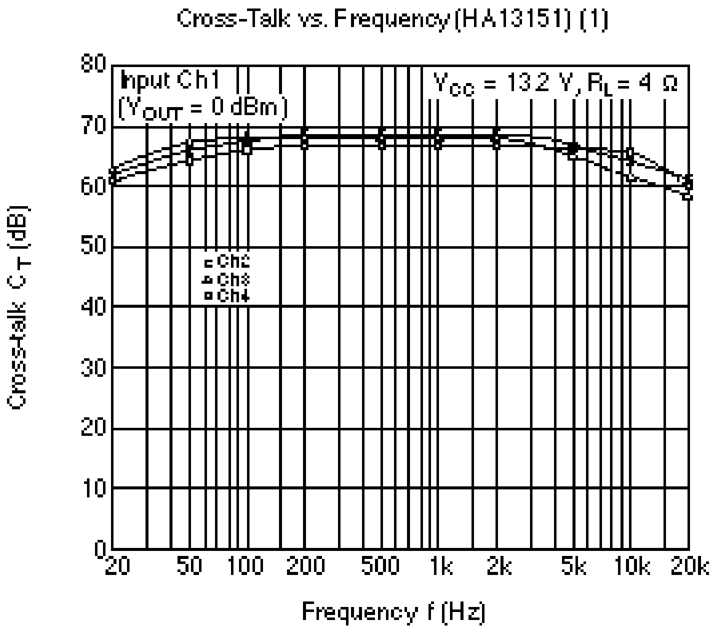
C (µF)	ON Time	OFF Time
nothing	under 1 µs	under 1 µs
0.47	2 ms	2 ms
4.7	19 ms	19 ms

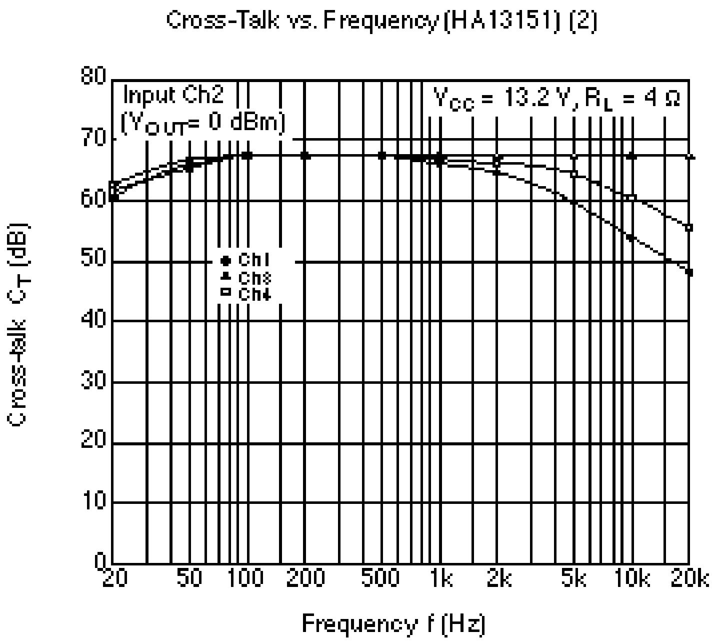

Quiescent Current vs. Supply Voltage (HA13151)
Quiescent current IQ (mA)
400
350
300
250
200
0
8
10
12
14
16
18
20
Supply Voltage VCC (V)


Output Power vs. Supply Voltage (HA13151)
Output power Po, Pomax (W)
4 Ch operating
RL = 4 Ω, f = 1 kHz
Po (THD = 10%)
40
35
30
25
20
15
10
5
0
8
10
12
14
16
18
20
Supply Voltage VCC (V)

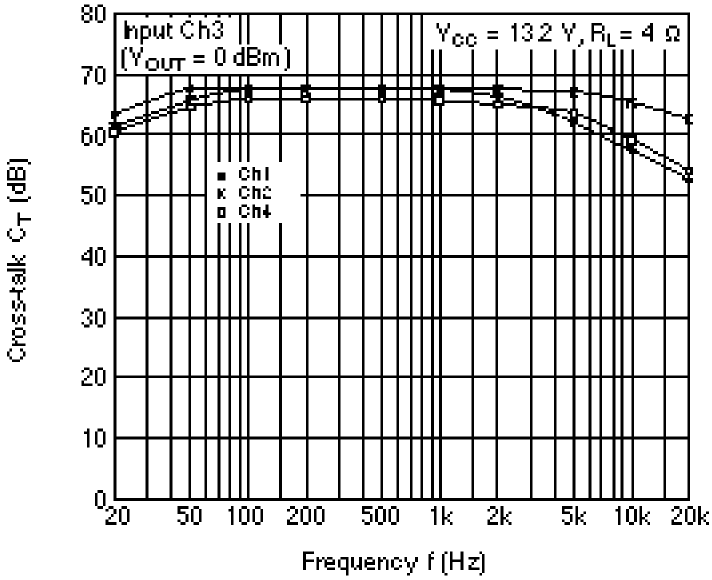

Total Harmonic Distortion vs. Frequency (HA13151)
V_{CC} = 13.2 V, R_L = 4 Ω
Po = 8.0 W (Ch1–Ch4)
Po = 1.5 W (Ch1–Ch4)
Total harmonic distortion THD (%)
5
2
1.0
0.5
0.2
0.1
0.05
0.02
0.01
20
50
100
200
500
1k
2k
5k
10k
20k
Frequency f (Hz)


Total Harmonic Distortion vs. Output Power (HA13151)
V_{CC} = 13.2 V, R_L = 4 Ω
f = 10 kHz (Ch1–Ch4)
1 kHz (Ch1–Ch4)
100 Hz (Ch1–Ch4)
Total harmonic distortion THD (%)
10
5
2
1.0
0.5
0.2
0.1
0.05
0.02
0.01
0.02
0.05
0.1
0.2
0.5
1.0
2
5
10
20
Output power Po (W)

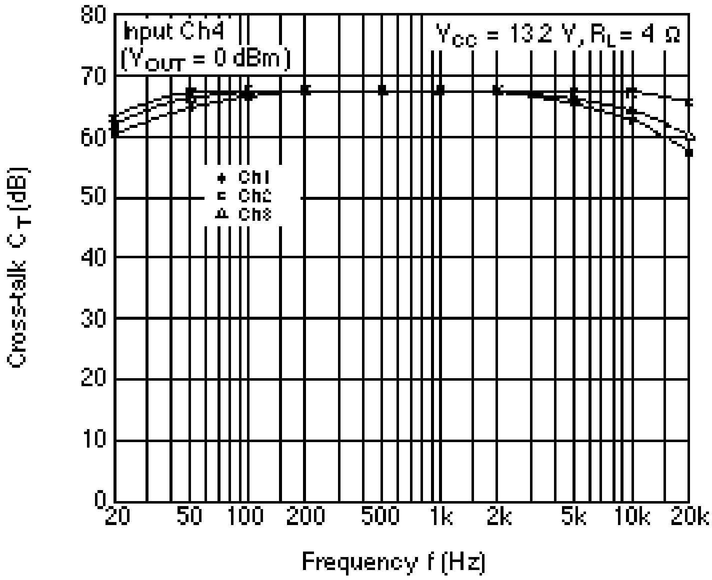

Cross-Talk vs. Frequency (HA13151) (1)
Input Ch1
(VOUT = 0 dBm)
VCC = 13.2 V, RL = 4 Ω
Ch2
Ch3
Ch4
Cross-talk CT (dB)
80
70
60
50
40
30
20
10
0
20
50
100
200
500
1k
2k
5k
10k
20k
Frequency f (Hz)


Cross-Talk vs. Frequency (HA13151) (2)
Input Ch2
(VOUT = 0 dBm)
VCC = 13.2 V, RL = 4 Ω
Ch1
Ch3
Ch4
Cross-talk CT (dB)
80
70
60
50
40
30
20
10
0
20
50
100
200
500
1k
2k
5k
10k
20k
Frequency f (Hz)

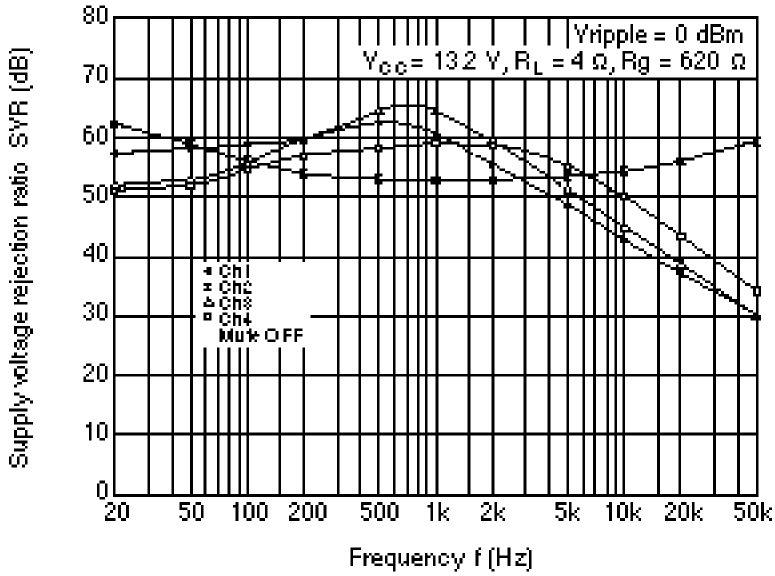
Cross-Talk vs. Frequency (HA13151) (3)



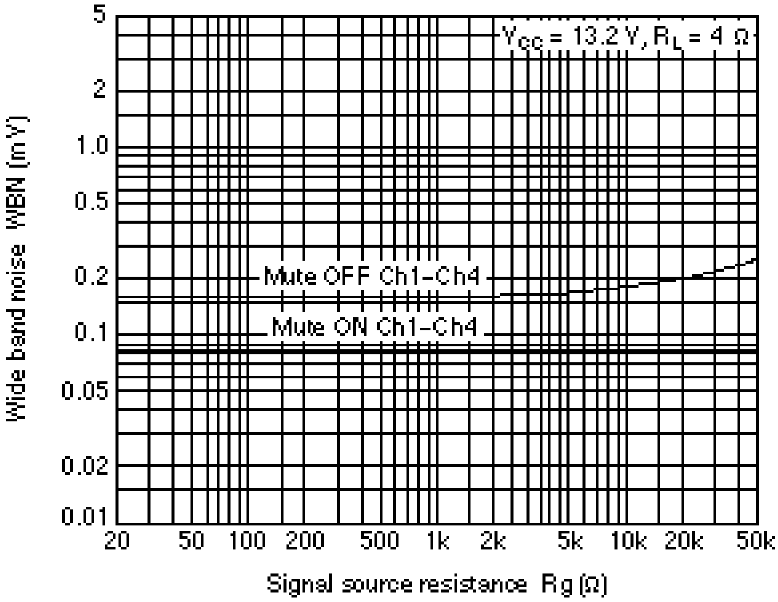
Cross-Talk vs. Frequency (HA13151) (4)

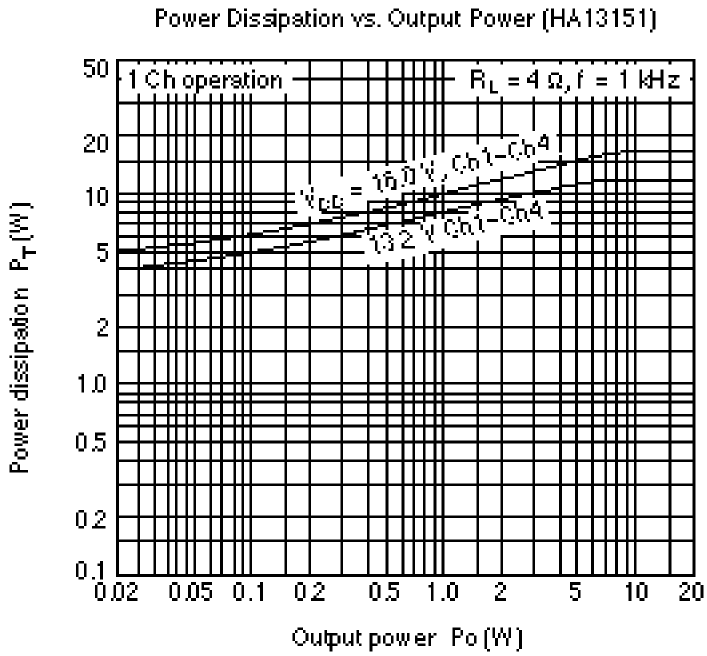


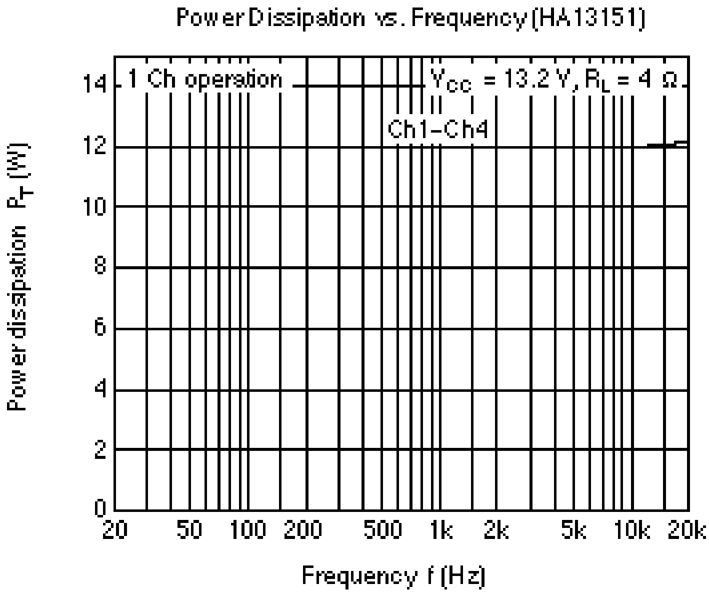
Supply Voltage Rejection Ratio vs. Frequency (HA13151)

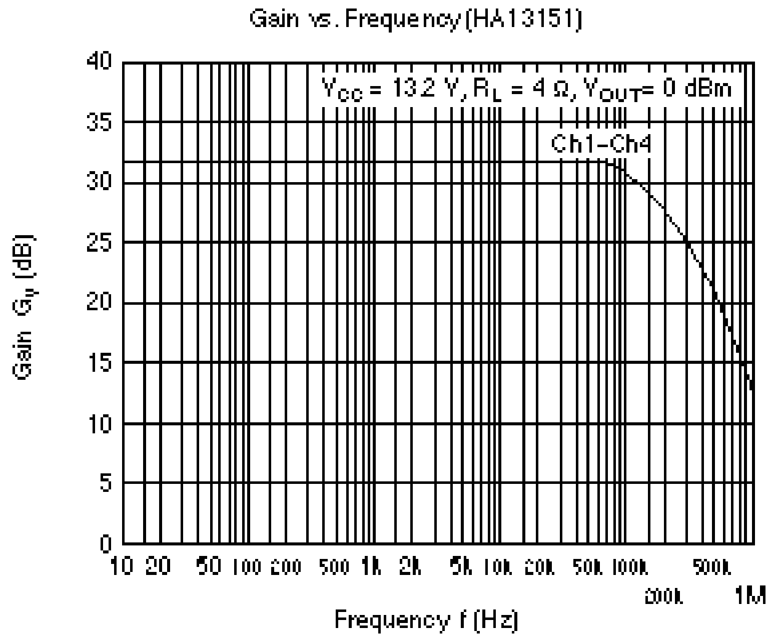


Wide Band Noise vs. Signal Source Resistance (HA13151)

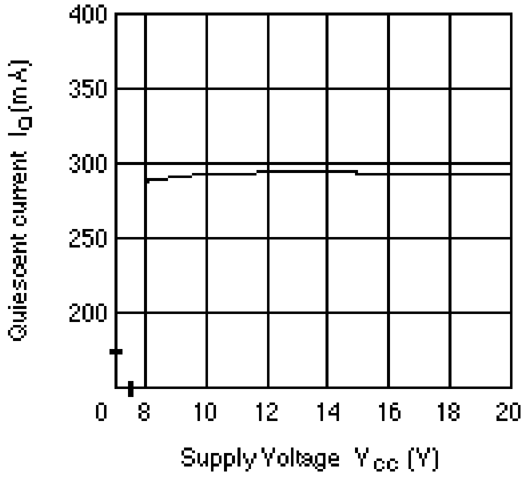



Power Dissipation vs. Output Power (HA13151)
1 Ch operation
R_L = 4 Ω, f = 1 kHz
V_{CC} = 16.0 V, Ch1–Ch4
13.2 V Ch1–Ch4
Power dissipation P_T (W)
Output power Po (W)
50
20
10
5
2
1.0
0.5
0.2
0.1
0.02
0.05
0.1
0.2
0.5
1.0
2
5
10
20

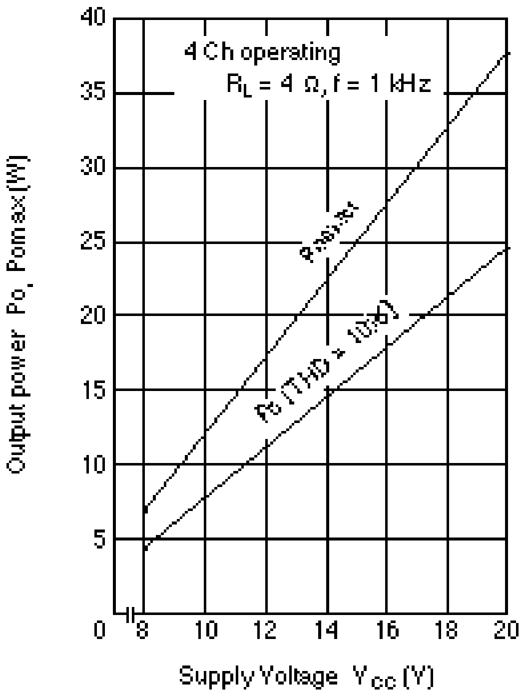

Power Dissipation vs. Frequency (HA13151)
1 Ch operation
V_{CC} = 13.2 V, R_L = 4 Ω
Ch1–Ch4
Power dissipation P_T (W)
Frequency f (Hz)
14
12
10
8
6
4
2
0
20
50
100
200
500
1k
2k
5k
10k
20k

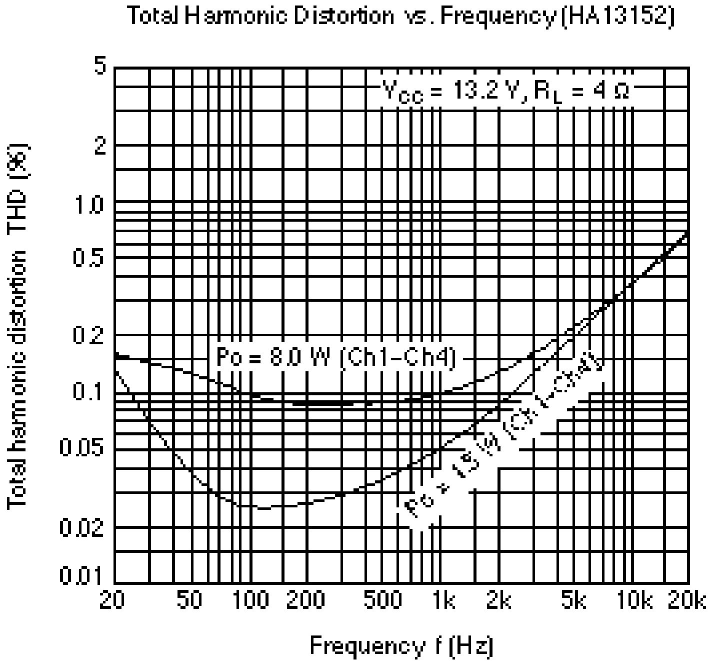

Gain vs. Frequency (HA13151)
VCC = 13.2 V, RL = 4 Ω, VOUT = 0 dBm
Ch1–Ch4
Gain GV (dB)
40
35
30
25
20
15
10
5
0
10 20 50 100 200 500 1k 2k 5k 10k 20k 50k 100k 200k 500k 1M
Frequency f (Hz)

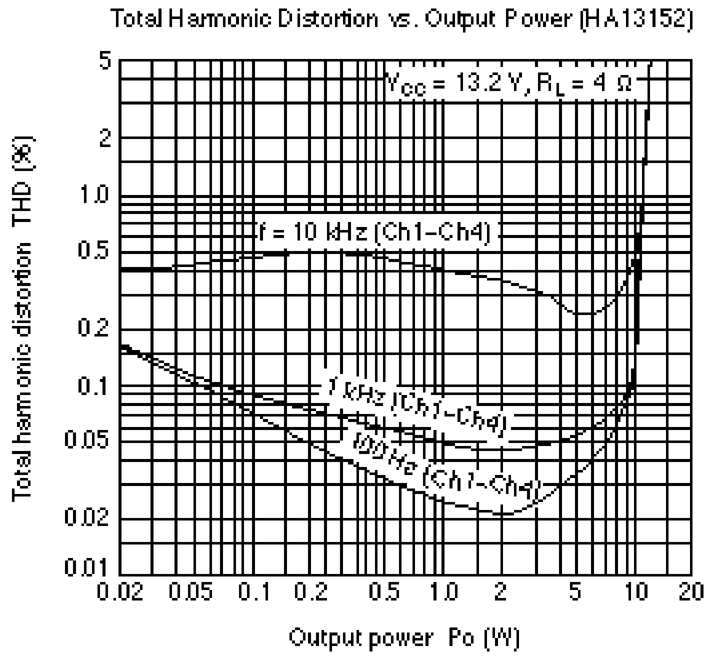
Quiescent Current vs. Supply Voltage (HA13152)



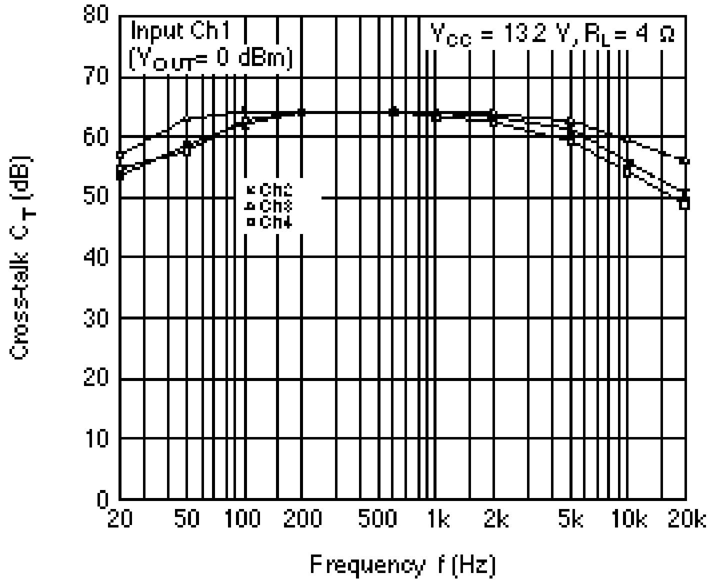
Output Power vs. Supply Voltage (HA13152)



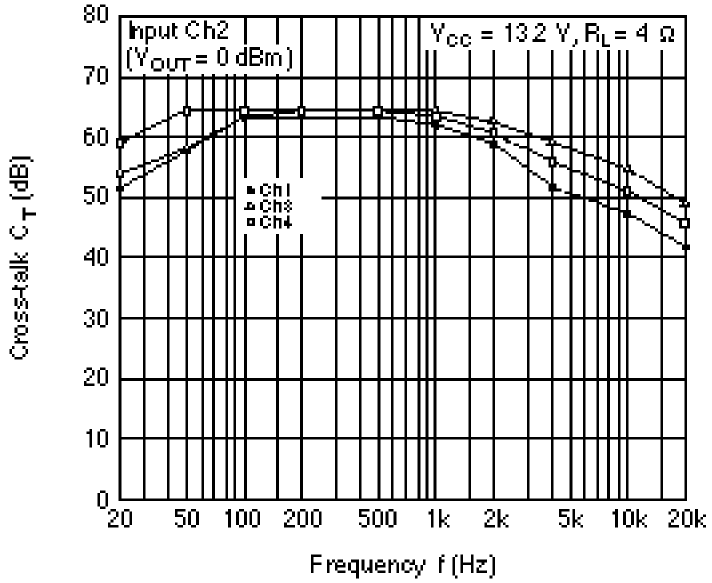

Total Harmonic Distortion vs. Frequency (HA13152)
Vcc = 13.2 V, RL = 4 Ω
Po = 8.0 W (Ch1−Ch4)
Po = 1.5 W (Ch1−Ch4)
Total harmonic distortion THD (%)
5
2
1.0
0.5
0.2
0.1
0.05
0.02
0.01
20
50
100
200
500
1k
2k
5k
10k
20k
Frequency f (Hz)

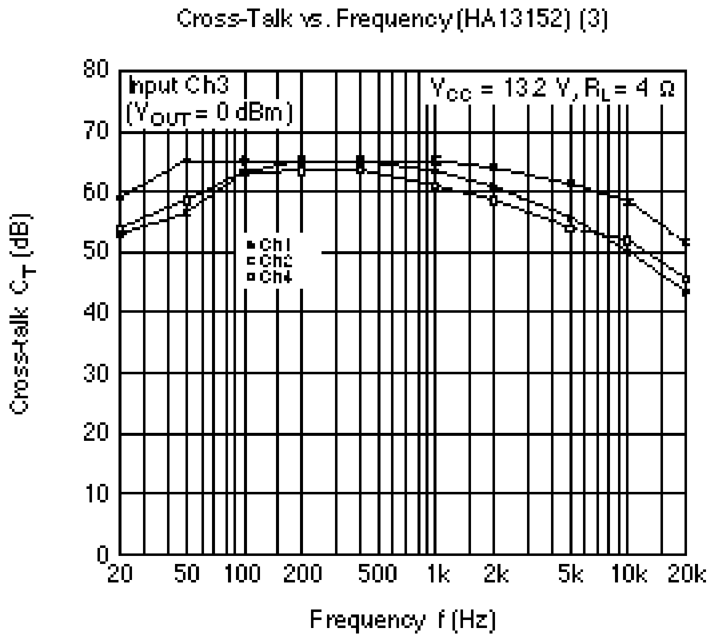

Total Harmonic Distortion vs. Output Power (HA13152)
Vcc = 13.2 V, RL = 4 Ω
f = 10 kHz (Ch1−Ch4)
1 kHz (Ch1−Ch4)
100 Hz (Ch1−Ch4)
Total harmonic distortion THD (%)
5
2
1.0
0.5
0.2
0.1
0.05
0.02
0.01
0.02
0.05
0.1
0.2
0.5
1.0
2
5
10
20
Output power Po (W)

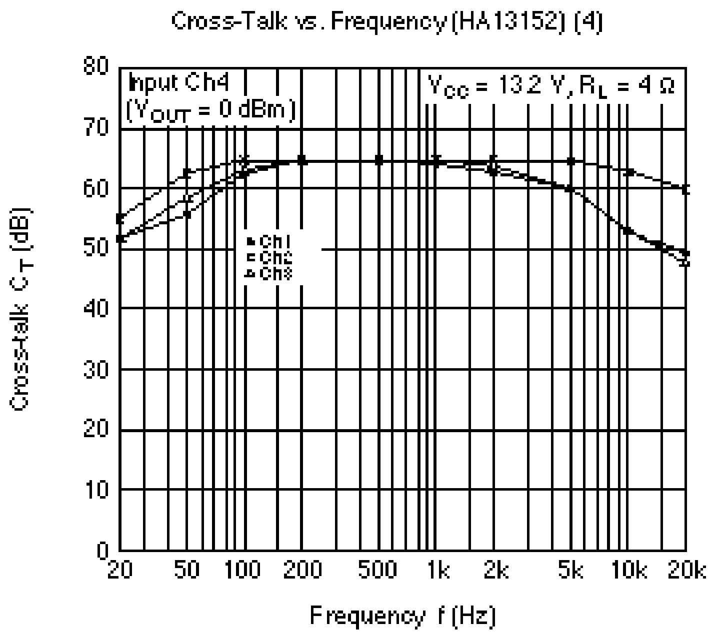
Cross-Talk vs. Frequency (HA13152) (1)



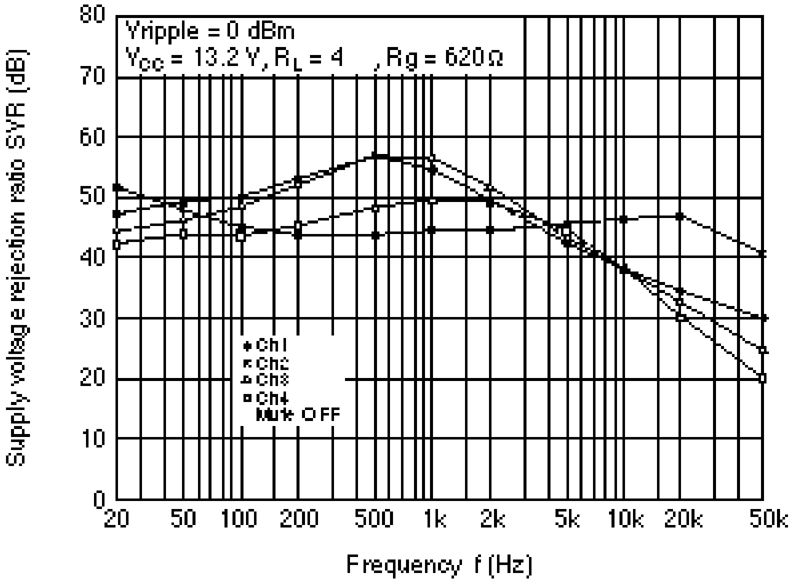
Cross-Talk vs. Frequency (HA13152) (2)



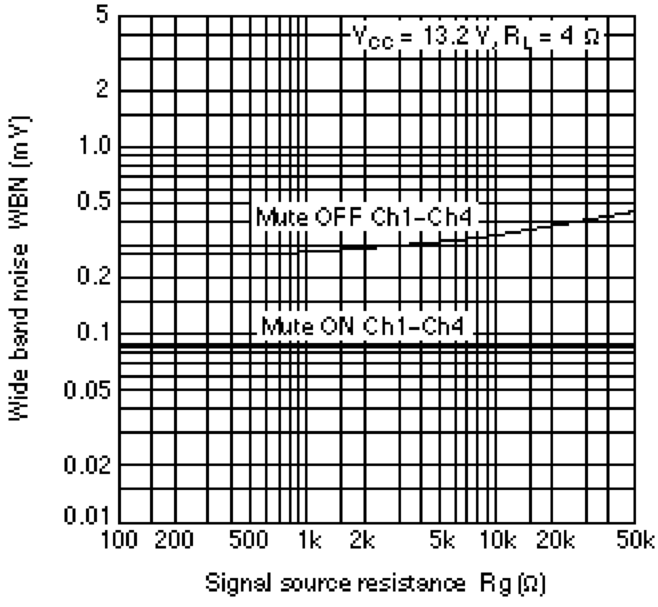

Cross-Talk vs. Frequency (HA13152) (3)
Input Ch3
(VOUT = 0 dBm)
VCC = 13.2 V, RL = 4 Ω
Ch1
Ch2
Ch4
Cross-talk CT (dB)
Frequency f (Hz)
80
70
60
50
40
30
20
10
0
20
50
100
200
500
1k
2k
5k
10k
20k


Cross-Talk vs. Frequency (HA13152) (4)
Input Ch4
(VOUT = 0 dBm)
VCC = 13.2 V, RL = 4 Ω
Ch1
Ch2
Ch3
Cross-talk CT (dB)
Frequency f (Hz)
80
70
60
50
40
30
20
10
0
20
50
100
200
500
1k
2k
5k
10k
20k

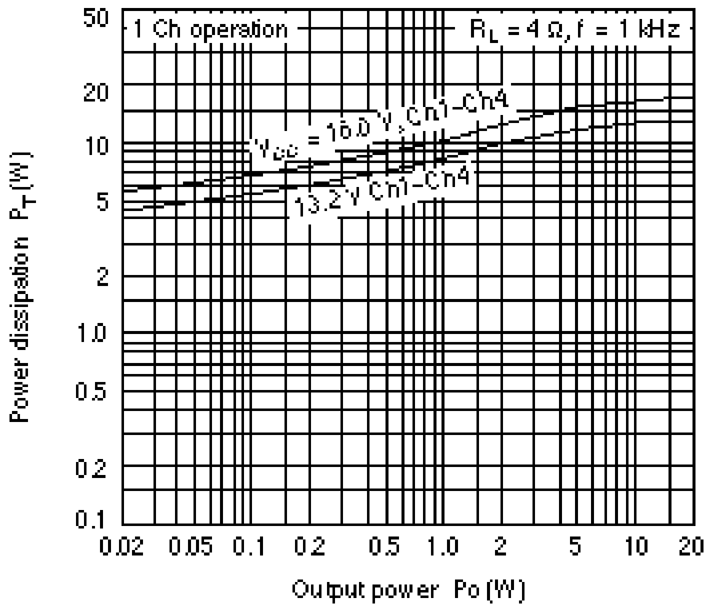
Supply Voltage Rejection Ratio vs. Frequency (HA13152)



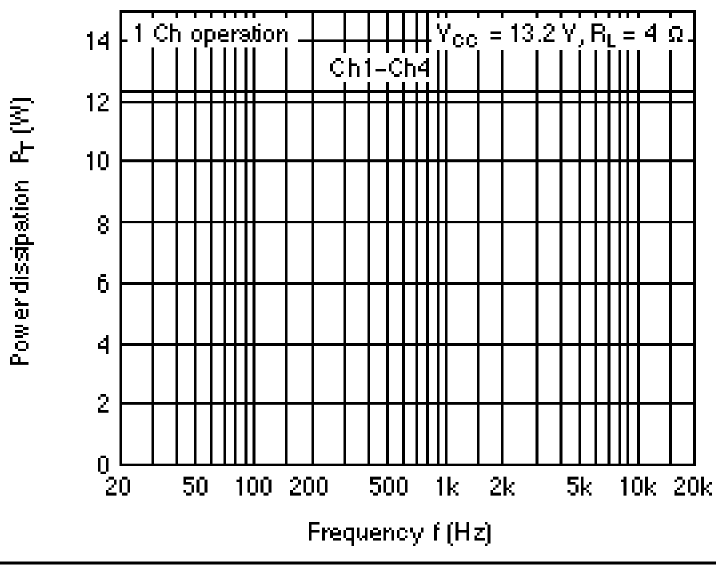
Wide Band Noise vs. Signal Source Resistance (HA13152)



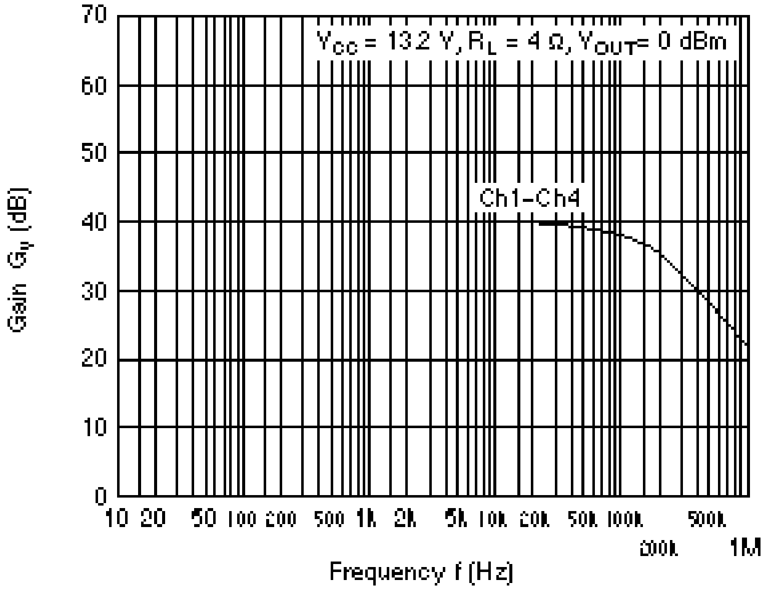
Power Dissipation vs. Output Power (HA13152)



Power Dissipation vs. Frequency (HA13152)



Gain vs. Frequency (HA13152)



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