HA12226F/HA12227F

Audio Signal Processor for Cassette Deck
(Dolby B-type NR with Recording System)

HITACHI

ADE-207-270E (Z)
6th Edition
Dec. 2000

Description

The HA12226F/HA12227F are silicon monolithic bipolar IC providing Dolby noise reduction system*[1], music sensor system, REC equalizer system and each electronic control switch in one chip.

Note: 1. Dolby is a trademark of Dolby Laboratories Licensing Corporation.
A license from Dolby Laboratories Licensing Corporation is required for the use of this IC.
The HA12227F is not built-in Dolby B-NR.

Functions

- Dolby B-NR*[2] × 2 channel
- REC equalizer × 2 channel
- Music sensor × 1 channel
- Pass amp. × 2 channel
- Each electronic control switch to change REC equalizer, bias, etc.

Note: 2. The HA12227F is not built-in Dolby B-NR.

Features

- REC equalizer is very small number of external parts and have 4 types of frequency characteristics built-in.
- 2 types of input for PB, 1 type of input for REC.
- 70µ - PB equalizer changing system built-in.
- Dolby NR*[2] with dubbing double cassette decks.
  Unprocessed signal output available from recording out terminals during PB mode.
- Provide stable music sensor system, available to design music sensing time and level.
- Controllable from direct micro-computer output.
- Bias oscillator control switch built-in.
- NR ON / OFF and REC / PB fully electronic control switching built-in.
- Normal-speed / high-speed, Normal / Crom and PB equalizer fully electronic control switching built-in.
- Available to reduce substrate-area because of high integration and small external parts.

Hitachi semiconductor

Ordering Information

Operating Voltage

Product	Power Supply Range (Single Supply)
HA12226F	11.0 V to 15.0 V
HA12227F	9.5 V to 15.0 V

Standard Level

Product	Package	PB-OUT Level	REC-OUT Level	Dolby Level
HA12226F	FP-56A	580 mVrms	300 mVrms	300 mVrms
HA12227F				—

Function

Product	Dolby B-NR	REC-EQ	Music Sensor	Pass Amp.	REC / PB Selection	ALC
HA12226F	❍	❍	❍	❍	❍	❍
HA12227F	×	❍	❍	❍	❍	❍

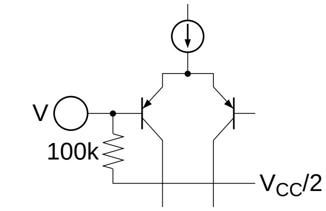
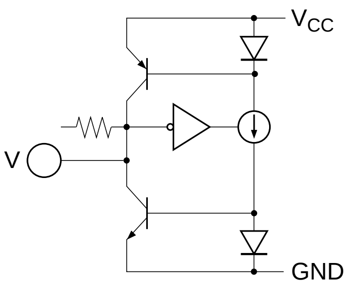
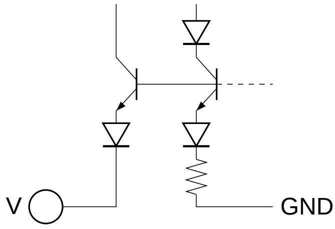
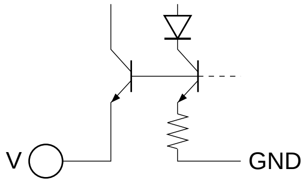
Note: Depending on the employed REC / PB head and test tape characteristics, there is a rare case that the REC-EQ characteristics of this LSI can not be matched to the required characteristics because of built-in resistors which determined the REC-EQ parameters in this case, please inquire the responsible agent because the adjustment built-in resistor is necessary.

Difference of HA12215F and HA12226F/HA12227F

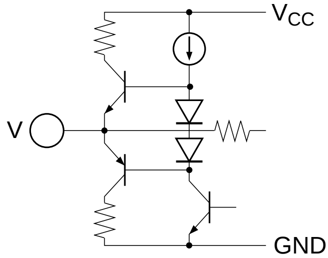
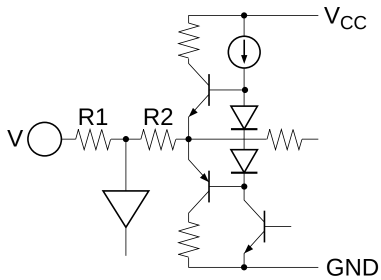
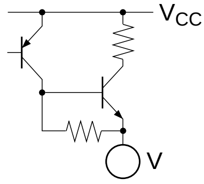
		Tape Correspondence		
Product	Supply Voltage	NORM	CROM	METAL
HA12226F/HA12227F	Single supply voltage	❍	❍	×
HA12215F	Split supply voltage	❍	❍	❍

Note: The HA12226F/HA12227F became single power supply for the HA12215F and deleted metal correspondence. The HA12227F is not built-in Dolby B-NR.
Other characteristic aspects are similar as the HA12215F.

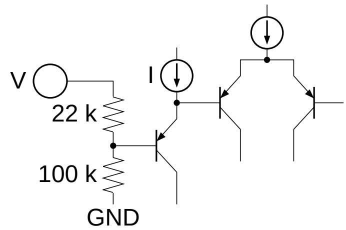
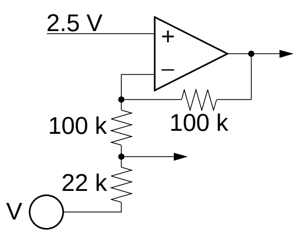
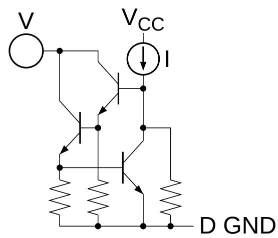
Pin Description, Equivalent Circuit (V_{CC} = 12 V, A system of single supply voltage, Ta = 25°C, No Signal, The value in the show typical value.)

Pin No.	Terminal Name	Note	Equivalent Circuit	Pin Description
51	AIN (R)	$V = V_{CC} / 2$		PB A Deck input
48	AIN (L)			
53	BIN (R)			PB B Deck input
46	BIN (L)			
56	RIN (R)			REC input
43	RIN (L)			
5	EQIN (R)			REC equalizer input
38	EQIN (L)			
1 *2	DET (R)	V = 2.7 V		Time constant pin for Dolby-NR
42 *2	DET (L)			
49	RIP			Ripple filter
2 *3	BIAS1	V = 0.6 V		Dolby bias current input
41	BIAS2	V = 1.3 V		REC equalizer bias current input

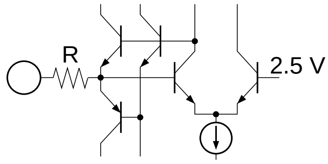
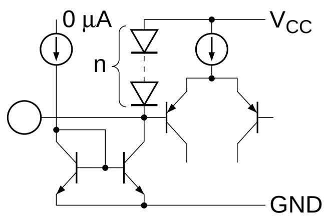
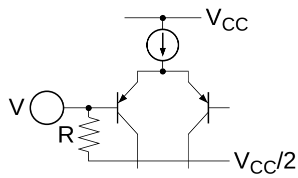
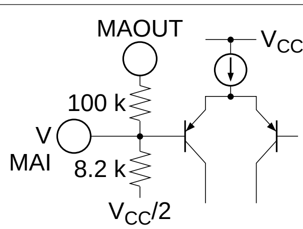
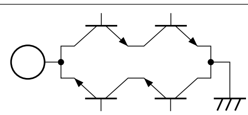
Pin Description, Equivalent Circuit (V_{CC} = 12 V, A system of single supply voltage, Ta = 25°C, No Signal, The value in the show typical value.) (cont)

Pin No.	Terminal Name	Note	Equivalent Circuit	Pin Description
3	PBOUT (R)	$V = V_{cc} / 2$		PB output
40	PBOUT (L)			
4	RECOUT (R)			REC output
39	RECOUT (L)			
7	EQOUT (R)			REC equalizer output
36	EQOUT (L)			
28	MAOUT			MS Amp. output *[1]
8	ROUT (R)			Input Amp. output
35	ROUT (L)			
52	ABO (R)	R1 = 15 k R2 = 12 k $V = V_{cc} / 2$		Time constant pin for PB equalizer (70µ)
47	ABO (L)			
6	BOOST (R)	R1 = 4.8 k R2 = 4.8 k $V = V_{cc} / 2$		Time constant pin for low boost
37	BOOST (L)			
32	BIAS (C)	$V = V_{cc} - 0.7$ V		REC bias current output
33	BIAS (N)			

Pin Description, Equivalent Circuit (V_{CC} = 12 V, A system of single supply voltage, Ta = 25°C, No Signal, The value in the show typical value.) (cont)

Pin No.	Terminal Name	Note	Equivalent Circuit	Pin Description
21	V_{CC}	V = V_{CC}		Power supply
50	GND	V = 0 V		GND pin
31, 45, 54	NC	No connection		No connection
15	ALC $\overline{\text{ON}}$/OFF	I = 20 µA		Mode control input
16	PB $\overline{\text{A}}$/B			
17	A $\overline{\text{120}}$/70			
18	$\overline{\text{NORM}}$/HIGH			
19	B $\overline{\text{NORM}}$/CROM			
20	BIAS ON/$\overline{\text{OFF}}$			
22	RM $\overline{\text{ON}}$/OFF			
23 *2	NR ON/$\overline{\text{OFF}}$			
25	LM ON/$\overline{\text{OFF}}$			
24	$\overline{\text{REC}}$/PB/PASS			Mode control input
26	MSOUT	I = 0 µA		MS output (to MPU) *1

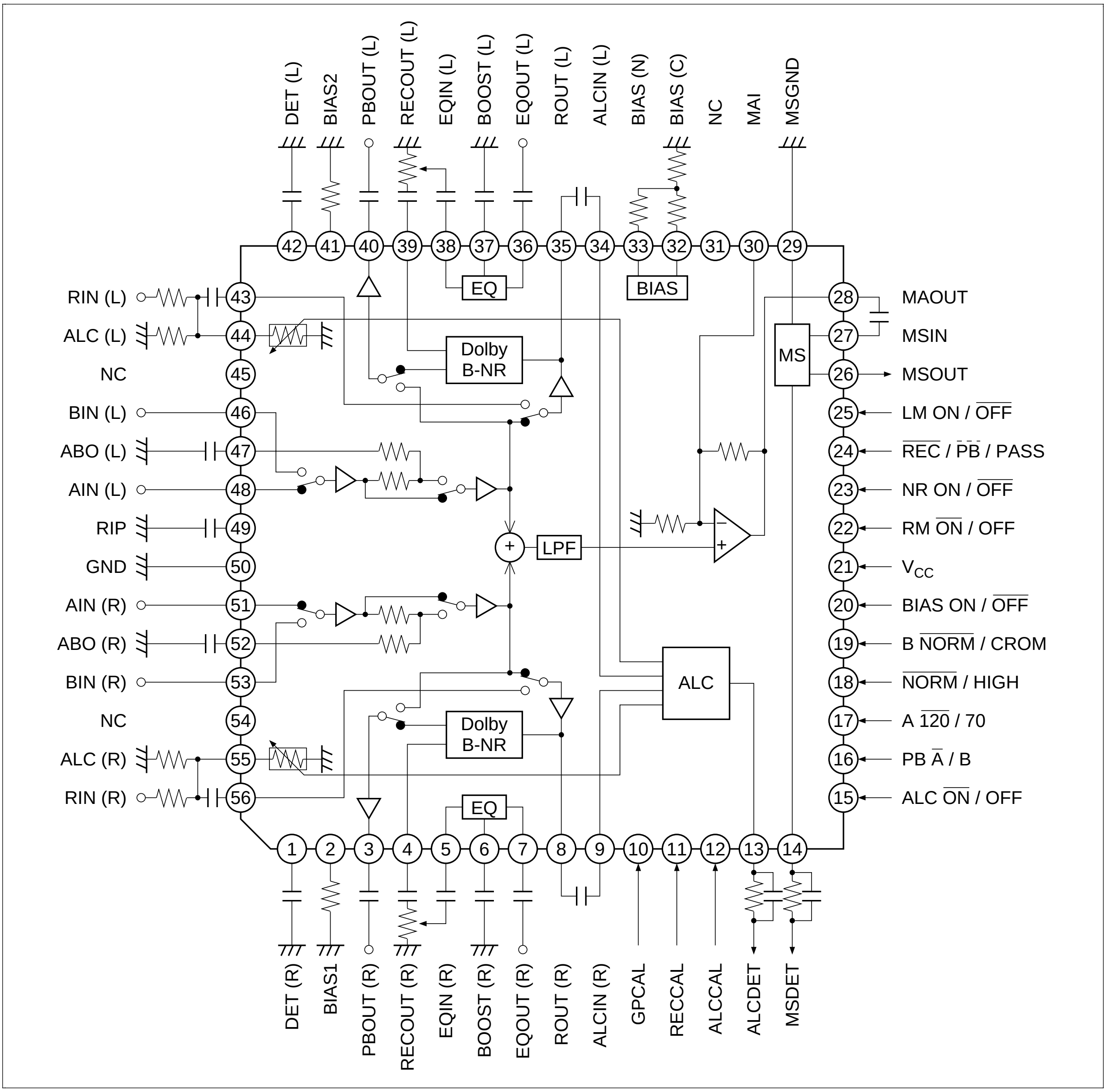
Pin Description, Equivalent Circuit (V_{CC} = 12 V, A system of single supply voltage, Ta = 25°C, No Signal, The value in the show typical value.) (cont)

Pin No.	Terminal Name	Note	Equivalent Circuit	Pin Description
10	GPCAL	R = 110 kΩ		GP gain calibration terminal
11	RECCAL	R = 110 kΩ		REC gain calibration terminal
12	ALCCAL	R = 140 kΩ		ALC operation level calibration terminal
14	MSDET	n = 6		Time constant pin for MS *[1]
13	ALCDET	n = 2		
27	MSIN	R = 50 kΩ		MS input *[1]
9	ALCIN (R)	R = 100 kΩ		
34	ALCIN (L)			
30	MAI	V = V_{CC} / 2		MS Amp. input *[1]
29	MS GND	V = 0 V		MS output voltage level control pin *[1]
55	ALC (R)	V = 0 V		Variable impedance for attenuation
44	ALC (L)			

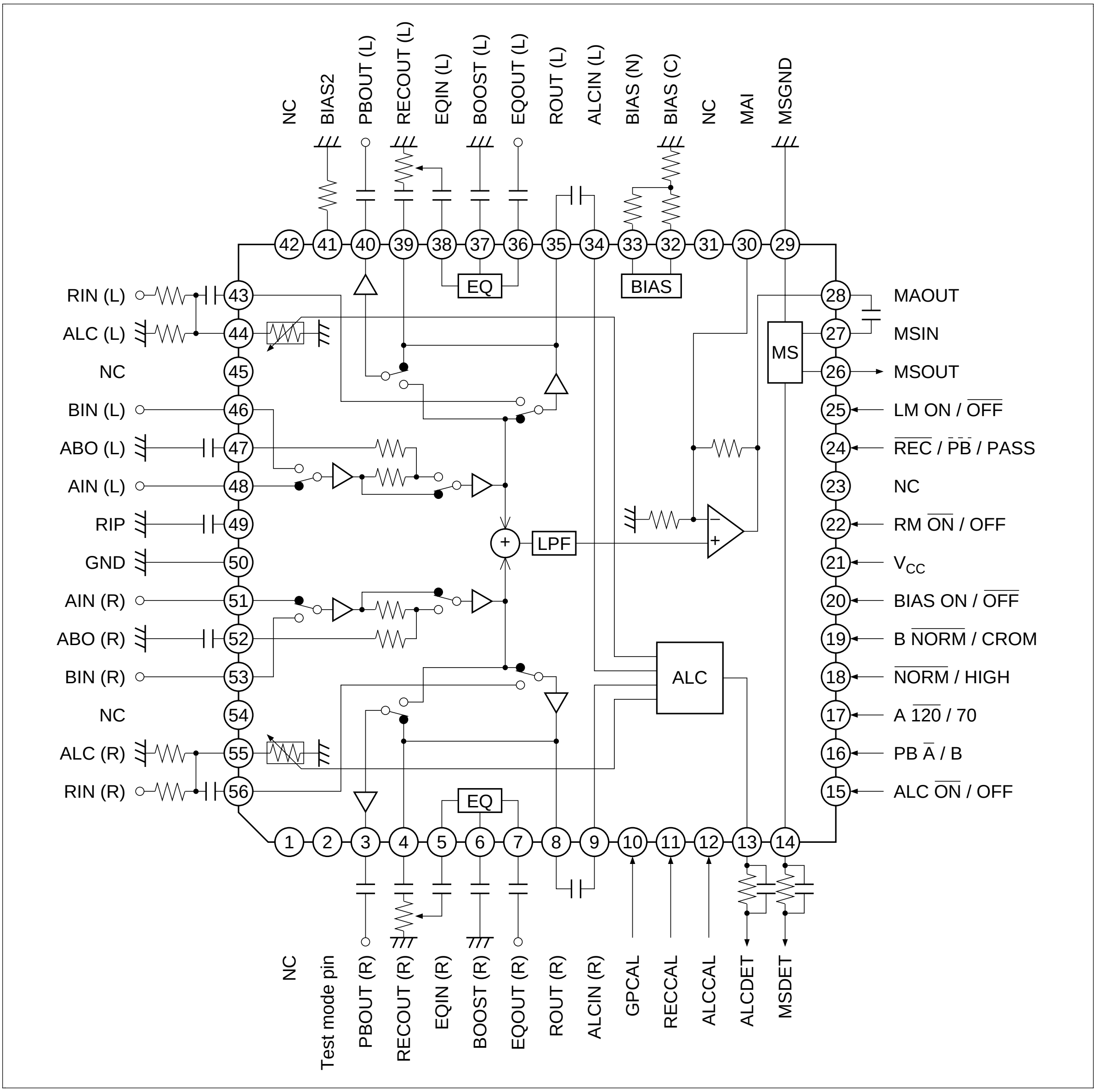
Note: 1. MS: Music Sensor
2. Non connection regarding the HA12227F.
3. Test pin regarding the HA12227F.

Block Diagram

HA12226F



HA12227F


NC
BIAS2
PBOUT (L)
RECOUT (L)
EQIN (L)
BOOST (L)
EQOUT (L)
ROUT (L)
ALCIN (L)
BIAS (N)
BIAS (C)
NC
MAI
MSGND
RIN (L)
ALC (L)
NC
BIN (L)
ABO (L)
AIN (L)
RIP
GND
AIN (R)
ABO (R)
BIN (R)
NC
ALC (R)
RIN (R)
EQ
BIAS
LPF
ALC
MS
MAOUT
MSIN
MSOUT
LM ON / OFF
REC / PB / PASS
NC
RM ON / OFF
V_{CC}
BIAS ON / OFF
B NORM / CROM
NORM / HIGH
A 120 / 70
PB A / B
ALC ON / OFF
NC
Test mode pin
PBOUT (R)
RECOUT (R)
EQIN (R)
BOOST (R)
EQOUT (R)
ROUT (R)
ALCIN (R)
GPCAL
RECCAL
ALCCAL
ALCDET
MSDET

Parallel-Data Format

Pin No.	Pin Name	Lo	Mid	Hi	MODE "Pin Open"
15	ALC ON/OFF	ALC ON	—	ALC OFF	Lo
16	PB A/B	Ain *1	—	Bin *1	Lo
17	A 120/70	*1	—	*1	Lo
22	RM ON/OFF	REC MUTE ON	—	REC MUTE OFF	Lo
20	BIAS ON/OFF	BIAS OFF	—	BIAS ON	Lo
23 *2	NR ON/OFF	NR OFF	—	NR ON	Lo
24	REC/PB/PASS	REC MODE	PB MODE	REC MODE PASS	Mid
25	LM ON/OFF	LINE MUTE OFF	—	LINE MUTE ON	Lo
18	NORM/HIGH	Normal speed	—	High speed	Lo
19	B NORM/CROM	REC EQ Normal *1 Bias Normal	REC EQ CROM *1 Bias CROM	REC EQ CROM *1 Bias CROM	Lo

Note: 1. PB EQ logic

A 120/70	B NORM / CROM	PB Lo	PB Hi
Lo	Lo	FLAT	FLAT
Lo	Mid or Hi	FLAT	70 µ
Hi	Lo	70 µ	FLAT
Hi	Mid or Hi	70 µ	70 µ

2. The HA12226F only.

Functional Description

Power Supply Range

These ICs are designed to operate on single supply.

Table 1 Supply Voltage

Product	Power Supply Range (Single Supply)
HA12226F	11.0 V to 15.0 V
HA12227F	9.5 V to 15.0 V

Note: The lower limit of supply voltage depends on the line output reference level.
The minimum value of the overload margin is specified as 12 dB by Dolby Laboratories (Dolby IC HA12226F).

Reference Voltage

The reference voltage are provided for the left channel and the right channel separately. The block diagram is shown as figure 1.

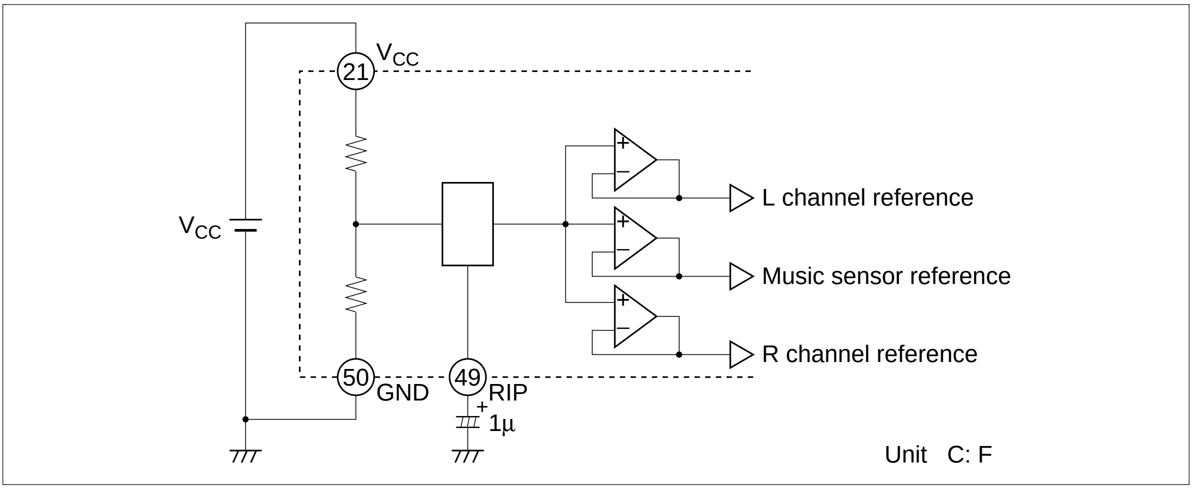
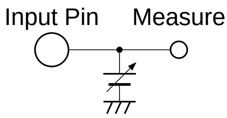


Figure 1 Reference Voltage

Operating Mode Control

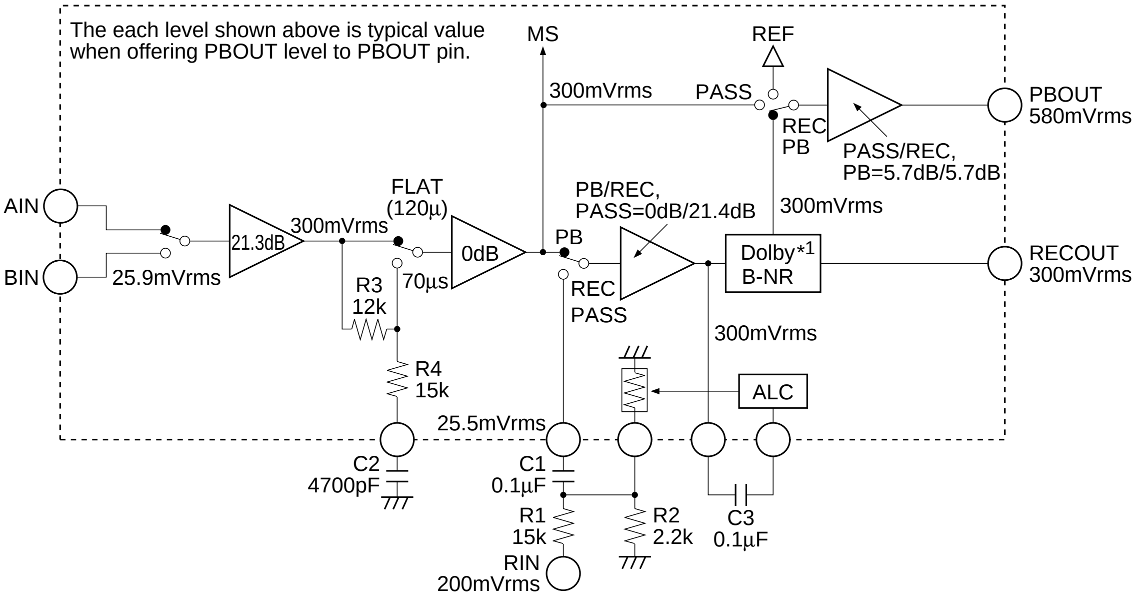
The HA12226F/HA12227F provide fully electronic switching circuits. And each operating mode control is controlled by parallel data (DC voltage).

Table 2 Control Voltage

Pin No.	Lo	Mid	Hi	Unit	Test Condition
15, 16, 17, 18, 20, 22, 23*[4], 25	–0.2 to 1.0	—	4.0 to V_{CC}	V	
19, 24	–0.2 to 1.0	2.0 to 3.0	4.0 to V_{CC}	V	

Notes:
1. Each pins are on pulled down with 100 kΩ internal resistor.
   Therefore, it will be low-level when each pins are open.
   But pin 24 is mid-level when it is open.
2. Over shoot level and under shoot level of input signal must be the standardized (High: V_{CC}, Low: –0.2 V).
3. For reduction of pop noise, connect 1 µF to 22 µF capacitor with mode control pins.
   But it is impossible to reduce completely in regard to Line mute, therefore, use external mute at the same time.
4. Non connection regarding the HA12227F.

Input Block Diagram and Level Diagram



Note: 1. The HA12227F is not built-in Dolby B-NR.

Figure 2 Input Block Diagram

PB Equalizer

By switching logical input level of pin 17 (for Ain) and pin 19 (for Bin), you can equalize corresponding to tape position at play back mode.

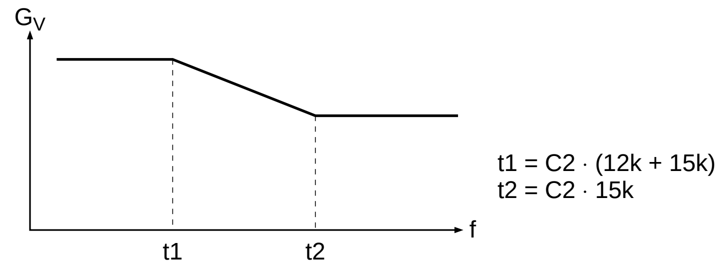


Figure 3 Frequency Characteristic of PB Equalizer

The Sensitivity Adjustment of Music Sensor

Adjusting MS Amp gain by external resistor, the sensitivity of music sensor can set up.

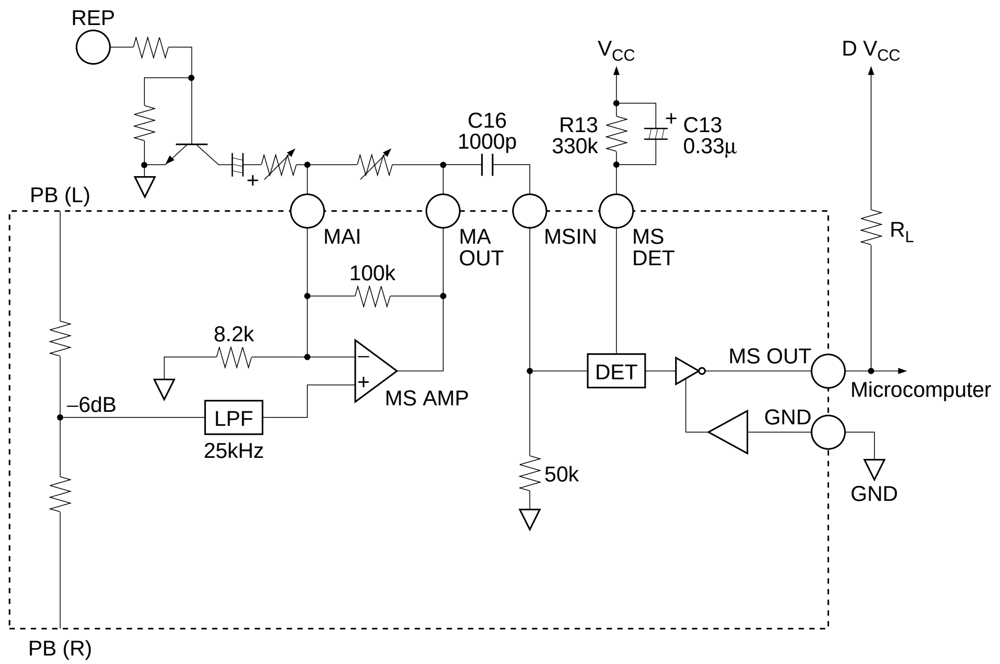


Figure 4 Music Sensor Block Diagram

The Sensitivity of Music Sensor

A standard level of MS input pin 25.9 mVrms, therefore, the sensitivity of music sensor (S) can request it, by lower formulas.

A = MS Amp Gain*1
B = PB input Gain $\times$ (1/2)*2 $\quad S = 20\log \dfrac{C}{25.9 \cdot A \cdot B}$ [dB]
C = Sensed voltage
20log (A $\times$ B) = D [dB] $\quad$ S = 14 – D [dB]
C = 130 [mVrms] (Intenally voltage in a standard)
PB input Gain = 21.3 [dB]

Notes: 1. When there is not a regulation outside.
2. Case of one-sided channel input.

But necessary to consider the same attenuation quantity practically, on account of A(B) have made frequency response.

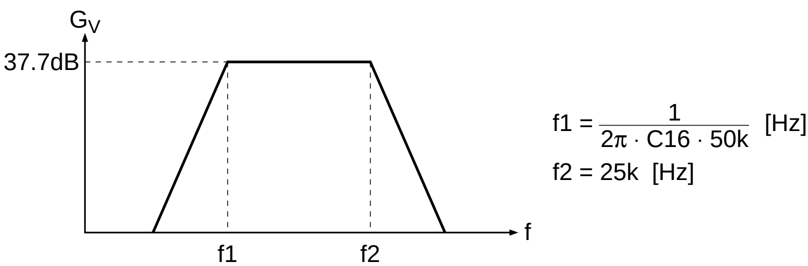


Figure 5 Frequency Characteristic of MSIN

Occasion of the external component of figure 4, f1 is 3.18 kHz.

Time constant of detection

Figure 6(1) generally shows that detection time is in proportion to value of capacitor C13. But, with Attack*2 and Recovery*3 the detection time differs exceptionally.

Notes 2. Attack : Non-music to Music
3. Recovery : Music to Non-music

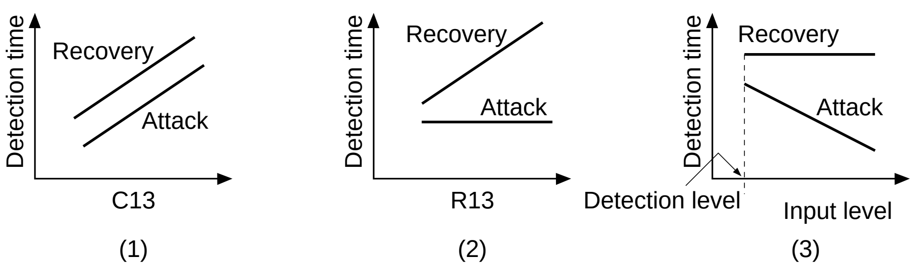


Figure 6 Function Characteristic of MS

Like the figure 6(2), Recovery time is variably possible by value of resistor R13. But Attack time gets about fixed value. Attack time has dependence by input level. When a large signal is inputted, Attack time is short tendency.

Music Sensor Output (MSOUT)

As for internal circuit of music sensor block, music sensor output pin is connected to the collector of NPN type directly, output level will be "high" when sensing no signal. And output level will be "low" when sensing signal.

Connection with microcomputer, it is requested to use external pull up resistor (R_L = 10 kΩ to 22 kΩ)

Note: Supply voltage of MSOUT pin must be less than V_{CC} voltage.

The Tolerances of External Components for Dolby NR-Block (Only the HA12226F)

For Dolby NR precision securing, please use external components shown at figure 7. If leak-current are a few electrolytic-capacitor, it can be applicable to C5 and C23.

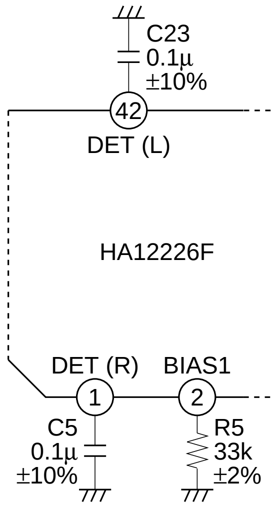


Figure 7 Tolerance of External Components

Low-Boost

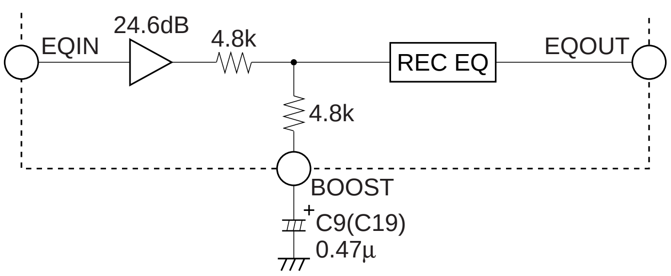


Figure 8 Example of Low Boost Circuit

External components shown figure 8 gives frequency response to take 6 dB boost. And cut off frequency can request it, by C9 (C19).

REC Equalizer

The outlines of REC Equalizing frequency characteristics are shown by figure 9. Those peak level can be set up by supplying voltage. (0 V to 5 V, GND = 0 V) to pin 10 (GPCAL).

And whole band gain can be set up by supplying voltage (0 V to 5 V, GND = 0 V) to pin 11 (RECCAL).

Both setting up range are ±4.5 dB. In case that you do not need setting up, pin 10, pin 11 should be open bias.

Note: Depending on the employed REC/PB head and test tape characteristics, there is a rare case that the REC-EQ characteristics of this LSI can not be matched to the required characteristics because of built-in resistors which determined the REC-EQ parameters in this care, please inquire the responsible agent because of the adjustment of built-in resistor is necessary.

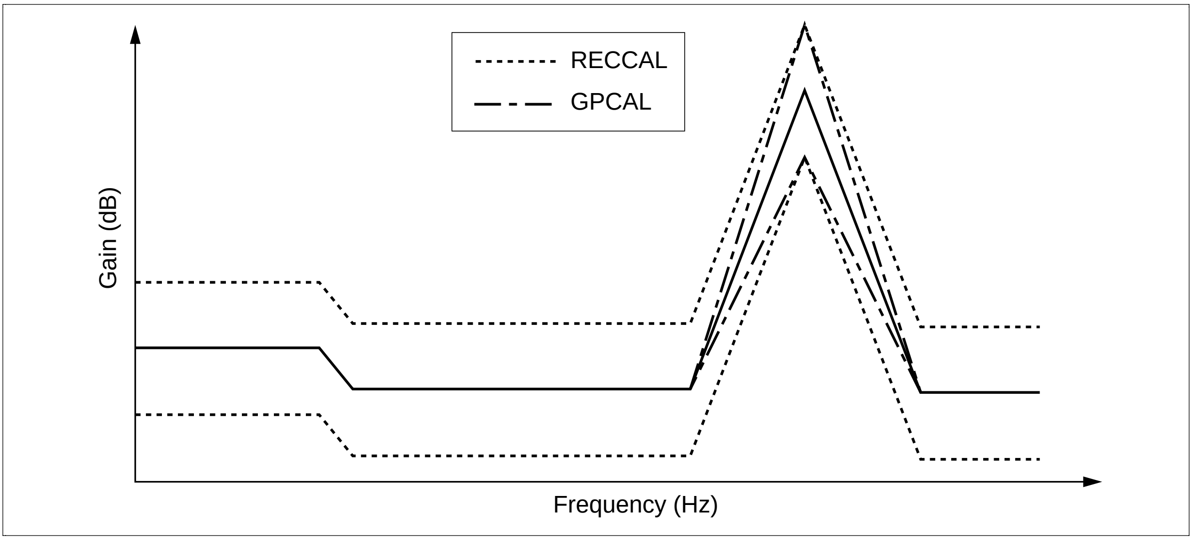


Figure 9 Frequency Characteristics of REC Equalizer

Bias Switch

The HA12215F built-in DC voltage generator for bias oscillator and its bias switches.

External resistor R20, R21 which corresponded with tape positions and bias out voltage are relater with below.

$$Vbias \fallingdotseq \left(\frac{R22}{(R20 \text{ or } R21) + R22}\right) \times (V_{CC} - 0.7) \quad [V]$$

Bias switch follows to a logic of pin 19 (B / Norm / Crom).

Note: A current that flows at bias out pin, please use it less than 5 mA.

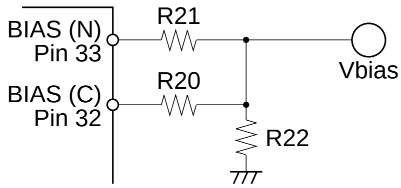


Figure 10 External Components of Bias Block

Automatic Level Control

ALC is the input decay rate variable system. It has internal variable resistors of pin 55 (pin 44) by RECOUT signal that is inputted to pin 9 (pin 34).

The operation is similitude to MS, detected by pin 13.

The signal input pin is pin 56 (pin 43). Resistor R1, R2 and capacitor C2, external components, for the input circuit are commended as figure 12. There are requested to use value of the block diagram figure for performance maintenance of S/N, T.H.D. etc.

Figure 11 shows the relation with R1 front RIN point and ROUT.

ALC operation level acts for the center of +4.5 dB at tape position TYPE I and the center of +2.5 dB at tape position TYPE II, to standard level (300 mVrms).

Then, adopted maximum value circuit, ALC is operated by a large channel of a signal.

ALC ON/OFF can switch it by pin 15. Please do ALC ON, after it does for one time ALC OFF inevitably, for ALC time to start usefully (when switching PB → PASS, when switching PB → PASS), in order to reset ALC circuit.

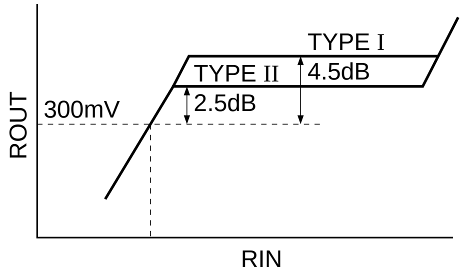


Figure 11 ALC Operation Level

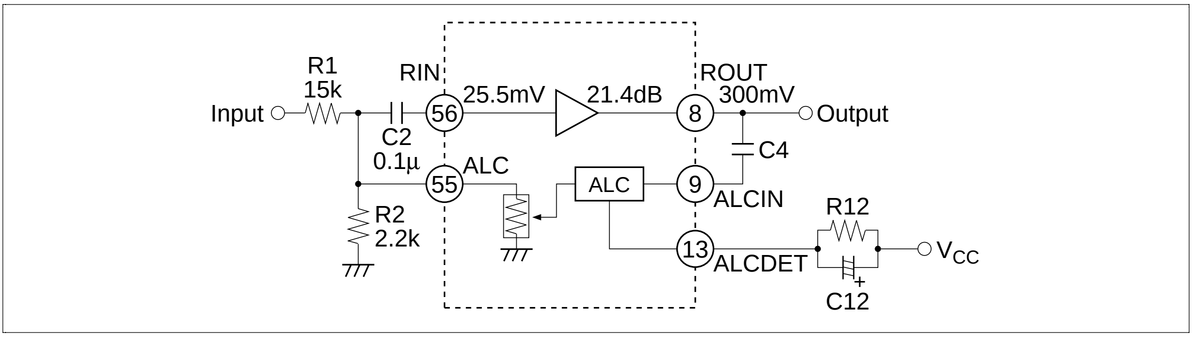


Figure 12 ALC Block Diagram

ALC Operation Level Necessary

ALC operation level is variable to pin 12 bias (ALC-CAL: 0 to 5 V), and its range is ±4.0 dB.

Unnecessary, pin 12 is unforced.

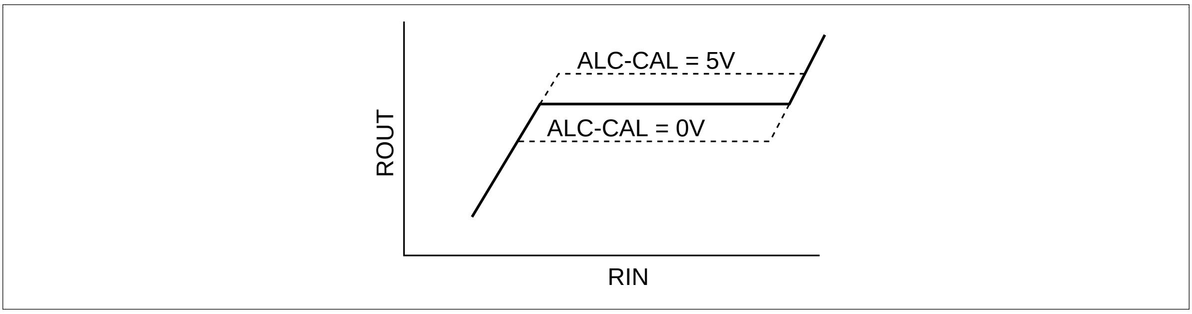


Figure 13 ALC-CAL Characteristics

About a Test Pin (Pin 2)

The HA12227F does for testing exclusive terminal for pin 2.

In mount circuit, this terminal is open or connected to GND with a resistor of 33 kΩ.

Absolute Maximum Ratings

Item	Symbol	Rating	Unit	Note
Max supply voltage	V_{CC} max	16	V	
Power dissipation	Pd	625	mW	Ta ≤ 75°C
Operating temperature	Topr	–40 to +75	°C	
Storage temperature	Tstg	–55 to +125	°C	

Electrical Characteristics

HA12226F

(Ta = 25°C, V_{CC} = 12 V, Dolby Level = REC-OUT Level = 300 mVrms = 0 dB)

Item	Symbol	Test Condition: IC Condition *1: NR ON/OFF	ALC ON/OFF	REC/PB /PASS	A/B	120µ/ 70µ	LINE MUTE	B N/C	fin (Hz)	RECOUT level (dB)	Other	Min	Typ	Max	Unit	Application Terminal: Input R	Input L	Output R	Output L	COM	Remark
Quiescent current	I_Q	OFF	OFF	PB	A	120	OFF	NORM	—	—	No signal	18.0	26.0	35.0	mA	—	—	—	—	21	
Input AMP. gain	G_V PB	OFF	OFF	PB	A/B	120	OFF	NORM	1k	0		25.5	27.0	28.5	dB	51/53	48/46	3	40	—	
	G_V REC	OFF	OFF	REC	A	120	OFF	NORM	1k	0		25.0	26.5	28.0		56	43	3	40	—	
B-type Encode boost	ENC 2k (1)	ON	OFF	REC	A	120	OFF	NORM	2k	–20		2.8	4.3	5.8	dB	56	43	4	39	—	
	ENC 2k (2)	ON	OFF	REC	A	120	OFF	NORM	2k	–30		7.0	8.5	10.0		56	43	4	39	—	
	ENC 5k (1)	ON	OFF	REC	A	120	OFF	NORM	5k	–20		1.7	3.2	4.7		56	43	4	39	—	
	ENC 5k (2)	ON	OFF	REC	A	120	OFF	NORM	5k	–30		6.7	8.2	9.7		56	43	4	39	—	
Signal handling	Vo max	ON	OFF	REC	A	120	OFF	NORM	1k	—	THD=1%	12.0	13.0	—	dB	56	43	4	39	—	2
Signal to noise ratio	S/N	ON	OFF	REC	A	120	OFF	NORM	1k	—	Rg=5.1kΩ, CCIR/ARM	64.0	70.0	—	dB	56	43	4	39	—	
Total Harmonic Distortion	THD	ON	OFF	REC	A	120	OFF	NORM	1k	0		—	0.05	0.3	%	56	43	4	39	—	
Channel separation	CTRL (1)	OFF	OFF	PB	A	120	OFF	NORM	1k	+12		70.0	80.0	—	dB	51	48	3	40	—	
	CTRL (2)	OFF	OFF	REC	A	120	OFF	NORM	1k	+12		70.0	85.0	—		56	43	3	40	—	
Crosstalk	CT A/B	OFF	OFF	PB	A/B	120	OFF	NORM	1k	+12		70.0	80.0	—	dB	51/53	48/46	3	40	—	
	CT R/P	OFF	OFF	REC/PB	A	120	OFF	NORM	1k	+12		70.0	80.0	—		51/56	48/43	3	40	—	
Pass AMP. gain	G_V PA	OFF	OFF	PASS	A/B	120	OFF	NORM	1k	0		25.5	27.0	28.5	dB	51/53	48/46	3	40	—	
Gain deviation	ΔG_V	OFF	OFF	PASS	A/B	120	OFF	NORM	1k	0	G_V PA – G_V PB	–1.0	0.0	1.0	dB	51/53	48/46	3	40	—	
MUTE ATT.	MUTE	OFF	OFF	PB	A	120	ON	NORM	1k	+12		70.0	80.0	—	dB	51	48	3	40	—	
70µ EQ gain	G_V EQ 1k	OFF	OFF	PB	A	70	OFF	CROM	1k	0		24.0	25.5	27.0	dB	51	48	3	40	—	
	G_V EQ 10k	OFF	OFF	PB	A	70	OFF	CROM	10k	0		20.8	22.3	23.8		51	48	3	40	—	
MS sensing level	V_{ON}	OFF	OFF	PB	A	120	OFF	NORM	5k	—		–26.0	–22.0	–18.0	dB	51	48	3	40	26	3
MS output low level	V_{OL}	OFF	OFF	PB	A	120	OFF	NORM	—	—		—	1.0	1.5	V	51	48	—	—	26	
MS output leak current	I_{OH}	OFF	OFF	PB	A	120	OFF	NORM	—	—		—	—	2.0	µA	—	—	—	—	26	
ALC operate level	ALC (1)	OFF	ON	REC	A	120	OFF	NORM	1k	+12		2.0	4.5	7.0	dB	56	43	4	39	—	
	ALC (2)	OFF	ON	REC	A	120	OFF	CROM	1k	+12		0.0	2.5	5.0		56	43	4	39	—	

Notes: 1. Other IC-condition : REC-MUTE OFF, Normal tape, Normal speed, Bias OFF
2. V_{CC} = 11.0 V
3. For inputting signal to one side channel

HA12226F (cont)

(Ta = 25°C, V_{CC} = 12 V)

Item	Symbol	Test Condition: TAPE	Test Condition: SPEED	Test Condition	Min	Typ	Max	Unit	Application Terminal: Input R	Input L	Output R	Output L	COM	Remark
Equalizer S/N	S/N (EQ)	NORM	NORM	Rg = 5.1kΩ, A-WTG Filter (0dB = –5dBs at EQOUT); SW22 (L), SW23 (R) OFF	55	58	—	dB	5	38	7	36	—	
Equalizer maximum input	Vin max (EQ)	NORM	NORM	f = 1kHz, THD = 1%, Vin = –26dBs = 0dB; SW22 (L), SW23 (R) OFF	10.5	12.5	—	dB	5	38	7	36	—	
Equalizer total harmonic distortion	T.H.D.1 (EQ)	NORM	NORM	f = 1kHz, Vin = –26dBs; SW22 (L), SW23 (R) OFF	—	0.2	0.5	%	5	38	7	36	—	
	T.H.D.2 (EQ)			f = 1kHz, Vin = –30dBs; SW22 (L), SW23 (R) OFF	—	0.2	0.5	%	5	38	7	36	—	
Equalizer offset voltage	Vofs (EQ)	NORM	NORM	No-Signal; SW22 (L), SW23 (R) OFF	–500	0	500	mV	5	38	7	36	—	
Equalizer frequency response (NORM - NORM)	$G_{VEQ-NN1}$	NORM	NORM	f = 3kHz, Vin = –46dBs; SW22 (L), SW23 (R) OFF	18.8	20.3	21.8	dB	5	38	7	36	—	
	$G_{VEQ-NN2}$			f = 8kHz, Vin = –46dBs; SW22 (L), SW23 (R) OFF	23.9	25.9	27.9	dB	5	38	7	36	—	
	$G_{VEQ-NN3}$			f = 12kHz, Vin = –46dBs; SW22 (L), SW23 (R) OFF	30.1	32.6	35.1	dB	5	38	7	36	—	
Equalizer frequency response (CROM - NORM)	$G_{VEQ-CN1}$	CROM	NORM	f = 3kHz, Vin = –46dBs; SW22 (L), SW23 (R) OFF	23.3	24.8	26.3	dB	5	38	7	36	—	
	$G_{VEQ-CN2}$			f = 8kHz, Vin = –46dBs; SW22 (L), SW23 (R) OFF	28.5	30.5	32.5	dB	5	38	7	36	—	
	$G_{VEQ-CN3}$			f = 12kHz, Vin = –46dBs; SW22 (L), SW23 (R) OFF	34.0	36.5	39.0	dB	5	38	7	36	—	
Equalizer frequency response (NORM - High)	$G_{VEQ-NH1}$	NORM	HIGH	f = 5kHz, Vin = –46dBs; SW22 (L), SW23 (R) OFF	15.0	16.5	18.0	dB	5	38	7	36	—	
	$G_{VEQ-NH2}$			f = 15kHz, Vin = –46dBs; SW22 (L), SW23 (R) OFF	19.9	21.9	23.9	dB	5	38	7	36	—	
	$G_{VEQ-NH3}$			f = 20kHz, Vin = –46dBs; SW22 (L), SW23 (R) OFF	23.4	25.9	28.4	dB	5	38	7	36	—	
Equalizer frequency Response (CROM - High)	$G_{VEQ-CH1}$	CROM	HIGH	f = 5kHz, Vin = –46dBs; SW22 (L), SW23 (R) OFF	19.7	21.2	22.7	dB	5	38	7	36	—	
	$G_{VEQ-CH2}$			f = 15kHz, Vin = –46dBs; SW22 (L), SW23 (R) OFF	23.5	25.5	27.5	dB	5	38	7	36	—	
	$G_{VEQ-CH3}$			f = 20kHz, Vin = –46dBs; SW22 (L), SW23 (R) OFF	26.5	29.0	31.5	dB	5	38	7	36	—	
REC-MUTE attenuation	REC-MUTE	NORM	NORM	f = 1kHz, Vin = –14dBs; SW22 (L), SW23 (R) OFF	60	70	—	dB	5	38	7	36	—	
REC CAL response	R-CAL1	NORM	NORM	f = 3kHz, Vin = –46dBs, $V_{REC-CAL}$ = 5V; SW22 (L), SW23 (R) OFF; $G_{V\ EQ-NN1}$ = 0dB	3.0	4.5	6.0	dB	5	38	7	36	—	
	R-CAL2			f = 3kHz, Vin = –46dBs, $V_{REC-CAL}$ = 0V; SW22 (L), SW23 (R) OFF; $G_{V\ EQ-NN1}$ = 0dB	–6.0	–4.5	–3.0	dB	5	38	7	36	—	
GP CAL response	GP-CAL1	NORM	NORM	f = 12kHz, Vin = –46dBs, V_{GP-CAL} = 0V; SW22 (L), SW23 (R) OFF; $G_{V\ EQ-NN3}$ = 0dB	3.0	4.5	6.0	dB	5	38	7	36	—	
	GP-CAL2			f = 12kHz, Vin = –46dBs, V_{GP-CAL} = 5V; SW22 (L), SW23 (R) OFF; $G_{V\ EQ-NN3}$ = 0dB	–6.0	–4.5	–3.0	dB	5	38	7	36	—	
ALC CAL response	ALC-CAL1	NORM	NORM	f = 1kHz, $V_{ALC-CAL}$ = 0V; ALC (1) = 0dB	—	–4.0	–3.0	dB	56	43	4	39	—	
	ALC-CAL2			f = 1kHz, $V_{ALC-CAL}$ = 5V; ALC (1) = 0dB	3.0	4.0	—	dB	56	43	4	39	—	
Bias out maximum level	Bias on	R_L = 2.2kΩ			V_{CC} –1.4	V_{CC} –0.7	—	V	—	—	—	—	32, 33	
Bias out offset	Bias off	R_L = 2.2kΩ			–0.1	0.0	0.1	V	—	—	—	—	32, 33	
Control voltage	V_{IL}				–0.2	—	1.0	V	—	—	—	—	—	15 to 20 22 to 25
	V_{IM}				2.0	—	3.0	V	—	—	—	—	—	19, 24
	V_{IH}				4.0	—	V_{CC}	V	—	—	—	—	—	15 to 20 22 to 25

HA12227F

(Ta = 25°C, V_{CC} = 12 V, Dolby Level = REC-OUT Level = 300 mVrms = 0 dB)

Item	Symbol	Test Condition: IC Condition *1: REC/PB /PASS	ALC ON/OFF	A/B	120µ/ 70µ	LINE MUTE	B N/C	fin (Hz)	RECOUT level (dB)	Other	Min	Typ	Max	Unit	Application Terminal: Input R	Input L	Output R	Output L	COM	Remark
Quiescent current	I_Q	PB	OFF	A	120	OFF	NORM	—	—	No signal	14.0	22.0	30.0	mA	—	—	—	—	21	
Input AMP. gain	G_V PB	PB	OFF	A/B	120	OFF	NORM	1k	0		25.5	27.0	28.5	dB	51/53	48/46	3	40	—	
	G_V REC	REC	OFF	A	120	OFF	NORM	1k	0		25.0	26.5	28.0		56	43	3	40	—	
Signal handling	Vo max	REC	OFF	A	120	OFF	NORM	1k	—	THD=1%	12.0	13.0	—	dB	56	43	4	39	—	2
Signal to noise ratio	S/N	REC	OFF	A	120	OFF	NORM	1k	—	Rg=5.1kΩ, CCIR/ARM	64.0	70.0	—	dB	56	43	4	39	—	
Total Harmonic Distortion	THD	REC	OFF	A	120	OFF	NORM	1k	0		—	0.05	0.3	%	56	43	4	39	—	
Channel separation	CTRL (1)	PB	OFF	A	120	OFF	NORM	1k	+12		70.0	80.0	—	dB	51	48	3	40	—	
	CTRL (2)	REC	OFF	A	120	OFF	NORM	1k	+12		70.0	85.0	—		56	43	3	40	—	
Crosstalk	CT A/B	PB	OFF	A/B	120	OFF	NORM	1k	+12		70.0	80.0	—	dB	51/53	48/46	3	40	—	
	CT R/P	REC/PB	OFF	A	120	OFF	NORM	1k	+12		70.0	80.0	—		51/56	48/43	3	40	—	
Pass AMP. gain	G_V PA	PASS	OFF	A/B	120	OFF	NORM	1k	0		25.5	27.0	28.5	dB	51/53	48/46	3	40	—	
Gain deviation	ΔG_V	PASS	OFF	A/B	120	OFF	NORM	1k	0	G_V PA – G_V PB	–1.0	0.0	1.0	dB	51/53	48/46	3	40	—	
MUTE ATT.	MUTE	PB	OFF	A	120	ON	NORM	1k	+12		70.0	80.0	—	dB	51	48	3	40	—	
70µ EQ gain	G_V EQ 1k	PB	OFF	A	70	OFF	CROM	1k	0		24.0	25.5	27.0	dB	51	48	3	40	—	
	G_V EQ 10k	PB	OFF	A	70	OFF	CROM	10k	0		20.8	22.3	23.8		51	48	3	40	—	
MS sensing level	V_{ON}	PB	OFF	A	120	OFF	NORM	5k	—		–26.0	–22.0	–18.0	dB	51	48	3	40	26	3
MS output low level	V_{OL}	PB	OFF	A	120	OFF	NORM	—	—		—	1.0	1.5	V	51	48	—	—	26	
MS output leak current	I_{OH}	PB	OFF	A	120	OFF	NORM	—	—		—	—	2.0	µA	—	—	—	—	26	
ALC operate level	ALC (1)	REC	ON	A	120	OFF	NORM	1k	+12		2.0	4.5	7.0	dB	56	43	4	39	—	
	ALC (2)	REC	ON	A	120	OFF	CROM	1k	+12		0.0	2.5	5.0		56	43	4	39	—	

Notes: 1. Other IC-condition : REC-MUTE OFF, Normal tape, Normal speed, Bias OFF
2. V_{CC} = 11.0 V
3. For inputting signal to one side channel

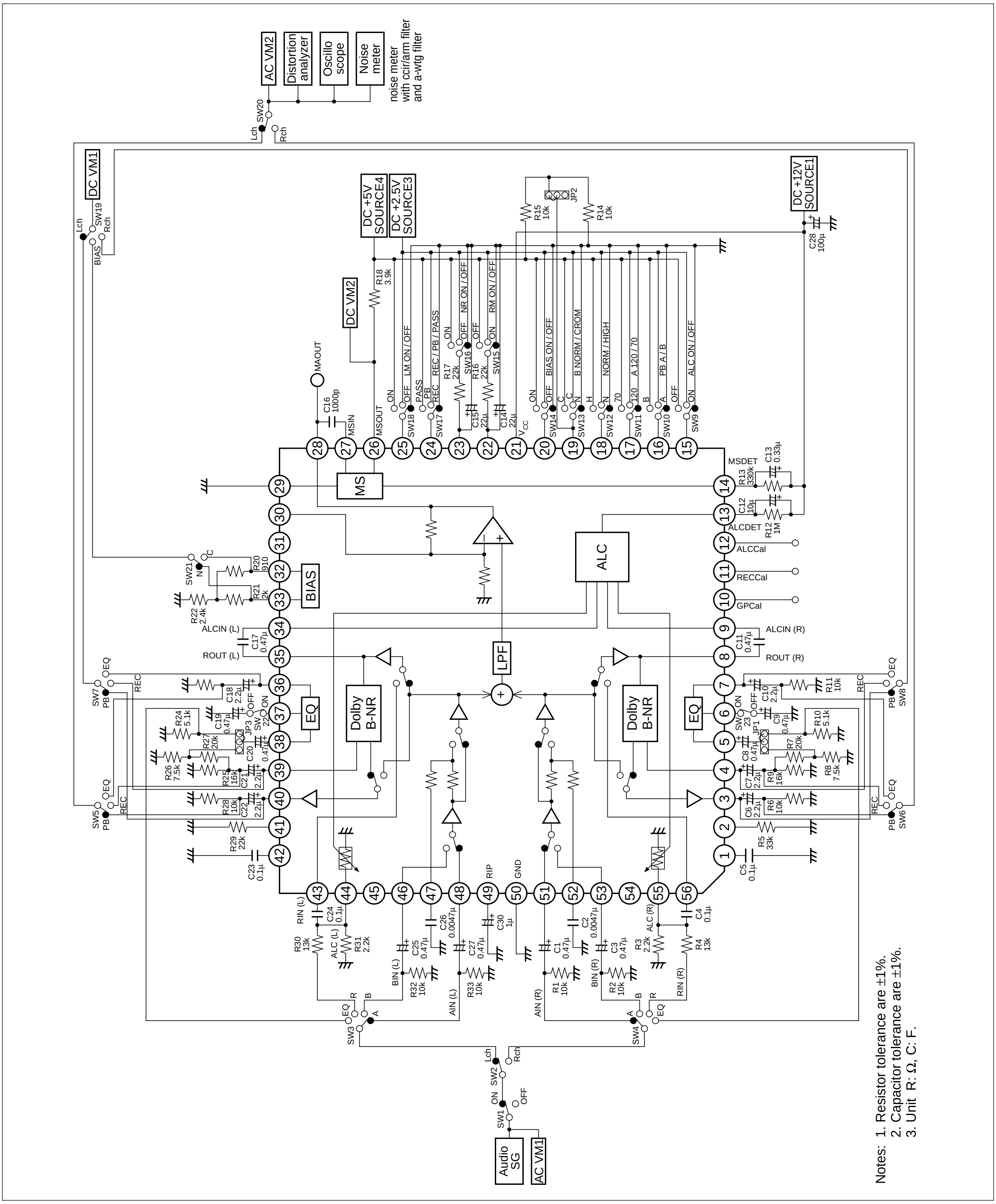
HA12227F (cont)

(Ta = 25°C, V_{CC} = 12 V)

Item	Symbol	TAPE	SPEED	Test Condition			Min	Typ	Max	Unit	Input R	Input L	Output R	Output L	COM	Remark
Equalizer S/N	S/N (EQ)	NORM	NORM	Rg = 5.1kΩ, A-WTG Filter (0dB = –5dBs at EQOUT)	SW22 (L), SW23 (R) OFF		55	58	—	dB	5	38	7	36	—	
Equalizer maximum input	Vin max (EQ)	NORM	NORM	f = 1kHz, THD = 1%, Vin = –26dBs = 0dB	SW22 (L), SW23 (R) OFF		10.5	12.5	—	dB	5	38	7	36	—	
Equalizer total harmonic distortion	T.H.D.1 (EQ)	NORM	NORM	f = 1kHz, Vin = –26dBs	SW22 (L), SW23 (R) OFF		—	0.2	0.5	%	5	38	7	36	—	
	T.H.D.2 (EQ)			f = 1kHz, Vin = –30dBs	SW22 (L), SW23 (R) OFF		—	0.2	0.5	%	5	38	7	36	—	
Equalizer offset voltage	Vofs (EQ)	NORM	NORM	No-Signal	SW22 (L), SW23 (R) OFF		–500	0	500	mV	5	38	7	36	—	
Equalizer frequency response (NORM - NORM)	$G_{VEQ-NN1}$	NORM	NORM	f = 3kHz, Vin = –46dBs	SW22 (L), SW23 (R) OFF		18.8	20.3	21.8	dB	5	38	7	36	—	
	$G_{VEQ-NN2}$			f = 8kHz, Vin = –46dBs	SW22 (L), SW23 (R) OFF		23.9	25.9	27.9	dB	5	38	7	36	—	
	$G_{VEQ-NN3}$			f = 12kHz, Vin = –46dBs	SW22 (L), SW23 (R) OFF		30.1	32.6	35.1	dB	5	38	7	36	—	
Equalizer frequency response (CROM - NORM)	$G_{VEQ-CN1}$	CROM	NORM	f = 3kHz, Vin = –46dBs	SW22 (L), SW23 (R) OFF		23.3	24.8	26.3	dB	5	38	7	36	—	
	$G_{VEQ-CN2}$			f = 8kHz, Vin = –46dBs	SW22 (L), SW23 (R) OFF		28.5	30.5	32.5	dB	5	38	7	36	—	
	$G_{VEQ-CN3}$			f = 12kHz, Vin = –46dBs	SW22 (L), SW23 (R) OFF		34.0	36.5	39.0	dB	5	38	7	36	—	
Equalizer frequency response (NORM - High)	$G_{VEQ-NH1}$	NORM	HIGH	f = 5kHz, Vin = –46dBs	SW22 (L), SW23 (R) OFF		15.0	16.5	18.0	dB	5	38	7	36	—	
	$G_{VEQ-NH2}$			f = 15kHz, Vin = –46dBs	SW22 (L), SW23 (R) OFF		19.9	21.9	23.9	dB	5	38	7	36	—	
	$G_{VEQ-NH3}$			f = 20kHz, Vin = –46dBs	SW22 (L), SW23 (R) OFF		23.4	25.9	28.4	dB	5	38	7	36	—	
Equalizer frequency Response (CROM - High)	$G_{VEQ-CH1}$	CROM	HIGH	f = 5kHz, Vin = –46dBs	SW22 (L), SW23 (R) OFF		19.7	21.2	22.7	dB	5	38	7	36	—	
	$G_{VEQ-CH2}$			f = 15kHz, Vin = –46dBs	SW22 (L), SW23 (R) OFF		23.5	25.5	27.5	dB	5	38	7	36	—	
	$G_{VEQ-CH3}$			f = 20kHz, Vin = –46dBs	SW22 (L), SW23 (R) OFF		26.5	29.0	31.5	dB	5	38	7	36	—	
REC-MUTE attenuation	REC-MUTE	NORM	NORM	f = 1kHz, Vin = –14dBs	SW22 (L), SW23 (R) OFF		60	70	—	dB	5	38	7	36	—	
REC CAL response	R-CAL1	NORM	NORM	f = 3kHz, Vin = –46dBs, $V_{REC-CAL}$ = 5V	SW22 (L), SW23 (R) OFF	$G_{V\ EQ-NN1}$ = 0dB	3.0	4.5	6.0	dB	5	38	7	36	—	
	R-CAL2			f = 3kHz, Vin = –46dBs, $V_{REC-CAL}$ = 0V	SW22 (L), SW23 (R) OFF		–6.0	–4.5	–3.0	dB	5	38	7	36	—	
GP CAL response	GP-CAL1	NORM	NORM	f = 12kHz, Vin = –46dBs, V_{GP-CAL} = 0V	SW22 (L), SW23 (R) OFF	$G_{V\ EQ-NN3}$ = 0dB	3.0	4.5	6.0	dB	5	38	7	36	—	
	GP-CAL2			f = 12kHz, Vin = –46dBs, V_{GP-CAL} = 5V	SW22 (L), SW23 (R) OFF		–6.0	–4.5	–3.0	dB	5	38	7	36	—	
ALC CAL response	ALC-CAL1	NORM	NORM	f = 1kHz, $V_{ALC-CAL}$ = 0V		ALC (1) = 0dB	—	–4.0	–3.0	dB	56	43	4	39	—	
	ALC-CAL2			f = 1kHz, $V_{ALC-CAL}$ = 5V			3.0	4.0	—	dB	56	43	4	39	—	
Bias out maximum level	Bias on	R_L = 2.2kΩ					V_{CC} –1.4	V_{CC} –0.7	—	V	—	—	—	—	32, 33	
Bias out offset	Bias off	R_L = 2.2kΩ					–0.1	0.0	0.1	V	—	—	—	—	32, 33	
Control voltage	V_{IL}						–0.2	—	1.0	V	—	—	—	—	—	15 to 20 22 to 25
	V_{IM}						2.0	—	3.0	V	—	—	—	—	—	19, 24
	V_{IH}						4.0	—	V_{CC}	V	—	—	—	—	—	15 to 20 22 to 25

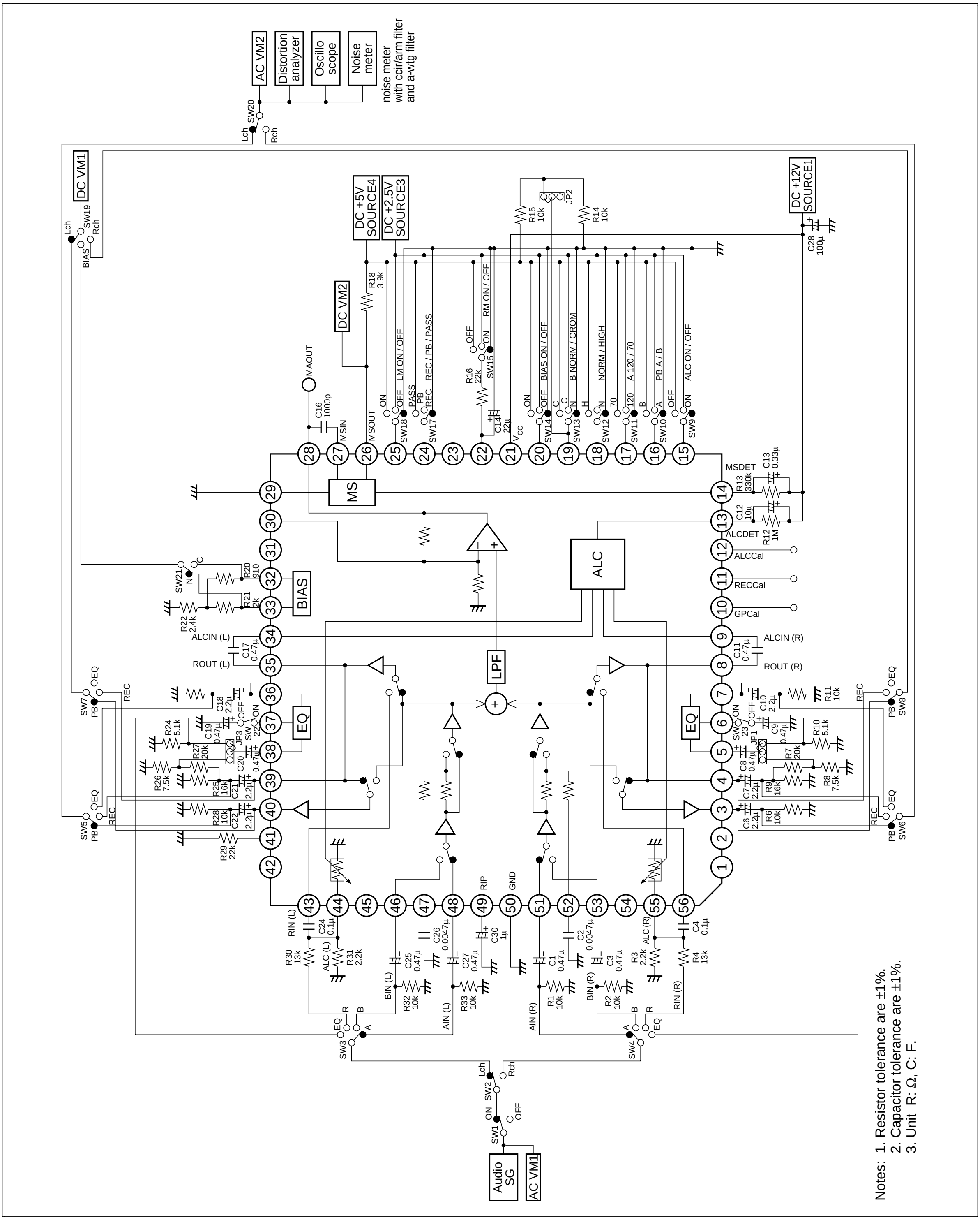
Test Circuit

HA12226F



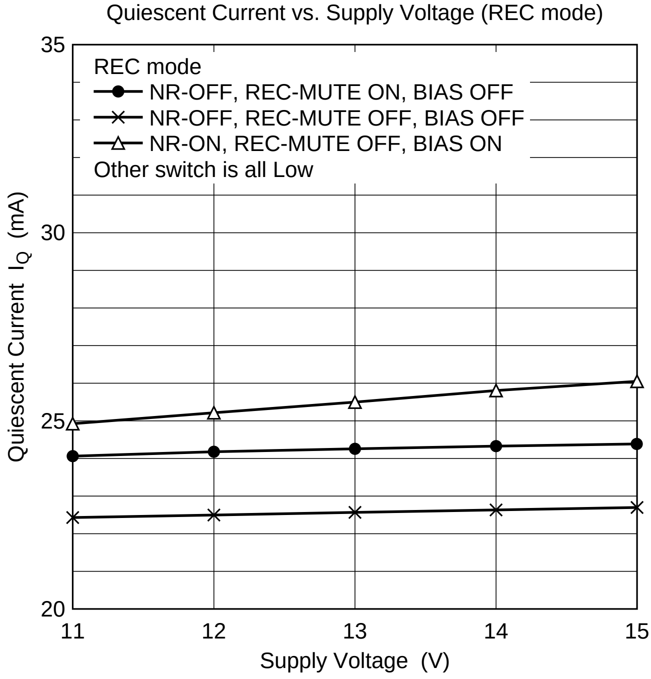
Notes: 1. Resistor tolerance are ±1%.
2. Capacitor tolerance are ±1%.
3. Unit R: Ω, C: F.

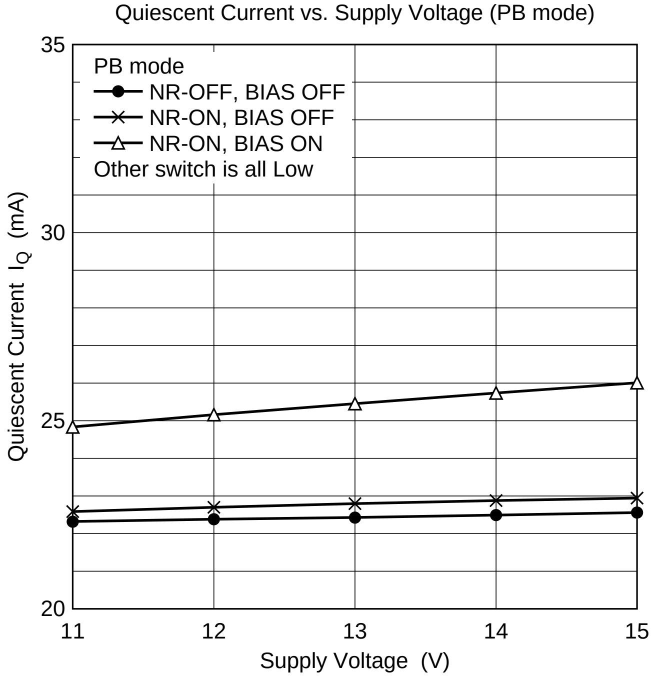
HA12227F


Notes: 1. Resistor tolerance are ±1%.
2. Capacitor tolerance are ±1%.
3. Unit R: Ω, C: F.

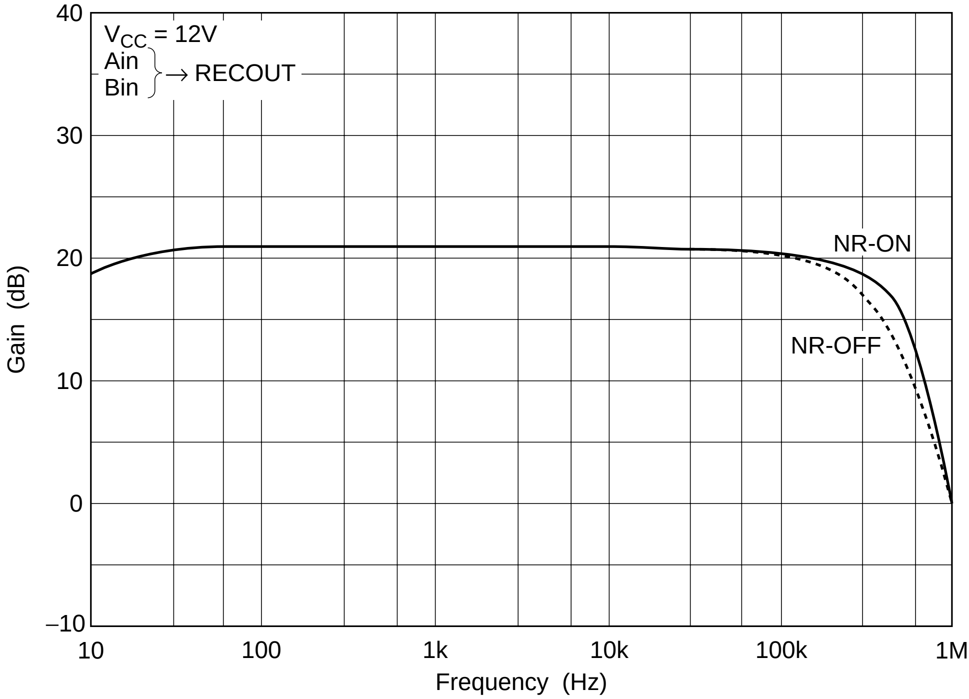
Characteristic Curves

HA12226F

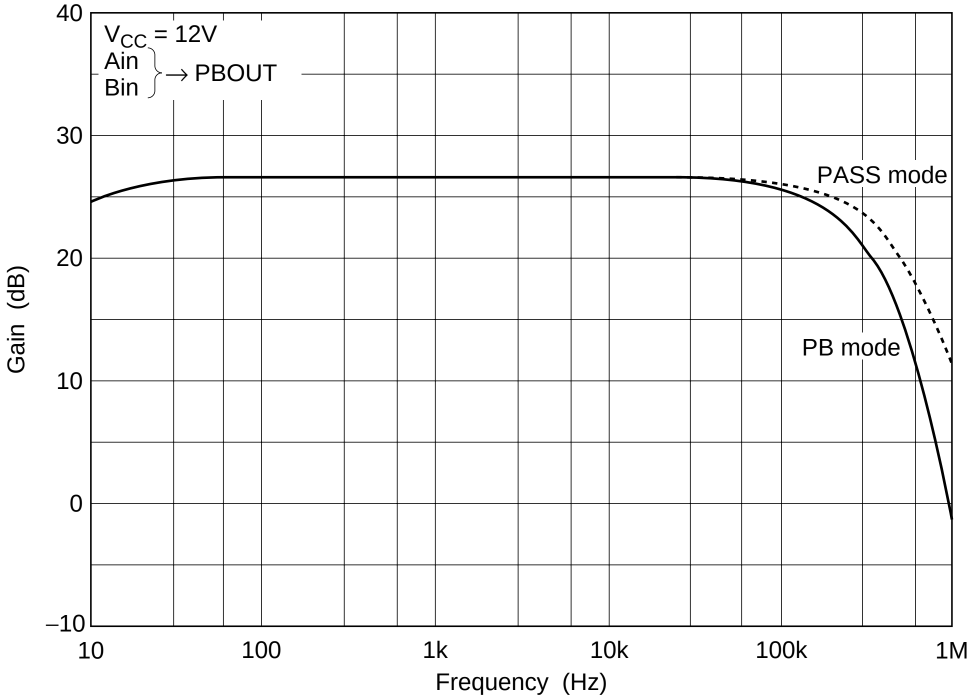


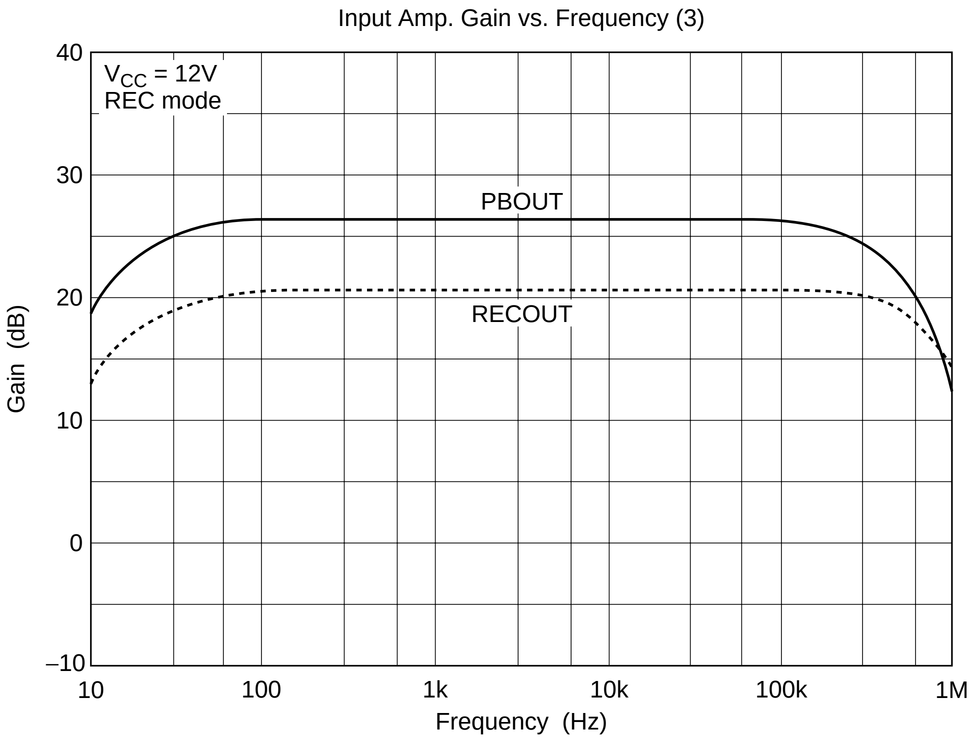


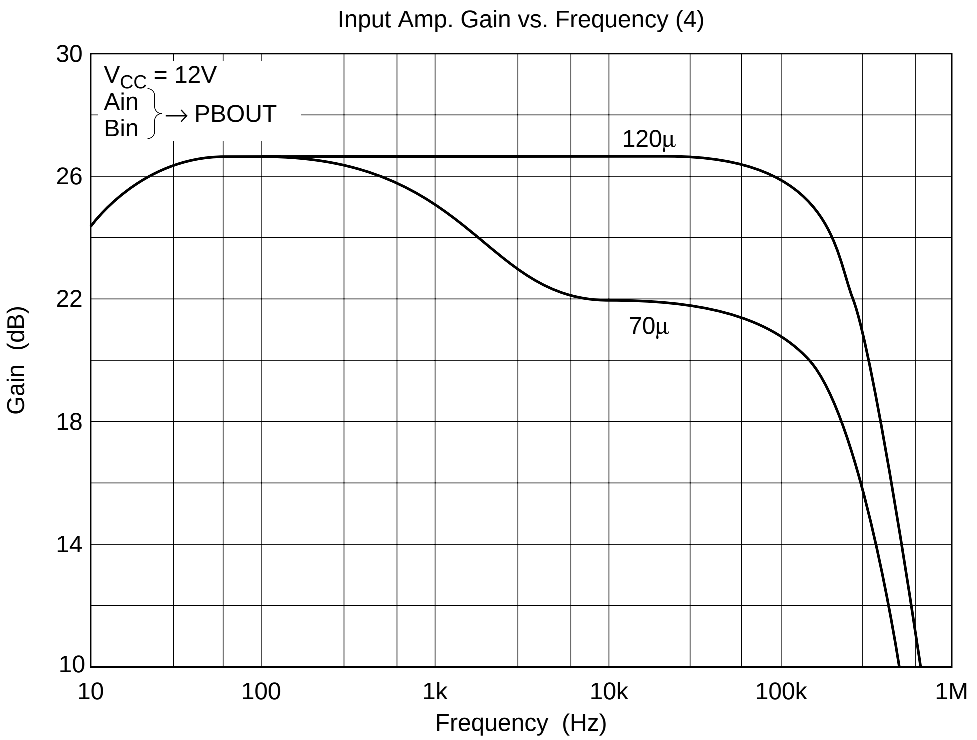
Input Amp. Gain vs. Frequency (1)

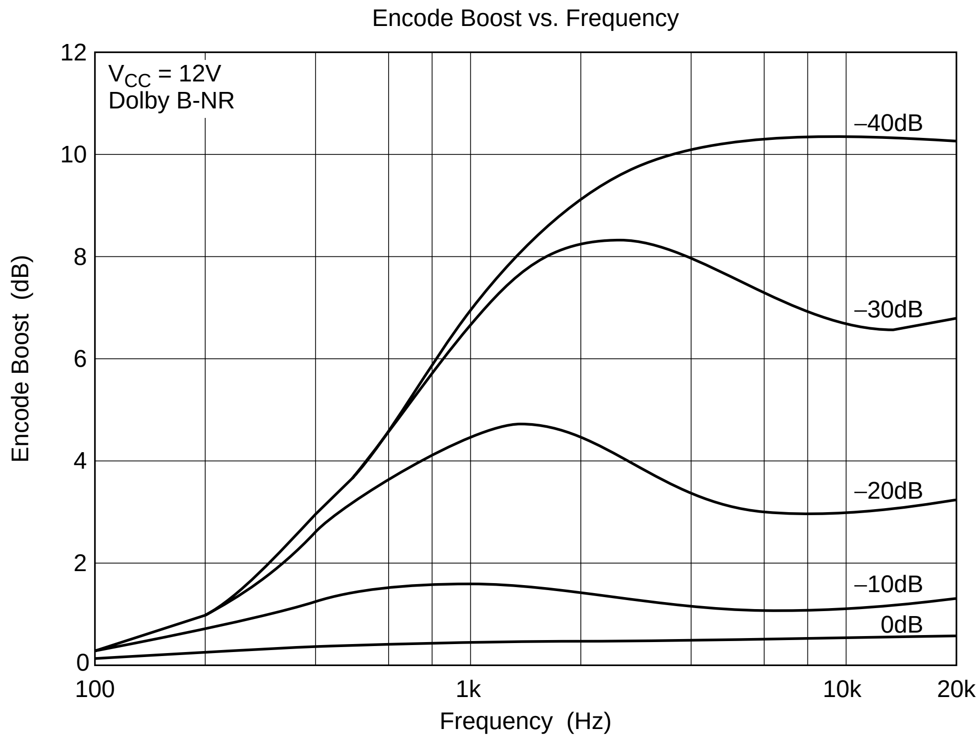


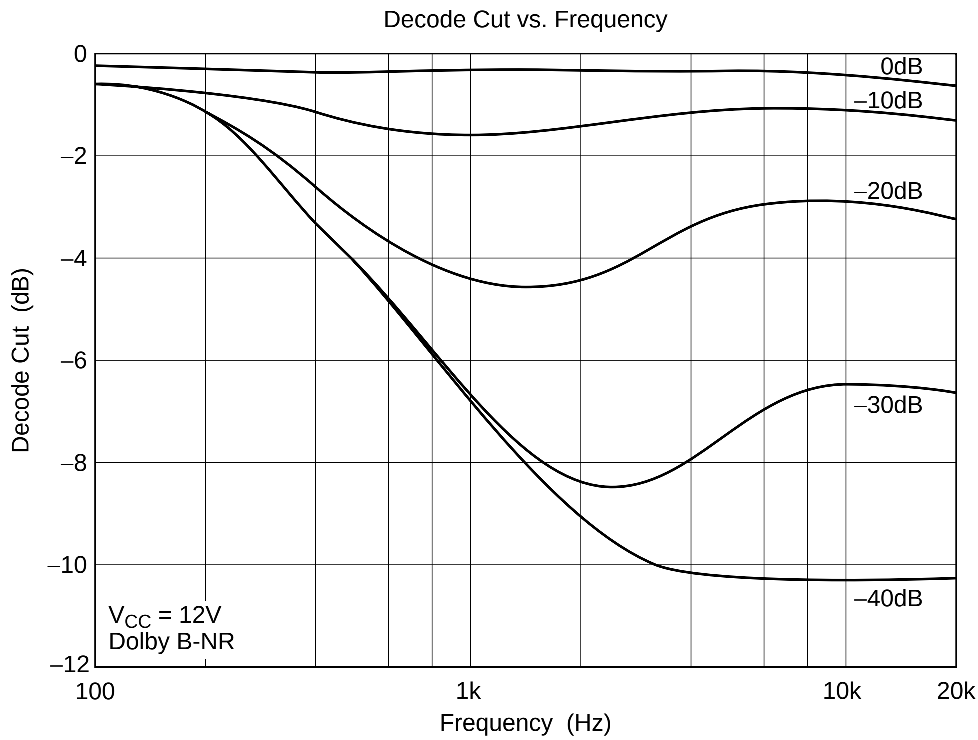
Input Amp. Gain vs. Frequency (2)



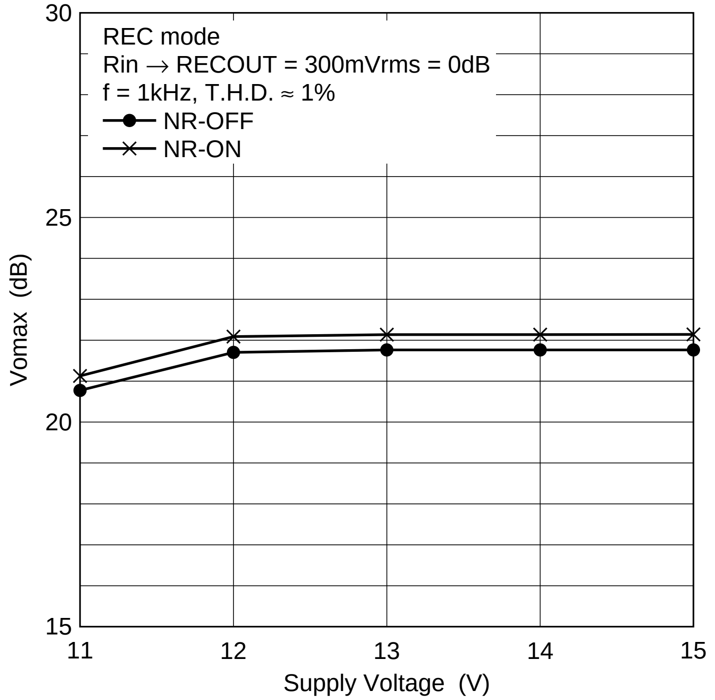

Input Amp. Gain vs. Frequency (3)
VCC = 12V
REC mode
PBOUT
RECOUT
Gain (dB)
40
30
20
10
0
–10
10
100
1k
10k
100k
1M
Frequency (Hz)


Input Amp. Gain vs. Frequency (4)
VCC = 12V
Ain
Bin
→ PBOUT
120µ
70µ
Gain (dB)
30
26
22
18
14
10
10
100
1k
10k
100k
1M
Frequency (Hz)

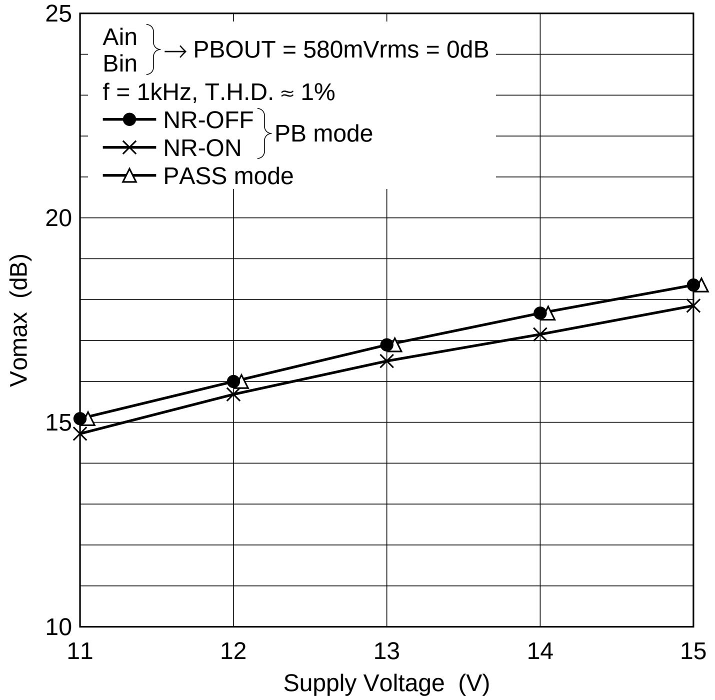

Encode Boost vs. Frequency
12
10
8
6
4
2
0
Encode Boost (dB)
VCC = 12V
Dolby B-NR
–40dB
–30dB
–20dB
–10dB
0dB
100
1k
10k
20k
Frequency (Hz)

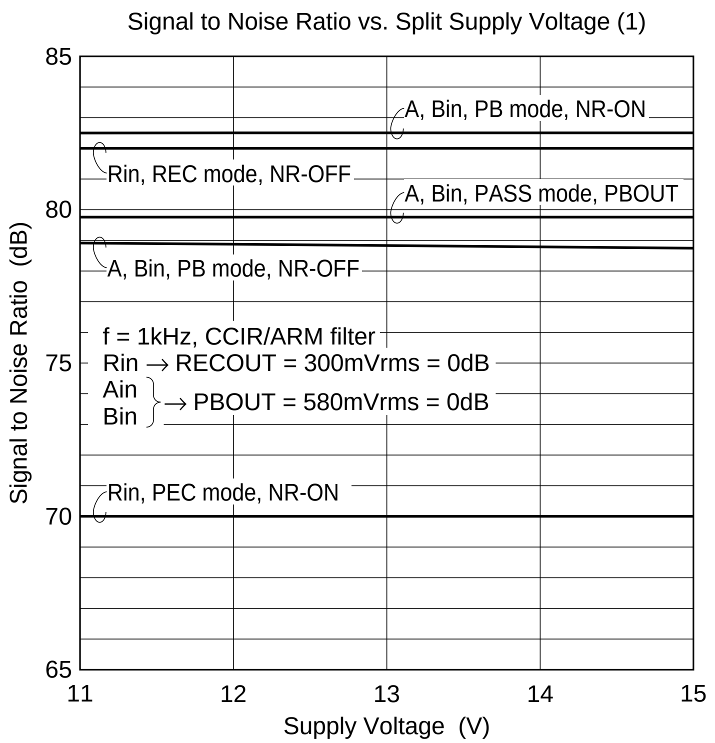

Decode Cut vs. Frequency
0
–2
–4
–6
–8
–10
–12
Decode Cut (dB)
0dB
–10dB
–20dB
–30dB
–40dB
VCC = 12V
Dolby B-NR
100
1k
10k
20k
Frequency (Hz)

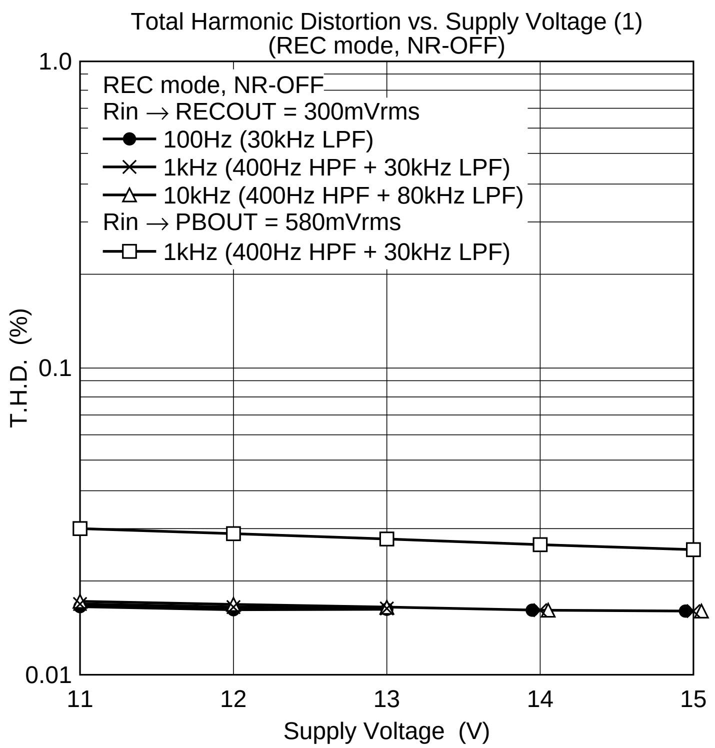
Signal Handling (1)

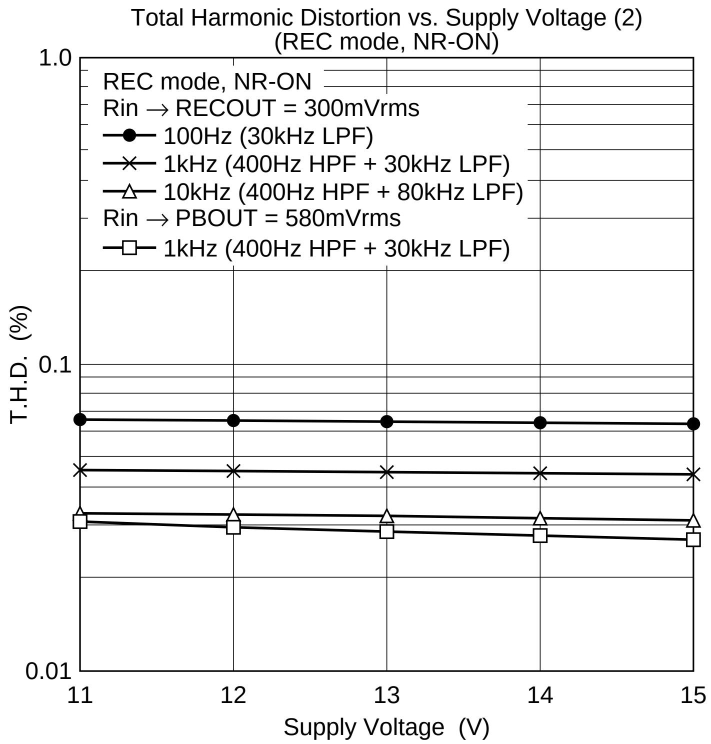


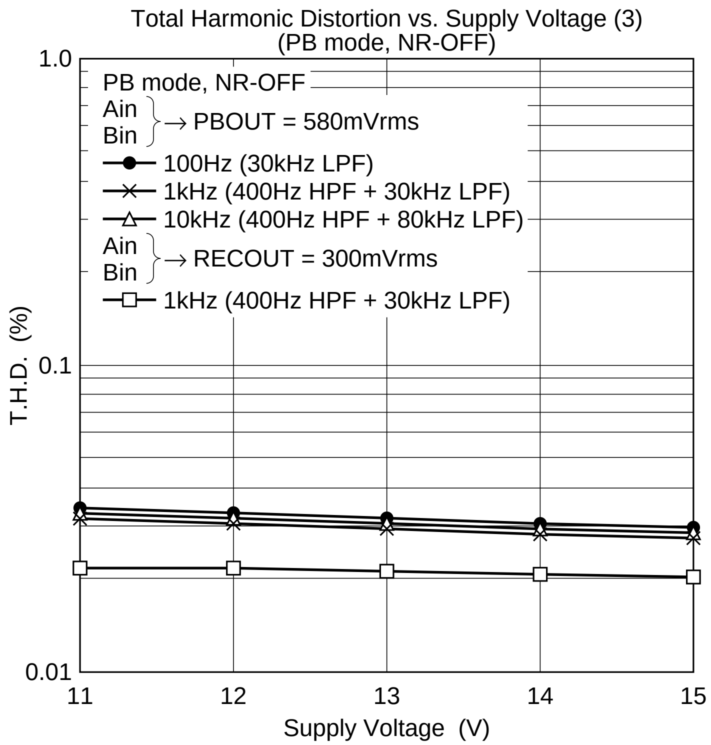
Signal Handling (2)

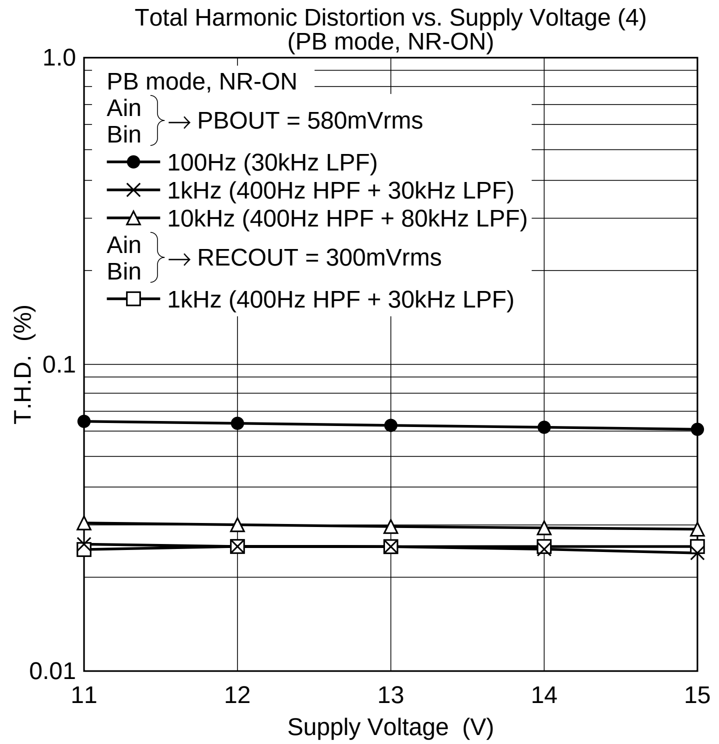


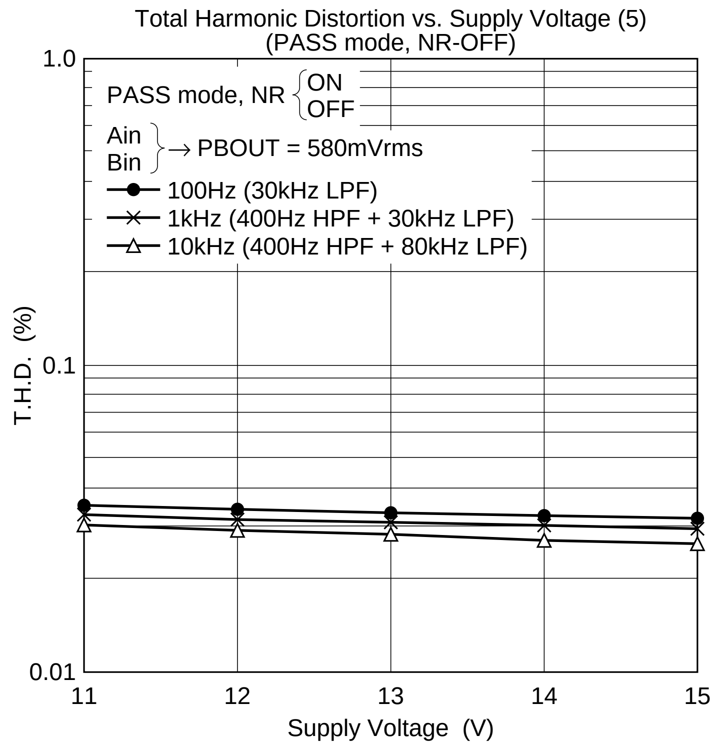

Signal to Noise Ratio vs. Split Supply Voltage (1)
Signal to Noise Ratio (dB)
85
80
75
70
65
A, Bin, PB mode, NR-ON
Rin, REC mode, NR-OFF
A, Bin, PASS mode, PBOUT
A, Bin, PB mode, NR-OFF
f = 1kHz, CCIR/ARM filter
Rin → RECOUT = 300mVrms = 0dB
Ain
Bin
→ PBOUT = 580mVrms = 0dB
Rin, PEC mode, NR-ON
11
12
13
14
15
Supply Voltage (V)

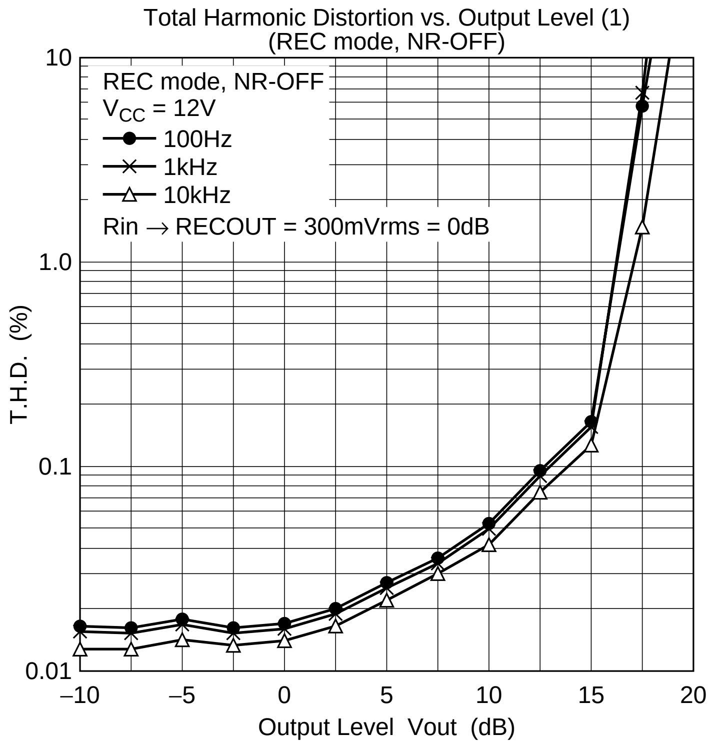

Total Harmonic Distortion vs. Supply Voltage (1)
(REC mode, NR-OFF)
T.H.D. (%)
1.0
0.1
0.01
REC mode, NR-OFF
Rin → RECOUT = 300mVrms
100Hz (30kHz LPF)
1kHz (400Hz HPF + 30kHz LPF)
10kHz (400Hz HPF + 80kHz LPF)
Rin → PBOUT = 580mVrms
1kHz (400Hz HPF + 30kHz LPF)
11
12
13
14
15
Supply Voltage (V)

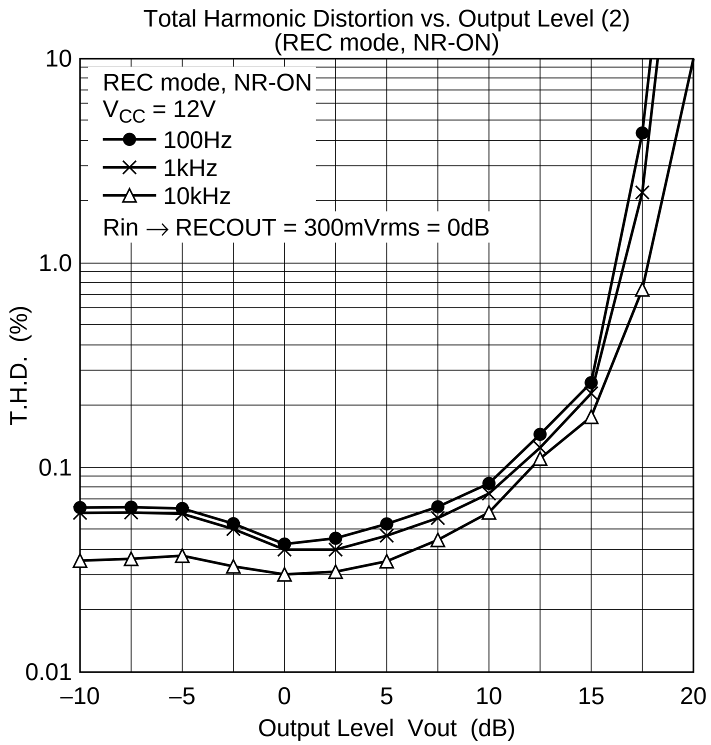

Total Harmonic Distortion vs. Supply Voltage (2)
(REC mode, NR-ON)
REC mode, NR-ON
Rin → RECOUT = 300mVrms
100Hz (30kHz LPF)
1kHz (400Hz HPF + 30kHz LPF)
10kHz (400Hz HPF + 80kHz LPF)
Rin → PBOUT = 580mVrms
1kHz (400Hz HPF + 30kHz LPF)
T.H.D. (%)
1.0
0.1
0.01
11
12
13
14
15
Supply Voltage (V)

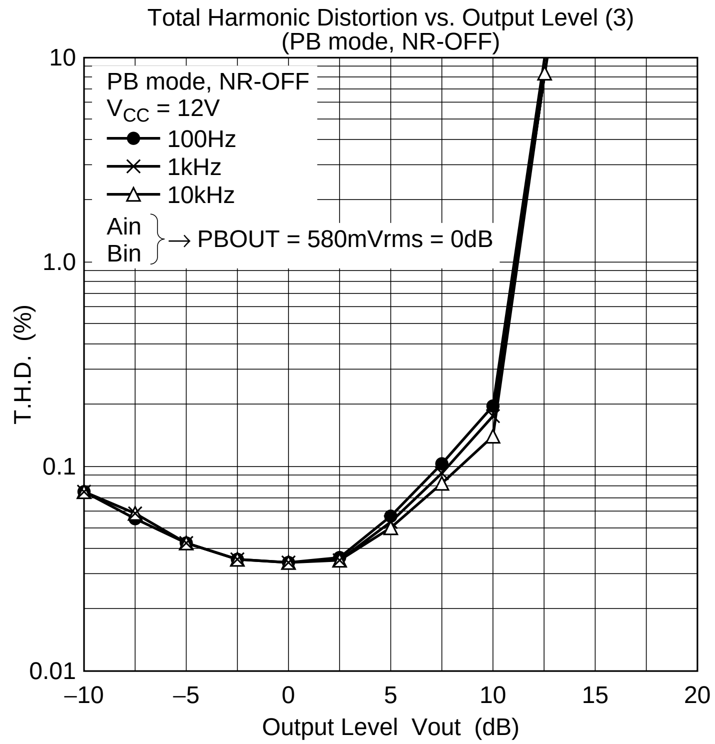

Total Harmonic Distortion vs. Supply Voltage (3)
(PB mode, NR-OFF)
PB mode, NR-OFF
Ain
Bin
→ PBOUT = 580mVrms
100Hz (30kHz LPF)
1kHz (400Hz HPF + 30kHz LPF)
10kHz (400Hz HPF + 80kHz LPF)
Ain
Bin
→ RECOUT = 300mVrms
1kHz (400Hz HPF + 30kHz LPF)
T.H.D. (%)
1.0
0.1
0.01
11
12
13
14
15
Supply Voltage (V)

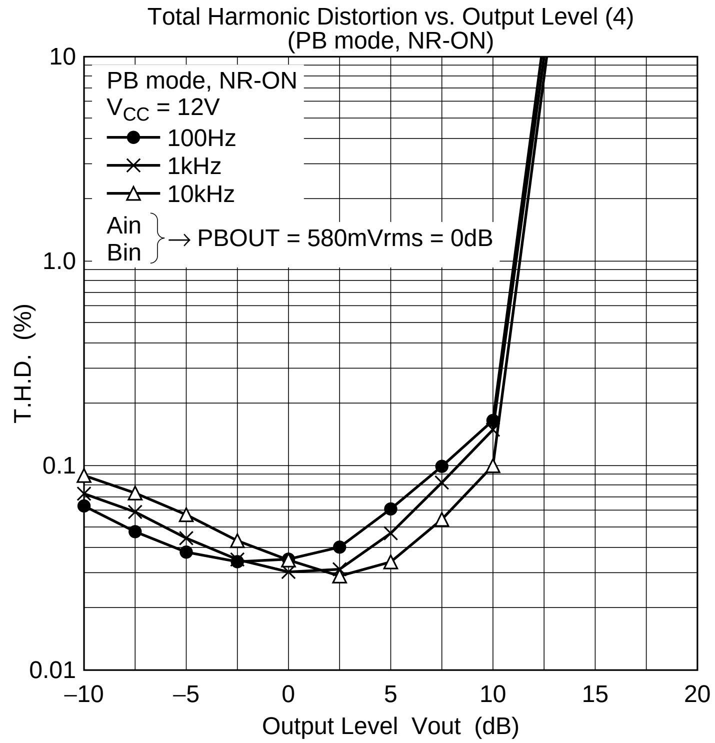

Total Harmonic Distortion vs. Supply Voltage (4)
(PB mode, NR-ON)
PB mode, NR-ON
Ain
Bin
→ PBOUT = 580mVrms
100Hz (30kHz LPF)
1kHz (400Hz HPF + 30kHz LPF)
10kHz (400Hz HPF + 80kHz LPF)
Ain
Bin
→ RECOUT = 300mVrms
1kHz (400Hz HPF + 30kHz LPF)
T.H.D. (%)
1.0
0.1
0.01
11
12
13
14
15
Supply Voltage (V)


Total Harmonic Distortion vs. Supply Voltage (5)
(PASS mode, NR-OFF)
PASS mode, NR
ON
OFF
Ain
Bin
→ PBOUT = 580mVrms
100Hz (30kHz LPF)
1kHz (400Hz HPF + 30kHz LPF)
10kHz (400Hz HPF + 80kHz LPF)
T.H.D. (%)
1.0
0.1
0.01
11
12
13
14
15
Supply Voltage (V)

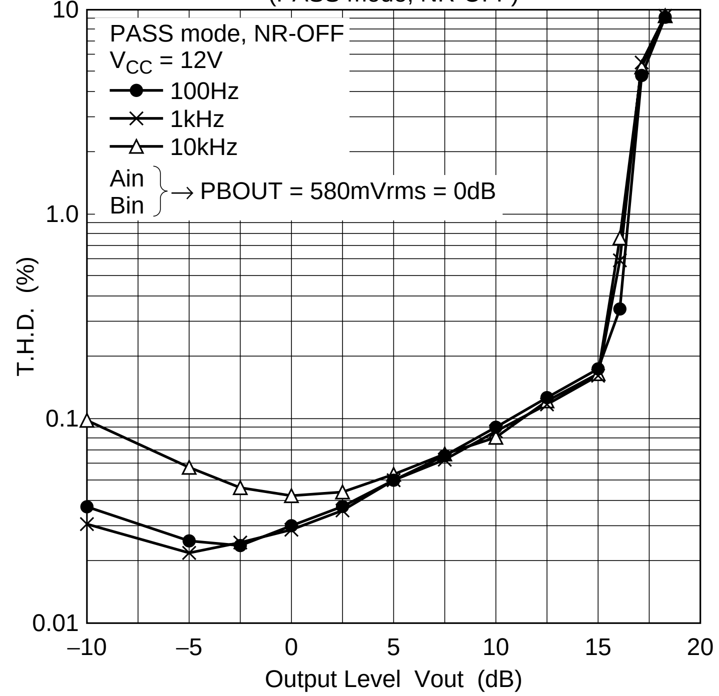

Total Harmonic Distortion vs. Output Level (1)
(REC mode, NR-OFF)
REC mode, NR-OFF
VCC = 12V
100Hz
1kHz
10kHz
Rin → RECOUT = 300mVrms = 0dB
T.H.D. (%)
10
1.0
0.1
0.01
–10
–5
0
5
10
15
20
Output Level Vout (dB)


Total Harmonic Distortion vs. Output Level (2)
(REC mode, NR-ON)
REC mode, NR-ON
VCC = 12V
100Hz
1kHz
10kHz
Rin → RECOUT = 300mVrms = 0dB
T.H.D. (%)
10
1.0
0.1
0.01
–10
–5
0
5
10
15
20
Output Level Vout (dB)

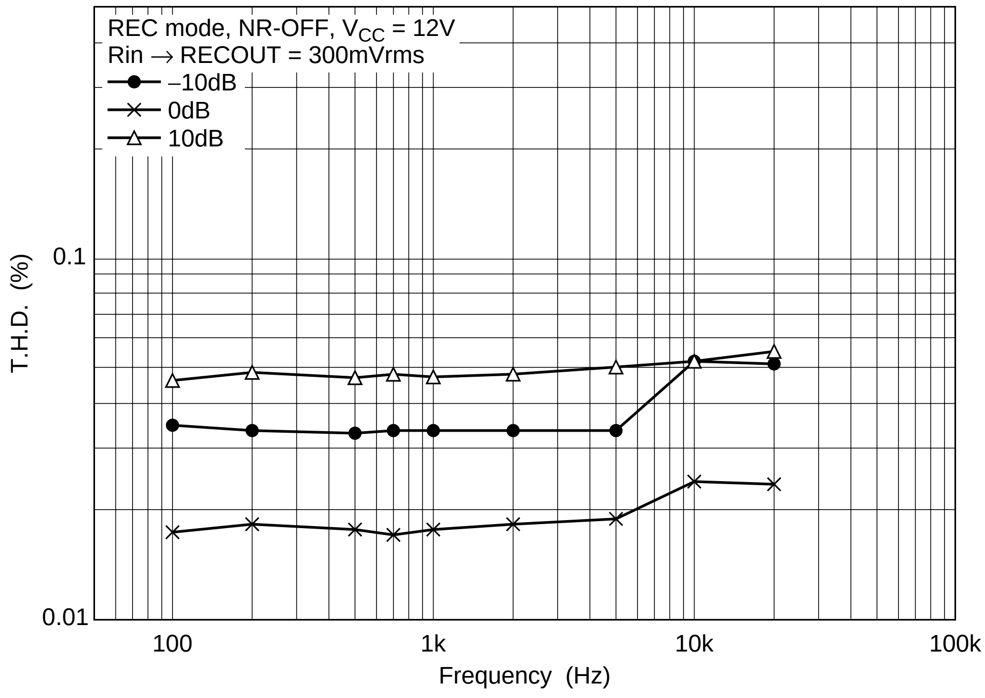

Total Harmonic Distortion vs. Output Level (3)
(PB mode, NR-OFF)
PB mode, NR-OFF
VCC = 12V
100Hz
1kHz
10kHz
Ain
Bin
→ PBOUT = 580mVrms = 0dB
T.H.D. (%)
10
1.0
0.1
0.01
–10
–5
0
5
10
15
20
Output Level Vout (dB)


Total Harmonic Distortion vs. Output Level (4)
(PB mode, NR-ON)
PB mode, NR-ON
VCC = 12V
100Hz
1kHz
10kHz
Ain
Bin
→ PBOUT = 580mVrms = 0dB
T.H.D. (%)
10
1.0
0.1
0.01
–10
–5
0
5
10
15
20
Output Level Vout (dB)

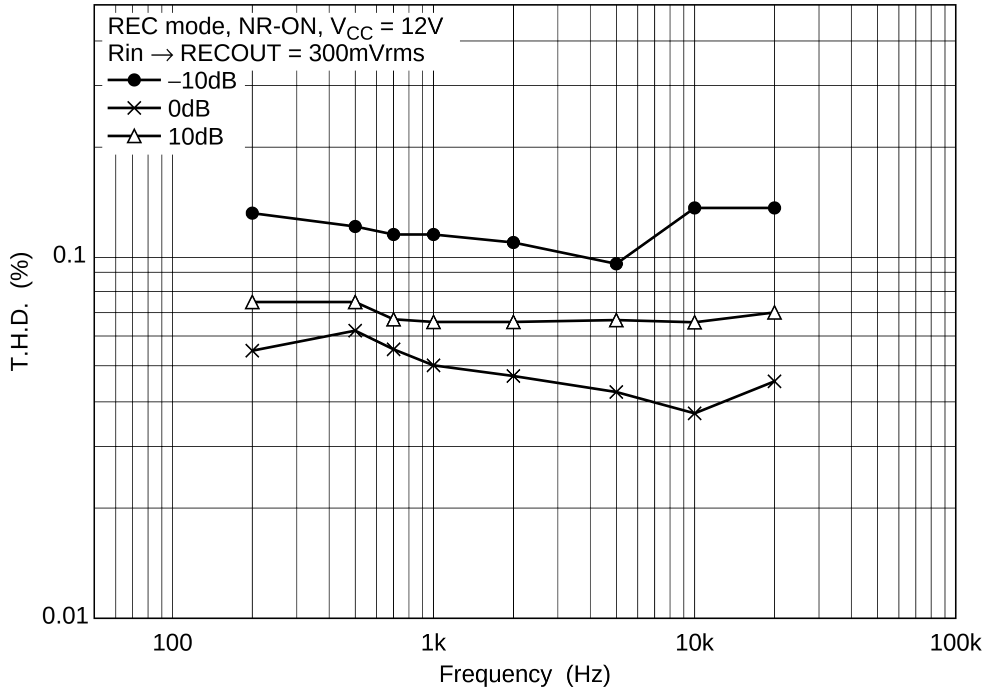
Total Harmonic Distortion vs. Output Level (5)
(PASS mode, NR-OFF)



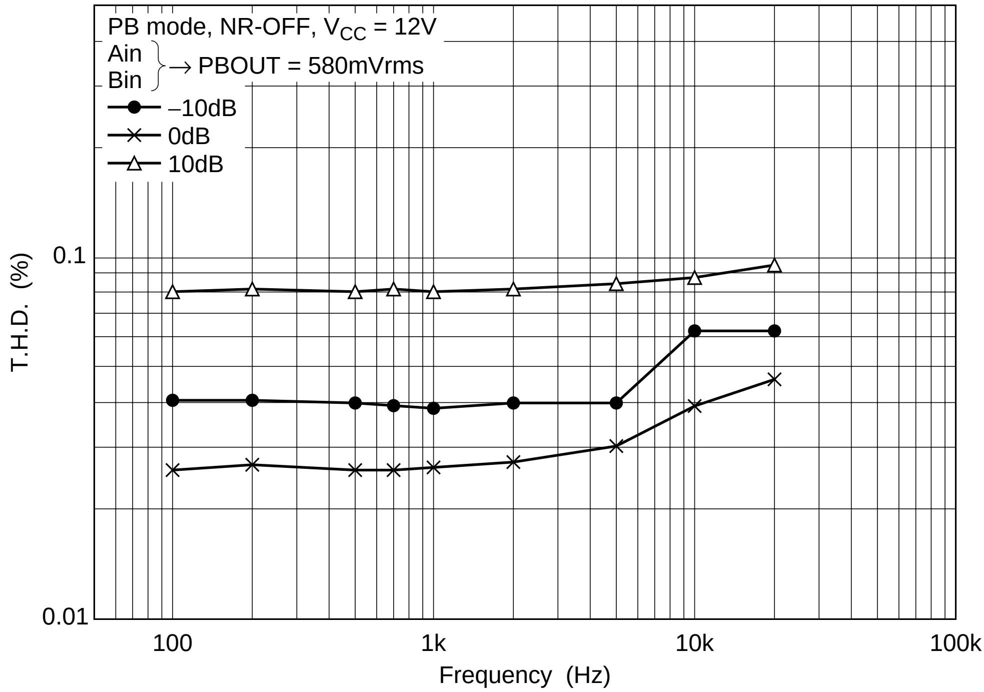
Total Harmonic Distortion vs. Frequency (1)



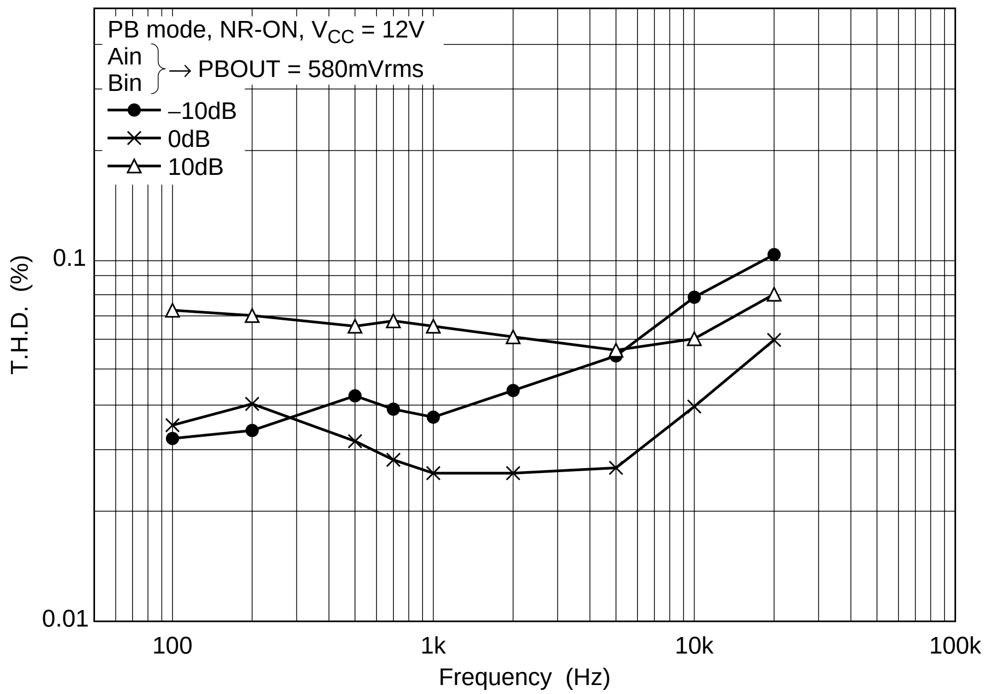
Total Harmonic Distortion vs. Frequency (2)



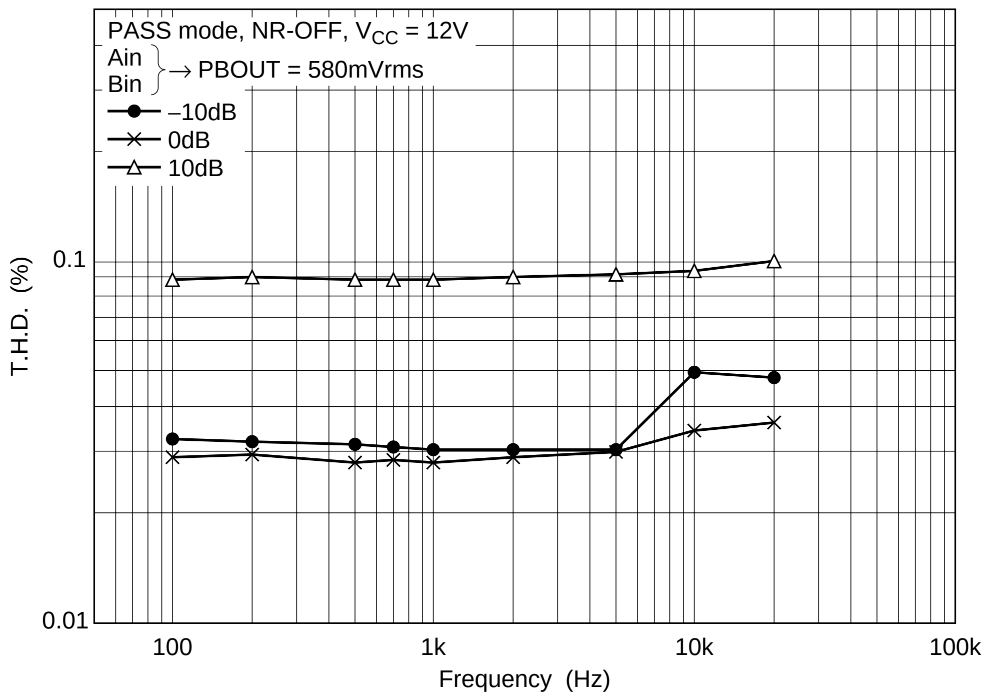
Total Harmonic Distortion vs. Frequency (3)



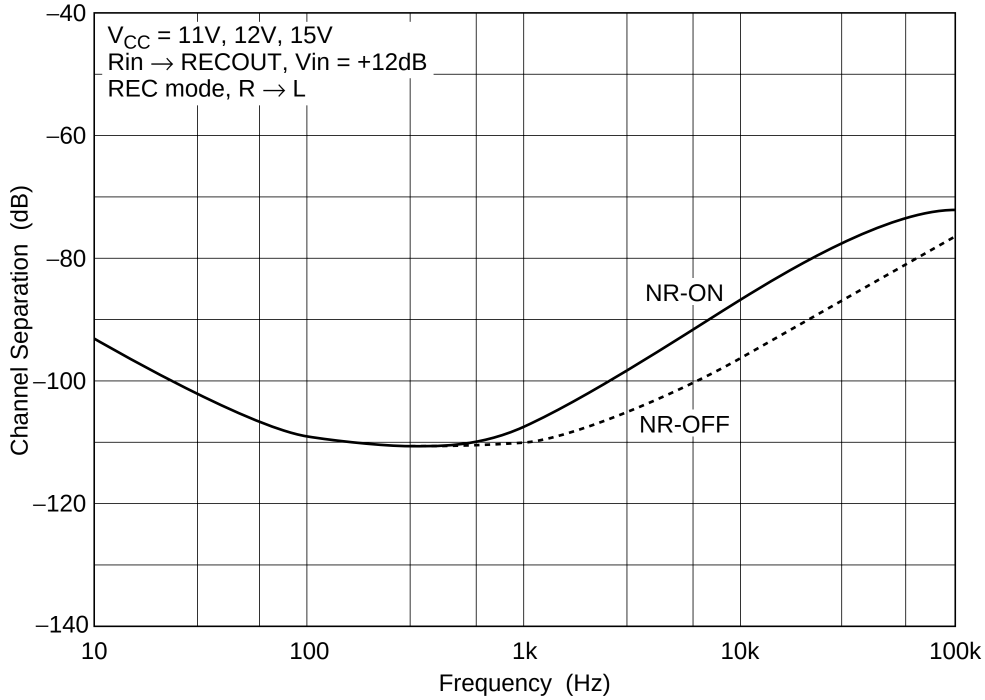
Total Harmonic Distortion vs. Frequency (4)



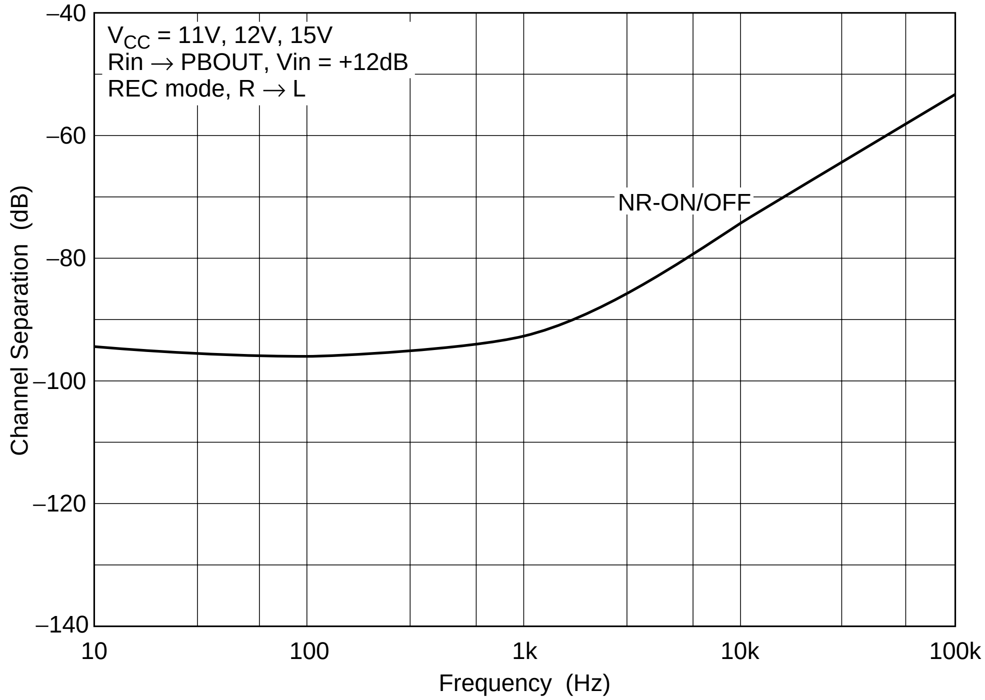
Total Harmonic Distortion vs. Frequency (5)

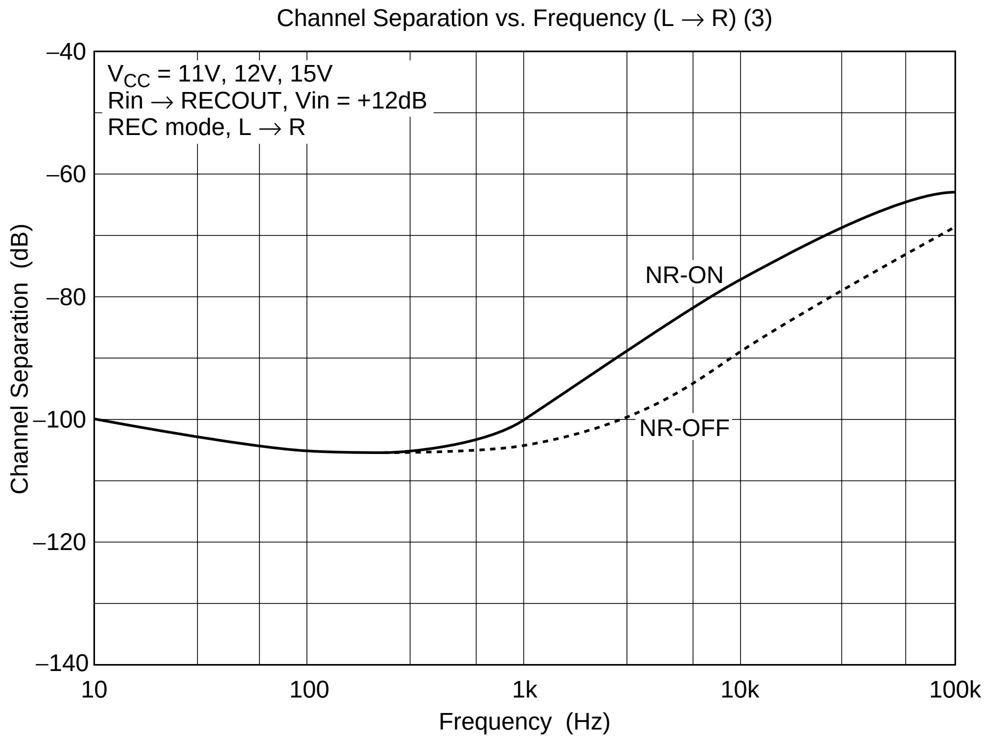


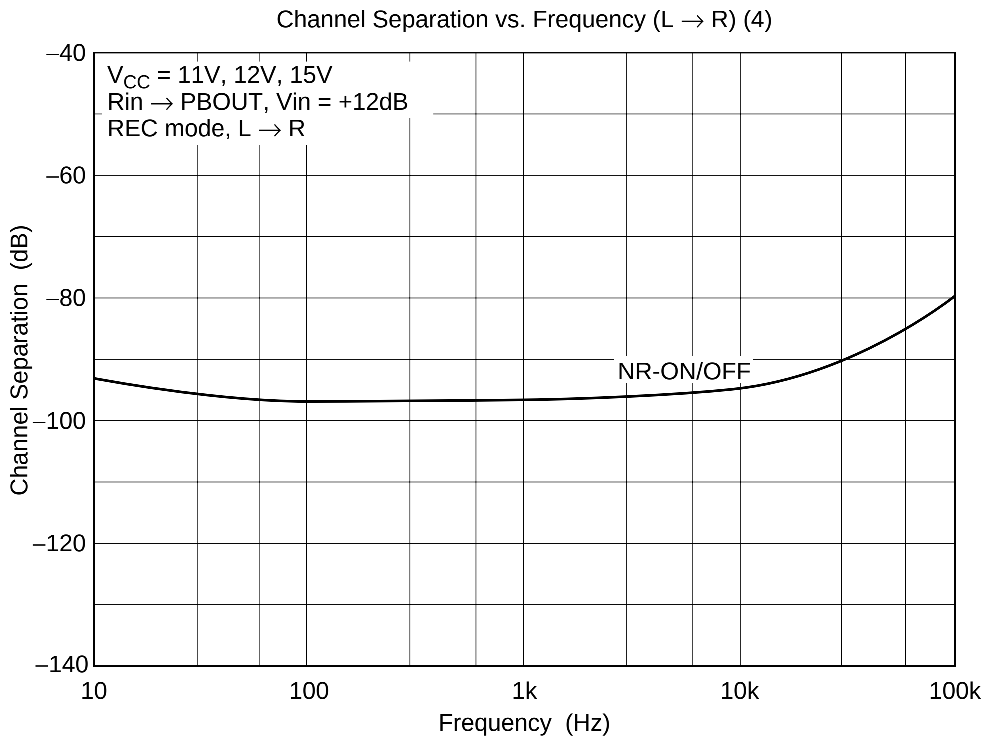
Channel Separation vs. Frequency (R → L) (1)

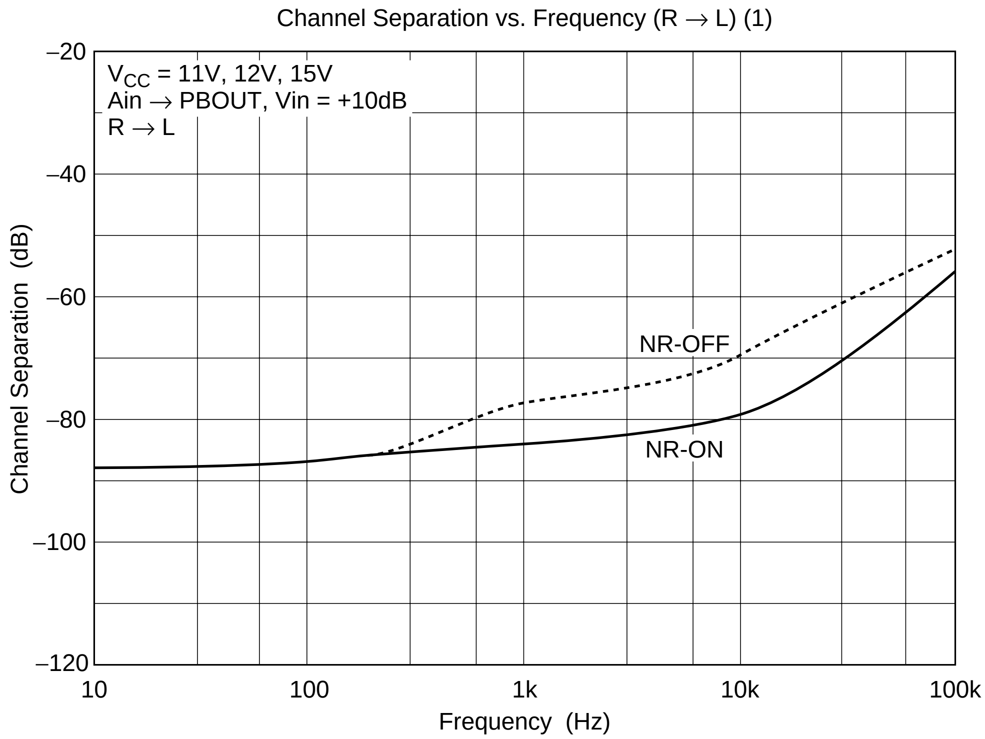


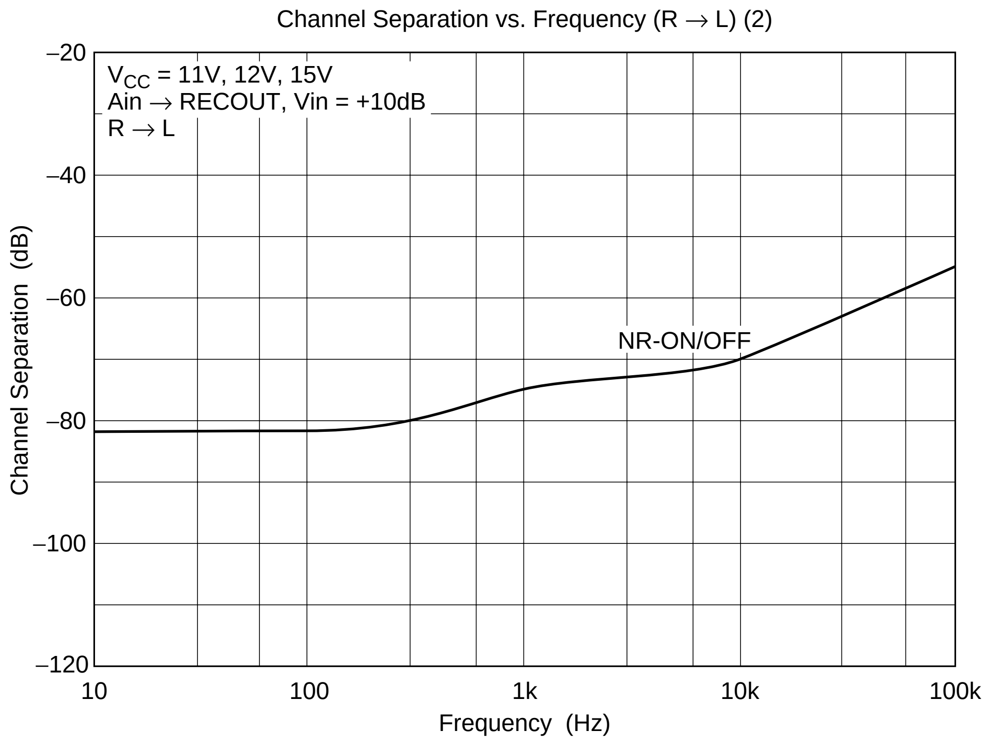
Channel Separation vs. Frequency (R → L) (2)

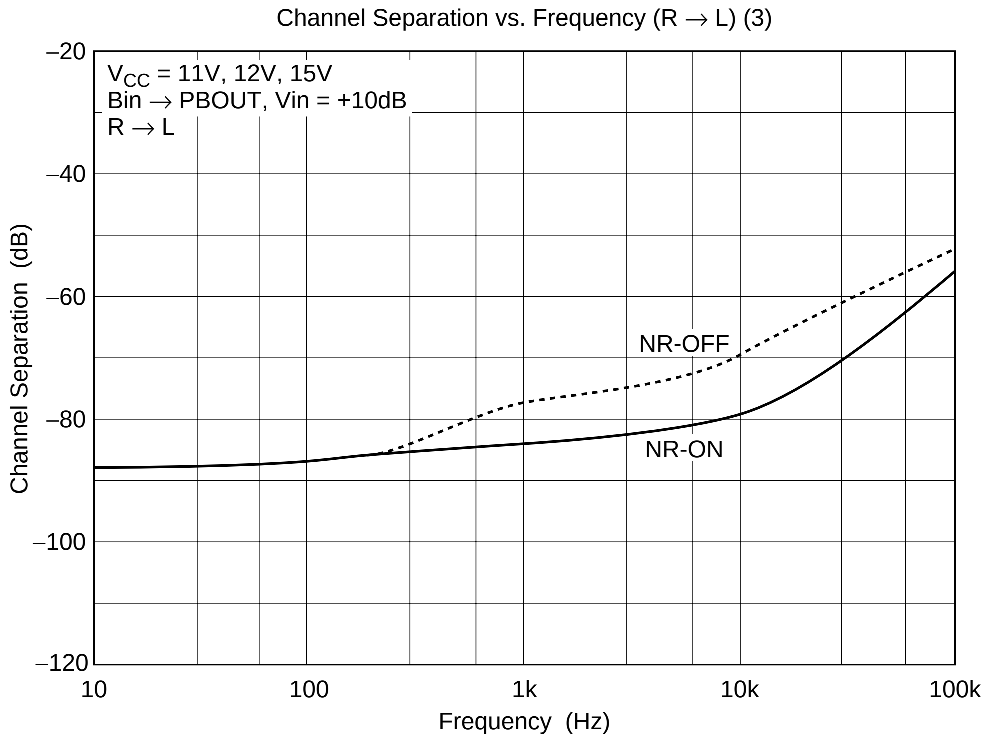


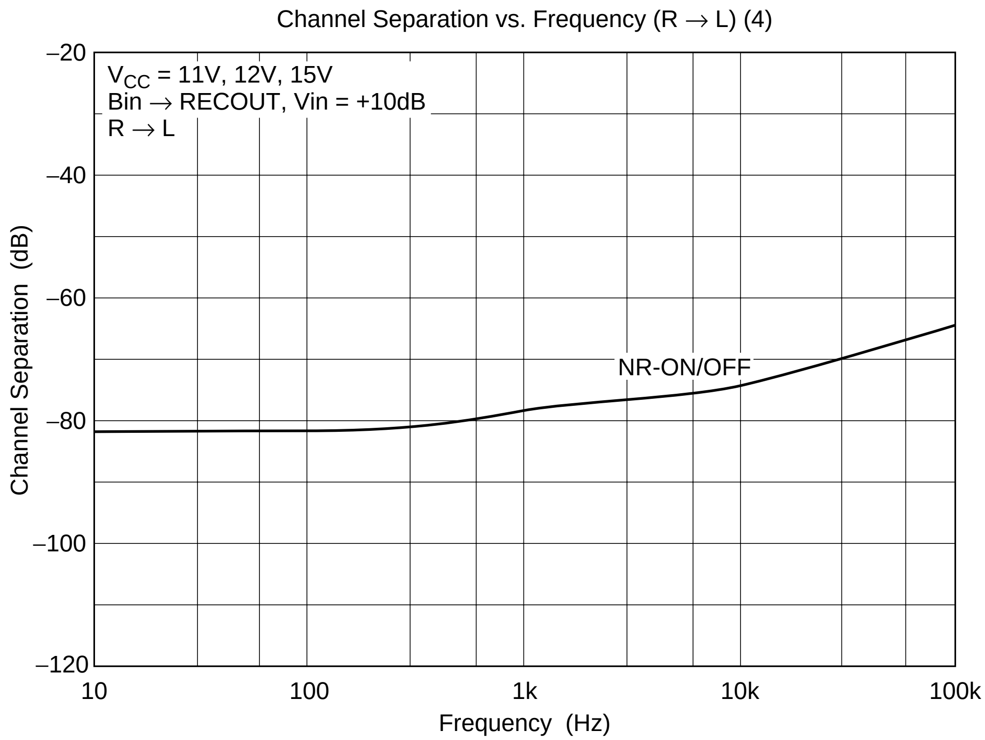

Channel Separation vs. Frequency (L → R) (3)
VCC = 11V, 12V, 15V
Rin → RECOUT, Vin = +12dB
REC mode, L → R
NR-ON
NR-OFF
–40
–60
–80
–100
–120
–140
Channel Separation (dB)
10
100
1k
10k
100k
Frequency (Hz)

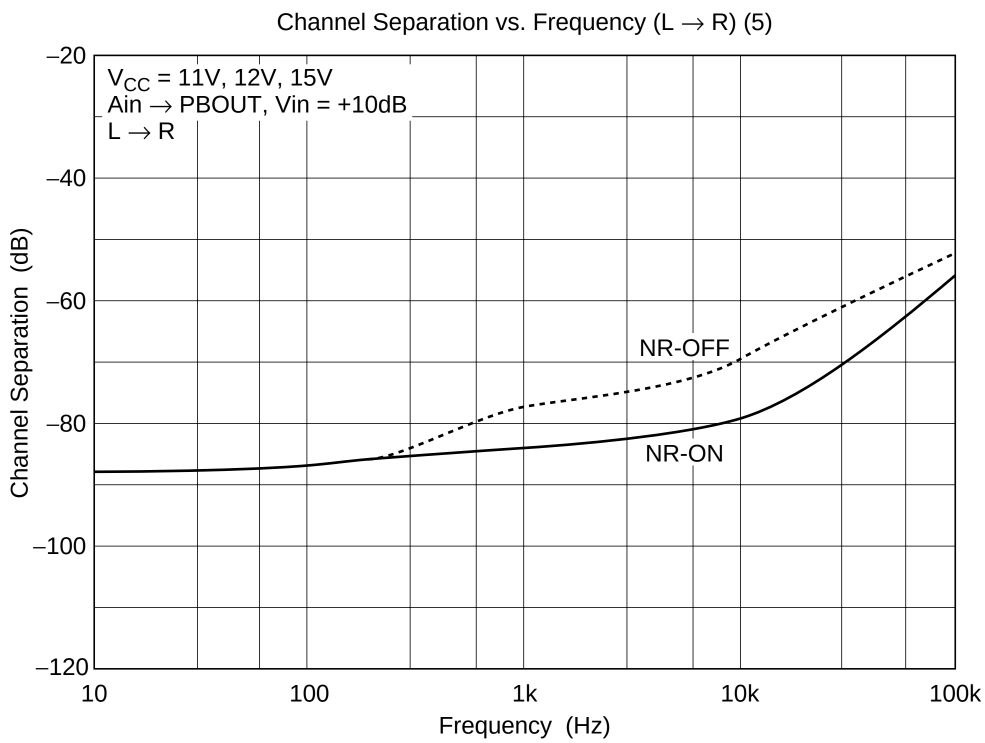

Channel Separation vs. Frequency (L → R) (4)
VCC = 11V, 12V, 15V
Rin → PBOUT, Vin = +12dB
REC mode, L → R
NR-ON/OFF
–40
–60
–80
–100
–120
–140
Channel Separation (dB)
10
100
1k
10k
100k
Frequency (Hz)

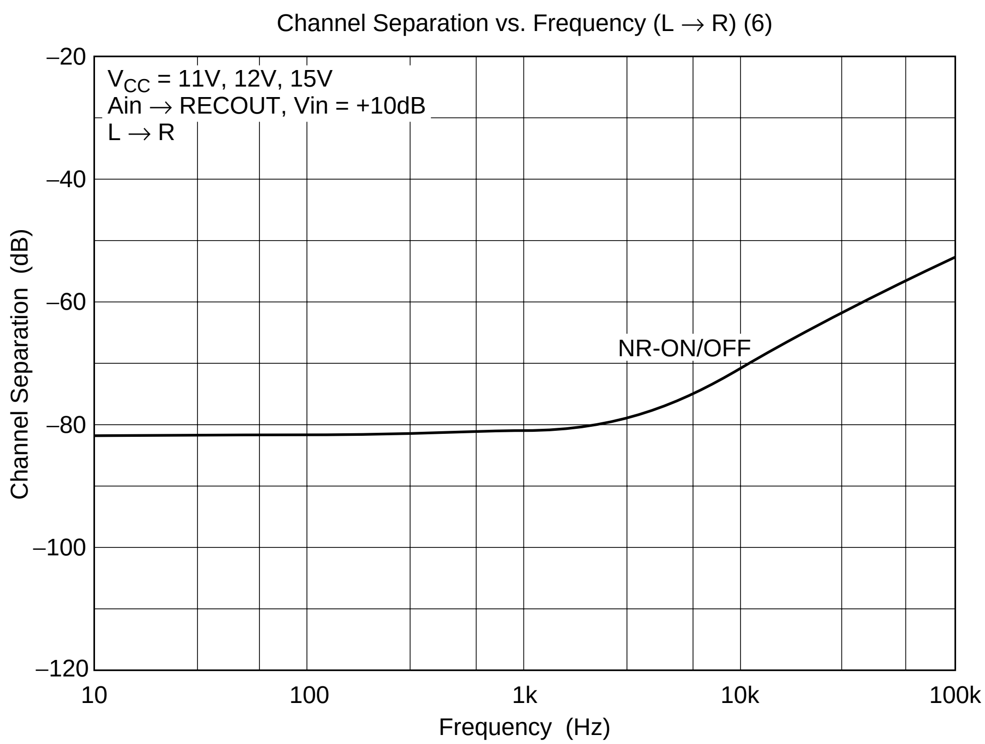

Channel Separation vs. Frequency (R → L) (1)
VCC = 11V, 12V, 15V
Ain → PBOUT, Vin = +10dB
R → L
NR-OFF
NR-ON
–20
–40
–60
–80
–100
–120
Channel Separation (dB)
10
100
1k
10k
100k
Frequency (Hz)

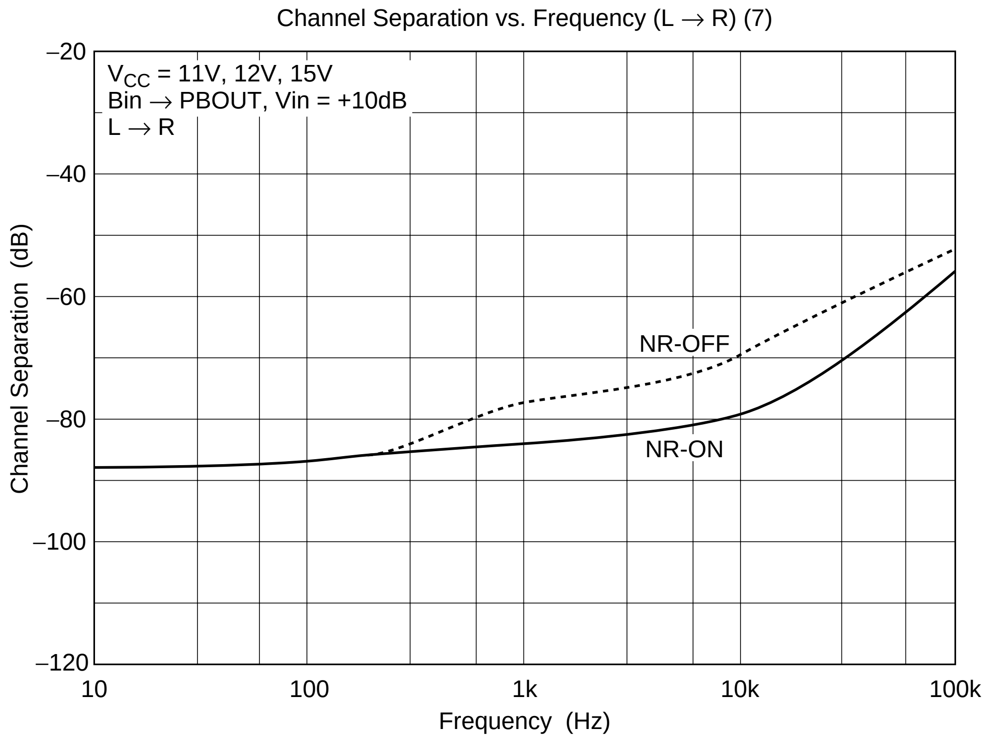

Channel Separation vs. Frequency (R → L) (2)
VCC = 11V, 12V, 15V
Ain → RECOUT, Vin = +10dB
R → L
NR-ON/OFF
–20
–40
–60
–80
–100
–120
Channel Separation (dB)
10
100
1k
10k
100k
Frequency (Hz)

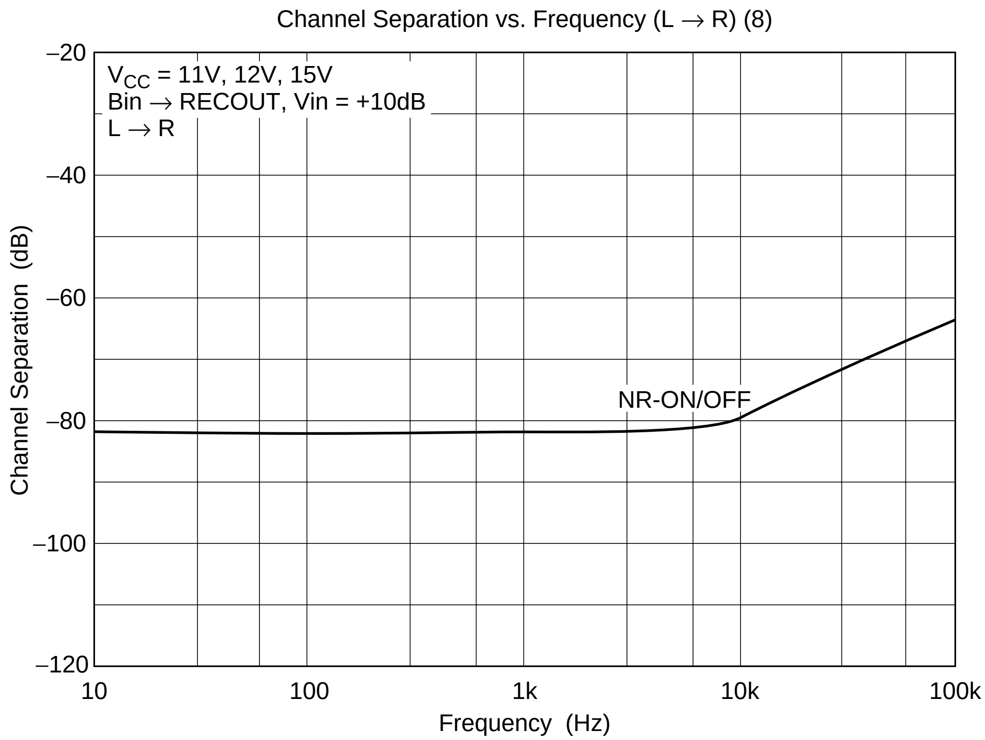

Channel Separation vs. Frequency (R → L) (3)
VCC = 11V, 12V, 15V
Bin → PBOUT, Vin = +10dB
R → L
NR-OFF
NR-ON
–20
–40
–60
–80
–100
–120
Channel Separation (dB)
10
100
1k
10k
100k
Frequency (Hz)


Channel Separation vs. Frequency (R → L) (4)
VCC = 11V, 12V, 15V
Bin → RECOUT, Vin = +10dB
R → L
NR-ON/OFF
–20
–40
–60
–80
–100
–120
Channel Separation (dB)
10
100
1k
10k
100k
Frequency (Hz)

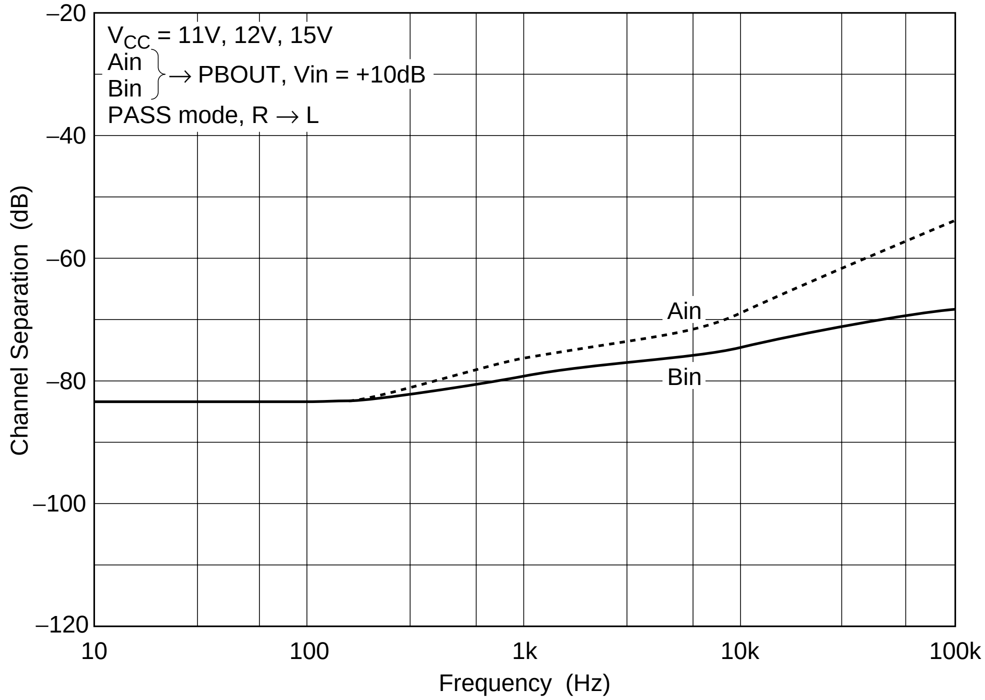

Channel Separation vs. Frequency (L → R) (5)
VCC = 11V, 12V, 15V
Ain → PBOUT, Vin = +10dB
L → R
NR-OFF
NR-ON
–20
–40
–60
–80
–100
–120
Channel Separation (dB)
10
100
1k
10k
100k
Frequency (Hz)


Channel Separation vs. Frequency (L → R) (6)
VCC = 11V, 12V, 15V
Ain → RECOUT, Vin = +10dB
L → R
NR-ON/OFF
–20
–40
–60
–80
–100
–120
Channel Separation (dB)
10
100
1k
10k
100k
Frequency (Hz)

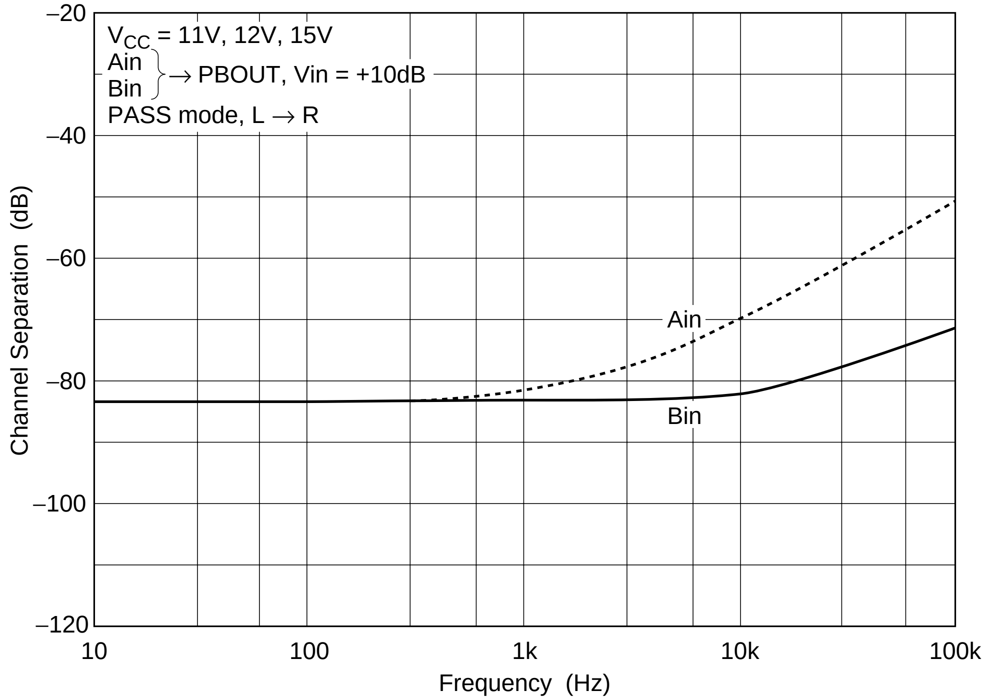

Channel Separation vs. Frequency (L → R) (7)
VCC = 11V, 12V, 15V
Bin → PBOUT, Vin = +10dB
L → R
NR-OFF
NR-ON
Channel Separation (dB)
–20
–40
–60
–80
–100
–120
10
100
1k
10k
100k
Frequency (Hz)


Channel Separation vs. Frequency (L → R) (8)
VCC = 11V, 12V, 15V
Bin → RECOUT, Vin = +10dB
L → R
NR-ON/OFF
Channel Separation (dB)
–20
–40
–60
–80
–100
–120
10
100
1k
10k
100k
Frequency (Hz)

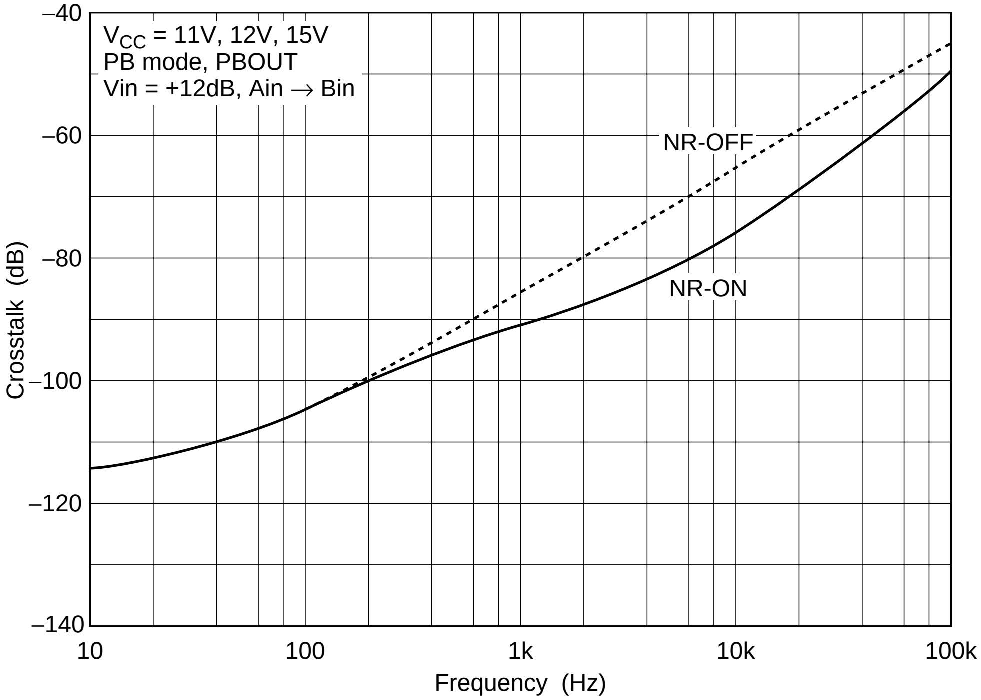
Channel Separation vs. Frequency (R → L) (1)



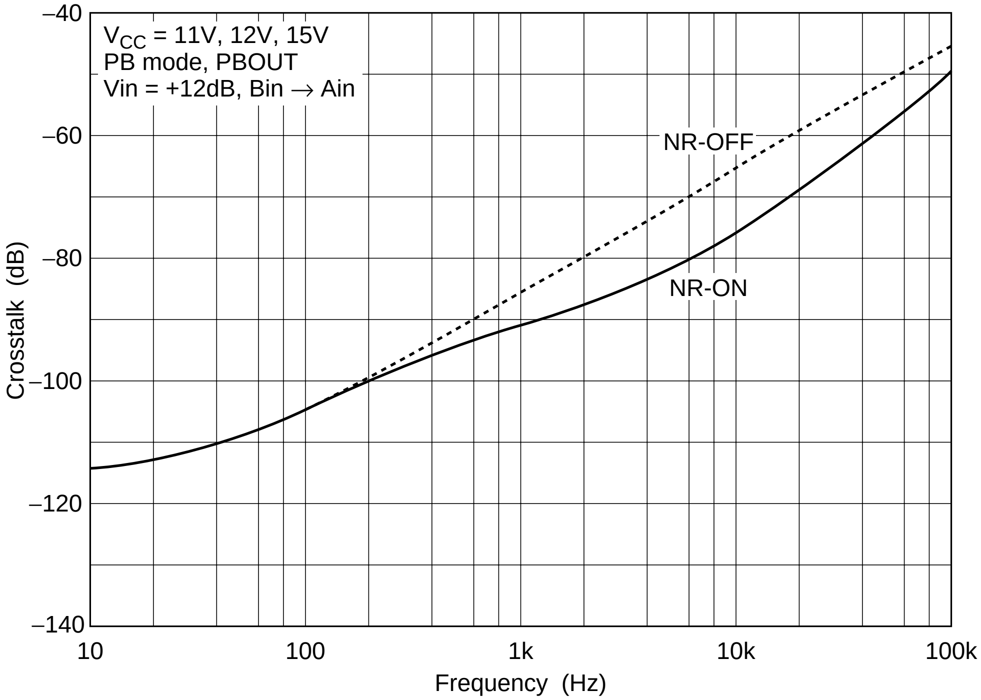
Channel Separation vs. Frequency (L → R) (2)

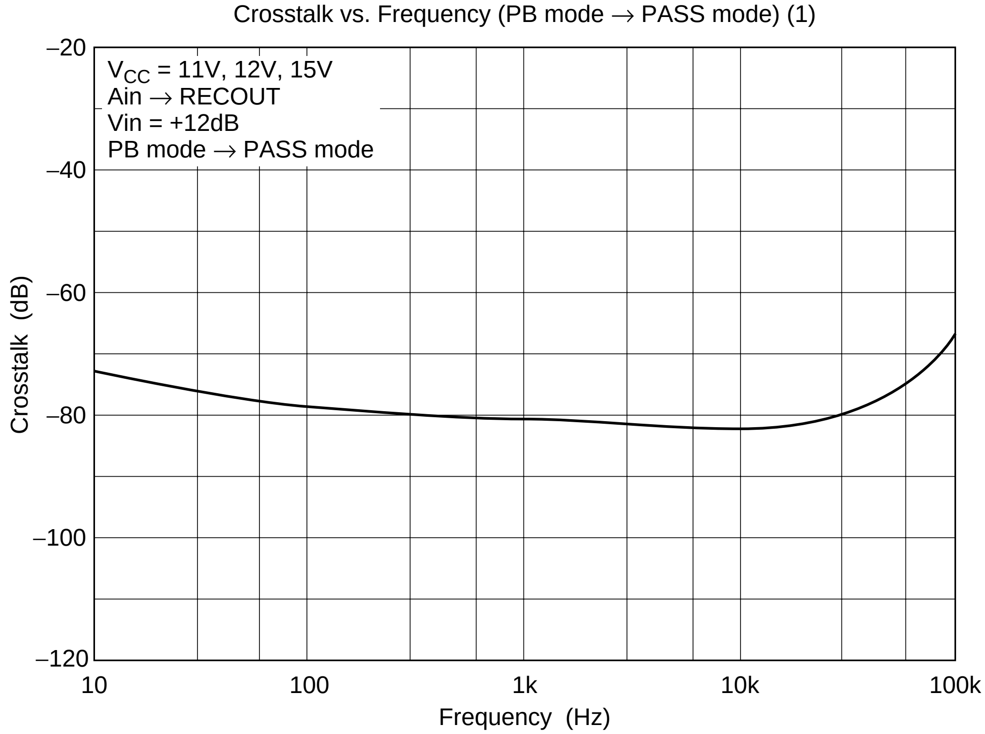


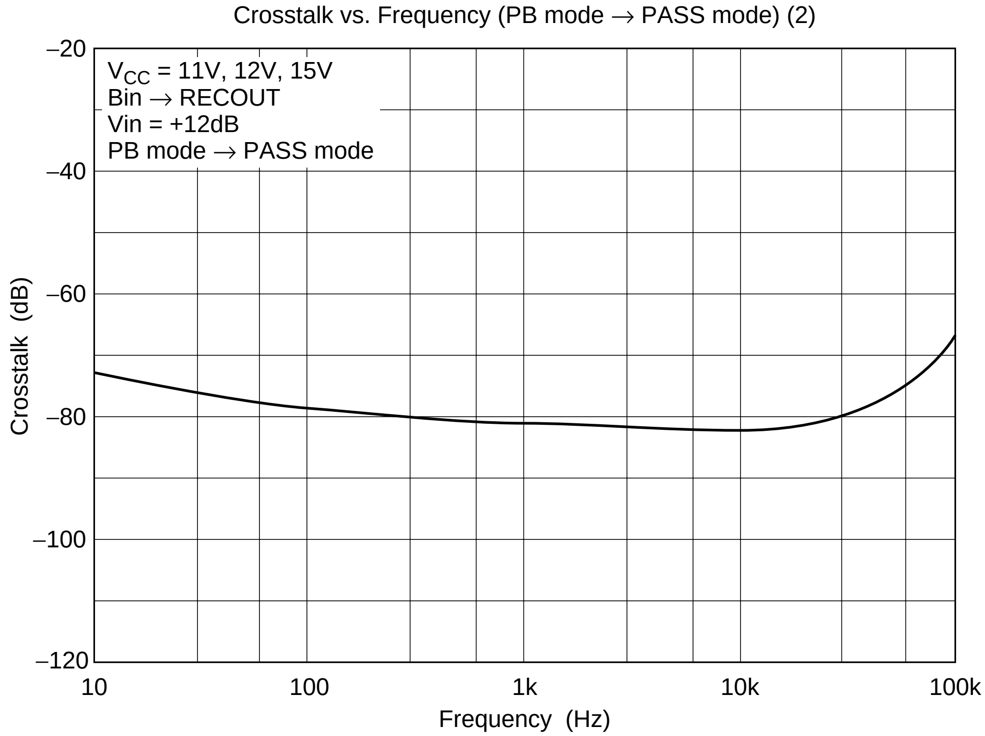
Crosstalk vs. Frequency (Ain → Bin) (1)

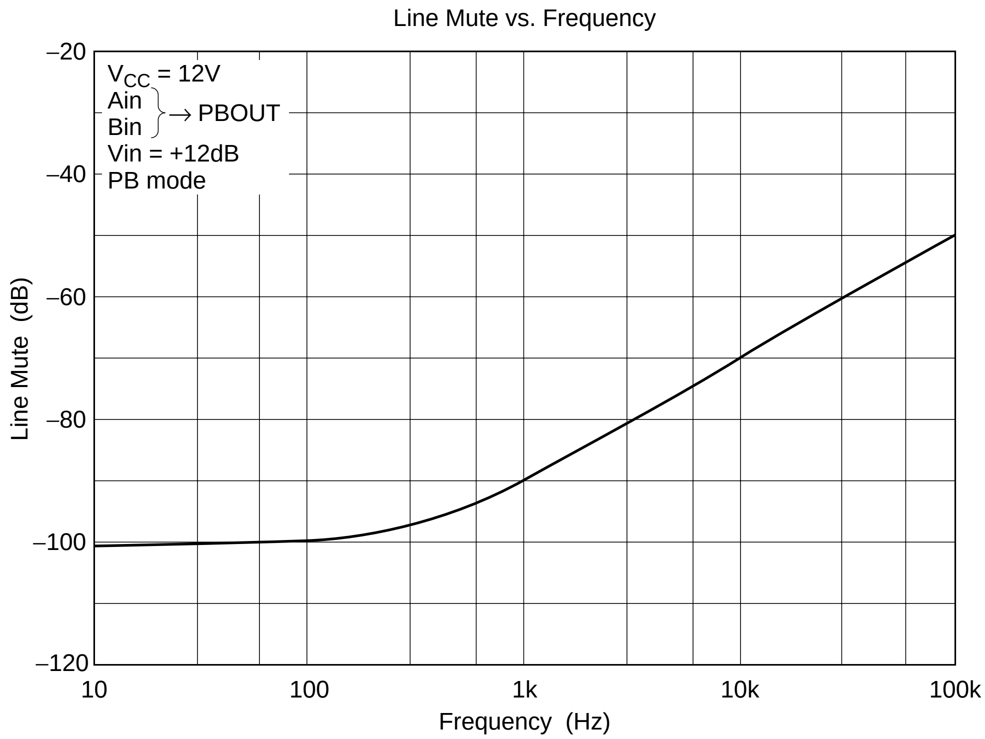


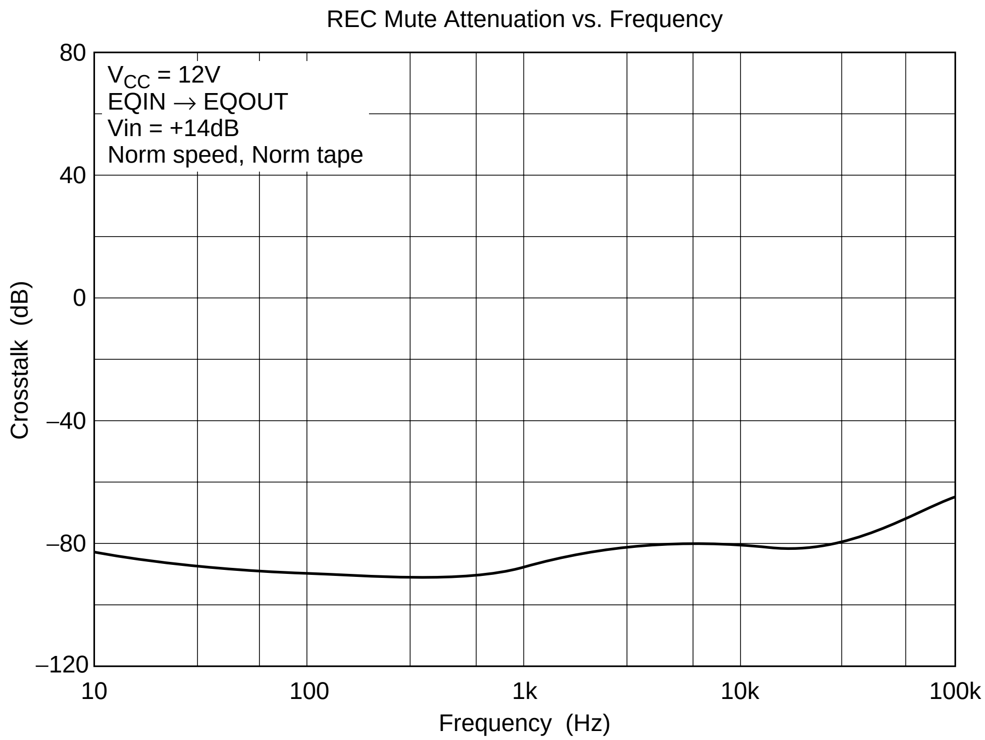
Crosstalk vs. Frequency (Bin → Ain) (2)



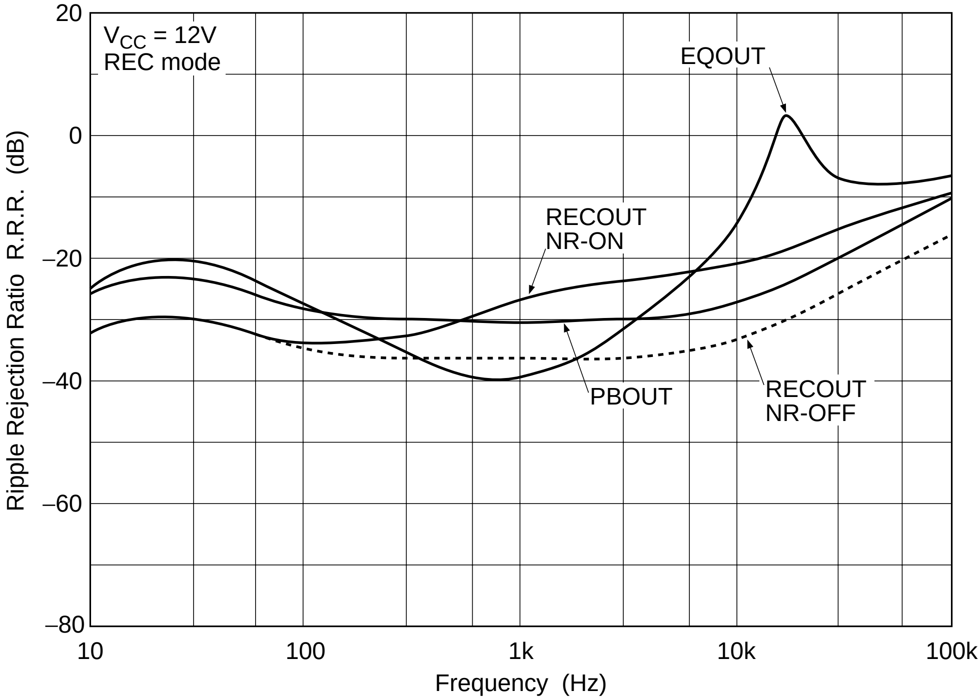

Crosstalk vs. Frequency (PB mode → PASS mode) (1)
V_{CC} = 11V, 12V, 15V
Ain → RECOUT
Vin = +12dB
PB mode → PASS mode
–20
–40
–60
–80
–100
–120
Crosstalk (dB)
10
100
1k
10k
100k
Frequency (Hz)


Crosstalk vs. Frequency (PB mode → PASS mode) (2)
V_{CC} = 11V, 12V, 15V
Bin → RECOUT
Vin = +12dB
PB mode → PASS mode
–20
–40
–60
–80
–100
–120
Crosstalk (dB)
10
100
1k
10k
100k
Frequency (Hz)

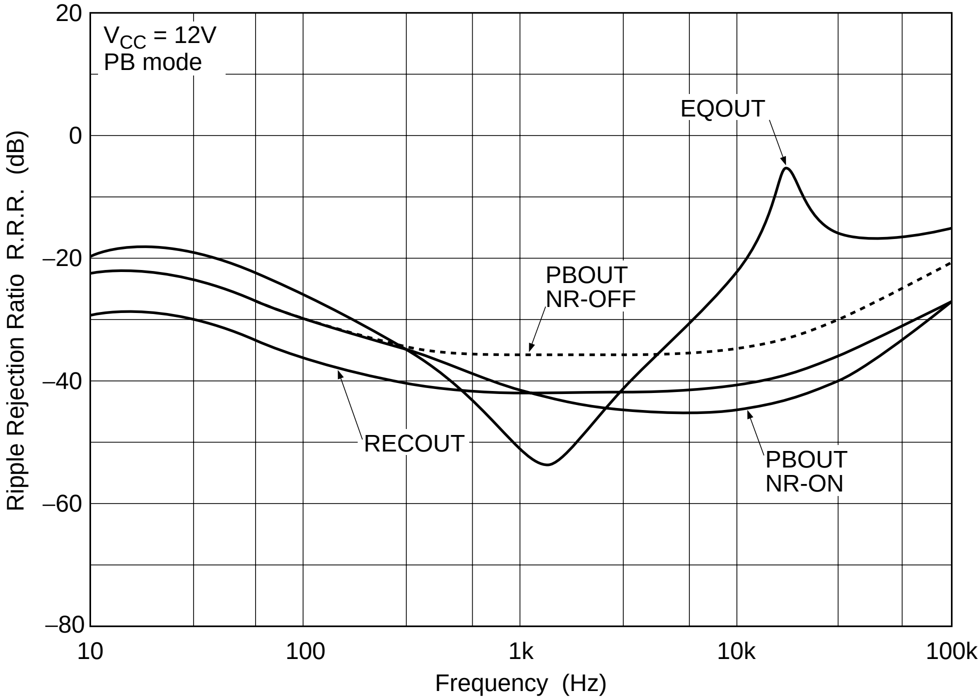

Line Mute vs. Frequency
VCC = 12V
Ain
Bin
→ PBOUT
Vin = +12dB
PB mode
–20
–40
–60
–80
–100
–120
Line Mute (dB)
10
100
1k
10k
100k
Frequency (Hz)

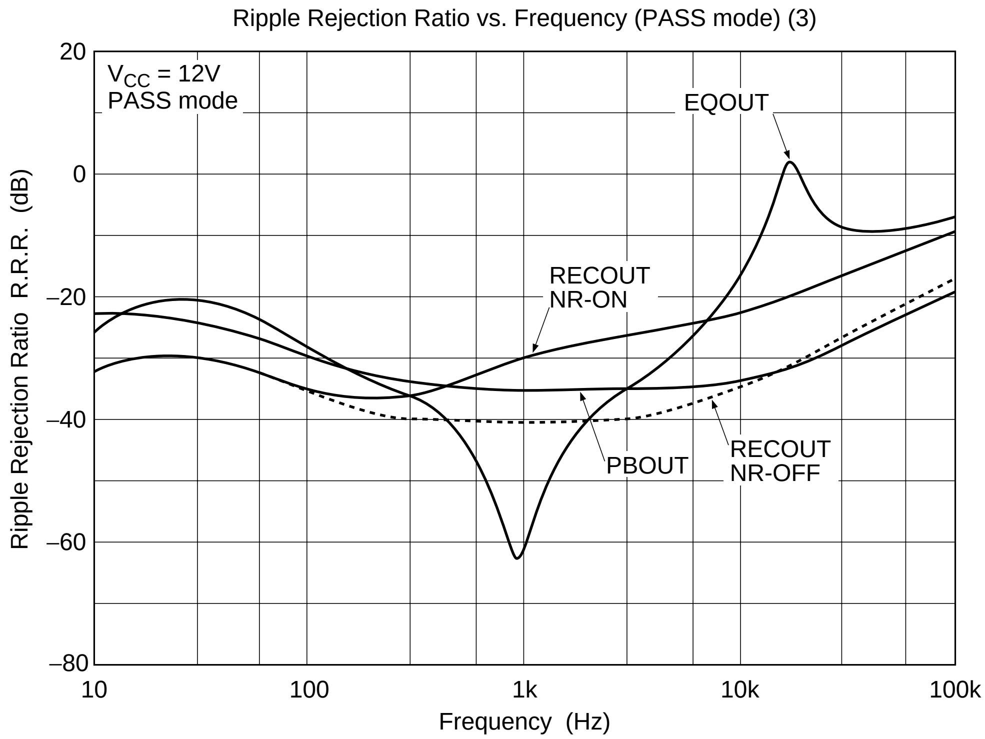

REC Mute Attenuation vs. Frequency
VCC = 12V
EQIN → EQOUT
Vin = +14dB
Norm speed, Norm tape
80
40
0
–40
–80
–120
Crosstalk (dB)
10
100
1k
10k
100k
Frequency (Hz)

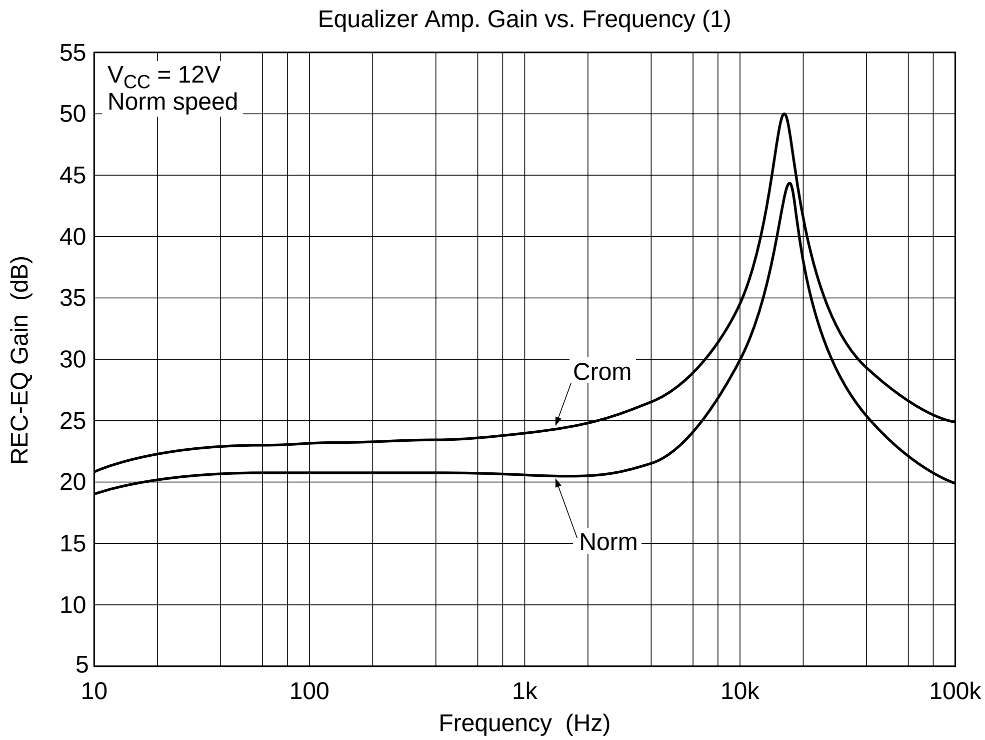
Ripple Rejection Ratio vs. Frequency (REC mode) (1)

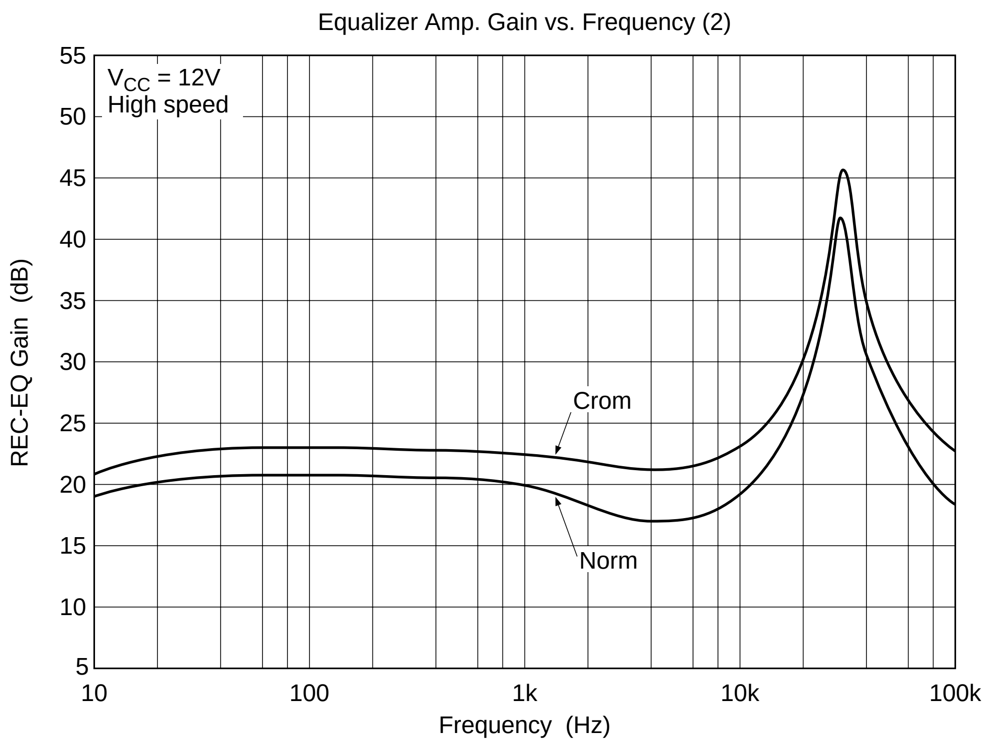


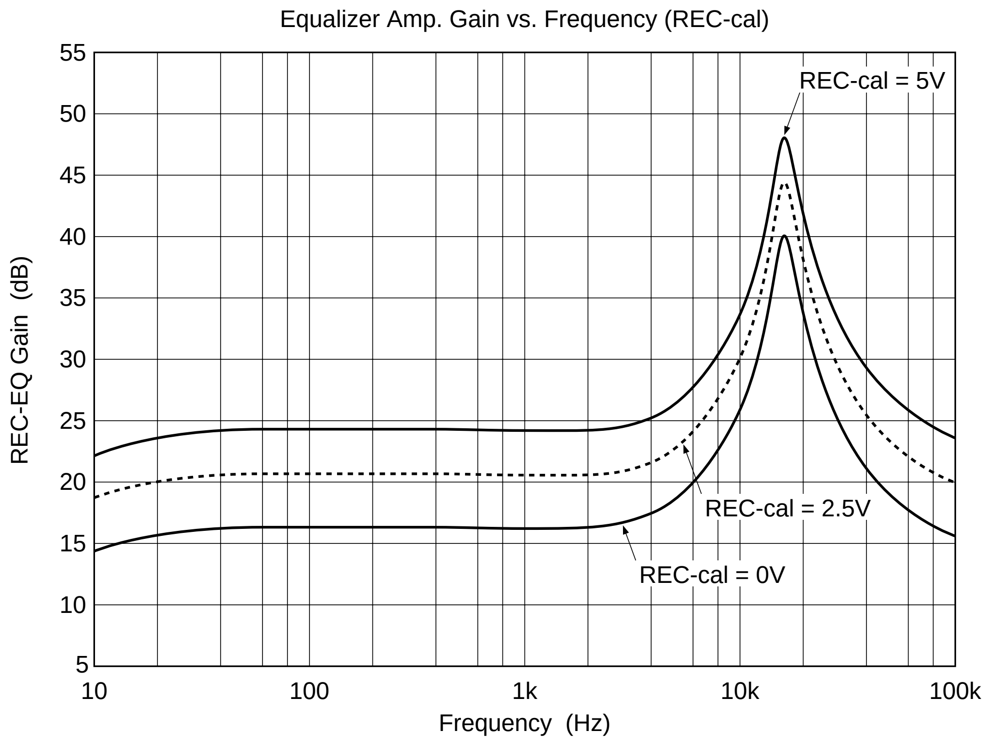
Ripple Rejection Ratio vs. Frequency (PB mode) (2)

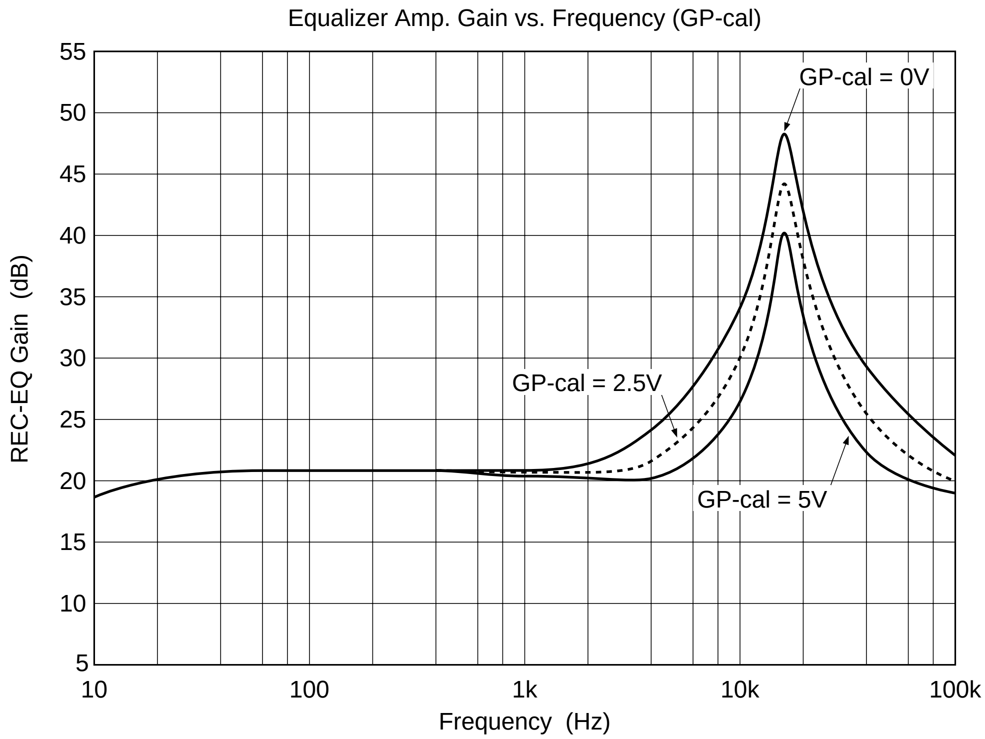


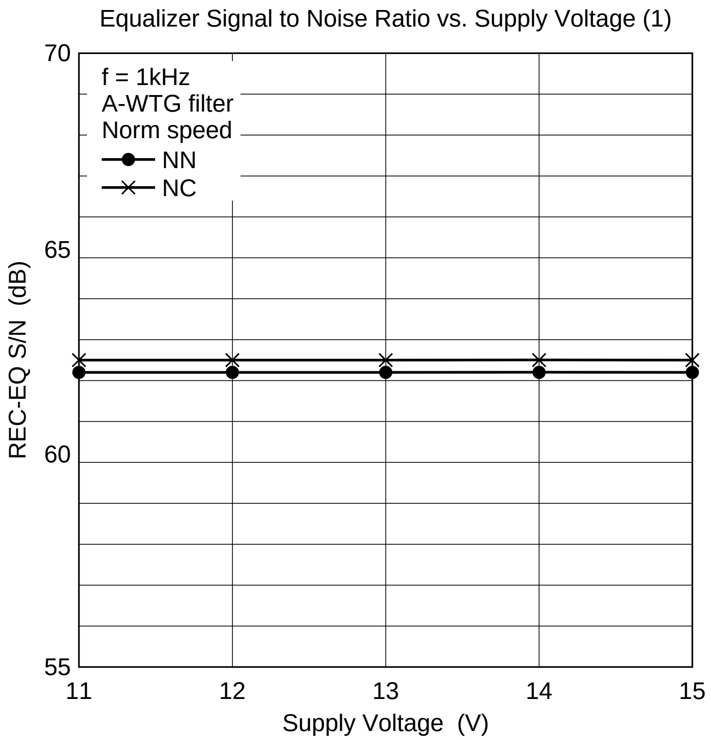

Ripple Rejection Ratio vs. Frequency (PASS mode) (3)
VCC = 12V
PASS mode
EQOUT
RECOUT
NR-ON
PBOUT
RECOUT
NR-OFF
Ripple Rejection Ratio R.R.R. (dB)
20
0
–20
–40
–60
–80
10
100
1k
10k
100k
Frequency (Hz)

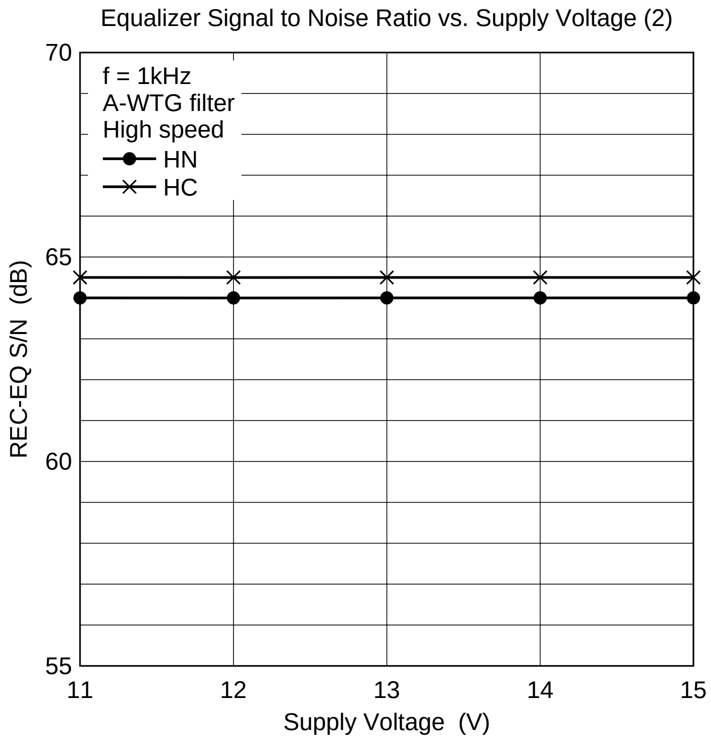

Equalizer Amp. Gain vs. Frequency (1)
VCC = 12V
Norm speed
Crom
Norm
REC-EQ Gain (dB)
55
50
45
40
35
30
25
20
15
10
5
10
100
1k
10k
100k
Frequency (Hz)

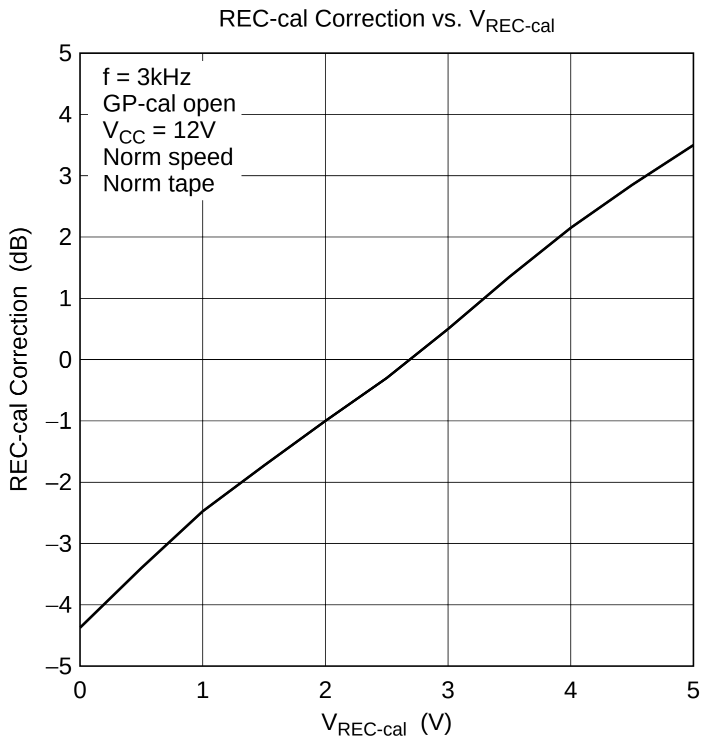

Equalizer Amp. Gain vs. Frequency (2)
V_{CC} = 12V
High speed
Crom
Norm
REC-EQ Gain (dB)
Frequency (Hz)
55
50
45
40
35
30
25
20
15
10
5
10
100
1k
10k
100k

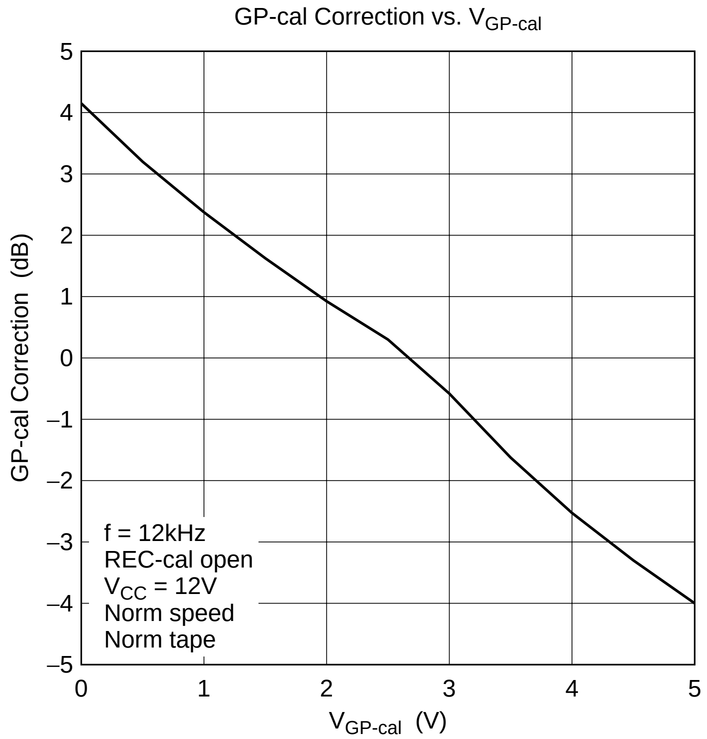

Equalizer Amp. Gain vs. Frequency (REC-cal)
REC-cal = 5V
REC-cal = 2.5V
REC-cal = 0V
REC-EQ Gain (dB)
Frequency (Hz)
55
50
45
40
35
30
25
20
15
10
5
10
100
1k
10k
100k

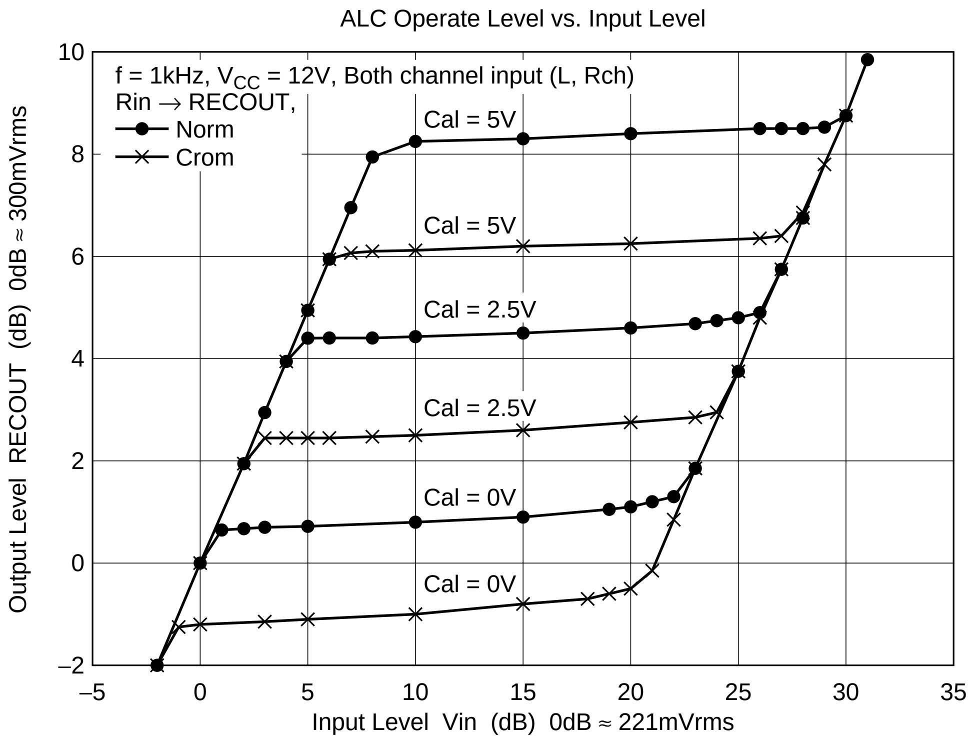

Equalizer Amp. Gain vs. Frequency (GP-cal)
GP-cal = 0V
GP-cal = 2.5V
GP-cal = 5V
REC-EQ Gain (dB)
55
50
45
40
35
30
25
20
15
10
5
10
100
1k
10k
100k
Frequency (Hz)


Equalizer Signal to Noise Ratio vs. Supply Voltage (1)
f = 1kHz
A-WTG filter
Norm speed
NN
NC
REC-EQ S/N (dB)
70
65
60
55
11
12
13
14
15
Supply Voltage (V)

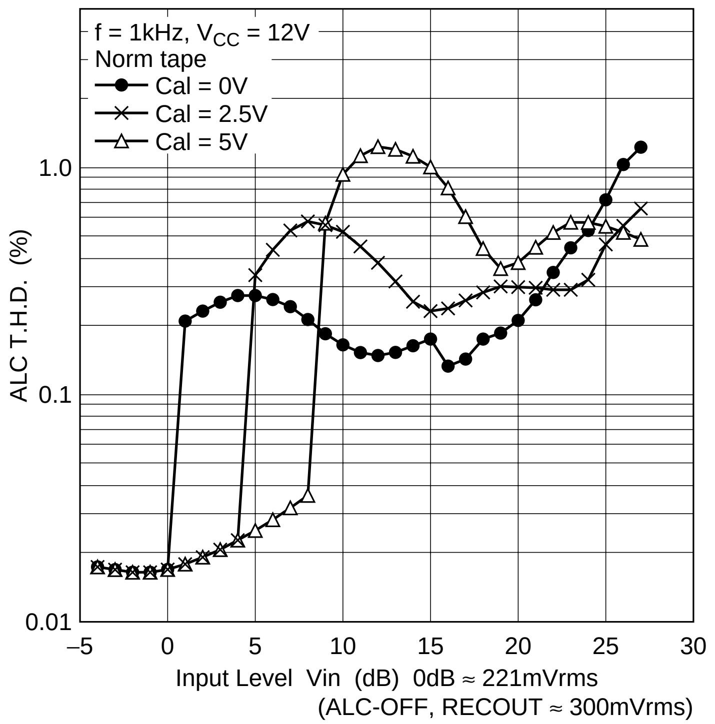

Equalizer Signal to Noise Ratio vs. Supply Voltage (2)
f = 1kHz
A-WTG filter
High speed
HN
HC
REC-EQ S/N (dB)
70
65
60
55
11
12
13
14
15
Supply Voltage (V)


REC-cal Correction vs. $V_{REC-cal}$
f = 3kHz
GP-cal open
V_{CC} = 12V
Norm speed
Norm tape
REC-cal Correction (dB)
5
4
3
2
1
0
–1
–2
–3
–4
–5
0
1
2
3
4
5
$V_{REC-cal}$ (V)

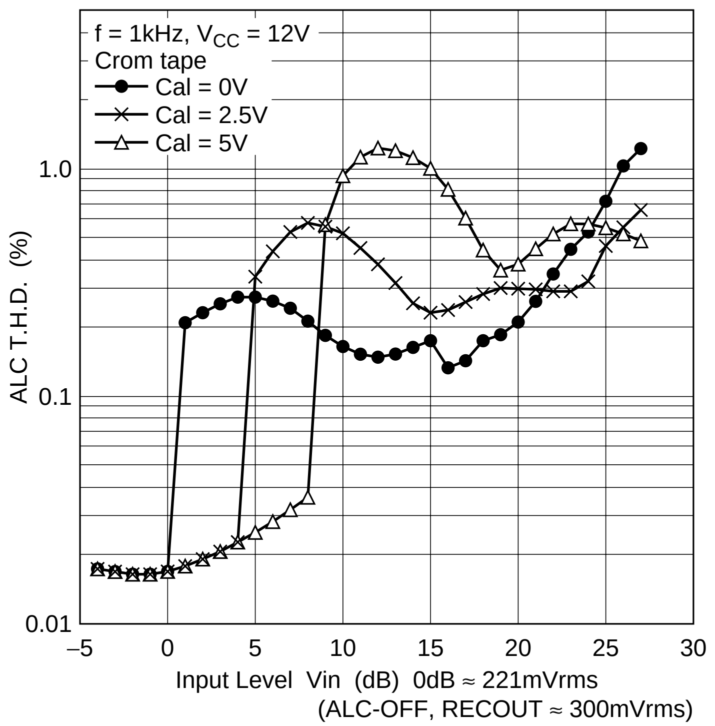

GP-cal Correction vs. $V_{GP\text{-}cal}$
GP-cal Correction (dB)
5
4
3
2
1
0
–1
–2
–3
–4
–5
f = 12kHz
REC-cal open
V_{CC} = 12V
Norm speed
Norm tape
0
1
2
3
4
5
$V_{GP\text{-}cal}$ (V)

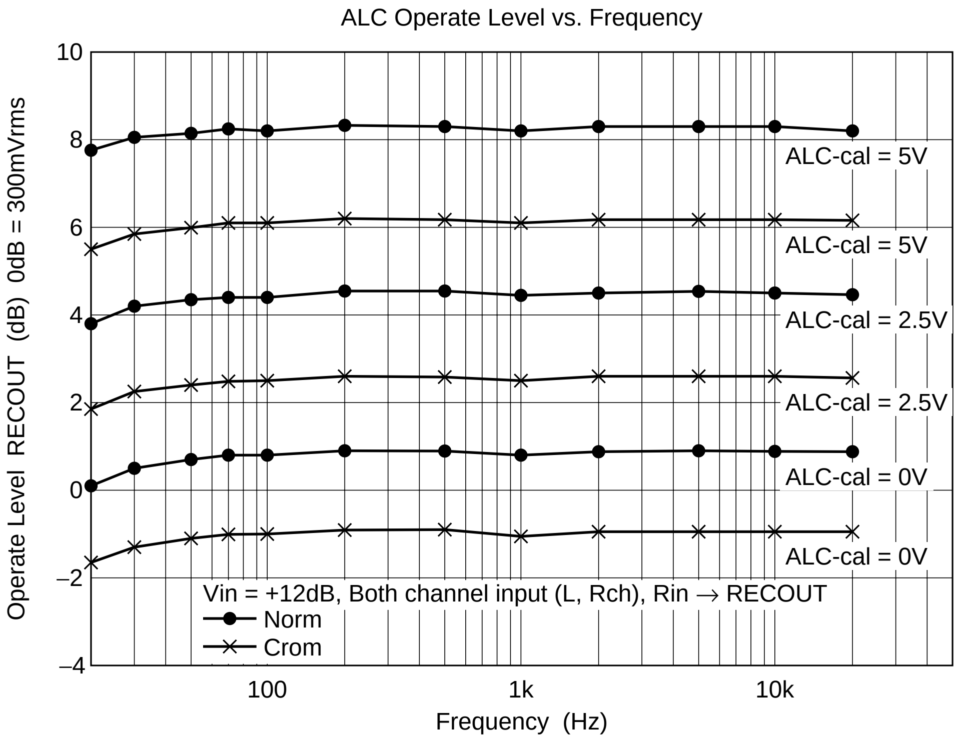

ALC Operate Level vs. Input Level
Output Level RECOUT (dB) 0dB ≈ 300mVrms
10
8
6
4
2
0
–2
f = 1kHz, V_{CC} = 12V, Both channel input (L, Rch)
Rin → RECOUT,
Norm
Crom
Cal = 5V
Cal = 5V
Cal = 2.5V
Cal = 2.5V
Cal = 0V
Cal = 0V
–5
0
5
10
15
20
25
30
35
Input Level Vin (dB) 0dB ≈ 221mVrms

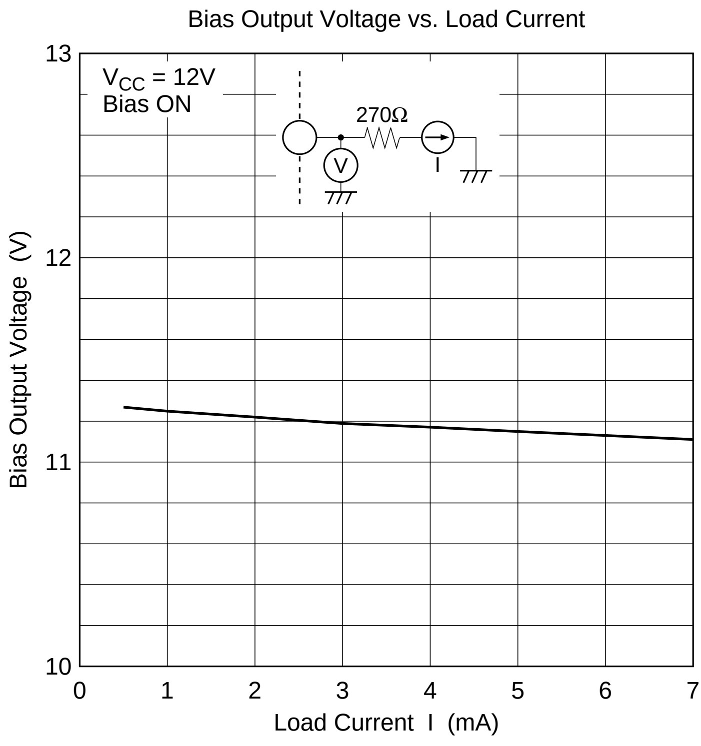
ALC Total Harmonic Distortion vs. Input Level (1)



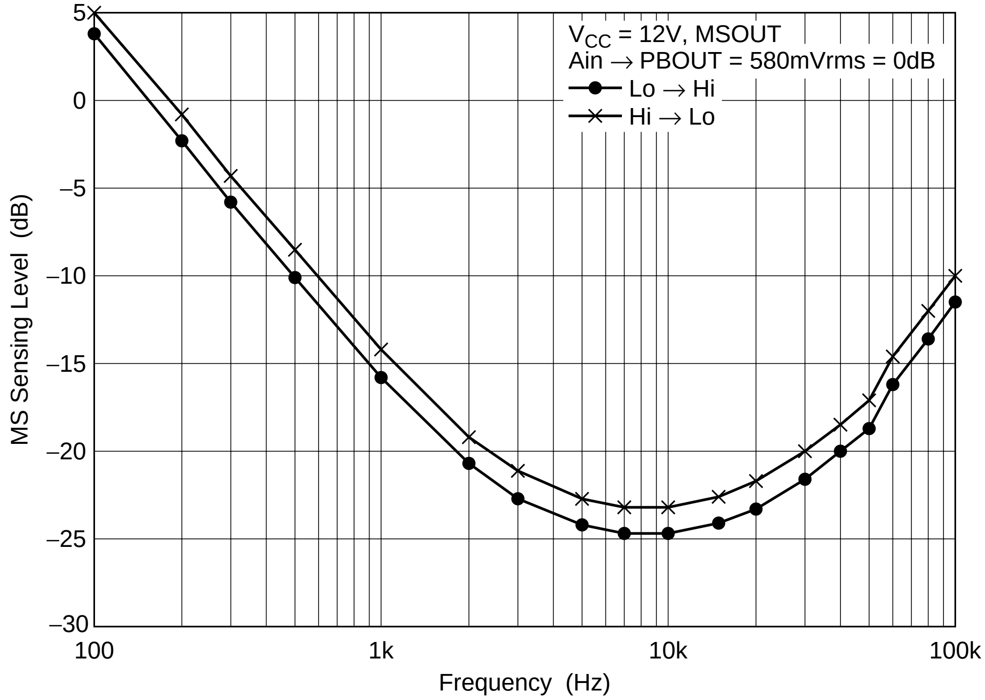
ALC Total Harmonic Distortion vs. Input Level (2)



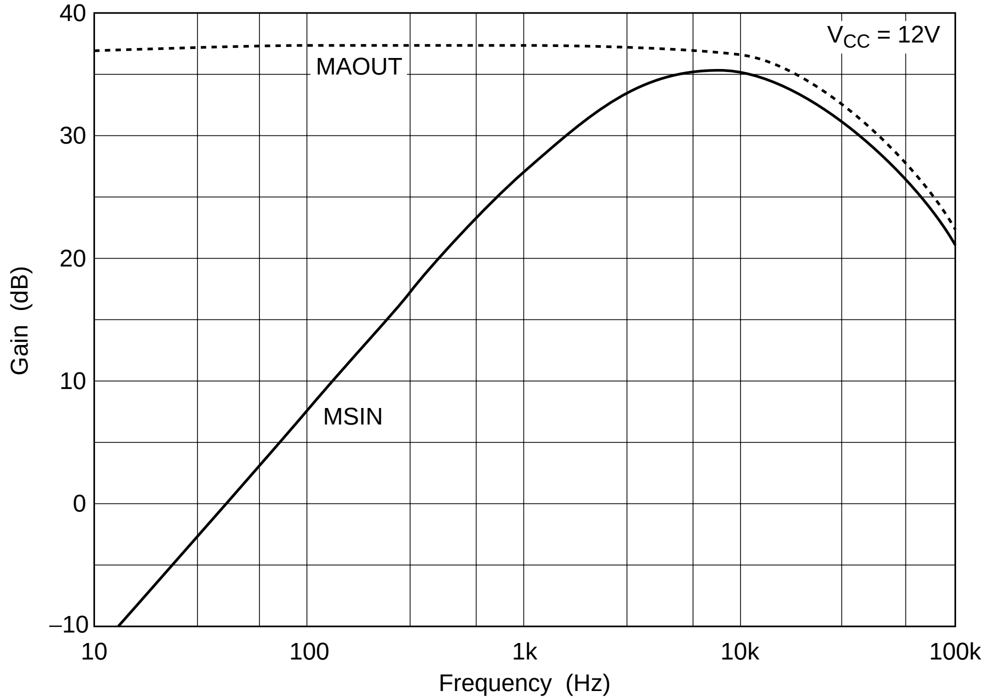

ALC Operate Level vs. Frequency
Operate Level RECOUT (dB) 0dB = 300mVrms
10
8
6
4
2
0
–2
–4
ALC-cal = 5V
ALC-cal = 5V
ALC-cal = 2.5V
ALC-cal = 2.5V
ALC-cal = 0V
ALC-cal = 0V
Vin = +12dB, Both channel input (L, Rch), Rin → RECOUT
Norm
Crom
100
1k
10k
Frequency (Hz)


Bias Output Voltage vs. Load Current
Bias Output Voltage (V)
13
12
11
10
VCC = 12V
Bias ON
270Ω
V
I
0
1
2
3
4
5
6
7
Load Current I (mA)

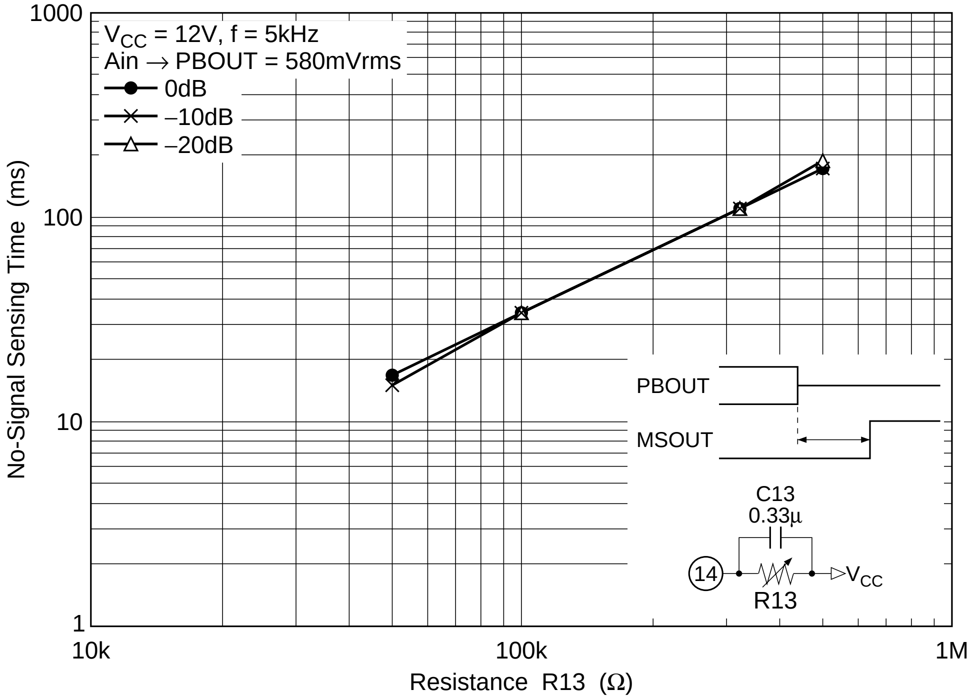
MS Sensing Level vs. Frequency



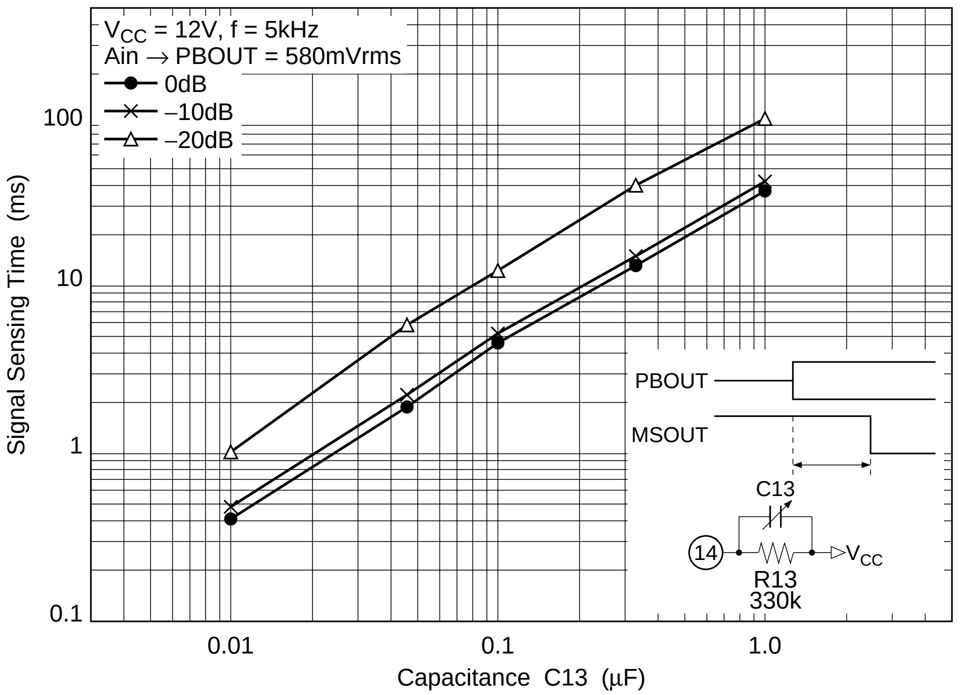
MS Amp. Gain vs. Frequency



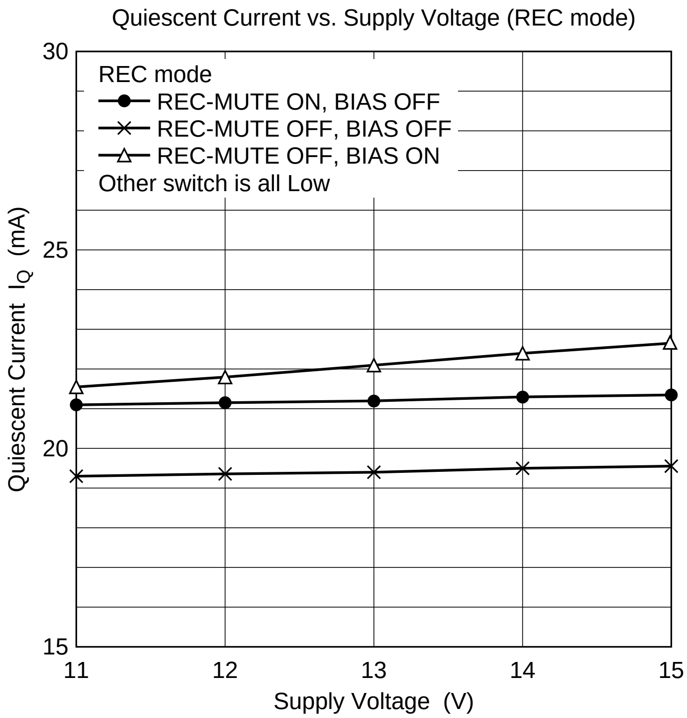
No-Signal Sensing Time vs. Resistance

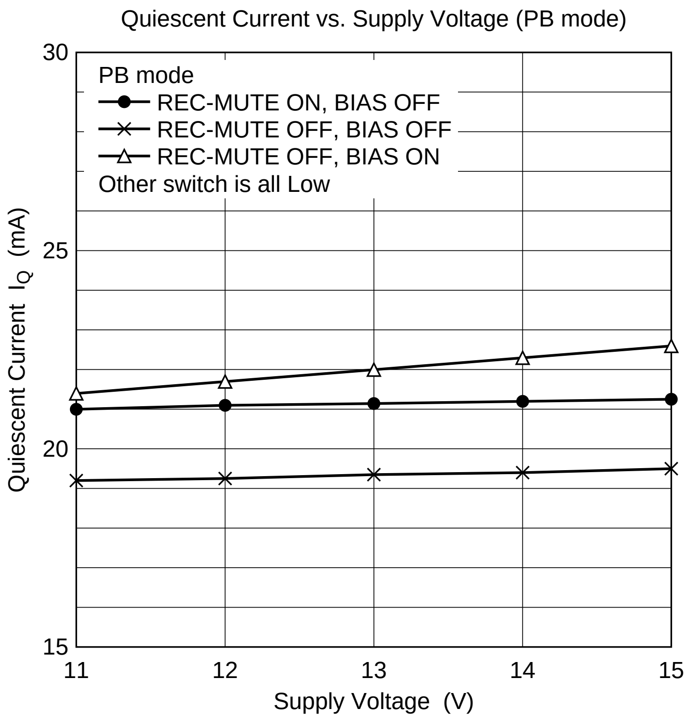


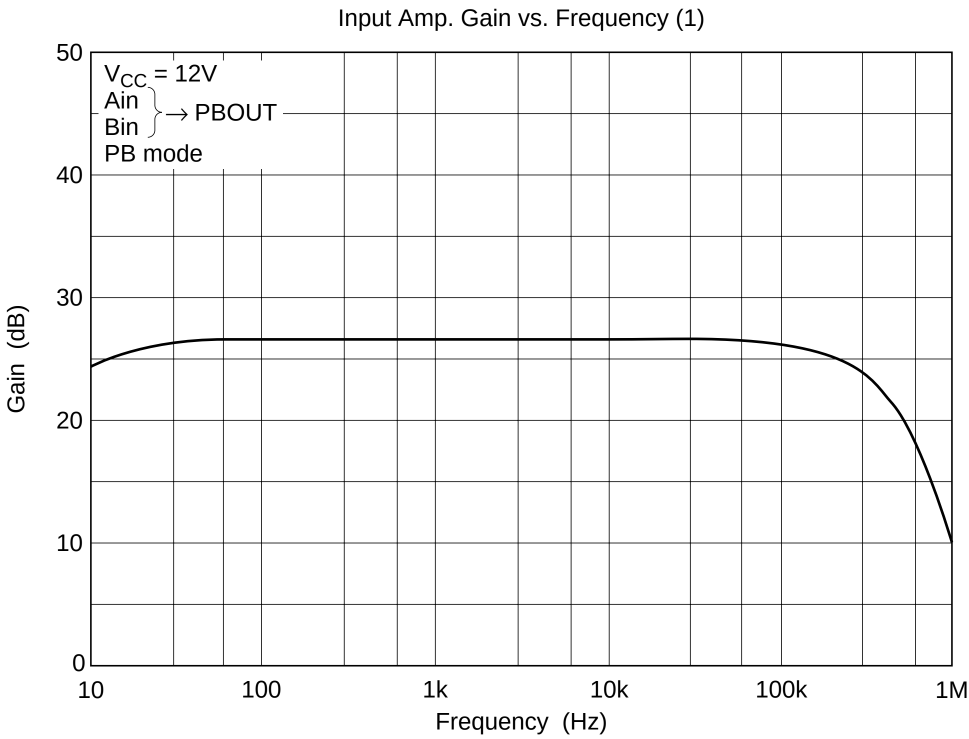
Signal Sensing Time vs. Capacitance

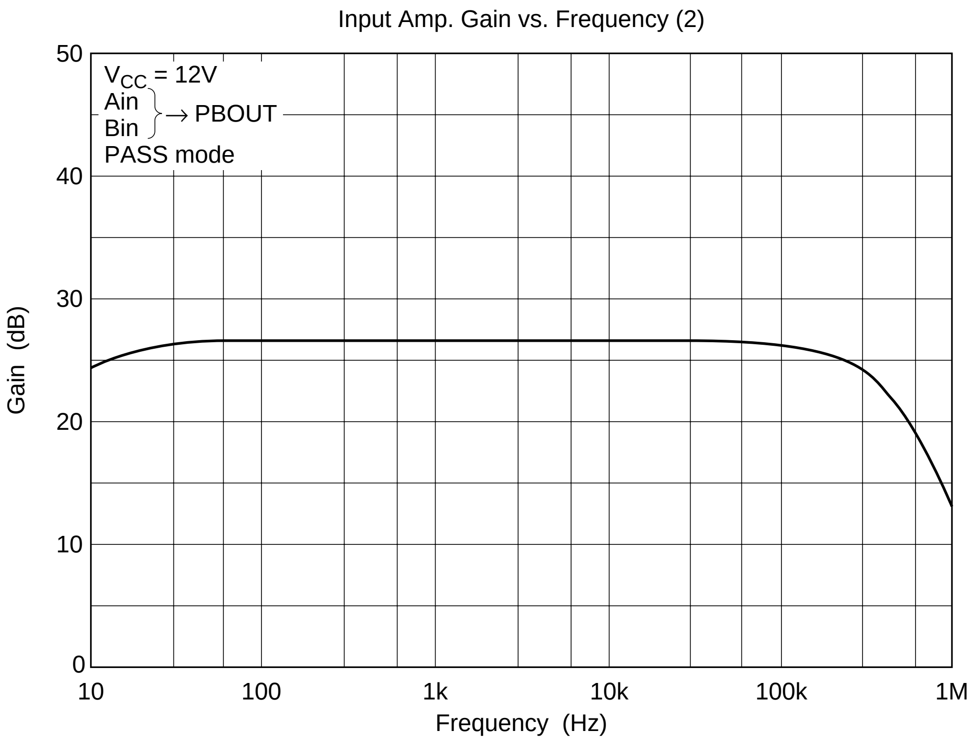


HA12227F

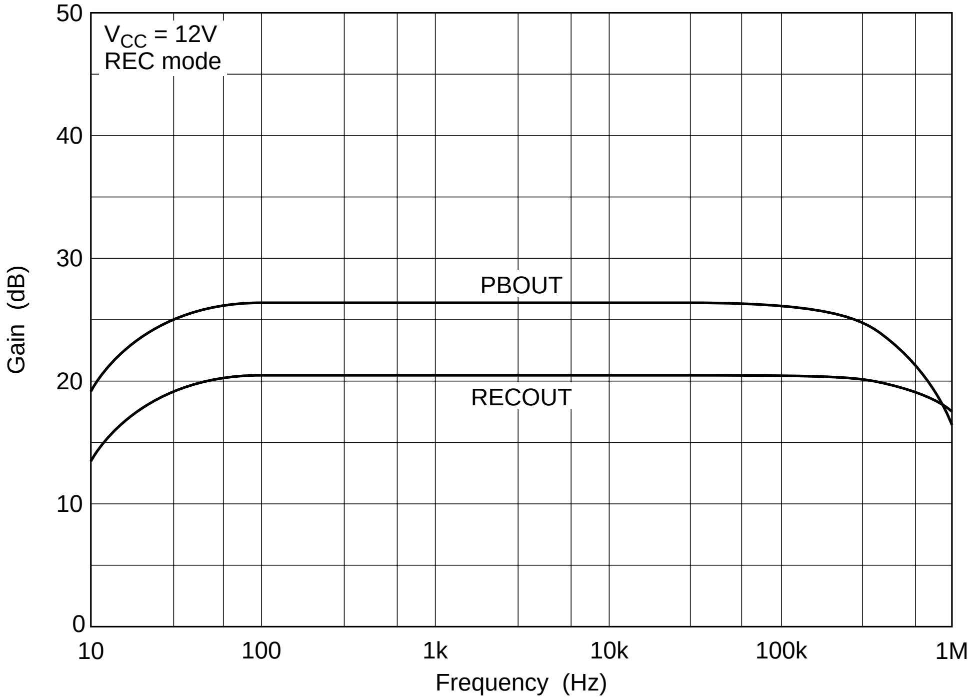

Quiescent Current vs. Supply Voltage (REC mode)
REC mode
REC-MUTE ON, BIAS OFF
REC-MUTE OFF, BIAS OFF
REC-MUTE OFF, BIAS ON
Other switch is all Low
Quiescent Current I_Q (mA)
30
25
20
15
11
12
13
14
15
Supply Voltage (V)


Quiescent Current vs. Supply Voltage (PB mode)
PB mode
REC-MUTE ON, BIAS OFF
REC-MUTE OFF, BIAS OFF
REC-MUTE OFF, BIAS ON
Other switch is all Low
Quiescent Current I_Q (mA)
30
25
20
15
11
12
13
14
15
Supply Voltage (V)

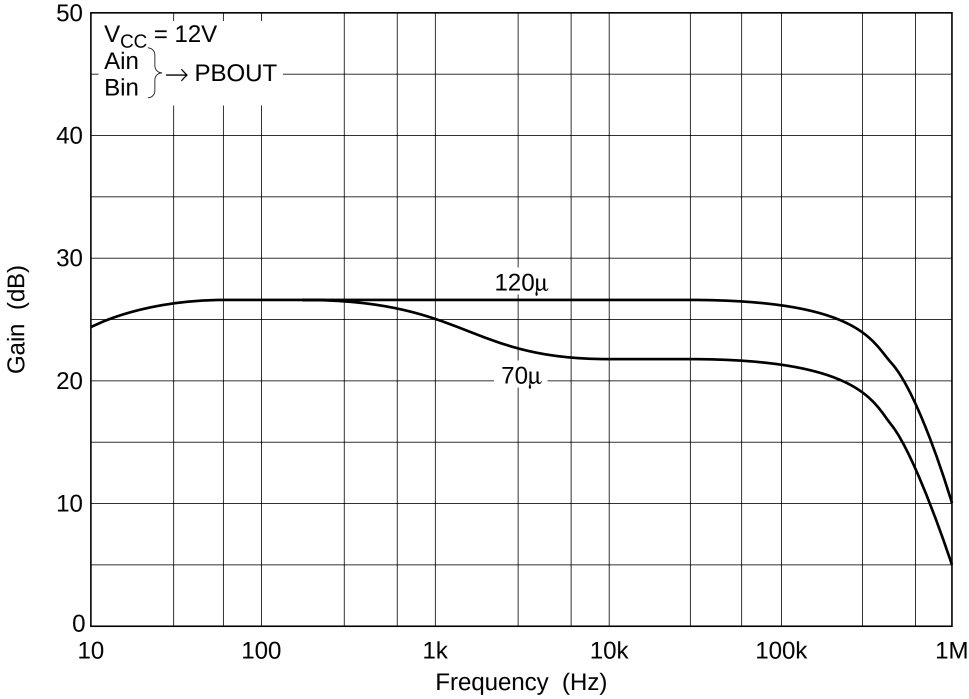

Input Amp. Gain vs. Frequency (1)
V_{CC} = 12V
Ain
Bin
→ PBOUT
PB mode
Gain (dB)
0
10
20
30
40
50
10
100
1k
10k
100k
1M
Frequency (Hz)

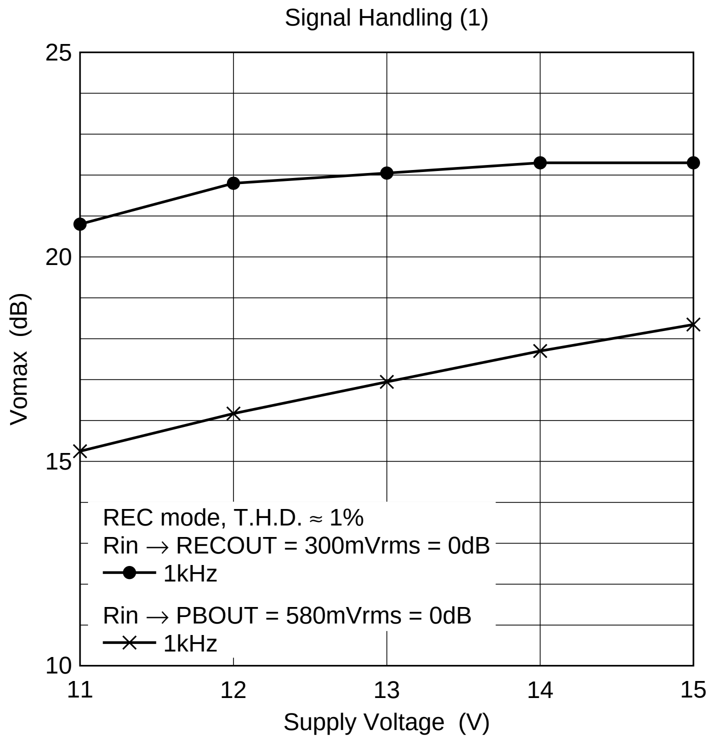

Input Amp. Gain vs. Frequency (2)
V_{CC} = 12V
Ain
Bin
→ PBOUT
PASS mode
Gain (dB)
0
10
20
30
40
50
10
100
1k
10k
100k
1M
Frequency (Hz)

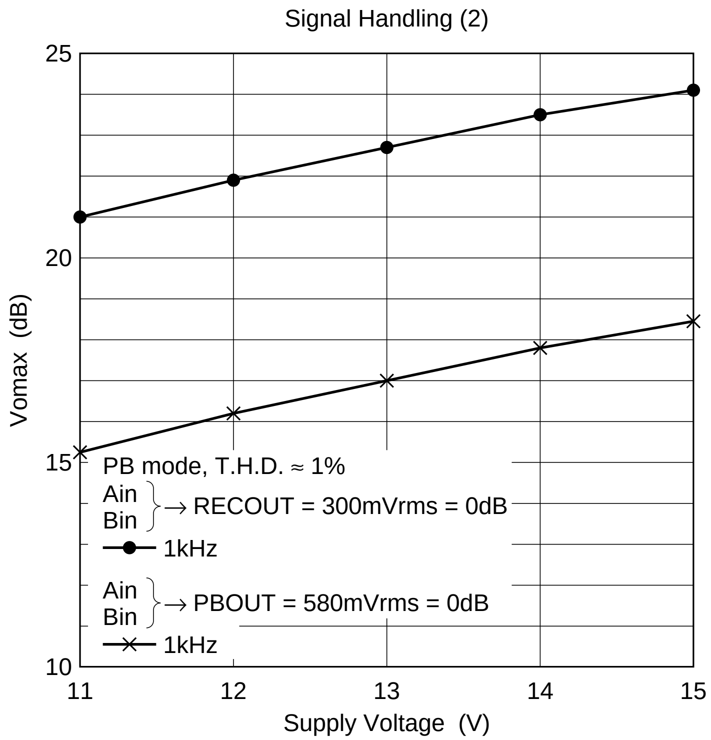
Input Amp. Gain vs. Frequency (3)

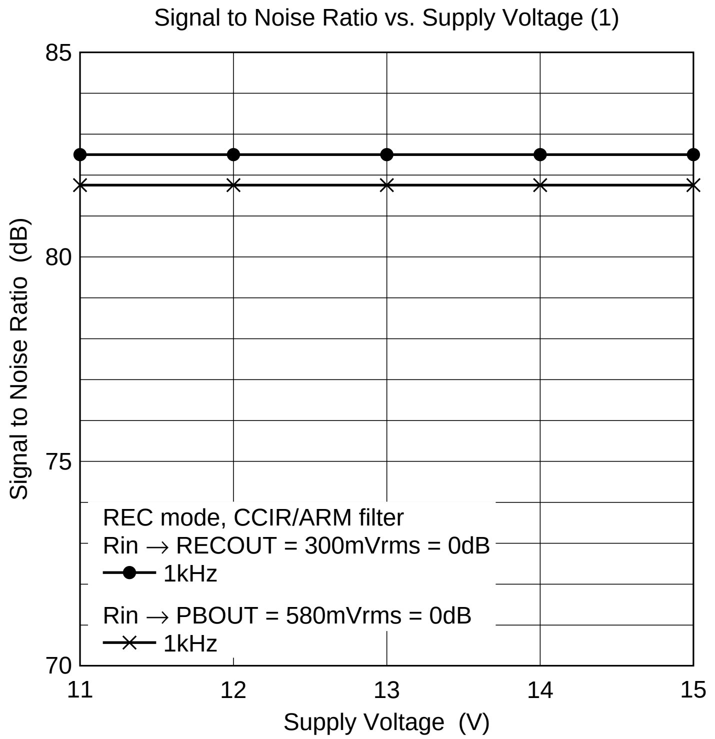


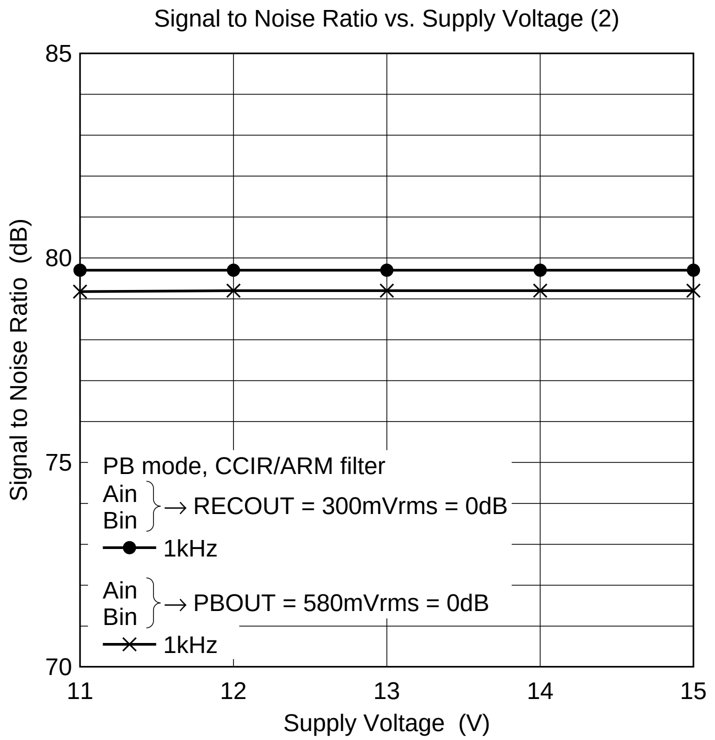
Input Amp. Gain vs. Frequency (4)

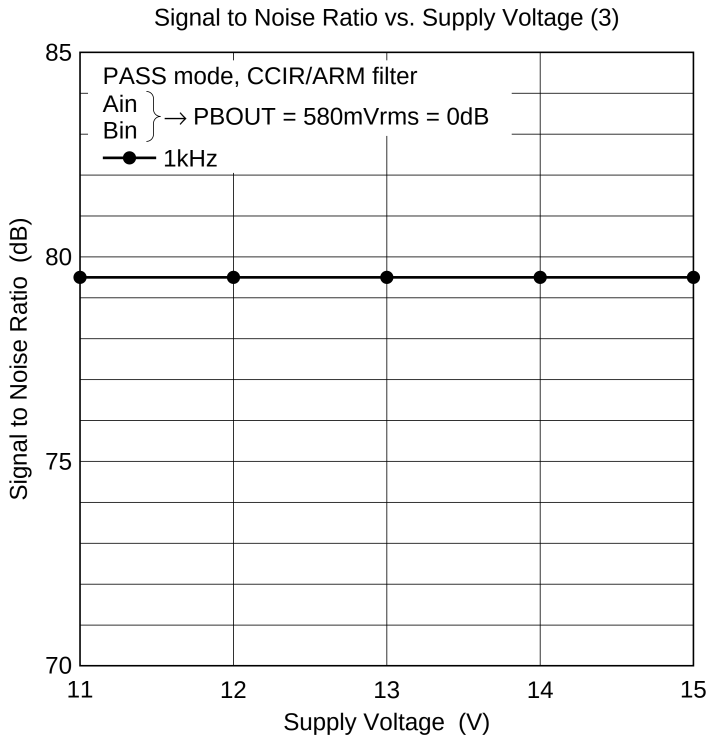


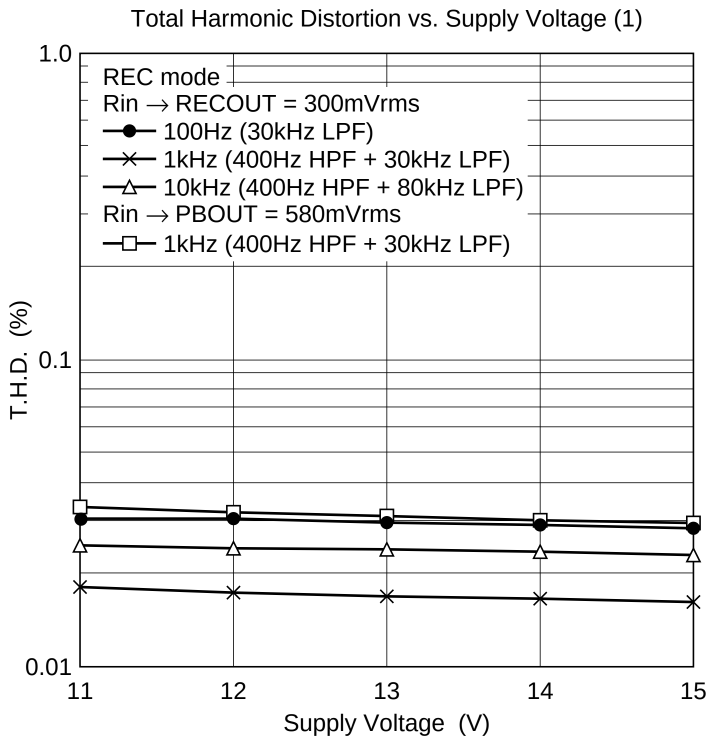

Signal Handling (1)
25
20
15
10
Vomax (dB)
11
12
13
14
15
Supply Voltage (V)
REC mode, T.H.D. ≈ 1%
Rin → RECOUT = 300mVrms = 0dB
1kHz
Rin → PBOUT = 580mVrms = 0dB
1kHz

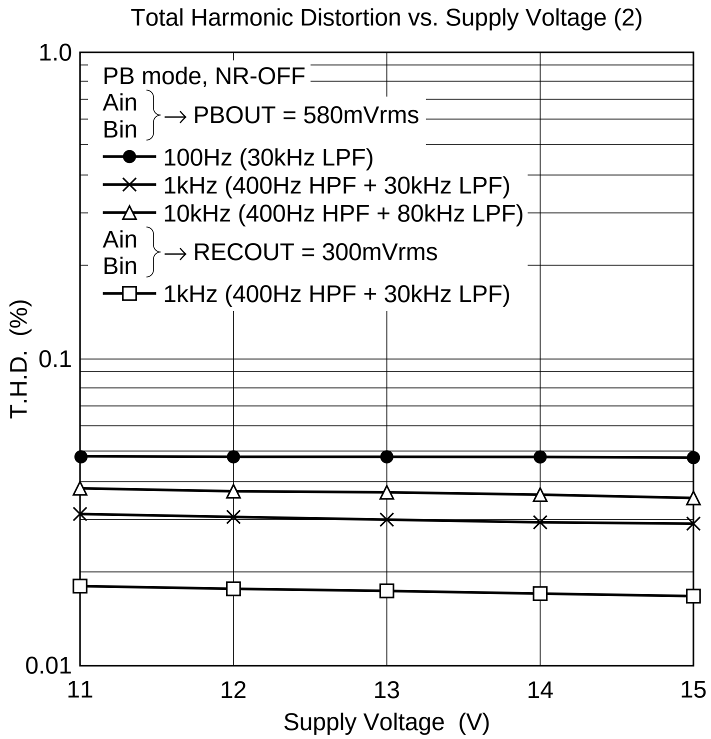

Signal Handling (2)
25
20
15
10
Vomax (dB)
11
12
13
14
15
Supply Voltage (V)
PB mode, T.H.D. ≈ 1%
Ain
Bin
→ RECOUT = 300mVrms = 0dB
1kHz
Ain
Bin
→ PBOUT = 580mVrms = 0dB
1kHz

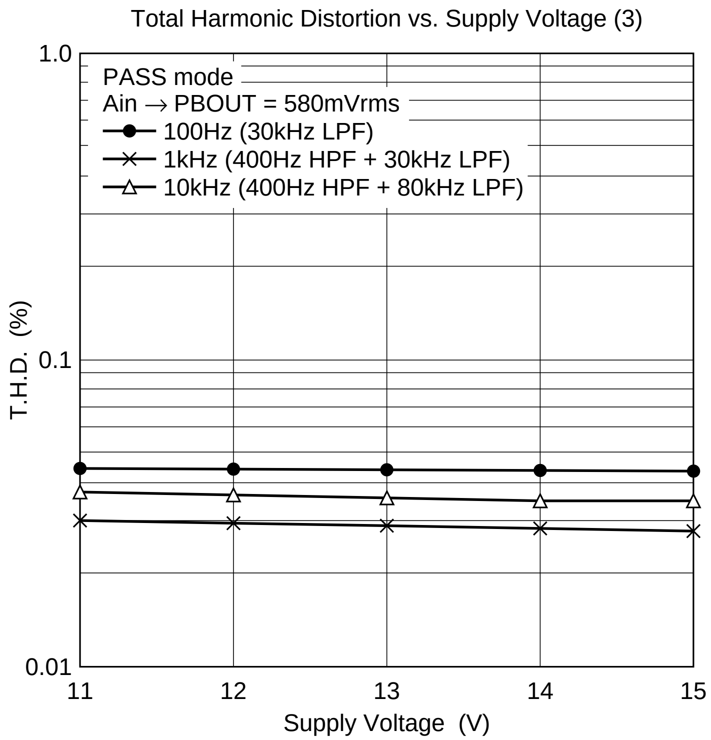

Signal to Noise Ratio vs. Supply Voltage (1)
85
80
75
70
Signal to Noise Ratio (dB)
11
12
13
14
15
Supply Voltage (V)
REC mode, CCIR/ARM filter
Rin → RECOUT = 300mVrms = 0dB
1kHz
Rin → PBOUT = 580mVrms = 0dB
1kHz


Signal to Noise Ratio vs. Supply Voltage (2)
85
80
75
70
Signal to Noise Ratio (dB)
11
12
13
14
15
Supply Voltage (V)
PB mode, CCIR/ARM filter
Ain
Bin
→ RECOUT = 300mVrms = 0dB
1kHz
Ain
Bin
→ PBOUT = 580mVrms = 0dB
1kHz

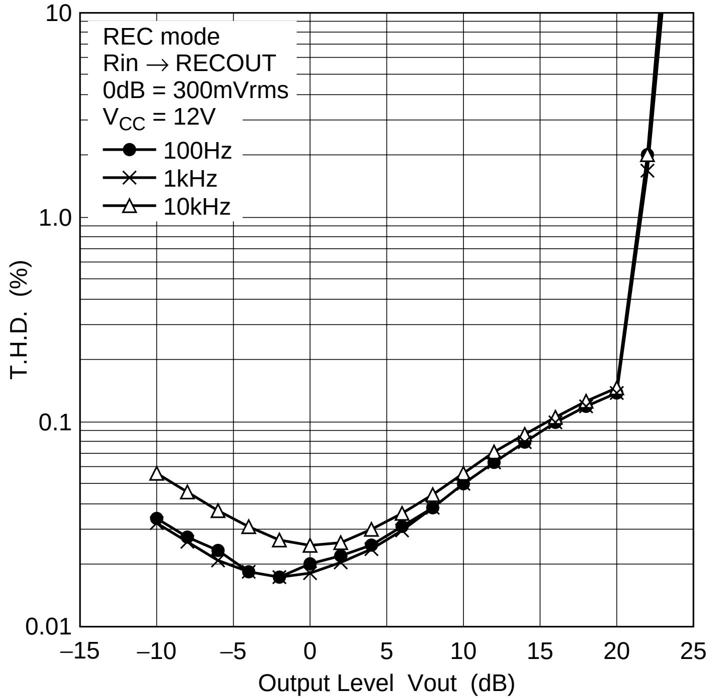

Signal to Noise Ratio vs. Supply Voltage (3)
PASS mode, CCIR/ARM filter
Ain
Bin
→ PBOUT = 580mVrms = 0dB
1kHz
85
80
75
70
11
12
13
14
15
Signal to Noise Ratio (dB)
Supply Voltage (V)


Total Harmonic Distortion vs. Supply Voltage (1)
REC mode
Rin → RECOUT = 300mVrms
100Hz (30kHz LPF)
1kHz (400Hz HPF + 30kHz LPF)
10kHz (400Hz HPF + 80kHz LPF)
Rin → PBOUT = 580mVrms
1kHz (400Hz HPF + 30kHz LPF)
1.0
0.1
0.01
11
12
13
14
15
T.H.D. (%)
Supply Voltage (V)

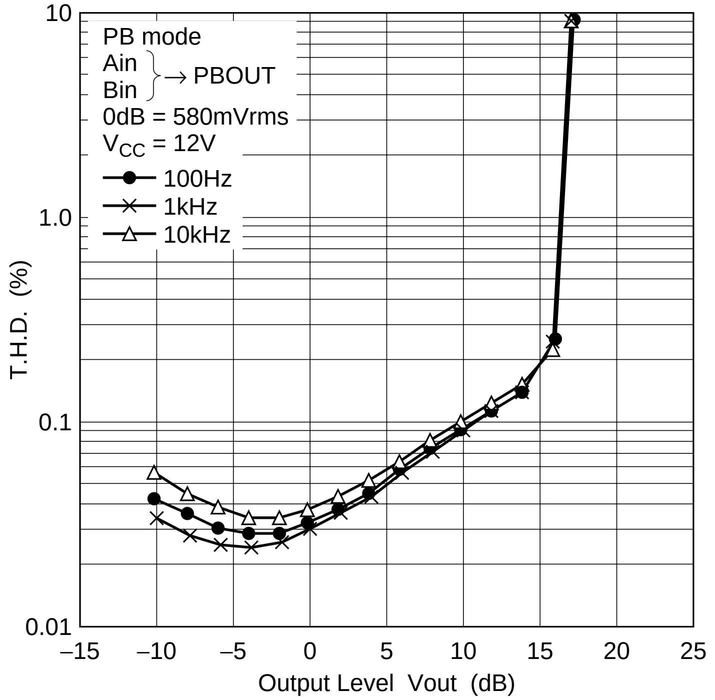

Total Harmonic Distortion vs. Supply Voltage (2)
PB mode, NR-OFF
Ain
Bin
→ PBOUT = 580mVrms
100Hz (30kHz LPF)
1kHz (400Hz HPF + 30kHz LPF)
10kHz (400Hz HPF + 80kHz LPF)
Ain
Bin
→ RECOUT = 300mVrms
1kHz (400Hz HPF + 30kHz LPF)
T.H.D. (%)
1.0
0.1
0.01
11
12
13
14
15
Supply Voltage (V)

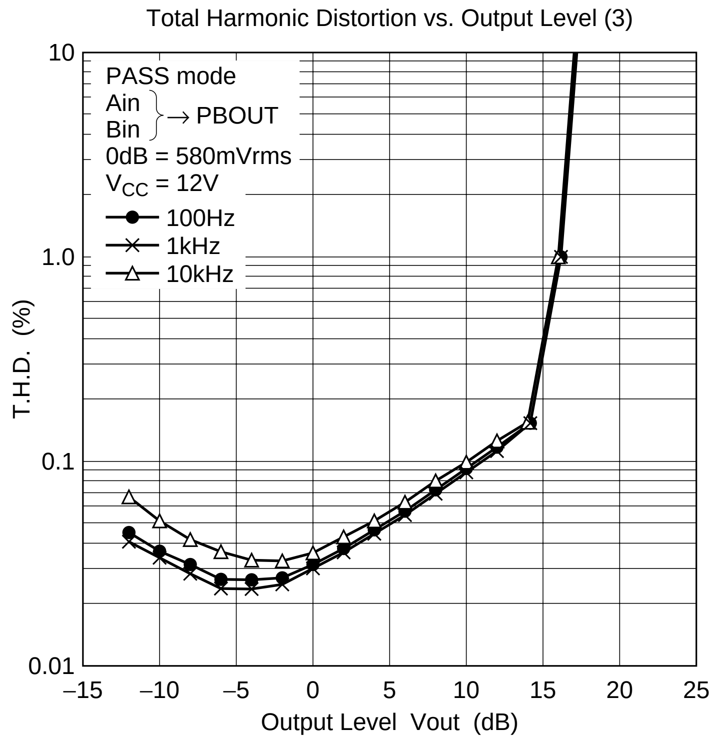

Total Harmonic Distortion vs. Supply Voltage (3)
PASS mode
Ain → PBOUT = 580mVrms
100Hz (30kHz LPF)
1kHz (400Hz HPF + 30kHz LPF)
10kHz (400Hz HPF + 80kHz LPF)
T.H.D. (%)
1.0
0.1
0.01
11
12
13
14
15
Supply Voltage (V)

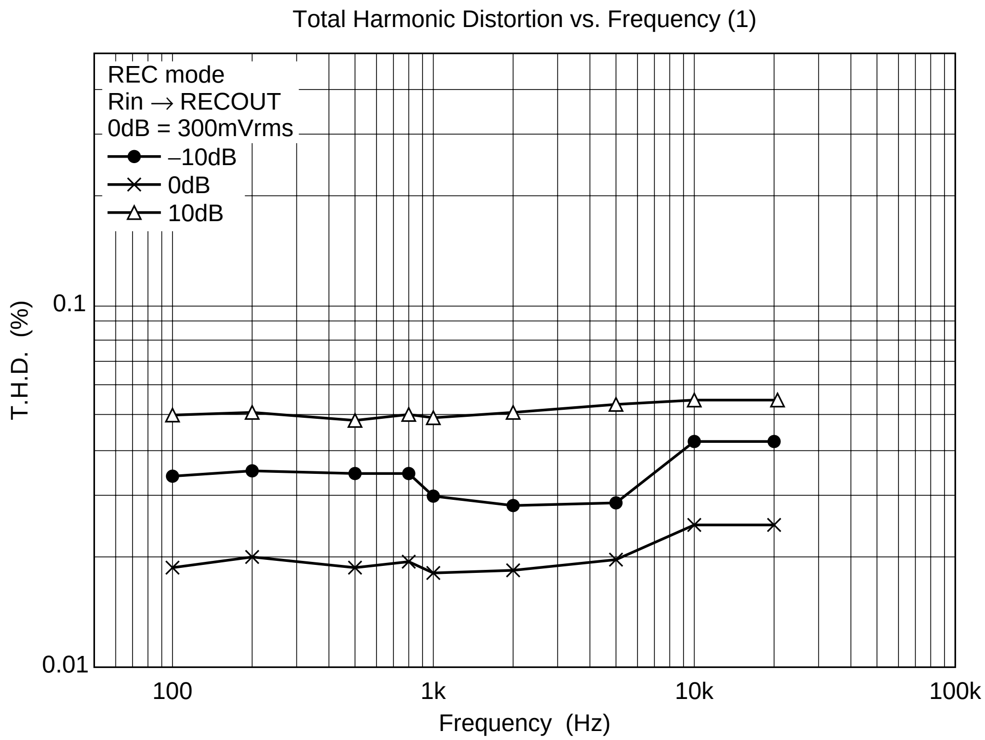
Total Harmonic Distortion vs. Output Level (1)



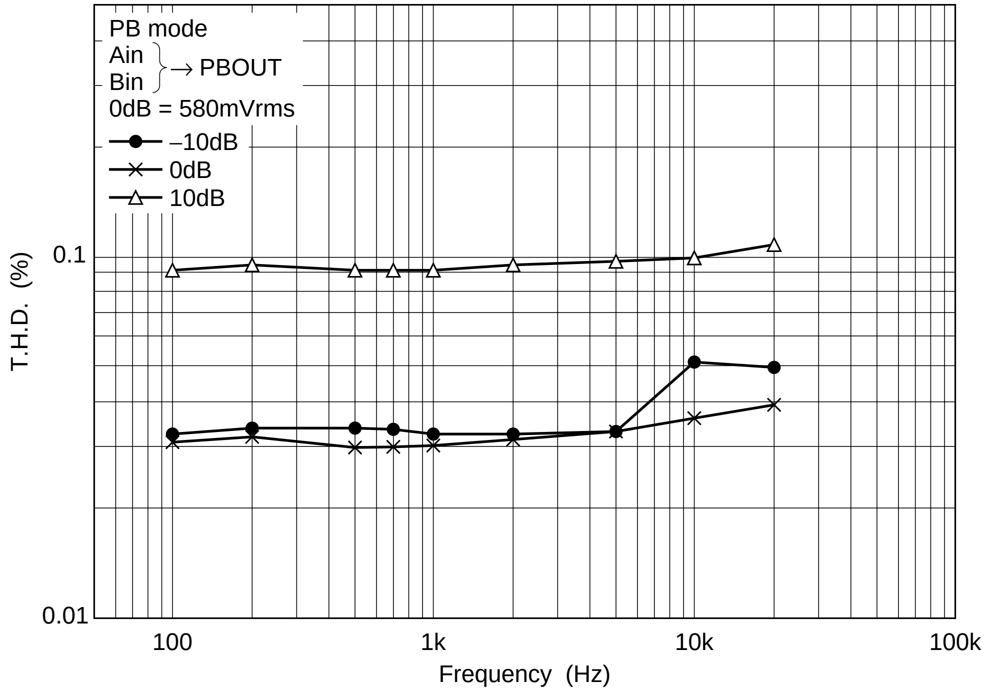
Total Harmonic Distortion vs. Output Level (2)



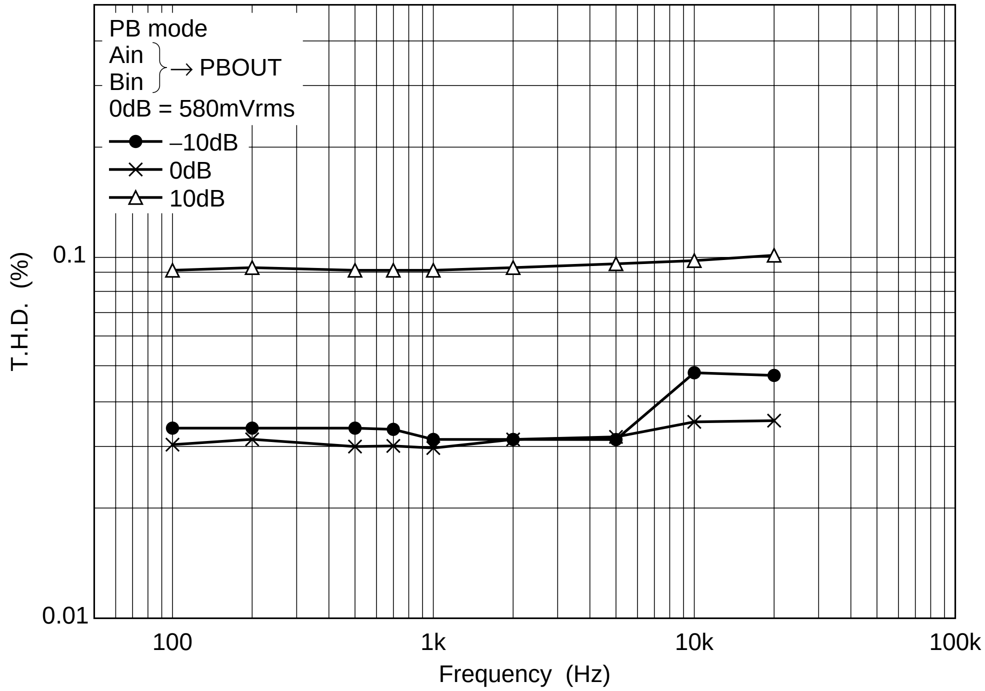

Total Harmonic Distortion vs. Output Level (3)
PASS mode
Ain
Bin
→ PBOUT
0dB = 580mVrms
VCC = 12V
100Hz
1kHz
10kHz
T.H.D. (%)
10
1.0
0.1
0.01
–15
–10
–5
0
5
10
15
20
25
Output Level Vout (dB)


Total Harmonic Distortion vs. Frequency (1)
REC mode
Rin → RECOUT
0dB = 300mVrms
–10dB
0dB
10dB
T.H.D. (%)
0.1
0.01
100
1k
10k
100k
Frequency (Hz)

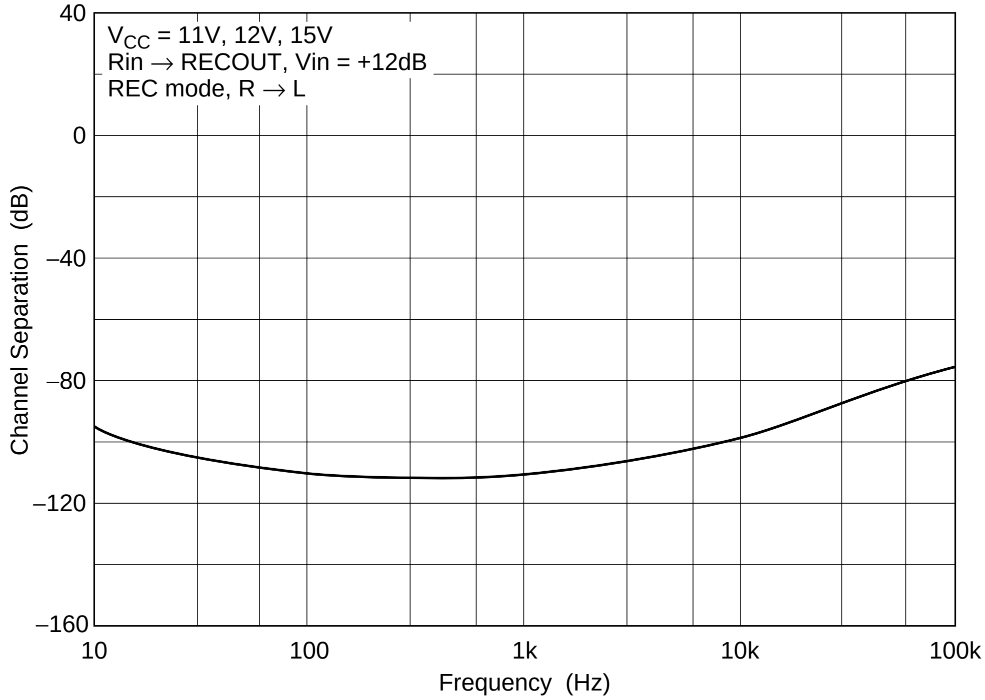
Total Harmonic Distortion vs. Frequency (2)



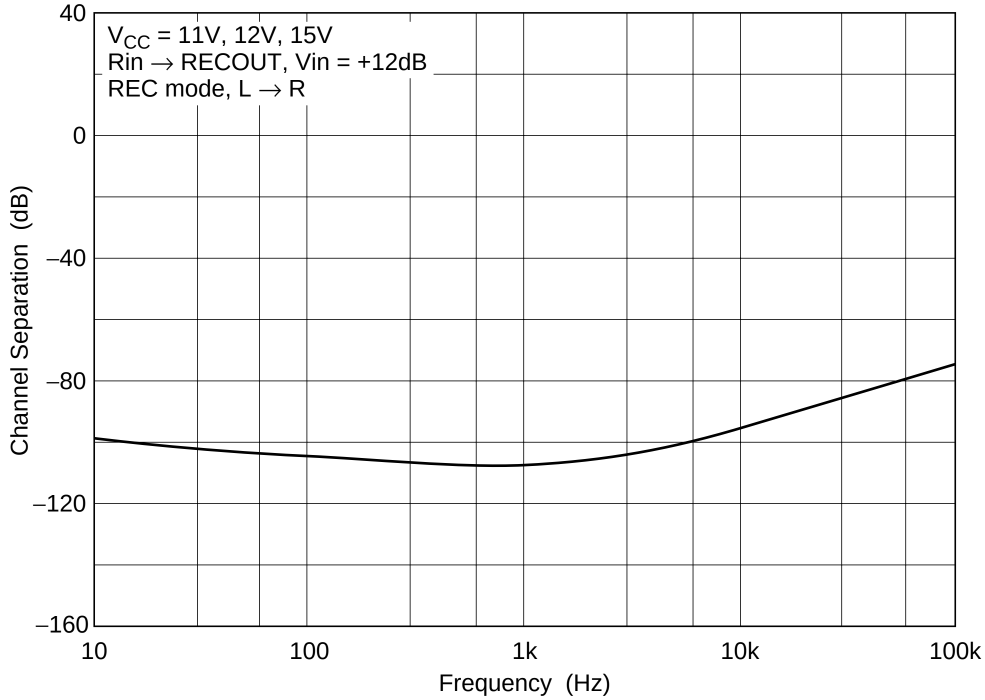
Total Harmonic Distortion vs. Frequency (3)



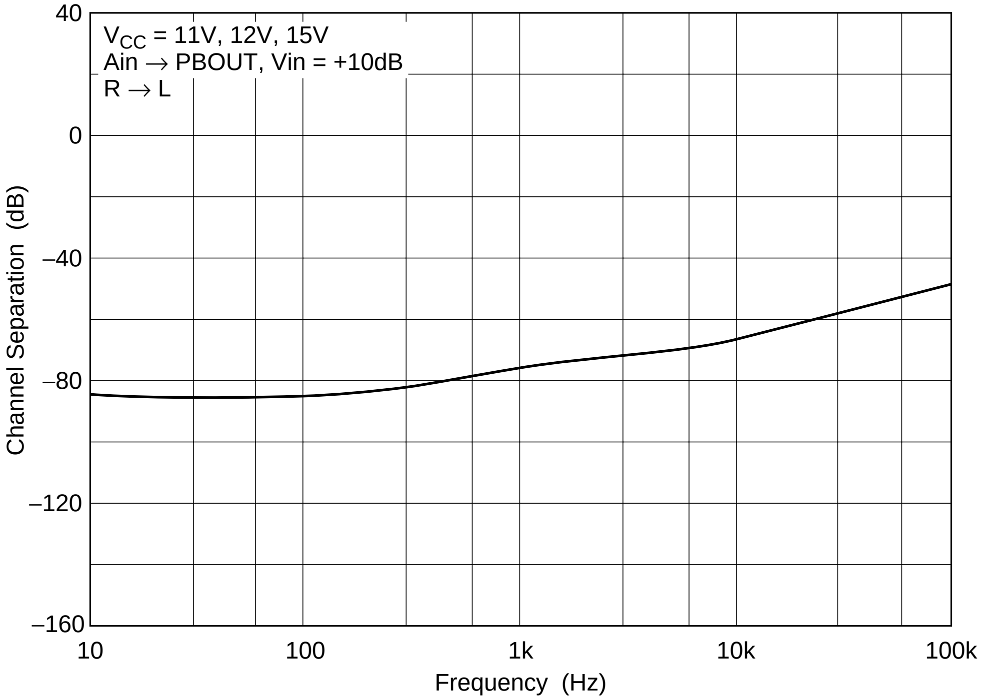
Channel Separation vs. Frequency (R → L) (1)



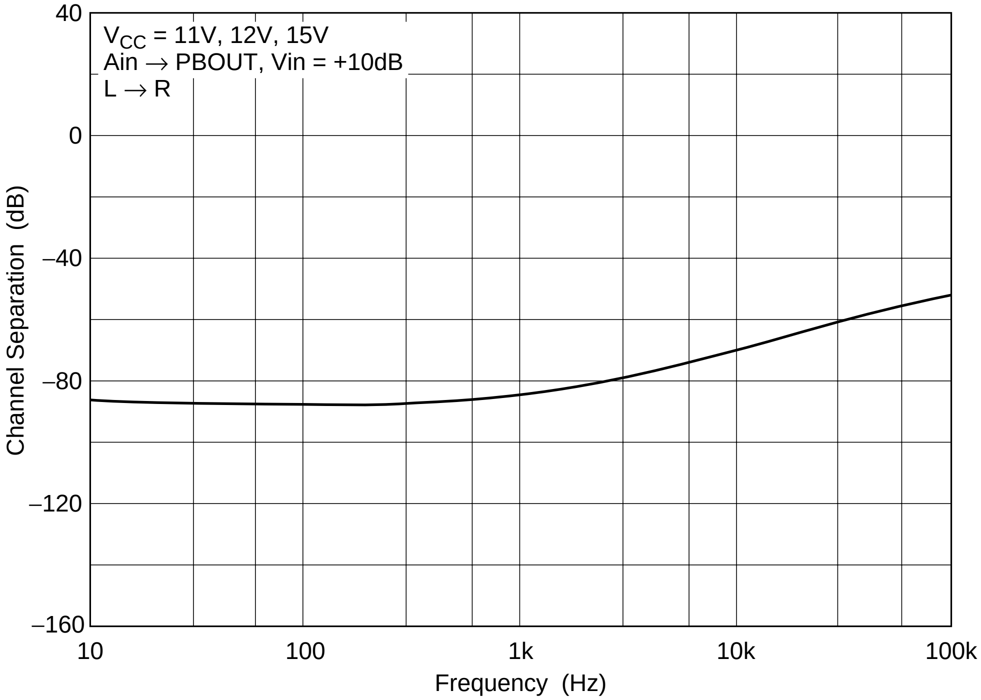
Channel Separation vs. Frequency (L → R) (2)

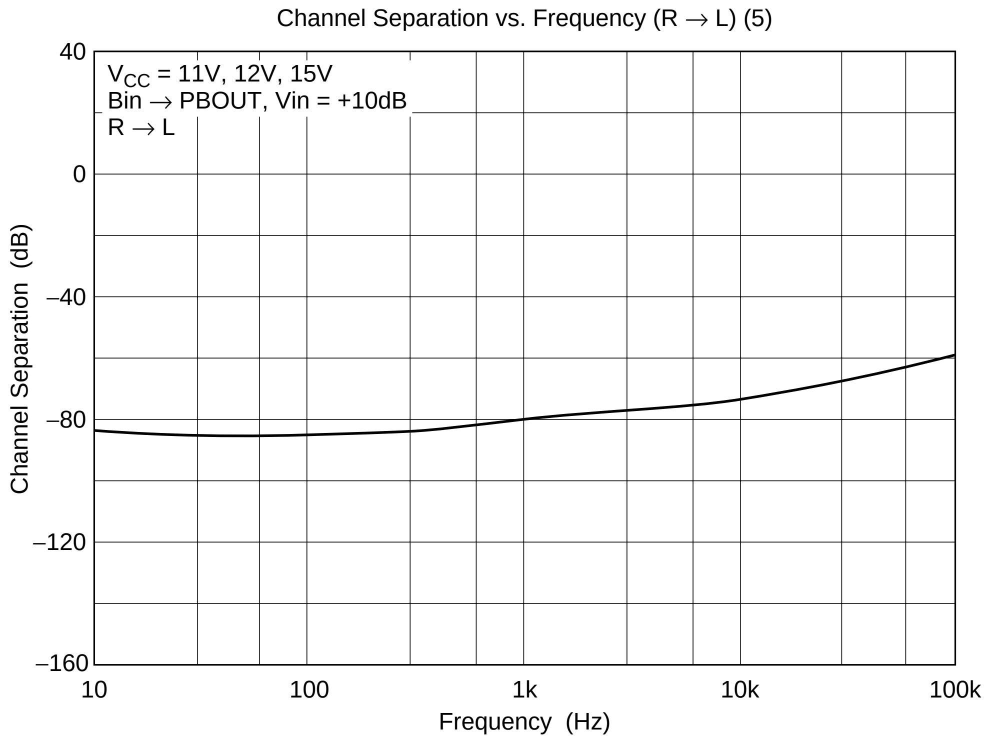


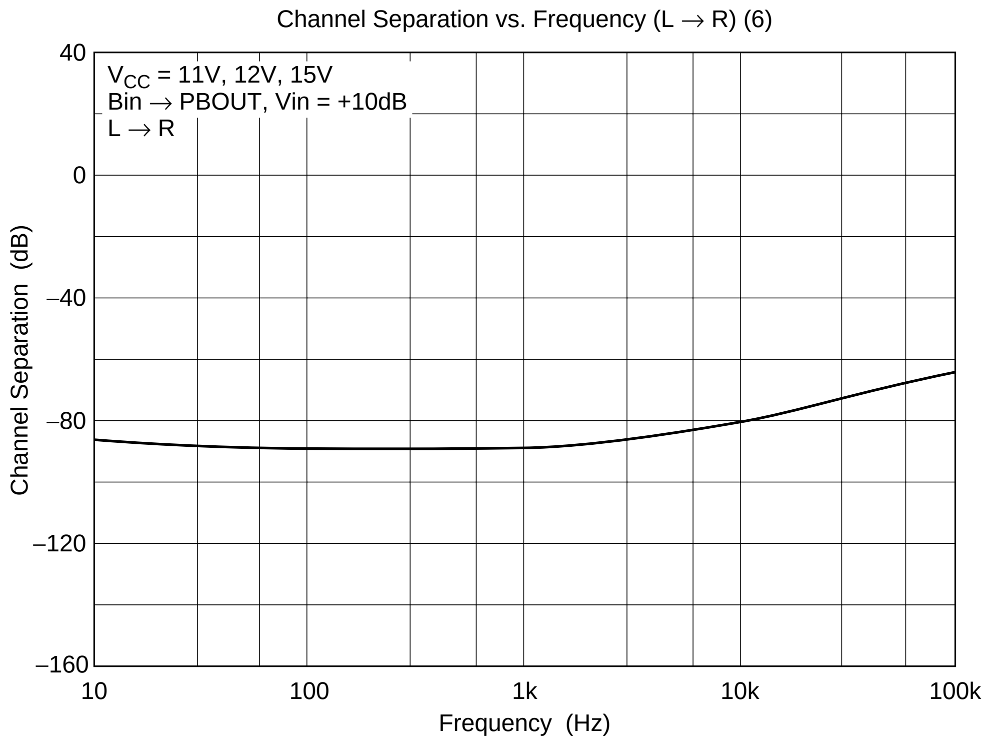
Channel Separation vs. Frequency (R → L) (3)



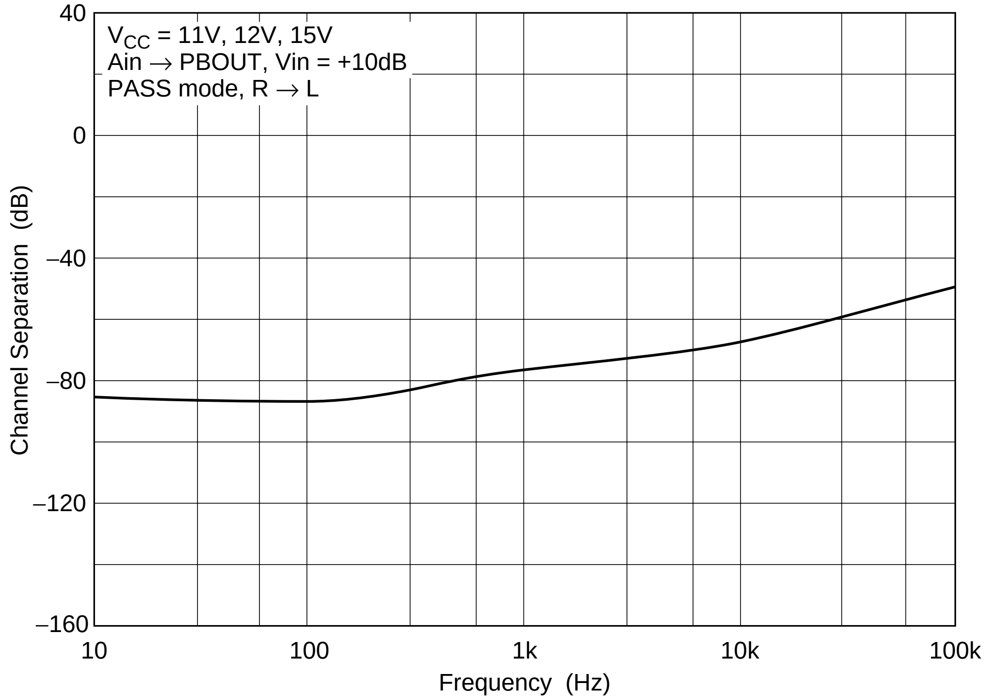
Channel Separation vs. Frequency (L → R) (4)



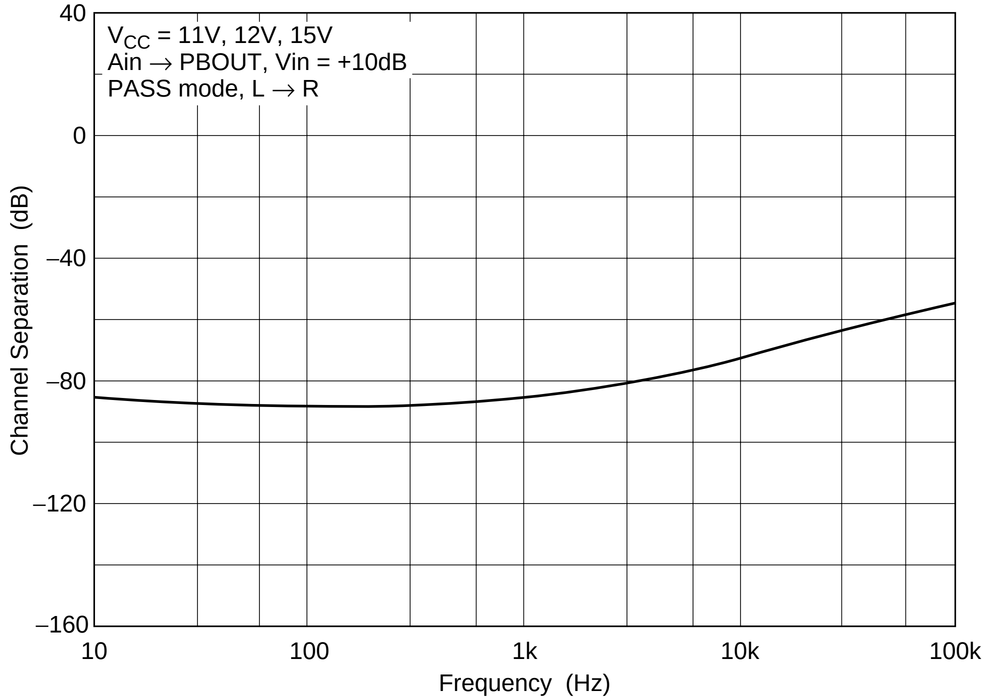

Channel Separation vs. Frequency (R → L) (5)
VCC = 11V, 12V, 15V
Bin → PBOUT, Vin = +10dB
R → L
40
0
–40
–80
–120
–160
Channel Separation (dB)
10
100
1k
10k
100k
Frequency (Hz)

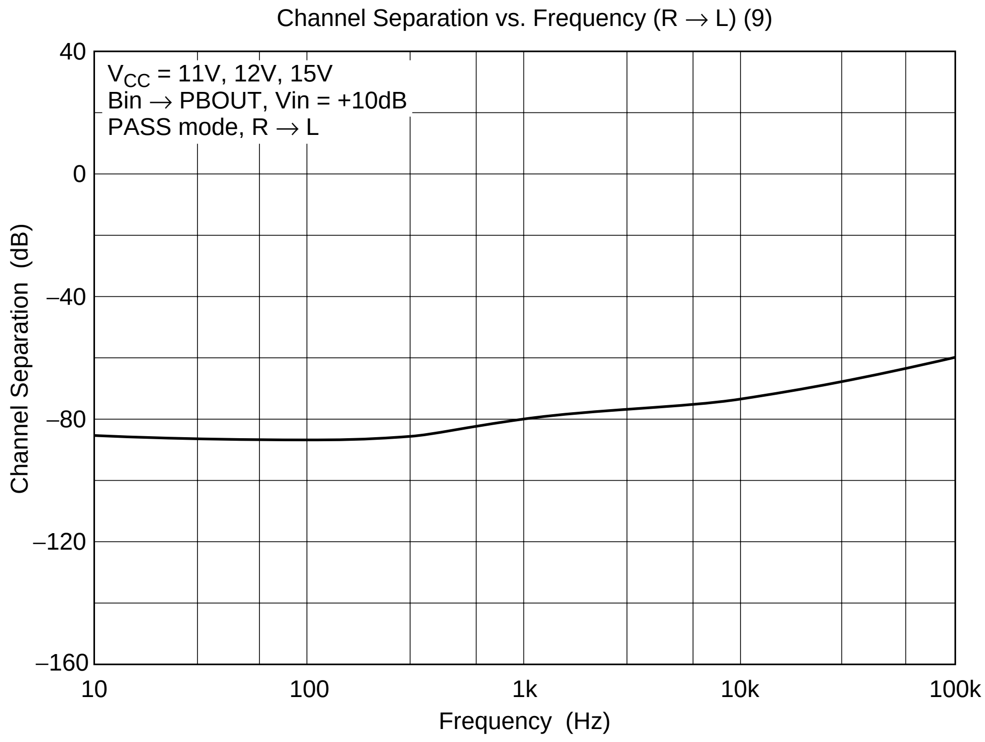

Channel Separation vs. Frequency (L → R) (6)
VCC = 11V, 12V, 15V
Bin → PBOUT, Vin = +10dB
L → R
40
0
–40
–80
–120
–160
Channel Separation (dB)
10
100
1k
10k
100k
Frequency (Hz)

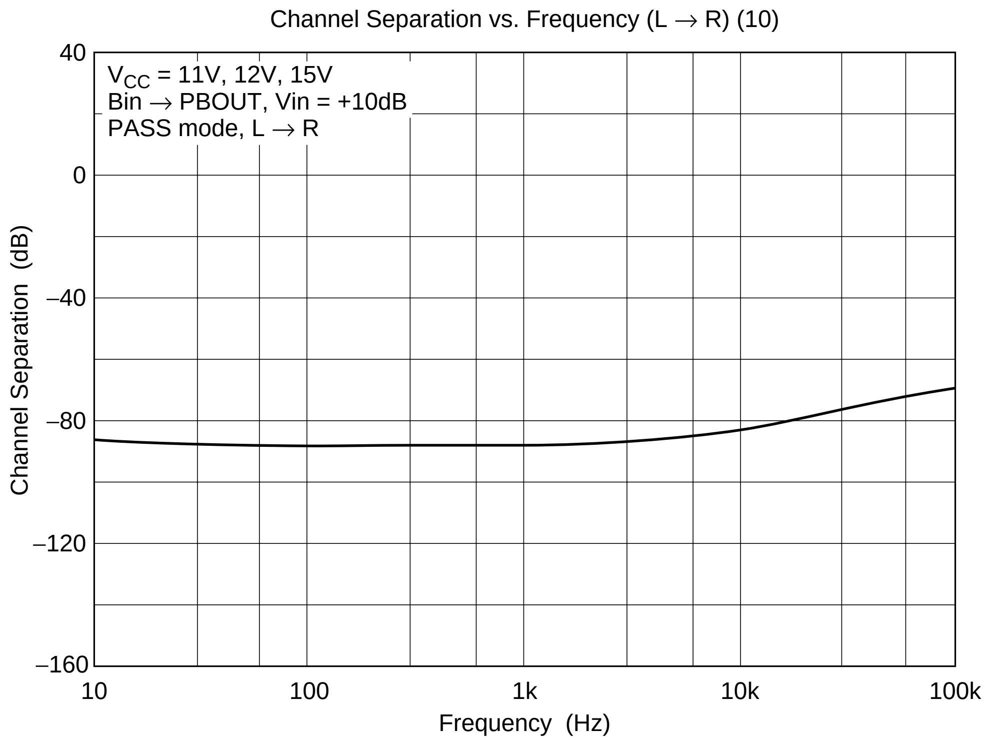
Channel Separation vs. Frequency (R → L) (7)



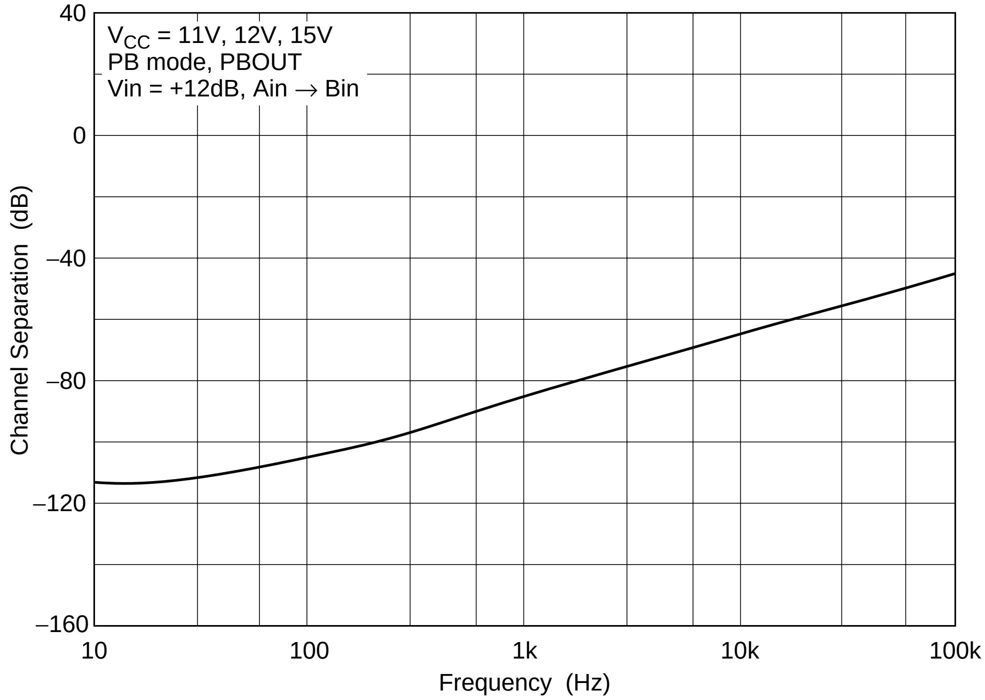
Channel Separation vs. Frequency (L → R) (8)



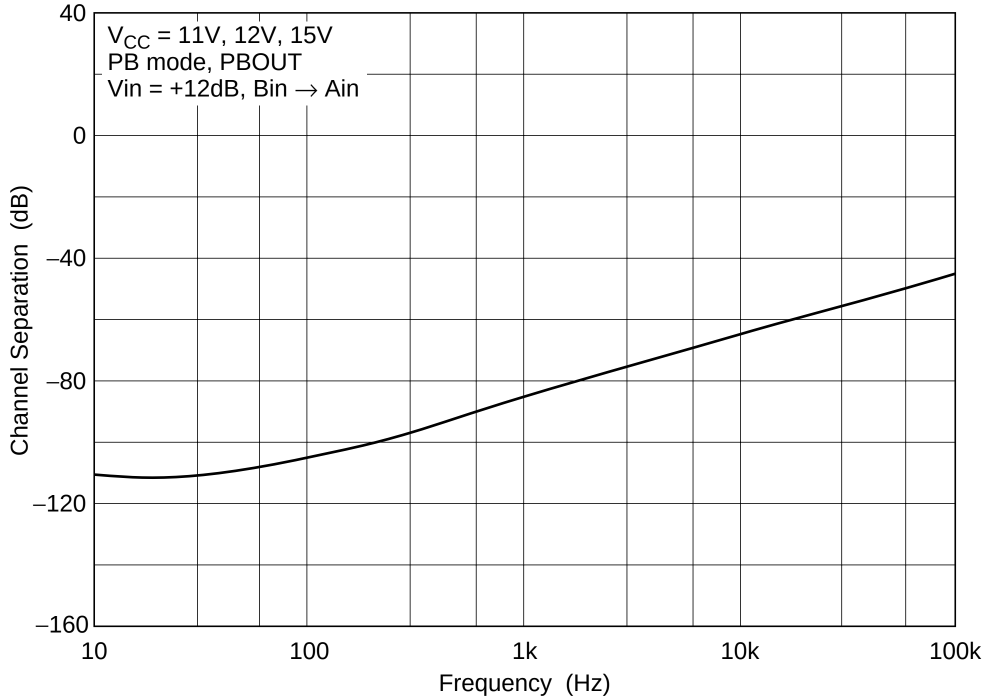

Channel Separation vs. Frequency (R → L) (9)
VCC = 11V, 12V, 15V
Bin → PBOUT, Vin = +10dB
PASS mode, R → L
40
0
–40
–80
–120
–160
Channel Separation (dB)
10
100
1k
10k
100k
Frequency (Hz)


Channel Separation vs. Frequency (L → R) (10)
VCC = 11V, 12V, 15V
Bin → PBOUT, Vin = +10dB
PASS mode, L → R
40
0
–40
–80
–120
–160
Channel Separation (dB)
10
100
1k
10k
100k
Frequency (Hz)

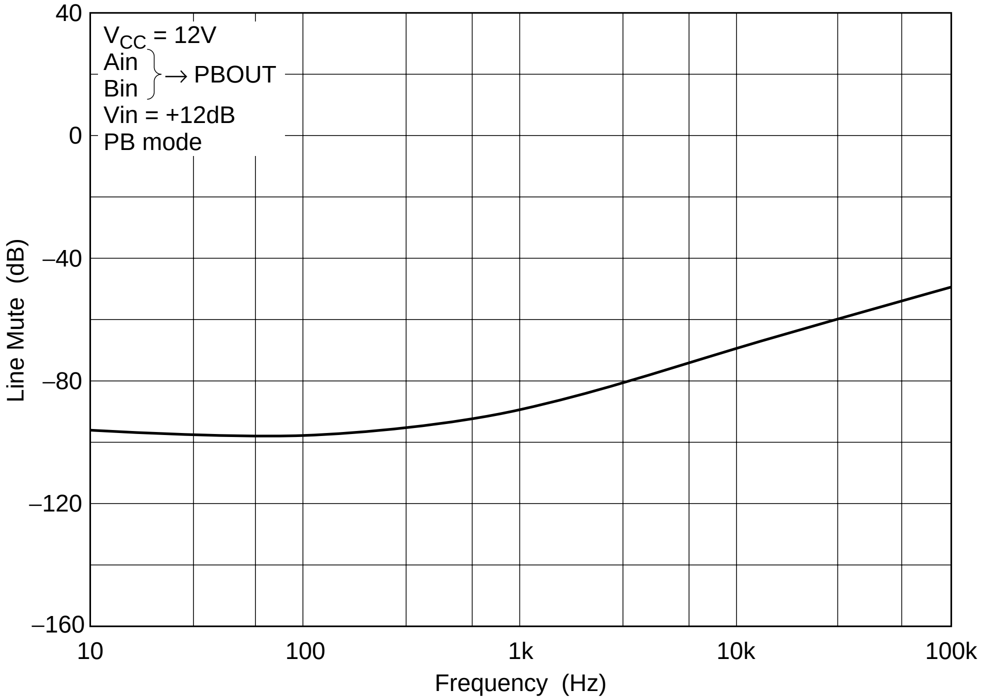
Crosstalk vs. Frequency (Ain → Bin) (1)



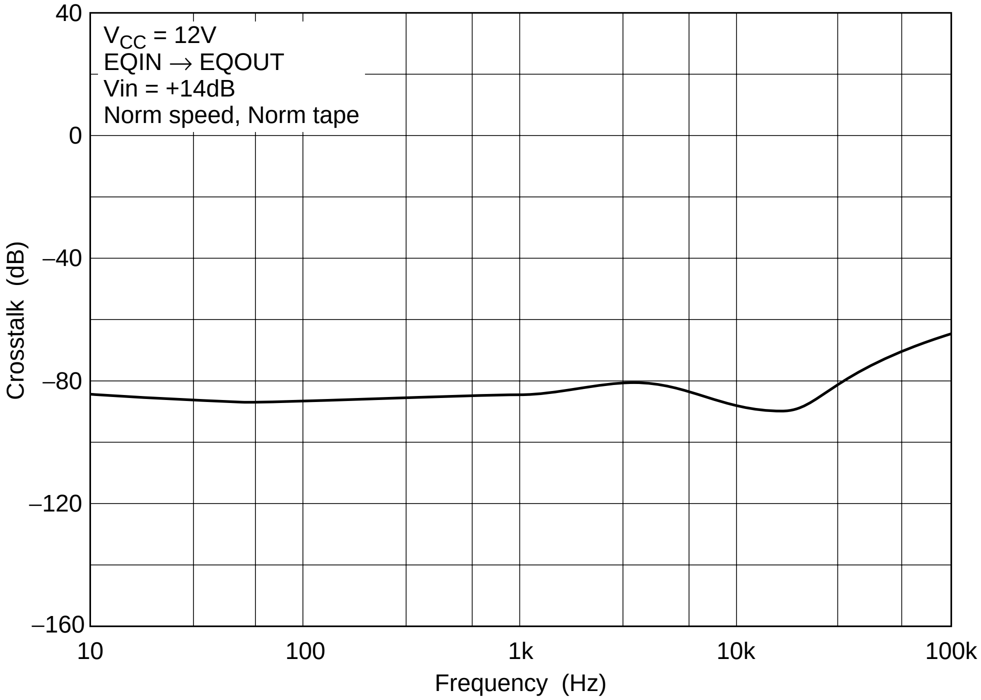
Crosstalk vs. Frequency (Bin → Ain) (2)



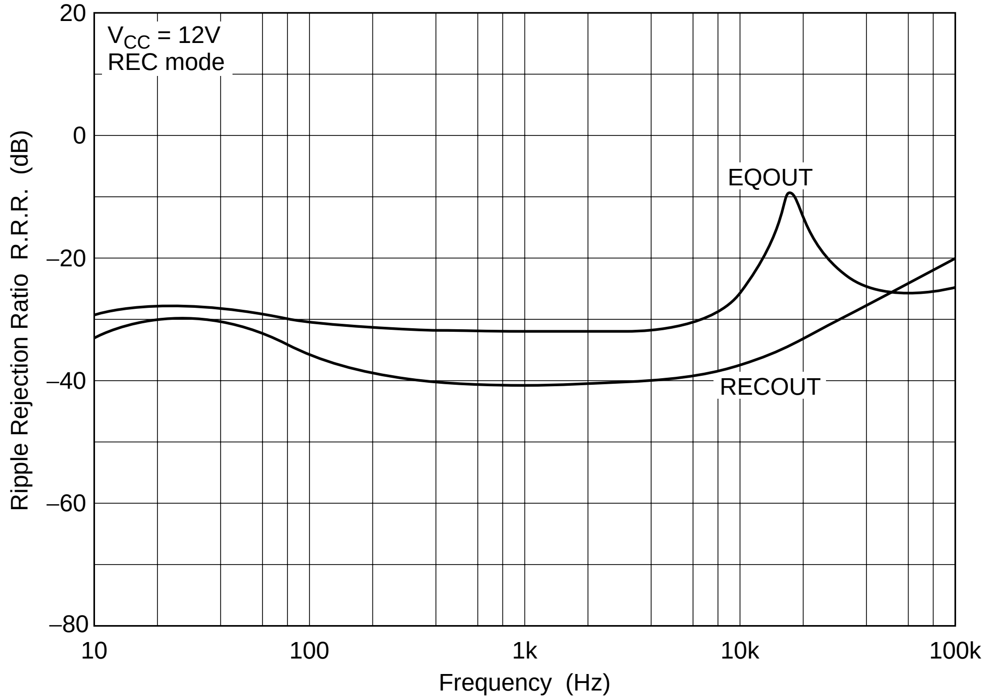
Line Mute vs. Frequency



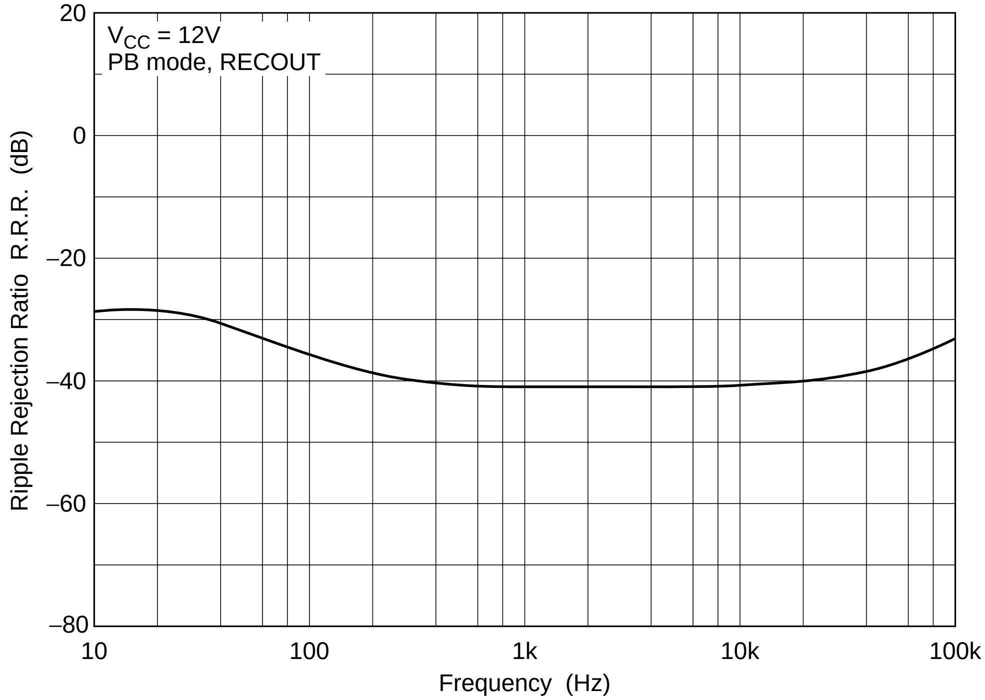
REC Mute Attenuation vs. Frequency

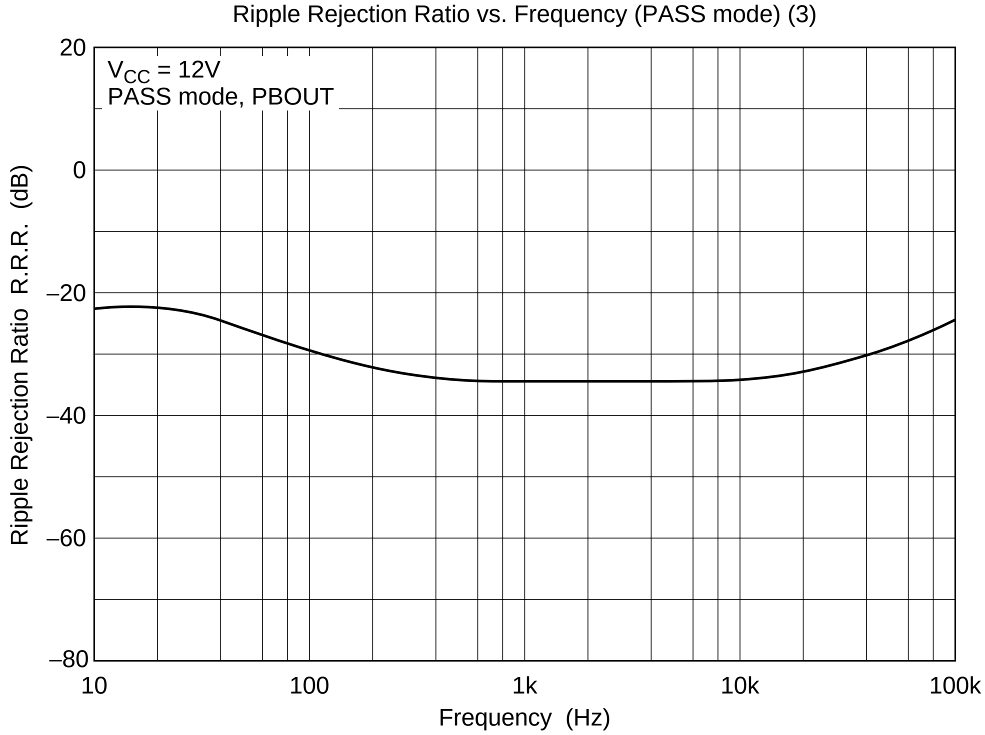


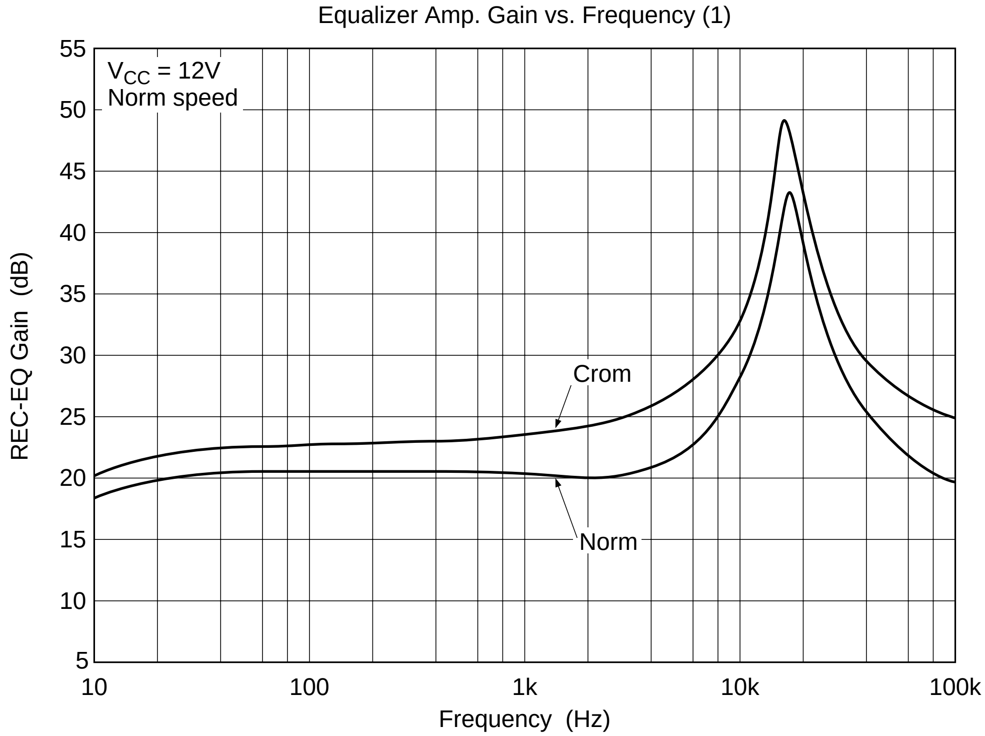
Ripple Rejection Ratio vs. Frequency (REC mode) (1)



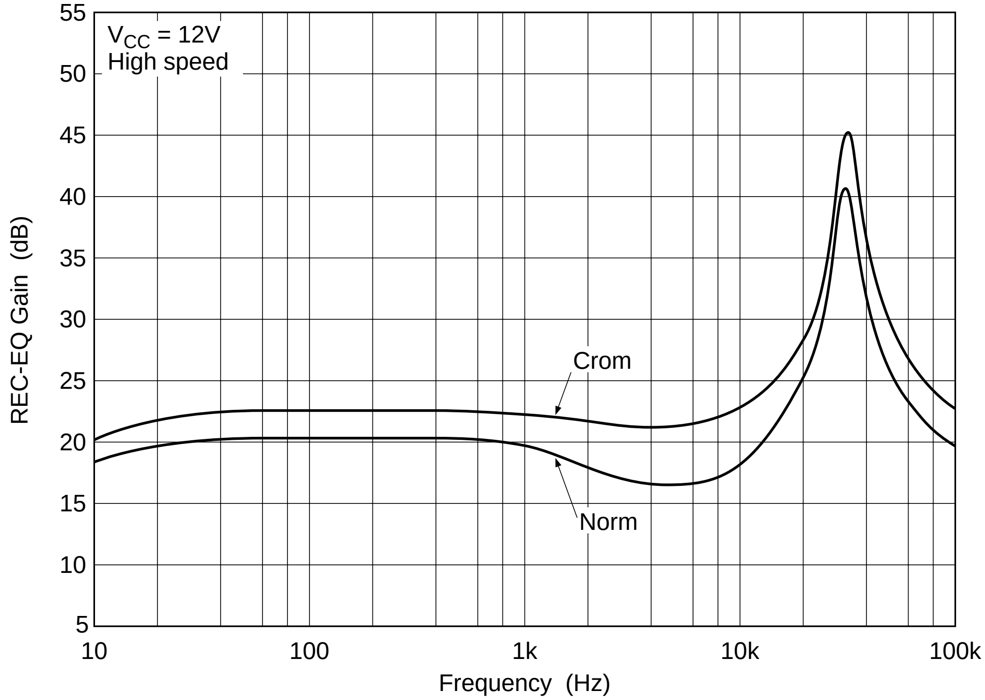
Ripple Rejection Ratio vs. Frequency (PB mode) (2)



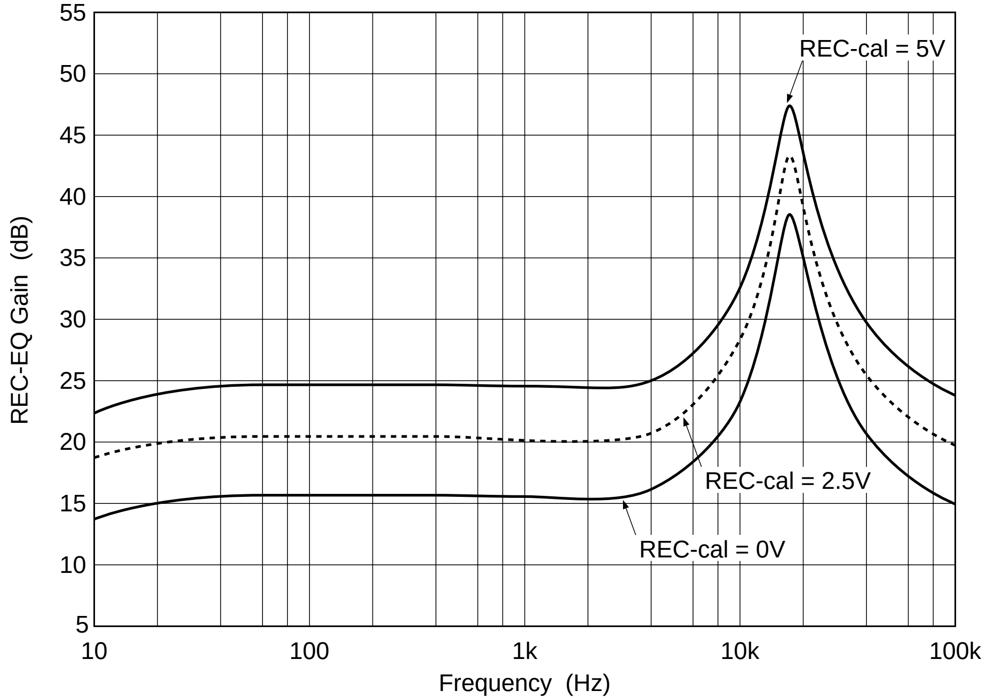

Ripple Rejection Ratio vs. Frequency (PASS mode) (3)
V_{CC} = 12V
PASS mode, PBOUT
Ripple Rejection Ratio R.R.R. (dB)
20
0
–20
–40
–60
–80
10
100
1k
10k
100k
Frequency (Hz)

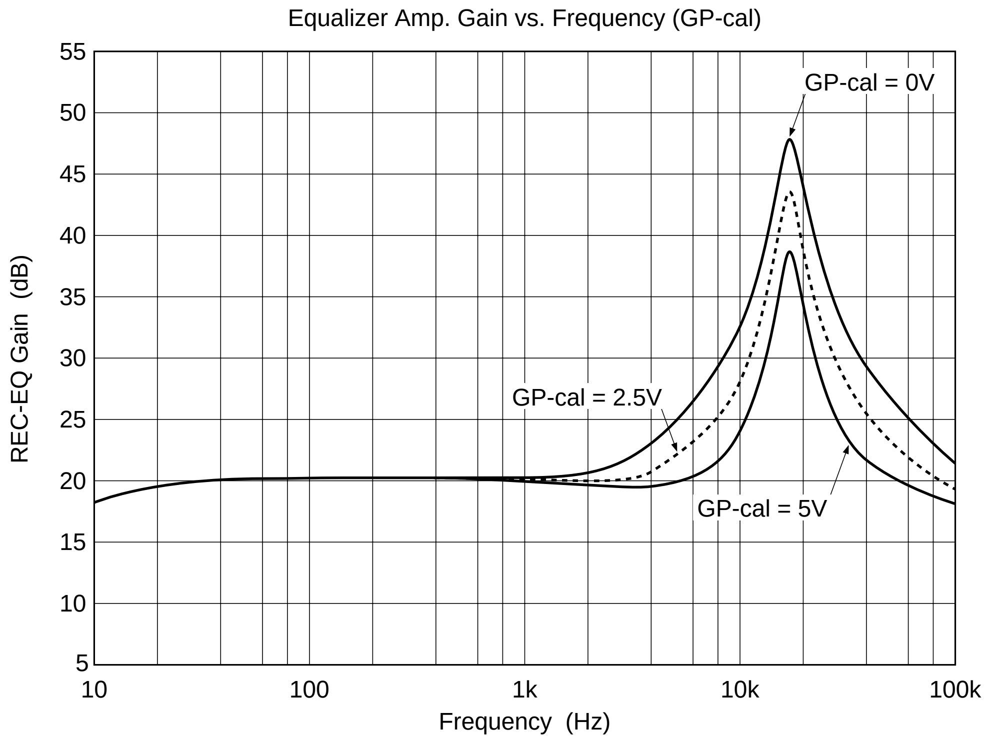

Equalizer Amp. Gain vs. Frequency (1)
V_{CC} = 12V
Norm speed
REC-EQ Gain (dB)
55
50
45
40
35
30
25
20
15
10
5
Crom
Norm
10
100
1k
10k
100k
Frequency (Hz)

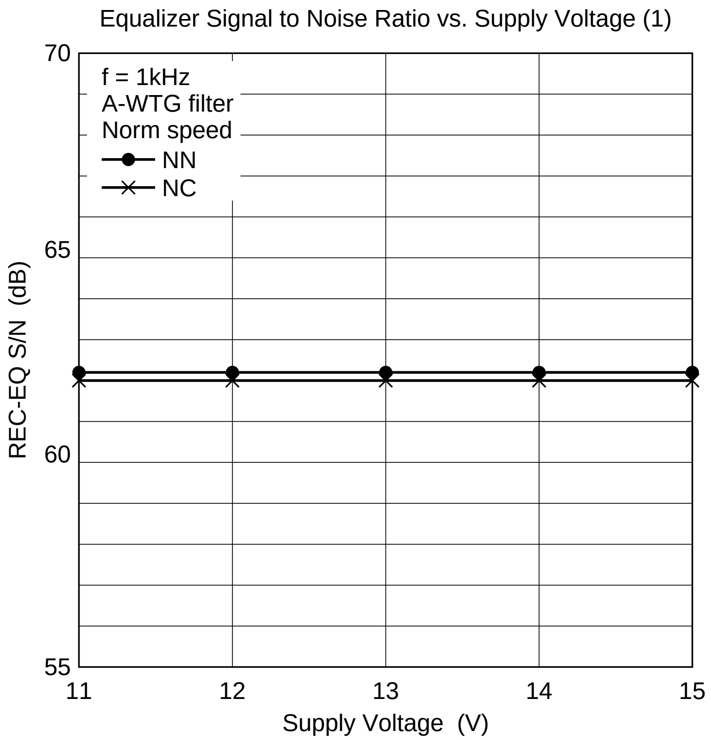
Equalizer Amp. Gain vs. Frequency (2)

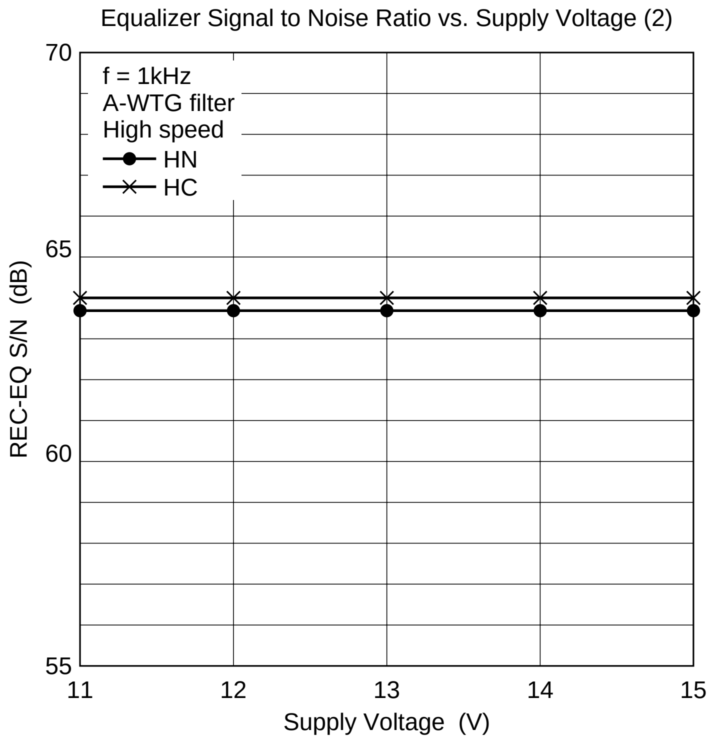


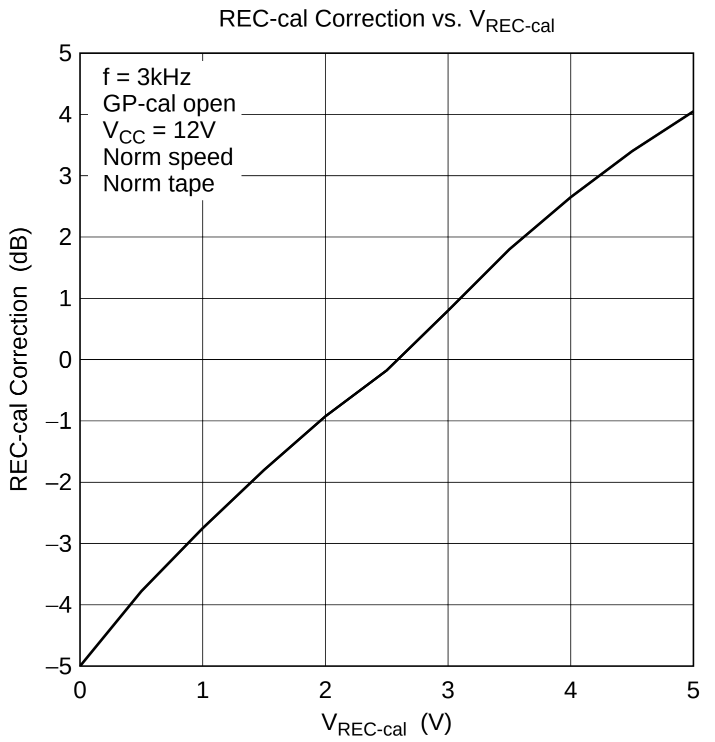
Equalizer Amp. Gain vs. Frequency (REC-cal)

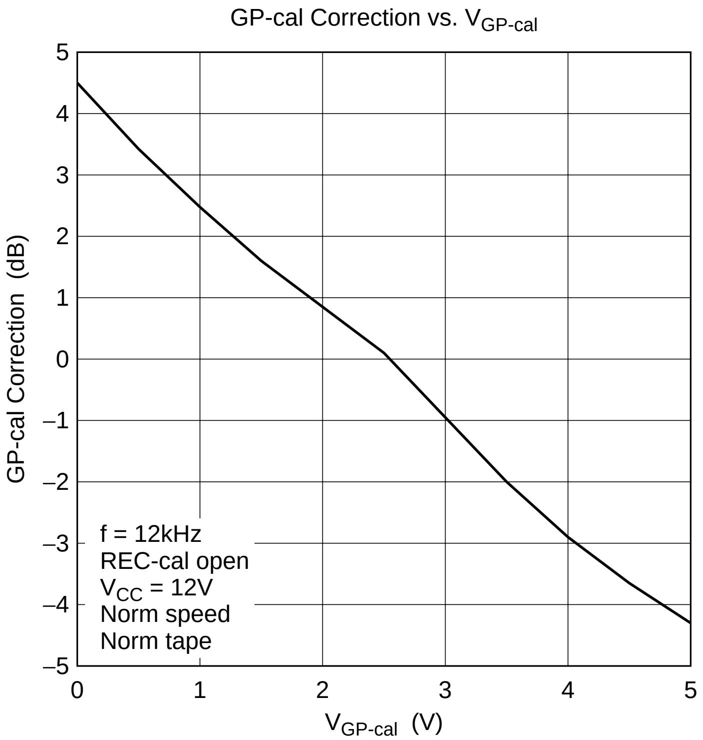


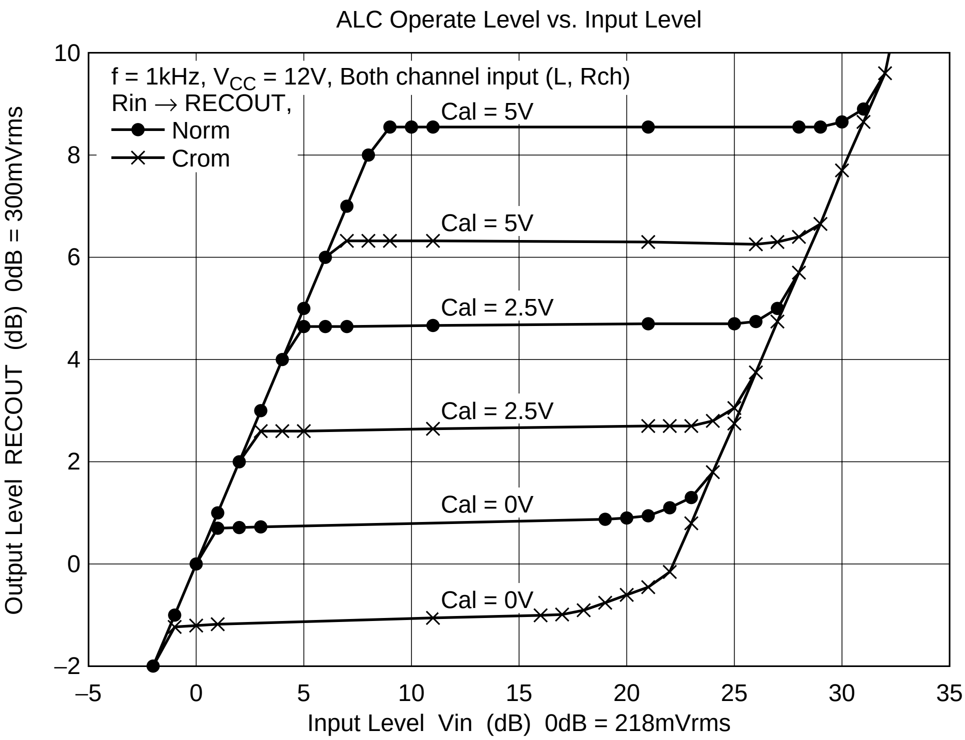

Equalizer Amp. Gain vs. Frequency (GP-cal)
REC-EQ Gain (dB)
55
50
45
40
35
30
25
20
15
10
5
10
100
1k
10k
100k
Frequency (Hz)
GP-cal = 0V
GP-cal = 2.5V
GP-cal = 5V


Equalizer Signal to Noise Ratio vs. Supply Voltage (1)
REC-EQ S/N (dB)
70
65
60
55
11
12
13
14
15
Supply Voltage (V)
f = 1kHz
A-WTG filter
Norm speed
NN
NC

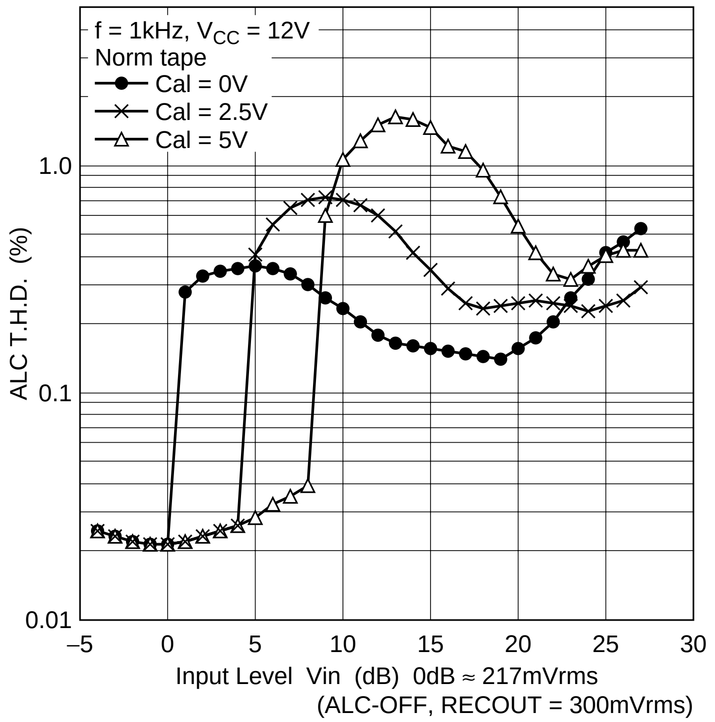

Equalizer Signal to Noise Ratio vs. Supply Voltage (2)
f = 1kHz
A-WTG filter
High speed
HN
HC
REC-EQ S/N (dB)
70
65
60
55
11
12
13
14
15
Supply Voltage (V)


REC-cal Correction vs. V REC-cal
f = 3kHz
GP-cal open
VCC = 12V
Norm speed
Norm tape
REC-cal Correction (dB)
5
4
3
2
1
0
–1
–2
–3
–4
–5
0
1
2
3
4
5
V REC-cal (V)

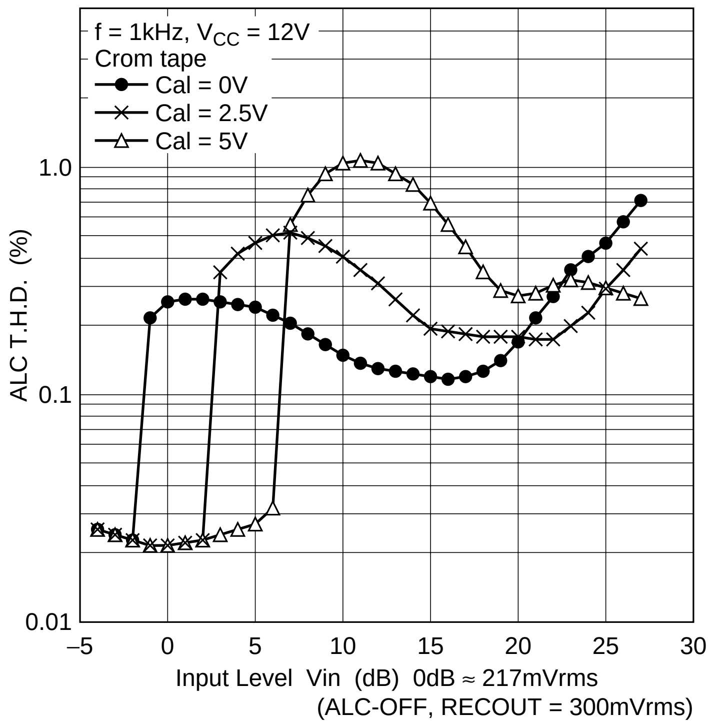

GP-cal Correction vs. V GP-cal
GP-cal Correction (dB)
5
4
3
2
1
0
–1
–2
–3
–4
–5
0
1
2
3
4
5
V GP-cal (V)
f = 12kHz
REC-cal open
VCC = 12V
Norm speed
Norm tape

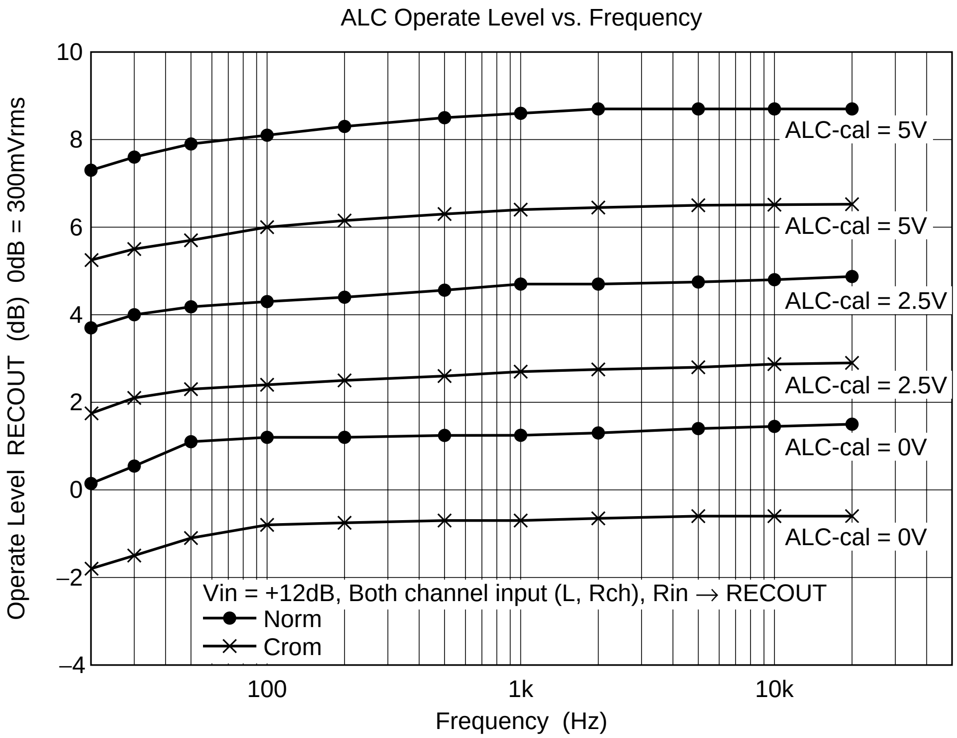

ALC Operate Level vs. Input Level
Output Level RECOUT (dB) 0dB = 300mVrms
Input Level Vin (dB) 0dB = 218mVrms
f = 1kHz, VCC = 12V, Both channel input (L, Rch)
Rin → RECOUT,
Norm
Crom
Cal = 5V
Cal = 5V
Cal = 2.5V
Cal = 2.5V
Cal = 0V
Cal = 0V
10
8
6
4
2
0
–2
–5
0
5
10
15
20
25
30
35

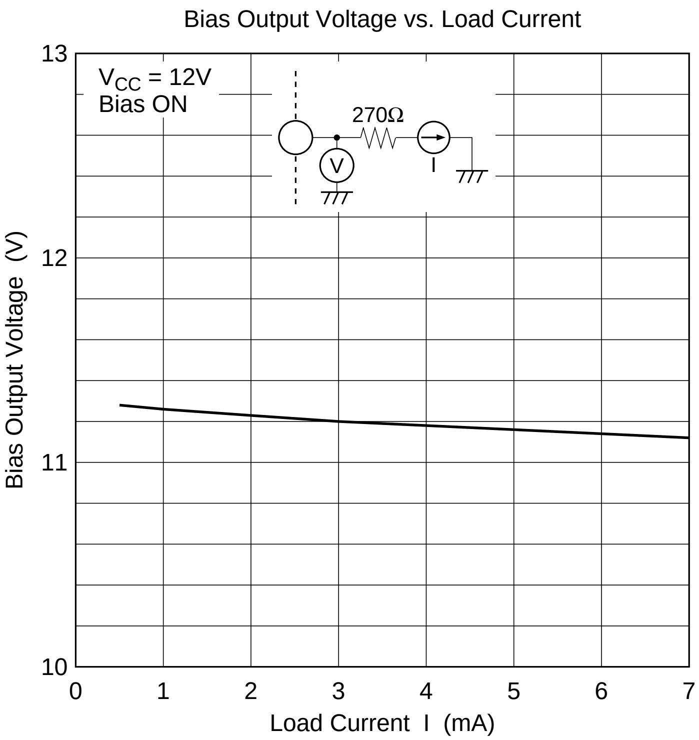
ALC Total Harmonic Distortion vs. Input Level (1)

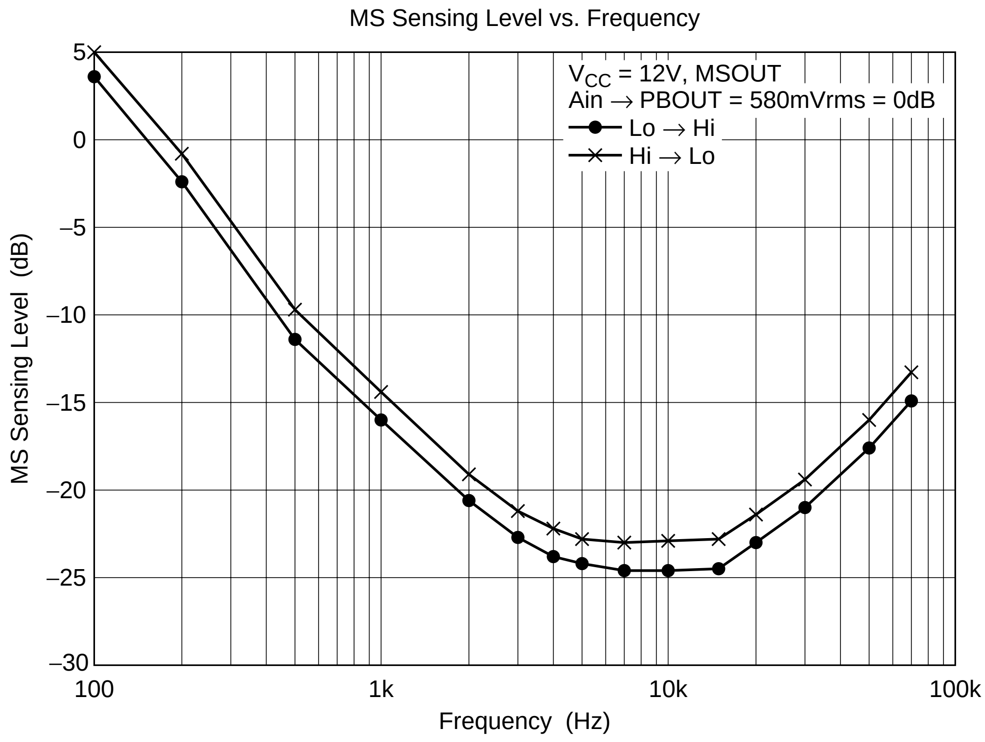


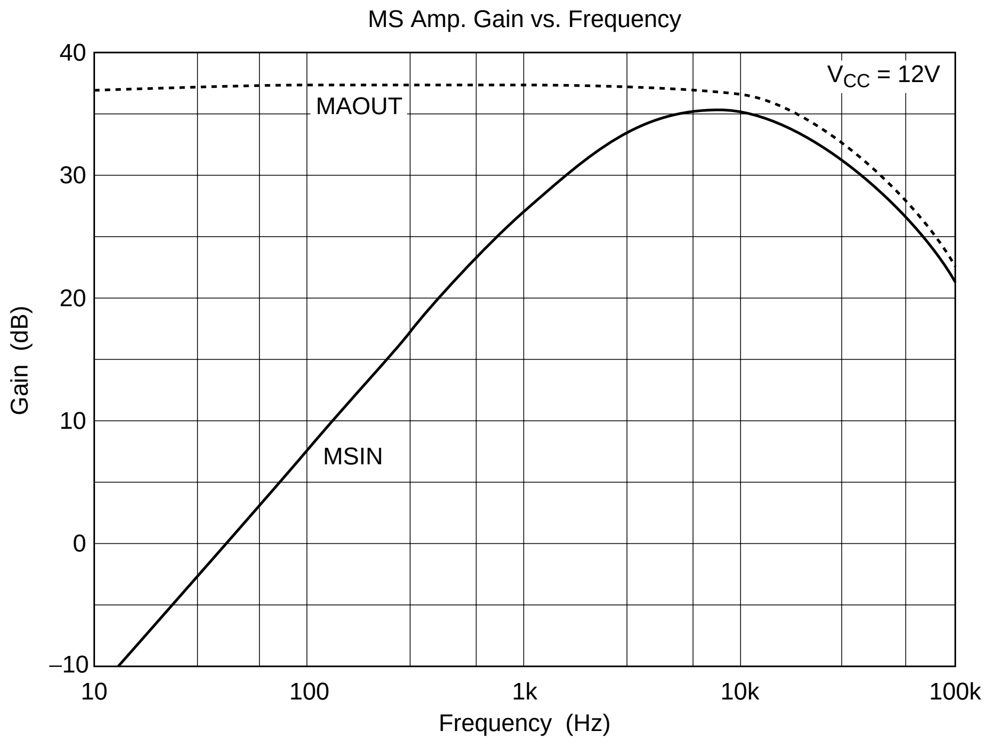
ALC Total Harmonic Distortion vs. Input Level (2)



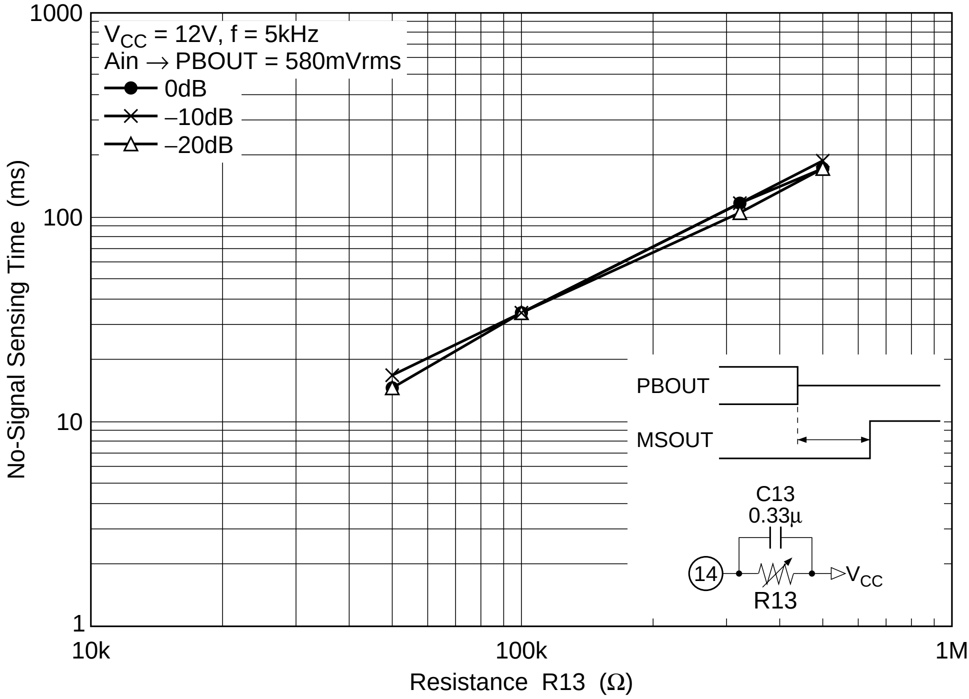

ALC Operate Level vs. Frequency
Operate Level RECOUT (dB) 0dB = 300mVrms
10
8
6
4
2
0
–2
–4
100
1k
10k
Frequency (Hz)
ALC-cal = 5V
ALC-cal = 5V
ALC-cal = 2.5V
ALC-cal = 2.5V
ALC-cal = 0V
ALC-cal = 0V
Vin = +12dB, Both channel input (L, Rch), Rin → RECOUT
Norm
Crom


Bias Output Voltage vs. Load Current
Bias Output Voltage (V)
13
12
11
10
0
1
2
3
4
5
6
7
Load Current I (mA)
VCC = 12V
Bias ON
270Ω
V
I

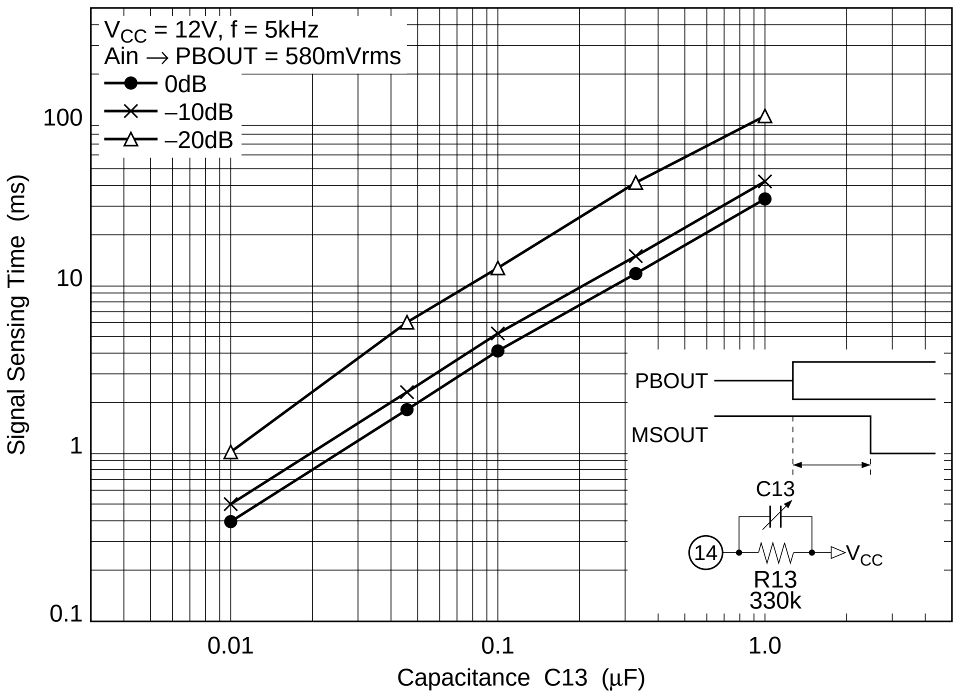

MS Sensing Level vs. Frequency
VCC = 12V, MSOUT
Ain → PBOUT = 580mVrms = 0dB
Lo → Hi
Hi → Lo
MS Sensing Level (dB)
5
0
–5
–10
–15
–20
–25
–30
100
1k
10k
100k
Frequency (Hz)


MS Amp. Gain vs. Frequency
VCC = 12V
MAOUT
MSIN
Gain (dB)
40
30
20
10
0
–10
10
100
1k
10k
100k
Frequency (Hz)

No-Signal Sensing Time vs. Resistance

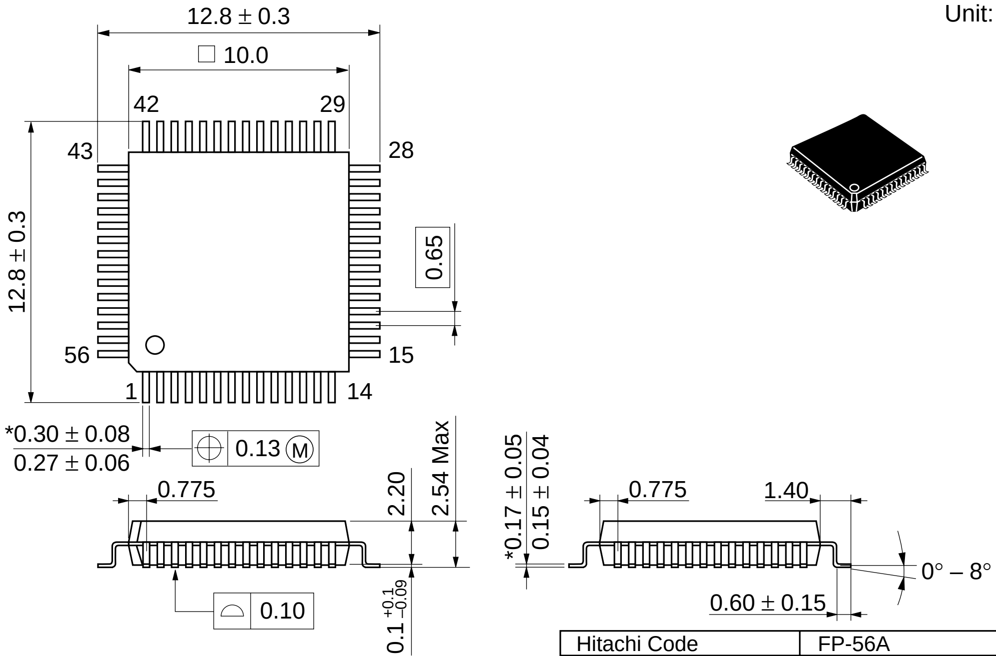


Signal Sensing Time vs. Capacitance



Package Dimensions

Unit: mm



Hitachi Code	FP-56A
JEDEC	—
EIAJ	—
Mass (reference value)	0.5 g

*Dimension including the plating thickness
Base material dimension

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Hitachi, Ltd.
Semiconductor & Integrated Circuits.
Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan
Tel: Tokyo (03) 3270-2111 Fax: (03) 3270-5109

URL NorthAmerica : http://semiconductor.hitachi.com/
Europe : http://www.hitachi-eu.com/hel/ecg
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For further information write to:

Hitachi Semiconductor (America) Inc.
179 East Tasman Drive,
San Jose,CA 95134
Tel: <1> (408) 433-1990
Fax: <1>(408) 433-0223

Hitachi Europe GmbH
Electronic Components Group
Dornacher Straβe 3
D-85622 Feldkirchen, Munich
Germany
Tel: <49> (89) 9 9180-0
Fax: <49> (89) 9 29 30 00

Hitachi Europe Ltd.
Electronic Components Group.
Whitebrook Park
Lower Cookham Road
Maidenhead
Berkshire SL6 8YA, United Kingdom
Tel: <44> (1628) 585000
Fax: <44> (1628) 585160

Hitachi Asia Ltd.
Hitachi Tower
16 Collyer Quay #20-00,
Singapore 049318
Tel : <65>-538-6533/538-8577
Fax : <65>-538-6933/538-3877
URL : http://www.hitachi.com.sg

Hitachi Asia Ltd.
(Taipei Branch Office)
4/F, No. 167, Tun Hwa North Road,
Hung-Kuo Building,
Taipei (105), Taiwan
Tel : <886>-(2)-2718-3666
Fax : <886>-(2)-2718-8180
Telex : 23222 HAS-TP
URL : http://www.hitachi.com.tw

Hitachi Asia (Hong Kong) Ltd.
Group III (Electronic Components)
7/F., North Tower,
World Finance Centre,
Harbour City, Canton Road
Tsim Sha Tsui, Kowloon,
Hong Kong
Tel : <852>-(2)-735-9218
Fax : <852>-(2)-730-0281
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