HA12209F

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

HITACHI

ADE-207-221A (Z)

2nd Edition
Jun. 1999

Description

HA12209F is silicon monolithic bipolar IC providing Dolby noise reduction system*, music sensor system, REC equalizer system and each electronic control switch in one chip.

Functions

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

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 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, TYPE I/TYPE II and PB equalizer fully electronic control switching built-in.
- Available to reduce substrate-area because of high integration and small external parts.

* Dolby is a trademark of Dolby Laboratories Licensing Corporation.
A license from Dolby Laboratories Licensing Corporation is required for the use of this IC.

Hitachi semiconductor

Ordering Information

Standard Level

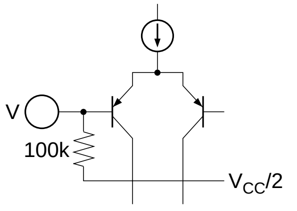
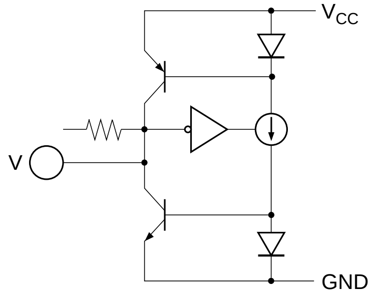
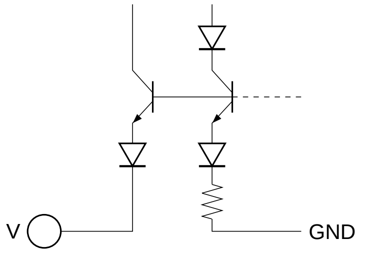
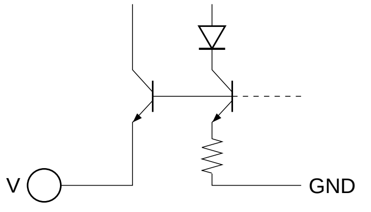
Product	Package	PB-OUT Level	REC-OUT Level	Dolby Level	Operating Voltage	
					Min	Max
HA12209F	FP-56	580mVrms	300mVrms	300mVrms	10V	15V

Function

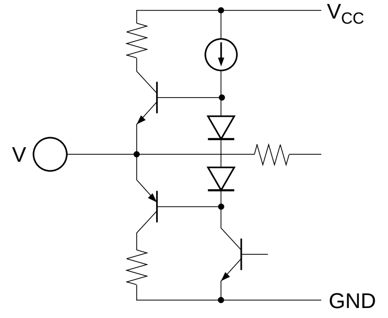
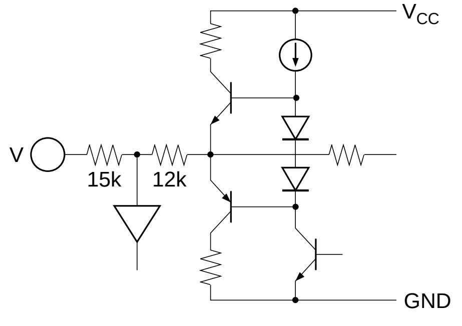
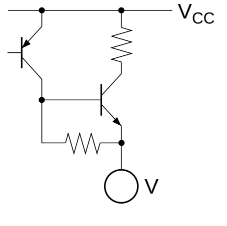
Product	Dolby B-NR	REC-EQ	Music Sensor	REC/PB Selection
HA12209F	❍	❍	❍	❍

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 of built-in resistor is necessary.

Pin Description, Equivalent Circuit (V_{CC}=12V, Ta=25°C, No signal, The value in the table show typical value.)

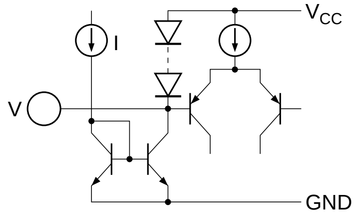
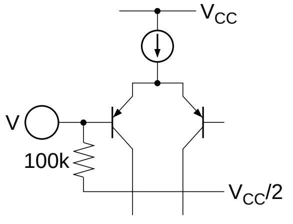
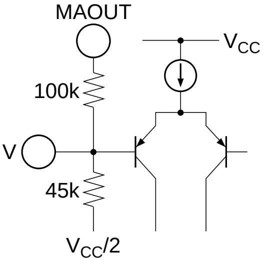
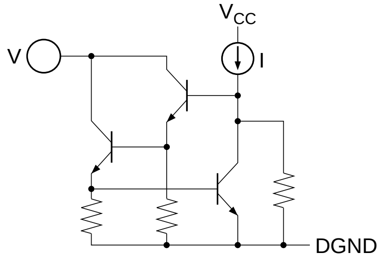
Pin No.	Pin Name	Note	Equivalent Circuit	Pin Description
52	AIN (R)	$V = V_{cc} / 2$		PB A deck input
48	AIN (L)			
54	BIN (R)			PB B deck input
45	BIN (L)			
56	RIN (R)			REC input
44	RIN (L)			
6	EQIN (R)			REC equalizer input
37	EQIN (L)			
4	DET (R)	V = 2.6V		Time constant pin for Dolby-NR
39	DET (L)			
49	RIP	$V = V_{cc} / 2$		Ripple filter
1	BIAS1	V = 0.6V		Dolby bias current input
42	BIAS2	V = 1.3V		REC equalizer bias current input

Pin Description, Equivalent Circuit (V_{CC}=12V, Ta=25°C, No signal, The value in the table show typical value.) (cont)

Pin No.	Pin Name	Note	Equivalent Circuit	Pin Description
3	PBOUT (R)	$V = V_{cc} / 2$		PB output
40	PBOUT (L)			
5	RECOUT (R)			REC output
38	RECOUT (L)			
8	EQOUT (R)			Equalizer output
35	EQOUT (L)			
32	MAOUT			MS amp. input *[1]
53	ABO (R)	$V = V_{cc} / 2$		Time constant pin for PB equalizer
46	ABO (L)			
25	BIAS (C)	$V = V_{cc} – 0.7$		REC bias current output
26	BIAS (N)			

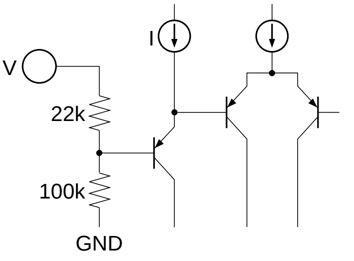
Note: 1. MS : Music Sensor

Pin Description, Equivalent Circuit (V_{CC}=12V, Ta=25°C, No signal, The value in the table show typical value.) (cont)

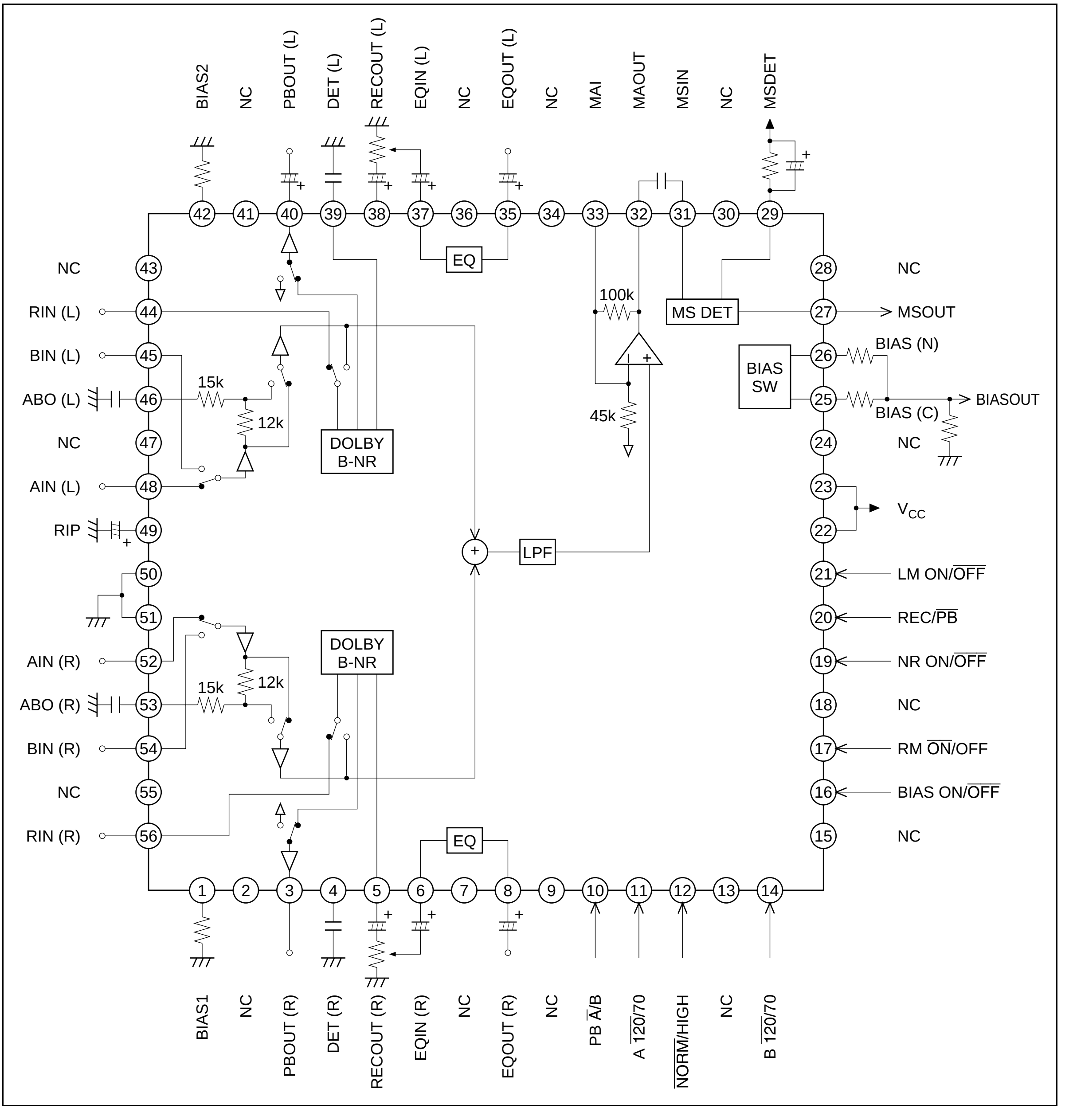
Pin No.	Pin Name	Note	Equivalent Circuit	Pin Description
29	MSDET	I = 0µA		Time constant pin for MS *[1]
31	MSIN	V = V_{cc} / 2		MS input
33	MAI	V = V_{cc} / 2		MS amp. output
27	MSOUT	I = 0µA		MS output (to MPU)

Note: 1. MS : Music Sensor

Pin Description, Equivalent Circuit (V_{CC}=12V, Ta=25°C, No signal, The value in the table show typical value.) (cont)

Pin No.	Pin Name	Note	Equivalent Circuit	Pin Description
10	PB A/B	I = 20µA		Mode control input
11	A 120/70			
12	NORM/HIGH			
14	B 120/70			
16	BIAS ON/OFF			
17	RM ON/OFF			
19	NR ON/OFF			
20	REC/PB			
21	LM ON/OFF			
22, 23	V_{CC}	$V = V_{CC}$		Power supply
50, 51	GND	V = 0V		GND pin
2, 7, 9, 13, 15, 18, 24, 28, 30, 34, 36, 41, 43, 47, 55	NC			No connection

Block Diagram



Functional Description

Power Supply Range

HA12209F is designed to operate on single supply.

Table 1 Spply Voltage

Item	Power Supply Range
Single Supply	10V to 15V

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

Reference Voltage

For this IC, the reference voltage ($V_{CC}/2$) occurrence device is built-in as AC grand. A capacitor for a ripple filter is greatly small characteristic with 1/100 compared with conventional device.

And, the reference voltage are provided for the left channel and the right channel separately.

The block diagram is shown as figure 1.

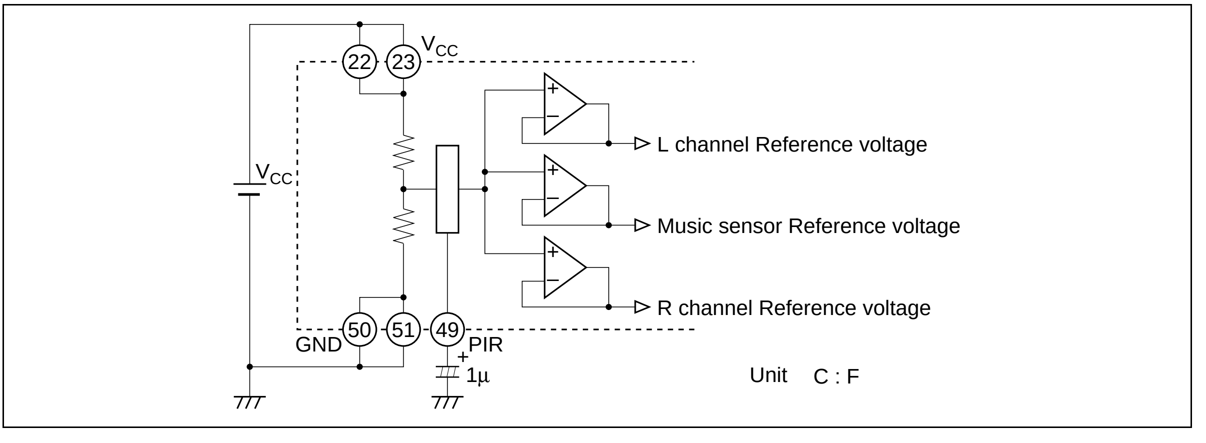
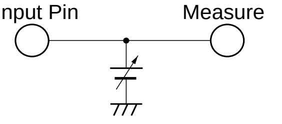


Figure 1 Reference Voltage

Operating Mode Control

HA12209F provides fully electronic switching circuits. And each operating mode control is controlled by parallel data (DC voltage).

Table 2 Control Voltage

Pin No.	Lo	Hi	Unit	Test Condition
10, 11, 12, 14, 16, 17, 19, 20, 21	–0.2 to 1.0	4.0 to 5.3	V	

Note: 1. Each pins are on pulled down with 100kΩ internal resistor. Therefore, it will be low-level when each pins are open.
2. Over shoot level and under shoot level of input signal must be the standardized. (High: 5.3V, Low: –0.2V)
3. For reduction of pop noise, connect 1µF to 22µF 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.

Input Block Diagram and Level Diagram

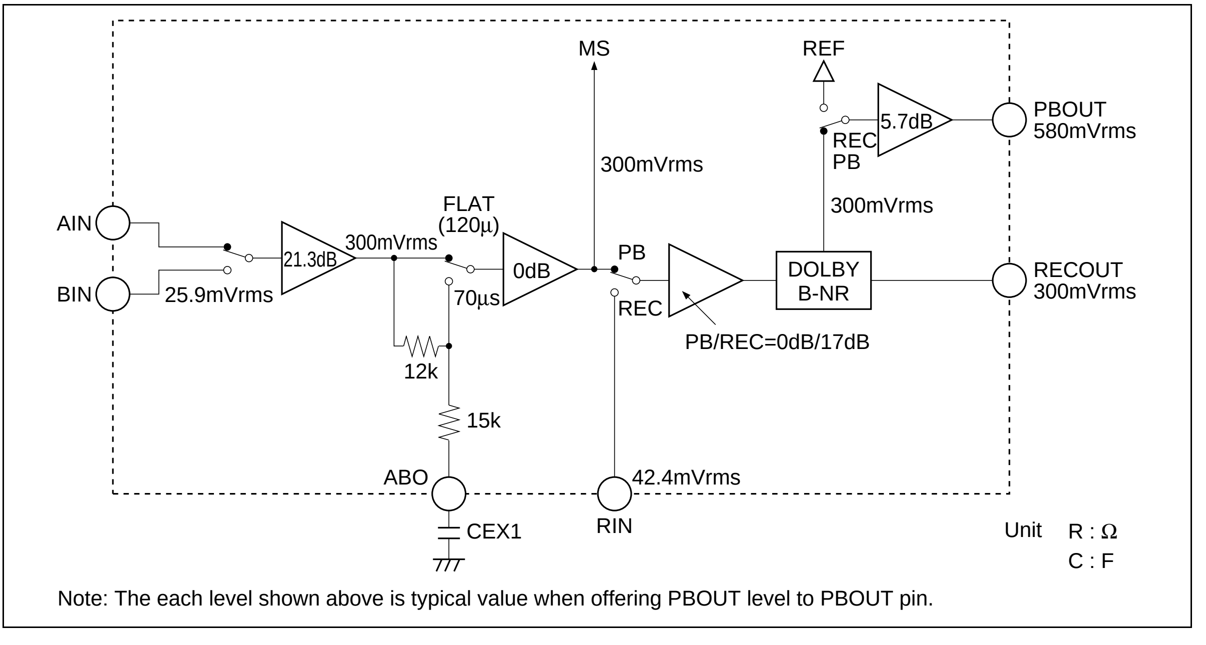


Figure 2 Input Block Diagram

PB Equalizer

By switching logical input level of 11 pin (for Ain) and 14 pin (for Bin), you can equalize corresponding to tape position at play back mode.

With the capacity CEX1 capacitance that we showed for figure 2 70 µs by the way figure seem to 3 they are decided.

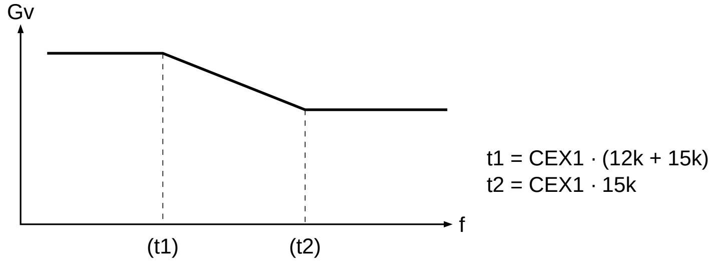


Figure 3   Frequency Characteristic of PB Equalizer

The sensitivity Adjustment of Music Sensor

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

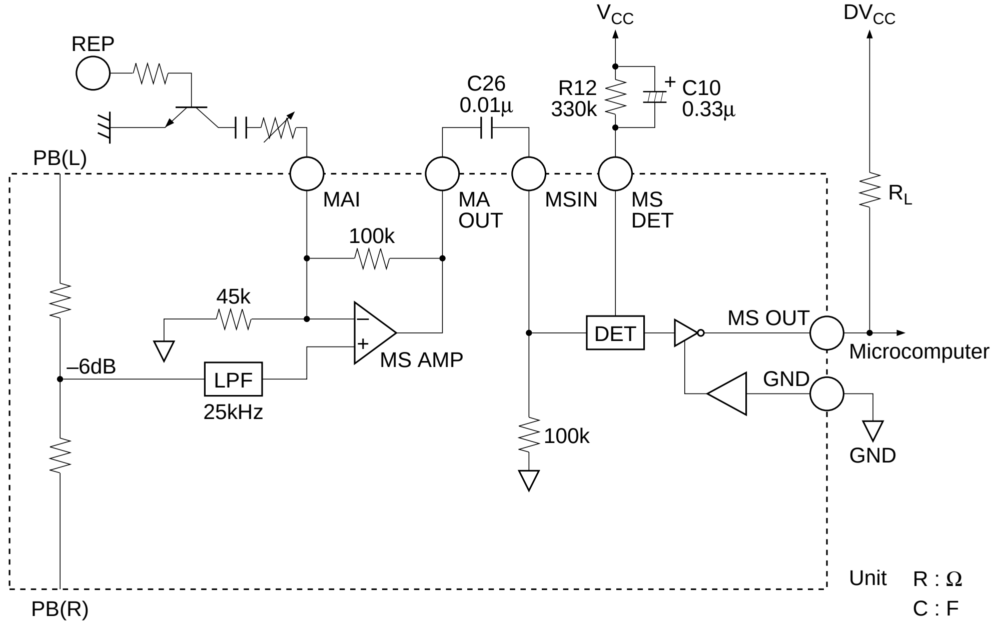


Figure 4   Music Sensor Block Diagram

The sensitivity of Music Sensor

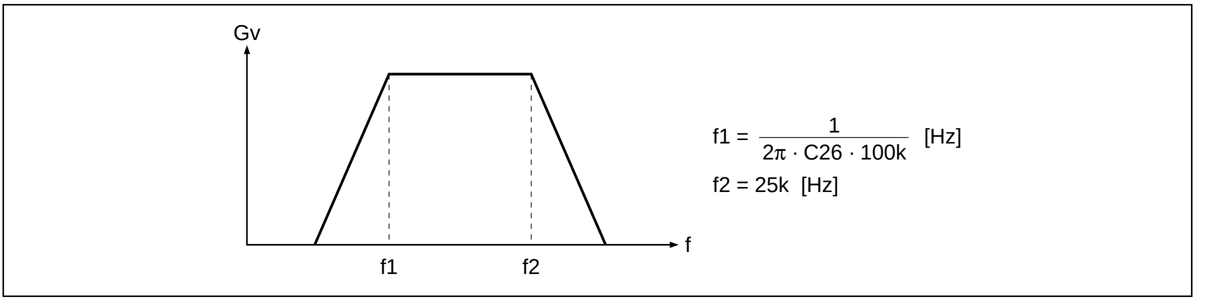


Figure 5 Frequency Characteristic of MSIN

Occasion of the external component of figure 4, f1 is 159Hz. A standard level of MS input pin 25.9mVrms, therefore, the sensitivity of music sensor (S) can request it, by lower formulas.

A = MS Amp Gain
B = PB input Gain $\times$ (1/2)*1
C = Sensed voltage

$$S = 20\log \frac{C}{25.9 \cdot A \cdot B} \ [\mathrm{dB}]$$

$20\log (A \times B) = D$ [dB]

PB input Gain = 21.3 [dB] $\qquad S = 14 - D$ [dB]

Note: 1. Case of one-sided channel input.

Time Constant of Detection

Figure 6(1) generally shows that detection time is in proportion to value of capacitor C10. But, with Attack*[2] and Recovery*[3] the detection time differs exceptionally.

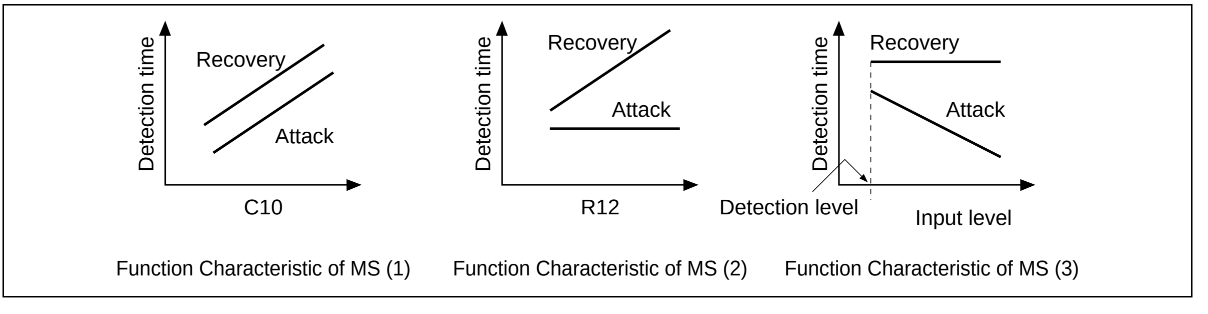


Figure 6 Function Characteristics of MS

Like the figure 6(2), Recovery time is variably possible by value of resistor R12. 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.

Note: 2. Attack : Non-music → Music
3. Recovery : Music → Non-music

Music Sensor Output (MSOUT)

As for internal circuit of music sensor block, music sensor out 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 = 10k to 22kΩ)

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

The Tolerances of External Components

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 C2 and C15.

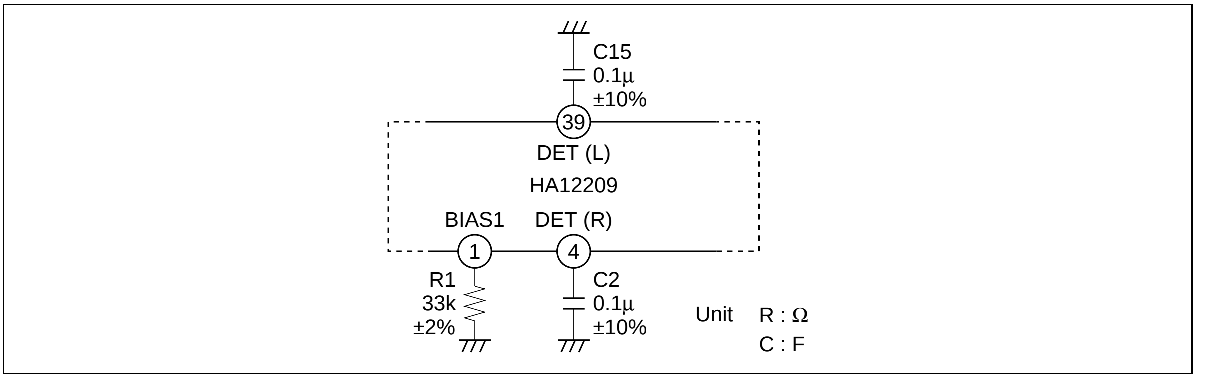


Figure 7 Tolerance of External Components

Low-Boost

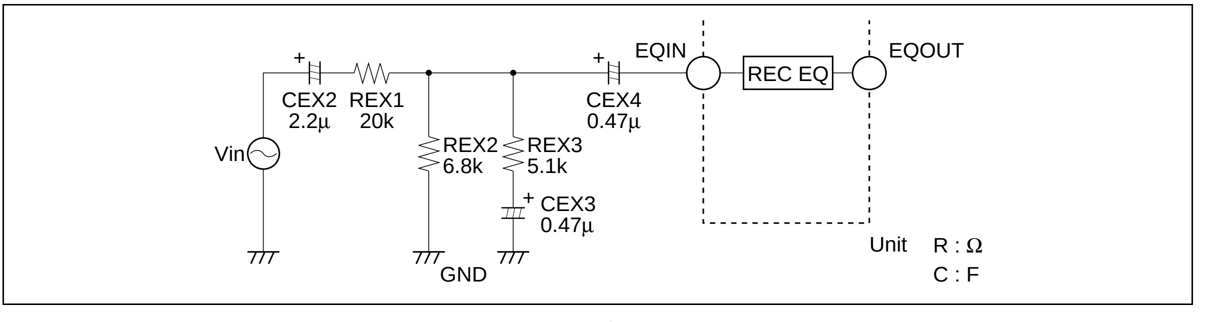
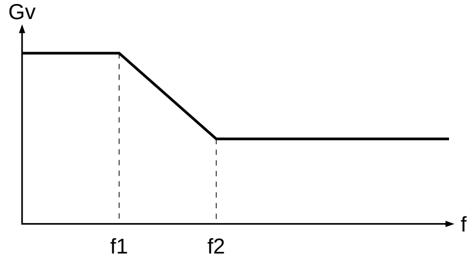


Figure 8 Example of Low Boost Circuit

External components shown figure 8 gives frequency response to take 6dB boost. And cut off frequency can request it, by lower formulas.



$$f1 = \frac{1}{2\pi \cdot CEX3 \cdot (REX3 + R0)} \ [Hz]$$

$$f2 = \frac{1}{2\pi \cdot CEX3 \cdot REX3} \ [Hz] \qquad R0 = \frac{REX1 \cdot REX2}{REX1 + REX2} \ [\Omega]$$

Figure 9   Frequency Characteristic of Low-Boost

Bias Switch

This series built-in DC voltage generator for bias oscillator and its bias switches.

External resistor R8, R10 which corresponded with tape positions and bias out voltage are relater with below.

$$Vbias \fallingdotseq \left(\frac{R9}{(R10 \text{ or } R8) + R9} \right) \times (VCC - 0.7) \ [V]$$

Bias switch follows to a logic of 14 pin (B 120/70).

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

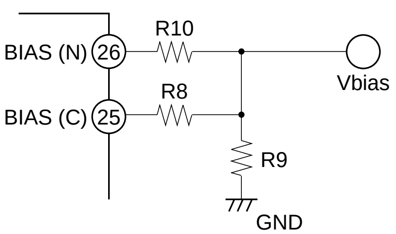


Figure 10   External Components of Bias Block

Absolute Maximum Rating (Ta=25°C)

Item	Symbol	Rating	Unit	Note
Max supply voltage	V_{CC} max	16	V	
Power dissipation	P_T	500	mW	Ta ≤ 75°C
Operating temperature	Topr	–40 to +75	°C	
Storage temperature	Tstg	–55 to +125	°C	

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

Item	Symbol	Min	Typ	Max	Unit	Test Condition: IC Condition*1 NR ON/OFF	REC/PB	A/B	120µ/70µ	MUTE	fin (Hz)	RECOUT level (dB)	Other
Quiescent current	I_Q	15.0	23.0	30.0	mA	OFF	PB	A	120	ON	—	—	No signal
Input AMP. gain	G_V PB	25.5	27.0	28.5	dB	OFF	PB	A/B	120	OFF	1k	0	
	G_V REC	21.2	22.7	24.2	dB	OFF	REC	A	120	OFF	1k	0	
B type Encode boost	ENC 2k (1)	2.8	4.3	5.8	dB	ON	REC	A	120	OFF	2k	–20	
	ENC 2k (2)	7.0	8.5	10.0	dB	ON	REC	A	120	OFF	2k	–30	
	ENC 5k (1)	1.7	3.2	4.7	dB	ON	REC	A	120	OFF	5k	–20	
	ENC 5k (2)	6.7	8.2	9.7	dB	ON	REC	A	120	OFF	5k	–30	
Signal handling	Vo max	12.0	13.0	—	dB	ON	REC	A	120	OFF	1k	—	THD=1%*2
Signal to noise ratio	S/N	64.0	70.0	—	dB	ON	REC	A	120	OFF	1k	—	Rg=5.1kΩ, CCIR/ARM
Total harmonic distortion	T.H.D.	Ñ	0.05	0.3	%	ON	REC	A	120	OFF	1k	0	
Channel separation	CTRL (1)	70.0	80.0	—	dB	OFF	PB	A/B	120	OFF	1k	+12	
	CTRL (2)	75.0	85.0	—	dB	OFF	REC	A	120	OFF	1k	+12	
Crosstalk	CT A/B	60.0	70.0	—	dB	OFF	PB	A/B	120	OFF	1k	+12	
	CT R/P	70.0	80.0	—	dB	OFF	REC/PB	A/B	120	OFF	1k	+12	
Mute attenuation	MUTE	70.0	80.0	—	dB	OFF	PB	A	120	ON	1k	+12	
70µ EQ gain	G_V EQ 1k	24.0	25.5	27.0	dB	OFF	PB	A/B	70	OFF	1k	0	
	G_V EQ 10k	20.8	22.3	23.8	dB	OFF	PB	A/B	70	OFF	10k	0	
MS sensing level*3	V_{ON}	–15.4	–11.4	–7.4	dB	OFF	PB	A	120	OFF	5k	—	
MS output low level	V_{OL}	—	1.0	1.5	V	OFF	PB	A	120	OFF	—	—	
MS output leak current	I_{OH}	—	—	2.0	µA	OFF	PB	A	120	OFF	—	—	
Control voltage	V_{IL}	–0.2	—	1.0	V	—	—	—	—	—	—	—	
	V_{IH}	4.0	—	5.3	V	—	—	—	—	—	—	—	

Note: 1. Other IC condition : REC-MUTE OFF, TYPE I, Normal speed, Bias OFF

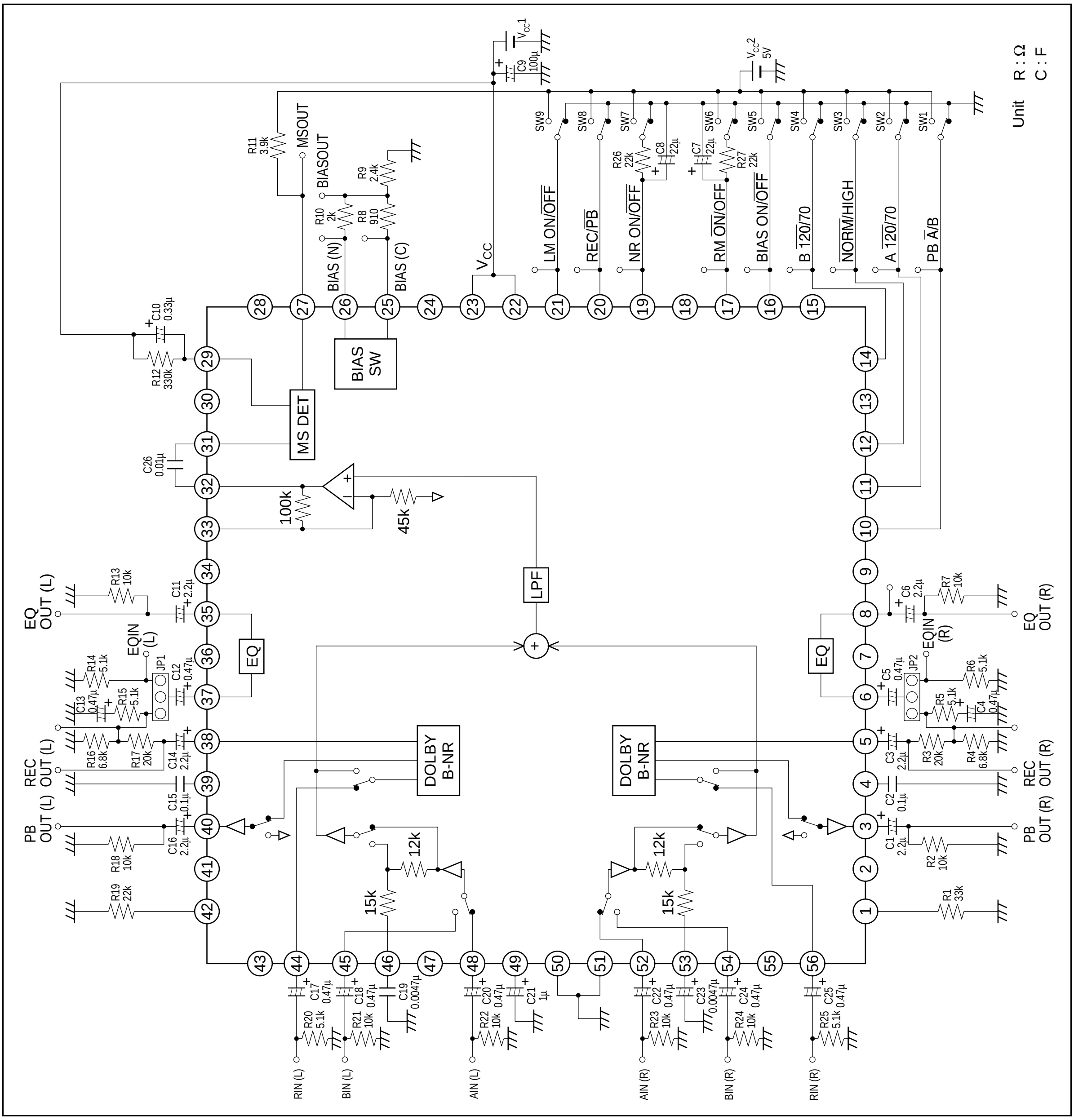
2. V_{CC}=10V

3. For inputting signal to one side channel

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

Item	Symbol	Min	Typ	Max	Unit	Test Condition TAPE	SPEED	
Equalizer S/N	S/N (EQ)	55	58	—	dB	TYPE I	NORM	Rg=5.1kΩ, A-WTG Filter
Equalizer maximum input	Vin max (EQ)	10.5	12.5	—	dB	TYPE I	NORM	f=1kHz, THD=1%, Vin=–26dBs=0dB
Equalizer Total Harmonic Distortion	T.H.D. (EQ)	—	0.2	0.5	%	TYPE I	NORM	f=1kHz, Vin=–26dBs
Equalizer offset voltage	Vofs (EQ)	–500	0	500	mV	TYPE I	NORM	No signal
Equalizer frequency responce (TYPE I-NORM)	$G_{VEQ-1N1}$	18.5	20.0	21.5	dB	TYPE I	NORM	f=1kHz, Vin=–46dBs
	$G_{VEQ-1N2}$	19.4	21.4	23.4	dB			f=5kHz, Vin=–46dBs
	$G_{VEQ-1N3}$	29.1	32.1	35.1	dB			f=12.5kHz, Vin=–46dBs
Equalizer frequency responce (TYPE II-NORM)	$G_{VEQ-2N1}$	21.4	22.9	24.4	dB	TYPE II	NORM	f=1kHz, Vin=–46dBs
	$G_{VEQ-2N2}$	23.3	25.3	27.3	dB			f=5kHz, Vin=–46dBs
	$G_{VEQ-2N3}$	32.0	35.0	38.0	dB			f=12.5kHz, Vin=–46dBs
Equalizer frequency responce (TYPE I-HIGH)	$G_{VEQ-1H1}$	17.7	19.2	20.7	dB	TYPE I	HIGH	f=2kHz, Vin=–46dBs
	$G_{VEQ-1H2}$	19.8	21.8	23.8	dB			f=10kHz, Vin=–46dBs
	$G_{VEQ-1H3}$	31.0	34.0	37.0	dB			f=25kHz, Vin=–46dBs
Equalizer frequency responce (TYPE II-HIGH)	$G_{VEQ-2H1}$	20.5	22.0	23.5	dB	TYPE II	HIGH	f=2kHz, Vin=–46dBs
	$G_{VEQ-2H2}$	24.3	26.3	28.3	dB			f=10kHz, Vin=–46dBs
	$G_{VEQ-2H3}$	35.7	38.7	41.7	dB			f=25kHz, Vin=–46dBs
REC MUTE attenuation	REC-MUTE	60	70	—	dB	TYPE I	NORM	f=1kHz, Vin=–14dBs
Bias out Max level	Bias on	V_{CC} –1.4	V_{CC} –1.0	—	V	RL=2.4kΩ+270Ω		
Bias out offset	Bias off	–100	0	100	mV	RL=2.4kΩ+270Ω		

Test Circuit



HITACHI

Parallel Data Format

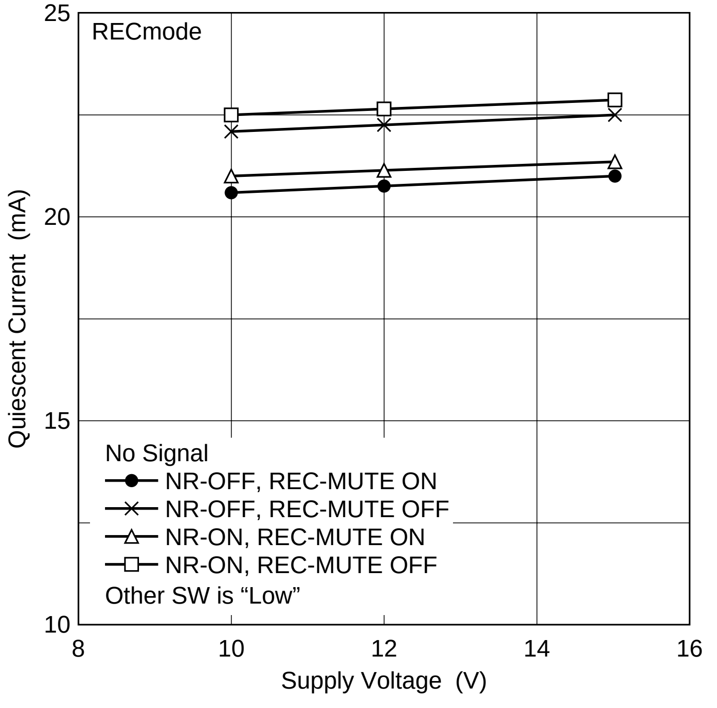
Pin No.	Pin Name	Lo	Hi	Mode “Pin Open”
10	PB $\overline{\text{A}}$/B	Ain*[1]	Bin*[1]	Lo
11	A $\overline{\text{120}}$/70	*[1]	*[1]	Lo
12	$\overline{\text{NORM}}$/HIGH	Normal speed	High speed	Lo
14	B $\overline{\text{120}}$/70	REC EQ TYPE I*[1] Bias TYPE I	REC EQ TYPE II*[1] Bias TYPE II	Lo
16	BIAS ON/$\overline{\text{OFF}}$	BIAS OFF	BIAS OFF	Lo
17	RM $\overline{\text{ON}}$/OFF	REC MUTE ON	REC MUTE OFF	Lo
19	NR ON/$\overline{\text{OFF}}$	NR OFF	NR ON	Lo
20	REC/$\overline{\text{PB}}$	PB MODE	REC MODE	Lo
21	LM ON/$\overline{\text{OFF}}$	LINE MUTE OFF	LINE MUTE ON	Lo

Note: 1. PB EQ LOGIC

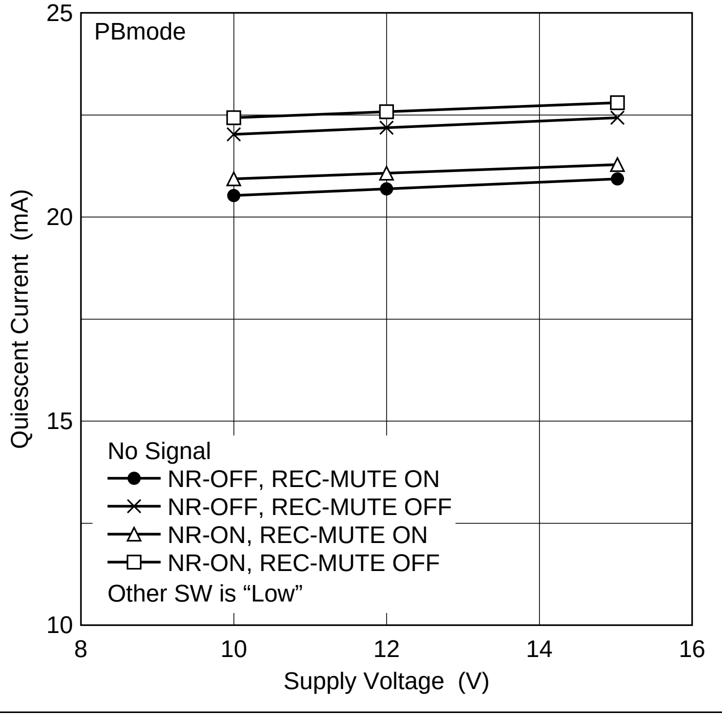
		PB $\overline{\text{A}}$/B	
A $\overline{\text{120}}$/70	**B $\overline{\text{120}}$/70**	**Lo**	**Hi**
Lo	Lo	FLAT	FLAT
Lo	Hi	FLAT	70μ
Hi	Lo	70μ	FLAT
Hi	Hi	70μ	70μ

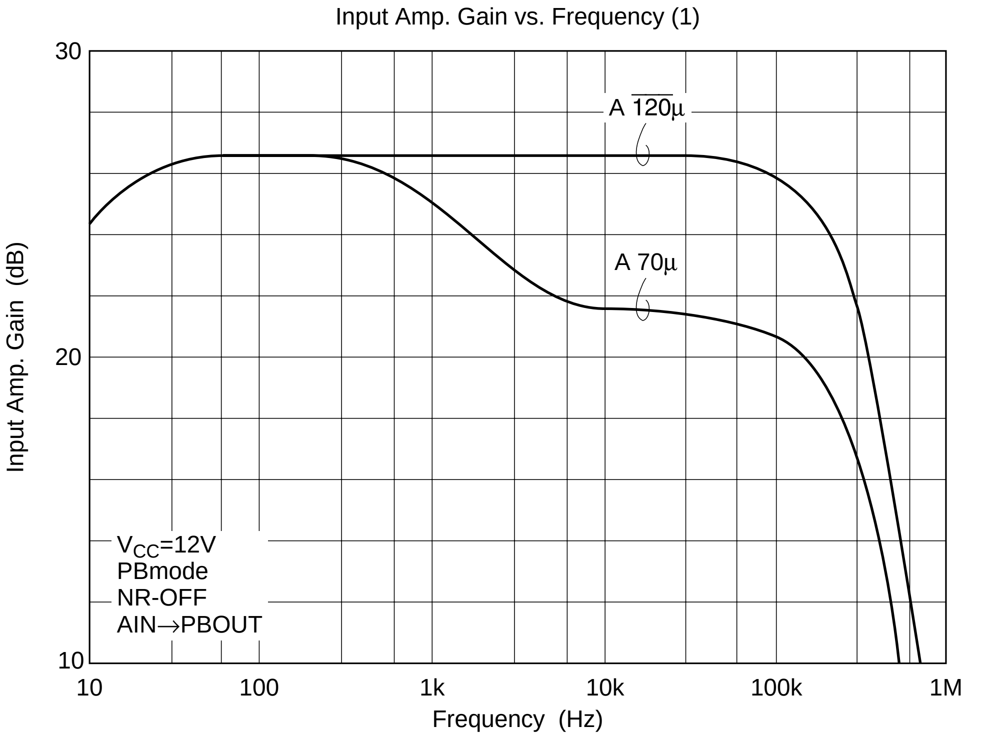
Characteristics Curve

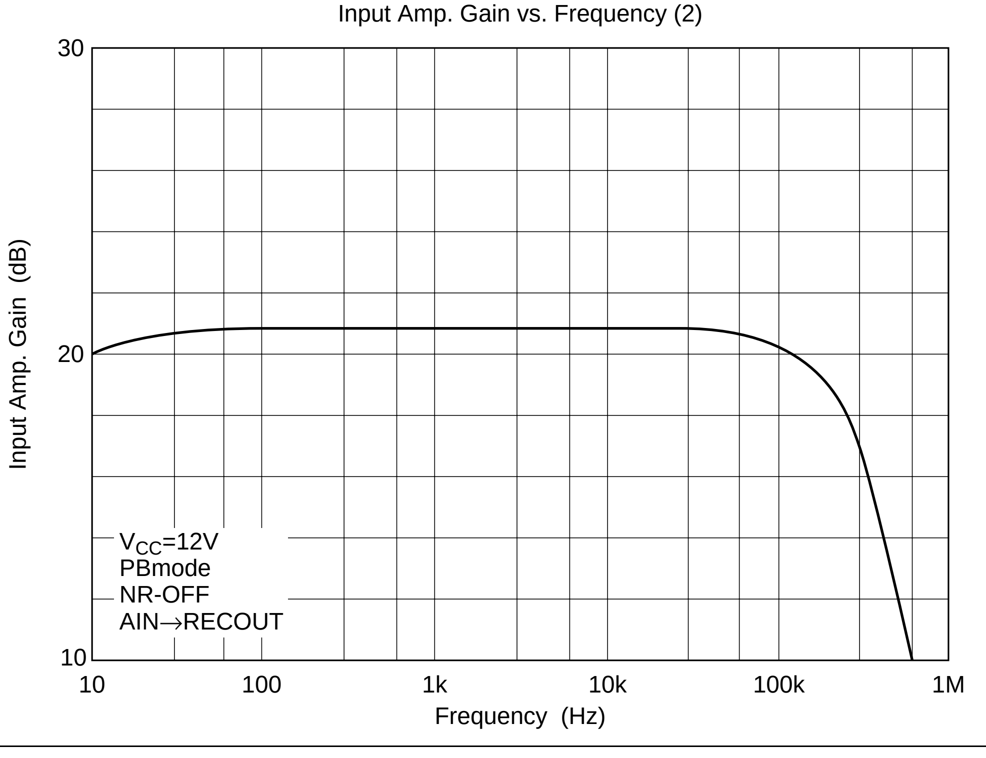
Quiescent Current vs. Supply Voltage (1)

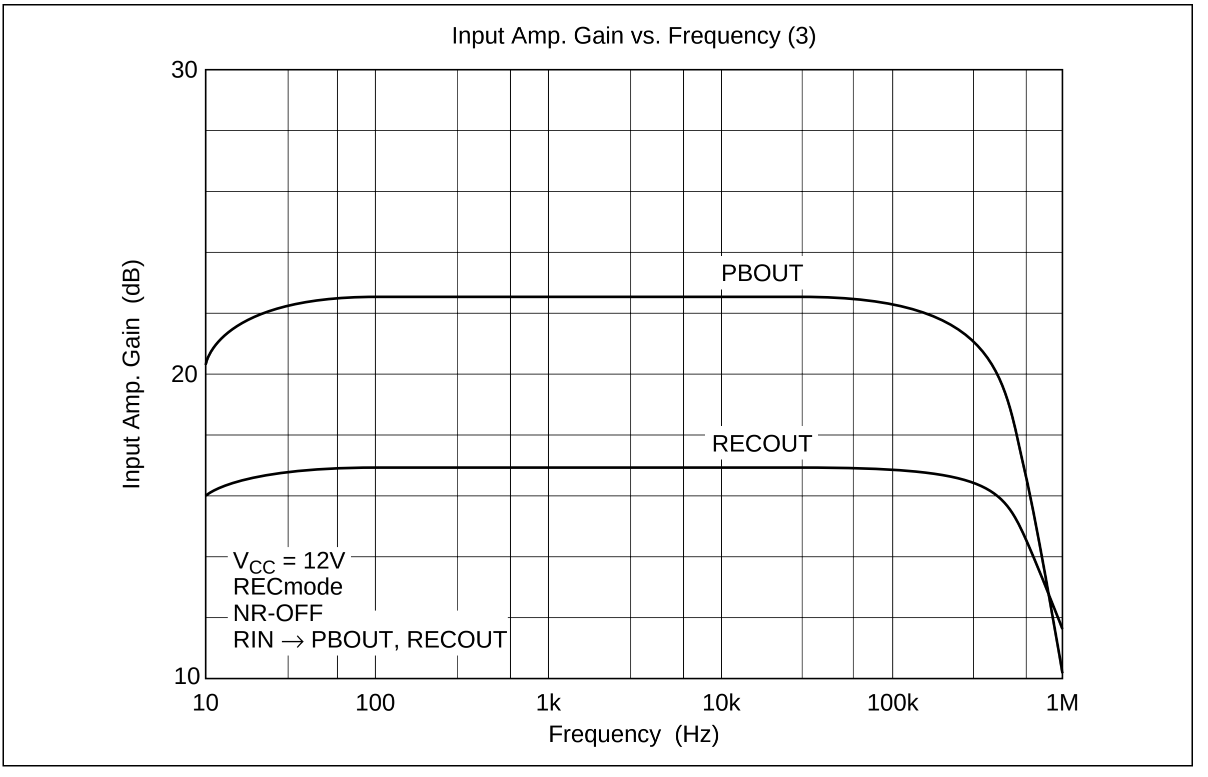


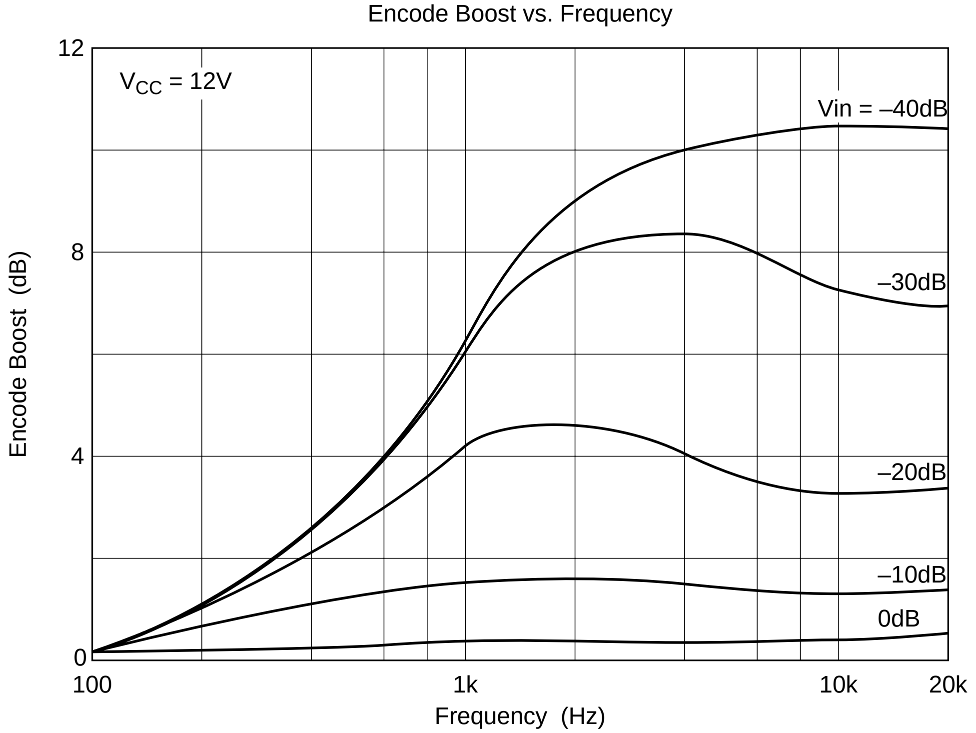
Quiescent Current vs. Supply Voltage (2)

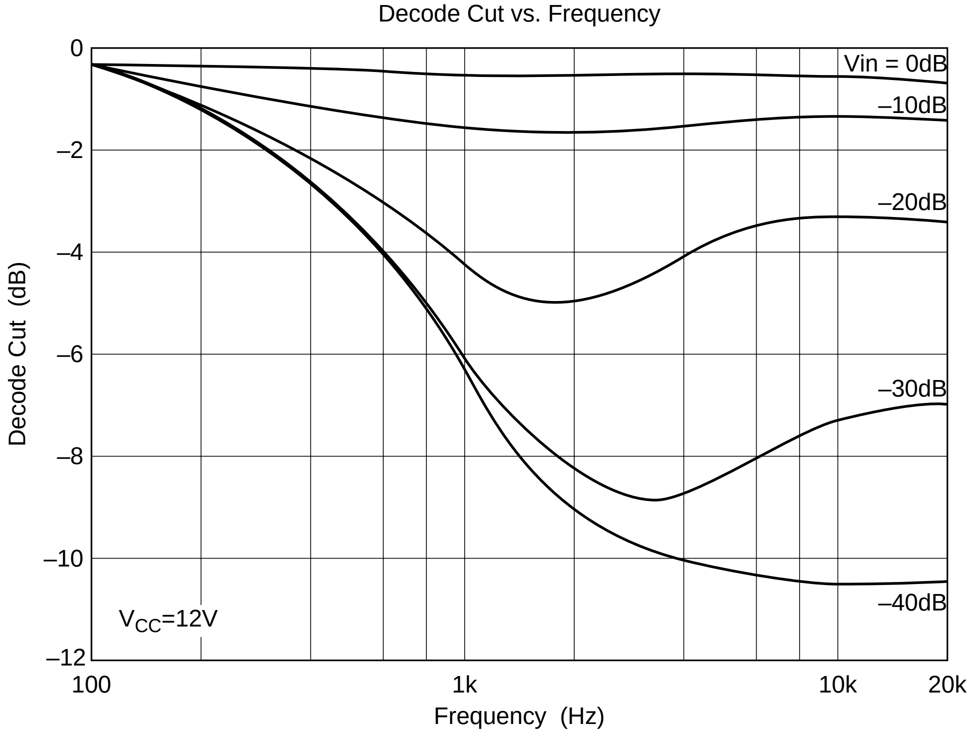


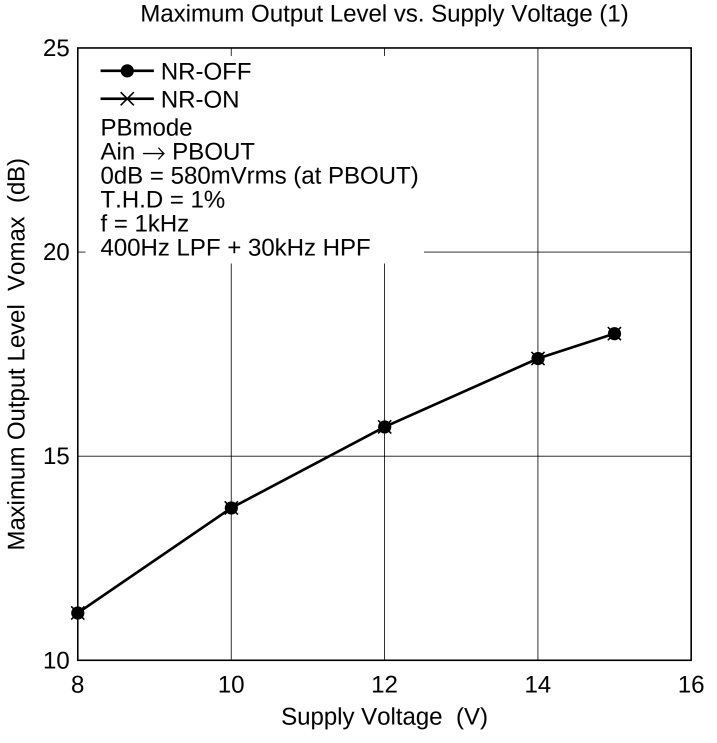

Input Amp. Gain vs. Frequency (1)
Input Amp. Gain (dB)
30
20
10
A 120μ
A 70μ
VCC=12V
PBmode
NR-OFF
AIN→PBOUT
10
100
1k
10k
100k
1M
Frequency (Hz)

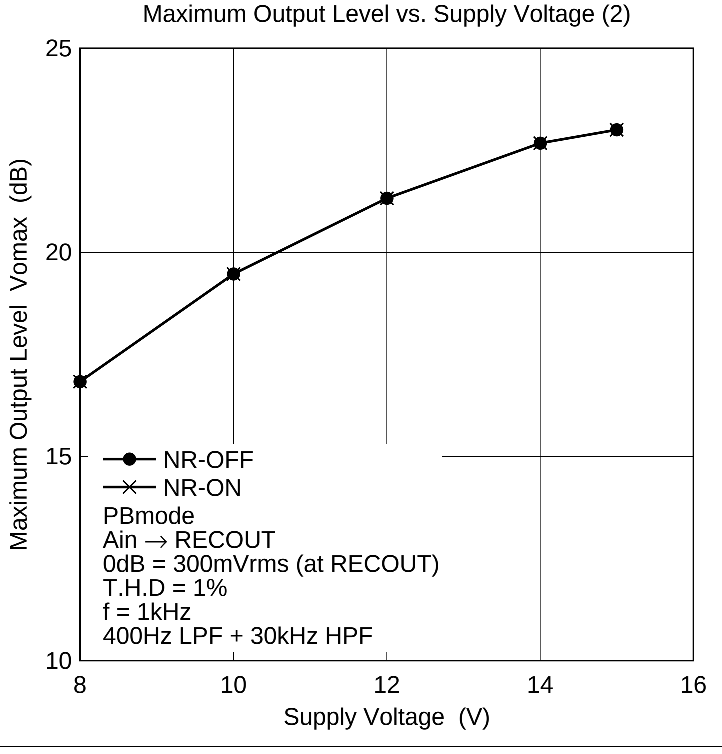

Input Amp. Gain vs. Frequency (2)
Input Amp. Gain (dB)
30
20
10
VCC=12V
PBmode
NR-OFF
AIN→RECOUT
10
100
1k
10k
100k
1M
Frequency (Hz)

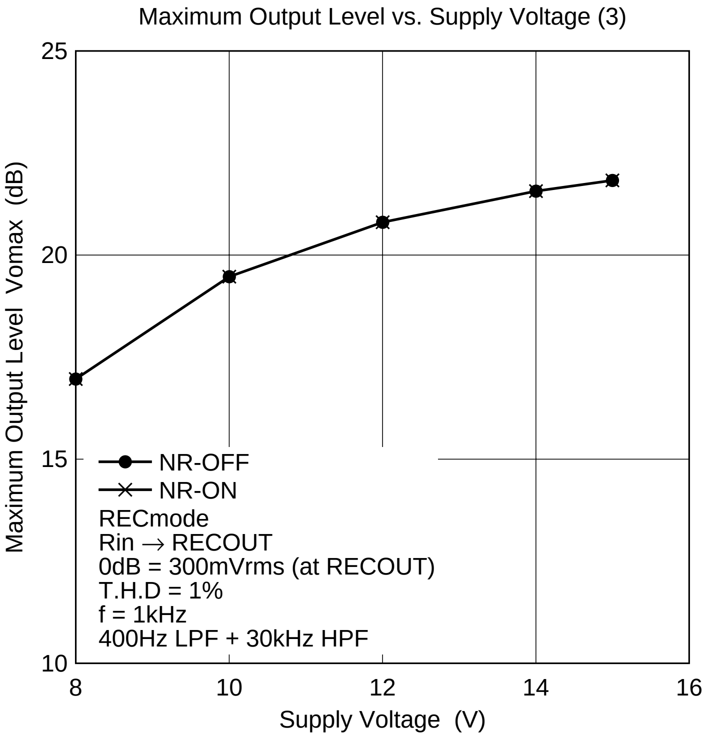

Input Amp. Gain vs. Frequency (3)
Input Amp. Gain (dB)
30
20
10
PBOUT
RECOUT
VCC = 12V
RECmode
NR-OFF
RIN → PBOUT, RECOUT
10
100
1k
10k
100k
1M
Frequency (Hz)

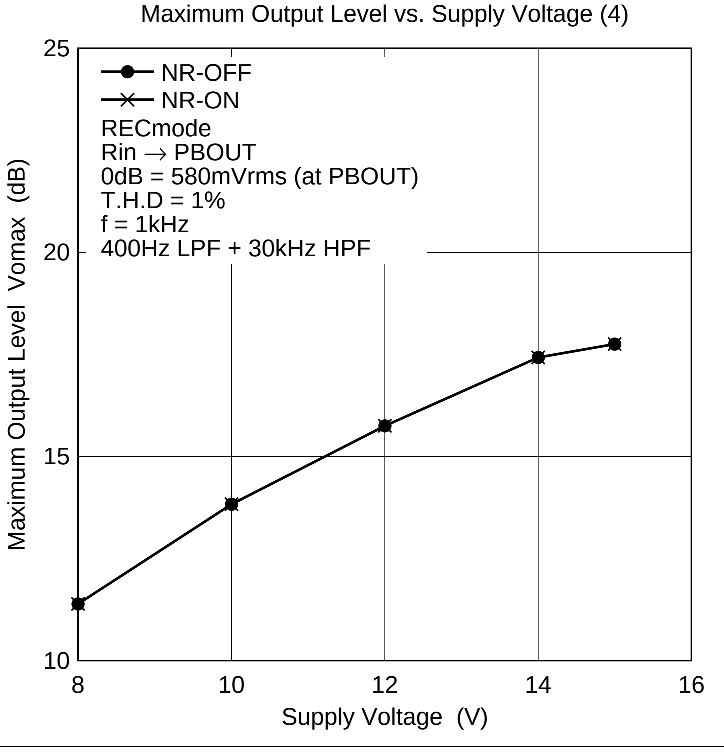

Encode Boost vs. Frequency
12
8
4
0
VCC = 12V
Vin = –40dB
–30dB
–20dB
–10dB
0dB
Encode Boost (dB)
100
1k
10k
20k
Frequency (Hz)

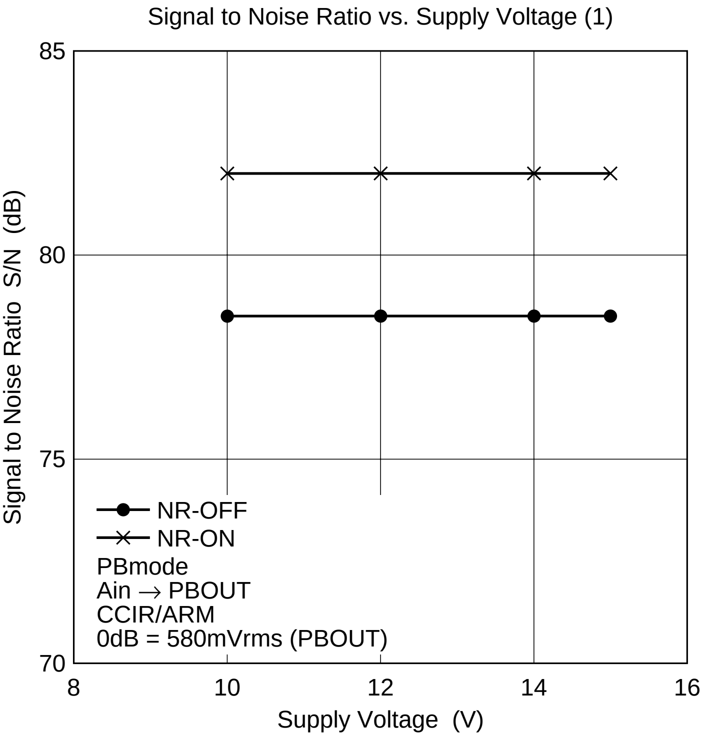

Decode Cut vs. Frequency
0
–2
–4
–6
–8
–10
–12
Vin = 0dB
–10dB
–20dB
–30dB
–40dB
VCC=12V
Decode Cut (dB)
100
1k
10k
20k
Frequency (Hz)

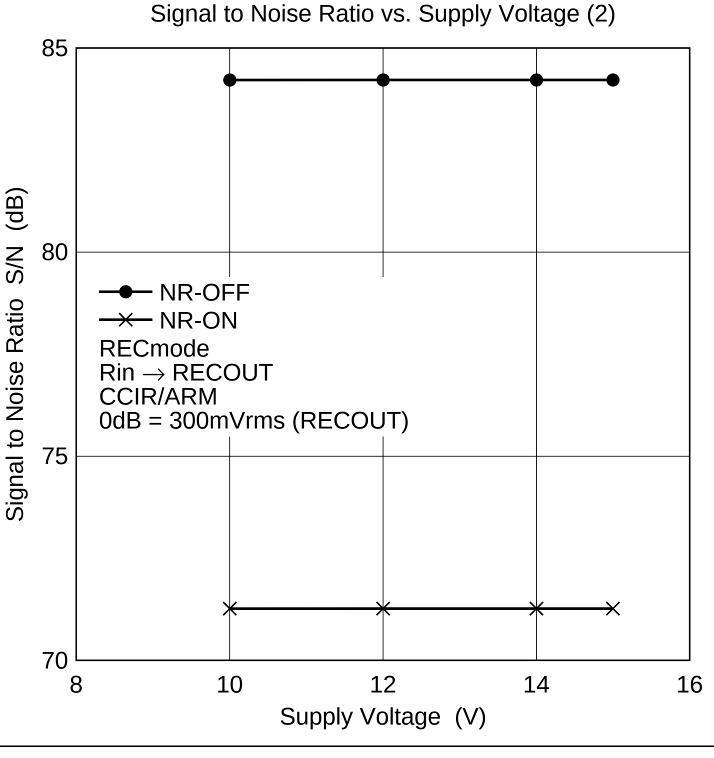

Maximum Output Level vs. Supply Voltage (1)
Maximum Output Level Vomax (dB)
25
20
15
10
8
10
12
14
16
Supply Voltage (V)
NR-OFF
NR-ON
PBmode
Ain → PBOUT
0dB = 580mVrms (at PBOUT)
T.H.D = 1%
f = 1kHz
400Hz LPF + 30kHz HPF


Maximum Output Level vs. Supply Voltage (2)
Maximum Output Level Vomax (dB)
25
20
15
10
8
10
12
14
16
Supply Voltage (V)
NR-OFF
NR-ON
PBmode
Ain → RECOUT
0dB = 300mVrms (at RECOUT)
T.H.D = 1%
f = 1kHz
400Hz LPF + 30kHz HPF


Maximum Output Level vs. Supply Voltage (3)
Maximum Output Level Vomax (dB)
25
20
15
10
8
10
12
14
16
Supply Voltage (V)
NR-OFF
NR-ON
RECmode
Rin → RECOUT
0dB = 300mVrms (at RECOUT)
T.H.D = 1%
f = 1kHz
400Hz LPF + 30kHz HPF

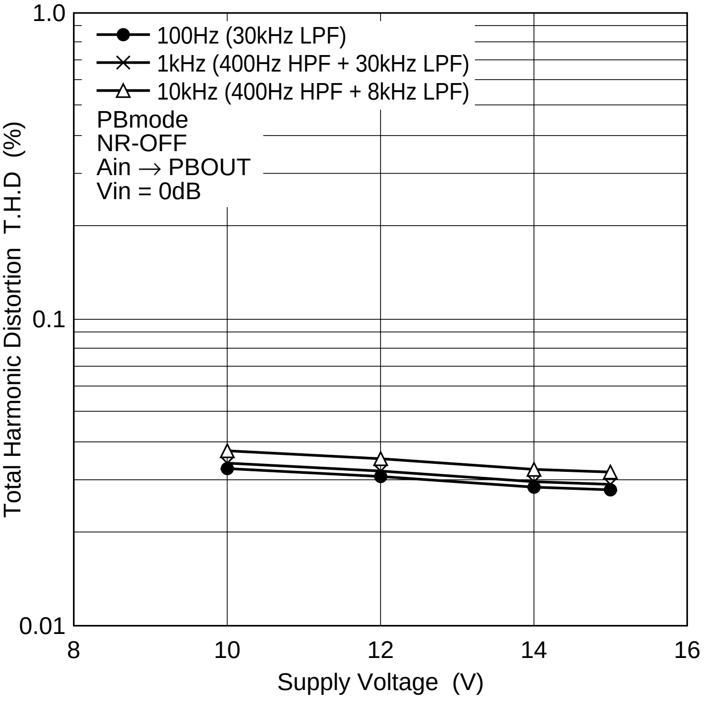

Maximum Output Level vs. Supply Voltage (4)
Maximum Output Level Vomax (dB)
25
20
15
10
8
10
12
14
16
Supply Voltage (V)
NR-OFF
NR-ON
RECmode
Rin → PBOUT
0dB = 580mVrms (at PBOUT)
T.H.D = 1%
f = 1kHz
400Hz LPF + 30kHz HPF


Signal to Noise Ratio vs. Supply Voltage (1)
Signal to Noise Ratio S/N (dB)
85
80
75
70
8
10
12
14
16
Supply Voltage (V)
NR-OFF
NR-ON
PBmode
Ain → PBOUT
CCIR/ARM
0dB = 580mVrms (PBOUT)

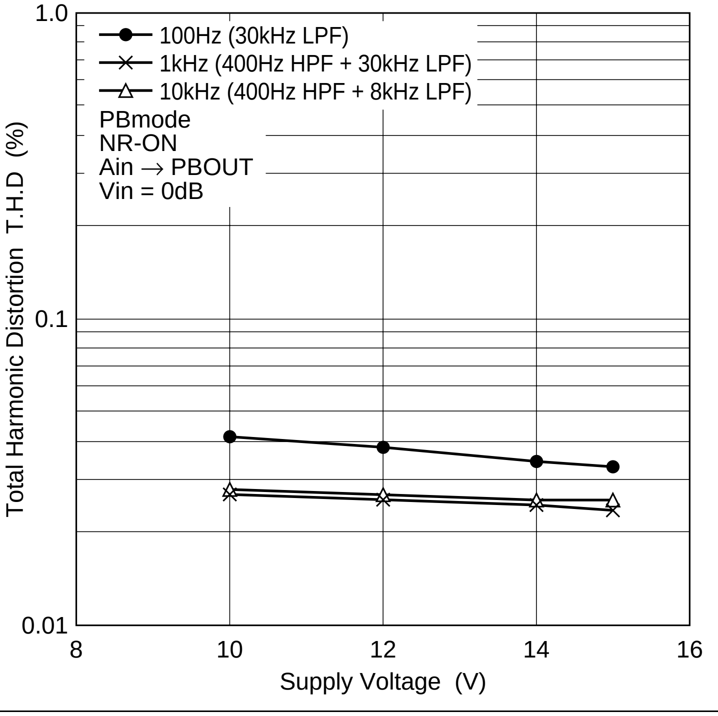

Signal to Noise Ratio vs. Supply Voltage (2)
Signal to Noise Ratio S/N (dB)
85
80
75
70
8
10
12
14
16
Supply Voltage (V)
NR-OFF
NR-ON
RECmode
Rin → RECOUT
CCIR/ARM
0dB = 300mVrms (RECOUT)

HITACHI

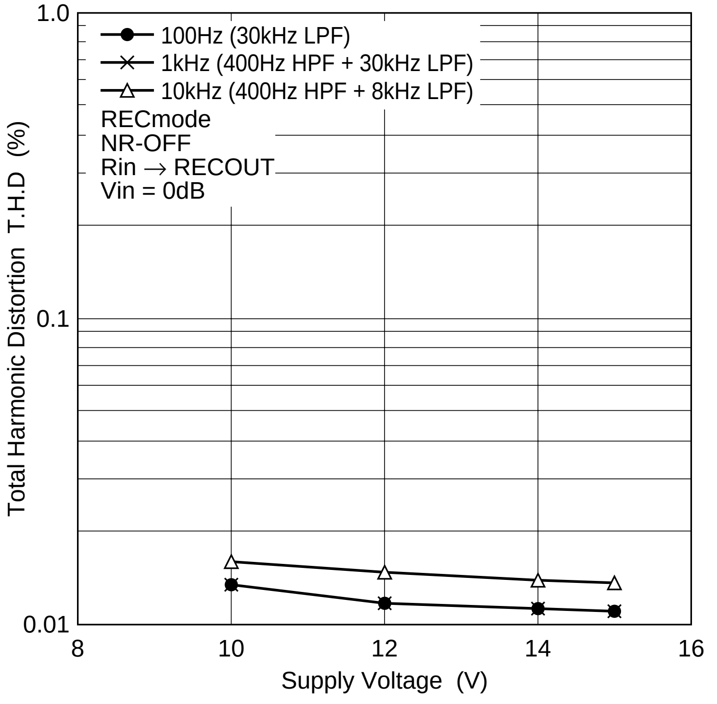
Total Harmonic Distortion vs. Supply Voltage (1)



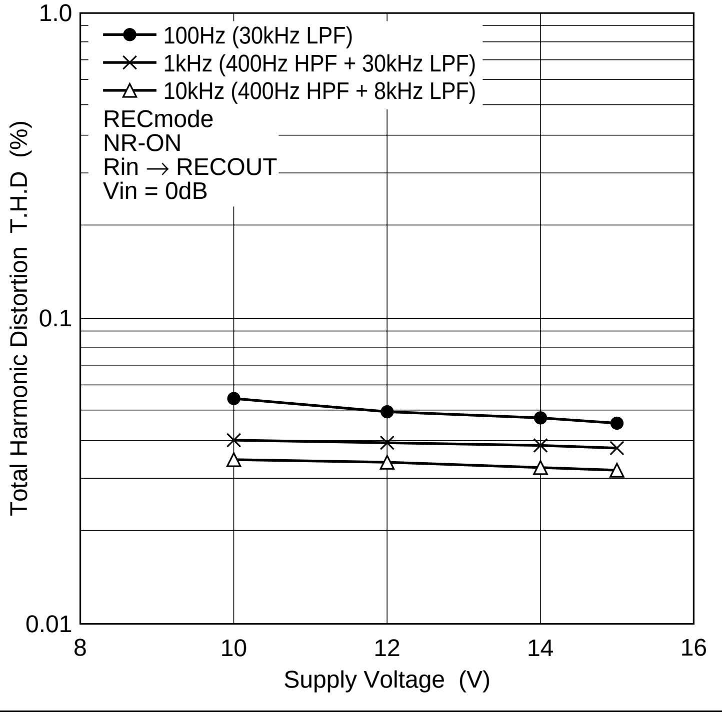
Total Harmonic Distortion vs. Supply Voltage (2)



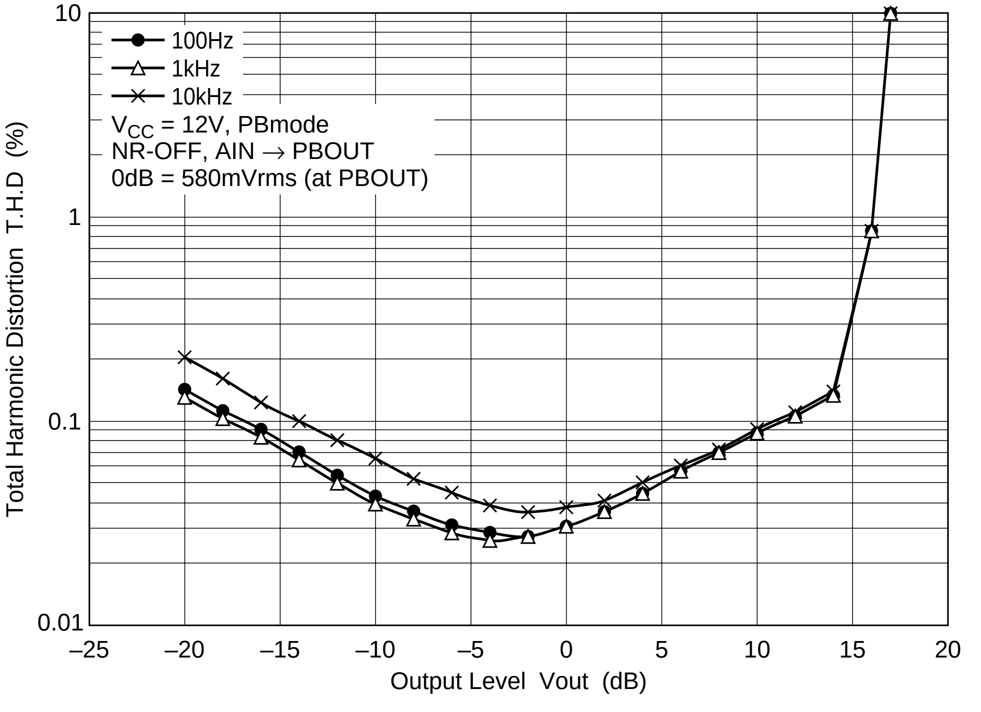
Total Harmonic Distortion vs. Supply Voltage (3)



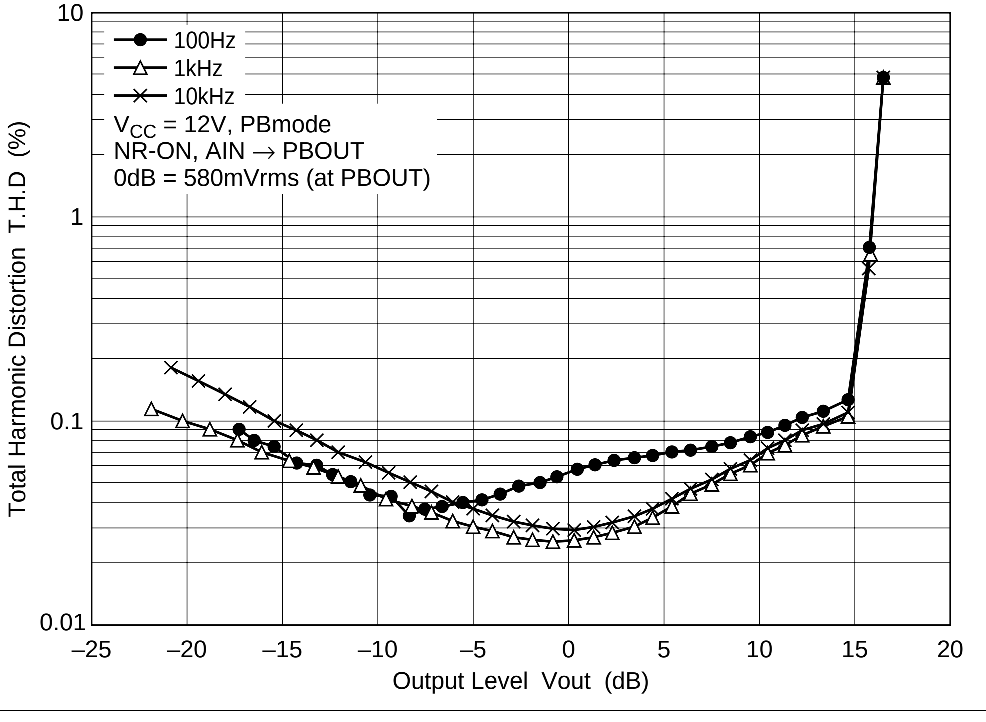
Total Harmonic Distortion vs. Supply Voltage (4)

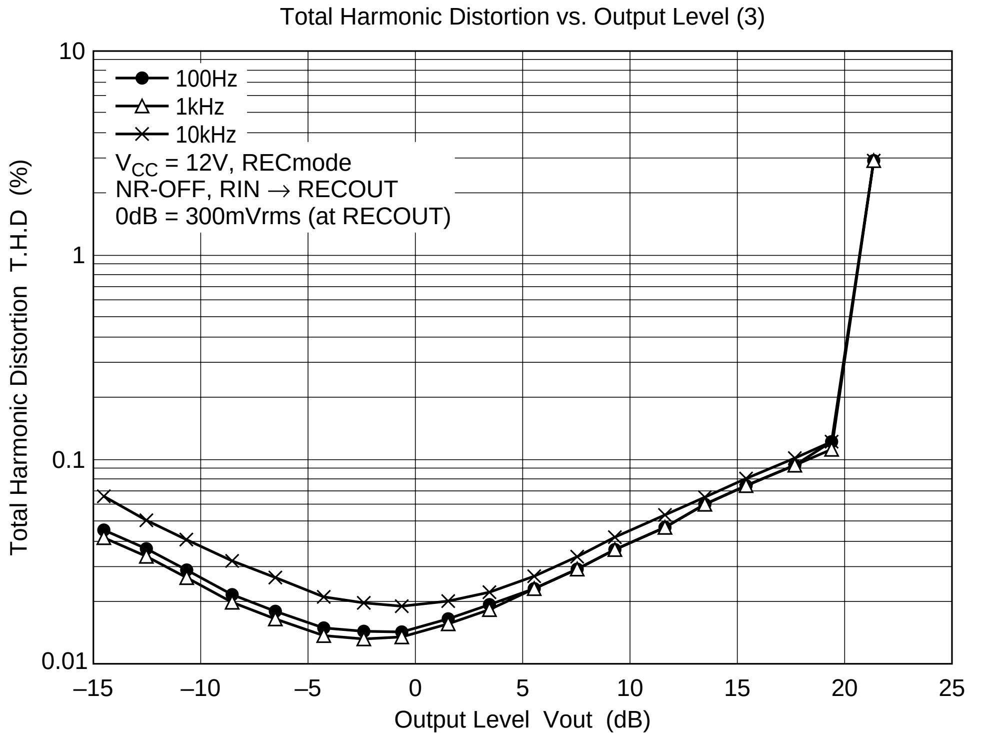


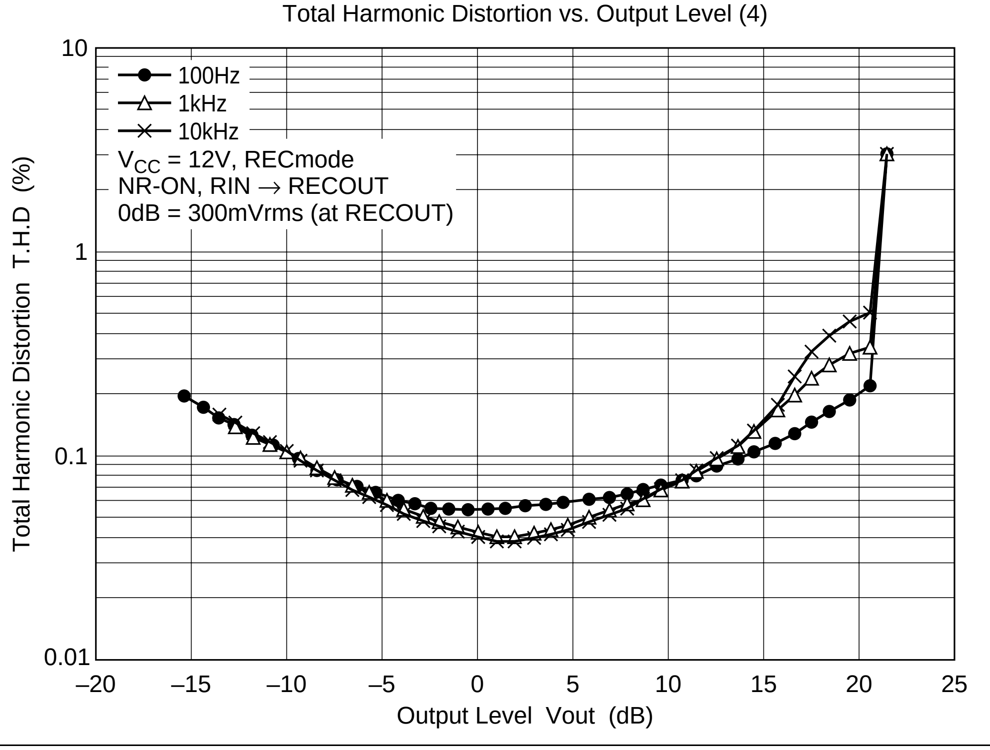
Total Harmonic Distortion vs. Output Level (1)



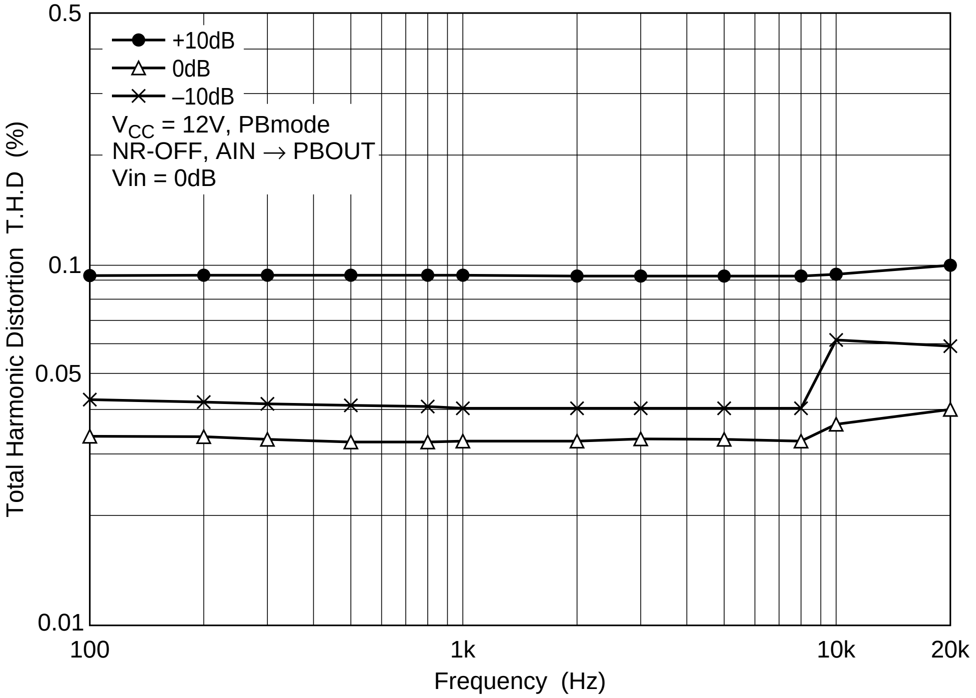
Total Harmonic Distortion vs. Output Level (2)



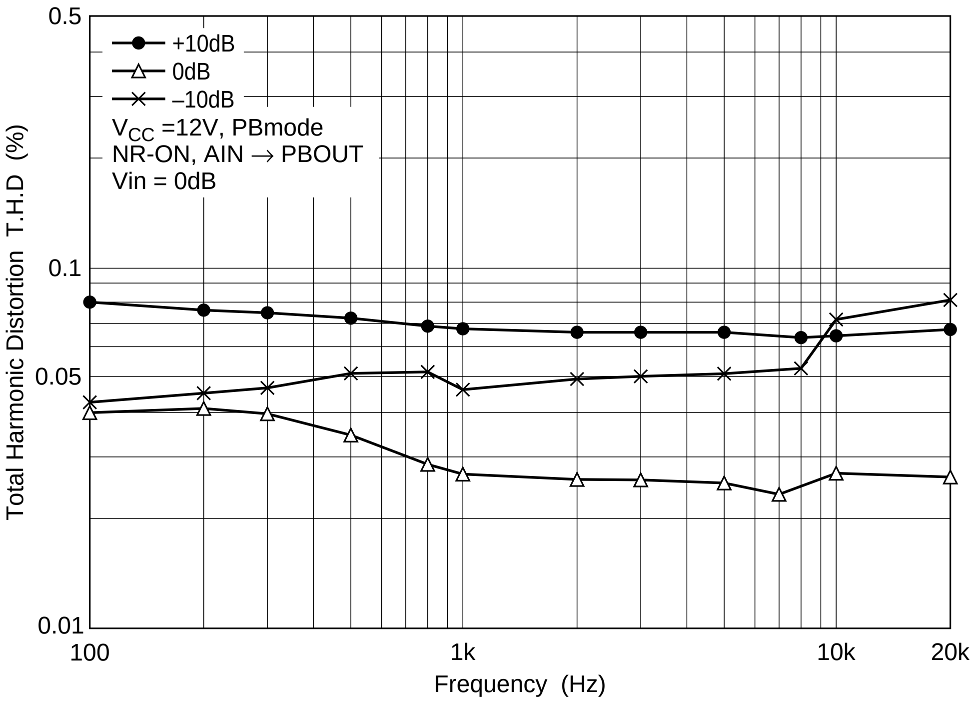

Total Harmonic Distortion vs. Output Level (3)
100Hz
1kHz
10kHz
VCC = 12V, RECmode
NR-OFF, RIN → RECOUT
0dB = 300mVrms (at RECOUT)
Total Harmonic Distortion T.H.D (%)
10
1
0.1
0.01
–15
–10
–5
0
5
10
15
20
25
Output Level Vout (dB)


Total Harmonic Distortion vs. Output Level (4)
100Hz
1kHz
10kHz
VCC = 12V, RECmode
NR-ON, RIN → RECOUT
0dB = 300mVrms (at RECOUT)
Total Harmonic Distortion T.H.D (%)
10
1
0.1
0.01
–20
–15
–10
–5
0
5
10
15
20
25
Output Level Vout (dB)

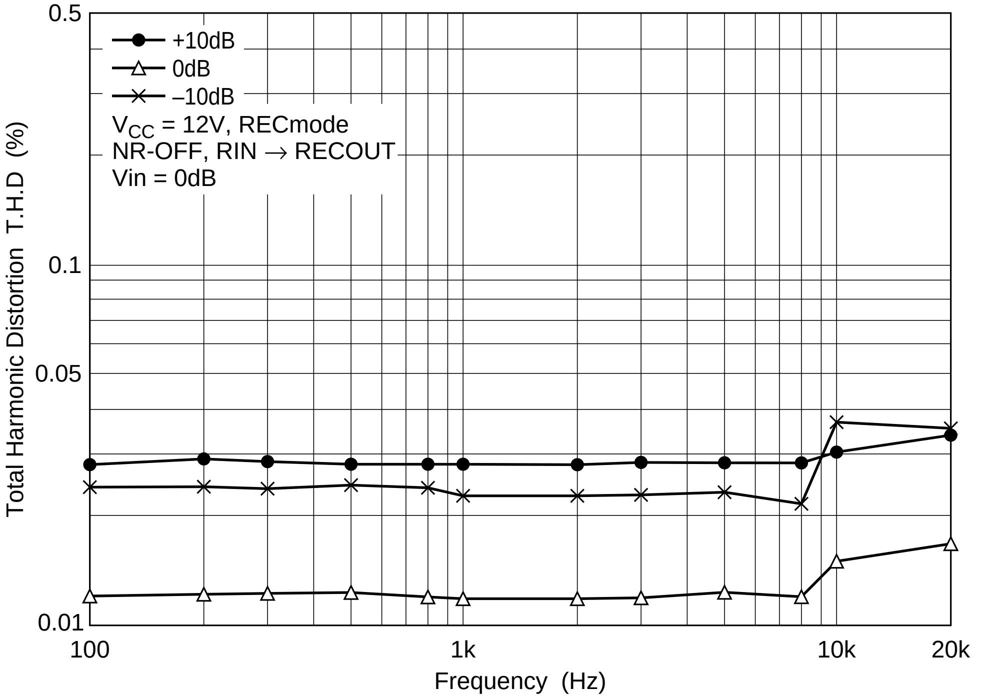
Total Harmonic Distortion vs. Frequency (1)



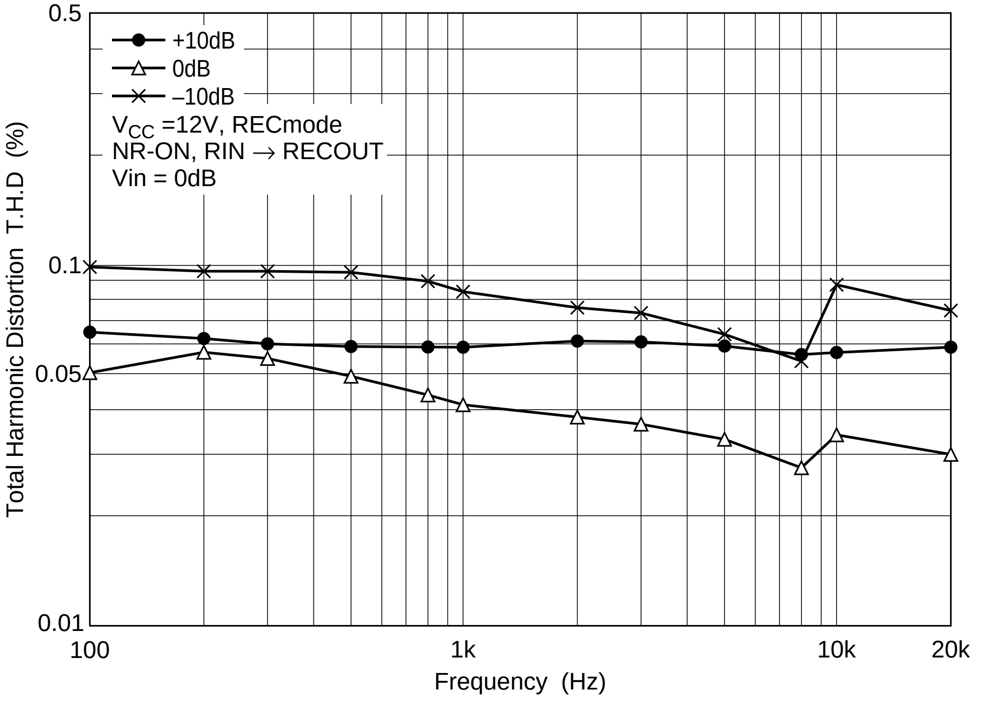
Total Harmonic Distortion vs. Frequency (2)

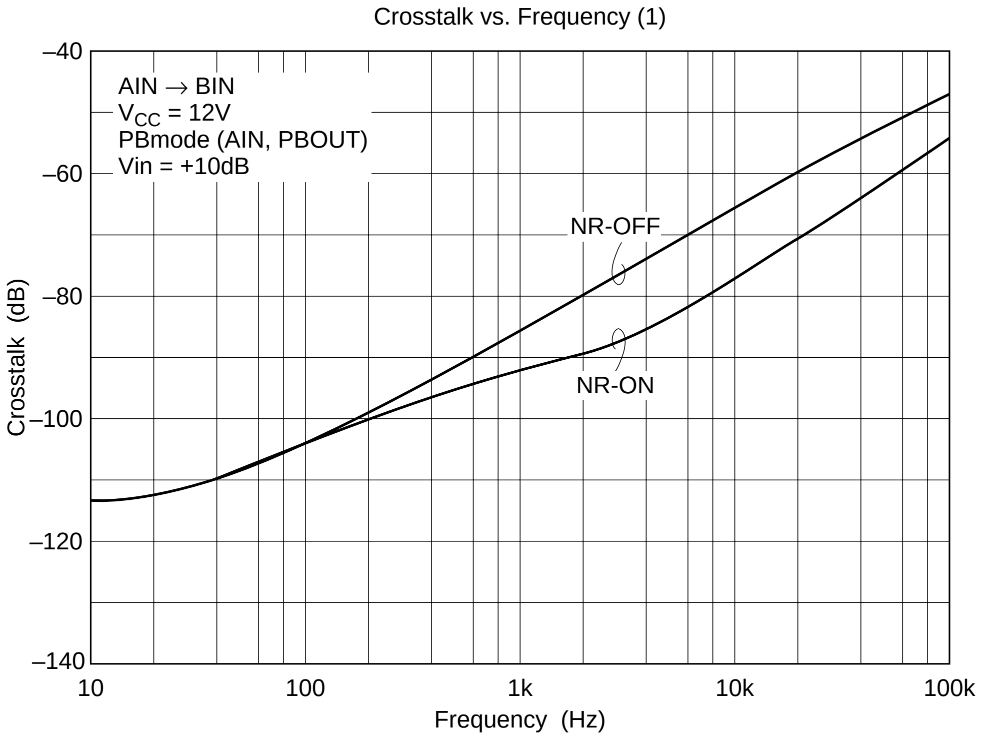


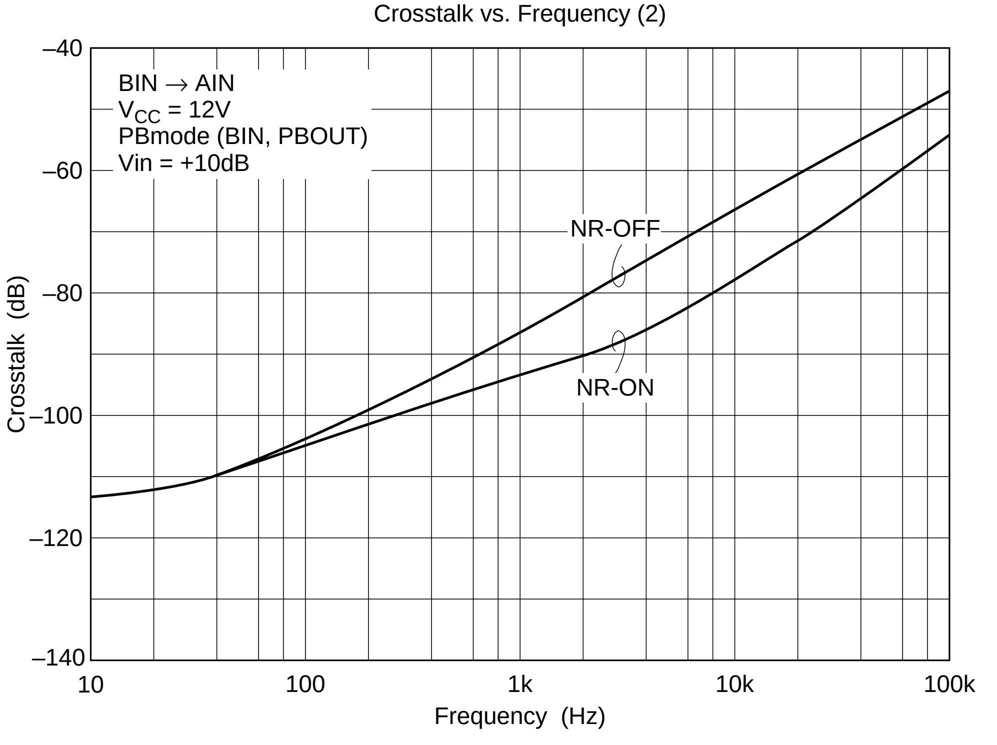
Total Harmonic Distortion vs. Frequency (3)



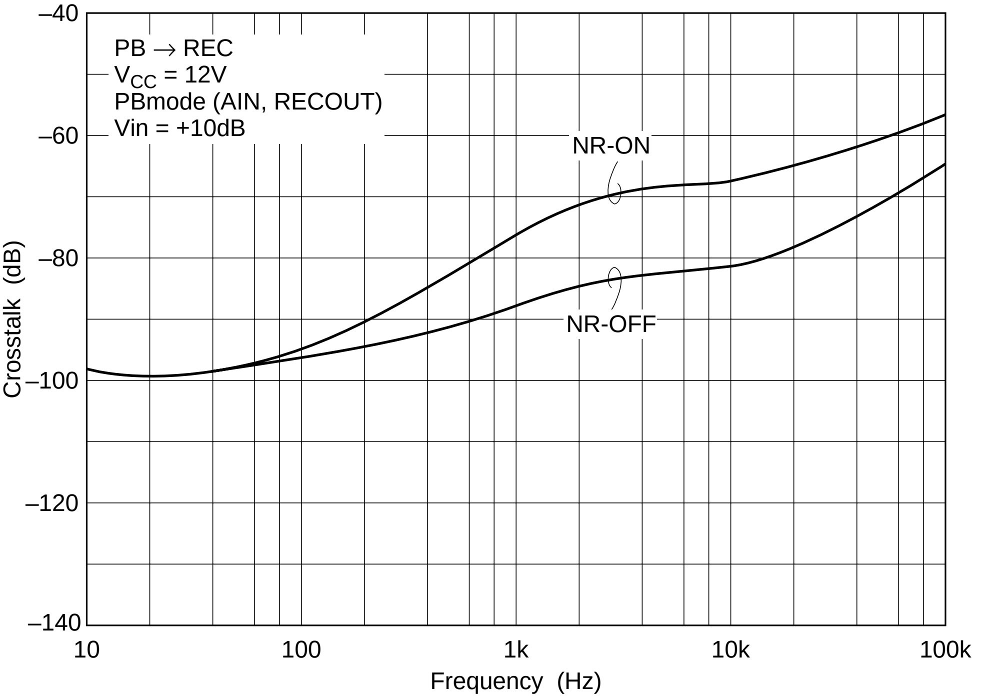
Total Harmonic Distortion vs. Frequency (4)



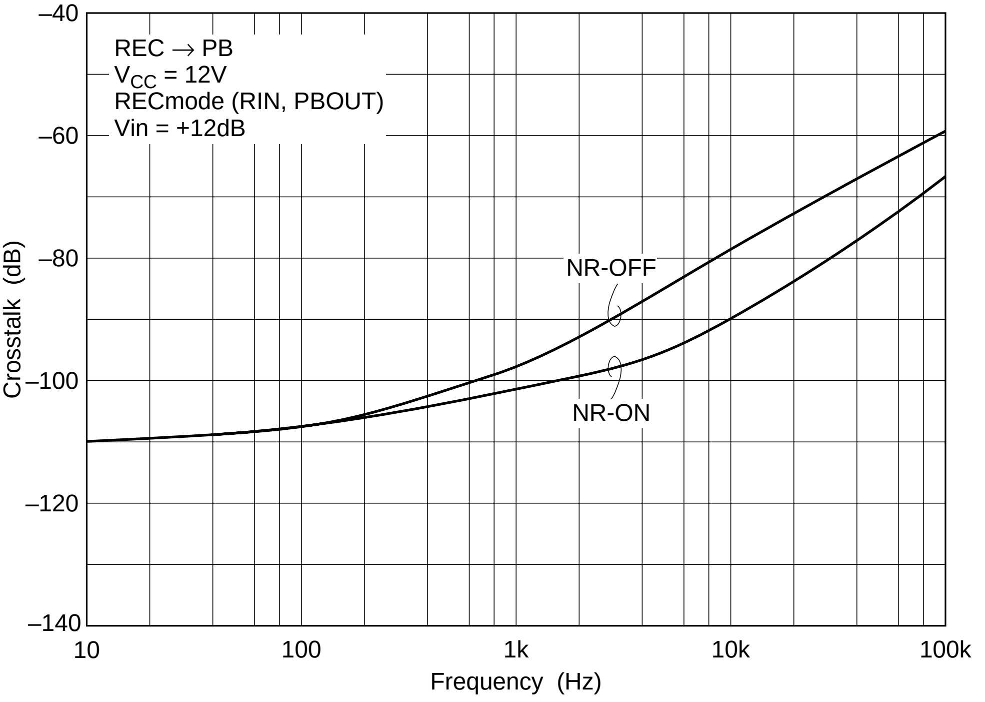

Crosstalk vs. Frequency (1)
AIN → BIN
V_{CC} = 12V
PBmode (AIN, PBOUT)
Vin = +10dB
NR-OFF
NR-ON
Crosstalk (dB)
–40
–60
–80
–100
–120
–140
10
100
1k
10k
100k
Frequency (Hz)

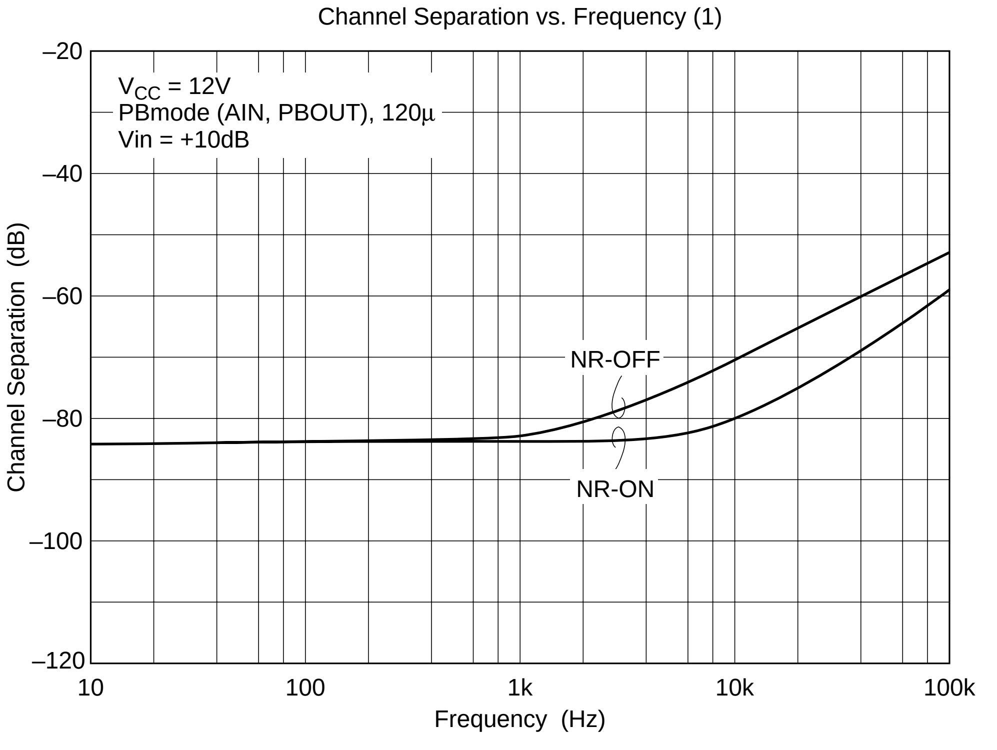

Crosstalk vs. Frequency (2)
BIN → AIN
V_{CC} = 12V
PBmode (BIN, PBOUT)
Vin = +10dB
NR-OFF
NR-ON
Crosstalk (dB)
–40
–60
–80
–100
–120
–140
10
100
1k
10k
100k
Frequency (Hz)

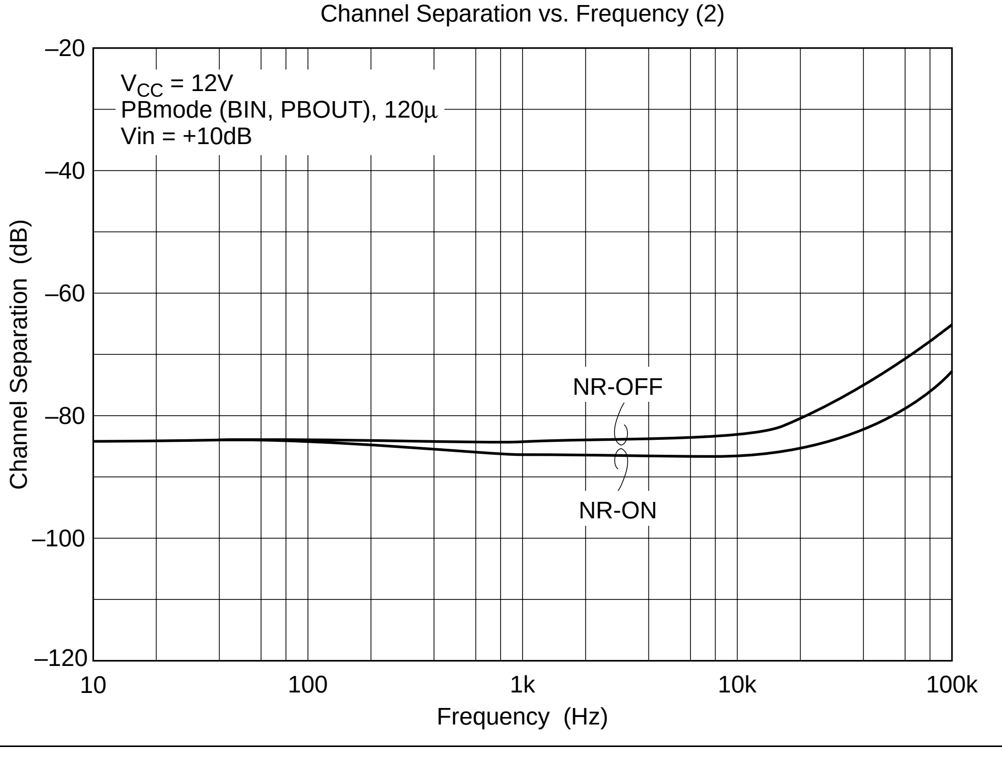
Crosstalk vs. Frequency (3)

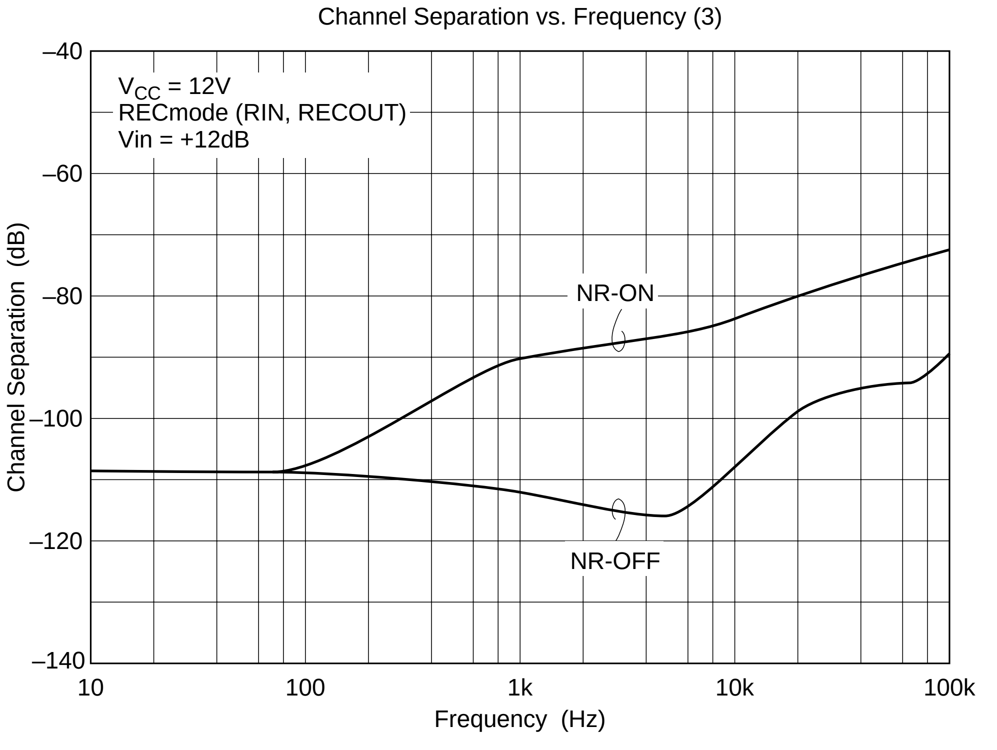


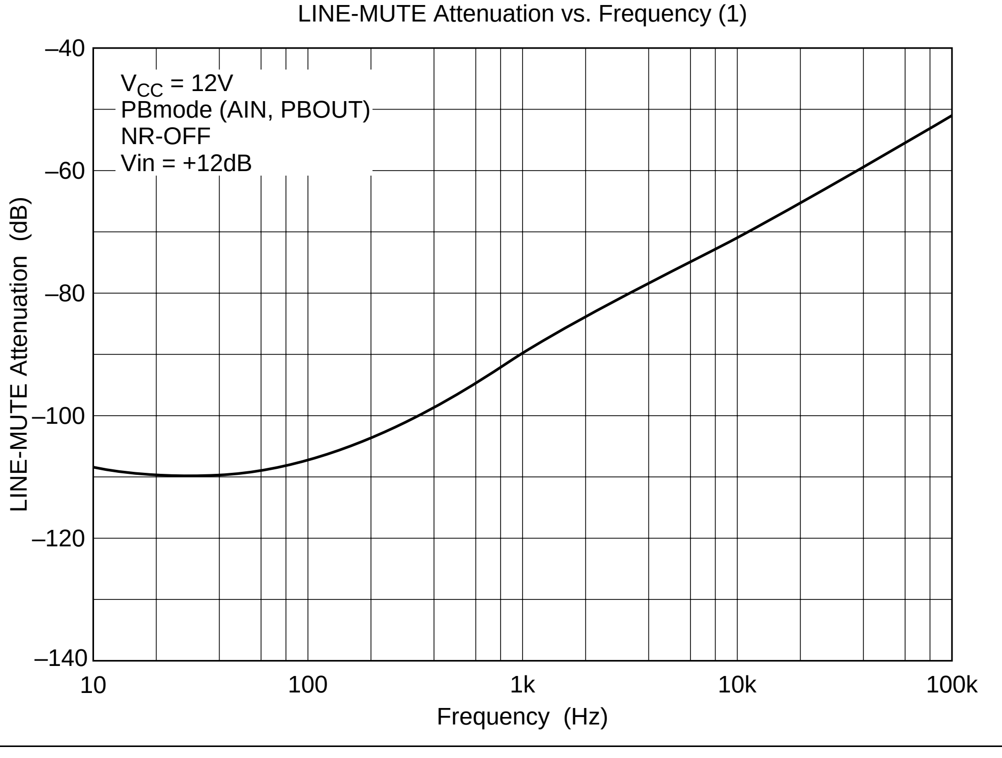
Crosstalk vs. Frequency (4)

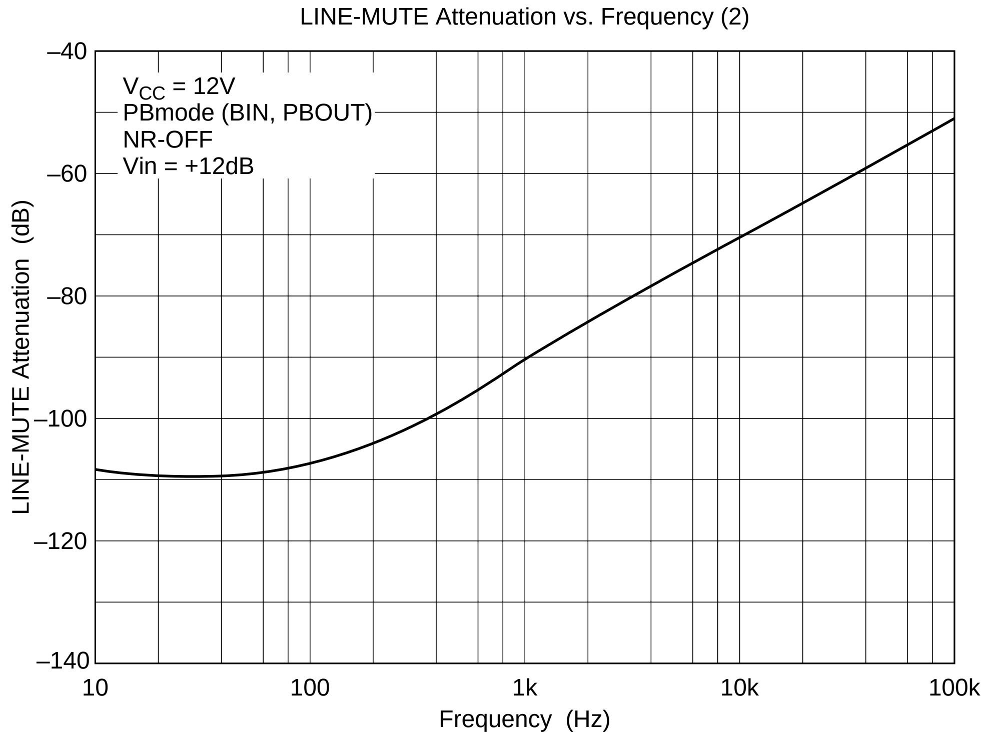


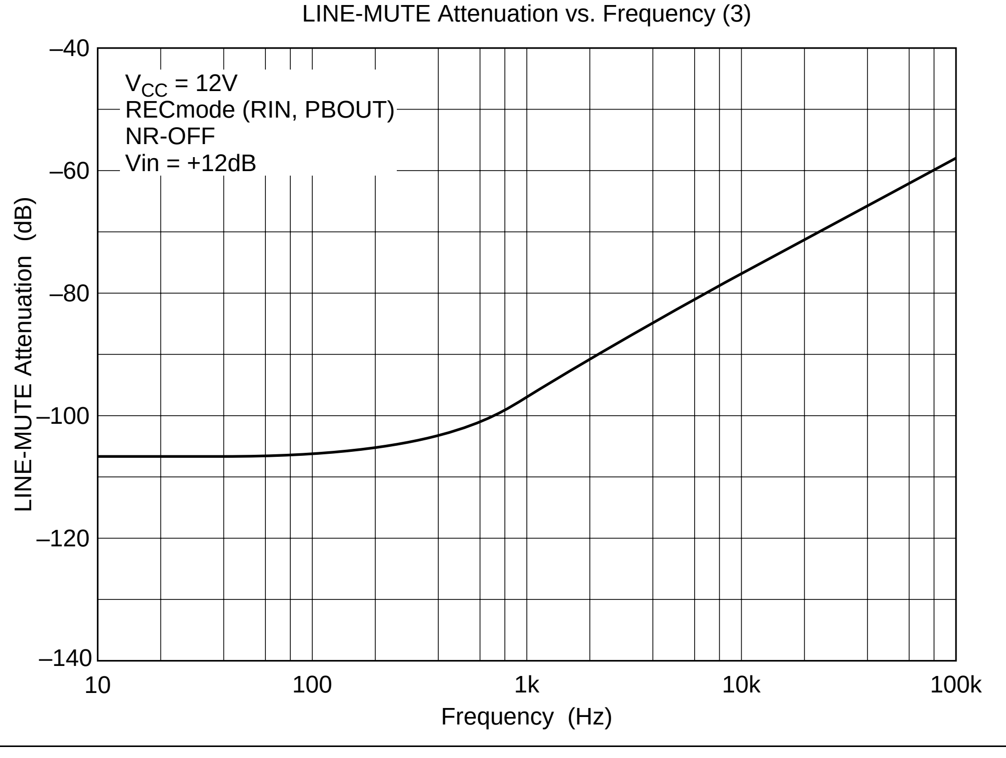

Channel Separation vs. Frequency (1)
VCC = 12V
PBmode (AIN, PBOUT), 120µ
Vin = +10dB
NR-OFF
NR-ON
Channel Separation (dB)
–20
–40
–60
–80
–100
–120
10
100
1k
10k
100k
Frequency (Hz)


Channel Separation vs. Frequency (2)
VCC = 12V
PBmode (BIN, PBOUT), 120µ
Vin = +10dB
NR-OFF
NR-ON
Channel Separation (dB)
–20
–40
–60
–80
–100
–120
10
100
1k
10k
100k
Frequency (Hz)

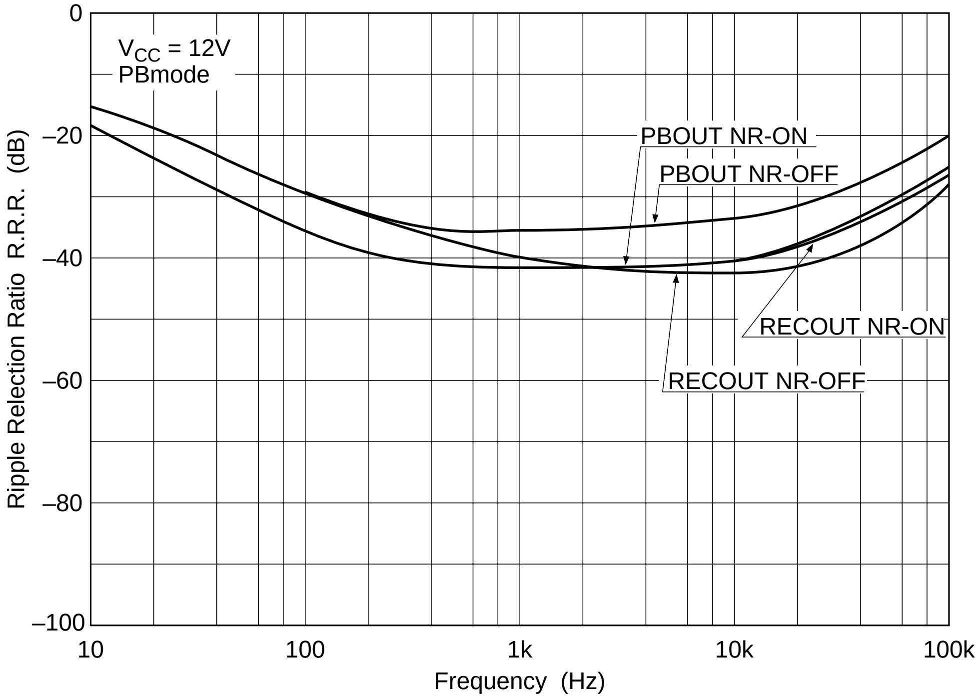

Channel Separation vs. Frequency (3)
VCC = 12V
RECmode (RIN, RECOUT)
Vin = +12dB
NR-ON
NR-OFF
Channel Separation (dB)
–40
–60
–80
–100
–120
–140
10
100
1k
10k
100k
Frequency (Hz)


LINE-MUTE Attenuation vs. Frequency (1)
VCC = 12V
PBmode (AIN, PBOUT)
NR-OFF
Vin = +12dB
LINE-MUTE Attenuation (dB)
–40
–60
–80
–100
–120
–140
10
100
1k
10k
100k
Frequency (Hz)

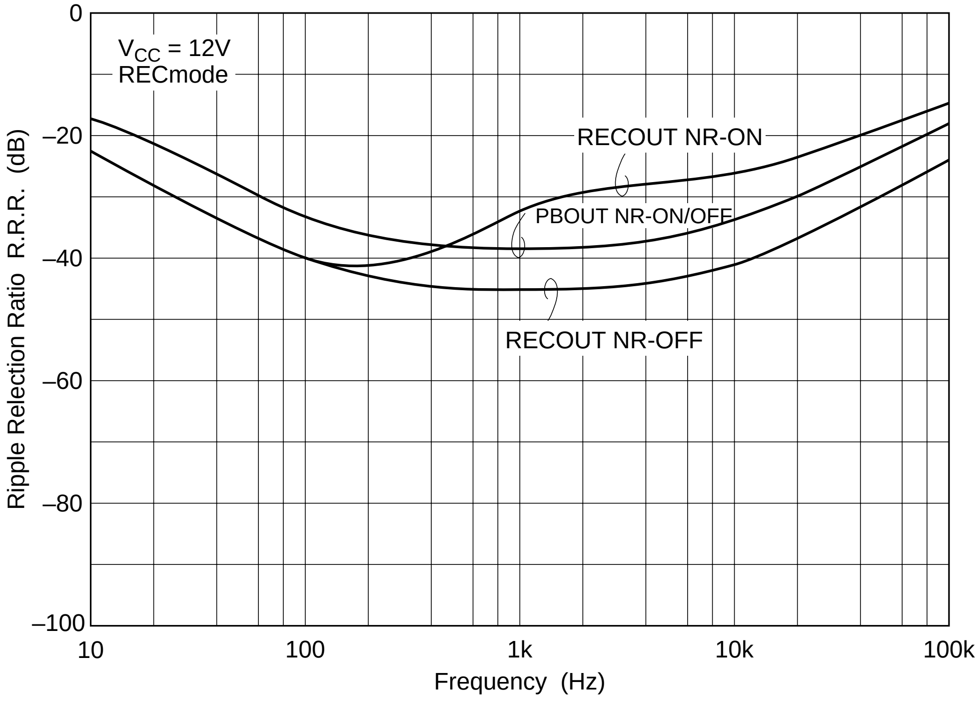

LINE-MUTE Attenuation vs. Frequency (2)
VCC = 12V
PBmode (BIN, PBOUT)
NR-OFF
Vin = +12dB
LINE-MUTE Attenuation (dB)
–40
–60
–80
–100
–120
–140
10
100
1k
10k
100k
Frequency (Hz)


LINE-MUTE Attenuation vs. Frequency (3)
VCC = 12V
RECmode (RIN, PBOUT)
NR-OFF
Vin = +12dB
LINE-MUTE Attenuation (dB)
–40
–60
–80
–100
–120
–140
10
100
1k
10k
100k
Frequency (Hz)

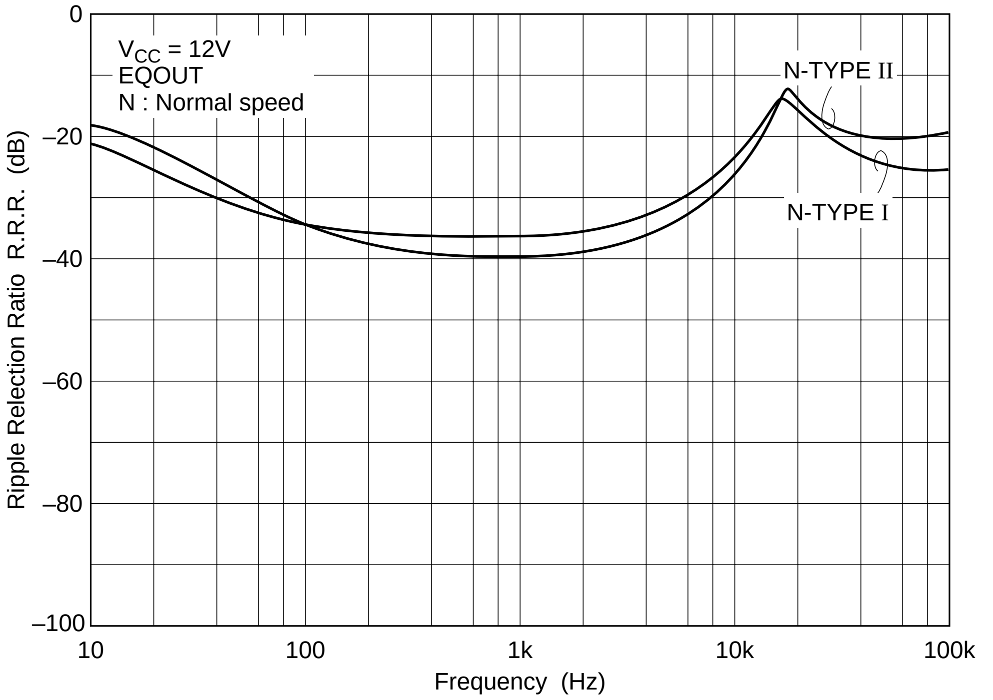
Ripple Relection Ratio vs. Frequency (1)



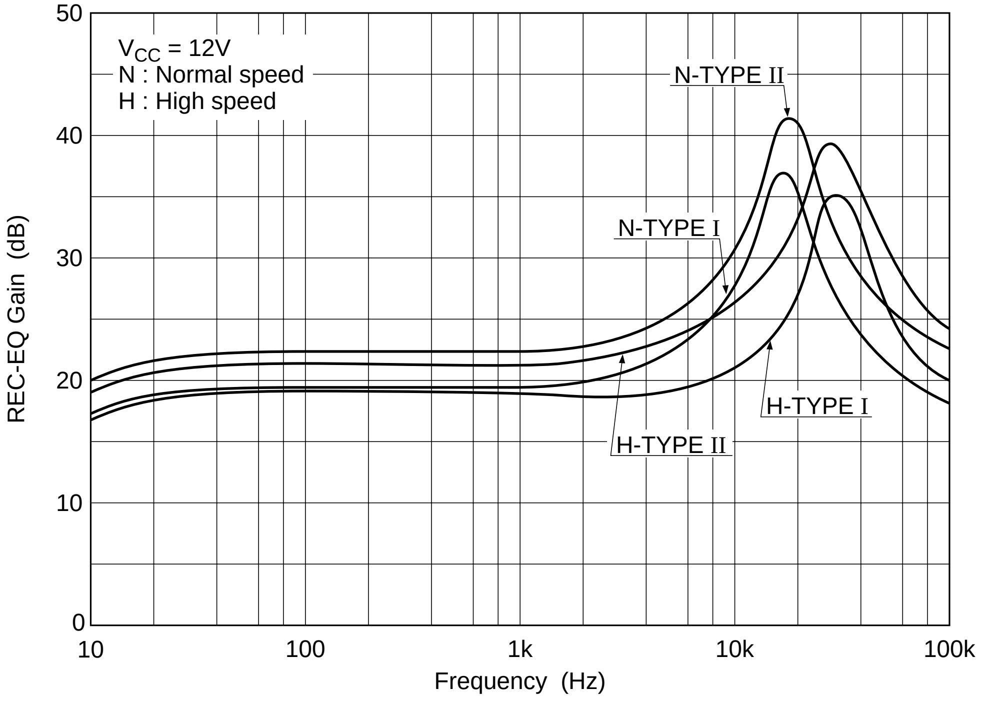
Ripple Relection Ratio vs. Frequency (2)



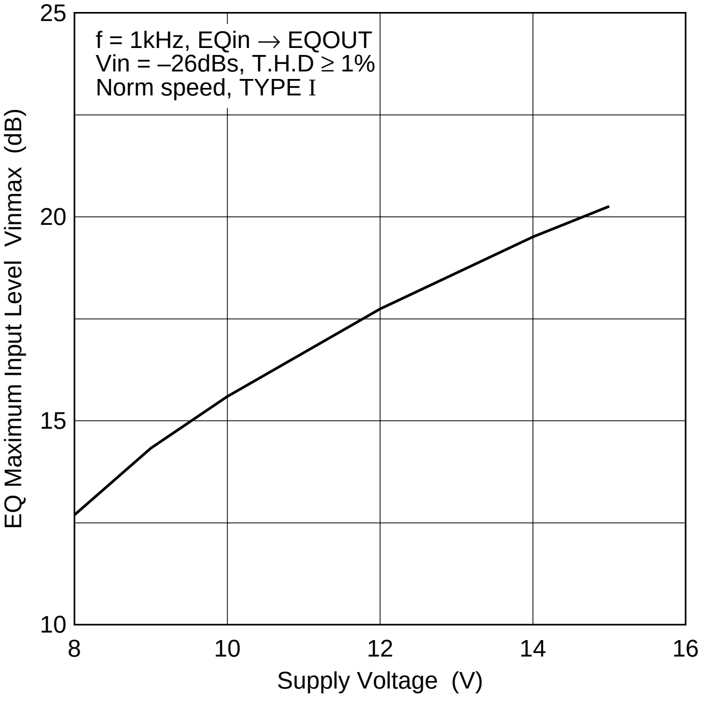
Ripple Relection Ratio vs. Frequency (3)



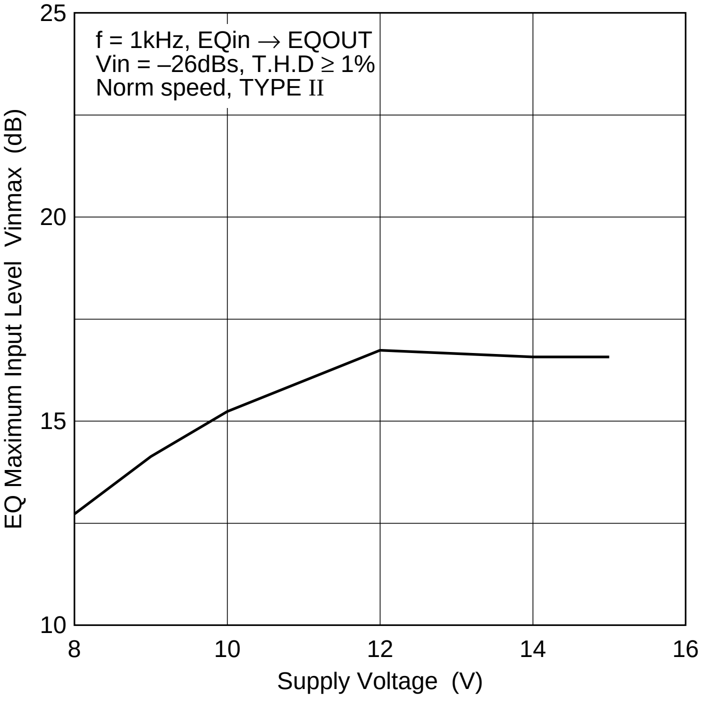
REC-EQ Gain vs. Frequency



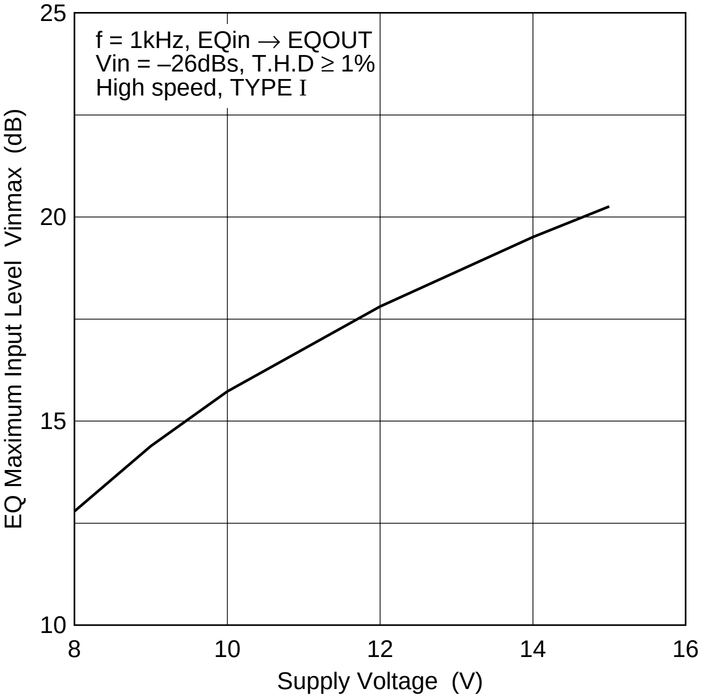
EQ Maximum Input Level vs. Supply Voltage (1)



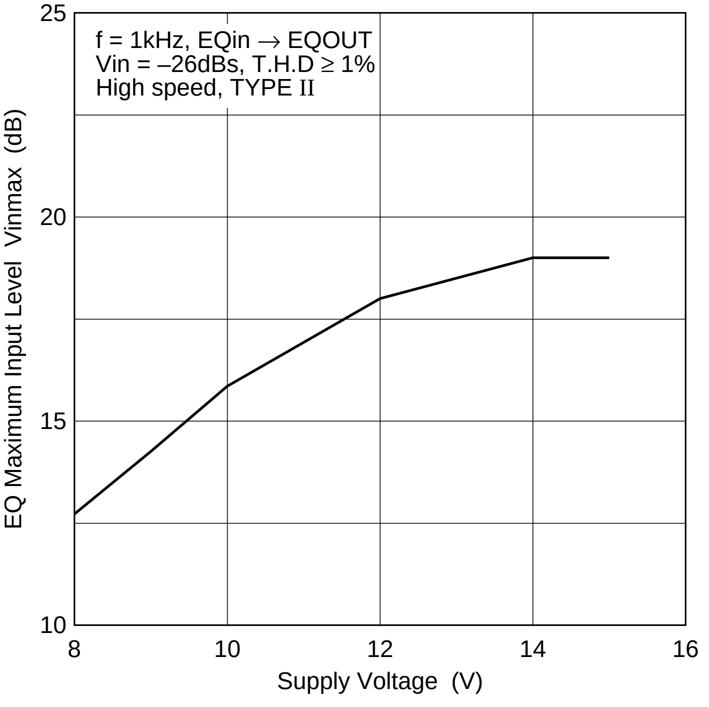
EQ Maximum Input Level vs. Supply Voltage (2)



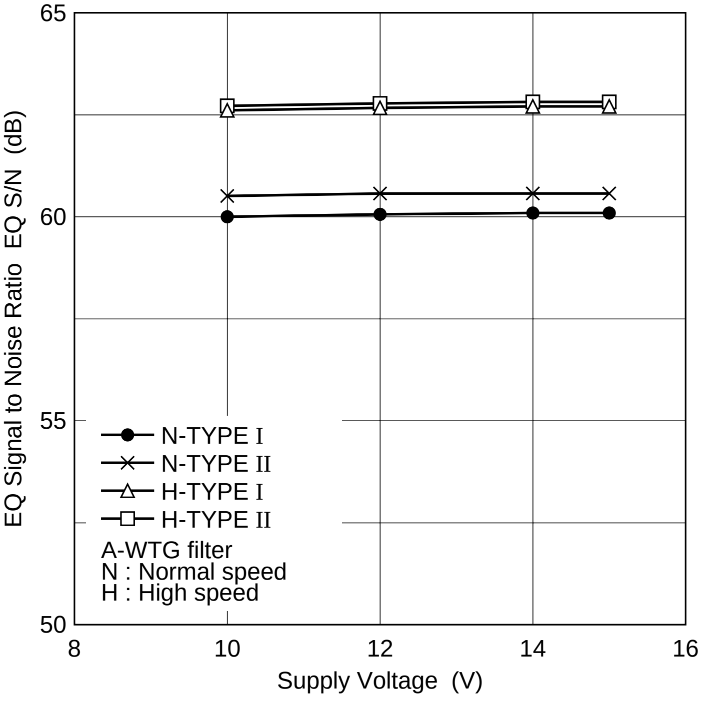
EQ Maximum Input Level vs. Supply Voltage (3)



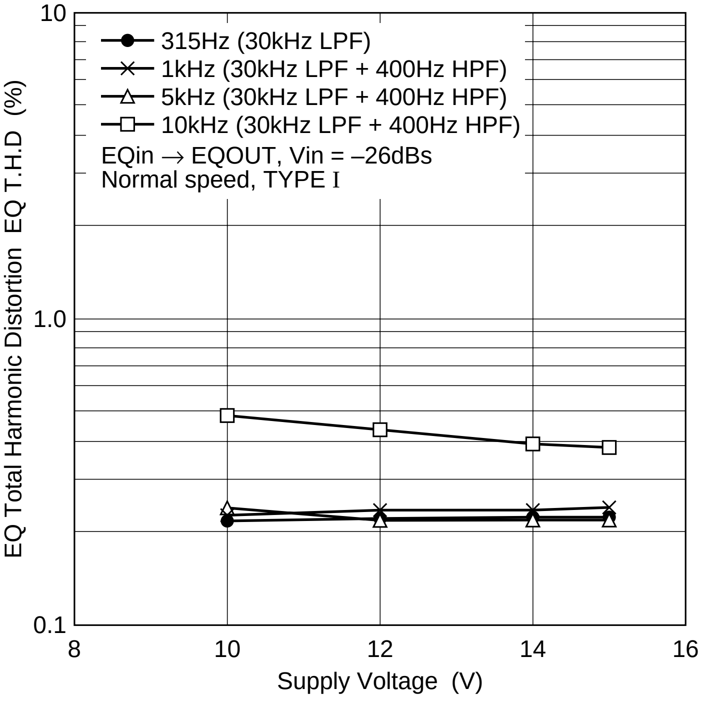
EQ Maximum Input Level vs. Supply Voltage (4)

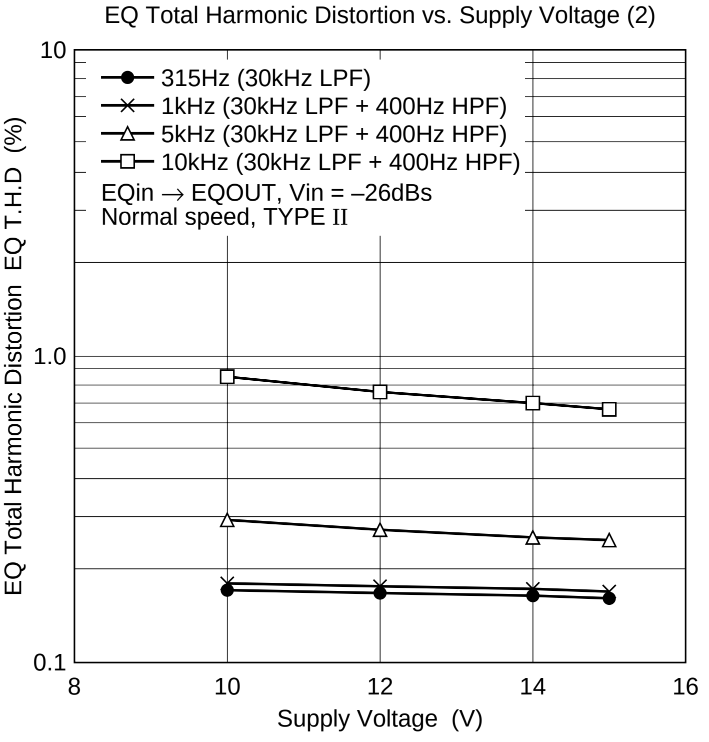


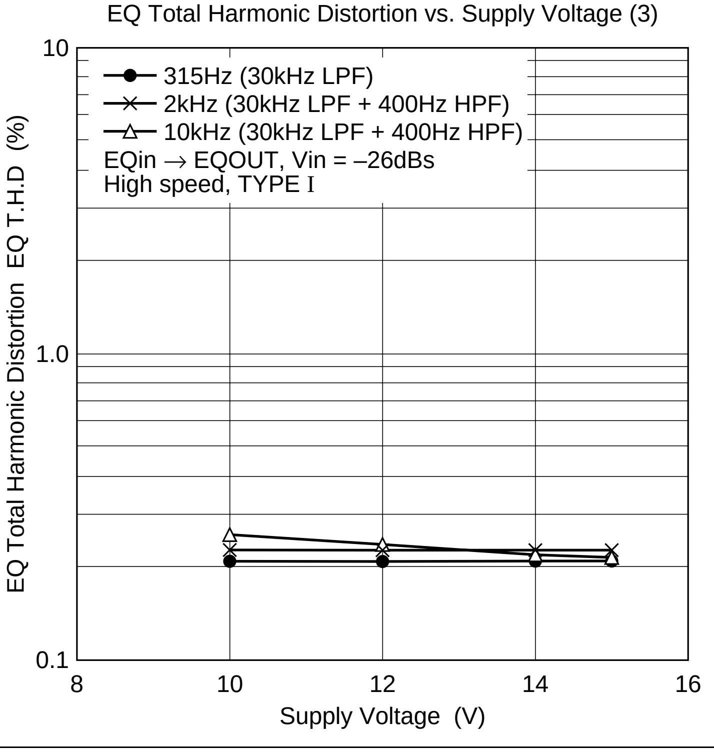
EQ Signal to Noise Ratio vs. Supply Voltage



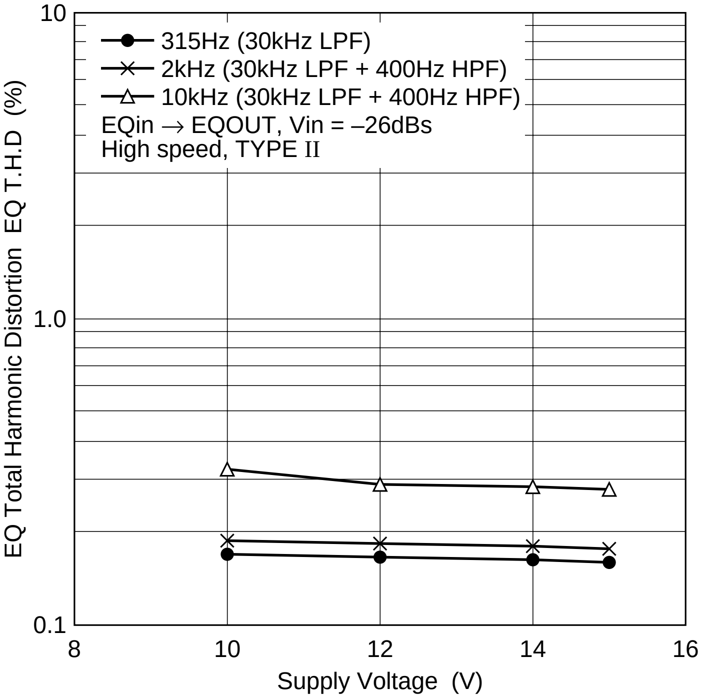
EQ Total Harmonic Distortion vs. Supply Voltage (1)



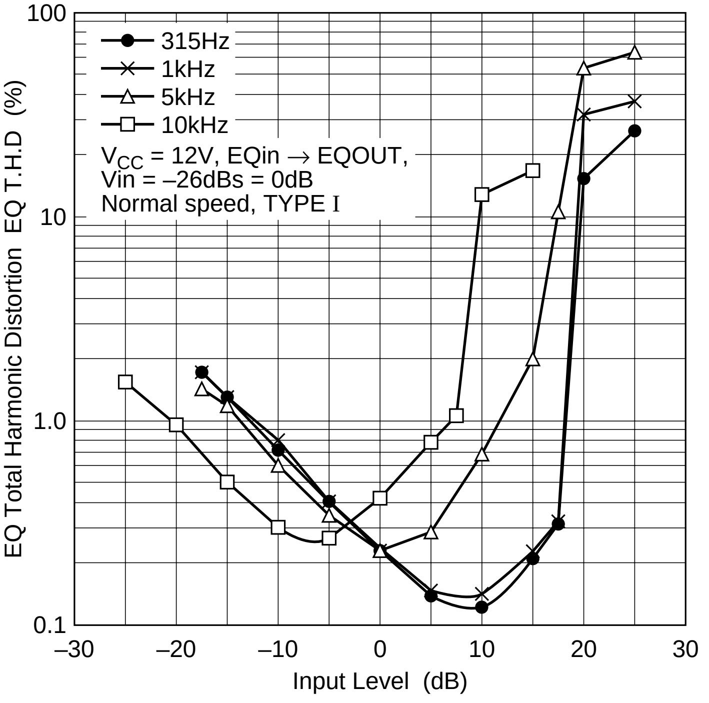

EQ Total Harmonic Distortion vs. Supply Voltage (2)
315Hz (30kHz LPF)
1kHz (30kHz LPF + 400Hz HPF)
5kHz (30kHz LPF + 400Hz HPF)
10kHz (30kHz LPF + 400Hz HPF)
EQin → EQOUT, Vin = –26dBs
Normal speed, TYPE II
EQ Total Harmonic Distortion EQ T.H.D (%)
10
1.0
0.1
8
10
12
14
16
Supply Voltage (V)

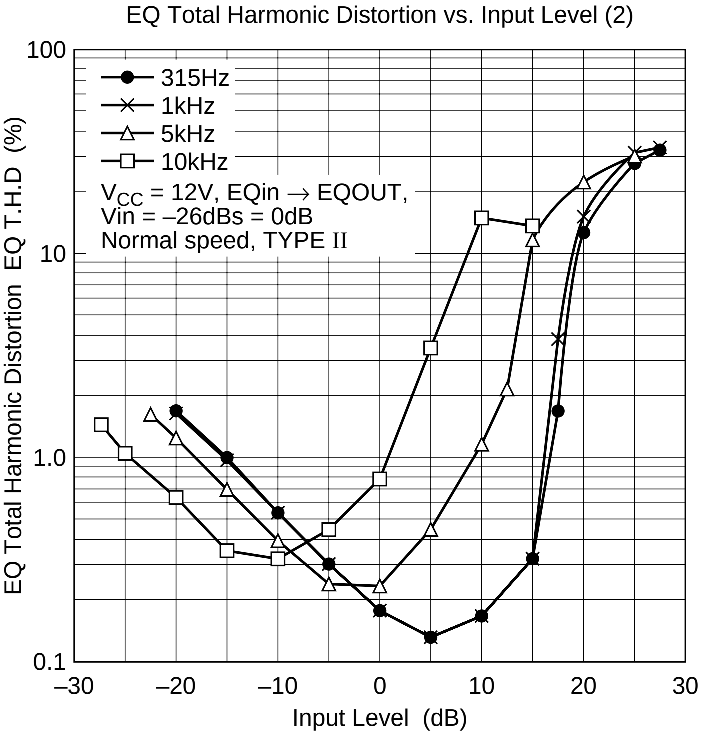

EQ Total Harmonic Distortion vs. Supply Voltage (3)
315Hz (30kHz LPF)
2kHz (30kHz LPF + 400Hz HPF)
10kHz (30kHz LPF + 400Hz HPF)
EQin → EQOUT, Vin = –26dBs
High speed, TYPE I
EQ Total Harmonic Distortion EQ T.H.D (%)
10
1.0
0.1
8
10
12
14
16
Supply Voltage (V)

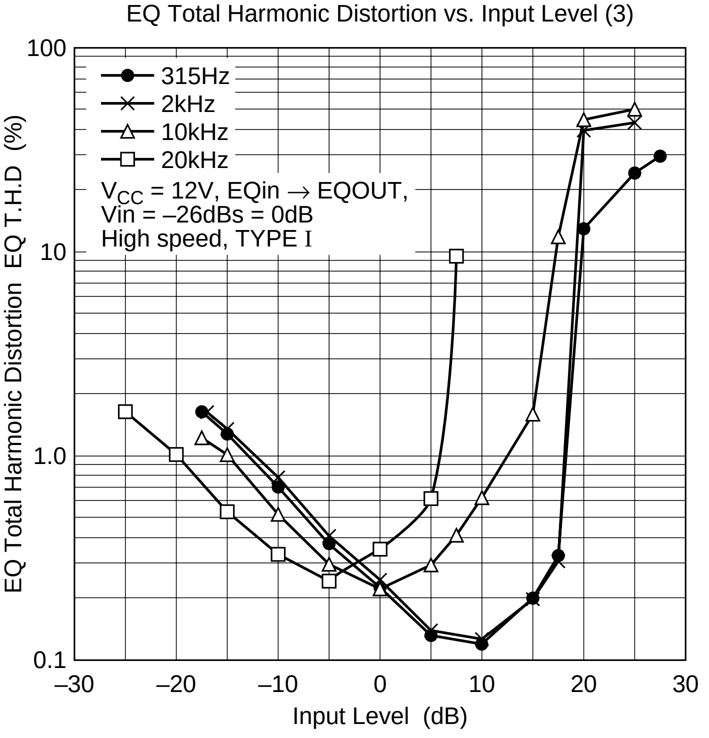
EQ Total Harmonic Distortion vs. Supply Voltage (4)

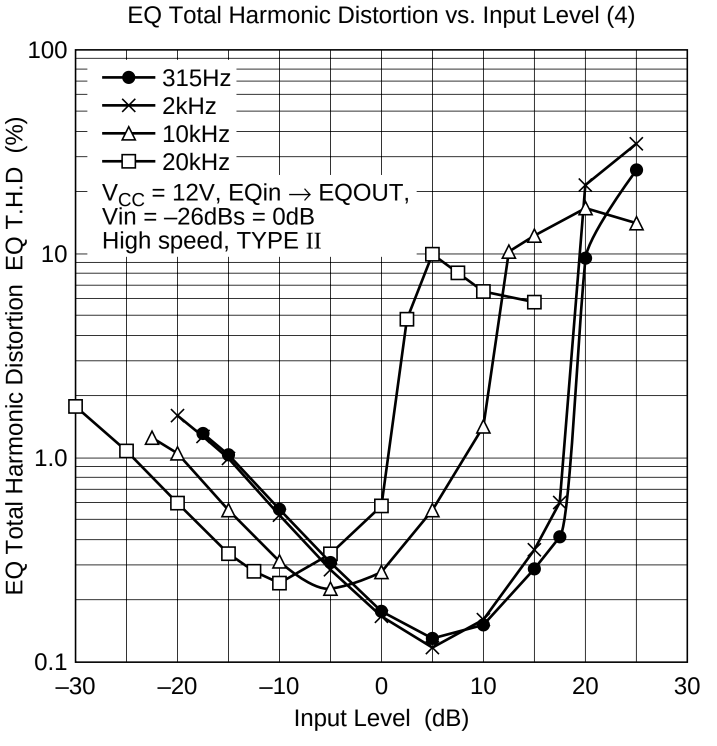


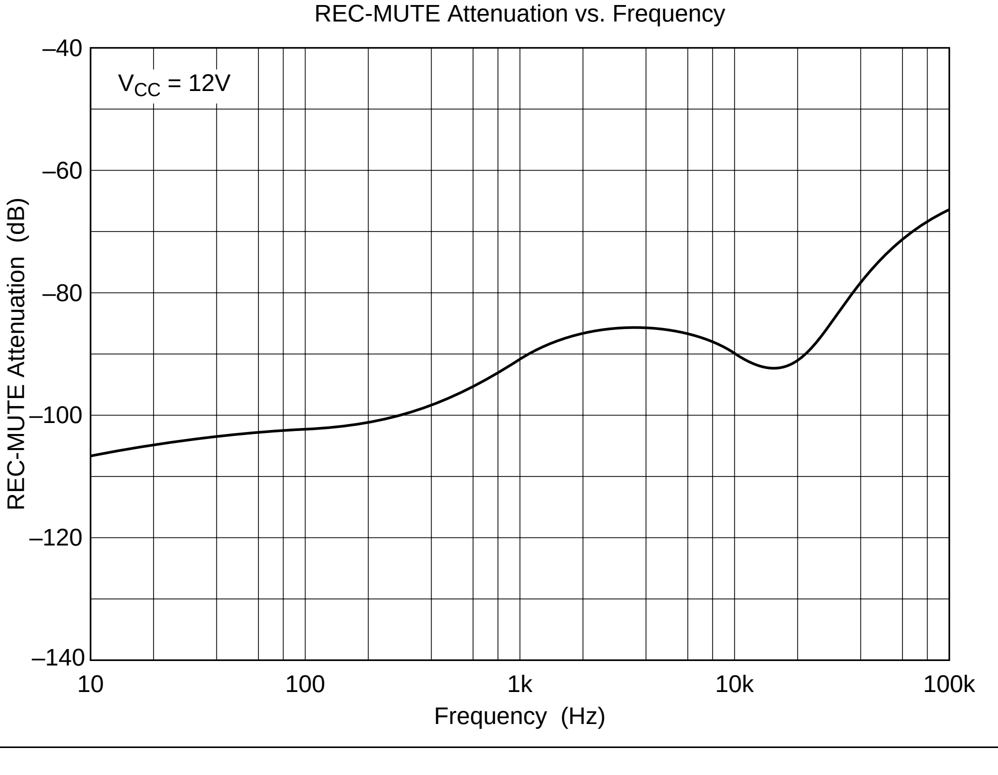
EQ Total Harmonic Distortion vs. Input Level (1)

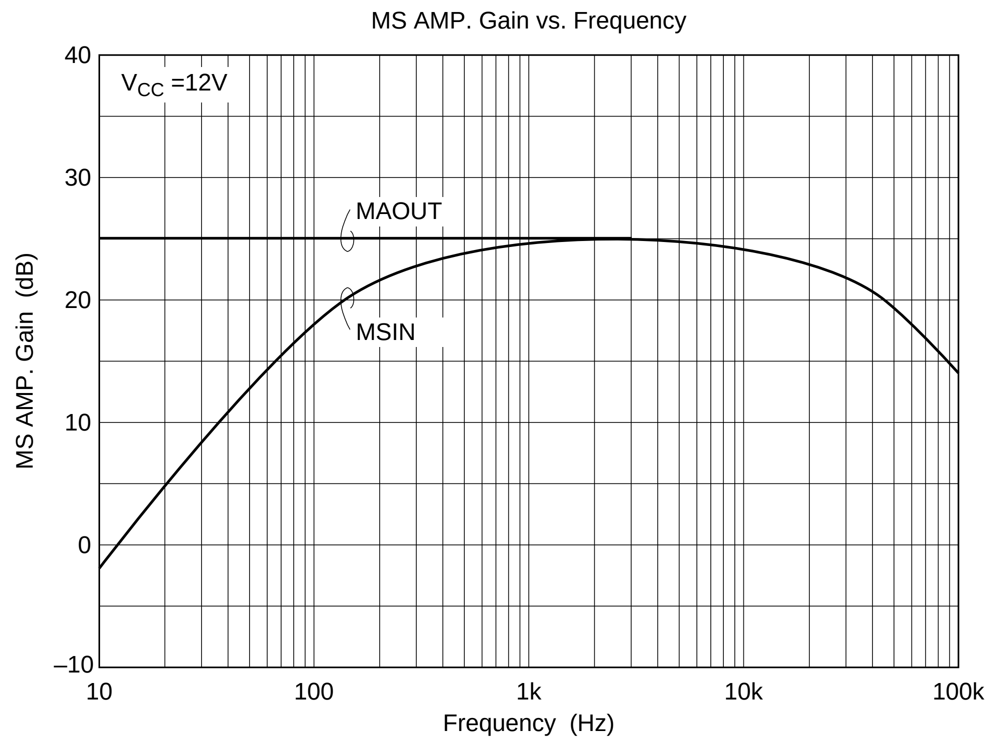


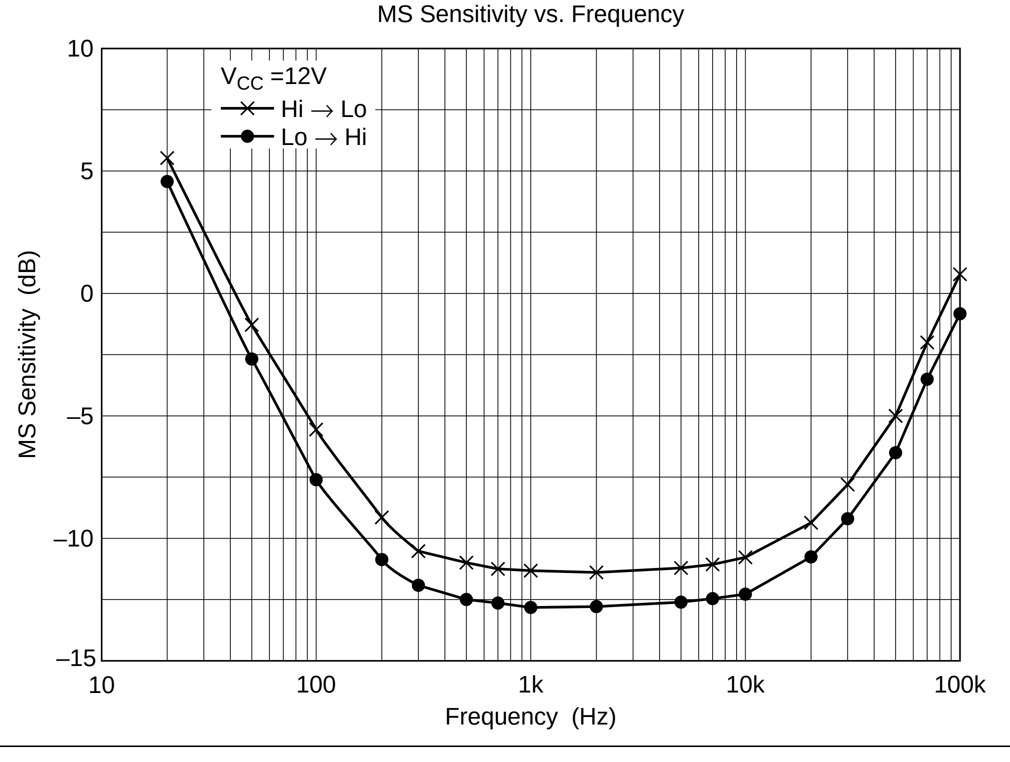

EQ Total Harmonic Distortion vs. Input Level (2)
315Hz
1kHz
5kHz
10kHz
VCC = 12V, EQin → EQOUT,
Vin = –26dBs = 0dB
Normal speed, TYPE II
EQ Total Harmonic Distortion EQ T.H.D (%)
100
10
1.0
0.1
–30
–20
–10
0
10
20
30
Input Level (dB)

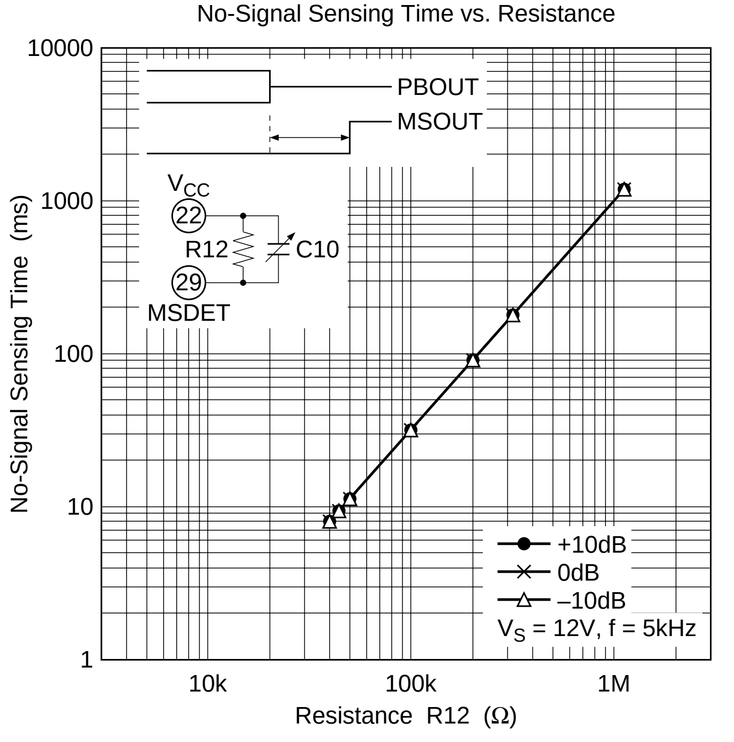

EQ Total Harmonic Distortion vs. Input Level (3)
315Hz
2kHz
10kHz
20kHz
VCC = 12V, EQin → EQOUT,
Vin = –26dBs = 0dB
High speed, TYPE I
EQ Total Harmonic Distortion EQ T.H.D (%)
100
10
1.0
0.1
–30
–20
–10
0
10
20
30
Input Level (dB)

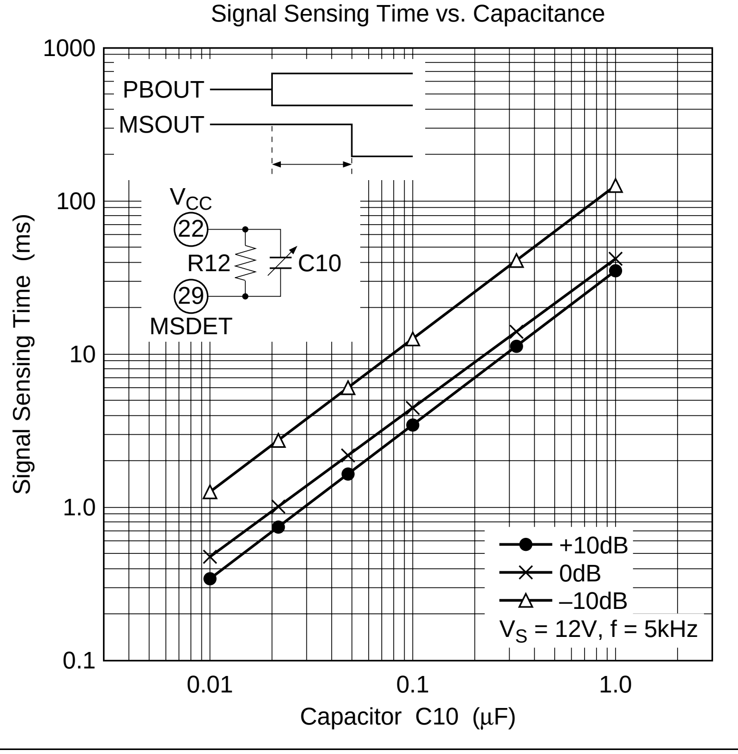

EQ Total Harmonic Distortion vs. Input Level (4)
315Hz
2kHz
10kHz
20kHz
VCC = 12V, EQin → EQOUT,
Vin = –26dBs = 0dB
High speed, TYPE II
EQ Total Harmonic Distortion EQ T.H.D (%)
100
10
1.0
0.1
–30
–20
–10
0
10
20
30
Input Level (dB)


REC-MUTE Attenuation vs. Frequency
VCC = 12V
REC-MUTE Attenuation (dB)
–40
–60
–80
–100
–120
–140
10
100
1k
10k
100k
Frequency (Hz)


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

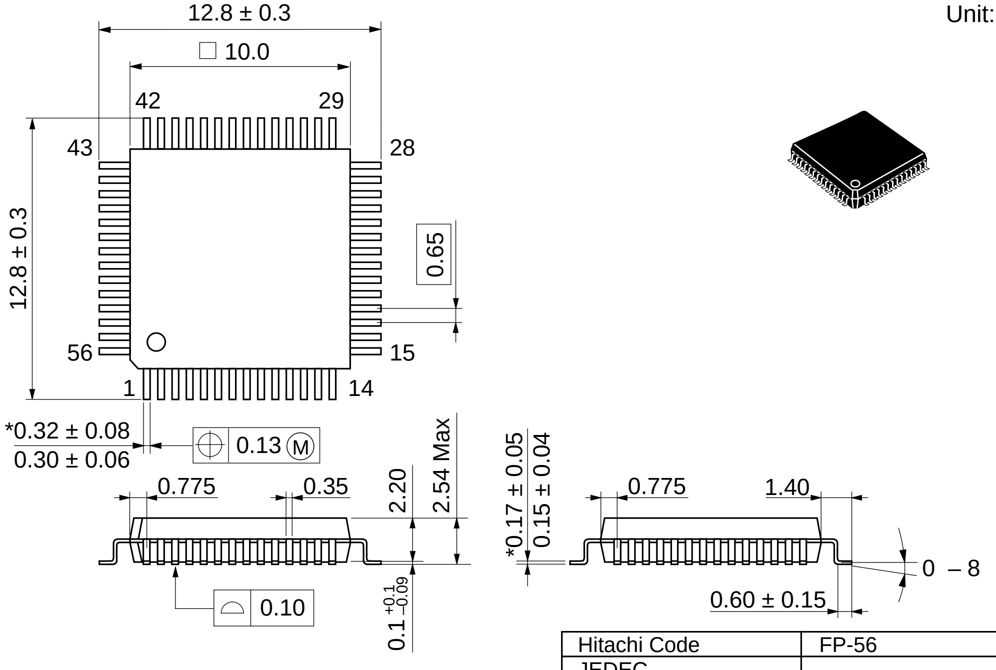

MS Sensitivity vs. Frequency
VCC =12V
Hi → Lo
Lo → Hi
MS Sensitivity (dB)
10
5
0
–5
–10
–15
10
100
1k
10k
100k
Frequency (Hz)


No-Signal Sensing Time vs. Resistance
10000
1000
100
10
1
No-Signal Sensing Time (ms)
PBOUT
MSOUT
VCC
22
R12
C10
29
MSDET
+10dB
0dB
–10dB
VS = 12V, f = 5kHz
10k
100k
1M
Resistance R12 (Ω)


Signal Sensing Time vs. Capacitance
1000
100
10
1.0
0.1
Signal Sensing Time (ms)
PBOUT
MSOUT
VCC
22
R12
C10
29
MSDET
+10dB
0dB
–10dB
VS = 12V, f = 5kHz
0.01
0.1
1.0
Capacitor C10 (µF)

Package Dimensions

Unit: mm



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

*Dimension including the plating thickness
Base material dimension

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