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# HA12228F/HA12229F

Audio Signal Processor for Car Deck  
(Decode only Dolby B-type NR\* with PB Amp.)

REJ03F0134-0200  
(Previous: ADE-207-325A)  
Rev.2.00  
Jun 15, 2005

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## Description

HA12228F/HA12229F are silicon monolithic bipolar IC providing Dolby noise reduction system\*, music sensor, PB equalizer system in one chip.

Notes: 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.

2. HA12229F is not built-in Dolby B-NR.

## Functions

- PB equalizer × 2 channel
- Music sensor × 1 channel
- Dolby B-NR (Only HA12228F) × 2 channel
- Line mute SW × 2 channel

## Features

- Different type of PB equalizer characteristics selection (120  $\mu$ s/70  $\mu$ s) is available with fully electronic control switching built-in.
- Easy interface with the PB head. (The PB-EQ resistance self-containing)
- Changeable to Forward, Reverse-mode for PB head with fully electronic control switching built-in.
- Available to change music sensing level by external resistor.
- Available to change response of music sensor by external capacitor.
- Music sensing level, built-in switch to change a band (MSG<sub>V</sub>).
- NR ON/OFF fully electronic control switching built-in. (Only HA12228F)
- Line mute control switching built-in.
- Available to connect direct with MPU.
- These ICs are strong for a cellular phone noise.

## Ordering Information

### Operating Voltage

Product	Min	Max	Unit
HA12228F	6.5	12	V
HA12229F			

Note: 1. These ICs are designed to operate on single supply.

### Standard Level

Product	Package Code (Previous Code)	PB-OUT Level
HA12228F	PLQP0040JB-A (FP-40B)	300 mVrms
HA12229F		

### Function

Product	PB-EQ	Music Sensor	Mute	Dolby B-NR
HA12228F	○	○	○	○
HA12229F	○	○	○	×

**Pin Description, Equivalent Circuit**

( $V_{CC} = 9\text{ V}$  single supply,  $T_a = 25^\circ\text{C}$ , No Signal, The value in the table shows typical value.)

Pin No.	Terminal Name	Note	Equivalent Circuit	Description
13	MSI	$V = V_{CC}/2$		MS input *1
4	TAI(L)			Tape input
27	TAI(R)			
23 *2	DET(R)	$V = 2.5\text{ V}$		Time constant pin for NR rectifier
8 *2	DET(L)			Ripple filter
26	RIP	$V = V_{CC}/2$		
5 *3	Bias	$V = 0.28\text{ V}$		Dolby bias current input
14	MSDET	—		Time constant pin for MS rectifier *1
25	PBOUT(R)	$V = V_{CC}/2$		PB output
6	PBOUT(L)			MS amp. output *1
12	MAOUT			
29	EQOUT(R)	$V = V_{CC}/2$		Equalizer output
2	EQOUT(L)			

- Notes: 1. MS: Music Sensor  
 2. Non connection regarding HA12229F.  
 3. Test pin regarding HA12229F. Usually open or pull down to GND with 18 kΩ.

Pin Description, Equivalent Circuit (cont.)

( $V_{CC} = 9\text{ V}$  single supply,  $T_a = 25^\circ\text{C}$ , No Signal, The value in the table shows typical value.)

Pin No.	Terminal Name	Note	Equivalent Circuit	Description
30	M-OUT(R)	$V = V_{CC}/2$		Equalizer output for time constant
1	M-OUT(L)			
37	FIN(R)	—		Equalizer input (FORWARD)
39	FIN(L)			Equalizer input (REVERSE)
35	RIN(R)			
33	RIN(L)			
20	MUTE ON/OFF	—		Mode control input
21 * <sup>1</sup>	NR ON/OFF			
19	120/70			
17	F/R			
18	S/R(MS G <sub>v</sub> )			
16	MSOUT	—		MS output (to MPU) * <sup>2</sup>
10	MS G <sub>v</sub> (S)	$V = V_{CC}/2$		MS gain terminal * <sup>2</sup>
11	MS G <sub>v</sub> (R)			
31	NFI(R)	$V = V_{CC}/2$		Equalizer output for time constant
40	NFI(L)			

Notes: 1. Non connection regarding HA12229F.

2. MS: Music Sensor

Pin Description, Equivalent Circuit (cont.)

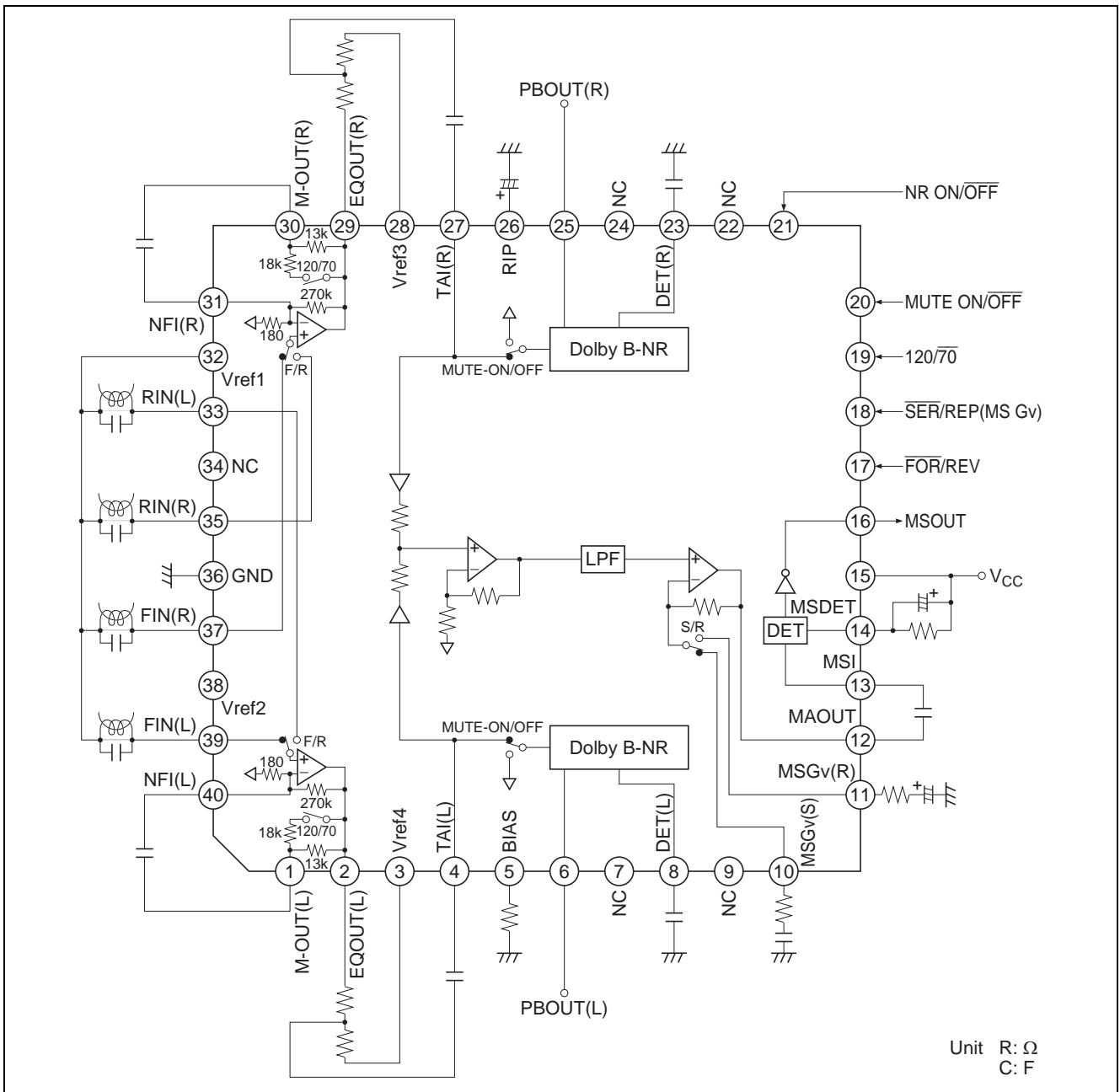
( $V_{CC} = 9\text{ V}$  single supply,  $T_a = 25^\circ\text{C}$ , No Signal, The value in the table shows typical value.)

Pin No.	Terminal Name	Note	Equivalent Circuit	Description
32	VREF1	$V = V_{CC}/2$		Reference output
38	VREF2			
28	VREF3			
3	VREF4			
15	$V_{CC}$	—		$V_{CC}$ pin
36	GND	—		GND pin
7	NC	—		
9				
22				
24				
34				

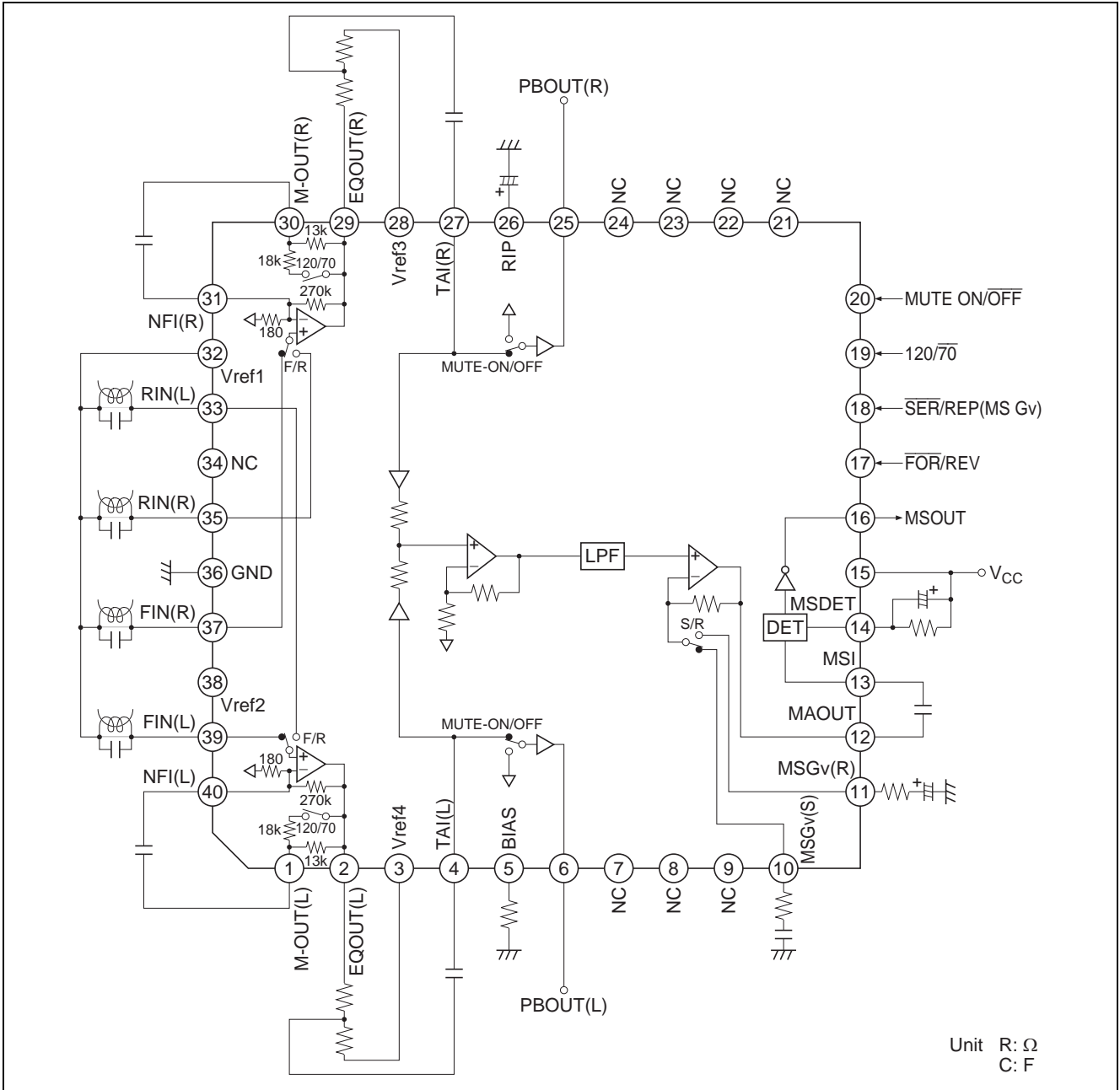
Note: 1.  $R_{AL}$ : Parasitic metal resistance

Block Diagram

HA12228F



HA12229F



## Functional Description

### Power Supply Range

HA12228F/HA12229F are provided with three line output level, which will permit on optimum overload margin for power supply conditions. And these are designed to operate on single supply only.

**Table 1 Supply Voltage Range**

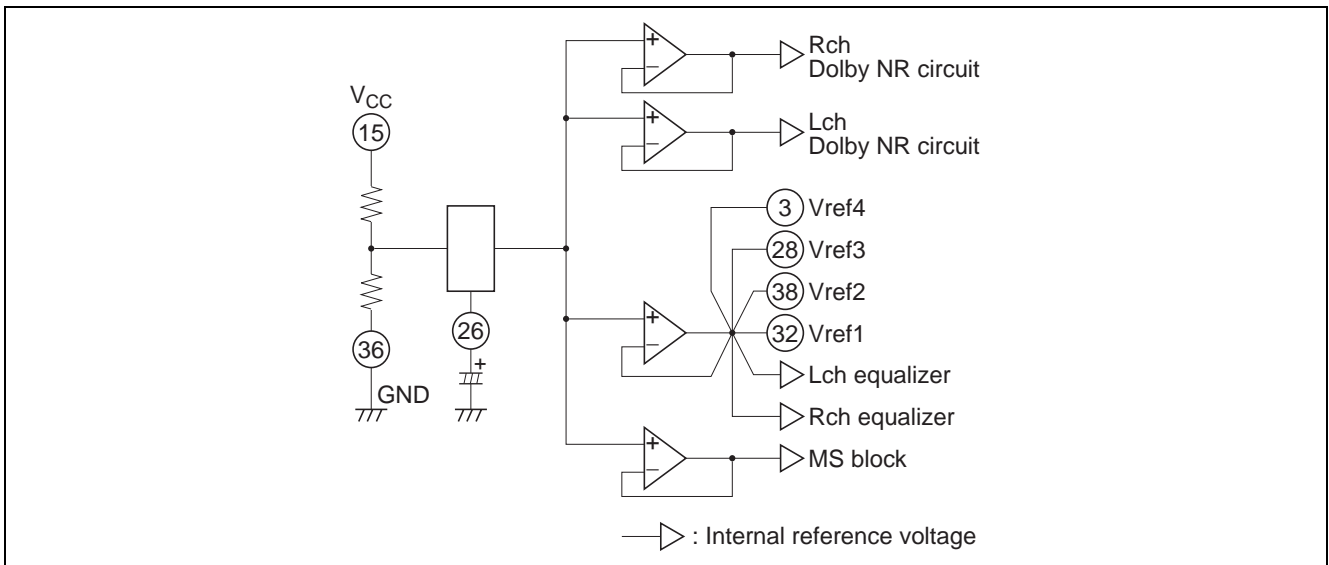
Product	Single Supply
HA12228F	6.5 V to 12.0 V
HA12229F	

Note: The lower limit of supply voltage depends on the line output reference level.

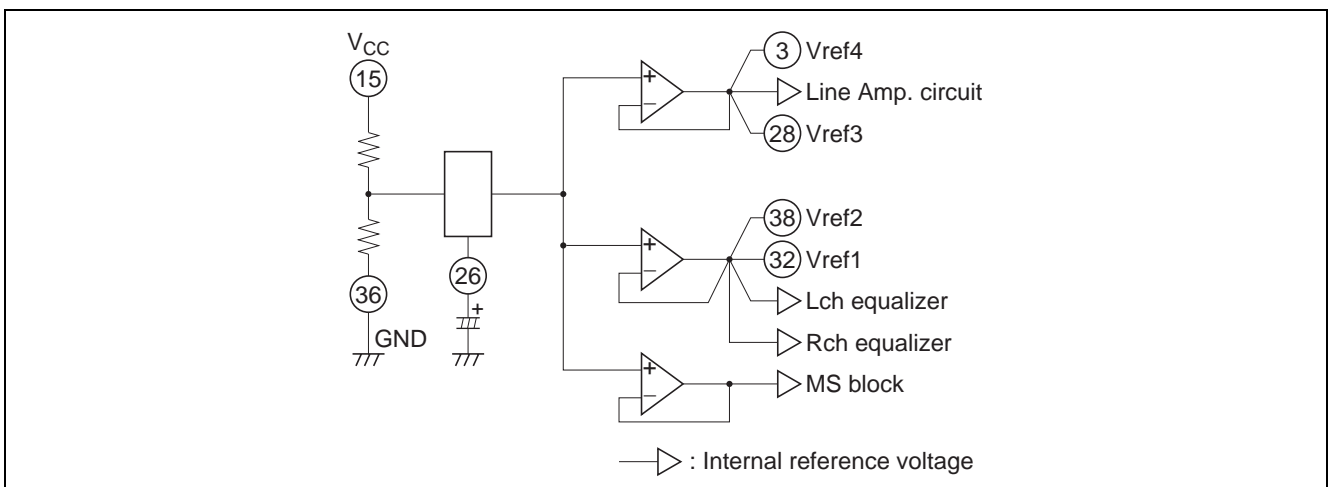
The minimum value of the overload margin is specified as 12 dB by Dolby Laboratories.

### Reference Voltage

These devices provide the reference voltage of half the supply voltage that is the signal grounds. As the peculiarity of these devices, the capacitor for the ripple filter is very small about 1/100 compared with their usual value. The block diagram is shown as figure 1.



**Figure 1a The HA12228F Block Diagram of Reference Supply Voltage**



**Figure 1b The HA12229F Block Diagram of Reference Supply Voltage**

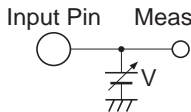


**Operating Mode Control**

HA12228F/HA12229F provides fully electronic switching circuits. And each operating mode control are controlled by parallel data (DC voltage).

When a power supply of this IC is cut off, for a voltage, in addition to a mode control terminal even though as do not destruct it, in series for resistance.

**Table 2 Threshold Voltage ( $V_{TH}$ )**

Pin No.	Lo	Hi	Unit	Test Condition
17, 18, 19, 20, 21*	-0.2 to 1.0	3.5 to $V_{CC}$	V	Input Pin Measure 

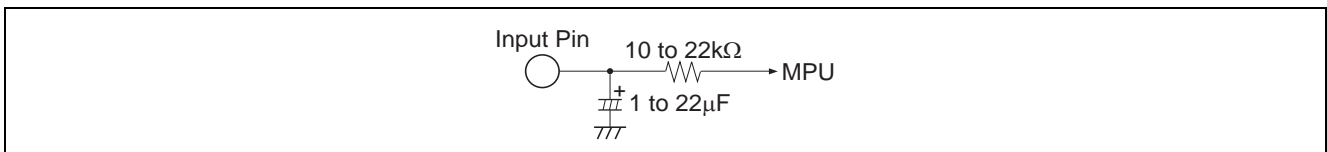
Note: \* Non connection regarding HA12229F.

**Table 3 Switching Truth Table**

Pin No.	Pin Name	Lo	Hi
17	Forward/Reverse	Forward	Reverse
18	Search/Repeat	Search (FF or REV)	Repeat (Normal speed)
19	120 $\mu$ /70 $\mu$	70 $\mu$ (Metal or Chrome)	120 $\mu$ (Normal)
20	MUTE ON/OFF	MUTE-OFF	MUTE-ON
21*	NR ON/OFF	NR-OFF	NR-ON

Notes: \* Non connection regarding HA12229F.

- Each pins are on pulled down with 100 k $\Omega$  internal resistor. Therefore, it will be low-level when each pins are open.
- Over shoot level and under shoot level of input signal must be the standardized. (High:  $V_{CC}$ , Low: -0.2 V)
- Reducing pop noise is so much better for 10 k $\Omega$  to 22 k $\Omega$  resistor and 1  $\mu$ F to 22  $\mu$ F capacitor shown figure 2.



**Figure 2 Interface for Reduction of Pop Noise**

Input Block Diagram and Level Diagram

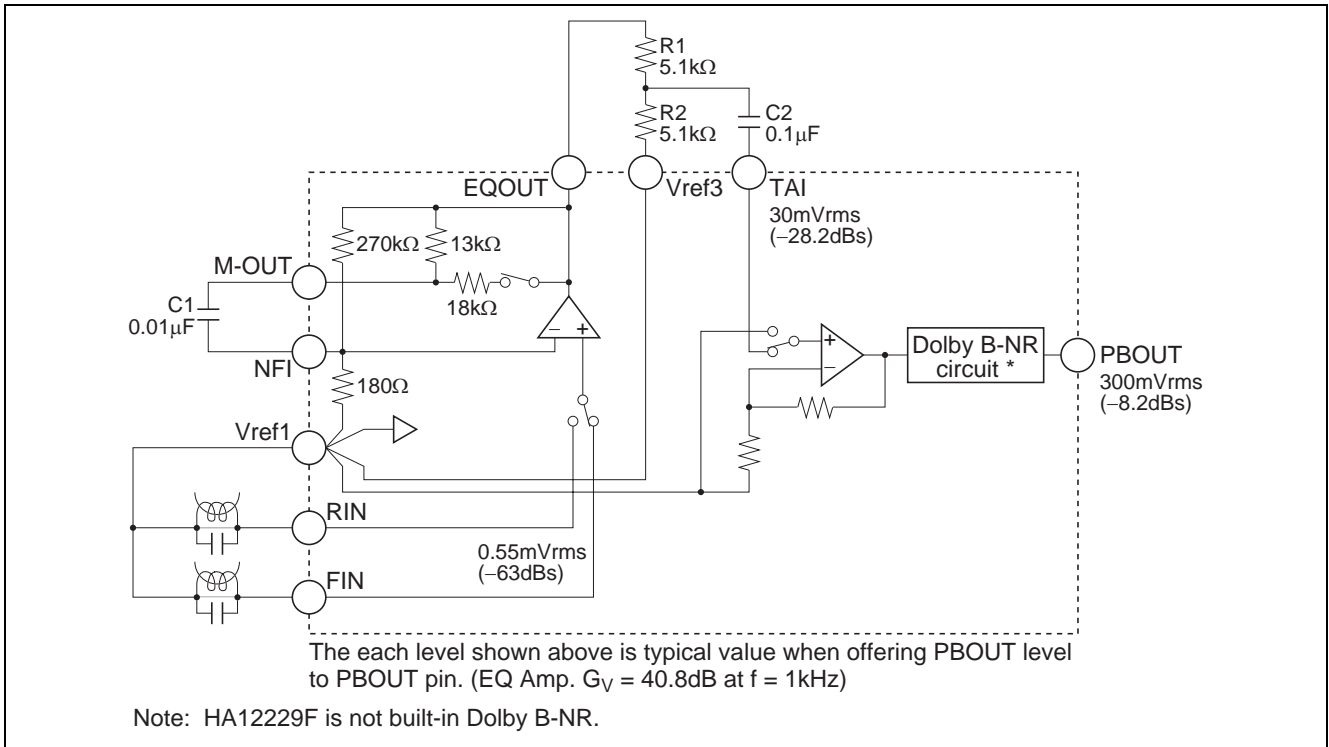


Figure 3 Input Block Diagram

Adjustment of Playback Dolby Level

After replace R5 and R6 with a half-fix volume of 10 kΩ, adjust playback Dolby level.

### The Sensitivity Adjustment of Music Sensor

Adjusting MS Amp. gain by external resistor, the sensitivity of music sensor can set up. The music sensor block diagram is shown in figure 4, and frequency response is shown in figure 5.

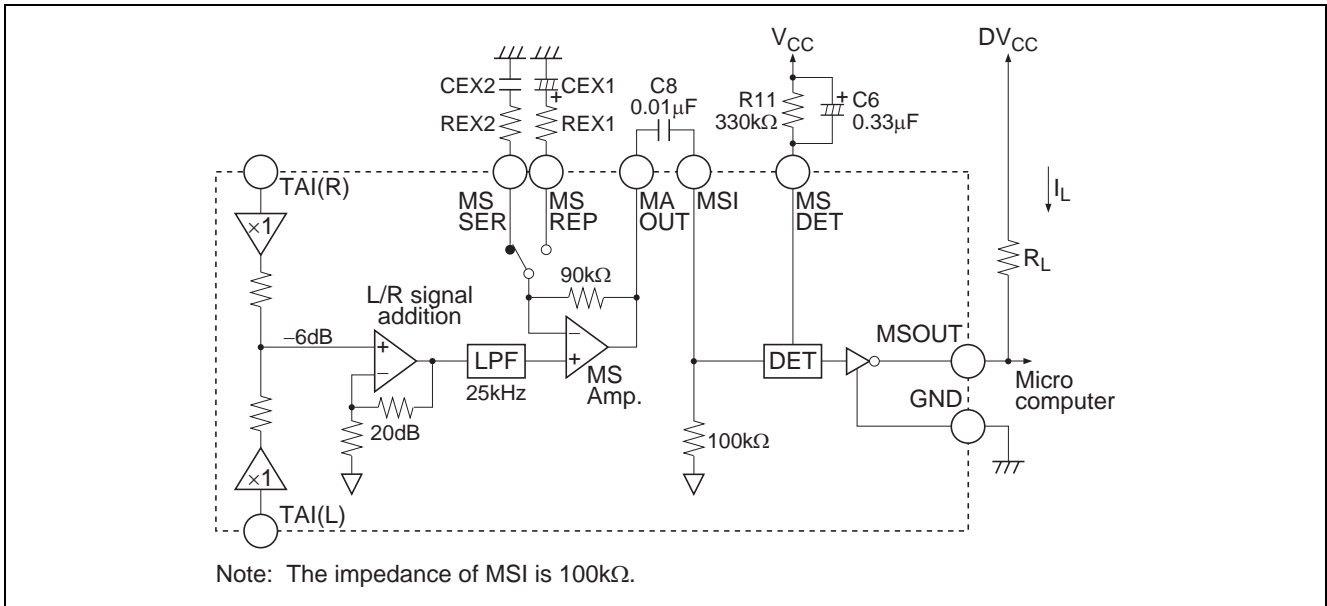


Figure 4 Music Sensor Block Diagram

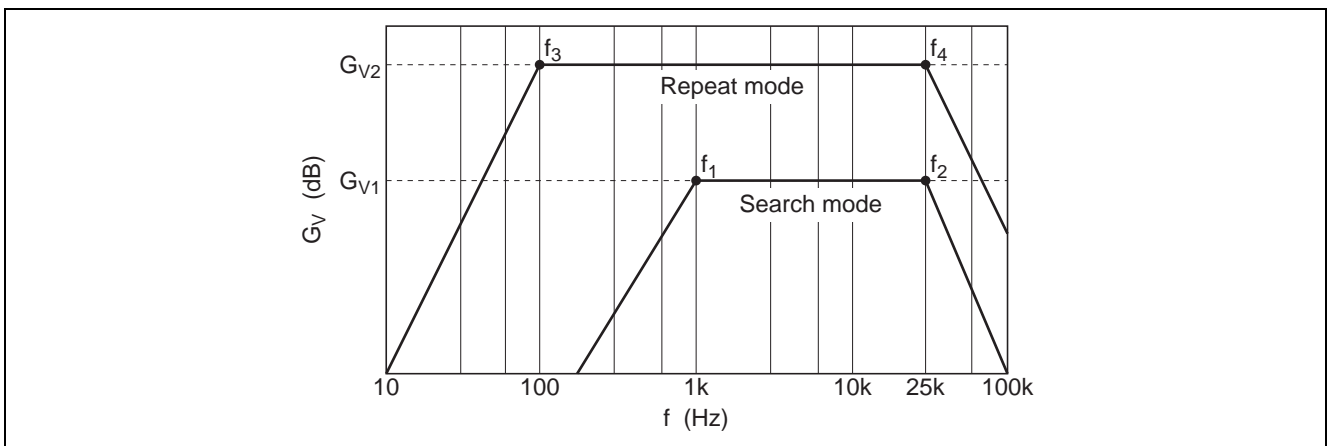


Figure 5 Frequency Response

1. Search mode

$$G_{V1} = 20\text{dB} + 20 \log \left( 1 + \frac{90\text{k}}{\text{REX2}} \right) \text{ [dB]}$$

$$f_1 = \frac{1}{2\pi \cdot \text{CEX2} \cdot \text{REX2}} \text{ [Hz]}, f_2 = 25\text{k} \text{ [Hz]}$$

2. Repeat mode

$$G_{V2} = 20\text{dB} + 20 \log \left( 1 + \frac{90\text{k}}{\text{REX1}} \right) \text{ [dB]}$$

$$f_3 = \frac{1}{2\pi \cdot \text{CEX1} \cdot \text{REX1}} \text{ [Hz]}, f_4 = 25\text{k} \text{ [Hz]}$$

$G_{VIA}$ : L-R signal addition circuit gain.

The sensitivity of music sensor (S) is computed by the formula mentioned below.

$$S = - \left( G_V^{*1} - 20 \log \frac{130^{*3}}{30^{*2}} \right) = 12.7 - G_V \text{ [dB]}$$

- Notes: 1. Search mode:  $G_{V1}$ , Repeat mode:  $G_{V2}$   
 2. Standard level of TAI pin (Dolby level correspondence) = 30 mVrms  
 3. Standard sensing level of music sensor = 130 mVrms

Item	REX1, 2	CEX1, 2	$G_{V1, 2}$	$f_{1, 3}$	$f_{2, 4}$	S (one side channel)	S (both channel)
Search mode	24 kΩ	0.01 μF	33.5 dB	663 Hz	25 kHz	-14.8 dB	-20.8 dB
Repeat mode	2.4 kΩ	1 μF	51.7 dB	66.3 Hz	25 kHz	-33.0 dB	-39.0 dB

Note: S is 6 dB down in case of one-side channel. And this MS presented hysteresis lest MSOUT terminal should turn over again High level or Low level, in case of thresh S level constantly.

**Music Sensor Time Constant**

- Sensing no signal to signal (Attack) is determined by C6, 0.01 μF to 1 μF capacitor C6 can be applicable.
- Sensing signal to no signal (Recovery) is determined by C6 and R11, however preceding (1), 100 kΩ to 1 MΩ can be applicable.

**Music Sensor Output (MSOUT)**

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

$$I_L = \frac{DV_{CC} - \text{MSOUT}_{LO}^*}{R_L}$$

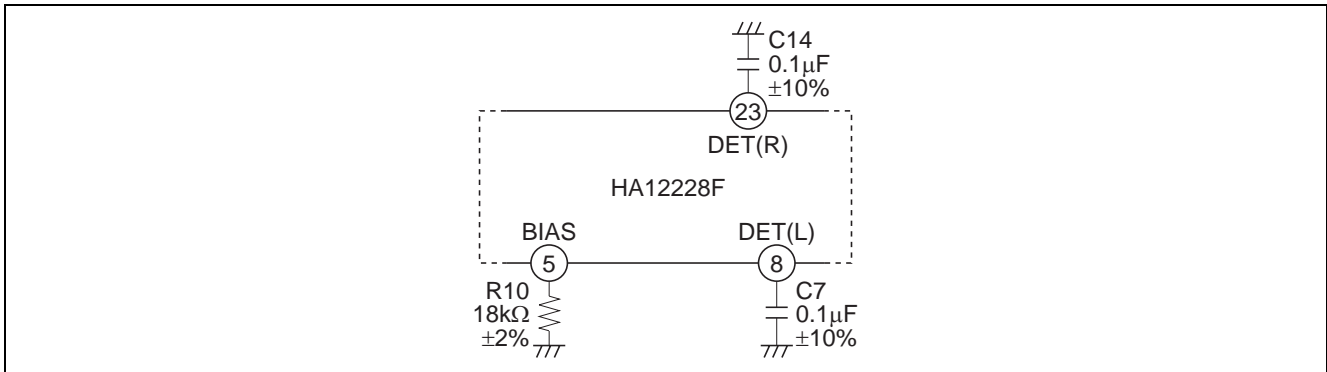
\* MSOUT<sub>LO</sub> : Sensing signal (about 1V)

Note: 1. Supply voltage of MSOUT pin must be less than  $V_{CC}$  voltage.

**The Tolerances of External Components for Dolby NR (Only HA12228F)**

For adequate Dolby NR tracking response, take external components shown below.

Also, leak is small capacity, and please employ a good quality object.



**Figure 6 Tolerance of External Components**

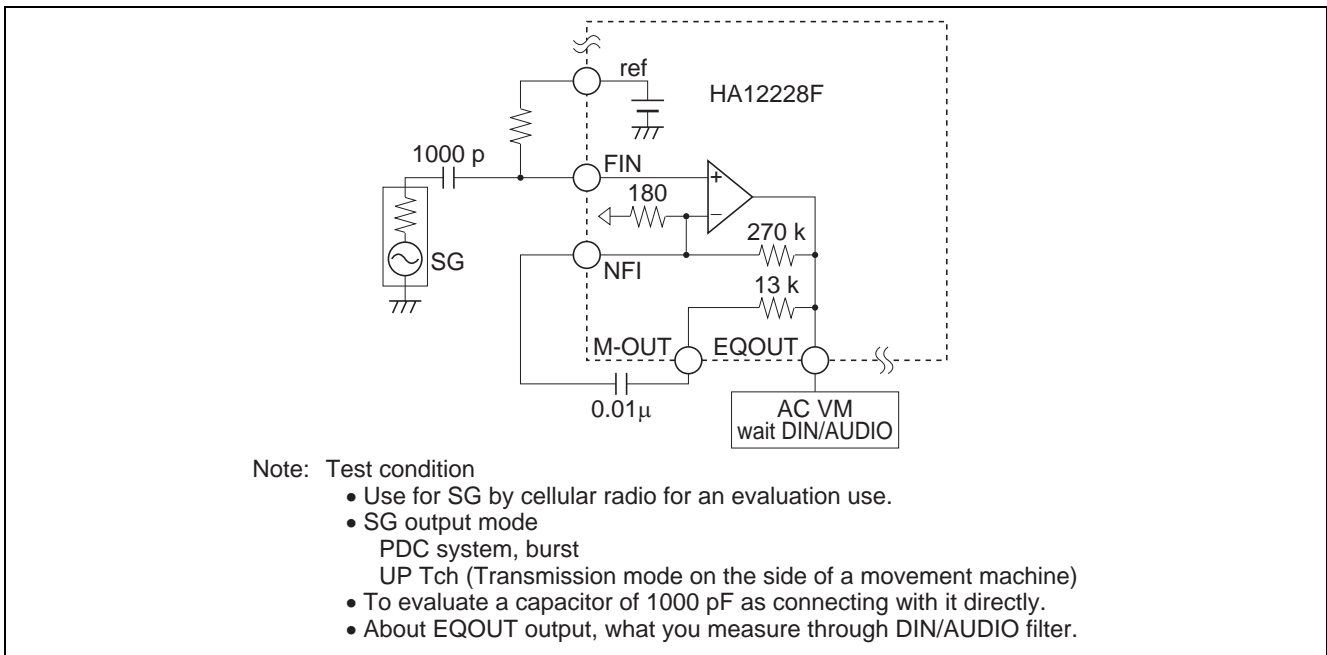
**Countermeasure of a Cellular Phone Noise**

This IC have reinforced a cellular phone noise countermeasure, to show it hereinafter.

However, it is presumed that this effect change it greatly, by a mount set.

Please sufficiently examine an arrangement of positions, shield method, wiring pattern, in order to obtain a maximum effect.

A high terminal of a noise sensitivity of this IC is FIN, RIN, NFI and RIP.



**Figure 7 Test Circuit**

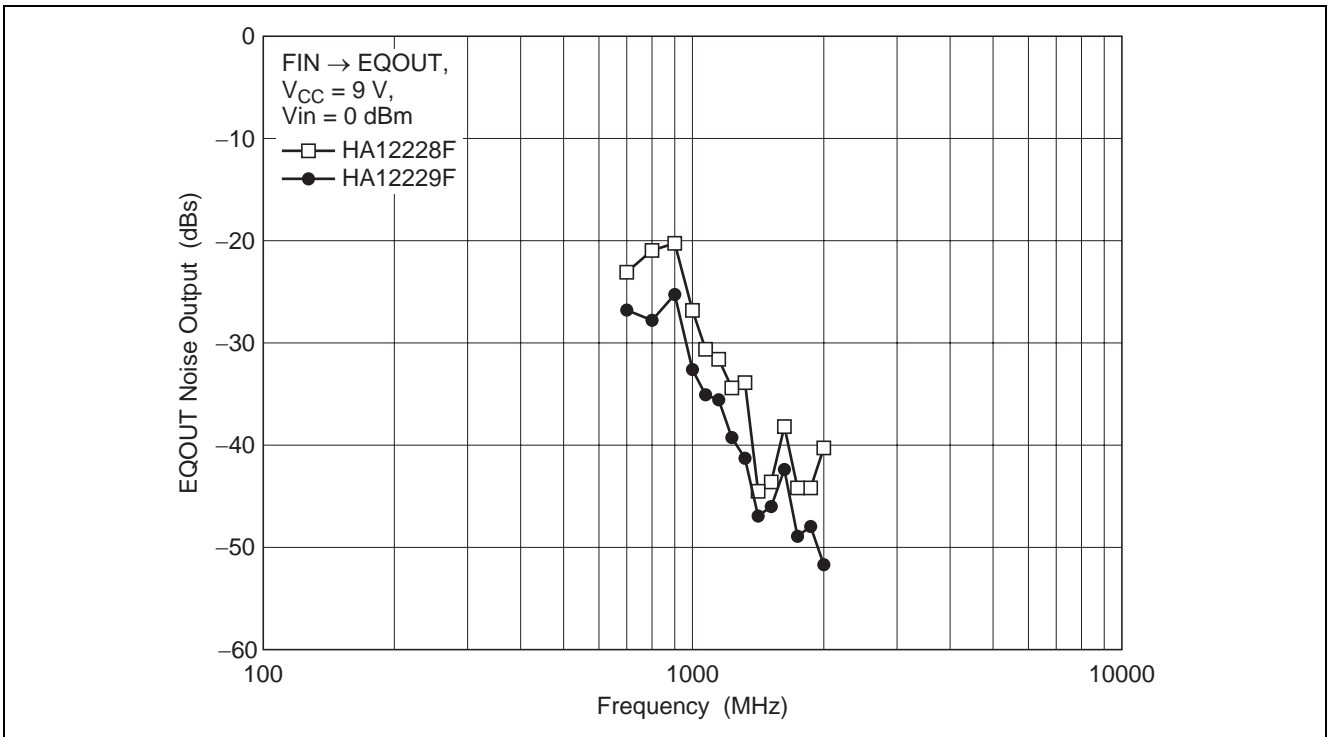


Figure 8 EQOUT Noise Output vs. Transmission Frequency Characteristic

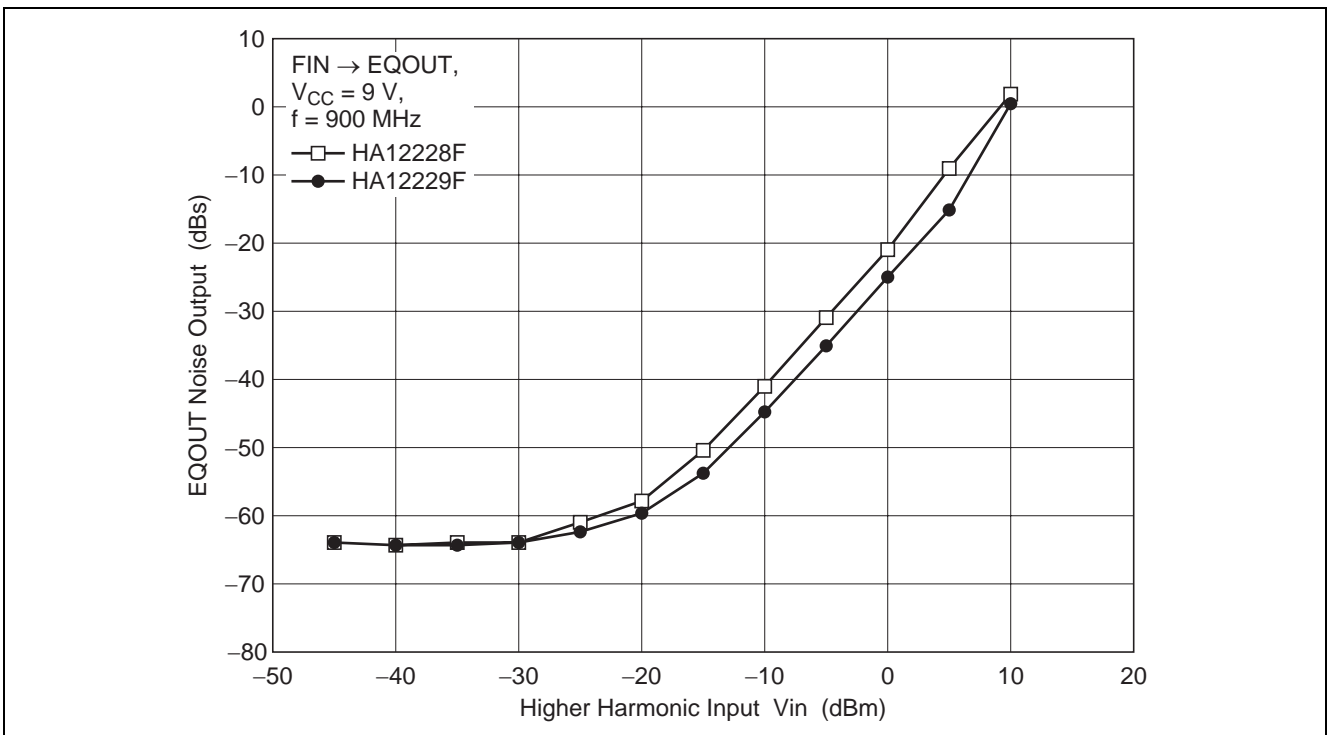


Figure 9 EQOUT Noise Output vs. Transmission Signal Input Level Characteristic

**Absolute Maximum Ratings**

(Ta = 25°C)

Item	Symbol	Rating	Unit	Note
Maximum supply voltage	V <sub>CC</sub> Max	16	V	
Power dissipation	Pd	400	mW	Ta ≤ 85°C
Operating temperature	T <sub>opr</sub>	-40 to +85	°C	
Storage temperature	T <sub>stg</sub>	-55 to +125	°C	

Electrical Characteristics

HA12228F

(Ta = 25°C, Vcc = 9 V, Dolby level 0 dB = PBOUT level 0 dB = 300 mVrms, EQOUT level 0 dB = 60 mVrms)

Item	Symbol	Test Condition										Specification				Application Terminal				Remark		
		IC Condition					PBOUT level (dB)					Min	Typ	Max	Unit	Input		Output				
		NR ON/OFF	MUTE ON/OFF	120µ/70µ SER	SER/REP	FOR/REV	fin (Hz)	PBOUT level (dB)	EQOUT level (dB)	Other	R					L	R	L	COM			
Quiescent current	I <sub>Q</sub>	OFF	OFF	70µ	SER	FOR	—	—	—	No signal	—	—	—	4.0	9.5	15.0	mA	—	—	—	15	
Input Amp. gain	G <sub>V</sub> A	OFF	OFF	—	—	—	—	—	—	—	1k	0	—	19.0	20.0	21.0	dB	27	4	25	6	
B-type decode cut	DEC 2k (1)	ON	OFF	—	—	—	—	—	—	—	2k	-20	—	-5.8	-4.3	-2.8	dB	27	4	25	6	
	DEC 2k (2)	ON	OFF	—	—	—	—	—	—	—	2k	-30	—	-10.0	-8.5	-7.0	dB	27	4	25	6	
	DEC 5k (1)	ON	OFF	—	—	—	—	—	—	—	5k	-20	—	-4.7	-3.2	-1.7	dB	27	4	25	6	
DEC 5k (2)	ON	OFF	—	—	—	—	—	—	—	5k	-30	—	-9.7	-8.2	-6.7	dB	27	4	25	6		
PBOUT offset	Vofs	OFF	OFF→	—	—	—	—	—	—	—	—	—	—	-150	0	150	mV	—	—	25	6	1
Signal handling	V <sub>o</sub> max	ON	OFF	—	—	—	—	—	—	—	1k	—	—	12.0	13.0	—	dB	27	4	25	6	2
Signal to noise ratio	S/N	ON	OFF	—	—	—	—	—	—	—	1k	(0)	—	—	80.0	—	dB	27	4	25	6	—
Total Harmonic Distortion	THD	ON	OFF	—	—	—	—	—	—	—	1k	0	—	—	0.05	0.3	%	27	4	25	6	—
Channel separation	CTRL (1)	—	—	—	—	—	—	—	—	—	1k	—	(+20)	—	60.0	—	dB	37	39	29→212→29	—	—
	CTRL (2)	OFF	OFF	—	—	—	—	—	—	—	1k	(+12)	—	—	80.0	—	dB	27	4	25→16→25	—	—
MUTE attenuation	CT MUTE	OFF	OFF→	—	—	—	—	—	—	—	1k	(+12)	—	—	80.0	—	dB	27	4	25	6	—
PB-EQ gain	G <sub>V</sub> EQ 1k	—	—	120µ	—	FOR/REV	—	—	—	—	1k	—	0	—	40.8	43.8	dB	37/35	39/33	29	2	—
	G <sub>V</sub> EQ 10k(1)	—	—	120µ	—	FOR	—	—	—	—	10k	—	0	—	36.9	39.9	dB	37	39	29	2	—
	G <sub>V</sub> EQ 10k(2)	—	—	70µ	—	FOR	—	—	—	—	10k	—	0	—	32.6	35.6	dB	37	39	29	2	—
PB-EQ Maximum output level	V <sub>OM</sub>	—	—	120µ	—	FOR	—	—	—	—	1k	—	—	300	600	mVrms	37	39	29	2	—	
PB-EQ T.H.D.	THD-EQ	—	—	120µ	—	FOR/REV	—	—	—	—	1k	—	+14dB	—	0.1	0.3	%	37/35	39/33	29	2	—
PB-EQ input conversion noise	V <sub>N</sub>	—	—	120µ	—	FOR/REV	—	—	—	—	(1k)	—	—	—	0.7	1.5	µVrms	37/35	39/33	29	2	—
MS sensing level	V <sub>ON</sub> (1)	OFF	OFF	—	SER	—	—	—	—	—	5k	—	—	-36.0	-32.0	-28.0	dB	27	4	25	6	16
	V <sub>ON</sub> (2)	OFF	OFF	—	REP	—	—	—	—	—	5k	—	—	-18.0	-14.0	-10.0	dB	27	4	25	6	16
MS output low level	V <sub>OL</sub>	OFF	OFF	—	SER	—	—	—	—	—	5k	0	—	—	1.0	1.5	V	27	4	—	—	16
MS output leakage current	I <sub>OH</sub>	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0	2.0	µA	—	—	—	—	16
Control voltage	V <sub>IL</sub>	—	—	—	—	—	—	—	—	—	—	—	—	-0.2	—	1.0	V	—	—	—	—	17 to 21
	V <sub>IH</sub>	—	—	—	—	—	—	—	—	—	—	—	—	3.5	—	V <sub>CC</sub>	V	—	—	—	—	—

Notes: 1. V<sub>CC</sub> = 12V  
 2. V<sub>CC</sub> = 6.5V  
 3. For inputting signal to one side channel



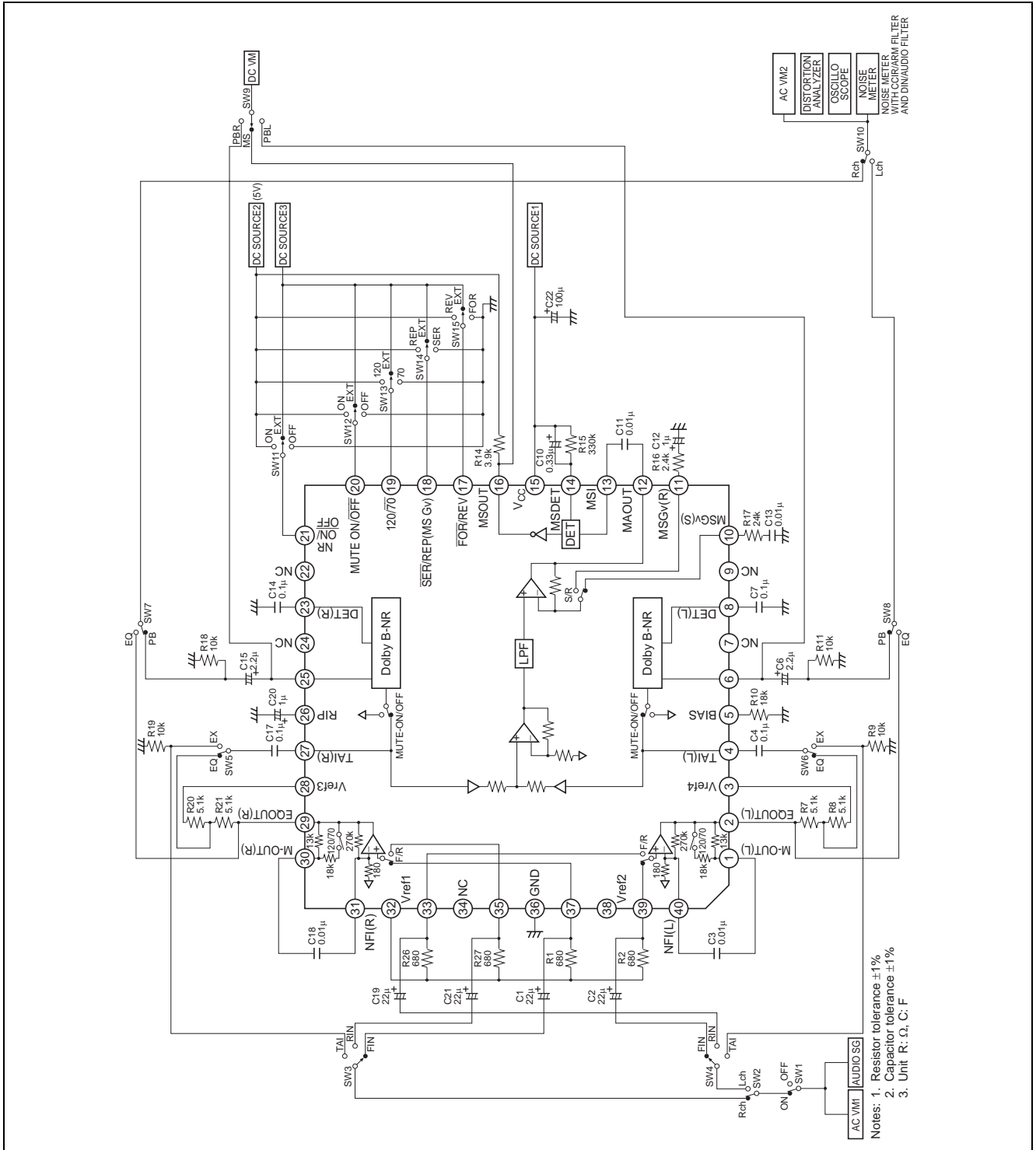
HA12229F

(Ta = 25°C, V<sub>CC</sub> = 9 V, PBOUT level 0 dB = 300 mVrms, EQOUT level 0 dB = 60 mVrms)

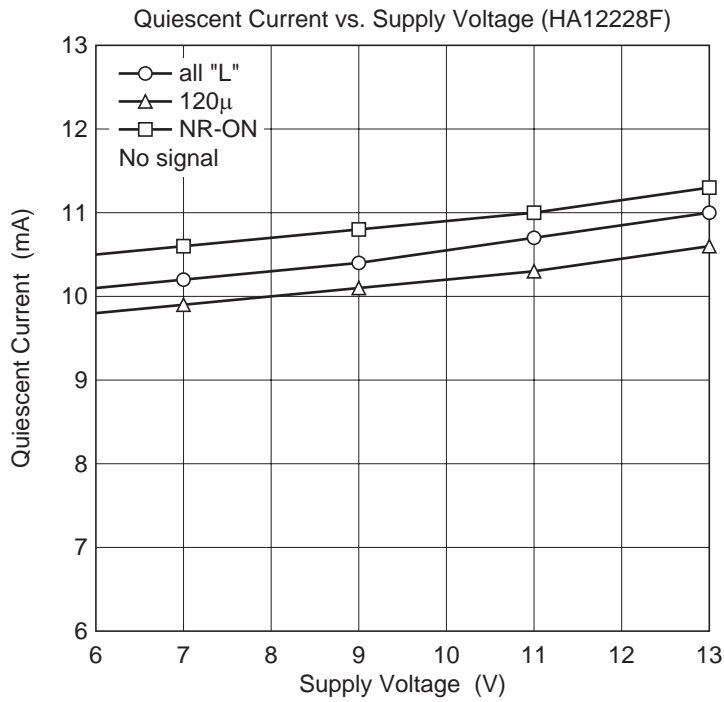
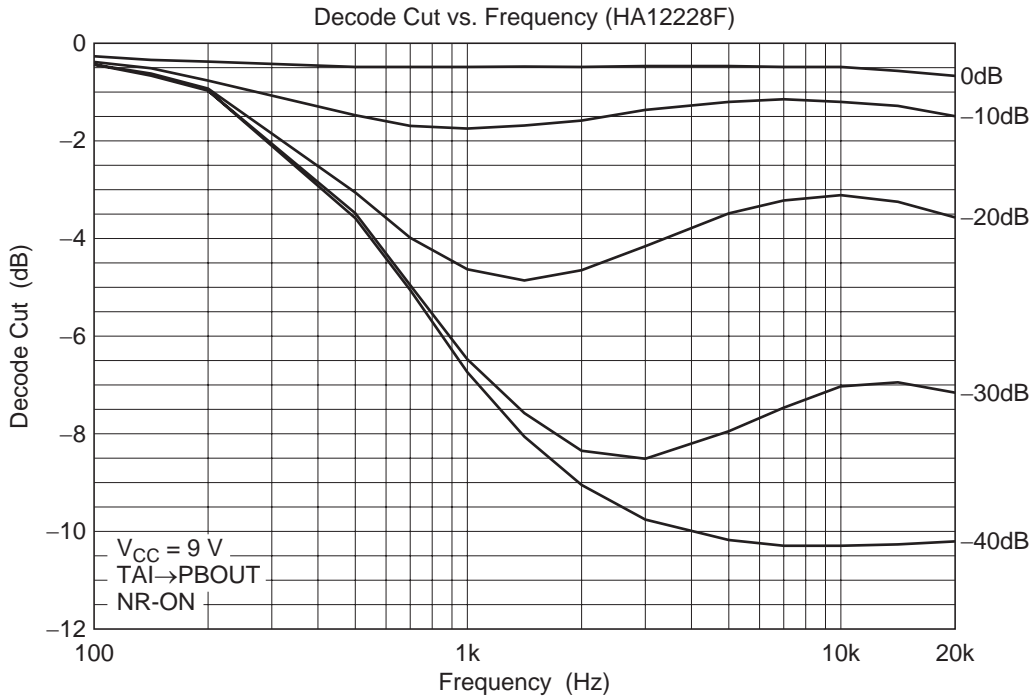
Item	Symbol	Test Condition										Specification				Application Terminal			
		IC Condition			MUTE ON/OFF	fin (Hz)	PBOUT level (dB)	EQOUT level (dB)	Other	Min	Typ	Max	Unit	Input		Output			
		120μ/ 70μ	SER/ REP	FOR/ REV										R	L	R	L	COM	Remark
Quiescent current	I <sub>Q</sub>	—	—	FOR	—	—	—	No signal	3.0	5.0	8.0	mA	—	—	—	—	15		
Input Amp. gain	G <sub>v</sub> /A	—	—	—	1k	0	—	No signal	19.0	20.0	21.0	dB	27	4	25	6			
PBOUT offset	V <sub>ofs</sub>	—	—	—	—	—	—	No signal	-150	0	150	mV	—	—	25	6	1		
Signal handling	V <sub>o max</sub>	—	—	—	1k	—	—	THD=1%	12.0	13.0	—	dB	27	4	25	6	2		
Signal to noise ratio	S/N	—	—	—	1k	(0)	—	Rg=10kΩ, CCIR/ARM	70.0	80.0	—	dB	27	4	25	6			
Total Harmonic Distortion	THD	—	—	—	1k	0	—		—	0.05	0.3	%	27	4	25	6			
Channel separation	CTRL (1)	—	—	FOR	1k	—	(+20)		50.0	60.0	—	dB	37	39	29→2	2→29			
	CTRL (2)	—	—	—	1k	(+12)	—		70.0	80.0	—	dB	27	4	25→6	6→25			
MUTE attenuation	CT MUTE	—	—	—	1k	(+12)	—		70.0	80.0	—	dB	27	4	25	6			
PB-EQ gain	G <sub>v</sub> /EQ 1k	—	120μ	FOR/ REV	1k	—	0		37.8	40.8	43.8	dB	37/35	39/33	29	2			
	G <sub>v</sub> /EQ 10k(1)	—	120μ	FOR	10k	—	0		33.9	36.9	39.9	dB	37	39	29	2			
	G <sub>v</sub> /EQ 10k(2)	—	70μ	FOR	10k	—	0		29.6	32.6	35.6	dB	37	39	29	2			
PB-EQ Maximum output level	V <sub>OM</sub>	—	120μ	FOR	1k	—	—	THD=1%	300	600	—	mVrms	37	39	29	2			
PB-EQ T.H.D.	THD-EQ	—	120μ	FOR/ REV	1k	—	+14dB		—	0.1	0.3	%	37/35	39/33	29	2			
PB-EQ input conversion noise	V <sub>N</sub>	—	120μ	FOR/ REV	(1k)	—	—	Rg=680Ω, DIN-AUDIO	—	0.7	1.5	μVrms	37/35	39/33	29	2			
MS sensing level	V <sub>ON</sub> (1)	OFF	—	SER	5k	—	—		-36.0	-32.0	-28.0	dB	27	4	25	6	16	3	
	V <sub>ON</sub> (2)	OFF	—	REP	5k	—	—		-18.0	-14.0	-10.0	dB	27	4	25	6	16	3	
MS output low level	V <sub>OL</sub>	OFF	—	SER	5k	0	—		—	1.0	1.5	V	27	4	—	—	16		
MS output leakage current	I <sub>OH</sub>	—	—	—	—	—	—	No signal	—	0.0	2.0	μA	—	—	—	—	16		
Control voltage	V <sub>IL</sub>	—	—	—	—	—	—		-0.2	—	1.0	V	—	—	—	—	17 to		
	V <sub>IH</sub>	—	—	—	—	—	—		3.5	—	V <sub>CC</sub>	V	—	—	—	—	20		

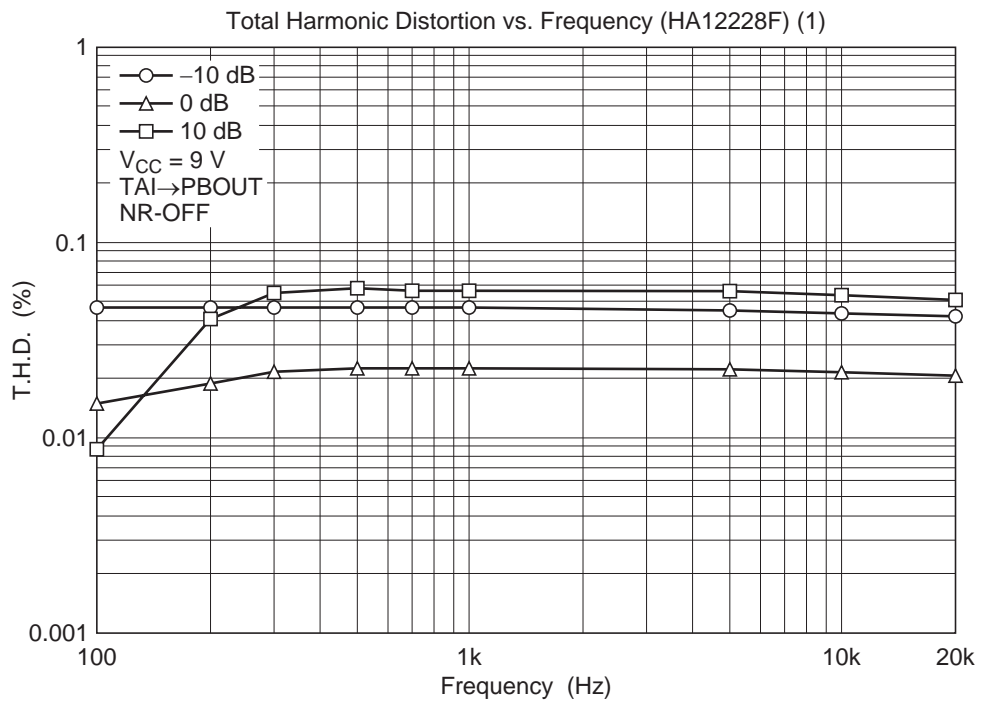
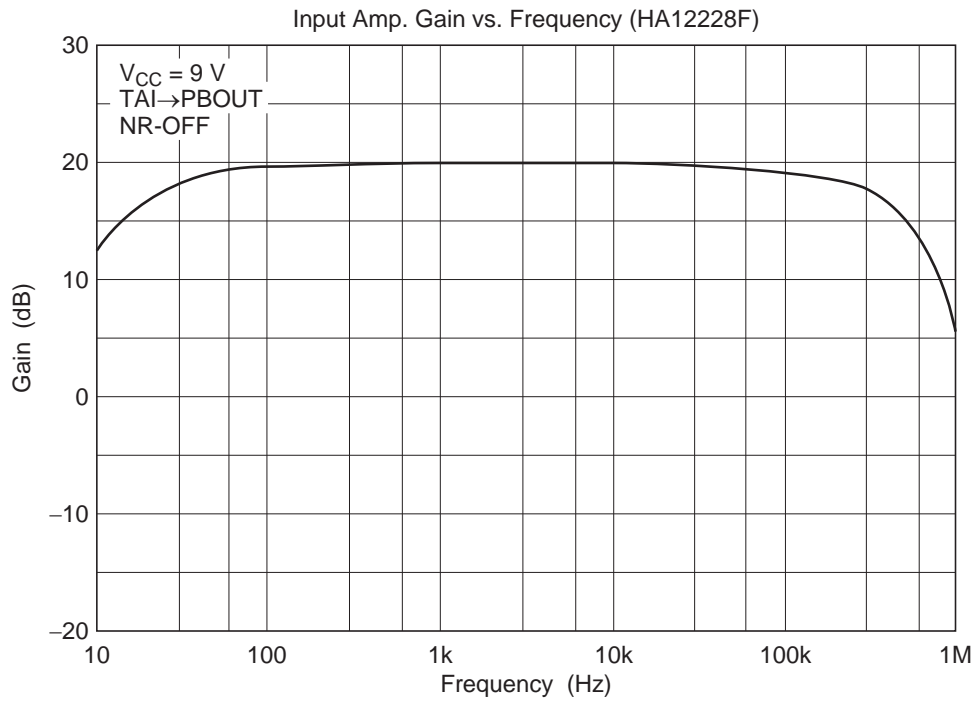
Notes: 1. V<sub>CC</sub> = 12V  
 2. V<sub>CC</sub> = 6.5V  
 3. For inputting signal to one side channel

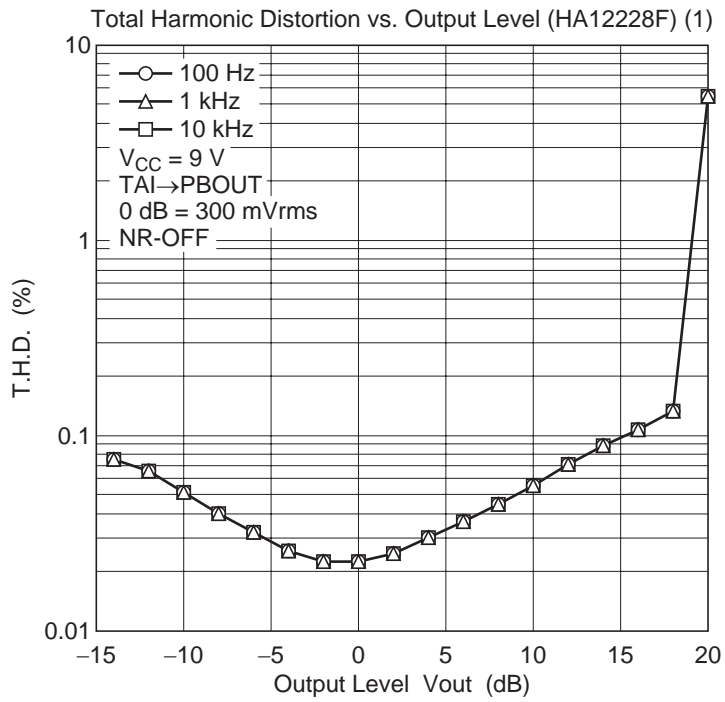
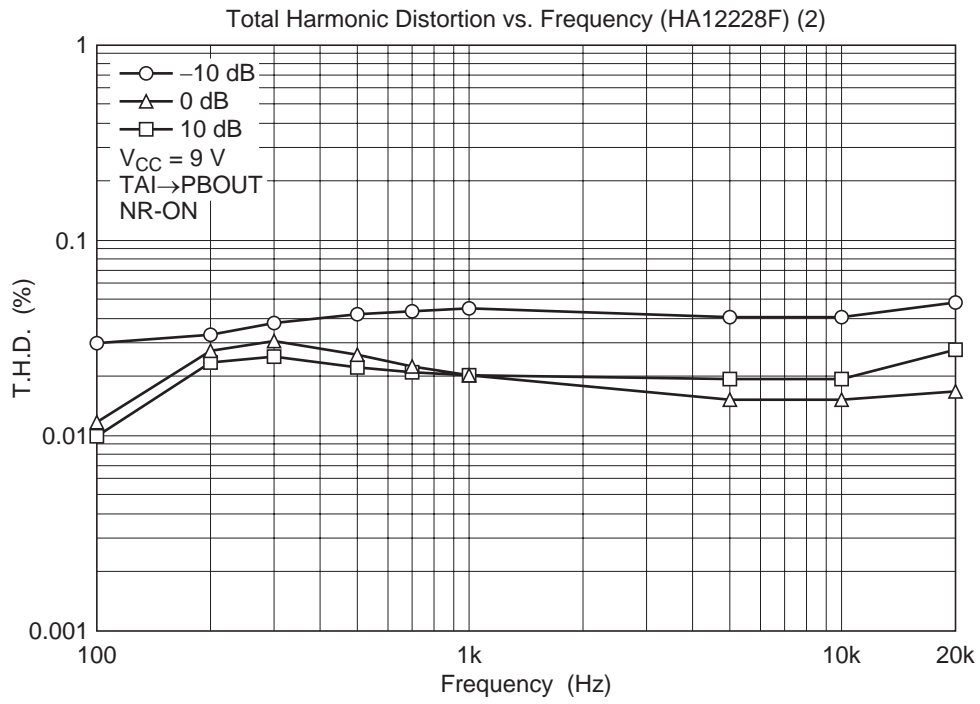
Test Circuit

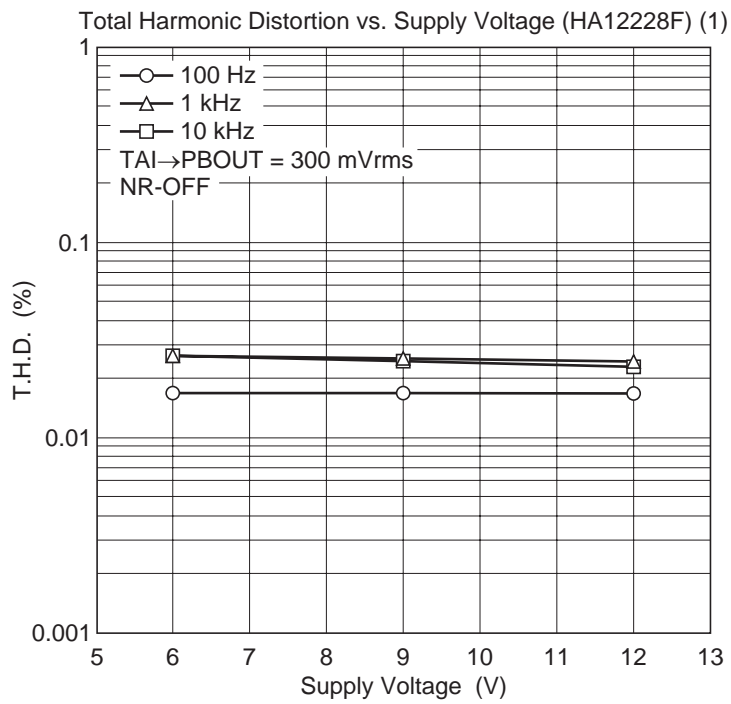
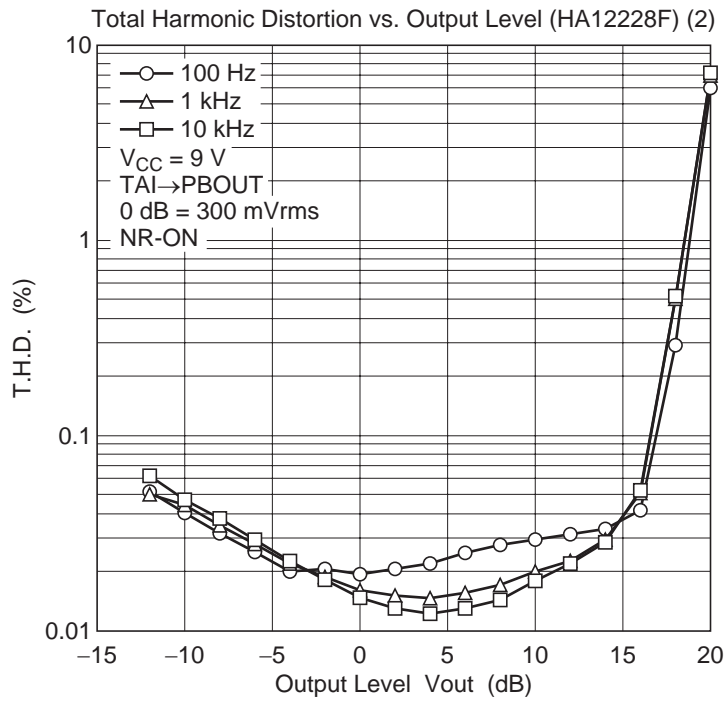


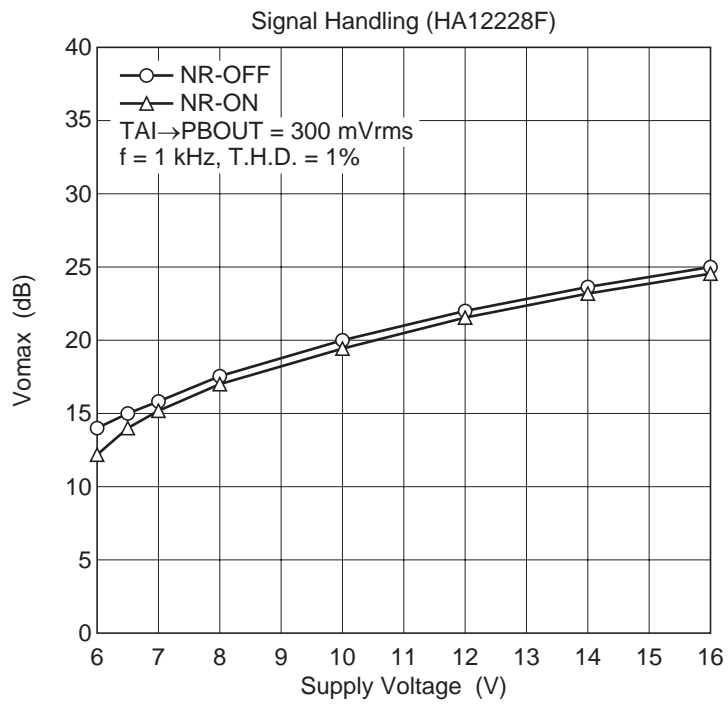
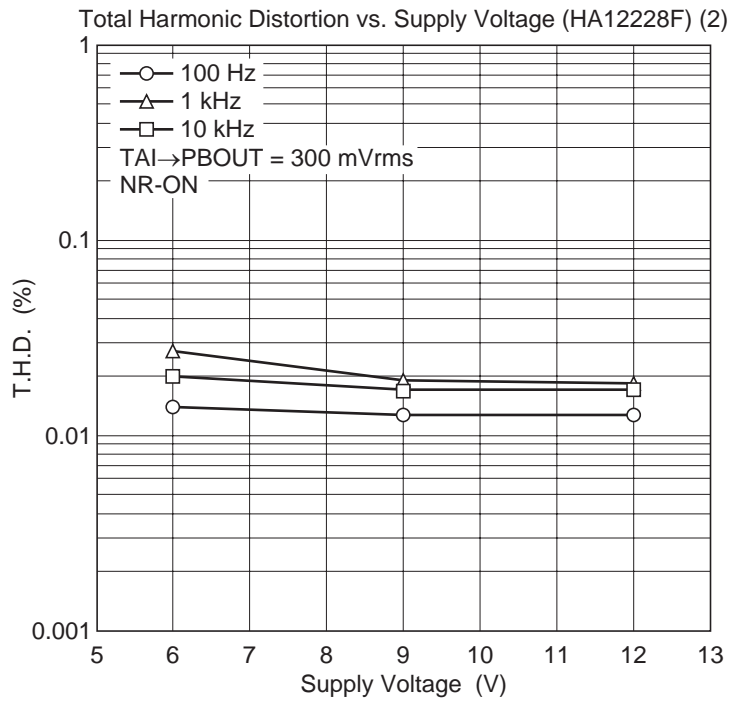
Characteristic Curves

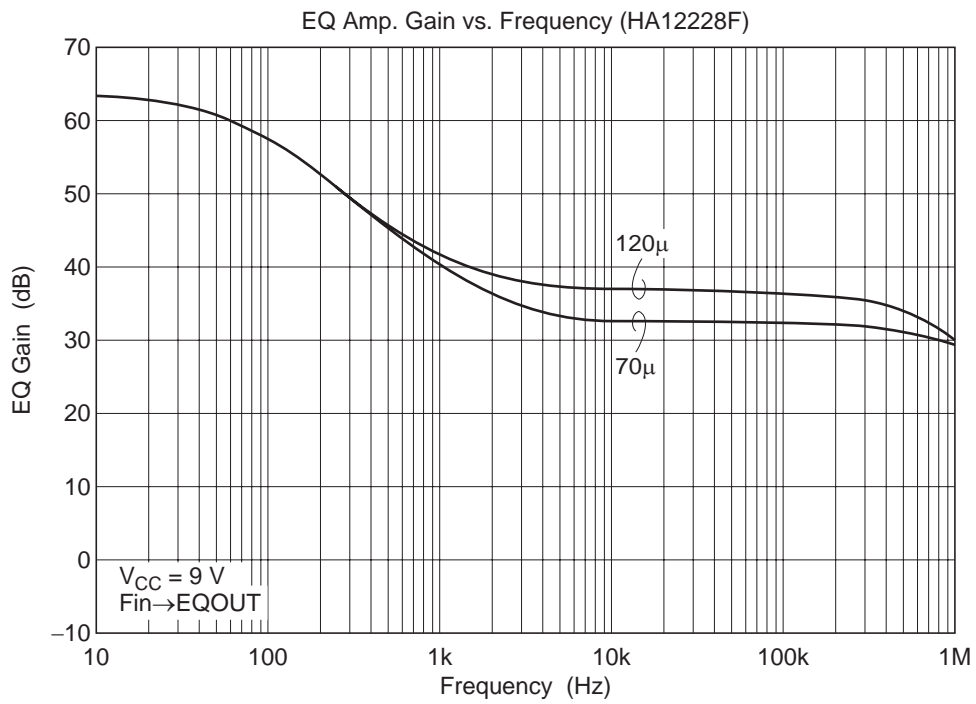
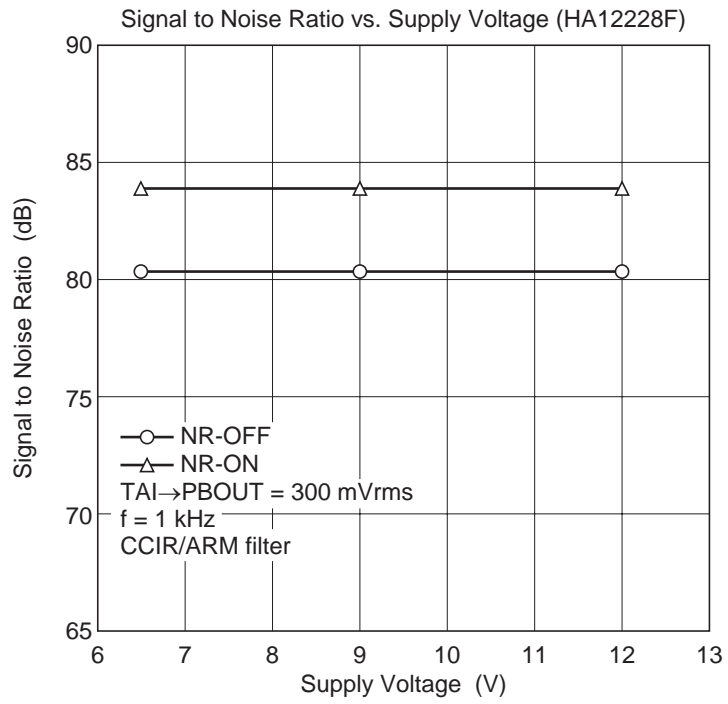




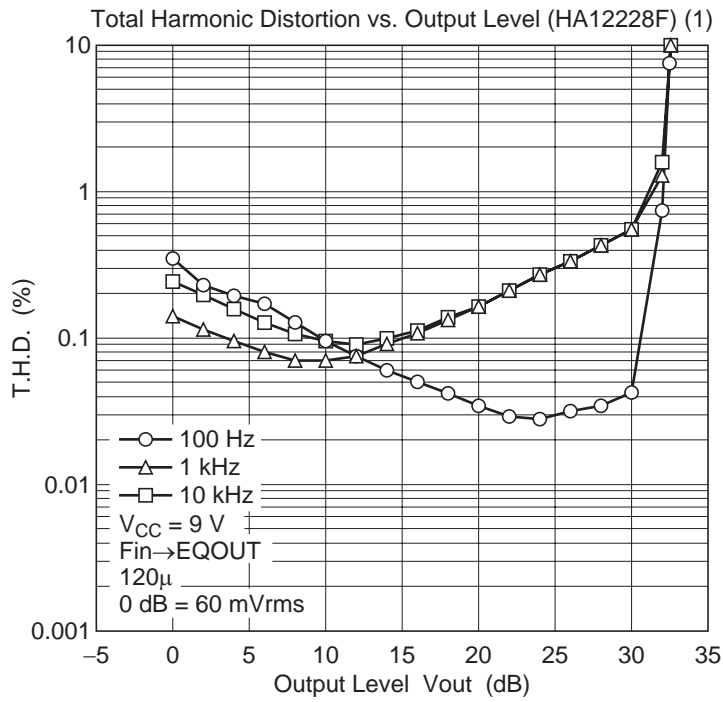
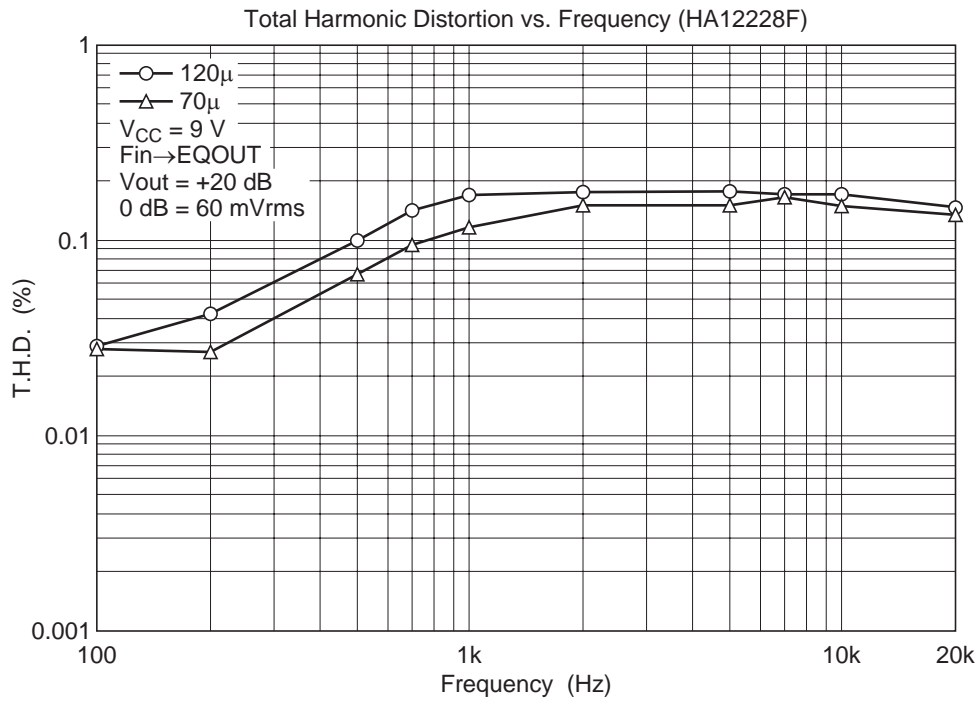


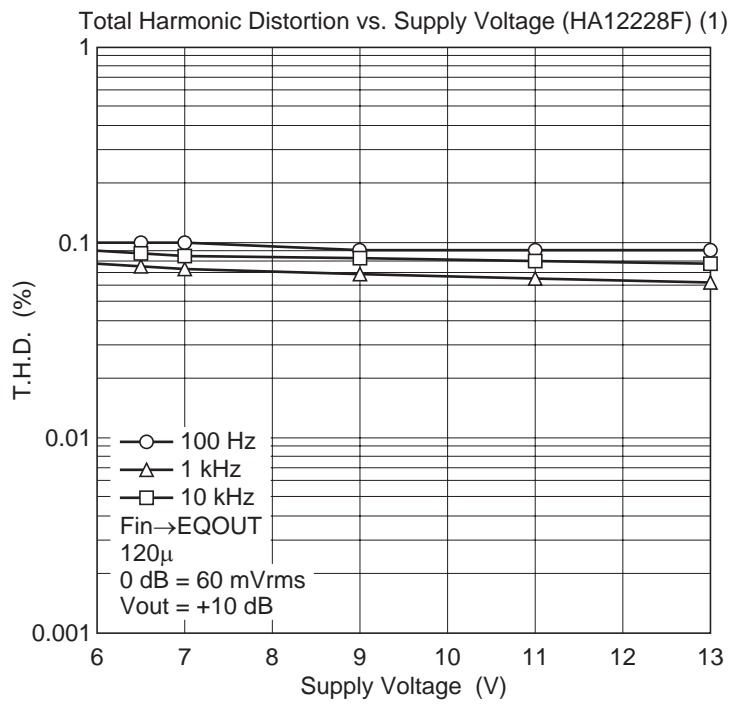
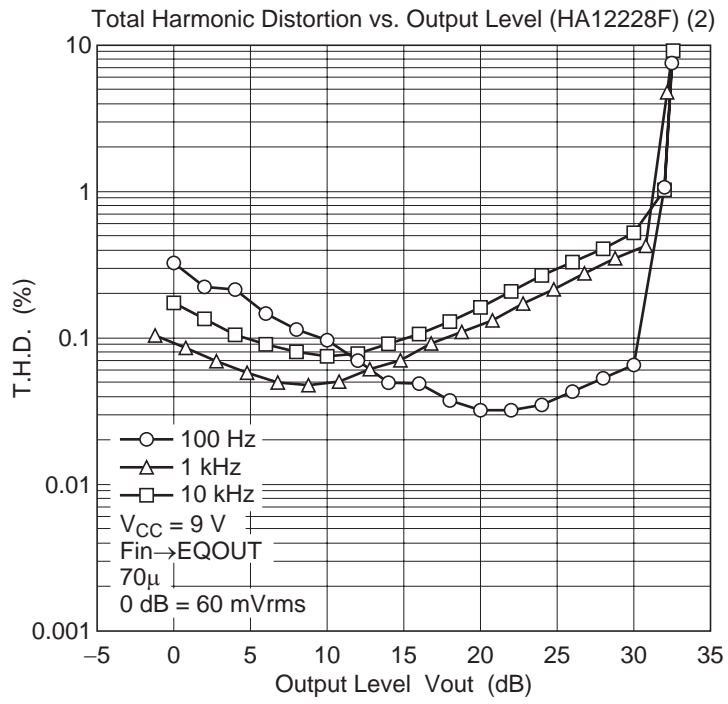


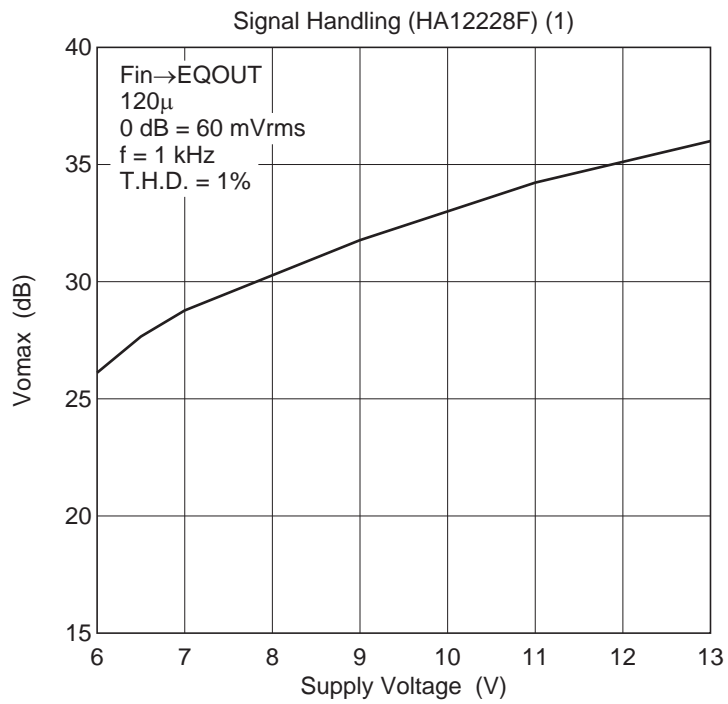
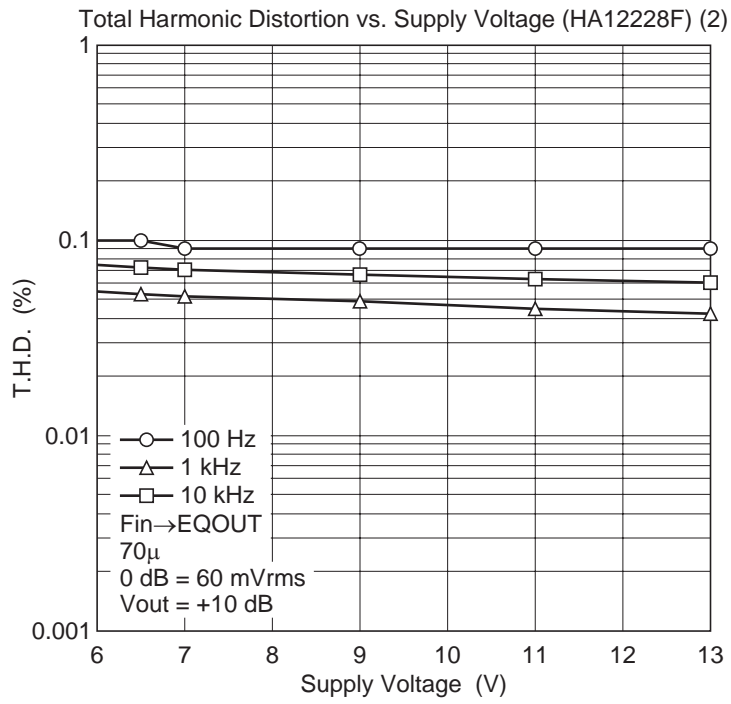


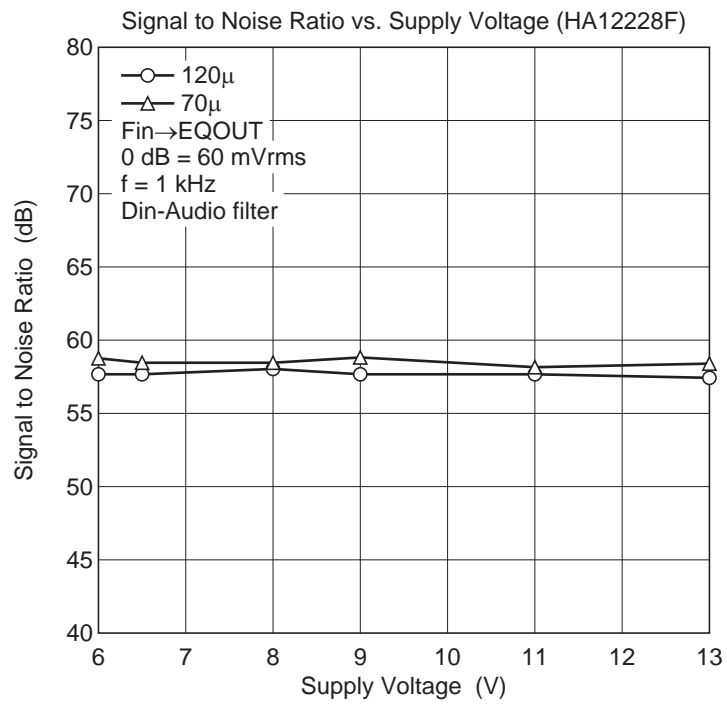
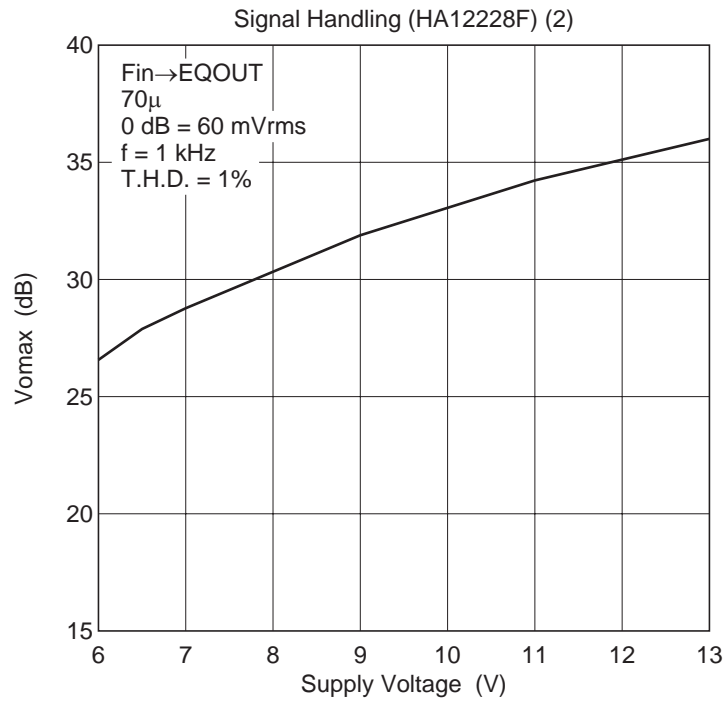


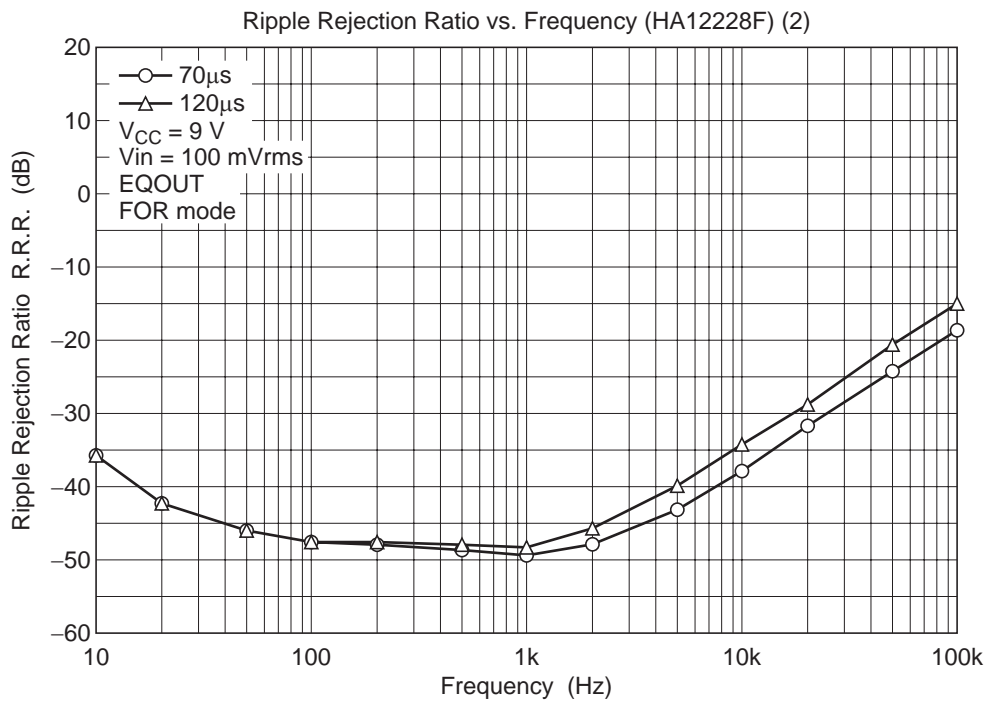
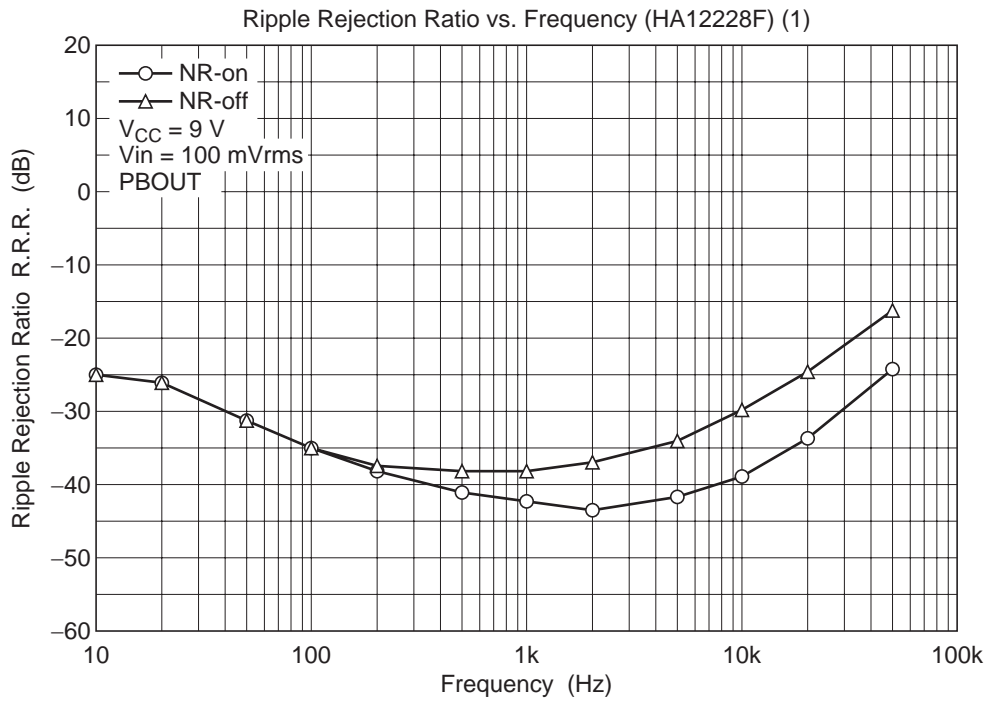


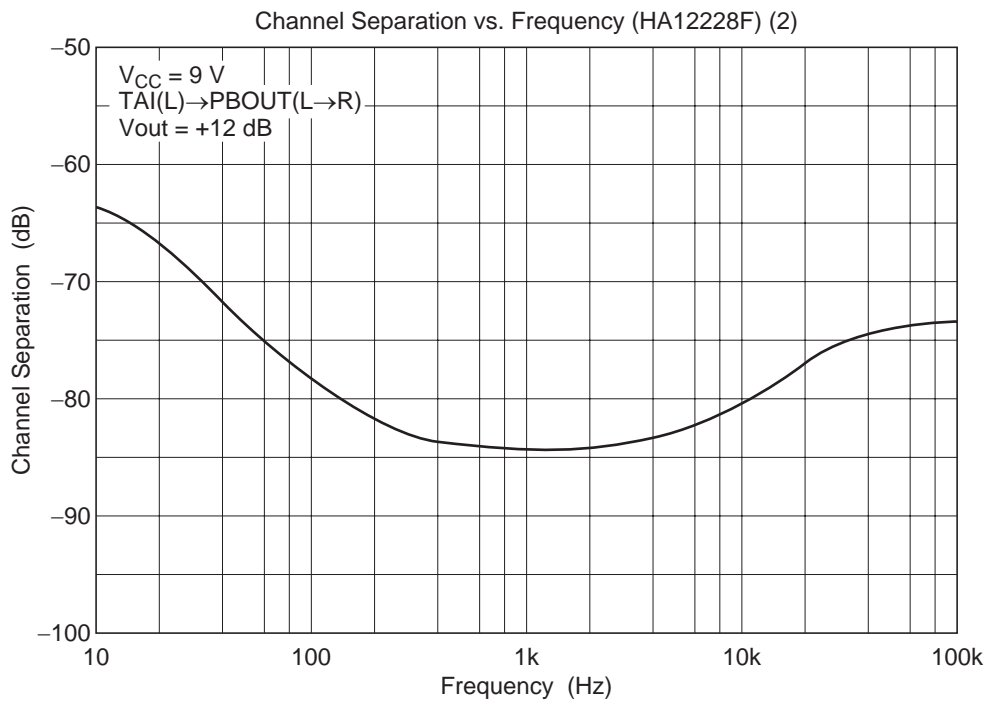
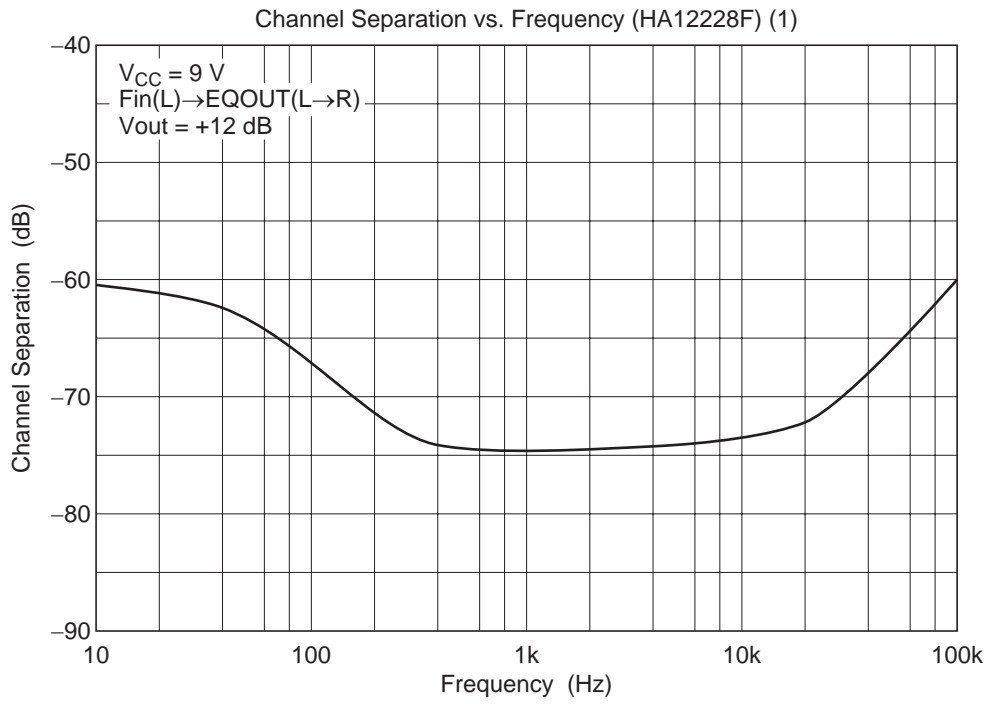


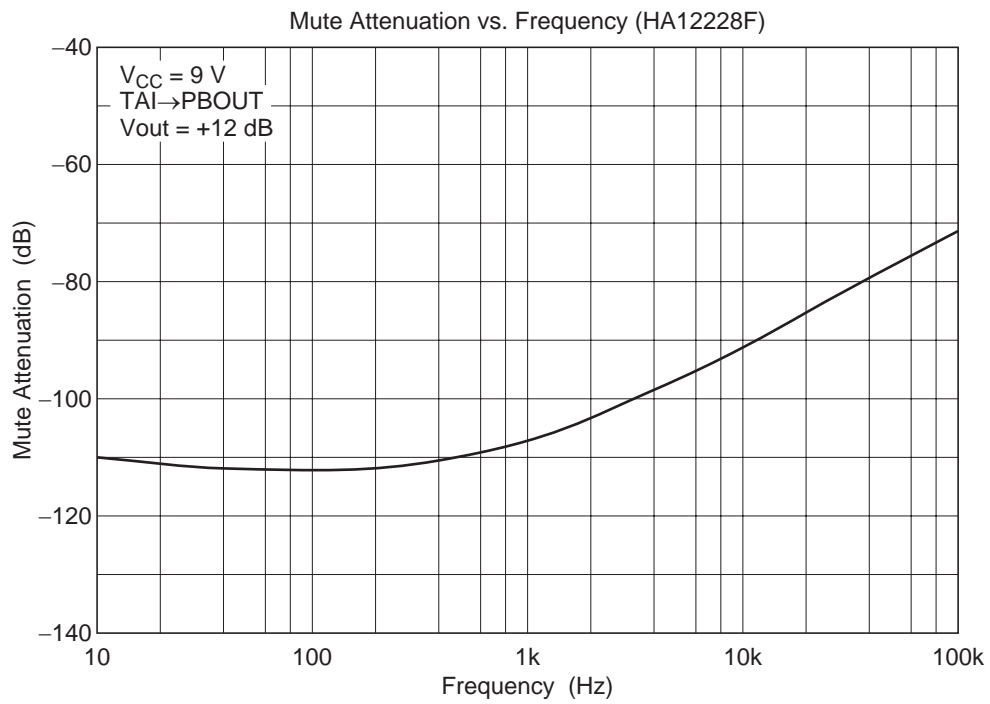
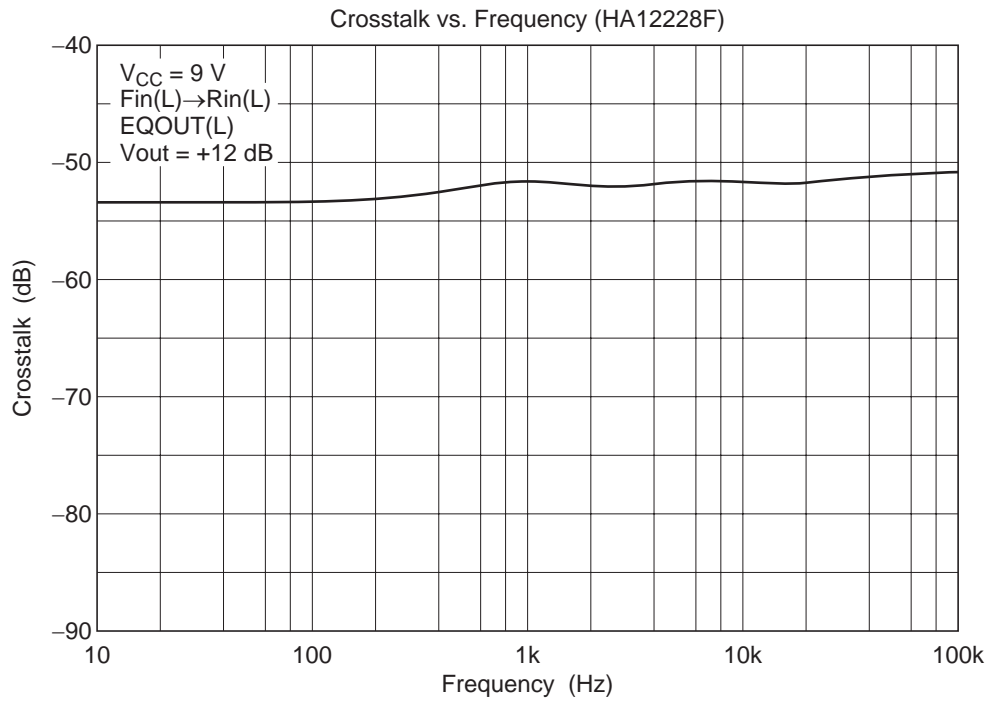


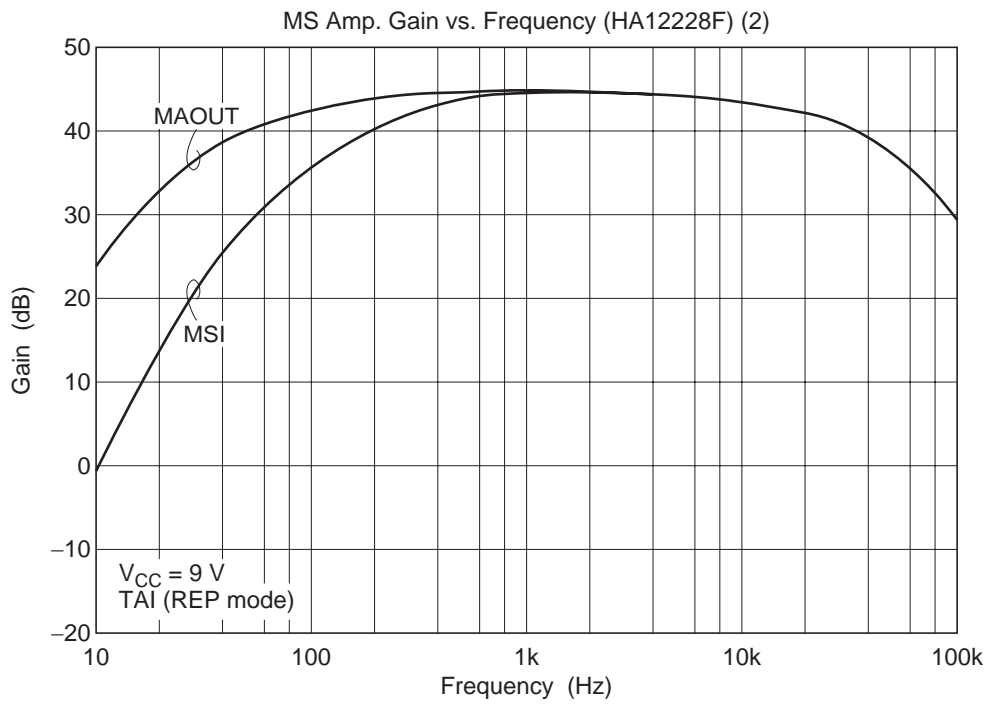
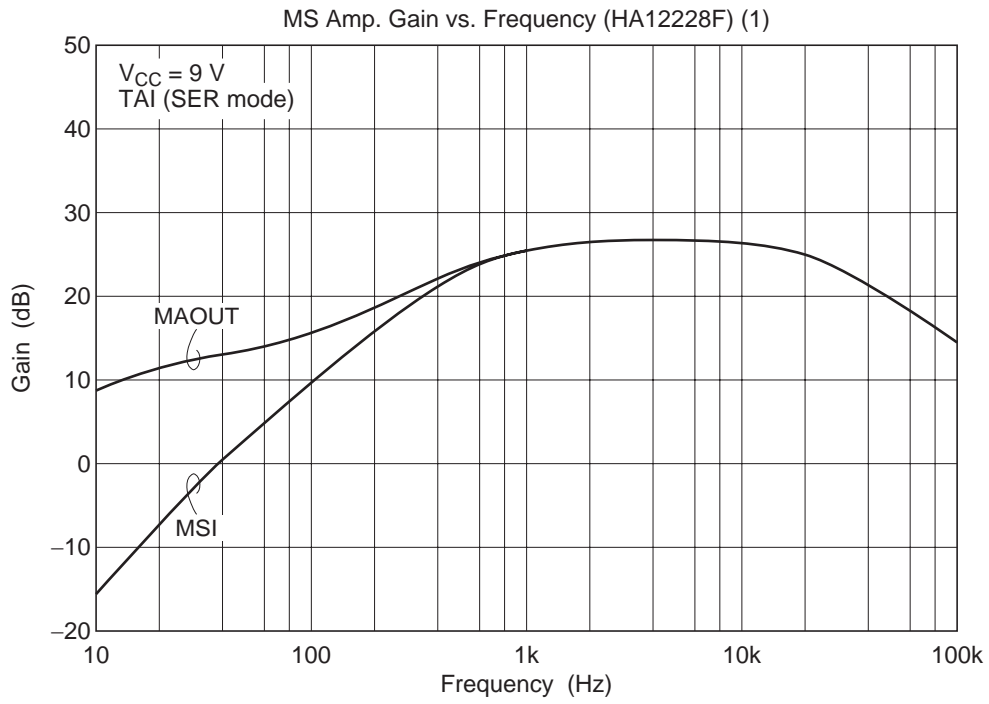




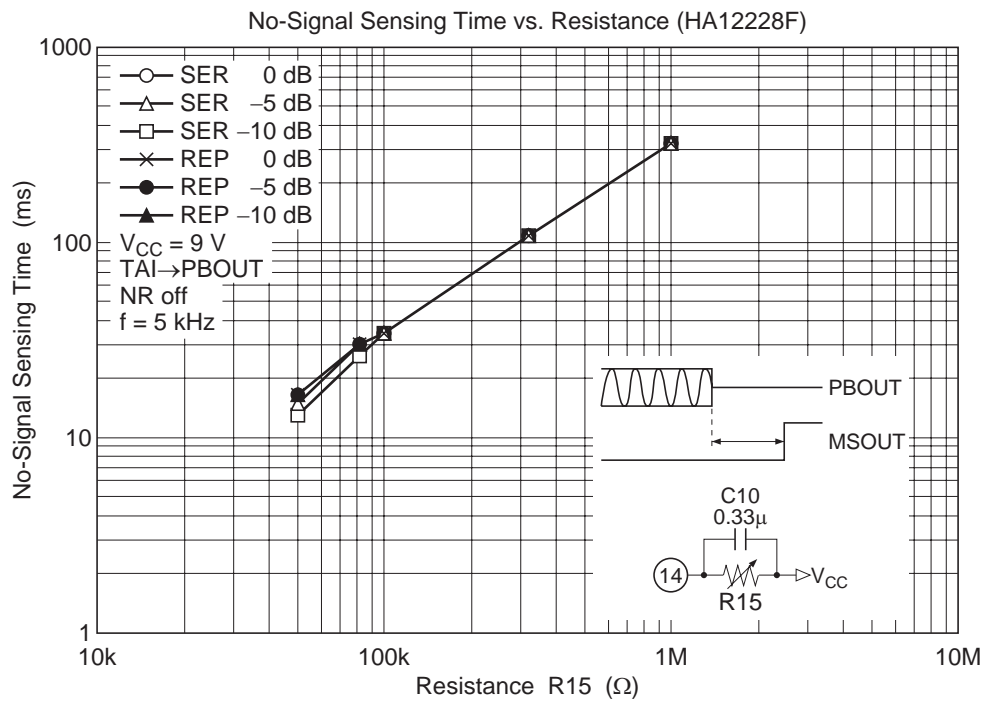
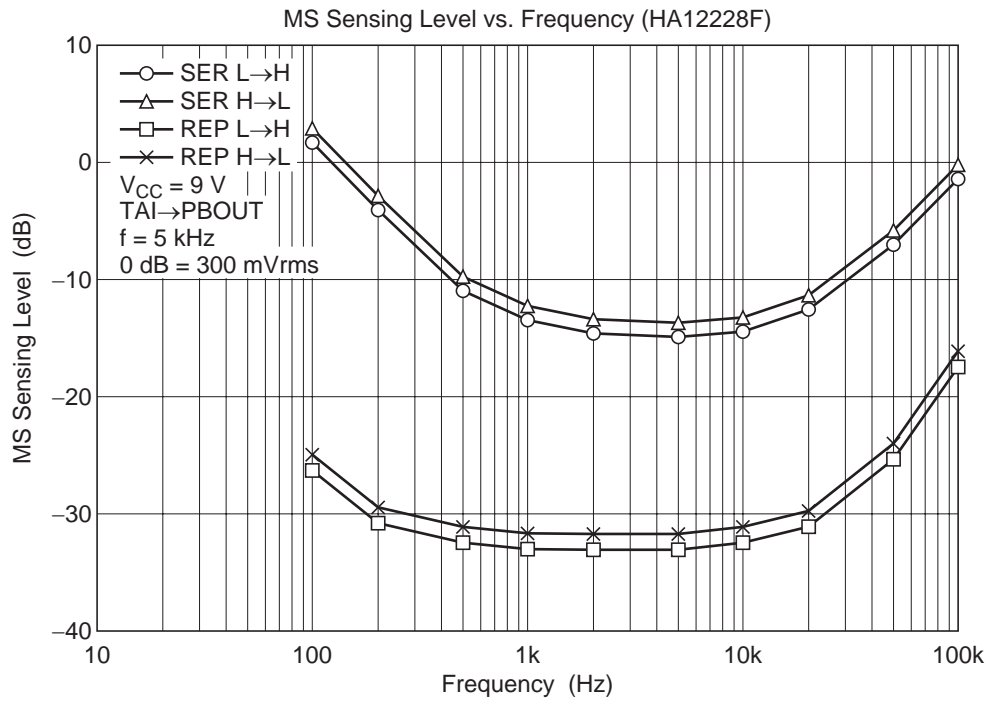


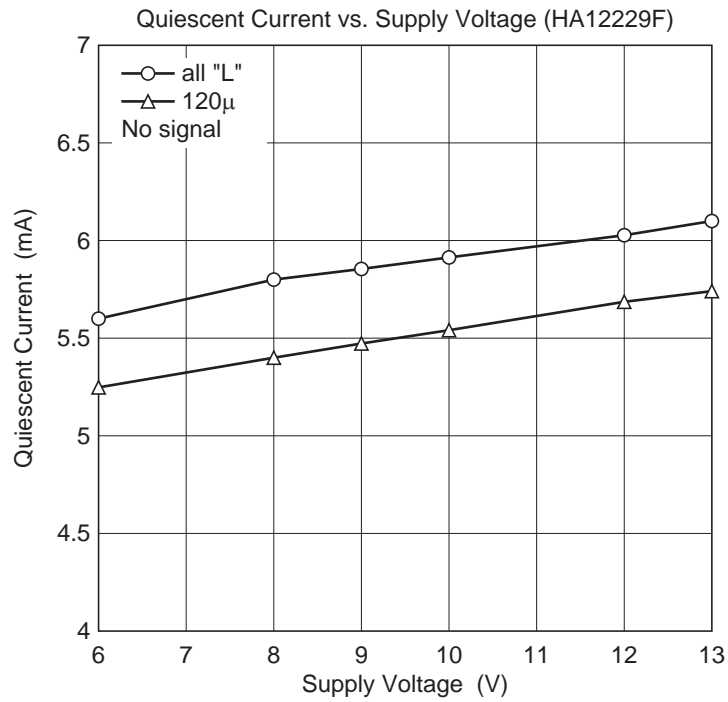
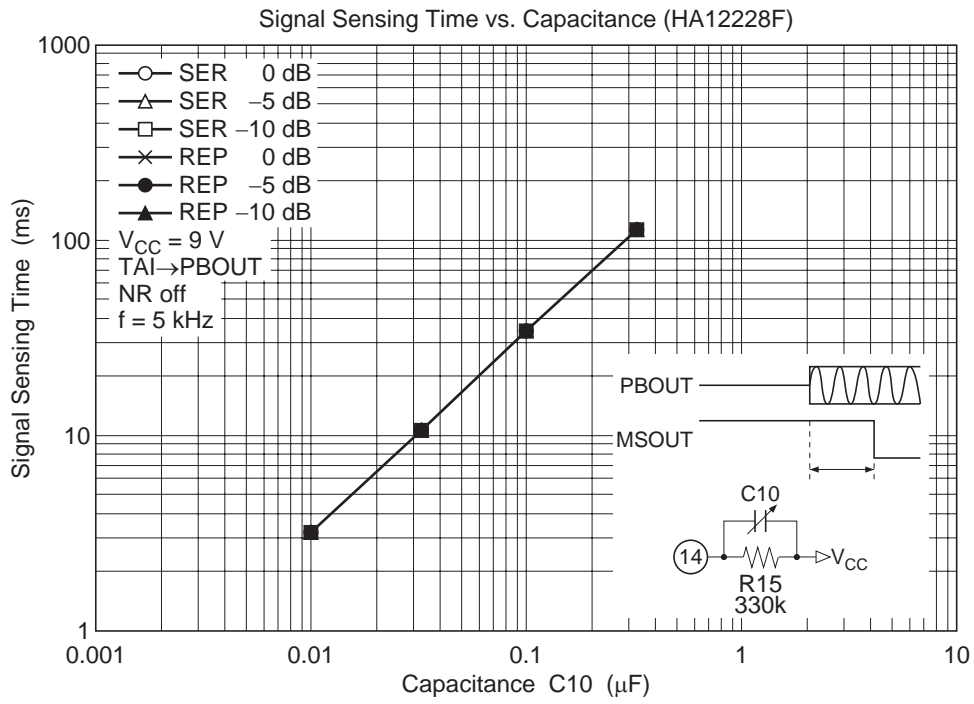


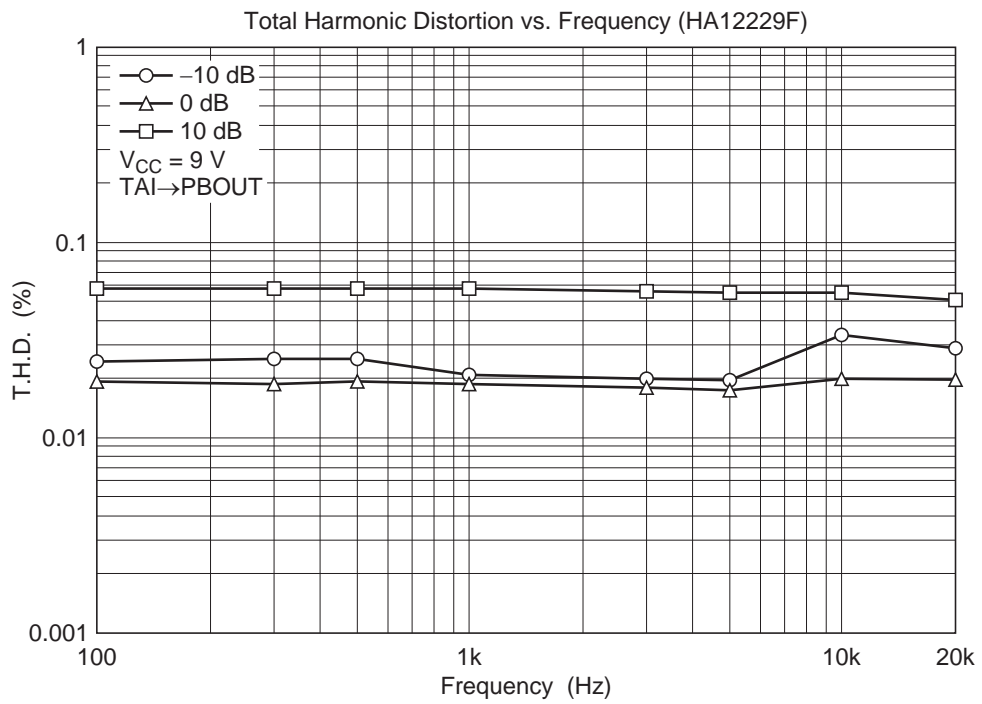
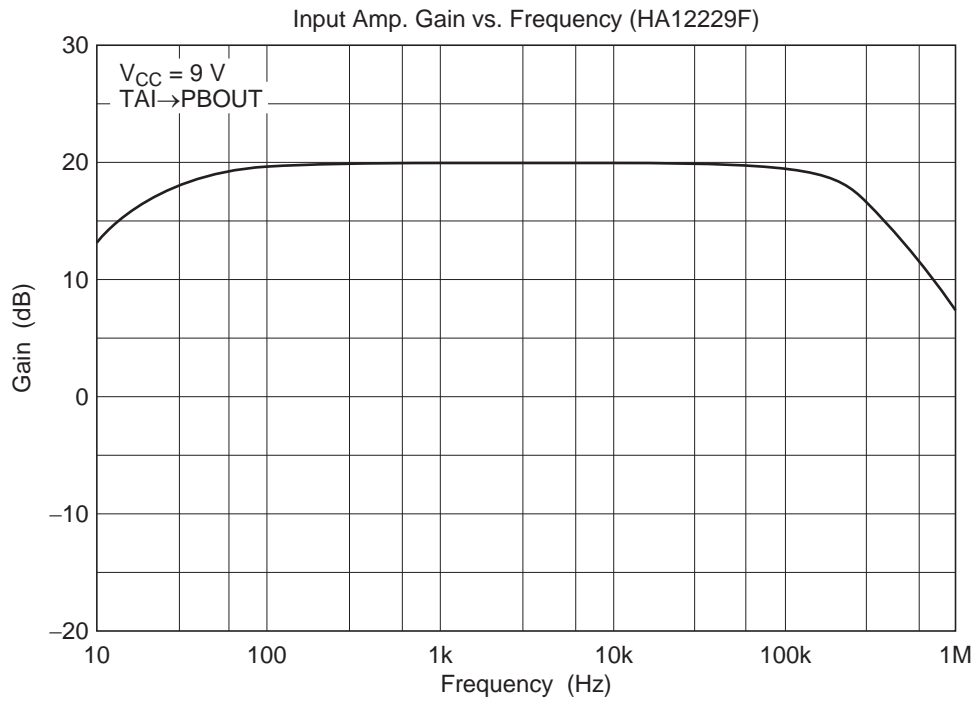


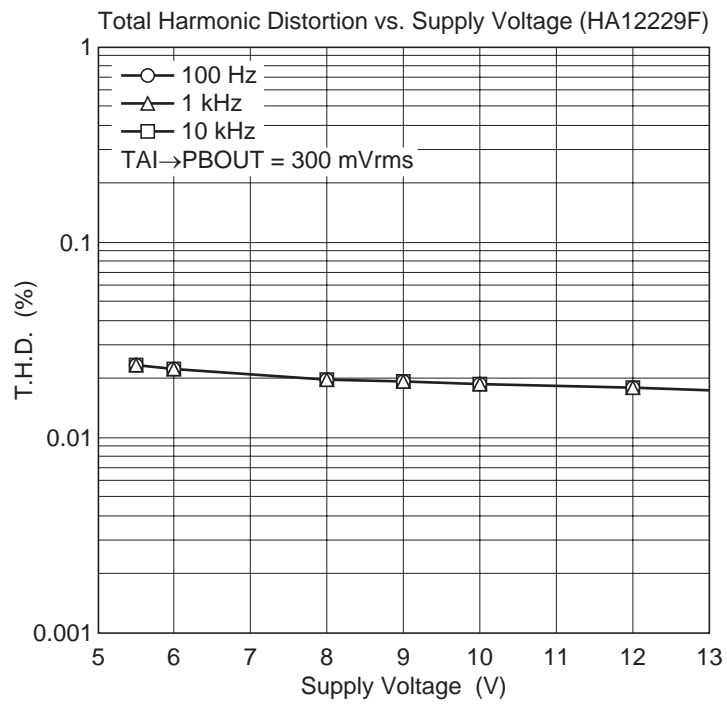
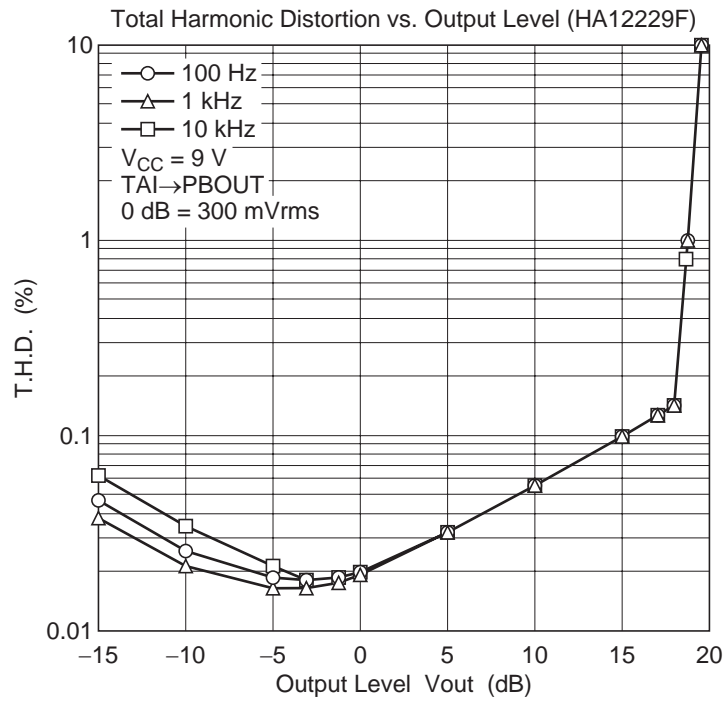


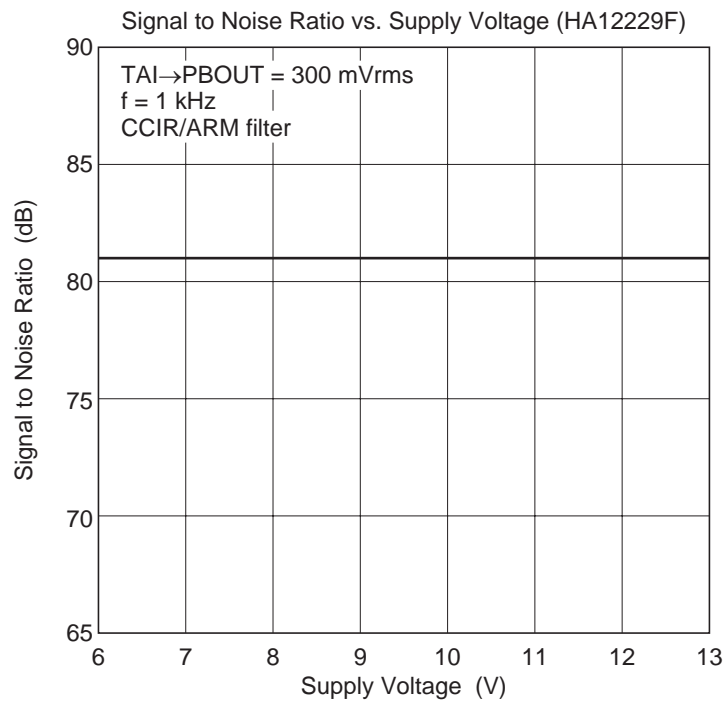
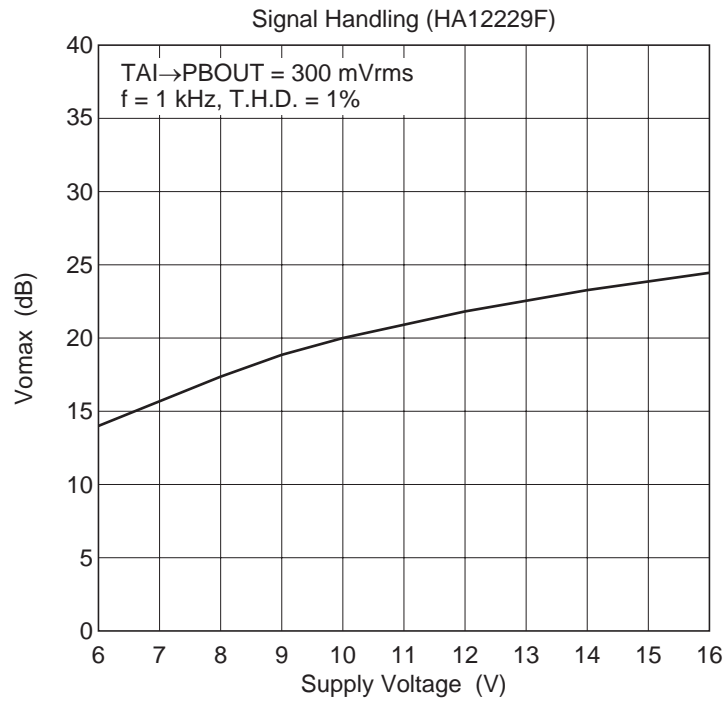


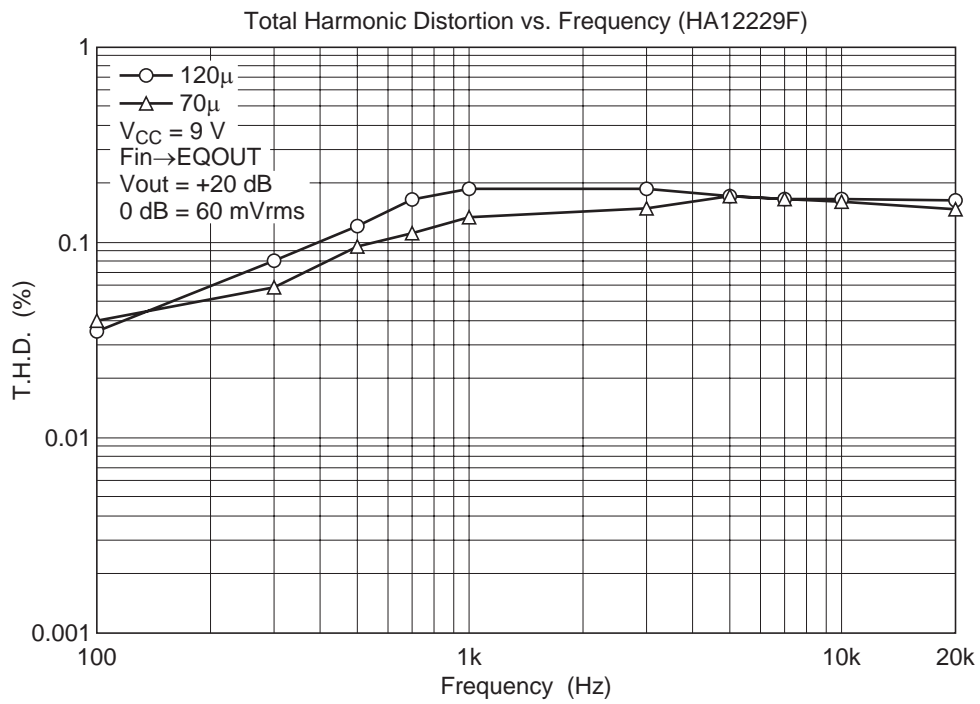
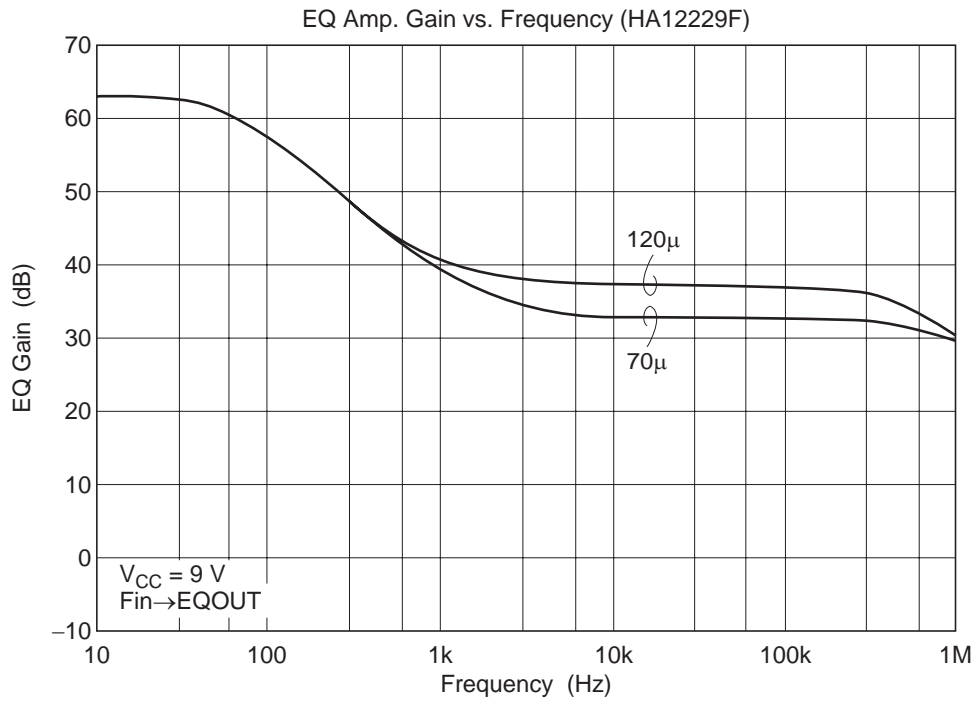


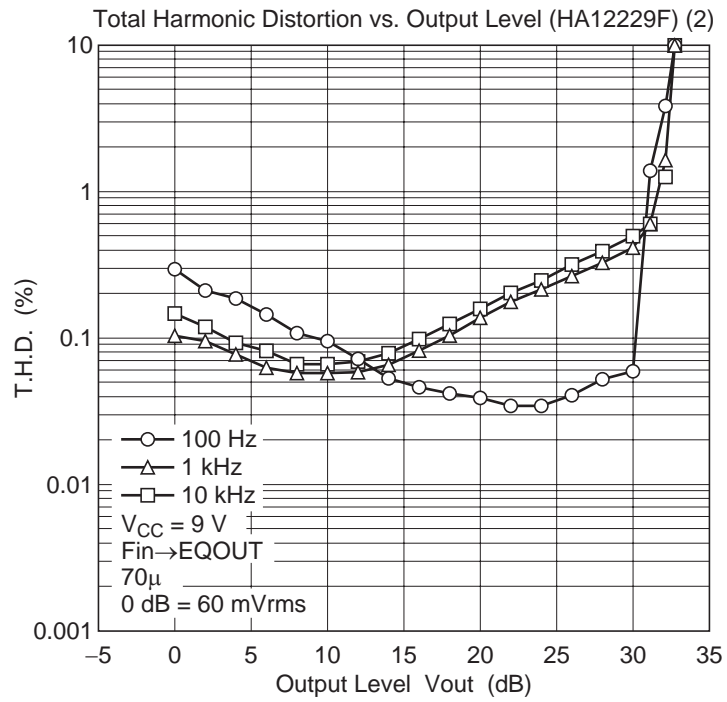
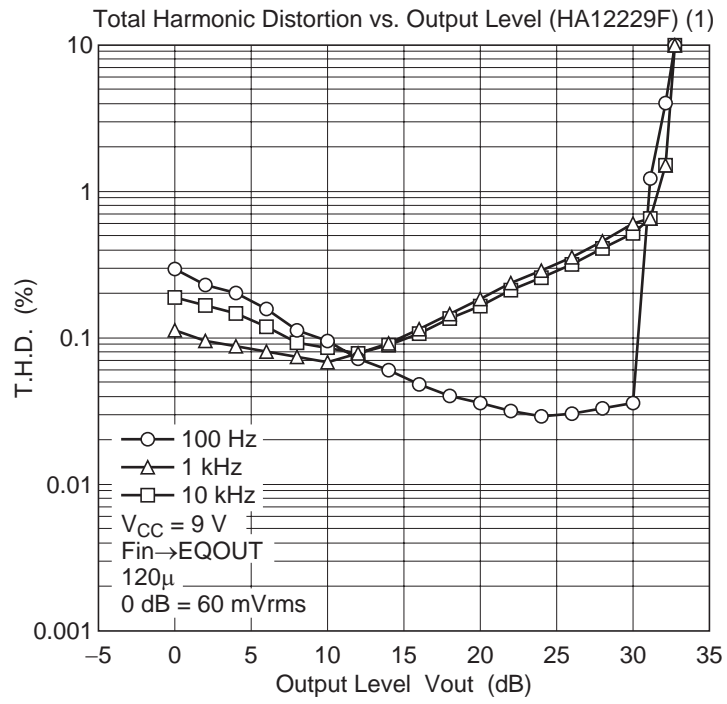


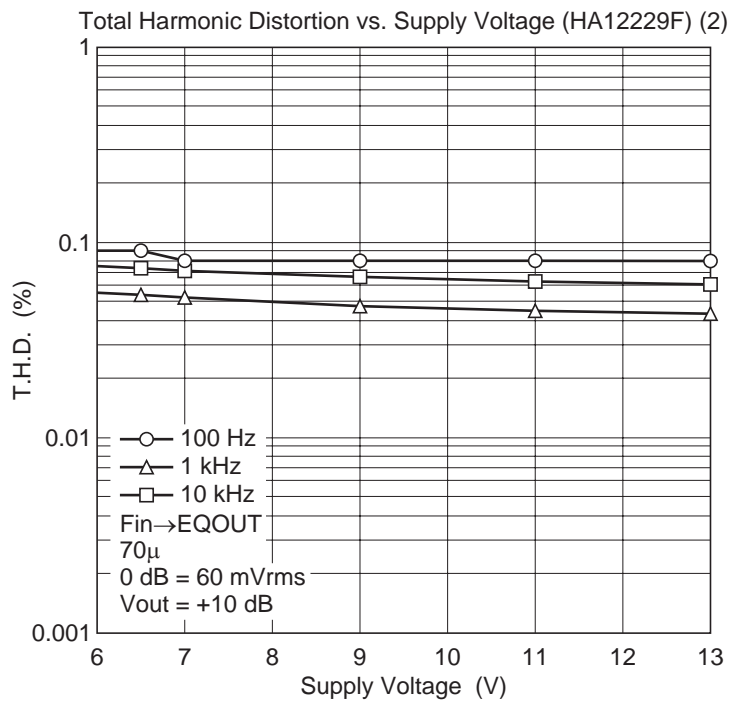
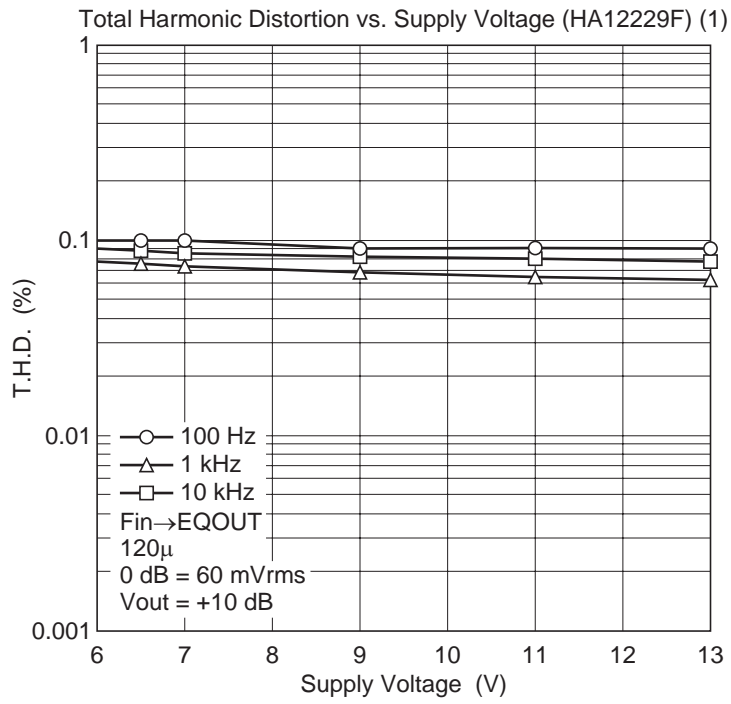




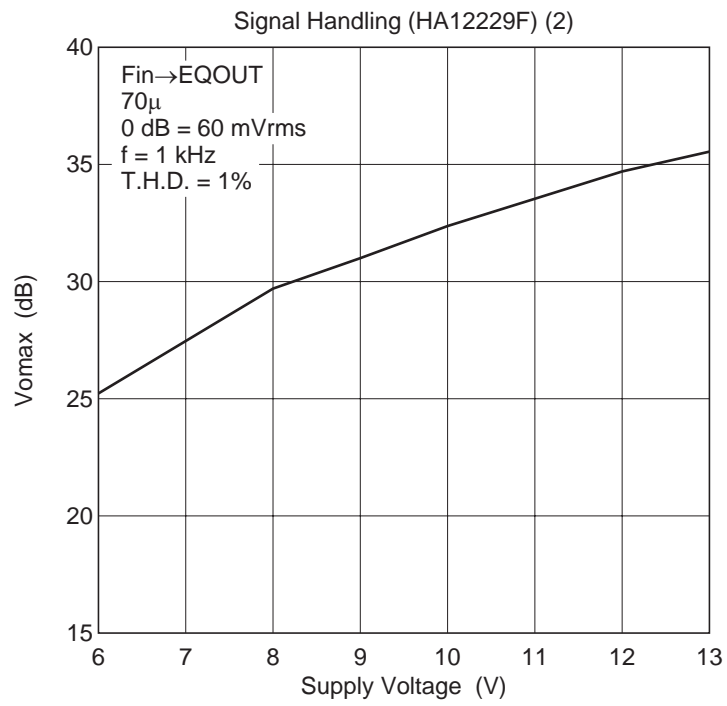
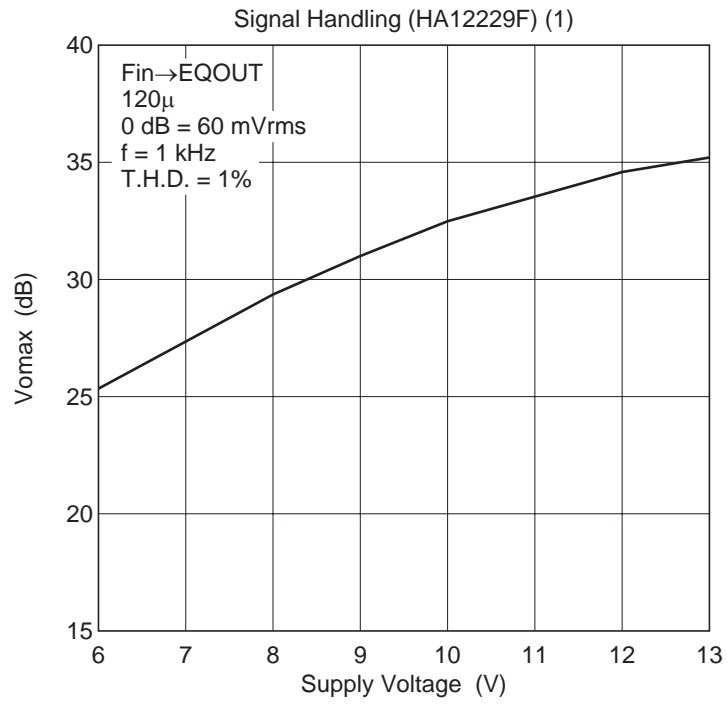


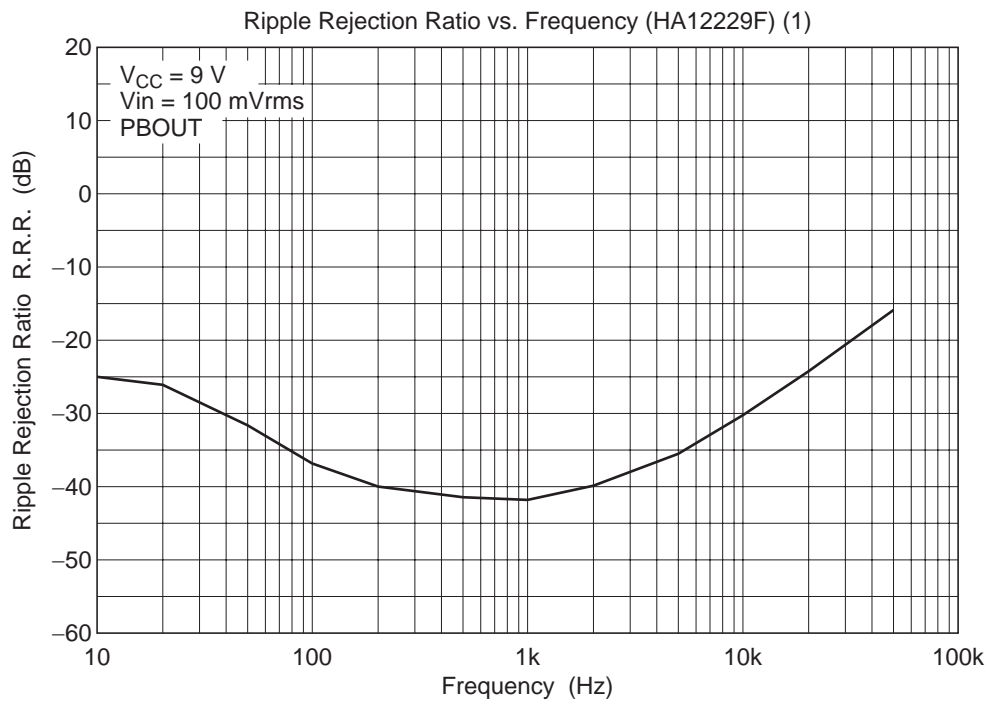
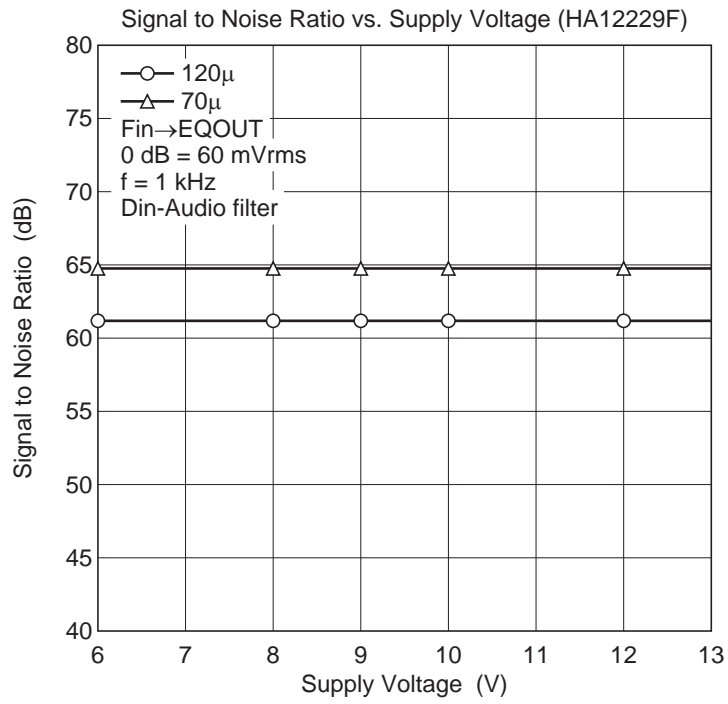


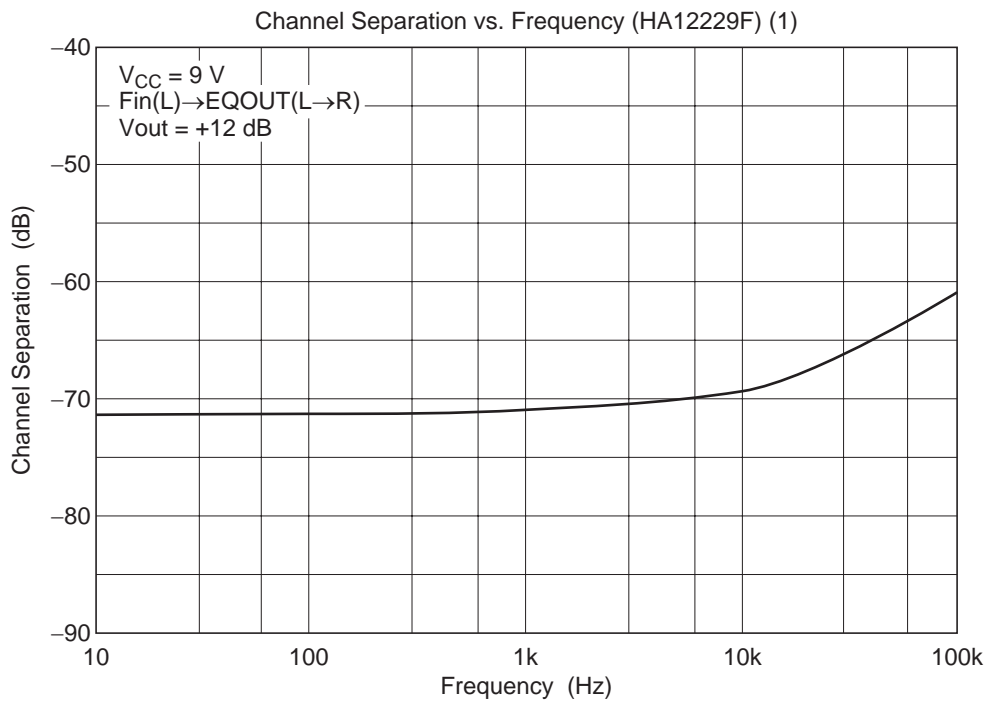
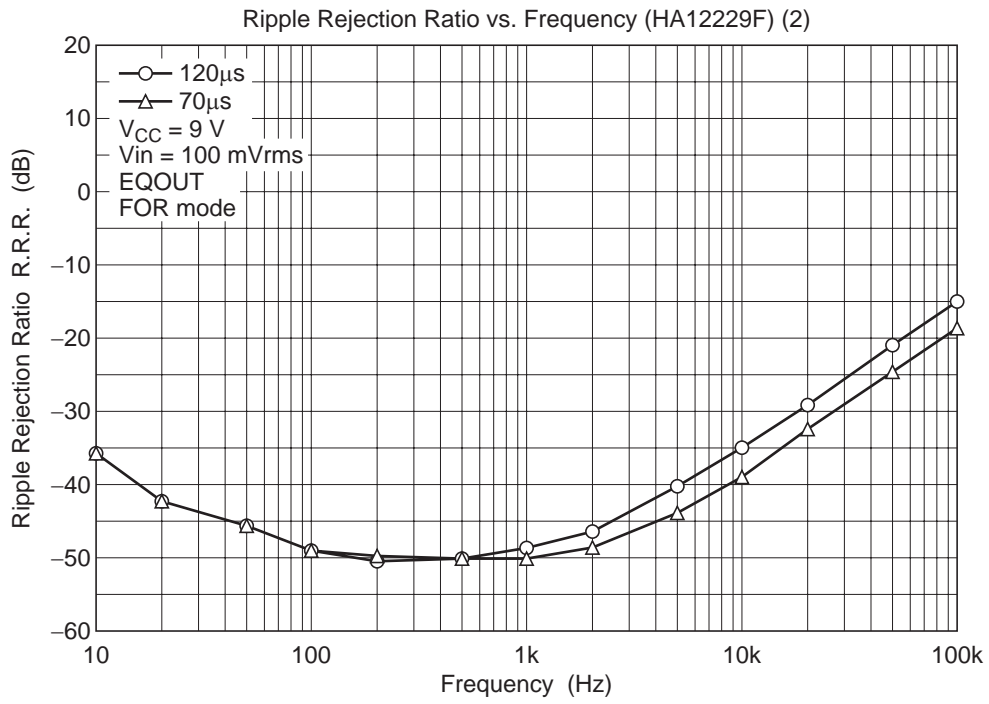


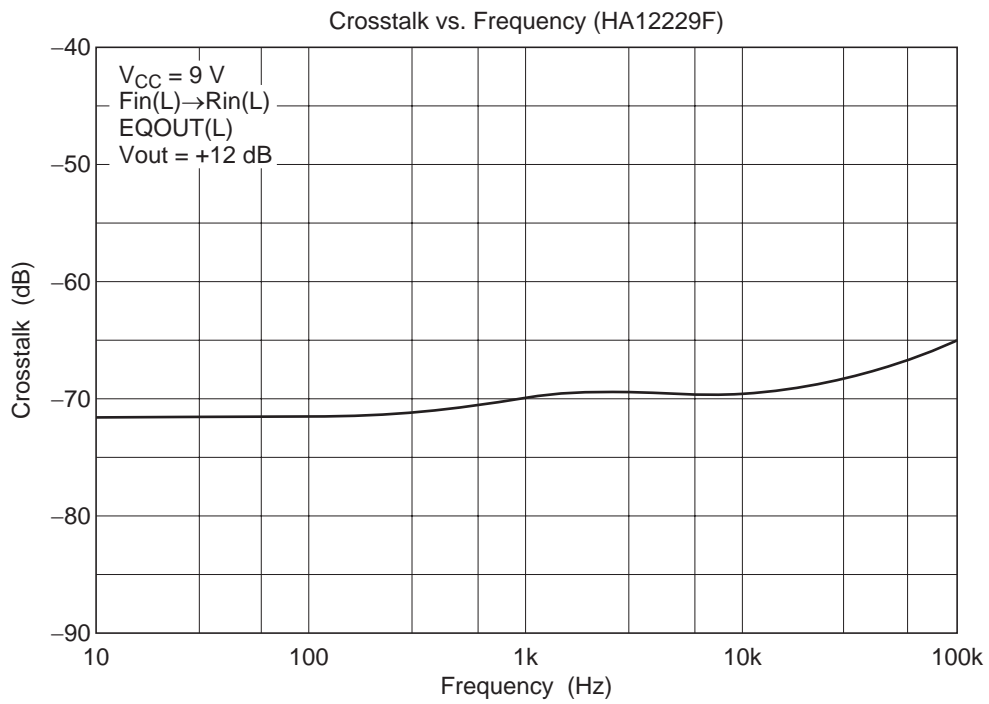
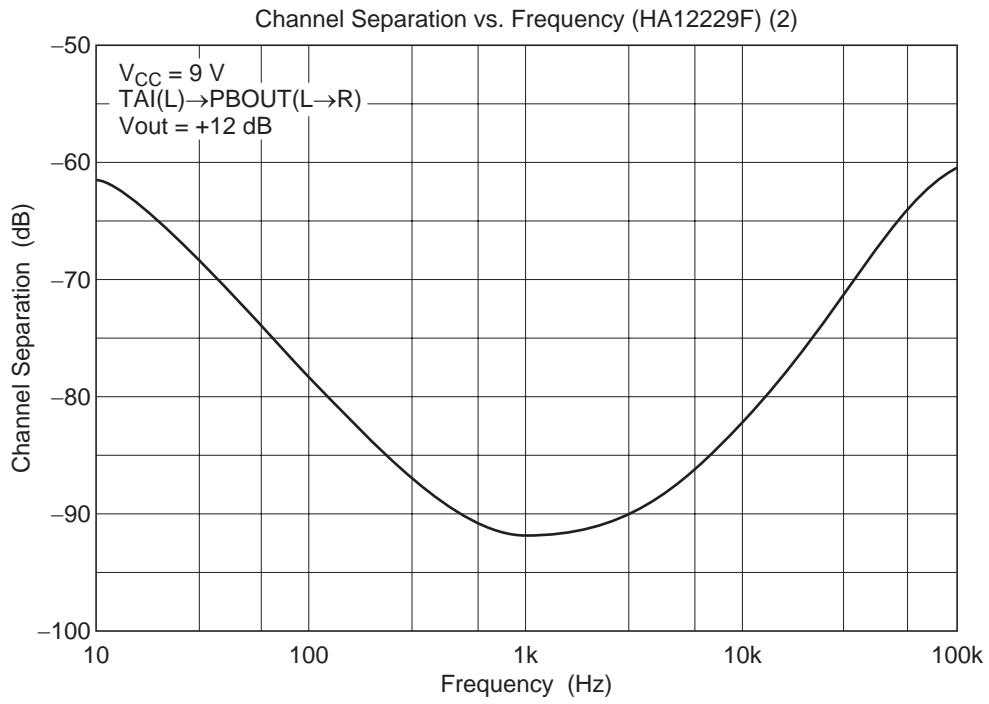


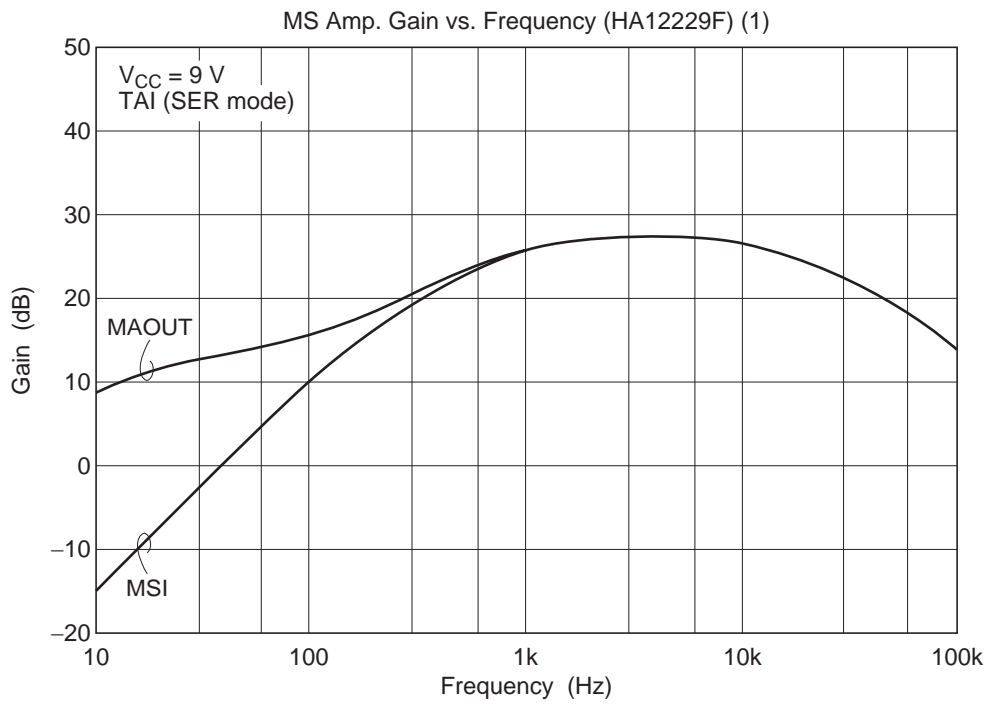
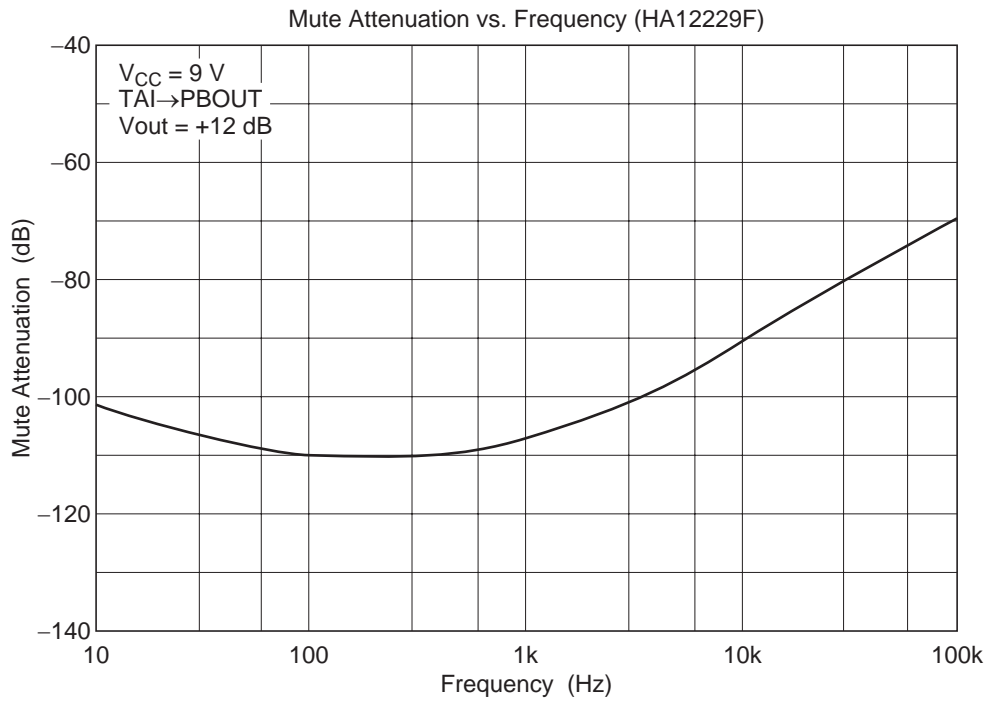


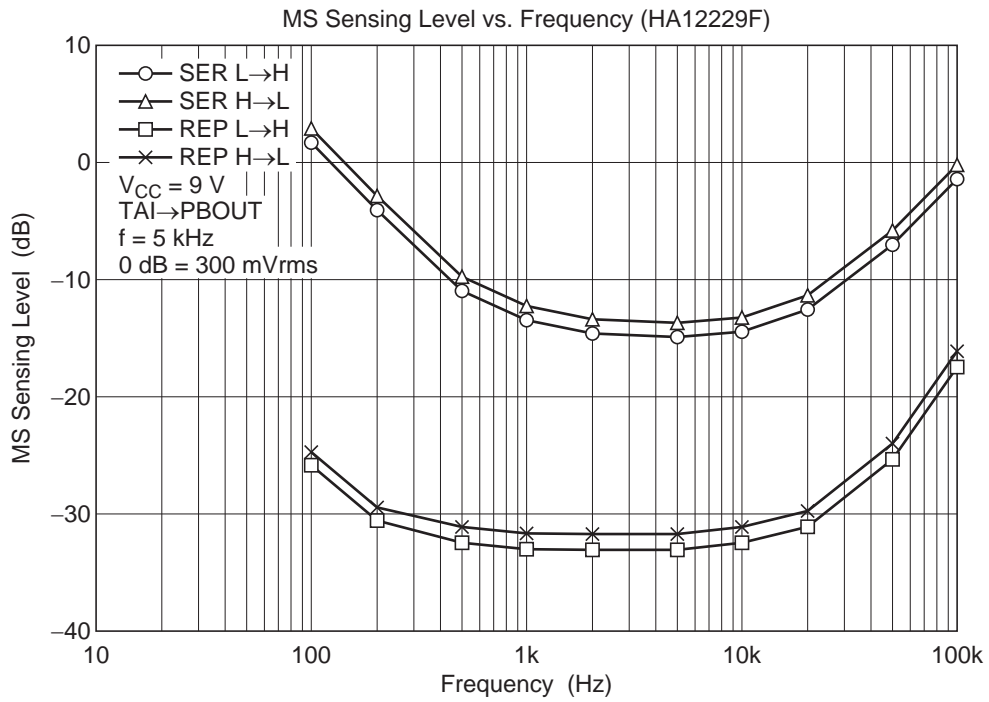
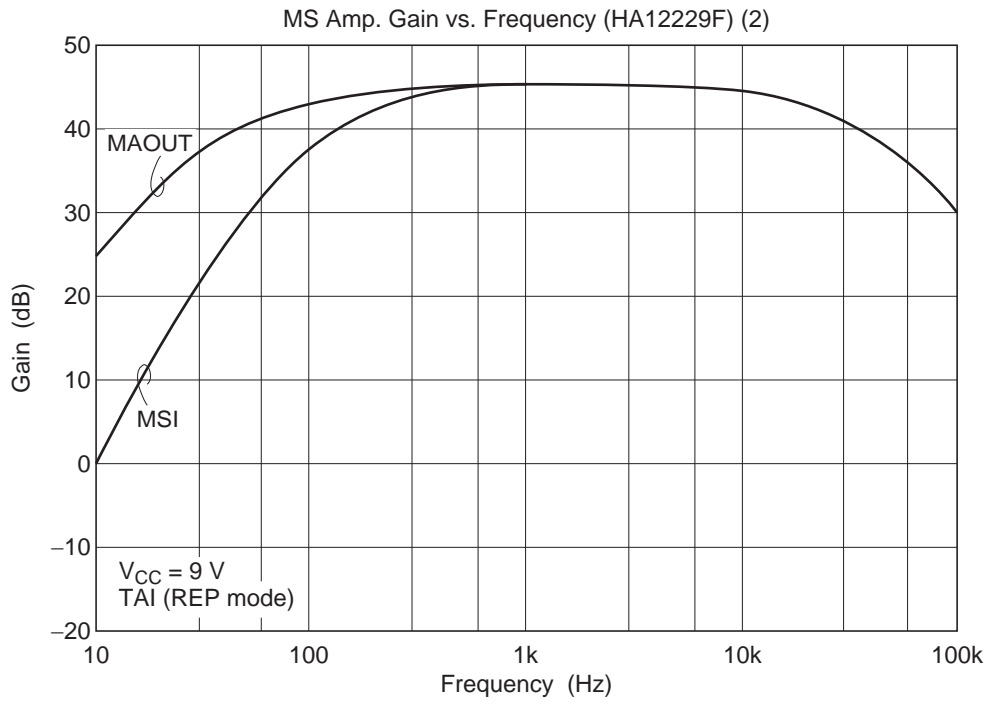


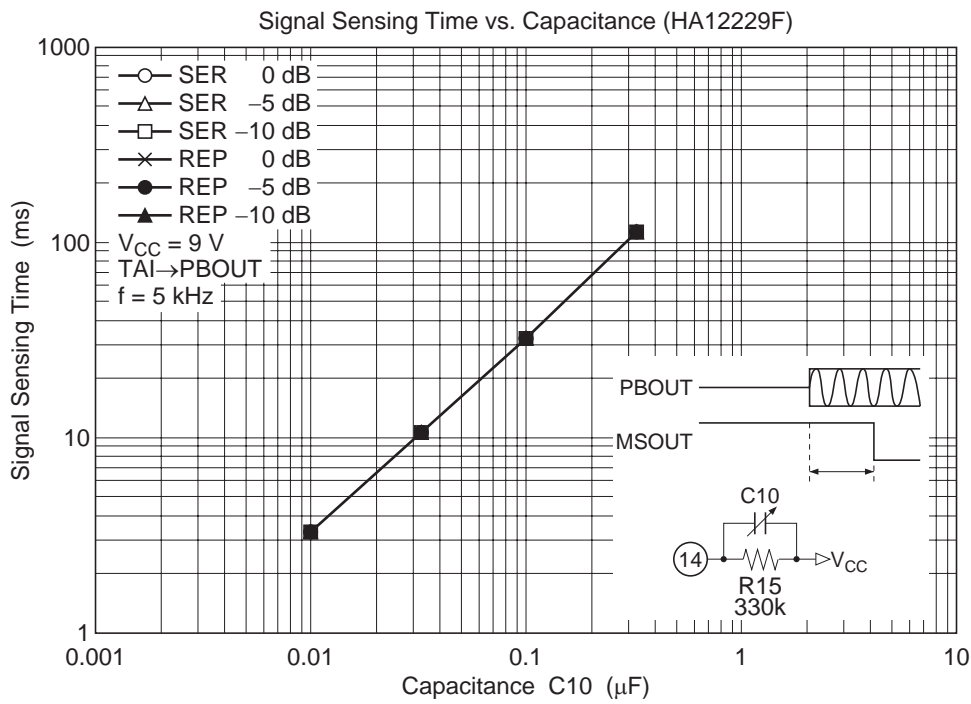
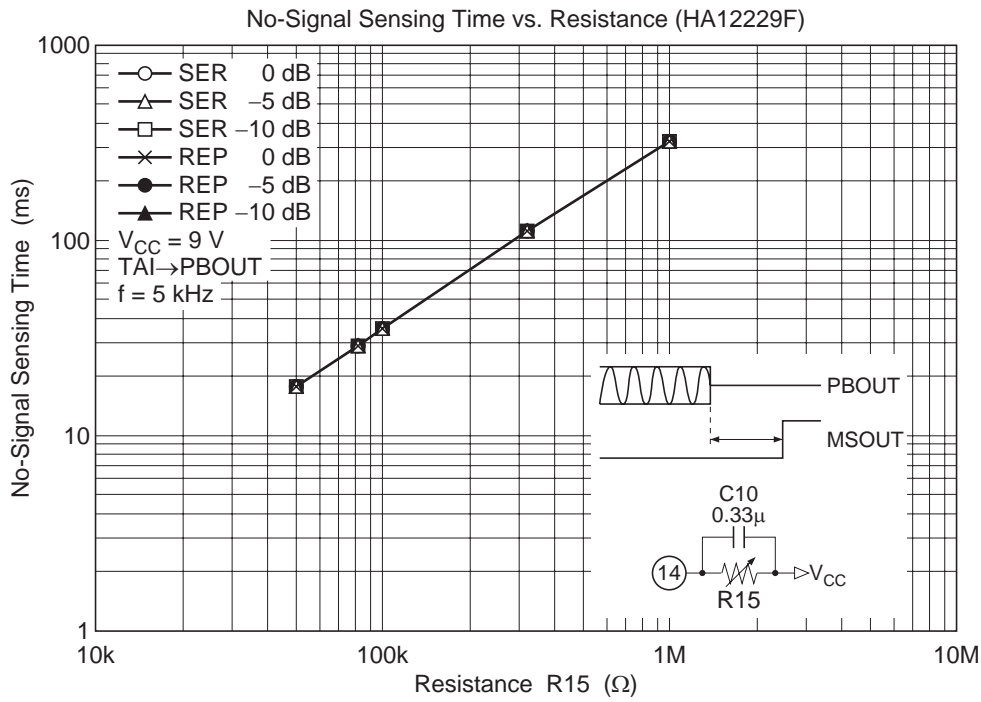




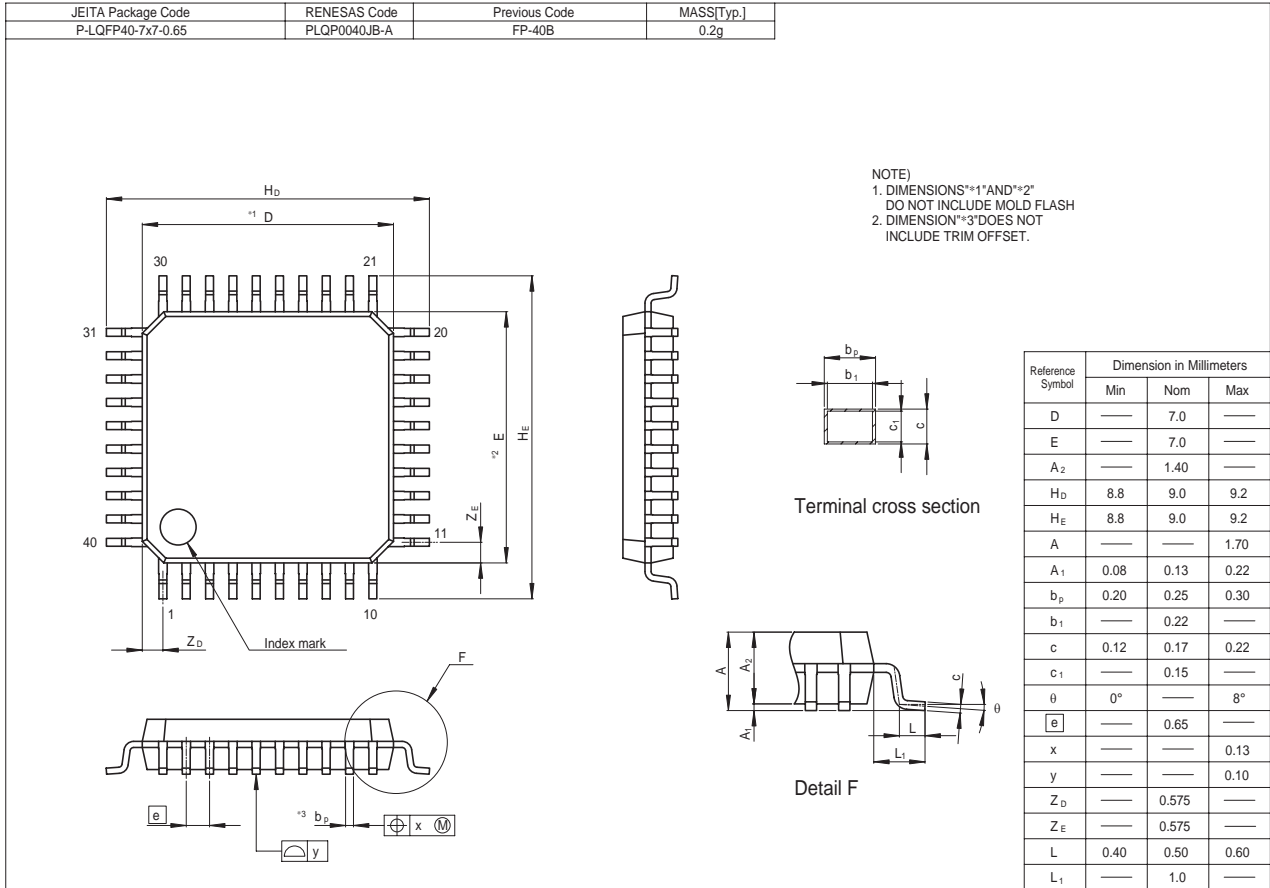








### Package Dimensions





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Tel: <86> (21) 6472-1001, Fax: <86> (21) 6415-2952

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1 Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632  
Tel: <65> 6213-0200, Fax: <65> 6278-8001