To our customers,

Old Company Name in Catalogs and Other Documents

On April 1st, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

Renesas Electronics website: http://www.renesas.com

April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (http://www.renesas.com)

Send any inquiries to http://www.renesas.com/inquiry.

Notice

1. All information included in this document is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas Electronics products listed herein, please confirm the latest product information with a Renesas Electronics sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas Electronics such as that disclosed through our website.
2. Renesas Electronics does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
3. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part.
4. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
5. When exporting the products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations. You should not use Renesas Electronics products or the technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations.
6. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
7. Renesas Electronics products are classified according to the following three quality grades: "Standard", "High Quality", and "Specific". The recommended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below. You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application categorized as "Specific" without the prior written consent of Renesas Electronics. Further, you may not use any Renesas Electronics product for any application for which it is not intended without the prior written consent of Renesas Electronics. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for an application categorized as "Specific" or for which the product is not intended where you have failed to obtain the prior written consent of Renesas Electronics. The quality grade of each Renesas Electronics product is "Standard" unless otherwise expressly specified in a Renesas Electronics data sheets or data books, etc.

   "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots.

   "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; safety equipment; and medical equipment not specifically designed for life support.

   "Specific": Aircraft; aerospace equipment; submersible repeaters; nuclear reactor control systems; medical equipment or systems for life support (e.g. artificial life support devices or systems), surgical implantations, or healthcare intervention (e.g. excision, etc.), and any other applications or purposes that pose a direct threat to human life.
8. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
9. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
11. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

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

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 µs/70 µs) 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_V).
- 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

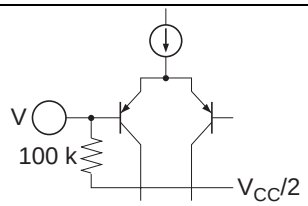
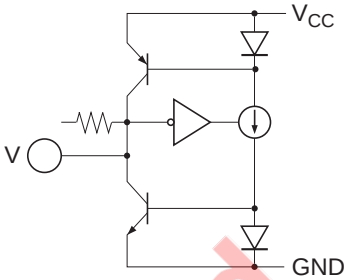
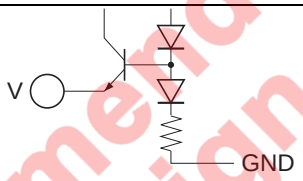
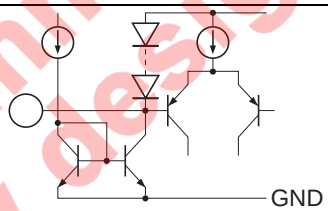
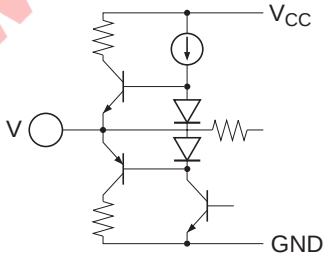
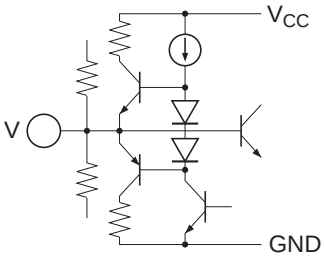
Product	Package Code (Previous Code)	PB-OUT Level
HA12228F	PLQP0040JB-A (FP-40B)	300 mVrms
HA12229F		

Function

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

Pin Description, Equivalent Circuit

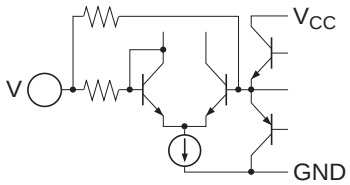
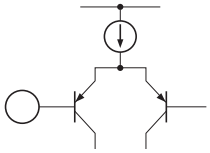
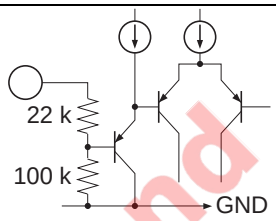
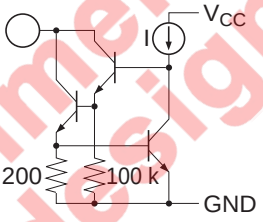
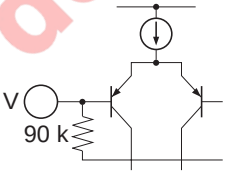
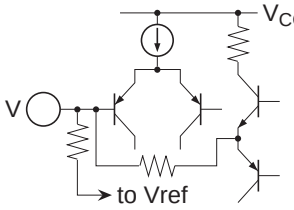
(V_{CC} = 9 V single supply, Ta = 25°C, No Signal, The value in the table shows typical value.)

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 V		Time constant pin for NR rectifier
8 *2	DET(L)			
26	RIP	V = V_{CC}/2		Ripple filter
5 *3	Bias	V = 0.28 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)			
12	MAOUT			MS amp. output *1
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.)

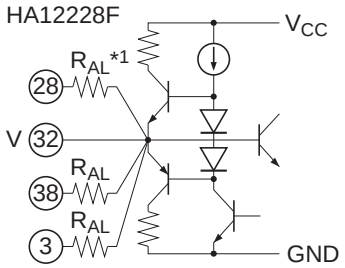
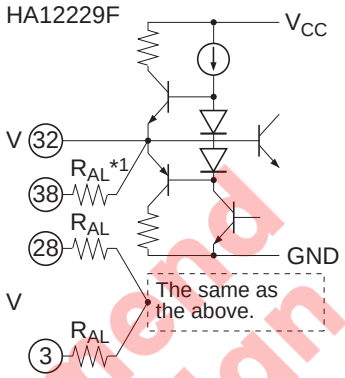
(V_{CC} = 9 V single supply, Ta = 25°C, No Signal, The value in the table shows typical value.)

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)			
35	RIN(R)	—		Equalizer input (REVERSE)
33	RIN(L)			
20	MUTE ON/OFF	—		Mode control input
21 *1	NR ON/OFF			
19	120/70			
17	F/R			
18	S/R(MS G_V)			
16	MSOUT	—		MS output (to MPU) *2
10	MS Gv(S)	V = V_{CC}/2		MS gain terminal *2
11	MS Gv(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.)

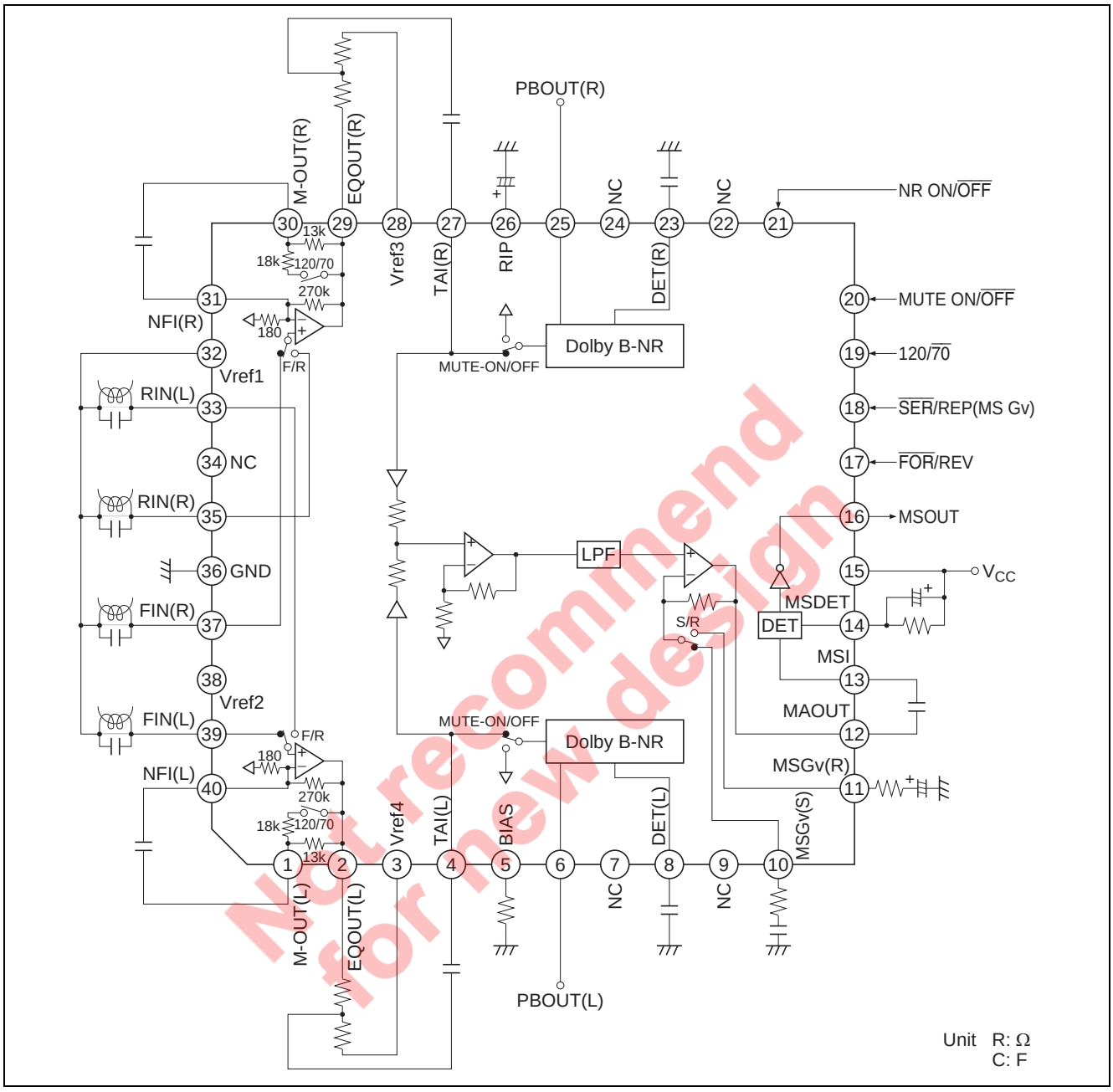
(V_{CC} = 9 V single supply, Ta = 25°C, No Signal, The value in the table shows typical value.)

Pin No.	Terminal Name	Note	Equivalent Circuit	Description
32	VREF1	V = V_{CC}/2	HA12228F 	Reference output
38	VREF2			
28	VREF3			
3	VREF4			
			HA12229F 	
15	V_{CC}	—		V_{CC} pin
36	GND	—		GND pin
7	NC	—		
9				
22				
24				
34				

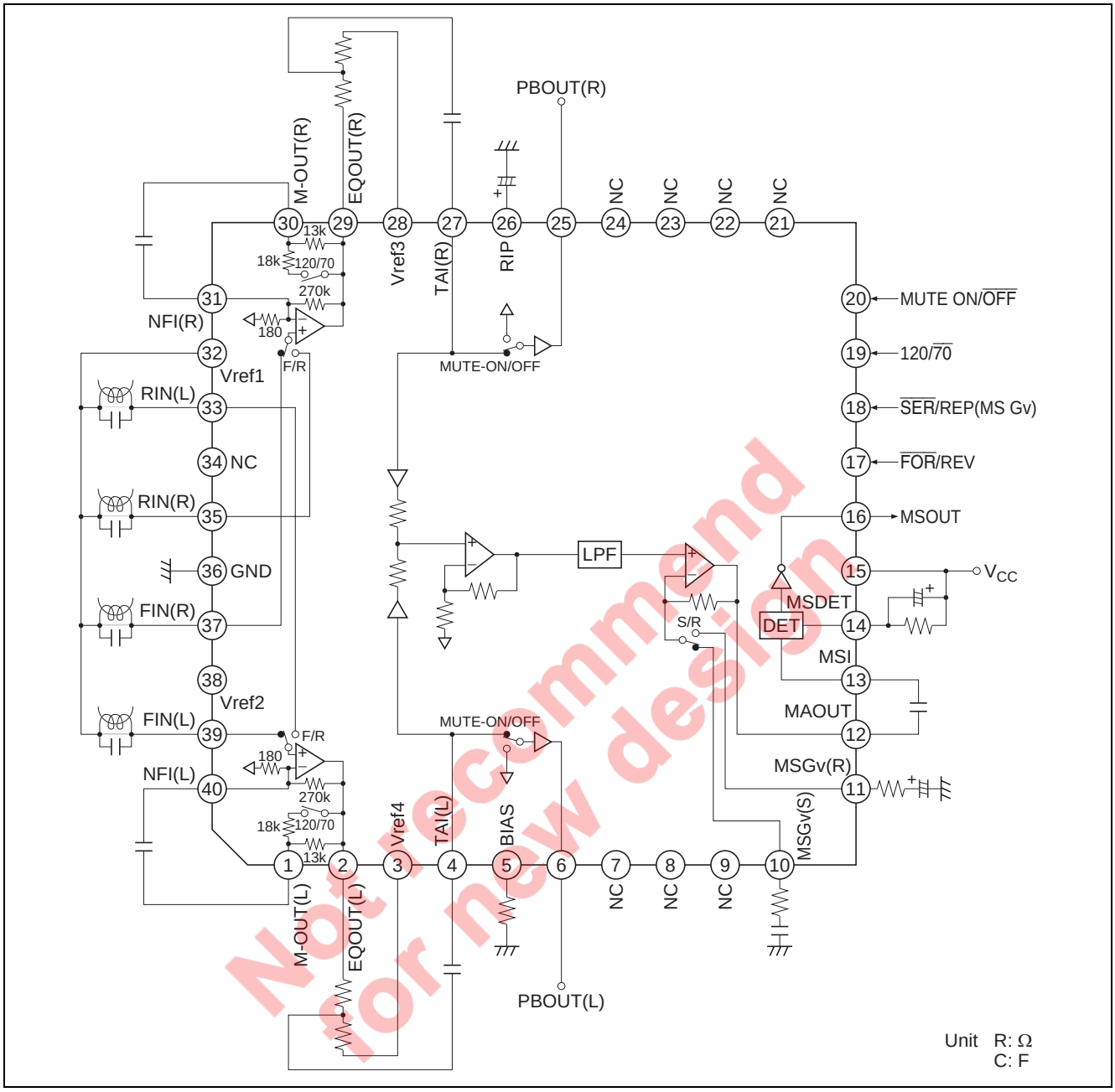
Note: 1. R_{AL}: Parasitic metal resistance

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.

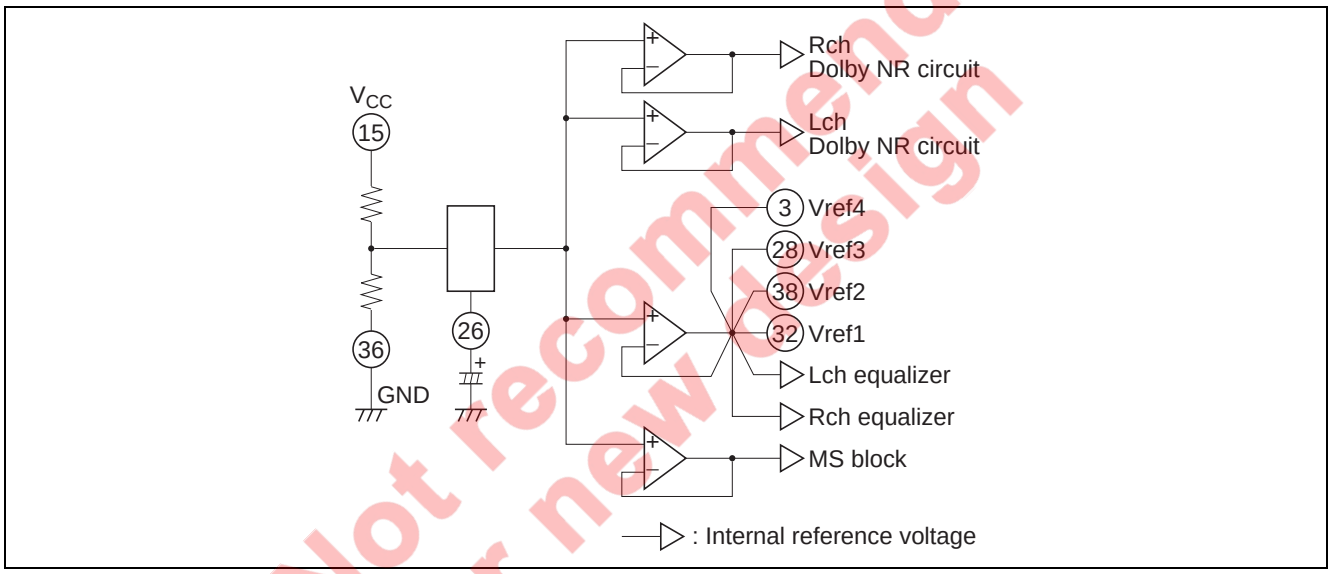


Figure 1a The HA12228F Block Diagram of Reference Supply Voltage

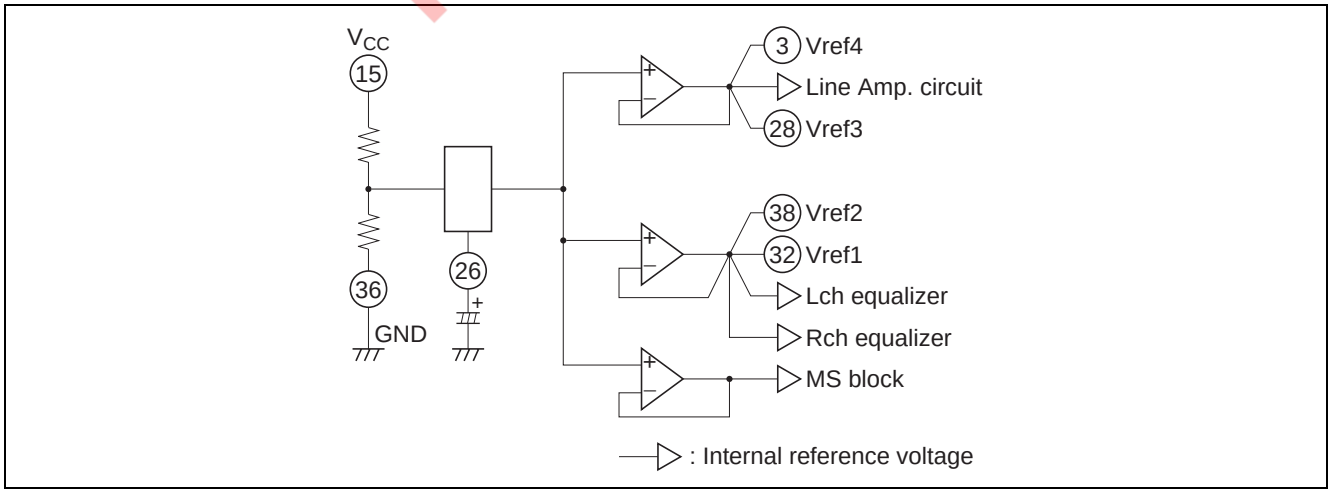


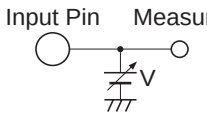
Figure 1b The HA12229F Block Diagram of Reference Supply Voltage

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	

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 µ/70 µ	70 µ (Metal or Chrome)	120 µ (Normal)
20	MUTE ON/OFF	MUTE-OFF	MUTE-ON
21*	NR ON/OFF	NR-OFF	NR-ON

Notes: * Non connection regarding HA12229F.

1. Each pins are on pulled down with 100 kΩ 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: V_{CC}, Low: –0.2 V)
3. Reducing pop noise is so much better for 10 kΩ to 22 kΩ resisitor and 1 µF to 22 µF capacitor shown figure 2.

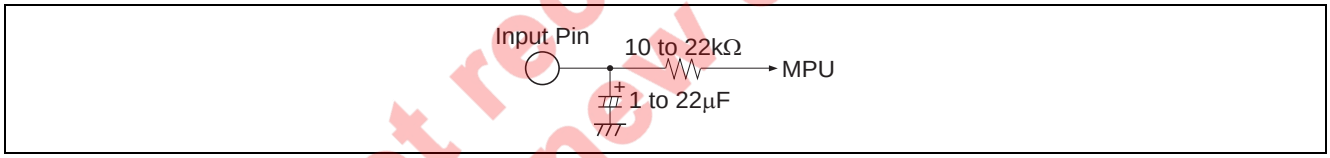


Figure 2 Interface for Reduction of Pop Noise

Input Block Diagram and Level Diagram

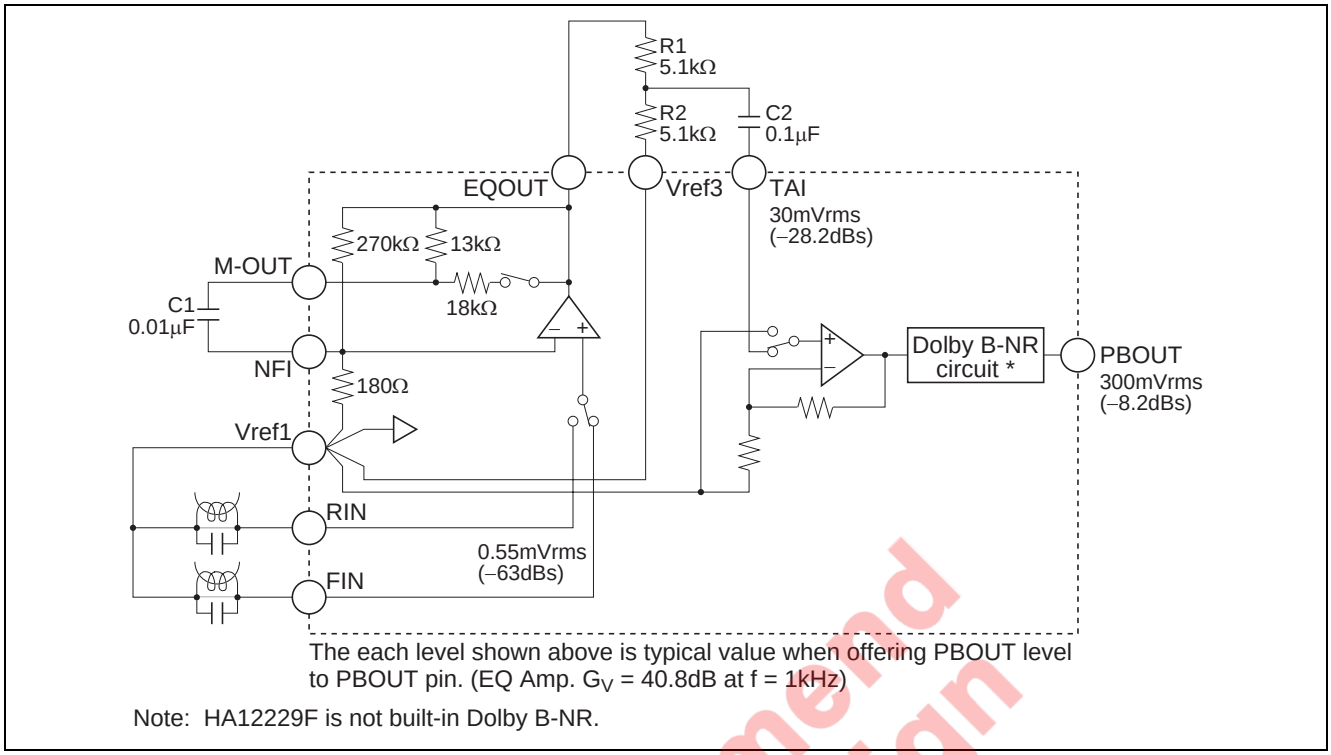


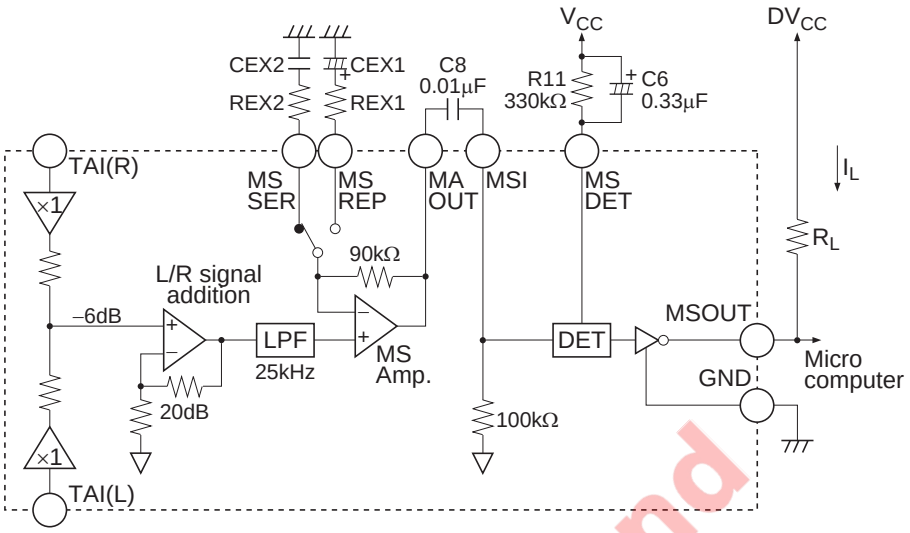
Figure 3 Input Block Diagram

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.



Note: The impedance of MSI is 100kΩ.

Figure 4 Music Sensor Block Diagram

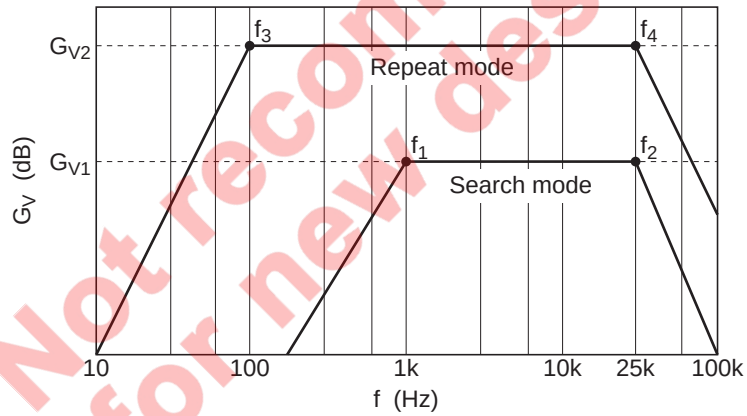


Figure 5 Frequency Response

1. Search mode

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

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

2. Repeat mode

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

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

G_VIA: L·R signal addition circuit gain.

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

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

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

1. Sensing no signal to signal (Attack) is determined by C6, 0.01 µF to 1 µF capacitor C6 can be applicable.
2. 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.

$$I_L = \frac{DV_{CC} - MSOUT_{LO}{}^*}{R_L}$$

* $MSOUT_{LO}$: 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.

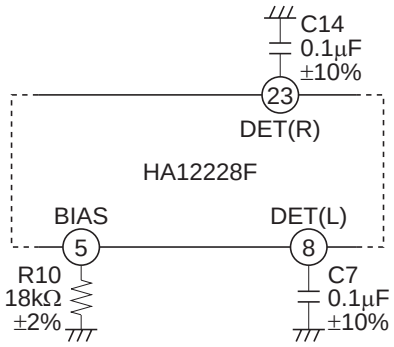


Figure 6 Tolerance of External Components

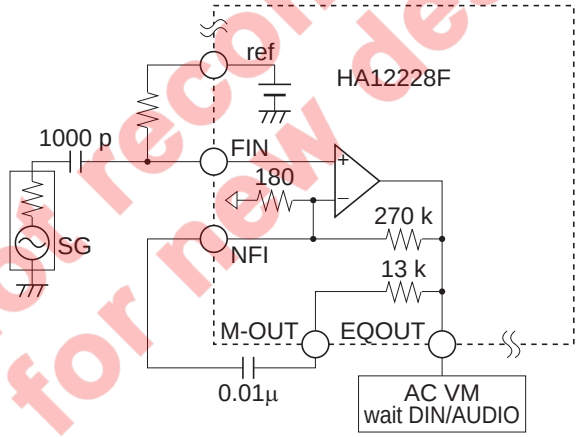
Countermeasure of a Cellular Phone Noise

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 oftain a maximum effect.

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



Note: Test condition
- Use for SG by cellular radio for an evaluation use.
- SG output mode
  PDC system, burst
  UP Tch (Transmission mode on the side of a movement machine)
- To evaluate a capacitor of 1000 pF as connecting with it directly.
- About EQOUT output, what you measure through DIN/AUDIO filter.

Figure 7 Test Circuit

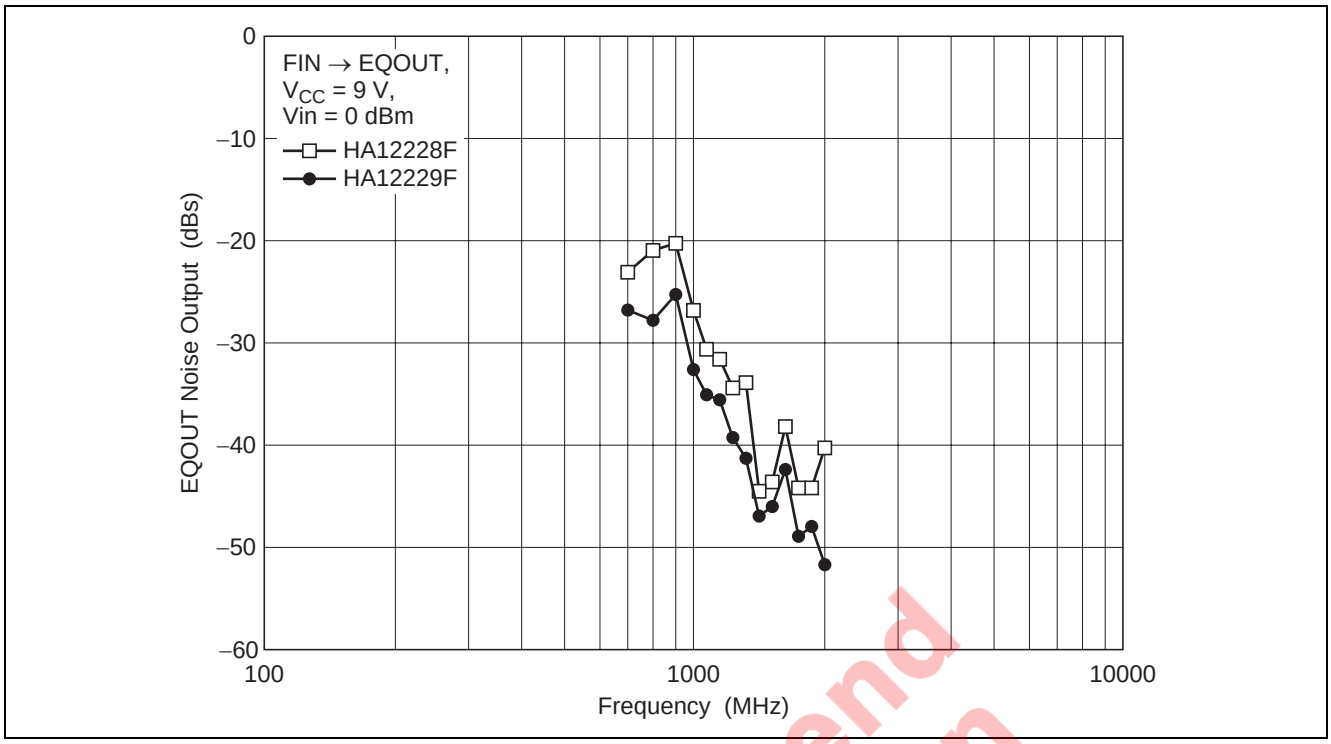


Figure 8 EQOUT Noise Output vs. Transmission Frequency Characteristic

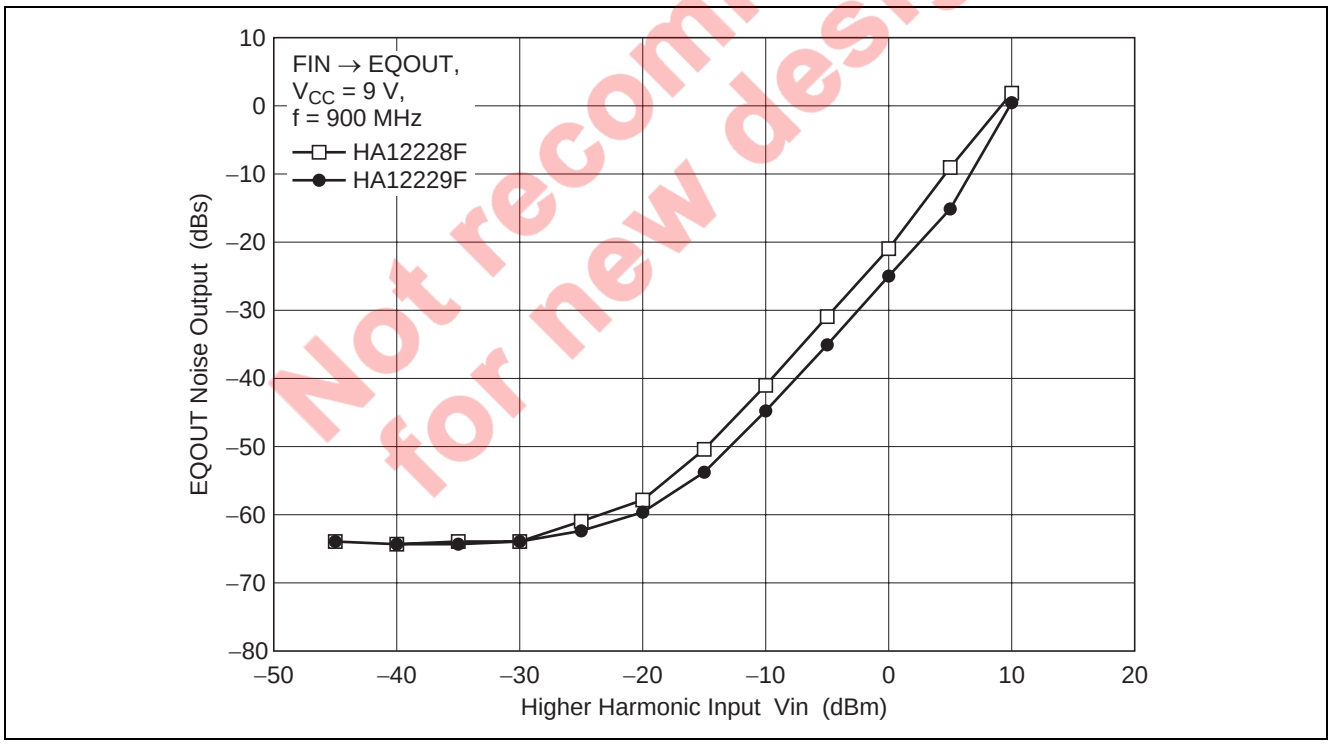


Figure 9 EQOUT Noise Output vs. Transmission Signal Input Level Characteristic

Absolute Maximum Ratings

(Ta = 25°C)

Item	Symbol	Rating	Unit	Note
Maximum supply voltage	V_{CC} Max	16	V	
Power dissipation	Pd	400	mW	Ta ≤ 85°C
Operating temperature	Topr	–40 to +85	°C	
Storage temperature	Tstg	–55 to +125	°C	

Electrical Characteristics

HA12228F

(Ta = 25°C, V_{CC} = 9 V, Dolby level 0 dB = PBOUT level 0 dB = 300 mVrms, EQOUT level 0 dB = 60 mVrms)

Item	Symbol	Test Condition: IC Condition: NR ON/OFF	MUTE ON/OFF	120µ/70µ	SER/REP	FOR/REV	fin (Hz)	PBOUT level (dB)	EQOUT level (dB)	Other	Specification: Min	Typ	Max	Unit	Application Terminal: Input R	Input L	Output R	Output L	COM	Remark
Quiescent current	I_Q	OFF	OFF	70µ	SER	FOR	—	—	—	No signal	4.0	9.5	15.0	mA	—	—	—	—	15	
Input Amp. gain	G_VIA	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→ ON	—	—	—	—	—	—	No signal	–150	0	150	mV	—	—	25	6		1
Signal handling	Vo max	ON	OFF	—	—	—	1k	—	—	THD=1%	12.0	13.0	—	dB	27	4	25	6		2
Signal to noise ratio	S/N	ON	OFF	—	—	—	1k	(0)	—	Rg=10kΩ, CCIR/ARM	70.0	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)	—	—	—	—	FOR	1k	—	(+20)		50.0	60.0	—	dB	37	39	29→2	2→29		
	CTRL (2)	OFF	OFF	—	—	—	1k	(+12)	—		70.0	80.0	—	dB	27	4	25→6	6→25		
MUTE attenuation	CT MUTE	OFF	OFF→ ON	—	—	—	1k	(+12)	—		70.0	80.0	—	dB	27	4	25	6		
PB-EQ gain	G_V EQ 1k	—	—	120µ	—	FOR/ REV	1k	—	0		37.8	40.8	43.8	dB	37/35	39/33	29	2		
	G_V EQ 10k(1)	—	—	120µ	—	FOR	10k	—	0		33.9	36.9	39.9	dB	37	39	29	2		
	G_V EQ 10k(2)	—	—	70µ	—	FOR	10k	—	0		29.6	32.6	35.6	dB	37	39	29	2		
PB-EQ Maximum output level	V_{OM}	—	—	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_N	—	—	120µ	—	FOR/ REV	(1k)	—	—	Rg=680Ω, DIN-AUDIO	—	0.7	1.5	µVrms	37/35	39/33	29	2		
MS sensing level	V_{ON} (1)	OFF	OFF	—	SER	—	5k	—	—		–36.0	–32.0	–28.0	dB	27	4	25	6	16	3
	V_{ON} (2)	OFF	OFF	—	REP	—	5k	—	—		–18.0	–14.0	–10.0	dB	27	4	25	6	16	3
MS output low level	V_{OL}	OFF	OFF	—	SER	—	5k	0	—		—	1.0	1.5	V	27	4	—	—	16	
MS output leakage current	I_{OH}	—	—	—	—	—	—	—	—	No signal	—	0.0	2.0	µA	—	—	—	—	16	
Control voltage	V_{IL}	—	—	—	—	—	—	—	—		–0.2	—	1.0	V	—	—	—	—	17 to 21	
	V_{IH}	—	—	—	—	—	—	—	—		3.5	—	V_{CC}	V	—	—	—	—		

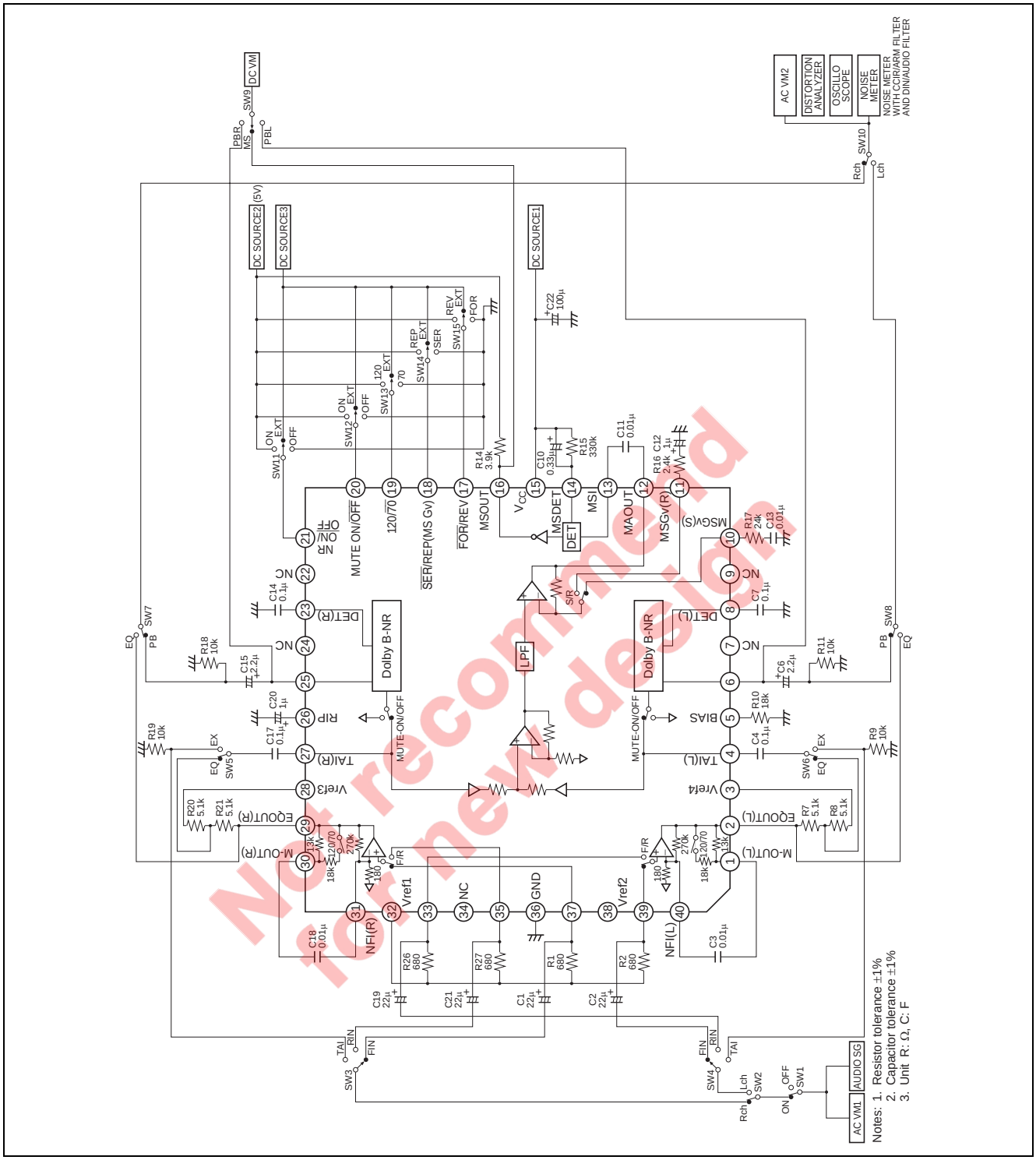
Notes: 1. V_{CC} = 12V
2. V_{CC} = 6.5V
3. For inputting signal to one side channel

(Ta = 25°C, V_{CC} = 9 V, PBOUT level 0 dB = 300 mVrms, EQOUT level 0 dB = 60 mVrms)

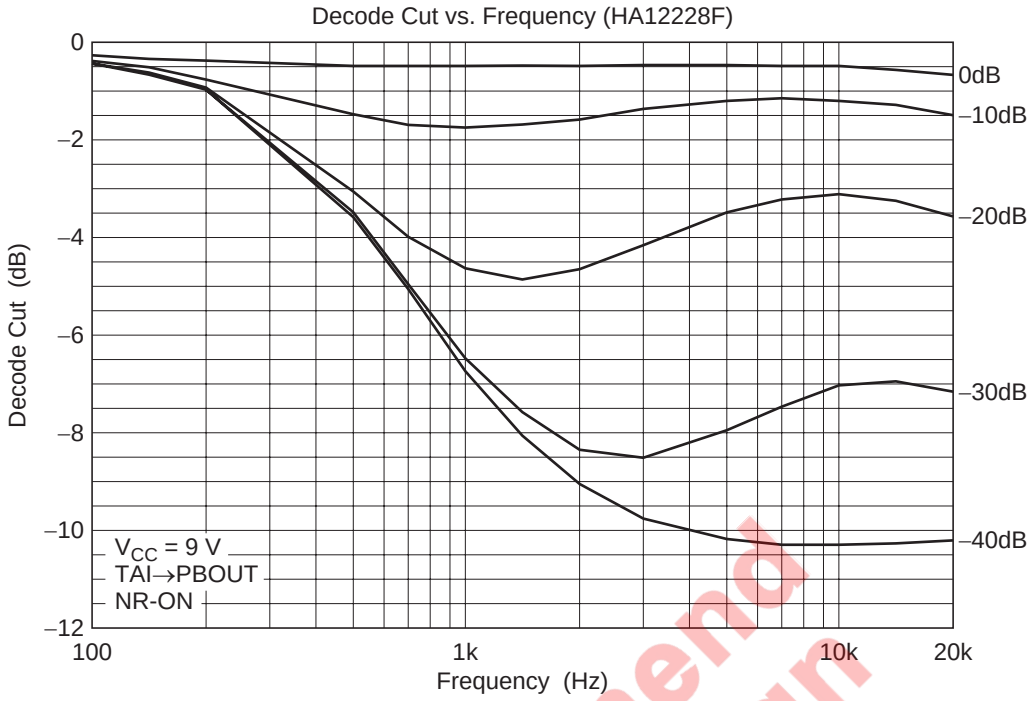
Item	Symbol	Test Condition								Specification			Unit	Application Terminal					Remark
		IC Condition												Input		Output			
		MUTE ON/OFF	120µ/ 70µ	SER/ REP	FOR/ REV	fin (Hz)	PBOUT level (dB)	EQOUT level (dB)	Other	Min	Typ	Max		R	L	R	L	COM	
Quiescent current	I_Q	OFF	70µ	SER	FOR	—	—	—	No signal	3.0	5.0	8.0	mA	—	—	—	—	15	
Input Amp. gain	G_VIA	OFF	—	—	—	1k	0	—		19.0	20.0	21.0	dB	27	4	25	6		
PBOUT offset	Vofs	OFF→ ON	—	—	—	—	—	—	No signal	–150	0	150	mV	—	—	25	6		1
Signal handling	Vo max	OFF	—	—	—	1k	—	—	THD=1%	12.0	13.0	—	dB	27	4	25	6		2
Signal to noise ratio	S/N	OFF	—	—	—	1k	(0)	—	Rg=10kΩ, CCIR/ARM	70.0	80.0	—	dB	27	4	25	6		
Total Harmonic Distortion	THD	OFF	—	—	—	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)	OFF	—	—	—	1k	(+12)	—		70.0	80.0	—	dB	27	4	25→6	6→25		
MUTE attenuation	CT MUTE	OFF→ ON	—	—	—	1k	(+12)	—		70.0	80.0	—	dB	27	4	25	6		
PB-EQ gain	G_V EQ 1k	—	120µ	—	FOR/ REV	1k	—	0		37.8	40.8	43.8	dB	37/35	39/33	29	2		
	G_V EQ 10k(1)	—	120µ	—	FOR	10k	—	0		33.9	36.9	39.9	dB	37	39	29	2		
	G_V EQ 10k(2)	—	70µ	—	FOR	10k	—	0		29.6	32.6	35.6	dB	37	39	29	2		
PB-EQ Maximum output level	V_{OM}	—	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_N	—	120µ	—	FOR/ REV	(1k)	—	—	Rg=680Ω, DIN-AUDIO	—	0.7	1.5	µVrms	37/35	39/33	29	2		
MS sensing level	V_{ON} (1)	OFF	—	SER	—	5k	—	—		–36.0	–32.0	–28.0	dB	27	4	25	6	16	3
	V_{ON} (2)	OFF	—	REP	—	5k	—	—		–18.0	–14.0	–10.0	dB	27	4	25	6	16	3
MS output low level	V_{OL}	OFF	—	SER	—	5k	0	—		—	1.0	1.5	V	27	4	—	—	16	
MS output leakage current	I_{OH}	—	—	—	—	—	—	—	No signal	—	0.0	2.0	µA	—	—	—	—	16	
Control voltage	V_{IL}	—	—	—	—	—	—	—		–0.2	—	1.0	V	—	—	—	—	17 to 20	
	V_{IH}	—	—	—	—	—	—	—		3.5	—	V_{CC}	V	—	—	—	—		

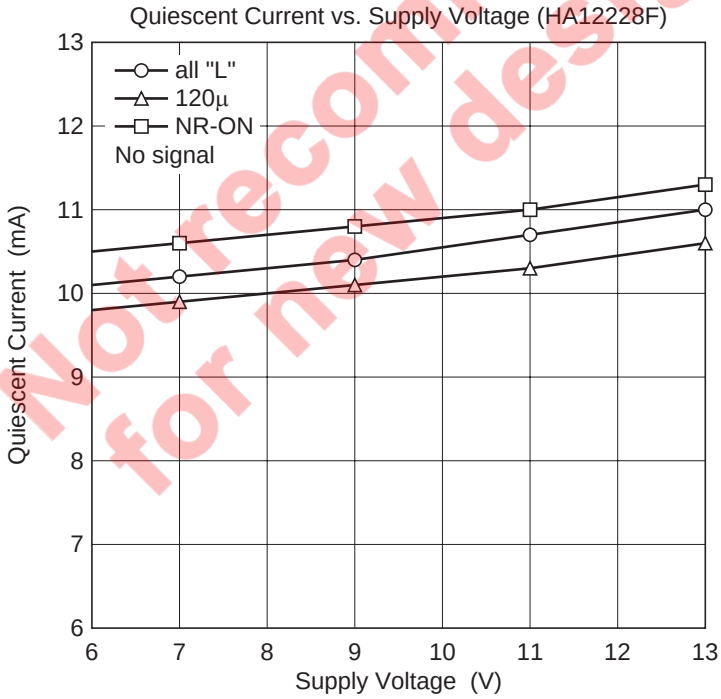
Notes: 1. V_{CC} = 12V
2. V_{CC} = 6.5V
3. For inputting signal to one side channel

Test Circuit

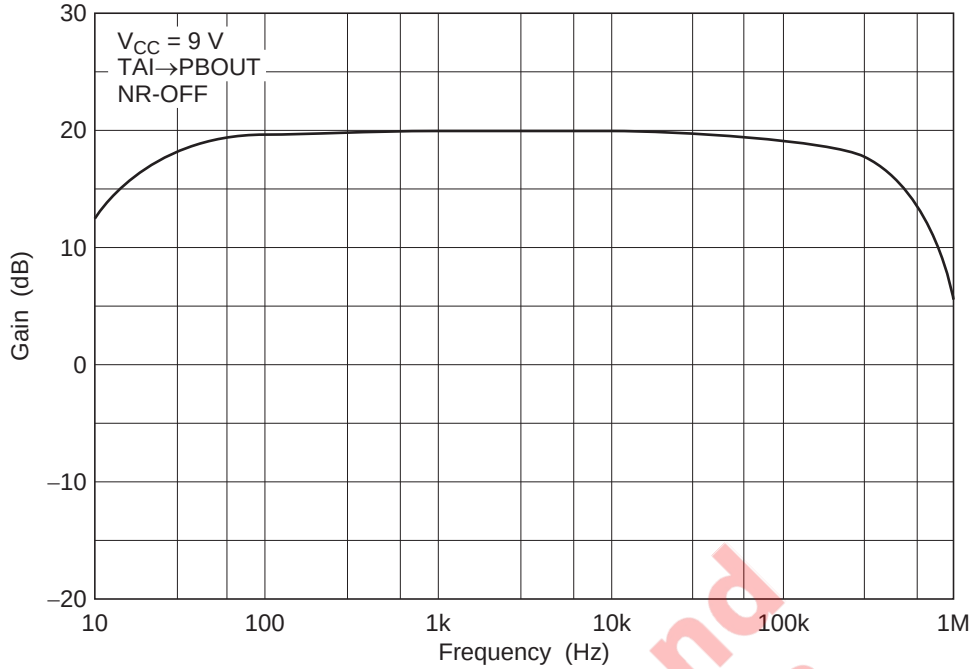


Characteristic Curves

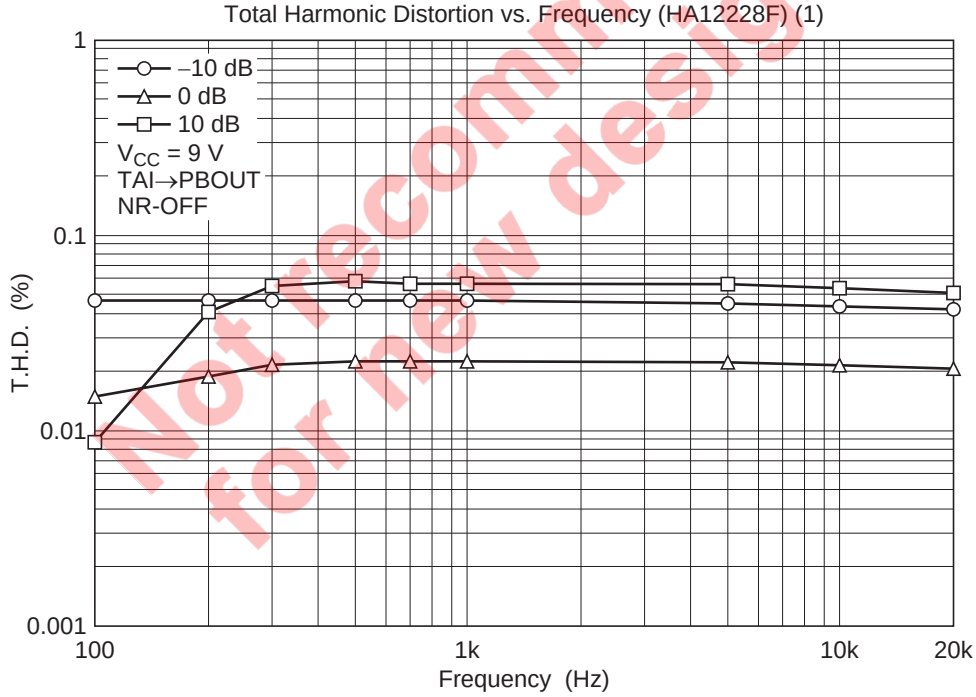




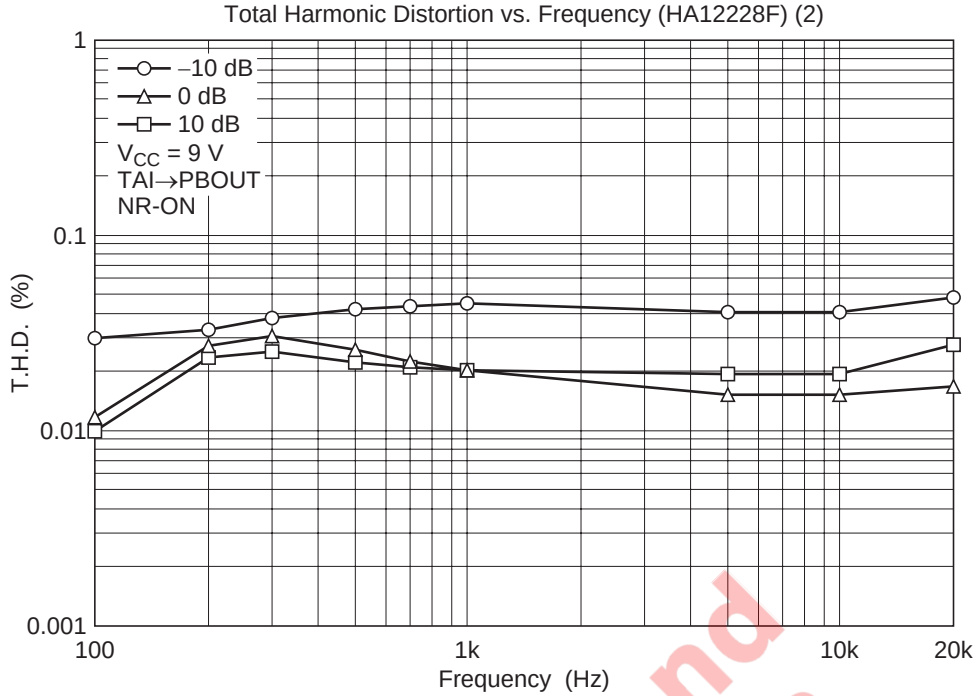
Input Amp. Gain vs. Frequency (HA12228F)



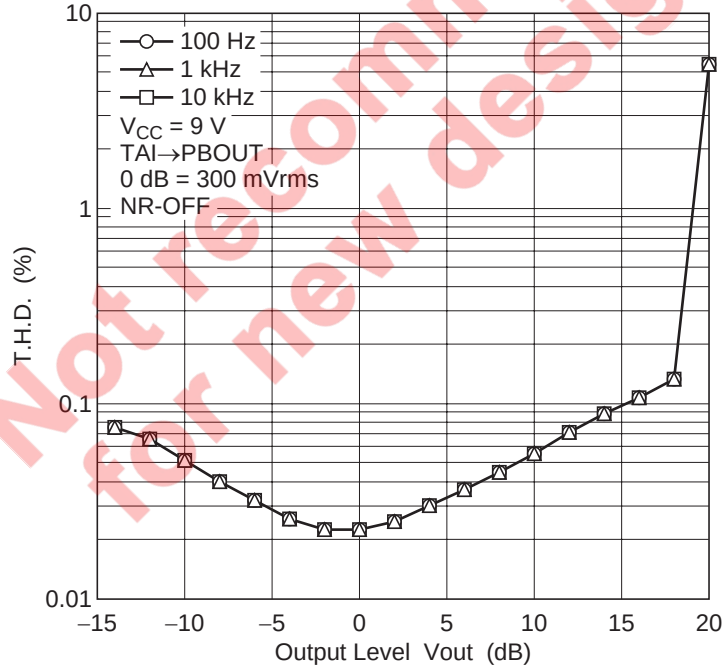
Total Harmonic Distortion vs. Frequency (HA12228F) (1)



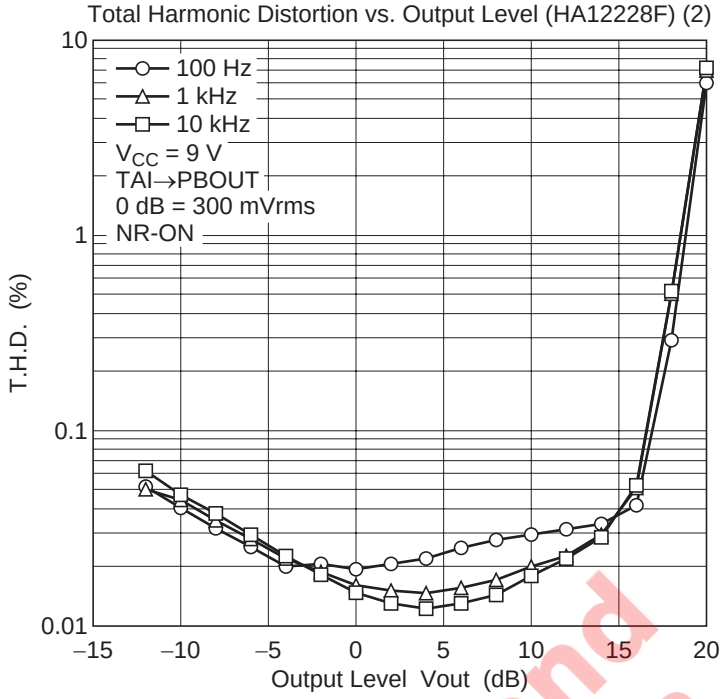
Total Harmonic Distortion vs. Frequency (HA12228F) (2)



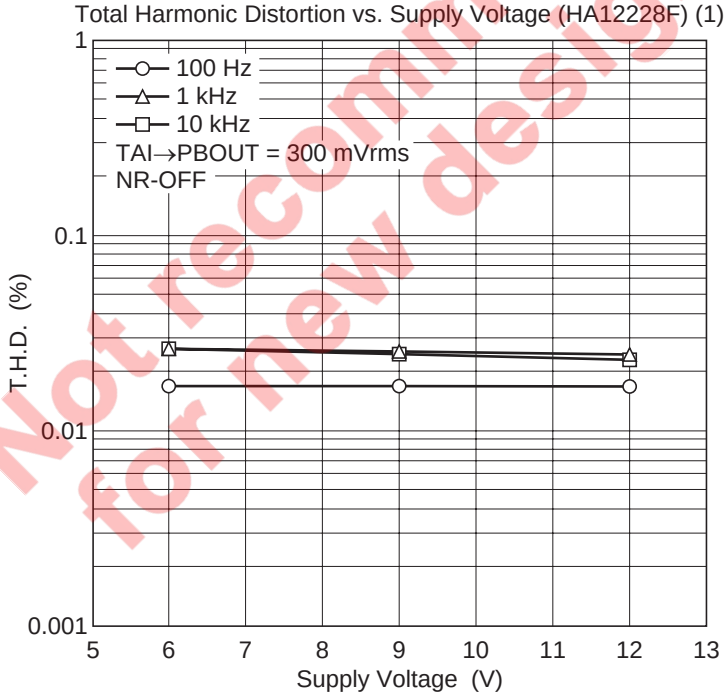
Total Harmonic Distortion vs. Output Level (HA12228F) (1)



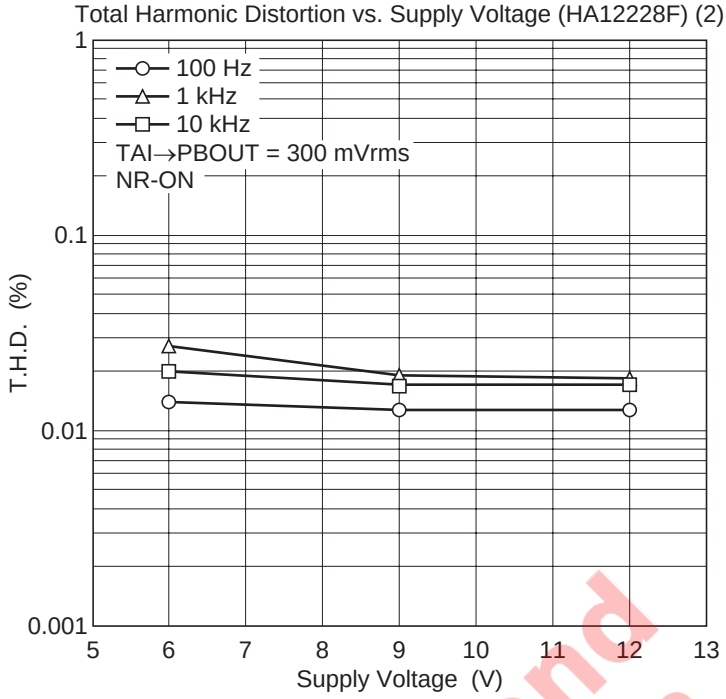
Total Harmonic Distortion vs. Output Level (HA12228F) (2)



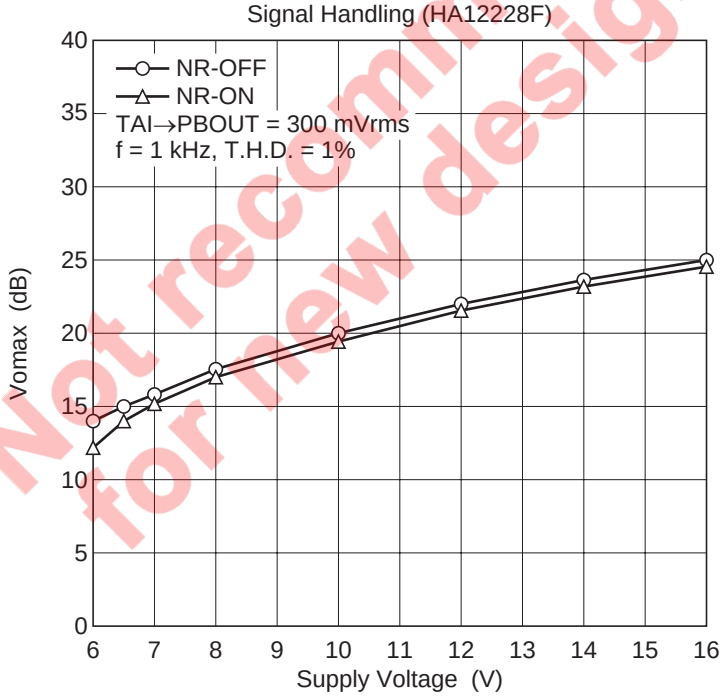
Total Harmonic Distortion vs. Supply Voltage (HA12228F) (1)



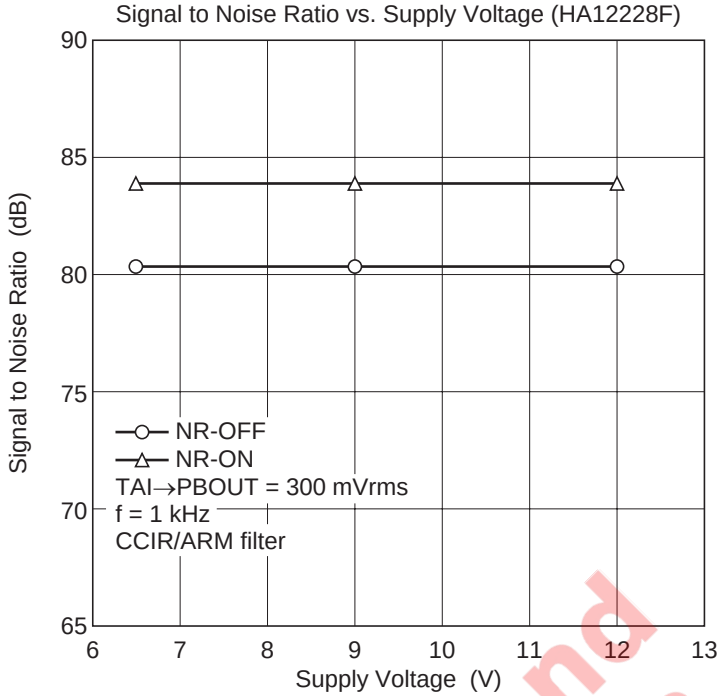
Total Harmonic Distortion vs. Supply Voltage (HA12228F) (2)



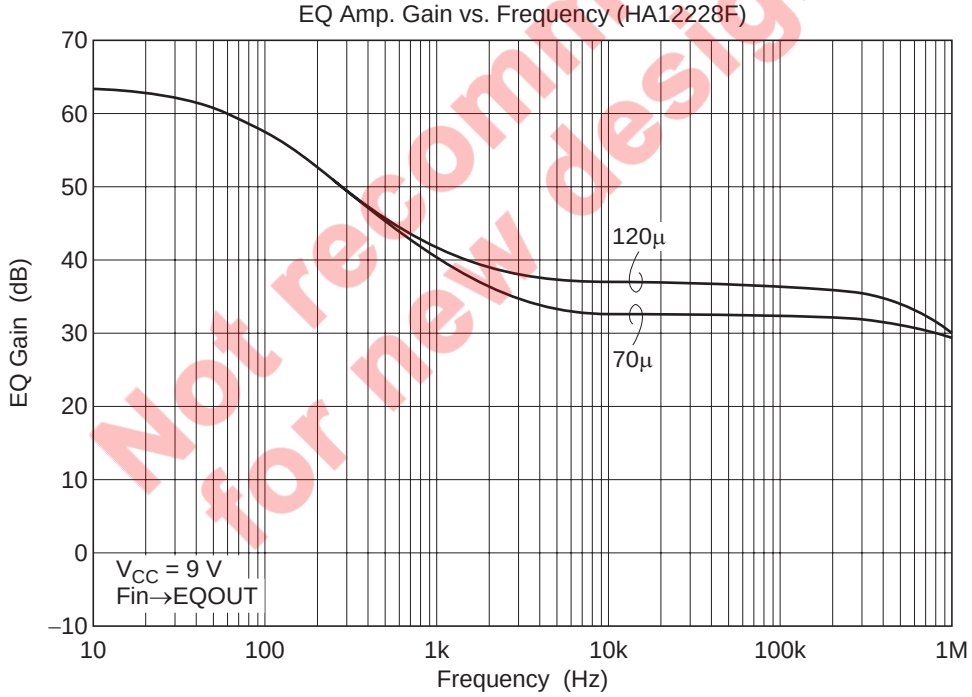
Signal Handling (HA12228F)



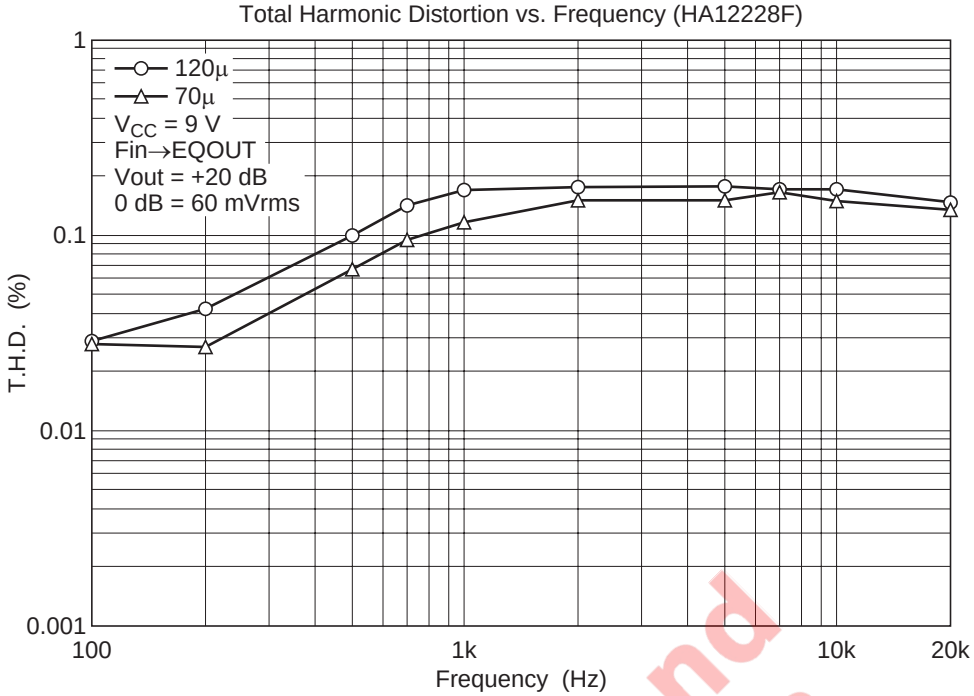
Signal to Noise Ratio vs. Supply Voltage (HA12228F)



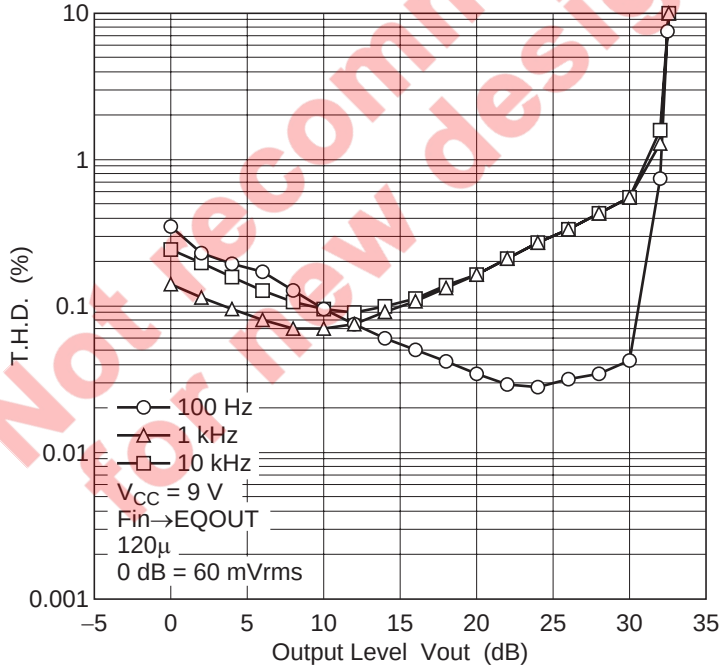
EQ Amp. Gain vs. Frequency (HA12228F)



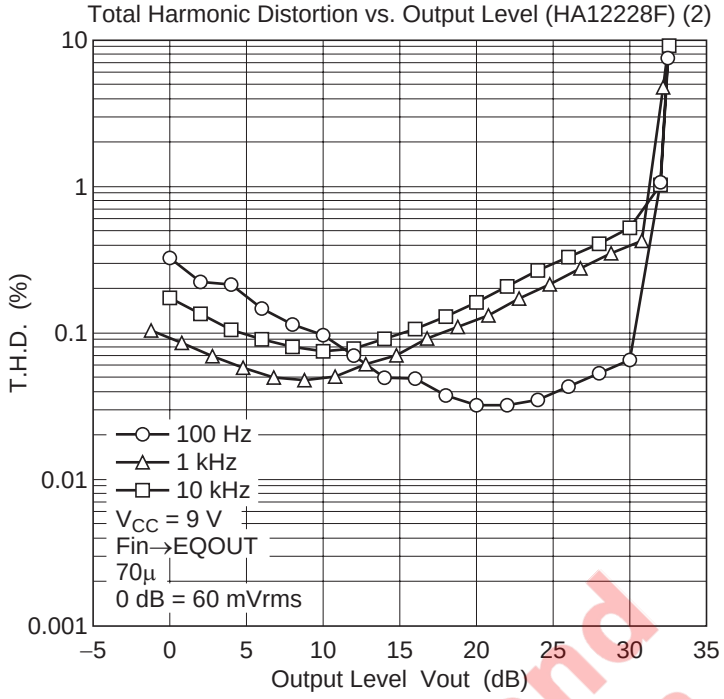
Total Harmonic Distortion vs. Frequency (HA12228F)



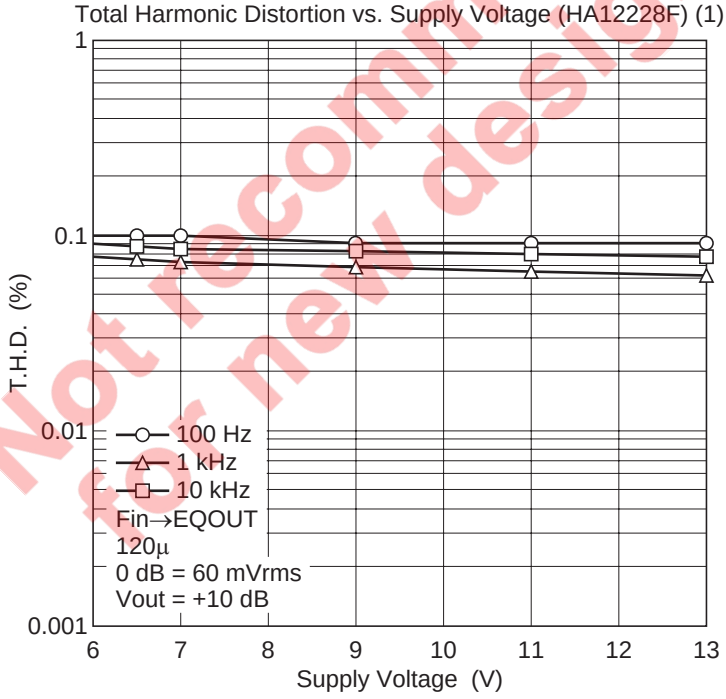
Total Harmonic Distortion vs. Output Level (HA12228F) (1)



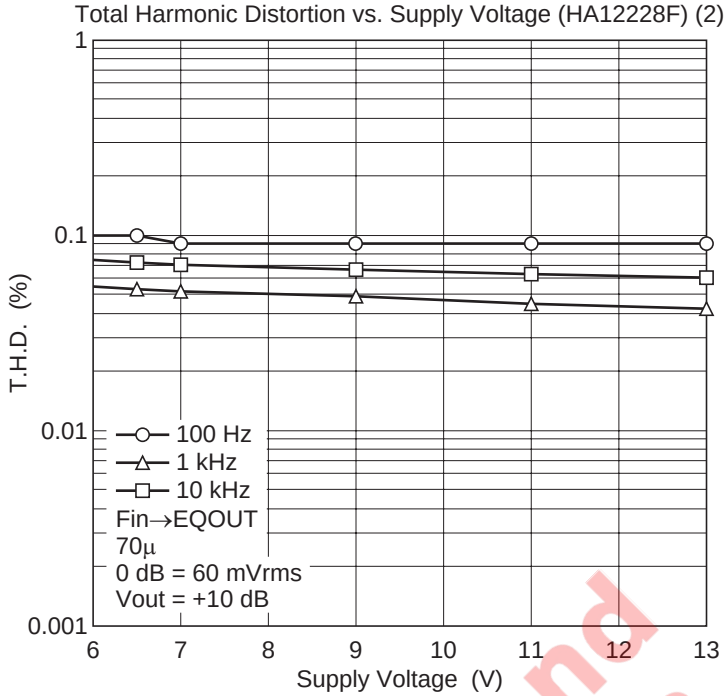
Total Harmonic Distortion vs. Output Level (HA12228F) (2)



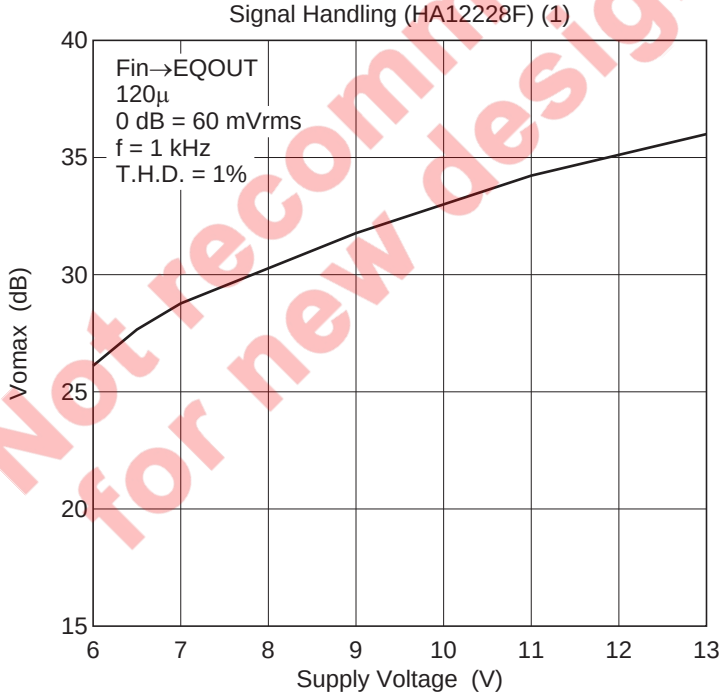
Total Harmonic Distortion vs. Supply Voltage (HA12228F) (1)



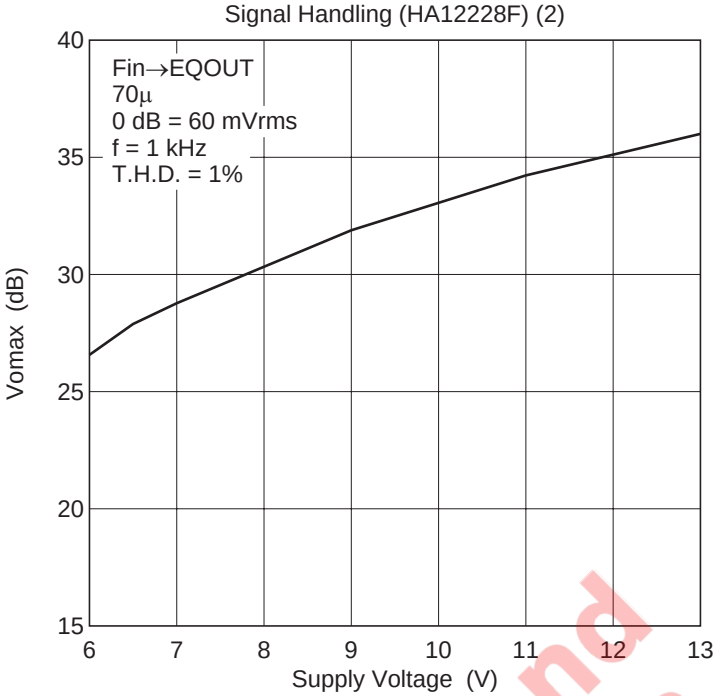
Total Harmonic Distortion vs. Supply Voltage (HA12228F) (2)



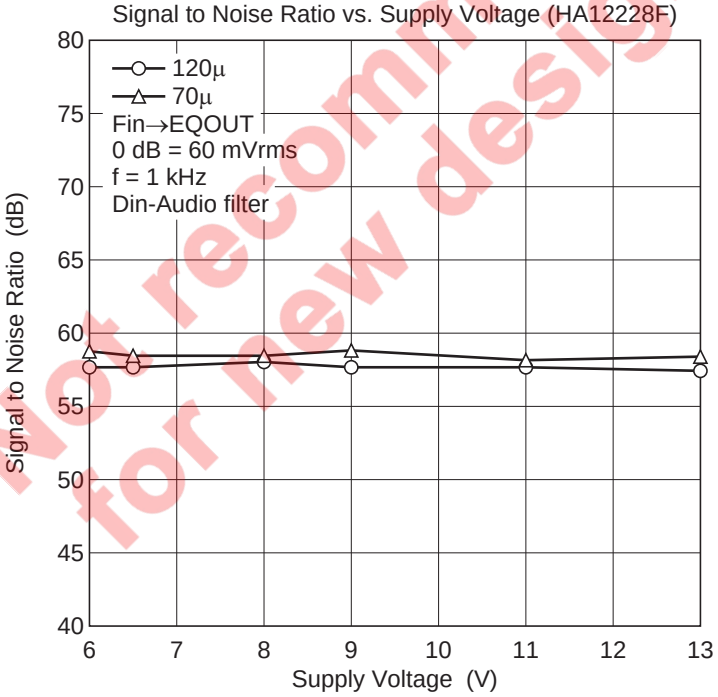
Signal Handling (HA12228F) (1)



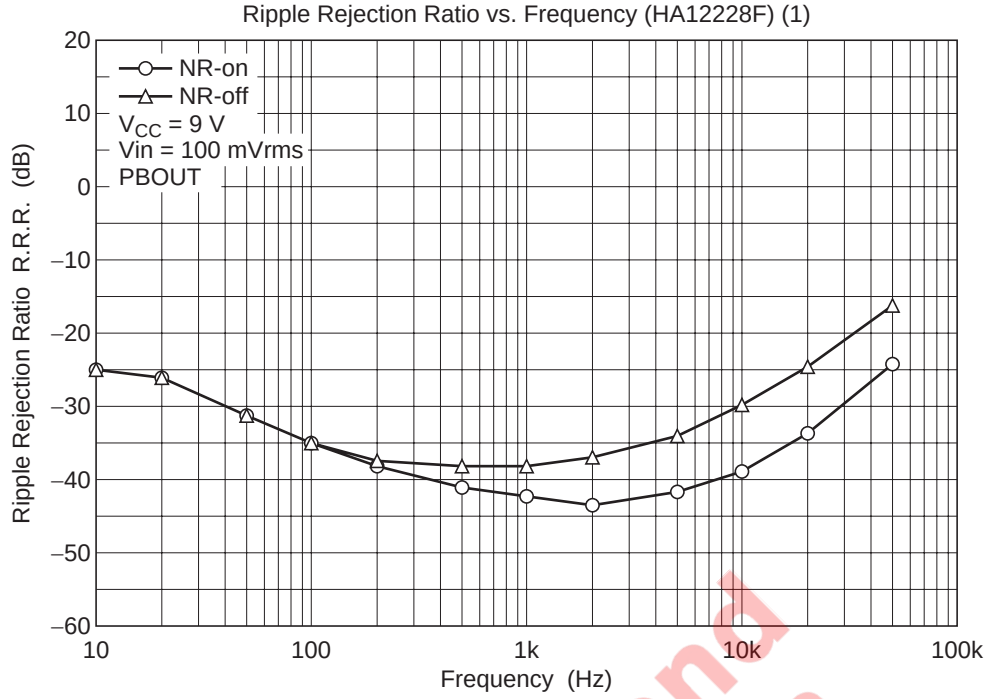
Signal Handling (HA12228F) (2)



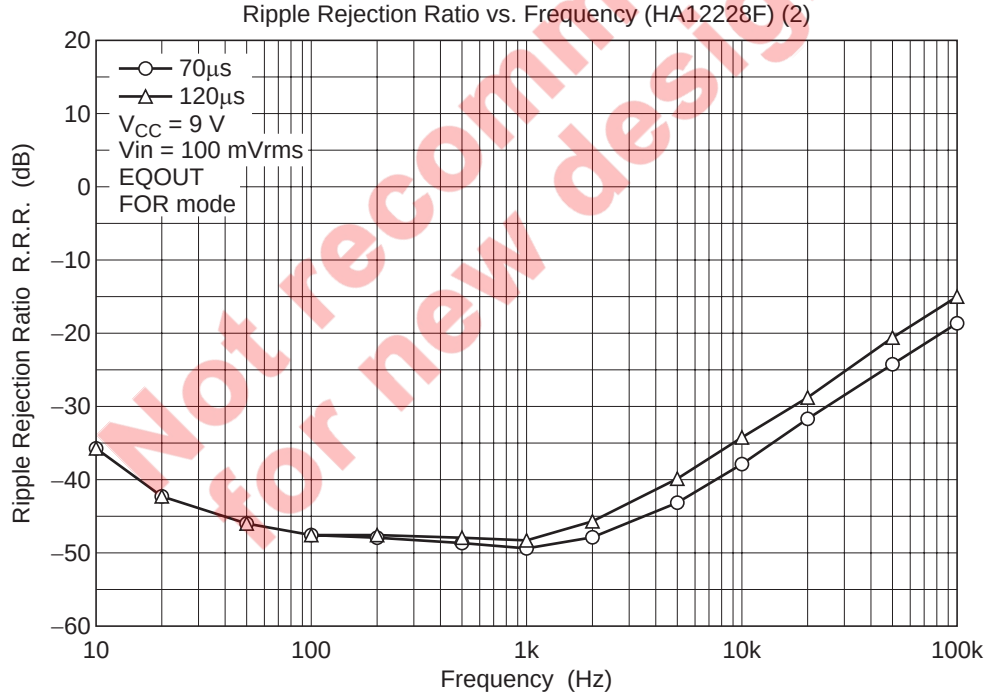
Signal to Noise Ratio vs. Supply Voltage (HA12228F)



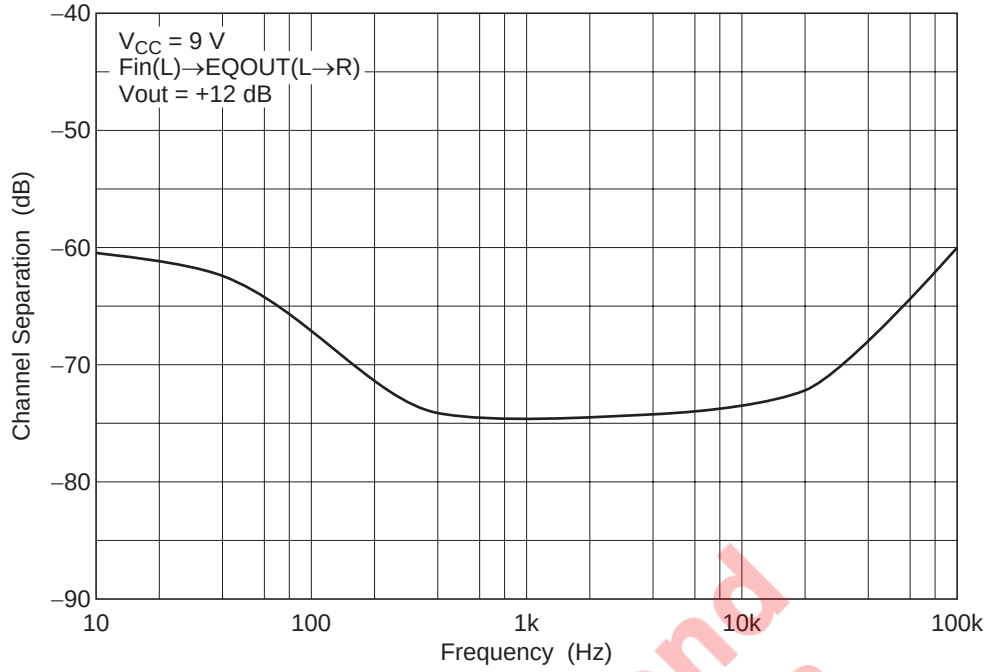
Ripple Rejection Ratio vs. Frequency (HA12228F) (1)



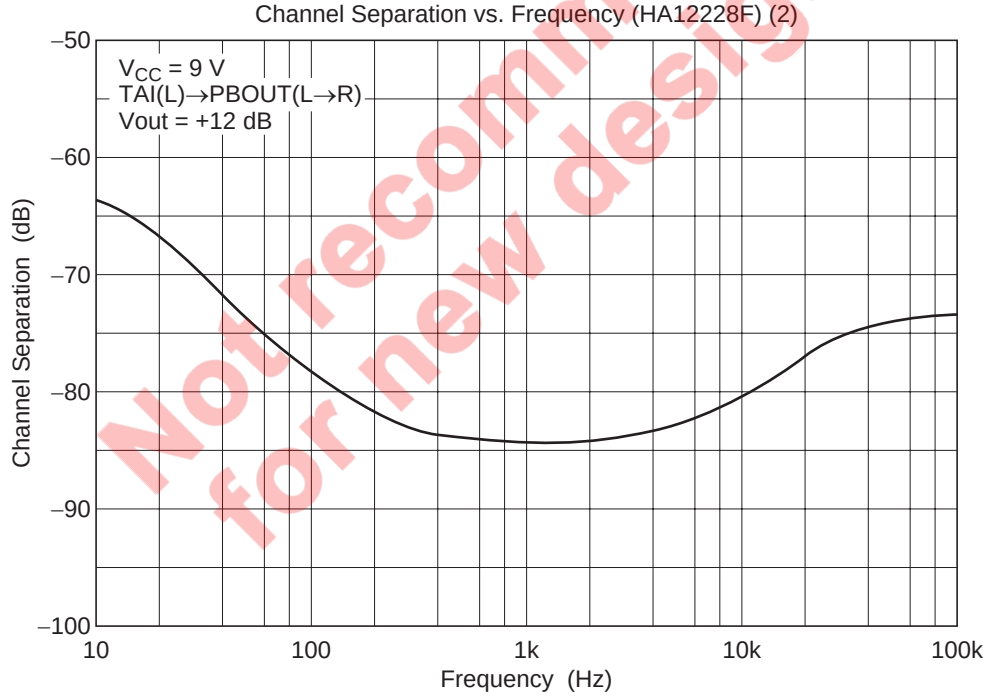
Ripple Rejection Ratio vs. Frequency (HA12228F) (2)

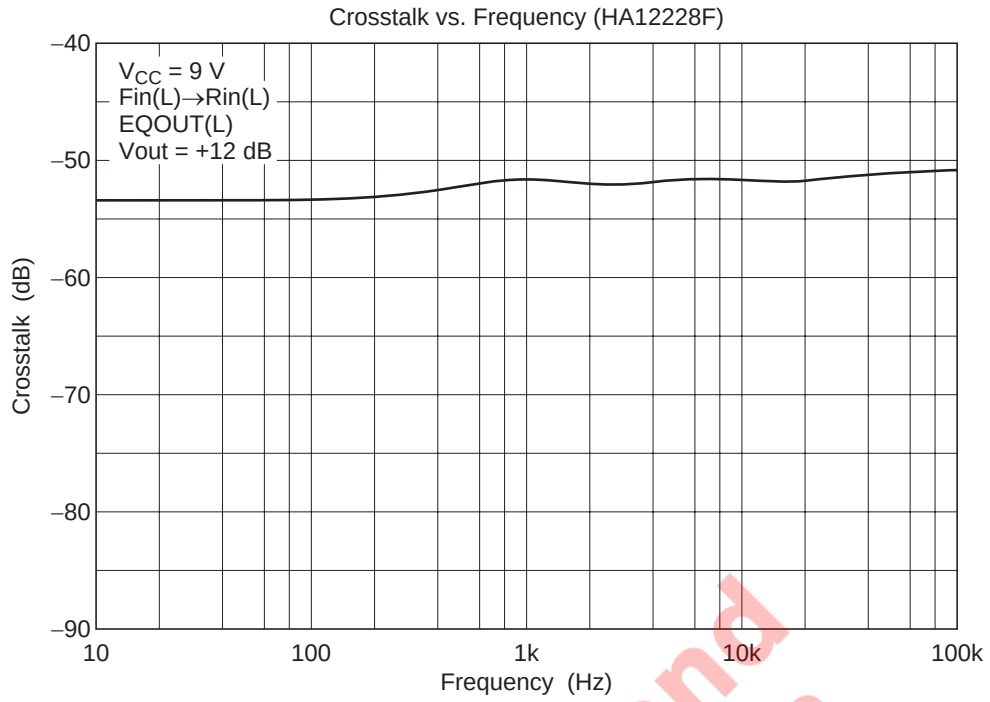


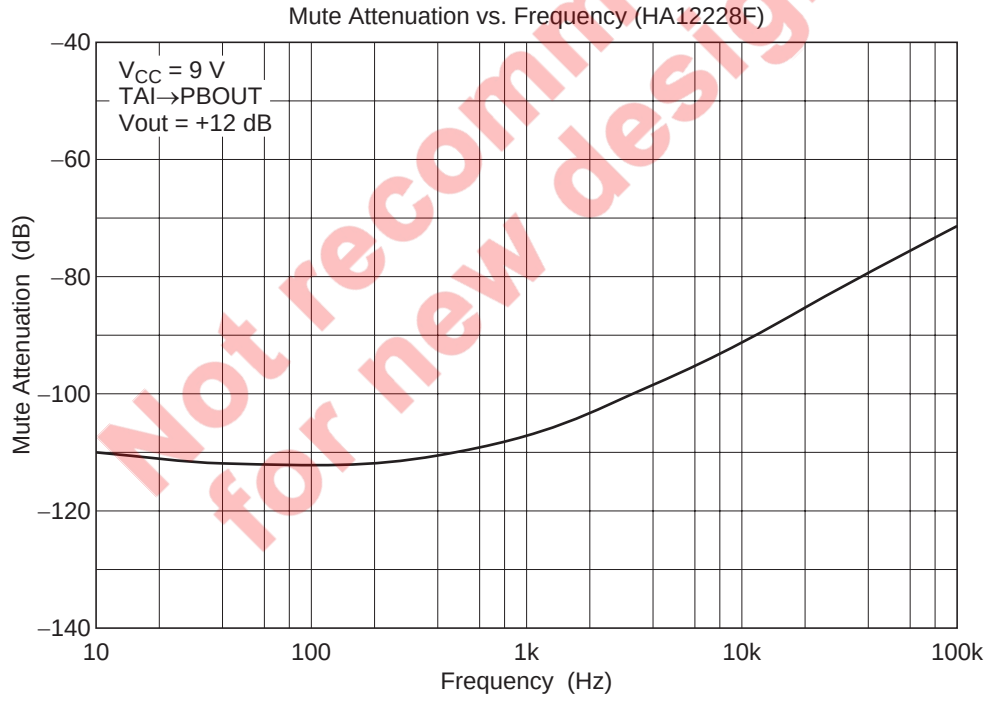
Channel Separation vs. Frequency (HA12228F) (1)



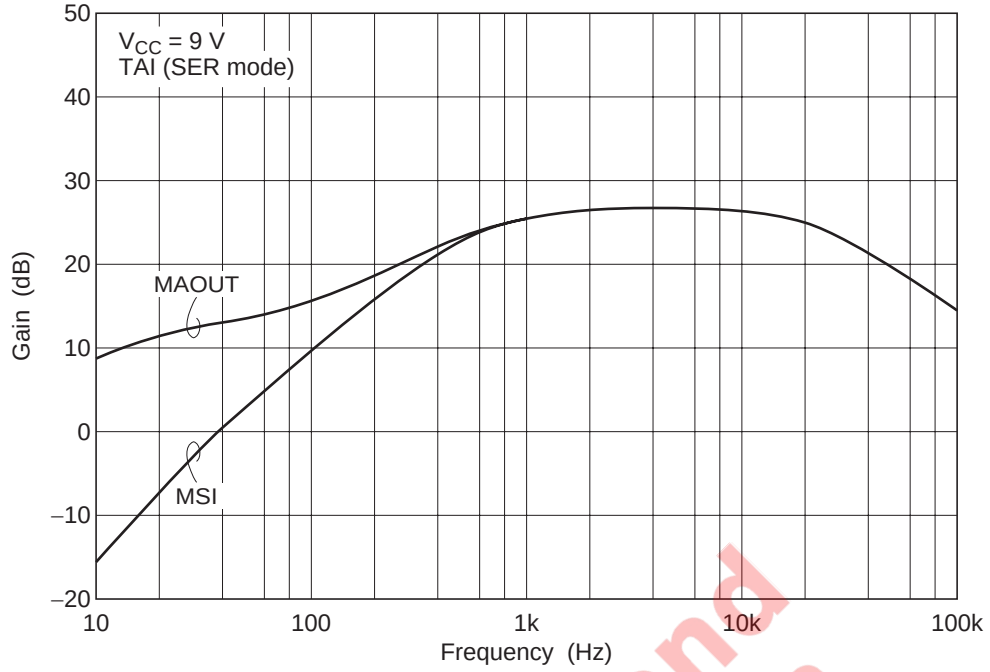
Channel Separation vs. Frequency (HA12228F) (2)



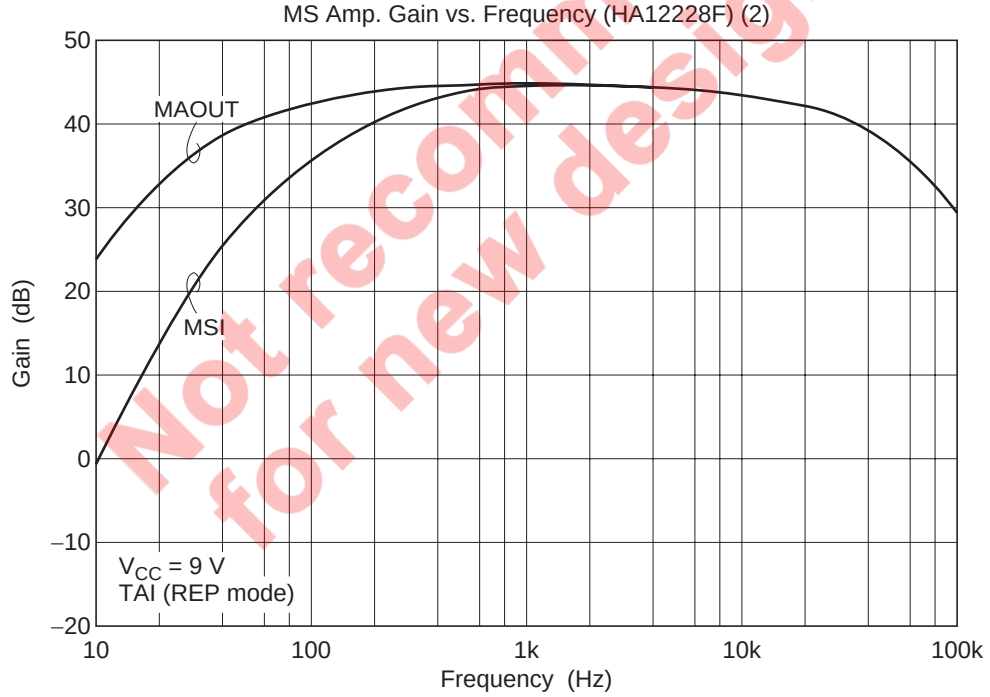




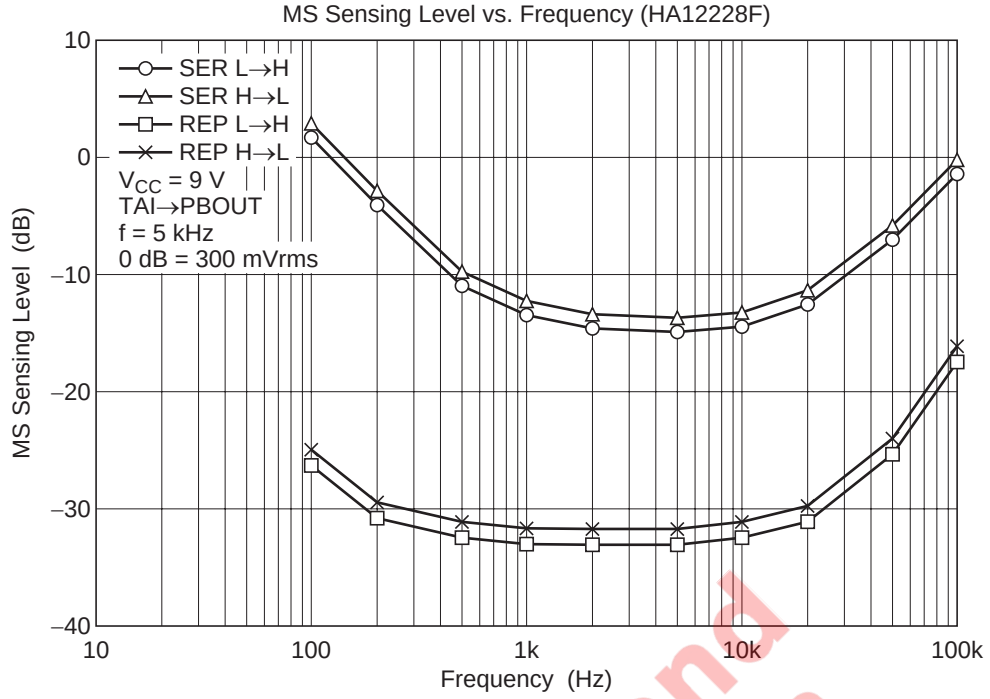
MS Amp. Gain vs. Frequency (HA12228F) (1)



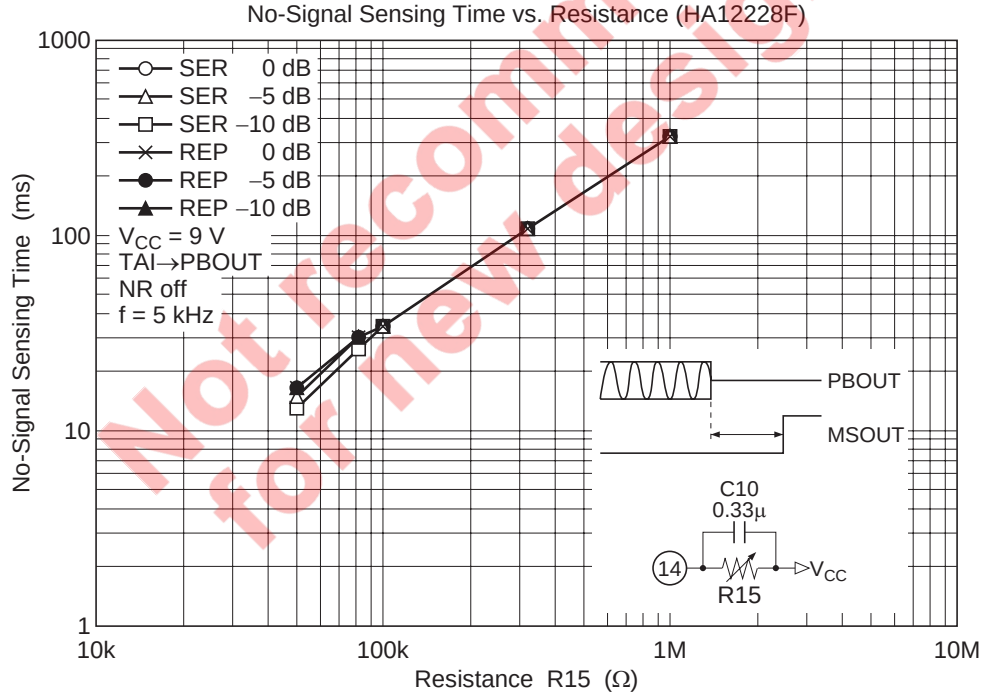
MS Amp. Gain vs. Frequency (HA12228F) (2)



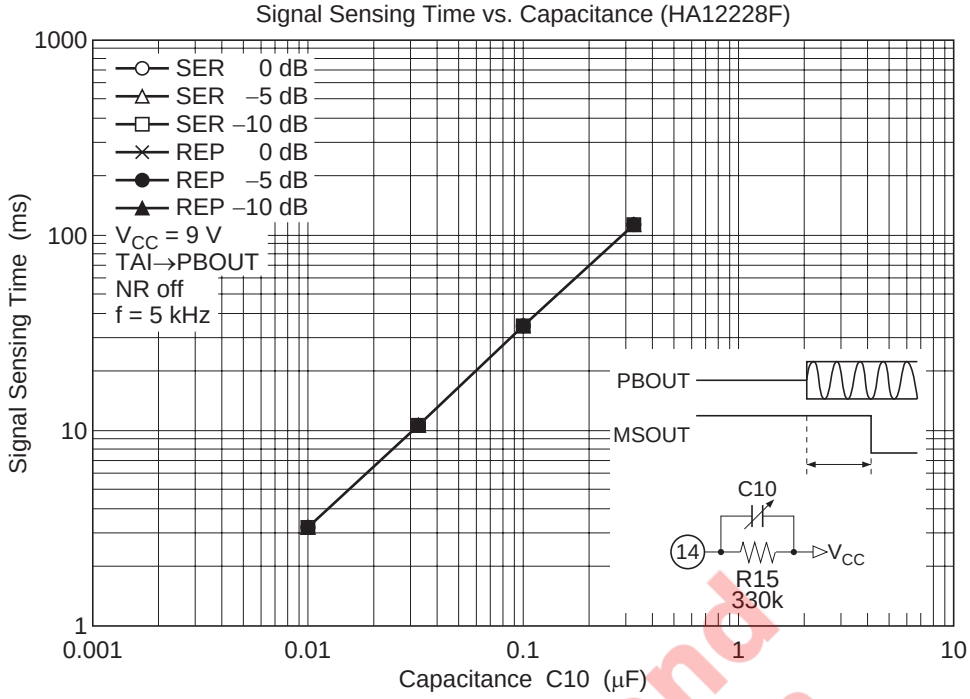
MS Sensing Level vs. Frequency (HA12228F)



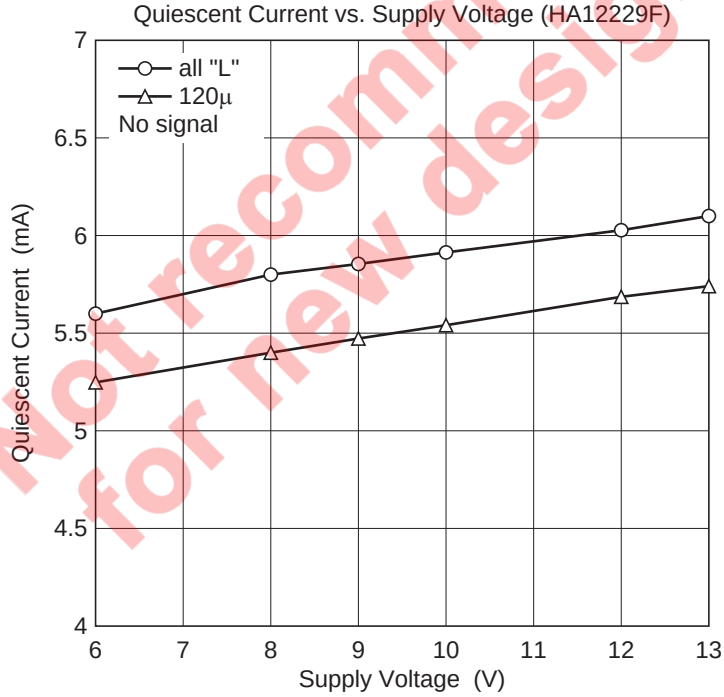
No-Signal Sensing Time vs. Resistance (HA12228F)



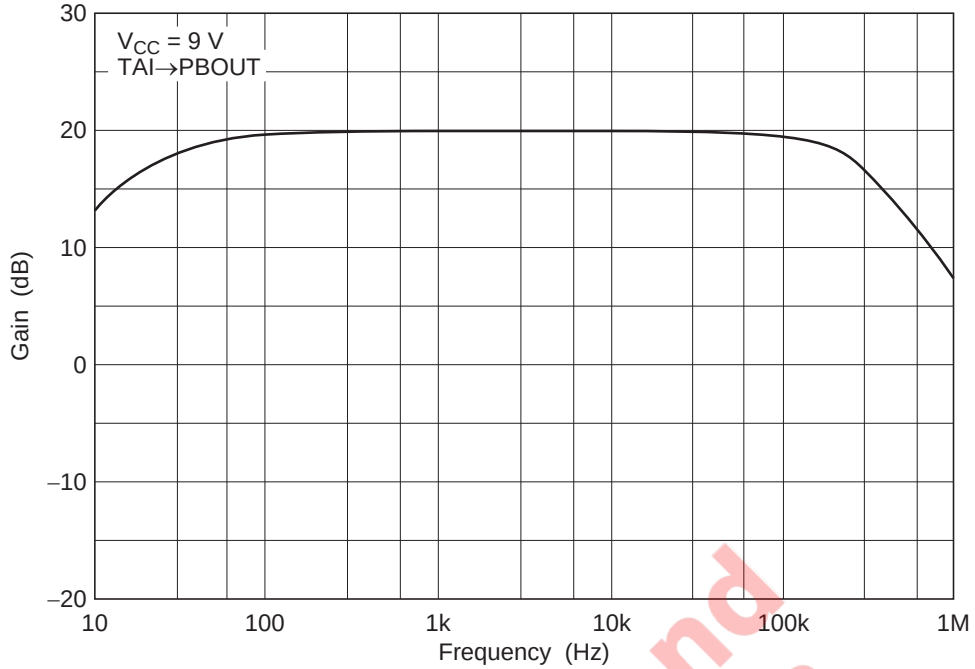
Signal Sensing Time vs. Capacitance (HA12228F)



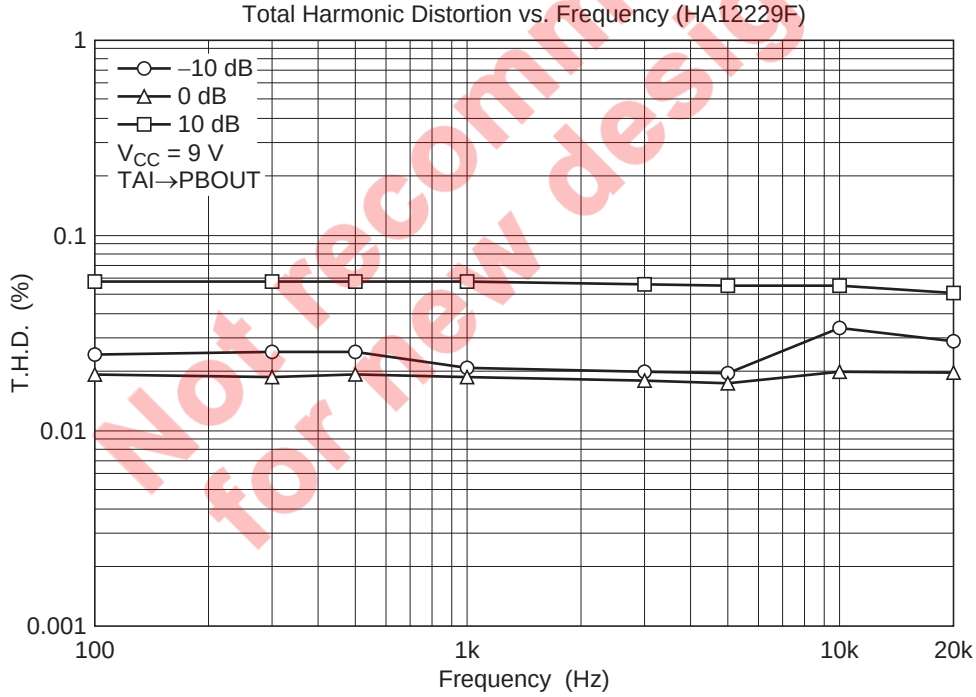
Quiescent Current vs. Supply Voltage (HA12229F)

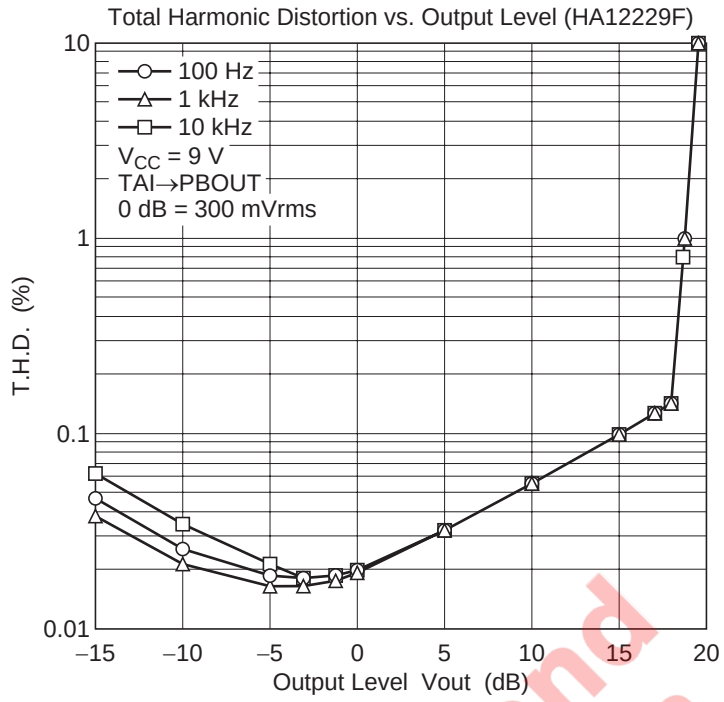


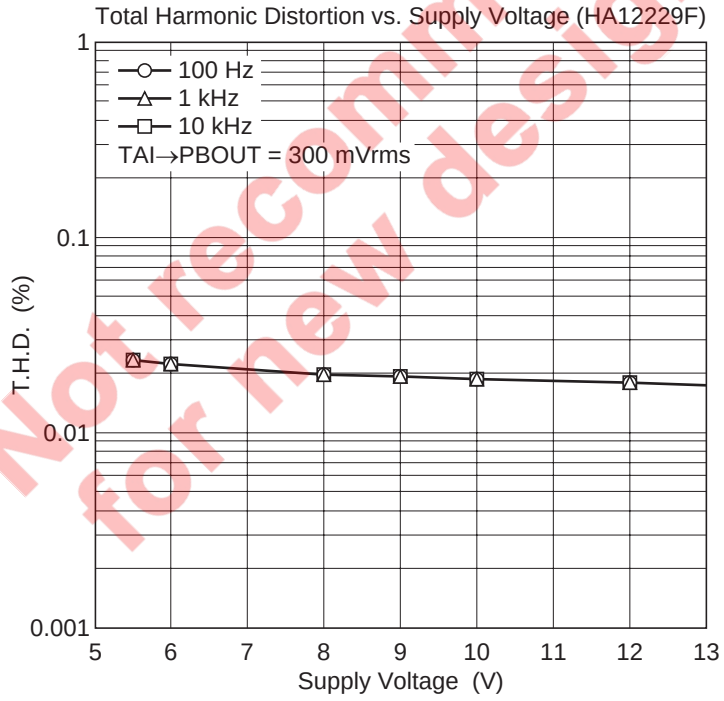
Input Amp. Gain vs. Frequency (HA12229F)



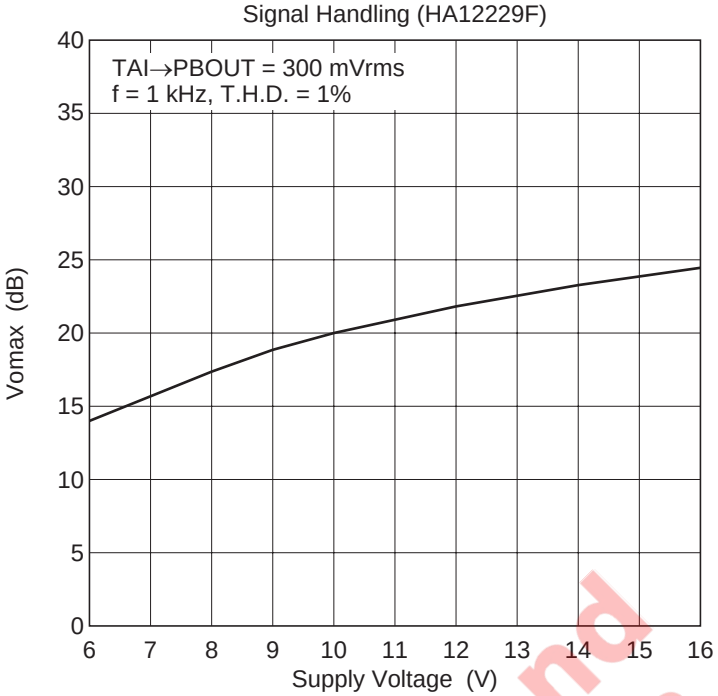
Total Harmonic Distortion vs. Frequency (HA12229F)



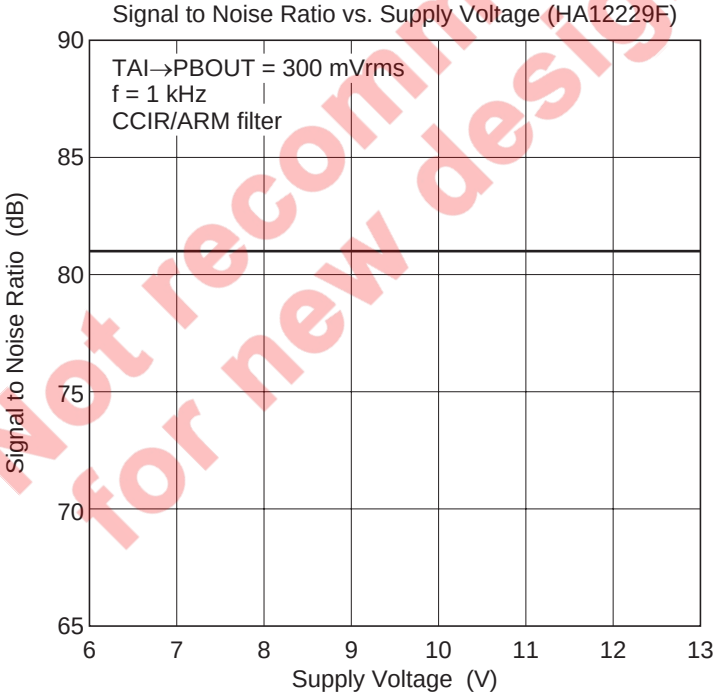




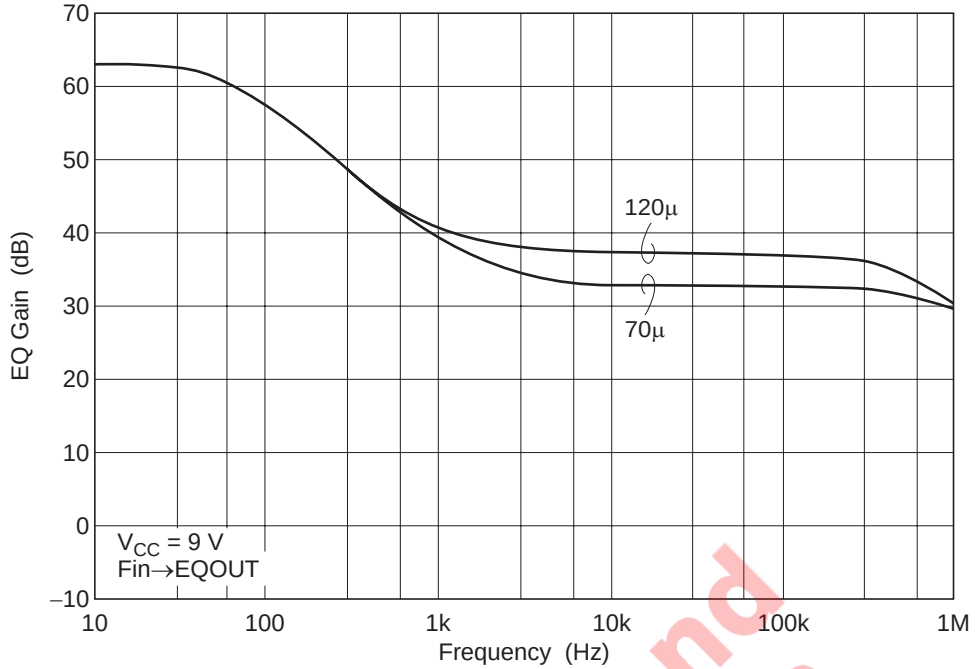
Signal Handling (HA12229F)



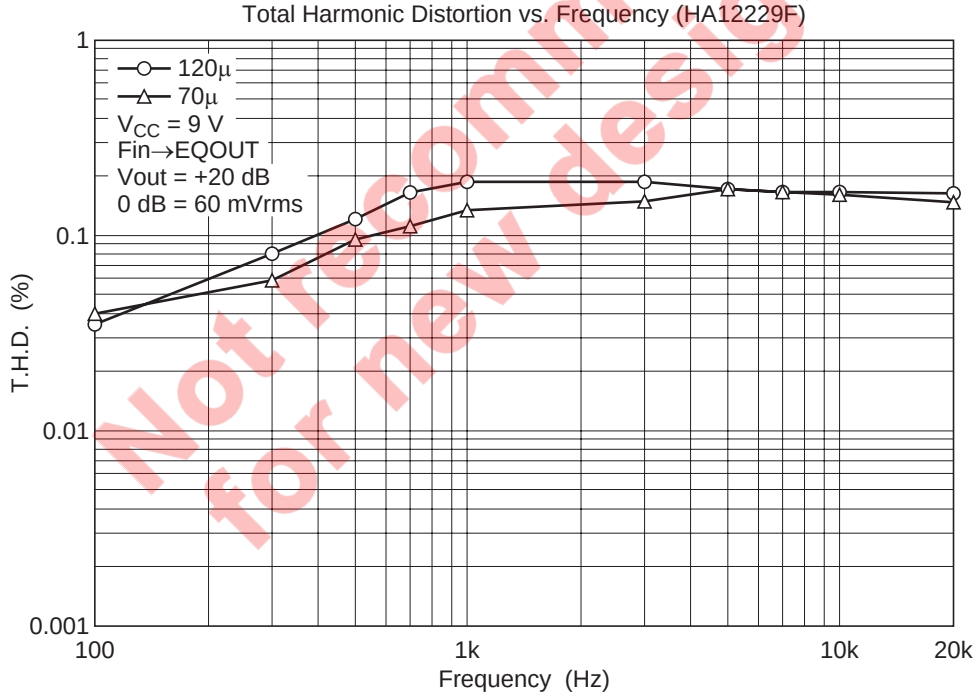
Signal to Noise Ratio vs. Supply Voltage (HA12229F)



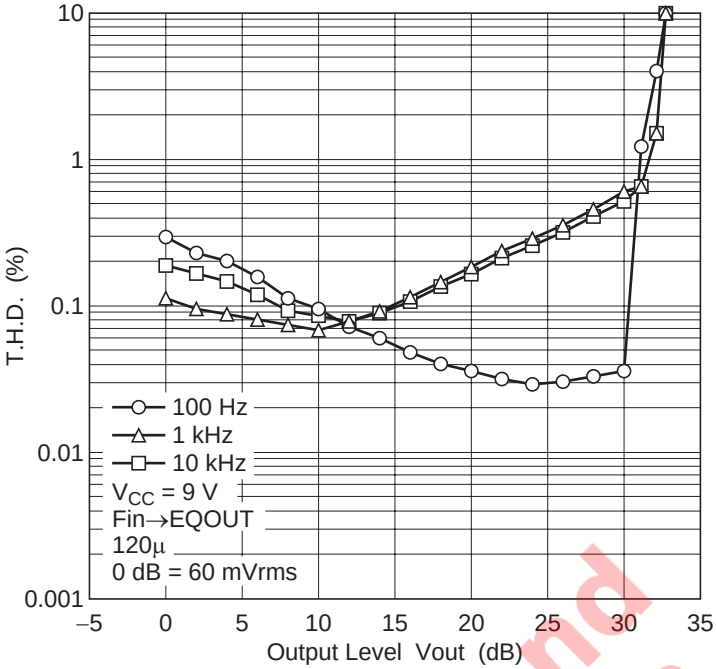
EQ Amp. Gain vs. Frequency (HA12229F)



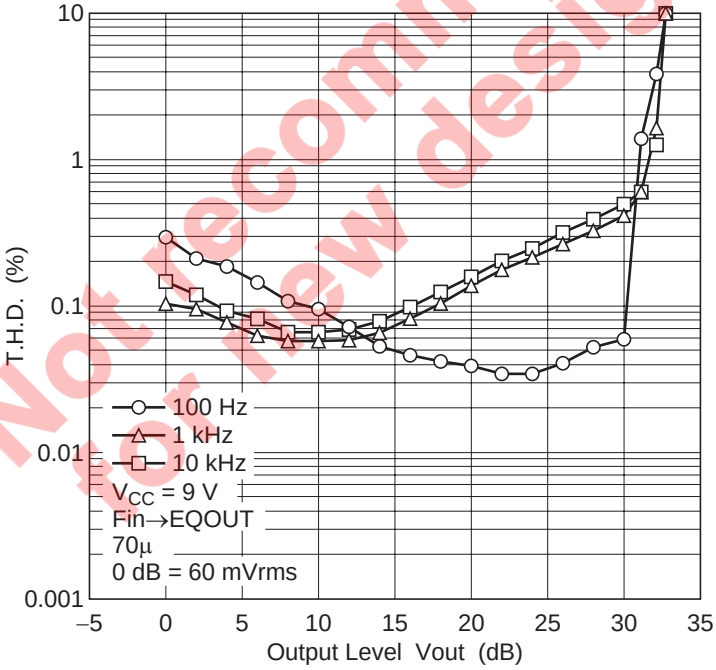
Total Harmonic Distortion vs. Frequency (HA12229F)



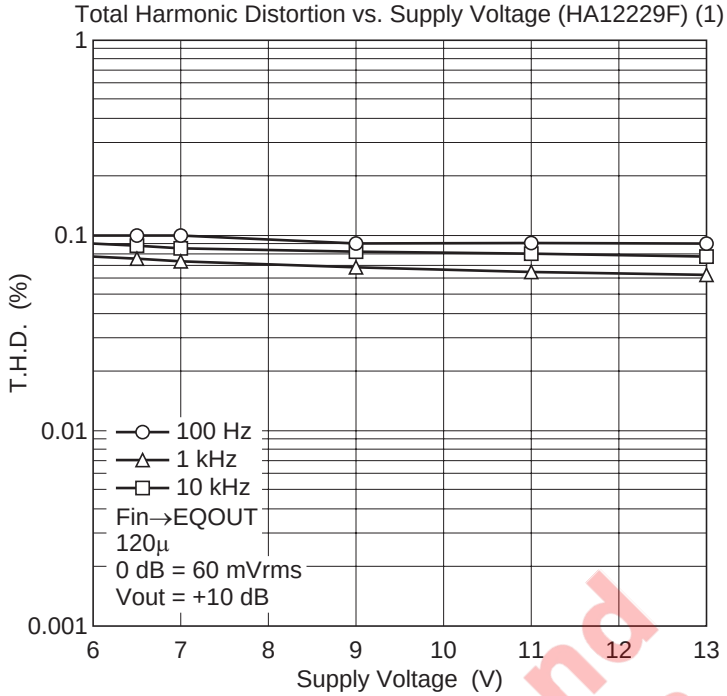
Total Harmonic Distortion vs. Output Level (HA12229F) (1)



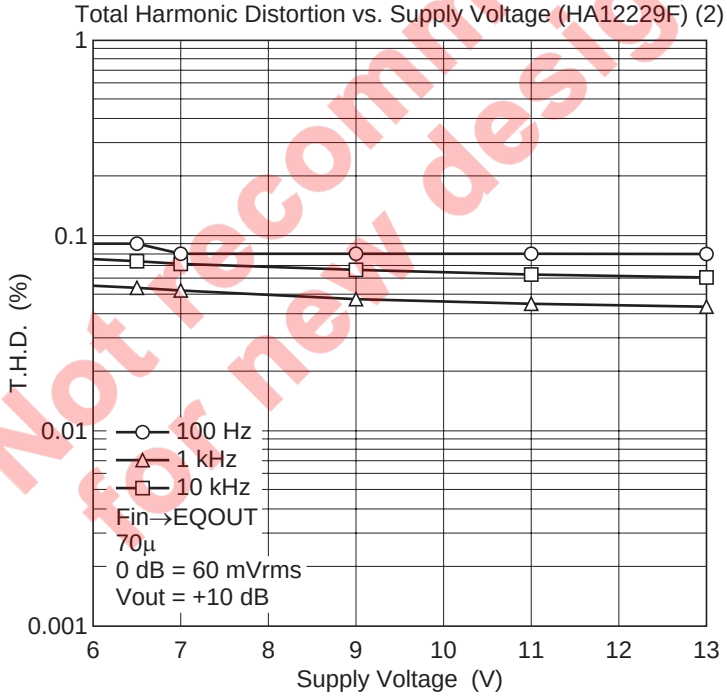
Total Harmonic Distortion vs. Output Level (HA12229F) (2)



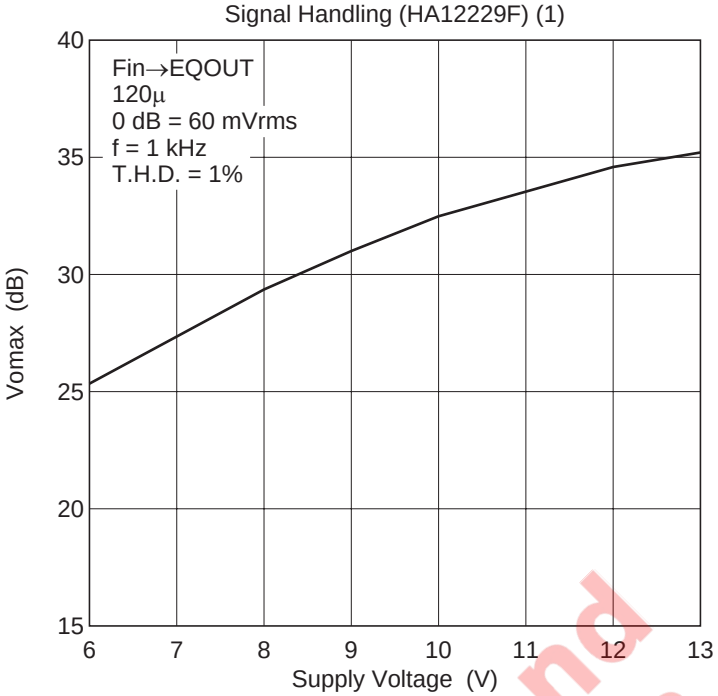
Total Harmonic Distortion vs. Supply Voltage (HA12229F) (1)



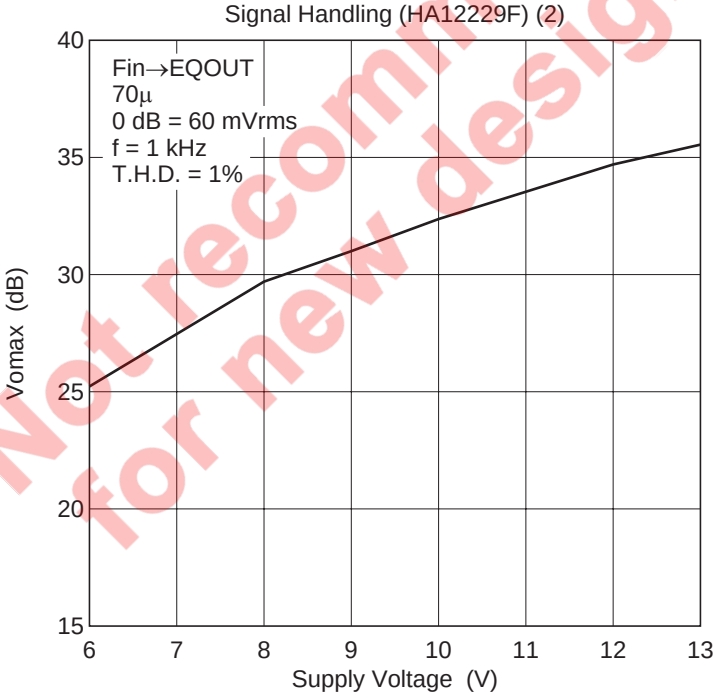
Total Harmonic Distortion vs. Supply Voltage (HA12229F) (2)



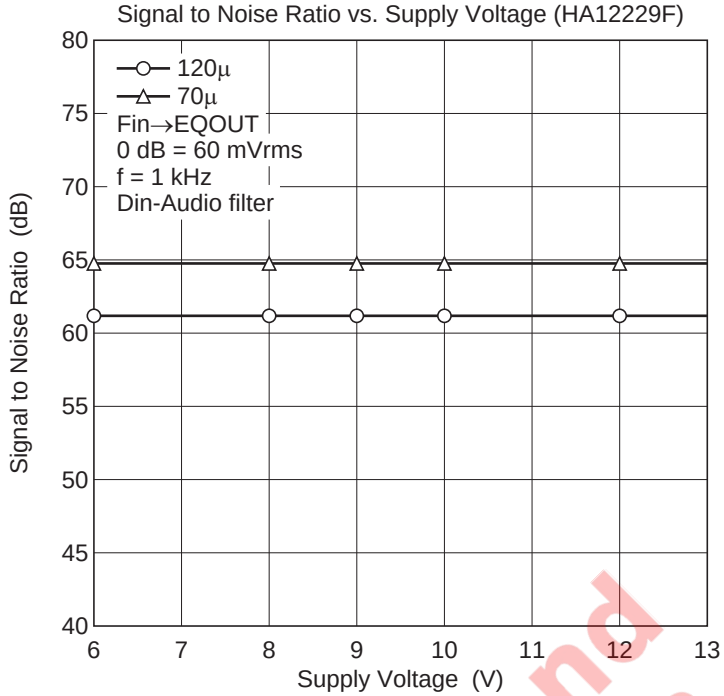
Signal Handling (HA12229F) (1)



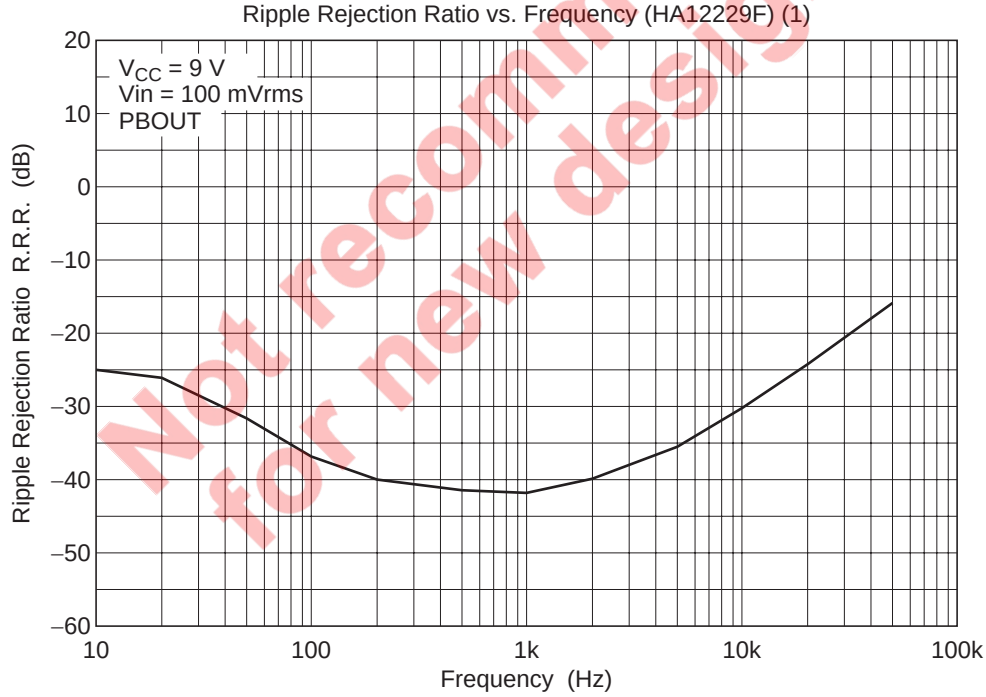
Signal Handling (HA12229F) (2)



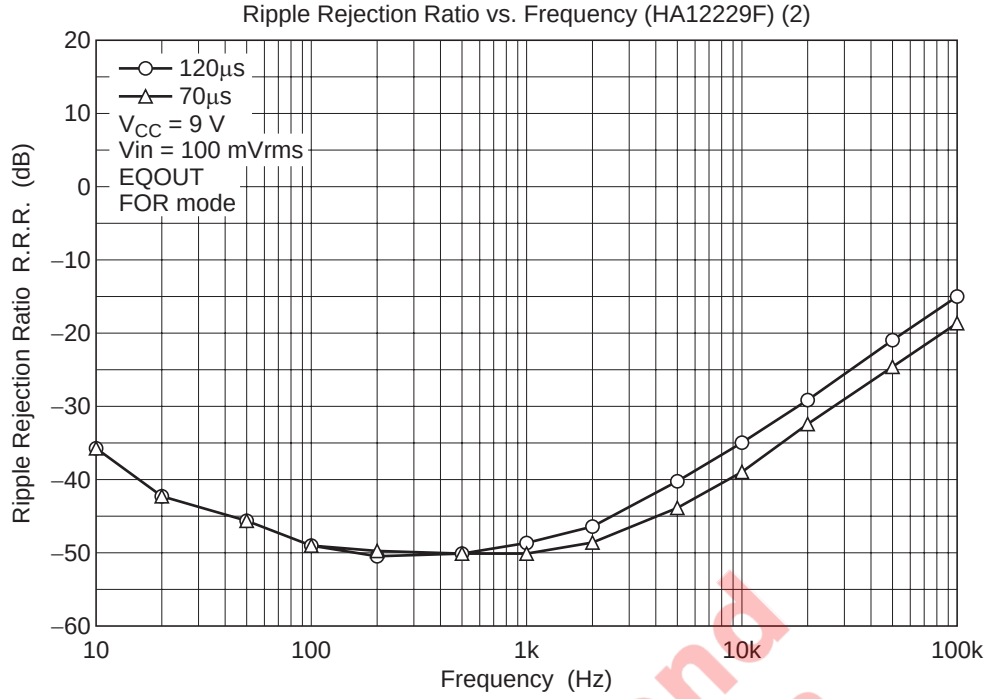
Signal to Noise Ratio vs. Supply Voltage (HA12229F)



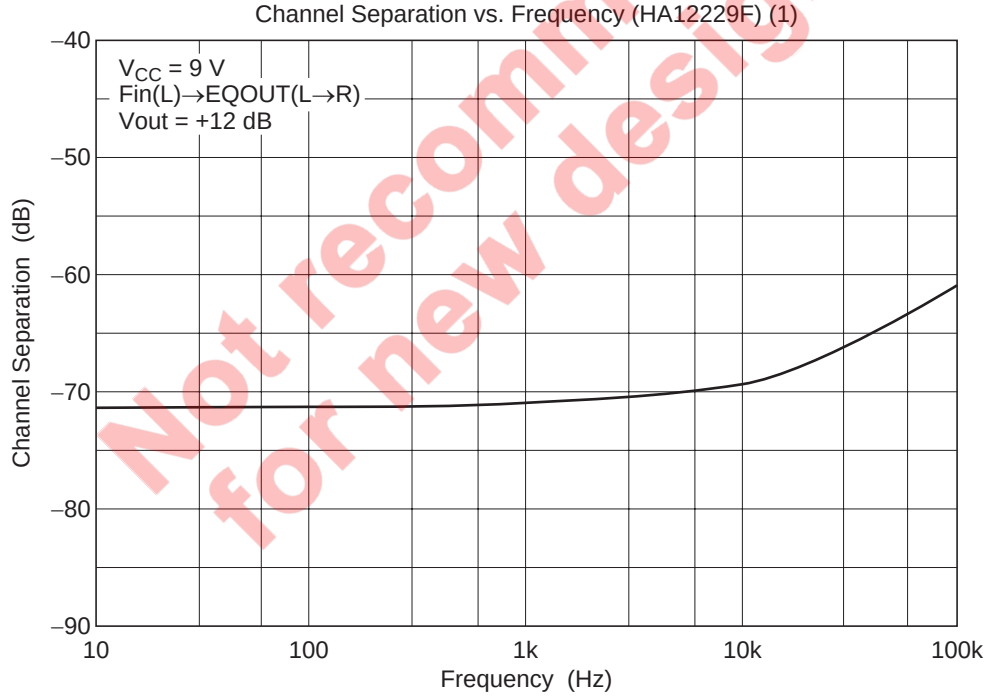
Ripple Rejection Ratio vs. Frequency (HA12229F) (1)



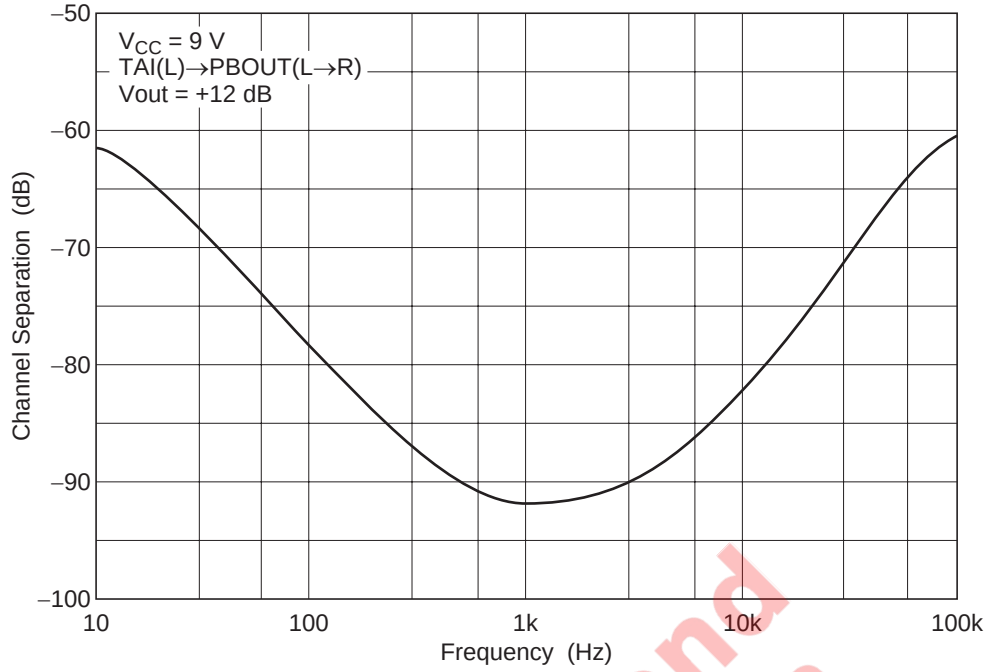
Ripple Rejection Ratio vs. Frequency (HA12229F) (2)



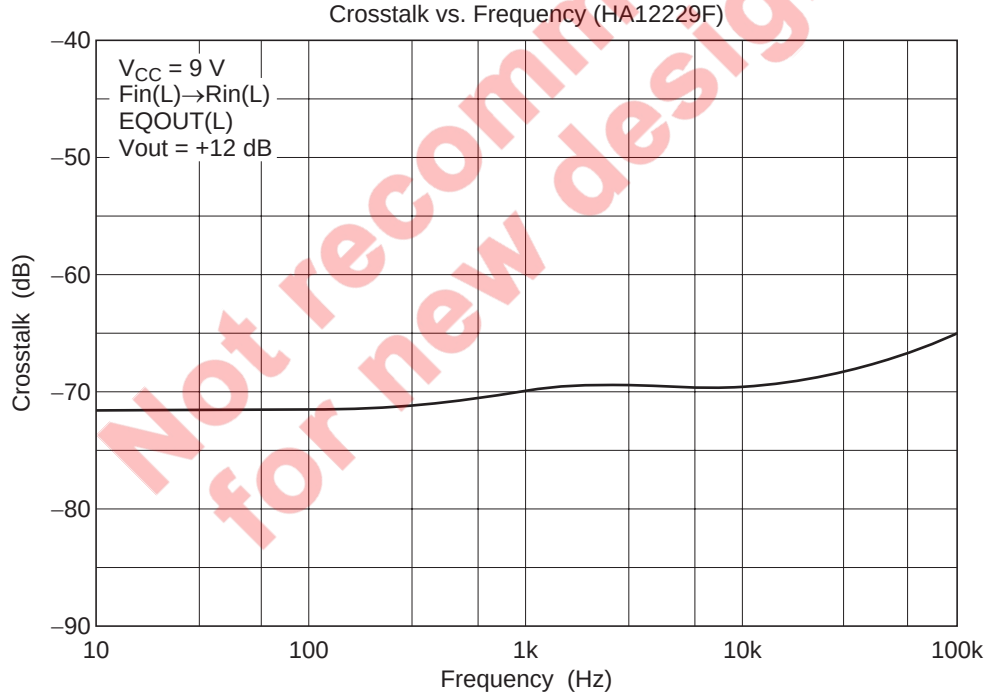
Channel Separation vs. Frequency (HA12229F) (1)



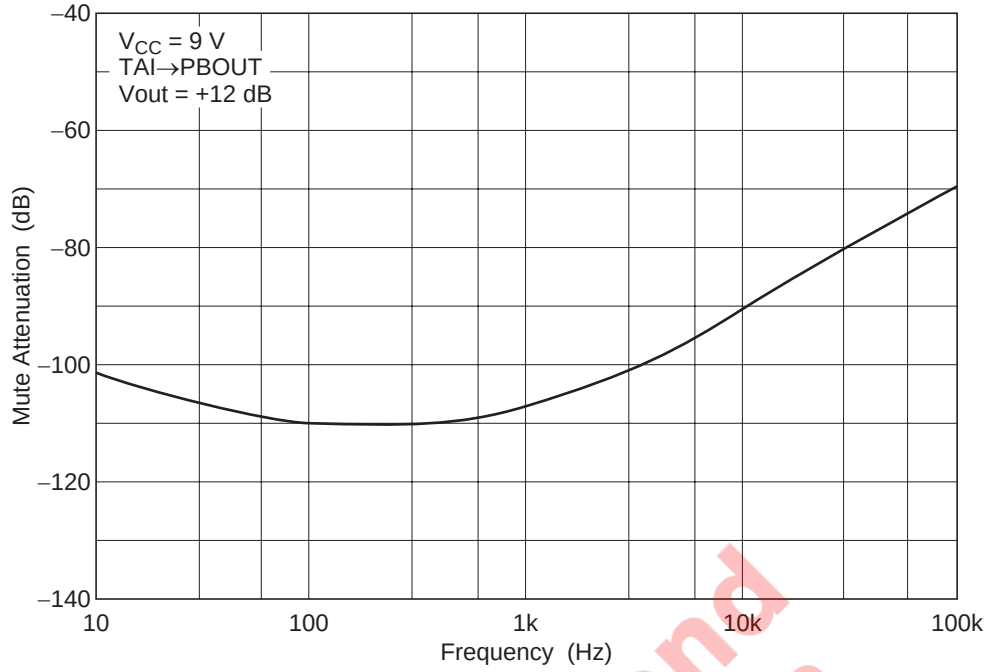
Channel Separation vs. Frequency (HA12229F) (2)



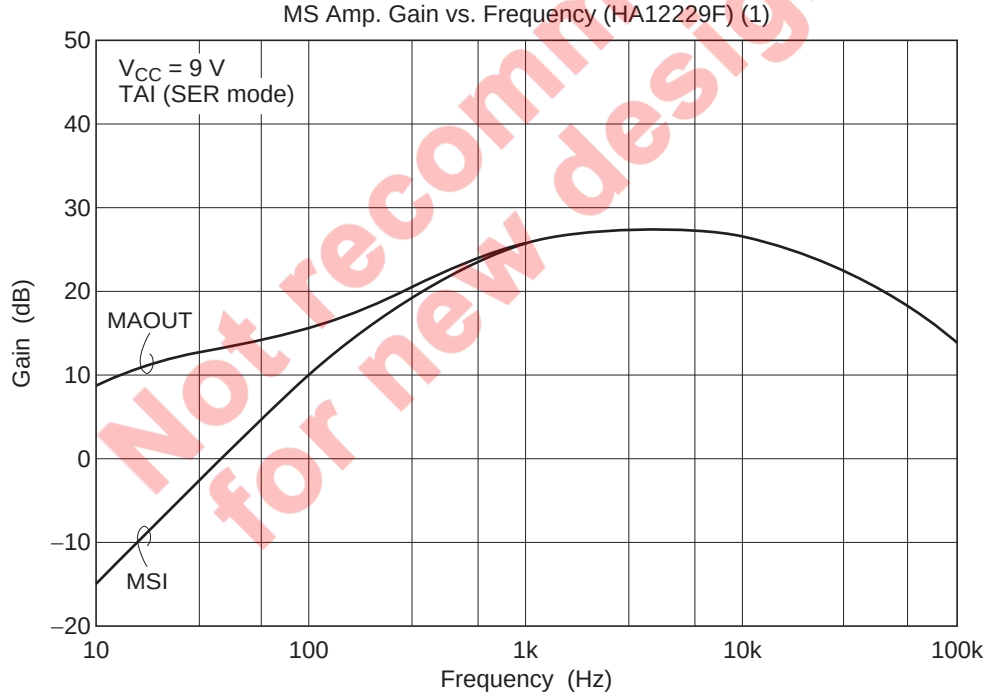
Crosstalk vs. Frequency (HA12229F)



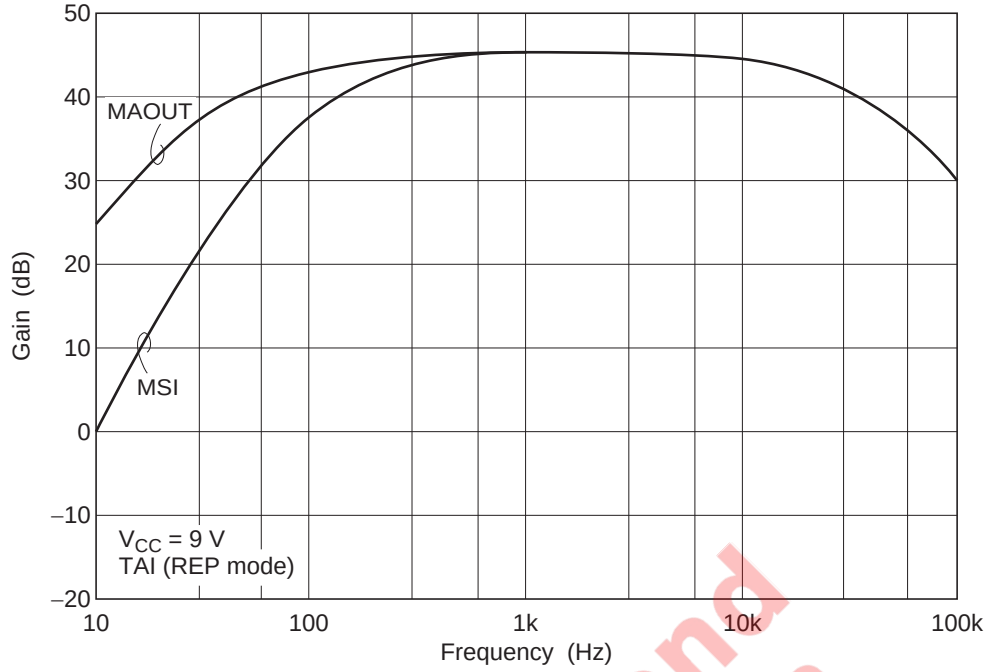
Mute Attenuation vs. Frequency (HA12229F)



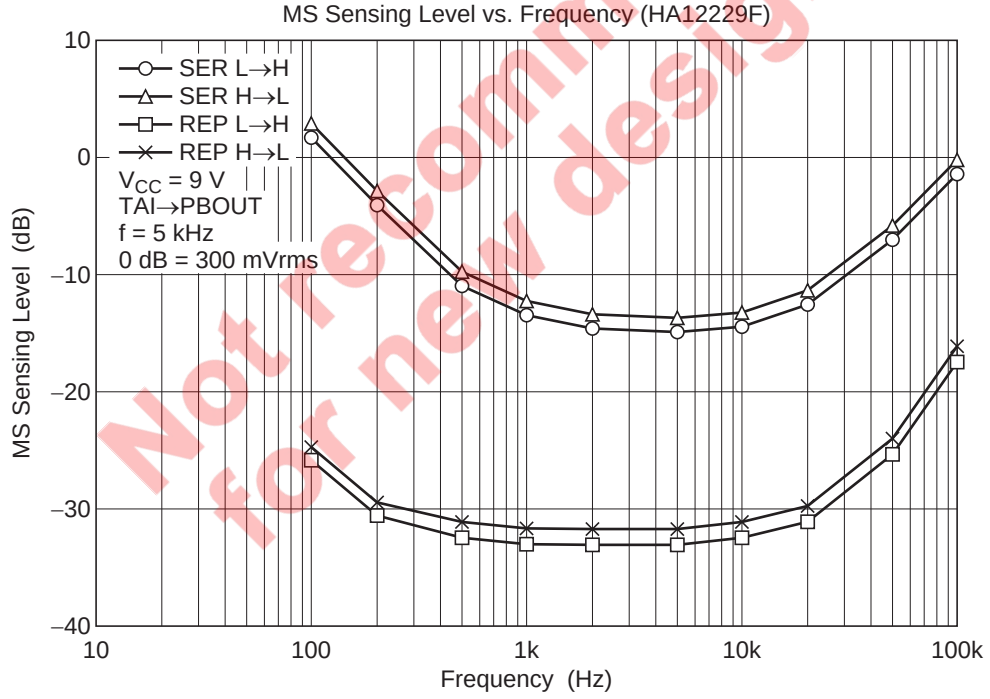
MS Amp. Gain vs. Frequency (HA12229F) (1)

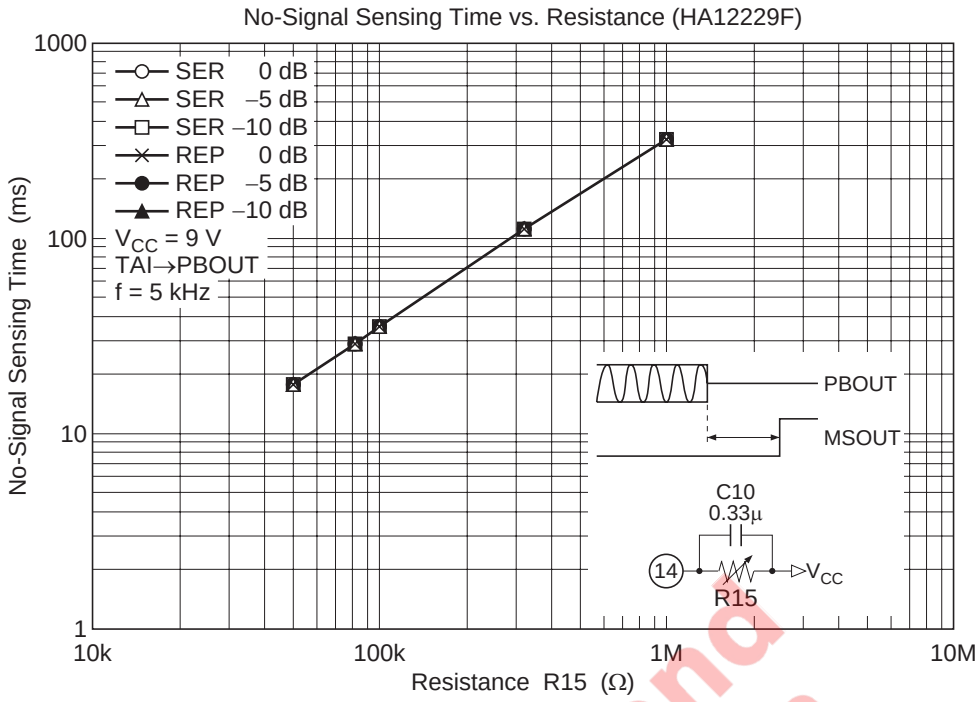


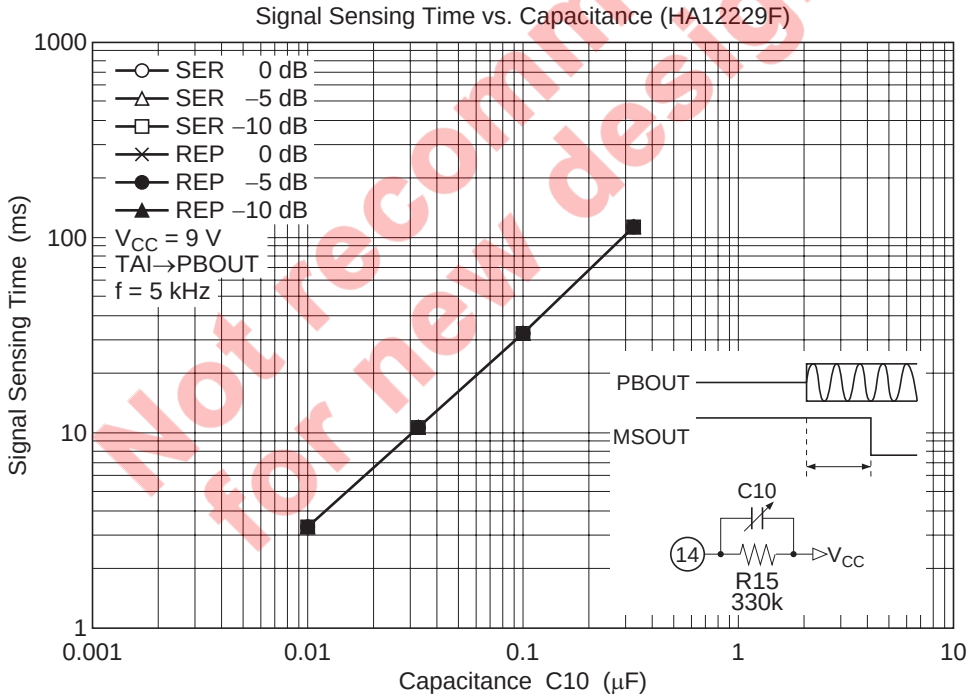
MS Amp. Gain vs. Frequency (HA12229F) (2)



MS Sensing Level vs. Frequency (HA12229F)

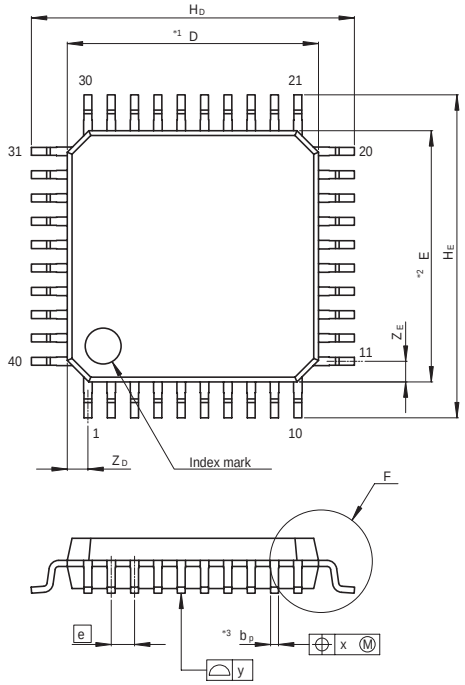




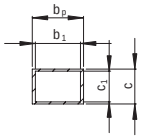


Package Dimensions

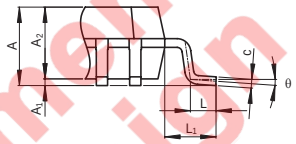
JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-LQFP40-7x7-0.65	PLQP0040JB-A	FP-40B	0.2g



NOTE)
1. DIMENSIONS"*1"AND"*2"
   DO NOT INCLUDE MOLD FLASH
2. DIMENSION"*3"DOES NOT
   INCLUDE TRIM OFFSET.



Terminal cross section



Detail F

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
D	—	7.0	—
E	—	7.0	—
A_2	—	1.40	—
H_D	8.8	9.0	9.2
H_E	8.8	9.0	9.2
A	—	—	1.70
A_1	0.08	0.13	0.22
b_p	0.20	0.25	0.30
b_1	—	0.22	—
c	0.12	0.17	0.22
c_1	—	0.15	—
θ	0°	—	8°
e	—	0.65	—
x	—	—	0.13
y	—	—	0.10
Z_D	—	0.575	—
Z_E	—	0.575	—
L	0.40	0.50	0.60
L_1	—	1.0	—

Renesas Technology Corp. Sales Strategic Planning Div. Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan

RENESAS SALES OFFICES

http://www.renesas.com

Refer to "**http://www.renesas.com/en/network**" for the latest and detailed information.

Renesas Technology America, Inc.
450 Holger Way, San Jose, CA 95134-1368, U.S.A
Tel: <1> (408) 382-7500, Fax: <1> (408) 382-7501

Renesas Technology Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.
Tel: <44> (1628) 585-100, Fax: <44> (1628) 585-900

Renesas Technology Hong Kong Ltd.
7th Floor, North Tower, World Finance Centre, Harbour City, 1 Canton Road, Tsimshatsui, Kowloon, Hong Kong
Tel: <852> 2265-6688, Fax: <852> 2730-6071

Renesas Technology Taiwan Co., Ltd.
10th Floor, No.99, Fushing North Road, Taipei, Taiwan
Tel: <886> (2) 2715-2888, Fax: <886> (2) 2713-2999

Renesas Technology (Shanghai) Co., Ltd.
Unit2607 Ruijing Building, No.205 Maoming Road (S), Shanghai 200020, China
Tel: <86> (21) 6472-1001, Fax: <86> (21) 6415-2952

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

Colophon 2.0