To our customers,

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April 1st, 2010
Renesas Electronics Corporation

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HA12216F/HA12221F Series

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

REJ03F0132-0600
(Previous: ADE-207-254E)
Rev.6.00
Jun 15, 2005

Description

HA12216F/HA12221F series are silicon monolithic bipolar IC providing Dolby B type noise reduction, 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. HA12221F series does not include Dolby B NR.

Functions

- PB equalizer × 2 channel
- Music sensor × 1 channel
- Dolby B NR (Only HA12216F series) × 2 channel
- Line mute (Tape radio) SW × 2 channel

Features

- Different type of PB equalizer characteristics selection (120 µs/70 µs) is available with fully electronic control switching built-in.
- 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 HA12216F series)
- Line mute (Tape radio) control switching built-in.
- Available to connect direct with MPU.
- These ICs are strong for a cellular phone noise. (18 dB improvement from HA12163)

Ordering Information

Operating Voltage

Product	Min	Max	Unit
HA12216F/HA12221F	6.5	12	V
HA12217F/HA12222F	6.8	12	V
HA12218F/HA12223F	7.2	12	V

Notes: 1. These ICs are designed to operate on single supply.
2. HA12217F and HA12218F, HA12222F and HA12223F are develop, there meets comply with your demands.

Standard Level

Product	Package Code (Previous Code)	PB-OUT Level
HA12216F/HA12221F	PLQP0040JB-A (FP-40B)	300 mVrms
HA12217F/HA12222F	PLQP0040JB-A (FP-40B)	387.5 mVrms
HA12218F/HA12223F	PLQP0040JB-A (FP-40B)	450 mVrms

Function

Product	PB-EQ	Music Sensor	Mute	Dolby B NR
HA12216F series	❍	❍	❍	❍
HA12221F series	❍	❍	❍	×

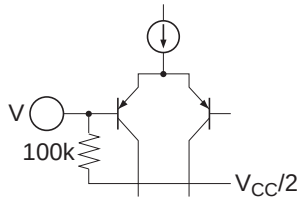
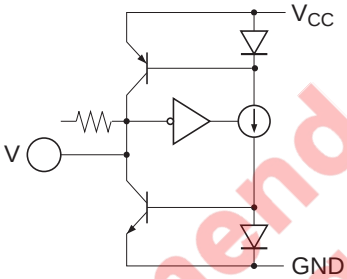
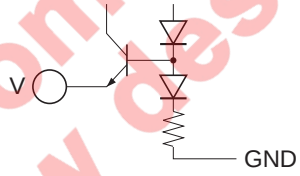
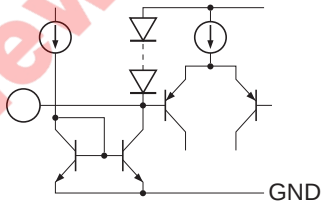
Parallel-Data Format

Pin No.	Pin Name	Lo	Hi
10	TAPE/RADIO	TAPE	RADIO
11*	NR ON/OFF	NR OFF	NR ON
12	120 µ/70 µ	120 µ (Normal)	70 µ (Metal or Chrome)
13	Forward/Reverse	Forward	Reverse
14	Search/Repeat	Search (FF or REV)	Repeat (Normal Speed)

Note: Non connection regarding HA12221F series.

Pin Description, Equivalent Circuit

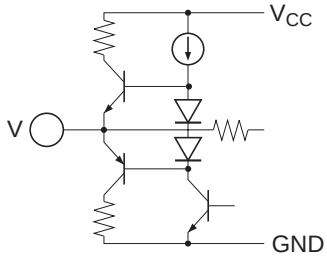
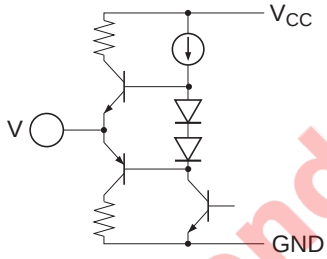
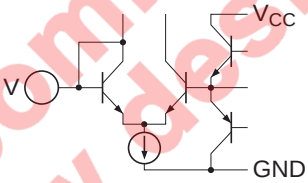
(V_{CC} = 9 V, A system of single supply voltage, Ta = 25°C, No Signal, The value in the show typical value.)

Pin No.	Terminal Name	Note	Equivalent Circuit	Pin Description
18	MSI	V = V_{CC}/2		MS input *1
28	TAI (L)			Tape input
3	TAI (R)			
26	RAI (L)			Radio input (Mute)
5	RAI (R)			
23 *2	DET (L)	V = 2.5V		Time constant pin for rectifier
8 *2	DET (R)			
33	RIP	V = V_{CC}/2		Ripple filter
4 *2	Bias	V = 0.28V		Dolby bias current input
17	MSDET	—		Time constant pin for rectifier

Notes: 1. MS: Music Sensor
2. Non connection regarding HA12221F series.

Pin Description, Equivalent Circuit (cont.)

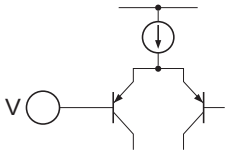
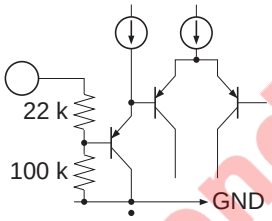
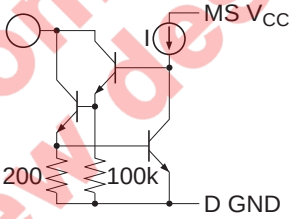
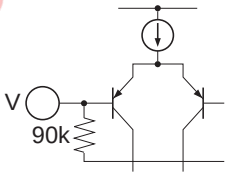
(V_{CC} = 9 V, A system of single supply voltage, Ta = 25°C, No Signal, The value in the show typical value.)

Pin No.	Terminal Name	Note	Equivalent Circuit	Pin Description
25	PBOUT (L)	V = V_{CC}/2		PB output
6	PBOUT (R)			
19	MAOUT	V = V_{CC}/2		MS amp. output *1
38	VREF			Reference output
29	EQOUT (L)			Equalizer output (120µ)
2	EQOUT (R)			
30	M-OUT (L)	V = V_{CC}/2		Equalizer output (70µ)
1	M-OUT (R)			
16	V_{CC}	—		Power supply
7	NC	—		No connection
9				
22				
24				
27				

Note: 1. MS: Music Sensor

Pin Description, Equivalent Circuit (cont.)

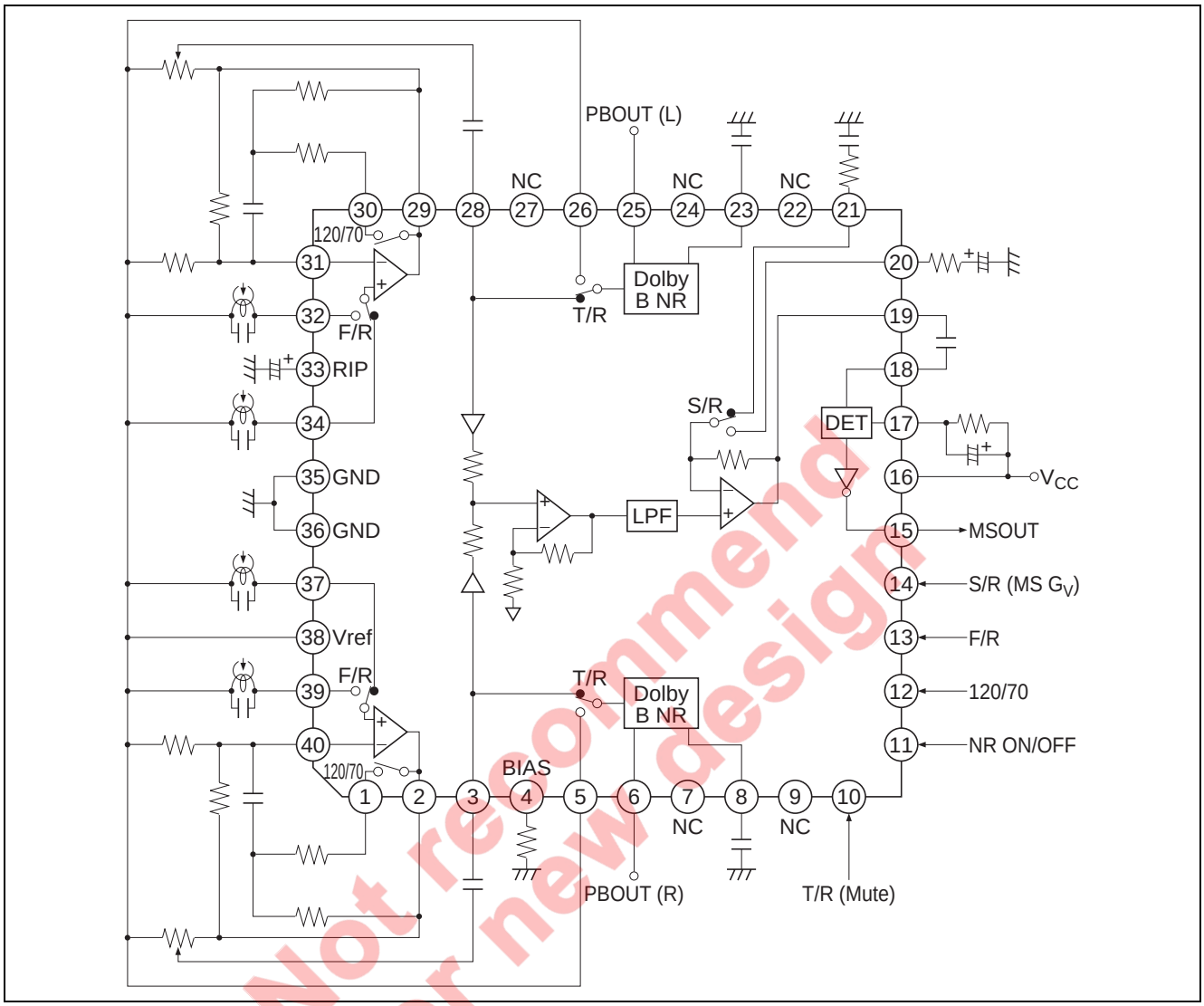
(V_{CC} = 9 V, A system of single supply voltage, Ta = 25°C, No Signal, The value in the show typical value.)

Pin No.	Terminal Name	Note	Equivalent Circuit	Pin Description
34	FIN (L)	—		Equalizer intput (Forward)
37	FIN (R)			
32	RIN (L)			Equalizer intput (Reverse)
39	RIN (R)			
31	NFI (L)			Negative feedback
40	NFI (R)			
10	T/R (Mute)	—		Mode control input
11 *2	NR ON/OFF			
12	120/70			
13	F/R			
14	S/R (MS G_V)			
15	MSOUT	—		MS output (to MPU) *1
20	MS G_V (R)	V = V_{CC}/2		MS gain terminal *1
21	MS G_V (S)			
35	GND	—		GND pin
36				

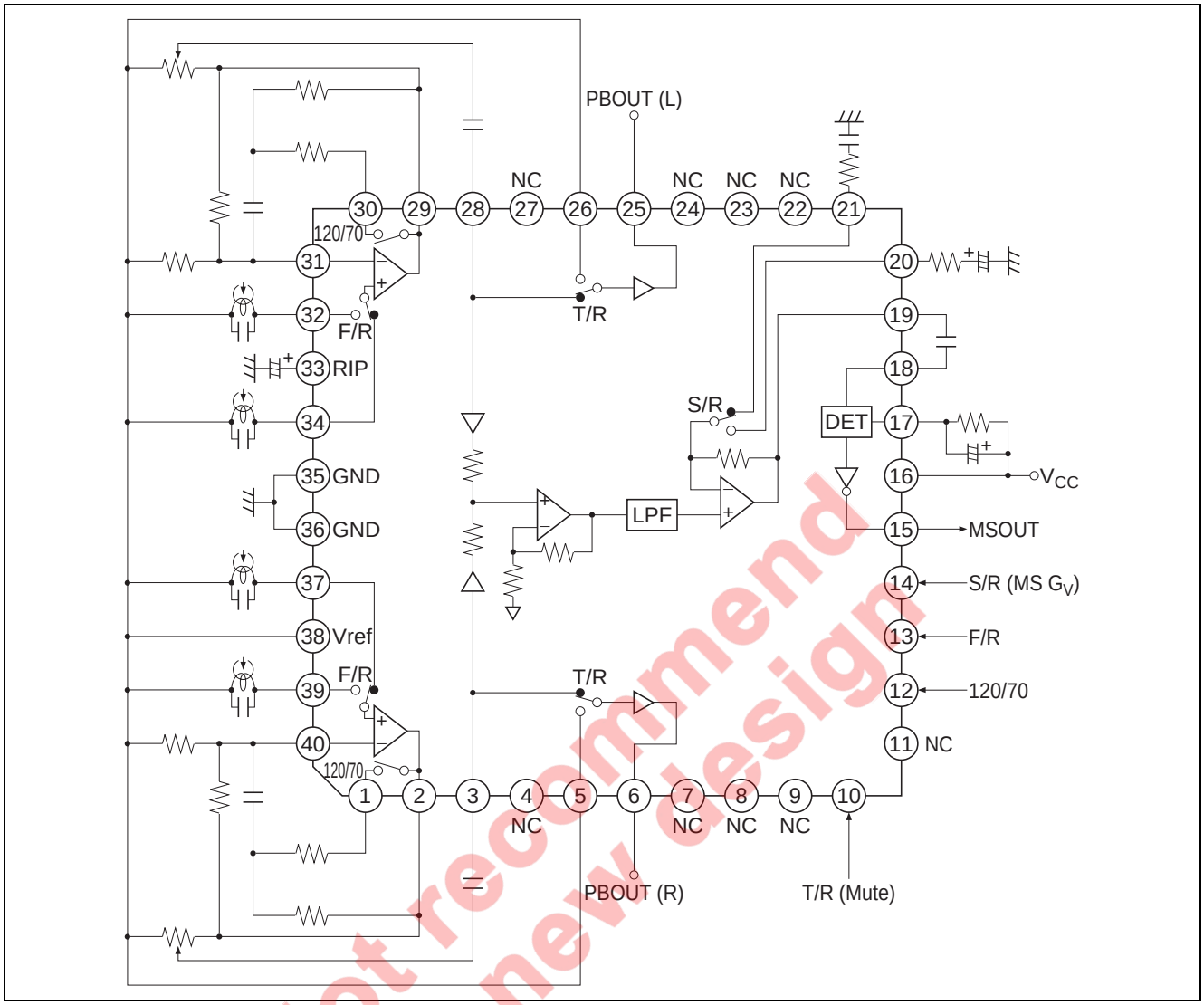
Notes: 1. MS: Music Sensor
2. Non connection regarding HA12221F series.

Block Diagram

HA12216F Series



HA12221F Series



Functional Description

Power Supply Range

HA12216F/HA12221F series 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
HA12216F/HA12221F	6.5 V to 12.0 V
HA12217F/HA12222F	6.8 V to 12.0 V
HA12218F/HA12223F	7.2 V to 12.0 V

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

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.

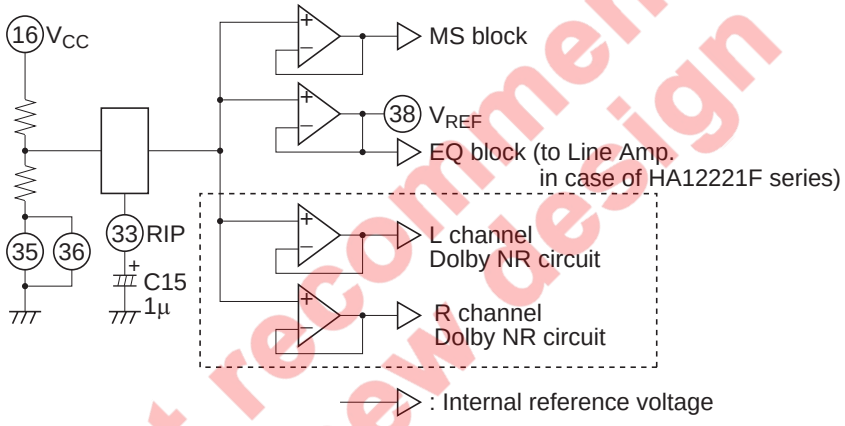


Figure 1 The Block Diagram of Reference Supply Voltage

Operating Mode Control

HA12216F/HA12221F series 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
10, 11*, 12, 13, 14	–0.2 to 1.0	3.5 to V_{CC}	V	Input Pin Measure V

Note: * Non connection regarding HA12221F series.

Table 3 Switching Truth Table

Pin No.	Lo	Hi
10	TAPE	RADIO
11*	NR OFF	NR ON
12	120 µ (Normal)	70 µ (Metal or Chrome)
13	FORWARD	REVERSE
14	SER (FF or REV)	REP (Normal Speed)

Notes: * Non connection regarding HA12221F series.

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.

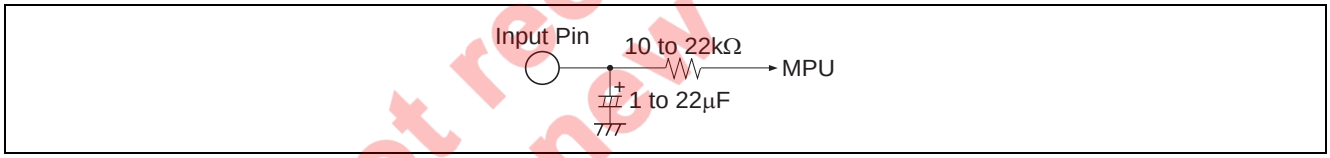


Figure 2 Interface for Reduction of Pop Noise

Input Block Diagram and Level Diagram

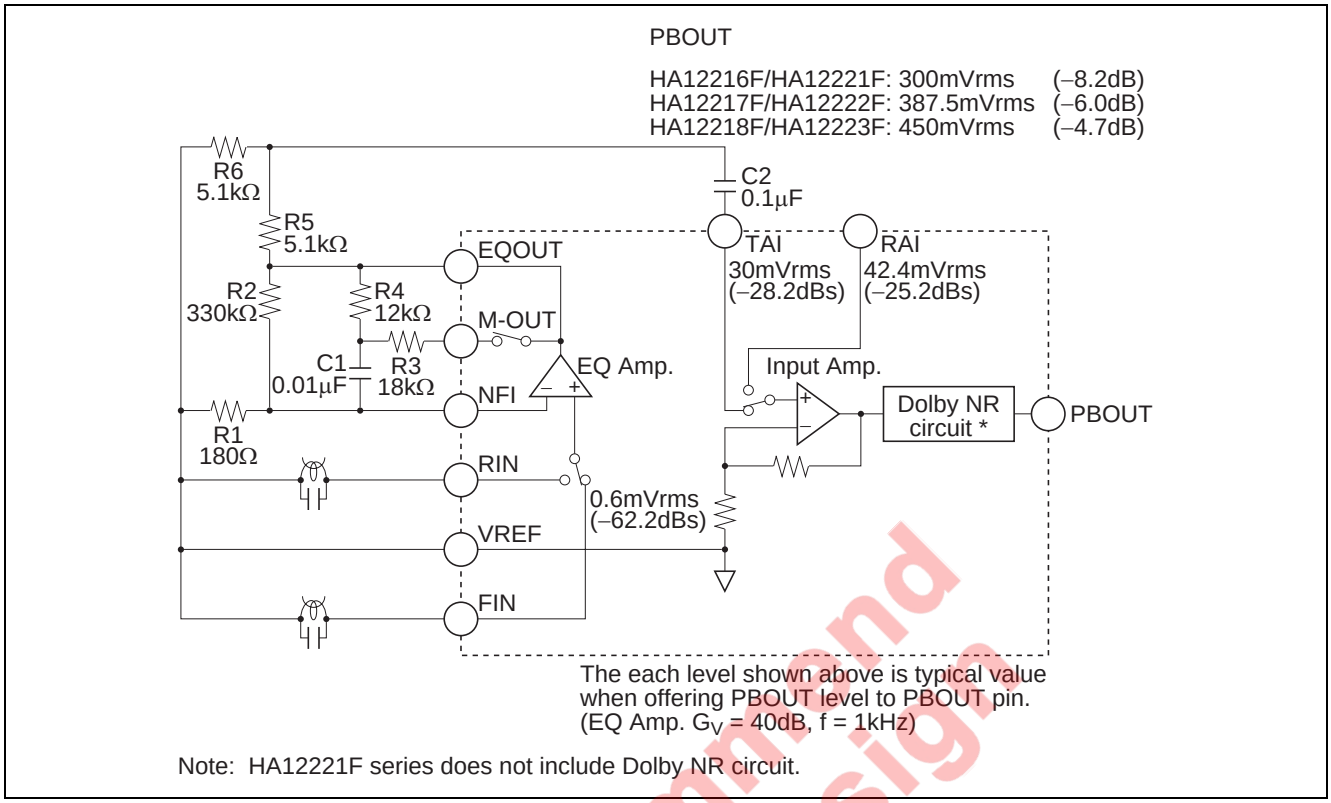


Figure 3 Input Block Diagram

Adjustment of Playback Reference Operate Level

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

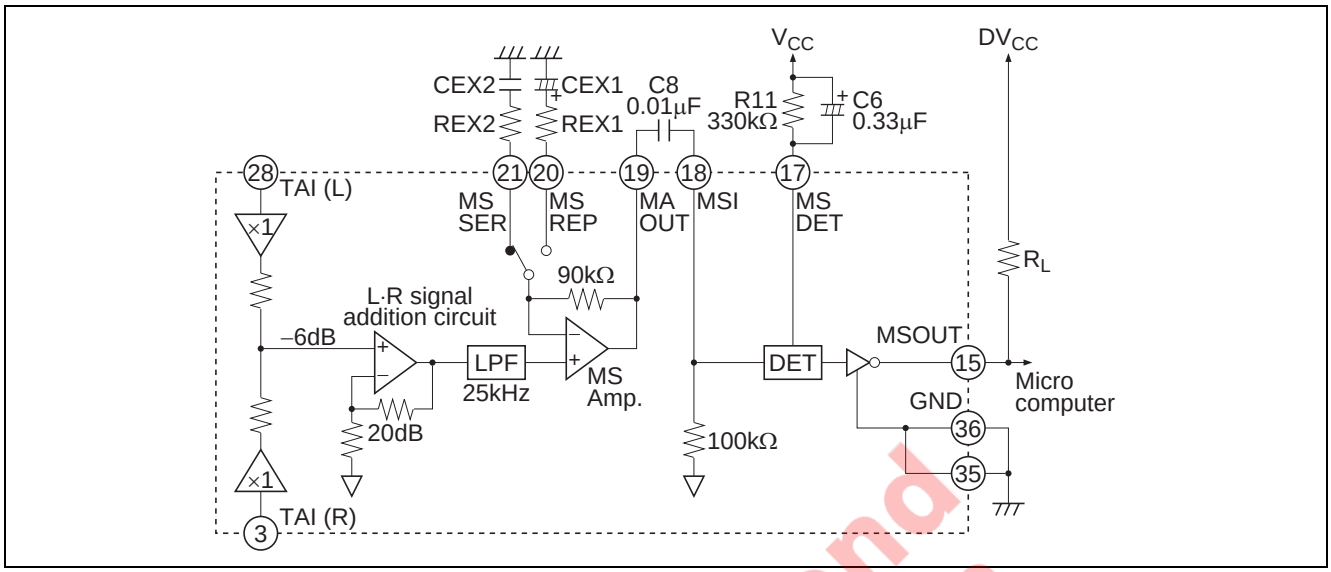


Figure 4 Music Sensor Block Diagram

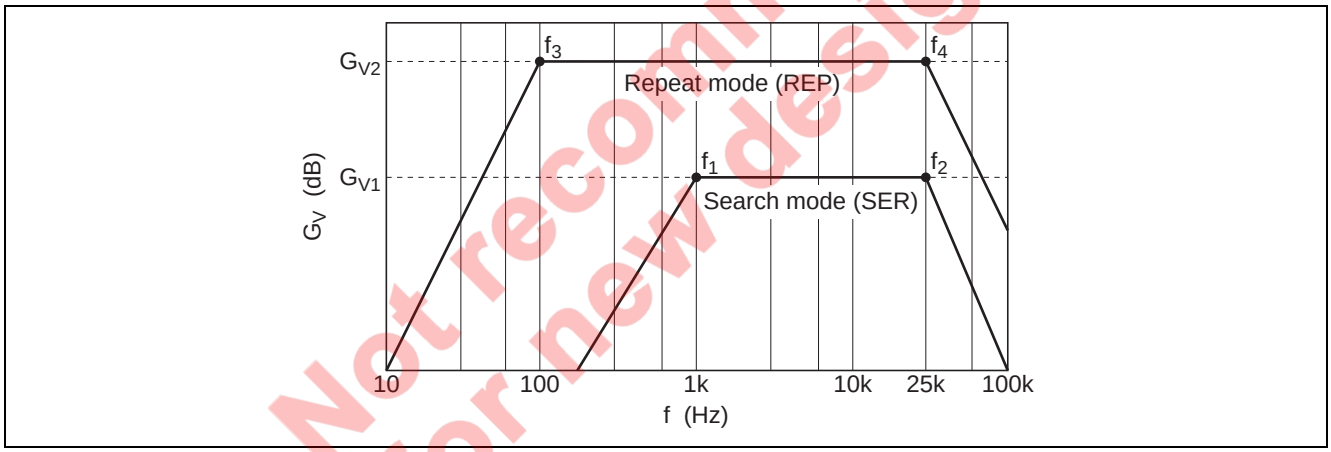


Figure 5 Frequency Response

1. Serch 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.

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

Note: 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 Hi level or Lo 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 HA12216F Series)

For adequate Dolby NR tracking response, take external components shown below.
Also, leak is small capacity, and please employ a good quality object.

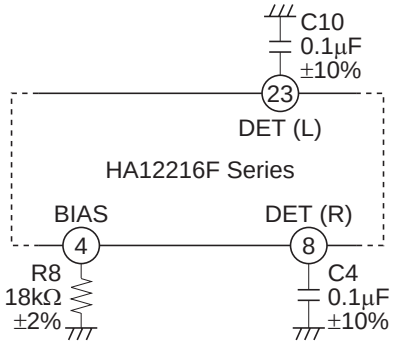
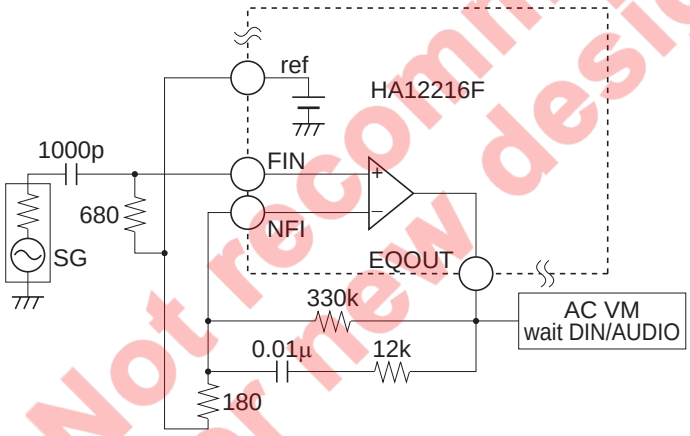


Figure 6 Tolerance of External Components

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

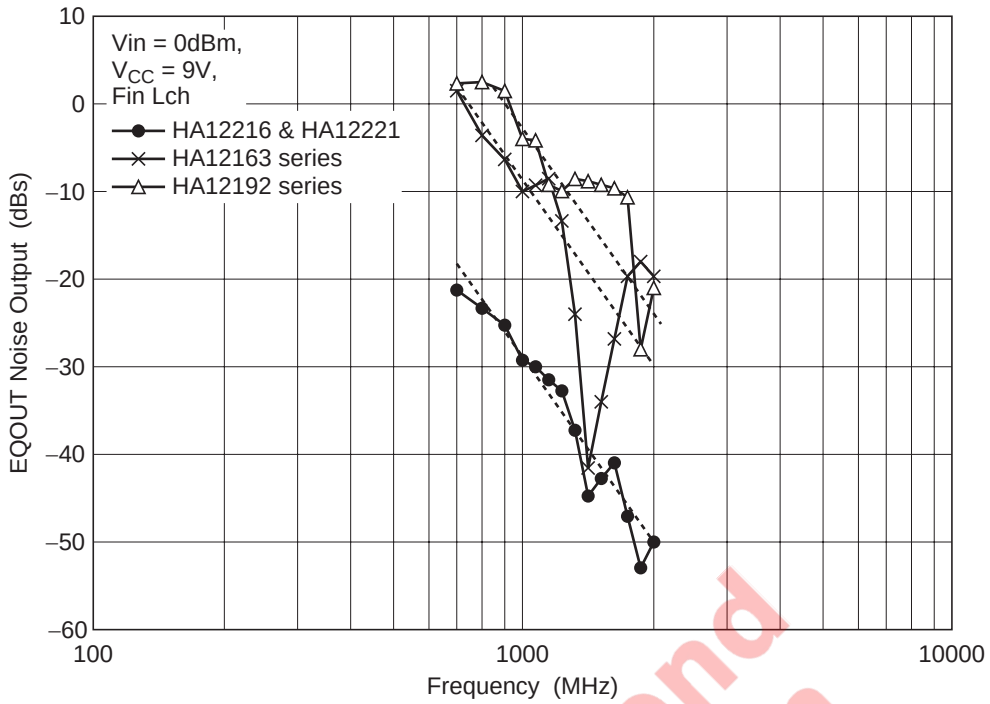


Figure 8 EQOUT Noise Output vs. Transmission Frequency Characteristic

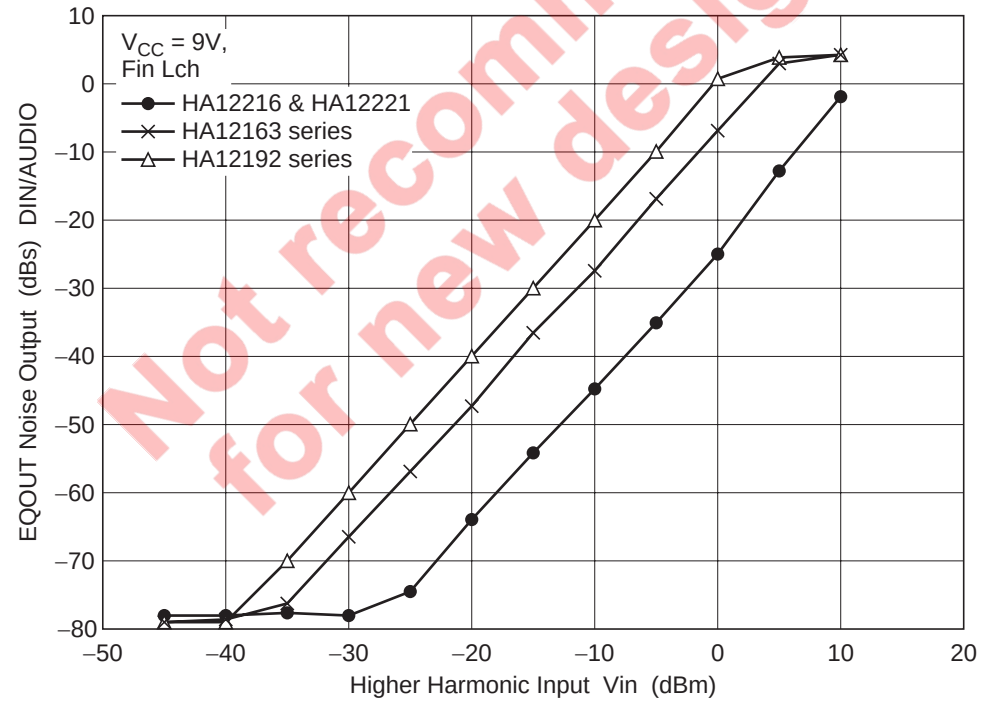


Figure 9 EQOUT Noise Output vs. Transmission

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

HA12216F Series

(Ta = 25°C, V_{CC} = 9.0 V, PBOUT Level 300 mVrms(HA12216F) 387.5 mVrms(HA12217F) 450 mVrms(HA12218F))

Item		Symbol	Test Condition										Min	Typ	Max	Unit	Application Terminal				Remark
			IC Condition					Input	Output	fin (Hz)	PBOUT level (dB)						Input		Output		
			NR ON/OFF	120µ/ 70µ	F/R	T/R	S/R										R	L	R	L	
Quiescent current		I_Q	ON	70µ	F	T	S	—	—	—	—	No signal	4.0	9.5	15.0	mA	—	—	—	—	16
Input Amp. gain	HA12216F	G_VIA TAI	OFF	—	—	T	—	TAI	PBOUT	1k	0		18.8	19.8	20.8	dB	3	28	6	25	
		G_VIA RAI	OFF	—	—	R	—	RAI	PBOUT	1k	0		15.8	16.8	17.8		5	26			
	HA12217F	G_VIA TAI	OFF	—	—	T	—	TAI	PBOUT	1k	0		21.2	22.2	23.2		3	28			
		G_VIA RAI	OFF	—	—	R	—	RAI	PBOUT	1k	0		18.2	19.2	20.2		5	26			
	HA12218F	G_VIA TAI	OFF	—	—	T	—	TAI	PBOUT	1k	0		22.5	23.5	24.5		3	28			
		G_VIA RAI	OFF	—	—	R	—	RAI	PBOUT	1k	0		19.5	20.5	21.5		5	26			
B-type decode cut		DEC-2k (1)	ON	—	—	T	—	TAI	PBOUT	2k	–20		2.8	4.3	5.8	dB	3	28	6	25	
		DEC-2k (2)	ON	—	—	T	—	TAI	PBOUT	2k	–30		7.0	8.5	10.0						
		DEC-5k (1)	ON	—	—	T	—	TAI	PBOUT	5k	–20		1.7	3.2	4.7						
		DEC-5k (2)	ON	—	—	T	—	TAI	PBOUT	5k	–30		6.7	8.2	9.7						
PBOUT offset		Vofs	OFF	—	—	T↔R	—	—	PBOUT	—	—	V_{CC}=12V, No signal	–150	0.0	150	mV	3	28	6	25	
Signal handling		Vo max	ON	—	—	T	—	TAI	PBOUT	1k	—	THD=1%	12.0	13.0	—	dB	3	28	6	25	1
Signal to noise ratio		S/N	ON	—	—	T	—	TAI	PBOUT	(1k)	(0)	Rg=10kΩ, CCIR/ARM	70.0	80.0	—	dB	(3)	(28)	6	25	
T.H.D.		THD	ON	—	—	T	—	TAI	PBOUT	1k	0		—	0.05	0.3	%	3	28	6	25	
Channel separation		CT RL (1)	OFF	—	—	R	—	RAI	PBOUT	1k	(+12)		70.0	80.0	—	dB	3	28	6→25	25→6	
		CT RL (2)	OFF	120µ	F	T	—	FIN	PBOUT	1k	(+12)		50.0	60.0	—		37	34			
Crosstalk		CT EQ→RAI	OFF	120µ	F	T→R	—	FIN	PBOUT	1k	(+12)		70.0	80.0	—	dB	37	34	6	25	
		CT RAI→EQ	OFF	120µ	F	R→T	—	RAI	PBOUT	1k	(+12)		50.0	60.0	—		5	26			
PB-EQ gain		G_V EQ 1k	—	120µ	F/R	—	—	FIN/RIN	EQOUT	1k	—	Vin=0.6mVrms	37.0	40.0	43.0	dB	37/39	34/32	2	29	
		G_V EQ 10k(1)	—	120µ	F	—	—	FIN	EQOUT	10k	—		33.0	36.0	39.0		37	34			
		G_V EQ 10k(2)	—	70µ	F	—	—	FIN	EQOUT	10k	—		29.0	32.0	35.0		37	34			
PB-EQ Max output level		V_{OM}	—	120µ	F/R	—	—	FIN	EQOUT	1k	—	THD=1%	300	600	—	mVrms	37/39	34/32	2	29	1
PB-EQ THD		THD-EQ	—	120µ	F/R	—	—	FIN/RIN	EQOUT	1k	—	Vin=3mVrms	—	0.1	0.3	%	37/39	34/32	2	29	
Noise level converted in input		V_N	—	120µ	F/R	—	—	FIN/RIN	EQOUT	(1k)	—	Rg=680Ω, DIN-AUDIO	—	0.7	1.5	µVrms	(37/39)	(34/32)	2	29	
MS sensitivity level		V_{ON} (1)	—	—	—	T	R	TAI	PBOUT	5k	—		–36	–32	–28	dB	3	28	2	29	15
		V_{ON} (2)	—	—	—	T	S	TAI	PBOUT	5k	—		–18	–14	–10						
MS output low level		V_{OL}	—	—	—	T	S	TAI	MSOUT	5k	0		—	1.0	1.5	V	3	28	—	—	15
MS output leak current		I_{OH}	—	—	—	—	—	—	MSOUT	—	—	No signal	—	0.0	2.0	µA	—	—	—	—	15
Control voltage		V_{IL}	—	—	—	—	—	—	—	—	—		–0.2	—	1.0	V	—	—	—	—	10 to 14
		V_{IH}	—	—	—	—	—	—	—	—	—		3.5	—	V_{CC}						

Note: 1. HA12216F: V_{CC} = 6.5V
HA12217F: V_{CC} = 6.8V
HA12218F: V_{CC} = 7.2V

HA12221F Series

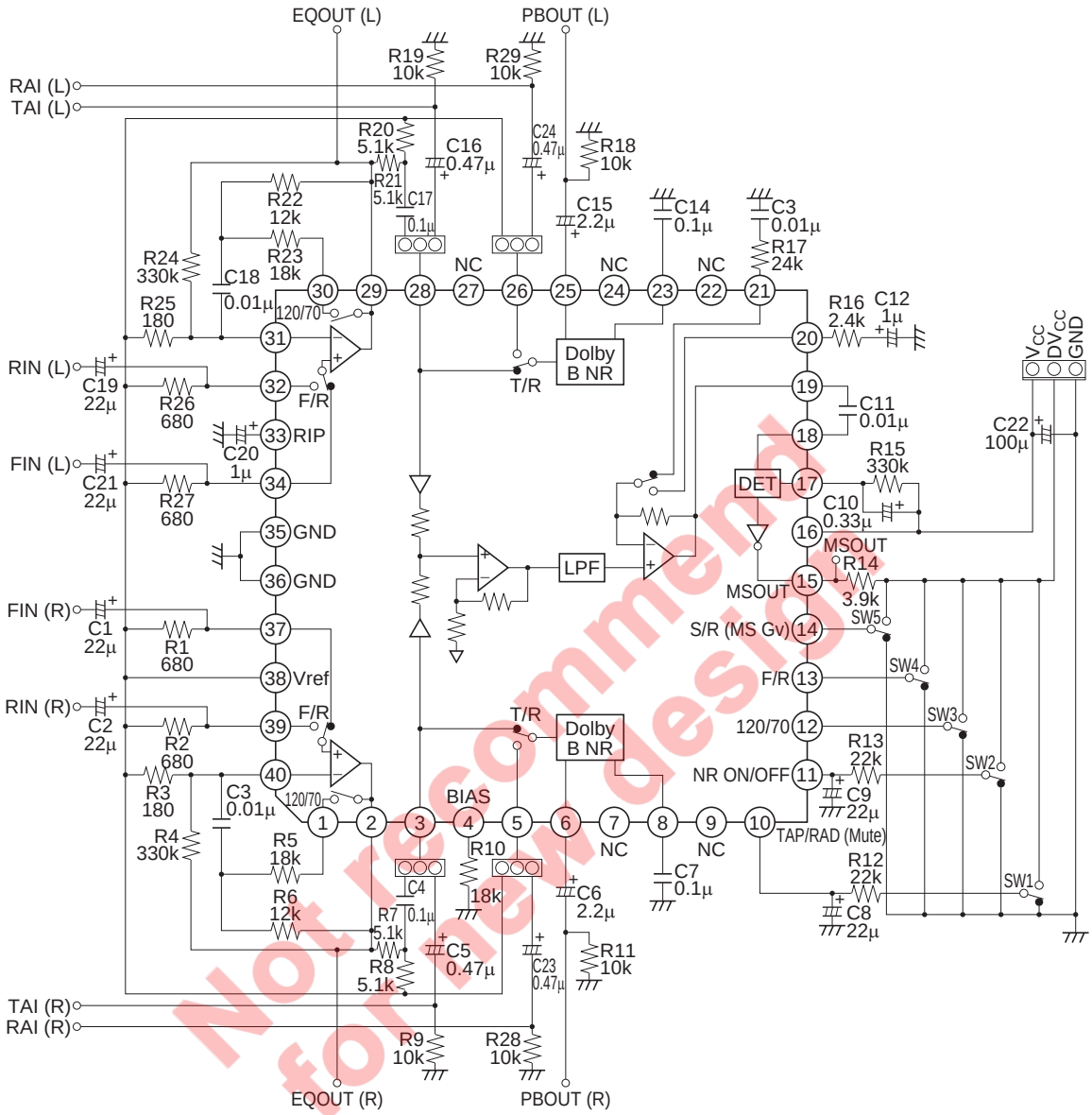
(Ta = 25°C, V_{CC} = 9.0 V, PBOUT Level 300 mVrms(HA12221F) 387.5 mVrms(HA12222F) 450 mVrms(HA12223F))

Item		Symbol	Test Condition											Min	Typ	Max	Unit	Application Terminal				Remark
			IC Condition					Input	Output	fin (Hz)	PBOUT level (dB)							Input		Output		
			120µ/70µ	F/R	T/R	S/R												R	L	R	L	
Quiescent current		I_Q	70µ	F	T	S	—	—	—	—	—	No signal		3.0	5.0	8.0	mA	—	—	—	—	16
Input Amp. gain	HA12221F	G_V/A TAI	—	—	T	—	TAI	PBOUT	1k	0				19.0	20.0	21.0	dB	3	28	6	25	
		G_V/A RAI	—	—	R	—	RAI	PBOUT	1k	0				16.0	17.0	18.0		5	26			
	HA12222F	G_V/A TAI	—	—	T	—	TAI	PBOUT	1k	0				21.2	22.2	23.2		3	28			
		G_V/A RAI	—	—	R	—	RAI	PBOUT	1k	0				18.2	19.2	20.2		5	26			
	HA12223F	G_V/A TAI	—	—	T	—	TAI	PBOUT	1k	0				22.5	23.5	24.5		3	28			
		G_V/A RAI	—	—	R	—	RAI	PBOUT	1k	0				19.5	20.5	21.5		5	26			
PBOUT offset		Vofs	—	—	T↔R	—	—	PBOUT	—	—	V_{CC}=12V, No signal			–150	0.0	150	mV	3	28	6	25	
Signal handling		Vo max	—	—	T	—	TAI	PBOUT	1k	—	THD=1%			12.0	13.0	—	dB	3	28	6	25	1
Signal to noise ratio		S/N	—	—	T	—	TAI	PBOUT	(1k)	(0)	Rg=10kΩ, CCIR/ARM			70.0	80.0	—	dB	(3)	(28)	6	25	
T.H.D.		THD	—	—	T	—	TAI	PBOUT	1k	0				—	0.05	0.3	%	3	28	6	25	
Channel separation		CT RL (1)	—	—	R	—	RAI	PBOUT	1k	(+12)				70.0	80.0	—	dB	3	28	6→25	25→6	
		CT RL (2)	120µ	F	T	—	FIN	PBOUT	1k	(+12)				50.0	60.0	—		37	34			
Crosstalk		CT EQ→RAI	120µ	F	T→R	—	FIN	PBOUT	1k	(+12)				70.0	80.0	—	dB	37	34	6	25	
		CT RAI→EQ	120µ	F	R→T	—	RAI	PBOUT	1k	(+12)				50.0	60.0	—		5	26			
PB-EQ gain		G_V EQ 1k	120µ	F/R	—	—	FIN/RIN	EQOUT	1k	—	Vin=0.6mVrms			37.0	40.0	43.0	dB	37/39	34/32	2	29	
		G_V EQ 10k(1)	120µ	F	—	—	FIN	EQOUT	10k	—				33.0	36.0	39.0		37	34			
		G_V EQ 10k(2)	70µ	F	—	—	FIN	EQOUT	10k	—				29.0	32.0	35.0		37	34			
PB-EQ Max output level		V_{OM}	120µ	F/R	—	—	FIN	EQOUT	1k	—	THD=1%			300	600	—	mVrms	37/39	34/32	2	29	1
PB-EQ THD		THD-EQ	120µ	F/R	—	—	FIN/RIN	EQOUT	1k	—	Vin=3mVrms			—	0.1	0.3	%	37/39	34/32	2	29	
Noise level converted in input		V_N	120µ	F/R	—	—	FIN/RIN	EQOUT	(1k)	—	Rg=680Ω, DIN-AUDIO			—	0.7	1.5	µVrms	(37/39)	(34/32)	2	29	
MS sensitivity level		V_{ON} (1)	—	—	T	R	TAI	PBOUT	5k	—				–36	–32	–28	dB	3	28	2	29	15
		V_{ON} (2)	—	—	T	S	TAI	PBOUT	5k	—				–18	–14	–10						
MS output low level		V_{OL}	—	—	T	S	TAI	MSOUT	5k	0				—	1.0	1.5	V	3	28	—	—	15
MS output leak current		I_{OH}	—	—	—	—	—	MSOUT	—	—	No signal			—	0.0	2.0	µA	—	—	—	—	15
Control voltage		V_{IL}	—	—	—	—	—	—	—	—				–0.2	—	1.0	V	—	—	—	—	10 to 14
		V_{IH}	—	—	—	—	—	—	—	—				3.5	—	V_{CC}						

Note: 1. HA12221F: V_{CC} = 6.5V
HA12222F: V_{CC} = 6.8V
HA12223F: V_{CC} = 7.2V

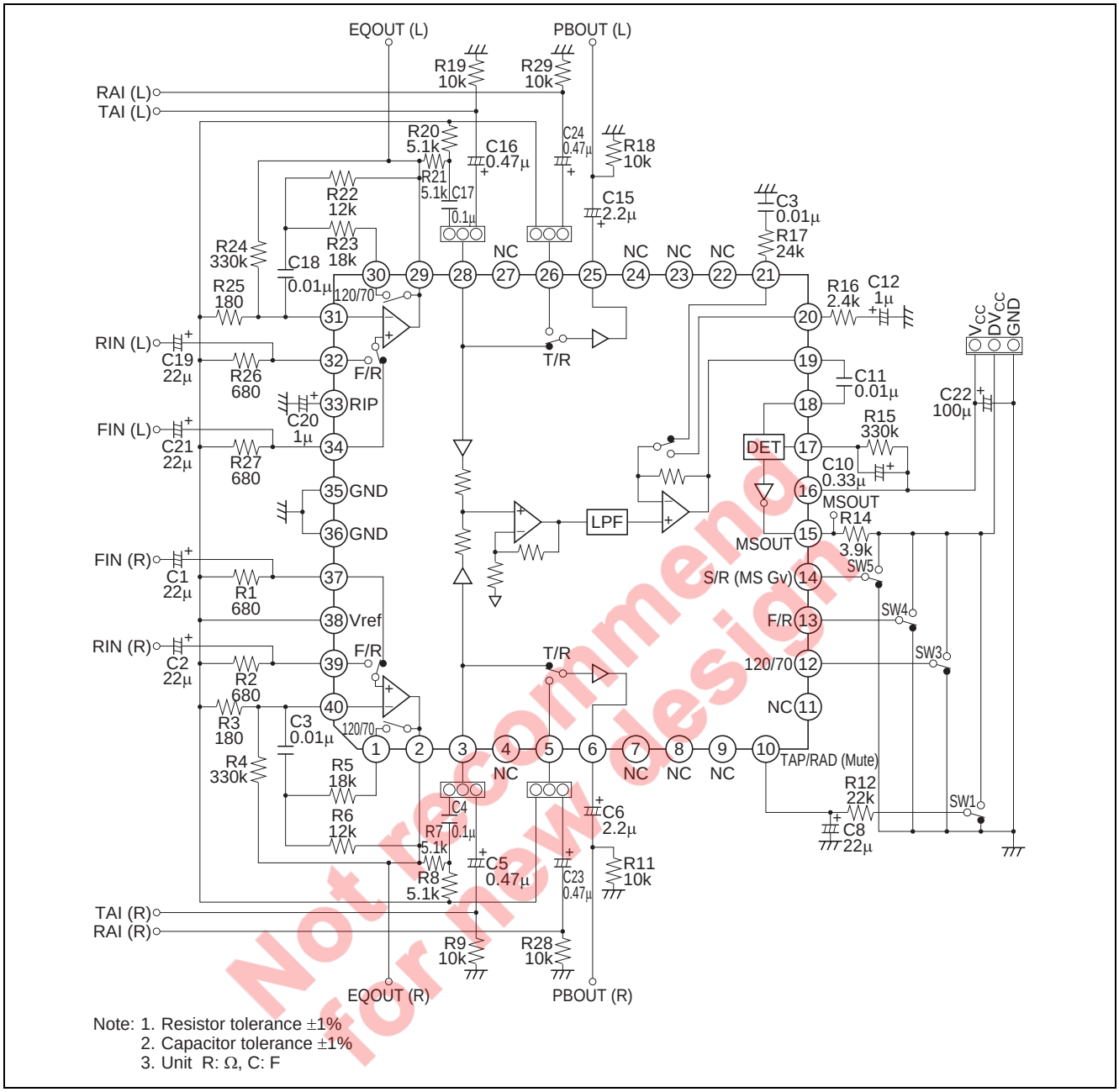
Test Circuit

HA12216F Series



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

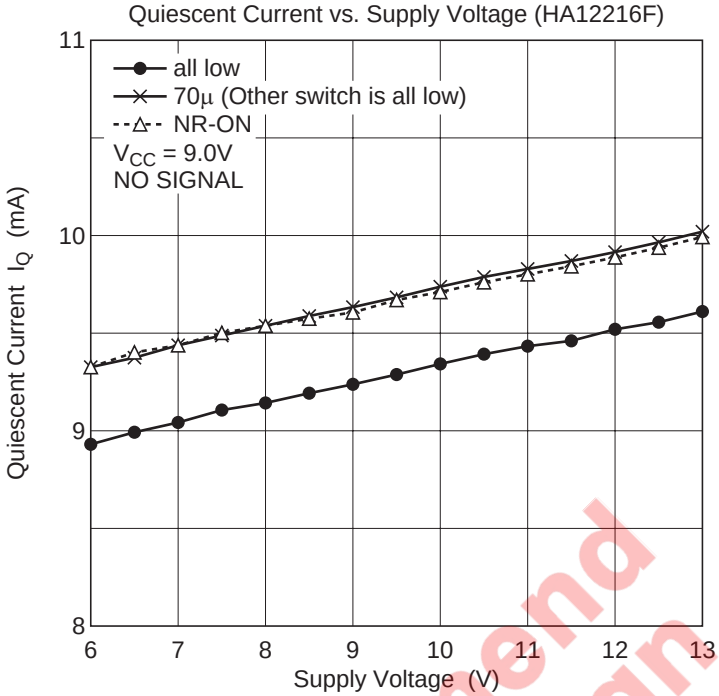
HA12221F Series



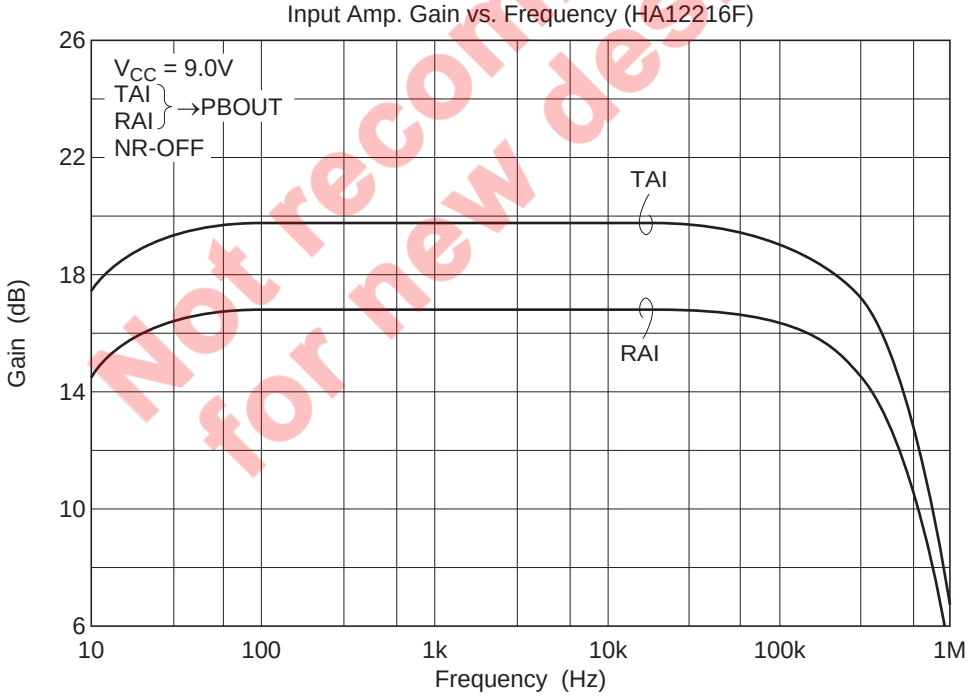
Note: 1. Resistor tolerance ±1%
2. Capacitor tolerance ±1%
3. Unit R: Ω, C: F

Characteristic Curves

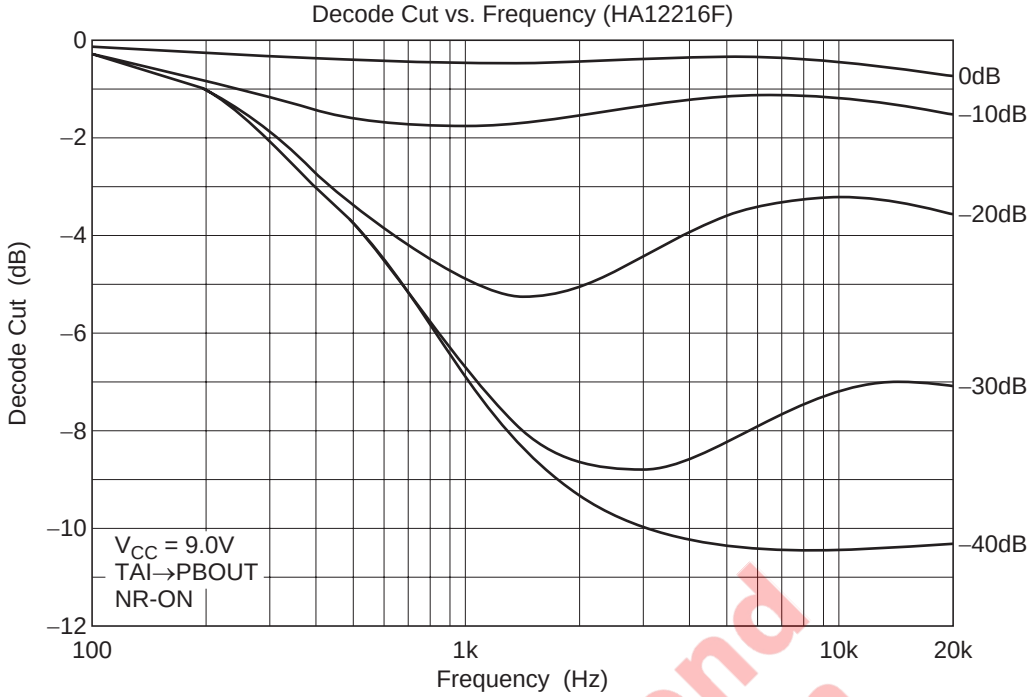
Quiescent Current vs. Supply Voltage (HA12216F)



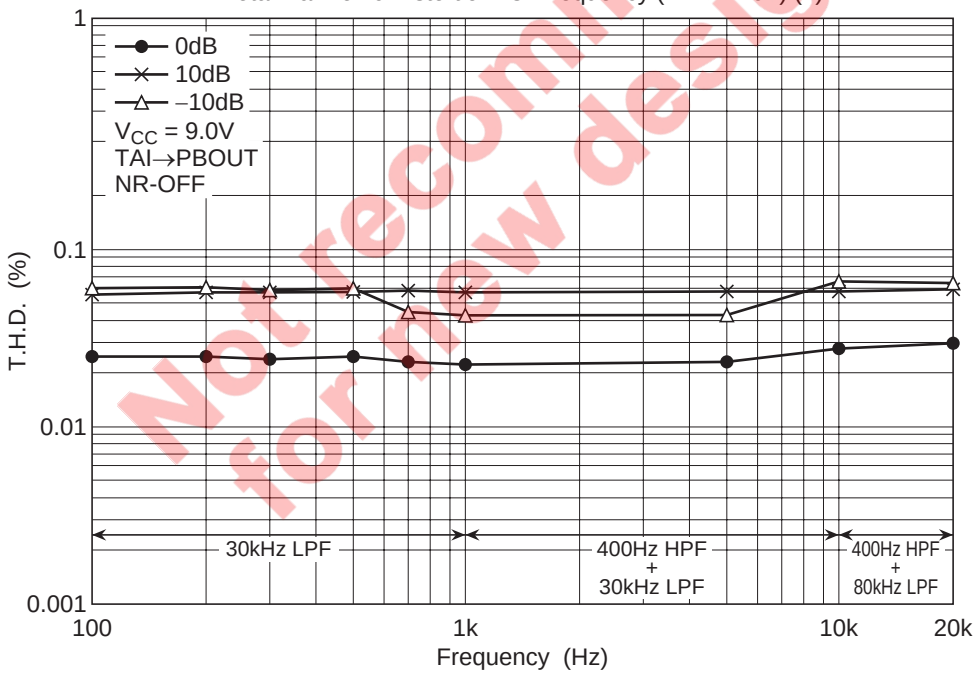
Input Amp. Gain vs. Frequency (HA12216F)



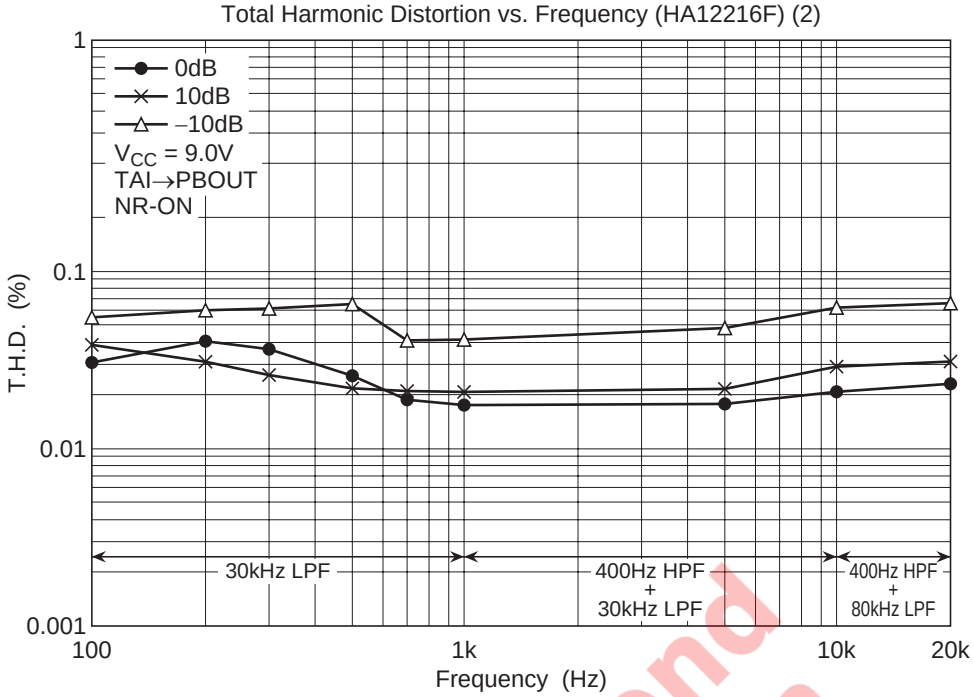
Decode Cut vs. Frequency (HA12216F)



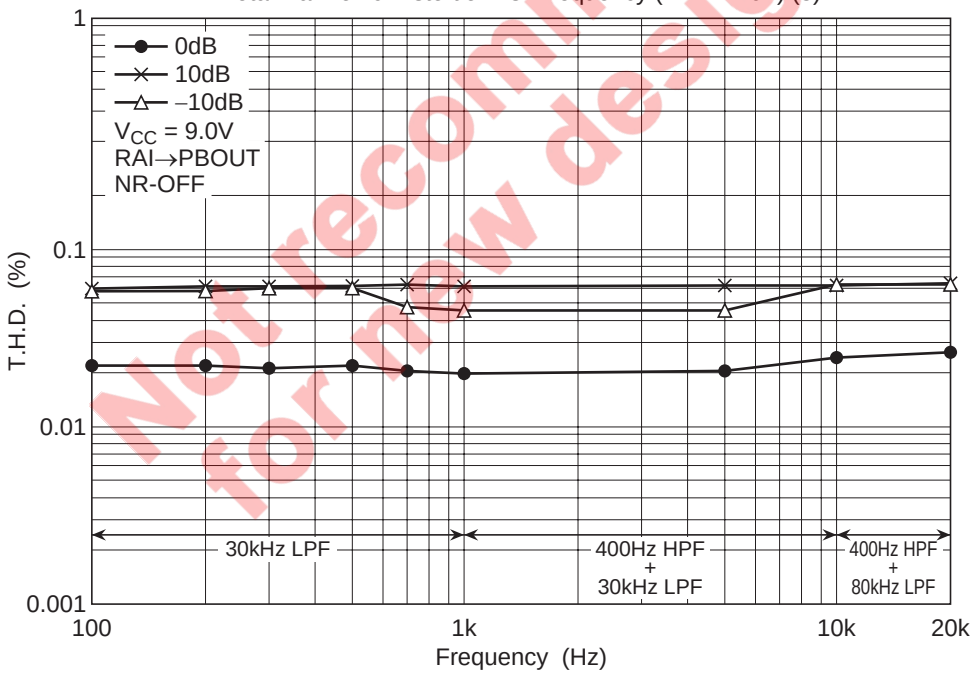
Total Harmonic Distortion vs. Frequency (HA12216F) (1)



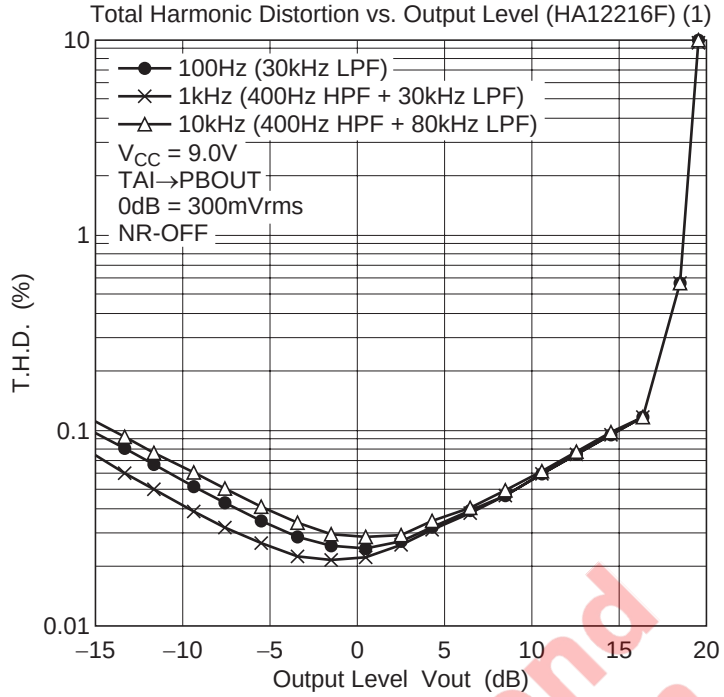
Total Harmonic Distortion vs. Frequency (HA12216F) (2)



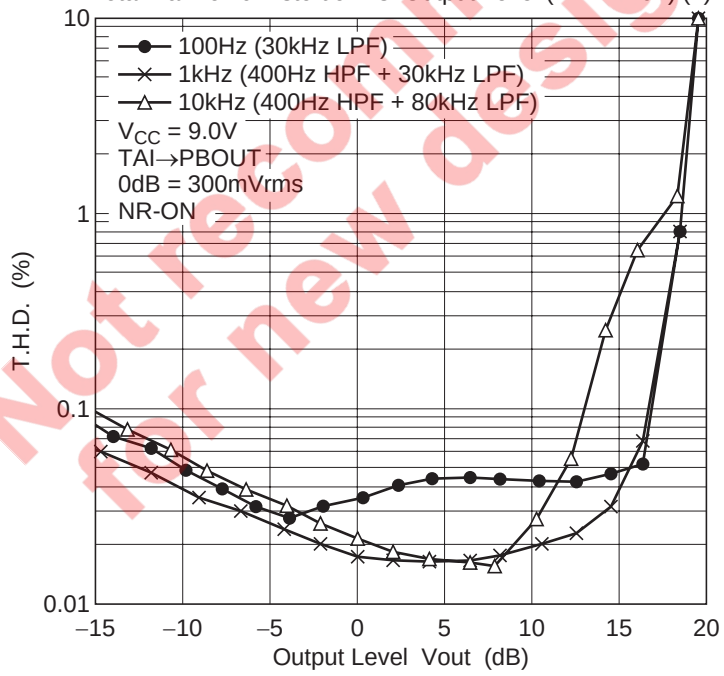
Total Harmonic Distortion vs. Frequency (HA12216F) (3)



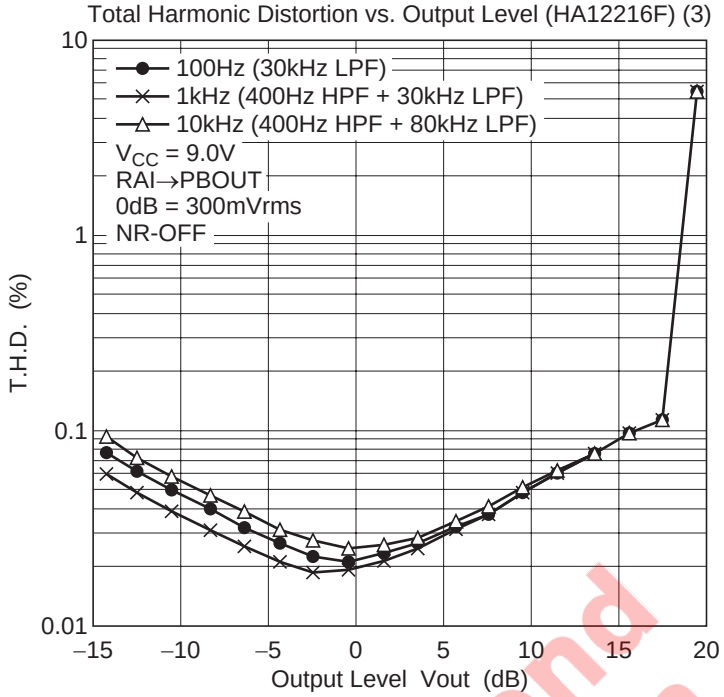
Total Harmonic Distortion vs. Output Level (HA12216F) (1)



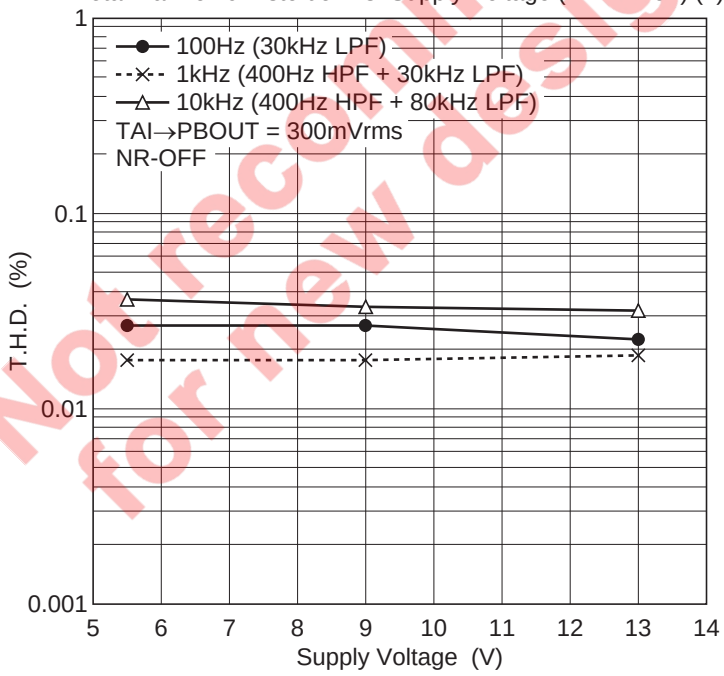
Total Harmonic Distortion vs. Output Level (HA12216F) (2)



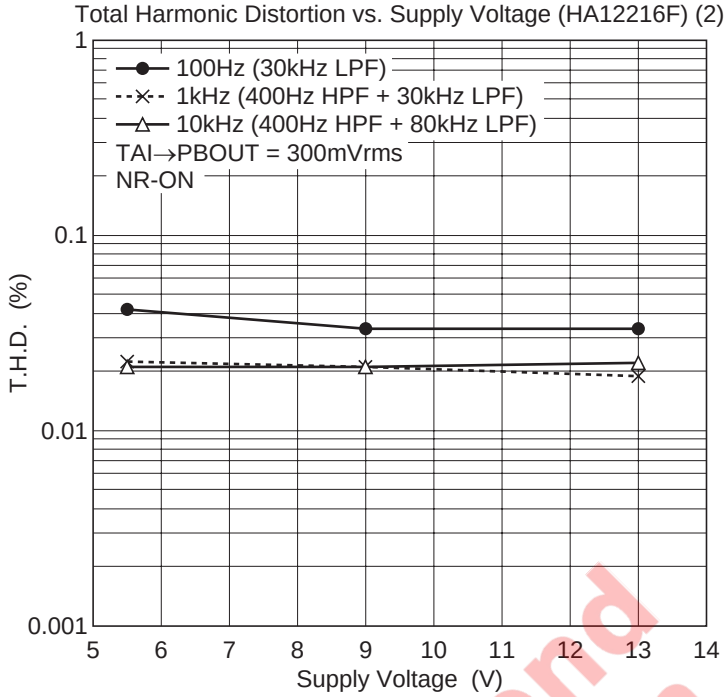
Total Harmonic Distortion vs. Output Level (HA12216F) (3)



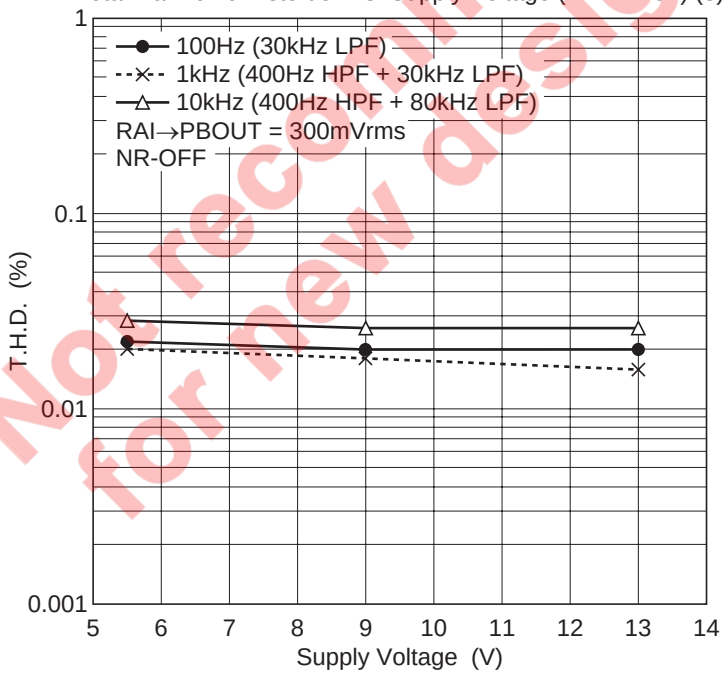
Total Harmonic Distortion vs. Supply Voltage (HA12216F) (1)



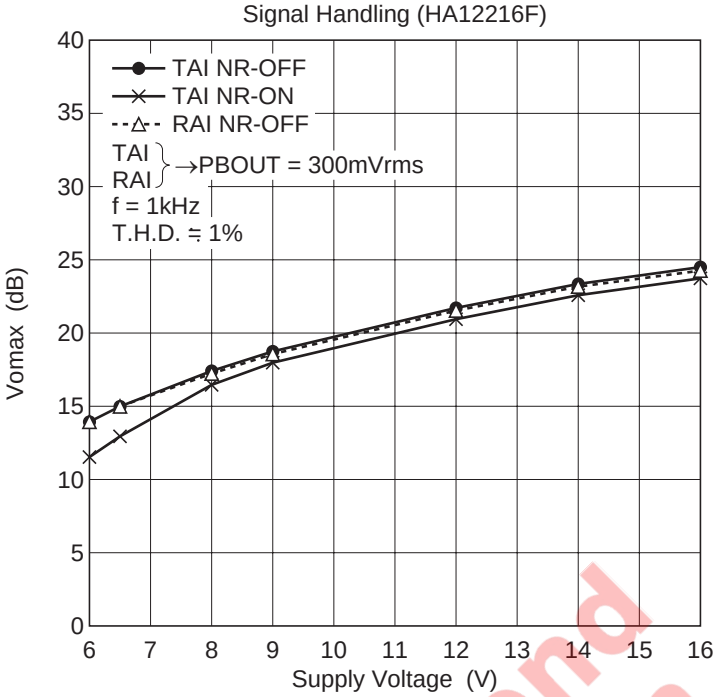
Total Harmonic Distortion vs. Supply Voltage (HA12216F) (2)



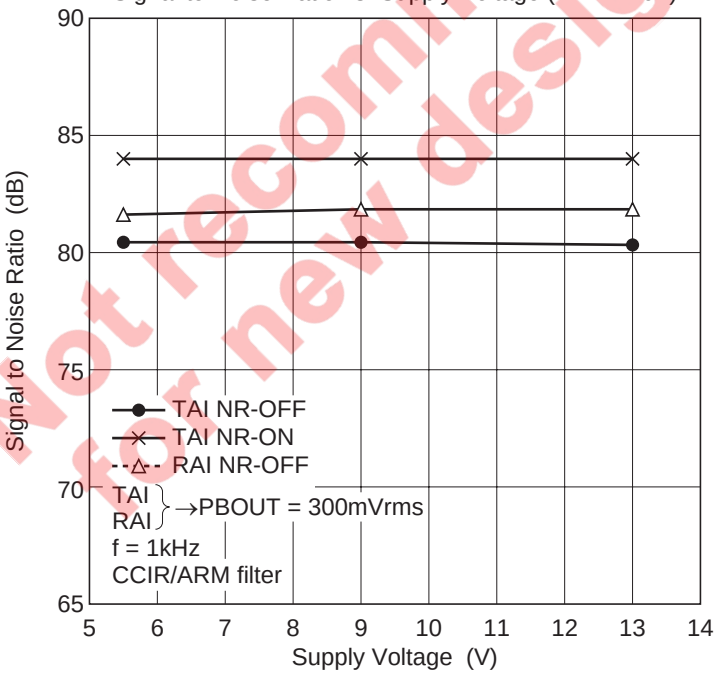
Total Harmonic Distortion vs. Supply Voltage (HA12216F) (3)



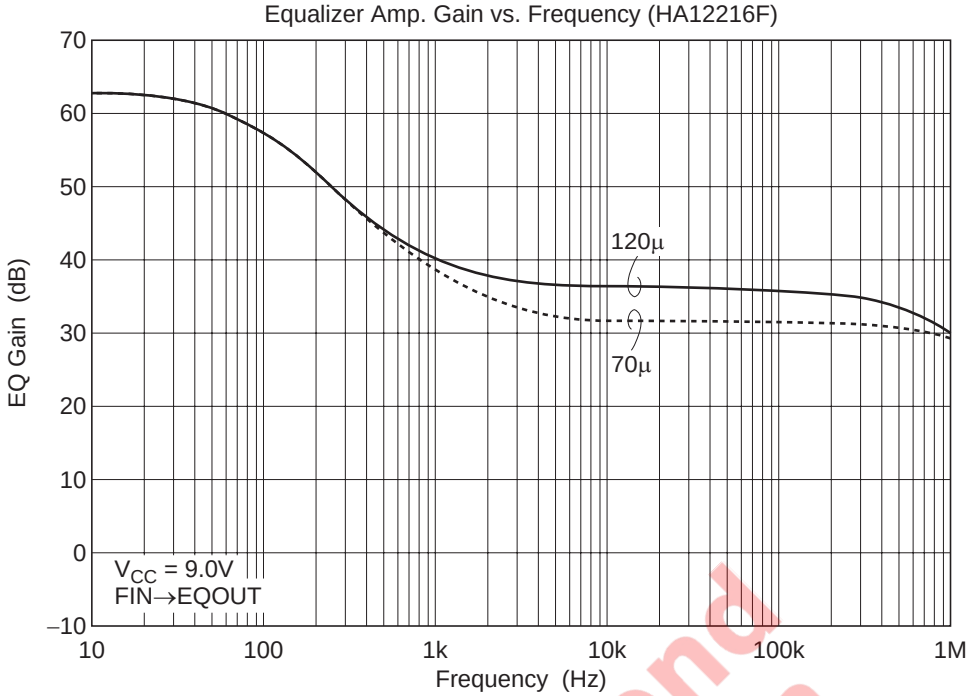
Signal Handling (HA12216F)



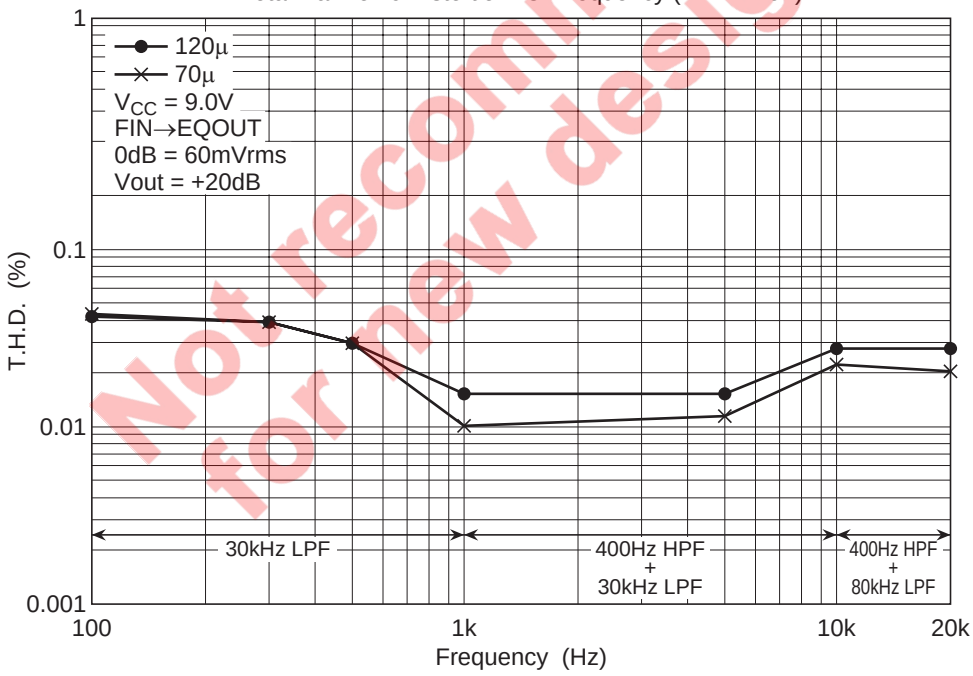
Signal to Noise Ratio vs. Supply Voltage (HA12216F)



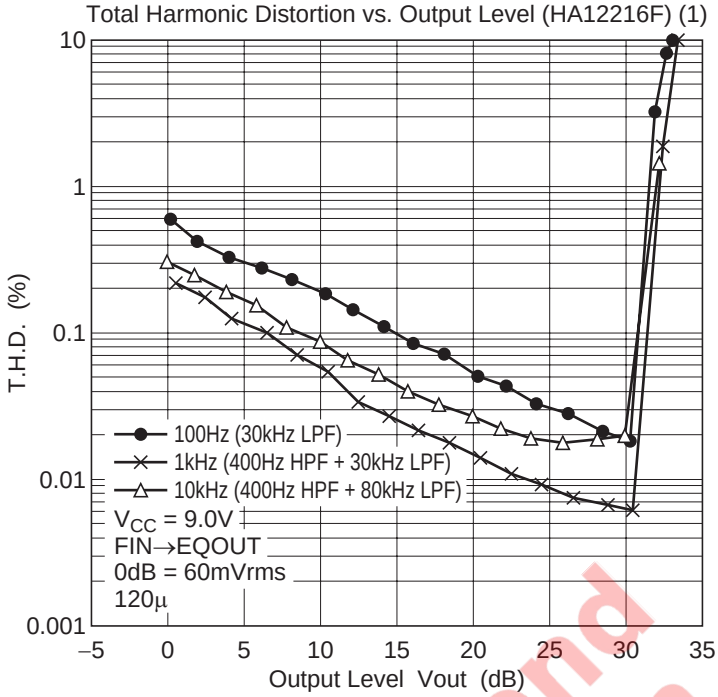
Equalizer Amp. Gain vs. Frequency (HA12216F)



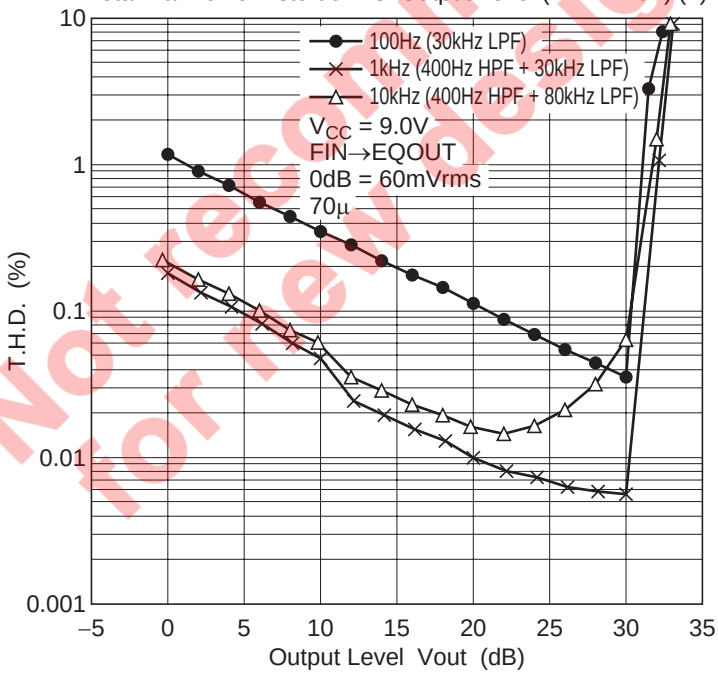
Total Harmonic Distortion vs. Frequency (HA12216F)



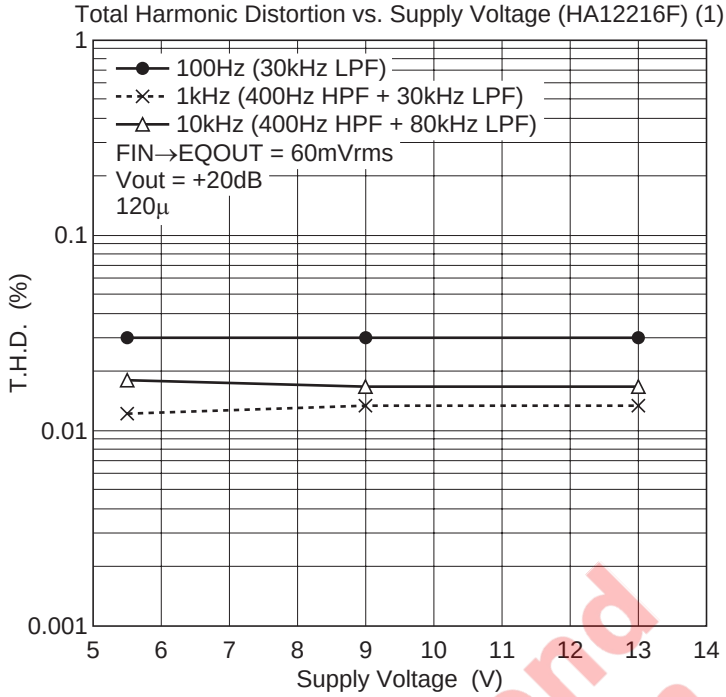
Total Harmonic Distortion vs. Output Level (HA12216F) (1)



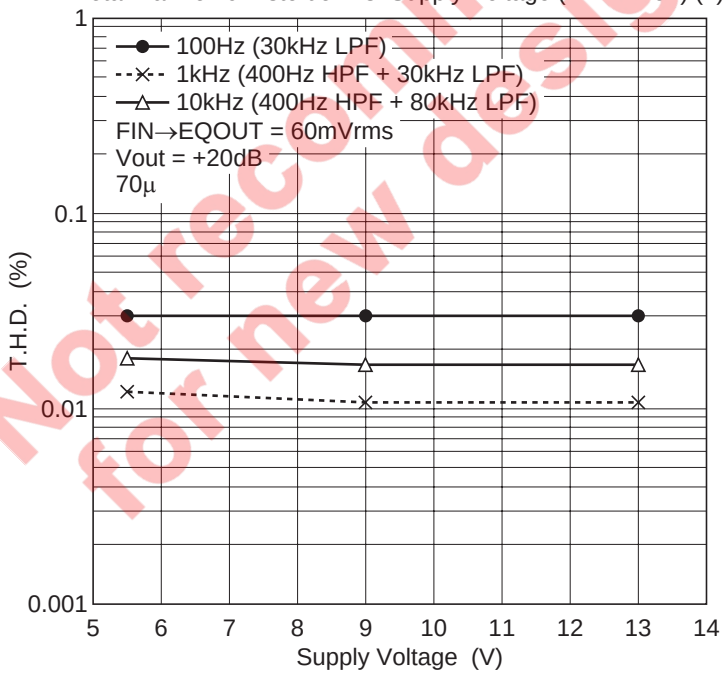
Total Harmonic Distortion vs. Output Level (HA12216F) (2)



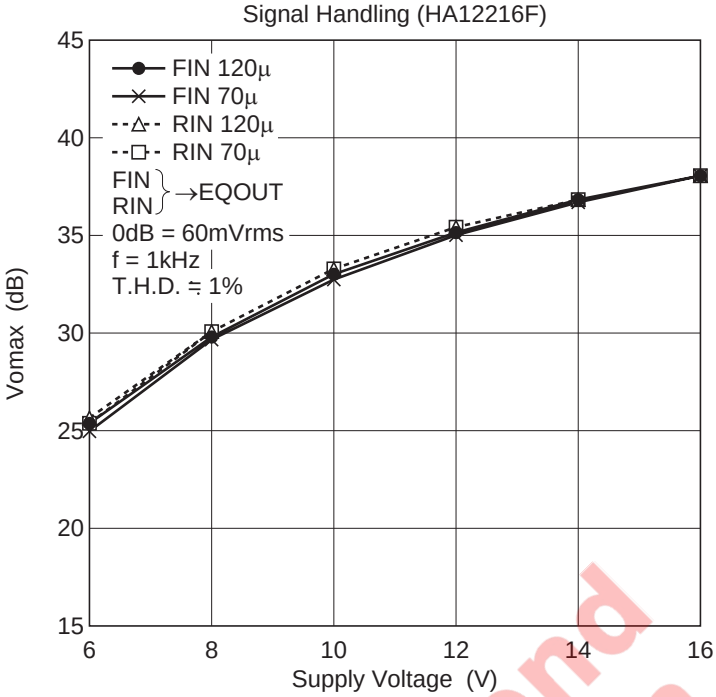
Total Harmonic Distortion vs. Supply Voltage (HA12216F) (1)



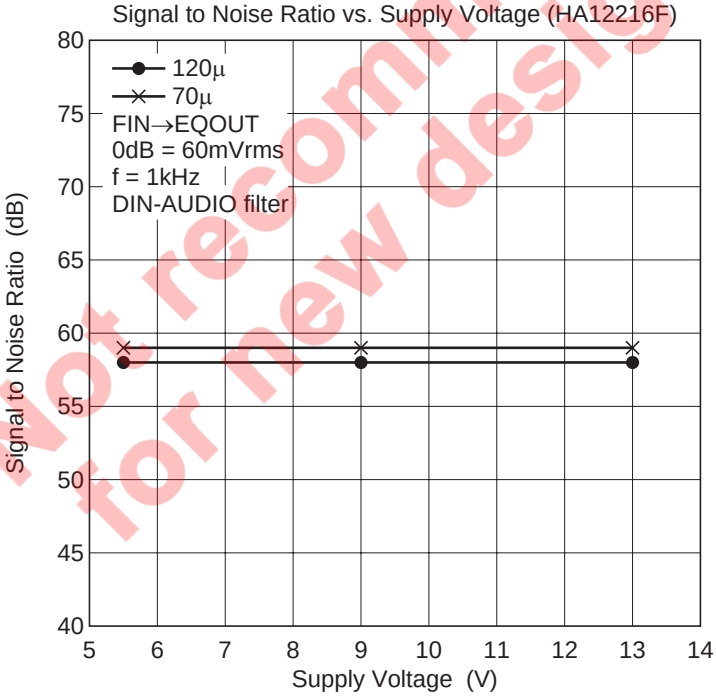
Total Harmonic Distortion vs. Supply Voltage (HA12216F) (2)



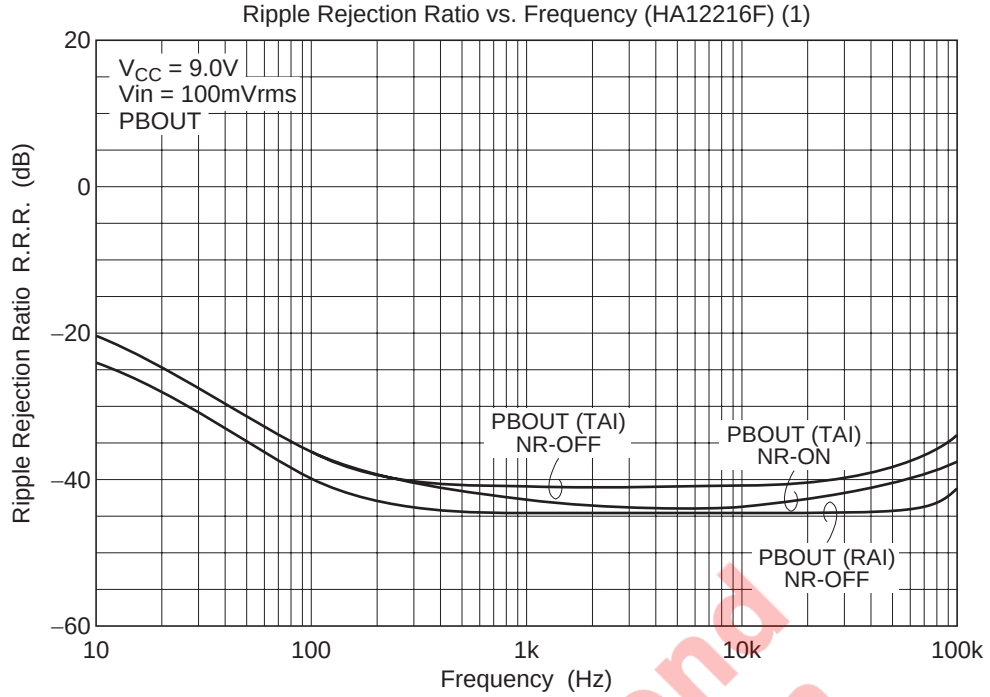
Signal Handling (HA12216F)



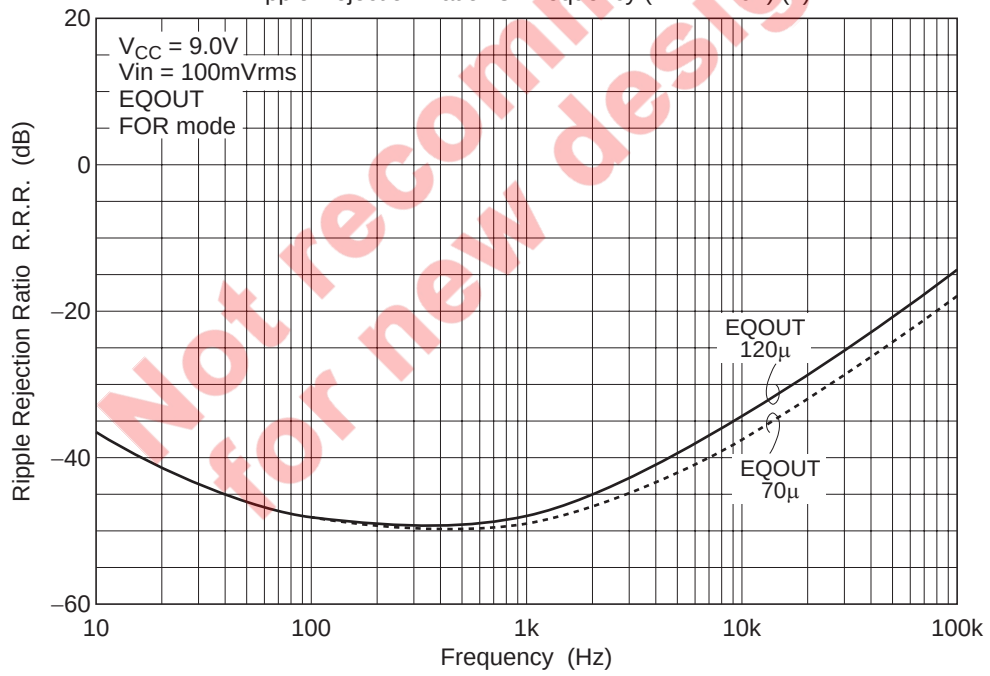
Signal to Noise Ratio vs. Supply Voltage (HA12216F)



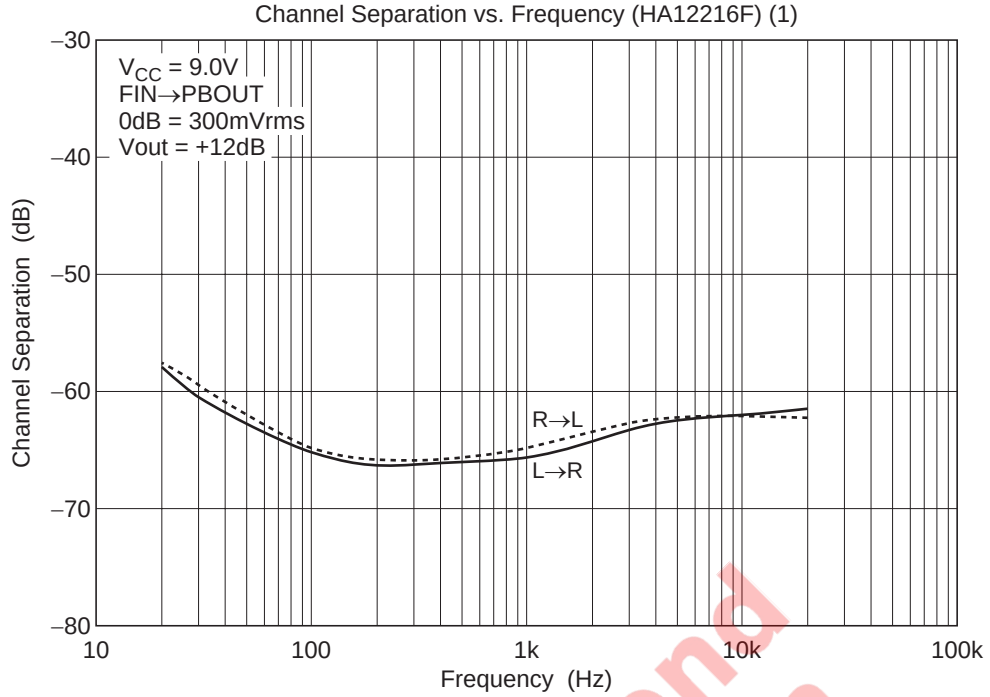
Ripple Rejection Ratio vs. Frequency (HA12216F) (1)



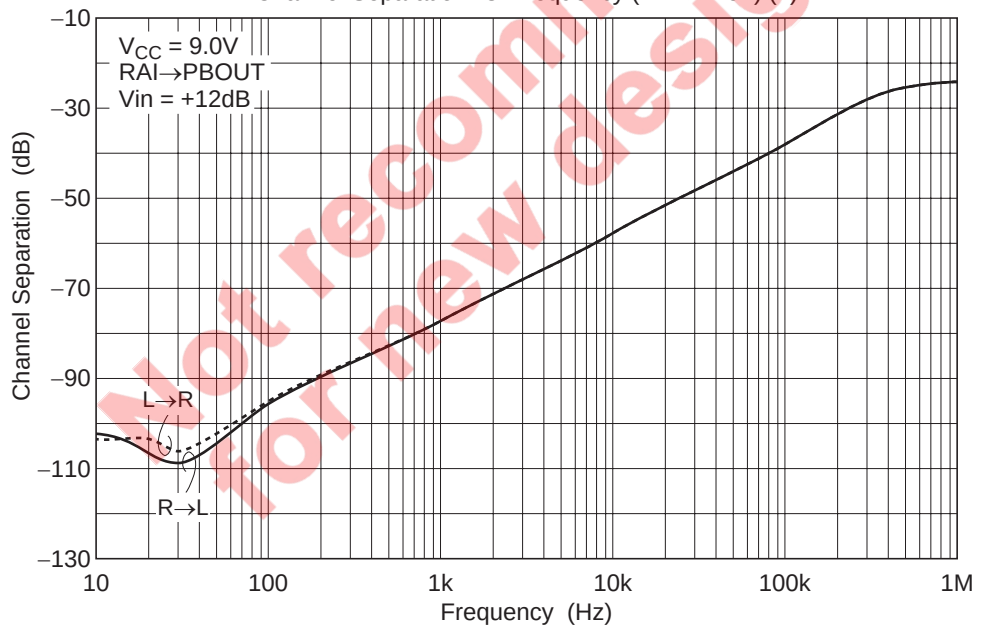
Ripple Rejection Ratio vs. Frequency (HA12216F) (2)

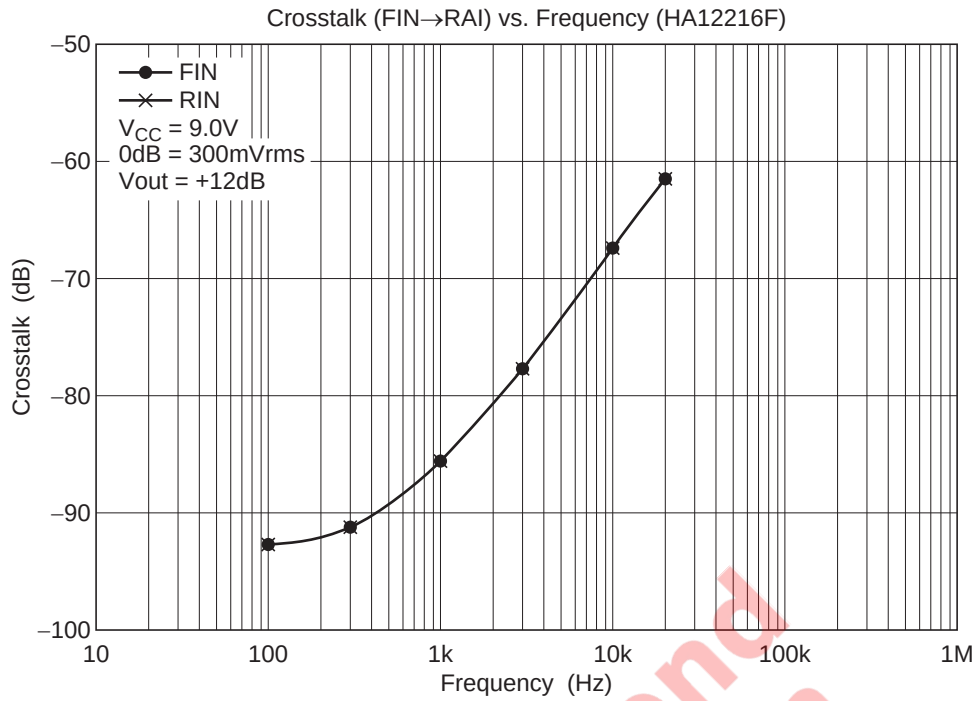


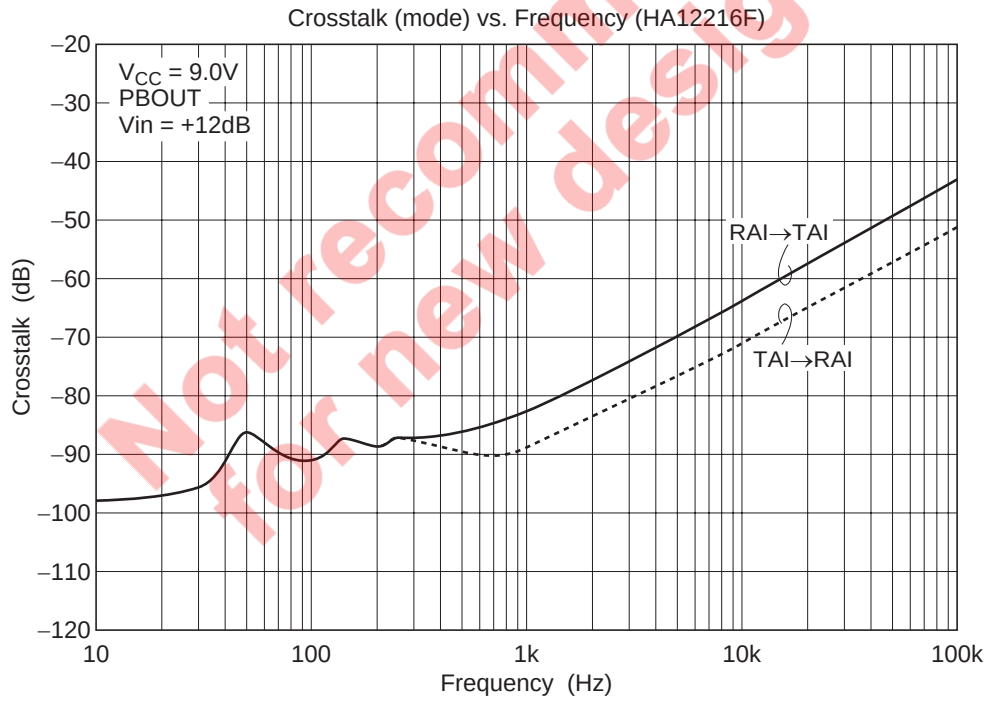
Channel Separation vs. Frequency (HA12216F) (1)



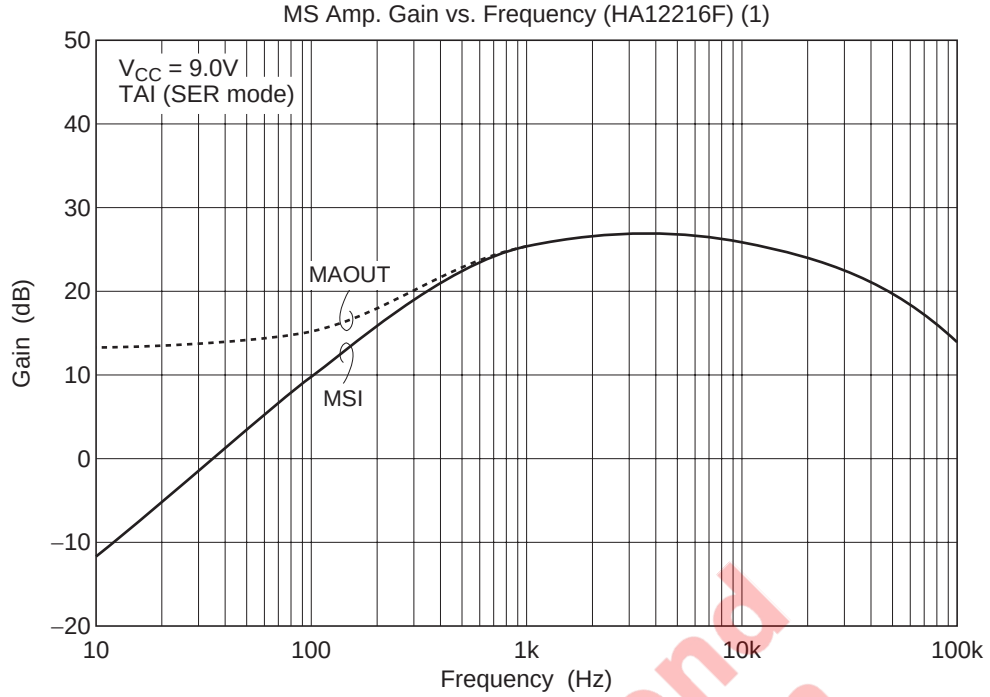
Channel Separation vs. Frequency (HA12216F) (2)



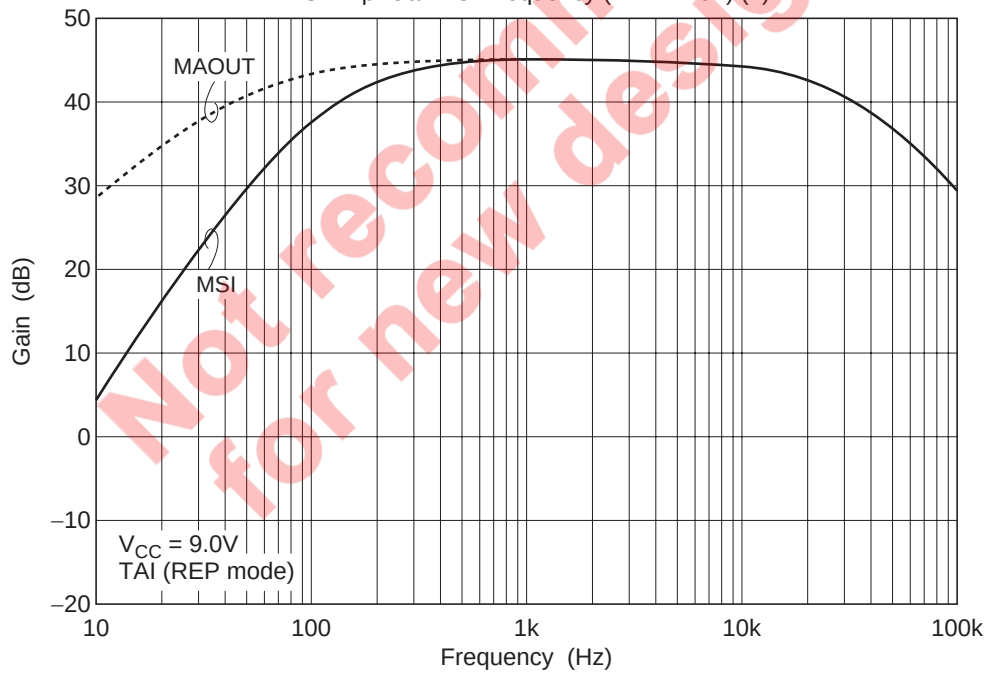




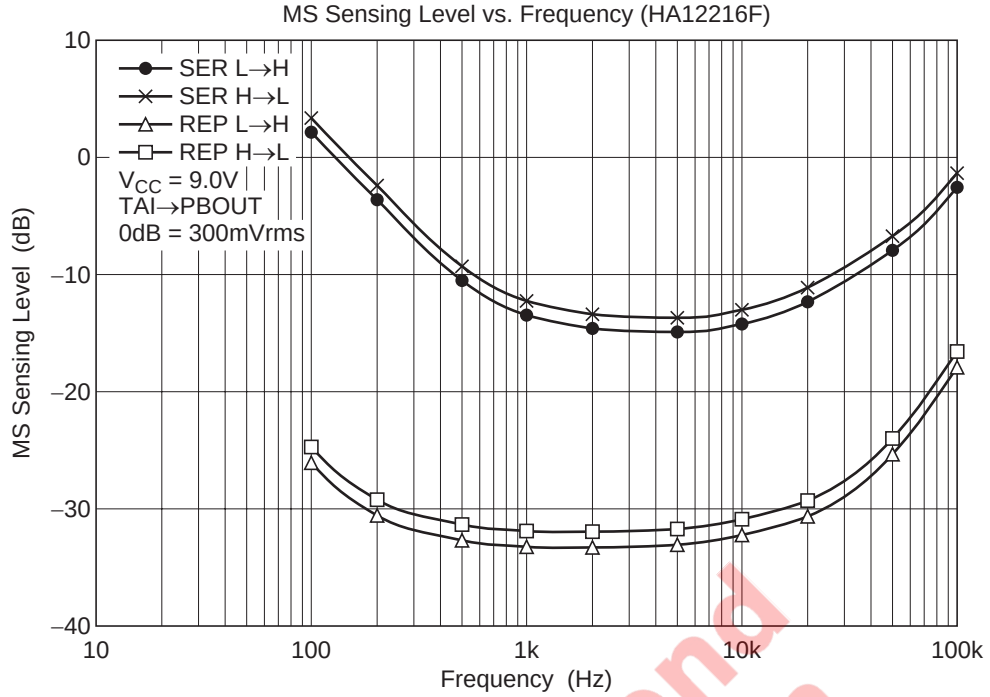
MS Amp. Gain vs. Frequency (HA12216F) (1)



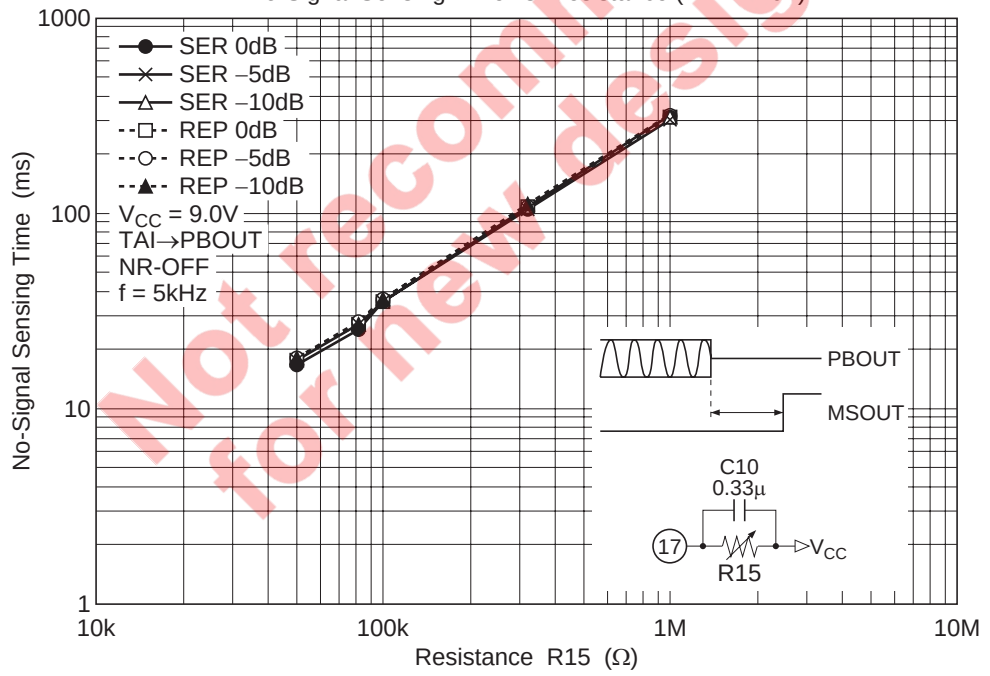
MS Amp. Gain vs. Frequency (HA12216F) (2)

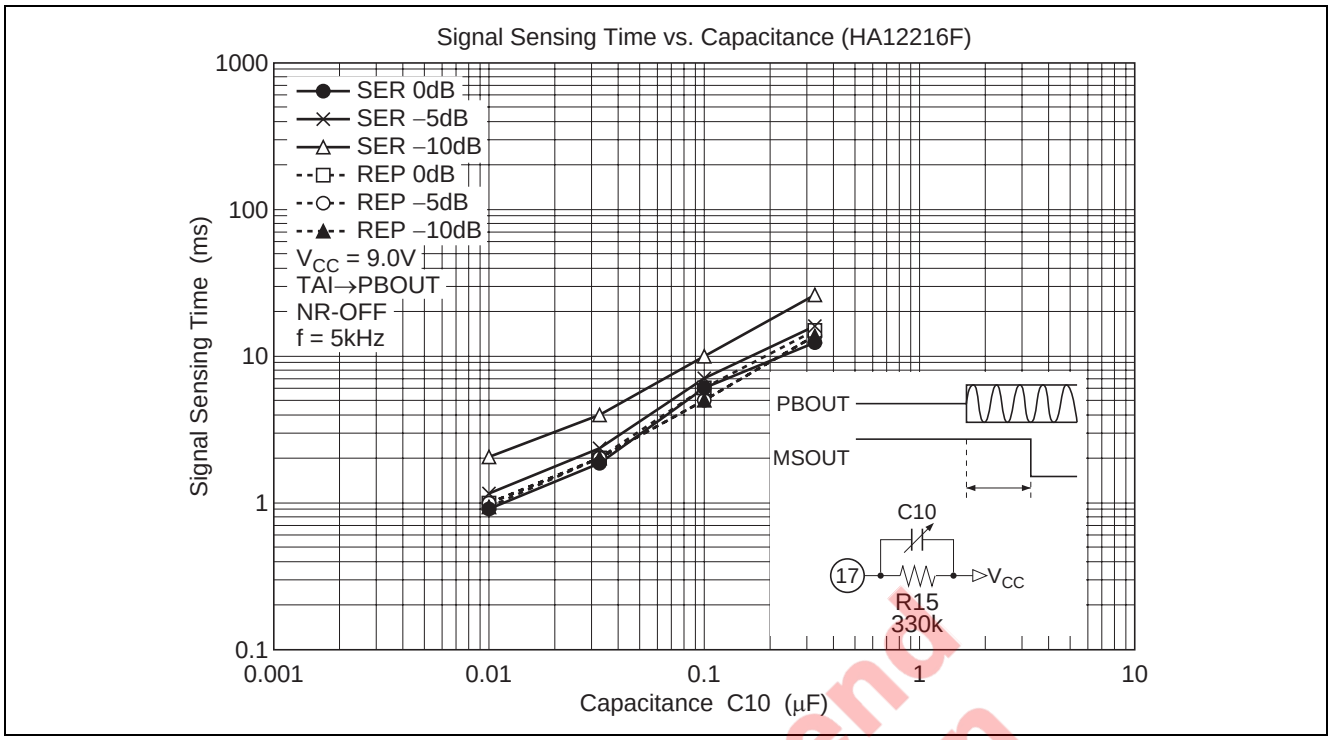


MS Sensing Level vs. Frequency (HA12216F)

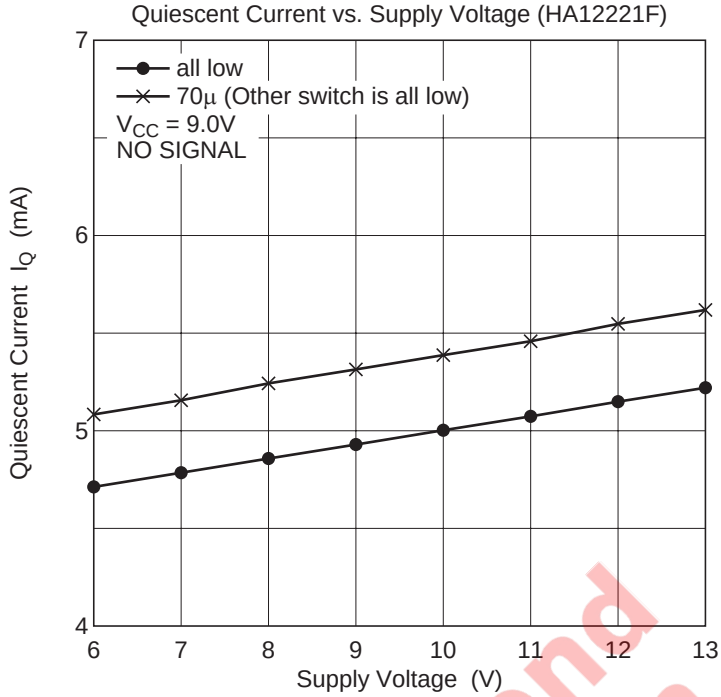


No-Signal Sensing Time vs. Resistance (HA12216F)

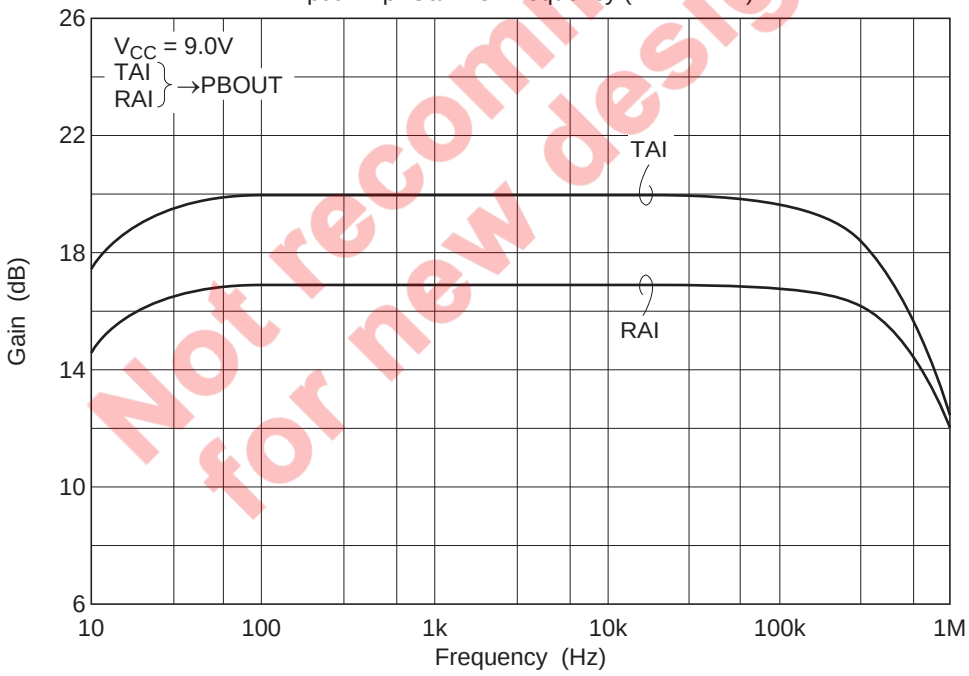




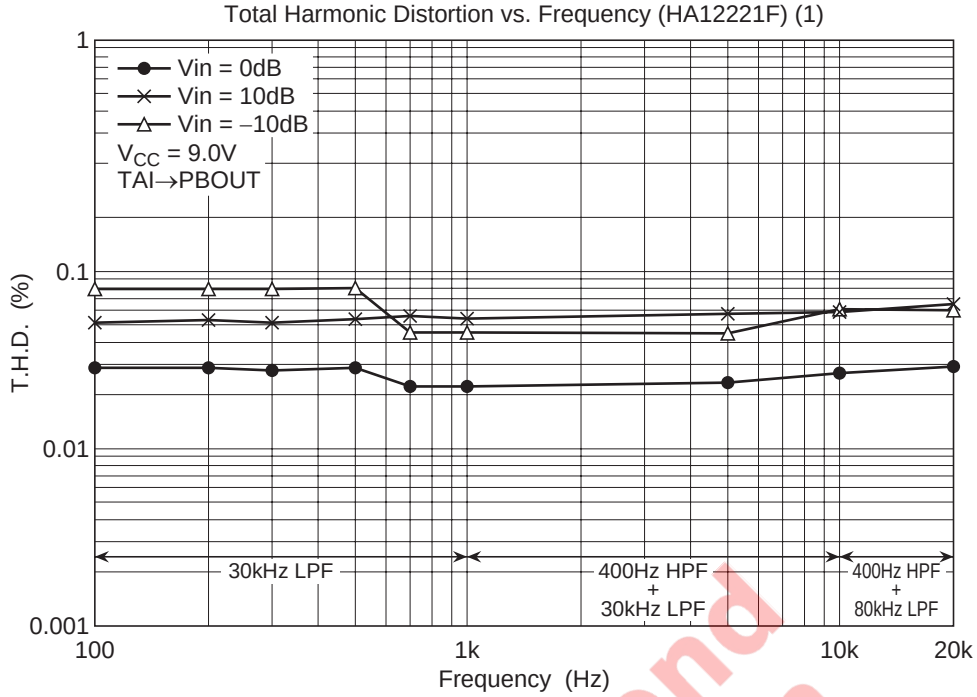
Quiescent Current vs. Supply Voltage (HA12221F)



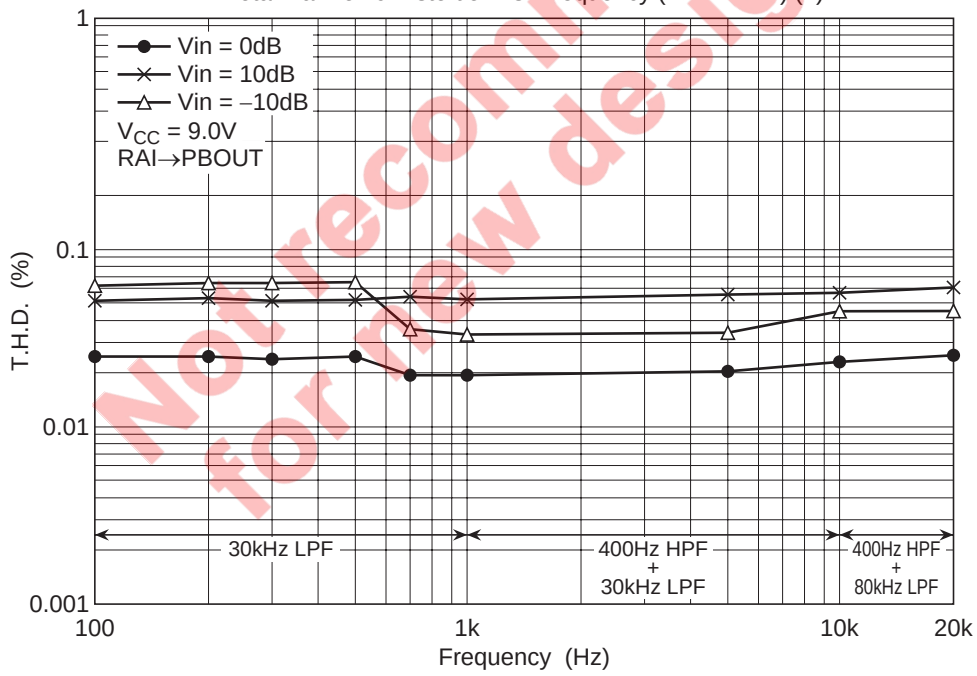
Input Amp. Gain vs. Frequency (HA12221F)



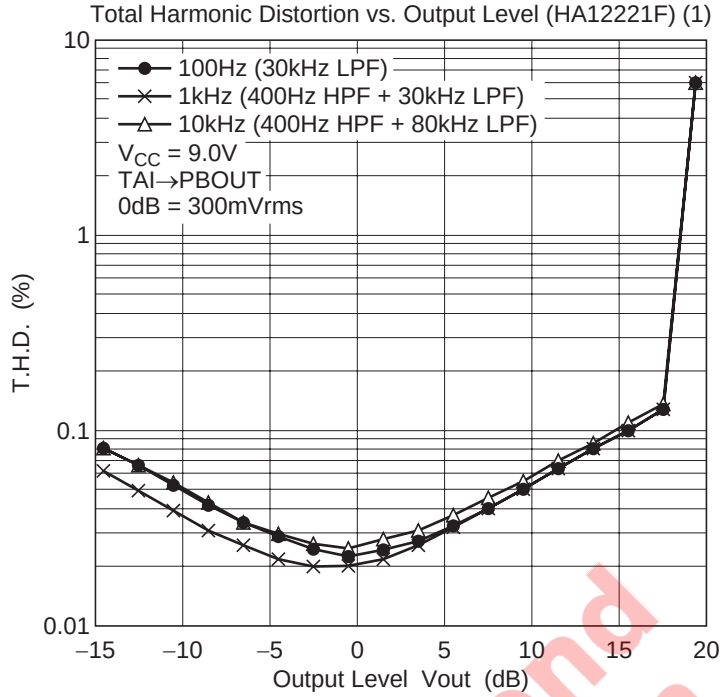
Total Harmonic Distortion vs. Frequency (HA12221F) (1)



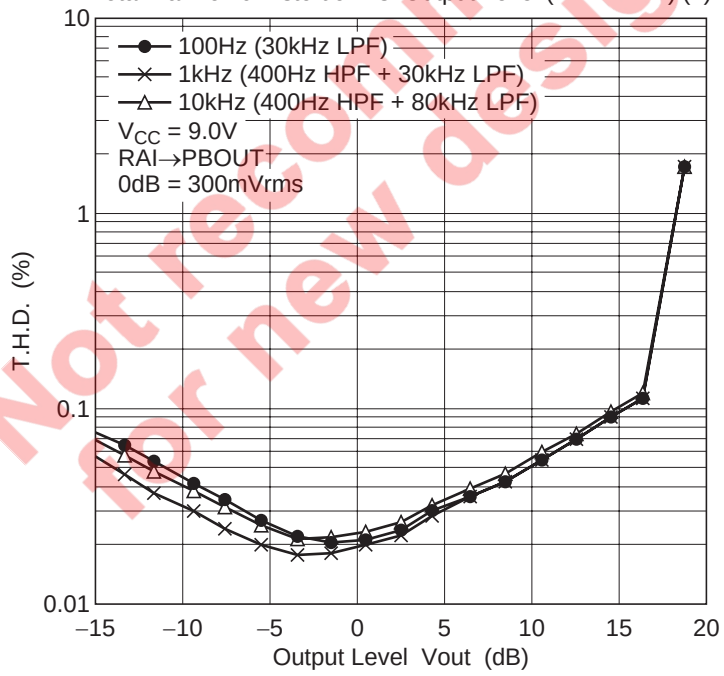
Total Harmonic Distortion vs. Frequency (HA12221F) (2)



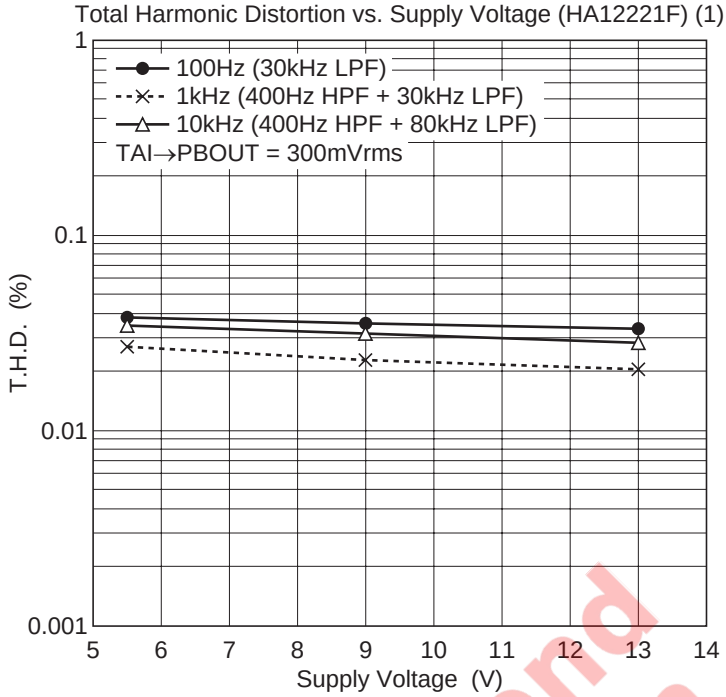
Total Harmonic Distortion vs. Output Level (HA12221F) (1)



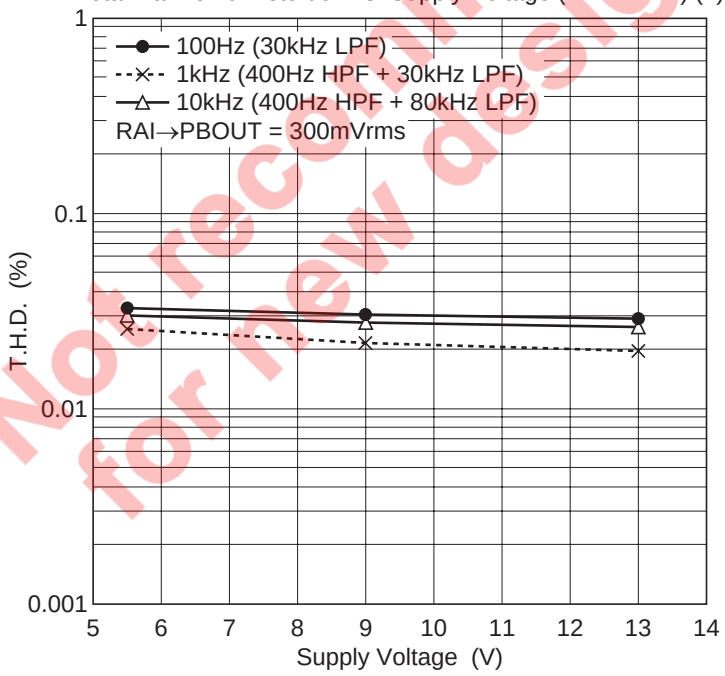
Total Harmonic Distortion vs. Output Level (HA12221F) (2)



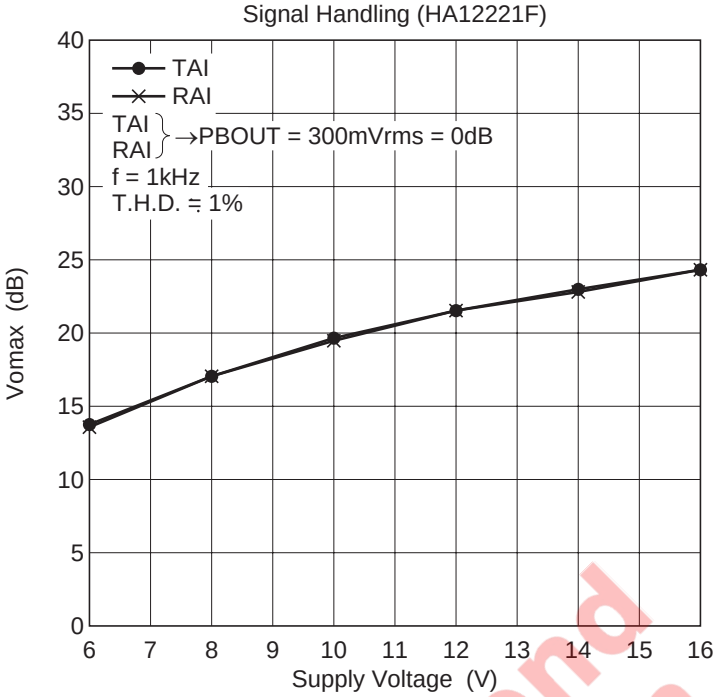
Total Harmonic Distortion vs. Supply Voltage (HA12221F) (1)



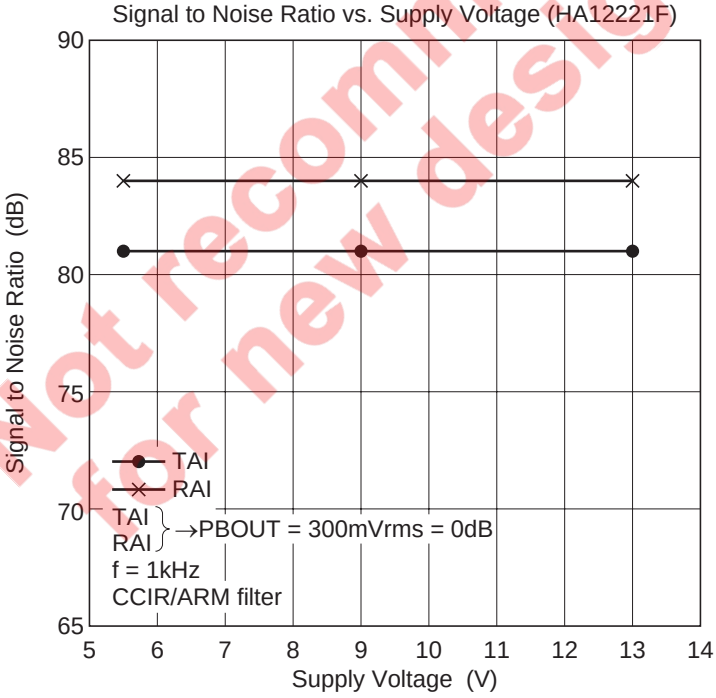
Total Harmonic Distortion vs. Supply Voltage (HA12221F) (2)



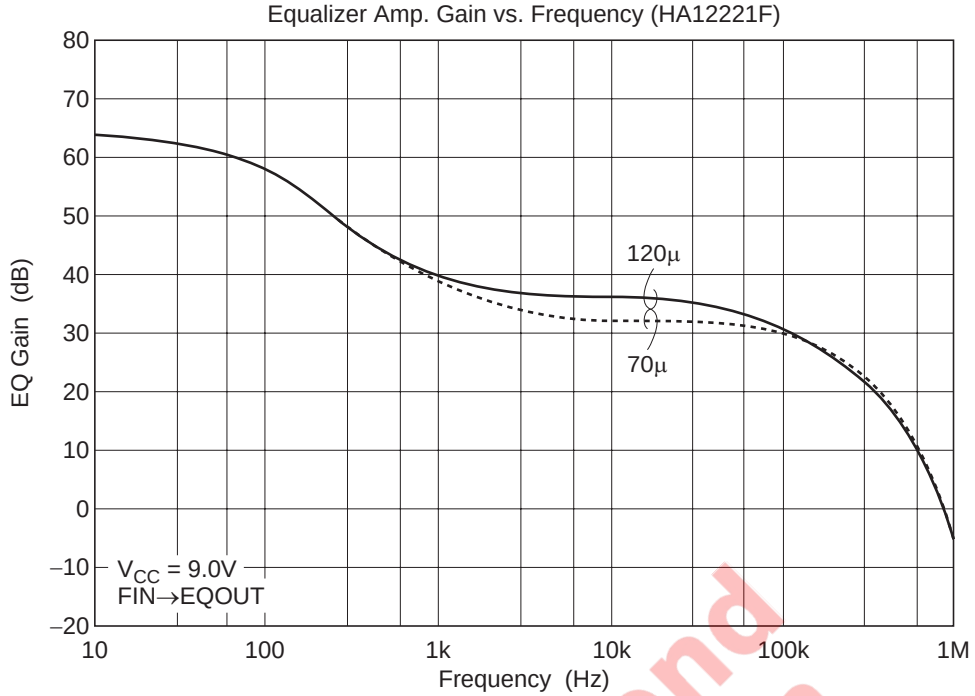
Signal Handling (HA12221F)



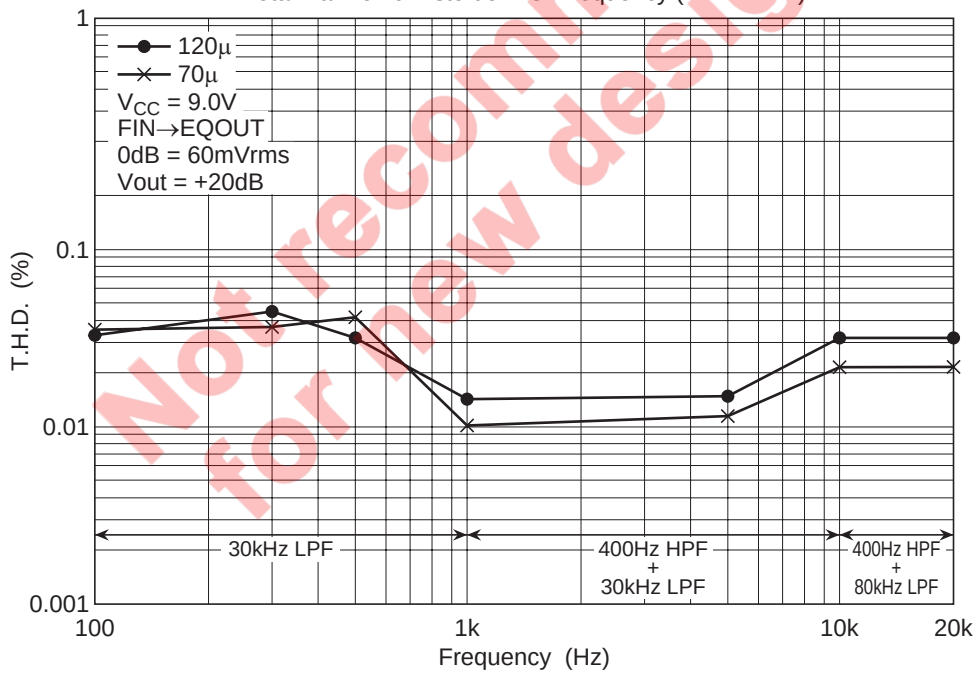
Signal to Noise Ratio vs. Supply Voltage (HA12221F)



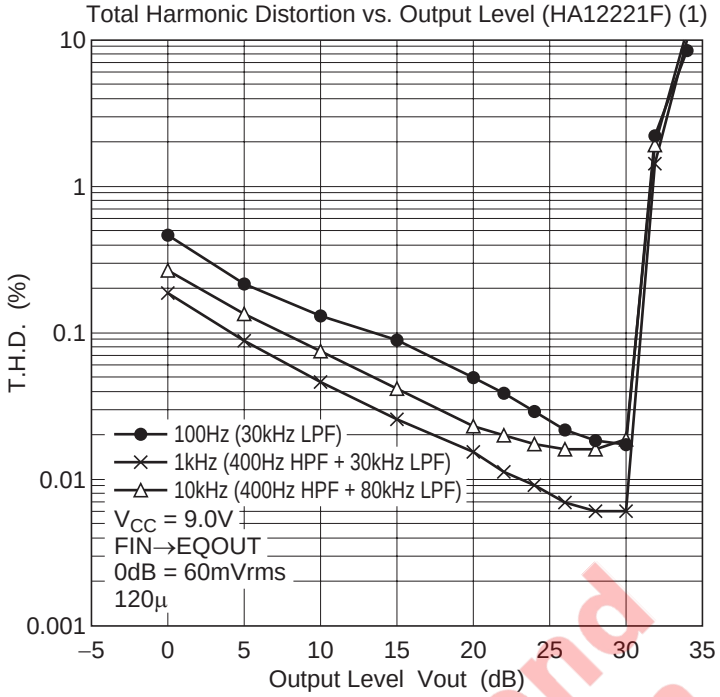
Equalizer Amp. Gain vs. Frequency (HA12221F)



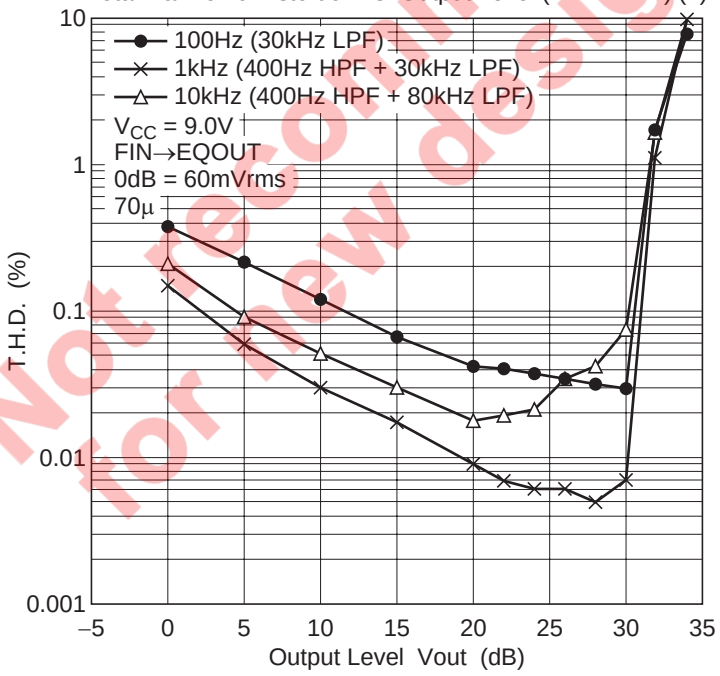
Total Harmonic Distortion vs. Frequency (HA12221F)



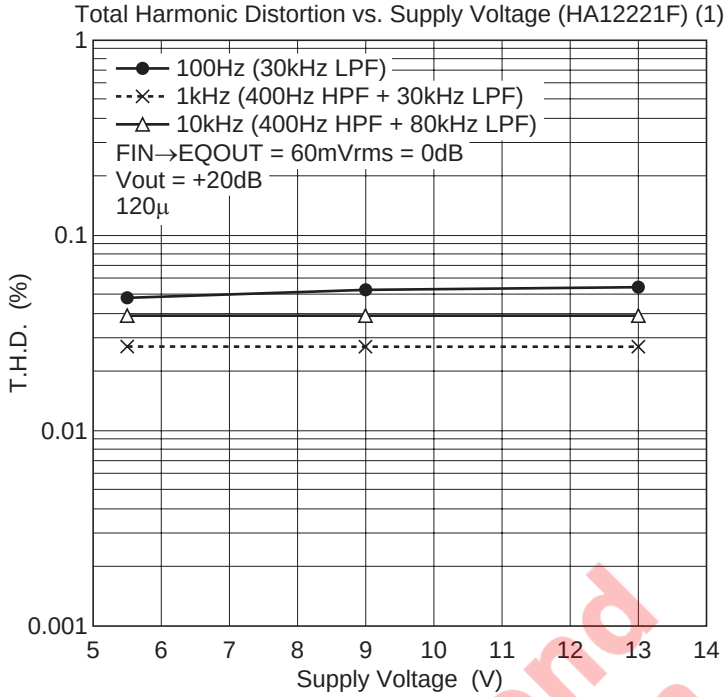
Total Harmonic Distortion vs. Output Level (HA12221F) (1)



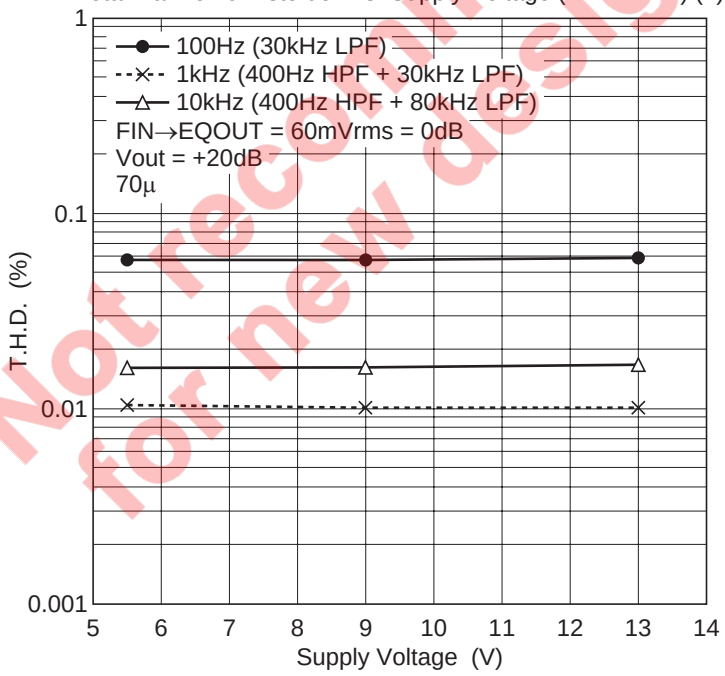
Total Harmonic Distortion vs. Output Level (HA12221F) (2)



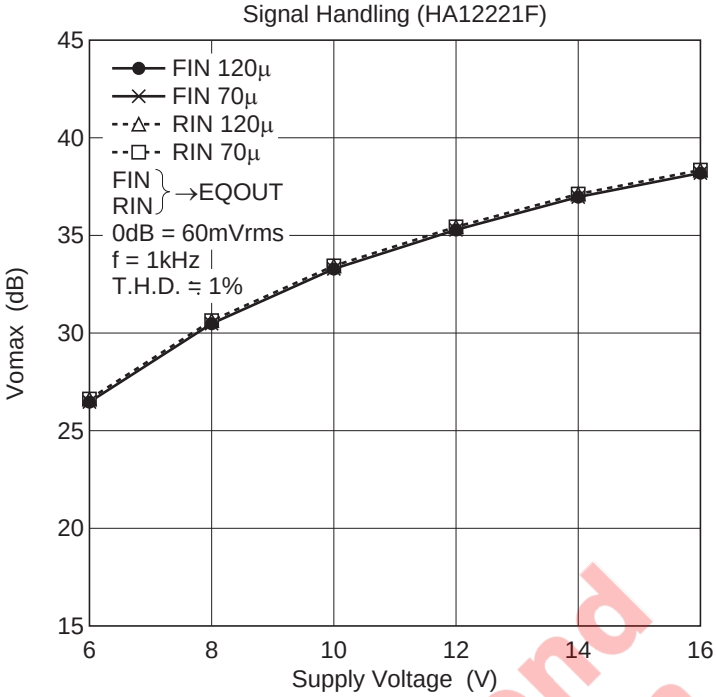
Total Harmonic Distortion vs. Supply Voltage (HA12221F) (1)



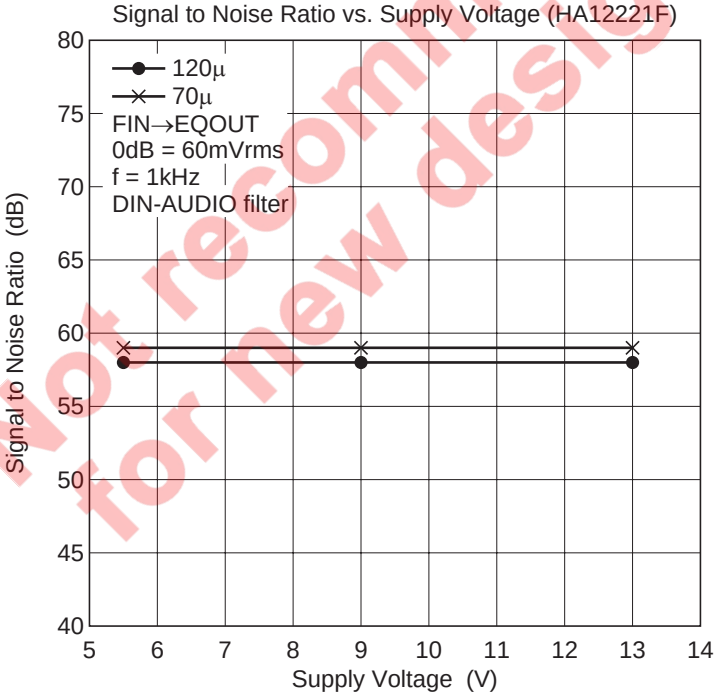
Total Harmonic Distortion vs. Supply Voltage (HA12221F) (2)



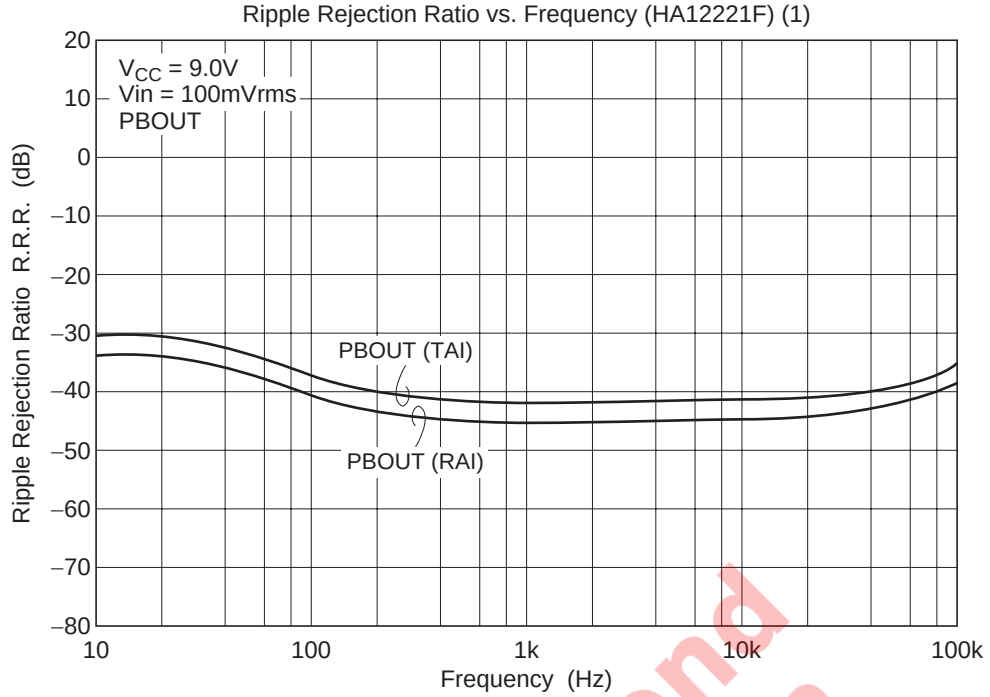
Signal Handling (HA12221F)



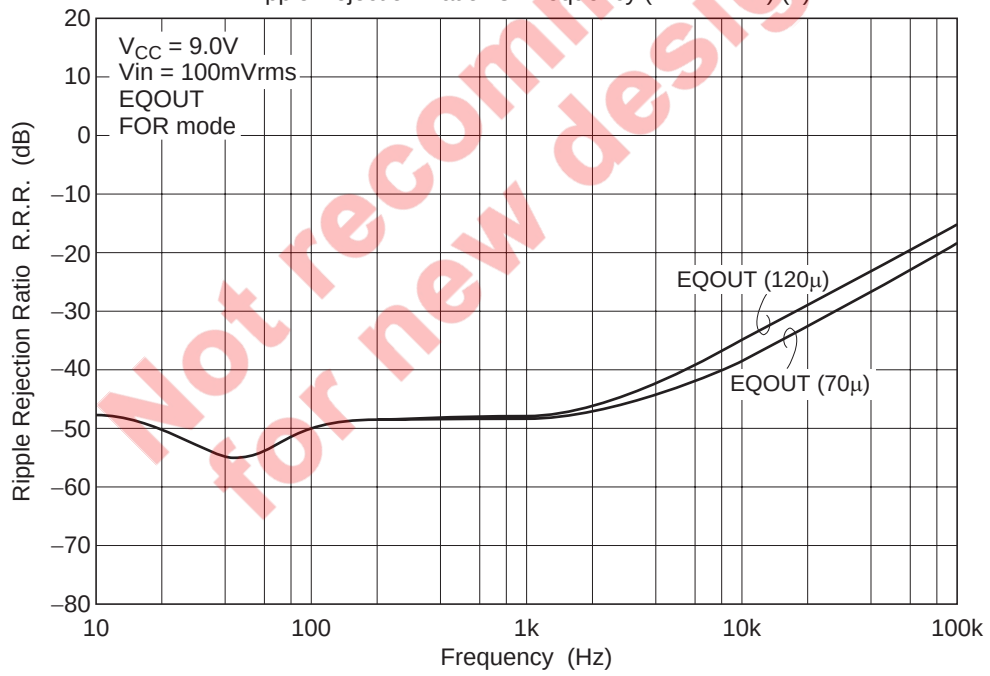
Signal to Noise Ratio vs. Supply Voltage (HA12221F)



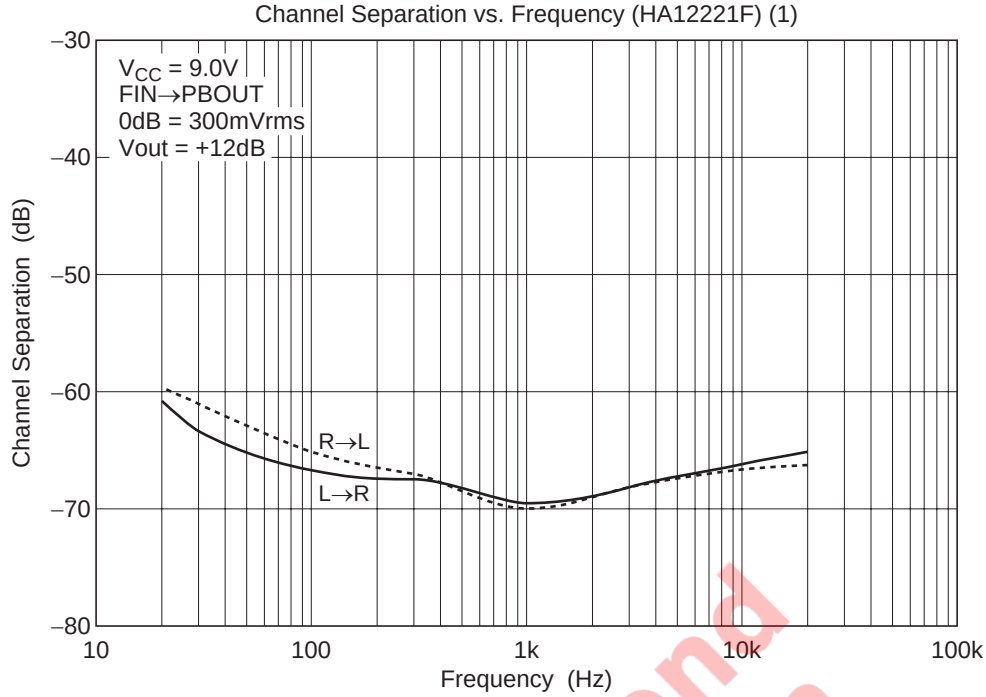
Ripple Rejection Ratio vs. Frequency (HA12221F) (1)



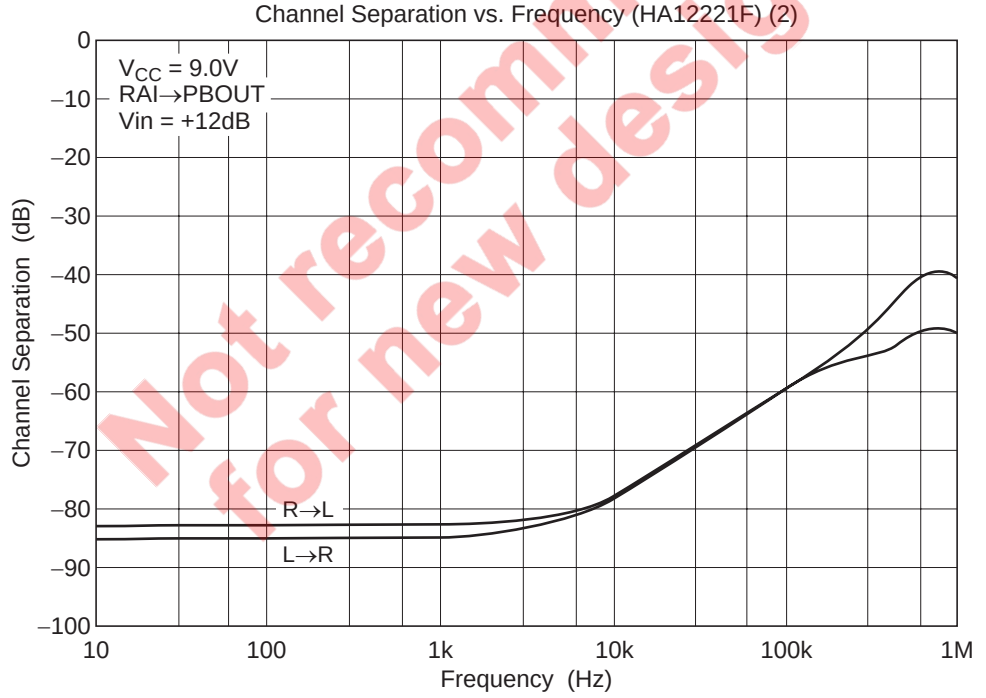
Ripple Rejection Ratio vs. Frequency (HA12221F) (2)



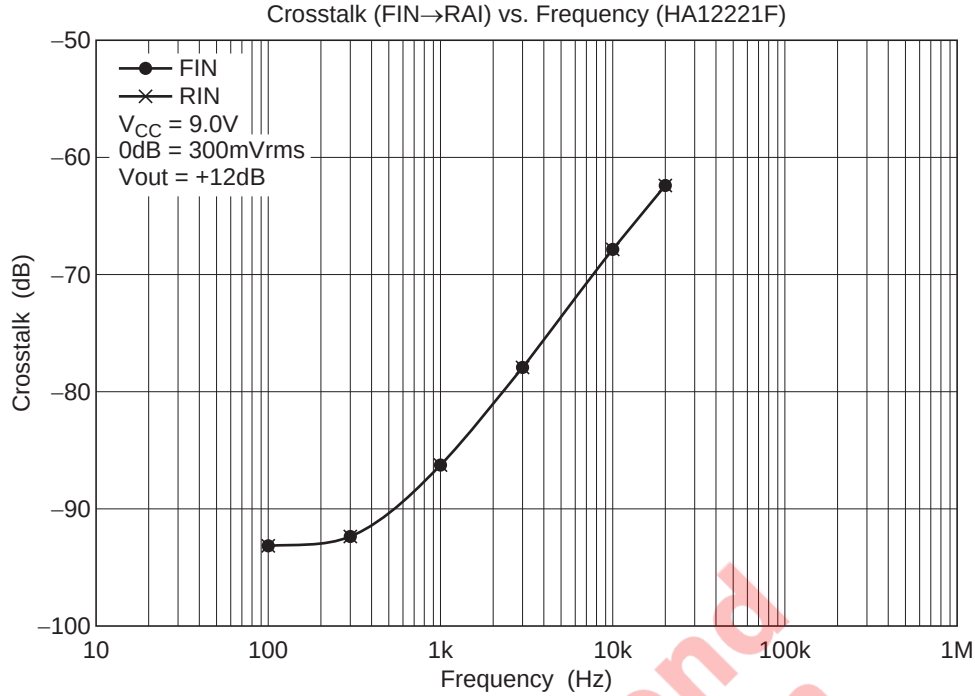
Channel Separation vs. Frequency (HA12221F) (1)



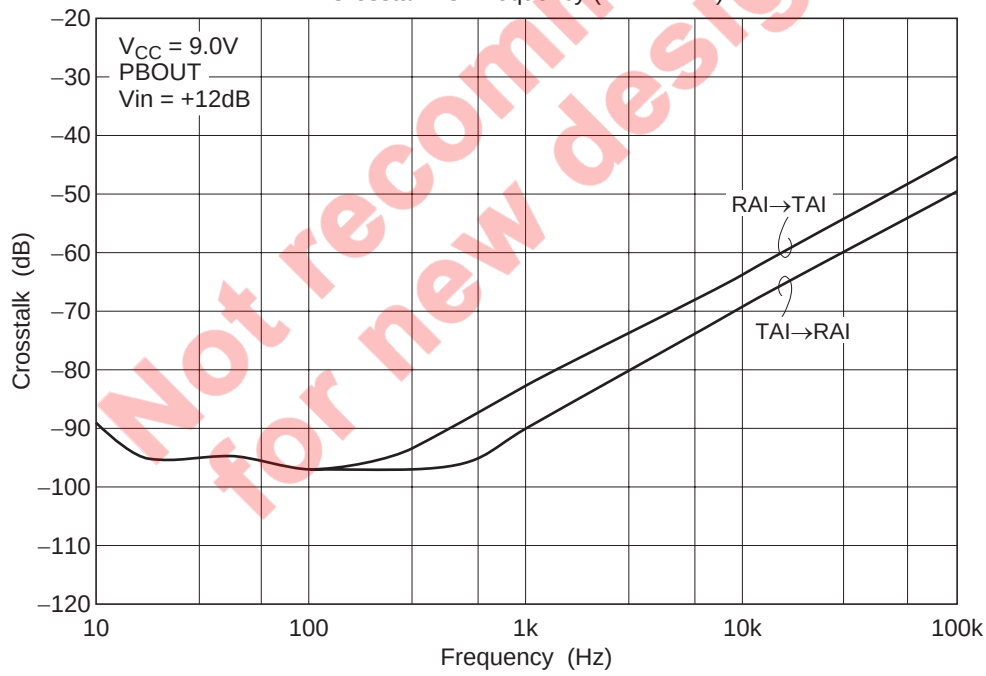
Channel Separation vs. Frequency (HA12221F) (2)



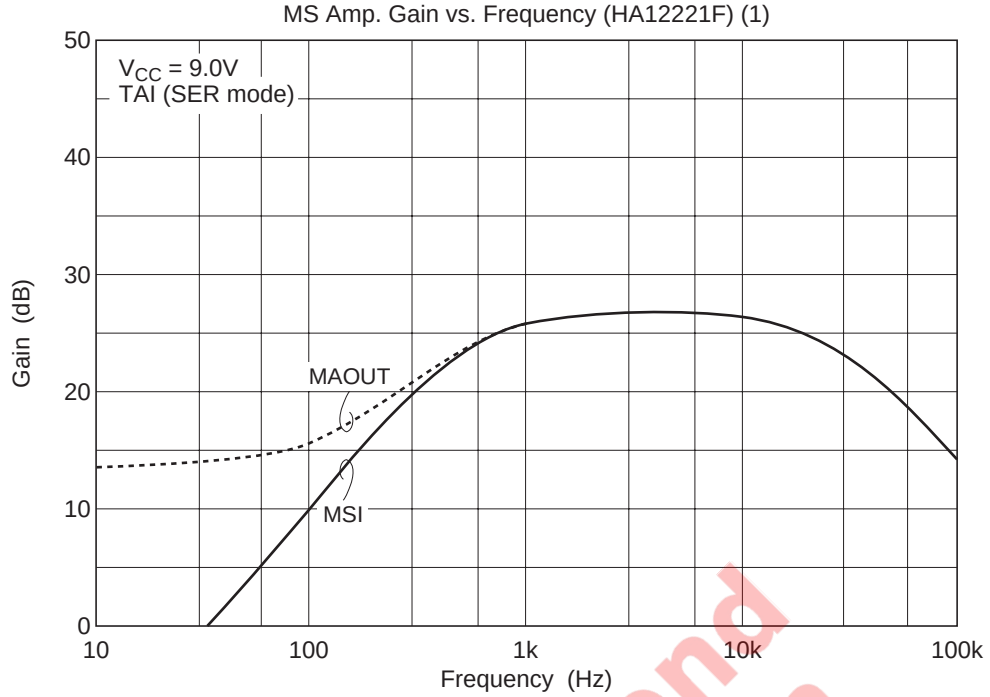
Crosstalk (FIN→RAI) vs. Frequency (HA12221F)



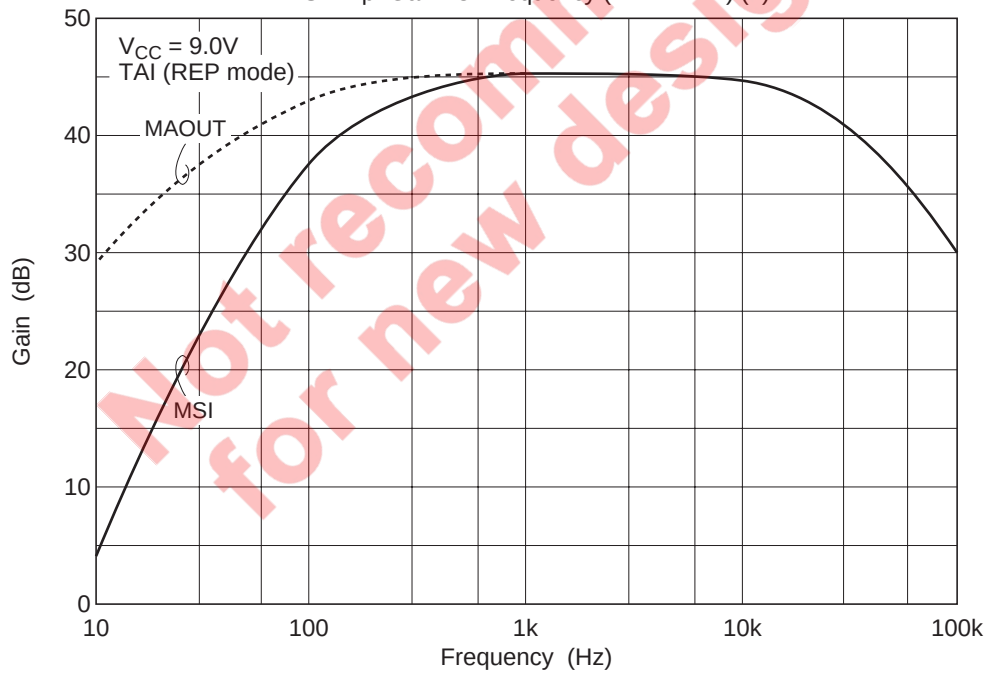
Crosstalk vs. Frequency (HA12221F)



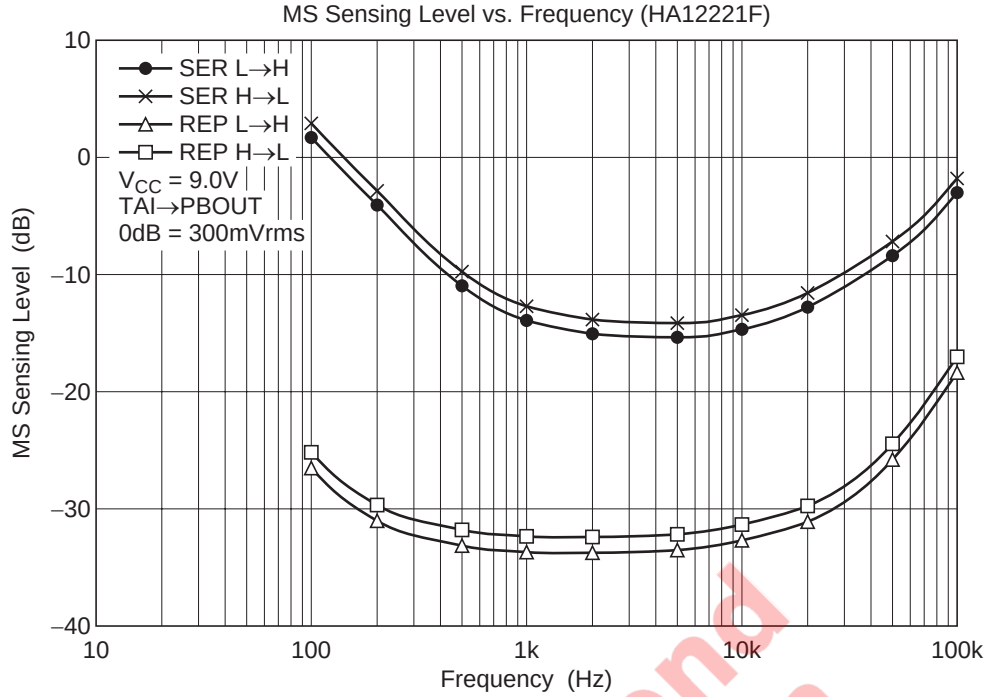
MS Amp. Gain vs. Frequency (HA12221F) (1)



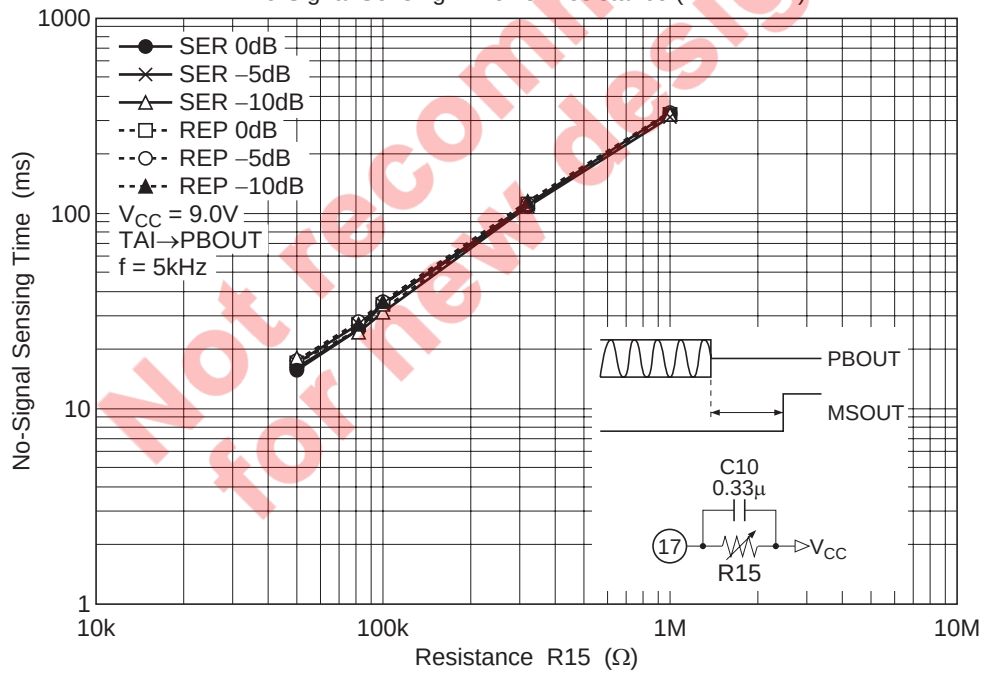
MS Amp. Gain vs. Frequency (HA12221F) (2)

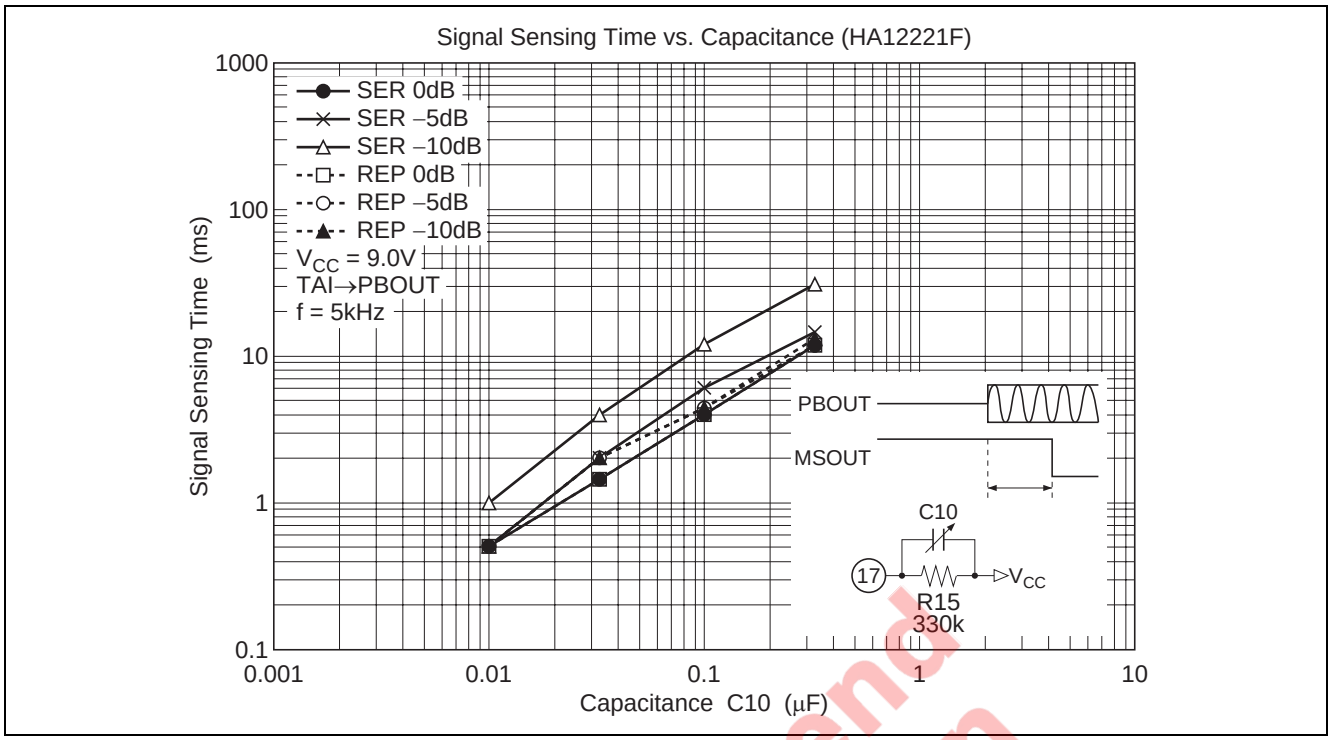


MS Sensing Level vs. Frequency (HA12221F)



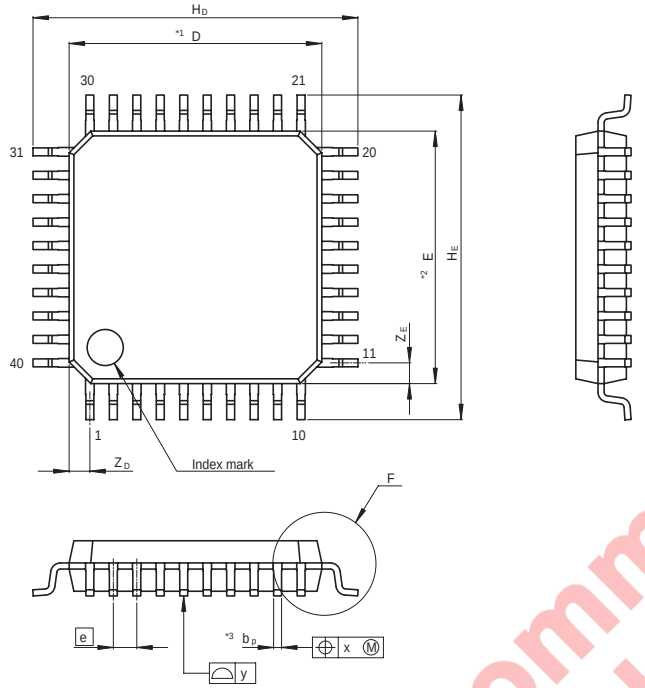
No-Signal Sensing Time vs. Resistance (HA12221F)



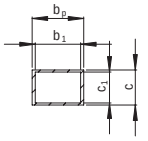


Package Dimensions

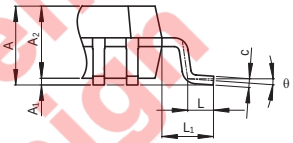
JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-LQFP40-7x7-0.65	PLQP0040JB-A	FP-40B	0.2g



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	—

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Colophon 2.0