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April 1st, 2010
Renesas Electronics Corporation

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HA12237F

Audio Signal Processor for Cassette Deck

REJ03F0137-0100
(Previous: ADE-207-343)
Rev.1.00
Jun 15, 2005

Description

HA12237F is silicon monolithic bipolar IC providing PB equalizer, REC equalizer system, ALC and each electronic control switch in one chip.

Functions

- PB equalizer × 2 channel
- REC equalizer × 2 channel
- ALC (Automatic Level Control)
- REC mute
- REC head return switch
- Line Amp. × 2 channel
- Line mute

Features

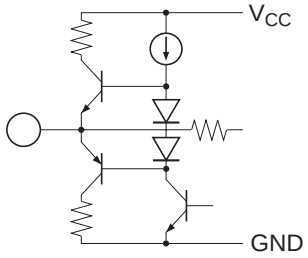
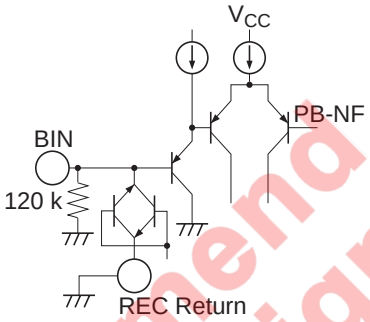
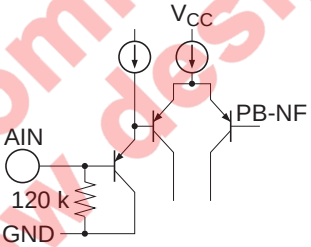
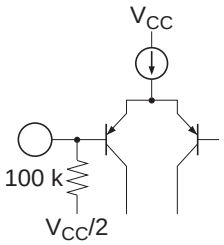
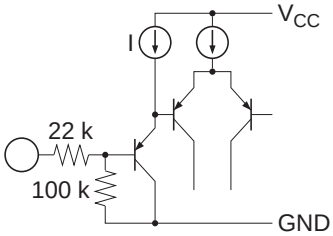
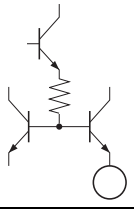
- REC equalizer is very small number of external parts built-in 2 types of frequency characteristics.
- TYPE I REC correspondence, High-speed dubbing correspondence.
- PB equalizer circuit built-in 2 types of frequency characteristics. (external parts of capacitor only)
- Head control switch built-in.
- Line mute switch built-in.
- Controllable from direct micro-computer output.

Parallel Data Format

Pin No.	Pin Name	Lo	Hi
11	ALC ON/$\overline{\text{OFF}}$	ALC OFF	ALC ON
12	High/$\overline{\text{Norm}}$	Normal speed	High speed
13	A/$\overline{\text{B}}$	B	A
	REC Return ON/$\overline{\text{OFF}}$	Return OFF	Return ON
14	MUTE ON/$\overline{\text{OFF}}$	MUTE OFF	MUTE ON
15	REC MUTE OFF/$\overline{\text{ON}}$	REC MUTE ON	REC MUTE OFF

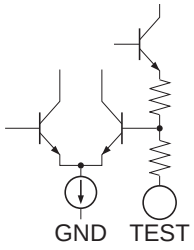
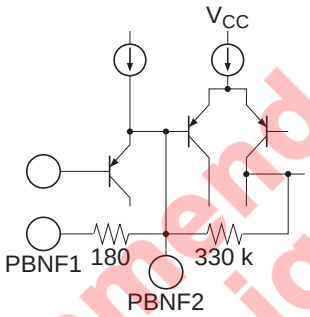
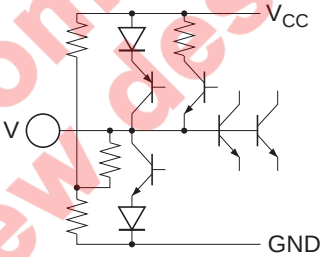
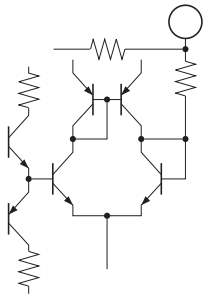
Pin Description, Equivalent Circuit

(V_{CC} = 12 V, Ta = 25°C, No Signal, The value in the table shows typical value.)

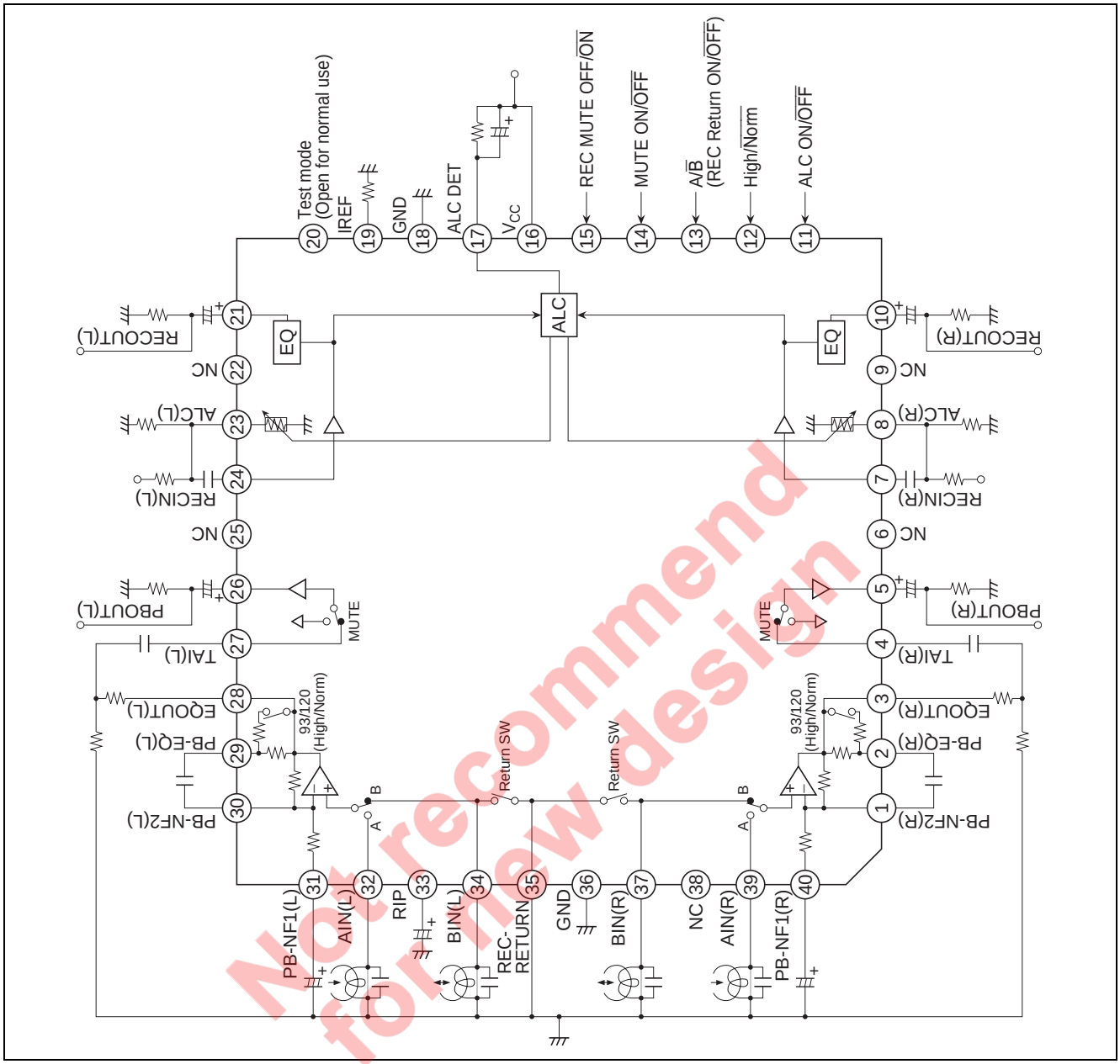
Pin No.	Pin Name	Note	Equivalent Circuit	Description
16	V_{CC}	V = V_{CC}		V_{CC} pin
21	RECOUT(L)	V = V_{CC}/2		REC output
10	RECOUT(R)			
26	PBOUT(L)			PB output
5	PBOUT(R)			
28	EQOUT(L)	V = 2.9 V		EQ output
3	EQOUT(R)			
35	REC-RETURN	V = 0 V		REC Return
34	BIN(L)			PB B deck input
37	BIN(R)			
32	AIN(L)	V = 0 V		PB A deck input
39	AIN(R)			
24	RECIN(L)	V = V_{CC}/2		REC-EQ input
7	RECIN(R)			
27	TAI(L)	V = V_{CC}/2		Tape input
4	TAI(R)			
11	ALC ON/$\overline{\text{OFF}}$	(Control voltage = 3 V)		Mode control input
12	High/$\overline{\text{Norm}}$			
13	A/$\overline{\text{B}}$			
14	MUTE ON/$\overline{\text{OFF}}$			
15	REC MUTE OFF/$\overline{\text{ON}}$			
19	IREF	V = 1.2 V		Equalizer reference current input

Pin Description, Equivalent Circuit (cont.)

(V_{CC} = 12 V, Ta = 25°C, No Signal, The value in the table shows typical value.)

Pin No.	Pin Name	Note	Equivalent Circuit	Description
18, 36	GND			GND pin
6, 9, 22, 25, 38	NC			NC pin
20	Test mode			Test mode pin
31	PB-NF1(L)	V = 0.6 V		PB EQ feed back
40	PB-NF1(R)			
30	PB-NF2(L)			
1	PB-NF2(R)			
33	RIP	V = V_{CC}/2		Ripple filter
29	PB-EQ(L)			NAB output
2	PB-EQ(R)			

Block Diagram



Functional Description

Power Supply Range

This IC designed to operate on single supply, shown by table 1.

Table 1 Supply Voltage

Item	Power Supply Range
Single supply	6.5 V to 15.0 V

Reference Voltage

This device provide the reference voltage of half the supply voltage that is the signal grounds. As the peculiarity of this device, 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.

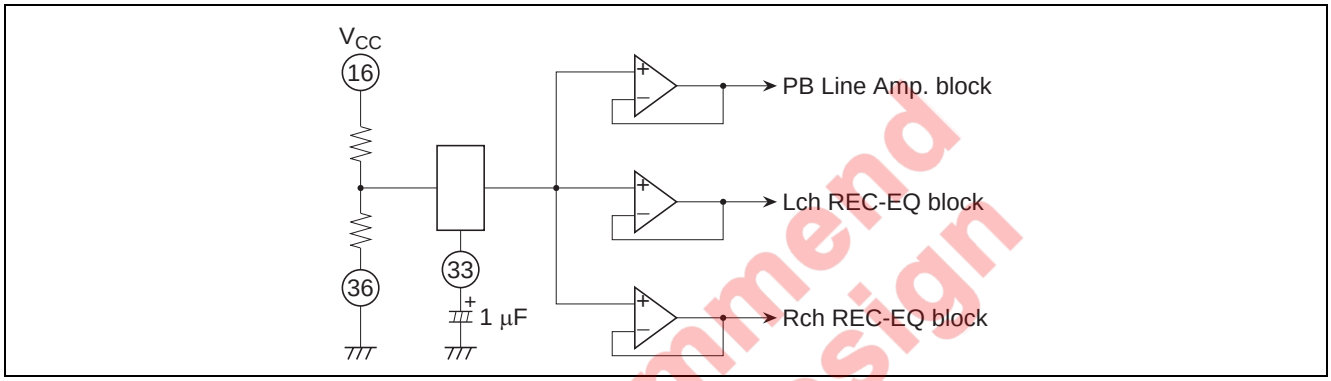


Figure 1 Block Diagram of Reference Supply Voltage

Operating Mode Control

HA12235F provide fully electronic switching circuits. And each operating mode control is controlled by parallel data (DC voltage).

Table 2 Threshold Voltage (V_{TH})

Pin No.	Lo	Mid	Hi	Unit	Test Condition
11 to 15	–0.2 to 0.5	—	2.4 to V_{CC}	V	Input Pin Measure V

Notes: 1. Each pins are on pulled down with 100 kΩ internal resistor. Therefore, it will be low-level when each pins are open.
2. Over shoot level and under shoot level of input signal must be the standardized. (High: V_{CC}, Low: –0.2 V)

Test Mode

Test mode becomes when pin 20 is shorted to GND. Please open pin 20 on the occasion of mount.

Block Diagram

As this IC is built-in REC return switch, the configuration system can be simple system using a few external component and the REC/PB head.

About these logics, please look at the Parallel Data Format.

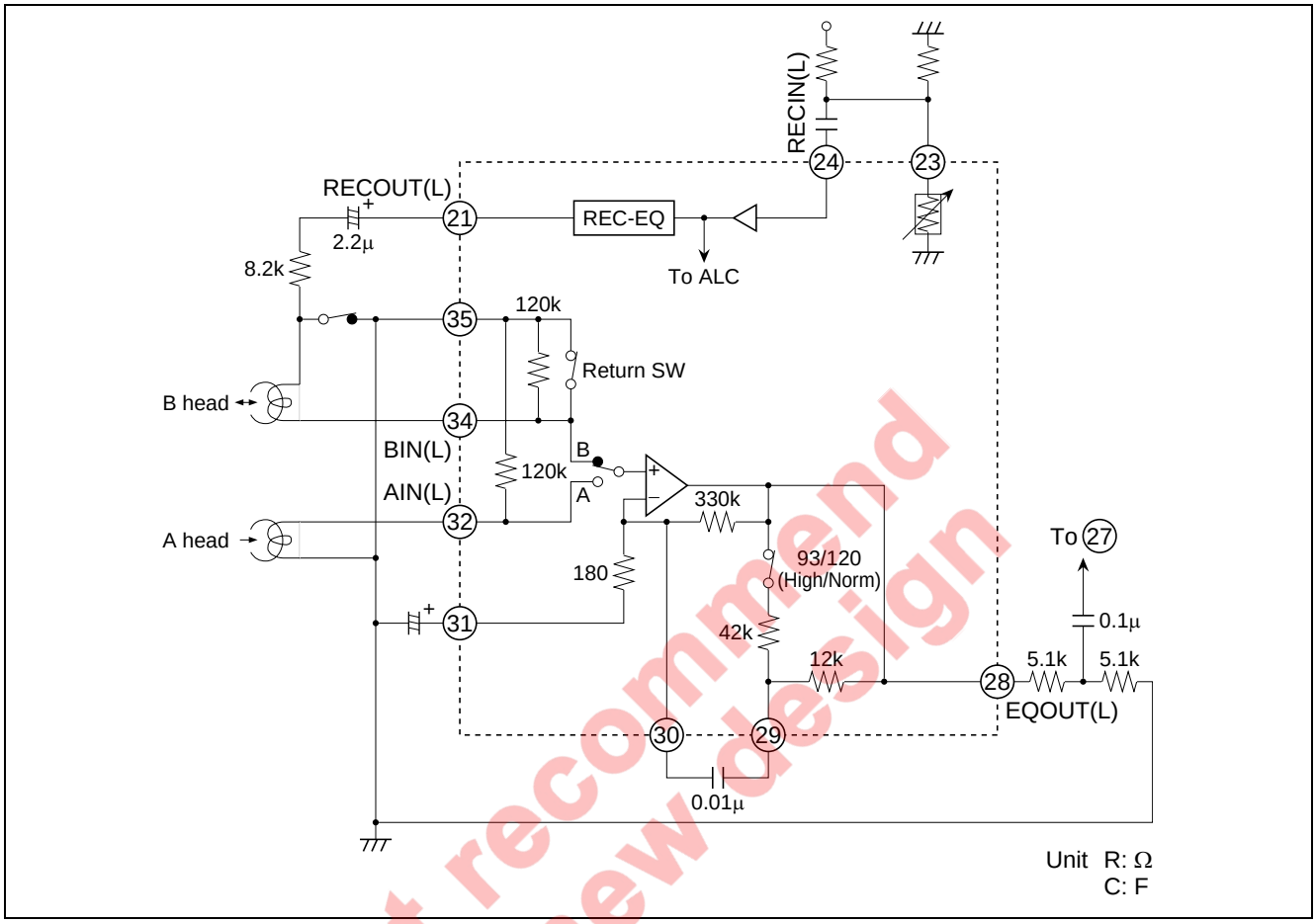


Figure 2 Block Diagram (Lch)

PB Equalizer

The gain establishment of PB-EQ considers PB output level {(internal Line Amp. + PB Amp.) = 580 mVrms} like figure 3 at the target.

After replace RA and RB with a half-fix volume, adjust level.

REC-EQ adjust the gain in front of input to this IC.

The level digram of 1 kHz is shown figure 3.

Please set “RA + RB ≥ 10 kΩ”

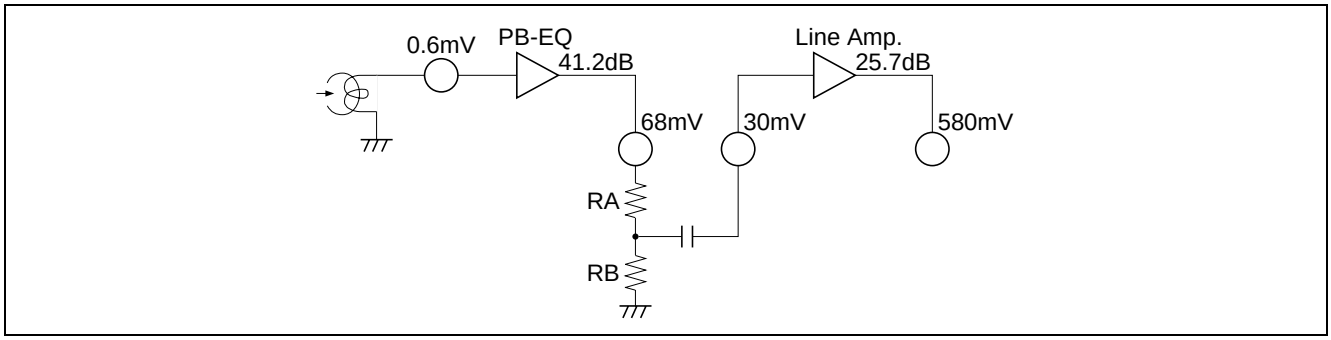


Figure 3 PB System Level Diagram (1 kHz)

Line Mute

This IC is built-in with mute circuit to Line Amp.

A mute control does with Low/High of pin 14.

Reducing pop noise is so much better 10 kΩ to 22 kΩ resistor to pin 14 in series and 1 µF to 22 µF capacitor.

A mute is not built-in when doing a power ON/OFF.

Please correspond to it, on the side of a set system.

REC Equalizer

REC-EQ gain adjust before the input of this IC.

R_L needs the value more than 5.6 kΩ based on the output at reference input.

Because mode establishment resistances are built-in, REC-EQ frequency characteristics are respectively fixed value.

In vase the change of the frequency characteristics are necessary, please inquire the responsible agent because the adjustment of resistors is necessary.

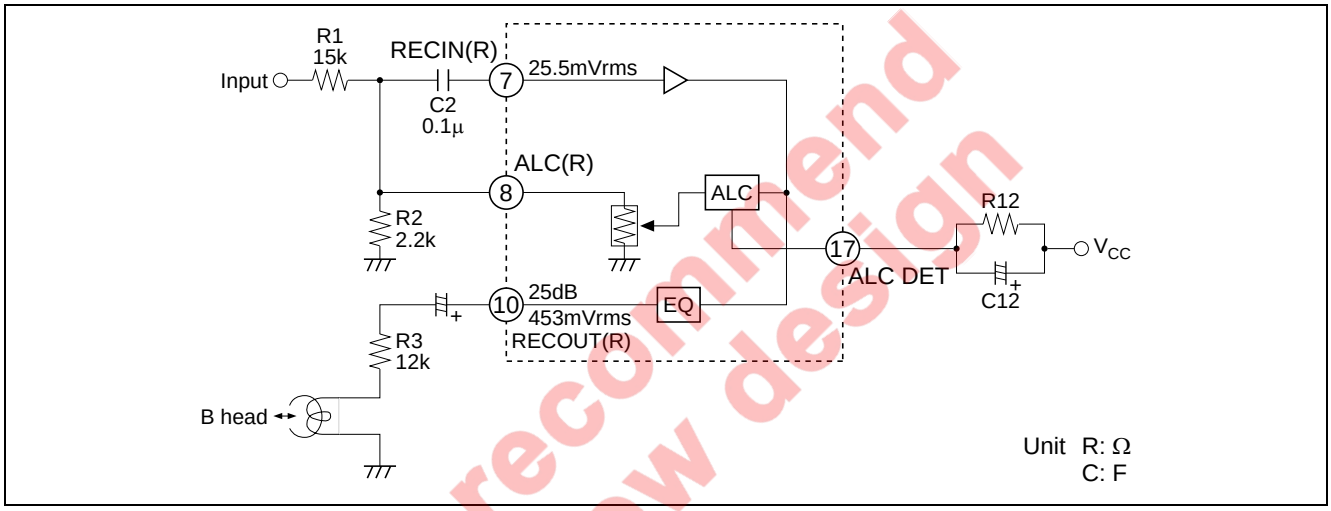


Figure 4 REC-EQ Block Diagram

ALC (Automatic Level Control)

ALC is the input decay rate variable system. It has internal variable resistors of pin 8 (pin 23) by REC signal that is inputted to pin 7 (pin 24).

Pin 17 is detector pin.

The signal input pin is pin 7 (pin 24). Resistor R1, R2 and capacitor C2, external components, for the input circuit are commended as figure 4. There are requested to use value of the block diagram figure for performance maintenance of S/N, T.H.D. etc.

Figure 5 shows the relation with R1 and C1 front input point and RECOUT.

ALC operation level acts for the center of +4.5 dB to standard level (453 mVrms).

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

ALC ON/OFF can switch it by pin 11. Please do ALC ON, after it does for one time ALC OFF inevitably, for ALC time to start usefully, in order to reset ALC circuit.

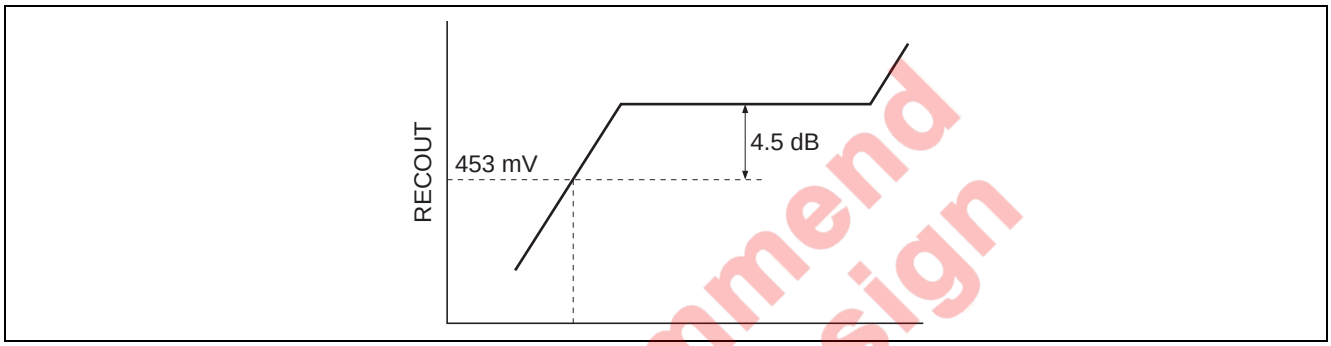


Figure 5 ALC Operation Level

Absolute Maximum Ratings

(Ta = 25°C)

Item	Symbol	Rating	Unit	Note
Maximum supply voltage	V_{CC} Max	16	V	
Power dissipation	P_T	625	mW	Ta ≤ 75°C
Operating temperature	Topr	–40 to +75	°C	
Storage temperature	Tstg	–55 to +125	°C	
Operating voltage	Vopr	6.5 to 15	V	

Note: HA12235F operates on single supply voltage.

Electrical Characteristics

(Ta = 25°C, V_{CC} = 12 V, PB-EQIN Standard level = 0.6 mVrms at 1 kHz, TAI Standard level = 30 mVrms, PBOUT Standard level = 580 mVrms)

Item	Symbol	Test Condition: IC Condition: A/$\overline{B}$	IC Condition: High/Norm	IC Condition: ALC ON/OFF	fin (Hz)	Vin (mVrms)	Other	Specification: Min	Typ	Max	Unit	Application Terminal: Input R	Input L	Output R	Output L	COM	Remark
Quiescent current	I_Q	A	Norm	OFF	—	—	No signal	—	12.2	20.2	mA	—	—	—	—	16	
Logical threshold	V_{IL}	—	—	—	—	—		–0.2	—	0.5	V	—	—	—	—	11 to 15	
	V_{IH}	—	—	—	—	—		2.4	—	V_{CC}	V	—	—	—	—	11 to 15	
PB-REC crosstalk	GT PB/REC(1)	A	Norm	OFF	1k	*1	REC-EQ→PB-EQ	50.0	60.0	—	dB	7	24	3	28	—	
	GT PB/REC(2)	A	Norm	OFF	1k	6.0	PB-EQ→REC-EQ	60.0	70.0	—	dB	39	32	10	21	—	
PB-EQ gain	GV PB(1)	A/B	Norm	OFF	1k	0.6		37.4	40.4	43.4	dB	39/37	28/29	3	28	—	
	GV PB(2)	A	Norm	OFF	10k	0.6		33.3	36.3	39.3	dB	39	32	3	28	—	
	GV PB(3)	A	High	OFF	20k	0.6		31.2	34.2	37.2	dB	39	32	3	28	—	
PB-EQ maximum output level	Vomax PB	A	Norm	OFF	1k	—	THD = 1%	0.3	0.6	—	Vrms	39	32	3	28	—	*2
PB-EQ T.H.D.	THD PB	A/B	Norm	OFF	1k	2.4		—	0.2	0.5	%	39/37	28/29	3	28	—	
PB-EQ noise voltage	VN PB	A/B	Norm	OFF	—	—	Rg = 680Ω, DIN-AUDIO	—	110	200	µVrms	39/37	28/29	3	28	—	
PB-EQ channel separation	CT R/L(1)	A	Norm	OFF	1k	6.0		50.0	60.0	—	dB	39	32	3	28	—	
PB-EQ crosstalk	CT A/B	A/B	Norm	OFF	1k	6.0		60.0	70.0	—	dB	39/37	28/29	3	28	—	
Line Amp. gain	G_V LA	A	Norm	OFF	1k	30.0		24.2	25.7	27.2	dB	4	27	5	26	—	
Line Amp. T.H.D.	THD LA	A	Norm	OFF	1k	30.0		—	0.05	0.30	%	4	27	5	26	—	
Line Amp. maximum output level	Vomax LA	A	Norm	OFF	1k	—	THD = 1%	1.16	1.40	—	Vrms	4	27	5	26	—	*2
Line mute attenuation	L-MUTE ATT	A	Norm	OFF	1k	120.0		70.0	80.0	—	dB	4	27	5	26	—	

Notes: 1. Large level without clipping
2. V_{CC} = 6.5V

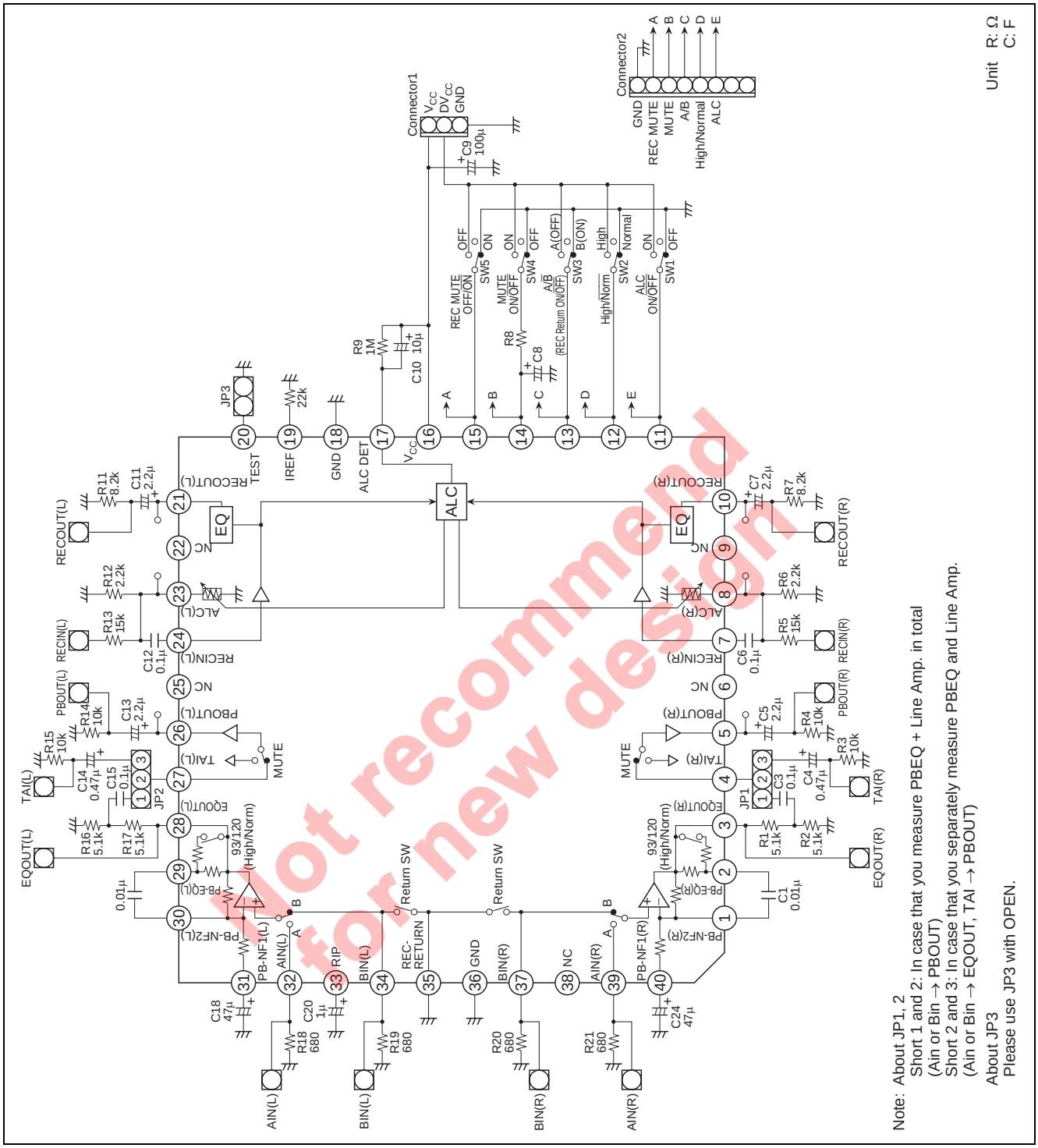
Electrical Characteristics (cont.)

($Ta = 25°C$, $V_{CC} = 12$ V, RECIN Standard level = 200 mVrms (IC in Level = 25.5 mVrms) = 0 dB

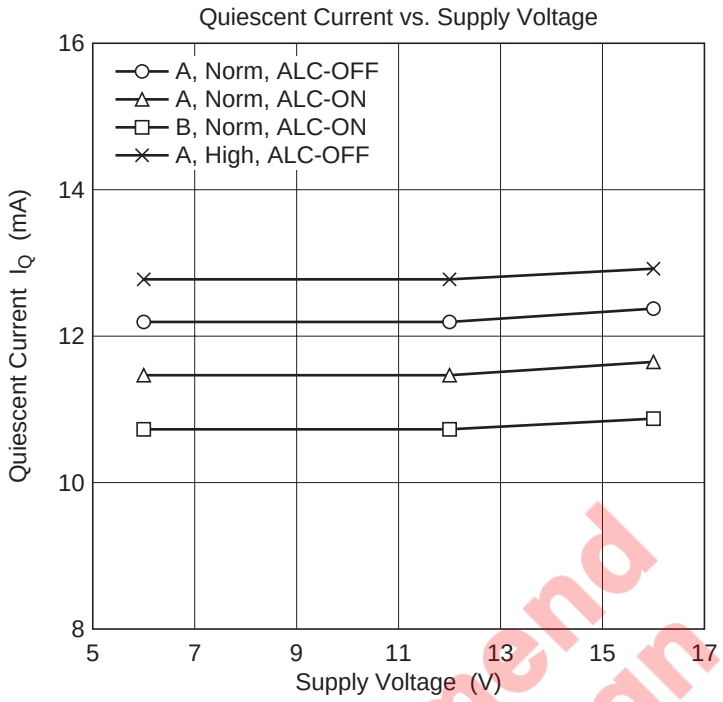
Item	Symbol	Test Condition						Specification			Unit	Application Terminal					Remark
		IC Condition										Input		Output			
		A/$\overline{B}$	High/$\overline{Norm}$	ALC ON/OFF	fin (Hz)	Vin (mVrms)	Other	Min	Typ	Max		R	L	R	L	COM	
ALC operate level	ALC	A	Norm	ON	1k	+12		2.0	4.5	7.0	dB	7	24	10	21	—	
REC-EQ frequency characteristics Normal speed	GV REC-NN1	A	Norm	OFF	1k	–26		23.5	25.0	26.5	dB	7	24	10	21	—	
	GV REC-NN2	A	Norm	OFF	5k	–26		26.9	28.9	30.9	dB	7	24	10	21	—	
	GV REC-NN3	A	Norm	OFF	10k	–26		33.2	35.7	38.2	dB	7	24	10	21	—	
REC-EQ frequency characteristics High speed	GV REC-HN1	A	High	OFF	2k	–26		23.4	24.9	26.4	dB	7	24	10	21	—	
	GV REC-HN2	A	High	OFF	10k	–26		26.5	28.5	30.5	dB	7	24	10	21	—	
	GV REC-HN3	A	High	OFF	20k	–26		33.4	35.9	38.4	dB	7	24	10	21	—	
REC-EQ channel separation	CT R/L(2)	A	Norm	OFF	1k	*1		61.0	70.0	—	dB	7	24	10	21	—	
REC-MUTE attenuation	R-MUTE ATT	A	Norm	OFF	1k	*1		66.0	76.0	—	dB	7	24	10	21	—	
REC-EQ maximum output level	Vomax REC	A	Norm	OFF	1k	—	THD = 1%	0.7	1.0	—	Vrms	7	24	10	21	—	*2
REC-EQ T.H.D.	THD REC	A	Norm	OFF	1k	0		—	0.2	0.5	%	7	24	10	21	—	
REC-EQ S/N	S/N REC	A	Norm	OFF	1k	—	Rg = 2.2kΩ, A-WTG	55.0	59.0	—	dB	—	—	10	21	—	

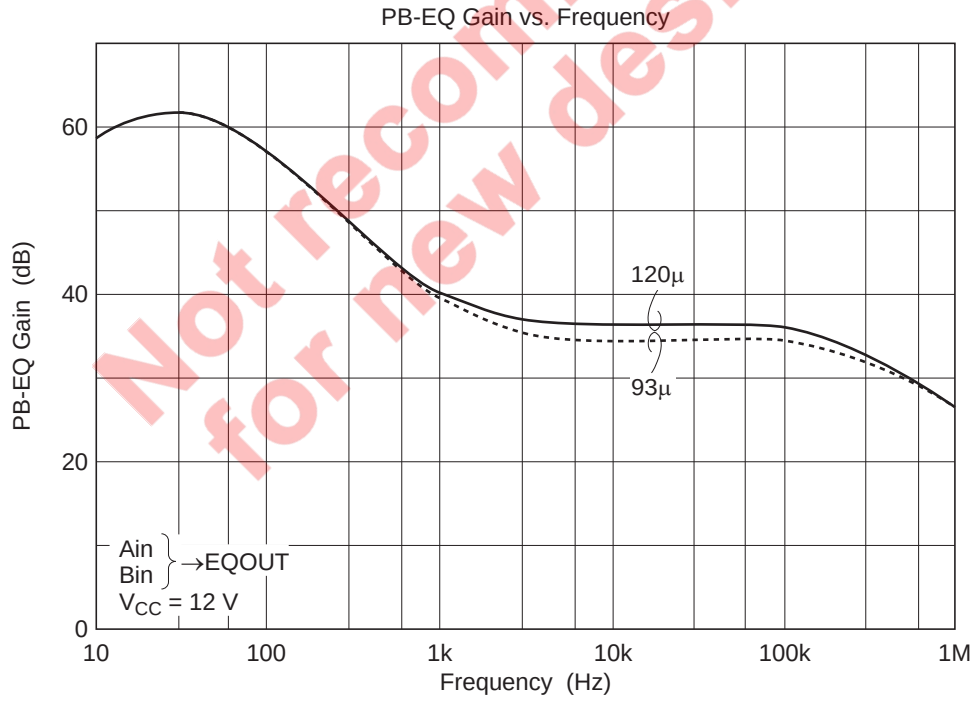
Notes: 1. Large level without clipping
2. $V_{CC} = 6.5V$

Test Circuit

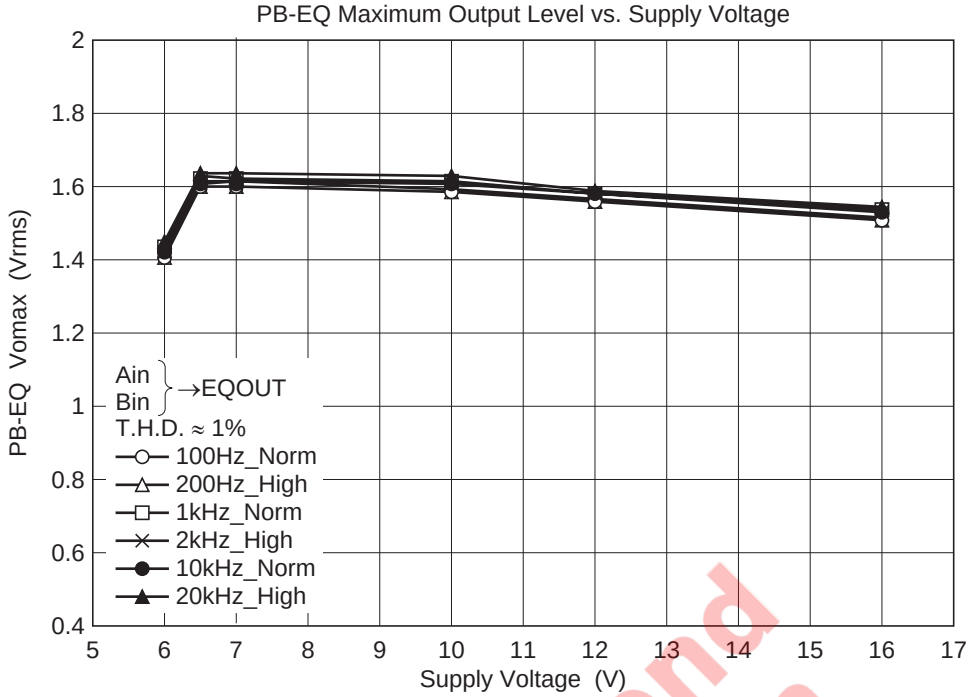


Characteristic Curves

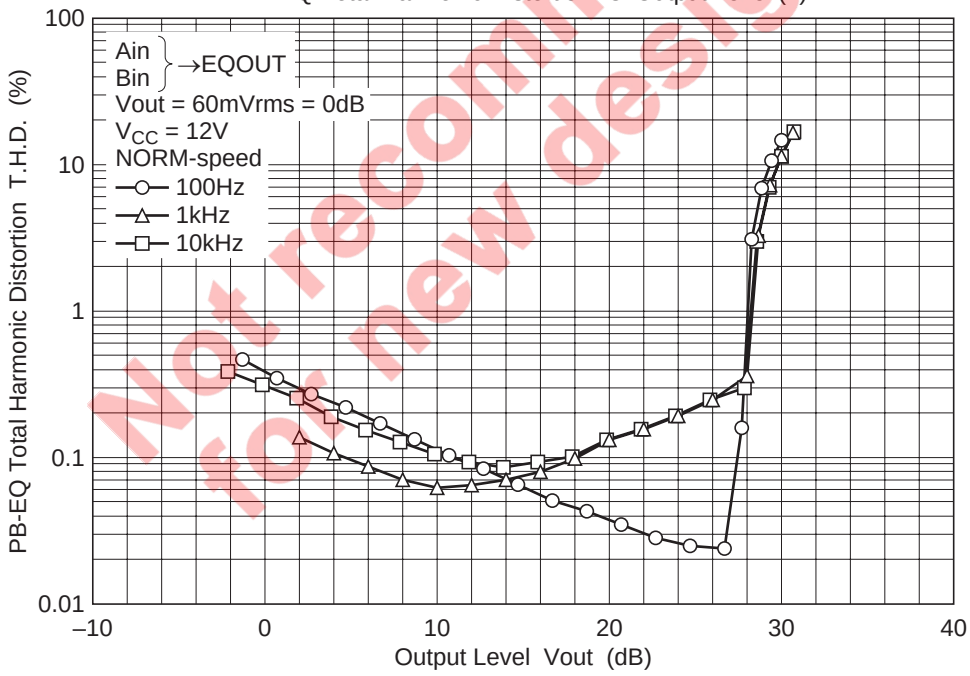




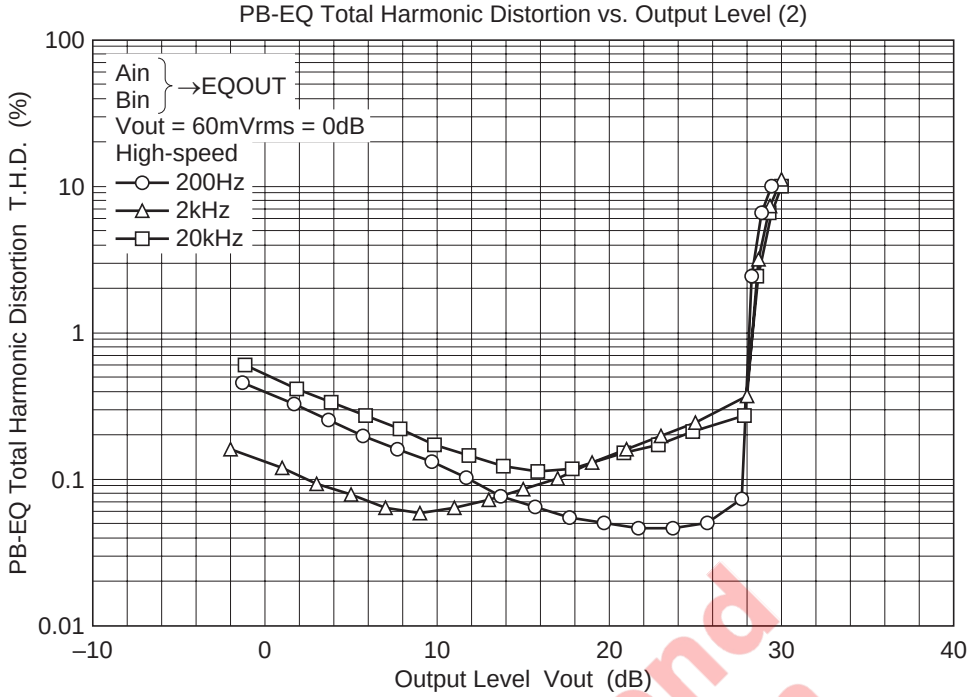
PB-EQ Maximum Output Level vs. Supply Voltage



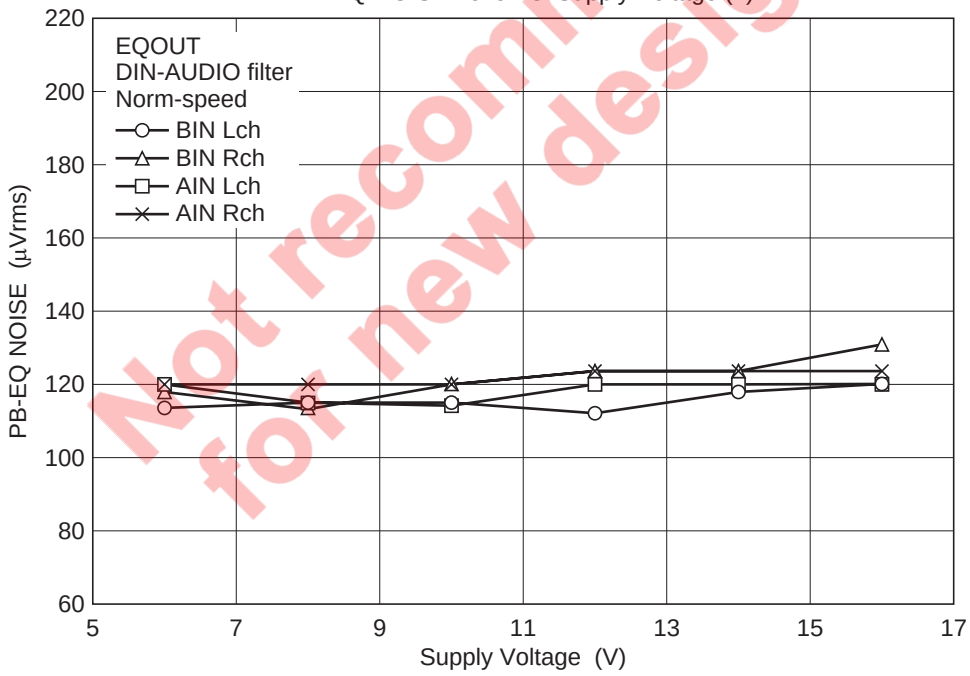
PB-EQ Total Harmonic Distortion vs. Output Level (1)



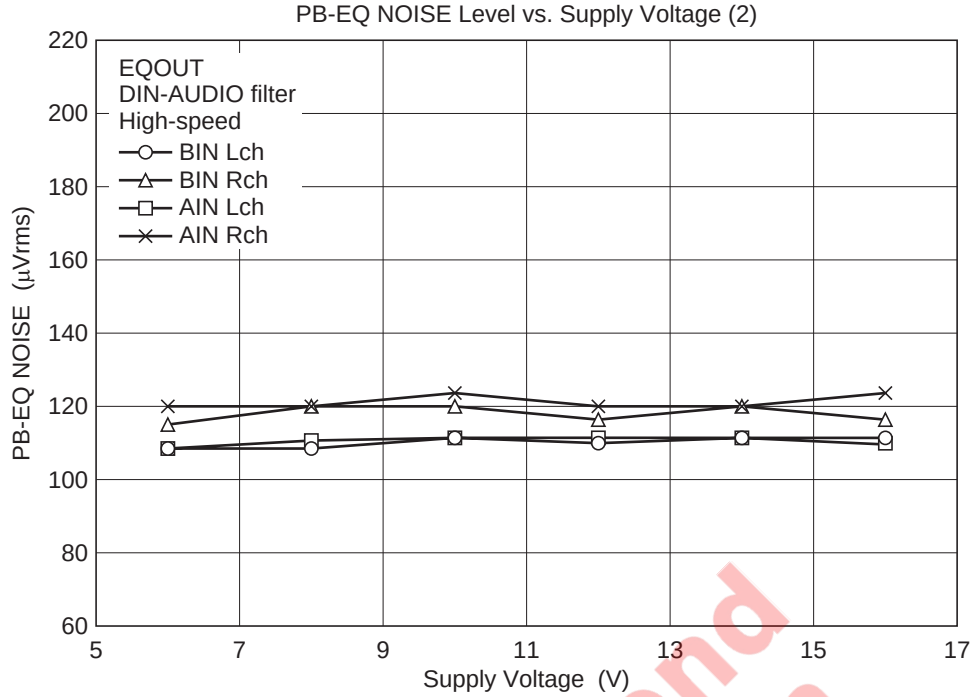
PB-EQ Total Harmonic Distortion vs. Output Level (2)



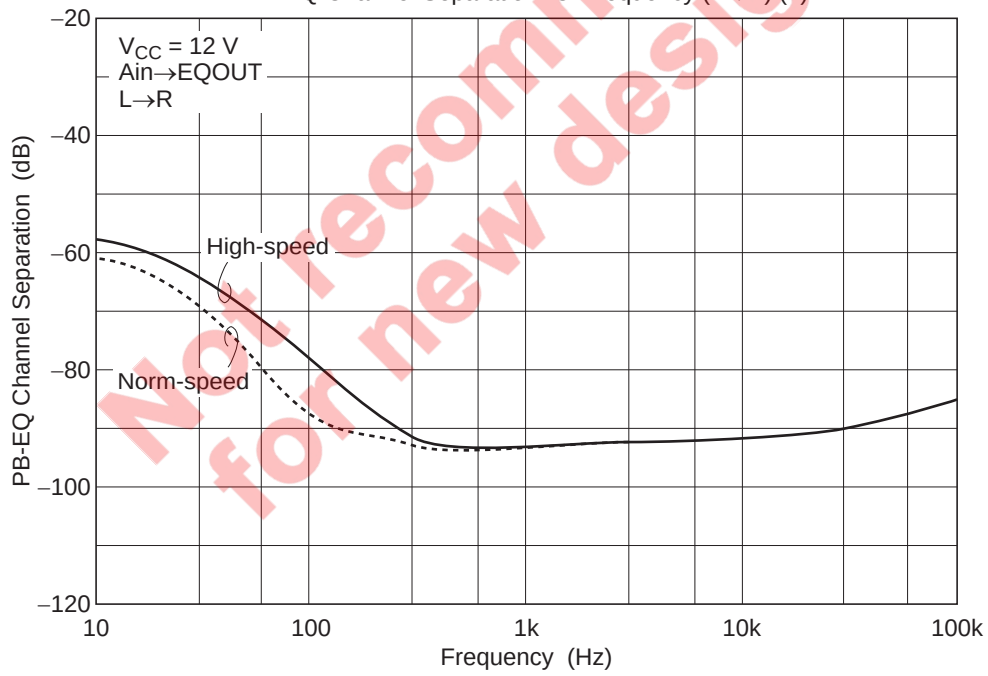
PB-EQ NOISE Level vs. Supply Voltage (1)



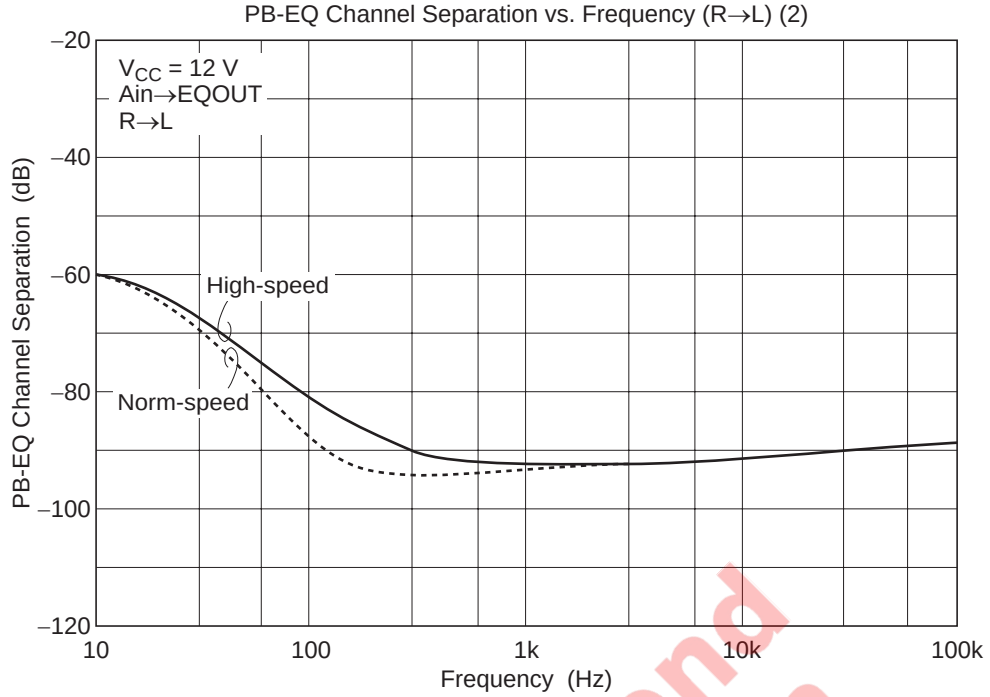
PB-EQ NOISE Level vs. Supply Voltage (2)



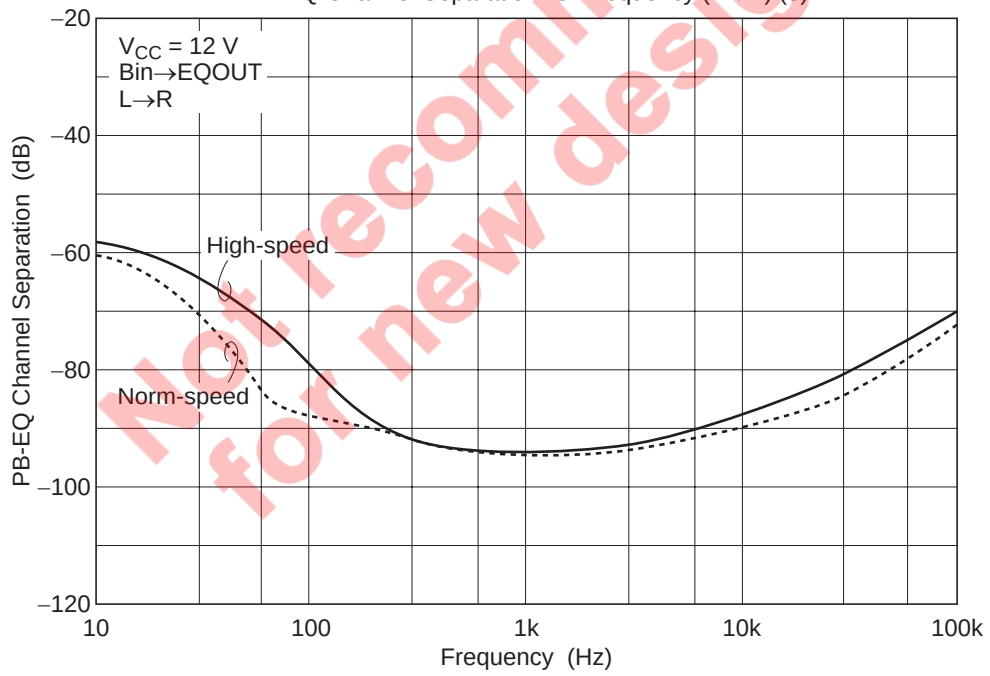
PB-EQ Channel Separation vs. Frequency (L→R) (1)



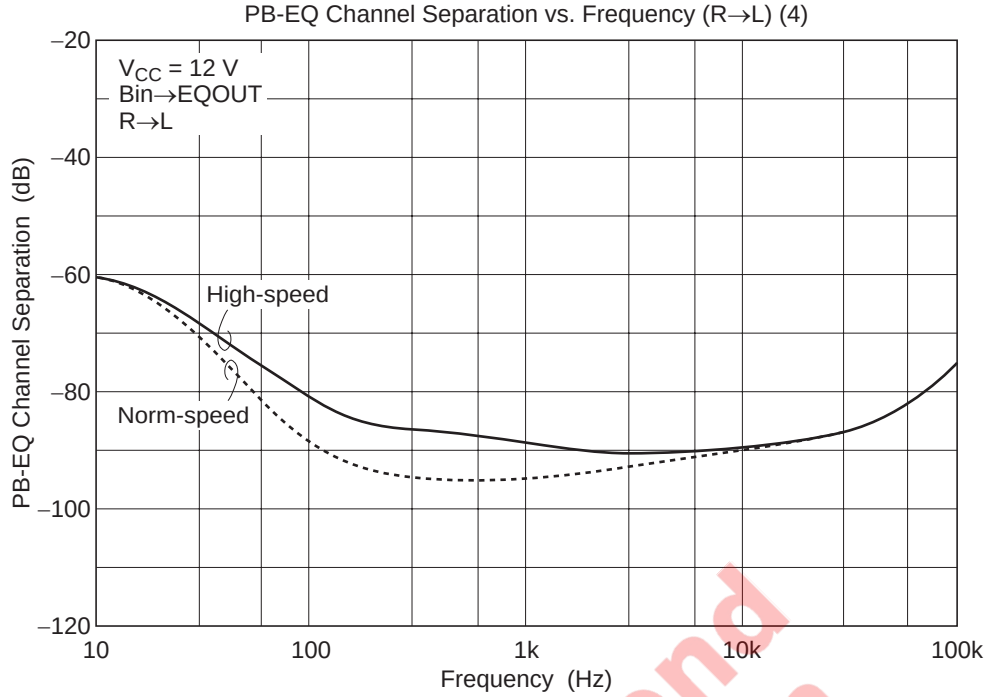
PB-EQ Channel Separation vs. Frequency (R→L) (2)



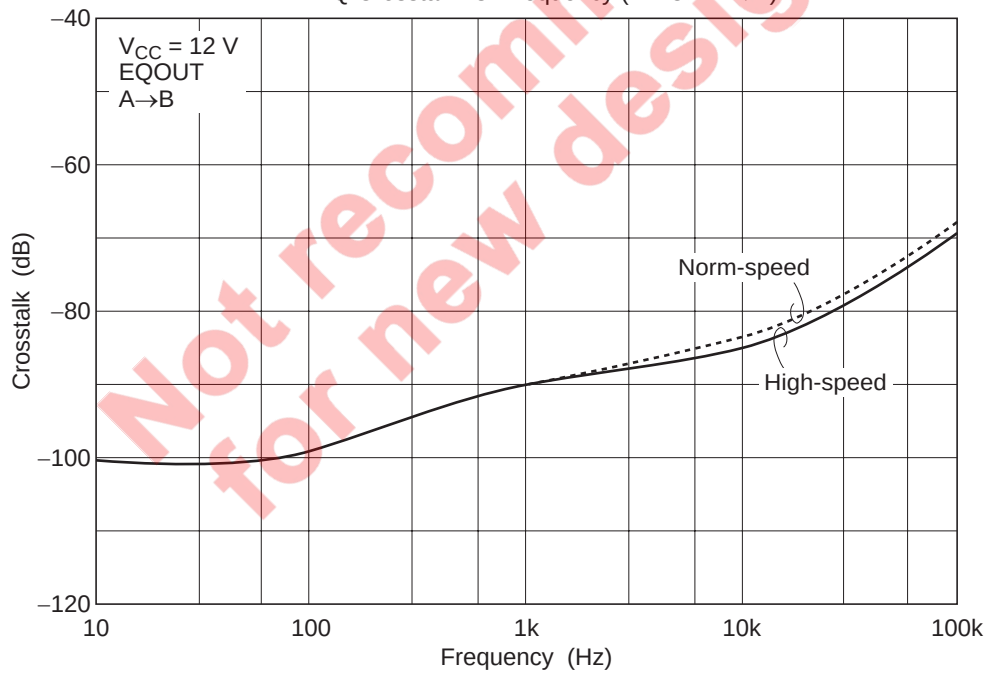
PB-EQ Channel Separation vs. Frequency (L→R) (3)



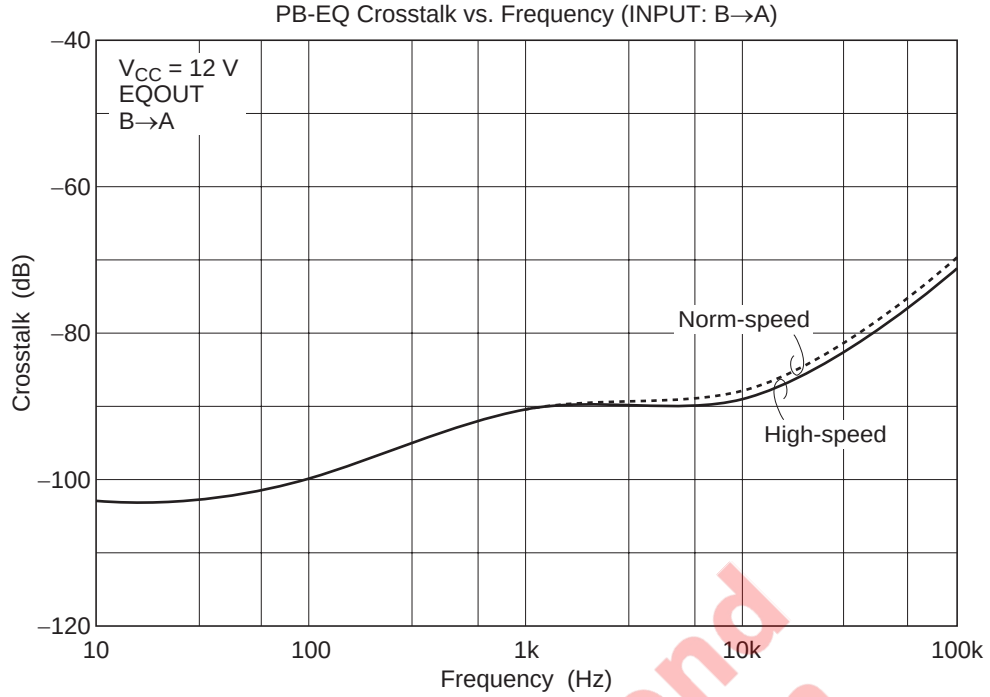
PB-EQ Channel Separation vs. Frequency (R→L) (4)



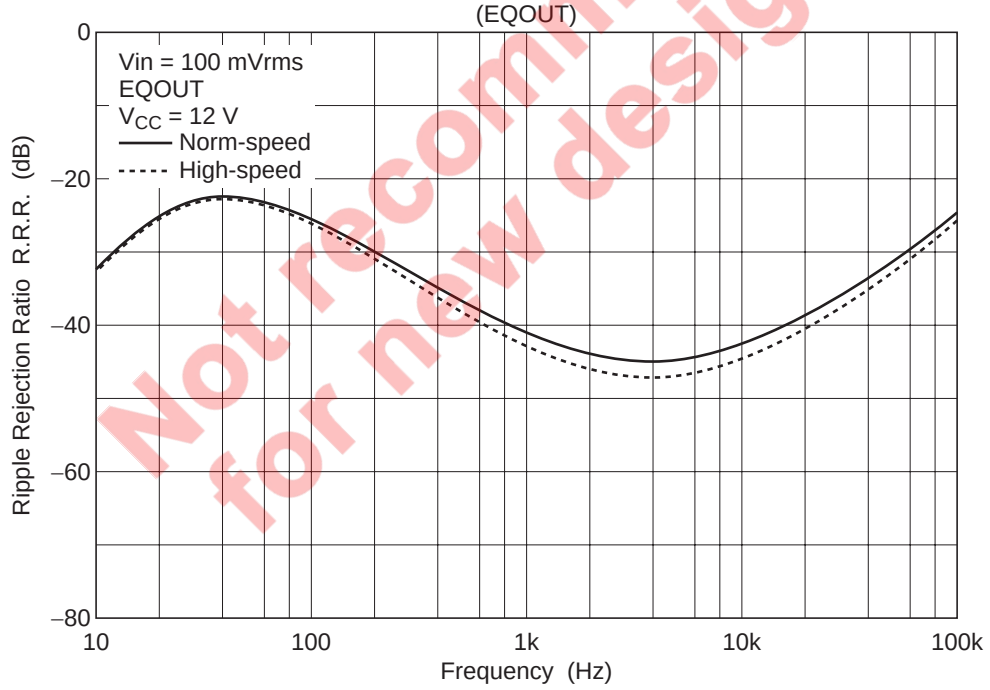
PB-EQ Crosstalk vs. Frequency (INPUT: A→B)



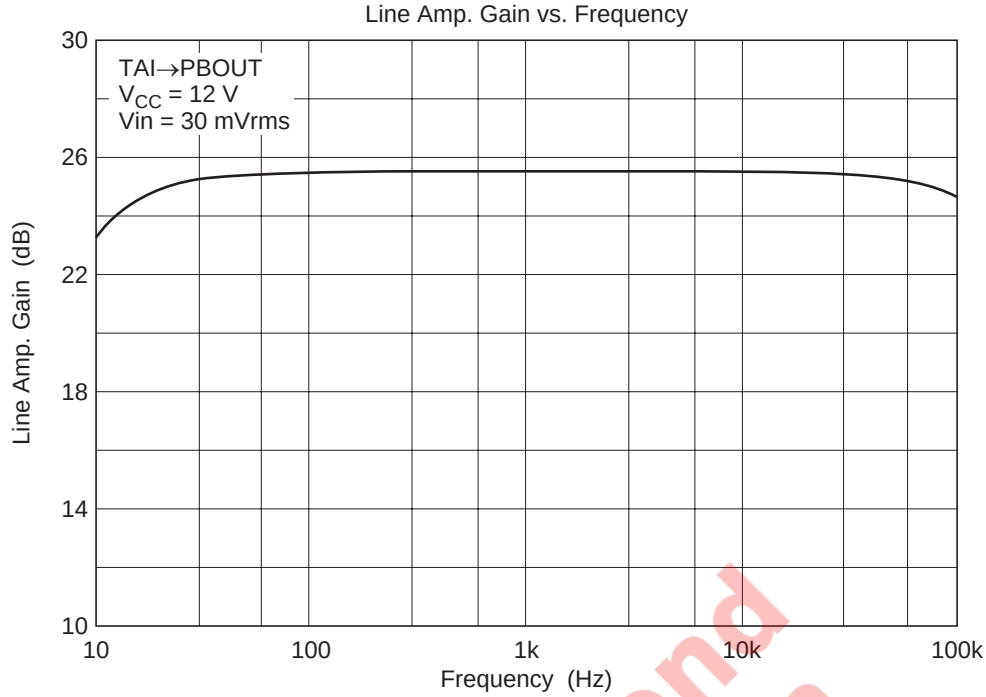
PB-EQ Crosstalk vs. Frequency (INPUT: B→A)



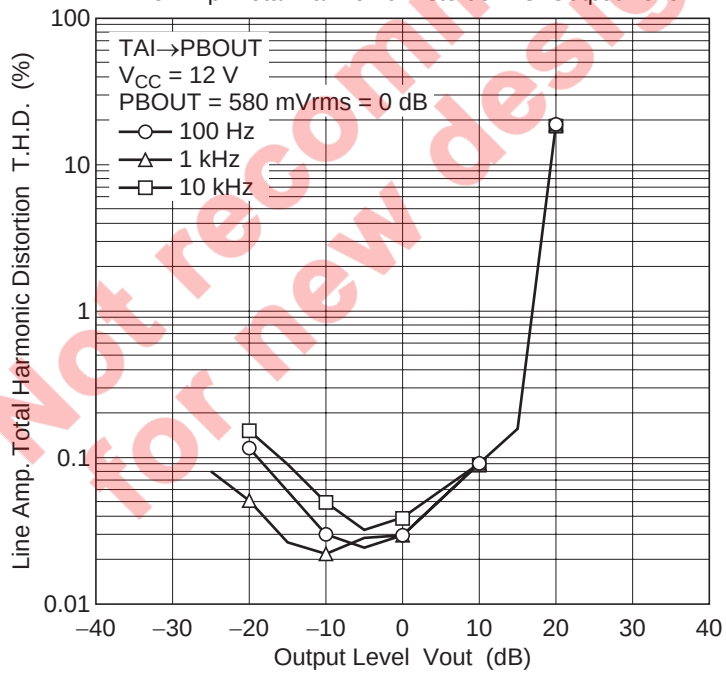
Ripple Rejection Ratio vs. Frequency (PB-EQ)
(EQOUT)



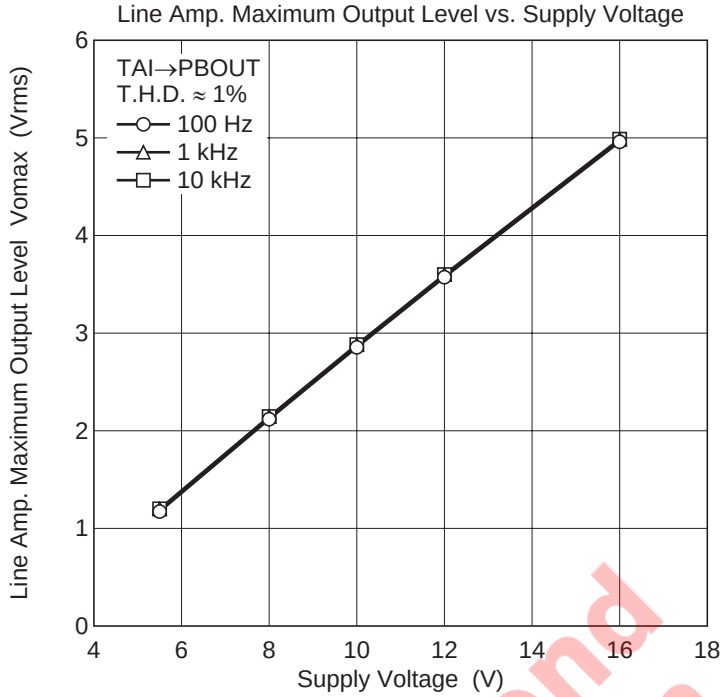
Line Amp. Gain vs. Frequency



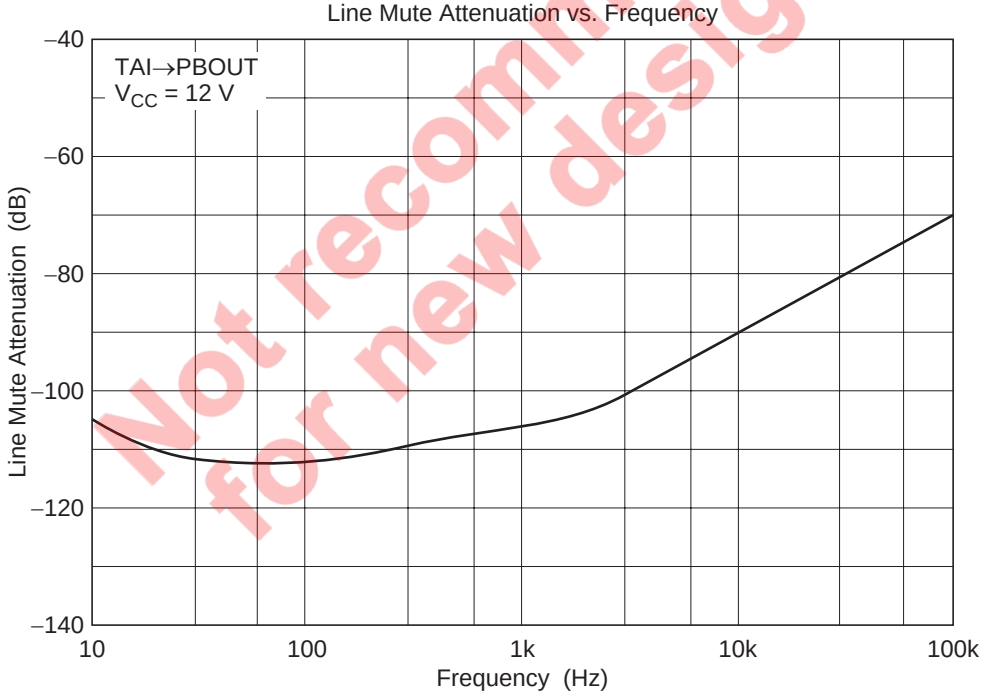
Line Amp. Total Harmonic Distortion vs. Output Level



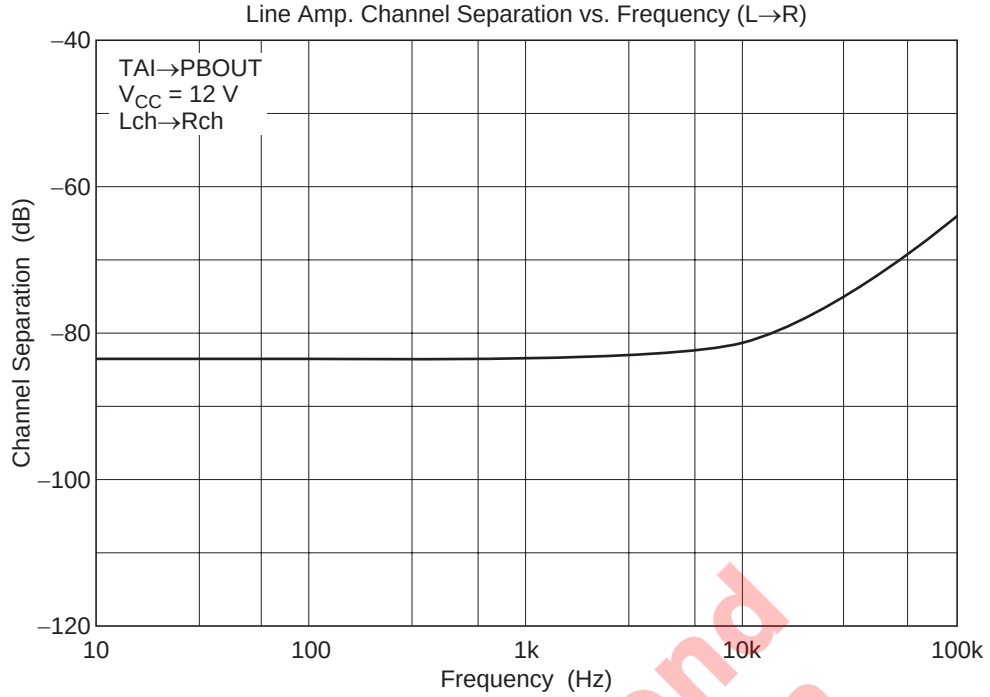
Line Amp. Maximum Output Level vs. Supply Voltage



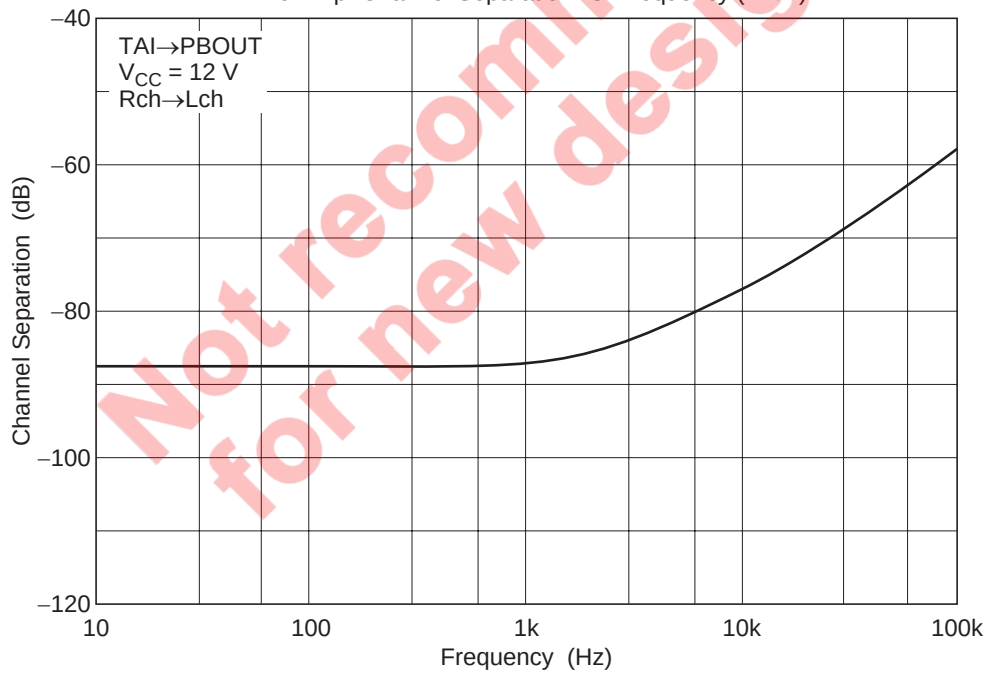
Line Mute Attenuation vs. Frequency



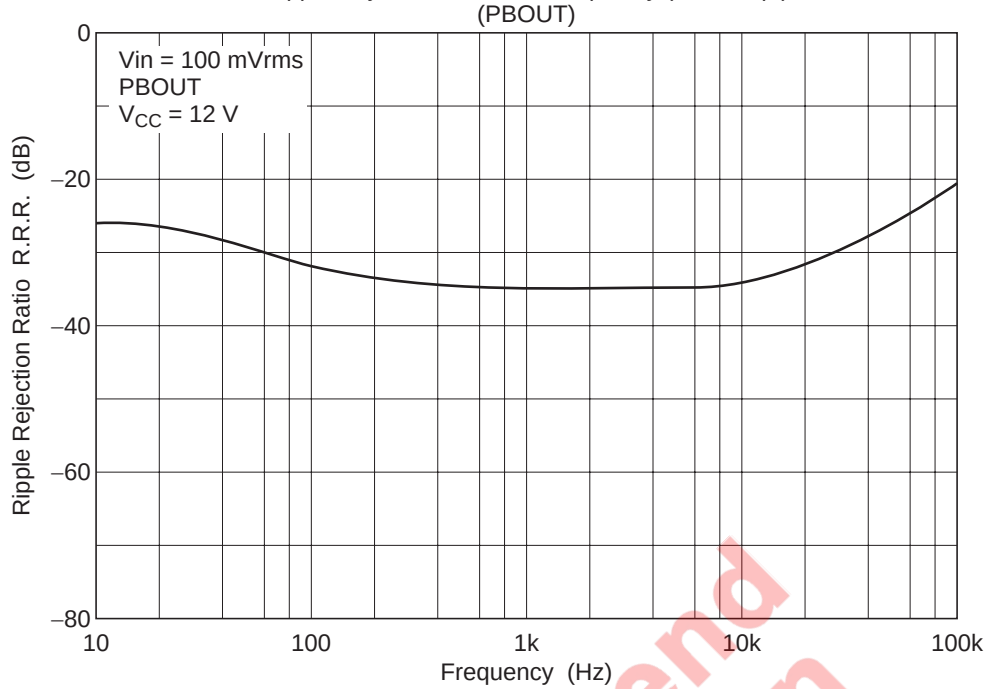
Line Amp. Channel Separation vs. Frequency (L→R)



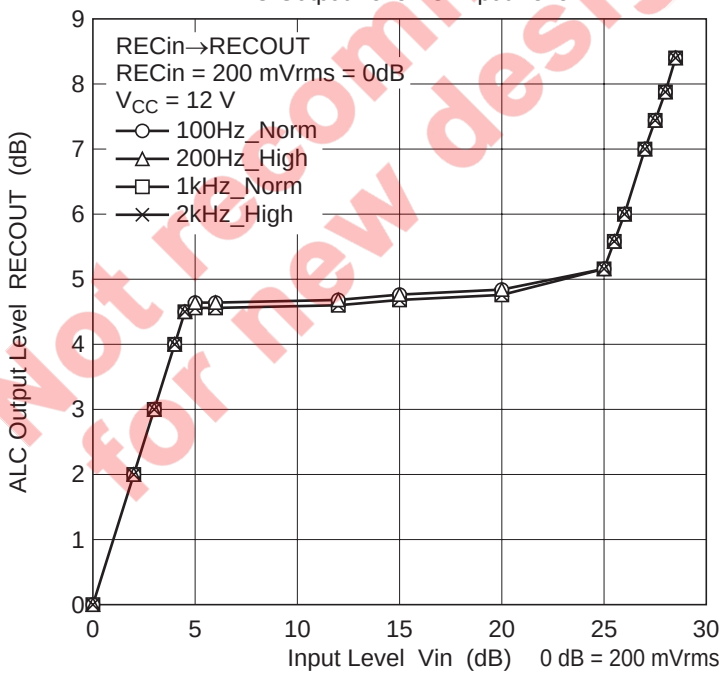
Line Amp. Channel Separation vs. Frequency (R→L)



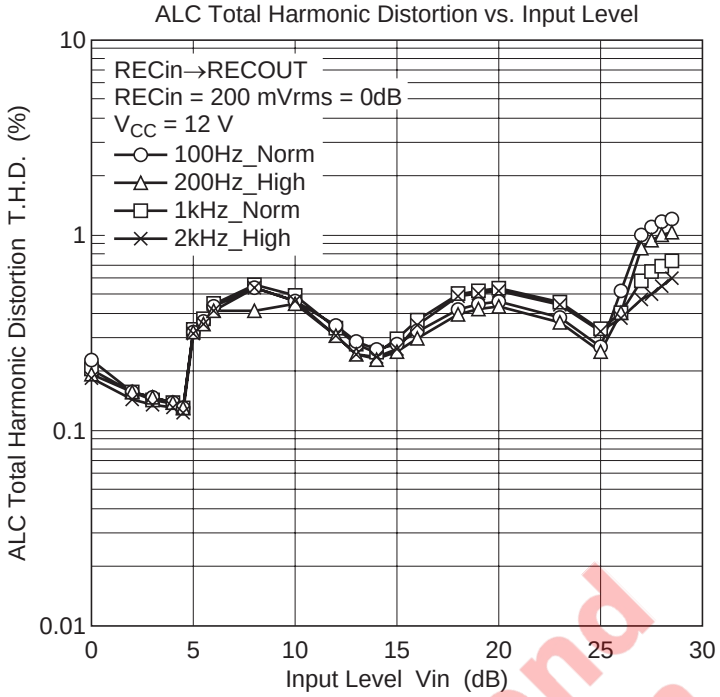
Ripple Rejection Ratio vs. Frequency (Line Amp.)
(PBOUT)



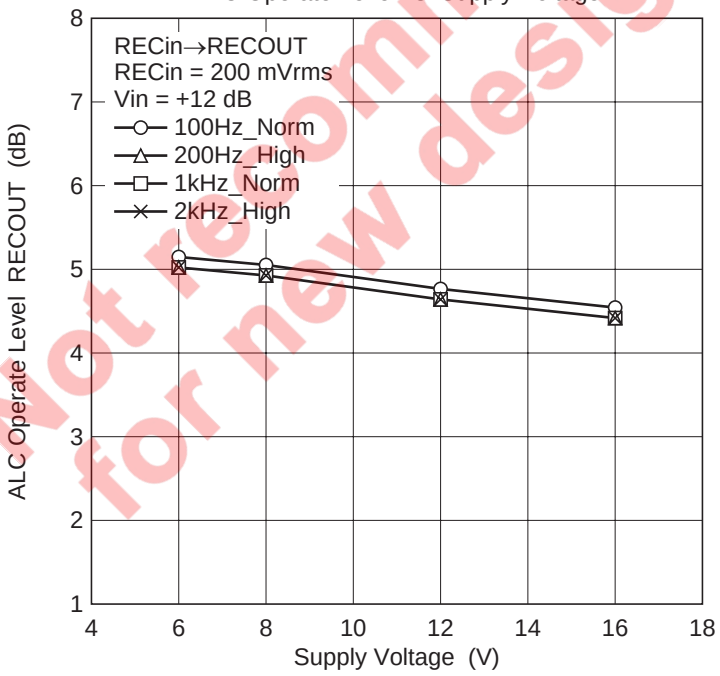
ALC Output Level vs. Input Level

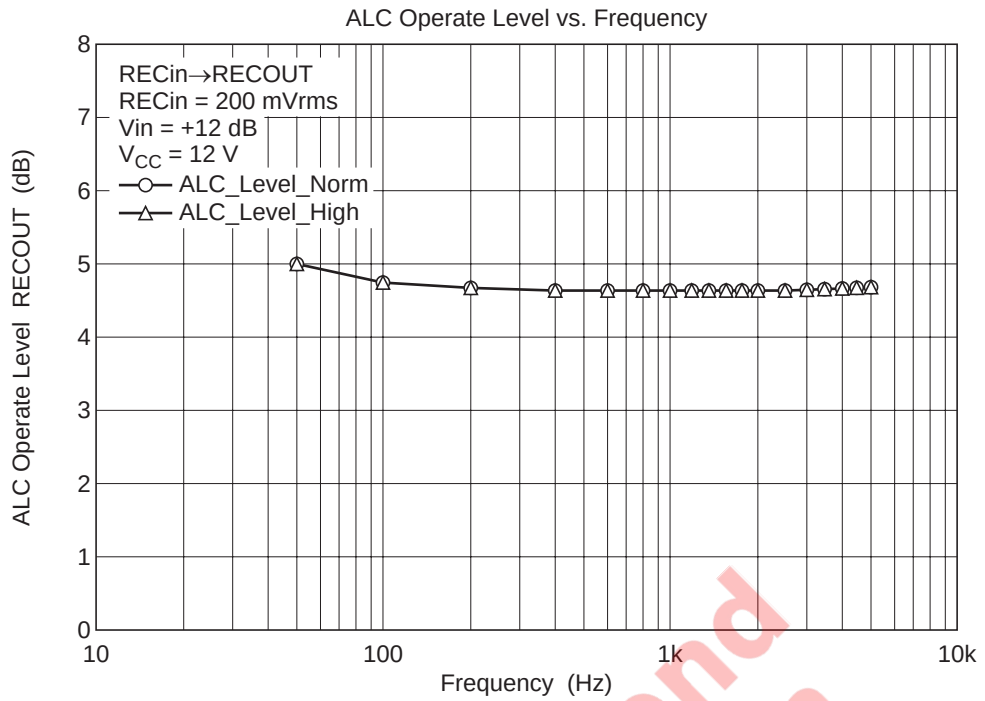


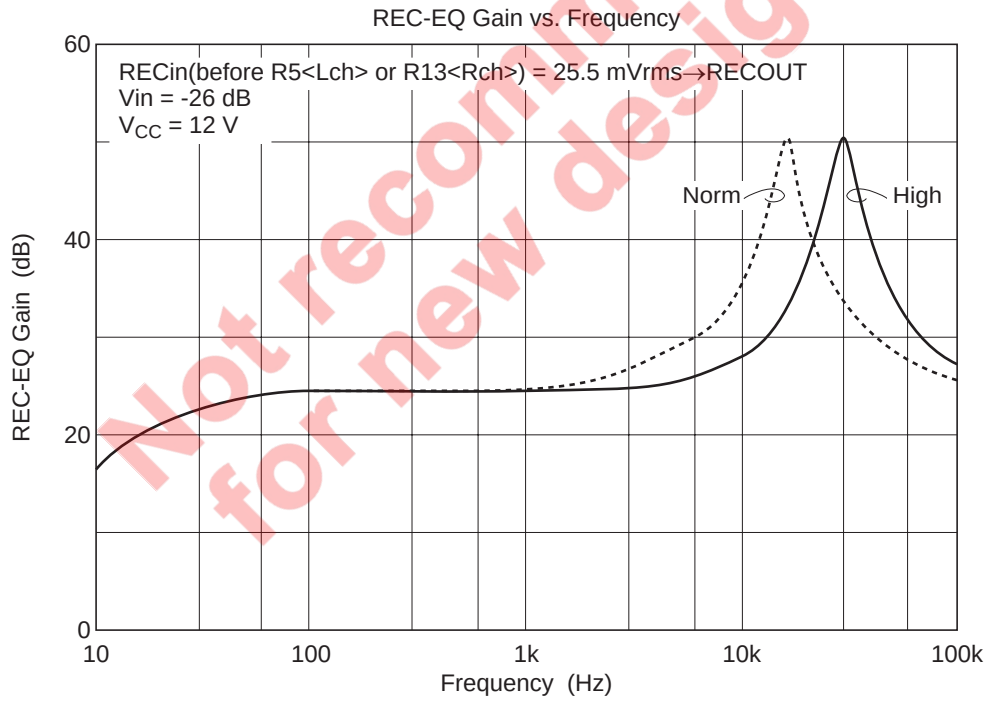
ALC Total Harmonic Distortion vs. Input Level



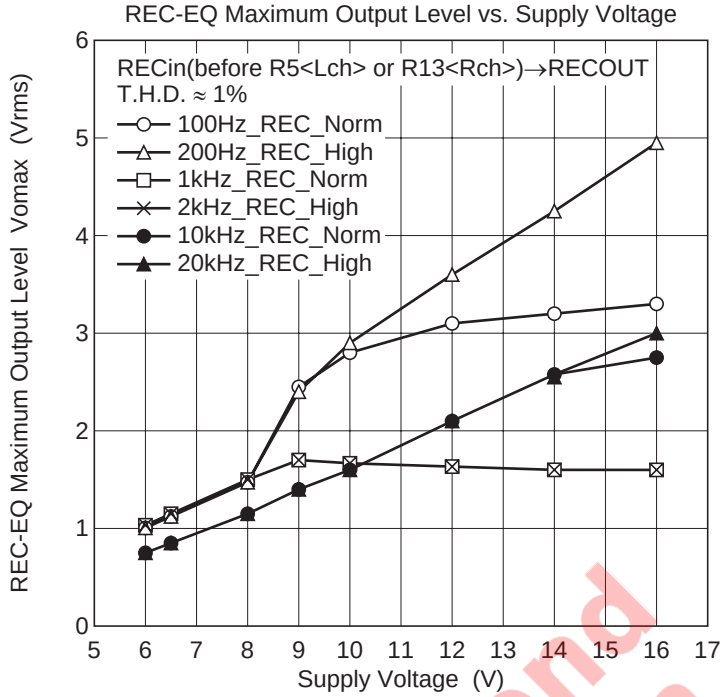
ALC Operate Level vs. Supply Voltage



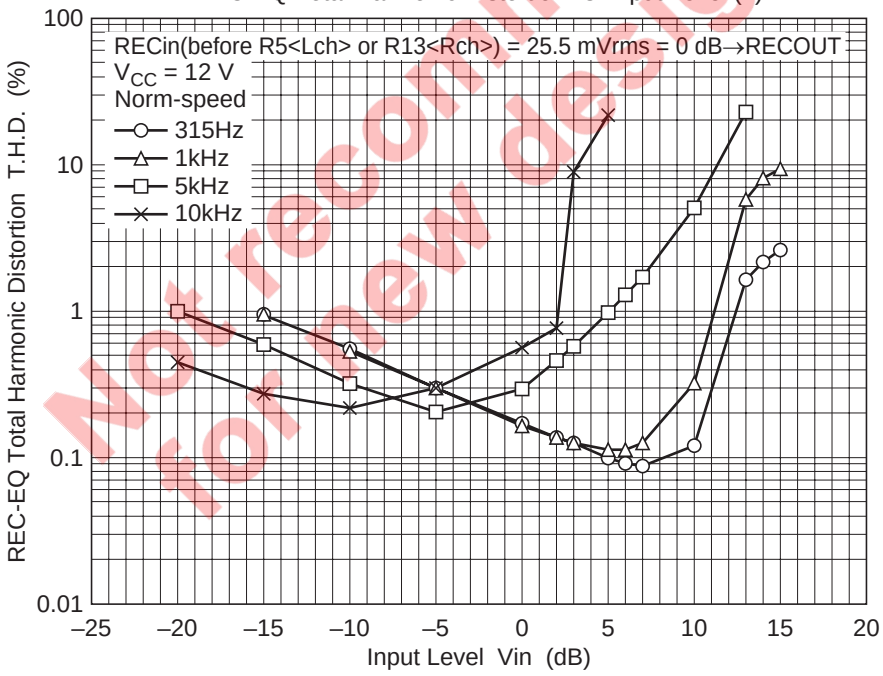




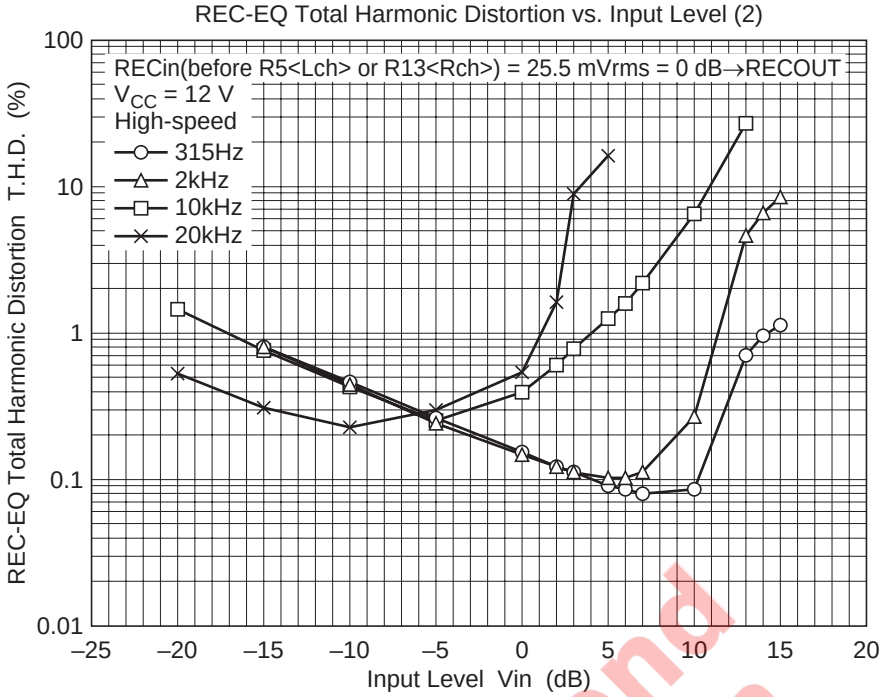
REC-EQ Maximum Output Level vs. Supply Voltage



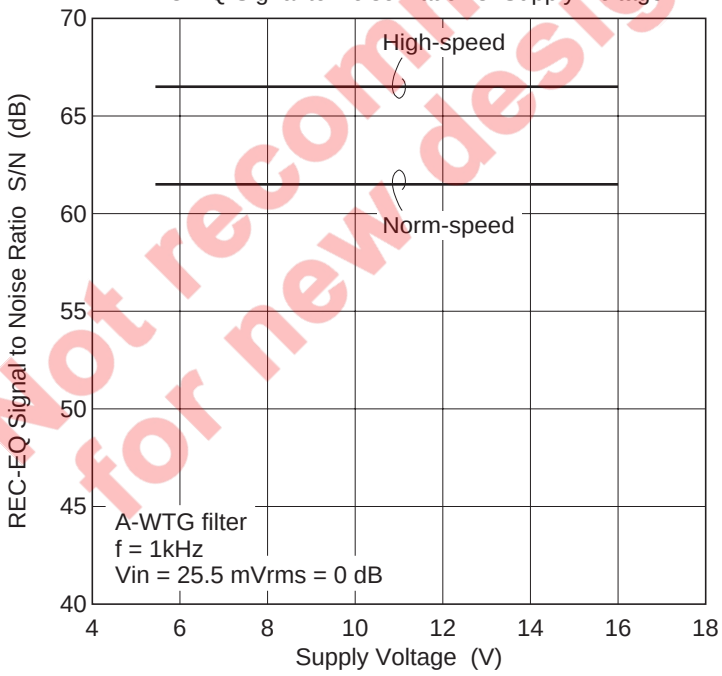
REC-EQ Total Harmonic Distortion vs. Input Level (1)



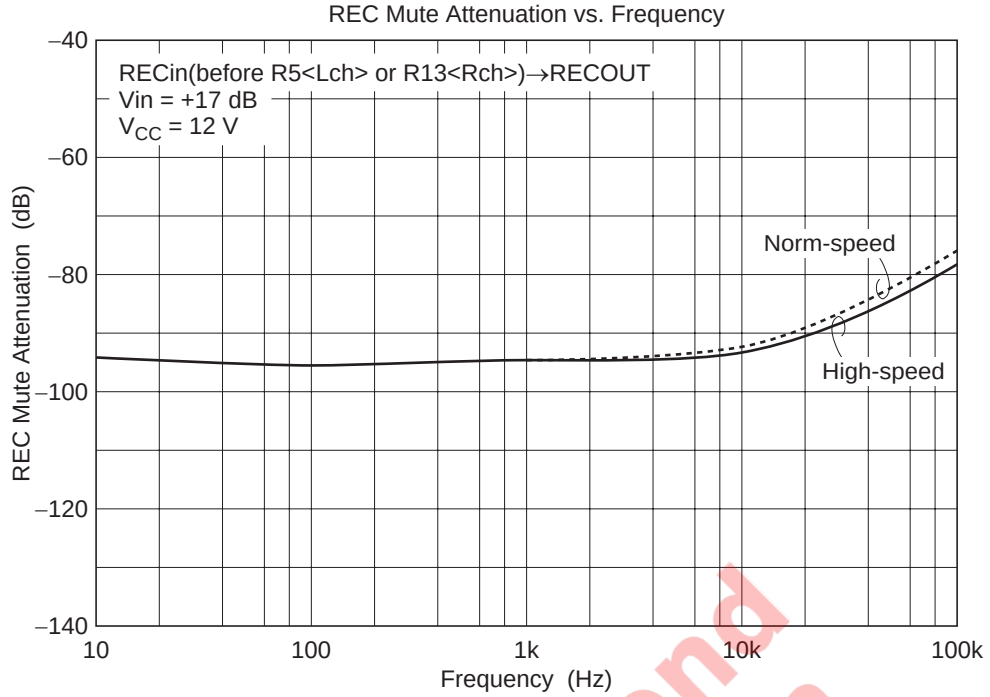
REC-EQ Total Harmonic Distortion vs. Input Level (2)



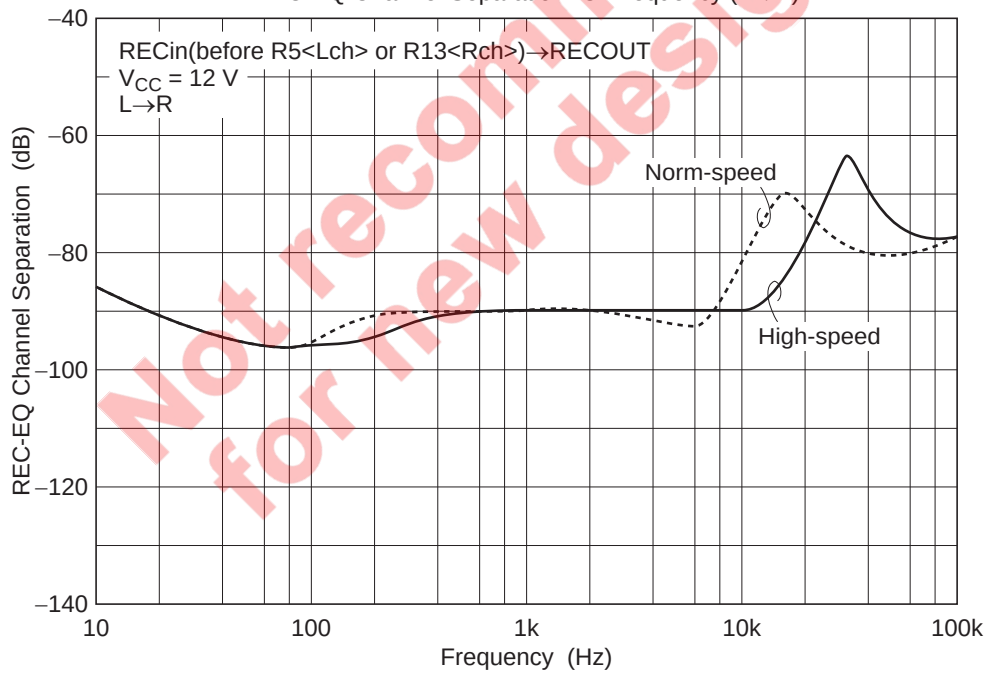
REC-EQ Signal to Noise Ratio vs. Supply Voltage



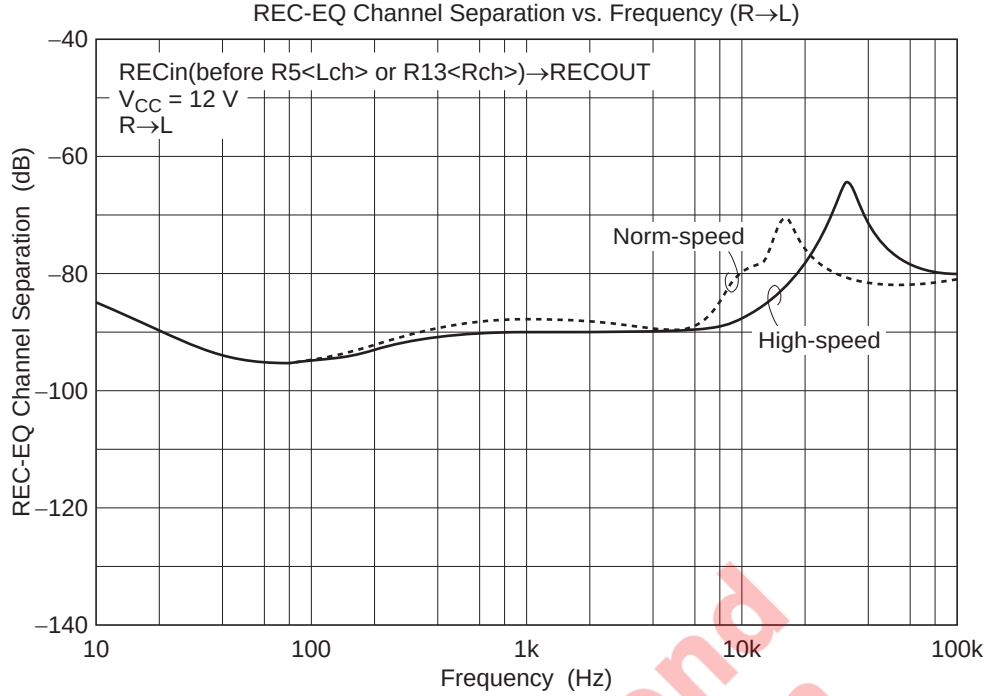
REC Mute Attenuation vs. Frequency



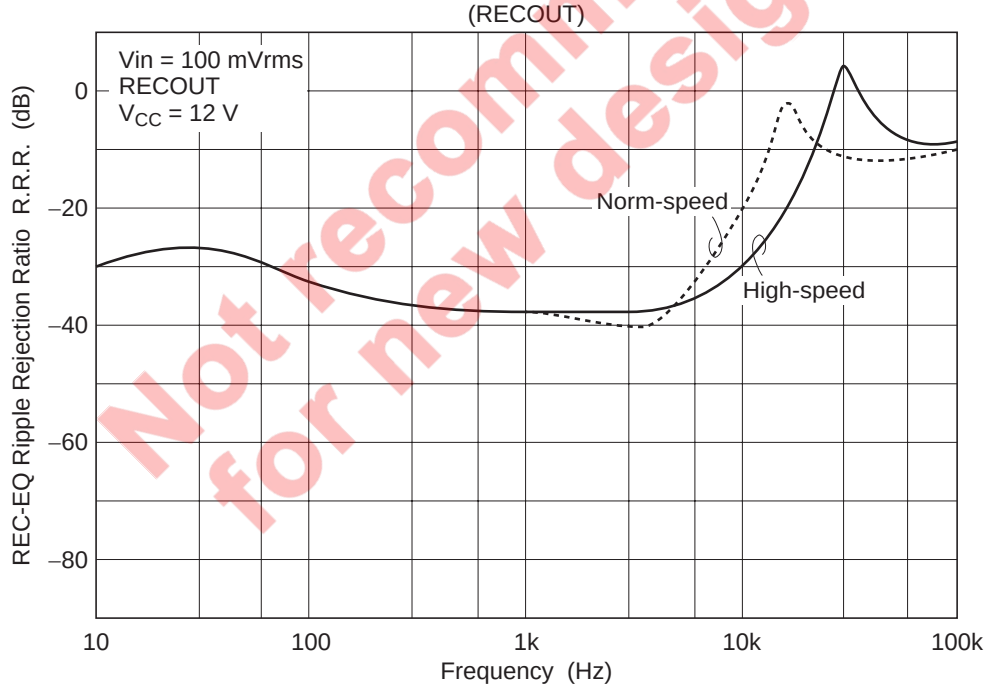
REC-EQ Channel Separation vs. Frequency (L→R)



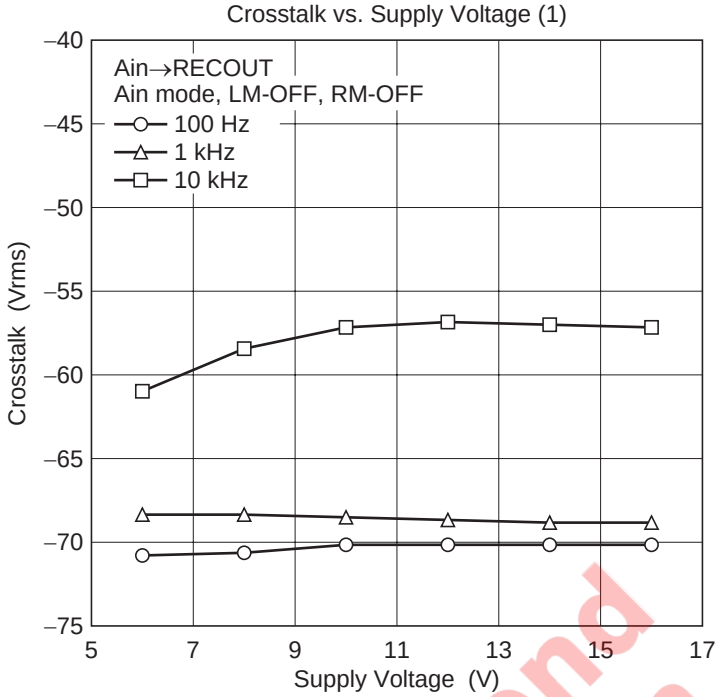
REC-EQ Channel Separation vs. Frequency (R→L)



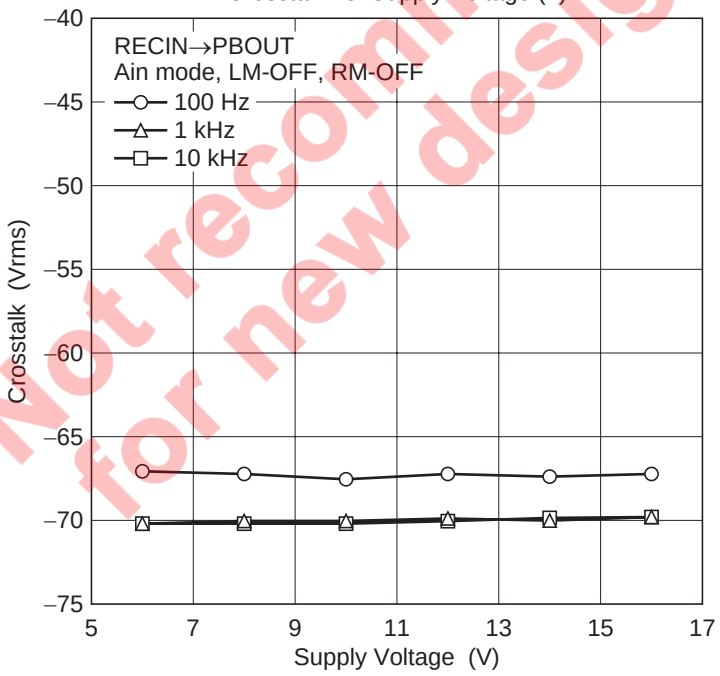
Ripple Rejection Ratio vs. Frequency (RECOUT)

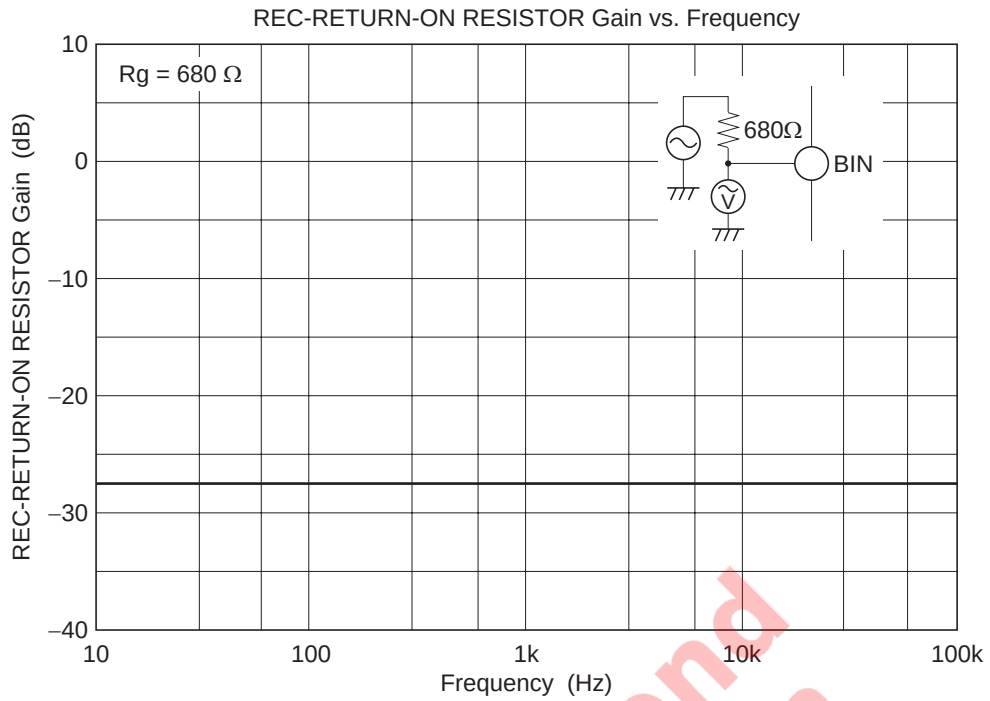


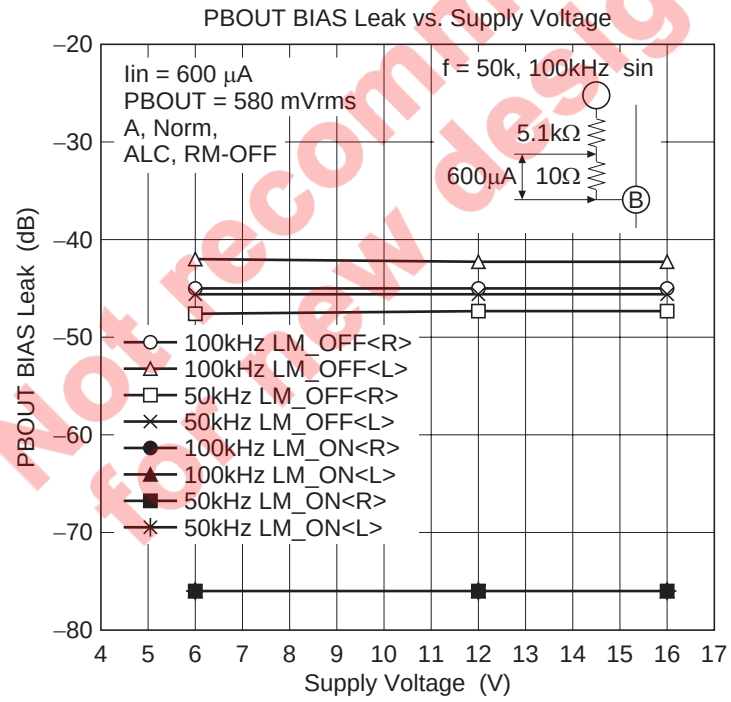
Crosstalk vs. Supply Voltage (1)



Crosstalk vs. Supply Voltage (2)

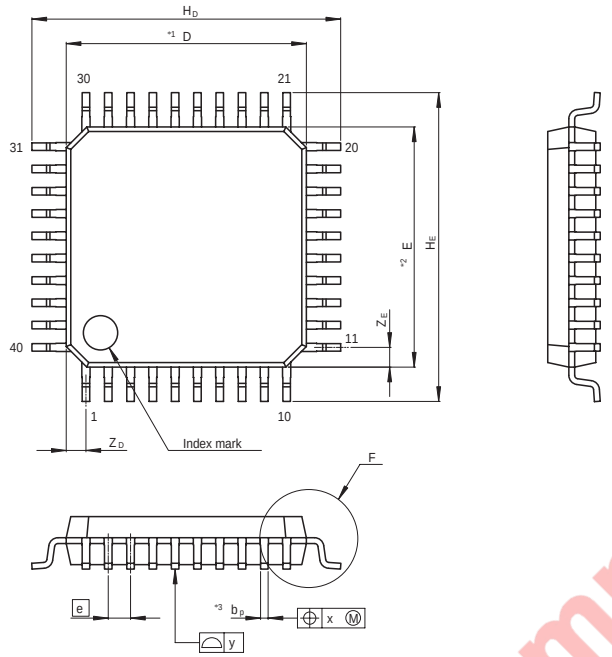




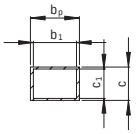


Package Dimensions

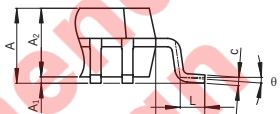
JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-LQFP40-7x7-0.65	PLQP0040JB-A	FP-40B	0.2g



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