Recording amplifier with built-in ALC for headphone stereos

BA3641FV

The BA3641FV is an option IC developed for the purpose of adding a recording function to 1-chip playback system ICs (BA3612AKV, etc.) for headphone stereos.

●Applications

Headphone stereos with recording function

●Features

1) Two built-in microphone amplifier channels.
2) Microphone mute function (radio / microphone switching).
3) Two built-in recording amplifier channels (with ALC).
4) Two built-in monitor output amplifier channels (radio / microphone switching).
5) Built-in regulators for the erase head and bias OSC circuit.

●Absolute maximum ratings (Ta = 25°C)

Parameter	Symbol	Limits	Unit
Power supply voltage	V_{CC}	4.5	V
Power dissipation	Pd	400*	mW
Operating temperature	Topr	−15～+75	℃
Storage temperature	Tstg	−55～+125	℃

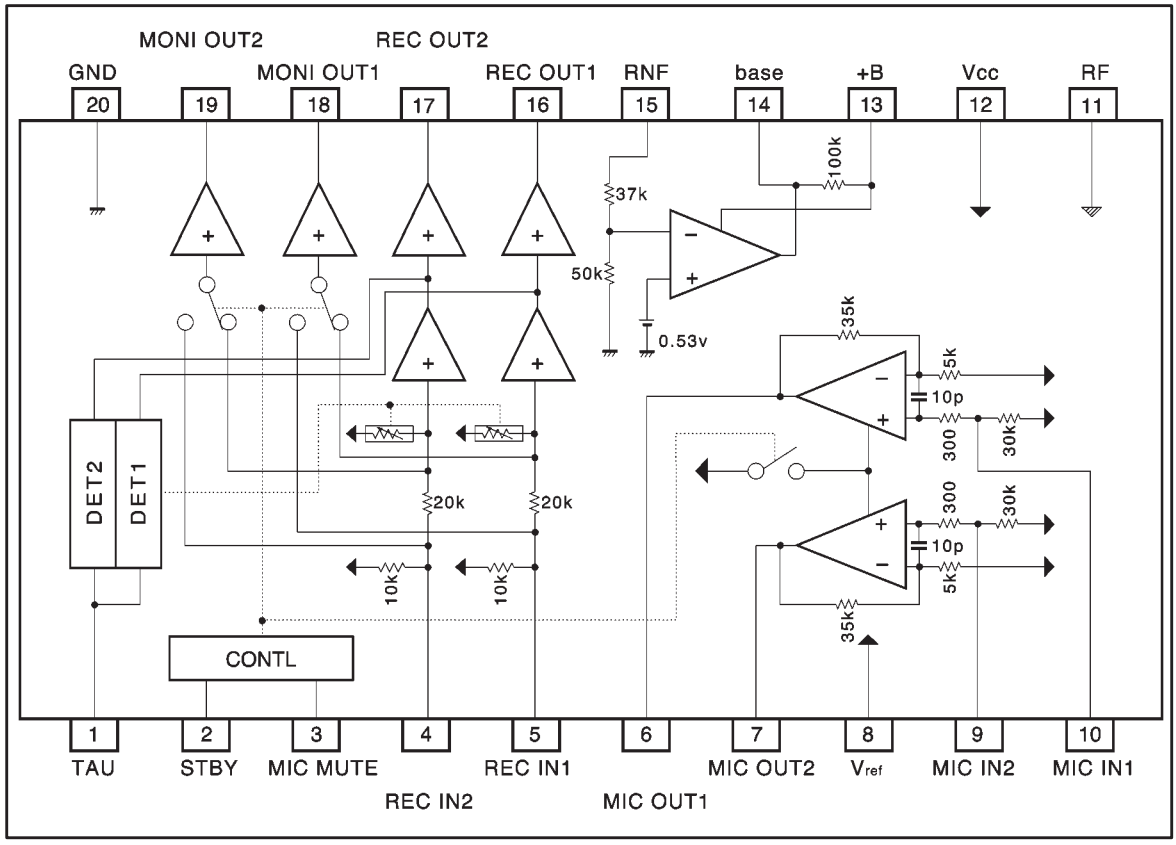
* Reduced by 4.0mW for each increase in Ta of 1℃ over 25℃.

●Recommended power supply voltage ranges (Ta = 25°C)

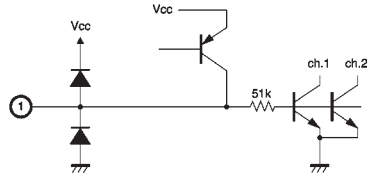
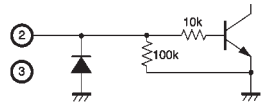
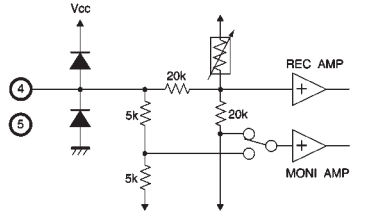
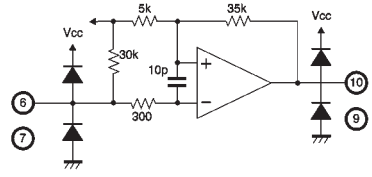
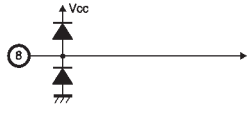
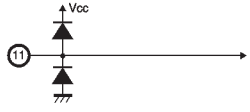
Parameter	Symbol	Limits	Unit
Power supply voltage	V_{CC}	1.7～3.6	V
	RF	1.5～3.6	V
	+B	0.9～3.6	V
	V_{ref}	0.95～2.0	V

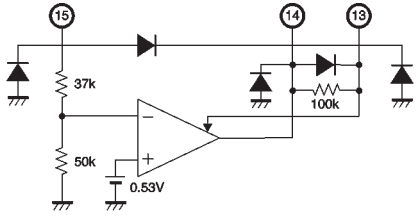
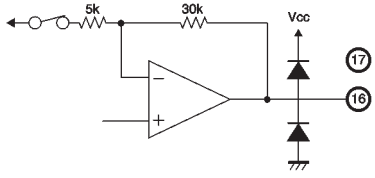
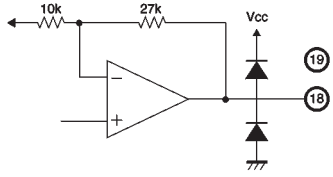
* RF voltage must be less than V_{CC} voltage.

●Block diagram



●Pin descriptions

Pin No.	Pin name	I / O	DC voltage	Equivalent circuit	Function
1	TAU	I / O	During detection 0.7V Not during detection 0V		ALC detector output smoothing pin Note ; As this pin has an extremely high impedance, the characteristics do not allow using an external resistor with a high resistance.
2	STBY	I	Hi : +B LO : 0V		IC supply voltage switch pin See the switch logic table
3	MIC MUTE	I	Hi : +B LO : 0V		Microphone amp mute control pin See the switch logic table
4	REC IN2	I	Vref		Common input pin for recording amp and monitor amp
5	REC IN1				
6	MIC OUT1	I / O	Vref		Microphone amp output pin
7	MIC OUT2				
9	MIC IN2	I			Microphone amp input pin
10	MIC IN1				
8	V_{ref}	I	Vref		Reference voltage input pin
11	RF	I	RF		Ripple filter voltage input pin

Pin No.	Pin name	I / O	DC voltage	Equivalent circuit	Function
12	Vcc	I	Vcc		Supply voltage input pin
13	+B	I	+B		Battery supply voltage input pin
14	base	O	+B−0.7V		Control pin for external regulator transistor
15	RNF	I	0.92V		Regulator output feedback pin
16	REC OUT1	I / O	Vref		Recording amp output pin STBY : When low Hi-Z
17	REC OUT2				
18	MONI OUT1	I / O	Vref		Monitor amp output pin
19	MONI OUT2				
20	GND	I	0V		Ground pin (SUB pin)

●Electrical characteristics (unless otherwise noted, V_{cc} = 2.3V, RF = 2.0V, +B = 1.2V, V_{REF} = 1.0V, R_L = 5kΩ, f = 1kHz, DIN-AUDIO, Ta = 25°C)

Parameter		Symbol	Min.	Typ.	Max.	Unit	Conditions
Quiescent current 1		IQV1	1.5	2.7	4.2	mA	〈MIC−REC〉 V_{ST} : Hi, V_{MUTE} : Lo
		IQR1	0.84	1.40	2.10	mA	
Quiescent current 2		IQV2	1.5	2.7	4.2	mA	〈Tuner−REC〉 V_{ST} : Hi, V_{MUTE} : Hi
		IQR2	0.7	1.1	1.6	mA	
Quiescent current 3		IQV3	−	0	5	μA	〈Tuner−PLAY〉 V_{ST} : Lo, V_{MUTE} : Hi
		IQR3	270	450	675	μA	
Regulator supply current		ICCB	−	4.03	4.28	mA	V_{ST} : Hi, Ireg=4.0mA
Standby supply current		ISTV	−	0	5	μA	〈TAPE−PLAY〉 V_{ST} : Lo, V_{MUTE} : Lo
		ISTR	−	0	5	μA	
		ISTB	−	0	5	μA	
Microphone amp	Closed loop voltage gain	GVC1	16	18	20	dB	Vo=−15dBv
	Maximum output voltage	VOM1	220	300	−	mV_{rms}	Vcc=1.7V, RF=1.5V, THD=1%
	Total harmonic distortion	THD1	−	0.1	0.8	%	Vcc=1.7V, RF=1.5V, Vo=−15dBv
	Output noise voltage	VNO1	−	14	30	μV_{rms}	R_g=6.8kΩ
	Microphone mute attenuation	MUTE1	80	88	−	dB	Vo=−15dBv, 1kHzBPF+DIN AUDIO
	Interchannel crosstalk	CT1	60	75	−	dB	Vo=−15dBv, 1kHzBPF+DIN AUDIO R_g=6.8kΩ
	Ripple rejection	RR1	70	85	−	dB	Vcc=1.7V(R=−20dBv), RF=1.5V 130HzBPF+DIN AUDIO R_g=6.8kΩ
	Input impedance	Rin1	20	30	40	kΩ	−
	Output impedance for muting	Rout1(z)	32	40	48	kΩ	V_{MUTE} : Hi
Monitor amp	Closed loop voltage gain	GVC2	10.0	11.5	13.0	dB	Vo=−15dBv, ALC=OFF
	Maximum output voltage	VOM2	220	300	−	mV_{rms}	ALC=OFF Vcc=1.7V, RF=1.5V, THD=1%
	Total harmonic distortion	THD2	−	0.1	0.8	%	ALC=OFF Vcc=1.7V, RF=1.5V, Vo=−15dBv
	Microphone noise voltage	VNO2M	−	18	40	μV_{rms}	R_g=100kΩ, V_{ST} : Hi, V_{MUTE} : Lo
	Tuner noise voltage	VNO2T		12	30	μV_{rms}	R_g=100kΩ, V_{ST} : Hi, V_{MUTE} : Hi
	Interchannel crosstalk	CT2	60	77	−	dB	Vo=−15dBv, 1kHzBPF+DIN AUDIO R_g=100kΩ, ALC=OFF
	Ripple rejection	RR2	75	85	−	dB	Vcc=1.7V(R=−20dBv), RF=1.5V 130HzBPF+DIN AUDIO R_g=100kΩ, ALC=OFF
	Standby output impedance	Rout2(z)	25	31	37	kΩ	V_{ST} : Lo, V_{MUTE} : Lo

	Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Recording amp	Closed loop voltage gain	GVC3	34	36	38	dB	Vo=−10dBv, ALC=OFF
	Maximum output voltage	VOM3	400	450	−	mV_{rms}	ALC=OFF Vcc=1.75V, RF=1.5V, THD=1%
	Total harmonic distortion	THD3	−	0.2	0.8	%	ALC=OFF Vcc=1.7V, RF=1.5V, Vo=−10dBv
	Output noise voltage	VNO3	−	350	500	μV_{rms}	R_g=100kΩ, V_{MUTE} : Hi
	Interchannel crosstalk	CT3	50	65	−	dB	Vo=−15dBv, 1kHzBPF+DIN AUDIO R_g=100kΩ, ALC=OFF
	Ripple rejection	RR3	55	65	−	dB	Vcc=1.7V(R=−20dBv), RF=1.5V 130HzBPF+DIN AUDIO R_g=100kΩ, ALC=OFF
	Input impedance	Rin3	6.4	8.0	9.6	kΩ	ALC=OFF
	Output impedance for muting	Rout3(z)	1.0	−	−	MΩ	V_{ST} : Lo, V_{MUTE} : Lo
Microphone amp and recording amp	REC OUT ALC characteristics	VALC1	−18.0	−16.0	−14.0	dBv	V_{IN}=−70dBv
		VALC2	−9.3	−7.8	−6.5	dBv	V_{IN}=−60dBv
		VALC3	−10.2	−8.2	−6.7	dBv	V_{IN}=−30dBv
	REC OUT total harmonic distortion	THD-R2	−	0.4	0.9	%	V_{IN}=−60dBv
		THD-R3	−	0.4	0.9	%	V_{IN}=−30dBv
	ALC channel balance	G_{CB}	−1.0	0.0	+1.0	dB	V_{IN}=−45dBv
	Output noise voltage	VNO4	−	1000	1700	μV_{rms}	R_g=6.8kΩ
	Interchannel crosstalk	CT4	45	52	−	dB	Vo=−15dBv, 1kHzBPF+DIN AUDIO R_g=6.8kΩ
	Ripple rejection A REC OUT	RR4	48	54	−	dB	Vcc=1.7V(R=−20dBv), RF=1.5V 130HzBPF+DIN AUDIO R_g=6.8kΩ
	Ripple rejection B MONI OUT	RR5	70	77	−	dB	Vcc=1.7V(R=−20dBv), RF=1.5V 130HzBPF+DIN AUDIO R_g=6.8kΩ
Regulator	Output voltage	Vreg	0.87	0.92	0.96	V	Ireg=50mA
	Load regulation	△Vreg	−	5	30	mV	Ireg=40mA~60mA
	Ripple leak	V_{RR}	−	−90	−70	dBv	Vcc=1.7V(R=−20dBv), RF=1.5V +B=1.2V(R=−30dBv), Ireg=50mA 130HzBPF+DIN AUDIO
Switch	High level voltage conditions	$V_{IN}H$	0.77	−	6.00	V	−
	Low level voltage conditions	$V_{IN}L$	−0.30	−	0.30	V	−
	Input resistance	RINS	80	100	120	kΩ	V_{IN}=0.3V

●Measurement circuit

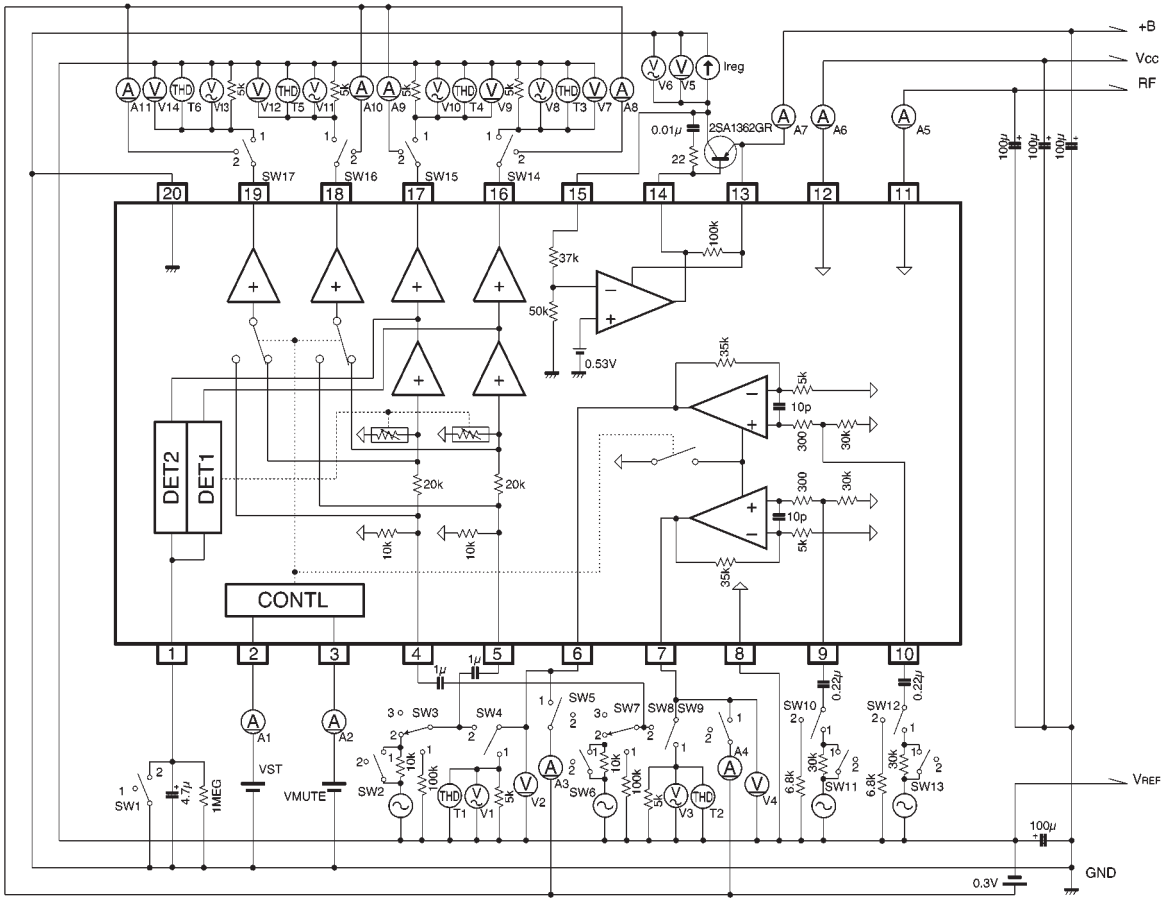


Fig. 1

Units
Resistors : Ω (±1%)
Ceramic capacitors : F (±1%)
Electrolytic capacitors : F (±5%)

●Switch logic table

MIC MUTE \ STBY	High	Low (open)
High	〈Tuner-REC〉 MIC-AMP OFF MONI-AMP ON (ALC : OFF) REC-AMP ON (ALC : ON) Regulator ON	〈Tuner-PLAY〉 MIC-AMP OFF MONI-AMP ON (ALC : OFF) REC-AMP OFF (Hi-Zo) Regulator OFF
Low (open)	〈MIC-REC〉 MIC-AMP ON MONI-AMP ON (ALC : ON) REC-AMP ON (ALC : ON) Regulator ON	〈TAPE-PLAY〉 MIC-AMP OFF MONI-AMP OFF REC-AMP OFF (Hi-Zo) Regulator OFF

●Application example

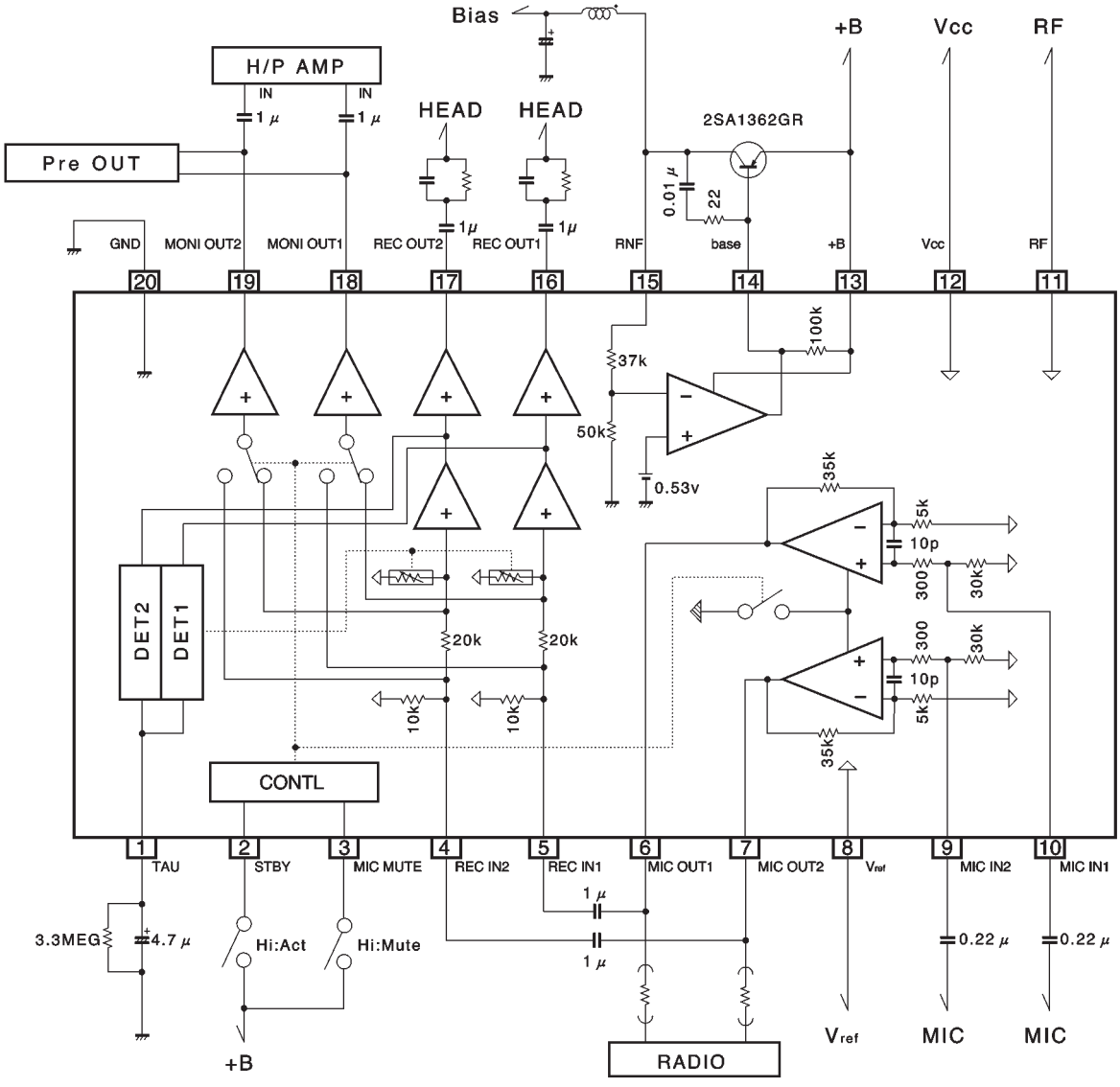


Fig. 2

Units
Resistors : Ω (±5%)
Ceramic capacitors : F (±10%)
Electrolytic capacitors : F (±20%)

●Electrical characteristic curves

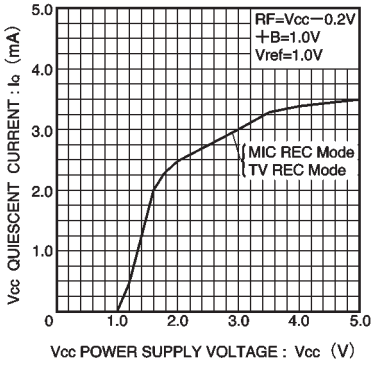


Fig. 3 Vcc quiescent current vs. power supply voltage

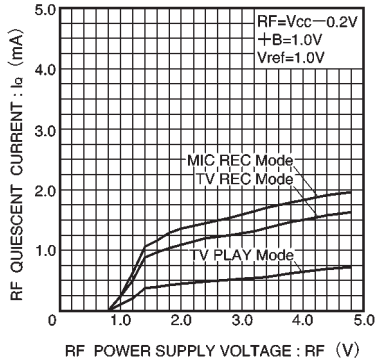


Fig. 4 RF quiescent current vs. power supply voltage

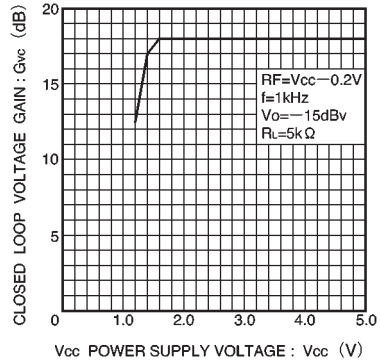


Fig. 5 Microphone amp voltage gain vs. power supply voltage

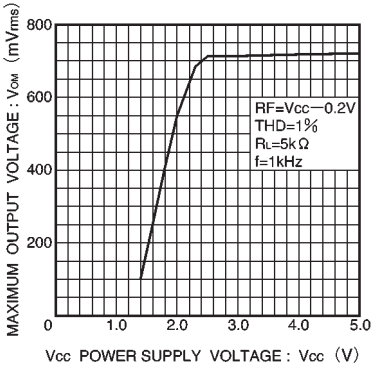


Fig. 6 Maximum microphone amp output voltage vs. power supply voltage

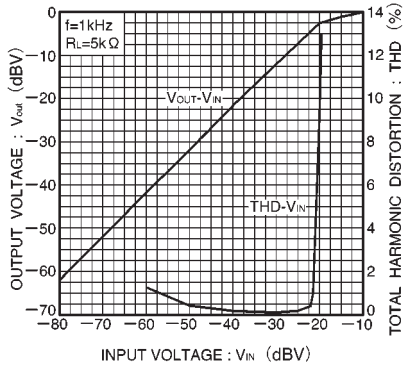


Fig. 7 Microphone amp input/output linearity

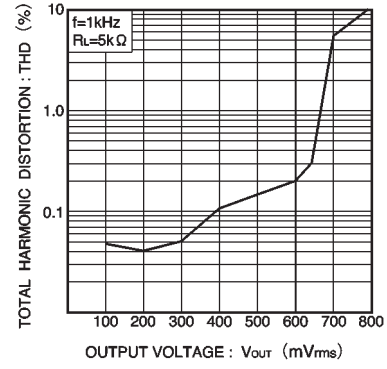


Fig. 8 Microphone amp total harmonic distortion vs. output voltage

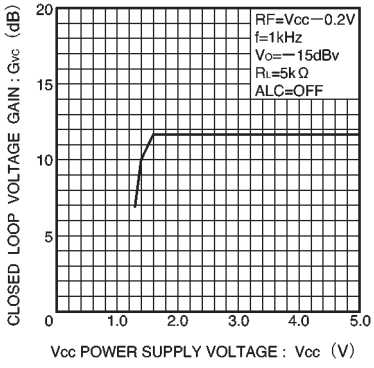


Fig. 9 Monitor amp voltage gain vs. power supply voltage

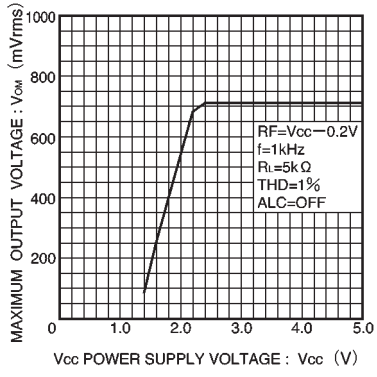


Fig. 10 Maximum monitor amp output voltage vs. power supply voltage

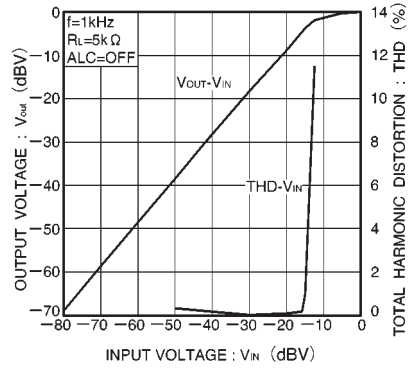


Fig. 11 Monitor amp input/output linearity

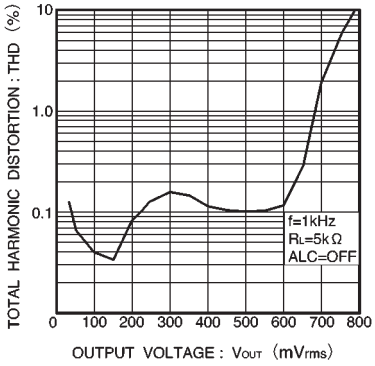


Fig. 12 Monitor amp total harmonic distortion vs. output voltage

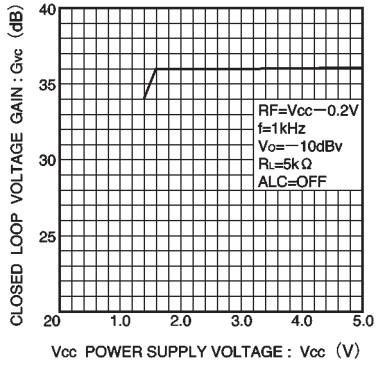


Fig. 13 Recording amp voltage gain vs. power supply voltage

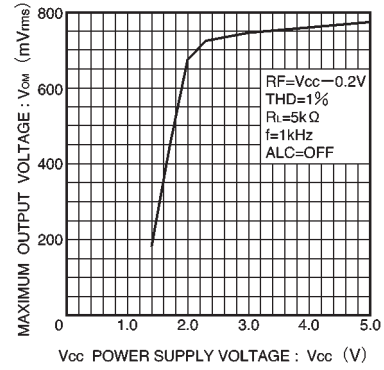


Fig. 14 Maximum recording amp output power voltage vs. power supply voltage

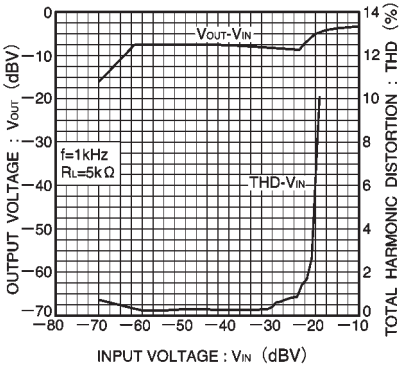


Fig. 15 ALC input/output characteristics of microphone and recording amps

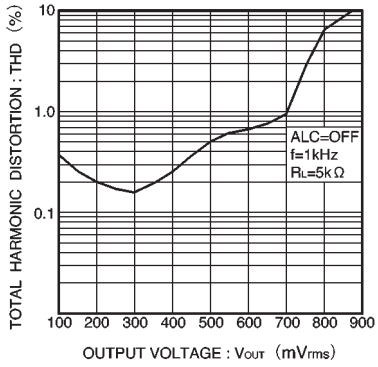


Fig. 16 Recording amp total harmonic distortion vs. output voltage

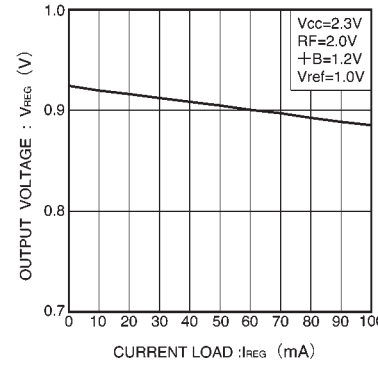


Fig. 17 Regulator output voltage vs. load current

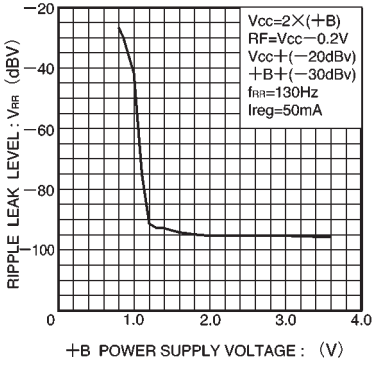


Fig. 18 Regulator ripple leak vs. power supply voltage

●External dimensions (Units: mm)