Stereo zoom microphone amplifier for camcorders

BA7780KV

The BA7780KV is a microphone amplifier developed for use in camcorders. The IC features an electronic volume circuit for presetting the curve required for the stereo zoom function, a microphone element power supply regulator, a wind-noise rejection filter, a current limiting circuit for external accessory power supplies, and an input for external microphone input. The IC operates off a 3.3V power supply.

●Applications
Camcorders

●Features
1) Operates off a 3.0V to 5.25V power supply.
2) Zoom microphone processing function on one chip.
3) Built-in electronic volume for external setting of sensitivity and control voltage.
4) Adjustable microphone element sensitivity.
5) Matrix amplifier for stereo emphasis.
6) Automatic switching circuit for external inputs, and built-in external monaural decision circuit.

●Absolute maximum ratings (Ta = 25°C)

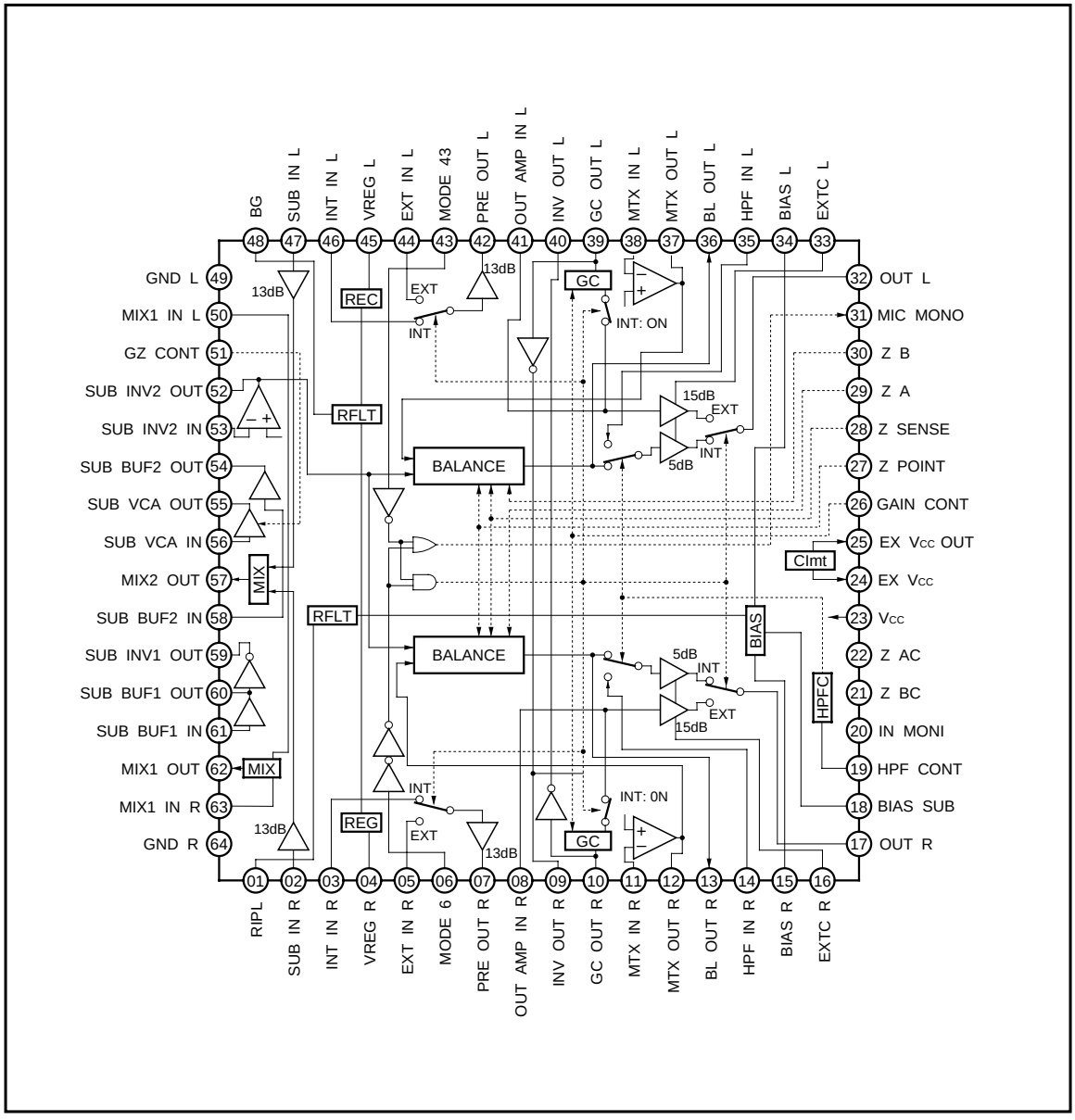
Parameter	Symbol	Limits	Unit
Power supply voltage	V_{CC}	7.0	V
Power dissipation	Pd	750*	mW
Operating temperature	Topr	– 10 ~ + 70	°C
Storage temperature	Tstg	– 55 ~ + 125	°C

* Reduced by 7.5mW for each increase in Ta of 1°C over 25°C.

●Recommended operating conditions (Ta = 25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage	V_{CCS}	3.0	—	5.25	V

●Block diagram



●Pin descriptions

Pin No.	Pin name	Function	Pin voltage (V)	Format
1	RIPL	For bias ripple filter capacitor	1.65	50kΩ
2	SUB IN R	Sub microphone input	1.65	100kΩ
3	INT IN R	Internal microphone input	1.65	75kΩ
4	VREG R	Regulator output	2.5	C
5	EXT IN R	External microphone input	1.65	75kΩ
6	MODE 6	Mode control 6 input	—	25kΩ
7	PRE OUT R	Preamplifier output	1.65	EF (P - P)
8	OUT AMP IN R	Out amplifier input	1.65	100kΩ
9	INV OUT R	Inverter output	1.65	EF (P - P)
10	GC OUT R	Gain control amplifier output	1.65	EF (P - P)
11	MTX IN R	Matrix amplifier input	1.65	B
12	MTX OUT R	Matrix amplifier output	1.65	EF (P - P)
13	BL OUT R	Zoom balance circuit output	1.65	EF (P - P)
14	HPF IN R	HPF input	1.65	100kΩ
15	BIAS R	Bias output	1.65	EF (P - P)
16	EXTC R	For connection of out amplifier output inhibit capacitor	2.3	C
17	OUT R	Signal output	1.65	C (P - P)
18	BIAS SUB	Sub bias output	1.65	EF (P - P)
19	HPF CONT	HFP control input	—	10kΩ
20	IN MONI	Input switch decision signal output	—	C
21	Z BC	For connection of noise cutting capacitor for zoom control signal	—	B
22	Z AC	For connection of noise cutting capacitor for zoom control signal	—	B
23	V_{CC}	V_{CC}	3.3	—
24	EX V_{CC}	Current limiter V_{CC}	4.75	—
25	EX V_{CC} OUT	Current limiter output	4.5	C
26	GAIN CONT	Gain control amplifier switch input	—	50kΩ
27	Z POINT	Cross-point variation input for zoom balance circuit	—	B
28	Z SENSE	Sensitivity variation input for zoom balance circuit	—	B
29	Z A	Zoom control input	—	B
30	Z B	Zoom control input	—	B
31	MIC MONO	External microphone monaural decision signal output	—	C
32	OUT L	Signal output	1.65	EF (P - P)
33	EXTC L	For connection of out amplifier output inhibit capacitor	2.3	C
34	BIAS L	Bias output	1.65	EF (P - P)
35	HPF IN L	HPF input	1.65	100kΩ
36	BL OUT L	Zoom balance circuit output	1.65	EF (P - P)
37	MTX OUT L	Matrix amplifier output	1.65	EF (P - P)
38	MTX IN L	Matrix amplifier input	1.65	B
39	GC OUT L	Gain control amplifier output	1.65	EF (P - P)
40	INV OUT L	Inverter output	1.65	EF (P - P)
41	OUT AMP IN L	Out amplifier input	1.65	100kΩ
42	PRE OUT L	Preamplifier output	1.65	EF (P - P)

Pin No.	Pin name	Function	Pin voltage (V)	Format
43	MODE 43	Mode control 43 input	—	25kΩ
44	EXT IN L	External microphone input	1.65	75kΩ
45	VREG L	Regulator output	2.5	C
46	INT IN L	Internal microphone input	1.65	75kΩ
47	SUB IN L	Sub microphone input	1.65	100kΩ
48	BG	For regulator ripple filter capacitor	1.25	10kΩ
49	GND L	Left channel GND	—	—
50	MIX 1 IN L	Mixer amplifier input	1.65	100kΩ
51	GZ CONT	Sub VCA control input	—	50kΩ
52	SUB INV2 OUT	Sub inverter 2 output	1.65	EF (P - P)
53	SUB INV2 IN	Sub inverter 2 input	1.65	B
54	SUB BUF2 OUT	Sub buffer 2 output	1.65	EF (P - P)
55	SUB VCA OUT	Sub VCA output	1.65	EF (P - P)
56	SUB VCA IN	Sub VCA input	1.65	100kΩ
57	MIX2 OUT	Mixer 2 output	1.65	EF (P - P)
58	SUB BUF2 IN	Sub buffer 2 input	1.65	100kΩ
59	SUB INV1 OUT	Sub inverter 1 output	1.65	EF (P - P)
60	SUB BUF1 OUT	Sub buffer 1 output	1.65	EF (P - P)
61	SUB BUF1 IN	Sub buffer 1 input	1.65	100kΩ
62	MIX1 OUT	Mixer 1 output	1.65	EF (P - P)
63	MIX1 IN R	Mixer 1 input	1.65	100kΩ
64	GND R	Right channel GND	—	—

∗ EF: emitter follower, P-P: push pull, B: base, and C: collector. All numerical values are standardized values.

●Electrical characteristics

Measurement conditions

Unless otherwise noted, the following conditions apply: Ta = 25°C, V_{CC}3.3V, external supply voltage (pin 24) = 4.75V, pin 19 = "H" or open, pin 26 = 1 / 2V_{CC}, pin 51 = 0.58 × pin 4, pin 27 = 0.733 × pin 4, pin 28 = 0.80 × pin 4, pin 29 = 2.2V, pin 30 = 2.2V

Input signal level Int = – 31.5dBV
Ext = – 38.5dBV
Sub = – 33.5dBV (1kHz)

Monitoring pins: 17 and 32

∗ 1 JIS–A filter used

∗ 2 400Hz to 30kHz filter used

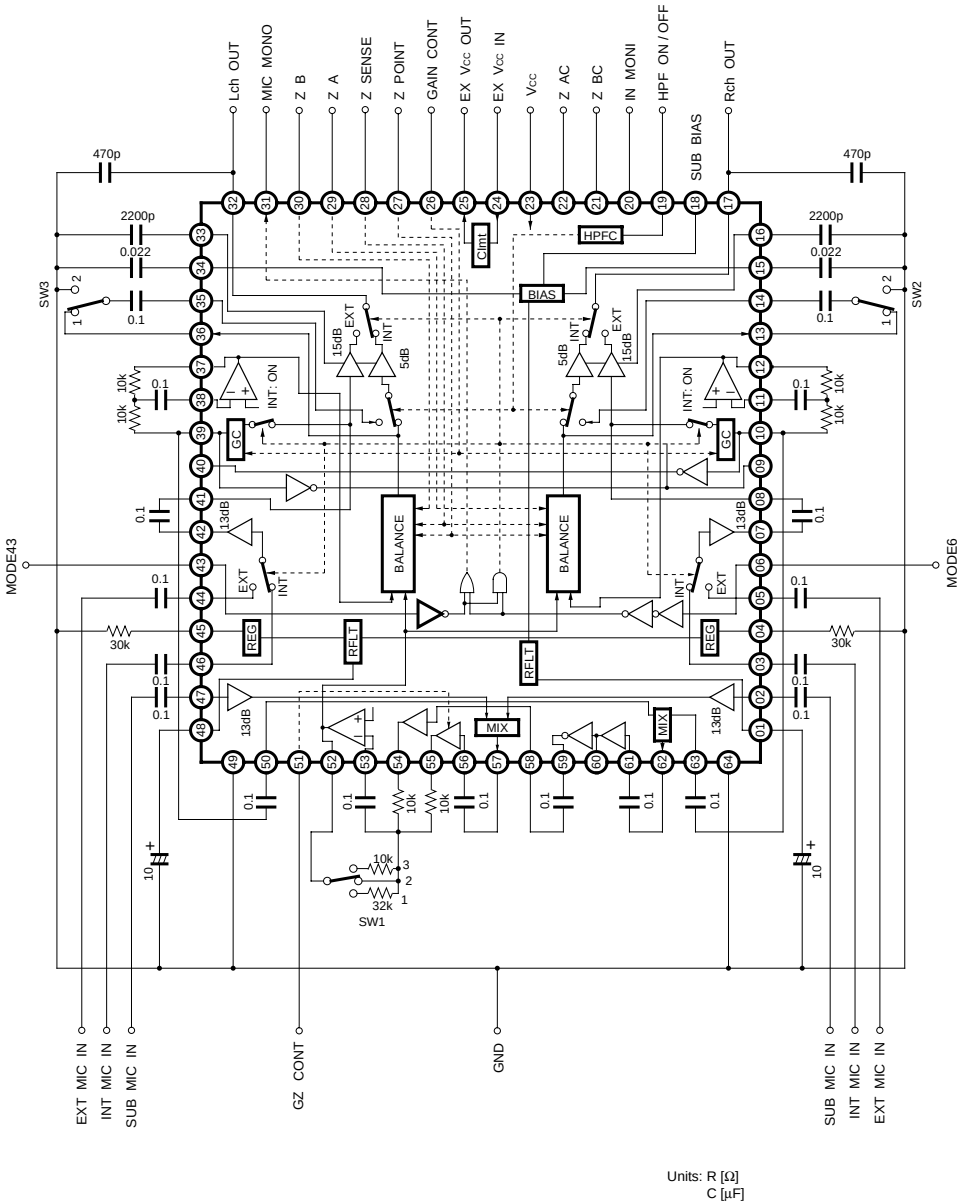
Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Current dissipation	I_{qE}	—	8.5	12.0	mA	INT / EXT MIC IN, No input
Voltage gain 1	GV_E	27.0	28.0	29.0	dB	EXT MIC IN
Voltage gain 2	GV_{IH}	21.5	24.5	27.5	dB	INT MIC IN, GAIN CTL H
Voltage gain 3	GV_{IM}	18.5	21.5	24.5	dB	INT MIC IN, GAIN CTL M
Voltage gain 4	GV_{IL}	16.5	18.5	21.5	dB	INT MIC IN, GAIN CTL L
Distortion 1	THD_W	—	0.05	0.5	%	INT MIC IN, WIDE, Vo = 300mV_{rms}
Distortion 2	THD_E	—	0.1	0.25	%	EXT MIC IN, V_O = 300mV_{rms}
Distortion 3	THD_Z	—	0.15	0.5	%	INT MIC IN, ZOOM, V_O = 300mV_{rms}
Maximum output	V_{OM}	0.75	0.95	—	V_{rms}	INT / EXT MIC IN, THD = 1%∗2
Output noise voltage 1 (EXT)	V_{ONE}	—	30	60	μV_{rms}	EXT MIC IN, R_g = 1kΩ∗1
Output noise voltage 2 (INT, WIDE)	V_{ONW}	—	30	60	μV_{rms}	INT MIC IN, R_g = 1kΩ∗1 GAIN CTL H
Output noise voltage 3 (INT, ZOOM)	V_{ONZ}	—	60	120	μV_{rms}	INT MIC IN, R_g = 1kΩ∗1 Pins 29 and 30 = 0V, GAIN CTL H
Input switch crosstalk (INT to EXT)	CT_{IE}	—	– 76	– 70	dB	Note 1
Interchannel crosstalk	CT_{CH}	—	– 76	– 70	dB	Note 2
GC OUT L / R gain differential	GV_{GLR}	– 1.5	0.0	1.5	dB	INT MIC IN, HML,10⇔39
Inverter OUT L / R gain differential	GV_{ILR}	– 1.5	0.0	1.5	dB	INT MIC IN, HML,9⇔40
Internal microphone power supply output voltage	V_{REG}	2.3	2.5	2.75	V	Pins 4 and 45 output current for 30kΩ load
External power supply output voltage	V_{EXT}	4.3	4.5	—	V	Pin 25 DC for pin 25 output current of 25mA
External power supply limit current	I_{LTD}	—	—	30	mA	Pin 25 output current when grounded
Input switching CTL holding voltage	V_{HSWH}	1.6	—	V_{CC}	V	"H" level, pin 6 / 43 DC
	V_{HSWL}	0	—	0.7	V	"L" level, pin 6 / 43 DC
Gain switching CTL holding voltage	V_{HGH}	2.8	—	V_{CC}	V	"H" level, pin 26 DC
	V_{HGM}	1.3	—	2.0	V	"M" level, pin 26 DC
	V_{HGL}	0	—	0.5	V	"L" level, pin 26 DC
HPF, CTL holding voltage	V_{HHPFH}	2.0	—	V_{CC}	V	HPF OFF, 19pin DC
	V_{HHPFL}	0	—	0.5	V	HPF ON, 19pin DC
MIX 1 gain	GV_{M1-1}	– 7.0	– 6.0	– 5.0	dB	63→62 / 50→62 pin
	GV_{M1-2}	– 1.0	0	1.0	dB	Gain differential for pins 63 to 62 and 50 to 62
MIX 2 gain	GV_{M2-1}	6.0	7.0	8.0	dB	INT L / M / H, 2→57, 47→57pin
	GV_{M2-2}	– 1.0	0	1.0	dB	Gain differential for pins 2 to 57 and 47 to 57

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
ZOOM - BALANCE Gain 1 Rch / Lch	12→13 or 37→36 pin					
	GV_{Z1-1}	– 23.0	– 20.0	– 17.0	dB	29, 30 pin 0.0V (DC)
	GV_{Z1-2}	– 11.7	– 7.7	– 4.7	dB	29, 30 pin 0.8V (DC)
	GV_{Z1-3}	– 2.0	1.0	4.0	dB	29, 30 pin 2.2V (DC)
ZOOM - BALANCE Gain 2 Rch / Lch	52→13 or 52→36 pin					
	GV_{Z2-1}	– 23.0	– 20.0	– 17.0	dB	29, 30 pin 2.2V (DC)
	GV_{Z2-2}	– 11.7	– 7.7	– 4.7	dB	29, 30 pin 1.4V (DC)
	GV_{Z2-3}	– 2.0	1.0	4.0	dB	29, 30 pin 0.0V (DC)
ZOOM - BALANCE Variable position Rch / Lch	28 pin 0.8 × 4pin, 29 30 pin 1.1V, 12→13 or 37→36 pin					
	GV_{Z3-1}	– 2.5	0.5	3.5	dB	27 pin 0.64 × 4pin (DC)
	GV_{Z3-2}	– 7.5	– 4.5	– 1.5	dB	27 pin 0.733 × 4pin (DC)
	GV_{Z3-3}	– 20.6	– 17.0	– 12.0	dB	27 pin 0.82 × 4pin (DC)
ZOOM - BALANCE Variable slope Rch / Lch	27 pin 0.733 × 4pin, 29 30 pin 0.4V, 12→13 or 37→36 pin					
	GV_{Z4-1}	– 5.5	– 2.5	0.5	dB	28 pin 0.59 × 4pin (DC)
	GV_{Z4-2}	– 9.5	– 6.5	– 3.5	dB	28 pin 0.69 × 4pin (DC)
	GV_{Z4-3}	– 17.5	– 14.5	– 11.5	dB	28 pin 0.8 × 4pin (DC)
Sub VCA gain 56pin ➡ 55pin	GV_{VCA1}	– 5.0	– 3.0	– 1.0	dB	51 pin 0.74 × 4pin (DC)
	GV_{VCA2}	– 2.0	0.0	2.0	dB	51 pin 0.58 × 4pin (DC)
	GV_{VCA3}	1.0	3.0	5.0	dB	51 pin 0.48 × 4pin (DC)

Note 1: Input switch crosstalk measurement method:
(pin 19 = "H" or open, pin 26 = GND, pin 27 = 0.733 × pin 4, pin 28 = 0.80 × pin 4, pin 29 = 2.2V, pin 30 = 2.2V)
Input 1kHz signals on the INT input pins (3 and 46) in INT input mode that give a distortion of 1% at the signal output pins (17 and 32), then connect the EXT input pins (5 and 44) to GND via R_g = 1kΩ Switch to EXT input mode, and measure the relative output level of the output pins (17 and 32).

Note 2: Interchannel crosstalk measurement method:
The mode pin conditions are the same as for input switch crosstalk.
Connect the input pin of the channel to be measured to GND via R_g = 1kΩ. Input a 1kHz signal on the other channel's input that gives a distortion of 1% on the signal output pins (17 and 32), and measure the relative output level between the signal output pins (17 and 32).

●Measurement circuit



Units: R [Ω]
C [µF]

Fig. 1

●Measurement circuit switching table (blank cells: no spesification)

Parameter		SW1	SW2	SW3	MODE6	MODE43	GAIN CTL	Signal input pin
Current dissipation		1	1	1	H, L	H, L	M	—
Voltage gain 1		—	—	—	L	L	M	Ext
Voltage gain 2		—	—	—	H	—	H	Int
Voltage gain 3		—	—	—	—	—	M	Int
Voltage gain 4		—	—	—	—	—	L	Int
Distortion 1		2	—	—	H	L	M	Int
Distortion 2		2	—	—	L	L	—	Ext
Distortion 3		1	—	—	H	L	M	Sub
Maximum output		1	—	—	H, L	L	L	Int, Ext, Sub
Output noise voltage 1 (EXT)		2	—	—	L	L	—	—
Output noise voltage 2 (WIDE)		2	—	—	H	L	H	—
Output noise voltage 3 (ZOOM)		3	—	—	H	L	H	—
Input switch crosstalk (INT to EXT)		2	—	—	L	L	L	Int
Interchannel crosstalk	INT	2	—	—	H	L	M	Int
	EXT	2	—	—	L	L	—	Ext
GC out L / R gain differential		1	—	—	H	L	H, M, L	Int
Inverter OUT L / R gain differential		1	—	—	H	L	H, M, L	Int
Internal microphone power supply voltage		—	—	—	—	—	—	—
External power supply output voltage		—	—	—	—	—	—	—
External power supply limit current		—	—	—	—	—	—	—
Input switching CTL holding voltage		2	—	—	H	Vth	—	Int, Ext
		2	—	—	Vth	L	—	Int, Ext
Gain switching CTL holding voltage		2	—	—	H	L	Vth	Int
		2	—	—	H	L	Vth	Int
		2	—	—	H	L	Vth	Int
HPF, CTL holding voltage		2	2.1	2.1	H	L	—	Int, Vth of pin 19
MIX 1 gain		—	—	—	H	L	M	Int
MIX 2 gain		—	—	—	H	L	—	Sub
ZOOM - BALANCE Gain 1		2	—	—	H	L	M	Int
ZOOM - BALANCE Gain 2		1	—	—	H	L	M	Sub
ZOOM - BALANCE Variable position		2	—	—	H	L	M	Int
ZOOM - BALANCE Variable inclination		2	—	—	H	L	M	Int
Sub VCA gain		—	—	—	H	L	—	Sub

✻ Gain CTL pin 26.
H, M, and L are V_{CC}, 1/2V_{CC}, and GND respectively.
Measure the voltage range that maintains the mode for Vth.

●Application example

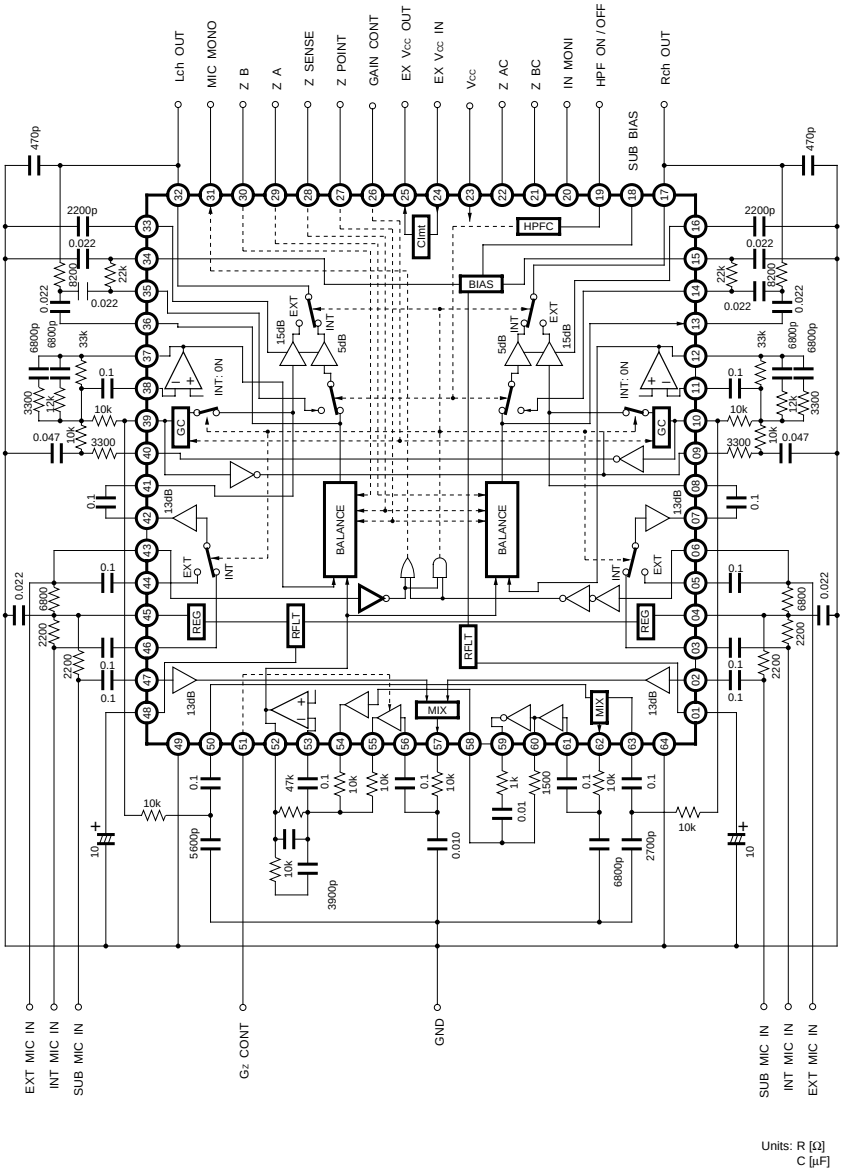


Fig. 2

●Operation notes

Points to note regarding zoom operation

When using a microprocessor to vary the voltages on pins 29 and 30 after presetting the electronic volume sensitivity and control voltage range, and with the pin 27 and 28 voltage fixed at a certain level, it is possible to minimize drift in the zoom characteristics due to tempreature fluctuations and differences between individual ICs by setting the pin 27 and 28 voltages using resistive voltage divider circuits connected to the pin 4 regulator voltage output.

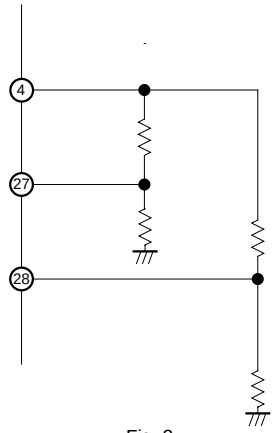


Fig. 3

●Electrical characteristic curves

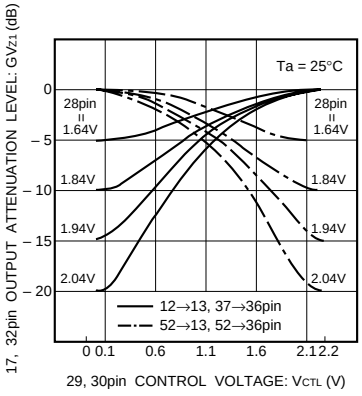


Fig. 4 Zoom control slope variation characteristics

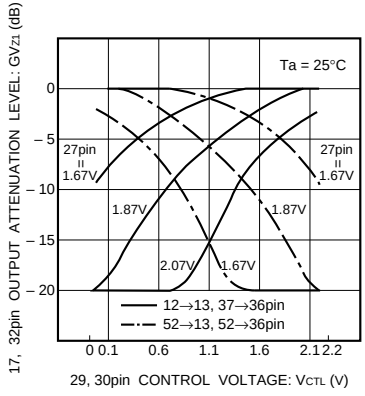
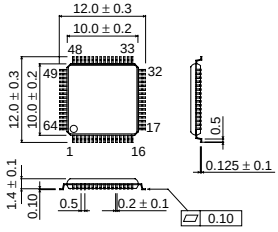


Fig. 5 Zoom control position variation characteristics

●External dimensions (Units: mm)



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