4-channel PRE / REC amplifier with auto-tracking interface

BA7184S

The BA7184S is a PRE / REC amplifier developed for use in video cassette recorders. It is compatible with four-head decks and features built-in FB damping, four preamplifiers, a chroma output amplifier, an FM output amplifier (with AGC), an envelope detector and envelope comparator, a constant-current BTL-drive REC amplifier (with AGC) and channel switching, EP / SP switching, and mode switching integrated onto a single monolithic IC.

●Applications

VCRs

●Features

1) The playback amplifier has a total gain of 56dB (Typ.), and has a low-noise preamplifier. Designed for VHS band operation with low external parts count. The IC has 4 circuits for 4-head VCR applications.
2) Two playback output systems (through output and AGC output). The AGC output level is 315mV$_{P-P}$ (Typ.); suitable for FM brightness signal output.
3) Auto-tracking interface for automated tracking adjustment. Linear detector characteristic with sensitivity that can be set using external components.
4) The recording amplifier uses constant-current BLT drive that handles load variations (i.e. headimpedance) well, and gives stable recording characteristics. 2 circuits are provided for 4-head VCR use.
5) Built-in recording level AGC means adjustment of FM recording current is not necessary.
6) Head switches for 4-channel PRE / REC system provided.
7) Operates off a single 5V power supply, with low power dissipation.

●Absolute maximum ratings (Ta = 25°C)

Parameter	Symbol	Limits	Unit
Applied voltage	V_{CC}	7.0	V
Power dissipation	Pd	1050*1	mW
Operating temperature	Topr	– 20 ~ + 65	°C
Storage temperature	Tstg	– 55 ~ + 125	°C

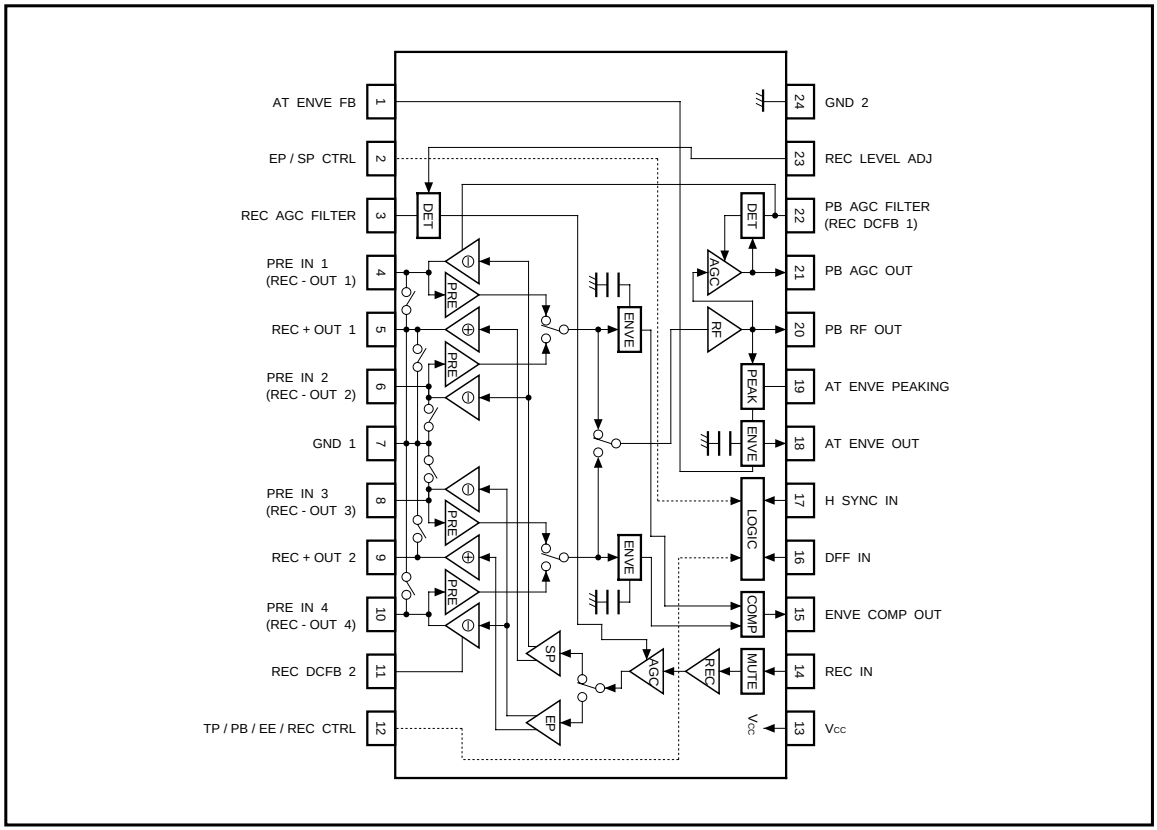
*1 Reduced by 10.5mW for each increase in Ta of 1°C over 25°C (free air).

●Recommended operating conditions (Ta = 25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Playback / recording	V_{CC}	4.5	5.0	5.5	V	13pin

○ Not designed for radiation resistance.

●Block diagram



●Electrical characteristics (unless otherwise noted, Ta = 25°C, V_{CC} = 5.0V and f = 4.0MHz)

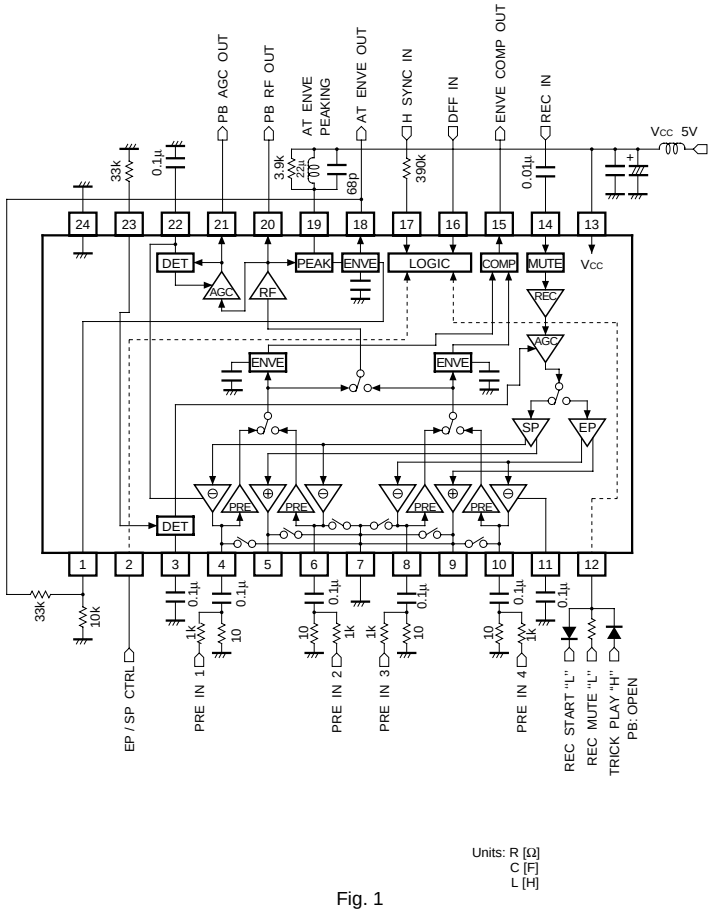
Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement circuit
⟨Playback system⟩ (Pin 12: H)							
Supply current	$I_{Q(P)}$	—	27	45	mA	No signal	Fig. 1
Voltage gain ch-1	G_{VP1}	52	56	60	dB	Pin 4 input = 0.3mV_{P-P}, pin 2: L, pin 16: L, pin 20 output measurement	Fig. 1
Voltage gain ch-2	G_{VP2}	52	56	60	dB	Pin 6 input = 0.3mV_{P-P}, pin 2: L, pin 16: H, pin 20 output measurement	Fig. 1
Voltage gain ch-3	G_{VP3}	52	56	60	dB	Pin 8 input = 0.3mV_{P-P}, pin 2: H, pin 16: L, pin 20 output measurement	Fig. 1
Voltage gain ch-4	G_{VP4}	52	56	60	dB	Pin 10 input = 0.3mV_{P-P}, pin 2: H, pin 16: H, pin 20 output measurement	Fig. 1
Voltage gain differential	ΔG_{VP}	– 1.5	—	+ 1.5	dB	$\Delta G_{VP} = G_{VP1} - G_{VP2}, G_{VP3} - G_{VP4}$	Fig. 1
Frequency characteristic	ΔG_{Vf}	– 8	– 1.7	—	dB	Pin 20 output level difference for f = 8.0 / 1.0MHz, V_{IN} = 0.3mV_{P-P}.	Fig. 1
2nd harmonic distortion	$2HD_P$	—	– 42	– 35	dBc	V_{IN} = 0.3mV_{P-P}, 8.0MHz spurious	Fig. 1
3rd harmonic distortion	$3HD_P$	—	– 50	– 35	dBc	V_{IN} = 0.3mV_{P-P}, 12.0MHz spurious*2	Fig. 1
Maximum output level	V_{OMP}	0.8	1.2	—	V_{P-P}	When pin 20 output 2nd harmonic distortion is – 30dBc	Fig. 1
Crosstalk	CT_P	—	– 45	– 30	dBc	Pin 20 output level difference for pin 2: H / L, pin 16: H / L.	Fig. 1
Output DC offset	ΔV_{ODC}	—	—	200	mV_{P-P}	Pin 20 output DC offset for pin 2: H / L, pin 16: H / L.	Fig. 1
Input conversion noise	V_{NIN}	—	0.25	1.0	μVrms	Rg = 10Ω, input conversion of pin 20 output noise*2	Fig. 1
AGC output level	V_{AGC}	265	315	365	mV_{P-P}	V_{IN} = 0.3mV_{P-P}, pin 21 output measurement	Fig. 1
AGC control sensitivity	ΔV_{AGC}	—	0.3	2.0	dB	Pin 21 output level differential for V_{IN} = 0.15 to 0.6mV_{P-P}.	Fig. 1
AGC frequency characteristic	ΔG_{VAF}	– 8	– 3	—	dB	f = 8.0 / 1.0MHz, V_{IN} = 0.3mV_{P-P}*2	Fig. 1
PB switch ON resistance	$R_{ON5, 9}$	—	5	10	Ω	Pin 5 and pin 9 impedance*2	Fig. 1
ENVE residual voltage	V_{ENV1}	—	0.7	1.0	V	Pin 18 output measurement when no signal	Fig. 1
ENVE output level	V_{ENV2}	2.4	2.9	3.4	V	Pin 18 output measurement when pin 20 output = 400mV_{P-P}	Fig. 1
ENVE saturation voltage	V_{ENV3}	4.0	4.5	—	V	Pin 18 output measurement for large signal	Fig. 1
PRE ch 2 and 4 holding voltage	V_{TH16H}	3.5	—	V_{CC}	V	Pin 16 DC voltage for ch 2 and 4 operation	Fig. 1
PRE ch 1 and 3 holding voltage	V_{TH16L}	0	—	1.2	V	Pin 16 DC voltage for ch 1 and 3 operation	Fig. 1
EP mode holding voltage	V_{TH2H}	3.5	—	V_{CC}	V	Pin 2 DC voltage for EP mode	Fig. 1
SP mode holding voltage	V_{TH2L}	0	—	1.2	V	Pin 2 DC voltage for SP mode	Fig. 1
TP mode holding voltage	V_{TH12T}	4.1	—	V_{CC}	V	Pin 12 DC voltage for TRICK PLAY mode	Fig. 1
PB mode holdihg voltage	V_{TH12H}	3.0	—	3.7	V	Pin 12 DC voltage for PB mode	Fig. 1
EE mode holding voltage	V_{TH12M}	1.1	—	2.6	V	Pin 12 DC voltage for REC MUTE mode	Fig. 1
REC mode holding voltage	V_{TH12L}	0	—	0.7	V	Pin 12 DC voltage for REC mode	Fig. 1

*2 Guaranteed design values.
Note: dBc: dB below carrier (used to express relative level from carrier reference for convenience sake)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement circuit
⟨Recording system⟩ (Pin 12: L)							
Quiescent current	$I_{q\,(R)}$	—	67	100	mA	No signal	Fig. 2
Recording AGC level 1	I_{OAR1}	27	30	33	mA_{P-P}	Pin 14 input = $125mV_{P-P}$, pin 2: L, pin 5 output measurement	Fig. 2
Recording AGC level 2	I_{OAR2}	24	27	30	mA_{P-P}	Pin 14 input = $125mV_{P-P}$, pin 2: H, pin 9 output measurement	Fig. 2
AGC control sensitivity	ΔI_{OAR}	—	0.3	2.0	dB	Pin 14 input = $62.5mV_{P-P}$, to $250mV_{P-P}$, pin 5 output level differential	Fig. 2
AGC frequency characteristic	ΔI_{OAF}	– 8	– 3	—	dB	f = 8.0 / 1.0MHz, pin 14 input = $125mV_{P-P}$,*2	Fig. 2
2nd harmonic distortion	$2HD_R$	—	– 45	– 35	dBc	Pin 14 input = $125mV_{P-P}$, 8MHz spurious	Fig. 2
3rd harmonic distortion	$3HD_R$	—	– 50	– 35	dBc	Pin 14 input = $125mV_{P-P}$, 12.0MHz spurious*2	Fig. 2
Cross modulation distortion	CMD_R	—	– 50	– 35	dBc	4.0MHz ± 630kHz spurious*2	Fig. 2
Maximum output level	I_{OMR}	40	50	—	mA_{P-P}	When pin 5 output 2nd harmonic distortion is – 30dB	Fig. 2
Recording current load characteristic	ΔI_{ORL}	– 2.0	– 0.3	—	dB	Pin 5 output level difference when load L: 8.2 and 12µH*2	Fig. 2
Mute attenuation ratio	MU_R	—	– 45	– 35	dBc	Pin 5 output level difference for pin 12: M / L	Fig. 2
AGC mode holding voltage	V_{TH17H}	2.8	—	V_{CC}	V	Pin 17 DC voltage to maintain recording AGC operation.	Fig. 2
$\overline{\text{AGC}}$ mode holding voltage	V_{TH17L}	0	—	1.2	V	Pin 17 DC voltage to maintain recording AGC stopped.	Fig. 2

*2 Guaranteed design values.
Note: dBc: dB below carrier (used to express relative level from carrier reference for convenience sake)

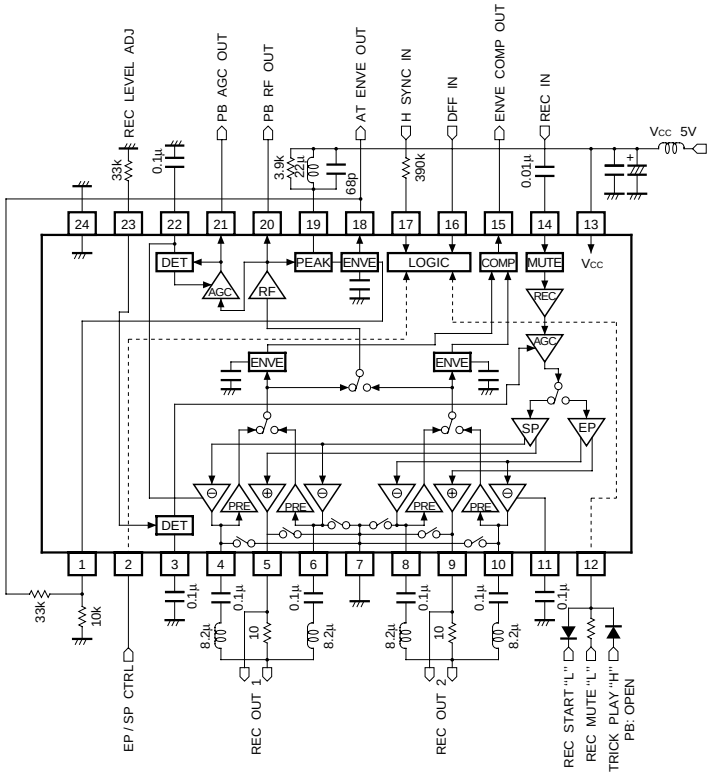
●Measurement circuits
(Playback system)



Units: R [Ω]
C [F]
L [H]

Fig. 1

(Recording system)



Units: R [Ω]
C [F]
L [H]

Fig. 2

●Control system logic table

(1) DFF IN (pin 16)

• Playback input selection (head switching)

Control pin		Function	Control voltage V_{CTRL16} [V]
DFF IN	EP / SP	Selected playback input	
L	H	Ch3 (PRE IN3 8pin)	3.5 ~ V_{CC}
H		Ch4 (PRE IN4 10pin)	0.0 ~ 1.2
L	L	Ch1 (PRE IN1 4pin)	—
H		Ch2 (PRE IN2 6pin)	—

(2) EP / SP control (pin 2)

• Recording output selection

• Playback input selection (see (1))

Control pin	Function	Control voltage V_{CTRL2} [V]
EP / SP	Selected recording output	
H	EP (REC OUT 8, 9, 10pin)	3.5 ~ V_{CC}
L	SP (REC OUT 4, 5, 6pin)	0.0 ~ 1.2

(3) TP / PB / EE / REC CTRL (pin 12)

• Special playback / playback / recording mute / recording mode switching

Control pin	Mode	Function					Control voltage V_{CTRL12} [V]
PB / EE / REC		PRE AMP	AT ENVE	ENV COMP	REC MUTE	REC AMP	
OT	TRICK PLAY	ON	ON	ON	OFF	OFF	4.1 ~ V_{CC}
H	PB	ON	ON	OFF	OFF	OFF	3.0 ~ 3.7
M	REC MUTE	OFF	OFF	OFF	ON	ON	1.1 ~ 2.6
L	REC	OFF	OFF	OFF	OFF	ON	0.0 ~ 0.7

• Pin 12 is biased internally in the IC. When open, PB mode is selected.

(4) H SYNC IN (pin 17)

• Special playback envelope comparator (ENVE COMP) output latch control.

• AGC operation control for recording.

Control pin	Function		Control voltage V_{CTRL17} [V]
H SYNC	ENVE COMP	AGC detector	
H	Set at falling edge	ON	2.8 ~ V_{CC}
L	—	OFF	0.0 ~ 1.2

(5) ENVE COMP OUT (pin 15)

• Outputs playback envelope comparator data for special playback.

Control pin	Function
ENVE COMP	Playback input level
H	Ch1 or Ch2 > Ch3 or Ch4
L	Ch1 or Ch2 < Ch3 or Ch4

●Application example

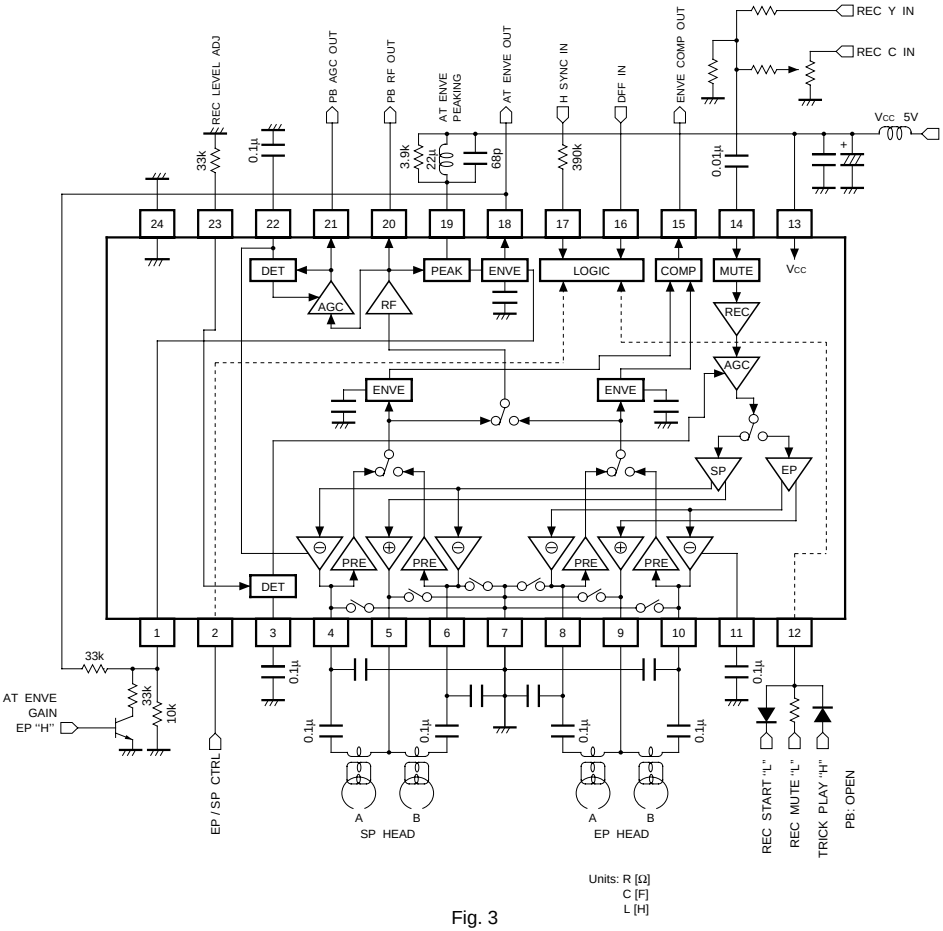
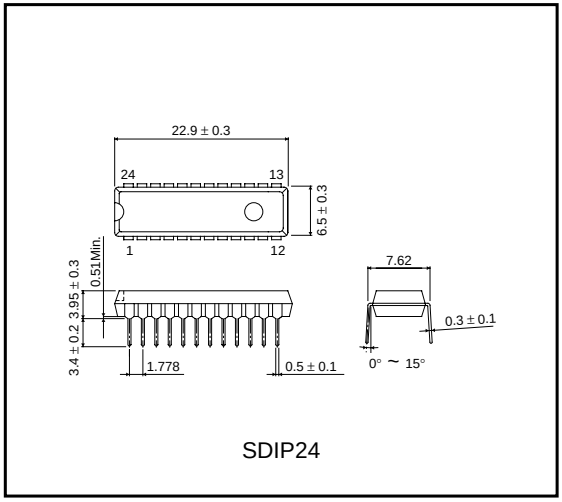


Fig. 3

●External dimensions (Units: mm)



SDIP24