Operational Amplifiers

Low Noise Operational Amplifiers

BA4580Rxxx BA4584FV BA4584Rxx

General Description

BA4580Rxxx, BA4584FV, BA4584Rxx integrates two or four independent high voltage gain Op-Amps on a single chip. Especially, this series are suitable for any audio applications due to low noise and low distortion characteristics and are usable for other many applications by wide operating supply voltage range.

Features

- High Voltage Gain
- Low Input Referred Noise Voltage
- Low Distortion
- Wide Operating Supply Voltage Range
- Wide Temperature Range

Application

- Audio Application
- Consumer Electronics

Packages

	W(Typ) x D(Typ) x H(Max)
SOP8	5.00mm x 6.20mm x 1.71mm
SOP-J8	4.90mm x 6.00mm x 1.65mm
TSSOP-B8	3.00mm x 6.40mm x 1.20mm
MSOP8	2.90mm x 4.00mm x 0.90mm
SOP14	8.70mm x 6.20mm x 1.71mm
SSOP-B14	5.00mm x 6.40mm x 1.35mm

Key Specification

- Operating Supply Voltage Range (Split Supply):
  BA4580Rxxx, BA4584FV ±2V to ±16V
  BA4584Rxx ±2V to ±9.5V
- Slew Rate: 5V/μs(Typ)
- Total Harmonic Distortion: 0.0005%(Typ)
- Input Referred Noise Voltage: 5 nV/√Hz (Typ)
- Operating Temperature Range:
  BA4584FV -40°C to +85°C
  BA4580Rxxx,BA4584Rxx -40°C to +105°C

Simplified Schematic

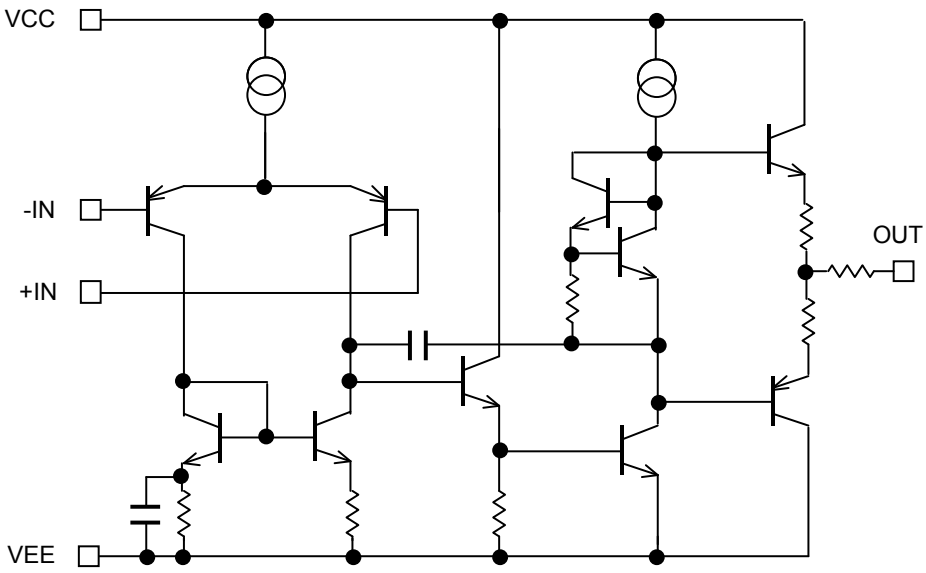
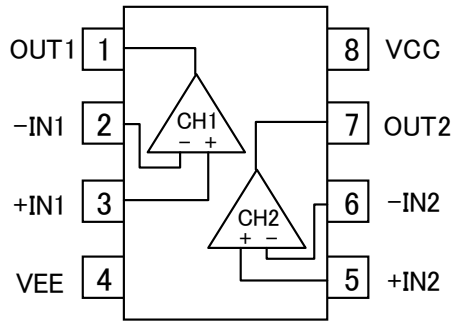


Figure 1. Simplified schematic

○Product structure：Silicon monolithic integrated circuit ○This product is not designed protection against radioactive rays.

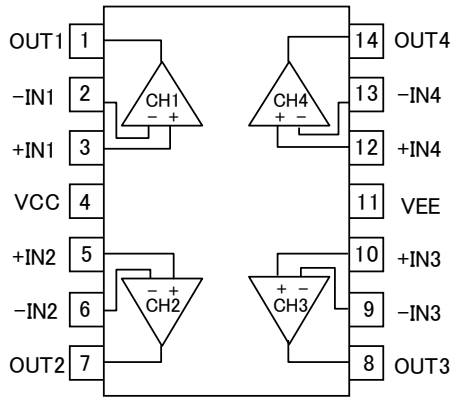
Pin Configuration

BA4580RF : SOP8
BA4580RFJ : SOP-J8
BA4580RFVT : TSSOP-B8
BA4580RFVM : MSOP8



Pin No.	Pin Name
1	OUT1
2	-IN1
3	+IN1
4	VEE
5	+IN2
6	-IN2
7	OUT2
8	VCC

BA4584RF : SOP14
BA4584FV, BA4584RFV : SSOP-B14



Pin No.	Pin Name
1	OUT1
2	-IN1
3	+IN1
4	VCC
5	+IN2
6	-IN2
7	OUT2
8	OUT3
9	-IN3
10	+IN3
11	VEE
12	+IN4
13	-IN4
14	OUT4

Package					
SOP8	SOP-J8	TSSOP-B8	MSOP8	SOP14	SSOP-B14
BA4580RF	BA4580RFJ	BA4580RFVT	BA4580RFVM	BA4584RF	BA4584FV BA4584RFV

Ordering Information

B A 4 5 8 x x x x x - x x

Part Number
BA4580Rxxx
BA4584FV
BA4584Rxx

Package
F : SOP8
SOP14
FJ : SOP-J8
FV : SSOP-B14
FVT : TSSOP-B8
FVM : MSOP8

Packaging and forming specification
E2: Embossed tape and reel
(SOP8/SOP-J8/TSSOP-B8/SOP14/
SSOP-B14)
TR: Embossed tape and reel
(MSOP8)

Line-up

Operating Temperature Range	Operating Supply Voltage Range (Split Supply)	Supply Current (Typ)	Slew Rate (Typ)	Package		Orderable Part Number
-40°C to +85°C	±2.0V to ±16.0V	12mA	5V/μs	SSOP-B14	Reel of 2500	BA4584FV-E2
-40°C to +105°C		6mA		SOP8	Reel of 2500	BA4580RF-E2
				SOP-J8	Reel of 2500	BA4580RFJ-E2
				TSSOP-B8	Reel of 3000	BA4580RFVT-E2
				MSOP8	Reel of 3000	BA4580RFVM-TR
	±2.0V to ±9.5V	11mA		SOP14	Reel of 2500	BA4584RF-E2
				SSOP-B14	Reel of 2500	BA4584RFV-E2

Absolute Maximum Ratings (T_A=25℃)

Parameter	Symbol		Ratings			Unit
			BA4580Rxxx	BA4584FV	BA4584Rxx	
Supply Voltage	VCC-VEE		+36			V
Power Dissipation	P_D	SOP8	0.78(Note1,7)	-		W
		SOP-J8	0.67(Note2,7)	-		
		TSSOP-B8	0.62(Note3,7)	-		
		MSOP8	0.59(Note4,7)	-		
		SOP14	-	-	0.61(Note5,7)	
		SSOP-B14	-	0.87(Note6,7)		
Differential Input Voltage(Note 8)	V_{ID}		+36			V
Input Common-mode Voltage Range	V_{ICM}		VEE to VEE+36			V
Input Current(Note 9)	I_I		±10			mA
Operating Supply Voltage Range	V_{opr}		+4 to +32 (±2 to ±16)		+4 to +19 (±2 to ±9.5)	V
Output Current	I_{OUT}		±50			mA
Operating Temperature Range	T_{opr}		-40 to +105	-40 to +85	-40 to +105	℃
Storage Temperature Range	T_{stg}		-55 to +150			℃
Maximum Junction Temperature	T_{Jmax}		+150			℃

(Note 1) To use at temperature above T_A=25℃ reduce 6.2mW/℃.
(Note 2) To use at temperature above T_A=25℃ reduce 5.4mW/℃
(Note 3) To use at temperature above T_A=25℃ reduce 5.0mW/℃
(Note 4) To use at temperature above T_A=25℃ reduce 4.8mW/℃
(Note 5) To use at temperature above T_A=25℃ reduce 4.9mW/℃
(Note 6) To use at temperature above T_A=25℃ reduce 7.0mW/℃
(Note 7) Mounted on a FR4 glass epoxy PCB(70mm×70mm×1.6mm).
(Note 8) The voltage difference between inverting input and non-inverting input is the differential input voltage.
Then input terminal voltage is set to more than VEE.
(Note 9) An excessive input current will flow when input voltages of more than VDD+0.6V or less than VSS-0.6V are applied.
The input current can be set to less than the rated current by adding a limiting resistor.
Caution: Operating the IC over the absolute maximum ratings may damage the IC. In addition, it is impossible to predict all destructive situations such as short-circuit modes, open circuit modes, etc. Therefore, it is important to consider circuit protection measures, like adding a fuse, in case the IC is operated in a special mode exceeding the absolute maximum ratings.

Electrical Characteristics

○BA4580R (Unless otherwise specified VCC=+15V, VEE=-15V, T_A=25℃)

Parameter	Symbol	Limits			Unit	Condition
		Min	Typ	Max		
Input Offset Voltage (Note 10)	V_{IO}	-	0.3	3	mV	R_S≦ 10kΩ
Input Offset Current (Note 10)	I_{IO}	-	5	200	nA	-
Input Bias Current (Note 11)	I_B	-	100	500	nA	-
Large Signal Voltage Gain	A_V	90	110	-	dB	R_L≧ 10kΩ, OUT=±10 V
Maximum Output Voltage	V_{OM}	±12	±13.5	-	V	R_L≧ 2kΩ
Input Common-mode Voltage Range	V_{ICM}	±12	±13.5	-	V	-
Common-mode Rejection Ratio	CMRR	80	110	-	dB	R_S≦ 10kΩ
Power Supply Rejection Ratio	PSRR	80	110	-	dB	R_S≦ 10kΩ
Supply Current	I_{CC}	-	6	9	mA	R_L=∞, All Op-Amps, VIN+=0V
Slew Rate	SR	-	5	-	V/μs	R_L≧ 2kΩ
Gain Bandwidth Product	GBW	-	10	-	MHz	f=10kHz
Unity Gain Frequency	f_T	-	5	-	MHz	R_L=2kΩ
Total Harmonic Distortion+ Noise	THD+N	-	0.0005	-	%	A_V=20dB, OUT=5Vrms R_L=2kΩ f=1kHz, 20Hz~20kHz BPF
Input Referred Noise Voltage	V_N	-	5	-	nV/√Hz	R_S=100Ω, V_I=0V, f=1kHz
		-	0.8	-	μVrms	RIAA, R_S=2.2 kΩ, 30kHz LPF
Channel Separation	CS	-	110	-	dB	R1=100Ω, f=1kHz

(Note 10) Absolute value

(Note 11) Current direction: Since first input stage is composed with PNP transistor, input bias current flows out of IC.

○BA4584 (Unless otherwise specified VCC=+15V, VEE=-15V, T_A =25°C)

Parameter	Symbol	Limits			Unit	Condition
		Min.	Typ.	Max.		
Input Offset Voltage (Note 12)	V_{IO}	-	0.3	3	mV	R_S≤ 10kΩ
Input Offset Current (Note 12)	I_{IO}	-	5	200	nA	-
Input Bias Current (Note 13)	I_B	-	100	500	nA	-
Large Signal Voltage Gain	A_V	90	110	-	dB	R_L≥ 10kΩ, OUT=±10 V
Maximum Output Voltage	V_{OM}	±12	±13.5	-	V	R_L≥ 2kΩ
Input Common-mode Voltage Range	V_{ICM}	±12	±13.5	-	V	-
Common-mode Rejection Ratio	CMRR	80	110	-	dB	R_S≤ 10kΩ
Power Supply Rejection Ratio	PSRR	80	110	-	dB	R_S≤ 10kΩ
Supply Current	I_{CC}	-	12	18	mA	R_L=∞, All Op-Amps, VIN+=0V
Slew Rate	SR	-	5	-	V/μs	R_L≥ 2kΩ
Gain Bandwidth Product	GBW	-	10	-	MHz	f=10kHz
Unity Gain Frequency	f_T	-	5	-	MHz	R_L=2kΩ
Total Harmonic Distortion+ Noise	THD+N	-	0.0005	-	%	A_V=20dB, OUT=5Vrms R_L=2kΩ f=1kHz, 20Hz~20kHz BPF
Input Referred Noise Voltage	V_N	-	5	-	nV/√Hz	R_S=100Ω, V_I=0V, f=1kHz
		-	0.8	-	μVrms	RIAA, R_S=2.2 kΩ, 30kHz LPF
Channel Separation	CS	-	110	-	dB	R1=100Ω, f=1kHz

(Note 12) Absolute value
(Note 13) Current direction: Since first input stage is composed with PNP transistor, input bias current flows out of IC.

○BA4584R（Unless otherwise specified VCC=+9.5V, VEE=-9.5V, T_A =25℃）

Parameter	Symbol	Limits			Unit	Condition
		Min.	Typ.	Max.		
Input Offset Voltage (Note 14)	V_{IO}	-	0.3	3	mV	R_S≤ 10kΩ
Input Offset Current (Note 14)	I_{IO}	-	5	200	nA	-
Input Bias Current (Note 15)	I_B	-	100	500	nA	-
Large Signal Voltage Gain	A_V	90	110	-	dB	R_L≥ 10kΩ, OUT=±10 V
Maximum Output Voltage	V_{OM}	±6.5	±8	-	V	R_L≥ 2kΩ
Input Common-mode Voltage Range	V_{ICM}	±6.5	±8	-	V	-
Common-mode Rejection Ratio	CMRR	80	110	-	dB	R_S≤ 10kΩ
Power Supply Rejection Ratio	PSRR	80	110	-	dB	R_S≤ 10kΩ
Supply Current	I_{CC}	-	11	17	mA	R_L=∞, All Op-Amps, VIN+=0V
Slew Rate	SR	-	5	-	V/μs	R_L≥ 2kΩ
Gain Bandwidth Product	GBW	-	10	-	MHz	f=10kHz
Unity Gain Frequency	f_T	-	5	-	MHz	R_L=2kΩ
Total Harmonic Distortion+ Noise	THD+N	-	0.0005	-	%	A_V=20dB, OUT=5Vrms R_L=2kΩ f=1kHz, 20Hz~20kHz BPF
Input Referred Noise Voltage	V_N	-	5	-	nV/√Hz	R_S=100Ω, V_I=0V, f=1kHz
		-	0.8	-	μVrms	RIAA, R_S=2.2 kΩ, 30kHz LPF
Channel Separation	CS	-	110	-	dB	R1=100Ω, f=1kHz

(Note 14) Absolute value
(Note 15) Current direction: Since first input stage is composed with PNP transistor, input bias current flows out of IC.

Description of Electrical Characteristics

Described below are descriptions of the relevant electrical terms used in this datasheet. Items and symbols used are also shown. Note that item name and symbol and their meaning may differ from those on another manufacturer's document or general document.

1. Absolute Maximum Ratings

Absolute maximum rating items indicate the condition which must not be exceeded. Application of voltage in excess of absolute maximum rating or use out of absolute maximum rated temperature environment may cause deterioration of characteristics.

1.1 Power Supply Voltage (VCC-VEE)
Indicates the maximum voltage that can be applied between the positive power supply terminal and negative power supply terminal without deterioration or destruction of characteristics of internal circuit.

1.2 Differential Input Voltage (V_{ID})
Indicates the maximum voltage that can be applied between non-inverting and inverting terminals without damaging the IC.

1.3 Input Common-mode Voltage Range (V_{ICM})
Indicates the maximum voltage that can be applied to the non-inverting and inverting terminals without deterioration or destruction of electrical characteristics. Input common-mode voltage range of the maximum ratings does not assure normal operation of IC. For normal operation, use the IC within the input common-mode voltage range characteristics.

1.4 Power Dissipation (P_D)
Indicates the power that can be consumed by the IC when mounted on a specific board at the ambient temperature 25°C (normal temperature). As for package product, Pd is determined by the temperature that can be permitted by the IC in the package (maximum junction temperature) and the thermal resistance of the package.

2. Electrical Characteristics Item

2.1 Input Offset Voltage (V_{IO})
Indicates the voltage difference between non-inverting terminal and inverting terminals. It can be translated into the input voltage difference required for setting the output voltage at 0 V.

2.2 Input Offset Current (I_{IO})
Indicates the difference of input bias current between the non-inverting and inverting terminals.

2.3 Input Bias Current (I_B)
Indicates the current that flows into or out of the input terminal. It is defined by the average of input bias currents at the non-inverting and inverting terminals.

2.4 Input Common-mode Voltage Range (V_{ICM})
Indicates the input voltage range where IC normally operates.

2.5 Large Signal Voltage Gain (A_V)
Indicates the amplifying rate (gain) of output voltage against the voltage difference between non-inverting terminal and inverting terminal. It is normally the amplifying rate (gain) with reference to DC voltage.
Av = (Output voltage) / (Differential Input voltage)

2.6 Circuit Current (I_{CC})
Indicates the current that flows within the IC under specified no-load conditions.

2.7 Output Saturation Voltage (V_{OM})
Signifies the voltage range that can be output under specific output conditions.

2.8 Common-mode Rejection Ratio (CMRR)
Indicates the ratio of fluctuation of input offset voltage when the input common mode voltage is changed. It is normally the fluctuation of DC.
CMRR = (Change of Input common-mode voltage)/(Input offset fluctuation)

2.9 Power Supply Rejection Ratio (PSRR)
Indicates the ratio of fluctuation of input offset voltage when supply voltage is changed. It is normally the fluctuation of DC.
PSRR= (Change of power supply voltage)/(Input offset fluctuation)

2.10 Channel Separation (CS)
Indicates the fluctuation in the output voltage of the driven channel with reference to the change of output voltage of the channel which is not driven.

2.11 Slew Rate (SR)
Indicates the ratio of the change in output voltage with time when a step input signal is applied.

2.12 Gain Band Width (GBW)
The product of the open-loop voltage gain and the frequency at which the voltage gain decreases 6dB/octave.

2.13 Unity Gain Frequency (f_T)
Indicates a frequency where the voltage gain of operational amplifier is 1.

2.14 Total Harmonic Distortion+ Noise (THD+N)
Indicates the fluctuation of input offset voltage or that of output voltage with reference to the change of output voltage of driven channel.

2.15 Input Referred Noise Voltage (V_N)
Indicates a noise voltage generated inside the operational amplifier equivalent by ideal voltage source connected in series with input terminal.