Integrated Circuits, Silicon Monolithic, Bipolar Operational Amplifiers

αRD108A

General Description

The **αRD108A** series are precision operational amplifiers having specifications about a factor of ten better than FET amplifiers over their operating temperature range. In addition to low input currents, these devices have extremely low offset voltage, making it possible to eliminate offset adjustments, in most cases, and obtain performance approaching chopper stabilized amplifiers. The devices operate with supply voltages from ±5V to ±20V and have sufficient supply rejection to use unregulated supplies. An alternate compensation scheme can be used to make it particularly insensitive to power supply noise and to make supply bypass capacitors unnecessary. The low current error of the **αRD108A** series makes possible many designs that are not practical with conventional amplifiers.

Features

- **Available with Radiation Specification**
  - **Total Ionization Dose (TID) 100 krad(Si) (Dose rate = 36 to 360 rad hr $^{-1}$)**
- **Supply voltage: ±5 V dc to ±20 V dc**
- **Offset voltage guaranteed less than 1.0 mV**
- **Maximum input bias current of 3.0 nA over temperature**
- **Offset current less than 400 pA over temperature**
- **Guaranteed 5 µV/ºC drift**

Ordering information

Table 1

Part	Temp. range, °C	Package	Package drawing	Burn-In case temp, °C	Burn-In time, hrs
αRD108A	–55 to +125	10-lead ceramic flatpack	Figure 3	+125±5	168

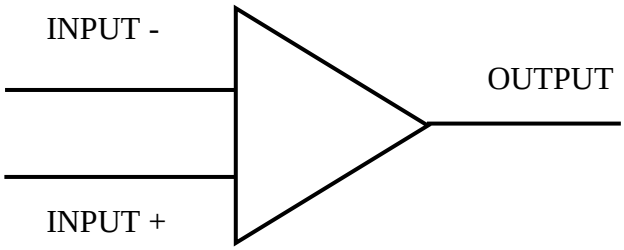
Pin Function Description

Table 2

Description	Mnemonic	Pin No
Non Contact	NC	1
Non Contact	NC	2
Negative Input	-IN	3
Positive Input	+IN	4
Non Contact	NC	5
Negative Supply	V_S-	6
Output	OUT	7
Positive Supply	V_S+	8
Compensation (A)	COMP(A)	9
Compensation (B)	COMP(B)	10

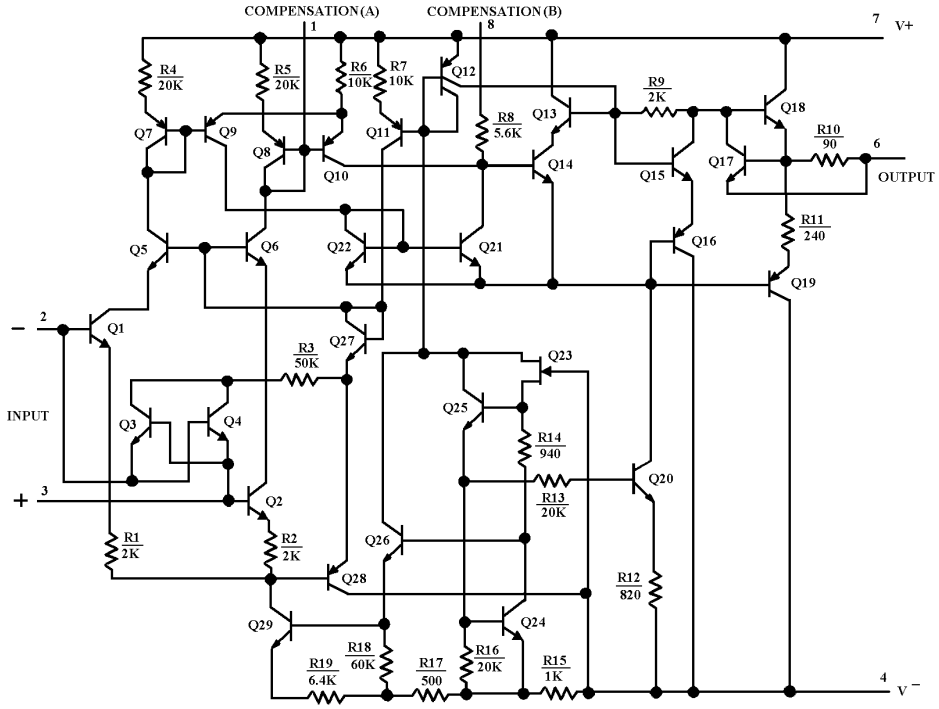
Functional Diagram

Figure 1



Circuit Schematic

Figure 2



Absolute maximum ratings

Table 3

No.	Characteristics	Symbol	Maximum ratings	Units	Remarks
1	Supply Voltage	V_S	±22	V	
2	Differential Input Voltage	V_{ID}	±30	V	Note 2
3	Input Voltage	V_I	±20	V	Note 3
4	Differential Input Current	I_I	±10 mA	mA	Note 4
5	Thermal Resistance: Junction – Ambient Junction - Case	θ_{JA} θ_{JC}	225 21	°C/W	
6	Output Short Circuit Duration	-	Continuous		Note 5
7	Operating Temperature Range	T_A	-55 to +125	°C	
8	Storage Temperature Range	T_A	- 65 to + 150	°C	
9	Maximum Junction Temperature		175	°C	
10	Lead Temperature (Soldering, 10 s)	Tsol	300	°C	
11	Thermal conductivity		18	W/mK	
12	ESD Tolerance		0	class	Note 6

Notes:

1. Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not ensure specific performance limits. For ensured specifications and test conditions, see the Electrical Characteristics. The ensured specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.
2. This rating is ±1.0 V unless resistances of 2 kΩ or greater are inserted in series with the inputs to limit current in the input shunt diodes to the maximum allowable value.
3. For supply voltages less than ±20V, the absolute maximum input voltage is equal to the supply voltage.
4. The inputs are shunted with back-to-back diodes for over voltage protection. Therefore, excessive current will flow if a differential input voltage in excess of 1V is applied between the inputs unless some limiting resistance is used.
5. Continuous short circuit is allowed for an ambient temperature of 70 °C and a case temperature of +125 °C.
6. Human body model, 1.5 kΩ in series with 100 pF.

Electrical DC characteristics within operating temperature range

Table 4

Notes (1, 2)

Parameter	Symbol	Conditions	T_A, °C	Limits Min	Limits Max	Units
Input Offset Voltage	V_{IO}	$+V_{CC}$ = 35 V, $-V_{CC}$ = -5 V; V_{CM} = -15 V	+22 ±3	- 0.5	0.5	mV
			+125(+0-3) -55(+ 5-0)	-1.0	1.0	
		R	+22 ±3	- 1.6	1.6	
		$+V_{CC}$ = 5 V, $-V_{CC}$ = -35 V; V_{CM} = 15 V	+22 ±3	- 0.5	0.5	mV
			+125(+0-3) -55(+ 5-0)	-1.0	1.0	
		R	+22 ±3	-1.6	1.6	
		$+V_{CC}$ = 20 V, $-V_{CC}$ = -20 V; V_{CM} = 0 V	+22 ±3	- 0.5	0.5	mV
			+125(+0-3) -55(+ 5-0)	-1.0	1.0	
		R	+22 ±3	-1.6	1.6	
		$+V_{CC}$ = 5 V, $-V_{CC}$ = -5 V	+22 ±3	- 0.5	0.5	mV
			+125(+0-3) -55(+ 5-0)	-1.0	1.0	
		R	+22 ±3	-1.6	1.6	
Temperature Coefficient of Input Offset Voltage	$\Delta V_{IO}/\Delta T$	Notes 6	-55 °C≤T_A≤125 °C	-5.0	5.0	µV/°C
Input Offset Current	I_{IO}	$+V_{CC}$ = 35 V, $-V_{CC}$ = -5 V; V_{CM} = -15 V ; R_S = 5 MΩ	+22 ±3	-0.2	0.2	nA
			+125(+0-3) -55(+ 5-0)	-0.4	0.4	
		R	+22 ±3	-0.5	0.5	
		$+V_{CC}$ = 5 V, $-V_{CC}$ = -35 V; V_{CM} = 15 V; R_S = 5 MΩ	+22 ±3	-0.2	0.2	nA
			+125(+0-3) -55(+ 5-0)	-0.4	0.4	
		R	+22 ±3	-0.5	0.5	
		$+V_{CC}$ = 5 V, $-V_{CC}$ = -5 V, R_S = 5 MΩ	+22 ±3	-0.2	0.2	nA
			+125(+0-3) -55(+ 5-0)	-0.4	0.4	
		R	+22 ±3	-0.5	0.5	
		$+V_{CC}$ = 20 V, $-V_{CC}$ = -20 V; V_{CM} = 0 V; R_S = 5 MΩ	+22 ±3	-0.2	0.2	nA
			+125(+0-3) -55(+ 5-0)	-0.4	0.4	
		R	+22 ±3	-0.5	0.5	
Temperature Coefficient of Input Offset Current	$\Delta I_{IO}/\Delta T$	Notes 6	55 °C≤T_A≤125 °C	-2.5	2.5	pA/°C

Electrical DC characteristics within operating temperature range

Table 4 (Continued)

Notes (1, 2)

Parameter	Symbol	Conditions	T_A, °C	Limits Min	Limits Max	Units
Input Bias Current	$\pm I_{IB}$	$+V_{CC}$ = 35 V, $-V_{CC}$ = -5 V; V_{CM} = -15 V; R_S = 5 MΩ	+22 ±3	- 0.1	2.0	nA
			+125(+0-3)	- 1.0	2.0	
			-55(+ 5-0)	- 1.0	3.0	
		R	+22 ±3	- 0.1	5.0	
		$+V_{CC}$ = 5 V, $-V_{CC}$ = -35 V; V_{CM} = 15 V; R_S = 5 MΩ	+22 ±3	- 0.1	2.0	nA
			+125(+0-3)	- 1.0	2.0	
			-55(+ 5-0)	- 1.0	3.0	
		R	+22 ±3	- 0.1	5.0	
		$+V_{CC}$ = 20 V, $-V_{CC}$ = -20 V; V_{CM} = 0 V; R_S = 5 MΩ	+22 ±3	- 0.1	2.0	nA
			+125(+0-3)	- 1.0	2.0	
			-55(+ 5-0)	- 1.0	3.0	
		R	+22 ±3	- 0.1	5.0	
		$+V_{CC}$ = 5 V, $-V_{CC}$ = -5 V; R_S = 5 MΩ	+22 ±3	- 0.1	2.0	nA
			+125(+0-3)	- 1.0	2.0	
			-55(+ 5-0)	- 1.0	3.0	
		R	+22 ±3	- 0.1	5.0	
Power Supply Rejection Ratio (Notes 7)	+PSRR	$+V_{CC}$ = 10 V ; $-V_{CC}$ = -20 V ; R_S = 50 Ω	+ 125°C ÷ -55°C	-16	16	µV/V
		R	+22 ±3			
	- PSRR	$+V_{CC}$ = 20 V ; $-V_{CC}$ = -10 V ; R_S = 50 Ω	+ 125°C ÷ -55°C	-16	16	µV/V
		R	+22 ±3			
Common Mode Rejection Ratio	CMRR	V_{CM} = ± 15 V	+ 125°C ÷ -55°C	96	-	dB
		R	+22 ±3			
Short Circuit Output Current (Plus) (Notes 7)	I_{OS}+	$\pm V_{CC}$ = ±15 V; t ≤ 25 ms	+ 125°C ÷ -55°C	-20	-	mA
		R	+22 ±3			
Short Circuit Output Current (Minus) (Notes 7)	I_{OS}-	$\pm V_{CC}$ = ±15 V; t ≤ 25 ms	+ 125°C ÷ -55°C	-	20	mA
		R	+22 ±3			
Power Supply Current (Notes 7)	I_{CC}	$\pm V_{CC}$ = ±15 V	+22 ±3 +125(+0-3)	-	0.6	mA
			-55(+ 5-0)	-	0.8	
		R	+22 ±3	-	0.6	

Electrical DC characteristics within operating temperature range

Table 4 (Continued)

Notes (1, 2)

Parameter	Symbol	Conditions	T_A, °C	Limits Min	Limits Max	Units
Open Loop Voltage Gain (single ended)	$A_{VS}(+)$	$\pm V_{CC}$ = ±20 V ; R_L = 10 kΩ ; V_{OUT} = +15V	+22 ±3	80	-	V/mV
			+125(+0-3), -55(+ 5-0)	40	-	
		R	+22 ±3	40	-	
	$A_{VS}(-)$	$\pm V_{CC}$ = ±20 V ; R_L = 10 kΩ ; V_{OUT} = -15 V	+22 ±3	80	-	V/mV
			+125(+0-3), -55(+ 5-0)	40	-	
		R	+22 ±3	40	-	
	A_{VS}	$\pm V_{CC}$ = ±5 V ; R_L = 10 kΩ ; V_{OUT} = ±2 V	+ 125°C ÷ -55°C	20	-	V/mV
		R	+22 ±3	20		
Output Voltage Swing (maximum)	$+V_{OP}$	R_L = 10 kΩ	+ 125°C ÷ -55°C	16.0	-	V
	$-V_{OP}$	R_L = 10 kΩ	+ 125°C ÷ -55°C	-	-16.0	V

Electrical AC characteristics within operating temperature range

Table 5

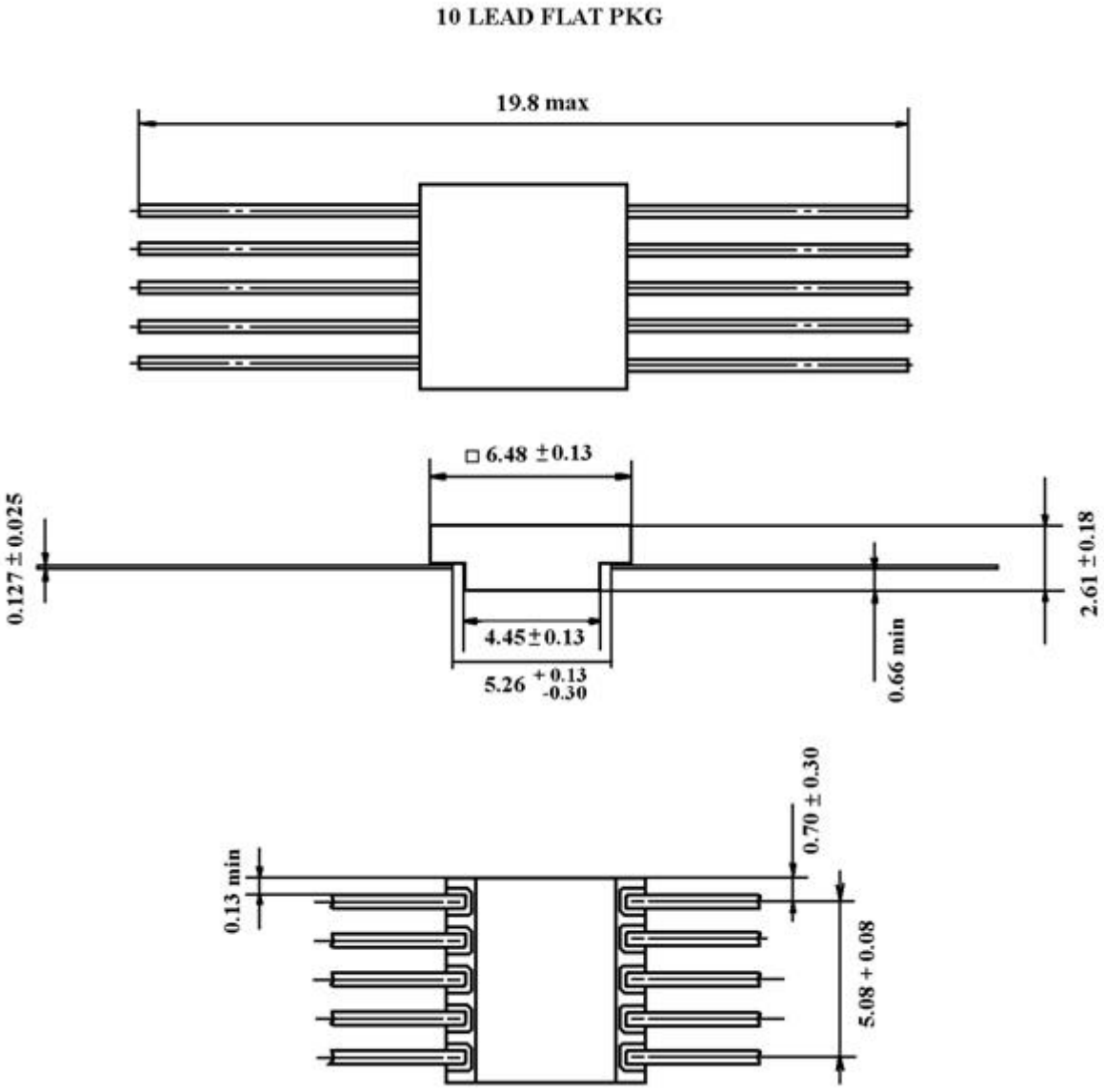
Parameter	Symbol	Test Conditions	T_A, °C	Limits Min	Limits Max	Units
Rise Time	$TR_{(tr)}$	R_L = 10 kΩ ; C_L = 100 pF ; f < 1 kHz V_{IN} = +50 mV	+ 125°C ÷ -55°C		1000	ns
Overshoot	$TR_{(OS)}$	R_L = 10 kΩ ; C_L = 100 pF ; f < 1 kHz V_{IN} = +50 mV	+ 125°C ÷ -55°C		50	%
Slew Rate (Plus)	SR(+)	V_{IN} = +5 V to -5 V; Cc = 20 pF; A_V = 1	+ 125°C ÷ -55°C	0.05		V/µs
Slew Rate (Minus)	SR(-)	V_{IN} = +5 V to -5 V; Cc = 20 pF; A_V = 1	+ 125°C ÷ -55°C	0.05		V/µs

Notes:

1. Post irradiation limits are identical to those listed under AC and DC electrical characteristics except as listed in the line denoted "R" of "Conditions" section Table 4. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate effect.
2. Radiation end point limits for the noted parameters are ensured only for the conditions as specified in MIL-STD-883, Method 1019
3. For sampling inspections and-end point tests the duration of measurement of I_{os} shall be 5 seconds minimum. For other tests, this duration may be reduced to be consistent with automatic test procedures provided that the same limits are maintained.
4. Unless otherwise specified test conditions include : V_{CC} = ±20 V, T_A=22±3°C, R_S = 50 Ω, V_{CM} = 0 V.
5. Sample Test Inspection Level = II, AQL = 2.5%.
6. Calculated parameters
7. This parameter not tested post radiation

Physical Dimensions

Figure 3



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