Integrated Circuits, Silicon Monolithic, Low Power, Quad, Bipolar Operational Amplifiers

αRD124A

General Description

The **αRD124A** consists of four independent, high gain, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

Application areas include transducer amplifiers, DC gain blocks and all the conventional op amp circuits which now can be more easily implemented in single power supply systems. The **αRD124A** can be directly operated off of the standard +5Vdc power supply voltage which is used in digital systems and will easily provide the required interface electronics without requiring the additional +15Vdc power supplies.

Features

- **Available with Radiation Specification**
  - **Total Ionization Dose (TID) 300 krad(Si)**
  - **ELDRS Free 300 krad(Si) (dose rate = 36 - 360rads(Si)/h)**
- **Internally Frequency Compensated for Unity Gain**
- **Large DC Voltage Gain 250 V/mV**
- **Wide Bandwidth (Unity Gain) 0.75 MHz (Temperature Compensated)**
- **Wide Power Supply Range:**
  - **Single Supply 3V to 32V**
  - **Or Dual Supplies ±1.5V to ±16V**
- **Very Low Supply Current Drain (700 µA) – Essentially Independent of Supply Voltage**
- **Low Input Biasing Current 45 nA (Temperature Compensated)**
- **Low Input Offset Voltage 2 mV and Offset Current: 5 nA**.
- **Input Common-Mode Voltage Range Includes Ground**
- **Differential Input Voltage Range Equal to the Power Supply Voltage**
- **Large Output Voltage Swing 0V to $V^+ - 1.5V$**

Unique Characteristics

- In the Linear Mode, the Input Common-Mode Voltage Range Includes Ground and the Output Voltage can also Swing to Ground, even though Operated from Only a Single Power Supply Voltage
- The Unity Gain Cross Frequency is Temperature Compensated
- The Input Bias Current is also Temperature Compensated

Advantages

- Eliminates Need for Dual Supplies
- Four Internally Compensated Op Amps in a Single Package
- Allows Directly Sensing near GND and V_{OUT} also Goes to GND
- Compatible with all Forms of Logic
- Power Drain Suitable for Battery Operation

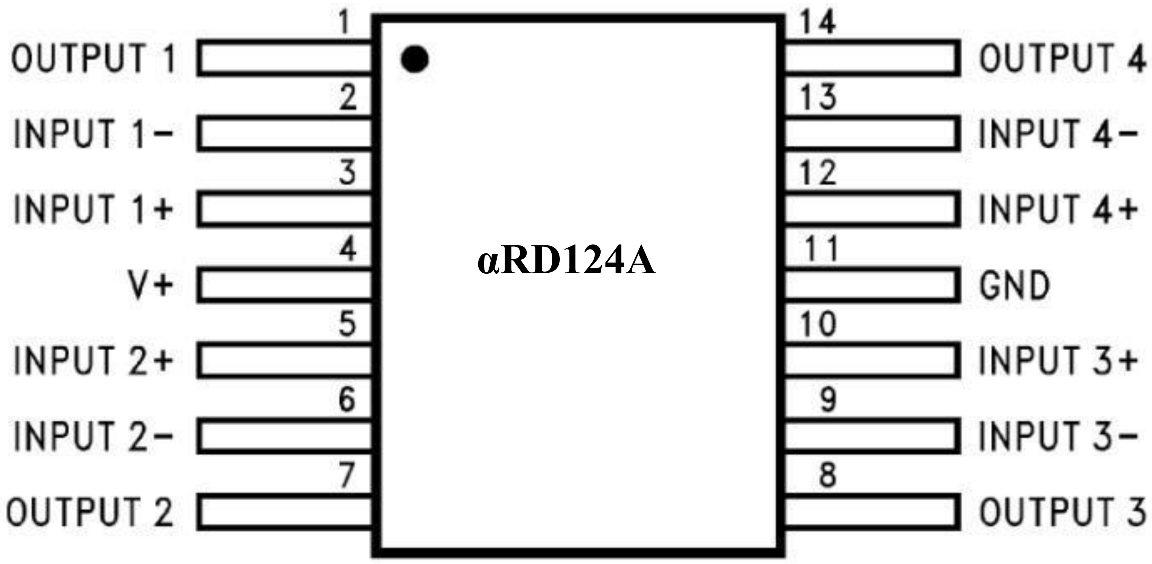
Ordering information

Table 1

Part	Temp. range, °C	Package	Package drawing	Burn-In case temp, °C	Burn-In time, hrs
αRD124A	–55 to +125	14-lead ceramic flatpack	Figure 3	+125	240

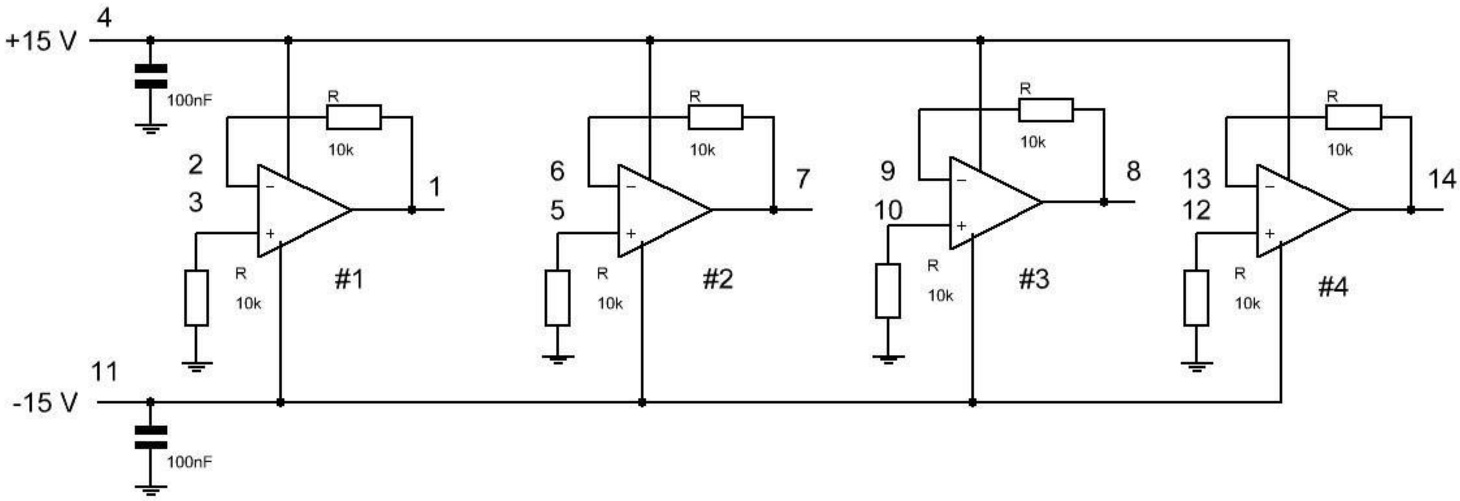
Pin Function Description

Figure 1



Functional Diagram

Figure 2



Absolute maximum ratings

Table 2

No	Characteristics	Symbol	Maximum ratings	Unit	Remarks
1	Supply Voltage	Vcc	32 or ±16	V	-
2	Differential Input Voltage	V_{ID}	32	V	-
3	Input Voltage		−0.3 to +32	V	(note 1)
4	Input Current (VIN < −0.3V)	I_{IN}	50	mA	(note 2)
5	Power Dissipation	P_D	700	mW	-
6	Output Short-Circuit Duration (One Amplifier)	Ios(t)	Indefinite		(note 3)
7	Operating Temperature Range	Top	−55 to +125	°C	-
8	Maximum Junction Temperature	Tj	+150	°C	-
9	Storage Temperature Range	Tstg	−65 to +150	°C	-
10	Lead Temperature (Soldering, 10 seconds)	Tsol	+260	°C	-
11	Thermal conductivity		18	W/mK	-
12	ESD Tolerance		250	V	(note 4)

Notes:

(1) For supply voltages less than +32V, the absolute maximum input voltage is equal to supply voltage.
(2) This input current will only exist when the voltage at any of the input leads is driven negative. It is due to the collector-base junction of the input PNP transistors becoming forward biased and thereby acting as input diode clamps. In addition to this diode action, there is also lateral NPN parasitic transistor action on the IC chip. This transistor action can cause the output voltages of the op amps to go to the V^+ voltage level (or to ground for a large overdrive) for the time duration that an input is driven negative. This is not destructive and normal output states will re-establish when the input voltage, which was negative, again returns to a value greater than -0.3VDC (at 22±3°C).
(3) Short circuits from the output to Vcc can cause excessive heating and eventual destruction. The maximum output current is approximately 20 mA, independent of the magnitude of +Vcc. At +Vcc > +15V, continuous short circuits can exceed the power dissipation ratings and cause eventual destruction.
(4) Human body model, 1.5 kΩ in series with 100 pF.

Electrical DC characteristics within operating temperature range

Table 3

Notes (1) (2)

Parameter	Symbol	Conditions		T_A, °C	Limits Min	Limits Max	Units
Input Offset Voltage	V_{IO}	$+V_{CC}$ = 30V, $-V_{CC}$ = Gnd, V_{CM} = +15V		+22 ±3	-2	2	mV
				+125(+0-3)	-4	4	
				-55(+ 5-0)	-4	4	
			R, A (note 1)	+22 ±3	-2.5	2.5	
		$+V_{CC}$ = 2V, $-V_{CC}$ = -28V, V_{CM} = -13V		+22 ±3	-2	2	mV
				+125(+0-3)	-4	4	
				-55(+ 5-0)	-4	4	
			R, A (note 1)	+22 ±3	-2.5	2.5	
		$+V_{CC}$ = 5V, $-V_{CC}$ = Gnd, V_{CM} =+1.4V		+22 ±3	-2	2	mV
				+125(+0-3)	-4	4	
				-55(+ 5-0)	-4	4	
			R, A (note 1)	+22 ±3	-2.5	2.5	
		$+V_{CC}$ = 2.5V, $-V_{CC}$ = -2.5, V_{CM} = -1.1V		+22 ±3	-2	2	mV
				+125(+0-3)	-4	4	
				-55(+ 5-0)	-4	4	
			R, A (note 1)	+22 ±3	-2.5	2.5	
Input Offset Current	I_{IO}	$+V_{CC}$ = 30V, $-V_{CC}$ = Gnd, V_{CM} = +15V		+22 ±3	-10	10	nA
				+125(+0-3)	-10	10	
				-55(+ 5-0)	-30	30	
			R, A (note 1)	+22 ±3	-15	15	
		$+V_{CC}$ = 2V, $-V_{CC}$ = -28V, V_{CM} = -13V		+22 ±3	-10	10	nA
				+125(+0-3)	-10	10	
				-55(+ 5-0)	-30	30	
			R, A (note 1)	+22 ±3	-15	15	
		$+V_{CC}$ = 5V, $-V_{CC}$ = Gnd, V_{CM} = +1.4V		+22 ±3	-10	10	nA
				+125(+0-3)	-10	10	
				-55(+ 5-0)	-30	30	
			R, A (note 1)	+22 ±3	-15	15	
		$+V_{CC}$ = 2.5V, $-V_{CC}$ = -2.5, V_{CM} = -1.1V		+22 ±3	-10	10	nA
				+125(+0-3)	-10	10	
				-55(+ 5-0)	-30	30	
			R, A (note 1)	+22 ±3	-15	15	

Electrical DC characteristics within operating temperature range

Table 3 (Continued)
Notes (1) (2)

Parameter	Symbol	Conditions	T_A, °C	Limits Min	Limits Max	Units
Input Bias Current	$\pm I_{IB}$	$+V_{CC}$ = 30V, $-V_{CC}$ = Gnd, V_{CM} = +15V	+22 ±3	-50	0.1	nA
			+125(+0-3)	-50	0.1	
			-55(+ 5-0)	-100	0.1	
		R (note 1)	+22 ±3	-75	0.1	
		A (note 1)	+22 ±3	-130	0.1	
		$+V_{CC}$ = 2V, $-V_{CC}$ = -28V, V_{CM} = -13V	+22 ±3	-50	0.1	nA
			+125(+0-3)	-50	0.1	
			-55(+ 5-0)	-100	0.1	
		R (note 1)	+22 ±3	-75	0.1	
		A (note 1)	+22 ±3	-130	0.1	
		$+V_{CC}$ = 5V, $-V_{CC}$ = Gnd, V_{CM} =+1.4V	+22 ±3	-50	0.1	nA
			+125(+0-3)	-50	0.1	
			-55(+ 5-0)	-100	0.1	
		R (note 1)	+22 ±3	-75	0.1	
		A (note 1)	+22 ±3	-130	0.1	
		$+V_{CC}$ = 2.5V, $-V_{CC}$ = -2.5, V_{CM} = -1.1V	+22 ±3	-50	0.1	nA
			+125(+0-3)	-50	0.1	
			-55(+ 5-0)	-100	0.1	
		R (note 1)	+22 ±3	-75	0.1	
		A (note 1)	+22 ±3	-130	0.1	
Power Supply Rejection Ratio	+PSRR	$-V_{CC}$ = Gnd, V_{CM} = +1.4V, 5V ≤ V_{CC} ≤ 30V	+ 125°C ÷ -55°C	-100	100	μV/V
Common Mode Rejection Ratio (note 3)	CMRR	$+V_{CC}$ = 30V, $-V_{CC}$ = Gnd, V_{CM} = 28.5V	+ 125°C ÷ -55°C	76	-	dB
Short Circuit Output Current	I_{OS}+	$+V_{CC}$ = 30V, $-V_{CC}$ = Gnd, V_O = 25V	+ 125°C ÷ -55°C	-70	-	mA
Power Supply Current	I_{CC}	$+V_{CC}$ = 30V, $-V_{CC}$ = Gnd, R_L = 10 kΩ	+22 ±3, +125(+0-3)	-	3	mA
			-55(+ 5-0)	-	4	
		R, A (note 1)	+22 ±3	-	3	
Low Level Output Voltage	V_{OL}	$+V_{CC}$ = 30V, $-V_{CC}$ = Gnd, R_L = 10kΩ	+ 125°C ÷-55°C	-	35	mV
		R, A (note 1)	+22 ±3			
		$+V_{CC}$ = 30V, $-V_{CC}$ = Gnd, I_{OL} = 5mA	+ 125°C ÷ -55°C	-	1.5	V
		$+V_{CC}$ = 4.5V, $-V_{CC}$ = Gnd, I_{OL} = 2μA	+ 125°C ÷ -55°C	-	0.4	V
High Level Output Voltage	V_{OH}	$+V_{CC}$ = 30V, $-V_{CC}$ = Gnd, I_{OH} = -10mA	+ 125°C ÷ -55°C	27	-	V
		R, A (note 1)	+22 ±3			
		$+V_{CC}$ = 4.5V, $-V_{CC}$ = Gnd, I_{OH} = -10mA	+ 125°C ÷ -55°C	2.4	-	V
Open Loop Voltage Gain (Plus)	+AVS	$+V_{CC}$ = 30V, $-V_{CC}$ = Gnd, 1V ≤ V_O ≤ 26V, R_L = 10kΩ	+22 ±3	50	-	V/mV
			+125(+0-3), -55(+ 5-0)	25	-	
		R, A (note 1)	+22 ±3	40	-	
		V_{CC} = 30V, $-V_{CC}$ = Gnd, 5V ≤ V_O ≤ 20V, R_L = 2kΩ	+22 ±3	50	-	V/mV
			+125(+0-3), -55(+ 5-0)	25	-	
		R, A (note 1)	+22 ±3	40	-	

Electrical DC characteristics within operating temperature range

Table 3 (Continued)
Notes (1) (2)

Parameter	Symbol	Conditions	T_A, °C	Limits Min	Limits Max	Units
Open Loop Voltage Gain	AVS	$+V_{CC}$ = 5V, $-V_{CC}$ = Gnd, 1V ≤ V_O ≤ 2.5V, R_L = 10kΩ	+ 125°C ÷ -55°C	10	-	V/mV
		$+V_{CC}$ = 5V, $-V_{CC}$ = Gnd, 1V ≤ V_O ≤ 2.5V, R_L = 2kΩ	+ 125°C ÷ -55°C	10	-	V/mV
Output Voltage Swing (Plus)	V_{OUT} (+)	$+V_{CC}$ = 30V, $-V_{CC}$ = Gnd, V_O = +30V, R_L = 10kΩ	+ 125°C ÷ -55°C	27	-	V
		$+V_{CC}$ = 30V, $-V_{CC}$ = Gnd, V_O = +30V, R_L = 2kΩ	+ 125°C ÷ -55°C	26	-	V
Input Offset Voltage Temperature Sensitivity (note 4)	$\Delta V_{IO}/\Delta T$	$+V_{CC}$ = 5V, $-V_{CC}$ = 0V, V_{CM} = +1.4V	-55°C ≤ T_A ≤ +25°C	-30	30	μV/ °C
Input Offset Current Temperature Sensitivity (note 4)	$\Delta I_{IO}/\Delta T$	$+V_{CC}$ = 5V, $-V_{CC}$ = 0V, V_{CM} = +1.4V	-55°C ≤ T_A ≤ +25°C	-700	700	pA/° C
Input Offset Voltage Temperature Sensitivity (note 4)	$\Delta V_{IO}/\Delta T$	$+V_{CC}$ = 5V, $-V_{CC}$ = 0V, V_{CM} = +1.4V	+25°C ≤ T_A ≤ +125°C	-30	30	μV/ °C
Input Offset Current Temperature Sensitivity (note 4)	$\Delta I_{IO}/\Delta T$	$+V_{CC}$ = 5V, $-V_{CC}$ = 0V, V_{CM} = +1.4V	+25°C ≤ T_A ≤ +125°C	-400	400	pA/° C

Electrical AC characteristics within operating temperature range

Table 4
Notes (1) (2)

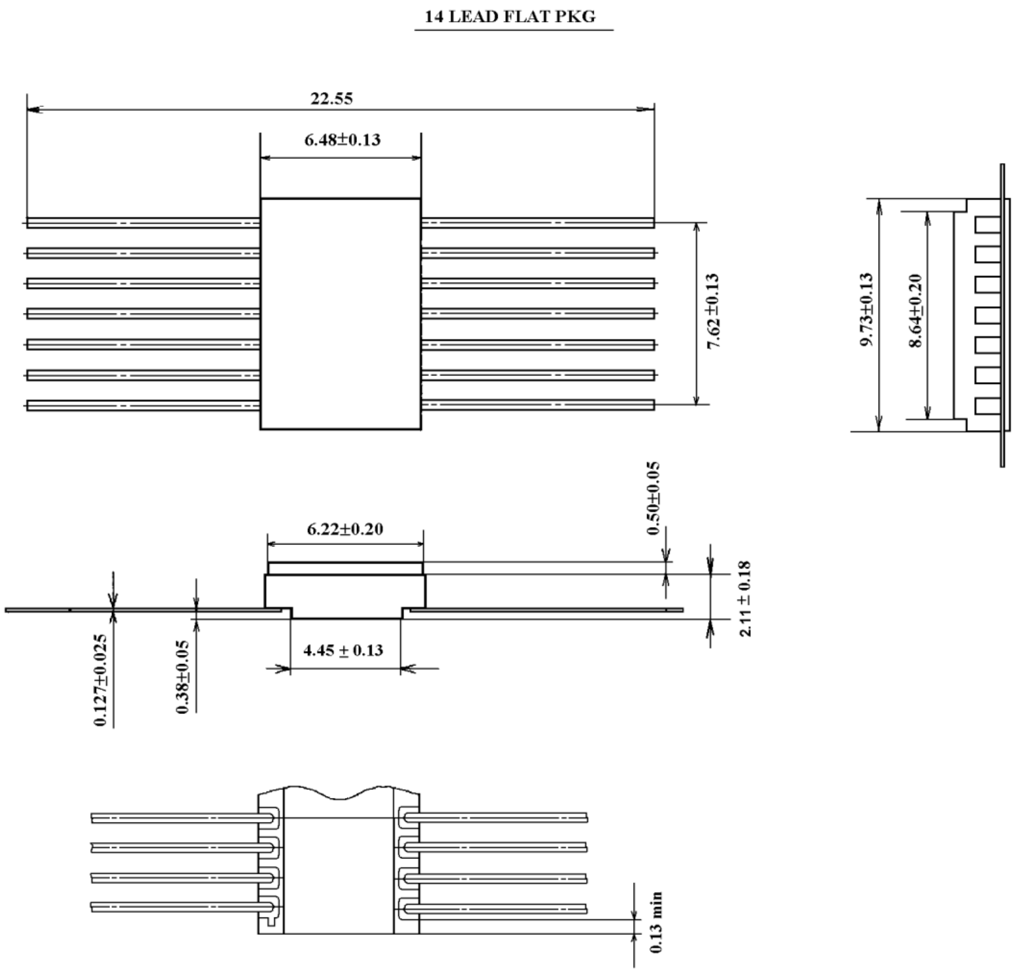
Parameter	Symbol	Test Conditions	T_A, °C	Limits Min	Limits Max	Units
Rise Time	Tr	$+V_{CC}$ = 30V, $-V_{CC}$ = Gnd, $Vout_{AC}$ = -200mV, $Vout_{DC}$ = +600mV, A_{CL}=+1, R_L=2 kΩ, C_L=50pF	+ 125°C ÷ -55°C	-	1	ms
Overshoot	OS	$+V_{CC}$ = 30V, $-V_{CC}$ = Gnd, Uout=(0V ÷ + 10V), A_{CL}=+1, R_L=2 kΩ, C_L=50pF	+ 125°C ÷ -55°C	-	50	%
Slew Rate (Plus)	SR(+)	$+V_{CC}$ = 30V, $-V_{CC}$ = Gnd, Uout=(0V ÷ + 10V), A_{CL}=+1, R_L=2 kΩ, C_L=50pF	+ 125°C ÷ -55°C	0.1	-	V/μs
		R, A (note 1)	+22 ±3			
Slew Rate (Minus)	SR(-)	$+V_{CC}$ = 30V, $-V_{CC}$ = Gnd, Uout=(0V ÷ +10V), A_{CL}=+1, R_L=2 kΩ, C_L=50pF	+ 125°C ÷ -55°C	0.1	-	V/μs
		R, A (note 1)	+22 ±3			
Noise Broadband	NIBB	$+V_{CC}$ = 15V, $-V_{CC}$ = -15V, BW = 10Hz to 5kHz	+22 ±3	-	15	μVrm s
Noise Popcorn	NIPC	$+V_{CC}$ = 15V, $-V_{CC}$ = -15V, R_S = 20kΩ, BW = 10Hz to 5kHz	+22 ±3	-	50	μVpK
Channel Separation (note 5)	Cs	$+V_{CC}$ = 30V, $-V_{CC}$ = Gnd, R_L = 2kΩ, V_{IN} = 1V and 16V	+22 ±3	80	-	dB

Notes: (1) Post irradiation limits are identical to those listed under AC and DC electrical characteristics except as listed in the line denoted "R" and "A" (correspond to 100 krads (Si) and 300 krads (Si) respectively) of

“Conditions” section Table 3, Table 4. Instead of RHA designator “A” can be used RHA designator “F” (correspond to 300 krads (Si) in accordance of MIL-PRF-38535).
Radiation end point limits for the noted parameters are ensured only for the conditions as specified in ESCC 22900.
(2) Low dose rate testing should be perform on a wafer-by-wafer basis, per ESCC 22900 p.5.2, with no enhanced low dose rate sensitivity (ELDRS) effect.
(3) The input common mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3 V. The upper end of the common mode voltage range is V^{+} -1.5 V (at +22 ±3) but either or both inputs can go to +30 V dc without damage independent of the magnitude of V^{+}.
(4) Calculated parameters
(5) Due to proximity of external components, insure that coupling is not originating via stray capacitance between these external parts. This typically can be detected as this type of capacitance increases at higher frequencies.

Physical Dimensions

Figure 3



All RD ALFA Microelectronics semiconductor products are manufactured, assembled and tested under ISO9001 quality systems certification.

For information regarding RD ALFA Microelectronics and its products, see web site http://www.rdalfa.eu