FAIRCHILD

A Schlumberger Company

μA124 • μA224 • μA324 • μA2902 Quad Operational Amplifiers

Description

The μA124 series of quad operational amplifiers consists of four independent high gain, internally frequency compensated operational amplifiers designed to operate from a single power supply or dual power supplies over a wide range of voltages. The common mode input range includes the negative supply, thereby eliminating the necessity for external biasing components in many applications. The output voltage range also includes the negative power supply voltage. They are constructed using the Fairchild Planar Epitaxial process.

- **Input Common Mode Voltage Range Includes Ground Or Negative Supply**
- **Output Voltage Can Swing To Ground Or Negative Supply**
- **Four Internally Compensated Operational Amplifiers In A Single Package**
- **Wide Power Supply Range; Single Supply Of 3.0 V to 30 V, Dual Supply of ±1.5 V to ±16 V**
- **Power Drain Suitable For Battery Operation**

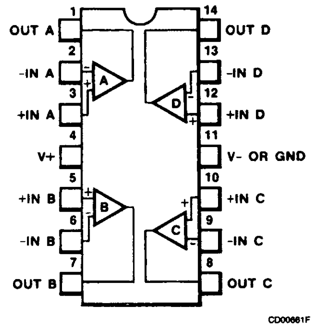
Absolute Maximum Ratings

Storage Temperature Range	
Ceramic DIP	-65°C to +175°C
Molded DIP and SO-14	-65°C to +150°C
Operating Temperature Range	
Extended (μA124M)	-55°C to +125°C
Automotive (μA2902V)	-40°C to +85°C
Industrial (μA224V)	-25°C to +85°C
Commercial (μA324C)	0°C to +70°C
Lead Temperature	
Ceramic DIP (soldering, 60 s)	300°C
Molded DIP and SO-14 (soldering, 10 s)	265°C
Internal Power Dissipation[1, 2]	
14L-Ceramic DIP	1.36 W
14L-Molded DIP	1.04 W
SO-14	0.93 W
Supply Voltage Between V+ and V−	32 V
Differential Input Voltage[3]	32 V
Input Voltage[3]	-0.3 V (V−) to V+

Notes

1. $T_{J\ Max}$ = 150°C for the Molded DIP and SO-14, and 175°C for the Ceramic DIP.
2. Ratings apply to ambient temperature at 25°C. Above this temperature derate the 14L-Ceramic DIP at 9.1 mW/°C, the 14L-Molded DIP at 8.3 mW/°C, and the SO-14 at 7.5 mW/°C.
3. The input common mode voltage or 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 $V_{CC}-1.5$ V, but either or both inputs can go to +32 V without damage (+26 V for μA2902).
4. Short circuits from the output to V_{CC} can cause excessive heating and eventual destruction. Destructive dissipation can result from simultaneous shorts on all amplifiers.

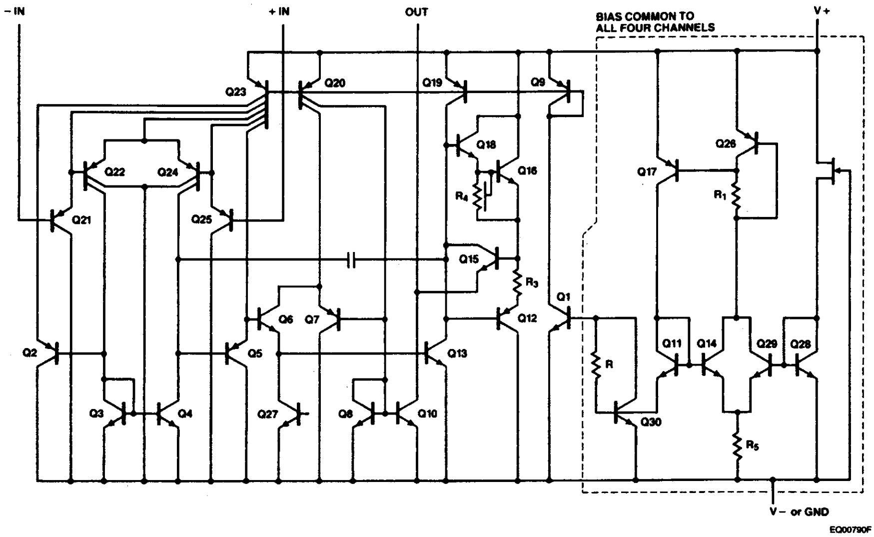
Connection Diagram
14-Lead DIP and SO-14 Package (Top View)



Order Information

Device Code	Package Code	Package Description
μA124DM	6A	Ceramic DIP
μA224DV	6A	Ceramic DIP
μA224PV	9A	Molded DIP
μA324DC	6A	Ceramic DIP
μA324PC	9A	Molded DIP
μA324SC	KD	Molded Surface Mount
μA2902PV	9A	Molded DIP

Equivalent Circuit (1/4 of Circuit)



μA124, μA224 and μA324

Electrical Characteristics $T_A = 25°C$, V+ = 5.0 V, V– = GND, unless otherwise specified.

Symbol	Characteristic	Condition	μA124/A224			μA324			Unit
			Min	Typ	Max	Min	Typ	Max	
V_{IO}	Input Offset Voltage	V+ = 5.0 V to 30 V V_{CM} = 0 V to (V–) – 1.5 V, $V_O \simeq 1.4$ V, $R_S \leqslant 50\ \Omega$		2.0	5.0		2.0	7.0	mV
I_{IO}	Input Offset Current			3.0	30		5.0	50	nA
I_{IB}	Input Bias Current			45	150		45	250	nA
CMR	Common Mode Rejection	$R_S \leqslant 10$ kΩ	70	85		65	70		dB
V_{IR}	Input Voltage Range	V+ = 30 V	0		28.5	0		28.5	V
PSRR	Power Supply Rejection Ratio		65	100		65	100		dB
I_{OS}	Output Short Circuit Current[1]			40	60		40	60	mA
I_{O+}	Output Source Current	V_{ID} = 1.0 V, V+ = 15 V	20	40		20	40		mA
I_{O-}	Output Sink Current	V_{ID} = –1.0 V, V+ = 15 V	10	20		10	20		mA
		V_{ID} = –1.0 V, V_O = 200 mV	12	50		12	50		μA
A_{VS}	Large Signal Voltage Gain	V+ = 15 V, $R_L \geqslant 2.0$ kΩ	50	100		25	100		V/mV
CS	Channel Separation	1.0 kHz ≤ f ≤ 20 kHz, (Input Referenced)		–120			–120		dB

µA124, µA224 and µA324 (Cont.)
Electrical Characteristics $T_A = 25°C$, V + = 5.0 V, V − = GND, unless otherwise specified.

Symbol	Characteristic	Condition	µA124/A224			µA324			Unit
			Min	Typ	Max	Min	Typ	Max	
The following specifications apply over the range of $-55°C \leqslant T_A \leqslant +125°C$ for the µA124; $-25°C \leqslant T_A \leqslant +85°C$ for the µA224; and the $0°C \leqslant T_A \leqslant +70°C$ for the µA324.									
V_{IO}	Input Offset Voltage	V + = 5.0 V to 30 V, V_{CM} = 0 V to V − = 2.0 V, $V_O \simeq 1.4$ V, $R_S \leqslant 50\ \Omega$			7.0			9.0	mV
$\Delta V_{IO}/\Delta T$	Input Offset Voltage Temperature Sensitivity			7.0			7.0		µV/°C
I_{IO}	Input Offset Current				100			150	nA
$\Delta I_{IO}/\Delta T$	Input Offset Current Temperature Sensitivity			10			10		pA/°C
I_{IB}	Input Bias Current			40	300		50	500	nA
I_{CC}	Supply Current	$V_O = 0$ V, $R_L = \infty$		0.7	1.2		0.7	1.2	mA
		V + = 30 V, $V_O = 0$ V, $R_L = \infty$		1.5	3.0		1.5	3.0	
V_{IR}	Input Voltage Range	V + = 30 V	0		28	0		28	V
I_{O+}	Output Source Current	$V_{IO} = +1.0$ V, V + = 15 V	10	20		10	20		mA
I_{O-}	Output Sink Current	$V_{IO} = -1.0$ V, V + = 15 V	5.0	8.0		5.0	8.0		mA
A_{VS}	Large Signal Voltage Gain	V + = 15 V, $R_L \geqslant 2.0$ kΩ	25			15			V/mV
V_{OH}	Output Voltage HIGH	V + = 30 V, $R_L = 10$ kΩ	27	28		27	28		V
		V + = 30 V, $R_L = 2.0$ kΩ	26			26			
V_{OL}	Output Voltage LOW	V + = 5.0 V, $R_L = 10$ kΩ		5.0	20		5.0	20	mV

µA2902
Electrical Characteristics $T_A = 25°C$, V + = 5.0 V, V − = GND, unless otherwise specified.

Symbol	Characteristic	Condition	Min	Typ	Max	Unit
V_{IO}	Input Offset Voltage	V + = 5.0 V to 26 V, V_{CM} = 0 V to (V−) − 1.5 V, $V_O \simeq 1.4$ V, $R_S \leqslant 50\ \Omega$		2.0	7.0	mV
I_{IO}	Input Offset Current			5.0	50	nA
I_{IB}	Input Bias Current			45	250	nA
CMR	Common Mode Rejection	$R_S \leqslant 10$ kΩ	50	70		dB
V_{IR}	Input Voltage Range	$V_{CC} = 26$ V	0		24.5	V
PSRR	Power Supply Rejection Ratio		50	100		dB
I_{OS}	Output Short Circuit Current[1]			40	60	mA

μA2902 (Cont.)

Electrical Characteristics $T_A = 25°C$, $V+ = 5.0$ V, $V- =$ GND, unless otherwise specified.

Symbol	Characteristic	Condition	Min	Typ	Max	Unit
I_{O+}	Output Source Current	$V_{ID} = +1.0$ V, $V+ = 15$ V	20	40		mA
I_{O-}	Output Sink Current	$V_{ID} = -1.0$ V, $V+ = 15$ V	10	20		mA
A_{VS}	Large Signal Voltage Gain	$V+ = 15$ V, $R_L \geqslant 2.0$ kΩ	15	100		V/mV
CS	Channel Separation	1.0 kHz $\leqslant f \leqslant$ 20 kHz, Input Referenced		-120		dB

The following specifications apply over the operating temperature range of $-40°C \leqslant T_A \leqslant +85°C$

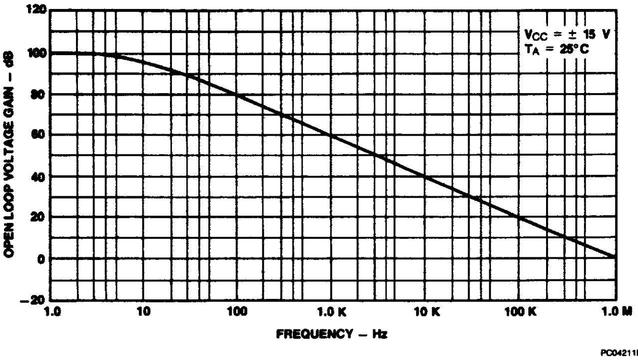
Symbol	Characteristic	Condition	Min	Typ	Max	Unit
V_{IO}	Input Offset Voltage	$V+ = 5.0$ V to 26 V, $V_{CM} = 0$ V to $V- = 2.0$ V, $V_O \simeq 1.4$ V, $R_S \leqslant 50$ Ω			10	mV
$\Delta V_{IO}/\Delta T$	Input Offset Voltage Temperature Sensitivity			7.0		μV/°C
I_{IO}	Input Offset Current			45	200	nA
$\Delta I_{IO}/\Delta T$	Input Offset Current Temperature Sensitivity			10		pA/°C
I_{IB}	Input Bias Current			50	500	nA
I_{CC}	Supply Current	$V_O = 0$ V, $R_L = \infty$		0.7	1.2	mA
		$V+ = 26$ V, $V_O = 0$ V, $R_L = \infty$		1.5	3.0	mA
V_{IR}	Input Voltage Range	$V+ = 26$ V	0		24	V
I_{O+}	Output Source Current	$V_{ID} = +1.0$ V, $V+ = 15$ V	10	20		mA
I_{O-}	Output Sink Current	$V_{ID} = -1.0$ V, $V+ = 15$ V	5.0	8.0		mA
A_{VS}	Large Signal Voltage Gain	$V+ = 15$ V, $R_L \geqslant 2.0$ kΩ	15	100		V/mV
V_{OH}	Output Voltage HIGH	$V+ = 26$ V, $R_L = 2.0$ kΩ	22			V
		$V+ = 26$ V, $R_L = 10$ kΩ	23	24		
V_{OL}	Output Voltage LOW	$V+ = 5.0$ V, $R_L = 10$ kΩ		5.0	100	mV

Notes

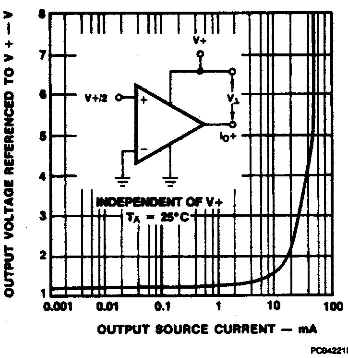
1. Short circuits from the output to V_{CC} can cause excessive heating and eventual destruction. Destructive dissipation can result from simultaneous shorts on all amplifiers.

Typical Performance Curves

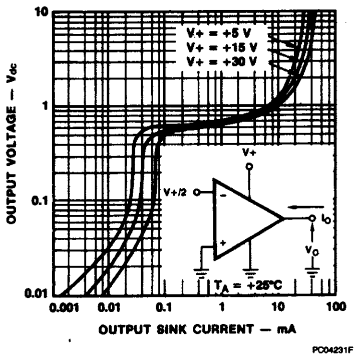
Open Loop Frequency Response



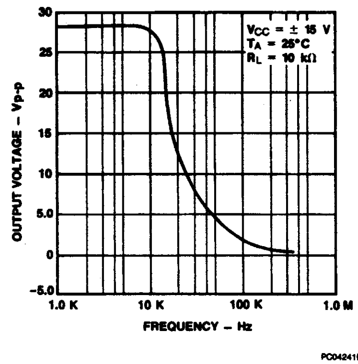
Output Characteristics Current Sourcing



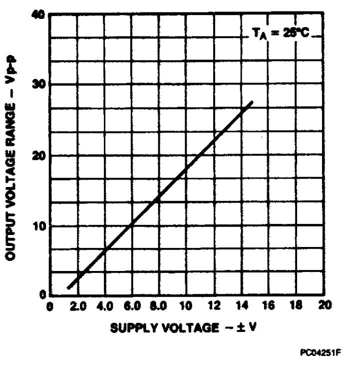
Output Characteristics Current Sinking



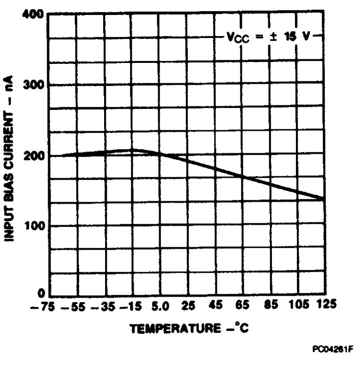
Output Voltage vs Frequency



Output Swing vs Supply Voltage



Input Bias Current vs Temperature



Input Bias Current vs Supply Voltage