μA124 • μA224 • μA324 • μA2902

QUAD OPERATIONAL AMPLIFIERS

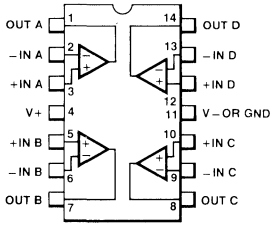
FAIRCHILD LINEAR INTEGRATED CIRCUITS

GENERAL 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 OF 3.0 V TO 30 V**
  DUAL SUPPLY OF ±1.5 V to ±16 V
- **POWER DRAIN SUITABLE FOR BATTERY OPERATION**

CONNECTION DIAGRAM
14-PIN DIP
(TOP VIEW)

PACKAGE OUTLINES 6A 9A
PACKAGE CODES D P



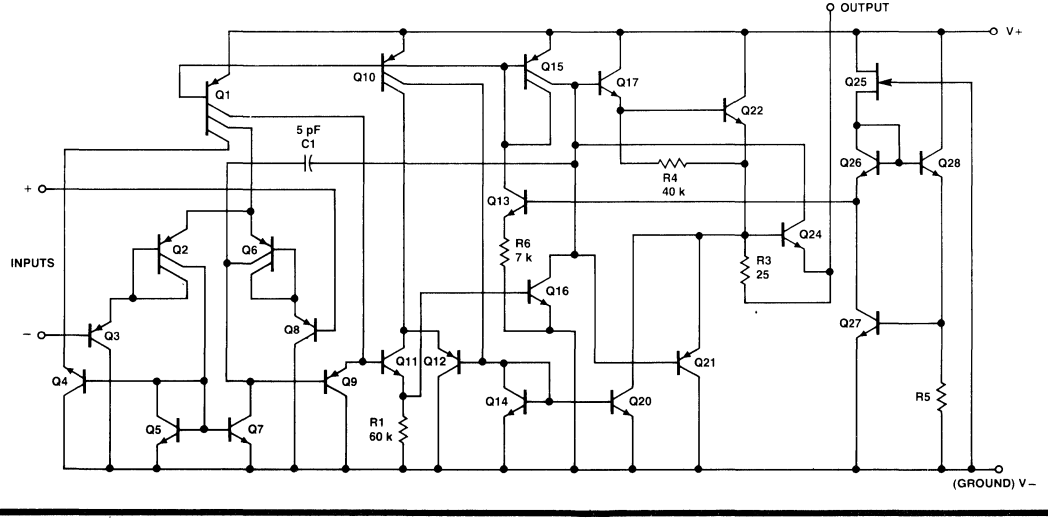
ABSOLUTE MAXIMUM RATINGS

Supply Voltage Between V+ and V–	32
Differential Input Voltage (Note 1)	32
Input Voltage (V–) (Note 1)	–0.3V (V–) to V+
Internal Power Dissipation (Note 2)	670 mW
Operating Temperature Range – μA124	–55°C to +125°C
μA224	–25°C to +85°C
μA324	0°C to +70°C
μA2902	–40°C to +85°C
Storage Temperature Range	
Molded Package	–55°C to +125°C
Hermetic Package	–65°C to +150°C
Pin Temperature	
Molded Package (Soldering, 10 s)	260°C
Hermetic Package (Soldering, 60 s)	300°C

ORDER INFORMATION

TYPE	PART NO.
μA124	μA124DM
μA224	μA224DM
μA324	μA324DC
μA324	μA324PC
μA2902	μA2902PC

1/4 EQUIVALENT CIRCUIT



μA124 • μA224

ELECTRICAL CHARACTERISTICS: V+ = 5.0 Vdc, T_A = 25°C unless otherwise specified.

CHARACTERISTICS		CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage		(Note 5)		2.0	5.0	mV
Input Offset Current				3.0	30	nA
Input Bias Current				−45	−150	nA
Input Common Mode Voltage Range			0		V+ −1.5 V	V
Common Mode Rejection Ratio		$R_S \leq 10$ kΩ	70	85		dB
Large Signal Open Loop Voltage Gain		V+ = +15 V, R_L = 2 kΩ	50	100		V/mV
Output Current	Source	$V_{IN}+$ = +1 Vdc, $V_{IN}-$ = 0 V+ = +15 V	20	40		mA
	Sink	$V_{IN}-$ = +1 Vdc $V_{IN}+$ = 0 V+ = +15 Vdc	10	20		mA
	Sink	$V_{IN}-$ = +1 Vdc, $V_{IN}+$ = 0 V_{OUT} = 200 mV	12	50		μA
Power Supply Rejection Ratio			65	100		dB
Channel Separation		f = 1 kHz to 20 kHz		−120		dB
Short Circuit Current		To ground		40	60	mA
The following specifications apply for $-55°C \leq T_A \leq +125°C$ for μA124 and −25°C to +85°C for μA224						
Input Offset Voltage		(Note 5)			7	mV
Average Temperature Coefficient of Input Offset Voltage		R_S = 0		7		μV/°C
Input Offset Current					±100	nA
Average Temperature Coefficient of Input Offset Current				10		pA/°C
Input Bias Current				−40	−300	nA
Large Signal Open Loop Voltage Gain		R_L = 2 kΩ, V+ = +15 V	25			V/mV
Output Voltage Range	V_{OH}	V+ = +30 Vdc, R_L = 2 kΩ	26			V
	V_{OH}	V+ = +30 Vdc, $R_L \geq 10$ kΩ	27	28		V
	V_{OL}	V+ = 5 Vdc, $R_L \leq 10$ kΩ		5	20	mV
Input Common Mode Voltage Range		V+ = +30 Vdc	0		V+ −2.0	V
Output Current	Source	$V_{IN}+$ = +1 V $V_{IN}-$ = 0, V+ = 15 V	10	20		mA
	Sink	$V_{IN}-$ = +1 V $V_{IN}+$ = 0, V+ = 15 V	5	8		mA
Differential Input Voltage					V+	V
Supply Current		$R_L = \infty$, V_{CC} = 30 V		1.5	3.0	mA
		$R_L = \infty$, V_{CC} = +5 V		0.7	1.2	mA

NOTES:

1. For supply voltage less than 30 V between V+ and V−, the absolute maximum input voltage is equal to the supply voltage.
2. Rating applies to ambient temperature up to 70°C. Above T_A = 70°C, derate linearly at 8.3 mW/°C.
3. Not to exceed maximum package power dissipation.
4. Output will swing to ground.
5. V_{OUT} = 1.4 Vdc, R_S = 0 Ω with V+ from 5 Vdc to +30 Vdc; and over the full input common mode range (0 to V+ − 2.0 Vdc) except at 25°C, where common mode range is 0 Vdc to V+ − 1.5 Vdc.

μA324

ELECTRICAL CHARACTERISTICS: V+ = 5.0 Vdc, T_A = 25°C unless otherwise specified.

CHARACTERISTICS		CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage		(Note 5)		2.0	7.0	mV
Input Offset Current				5.0	50	nA
Input Bias Current				−45	−250	nA
Input Common Mode Voltage Range			0		V+ −1.5 V	V
Common Mode Rejection Ratio		$R_S \leq 10$ kΩ	65	70		dB
Large Signal Open Loop Voltage Gain		V+ = +15 V, R_L = 2 kΩ	25	100		V/mV
Output Current	Source	$V_{IN}+$ = +1 Vdc, $V_{IN}-$ = 0, V+ = +15 V	20	40		mA
	Sink	$V_{IN}-$ = +1 Vdc, $V_{IN}+$ = 0, V+ = +15 Vdc	10	20		mA
	Sink	$V_{IN}-$ = +1 Vdc, $V_{IN}+$ = 0, V_{OUT} = 200 mV	12	50		μA
Power Supply Rejection Ratio			65	100		dB
Channel Separation		f = 1 kHz to 20 kHz		−120		dB
Short Circuit Current		To ground		40	60	mA
The following specifications apply for 0°C to +70°C						
Input Offset Voltage		(Note 5)			9	mV
Average Temperature Coefficient of Input Offset Voltage		R_S = 0		7		μV/°C
Input Offset Current				±100	±150	nA
Average Temperature Coefficient of Input Offset Current				10		pA/°C
Input Bias Current				−40	−500	nA
Large Signal Open Loop Voltage Gain		R_L = 2 kΩ, V+ = +15 V	15			V/mV
Output Voltage Range	V_{OH}	V+ = +30 Vdc, R_L = 2 kΩ	26			V
	V_{OH}	V+ = +30 Vdc, $R_L \geq 10$ kΩ	27	28		V
	V_{OL}	V+ = 5 Vdc, $R_L \leq 10$ kΩ		5	20	mV
Input Common Mode Voltage Range		V+ = +30 Vdc	0		V+ −2.0	V
Output Current	Source	$V_{IN}+$ = +1 V, $V_{IN}-$ = 0, V+ = 15 V	10	20		mA
	Sink	$V_{IN}-$ = +1 V, $V_{IN}+$ = 0, V+ = 15 V	5	8		mA
Differential Input Voltage					V+	V
Supply Current		$R_L = \infty$, V_{CC} = 30 V		1.5	3.0	mA
		$R_L = \infty$, V_{CC} = +5 V		0.7	1.2	mA

NOTES:
1. For supply voltage less than 30 V between V+ and V−, the absolute maximum input voltage is equal to the supply voltage.
2. Rating applies to ambient temperature up to 70°C. Above T_A = 70°C, derate linearly at 8.3 mW/°C.
3. Not to exceed maximum package power dissipation.
4. Output will swing to ground.
5. V_{OUT} = 1.4 Vdc, R_S = 0 Ω with V+ from 5 Vdc to +30 Vdc; and over the full input common mode range (0 to V+ − 2.0 Vdc) except at 25°C, where common mode range is 0 Vdc to V+ − 1.5 Vdc.

μA2902

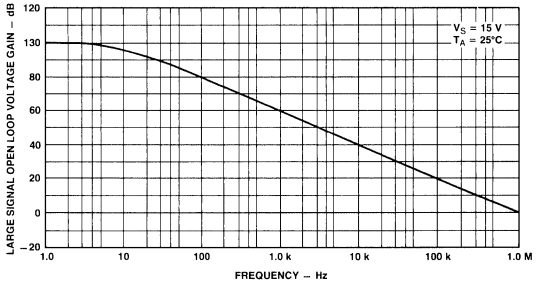
ELECTRICAL CHARACTERISTICS: V+ = 5.0 Vdc, T_A = 25°C unless otherwise specified.

CHARACTERISTICS		CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage		(Note 5)		2.0	7.0	mV
Input Offset Current				5.0	50	nA
Input Bias Current				−45	−250	nA
Input Common Mode Voltage Range			0		V+ −1.5 V	V
Common Mode Rejection Ratio		$R_S \leq 10$ kΩ	50	70		dB
Large Signal Open Loop Voltage Gain		V+ = +15 V, R_L = 2 kΩ		100		V/mV
Output Current	Source	$V_{IN}+$ = +1 Vdc, $V_{IN}-$ = 0, V+ = +15 V	20	40		mA
	Sink	$V_{IN}-$ = +1 Vdc, $V_{IN}+$ = 0, V+ = +15 Vdc	10	20		mA
Power Supply Current		$R_L = \infty$			3.0	mA
Power Supply Rejection Ratio			50	100		dB
Short Circuit Current		To ground		40	60	mA
Channel Separation		f = 1 kHz to 20 kHz		−120		dB
The following specifications apply for −40°C to +85°C						
Input Offset Voltage		(Note 5)			10	mV
Average Temperature Coefficient of Input Offset Voltage		R_S = 0		7		μV/°C
Input Offset Current				±45	±200	nA
Average Temperature Coefficient of Input Offset Current				10		pA/°C
Input Bias Current				−40	−500	nA
Large Signal Open Loop Voltage Gain		R_L = 2 kΩ, V+ = +15 V	15			V/mV
Output Voltage Range	V_{OH}	V+ = +30 Vdc, R_L = 2 kΩ	22			V
	V_{OH}	V+ = +30 Vdc, $R_L \geq 10$ kΩ	23	24		V
	V_{OL}	V+ = 5 Vdc, $R_L \leq 10$ kΩ		5	100	mV
Input Common Mode Voltage Range		V+ = +30 Vdc	0		V+ −2.0	V
Output Current	Source	$V_{IN}+$ = +1 V, $V_{IN}-$ = 0, V+ = 15 V	10	20		mA
	Sink	$V_{IN}-$ = +1 V, $V_{IN}+$ = 0, V+ = 15 V	5	8		mA
Differential Input Voltage					V+	V

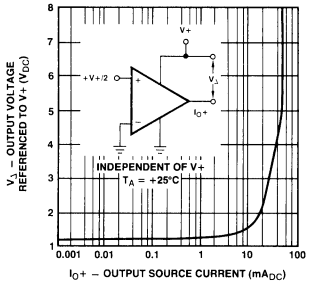
NOTES:
1. For supply voltage less than 30 V between V+ and V−, the absolute maximum input voltage is equal to the supply voltage.
2. Rating applies to ambient temperature up to 70°C. Above T_A = 70°C, derate linearly at 8.3 mW/°C.
3. Not to exceed maximum package power dissipation.
4. Output will swing to ground.
5. V_{OUT} = 1.4 Vdc, R_S = 0 Ω with V+ from 5 Vdc to +30 Vdc; and over the full input common mode range (0 to V+ − 2.0 Vdc) except at 25°C, where common mode range is 0 Vdc to V+ − 1.5 Vdc.

TYPICAL PERFORMANCE CURVES

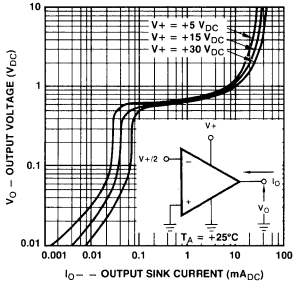
LARGE SIGNAL OPEN LOOP VOLTAGE GAIN AS A FUNCTION OF FREQUENCY



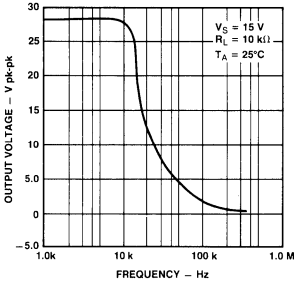
OUTPUT CHARACTERISTICS CURRENT SOURCING



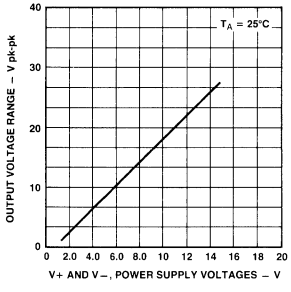
OUTPUT CHARACTERISTICS CURRENT SINKING



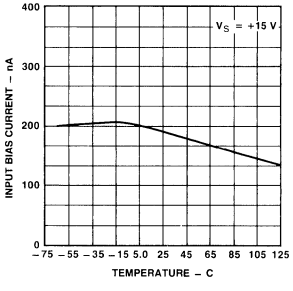
OUTPUT VOLTAGE AS A FUNCTION OF FREQUENCY



OUTPUT SWING AS A FUNCTION OF SUPPLY VOLTAGE



INPUT BIAS CURRENT AS A FUNCTION OF TEMPERATURE



INPUT BIAS CURRENT AS A FUNCTION OF SUPPLY VOLTAGE