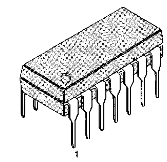
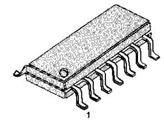
QUAD OPERATIONAL AMPLIFIERS

14 DIP



14 SOP



The LM224 series 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 voltage range.
Operation from split power supplies is also possible so long as the difference between the two supplies is 3 volts to 32 volts.

Application areas include transducer amplifier, DC gain blocks and all the conventional OP amp circuits which now can be easily implemented in single power supply systems.

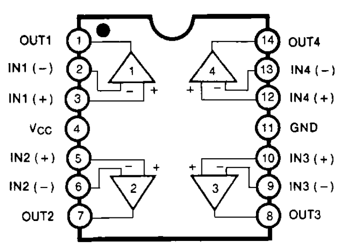
FEATURES

- Internally frequency compensated for unity gain
- Large DC voltage gain: 100dB
- Wide power supply range: LM224/A, LM324/A: 3V ~32V (or ±1.5 ~ 15V)
  LM2902: 3V~26V (or ±1.5V ~ 13V)
- Input common-mode voltage range includes ground
- Large output voltage swing: 0V DC to V_{CC} -1.5V DC
- Power drain suitable for battery operation.

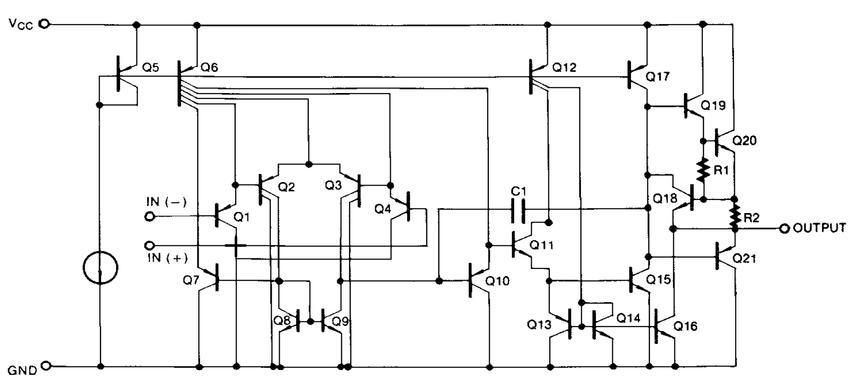
ORDERING INFORMATION

Device	Package	Operating Temperature
LM324N LM324AN	14 DIP	0 ~ + 70°C
LM324M LM324AM	14 SOP	
LM224N LM224AN	14 DIP	-25 ~ +85 °C
LM224M LM224AM	14 SOP	
LM2902N	14 DIP	-40 ~ + 85 °C
LM2902M	14 SOP	

BLOCK DIAGRAM



SCHEMATIC DIAGRAM (One Section Only)



Rev. B

FAIRCHILD SEMICONDUCTOR ™

ABSOLUTE MAXIMUM RATINGS

Characteristic	Symbol	LM224/LM224A	LM324/LM324A	LM2902	Unit
Power Supply Voltage	V_{CC}	±18 or 32	±18 or 32	±13 or 26	V
Differential Input Voltage	$V_{I(DIFF)}$	32	32	26	V
Input Voltage	V_I	-0.3 to + 32	-0.3 to +32	-0.3 to +26	V
Output Short Circuit to GND $V_{CC} \leq 15V$ T_A=25 °C(One Amp)		Continuous	Continuous	Continuous	
Power Dissipation	P_D	570	570	570	mW
Operating Temperature Range	T_{OPR}	-25 ~ +85	0 ~ + 70	-40 ~ + 85	°C
Storage Temperature Range	T_{STG}	-65 ~ + 150	-65 ~ + 150	-65 ~ + 150	°C

ELECTRICAL CHARACTERISTICS

(V_{CC}=5.0V, V_{EE}=GND, T_A=25 °C, unless otherwise specified)

Characteristic	Symbol	Test Conditions	LM224			LM324			LM2902			Unit
			Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage	V_{IO}	V_{CM} = 0V to V_{CC} = 1.5V $V_{O(P)}$ = 1.4V, R_S = 0Ω		1.5	5.0		1.5	7.0		1.5	7.0	mV
Input Offset Current	I_{IO}			2.0	30		3.0	50		3.0	50	nA
Input Bias Current	I_{BIAS}			40	150		40	250		40	250	nA
Input Common-Mode Voltage Range	$V_{I(R)}$	V_{CC} = 30V (V_{CC} = 26V for KA2902)	0		V_{CC} -1.5	0	V_{CC} -1.5		0		V_{CC} -1.5	V
Supply Current	I_{CC}	R_L = ∞,V_{CC} = 30V (all Amps)		1.0	3		1.0	3		1.0	3	mA
		R_L = ∞,V_{CC} = 5V (all Amps) (V_{CC} = 26V for KA2902)		0.7	1.2		0.7	1.2		0.7	1.2	mA
Large Signal Voltage Gain	G_V	V_{CC} = 15V, $R_L \geq 2K\Omega$ $V_{O(P)}$ = 1V to 11V	50	100		25	100			100		V/mV
Output Voltage Swing	$V_{O(H)}$	V_{CC} = 30V, R_L = 2KΩ	26			26			22			V
		V_{CC}=26V for 2902, R_L = 10KΩ	27	28		27	28		23	24		V
	$V_{O(L)}$	V_{CC} = 5V, $R_L \geq 10K\Omega$		5	20		5	20		5	100	mV
Common-Mode Rejection Ratio	CMRR		70	85		65	75		50	75		dB
Power Supply Rejection Ratio	PSRR		65	100		65	100		50	100		dB
Channel Separation	CS	f = 1KHz to 20KHz		120			120			120		dB
Short Circuit to GND	I_{SC}			40	60		40	60		40	60	mA
Output Current	I_{SOURCE}	$V_{I(+)}$ = 1V, $V_{I(-)}$ = 0V V_{CC} = 15V, $V_{O(P)}$ = 2V	20	40		20	40		20	40		mA
	I_{SINK}	$V_{I(+)}$ = 0V, $V_{I(-)}$ = 1V V_{CC} = 15V, $V_{O(P)}$ = 2V	10	13		10	13		10	13		mA
		$V_{I(+)}$ = 0V, $V_{I(-)}$ = 1V V_{CC} = 15V,$V_{O(R)}$ = 200mV	12	45		12	45					µA
Differential Input Voltage	$V_{I(DIFF)}$				V_{CC}			V_{CC}			V_{CC}	V

ELECTRICAL CHARACTERISTICS

(V_{CC} = 5.0V, V_{EE} = GND, unless otherwise specified)
The following specification apply over the range of -25 °C ≤ T_A ≤ + 85 °C for the LM224; and the 0 °C ≤ T_A ≤ +70 °C for the LM324 ; and the - 40 °C ≤ T_A ≤ +85 °C for the LM2902

Characteristic	Symbol	Test Conditions	LM224			LM324			LM2902			Unit
			Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage	V_{IO}	V_{ICM} = 0V to V_{CC} = 1.5V $V_{O(P)}$ = 1.4V, R_S = 0Ω			7.0			9.0			10.0	mV
Input Offset Voltage Drift	$\Delta V_{IO}/\Delta T$			7.0			7.0			7.0		μV/ °C
Input Offset Current	I_{IO}				100			150			200	nA
Input Offset Current Drift	$\Delta I_{IO}/\Delta T$			10			10			10		pA/ °C
Input Bias Current	I_{BIAS}				300			500			500	nA
Input Common-Mode Voltage Range	$V_{IC(R)}$	V_{CC} = 30V (V_{CC} = 26V for KA2902)	0		V_{CC} -2.0	0		V_{CC} -2.0	0		V_{CC} -2.0	V
Large Signal Voltage Gain	G_V	V_{CC} = 15V, R_L ≥ 2.0KΩ $V_{O(P)}$ = 1V to 11V	25			15			15			V/mV
Output Voltage Swing	$V_{O(H)}$	V_{CC} = 30V, R_L = 2KΩ	26			26			22			V
		V_{CC} =26V for 2902, R_L = 10KΩ	27	28		27	28		23	24		V
	$V_{O(L)}$	V_{CC} = 5V, R_L≥10KΩ		5	20		5	20		5	100	mV
Output Current	I_{SOURCE}	$V_{I(+)}$ = 1V, $V_{I(-)}$ = 0V V_{CC} = 15V, $V_{O(P)}$ = 2V	10	20		10	20		10	20		mA
	I_{SINK}	$V_{I(+)}$ = 0V, $V_{I(-)}$ = 1V V_{CC} = 15V, $V_{O(P)}$ = 2V	10	13		5	8		5	8		mA
Differential Input Voltage	$V_{I(DIFS)}$				V_{CC}			V_{CC}			V_{CC}	V

ELECTRICAL CHARACTERISTICS

(V_{CC}=50V, V_{EE} = GND, T_A=25 °C, unless otherwise specified)

Characteristic	Symbol	Test Conditions		LM224A			LM324A			Unit
				Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage	V_{IO}	V_{CM} = 0V to V_{CC} = 1.5V $V_{O(P)}$ = 1.4V, R_S = 0 Ω			1.0	3.0		1.5	3.0	mV
Input Offset Current	I_{IO}				2	15		3.0	30	nA
Input Bias Current	I_{BIAS}				40	80		40	100	nA
Input Common-Mode Voltage Range	$V_{I(R)}$	V_{CC} = 30V		0		V_{CC} -1.5	0		V_{CC} -1.5	V
Supply Current (All Amps)	I_{CC}	V_{CC} = 30V			1.5	3		1.5	3	mA
		V_{CC} = 5V			0.7	1.2		0.7	1.2	mA
Large Signal Voltage Gain	G_V	V_{CC} = 15V, $R_L \geq$ 2 KΩ $V_{O(P)}$ = 1V to 11V		50	100		25	100		V/mV
Output Voltage Swing	$V_{O(H)}$	V_{CC} = 30V	R_L = 2 KΩ	26			26			V
		V_{CC} = 26V for 2902	R_L = 10 KΩ	27	28		27	28		V
	$V_{O(L)}$	V_{CC} = 5V, $R_L \geq$ 10 KΩ			5	20		5	20	mV
Common-Mode Rejection Ratio	CMRR			70	85		65	85		dB
Power Supply Rejection Ratio	PSRR			65	100		65	100		dB
Channel Separation	CS	f = 1KHz to 20KHz			120			120		dB
Short Circuit to GND	I_{SC}				40	60		40	60	mA
Output Current	I_{SOURCE}	$V_{I(+)}$ = 1V, $V_{I(-)}$ = 0V V_{CC} = 15V		20	40		20	40		mA
	I_{SINK}	$V_{I(+)}$ = 0V, $V_{I(-)}$ = 1V V_{CC} = 15V, $V_{O(P)}$ = 2V		10	20		10	20		mA
		$V_{I(+)}$ = 0v, $V_{I(-)}$ = 1V V_{CC} = 15V, $V_{O(P)}$ = 200mV		12	50		12	50		µA
Differential Input Voltage	$V_{I(DIFF)}$					V_{CC}			V_{CC}	V

ELECTRICAL CHARACTERISTICS

(V_{CC} = 5.0V, V_{EE} = GND, unless otherwise specified)
The following specification apply over the range of -25°C ≤ T_A ≤ + 85 °C for the LM224A; and the 0 °C ≤ T_A ≤+70 °C for the LM324A

Characteristic	Symbol	Test Conditions		LM224A			LM324A			Unit
				Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage	V_{IO}	V_{CM} = 0V to V_{CC} = 1.5V $V_{O(P)}$ = 1.4V, R_S = 0Ω				4.0			5.0	mV
Input Offset Voltage Drift	$\Delta V_{IO}/\Delta T$				7.0	20		7.0	30	μV/ °C
Input Offset Current	I_{IO}					30			75	nA
Input Offset Current Drift	$\Delta I_{IO}/\Delta T$				10	200		10	300	pA/ °C
Input Bias Current	I_{BIAS}				40	100		40	200	nA
Input Common-Mode Voltage Range	$V_{I(R)}$	V_{CC} = 30V		0		V_{CC} -2.0	0		V_{CC} -2.0	V
Large Signal Voltage Gain	G_V	V_{CC} = 15V, R_L≥ 2.0KΩ		25			15			V/mV
Output Voltage Swing	$V_{O(P-P)}$	V_{CC} = 30V	R_L = 2KΩ	26			26			V
			R_L = 10KΩ	27	28		27	28		V
		V_{CC} = 5V, R_L≥ 10KΩ			5	20		5	20	mA
Output Current	I_{SOURCE}	$V_{I(+)}$ = 1V, $V_{I(-)}$ = 0V V_{CC} = 15V		10	20		10	20		mA
	I_{SINK}	$V_{I(+)}$ = 0V, $V_{I(-)}$ = 1V V_{CC} = 15V		5	8		5	8		mA
Differential Input Voltage	$V_{I(DIFF)}$					V_{CC}			V_{CC}	V

TYPICAL PERFORMANCE CHARACTERISTICS

Fig. 1 INPUT VOLTAGE RANGE

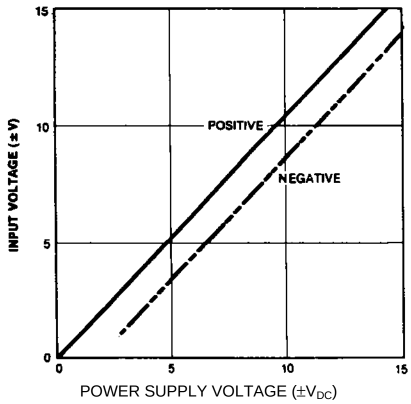


Fig. 2 INPUT CURRENT

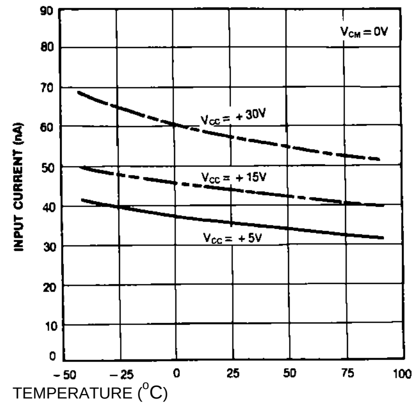


Fig. 3 SUPPLY CURRENT

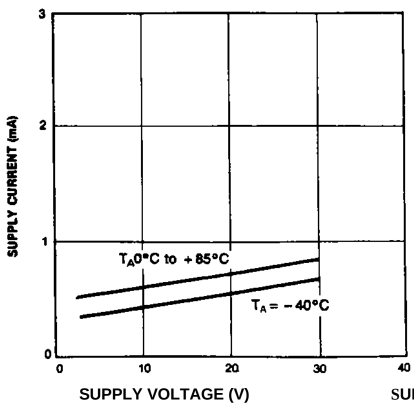


Fig. 4 VOLTAGE GAIN

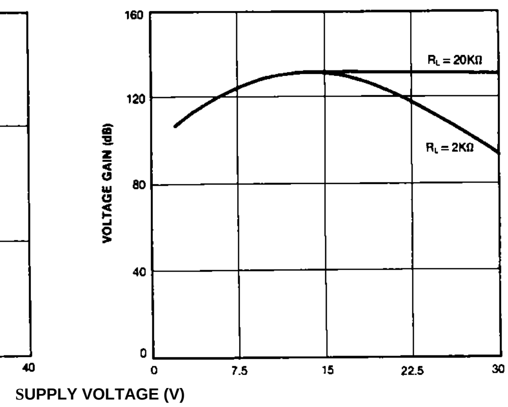


Fig. 5 OPEN LOOP FREGUENCY RESPONSE

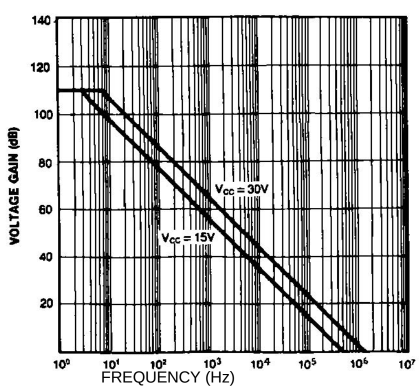


Fig. 6 COMMON.MOOE REJECTION RATIO

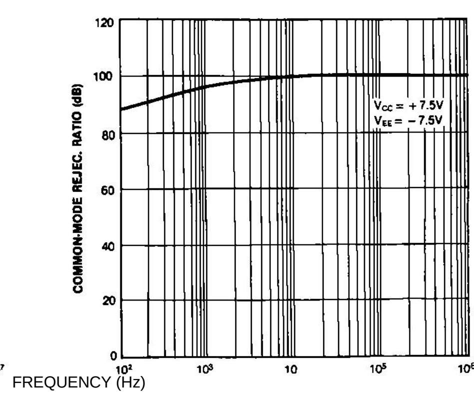


Fig.7 SLEW RATE

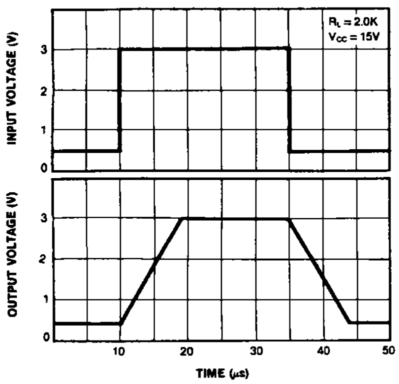


Fig. 8 VOLTAGE FOLLOWER PULSE

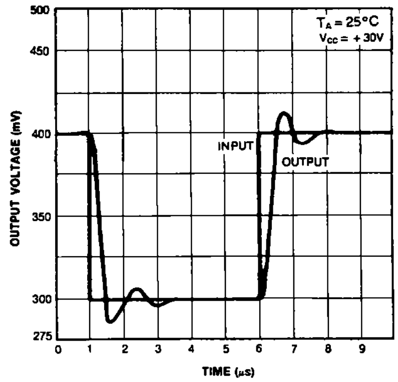
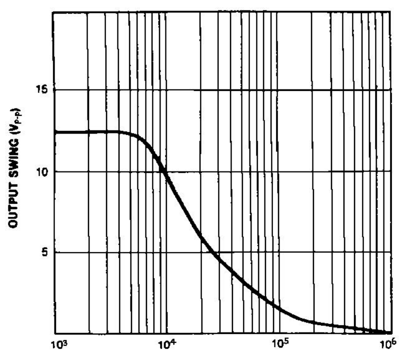
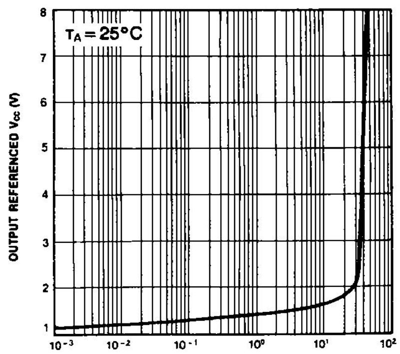


Fig. 9 LARGE SIGNAL FREQUECY RESPONSE



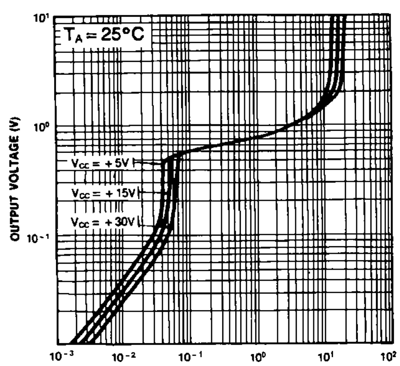
FREQUENCY (Hz)

Fig. 10 OUTPUT CHARACTERISTICS CURRENT SOURCING



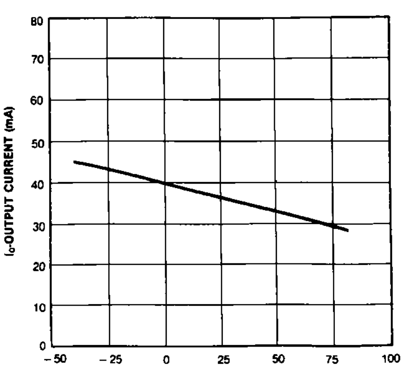
OUTPUT SOURCE CURRENT (mA)

Fig. 11 OUTPUT CHARACTERISTICS CURRENT SINKING



OUTPUT SINK CURRENT (mA)

Fig. 12 CURRENT LIMITING



TEMPERATURE (^{0}C)

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
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