μA148 • μA248 • μA348
μA149 • μA249 • μA349
QUAD OPERATIONAL AMPLIFIERS
FAIRCHILD LINEAR INTEGRATED CIRCUITS

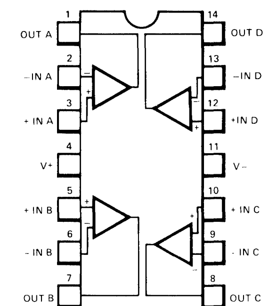
GENERAL DESCRIPTION — The μA148 series is a true quad μA741. It consists of four independent, high gain, internally compensated, low power operational amplifiers which have been designed to provide functional characteristics identical to those of the familiar μA741 operational amplifier. In addition, the total supply current for all four amplifiers is comparable to the supply current of a single μA741 type op amp.

Other features include input offset currents and input bias current which are much less than those of a standard μA741. Also, excellent isolation between amplifiers has been achieved by independently biasing each amplifier and using layout techniques which minimize thermal coupling. The μA149 series has the same features as the μA148 except that it is decompensated to give a gain bandwidth product of 4 MHz typical at a gain greater than 5.

- **μA741 OP AMP OPERATING CHARACTERISTICS**
- **LOW SUPPLY CURRENT DRAIN**
- **CLASS AB OUTPUT STAGE - NO CROSSOVER DISTORTION**
- **PIN COMPATIBLE WITH THE μA324 & μA3403**
- **LOW INPUT OFFSET VOLTAGE — 1 mV TYP**
- **LOW INPUT OFFSET CURRENT — 4 nA TYP**
- **LOW INPUT BIAS CURRENT — 30 nA TYP**
- **GAIN BANDWIDTH PRODUCT**
  μA148 (UNITY GAIN) — 1.0 MHz TYP
  μA149 (AV>5) — 4 MHz TYP
- **HIGH DEGREE OF ISOLATION BETWEEN AMPLIFIERS — 120 dB**
- **OVERLOAD PROTECTION FOR INPUTS AND OUTPUTS**

CONNECTION DIAGRAM
14-PIN DIP
(TOP VIEW)

PACKAGE OUTLINES 6A 9A
PACKAGE CODES D P



ORDER INFORMATION

TYPE	PART NO.
μA148	μA148DM
μA248	μA248DC
μA248	μA248PC
μA348	μA348DC
μA348	μA348PC
μA149	μA149DM
μA249	μA249DC
μA249	μA249PC
μA349	μA349DC
μA349	μA349PC

ABSOLUTE MAXIMUM RATINGS

		μA148/μA149	μA248/μA249	μA348/μA349
Supply Voltage		±22 V	±18 V	±18 V
Differential Input Voltage		±44 V	±36 V	±36 V
Input Voltage		±22 V	±18 V	±18 V
Output Short Circuit Duration (Note 1)		continuous	continuous	continuous
Power Dissipation (P_D at 25°C) and Thermal Resistance (θ_{JA}), (Note 2)				
Plastic DIP	P_D	--	--	700 mW
	θ_{JA}	--	--	150°C/W
Ceramic DIP	P_D	670 mW	670 mW	670 mW
	θ_{JA}	100°C/W	100°C/W	100°C/W
Operating Temperature Range		-55°C<T_A<+125°C	-25°C<T_A<+85°C	0°C<T_A<+70°C
Storage Temperature Range		-65°C to +150°C	-65°C to +150°C	-65°C to +150°C
Pin Temperature				
Molded Package (Soldering, 10 s)			260°C	260°C
Hermetic Package (Soldering, 60 s)		300°C	300°C	300°C

DC ELECTRICAL CHARACTERISTICS: $V_S = \pm 15$ V, $T_A = 25°C$ unless otherwise noted

CHARACTERISTIC	CONDITIONS	μA148/μA149			UNITS
		MIN	TYP	MAX	
Input Offset Voltage	Rs ≤ 10 kΩ		1.0	5.0	mV
Input Offset Current			4	25	nA
Input Bias Current			30	100	nA
Input Resistance		0.8	2.5		MΩ
Supply Current All Amplifiers			2.4	3.6	mA
Large Signal Voltage Gain	$V_{OUT} = \pm 10$ V, $R_L \geq 2$ kΩ	50	160		V/mV
Amplifier to Amplifier Coupling	f = 1 Hz to 20 kHz (Input Referred)		−120		dB
Output Short Circuit Current			25		mA
The following specification apply for $-55°C \leq T_A \leq +125°C$					
Input Offset Voltage	Rs ≤ 10 kΩ			6.0	mV
Input Offset Current				75	nA
Input Bias Current				325	nA
Large Signal Voltage Gain	$R_L \geq 2$ kΩ, $V_{OUT} = \pm 10$ V	25			V/mV
Output Voltage Swing	$R_L = 10$ kΩ	±12	±13		V
	$R_L = 2$ kΩ	±10	±12		V
Input Voltage Range		±12			V
Common-Mode Rejection Ratio	Rs ≤ 10 kΩ	70	90		dB
Supply Voltage Rejection	Rs ≤ 10 kΩ	77	96		dB

AC CHARACTERISTICS: $V_S = \pm 15$ V, $T_A = 25°C$ unless otherwise noted

Small Signal Bandwidth	μA148		1.0		MHz
	μA149		4.0		MHz
Phase Margin	μA148 (Av = 1)		60		degrees
	μA149 (Av = 5)		60		degrees
Slew Rate	μA148 (Av = 1)		0.5		V/μs
	μA149 (Av = 5)		2.0		V/μs

NOTES:
1. Any of the amplifier outputs can be shorted to ground indefinitely; however, more than one should not be simultaneously shorted as the maximum junction temperature will be exceeded.
2. The maximum power dissipation for these devices must be derated at elevated temperatures and is dictated by $T_{J\,(MAX)}$, θ_{JA}, and the ambient temperature, T_A. The maximum available power dissipation at any temperature is $P_D = (T_{J\,(MAX)} - T_A)/\theta_{JA}$ or the 25°C $P_{D\,(MAX)}$, whichever is less.
3. μA148, 248, 348 are capable of driving 100 pF capacitive load. μA149, 249, 349 are capable of driving 50 pF capacitive load.

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DC ELECTRICAL CHARACTERISTICS: $V_S = \pm15$ V, $T_A = 25°C$ unless otherwise noted

CHARACTERISTIC	CONDITIONS	μA248/μA249 MIN	TYP	MAX	UNITS
Input Offset Voltage	Rs ≤ 10 kΩ		1.0	6.0	mV
Input Offset Current			4	50	nA
Input Bias Current			30	200	nA
Input Resistance		0.8	2.5		MΩ
Supply Current All Amplifiers			2.4	4.5	mA
Large Signal Voltage Gain	$V_{OUT} = \pm10$ V, $R_L \geq 2$ kΩ	25	160		V/mV
Amplifier to Amplifier Coupling	f = 1 Hz to 20 kHz (Input Referred)		−120		dB
Output Short Circuit Current			25		mA

The following specification apply for $-25°C \leq T_A \leq 85°C$

CHARACTERISTIC	CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage	Rs ≤ 10 kΩ			7.5	mV
Input Offset Current				125	nA
Input Bias Current				500	nA
Large Signal Voltage Gain	$R_L \geq 2$ kΩ, $V_{OUT} = \pm10$ V	15			V/mV
Output Voltage Swing	$R_L = 10$ kΩ	±12	±13		V
	$R_L = 2$ kΩ	±10	±12		V
Input Voltage Range		±12			V
Common-Mode Rejection Ratio	Rs ≤ 10 kΩ	70	90		dB
Supply Voltage Rejection	Rs ≤ 10 kΩ	77	96		dB

AC CHARACTERISTICS: $V_S = \pm15$ V, $T_A = 25°C$ unless otherwise noted

CHARACTERISTIC	CONDITIONS	MIN	TYP	MAX	UNITS
Small Signal Bandwidth	μA248		1.0		MHz
	μA249		4.0		MHz
Phase Margin	μA248 (Av = 1)		60		degrees
	μA249 (Av = 5)		60		degrees
Slew Rate	μA248 (Av = 1)		0.5		V/μs
	μA249 (Av = 5)		2.0		V/μs

NOTES:
1. Any of the amplifier outputs can be shorted to ground indefinitely; however, more than one should not be simultaneously shorted as the maximum junction temperature will be exceeded.
2. The maximum power dissipation for these devices must be derated at elevated temperatures and is dictated by $T_{J\,(MAX)}$, θ_{JA}, and the ambient temperature, T_A. The maximum available power dissipation at any temperature is $P_D = (T_{J\,(MAX)} - T_A)/\theta_{JA}$ or the 25° C $P_{D\,(MAX)}$, whichever is less.
3. μA148, 248, 348 are capable of driving 100 pF capacitive load. μA149, 249, 349 are capable of driving 50 pF capacitive load.

DC ELECTRICAL CHARACTERISTICS: $V_S = \pm15$ V, $T_A = 25°C$ unless otherwise noted

CHARACTERISTIC	CONDITIONS	μA348/μA349 MIN	TYP	MAX	UNITS
Input Offset Voltage	Rs ≤ 10 kΩ		1.0	6.0	mV
Input Offset Current			4	50	nA
Input Bias Current			30	200	nA
Input Resistance		0.8	2.5		MΩ
Supply Current All Amplifiers			2.4	4.5	mA
Large Signal Voltage Gain	$V_{OUT} = \pm10$ V, $R_L \geq 2$ kΩ	25	160		V/mV
Amplifier to Amplifier	f = 1 Hz to 20 kHz (Input Referred)		−120		dB
Output Short Circuit Current			25		mA

The following specification apply for $0°C \leq T_A \leq 70°C$

CHARACTERISTIC	CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage	Rs ≤ 10 kΩ			7.5	mV
Input Offset Current				100	nA
Input Bias Current				400	nA
Large Signal Voltage Gain	$R_L \geq 2$ k , $V_{OUT} = \pm10$ V	15			V/mV
Output Voltage Swing	$R_L = 10$ kΩ	±12	±13		V
	$R_L = 2$ kΩ	±10	±12		V
Input Voltage Range		±12			V
Common-Mode Rejection Ratio	Rs ≤ 10 kΩ	70	90		dB
Supply Voltage Rejection	Rs ≤ 10 kΩ	77	96		dB

AC CHARACTERISTICS: $V_S = \pm15$ V, $T_A = 25°C$ unless otherwise noted

CHARACTERISTIC	CONDITIONS	MIN	TYP	MAX	UNITS
Small Signal Bandwidth	μA348		1.0		MHz
	μA349		4.0		MHz
Phase Margin	μA348 (Av = 1)		60		degrees
	μA349 (Av = 5)		60		degrees
Slew Rate	μA348 (Av = 1)		0.5		V/μs
	μA349 (Av = 5)		2.0		V/μs

NOTES:
1. Any of the amplifier outputs can be shorted to ground indefinitely; however, more than one should not be simultaneously shorted as the maximum junction temperature will be exceeded.
2. The maximum power dissipation for these devices must be derated at elevated temperatures and is dictated by $T_{J\,(MAX)}$, θ_{JA}, and the ambient temperature, T_A. The maximum available power dissipation at any temperature is $P_D = (T_{J\,(MAX)} - T_A)/\theta_{JA}$ or the 25°C $P_{D\,(MAX)}$, whichever is less.
3. μA148, 248, 348 are capable of driving 100 pF capacitive load. μA149, 249, 349 are capable of driving 50 pF capacitive load.

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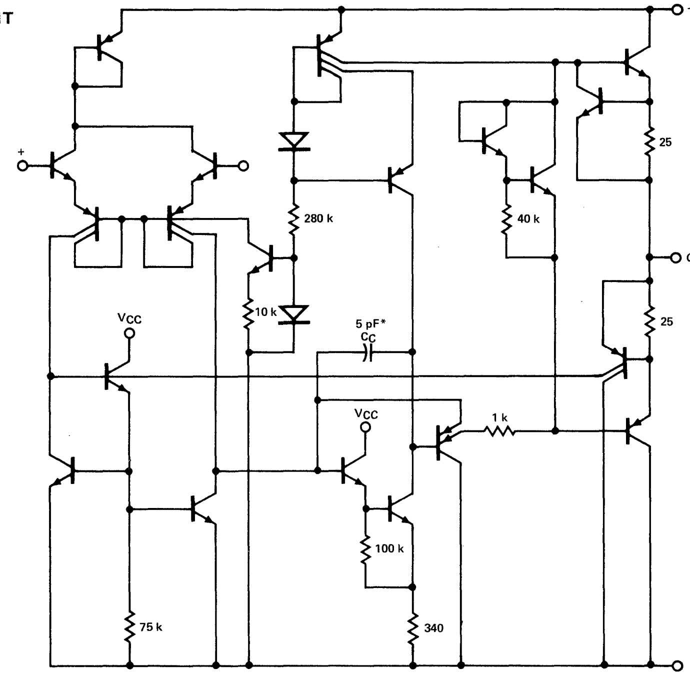
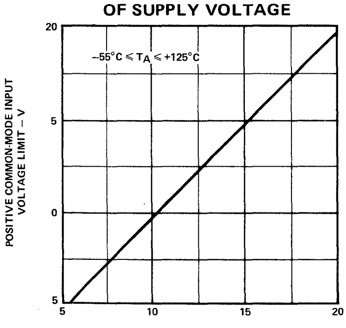
¼ EQUIVALENT CIRCUIT



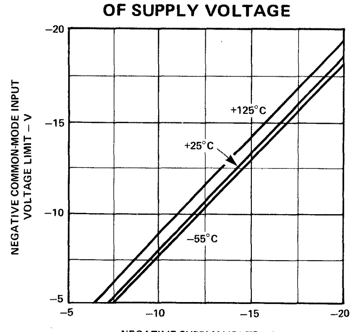
* 1 pF on the μA149

TYPICAL PERFORMANCE CURVES

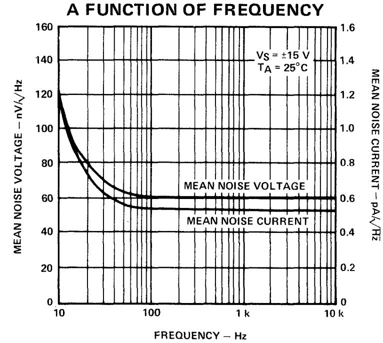
POSITIVE COMMON MODE INPUT VOLTAGE LIMIT AS A FUNCTION OF SUPPLY VOLTAGE



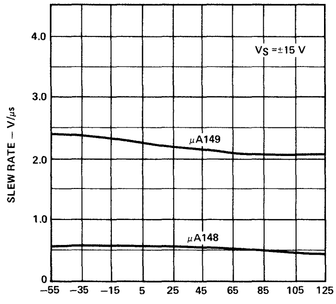
NEGATIVE COMMON MODE INPUT VOLTAGE LIMIT AS A FUNCTION OF SUPPLY VOLTAGE



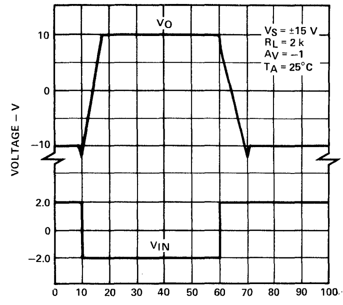
INPUT NOISE VOLTAGE AND NOISE CURRENT AS A FUNCTION OF FREQUENCY



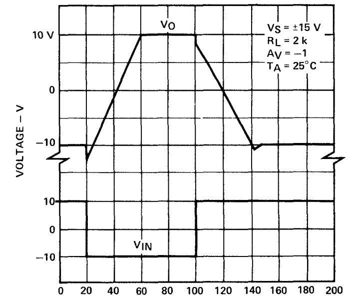
SLEW RATE AS A FUNCTION OF TEMPERATURE



INVERTING LARGE SIGNAL PULSE RESPONSE (μA149)

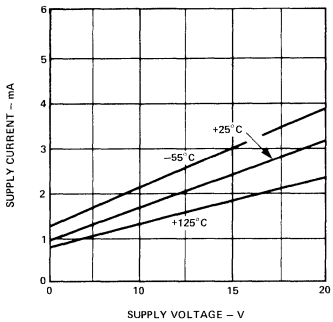


INVERTING LARGE SIGNAL PULSE RESPONSE (μA148)

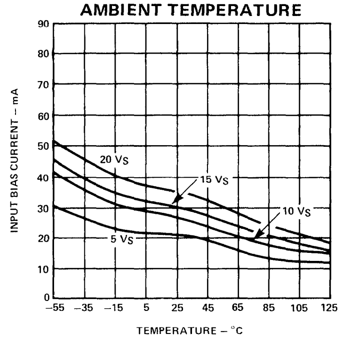


TYPICAL PERFORMANCE CURVES (Cont'd)

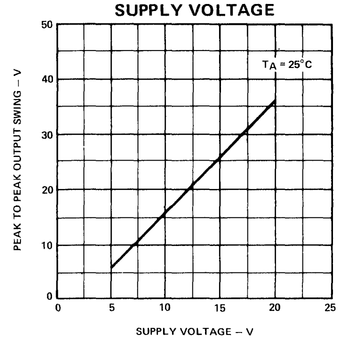
SUPPLY CURRENT AS A FUNCTION OF POWER SUPPLY VOLTAGE



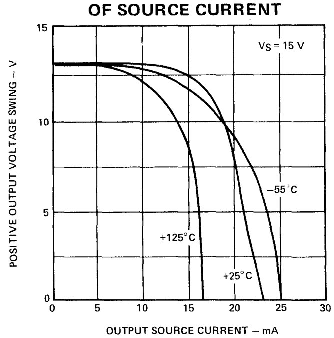
INPUT BIAS CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



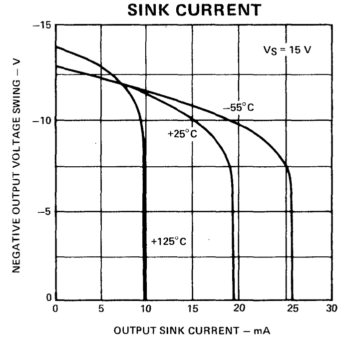
OUTPUT VOLTAGE SWING AS A FUNCTION OF SUPPLY VOLTAGE



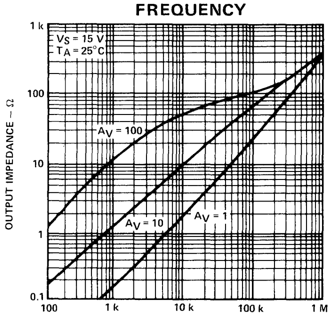
OUTPUT VOLTAGE AS A FUNCTION OF SOURCE CURRENT



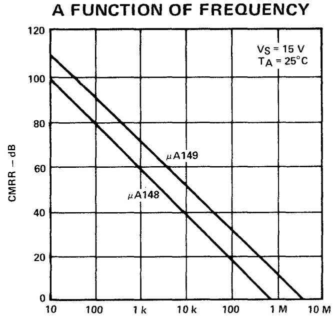
OUTPUT VOLTAGE AS A FUNCTION OF SINK CURRENT



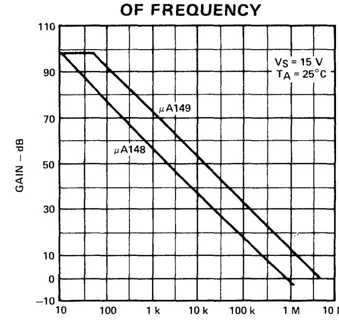
OUTPUT IMPEDANCE AS A FUNCTION OF FREQUENCY



COMMON MODE REJECTION RATIO AS A FUNCTION OF FREQUENCY



OPEN LOOP FREQUENCY RESPONSE AS A FUNCTION OF FREQUENCY



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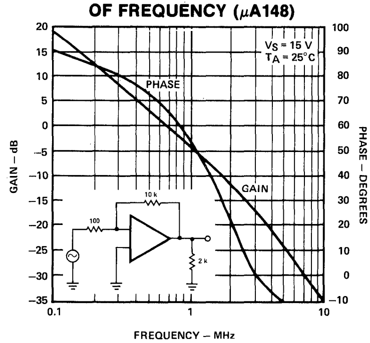
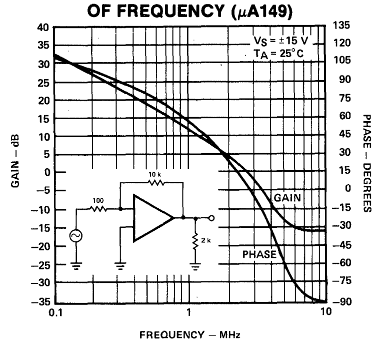
TYPICAL PERFORMANCE CURVES (Cont'd)

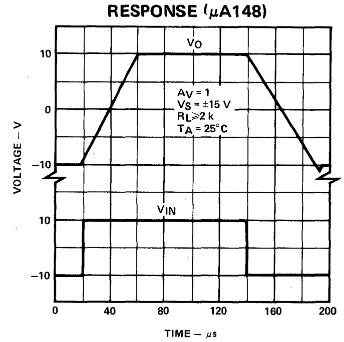
GAIN AS A FUNCTION OF FREQUENCY (μA148)



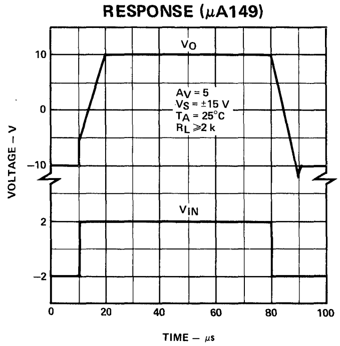
GAIN AS A FUNCTION OF FREQUENCY (μA149)



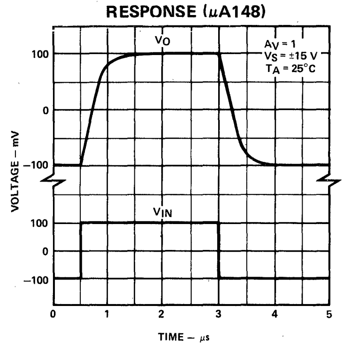
LARGE SIGNAL PULSE RESPONSE (μA148)



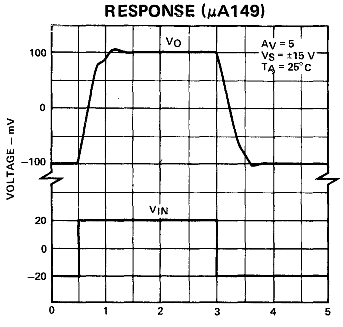
LARGE SIGNAL PULSE RESPONSE (μA149)



SMALL SIGNAL PULSE RESPONSE (μA148)



SMALL SIGNAL PULSE RESPONSE (μA149)



GAIN BANDWIDTH AS A FUNCTION OF TEMPERATURE