μA748

OPERATIONAL AMPLIFIER

FAIRCHILD LINEAR INTEGRATED CIRCUITS

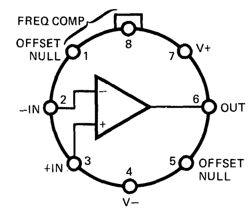
GENERAL DESCRIPTION — The μA748 is a High Performance Monolithic Operational Amplifier constructed using the Fairchild Planar* epitaxial process. It is intended for a high wide range of analog applications where tailoring of frequency characteristics is desirable. High common mode voltage range and absence of latch-up make the μA748 ideal for use as a voltage follower. The high gain and wide range of operating voltages provide superior performance in integrator, summing amplifier, and general feedback applications. The μA748 is short-circuit protected and has the same pin configuration as the popular μA741 operational amplifier. Unity gain frequency compensation is achieved by means of a single 30 pF capacitor. For superior performance, see μA777 data sheet.

- **SHORT-CIRCUIT PROTECTION**
- **OFFSET VOLTAGE NULL CAPABILITY**
- **LARGE COMMON-MODE AND DIFFERENTIAL VOLTAGE RANGES**
- **LOW POWER CONSUMPTION**
- **NO LATCH UP**

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	±22 V
Internal Power Dissipation (Note 1)	
Metal Can	500 mW
DIP	670 mW
Mini DIP	310 mW
Flatpak	570 mW
Differential Input Voltage	±30 V
Input Voltage (Note 2)	±15 V
Storage Temperature Range	
Metal Can, DIP, and Flatpak	−65°C to +150°C
Mini DIP	−55°C to +125°C
Operating Temperature Range	
Military (μA748)	−55°C to +125°C
Commercial (μA748C)	0°C to +70°C
Pin Temperature (Soldering 60 s)	
Metal Can, Flatpak, and Hermetic DIPs	300°C
Molded Mini DIP	260°C
Output Short-Circuit Duration (Note 3)	Indefinite

CONNECTION DIAGRAMS
8-PIN METAL CAN
(TOP VIEW)
PACKAGE OUTLINE 5S
PACKAGE CODE H

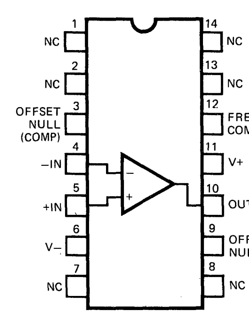


NOTE: Pin 4 connected to case

ORDER INFORMATION

TYPE	PART NO.
μA748	μA748HM
μA748A	μA748AHM
μA748C	μA748HC

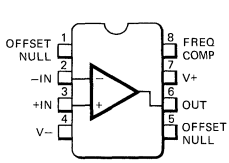
14-PIN DIP
(TOP VIEW)
PACKAGE OUTLINE 6A
PACKAGE CODE D



ORDER INFORMATION

TYPE	PART NO.
μA748	μA748DM
μA748A	μA748ADM
μA748C	μA748DC

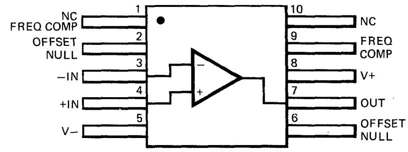
CONNECTION DIAGRAMS
8-PIN MINI DIP
(TOP VIEW)
PACKAGE OUTLINE 9T
PACKAGE CODE T



ORDER INFORMATION

TYPE	PART NO.
μA748C	μA748TC

10-PIN FLATPAK*
(TOP VIEW)
PACKAGE OUTLINE 3F
PACKAGE CODE F



***Available on special request.**

ORDER INFORMATION

TYPE	PART NO.
μA748	μA748FM
μA748A	μA748AFM

Notes and equivalent circuit on following pages.

*Planar is a patented Fairchild process.

μA748A

ELECTRICAL CHARACTERISTICS: $V_S = \pm 15$ V, $T_A = 25°C$, $C_C = 30pF$ unless otherwise specified.

CHARACTERISTICS		CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage		$R_S \leqslant 50$ kΩ		0.5	2.0	mV
Input Offset Current				2.0	10	nA
Input Bias Current				20	75	nA
Input Resistance			2.0	10.0		MΩ
Input Capacitance				3.0		pF
Offset Voltage Adjustment Range				±25		mV
Large Signal Voltage Gain		$R_L \geqslant 2$ kΩ, $V_{OUT} = \pm 10V$	50,000	250,000		V/V
Output Resistance				100		Ω
Output Short Circuit Current				±25		mA
Supply Current				1.9	2.8	mA
Power Consumption				60	85	mW
Transient Response (Voltage Follower, Gain of 1)	Rise Time	$V_{IN} = 20$ mV, $C_C = 30$ pF, $R_L = 2$ kΩ, $C_L \leqslant 100$ pF		0.3		μs
	Overshoot			5.0		%
Slew Rate (Voltage Follower, Gain of 1)		$R_L \geqslant 2$kΩ		0.5		V/μs
Transient Response (Voltage Follower, Gain of 10)	Rise Time	$V_{IN} = 20$ mV, $C_C = 3.5$ pF, $R_L = 2$ kΩ, $C_L \leqslant 100$ pF		0.2		μs
	Overshoot			5.0		%
Slew Rate (Voltage Follower, Gain of 10)		$R_L \geqslant 2$ kΩ, $C_C = 3.5$ pF		5.5		V/μs
The following specifications apply for $-55°C \leqslant T_A \leqslant +125°C$:						
Input Offset Voltage		$R_S \leqslant 50$ kΩ		0.5	3.0	mV
Average Input Offset Voltage Drift		$R_S \leqslant 50$ kΩ		2.5	15	μV/°C
Input Offset Current					25	nA
Average Input Offset Current Drift		$25°C \leqslant T_A \leqslant +125°C$		2.5	30	pA/°C
		$-55°C \leqslant T_A \leqslant 25°C$		6.5	150	pA/°C
Input Bias Current					100	nA
Input Voltage Range			±12	±13		V
Common Mode Rejection Ratio		$R_S \leqslant 50$ kΩ	80	95		dB
Supply Voltage Rejection Ratio		$R_S \leqslant 50$ kΩ		13	100	μV/V
Large Signal Voltage Gain		$R_L \geqslant 2$ kΩ, $V_{OUT} = \pm 10$ V	25,000			V/V
Output Voltage Swing		$R_L \geqslant 10$ kΩ	±12	±14		V
		$R_L \geqslant 2$ kΩ	±10	±13		V
Supply Current		$T_A = +125°C$		1.5	2.5	mA
		$T_A = -55°C$		2.0	3.3	mA
Power Consumption		$T_A = +125°C$		40	75	mW
		$T_A = -55°C$		60	100	mW

NOTES

1. Rating applies to ambient temperatures up to 70°C. Above 70°C ambient derate linearly at 6.3 mW/°C for metal can, 8.3 mW/°C for the DIP 5.6 mW/°C for the mini DIP and 7.1 mW/°C for the flatpak.
2. For supply voltages less than ±15 V, the absolute maximum input voltage is equal to the supply voltage.
3. Short circuit may be to ground or either supply. Rating applies to +125°C case temperature or +75°C ambient temperature.

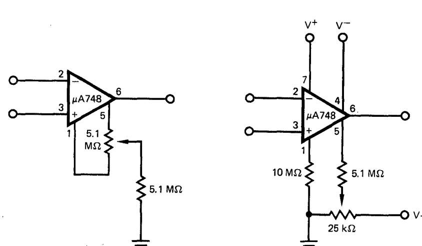
5

μA748

ELECTRICAL CHARACTERISTICS: $V_S = \pm 15$ V, $T_A = 25°C$, $C_C = 30pF$ unless otherwise specified.

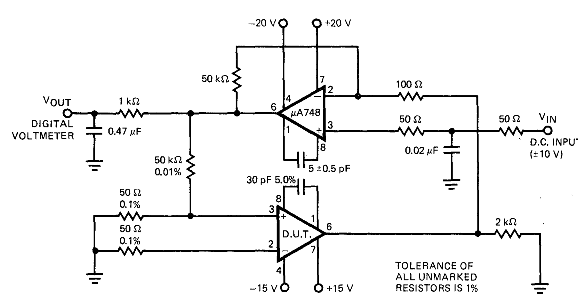
CHARACTERISTICS (see definitions)	CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage	$R_S \leq 10$ kΩ		1.0	5.0	mV
Input Offset Current			20	200	nA
Input Bias Current			80	500	nA
Input Resistance		0.3	2.0		MΩ
Input Capacitance			2.0		pF
Offset Voltage Adjustment Range			±15		mV
Large Signal Voltage Gain	$R_L \geq 2$ kΩ, $V_{OUT} = \pm 10$ V	50,000	150,000		V/V
Output Resistance			75		Ω
Output Short-Circuit Current			25		mA
Supply Current			1.9	2.8	mA
Power Consumption			60	85	mW
Transient Response (Voltage Follower, Gain of 1) — Rise Time	$V_{IN} = 20$ mV, $C_C = 30$ pF, $R_L = 2$ kΩ, $C_L \leq 100$ pF		0.3		μs
Transient Response (Voltage Follower, Gain of 1) — Overshoot			5.0		%
Slew Rate (Voltage Follower, Gain of 1)	$R_L \geq 2$ kΩ		0.5		V/μs
Transient Response (Voltage Follower, Gain of 10) — Rise Time	$V_{IN} = 20$ mV, $C_C = 3.5$ pF, $R_L = 2$ kΩ, $C_L \leq 100$ pF		0.2		μs
Transient Response (Voltage Follower, Gain of 10) — Overshoot			5.0		%
Slew Rate (Voltage Follower, Gain of 10)	$R_L \geq 2$ kΩ, $C_C = 3.5$ pF		5.5		V/μs
The following specifications apply for $-55°C \leq T_A \leq +125°C$:					
Input Offset Voltage	$R_S \leq 10$ kΩ		1.0	6.0	mV
Input Offset Current	$T_A = +125°C$		10	200	nA
	$T_A = -55°C$		50	500	nA
Input Bias Current	$T_A = +125°C$		0.03	0.5	μA
	$T_A = -55°C$		0.3	1.5	μA
Input Voltage Range		±12	±13		V
Common Mode Rejection Ratio	$R_S \leq 10$ kΩ	70	90		dB
Supply Voltage Rejection Ratio	$R_S \leq 10$ kΩ		30	150	μV/V
Large Signal Voltage Gain	$R_L \geq 2$ kΩ, $V_{OUT} = \pm 10$ V	25,000			V/V
Output Voltage Swing	$R_L \geq 10$ kΩ	±12	±14		V
	$R_L \geq 2$ kΩ	±10	±13		V
Supply Current	$T_A = +125°C$		1.5	2.5	mA
	$T_A = -55°C$		2.0	3.3	mA
Power Consumption	$T_A = +125°C$		45	75	mW
	$T_A = -55°C$		60	100	mW

VOLTAGE OFFSET NULL CIRCUIT



SUGGESTED **ALTERNATE**

GAIN TEST CIRCUIT



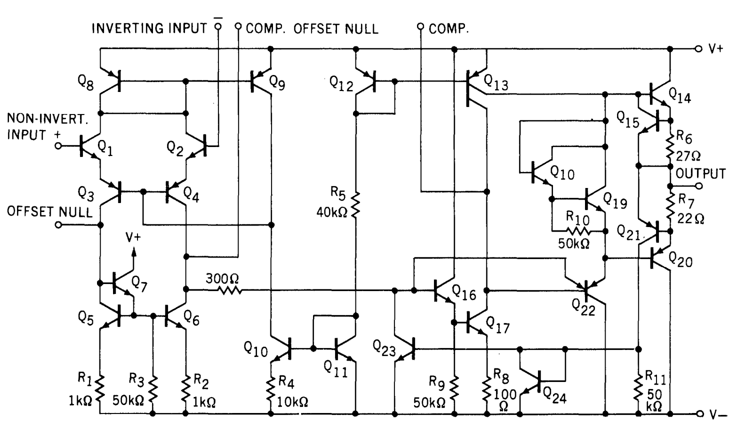
$$A_{VO} = \frac{V_{IN} \times 10^3}{V_{OUT}} = \frac{10 \times 10^3}{V_{OUT}} \text{ FOR } V_{IN} \text{ SPECIFIED}$$

μA748C

ELECTRICAL CHARACTERISTICS: $V_S = \pm 15$ V, $T_A = 25°C$, $C_C = 30pF$ unless otherwise specified.

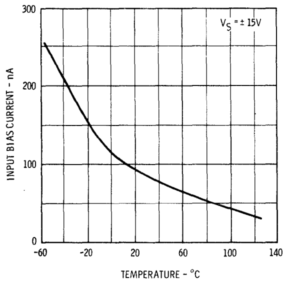
CHARACTERISTICS		CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage		$R_S \leq 10$ kΩ		2.0	6.0	mV
Input Offset Current				20	200	nA
Input Bias Current				80	500	nA
Input Resistance			0.3	2.0		MΩ
Input Capacitance				2.0		pF
Offset Voltage Adjustment Range				±15		mV
Large Signal Voltage Gain		$R_L \geq 2$ kΩ, $V_{OUT} = \pm 10$ V	20,000	150,000		V/V
Output Resistance				75		Ω
Output Short-Circuit Current				25		mA
Supply Current				1.9	2.8	mA
Power Consumption				60	85	mW
Transient Response (Voltage Follower, Gain of 1)	Rise Time	$V_{IN} = 20$ mV, $C_C = 30$ pF, $R_L = 2$ kΩ, $C_L \leq 100$ pF		0.3		μs
	Overshoot			5.0		%
Slew Rate (Voltage Follower, Gain of 1)		$R_L \geq 2$ kΩ		0.5		V/μs
Transient Response (Voltage Follower, Gain of 10)	Rise Time	$V_{IN} = 20$ mV, $C_C = 3.5$ pF, $R_L = 2$ kΩ, $C_L \leq 100$ pF		0.2		μs
	Overshoot			5.0		%
Slew Rate (Voltage Follower, Gain of 10)		$R_L \geq 2$ kΩ, $C_C = 3.5$ pF		5.5		V/μs
The following specifications apply for $0°C \leq T_A \leq +70°C$:						
Input Offset Voltage		$R_S \leq 10$ kΩ			7.5	mV
Input Offset Current					300	nA
Input Bias Current					800	nA
Input Voltage Range			±12	±13		V
Common Mode Rejection Ratio		$R_S \leq 10$ kΩ	70	90		dB
Supply Voltage Rejection Ratio		$R_S \leq 10$ kΩ		30	150	μV/V
Large Signal Voltage Gain		$R_L \geq 2$ kΩ, $V_{OUT} = \pm 10$ V	15,000			V/V
Output Voltage Swing		$R_L \geq 10$ kΩ	±12	±14		V
		$R_L \geq 2$ kΩ	±10	±13		V
Power Consumption				60	100	mW

EQUIVALENT CIRCUIT

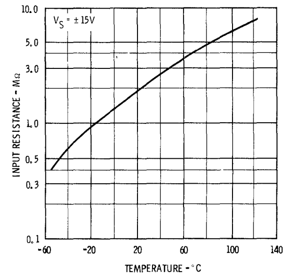


TYPICAL PERFORMANCE CURVES FOR μA748

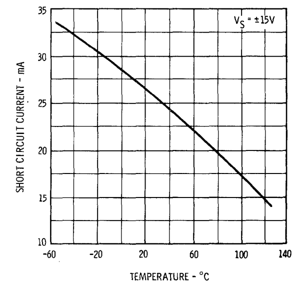
INPUT BIAS CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



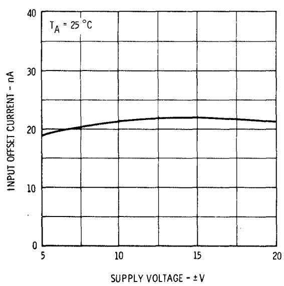
INPUT RESISTANCE AS A FUNCTION OF AMBIENT TEMPERATURE



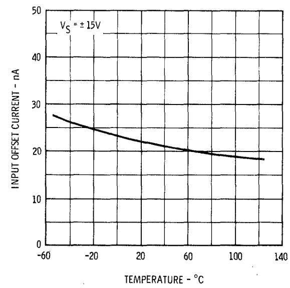
OUTPUT SHORT-CIRCUIT CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



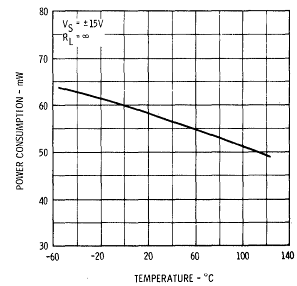
INPUT OFFSET CURRENT AS A FUNCTION OF SUPPLY VOLTAGE



INPUT OFFSET CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE

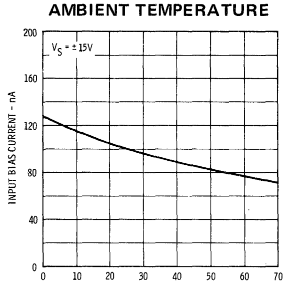


POWER CONSUMPTION AS A FUNCTION OF AMBIENT TEMPERATURE

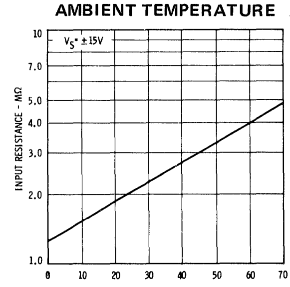


TYPICAL PERFORMANCE CURVES FOR μA748C

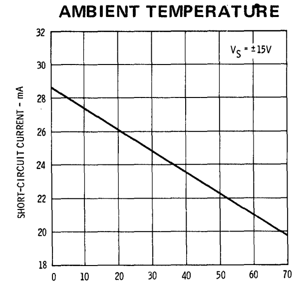
INPUT BIAS CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



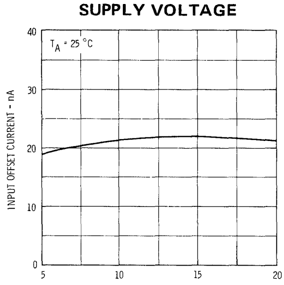
INPUT RESISTANCE AS A FUNCTION OF AMBIENT TEMPERATURE



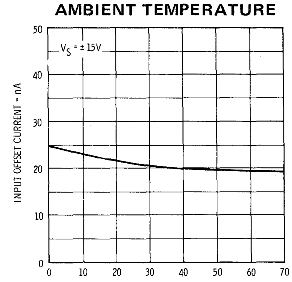
OUTPUT SHORT-CIRCUIT CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



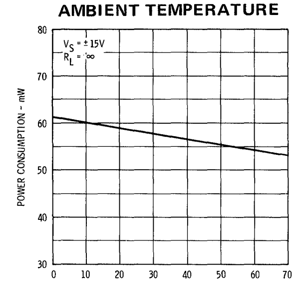
INPUT OFFSET CURRENT AS A FUNCTION OF SUPPLY VOLTAGE



INPUT OFFSET CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE

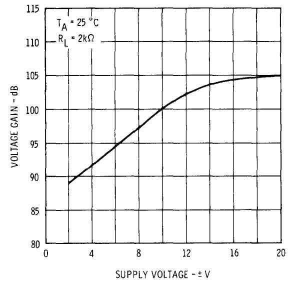


POWER CONSUMPTION AS A FUNCTION OF AMBIENT TEMPERATURE

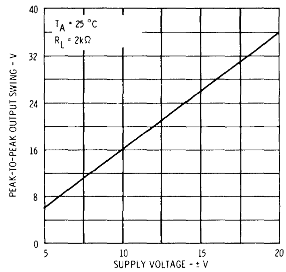


TYPICAL PERFORMANCE CURVES FOR μA748 AND μA748C

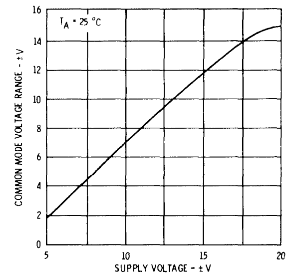
OPEN LOOP VOLTAGE GAIN AS A FUNCTION OF SUPPLY VOLTAGE



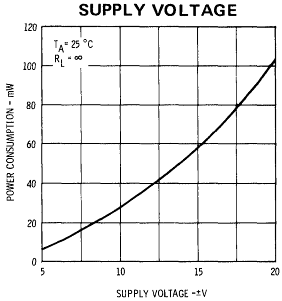
OUTPUT VOLTAGE SWING AS A FUNCTION OF SUPPLY VOLTAGE



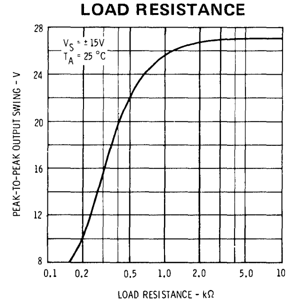
INPUT COMMON MODE VOLTAGE RANGE AS A FUNCTION OF SUPPLY VOLTAGE



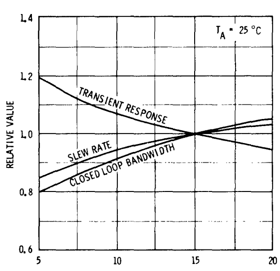
POWER CONSUMPTION AS A FUNCTION OF SUPPLY VOLTAGE



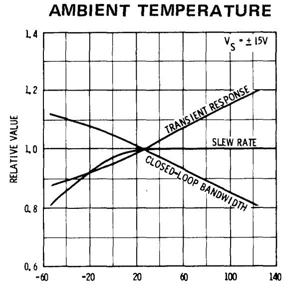
OUTPUT VOLTAGE SWING AS A FUNCTION OF LOAD RESISTANCE



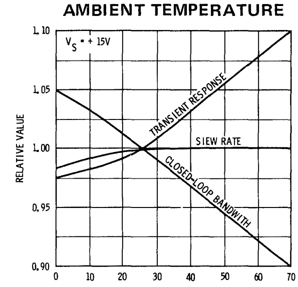
FREQUENCY CHARACTERISTICS AS A FUNCTION OF SUPPLY VOLTAGE



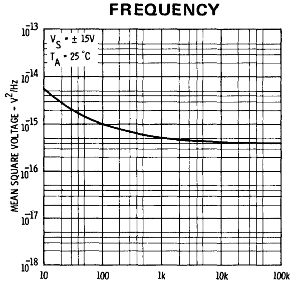
μA748 FREQUENCY CHARACTERISTICS AS A FUNCTION OF AMBIENT TEMPERATURE



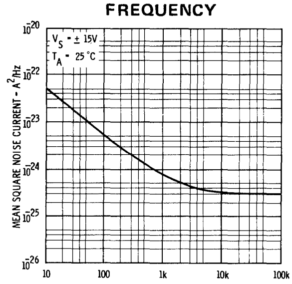
748C FREQUENCY CHARACTERISTICS AS A FUNCTION OF AMBIENT TEMPERATURE



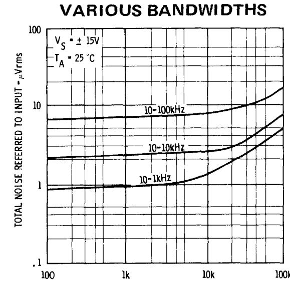
INPUT NOISE VOLTAGE AS A FUNCTION OF FREQUENCY



INPUT NOISE CURRENT AS A FUNCTION OF FREQUENCY

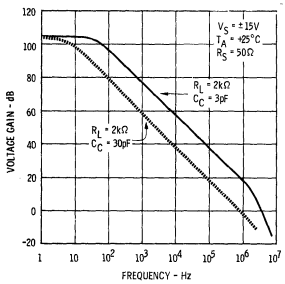


BROAD BAND NOISE FOR VARIOUS BANDWIDTHS

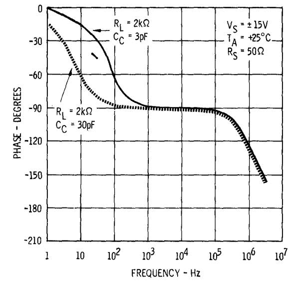


TYPICAL PERFORMANCE CURVES FOR μA748 AND μA748C

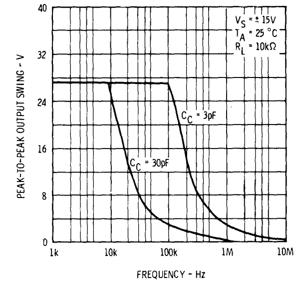
OPEN LOOP VOLTAGE GAIN AS A FUNCTION OF FREQUENCY



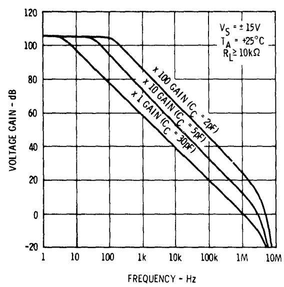
OPEN LOOP PHASE RESPONSE AS A FUNCTION OF FREQUENCY



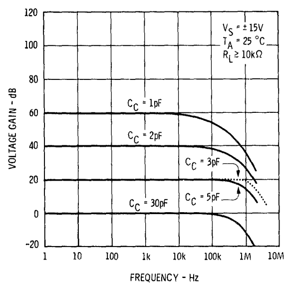
OUTPUT VOLTAGE SWING AS A FUNCTION OF FREQUENCY



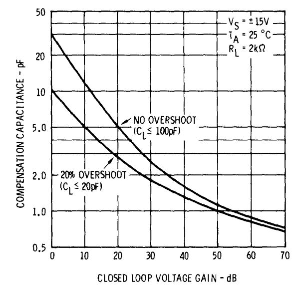
OPEN LOOP VOLTAGE GAIN AS A FUNCTION OF FREQUENCY FOR VARIOUS GAIN/COMPENSATION OPTIONS



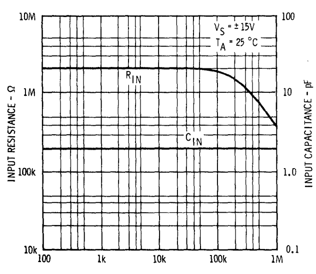
FREQUENCY RESPONSE FOR VARIOUS CLOSED LOOP GAINS



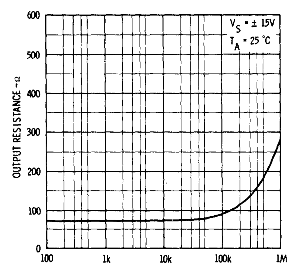
COMPENSATION CAPACITANCE AS A FUNCTION OF CLOSED LOOP VOLTAGE GAIN



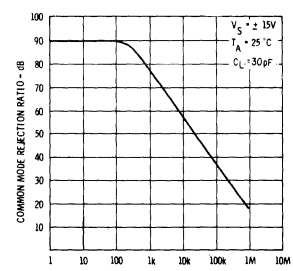
INPUT RESISTANCE AND INPUT CAPACITANCE AS A FUNCTION OF FREQUENCY



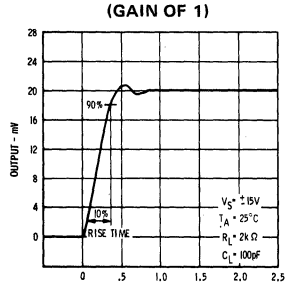
OUTPUT RESISTANCE AS A FUNCTION OF FREQUENCY



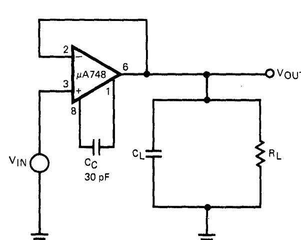
COMMON MODE REJECTION RATIO AS A FUNCTION OF FREQUENCY



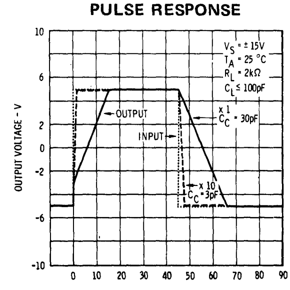
VOLTAGE FOLLOWER TRANSIENT RESPONSE (GAIN OF 1)



TRANSIENT RESPONSE TEST CIRCUIT

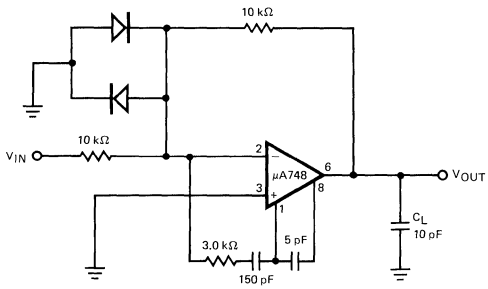


VOLTAGE FOLLOWER LARGE-SIGNAL PULSE RESPONSE

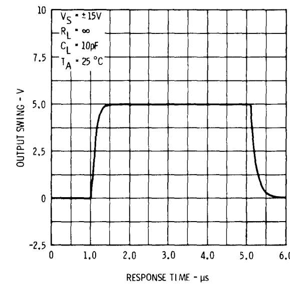


TYPICAL PERFORMANCE CURVES FOR μA748 AND μA748C

FEED FORWARD COMPENSATION

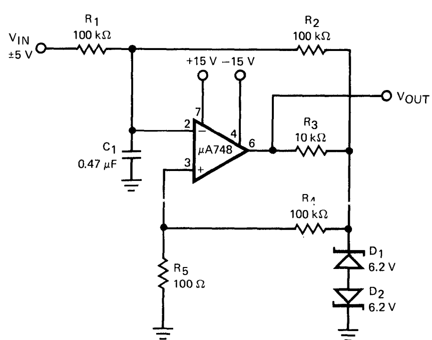


LARGE SIGNAL FEED FORWARD TRANSIENT RESPONSE



TYPICAL APPLICATIONS

PULSE WIDTH MODULATOR



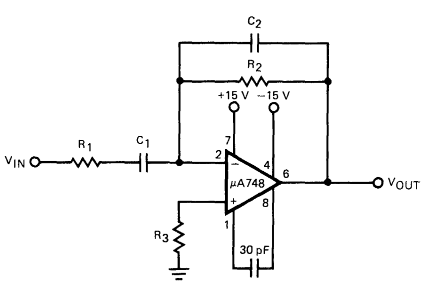
$$f_c = \frac{1}{2\pi\ R2\ C1}$$

$$f_n = \frac{1}{2\pi\ R1\ C1}$$

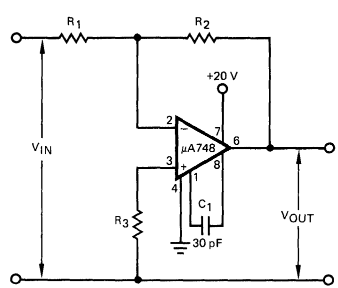
$$= \frac{1}{2\pi\ R2\ C2}$$

$$f_c < f_n < f_{unity\ gain}$$

PRACTICAL DIFFERENTIATOR



CIRCUIT FOR OPERATING THE μA748 WITHOUT A NEGATIVE SUPPLY



NOTES

1. Rating applies to ambient temperature up to 70°C. Above 70°C ambient derate linearly at 6.3 mW/°C for the metal can, 8.3 mW/°C for the DIP, 5.6 mW/°C for the mini DIP and 7.1 mW/°C for the flatpak.
2. For supply voltages less than ±15 V, the absolute maximum input voltage is equal to the supply voltage.
3. Short circuit may be to ground or either supply. Rating applies to +125°C case temperature or +75°C case temperature or +75°C ambient temperature.