

μA741

FREQUENCY-COMPENSATED OPERATIONAL AMPLIFIER

FAIRCHILD LINEAR INTEGRATED CIRCUIT

GENERAL DESCRIPTION – The μA741 is a high performance monolithic Operational Amplifier constructed using the Fairchild Planar* epitaxial process. It is intended for a wide range of analog applications. High common mode voltage range and absence of latch-up tendencies make the μA741 ideal for use as a voltage follower. The high gain and wide range of operating voltage provides superior performance in integrator, summing amplifier, and general feedback applications. Electrical characteristics of the μA741A and E are identical to MIL-M-38510/10101.

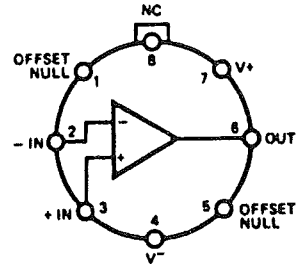
- NO FREQUENCY COMPENSATION REQUIRED
- SHORT CIRCUIT PROTECTION
- OFFSET VOLTAGE NULL CAPABILITY
- LARGE COMMON MODE AND DIFFERENTIAL VOLTAGE RANGES
- LOW POWER CONSUMPTION
- NO LATCH-UP

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	±22 V
μA741A, μA741, μA741E	
μA741C	±18 V
Internal Power Dissipation (Note 1)	
Metal Can	500 mW
Molded and Hermetic 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, Hermetic DIP, and Flatpak	–65°C to +150°C
Mini DIP, Molded DIP	–55°C to +125°C
Operating Temperature Range	
Military (μA741A, μA741)	–55°C to +125°C
Commercial (μA741E, μA741C)	0°C to +70°C
Lead Temperature (Soldering)	
Metal Can, Hermetic DIPs, and Flatpak (60 s)	300°C
Molded DIPs (10 s)	260°C
Output Short Circuit Duration (Note 3)	Indefinite

CONNECTION DIAGRAMS

**8-LEAD METAL CAN
(TOP VIEW)
PACKAGE OUTLINE 5B**

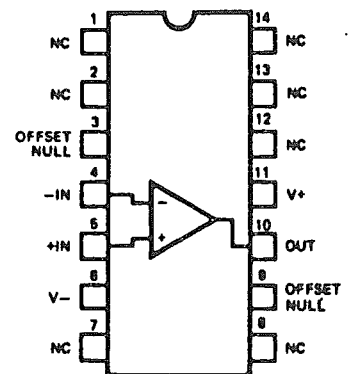


Note: Pin 4 connected to case

ORDER INFORMATION

TYPE	PART NO.
μA741A	μA741AHM
μA741	μA741HM
μA741E	μA741EHC
μA741C	μA741HC

**14-LEAD DIP
(TOP VIEW)
PACKAGE OUTLINE 6A, 9A**

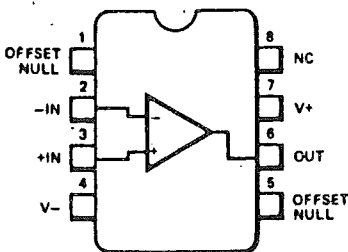


ORDER INFORMATION

TYPE	PART NO.
μA741A	μA741ADM
μA741	μA741DM
μA741E	μA741EDC
μA741C	μA741DC
μA741C	μA741PC

*Planar is a patented Fairchild process.

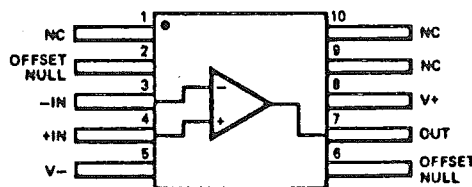
**8-LEAD MINIDIP
(TOP VIEW)
PACKAGE OUTLINES 6T 9T
PACKAGE CODES T R**



ORDER INFORMATION

TYPE	PART NO.
μA741C	μA741TC
μA741C	μA741RC

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



ORDER INFORMATION

TYPE	PART NO.
μA741A	μA741AFM
μA741	μA741FM

Notes on following pages.

FAIRCHILD LINEAR INTEGRATED CIRCUITS • $\mu A741$

$\mu A741A$

ELECTRICAL CHARACTERISTICS ($V_S = \pm 15V$, $T_A = 25^\circ C$ unless otherwise specified)

PARAMETERS (see definitions)	CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage	$R_S < 50\Omega$		0.8	3.0	mV
Average Input Offset Voltage Drift				15	$\mu V/^\circ C$
Input Offset Current			3.0	30	nA
Average Input Offset Current Drift				0.5	$nA/^\circ C$
Input Bias Current			30	80	nA
Power Supply Rejection Ratio	$V_S = +10, -20; V_S = +20, -10V, R_S = 50\Omega$		15	50	$\mu V/V$
Output Short Circuit Current		10	25	35	mA
Power Dissipation	$V_S = \pm 20V$		80	150	mW
Input Impedance	$V_S = \pm 20V$	1.0	6.0		$M\Omega$
Large Signal Voltage Gain	$V_S = \pm 20V, R_L = 2k\Omega, V_{OUT} = \pm 15V$	50			V/mV
Transient Response (Unity Gain)	Rise Time		0.25	0.8	μs
	Overshoot		6.0	20	%
Bandwidth (Note 4)		.437	1.5		MHz
Slew Rate (Unity Gain)	$V_{IN} = \pm 10V$	0.3	0.7		V/ μs
The following specifications apply for $-55^\circ C < T_A < +125^\circ C$					
Input Offset Voltage				4.0	mV
Input Offset Current				70	nA
Input Bias Current				210	nA
Common Mode Rejection Ratio	$V_S = \pm 20V, V_{IN} = \pm 15V, R_S = 50\Omega$	80	95		dB
Adjustment For Input Offset Voltage	$V_S = \pm 20V$	10			mV
Output Short Circuit Current		10		40	mA
Power Dissipation	$V_S = \pm 20V$	$-55^\circ C$		165	mW
		$+125^\circ C$		135	mW
Input Impedance	$V_S = \pm 20V$	0.5			$M\Omega$
Output Voltage Swing	$V_S = \pm 20V,$	$R_L = 10k\Omega$	± 16		V
		$R_L = 2k\Omega$	± 15		V
Large Signal Voltage Gain	$V_S = \pm 20V, R_L = 2k\Omega, V_{OUT} = \pm 15V$	32			V/mV
	$V_S = \pm 5V, R_L = 2k\Omega, V_{OUT} = \pm 2V$	10			V/mV

NOTES

- Rating applies to ambient temperatures up to $70^\circ C$. Above $70^\circ C$ ambient derate linearly at $6.3mW/^\circ C$ for the metal can, $8.3mW/^\circ C$ for the DIP and $7.1mW/^\circ C$ for the Flatpak.
- For supply voltages less than $\pm 15V$, the absolute maximum input voltage is equal to the supply voltage.
- Short circuit may be to ground or either supply. Rating applies to $+125^\circ C$ case temperature or $75^\circ C$ ambient temperature.
- Calculated value from: $BW(MHz) = \frac{0.35}{\text{Rise Time } (\mu s)}$

FAIRCHILD LINEAR INTEGRATED CIRCUITS • $\mu A741$

$\mu A741$

ELECTRICAL CHARACTERISTICS ($V_S = \pm 15\text{ V}$, $T_A = 25^\circ\text{C}$ unless otherwise specified)

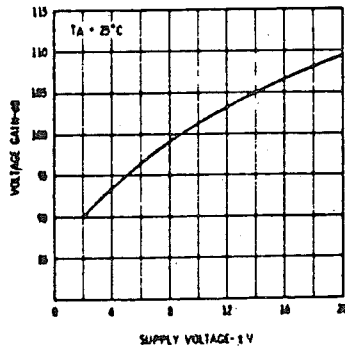
PARAMETERS (see definitions)	CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage	$R_S < 10\text{ k}\Omega$		1.0	5.0	mV
Input Offset Current			20	200	nA
Input Bias Current			80	500	nA
Input Resistance		0.3	2.0		M Ω
Input Capacitance			1.4		pF
Offset Voltage Adjustment Range			± 15		mV
Large Signal Voltage Gain	$R_L > 2\text{ k}\Omega$, $V_{OUT} = \pm 10\text{ V}$	50,000	200,000		
Output Resistance			75		Ω
Output Short Circuit Current			25		mA
Supply Current			1.7	2.9	mA
Power Consumption			50	85	mW
Transient Response (Unity Gain)	Rise time	$V_{IN} = 20\text{ mV}$, $R_L = 2\text{ k}\Omega$, $C_L < 100\text{ pF}$	0.3		μs
	Overshoot		5.0		%
Slew Rate	$R_L > 2\text{ k}\Omega$		0.5		V/ μs

The following specifications apply for $-55^\circ\text{C} < T_A < +125^\circ\text{C}$:

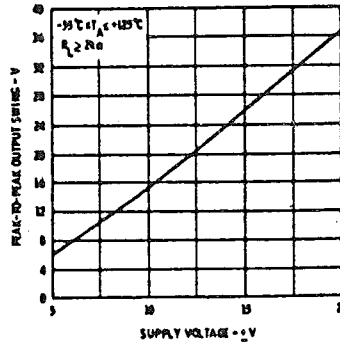
Input Offset Voltage	$R_S < 10\text{ k}\Omega$		1.0	6.0	mV
Input Offset Current	$T_A = +125^\circ\text{C}$		7.0	200	nA
	$T_A = -55^\circ\text{C}$		85	500	nA
Input Bias Current	$T_A = +125^\circ\text{C}$		0.03	0.5	μA
	$T_A = -55^\circ\text{C}$		0.3	1.5	μA
Input Voltage Range		± 12	± 13		V
Common Mode Rejection Ratio	$R_S < 10\text{ k}\Omega$	70	90		dB
Supply Voltage Rejection Ratio	$R_S < 10\text{ k}\Omega$		30	150	$\mu\text{V/V}$
Large Signal Voltage Gain	$R_L > 2\text{ k}\Omega$, $V_{OUT} = \pm 10\text{ V}$	25,000			
Output Voltage Swing	$R_L > 10\text{ k}\Omega$	± 12	± 14		V
	$R_L > 2\text{ k}\Omega$	± 10	± 13		V
Supply Current	$T_A = +125^\circ\text{C}$		1.5	2.5	mA
	$T_A = -55^\circ\text{C}$		2.0	3.3	mA
Power Consumption	$T_A = +125^\circ\text{C}$		45	75	mW
	$T_A = -55^\circ\text{C}$		60	100	mW

TYPICAL PERFORMANCE CURVES FOR $\mu A741A$ AND $\mu A741$

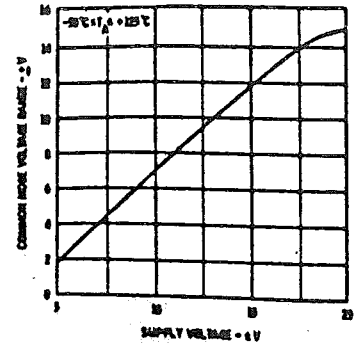
OPEN LOOP VOLTAGE GAIN AS A FUNCTION OF SUPPLY VOLTAGE



OUTPUT VOLTAGE SWING AS A FUNCTION OF SUPPLY VOLTAGE



INPUT COMMON MODE VOLTAGE RANGE AS A FUNCTION OF SUPPLY VOLTAGE



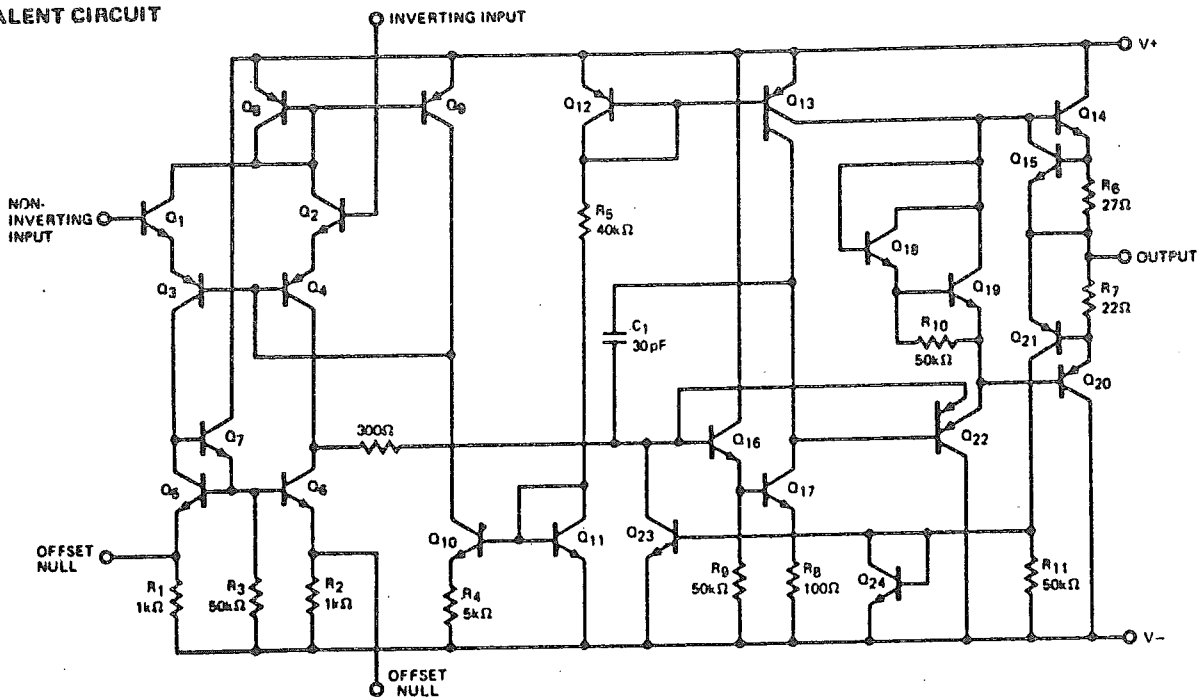
FAIRCHILD LINEAR INTEGRATED CIRCUITS • $\mu A741$

$\mu A741E$

ELECTRICAL CHARACTERISTICS ($V_S = \pm 15V$, $T_A = 25^\circ C$ unless otherwise specified)

PARAMETERS (see definitions)	CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage	$R_S < 50\Omega$		0.8	3.0	mV
Average Input Offset Voltage Drift				15	$\mu V/^\circ C$
Input Offset Current			3.0	30	nA
Average Input Offset Current Drift				0.5	$nA/^\circ C$
Input Bias Current			30	80	nA
Power Supply Rejection Ratio	$V_S = +10, -20; V_S = +20, -10V, R_S = 50\Omega$		15	50	$\mu V/V$
Output Short Circuit Current		10	25	35	mA
Power Dissipation	$V_S = \pm 20V$		80	150	mW
Input Impedance	$V_S = \pm 20V$	1.0	6.0		M Ω
Large Signal Voltage Gain	$V_S = \pm 20V, R_L = 2k\Omega, V_{OUT} = \pm 15V$	50			V/mV
Transient Response (Unity Gain)	Rise Time		0.25	0.8	μs
	Overshoot		6.0	20	%
Bandwidth (Note 4)		.437	1.5		MHz
Slew Rate (Unity Gain)	$V_{IN} = \pm 10V$	0.3	0.7		V/ μs
The following specifications apply for $0^\circ C < T_A < 70^\circ C$					
Input Offset Voltage				4.0	mV
Input Offset Current				70	nA
Input Bias Current				210	nA
Common Mode Rejection Ratio	$V_S = \pm 20V, V_{IN} = \pm 15V, R_S = 50\Omega$	80	95		dB
Adjustment For Input Offset Voltage	$V_S = \pm 20V$	10			mV
Output Short Circuit Current		10		40	mA
Power Dissipation	$V_S = \pm 20V$			150	mW
Input Impedance	$V_S = \pm 20V$	0.5			M Ω
Output Voltage Swing	$V_S = \pm 20V, R_L = 10k\Omega$ $R_L = 2k\Omega$		± 16		V
			± 15		V
Large Signal Voltage Gain	$V_S = \pm 20V, R_L = 2k\Omega, V_{OUT} = \pm 15V$	32			V/mV
	$V_S = \pm 5V, R_L = 2k\Omega, V_{OUT} = \pm 2V$	10			V/mV

EQUIVALENT CIRCUIT



FAIRCHILD LINEAR INTEGRATED CIRCUITS • $\mu A741$

$\mu A741C$

ELECTRICAL CHARACTERISTICS ($V_S = \pm 15\text{ V}$, $T_A = 25^\circ\text{C}$ unless otherwise specified)

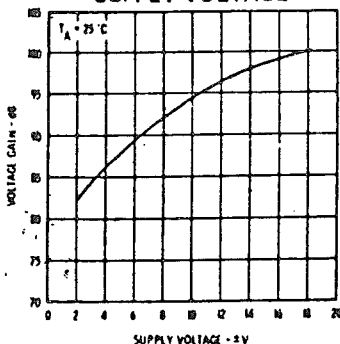
PARAMETERS (see definitions)	CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage	$R_S \leq 10\text{ k}\Omega$		2.0	6.0	mV
Input Offset Current			20	200	nA
Input Bias Current			80	500	nA
Input Resistance		0.3	2.0		$M\Omega$
Input Capacitance			1.4		pF
Offset Voltage Adjustment Range			± 15		mV
Input Voltage Range		± 12	± 13		V
Common Mode Rejection Ratio	$R_S \leq 10\text{ k}\Omega$	70	90		dB
Supply Voltage Rejection Ratio	$R_S \leq 10\text{ k}\Omega$		30	150	$\mu\text{V/V}$
Large Signal Voltage Gain	$R_L \geq 2\text{ k}\Omega$, $V_{OUT} = \pm 10\text{ V}$	20,000	200,000		
Output Voltage Swing	$R_L \geq 10\text{ k}\Omega$	± 12	± 14		V
	$R_L \geq 2\text{ k}\Omega$	± 10	± 13		V
Output Resistance			75		Ω
Output Short Circuit Current			25		mA
Supply Current			1.7	2.8	mA
Power Consumption			50	85	mW
Transient Response (Unity Gain)	Rise time	$V_{IN} = 20\text{ mV}$, $R_L = 2\text{ k}\Omega$, $C_L \leq 100\text{ pF}$		0.3	μs
	Overshoot			5.0	%
Slew Rate	$R_L \geq 2\text{ k}\Omega$		0.5		V/ μs

The following specifications apply for $0^\circ\text{C} < T_A \leq +70^\circ\text{C}$:

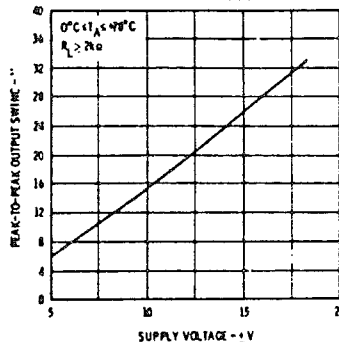
Input Offset Voltage				7.5	mV
Input Offset Current				300	nA
Input Bias Current				800	nA
Large Signal Voltage Gain	$R_L \geq 2\text{ k}\Omega$, $V_{OUT} = \pm 10\text{ V}$	15,000			
Output Voltage Swing	$R_L \geq 2\text{ k}\Omega$	± 10	± 13		V

TYPICAL PERFORMANCE CURVES FOR $\mu A741E$ AND $\mu A741C$

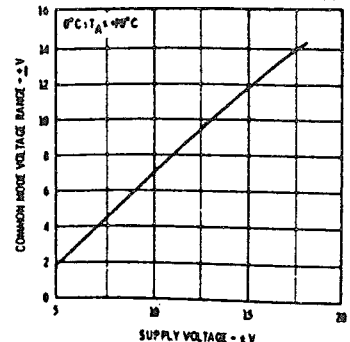
OPEN LOOP VOLTAGE GAIN AS A FUNCTION OF SUPPLY VOLTAGE



OUTPUT VOLTAGE SWING AS A FUNCTION OF SUPPLY VOLTAGE

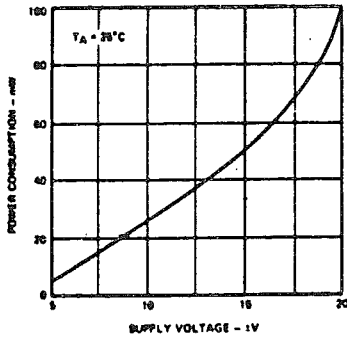


INPUT COMMON MODE VOLTAGE RANGE AS A FUNCTION OF SUPPLY VOLTAGE

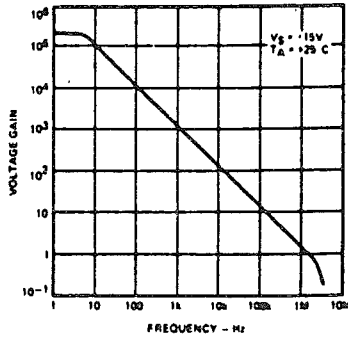


TYPICAL PERFORMANCE CURVES FOR $\mu A741A$, $\mu A741$, $\mu A741E$ AND $\mu A741C$

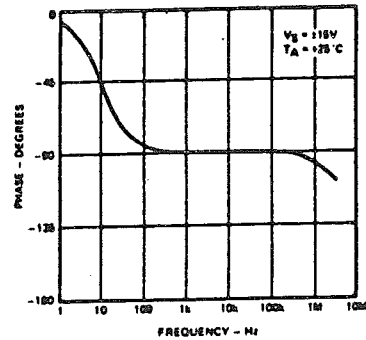
POWER CONSUMPTION AS A FUNCTION OF SUPPLY VOLTAGE



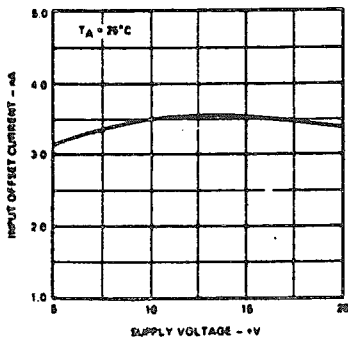
OPEN LOOP VOLTAGE GAIN AS A FUNCTION OF FREQUENCY



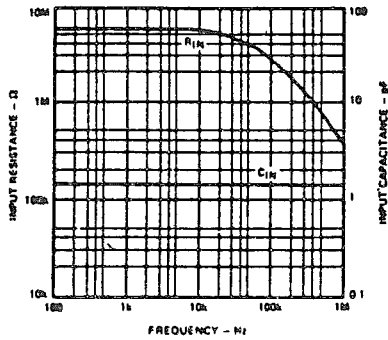
OPEN LOOP PHASE RESPONSE AS A FUNCTION OF FREQUENCY



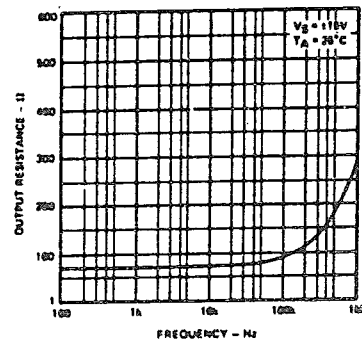
INPUT OFFSET CURRENT AS A FUNCTION OF SUPPLY VOLTAGE



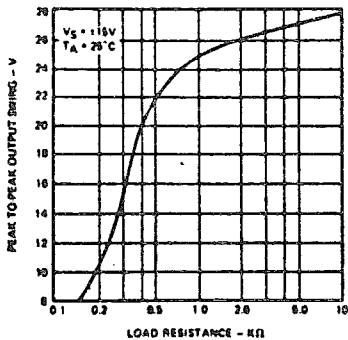
INPUT RESISTANCE AND INPUT CAPACITANCE AS A FUNCTION OF FREQUENCY



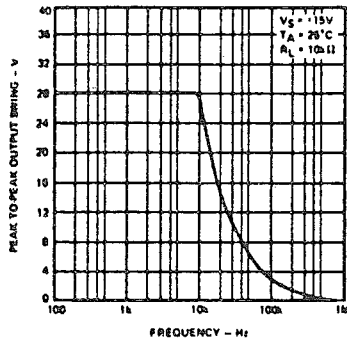
OUTPUT RESISTANCE AS A FUNCTION OF FREQUENCY



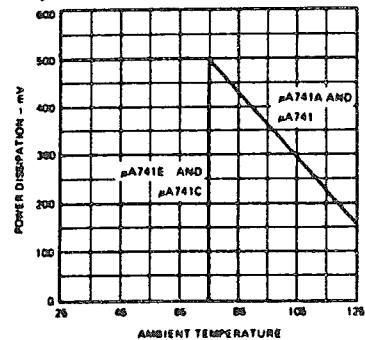
OUTPUT VOLTAGE SWING AS A FUNCTION OF LOAD RESISTANCE



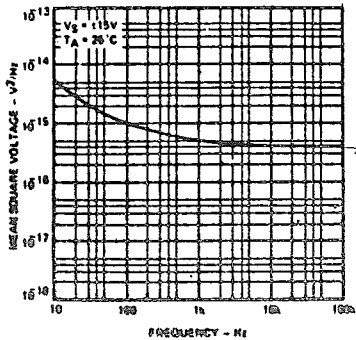
OUTPUT VOLTAGE SWING AS A FUNCTION OF FREQUENCY



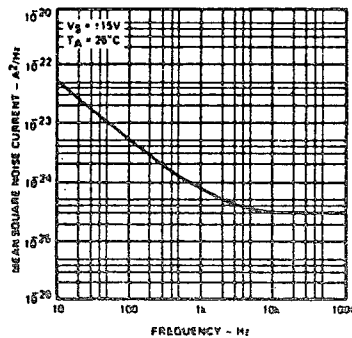
ABSOLUTE MAXIMUM POWER DISSIPATION AS A FUNCTION OF AMBIENT TEMPERATURE



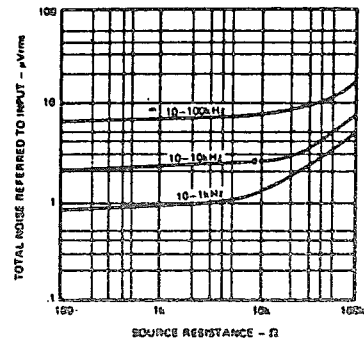
INPUT NOISE VOLTAGE AS A FUNCTION OF FREQUENCY



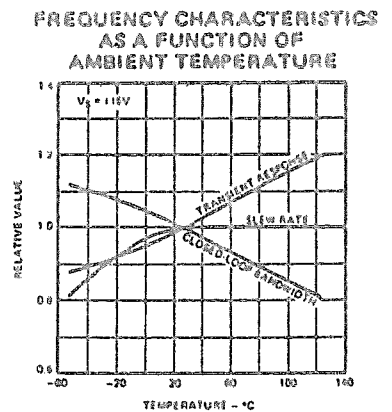
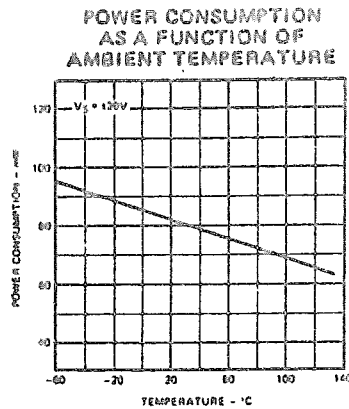
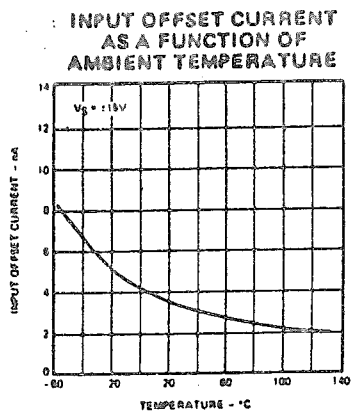
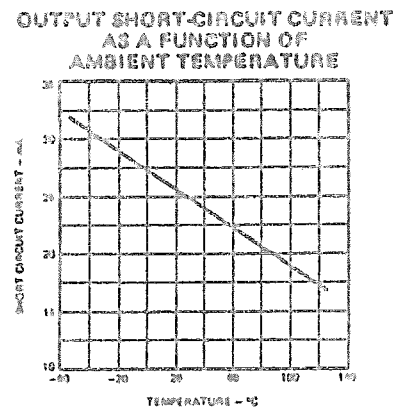
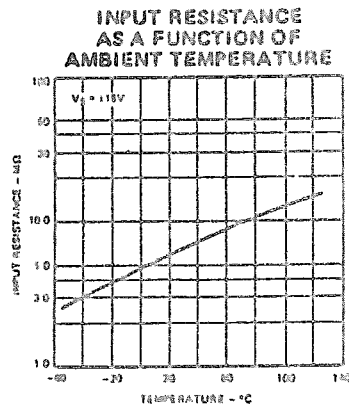
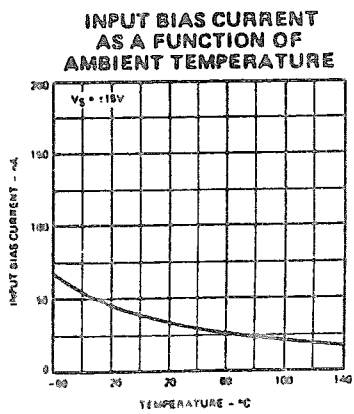
INPUT NOISE CURRENT AS A FUNCTION OF FREQUENCY



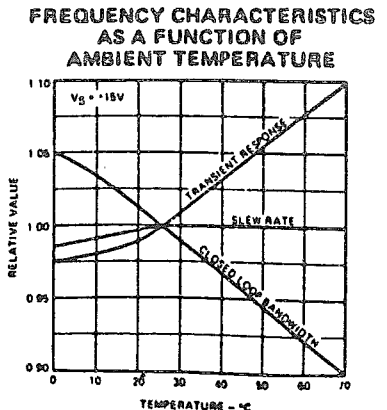
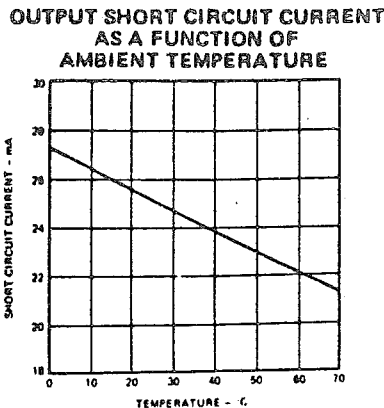
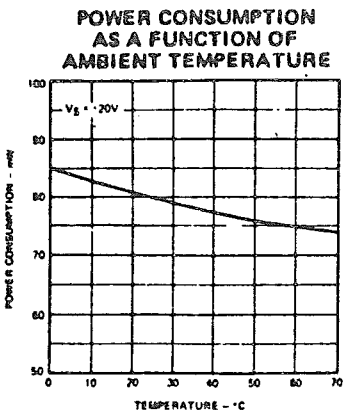
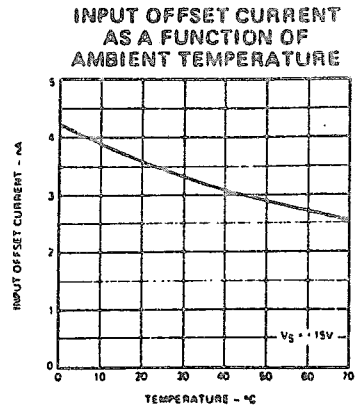
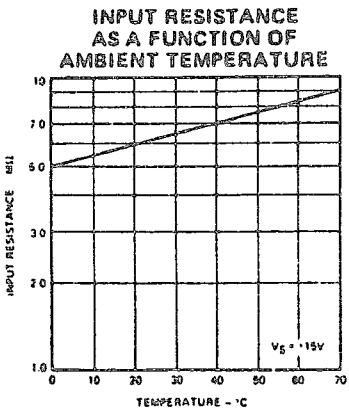
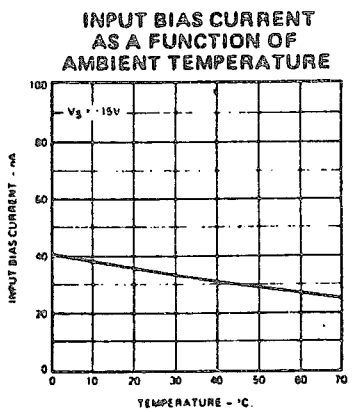
BROADBAND NOISE FOR VARIOUS BANDWIDTHS



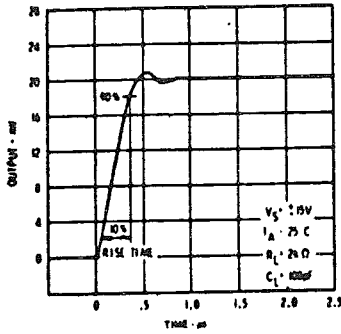
TYPICAL PERFORMANCE CURVES FOR μ A741A AND μ A741



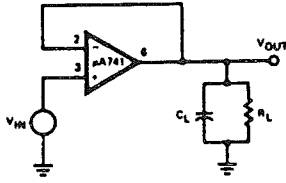
TYPICAL PERFORMANCE CURVES FOR μ A741E AND μ A741C



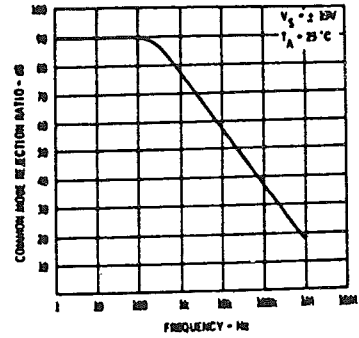
TRANSIENT RESPONSE



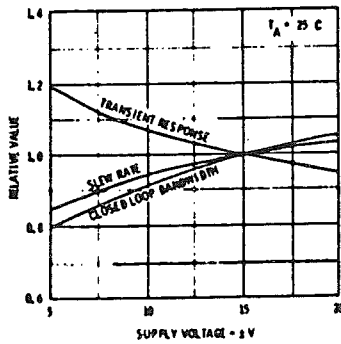
TRANSIENT RESPONSE TEST CIRCUIT



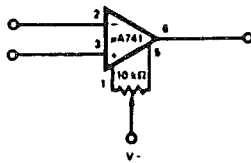
COMMON MODE REJECTION RATIO AS A FUNCTION OF FREQUENCY



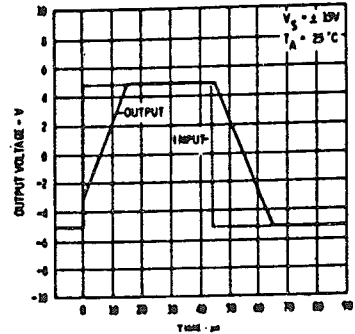
FREQUENCY CHARACTERISTICS AS A FUNCTION OF SUPPLY VOLTAGE



VOLTAGE OFFSET NULL CIRCUIT

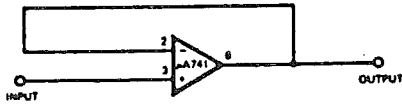


VOLTAGE FOLLOWER LARGE SIGNAL PULSE RESPONSE



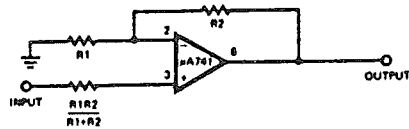
TYPICAL APPLICATIONS

UNITY-GAIN VOLTAGE FOLLOWER



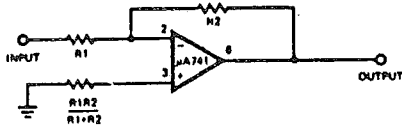
$R_{IN} = 400 \text{ M}\Omega$
 $C_{IN} = 1 \text{ pF}$
 $R_{OUT} \ll 1 \Omega$
 B.W. = 1 MHz

NON-INVERTING AMPLIFIER



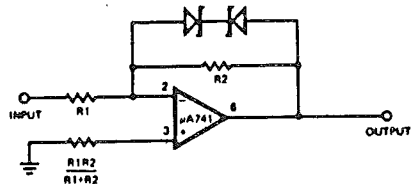
GAIN	R1	R2	BW	R_{IN}
10	1 k Ω	9 k Ω	100 kHz	400 M Ω
100	100 Ω	9.9 k Ω	10 kHz	280 M Ω
1000	100 Ω	99.9 k Ω	1 kHz	80 M Ω

INVERTING AMPLIFIER



GAIN	R1	R2	BW	R_{IN}
1	10 k Ω	10 k Ω	1 MHz	10 k Ω
10	1 k Ω	10 k Ω	100 kHz	1 k Ω
100	1 k Ω	100 k Ω	10 kHz	1 k Ω
1000	100 Ω	100 k Ω	1 kHz	100 Ω

CLIPPING AMPLIFIER

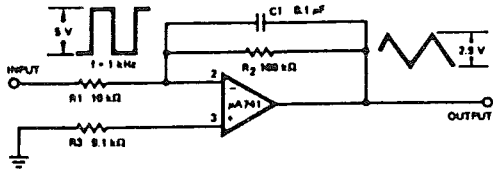


$$\frac{E_{OUT}}{E_{IN}} = \frac{R2}{R1} \text{ if } |E_{OUT}| < V_Z + 0.7 \text{ V}$$

where V_Z = Zener breakdown voltage

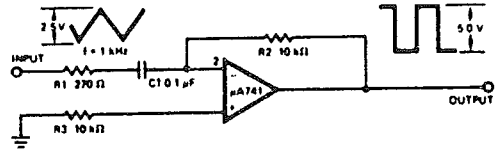
TYPICAL APPLICATIONS (Cont'd)

SIMPLE INTEGRATOR



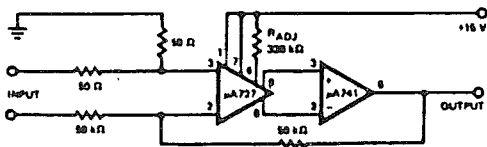
$$E_{OUT} = - \frac{1}{R_1 C_1} \int E_{IN} dt$$

SIMPLE DIFFERENTIATOR



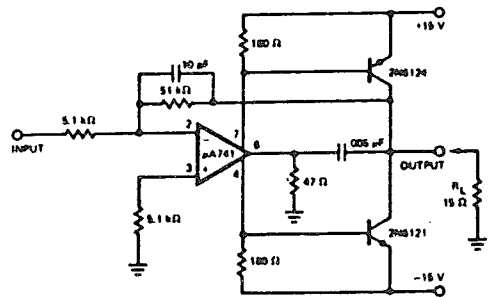
$$E_{OUT} = - R_2 C_1 \frac{dE_{IN}}{dt}$$

LOW DRIFT LOW NOISE AMPLIFIER

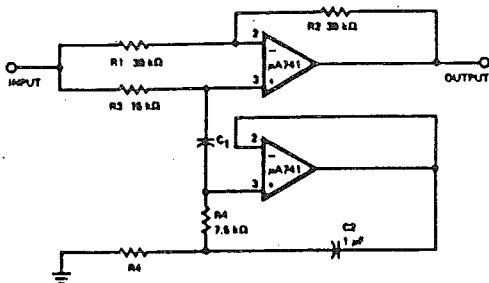


Voltage Gain = 10^3
 Input Offset Voltage Drift = $0.6 \mu V/^{\circ}C$
 Input Offset Current Drift = $2.0 pA/^{\circ}C$

HIGH SLEW RATE POWER AMPLIFIER



NOTCH FILTER USING THE μ A741 AS A GYRATOR



Trim R3 such that

$$\frac{R_1}{R_2} = \frac{R_3}{2 R_4}$$

NOTCH FREQUENCY AS A FUNCTION OF C1

