µA741

FREQUENCY-COMPENSATED OPERATIONAL AMPLIFIER

FAIRCHILD LINEAR INTEGRATED CIRCUIT

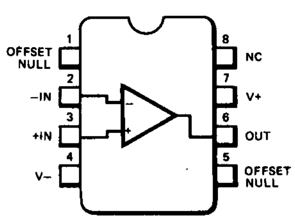
GENERAL DESCRIPTION — The µA741 is a high performance monolithic Operational Amplifier constructed using the Fairchild Planar* epitaxial process. It is intended for a wide range of analog applications. High common mode voltage range and absence of latch-up tendencies make the µA741 ideal for use as a 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	
µA741A, µA741, µA741E	±22 V
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

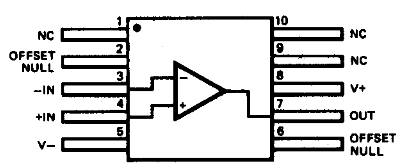
8-LEAD MINIDIP
(TOP VIEW)
PACKAGE OUTLINES 6T 9T
PACKAGE CODES T R



ORDER INFORMATION

TYPE	PART NO.
µA741C	µA741TC
µA741C	µA741RC

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

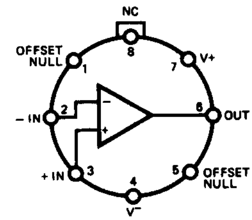


ORDER INFORMATION

TYPE	PART NO.
µA741A	µA741AFM
µA741	µA741FM

CONNECTION DIAGRAMS

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

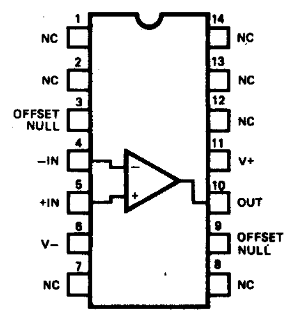


Note: Pin 4 connected to case

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

12

Notes on following pages.

*Planar is a patented Fairchild process.

µA741

ELECTRICAL CHARACTERISTICS (V_S = ±15 V, T_A = 25°C unless otherwise specified)

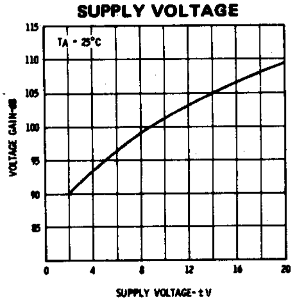
PARAMETERS (see definitions)	CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage	R_S < 10 kΩ		1.0	5.0	mV
Input Offset Current			20	200	nA
Input Bias Current			80	500	nA
Input Resistance		0.3	2.0		MΩ
Input Capacitance			1.4		pF
Offset Voltage Adjustment Range			±15		mV
Large Signal Voltage Gain	R_L > 2 kΩ, V_{OUT} = ±10 V	50,000	200,000		
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 mV, R_L = 2 kΩ, C_L < 100 pF		0.3		µs
Transient Response (Unity Gain) — Overshoot	V_{IN} = 20 mV, R_L = 2 kΩ, C_L < 100 pF		5.0		%
Slew Rate	R_L > 2 kΩ		0.5		V/µs

The following specifications apply for −55°C < T_A < +125°C:

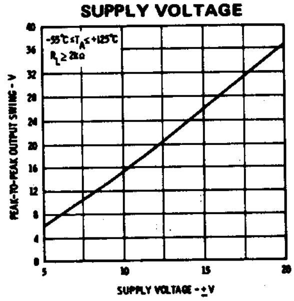
PARAMETERS	CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage	R_S < 10 kΩ		1.0	6.0	mV
Input Offset Current	T_A = +125°C		7.0	200	nA
	T_A = −55°C		85	500	nA
Input Bias Current	T_A = +125°C		0.03	0.5	µA
	T_A = −55°C		0.3	1.5	µA
Input Voltage Range		±12	±13		V
Common Mode Rejection Ratio	R_S < 10 kΩ	70	90		dB
Supply Voltage Rejection Ratio	R_S < 10 kΩ		30	150	µV/V
Large Signal Voltage Gain	R_L > 2 kΩ, V_{OUT} = ±10 V	25,000			
Output Voltage Swing	R_L > 10 kΩ	±12	±14		V
	R_L > 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

TYPICAL PERFORMANCE CURVES FOR µA741A AND µA741

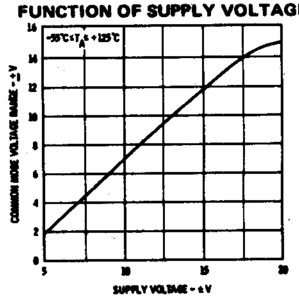
OPEN LOOP VOLTAGE GAIN AS A FUNCTION OF SUPPLY VOLTAGE



OUTPUT VOLTAGE SWING AS A FUNCTION OF SUPPLY VOLTAGE



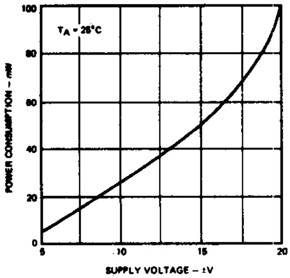
INPUT COMMON MODE VOLTAGE RANGE AS A FUNCTION OF SUPPLY VOLTAGE



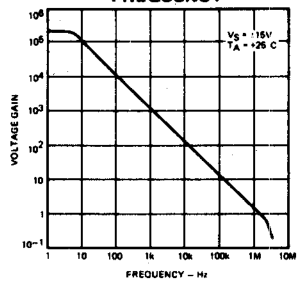
12

TYPICAL PERFORMANCE CURVES FOR μA741A, μA741, μA741E AND μA741C

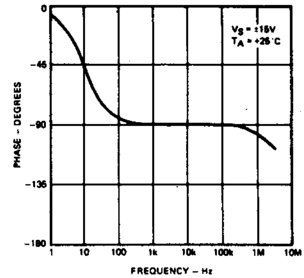
POWER CONSUMPTION AS A FUNCTION OF SUPPLY VOLTAGE



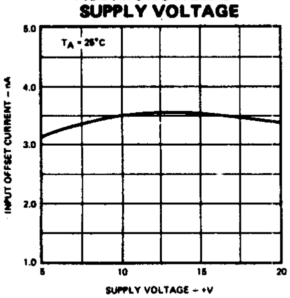
OPEN LOOP VOLTAGE GAIN AS A FUNCTION OF FREQUENCY



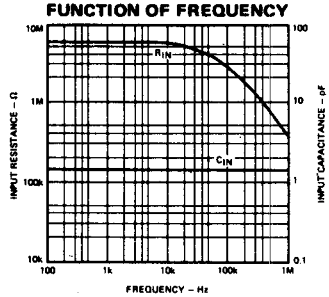
OPEN LOOP PHASE RESPONSE AS A FUNCTION OF FREQUENCY



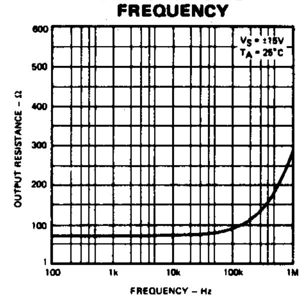
INPUT OFFSET CURRENT AS A FUNCTION OF SUPPLY VOLTAGE



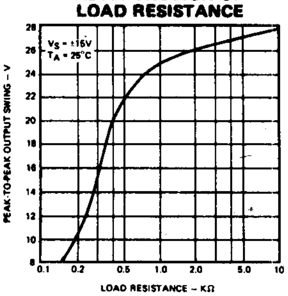
INPUT RESISTANCE AND INPUT CAPACITANCE AS A FUNCTION OF FREQUENCY



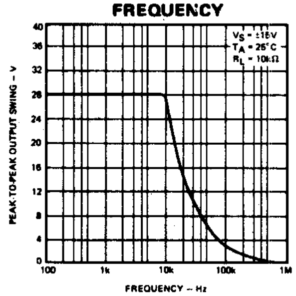
OUTPUT RESISTANCE AS A FUNCTION OF FREQUENCY



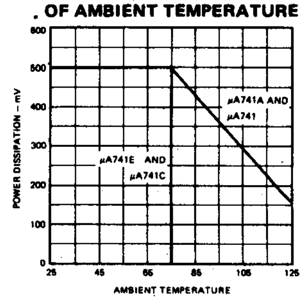
OUTPUT VOLTAGE SWING AS A FUNCTION OF LOAD RESISTANCE



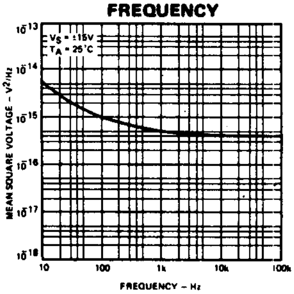
OUTPUT VOLTAGE SWING AS A FUNCTION OF FREQUENCY



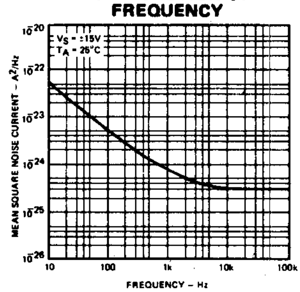
ABSOLUTE MAXIMUM POWER DISSIPATION AS A FUNCTION OF AMBIENT TEMPERATURE



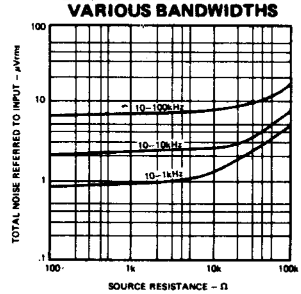
INPUT NOISE VOLTAGE AS A FUNCTION OF FREQUENCY



INPUT NOISE CURRENT AS A FUNCTION OF FREQUENCY

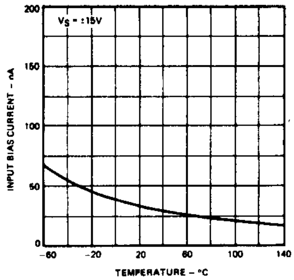


BROADBAND NOISE FOR VARIOUS BANDWIDTHS

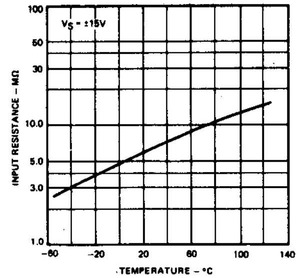


TYPICAL PERFORMANCE CURVES FOR μA741A AND μA741

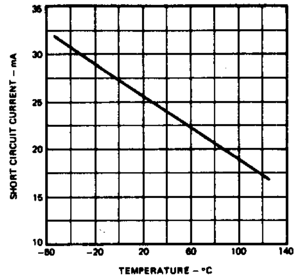
INPUT BIAS CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



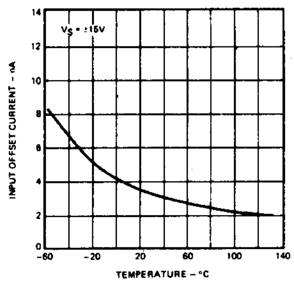
INPUT RESISTANCE AS A FUNCTION OF AMBIENT TEMPERATURE



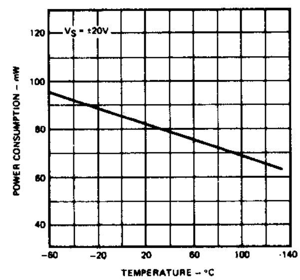
OUTPUT SHORT-CIRCUIT CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



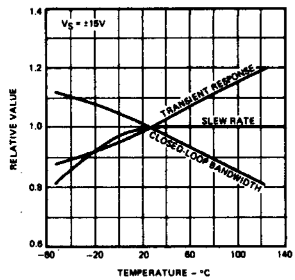
INPUT OFFSET CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



POWER CONSUMPTION AS A FUNCTION OF AMBIENT TEMPERATURE

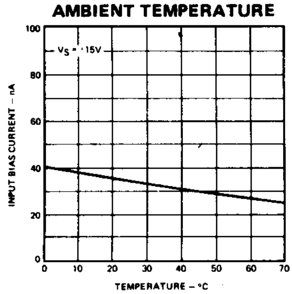


FREQUENCY CHARACTERISTICS AS A FUNCTION OF AMBIENT TEMPERATURE

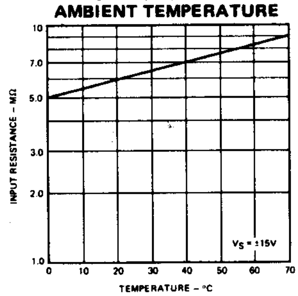


TYPICAL PERFORMANCE CURVES FOR μA741E AND μA741C

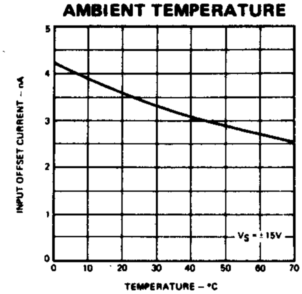
INPUT BIAS CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



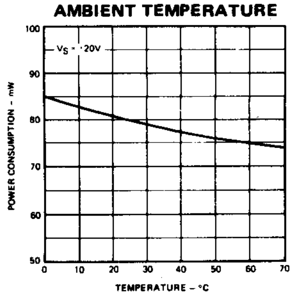
INPUT RESISTANCE AS A FUNCTION OF AMBIENT TEMPERATURE



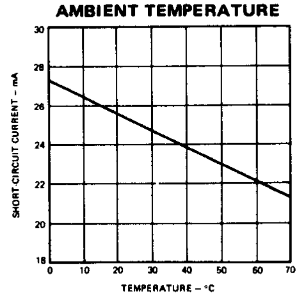
INPUT OFFSET CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



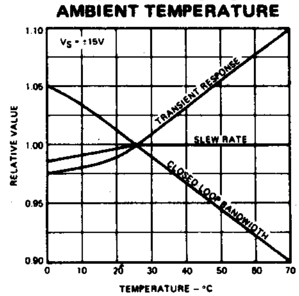
POWER CONSUMPTION AS A FUNCTION OF AMBIENT TEMPERATURE



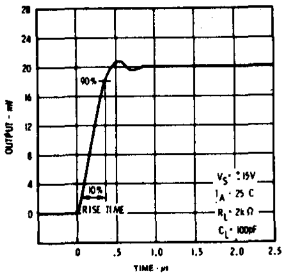
OUTPUT SHORT CIRCUIT CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



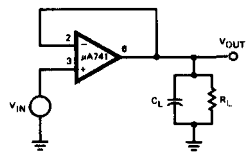
FREQUENCY CHARACTERISTICS AS A FUNCTION OF AMBIENT TEMPERATURE



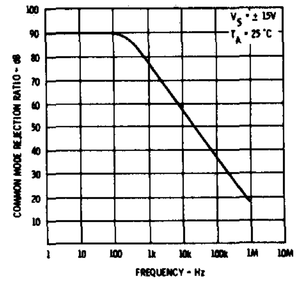
TRANSIENT RESPONSE



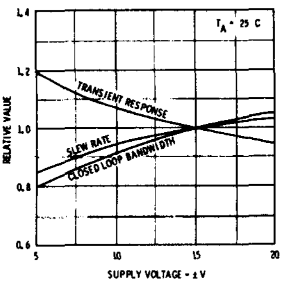
TRANSIENT RESPONSE TEST CIRCUIT



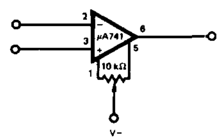
COMMON MODE REJECTION RATIO AS A FUNCTION OF FREQUENCY



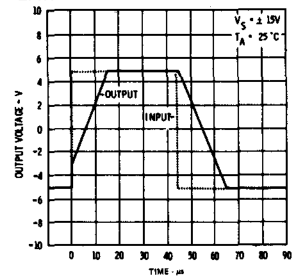
FREQUENCY CHARACTERISTICS AS A FUNCTION OF SUPPLY VOLTAGE



VOLTAGE OFFSET NULL CIRCUIT

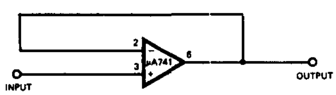


VOLTAGE FOLLOWER LARGE SIGNAL PULSE RESPONSE



TYPICAL APPLICATIONS

UNITY-GAIN VOLTAGE FOLLOWER



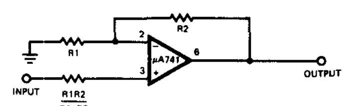
R_{IN} = 400 MΩ

C_{IN} = 1 pF

R_{OUT} << 1 Ω

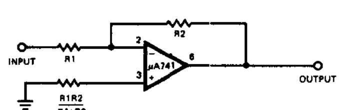
B.W. = 1 MHz

NON-INVERTING AMPLIFIER



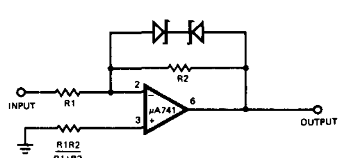
GAIN	R1	R2	B W	R_{IN}
10	1 kΩ	9 kΩ	100 kHz	400 MΩ
100	100 Ω	9.9 kΩ	10 kHz	280 MΩ
1000	100 Ω	99.9 kΩ	1 kHz	80 MΩ

INVERTING AMPLIFIER



GAIN	R1	R2	B W	R_{IN}
1	10 kΩ	10 kΩ	1 MHz	10 kΩ
10	1 kΩ	10 kΩ	100 kHz	1 kΩ
100	1 kΩ	100 kΩ	10 kHz	1 kΩ
1000	100 Ω	100 kΩ	1 kHz	100 Ω

CLIPPING AMPLIFIER

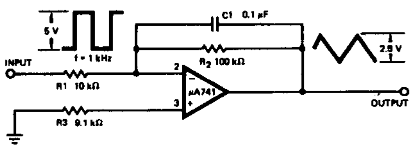


$$\frac{E_{OUT}}{E_{IN}} = \frac{R2}{R1} \text{ if } |E_{OUT}| \leq V_Z + 0.7\text{ V}$$

where V_Z = Zener breakdown voltage

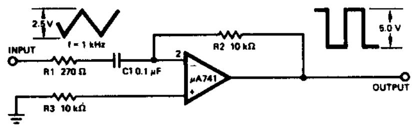
TYPICAL APPLICATIONS (Cont'd)

SIMPLE INTEGRATOR



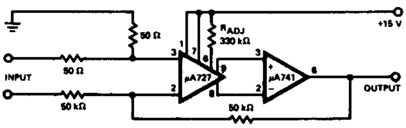
$$E_{OUT} = -\frac{1}{R_1C_1}\int E_{IN}dt$$

SIMPLE DIFFERENTIATOR



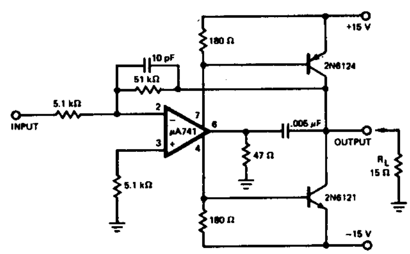
$$E_{OUT} = -R2C1\frac{dE_{IN}}{dt}$$

LOW DRIFT LOW NOISE AMPLIFIER

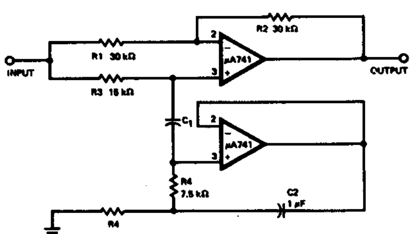


Voltage Gain = 10^3
Input Offset Voltage Drift = 0.6 μV/°C
Input Offset Current Drift = 2.0 pA/°C

HIGH SLEW RATE POWER AMPLIFIER



NOTCH FILTER USING THE μA741 AS A GYRATOR



Trim R3 such that

$$\frac{R1}{R2} = \frac{R3}{2\,R4}$$

NOTCH FREQUENCY AS A FUNCTION OF C1