

μA741

FREQUENCY-COMPENSATED OPERATIONAL AMPLIFIER

FAIRCHILD LINEAR INTEGRATED CIRCUITS

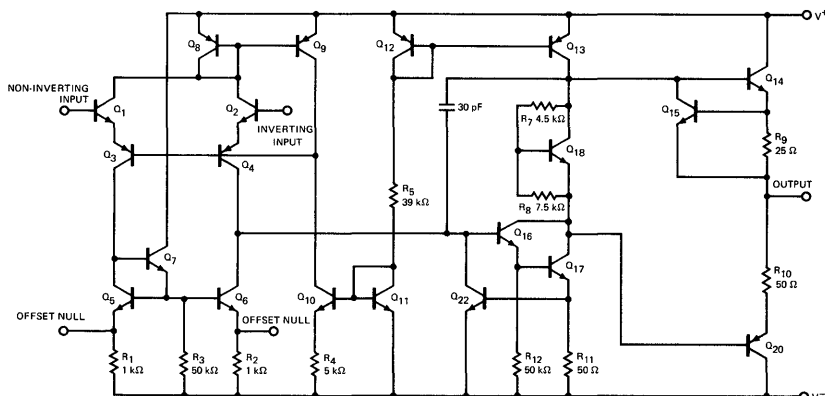
GENERAL DESCRIPTION — The μA741 is a high performance monolithic Operational Amplifier constructed using the Fairchild Planar* epitaxial process. It is intended for a wide range of analog applications. High common mode voltage range and absence of "latch-up" tendencies make the μA741 ideal for use as a voltage follower. The high gain and wide range of operating voltage provides superior performance in integrator, summing amplifier, and general feedback applications.

- 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	
Military (741)	±22 V
Commercial (741C)	±18 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 (741)	−55°C to +125°C
Commercial (741C)	0°C to +70°C
Lead Temperature (Soldering)	
Metal Can, DIP, and Flatpak (60 seconds)	300°C
Mini DIP (10 seconds)	260°C
Output Short Circuit Duration (Note 3)	Indefinite

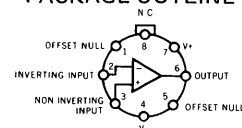
EQUIVALENT CIRCUIT



Notes on following pages.

CONNECTION DIAGRAMS

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

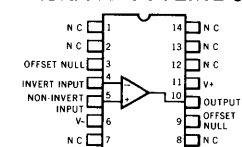


Note: Pin 4 connected to case

ORDER INFORMATION

TYPE	PART NO.
741	741HM
741C	741HC

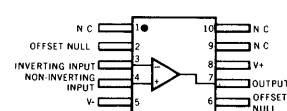
14-LEAD DIP (TOP VIEW) PACKAGE OUTLINE 6A



ORDER INFORMATION

TYPE	PART NO.
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741C	741DC

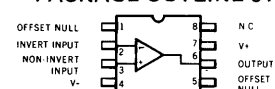
10-LEAD FLATPAK (TOP VIEW) PACKAGE OUTLINE 3F



ORDER INFORMATION

TYPE	PART NO.
741	741FM

8-LEAD MINIDIP (TOP VIEW) PACKAGE OUTLINE 9T



ORDER INFORMATION

TYPE	PART NO.
741C	741TC

*Planar is a patented Fairchild process.

741

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

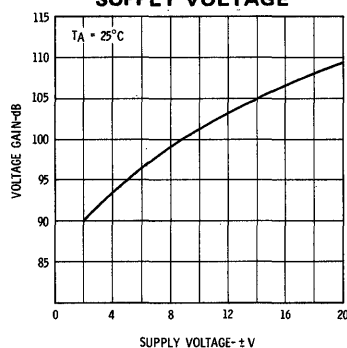
PARAMETERS (see definitions)		CONDITIONS	MIN.	TYP.	MAX.	UNITS
Input Offset Voltage		$R_S \leq 10\text{ k}\Omega$		1.0	5.0	mV
Input Offset Current				20	200	nA
Input Bias Current				80	500	nA
Input Resistance			0.3	2.0		M Ω
Input Capacitance				1.4		pF
Offset Voltage Adjustment Range				± 15		mV
Large Signal Voltage Gain		$R_L \geq 2\text{ k}\Omega$, $V_{OUT} = \pm 10\text{ V}$	50,000	200,000		
Output Resistance				75		Ω
Output Short Circuit Current				25		mA
Supply Current				1.7	2.8	mA
Power Consumption				50	85	mW
Transient Response (Unity Gain)	Risetime	$V_{IN} = 20\text{ mV}$, $R_L = 2\text{ k}\Omega$, $C_L \leq 100\text{ pF}$		0.3		μs
	Overshoot			5.0		%
Slew Rate		$R_L \geq 2\text{ k}\Omega$		0.5		V/ μs

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

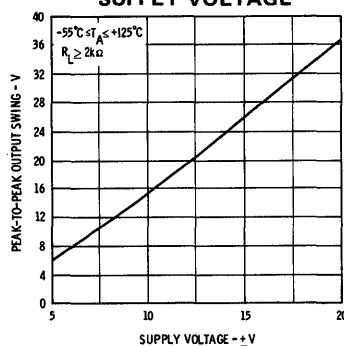
Input Offset Voltage	$R_S \leq 10\text{ k}\Omega$		1.0	6.0	mV
Input Offset Current	$T_A = +125^\circ\text{C}$		7.0	200	nA
	$T_A = -55^\circ\text{C}$		85	500	nA
Input Bias Current	$T_A = +125^\circ\text{C}$		0.03	0.5	μA
	$T_A = -55^\circ\text{C}$		0.3	1.5	μA
Input Voltage Range		± 12	± 13		V
Common Mode Rejection Ratio	$R_S \leq 10\text{ k}\Omega$	70	90		dB
Supply Voltage Rejection Ratio	$R_S \leq 10\text{ k}\Omega$		30	150	$\mu\text{V/V}$
Large Signal Voltage Gain	$R_L \geq 2\text{ k}\Omega$, $V_{OUT} = \pm 10\text{ V}$	25,000			
Output Voltage Swing	$R_L \geq 10\text{ k}\Omega$	± 12	± 14		V
	$R_L \geq 2\text{ k}\Omega$	± 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 741

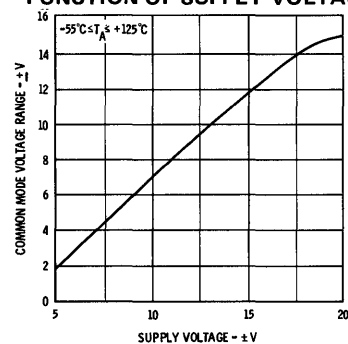
**OPEN LOOP VOLTAGE GAIN
AS A FUNCTION OF
SUPPLY VOLTAGE**



**OUTPUT VOLTAGE SWING
AS A FUNCTION OF
SUPPLY VOLTAGE**



**INPUT COMMON MODE
VOLTAGE RANGE AS A
FUNCTION OF SUPPLY VOLTAGE**



741C

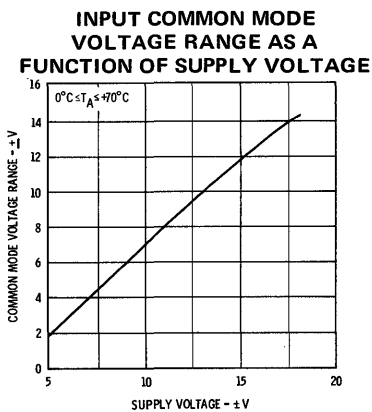
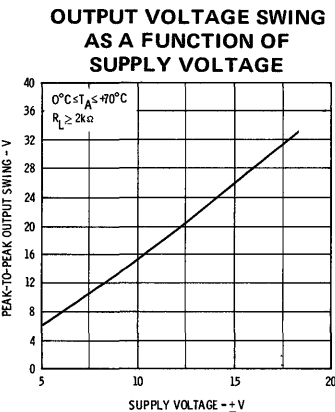
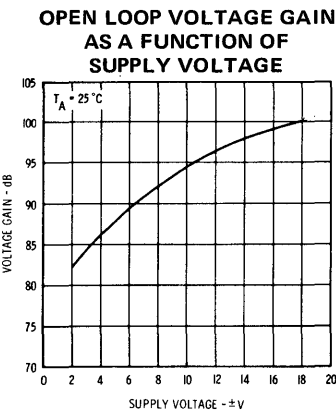
ELECTRICAL CHARACTERISTICS ($V_S = \pm 15\text{ V}$, $T_A = 25^\circ\text{C}$ unless otherwise specified)

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 Ω
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)	Risetime	$V_{IN} = 20\text{ mV}$, $R_L = 2\text{ k}\Omega$, $C_L \leq 100\text{ pF}$		0.3		μs
	Overshoot			5.0		%
Slew Rate		$R_L \geq 2\text{ k}\Omega$		0.5		V/ μs

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

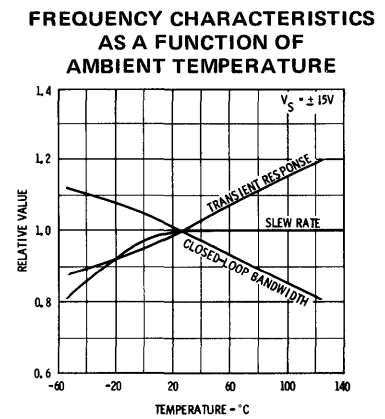
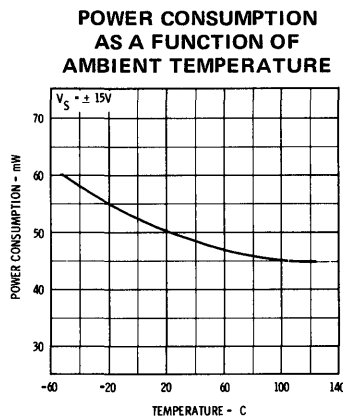
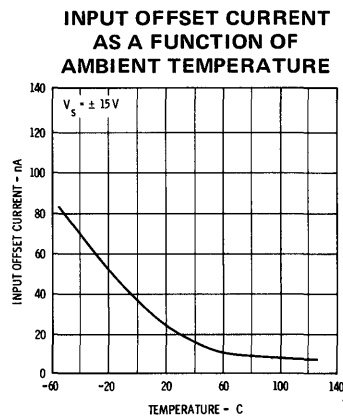
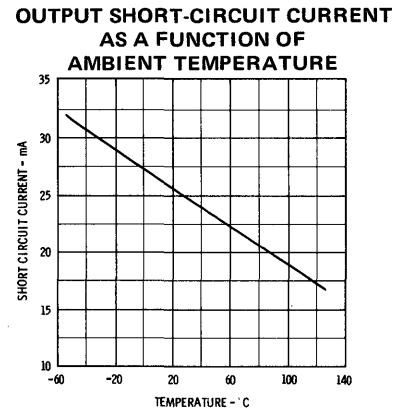
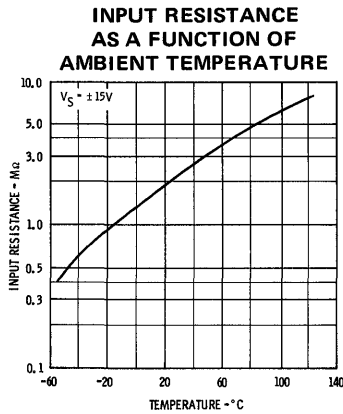
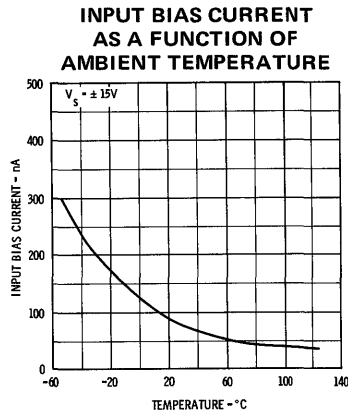
Input Offset Voltage				7.5	mV
Input Offset Current				300	nA
Input Bias Current				800	nA
Large Signal Voltage Gain		$R_L \geq 2\text{ k}\Omega$, $V_{OUT} = \pm 10\text{ V}$	15,000		
Output Voltage Swing		$R_L \geq 2\text{ k}\Omega$	± 10	± 13	V

TYPICAL PERFORMANCE CURVES FOR 741C

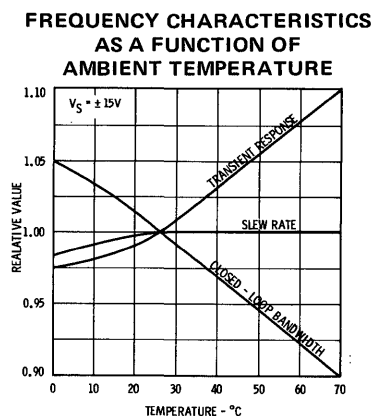
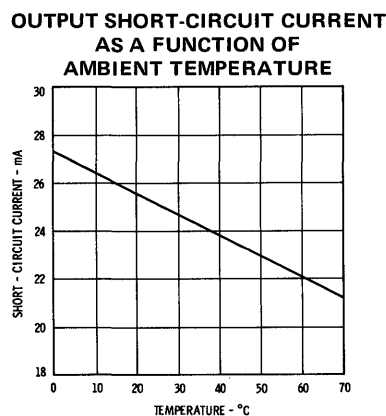
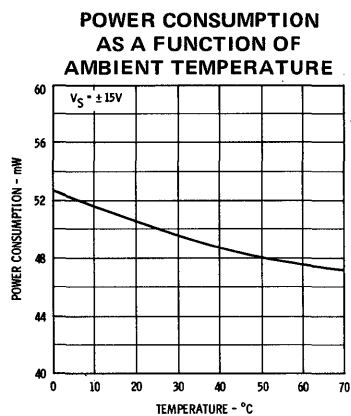
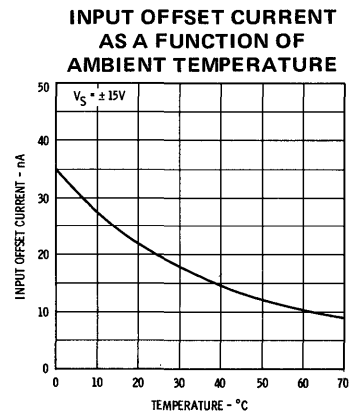
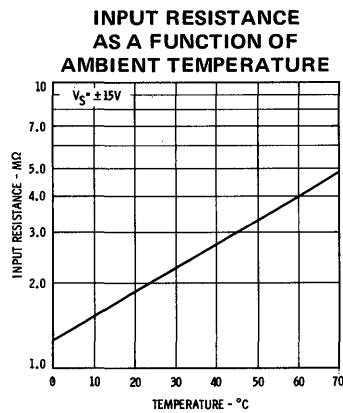
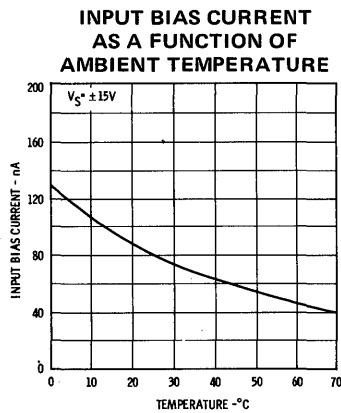


- NOTES:
1. Rating applies to ambient temperatures up to 70°C . Above 70°C ambient derate linearly at $6.3\text{ mW}/^\circ\text{C}$ for the Metal Can, $8.3\text{ mW}/^\circ\text{C}$ for the DIP, $5.6\text{ mW}/^\circ\text{C}$ for the Mini DIP and $7.1\text{ mW}/^\circ\text{C}$ for the Flatpak.
 2. For supply voltages less than $\pm 15\text{ V}$, the absolute maximum input voltage is equal to the supply voltage.
 3. Short circuit may be to ground or either supply. Rating applies to $+125^\circ\text{C}$ case temperature or 75°C ambient temperature.

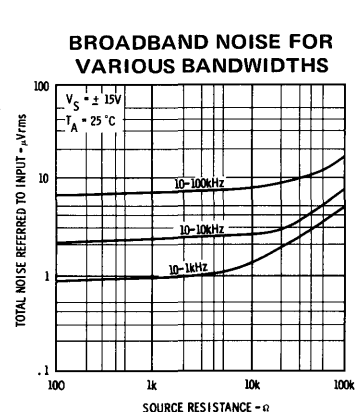
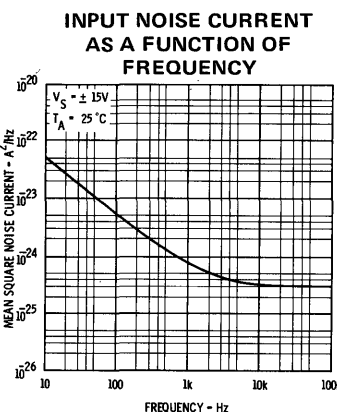
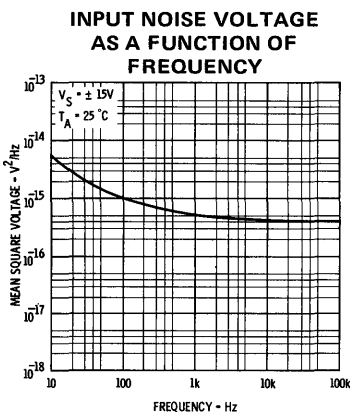
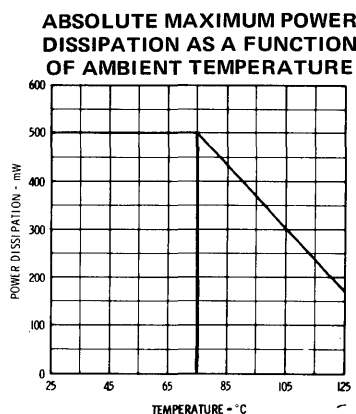
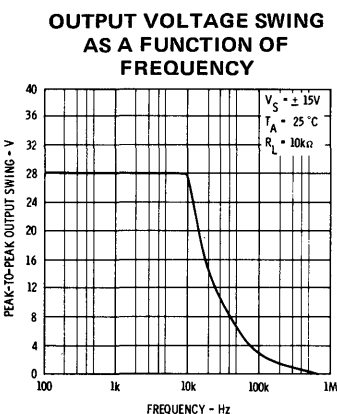
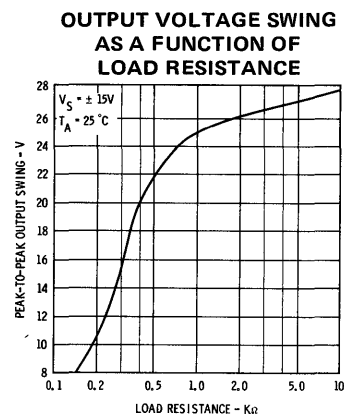
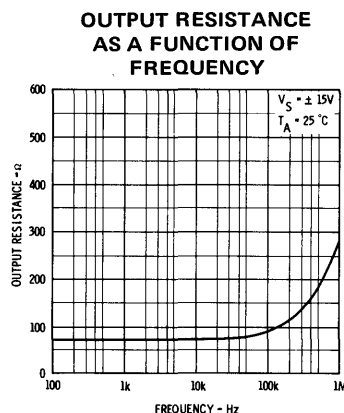
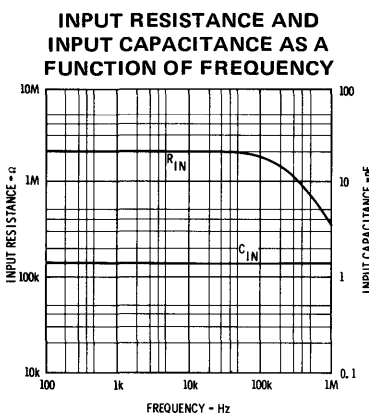
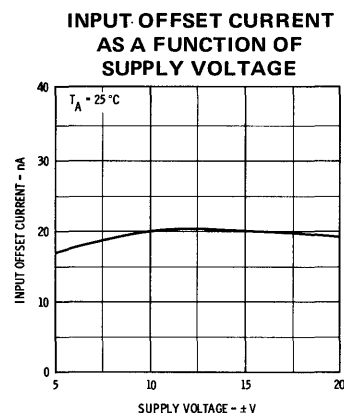
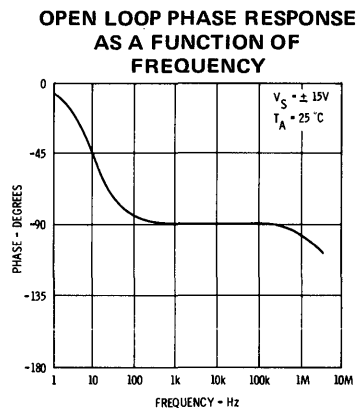
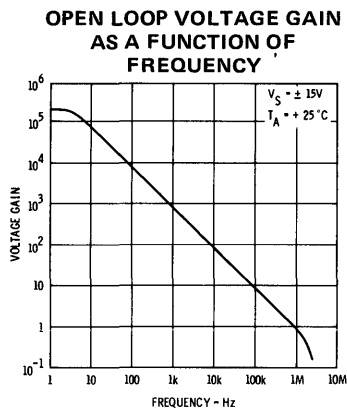
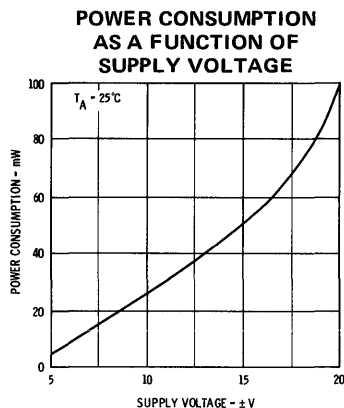
TYPICAL PERFORMANCE CURVES FOR 741



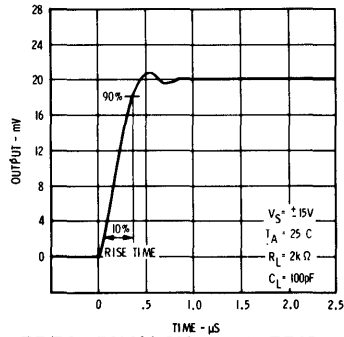
TYPICAL PERFORMANCE CURVES FOR 741C



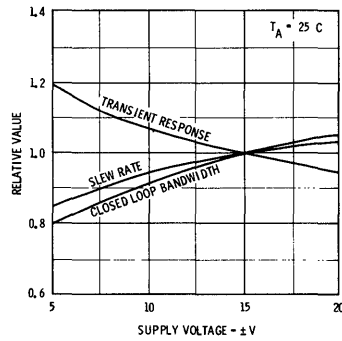
TYPICAL PERFORMANCE CURVES FOR 741 AND 741C (Cont'd)



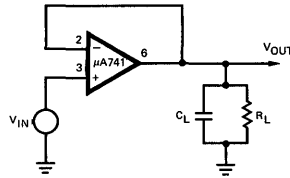
TRANSIENT RESPONSE



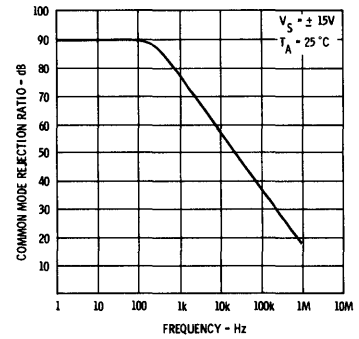
FREQUENCY CHARACTERISTICS AS A FUNCTION OF SUPPLY VOLTAGE



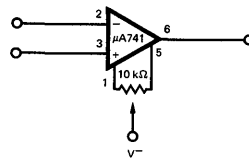
TRANSIENT RESPONSE TEST CIRCUIT



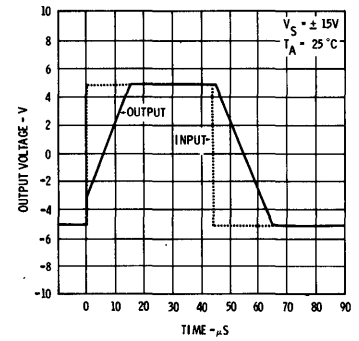
COMMON MODE REJECTION RATIO AS A FUNCTION OF FREQUENCY



VOLTAGE OFFSET NULL CIRCUIT

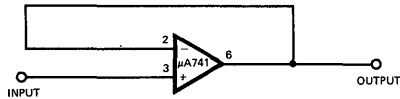


VOLTAGE FOLLOWER LARGE-SIGNAL PULSE RESPONSE



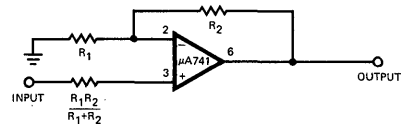
TYPICAL APPLICATIONS

UNITY-GAIN VOLTAGE FOLLOWER



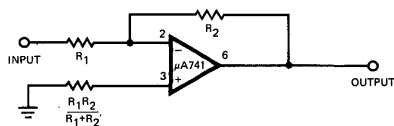
$R_{IN} = 400 \text{ M}\Omega$
 $C_{IN} = 1 \text{ pF}$
 $R_{OUT} < 1 \Omega$
 B.W. = 1 MHz

NON-INVERTING AMPLIFIER



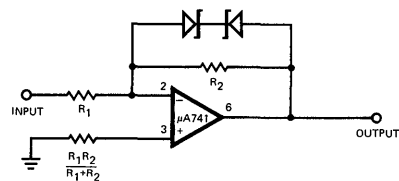
GAIN	R_1	R_2	B.W.	R_{IN}
10	1 k Ω	9 k Ω	100 kHz	400 M Ω
100	100 Ω	9.9 k Ω	10 kHz	280 M Ω
1000	100 Ω	99.9 k Ω	1 kHz	80 M Ω

INVERTING AMPLIFIER



GAIN	R_1	R_2	B.W.	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

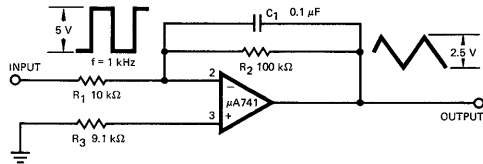


$$\frac{E_{OUT}}{E_{IN}} = \frac{R_2}{R_1} \text{ if } |E_{OUT}| \leq V_Z + 0.7 \text{ V}$$

where V_Z = Zener breakdown voltage

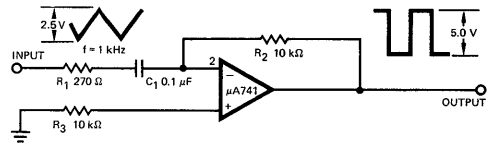
TYPICAL APPLICATIONS (Cont'd)

SIMPLE INTEGRATOR



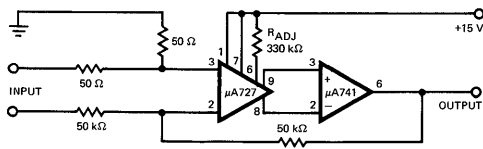
$$E_{OUT} = - \frac{1}{R_1 C_1} \int E_{IN} dt$$

SIMPLE DIFFERENTIATOR



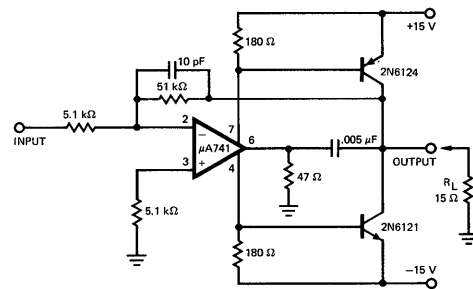
$$E_{OUT} = - R_2 C_1 \frac{dE_{IN}}{dt}$$

LOW DRIFT LOW NOISE AMPLIFIER

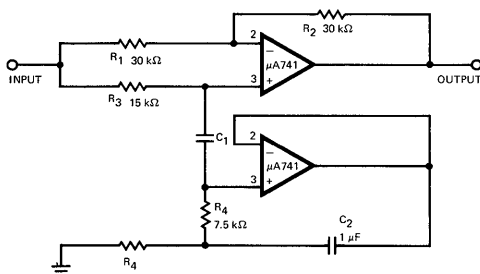


Voltage Gain = 10^3
Input Offset Voltage Drift = $0.6 \mu V/^{\circ}C$
Input Offset Current Drift = $2.0 pA/^{\circ}C$

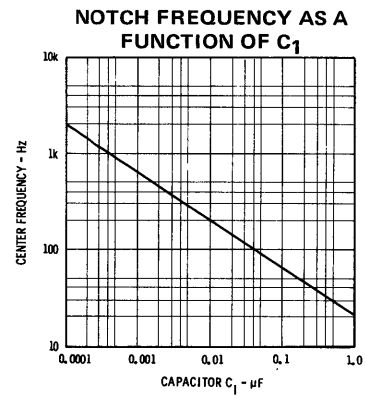
HIGH SLEW RATE POWER AMPLIFIER



NOTCH FILTER USING THE $\mu A741$ AS A GYRATOR



Trim R_3 such that
 $\frac{R_1}{R_2} = \frac{R_3}{2 R_4}$



μA741A • μA741E

FREQUENCY COMPENSATED OPERATIONAL AMPLIFIER

FAIRCHILD LINEAR INTEGRATED CIRCUITS

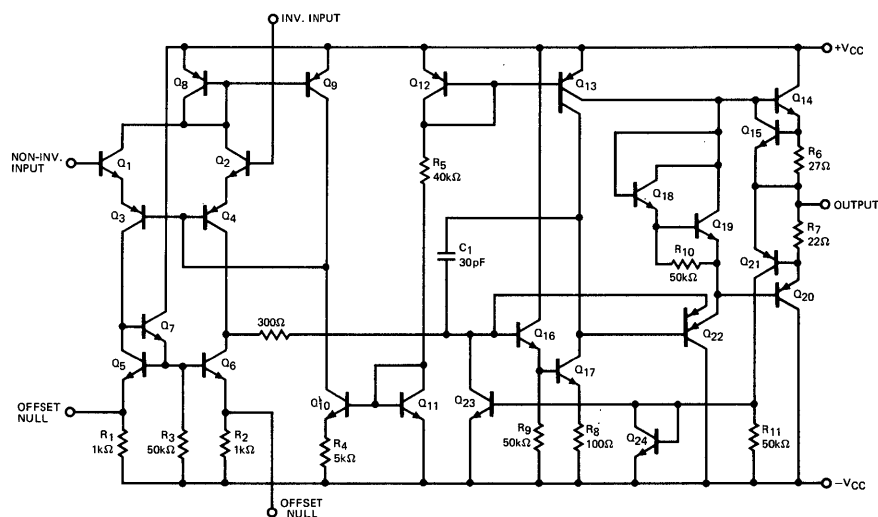
GENERAL DESCRIPTION — The μA741A and E are high performance monolithic Operational Amplifiers constructed using the Fairchild Planar* epitaxial process. They are intended for a wide range of analog applications. High common mode voltage range and absence of "latch-up" tendencies make the μA741A and E ideal for use as voltage followers. The high gain and wide range of operating voltage provides superior performance in integrator, summing amplifier, and general feed-back applications. Electrical characteristics 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	±22V
Internal Power Dissipation (Note 1)	
Metal Can	500mW
DIP	670mW
Flatpak	570mW
Differential Input Voltage	±30V
Input Voltage (Note 2)	±15V
Storage Temperature Range	−65°C to +150°C
Operating Temperature Range	
Military (741A)	−55°C to +125°C
Commercial (741E)	0°C to +70°C
Lead Temperature (Soldering, 60 seconds)	300°C
Output Short Circuit Duration (Note 3)	Indefinite

EQUIVALENT CIRCUIT

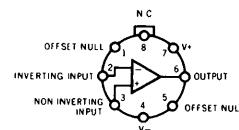


Notes on following pages.

CONNECTION DIAGRAMS

8-LEAD METAL CAN (TOP VIEW)

PACKAGE OUTLINE 5B

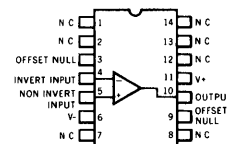


ORDER INFORMATION

TYPE	PART NO.
741A	741AHM
741EC	741EHC

14-LEAD DIP (TOP VIEW)

PACKAGE OUTLINE 6A

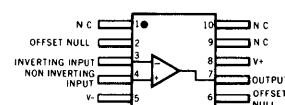


ORDER INFORMATION

TYPE	PART NO.
741A	741ADM
741EC	741EDC

10-LEAD FLATPAK (TOP VIEW)

PACKAGE OUTLINE 3F



ORDER INFORMATION

TYPE	PART NO.
741A	741AFM

*Planar is a patented Fairchild process.

741A

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		$R_S \leq 50\Omega$		0.8	3.0	mV
Average Input Offset Voltage Drift					15	$\mu\text{V}/^\circ\text{C}$
Input Offset Current				3.0	30	nA
Average Input Offset Current Drift					0.5	$\text{nA}/^\circ\text{C}$
Input Bias Current				30	80	nA
Power Supply Rejection Ratio		$V_S = +10, -20; V_S = +20, -10\text{V}, R_S = 50\Omega$		15	50	$\mu\text{V}/\text{V}$
Output Short Circuit Current			10	25	35	mA
Power Dissipation		$V_S = \pm 20\text{V}$		80	150	mW
Input Impedance		$V_S = \pm 20\text{V}$	1.0	6.0		$\text{M}\Omega$
Large Signal Voltage Gain		$V_S = \pm 20\text{V}, R_L = 2\text{k}\Omega, V_{\text{OUT}} = \pm 15\text{V}$	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)		$V_{\text{IN}} = \pm 10\text{V}$	0.3	0.7		$\text{V}/\mu\text{s}$
The following specifications apply for $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$						
Input Offset Voltage					4.0	mV
Input Offset Current					70	nA
Input Bias Current					210	nA
Common Mode Rejection Ratio		$V_S = \pm 20\text{V}, V_{\text{IN}} = \pm 15\text{V}, R_S = 50\Omega$	80	95		dB
Adjustment For Input Offset Voltage		$V_S = \pm 20\text{V}$	10			mV
Output Short Circuit Current			10		40	mA
Power Dissipation	$V_S = \pm 20\text{V}$	-55°C			165	mW
		$+125^\circ\text{C}$			135	mW
Input Impedance		$V_S = \pm 20\text{V}$	0.5			$\text{M}\Omega$
Output Voltage Swing	$V_S = \pm 20\text{V},$	$R_L = 10\text{k}\Omega$	± 16			V
		$R_L = 2\text{k}\Omega$	± 15			V
Large Signal Voltage Gain	$V_S = \pm 20\text{V}, R_L = 2\text{k}\Omega, V_{\text{OUT}} = \pm 15\text{V}$		32			V/mV
	$V_S = \pm 5\text{V}, R_L = 2\text{k}\Omega, V_{\text{OUT}} = \pm 2\text{ V}$		10			V/mV

NOTES

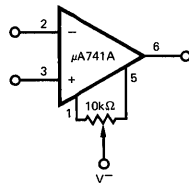
- Rating applies to ambient temperatures up to $70^\circ C$. Above $70^\circ C$ ambient derate linearly at $6.3mW/^\circ C$ for the Metal Can, $8.3mW/^\circ C$ for the DIP and $7.1mW/^\circ C$ for the Flatpak.
- For supply voltages less than $\pm 15V$, the absolute maximum input voltage is equal to the 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: $BW(MHz) = \frac{0.35}{\text{Rise Time } (\mu s)}$

741E

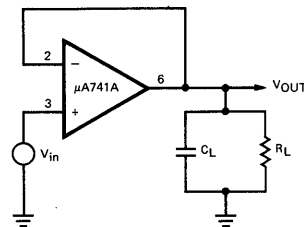
ELECTRICAL CHARACTERISTICS ($V_S = \pm 15V$, $T_A = 25^\circ C$ unless otherwise specified)

PARAMETERS (see definitions)	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Input Offset Voltage	$R_S \leq 50\Omega$		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 $0^\circ C \leq T_A \leq 70^\circ C$					
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	$V_S = \pm 20V, R_L = 10k\Omega$	± 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

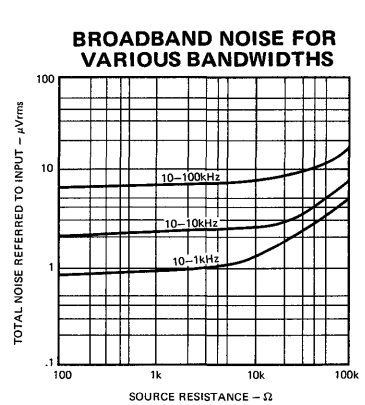
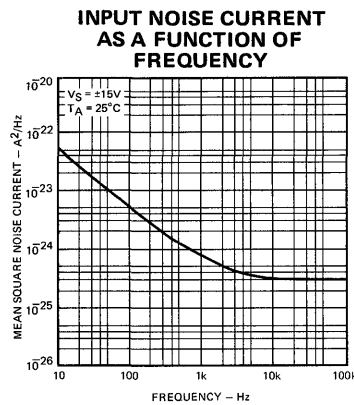
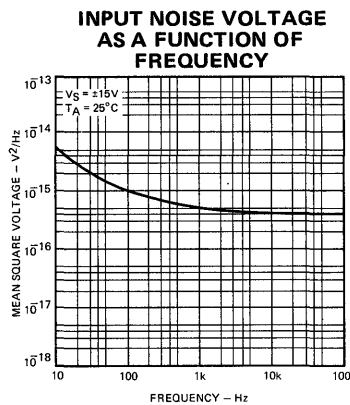
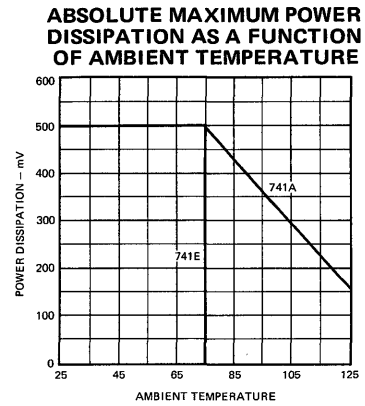
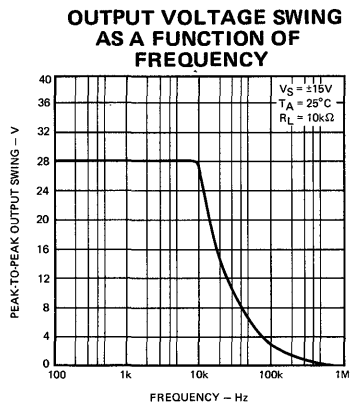
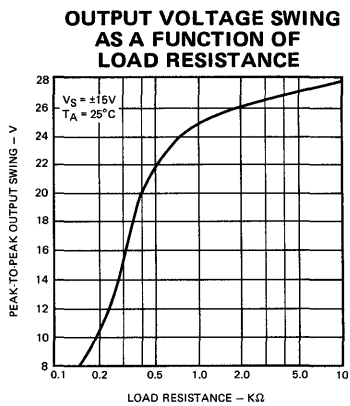
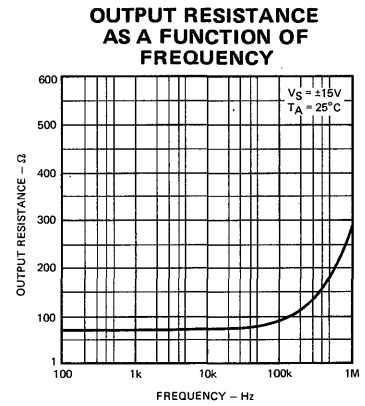
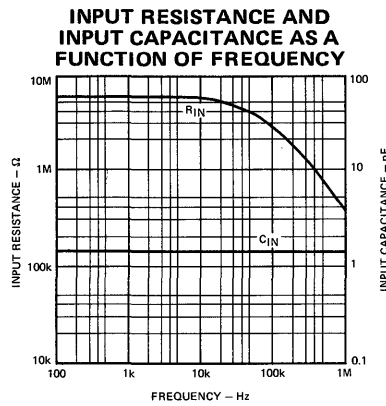
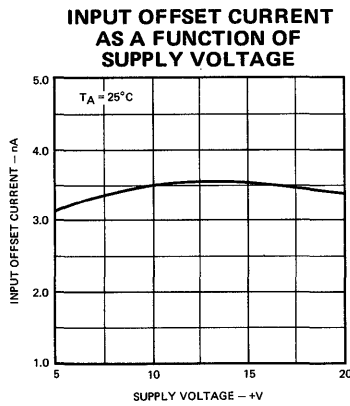
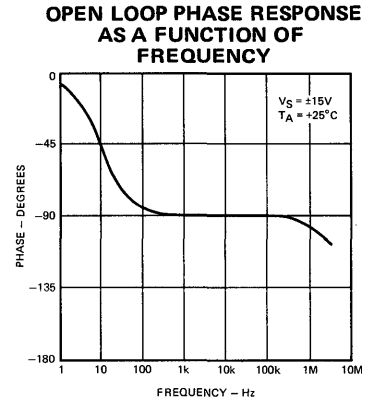
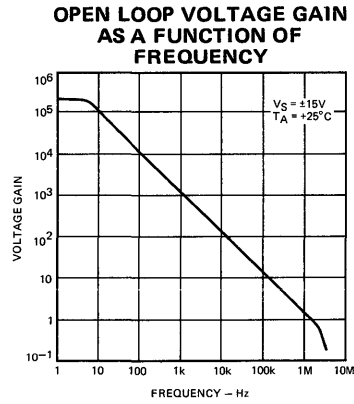
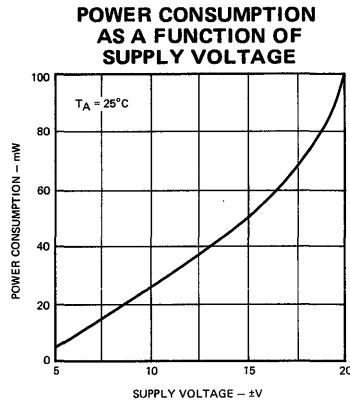
**VOLTAGE OFFSET
NULL CIRCUIT**



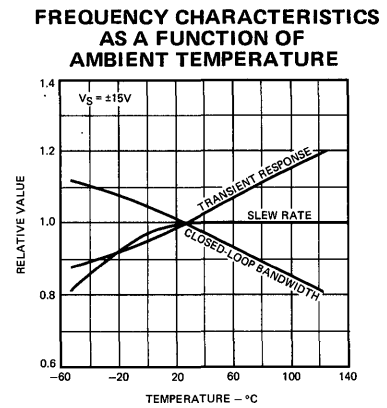
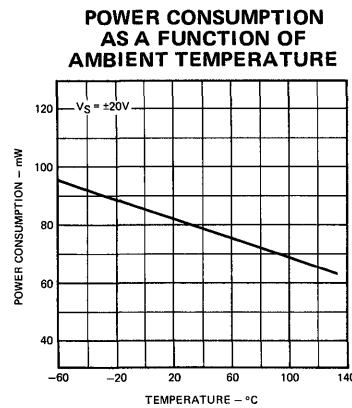
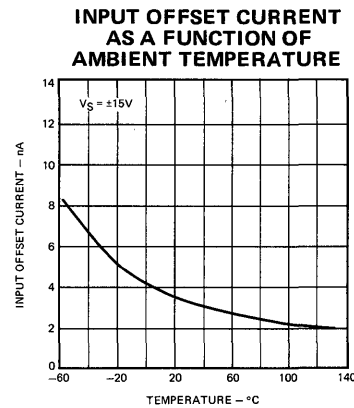
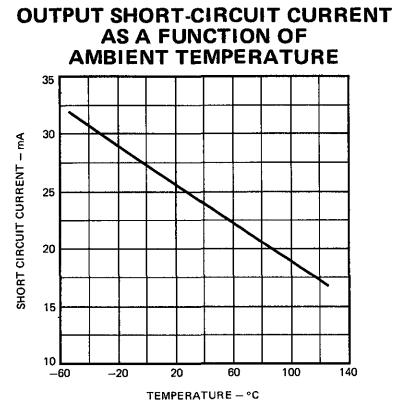
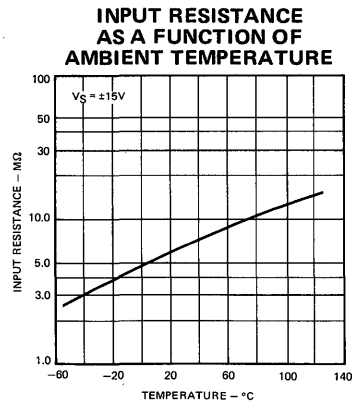
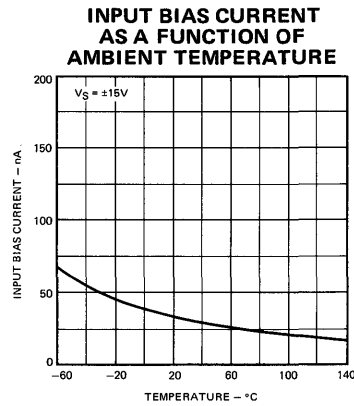
**TRANSIENT RESPONSE
TEST CIRCUIT**



TYPICAL PERFORMANCE CURVES FOR 741A AND 741E



TYPICAL PERFORMANCE CURVES FOR 741A



TYPICAL PERFORMANCE CURVES FOR 741E

