µA702

WIDEBAND DC AMPLIFIER

FAIRCHILD LINEAR INTEGRATED CIRCUITS

GENERAL DESCRIPTION – The µA702 is a monolithic DC Amplifier constructed using the Fairchild Planar* epitaxial process. It is intended for use as an operational amplifier in analog computers, as a precision instrumentation amplifier, or in other applications requiring a feedback amplifier useful from dc to 30 MHz.

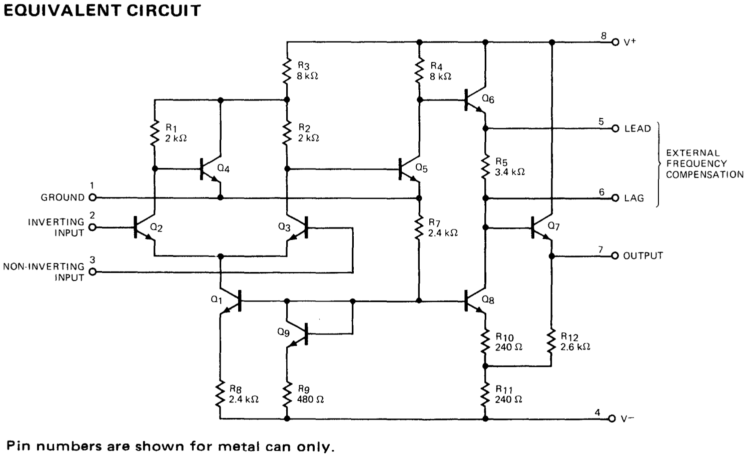
- **LOW OFFSET VOLTAGE**
- **LOW OFFSET VOLTAGE DRIFT**
- **WIDE BANDWIDTH – 20 MHz TYP**
- **HIGH SLEW RATE – 5 V/µs TYP**

ABSOLUTE MAXIMUM RATINGS

Voltage Between V+ and V– Terminals	21 V
Peak Output Current	50 mA
Differential Input Voltage	±5.0 V
Input Voltage	+1.5 V to –6.0 V
Internal Power Dissipation (Note)	
Metal Can	500 mW
DIP	670 mW
Flatpak	570 mW
Operating Temperature Range	
Military (µA702)	–55°C to +125°C
Commercial (µA702C)	0°C to +70°C
Storage Temperature Range	–65°C to +150°C
Pin Temperature (Soldering, 60 s)	300°C

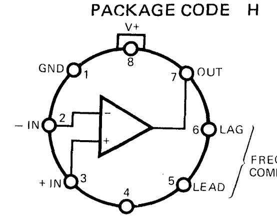
NOTE
Rating applies to ambient temperature up to 70°C. Above 70°C ambient derate linearly at 6.3mW/°C for Metal Can, 8.3mW/°C for DIP and 7.1 mW/°C for the Flatpak.

EQUIVALENT CIRCUIT



Pin numbers are shown for metal can only.

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

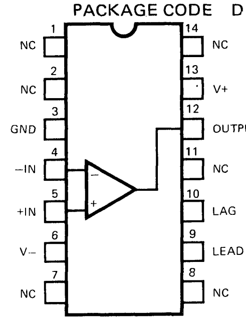


NOTE: Pin 4 connected to case.

ORDER INFORMATION

TYPE	PART NO.
µA702	µA702HM
µA702C	µA702HC

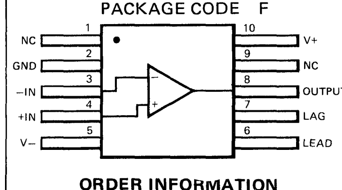
14-PIN DIP
(TOP VIEW)
PACKAGE OUTLINE 6A
PACKAGE CODE D



ORDER INFORMATION

TYPE	PART NO.
µA702	µA702DM
µA702C	µA702DC

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



ORDER INFORMATION

TYPE	PART NO.
µA702	µA702FM

*Planar is a patented Fairchild process.

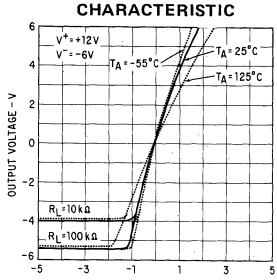
μA702

ELECTRICAL CHARACTERISTICS: T_A = 25°C unless otherwise specified.

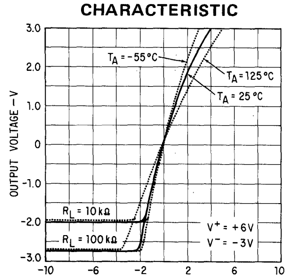
CHARACTERISTICS	CONDITIONS	V+ = 12.0V, V− = −6.0V MIN	TYP	MAX	V+ = 6.0V, V− = −3.0V MIN	TYP	MAX	UNITS
Input Offset Voltage	$R_S \leqslant 2$ kΩ		0.5	2.0		0.7	3.0	mV
Input Offset Current			180	500		120	500	nA
Input Bias Current			2.0	5.0		1.2	3.5	μA
Input Resistance		16	40		22	67		kΩ
Input Voltage Range		−4.0		+0.5	−1.5		+0.5	V
Common Mode Rejection Ratio	$R_S \leqslant 2$ kΩ, f ⩽ 1 kHz	80	100		80	100		dB
Large Signal Voltage Gain	$R_L \geqslant 100$ kΩ, V_{OUT} = ±5.0 V	2500	3600	6000				
	$R_L \geqslant 100$ kΩ, V_{OUT} = ±2.5 V				600	900	1500	
Output Resistance			200	500		300	700	Ω
Supply Current	V_{OUT} = 0		5.0	6.7		2.1	3.3	mA
Power Consumption	V_{OUT} = 0		90	120		19	30	mW
Transient Response (unity-gain) Rise Time	CI = 0.01 μF, RI = 20 Ω, $R_L \geqslant 100$ kΩ, V_{IN} = 10 mV		25	120				ns
Transient Response (unity-gain) Overshoot	$C_L \leqslant 100$ pF		10	50				%
Transient Response (x100 gain) Rise Time	C3 = 50 pF, $R_L \geqslant 100$ kΩ,		10	30				ns
Transient Response (x100 gain) Overshoot	V_{IN} = 1 mV		20	40				%
The following specifications apply for −55°C ⩽ T_A ⩽ +125°C:								
Input Offset Voltage	$R_S \leqslant 2$ kΩ			3.0			4.0	mV
Average Temperature Coefficient of Input Offset Voltage	R_S = 50 Ω, T_A = 25°C to +125°C		2.5	10		3.5	15	μV/°C
	R_S = 50 Ω, T_A = 25°C to −55°C		2.0	10		3.0	15	μV/°C
Input Offset Current	T_A = +125°C		80	500		50	500	nA
	T_A = −55°C		400	1500		280	1500	nA
Average Temperature Coefficient of Input Offset Current	T_A = 25°C to +125°C		1.0	5.0		0.7	4.0	nA/°C
	T_A = 25°C to −55°C		3.0	16		2.0	13	nA/°C
Input Bias Current	T_A = −55°C		4.3	10		2.6	7.5	μA
Input Resistance		6.0			8.0			kΩ
Common Mode Rejection Ratio	$R_S \leqslant 2$ kΩ, f ⩽ 1 kHz	70	95		70	95		dB
Supply Voltage Rejection Ratio	V+ = 12 V, V− = −6.0 V to V+ = 6.0 V, V− = −3.0 V $R_S \leqslant 2$ kΩ		75	200		75	200	μV/V
Large Signal Voltage Gain	$R_L \geqslant 100$ kΩ, V_{OUT} = ±5.0 V	2000		7000				
	$R_L \geqslant 100$ kΩ, V_{OUT} = ±2.5 V				500		1750	
Output Voltage Swing	$R_L \geqslant 100$ kΩ	±5.0	±5.3		±2.5	±2.7		V
	$R_L \geqslant 10$ kΩ	±3.5	±4.0		±1.5	±2.0		V
Supply Current	T_A = +125°C, V_{OUT} = 0		4.4	6.7		1.7	3.3	mA
	T_A = −55°C, V_{OUT} = 0		5.0	7.5		2.1	3.9	mA
Power Consumption	T_A = +125°C, V_{OUT} = 0		80	120		15	30	mW
	T_A = −55°C, V_{OUT} = 0		90	135		19	35	mW

TYPICAL PERFORMANCE CURVE FOR μA702

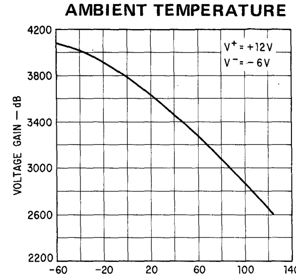
VOLTAGE TRANSFER CHARACTERISTIC



VOLTAGE TRANSFER CHARACTERISTIC



VOLTAGE GAIN AS A FUNCTION OF AMBIENT TEMPERATURE



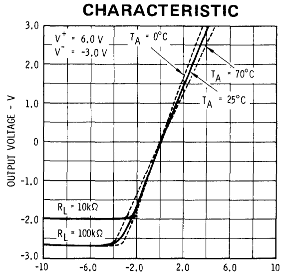
μA702C

ELECTRICAL CHARACTERISTICS: T_A = 25°C unless otherwise specified.

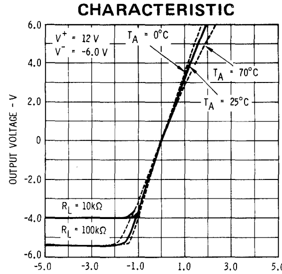
CHARACTERISTICS	CONDITIONS	V+ = 12.0 V, V– = –6.0 V MIN	TYP	MAX	V+ = 6.0 V, V– = –3.0 V MIN	TYP	MAX	UNITS
Input Offset Voltage	$R_S \leqslant 2\,k\Omega$		1.5	5.0		1.7	6.0	mV
Input Offset Current			0.5	2.0		0.3	2.0	μA
Input Bias Current			2.5	7.5		1.5	5.0	μA
Input Resistance		10	32		16	55		kΩ
Input Voltage Range		–4.0		+0.5	–1.5		+0.5	V
Common Mode Rejection Ratio	$R_S \leqslant 2\,k\Omega$, f ⩽ 1 kHz	70	92		70	92		dB
Large Signal Voltage Gain	$R_L \geqslant 100\,k\Omega$, V_{OUT} = ±5.0 V	2000	3400	6000				
	$R_L \geqslant 100\,k\Omega$, V_{OUT} = ±2.5 V				500	800	1500	
Output Resistance			200	600		300	800	Ω
Supply Current	V_{OUT} = 0		5.0	6.7		2.1	3.3	mA
Power Consumption	V_{OUT} = 0		90	120		19	30	mW
Transient Response (unity gain) Rise Time	C1 = 0.01 μF, R_I = 20 Ω, $R_L \leqslant 100\,k\Omega$, V_{IN} = 10 mV		25	120				ns
Transient Response (unity gain) Overshoot	$C_L \leqslant 100$ pF		10	50				%
Transient Response (x100 gain) Rise Time	C3 = 50 pF, $R_L \geqslant 100\,k\Omega$,		10	30				ns
Transient Response (x100 gain) Overshoot	V_{IN} = 1 mV		20	40				%
The following specifications apply for 0°C ⩽ T_A ⩽ +70°C:								
Input Offset Voltage	$R_S \leqslant 2\,k\Omega$			6.5			7.5	mV
Average Temperature Coefficient of Input Offset Voltage	R_S = 50 Ω, T_A = +70°C to 0°C		5.0	20		7.5	25	μV/°C
Input Offset Current				2.5			2.5	μA
Average Temperature Coefficient of Input Offset Current	T_A = 25°C to +70°C		4.0	10		3.0	8.0	nA/°C
	T_A = 25°C to 0°C		6.0	20		5.5	18	nA/°C
Input Bias Current	T_A = 0°C		4.0	12		2.7	8	μA
Input Resistance		6.0	18		9.0	27		kΩ
Common Mode Rejection Ratio	$R_S \leqslant 2\,k\Omega$, f ⩽ 1 kHz	65	86		65	86		dB
Supply Voltage Rejection Ratio	V+ = 12 V, V– = –6.0 V to V+ = 6.0 V, V– = –3.0 V, $R_S \leqslant 2\,k\Omega$		90	300		90	300	μV/V
Large Signal Voltage Gain	$R_L \geqslant 100\,k\Omega$, V_{OUT} = ±5.0 V	1500		7000				
	$R_L \geqslant 100\,k\Omega$, V_{OUT} = ±2.5 V				400		1750	
Output Voltage Swing	$R_L \geqslant 100\,k\Omega$	±5.0	±5.3		±2.5	±2.7		V
	$R_L \geqslant 10\,k\Omega$	±3.5	±4.0		±1.5	±2.0		V
Supply Current	V_{OUT} = 0		5.0	7.0		2.1	3.9	mA
Power Consumption	V_{OUT} = 0		90	125		19	35	mW

TYPICAL PERFORMANCE CURVES FOR μA702C

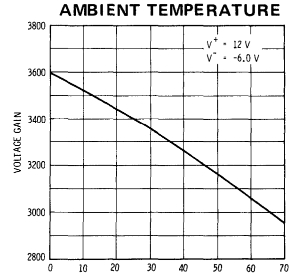
VOLTAGE TRANSFER CHARACTERISTIC



VOLTAGE TRANSFER CHARACTERISTIC

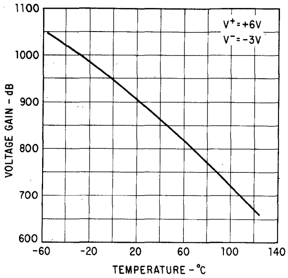


VOLTAGE GAIN AS A FUNCTION OF AMBIENT TEMPERATURE

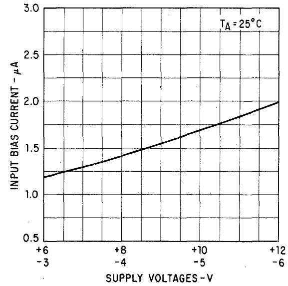


TYPICAL PERFORMANCE CURVES FOR μA702

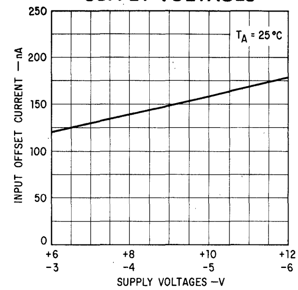
VOLTAGE GAIN AS A FUNCTION OF AMBIENT TEMPERATURE



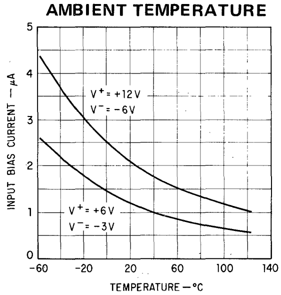
INPUT BIAS CURRENT AS A FUNCTION OF SUPPLY VOLTAGES



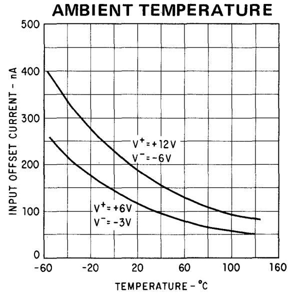
INPUT OFFSET CURRENT AS A FUNCTION OF SUPPLY VOLTAGES



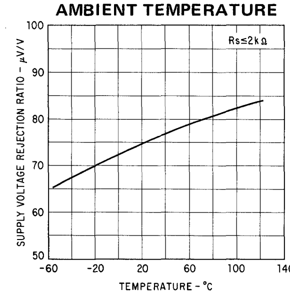
INPUT BIAS CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



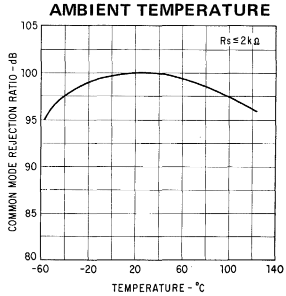
INPUT OFFSET CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



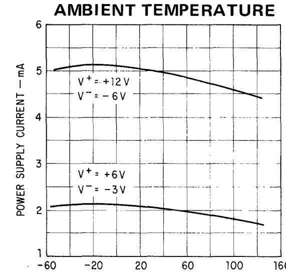
SUPPLY VOLTAGE REJECTION RATIO AS A FUNCTION OF AMBIENT TEMPERATURE



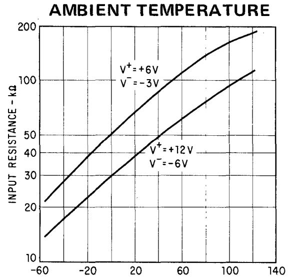
COMMON MODE REJECTION RATIO AS A FUNCTION OF AMBIENT TEMPERATURE



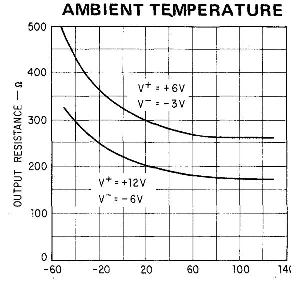
POWER SUPPLY CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



INPUT RESISTANCE AS A FUNCTION OF AMBIENT TEMPERATURE

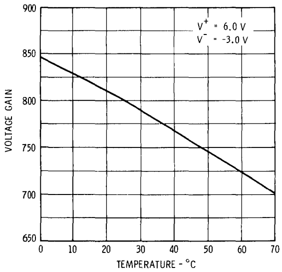


OUTPUT RESISTANCE AS A FUNCTION OF AMBIENT TEMPERATURE

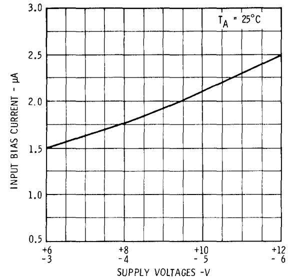


TYPICAL PERFORMANCE CURVES FOR μA702C

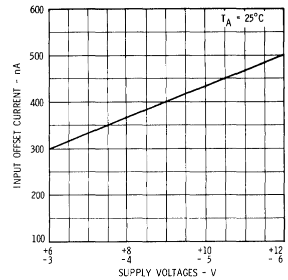
VOLTAGE GAIN AS A FUNCTION OF AMBIENT TEMPERATURE



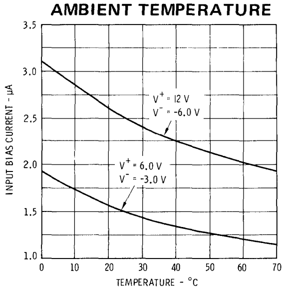
INPUT BIAS CURRENT AS A FUNCTION OF SUPPLY VOLTAGES



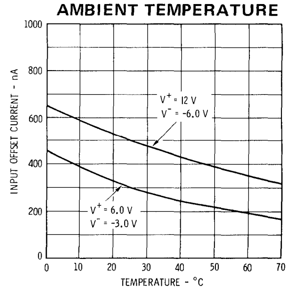
INPUT OFFSET CURRENT AS A FUNCTION OF SUPPLY VOLTAGES



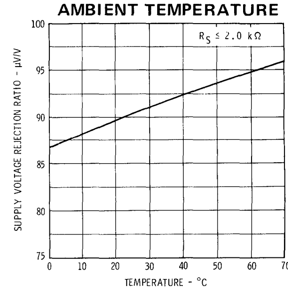
INPUT BIAS CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



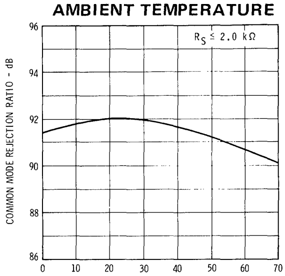
INPUT OFFSET CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



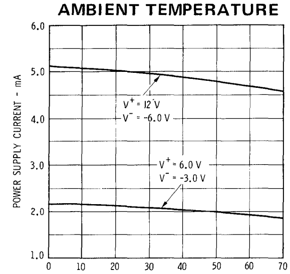
SUPPLY VOLTAGE REJECTION RATIO AS A FUNCTION OF AMBIENT TEMPERATURE



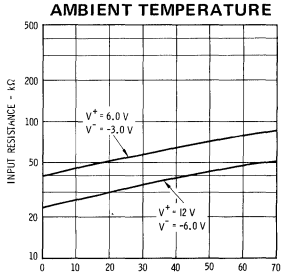
COMMON MODE REJECTION RATIO AS A FUNCTION OF AMBIENT TEMPERATURE



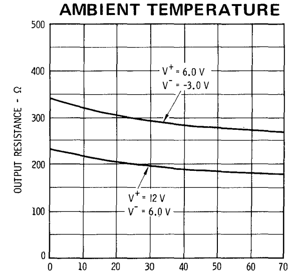
POWER SUPPLY CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



INPUT RESISTANCE AS A FUNCTION OF AMBIENT TEMPERATURE

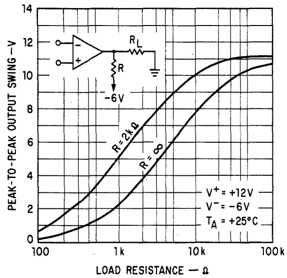


OUTPUT RESISTANCE AS A FUNCTION OF AMBIENT TEMPERATURE

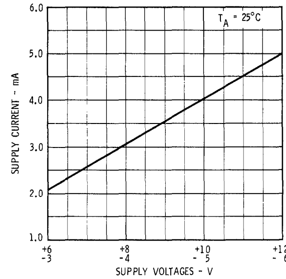


TYPICAL PERFORMANCE CURVES FOR μA702 AND μA702C

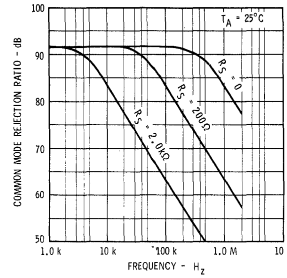
OUTPUT VOLTAGE SWING AS A FUNCTION OF LOAD RESISTANCE



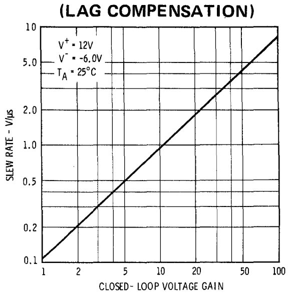
SUPPLY CURRENT AS A FUNCTION OF SUPPLY VOLTAGES



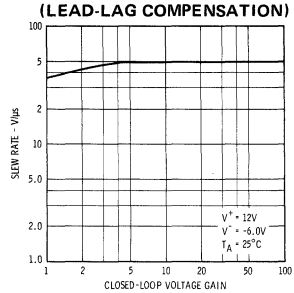
COMMON MODE REJECTION RATIO AS A FUNCTION OF FREQUENCY



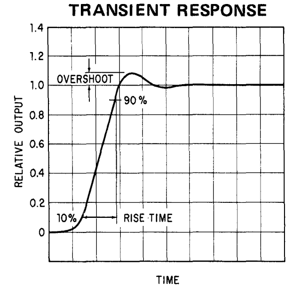
SLEW RATE AS A FUNCTION OF CLOSED LOOP VOLTAGE GAIN (LAG COMPENSATION)



SLEW RATE AS A FUNCTION OF CLOSED LOOP VOLTAGE GAIN (LEAD-LAG COMPENSATION)

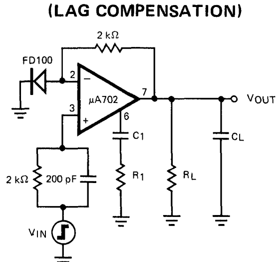


TRANSIENT RESPONSE

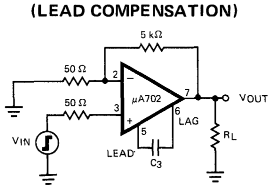


TRANSIENT RESPONSE TEST CIRCUITS

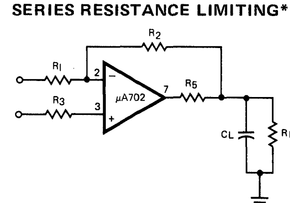
UNITY-GAIN AMPLIFIER (LAG COMPENSATION)



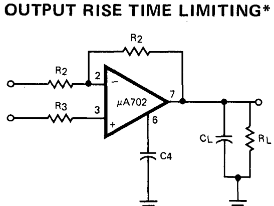
X100 AMPLIFIER (LEAD COMPENSATION)



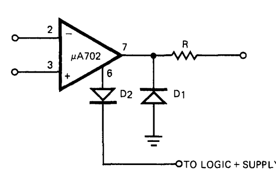
SERIES RESISTANCE LIMITING*



OUTPUT RISE TIME LIMITING*



LOGIC COMPATIBILITY

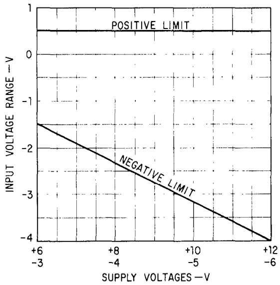


*Peak current limiting with capacitive loads.

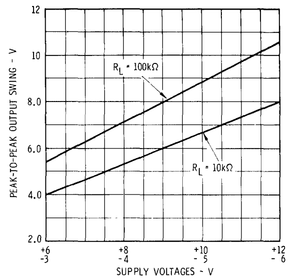
Pin numbers are shown for metal can only.

TYPICAL PERFORMANCE CURVES FOR μA702 AND μA702C

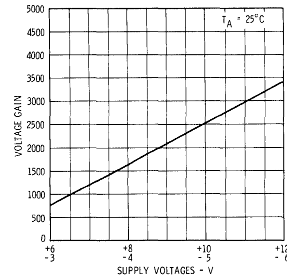
INPUT VOLTAGE RANGE AS A FUNCTION OF SUPPLY VOLTAGES



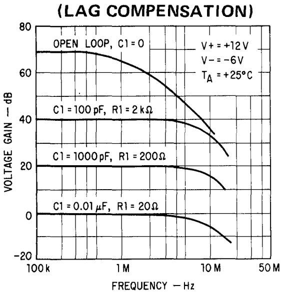
OUTPUT VOLTAGE SWING AS A FUNCTION OF SUPPLY VOLTAGES



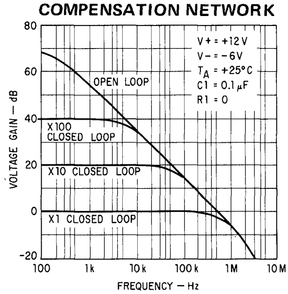
VOLTAGE GAIN AS A FUNCTION OF SUPPLY VOLTAGES



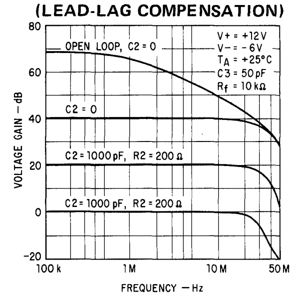
FREQUENCY RESPONSE FOR VARIOUS CLOSED-LOOP GAINS (LAG COMPENSATION)



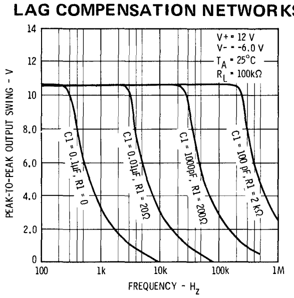
FREQUENCY RESPONSE WITH CONSERVATIVE COMPENSATION NETWORK



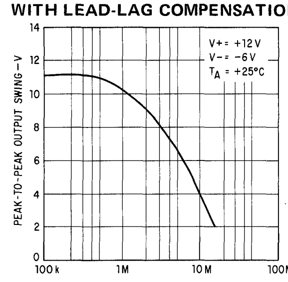
FREQUENCY RESPONSE FOR VARIOUS CLOSED-LOOP GAINS (LEAD-LAG COMPENSATION)



OUTPUT VOLTAGE SWING AS A FUNCTION OF FREQUENCY FOR VARIOUS LAG COMPENSATION NETWORKS

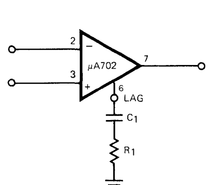


OUTPUT VOLTAGE SWING AS A FUNCTION OF FREQUENCY WITH LEAD-LAG COMPENSATION

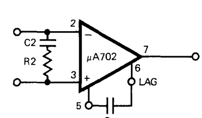


FREQUENCY COMPENSATION CIRCUITS

LAG COMPENSATION



LEAD-LAG COMPENSATION



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