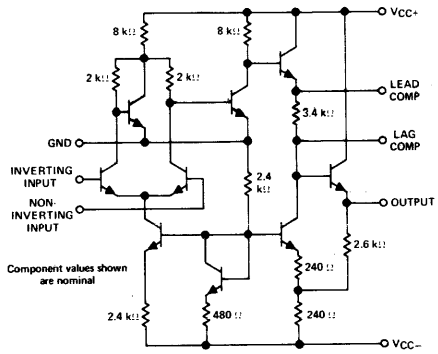
CIRCUIT TYPES SN52702A, SN52702, SN72702 GENERAL-PURPOSE OPERATIONAL AMPLIFIERS

SN52702A features

- Open-Loop Voltage Amplification . . . 3600 Typ
- Designed to be Interchangeable With Fairchild μA702A
- CMRR . . . 100 dB Typ

schematic



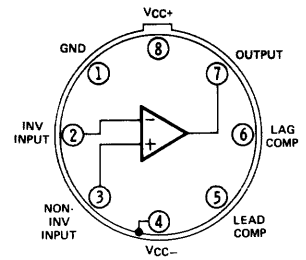
description

The SN52702A, SN52702 and SN72702 circuits are high-gain, wideband operational amplifiers, each having differential inputs and single-ended emitter-follower outputs. Provisions are incorporated within the circuit whereby external components may be used to compensate the amplifier for stable operation under various feedback or load conditions. Component matching, inherent in silicon monolithic circuit-fabrication techniques, produces an amplifier with low-drift and low-offset characteristics. The SN52702A is an improved version of the SN52702. These amplifiers are particularly useful for applications requiring transfer or generation of linear and non-linear functions up to a frequency of 30 MHz.

The SN52702A and SN52702 circuits are characterized for operation over the full military temperature range of −55°C to 125°C. The SN72702 circuit is characterized for operation over the temperature range of 0°C to 70°C.

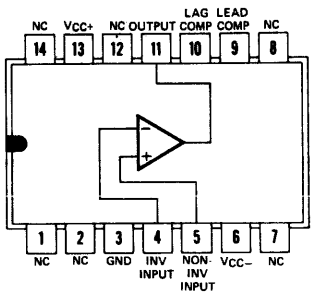
terminal assignments

L PLUG-IN PACKAGE (TOP VIEW)

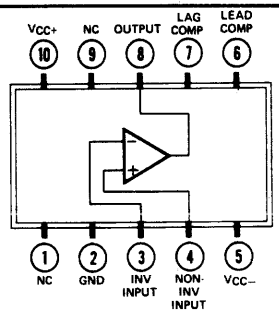


PIN 4 IS IN ELECTRICAL CONTACT WITH THE CASE

N DUAL-IN-LINE PACKAGE (TOP VIEW)



S FLAT PACKAGE (TOP VIEW)



PIN 5 IS IN ELECTRICAL CONTACT WITH THE CASE

NC—No internal connection

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

		SN52702A, SN52702	SN72702	UNIT
Supply voltage V_{CC+} (see Note 1)		14	14	V
Supply voltage V_{CC-} (see Note 1)		−7	−7	V
Differential input voltage (see Note 2)		±5	±5	V
Input voltage (either input, see Notes 1 and 3)		−6 to 1.5	−6 to 1.5	V
Peak output current ($t_w \leq 1$ S)		50	50	mA
Continuous total dissipation at (or below) 70°C free-air temperature (see Note 4)		300	300	mW
Operating free-air temperature range		−55 to 125	0 to 70	°C
Storage temperature range		−65 to 150	−65 to 150	°C
Lead temperature 1/16 inch from case for 60 seconds	L or S Package	300	300	°C
Lead temperature 1/16 inch from case for 10 seconds	N Package	260	260	°C

NOTES: 1. All voltage values, unless otherwise noted, are with respect to the network ground terminal.
2. Differential voltages are at the noninverting input terminal with respect to the inverting input terminal.
3. The magnitude of the input voltage must never exceed the magnitude of the lesser of the two supply voltages.
4. For operation of SN52702A and SN52702 above 70°C free-air temperature, refer to Dissipation Derating Curve, Figure 3.

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SN52702A

electrical characteristics at specified free-air temperature

PARAMETER		TEST CONDITIONS†			SN52702A V_{CC+} = 12 V, V_{CC-} = −6 V MIN	SN52702A V_{CC+} = 12 V, V_{CC-} = −6 V TYP	SN52702A V_{CC+} = 12 V, V_{CC-} = −6 V MAX	SN52702A V_{CC+} = 6 V, V_{CC-} = −3 V MIN	SN52702A V_{CC+} = 6 V, V_{CC-} = −3 V TYP	SN52702A V_{CC+} = 6 V, V_{CC-} = −3 V MAX	UNIT
V_{IO}	Input offset voltage	$R_S \leq 2\ k\Omega$		25°C		0.5	2		0.7	3	mV
				Full range			3			4	
α_{VIO}	Average temperature coefficient of input offset voltage	$R_S = 50\ \Omega$		−55°C to 25°C		2	10		3	15	μV/°C
				25°C to 125°C		2.5	10		3.5	15	
I_{IO}	Input offset current			25°C		0.2	0.5		0.12	0.5	μA
				−55°C		0.4	1.5		0.3	1.5	
				125°C		0.08	0.5		0.05	0.5	
α_{IIO}	Average temperature coefficient of input offset current			−55°C to 25°C		3	16		2	13	nA/°C
				25°C to 125°C		1	5		0.7	4	
I_{IB}	Input bias current			25°C		2	5		1.2	3.5	μA
				−55°C		4.3	10		2.6	7.5	
V_I	Input voltage range	Positive swing		25°C	0.5	1		0.5	1		V
		Negative swing			−4	−5		−1.5	−2		
V_{OPP}	Maximum peak-to-peak output voltage swing	$R_L \geq 100\ k\Omega$		25°C	10	10.6		5	5.4		V
				Full range	10			5			
		$R_L = 10\ k\Omega$		25°C	7	8		3	4		
		$R_L \geq 10\ k\Omega$		Full range	7			3			
A_{VD}	Large-signal differential voltage amplification	$R_L \geq 100\ k\Omega$	$V_O = \pm 5$ V	25°C	2500	3600	6000				
				Full range	2000		7000				
			$V_O = \pm 2.5$ V	25°C				600	900	1500	
				Full range				500		1750	
r_i	Input resistance			25°C	16	40		22	67		kΩ
				Full range	6			8			
r_o	Output resistance	V_O = 0,	See Note 3	25°C		200	500		300	700	Ω
CMRR	Common-mode rejection ratio	$R_S \leq 2\ k\Omega$		25°C	80	100		80	100		dB
				Full range	70			70			
$\Delta V_{IO}/\Delta V_{CC}$	Power supply sensitivity	$R_S \leq 2\ k\Omega$		25°C		75			75		μV/V
				Full range			200			200	
I_{CC}	Supply current	No load,	No signal	25°C		5	6.7		2.1	3.3	mA
				−55°C		5	7.5		2.1	3.9	
				125°C		4.4	6.7		1.7	3.3	
P_D	Total power dissipation	No load,	No signal	25°C		90	120		19	30	mW
				−55°C		90	135		19	35	
				125°C		80	120		15	30	

†All characteristics are specified under open-loop operation. Full range for SN52702A is −55°C to 125°C.

NOTE 3: This typical value applies only at frequencies above a few hundred hertz because of the effects of drift and thermal feedback.

SN52702

electrical characteristics at specified free-air temperature

PARAMETER		TEST CONDITIONS†			SN52702 V_{CC+} = 12 V, V_{CC-} = −6 V			SN52702 V_{CC+} = 6 V, V_{CC-} = −3 V			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	$R_S \leq 2\ k\Omega$		25°C		2	5		2	5	mV
				Full range			6			6	
α_{VIO}	Average temperature coefficient of input offset voltage	$R_S = 50\ \Omega$		−55°C to 25°C		10			10		μV/°C
				25°C to 125°C		5			5		
I_{IO}	Input offset current			25°C		0.5	2		0.3	2	μA
				−55°C		1	3			3	
				125°C		0.2	3			3	
α_{IIO}	Average temperature coefficient of input offset current			−55°C to 25°C		6			5		nA/°C
				25°C to 125°C		3			2		
I_{IB}	Input bias current			25°C		4	10		2.5	7	μA
				−55°C		6.5	20			14	
V_I	Input voltage range	Positive swing		25°C	0.5	1		0.5	1		V
		Negative swing			−4	−5		−1.5	−2		
V_{OPP}	Maximum peak-to-peak output voltage swing	$R_L \geq 100\ k\Omega$			10	10.6		5	5.4		V
		$R_L = 10\ k\Omega$				8			4		
A_{VD}	Large-signal differential voltage amplification	$R_L \geq 100\ k\Omega$	$V_O = \pm 5$ V	25°C	1400	2600					
				Full range	1000						
			$V_O = \pm 2.5$ V	25°C				380	700		
r_i	Input resistance			25°C	8	25		12	40		kΩ
				Full range	3			4			
r_o	Output resistance	$V_O = 0$,	See Note 3	25°C		200	500		300	700	Ω
CMRR	Common-mode rejection ratio	$R_S \leq 2\ k\Omega$		25°C	70	80		70	80		dB
$\Delta V_{IO}/\Delta V_{CC}$	Power supply sensitivity	$R_S \leq 2\ k\Omega$		25°C		60	300		60	300	μV/V
I_{CC}	Supply current	No load,	No signal	25°C		5	6.7		2.1	3.9	mA
P_D	Total power dissipation	No load,	No signal	25°C		90	120		19	35	mW

† All characteristics are specified under open-loop operation. Full range for SN52702 is −55°C to 125°C.

NOTE 3: This typical value applies only at frequencies above a few hundred hertz because of the effects of drift and thermal feedback.

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SN72702

electrical characteristics at specified free-air temperature, V_{CC+} = 12 V, V_{CC-} = −6 V

PARAMETER		TEST CONDITIONS†			SN72702 MIN	SN72702 TYP	SN72702 MAX	UNIT
V_{IO}	Input offset voltage	$R_S \leq 2\ k\Omega$		25°C		5	10	mV
				Full Range			15	
α_{VIO}	Average temperature coefficient of input offset voltage	$R_S = 50\ \Omega$		Full Range		5		μV/°C
I_{IO}	Input offset current			25°C		0.5	5	μA
				Full Range			7.5	
α_{IIO}	Average temperature coefficient of input offset current			0°C to 25°C		5		nA/°C
				25°C to 70°C		3		
I_{IB}	Input bias current			25°C		4	15	μA
				0°C		4.5	20	
V_I	Input voltage range	Positive swing		25°C	0.5	1		V
		Negative swing			−4	−5		
V_{OPP}	Maximum peak-to-peak output voltage swing	$R_L \geq 100\ k\Omega$		25°C	10	10.6		V
A_{VD}	Large-signal differential voltage amplification	$R_L \geq 100\ k\Omega$,	$V_O = \pm 5$ V	25°C	1000	2600		
				Full Range	800			
r_i	Input resistance			25°C	6	25		kΩ
				Full Range	3.5			
r_o	Output resistance	V_O = 0,	See Note 3	25°C		200	600	Ω
CMRR	Common-mode rejection ratio	$R_S \leq 2\ k\Omega$		25°C	65	80		dB
$\Delta V_{IO}/\Delta V_{CC}$	Power supply sensitivity	$R_S \leq 2\ k\Omega$		25°C		60	300	μV/V
I_{CC}	Supply current	No load,	No signal	25°C		5	7	mA
P_D	Total power dissipation	No load,	No signal	25°C		90	125	mW

†All characteristics are specified under open-loop operation. Full range for SN72702 is 0°C to 70°C.
NOTE 3: This typical value applies only at frequencies above a few hundred hertz because of the effects of drift and thermal feedback.

SN52702A, SN52702, SN72702

operating characteristics V_{CC+} = 12 V, V_{CC-} = −6 V, T_A = 25°C

PARAMETER		TEST FIGURE	TEST CONDITIONS		ALL TYPES MIN	ALL TYPES TYP	ALL TYPES MAX	UNIT
t_r	Rise time	1	V_I = 10 mV,	C_L = 0		25	120	ns
		2	V_I = 1 mV			10	30	ns
	Overshoot	1	V_I = 10 mV,	C_L = 100 pF		10%	50%	
		2	V_I = 1 mV			20%	40%	
SR	Slew rate	1	V_I = 6 V,	C_L = 100 pF		1.7		V/μs
		2	V_I = 100 mV			11		

PARAMETER MEASUREMENT INFORMATION

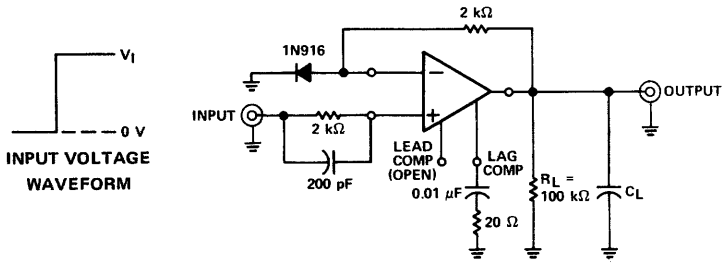

FIGURE 1–UNITY-GAIN AMPLIFIER

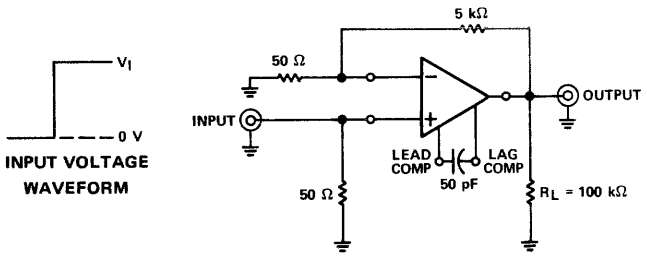

FIGURE 2–GAIN-OF-100 AMPLIFIER

THERMAL INFORMATION

SN52702A, SN52702
DISSIPATION DERATING CURVE

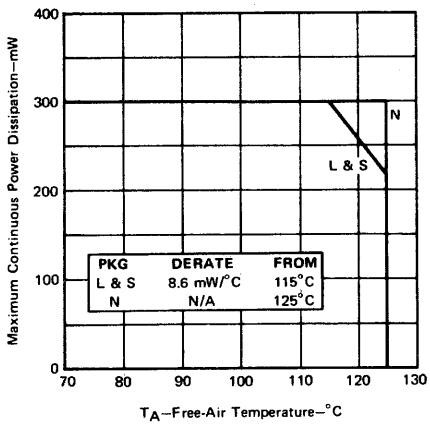

FIGURE 3

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DEFINITION OF TERMS

Input Offset Voltage (V_{IO}) The d-c voltage which must be applied between the input terminals to force the quiescent d-c output voltage to zero. The input offset voltage may also be defined for the case where two equal resistances (R_S) are inserted in series with the input leads.

Average Temperature Coefficient of Input Offset Voltage (α_{VIO}) The ratio of the change in input offset voltage to the change in free-air temperature. This is an average value for the specified temperature range.

$$\alpha_{VIO} = \left| \frac{(V_{IO} @ T_{A(1)}) - (V_{IO} @ T_{A(2)})}{T_{A(1)} - T_{A(2)}} \right| \text{ where } T_{A(1)} \text{ and } T_{A(2)} \text{ are the specified temperature extremes.}$$

Input Offset Current (I_{IO}) The difference between the currents into the two input terminals with the output at zero volts.

Average Temperature Coefficient Of Input Offset Current (α_{IIO}) The ratio of the change in input offset current to the change in free-air temperature. This is an average value for the specified temperature range.

$$\alpha_{IIO} = \left| \frac{(I_{IO} @ T_{A(1)}) - (I_{IO} @ T_{A(2)})}{T_{A(1)} - T_{A(2)}} \right| \text{ where } T_{A(1)} \text{ and } T_{A(2)} \text{ are the specified temperature extremes.}$$

Input Bias Current (I_{IB}) The average of the currents into the two input terminals with the output at zero volts.

Input Voltage Range (V_I) The range of voltage which if exceeded at either input terminal will cause the amplifier to cease functioning properly.

Maximum Peak-to-Peak Output Voltage Swing (V_{OPP}) The maximum peak-to-peak output voltage which can be obtained without waveform clipping when the quiescent d-c output voltage is zero.

Large-Signal Differential Voltage Amplification (A_{VD}) The ratio of the peak-to-peak output voltage swing to the change in differential input voltage required to drive the output.

Input Resistance (r_i) The resistance between the input terminals with either input grounded.

Output Resistance (r_o) The resistance between the output terminal and ground.

Common-Mode Rejection Ratio (CMRR) The ratio of differential voltage amplification to common-mode voltage amplification. This is measured by determining the ratio of a change in input common-mode voltage to the resulting change in input offset voltage.

Power Supply Sensitivity ($\Delta V_{IO}/\Delta V_{CC}$) The ratio of the change in input offset voltage to the change in supply voltages producing it. For these devices, both supply voltages are varied symmetrically.

Total Power Dissipation (P_D) The total d-c power supplied to the device less any power delivered from the device to a load. At no load: $P_D = V_{CC+} \cdot I_{CC+} + V_{CC-} \cdot I_{CC-}$.

Rise Time (t_r) The time required for an output voltage step to change from 10% to 90% of its final value.

Overshoot The quotient of: (1) the largest deviation of the output signal value from its steady-state value after a step-function change of the input signal, and (2) the difference between the output signal values in the steady state before and after the step-function change of the input signal.

Slew Rate (SR) The average time rate of change of the closed-loop amplifier output voltage for a step-signal input. Slew rate is measured between specified output levels (0 and 10 volts for this device) with feedback adjusted for unity gain.

TYPICAL CHARACTERISTICS

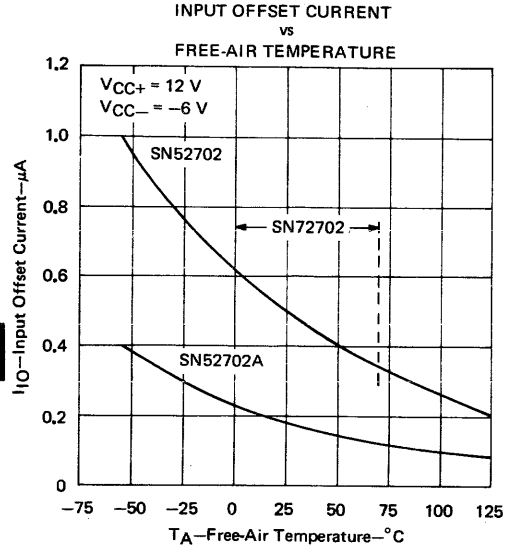


FIGURE 4

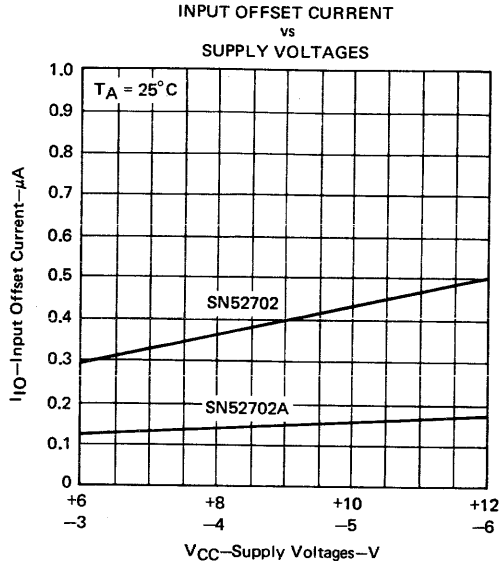


FIGURE 5

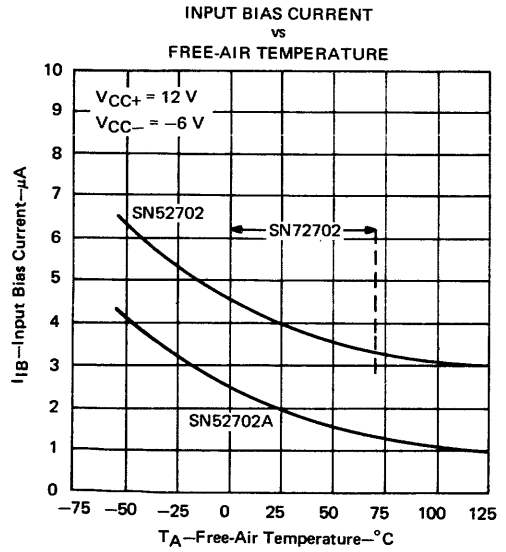


FIGURE 6

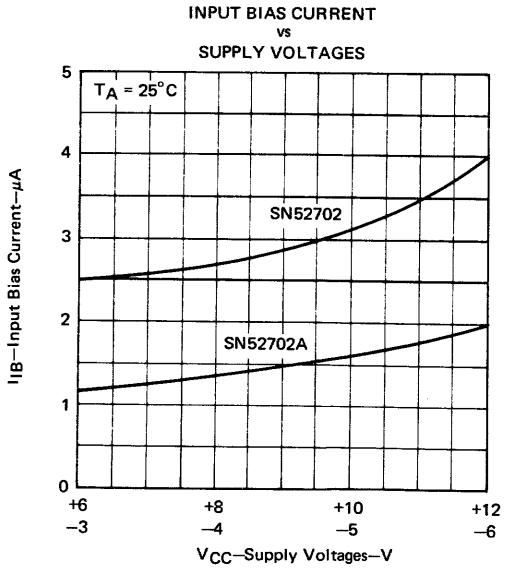


FIGURE 7

TYPICAL CHARACTERISTICS

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE
vs
FREQUENCY
(for various lag compensations)

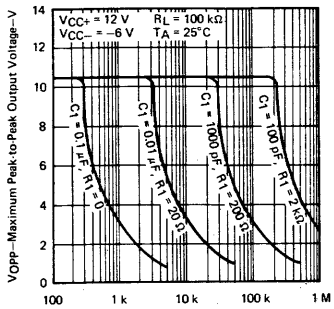
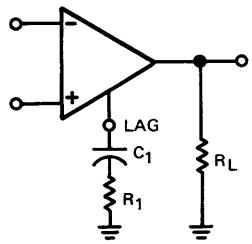


FIGURE 8



LAG COMPENSATION CIRCUIT
FOR FIGURES 8, 9, AND 10

SN52709A
LARGE-SIGNAL DIFFERENTIAL
VOLTAGE AMPLIFICATION
vs
FREQUENCY

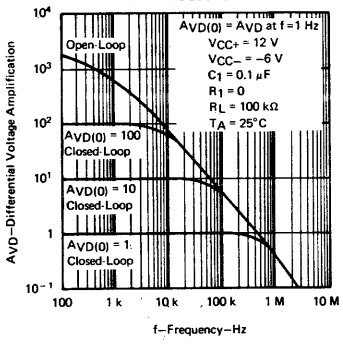


FIGURE 9

SN52702A
LARGE-SIGNAL DIFFERENTIAL
VOLTAGE AMPLIFICATION
vs
FREQUENCY
(for various lag compensations)

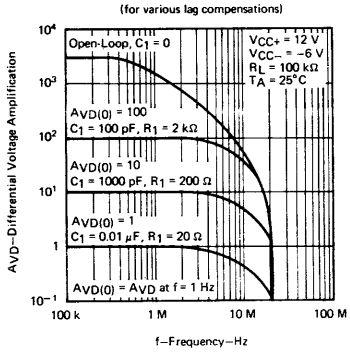


FIGURE 10

SN52702A
LARGE-SIGNAL DIFFERENTIAL
VOLTAGE AMPLIFICATION
vs
FREQUENCY
(for various lag compensations)

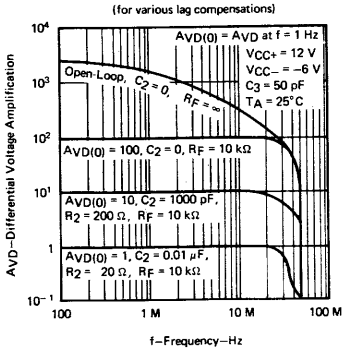
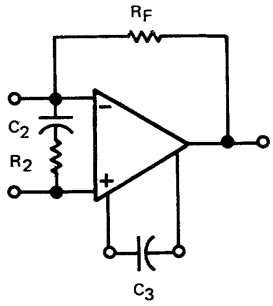


FIGURE 11



LEAD-LAG COMPENSATION CIRCUIT
FOR FIGURE 11

3

TYPICAL CHARACTERISTICS

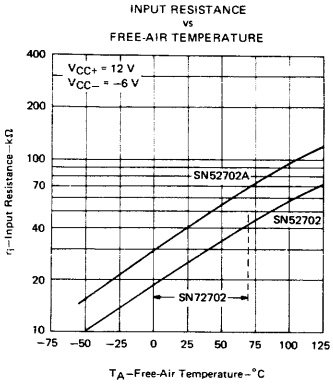


FIGURE 12

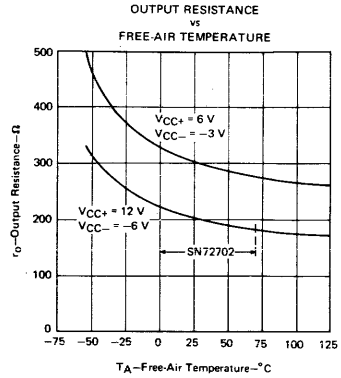


FIGURE 13

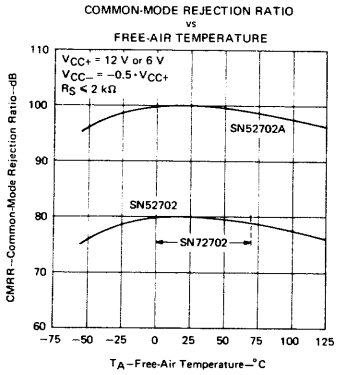


FIGURE 14

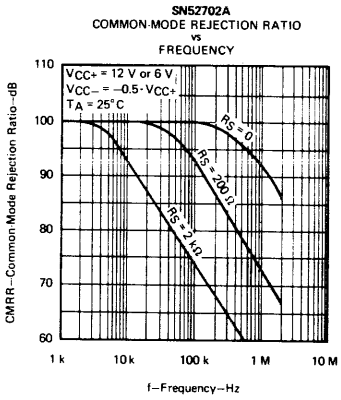


FIGURE 15

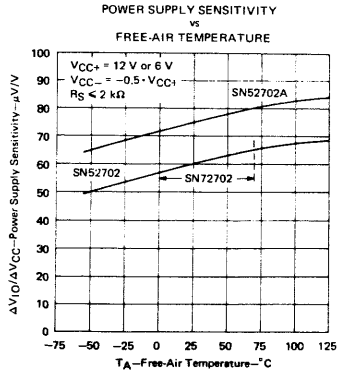


FIGURE 16

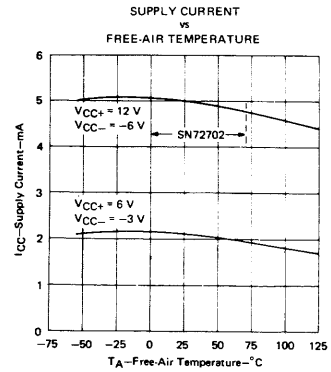


FIGURE 17

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