



# MC12002

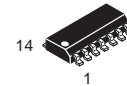
## Analog Mixer

The MC12002 is a double balanced analog mixer, including an input amplifier feeding the mixer carrier port and a temperature compensated bias regulator. The input circuits for both the amplifier and mixer are differential amplifier circuits. The on-chip regulator provides all of the required biasing.

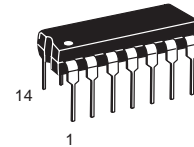
This circuit is designed for use as a balanced mixer in high-frequency wide-band circuits. Other typical applications include suppressed carrier and amplitude modulation, synchronous AM detection, FM detection, phase detection, and frequency doubling, at frequencies up to UHF.

### ANALOG MIXER

#### SEMICONDUCTOR TECHNICAL DATA



**D SUFFIX**  
PLASTIC PACKAGE  
CASE 751A  
(SO-14)

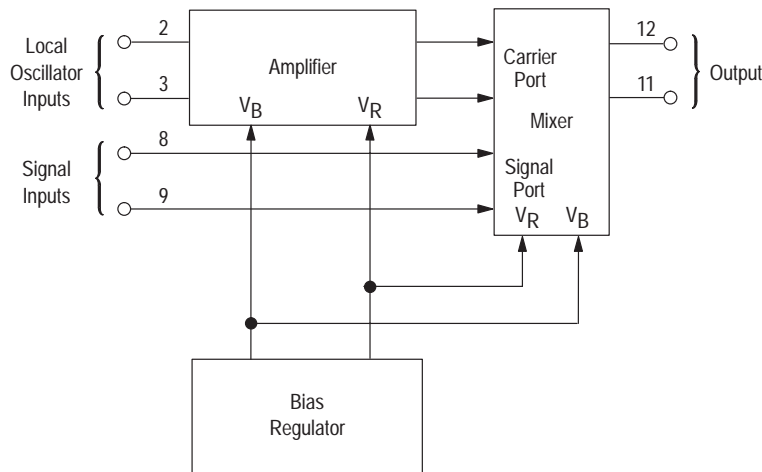


**P SUFFIX**  
PLASTIC PACKAGE  
CASE 646

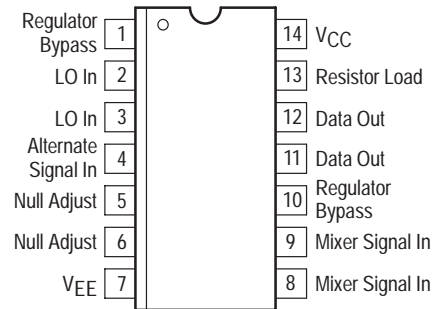
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Figure 1. Logic Diagram



### PIN CONNECTIONS



(Top View)

### ORDERING INFORMATION

Device	Operating Temperature Range	Package
MC12002D	$T_A = -30$ to $85^\circ\text{C}$	SO-14
MC12002P		Plastic DIP

**ELECTRICAL CHARACTERISTICS**

										TEST VOLTAGE VALUES				
										Volts				
										V <sub>IHmax</sub>	V <sub>ILmin</sub>	V <sub>CC</sub>		
										2.9	2.0	5.0		
										VOLTAGE APPLIED TO PINS LISTED BELOW				
Characteristic	Symbol	Pin Under Test	Test Limits						Unit	V <sub>IHmax</sub>	V <sub>ILmin</sub>	V <sub>CC</sub>	Gnd	
			-30°C		25°C		85°C							
			Min	Max	Min	Max	Min	Max						
Power Supply Drain	I <sub>CC</sub>	14	—	—	—	16	—	—	mAdc	—	—	11,12,14	5,6,7	
Input Current	I <sub>inH</sub>	2	—	—	—	0.75	—	—	mAdc	2	—	11,12,14	5,6,7	
		3	—	—	—	0.75	—	—	mAdc	3	—	11,12,14	5,6,7	
		8	—	—	—	0.75	—	—	mAdc	8	—	11,12,14	5,6,7	
		9	—	—	—	0.75	—	—	mAdc	9	—	11,12,14	5,6,7	
	I <sub>inL</sub>	2	—	—	-0.7	—	—	—	mAdc	—	2	11,12,14	5,6,7	
		3	—	—	-0.7	—	—	—	mAdc	—	3	11,12,14	5,6,7	
		8	—	—	-0.7	—	—	—	mAdc	—	8	11,12,14	5,6,7	
		9	—	—	-0.7	—	—	—	mAdc	—	9	11,12,14	5,6,7	
			—	—	-0.7	—	—	—	mAdc	—	9	11,12,14	5,6,7	
Output Current	I <sub>O1</sub>	11	—	—	0.7	1.3	—	—	mAdc	—	—	11,12,14	7	
		12	—	—	0.7	1.3	—	—	mAdc	—	—	11,12,14	7	
	I <sub>O2</sub>	11	—	—	2.1	3.9	—	—	mAdc	—	—	11,12,14	5,6,7	
		12	—	—	2.1	3.9	—	—	mAdc	—	—	11,12,14	5,6,7	
	I <sub>out</sub>	11	—	—	4.2	7.8	—	—	mAdc	2,9	—	11,12,14	5,6,7	
		11	—	—	4.2	7.8	—	—	mAdc	3,8	—	11,12,14	5,6,7	
		12	—	—	4.2	7.8	—	—	mAdc	2,8	—	11,12,14	5,6,7	
		12	—	—	4.2	7.8	—	—	mAdc	3,9	—	11,12,14	5,6,7	
	Differential Current	ΔI <sub>O1</sub>	11,12	-100	100	-100	100	-100	100	μAdc	—	—	11,12,14	7
ΔI <sub>O2</sub>		11,12	-200	200	-200	200	-200	200	μAdc	—	—	11,12,14	5,6,7	
Bias Voltage	V <sub>Bias</sub>	1	2.33	2.53	2.32	2.52	2.3	2.5	Vdc	—	—	11,12,14	5,6,7	
		4	390	590	400	600	410	610	mVdc	—	—	11,12,14	5,6,7	
		5	275	415	285	425	295	435	mVdc	—	—	11,12,14	7	
		6	275	415	285	425	295	435	mVdc	—	—	11,12,14	7	
		10	1.26	1.46	1.185	1.385	1.105	1.305	Vdc	—	—	11,12,14	5,6,7	
AC Gain (See Figure 1) (Frequency = 100 MHz) [Note]	A <sub>v</sub>	11	—	—	5.0	—	—	—	V/V	Pulse In 2	Pulse Out 11	-3.0 V 9	Gnd 14	V <sub>EE</sub> 7
		11	—	—	0.28	—	—	—	V/V	8	11	3	14	7

**NOTE:** AC Gain is a function of collector load impedance.

Figure 2. Analog Mixer Circuit Schematic

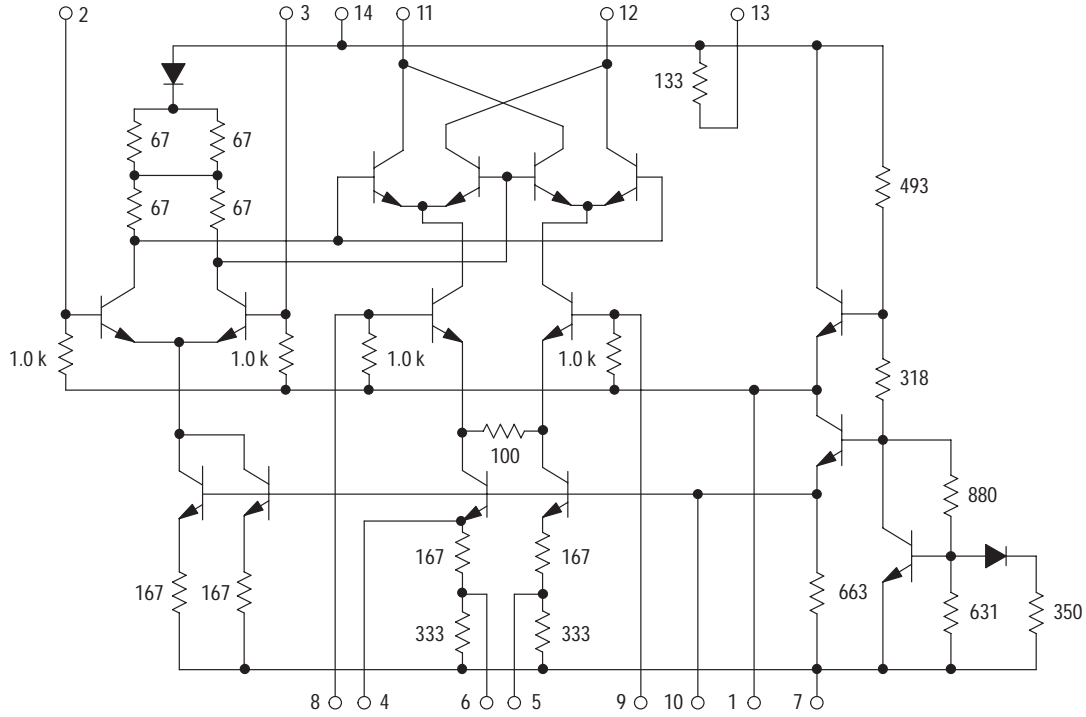
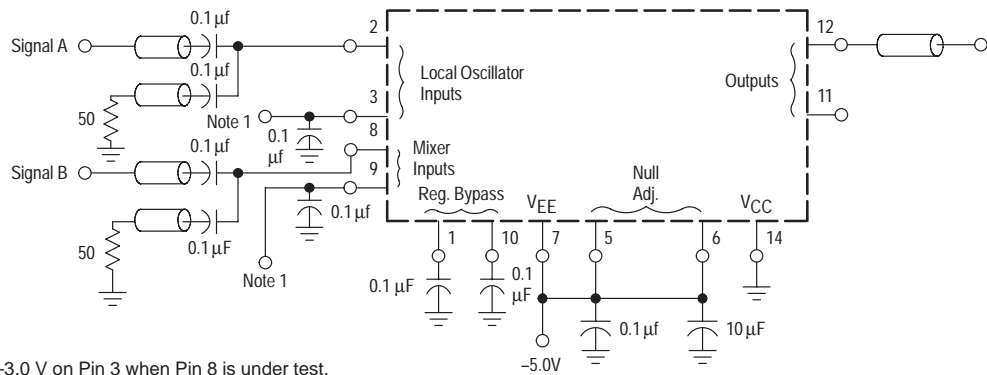


Figure 3. AC Gain Test



Note 1:  $V_{IL} = -3.0\text{ V}$  on Pin 3 when Pin 8 is under test.  
 $V_{IL} = -3.0\text{ V}$  on Pin 9 when Pin 2 is under test.

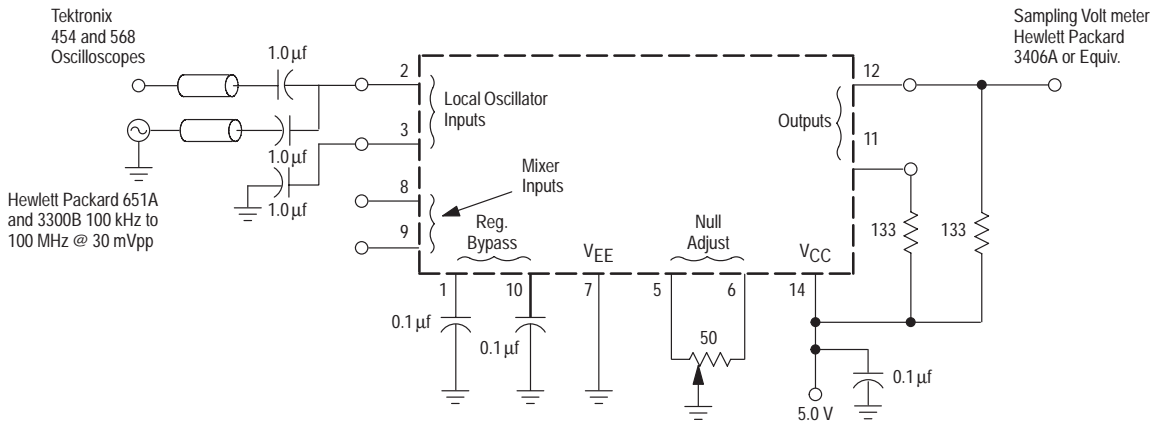
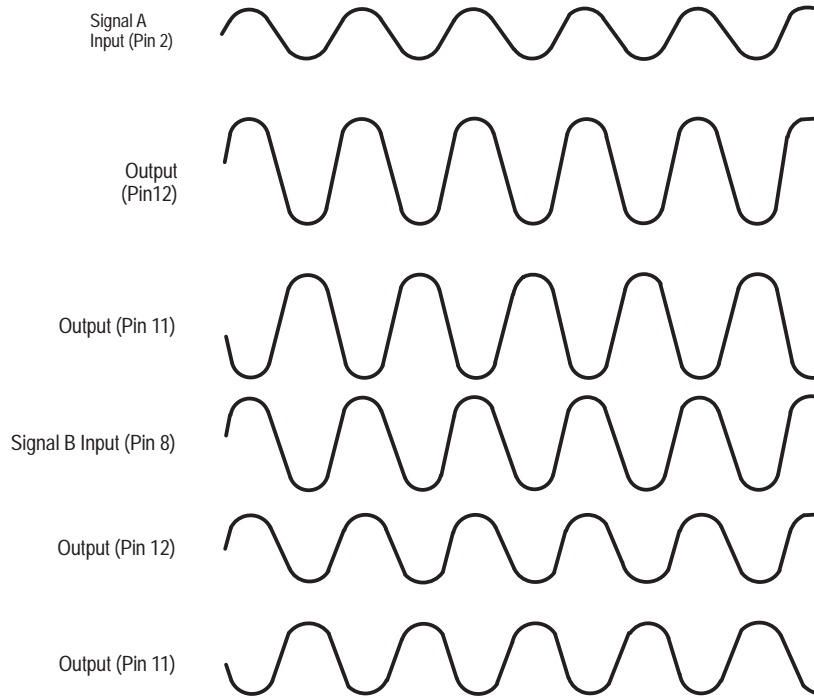
Signal A = 30 mVpp  
 Signal B = 300 mVpp  
 Freq. = 100 MHz

All input and output cables to the scope are equal lengths of 50- $\Omega$  coaxial cable.  
 The unused output is connected to a 50- $\Omega$  resistor to ground.

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**Figure 4. Carrier Feedthrough Test Circuits**



**Note:** Test 1 – Adjust potentiometer for carrier null at  $f_c = 100$  kHz.  
Test 2 – Connect Pins 5 and 6 to Gnd.

All Input and output cables to the scope are equal lengths of 50-Ω coaxial cable.

Figure 5. Carrier Feedthrough versus Frequency (Test 1)

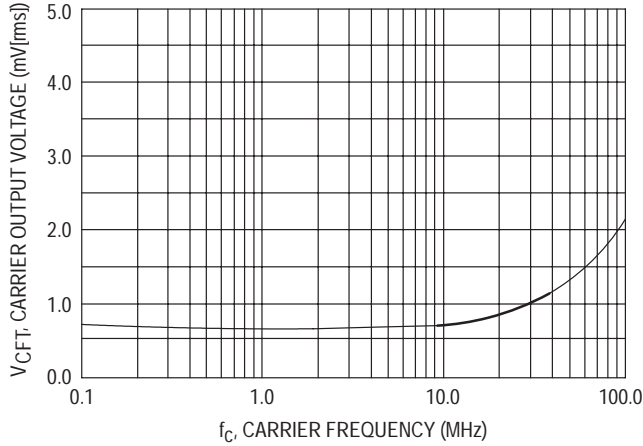


Figure 6. Carrier Feedthrough versus Frequency (Test 2)

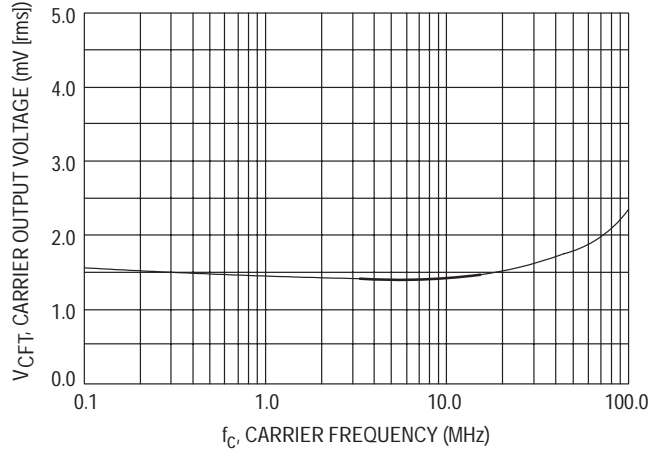
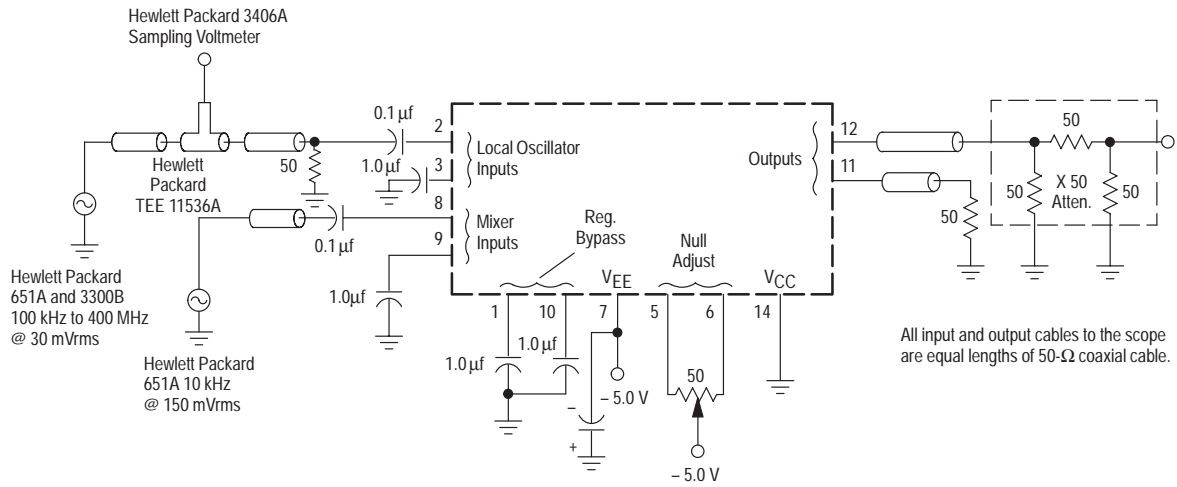


Figure 7. Carrier Suppression Test Circuit



**Note:** Test 1 – Adjust potentiometer for carrier null @  $f_c = 100$  kHz  
 Test 2 – Connect Pins 5 and 6 to  $-5.0$  V  
 Test 3 – Adjust potentiometer for carrier null @  $25^\circ\text{C}$

Figure 8. Carrier Suppression versus Frequency (Test 1)

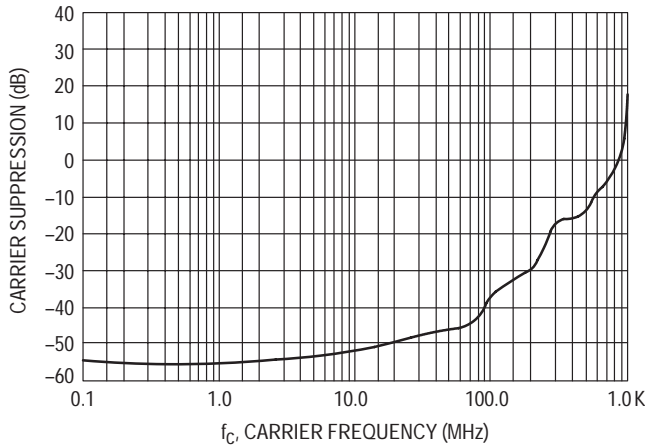


Figure 9. Carrier Suppression versus Frequency (Test 2)

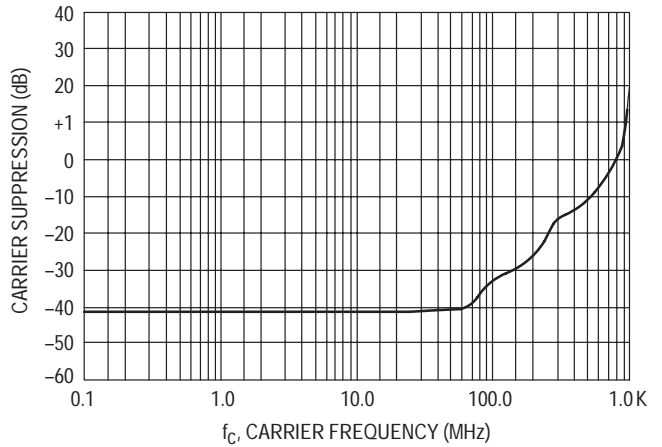


Figure 10. Carrier Suppression versus Temperature

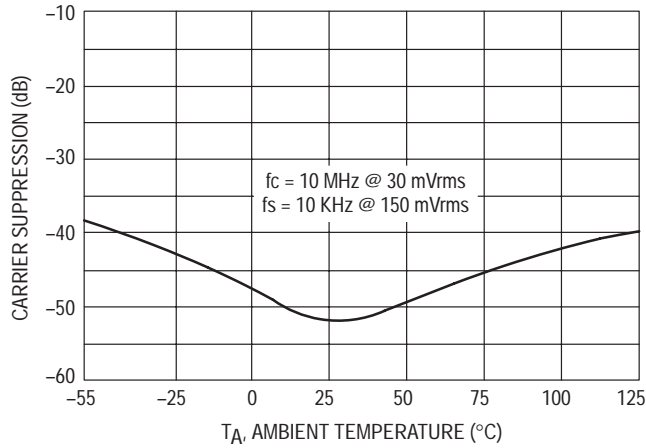
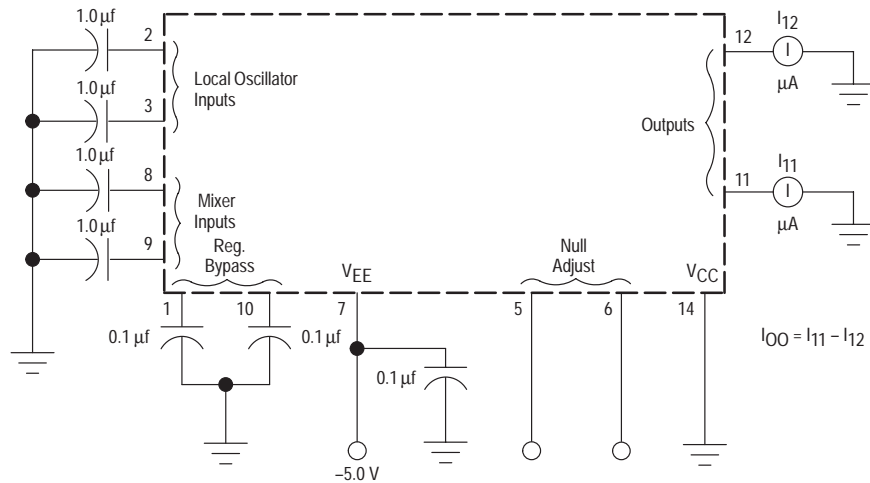


Figure 11. Output Offset Current (I<sub>00</sub>) versus Temperature



Note: Test 1 - Pins 5 and 6 left open  
Test 2 - Pins 5 and 6 are tied to -5.0 V

Figure 12. Output Offset Current versus Temperature

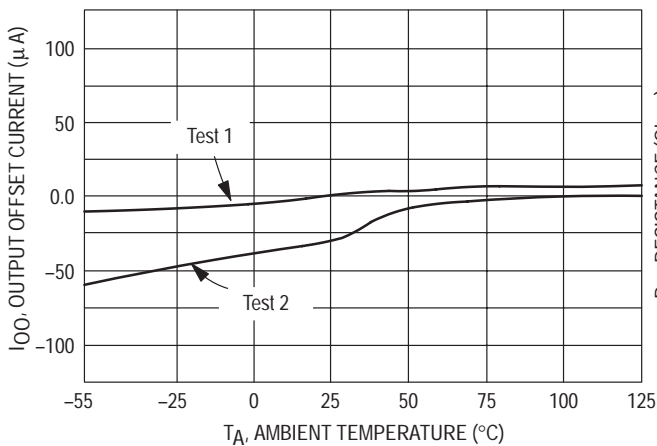
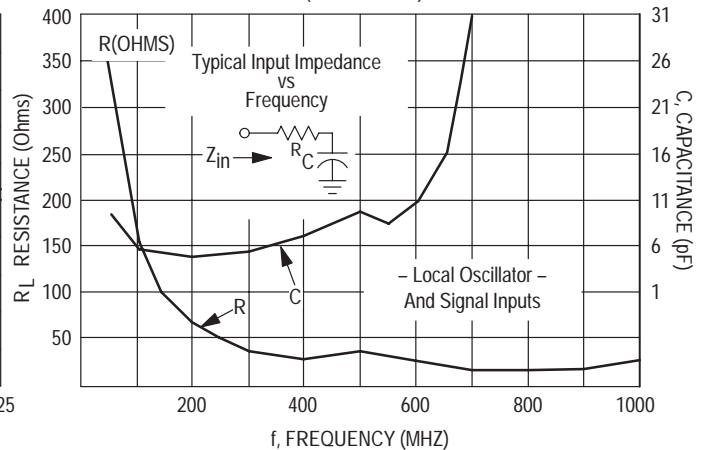
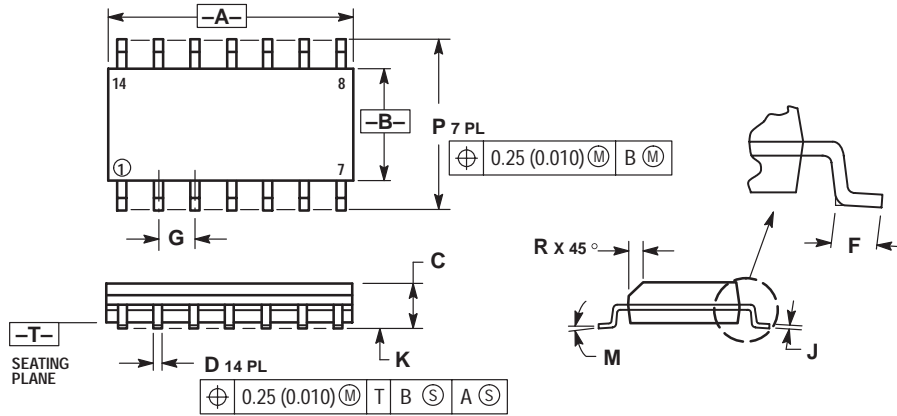


Figure 13. Typical Input Impedance versus Frequency (No Circuit)



OUTLINE DIMENSIONS

D SUFFIX  
PLASTIC PACKAGE  
CASE 751A-03  
ISSUE F

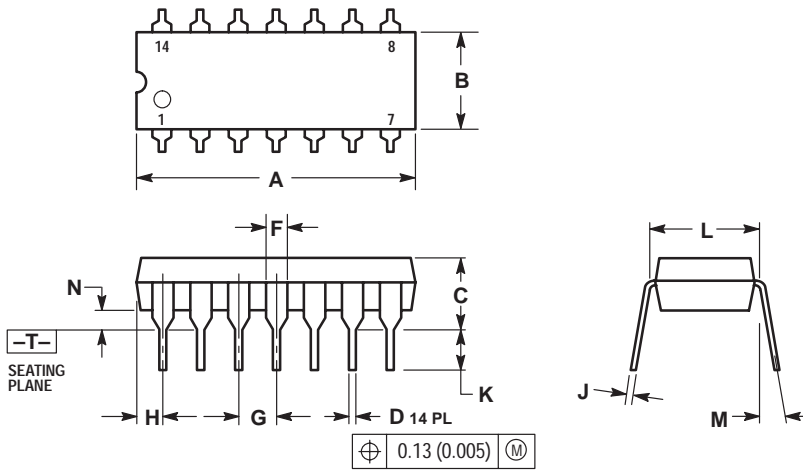


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	8.55	8.75	0.337	0.344
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.228	0.244
R	0.25	0.50	0.010	0.019

P SUFFIX  
PLASTIC PACKAGE  
CASE 646-06  
ISSUE M



NOTES:


1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.715	0.770	18.16	18.80
B	0.240	0.260	6.10	6.60
C	0.145	0.185	3.69	4.69
D	0.015	0.021	0.38	0.53
F	0.040	0.070	1.02	1.78
G	0.100 BSC		2.54 BSC	
H	0.052	0.095	1.32	2.41
J	0.008	0.015	0.20	0.38
K	0.115	0.135	2.92	3.43
L	0.290	0.310	7.37	7.87
M	---	10°	---	10°
N	0.015	0.039	0.38	1.01



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