

# MC12002

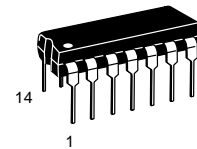
## Analog Mixer

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.

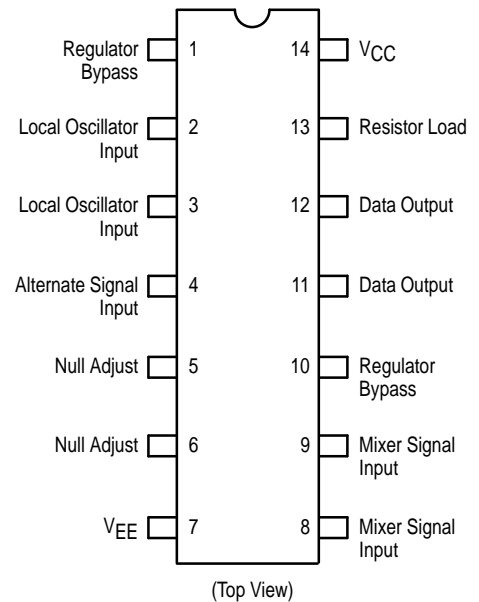
### ANALOG MIXER

#### SEMICONDUCTOR TECHNICAL DATA



**P SUFFIX**  
PLASTIC PACKAGE  
CASE 646

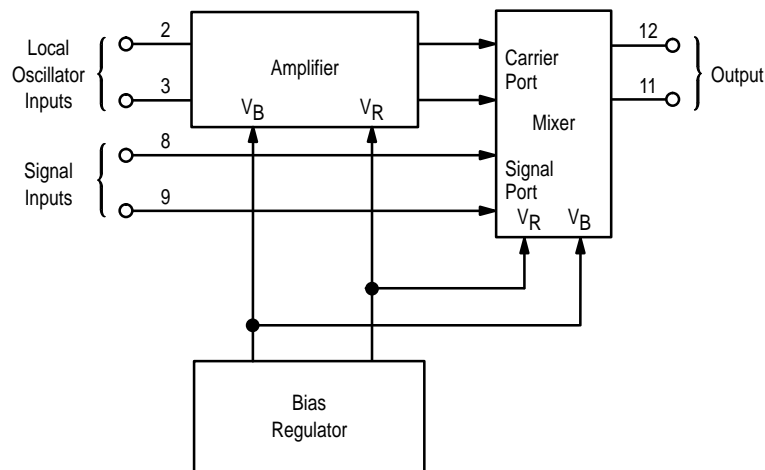
#### PIN CONNECTIONS



#### ORDERING INFORMATION

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

**Figure 1. Logic Diagram**



# MC12002

## ELECTRICAL CHARACTERISTICS

										TEST VOLTAGE VALUES				
										Volts				
										V <sub>IHmax</sub>	V <sub>ILmin</sub>	V <sub>CC</sub>		
										+2.9	+2.0	+5.0		
Characteristic	Symbol	Pin Under Test	Test Limits						VOLTAGE APPLIED TO PINS LISTED BELOW					
			-30°C		+25°C		+85°C		Unit	V <sub>IHmax</sub>	V <sub>ILmin</sub>	V <sub>CC</sub>	Gnd	
			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	
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:** \*Note: AC Gain is a function of collector load impedance.

# MC12002

Figure 2. Analog Mixer Circuit Schematic

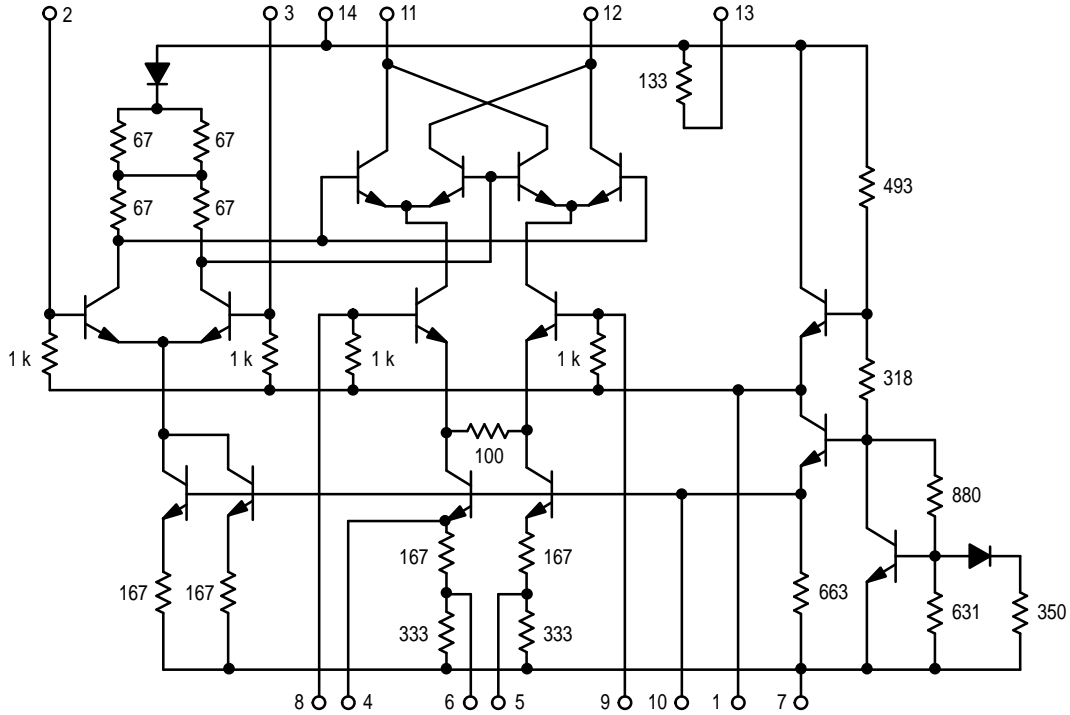
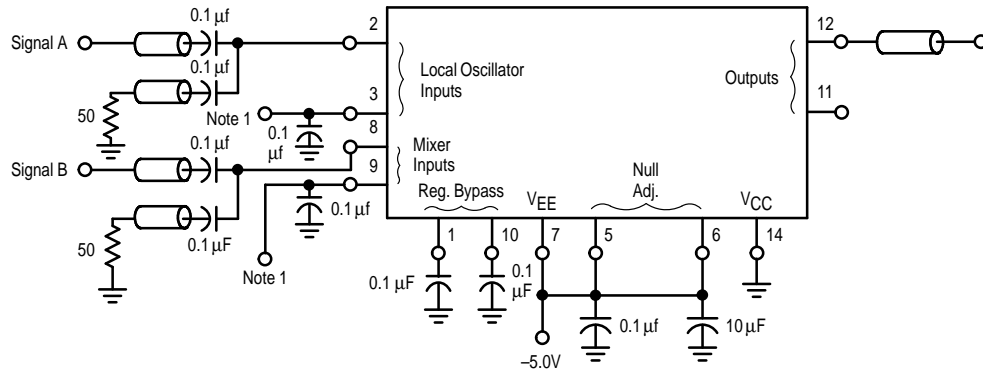


Figure 3. AC Gain Test



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

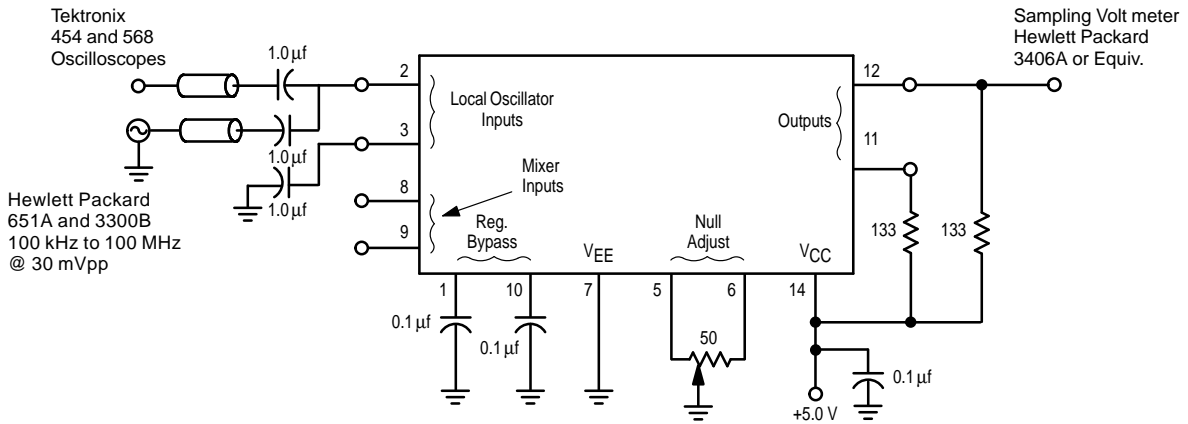
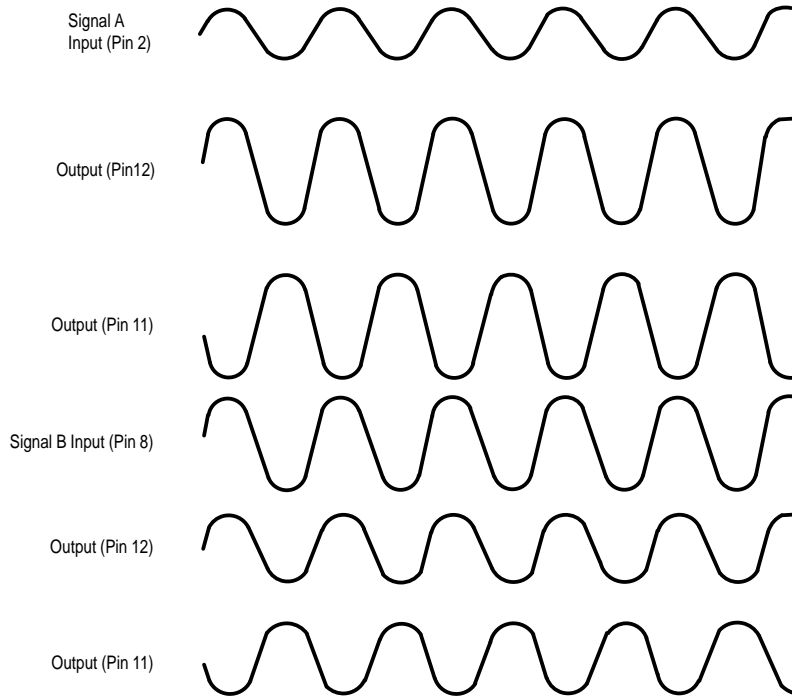
Signal B = 300 mVpp

Freq. = 100 MHz

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

# MC12002

Figure 4. Carrier Feedthrough Test Circuits



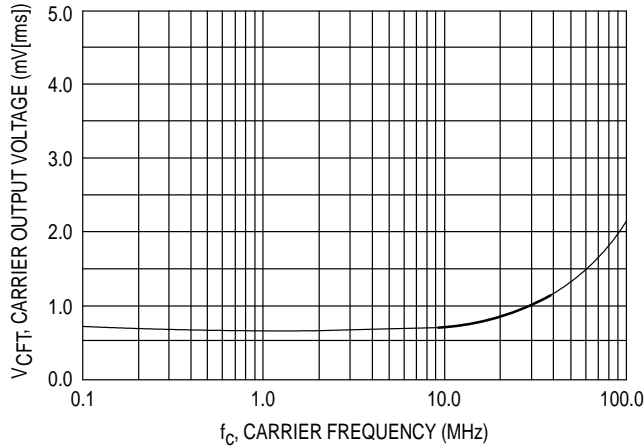
**Notes:**

- Test 1 – Adjust potentiometer for carrier null at  $f_c = 100$  kHz.
- Test 2 – Connect pins 5 and 6 to Gnd.

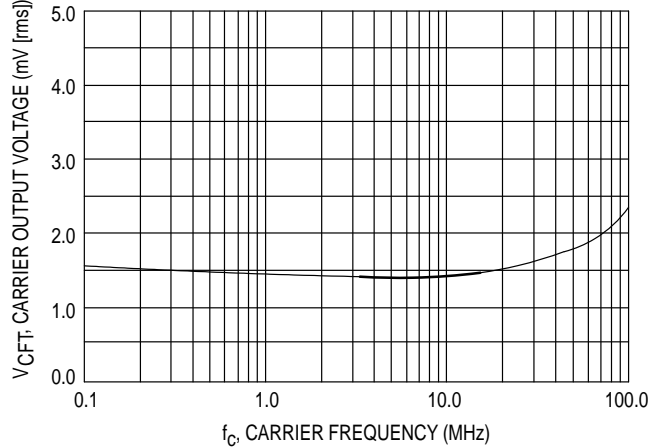
All Input and output cables to the scope are equal lengths of 50-ohm coaxial cable.

# MC12002

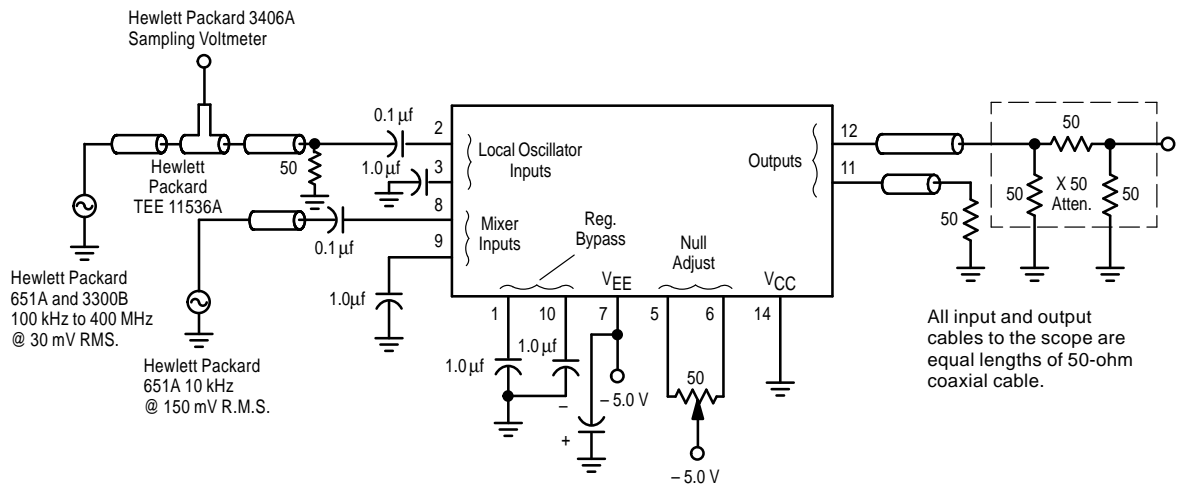
**Figure 5. Carrier Feedthrough versus Frequency (Test 1)**



**Figure 6. Carrier Feedthrough versus Frequency (Test 2)**

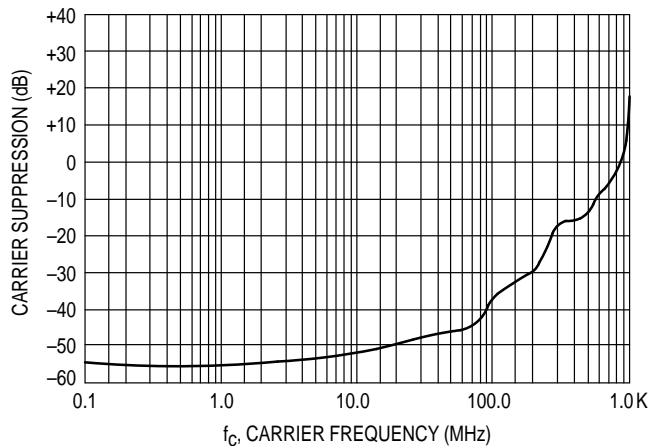


**Figure 7. Carrier Suppression Test Circuit**

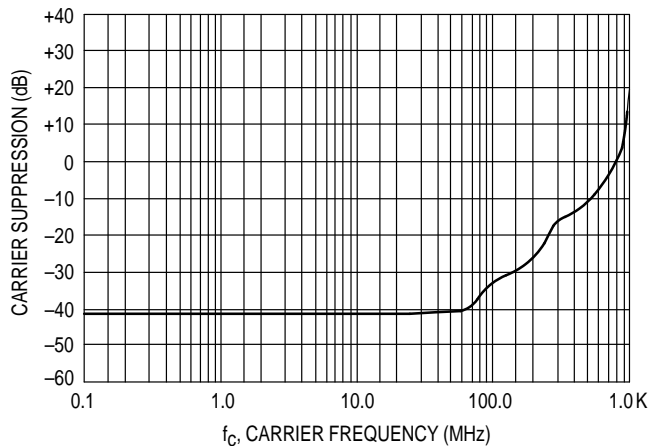


- Notes:  
 Test 1 – Adjust potentiometer for carrier null @  $f_c = 100$  kHz  
 Test 2 – Connect pins 5 and 6 to  $-5.0$  volts  
 Test 3 – Adjust potentiometer for carrier null @  $25^\circ$  C

**Figure 8. Carrier Suppression versus Frequency (Test 1)**

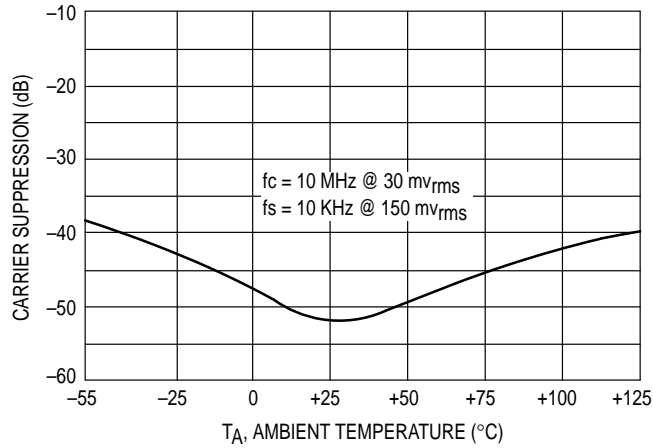


**Figure 9. Carrier Suppression versus Frequency (Test 2)**

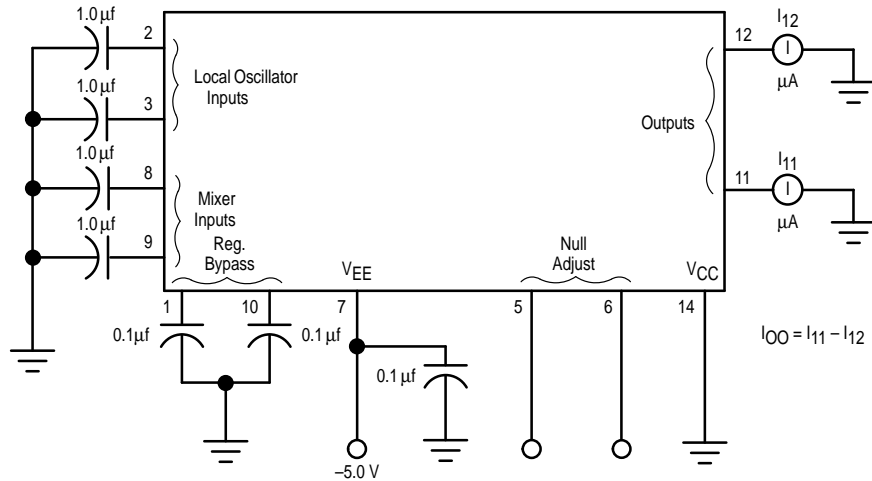


# MC12002

**Figure 10. Carrier Suppression versus Temperature**

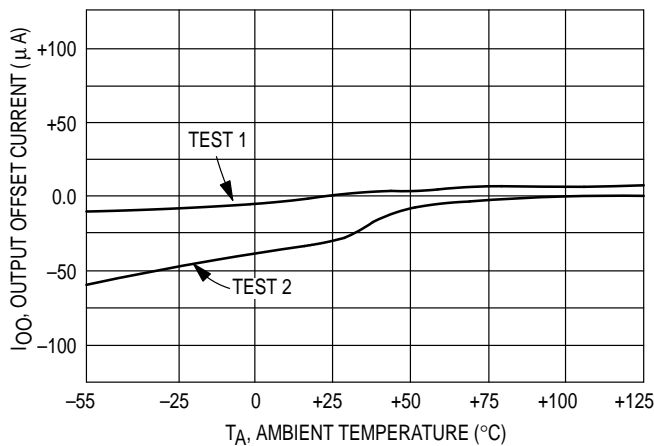


**Figure 11. Output Offset Current ( $I_{OO}$ ) versus Temperature**

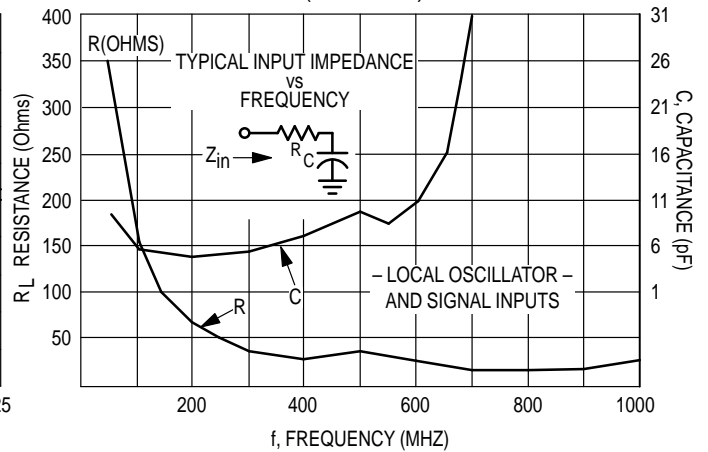


Notes:  
 Test 1 - Pins 5 and 6 left open  
 Test 2 - Pins 5 and 6 are tied to -5.0 volts

**Figure 12. Output Offset Current versus Temperature**



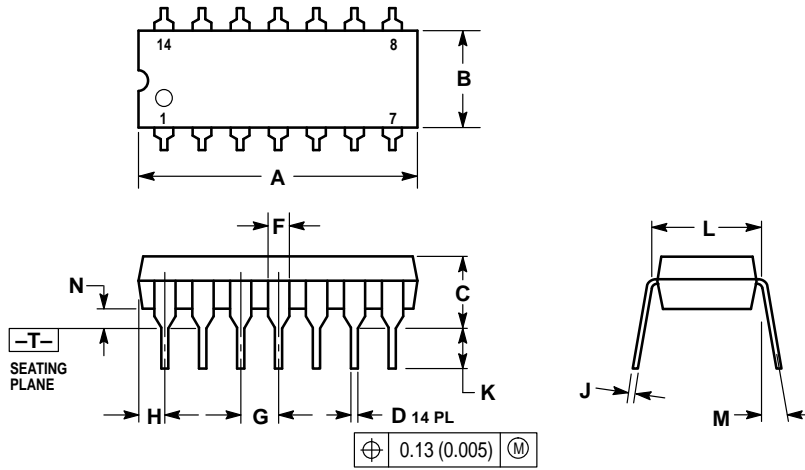
**Figure 13. Typical Input Impedance versus Frequency (No Circuit)**



# MC12002

## OUTLINE DIMENSIONS

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°	
N	0.015	0.039	0.38	1.01

# MC12002

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