MOTOROLA

MC12002

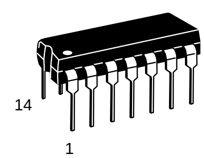
Analog Mixer

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

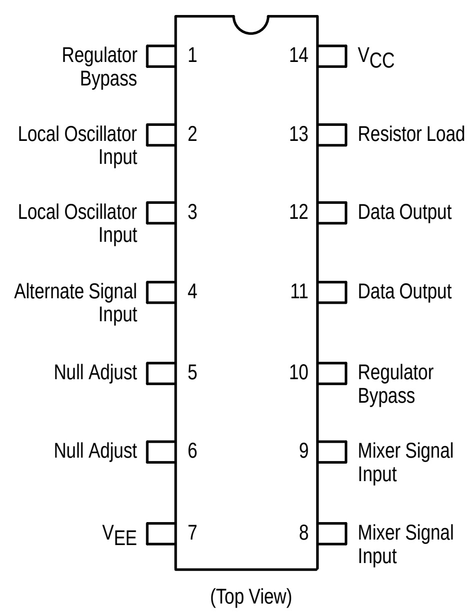
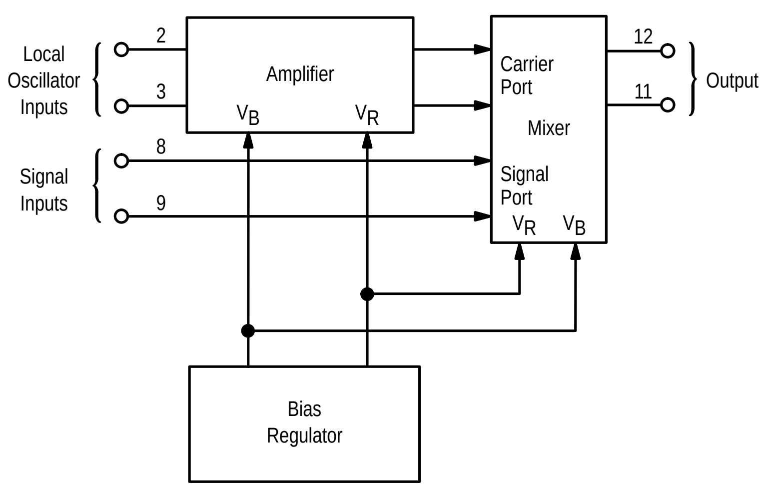


Figure 1. Logic Diagram



ORDERING INFORMATION

Device	Operating Temperature Range	Package
MC12002P	T_A = –30° to +85°C	Plastic

ELECTRICAL CHARACTERISTICS

										TEST VOLTAGE VALUES			
										Volts			
										V_{IHmax}	V_{ILmin}	V_{CC}	
										+2.9	+2.0	+5.0	
			Test Limits							VOLTAGE APPLIED TO PINS LISTED BELOW			
			–30°C		+25°C		+85°C						
Characteristic	**Symbol**	**Pin Under Test**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Unit**	V_{IHmax}	V_{ILmin}	V_{CC}	**Gnd**
Power Supply Drain	I_{CC}	14	—	—	—	16	—	—	mAdc	—	—	11,12,14	5,6,7
Input Current	I_{inH}	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_{inL}	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	IO_1	11	—	—	0.7	1.3	—	—	mAdc	—	—	11,12,14	7
		12	—	—	0.7	1.3	—	—	mAdc	—	—	11,12,14	7
	IO_2	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_{out}	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	ΔIO_1	11,12	–100	+100	–100	+100	–100	+100	µAdc	—	—	11,12,14	7
	ΔIO_2	11,12	–200	+200	–200	+200	–200	+200	µAdc	—	—	11,12,14	5,6,7
Bias Voltage	V_{Bias}	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
										Pulse In	**Pulse Out**	**–3.0 V**	**Gnd**	**V_{EE}**
AC Gain (See Figure 1)	A_V	11	—	—	5.0	—	—	—	V/V	2	11	9	14	7
(Frequency = 100 MHz) *Note		11	—	—	0.28	—	—	—	V/V	8	11	3	14	7

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

Figure 2. Analog Mixer Circuit Schematic

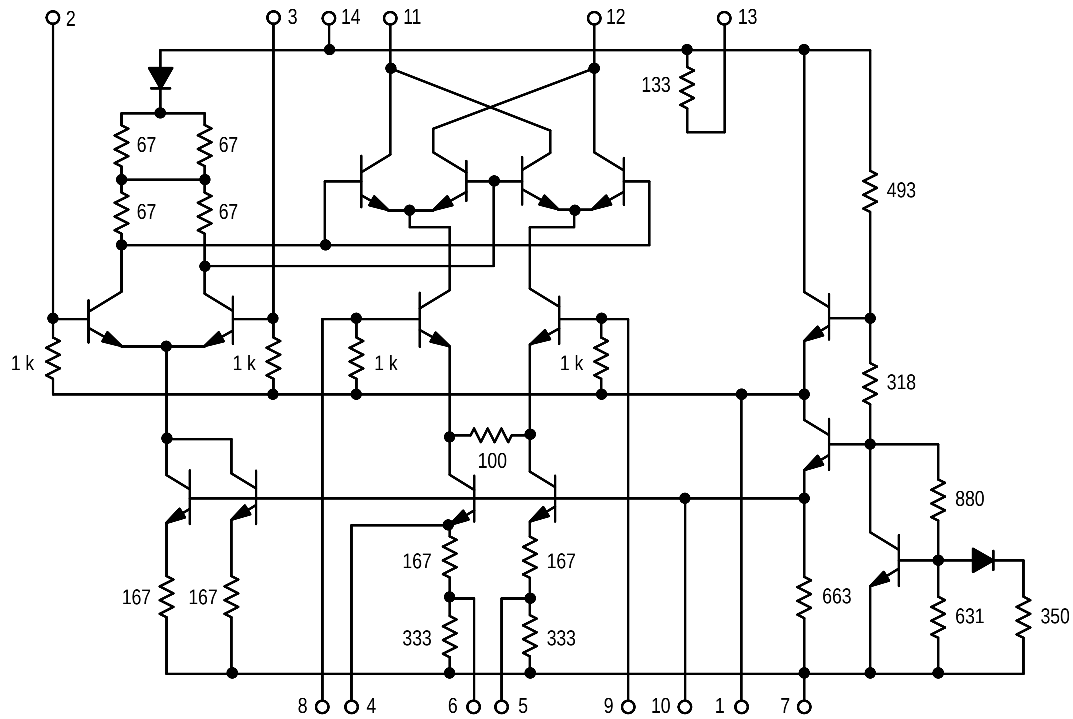
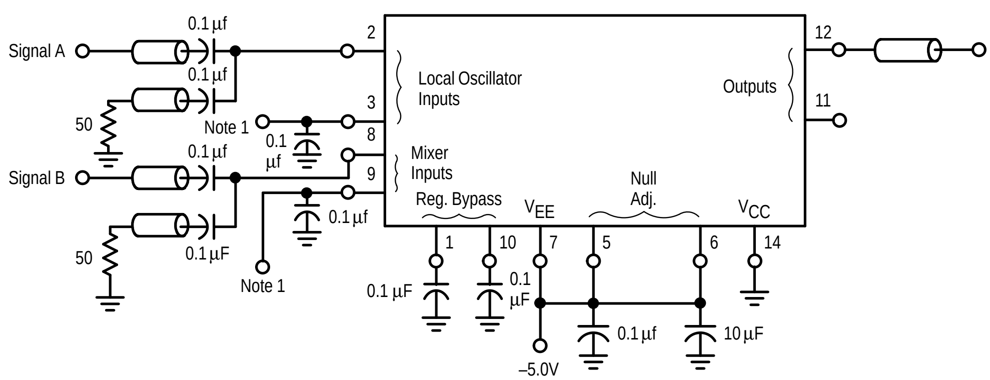


Figure 3. AC Gain Test



Note 1:
V_{IL} = –3.0 V on pin 3 when pin 8 is under test.
V_{IL} = –3.0 V on pin 9 when pin 2 is under test.

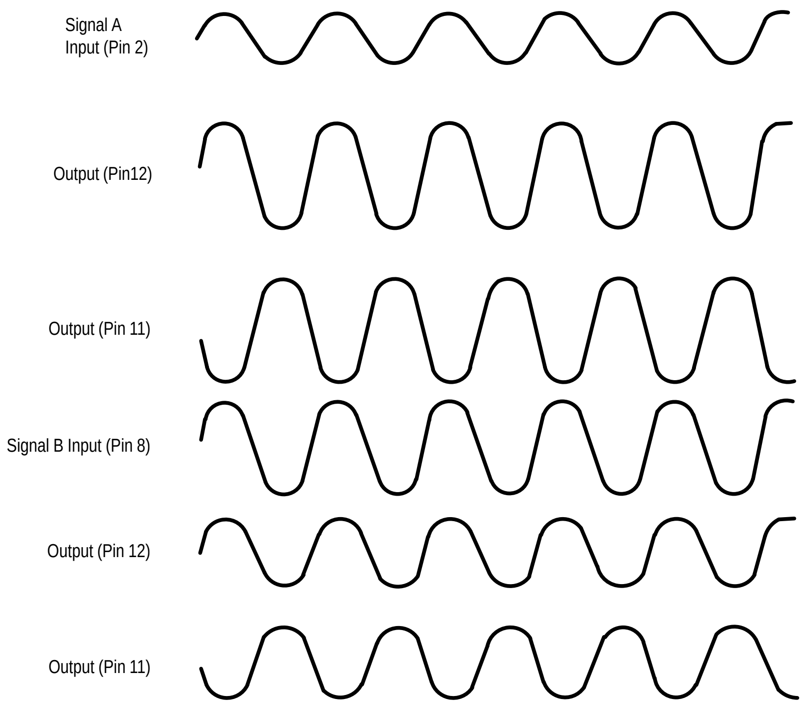
Signal A = 30 mVpp

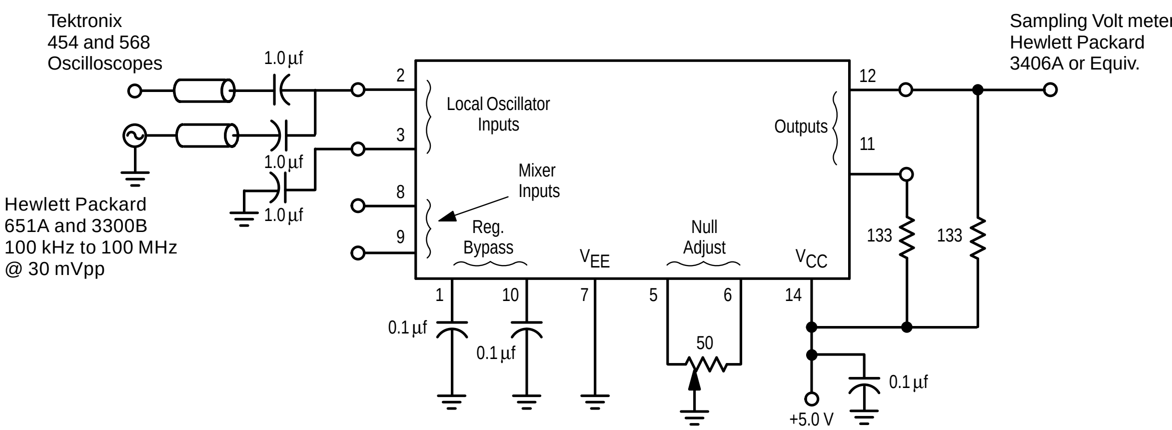
Signal B = 300 mVpp

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.

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.

Figure 5. Carrier Feedthrough versus Frequency
(Test 1)

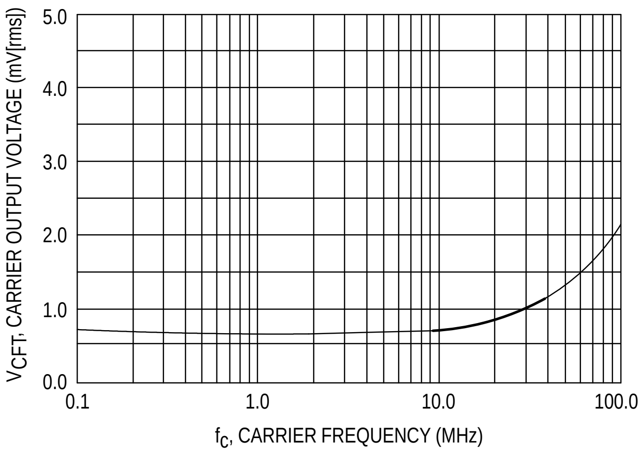


Figure 6. Carrier Feedthrough versus Frequency
(Test 2)

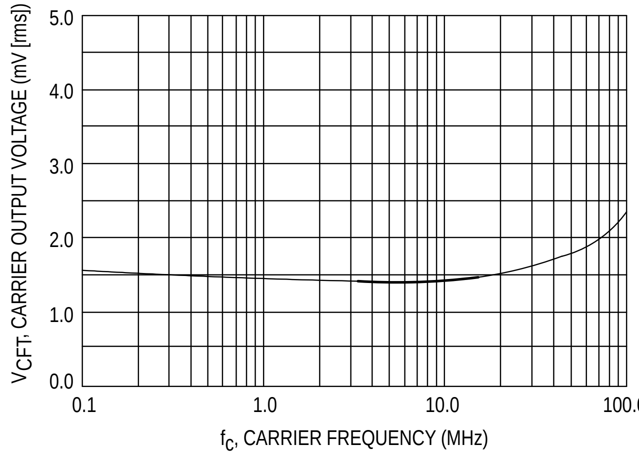
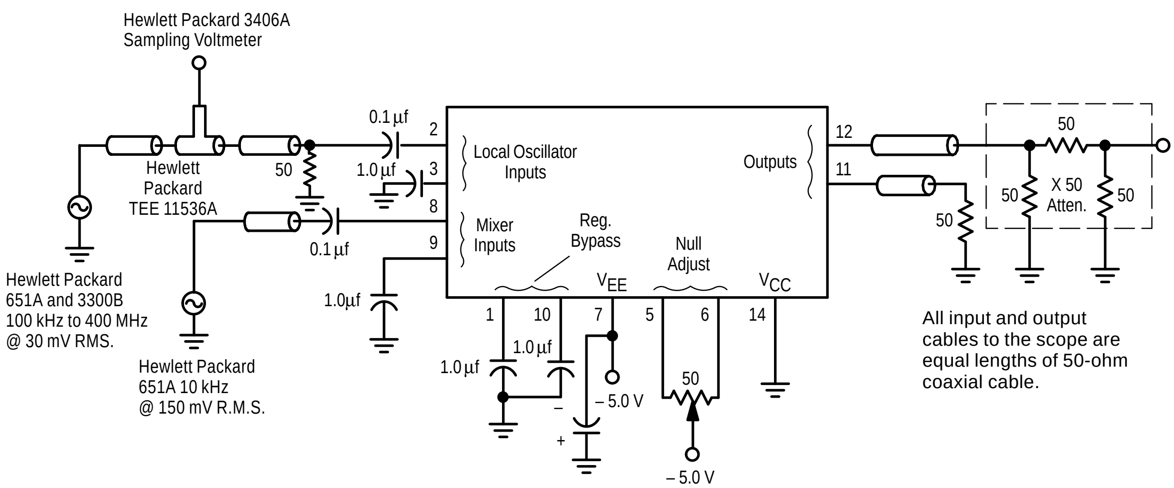


Figure 7. Carrier Suppression Test Circuit



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° C

Figure 8. Carrier Suppression versus Frequency
(Test 1)

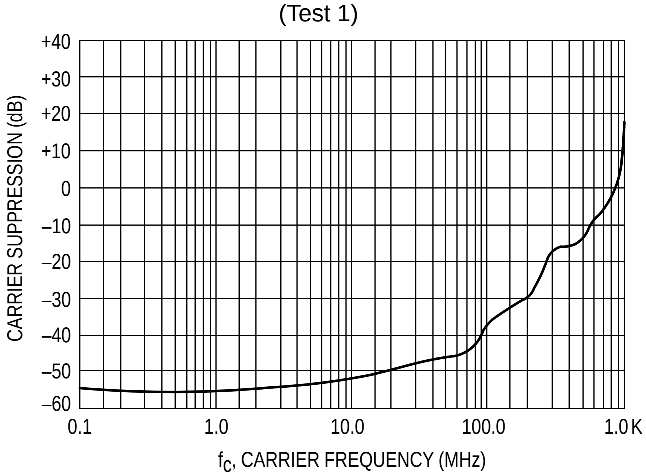


Figure 9. Carrier Suppression versus Frequency
(Test 2)

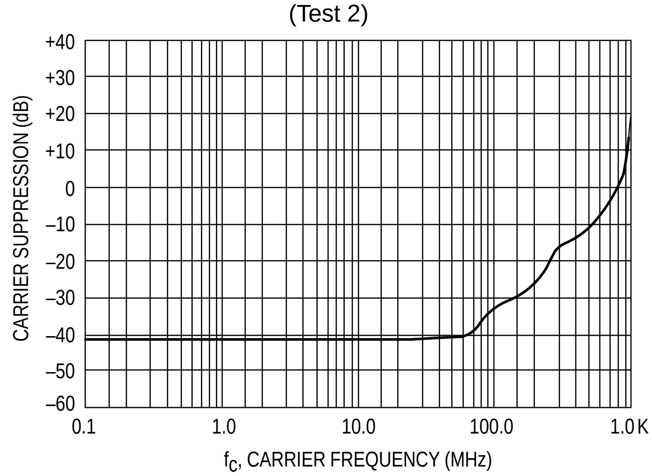


Figure 10. Carrier Suppression versus Temperature

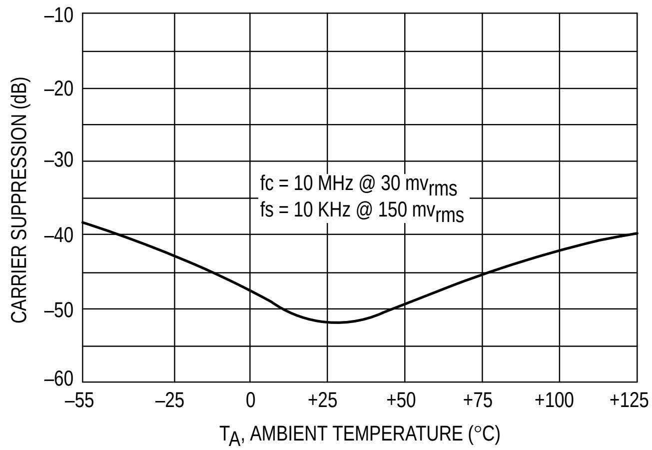
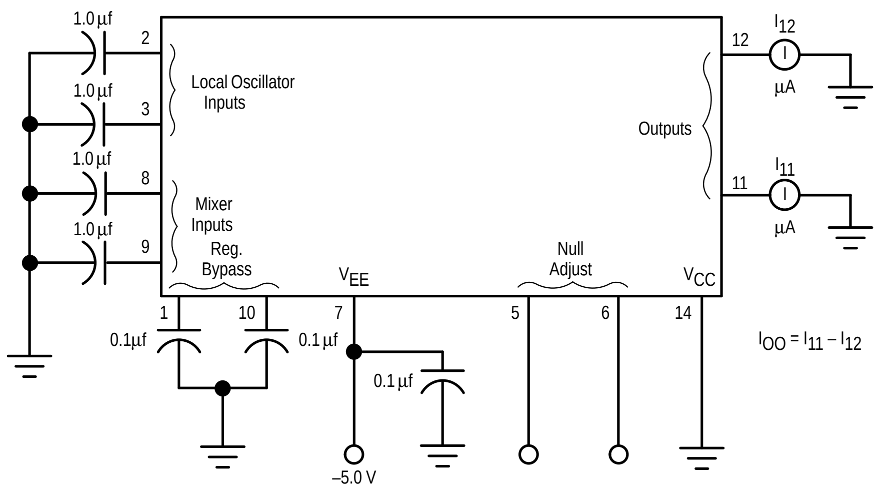


Figure 11. Output Offset Current (I_{OO}) versus Temperature



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

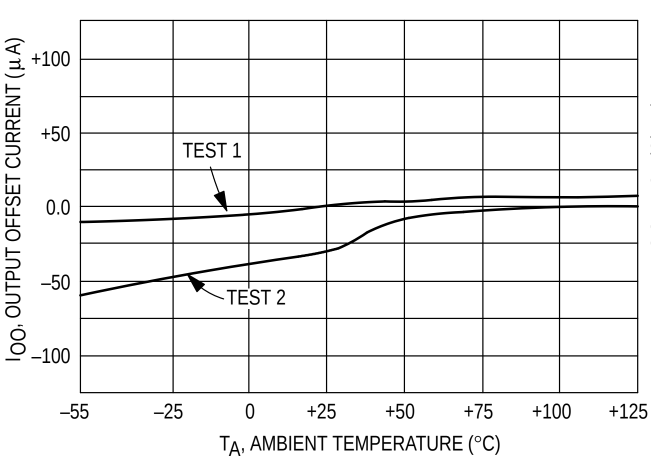
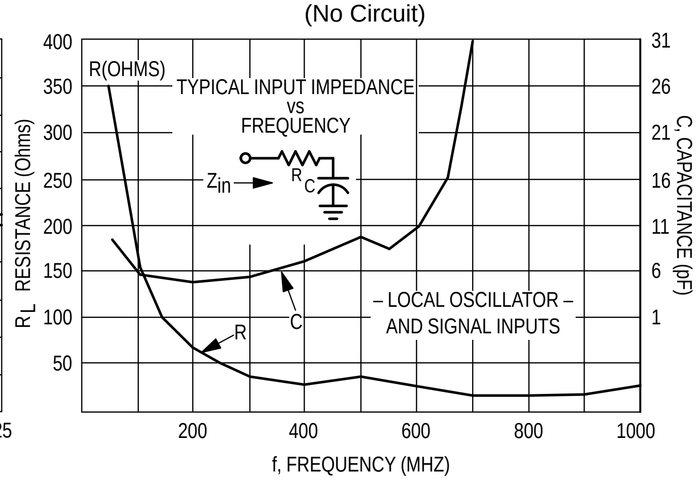
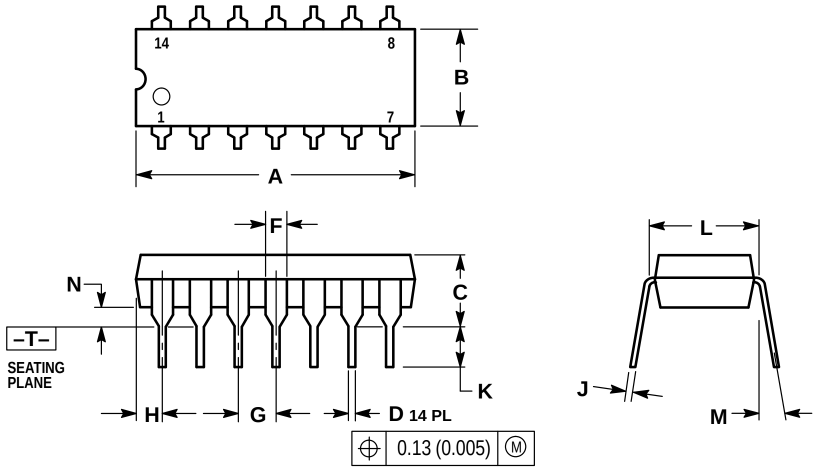


Figure 13. Typical Input Impedance versus Frequency
(No Circuit)



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.

	INCHES		MILLIMETERS	
DIM	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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