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MOTOROLA

MC12002

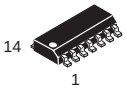
Analog Mixer

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.

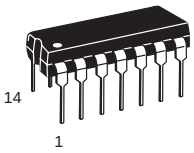
This circuit is designed for use as a balanced mixer in high-frequency wide-band circuits. Other typical applications include suppressed carrier and amplitude modulation, synchronous AM detection, FM detection, phase detection, and frequency doubling, at frequencies up to UHF.

ANALOG MIXER

SEMICONDUCTOR TECHNICAL DATA

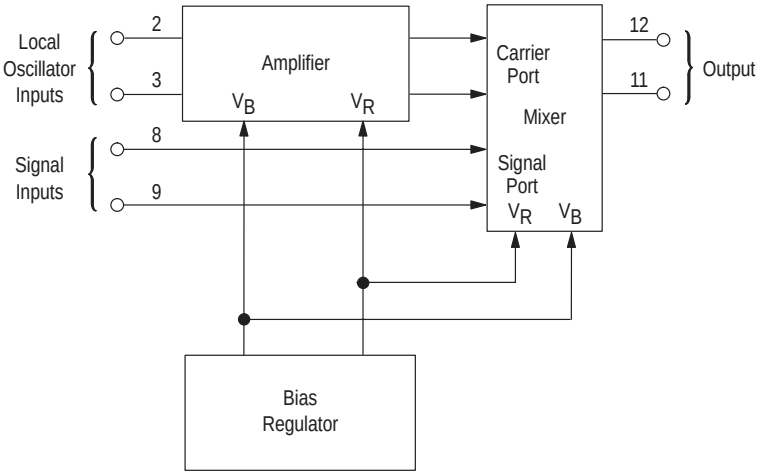


D SUFFIX
PLASTIC PACKAGE
CASE 751A
(SO–14)

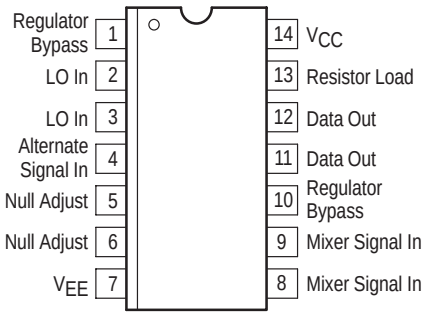


P SUFFIX
PLASTIC PACKAGE
CASE 646

Figure 1. Logic Diagram



PIN CONNECTIONS



(Top View)

ORDERING INFORMATION

Device	Operating Temperature Range	Package
MC12002D	T_A = –30 to 85°C	SO–14
MC12002P		Plastic DIP

ARCHIVE INFORMATION

ELECTRICAL CHARACTERISTICS

			Test Limits							TEST VOLTAGE VALUES (Volts) V_{IHmax} = 2.9	V_{ILmin} = 2.0	V_{CC} = 5.0	
			–30°C		25°C		85°C			VOLTAGE APPLIED TO PINS LISTED BELOW			
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: AC Gain is a function of collector load impedance.

ARCHIVE INFORMATION

Figure 2. Analog Mixer Circuit Schematic

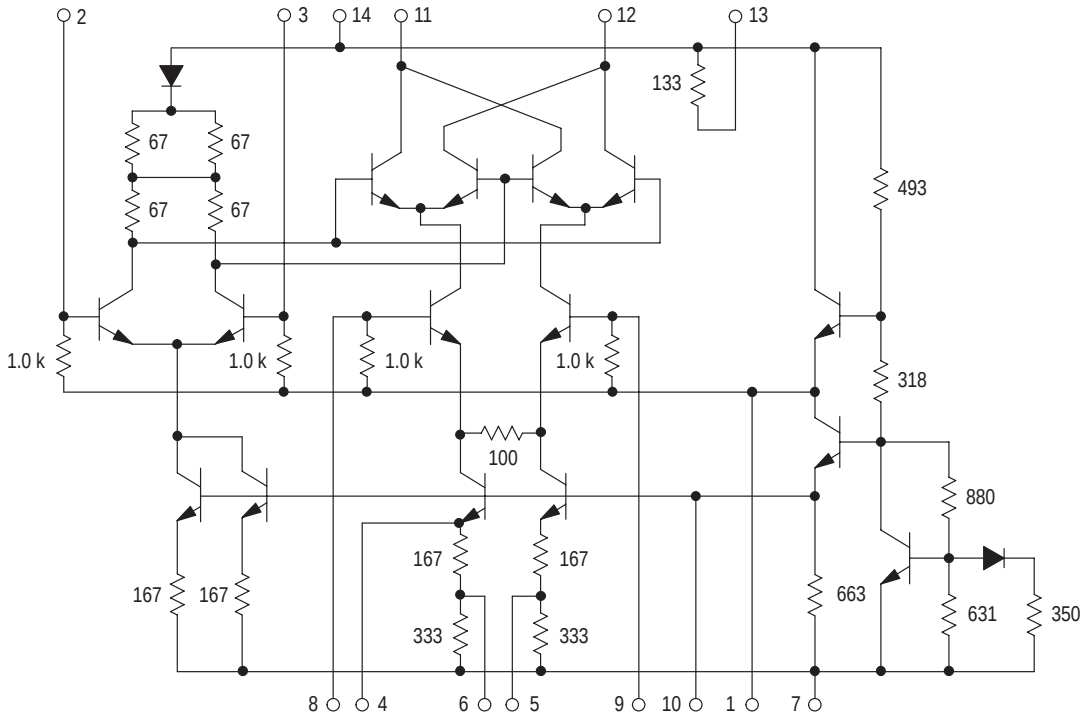
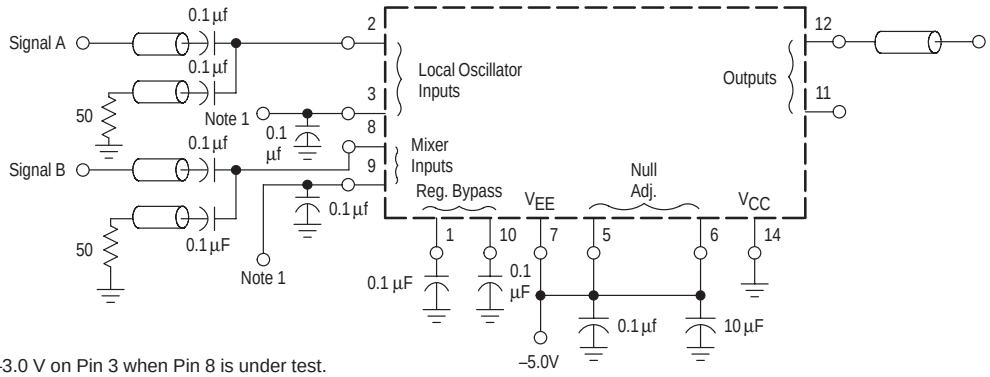


Figure 3. AC Gain Test

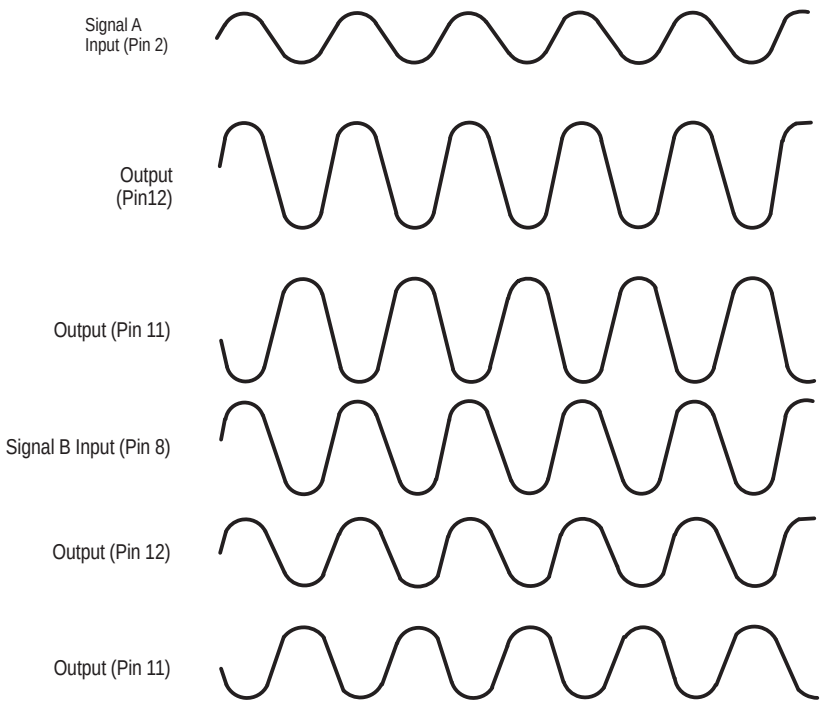


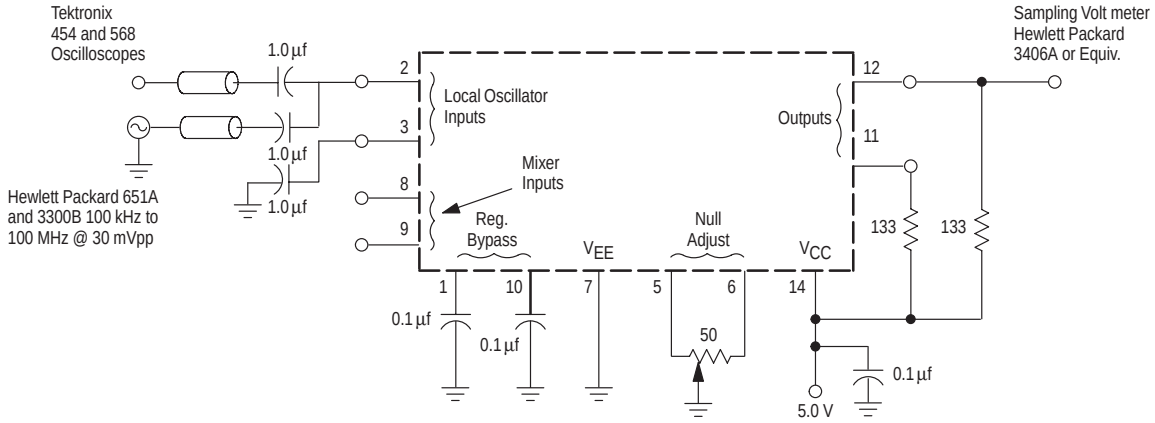
Note 1: V_{IL} = –3.0 V on Pin 3 when Pin 8 is under test.
V_{IL} = –3.0 V on Pin 9 when Pin 2 is under test.

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

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

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)

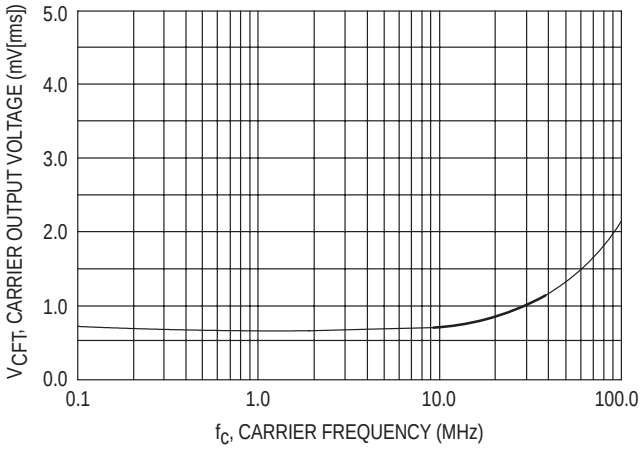


Figure 6. Carrier Feedthrough versus Frequency
(Test 2)

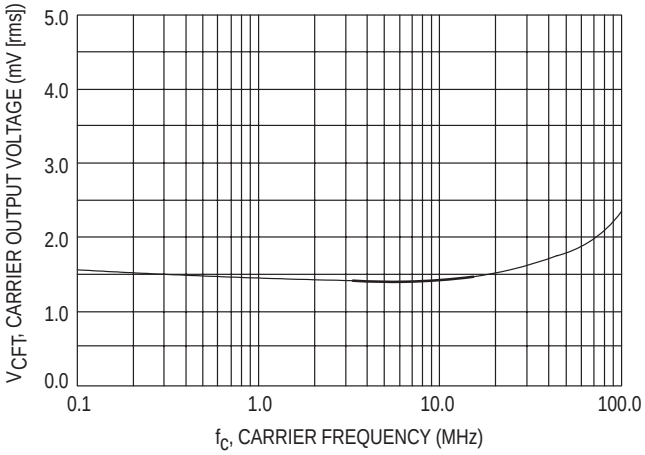
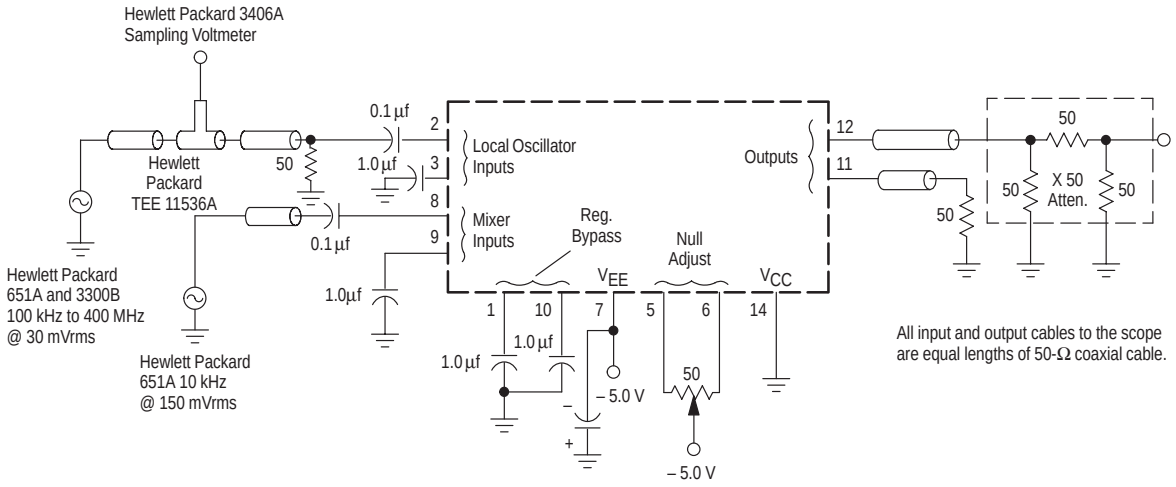


Figure 7. Carrier Suppression Test Circuit



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°C

Figure 8. Carrier Suppression versus Frequency
(Test 1)

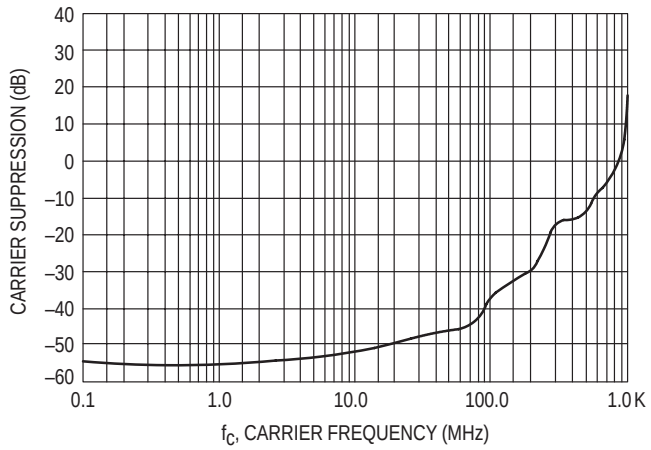


Figure 9. Carrier Suppression versus Frequency
(Test 2)

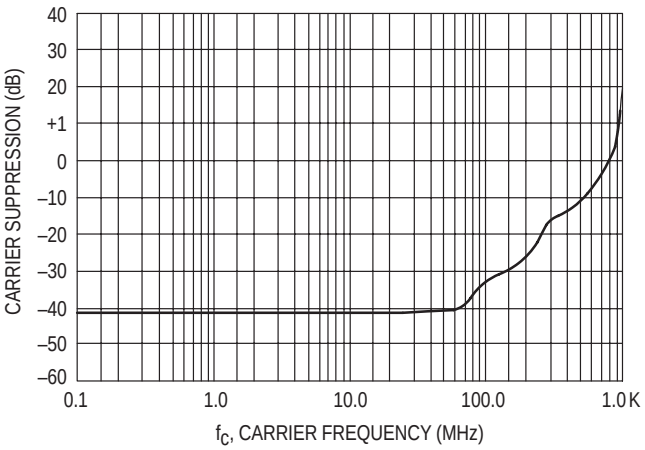


Figure 10. Carrier Suppression versus Temperature

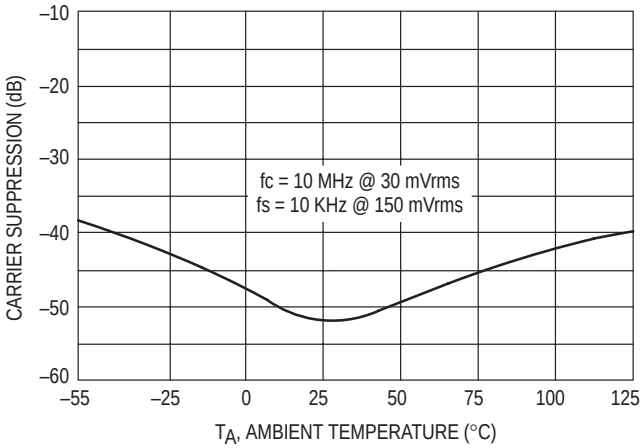
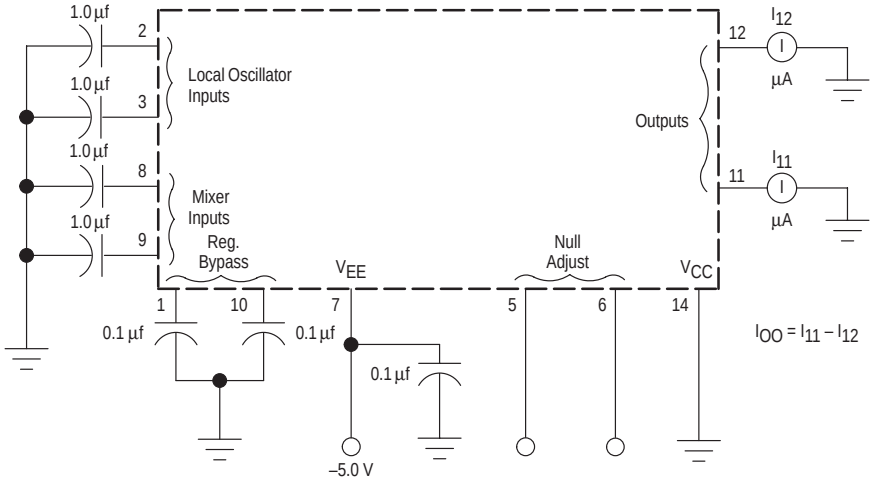


Figure 11. Output Offset Current (I_{OO}) versus Temperature



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

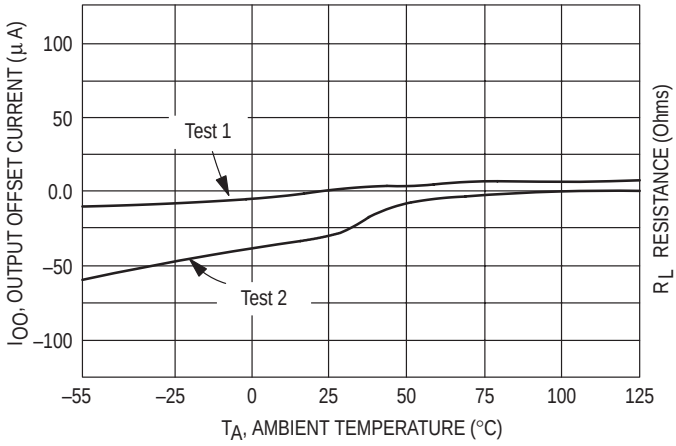
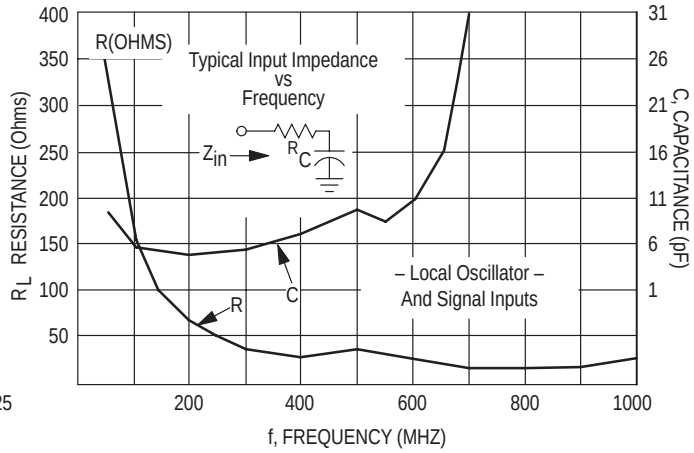
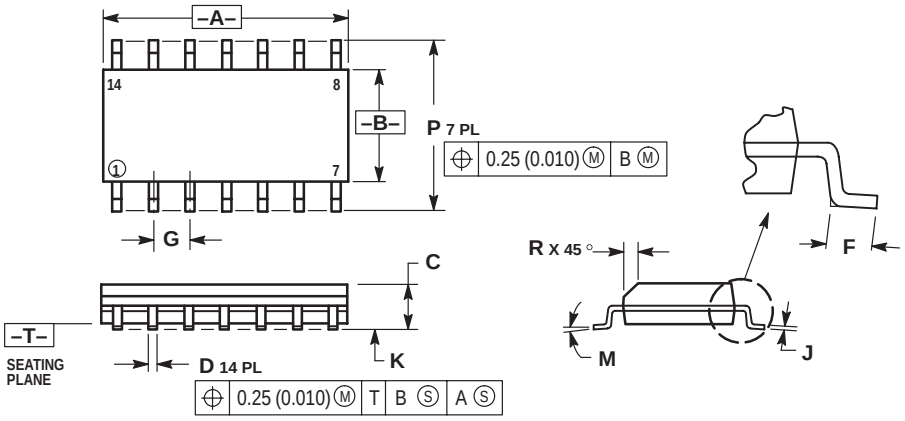


Figure 13. Typical Input Impedance versus Frequency
(No Circuit)



OUTLINE DIMENSIONS

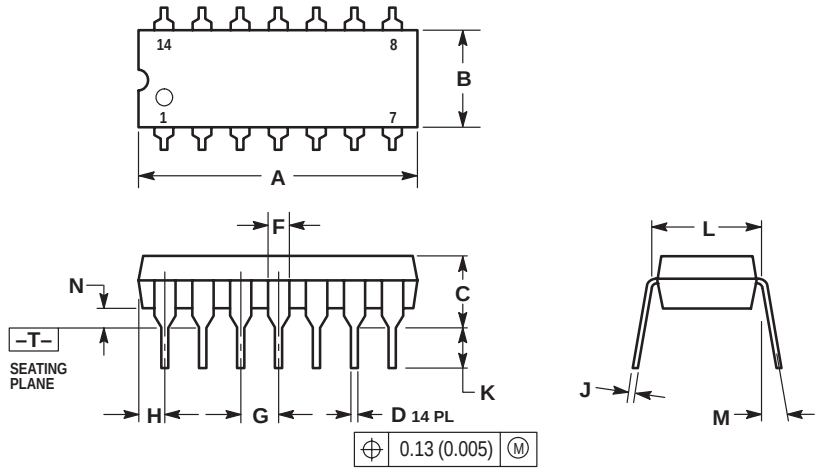
D SUFFIX
PLASTIC PACKAGE
CASE 751A–03
ISSUE F



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.

	MILLIMETERS		INCHES	
DIM	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.

	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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