LANSDALE Semiconductor, Inc.

ML12502

Analog Mixer With On–Chip Regulator For Bias Control

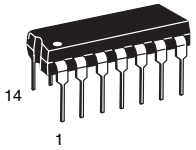
Legacy Device: *Motorola 12502*

The ML12502 is the military temperature version of the commercial ML12002 device. It 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.

There are two package offerings:

- Dual Inline 14 Lead, Ceramic Package.
- Operating Temperature Range: T_A = –55° to +125°C

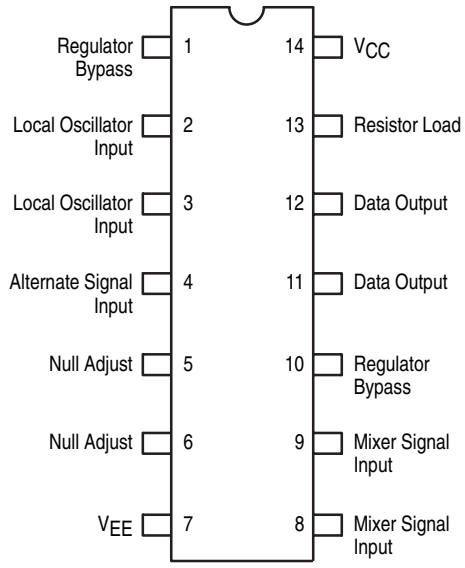


CERDIP 14 = C
CERAMIC PACKAGE
CASE 632

CROSS REFERENCE/ORDERING INFORMATION

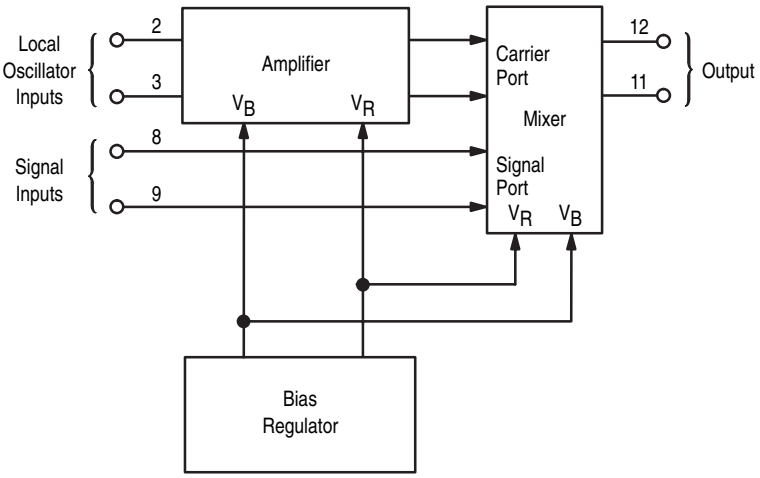
PACKAGE	MOTOROLA	LANSDALE
CERDIP 14	12502/BCA	ML12502/BCA

PIN CONNECTIONS



(Top View)

Figure 1. Logic Diagram



ELECTRICAL CHARACTERISTICS

Test Temperature	Test Voltage Values (Volts)				
	V_{IH}	V_{IL}	V_{ILX}	V_{CC}	V_{EE}
T_A = 25 °C	+ 2.9	+ 2.0	-3.0	+ 5.0	-5.0
T_A = 125 °C	+ 2.9	+ 2.0		+ 5.0	
T_A = -55 °C	+ 2.9	+ 2.0		+ 5.0	

ABSOLUTE MAXIMUM RATINGS	Symbol	Min.	Max.	Units
Supply Voltage	V_{CC}		+ 7.0	Vdc
Output Voltage	V_{OUT}		+ 5.5	Vdc
Input Voltage	V_{IN}		+ 5.5	Vdc
Operating Temperature Range	T_A	– 55	+ 125	°C
Storage Temperature Range	T_{stg}	– 65	+ 175	°C

Symbol	Parameter	Limits						Units	TEST VOLTAGE APPLIED TO PINS BELOW				
	Functional Parameters:	+ 25 °C		+ 125 °C		- 55 °C			Pinouts referenced are for DIL package, check Pin Assignments Output Load = 50 Ω to Gnd				
		Subgroup 1		Subgroup 2		Subgroup 3							
		Min	Max	Min	Max	Min	Max		V_{IH}	V_{IL}	V_{CC}	V_{EE}	P.U.T.
$V_{Bias\ 1}$	Bias Voltage	2.32	2.52	2.29	2.49	2.34	2.54	V			11, 12, 14	5 - 7	1
$V_{Bias\ 4}$	Bias Voltage	400	600	420	620	390	590	mV			11, 12, 14	5 - 7	4
$V_{Bias\ 5}$	Bias Voltage	285	425	305	445	275	415	mV			11, 12, 14	5 - 7	5
$V_{Bias\ 6}$	Bias Voltage	285	425	305	445	275	415	mV			11, 12, 14	5 - 7	6
$V_{Bias\ 10}$	Bias Voltage	1.185	1.385	1.05	1.25	1.3	1.5	V			11, 12, 14	5 - 7	10
IO_1	Power Supply Drain Current	0.7	1.3					mA			11, 12, 14	5 - 7	11, 12
ΔIO_1	Differential Current	- 50	50					µA			11, 12, 14	5 - 7	11, 12
IO_2	Power Supply Drain Current	2.1	3.9					mA			11, 12, 14	5 - 7	11, 12
ΔIO_2	Differential Current	- 100	100					µA			11, 12, 14	5 - 7	11, 12
I_{CC}	Power Supply Drain Current		16.0					mA			11, 12, 14	5 - 7	14
I_{INH}	Input Current High		0.75					mA	2, 3, 8, 9		11, 12, 14	5 - 7	2, 3, 8, 9
I_{INL}	Input Current Low	- 0.7						mA		2, 3, 8, 9	11, 12, 14	5 - 7	2, 3, 8, 9
I_{OUT}	Output Current	4.2	7.8					mA	2, 3, 8, 9		11, 12, 14	2, 3, 8, 9	11, 12

ELECTRICAL CHARACTERISTICS

Test Temperature	Test Voltage Values (Volts)				
	V_{IH}	V_{IL}	V_{ILX}	V_{CC}	V_{EE}
T_A = 25 °C	+ 2.9	+ 2.0	-3.0	+ 5.0	-5.0
T_A = 125 °C	+ 2.9	+ 2.0		+ 5.0	
T_A = -55 °C	+ 2.9	+ 2.0		+ 5.0	

Symbol	Parameter	Limits						Units	TEST VOLTAGE APPLIED TO PINS BELOW					
	Functional Parameters:	+ 25 °C Subgroup 9		+ 125 °C Subgroup 10		- 55 °C Subgroup 11			Pinouts referenced are for DIL package, check Pin Assignments Output Load = 50 Ω to GND					
		Min	Max	Min	Max	Min	Max		V_{ILX}	V_{IN}	V_{OUT}	V_{CC}	V_{EE}	P.U.T.
A_{V1}	AC Gain	5.0						V/V	9	2	11, 12	14	7	11, 12
A_{V2}	AC Gain	0.28						V/V	3	8	11, 12	14	7	11, 12

NOTE: AC Gain is a function of the collecter impedance.

Figure 2. Analog Mixer Circuit Schematic

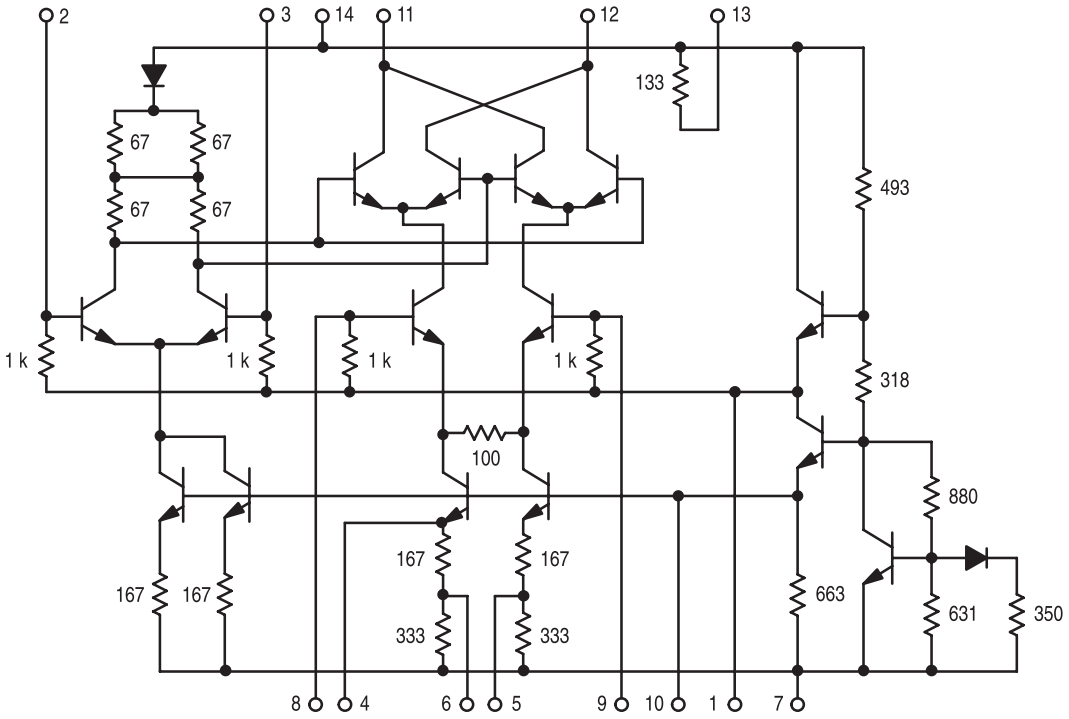
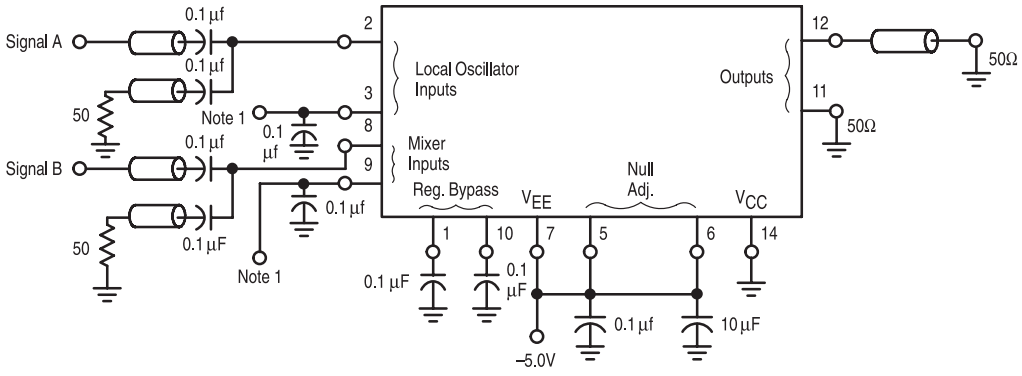


Figure 3. AC Gain Test



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.

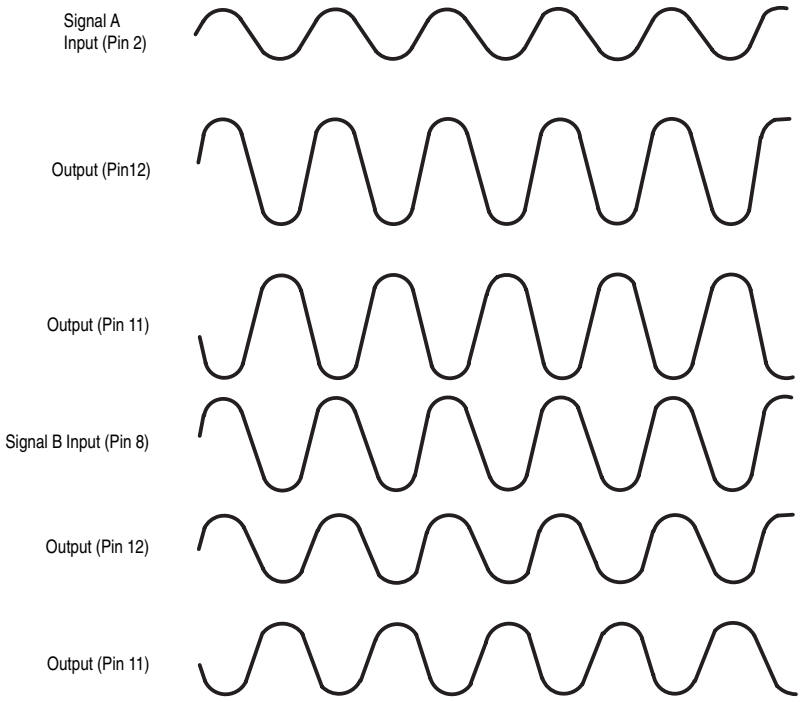
Signal A = 30 mVpp

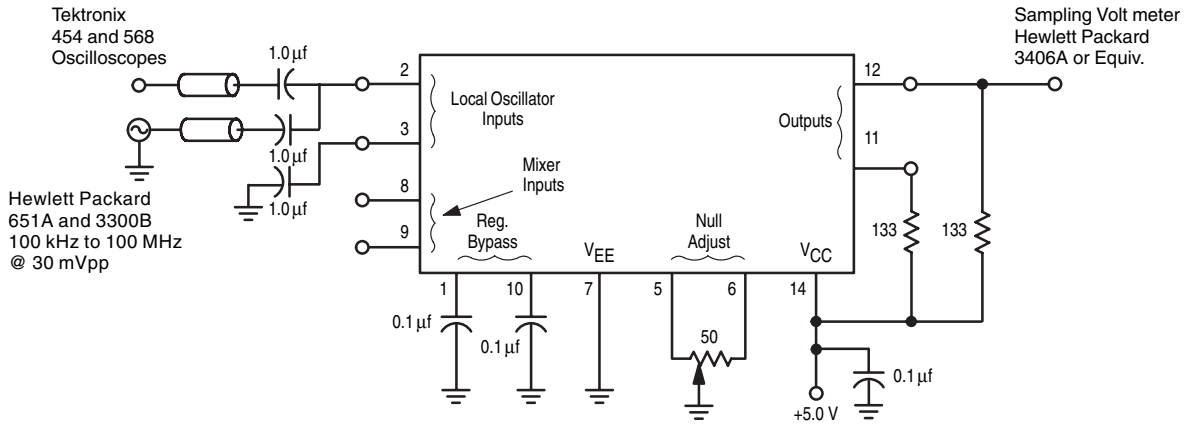
Signal B = 300 mVpp

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)

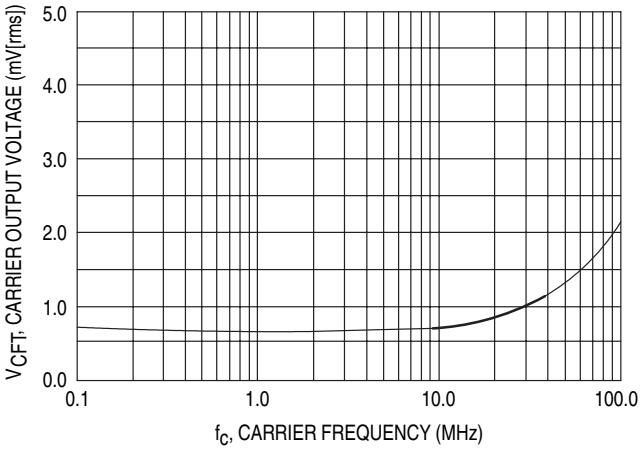


Figure 6. Carrier Feedthrough versus Frequency
(Test 2)

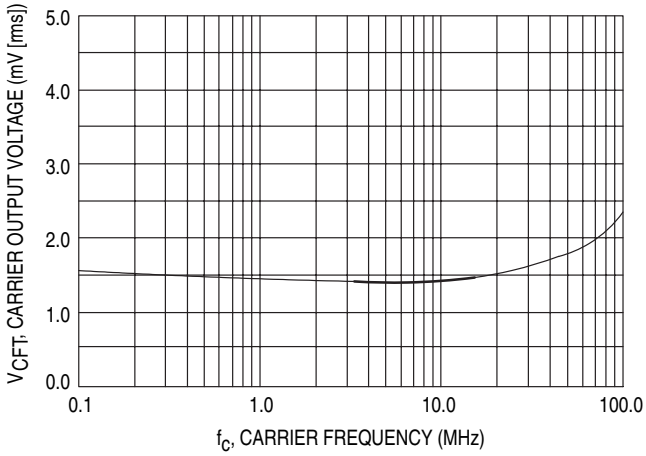
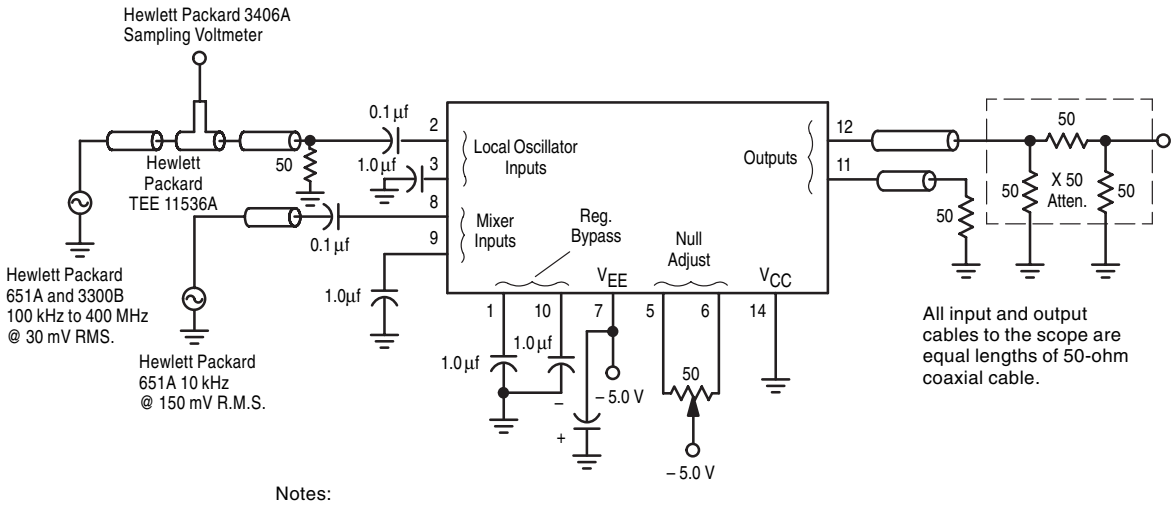


Figure 7. Carrier Suppression Test Circuit



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)

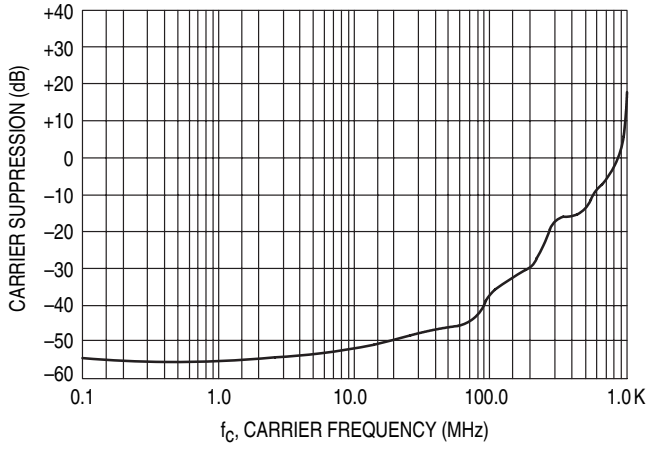


Figure 9. Carrier Suppression versus Frequency
(Test 2)

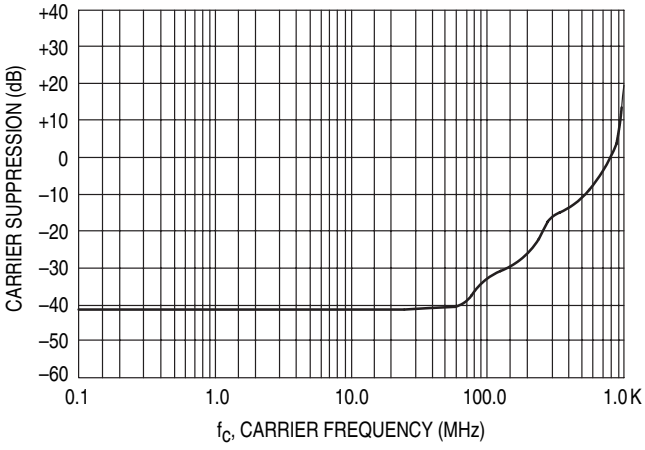


Figure 10. Carrier Suppression versus Temperature

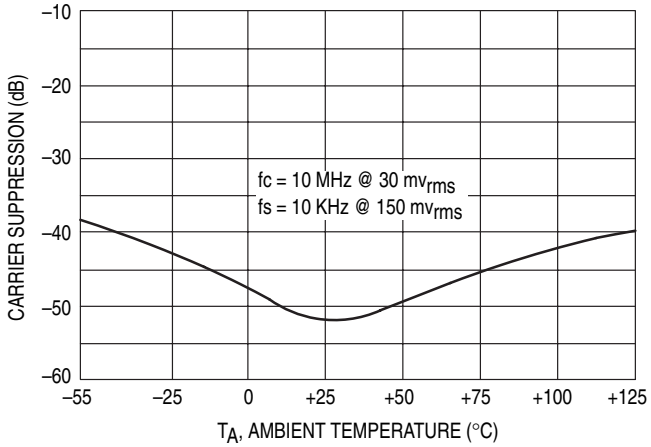
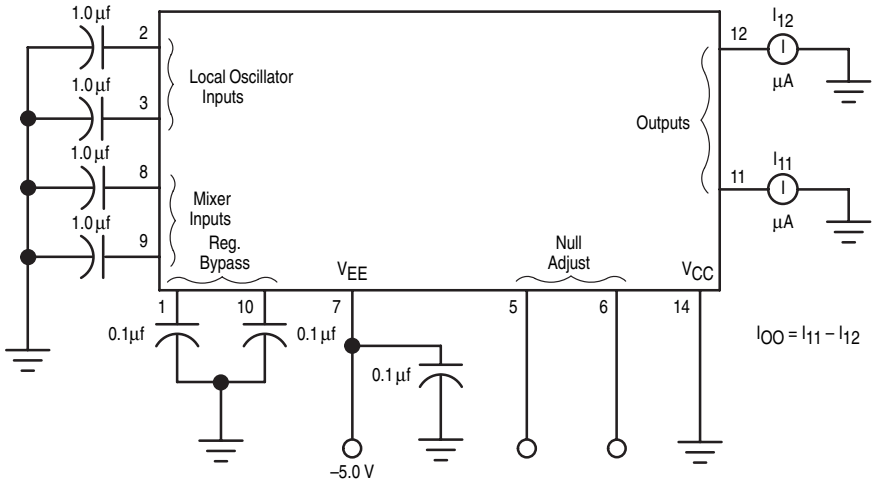


Figure 11. Output Offset Current (I_{OO}) versus Temperature



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

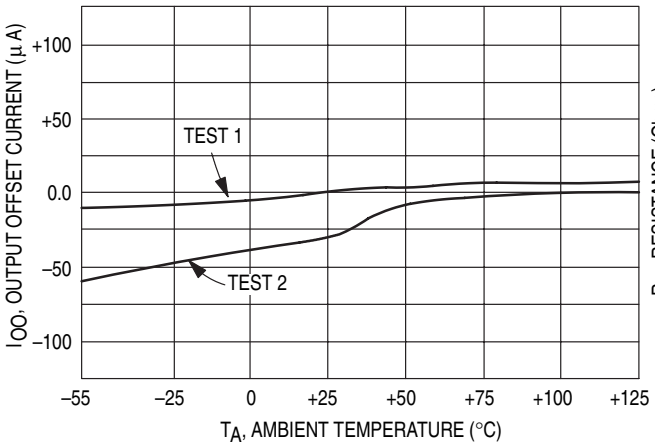
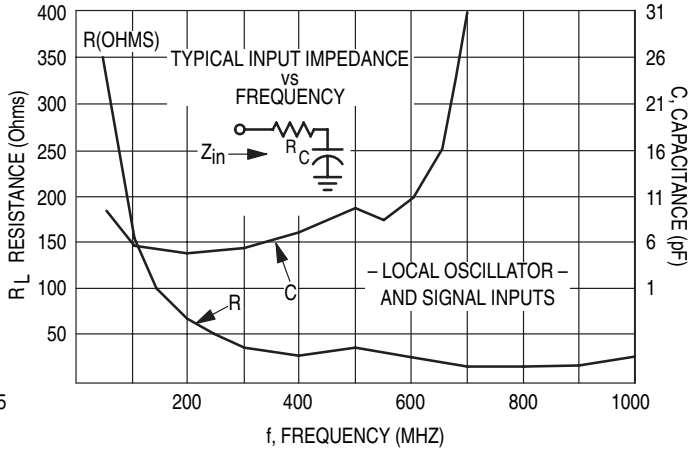


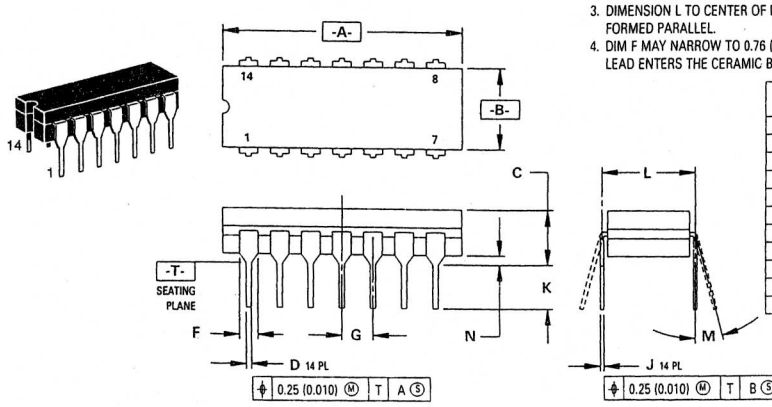
Figure 13. Typical Input Impedance versus Frequency
(No Circuit)



OUTLINE DIMENSIONS

CERDIP 14 = C
(ML12502/BCA)
CASE 632

NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
4. DIM F MAY NARROW TO 0.76 (0.030) WHERE THE LEAD ENTERS THE CERAMIC BODY.



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	19.05	19.94	0.750	0.785
B	6.23	7.11	0.245	0.280
C	3.94	5.08	0.155	0.200
D	0.39	0.50	0.015	0.020
F	1.40	1.65	0.055	0.065
G	2.54 BSC		0.100 BSC	
J	0.21	0.38	0.008	0.015
K	3.18	4.31	0.125	0.170
L	7.62 BSC		0.300 BSC	
M	0°	15°	0°	15°
N	0.51	1.01	0.020	0.040