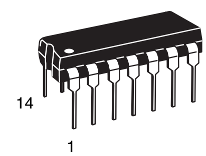
ML12502

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.



CERDIP 14 = C
CERAMIC PACKAGE
CASE 632

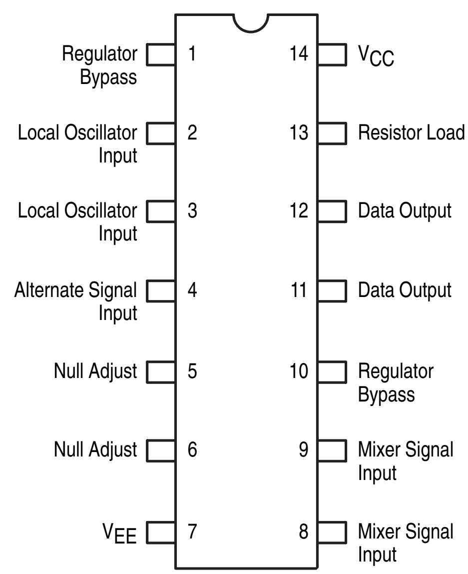
CROSS REFERENCE/ORDERING INFORMATION

PACKAGE	MOTOROLA	LANSDALE
CERDIP 14	12502/BCA	ML12502/BCA

There are two package offerings:

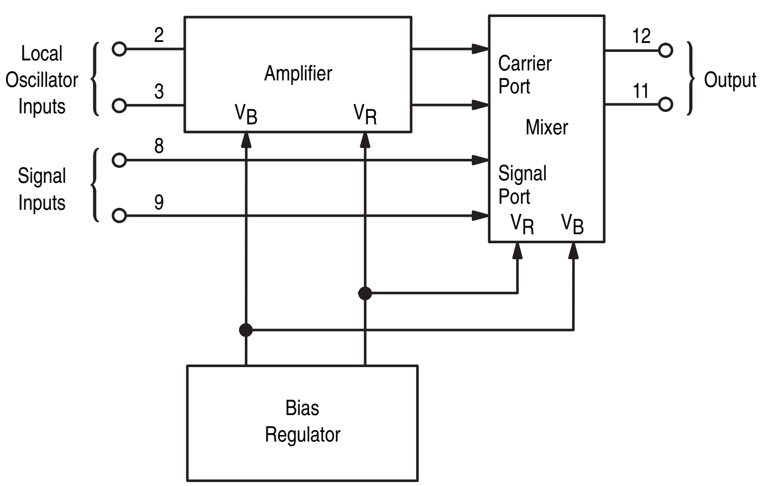
- Dual Inline 14 Lead, Ceramic Package.
- Operating Temperature Range: T_A = –55° to +125°C

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		+ 125 °C		- 55 °C			Pinouts referenced are for DIL package, check Pin Assignments Output Load = 50 Ω to GND					
		Subgroup 9		Subgroup 10		Subgroup 11								
		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

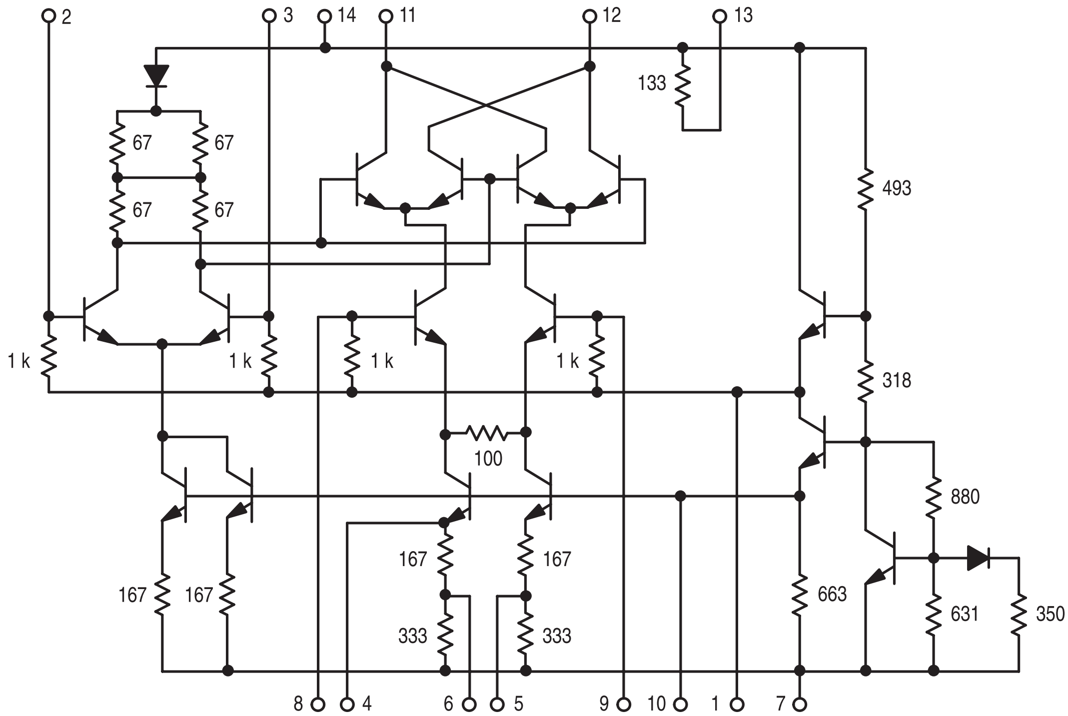
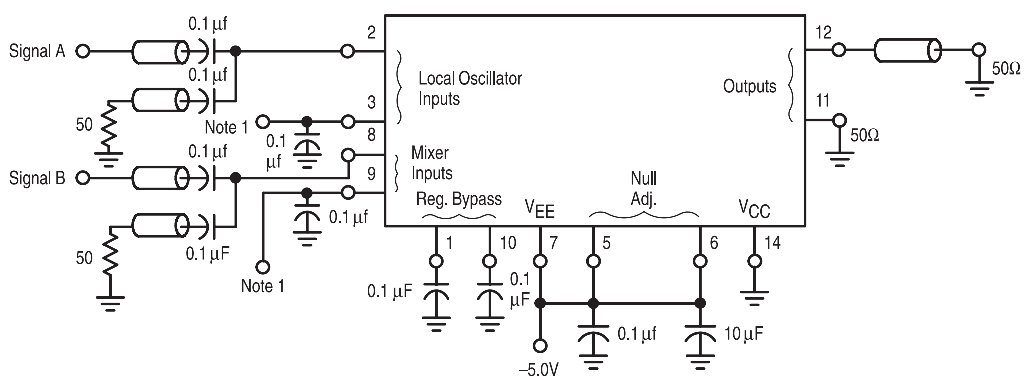


Figure 3. AC Gain Test



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.

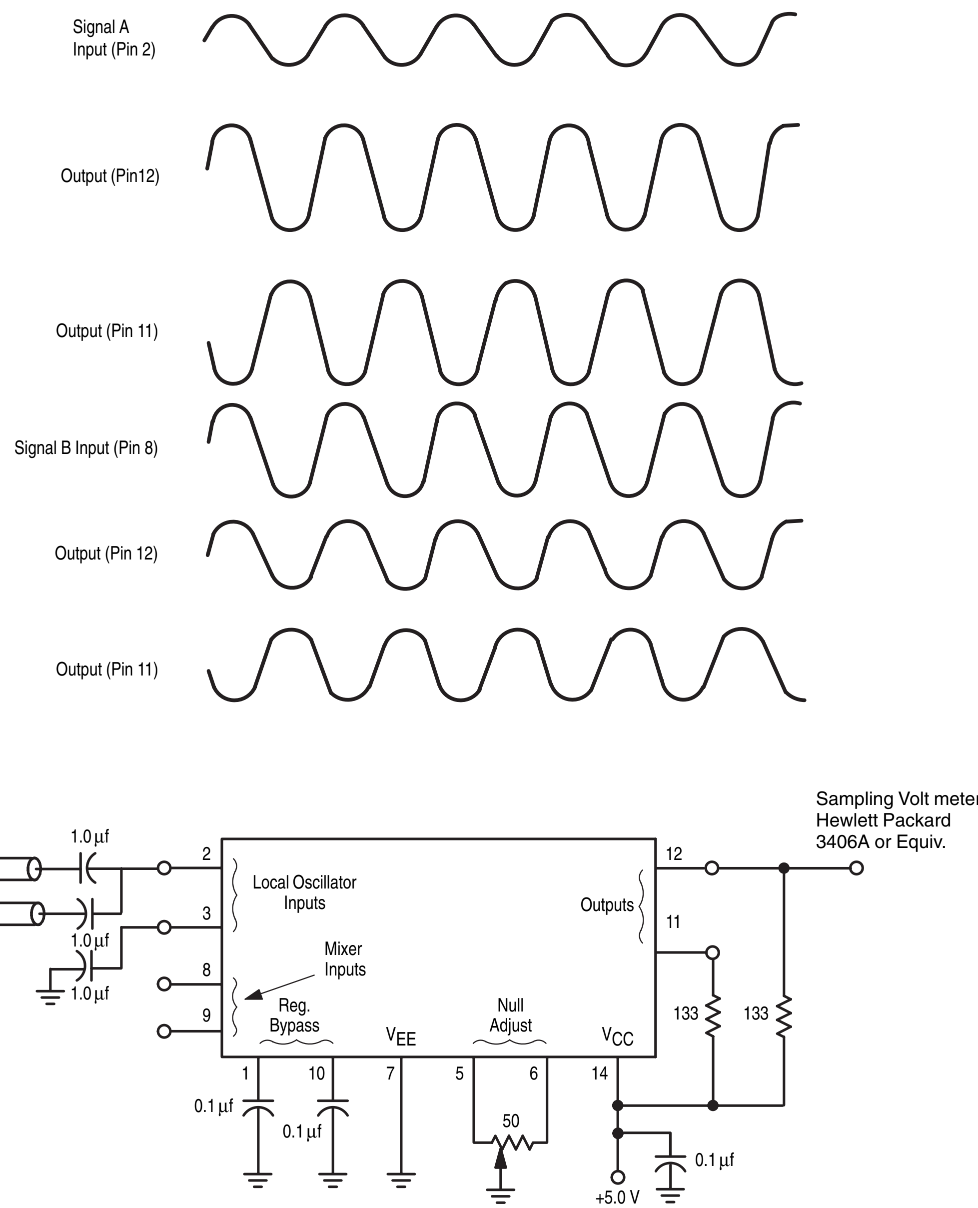
Signal A = 30 mVpp

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)

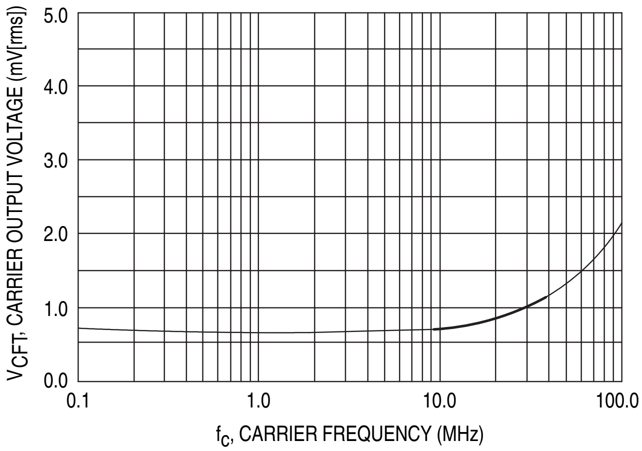


Figure 6. Carrier Feedthrough versus Frequency
(Test 2)

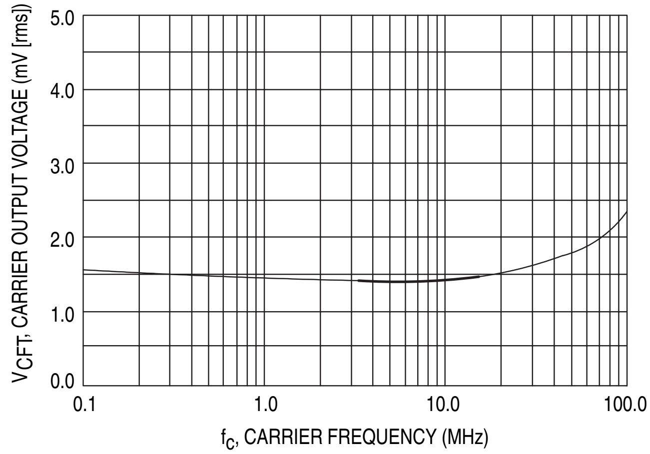
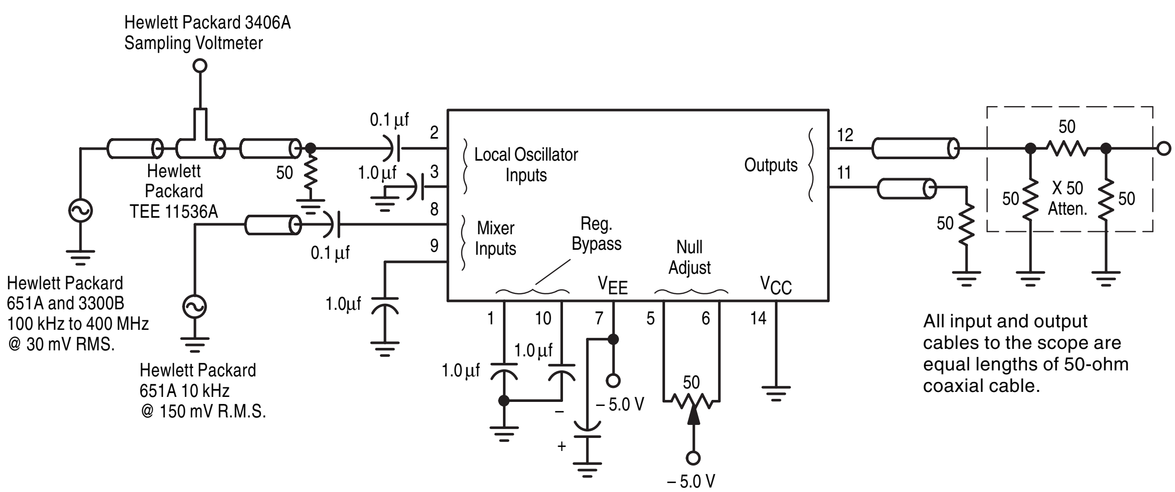


Figure 7. Carrier Suppression Test Circuit



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)

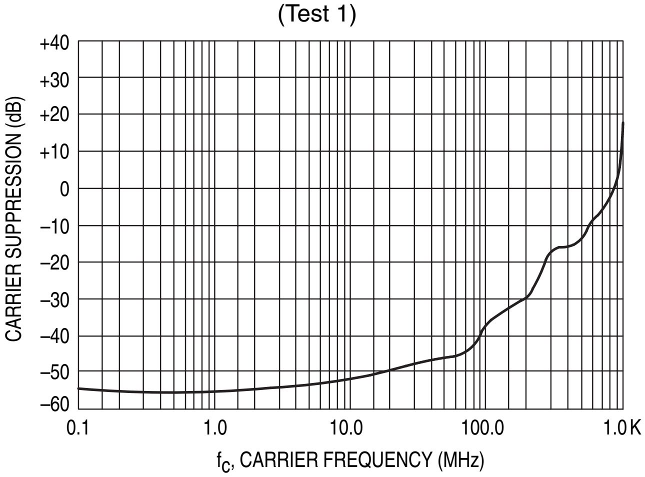


Figure 9. Carrier Suppression versus Frequency
(Test 2)

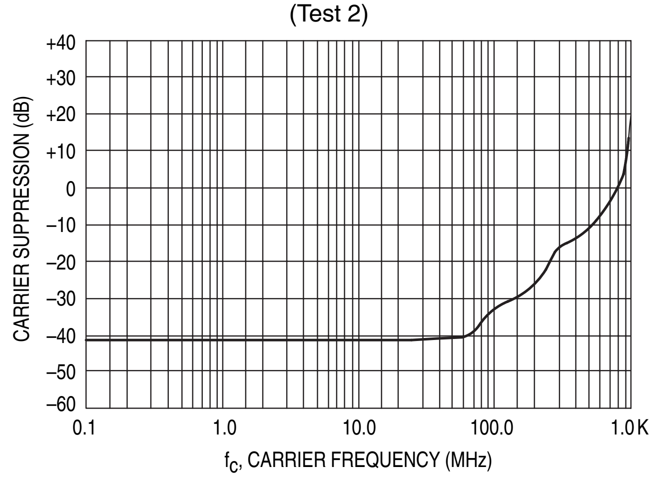


Figure 10. Carrier Suppression versus Temperature

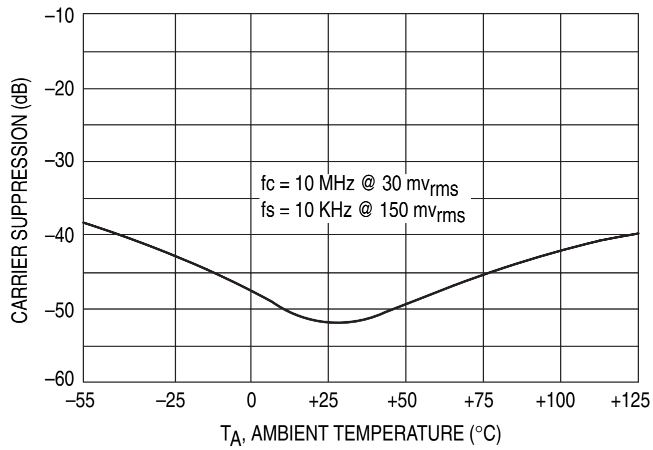
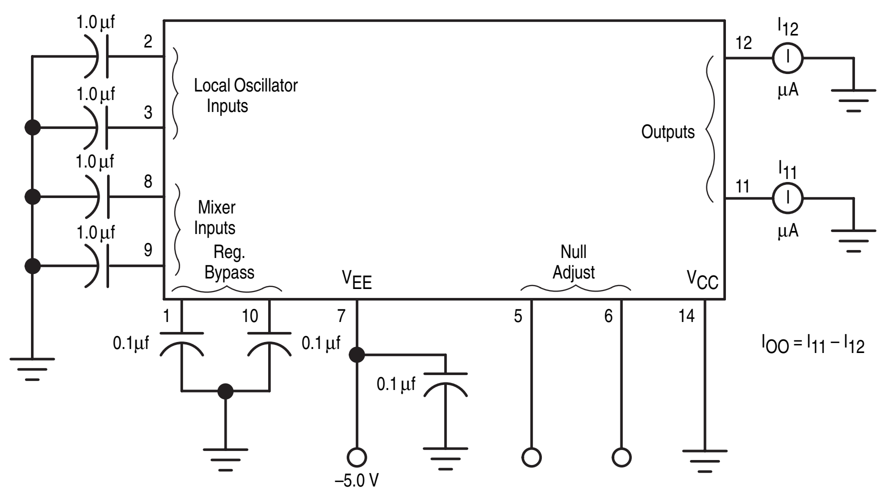


Figure 11. Output Offset Current (I_{OO}) versus Temperature



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

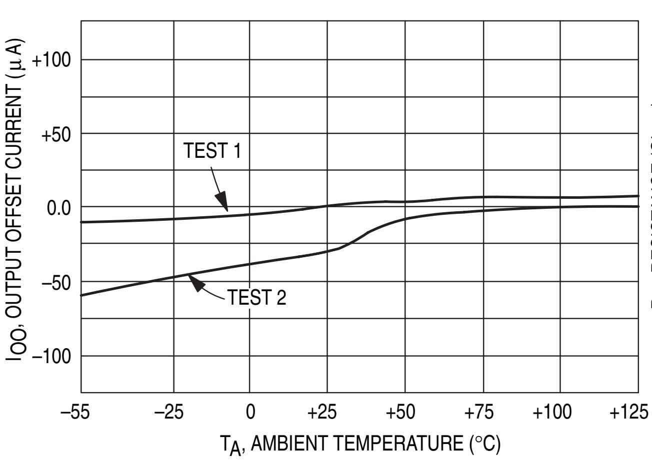
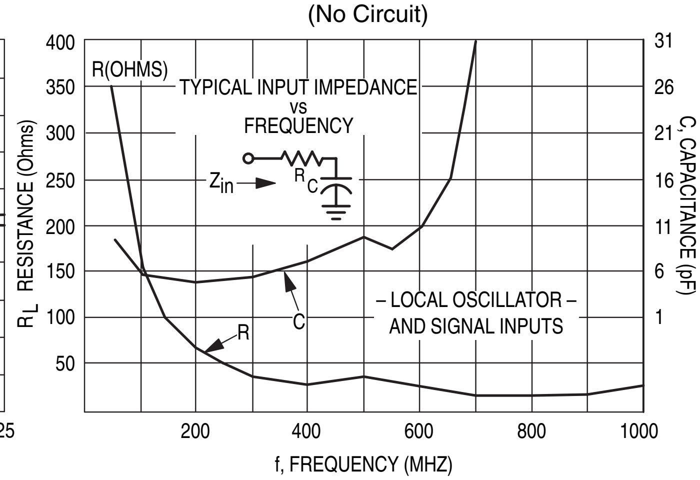


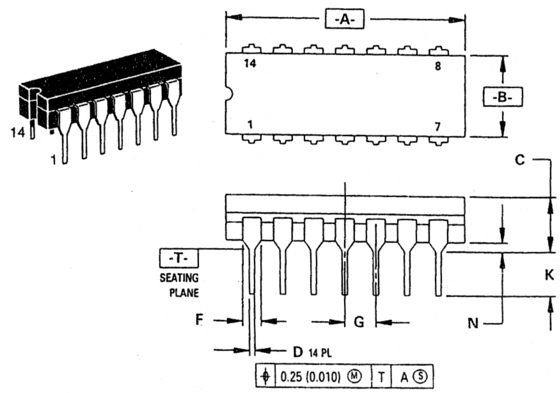
Figure 13. Typical Input Impedance versus Frequency
(No Circuit)

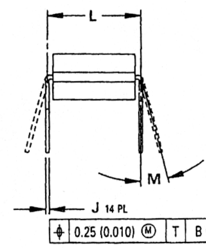


OUTLINE DIMENSIONS

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 MIN	MILLIMETERS MAX	INCHES MIN	INCHES 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