LANSDALE Semiconductor, Inc.

ML12002
Analog Mixer

Legacy Device: *Motorola MC12002*

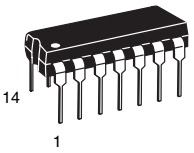
The ML12002 is a double balanced analog mixer, including an input amplifier feeding the mixer carrier port and a temperature compensated bias regulator. The input circuits for both the amplifier and mixer are differential amplifier circuits. The on-chip regulator provides all of the required biasing.

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.

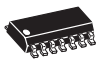
There are two package offerings:

- Plastic Dual Inline 14 Lead, P Dip.
- Plastic Surface Mount 14 Lead SOIC.

- Operating Temperature Range: T_A = –30° to +85°C



P DIP 14 = CP
PLASTIC PACKAGE
CASE 646



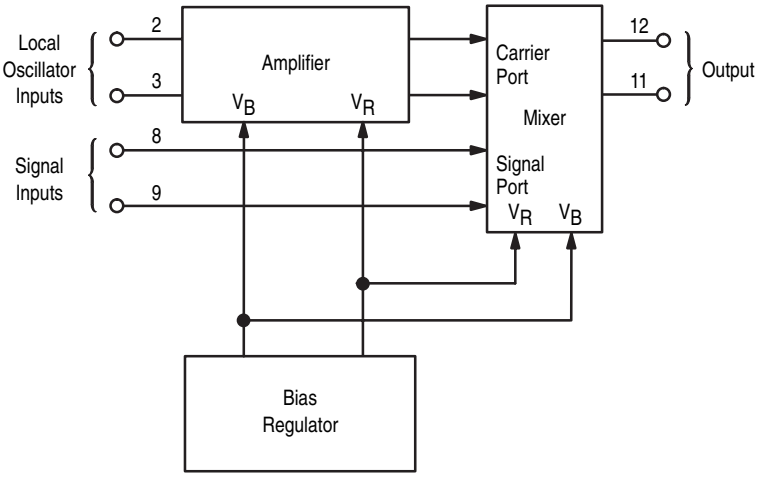
SOG 14 = -5P
SOG
CASE 751A

CROSS REFERENCE/ORDERING INFORMATION

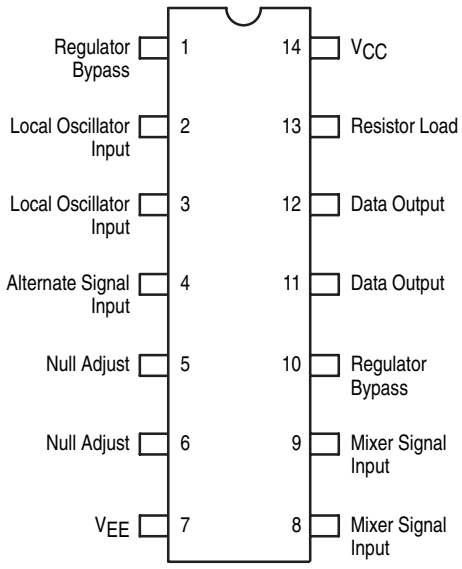
PACKAGE	MOTOROLA	LANSDALE
P DIP 14	MC12002P	ML12002CP
SOG 14	MC12002D	ML12002-5P

Note: Lansdale lead free (**Pb**) product, as it becomes available, will be identified by a part number prefix change from **ML** to **MLE**.

Figure 1. Logic Diagram



PIN CONNECTIONS



(Top View)

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**				
		Pin Under	**–30°C**		**+25°C**		**+85°C**						
Characteristic	**Symbol**	**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

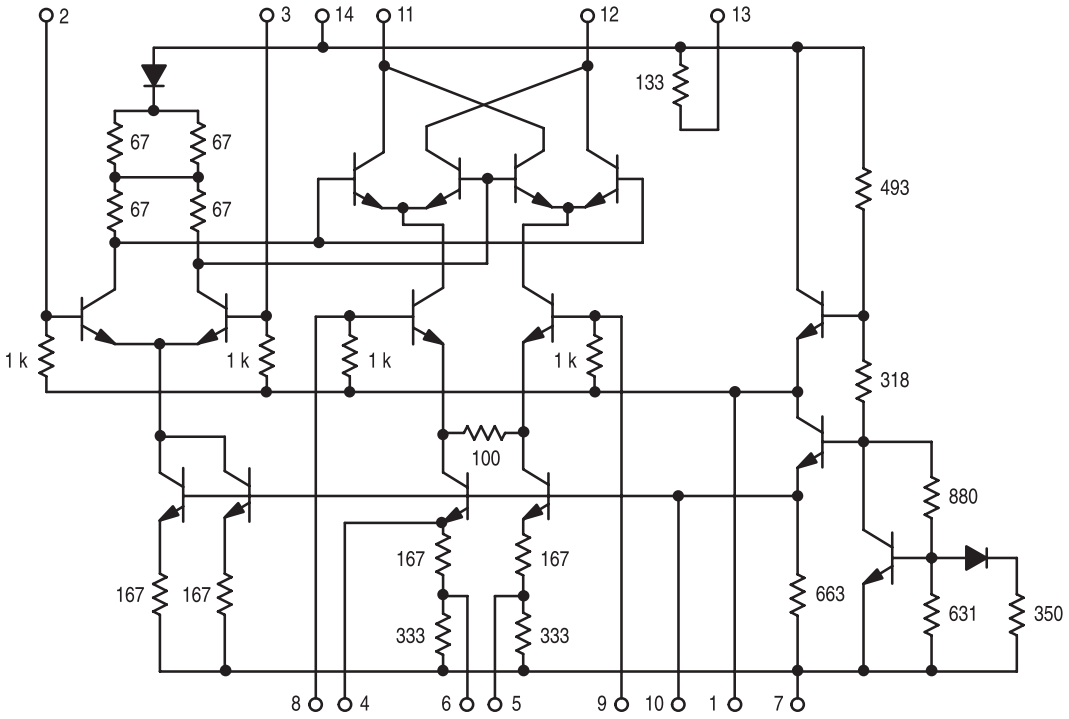
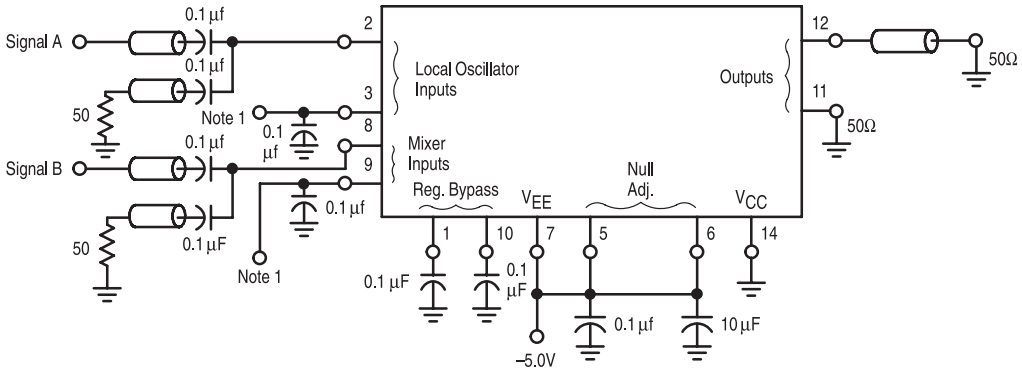


Figure 3. AC Gain Test



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.

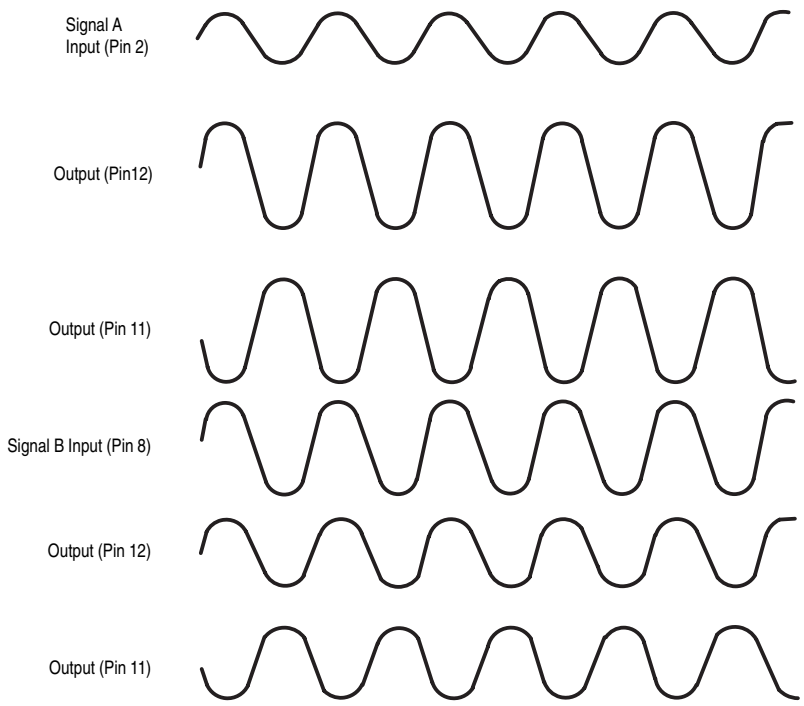
Signal A = 30 mVpp

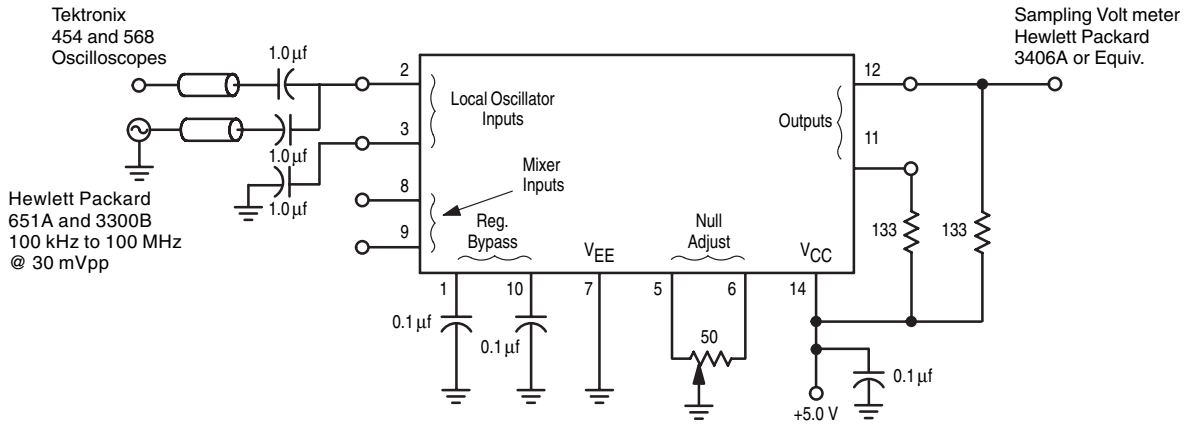
Signal B = 300 mVpp

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)

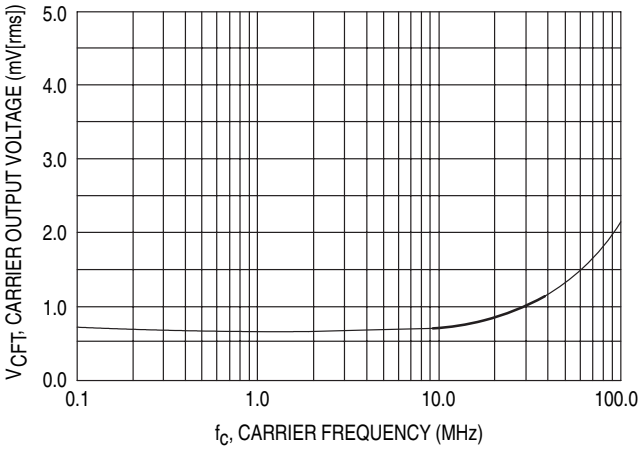


Figure 6. Carrier Feedthrough versus Frequency
(Test 2)

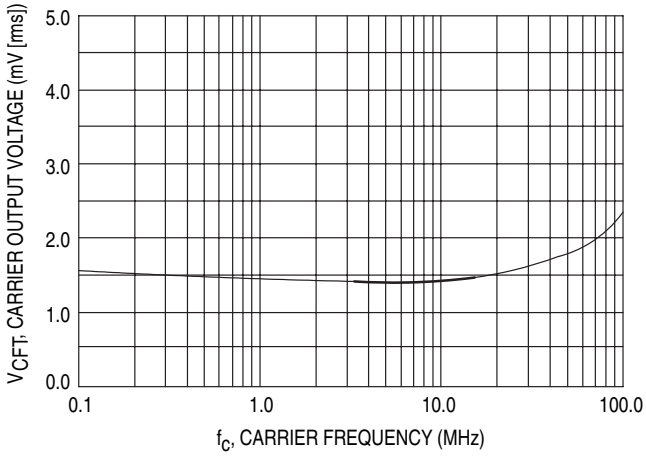
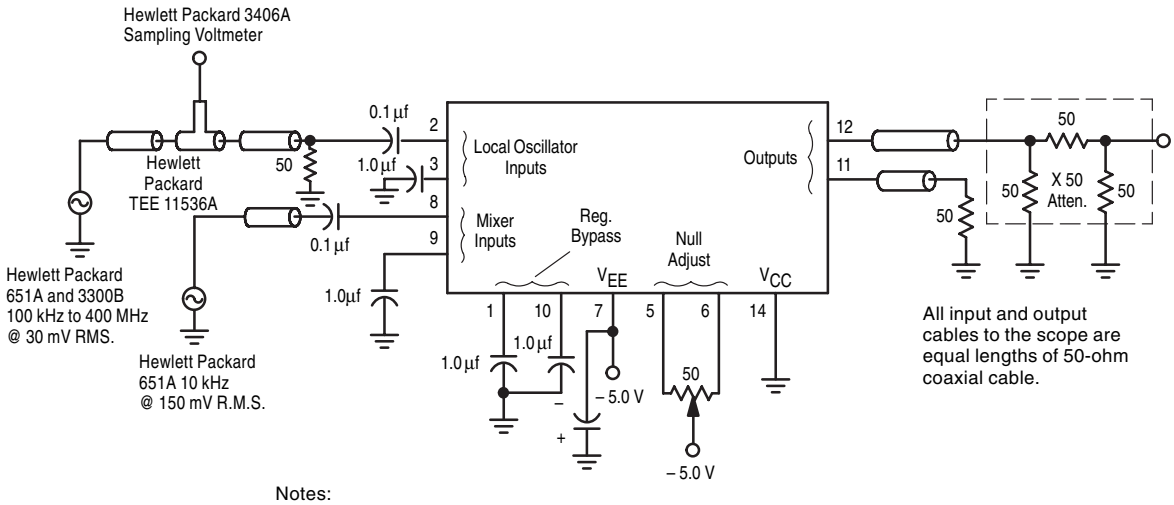


Figure 7. Carrier Suppression Test Circuit



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)

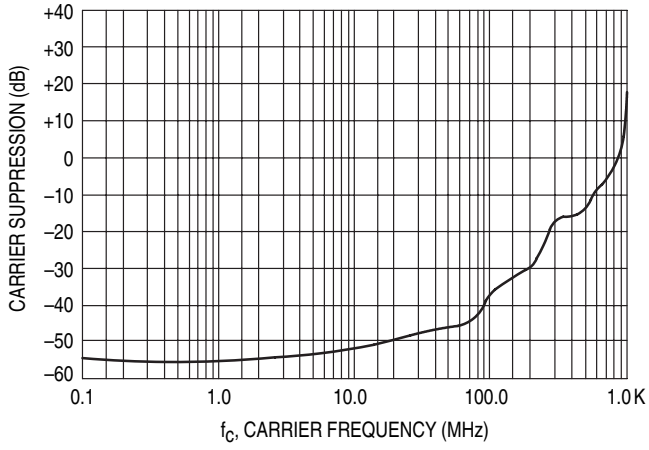


Figure 9. Carrier Suppression versus Frequency
(Test 2)

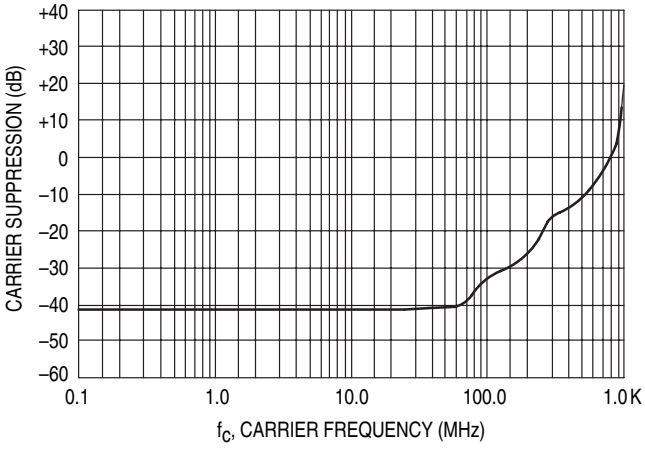


Figure 10. Carrier Suppression versus Temperature

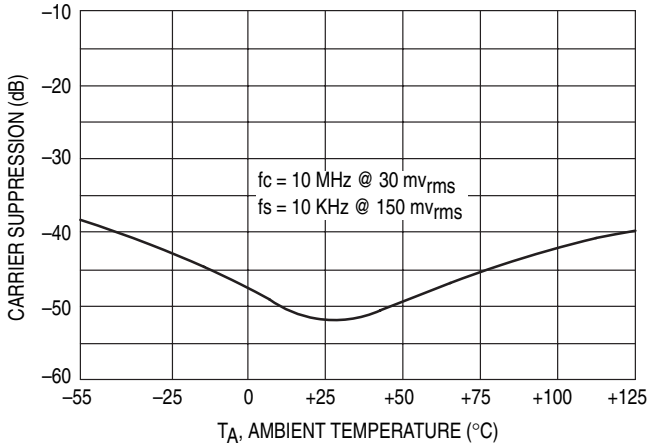
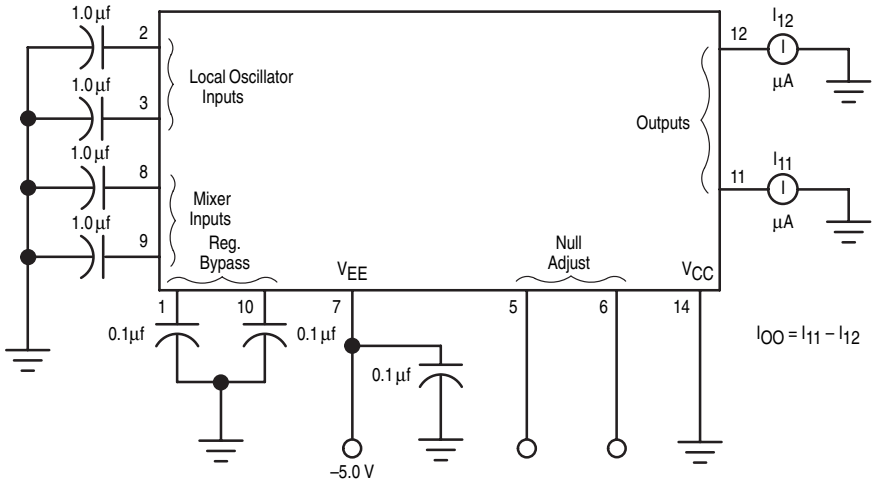


Figure 11a. Output Offset Current (I_{OO}) versus Temperature



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

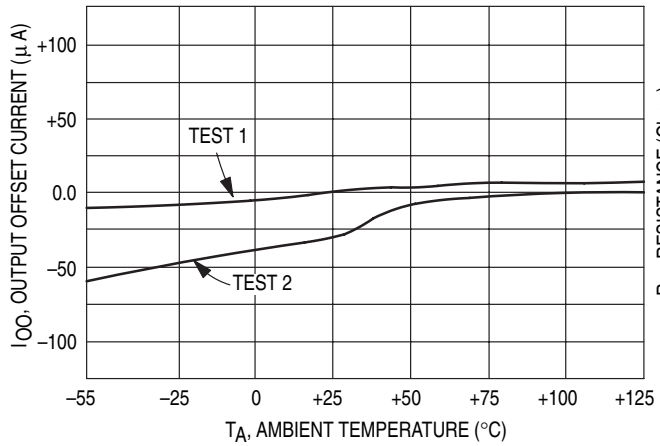
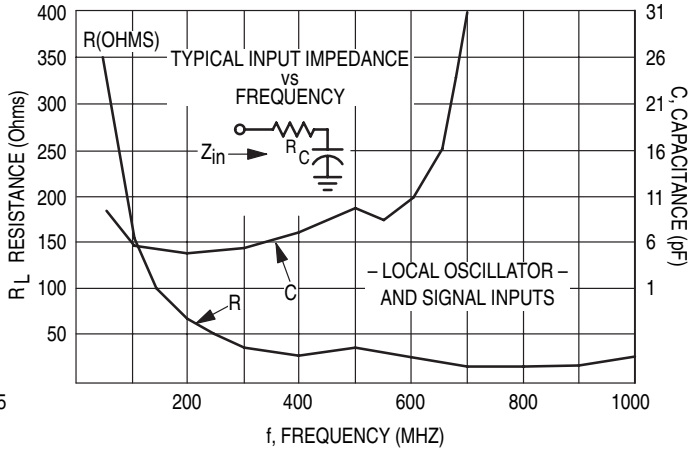


Figure 13. Typical Input Impedance versus Frequency
(No Circuit)



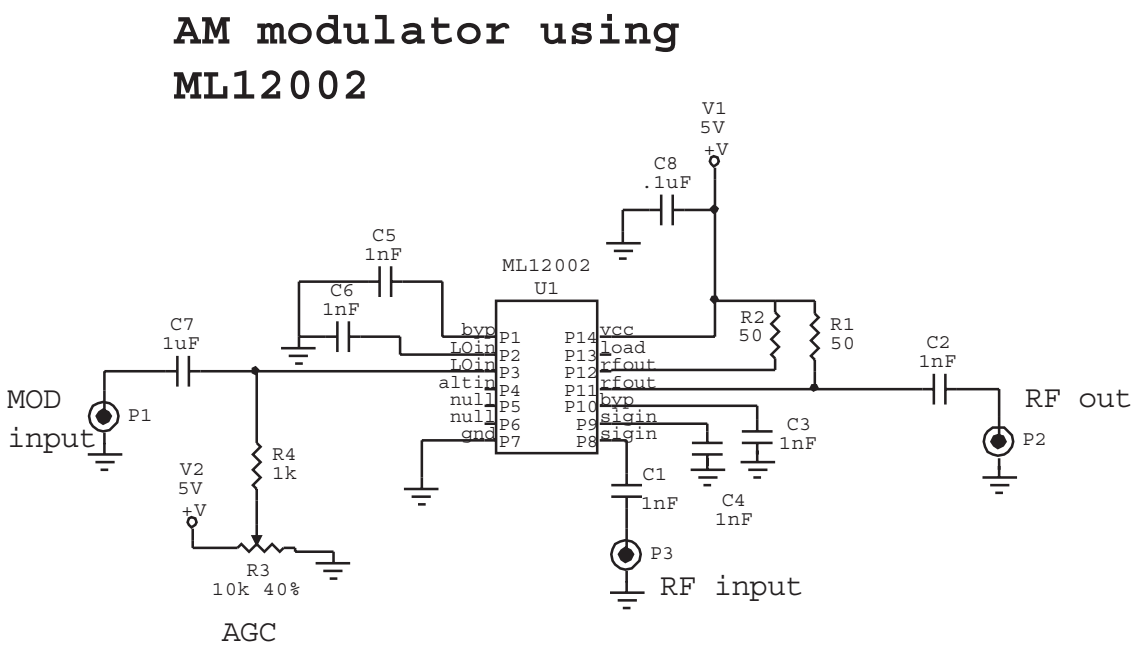
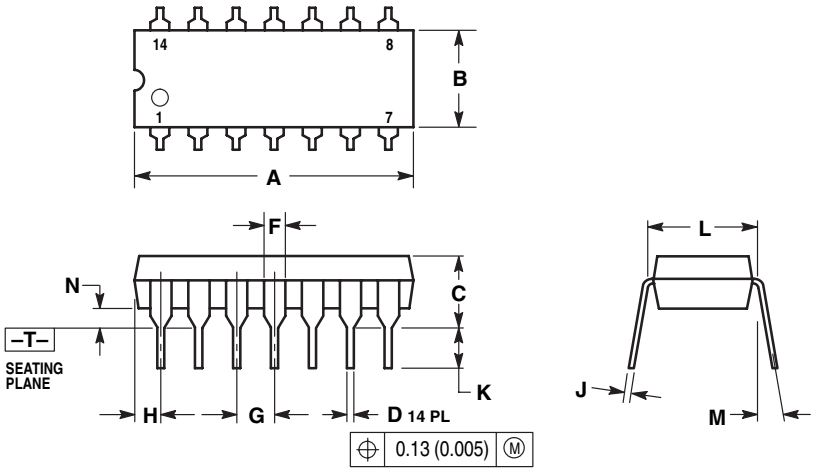


Figure 11b. Application Circuite Using ML12002 as a AM Modulator

OUTLINE DIMENSIONS

P DIP 14 = CP
PLASTIC PACKAGE
(ML12002CP)
CASE 646–06
ISSUE M

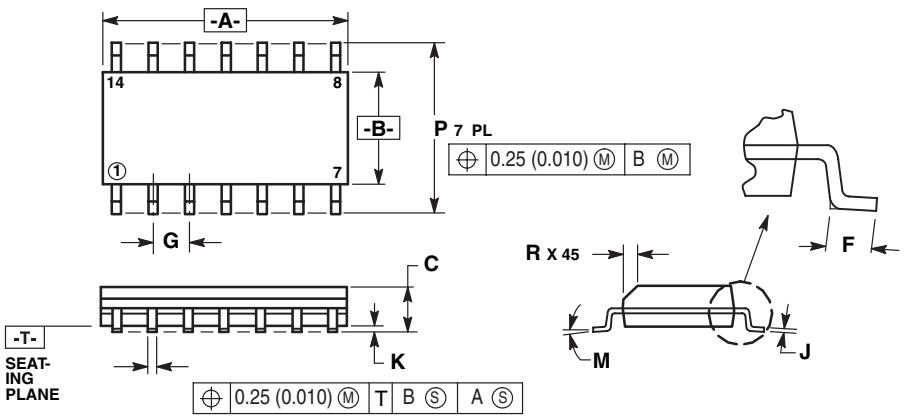


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

	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

OUTLINE DIMENSIONS

SOG 14 = -5P
(ML12002-5P)
CASE 751A-03



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 HOLD 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

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	8.55	8.75	0.337	0.334
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