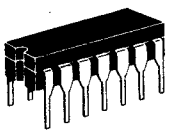
**ANALOG MIXER**

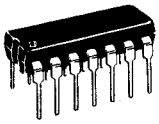
# MC12002
# MC12502

The MC12002/MC12502 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.

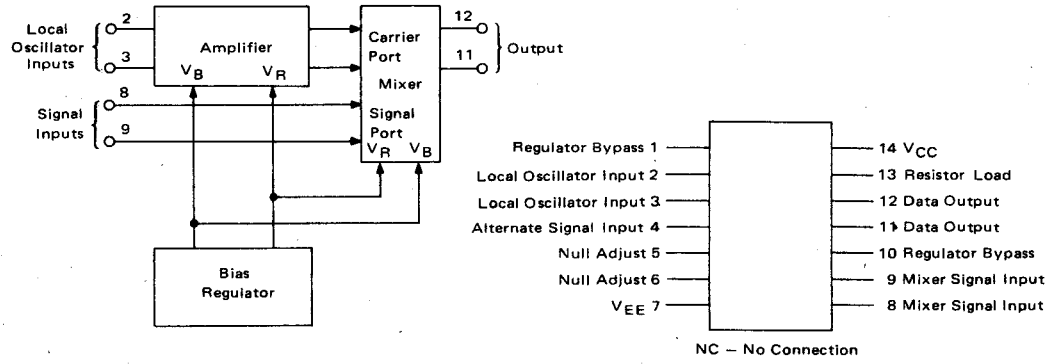


MC12002 – MC12502
**L SUFFIX**
CERAMIC PACKAGE
CASE 632

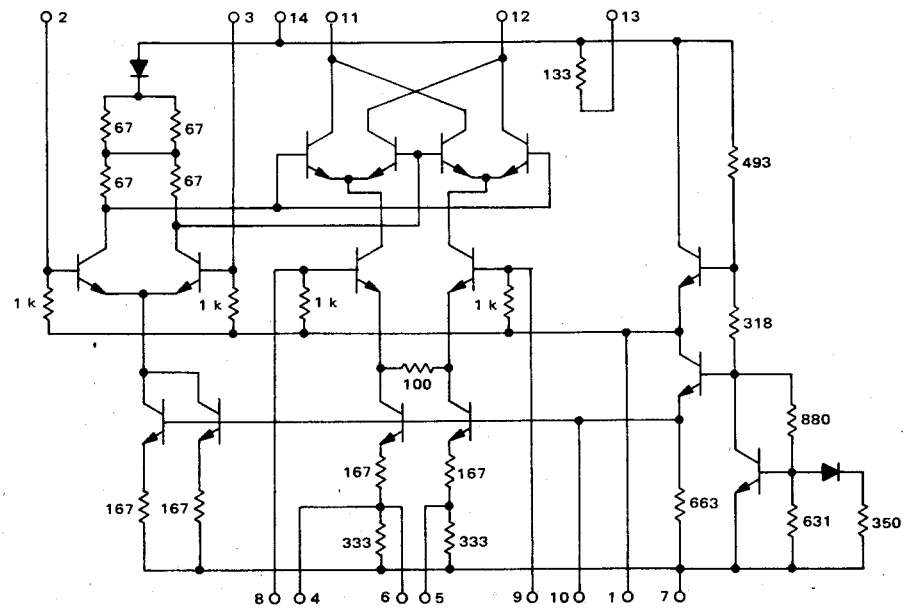


MC12002 only
**P SUFFIX**
PLASTIC PACKAGE
CASE 646

**BLOCK DIAGRAM**




**ANALOG MIXER CIRCUIT SCHEMATIC**

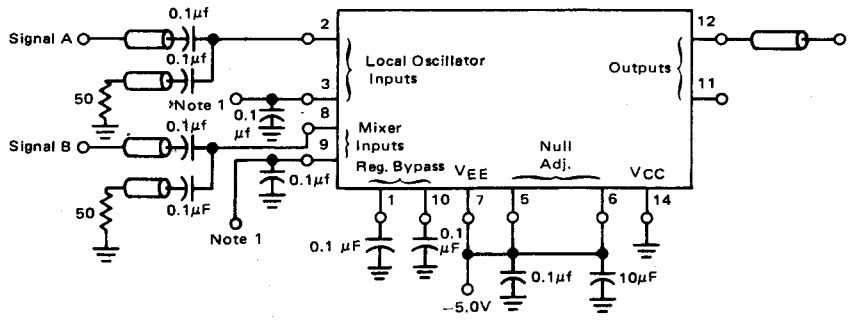


## ELECTRICAL CHARACTERISTICS

| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | TEST VOLTAGE VALUES | | | | | |
| | | | | | | | | | | | | | | | | | Volts | | | | | |
| | | | | | | | | | | | | | | | | | $V_{IHmax}$ | $V_{ILmin}$ | $V_{CC}$ | | | |
| | | | | | | | | | | | | | | | | MC12502 | +2.9 | +2.0 | +5.0 | | | |
| | | | | | | | | | | | | | | | | MC12002 | +2.9 | +2.0 | +5.0 | | | |
| | | | MC12502 Test Limits | | | | | | | MC12002 Test Limits | | | | | | | VOLTAGE APPLIED TO PINS LISTED BELOW | | | | | |
| | | Pin Under | −55°C | | +25°C | | +125°C | | | −30°C | | +25°C | | +85°C | | | | | | | | |
| Characteristic | Symbol | Test | Min | Max | Min | Max | Min | Max | Unit | Min | Max | Min | Max | Min | Max | Unit | $V_{IHmax}$ | $V_{ILmin}$ | $V_{CC}$ | Gnd | | |
| Power Supply Drain | $I_{CC}$ | 14 | – | – | – | 16 | – | – | mAdc | – | – | – | 16 | – | – | mAdc | – | – | 11,12,14 | 5,6,7 | | |
| Input Current | $I_{inH}$ | 2 | – | – | – | 0.75 | – | – | mAdc | – | – | – | 0.75 | – | – | mAdc | 2 | – | 11,12,14 | 5,6,7 | | |
| | | 3 | – | – | – | 0.75 | – | – | mAdc | – | – | – | 0.75 | – | – | mAdc | 3 | – | 11,12,14 | 5,6,7 | | |
| | | 8 | – | – | – | 0.75 | – | – | mAdc | – | – | – | 0.75 | – | – | mAdc | 8 | – | 11,12,14 | 5,6,7 | | |
| | | 9 | – | – | – | 0.75 | – | – | mAdc | – | – | – | 0.75 | – | – | mAdc | 9 | – | 11,12,14 | 5,6,7 | | |
| | $I_{inL}$ | 2 | – | – | −0.7 | – | – | – | mAdc | – | – | −0.7 | – | – | – | mAdc | – | 2 | 11,12,14 | 5,6,7 | | |
| | | 3 | – | – | −0.7 | – | – | – | mAdc | – | – | −0.7 | – | – | – | mAdc | – | 3 | 11,12,14 | 5,6,7 | | |
| | | 8 | – | – | −0.7 | – | – | – | mAdc | – | – | −0.7 | – | – | – | mAdc | – | 8 | 11,12,14 | 5,6,7 | | |
| | | 9 | – | – | −0.7 | – | – | – | mAdc | – | – | −0.7 | – | – | – | mAdc | – | 9 | 11,12,14 | 5,6,7 | | |
| Output Current | $IO_1$ | 11 | – | – | 0.7 | 1.3 | – | – | mAdc | – | – | 0.7 | 1.3 | – | – | mAdc | – | – | 11,12,14 | 7 | | |
| | | 12 | – | – | 0.7 | 1.3 | – | – | mAdc | – | – | 0.7 | 1.3 | – | – | mAdc | – | – | 11,12,14 | 7 | | |
| | $IO_2$ | 11 | – | – | 2.1 | 3.9 | – | – | mAdc | – | – | 2.1 | 3.9 | – | – | mAdc | – | – | 11,12,14 | 5,6,7 | | |
| | | 12 | – | – | 2.1 | 3.9 | – | – | mAdc | – | – | 2.1 | 3.9 | – | – | mAdc | – | – | 11,12,14 | 5,6,7 | | |
| | $I_{out}$ | 11 | – | – | 4.2 | 7.8 | – | – | mAdc | – | – | 4.2 | 7.8 | – | – | mAdc | 2,9 | – | 11,12,14 | 5,6 | | |
| | | 11 | – | – | 4.2 | 7.8 | – | – | mAdc | – | – | 4.2 | 7.8 | – | – | mAdc | 3,8 | – | 11,12,14 | 5,6 | | |
| | | 12 | – | – | 4.2 | 7.8 | – | – | mAdc | – | – | 4.2 | 7.8 | – | – | mAdc | 2,8 | – | 11,12,14 | 5,6 | | |
| | | 12 | – | – | 4.2 | 7.8 | – | – | mAdc | – | – | 4.2 | 7.8 | – | – | mAdc | 3,9 | – | 11,12,14 | 5,6 | | |
| Differential Current | $\Delta IO_1$ | 11,12 | −50 | +50 | −50 | +50 | −50 | +50 | µAdc | −100 | +100 | −100 | +100 | −100 | +100 | µAdc | – | – | 11,12,14 | 7 | | |
| | $\Delta IO_2$ | 11,12 | −100 | +100 | −100 | +100 | −100 | +100 | µAdc | −200 | +200 | −200 | +200 | −200 | +200 | µAdc | – | – | 11,12,14 | 5,6,7 | | |
| Bias Voltage | $V_{Bias}$ | 1 | 2.34 | 2.54 | 2.32 | 2.52 | 2.29 | 2.49 | Vdc | 2.33 | 2.53 | 2.32 | 2.52 | 2.30 | 2.50 | Vdc | – | – | 11,12,14 | 5,6,7 | | |
| | | 4 | 390 | 590 | 400 | 600 | 420 | 620 | mVdc | 390 | 590 | 400 | 600 | 410 | 610 | mVdc | – | – | 11,12,14 | 5,6,7 | | |
| | | 5 | 275 | 415 | 285 | 425 | 305 | 445 | mVdc | 275 | 415 | 285 | 425 | 295 | 435 | mVdc | – | – | 11,12,14 | 7 | | |
| | | 6 | 275 | 415 | 285 | 425 | 305 | 445 | mVdc | 275 | 415 | 285 | 425 | 295 | 435 | mVdc | – | – | 11,12,14 | 7 | | |
| | | 10 | 1.300 | 1.500 | 1.185 | 1.385 | 1.050 | 1.250 | Vdc | 1.260 | 1.460 | 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 | – | – | 6.0 | – | – | – | V/V | – | – | 5.0 | – | – | – | V/V | 2 | 11 | 9 | 14 | 7 | |
| (Frequency = 100 MHz) *Note | | 11 | – | – | 0.33 | – | – | – | V/V | – | – | 0.28 | – | – | – | V/V | 8 | 11 | 3 | 14 | 7 | |

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

FIGURE 1 – A.C. 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 mV p-p

Signal B = 300 mV p-p

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.

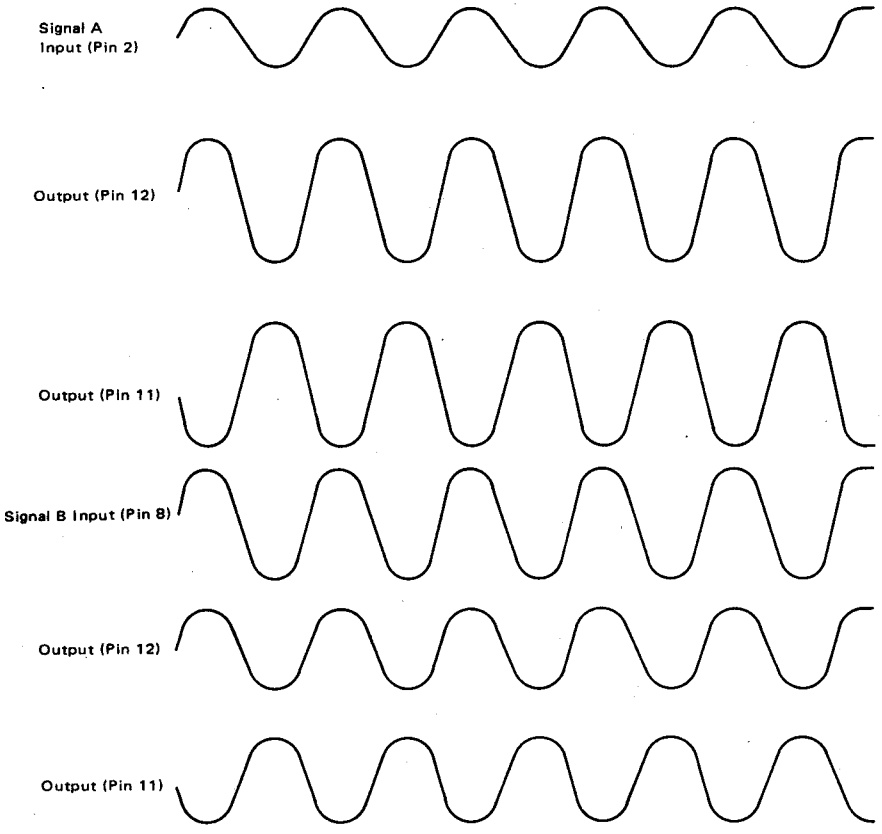


FIGURE 2 – CARRIER FEEDTHROUGH TEST CIRCUITS

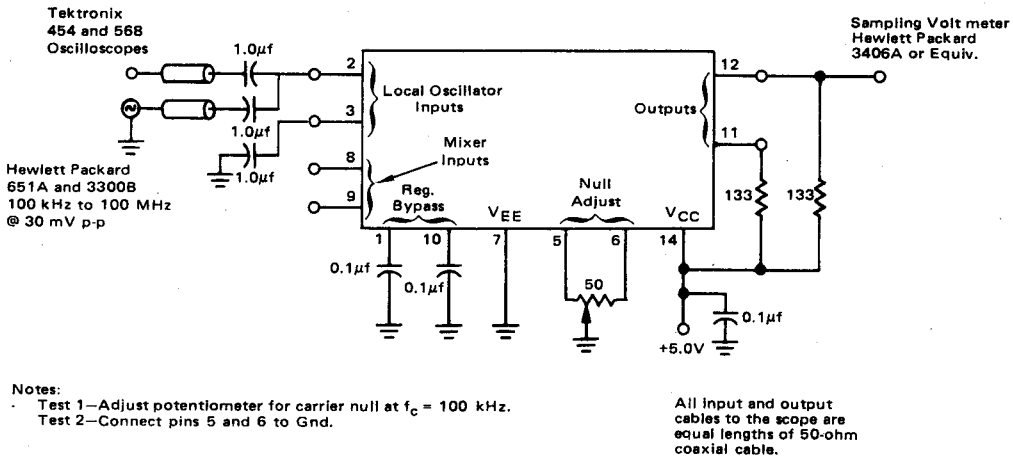



FIGURE 3 – CARRIER FEEDTHROUGH VERSUS FREQUENCY (Test 1)

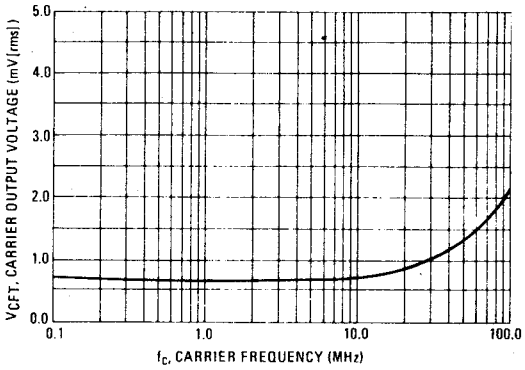



FIGURE 4 – CARRIER FEEDTHROUGH VERSUS FREQUENCY (Test 2)

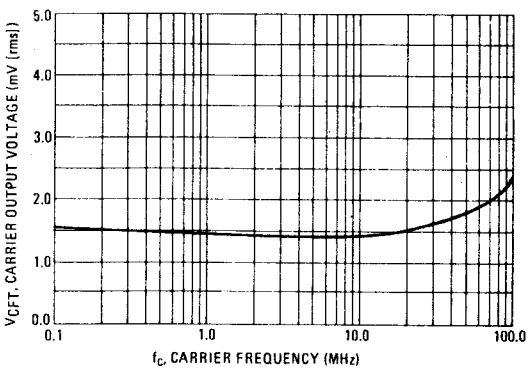
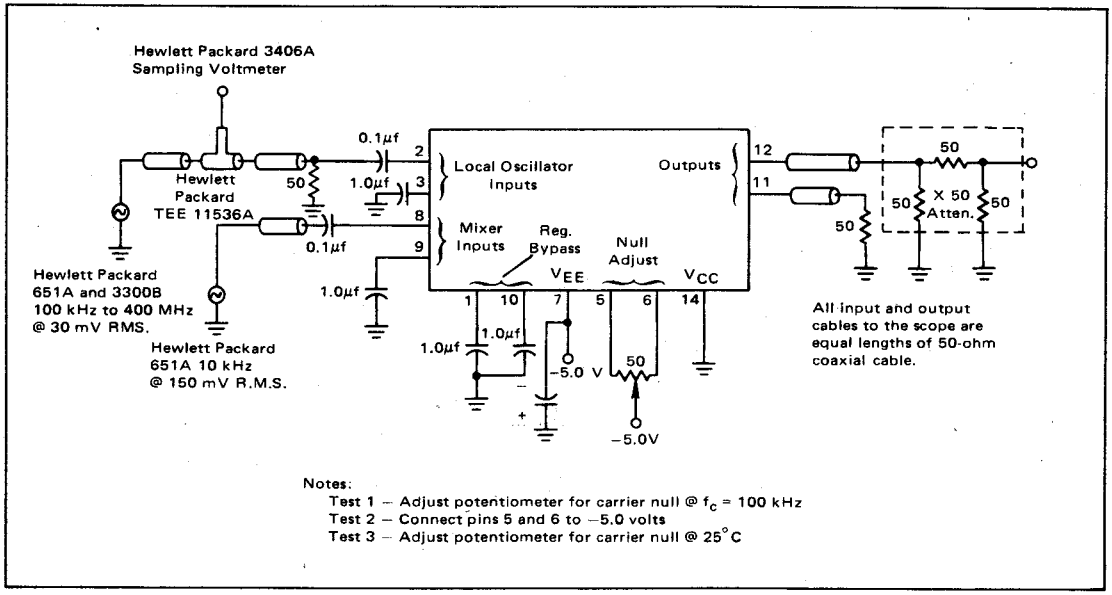


**FIGURE 5 – CARRIER SUPPRESSION TEST CIRCUIT**




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 6 – CARRIER SUPPRESSION VERSUS FREQUENCY (Test 1)**

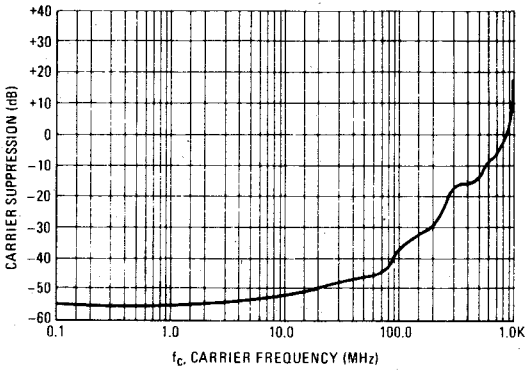



**FIGURE 7 – CARRIER SUPPRESSION VERSUS FREQUENCY (Test 2)**

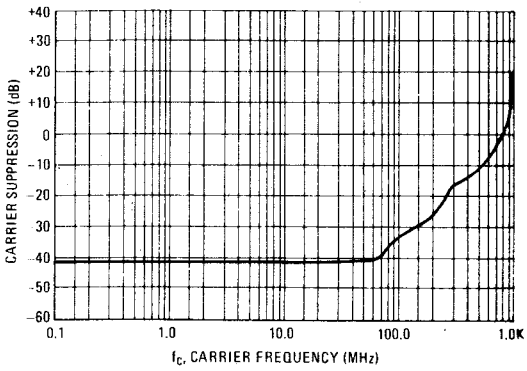



**FIGURE 8 – CARRIER SUPPRESSION VERSUS TEMPERATURE**

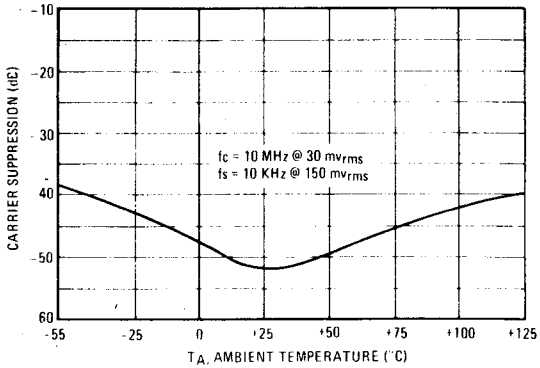
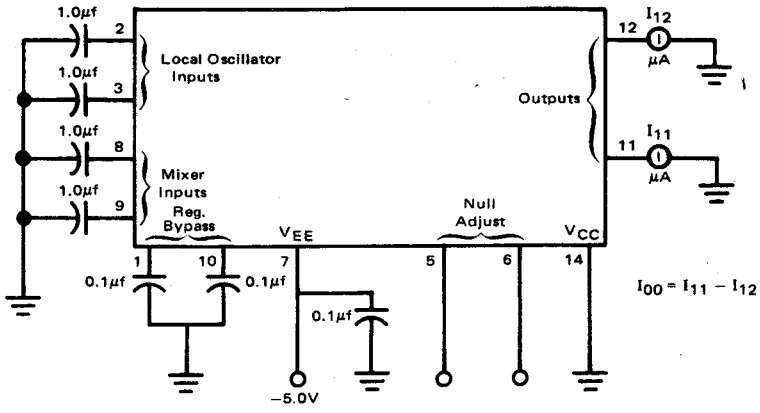


**FIGURE 9 – OUTPUT OFFSET CURRENT ($I_{00}$) VERSUS TEMPERATURE**




Notes:
Test 1 – Pins 5 and 6 left open
Test 2 – Pins 5 and 6 are tied to −5.0 volts

**FIGURE 10 – OUTPUT OFFSET CURRENT VERSUS TEMPERATURE**

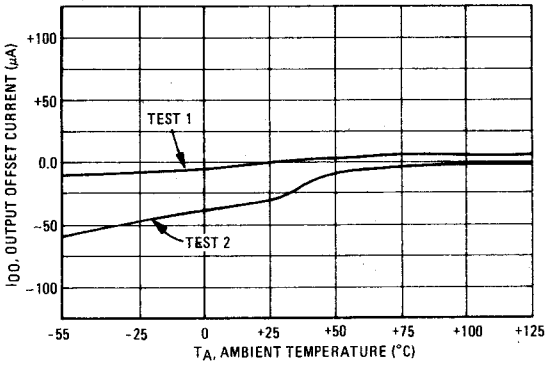



**FIGURE 11 – TYPICAL INPUT IMPEDANCE VERSUS FREQUENCY (NO CIRCUIT)**