

# ULTRA-REL<sup>®</sup> Ceramic Hermetic Frequency Mixers

## MAC Series

300 MHz to 12 GHz LO Levels 4 to 17 dBm

### The Big Deal

- 3-Year Guarantee
- Hermetically sealed LTCC construction
- Low-profile case, 0.06" high
- Priced for outstanding VALUE



CASE STYLE: DZ1650

MIL Screening Available  
Please consult Applications Dept.

### Product Overview

Mini-Circuits' MAC mixers employ a unique new design and a highly repeatable, tightly controlled, automated process that delivers industry-leading reliability at a remarkably affordable price. Schottky diode quads meeting our strict specifications are bonded to a multilayer integrated LTCC substrate, and then hermetically sealed under a controlled atmosphere with gold-plated covers and eutectic AuSn solder. These passive, double-balanced mixers are capable of meeting MIL requirements for gross leak, fine leak, thermal shock, vibration, acceleration, mechanical shock, and HTOL (The testing can be done if requested), and every MAC mixer is backed with our 3-year guarantee.

### Key Features

| Feature                           | Advantages                                                                                                                                                                                                                                     |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Low, Flat Conversion Loss         | No need to compensate for variations over frequency.                                                                                                                                                                                           |
| Hermetically Sealed               | Ideal for use anywhere long-term reliability adds bottom-line value: high moisture areas, busy production lines, high-speed distribution centers, heavy industry, outdoor settings, and unmanned facilities, as well as military applications. |
| Rugged LTCC/Hermetic Construction | Demonstrated reliability in harsh, physically abusive environments with high vibration, acceleration, and/or mechanical shock.                                                                                                                 |
| Wide Operating Temperature Range  | Guaranteed performance from -55 to +125°C. MAC mixers have also passed thermal shock testing from -55 to +150°C, through 1000 cycles, 15 minutes per cycle.                                                                                    |
| Exposed Termination Ends          | Our unique case design allows for easy visual inspection of side solder fillets per IPC-A-610 section 8.3.4.6, and features gold-plated terminations for excellent solderability.                                                              |
| Incredible Performance/Price      | Game-changing affordability brings Hi-Rel hermetic mixers within the reach of commercial budgets.                                                                                                                                              |

#### Notes

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B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.  
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# Ceramic, Hermetically Sealed Frequency Mixer WIDE BAND

Level 10 (LO Power+10 dBm) 1600 to 6000 MHz

MAC-60LH+



Generic photo used for illustration purposes only

CASE STYLE: DZ1650

## Maximum Ratings

|                                                                 |                |
|-----------------------------------------------------------------|----------------|
| Operating Temperature                                           | -55°C to 125°C |
| Storage Temperature                                             | -65°C to 150°C |
| RF Power                                                        | 50 mW          |
| IF Current                                                      | 40 mA          |
| Permanent damage may occur if any of these limits are exceeded. |                |

## Pin Connections

|        |               |
|--------|---------------|
| LO     | 10            |
| RF     | 5             |
| IF     | 3             |
| GROUND | 1,2,4,6,7,8,9 |

## Features

- wide bandwidth, 1600 to 6000 MHz
- low conversion loss, 6.5 dB typ.
- excellent L-R isolation, 35 dB typ.
- LTCC double balanced mixer
- aqueous washable
- low cost
- low profile, 0.060"
- protected by US Patent 7,027,795
- 3-YEAR GUARANTEE - The Most Reliable Mixers

## Applications

- PCN
- defense and weather radar
- WCDMA
- defense communications

## +RoHS Compliant

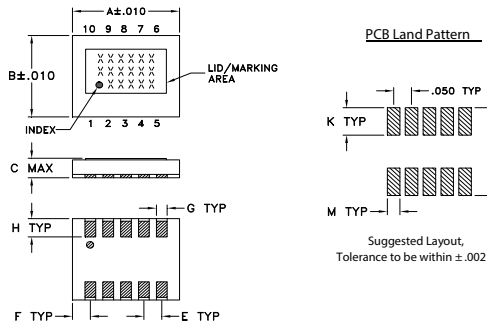
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications



Available Tape and Reel  
at no extra cost

| Reel Size | Devices/Reel     |
|-----------|------------------|
| 7"        | 20, 50, 100, 200 |
| 13"       | 500, 1000        |

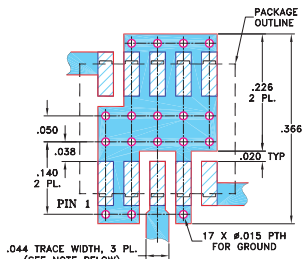
## Outline Drawing



## Outline Dimensions (inch mm)

| A    | B    | C    | D    | E    | F     | G    |
|------|------|------|------|------|-------|------|
| .30  | .250 | .060 | --   | .050 | .050  | .030 |
| 7.62 | 6.35 | 1.52 | --   | 1.27 | 1.27  | 0.76 |
| H    | J    | K    | L    | M    | wt    |      |
| .056 | --   | .085 | .270 | .035 | grams |      |
| 1.42 | --   | 2.16 | 6.86 | 0.89 | 0.29  |      |

## Demo Board MCL P/N: TB-956+ Suggested PCB Layout (PL-045)



NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .020" ± .0015"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.

2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

■ DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)

■ DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

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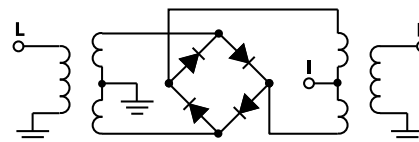
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[www.minicircuits.com](http://www.minicircuits.com) P.O. Box 350166, Brooklyn, NY 11235-0003 (718) 934-4500 [sales@minicircuits.com](mailto:sales@minicircuits.com)

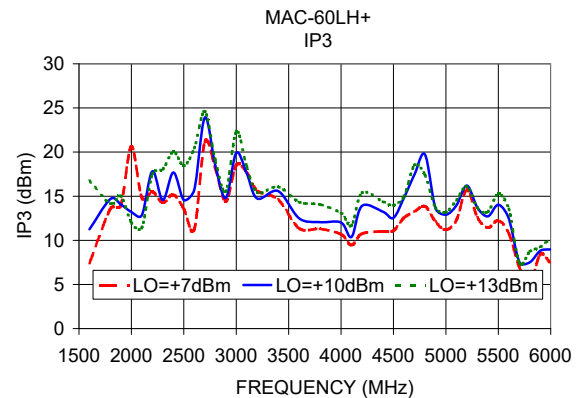
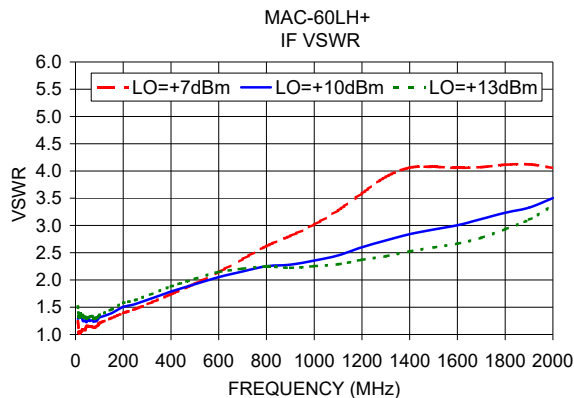
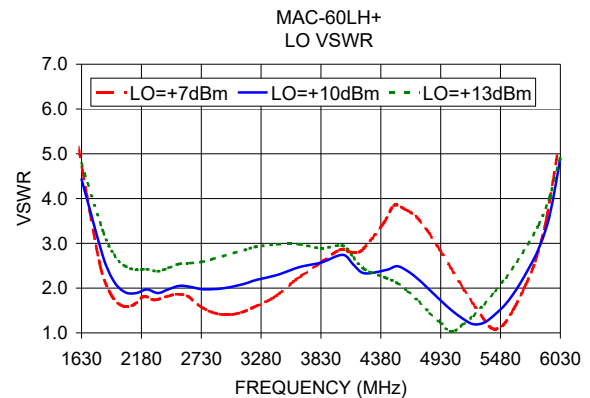
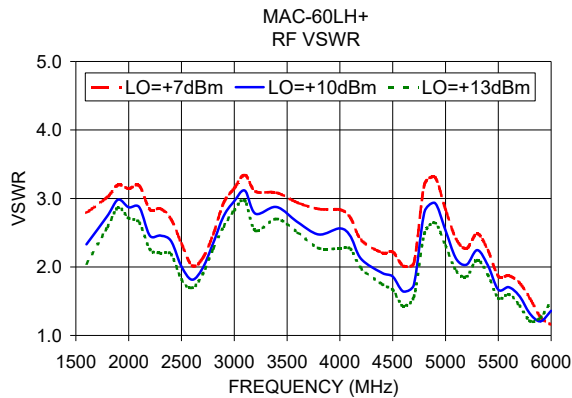
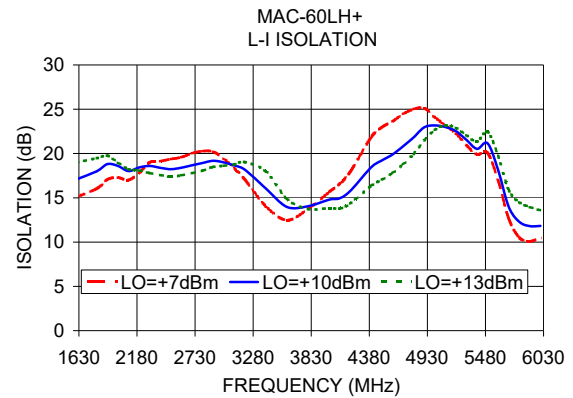
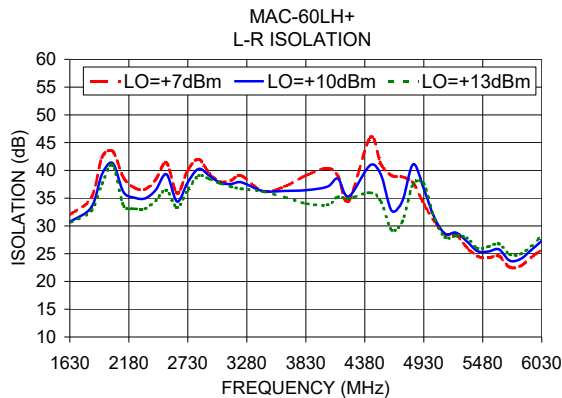
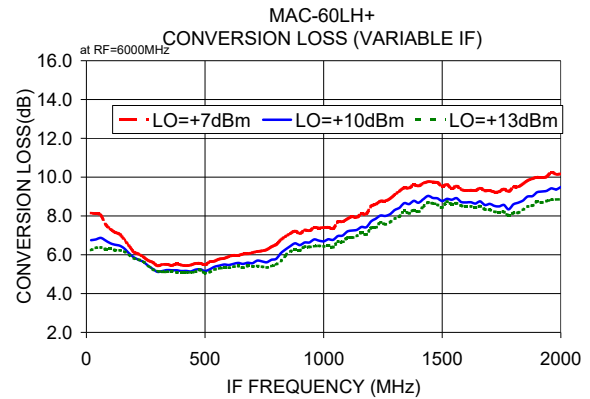
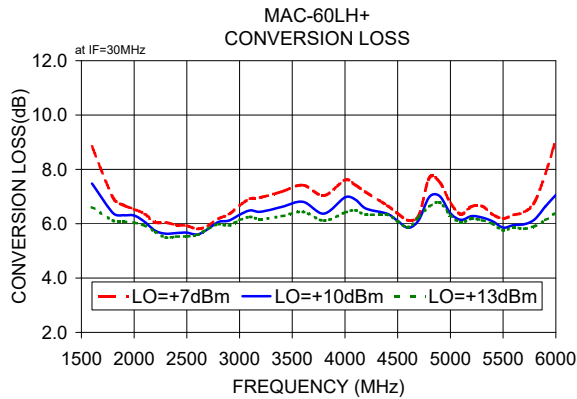
## Electrical Schematic



REV. F  
M175291  
ED-14156/9  
MAC-60LH+  
DJ/CP/AM  
200604  
Page 2 of 4

# Performance Charts

# MAC-60LH+

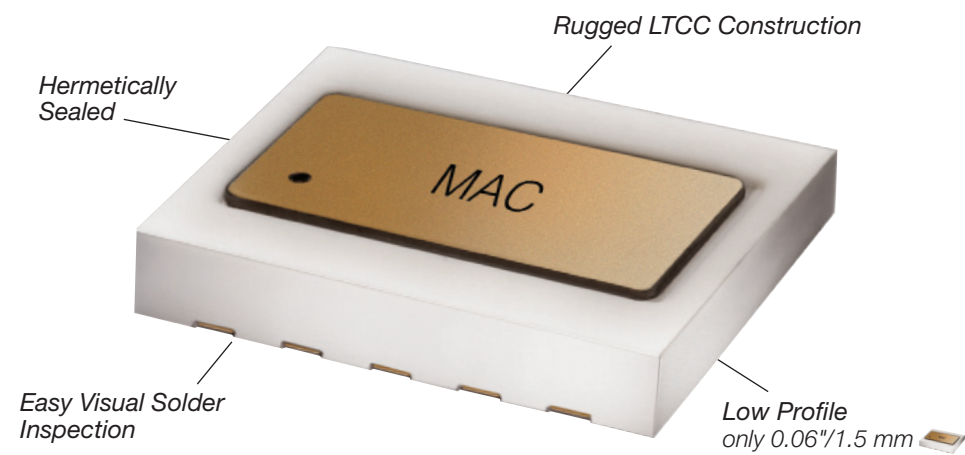


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# Designed and Built for Long-Term Reliability in HOSTILE ENVIRONMENTS



## Qualification Testing

The table below shows the initial qualification testing performed. If required, parts can be subjected to 100% screening and qualifications testing per MIL standard requirement.

|                   |                                                                                                          |
|-------------------|----------------------------------------------------------------------------------------------------------|
| Gross Leak        | MIL-STD-202 Method 112, Condition D<br>(100% of all MAC Mixers we ship)                                  |
| Fine Leak         | MIL-STD-202 Method 112, Condition C,<br>Procedure IIIa                                                   |
| Thermal Shock     | MIL-STD-202 Method 107<br>(-55/+100C°, 1000 cycles, 15 minutes)<br>(-55/+150C°, 1000 cycles, 15 minutes) |
| Vibration         | MIL-STD-202 Method 204, Condition D<br>(10-2000Hz sine, 20g, 3 axis, 12 c.y.ea.)                         |
| Acceleration      | MIL- STD-883 Method 2001, Condition E                                                                    |
| Mechanical Shock  | MIL-STD-202 Method 213, Condition A                                                                      |
| HTOL              | MIL-STD-202 Method 108, Condition D<br>(1000 hours, 125°C, at rated LO level)                            |
| Multiple Reflow   | JESD22-B102                                                                                              |
| Bend Test         | JESD22-B113                                                                                              |
| Adhesion Strength | Push test >10lb                                                                                          |



All Photos courtesy of U.S. Military and NASA

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# Frequency Mixer

# MAC-60LH+

## Typical Performance Data

| RF<br>(IN)<br>(MHz) | LO<br>(MHz) | CONVERSION LOSS<br>IF FIXED<br>@IF(OUT)=30MHz<br>(dB) |      |      |
|---------------------|-------------|-------------------------------------------------------|------|------|
|                     |             | @LO (dBm)                                             |      |      |
|                     |             | +7                                                    | +10  | +13  |
| 1600.1              | 1630.1      | 8.84                                                  | 7.48 | 6.61 |
| 1700.1              | 1730.1      | 7.68                                                  | 6.80 | 6.32 |
| 1800.1              | 1830.1      | 6.95                                                  | 6.39 | 6.11 |
| 1900.1              | 1930.1      | 6.68                                                  | 6.31 | 6.08 |
| 2000.1              | 2030.1      | 6.53                                                  | 6.30 | 6.03 |
| 2100.1              | 2130.1      | 6.36                                                  | 6.07 | 5.93 |
| 2200.1              | 2230.1      | 6.04                                                  | 5.74 | 5.70 |
| 2300.1              | 2330.1      | 6.04                                                  | 5.63 | 5.49 |
| 2400.1              | 2430.1      | 5.96                                                  | 5.66 | 5.53 |
| 2500.1              | 2530.1      | 5.93                                                  | 5.67 | 5.53 |
| 2600.1              | 2630.1      | 5.81                                                  | 5.60 | 5.59 |
| 2700.1              | 2730.1      | 5.92                                                  | 5.80 | 5.81 |
| 2800.1              | 2830.1      | 6.19                                                  | 6.07 | 5.98 |
| 2900.1              | 2930.1      | 6.35                                                  | 6.12 | 5.93 |
| 3000.1              | 3030.1      | 6.67                                                  | 6.33 | 6.14 |
| 3100.1              | 3130.1      | 6.92                                                  | 6.49 | 6.25 |
| 3200.1              | 3230.1      | 6.97                                                  | 6.44 | 6.17 |
| 3400.1              | 3430.1      | 7.18                                                  | 6.62 | 6.28 |
| 3600.1              | 3630.1      | 7.42                                                  | 6.81 | 6.43 |
| 3800.1              | 3830.1      | 7.04                                                  | 6.37 | 6.11 |
| 4000.1              | 4030.1      | 7.61                                                  | 6.97 | 6.41 |
| 4100.1              | 4130.1      | 7.42                                                  | 6.88 | 6.50 |
| 4200.1              | 4230.1      | 7.15                                                  | 6.56 | 6.33 |
| 4400.1              | 4430.1      | 6.67                                                  | 6.37 | 6.33 |
| 4500.1              | 4530.1      | 6.38                                                  | 6.11 | 6.08 |
| 4600.1              | 4630.1      | 6.13                                                  | 5.85 | 5.87 |
| 4700.1              | 4730.1      | 6.29                                                  | 6.13 | 6.25 |
| 4800.1              | 4830.1      | 7.69                                                  | 6.98 | 6.63 |
| 4900.1              | 4930.1      | 7.52                                                  | 7.01 | 6.78 |
| 5000.1              | 5030.1      | 6.77                                                  | 6.38 | 6.30 |
| 5100.1              | 5130.1      | 6.35                                                  | 6.14 | 6.05 |
| 5200.1              | 5230.1      | 6.63                                                  | 6.28 | 6.19 |
| 5300.1              | 5330.1      | 6.65                                                  | 6.23 | 6.13 |
| 5400.1              | 5430.1      | 6.34                                                  | 6.09 | 6.00 |
| 5500.1              | 5530.1      | 6.19                                                  | 5.86 | 5.76 |
| 5600.1              | 5630.1      | 6.33                                                  | 5.95 | 5.87 |
| 5700.1              | 5730.1      | 6.43                                                  | 5.98 | 5.81 |
| 5800.1              | 5830.1      | 6.81                                                  | 6.16 | 5.91 |
| 5900.1              | 5930.1      | 7.84                                                  | 6.63 | 6.13 |
| 6000.1              | 6030.1      | 9.09                                                  | 7.06 | 6.41 |

| RF<br>(IN)<br>(MHz) | LO<br>(MHz) | IP-3 INPUT<br>(dBm) |       |       |
|---------------------|-------------|---------------------|-------|-------|
|                     |             | @LO (dBm)           |       |       |
|                     |             | +7                  | +10   | +13   |
| 1600.1              | 1630.1      | 7.42                | 11.25 | 16.74 |
| 1700.1              | 1730.1      | 11.25               | 12.77 | 13.60 |
| 1800.1              | 1830.1      | 13.58               | 14.69 | 14.18 |
| 1900.1              | 1930.1      | 13.97               | 14.06 | 15.00 |
| 2000.1              | 2030.1      | 20.63               | 13.21 | 12.01 |
| 2100.1              | 2130.1      | 14.82               | 12.84 | 11.44 |
| 2200.1              | 2230.1      | 15.49               | 17.82 | 17.53 |
| 2300.1              | 2330.1      | 14.30               | 14.57 | 18.05 |
| 2400.1              | 2430.1      | 15.17               | 17.69 | 20.02 |
| 2500.1              | 2530.1      | 13.54               | 14.56 | 18.45 |
| 2600.1              | 2630.1      | 11.27               | 15.77 | 20.46 |
| 2700.1              | 2730.1      | 21.13               | 23.91 | 24.60 |
| 2800.1              | 2830.1      | 18.15               | 18.50 | 19.11 |
| 2900.1              | 2930.1      | 14.42               | 14.79 | 15.56 |
| 3000.1              | 3030.1      | 18.51               | 19.90 | 22.32 |
| 3100.1              | 3130.1      | 17.66               | 17.59 | 18.35 |
| 3200.1              | 3230.1      | 15.62               | 14.73 | 15.42 |
| 3400.1              | 3430.1      | 14.61               | 15.58 | 16.06 |
| 3600.1              | 3630.1      | 11.36               | 12.49 | 14.34 |
| 3800.1              | 3830.1      | 11.30               | 12.06 | 14.05 |
| 4000.1              | 4030.1      | 10.69               | 12.02 | 13.09 |
| 4100.1              | 4130.1      | 9.47                | 10.39 | 11.68 |
| 4200.1              | 4230.1      | 10.74               | 13.91 | 15.38 |
| 4400.1              | 4430.1      | 11.02               | 13.23 | 14.38 |
| 4500.1              | 4530.1      | 11.08               | 12.55 | 13.97 |
| 4600.1              | 4630.1      | 12.54               | 14.81 | 14.98 |
| 4700.1              | 4730.1      | 13.24               | 17.47 | 18.50 |
| 4800.1              | 4830.1      | 13.86               | 19.71 | 17.40 |
| 4900.1              | 4930.1      | 12.12               | 13.65 | 13.69 |
| 5000.1              | 5030.1      | 11.20               | 12.90 | 13.17 |
| 5100.1              | 5130.1      | 12.28               | 13.96 | 14.54 |
| 5200.1              | 5230.1      | 15.74               | 16.21 | 16.12 |
| 5300.1              | 5330.1      | 12.59               | 13.73 | 13.70 |
| 5400.1              | 5430.1      | 11.45               | 12.71 | 13.23 |
| 5500.1              | 5530.1      | 12.23               | 14.03 | 15.28 |
| 5600.1              | 5630.1      | 10.79               | 12.47 | 13.55 |
| 5700.1              | 5730.1      | 6.94                | 7.56  | 7.42  |
| 5800.1              | 5830.1      | 5.01                | 7.51  | 8.73  |
| 5900.1              | 5930.1      | 8.39                | 8.81  | 9.24  |
| 6000.1              | 6030.1      | 7.40                | 8.98  | 10.21 |

| RF<br>(IN)<br>(MHz) | LO<br>(MHz) | COMPRESSION<br>@RF IN=+5dBm<br>(dB) |      |      |
|---------------------|-------------|-------------------------------------|------|------|
|                     |             | @LO (dBm)                           |      |      |
|                     |             | +7                                  | +10  | +13  |
| 1600.1              | 1630.1      | 1.26                                | 1.36 | 1.38 |
| 1700.1              | 1730.1      | 1.59                                | 1.50 | 1.34 |
| 1800.1              | 1830.1      | 1.69                                | 1.55 | 1.35 |
| 1900.1              | 1930.1      | 1.44                                | 1.26 | 1.16 |
| 2000.1              | 2030.1      | 1.25                                | 1.00 | 1.01 |
| 2100.1              | 2130.1      | 1.29                                | 1.17 | 1.07 |
| 2200.1              | 2230.1      | 1.13                                | 0.85 | 0.63 |
| 2300.1              | 2330.1      | 0.94                                | 0.77 | 0.61 |
| 2400.1              | 2430.1      | 0.99                                | 0.69 | 0.52 |
| 2500.1              | 2530.1      | 0.95                                | 0.60 | 0.44 |
| 2600.1              | 2630.1      | 1.00                                | 0.58 | 0.37 |
| 2700.1              | 2730.1      | 0.89                                | 0.55 | 0.38 |
| 2800.1              | 2830.1      | 1.02                                | 0.67 | 0.52 |
| 2900.1              | 2930.1      | 1.15                                | 0.83 | 0.65 |
| 3000.1              | 3030.1      | 1.34                                | 1.09 | 0.93 |
| 3100.1              | 3130.1      | 1.31                                | 1.11 | 0.97 |
| 3200.1              | 3230.1      | 1.21                                | 0.95 | 0.74 |
| 3400.1              | 3430.1      | 1.31                                | 1.11 | 0.95 |
| 3600.1              | 3630.1      | 1.15                                | 1.11 | 1.01 |
| 3800.1              | 3830.1      | 1.12                                | 1.04 | 0.90 |
| 4000.1              | 4030.1      | 0.97                                | 0.71 | 0.76 |
| 4100.1              | 4130.1      | 1.29                                | 0.92 | 0.84 |
| 4200.1              | 4230.1      | 1.36                                | 0.97 | 0.81 |
| 4400.1              | 4430.1      | 1.13                                | 0.79 | 0.67 |
| 4500.1              | 4530.1      | 1.11                                | 0.70 | 0.56 |
| 4600.1              | 4630.1      | 0.97                                | 0.46 | 0.25 |
| 4700.1              | 4730.1      | 1.36                                | 0.83 | 0.54 |
| 4800.1              | 4830.1      | 1.12                                | 0.97 | 0.89 |
| 4900.1              | 4930.1      | 1.00                                | 0.93 | 0.90 |
| 5000.1              | 5030.1      | 1.31                                | 1.15 | 0.97 |
| 5100.1              | 5130.1      | 1.18                                | 0.91 | 0.78 |
| 5200.1              | 5230.1      | 0.97                                | 0.75 | 0.59 |
| 5300.1              | 5330.1      | 1.35                                | 1.15 | 0.97 |
| 5400.1              | 5430.1      | 1.46                                | 1.18 | 0.98 |
| 5500.1              | 5530.1      | 1.18                                | 0.99 | 0.83 |
| 5600.1              | 5630.1      | 1.66                                | 1.48 | 1.30 |
| 5700.1              | 5730.1      | 2.05                                | 1.97 | 1.88 |
| 5800.1              | 5830.1      | 2.11                                | 1.91 | 1.92 |
| 5900.1              | 5930.1      | 2.12                                | 1.93 | 1.95 |
| 6000.1              | 6030.1      | 2.32                                | 2.38 | 2.07 |

## Typical Performance Data

| IF<br>(OUT)<br>(MHz) | LO<br>(MHz) | CONVERSION LOSS<br>VS. IF FREQUENCY<br>@RF(IN)=3800.1MHz<br>(dB) | IF<br>(OUT)<br>(MHz) | LO<br>(MHz) | CONVERSION LOSS<br>VS. IF FREQUENCY<br>@RF(IN)=1600.1MHz<br>(dB) | IF<br>(OUT)<br>(MHz) | LO<br>(MHz) | CONVERSION LOSS<br>VS. IF FREQUENCY<br>@RF(IN)=6000.1MHz<br>(dB) |
|----------------------|-------------|------------------------------------------------------------------|----------------------|-------------|------------------------------------------------------------------|----------------------|-------------|------------------------------------------------------------------|
|                      |             | @LO (dBm)                                                        |                      |             | @LO (dBm)                                                        |                      |             | @LO (dBm)                                                        |
|                      |             | +10                                                              |                      |             | +10                                                              |                      |             | +10                                                              |
| 2800.0               | 1000.1      | 23.81                                                            | 10.0                 | 1610.1      | 7.55                                                             | 3250.0               | 2750.1      | 16.65                                                            |
| 2600.0               | 1200.1      | 18.70                                                            | 20.0                 | 1620.1      | 7.42                                                             | 3200.0               | 2800.1      | 15.43                                                            |
| 2400.0               | 1400.1      | 12.07                                                            | 30.0                 | 1630.1      | 7.45                                                             | 3100.0               | 2900.1      | 13.80                                                            |
| 2200.0               | 1600.1      | 10.08                                                            | 40.0                 | 1640.1      | 7.21                                                             | 3000.0               | 3000.1      | 11.86                                                            |
| 2000.0               | 1800.1      | 8.17                                                             | 50.0                 | 1650.1      | 7.17                                                             | 2900.0               | 3100.1      | 11.03                                                            |
| 1800.0               | 2000.1      | 8.39                                                             | 60.0                 | 1660.1      | 7.14                                                             | 2800.0               | 3200.1      | 11.16                                                            |
| 1600.0               | 2200.1      | 8.54                                                             | 70.0                 | 1670.1      | 7.13                                                             | 2700.0               | 3300.1      | 10.87                                                            |
| 1400.0               | 2400.1      | 10.05                                                            | 80.0                 | 1680.1      | 6.94                                                             | 2600.0               | 3400.1      | 10.55                                                            |
| 1200.0               | 2600.1      | 9.97                                                             | 90.0                 | 1690.1      | 7.14                                                             | 2500.0               | 3500.1      | 10.87                                                            |
| 1000.0               | 2800.1      | 9.44                                                             | 100.0                | 1700.1      | 6.96                                                             | 2400.0               | 3600.1      | 11.22                                                            |
| 800.0                | 3000.1      | 8.07                                                             | 200.0                | 1800.1      | 6.50                                                             | 2300.0               | 3700.1      | 11.03                                                            |
| 600.0                | 3200.1      | 7.16                                                             | 300.0                | 1900.1      | 6.16                                                             | 2200.0               | 3800.1      | 10.19                                                            |
| 400.0                | 3400.1      | 6.60                                                             | 400.0                | 2000.1      | 6.27                                                             | 2100.0               | 3900.1      | 9.65                                                             |
| 200.0                | 3600.1      | 6.46                                                             | 500.0                | 2100.1      | 6.19                                                             | 2000.0               | 4000.1      | 9.49                                                             |
| 120.0                | 3680.1      | 6.51                                                             | 600.0                | 2200.1      | 6.24                                                             | 1900.0               | 4100.1      | 9.22                                                             |
| 100.0                | 3700.1      | 6.44                                                             | 700.0                | 2300.1      | 6.31                                                             | 1800.0               | 4200.1      | 8.60                                                             |
| 80.0                 | 3720.1      | 6.48                                                             | 800.0                | 2400.1      | 6.37                                                             | 1700.0               | 4300.1      | 8.62                                                             |
| 60.0                 | 3740.1      | 6.48                                                             | 900.0                | 2500.1      | 6.73                                                             | 1600.0               | 4400.1      | 8.70                                                             |
| 40.0                 | 3760.1      | 6.38                                                             | 1000.0               | 2600.1      | 7.01                                                             | 1500.0               | 4500.1      | 8.77                                                             |
| 20.0                 | 3780.1      | 6.31                                                             | 1100.0               | 2700.1      | 7.22                                                             | 1400.0               | 4600.1      | 8.68                                                             |
| 10.0                 | 3810.1      | 6.25                                                             | 1200.0               | 2800.1      | 6.82                                                             | 1300.0               | 4700.1      | 8.31                                                             |
| 30.0                 | 3830.1      | 6.34                                                             | 1300.0               | 2900.1      | 6.57                                                             | 1200.0               | 4800.1      | 7.72                                                             |
| 50.0                 | 3850.1      | 6.28                                                             | 1400.0               | 3000.1      | 6.54                                                             | 1100.0               | 4900.1      | 7.20                                                             |
| 70.0                 | 3870.1      | 6.36                                                             | 1500.0               | 3100.1      | 6.86                                                             | 1000.0               | 5000.1      | 6.69                                                             |
| 90.0                 | 3890.1      | 6.39                                                             | 1600.0               | 3200.1      | 7.11                                                             | 900.0                | 5100.1      | 6.50                                                             |
| 120.0                | 3920.1      | 6.54                                                             | 1700.0               | 3300.1      | 7.29                                                             | 800.0                | 5200.1      | 5.79                                                             |
| 160.0                | 3960.1      | 6.64                                                             | 1800.0               | 3400.1      | 7.96                                                             | 700.0                | 5300.1      | 5.56                                                             |
| 200.0                | 4000.1      | 6.76                                                             | 1900.0               | 3500.1      | 8.59                                                             | 600.0                | 5400.1      | 5.47                                                             |
| 400.0                | 4200.1      | 6.92                                                             | 2000.0               | 3600.1      | 9.05                                                             | 500.0                | 5500.1      | 5.16                                                             |
| 600.0                | 4400.1      | 6.63                                                             | 2100.0               | 3700.1      | 9.02                                                             | 400.0                | 5600.1      | 5.16                                                             |
| 800.0                | 4600.1      | 6.71                                                             | 2200.0               | 3800.1      | 9.26                                                             | 300.0                | 5700.1      | 5.12                                                             |
| 1000.0               | 4800.1      | 7.52                                                             | 2300.0               | 3900.1      | 9.63                                                             | 200.0                | 5800.1      | 5.87                                                             |
| 1200.0               | 5000.1      | 9.05                                                             | 2400.0               | 4000.1      | 9.83                                                             | 160.0                | 5840.1      | 6.32                                                             |
| 1400.0               | 5200.1      | 9.55                                                             | 2500.0               | 4100.1      | 9.86                                                             | 140.0                | 5860.1      | 6.47                                                             |
| 1600.0               | 5400.1      | 8.99                                                             | 2600.0               | 4200.1      | 9.99                                                             | 120.0                | 5880.1      | 6.52                                                             |
| 1800.0               | 5600.1      | 8.68                                                             | 2700.0               | 4300.1      | 10.50                                                            | 100.0                | 5900.1      | 6.60                                                             |
| 2000.0               | 5800.1      | 9.75                                                             | 2800.0               | 4400.1      | 11.04                                                            | 80.0                 | 5920.1      | 6.74                                                             |
| 2200.0               | 6000.1      | 10.65                                                            | 2900.0               | 4500.1      | 12.02                                                            | 60.0                 | 5940.1      | 6.87                                                             |
| 2400.0               | 6200.1      | 14.68                                                            | 3000.0               | 4600.1      | 13.03                                                            | 40.0                 | 5960.1      | 6.79                                                             |
| 2600.0               | 6400.1      | 17.19                                                            | 3100.0               | 4700.1      | 14.43                                                            | 20.0                 | 5980.1      | 6.75                                                             |

# Frequency Mixer

MAC-60LH+

## Typical Performance Data

| LO<br><br>(MHz) | LO-RF ISOLATION<br>(dB) |       |       | LO-IF ISOLATION<br>(dB) |       |       | RF<br>(IN)<br>(MHz) | LO<br>(MHz) | RF-IF ISOLATION<br>(dB) |       |       |
|-----------------|-------------------------|-------|-------|-------------------------|-------|-------|---------------------|-------------|-------------------------|-------|-------|
|                 | @LO (dBm)               |       |       | @LO (dBm)               |       |       |                     |             | @LO (dBm)               |       |       |
|                 | +7                      | +10   | +13   | +7                      | +10   | +13   |                     |             | +7                      | +10   | +13   |
| 1630.1          | 31.99                   | 30.71 | 30.56 | 15.05                   | 17.05 | 18.96 | 1600.1              | 1630.1      | 12.49                   | 11.14 | 10.41 |
| 1730.1          | 32.82                   | 31.73 | 31.56 | 15.34                   | 17.37 | 19.17 | 1700.1              | 1730.1      | 13.16                   | 12.02 | 11.43 |
| 1830.1          | 35.09                   | 33.36 | 32.71 | 16.05                   | 18.01 | 19.47 | 1800.1              | 1830.1      | 15.21                   | 13.93 | 13.20 |
| 1930.1          | 42.39                   | 39.33 | 37.55 | 17.07                   | 18.81 | 19.76 | 1900.1              | 1930.1      | 18.95                   | 17.48 | 16.46 |
| 2030.1          | 43.44                   | 41.31 | 40.92 | 17.29                   | 18.60 | 18.97 | 2000.1              | 2030.1      | 21.18                   | 20.47 | 19.79 |
| 2130.1          | 38.68                   | 36.08 | 33.63 | 17.00                   | 18.01 | 18.23 | 2100.1              | 2130.1      | 22.52                   | 23.81 | 25.30 |
| 2230.1          | 36.90                   | 35.09 | 33.10 | 17.79                   | 18.42 | 18.09 | 2200.1              | 2230.1      | 24.48                   | 24.18 | 23.51 |
| 2330.1          | 36.59                   | 34.94 | 33.08 | 19.00                   | 18.60 | 17.79 | 2300.1              | 2330.1      | 23.96                   | 22.79 | 21.80 |
| 2430.1          | 38.33                   | 36.43 | 34.55 | 19.13                   | 18.38 | 17.57 | 2400.1              | 2430.1      | 24.11                   | 22.90 | 22.06 |
| 2530.1          | 41.34                   | 39.31 | 36.43 | 19.36                   | 18.23 | 17.37 | 2500.1              | 2530.1      | 22.13                   | 20.77 | 19.98 |
| 2630.1          | 35.92                   | 34.39 | 33.32 | 19.57                   | 18.40 | 17.53 | 2600.1              | 2630.1      | 20.59                   | 19.69 | 19.08 |
| 2730.1          | 40.04                   | 37.87 | 36.43 | 20.01                   | 18.67 | 17.78 | 2700.1              | 2730.1      | 20.19                   | 19.58 | 19.13 |
| 2830.1          | 42.00                   | 40.26 | 39.02 | 20.26                   | 18.93 | 18.07 | 2800.1              | 2830.1      | 20.80                   | 20.32 | 20.03 |
| 2930.1          | 39.48                   | 39.06 | 38.48 | 20.21                   | 19.18 | 18.48 | 2900.1              | 2930.1      | 22.13                   | 21.50 | 21.10 |
| 3030.1          | 37.96                   | 37.80 | 37.69 | 19.44                   | 18.99 | 18.61 | 3000.1              | 3030.1      | 24.19                   | 23.43 | 22.89 |
| 3130.1          | 38.19                   | 37.55 | 37.07 | 18.34                   | 18.65 | 18.77 | 3100.1              | 3130.1      | 26.82                   | 26.00 | 25.48 |
| 3230.1          | 39.03                   | 37.85 | 36.68 | 17.08                   | 18.19 | 19.04 | 3200.1              | 3230.1      | 24.67                   | 24.11 | 23.53 |
| 3430.1          | 36.22                   | 36.28 | 36.19 | 14.05                   | 16.06 | 17.98 | 3400.1              | 3430.1      | 24.26                   | 24.47 | 24.57 |
| 3630.1          | 37.07                   | 36.30 | 35.18 | 12.47                   | 13.97 | 14.89 | 3600.1              | 3630.1      | 31.62                   | 31.39 | 31.35 |
| 3830.1          | 39.09                   | 36.44 | 34.04 | 13.74                   | 14.05 | 13.73 | 3800.1              | 3830.1      | 20.03                   | 19.72 | 19.50 |
| 4030.1          | 40.38                   | 37.06 | 33.78 | 15.65                   | 14.79 | 13.84 | 4000.1              | 4030.1      | 16.01                   | 15.75 | 15.56 |
| 4130.1          | 38.99                   | 38.52 | 35.20 | 16.59                   | 14.95 | 13.78 | 4100.1              | 4130.1      | 15.11                   | 14.67 | 14.38 |
| 4230.1          | 34.51                   | 35.33 | 34.95 | 17.94                   | 15.78 | 14.35 | 4200.1              | 4230.1      | 14.71                   | 14.25 | 13.99 |
| 4430.1          | 45.90                   | 40.93 | 35.98 | 21.89                   | 18.46 | 16.36 | 4400.1              | 4430.1      | 15.31                   | 14.59 | 14.13 |
| 4530.1          | 41.10                   | 39.24 | 34.38 | 22.97                   | 19.22 | 17.05 | 4500.1              | 4530.1      | 16.56                   | 15.89 | 15.34 |
| 4630.1          | 39.08                   | 32.74 | 29.27 | 23.62                   | 19.89 | 17.79 | 4600.1              | 4630.1      | 16.35                   | 15.87 | 15.37 |
| 4730.1          | 38.83                   | 34.46 | 30.77 | 24.45                   | 20.82 | 18.77 | 4700.1              | 4730.1      | 16.89                   | 16.36 | 16.01 |
| 4830.1          | 37.71                   | 41.10 | 37.55 | 25.01                   | 21.82 | 19.96 | 4800.1              | 4830.1      | 17.89                   | 17.06 | 16.46 |
| 4930.1          | 33.96                   | 36.69 | 37.58 | 25.12                   | 22.96 | 21.49 | 4900.1              | 4930.1      | 17.64                   | 17.11 | 16.71 |
| 5030.1          | 30.81                   | 31.45 | 31.27 | 24.11                   | 23.17 | 22.67 | 5000.1              | 5030.1      | 16.77                   | 16.33 | 16.03 |
| 5130.1          | 28.50                   | 28.58 | 27.96 | 23.18                   | 22.99 | 23.16 | 5100.1              | 5130.1      | 16.79                   | 16.32 | 16.13 |
| 5230.1          | 28.38                   | 28.79 | 28.22 | 22.25                   | 22.52 | 22.90 | 5200.1              | 5230.1      | 17.54                   | 17.13 | 16.88 |
| 5330.1          | 26.14                   | 27.26 | 27.88 | 20.94                   | 21.54 | 22.08 | 5300.1              | 5330.1      | 17.92                   | 17.64 | 17.50 |
| 5430.1          | 24.55                   | 25.46 | 25.99 | 19.91                   | 20.52 | 21.36 | 5400.1              | 5430.1      | 16.81                   | 16.16 | 15.77 |
| 5530.1          | 24.23                   | 25.39 | 26.26 | 20.05                   | 21.15 | 22.41 | 5500.1              | 5530.1      | 16.20                   | 15.42 | 15.02 |
| 5630.1          | 24.57                   | 25.79 | 26.78 | 16.97                   | 18.13 | 19.73 | 5600.1              | 5630.1      | 19.71                   | 18.72 | 18.04 |
| 5730.1          | 22.58                   | 23.77 | 24.88 | 12.65                   | 13.99 | 15.86 | 5700.1              | 5730.1      | 21.97                   | 20.61 | 19.37 |
| 5830.1          | 22.76                   | 24.02 | 24.91 | 10.52                   | 12.28 | 14.50 | 5800.1              | 5830.1      | 21.93                   | 20.84 | 19.71 |
| 5930.1          | 24.32                   | 25.63 | 26.34 | 10.09                   | 11.80 | 13.95 | 5900.1              | 5930.1      | 25.29                   | 22.19 | 20.92 |
| 6030.1          | 25.70                   | 27.32 | 28.25 | 10.47                   | 11.83 | 13.58 | 6000.1              | 6030.1      | 25.49                   | 22.58 | 21.07 |

## Typical Performance Data

| RF<br>(IN)<br>(MHz) | LO<br>(MHz) | RF VSWR<br>(:1) |      |      | LO<br>(MHz) | LO VSWR<br>(:1) |      |      | IF<br>(OUT)<br>(MHz) | IF VSWR<br>@LO=6000.1MHz<br>(:1) |      |      |
|---------------------|-------------|-----------------|------|------|-------------|-----------------|------|------|----------------------|----------------------------------|------|------|
|                     |             | @LO (dBm)       |      |      |             | @LO (dBm)       |      |      |                      | @LO (dBm)                        |      |      |
|                     |             | +7              | +10  | +13  |             | +7              | +10  | +13  |                      | +7                               | +10  | +13  |
| 1600.1              | 1630.1      | 2.79            | 2.33 | 2.05 | 1630.1      | 5.15            | 4.43 | 4.78 | 10.1                 | 1.24                             | 1.29 | 1.51 |
| 1700.1              | 1730.1      | 2.85            | 2.52 | 2.32 | 1730.1      | 3.40            | 3.36 | 3.85 | 15.1                 | 1.03                             | 1.30 | 1.32 |
| 1800.1              | 1830.1      | 3.02            | 2.75 | 2.58 | 1830.1      | 2.50            | 2.68 | 3.25 | 20.1                 | 1.05                             | 1.35 | 1.37 |
| 1900.1              | 1930.1      | 3.20            | 2.98 | 2.86 | 1930.1      | 1.86            | 2.14 | 2.74 | 25.1                 | 1.06                             | 1.33 | 1.33 |
| 2000.1              | 2030.1      | 3.14            | 2.87 | 2.71 | 2030.1      | 1.61            | 1.91 | 2.49 | 30.1                 | 1.09                             | 1.25 | 1.35 |
| 2100.1              | 2130.1      | 3.18            | 2.87 | 2.65 | 2130.1      | 1.62            | 1.89 | 2.41 | 35.1                 | 1.09                             | 1.24 | 1.32 |
| 2200.1              | 2230.1      | 2.84            | 2.46 | 2.26 | 2230.1      | 1.81            | 1.97 | 2.42 | 40.1                 | 1.08                             | 1.26 | 1.32 |
| 2300.1              | 2330.1      | 2.85            | 2.46 | 2.20 | 2330.1      | 1.73            | 1.89 | 2.38 | 45.1                 | 1.14                             | 1.23 | 1.30 |
| 2400.1              | 2430.1      | 2.70            | 2.38 | 2.19 | 2430.1      | 1.80            | 1.97 | 2.45 | 50.1                 | 1.16                             | 1.25 | 1.31 |
| 2500.1              | 2530.1      | 2.34            | 2.01 | 1.82 | 2530.1      | 1.86            | 2.05 | 2.54 | 55.1                 | 1.15                             | 1.27 | 1.30 |
| 2600.1              | 2630.1      | 2.02            | 1.81 | 1.69 | 2630.1      | 1.83            | 2.03 | 2.56 | 60.1                 | 1.15                             | 1.25 | 1.32 |
| 2700.1              | 2730.1      | 2.13            | 1.98 | 1.89 | 2730.1      | 1.63            | 1.98 | 2.58 | 65.1                 | 1.14                             | 1.26 | 1.33 |
| 2800.1              | 2830.1      | 2.48            | 2.35 | 2.27 | 2830.1      | 1.49            | 1.97 | 2.65 | 70.1                 | 1.14                             | 1.26 | 1.34 |
| 2900.1              | 2930.1      | 2.94            | 2.74 | 2.59 | 2930.1      | 1.42            | 2.00 | 2.71 | 75.1                 | 1.13                             | 1.23 | 1.30 |
| 3000.1              | 3030.1      | 3.15            | 2.96 | 2.83 | 3030.1      | 1.41            | 2.04 | 2.78 | 80.1                 | 1.13                             | 1.24 | 1.30 |
| 3100.1              | 3130.1      | 3.34            | 3.11 | 2.97 | 3130.1      | 1.46            | 2.10 | 2.85 | 85.1                 | 1.14                             | 1.24 | 1.30 |
| 3200.1              | 3230.1      | 3.10            | 2.78 | 2.53 | 3230.1      | 1.56            | 2.18 | 2.92 | 90.1                 | 1.16                             | 1.25 | 1.31 |
| 3400.1              | 3430.1      | 3.08            | 2.88 | 2.70 | 3430.1      | 1.80            | 2.30 | 2.98 | 95.1                 | 1.18                             | 1.28 | 1.33 |
| 3600.1              | 3630.1      | 2.94            | 2.65 | 2.50 | 3630.1      | 2.19            | 2.47 | 2.98 | 100.1                | 1.21                             | 1.31 | 1.36 |
| 3800.1              | 3830.1      | 2.85            | 2.47 | 2.27 | 3830.1      | 2.52            | 2.57 | 2.89 | 150.1                | 1.30                             | 1.39 | 1.46 |
| 4000.1              | 4030.1      | 2.84            | 2.56 | 2.27 | 4030.1      | 2.85            | 2.74 | 2.95 | 200.1                | 1.39                             | 1.51 | 1.58 |
| 4100.1              | 4130.1      | 2.72            | 2.45 | 2.26 | 4130.1      | 2.80            | 2.52 | 2.68 | 250.1                | 1.47                             | 1.56 | 1.63 |
| 4200.1              | 4230.1      | 2.40            | 2.12 | 1.98 | 4230.1      | 2.83            | 2.33 | 2.42 | 300.1                | 1.56                             | 1.65 | 1.73 |
| 4400.1              | 4430.1      | 2.21            | 1.91 | 1.75 | 4430.1      | 3.43            | 2.40 | 2.23 | 400.1                | 1.74                             | 1.79 | 1.88 |
| 4500.1              | 4530.1      | 2.22            | 1.86 | 1.66 | 4530.1      | 3.84            | 2.49 | 2.11 | 500.1                | 1.93                             | 1.92 | 2.02 |
| 4600.1              | 4630.1      | 2.02            | 1.64 | 1.43 | 4630.1      | 3.76            | 2.37 | 1.93 | 600.1                | 2.15                             | 2.05 | 2.15 |
| 4700.1              | 4730.1      | 2.06            | 1.74 | 1.56 | 4730.1      | 3.60            | 2.19 | 1.69 | 700.1                | 2.38                             | 2.16 | 2.21 |
| 4800.1              | 4830.1      | 3.20            | 2.80 | 2.48 | 4830.1      | 3.31            | 1.96 | 1.45 | 800.1                | 2.62                             | 2.25 | 2.25 |
| 4900.1              | 4930.1      | 3.31            | 2.93 | 2.64 | 4930.1      | 2.94            | 1.72 | 1.22 | 900.1                | 2.81                             | 2.28 | 2.22 |
| 5000.1              | 5030.1      | 2.84            | 2.53 | 2.31 | 5030.1      | 2.55            | 1.51 | 1.03 | 1000.1               | 3.02                             | 2.36 | 2.25 |
| 5100.1              | 5130.1      | 2.41            | 2.12 | 1.94 | 5130.1      | 2.14            | 1.32 | 1.18 | 1100.1               | 3.28                             | 2.45 | 2.29 |
| 5200.1              | 5230.1      | 2.27            | 2.03 | 1.86 | 5230.1      | 1.75            | 1.20 | 1.39 | 1200.1               | 3.59                             | 2.60 | 2.37 |
| 5300.1              | 5330.1      | 2.48            | 2.25 | 2.10 | 5330.1      | 1.39            | 1.23 | 1.64 | 1300.1               | 3.89                             | 2.73 | 2.44 |
| 5400.1              | 5430.1      | 2.25            | 2.03 | 1.89 | 5430.1      | 1.10            | 1.41 | 1.93 | 1400.1               | 4.06                             | 2.84 | 2.53 |
| 5500.1              | 5530.1      | 1.87            | 1.67 | 1.54 | 5530.1      | 1.17            | 1.65 | 2.24 | 1500.1               | 4.07                             | 2.93 | 2.60 |
| 5600.1              | 5630.1      | 1.87            | 1.70 | 1.60 | 5630.1      | 1.53            | 1.99 | 2.59 | 1600.1               | 4.06                             | 3.00 | 2.67 |
| 5700.1              | 5730.1      | 1.77            | 1.57 | 1.44 | 5730.1      | 2.01            | 2.40 | 2.98 | 1700.1               | 4.07                             | 3.12 | 2.77 |
| 5800.1              | 5830.1      | 1.54            | 1.32 | 1.21 | 5830.1      | 2.60            | 2.88 | 3.41 | 1800.1               | 4.12                             | 3.23 | 2.93 |
| 5900.1              | 5930.1      | 1.27            | 1.21 | 1.26 | 5930.1      | 3.52            | 3.60 | 4.02 | 1900.1               | 4.12                             | 3.33 | 3.11 |
| 6000.1              | 6030.1      | 1.16            | 1.36 | 1.50 | 6030.1      | 4.96            | 4.89 | 4.94 | 2000.1               | 4.05                             | 3.50 | 3.36 |

## Harmonics Tables

RF HARMONICS ORDER

|    | (-dBm) | (-dBc) |        |        |        |        |        |        |        |        |        |        |
|----|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0  | ---    | ---    | -12.79 | 19.49  | 21.66  | 28.00  | 11.96  | 61.79  | ---    | ---    | ---    | ---    |
| 1  | ---    | 13.27  | ---    | 30.10  | 18.81  | 41.81  | 29.75  | 64.42  | 63.82  | ---    | ---    | ---    |
| 2  | 120.42 | 51.46  | 43.40  | 53.62  | 43.70  | 53.04  | 64.80  | 55.12  | 48.73  | 79.20  | ---    | ---    |
| 3  | 123.19 | 64.69  | 57.88  | 79.05  | 59.13  | 66.19  | 80.39  | 73.23  | 74.65  | 74.40  | 100.76 | ---    |
| 4  | 125.21 | 83.34  | 93.09  | 85.71  | 80.16  | 88.05  | 79.49  | 83.92  | 96.96  | 78.64  | 81.03  | 100.91 |
| 5  | 119.69 | 94.53  | 103.61 | 103.28 | 100.50 | 107.40 | 88.84  | 90.30  | 99.16  | 102.26 | 97.28  | 97.44  |
| 6  | 133.21 | 110.81 | 100.80 | 105.46 | 104.65 | 109.68 | 88.44  | 99.64  | 86.83  | 105.29 | 106.32 | 98.95  |
| 7  | ---    | ---    | 111.54 | 102.06 | 105.00 | 99.31  | 100.00 | 89.87  | 97.38  | 85.77  | 104.04 | 105.49 |
| 8  | ---    | ---    | ---    | 111.16 | 95.85  | 104.99 | 102.35 | 101.45 | 107.89 | 104.10 | 104.43 | 110.62 |
| 9  | ---    | ---    | ---    | ---    | 112.46 | 104.12 | 98.77  | 105.00 | 104.85 | 105.59 | 107.99 | 102.43 |
| 10 | ---    | ---    | ---    | ---    | ---    | 109.73 | 97.32  | 101.32 | 107.00 | 104.73 | 104.38 | 109.43 |
|    | RF CAL | 0      | 1      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     |

### LO HARMONICS ORDER

Test conditions:

RF IN: 3800.1 MHz; -10.00 dBm  
LO IN: 3830.1 MHz; +10.00 dBm  
IF OUT: 30 MHz; -16.36 dBm

RF HARMONICS ORDER

|    | (-dBm) | (-dBc) |        |        |        |        |       |        |        |        |       |        |
|----|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|-------|--------|
| 0  | ---    | ---    | -2.67  | 30.00  | 32.21  | 46.91  | 24.33 | 71.31  | ---    | ---    | ---   | ---    |
| 1  | ---    | 13.12  | ---    | 32.82  | 18.45  | 43.44  | 30.52 | 60.65  | 67.37  | ---    | ---   | ---    |
| 2  | 112.44 | 40.74  | 34.65  | 44.63  | 36.33  | 47.78  | 58.63 | 55.31  | 44.03  | 80.25  | ---   | ---    |
| 3  | 119.06 | 44.32  | 37.14  | 59.93  | 39.06  | 47.95  | 57.61 | 57.62  | 57.17  | 68.69  | 84.19 | ---    |
| 4  | 111.51 | 60.25  | 71.84  | 61.69  | 55.73  | 58.84  | 55.01 | 58.99  | 78.42  | 59.74  | 62.21 | 84.57  |
| 5  | 117.78 | 81.40  | 84.49  | 69.78  | 65.40  | 85.68  | 53.65 | 66.12  | 63.37  | 71.81  | 65.70 | 73.58  |
| 6  | 120.41 | 97.21  | 75.18  | 76.32  | 82.74  | 78.69  | 73.92 | 75.07  | 72.56  | 74.03  | 89.34 | 69.55  |
| 7  | ---    | ---    | 111.92 | 85.65  | 85.51  | 82.44  | 76.84 | 103.97 | 66.67  | 74.33  | 75.76 | 81.02  |
| 8  | ---    | ---    | ---    | 114.05 | 85.93  | 85.59  | 92.19 | 92.06  | 88.77  | 86.79  | 83.74 | 83.50  |
| 9  | ---    | ---    | ---    | ---    | 119.38 | 101.83 | 99.05 | 91.61  | 93.65  | 93.83  | 79.95 | 84.27  |
| 10 | ---    | ---    | ---    | ---    | ---    | 112.18 | 89.36 | 92.43  | 100.33 | 100.29 | 94.49 | 101.94 |
|    | RF CAL | 0      | 1      | 2      | 3      | 4      | 5     | 6      | 7      | 8      | 9     | 10     |

### LO HARMONICS ORDER

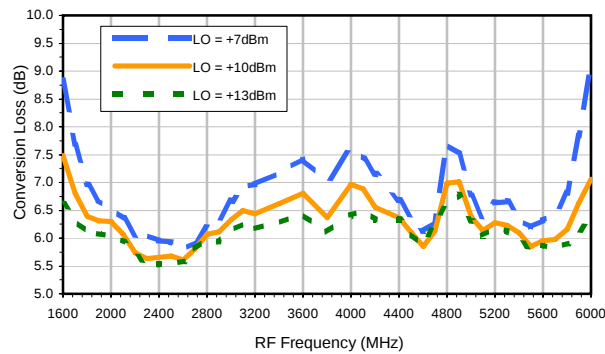
Test conditions:

RF IN: 3800.1 MHz; 0 dBm  
LO IN: 3830.1 MHz; +10.00 dBm  
IF OUT: 30 MHz; -6.43 dBm

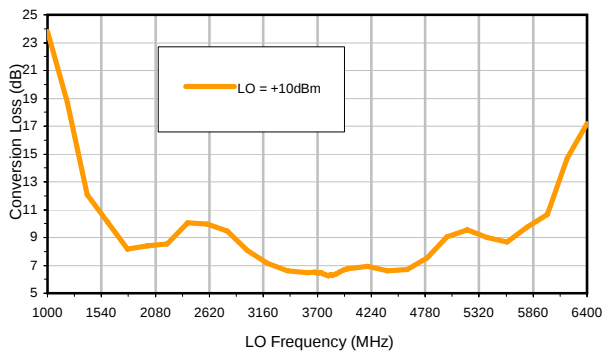
- Notes:
1. All Harmonics are in (dBc) relative to IF OUTPUT
  2. + entry denotes harmonics are in (dBc) above IF OUTPUT
  3. RF Cal represents the Harmonics level of the RF Input Signal to the mixer

## Typical Performance Curves

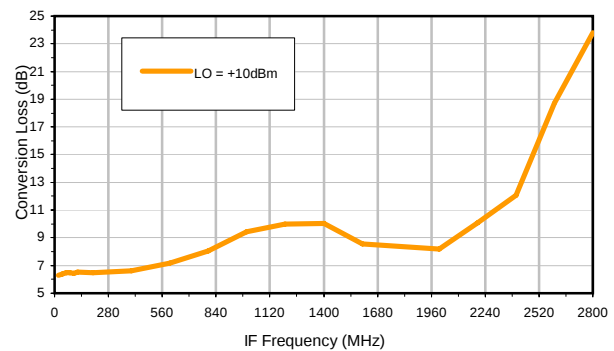
Conversion Loss @IF=30 MHz



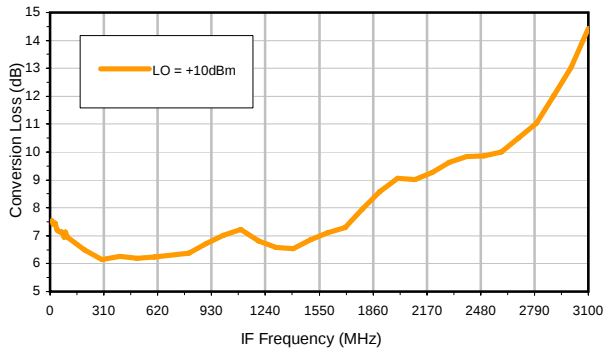
Conversion Loss vs. LO @ RF=3800.1 MHz



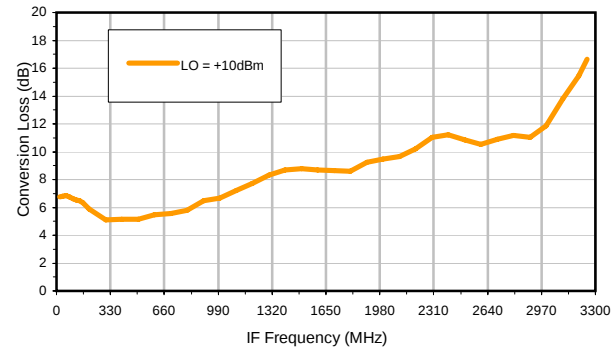
Conversion Loss vs. IF @ RF=3800.1 MHz



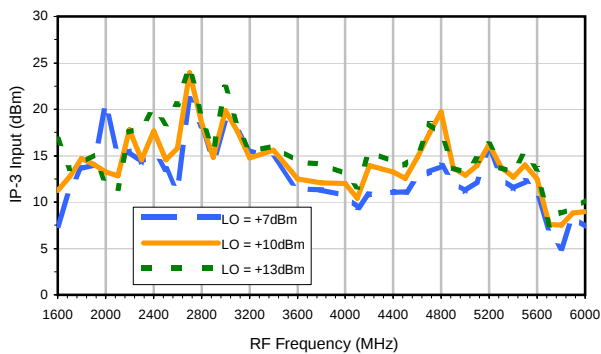
Conversion Loss vs. IF @ RF=1600.1 MHz



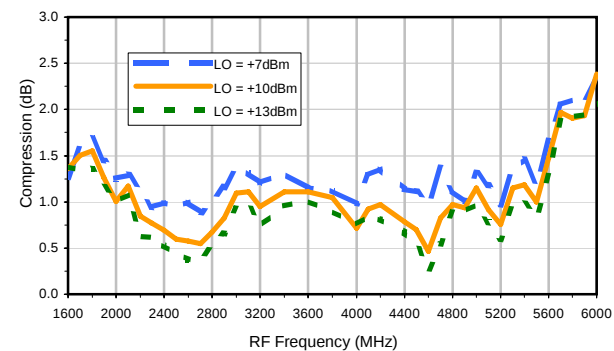
Conversion Loss vs. IF @ RF=6000.1 MHz



IP-3 Input

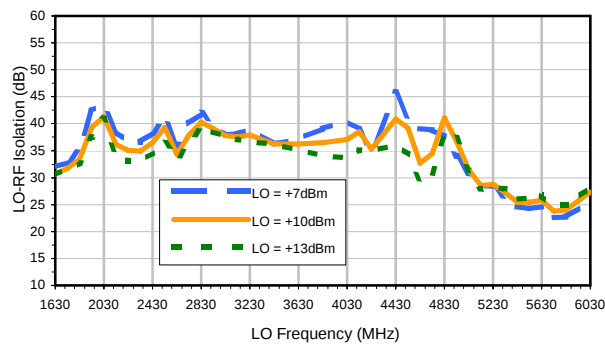


Compression @RF IN=+5 dBm

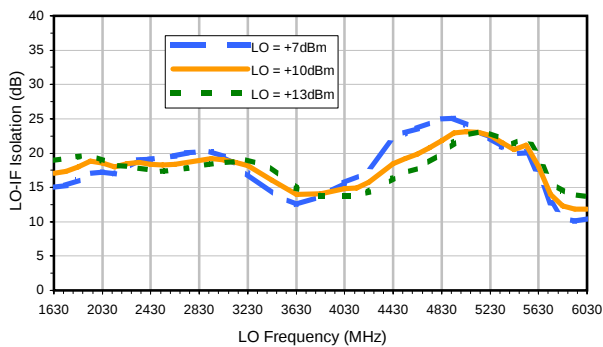


## Typical Performance Curves

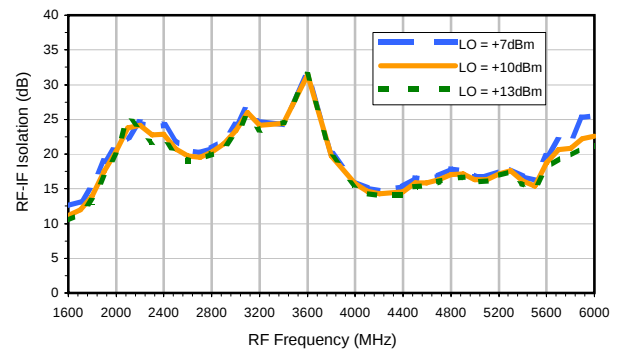
LO-RF Isolation



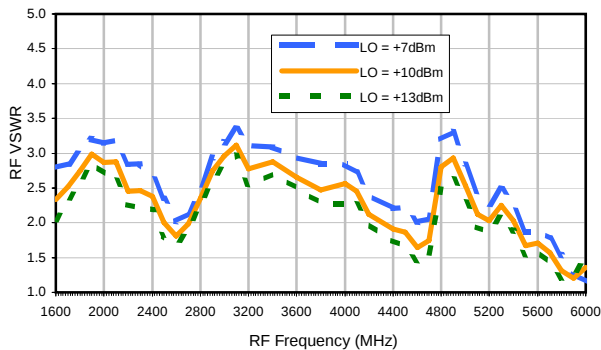
LO-IF Isolation



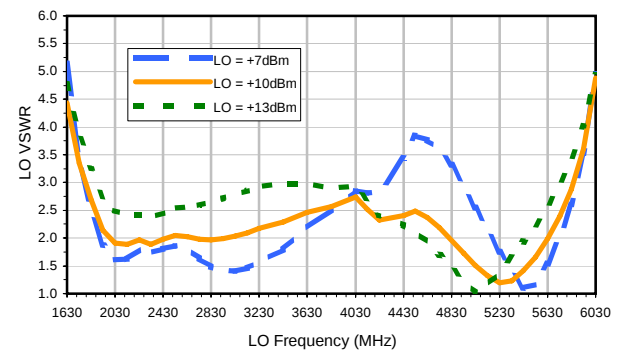
RF-IF Isolation



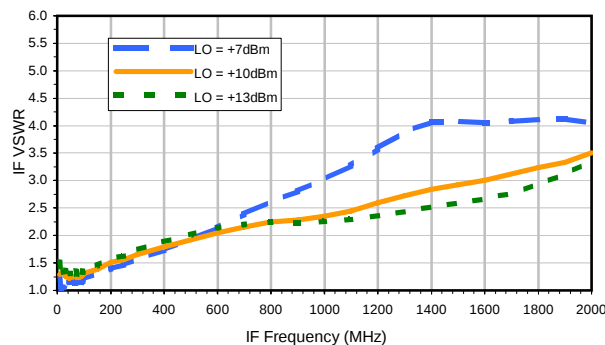
RF VSWR



LO VSWR



IF VSWR



## Harmonics Tables

RF HARMONICS ORDER

|    | (-dBm) | (-dBc) |        |        |        |        |        |        |        |        |        |        |
|----|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0  | ---    | ---    | -12.79 | 19.49  | 21.66  | 28.00  | 11.96  | 61.79  | ---    | ---    | ---    | ---    |
| 1  | ---    | 13.27  | ---    | 30.10  | 18.81  | 41.81  | 29.75  | 64.42  | 63.82  | ---    | ---    | ---    |
| 2  | 120.42 | 51.46  | 43.40  | 53.62  | 43.70  | 53.04  | 64.80  | 55.12  | 48.73  | 79.20  | ---    | ---    |
| 3  | 123.19 | 64.69  | 57.88  | 79.05  | 59.13  | 66.19  | 80.39  | 73.23  | 74.65  | 74.40  | 100.76 | ---    |
| 4  | 125.21 | 83.34  | 93.09  | 85.71  | 80.16  | 88.05  | 79.49  | 83.92  | 96.96  | 78.64  | 81.03  | 100.91 |
| 5  | 119.69 | 94.53  | 103.61 | 103.28 | 100.50 | 107.40 | 88.84  | 90.30  | 99.16  | 102.26 | 97.28  | 97.44  |
| 6  | 133.21 | 110.81 | 100.80 | 105.46 | 104.65 | 109.68 | 88.44  | 99.64  | 86.83  | 105.29 | 106.32 | 98.95  |
| 7  | ---    | ---    | 111.54 | 102.06 | 105.00 | 99.31  | 100.00 | 89.87  | 97.38  | 85.77  | 104.04 | 105.49 |
| 8  | ---    | ---    | ---    | 111.16 | 95.85  | 104.99 | 102.35 | 101.45 | 107.89 | 104.10 | 104.43 | 110.62 |
| 9  | ---    | ---    | ---    | ---    | 112.46 | 104.12 | 98.77  | 105.00 | 104.85 | 105.59 | 107.99 | 102.43 |
| 10 | ---    | ---    | ---    | ---    | ---    | 109.73 | 97.32  | 101.32 | 107.00 | 104.73 | 104.38 | 109.43 |
|    | RF CAL | 0      | 1      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     |

### LO HARMONICS ORDER

Test conditions:

RF IN: 3800.1 MHz; -10.00 dBm  
LO IN: 3830.1 MHz; +10.00 dBm  
IF OUT: 30 MHz; -16.36 dBm

RF HARMONICS ORDER

|    | (-dBm) | (-dBc) |        |        |        |        |       |        |        |        |       |        |
|----|--------|--------|--------|--------|--------|--------|-------|--------|--------|--------|-------|--------|
| 0  | ---    | ---    | -2.67  | 30.00  | 32.21  | 46.91  | 24.33 | 71.31  | ---    | ---    | ---   | ---    |
| 1  | ---    | 13.12  | ---    | 32.82  | 18.45  | 43.44  | 30.52 | 60.65  | 67.37  | ---    | ---   | ---    |
| 2  | 112.44 | 40.74  | 34.65  | 44.63  | 36.33  | 47.78  | 58.63 | 55.31  | 44.03  | 80.25  | ---   | ---    |
| 3  | 119.06 | 44.32  | 37.14  | 59.93  | 39.06  | 47.95  | 57.61 | 57.62  | 57.17  | 68.69  | 84.19 | ---    |
| 4  | 111.51 | 60.25  | 71.84  | 61.69  | 55.73  | 58.84  | 55.01 | 58.99  | 78.42  | 59.74  | 62.21 | 84.57  |
| 5  | 117.78 | 81.40  | 84.49  | 69.78  | 65.40  | 85.68  | 53.65 | 66.12  | 63.37  | 71.81  | 65.70 | 73.58  |
| 6  | 120.41 | 97.21  | 75.18  | 76.32  | 82.74  | 78.69  | 73.92 | 75.07  | 72.56  | 74.03  | 89.34 | 69.55  |
| 7  | ---    | ---    | 111.92 | 85.65  | 85.51  | 82.44  | 76.84 | 103.97 | 66.67  | 74.33  | 75.76 | 81.02  |
| 8  | ---    | ---    | ---    | 114.05 | 85.93  | 85.59  | 92.19 | 92.06  | 88.77  | 86.79  | 83.74 | 83.50  |
| 9  | ---    | ---    | ---    | ---    | 119.38 | 101.83 | 99.05 | 91.61  | 93.65  | 93.83  | 79.95 | 84.27  |
| 10 | ---    | ---    | ---    | ---    | ---    | 112.18 | 89.36 | 92.43  | 100.33 | 100.29 | 94.49 | 101.94 |
|    | RF CAL | 0      | 1      | 2      | 3      | 4      | 5     | 6      | 7      | 8      | 9     | 10     |

### LO HARMONICS ORDER

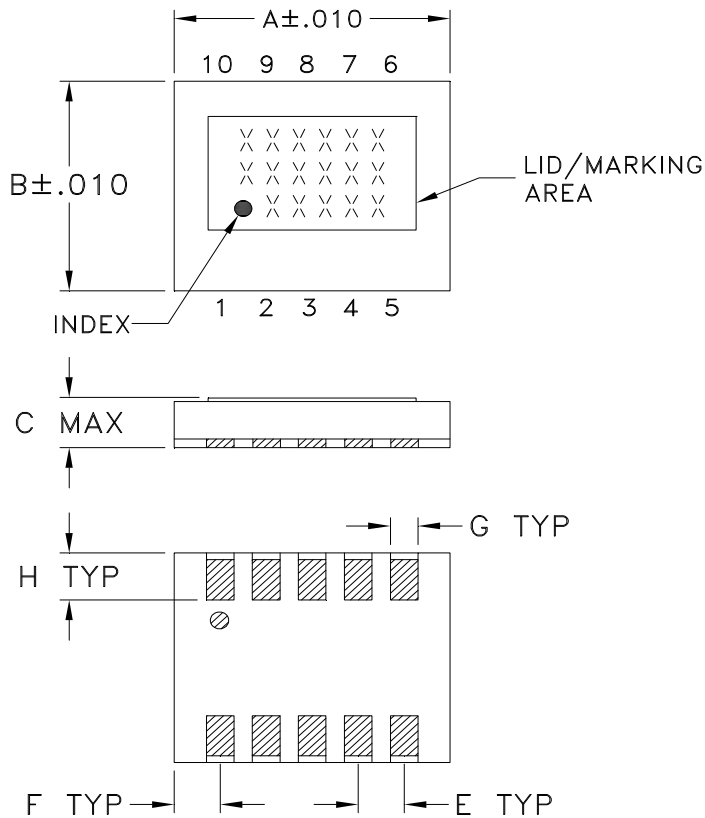
Test conditions:

RF IN: 3800.1 MHz; 0 dBm  
LO IN: 3830.1 MHz; +10.00 dBm  
IF OUT: 30 MHz; -6.43 dBm

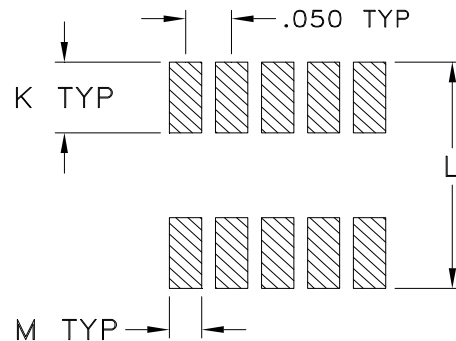
- Notes:
1. All Harmonics are in (dBc) relative to IF OUTPUT
  2. + entry denotes harmonics are in (dBc) above IF OUTPUT
  3. RF Cal represents the Harmonics level of the RF Input Signal to the mixer

**DZ1650**

## Outline Dimensions



## PCB Land Pattern



Suggested Layout,  
Tolerance to be within  $\pm .002$

| CASE#  | A              | B              | C              | D        | E              | F              | G             | H              | J        | K              | L              | M             | WT.<br>GRAMS |
|--------|----------------|----------------|----------------|----------|----------------|----------------|---------------|----------------|----------|----------------|----------------|---------------|--------------|
| DZ1650 | .300<br>(7.62) | .250<br>(6.35) | .060<br>(1.52) | --<br>-- | .050<br>(1.27) | .050<br>(1.27) | .030<br>(.76) | .056<br>(1.42) | --<br>-- | .085<br>(2.16) | .270<br>(6.86) | .035<br>(.89) | .29          |

Dimensions are in inches (mm). Tolerances: 2Pl.  $\pm .01$ ; 3Pl.  $\pm .005$

### Notes:

- Case material: Ceramic.
- Termination finish:  
For RoHS Case Styles: 1.2  $\mu$  inch (0.03microns) Gold over 8  $\mu$  inch (0.2 microns) Palladium and 158  $\mu$  inch (4.0 microns) Nickel plate.  
All models, (+) suffix.



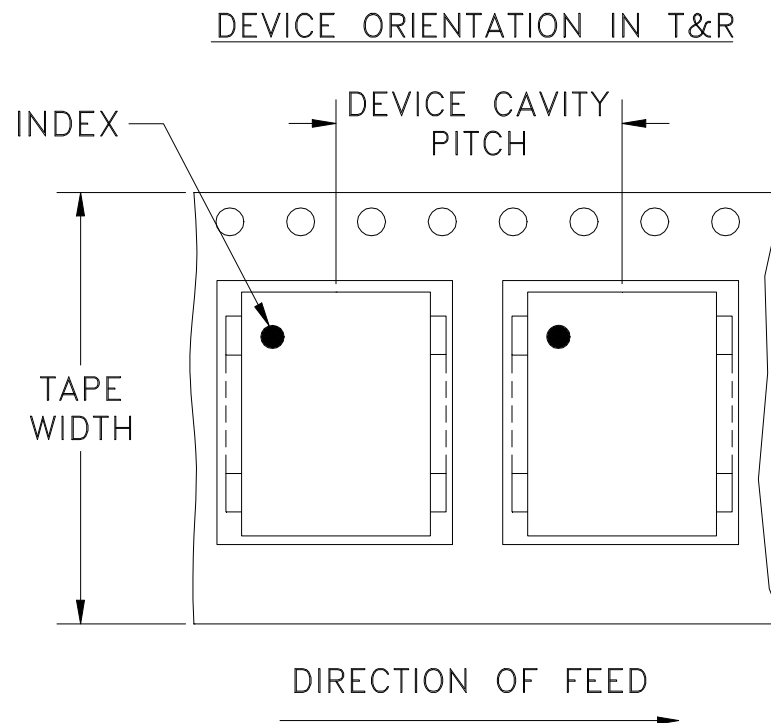
INTERNET <http://www.minicircuits.com>

P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661

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Mini-Circuits ISO 9001 & ISO 14001 Certified

# Tape & Reel Packaging TR-F34



| Tape Width,<br>mm | Device Cavity<br>Pitch, mm | Reel Size,<br>inches | Devices per Reel<br>see note                |      |
|-------------------|----------------------------|----------------------|---------------------------------------------|------|
| 16                | 12                         | 7                    | Small<br>quantity<br>standard<br>(see note) | 20   |
|                   |                            |                      |                                             | 50   |
|                   |                            |                      |                                             | 100  |
|                   |                            |                      |                                             | 200  |
|                   |                            | 13                   | Standard                                    | 500  |
|                   |                            |                      |                                             | 1000 |

Note: Availability of small reel quantity varies by model.  
Refer to pricing and availability on individual model dashboard.

Mini-Circuits carrier tape materials provide protection from ESD (Electro-Static Discharge) during handling and transportation. Tapes are static dissipative and comply with industry standards EIA-481/EIA-541.

Go to: [www.minicircuits.com/pages/pdfs/tape.pdf](http://www.minicircuits.com/pages/pdfs/tape.pdf)



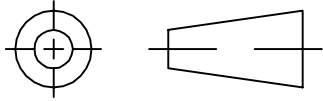
INTERNET <http://www.minicircuits.com>

P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661

Distribution Centers NORTH AMERICA 800-654-7949 • 417-335-5935 • Fax 417-335-5945 • EUROPE 44-1252-832600 • Fax 44-1252-837010

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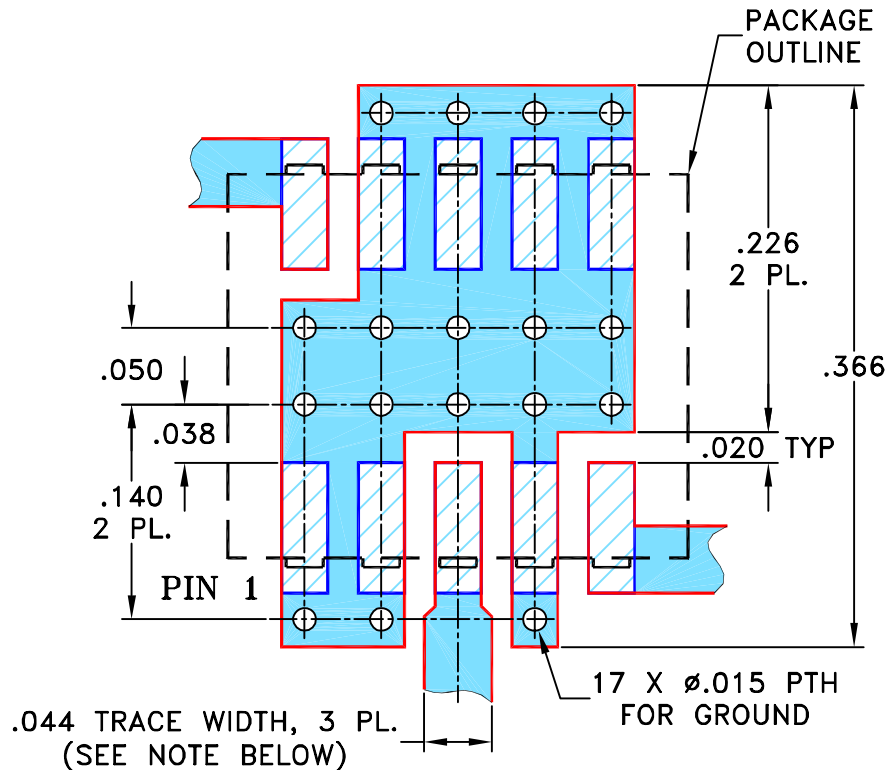
## THIRD ANGLE PROJECTION



## REVISIONS

| REV | ECN No. | DESCRIPTION                     | DATE     | DR  | AUTH |
|-----|---------|---------------------------------|----------|-----|------|
| A   | M81781  | UPDATED PCB LAYOUT              | 06/07/02 | GF  | DJ   |
| B   | M82377  | UPDATED DRAWING                 | 07/31/02 | AV  | WL   |
| C   | M102713 | ADDED NOTE 2 & "...WITH SMOBC"  | 01/17/06 | MMG | IL   |
| D   | M135488 | ADDED DZ1650, CHANGED PIN CONN. | 02/02/12 | GF  | DJ   |

## SUGGESTED MOUNTING CONFIGURATION FOR DZ883, DZ885 & DZ1650 CASE STYLES, "10MX01" PIN CONNECTION



- NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .020"  $\pm$  .0015"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.



DENOTES PCB COPPER LAYOUT WITH SMOBC  
(SOLDER MASK OVER BARE COPPER)



DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

UNLESS OTHERWISE SPECIFIED

INITIALS

DATE

DIMENSIONS ARE IN INCHES

TOLERANCES ON:  
2 PL DECIMALS  $\pm$   
3 PL DECIMALS  $\pm$  .005  
ANGLES  $\pm$   
FRACTIONS  $\pm$

DRAWN

AV

05/08/02

CHECKED

DB

05/16/02

APPROVED

WL

05/16/02

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ASHEETA1.DWG REV:A DATE:01/12/95



# Mini-Circuits®

13 Neptune Avenue  
Brooklyn NY 11235

## PL, 10MX01, DZ883/885/1650, TB-144

SIZE  
A

CODE IDENT  
15542

DRAWING NO:  
98-PL-045

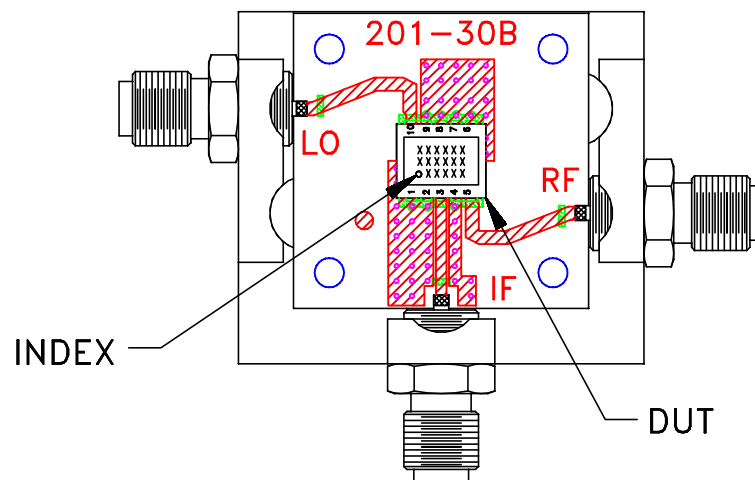
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FILE: 98PL045

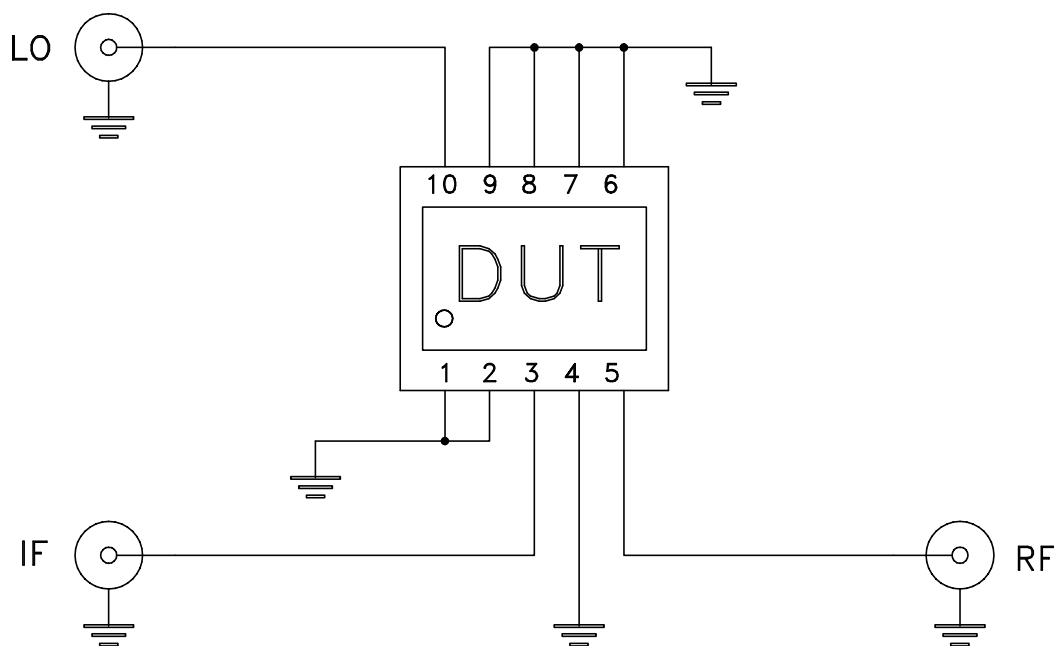
SCALE: 8:1

SHEET: 1 OF 1

# Evaluation Board and Circuit



TB-956+



Schematic Diagram

## Notes:

1. 50 Ohm SMA Female connectors.
2. PCB Material: R04350 or equivalent,  
Dielectric Constant=3.5, Thickness=.020 inch.

 **Mini-Circuits®**



All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

| Specification              | Test/Inspection Condition                                                          | Reference/Spec                                |
|----------------------------|------------------------------------------------------------------------------------|-----------------------------------------------|
| Operating Temperature      | -55° to 125° C<br>Ambient Environment                                              | Individual Model Data Sheet                   |
| Storage Temperature        | -65° to 150° C<br>Ambient Environment                                              | Individual Model Data Sheet                   |
| Thermal Shock              | -55° to 100° C, 1000 cycles, 15 minutes<br>-55° to 150° C, 1000 cycles, 15 minutes | MIL-STD-202, Method 10                        |
| HTOL                       | 1000 hrs, 125°, at rated Lo Level                                                  | MIL-STD-202, Method 108, Condition D          |
| High Temp Storage          | 150°C 1008 hours                                                                   | JESD22-A103                                   |
| Resistance to Solvent      | Per Reference Spec                                                                 | MIL-STD-202, Method 215J                      |
| Fine and Gross Leak Test   | Per Reference Spec                                                                 | MIL-STD-202, Method 112 Test, Conditions C, D |
| Constant Acceleration      | Y1 plane only, 30,000 g                                                            | MIL-STD-883, Method 2001, Condition E         |
| Mechanical Shock           | Per Reference Spec                                                                 | MIL-STD-202, Method 213, Condition A          |
| Vibration (High Frequency) | 20g peak, 10-2000 Hz, 12 times in each of three perpendicular directions           | MIL-STD-202, Method 204, Condition D          |
| Solderability              | 3X, 245° peak temp                                                                 | JESD22-B102                                   |
| Bend Test                  | 1MM, deflection for 5 secs.                                                        | JESD22-B113                                   |