

# 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

## MAC-12G+

Level 7 (LO Power+7 dBm) 3800 to 12000 MHz

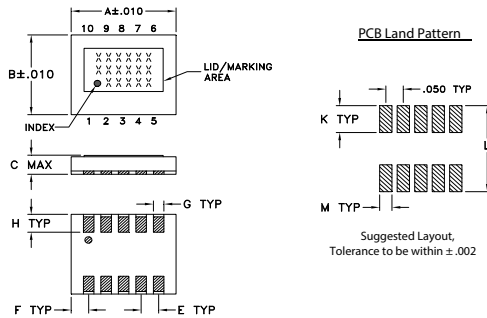
### Maximum Ratings

|   |                |
|---|----------------|
| 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 |

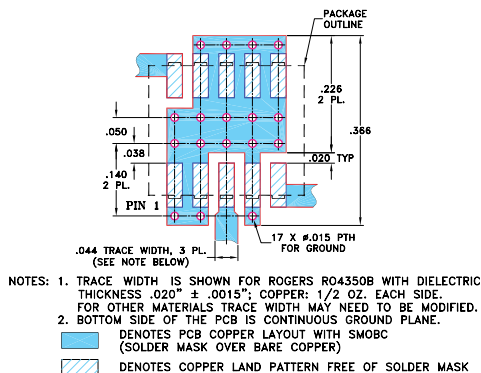
### Outline Drawing



### 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)



### Features

- wide bandwidth, 3800 to 12000 MHz
- low conversion loss, 6.0 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

- satellite up and down converters
- line of sight links
- defense radar
- defense communications
- federal fixed service

### Electrical Specifications at 25°C

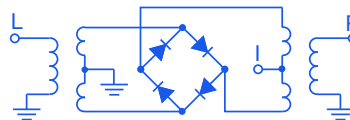
| Parameter                          | Condition (MHz)                            | Min.           | Typ.              | Max.              | Units |
|------------------------------------|--|----------------|-------------------|-------------------|-------|
| Frequency Range, LO/RF             |  |                | 3800 - 12000      |                   | MHz   |
| Frequency Range, IF                |  |                | DC - 1800         |                   | MHz   |
| Conversion Loss*                   | 3800 - 6500<br>6500 - 9500<br>9500 - 12000 | —<br>—<br>—    | 5.6<br>5.9<br>6.0 | 7.7<br>8.2<br>9.4 | dB    |
| LO to RF Isolation                 | 3800 - 6500<br>6500 - 9500<br>9500 - 12000 | 18<br>24<br>17 | 32<br>38<br>26    | —<br>—<br>—       | dB    |
| LO to IF Isolation                 | 3800 - 6500<br>6500 - 9500<br>9500 - 12000 | 8<br>21<br>14  | 13<br>39<br>23    | —<br>—<br>—       | dB    |
| IP3                                | 3800 - 6500<br>6500 - 9500<br>9500 - 12000 | —<br>—<br>—    | 10<br>7<br>10     | —<br>—<br>—       | dBm   |
| RF Input Power at 1 dB Compression |  |                | +1                |                   | dBm   |

\*Conversion Loss measured at 30 MHz IF.

### Typical Performance Data at 25°C and LO=+7dBm

| Frequency (MHz) |         | Conversion Loss (dB) | Isolation L-R (dB) | Isolation L-I (dB) | VSWR RF Port (:1) | VSWR LO Port (:1) |
|-----------------|---------|----------------------|--------------------|--------------------|-------------------|-------------------|
| RF              | LO      | LO +7dBm             | LO +7dBm           | LO +7dBm           | LO +7dBm          | LO +7dBm          |
| 3800.1          | 3830.1  | 5.99                 | 31.07              | 10.00              | 1.91              | 2.94              |
| 4200.1          | 4230.1  | 5.27                 | 30.81              | 11.42              | 1.75              | 2.96              |
| 4600.1          | 4630.1  | 5.04                 | 26.94              | 12.37              | 1.62              | 3.01              |
| 5000.1          | 5030.1  | 4.87                 | 29.19              | 12.85              | 1.74              | 3.04              |
| 5400.1          | 5430.1  | 6.00                 | 28.42              | 14.42              | 2.30              | 3.07              |
| 5800.1          | 5830.1  | 6.41                 | 23.66              | 17.11              | 1.62              | 3.11              |
| 6200.1          | 6230.1  | 5.42                 | 27.88              | 23.68              | 1.27              | 3.48              |
| 6600.1          | 6630.1  | 5.21                 | 33.16              | 30.31              | 1.16              | 3.58              |
| 7000.1          | 7030.1  | 6.24                 | 35.43              | 35.14              | 1.96              | 3.49              |
| 7400.1          | 7430.1  | 5.63                 | 37.74              | 37.00              | 2.13              | 3.20              |
| 7800.1          | 7830.1  | 5.46                 | 38.95              | 37.21              | 2.50              | 2.56              |
| 8200.1          | 8230.1  | 5.90                 | 38.84              | 39.61              | 2.83              | 1.83              |
| 8600.1          | 8630.1  | 6.44                 | 34.18              | 43.03              | 3.20              | 1.73              |
| 9000.1          | 9030.1  | 6.57                 | 38.49              | 48.65              | 3.02              | 1.88              |
| 9400.1          | 9430.1  | 5.86                 | 34.37              | 40.17              | 2.71              | 2.35              |
| 9800.1          | 9830.1  | 5.58                 | 30.24              | 30.03              | 2.37              | 2.72              |
| 10200.1         | 10230.1 | 5.70                 | 30.90              | 19.19              | 1.69              | 2.90              |
| 10800.1         | 10830.1 | 5.58                 | 24.14              | 22.91              | 1.18              | 2.38              |
| 11600.1         | 11630.1 | 6.16                 | 21.85              | 28.95              | 1.65              | 1.40              |
| 12000.1         | 12030.1 | 6.38                 | 24.79              | 23.67              | 1.96              | 1.59              |

### Electrical Schematic



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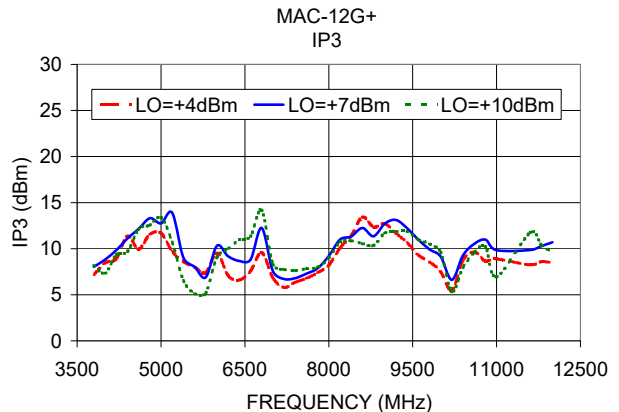
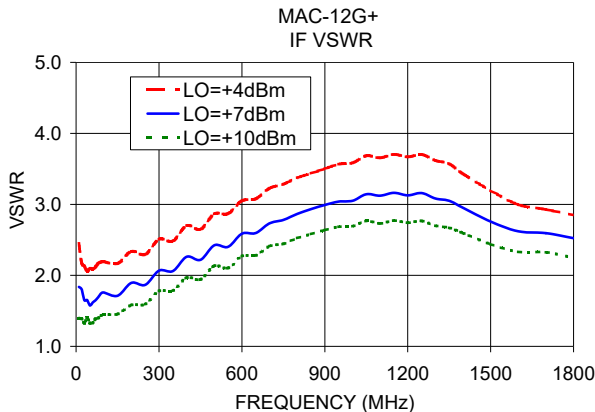
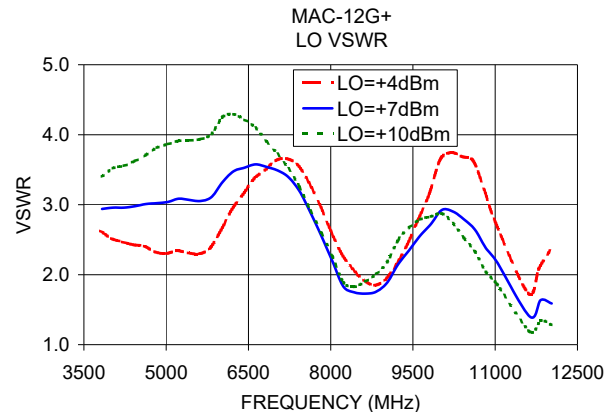
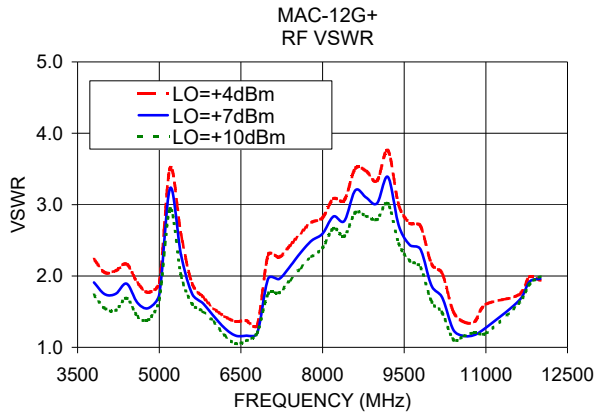
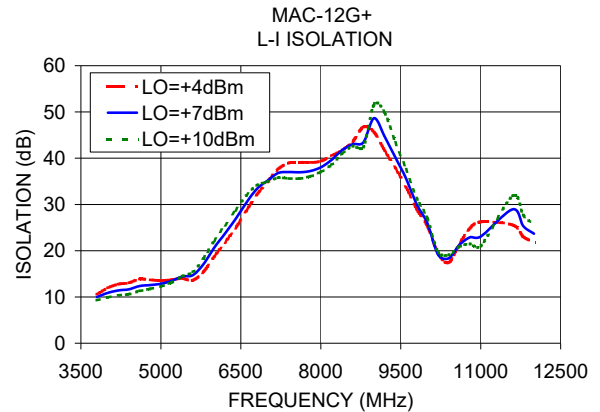
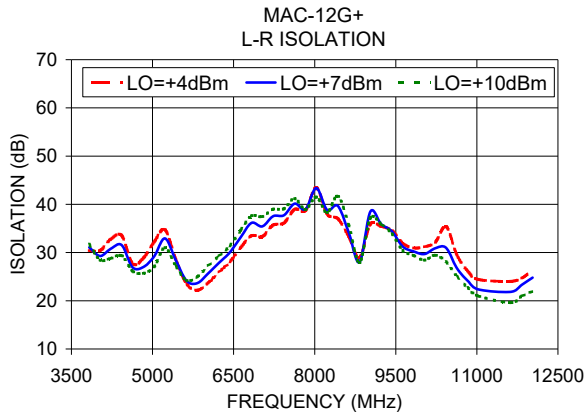
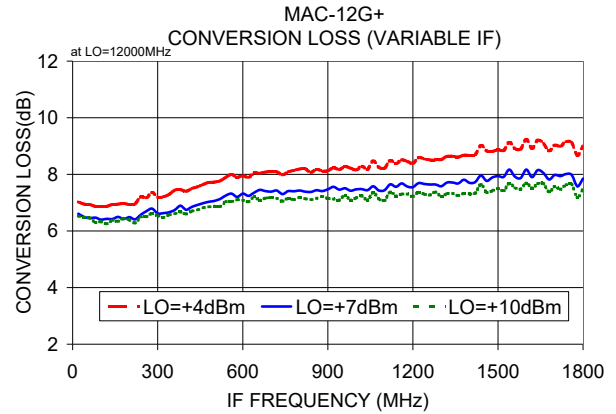
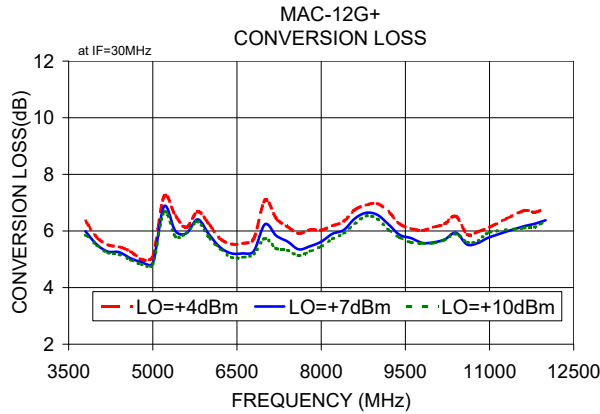
Generic photo used for illustration purposes only

CASE STYLE: DZ1650

### +RoHS Compliant

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

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

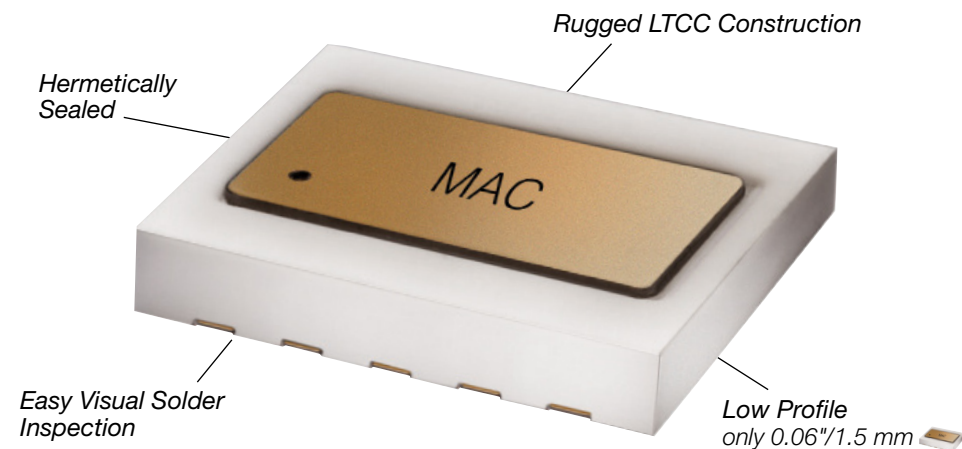


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# Designed and Built for Long-Term Reliability in HOSTILE ENVIRONMENTS



## 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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