

## MICROLITHIC™ DOUBLE-BALANCED MIXER

### ML1-0113

The ML1-0113 is a Microlithic™ double balanced mixer. As with all Microlithic™ mixers (patent pending), it features excellent conversion loss, isolations, and spurious performance across a broad bandwidth and in a miniaturized form factor. Accurate, nonlinear software models are available for Microwave Office through the Marki Microwave PDK. The ML1-0113 is available as a wire bondable chip or an SMA connectorized package. The surface mount version of this mixer can be found here: [ML1-0110SM](#). The ML1-0113 is an excellent alternative to Marki Microwave M1 and M3 mixers



#### Features

- Compact Chip Style Package (0.152" x 0.090" x 0.010")
- CAD Optimized for Superior Isolation and Spurious Response
- Broadband Performance
- Excellent Unit-to-Unit Repeatability
- Surface Mount Version: [ML1-0110SM](#)
- Fully nonlinear software models available with Marki PDK for Microwave Office
- RoHS Compliant

| Mixer Line | Suitable Replacement for Models                      |
|------------|------------------------------------------------------|
| M1         | M1-0204, M1-0208, M1-0212, M1-0310, M1-0408, M1-0412 |
| M3         | M3-0309, M3-0312, M3-0408, M3-0412                   |
| M8         | M8-0412, M8-4595                                     |

**Electrical Specifications** - Specifications guaranteed from -55 to +100°C, measured in a 50Ω system.

| Parameter                                        | LO<br>(GHz) | RF<br>(GHz) | IF<br>(GHz) | Min | Typ | Max | Diode Option<br>LO drive level (dBm) |
|--------------------------------------------------|-------------|-------------|-------------|-----|-----|-----|--------------------------------------|
| Conversion Loss (dB)                             | 1.5-13      |             | DC-1        |     | 7   | 10  |                                      |
|                                                  |             |             | 1-2         |     | 9   | 11  |                                      |
| Isolation (dB)                                   |             |             |             |     | -45 |     |                                      |
| LO-RF                                            |             |             |             |     | -20 |     |                                      |
| LO-IF                                            |             |             |             |     | -30 |     |                                      |
| RF-IF                                            |             |             |             |     |     |     |                                      |
| Input 1 dB Compression (dBm)                     |             |             |             |     | +3  |     | L (+10 to +13)                       |
|                                                  |             |             |             |     | +9  |     | I (+15 to +19)                       |
| Input Two-Tone Third Order Intercept Point (dBm) |             |             |             |     | +14 |     | L (+10 to +13)                       |
|                                                  |             |             |             |     | +21 |     | I (+15 to +19)                       |

#### Part Number Options

| Please specify diode level and package style by adding to model number. |                      |                                     |                                     |                                   |
|-------------------------------------------------------------------------|----------------------|-------------------------------------|-------------------------------------|-----------------------------------|
| Package Styles                                                          |                      | Examples                            |                                     |                                   |
| Connectorized <sup>1</sup>                                              | <a href="#">S</a>    | ML1-0113LCH-2, ML1-0113LS           |                                     |                                   |
| Chip <sup>2</sup> (RoHS)                                                | <a href="#">CH-2</a> | <a href="#">ML1-0113</a><br>(Model) | <a href="#">L</a><br>(Diode Option) | <a href="#">CH-2</a><br>(Package) |

<sup>1</sup>Connectorized package consists of chip package wire bonded to a substrate, equivalent to an evaluation board.

<sup>2</sup>Chip package connects to external circuit through wire bondable gold pads.



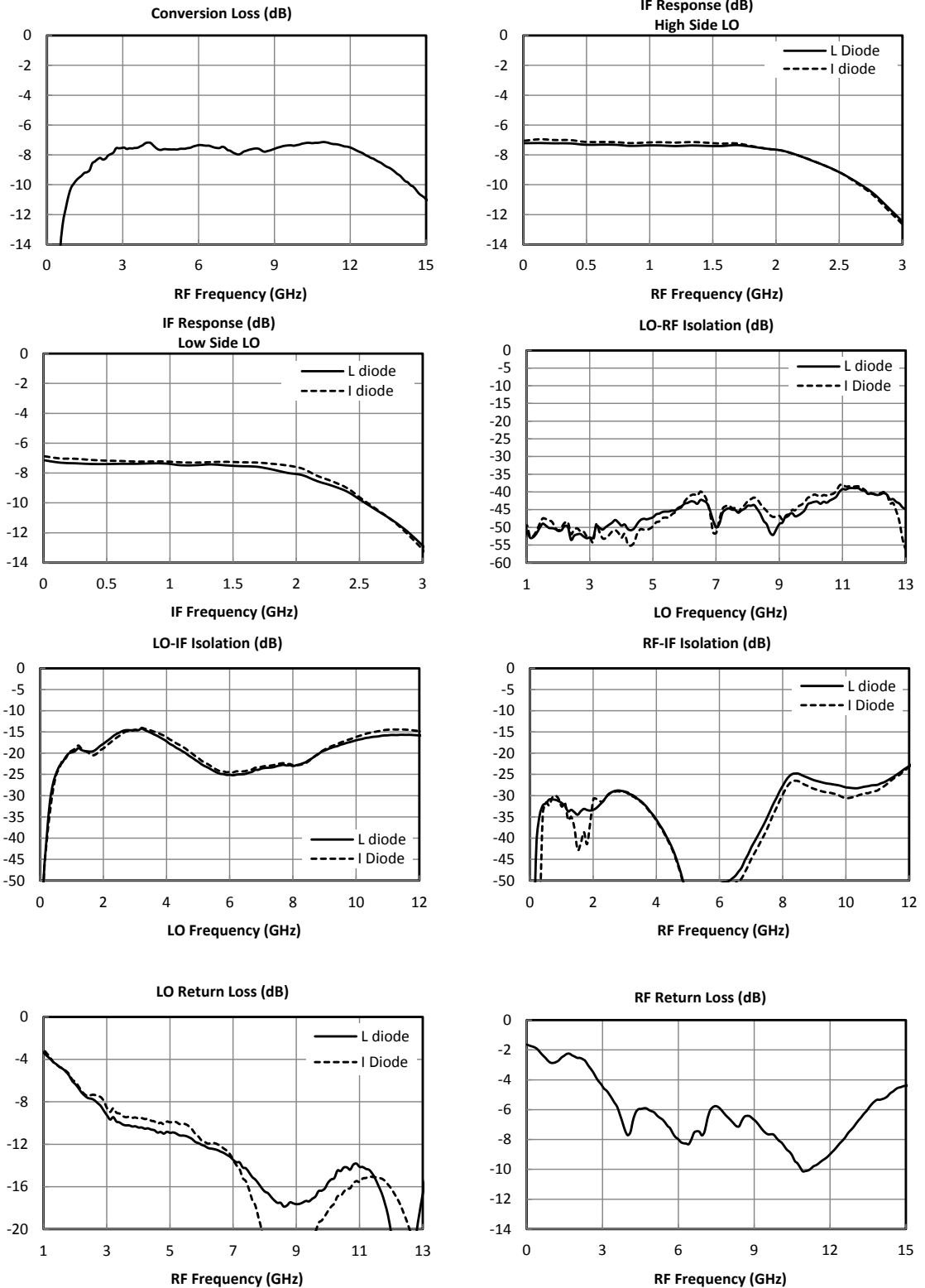
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LO/RF 1.5 to 13 GHz  
IF DC to 2 GHz

Typical Performance



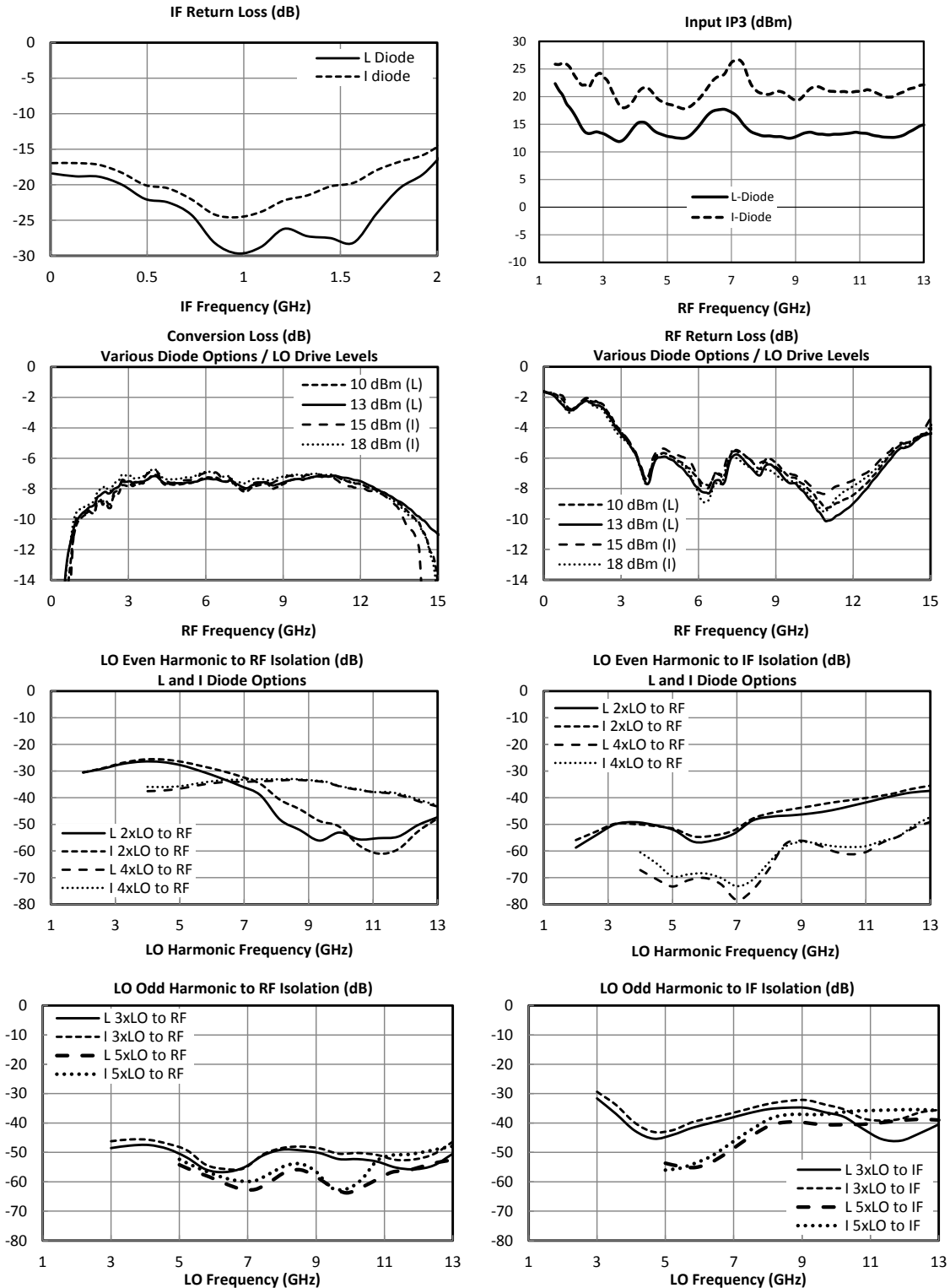
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LO/RF 1.5 to 13 GHz  
IF DC to 2 GHz

## Typical Performance

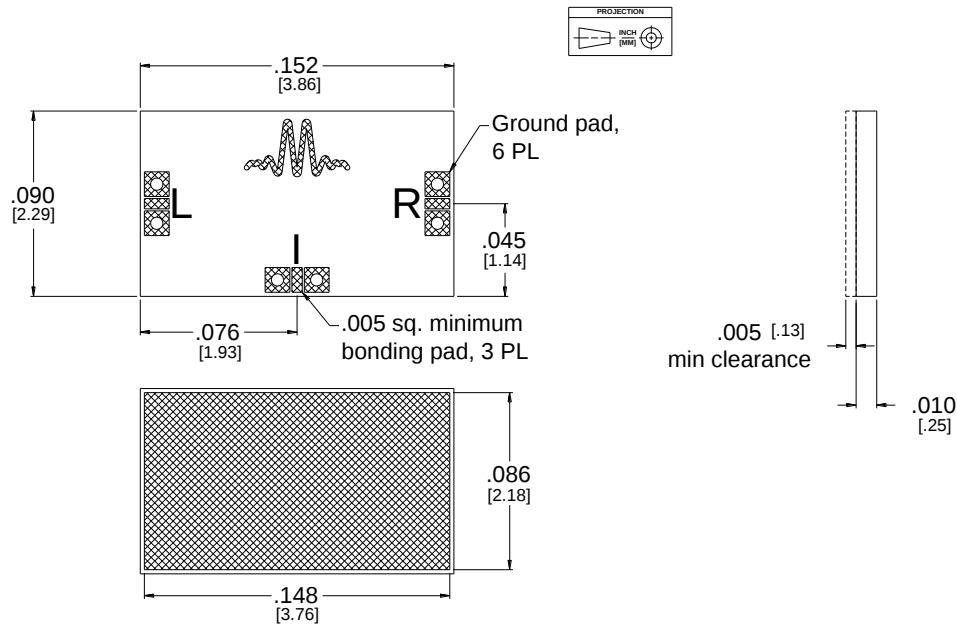


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LO/RF 1.5 to 13 GHz  
IF DC to 2 GHz

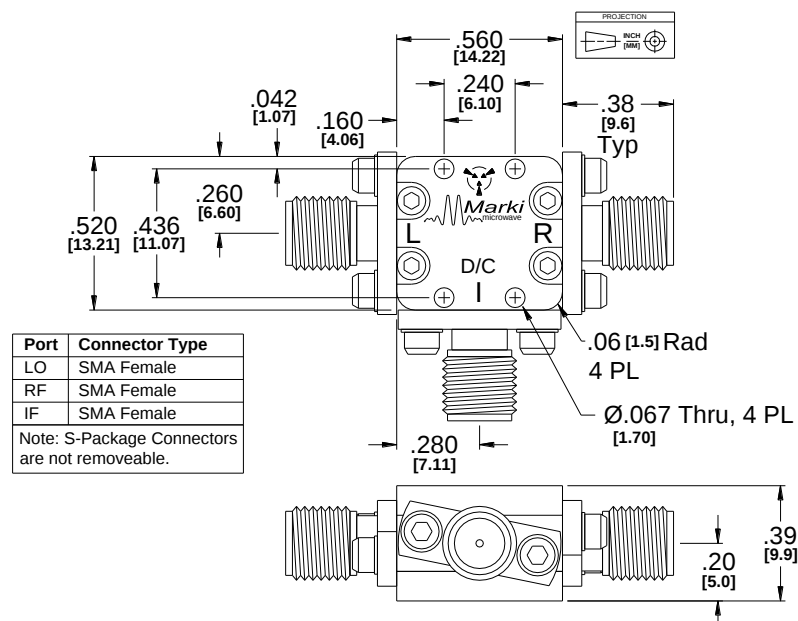


Outline Drawing – CH-2 package\*

\*CH Substrate material is .010 thick Ceramic.

I/O traces and ground plane finish is 2.5 microns Au over .05 microns WTi.

Wire Bonding - Ball or wedge bond with 0.025 mm (1 mil) diameter pure gold wire. Thermosonic wirebonding with a nominal stage temperature of 150 °C and a ball bonding force of 40 to 50 grams or wedge bonding force of 18 to 22 grams is recommended. Use the minimum level of ultrasonic energy to achieve reliable wirebonds. Wirebonds should be started on the chip and terminated on the package or substrate. All bonds should be as short as possible <0.31 mm (12 mils).



Outline Drawing – S package



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**LO/RF 1.5 to 13 GHz  
IF DC to 2 GHz**

## Downconversion Spurious Suppression

Spurious data is taken by selecting RF and LO frequencies ( $\pm mLO \pm nRF$ ) within the 1.5 to 13 GHz RF/LO bands, which create a 100 MHz IF spurious output. The mixer is swept across the full spurious band and the mean is calculated. The numbers shown in the table below are for a -10 dBm RF input. Spurious suppression is scaled for different RF power levels by (n-1), where “n” is the RF spur order. For example, the 2RFx2LO spur is 67 dBc for a -10 dBm input, so a -20 dBm RF input creates a spur that is (2-1) x (-10 dB) dB lower, or 77 dBc.

**Typical Downconversion Spurious Suppression (dBc): I diode (L diode) LO<sup>5</sup>**

| -10 dBm RF Input | 0xLO         | 1xLO                                                                  | 2xLO        | 3xLO      | 4xLO        | 5xLO      |
|------------------|--------------|-----------------------------------------------------------------------|-------------|-----------|-------------|-----------|
| 0xRF             | -----        | See LO to IF Isolation and LO Harmonic to IF Isolation Plots (Page 3) |             |           |             |           |
| 1xRF             | 24 (23)      | Reference                                                             | 30 (27)     | 10 (10)   | 31 (30)     | 20 (20)   |
| 2xRF             | 70 (65)      | 60 (53)                                                               | 67 (60)     | 55 (50)   | 61 (60)     | 50 (50)   |
| 3xRF             | 90 (83)      | 69 (55)                                                               | 80 (69)     | 70 (59)   | 80 (70)     | 66 (58)   |
| 4xRF             | >100 ( >100) | >100 (95)                                                             | >100 (98)   | >100 (95) | >100 (95)   | >100 (85) |
| 5xRF             | >100 ( >100) | >100 (>100)                                                           | >100 (>100) | >100 (95) | >100 (>100) | >100 (95) |

## Upconversion Spurious Suppression

Spurious data is taken by mixing a 100 MHz IF with LO frequencies ( $\pm mLO \pm nIF$ ), which creates an RF within the 1.5 to 13 GHz RF band. The mixer is swept across the full spurious output band and the mean is calculated. The numbers shown in the table below are for a -10 dBm IF input. Spurious suppression is scaled for different IF input power levels by (n-1), where “n” is the IF spur order. For example, the 2IFx1LO spur is typically 65 dBc for a -10 dBm input, so a -20 dBm IF input creates a spur that is (2-1) x (-10 dB) dB lower, or 75 dBc.

**Typical Upconversion Spurious Suppression (dBc): I diode (L diode) LO<sup>5</sup>**

| -10 dBm IF Input | 0xLO         | 1xLO                                                                  | 2xLO         | 3xLO      | 4xLO         | 5xLO    |
|------------------|--------------|-----------------------------------------------------------------------|--------------|-----------|--------------|---------|
| 0xIF             | -----        | See LO to RF Isolation and LO Harmonic to RF Isolation Plots (Page 3) |              |           |              |         |
| 1xIF             | 25 (25)      | Reference                                                             | 25 (30)      | 9 (10)    | 30 (35)      | 14 (14) |
| 2xIF             | 57 (55)      | 65 (62)                                                               | 56 (55)      | 60 (65)   | 44 (48)      | 55 (60) |
| 3xIF             | 83 (83)      | 68 (75)                                                               | 78 (60)      | 62 (60)   | 75 (72)      | 62 (55) |
| 4xIF             | >100 ( >100) | >100 ( >100)                                                          | 95 (92)      | 95 (>100) | 90 (85)      | 95 (92) |
| 5xIF             | >100 (>100)  | >100 ( >100)                                                          | >100 ( >100) | >100 (95) | >100 ( >100) | 95 (95) |

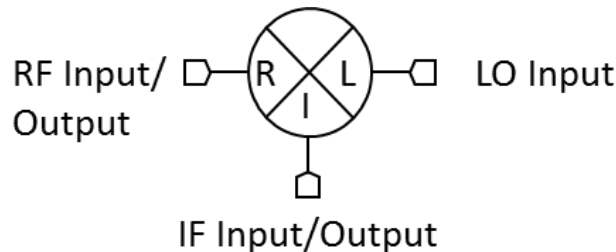


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LO/RF 1.5 to 13 GHz  
IF DC to 2 GHz



| Port | Description                                                                                                         | DC Interface Schematic |
|------|---------------------------------------------------------------------------------------------------------------------|------------------------|
| LO   | The LO port is DC short to ground and AC matched to 50 Ohms from 1.5 GHz to 13 GHz. Blocking capacitor is optional. |                        |
| RF   | The RF port is DC short to ground and AC matched to 50 Ohms from 1.5 GHz to 13 GHz. Blocking capacitor is optional. |                        |
| IF   | The IF port is DC coupled to the diodes. Blocking capacitor is optional.                                            |                        |

| Absolute Maximum Ratings  |                                                         |
|---------------------------|---------------------------------------------------------|
| Parameter                 | Maximum Rating                                          |
| RF DC Current             | 1 Amp                                                   |
| LO DC Current             | 1 Amp                                                   |
| IF DC Current             | 50 mA                                                   |
| RF Power Handling (RF+LO) | +25 dBm at +25°C, derated linearly to +20 dBm at +100°C |
| Operating Temperature     | -55°C to +100°C                                         |
| Storage Temperature       | -65°C to +125°C                                         |

## DATA SHEET NOTES:

1. Mixer Conversion Loss Plot IF frequency is 100 MHz.
2. Mixer Noise Figure typically measures within 0.5 dB of conversion loss for IF frequencies greater than 5 MHz.
3. Conversion Loss typically degrades less than 0.5 dB for LO drives 2 dB below the lowest and 3 dB above highest nominal LO drive levels.
4. Conversion Loss typically degrades less than 0.5 dB at +100°C and improves less than 0.5 dB at -55°C.
5. Unless otherwise specified L diode data taken with 13 dBm LO drive, I diode data taken with 17 dBm LO drive.
6. Specifications are subject to change without notice. Contact Marki Microwave for the most recent specifications and data sheets.
7. Catalog mixer circuits are continually improved. Configuration control requires custom mixer model numbers and specifications.

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