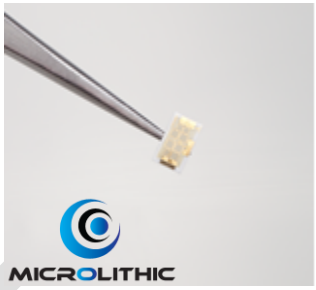
MICROLITHIC™ DOUBLE-BALANCED MIXER ML1-0113



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

Note: This part is being discontinued due to material obsolescence. Please see this EOL letter for recommended replacements.

Features

- Compact Chip Style Package (0.152" x 0.090"x0.010")
- 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 (GHz)	RF (GHz)	IF (GHz)	Min	Typ	Max	Diode Option LO drive level (dBm)
Conversion Loss (dB)	1.5-13		DC-1 1-2		7 9	10 11	
Isolation (dB) LO-RF LO-IF RF-IF					 -45 -20 -30		
Input 1 dB Compression (dBm)					+3 +9		L (+10 to +13) I (+15 to +19)
Input Two-Tone Third Order Intercept Point (dBm)					+14 +21		L (+10 to +13) I (+15 to +19)

Part Number Options

Please specify diode level and package style by adding to model number.

Package Styles		Examples		
Connectorized[1]	S	ML1-0113LCH-2, ML1-0113LS		
Chip[2] (RoHS)	CH-2	ML1-0113 (Model)	L (Diode Option)	CH-2 (Package)

[1]Connectorized package consists of chip package wire bonded to a substrate, equivalent to an evaluation board.
[2]Chip package connects to external circuit through wire bondable gold pads.

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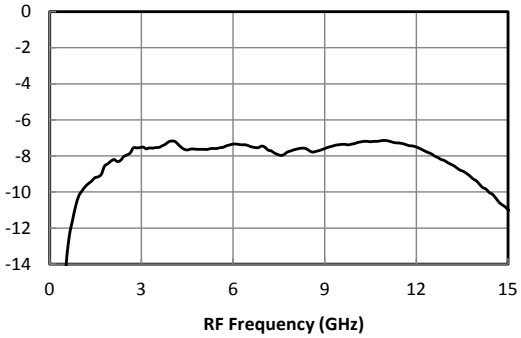
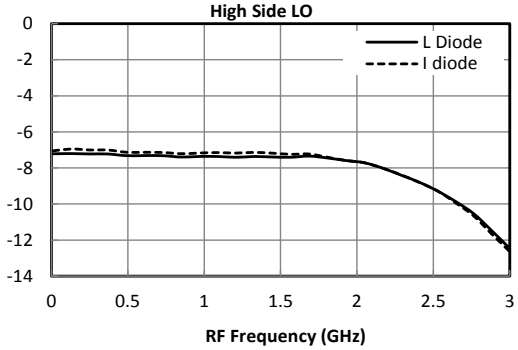
LO/RF 1.5 to 13 GHz
IF DC to 2 GHz

Typical Performance

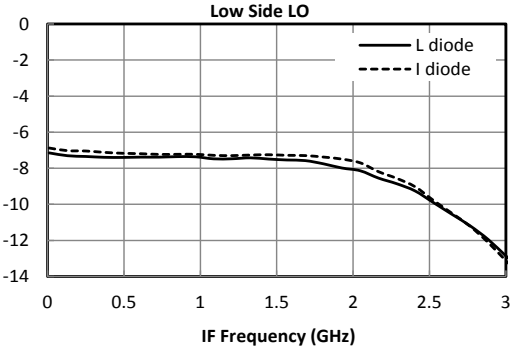
Conversion Loss (dB)



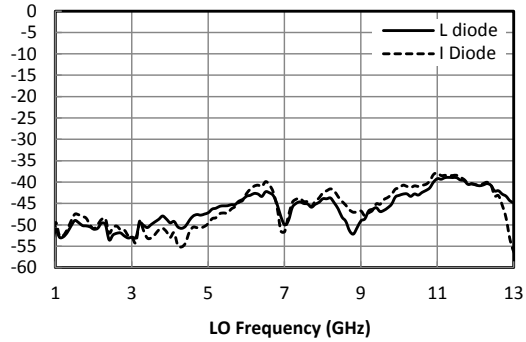
IF Response (dB)
High Side LO



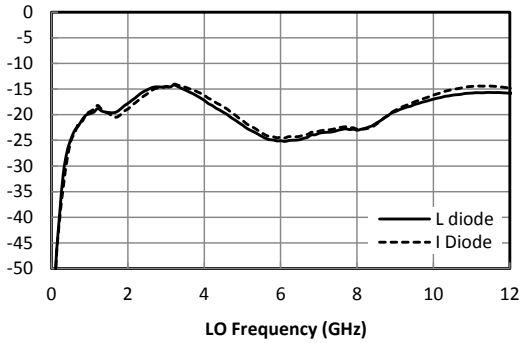
IF Response (dB)
Low Side LO



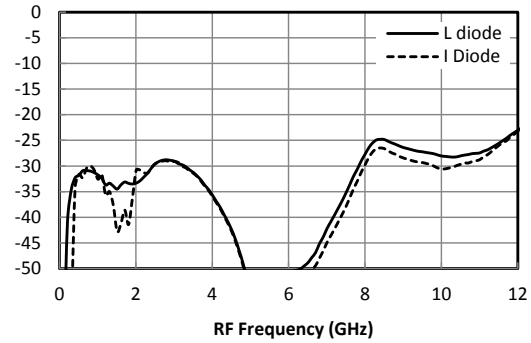
LO-RF Isolation (dB)



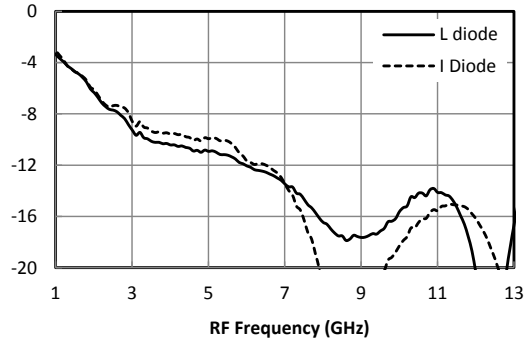
LO-IF Isolation (dB)



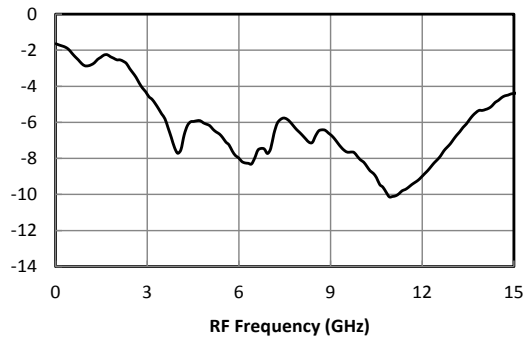
RF-IF Isolation (dB)



LO Return Loss (dB)



RF Return Loss (dB)

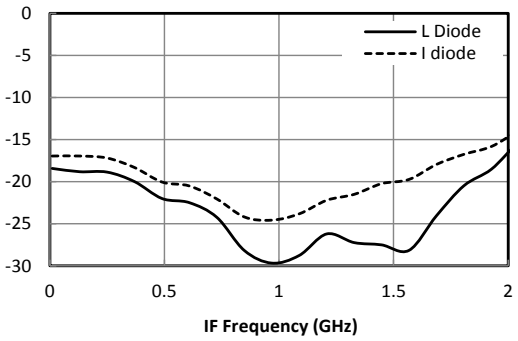


MICROLITHIC™ DOUBLE-BALANCED MIXER ML1-0113

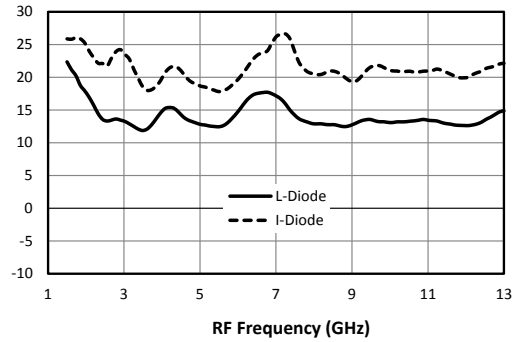
LO/RF 1.5 to 13 GHz
IF DC to 2 GHz

Typical Performance

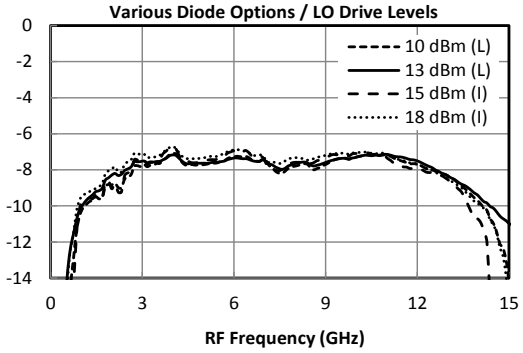
IF Return Loss (dB)



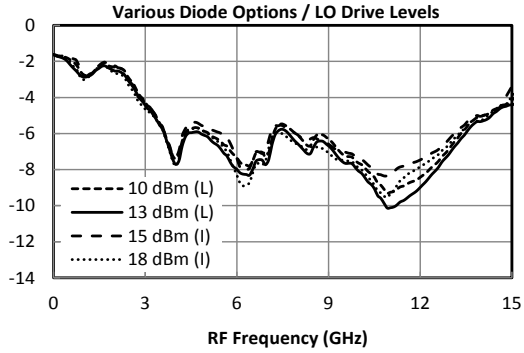
Input IP3 (dBm)



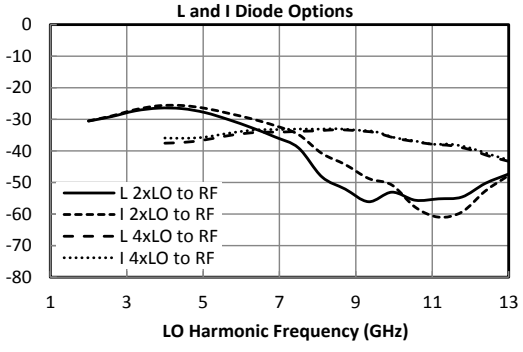
Conversion Loss (dB)
Various Diode Options / LO Drive Levels



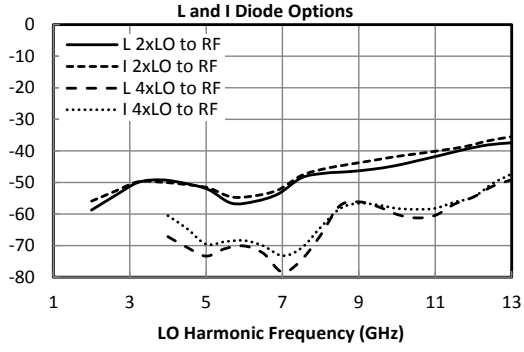
RF Return Loss (dB)
Various Diode Options / LO Drive Levels



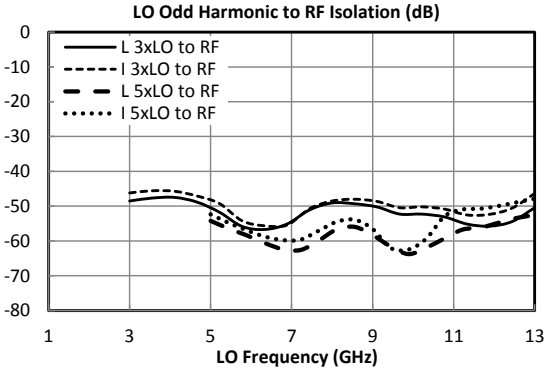
LO Even Harmonic to RF Isolation (dB)
L and I Diode Options



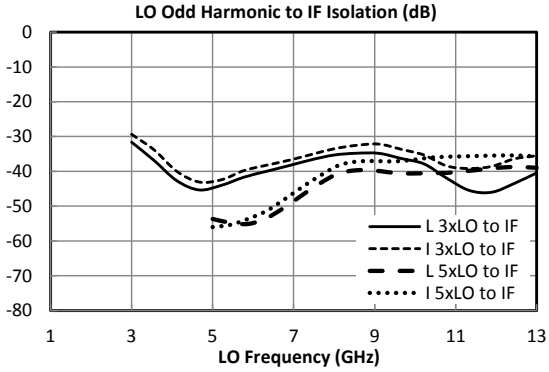
LO Even Harmonic to IF Isolation (dB)
L and I Diode Options



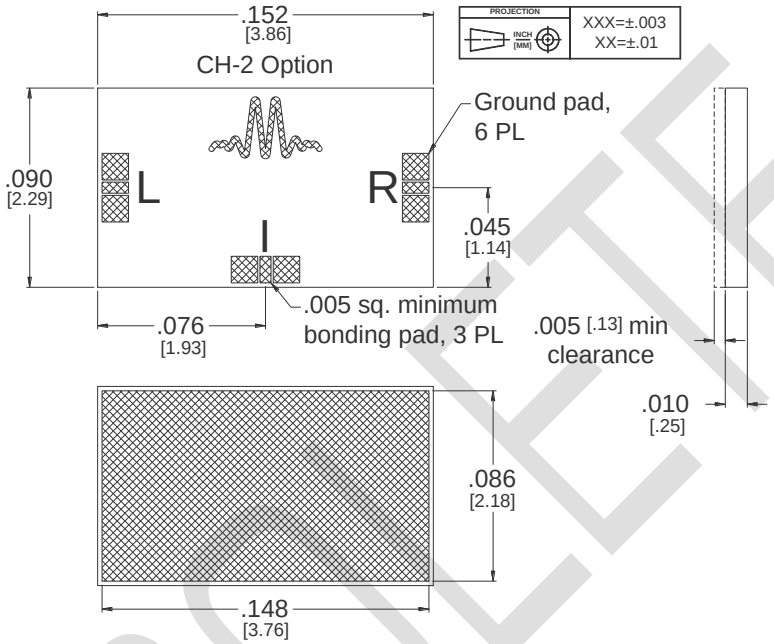
LO Odd Harmonic to RF Isolation (dB)



LO Odd Harmonic to IF Isolation (dB)

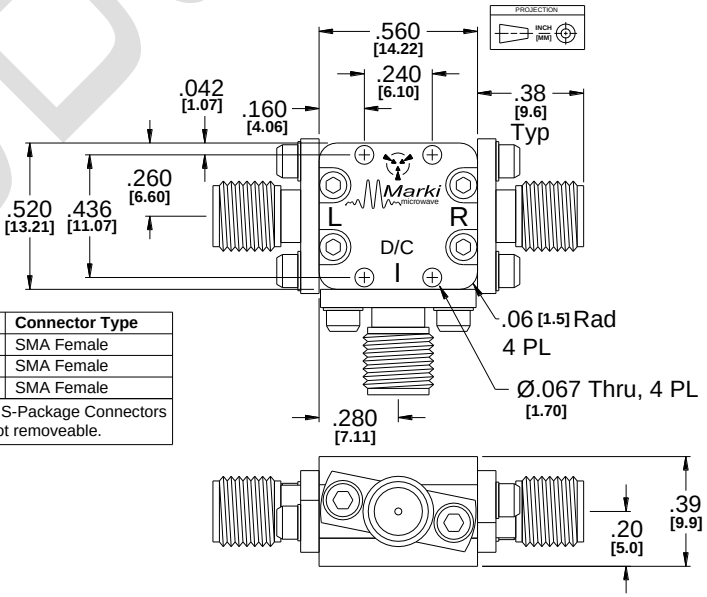


LO/RF 1.5 to 13 GHz
IF DC to 2 GHz



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).



Port	Connector Type
LO	SMA Female
RF	SMA Female
IF	SMA Female
Note: S-Package Connectors are not removeable.	

Outline Drawing – S package

Downconversion Spurious Suppression

Spurious data is taken by selecting RF and LO frequencies (±mLO±nRF) within the RF/LO bands, to create a spurious output within the IF band. 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[5]

-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 an input within the IF band, with LO frequencies (±mLO±nIF), to create a spurious output within the RF output 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[5]

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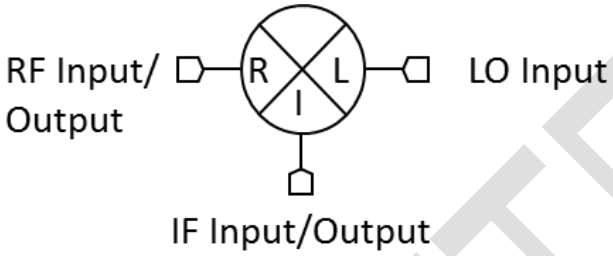
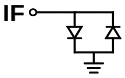
LO/RF 1.5 to 13 GHz
IF DC to 2 GHz



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	-55ºC to +100ºC
Storage Temperature	-65ºC to +125ºC

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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