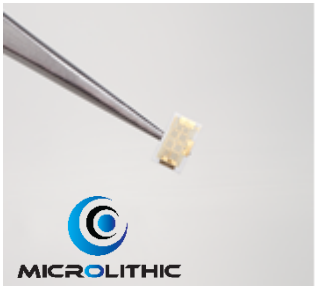
MICROLITHIC™ DOUBLE-BALANCED MIXER ML1-1040

The ML1-1040 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 ML1-1040 is available as a wire bondable chip or in a connectorized package. The ML1-1040 is an excellent alternative to Marki Microwave M9 mixers packaged in drop-in carriers such as the ES carrier.



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
- Fully nonlinear software models available with Marki PDK for Microwave Office
- RoHS Compliant

Electrical Specifications

- Specifications guaranteed from -55 to +100°C, measured in a 50Ω system.
Specifications are shown for Configurations A (B). See page 2 for port locations.
All bare die are 100% DC tested and 100% visually inspected. RF testing is performed on a sample basis to verify conformance to datasheet guaranteed specifications.
Consult factory for more information.

Parameter	LO (GHz)	RF (GHz)	IF (GHz)	Min	Typ	Max	LO drive level (dBm)
Conversion Loss (dB) [1]	10-40	10-40	DC-14 14-16		8 11	13.5 16.5	
Isolation (dB) LO-RF LO-IF RF-IF			DC-16		See Plots		
Input 1 dB Compression (dBm)					+3 +9		L (+10 to +13) I (+15 to +19)
Input Two-Tone Third Order Intercept Point (dBm)[2]					+15 +21		L (+10 to +13) I (+15 to +19)

[1]Measured Conversion Loss measured at 91 MHz fixed IF

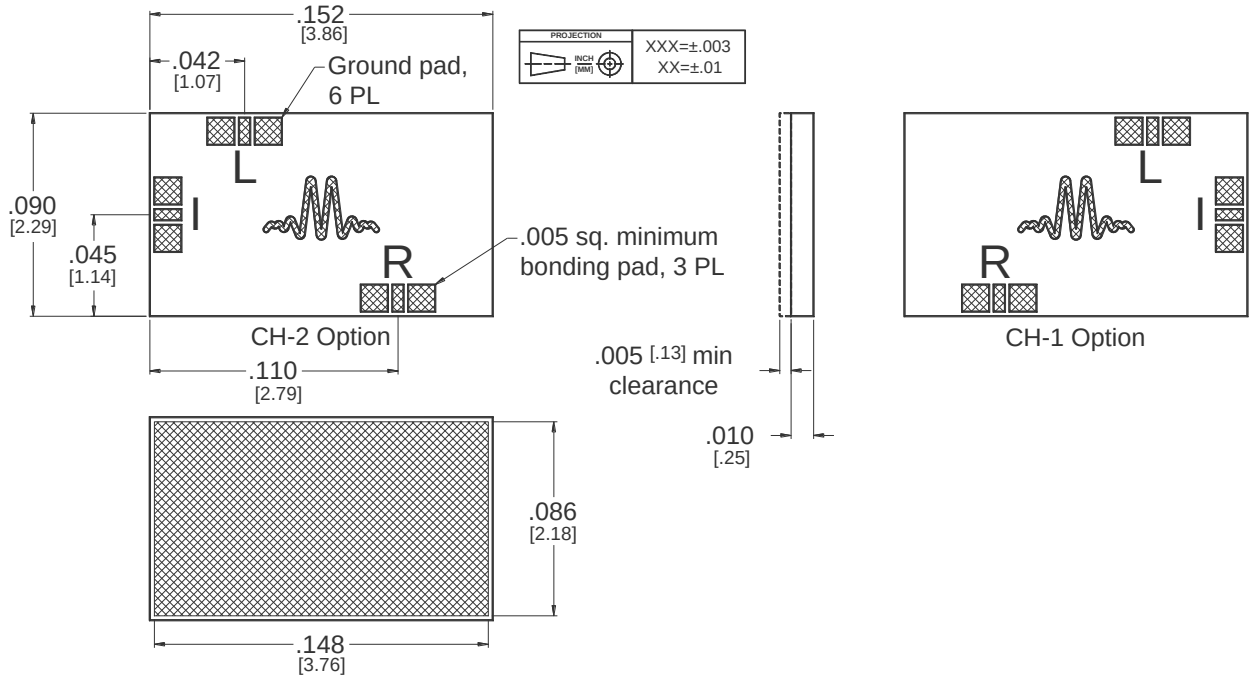
[2]IP3 depends on LO drive conditions, see plots for more details

Part Number Options

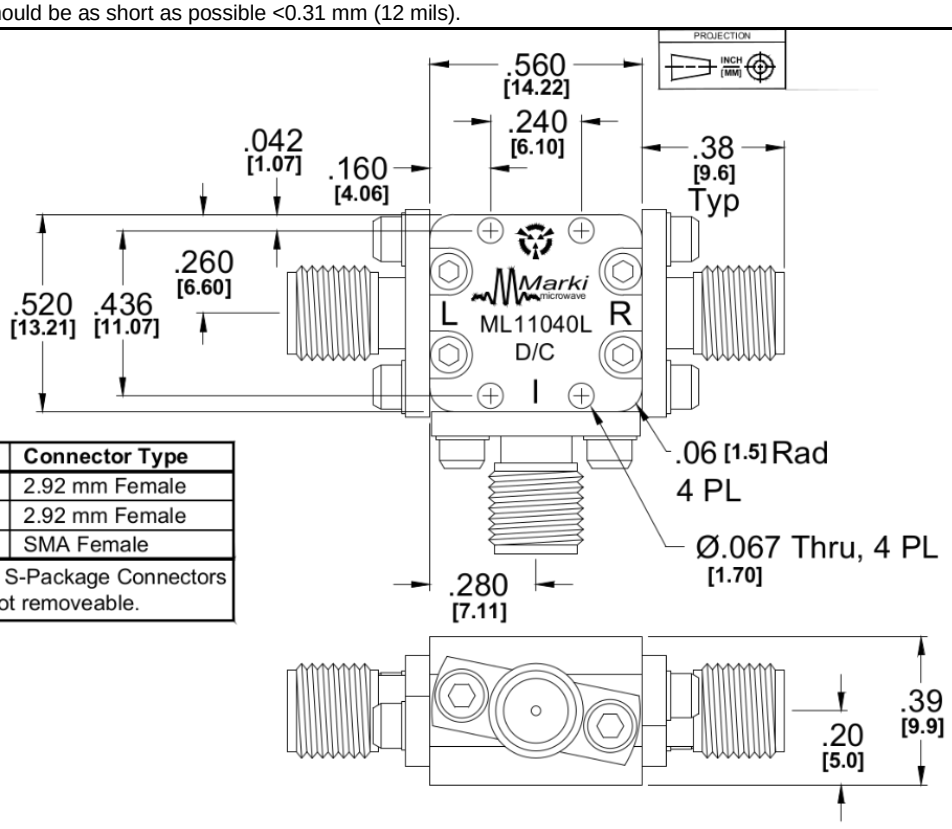
Please specify diode level and package style by adding to model number.

Package Styles		Examples		
Connectorized[1, 3]	S	ML1-1040LCH-2, ML1-1040LS		
Chip[2, 3] (RoHS)	CH-2	ML1-1040 (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.
[3]Note: For port locations and I/O designations, refer to the drawings on page 2 of this document.



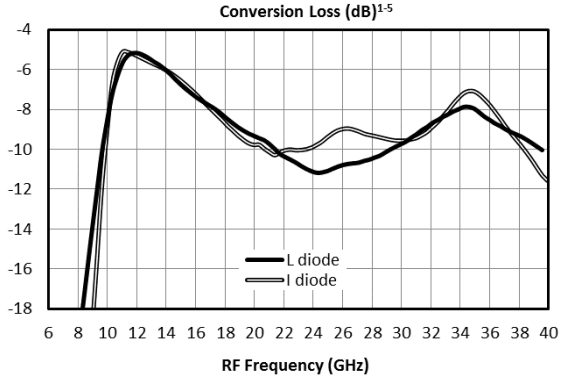
1. CH Substrate material is .010 thick Ceramic.
2. I/O traces and ground plane finish is 2.5 microns Au over .05 microns WTi.
3. Wire Bonding - Ball or wedge bond with 0.025 mm (1 mil) diameter pure gold wire. Thermosonic wirebonding with a nominal stage temperature of 150 °C and a ball bonding force 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).



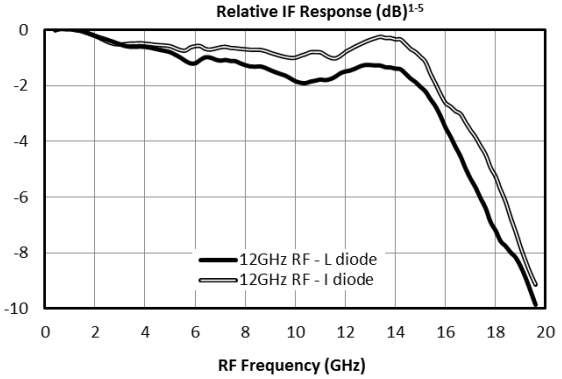
Port	Connector Type
LO	2.92 mm Female
RF	2.92 mm Female
IF	SMA Female
Note: S-Package Connectors are not removeable.	

Typical Performance

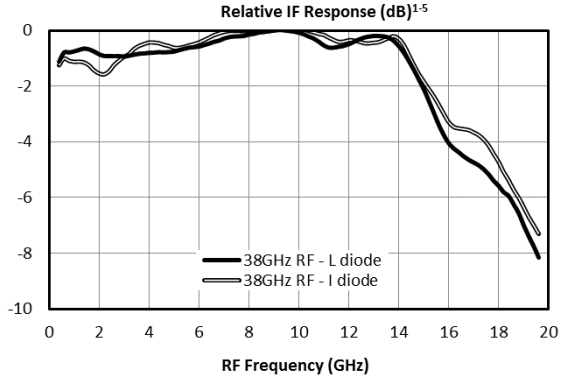
Conversion Loss (dB)[1-5]



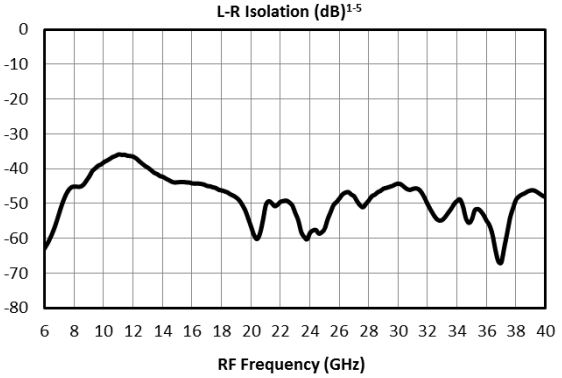
Relative IF Response (dB)[1-5]



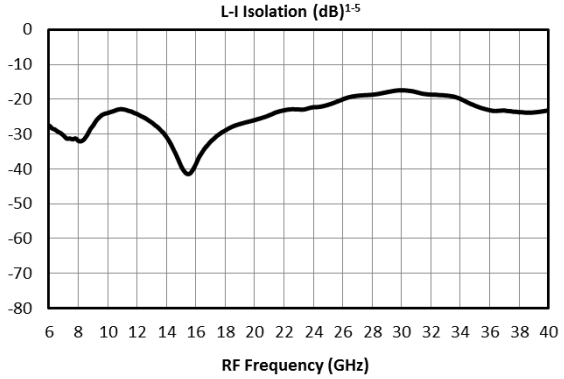
Relative IF Response (dB)[1-5]



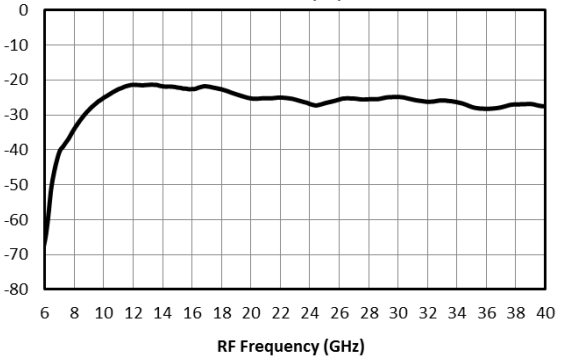
L-R Isolation (dB)[1-5]



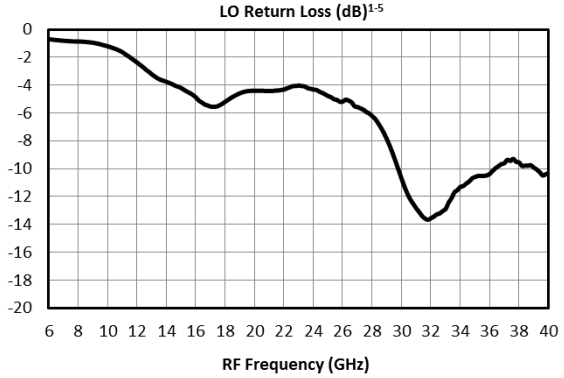
L-I Isolation (dB)[1-5]



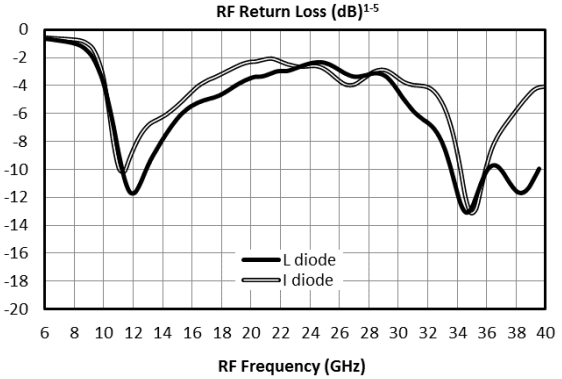
R-I Isolation (dB)[1-5]



LO Return Loss (dB)[1-5]

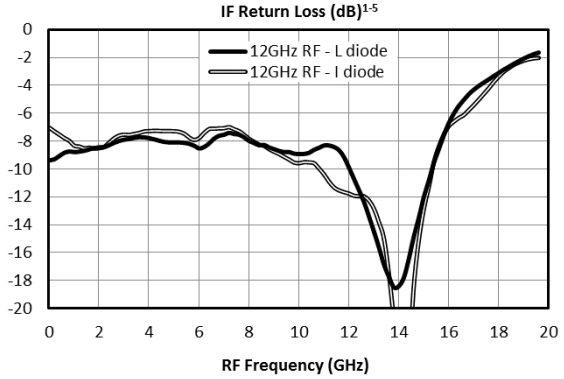


RF Return Loss (dB)[1-5]

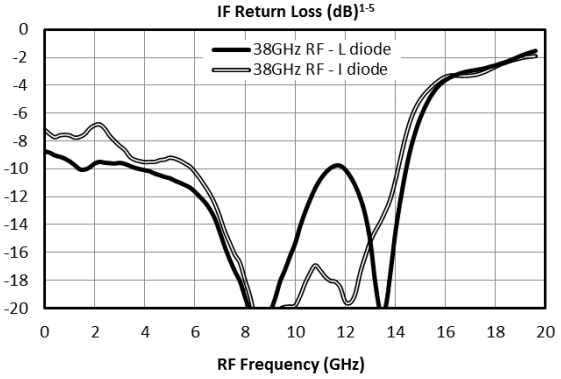


Typical Performance

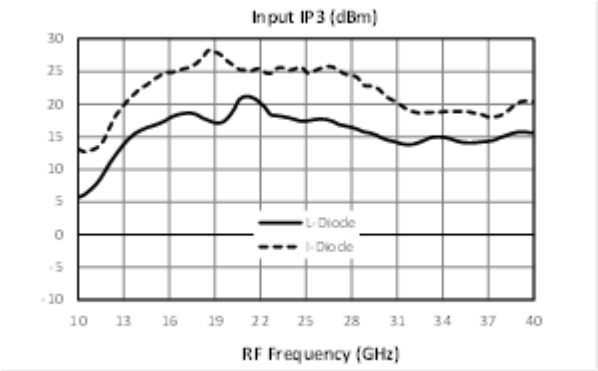
IF Return Loss (dB)[1-5]



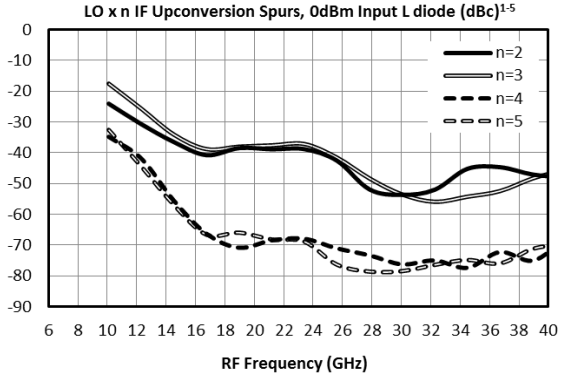
IF Return Loss (dB)[1-5]



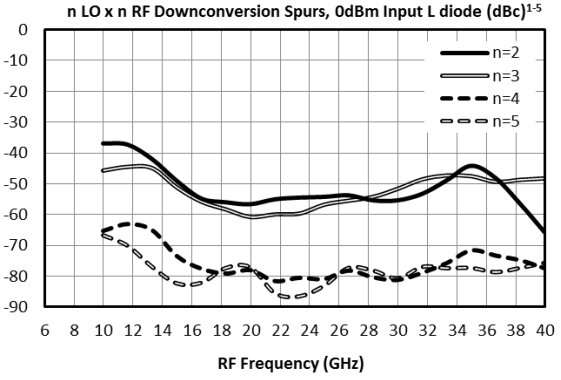
Input IP3 (dBm)



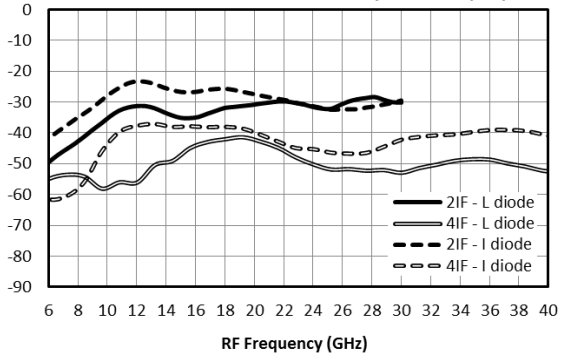
LO x n IF Upconversion Spurs, 0dBm Input L diode (dBc)[1-5]



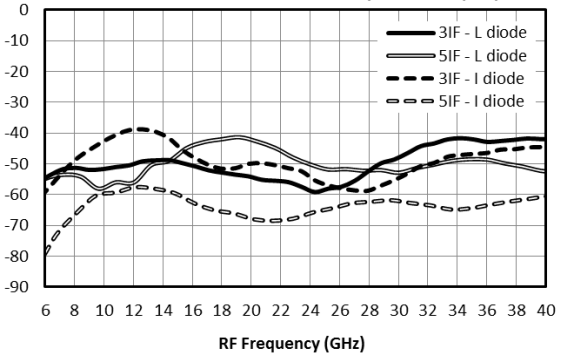
n LO x n RF Downconversion Spurs, 0dBm Input L diode (dBc)[1-5]



Even Harmonic IF Isolation, 0dBm Input, L diode (dBc)[1-5]



Odd Harmonic IF Isolation, 0dBm Input, L diode (dBc)[1-5]



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 58 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 68 dBc.

Typical Downconversion Spurious Suppression (dBc): I diode (L diode) [5]

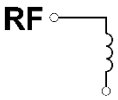
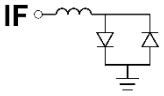
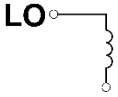
-10 dBm RF Input	1xLO	2xLO	3xLO	4xLO	5xLO
1xRF	Reference	29(23)	16(16)	27(23)	30(30)
2xRF	44(61)	58(61)	47(59)	55(56)	48(57)
3xRF	76(61)	84(78)	72(72)	82(82)	74(74)
4xRF	114(110)	98(105)	94(106)	102(106)	94(106)
5xRF	123(122)	120(112)	120(119)	118(118)	115(118)

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 53 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 63 dBc.

Typical Upconversion Spurious Suppression (dBc): I diode (L diode) [5]

-10 dBm IF Input	1xLO	2xLO	3xLO	4xLO	5xLO
1xIF	Reference	20(23)	15(14)	34(35)	37(37)
2xIF	53(53)	47(48)	50(49)	51(45)	56(58)
3xIF	57(61)	65(61)	61(55)	63(59)	69(72)
4xIF	94(95)	90(88)	92(78)	78(75)	81(80)
5xIF	105(107)	107(98)	99(84)	95(91)	92(93)

Port	Description	DC Interface Schematic
RF	The RF port is DC open and AC matched to 50 Ω from 10 to 40 GHz. Blocking capacitor is optional.	
IF	The IF port is DC coupled to the diodes. Blocking capacitor is optional.	
LO	The LO port is DC open and AC matched to 50 Ω from 10 to 40 GHz. 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.

Note: Exposure to maximum rating conditions for extended periods may reduce device reliability. There is no damage to device with only one parameter set at the limit and all other parameters set at or below their nominal value. Exceeding any of the limits listed here may result in permanent damage to the device.