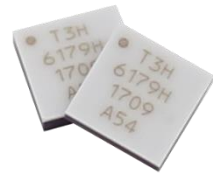


# GaAs MMIC High Dynamic Range Mixer

# MT3H-0113HSM

Page 1

The MT3H-0113HSM is a triple balanced passive diode mixer offering high dynamic range, low conversion loss, and excellent repeatability. As with all T3 mixers, this mixer offers unparalleled nonlinear performance in terms of IIP3, P<sub>1dB</sub>, and spurious performance with a flexible LO drive requirement from +16 dBm to +24 dBm. RF, LO, and IF ports are all operated single ended due to integrated baluns. The MT3H-0113HSM is available in a 4x4mm QFN, or in an SMA connectorized evaluation fixture. The MT3H-0113HSM is a superior alternative to Marki Microwave carrier and packaged T3 mixers. For a list of recommended LO driver amps for all mixers and IQ mixers, see [here](#).



## Features

- Industry-Leading Spurious, IP3, and P<sub>1dB</sub> Performance
- RoHS Compliant
- Broadband, Overlapping RF, LO and IF
- Application Note: [T3 Mixer Primer](#)

**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) <sup>1</sup>                             | 1.5-13   | 1.5-13   | 0.8-1    |     | 8            | 12  | +20 (+20)            |  |                                                |
|                                                               |          |          | 1-8.5    |     | 11.5         |     |                      |  |                                                |
| Isolation (dB)<br>LO-RF<br>LO-IF<br>RF-IF                     |          |          |          |     | 0.8-8.5      |     | See Plots            |  | Config. A: +16 to +24<br>Config. B: +16 to +24 |
| Input 1 dB Compression (dBm)                                  |          |          |          |     |              |     | See Plots            |  |                                                |
| Input Two-Tone Third Order Intercept Point (dBm) <sup>2</sup> |          |          |          |     | +29<br>(+30) |     |                      |  |                                                |

<sup>1</sup>Measured Conversion Loss measured at 1 GHz fixed IF

<sup>2</sup>IP3 depends on LO drive conditions, see plots for more details

## Part Number Options

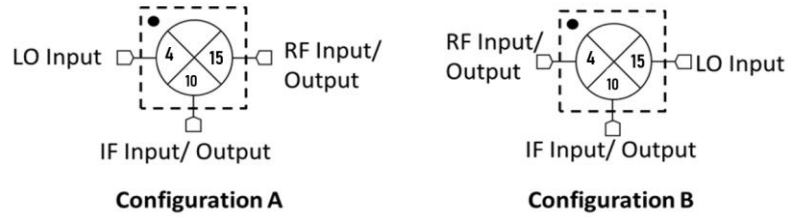
| Model Number                | Description                             |
|-----------------------------|-----------------------------------------|
| MT3H-0113HSM-2 <sup>1</sup> | Surface Mount, IF Port Configuration -2 |
| EVAL-MT3H-0113H             | Connectorized Evaluation Fixture        |

<sup>1</sup>Note: For port locations and I/O designations, refer to the drawings on page 2 of this document.

# GaAs MMIC High Dynamic Range Mixer

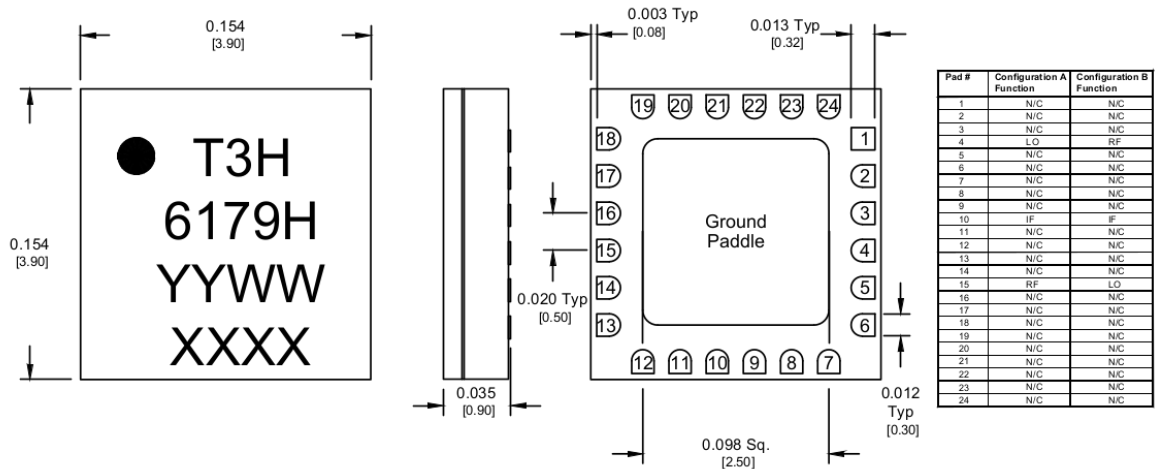
# MT3H-0113HSM

Page 2



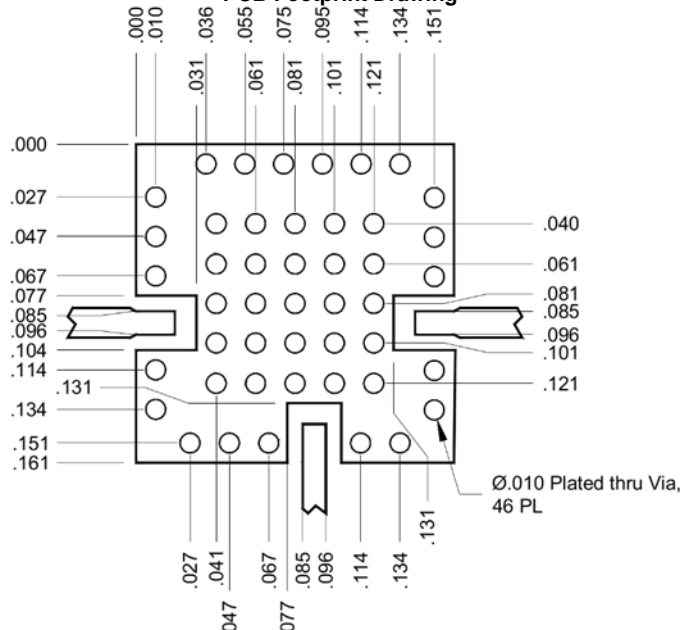
1. Configuration A/B refer to the same part number (MT3H-0113H) used in one of two different ways for optimal spurious performance. For the lowest conversion loss, use the mixer in Configuration A (pin 4 as the LO input, pin 15 as the RF input or output). If you need to use a lower LO drive, use the mixer in Configuration B (pin 4 as the RF input or output, pin 15 as the LO input). For optimal spurious suppression, experimentation or simulation is required to choose between Configuration A and B. For more information, [see here](#).

### Outline Drawing



- Substrate material is Ceramic.
- All unconnected pads should be connected to PCB RF ground.
- ENEPIG Plating/Finish: Ni: 8.89 micron max, 1.27 micron min. Pd: 0.17 micron max, 0.07 micron min. Au: 0.254 micron max, 0.03 micron min.

### PCB Footprint Drawing

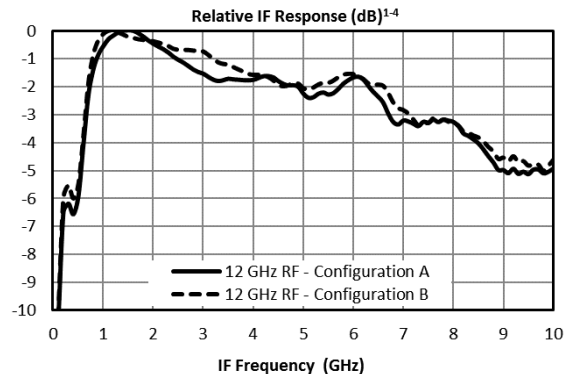
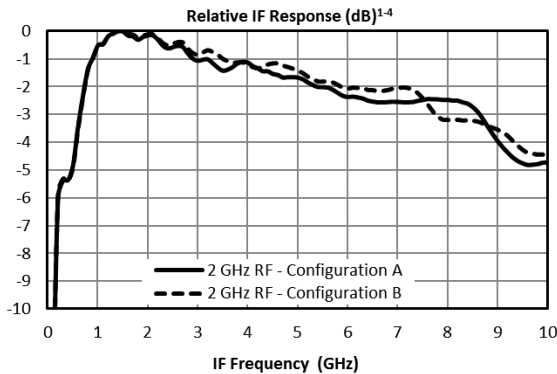
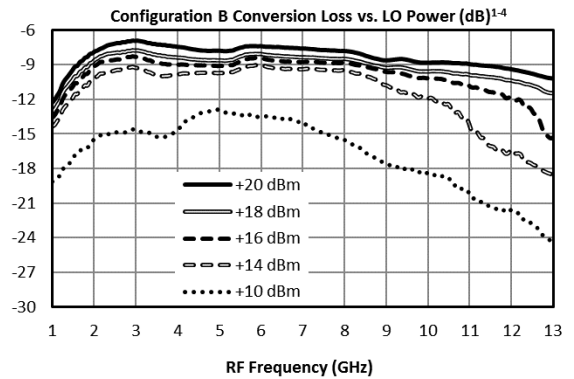
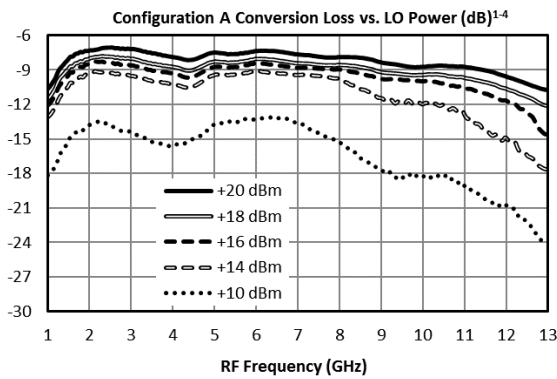
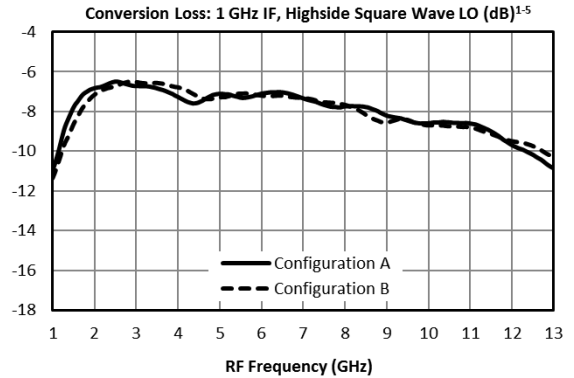
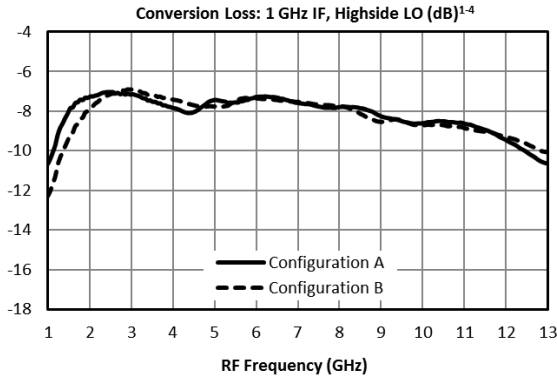


[QFN-Package Surface-Mount Landing Pattern](#)

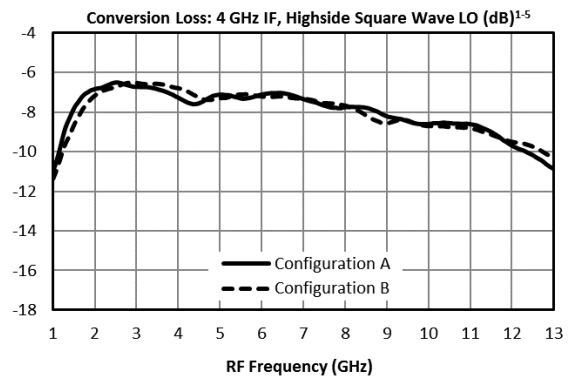
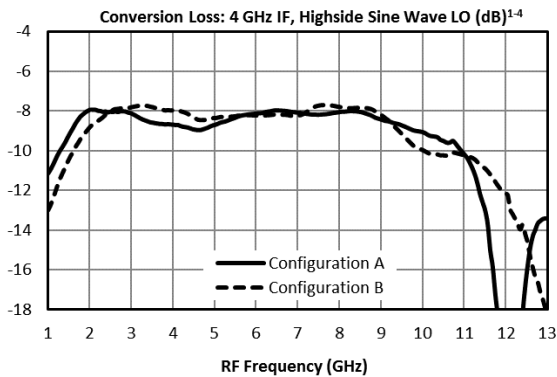
[Click here for a DXF of the above layout.](#)

[Click here for leaded solder reflow.](#) [Click here for lead-free solder reflow.](#)

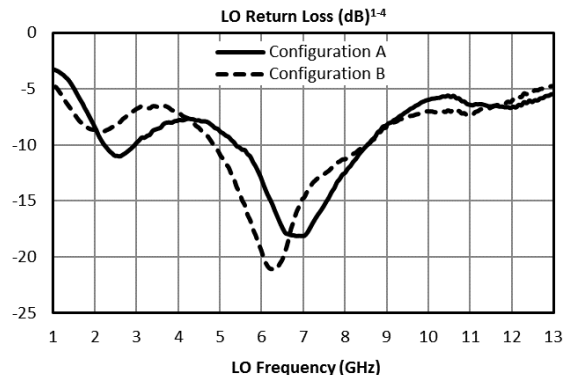
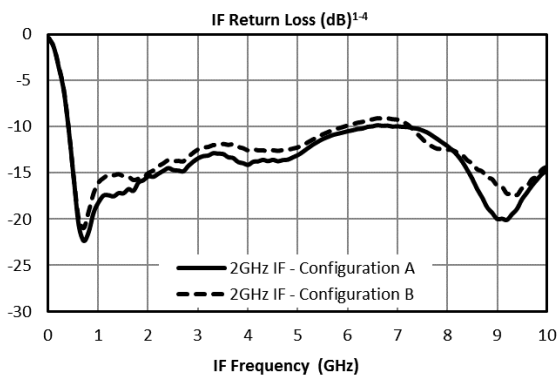
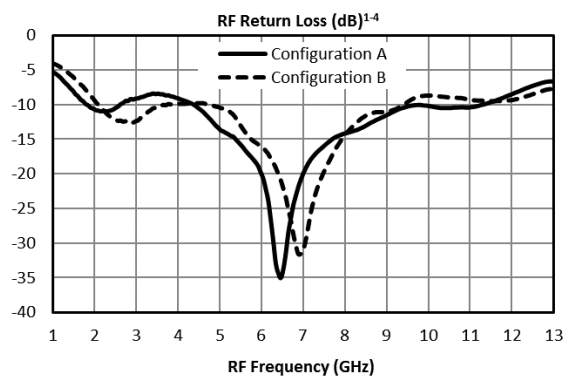
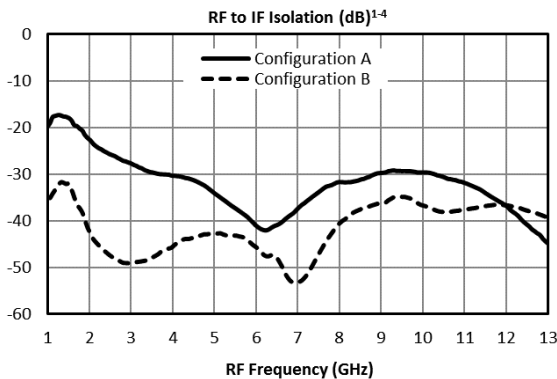
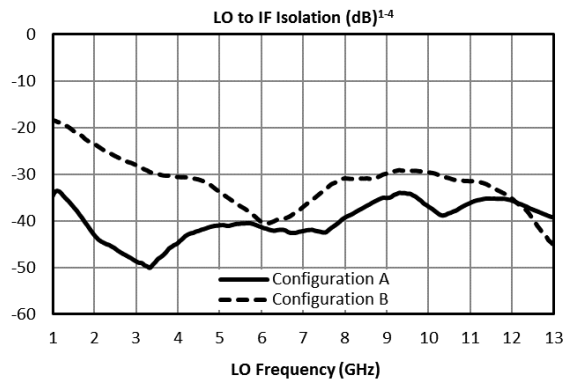
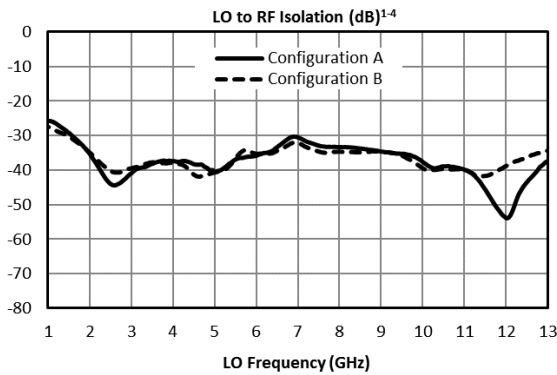
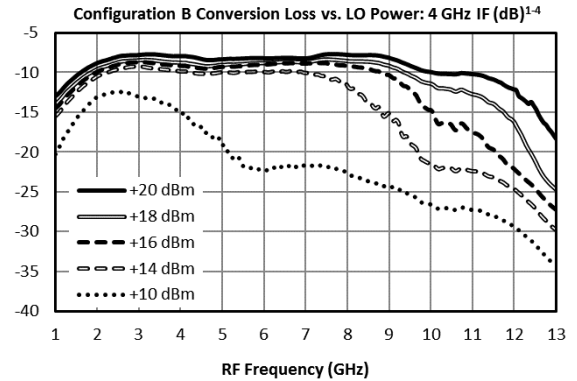
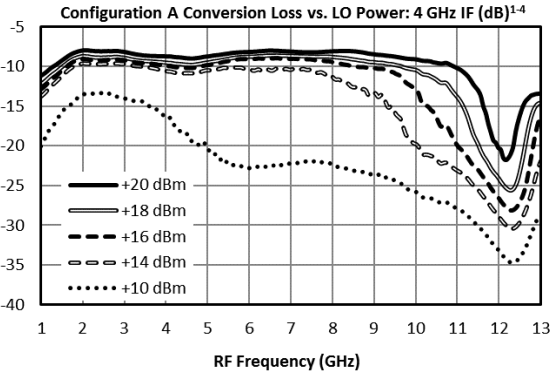
Typical Performance



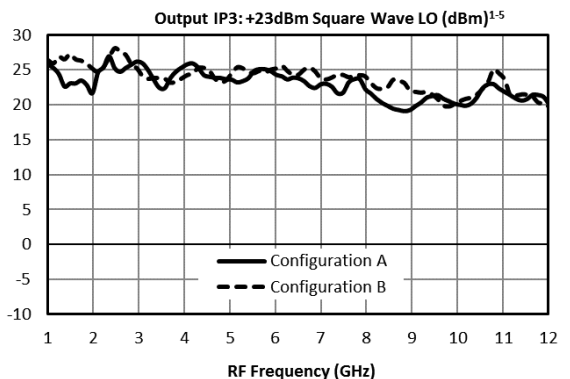
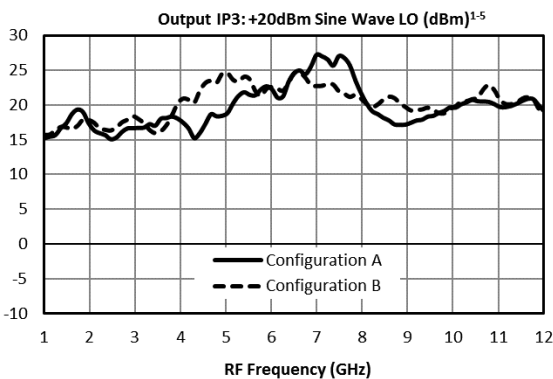
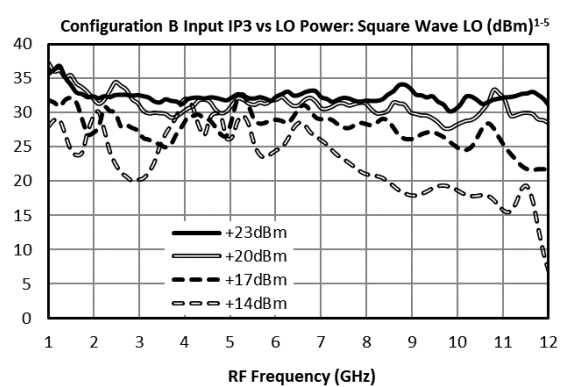
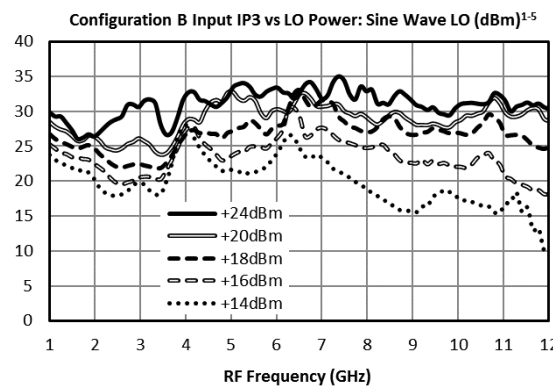
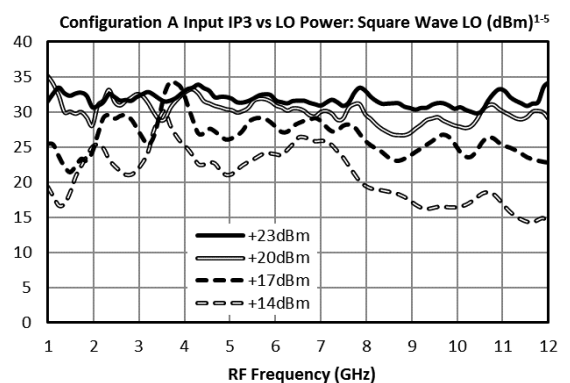
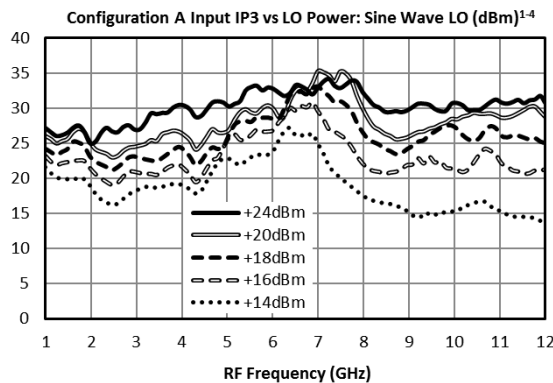
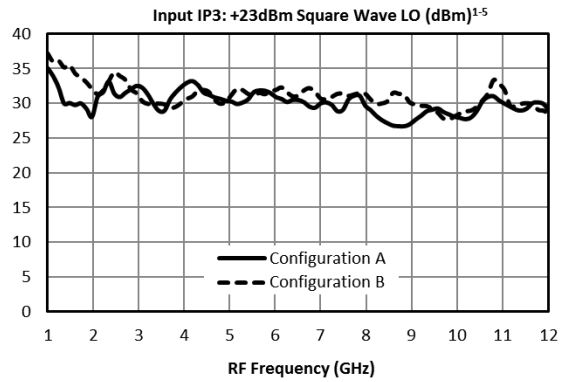
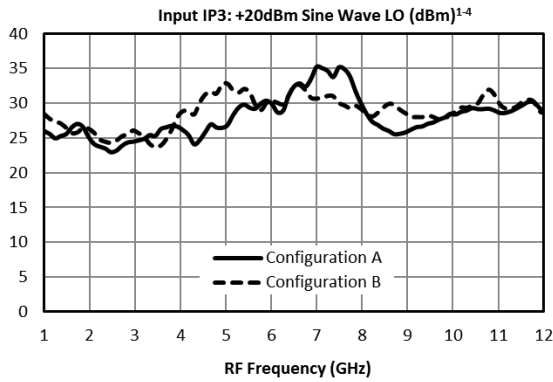
3



## Typical Performance



Typical Performance

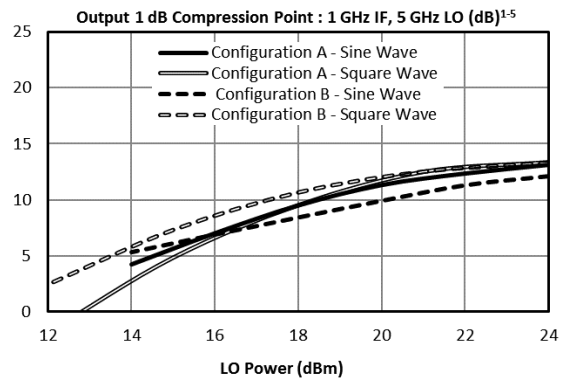
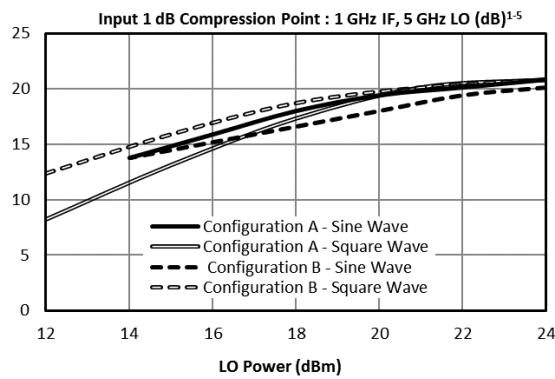
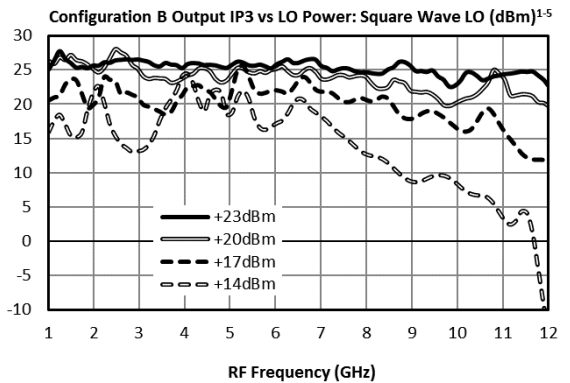
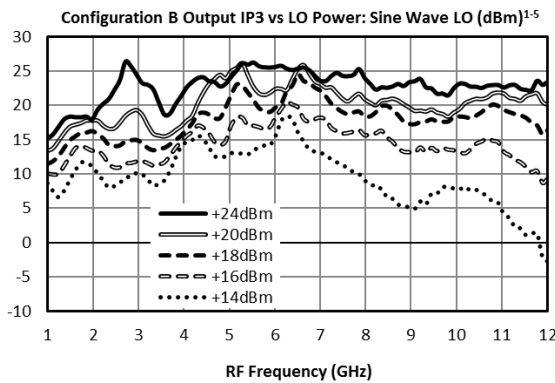
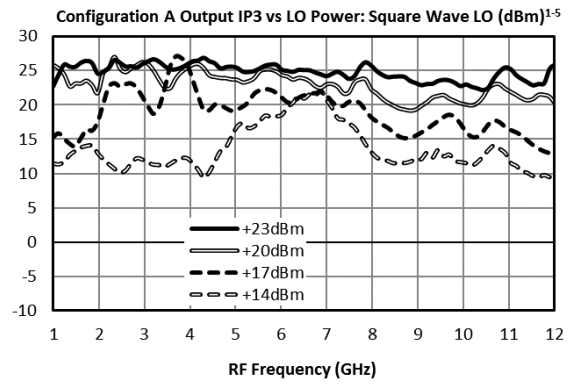
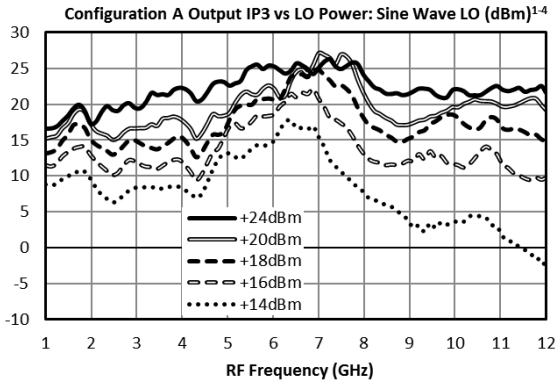


# GaAs MMIC High Dynamic Range Mixer

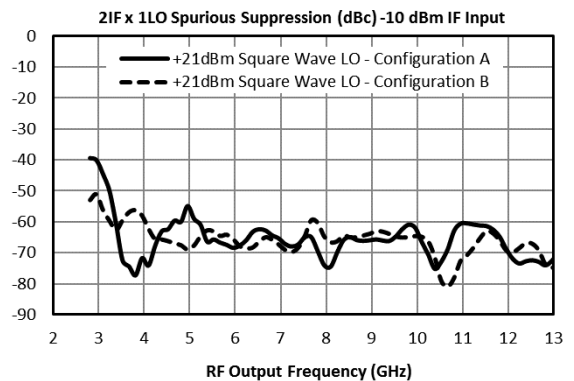
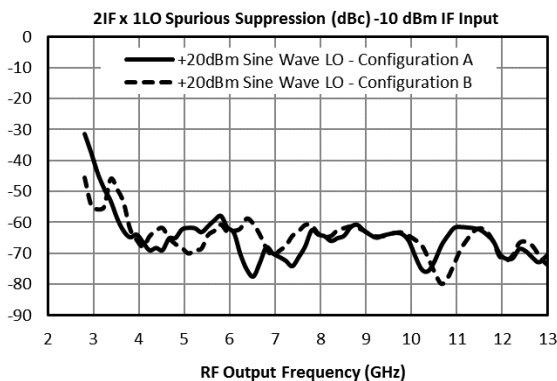
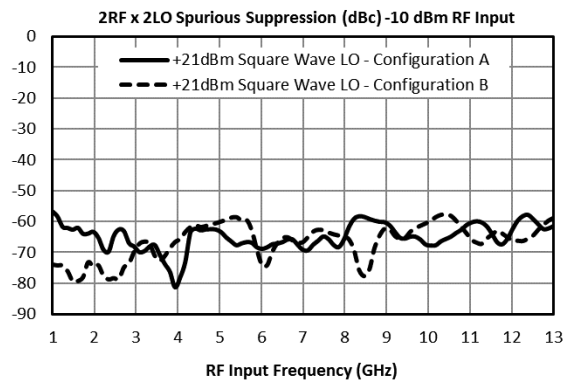
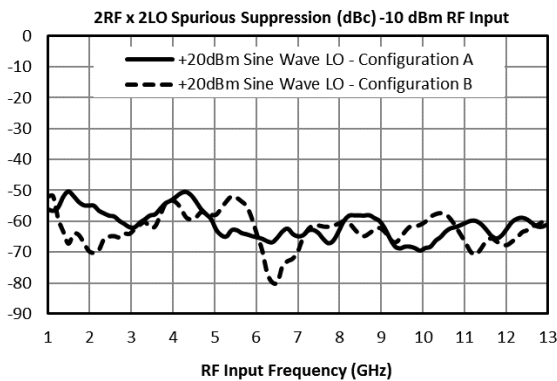
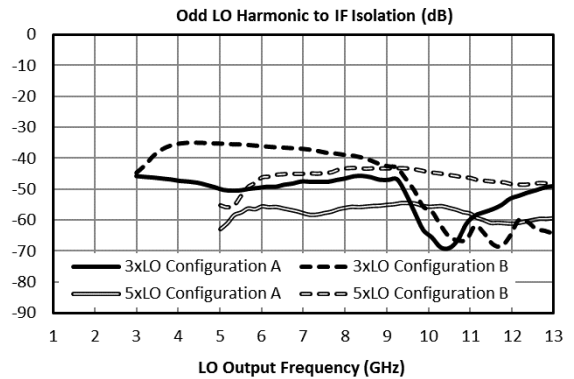
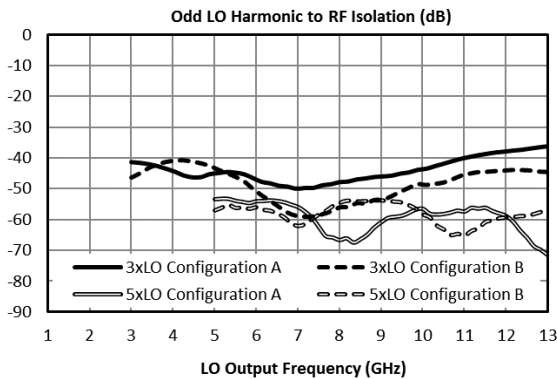
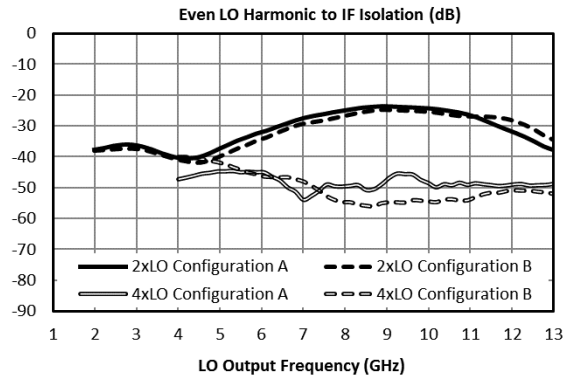
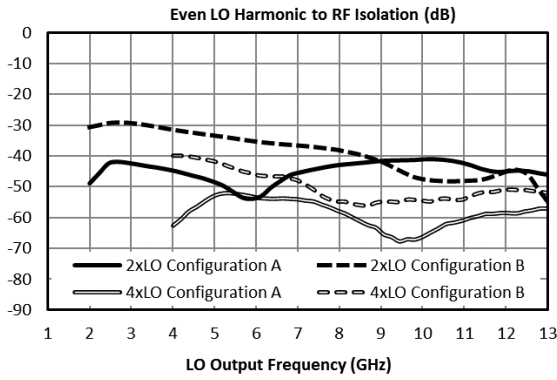
# MT3H-0113HSM

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## Typical Performance



Typical Performance





# GaAs MMIC High Dynamic Range Mixer

# MT3H-0113HSM

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### Downconversion Spurious Suppression

Spurious data is taken by selecting RF and LO frequencies ( $\pm mLO \pm nRF$ ) 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  $2RF \times 2LO$  spur is 61 dBc for the A configuration for a -10 dBm input, so a -20 dBm RF input creates a spur that is  $(2-1) \times (-10 \text{ dB})$  dB lower, or 71 dBc.

### Typical Downconversion Spurious Suppression (dBc): A Configuration (B Configuration), Sine Wave LO <sup>6</sup>

| -10 dBm RF Input | 0xLO      | 1xLO      | 2xLO      | 3xLO      | 4xLO      | 5xLO      |
|------------------|-----------|-----------|-----------|-----------|-----------|-----------|
| 1xRF             | 27 (31)   | Reference | 30 (36)   | 21 (19)   | 22 (33)   | 20 (24)   |
| 2xRF             | 60 (59)   | 66 (62)   | 61 (63)   | 63 (59)   | 61 (64)   | 66 (58)   |
| 3xRF             | 105 (97)  | 83 (86)   | 91 (93)   | 77 (78)   | 94 (93)   | 118 (120) |
| 4xRF             | 126 (128) | 125 (126) | 123 (123) | 122 (121) | 119 (121) | 121 (124) |
| 5xRF             | 152 (157) | 149 (154) | 148 (149) | 144 (144) | 147 (149) | 140 (141) |

### Typical Downconversion Spurious Suppression (dBc): A Configuration (B Configuration), Square Wave LO <sup>6</sup>

| -10 dBm RF Input | 0xLO      | 1xLO      | 2xLO      | 3xLO      | 4xLO      | 5xLO      |
|------------------|-----------|-----------|-----------|-----------|-----------|-----------|
| 1xRF             | 27 (32)   | Reference | 29 (36)   | 15 (13)   | 24 (39)   | 19 (20)   |
| 2xRF             | 62 (58)   | 67 (63)   | 65 (67)   | 66 (62)   | 64 (67)   | 68 (64)   |
| 3xRF             | 104 (103) | 97 (99)   | 103 (108) | 91 (94)   | 100 (107) | 129 (128) |
| 4xRF             | 126 (127) | 131 (134) | 128 (134) | 130 (131) | 128 (134) | 126 (129) |
| 5xRF             | 163 (162) | 164 (169) | 164 (168) | 163 (163) | 166 (170) | 160 (165) |





# GaAs MMIC High Dynamic Range Mixer

# MT3H-0113HSM

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## Upconversion Spurious Suppression

Spurious data is taken by mixing an input within the IF band, with LO frequencies ( $\pm mLO \pm nIF$ ), 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 the A configuration 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): A Configuration (B Configuration), Sine Wave LO <sup>6</sup>

| -10 dBm RF Input | 0xLO      | 1xLO      | 2xLO      | 3xLO      | 4xLO      | 5xLO      |
|------------------|-----------|-----------|-----------|-----------|-----------|-----------|
| 1xIF             | 22 (27)   | Reference | 29 (34)   | 19 (18)   | 26 (38)   | 21 (22)   |
| 2xIF             | 69 (61)   | 65 (65)   | 62 (56)   | 61 (63)   | 56 (49)   | 56 (58)   |
| 3xIF             | 92 (78)   | 98 (98)   | 98 (99)   | 85 (87)   | 87 (95)   | 79 (84)   |
| 4xIF             | 119 (116) | 128 (129) | 122 (124) | 120 (124) | 120 (120) | 113 (119) |
| 5xIF             | 149 (140) | 158 (163) | 162 (161) | 152 (153) | 155 (154) | 146 (144) |

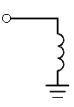

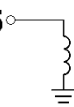
### Typical Upconversion Spurious Suppression (dBc): A Configuration (B Configuration), Square Wave LO <sup>6</sup>

| -10 dBm RF Input | 0xLO      | 1xLO      | 2xLO      | 3xLO      | 4xLO      | 5xLO      |
|------------------|-----------|-----------|-----------|-----------|-----------|-----------|
| 1xIF             | 22 (27)   | Reference | 31 (37)   | 15 (13)   | 24 (39)   | 19 (20)   |
| 2xIF             | 69 (61)   | 65 (65)   | 61 (57)   | 66 (62)   | 64 (67)   | 68 (64)   |
| 3xIF             | 92 (78)   | 97 (99)   | 98 (106)  | 91 (94)   | 100 (107) | 129 (128) |
| 4xIF             | 119 (116) | 128 (129) | 124 (128) | 130 (131) | 128 (134) | 126 (129) |
| 5xIF             | 149 (140) | 158 (163) | 163 (166) | 163 (163) | 166 (170) | 160 (165) |

# GaAs MMIC High Dynamic Range Mixer

# MT3H-0113HSM

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| Pin Number             | Function         | Description                                                                                          | DC Interface Schematic                                                                            |
|------------------------|------------------|------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| 1-3, 5-9, 11-14, 16-24 | Non-connect (NC) | These pins are not connected internally. Datasheet performance is tested with NC pins grounded.      |                                                                                                   |
| 4                      | RF/LO            | Pin 4 is DC short and AC matched to 50 $\Omega$ from 0.8 to 13 GHz. Blocking capacitor is optional.  | <b>Pin 4</b>   |
| 10                     | IF               | Pin 10 is DC open. Blocking capacitor is optional.                                                   | <b>Pin 10</b>  |
| 15                     | RF/LO            | Pin 15 is DC short and AC matched to 50 $\Omega$ from 0.8 to 13 GHz. Blocking capacitor is optional. | <b>Pin 15</b>  |
| Paddle                 | Ground (GND)     | Ground pad should be connected to RF/DC ground with low electrical and thermal resistance.           |                                                                                                   |

| Absolute Maximum Ratings  |                      |
|---------------------------|----------------------|
| Parameter                 | Maximum Rating       |
| Pin 4 DC Current          | TBD                  |
| Port 10 DC Current        | N/A                  |
| Port 15 DC Current        | TBD                  |
| RF Power Handling (RF+LO) | +30 dBm (H -Version) |
| 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 1 GHz unless otherwise specified.
- Mixer Noise Figure typically measures within 0.5 dB of conversion loss for IF frequencies greater than 5 MHz.
- Conversion Loss typically degrades less than 0.5 dB at +100°C and improves less than 0.5 dB at -55°C.
- Unless otherwise specified, data is taken with highside, +20 dBm sine wave LO drive.
- Square wave LO generated using 2x [ADM1-0026PA](#) with +10 dBm input into the first stage. LO Power reported in plots is of the fundamental tone only. Square wave LO power in plots is stepped down using broadband DC-40 GHz attenuators.
- Specifications are subject to change without notice. Contact Marki Microwave for the most recent specifications and data sheets.
- 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.