The MT3-0113HCQG is a triple balanced passive diode GaAs MMIC 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, P1dB, and spurious performance with a flexible LO drive requirement from +16 dBm to +24 dBm. The MT3-0113HCQG is available in a surface-mount outline, or in an SMA connectorized evaluation fixture. The MT3-0113HCQG is a superior alternative to Marki Microwave carrier and packaged T3 mixers, and is form-fit compatible with legacy T3’s in the CQ and CQG footprints.

**Features**

- Form-Fit Compatible with Legacy CQ and CQG T3 Mixers
- Broadband, Overlapping RF, LO and IF
- Suitable for Up or Down Conversion
- Compatible with Sine or Square-Wave LO
- Square-Wave LO delivers Industry-Leading Spurious, IP3, and P1dB Performance
- Application Note: T3 Mixer Primer
- Recommended Surface Mount LO Buffer Amplifiers: ADM-0012-5931SM, ADM-0026-5929SM
- Recommended LO Buffer Amplifier Modules: ADM1-0026PA

**Electrical Specifications** - Specifications guaranteed over -40 to +100°C temperature range, measured in a 50Ω system. Specifications are shown for Configurations A (B). See page 2 for port locations. Consult factory for more information.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>LO (GHz)</th>
<th>RF (GHz)</th>
<th>IF (GHz)</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>LO drive level (dBm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conversion Loss (dB) ¹</td>
<td></td>
<td></td>
<td></td>
<td>0.01-0.5</td>
<td>7.5 (7.5)</td>
<td>10.5</td>
<td>+20 (+20)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.5-7.0</td>
<td>10 (10)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolation (dB) LO-RF</td>
<td>1.5-13</td>
<td>1.5-13</td>
<td>0.01-7</td>
<td></td>
<td>See Plots</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolation (dB) LO-IF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>See Plots</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolation (dB) RF-IF</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>See Plots</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input 1 dB Compression (dBm) ²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Config. A: +16 to +24</td>
<td>Config. B: +16 to +24</td>
<td></td>
</tr>
<tr>
<td>Input Two-Tone Third Order Intercept Point (dBm) ³</td>
<td></td>
<td></td>
<td></td>
<td>+30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+29</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹Unless otherwise specified, Conversion Loss and Spurious data is measured with a 100 MHz fixed IF.
²P1dB is typically within 1-2 dB of LO drive power.
³The typical value is for a +20 dBm Sine-Wave LO. IP3 is dependent on LO drive and waveform. See plots and data sheet notes on page 10 for more details.

**Part Number Options**

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT3-0113HCQG-2 ¹</td>
<td>RoHS Compliant Surface Mount, IF Port Configuration -2</td>
</tr>
<tr>
<td>EVAL-MT3-0113H</td>
<td>Connectorized Evaluation Fixture</td>
</tr>
</tbody>
</table>

¹Note: For port locations and I/O designations, refer to the drawings on page 2 of this document.
GaAs MMIC High Dynamic Range Mixer

MT3-0113HCQG

1. Configuration A/B refer to the same part number (MT3-0113HCQG) used in one of two different ways for optimal spurious performance. For the lowest conversion loss, use the mixer in Configuration A (port 1 as the LO input, port 3 as the RF input or output). If you need to use a lower LO drive, use the mixer in Configuration B (port 1 as the RF input or output, port 3 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.

I/O Connections & Ground Plane Finish is Gold Flash, 5 to 10 µ-inches, over Solderable Nickel, 100-200 µ-inches, over Cu.

Outline Drawing – CQG-2 Package

Click here for a DXF of the above layout. Click here for leaded solder reflow. Click here for lead-free solder reflow.
GaAs MMIC High Dynamic Range Mixer

MT3-0113HCQG

Typical Performance

Conversion Loss: 100 MHz IF (dB)

Configuration A: +20 dBm Sine-Wave LO
Configuration B: +20 dBm Square-Wave LO

Configuration A Conversion Loss vs. LO Power: 100 MHz IF (dB)
+24 dBm Sine-Wave LO
+18 dBm Sine-Wave LO
+16 dBm Sine-Wave LO
+14 dBm Sine-Wave LO

Configuration B Conversion Loss vs. LO Power: 100 MHz IF (dB)
+24 dBm Sine-Wave LO
+18 dBm Sine-Wave LO
+16 dBm Sine-Wave LO
+14 dBm Sine-Wave LO

Relative IF Response (dB)

1.5 GHz RF - Configuration A
1.5 GHz RF - Configuration B

LO to RF Isolation (dB)

Configuration A
Configuration B

LO to IF Isolation (dB)

Configuration A
Configuration B
GaAs MMIC High Dynamic Range Mixer

MT3-0113HCQG

Typical Performance

RF Return Loss (dB)
- Configuration A
- Configuration B

LO Return Loss (dB)
- Configuration A
- Configuration B

IF Return Loss (dB)
- 1.5 GHz RF - Configuration A
- 1.5 GHz RF - Configuration B
- 12 GHz RF - Configuration A
- 12 GHz RF - Configuration B

RF to IF Isolation (dB)
- Configuration A
- Configuration B

Compression with +16 dBm RF Input: 100 MHz IF (dB)
- Configuration A: +20 dBm Sine-Wave LO
- Configuration A: Saturated Square-Wave LO
- Configuration B: +20 dBm Sine-Wave LO
- Configuration B: Saturated Square-Wave LO

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GaAs MMIC High Dynamic Range Mixer

MT3-0113HCQG

Typical Performance

Input 1-dB Compression vs LO Power: 5 GHz RF, 100 MHz IF (dB)

Configuration A: Sine-Wave LO
Configuration B: Sine-Wave LO

Configuration A: Square-Wave LO
Configuration B: Square-Wave LO

Even LO Harmonic to RF Isolation (dB): +20 dBm Sine-Wave LO

Odd LO Harmonic to RF Isolation (dB): +20 dBm Sine-Wave LO

Even LO Harmonic to IF Isolation (dB): +20 dBm Sine-Wave LO

Odd LO Harmonic to IF Isolation (dB): +20 dBm Sine-Wave LO
GaAs MMIC High Dynamic Range Mixer

MT3-0113HCQG

Typical Performance

Configuration - A Input IP3: 100 MHz IF (dBm)
-24 dBm Sine-Wave LO
-20 dBm Sine-Wave LO
-18 dBm Sine-Wave LO
-16 dBm Sine-Wave LO
-14 dBm Sine-Wave LO
-20 dBm Sine-Wave LO
-18 dBm Sine-Wave LO
-16 dBm Sine-Wave LO
-14 dBm Sine-Wave LO
-20 dBm Sine-Wave LO
-18 dBm Sine-Wave LO
-16 dBm Sine-Wave LO
-14 dBm Sine-Wave LO

Configuration - A Output IP3: 100 MHz IF (dBm)
-24 dBm Sine-Wave LO
-20 dBm Sine-Wave LO
-18 dBm Sine-Wave LO
-16 dBm Sine-Wave LO
-14 dBm Sine-Wave LO
-20 dBm Sine-Wave LO
-18 dBm Sine-Wave LO
-16 dBm Sine-Wave LO
-14 dBm Sine-Wave LO

Configuration - B Input IP3: 100 MHz IF (dBm)
-24 dBm Sine-Wave LO
-20 dBm Sine-Wave LO
-18 dBm Sine-Wave LO
-16 dBm Sine-Wave LO
-14 dBm Sine-Wave LO
-20 dBm Sine-Wave LO
-18 dBm Sine-Wave LO
-16 dBm Sine-Wave LO
-14 dBm Sine-Wave LO

Configuration - B Output IP3: 100 MHz IF (dBm)
-24 dBm Sine-Wave LO
-20 dBm Sine-Wave LO
-18 dBm Sine-Wave LO
-16 dBm Sine-Wave LO
-14 dBm Sine-Wave LO
-20 dBm Sine-Wave LO
-18 dBm Sine-Wave LO
-16 dBm Sine-Wave LO
-14 dBm Sine-Wave LO
GaAs MMIC High Dynamic Range Mixer

MT3-0113HCQG

Typical Performance

2RF x 2LO Spurious Suppression (dBc) -10 dBm RF Input

Configuration A: +20 dBm Sine-Wave LO
Configuration B: +20 dBm Sine-Wave LO

2IF x 1LO Spurious Suppression (dBc) -10 dBm IF Input

Configuration A: +20 dBm Sine-Wave LO
Configuration B: +20 dBm Sine-Wave LO

Configuration A: Saturated Square-Wave LO
Configuration B: Saturated Square-Wave LO
Downconversion Spurious Suppression

Spurious data is taken by selecting RF and LO frequencies (\(\pm m\text{LO} \pm n\text{RF}\)) 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 68 dBc for the A configuration for a -10 dBm input with a sine-wave LO, so a -20 dBm RF input creates a spur that is (2-1) x (-10 dB) dB lower, or 78 dBc.

Typical Downconversion Spurious Suppression (dBc): A Configuration (B Configuration), Sine Wave LO

<table>
<thead>
<tr>
<th>-10 dBm RF Input</th>
<th>0xLO</th>
<th>1xLO</th>
<th>2xLO</th>
<th>3xLO</th>
<th>4xLO</th>
<th>5xLO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1xRF</td>
<td>30 (37)</td>
<td>Reference</td>
<td>42 (41)</td>
<td>19 (18)</td>
<td>42 (46)</td>
<td>25 (33)</td>
</tr>
<tr>
<td>2xRF</td>
<td>61 (66)</td>
<td>70 (69)</td>
<td>68 (66)</td>
<td>74 (67)</td>
<td>67 (62)</td>
<td>72 (64)</td>
</tr>
<tr>
<td>3xRF</td>
<td>112 (113)</td>
<td>89 (88)</td>
<td>99 (102)</td>
<td>88 (87)</td>
<td>100 (100)</td>
<td>81 (82)</td>
</tr>
<tr>
<td>4xRF</td>
<td>122 (131)</td>
<td>125 (128)</td>
<td>122 (122)</td>
<td>127 (126)</td>
<td>127 (123)</td>
<td>131 (126)</td>
</tr>
<tr>
<td>5xRF</td>
<td>158 (164)</td>
<td>145 (149)</td>
<td>149 (149)</td>
<td>142 (144)</td>
<td>151 (151)</td>
<td>146 (144)</td>
</tr>
</tbody>
</table>

Typical Downconversion Spurious Suppression (dBc): A Configuration (B Configuration), Square Wave LO

<table>
<thead>
<tr>
<th>-10 dBm RF Input</th>
<th>0xLO</th>
<th>1xLO</th>
<th>2xLO</th>
<th>3xLO</th>
<th>4xLO</th>
<th>5xLO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1xRF</td>
<td>32 (39)</td>
<td>Reference</td>
<td>30 (29)</td>
<td>12 (11)</td>
<td>27 (27)</td>
<td>19 (18)</td>
</tr>
<tr>
<td>2xRF</td>
<td>62 (68)</td>
<td>72 (69)</td>
<td>70 (70)</td>
<td>71 (76)</td>
<td>65 (64)</td>
<td>74 (73)</td>
</tr>
<tr>
<td>3xRF</td>
<td>113 (113)</td>
<td>90 (89)</td>
<td>103 (105)</td>
<td>92 (92)</td>
<td>100 (107)</td>
<td>93 (95)</td>
</tr>
<tr>
<td>4xRF</td>
<td>132 (132)</td>
<td>130 (134)</td>
<td>129 (127)</td>
<td>135 (135)</td>
<td>130 (133)</td>
<td>132 (136)</td>
</tr>
<tr>
<td>5xRF</td>
<td>172 (174)</td>
<td>148 (152)</td>
<td>151 (151)</td>
<td>150 (151)</td>
<td>152 (153)</td>
<td>150 (155)</td>
</tr>
</tbody>
</table>
### Upconversion Spurious Suppression

Spurious data is taken by mixing an input within the IF band, with LO frequencies \((\pm m\text{LO} \pm n\text{IF})\), 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 67 dBc for the A configuration for a -10 dBm input with a sine-wave LO, so a -20 dBm IF input creates a spur that is \((2-1) \times (-10\, \text{dB})\) dB lower, or 77 dBc.

#### Typical Upconversion Spurious Suppression (dBc): A Configuration (B Configuration), Sine Wave LO

<table>
<thead>
<tr>
<th>-10 dBm IF Input</th>
<th>0xLO</th>
<th>1xLO</th>
<th>2xLO</th>
<th>3xLO</th>
<th>4xLO</th>
<th>5xLO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1xIF</td>
<td>27 (39)</td>
<td>Reference</td>
<td>38 (40)</td>
<td>17 (16)</td>
<td>37 (43)</td>
<td>26 (22)</td>
</tr>
<tr>
<td>2xIF</td>
<td>72 (68)</td>
<td>67 (64)</td>
<td>63 (59)</td>
<td>66 (58)</td>
<td>69 (58)</td>
<td>67 (59)</td>
</tr>
<tr>
<td>3xIF</td>
<td>112 (112)</td>
<td>80 (78)</td>
<td>91 (93)</td>
<td>76 (72)</td>
<td>87 (93)</td>
<td>74 (71)</td>
</tr>
<tr>
<td>4xIF</td>
<td>124 (130)</td>
<td>122 (118)</td>
<td>119 (113)</td>
<td>118 (110)</td>
<td>123 (106)</td>
<td>114 (108)</td>
</tr>
<tr>
<td>5xIF</td>
<td>153 (154)</td>
<td>139 (139)</td>
<td>141 (144)</td>
<td>128 (127)</td>
<td>137 (134)</td>
<td>117 (114)</td>
</tr>
</tbody>
</table>

#### Typical Upconversion Spurious Suppression (dBc): A Configuration (B Configuration), Square Wave LO

<table>
<thead>
<tr>
<th>-10 dBm IF Input</th>
<th>0xLO</th>
<th>1xLO</th>
<th>2xLO</th>
<th>3xLO</th>
<th>4xLO</th>
<th>5xLO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1xIF</td>
<td>28 (38)</td>
<td>Reference</td>
<td>30 (32)</td>
<td>12 (11)</td>
<td>26 (27)</td>
<td>21 (17)</td>
</tr>
<tr>
<td>2xIF</td>
<td>81 (69)</td>
<td>67 (65)</td>
<td>64 (63)</td>
<td>62 (65)</td>
<td>61 (63)</td>
<td>53 (62)</td>
</tr>
<tr>
<td>3xIF</td>
<td>113 (112)</td>
<td>83 (83)</td>
<td>94 (95)</td>
<td>79 (80)</td>
<td>89 (90)</td>
<td>77 (78)</td>
</tr>
<tr>
<td>4xIF</td>
<td>133 (137)</td>
<td>128 (125)</td>
<td>120 (120)</td>
<td>117 (122)</td>
<td>114 (118)</td>
<td>104 (119)</td>
</tr>
<tr>
<td>5xIF</td>
<td>154 (154)</td>
<td>148 (149)</td>
<td>144 (146)</td>
<td>138 (141)</td>
<td>137 (141)</td>
<td>125 (129)</td>
</tr>
</tbody>
</table>
### Port Description

**Port 1**
- Port 1 is DC short and AC matched to 50 Ω from 1.5 to 13 GHz.
- Blocking capacitor is optional.

**Port 2**
- Port 2 is DC open. Blocking capacitor is optional.

**Port 3**
- Port 3 is DC short and AC matched to 50 Ω from 1.5 to 13 GHz.
- Blocking capacitor is optional.

### Absolute Maximum Ratings (see note 8)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Maximum Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port 1 DC Current</td>
<td>TBD mA</td>
</tr>
<tr>
<td>Port 2 DC Current</td>
<td>N/A</td>
</tr>
<tr>
<td>Port 3 DC Current</td>
<td>TBD mA</td>
</tr>
<tr>
<td>RF Power Handling (RF+LO)</td>
<td>+30 dBm</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40 to +100°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-40 to +150°C</td>
</tr>
</tbody>
</table>

### Revision History

<table>
<thead>
<tr>
<th>Revision Code</th>
<th>Revision Date</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>October 2018</td>
<td>Pre-release</td>
</tr>
<tr>
<td>A</td>
<td>February 2019</td>
<td>Active - Full Production</td>
</tr>
</tbody>
</table>

### DATA SHEET NOTES:

1. Mixer Conversion Loss Plot IF frequency is 100 MHz unless otherwise specified.
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 at +100°C and improves less than 0.5 dB at -55°C.
4. Unless otherwise specified, sine-wave data is taken with +20 dBm LO drive.
5. The square-wave LO is generated using an ADM-0012-5931SM pre-amplifier and an ADM-0026-5929SM output amplifier. The two amplifiers are biased with +7V, -0.25V. When specified, square-wave output power is the total of the fundamental plus harmonics. Unspecified square-wave LO (unspecified output power) is generated by saturating the amplifier chain with a +12 dBm input.
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.
8. Environmental specifications are currently under evaluation. Contact support for more information.

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