# High Isolation GaAs MMIC Doubler

# MMD-1648L



The MMD-1648L is a balanced MMIC doubler covering 16 to 48 GHz on the output. It features superior isolations and harmonic suppressions across a broad bandwidth in a highly miniaturized form factor. Accurate, nonlinear simulation models are available for Microwave Office® through the Marki Microwave PDK. The MMD-1648L is available as a wire bondable chip or a connectorized package. The MMD-1648L is a superior alternative to Marki Microwave carrier and packaged doublers.

### Features

- Compact Chip Style Package (0.058" x 0.096"x0.004")
- CAD Optimized for Superior Suppressions and Efficiency
- 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. 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 | Input (GHz) | Output (GHz) | Min | Typ | Max | Diode Option **Input drive level** (dBm) |
|---|---|---|---|---|---|---|
| 2F (out) Conversion Loss (dB) | 8-24 | 16-48 | | 15 | 20 | +13 |
| Suppressions (dBc)[1] | | | | | | +10 to +15 |
| 1F (in) Fundamental | | | | 44 | | |
| 3F (out) Third Harmonic | | | | 69 | | |
| 4F (out) Fourth Harmonic | | | | 33 | | |
| 5F (out) Fourth Harmonic | | | | 58 | | |
| Isolations (dB)[2] | | | | | | |
| 1F (in) Fundamental | | | | 59 | | |
| 3F (out) Third Harmonic | | | | 85 | | |
| 4F (out) Fourth Harmonic | | | | 33 | | |
| 5F (out) Fourth Harmonic | | | | 57 | | |

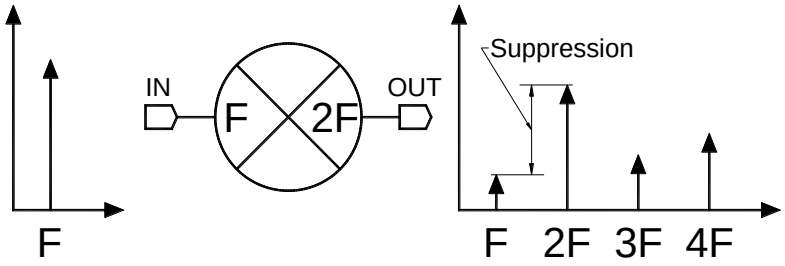
[1]Suppression is relative to 2F doubled output power.
[2]Isolation is defined as relative to the 1F fundamental input power.

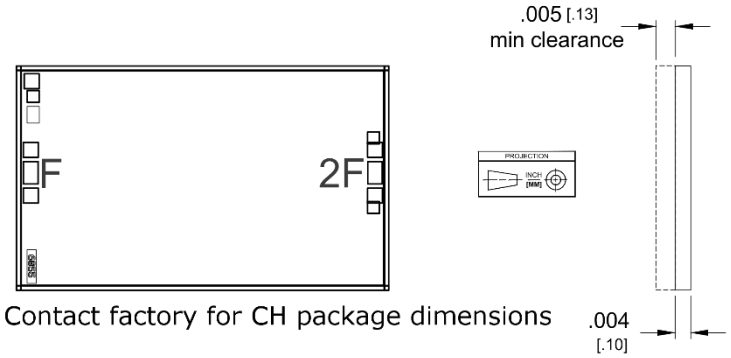
### Part Number Options

*Please specify package style by adding to model number.*

| Package Styles | | Examples | | |
|---|---|---|---|---|
| Connectorized[1, 3] | S | MMD-1648LCH, MMD-1648LS | | |
| Chip[2, 3] (RoHS) | CH | MMD-1648 (Model) | L (Diode Option) | CH (Package) |

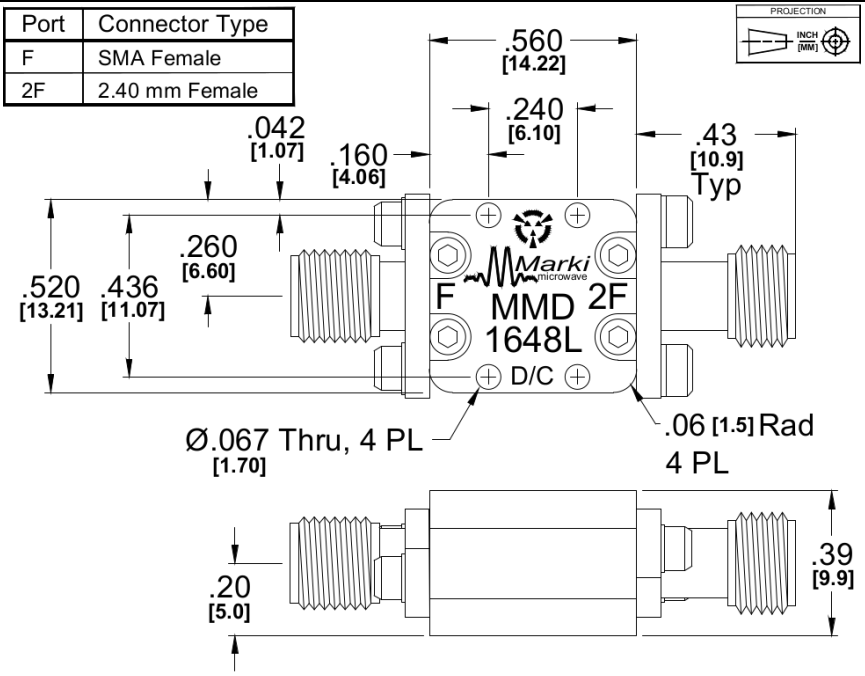
[1]Connectorized package consists of chip package wire bonded to a substrate, equivalent to an evaluation board.
[2]Chip package connects to external circuit through wire bondable gold pads.
[3]Note: For port locations and I/O designations, refer to the drawings on page 2 of this document.



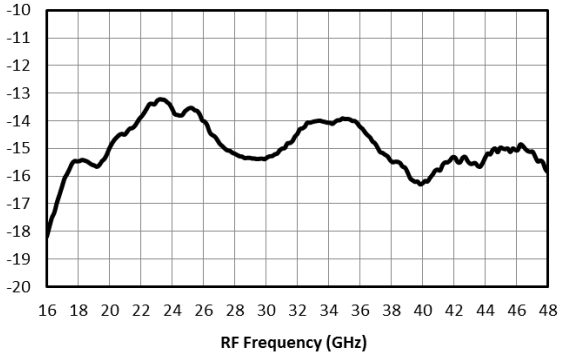

1. CH Substrate material is .004 thick GaAs.
2. I/O traces and ground plane finish are 2 microns Au.
3. Wire Bonding - Ball or wedge bond with 0.025 mm (1 mil) diameter pure gold wire. Thermosonic wirebonding with a nominal stage temperature of 150 °C and a ball bonding force of 40 to 50 grams or wedge 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 |
|---|---|
| F | SMA Female |
| 2F | 2.40 mm Female |

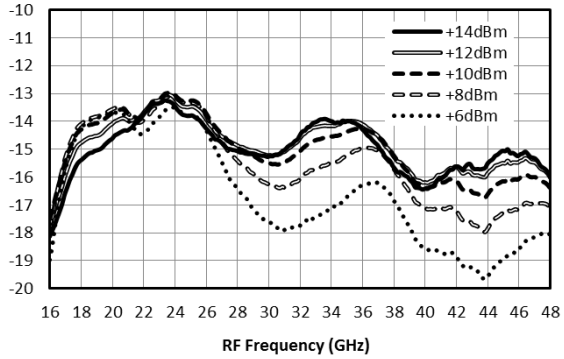


Typical Performance

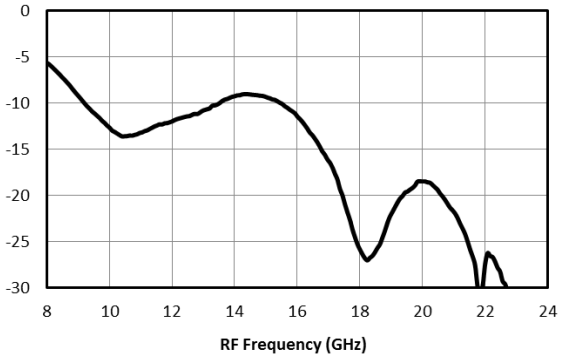
2F Output Conversion Loss (dB)[1-3]



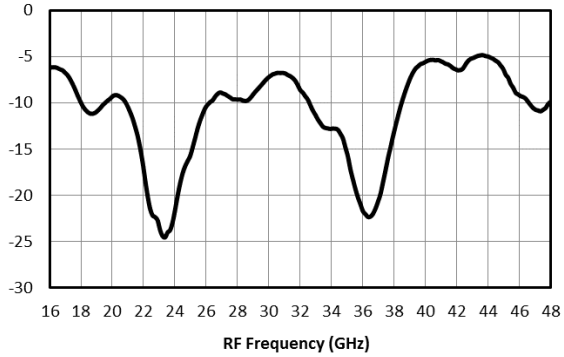

2F Output Conversion Loss vs Input Power (dB)[1-3]



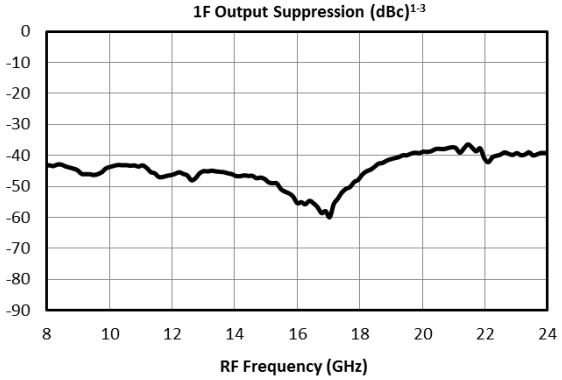

Input Return Loss (dB)[1-3]



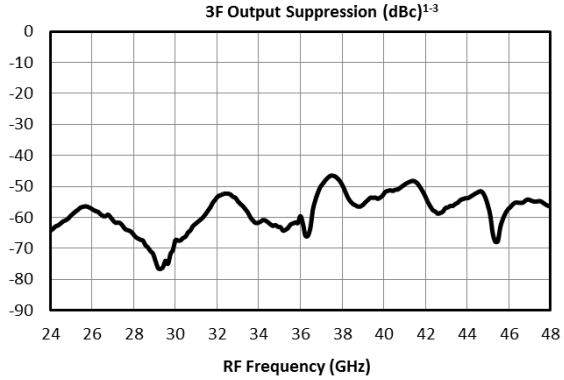

Output Return Loss (dB)[1-3]



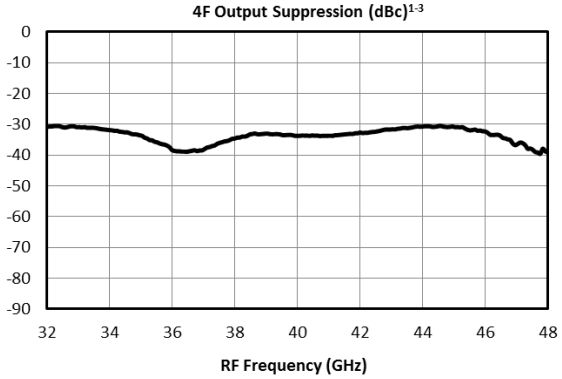

1F Output Suppression (dBc)[1-3]



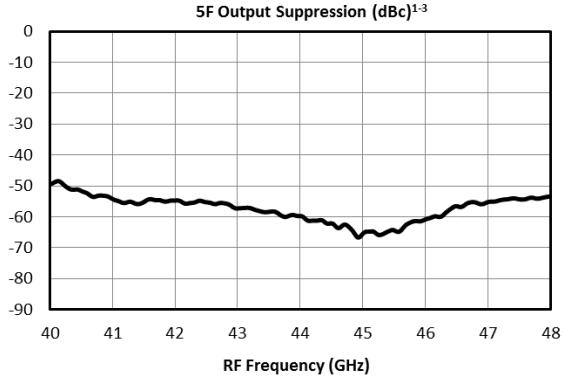

3F Output Suppression (dBc)[1-3]




4F Output Suppression (dBc)[1-3]




5F Output Suppression (dBc)[1-3]



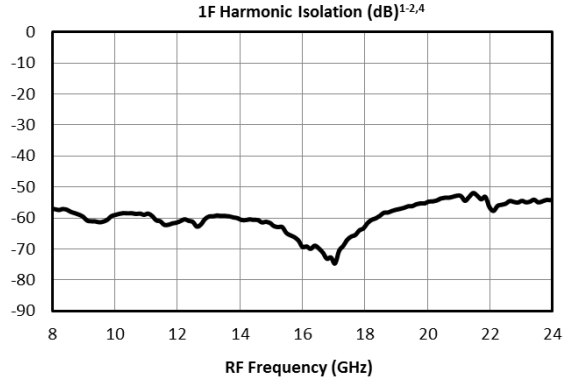
# High Isolation GaAs MMIC Doubler

# MMD-1648L

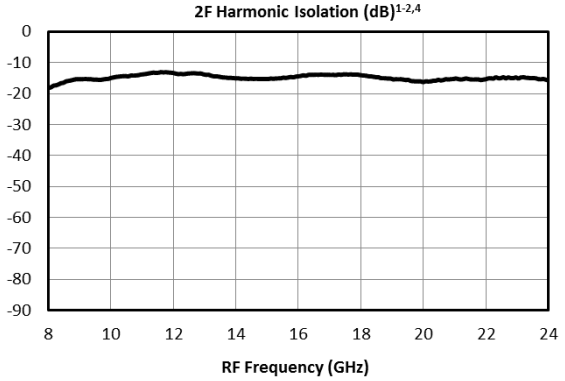


Typical Performance

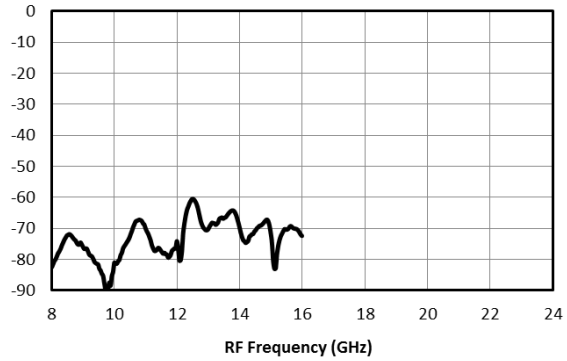
1F Harmonic Isolation (dB)[1-2,4]



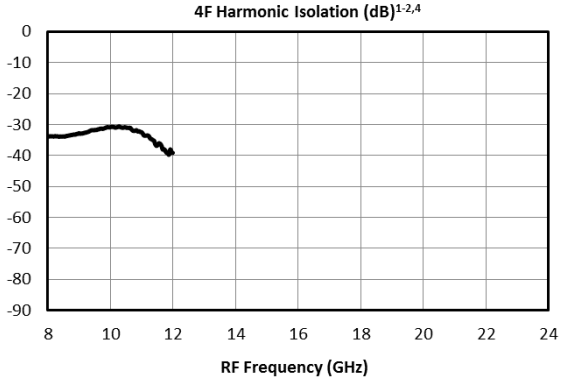

2F Harmonic Isolation (dB)[1-2,4]



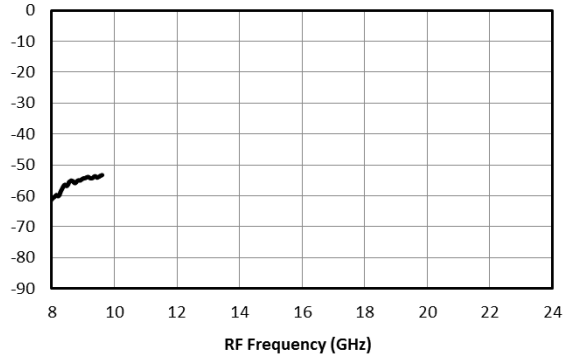

3F Harmonic Isolation (dB)[1-2,4]




4F Harmonic Isolation (dB)[1-2,4]




5F Harmonic Isolation (dB)[1-2,4]



**Mounting and Bonding Recommendations**

Marki MMICs should be attached directly to a ground plane with conductive epoxy. The ground plane electrical impedance should be as low as practically possible. This will prevent resonances and permit the best possible electrical performance. Datasheet performance is only guaranteed in an environment with a low electrical impedance ground.

**Mounting** - To epoxy the chip, apply a minimum amount of conductive epoxy to the mounting surface so that a thin epoxy fillet is observed around the perimeter of the chip. Cure epoxy according to manufacturer instructions.

**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).

**Circuit Considerations** – 50 Ω transmission lines should be used for all high frequency connections in and out of the chip. Wirebonds should be kept as short as possible, with multiple wirebonds recommended for higher frequency connections to reduce parasitic inductance. In circumstances where the chip more than .001" thinner than the substrate, a heat spreading spacer tab is optional to further reduce bondwire length and parasitic inductance.

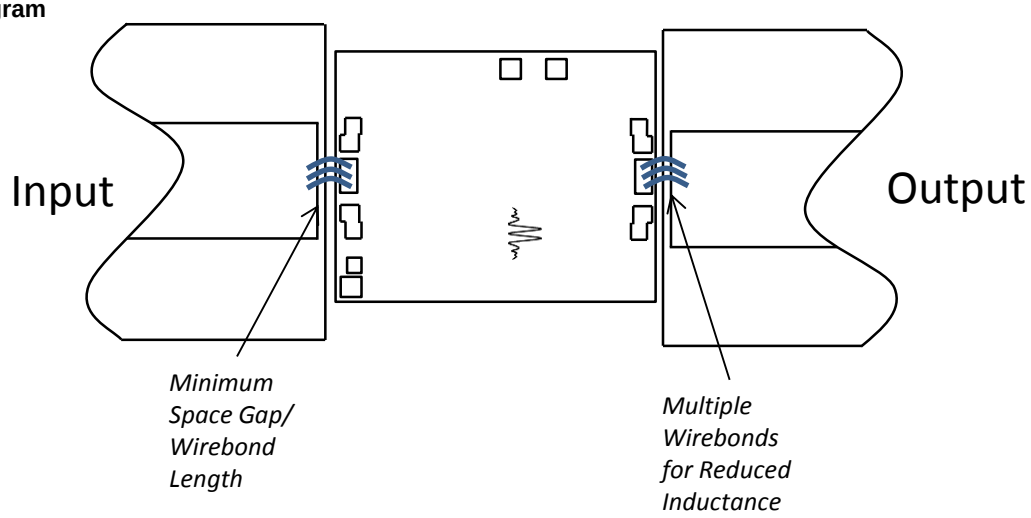
**Handling Precautions**

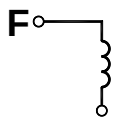
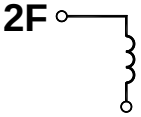
**General Handling**: Chips should be handled with a vacuum collet when possible, or with sharp tweezers using well trained personnel. The surface of the chip is fragile and should not be contacted if possible.

**Static Sensitivity**: GaAs MMIC devices are subject to static discharge, and should be handled, assembled, tested, and transported only in static protected environments.

**Cleaning and Storage**: Do not attempt to clean the chip with a liquid cleaning system or expose the bare chips to liquid. Once the ESD sensitive bags the chips are stored in are opened, chips should be stored in a dry nitrogen atmosphere.

**Bonding Diagram**



| Port | Description | DC Interface Schematic |
|---|---|---|
| F Input | The input port is DC open and AC matched to 50 Ohms from 8 to 24 GHz. Blocking capacitor is optional. |   |
| 2F Output | The output port is DC open and AC matched to 50 Ohms from 16 to 48 GHz. Blocking capacitor is optional. |   |

| Absolute Maximum Ratings | |
|---|---|
| **Parameter** | **Maximum Rating** |
| Input DC Current | N/A |
| Output DC Current | N/A |
| RF Power Handling | +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. Doubled Loss typically degrades less than 0.5 dB at +100°C and improves less than 0.5 dB at -55°C.
2. Unless otherwise specified, L-Diode data is taken with a +13 dBm input.
3. Suppression (dBc) specified as relative to the 2F output frequency.
4. Measured data from connectorized package. Contact support for details on how to test for high isolation levels.
5. Specifications are subject to change without notice. Contact Marki Microwave for the most recent specifications and data sheets.
6. Catalog doubler circuits are continually improved. Configuration control requires custom 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.