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Tech Support: support@markimicrowave.com

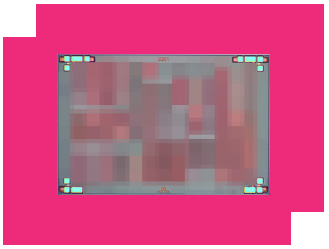
MQH-2R58R5CH

MMIC 2.5-8.5GHz Quadrature Hybrid

DEVICE OVERVIEW

General Description

The MQH-2R58R5 is a MMIC 2.5 GHz – 8.5 GHz quadrature (90°) hybrid. Wire bondable 50Ω terminations are available on-chip. Passive GaAs MMIC technology allows production of smaller constructions that replace larger form factor circuit board constructions. Tight fabrication tolerances allow for less unit to unit variation than traditional quadrature hybrid technologies. The MQH-2R58R5 is available as a wire bondable chip or connectorized module. Low variation allows for accurate simulations using the provided S4P file taken from measured production units. Applications include single sideband upconverters, image rejection downconverters, IQ modulators, balanced amplifiers, microwave correlators, and microwave Butler matrices.



Download s-parameters here

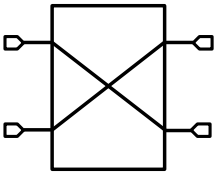
Features

- Designed for S/C-band applications
- Excellent amplitude and phase balance
- High isolation
- Low insertion loss
- On-chip 50Ω load terminations

Applications

- Single Sideband Upconverters
- Image Rejection Downconverters
- IQ Modulators
- Balanced Amplifiers
- Microwave Correlators
- Microwave Butler Matrices

Functional Block Diagram



Part Ordering Options

Part Number	Description	Package	Connectors	Green Status	Product Lifecycle	Export Classification
MQH-2R58R5UB	MMIC 2.5-8.5GHz Quadrature Hybrid	UB	Standard	REACH RoHS	Released	EAR99
MQH-2R58R5CH	MMIC 2.5-8.5GHz Quadrature Hybrid	CH	-	REACH RoHS	Released	EAR99

Table Of Contents

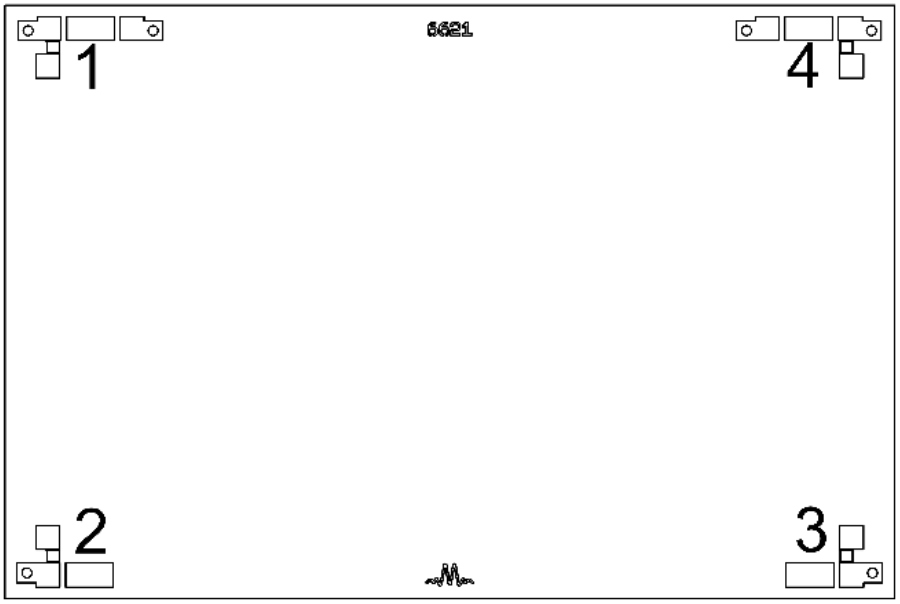
Revision History

Revision Code	Revision Date	Comment
-	2018-08-01	Datasheet Initial Release

Port Configuration and Functions

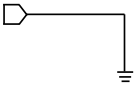
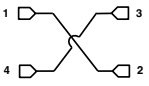
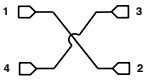
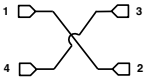
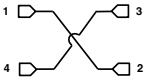
Port Diagram

A top-down view of the MQH-2R58R5CH package outline drawing is shown below. This MMIC quadrature hybrid is a passive reciprocal device allowing any port to be used as the input. Ports 1 – 4 correspond to the UB package designation.

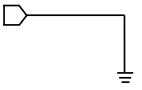
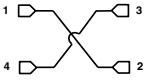
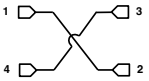
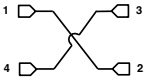
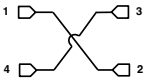


Port Functions

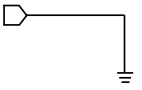
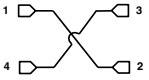
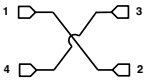
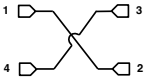
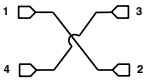
Configuration A

Port	Function	Description	Equivalent Circuit for Package
Pad	Ground	CH package ground path is provided through the substrate and ground bond pads.	
Pad 1	Input	Port 1 is DC short to port 2 and open to ground.	
Pad 2	0° Output	Port 2 is DC short to port 1 and open to ground.	
Pad 3	90° Output	Port 3 is DC short to port 4 and open to ground.	
Pad 4	Isolated	Port 4 is DC short to port 3 and open to ground.	

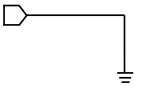
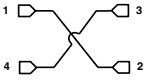
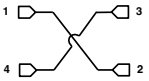
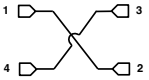
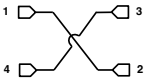
Configuration B

Port	Function	Description	Equivalent Circuit for Package
Pad	Ground	CH package ground path is provided through the substrate and ground bond pads.	
Pad 1	0° Output	Port 1 is DC short to port 2 and open to ground.	
Pad 2	Input	Port 2 is DC short to port 1 and open to ground.	
Pad 3	Isolated	Port 3 is DC short to port 4 and open to ground.	
Pad 4	90° Output	Port 4 is DC short to port 3 and open to ground.	

Configuration C

Port	Function	Description	Equivalent Circuit for Package
Pad	Ground	CH package ground path is provided through the substrate and ground bond pads.	
Pad 1	90° Output	Port 1 is DC short to port 2 and open to ground.	
Pad 2	Isolated	Port 2 is DC short to port 1 and open to ground.	
Pad 3	Input	Port 3 is DC short to port 4 and open to ground.	
Pad 4	0° Output	Port 4 is DC short to port 3 and open to ground.	

Configuration D

Port	Function	Description	Equivalent Circuit for Package
Pad	Ground	CH package ground path is provided through the substrate and ground bond pads.	
Pad 1	Isolated	Port 1 is DC short to port 2 and open to ground.	
Pad 2	90° Output	Port 2 is DC short to port 1 and open to ground.	
Pad 3	0° Output	Port 3 is DC short to port 4 and open to ground.	
Pad 4	Input	Port 4 is DC short to port 3 and open to ground.	

Specifications

Absolute Maximum Ratings

The Absolute Maximum Ratings indicate limits beyond which damage may occur to the device. If these limits are exceeded, the device may be inoperable or have a reduced lifetime.

Parameter	Maximum Rating	Unit
Maximum Operating Temperature	100	°C
Maximum Storage Temperature	125	°C
Minimum Operating Temperature	-55	°C
Minimum Storage Temperature	-65	°C

Package Information

Parameter	Details	Rating
Dimensions	-	3.75 x 2.50 mm

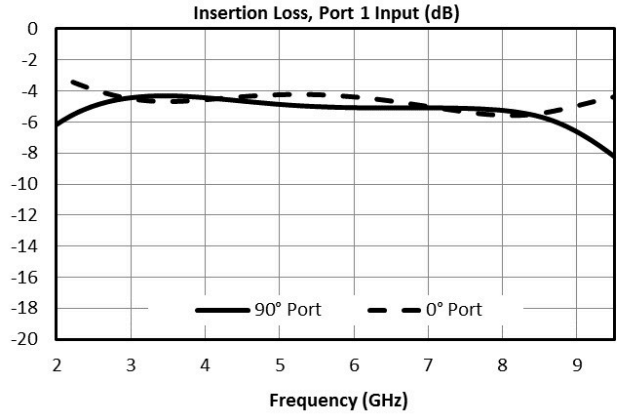
Electrical Specifications

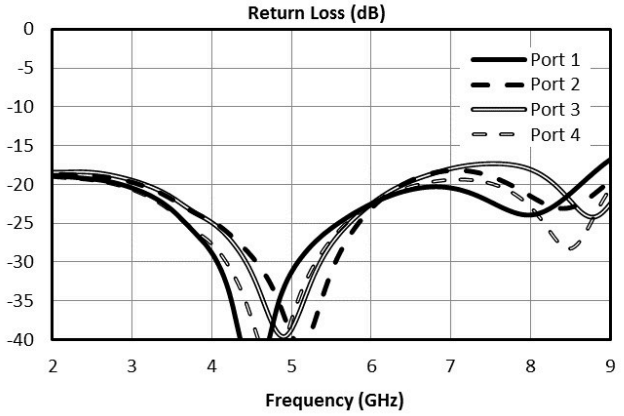
The electrical specifications apply at Tau=+25°C in a 50Ω system.

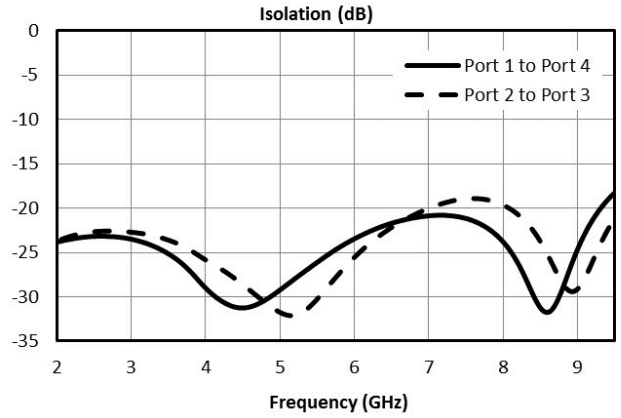
Parameter	Port Configuration	Test Conditions	Minimum Frequency (GHz)	Maximum Frequency (GHz)	Min	Typ	Max	Unit
Amplitude Balance	A	-	2.5	8.5	-	0.4	2	dB
Excess Through Line Insertion Loss	A	-	2.5	8.5	-	2	4	dB
Impedance	A	-	2.5	8.5	-	50	-	Ω
Isolation	A	-	2.5	8.5	14	23	-	dB
Mean Coupling	A	-	2.5	8.5	-	3	-	dB
Nominal Phase Shift	A	-	2.5	8.5	-	90	-	°
Phase Balance	A	-	2.5	8.5	-	3	10	°
VSWR	A	-	2.5	8.5	-	1.15	-	

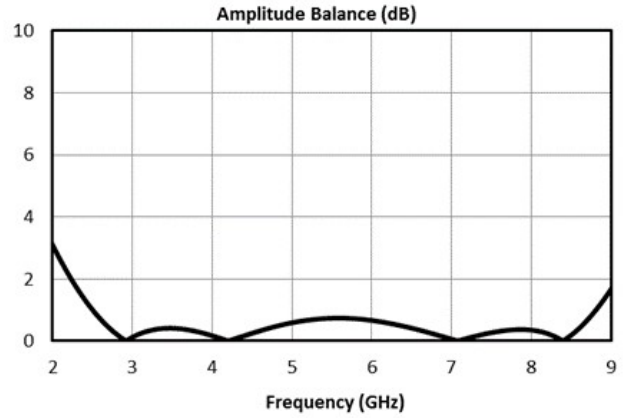
Quadrature hybrid is reciprocal. Reverse measurement is equivalent to forward measurement.

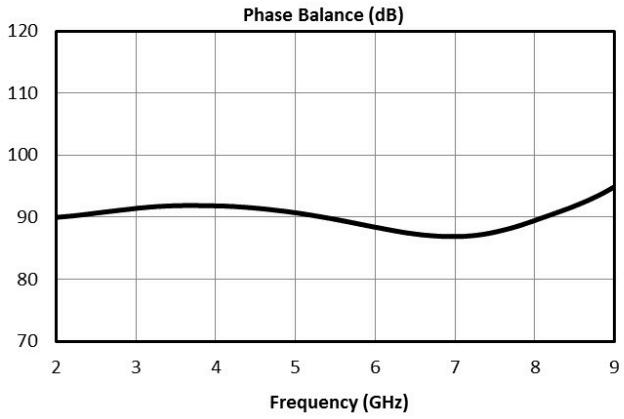
Typical Performance Plots

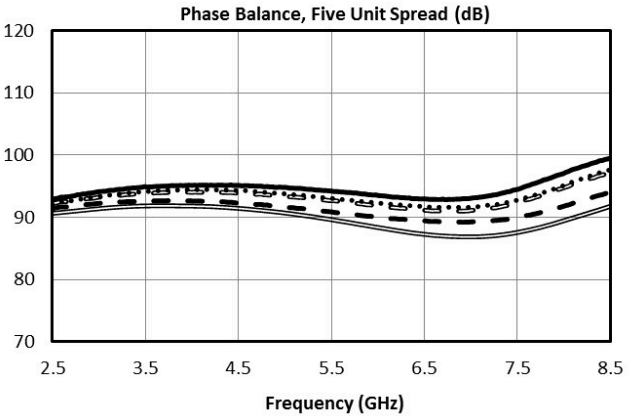






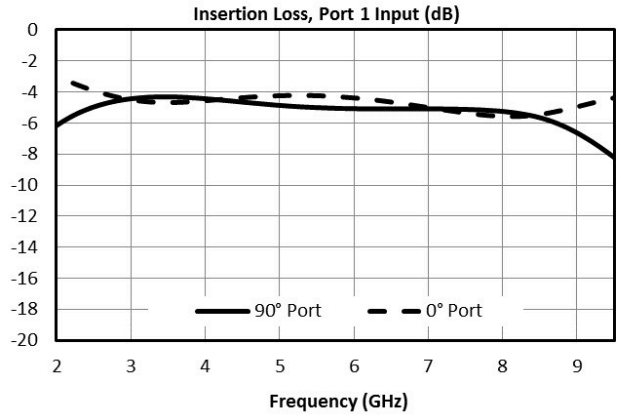


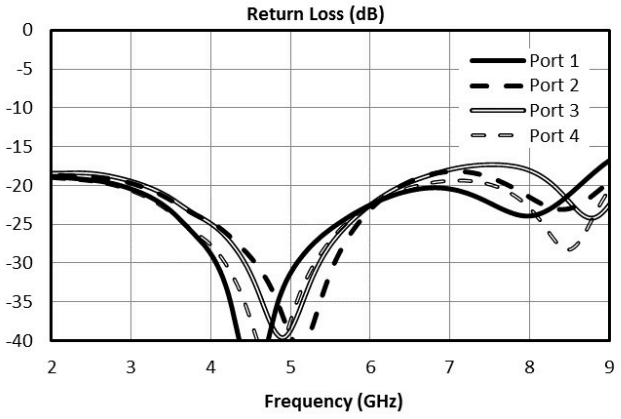


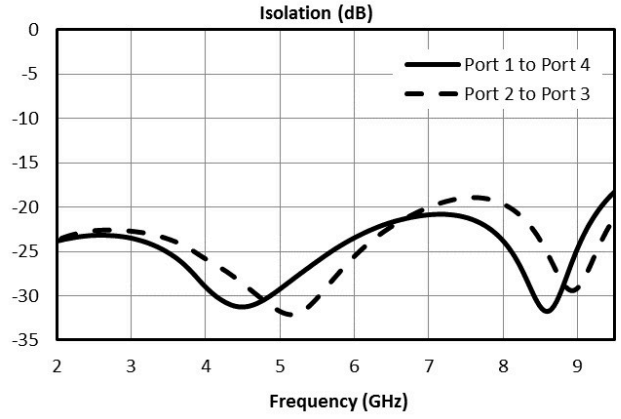


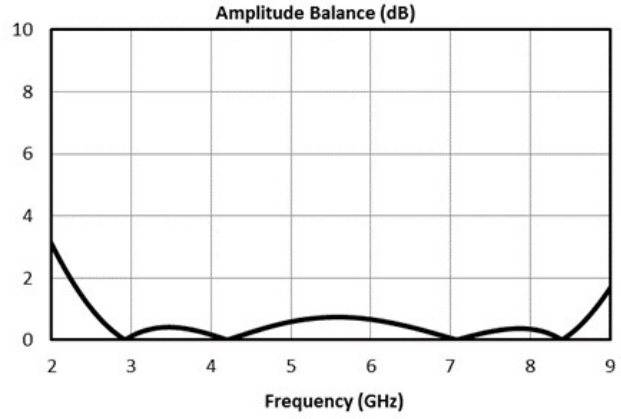
MQH-2R58R5UB - Typical Performance Plots

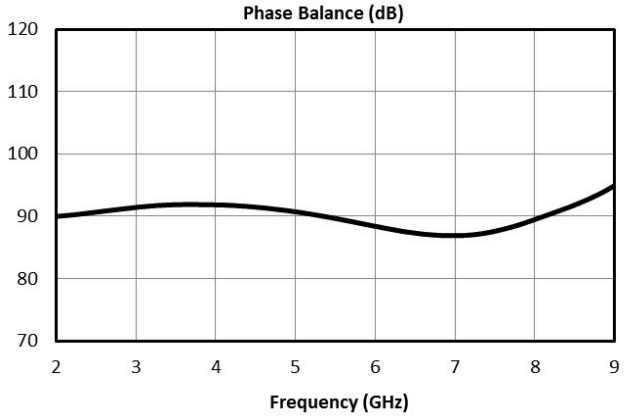
Performance plots for the connectorized module are shown for measurements where directly probed measurements of the die are unavailable. Note that the following measurements include losses from connectors and microstrip traces.

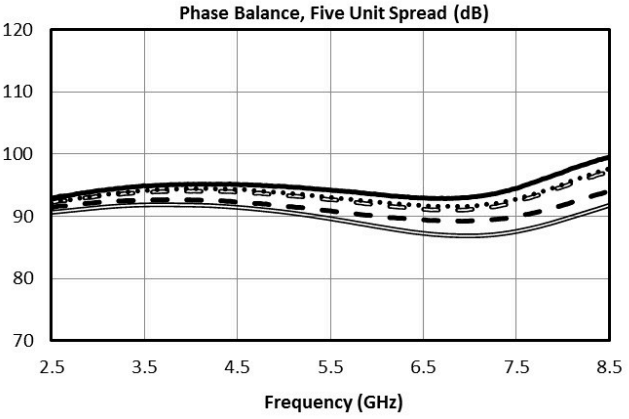












Application Information

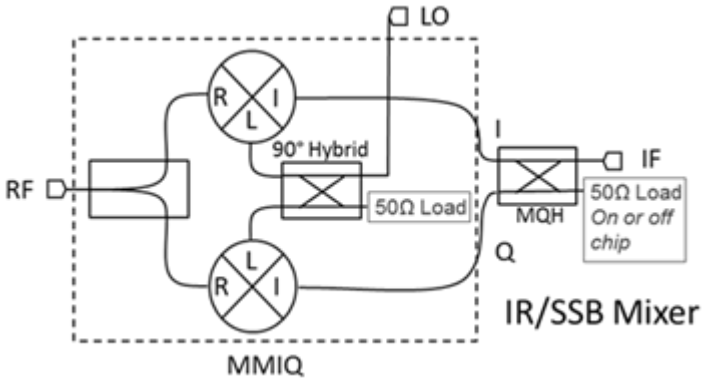
Quadrature signal generation is useful for many applications in analog signal processing. Marki MQH/S MMIC quadrature hybrids and 90˚ Splitter/Combiners offer this functionality in a small factor with high repeatability. Below are applications and how they can be realized with the MQH and MQS product lines.

Quadrature Hybrids vs 90˚ Splitter/Combiners

Some products are 'true' quadrature hybrids, while others are 90˚ Splitter/Combiners. What is the difference? A quadrature hybrid is symmetric about all four ports, meaning that in a splitting application any port can be used as an input, with the isolated and output ports following from this selection. Likewise, for a combining application, any port can be used as an output.

A 90˚ Splitter/Combiner is not symmetric. When splitting, only ports 1 and 2 can be used as an input. If ports 3 or 4 were used, there would be significant phase walk-off between the output ports. As a combiner, only ports 1 and 2 are suitable as output ports. The phase walk-off introduced when using ports 3 or 4 as an output means that reflected signals recombine and cancel poorly inside a 90° Splitter/Combiner.

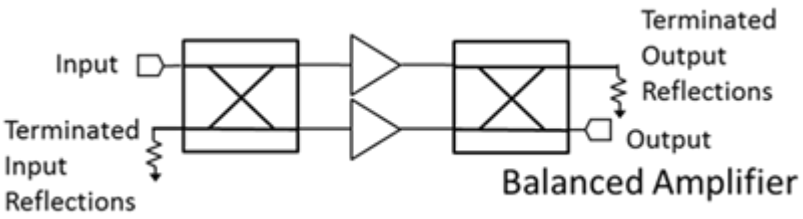
Single Sideband and Image Reject Mixers



The primary application for the MQH and MQS series is as IF or LO quadrature signal splitter/combiners. They can be used in combination with the MMIQ series of IQ mixers to create broadband single sideband and image reject mixers. Either 90˚ Splitter/Combiners or quadrature hybrids can be used as the IF hybrid, but if a 90˚ Splitter/Combiner is used only one sideband (or image) is accessible, whereas if a quadrature hybrid is used than both sidebands are accessible.

If a 90˚ Splitter/Combiner is used for a single sideband upconverter or image reject mixer, port 1 (or 2) should be used as the IF input/output and ports 2 and 3 (or 1 and 4) should be connected to the I and Q ports. Selecting port 1 or 2 to terminate will select which sideband of the mixer to reject.

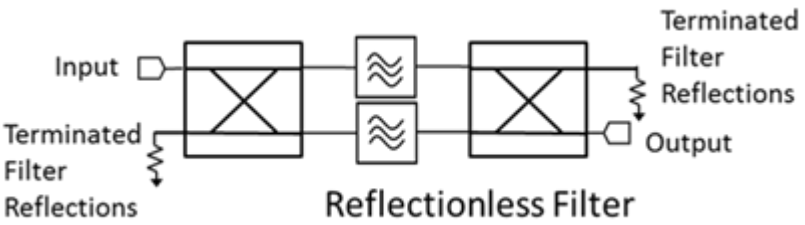
Balanced Amplifiers



In a balanced amplifier, the poor return loss of an amplifier is compensated for with a quadrature hybrid. In this application, the reflections from the input or output are collected at the isolated port of the quadrature hybrid and terminated.

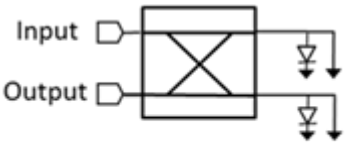
Since a 90˚ Splitter/Combiner is not completely symmetric, reflected signals will not terminate as well as with a quadrature hybrid. An MQH option is recommended for this application. Testing/simulation is recommended when considering if a 90° Splitter/Combiner is suitable.

Reflectionless Filter

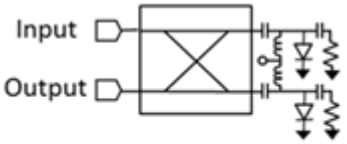


Similar to a balanced amplifier, a reflectionless filter will terminate reflections that are out of band for a filter (but in band for the quadrature hybrid) at the isolated port.

Since a 90˚ Splitter/Combiner is not completely symmetric, reflected signals will not terminate as well as with a quadrature hybrid. An MQH option is recommended for this application. Testing/simulation is recommended when considering if a 90° Splitter/Combiner is suitable.



Reflective Phase Shifter



Reflective Attenuator

Die Mounting Recommendations

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.

Circuit Considerations – 50 Ω transmission lines should be used for all high frequency connections in and out of the chip. 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.

Special Considerations for 90° Splitters – Transitions between the chip and transmission line should be as close to 50 Ω as possible. Small impedance mismatches will result in poor phase balance mid-band due to reflections. Length and number of wire bonds should be adjusted to tune inductance for an optimal 50 Ω match. In the modules, chip transitions are optimized for broadband performance.

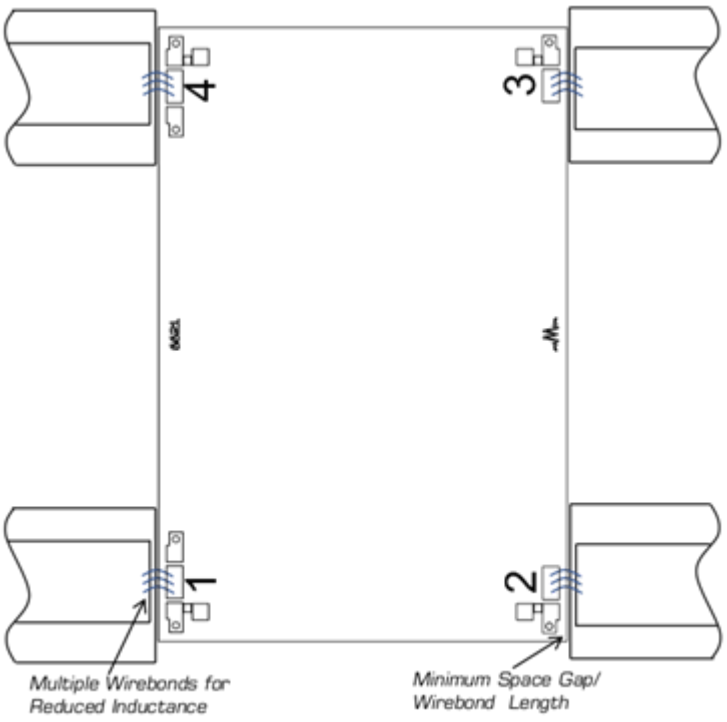
Handling Precautions

General Handling
Chips should be handled with care using tweezers or a vacuum collet. Users should take precautions to protect chips from direct human contact that can deposit contaminants, like perspiration and skin oils on any of the chip's surfaces.

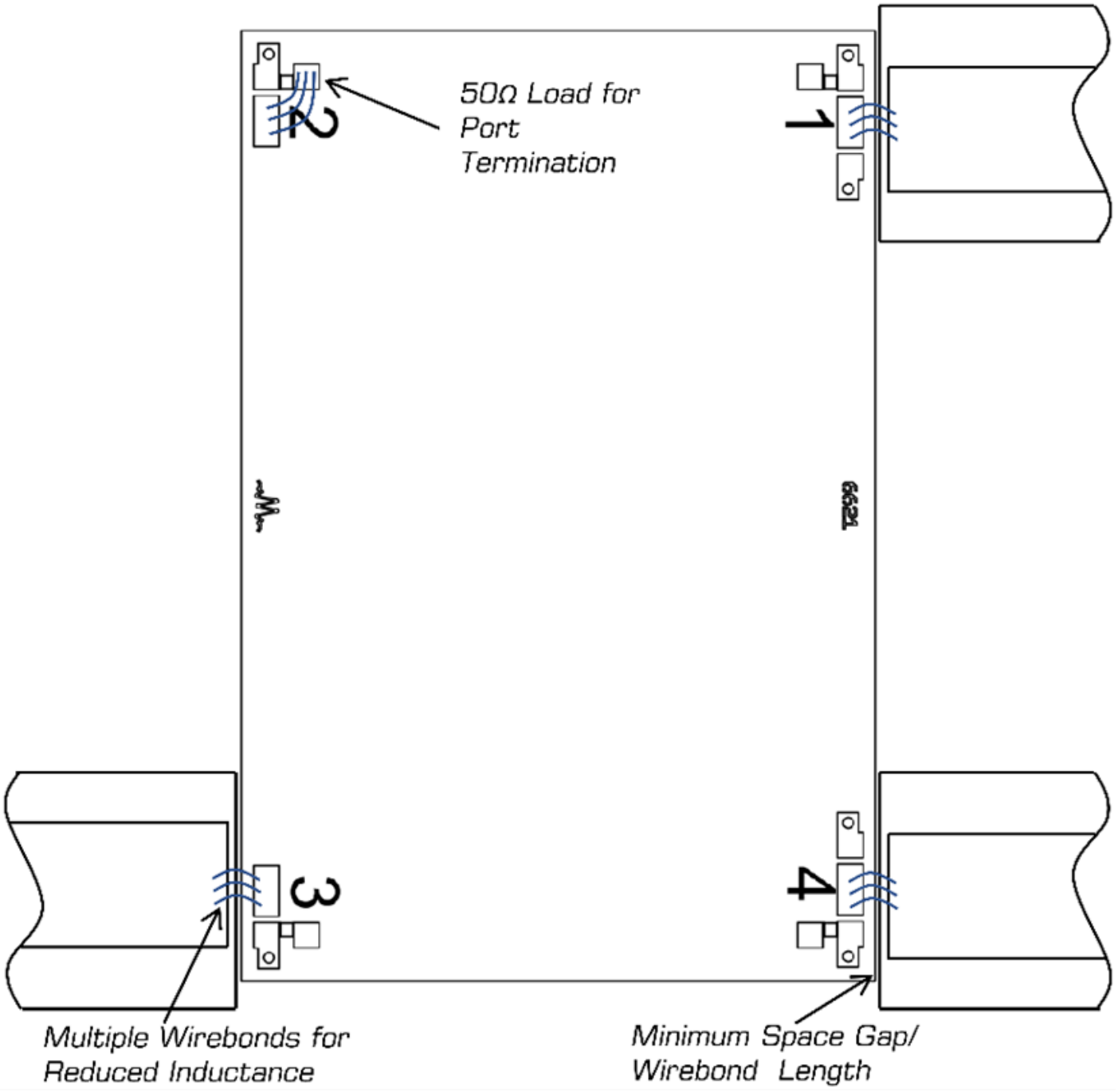
Cleaning and Storage: Do not attempt to clean the chip with a liquid cleaning system or expose the bare chips to liquid. Once the ESD sensitive bags the chips are stored in are opened, chips should be stored in a dry nitrogen atmosphere.

Bonding Diagram

Four Port Device



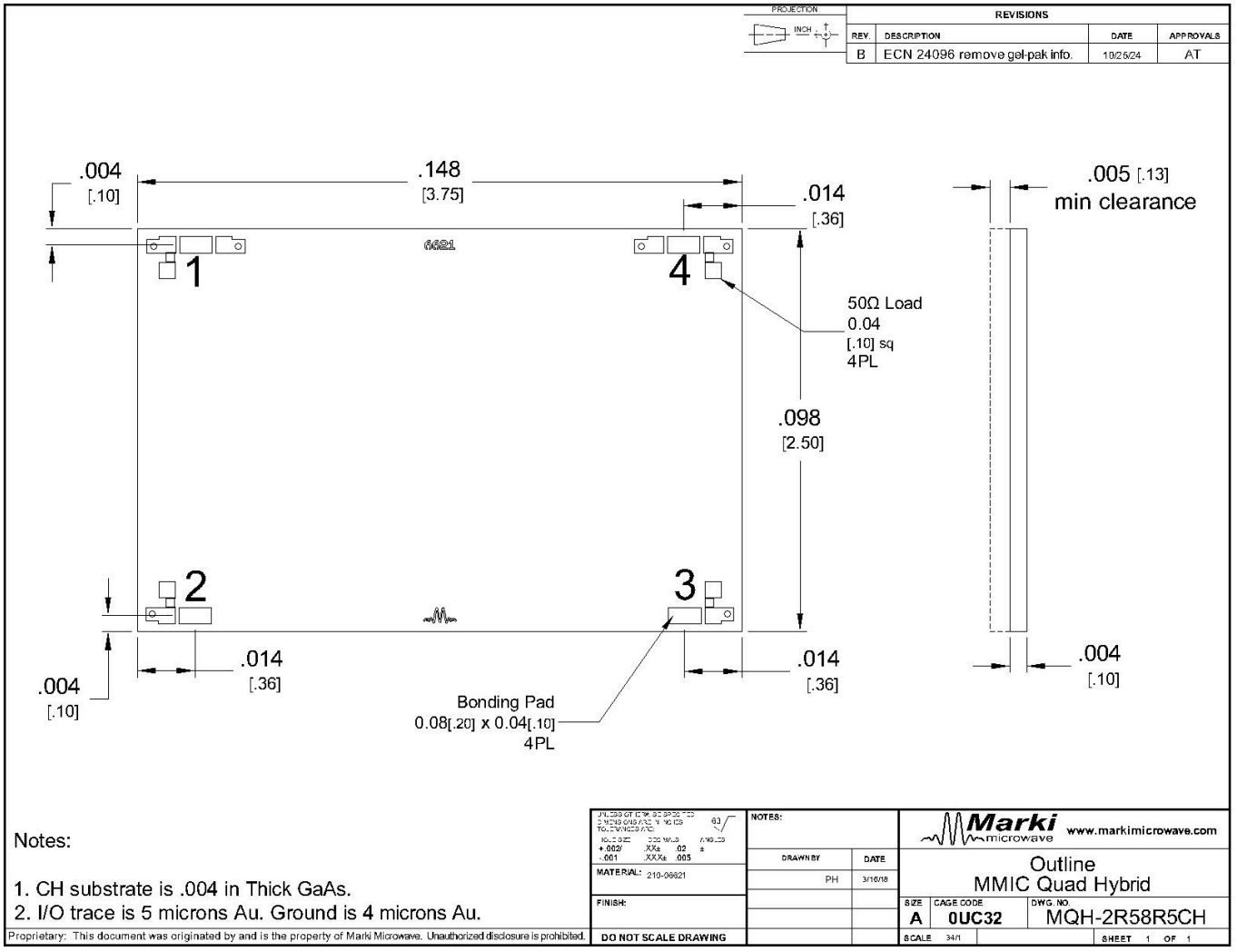
Isolated Port Terminated



Mechanical Data

Outline Drawing

Download : Outline 2D Drawing



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