

# BALH-0003SMG

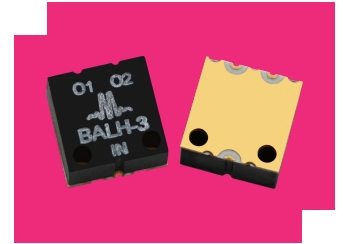
## High Power Surface-Mount Balun

### DEVICE OVERVIEW

#### General Description

The BALH-0003SMG is a broadband surface mount balun, hand-tuned for optimal phase and amplitude balance over a 500 kHz to 3 GHz bandwidth. It serves as an excellent choice for analog to digital converters, balanced receivers, baseband digital modulations, and signal integrity enhancement.

[Download s-parameters here](#)



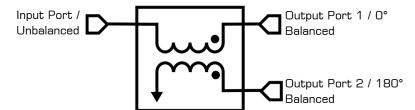
#### Features

- 1:1 Impedance Ratio
- 500 kHz to 3 GHz Balun (Balanced to Unbalanced Transformer)
- High 37 dBm 1-dB compression enables high power applications
- Tuned for Optimal Phase/Amplitude Balance

#### Applications

- Balanced Amplifiers
- Baseband Digital Modulation
- Signal Integrity

#### Functional Block Diagram



#### Part Ordering Options

Part Number	Description	Package	Green Status	Product Lifecycle	Export Classification
BALH-0003SMG	High Power Surface-Mount Balun	SMG	REACH RoHS	Released	EAR99
EVAL-BALH-0003	Evaluation Board, High Power Surface-Mount Balun	EVAL	<a href="#">Consult Factory</a>	Released	EAR99

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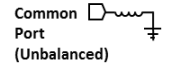
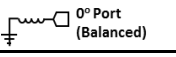
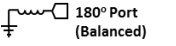
- **Device Overview**
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## Revision History

Revision Code	Revision Date	Comment
-	2013-02-01	Datasheet initial Release
A	2019-03-01	Evaluation board outline added
B	2019-10-01	Mixed Mode Scattering Parameters added
C	2020-04-01	Unit Spread Graphs Added
D	2020-07-01	Specs table update
E	2020-10-01	Specs table update
F	2022-05-01	Max DC Current, Ground Plane Finish Update
G	2024-03-06	Updated electrical specs table to add frequency resolution to insertion loss, balance and rejection specs.

**Port Configuration and Functions**

**Port Functions**

Port	Function	Description	DC Equivalent Circuit
Common Port / In (Unbalanced)	RF Input	The common port is DC short to ground.	 Common Port (Unbalanced)
Out 1 / 0° Port (Balanced)	0° Port	The 0° port is DC short to ground.	 0° Port (Balanced)
Out 2 / 180° Port (Balanced)	180° Port	The 180° port is DC short to ground.	 180° Port (Balanced)

## Specifications

### Absolute Maximum Ratings

Parameter	Maximum Rating	Unit
DC Current	1	A
Maximum Operating Temperature	100	°C
Maximum Storage Temperature	125	°C
Minimum Operating Temperature	-55	°C
Minimum Storage Temperature	-65	°C
RF Power Handling	33	dBm

### Package Information

Parameter	Details	Rating
Weight	Package name: SMG	0.24g
Dimensions	-	8.13 x 8.13 mm
Moisture Sensitivity Level	-	MSL 1

**Electrical Specifications**

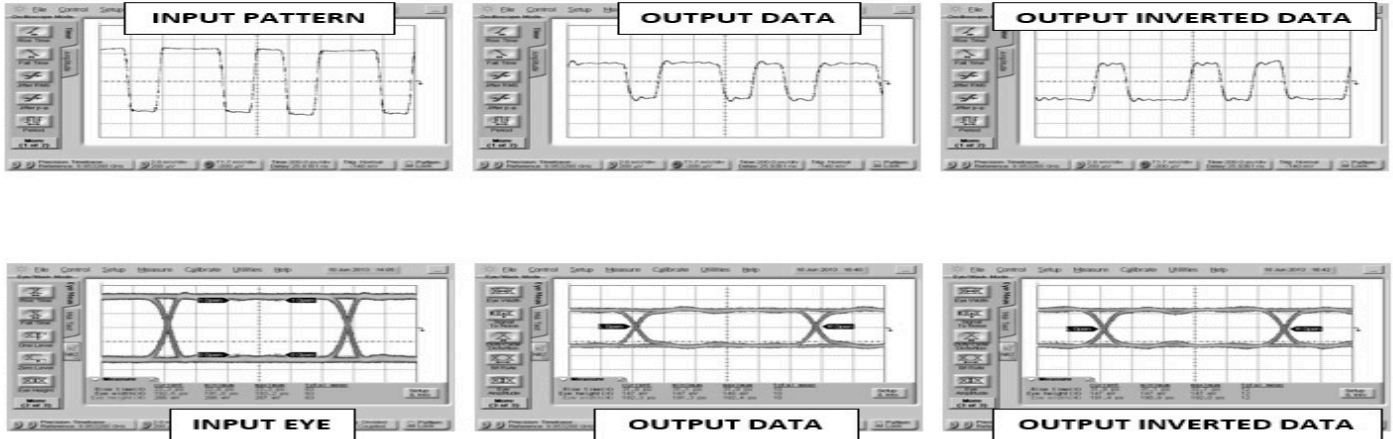
The electrical specifications apply at TA=+25°C in a 50Ω system. Min and Max limits are guaranteed at TA=+25°C.

Parameter	Test Conditions	Minimum Frequency (GHz)	Maximum Frequency (GHz)	Min	Typ	Max	Unit
VSWR (Input)	-	0.0005	3	-	1.6	-	
VSWR (Output)	-	0.0005	3	-	1.1	-	
Isolation	-	0.0005	3	-	7	-	dB
Input P1dB	-	0.0005	3	-	37	-	dBm
Impedance Ratio	-	-	-	-	1:1	-	
Risetime/Falltime <sup>1</sup>	-	0.0005	3	-	22	-	ps
Nominal Phase Shift	-	0.0005	3	-	180	-	°
Amplitude Balance	-	0.0005	0.002	-	0.5	-	dB
Amplitude Balance	-	0.002	0.01	-	0.2	3.5	dB
Amplitude Balance	-	0.01	3	-	0.2	0.8	dB
Phase Balance	-	0.0005	0.002	-	2.5	-	°
Phase Balance	-	0.002	0.01	-	2	14	°
Phase Balance	-	0.01	3	-	2	8	°
Common Mode Rejection	-	0.0005	0.002	-	30	-	dB
Common Mode Rejection	-	0.002	0.01	13	32	-	dB
Common Mode Rejection	-	0.01	3	20	35	-	dB
Insertion Loss as a Mode Converter	-	0.0005	0.002	-	2	-	dB
Insertion Loss as a Mode Converter	-	0.002	0.01	-	1.9	4	dB
Insertion Loss as a Mode Converter	-	0.01	3	-	2	3.5	dB

<sup>[1]</sup> Specified as 90%/10%. Calculated from  $\tau_{balun2} = (\tau_{out}^2 - \tau_{in}^2)$

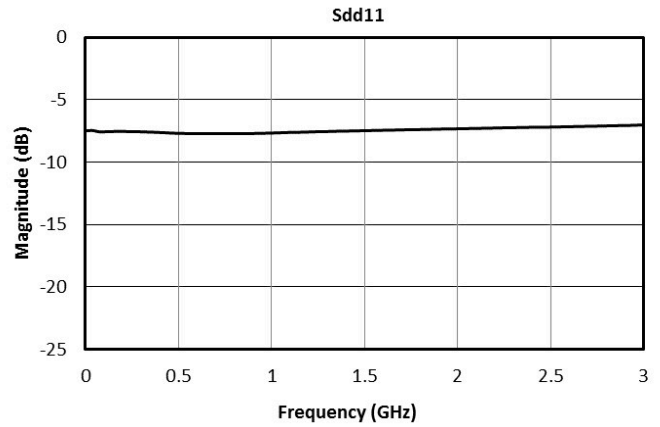
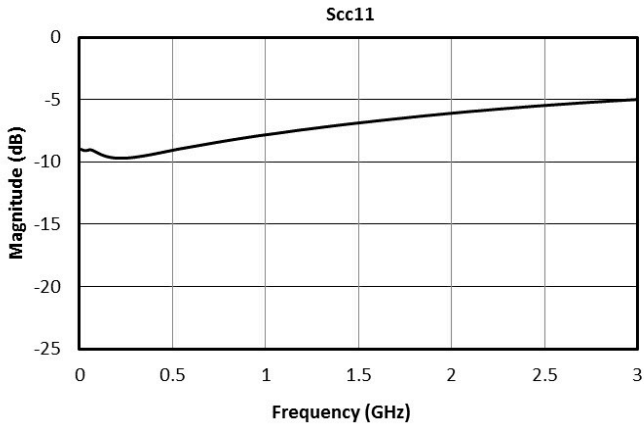
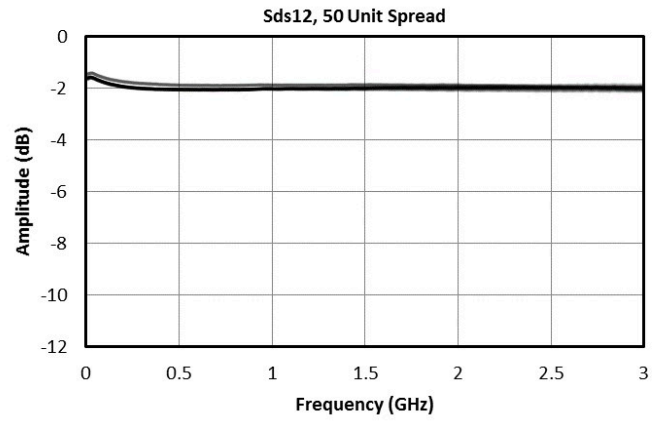
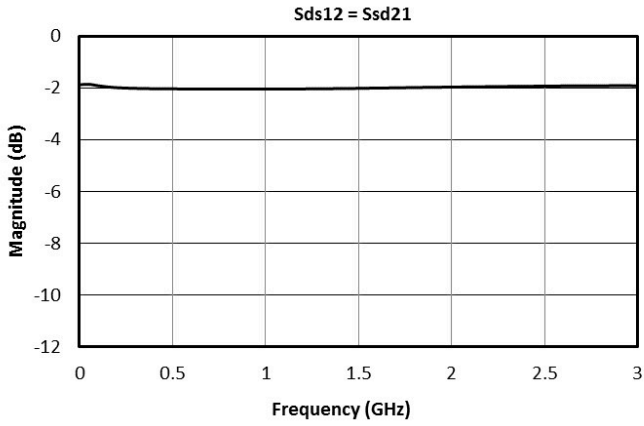
**Time Domain Performance Plots**

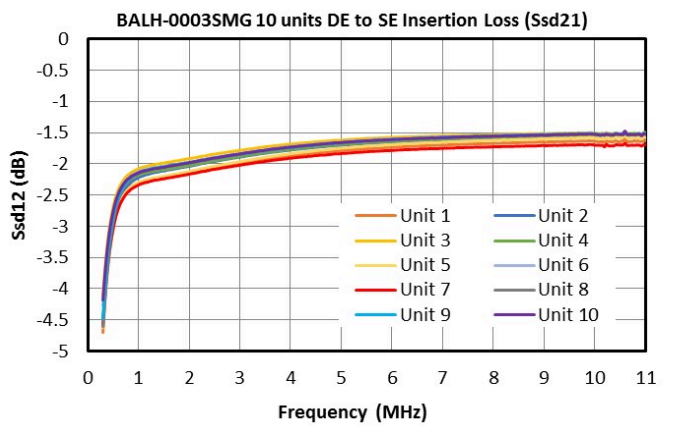
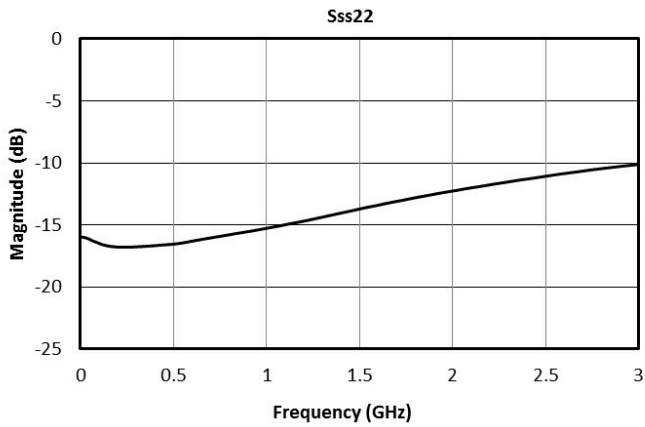
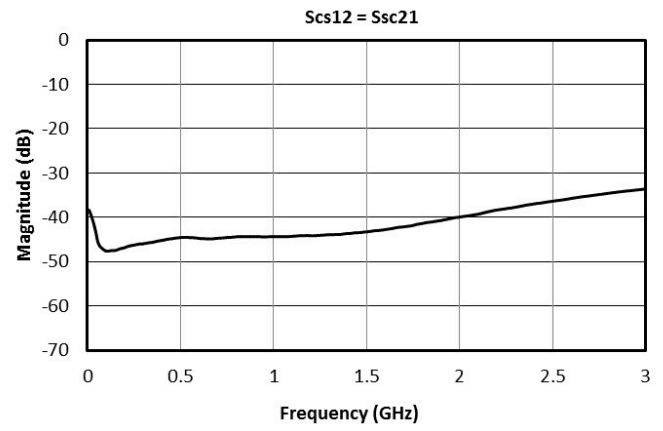
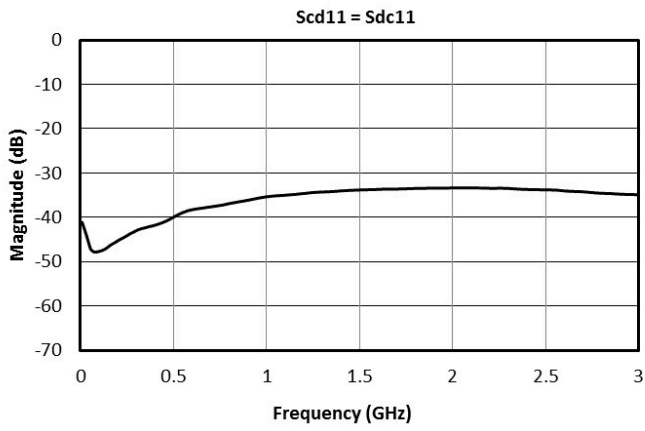
Oscilloscope measurements of the BALH-0003SMG with a 5 Gb/s PRBS pattern. Bit pattern is measured with a 27-1 PRBS input demonstrating extremely good pulse fidelity for both inverted and non-inverted output. Eye diagrams are taken with a 231-1 PRBS input demonstrating minimal eye distortion/closure afforded by the extremely low frequency operation of the balun (<500 kHz).



### Mixed Mode Scattering Parameters

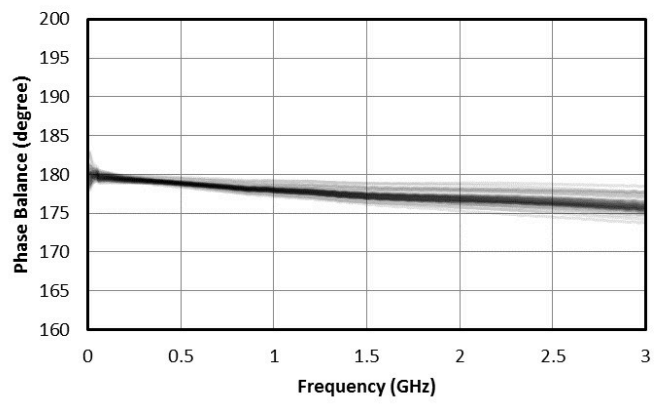
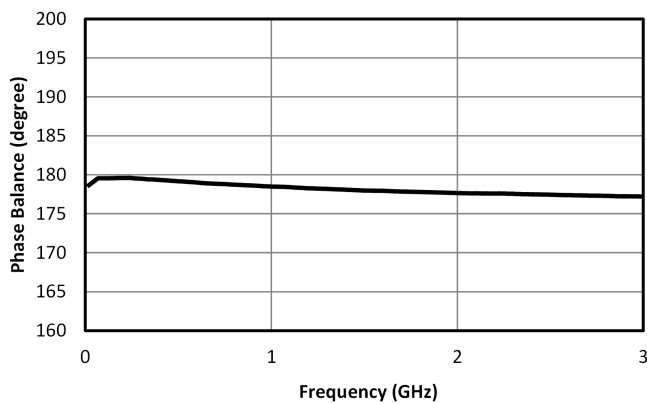
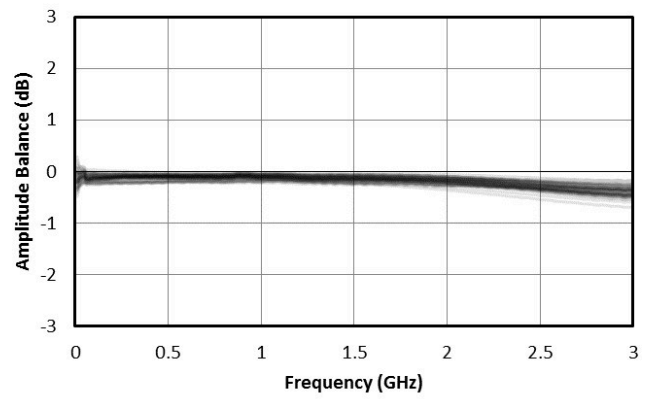
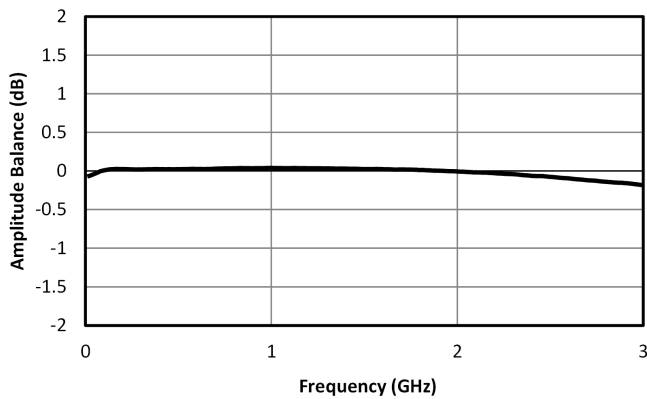
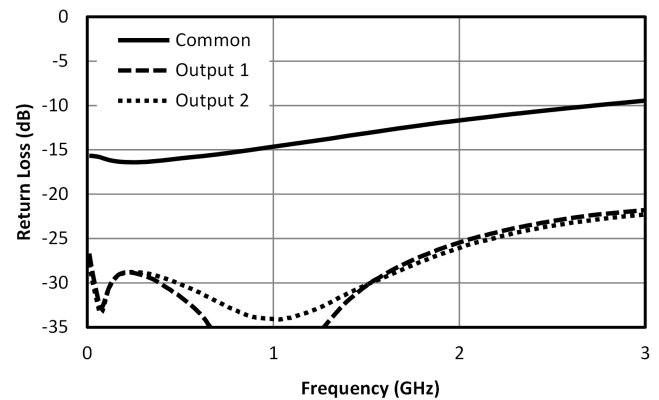
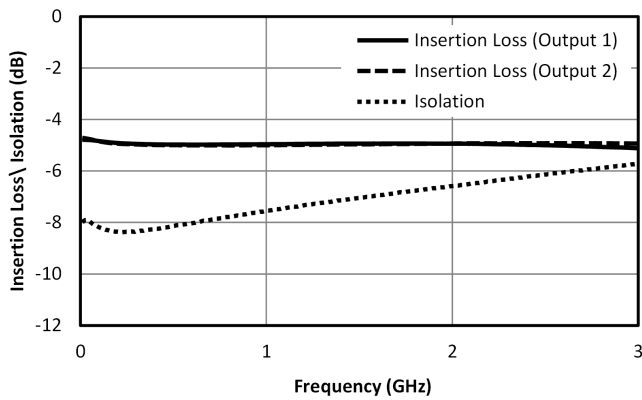
Mixed mode scattering parameters are used to characterize differential circuits. For baluns, this means that the 0° and 180° ports become a single 100Ω differential port and the common port remains the same 50Ω common port. The two-port s-parameters of the balun are then characterized based on differential (d), common mode (c), or single-ended (s) signals. For example: Sds12 is the differential output response given a single ended input.

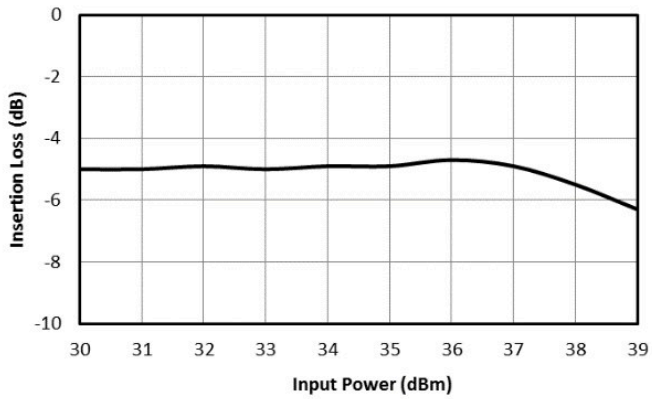
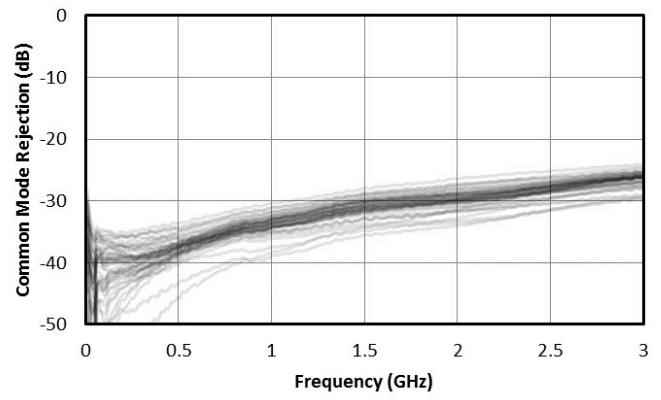
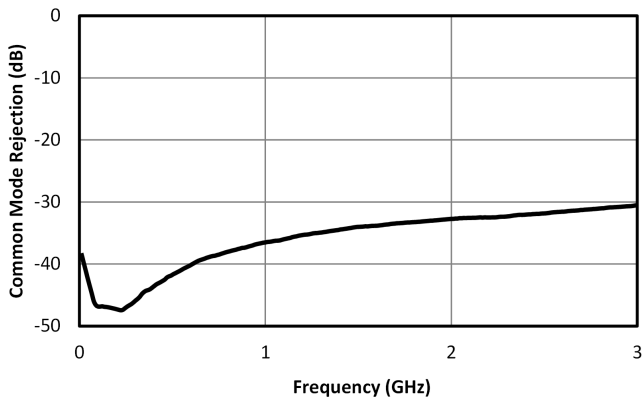




### Typical Performance Scattering Parameters

Three port scattering parameters measured as three single-ended 50Ω ports showing relationship between any two ports. For example: S21 and S31, often referred to as insertion loss of a balun, is the output response on ports 2 and 3 with an input stimulus on port 1.

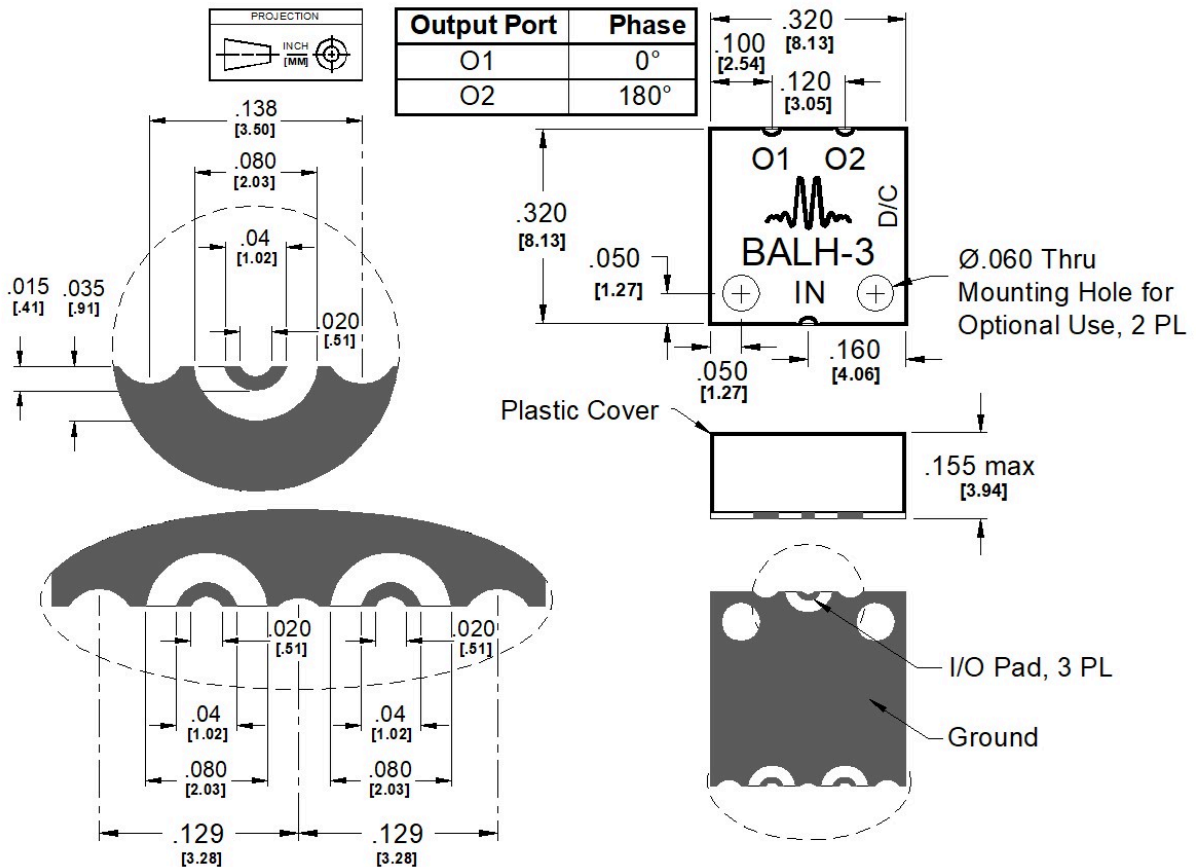




**Mechanical Data**

**Outline Drawing**

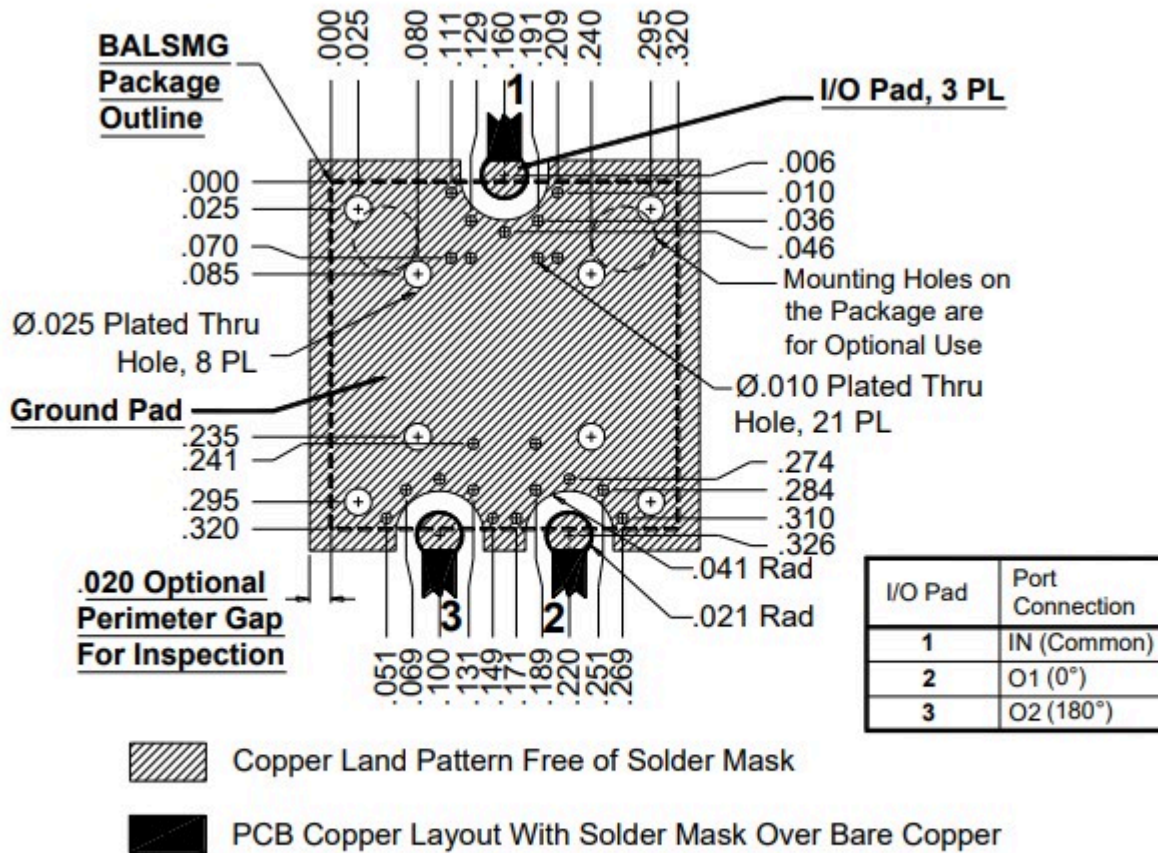
Download : [Outline 2D Drawing](#) | [Outline 3D Drawing](#) | [Outline 3D STP](#)



Substrate material is 8-mil thick Rogers 4003, 1 Oz Electrodeposited Cu. I/O Pads & Ground Plane Finish is Gold Flash, 5 to 10 μinches, over Electroplated Nickel, 100-200 μinches, over Cu.

Footprint Image

Download: [Footprint Drawing](#)

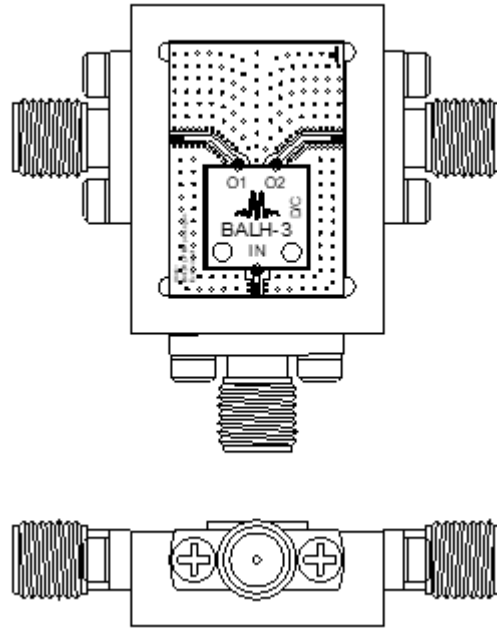


**Note:** Trace widths shown are for Rogers RO5880/Taconic TLY-5, .010" thick, ½ Oz copper. Widths may need to be modified for other materials.

**Evaluation Board - Performance Data**

Parameter	Test Conditions	Frequency Range (GHz)	Min	Typ	Max	Unit
Impedance Ratio	-	-	-	1	-	

**Evaluation Board - Outline Drawing**



## Notes

### DATASHEET NOTES:

- 1. Sdd22: differential return loss of the differential port driven with a differential signal
- Sdc22: differential return loss of the differential port driven with a common signal
- Sds21: insertion loss from a single ended input to a differential output
- Scc22: common mode return loss of the differential port driven with a common signal
- Scd22: common mode return loss of the differential port driven with a differential signal
- Scs21: insertion loss from a single ended input to a common output
- Sss11: single ended return loss
- Ssd12: insertion loss from a differential signal to single ended output
- Ssc12: insertion loss from a common signal to single ended output

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