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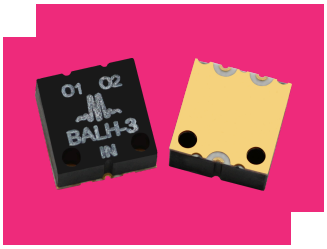
BALH-0003SMG

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

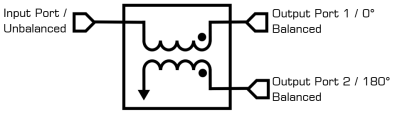
Features

- 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	Consult Factory	Released	EAR99

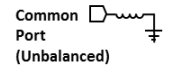
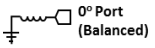
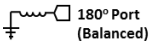
Table Of Contents

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.	
Out 1 / 0° Port (Balanced)	0° Port	The 0° port is DC short to ground.	
Out 2 / 180° Port (Balanced)	180° Port	The 180° port is DC short to ground.	

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

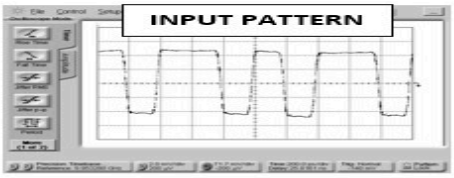
The electrical specifications apply at TA=+25°C in a 50Ω system. Min and Max limits are guaranteed at TA=+25°C.

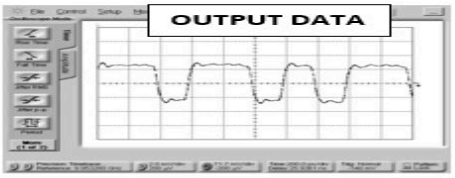
Parameter	Test Conditions	Minimum Frequency (GHz)	Maximum Frequency (GHz)	Min	Typ	Max	Unit
VSWR (Input)	-	0.0005	3	-	1.6	-	
VSWR (Output)	-	0.0005	3	-	1.1	-	
Isolation	-	0.0005	3	-	7	-	dB
Input P1dB	-	0.0005	3	-	37	-	dBm
Impedance Ratio	-	-	-	-	1:1	-	
Risetime/Falltime [1]	-	0.0005	3	-	22	-	ps
Nominal 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

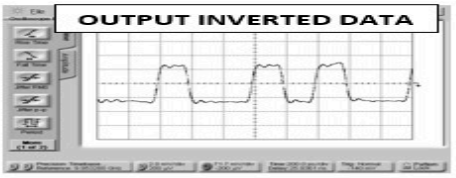
[1] Specified as 90%/10%. Calculated from Tau_balun2 = (Tau_out^2 – Tau_in^2)

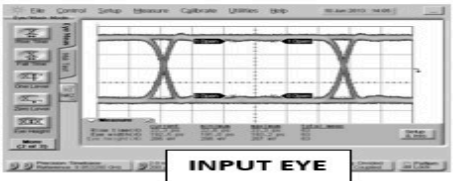
Time Domain Performance Plots

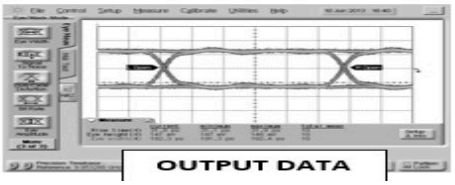
Oscilloscope measurements of the BALH-0003SMG with a 5 Gb/s PRBS pattern. Bit pattern is measured with a 27-1 PRBS input demonstrating extremely good pulse fidelity for both inverted and non-inverted output. Eye diagrams are taken with a 231-1 PRBS input demonstrating minimal eye distortion/closure afforded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

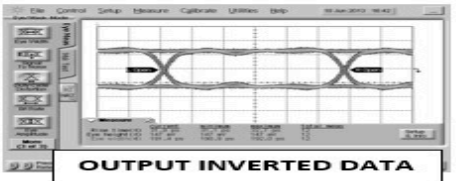






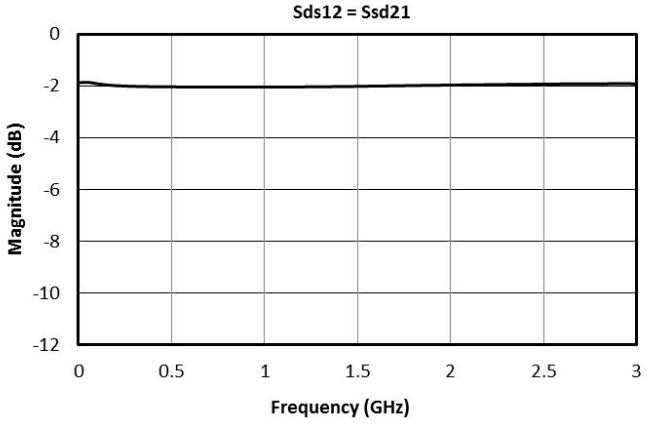


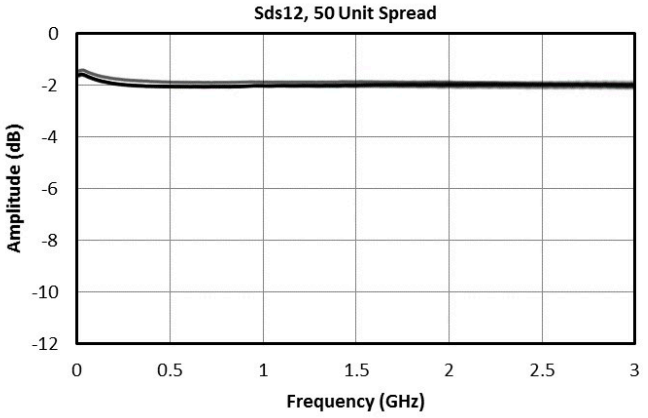


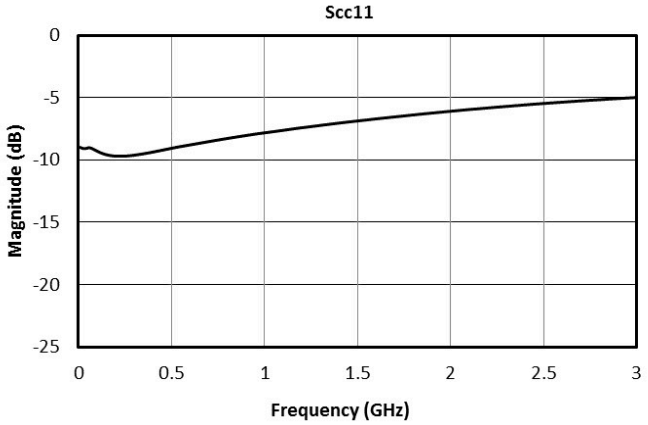


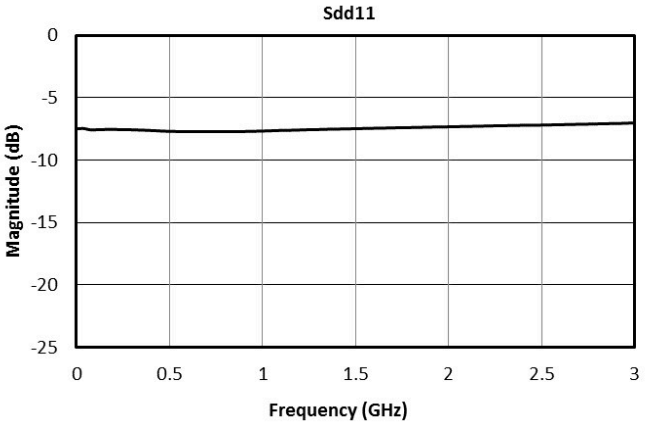
Mixed Mode Scattering Parameters

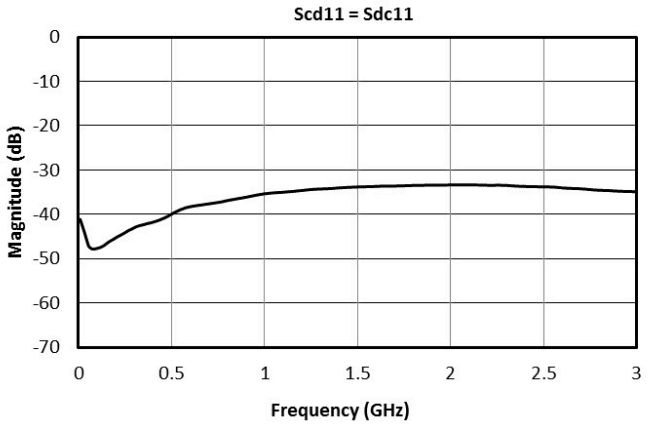
Mixed mode scattering parameters are used to characterize differential circuits. For baluns, this means that the 0° and 180° ports become a single 100Ω differential port and the common port remains the same 50Ω common port. The two-port s-parameters of the balun are then characterized based on differential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

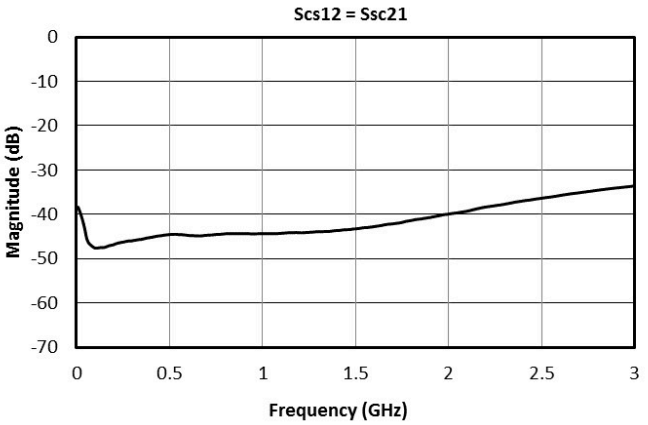


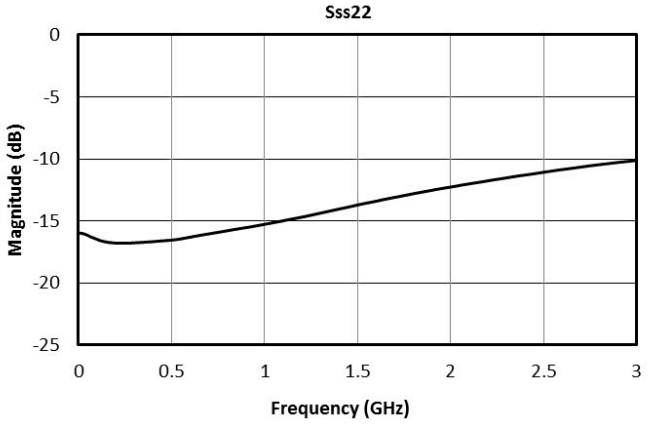


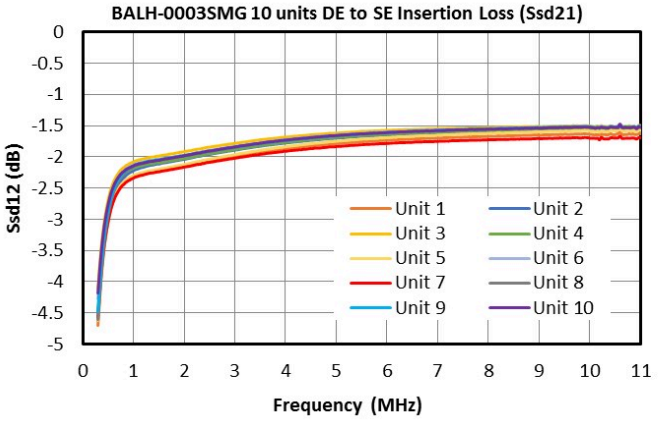






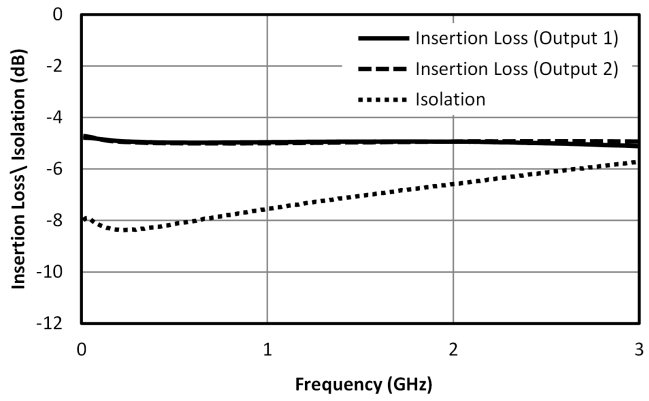


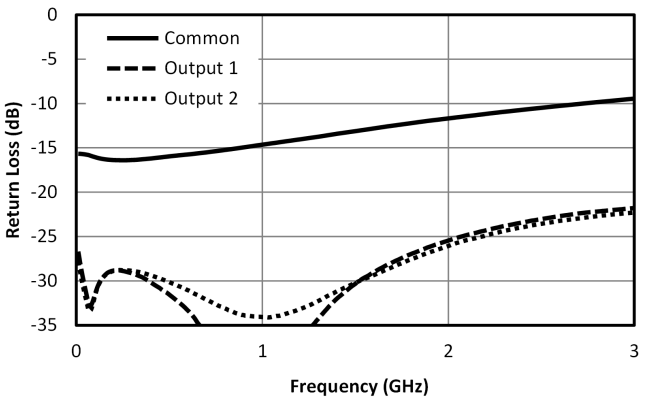


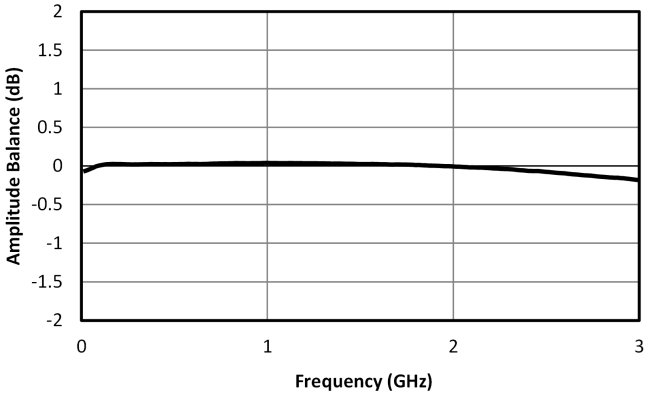


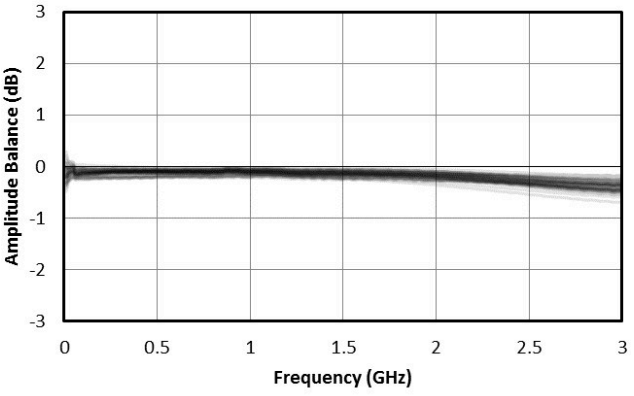
Typical Performance Scattering Parameters

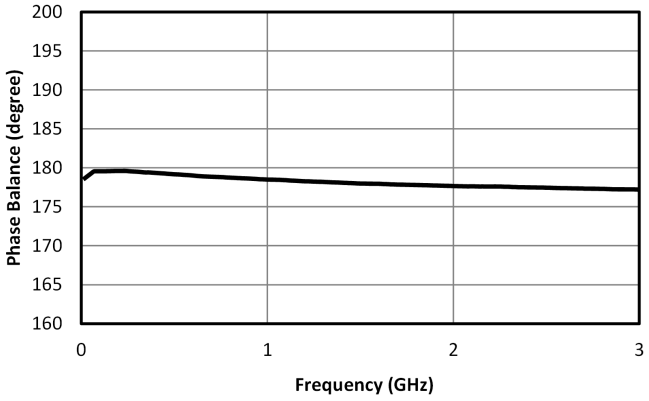
Three port scattering parameters measured as three single-ended 50Ω ports showing relationship between any two ports. For example: S21 and S31, often referred to as insertion loss of a balun, is the output response on ports 2 and 3 with an input stimulus on port 1.

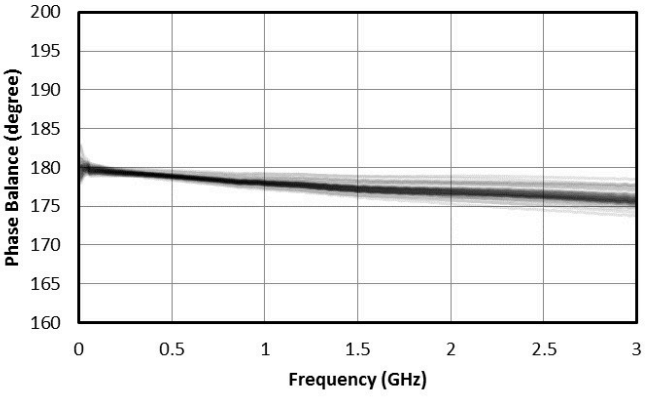


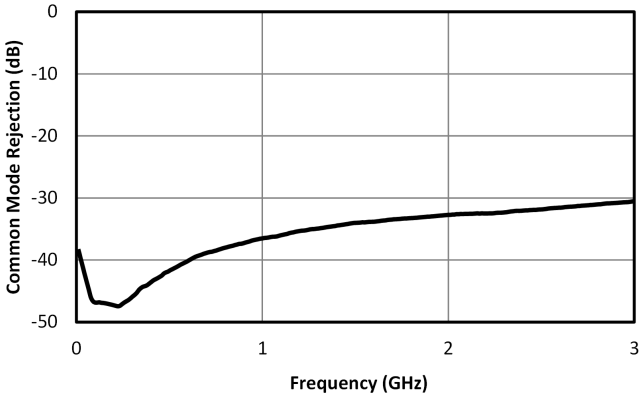


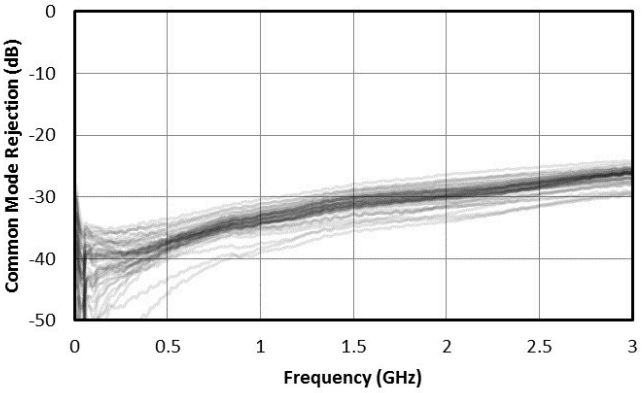


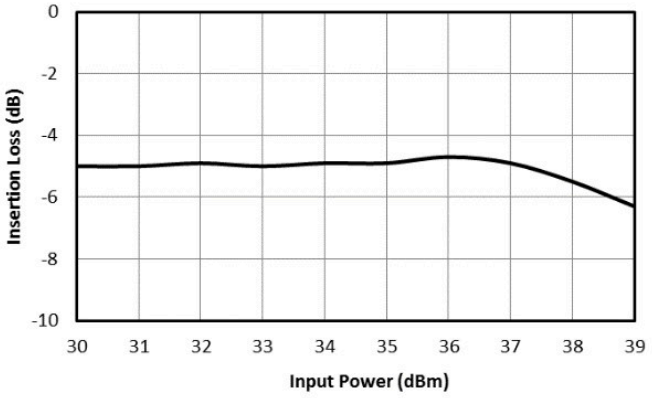








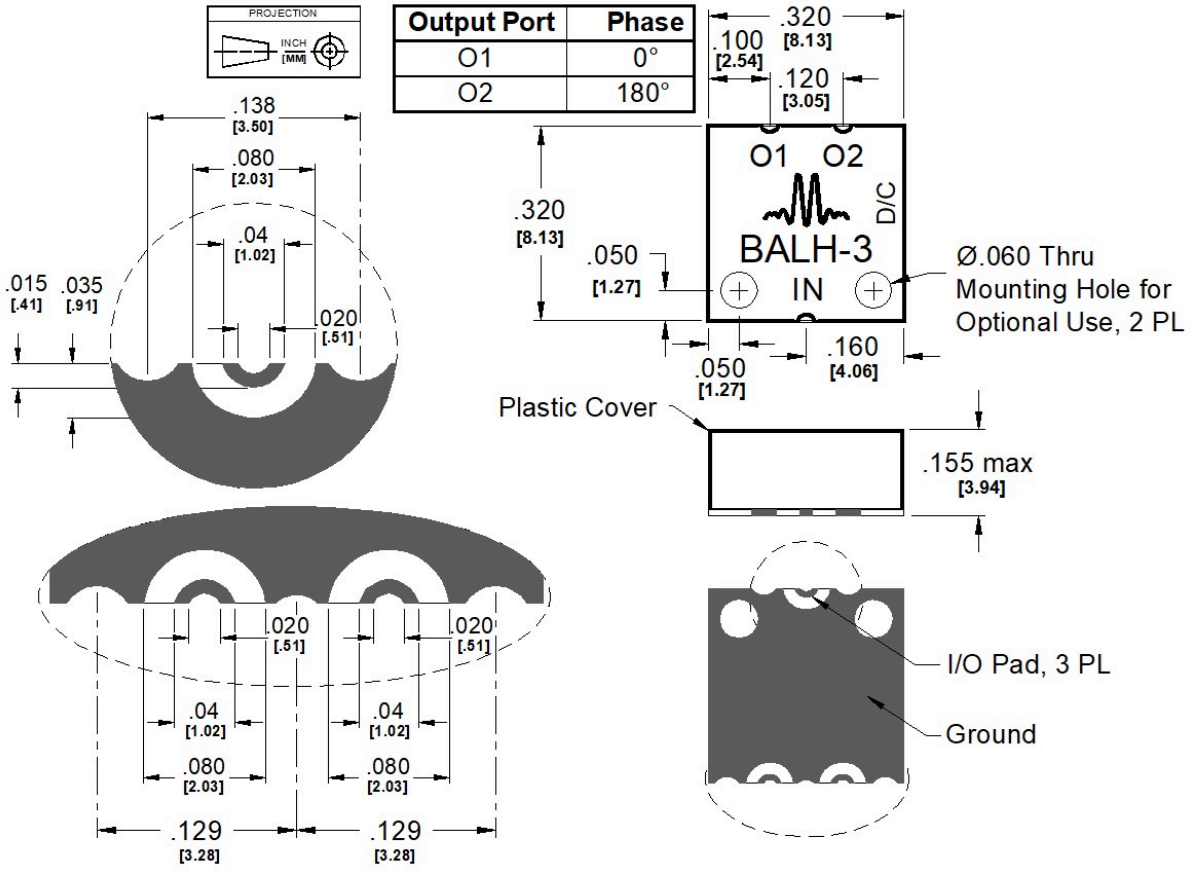




Mechanical Data

Outline Drawing

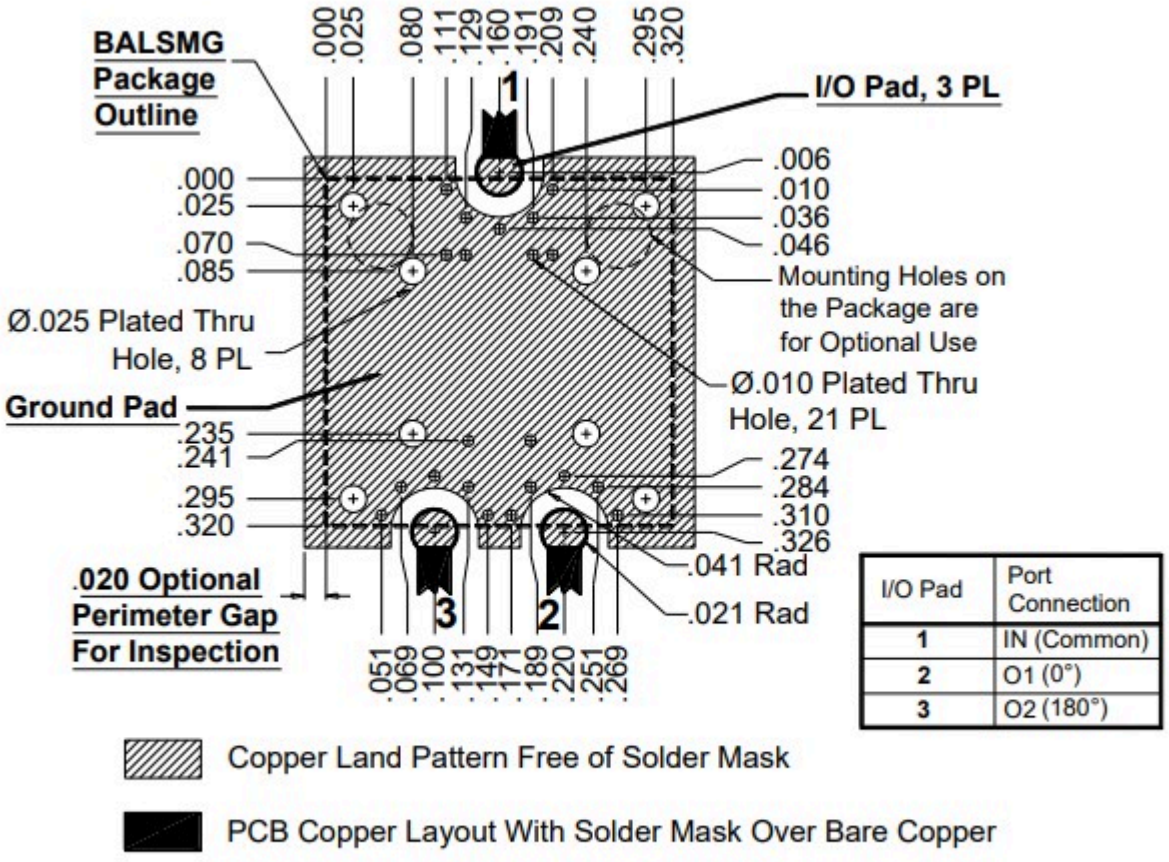
Download : Outline 2D Drawing | Outline 3D Drawing | Outline 3D STP



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 µ-inches, over Cu.

Footprint Image

Download : Footprint Drawing



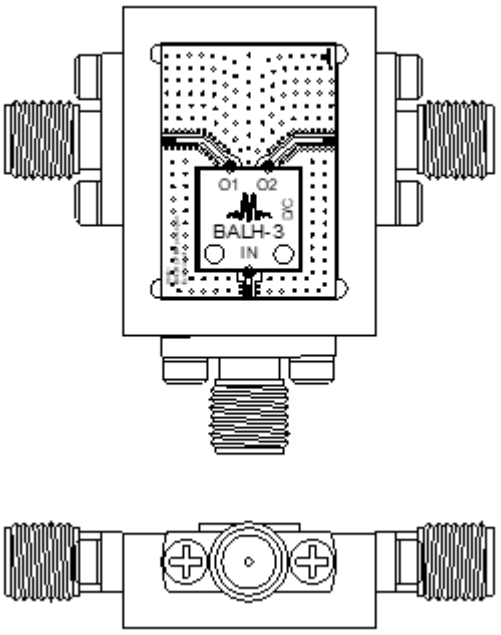
I/O Pad	Port Connection
1	IN (Common)
2	O1 (0°)
3	O2 (180°)

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