

BAL-0009SMG

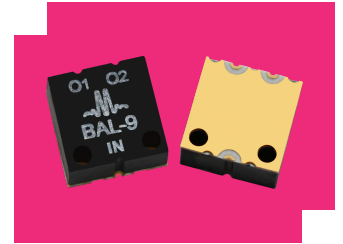
SURFACE MOUNT BROADBAND BALUN

DEVICE OVERVIEW

General Description

The BAL-0009SMG is a broadband surface mount balun, hand-tuned for optimal phase and amplitude balance over a 500 kHz to 9 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](#)



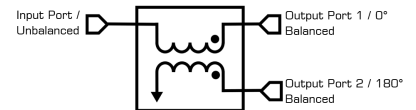
Features

- 2:1 Impedance Ratio
- 500 kHz to 9 GHz Balun (Balanced to Unbalanced Transformer)
- Transforms 50 Ω Input to 100 Ω Differential (50 Ohm Single) Output
- Tuned for Optimal Phase/Amplitude Balance

Applications

- Analog to Digital Converters
- Balanced Receivers
- Baseband Digital Modulation
- Signal Integrity

Functional Block Diagram



Part Ordering Options

Part Number	Description	Package	Packing Size	Green Status	Product Lifecycle	Export Classification
BAL-0009SMG	SURFACE MOUNT BROADBAND BALUN	SMG	-	REACH RoHS	Released	EAR99
EVAL-BAL-0009	Evaluation Board, High Power 0.0005 - 9 GHz Broadband Balun	EVAL	-	Consult Factory	Released	EAR99
BAL-0009SMG-TR	Tape and Reel, SURFACE MOUNT BROADBAND BALUN	SMG	13"	REACH RoHS	Released	EAR99

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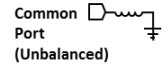
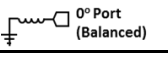
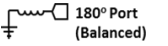
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Revision History

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	Update Specs table & low frequency Ssd21 plot added
E	2020-10-01	Update Specs table
F	2022-05-01	Max DC Current update, Ground Plane Finish update
G	2022-11-01	Banded Electrical Specifications Added
H	2023-12-21	Updated Specs table to add sub-banding for certain specifications.

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
RF Power Handling	1	W

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

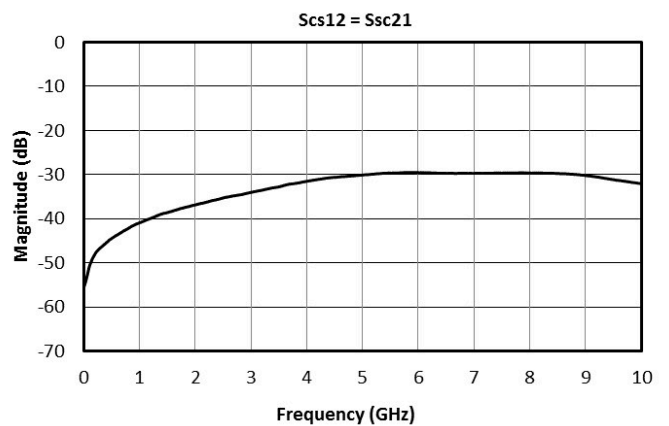
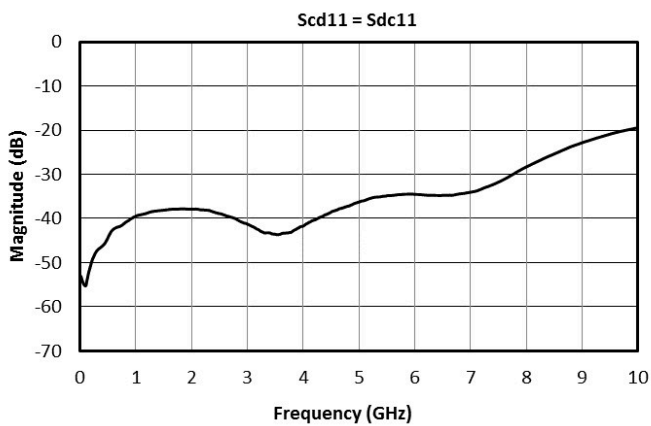
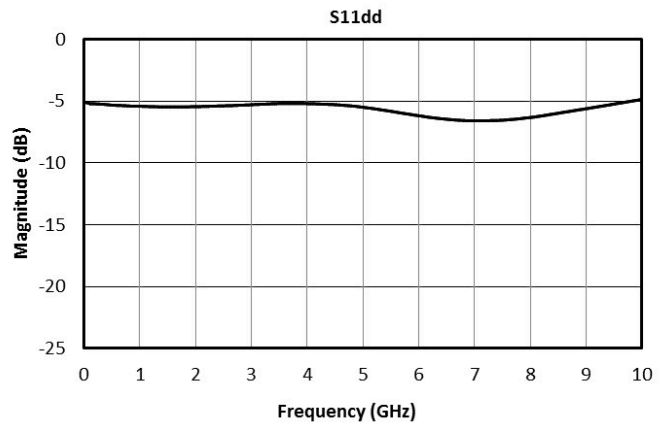
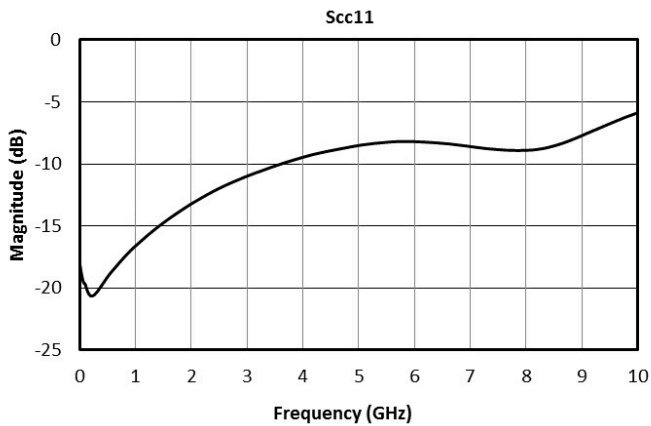
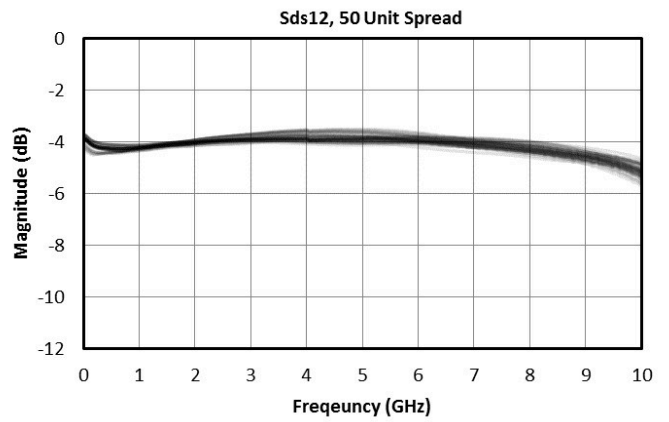
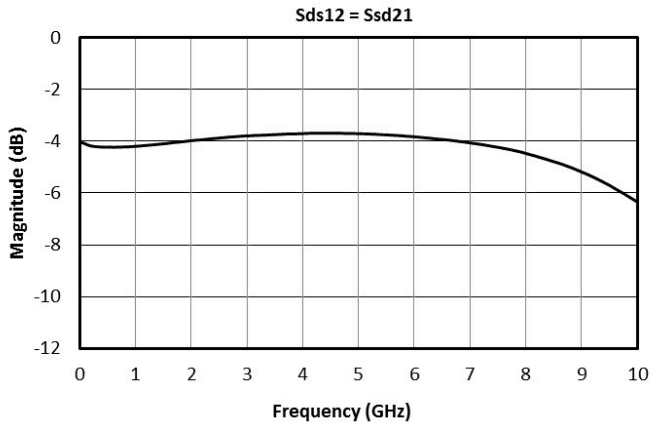
The electrical specifications apply at TA=+25°C in a 50Ω system. Min and Max limits are guaranteed at TA=+25°C.

Parameter	Test Conditions	Minimum Frequency (GHz)	Maximum Frequency (GHz)	Min	Typ	Max	Unit
VSWR	-	0.0005	9	-	1.5	-	
Isolation	-	0.0005	9	-	8	-	dB
Impedance Ratio	-	-	-	-	2:1	-	
Risetime/Falltime ¹	-	0.0005	9	-	16	-	ps
Nominal Phase Shift	-	0.0005	9	-	180	-	°
Amplitude Balance	-	0.0005	0.002	-	0.1	-	dB
Amplitude Balance	-	0.002	0.006	-	0.1	3	dB
Amplitude Balance	-	0.006	9	-	0.6	1.6	dB
Phase Balance	-	0.0005	0.002	-	0.9	-	°
Phase Balance	-	0.002	0.006	-	0.4	12	°
Phase Balance	-	0.006	9	-	5	12	°
Common Mode Rejection	-	0.0005	0.002	-	39	-	dB
Common Mode Rejection	-	0.002	0.006	16	45	-	dB
Common Mode Rejection	-	0.006	9	18	26	-	dB
Insertion Loss as a Mode Converter	-	0.0005	0.002	-	3.9	-	dB
Insertion Loss as a Mode Converter	-	0.002	0.006	-	3.8	6.5	dB
Insertion Loss as a Mode Converter	-	0.006	9	-	4.5	6.5	dB

^[1] Specified as 90%/10%. Calculated from $\text{Tau}_{\text{balun}}^2 = (\text{Tau}_{\text{out}}^2 - \text{Tau}_{\text{in}}^2)$

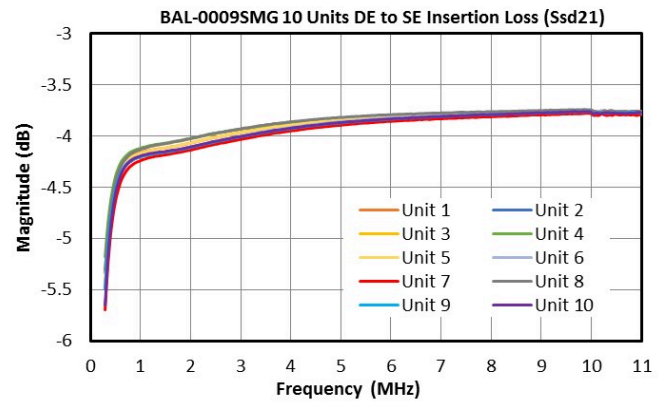
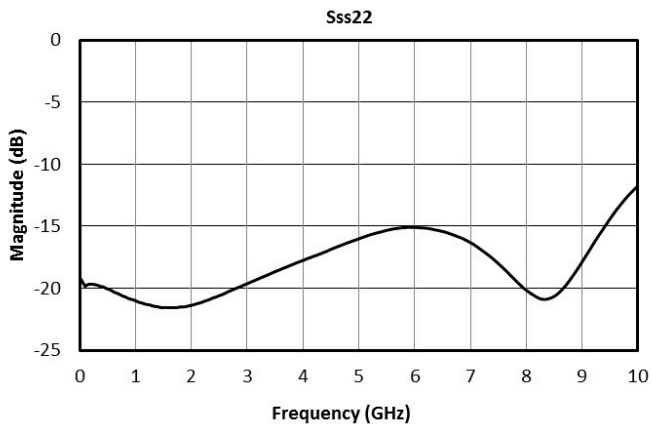
Mixed Mode Scattering Parameters

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.



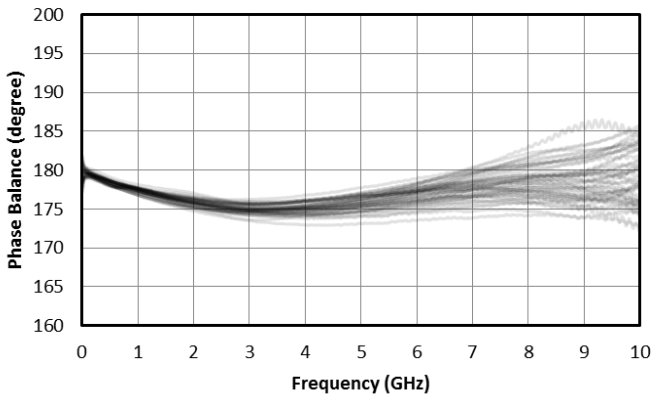
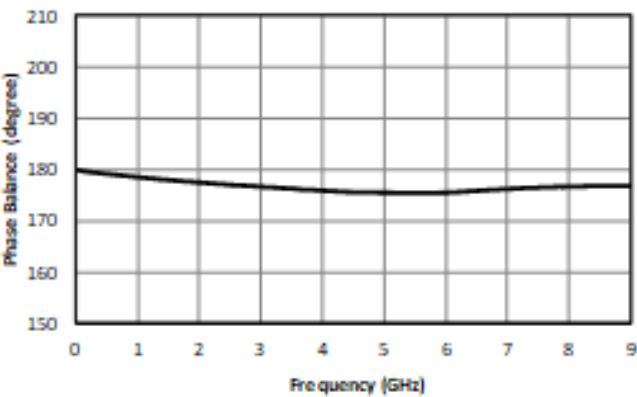
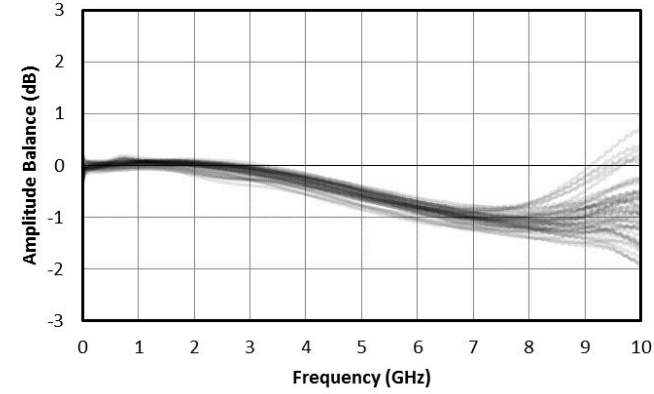
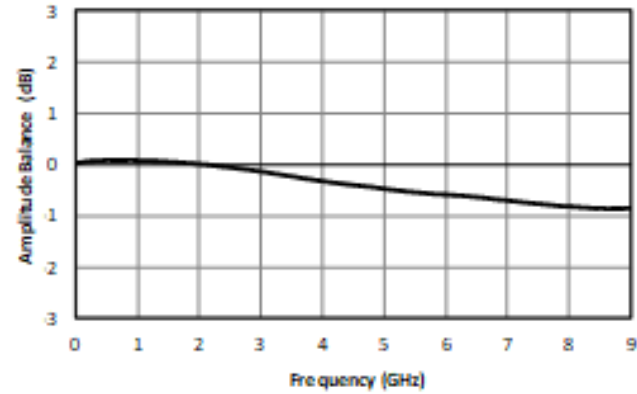
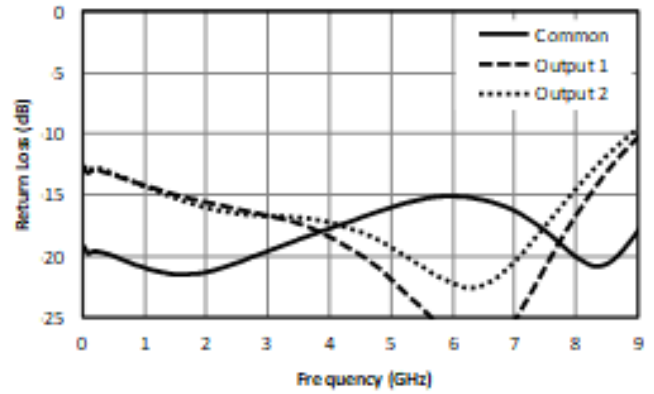
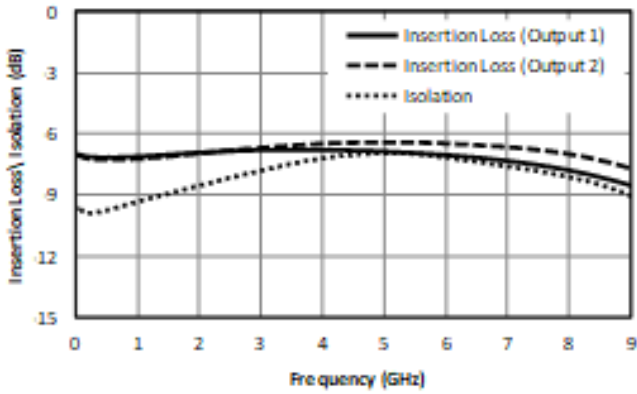
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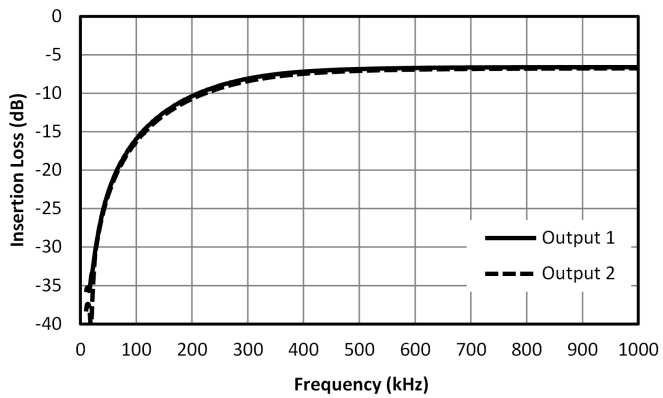
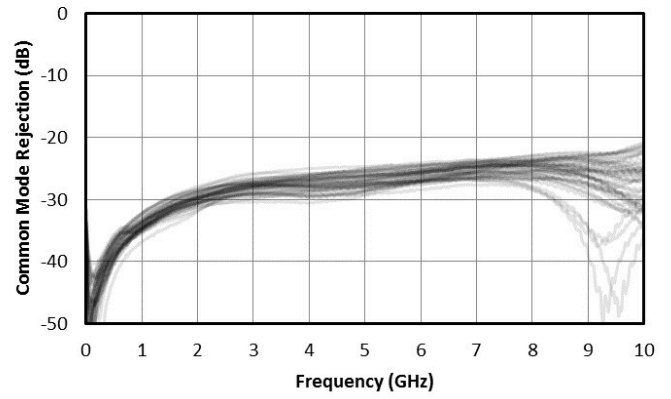
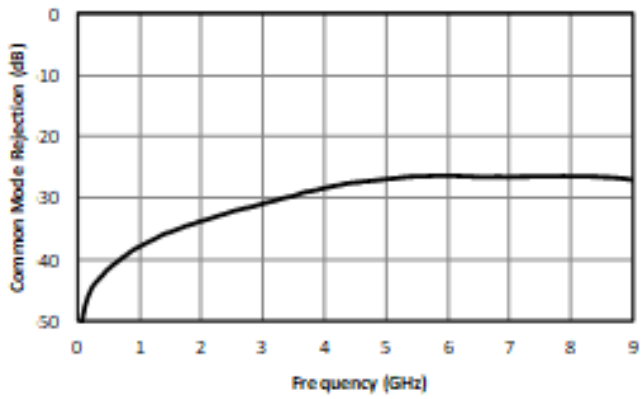
Typical Performance Scattering Parameters

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.



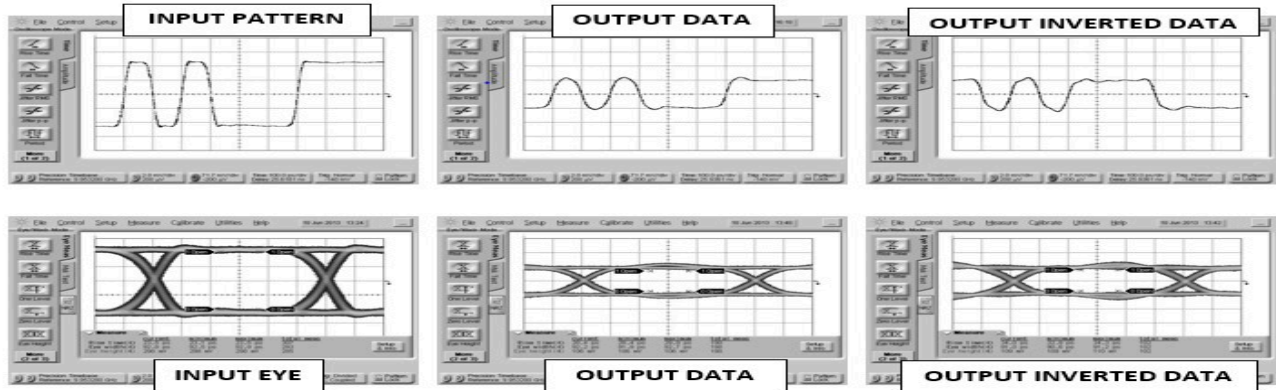
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Time Domain Performance Plots

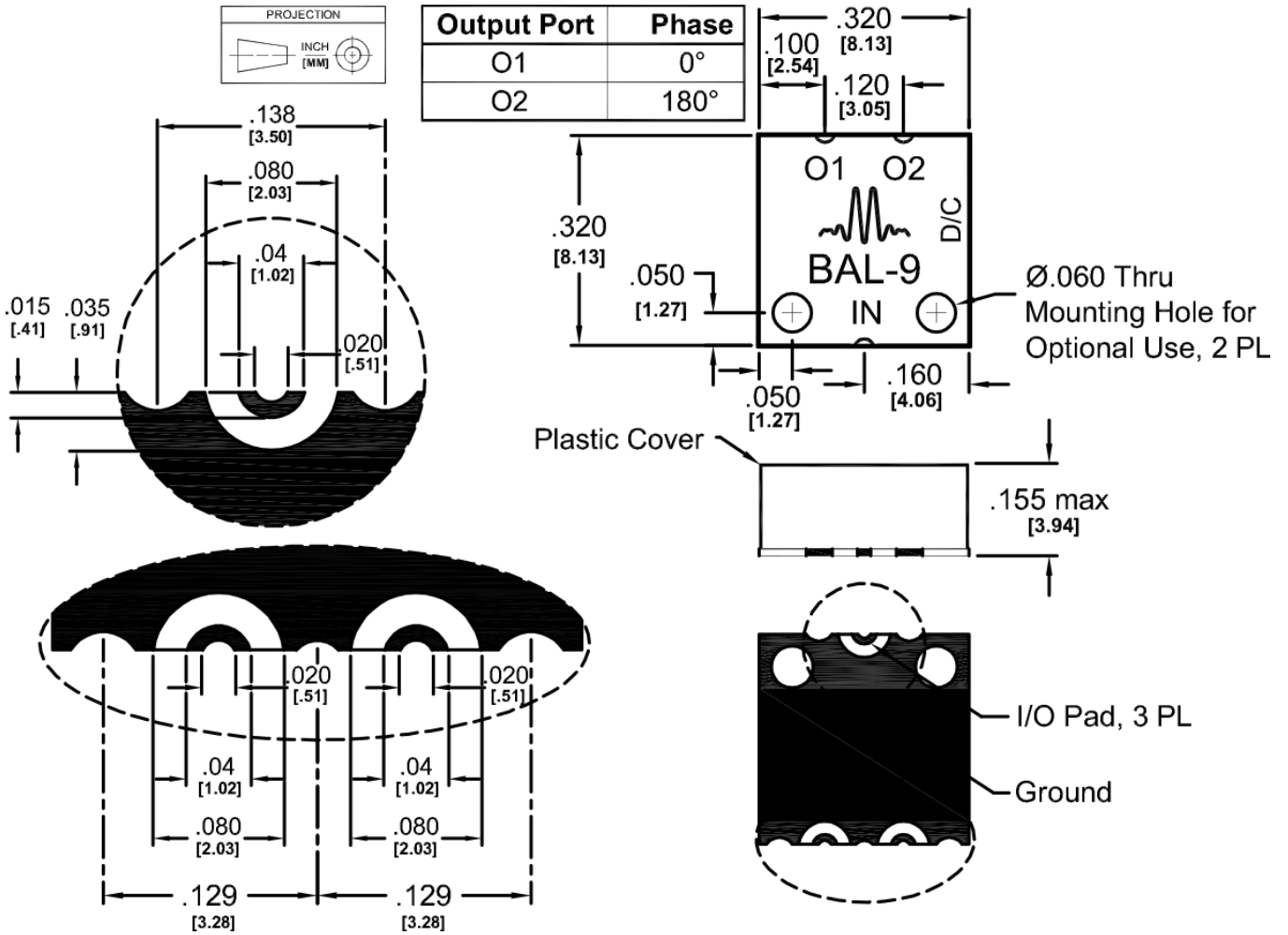
Oscilloscope measurements of the BAL-0009SMG with a 10 Gb/s PRBS pattern. Bit pattern is measured with a 27-1 PRBS input demonstrating extremely good pulse fidelity for both inverted and non-inverted output. Eye diagrams are taken with a 231-1 PRBS input demonstrating minimal eye distortion/closure afforded by the extremely low frequency operation of the balun (<500 kHz)



Mechanical Data

Outline Drawing

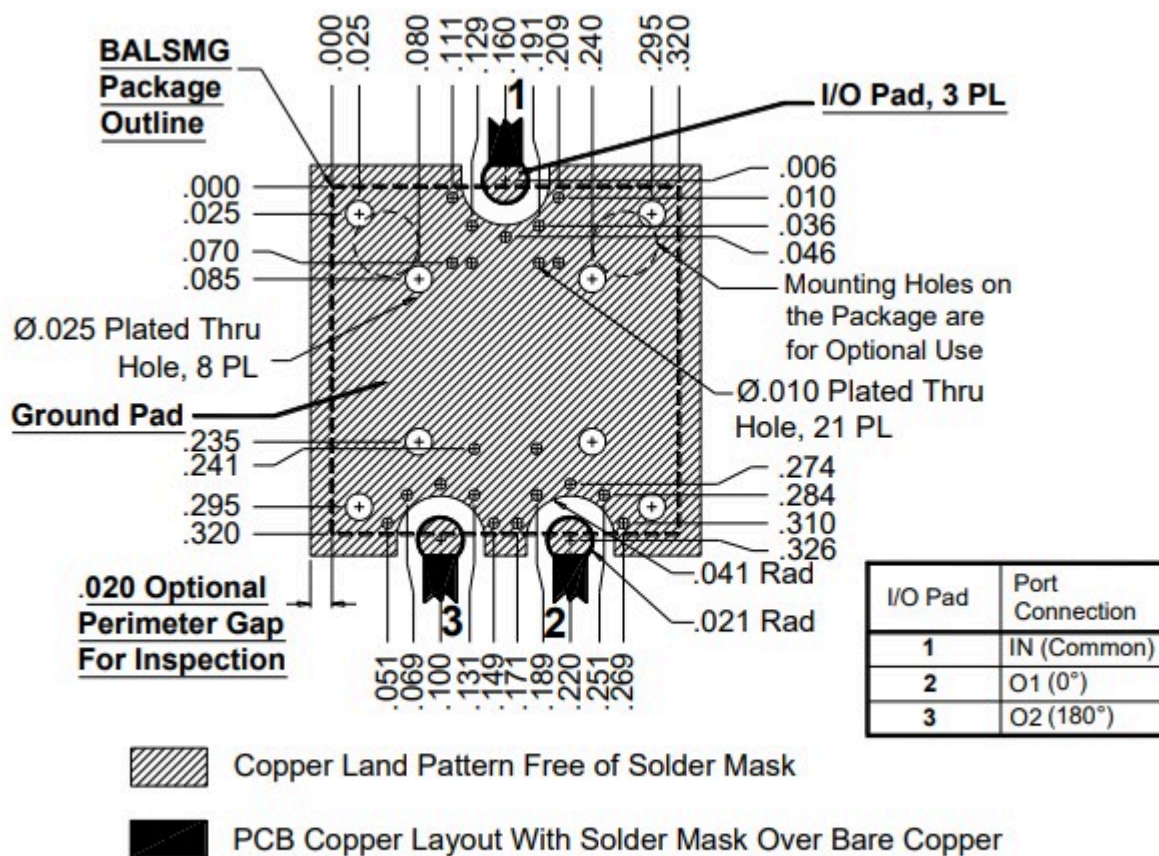
Download : [Outline 2D Drawing](#) | [Outline 3D Drawing](#) | [Outline 3D STP](#)



Substrate material is 8-mil thick Rogers 4003, 1 Oz Electrodeposited Cu. I/O Pads & Ground Plane Finish is Gold Flash, 5 to 10 microns, over Electroplated Nickel, 100-200 μ-inches, 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	-	-	-	2	-	

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