

# BALH-0009SMG

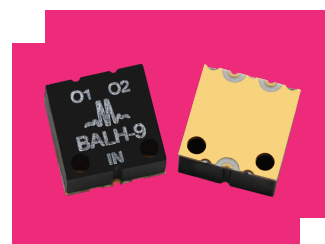
## HIGH POWER SURFACE-MOUNT BALUN

### DEVICE OVERVIEW

#### General Description

The BALH-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](#)



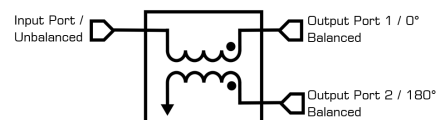
#### Features

- 500 kHz to 9 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-0009SMG          | HIGH POWER SURFACE-MOUNT BALUN                   | SMG     | REACH<br>RoHS                    | Released          | EAR99                 |
| <u>EVAL-BALH-0009</u> | Evaluation Board, High Power Surface-Mount Balun | EVAL    | <u>Consult</u><br><u>Factory</u> | Released          | EAR99                 |

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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 update, Ground Plane Finish Update                                               |
| G             | 2022-08-01    | Over Temperature Performance Plots Added                                                        |
| H             | 2022-11-01    | Banded Electrical Specifications Added                                                          |
| I             | 2024-03-06    | Updated specs table to add frequency resolution to insertion loss, balance and rejection specs. |

**Specifications**

**Absolute Maximum Ratings**

| Parameter         | Maximum Rating | Unit |
|-------------------|----------------|------|
| RF Power Handling | 33             | dBm  |

**Package Information**

| Parameter                  | Details | Rating         |
|----------------------------|---------|----------------|
| Dimensions                 | -       | 8.13 x 8.13 mm |
| Moisture Sensitivity Level | -       | MSL 1          |

## Electrical Specifications

Specifications guaranteed from -55 to +100°C, measured in a 50Ω system.

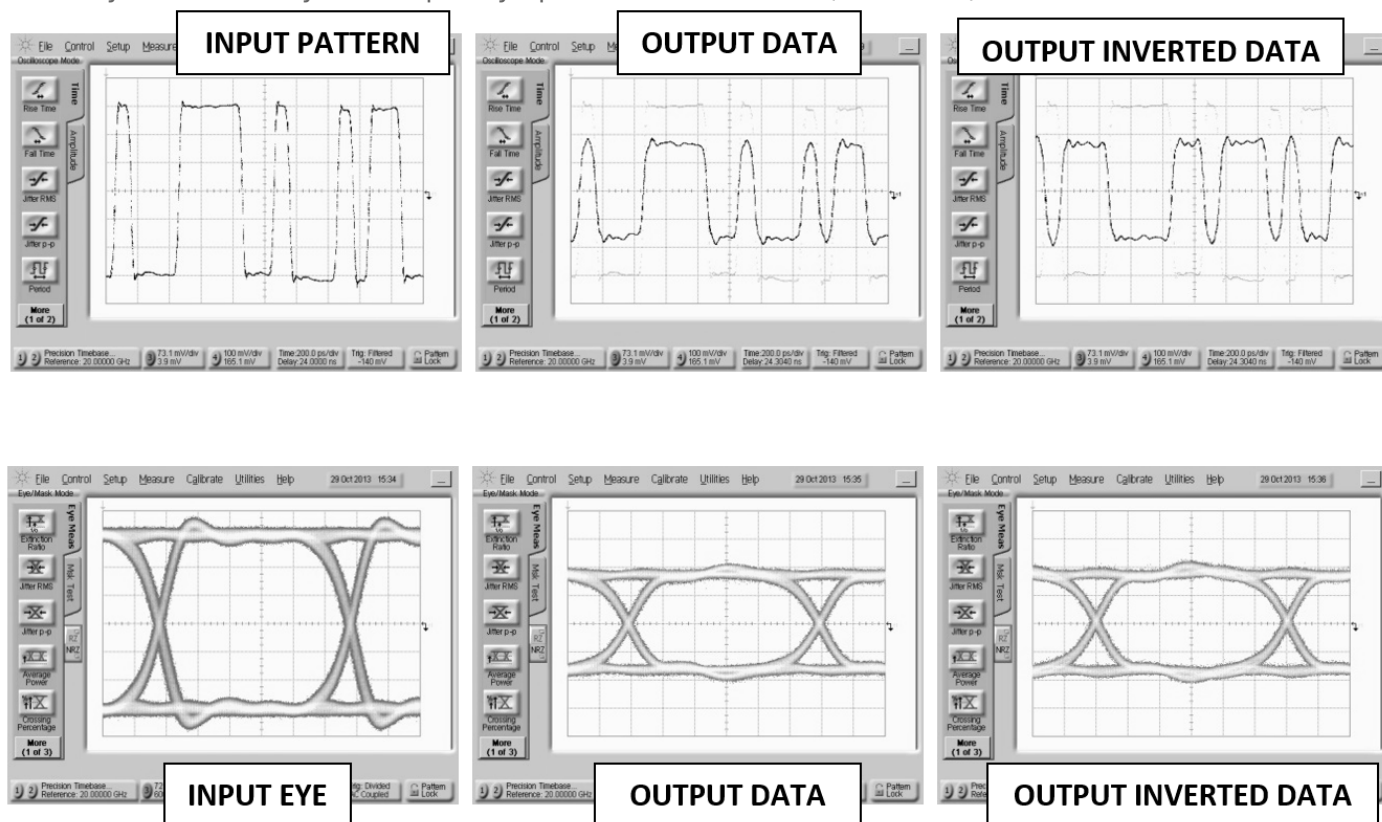
| Parameter                          | Test Conditions | Minimum Frequency (GHz) | Maximum Frequency (GHz) | Min | Typ | Max | Unit |
|------------------------------------|-----------------|-------------------------|-------------------------|-----|-----|-----|------|
| Insertion Loss as a Mode Converter | -               | 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                    | 9                       | -   | 2   | 4   | dB   |
| Nominal Phase Shift                | -               | 0.0005                  | 9                       | -   | 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                    | 9                       | -   | 0.8 | 1.6 | dB   |
| Phase Balance                      | -               | 0.0005                  | 0.002                   | -   | 2.5 | -   | °    |
| Phase Balance                      | -               | 0.002                   | 0.01                    | -   | 2   | 14  | °    |
| Phase Balance                      | -               | 0.01                    | 9                       | -   | 5   | 12  | °    |
| Common Mode Rejection              | -               | 0.0005                  | 0.002                   | -   | 30  | -   | dB   |
| Common Mode Rejection              | -               | 0.002                   | 0.01                    | 13  | 32  | -   | dB   |
| Common Mode Rejection              | -               | 0.01                    | 9                       | 17  | 25  | -   | dB   |
| Isolation                          | -               | 0.0005                  | 3                       | -   | 7   | -   | dB   |
| Isolation                          | -               | 3                       | 9                       | -   | 6   | -   | dB   |
| Input 1 dB Compression             | -               | 0.0005                  | 9                       | -   | 37  | -   | dBm  |
| Input VSWR                         | -               | 0.0005                  | 3                       | -   | 1.6 | -   | -    |
| Output VSWR                        | -               | 0.0005                  | 3                       | -   | 1.1 | -   | -    |
| Risetime/Falltime <sup>1</sup>     | -               | 0.0005                  | 6                       | -   | 22  | -   | ps   |
| Input VSWR                         | -               | 3                       | 9                       | -   | 2.1 | -   | -    |
| Output VSWR                        | -               | 3                       | 6                       | -   | 1.2 | -   | -    |
| Output VSWR                        | -               | 6                       | 9                       | -   | 1.3 | -   | -    |
| Risetime/Falltime <sup>2</sup>     | -               | 6                       | 9                       | -   | 25  | -   | ps   |

<sup>[1]</sup> Specified as 90%/10%. Calculated from  $\text{Tau\_balun}^2 = (\text{Tau\_out}^2 - \text{Tau\_in}^2)$ .

<sup>[2]</sup> Specified as 90%/10%. Calculated from  $\text{Tau\_balun}^2 = (\text{Tau\_out}^2 - \text{Tau\_in}^2)$ .

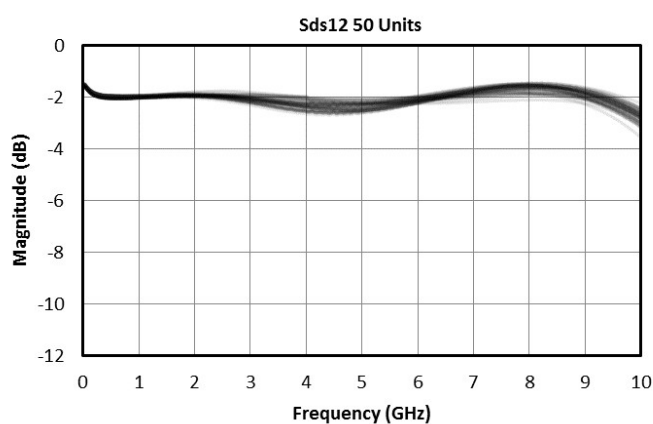
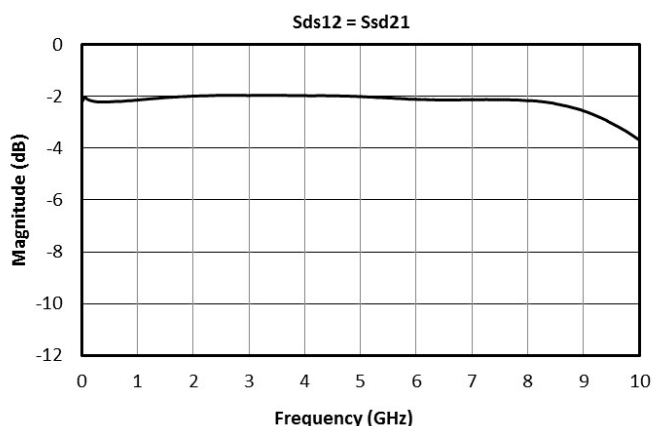
### Time Domain Performance Plots

Oscilloscope measurements of the BALH-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).



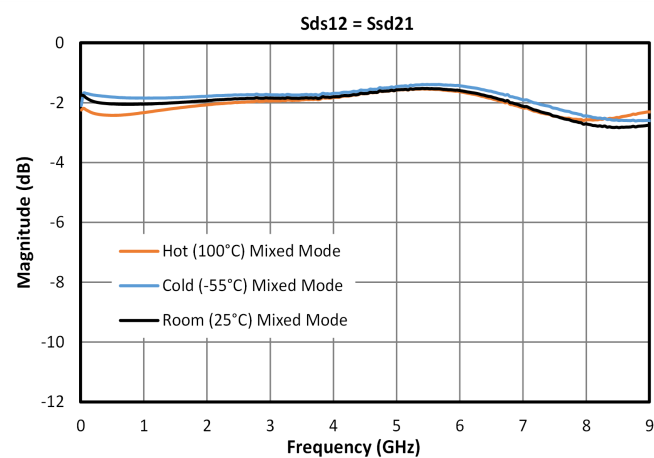
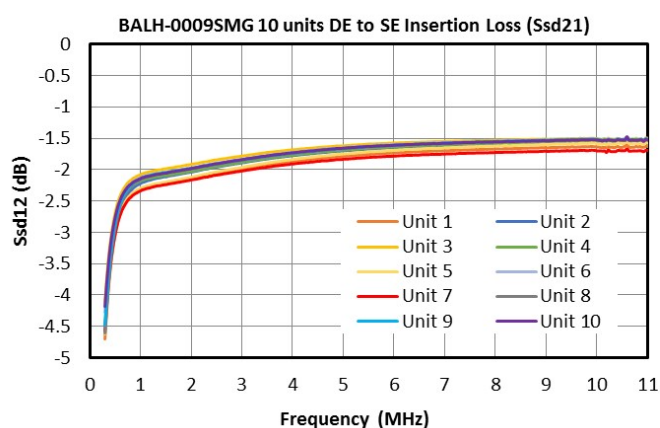
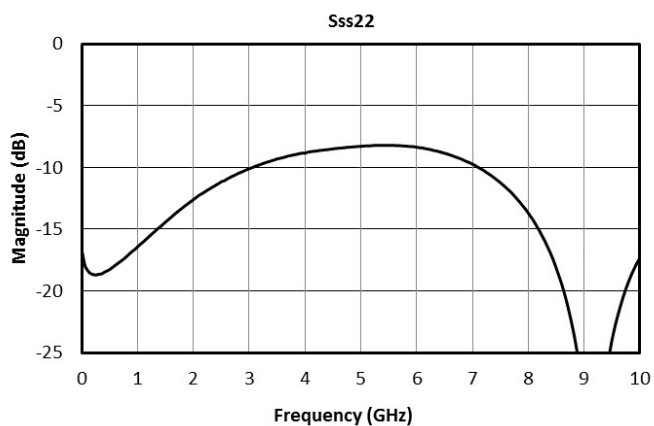
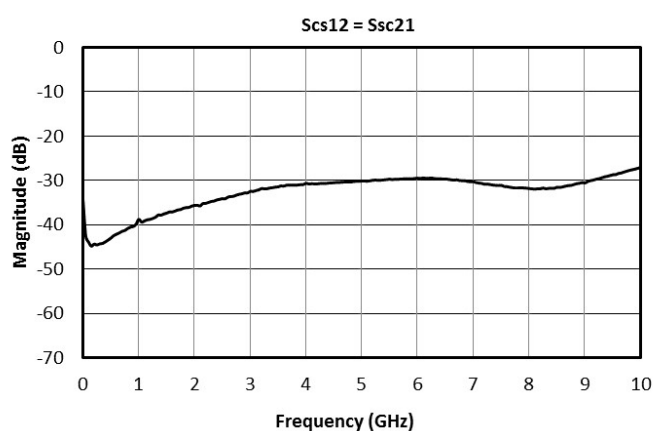
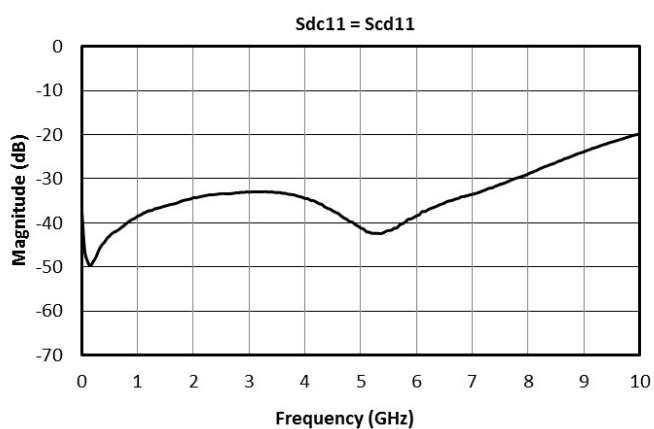
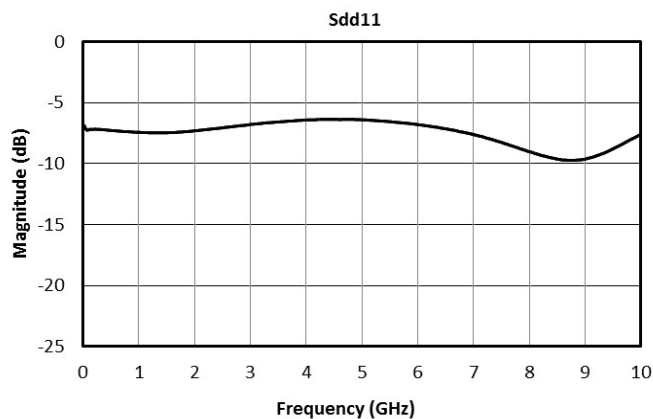
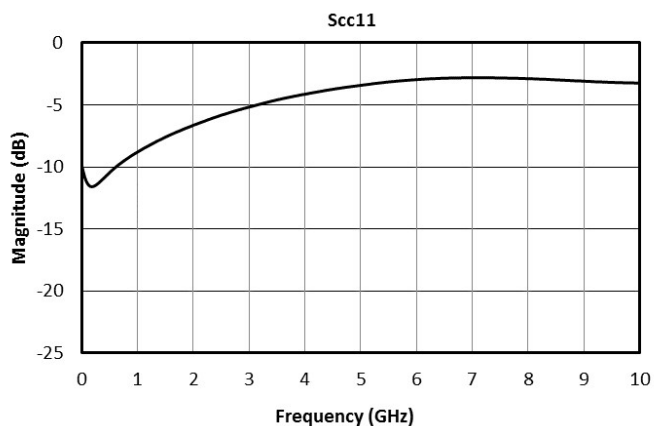
### Mixed Mode Scattering Parameters

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.



## BALH-0009SMG

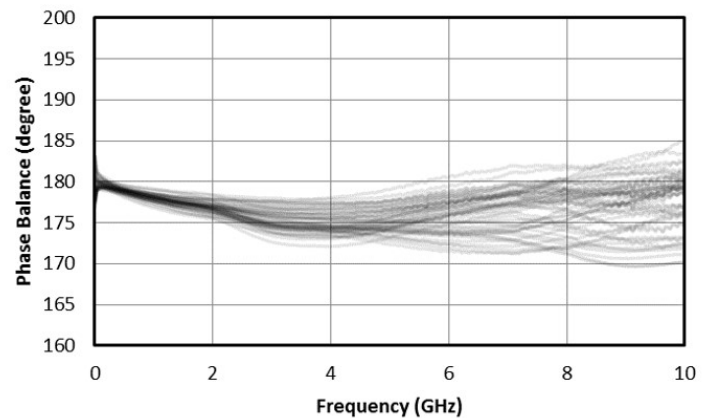
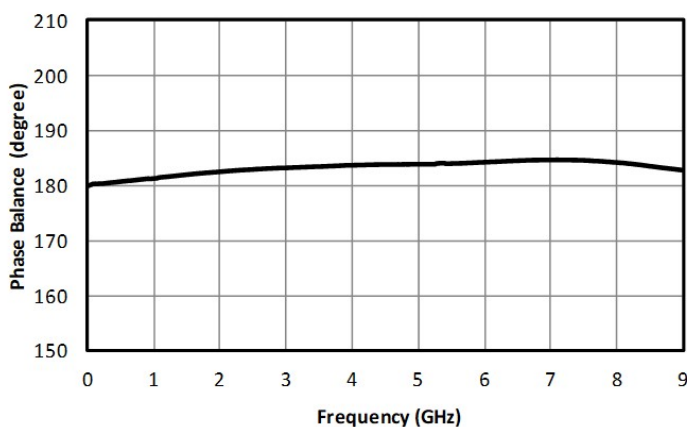
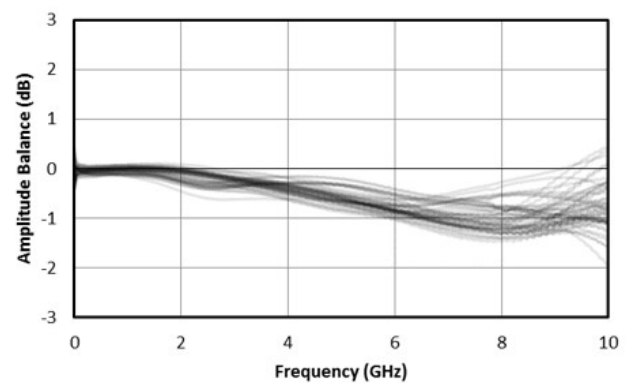
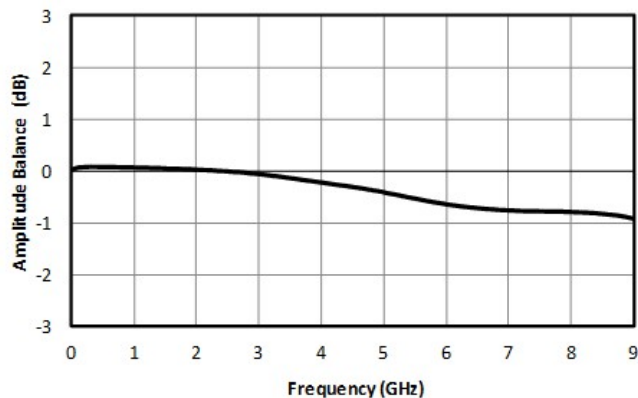
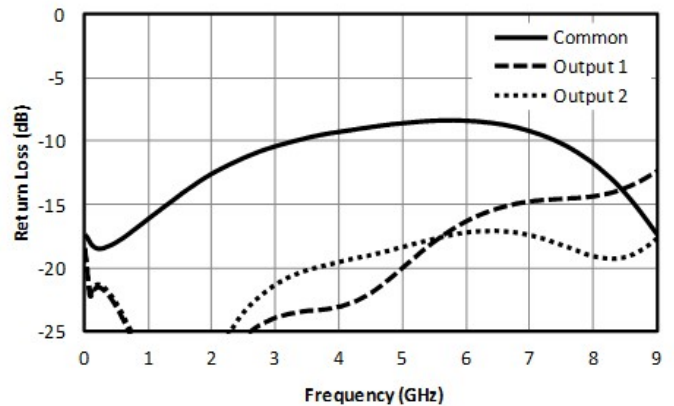
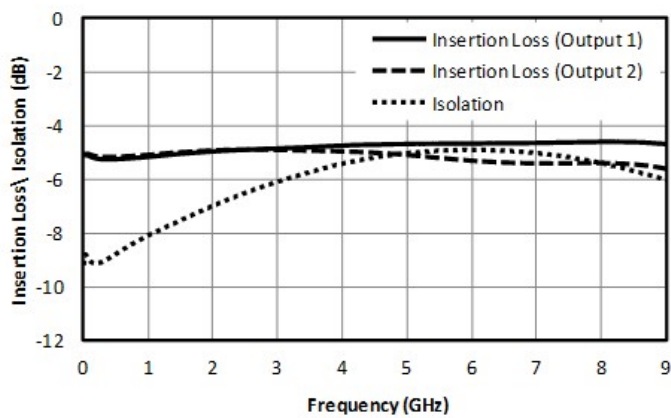
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### Typical Performance Scattering Parameters

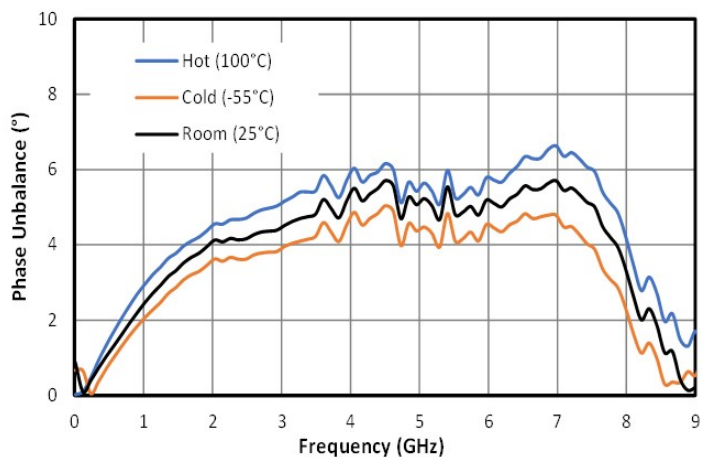
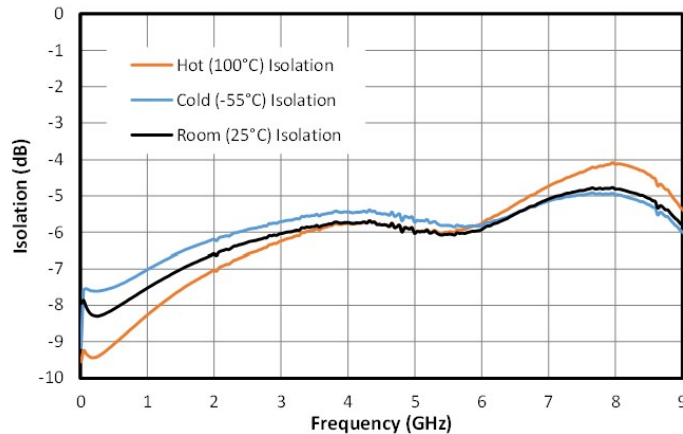
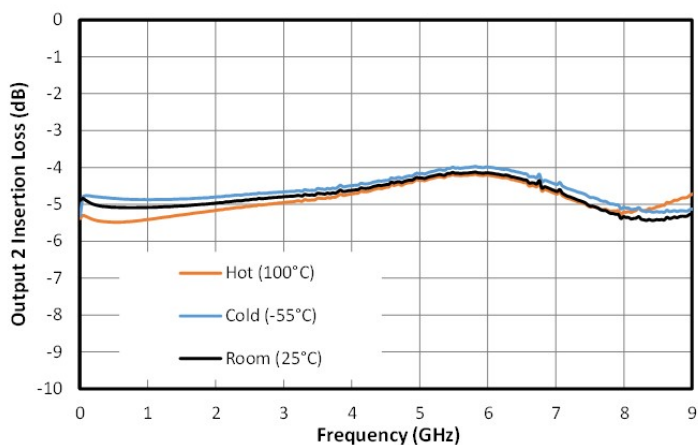
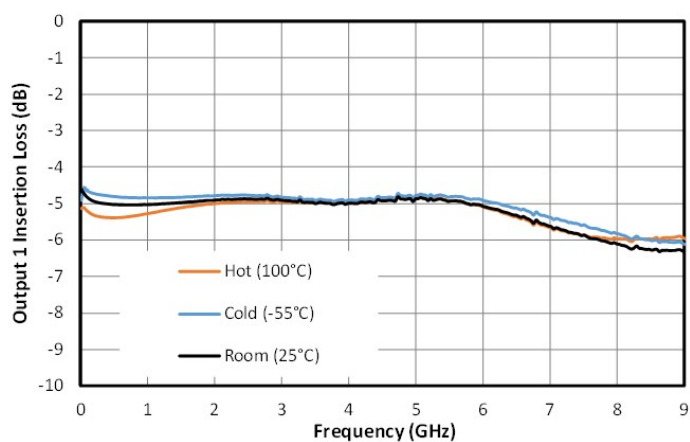
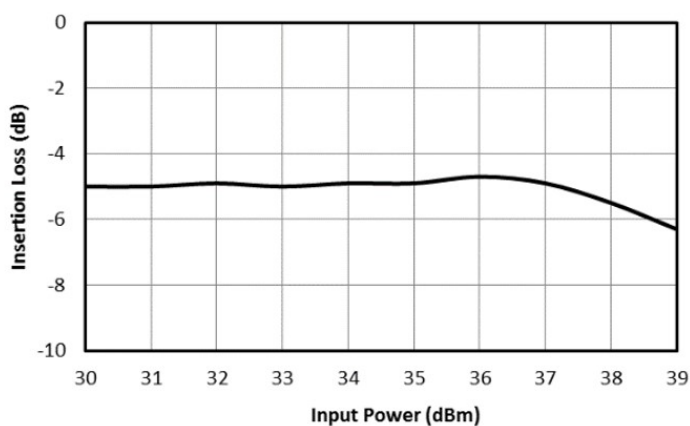
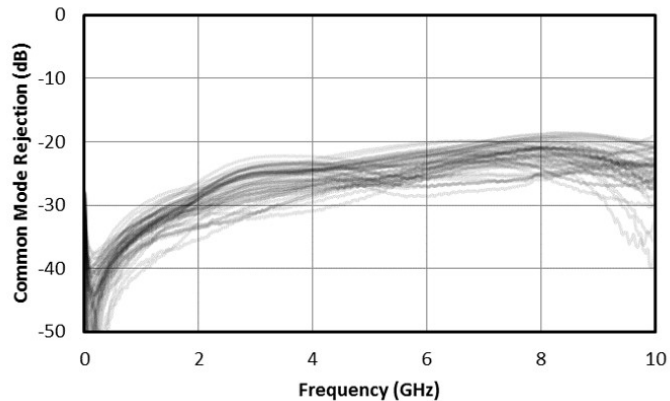
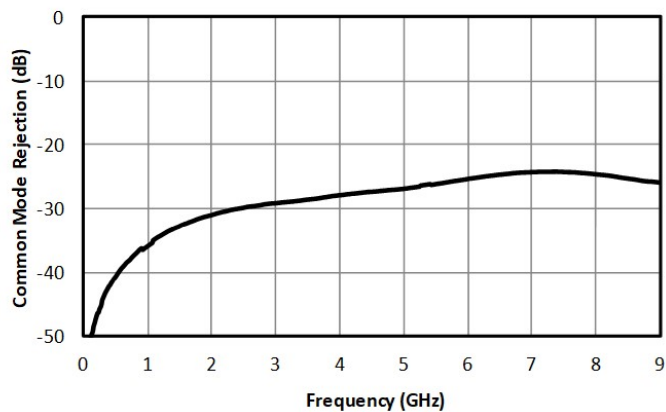
Three port scattering parameters measured as three single-ended 50Ω ports showing relationship between any two ports. For example: S21 and S31, often referred to as insertion loss of a balun, is the output response on ports 2 and 3 with an input stimulus on port 1.

Measured as phase deviation from 180° between output 1 and output 2.



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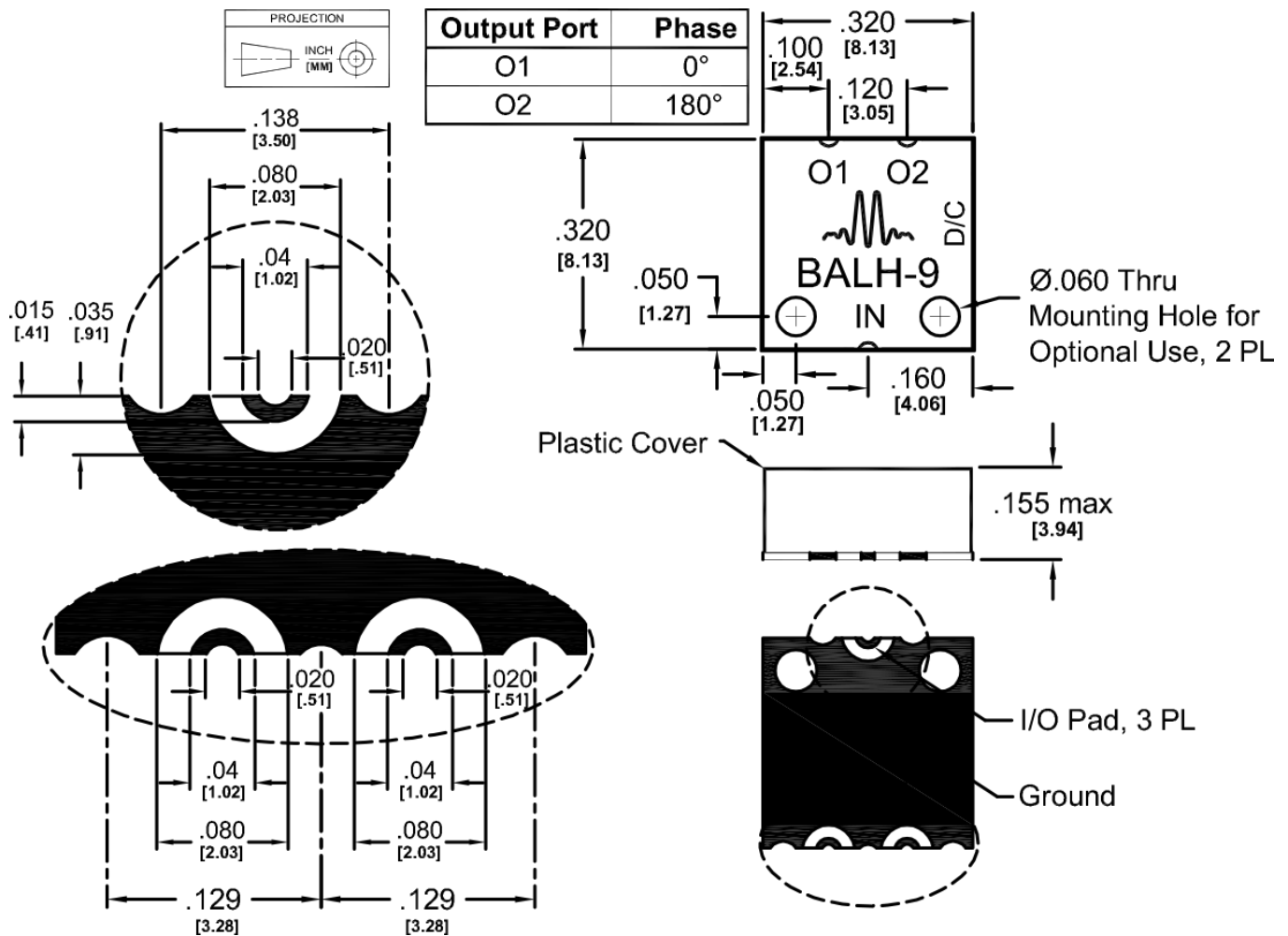
### HIGH POWER SURFACE-MOUNT BALUN



## Mechanical Data

### Outline Drawing

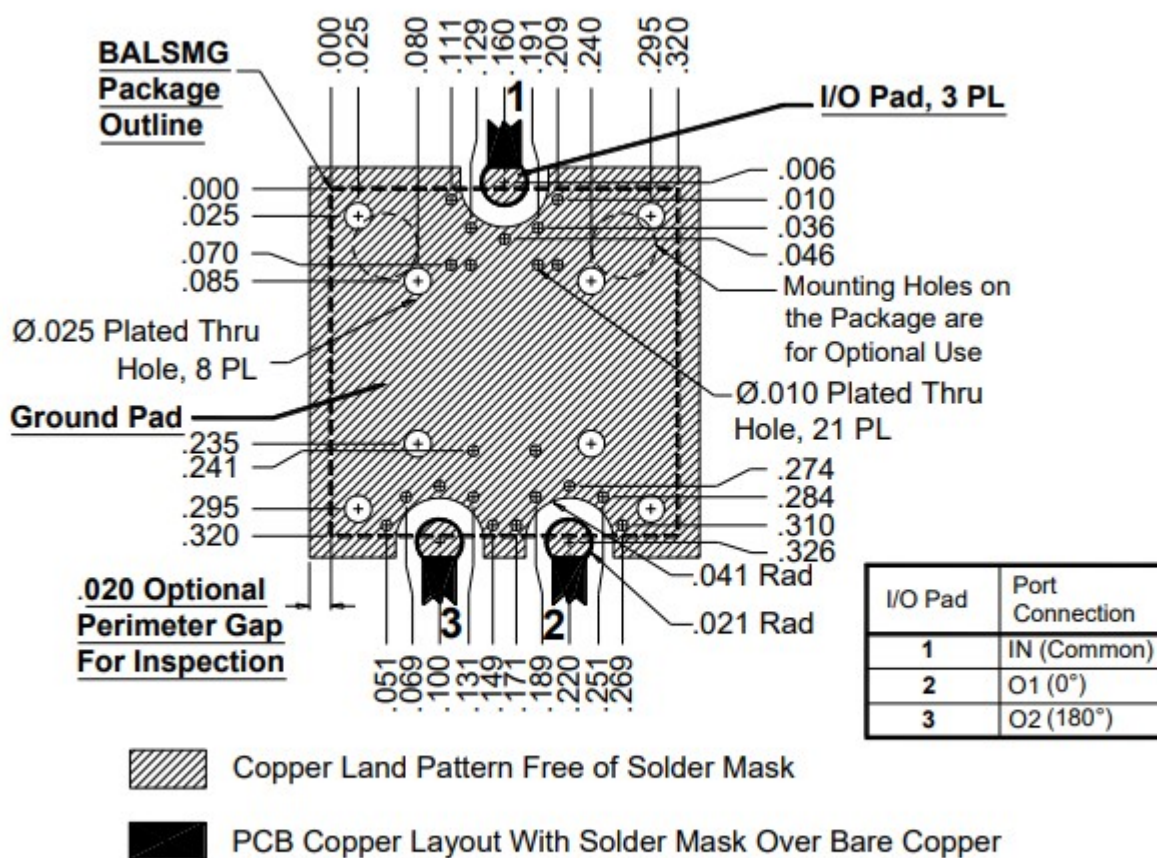
Download : [Outline 2D Drawing](#) | [Outline 3D Drawing](#) | [Outline 3D STP](#)



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

## Footprint Image

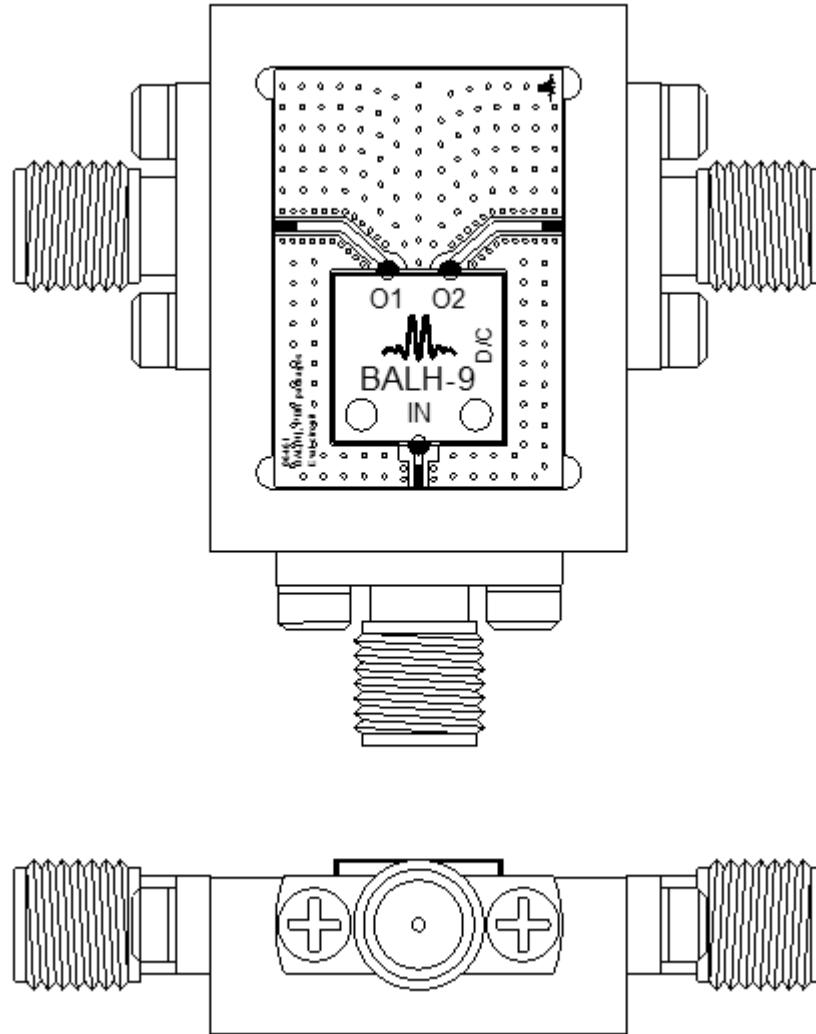
Download : [Footprint Drawing](#)



**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.

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