

# BAL-0009SMG

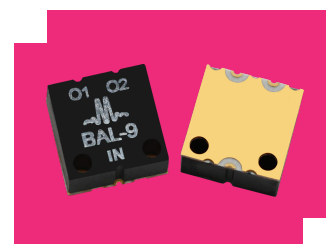
## SURFACE MOUNT BROADBAND BALUN

### 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](#)



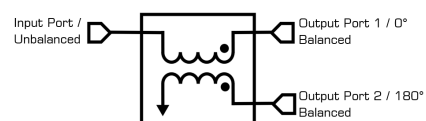
#### Features

- 500 kHz to 9 GHz 1:2 Balun (Balanced to Unbalanced Transformer)
- Transforms 50  $\Omega$  Input to 100  $\Omega$  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     | -            | RoHS         | Released          | EAR99                 |
| <u>EVAL-BAL-0009</u> | Evaluation Board, High Power 0.0005 - 9 GHz Broadband Balun | -       | -            | RoHS         | 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    | 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              |

## Specifications

### Package Information

| Parameter  | Details | Rating         |
|------------|---------|----------------|
| Dimensions | -       | 8.13 x 8.13 mm |

### Electrical Specifications

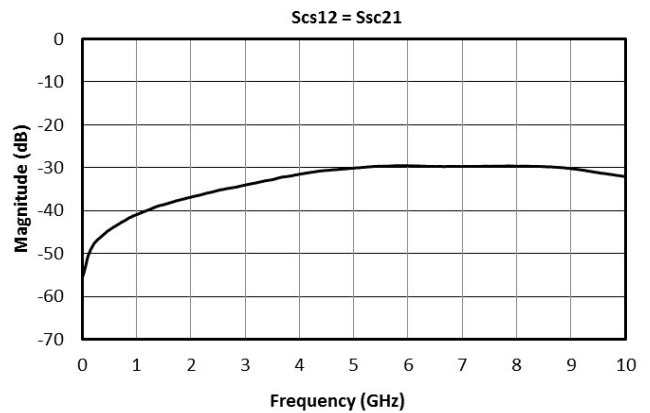
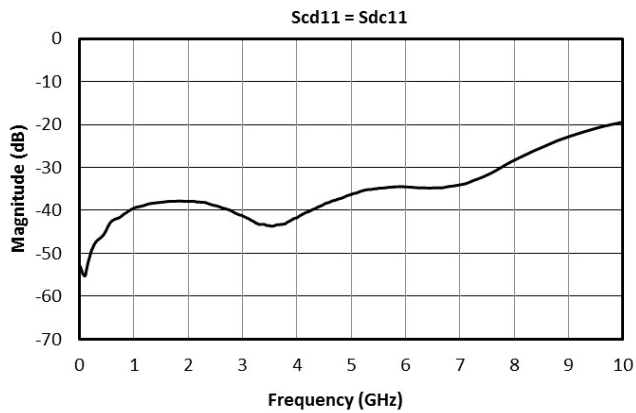
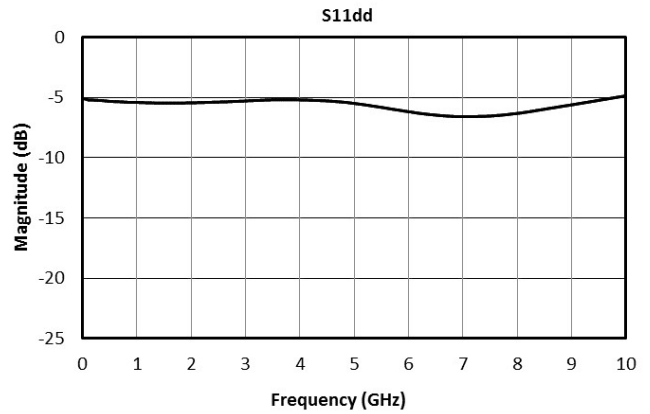
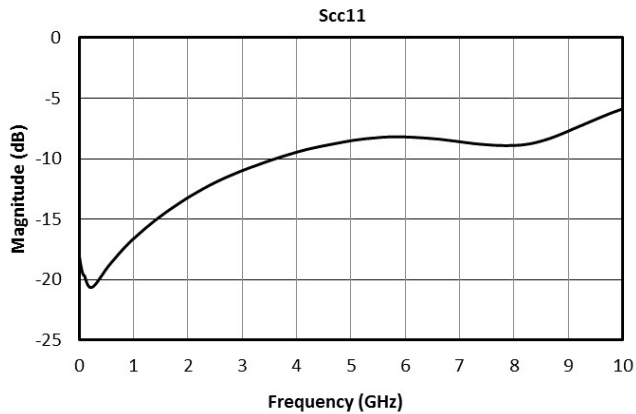
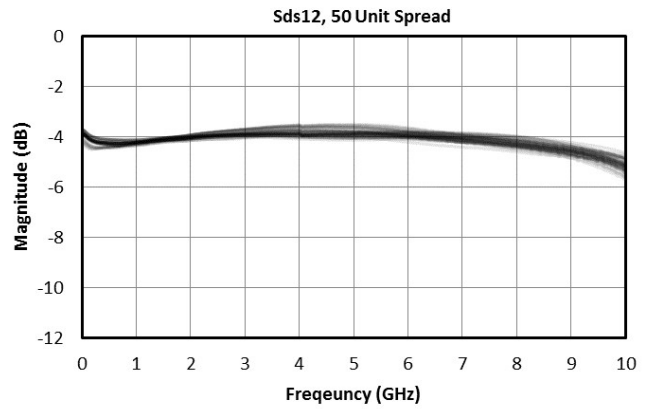
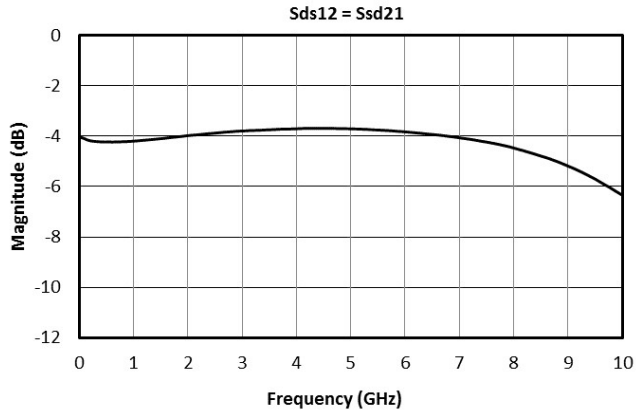
Electrical Specifications - Specifications guaranteed from -55 to +100°C, measured in a 50Ω system.

| Parameter                          | Test Conditions | Minimum Frequency (GHz) | Maximum Frequency (GHz) | Min | Typ | Max | Unit |
|------------------------------------|-----------------|-------------------------|-------------------------|-----|-----|-----|------|
| Insertion Loss as a Mode Converter | -               | 0.0005                  | 9                       | -   | 4.5 | 6.5 | dB   |
| Nominal Phase Shift                | -               | 0.0005                  | 9                       | -   | 180 | -   | °    |
| Amplitude Balance                  | -               | 0.0005                  | 9                       | -   | 0.6 | 1.6 | dB   |
| Phase Balance                      | -               | 0.0005                  | 9                       | -   | 5   | 12  | °    |
| Common Mode Rejection              | -               | 0.0005                  | 9                       | 18  | 26  | -   | dB   |
| Isolation                          | -               | 0.0005                  | 9                       | -   | 8   | -   | dB   |
| VSWR                               | -               | 0.0005                  | 9                       | -   | 1.5 | -   | -    |
| Risetime/Falltime <sup>1</sup>     | -               | 0.0005                  | 9                       | -   | 16  | -   | ps   |
| Total Input Power                  | -               | 0.0005                  | 9                       | -   | -   | 1   | W    |

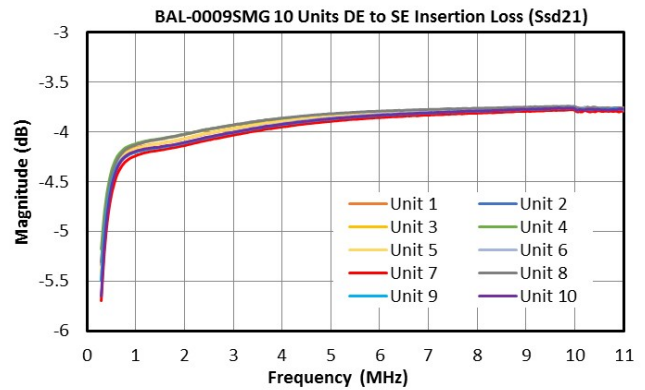
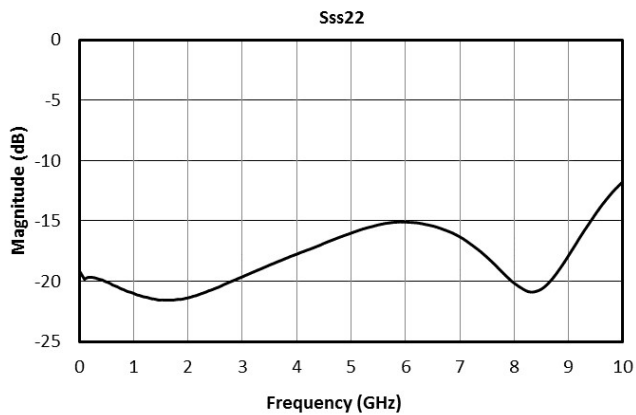
<sup>[1]</sup> Specified as 90%/10%. Calculated from  $\tau_{balun}^2 = (\tau_{out}^2 - \tau_{in}^2)$

## Mixed Mode Scattering Parameters

Mixed mode scattering parameters are used to characterize differential circuits. For baluns, this means that the  $0^\circ$  and  $180^\circ$  ports become a single  $100\Omega$  differential port and the common port remains the same  $50\Omega$  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.

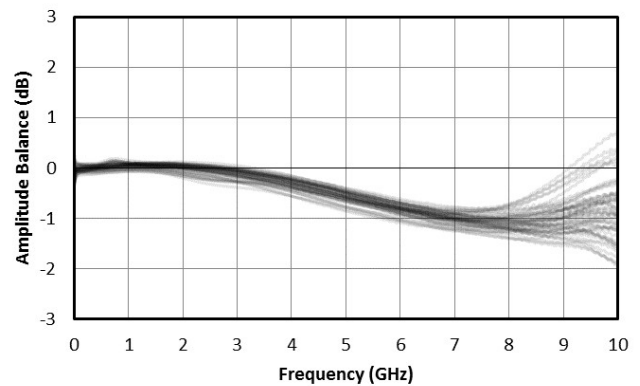
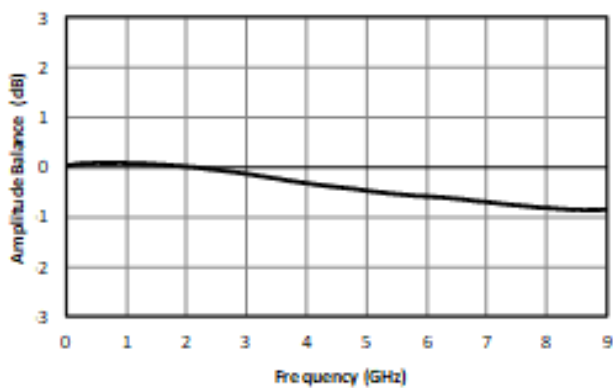
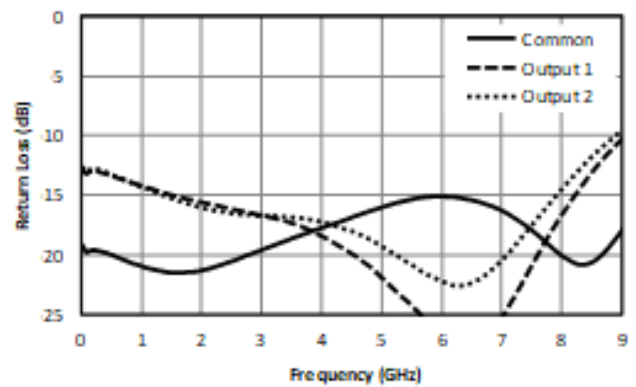
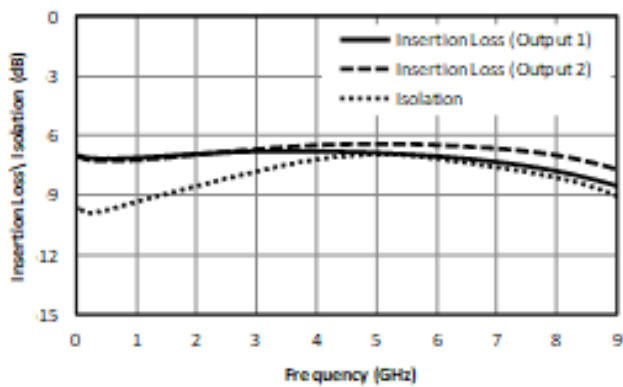


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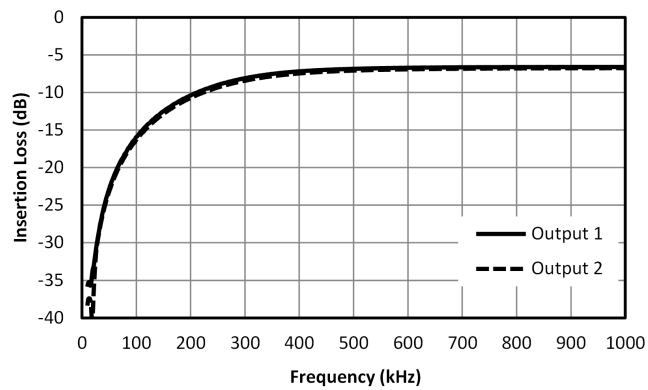
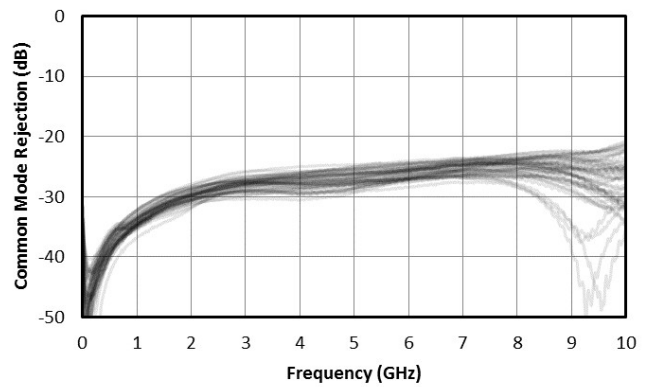
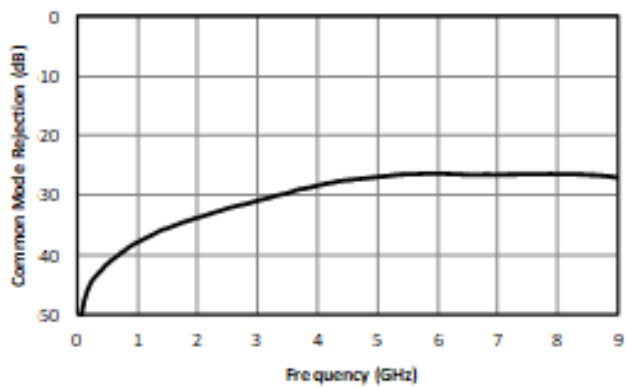
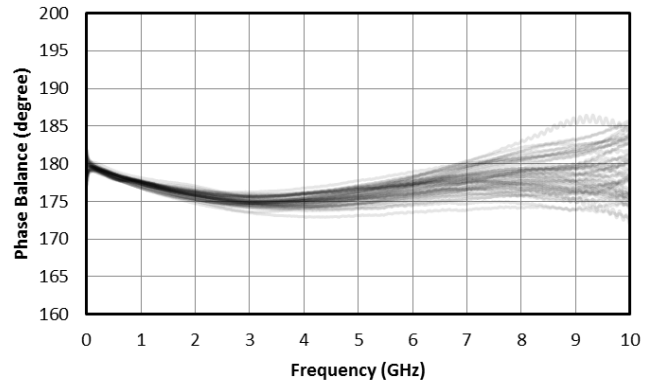
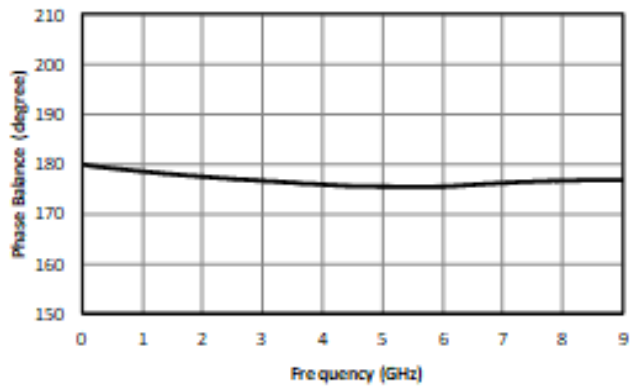


### **Typical Performance Scattering Parameters**

Three port scattering parameters measured as three single-ended 50Ω ports showing relationship between any two ports. For example: S<sub>21</sub> and S<sub>31</sub>, 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.

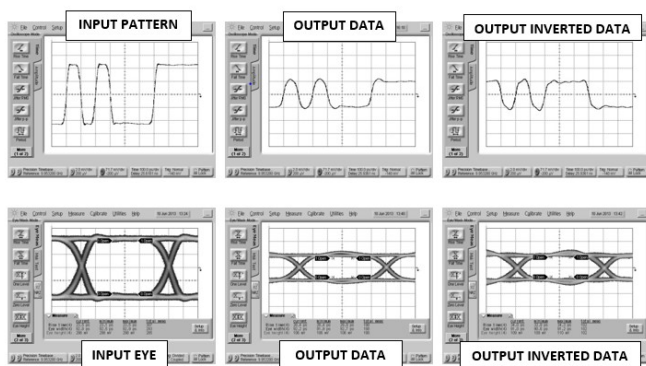


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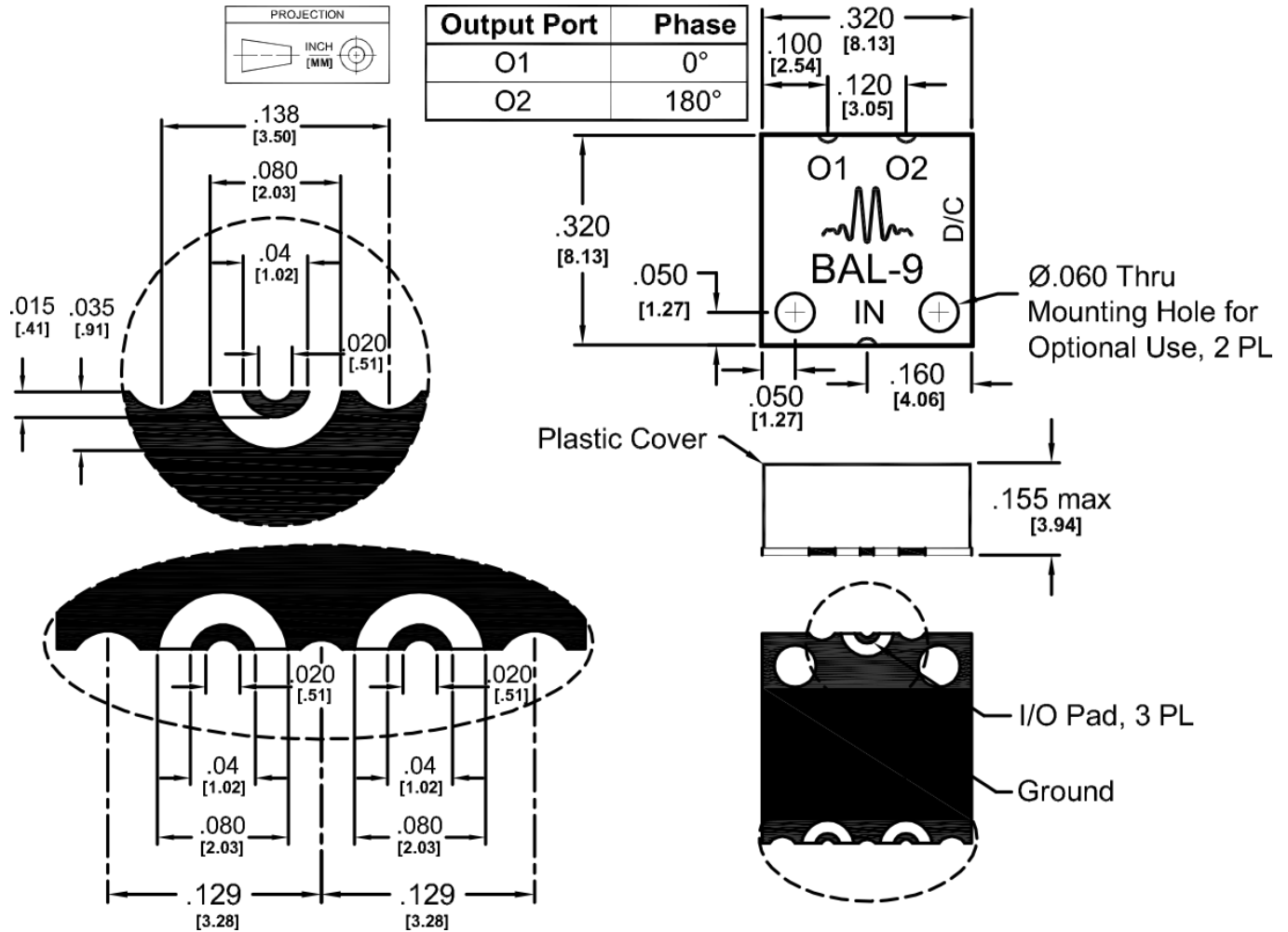
## Time Domain Performance Plots

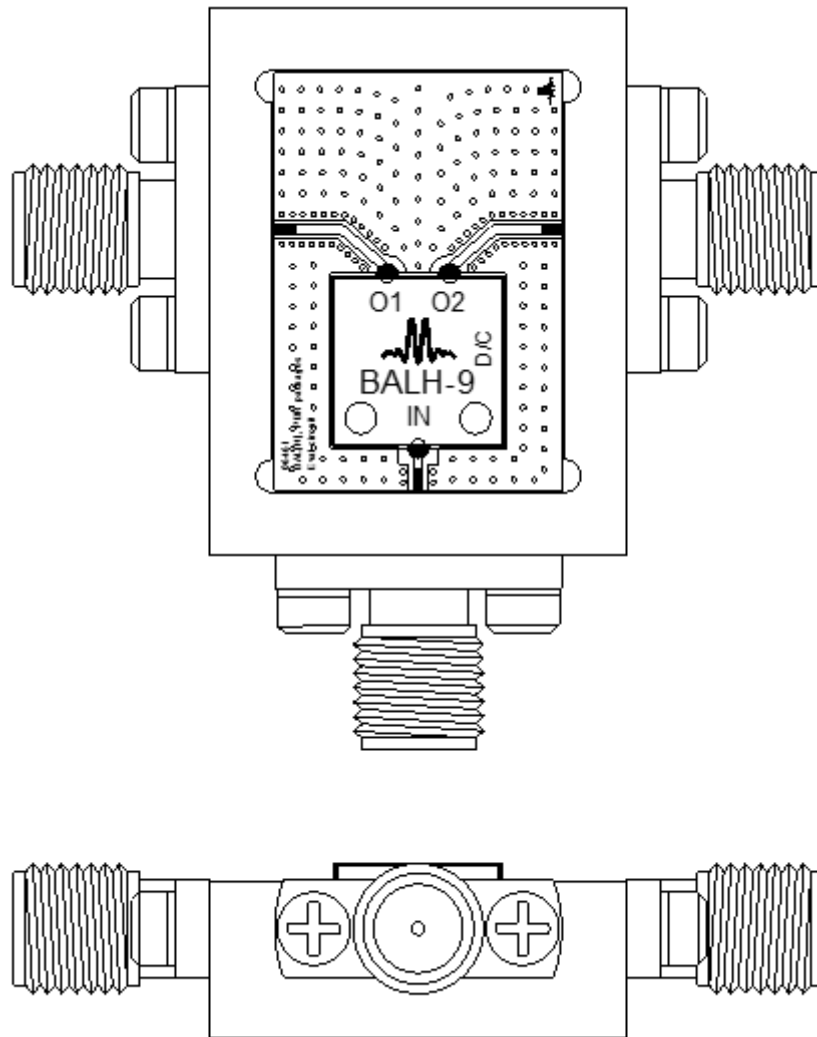
Oscilloscope measurements of the BAL-0009SMG with a 10 Gb/s PRBS pattern. Bit pattern is measured with a 27-1 PRBS input demonstrating extremely good pulse fidelity for both inverted and non-inverted output. Eye diagrams are taken with a 231-1 PRBS input demonstrating minimal eye distortion/closure afforded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



**Mechanical Data**

**Outline Drawing**





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