

# BALH-0003SMG

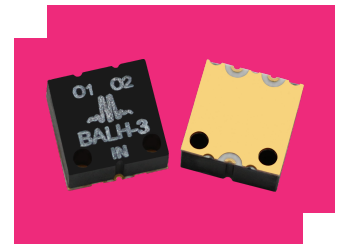
## High Power Surface-Mount Balun

### 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](#)



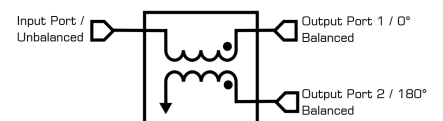
#### Features

- 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 | Packing Size | Green Status | Product Lifecycle | Export Classification |
|----------------|--------------------------------------------------|---------|--------------|--------------|-------------------|-----------------------|
| BALH-0003SMG   | High Power Surface-Mount Balun                   | SMG     | -            | RoHS         | Released          | EAR99                 |
| EVAL-BALH-0003 | Evaluation Board, High Power Surface-Mount Balun | -       | -            | RoHS         | Released          | EAR99                 |

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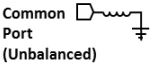
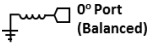
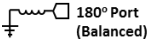
- **Device Overview**
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## Revision History

| 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 |

**Port Configuration and Functions**

**Port Functions**

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

**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         |
|------------|---------|----------------|
| Dimensions | -       | 8.13 x 8.13 mm |

### Electrical Specifications

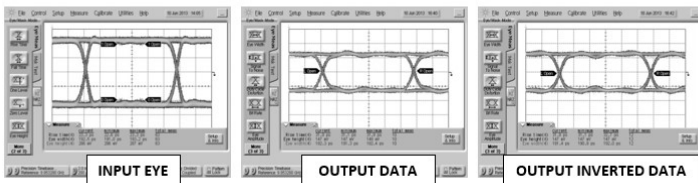
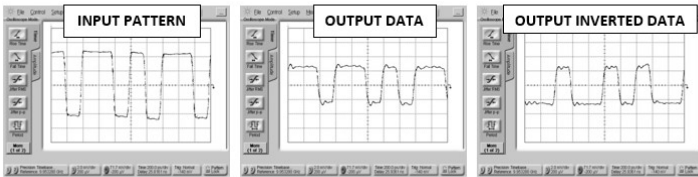
Specifications guaranteed from -55 to +100°C, measured in a 50Ω system.

| Parameter                          | Test Conditions | Minimum Frequency (GHz) | Maximum Frequency (GHz) | Min | Typ | Max | Unit |
|------------------------------------|-----------------|-------------------------|-------------------------|-----|-----|-----|------|
| Insertion Loss as a Mode Converter | -               | 0.0005                  | 3                       | -   | 2   | 3.5 | dB   |
| Nominal Phase Shift                | -               | 0.0005                  | 3                       | -   | 180 | -   | °    |
| Amplitude Balance                  | -               | 0.0005                  | 3                       | -   | 0.2 | 0.8 | dB   |
| Phase Balance                      | -               | 0.0005                  | 3                       | -   | 2   | 8   | °    |
| Common Mode Rejection              | -               | 0.0005                  | 3                       | 20  | 35  | -   | dB   |
| Isolation                          | -               | 0.0005                  | 3                       | -   | 7   | -   | dB   |
| Input 1 dB Compression             | -               | 0.0005                  | 3                       | -   | 37  | -   | dBm  |
| Risetime/Falltime <sup>1</sup>     | -               | 0.0005                  | 3                       | -   | 22  | -   | ps   |
| VSWR (Input)                       | -               | 0.0005                  | 3                       | -   | 1.6 | -   | -    |
| VSWR (Output)                      | -               | 0.0005                  | 3                       | -   | 1.1 | -   | -    |

<sup>[1]</sup> Specified as 90%/10%. Calculated from  $\text{Tau\_balun2} = (\text{Tau\_out}^2 - \text{Tau\_in}^2)$

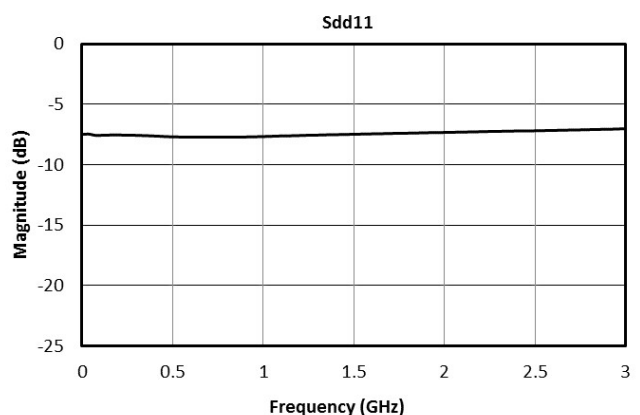
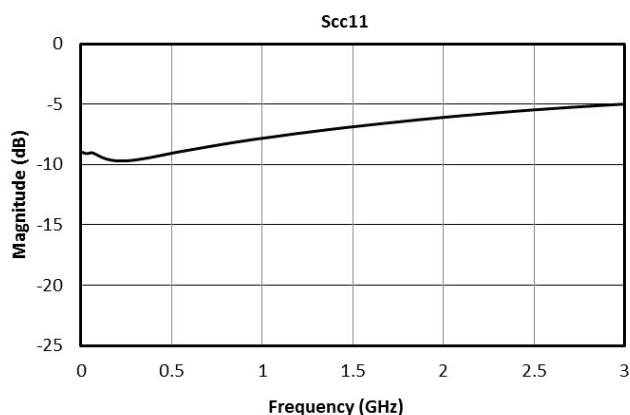
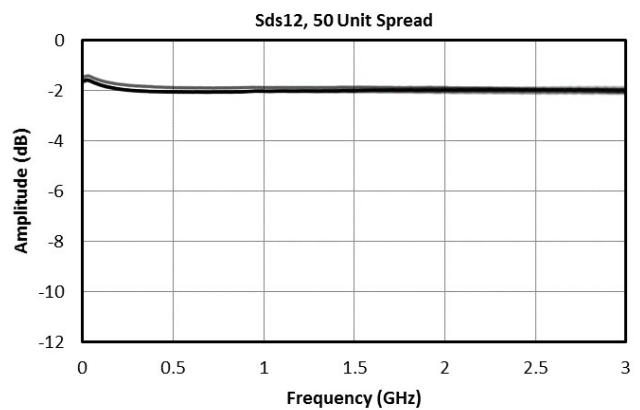
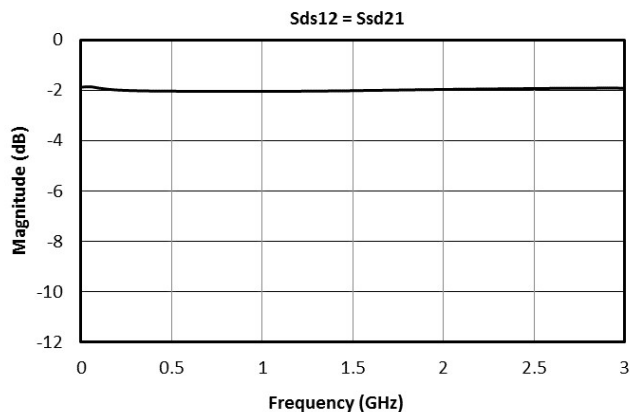
## Time Domain Performance Plots

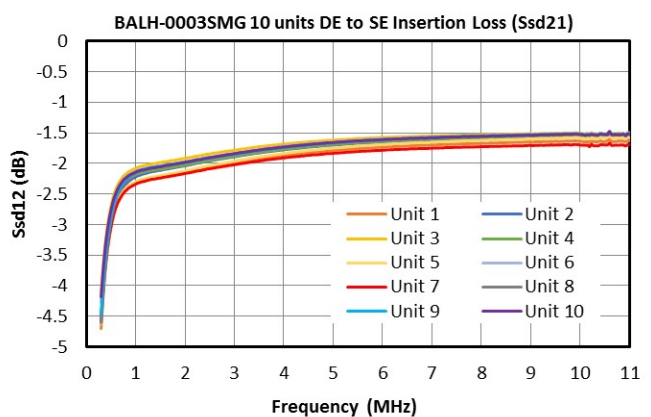
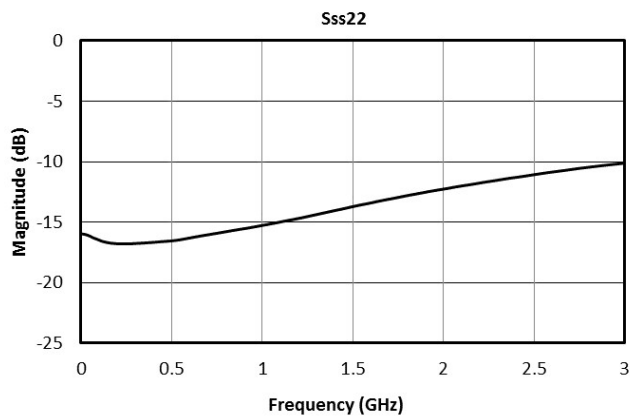
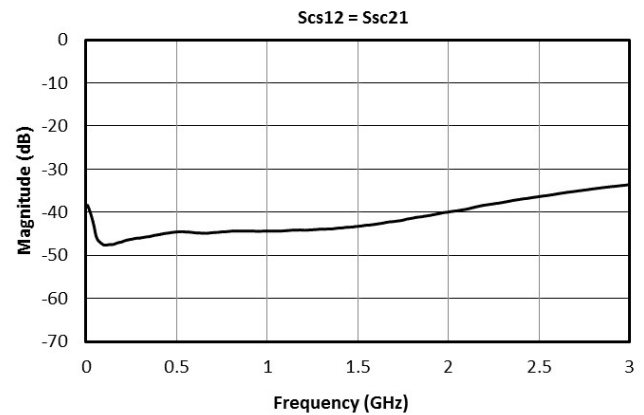
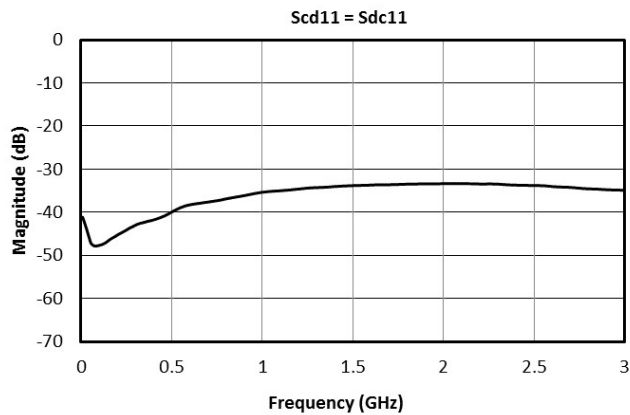
Oscilloscope measurements of the BALH-0003SMG with a 5 Gb/s PRBS pattern. Bit pattern is measured with a 27-1 PRBS input demonstrating extremely good pulse fidelity for both inverted and non-inverted output. Eye diagrams are taken with a 231-1 PRBS input demonstrating minimal eye distortion/closure afforded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



## Mixed Mode Scattering Parameters

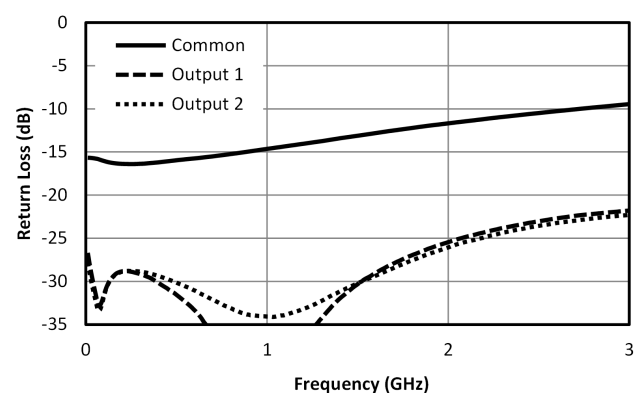
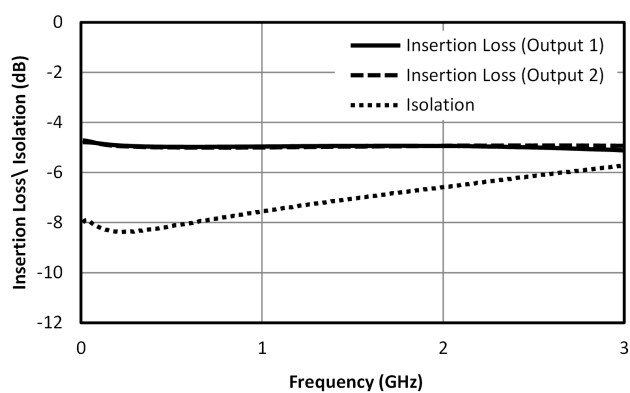
Mixed mode scattering parameters are used to characterize differential circuits. For baluns, this means that the  $0^\circ$  and  $180^\circ$  ports become a single  $100\Omega$  differential port and the common port remains the same  $50\Omega$  common port. The two-port s-parameters of the balun are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

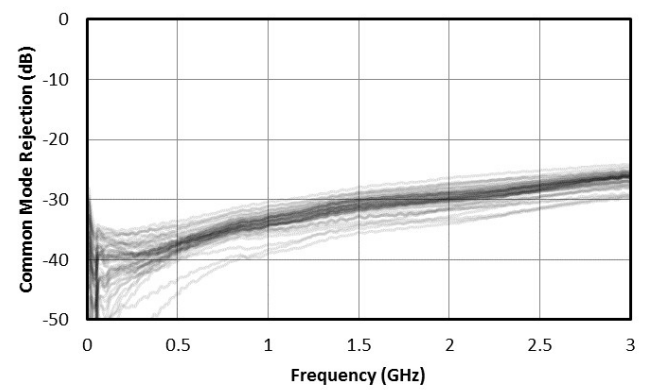
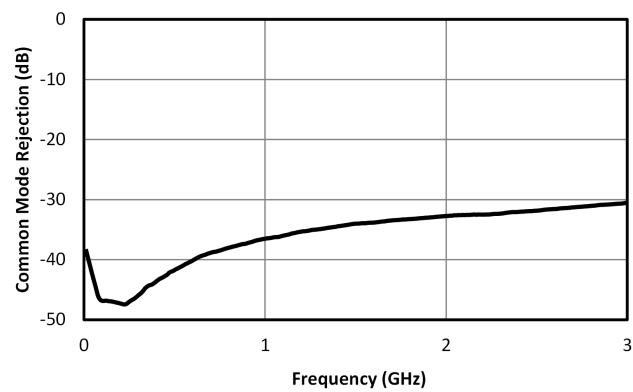
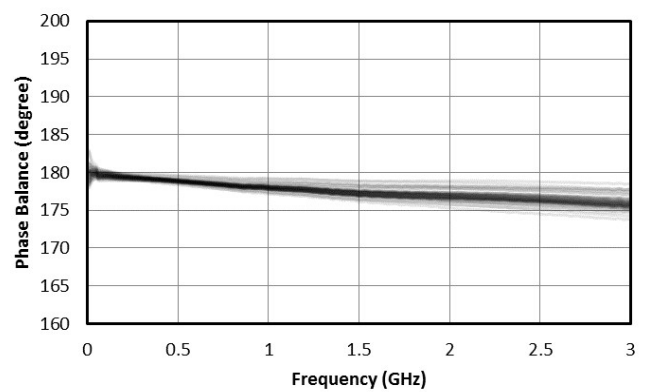
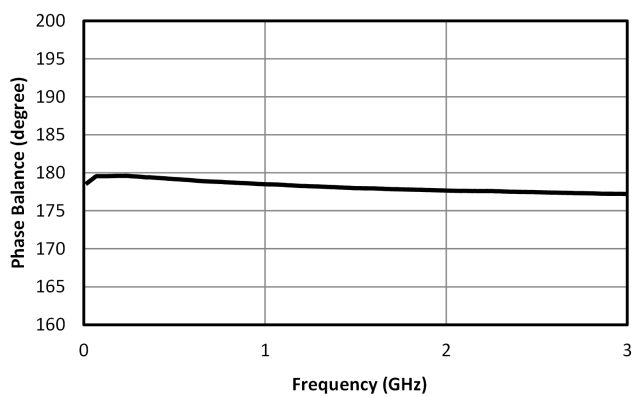
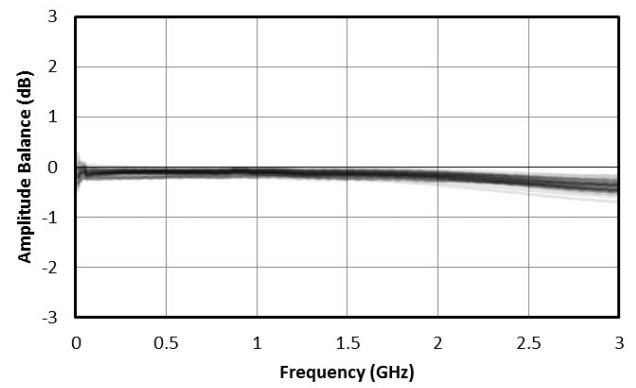
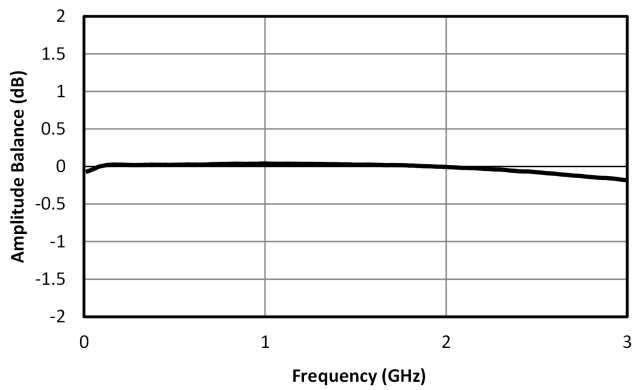


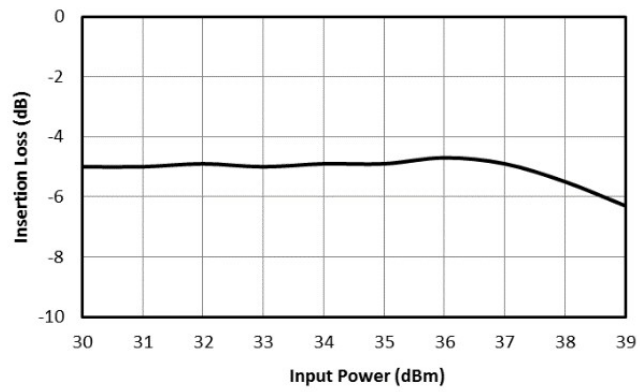


## Typical Performance Scattering Parameters

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.

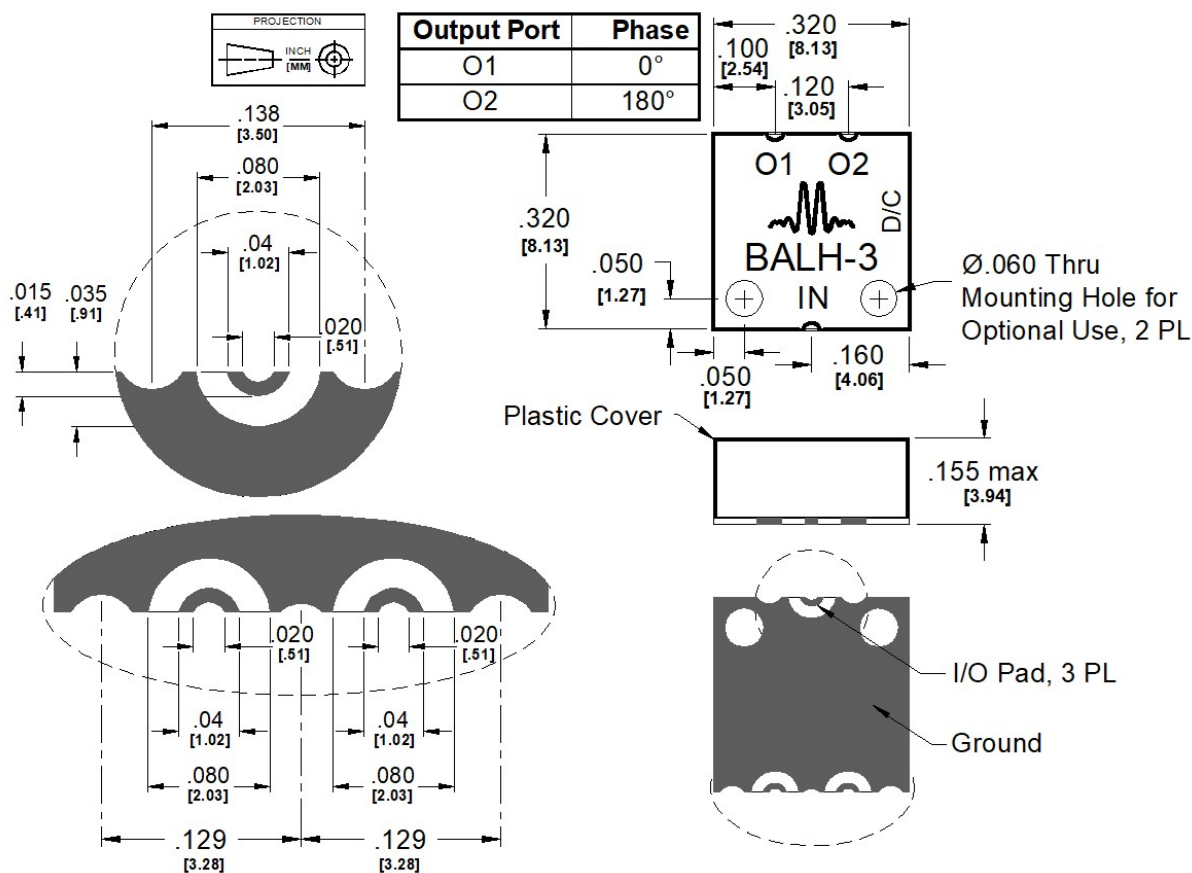


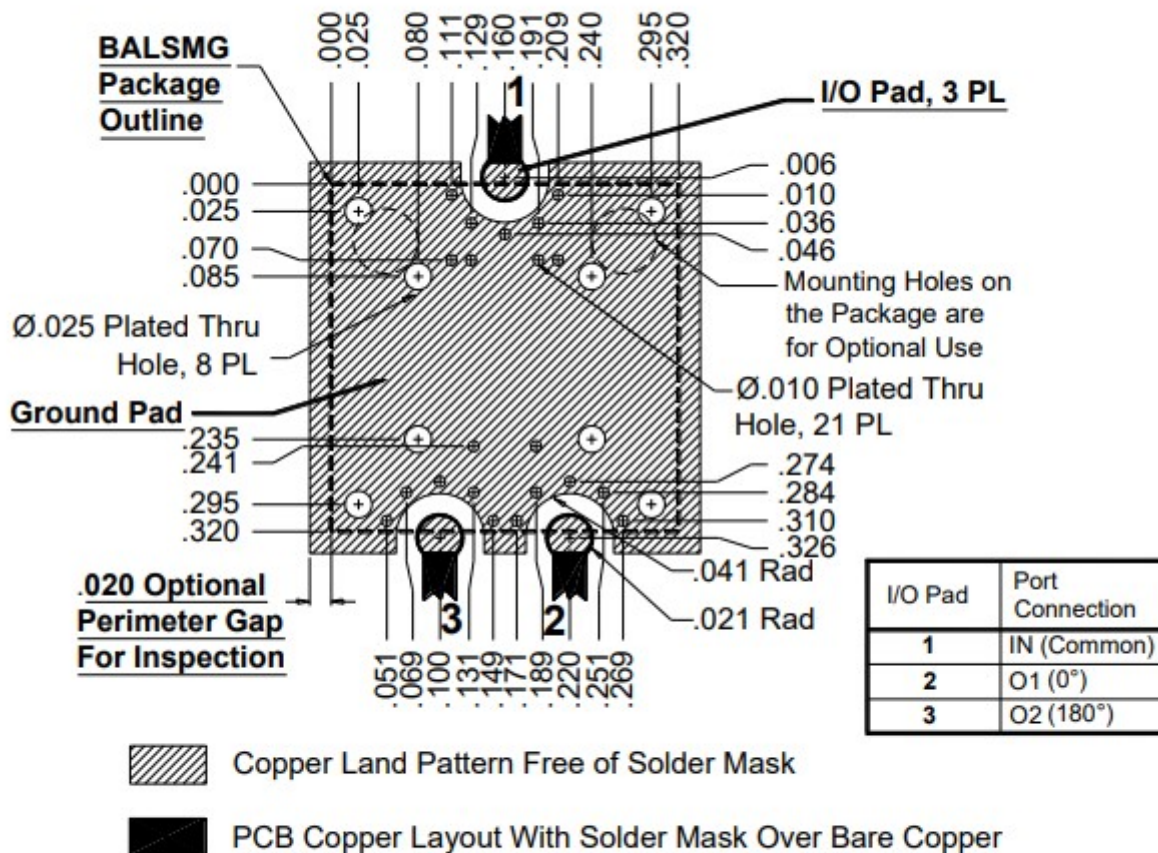




Mechanical Data

Outline Drawing

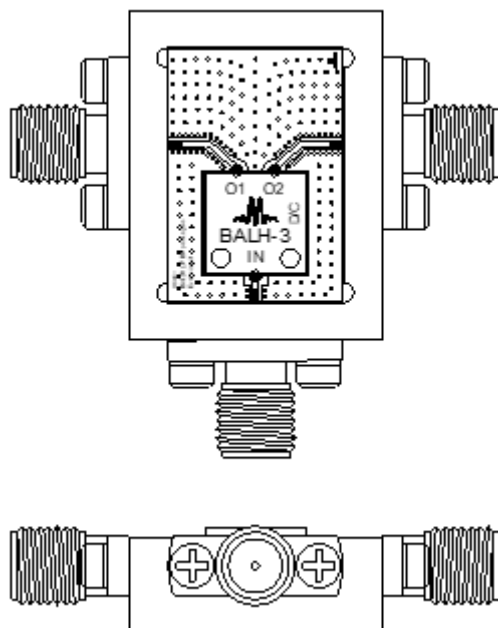


**Footprint Image**


**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.

## BALH-0003SMG

High Power Surface-Mount Balun



## 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
- Scs22: 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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