**LEAD-FREE / RoHS-COMPLIANT**

**SURFACE-MOUNT BROADBAND BALUN**

**Features**
- 10 MHz to 12 GHz 1:2 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
- BAL-0012SSG.s3p

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Frequency Range</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
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</thead>
<tbody>
<tr>
<td>Insertion Loss as a mode converter (dB)</td>
<td>10 MHz to 12 GHz</td>
<td>5</td>
<td>6.5</td>
<td></td>
</tr>
<tr>
<td>Nominal Phase Shift (Degrees)</td>
<td></td>
<td>180</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amplitude Balance (dB)</td>
<td></td>
<td>0.6</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>Phase Balance (Degrees)</td>
<td></td>
<td>5</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Common Mode Rejection (dB)</td>
<td></td>
<td>18</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>Isolation (dB)</td>
<td></td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VSWR</td>
<td></td>
<td>1.6</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Total Input Power (W)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>BAL-0012SSG</td>
<td>10 MHz to 12 GHz Balun, Surface Mount, LEAD-FREE/RoHS COMPLIANT</td>
</tr>
<tr>
<td>EVAL-BAL-0012</td>
<td>Connectorized Evaluation Fixture, LEAD-FREE/RoHS COMPLIANT</td>
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</tbody>
</table>
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BAL-0012SSG

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Block Diagram

- Single ended to differential
- Differential to single ended

Outline Drawing

Shaded Areas are Metal

Substrate material is 8-mil thick Rogers 4003, 1 Oz Rolled Cu. I/O Pads & Ground Plane Finish is Gold, 2 to 8 µ-inches, over solderable Electroplated Nickel, 100-200 µ-inches per QQ-N-290A. Or ENIG

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PCB Footprint Drawing

BALSSG Package
Bottom View

 Ground Pad/ Apply solder paste in hatch pattern with 40-60% fill ratio to prevent signal shorts

I/O Pad, 3 PL

All measurements are typical.

Ø0.010 plated thru
Vias, epoxy or copper filled is recomended, 18 PL

R0.013

0.050 Taper length

-0.010

-0.014

R0.020

0.050 Taper length

The landing pattern is to be used on Rogers4003 0.008" thick .
Grounded coplanar wave guide with 0.005" slot

Eval Package Outline Drawing

SMA female connector, 3PL

Click here for a DXF of the above layout.
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: $S_{ds21}$ is the differential output response given a single ended input.

Fig. 1. Insertion loss as a mode converter

Fig. 2. Insertion loss as a mode converter, 50 units spread

Fig. 3. Differential port return loss

Fig. 4. Insertion loss of a common mode signal

Fig. 5. Reflection converted between differential and common modes

Fig. 6. Return loss of a common mode signal
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Fig. 7. Unbalanced port return loss

**Typical Performance Scattering Parameter**

Three port scattering parameters measured as three single-ended 50Ω ports showing relationship between any two ports.

Fig. 8. Common to output port insertion loss

Fig. 9. Return loss for common port and output ports.

Fig. 10. Common mode rejection.

Fig. 11. Common mode rejection, 50 units spread.
Fig. 12. Amplitude balance between output ports.

Fig. 13. Amplitude balance between output ports, 50 unit spread.

Fig. 14. Phase balance between output ports.

Fig. 15. Phase balance between output ports, 50 unit spread.

Fig. 16. Isolation between output ports.

Fig. 17. Low Frequency Insertion Loss
### DC Interface

<table>
<thead>
<tr>
<th>Port</th>
<th>Description</th>
<th>DC Interface Schematic</th>
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</thead>
<tbody>
<tr>
<td>Common Port / In</td>
<td>The common port is DC short to ground.</td>
<td>![Common Port (Unbalanced)]</td>
</tr>
<tr>
<td>(Unbalanced)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Out 1 / 0° Port</td>
<td>The 0° port is DC short to ground.</td>
<td>![0° Port (Balanced)]</td>
</tr>
<tr>
<td>(Balanced)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Out 2 / 180° Port</td>
<td>The 180° port is DC short to ground.</td>
<td>![180° Port (Balanced)]</td>
</tr>
<tr>
<td>(Balanced)</td>
<td></td>
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### Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Maximum Rating</th>
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<tbody>
<tr>
<td>DC Current</td>
<td>TBD</td>
</tr>
<tr>
<td>RF Power Handling</td>
<td>30 dBm</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-55°C to +100°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-65°C to +125°C</td>
</tr>
</tbody>
</table>
DATASHEET NOTES:
1. Excess Insertion Loss = (Common Port to Output Port Insertion Loss) – 6 dB.
2. Sdd11: differential return loss of the differential port driven with a differential signal
   Sdc11: differential return loss of the differential port driven with a common signal
   Sds12: insertion loss from a single ended input to a differential output
   Scc11: common mode return loss of the differential port driven with a common signal
   Scd11: common mode return loss of the differential port driven with a differential signal
   Scs12: insertion loss from a single ended input to a common output
   Sss22: single ended return loss
   Ssd21: insertion loss from a differential signal to single ended output
   Ssc12: insertion loss from a common signal to single ended output

Revision History

<table>
<thead>
<tr>
<th>Revision code</th>
<th>Revision Date</th>
<th>Comment</th>
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<tbody>
<tr>
<td>-</td>
<td>June 2020</td>
<td>Initial Datasheet Release</td>
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