BALF-NRG-02D3

50 ohm nominal input / conjugate match to BlueNRG tranceiver, with integrated harmonic filter

Datasheet - production data

Description

This device is an ultra-miniature balun which integrates matching network and harmonics filter. Matching impedance has been customized for the BlueNRG ST transceiver. The BALF-NRG-02D3 uses STMicroelectronics IPD technology on non-conductive glass substrate which optimizes RF performance.

![Chip Scale package on glass 4 bumps - 1.4 x 0.85 mm²](image)

Features
- 50 Ω nominal input / conjugate match to BlueNRG device
- Low insertion loss
- Low amplitude imbalance
- Low phase imbalance

Benefits
- Small footprint
- RF BOM reduction
- High RF performance

Applications
- Bluetooth low energy impedance matched balun filter
- Optimized for ST BlueNRG RFIC

![Figure 1: Pin configuration (bump view)](image)
1 Application schematic

Figure 2: Application diagram example (refer to BlueNRG reference design)
## Characteristics

### Table 1: Absolute maximum ratings (limiting values)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_{IN}$</td>
<td>Input power RFIN</td>
<td>-</td>
<td>10</td>
</tr>
<tr>
<td>$V_{ESD}$</td>
<td>ESD ratings human body model, all I/O one at a time while others connected to GND</td>
<td>2000</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>ESD ratings machine model (MM: $C = 200$ pF, $R = 25$ $\Omega$, $L = 500$ nH)</td>
<td>200</td>
<td>-</td>
</tr>
<tr>
<td>$T_{OP}$</td>
<td>Operating temperature</td>
<td>-40</td>
<td>-</td>
</tr>
</tbody>
</table>

### Table 2: Electrical characteristics ($T_{amb} = 25$ °C)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Definition</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Z_{diff}$</td>
<td>Nominal differential impedance</td>
<td>Match to BlueNRG</td>
<td>Ω</td>
</tr>
<tr>
<td>$Z_{ANT}$</td>
<td>Nominal antenna impedance</td>
<td>50</td>
<td>Ω</td>
</tr>
<tr>
<td>$f$</td>
<td>Frequency range (bandwidth)</td>
<td>2400</td>
<td>2500</td>
</tr>
<tr>
<td>$I_{L}$</td>
<td>Insertion loss in bandwidth</td>
<td>1.33</td>
<td>1.85</td>
</tr>
<tr>
<td>$RL_{SE}$</td>
<td>Single ended return loss in bandwidth</td>
<td>21</td>
<td>30</td>
</tr>
<tr>
<td>$RL_{DIFF}$</td>
<td>Differential return loss in bandwidth</td>
<td>17</td>
<td>19</td>
</tr>
<tr>
<td>$H2$</td>
<td>Second harmonic attenuation (differential mode)</td>
<td>40</td>
<td>49</td>
</tr>
<tr>
<td>$H3$</td>
<td>Third harmonic attenuation (differential mode)</td>
<td>46</td>
<td>55</td>
</tr>
<tr>
<td>$H4$</td>
<td>Fourth harmonic attenuation (differential mode)</td>
<td>42</td>
<td>50</td>
</tr>
<tr>
<td>$H5$</td>
<td>Fifth harmonic attenuation (differential mode)</td>
<td>31</td>
<td>56</td>
</tr>
<tr>
<td>$H6$</td>
<td>Fifth harmonic attenuation (differential mode)</td>
<td>29</td>
<td>45</td>
</tr>
<tr>
<td>$H7$</td>
<td>Fifth harmonic attenuation (differential mode)</td>
<td>30</td>
<td>42</td>
</tr>
<tr>
<td>$\Phi_{imb}$</td>
<td>Output phase imbalance</td>
<td>-3.5</td>
<td>0</td>
</tr>
<tr>
<td>$A_{imb}$</td>
<td>Output amplitude imbalance</td>
<td>-1</td>
<td>0</td>
</tr>
</tbody>
</table>
2.1 RF measurement

Figure 3: Differential transmission (dB)

Figure 4: Insertion loss (dB)

Figure 5: Return loss single ended (dB)

Figure 6: Return loss differential (dB)

Figure 7: H2 harmonic attenuation (dB)

Figure 8: H3 harmonic attenuation (dB)
Figure 9: H4 harmonic attenuation (dB)

Figure 10: H5 harmonic attenuation (dB)

Figure 11: H6 harmonic attenuation (dB)

Figure 12: H7 harmonic attenuation (dB)

Figure 13: Amplitude imbalance in dB

Figure 14: Phase imbalance in deg
3 Application information


Figure 15: Recommended balun land pattern
4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK® is an ST trademark.

4.1 CSPG 0.4 package information

Figure 16: CSPG package outline (bump view)
Figure 17: Footprint - 3 mils stencil - non solder mask defined

Copper pad diameter:
- 220 µm recommended
- 180 µm minimum
- 260 µm maximum

Solder mask opening:
- 320 µm recommended
- 300 µm minimum
- 340 µm maximum

Solder stencil opening:
- 220 µm recommended

*depending on paste, it can go down to 270 µm

Figure 18: Footprint - 3 mils stencil - solder mask defined

Copper pad diameter:
- 220 µm recommended
- 180 µm minimum
- 260 µm maximum

Solder mask opening:
- 220 µm recommended

Figure 19: Footprint - 5 mils stencil - non solder mask defined

Copper pad diameter:
- 220 µm recommended
- 180 µm minimum
- 260 µm maximum

Solder mask opening:
- 320 µm recommended
- 300 µm minimum
- 340 µm maximum

Solder stencil opening:
- 330 µm recommended*

*depending on paste, it can go down to 270 µm

Figure 20: Footprint - 5 mils stencil - solder mask defined

Copper pad diameter:
- 220 µm recommended
- 180 µm minimum
- 260 µm maximum

Solder mask opening:
- 320 µm recommended
- 300 µm minimum

Solder stencil opening:
- 330 µm recommended*

*depending on paste, it can go down to 270 µm
4.2 CSPG 0.4 packing information

Figure 21: Marking

- Dot, ST logo
- ECOPACK® Grade
- xx = marking
- ZZ = manufacturing location
- XY = datecode
- y = year
- w = week

Figure 22: Flip Chip tape and reel specifications

All dimensions are typical values in mm

More packing information is available in the application note:
- AN2348 Flip-Chip: “Package description and recommendations for use”
5 Ordering information

Figure 23: Ordering information scheme

<table>
<thead>
<tr>
<th>Order code</th>
<th>Marking</th>
<th>Package</th>
<th>Weight</th>
<th>Base qty.</th>
<th>Delivery mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>BALF-NRG-02D3</td>
<td>TK</td>
<td>CSPG</td>
<td>1.37 mg</td>
<td>5000</td>
<td>Tape and reel</td>
</tr>
</tbody>
</table>

6 Revision history

Table 5: Document revision history

<table>
<thead>
<tr>
<th>Date</th>
<th>Revision</th>
<th>Changes</th>
</tr>
</thead>
</table>
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