

50 Ω nominal input / conjugate match balun to SPIRIT1, with integrated harmonic filter

Datasheet – production data

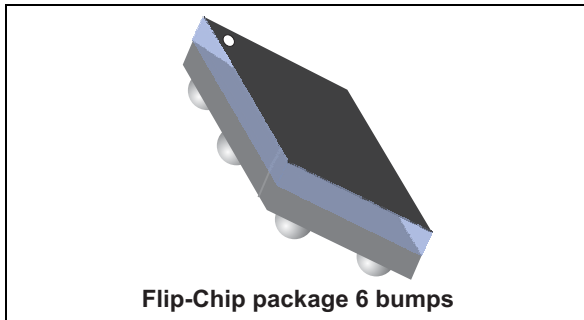


Figure 1. Pin coordinates (top view)

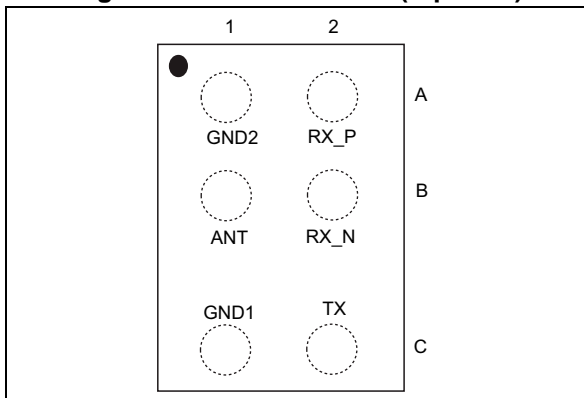
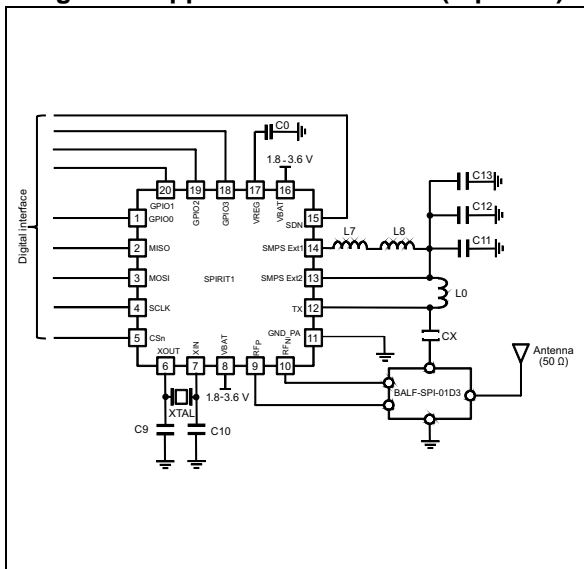


Figure 2. Application schematic (top view)



Features

- 50 Ω nominal input / conjugate match to SPIRIT1
- Low insertion loss
- Low amplitude imbalance
- Low phase imbalance
- Small footprint

Benefits

- Very low profile (< 670 μm)
- High RF performance
- RF BOM and area reduction

Applications

- 868 MHz and 915 MHz impedance matched balun filter
- Optimized for SPIRIT1 sub GHz RFIC

Description

STMicroelectronics BALF-SPI-01D3 is an ultra miniature balun. The BALF-SPI-01D3 integrates matching network and harmonics filters. Matching impedance has been customized for the SPIRIT1 ST transceiver.

The BALF-SPI-01D3 uses STMicroelectronics IPD technology on non-conductive glass substrate which optimize RF performance.

1 Characteristics

Table 1. Absolute maximum ratings (limiting values)

| Symbol | Parameter | Value | | | Unit |
|-----------|---|-------|------|------|------|
| | | Min. | Typ. | Max. | |
| P_{IN} | Input power RFIN | | - | 20 | dBm |
| V_{ESD} | ESD ratings human body model (JESD22-A114-C), all I/O one at a time while others connected to GND | 2000 | - | | V |
| | ESD ratings machine model, all I/O | 200 | - | | |
| T_{OP} | Operating temperature (JESD22-A115-C), all I/O | -40 | - | +85 | °C |

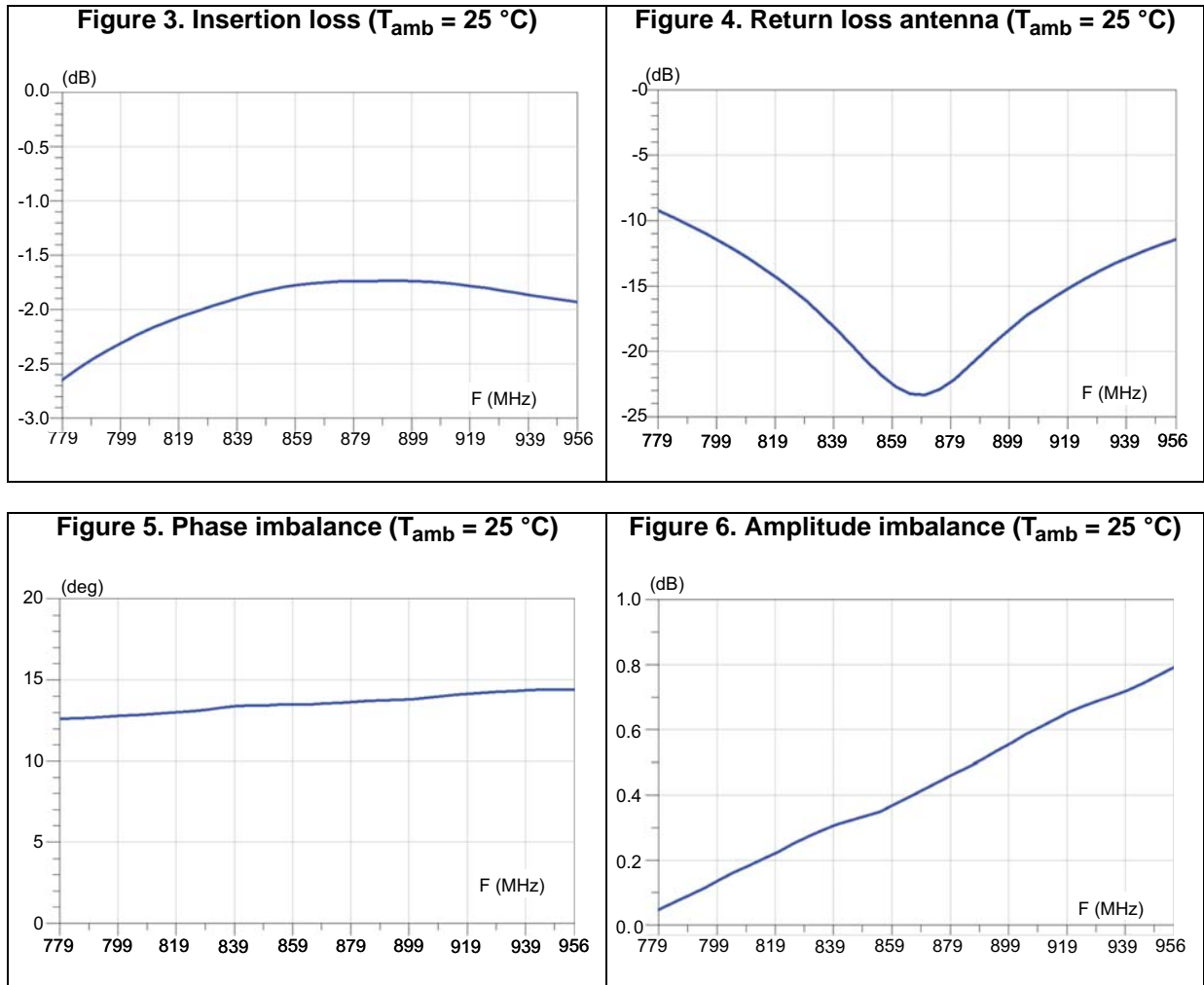
Table 2. Impedances ($T_{amb} = 25\text{ °C}$)

| Symbol | Parameter | Value | | | Unit |
|-----------|---|-------|------------------|------|----------|
| | | Min. | Typ. | Max. | |
| Z_{RX} | Nominal differential RX balun impedance | - | match to SPIRIT1 | - | Ω |
| Z_{TX} | Nominal TX filter impedance | | | | |
| Z_{ANT} | Antenna impedance | - | 50 | - | Ω |

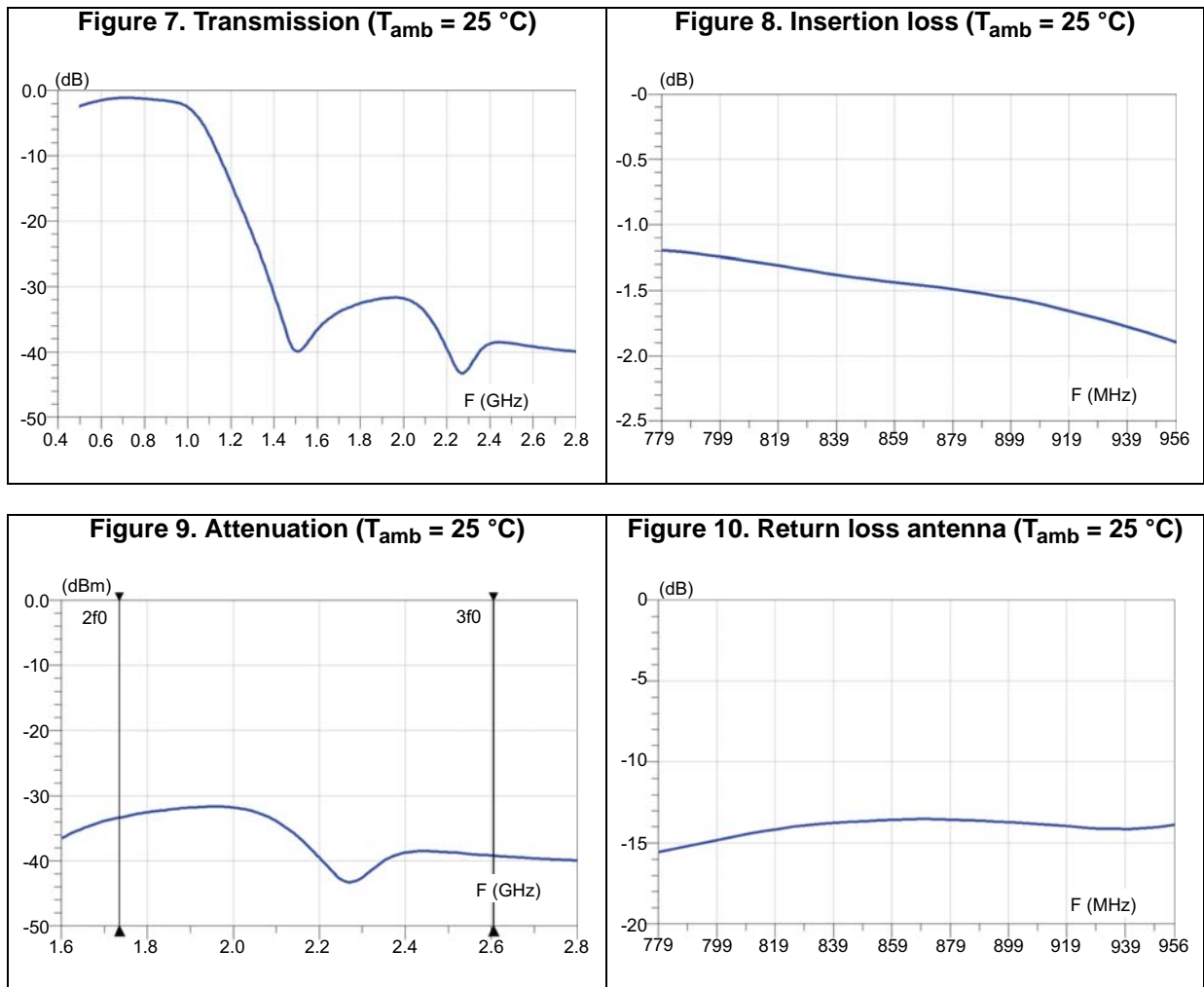
Table 3. RF performance ($T_{amb} = 25\text{ °C}$)

| Symbol | Parameter | Test condition | Value | | | Unit |
|-------------------|---|--------------------|-------|------|------|------|
| | | | Min. | Typ. | Max. | |
| F | Frequency range (bandwidth) | | 779 | 868 | 956 | MHz |
| $S_{21_{RX-ANT}}$ | Insertion loss in bandwidth without mismatch loss (RX balun) | | | -1.7 | -2 | dB |
| $S_{21_{TX-ANT}}$ | Insertion loss in bandwidth without mismatch loss (TX filter) | | | -1.4 | -2 | dB |
| $S_{11_{ANT}}$ | Input return loss in bandwidth (RX balun) | | | -23 | -15 | dB |
| $S_{11_{ANT}}$ | Input return loss in bandwidth (TX filter) | | | -15 | -12 | dB |
| ϕ_{imb} | Output phase imbalance (RX balun) | | 5 | 10 | 15 | ° |
| A_{imb} | Output amplitude imbalance (RX balun) | | | 0.35 | 0.8 | dB |
| Att | Harmonic levels (TX filter) | Attenuation at 2fo | | -35 | | dBm |
| | | Attenuation at 3fo | | -40 | | |

1.1 RF measurement (Rx balun)



1.2 RF measurement (Tx filter)



2 Application information

Figure 11. Application board EVB (4 layers)

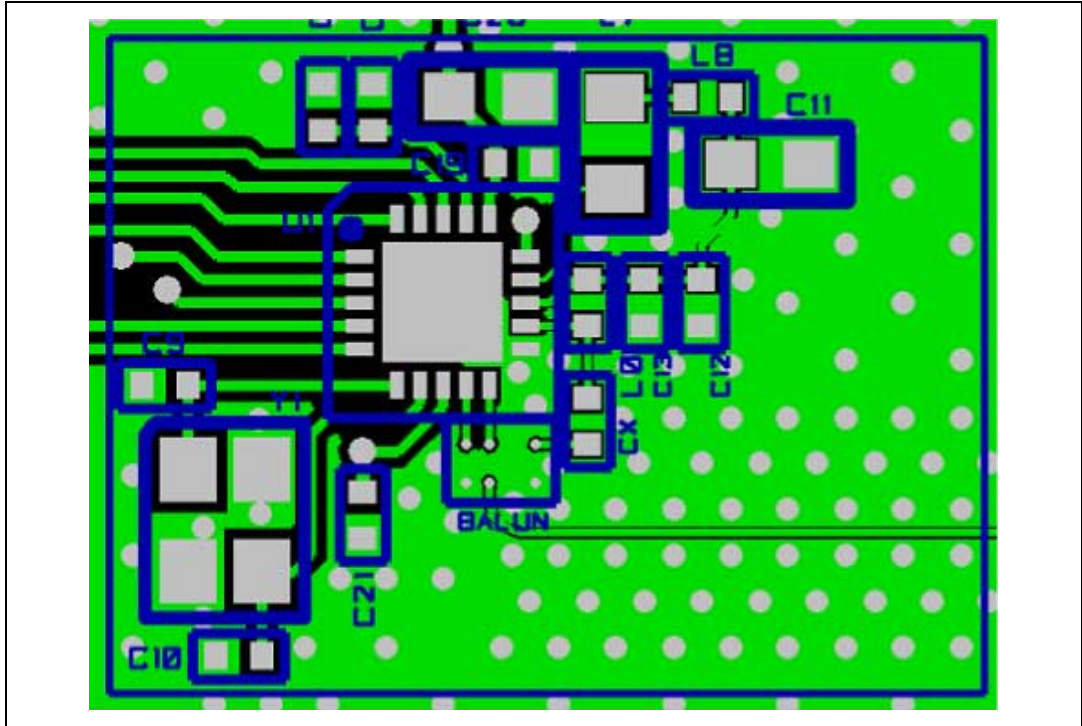


Figure 12. TX output measurements with BALF-SPI-01D3 at 868 MHz

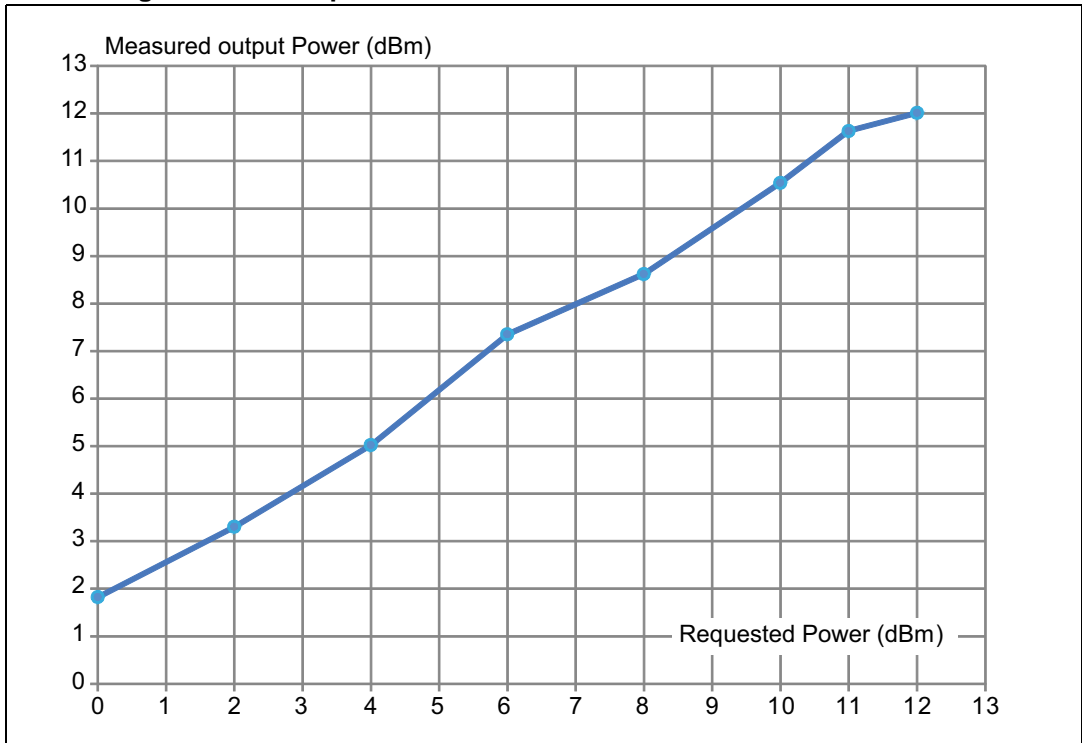


Figure 13. TX output power measurements over frequency with BALF-SPI-01D3

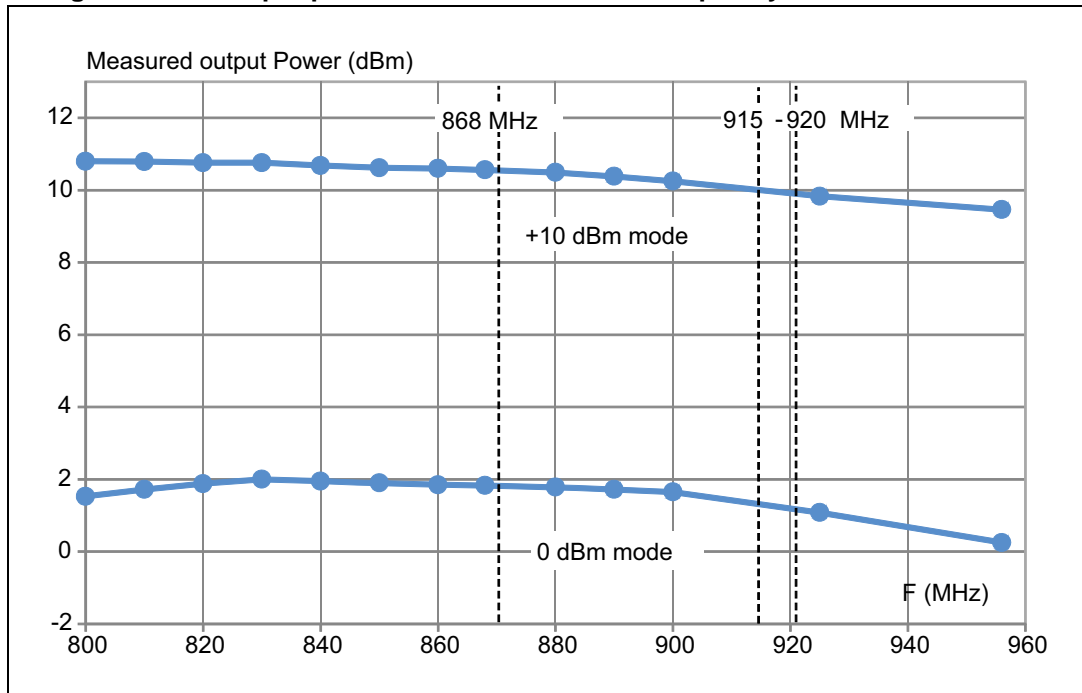
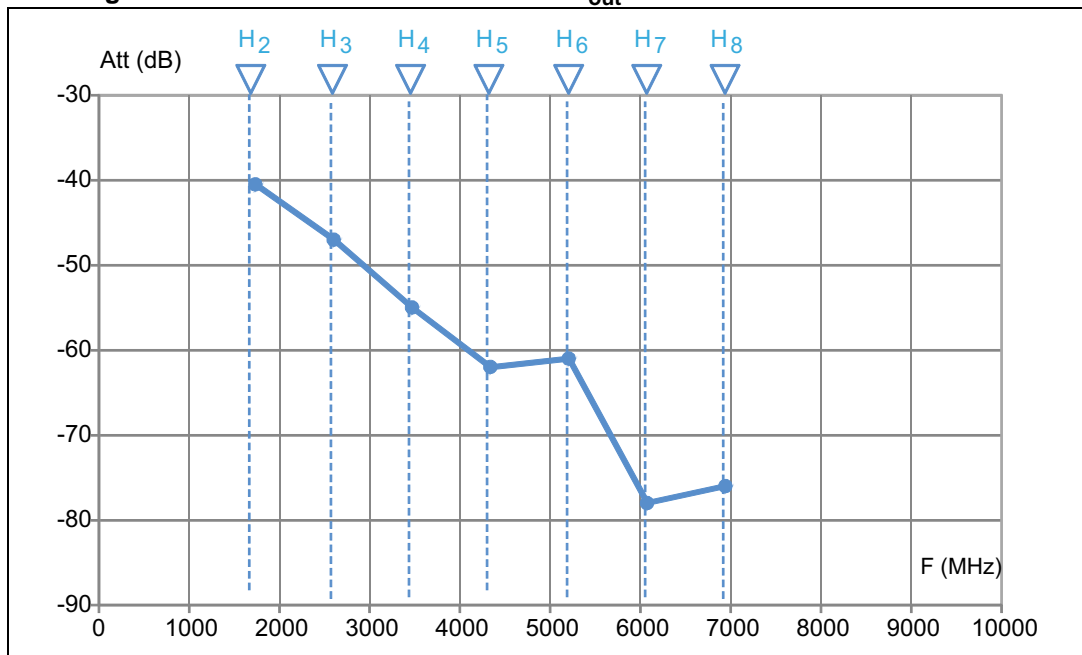


Figure 14. Harmonic measurements at $P_{out} = 10$ dBm with BALF-SPI-01D3



3 Package information

- Epoxy meets UL94, V0
- Lead-free package

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.

3.1 Flip-Chip package information

Figure 15. Flip-Chip package outline

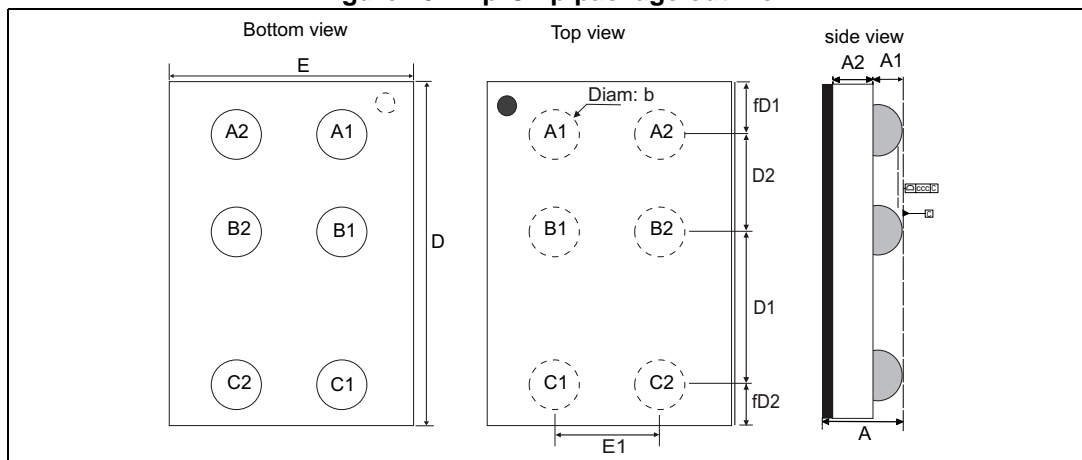


Table 4. Flip-Chip package mechanical data

| Parameter | Description | Min. | Typ. | Max. | Unit |
|-----------|---|-------|-------|-------|------|
| A | Bump height + substrate thickness | 0.590 | 0.650 | 0.710 | mm |
| A1 | Bump height | | 0.200 | | mm |
| A2 | Substrate thickness | | 0.400 | | mm |
| b | Bump diameter | 0.210 | 0.250 | 0.290 | mm |
| D | Y dimension of the die | 1.950 | 2.000 | 1.950 | mm |
| D1 | Y pitch | 0.960 | 1.000 | 1.040 | mm |
| D2 | Y pitch2 | 0.460 | 0.500 | 0.540 | mm |
| E | X dimension of the die | 1.350 | 1.400 | 1.450 | mm |
| E1 | X pitch | 0.790 | 0.820 | 0.850 | mm |
| fD1 | Distance from bump to edge of die on Y axis | | 0.295 | | mm |
| fD2 | Distance from bump to edge of die on Y axis | | 0.195 | | mm |
| ccc | | | | 0.05 | mm |

Figure 16. Recommended balun land pattern

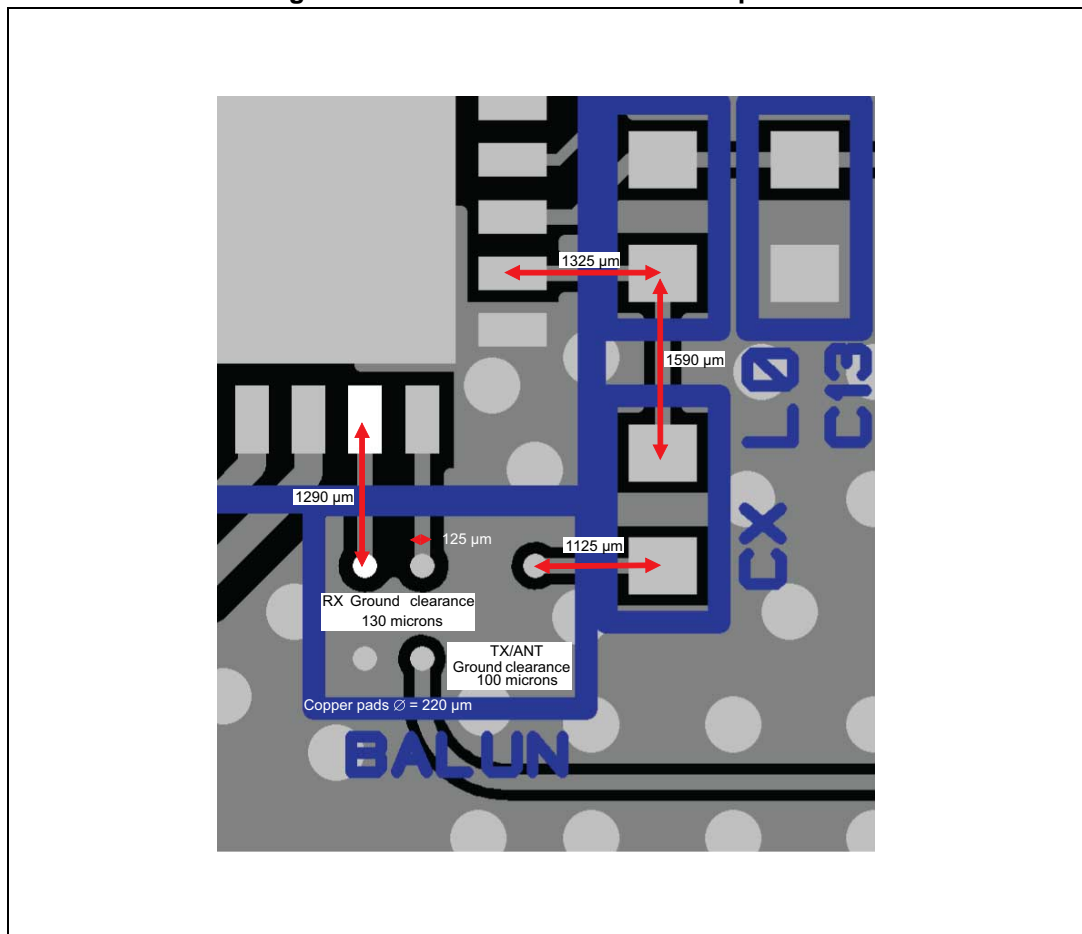


Figure 17. Footprint - 3 mils stencil - non solder mask defined

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

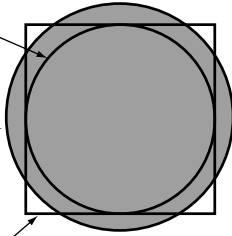


Figure 18. Footprint - 3 mils stencil - solder mask defined

Solder mask opening:
220 μm recommended
180 μm minimum
260 μm maximum

Copper pad diameter:
320 μm recommended
300 μm minimum

Solder stencil opening:
220 μm recommended

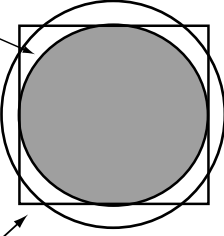


Figure 19. Footprint - 5 mils stencil - non solder mask defined

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

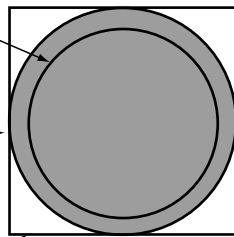


Figure 20. Footprint - 5 mils stencil - solder mask defined

Solder mask opening:
220 μm recommended
180 μm minimum
260 μm maximum

Copper pad diameter:
320 μm recommended
300 μm minimum

Solder stencil opening:
330 μm recommended*

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

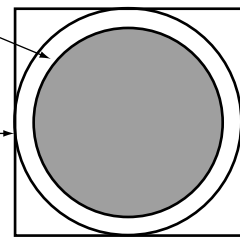


Figure 21. Marking

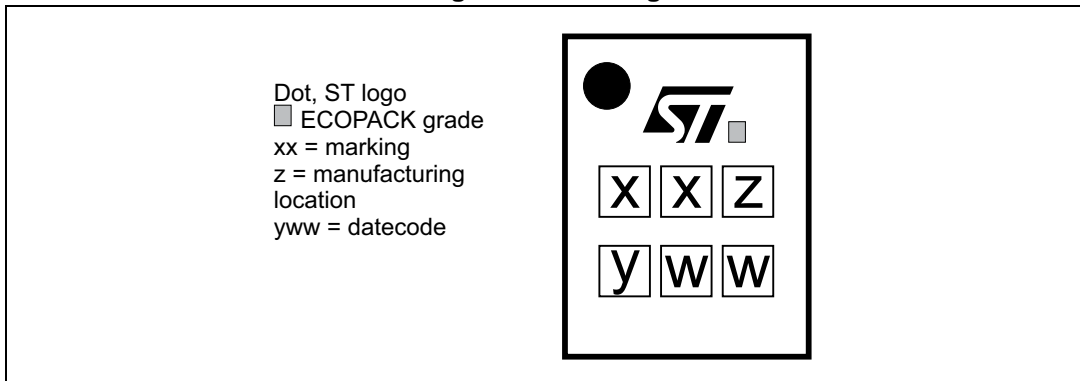
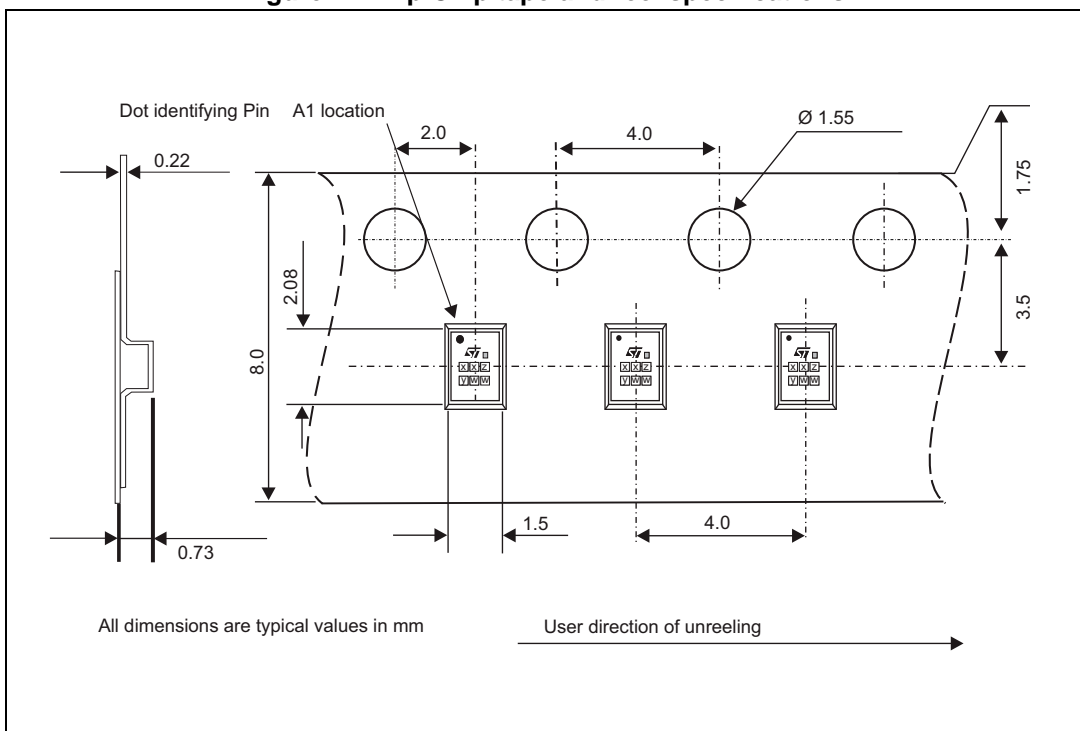


Figure 22. Flip Chip tape and reel specifications



Note: More information is available in the STMicroelectronics Application note: AN2348 Flip-Chip: "Package description and recommendations for use"

4 Ordering information

Table 5. Ordering information

| Order code | Marking | Weight | Base Qty | Delivery mode |
|---------------|---------|--------|----------|---------------|
| BALF-SPI-01D3 | SJ | 3.0 mg | 5000 | Tape and Reel |

5 Revision history

Table 6. Document revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 27-Aug-2013 | 1 | Initial release. |
| 03-Oct-2013 | 2 | Updated document title. Updated Table 1 with JESD22 references. |
| 15-May-2015 | 3 | Updated Figure 1 and Figure 15. Added Figure 19 and Figure 20. |
| 18-Sep-2015 | 4 | Updated Figure 15 and added Table 4. |
| 17-Nov-2015 | 5 | Updated Figure 2 and Figure 15 . |

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