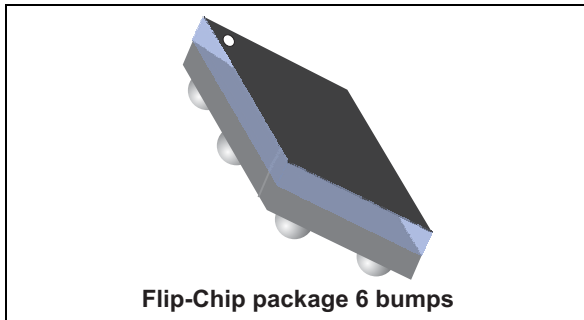
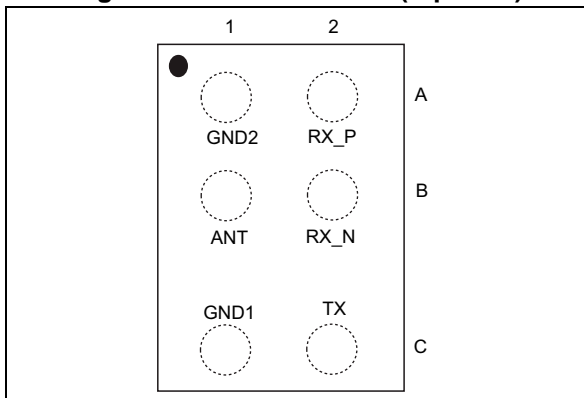


## 50 $\Omega$ nominal input / conjugate match balun to SPIRIT1, with integrated harmonic filter

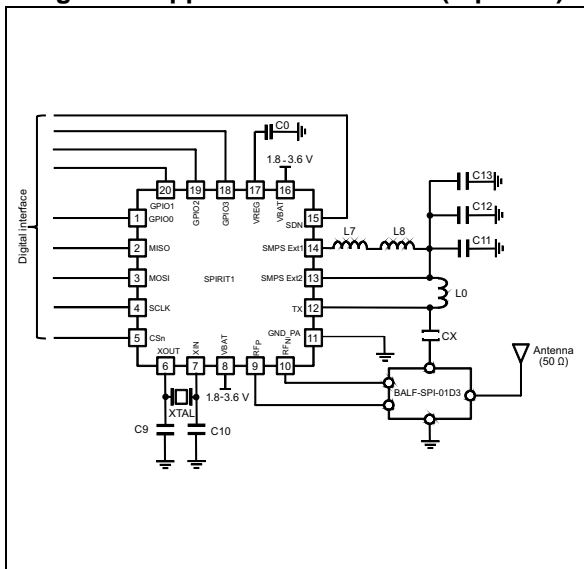
Datasheet – production data



**Figure 1. Pin coordinates (top view)**



**Figure 2. Application schematic (top view)**



### Features

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

### Benefits

- Very low profile (< 670  $\mu\text{m}$ )
- 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

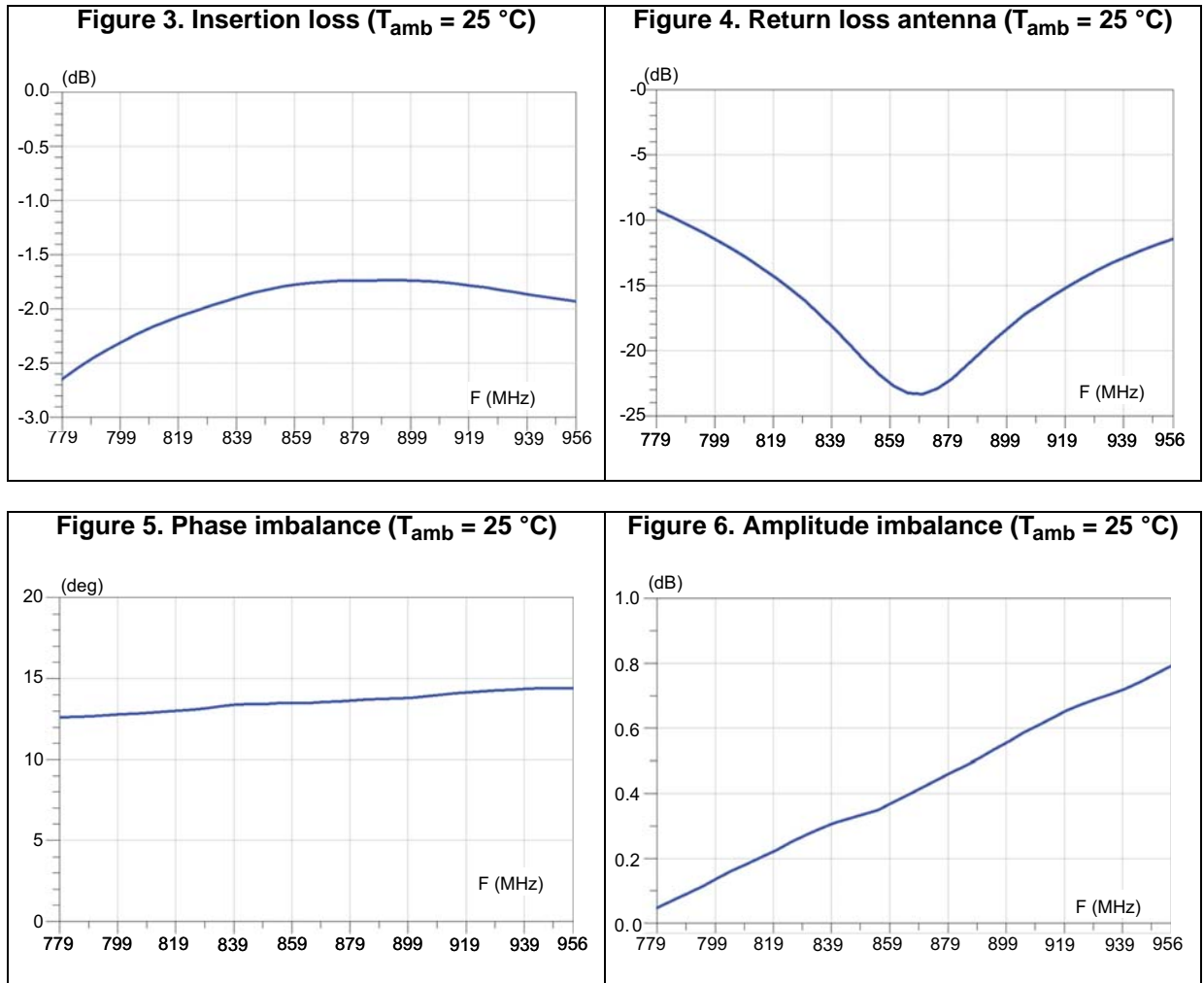
**Table 2. Impedances ( $T_{amb} = 25\text{ °C}$ )**

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

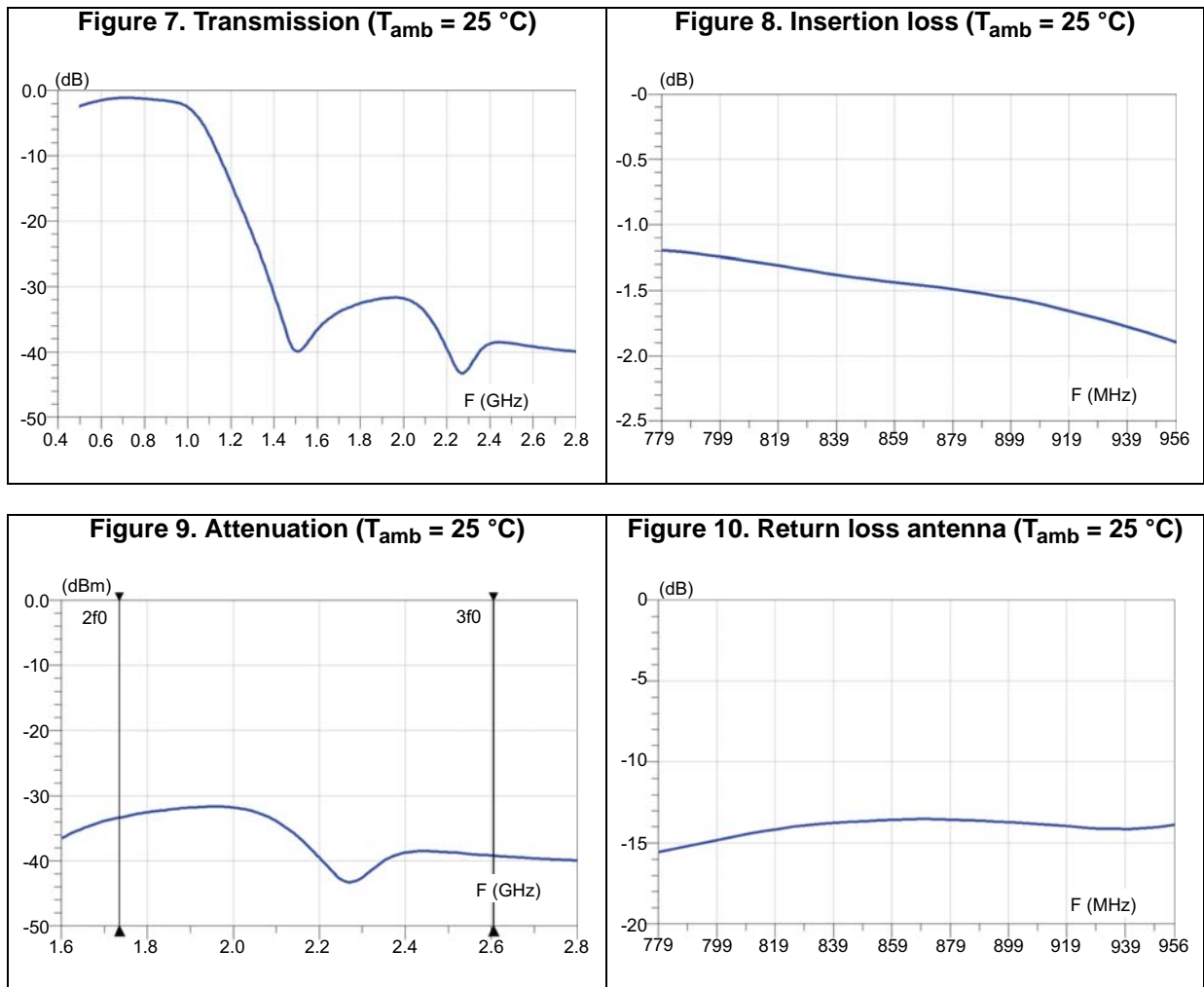
**Table 3. RF performance ( $T_{amb} = 25\text{ °C}$ )**

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
$\phi_{imb}$	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)

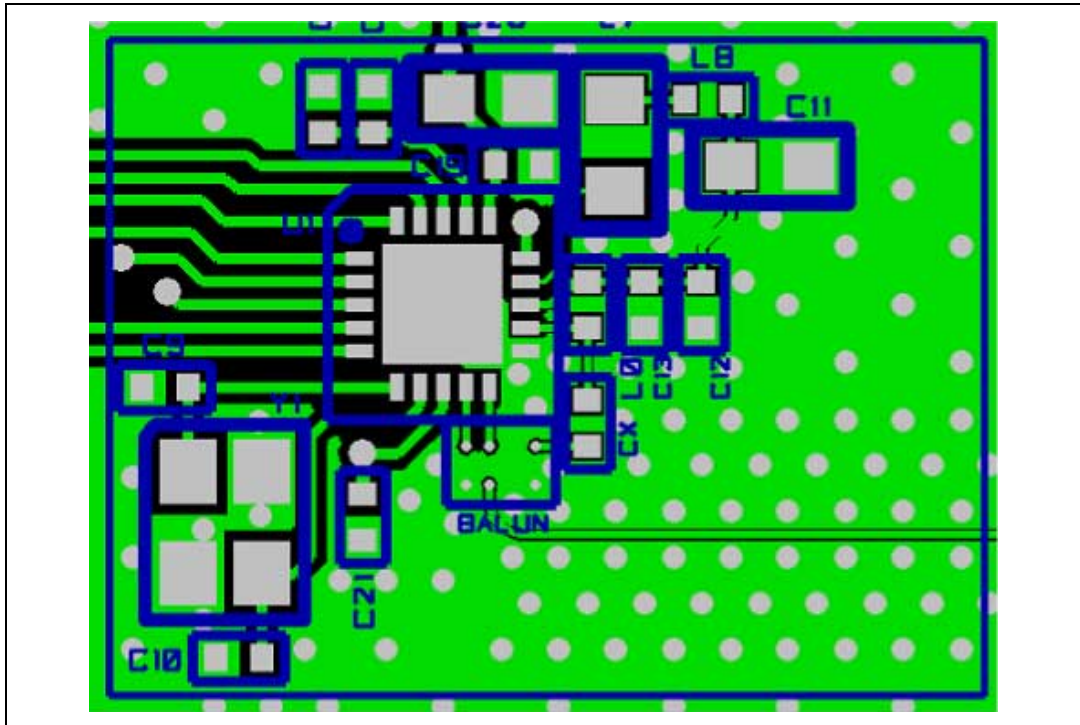


Figure 12. TX output measurements with BALF-SPI-01D3 at 868 MHz

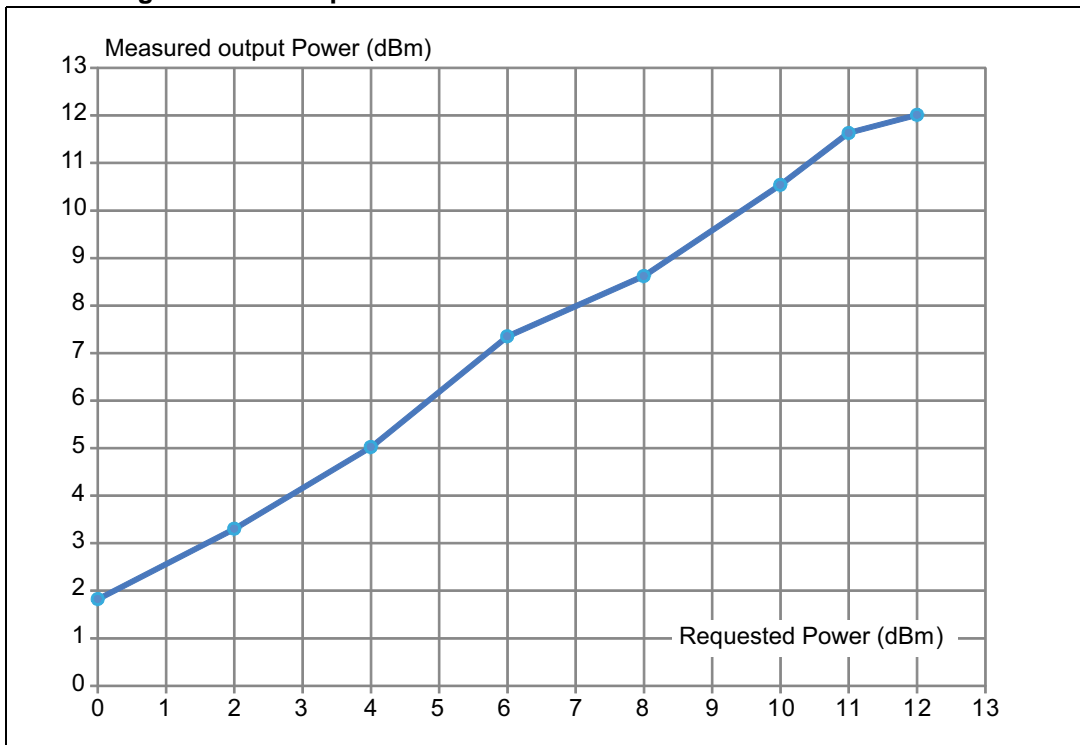


Figure 13. TX output power measurements over frequency with BALF-SPI-01D3

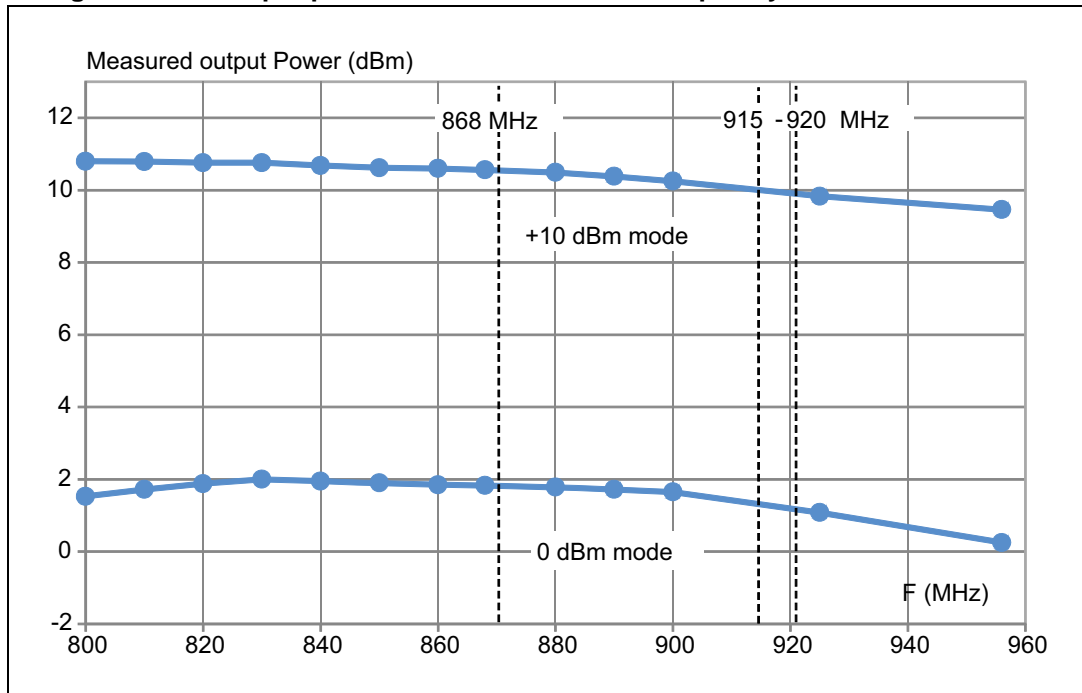
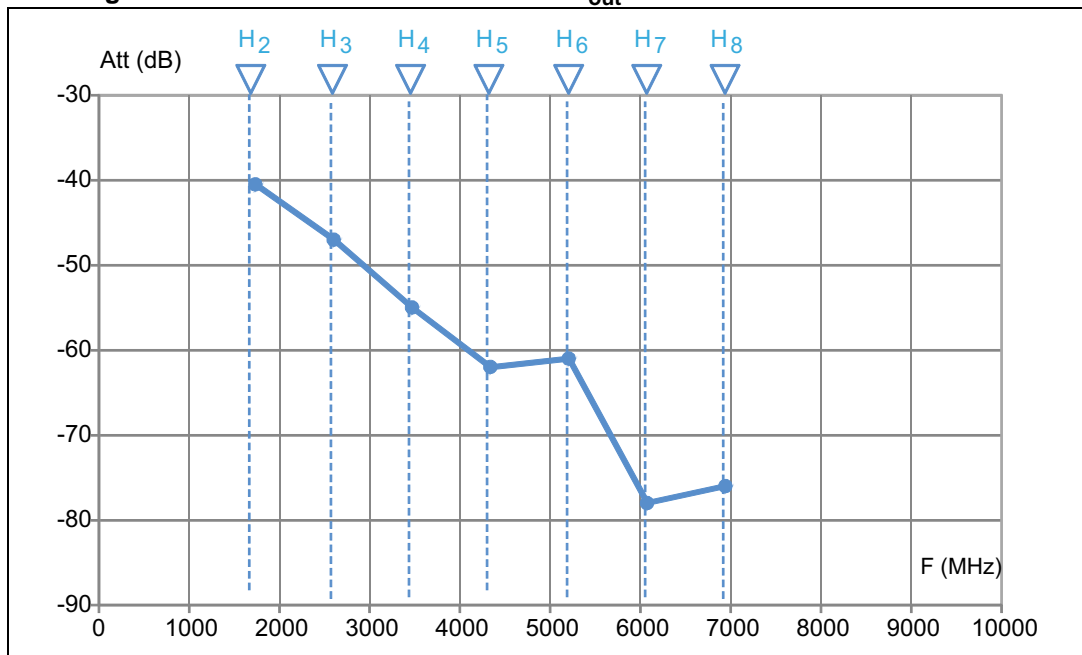


Figure 14. Harmonic measurements at  $P_{out} = 10$  dBm with BALF-SPI-01D3



### 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<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

#### 3.1 Flip-Chip package information

Figure 15. Flip-Chip package outline

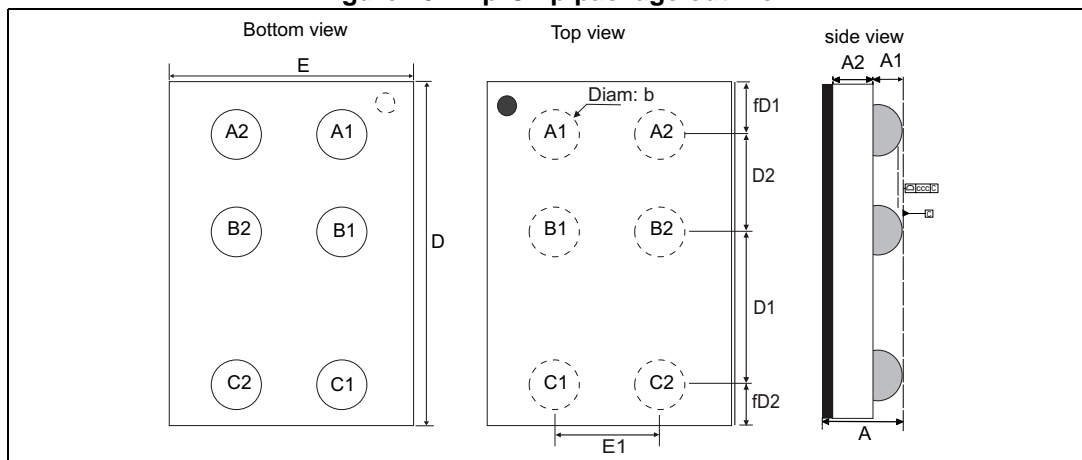
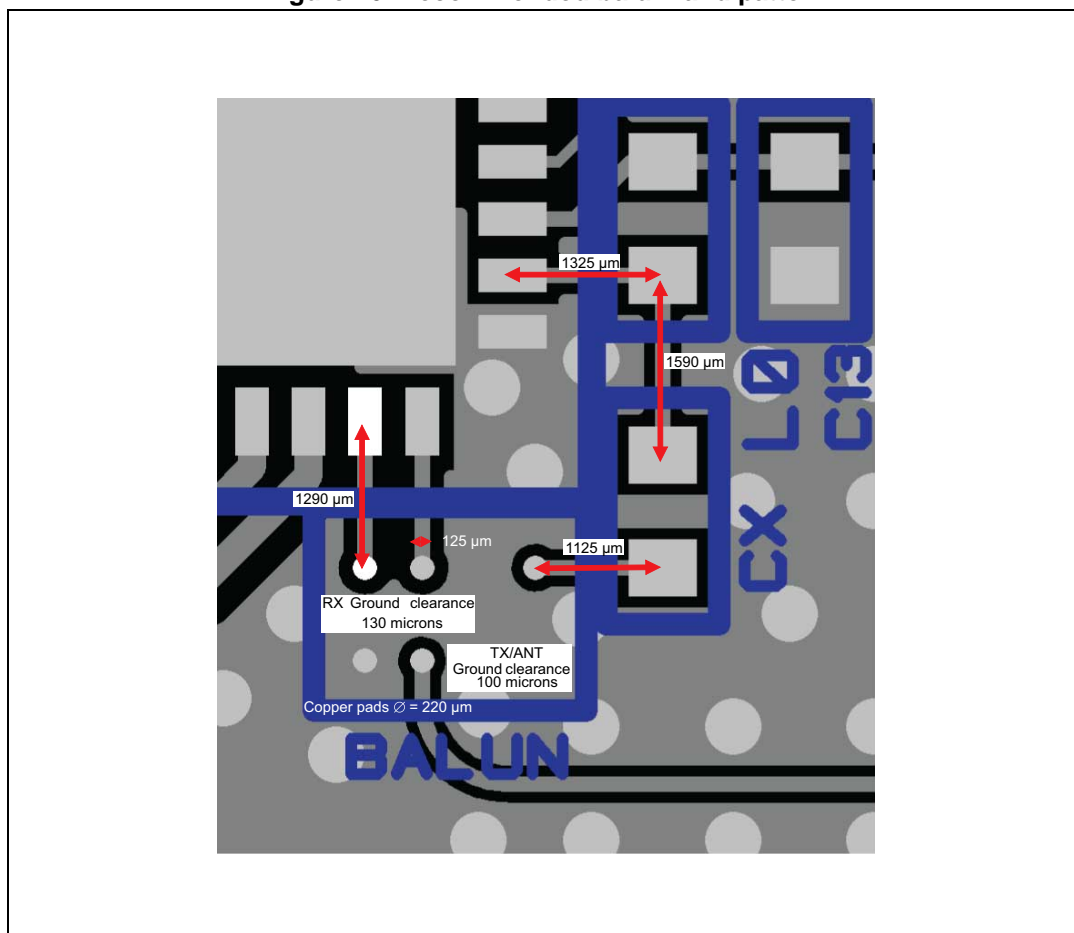


Table 4. Flip-Chip package mechanical data

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



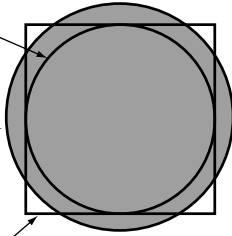


**Figure 17. Footprint - 3 mils stencil - non solder mask defined**

Copper pad diameter:  
220  $\mu\text{m}$  recommended  
180  $\mu\text{m}$  minimum  
260  $\mu\text{m}$  maximum

Solder mask opening:  
320  $\mu\text{m}$  recommended  
300  $\mu\text{m}$  minimum  
340  $\mu\text{m}$  maximum

Solder stencil opening:  
220  $\mu\text{m}$  recommended

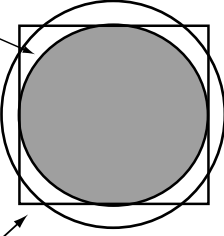


**Figure 18. Footprint - 3 mils stencil - solder mask defined**

Solder mask opening:  
220  $\mu\text{m}$  recommended  
180  $\mu\text{m}$  minimum  
260  $\mu\text{m}$  maximum

Copper pad diameter:  
320  $\mu\text{m}$  recommended  
300  $\mu\text{m}$  minimum

Solder stencil opening:  
220  $\mu\text{m}$  recommended



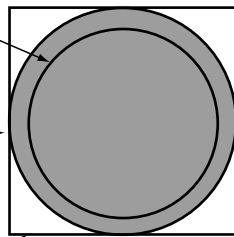
**Figure 19. Footprint - 5 mils stencil - non solder mask defined**

Copper pad diameter:  
220  $\mu\text{m}$  recommended  
180  $\mu\text{m}$  minimum  
260  $\mu\text{m}$  maximum

Solder mask opening:  
320  $\mu\text{m}$  recommended  
300  $\mu\text{m}$  minimum  
340  $\mu\text{m}$  maximum

Solder stencil opening:  
330  $\mu\text{m}$  recommended\*

\*depending on paste, it can go down to 270  $\mu\text{m}$



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

Solder mask opening:  
220  $\mu\text{m}$  recommended  
180  $\mu\text{m}$  minimum  
260  $\mu\text{m}$  maximum

Copper pad diameter:  
320  $\mu\text{m}$  recommended  
300  $\mu\text{m}$  minimum

Solder stencil opening:  
330  $\mu\text{m}$  recommended\*

\*depending on paste, it can go down to 270  $\mu\text{m}$

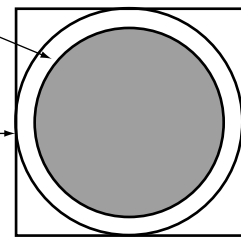


Figure 21. Marking

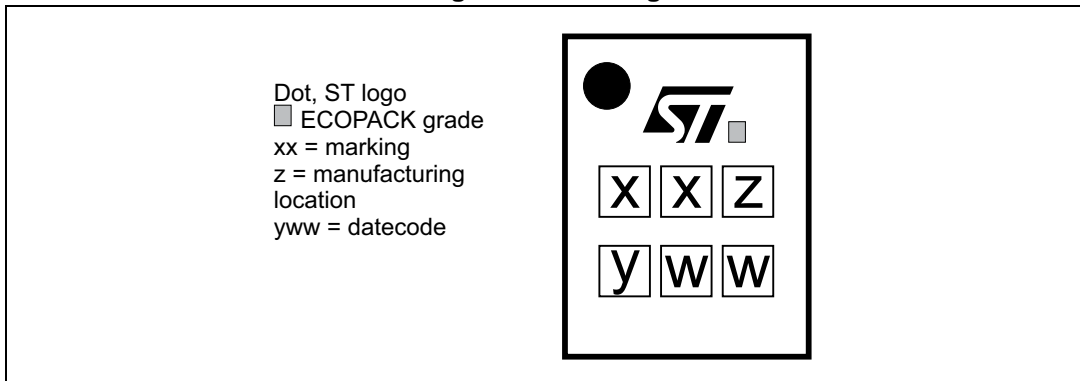
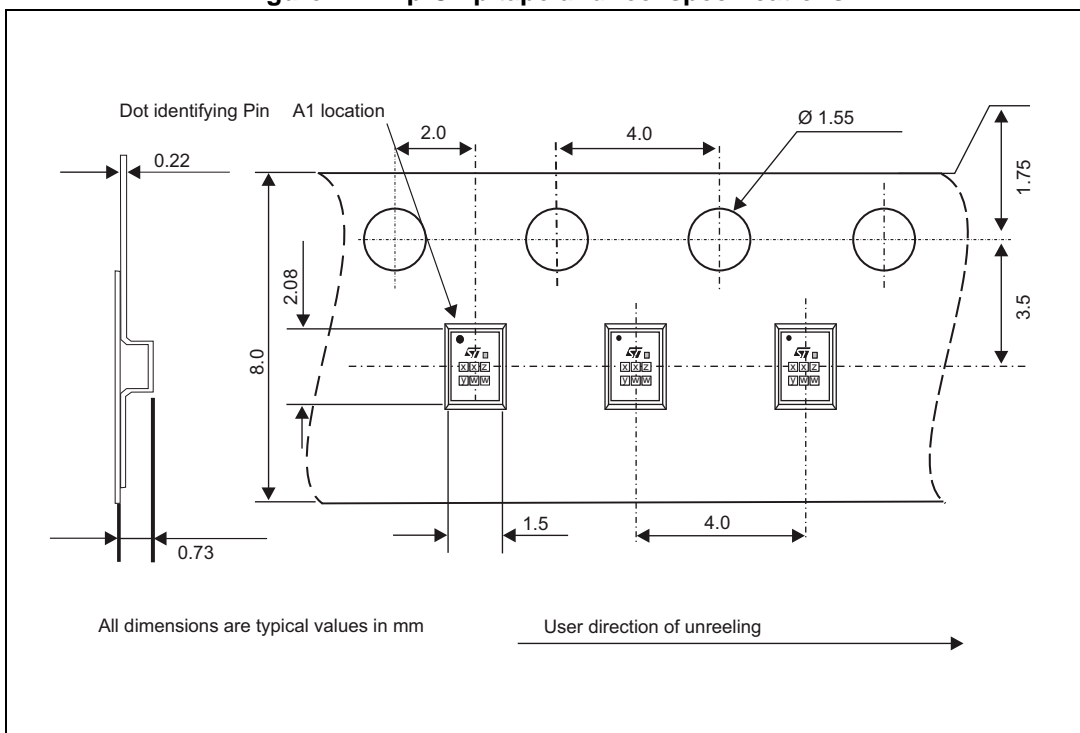


Figure 22. Flip Chip tape and reel specifications



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 <a href="#">Figure 2</a> and <a href="#">Figure 15</a> .

**IMPORTANT NOTICE – PLEASE READ CAREFULLY**

STMicroelectronics NV and its subsidiaries (“ST”) reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST’s terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers’ products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2015 STMicroelectronics – All rights reserved