

## 50 ohm nominal input / conjugate match balun to Spirit1, with integrated harmonic filter

Datasheet – production data

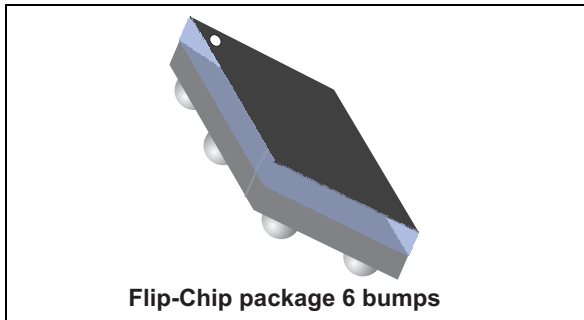


Figure 1. Pin coordinates (top view)

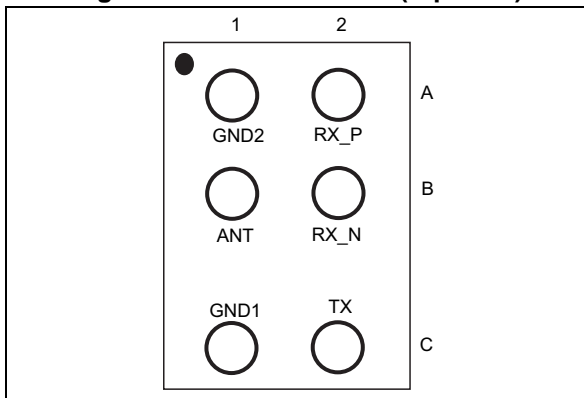
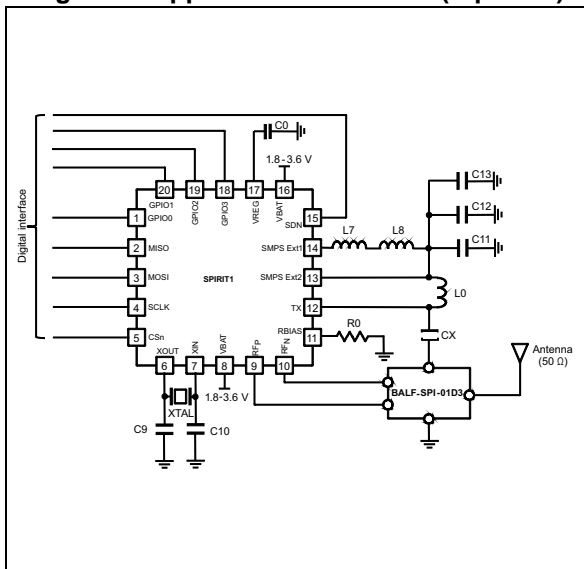


Figure 2. Application schematic (top view)



### 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 ultraminiature 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 performances.

# 1 Characteristics

**Table 1. Absolute maximum ratings (limiting values)**

Symbol	Parameter	Value			Unit
		Min.	Typ.	Max.	
P <sub>IN</sub>	Input power RFIN			20	dBm
V <sub>ESD</sub>	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 <sub>OP</sub>	Operating temperature (JESD22-A115-C), all I/O	-40		+85	°C

**Table 2. Impedances (T<sub>amb</sub> = 25 °C)**

Symbol	Parameter	Value			Unit
		Min.	Typ.	Max.	
Z <sub>RX</sub>	Nominal differential RX balun impedance		match to Spirit1		Ω
Z <sub>TX</sub>	Nominal TX filter impedance				
Z <sub>ANT</sub>	Antenna impedance		50		Ω

**Table 3. RF performance (T<sub>amb</sub> = 25 °C)**

Symbol	Parameter	Test condition	Value			Unit
			Min.	Typ.	Max.	
F	Frequency range (bandwidth)		779	868	956	MHz
S <sub>21</sub> <sub>RX-ANT</sub>	Insertion loss in bandwidth without mismatch loss (RX balun)			-1.7	-2	dB
S <sub>21</sub> <sub>TX-ANT</sub>	Insertion loss in bandwidth without mismatch loss (TX filter)			-1.4	-2	dB
S <sub>11</sub> <sub>ANT</sub>	Input return loss in bandwidth (RX balun)			-23	-15	dB
S <sub>11</sub> <sub>ANT</sub>	Input return loss in bandwidth (TX filter)			-15	-12	dB
Φ <sub>imb</sub>	Output phase imbalance (RX balun)		5	10	15	°
A <sub>imb</sub>	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)

Figure 3. Insertion loss ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ )

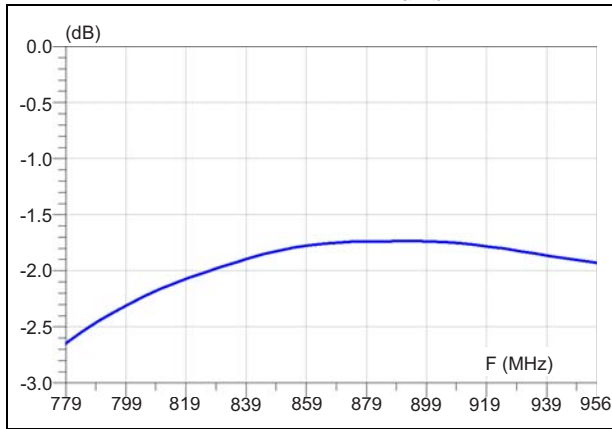


Figure 4. Return loss antenna ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ )

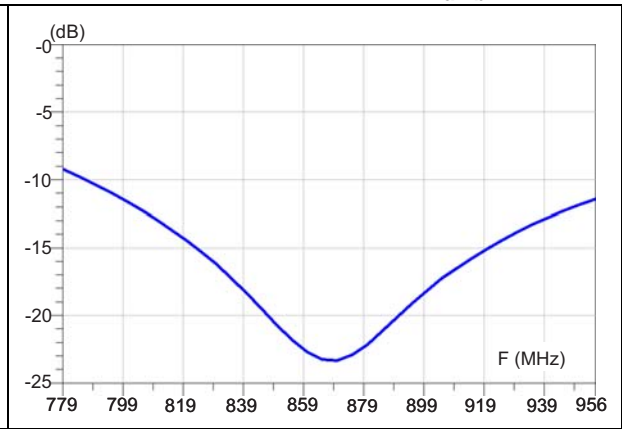


Figure 5. Phase imbalance ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ )

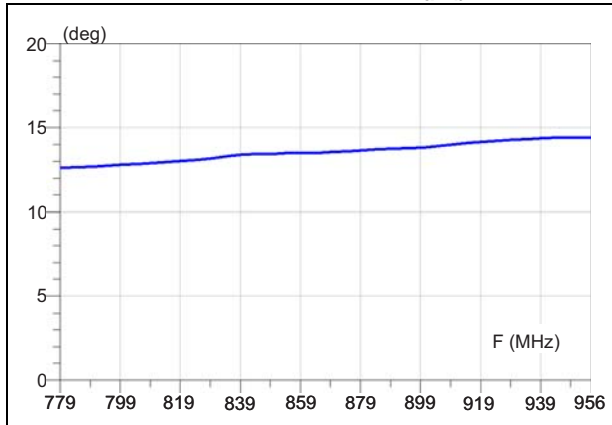
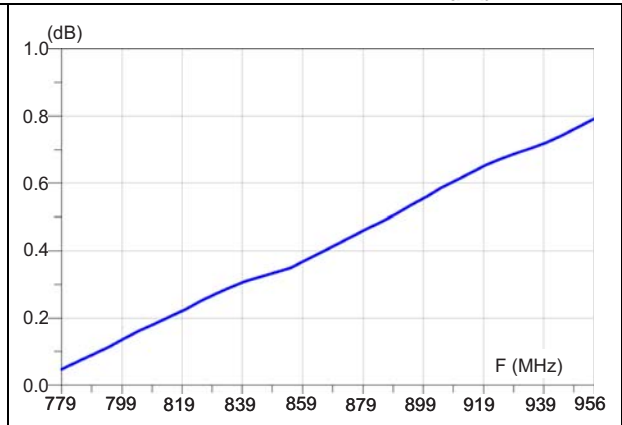


Figure 6. Amplitude imbalance ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ )



## 1.2 RF measurement (Tx filter)

Figure 7. Transmission ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ )

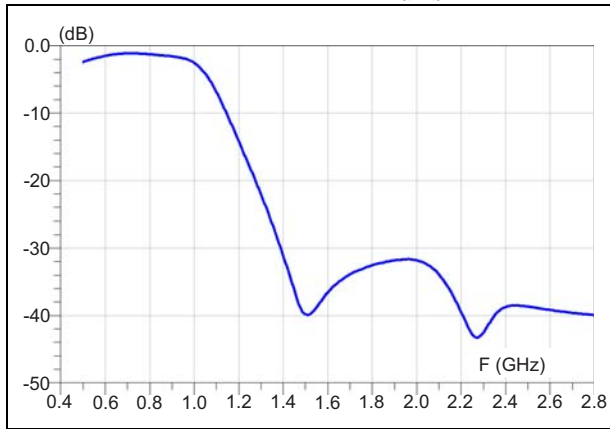


Figure 8. Insertion loss ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ )

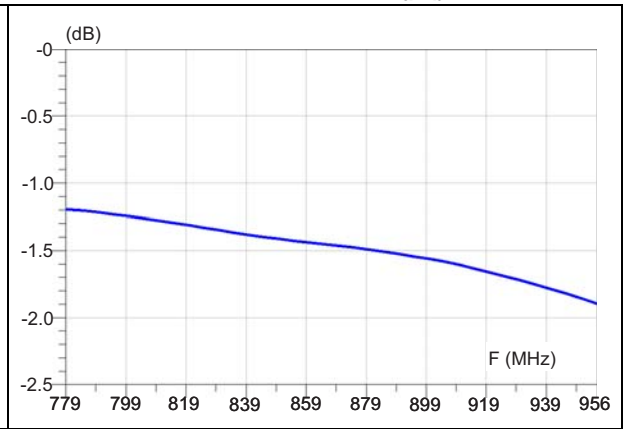


Figure 9. Attenuation ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ )

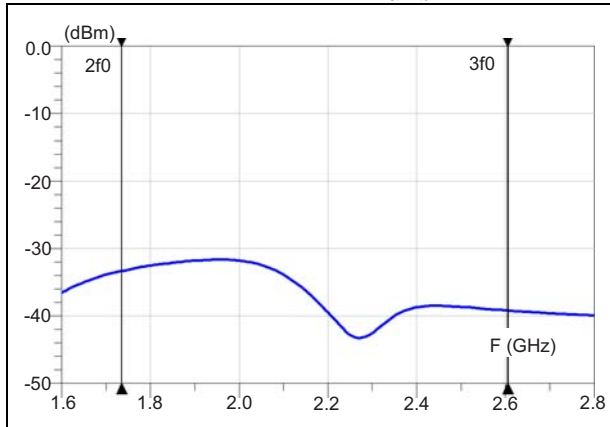
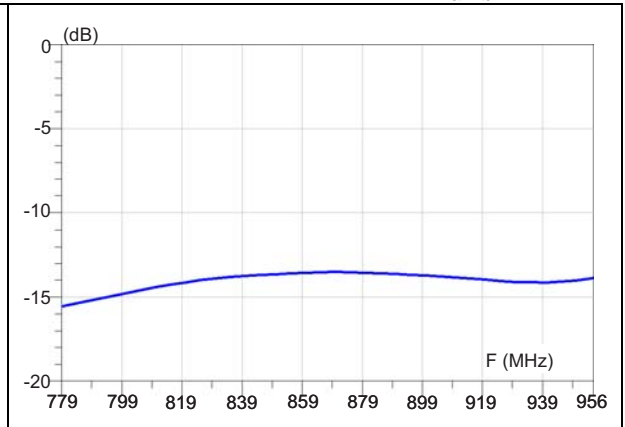


Figure 10. Return loss antenna ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ )



## 2 Application information

Figure 11. Application board EVB (4 layers)

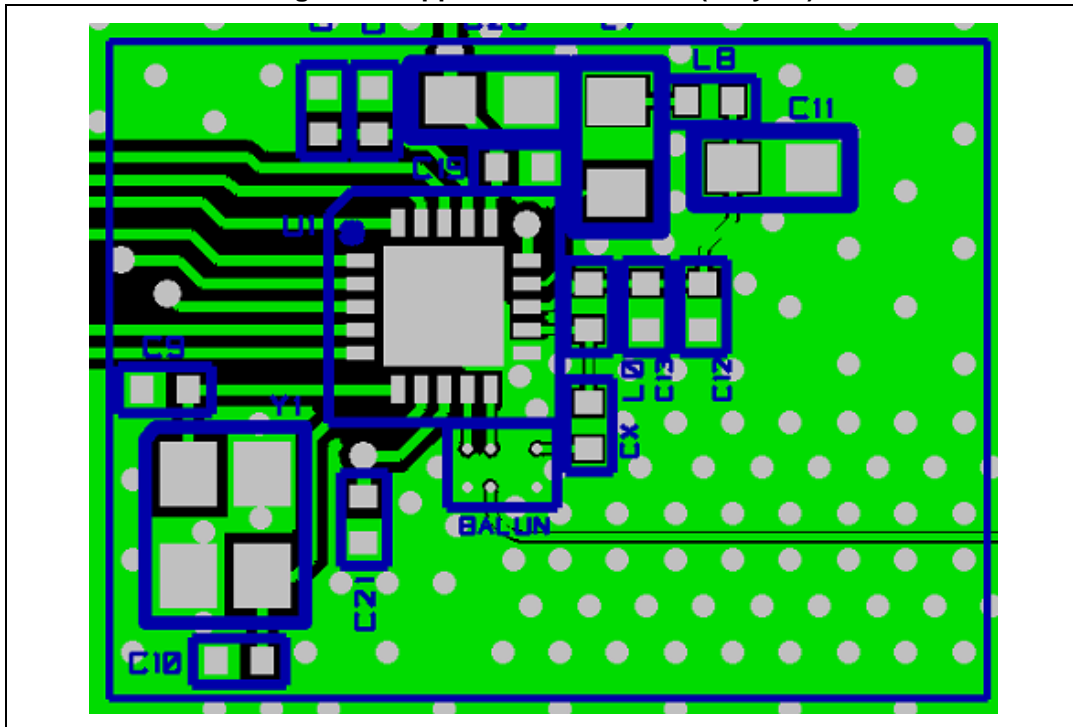


Figure 12. TX output measurements with BALF-SPI-01D3 at 868 MHz

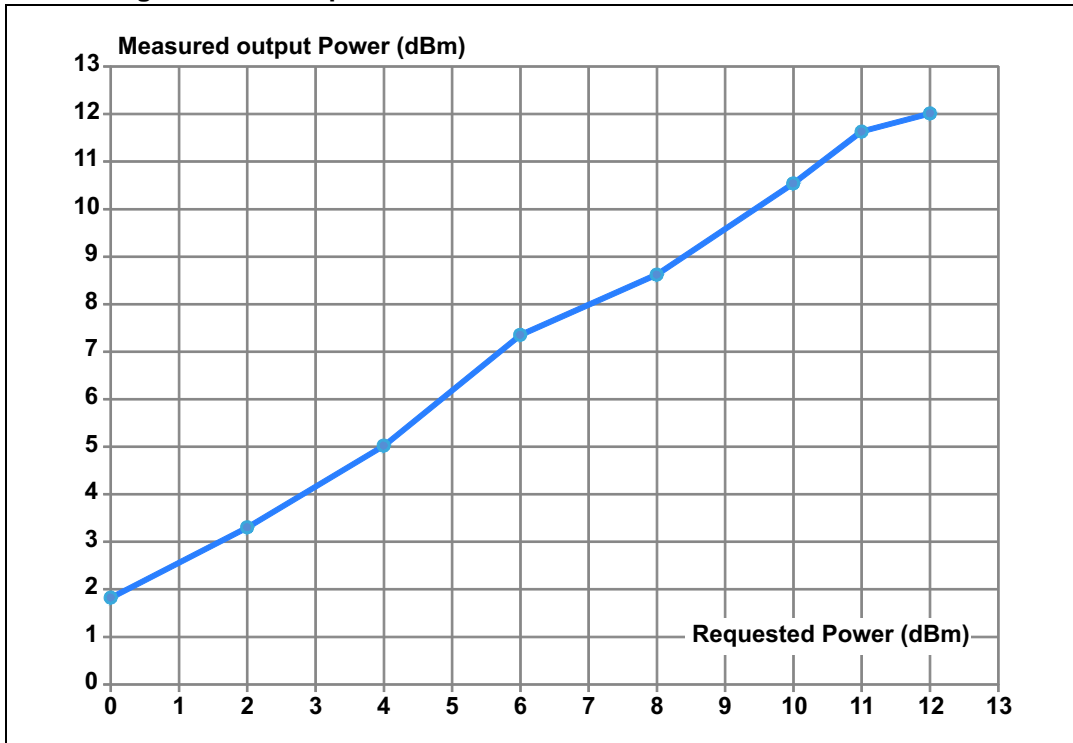


Figure 13. TX output power measurements over frequency with BALF-SPI-01D3

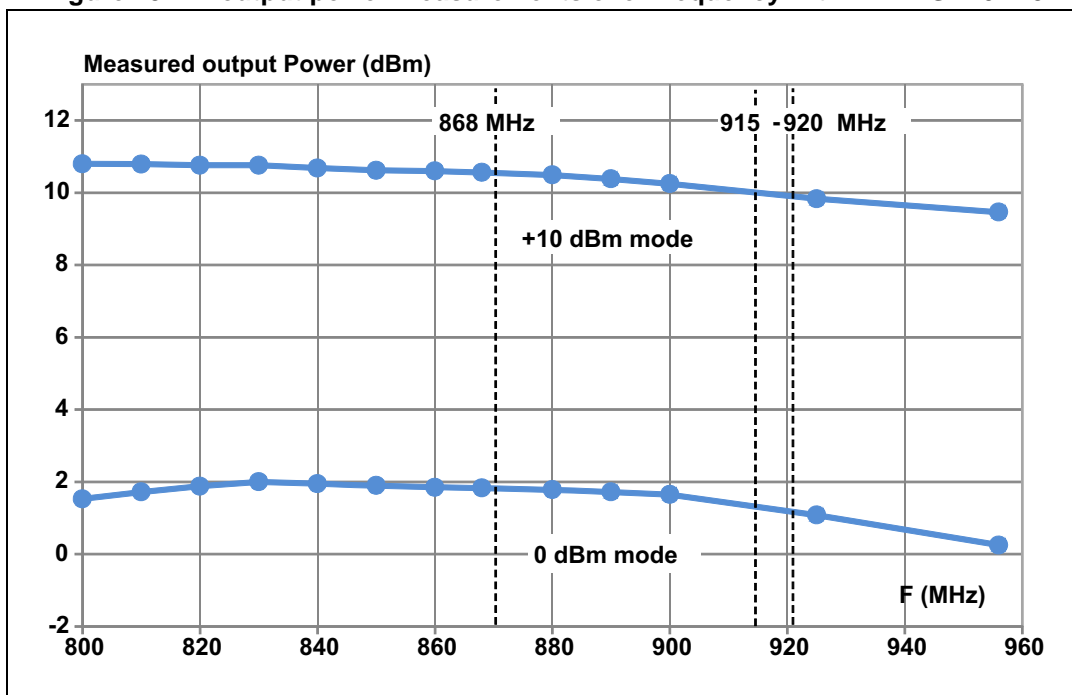
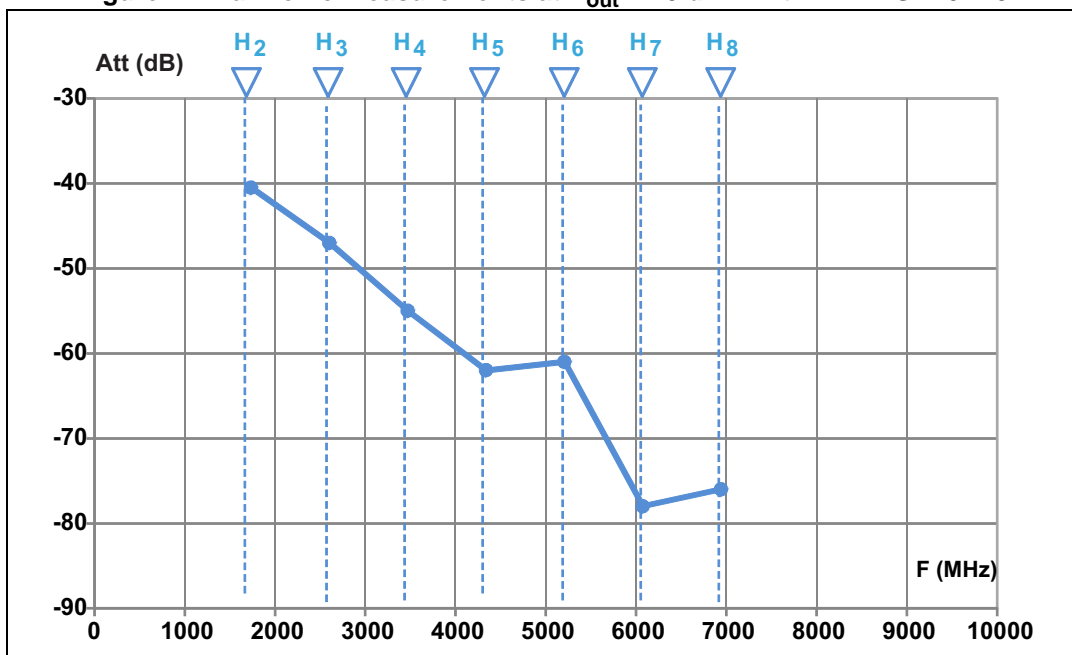


Figure 14. Harmonic measurements at  $P_{out} = 10$  dBm with BALF-SPI-01D3



### 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.

Figure 15. Package dimensions (top and side view)

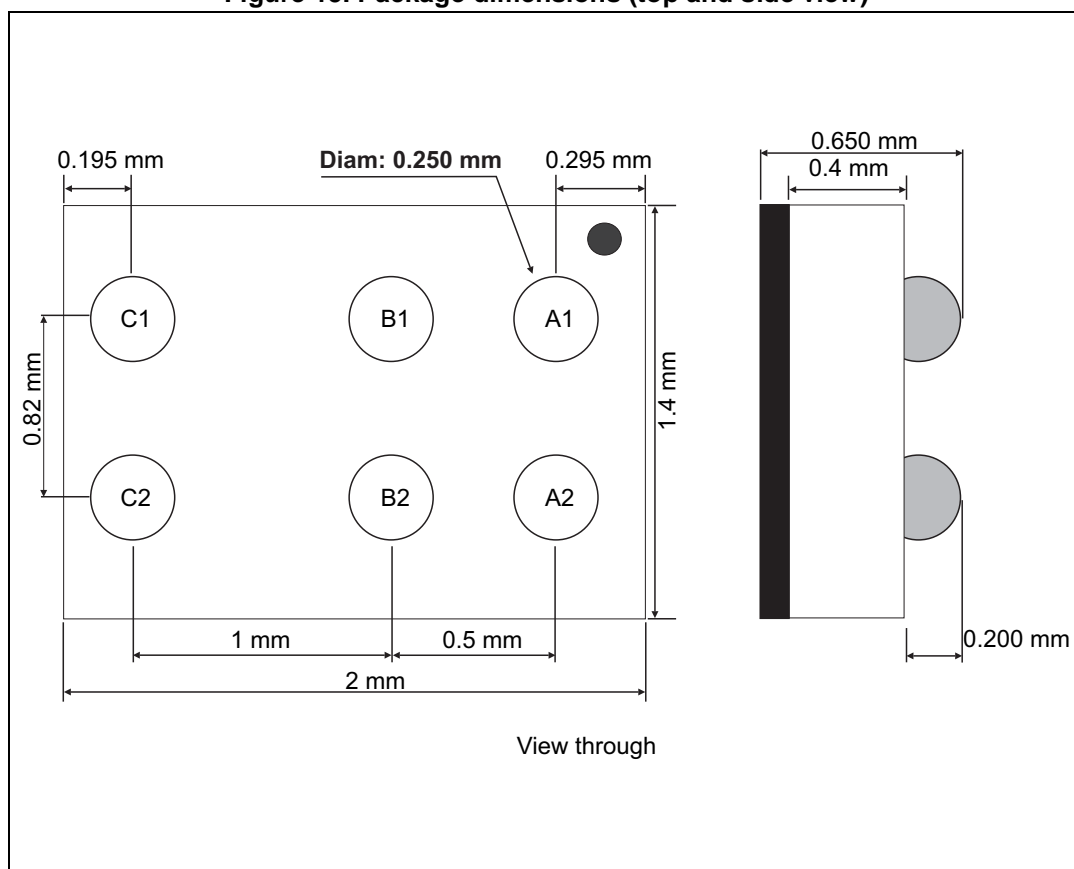


Figure 16. Recommended balun land pattern

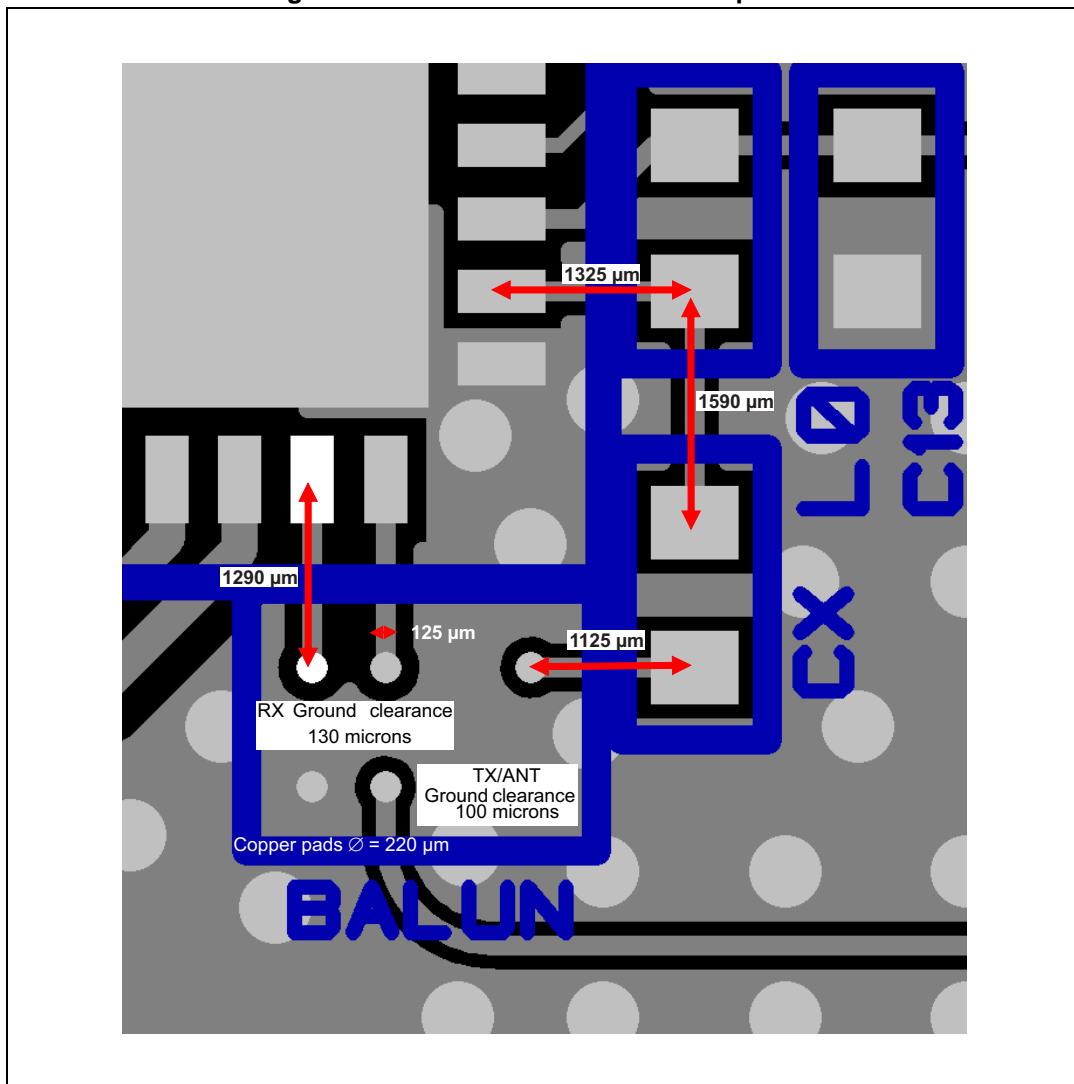


Figure 17. Footprint - non solder mask defined

Figure 18. Footprint - solder mask defined

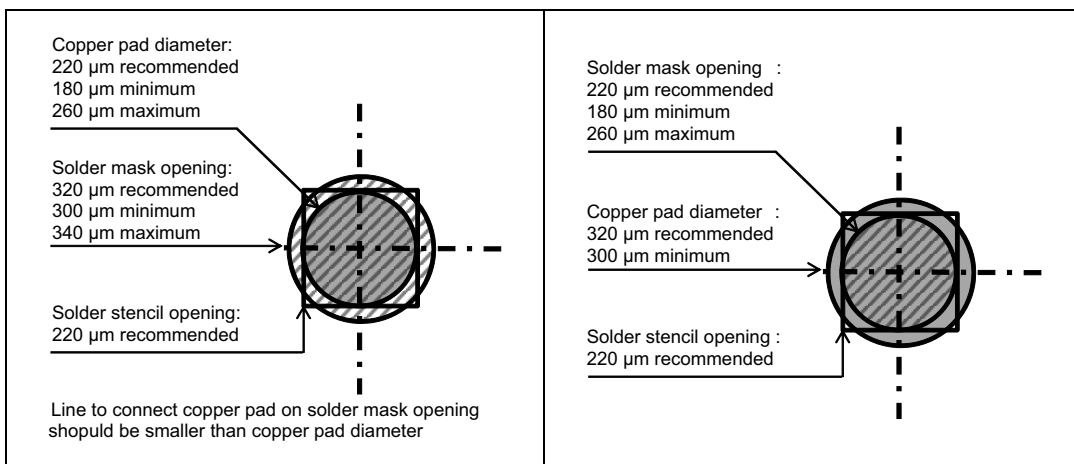




Figure 19. Marking

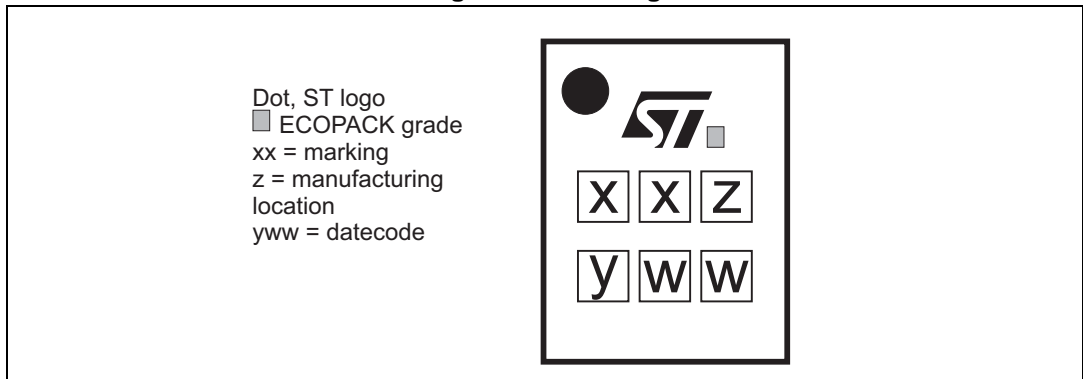
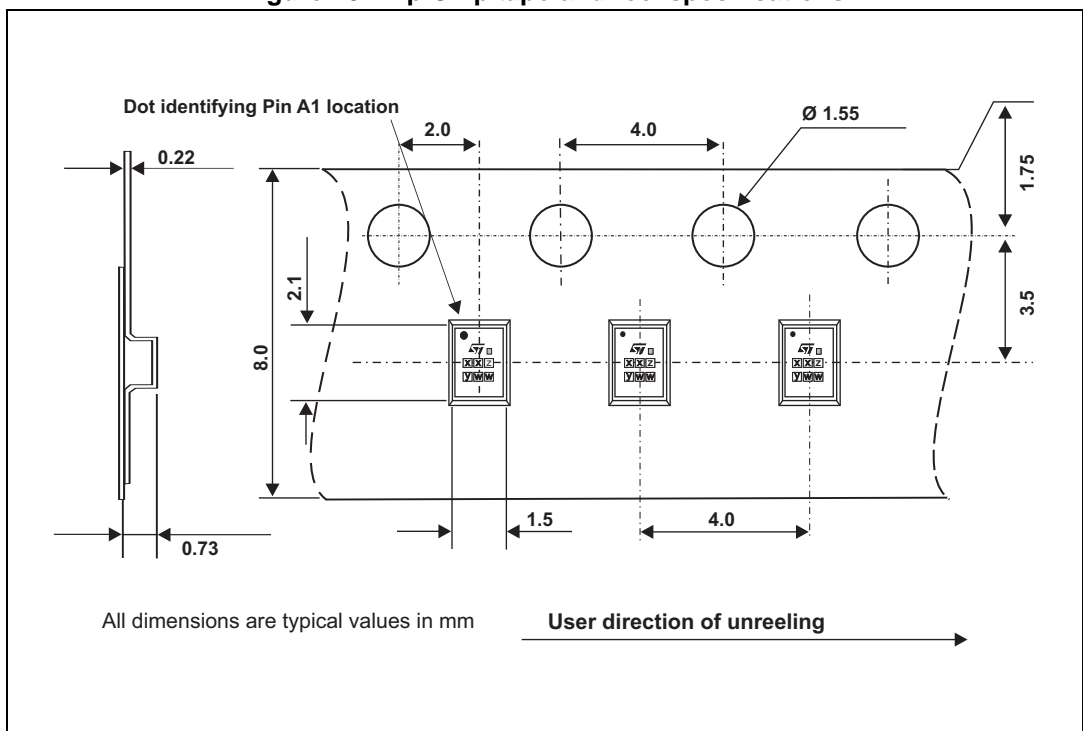


Figure 20. Flip Chip tape and reel specifications



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

## 4 Ordering information

Table 4. 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 5. Document revision history

Date	Revision	Changes
27-Aug-2013	1	Initial release
03-Oct-2013	2	Updated document title. Updated <a href="#">Table 1</a> with JESD22 references.

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