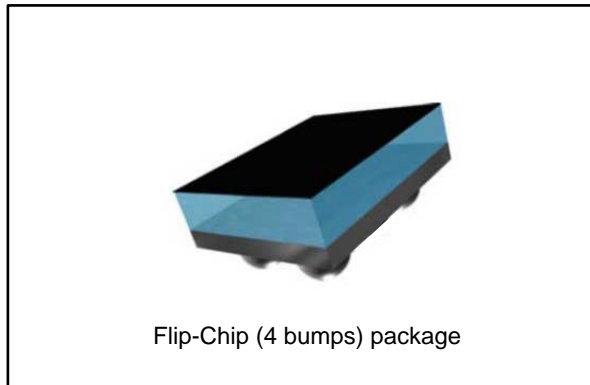


50 ohm nominal input / conjugate match balun balun to BlueNRG tranceiver, with integrated harmonic filter

Datasheet - production data



## Features

- 50  $\Omega$  nominal input / conjugate match to BlueNRG device
- Low insertion loss
- Low amplitude imbalance
- Low phase imbalance
- Wafer level chip scale package (WLCSP)

## Benefits

- Very low profile < 670  $\mu\text{m}$
- High RF performance
- RF BOM reduction
- Small footprint

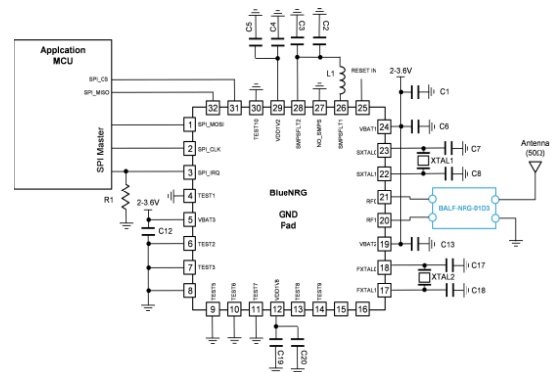
## Applications

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

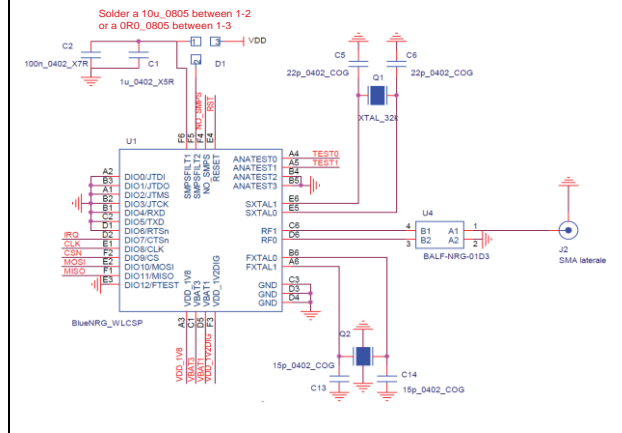
## Description

STMicroelectronics BALF-NRG-01D3 is an ultra miniature balun. The BALF-NRG-01D3 integrates matching network and harmonics filter. Matching impedance has been customized for the BlueNRG ST transceiver (both QFN and WLCSP versions). It is using STMicroelectronics IPD technology on non conductive glass substrate which optimizes RF performance.

**Figure 1: Application schematic with QFN type BlueNRG**



**Figure 2: Application schematic with WLCSP type BlueNRG**



# 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 MIL STD883C (HBM: C = 100 pF, R = 1.5 Ω, air discharge)	2000	-		V
	ESD ratings machine model (MM: C = 200 pF, R = 25 W, L = 500 nH)	200	-		
T <sub>OP</sub>	Operating temperature	-40	-	+105	°C

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

Symbol	Parameter	Value			Unit
		Min.	Typ.	Max.	
Z <sub>OUT</sub>	Nominal differential output impedance	-	Match to BlueNRG	-	Ω
Z <sub>IN</sub>	Nominal input 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)		2400		2500	MHz
S <sub>11</sub>	Input return loss bandwidth			-20		dB
S <sub>21</sub>	Insertion loss			-1.1		dB
S <sub>21</sub>	Harmonic rejection (differential mode)	H2		-8		dB
		H3		-38		
		H4		-31		
		H5		-23		
φ <sub>imb</sub>	Output phase imbalance			7		°
A <sub>imb</sub>	Output amplitude imbalance			0.5		dB

## 1.1 RF measurement

Figure 3: Differential transmission

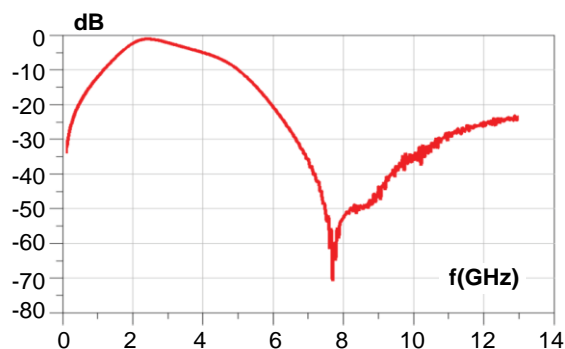


Figure 4: Return loss

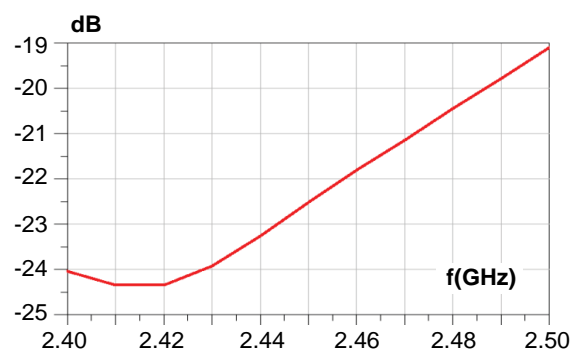


Figure 5: Insertion loss

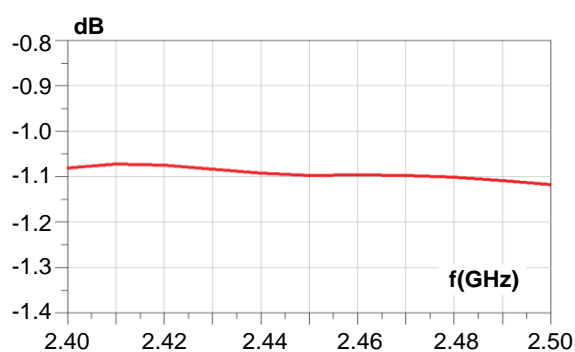


Figure 6: H2 filtering

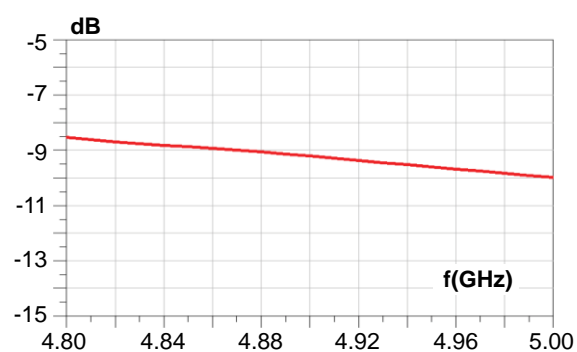


Figure 7: H3 filtering

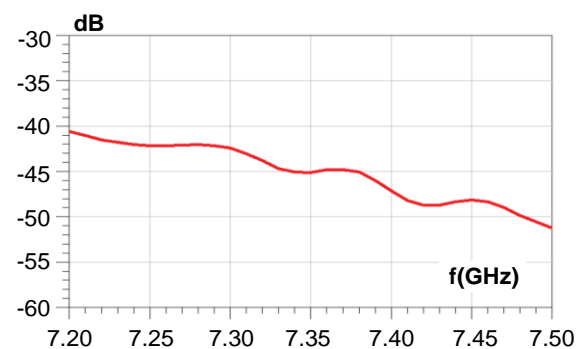


Figure 8: H4 filtering

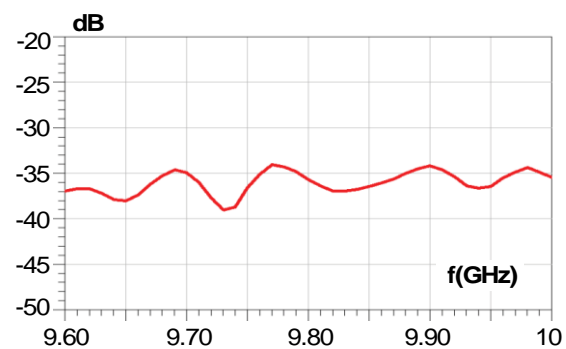


Figure 9: H5 filtering

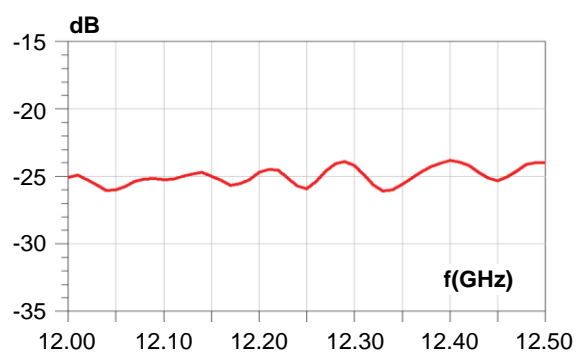


Figure 10: Amplitude imbalance

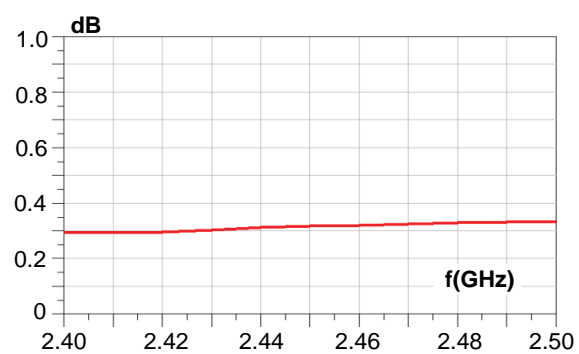
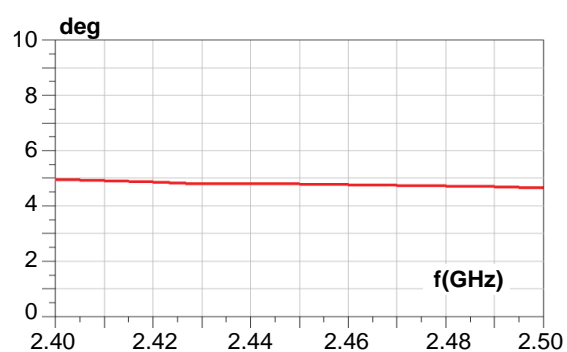


Figure 11: Phase imbalance



## 2 BALF-NRG-01D3 with QFN type BlueNRG

Figure 12: Application board EVB (2 layers)

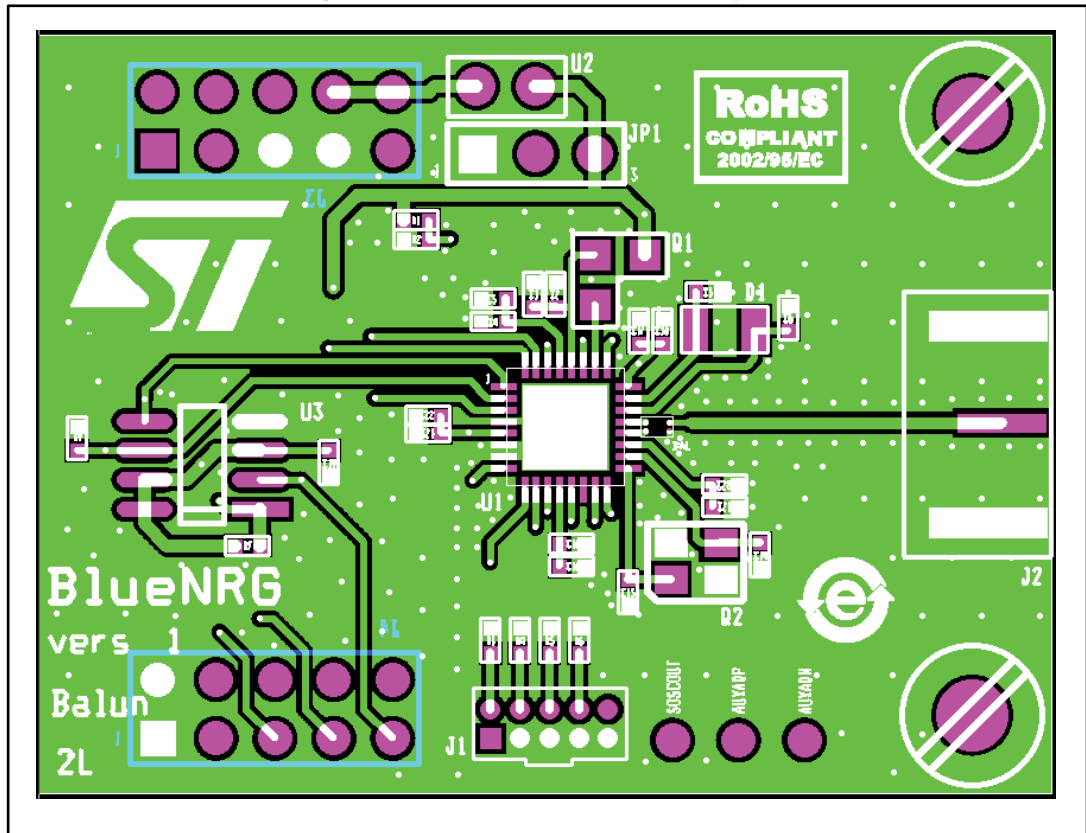
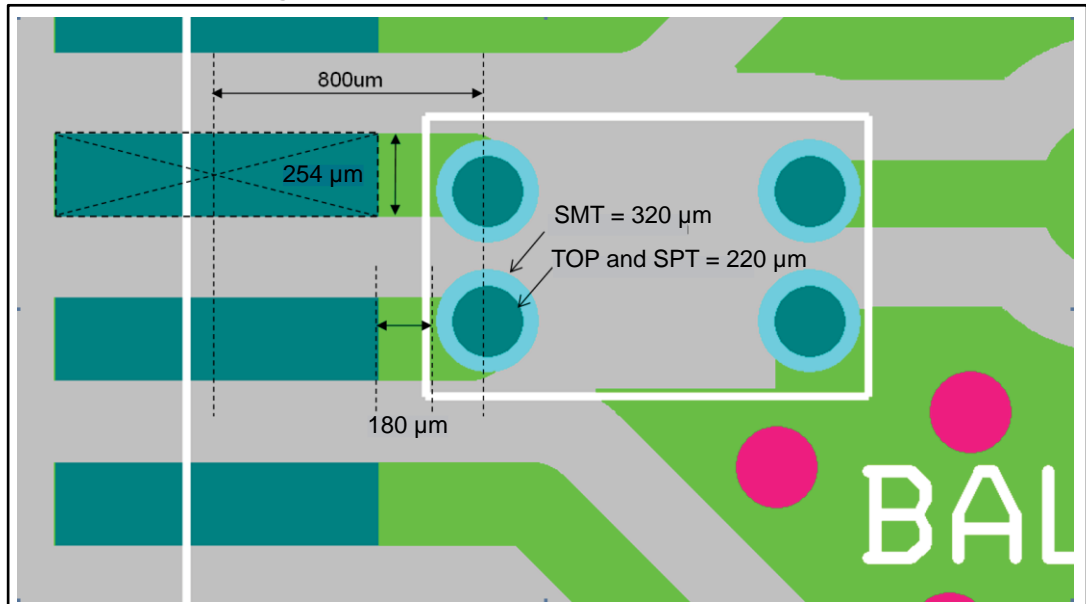


Figure 13: Recommended balun land pattern (EVB)



## 2.1 BALF-NRG-01D3 measurements on QFN EVB

Figure 14: Harmonics

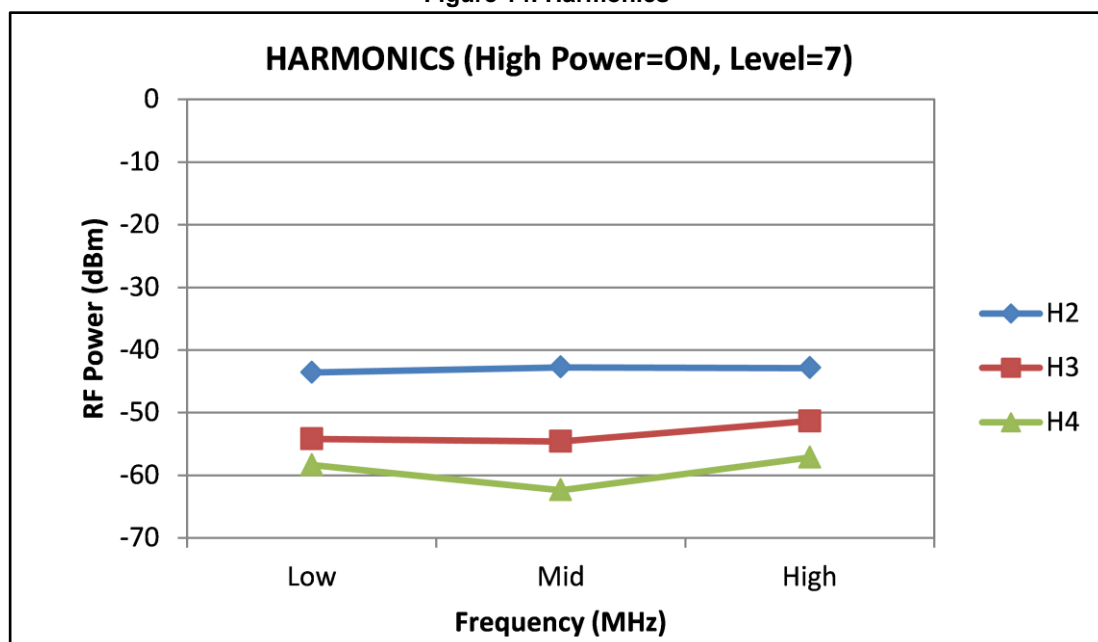


Figure 15: Sensitivity

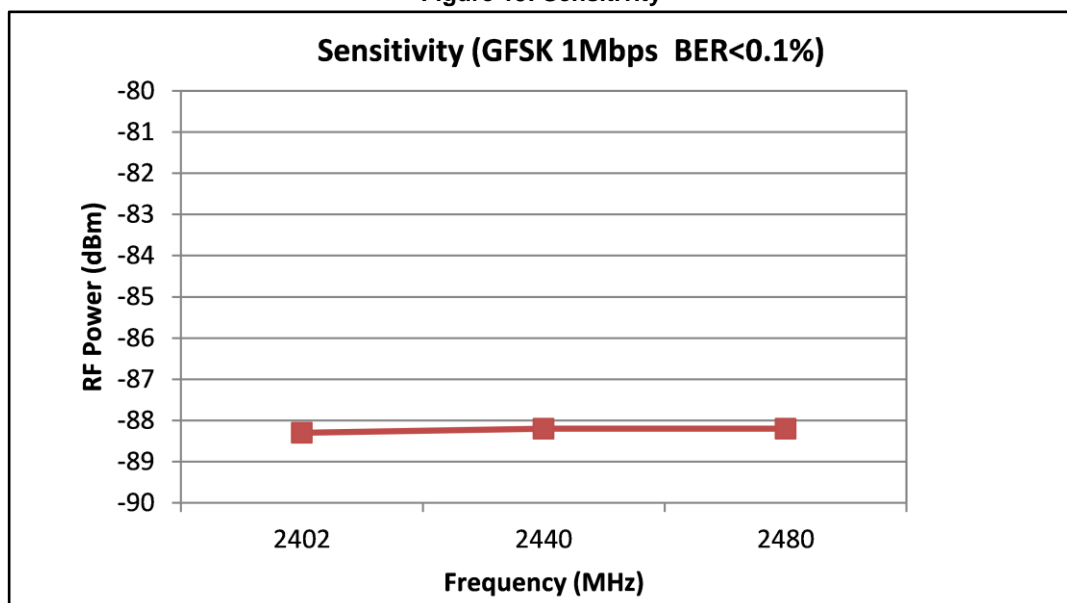
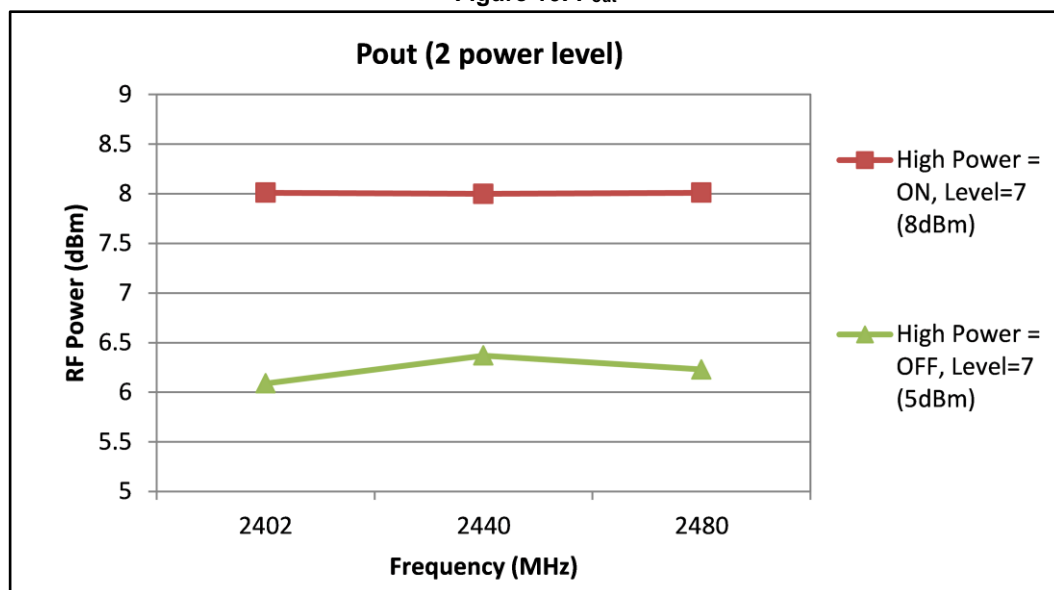


Figure 16: P<sub>out</sub>

### 3 BALF-NRG-01D3 with WLCSP type BlueNRG

Figure 17: Recommended balun land pattern (WLCSP)

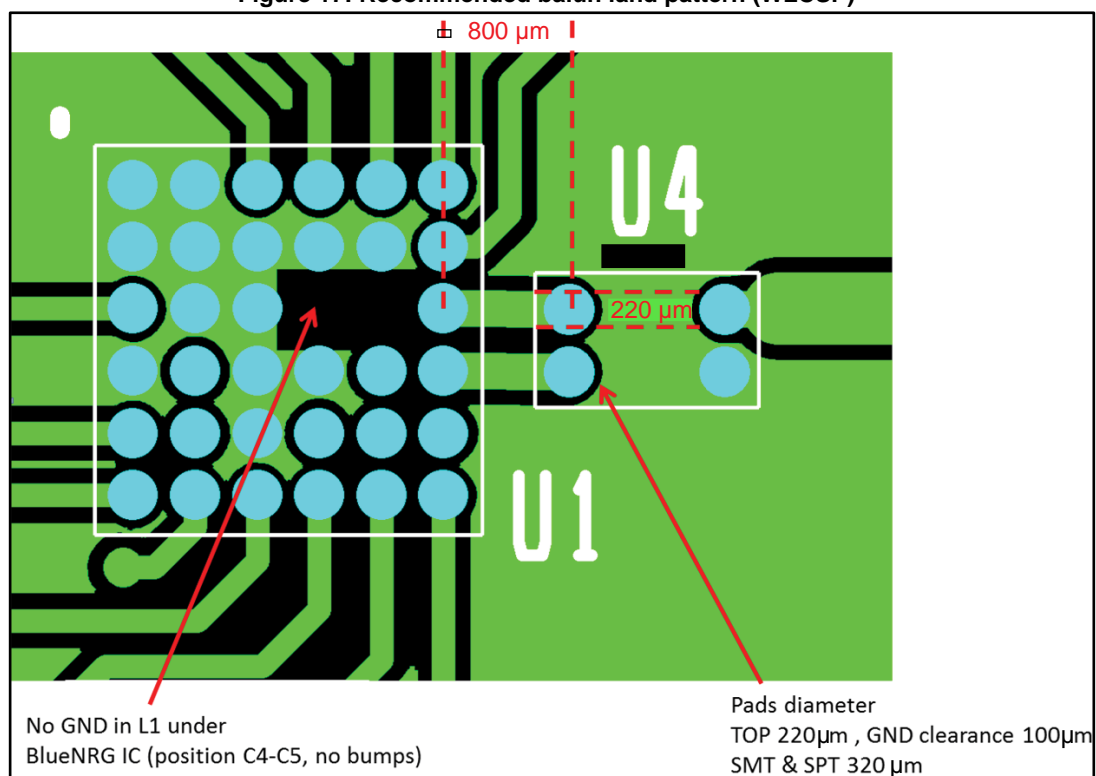


Figure 18: PCB stack-up recommendation





### 3.1 BALF-NRG-01D3 measurements on WLCSP EVB

Figure 19: Harmonics

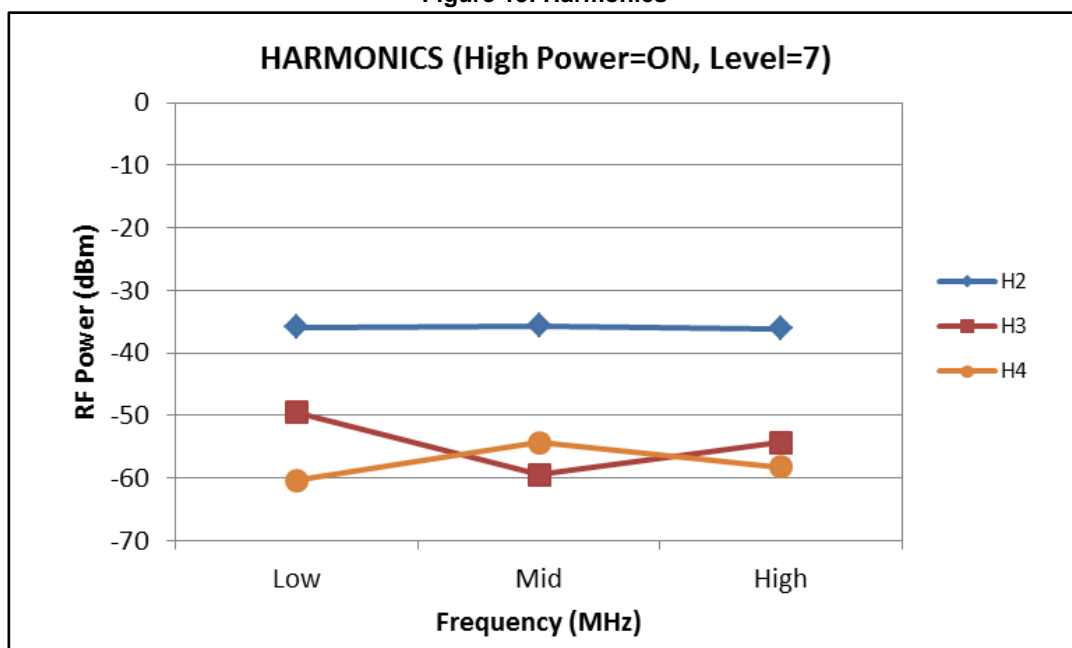


Figure 20: Sensitivity

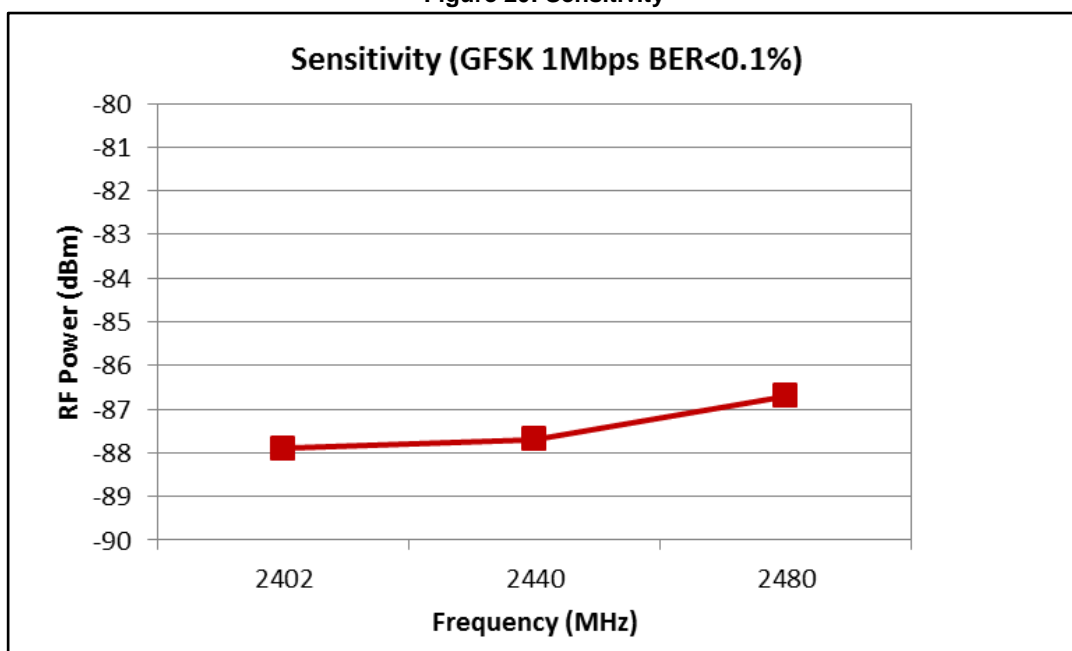
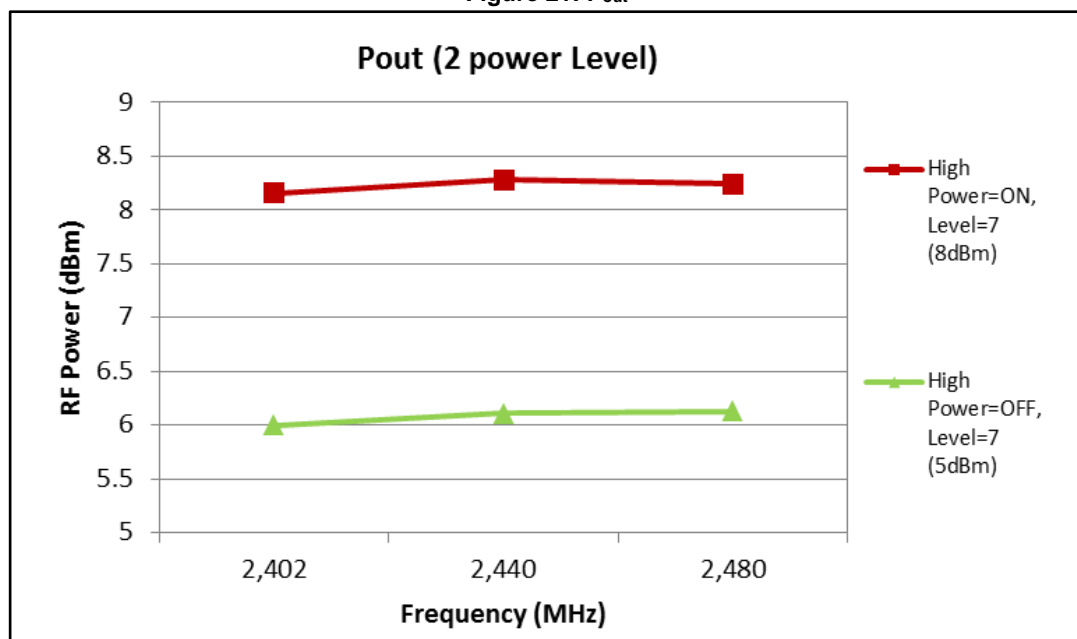


Figure 21: P<sub>out</sub>

## 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](http://www.st.com). ECOPACK® is an ST trademark.

- Epoxy meets UL94, V0
- Lead-free package

### 4.1 Flip-Chip 4 bumps package information

Figure 22: Flip-Chip 4 bumps package outline

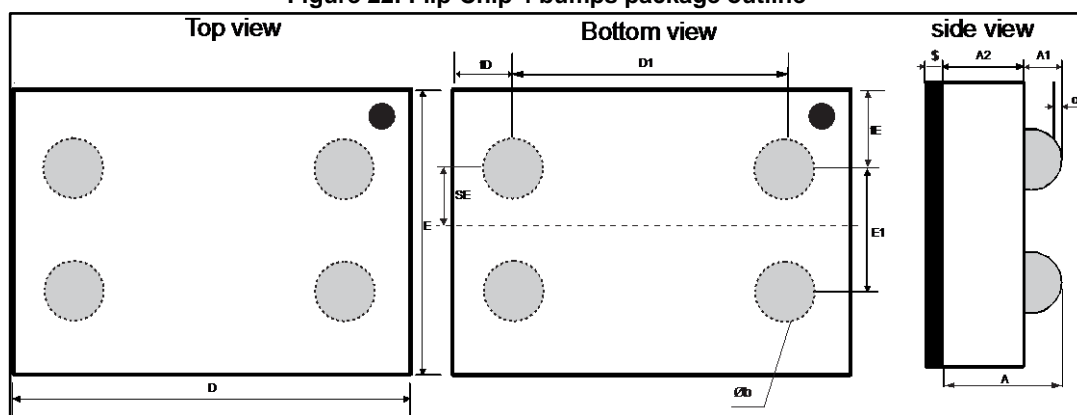


Table 4: Flip-Chip 5 bumps dimensions

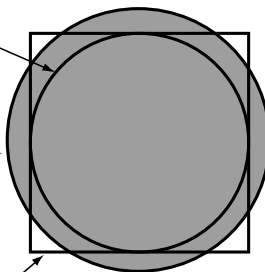
Parameter	Dimensions (in mm)		
	Min.	Typ.	Max.
A	0.580	0.630	0.680
A1	0.180	0.205	0.230
A2	0.380	0.400	0.420
b	0.230	0.255	0.280
D	1.375	1.400	1.425
D1	0.990	1.000	1.010
E	0.825	0.850	0.875
E1	0.390	0.400	0.410
SE		0.200	
fD	0.170	0.200	0.230
fE	0.195	0.225	0.255
ccc			0.050
Ø		0.025	

**Figure 23: 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

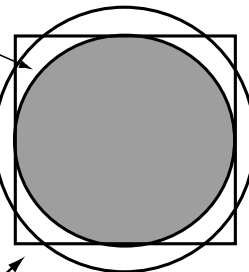
Solder stencil opening:  
220  $\mu\text{m}$  recommended

**Figure 24: 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

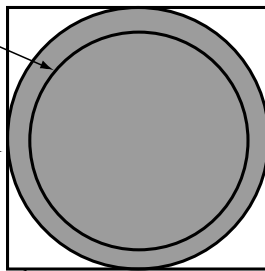
**Figure 25: Footprint - 5 mils stencil -non solder mask defined**

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  $\mu\text{m}$

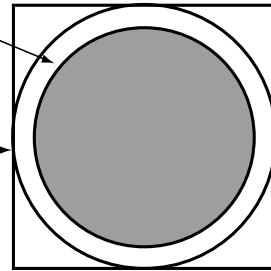
**Figure 26: Footprint - 5 mils stencil - solder mask defined**

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  $\mu\text{m}$



## 4.2 Flip-chip 4 bumps packing information

### Figure 27: Marking

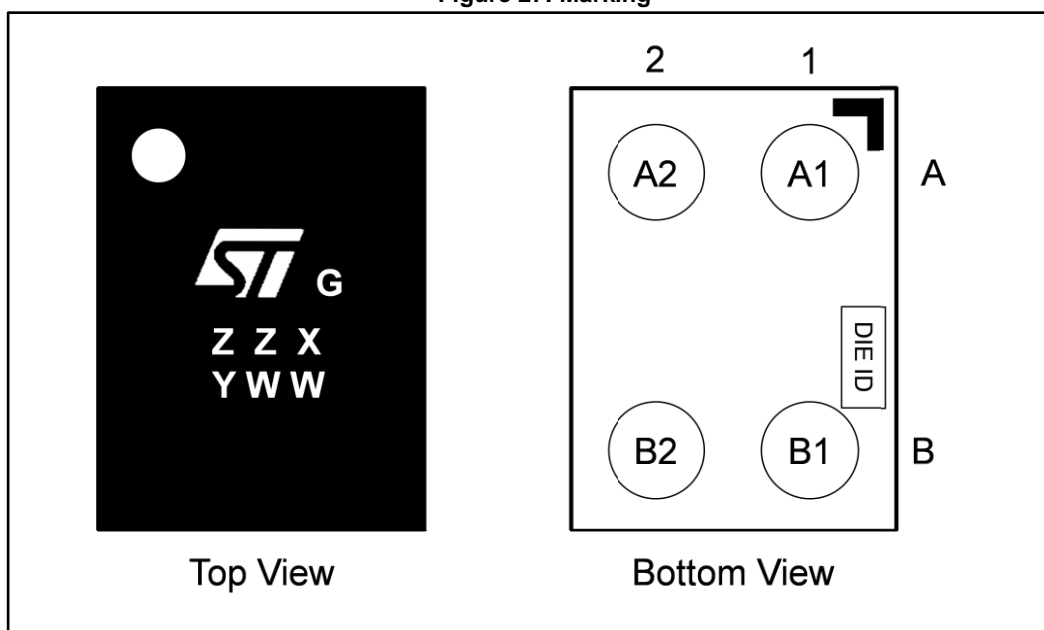
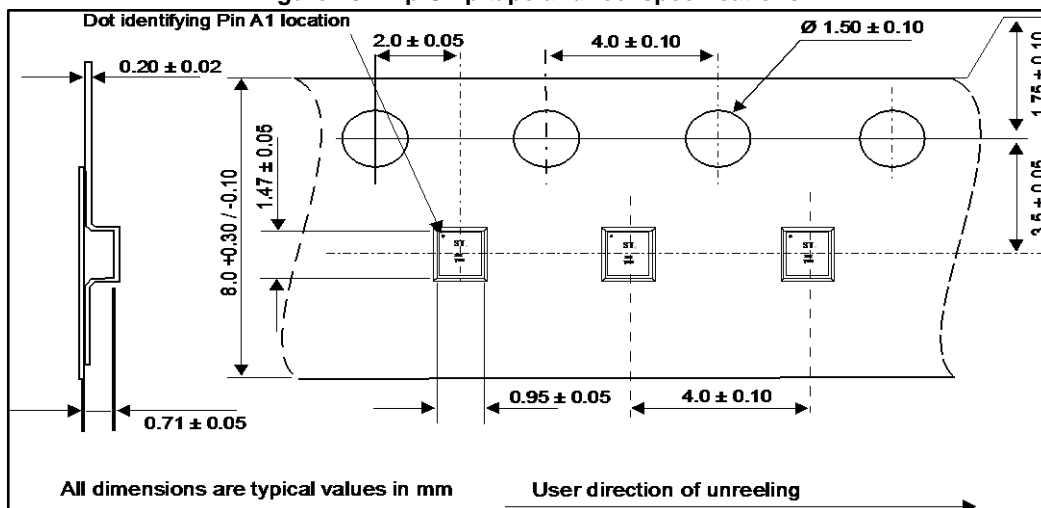


Table 5: Document revision history

Ball	Name	Description
A1	ANT	Antenna connection
A2	GND	Ground
B1	Rx_P	Balun receive positive output
B2	Rx_N	Balun receive negative output

**Figure 28: Flip Chip tape and reel specifications**



More packing information is available in the application note:

- AN2348 Flip-Chip: “Package description and recommendations for use”

## 5 Ordering information

Table 6: Ordering information

Order code	Marking	Package	Weight	Base qty.	Delivery mode
BALF-NRG-01D3	SV	Flip-Chip package (4 bumps)	1.35 mg	5000	Tape and reel (7")

## 6 Revision history

Table 7: Document revision history

Date	Revision	Changes
17-Jun-2014	1	Initial release.
17-Jul-2014	2	Updated Figure 13, Figure 17, Figure 22 and package view on cover page. Corrected typo error on Table 2.
18-Aug-2014	3	Updated title and description in cover page.
29-Sep-2015	4	Updated Figure 22. Added Figure 25 and Figure 26. Reformatted to current standards.
04-May-2017	5	Updated <a href="#">Figure 2: "Application schematic with WLCSP type BlueNRG"</a> .

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