

**Johanson Technology, Inc. Highly temperature-stable Impedance Matched RF  
Front End Differential Balun-Band Pass Filter Integrated Ceramic  
Component**

**For the Texas Instruments' CC253X, CC254X, CC257X, CC853X and  
CC852X Family of Chipsets**

**October 2012**

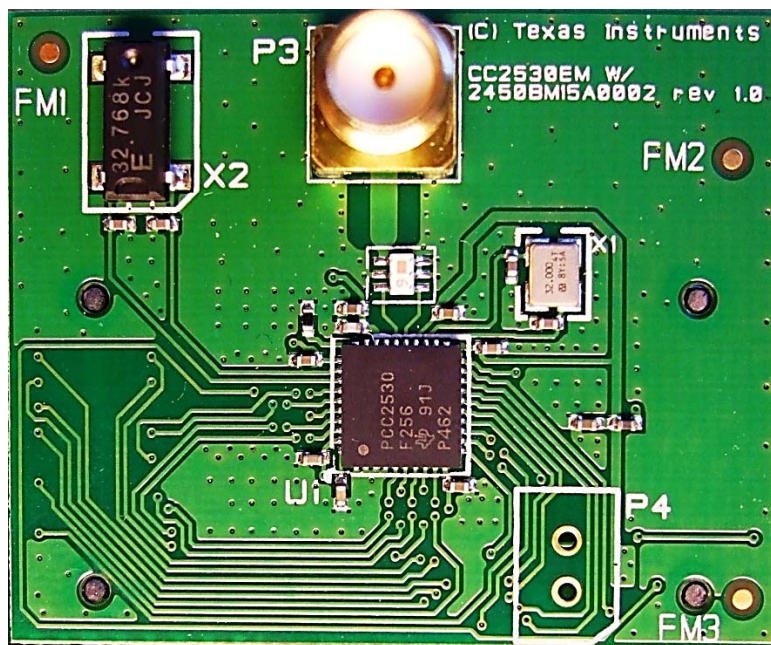
**1. Introduction**

The CC2530, CC2531, CC2533, CC2540, CC2541, CC2543, CC2544, CC2570, CC2571, CC8530, CC8531, CC8520, and CC8521 chipset family from Texas Instruments are single-chip solutions for 2.4 GHz Bluetooth, IEEE 802.15.4, RF4CE, ZigBee, ANT RF network processors, Smart Energy and PurePath™ audio transmission.

Johanson Technology, Inc.'s 2450BM15A0002 Impedance Matched RF Front-End Differential Balun-BPF integrated passive component was specifically designed for use with the CC253X, CC254X, CC257X, CC853X and CC852X family of chipsets. This matched balun simplifies the RF front-end by considerably reducing component count, increase reliability, temperature stability, and implementation area size.

Highly temperature stable ceramic is used to manufacture the 2450BM15A0002 which is optimum for temperature-varied applications such as lighting (rated 125C) or outdoor.

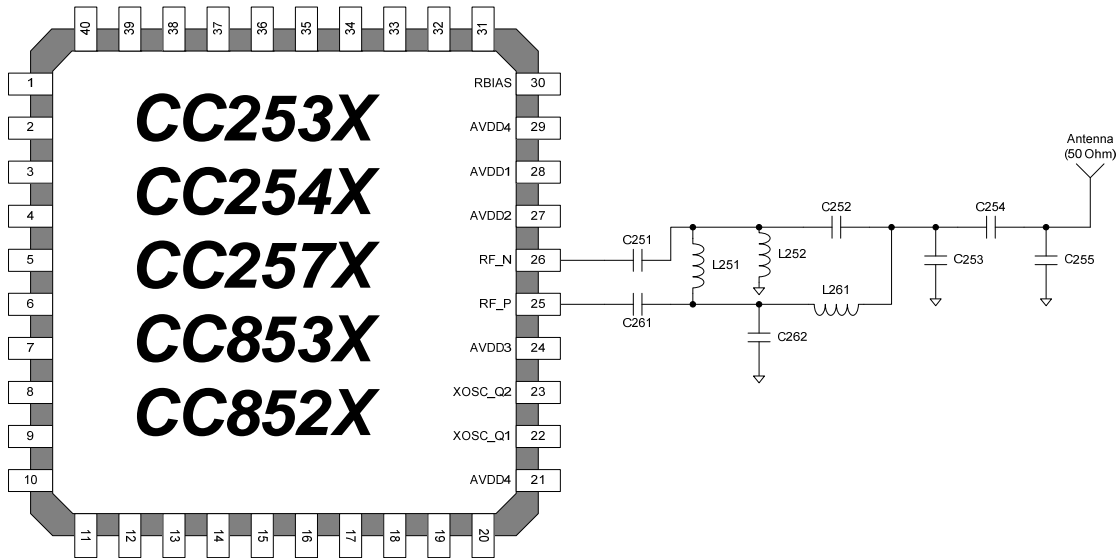
The 2450BM15A0002 is a six-pin device with small mechanical dimensions of only 2.0 mm x 1.25 mm x 0.7mm (EIA 0805) and an approximate footprint of 1.65 mm x 2.8 mm.



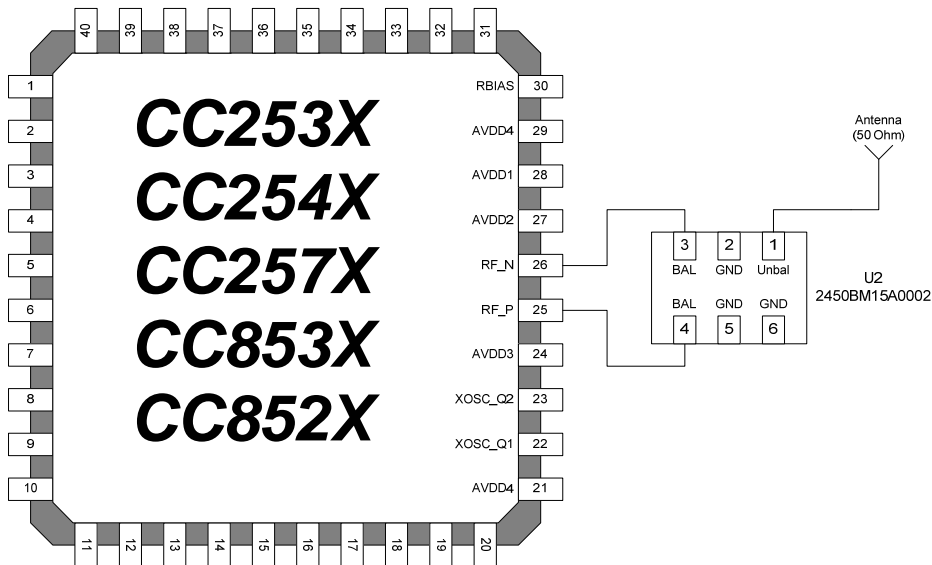
**Figure 1. JTI Photograph of Reference Design for the CC2530**

## 2. Description of the Reference Design

The traditional reference design for the CC253X, CC254X, CC257X, CC853X and CC852X families have been the discrete solutions like the one shown in Figure 2. Johanson Technology has developed a single-SMD component solution with a chip Balun-BPF that is especially matched for the aforementioned family of ICs. The alternate reference design is shown in Figure 3 (pin # and assignment may vary)



**Figure 2. Discrete Reference Design example**



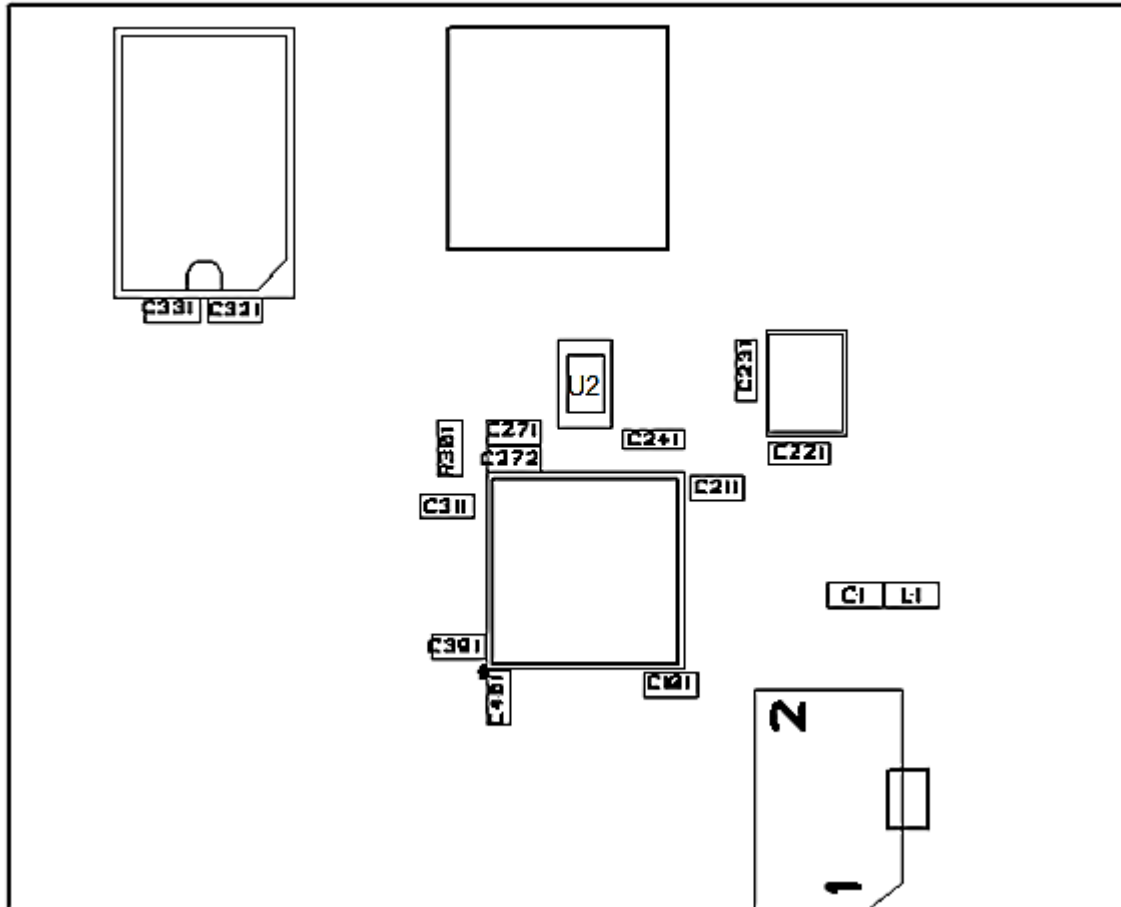
**Figure 3. Johanson Integrated Reference Design example**

Referring to Figure 3, U2 is the JTI matched balun 2450BM15A0002.

Please refer to Appendix A for the datasheet of this component.

For more updated information from the Johanson Technology web site at:

<http://www.johansontechnology.com/en/integrated-passives/chipset-specific-ipc.html>



**Figure 4. Component Placement**

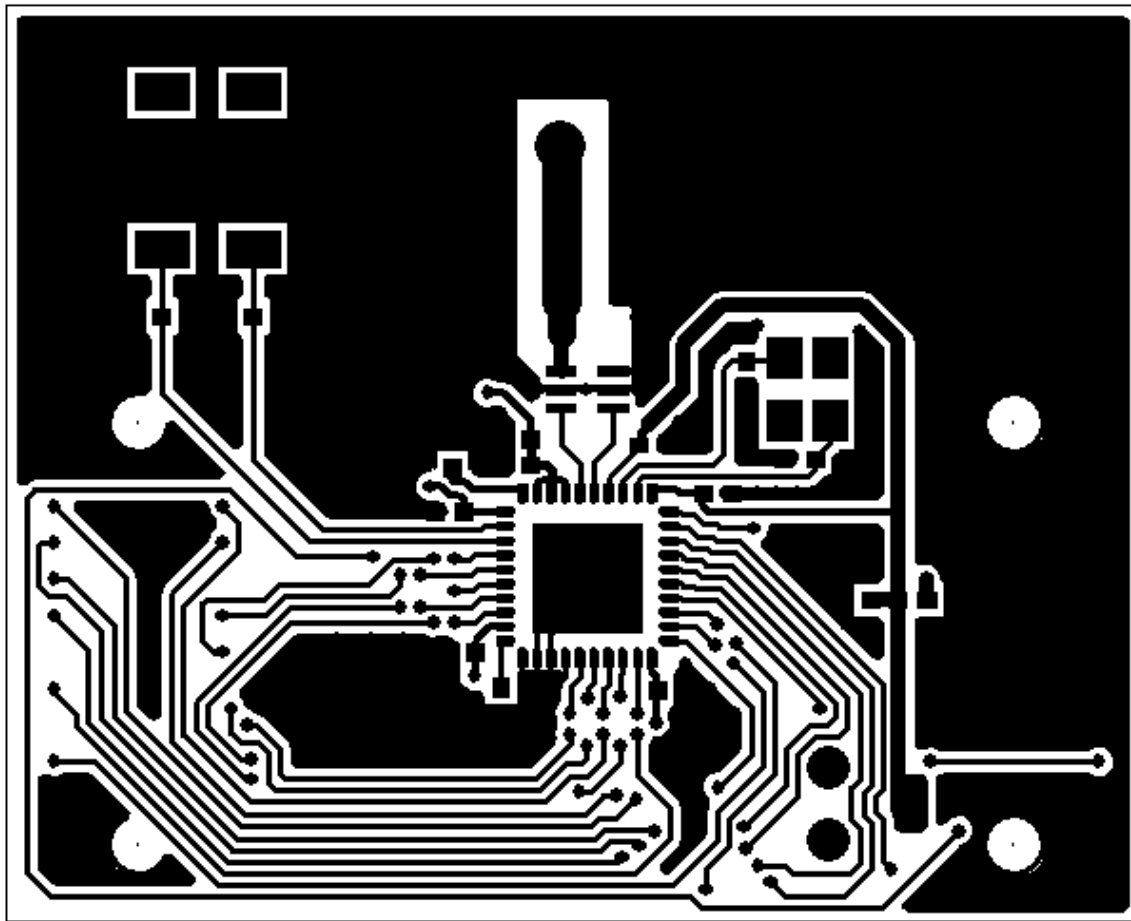
The component placement influences the RF performance. It is recommended that the reference PCB layout be copied as closely as possible. In particular, the designer should make note of all dimensions between the CC253X, CC254X, CC257X, CC853X, CC852X and 2450BM15A0002.



### 3. Layout

Johanson's 2450BM15A0002 Matched Balun-LPF enables the designer to reduce the layout area due to component cutback (to one component); furthermore, PCB sensitivity is also decreased compared to the discrete (L/C) passive solution.

The layout greatly influences the RF performance. It is recommended to copy the reference design as closely as possible.



**Figure 6. Layer 1 of the CC2530 JTI Reference Design Layout (with 2450BM15A0002)**

In the event that the reference design can not be copied, then the routing from the RF pins RF\_P and RF\_N must be symmetrical to the matched balun component, U2. The length of the tracks should be kept to a minimum and preferably the same length and width that are used in the reference design. If this routing is not symmetrical, then the output power may be reduced and the harmonics may increase.

Go to: <http://www.ti.com/litv/zip/swra297a> to download the gerber files.

## 4. Measurement Results

All results presented in this chapter are based on measurements performed with CC2530EM JTI rev 1.0 Reference Design board with Johanson's 2450BM15A0002. All measurement results presented are the average of each batch tested from typical devices. The output power and harmonics measurements were performed with 0xF5 settings.

Johanson's 2450BM15A0002 Matched Balun-BPF offers improved 2nd and 3rd harmonic, it eases implementation, increases margin to FCC/ETSI compliance when compared to solution with discrete passives and provides unmatched temperature stability.

Note: all values are in dBm if not otherwise stated.

		Datasheet		Measured	
		CC2530EM discrete	10 passive components	CC2530EM w/2450BM15A0002	1 passive component
		typ		typ	unit
<b>Receiver sensitivity</b>	PER =1% as specified by [1]	-97		-96.6	dBm
	[1] requires -85dBm				dBm
<b>Output Power (0xF5)</b>	Delivered to a single ended 50Ω load through a balun using max recommended output setting (0xF5)	50		50	Ω
	[1] requires minimum -3dBm	4.5		3.3	dBm
<b>Spurious Emission</b>	25MHz-1000MHz (outside restricted bands)	-60		-64	dBm
	25MHz-2400MHz (within FCC restricted bands)	-60		-64	dBm
	25MHz-1000MHz (within ETSI restricted bands)	-60		-64	dBm
	1800-1900MHz (ETSI restricted band)	-57		-64	dBm
	5150-5300MHz (ETSI restricted band)	-55		-55	dBm
	At 2xfc and 3xfc (FCC restricted band)	-42		-47.3	dBm
	At 2xfc and 3xfc (ETSI EN 300-440 and EN300-328)	-31		-38.2	dBm
	1GHz-12.75GHz (Outside restricted bands)	-53		-57.4	dBm
	At 2483.5MHz and above (FCC restricted bands) fc=2480MHz	-42		-51.6	dBm
<b>EVM</b>	Measured as defined by [1]				
	using maximum recommended output power setting				
	[1] Requires maximum 35%	2		2	%
<b>Current Consumption</b>	32MHz XOSC running, radio in RX mode, -50dBm input power				
	No peripherals active, CPU idle	20.5		21.3	mA
	32MHz XOSC running, radio in RX mode, -100dBm input power				
	No peripherals active, CPU idle	24.3		24.6	mA
	32MHz XOSC running, radio in Txmode, output power 0xD5				
	No peripherals active, CPU idle	28.7		29.1	mA
32MHz XOSC running, radio in Txmode, output power 0xF5					
No peripherals active, CPU idle	33.5		33.3	mA	

Other datasheet performance expected identical.

All results presented in this chapter are based on measurements performed with CC2530EM JTI rev 1.0 Reference Design board with Johanson's 2450BM15A0002

## 5. References

[1] IEEE Std. 802.15.4-2006: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specification for Low-Rate Wireless Personal Area Network (LR-WPAN)  
<http://standards.ieee.org/getieee802/download/802.15.4-2006.pdf>

## 6. Appendix A

# High Frequency Ceramic Solutions

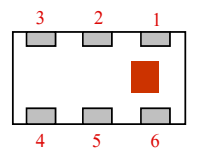
**2.45 GHz Impedance Matched Balun-Filter: For TI CC253X, CC254X, CC257X, CC853X and CC852X Chipset family** P/N 2450BM15A0002  
 Detail Specification: 10/25/2012 Page 1 of 2

General Specifications	
Part Number	2450BM15A0002
Frequency (MHz)	2400 - 2500
Unbalanced Impedance	50 Ω
Balanced Differential Impedance	Impedance match to T.I. CC253X, CC254X, CC257X, CC853X and CC852X Chipsets
Insertion Loss	1.5 dB max. (-40°C to +85°C)
Insertion Loss	1.7 dB max. (-40°C to +125°C)
Return Loss (-40°C to 125°C)	9.5 dB min.

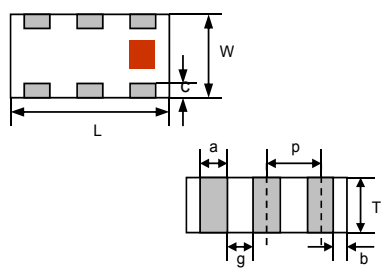
Differential Mode Attenuation (dB) -40°C to 125°C	12 min. @ 1GHz
	18 min. @ 4800~5000MHz
	20 min. @ 7200~7500MHz
Phase Diff. (-40°C to 125°C)	180° ± 15
Input Power	2W max.
Reel Quantity	4,000
Operating Temperature	-40°C to +125°C
Recommended Storage Conditions	+5 ~ +35 °C, Humidity 45~75%RH, 18 mos. max

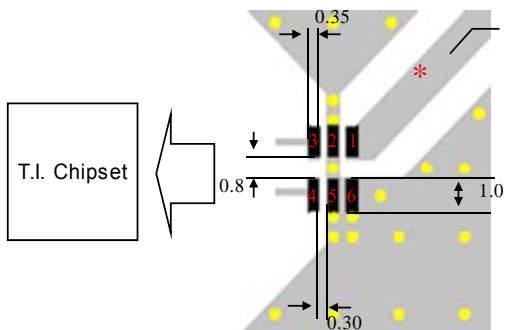
Part Number Explanation				
P/N	Packaging Style	Bulk	Suffix = S	Eg. 2450BM15A0002S
		T & R	Suffix = E	Eg. 2450BM15A0002E
Suffix	Termination Style	100% Tin	Suffix = None	Eg. 2450BM15A0002(E or S)
	Evaluation Board	2450BM15A0002-EBSMA		

Terminal Configuration	
No.	Function
1	Unbalanced Port
2	GND
3	Balanced Port
4	Balanced Port
5	GND
6	GND



Mechanical Dimensions		
L	0.079 ± 0.004	2.00 ± 0.10
W	0.049 ± 0.004	1.25 ± 0.10
T	0.028 ± 0.004	0.70 ± 0.10
a	0.012 ± 0.004	0.30 ± 0.10
b	0.008 ± 0.004	0.20 ± 0.10
c	0.012 +0.004/-0.008	0.30 +0.1/-0.2
g	0.014 ± 0.004	0.35 ± 0.10
p	0.026 ± 0.002	0.65 ± 0.05



Mounting Considerations	
Mount these devices with brown mark facing up. Units: mm	
* Line width should be designed to provide 50 Ω impedance matching characteristics.	
<ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: gray; margin-right: 5px;"></span> Solder Resist</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: black; margin-right: 5px;"></span> Land</li> <li><span style="display: inline-block; width: 10px; height: 10px; border: 1px solid black; border-radius: 50%; margin-right: 5px;"></span> Through-hole (φ0.3)</li> </ul>	 <p style="font-size: small;">Note: No DC Blocking Capacitor required (internal)</p>

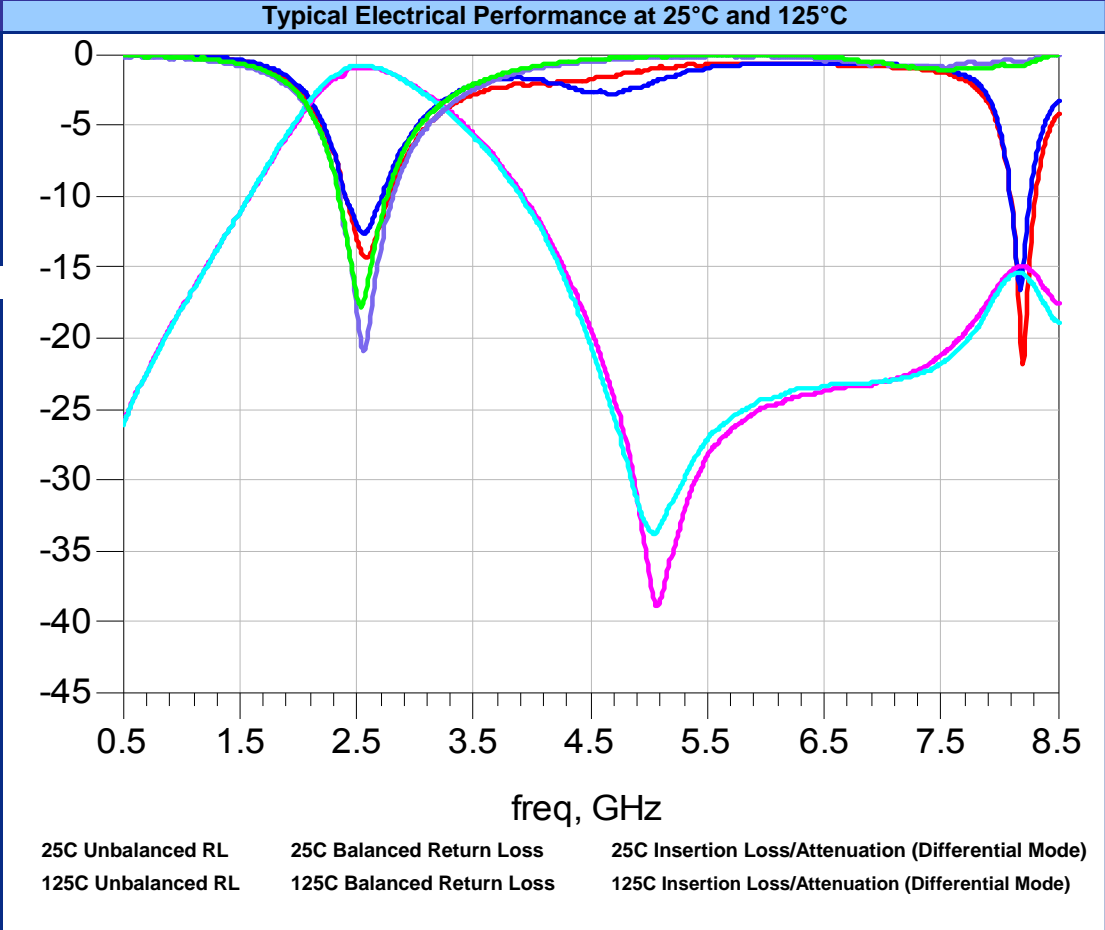
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The latest specification can be downloaded from the following link:  
<http://www.johansontechnology.com/en/integrated-passives/chipset-specific-ipc/texas-instruments-ti.html>



# High Frequency Ceramic Solutions

**2.45 GHz Impedance Matched Balun-Filter: For TI CC253X, CC254X, CC257X, CC853X and CC852X Chipset family** P/N 2450BM15A0002  
 Detail Specification: ##### Page 2 of 2




**Technical notes and Reference Designs**

Technical Note:  
<http://www.johansontechnology.com/en/technical-notes/integrated-passives-rf-comp/2450bm15a0002-matched-balun-for-the-texas-instruments-cc2530-zigbee-transceiver.html>

Technical Note:  
<http://www.johansontechnology.com/en/integrated-passives/chipset-specific-baluns/texas-instruments-ti.html>

Reference Design:  
<http://www.ti.com/litv/pdf/swra297a>

Gerbers:  
<http://www.ti.com/litv/zip/swra297a>



This component is MSL 1 and fully RoHS compliant  
 The latest specification can be downloaded from the following link:  
<http://www.johansontechnology.com/en/integrated-passives/chipset-specific-ipc/texas-instruments-ti.html>



## 7. Revision History

Revision	Date	Description/Changes
2450BM15A0002 App Note for the CC253X_9	Jul-09	Initial Release
2450BM15A0002 App Note for the CC253X_10	Jun-10	-Page1: The CC253X chipset family -Page2: CC253X -Page6: Johanson's 2450BM15A0002 BPF-balun -Page7: Appendix A
2450BM15A0002 App Note for the CC253X_11	Oct-12	-Page1: Highly temperature-stable Impedance Matched RF Front End Differential Balun-Band Pass Filter Integrated Ceramic Component For the Texas Instruments' CC253X, CC254X, CC257X, CC853X and CC852X Family of Chipsets. Designed for use with the CC253X, CC254X, CC257X, CC853X and CC852X family of chipsets. Highly temperature stable ceramic is used to manufacture the 2450BM15A0002 which is optimum for temperature-varied applications such as lighting (rated 125C) or outdoor. -Page2: single-SMD component solution with a chip Balun-BPF. CC253X CC254X CC257X CC853X CC852X -Page7/8: Appendix A -Page9: Revision History

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