Johanson Technology, Inc. Highly temperature-stable Impedance Matched RF Front End Differential Balun-Low 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 ENergyand PurePath™ audio transmission.

Johanson Technology, Inc.'s 2450BM15A0002 Impedance Matched RF Front End Differential Balun-Low Pass Filter 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 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.

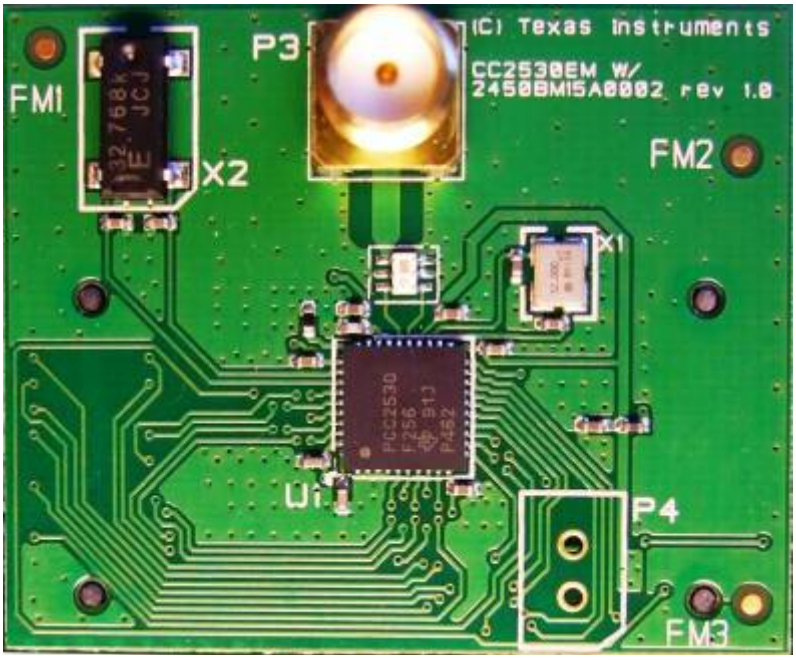


Figure 1. JTI Photograph of Reference Design for the CC2530

www.johnsontechnology.com/ti.html

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 solution with a chip Balun-LPF that is especially matched for the aforementioned family of ICs. The alternate reference design is shown in Figure 3 (pin # and assignment may vary)

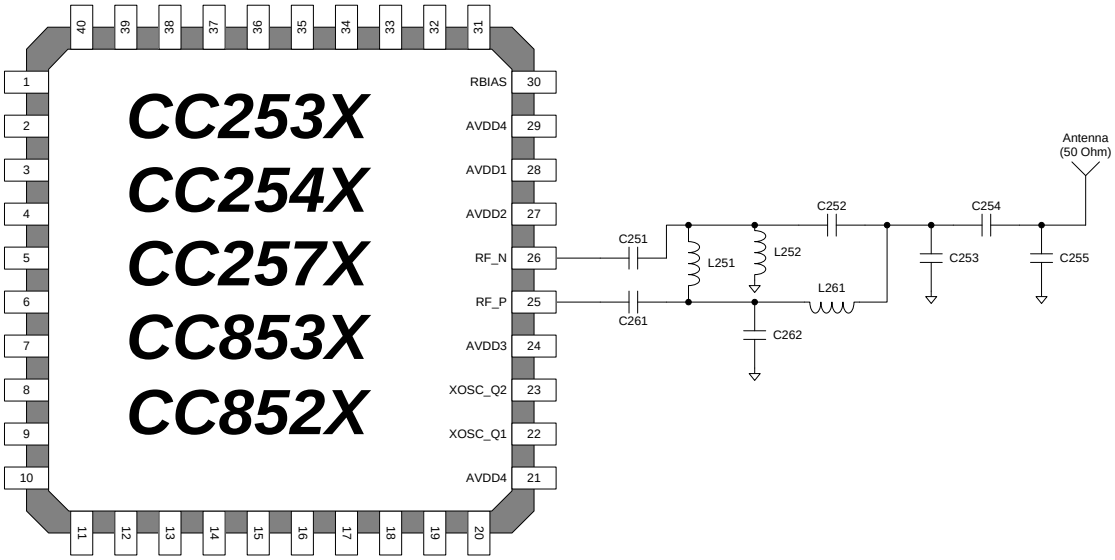


Figure 2. Discrete Reference Design example

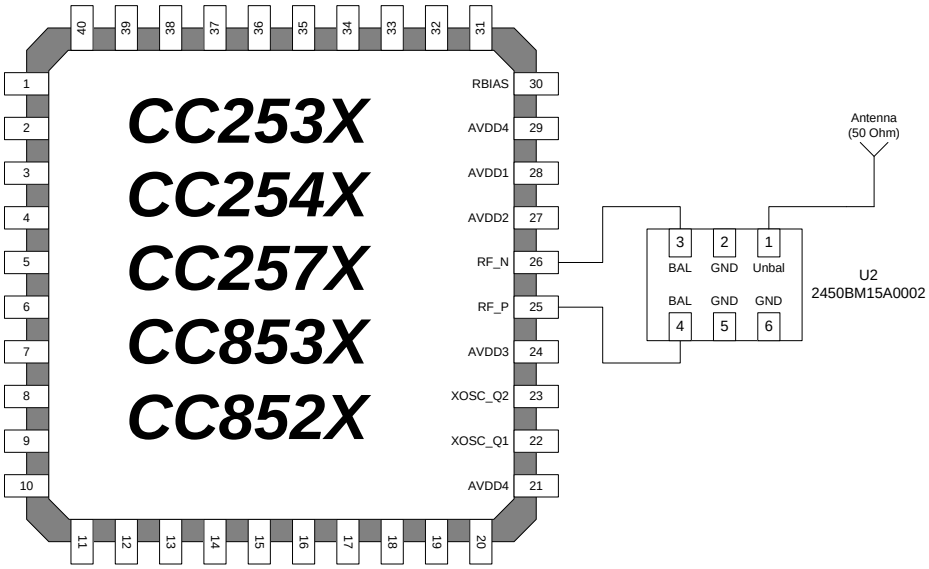


Figure 3. Johanson Integrated Reference Design example

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

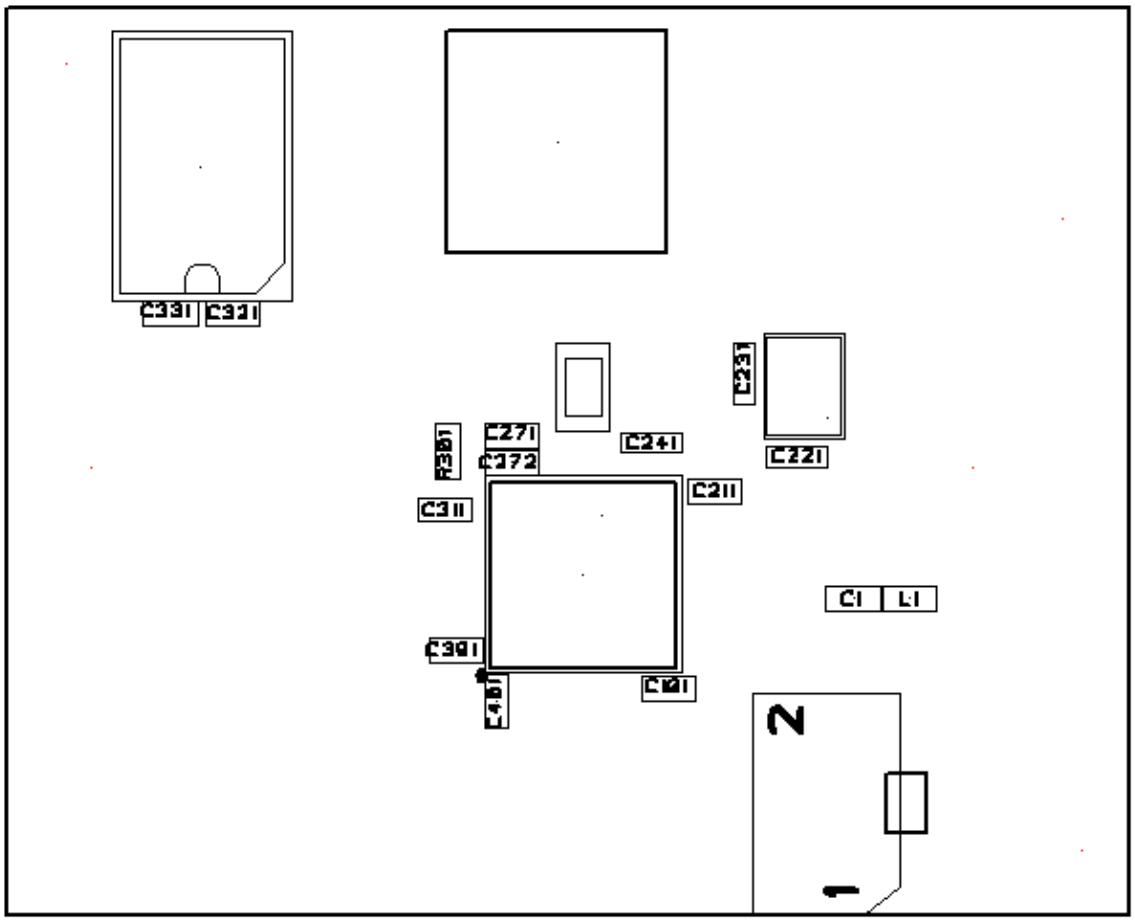


Figure 4. Component Placement

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.

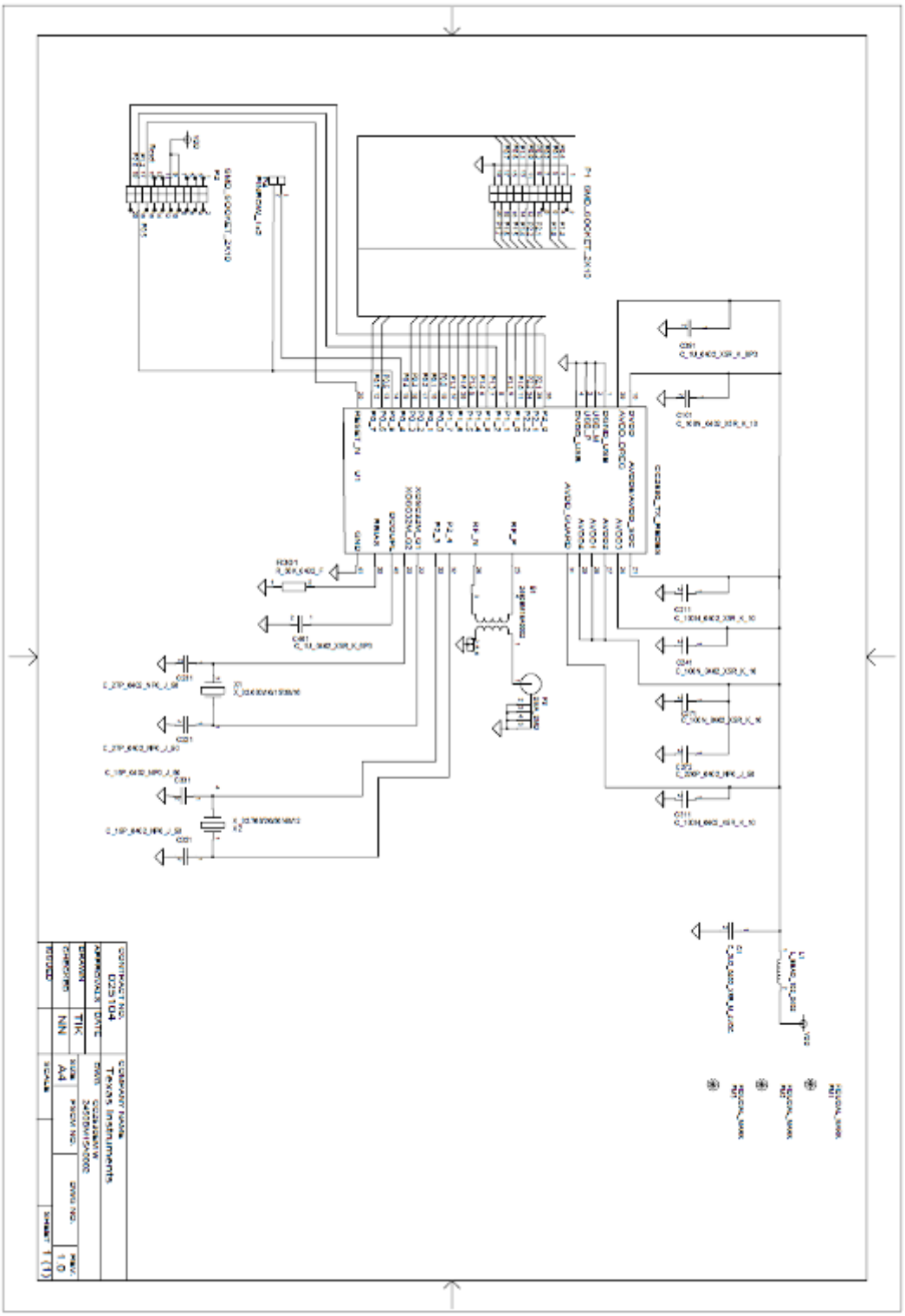


Figure 5. Example of CC2530 JTI Reference Design Schematic (with 2450BM15A0002)

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 passive solution.

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

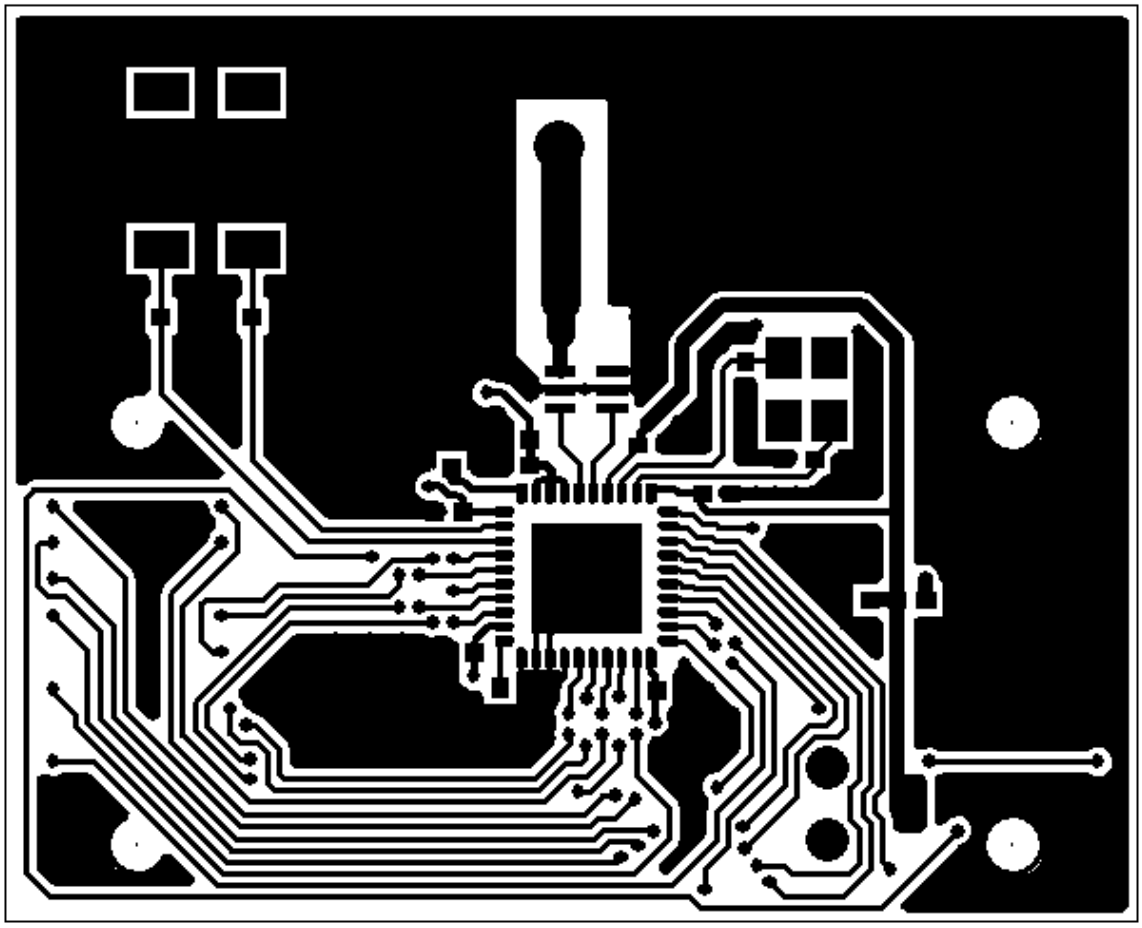


Figure 6. Layer 1 of the CC2530 JTI Reference Design Layout (with 2450BM15A0002)

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-LPF offers improved 2nd and 3rd harmonic, it eases implementation and increases margin to FCC/ETSI compliance when compared to solution with discrete passives.

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

		Datasheet CC2530EM discrete **10** passive components *typ*	**Measured** CC2530EM **w/2450BM15A0002** **1** passive component *typ*	unit
Receiver sensitivity	PER =1% as specified by [1]	-97	-96.6	dBm
	[1] requires -85dBm			dBm
Ouput Power (0xF5)	Delivered to a single ended 50Ω load through a balun	50	50	Ω
	using max recomended output setting (0xF5)	4.5	3.3	dBm
	[1] requires minimum -3dBm			dBm
Spurius Emission	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
EVM	Measured as defined by [1] using maximum recommended output power setting			
	[1] Requires maximum 35%	2	2	%
Current Consumption	32MHz XOSC running, radio in RX mode, -50dBm input power No peripherials active, CPU idle	20.5	21.3	mA
	32MHz XOSC running, radio in RX mode, -100dBm input power No peripherials active, CPU idle	24.3	24.6	mA
	32MHz XOSC running, radio in Txmode, output power 0xD5 No peripherials active, CPU idle	28.7	29.1	mA
	32MHz XOSC running, radio in Txmode, output power 0xF5 No peripherials 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

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

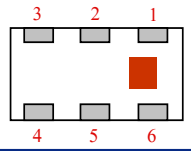
General Specifications	
Part Number	2450BM15A0002
Frequency (MHz)	2400 - 2500
Unbalanced Impedance	50 Ω
Balanced Differential Impedance	Impedance match to T.I. CC253X, CC254X, CC257X, CC853X and CC852X Chipsets
Insertion Loss	1.5 dB max. (-40°C to +85°C)
Insertion Loss	1.7 dB max. (-40°C to +125°C)
Return 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 Quanity	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 Suffix	**Packaging Style**	Bulk	Suffix = S	Eg. 2450BM15A0002S
		T & R	Suffix = E	Eg. 2450BM15A0002E
	Termination Style	100% Tin	Suffix = None	Eg. 2450BM15A0002(E or S)
	Evaluation Board		2450BM15A0002-EBSMA	

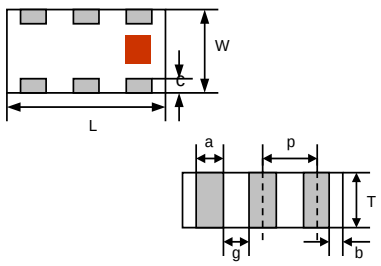
Terminal Configuration

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



Mechanical Dimensions

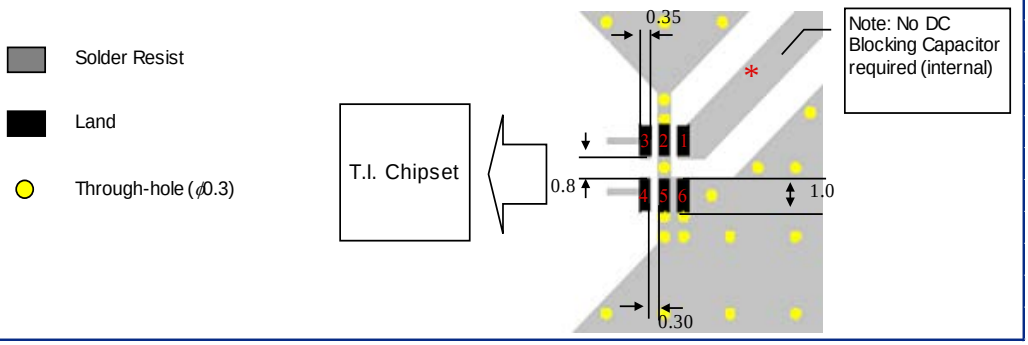
	In	mm
L	0.079 ± 0.004	2.00 ± 0.10
W	0.049 ± 0.004	1.25 ± 0.10
T	0.028 ± 0.004	0.70 ± 0.10
a	0.012 ± 0.004	0.30 ± 0.10
b	0.008 ± 0.004	0.20 ± 0.10
c	0.012 +.004/-.008	0.30 +0.1/-0.2
g	0.014 ± 0.004	0.35 ± 0.10
p	0.026 ± 0.002	0.65 ± 0.05



Mounting Considerations

Mount these devices with brown mark facing up. Units: mm

* Line width should be designed to provide 50 Ω impedance matching characteristics.



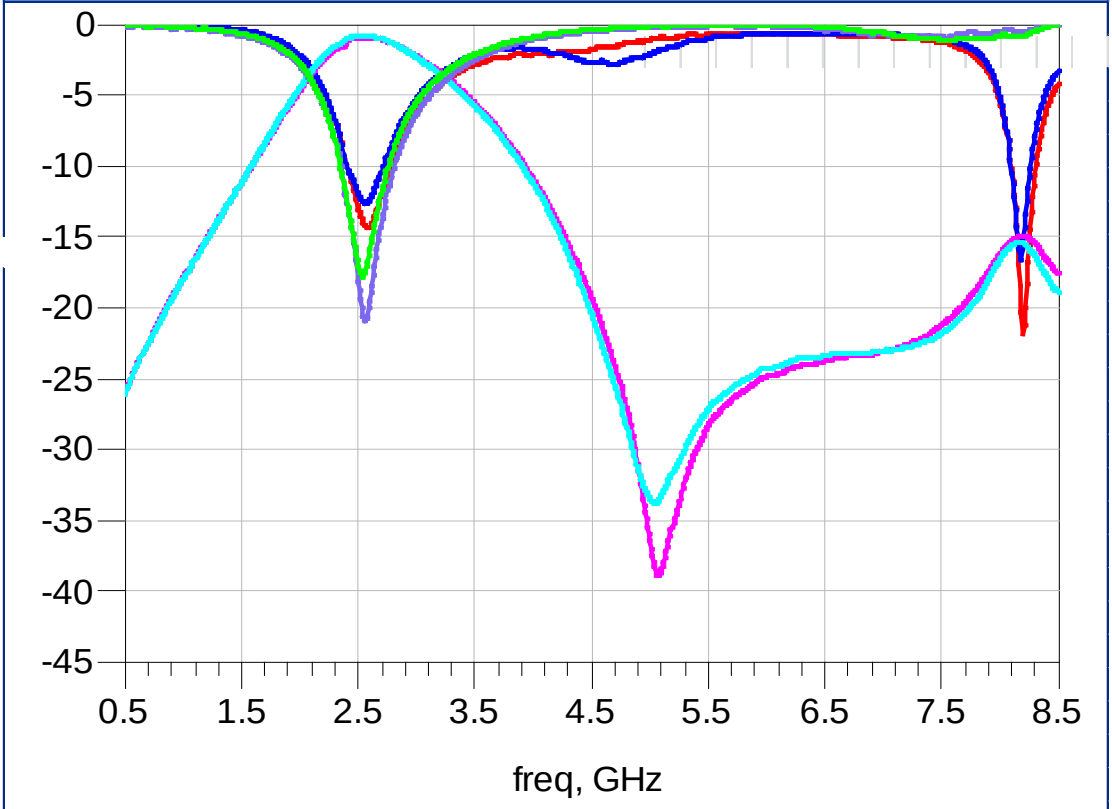
The latest specification can be downloaded from the following link:
http://www.johansontechnology.com/en/integrated-passives/chipset-specific-ipc/texas-instruments-ti.html

www.johnsontechnology.com/ti.html

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

Typical Electrical Performance at 25°C and 125°C



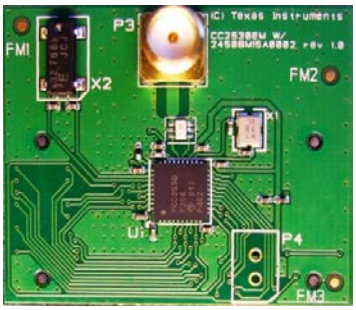
Technical notes and Reference Designs

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