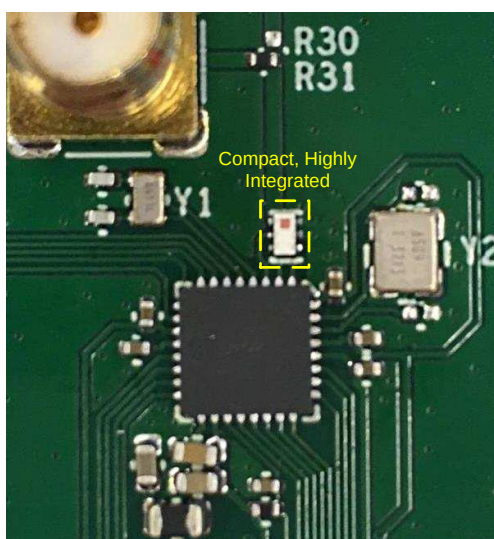


# Johanson Balun for the CC26xx Device Family

*Smart Connectivity Solutions*

## ABSTRACT

This application report describes the implementation, active measurements, schematics, and design files when pairing Johanson Technology Inc.'s 2450BM14G0011 impedance-matched integrated balun-filter with Texas Instruments' CC26xx family of cost-effective, ultra-low power, 2.4-GHz wireless MCUs.



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## 1 Introduction

The 2450BM14G0011 was developed in order to satisfy the space constraints of compact designs as well as layouts sensitive to assembly pick and place costs. This IPC provides the following benefits:

- Consolidates Texas Instruments' reference 9 discrete LC components into a single component
- Overall RF performance (insertion loss, return loss, output power, harmonic rejection) comparable to discrete LC solution at a fraction of the size
- Complex impedance matched to all variants of the CC26XX
- Provides harmonic rejection necessary for FCC and ETSI compliance

This front-end solution reduces implementation size area by using smaller effective PCB real estate while reducing component count, increasing performance consistency (100% RF tested before T&R), and offering excellent temperature stability (4ppm). AEC-Q200 qualification is available.

- Design/Layout Files: <http://www.ti.com/lit/zip/swrc326>
- Technical Support: <http://www.johansontechnology.com/ask-a-question>
- 2450BM14G0011 Datasheet: <https://www.johansontechnology.com/datasheets/baluns-matched/2450BM14G0011.pdf>
- 2450BM14G0011T-AEC Datasheet: <https://www.johansontechnology.com/downloads/2450BM14G0011T-AEC.pdf>

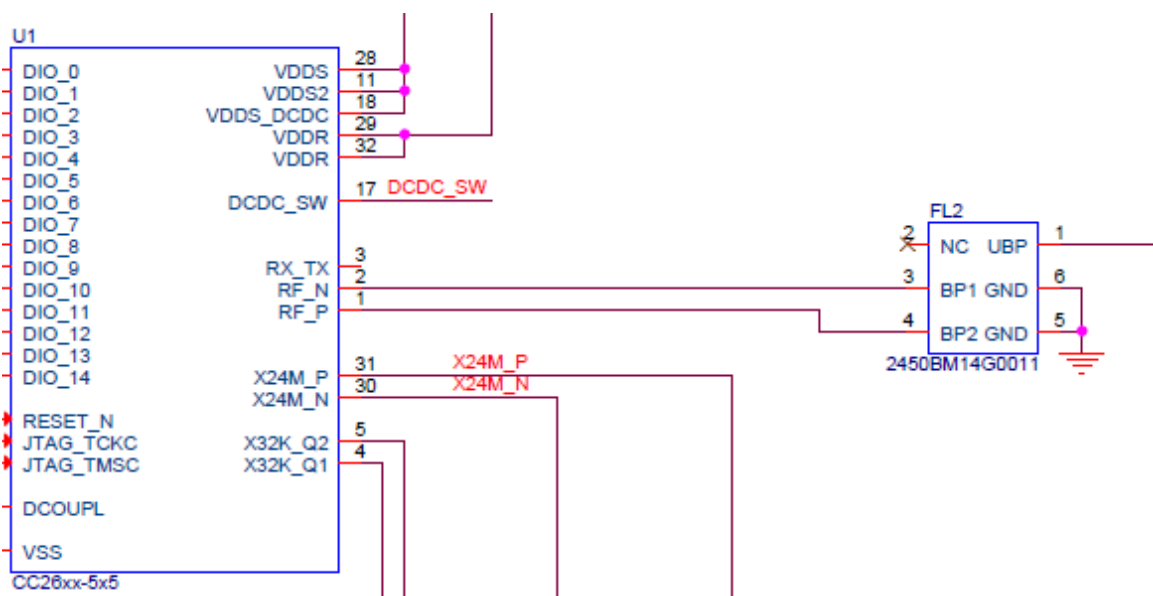
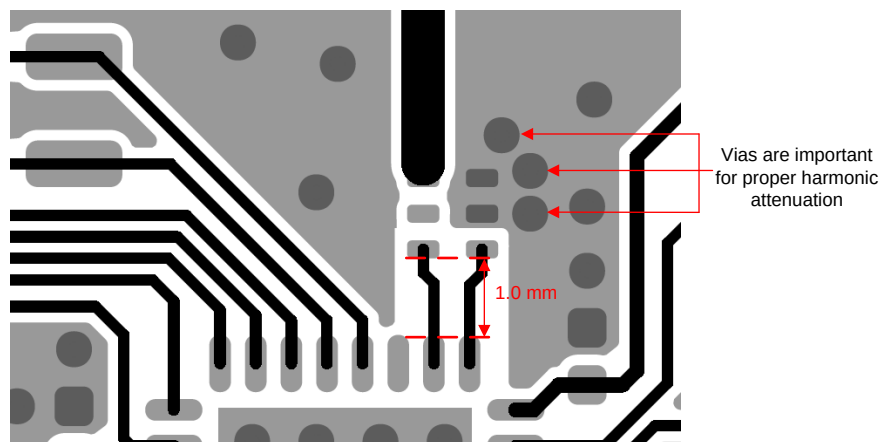


Figure 1. Schematic TI CC26XX With Impedance-Matched Filter 2450BM14G0011



**Figure 2. PCB Layout Reference for TI CC26XX and Impedance Matched Filter 2450BM14G0011**

For more examples and alternative products see [www.johansontechnology.com/ti](http://www.johansontechnology.com/ti).

**Table 1. +5 dBm Measurements**

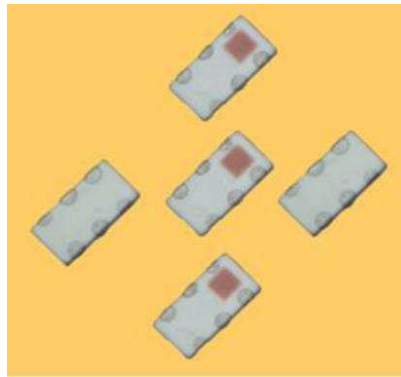
| Fundamental         | 2450BM14G0011<br>Sample 1 | 2450BM14G0011<br>Sample 2 | 2450BM14G0011<br>Sample 3 | 2450BM14G0011<br>Sample 4 |
|---------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| MHz                 | dBm                       | dBm                       | dBm                       | dBm                       |
| 2402                | 4.1                       | 4.3                       | 4.6                       | 4.6                       |
| 2426                | 4.1                       | 4.2                       | 4.5                       | 4.5                       |
| 2440                | 3.9                       | 4.1                       | 4.3                       | 4.3                       |
| 2480                | 3.7                       | 3.8                       | 4.0                       | 4.2                       |
| <b>2nd Harmonic</b> |                           |                           |                           |                           |
| MHz                 | dBm                       | dBm                       | dBm                       | dBm                       |
| 2402                | -46.5                     | -44.8                     | -44.3                     | -44.2                     |
| 2426                | -46.2                     | -44.9                     | -43.7                     | -43.8                     |
| 2440                | -46.7                     | -44.6                     | -44.3                     | -44.2                     |
| 2480                | -46.5                     | -44.3                     | -44.6                     | -43.7                     |
| <b>3rd Harmonic</b> |                           |                           |                           |                           |
| MHz                 | dBm                       | dBm                       | dBm                       | dBm                       |
| 2402                | -48.8                     | -54.9                     | -53.1                     | -54.1                     |
| 2426                | -49.7                     | -55.0                     | -53.5                     | -54.6                     |
| 2440                | -51.1                     | -55.9                     | -54.1                     | -55.3                     |
| 2480                | -53.6                     | -54.9                     | -54.4                     | -54.9                     |

**Table 2. RX Sensitivity Measurements**

| MHz  | 2450BM14G0011<br>Sample 1/ 3 V DC | 2450BM14G0011<br>Sample 2/ 3 V DC | 2450BM14G0011<br>Sample 3/ 3 V DC | 2450BM14G0011<br>Sample 4/ 3 V DC |
|------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|
| 2402 | -95.7                             | -95.5                             | -95.7                             | -95.7                             |
| 2426 | -95.7                             | -95.8                             | -96.0                             | -95.9                             |
| 2440 | -95.7                             | -95.7                             | -96.0                             | -95.9                             |
| 2480 | -96.0                             | -95.8                             | -96.1                             | -96.1                             |

To revise your layout, contact Johanson Technology's RF applications engineers at:  
[www.johansontechnology.com/ask-a-question](http://www.johansontechnology.com/ask-a-question).

## 2 General Specifications



**Figure 3. 2450BM14G0011**

**Table 3. General Specifications**

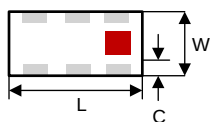
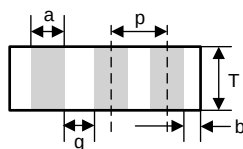
| Part Number                                                               | 2450BM14G0011                                                                                 |
|---------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| Frequency (MHz)                                                           | 2400 - 2500                                                                                   |
| Unbalanced Impedance                                                      | 50 $\Omega$                                                                                   |
| Balanced Differential Impedance                                           | Conjugate match to TI CC2620, CC2630, CC2640, CC2650, chipsets operated on INTERNAL BIAS MODE |
| Insertion Loss when component measured by itself (passive insertion loss) | 1.5 Typ.<br>(1.8dB max. -40°C to +85°C)                                                       |
| Return Loss (dB):                                                         | 9.5 min.                                                                                      |
| • 25 typ. / 14dB min. @ 4800-5000 MHz                                     |                                                                                               |
| • 20 typ. / 15dB min. @ 7200-7500 MHz                                     |                                                                                               |
| Phase Difference (deg.)                                                   | 180 $\pm$ 10                                                                                  |
| Amplitude Difference                                                      | 2.0 maximum                                                                                   |
| Power Capacity                                                            | 2W max (CW)                                                                                   |
| Qty/Reel (pcs)                                                            | 4,000                                                                                         |
| Operating Temperature Range                                               | -40 ~ +85°C                                                                                   |
| Storage Temperature Range                                                 | -40 ~ +85°C                                                                                   |
| Recommended Storage Conditions of Unused Product on T&R                   | +5 ~ +35 °C,<br>5 ~ +35 °C, Humidity 45-75%                                                   |
| Storage Period                                                            | 18 months maximum                                                                             |

**Table 4. Part Number Explanation**

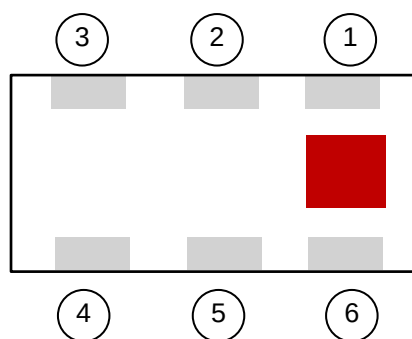
|            |                   |          |               |                       |
|------------|-------------------|----------|---------------|-----------------------|
| P/N Suffix | Packaging Style   | Bulk     | Suffix = S    | 2450BM14G0011S        |
|            |                   | T & R    | Suffix = T    | 2450BM14G0011T        |
|            | Termination Style | 100% Tin | Suffix = None | 2450BM14G0011(T or S) |

**Table 5. Mechanical Dimensions**

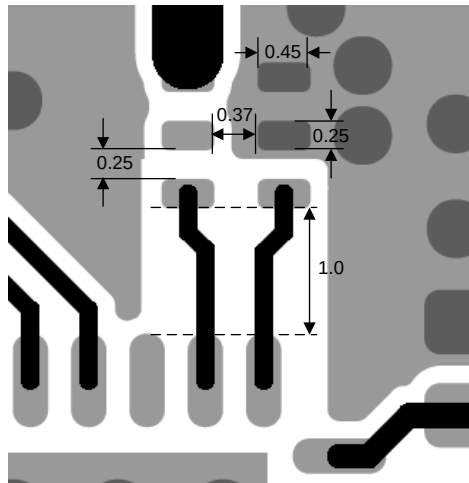
|   | Inches                 | Millimeter           |
|---|------------------------|----------------------|
| L | $0.063 \pm 0.004$      | $1.6 \pm 0.10$       |
| W | $0.031 \pm 0.004$      | $0.8 \pm 0.10$       |
| T | $0.024 \pm 0.004$      | $0.6 \pm 0.10$       |
| a | $0.008 \pm 0.004$      | $0.2 \pm 0.10$       |
| b | $0.008 \pm +0.1/-0.15$ | $0.2 \pm +0.1/-0.15$ |
| c | $0.006 \pm 0.004$      | $0.15 \pm 0.10$      |
| g | $0.012 \pm 0.004$      | $0.3 \pm 0.10$       |
| p | $0.020 \pm 0.002$      | $0.5 \pm 0.05$       |


**Figure 4. Mechanical Dimensions**

**Figure 5. Mechanical Dimensions**
**Table 6. Terminal Configuration**

| No | Function             | No | Function            |
|----|----------------------|----|---------------------|
| 1  | Unbalanced Port (IN) | 4  | Balanced Port (OUT) |
| 2  | NC                   | 5  | GND                 |
| 3  | Balanced Port (OUT)  | 6  | GND                 |


**Figure 6. Terminal Configuration**

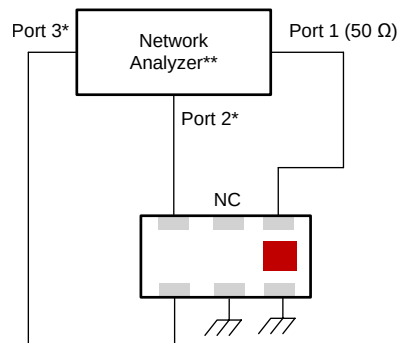
## 2.1 Mounting Considerations



**Figure 7. Mounting Considerations**

- Line width should be designed to match 50Ω characteristic impedance, depending on PCB material and thickness.
  - Land
  - Through-hole (0.3/0.2) vias to GND

## 2.2 Measuring Diagram



- (1) Impedance for ports 2 and 3 = Conjugate to Balanced Impedance/2
- (2) E5071C from Agilent

**Figure 8. Measuring Diagram**

- Port 1: Unbalanced Port
- Ports 2 and 3: Balanced Port
  - $IL = S_{ds21}$
  - $RL = S_{ss11}$
- $Amp\_balance = dB(S(2,1)/S(3,1))$
- $Phase\_balance = Phase(S(2,1)/S(3,1))$

### 3 Typical Electrical Characteristics

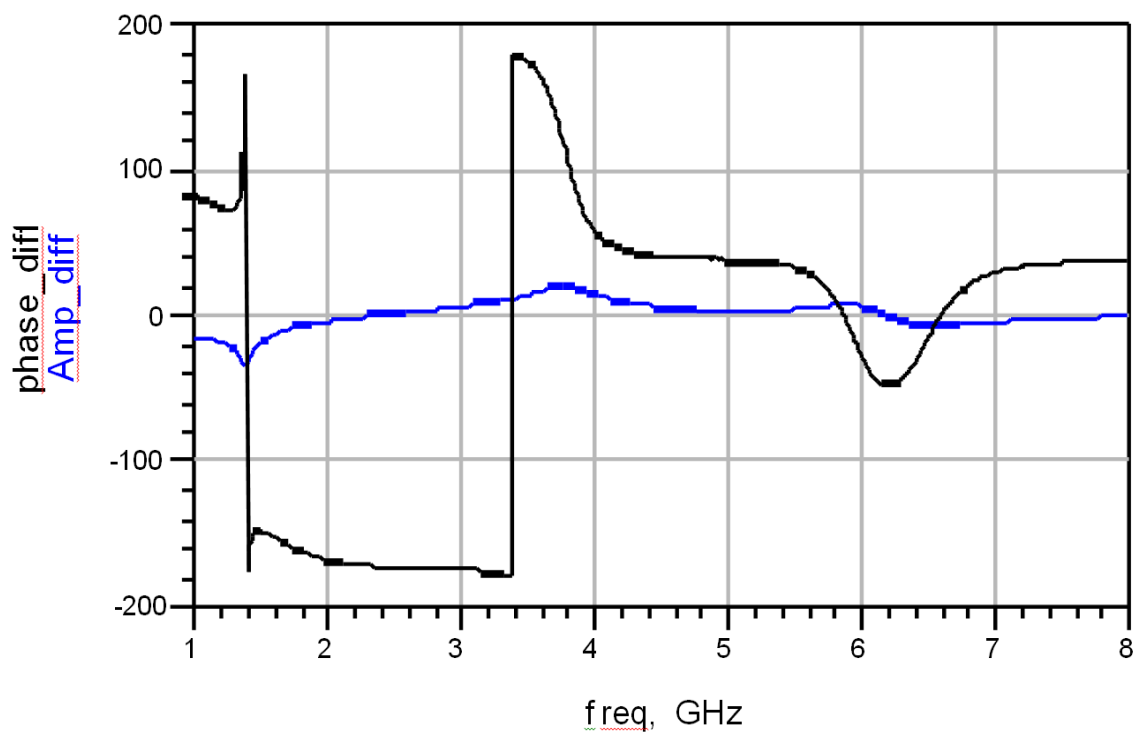


Figure 9. Insertion and Return Loss

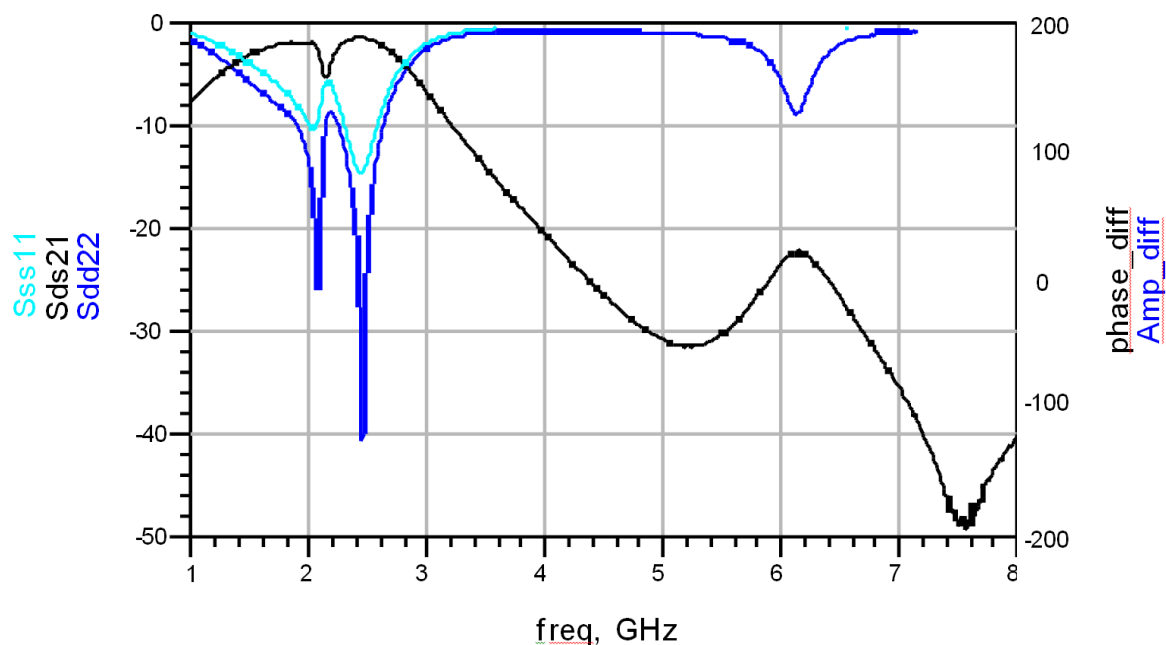


Figure 10. Amplitude and Phase Balance

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