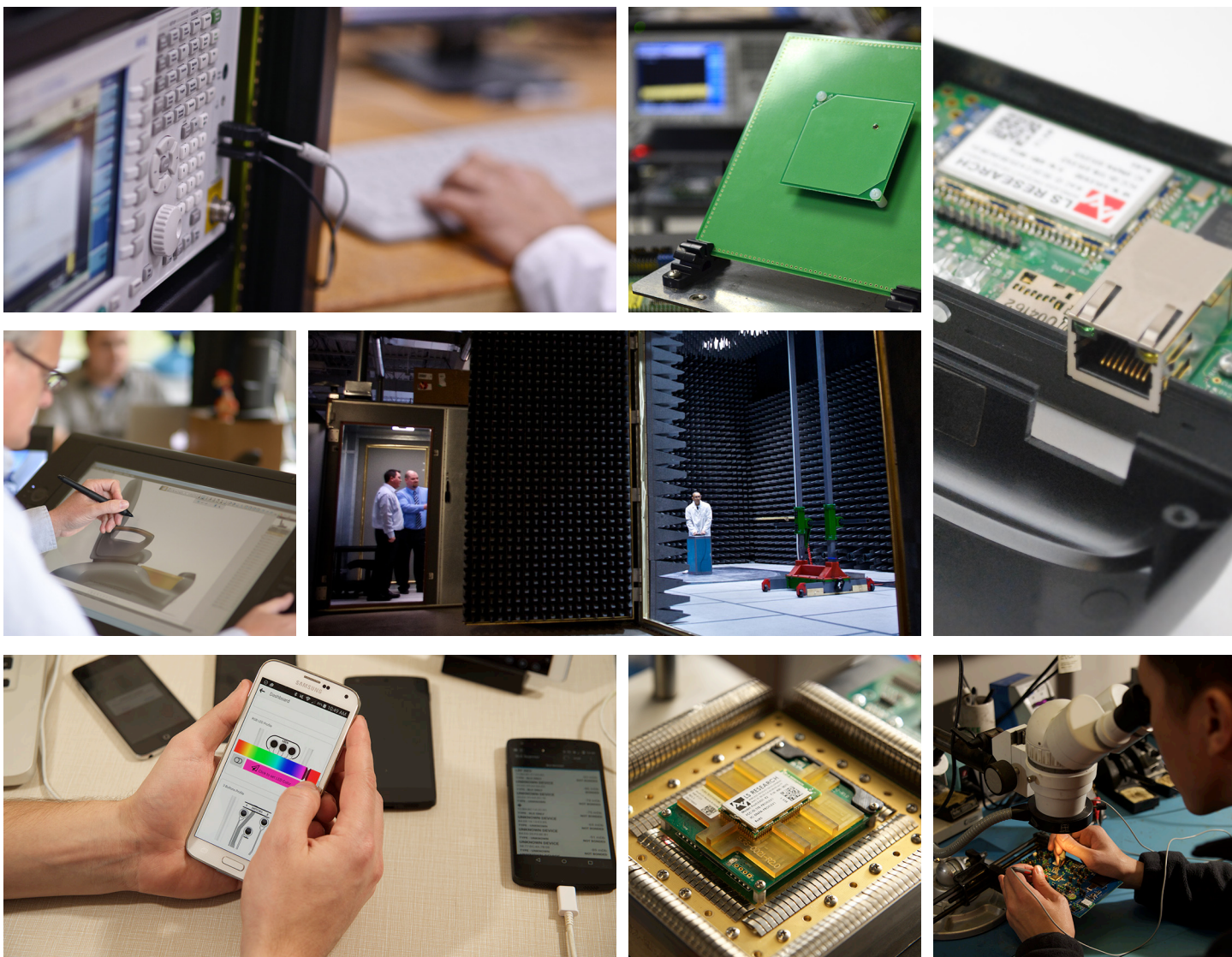


TiWi-C-W™ Embedded Wi-Fi® Module Chip Antenna Implementation



About LSR

Inspiring through Wireless InnovationsSM

Bringing a winning product to market in today's competitive environment requires greater skill, creativity and experience than ever before. More and more, your customers demand intuitive, reliable wireless capabilities that give them the real-time information and controls to be more connected.

Since 1980, our partners, spanning a wide range of industries, have trusted LSR to help develop solutions that exceed their customers' expectations. We provide an unmatched suite of wireless product design services, EMC Testing & Certification, and performance RF products, all to improve speed to market and return on your development investment.

Our experienced professionals are passionate and committed to partnering with you, allowing your team to focus on the most important element of product development: the unique needs of your customers.

Learn more at www.lsr.com and follow us on [LinkedIn](#) and Twitter ([@LSResearch](#)).

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1. Introduction

Purpose & Scope

The purpose of this document is to provide details regarding the straight-forward steps to implement a certified antenna with the TiWi-C-W™ 802.11 b/g/n WLAN module into your product design. This app note focuses on implementing a ceramic chip antenna, which is one of three certified off-module antenna options for the TiWi-C-W. It will also walk through the required PCB details required to retain the LSR modular certification for the TiWi-C-W module. For detailed information on implementing other approved antennas, please reference the TiWi-C-W Module Application Guide (330-0158).

Applicable Documents

- [TiWi-C-W Datasheet](#) (330-0129)
- [TiWi-C-W Module Application Guide](#) (330-0158)
- [TiWi-C-W Evaluation Platform User Guide](#) (330-0159)

Revision History

Date	Change Description	Revision
8/10/2015	Initial Release	1.0

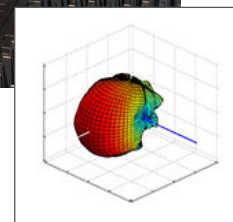
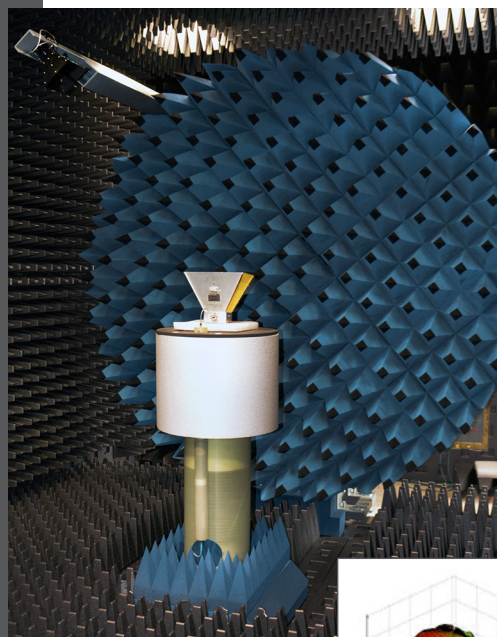


Design Support - Complimentary 3D Antenna Scan and Design Review

LSR is committed to simplifying and accelerating wireless design for its module customers. To that end, LSR is offering a complimentary antenna scan and design review to any customer looking to integrate an LSR module, such as the TiWi-C-W, into a product design.

This service includes a 3-dimensional antenna scan (\$1,800 value) conducted in a dedicated anechoic antenna chamber on-site at LSR. Along with a report of those scan results, LSR will also provide a free design review to ensure the appropriate design steps were taken to utilize the FCC/IC/CE certification of the TiWi-C-W module.

To request a free Antenna Scan & Design Review, submit the request form on LSR.com at: <http://www.lsr.com/embedded-wireless-modules>.



2. TiWi-C-W Module and Accessories

The TiWi-C-W Module is a System in Package (SiP) with an on-board ARM Cortex-M3 application processor. The TiWi-C-W module is certified with several off module antennas. The scope of this document will focus on the simple steps to integrating the TiWi-C-W with a 2.4 GHz ceramic chip antenna.

	Part Number	Description
	LSR 450-0118R LSR 450-0118C	TiWi-C-W Module, Tape & Reel TiWi-C-W Module, Cut Tape
	Johanson 2450AT18A100	2.4 GHz Ceramic Chip Antenna
	LSR 001-0014	2.4 GHz FlexPIFA Antenna with U.FL Cable
	LSR 001-0001	2.4 GHz Dipole Antenna with Reverse Polarity SMA Connector
	LSR 080-0001	U.FL to Reverse Polarity SMA Bulkhead Cable 105 mm
	Hirose U.FL-R-SMT (10)	PCB Mounted U.FL Connector

Table 2: TiWi-C-W Module and Accessories

3. TiWi-C-W Approved Chip Antenna Specifications

The Johanson 2450AT18A100 Ceramic Chip Antenna provides an off-module, PCB mounted, antenna solution for the TiWi-C-W module. There are two antennas on the TiWi-C-W evaluation platform, ANT1 and ANT2, as the module supports antenna diversity. You can choose to implement a single antenna or a diversity antenna configuration. They are positioned on the PCB to allow maximum performance while using a minimum amount of board space. The antenna placement provides for both spatial and polarized receive and transmit diversity. To view the chip antenna typical Radiation Patterns, available for both 4-layer and 2-layer designs, please refer to the detailed [Module Application Guide \(330-0158\)](#).

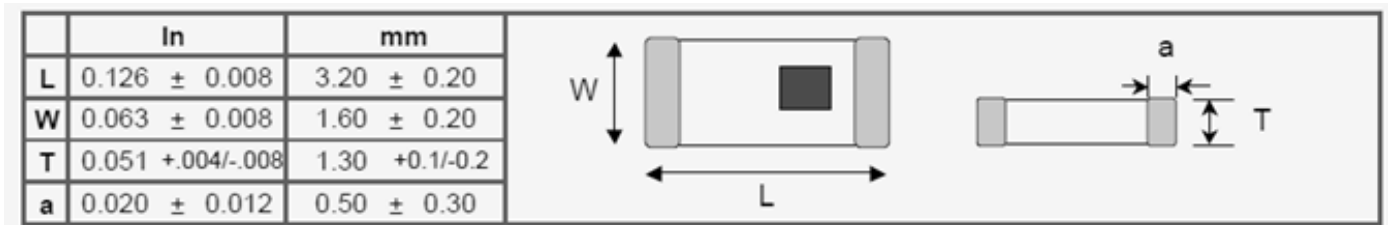


Figure 1: Chip Antenna Dimensions

4. PCB Layout Requirements

Since this module and its associated set of approved antennas has been certified by the FCC and Industry Canada (IC) as a Modular Radio, the end user is authorized to integrate this module into an end-product, and thus is solely responsible for the Unintentional Emissions levels produced by the end-product.

In order to preserve the Modular Radio certifications, the integrator of the module must abide by the PCB layout recommendations outlined in the following paragraphs. Any divergence from these recommendations will invalidate the modular radio certifications and require the integrator to re-certify the module and/or end-product.

The module must be used with one of the approved antennas:

1. Johanson Technology 2450AT18A100 Ceramic Chip Antenna.
2. LSR 001-0001 center-fed 2.4 GHz dipole antenna and 080-0001 U.FL to Reverse Polarity SMA connector cable.
3. LSR 001-0014 2.4 GHz FlexPIFA Antenna w/U.FL cable.

When using the module and the reference design that supports the off module U.FL connector(s), you may use a substitute antenna if the antenna gain is less than or equal to +2 dBi. It may be possible to use a substitute chip antenna, however there are restrictions, so please contact LSR for guidance prior to making any chip antenna substitutions.

LSR provides both a 4-Layer and a 2-Layer FCC Modular Certified reference design. The primary reference design is based on a 4-Layer PCB. It is a controlled-impedance PCB that uses a microstrip trace design to route RF signals from the TiWi-C-W module to the Antennas and coaxial connectors.

A secondary reference design is based on a 2-Layer PCB. It is also a controlled impedance PCB but because of the 2-Layer stack up, it uses a coplanar waveguide trace design to route RF signals from the TiWi-C-W module to the Antennas and coaxial connectors.

Please use the latest CAD files from the LSR web site when incorporating the TiWi-C-W module into a new design. CAD files are provided in native Mentor Graphics PADS PCB and PADS Logic formats, as well as ASCII, Gerber, and PDF formats. CAD files can also be translated to most popular CAD package. Contact LSR Tech support for CAD translation.

Visit the [TiWi-C-W Module](#) web page for current PCB and Schematic CAD files.

4-Layer Reference Design

In order to use the modular certification for your design, it is critical that the reference design is correctly followed. This section describes the details of using a PCB that is a 4-layer stack up. The full 4-layer PCB reference design is shown in Figure 2. It is not required to replicate the entire design, but what is required are the circuitry and layout as it pertains to the antenna configuration being used in your design as shown in Figure 2.

2.4 GHz Chip Antenna Implementation

When using the certified Chip Antenna (Johanson Part Number 2450AT18A100), the PCB layout shown in Figure 2 should be followed. It is acceptable to keep the U.FL circuitry J7 and J8, and the U.FL connectors can either be populated or not.

The full schematic files can be downloaded from LSR.com here:

<http://www.lsr.com/embedded-wireless-modules/wifi-module/tiwi-cw#product-documents>

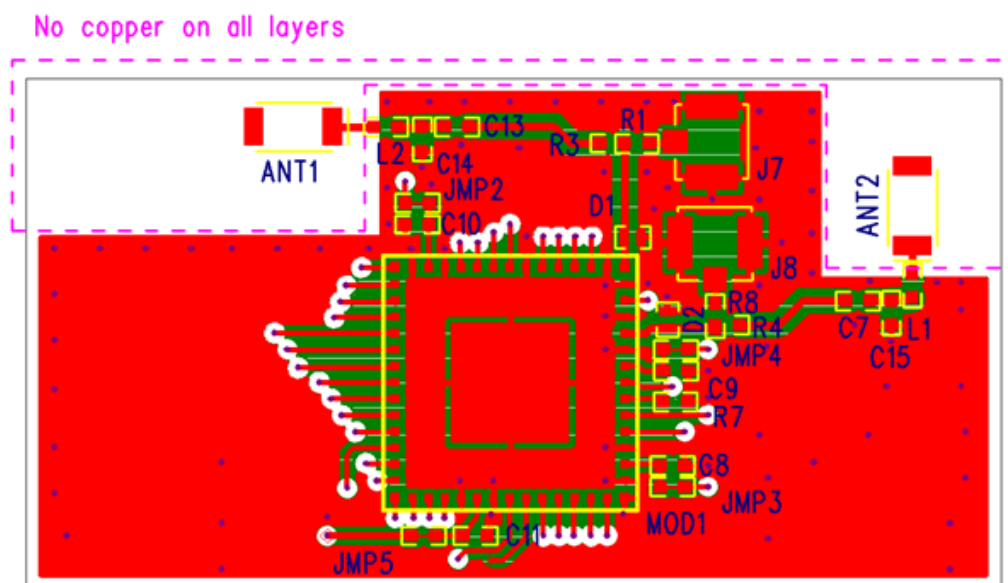


Figure 2: 4-Layer Reference Design Chip Antenna PCB Layout4-Layer Reference Design

2-Layer Reference Design

In order to use the modular certification for your design, it is critical that the reference design is correctly followed. This section describes the details of using a PCB that is a 2-layer stack up. The full 2-layer PCB reference design is shown in Figure 3. It is not required to replicate the entire design, but what is required are the circuitry and layout as it pertains to the antenna configuration being used in your design as shown in Figure 3.

2.4 GHz Chip Antenna Implementation

When using the certified Chip Antenna (Johanson Part Number 2450AT18A100), the PCB layout shown in Figure 3 should be followed. It is acceptable to keep the U.FL circuitry J7 and J8, and the U.FL connectors can either be populated or not.

The full schematic files can be downloaded from LSR.com here:

<http://www.lsr.com/embedded-wireless-modules/wifi-module/tiwi-cw#product-documents>

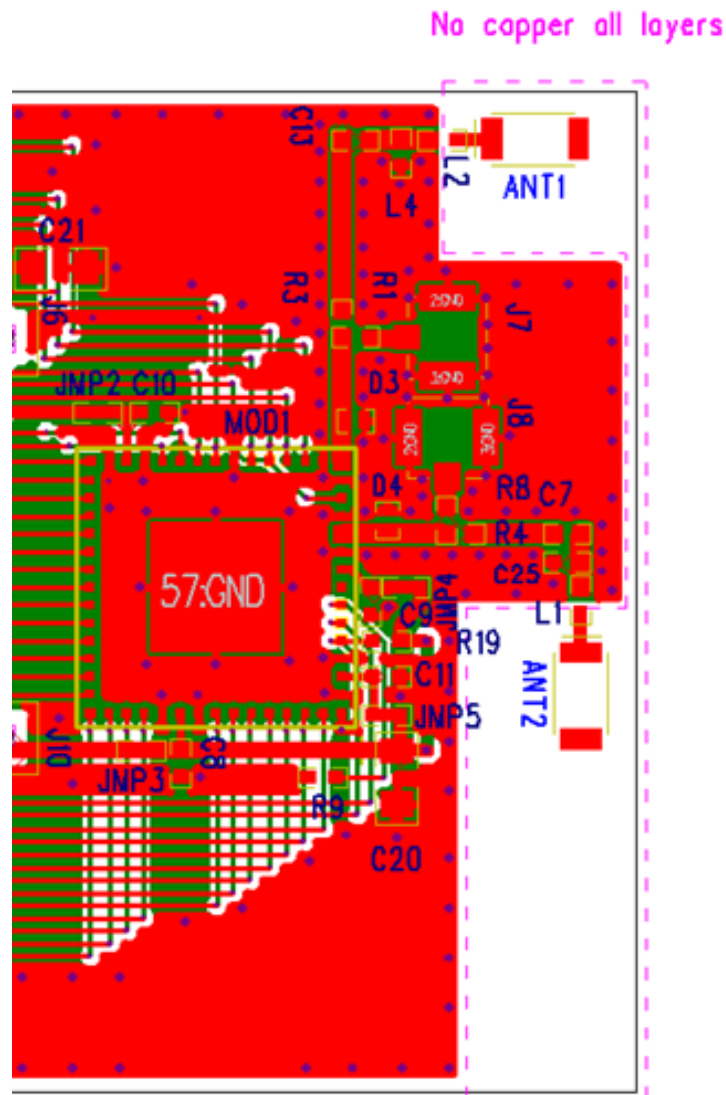


Figure 3: 2-Layer Reference Design Chip Antenna PCB Layout

5. EMC Compliance

Summary

The TiWi-C-W module has been tested and approved as a Modular Radio in accordance with the appropriate FCC and IC standards. The supporting test data may be found in the modular test report, available from LSR.

Since this module and its associated set of approved antennas have been certified as a Modular Radio, this allows the end user to integrate this module into an end-product without the requirement of re-certifying the radio module. The module-integrator is responsible for the unintentional conducted and radiated emissions and must verify that the integrated product is compliant with the rules associated with unintentional radia-

tors. The module integrator is also required to maintain an engineering record of the verification testing and declare on the product through proper labeling and marking that the device is compliant with these particular rules.

The installed module's FCC ID and IC numbers need to be clearly marked on the product with the following verbiage "Contains FCC ID: TFB-1001" and "Contains IC: 5969A-1001".

For comprehensive details on the EMC Compliance requirements for a product implementing the TiWi-C-W module, please refer to the TiWi-C-W Module Application Guide (330-0158).

Module Integration Considerations - Antenna Systems

The module must be used with one of the approved antennas:

1. LSR 001-0001 2.4 GHz center-fed dipole antenna and LSR 080-0001 U.FL to Reverse Polarity SMA connector cable.
2. LSR 001-0014 2.4 GHz FlexPIFA antenna.
3. Johanson 2450AT18A100 chip antenna.

The antenna should be placed such that it is minimally disturbed by the product's packaging material. The incorporation of the largest practical free-space clearance around the antenna is important for maximizing overall performance. Further, the antenna must be placed such that at least a 20 cm separation distance is maintained from the antenna to all other radio transmitters.

Module Integration Considerations - Substitute Antenna Systems

The module's certification is only valid for the list of approved antennas presented in the prior paragraph.

When using the U.FL connector, you may use a substitute antenna if the peak antenna gain is to equal or less than +2 dBi. It may be possible to use a substitute chip antenna, however there are restrictions, so please contact LSR for guidance prior to making any chip antenna substitutions.

6. Contacting LSR

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