TI CC3000 Evaluation Module

User's Guide

Literature Number: SWRU326
November 2012

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About This Manual

This user guide describes how to use the TI CC3000 evaluation module (EM) board to evaluate the performance of the TI CC3000 module.

Related Documentation From Texas Instruments

- *TI SimpleLink™ CC3000 Module – Wi-Fi 802.11b/g Network Processor Data Sheet* (SWRS126)
- CC3000 Wiki for MCU: http://processors.wiki.ti.com/index.php/CC3000_Wi-Fi_for_MCU

If You Need Assistance

The primary sources of CC3000 information are the device-specific data sheets and user's guides. For the most up-to-date version of the user's guide and data sheets, go to http://www.ti.com/product/cc3000.

FCC Warning

This equipment is intended for use in a laboratory test environment only. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to subpart J of part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

Introduction

This user guide describes how to use the TI CC3000 evaluation module (EM) board to evaluate the performance and functionality of the TI CC3000 module. The CC3000 module is a self-contained Wi-Fi® solution that enables internet connectivity for a wide variety of microcontroller (MCU) systems. The SimpleLink Wi-Fi from TI minimizes the host MCU software requirements, making it ideal for low-power and low-cost applications. The CC3000 EM board is targeted for TI MCUs, such as the MSP430-FR5739 and other various host platforms. This document details the key parts and features of the CC3000 EM board and the different options available to the user. This document includes layout guidelines to assist the designer in PCB development.

CC3000 EM Board

This section describes the key parts and features of the CC3000 EM board top and bottom views.

2.1 EM Board Top View

Figure 2-1 shows the key parts and jumpers mounted on the top of the CC3000 EM board. Table 2-1 describes the key parts of the EM board. Table 2-2 describes the J2 configuration of the CC3000 EM board. Table 2-3 and Table 2-4 describe the J4 and J5 signals, respectively.

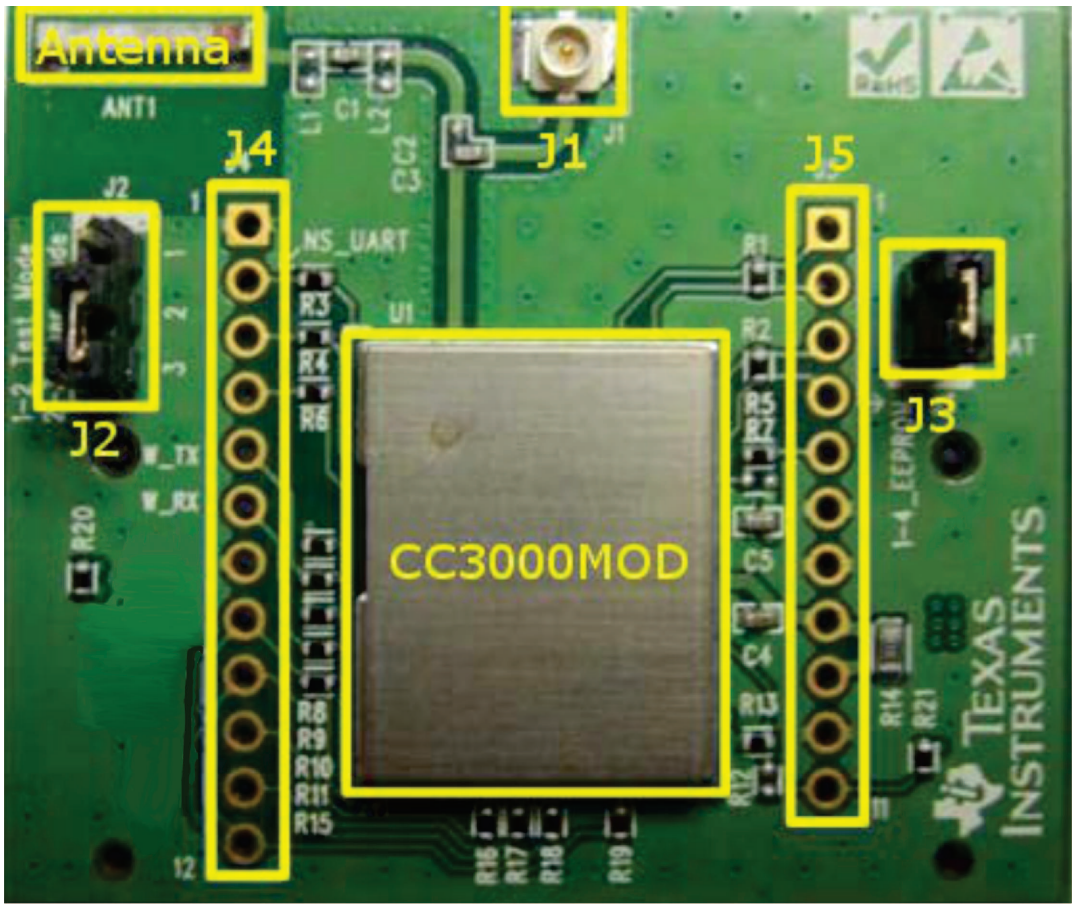


Figure 2-1. CC3000 EM Board Top View

Table 2-1. Key Parts of CC3000 EM Board Top View

Key Parts	Descriptions
CC3000MOD	Core module for performance evaluation (for more information, see the CC3000 module data sheet).
Antenna	Can be used for radiated testing by reworking the capacitor to correct pads
J1	U.FL RF connector used for conductive RF test
J2	Used to switch between test mode and operation mode. When pins 2 and 3 are shorted, J2 runs in operation mode. When pins 1 and 2 are shorted, J2 runs in test mode.
J3	Used to test power consumption. The pins of the jumper are shorted in operation mode. For power testing, the jumper is removed and an ammeter bridges the pins.
J4	Through-hole test points (For more information, see Table 2-3.)
J5	Through-hole test points (For more information, see Table 2-4.)

Table 2-2. J2 Configuration of the CC3000 EM Board

Mode	Description
Test mode: CC3000 radio tool(1)	Connect pins 1 and 2. Test mode is used with the CC3000 radio tool for operating, testing, and calibrating the CC3000 chip-set designs during development. This tool uses the RS232/UART pins to run radio frequency (RF) RX and TX tests on the CC3000 module. For more information, see the CC3000 wiki.
Functional mode: Normal mode	Connect pins 2 and 3. Normal mode is for regular functionality between the host platform and the CC3000 module.

(1) For more information about test software for the PC, go to the CC3000 wiki at http://processors.wiki.ti.com/index.php/CC3000_Wi-Fi_for_MCU.

Table 2-3. Header J4 of the CC3000 EM Board Top View

J4 Pin	Pin Name	Pin Type	Descriptions
1	GND	–	Ground
2	Reserved	–	Reserved
3	Reserved	–	Reserved
4	Reserved	–	Reserved
5	WL_RS232_TX	Output	RS232 transmit output; used for the radio tool serial interface in test mode. Leave floating in functional mode.
6	WL_RS232_RX	Input	RS232 receive output; used for the radio tool serial interface in test mode. Leave floating in functional mode.
7	GND	–	Ground
8	WL_SPI_CS	Input	Host interface SPI chip select
9	WL_SPI_DOUT	Output	Host interface SPI data output
10	WL_SPI_IRQ	Output	Host interface SPI interrupt request
11	WL_SPI_DIN	Input	Host interface SPI data input
12	WL_SPI_CLK	Input	Host interface SPI clock input

Table 2-4. Header J5 of the CC3000 EM Board Top View

J5 Pin	Pin Name	Pin Type	Descriptions
1	SCL_CC3000[(1)]	Output	I2C clock signal output from the CC3000 module. This pin is connected to SCL_EEPROM through a 0-Ω resistor and is not used by end users.
2	SCL_EEPROM[(1)]	Input	I2C clock signal input from EEPROM inside the CC3000 module. This pin is connected to SCL_CC3000 using a 0-Ω resistor and is not used by end users.
3	SDA_CC3000[(1)]	Input/Output	I2C data signal from the CC3000 module. This pin is connected to SDA_EEPROM using a 0-Ω resister and is not used by end users.
4	SDA_EEPROM[(1)]	Input/Output	I2C data signal from EEPROM inside the CC3000 module. This pin is connected to the SDA_CC3000 device using a 0-Ω resistor and is not used by end users.
5	VBAT_SW_EN	Input	Active-high enables the signal from the host device.
6	GND	–	Ground
7	GND	–	Ground
8	VIO_HOST	Power In	VIO power supply from the host to the module. For the MSP430 host platform, VIO_HOST = VBAT_IN. For other platforms that have different voltage levels from battery voltages, R14 can be removed.
9	VBAT_IN	Power In	Battery voltage input to module. For the MSP430 host platform, VIO_HOST = VBAT_IN. For other platforms that have different voltage levels from the battery voltages, R14 can be removed.
10	GND	–	Ground
11	Reserved	–	Reserved

(1) The EM board arrives with EEPROM preprogrammed.

2.2 EM Board Bottom View

The two EM board mating connectors J6 and J7 connect to the host platform and are mounted on the bottom of the EM board, as shown in Figure 2-2. Table 2-5 and Table 2-6 describe the signals brought out from these two EM mating connectors.

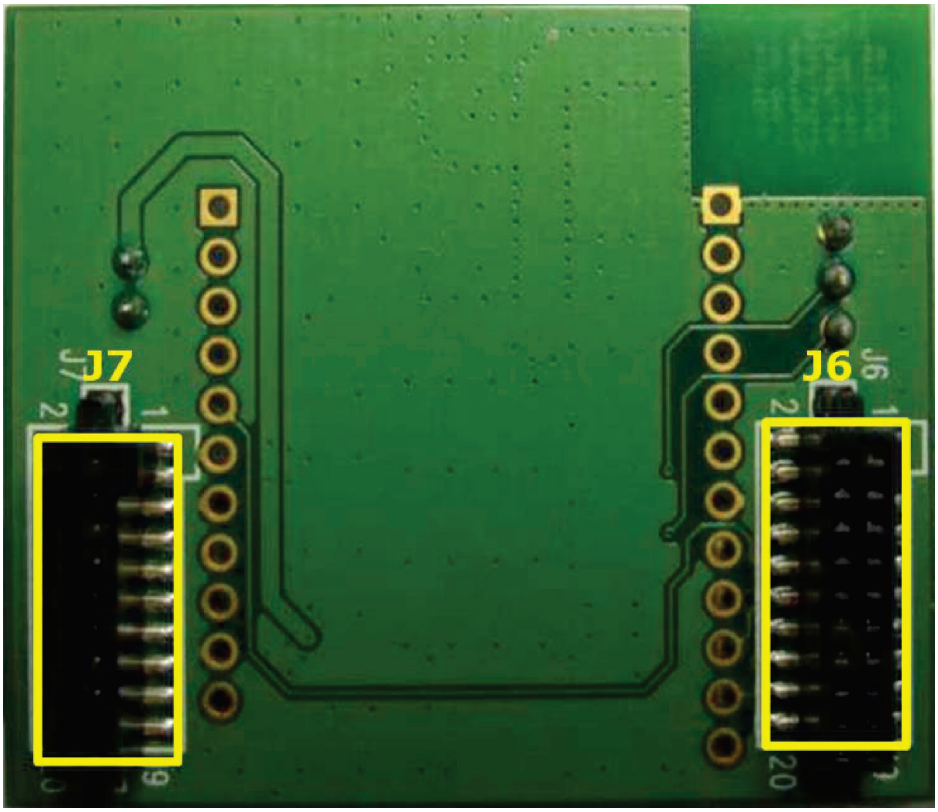


Figure 2-2. CC3000 EM Board Bottom View

Table 2-5. Header J6 of CC3000 EM Board Bottom View

J6 Pin	Pin Name	Module Pin Type	Description
1	GND	–	Ground
5	Reserved	–	Reserved
10	VBAT_SW_EN	Input	Active-high enable signal from the host device
12	WL_SPI_IRQ	Output	Host interface SPI interrupt request
14	WL_SPI_CS	Input	Host interface SPI CS
16	WL_SPI_CLK	Input	Host interface SPI clock input
18	WL_SPI_DIN	Input	Host Interface SPI data input
19	GND	–	Ground
20	WL_SPI_DOUT	Output	Host interface SPI data output

Table 2-6. J7 of CC3000 EM Board Bottom View

J7 Pin	Pin Name	Module Pin Type	Description
2	GND	–	Ground
7	VBAT_IN	Power In	Battery voltage input to the module
9	VBAT_IN	Power In	Battery voltage input to the module
15	Reserved	–	Reserved

2.3 Antenna

The ACX ceramic antenna is mounted on the EM board with a specific layout and matching circuit for the radiation tests conducted in FCC, CE, and IC certifications. Figure 2-3 shows the location of the ACX ceramic antenna on the EM board and the RF trace routing from the CC3000 module to the antenna. Figure 2-4 shows the matching circuit between the antenna and the EM board. The return loss is based on the matching circuit and RF trace routing, as shown in Figure 2-5. Figure 2-6 shows the radiation patterns on XY, XZ, and YZ planes.

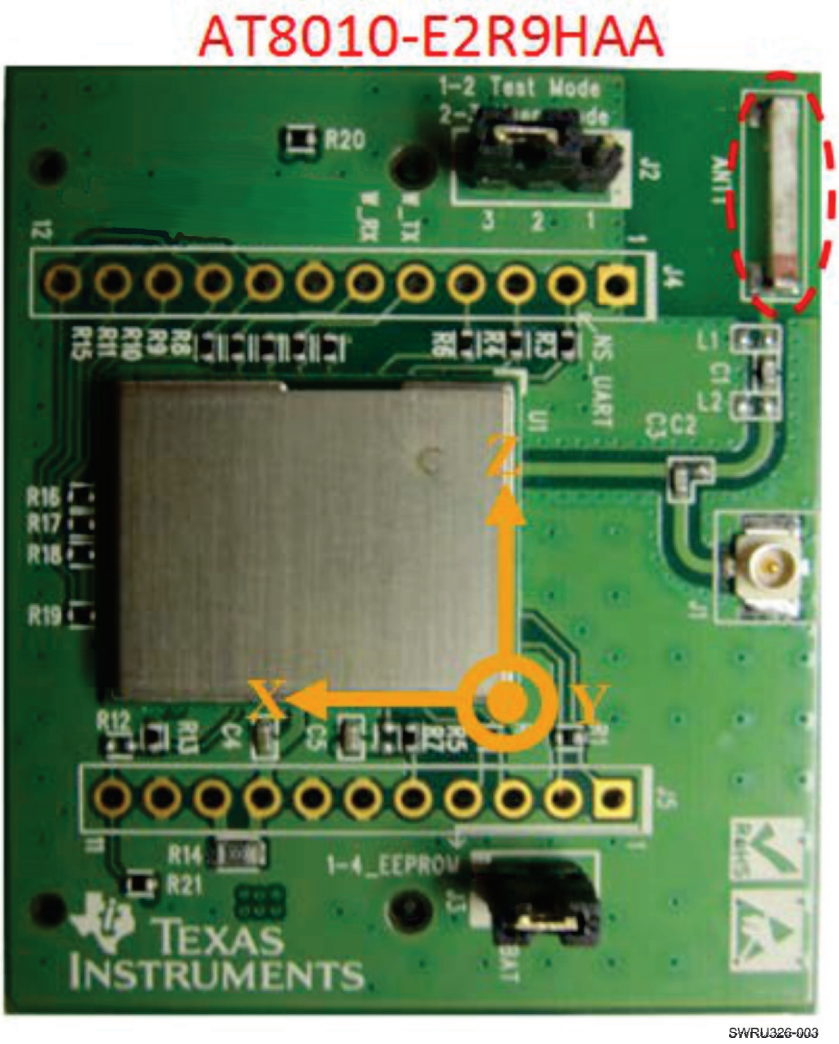


Figure 2-3. Antenna Location and RF Trace Routing

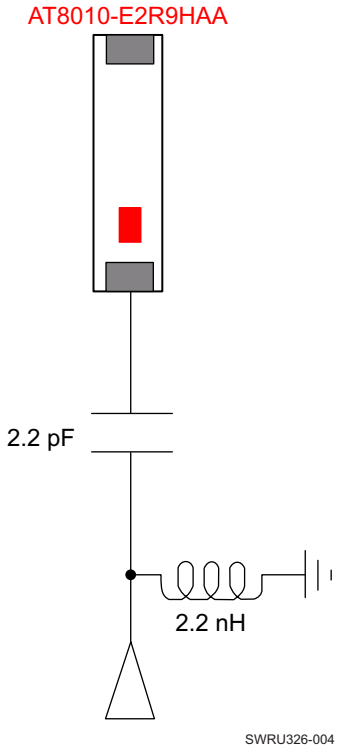


Figure 2-4. Matching Circuit Between the Antenna and the CC3000 EM Board

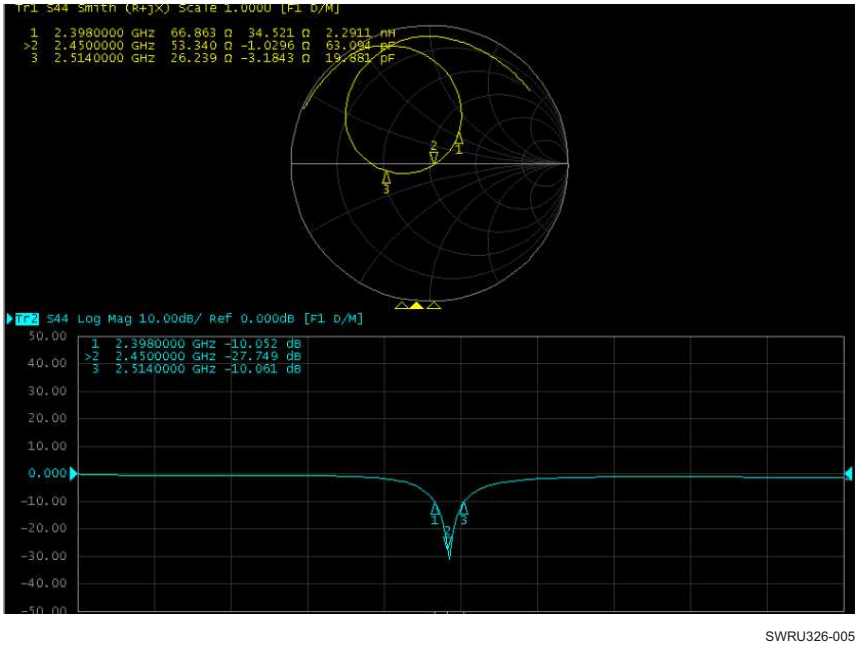
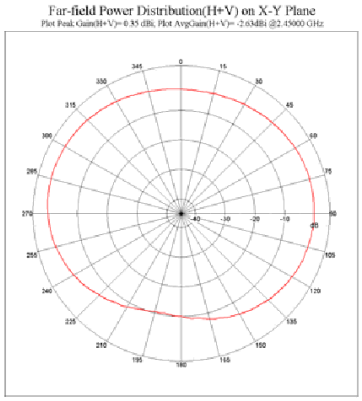


Figure 2-5. Return Loss from the ACX Antenna and Matching Circuit

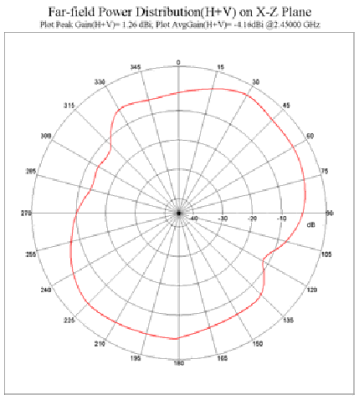
XY plane



Unit : dBi

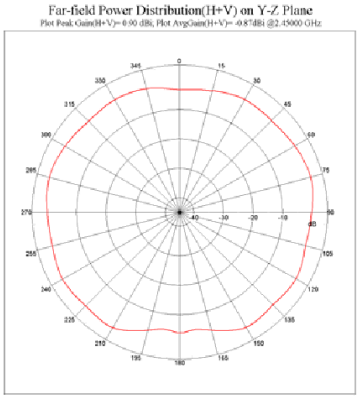
	Peak gain	Avg. gain
XY plane	0.3	–2.6

XZ plane



	Peak gain	Avg. gain
XZ plane	1.3	–4.2

YZ plane



	Peak gain	Avg. gain
YZ plane	0.9	–0.9

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Figure 2-6. Antenna Radiation Patterns

2.4 Hardware Setup

Before conducting performance tests, the EM board must be connected to the host platform, either with the mating connectors (J6 and J7) or the single-row headers (J4 and J5). To use the EM mating connectors to connect the hardware, the mating EM connector must be lined up and spaced 1.2 inches apart (see Figure 2-7). To use the single-row headers, the required signals from the EM mating connectors must be wired to the host platform.

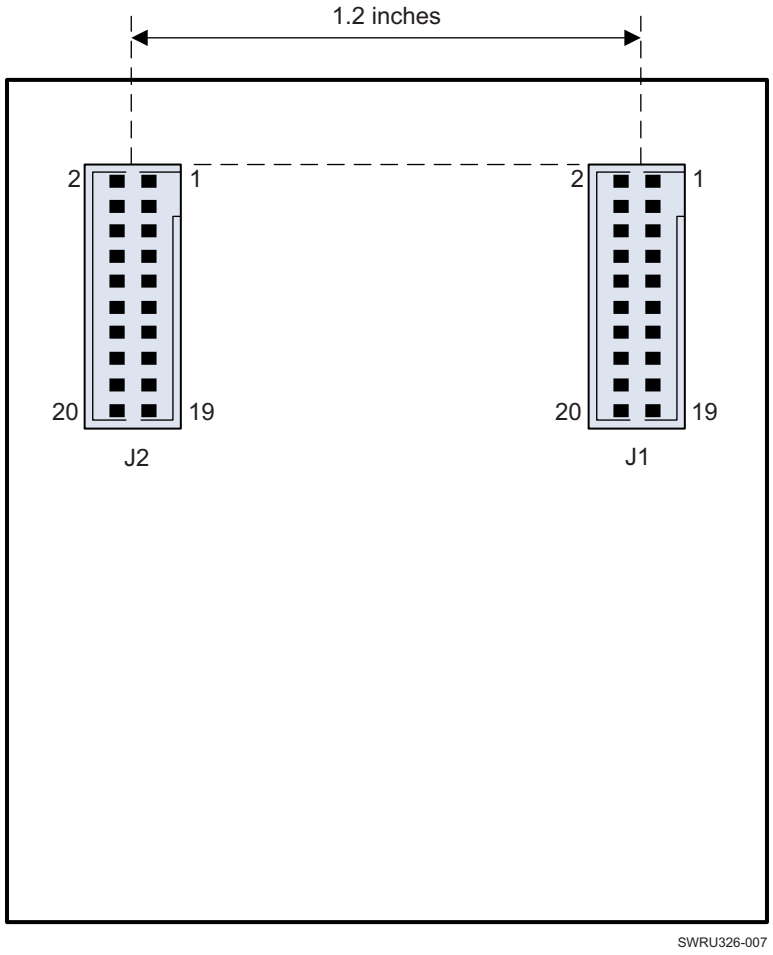

Figure 2-7. Host PCB Mating Connector Arrangement

2.5 Schematics

Figure 2-8 shows the schematics of the CC3000 EM board.

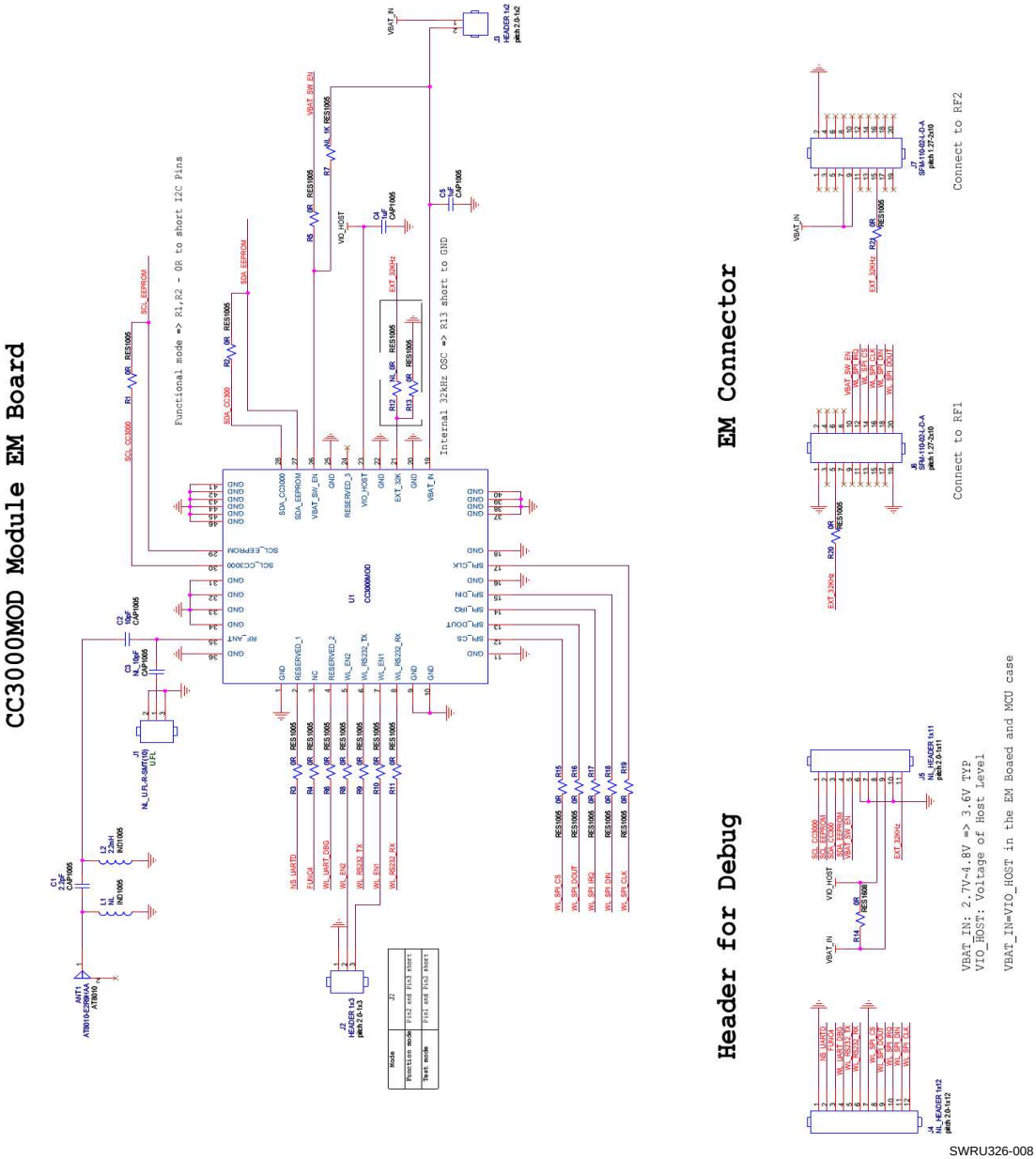

Figure 2-8. Schematics of the CC3000 EM Board

2.6 Bill of Materials (BOM)

Table 2-7 lists the BOM for the TI CC3000 EM board.

Table 2-7. BOM for the TI CC3000 EM Board

Items	Reference Designator	Description
1	U1	TI CC3000 Wi-Fi b/g module (BM)
2	ANT1	ANT, 2.4 GHz, peak gain 2.5 dB
3	J1	Mini RF header receptacle
4	J2	CON male 1 x 3, pitch 2.0 mm
5	J3	CON male 1 x 2, pitch 2.0 mm
6	J6,J7	Female header, Fool Proof H:4.3, 2 x 10, pitch 1.27 mm, SMT
7	C1,C3	CAP 0402 10 pF, 50 V, NPO, ±5%
8	C4,C5	CAP 0402 1 µF, X5R, 6.3 V, ±10%, HF
9	R1, R2, R3, R4, R5, R6, R8, R9, R10, R11, R13, R15, R16, R17, R18, R19, R20, R21	RES 0402, 0-Ω jumper
10	R14	RES 0603, 0-Ω jumper

Layout Guidelines

This section presents guidelines that must be followed when creating a board design incorporating the TI CC3000 module.

Figure 3-1 shows the TI CC3000 EM four-layer board. Table 3-1 and Figure 3-2 describe instances of good layout practices.

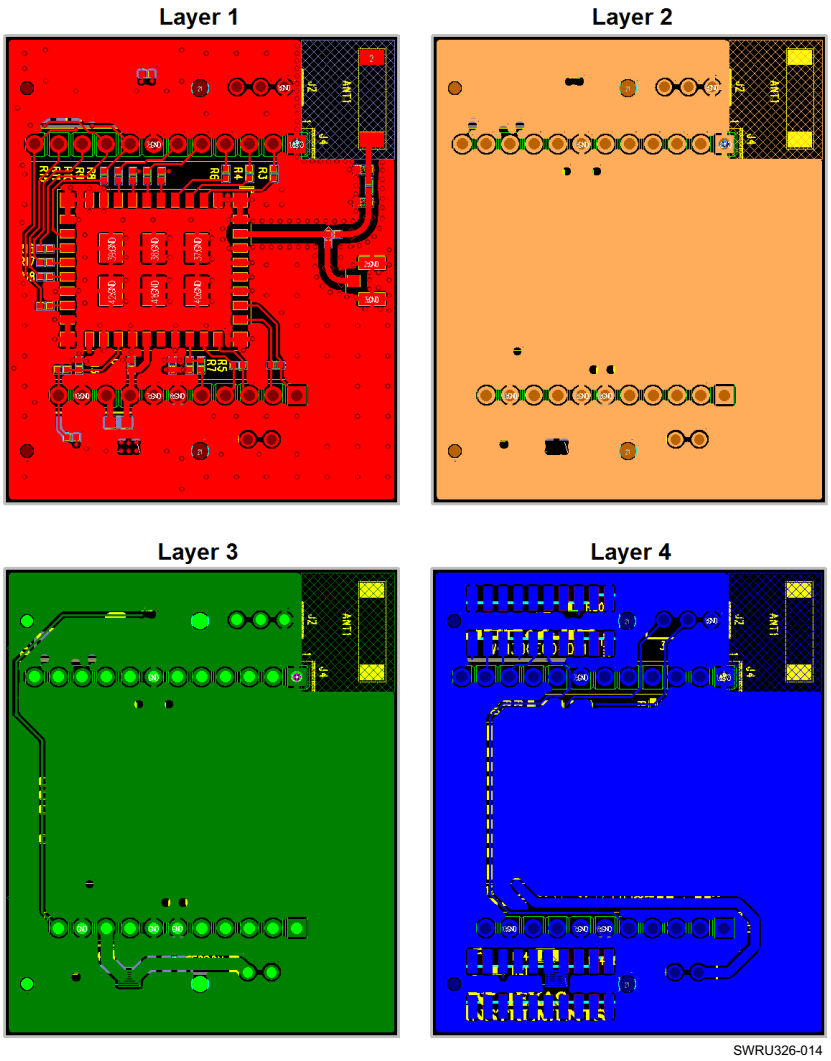

Figure 3-1. Module Layout Guidelines

Table 3-1. Module Layout Guidelines

Reference (1)	Guideline Description
1	The proximity of ground vias must be close to the pad.
2	Signal traces must not be run underneath the module on the layer where the module is mounted.
3	Have a complete ground pour in layer 2 for thermal dissipation.
4	Have a solid ground plane and ground vias under the module for stable system and thermal dissipation.
5	Increase the ground pour in the first layer and have all of the traces from the first layer on the inner layers, if possible.
6	Signal traces can be run on a third layer under the solid ground layer, which is below the module mounting layer.

(1) See Figure 3-2.

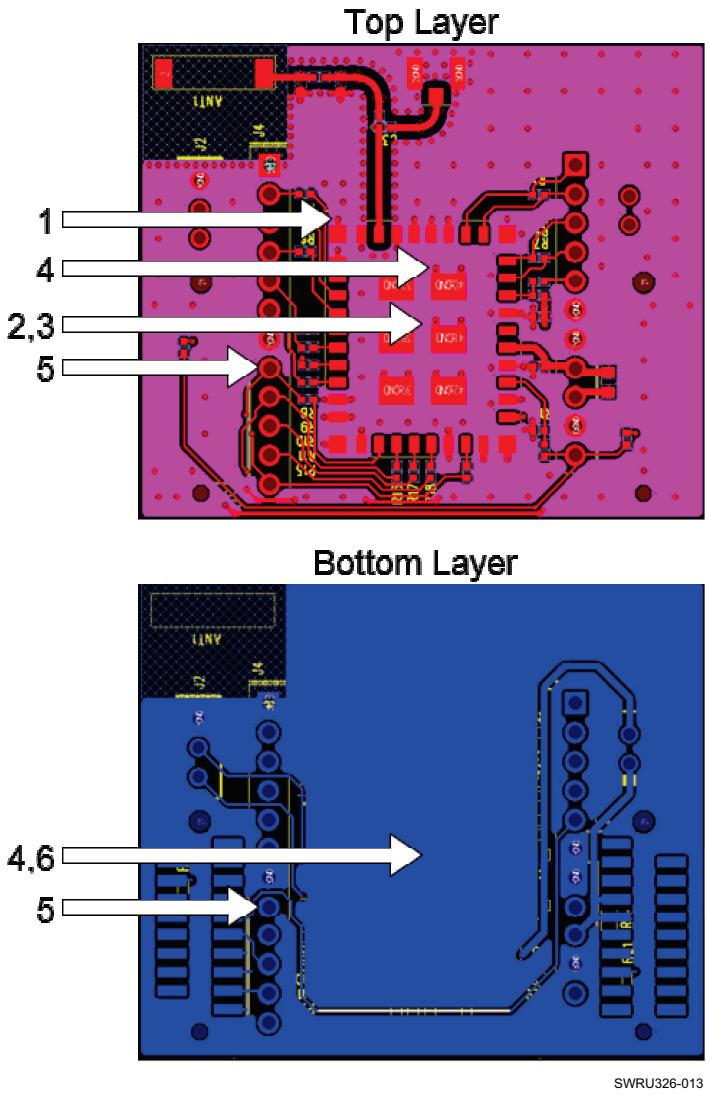

Figure 3-2. Module Layout Guidelines

Figure 3-3 shows the trace design for the PCB. A 50-Ω impedance match on the trace to the antenna should be used. Also, 50-Ω traces are recommended for the PCB layout. Table 3-2 lists the distances shown in Figure 3-3. Figure 3-4 shows layer 1 with the trace to the antenna over ground layer 2. Table 3-3 and Figure 3-5 describe instances of good layout practices for the antenna and RF trace routing.

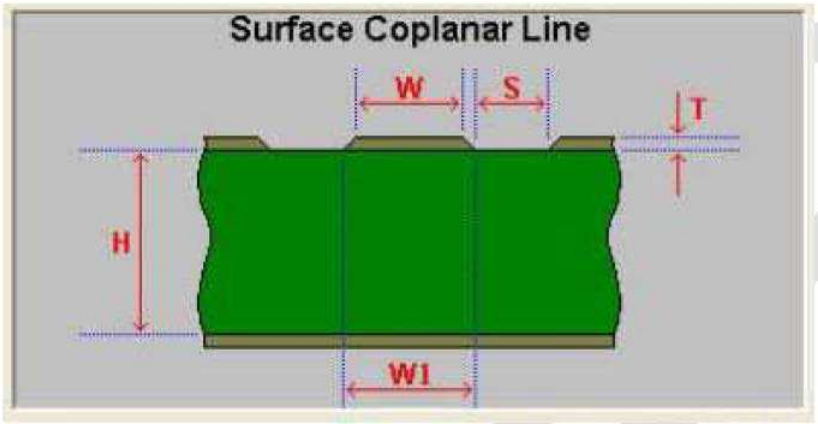

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Figure 3-3. Trace Design for the PCB Layout

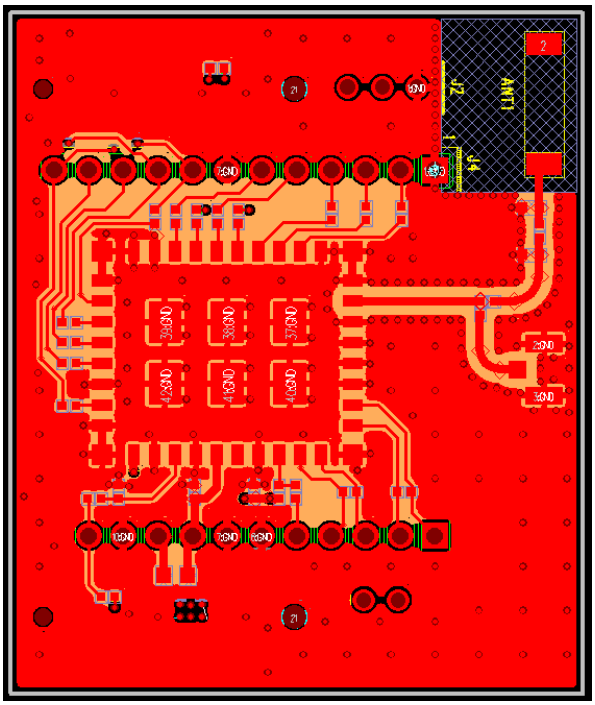

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Figure 3-4. Layer 1 Combined With Layer 2

Table 3-2. Trace Design Measurement Values

Measurement	Length
H (height between L1 and L2)	12.0 mil
W (RF trace)	14.3 mil
T (thickness)	1.2 mil
S (separation)	10.0 mil
ε_r (dielectric)	4.3

Table 3-3. Antenna and RF Trace Routing Layout Guidelines

Reference (1)	Guideline Description
1	The RF trace antenna feed must be as short as possible beyond the ground reference. At this point, the trace starts to radiate.
2	The RF trace bends must be gradual with an approximate maximum bend of 45 degrees with trace mitered. RF traces must not have sharp corners.
3	RF traces must have via stitching on the ground plane beside the RF trace on both sides.
4	RF traces must have constant impedance (microstrip transmission line).
5	For best results, the RF trace ground layer must be the ground layer immediately below the RF trace. The ground layer must be solid.
6	There must be no traces or ground under the antenna section.
7	The PCB designer must understand the microstrip model used and the scale line width according to the microstrip model.
8	RF traces must be as short as possible. The antenna, RF traces, and modules must be on the edge of the PCB product. The proximity of the antenna to the enclosure and the enclosure material must also be considered.

(1) See Figure 3-5.

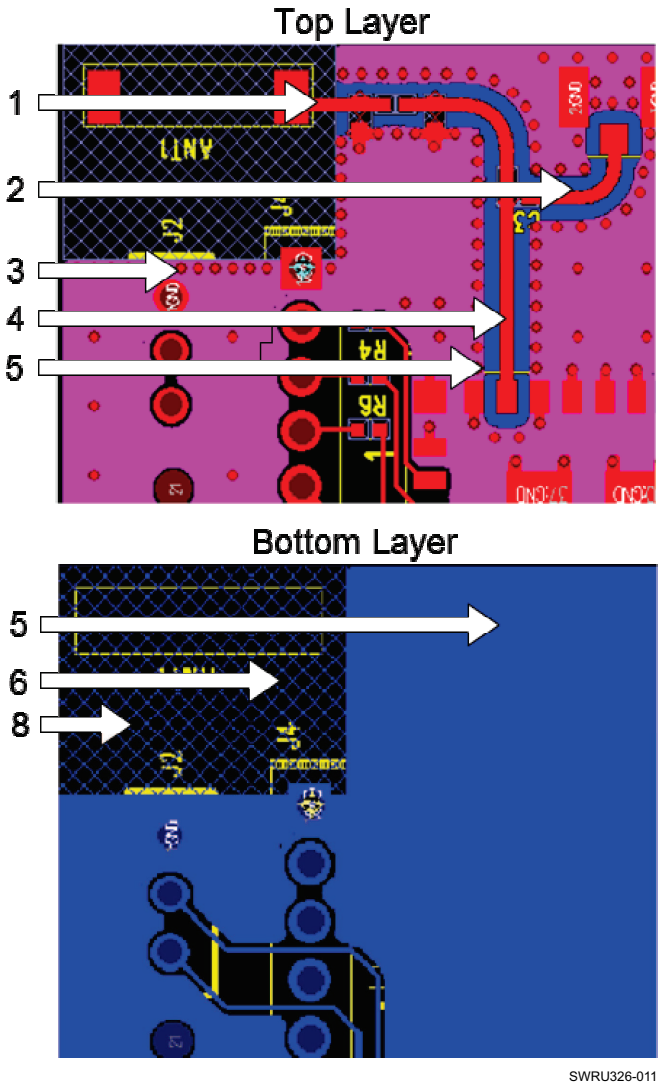

Figure 3-5. Antenna and RF Trace Routing Layout Guidelines

Figure 3-6 shows the supply routing guidelines:

- For power supply routing, the power trace for VBAT must be at least 40 mil wide.
- The 1.8-V trace must be at least 18 mil wide.
- Make VBAT traces as wide as possible to ensure reduced inductance and trace resistance.
- If possible, shield VBAT traces with ground above, below, and beside the traces.

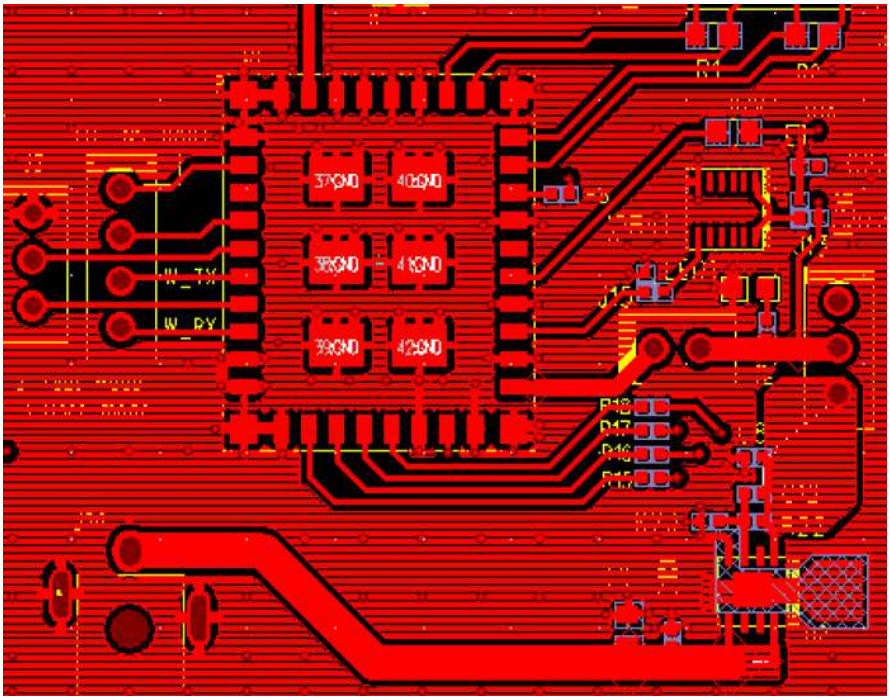

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Figure 3-6. Power Supply Routing of the CC3000 EM Board

Application Development

TI supports the CC3000 EM board when paired with the following TI MCU host platforms:

- MSP-EXP430FR5739
- MSP-EXP430F5529
- MSP-EXP430F5438
- MSP-EXP430FG4618
- DK-LM3S9B96
- EK-LM4F232

To find example applications for each of the listed host platforms, go to the TI wiki at: http://processors.wiki.ti.com/index.php/CC3000_Wi-Fi_for_MCU#TI_Platforms.

In addition to the TI MCU platforms, the CC3000 EM board can be used on other platforms with the same RF connector interface. For a host driver porting guide to assist with porting to other platforms, go to http://processors.wiki.ti.com/index.php/CC3000_Host_Driver_Porting_Guide.

Figure 4-1 shows the MSP-EXP430FR5739 test platform and CC3000 EM board.

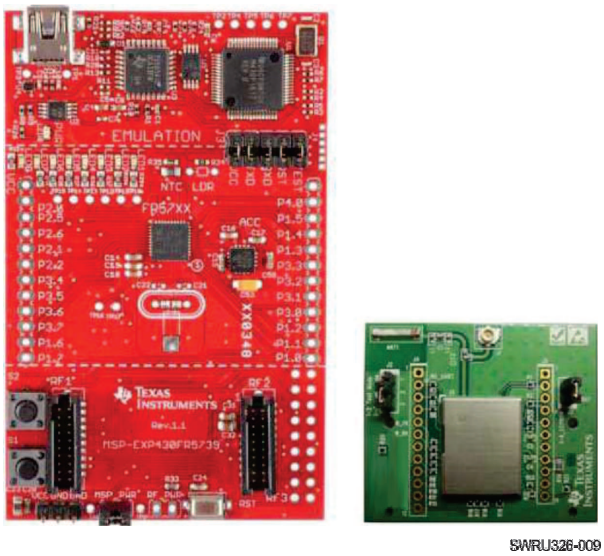

Figure 4-1. MSP-EXP430FR5739 Test Platform and CC3000 EM Board

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Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265

REGULATORY COMPLIANCE INFORMATION

When the radio module is included in a final product, the following warning statements must be included in the final product user guide

Caution
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A devices
This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B devices
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
• Reorient or relocate the receiving antenna.
• Increase the separation between the equipment and receiver.
• Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
• Consult the dealer or an experienced radio/TV technician for help.

Industry Canada Warnings
This Class B digital apparatus complies with Canadian ICES-003.
Changes or modifications not expressly approved by the party responsible for compliance could void the user’s authority to operate the equipment.

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.
Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l’autorité de l'utilisateur pour actionner l'équipement.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.
Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d’usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

Labeling of the final product
The final product must contain a label with the statement “Contains radio module FCC ID: Z64-CC3000EM, IC: 451I-CC3000EM”.