

RMODIT Hardware User Guide

1 Revision History

Revision	Reviser	Date	Comments
0.7	Alex Bahk	11/21/2019	-9.4 Antenna Update
0.6	Alex Bahk	9/3/2019	-9.4 Antenna Update
0.5	Tyler Fultz	6/14/2016	-9.4 Antenna Update
0.4	Tyler Fultz	6/6/2016	-9.6 more label corrections
0.3	Tyler Fultz	5/24/2016	-9.6 more label corrections
0.2	Tyler Fultz	4/26/2016	-9.4 added model name -9.5 added 20 cm distance -9.4 added monopole antenna -9.6 corrected label requirements
0.1	Tyler Fultz	4/21/2016	Initial Draft

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3 Ordering Options

There are four build variants available for RMODIT. The variant choices are based on antenna selections.

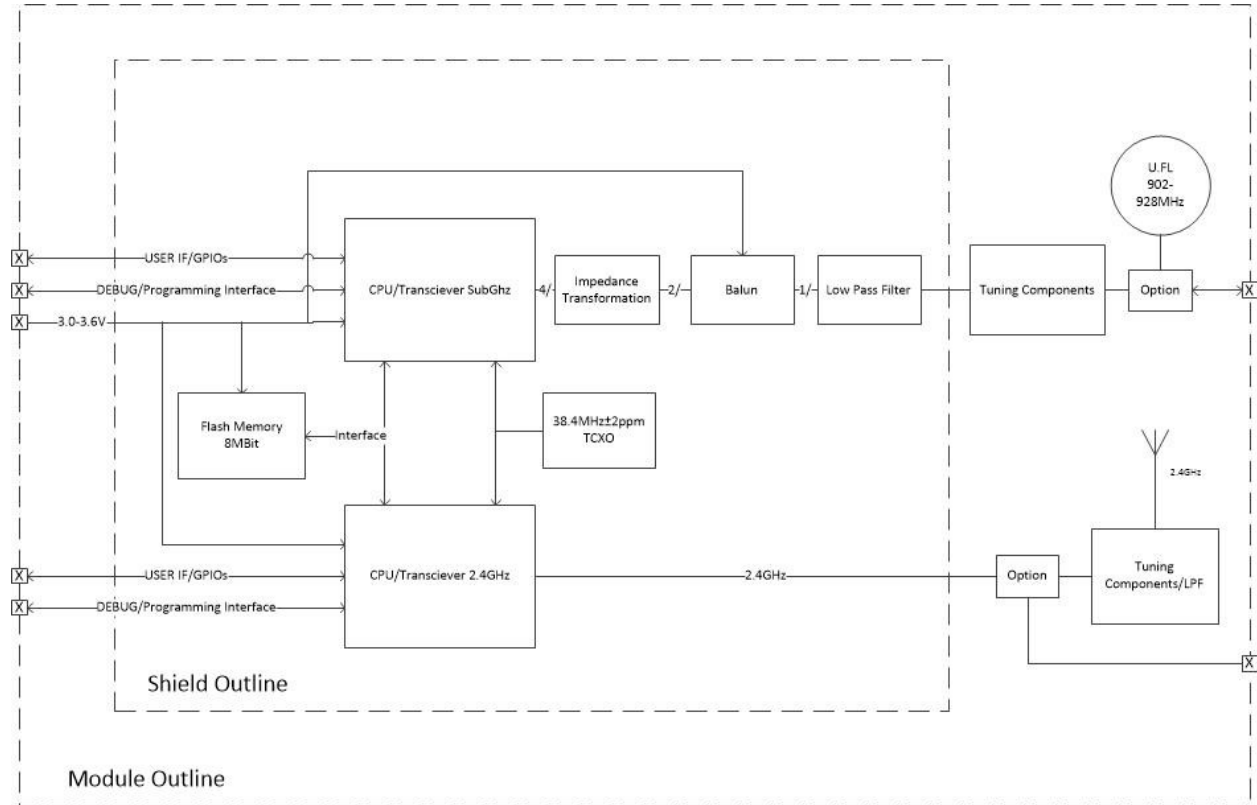
Assembly Number	Sub Ghz Antenna	BLE Antenna
501-00736-001	Onboard U.FL	Onboard Antenna
501-00736-002	Offboard connection	Onboard Antenna
501-00736-003	Onboard U.FL	Offboard connection
501-00736-004	Offboard connection	Onboard connection

4 Reference Documents

All specifications in this documents are specific to RMODIT. For information regarding RMODIT components, reference the following documents.

Component	Manufacture	Manufacture Part Number	Reference Document
SubGhz SOC	Silicon Labs	EFR32MG1P232F256GM48	Unreleased
2.4GHz SOC	Silicon Labs	EFR32BG1B232F128GM32	Unreleased
Flash Memory	Macronix	MX25R8035FZUILO	Datasheet
SubGhz Antenna Connector	Hirose	U.FL-R-SMT-1	Datasheet
2.4GHz Antenna	Molex	47948-0001	Datasheet

5 System Block Diagram



6 Pinout and Footprint

6.1 Pinout

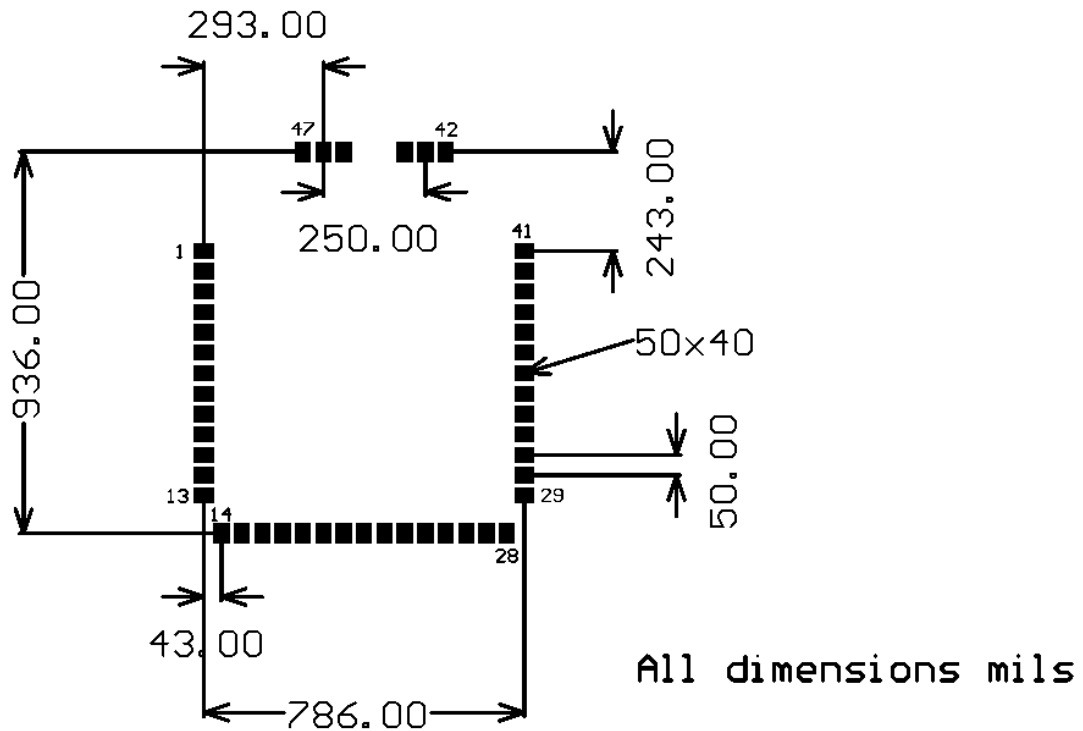
Pin	Function	Processor	Processor Pin	Alternate Function	Recommended Alternate Function
1	GND				
2	nRESET	EFR32MG			
3	GPIO	EFR32BG	PD13	YES	
4	GND				
5	GPIO	EFR32BG	PB14	YES	
6	GPIO	EFR32BG	PB15	YES	
7	GND				
8	GPIO	EFR32MG	PA0	YES	ADC0+
9	GPIO	EFR32MG	PA1	YES	ADC0-
10	GND				

11	VIN				
12	VIN				
13	VIN				
14	GND				
15	GND				
16	GND				
17	I2C SDA	EFR32MG	PA5	NO	
18	I2C SCL	EFR32MG	PA4	NO	
19	No Connect				
20	USER I/F TX	EFR32MG	PA3	NO	
21	USER I/F RX	EFR32MG	PA2	NO	
22	nRESET	EFR32BG		NO	
23	GPIO	EFR32MG	PB14	YES	
24	GPIO	EFR32MG	PB15	YES	
25	GPIO	EFR32MG	PC10	YES	
26	GPIO	EFR32MG	PC11	YES	
27	DBG SWCLK	EFR32MG	PF0	NO	
28	DBG SWDIO	EFR32MG	PF1	NO	
29	DBG SWO	EFR32MG	PF2	YES	
30	No Connect				
31	GPIO	EFR32MG	PF4	YES	LEDCODE
32	GPIO	EFR32MG	PF5	YES	ACMP Output
33	GPIO	EFR32MG	PF6	YES	ACMP0+
34	GPIO	EFR32MG	PF7	YES	ACMP0-
35	GND				
36	GPIO	EFR32MG	PD14	YES	IDAC+
37	GPIO	EFR32MG	PD13	YES	IDAC-
38	DBG SWCLK	EFR32BG	PF0	NO	
39	DBG SWDIO	EFR32BG	PF1	NO	
40	DBG SWO	EFR32BG	PF2	YES	
41	DBG TDI	EFR32BG	PF3	YES	
42	GND				
43	915MHZ				
44	GND				
45	GND				
46	2.4GHZ				
47	GND				

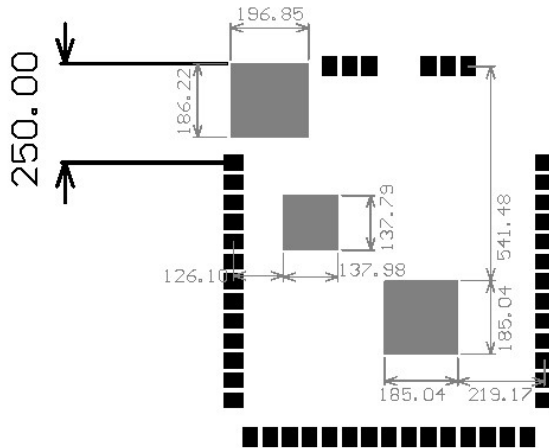
EFR32MG refers to EFR32MG1P232F256GM48. EFR32BG refers to EFR32BG1B232F128GM32.

Reference EFR332MG and EFR32BG reference documentation for alternate pin functionality.

6.2 Footprint Drawing



Pad Layout



All dimensions mils

Keepout Regions

7 Electrical Specifications

7.1 Absolute Maximums

Parameter	Symbol	Min	Typ	Max	Unit
Input Voltage	V_{IN}	1.8	3.3	3.6	V
I/O Voltage and Current	Reference Silicon Lab's Datasheets				
RF Pin max power	Reference Silicon Lab's Datasheets				

7.2 Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit
Input Voltage	V_{IN}	-	3.3	-	V
Input Current	I_{IN}	-	-	200	mA

7.3 Current Consumption

All testing done at 20C and 3.3V input. 2.4GHz radio in power down unless specified.

Parameter	Symbol	Min	Typ	Max	Unit
Receive Current	I _{rx}			TBD	mA
Module Sleep Current	I _{sleep}			TBD	uA
Receive Current with Beacons	I _{rx+ble}			TBD	mA
Max Power SubGhz TX	I _{TX200}			TBD	mA
Mid Power SubGhz TX	I _{TX100}			TBD	mA
Low Power SubGhz TX	I _{TX0}			TBD	mA
Max Power BLE TX ¹	I _{TX100BLE}				
Mid Power BLE TX ¹	I _{TX50BLE}				
Low Power BLE TX ¹	I _{TX0BLE}				

¹2.4GHz radio is powered up and transmitting, 915MHz radio is in receive mode

7.4 Radio Parameters

7.4.1 SubGhz

7.4.1.1 Power Level Measurement

All testing done at 20°C on channel 7 (916MHz).

Input Voltage	RF Power level		
TX Setting:	200	100	0
1.8	14.1	7.4	-2.67
1.9	14.6	7.91	-2.2
2	15.1	8.3	-1.87
2.1	15.5	8.58	-1.67
2.2	15.9	8.76	-1.55
2.3	16.3	8.86	-1.51
2.4	16.6	8.91	-1.5
2.5	16.9	8.92	-1.51
2.6	17.1	8.92	-1.51
2.7	17.4	8.93	-1.54
2.8	17.6	8.95	-1.53
2.9	17.9	8.96	-1.52

3	18.1	8.98	-1.52
3.1	18.3	8.99	-1.51
3.2	18.5	9.01	-1.49
3.3	18.6	9.02	-1.49
3.4	18.8	9.03	-1.48
3.5	18.9	9.04	-1.47
3.6	19.1	9.05	-1.46

7.4.1.2 Channel Map

Channel	Center Frequency (Mhz)
0	902
1	904
2	906
3	908
4	910
5	912
6	914
7	916
8	918
9	920
10	922
11	924
12	926
13	928

7.4.2 Bluetooth

7.4.2.1 Power Level Measurement

All testing done at 20°C on channel 38 (2426MHz).

Input Voltage	RF Power level		
TX Setting:	100	50	0
1.8			
1.9			
2			
2.1			
2.2			

2.3			
2.4			
2.5			
2.6			
2.7			
2.8			
2.9			
3			
3.1			
3.2			
3.3			
3.4			
3.5			
3.6			

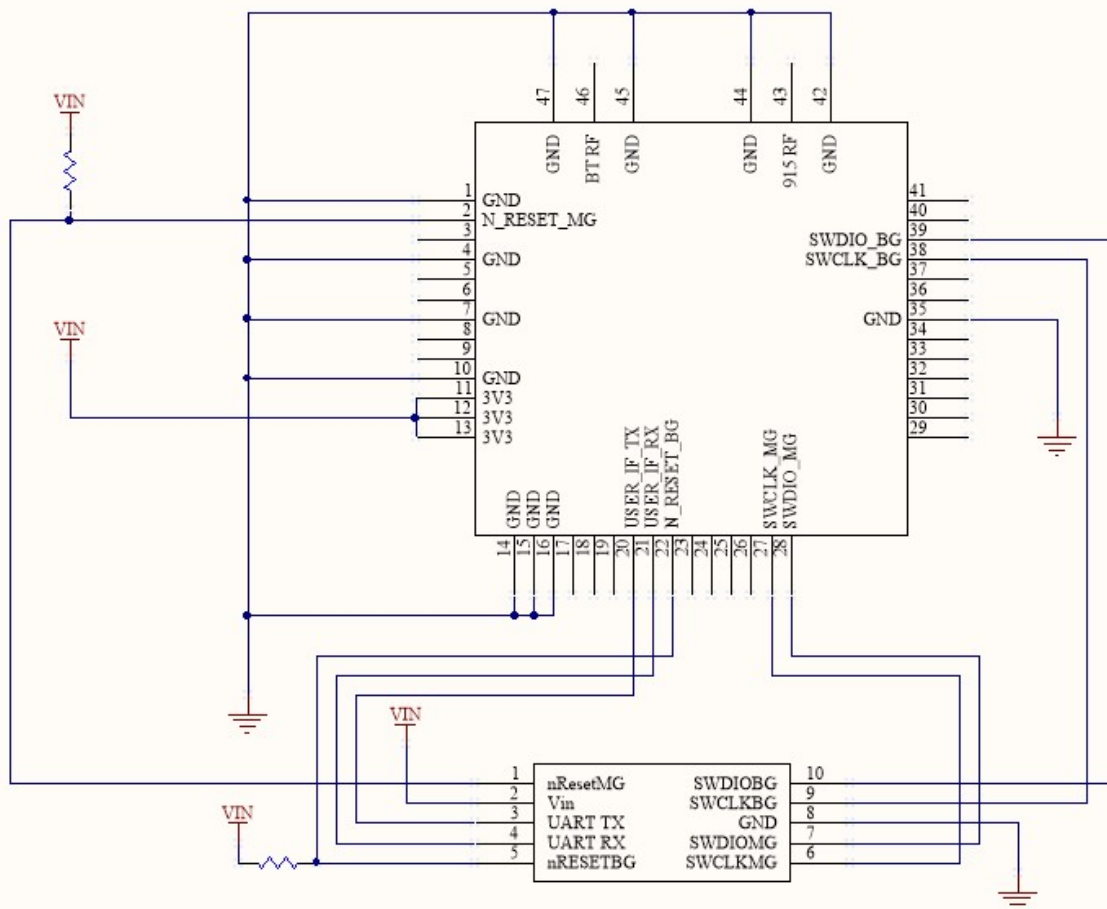
7.4.2.2 Channel Map

Reference the Bluetooth 4.0 Specification.

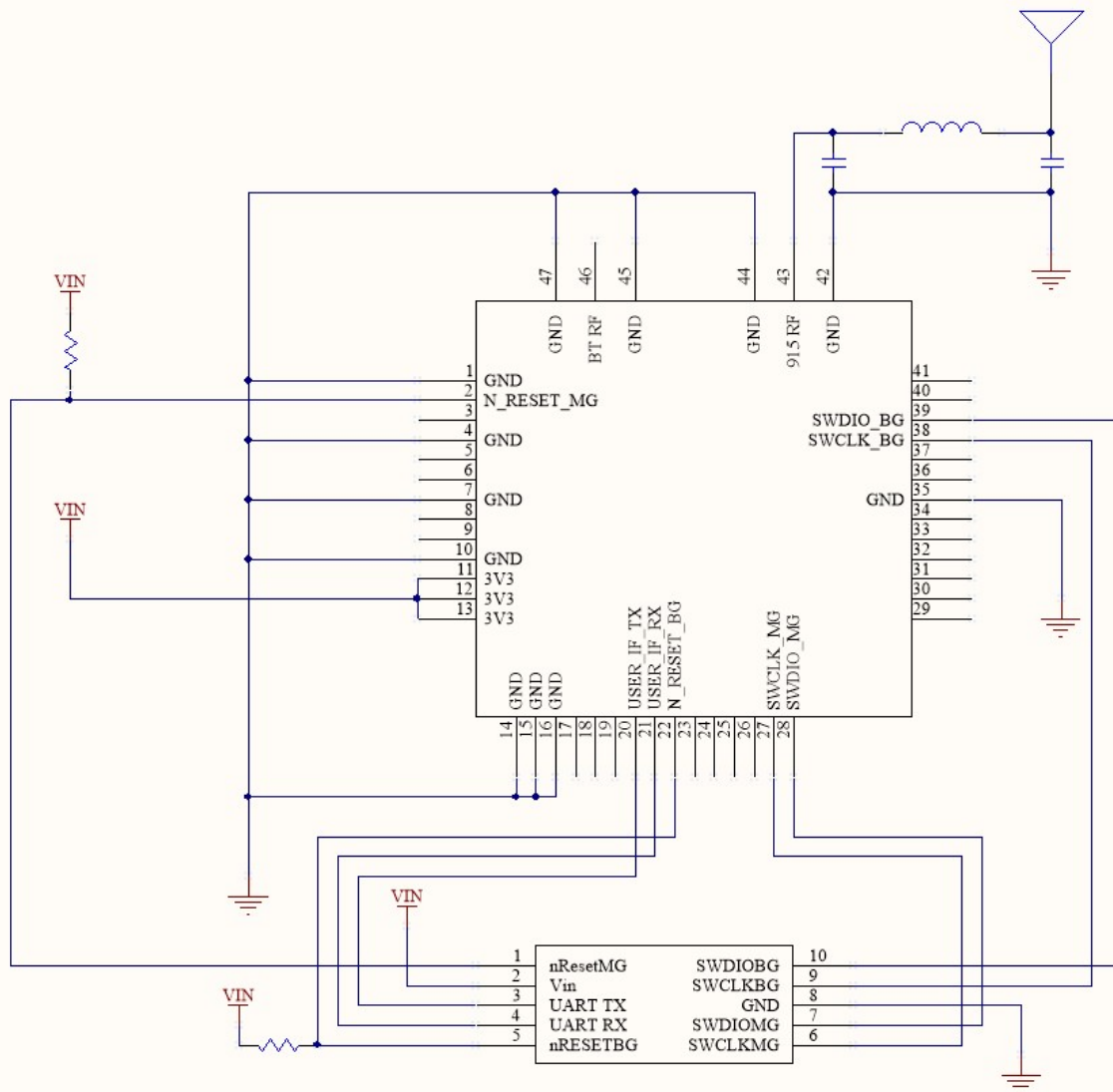
8 Application Information

8.1 Reference Design

8.1.1 Onboard Antennas

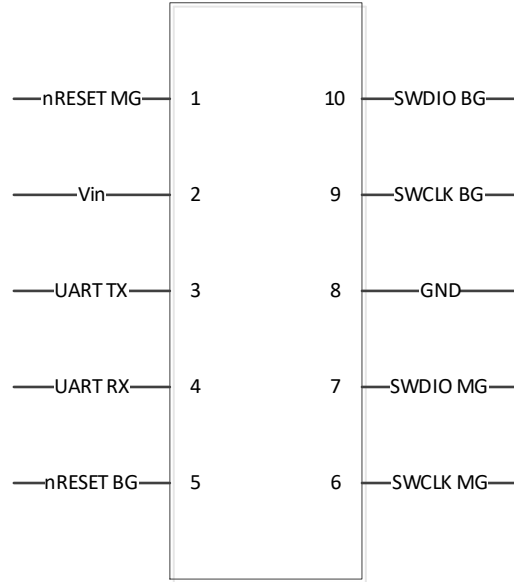


8.1.2 Off Board 915MHz Antenna



The debug connection must be standard for all end products using the module. This allows for consistent debug and field support of the module.

8.2.1 Debug Connector Pinout



The pinout of this debug connector is described in the table below.

Pin Number	Pin Name	Description
1	nRESET MG	Reset for EFR32MG
2	Vin	Voltage Input
3	UART TX	User Interface TX from IC (output)
4	UART RX	User Interface RX to IC (input)
5	nRESET BG	Reset for EFR32BG
6	SWCLK MG	EFR32MG SWCLK (PTI)
7	SWDIO MG	EFR32MG SWDIO (PTI)
8	GND	Ground
9	SWCLK BG	EFR32BG SWCLK (PTI)
10	SWDIO BG	EFR32BG SWDIO (PTI)

The voltage input must be connected to directly to the module.

8.2.2 Debug Connector Footprint

There are two recommended footprints for the debug connector and three connection options, depending on board requirements. The connector should be placed on the same side as board test points, as the connector pads are sufficient test points for manufacturing test.

8.2.2.1 Standard Connector

The standard connector is recommended for boards without strict size and density requirements. The connector requires no component for connection, but relies on a cable with spring loaded pins to make electrical contact.

Reference Tag-Connect Part number TC2050-IDC at this link: <http://www.tag-connect.com/Materials/TC2050-IDC%20Datasheet.pdf>

Follow all layout recommendations from this vendor for this connector option.

8.2.2.2 Under Mount connector

The under mount connector is recommended for board with small size or high density requirements. The connector can be placed under the module.

Reference Tag-Connect Part number TC2050-IDC-NL-SP at this link: <http://www.tag-connect.com/Materials/TC2050-IDC-NL%20Datasheet.pdf>

You must specify SP when ordering the part. This specifies shorter alignment pins to allow for alignment when the module is located on the other side of the through holes.

8.2.2.3 Permanent Connector

A permanent connector can be used with the specified pads for development purposes, without modification. For development, hand solder a 2x5 0.05" pitch SMT type header to the test pads. In production, use the Tag-Connect pads for test points and field analysis.

An example of an acceptable connector is here: <http://www.digikey.com/product-detail/en/amphenol-fci/20021121-00010C4LF/609-3695-2-ND/2209057>

9 Regulatory Approval

Warning: Changes or modifications to this device not expressly approved by Acuity Brands Lighting, INC could void the user's authority to operate the equipment.

The RMODIT module has received regulatory approvals for limited modular devices in the United States and Canada. Limited modular device approval allows Acuity Brands Lighting, INC to place the RMODIT inside a finished product and not require regulatory testing for an intentional radiator (RF transmitter),

provided no changes or modifications are made to the module circuitry and the specified conditions are met.

9.1 Operating Conditions

To meet FCC and ISED requirements, the following conditions must be observed by the integrator.

9.1.1 Power Regulation

The integrator must provide a regulated voltage input no greater than 3.6VDC and no less than 1.8VDC.

9.1.2 Firmware

The integrator must use Acuity Brands Lighting INC. radio firmware. Only provided radio firmware is approved to meet regulatory requirements.

9.2 US

NOTE: 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.*

9.3 Canada

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.

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.

9.4 Antenna Requirement

This radio transmitter RMODIT has been approved by Industry Canada to operate with the antenna types listed below 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.

Le présent émetteur radio (identifier le dispositif par son numéro de certification ou son numéro de modèle s'il fait partie du matériel de catégorie I) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous 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.

9.4.1 Antennas

The antennas listed are approved for use with RMODIT without recertification. Antennas of the same type and equal or less gain, measured in dBi, are also acceptable.

9.4.1.1 SubGhz

Type	Gain	Connection	Manufacture	Part Number	Description
Chip	1.0dBi	Edge	Johanson	0915AT43A0026	Ceramic Chip antenna on Host PCB
Dipole	0dBi	U.FL	Taoglas	TI.09.A.0111	Whip Antenna connected with cable
Monopole	0dBi	U.FL	Amphenol	Custom Part	Bare NiTi Wire crimped to Coax
Inverted F PCB Trace Antenna	2.1 dBi	Edge	Acuity Brands Lighting, Inc.	Custom Part	Inverted F Copper Trace Antenna on Host PCB
Dual Band Monopole Antenna	1.5dBi	U.FL	Pulse	W1990WSA	SMA RP dual band Stubby Monopole

9.4.1.1.1 Layout for 0915AT43A0026

NEED MATT'S INPUT

9.4.1.2 2.4GHz

Type	Gain	Connection	Manufacture	Part Number	Description
------	------	------------	-------------	-------------	-------------

Surface Mount Device Antenna	3dBi	Built In	Molex	0479480001	2.4GHz Surface Mount Device (SMD) On Ground Antenna, 50 Ohms
Dual Band Monopole Antenna	3dBi	U.FL	Pulse	W1990WSA	SMA RP dual band Stubby Monopole

9.5 RF Exposure

This equipment complies with radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Cet équipement est conforme aux limites d'exposition aux radiations dans un environnement non contrôlé. Cet équipement doit être installé et utilisé à distance minimum de 20 cm entre le radiateur et votre corps. Cet émetteur ne doit pas être co-localisées ou opérant en conjonction avec tout autre antenne ou transmetteur.

9.6 Labeling Requirements

To meet FCC and ISED requirements, a label must be affixed to any end product containing RMODIT. The label shall be visible to the end user and contain the following text:

Contains FCC ID: 2ADCB-RMODIT
Contains IC: 6715C-RMODIT
Acuity Brands Lighting Inc.
RMODIT 501-00736-XXX

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.

The label shall be sized appropriately for the end product, but maintain readability to the user. The XXX should be replaced with the correct option number from Section 3.