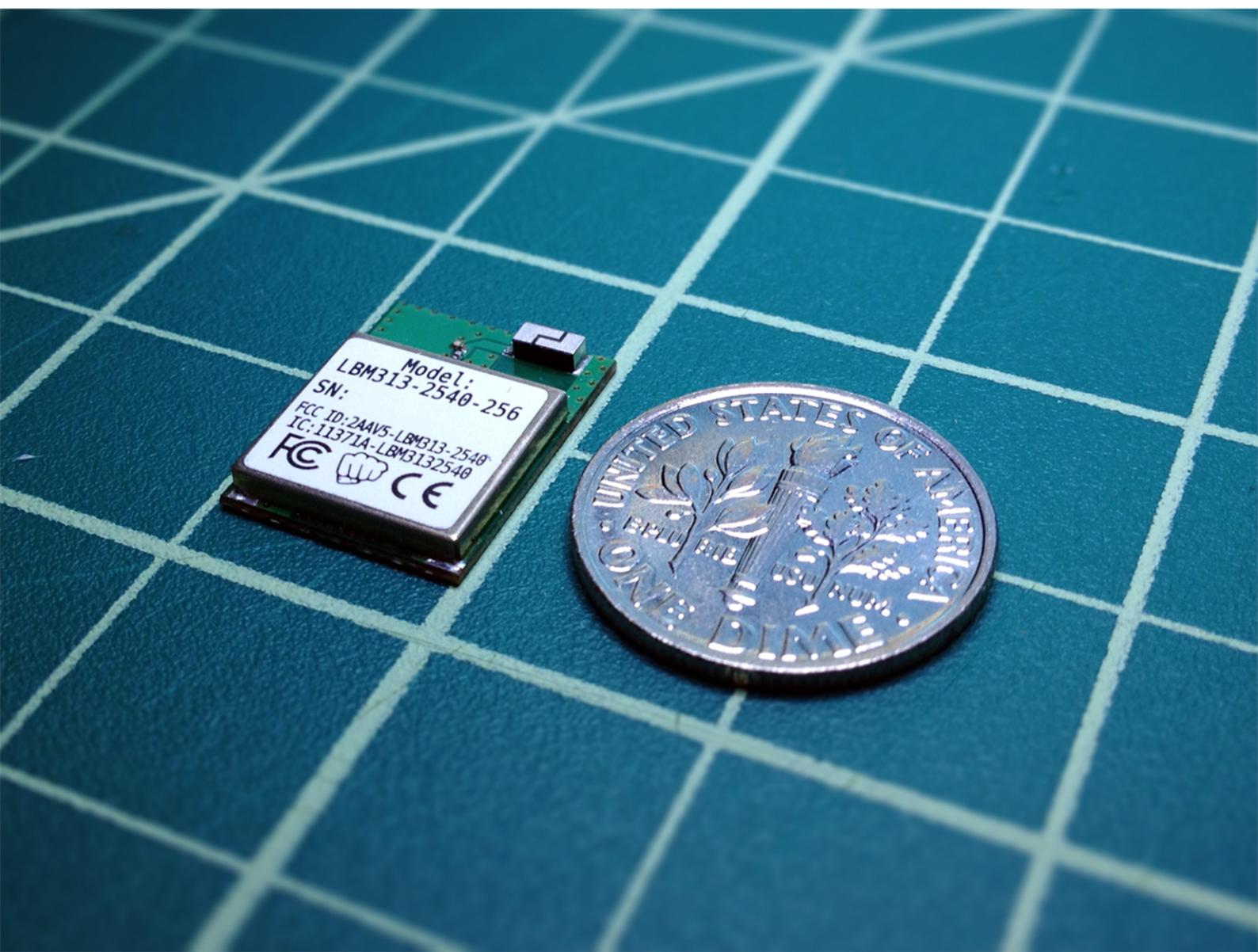


LBM313-2540

Bluetooth 4.0 Module



Product Datasheet

LBM313 Datasheet

Version 0.21

May 27, 2014

1 Introduction

The LightBlueM Module is a full-featured Bluetooth 4.0 module with built in 8-bit SoC. It is based on Texas Instruments' CC2540 system on chip. The LBM313 features a very small footprint size and is optimized for implementation in very low-power wireless applications. The module offers design flexibility, allowing for use as a single-chip solution or together with an external microcontroller for more demanding applications. Additionally, the LBM313 features a fully qualified antenna, which makes the LBM313 the perfect option for simple drop-in functionality.

This datasheet describes this particular implementation of the CC2540. For any information specific to that part, such as peripheral set ups, internal specifics, etc, please refer to TI's specifications¹ or the CC2540 Datasheet²

1.1 Version History

Version	Details
0.10	Draft
0.11	Updated IC ID, added labeling requirements.
0.12	Updated IC info, added more escape patterns.
0.13	Additional information and minor updates.
0.20	Updated solder recommendations, certification IDs, USB P / N pin types
0.21	Updated footprint for clarity

1.2 Abbreviations Used

Abbreviation	Description
BLE	Bluetooth Low Energy
BT	Bluetooth
FW	Firmware
TI	Texas Instruments
PCB	Printed Circuit Board

¹ <http://www.ti.com/product/cc2540&DCMP=LowPowerRFICs+Other&HQS=Other+OT+cc2540>
² <http://www.ti.com/lit/ds/symlink/cc2540.pdf>

Contents

1.3 Copyright

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The Bluetooth trademark is owned by the Bluetooth SIG Inc., USA. All other trademarks listed herein are owned by their respective owners.

1.4 Key Features

- 2.4Ghz bluetooth low energy (Bluetooth Smart, Bluetooth 4.0) compliant
- Data rates from 250kbps to 1mbps
- Programmable output power
- Operating voltage range of 2.0V to 3.6V
- 8051 microcontroller with 256k of in system programmable flash and 8kb of RAM
- Eight channel 12-bit ADC
- Two USARTs supporting both UART and SPI protocol.
- USB 2.0 full speed interface
- AES Security Coprocessor
- 23 General Purpose I/O
- Integrated Comparator
- Extensive development tools including IAR Embedded Workbench.
- Bluetooth 4.0 Stack that supports both master and slave
- Certification under FCC, IC, CE saves more than \$30,000 and 3 months of development.

2 Footprint

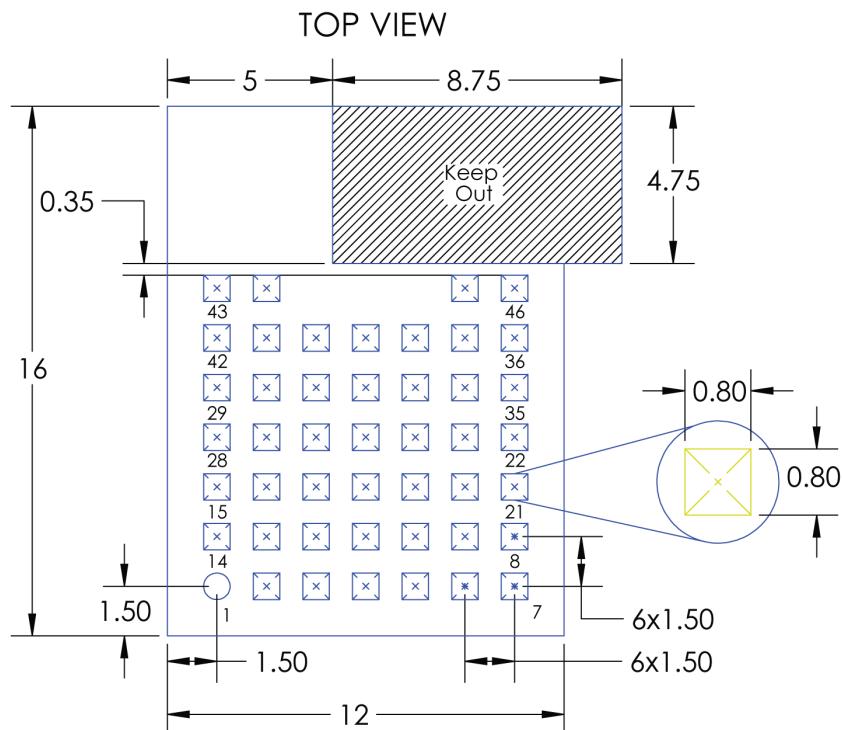


Figure 1: Top view of module.

The keep out area is critical to antenna performance, make sure there are no conductive materials nearby. All power and ground pins must be connected.

3 Pinout

3.1 Schematic Symbol

Verified schematic symbols + footprints are available for common ECAD packages such as Altium, KiCad, Eagle. Download them at <http://punchthrough.com/docs/doku.php?id=lbm313>

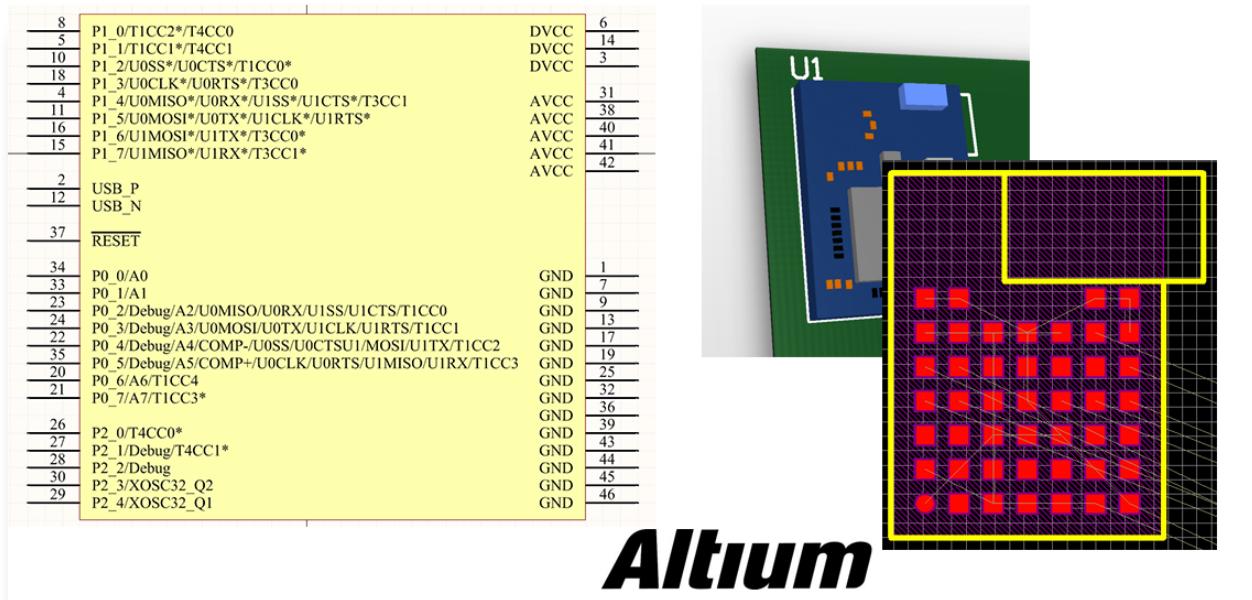


Figure 2: Schematic Symbol in Altium.

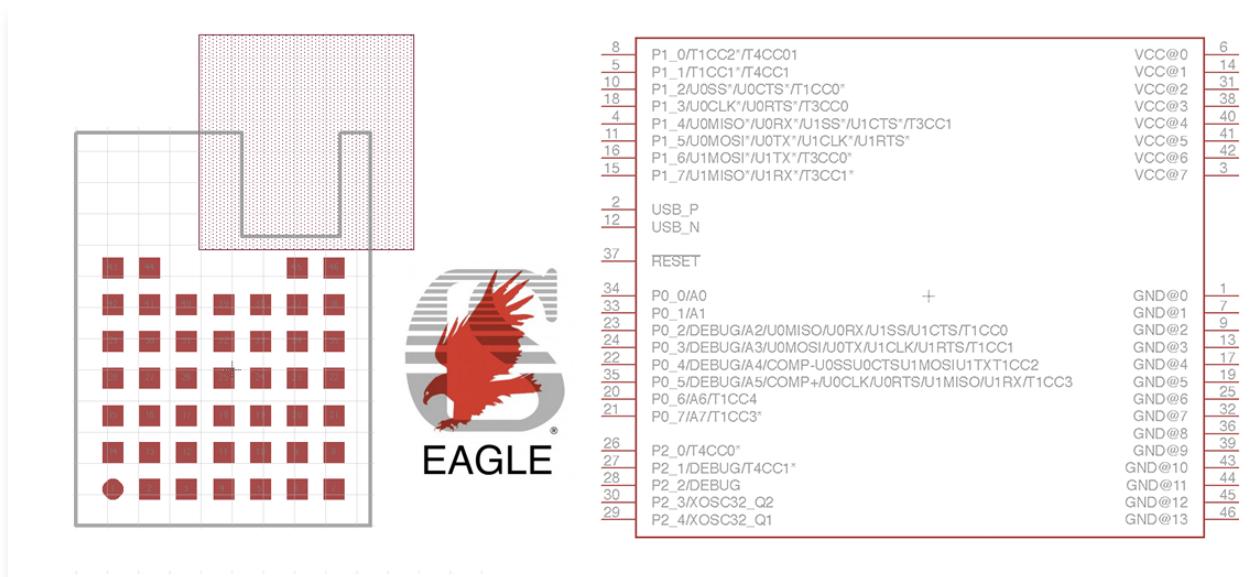


Figure 3: Schematic Symbol in EAGLE.

8	P1_0/T1CC2*/T4CC0	DVCC	6
5	P1_1/T1CC1*/T4CC1	DVCC	14
10	P1_2/U0SS*/U0CTS*/T1CC0*	DVCC	3
18	P1_3/U0CLK*/U0RTS*/T3CC0		
4	P1_4/U0MISO*/U0RX*/U1SS*/U1CTS*/T3CC1	AVCC	31
11	P1_5/U0MOSI*/U0TX*/U1CLK*/U1RTS*	AVCC	38
16	P1_6/U1MOSI*/U1TX*/T3CC0*	AVCC	40
15	P1_7/U1MISO*/U1RX*/T3CC1*	AVCC	41
2	USB_P	AVCC	42
12	USB_N		
37	RESET		
34	P0_0/A0	GND	1
33	P0_1/A1	GND	7
23	P0_2/Debug/A2/U0MISO/U0RX/U1SS/U1CTS/T1CC0	GND	9
24	P0_3/Debug/A3/U0MOSI/U0TX/U1CLK/U1RTS/T1CC1	GND	13
22	P0_4/Debug/A4/COMP-/U0SS/U0CTS/U1MOSI/U1TX/T1CC2	GND	17
35	P0_5/Debug/A5/COMP+/U0CLK/U0RTS/U1MISO/U1RX/T1CC3	GND	19
20	P0_6/A6/T1CC4	GND	25
21	P0_7/A7/T1CC3*	GND	32
26	P2_0/T4CC0*	GND	36
27	P2_1/Debug/T4CC1*	GND	39
28	P2_2/Debug	GND	43
30	P2_3/XOSC32_Q2	GND	44
29	P2_4/XOSC32_Q1	GND	45
		GND	46

Figure 4: Schematic Symbol.

3.2 Pin List

The pin names correspond directly to the pin names used on the CC2540, so they can be cross referenced with the CC2540 datasheet³

Name	Pin	Pin Type	Description
USB_P	2	USB_P	USB Data line
P1_4	4	GPIO	
P1_1	5	GPIO	
P1_0	8	GPIO	
P1_2	10	GPIO	
P1_5	11	GPIO	
USB_N	12	USB_N	USB Data line
P1_7	15	GPIO	
P1_6	16	GPIO	
P1_3	18	GPIO	
P0_6	20	GPIO	
P0_7	21	GPIO	
P0_4	22	GPIO	
P0_2	23	GPIO	
P0_3	24	GPIO	
P2_0	26	GPIO	
P2_1	27	GPIO	
P2_2	28	GPIO	
P2_4/OSC32K_Q1	29	GPIO/CLK	If a low frequency clock is desired, this must be connected to an external 32.768kHz crystal. See Section ?? for more info.
P2_3/OSC32K_Q2	30	GPIO/CLK	If a low frequency clock is desired, this must be connected to an external 32.768kHz crystal. See Section ?? for more info.
P0_1	33	GPIO	
P0_0	34	GPIO	
P0_5	35	GPIO	
RESET_N	37	Digital Input	Active low reset. Internally connected through an RC low pass filter.
VCC	3, 6, 14, 31, 38, 40, 41, 42	Power	Supply Voltage 2.0-3.6V
GND	1, 7, 9, 13, 17, 19, 25, 32, 36, 39, 43, 44, 45, 46	Ground	Ground

Table 1: Pin list

³<http://www.ti.com/lit/ds/symlink/cc2540.pdf>

3.3 Peripheral Map

This is a helpful map that shows which pins are connected to which peripherals. See the CC2540 datasheet⁴ and Software Developer's Guide⁵ for more info.

Pin	CC2540 Pin	Debug	Analog	Comparator	USART0 SPI	USART0 UART	USART1 SPI	USART1 UART	TMR1	TMR3	TMR4
1	GND										
2	USB_P										
3	VCC_USB										
4	P1.4				U0MISO*	U0RX*	U1SS*	U1CTS*		T3CC1	
5	P1.1								T1CC1*		T4CC1
6	VCC										
7	GND										
8	P1.0								T1CC2*		T4CC0
9	GND										
10	P1.2				U0SS*	U0CTS*			T1CC0*		
11	P1.5				U0MOSI*	U0TX*	U1CLK*	U1RTS*			
12	USB_N										
13	GND										
14	VCC										
15	P1.7						U1MISO*	U1RX*			T3CC1*
16	P1.6						U1MOSI*	U1TX*			T3CC0*
17	GND										
18	P1.3				U0CLK*	U0RTS*				T3CC0	
19	GND										
20	P0.6	A6								T1CC4	
21	P0.7	A7								T1CC3*	
22	P0.4	A4	COMP-		U0SS	U0CTS	U1MOSI	U1TX	T1CC2		
23	P0.2	A2			U0MISO	U0RX	U1SS	U1CTS	T1CC0		
24	P0.3	A3			U0MOSI	U0TX	U1CLK	U1RTS	T1CC1		
25	GND										
26	P2.0	X									T4CC0*
27	P2.1	X									T4CC1*
28	P2.2										
29	P2.4/OSC32K.Q1										
30	P2.3/OSC32K.Q2										
31	VCC										
32	GND										
33	P0.1	A1									
34	P0.0	A0									
35	P0.5	A5	COMP+		U0CLK	U0RTS	U1MISO	U1RX	T1CC3		
36	GND										
37	RESET_N	X									
38	VCC										
39	GND										
40	VCC										
41	VCC										
42	VCC										
43	GND										
44	GND										
45	GND										
46	GND										

Table 2: Pinout and peripherals.

⁴<http://www.ti.com/lit/ds/symlink/cc2540.pdf>

⁵<http://www.ti.com/litv/pdf/swru271f>

4 Block Diagram

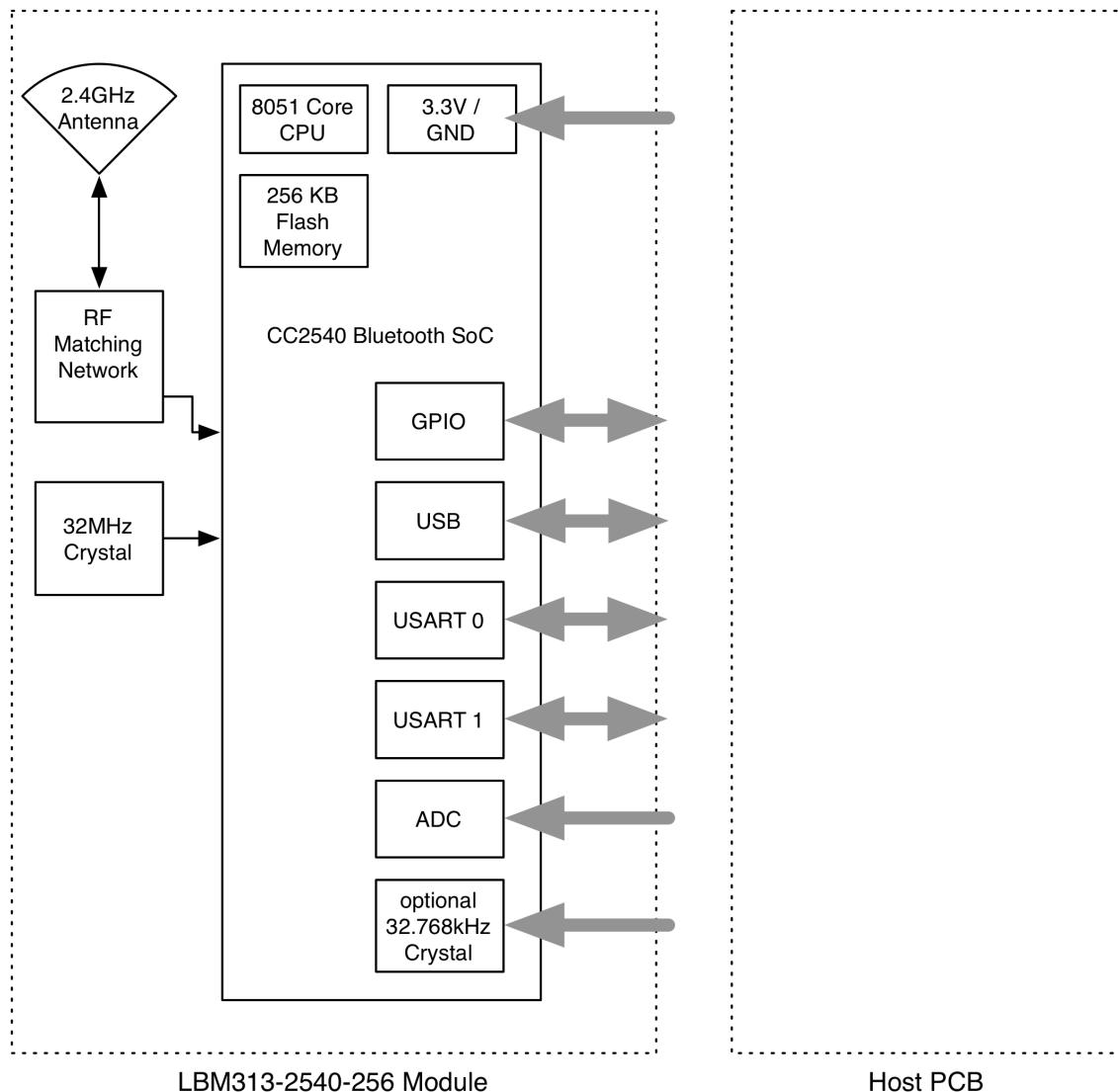


Figure 5: LBM313 Block Diagram.

5 Electrical Characteristics

5.1 Absolute Maximum Ratings

Values outside the ranges established here may cause permanent damage to the device. Functional operation should occur within the ranges given in Section ??, Recommended Operating Conditions.

Rating	Min	Max	Unit
Storage Temperature Range	-40	125	°C
Vcc	-0.3	3.9	V
IO Voltage	-0.3	VDD + 0.3, ≤3.9	V

5.2 Recommended Operating Conditions

Rating	Min	Max	Unit
Temperature Range	-40	85	°C
Vcc	2.0	3.6	V

For more detailed specifications on I/O characteristics, power, current, etc, refer to the CC2540 datasheet ⁶

⁶<http://www.ti.com/lit/ds/symlink/cc2540.pdf>

6 Antenna Characteristics

The Antenna used is the Pulse W3008 ceramic chip antenna. This part was chosen for it's very small keep out area, high gain, omnidirectional radiation and smooth radiation patterns. The basic characteristics are listed in Table ??.

Linear Max Gain	Efficiency	Return Loss Min.	Operating Temperature
1.7 dBi (Peak)	70% or -1.6dB Peak	-8 dB	-40 to 85°C

Table 3: Pin list

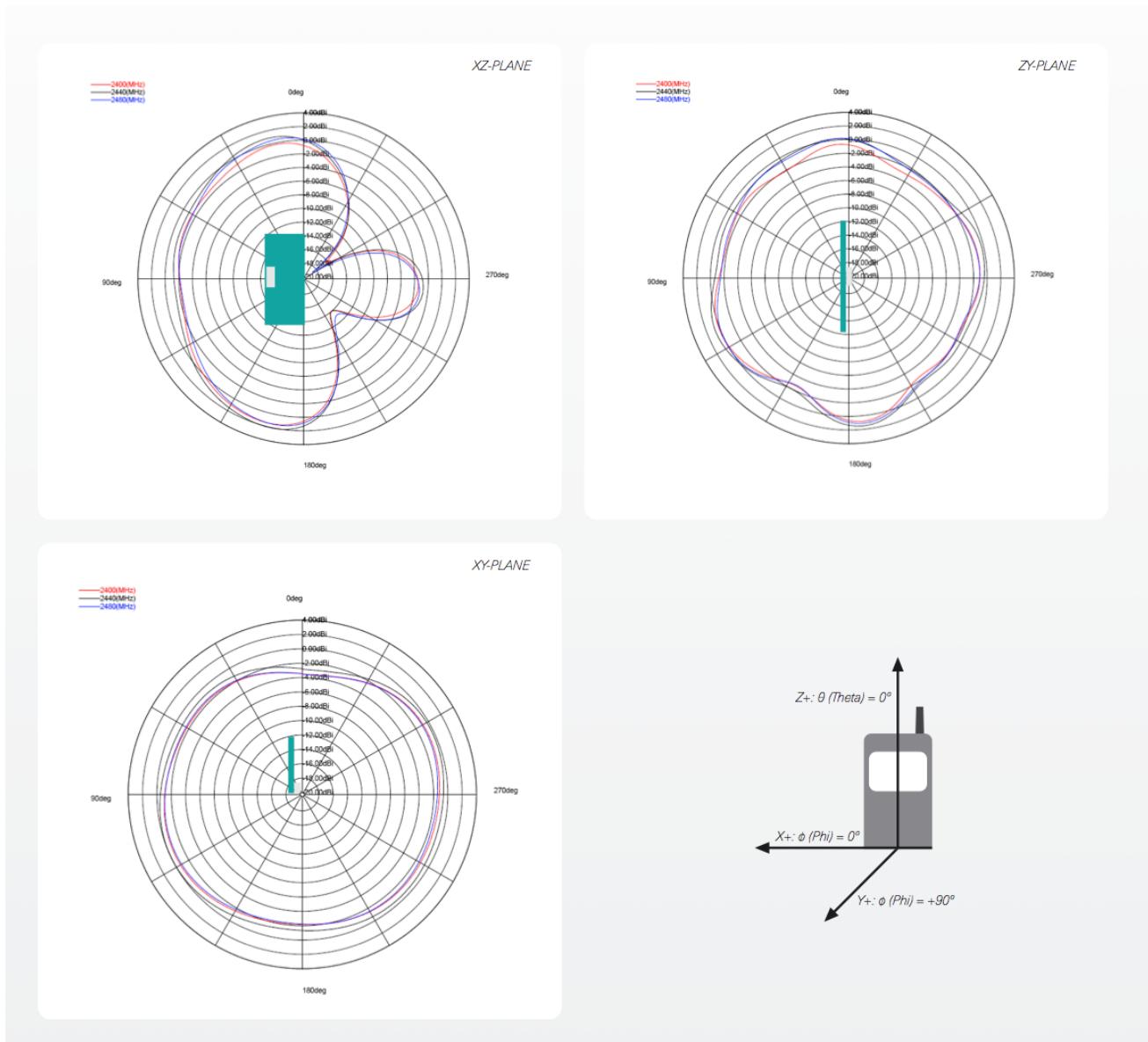


Figure 6: W3008 Radiation Patterns.

7 Design Guidelines

7.1 Reference Design - Simple Case

Use this as a reference for typical pin connections. Download schematics in PDF or Altium format from <http://punchthrough.com/docs/doku.php?id=lbm313>

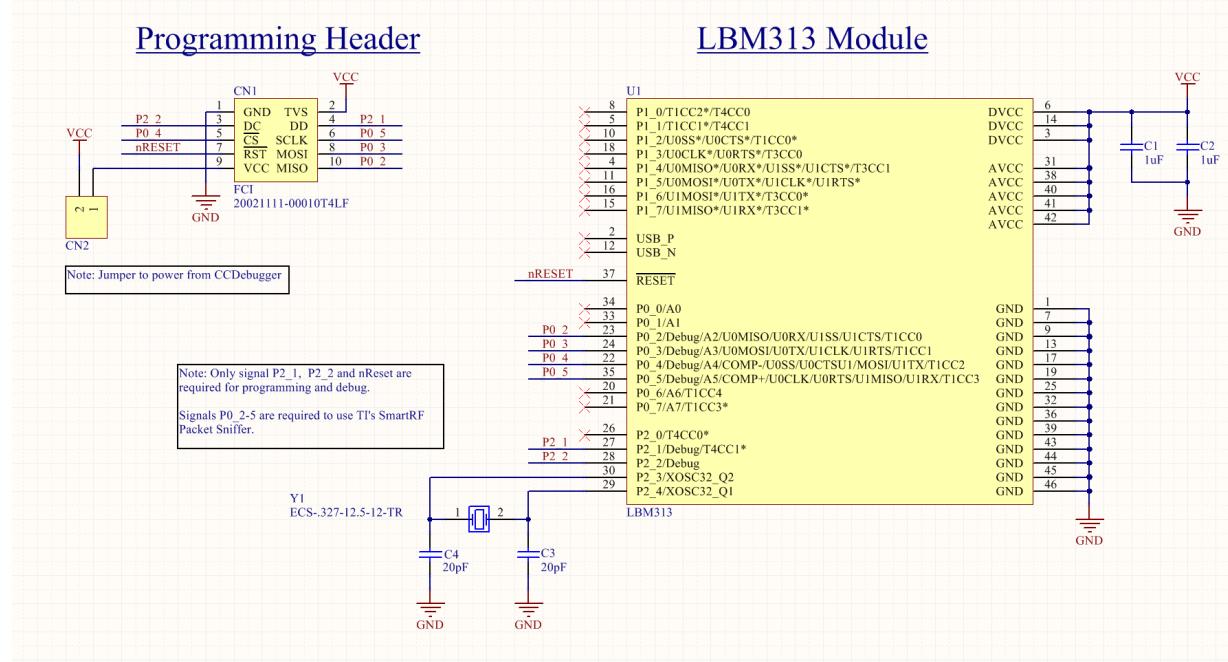
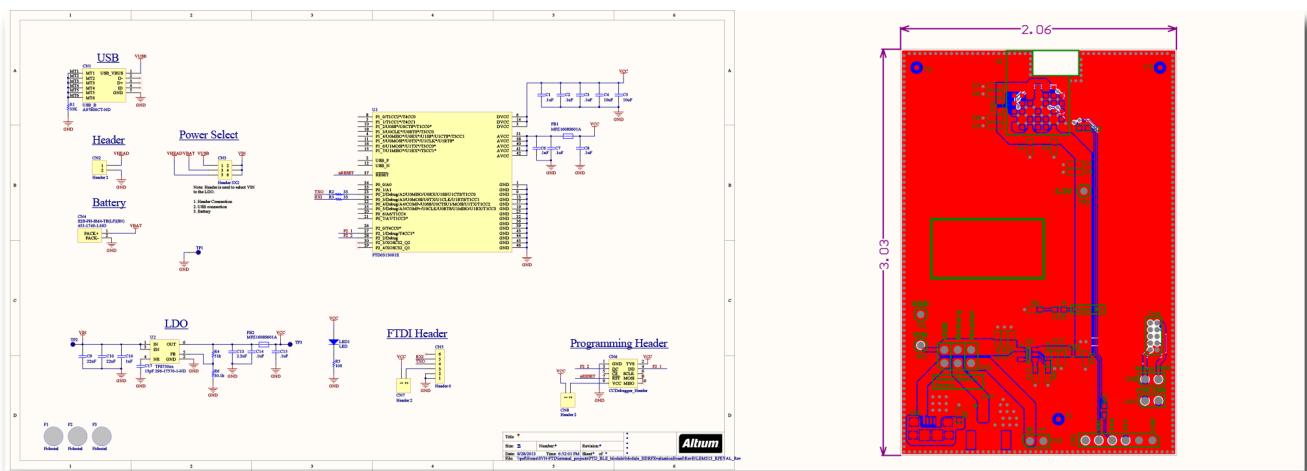


Figure 7: LBM313 Reference Design.

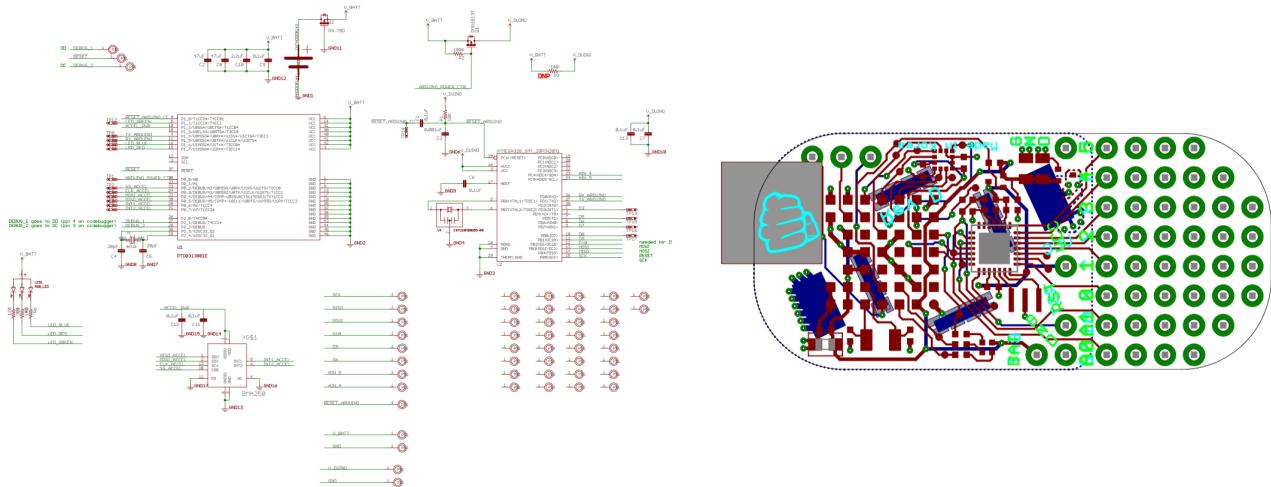
7.2 Reference Design - RF Evaluation Design

Files available for download at <http://punchthrough.com/docs/doku.php?id=lbm313>



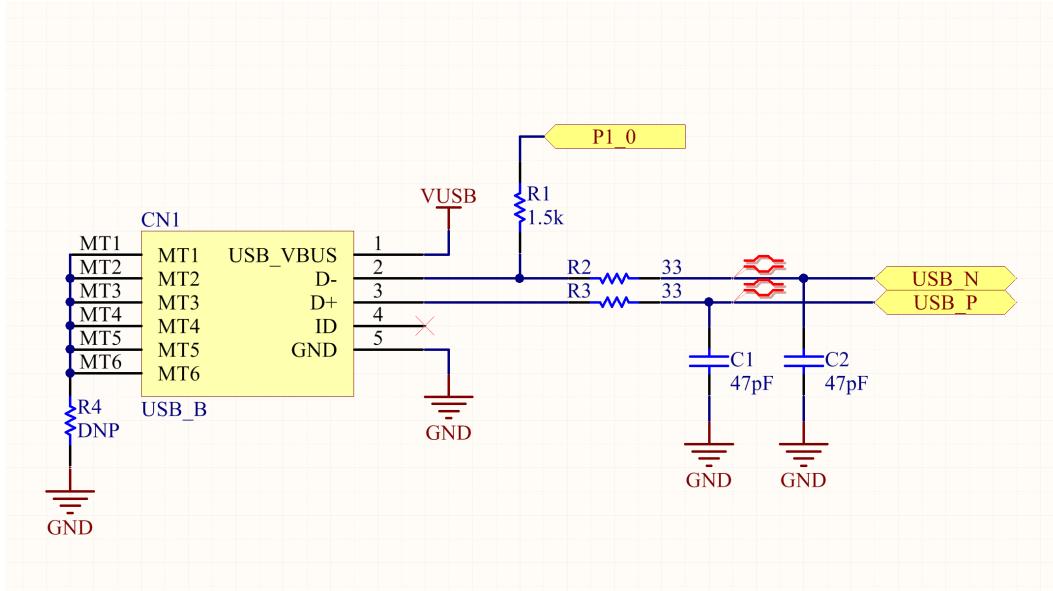
7.3 Reference Design - Bluetooth Arduino: LightBlue™ Bean

Files available for download at <http://punchthrough.com/docs/doku.php?id=lbm313>. Watch for announcements on our web page <http://punchthrough.com> and our Twitter page <https://twitter.com/PunchThrough> or more info at <https://launch.punchthrough.com/>.



7.4 USB 2.0 Full Speed Design Considerations

The USB data lines connected to the LBM313 must be routed with a 90 ohm differential impedance +/- 10%. If the host board is powered by the USB port the 1.5k pull-up should be connected to a GPIO on the LBM313, this is to allow the internal CC2540 USB PLL circuitry to stabilize before communication is initiated by the host.



7.5 Layout Tips

7.5.1 Escape routing

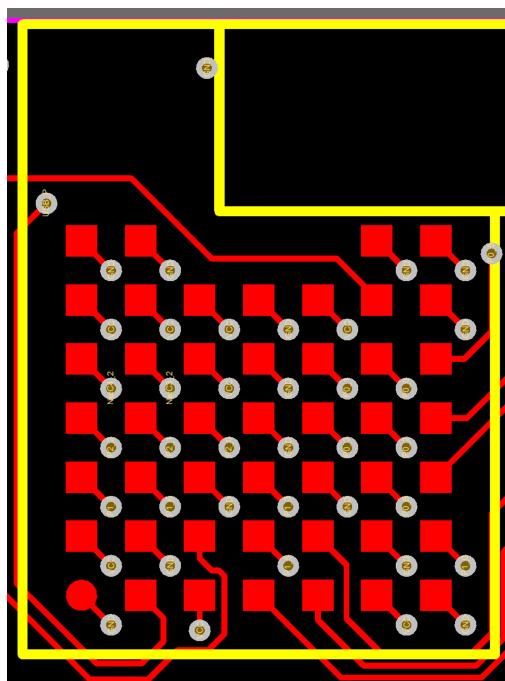


Figure 8: Altium 4-layer escape pattern.

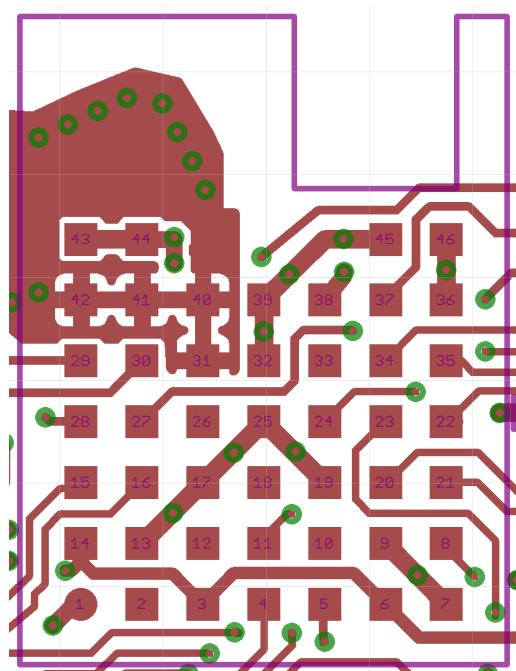


Figure 9: Eagle escape pattern.

7.5.2 Recommended layout

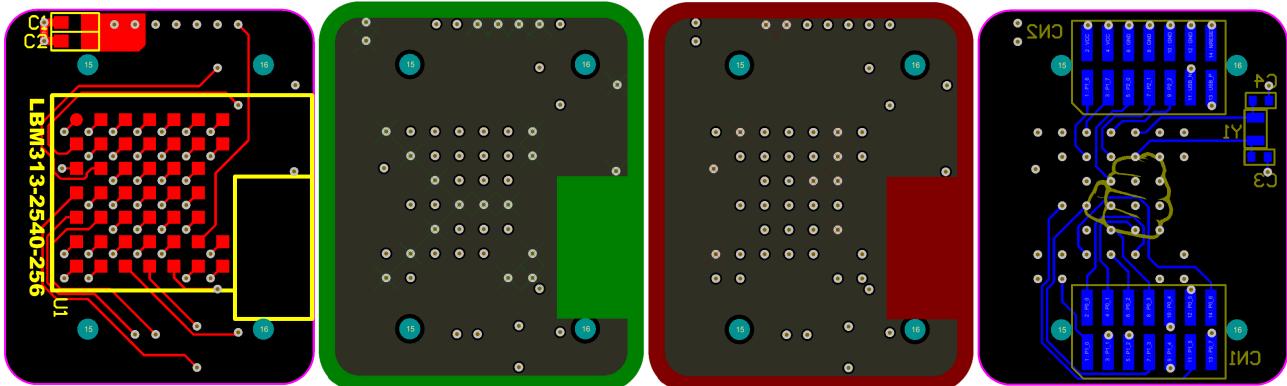


Figure 10: LBM313 Adapter Board: Signal (top), GND (mid 1), PWR (mid 2), Signal (bottom)

8 Soldering Recommendations

Escape vias located under the module should be covered with soldermask to prevent unwanted shorts. Also, vias should be filled in order to prevent robbing solder from the designed solderable area and to prevent solder joint voids. It is recommended to match solder paste stencil aperture size to the target pad size.

No clean solder paste is recommended with the LBM313 module due to the low stand-off height of LGA packages. Selection of a low voiding paste will increase solder joint reliability. It is essential to use a solder reflow profile that is recommended by the solder paste supplier. If necessary, the profile can be further optimized and proven through iteration, as the ideal profile may depend on a number of factors specific to the target PCB.

9 Certifications

9.1 ID Numbers

FCC ID: 2AAV5-LBM313-2540

IC ID: 11371A-LBM3132540

CE: Certified to comply against the following Standards;

EN 301 489-17 V2.2.1 (2012-09)

EN 301 489-1 V1.9.2 (2011-09)

EN 300 328 V 1.8.1 (2012-06)

9.2 End Product Labeling

The LBM313 is marked with an FCC ID and IC certification number. These must be visible in the end product. If the LBM313 is inside the end product, then there must be a label present on the outside of the product with these markings:

Contains Transmitter Module FCC ID: 2AAV5-LBM313-2540

Contains Transmitter Module IC: 11371A-LBM3132540

or

Contains FCC ID: 2AAV5-LBM313-2540

Contains IC: 11371A-LBM3132540

The customer integrating the module must not provide information to the end user on how to install, remove, or modify the RF related parameters of the LBM313 module.

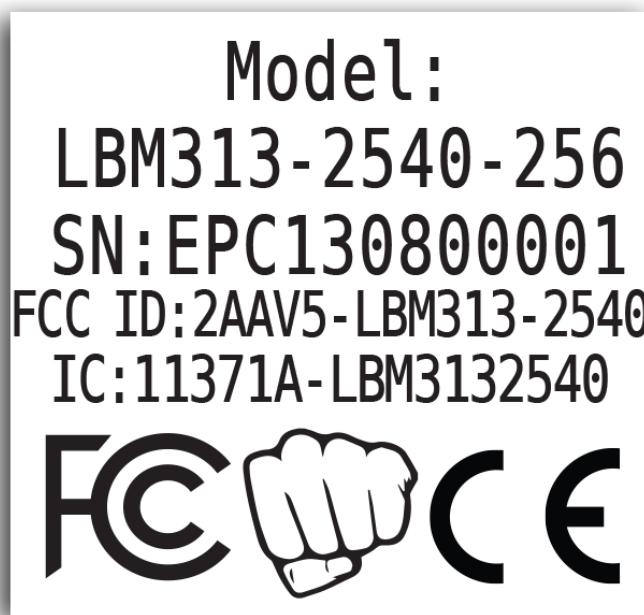


Figure 11: Label that is placed on each module.

9.3 FCC Class A Notice

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.
2. This device must accept any interference received, including interference that may cause undesired operation.

Note: 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 it is not installed and used in accordance with the instruction manual, it 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.

Modifications: Any modifications made to this device that are not approved by Punch Through Design may void the authority granted to the user by the FCC to operate this equipment.

9.4 FCC Class B Notice

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.
2. This device must accept any interference received, including interference that may cause undesired operation.

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/television technician for help. Modifications: Any modifications made to this device that are not approved by Punch Through Design may void the authority granted to the user by the FCC to operate this equipment.

9.5 IC Statement

9.5.1 English

This device complies with part 15 of the FCC Rules and Industrial Canada license standard. 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.

9.5.2 French

Cet appareil est conforme à Industrie Canada une licence standard RSS exonérés (s). Son fonctionnement est soumis aux deux conditions suivantes: (1) Cet appareil ne doit pas provoquer d'interférences (2) Cet appareil doit accepter toute interférence reçue, y compris les interférences pouvant provoquer un fonctionnement indésirable de l'appareil.

10 Contact Info

10.1 Web

General Info: <http://punchthrough.com>

General LBM313 Info: <http://punchthrough.com/docs/doku.php?id=lbm313>

Twitter: <https://twitter.com/PunchThrough>

10.2 Email

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