LBM313 Datasheet

Version 0.1

September 20, 2013

1 Introduction

The LightBlueM Module is a full-featured Bluetooth 4.0 module with built in 8-bit SoC. It is based off the CC2540, Texas Instruments' most advanced Bluetooth 4.0 system on chip.

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 specifications[1] or the CC2540 Datasheet[2]

1.1 Version History

Version	Details
0.10	Draft
0.11	Updated IC ID, added labeling requirements.

1.2 Abbreviations Used

Abbreviation	Description
BLE	Bluetooth Low Energy
BT	Bluetooth
FW	Firmware
TI	Texas Instruments

[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 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.
- i2C serial 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
- Modular Certification under FCC, IC, CE saves $30,000+ and 3 months of development.

2 Footprint

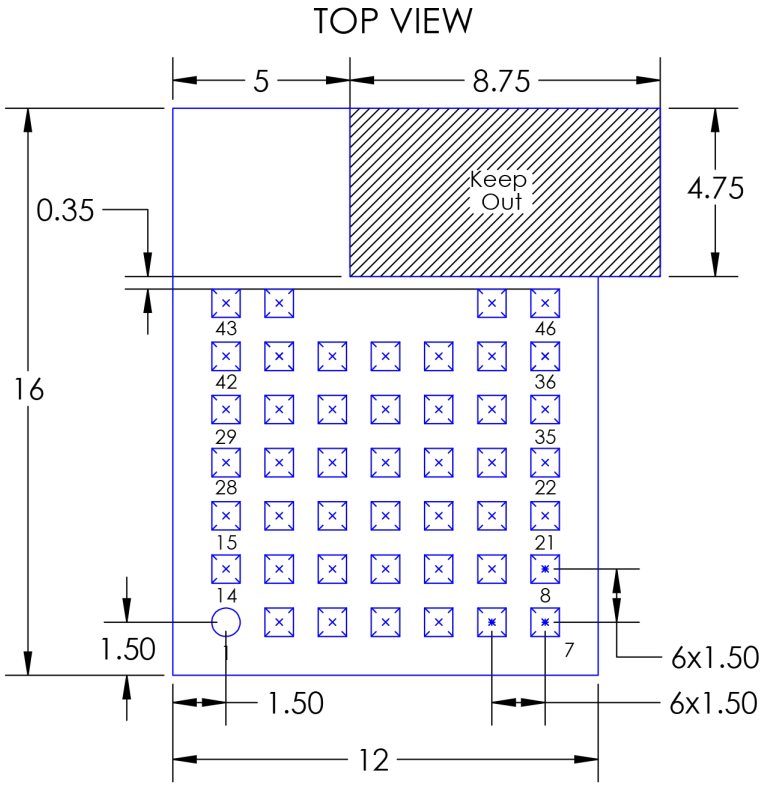


Figure 1: Top view of module.

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`

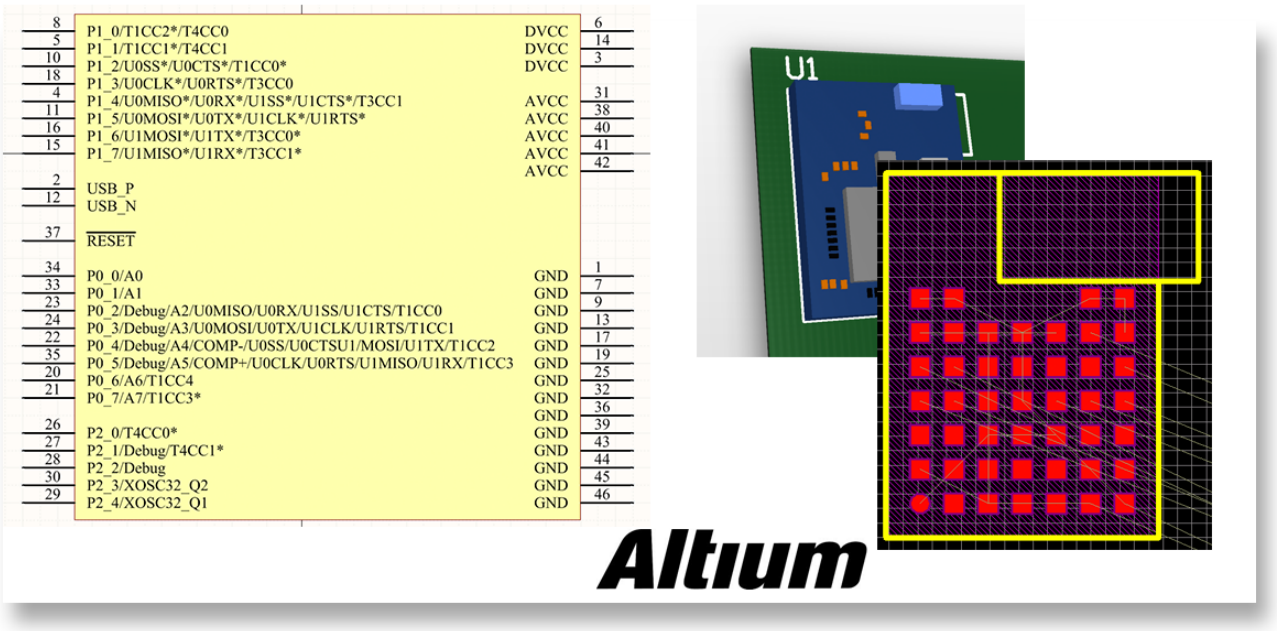


Figure 2: Schematic Symbol in Altium.

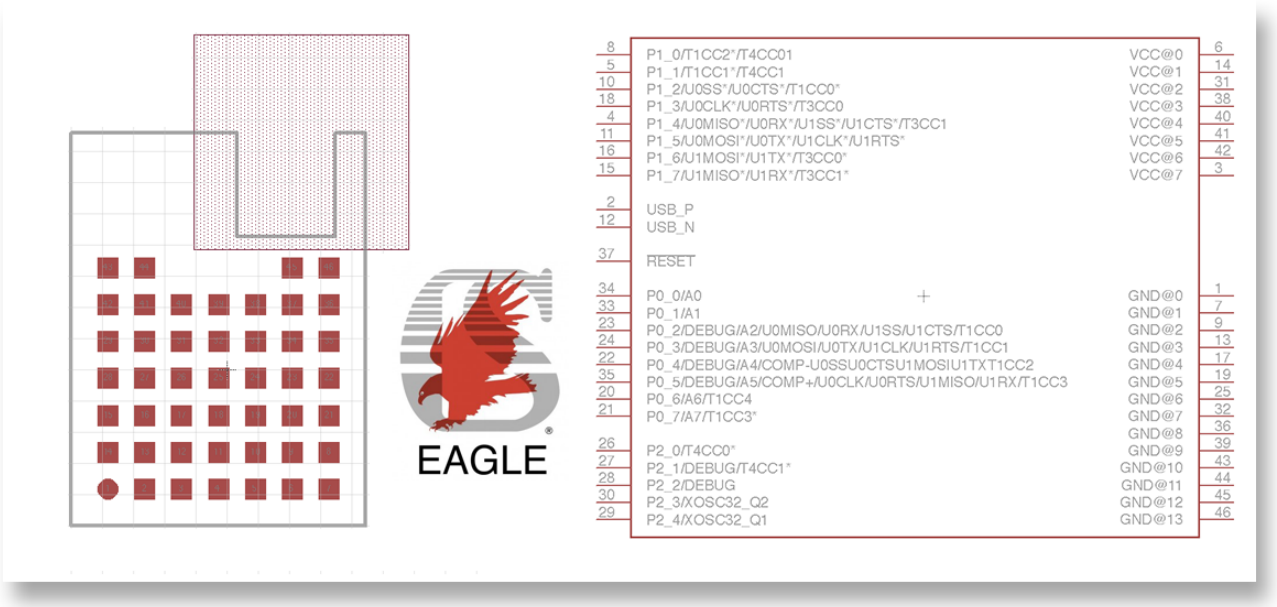


Figure 3: Schematic Symbol in EAGLE.

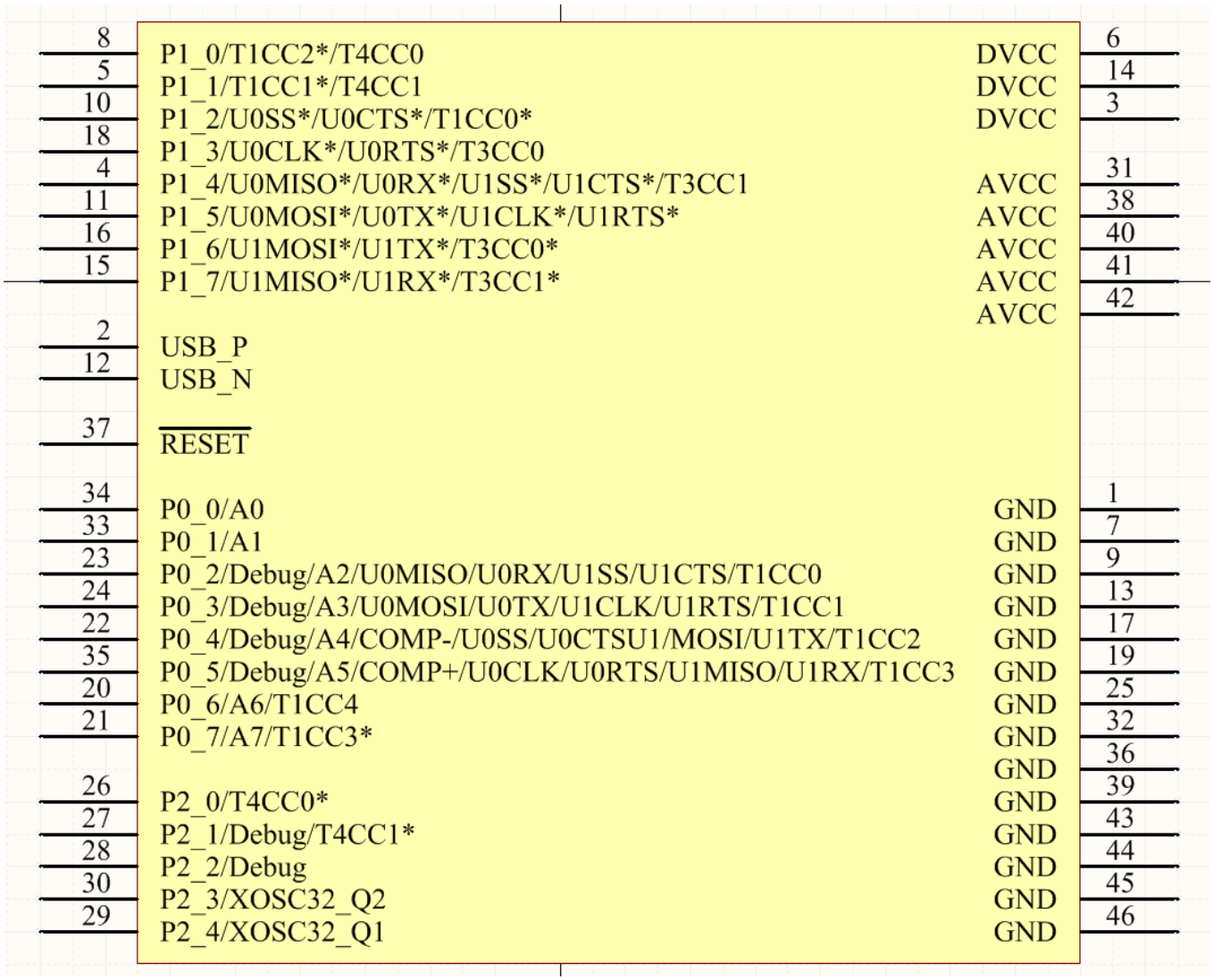


Figure 4: Schematic Symbol.

3.2 Pin List

The pin names correspond directly to the pin names used on the CC2540/1, so they can be cross referenced with the CC2540/1 datasheet [3]

Name	Pin	Pin Type	Description
USB_P	2	USB_N	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_P	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 7.1 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 7.1 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	So I threw it on the 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 datasheet[4]and Software Developer's Guide [5] for more info.

Pin	CC2540 Pin	Debug	Analog	Comp arator	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										T4CC0*
27	P2_1										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										
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

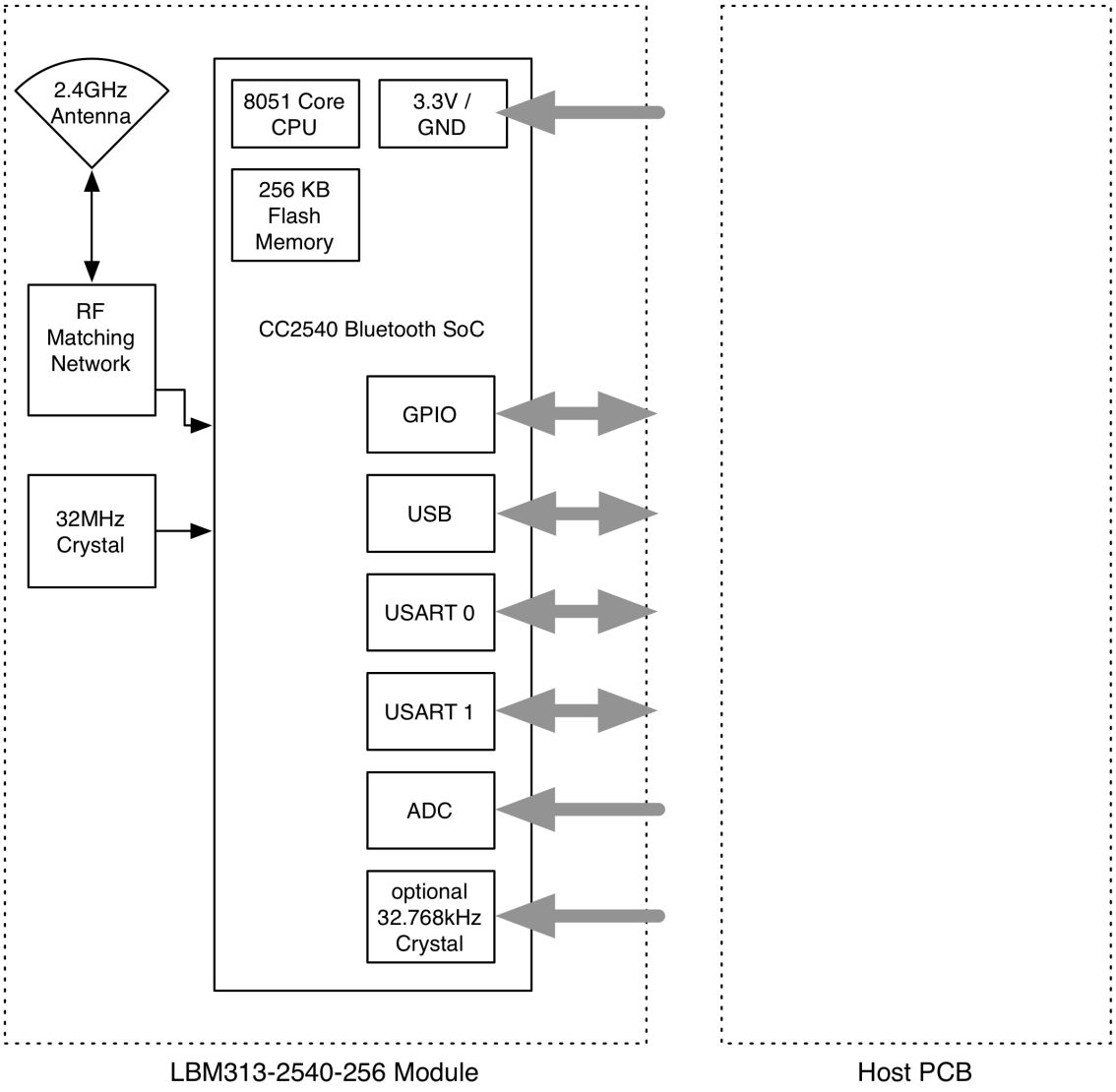


Figure 5: LBM313 Block Diagram.

5 Electrical Characteristics

5.1 Absolute Maximum Ratings

Values outside the ranges given here may cause permanent damage to the device. Functional operation should occur within the ranges given in Section 5.2, 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. This part was chosen for it's very small keep out area, high gain, and smooth radiation patterns. The basic characteristics are listed in Table 3

What type of chip antenna? What thickness host PCB?

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

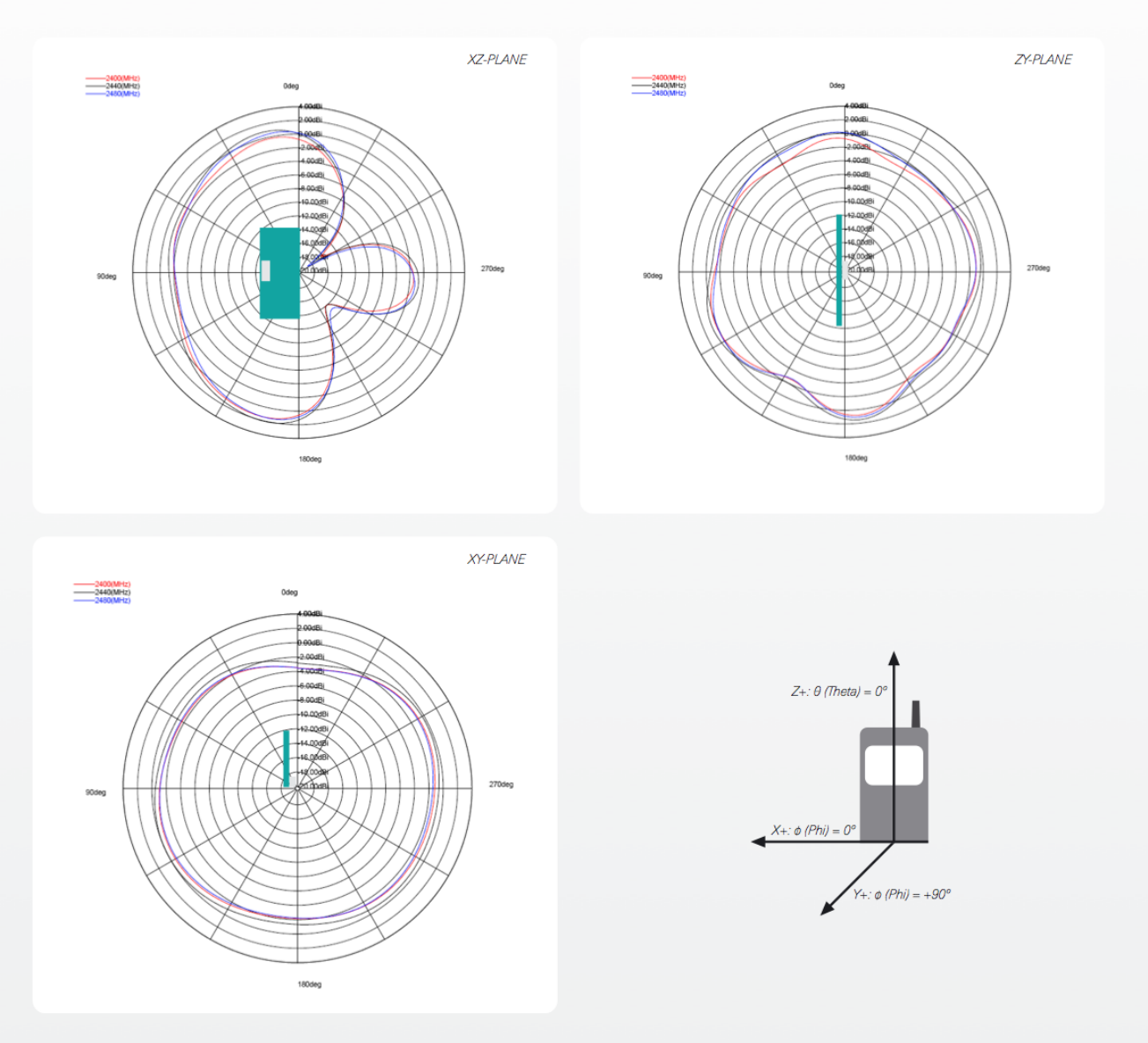


Figure 6: W3008 Radiation Patterns.

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`

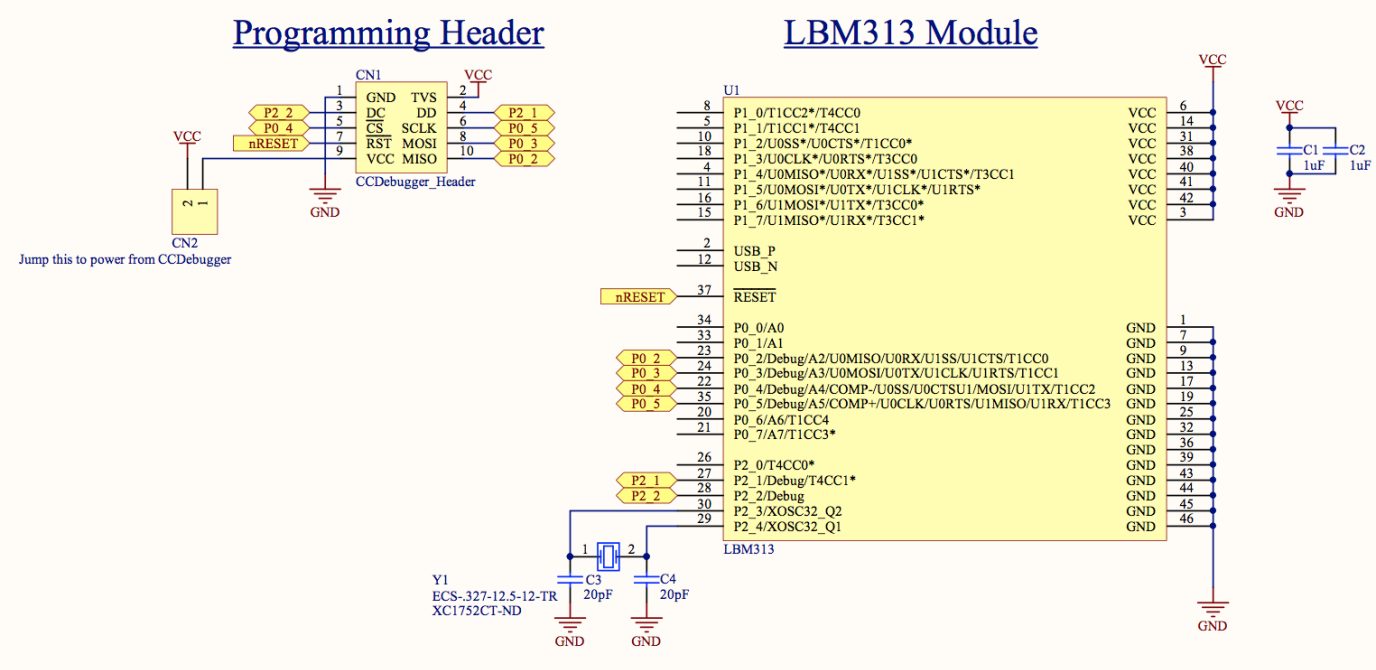
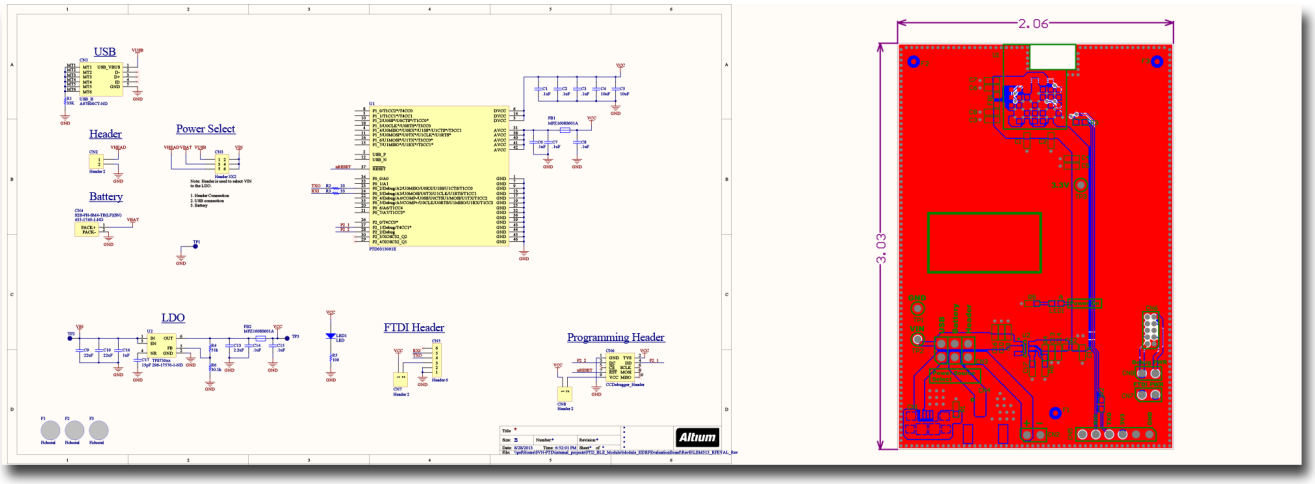


Figure 7: LBM313 Reference Design.

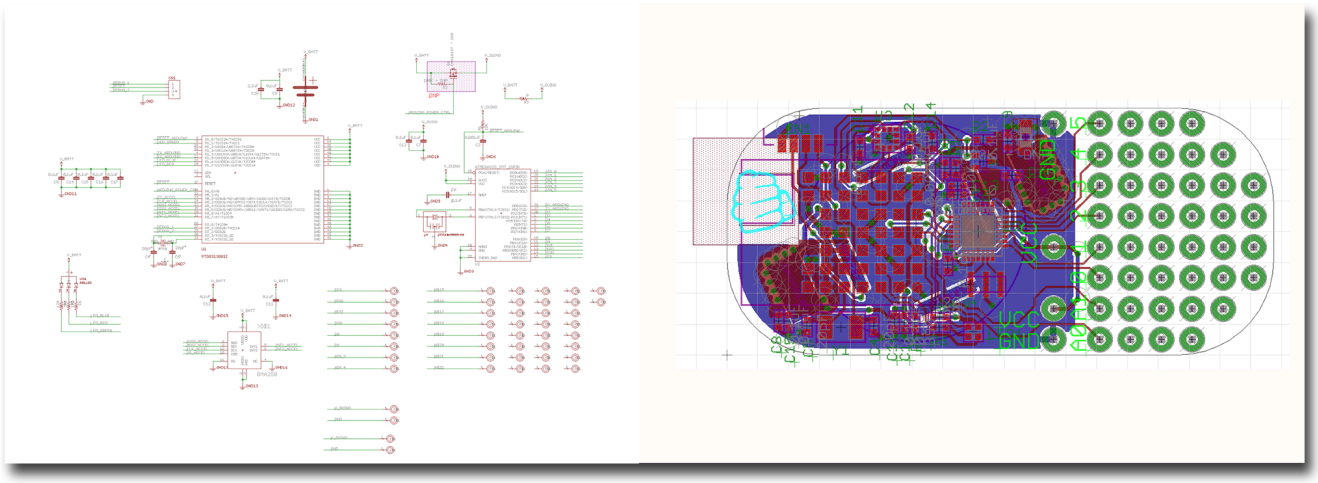
7.2 Reference Design - RF Evaluation Design

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



7.3 Reference Design - Bluetooth Arduino

Coming October 1, 2013. Watch for our announcement on our web page `http://punchthrough.com` and our Twitter page `https://twitter.com/PunchThrough`



7.4 Layout Tips

7.4.1 Escape routing

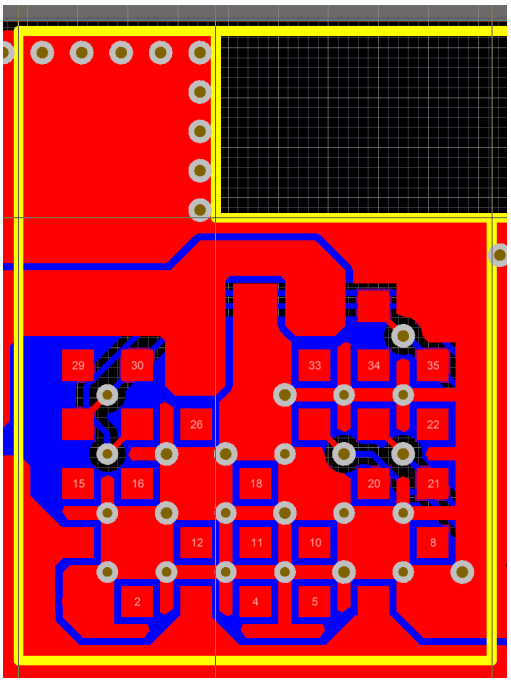


Figure 8: Altium escape pattern.

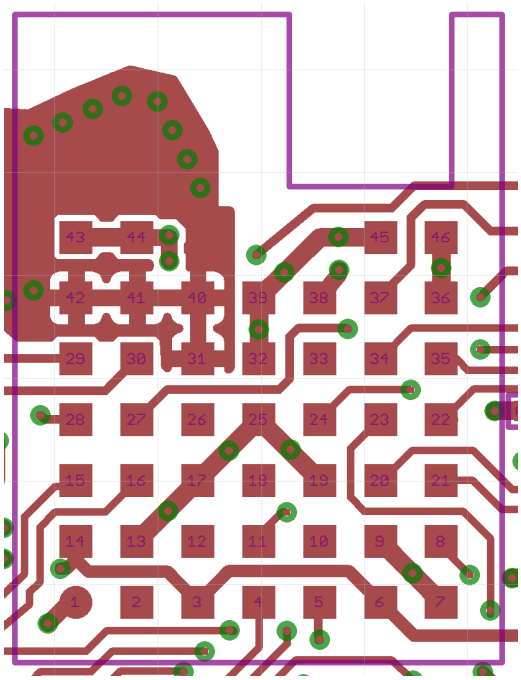


Figure 9: Eagle escape pattern.

8 Soldering Tips

The LBM313 should be used with typical industrial standard reflow profiles for lead free solders. Refer to the datasheet of solder paste used for more specific reflow profiles.

The LBM313 is compatible with industrial standard reflow profile for Pb-free solders. The reflow profile used is dependent on the thermal mass of the entire populated PCB, heat transfer efficiency of the oven and particular type of solder paste used. Consult the datasheet of particular solder paste for profile configurations.

Tips: Avoid reflowing twice Aperture size of stencil should be about the same size as the pad. Ideally solder paste with 'no-clean' flux should be used.

9 Certifications

9.1 ID Numbers

FCC ID: 2AAV5-LBM313-2540
Approval expected on or before 9/25/13

IC ID: 11371A-LBM3132540
Approval expected on or before 9/25/13

CE: TBA
Approval expected on or before 10/15/13

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 ouside 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.

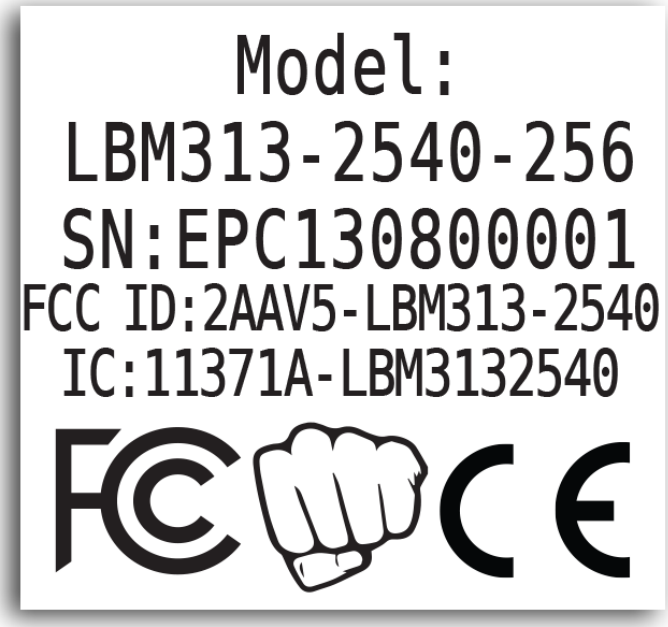


Figure 10: Label that is placed on each module.

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.

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

Colin Karpfinger `ck@punchthrough.com`
`info@punchthrough.com`