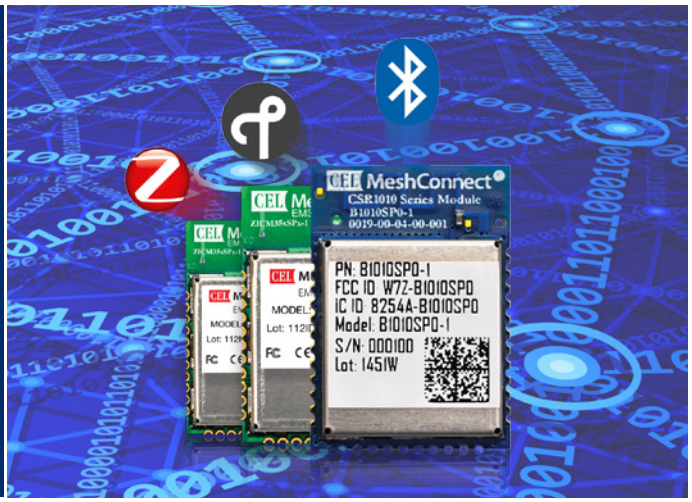
0011-00-16-11-000
Mini Module External Antenna Implementation

Document No:
0011-00-16-11-000 (Issue C)



INTRODUCTION

This Technical Note describes the host board layout requirements for using an external antenna with the MeshConnect™ ZigBee and Thread Mini Modules from California Eastern Laboratories (CEL). The ZigBee and Thread ZICM35x Mini Modules have been certified for use with an external antenna through the use of the Mini Module castellation pin, a U.FL connector, a U.FL cable assembly and the specified external antenna. For the B1010SPx Mini Modules please refer to the datasheet for latest regulatory certification. This document details the implementation required to be compliant with the regulatory certification. In order to preserve the Modular Radio certification, the integrator of the module must abide by these layout recommendations outlined in this document. Any divergence from these recommendations will invalidate the modular radio certifications and require the integrator to re-certify the module and/or end-product.

COPLANAR WAVEGUIDE

An RF coplanar waveguide with ground plane structure consists of an RF trace on the topside of the printed circuit board with adjacent ground planes spaced close to the RF transmission line. A ground plane under the RF trace should also exist directly below the transmission line. Since the module castellation pad is 40 mils wide on the bottom of the module, an RF trace width of 40 mils, along with a gap of 8 mils separation from the ground plane, will result in a 50 Ω transmission line on a standard two layer FR4 printed circuit board with a thickness of 0.062 inches. Using the transmission line width equal to the castellation pad width eliminates any RF discontinuity which could degrade the return loss.

PCB IMPLEMENTATION REQUIREMENTS

The ZICM35xSP0-1C was certified with two external antennas and the ZICM35xSP2-1C was certified with one external antenna. The first implementation uses a U.FL non-standard connector to interface to an external antenna with its own coaxial cable. The second configuration for the ZICM35xSP0-1C uses the non-standard reverse polarity SMA (RP-SMA) end launch connector to interface to a 3" cable and external antenna.

The figures below detail the Gerber layout for the using a U.FL connector for both the ZICM35xSP0-1C and the ZICM35xSP2-1C. The transmission line is 40 mils wide with an 8 mil gap to the ground. The length of the transmission line is 200 mils long from the castellation pad to the edge of the U.FL connector. Figure 1 below represents the top layer, while Figure 2 is the bottom layer on the two layer FR4 printed circuit board.

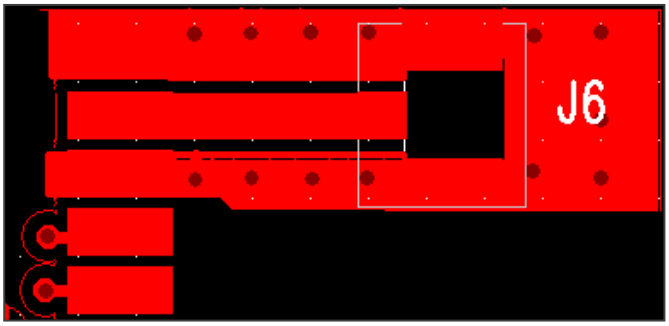


Figure 1. Top Layer

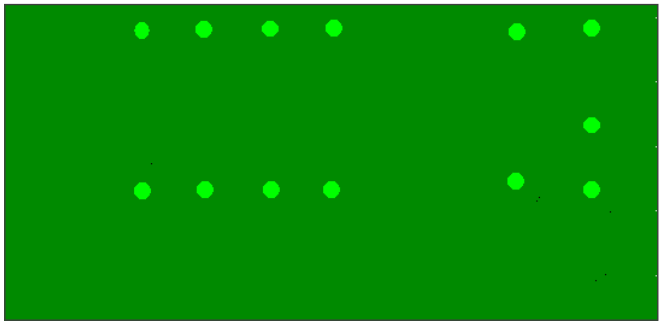


Figure 2. Bottom Layer

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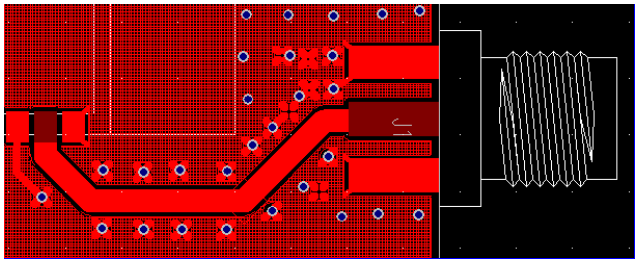
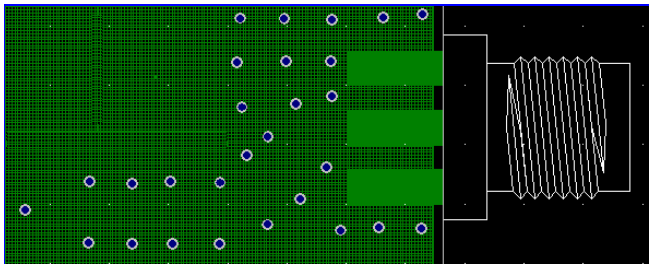
PCB IMPLEMENTATION REQUIREMENTS (CONTINUED)

The second configuration is detailed below and pertains only to the ZICM35xSP0-1C. Once again a 400mil wide trace with an 8 mil gap to the adjacent ground planes. It extends from the module footprint to the edge launch RP-SMA connector which has been placed 200 mils from the top edge of the module. The RF trace is 590 mils in length between the pad of the module and the RPSMA center pin. A continuous ground plane must be present under the RF trace once again.





COMPONENTS USED IN THE IMPLEMENTATION

The following components specify the requirements for this implementation:

- CEL Module Part Number: ZICM35xSP0-1C is certified with external Antennas "E-2820-CA" & LSR 001-0100"
- CEL Module Part Number: ZICM35xSP2-1C is certified with external antenna "Nearson S181AH-2450S"
- U.FL Connector Part Number: U.FL-R-SMT(10) from Hirose Electric Co. Ltd.
- RP-SMA end launch Part Number: Amphenol 132255RP
- Host Board: FR4 two layer, 0.062" thick with dielectric constant of 4.2 typical. The transmission line between the module and the U.FL connector should be a straight line with a width of 40 mils, and ground plane spaced 8 mils apart on the top layer. The bottom layer should be a continuous ground plane under the transmission line. Ground vias should be included between the module castellation pins and the U.FL connector ground pads to provide a good RF ground connection.
- Connectors, Cable assemblies, and antennas must be as specified in photos below or equivalent.

Figure 3 and 4 illustrates the implementation.

Part Number ZICM35xSP1-1C
External Antenna Implementation

Figure 3. Implementation using connector, cable and external antenna

COMPONENTS USED IN THE IMPLEMENTATION (CONTINUED)

Part Number ZICM35xSP2-1C
External Antenna Implementation

Figure 4. Implementation using connector, cable and external antenna

DESIGN VERIFICATION TEST PROCEDURE

Any manufacturer that chooses to implement the external antenna on their host board should verify that the implementation was done properly. To assist with this, the following Test Procedure can be used. The procedure uses a Network Analyzer capable of making return loss measurements at 2.4 GHz.

1. Calibrate the network analyzer for a one port measurement with a center frequency of 2.44 GHz and a span of 200 MHz.
2. Take a blank host board and solder a 100 Ω resistor between castellation Pin 31 and 32.
3. Solder a second 100 Ω resistor between castellation Pin 32 and 33.
4. Solder the U.FL connector on the host board.
5. Using the appropriate U.FL to SMA adapter for your network analyzer, measure the Return Loss of the trace, (either S11 or S22 depending on which port was chosen during the 1-port calibration).
6. A return loss of -15 dB or lower indicates an acceptable implementation (PASS).

DESIGN VERIFICATION TEST PROCEDURE (CONTINUED)

Figure 5. displays the measurement where Port 2 was used as the measurement Port.

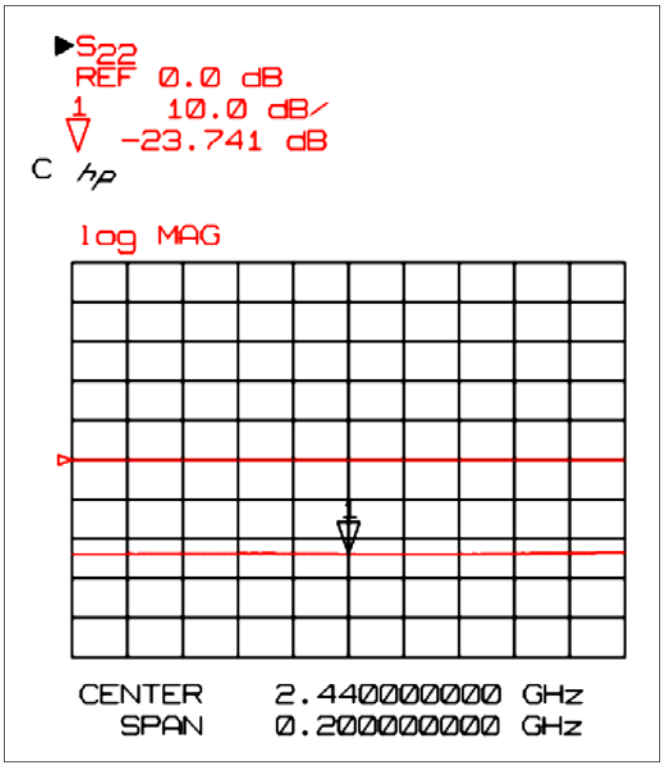


Figure 5. Measured Return Loss of RF trace

PRODUCTION TEST PROCEDURE FOR ENSURING COMPLIANCE

During production, host boards should be tested to ensure compliance. CEL recommends that when the host board is manufactured, the requirement of “Electrical Testing” is specified with the PCB order to guarantee that no short is present anywhere on the host board (which includes the trace between the U.FL connector location and the module RF castellation pad). This greatly simplifies the production test requirements down to verifying that a solder short did not occur during the component placement and reflow of the host board assembly. Verifying no solder short has occurred can be done by measuring an open circuit between castellation pins 32 and 33 using a DC multi-meter.

REFERENCES

Reference Documents	Download
California Eastern Laboratories	
0011-00-07-00-000 CEL – EM357 Mini Modules Datasheet	Link
0019-00-07-00-000 CEL – B1010SP0 Mini Modules Datasheet	Link

REVISION HISTORY

Previous Versions	Changes to Current Version	Page(s)
0011-00-16-11-000 (Issue A) August 26, 2013	Initial Technical Note	N/A
0011-00-16-11-000 (Issue B) September 4, 2015	Update to include all Mini Modules	ALL
0011-00-16-11-000 (Issue C) August 03, 2016	Added external antenna certification information for ZICM35xSPx-1C. Added new photos under Components Used in the Implementation section Added PCB Implementation Requirements Section	1,3

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