

# Hardware User Guide Overview for Open Smart Device Interface (OSDI) SecureMesh™ Module (OSDI-4000-1x)

**Document Number:** DT-0237A

**Revision:** 1.3

**Date:** February 20, 2025

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## Table of Contents

|  |           |
|--|-----------|
| Chapter 1: Overview .....  | 6         |
| Chapter 2: Features and Specifications.....                                  | 7         |
| Chapter 3: Functional Description .....                                      | 9         |
| <b>3.1 OSDI Module .....</b>   | <b>9</b>  |
| <b>3.2 Host Interface &amp; Optional IOs .....</b>                           | <b>9</b>  |
| <b>3.3 Interface and Control Signals .....</b>                               | <b>10</b> |
| Chapter 4: Antennas.....   | 12        |
| <b>4.1 Antenna Placement.....</b>  | <b>12</b> |
| <b>4.2 On Board Antennas .....</b>   | <b>13</b> |
| 4.2.1 'M' Antenna .....  | 13        |
| 4.2.2 uSplat planar Antenna .....  | 14        |
| 4.2.3 Spring Antenna.....  | 15        |
| <b>4.3 External Antennas .....</b>   | <b>16</b> |
| 4.3.1 Larsen RO2406NM.....   | 16        |
| 4.3.2 MobileMark IMAG5-2400.....   | 17        |
| 4.3.3 L-Com HG2403RD-RTF .....   | 18        |
| 4.3.4 Mobile Mark CVS-2400 .....   | 19        |
| 4.3.5 Molex 1461530100.....  | 20        |
| Chapter 5: Host PCB Requirements.....  | 21        |
| <b>5.1 Recommended Footprint.....</b>  | <b>21</b> |
| <b>5.2 PasteMask .....</b>   | <b>21</b> |
| <b>5.3 Layout requirements .....</b>   | <b>21</b> |
| <b>5.4 Reference trace designs.....</b>                                      | <b>22</b> |
| 5.4.1 Layout and parts for M antenna .....                                   | 23        |
| 5.4.2 Layout and parts for uSplash antenna .....                             | 24        |
| 5.4.3 Layout and parts for Spring antenna.....                               | 25        |
| 5.4.4 Layout and parts for external antennas with SMA connector 4 legs ..... | 26        |

|   |           |
|---|-----------|
| 5.4.5 Layout and parts for external antennas with SMA connector on side ..... | 27        |
| 5.4.6 Layout and parts for external antennas with u.fl.....                   | 28        |
| 5.4.7 Layout and parts for external antennas with MMCX female .....           | 29        |
| 5.4.8 Layout and parts for external antennas with MMCX.....                   | 30        |
| 5.4.9 Design validation & production procedures.....                          | 30        |
| 5.4.10 Other considerations .....   | 31        |
| <b>5.5 Modifying the RF Signal Routing .....</b>                              | <b>31</b> |
| <b>5.6 Pin Numbering .....</b>  | <b>33</b> |
| <b>5.7 Pin Description.....</b>   | <b>33</b> |
| <b>5.8 Suggested Reflow profile, for reference only .....</b>                 | <b>40</b> |
| <b>Chapter 6: SecureMesh Configuration .....</b>                              | <b>41</b> |
| <b>6.1 Mesh Programming tool.....</b>   | <b>41</b> |
| <b>6.2 Data Link Library.....</b>   | <b>41</b> |
| <b>Chapter 7: Regulatory Agency Approvals.....</b>                            | <b>42</b> |
| <b>7.1 United States.....</b>   | <b>42</b> |
| 7.1.1 RF Human Exposure .....   | 43        |
| 7.1.2 Approved External Antenna Types .....                                   | 44        |
| 7.1.3 Helpful Web Sites .....   | 44        |
| <b>7.2 Canada.....</b>  | <b>44</b> |
| 7.2.1 RF Human Exposure .....   | 45        |
| 7.2.2 Approved External Antenna Types .....                                   | 46        |
| 7.2.3 Helpful Web Sites .....   | 46        |

## Chapter 1: Overview

The SecureMesh Ready, Open Smart Device Interface Modules (OSDI) are Trilliant 2.4GHz RF modules which can be integrated into a variety of third-party OEM products. These small and versatile modules include a microcontroller, memory, transceiver, power management all on an LGA circuit board.

Based on IEEE 802.15.4 wireless communication standard and utilizing Trilliant's robust SecureMesh networking protocol, the OSDI modules deliver industry leading 2.4GHz networking solution. The modules are easy to integrate, provide low power consumption, long range and many more features and functionalities.

The OSDI family of products are currently available in 2 base hardware models.

**Table 1 Hardware models**

| Hardware Model      | Description   |
|---------------------|---|
| <b>OSDI-4000-1A</b> | 4 <sup>th</sup> generation OSDI module with maximum transmit power of 1 watt; ANSI protocol       |
| <b>OSDI-4000-1D</b> | 4 <sup>th</sup> generation OSDI module with maximum transmit power of 1 watt; DLMS/COSEM Protocol |

Throughout the remainder of this document, the OSDI module platforms will be referred to by the base hardware model.

## Chapter 2: Features and Specifications

The OSDI modules are designed for a broad range of applications and products. it provides a compliant ready RF mesh solution for both domestic and international markets. The modules have a unique set of features, including:

- Reporting Retries and Acknowledgements.
- Remote Firmware upgrades.
- Programmable Network Parameters.
- AES, DES Encryption crypto module.
- Frequency hopping for a reliable communication link against interference (future enhancement)

**Table 2 SecureMesh NAN Radio Performance**

| Parameter                     | Description  |
|-------------------------------|--|
| <b>Protocols</b>              | <ul style="list-style-type: none"> <li>• SecureMesh NAN Transport layer</li> <li>• SecureMesh NAN Network layer</li> <li>• IEEE 802.15.4 MAC layer</li> <li>• IEEE 802.15.4 PHY layer (2.4 GHz)</li> </ul>   |
| <b>Modulations</b>            | <ul style="list-style-type: none"> <li>• OQPSK<br/>Offset Quadrature Phase-Shift Keying<br/>Data rate: 250 kbps (transmit/receive)</li> <li>• OFDM<br/>Orthogonal Frequency-Division<br/>Multiplexing<br/>Data rate: up to 1200 kbps (transmit/receive)</li> </ul> |
| <b>Frequency band</b>         | 2.400 - 2.4835 GHz (unlicensed operation)  |
| <b>Frequency channels</b>     | <ul style="list-style-type: none"> <li>• 15 (OQPSK)</li> <li>• 49 (OFDM)</li> </ul>  |
| <b>Channel spacing</b>        | <ul style="list-style-type: none"> <li>• 5 MHz (OQPSK)</li> <li>• 1.2 MHz (OFDM)</li> </ul>  |
| <b>Maximum transmit power</b> | +30dBm   |
| <b>Receive sensitivity</b>    | -103dBm  |

**Table 3 Electrical specifications**

|                | Min. | Typ. | Max. |
|----------------|------|------|------|
| <b>Voltage</b> | 4.0  | 4.5  | 5.0  |
| <b>Current</b> |      | 1.2A |      |

**Table 4 Physical, & Environmental**

| Parameter              | Description             |
|------------------------|-------------------------|
| Mounting method        | LGA (Land Grid Array)   |
| Dimensions (L x W x H) | 29.8 x 35.3 x 4.4 mm    |
| Operating temperature  | -40 °C to +85 °C        |
| Humidity               | 5 to 95% non-condensing |
|                        |                         |

**Table 5 Compliance**

| Parameter                  | Description  |
|----------------------------|--|
| Radio emissions            | <ul style="list-style-type: none"><li>• FCC Part 15 Class B</li><li>• ISED ICES-003 Class B</li><li>• EN 55032, EN 55035</li><li>• EN 300 489-1, EN 300 489-17</li></ul> |
| Unlicensed radio operation | <ul style="list-style-type: none"><li>• FCC Part 15.212, 15.247</li><li>• ISED RSS-Gen, RSS-247</li><li>• EN 300 328</li><li>• Others worldwide</li></ul>                |
| Human Exposure             | <ul style="list-style-type: none"><li>• FCC Part 2.1091, 2.1093</li><li>• RSS-102</li><li>• EN 62209-2</li></ul>   |

## Chapter 3: Functional Description

### 3.1 OSDI Module

The OSDI modules are low power 2.4GHz ISM band transceivers. Figure 1 below shows a block diagram of the OSDI-4000 modules and the surrounding optional functionalities that are intended as a reference implementation example.

The configuration of the transceiver, reading and writing of Frame Buffer is controlled by a SPI interface and additional control lines. The control of the RF front-end is done via the transceiver digital control pins.

The OSDI modules are equipped with a Low Drop Out voltage (LDO) regulator that enables them to work in standalone mode with a voltage supply between 4 and 5 volts.

The VCPU power supply line of the microcontroller is available on the external connection for optional backup supply when Real Time Power Outage Reporting (RTPOR) is required.

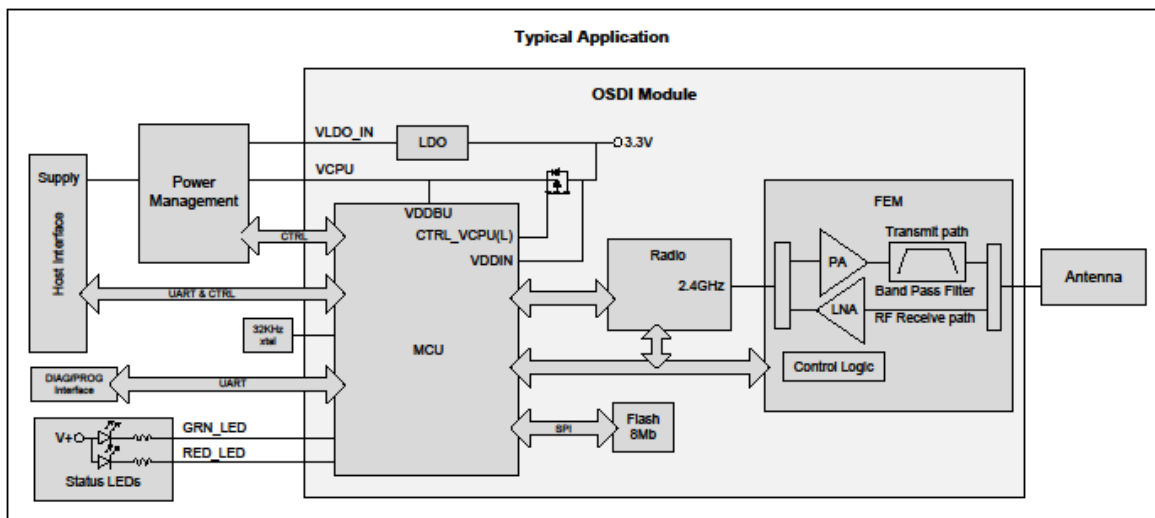


Figure 1: Typical application with OSDI Module

### 3.2 Host Interface & Optional IOs

Communication with the host is achieved using a serial communication port and control signals that are bundled with the power lines inside the host connector. Diagnostic and programming signals are available to the host. See Table 1 below for the description of the various signals found in the diagnostic and programming interface. The RF input/output signal must be routed through the host device as described in section 5.4. Antennas of section Chapter 4: can be used in relation with regulation. The OSDI module is designed with outputs to drive a multicolor LED indicator that allows visual diagnostic and status monitoring of the device. See Table 6 below for an interpretation of the existing LED patterns.

## 3.3 Interface and Control Signals

**Table 6: OSDI module control signals description and usage.**

| Signal                     | Description  | Usage  |
|----------------------------|--|--|
| <b>TX_EXT-RX_LGA</b>       | Transmit from the meter / Receive to the module.<br>Signal Type: UART.   | <ul style="list-style-type: none"> <li>Meter Connector serial port.</li> <li>Meter USB Port.</li> <li>Default baud rate is set to 9.6 kbps.</li> </ul>   |
| <b>RX_EXT-TX_LGA</b>       | Receive to the meter / Transmit from the module.<br>Signal Type: UART.   |  |
| <b>DIAG-RX_LGA</b>         | Module receive diagnostic port.<br>Signal Type: UART.  | <ul style="list-style-type: none"> <li>Diagnostic serial port</li> <li>Diagnostic USB Port.</li> <li>Default baud rate is set to 9.6 kbps in diagnostic mode and 19.2 kbps in trace mode.</li> <li>Should be accessible via test points in normal design.</li> </ul>   |
| <b>DIAG-TX_LGA</b>         | Module transmit diagnostic port.<br>Signal Type: UART.   |  |
| <b>RED_LED and GRN_LED</b> | Control Red and Green LEDs.<br>Signal Type: Active low output.<br>0=LED on, 1= LED off.<br>Note: Red and green led are in one physical unit. Yellow is produced when both LEDs are on. | <p>Diagnostic LEDs.<br/>Needs to be visible from the outside of the meter for installation purposes in normal design.</p> <p><b>LEDs off:</b> Power save mode/POR mode or no power.<br/> <b>Flashing green:</b> Initialization (5 sec).<br/> <b>Steady Red:</b> Working but not associated to a network.<br/> <b>Steady Yellow:</b> Working and trying to associate to a network.<br/> <b>Steady Green:</b> Working and associated to a network.<br/> <b>Flashing Yellow:</b> Working and exchanging info.</p> |
| <b>P-FAIL_EXT</b>          | External signal from the meter indicating that an interruption of power has been detected.<br>Signal Type: Active low input from the meter.<br>0 = Power fail, 1 = Normal condition.   | <ul style="list-style-type: none"> <li>Meter Connector.</li> <li>PFAIL Circuit.</li> </ul> <p>Provides an early detection of power outage events.</p>  |
| <b>P-FAIL</b>              | Signal indicating that an interruption of power has been detected.<br>Signal Type: Interrupt input.<br>0 = Power fail, 1 = Normal condition.   | <ul style="list-style-type: none"> <li>PFAIL Circuit.</li> <li>CPU Reset Control Circuit.</li> </ul> <p>Provides early detection of power outage events.</p>   |
| <b>RESET</b>               | Signal Type: Hardware reset.<br>0 = Reset, 1 = Normal operation.   | <ul style="list-style-type: none"> <li>CPU Reset Control Circuit.</li> <li>For use during development only.</li> <li>Do not connect to the meter.</li> </ul>   |
| <b>TEST</b>                | Select test / diagnostic mode.<br>Signal Type: Active high input.  | <ul style="list-style-type: none"> <li>Reserved</li> <li>Diagnostic/Programming Connector.</li> </ul>  |

| Signal  | Description   | Usage  |
|---|---|--|
|   | 1 = Diagnostic mode, 0 = Normal mode.   | <ul style="list-style-type: none"> <li>Should be accessible via test points in normal design.</li> </ul>   |
| <b>SC_HI</b>                                      | Signal Type: Input.<br>1 = Supercap voltage > 3.6V  | <ul style="list-style-type: none"> <li>On/off signal from the fail safe circuit to detect if the super cap is higher than 3.6V.</li> </ul>   |
| <b>PWR_MON</b>                                    | Power supply monitoring signal.<br>Signal Type: Analog.   | <ul style="list-style-type: none"> <li>Meter Connector.</li> </ul> Provision for self-detection of power outages by the OSDI modules, if P-FAIL is not available.  |
| <b>RESET-PDI_CLK, TDI-PDI_DATA, TDO, TMS, TCK</b> | Program and Debug Interface.  | <ul style="list-style-type: none"> <li>Diagnostic/Programming Connector.</li> <li>Used only during development.</li> <li>See schematic for proper use.</li> <li>Should be accessible via test points in normal design.</li> </ul>  |
| <b>SLEEP</b>                                      | Sleep mode power activation.<br>Signal Type: low open-drain output.<br>0 = SLEEP Enabled, 1 = SLEEP Disabled. | <ul style="list-style-type: none"> <li>RTPOR Supply Management circuit.</li> </ul> Used to send the command to the power management circuit to connect the 1.5 Farad capacitor (+V1.5F) directly to the input supply (+VCPU) of OSDI module's CPU in order to feed it with minimum power waste, in sleep mode. |
| <b>MESURE_VCAP</b>                                | 1.5 Farad capacitor voltage monitoring.<br>Signal Type: Analog, feeds ADC input.                              | Provision for monitoring of voltage level of the 1.5F capacitor.   |
| <b>+3.3V</b>                                      | LDO voltage regulator's output.   | Regulated 3.3V voltage supply from the OSDI module.  |
| <b>+VMAIN</b>                                     | Main power supply input.  | Used by the power management circuit as input to the LDO regulator and to charge the 1.5 Farad super capacitor.  |
| <b>+VCPU2</b>                                     | 3.3 Volts supply for OSDI module's CPU.   | Used to feed power to the CPU during debug and programming.  |
| <b>+VCPU</b>                                      | 3.3 Volts supply for OSDI module's CPU.   | Input supply (+VCPU) of OSDI module's CPU.   |
| <b>+VLDO_IN</b>                                   | LDO regulator's input.  | Input of the LDO regulator (+VLDO) of the OSDI module.   |
| <b>+V1.5F_SW</b>                                  | 1.5 Farad capacitor switched voltage.   | Power path for the sleep mode power supply.  |

## Chapter 4: Antennas

The maximum output power authorized by the FCC and Innovation, Science and Economic Development Canada in the 2.4GHz band is 36 dBm EIRP. For the OSDI-4000-1x, the maximum output power of the radio is 30 dBm which can be combined to an antenna with a maximum gain of 6 dBi.

The OSDI module has been certified with many different types of integrated antennas as described in the following sections. The information shown was taken from datasheets or measured when mounted on specific products. Actual patterns will be influenced by the PCB layout and by surrounding material.

**NOTE: Certification regulations differ from one country to the other. It remains the responsibility of the meter manufacturer to choose an antenna that will meet the requirements of the country where the meters will be deployed as well as any local certifications that may be required to comply with specific market regulations. See section Chapter 7: for more details.**

### 4.1 Antenna Placement

Antenna performance is significantly impacted by the type and physical placement of the antenna. The antenna should be oriented in the device to properly radiate the RF emissions from the face of the device forward and in an upward direction for optimal connectivity to the Trilliant SecureMesh network infrastructure. In addition, there should be as few obstacles as possible between the antenna and the outside of the device.

Through the following examples, Trilliant is attempting to provide antenna options for the most commonly used antenna design scenarios but keep in mind that this is greatly dependent on the host device design. If you are unsure about which antenna to select, or how it should be implemented into the overall design, please contact Trilliant for guidance.

The RF connection from the OSDI module to the antenna is made using a 50 ohms micro-strip trace on the host's PCB. See section 5.4 for routing instructions.

## 4.2 On Board Antennas

### 4.2.1 ‘M’ Antenna

Trilliant p/n: CP-0299A

|           |              | Chan. 18, P=28.7 dBm |           |           |
|-----------|--------------|----------------------|-----------|-----------|
| Plane     | Polarization | Min (dBi)            | Max (dBi) | Avg (dBi) |
| Azimuthal | Vertical     | -23.1                | 3.6       | -5.6      |
|           | Horizontal   | -25.1                | -8.5      | -15.7     |
| Elevation | Vertical     | -30.7                | -12.3     | -19.0     |
|           | Horizontal   | -21.5                | 4.8       | -7.7      |

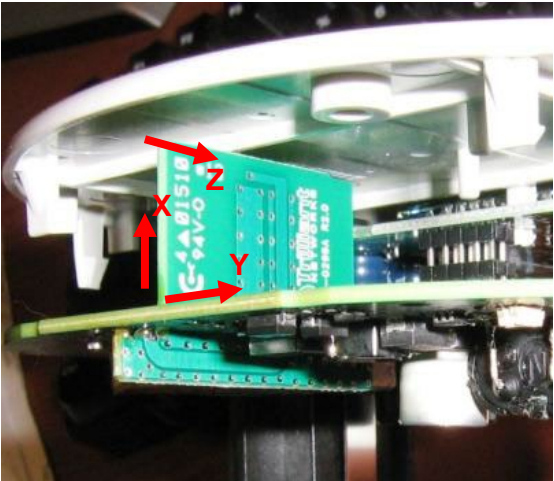


Figure 2: M Antenna orientation inside scanned product.

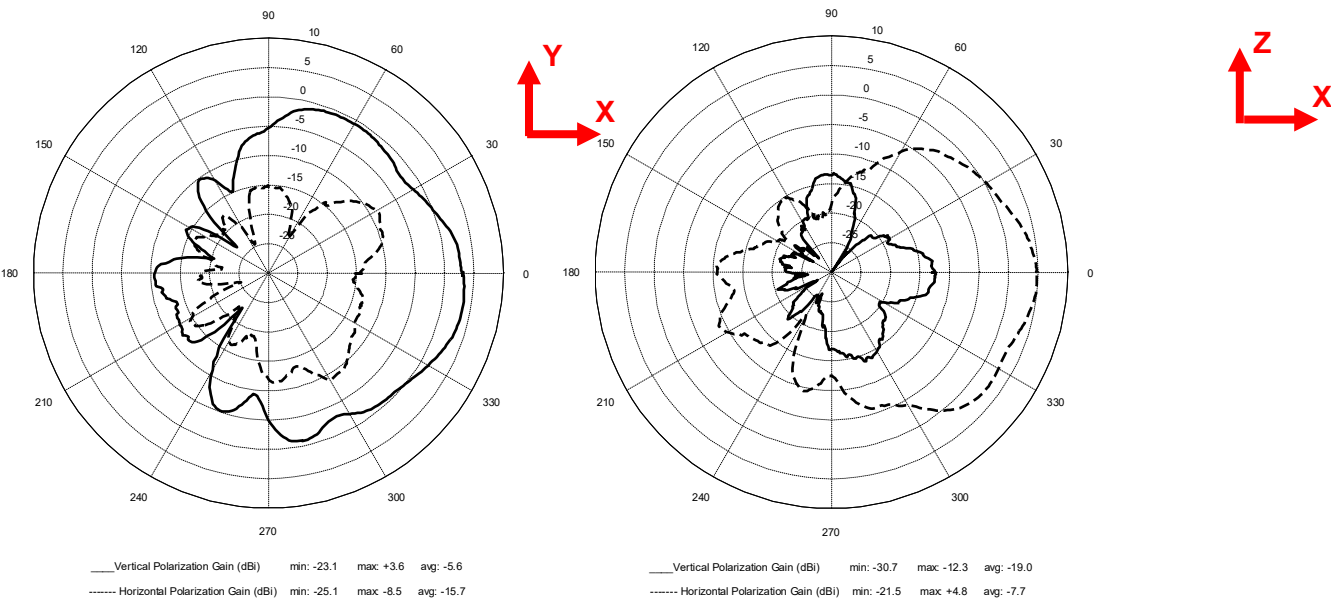


Figure 3 M Antenna Azimuth (left) and Elevation (right) Patterns.

## 4.2.2 uSplash planar Antenna

- Linx #: ANT-2.4-uSP
- Center frequency: 2.4 GHz
- Bandwidth: 150 MHz
- Wavelength:  $\frac{1}{4}$ -wave
- VSWR:  $\leq 2.0$  typical at center
- Peak gain: 3.8 dBi
- Impedance: 50 ohms



Figure 4: uSplash Planar Antenna Picture.

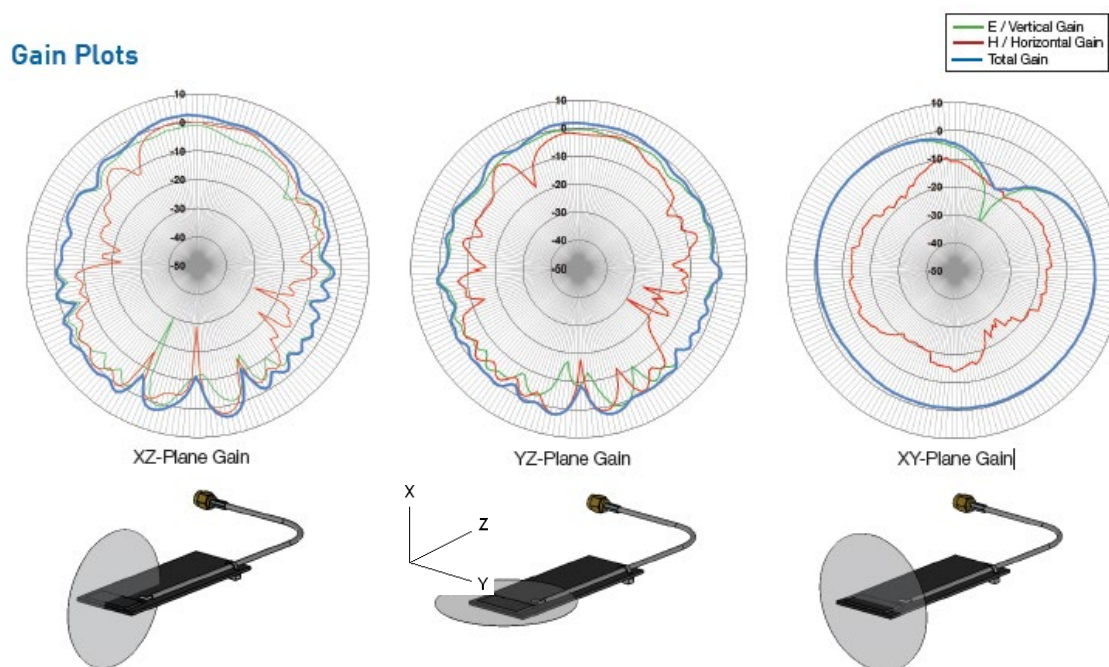


Figure 5: uSplash Antenna Radiation Patterns.

### 4.2.3 Spring Antenna

- Vendor: TopPoint Technology
- Vendor #: DD100006143
- Center frequency: 2.4 GHz
- Bandwidth: 100 MHz
- VSWR:  $\leq 2.0$
- Peak gain: 3.5 dBi
- Impedance: 50 ohms
- Type: monopole



Figure 6 Spring Antenna

### VSWR

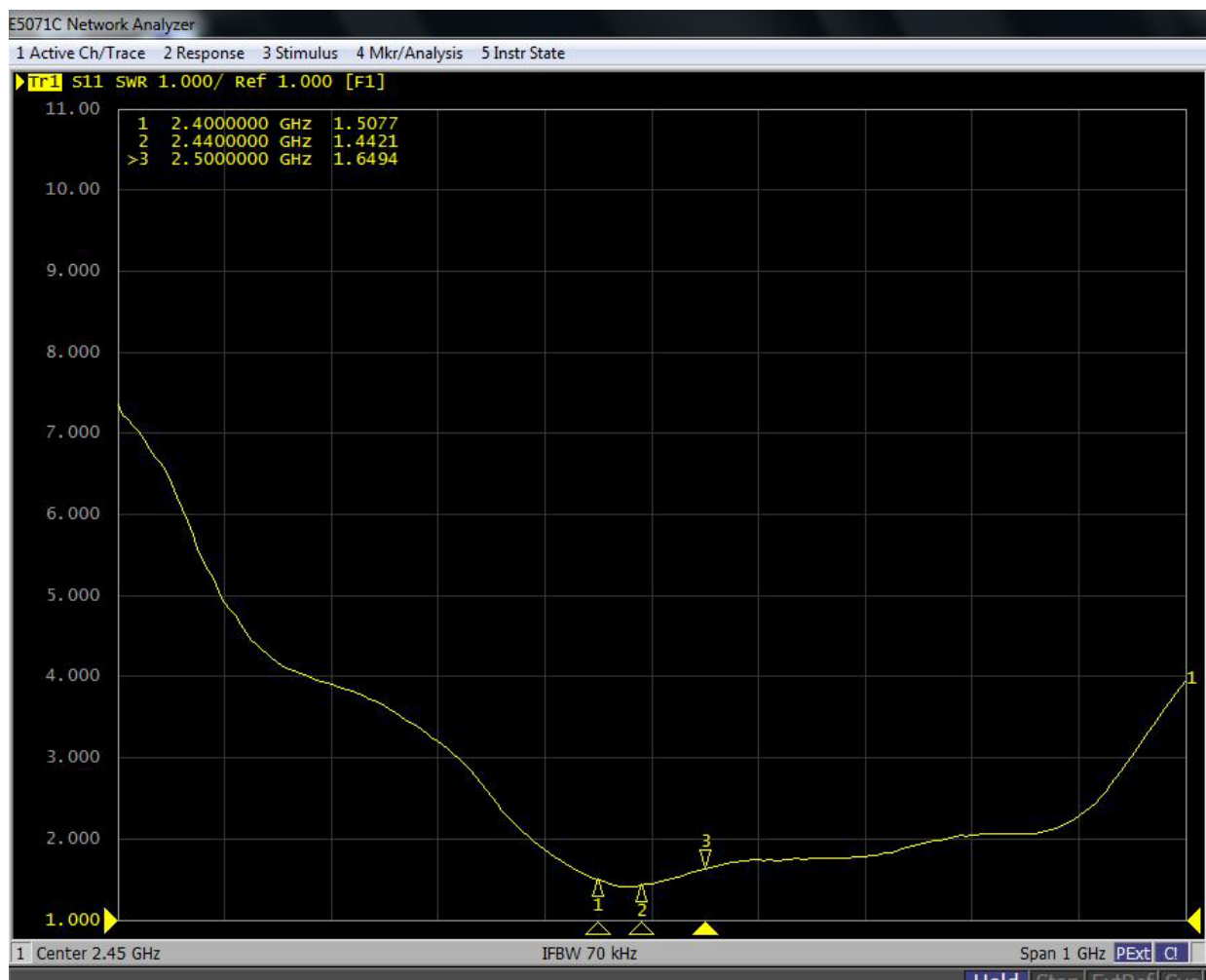


Figure 7 Spring Antenna VSWR

## 4.3 External Antennas

The following section describes types of external antennas that have been certified with the OSDI-4000 module.

**Note that a Reverse Polarity connector must be used for external antennas.**

### 4.3.1 Larsen RO2406NM

- Vendor: Larsen
- Vendor #: RO2406NM
- Frequency: 2400-2500 MHz
- Nominal Impedance: 50 Ohms
- VSWR: 2:1 Max
- Gain: 6 dBi
- Polarization: Vertical
- Power withstanding: 20 W
- Connector: N-Type Male (To use this antenna with the OSDI module, a RP connector that is actually in discussion, must be used; the part number will change accordingly)

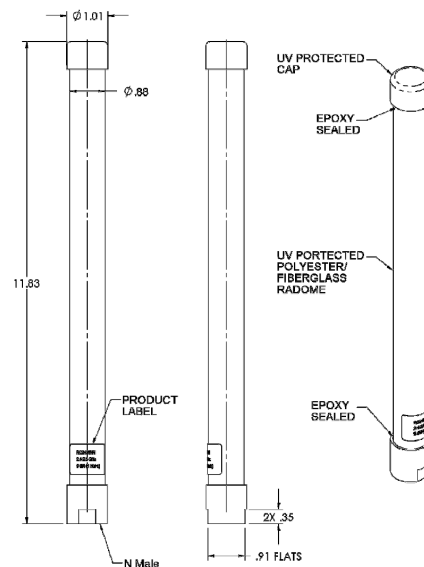


Figure 8: Larsen RO2406NM Drawing.

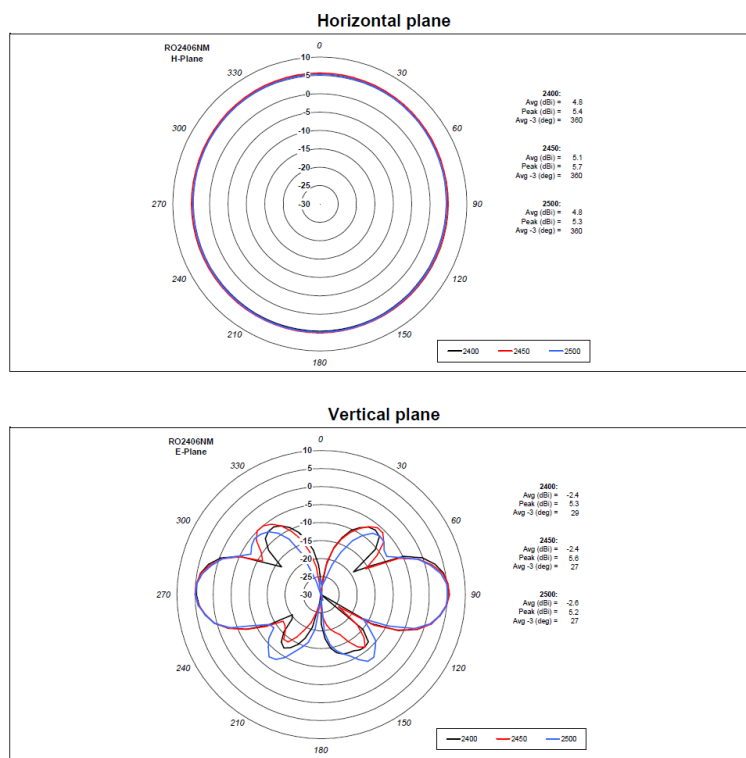


Figure 9: Larsen RO2406NM Radiation Patterns.

### 4.3.2 MobileMark IMAG5-2400

- Vendor: MobileMark
- Vendor #: IMAG5-2400-3K-BLK-120
- Frequency: 2400-2485 MHz
- Nominal Impedance: 50 Ohms
- VSWR: 2:1 over band
- Gain: 5 dBi
- Maximum Power: 10 Watts
- Connector: TNC Plug-RP (female center pin)
- Temperature: -40°C to +85°C



### IMAG5 Series

*Figure 10: MobileMark IMAG5-2400-3K-BLK-120.*

### 4.3.3 L-Com HG2403RD-RTF

- Vendor = L-Com Global Connectivity
- Vendor #: HG2403RD-RTF
- Frequency: 2400 – 2 500 MHz
- Gain: 3 dBi max
- VSWR: <2.0
- Impedance: 50 ohm
- Polarization: Vertical
- Connector: TNC Plug-RP (female center pin)
- Temperature Range: -40° to +85°C



Figure 11: L-Com HG2403RD-RTF.

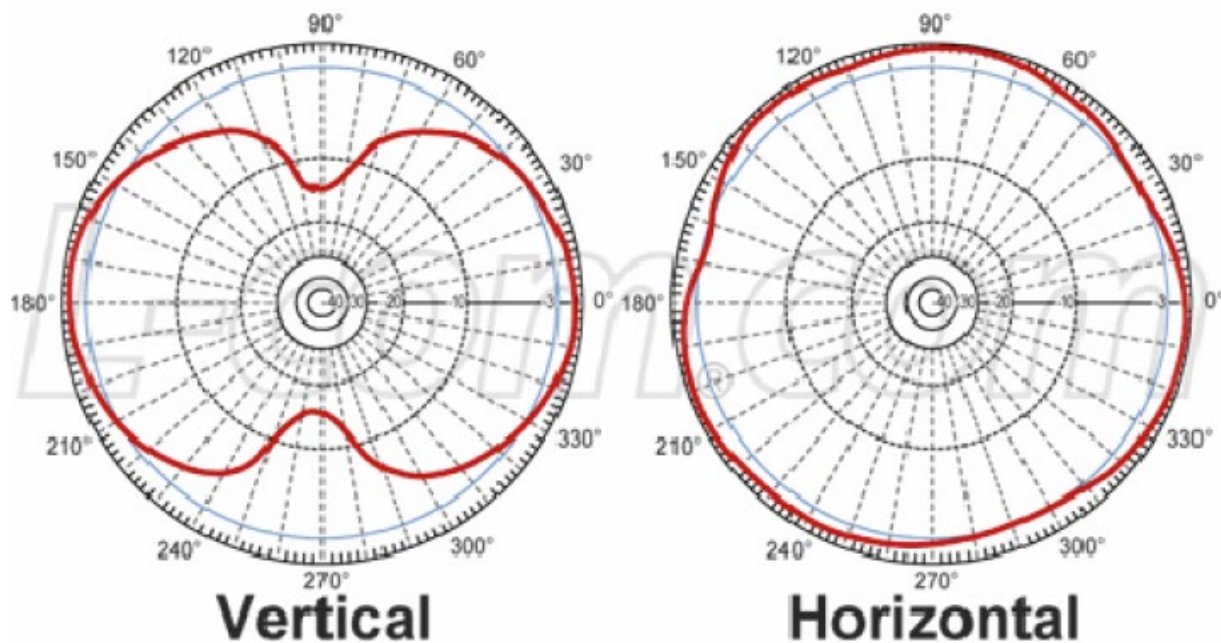


Figure 12: L-Com HG2403RD-RTF Radiation Patterns.

### 4.3.4 Mobile Mark CVS-2400

- Vendor = Mobile Mark
- Vendor #: CVS-2400-2SA-BLK-13
- Frequency: 2.4 – 2.5 GHz
- Gain: 2.0 dBi max
- VSWR: 2:1 over band
- Impedance: 50 ohm nominal
- Maximum Power: 10 Watts
- Connector: SMA Plug-RP
- Temperature Range: -40° to +85°C

#### Antenna Dimensions:

- 3 3/4" Length x 1 1/4" Width x 3/8" Deep
- (95 mm x 32 mm x 9 mm)

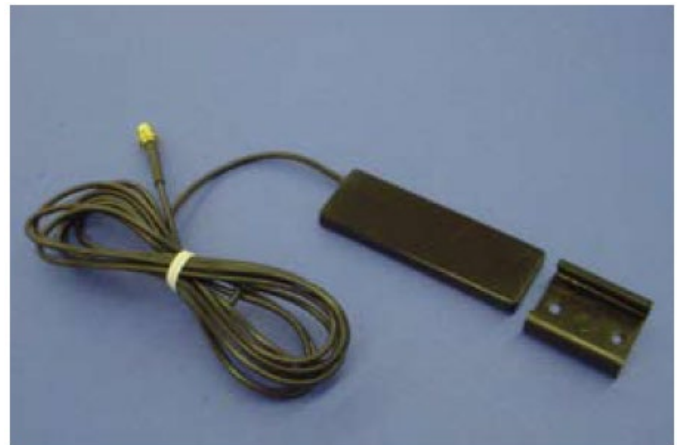


Figure 13: Mobile Mark CVS-2400.

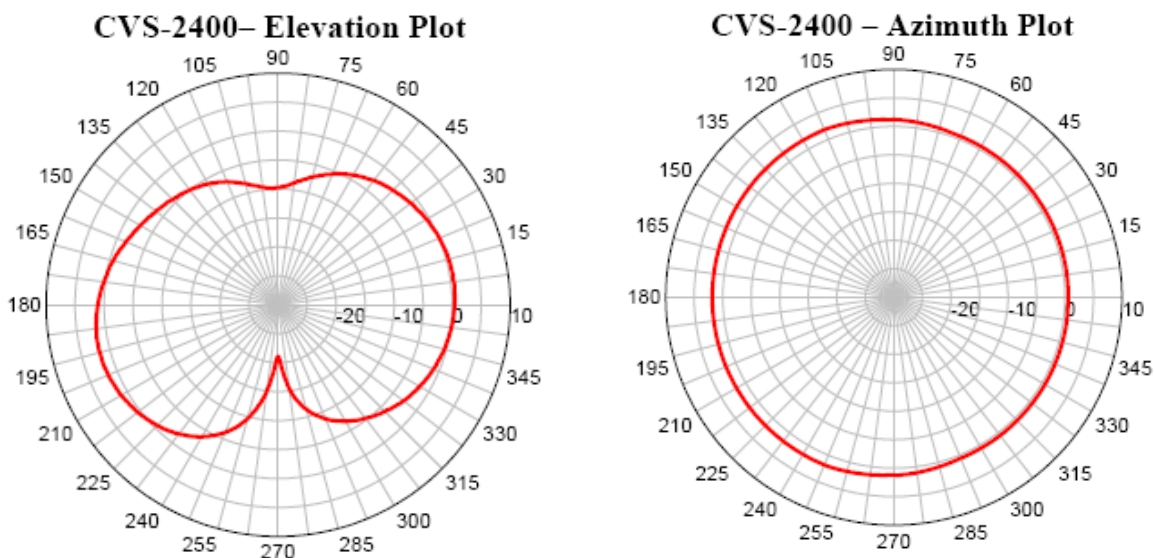


Figure 14: Mobile Mark CVS-2400 Radiation Patterns.

### 4.3.5 Molex 1461530100

- Vendor = Molex
- Vendor #: 1461530100
- Frequency: 2.4 / 5 GHz
- Peak Gain: 3.0 dBi at 2.4 GHz
- 4.5 dBi at 5 GHz
- Impedance: 50 ohm nominal
- Maximum Power: 2 Watts
- Connector: U.FL
- Temperature Range: -30° to +85°C

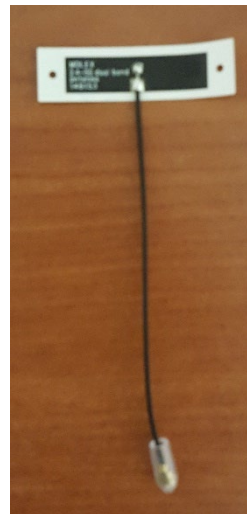


Figure 15: Molex 1461530100

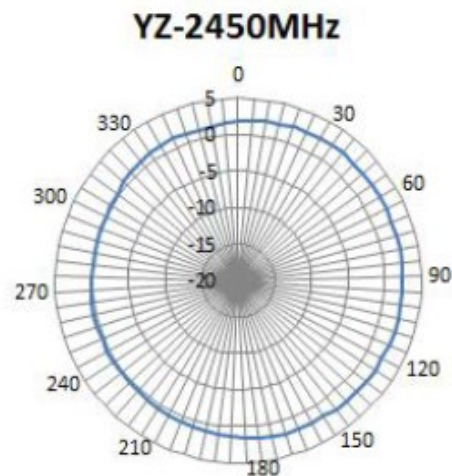
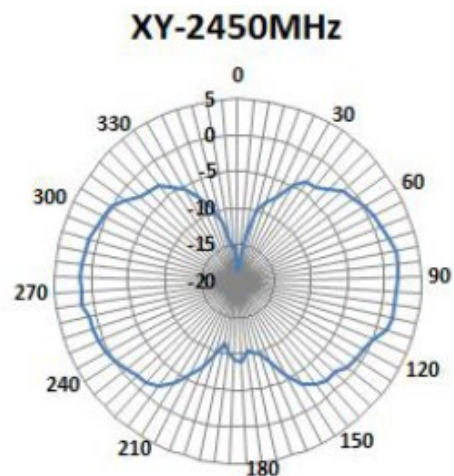
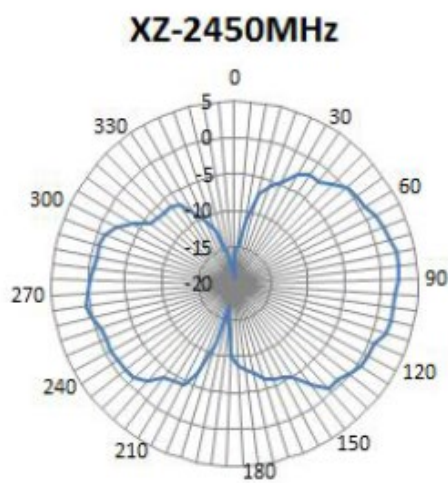
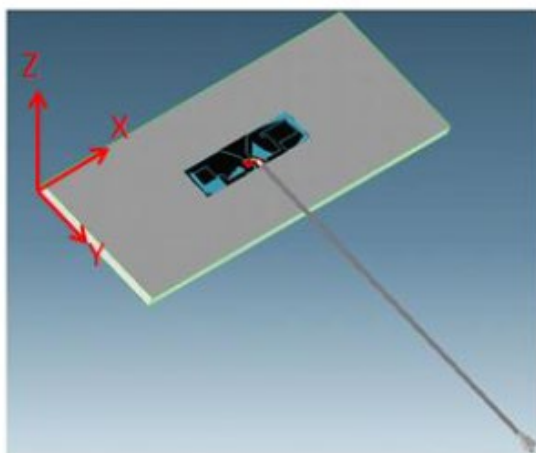


Figure 16 Molex 1461530100 Radiation Patterns.

## Chapter 5: Host PCB Requirements

### 5.1 Recommended Footprint

The footprints shown below are available upon request as a PAD Layout source file.

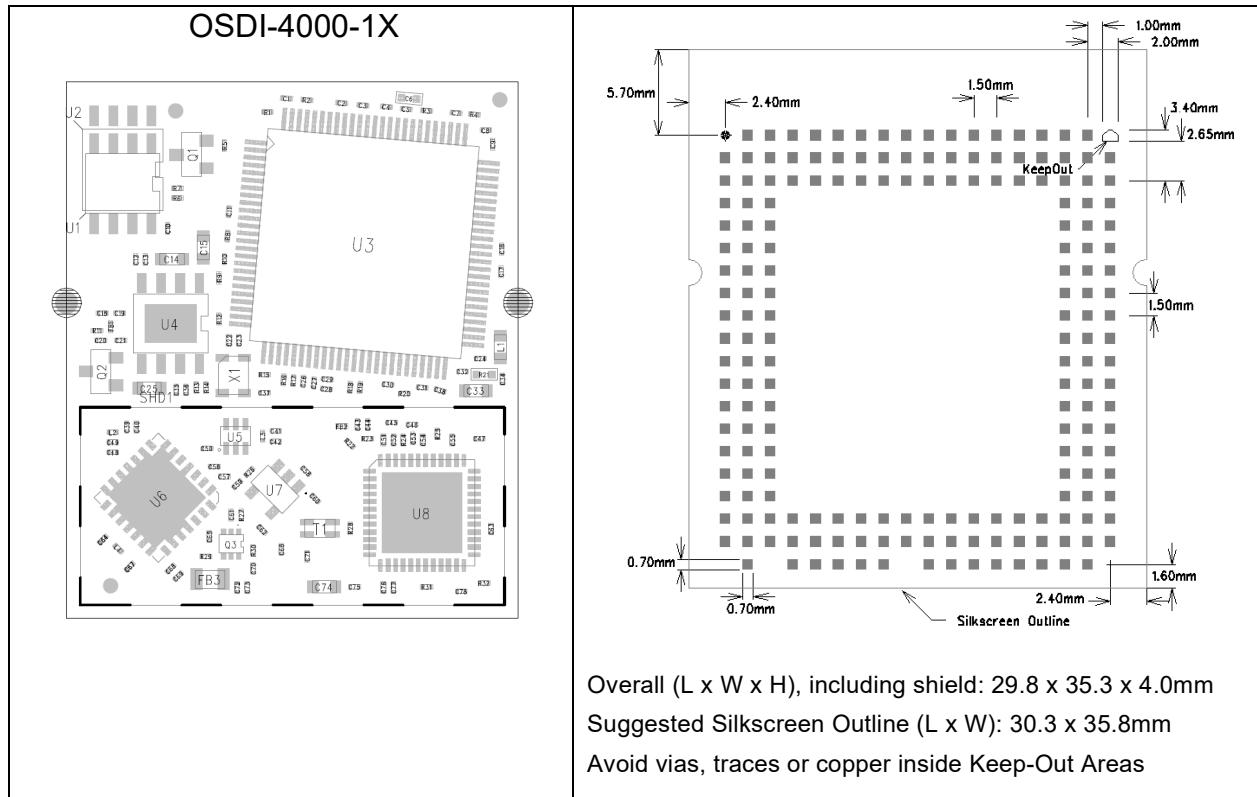


Figure 17 Footprint OSDI-4000-1X

### 5.2 PasteMask

Paste Mask Stencil openings can be of the same size as the recommended footprint (1:1); suggested thickness of stencil foil  $\geq 120\mu\text{m}$ .

### 5.3 Layout requirements

- Traces routed to RF\_EXT pad must be 50 ohm.
- Traces current rating:

|           |                       |
|-----------|-----------------------|
| +VCPU     | $\geq 90\text{ mA}$   |
| +3.3V     | $\geq 90\text{ mA}$   |
| +VLDO_IN  | $\geq 1.4\text{ Amp}$ |
| +V1.5F_SW | $\geq 90\text{mA}$    |

- Thermal reliefs are strongly recommended for all pads connected to Ground net.
- Finish recommendation for PCB pad surfaces: ROHS Compliant (EU Directive 2002/95/EC) 2-10  $\mu$ IN Immersion Gold Over 50-200 $\mu$ IN Electro less Nickel (ENIG)
- Non Solder Mask Defined (NSMD) type is recommended for the solder pads on the PCB.

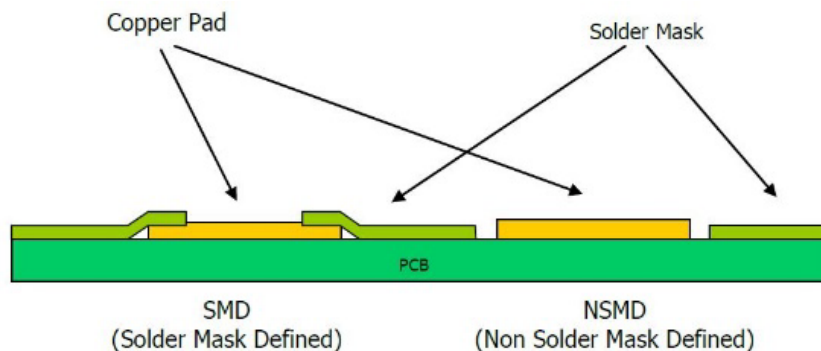


Figure 18 Solder Mask recommendation

- Pads Solder Mask Opening of 0.1mm is recommended.

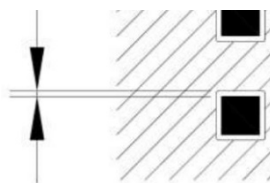


Figure 19 Solder mask opening

## 5.4 Reference trace designs

RF traces from OSDI module pads W10 and W16 to the antenna must be made using micro-strip traces. This micro-strip trace must respect the design of the Gerber files associated with the following designs in order to obtain a uniform transmission line with a characteristic impedance of 50 ohms. The reference trace designs are shown in the following sections.

### 5.4.1 Layout and parts for M antenna

The reference trace for this antenna is the green traces along with the side copper filled with vias on the left side of Figure 20 where components G8, G9, G11 and G12 are not installed. As preliminary information the traces width of all sections are 0.27mm and the length of each section, starting from the LGA pad to the M antenna are: LGA pad to G7: 15.38mm; G7 to G10: 12.37mm; G10 to R50: 2.3mm; R50 to M antenna: 4.85mm. However, refer to associated Gerber files for more accurate details on dimensions and refer to Trilliant Networks Inc for more details on the Gerber files. Table 7 shows the parts used in this reference trace design.

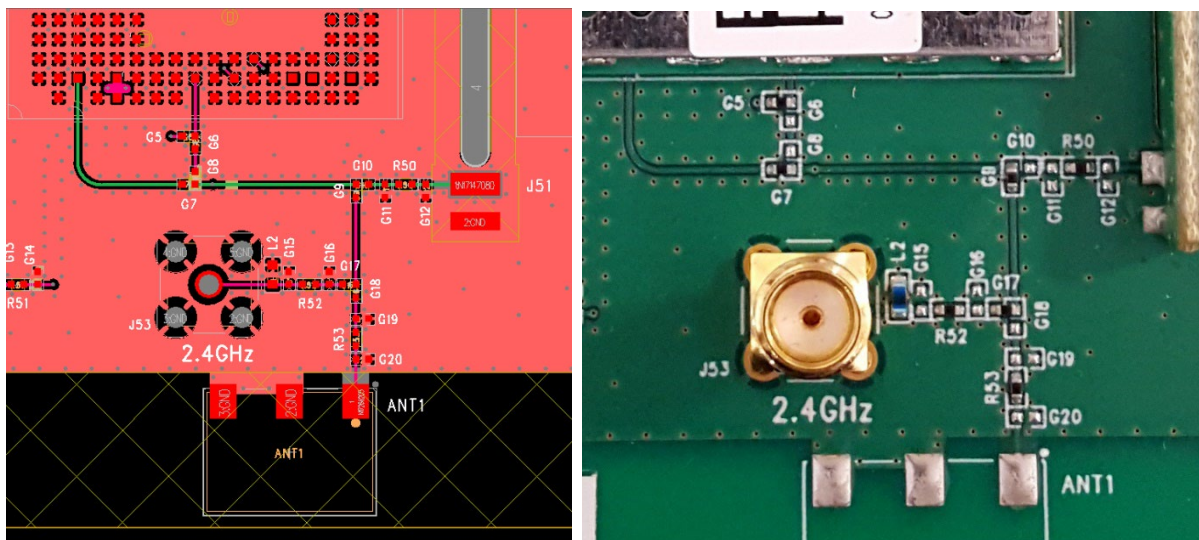


Figure 20 FCC and ISED approved trace design layout and picture for the M antenna of section 4.2.1

Table 7 Antenna micro-strip trace parts for M antenna

| Part Number | Designator       | Description                         | Manufacturer          |
|-------------|------------------|-------------------------------------|-----------------------|
| N/A         | G8, G9, G11, G12 | Not installed                       | N/A                   |
| RK73Z1ETTP  | G7, G10, R50     | RESISTOR 0.0 OHMS 1/16W 5% 0402 SMT | KOA Speer Electronics |
| CP-0299A    | J51              | Trilliant M antenna                 | Trilliant             |

### 5.4.2 Layout and parts for uSplash antenna

The reference trace for this antenna is the green traces along with the side copper filled with vias on the left side of Figure 21 where components G8, G10, G17, G19 and G20 are not installed. As preliminary information the traces width of all sections are 0.27mm and the length of each section, starting from the LGA pad to the uSplash are: LGA pad to G7: 15.38mm; G7 to G9: 12.37mm; G9 to G17: 6.7mm; G17 to R53: 2.1mm and R53 to uSplash antenna: 7.2mm. However, refer to associated Gerber files for more accurate details on dimensions and refer to Trilliant Networks Inc for more details on the Gerber files. Table 8 shows the parts used in this reference trace design.

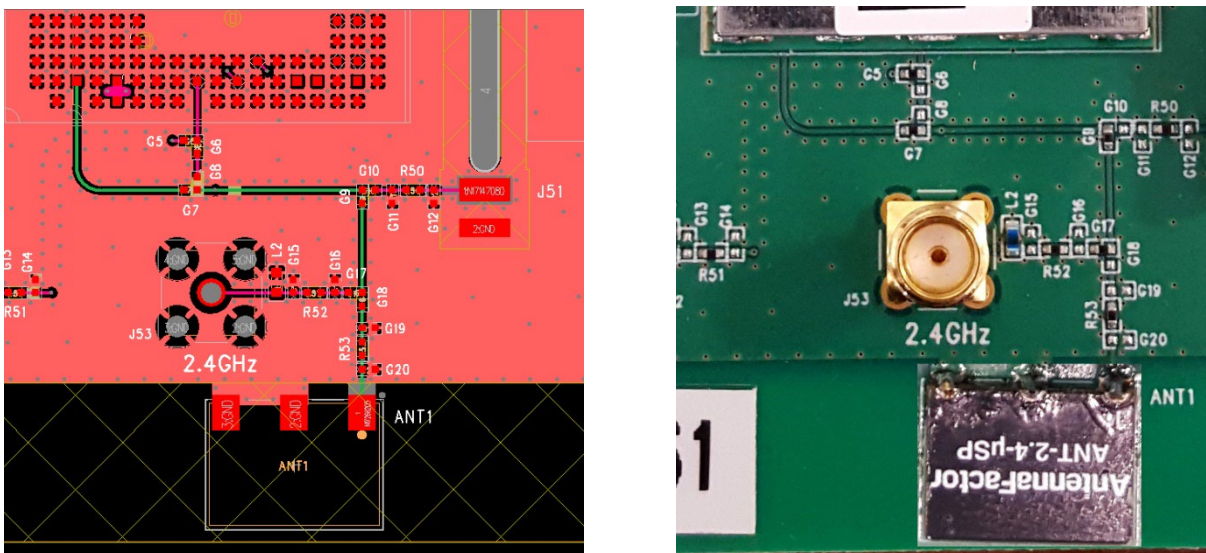


Figure 21 FCC and ISED approved trace design layout and picture for the uSplash antenna of section 4.2.2

Table 8 Antenna micro-strip trace parts for uSplash antenna

| Part Number | Designator       | Description                         | Manufacturer          |
|-------------|------------------|-------------------------------------|-----------------------|
| N/A         | G8, G9, G11, G12 | Not installed                       | N/A                   |
| RK73Z1ETTP  | G7, G9, G18, R53 | RESISTOR 0.0 OHMS 1/16W 5% 0402 SMT | KOA Speer Electronics |
| ANT-2.4-uSP | ANT1             | PC mount quarter-wave antenna       | Linx                  |

### 5.4.3 Layout and parts for Spring antenna

The reference trace for this antenna is the trace going up with an S shape in Figure 22, where components L4, C21 and C29 are not installed. As preliminary information the traces width of all sections are 0.64 mm and the length of each section, starting from the LGA pad to the pad called SMA1: LGA pad to R11: 8.38 mm; R11 to R13: 5.7 mm; R13 to connector of Spring antenna SMA1: 3.2mm. However, refer to associated Gerber files for more accurate details on dimensions and refer to Trilliant Networks Inc for more details on the Gerber files. Table 9 shows the parts used in this reference trace design.

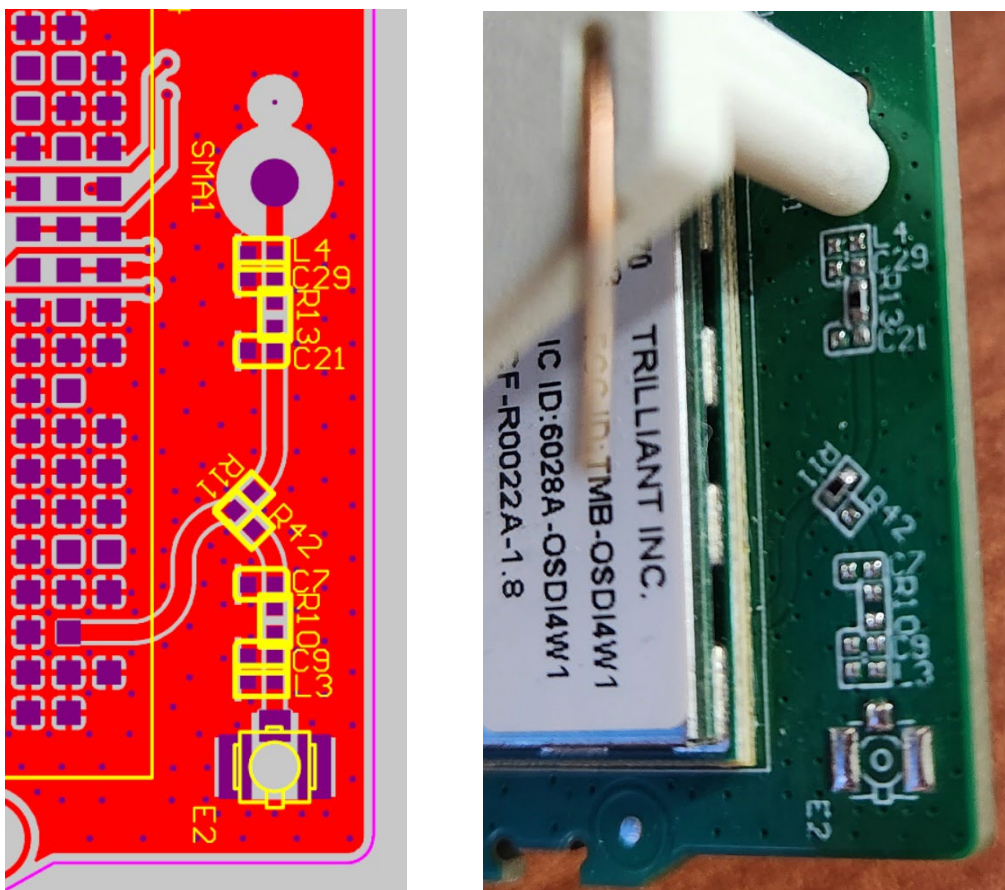


Figure 22 FCC and ISED approved trace design layout and picture for the uSplash antenna of section 4.2.3

Table 9 Antenna micro-strip trace parts for Spring antenna

| Part Number | Designator   | Description                         | Manufacturer  |
|-------------|--------------|-------------------------------------|---|
| N/A         | L4, C21, C29 | Not installed                       | N/A   |
| R00041S1    | R11, R13     | RESISTOR 0.0 OHMS 1/16W 5% 0402 SMT | Guangdong Fenghua Advanced Technology Holding Co.,Ltd |
| DD100006143 | SMA1         | Spring Antenna                      | TopPoint Technology                                   |

#### 5.4.4 Layout and parts for external antennas with SMA connector 4 legs

The reference traces for these antennas are the green traces along with the side copper filled with vias on the left side of Figure 23 where components G8, G10, G15, G16 and G18 are not installed, the left side of Figure 24 where G4 is not install, the pink trace on the left side of Figure 25 where R13 and R15 are not installed and the left side of Figure 26 where G1 and G2 are not installed.

As preliminary information for Figure 23 the traces width of all sections are 0.27mm and the length of each section, starting from the LGA pad to J53 connector are: LGA pad to G7: 15.38mm; G7 to G9: 12.37mm; G9 to G17: 6.7mm; G17 to R52: 2.1mm; R52 to J53: 7.2mm. However, refer to associated Gerber files for more accurate details on dimensions and refer to Trilliant Networks Inc for more details on the Gerber files. Table 10 shows the parts used in the reference trace design.

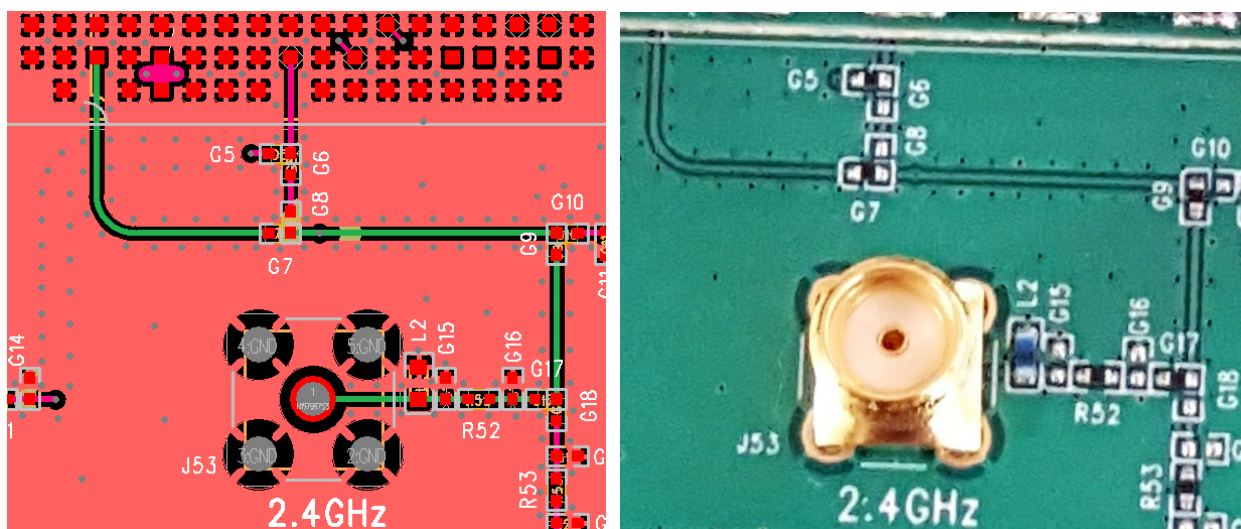


Figure 23 FCC and ISED approved trace design layout and picture for external antennas of section 4.2.3

Table 10 Antenna micro-strip trace parts for external antennas SMA connector 4 legs

| Part Number    | Designator             | Description   | Manufacturer          |
|----------------|------------------------|---|-----------------------|
| N/A            | G8, G10, G15, G16, G18 | Not installed   | N/A                   |
| RK73Z1ETTP     | G7, G9, G17, R52       | RESISTOR 0.0 OHMS 1/16W 5% 0402 SMT                       | KOA Speer Electronics |
| LQW18AN75NG00D | L2                     | INDUCTOR 75nH, 2%, 270mA 560mΩ, 0603 SMT                  | Murata Manufacturing  |
| 1-1478979-0    | J53                    | SMA JACK CONNECTOR (FEMALE) PCB Mount 4 legs, SS/Gold pl. | TE Connectivity       |

### 5.4.5 Layout and parts for external antennas with SMA connector on side

As preliminary information for Figure 24, the traces width of all sections are 1mm and the length of each section, starting from the LGA pad to J5 connector are: LGA pad to G3: 14.18mm; G3 to J5: 5.05mm. However, refer to associated Gerber files for more accurate details on dimensions and refer to Trilliant Networks Inc for more details on the Gerber files. Table 11 shows the parts used in the reference trace design.

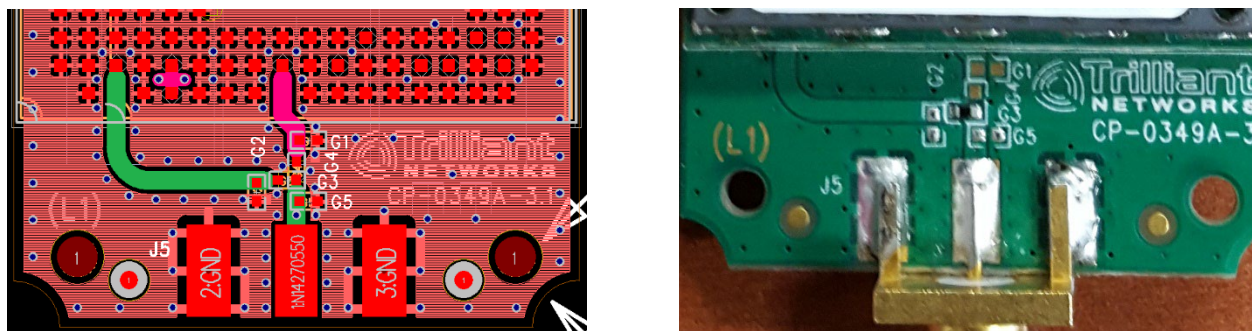


Figure 24 FCC and ISED approved trace design layout and picture for external antennas of section 4.2.3

Table 11 Antenna micro-strip trace parts for external antennas SMA on side

| Part Number  | Designator | Description   | Manufacturer          |
|--------------|------------|---|-----------------------|
| N/A          | G4         | Not installed   | N/A                   |
| RK73Z1ETTP   | G3         | RESISTOR 0.0 OHMS 1/16W 5% 0402 SMT                             | KOA Speer Electronics |
| 142-0701-801 | J5         | SMA End Launch Jack receptacle (FEMALE) Round Contact, Gold pl. | Johnson Components    |

### 5.4.6 Layout and parts for external antennas with u.fl

As preliminary information for Figure 25, the traces width of all sections is 0.6mm and the length of each section, starting from the LGA pad to J4 connector are: LGA pad to R14: 14.7mm; R14 to J4: 2.1mm. However, refer to associated Gerber files for more accurate details on dimensions and refer to Trilliant Networks Inc for more details on the Gerber files. Table 12 shows the parts used in the reference trace design.

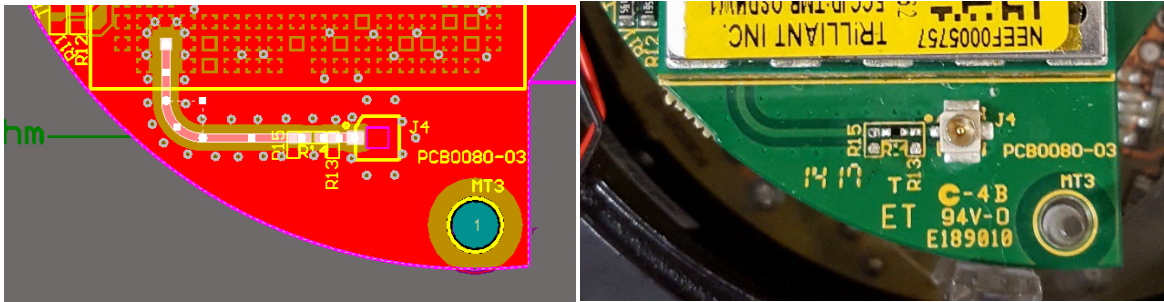


Figure 25 FCC and ISED approved trace design layout and picture for external antennas

Table 12 Antenna micro-strip trace parts for external antennas u.fl

| Part Number               | Designator | Description                    | Manufacturer       |
|---------------------------|------------|--------------------------------|--------------------|
| <b>ESR01MZPJ391</b>       | R13, R15   | RES SMD 390 OHM 5% 1/5W 0402   | Rohm Semiconductor |
| <b>CRCW040210R7FKEDHP</b> | R14        | RES SMD 10.7 OHM 1% 1/5W 0402  | Vishay             |
| <b>73412-0110</b>         | J4         | JACK, U.FL, Straight, PCB, SMT | Molex              |

### 5.4.7 Layout and parts for external antennas with MMCX female

As preliminary information for Figure 26, the traces width of all sections is 0.2mm and the length of each section, starting from the LGA pad to J7 connector are: LGA pad to R18: 11.82mm; R18 to J7: 5.2mm. However, refer to associated Gerber files for more accurate details on dimensions and refer to Trilliant Networks Inc for more details on the Gerber files. Table 13 shows the parts used in the reference trace design.

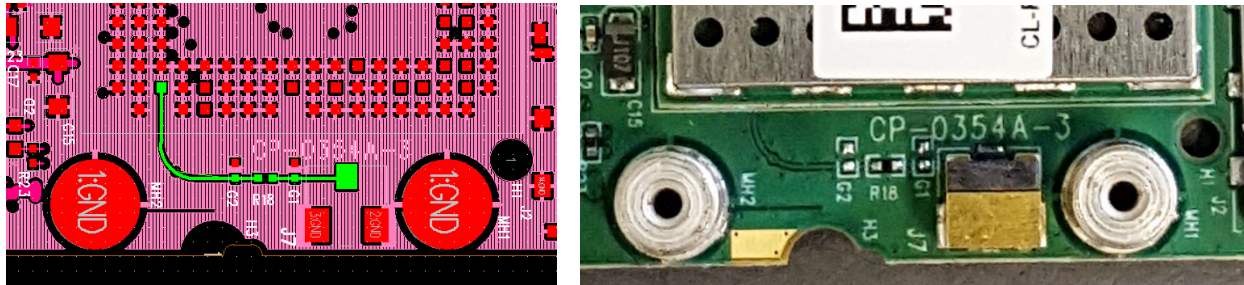


Figure 26 FCC and ISED approved trace design layout and picture for external antennas

Table 13 Antenna micro-strip trace parts for external antennas MMCX female

| Part Number | Designator | Description  | Manufacturer          |
|-------------|------------|--|-----------------------|
| N/A         | G1, G2     | Not installed  | N/A                   |
| RK73Z1ETTP  | R18        | RESISTOR 0.0 OHMS 1/16W 5%<br>1005/0402 SMT              | KOA Speer Electronics |
| 6-1460820-2 | J7         | MMCX CONNECTOR RIGHT ANGLE<br>JACK (female), Tin pl. SMT | TE Connectivity       |

### 5.4.8 Layout and parts for external antennas with MMCX

As preliminary information for Figure 27, the traces width of all sections is 0.2mm and the length of each section, starting from the LGA pad to J1 connector are: LGA pad to G2: 5.65mm; G2 to J1: 7.35mm. However, refer to associated Gerber files for more accurate details on dimensions and refer to Trilliant Networks Inc for more details on the Gerber files. Table 14 shows the parts used in the reference trace design.

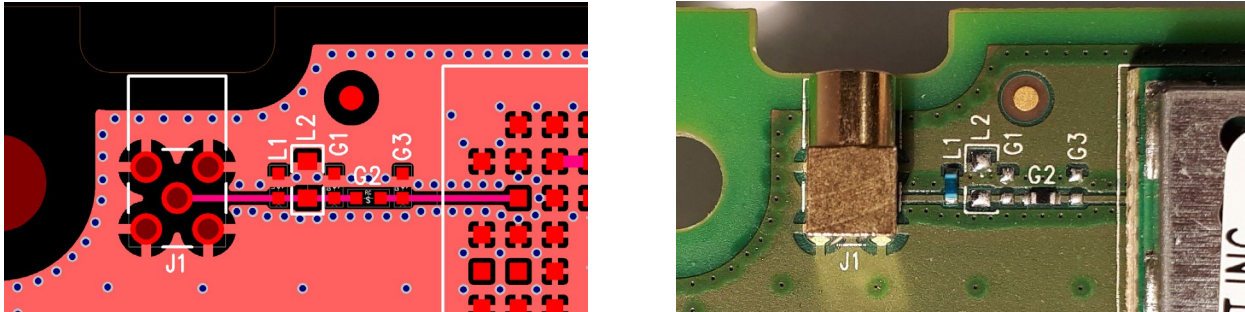


Figure 27 FCC and ISED approved trace design layout and picture for external antennas

Table 14 Antenna micro-strip trace parts for external antennas MMCX

| Part Number    | Designator | Description  | Manufacturer         |
|----------------|------------|--|----------------------|
| N/A            | L2, G1, G3 | Not installed  | N/A                  |
| RMC16S-000T    | G2         | RESISTOR 0.0 OHMS 1/16W 5% 1005/0402 SMT                       | Megastar Electronics |
| LQW15AN75NG00D | L1         | INDUCTOR 75nH 2% 135mA 2.1Ohm, Self-resonance 2.4GHz, 0402 SMT | MURATA               |
| CONMMCX002     | J1         | MMCX CONNECTOR RIGHT ANGLE JACK RECEPTACLE TH, Brass Gold pl.  | Linx Technologies    |

### 5.4.9 Design validation & production procedures

To verify compliance of the reference trace, a coupon must be requested with every manufacturing panel form and for which the characteristics are described in the Gerber files. Part of these characteristic are shown in Figure 28. Then a network analyzer is used to measure the impedance of this coupon in order to validate the antenna trace.

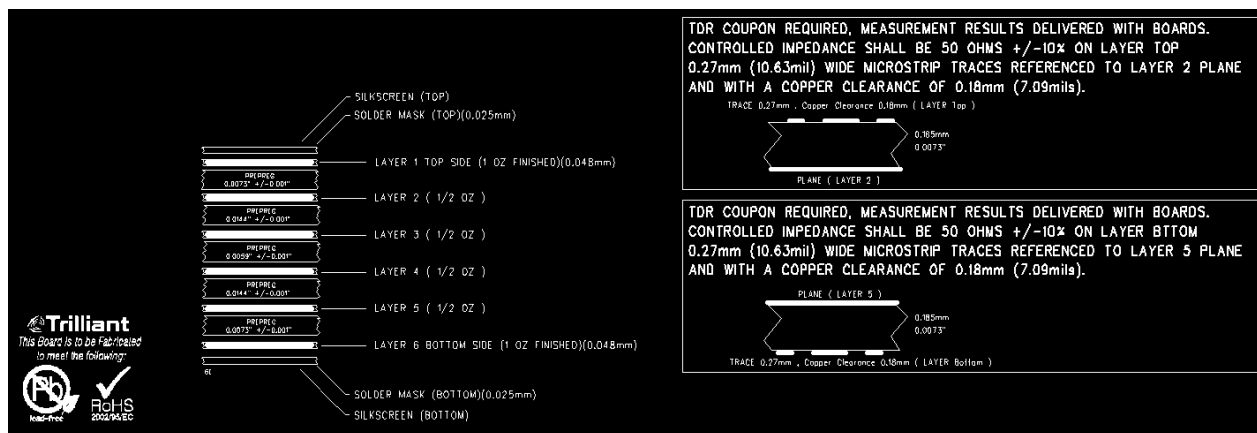


Figure 28 Coupon requirements to validate trace impedance

### 5.4.10 Other considerations

The only antennas, also describe is section 4.2.3, that can be used with the module using the reference trace design are the:

- Trilliant, CP-0299A, 4.8 dBi
- Linx, ANT-2.4-uSP, 3.8 dBi
- Larsen Antenna, RO2406NM, 6 dBi
- Mobile Mark, IMAG5-2400-3K-BLK-120, 5 dBi
- L-Com, HG2403RD-RTF, 3 dBi
- Mobile Mark, CVS-2400, 2.5 dBi
- Molex 1461530100, 3 dBi

The use of any other antenna or any changes to the reference trace design are subject to additional testing and authorization through a Class II permissive change.

## 5.5 Modifying the RF Signal Routing

As previously mentioned, any changes to the RF traces is subject to approbation, additional testing and authorization through a Class II permissive change on the FCC and ISSED grants.

The objective is to use the W10 and W16 pads from OSDI module to route a micro-strip traces in order to obtain a uniform transmission line with a characteristic impedance of 50 ohms. The characteristic impedance depends on the geometry of the trace and on the relative dielectric constant of the PCB as shown in Figure 29. However, the characteristic impedance does not depend on the length of the trace. Many tools are available on the web to help calculate the optimum dimensions.

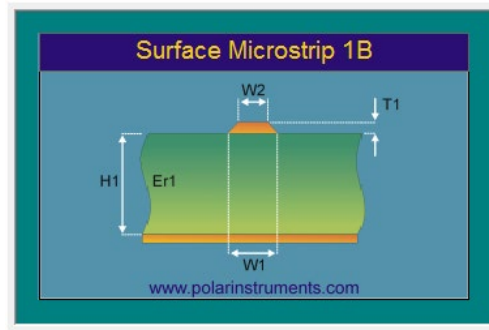


Figure 29: Micro-strip trace parameters

H1 and T1 are taken from the stack-up parameter of the host's PCB as shown in Figure 30, the relative dielectric constant depend on the material used.

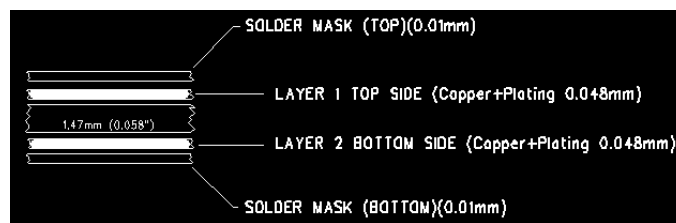


Figure 30: Example stack-up

An example stack-up, copper thickness, RF traces width and traces to copper clearance in order to get 50 ohms is presented below. The calculation tool is then used to find the remaining parameters of the micro-strip traces as shown in Figure 31.

| Parameter               | Symbol | Value  | Action    |
|-------------------------|--------|--------|-----------|
| Substrate 1 Height      | H1     | 1.4700 | Calculate |
| Substrate 1 Dielectric  | Er1    | 4.2000 | Calculate |
| Lower Trace Width       | W1     | 0.7000 |           |
| Upper Trace Width       | W2     | 0.6750 | Calculate |
| Ground Strip Separation | D1     | 0.1445 | Calculate |
| Trace Thickness         | T1     | 0.0480 | Calculate |
| Coating Above Substrate | C1     | 0.0100 |           |
| Coating Above Trace     | C2     | 0.0100 |           |
| Coating Dielectric      | CEr    | 4.0000 |           |
| Impedance               | Zo     | 50.01  | Calculate |

Notes: (First 5 lines will print) Interface Style

Figure 31: 50 ohms calculation (mm) Trace width: 0.7mm Copper clearance: 0.1445mm

The resulting parameters can then be used to define the trace width and copper clearance on RF traces of the host's PCB. The RF traces must be surrounded by copper all along the path of undefined length; the path should be as short as possible to reduce losses. Vias must be added all along the RF traces. See reference trace design in Figure 23 for an example.

**Note: a new trace design is subject to validation, additional testing and authorization through a Class II Permissive change on the FCC and ISED grants.**

## 5.6 Pin Numbering

|    |    |    |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |
|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|    | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | A11 | A12 | A13 | A14 | A15 | A16 | A17 |     |
| B1 | B2 | B3 | B4 | B5 | B6 | B7 | B8 | B9 | B10 | B11 | B12 | B13 | B14 | B15 | B16 | B17 | B18 |
| C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | C10 | C11 | C12 | C13 | C14 | C15 | C16 | C17 | C18 |
| D1 | D2 | D3 |    |    |    |    |    |    |     |     |     |     |     |     | D16 | D17 | D18 |
| E1 | E2 | E3 |    |    |    |    |    |    |     |     |     |     |     |     | E16 | E17 | E18 |
| F1 | F2 | F3 |    |    |    |    |    |    |     |     |     |     |     |     | F16 | F17 | F18 |
| G1 | G2 | G3 |    |    |    |    |    |    |     |     |     |     |     |     | G16 | G17 | G18 |
| H1 | H2 | H3 |    |    |    |    |    |    |     |     |     |     |     |     | H16 | H17 | H18 |
| J1 | J2 | J3 |    |    |    |    |    |    |     |     |     |     |     |     | J16 | J17 | J18 |
| K1 | K2 | K3 |    |    |    |    |    |    |     |     |     |     |     |     | K16 | K17 | K18 |
| L1 | L2 | L3 |    |    |    |    |    |    |     |     |     |     |     |     | L16 | L17 | L18 |
| M1 | M2 | M3 |    |    |    |    |    |    |     |     |     |     |     |     | M16 | M17 | M18 |
| N1 | N2 | N3 |    |    |    |    |    |    |     |     |     |     |     |     | N16 | N17 | N18 |
| P1 | P2 | P3 |    |    |    |    |    |    |     |     |     |     |     |     | P16 | P17 | P18 |
| R1 | R2 | R3 |    |    |    |    |    |    |     |     |     |     |     |     | R16 | R17 | R18 |
| T1 | T2 | T3 |    |    |    |    |    |    |     |     |     |     |     |     | T16 | T17 | T18 |
| U1 | U2 | U3 |    |    |    |    |    |    |     |     |     |     |     |     | U16 | U17 | U18 |
| V1 | V2 | V3 | V4 | V5 | V6 | V7 | V8 | V9 | V10 | V11 | V12 | V13 | V14 | V15 | V16 | V17 | V18 |
| W1 | W2 | W3 | W4 | W5 | W6 | W7 | W8 | W9 | W10 | W11 | W12 | W13 | W14 | W15 | W16 | W17 | W18 |
|    | Y2 | Y3 | Y4 | Y5 | Y6 | Y7 | Y8 | Y9 |     | Y11 | Y12 | Y13 | Y14 | Y15 |     | Y17 |     |

Figure 32: Pin Numbering Diagram (Bottom view)

## 5.7 Pin Description

Table 15: Pin numbering details.

| Pad | Name     | Description     |
|-----|----------|-----------------|
| A2  | *8_NRST  | Test point only |
| A3  | PB31     | Do not connect  |
| A4  | PB23/AD4 | Spare I/O       |
| A5  | PA12/AD0 | Spare I/O       |
| A6  | RESERVED | Do not connect  |
| A7  | +VCPU    | +VCPU           |
| A8  | *12_PA16 | Spare I/O       |
| A9  | PB28     | Spare I/O       |

| Pad | Name              | Description                |
|-----|-------------------|----------------------------|
| A10 | PB4/RX0           | Test point only            |
| A11 | PB5/TX0           | Test point only            |
| A12 | PB7               | Status LED                 |
| A13 | RESERVED          | Do not connect             |
| A14 | +VCPU             | +VCPU                      |
| A15 | RESERVED          | Do not connect             |
| A16 | PA0_*1            | Spare I/O                  |
| A17 | *1_PB26           | Spare I/O                  |
| B1  | PA13/SCK_EXT1     | Provision for external SPI |
| B2  | PA14/CS_EXT1      | Provision for external SPI |
| B3  | PA15              | Spare I/O                  |
| B4  | PB27              | Power management signal    |
| B5  | RESERVED          | Do not connect             |
| B6  | RESERVED          | Do not connect             |
| B7  | RESERVED          | Do not connect             |
| B8  | RESERVED          | Do not connect             |
| B9  | PA2_*5            | Spare I/O                  |
| B10 | RESERVED          | Do not connect             |
| B11 | SHDN              | Power management signal    |
| B12 | PB8               | Status LED                 |
| B13 | PB25              | Spare I/O                  |
| B14 | PB10_*4           | Spare I/O                  |
| B15 | PB14_*5           | Spare I/O                  |
| B16 | PB11_*6           | Spare I/O                  |
| B17 | PB12_*1           | Spare I/O                  |
| B18 | PB16/MISO_EXT2_*2 | Spare I/O                  |
| C1  | PA10/MOSI_EXT1    | Provision for external SPI |
| C2  | PB1/TDO_*11       | Spare I/O                  |
| C3  | RESERVED          | Do not connect             |

| Pad        | Name              | Description                |
|------------|-------------------|----------------------------|
| <b>C4</b>  | PA17/PFAIL        | Power management signal    |
| <b>C5</b>  | RESERVED          | Do not connect             |
| <b>C6</b>  | RESERVED          | Do not connect             |
| <b>C7</b>  | RESERVED          | Do not connect             |
| <b>C8</b>  | RESERVED          | Do not connect             |
| <b>C9</b>  | RESERVED          | Do not connect             |
| <b>C10</b> | RESERVED          | Do not connect             |
| <b>C11</b> | +VCPU             | +VCPU                      |
| <b>C12</b> | GND_NC            | Do not connect             |
| <b>C13</b> | PB29              | Spare I/O                  |
| <b>C14</b> | RESERVED          | Do not connect             |
| <b>C15</b> | PC0/TX1           | Meter interface            |
| <b>C16</b> | RESERVED          | Do not connect             |
| <b>C17</b> | RESERVED          | Do not connect             |
| <b>C18</b> | RESERVED          | Do not connect             |
| <b>D1</b>  | PA9/MISO_EXT1     | Provision for external SPI |
| <b>D2</b>  | PB3/TCK_*11       | Spare I/O                  |
| <b>D3</b>  | PB2/TMS_*11       | Spare I/O                  |
| <b>D16</b> | GND_NC            | Do not connect             |
| <b>D17</b> | RESERVED          | Do not connect             |
| <b>D18</b> | PC1/RX1           | Meter interface            |
| <b>E1</b>  | *9_NRST           | Test point only            |
| <b>E2</b>  | RESERVED          | Do not connect             |
| <b>E3</b>  | PB13/AD3          | Power management signal    |
| <b>E16</b> | PA19/CS_EXT2_*2   | Spare I/O                  |
| <b>E17</b> | PB18/SCK_EXT2_*2  | Spare I/O                  |
| <b>E18</b> | PB17/MOSI_EXT2_*2 | Spare I/O                  |
| <b>F1</b>  | PB0/TDI           | Spare I/O                  |
| <b>F2</b>  | PA4/AD1           | Power management signal    |

| Pad | Name     | Description                           |
|-----|----------|---------------------------------------|
| F3  | RESERVED | Do not connect                        |
| F16 | RESERVED | Do not connect                        |
| F17 | RESERVED | Do not connect                        |
| F18 | +VLDO_IN | Input of LGA LDO                      |
| G1  | RESERVED | Do not connect                        |
| G2  | *3_PC5   | Spare I/O                             |
| G3  | +VCPU    | +VCPU                                 |
| G16 | GND_NC   | Do not connect                        |
| G17 | GND_NC   | Do not connect                        |
| G18 | +VLDO_IN | Input of LGA LDO                      |
| H1  | RESERVED | Do not connect                        |
| H2  | GND_NC   | Do not connect                        |
| H3  | RESERVED | Connected to Gnd via 0 ohms resistor. |
| H16 | GND_NC   | Do not connect                        |
| H17 | GND_NC   | Do not connect                        |
| H18 | GND_NC   | Do not connect                        |
| J1  | GND_NC   | Do not connect                        |
| J2  | GND_NC   | Do not connect                        |
| J3  | RESERVED | Connected to Gnd via 0 ohms resistor. |
| J16 | GND_NC   | Do not connect                        |
| J17 | GND_NC   | Do not connect                        |
| J18 | GND_NC   | Do not connect                        |
| K1  | GND_NC   | Do not connect                        |
| K2  | GND_NC   | Do not connect                        |
| K3  | RESERVED | Do not connect                        |
| K16 | RESERVED | Do not connect                        |
| K17 | RESERVED | Do not connect                        |
| K18 | XIN32    | 32KHz xtal                            |
| L1  | GND_NC   | Do not connect                        |

| Pad | Name      | Description         |
|-----|-----------|---------------------|
| L2  | GND_NC    | Do not connect      |
| L3  | GND_NC    | Do not connect      |
| L16 | PB15_*13  | Spare I/O           |
| L17 | +3.3V     | Output from LGA LDO |
| L18 | XOUT32    | 32KHz xtal          |
| M1  | GND       | GND                 |
| M2  | RESERVED  | Do not connect      |
| M3  | GND_NC    | Do not connect      |
| M16 | GND       | GND                 |
| M17 | GND       | GND                 |
| M18 | +V1.5F_SW | LGA backup power    |
| N1  | GND       | GND                 |
| N2  | GND_NC    | Do not connect      |
| N3  | GND       | GND                 |
| N16 | GND       | GND                 |
| N17 | GND       | GND                 |
| N18 | +3.3V     | Output from LGA LDO |
| P1  | GND       | GND                 |
| P2  | GND_NC    | Do not connect      |
| P3  | GND_NC    | Do not connect      |
| P16 | GND       | GND                 |
| P17 | GND       | GND                 |
| P18 | +3.3V     | Output from LGA LDO |
| R1  | GND       | GND                 |
| R2  | GND_NC    | Do not connect      |
| R3  | GND       | GND                 |
| R16 | GND       | GND                 |
| R17 | GND       | GND                 |
| R18 | GND       | GND                 |

| Pad        | Name     | Description    |
|------------|----------|----------------|
| <b>T1</b>  | GND      | GND            |
| <b>T2</b>  | GND_NC   | Do not connect |
| <b>T3</b>  | GND_NC   | Do not connect |
| <b>T16</b> | GND      | GND            |
| <b>T17</b> | GND      | GND            |
| <b>T18</b> | GND      | GND            |
| <b>U1</b>  | GND      | GND            |
| <b>U2</b>  | GND      | GND            |
| <b>U3</b>  | GND      | GND            |
| <b>U16</b> | GND      | GND            |
| <b>U17</b> | GND      | GND            |
| <b>U18</b> | GND      | GND            |
| <b>V1</b>  | GND      | GND            |
| <b>V2</b>  | GND_NC   | Do not connect |
| <b>V3</b>  | RESERVED | Do not connect |
| <b>V4</b>  | GND      | GND            |
| <b>V5</b>  | GND      | GND            |
| <b>V6</b>  | GND      | GND            |
| <b>V7</b>  | RESERVED | Do not connect |
| <b>V8</b>  | GND      | GND            |
| <b>V9</b>  | GND      | GND            |
| <b>V10</b> | GND      | GND            |
| <b>V11</b> | GND      | GND            |
| <b>V12</b> | GND      | GND            |
| <b>V13</b> | GND      | GND            |
| <b>V14</b> | GND      | GND            |
| <b>V15</b> | GND      | GND            |
| <b>V16</b> | GND      | GND            |
| <b>V17</b> | GND      | GND            |

| Pad | Name           | Description        |
|-----|----------------|--------------------|
| V18 | GND            | GND                |
| W1  | GND            | GND                |
| W2  | GND_NCRESERVED | Do not connect     |
| W3  | GND            | GND                |
| W4  | RESERVED       | Do not connect     |
| W5  | RESERVED       | Do not connect     |
| W6  | GND            | GND                |
| W7  | RESERVED       | Do not connect     |
| W8  | RESERVED       | Do not connect     |
| W9  | GND            | GND                |
| W10 | RESERVED       | Do not connect     |
| W11 | GND            | GND                |
| W12 | GND            | GND                |
| W13 | GND            | GND                |
| W14 | RESERVED       | Do not connect     |
| W15 | GND            | GND                |
| W16 | RF_EXT1        | RF to/from antenna |
| W17 | GND            | GND                |
| W18 | GND            | GND                |
| Y2  | GND            | GND                |
| Y3  | GND            | GND                |
| Y4  | GND            | GND                |
| Y5  | GND            | GND                |
| Y6  | GND            | GND                |
| Y7  | GND            | GND                |
| Y8  | GND            | GND                |
| Y9  | GND            | GND                |
| Y11 | GND            | GND                |
| Y12 | GND            | GND                |

| Pad | Name     | Description    |
|-----|----------|----------------|
| Y13 | GND      | GND            |
| Y14 | RESERVED | Do not connect |
| Y15 | GND      | GND            |
| Y17 | GND      | GND            |

## 5.8 Suggested Reflow profile, for reference only

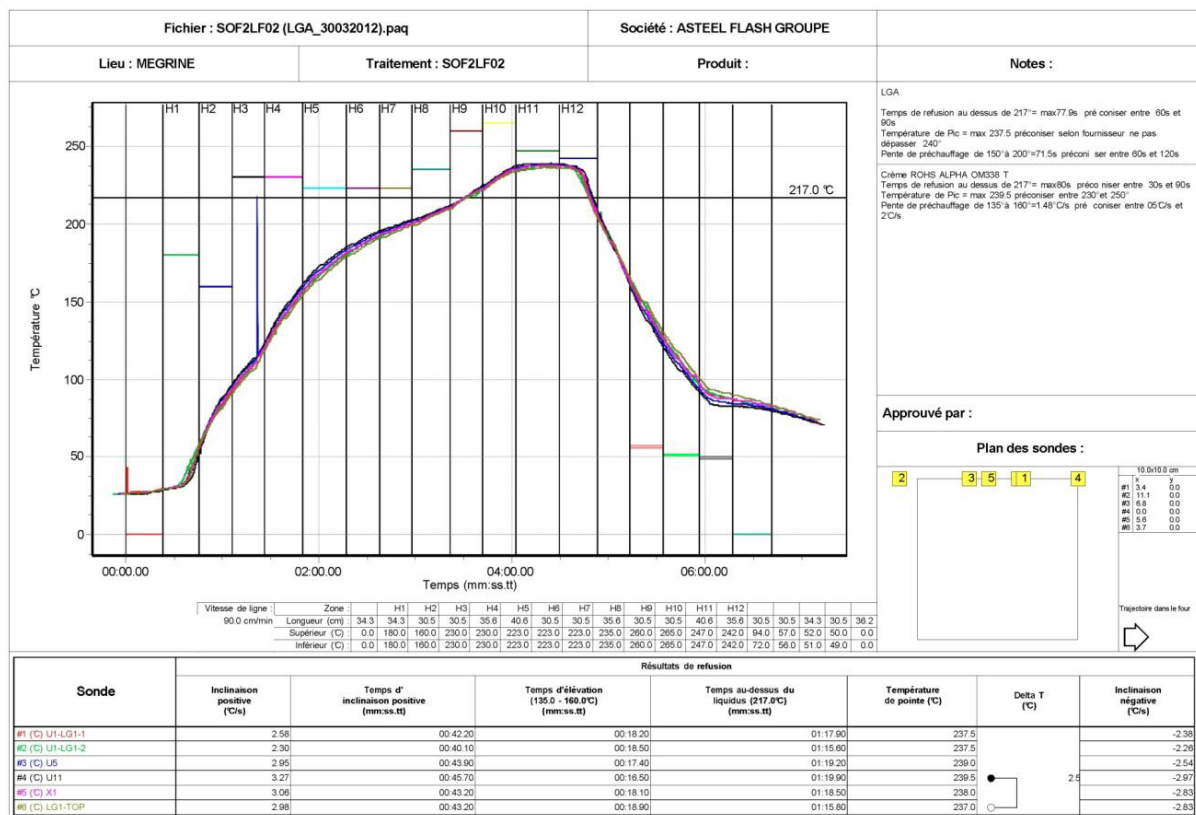


Figure 33: Preliminary OSDI Module Reflow Profile and Set Points.

## Chapter 6: SecureMesh Configuration

The configuration of the OSDI module is the last step in the manufacturing process, just before shipping to the customer. This process consists of configuring of programming the customer related parameters as applicable, via the SecureMesh network, using the Mesh Programming tool.

### 6.1 Mesh Programming tool

Trilliant's Mesh Programming tool is an MS Windows application that communicates with the OSDI modules using a SecureMesh USB radio dongle.

The configuration file is generated by Trilliant for each deployment project to define the configuration parameters for each OSDI module in a given SecureMesh network.

Refer to document DP-1145 for more details.

### 6.2 Data Link Library

A DLL can also be used for volume production. It contains the necessary functions to allow the automatic test equipment to configure the OSDI modules according to the configuration file generated by Trilliant.

## Chapter 7: Regulatory Agency Approvals

Modular approval allows end users to place the OSDI module inside a finished product without the need for regulatory testing, provided no changes or modifications are made to the module circuitry. Changes or modifications could void the user's authority to operate the equipment. The end user must comply with all of the instructions provided by the grantee, which indicate installation and/or operating conditions necessary for compliance.

The OSDI Module has been tested and conforms to FCC and ISED regulation for unlicensed transmitter module. The module tests can be applied toward final product certification. Additional testing may be required depending on the targeted application.

The integrator may still be responsible for testing the end product for any additional compliance requirements that become necessary.

For more information on regulatory compliance, refer to the specific country radio regulations in the following sections.

### 7.1 United States

With the approval of Federal Communications Commission (FCC) CFR47 Telecommunications, Part 15 Subpart C-Intentional Radiators 15.212 Modular Transmitter approval, the OSDI module is authorized to be integrated into a finished product without obtaining subsequent and separate FCC approvals for intentional radiation.

The OSDI module is labeled with its own FCC ID number. If the FCC ID is not visible when the module is installed inside another device, then the outside of the finished product into which the module is installed shall display a label referring to the enclosed module. This exterior label shall bear the following statement:

Contains Transmitter Module FCC ID: **TMB-OSDI4W1**

Or

Contains FCC ID: **TMB- OSDI4W1**

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.

A user manual for the finish product shall include the following statement:

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.

### 7.1.1 RF Human Exposure

All transmitters regulated by FCC must comply with RF exposure requirements. Part 1.1310, ***Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields***, provides assistance in determining whether proposed or existing transmitting facilities, operations or devices comply with limits for human exposure to Radio Frequency (RF) fields adopted by the Federal Communications Commission (FCC). The bulletin offers guidelines and suggestions for evaluating compliance.

If appropriate, compliance with exposure guidelines for mobile and unlicensed devices can be accomplished by the use of warning labels and by providing users with information concerning minimum separation distances from transmitting structures and proper installation of antennas.

The following statement must be included as a CAUTION statement in manuals and OEM products to alert users of FCC RF exposure compliance:

To satisfy FCC RF Exposure requirements for mobile and base station transmission devices, a separation distance of 20 cm or more (100 cm or more when collocated with radio RV7-5G1100) should be maintained between the antenna of this device and persons during operation. To ensure compliance, operation at closer than these distances is not recommended.

If the OSDI modules are used in a portable application (i.e., the antenna is less than 20 cm from persons during operation), the integrator is responsible for performing Specific Absorption Rate (SAR) testing in accordance with FCC rules 2.1091.

### 7.1.2 Approved External Antenna Types

To maintain modular approval in the United States, only the antenna types that have been tested shall be used. It is permissible to use different antenna manufacturer provided the same antenna type and antenna gain (equal to or less than) is used. Also, the antenna(s) used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Testing of the OSDI module has been performed with the antenna types listed in Section 4.2.3 above.

### 7.1.3 Helpful Web Sites

Federal Communications Commission (FCC): <http://www.fcc.gov>.

## 7.2 Canada

The OSDI module targets certification for use in Canada under Innovation, Science and Economic Development Canada (ISED) Radio Standards Specification (RSS) RSS-247 and RSS-Gen. Modular approval permits the installation of a module in a host device without the need to recertify the device.

Labeling Requirements for the Host Device (from Section 7.2, RSP-100, Issue 10, November 2014):

The host device shall be properly labeled to identify the module within the host device.

The ISED Canada certification label of a module shall be clearly visible at all times when installed in the host device, otherwise the host device must be labeled to display the ISED certification number of the module, preceded by the words “Contains transmitter module”, or the word “Contains”, or similar wording expressing the same meaning, as follows:

|   |
|---|
| Contains transmitter module ISED: <b>6028A-OSDI4W1</b><br>Or<br>Contains ISED: <b>6028A-OSDI4W1</b> |
|---|

User Manual Notice for License-Exempt Radio Apparatus (from Section 8.4 RSS-Gen, Issue 4, November 2014):

User manuals for license-exempt radio apparatus shall contain the following or equivalent notice in a conspicuous location in the user manual or alternatively on the device or both:

This device complies with Innovation, Science and Economic Development Canada license-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'Innovation, Sciences et Développement économique 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.

### 7.2.1 RF Human Exposure

All transmitters regulated by ISED must comply with RF exposure requirements. RSS-102, **Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)**, sets out the requirements and measurement techniques used to evaluate radio frequency (RF) exposure compliance of radiocommunication apparatus designed to be used within the vicinity of the human body.

If appropriate, compliance with exposure requirements for mobile and unlicensed devices can be accomplished by the use of warning labels and by providing users with information concerning minimum separation distances from transmitting structures and proper installation of antennas.

The following statement must be included as a CAUTION statement in manuals of OEM products to alert users of ISED RF exposure compliance:

To satisfy Innovation, Science and Economic Development Canada RF Exposure requirements for mobile and base station transmission devices, a separation distance of 20 cm or more (100 cm or more when colocated with radio 6028A-5G1100) should be maintained between the antenna of this device and persons during operation. To ensure compliance, operation at closer than this distance is not recommended.

Pour satisfaire les requis d'Innovation, Sciences et Développement économique Canada sur les expositions aux radiofréquences pour les appareils mobiles et les stations de transmission, une distance de 20 cm ou plus (100 cm ou plus lorsqu'en colocation avec la radio 6028A-5G1100) doit être maintenue entre l'antenne de cet appareil et les personnes durant l'opération. Pour assurer la conformité, les opérations à des distances inférieures ne sont pas recommandées.

If the OSDI modules are used in a portable application (i.e., the antenna is less than 20 cm from persons during operation), the integrator is responsible for performing Specific Absorption Rate (SAR) testing in accordance with ISED RSS-102.

## 7.2.2 Approved External Antenna Types

The OSDI modules may operate with different types of antennas. However, it is not permissible to exceed the maximum equivalent isotropically radiated power (e.i.r.p.) limits specified in the applicable standard (RSS) for the licence-exempt apparatus.

Testing shall be performed using the highest gain antenna of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on measurement or on data from the antenna manufacturer. User manuals for transmitters equipped with detachable antennas shall also contain the following notice in a conspicuous location:

This radio transmitter TMB-OSDI4W1 has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below with the maximum permissible gain 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 TMB-OSDI4W1 a été approuvé par Innovation, Sciences et Développement économique Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal. Les types d'antenne non inclus dans cette liste, et dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types approved for use with the transmitter, indicating the maximum permissible antenna gain (in dBi).

The antenna(s) used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Projected approved external antenna types for the OSDI modules are listed in Section 4.2.3 above.

## 7.2.3 Helpful Web Sites

Innovation, Science and Economic Development Canada: <http://www.ic.gc.ca/>