



# PremierWave® 2050

## 802.11ac Embedded Wi-Fi® IoT Gateway Integration Guide

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This equipment has to be 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 of the following measures:

1. Reorient or relocate the receiving antenna.
2. Increase the separation between the equipment and receiver.
3. Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
4. Consult the dealer or an experienced radio/TV technician for help.

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.

This device is intended only for OEM Integrators. The OEM integrator should be aware of the following important considerations.

## Labeling of the End Product

The label on the end product incorporating the PremierWave 2050 gateway must clearly state that it contains an FCC-approved RF gateway. Canada and Japan also require a similar statement.

For example, "This product contains RF transmitter ID # (put FCC, IC, CMIIT, and/or Japan gateway grant numbers here)." The label must include the ID numbers for the regions where the end product is installed. The grant numbers are below.

- ◆ PremierWave 2050 FCC ID number: R68PW2050
- ◆ PremierWave 2050 IC ID number: 3867A-PW2050
- ◆ PremierWave 2050 Japan ID numbers: 201-152843
- ◆ PremierWave 2050 China SRRC CMIIT ID: 2015AJ6847 (M)

## RSS-GEN Sections 7.1.4 and 7.1.5 Statement for Devices with Detachable Antennas

This device has been designed to operate with the antennas listed in the Certificate, and having a maximum gain of 5.5 dBi. Antennas not included in this list or having a gain greater than 5.5 dBi are strictly prohibited for use with this device, unless system level approval is gained. The required antenna impedance is 50 ohms.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that required for successful communication.

## Integration Notes

This gateway is authorized under limited gateway approval specific to mobile host equipment. The antenna must be installed with a 20 cm space maintained between the antenna and users.

The transmitter gateway may not be co-located with any other transmitter or antenna.

As long as the two conditions above are met, further transmitter testing will not be required. However, the OEM integrator is still responsible for testing their end product for any additional compliance requirements required with this gateway installed (for example, digital device emission, PC peripheral requirements, etc.)

In the event that these conditions cannot be met (for example certain laptop configurations, general purpose PCMCIA or similar cards, or co-location with another transmitter) and obtaining a separate FCC authorization will be required, then the FCC authorization is no longer considered valid and the FCC ID cannot be used on the final product (including the transmitter).

Changes or modifications to this device not explicitly approved by Lantronix will void the user's authority to operate this device.

**Note:** *With the purchase of any PremierWave 2050 family product, the OEM agrees to an OEM firmware license agreement that grants the OEM a non-exclusive, royalty-free firmware license to use and distribute the binary firmware image provided, only to the extent necessary to use the PremierWave 2050 hardware. For further details, please see the PremierWave 2050 OEM firmware license agreement.*

**Note:** *Please refer to the PremierWave 2050 802.11ac Embedded Wi-Fi IoT Gateway Datasheet, available at [www.lantronix.com/support/documentation](http://www.lantronix.com/support/documentation), for the full compliance specification and requirements.*

## Warranty

For details on the Lantronix warranty policy, please go to our Web site at [www.lantronix.com/support/warranty](http://www.lantronix.com/support/warranty).

## Revision History

| Date          | Rev. | Comments                                                        |
|---------------|------|-----------------------------------------------------------------|
| February 2016 | A    | Initial document.                                               |
| May 2016      | B    | Added the "Sample Solder Process Using 5 Mil Stencil" section.  |
| February 2017 | C    | Updated the DEFAULT#, WAKE and SHDN signal descriptions.        |
| August 2017   | D    | Updated product label.                                          |
| January 2019  | E    | Added the "Integrating Secure Element in Your Designs" section. |

For the latest revision of this product document, please check our online documentation at [www.lantronix.com/support/documentation](http://www.lantronix.com/support/documentation).

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# 1: Introduction

## About the Integration Guide

This user guide provides the information needed to integrate the Lantronix® PremierWave® 2050 family of products into customer-printed circuit boards. This manual is intended for engineers responsible for integrating the PremierWave 2050 802.11ac Embedded Wi-Fi® IoT Gateway into their product. This document provides instruction for connecting to the various gateway pin function groups as well as general gateway placement and mounting. For detailed technical and compliance specifications please refer to the *PremierWave 2050 802.11ac Embedded Wi-Fi IoT Gateway Datasheet* available at [www.lantronix.com/support/documentation](http://www.lantronix.com/support/documentation).

The table below describes the integration guide sections.

**Table 1-1 PremierWave 2050 Integration Guide Sections**

| Section                                 | Description                                                                       |
|-----------------------------------------|-----------------------------------------------------------------------------------|
| PremierWave 2050 Features               | Provides an overview of the gateway functions and mechanical drawing              |
| PremierWave 2050 Block Diagram          | Shows the gateway functional blocks                                               |
| Signal Descriptions                     | Provides signal descriptions and pinout information                               |
| Antenna Interface                       | Lists the antennas pre-certified for use with the gateway                         |
| Antenna Placement                       | Provides a general recommendation for antenna placement                           |
| Using the RF1 Signal Pin                | This section is reserved for a future off gateway antenna connection option       |
| Serial Interface                        | Provides an example on how to connect the unit to external RS232/485/422 networks |
| Ethernet Interface                      | Gives an example on how to connect the gateway Ethernet                           |
| USB Device Port                         | Provides an example on how to connect the unit up as a USB device port            |
| USB Host Port                           | Provides an example on how to connect the gateway USB host ports                  |
| LEDs                                    | Describes the gateway LED connections                                             |
| General Purpose IO Pins                 | Describes the gateway GPIO connections                                            |
| Reset Pins                              | Describes the gateway RESET, DEFAULT, and WAKE pins                               |
| Mounting Instructions and PCB Footprint | Provides the gateway PCB footprint and solder profile                             |
| Product Information Label               | Provides an image and description of the unit label contents                      |
| Evaluation Board Schematic              | Provides the PremierWave 2050 evaluation board schematic.                         |

## Additional Documentation

Visit the Lantronix web site at [www.lantronix.com/support/documentation](http://www.lantronix.com/support/documentation) for the latest documentation and the following additional documentation.

| Document                                                                                            | Description                                                                                               |
|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| <b><i>PremierWave 2050 802.11ac Embedded Wi-Fi IoT Gateway Datasheet</i></b>                        | Provides a unit description and all technical and compliance specifications for the gateway               |
| <b><i>PremierWave 2050 802.11ac Embedded Wi-Fi IoT Gateway User Guide</i></b>                       | Provides information needed to configure, use, and update the PremierWave 2050 firmware.                  |
| <b><i>PremierWave 2050 802.11ac Embedded Wi-Fi IoT Gateway Evaluation Kit Quick Start Guide</i></b> | Provides the steps for getting the PremierWave 2050 and PremierWave 2050 evaluation kit up and running.   |
| <b><i>PremierWave 2050 802.11ac Embedded Wi-Fi IoT Gateway Evaluation Kit User Guide</i></b>        | Provides a detailed description of the PremierWave 2050 evaluation kit hardware                           |
| <b><i>Notification Soldering Profile and Washing</i></b>                                            | Provides guidance in developing a manufacturing assembly process for various Lantronix embedded products. |

## 2: Functional Description

Designed for quick integration with minimal engineering effort, the chip-sized PremierWave 2050 gateway provides simplicity and flexibility making it the easiest and fastest networking-enabling gateway on the market.

PremierWave 2050 gateways are extremely compact networking solutions that enable Ethernet or wireless connectivity on virtually any device with a serial interface. The included industry-proven Lantronix gateway application and full IP stack allow seamless remote access to device data simplifying design integration while providing robust connectivity.

The PremierWave 2050 gateway s can be utilized in designs typically intended for chip solutions. A key difference with the PremierWave 2050 gateway is that there is virtually no need to write a single line of code, translating to a much lower development cost and faster time-to-market.

**Table 2-1 PremierWave 2050 Part Numbers**

| Part Number         | Description                                                                               |
|---------------------|-------------------------------------------------------------------------------------------|
| <b>PW205010001B</b> | PremierWave 2050, 802.11ac embedded Wi-Fi IoT gateway, dual U.FL, ind. temp, Bulk         |
| <b>PW205020001B</b> | PremierWave 2050, 802.11ac embedded Wi-Fi IoT gateway, chip ant +U.FL, ind. temp, Bulk    |
| <b>PW205010001S</b> | PremierWave 2050, 802.11ac embedded Wi-Fi IoT gateway, dual U.FL, ind. temp, Sample       |
| <b>PW205020001S</b> | PremierWave 2050, 802.11ac embedded Wi-Fi IoT gateway, chip ant + U.FL, ind. temp, Sample |
| <b>PWGG2051000K</b> | PremierWave 2050 evaluation Kit, 802.11ac embedded Wi-Fi IoT gateway, dual U.FL           |
| <b>PWGG2052000K</b> | PremierWave 2050 evaluation kit, 802.11ac embedded Wi-Fi IoT gateway, chip ant            |

### PremierWave 2050 Features

The PremierWave 2050 gateway is built around a 400 Mhz ARM9 processor with 32 MB of DDR2 DRAM and 128 MB of embedded flash memory. Network connections are provided by a dual band 802.11 ac/b/g/n WLAN radio and 10/100Mbps Ethernet MAC and PHY.

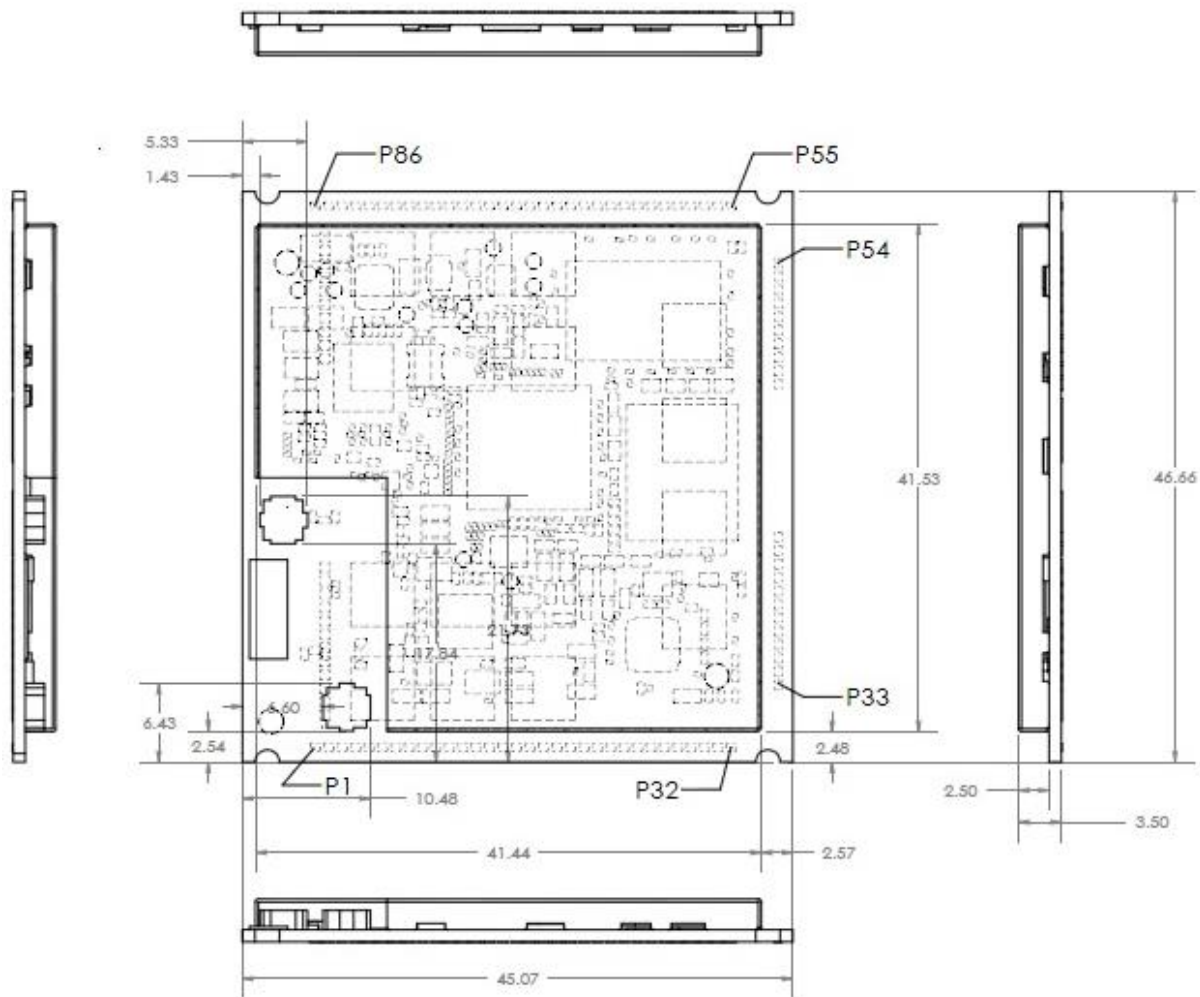
The PremierWave 2050 gateway also supports the following:

- ◆ 400 Mhz ARM9 CPU
- ◆ 32 MB DDR2 DRAM
- ◆ 128 MB NAND Flash
- ◆ 802.11 ac/bgn wireless with option for on gateway antenna or on gateway U.FL
- ◆ On gateway 10/100 Mbps Ethernet MAC/PHY. External magnetic and RJ45 required.

- ◆ One USB 2.0 high speed host/device interface.
- ◆ One USB 2.0 high speed host only port
- ◆ One USB 2.0 full speed host only port
- ◆ Two 3.3V serial interface
- ◆ 13 configurable I/O pins
- ◆ Power supply filters
- ◆ Reset circuit
- ◆ Integrated wake up and shutdown for sleep and standby states
- ◆ Interface for connection to an external JTAG software debugger.
- ◆ Dedicated two wire serial port for debug

The PremierWave 2050 gateway requires +5V DC power and is designed to operate in an extended temperature range. (See the *PremierWave 2050 802.11ac Embedded Wi-Fi IoT Gateway Datasheet* available at [www.lantronix.com/support/documentation](http://www.lantronix.com/support/documentation) for all technical specifications.)

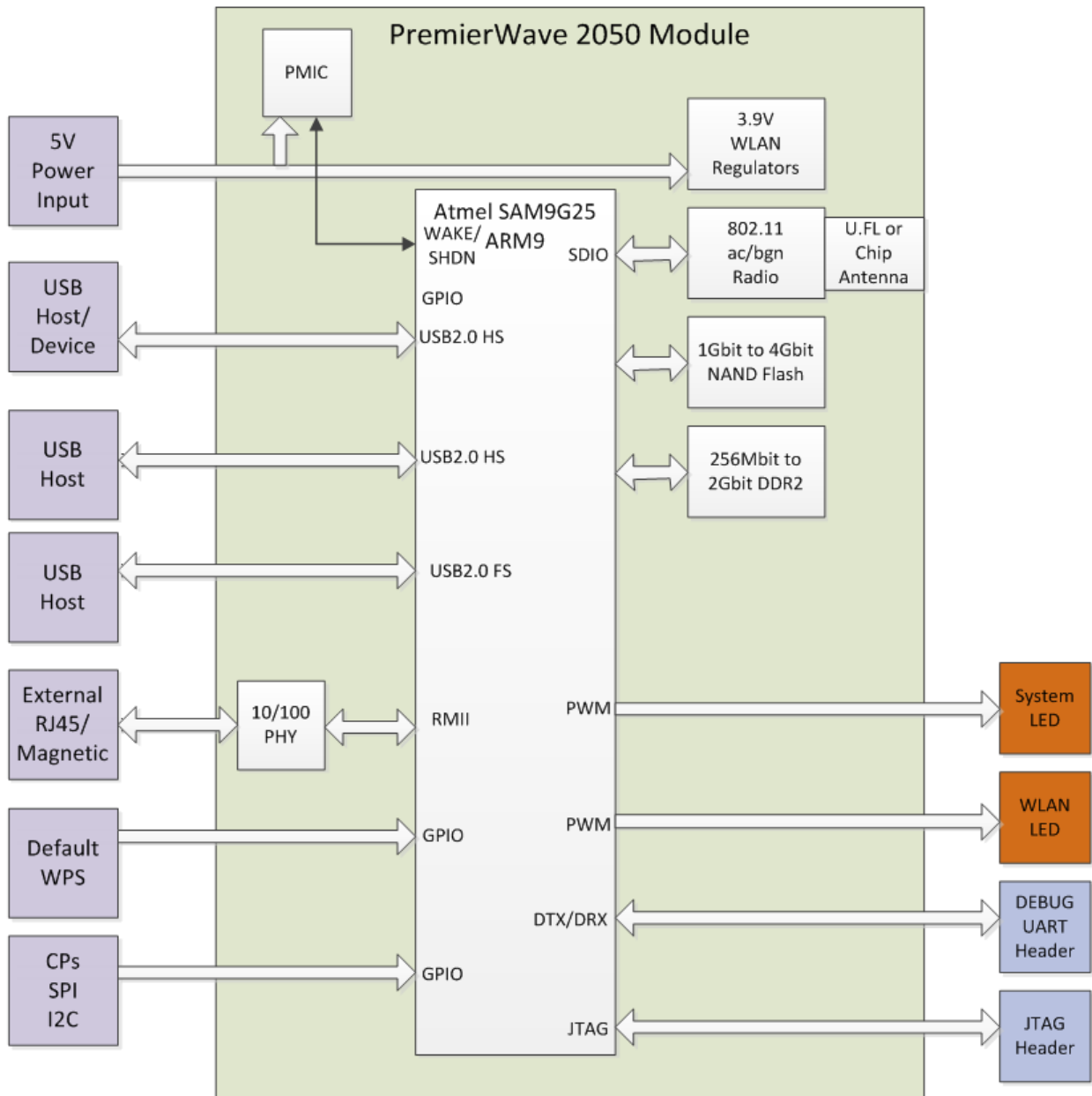
**Figure 2-1 PremierWave 2050 Dimensions and Views**



## PremierWave 2050 Block Diagram

The following drawing is a block diagram of the PremierWave 2050 gateway showing the relationships of the components.

Figure 2-2 PremierWave 2050 Block Diagram



## Signal Descriptions

The PremierWave 2050 gateway has a serial interface compatible with data rates up to 921,600 bps. All of the logic IO pins are 3.3V tolerant. The serial signals usually connect to an internal device, such as a UART. For applications requiring an external cable running with RS-232 or RS422/485 voltage levels, the PremierWave 2050 must interface to a serial transceiver chip.

An on-gateway 10/100 Mbps Ethernet MAC and PHY are included on the PW2050 gateway. For connection to an external Ethernet network, external magnetics and an RJ45 are required.

The gateway has options for an on-gateway chip antenna and an external antenna via an on-gateway U.FL connection.

**Table 2-2 PremierWave 2050 PCB Interface Signals**

| Signal Name | PremierWave 2050 Pin # | Primary Function                                                               | Reset State | Internal Pull-up /Pull-down | Driver Strength |
|-------------|------------------------|--------------------------------------------------------------------------------|-------------|-----------------------------|-----------------|
| RF1         | 2                      | Reserved for future use. Do not connect                                        |             |                             |                 |
| RF2         | 4                      | Reserved for future use. Do not connect                                        |             |                             |                 |
| CP3/MISO    | 12                     | Configurable GPIO / SPI master serial data input, SPI slave serial data output |             |                             |                 |
| CP4/MOSI    | 13                     | Configurable GPIO / SPI master serial data output, SPI slave serial data input |             |                             |                 |
| CP7/SCK     | 14                     | Configurable GPIO / SPI clock                                                  |             |                             |                 |
| CP8/CS      | 15                     | Configurable GPIO, multiplexed with SPI interface chip select                  |             |                             |                 |
| CP5         | 16                     | Configurable GPIO / I2C data                                                   |             | 10K PU                      |                 |
| CP6         | 17                     | Configurable GPIO / I2C clock                                                  |             | 10K PU                      |                 |
| USB1+/DDP   | 18                     | USB (Positive)<br>USB high speed host/device port                              |             |                             |                 |
| USB1-/DDM   | 19                     | USB (Negative)<br>USB high speed host/device port                              |             |                             |                 |
| USB2+       | 21                     | USB (Positive)<br>USB high speed host port                                     |             |                             |                 |
| USB2-       | 22                     | USB (Negative)<br>USB high speed host port                                     |             |                             |                 |
| RTS2        | 24                     | UART2 serial ready to send output                                              |             |                             |                 |
| CTS2        | 25                     | UART2 clear to send input                                                      |             |                             |                 |
| CP9         | 26                     | Configurable GPIO                                                              |             |                             |                 |
| DBTX        | 27                     | Debug UART serial transmit data output                                         |             |                             |                 |

| Signal Name  | PremierWave 2050 Pin # | Primary Function                                                                               | Reset State | Internal Pull-up /Pull-down | Driver Strength |
|--------------|------------------------|------------------------------------------------------------------------------------------------|-------------|-----------------------------|-----------------|
| DBRX         | 28                     | Debug UART serial receive data input                                                           |             | 10K PU                      |                 |
| ETXP (ETH1+) | 34                     | Ethernet TX (Positive)<br>Future Gbit pair 1 (pos)                                             |             |                             |                 |
| ETXM (ETH1-) | 35                     | Ethernet TX (Negative)<br>Future Gbit pair 1 (net)                                             |             |                             |                 |
| TXCT (ECT1)_ | 37                     | Center tap connection for Ethernet TX pair                                                     |             |                             |                 |
| RXCT (ECT2)  | 38                     | Center tap connection for Ethernet RX pair                                                     |             |                             |                 |
| ERXP (ETH2+) | 40                     | Ethernet RX (Positive)<br>Future Gbit pair 2 (pos)                                             |             |                             |                 |
| ERXM (ETH2-) | 41                     | Ethernet RX (Negative)<br>Future Gbit pair 2 (neg)                                             |             |                             |                 |
| ETH3+        | 43                     | Reserved for future Gbit Ethernet pair 3 (Positive)                                            |             |                             |                 |
| ETH3-        | 44                     | Reserved for future Gbit Ethernet pair 3 (Negative)                                            |             |                             |                 |
| ETH4+        | 46                     | Reserved for future Gbit Ethernet pair 4 (Positive)                                            |             |                             |                 |
| ETH4-        | 47                     | Reserved for future Gbit Ethernet pair 4 (Negative)                                            |             |                             |                 |
| ECT3         | 49                     | Reserved for future Gbit center tap 3 connection                                               |             |                             |                 |
| ECT4         | 50                     | Reserved for future Gbit center tap 4 connection                                               |             |                             |                 |
| USB3+        | 52                     | USB (Positive)<br>USB full speed host port                                                     |             |                             |                 |
| USB3-        | 53                     | USB (Negative)<br>USB full speed host port                                                     |             |                             |                 |
| SPEED_LED    | 56                     | Ethernet speed LED, active low for 100 Mbps                                                    |             |                             |                 |
| CP13         | 57                     | Configurable GPIO                                                                              |             |                             |                 |
| CP12         | 58                     | Configurable GPIO                                                                              |             |                             |                 |
| CP11         | 59                     | Configurable GPIO                                                                              |             |                             |                 |
| CP10         | 60                     | Configurable GPIO                                                                              |             |                             |                 |
| WAKE         | 65                     | CPU wake up input. PW2050 gateway wakes from low power state on a rising edge                  |             | 100K PU                     |                 |
| DEFAULT#     | 66                     | Unit reset to default, active low. Drive low for xx seconds to reset unit to default settings. |             |                             |                 |

| Signal Name | PremierWave 2050 Pin #                                                                                       | Primary Function                                                              | Reset State | Internal Pull-up /Pull-down | Driver Strength |
|-------------|--------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|-------------|-----------------------------|-----------------|
| SYS_LED     | 67                                                                                                           | System status LED, active high                                                |             |                             |                 |
| CP2/INT     | 68                                                                                                           | Configurable GPIO / SPI interrupt external interrupt input                    |             |                             |                 |
| CP1         | 71                                                                                                           | Configurable GPIO                                                             |             |                             |                 |
| LINK_ACT    | 72                                                                                                           | Ethernet link/activity LED active low for link. toggle for activity.          |             |                             |                 |
| WLAN LED    | 73                                                                                                           | LED function for WLAN link indication, active low                             |             |                             |                 |
| RESET#      | 77                                                                                                           | Unit hardware reset, active low. Drive low to reboot unit                     |             | 35K PU                      |                 |
| RXD2        | 78                                                                                                           | UART2 serial receive data input                                               |             |                             |                 |
| TXD2        | 79                                                                                                           | UART2 serial transmit data output                                             |             |                             |                 |
| CTS1        | 80                                                                                                           | UART1 clear to send input                                                     |             |                             |                 |
| RTS1        | 81                                                                                                           | UART1 serial ready to send output                                             |             |                             |                 |
| RXD1        | 82                                                                                                           | UART1 Serial receive data input                                               |             |                             |                 |
| TXD1        | 83                                                                                                           | UART1 serial transmit data output                                             |             |                             |                 |
| SHDN        | 88                                                                                                           | Indicates when gateway is in standby state. Use to power off external devices |             |                             |                 |
| RF1_CTL     | 97                                                                                                           | Reserved for future use. Do not connect                                       |             |                             |                 |
| TRST        | 100                                                                                                          | TRST signal for external debugger                                             |             |                             |                 |
| TDO         | 101                                                                                                          | TDO signal for external debugger                                              |             |                             |                 |
| TDI         | 104                                                                                                          | TDI signal for external debugger                                              |             |                             |                 |
| TCK         | 105                                                                                                          | TCK signal for external debugger                                              |             |                             |                 |
| TMS         | 106                                                                                                          | TMS signal for external debugger                                              |             |                             |                 |
|             |                                                                                                              |                                                                               |             |                             |                 |
| VCC         | 29,30,31                                                                                                     | 5V power input                                                                |             |                             |                 |
| GND         | 1,3,5,20,23,32,33,36,39,42,45,48,51,54,55,61,64,84,86,87,94,95,96,98,99,102,103,107,108,109,110,111,112,113, | Signal ground                                                                 |             |                             |                 |

Note2: The logic IO pins are 3.3V tolerant.

## Antenna Interface

The PremierWave 2050 gateway has been certified using the external antennas listed below. Per FCC guidelines, the PremierWave 2050 Wi-Fi certification remains valid if using an antenna of similar type to the antennas below. If using an antenna of similar type to one of the antennas below, but from a different manufacturer part number the antenna gain must be equal to or less than specified in the table. Refer to the *PremierWave 2050 802.11ac Embedded Wi-Fi IoT Gateway Datasheet*, available at [www.lantronix.com/support/documentation](http://www.lantronix.com/support/documentation), for full compliance instructions and information. Consult with your certification lab for more details.

**Table 2-3 PremierWave 2050 Wi-Fi On-Gateway Antenna**

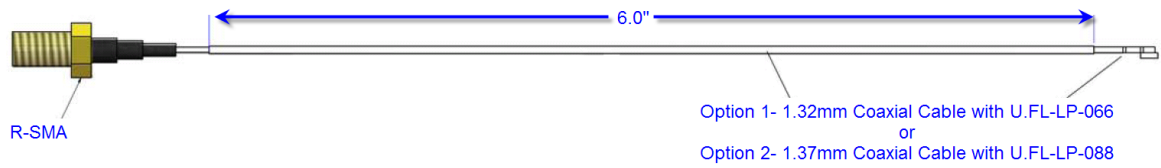
| Antenna Type    | Peak Gain Typical                                           | Lantronix Part Number | Vendor | Vendor Part Number | Approved Region                          |
|-----------------|-------------------------------------------------------------|-----------------------|--------|--------------------|------------------------------------------|
| Ceramic Antenna | 2.17dBi, 2.4 GHz to 2.5 GHz<br>2.74 dBi, 4.9 GHz to 5.8 GHz | N/A                   | N/A    | N/A                | FCC, IC, EU, AUS/NZS, JPN, China, Mexico |

**Table 2-4 PremierWave 2050 Wi-Fi External Antenna Options via On-Gateway U.FL**

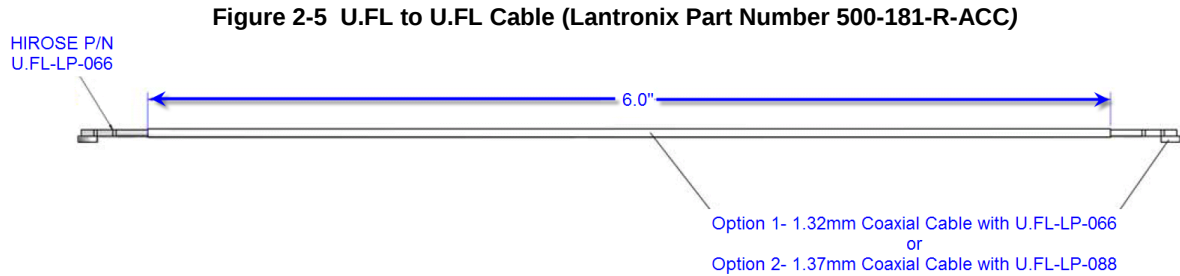
| Antenna Type                                                              | Peak Gain Typical                                         | Lantronix Part Number                 | Vendor        | Vendor Part Number          | Approved Region                          |
|---------------------------------------------------------------------------|-----------------------------------------------------------|---------------------------------------|---------------|-----------------------------|------------------------------------------|
| PCB Strip Antenna with 50 mm cable to U.FL connector With tape backing    | 2.5dBi, 2.39 GHz to 2.49 GHz<br>5 dBi, 4.9 GHz to 5.9 GHz | XPW100A003-01-B<br>50 piece bulk pack | Ethertronics® | 1001077                     | FCC, IC, EU, AUS/NZS, JPN, China, Mexico |
| PCB Strip Antenna with 50 mm cable to U.FL connector Without tape backing | 2.5dBi, 2.39 GHz to 2.49 GHz<br>5dBi, 4.9GHz to 5.9GHz    |                                       | Ethertronics  | 1000668                     | FCC, IC, EU, AUS/NZS, JPN, China, Mexico |
| Swivel type antenna, with RP-SMA(M) connector                             | 2 dBi, 2.4 GHz to 2.5 GHz, 2 dBi, 5.15 GHz to 5.85 GHz    | 930-033-R-ACC<br>50 piece bulk pack   | Wanshih       | WSS002                      | FCC, IC, EU, AUS/NZS, JPN, China, Mexico |
| Swivel type antenna, with RP-SMA(M) connector                             | 3.8 dBi, 2.4GHz to 2.5Ghz, 5.5 dBi, 4.9 GHz to 5.8Ghz     |                                       | Taoglas       | GW.71.5153 (Not for EU use) | FCC, IC, AUS/NZS, JPN, China, Mexico     |

**Note:** The PCB strip antenna is available from Ethertronics with or without adhesive tape backing for mounting to a plastic case. The antennas Lantronix supplies include an adhesive backing. For the component without tape backing a non-conductive double sided adhesive tape can be used to fix the antenna in place. The Ethertronics part numbers listed above come with a 50 mm U.FL cable attached to the PCB strip antenna. The 50 mm cable length is the minimum allowed cable length for use with the PremierWave 2050 gateway. For similar PCB strip antennas with longer cables consult with Ethertronics ([www.ethertronics.com](http://www.ethertronics.com)).

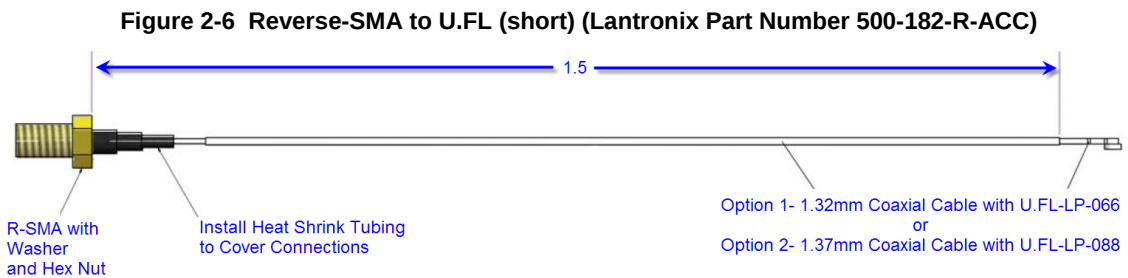
Lantronix provides a U.FL to Reverse SMA antenna cable in with the evaluation board and sample kits for development work. These cables can be purchased from Lantronix for production or supplied by an RF cable manufacturer. External antennas can be purchased from an antenna vendor. Components for cable design should be selected for low loss over the entire 2.4 GHz to 5.9 GHz signal range. The cable target impedance should be 50 ohms.



**Figure 2-4 Reverse-SMA to U.FL (Long) (Lantronix Part Number 500-180-R-ACC)**



**Figure 2-5 U.FL to U.FL Cable (Lantronix Part Number 500-181-R-ACC)**



**Figure 2-6 Reverse-SMA to U.FL (short) (Lantronix Part Number 500-182-R-ACC)**

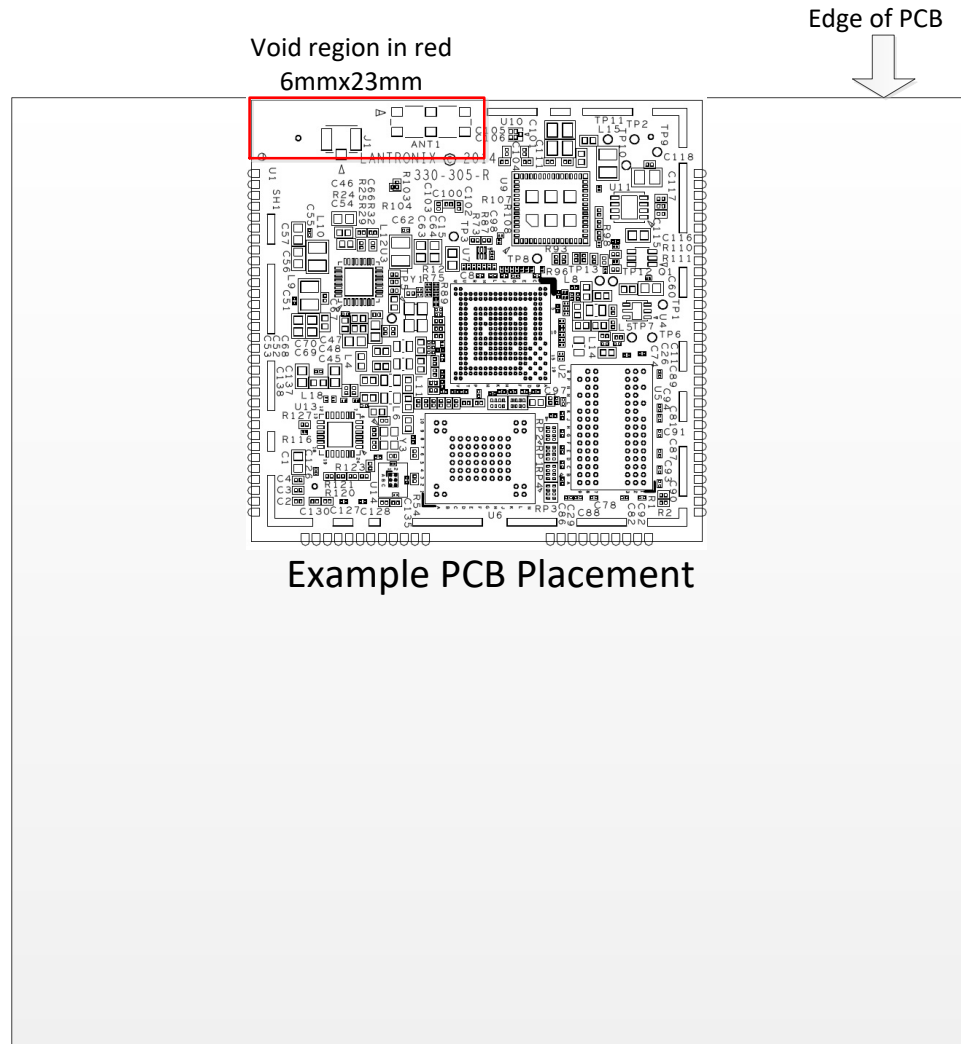
## Antenna Placement

When designing the PremierWave 2050 gateway to a mating board, it is important to consider the final installation of the gateway and its location with respect to connecting access points. The antenna should be placed so that it has as clear as possible path to the connecting access point for maximum range. Avoid placing the antenna such that it is blocked by metal walls or ground planes of adjacent circuit boards.

When using the on board chip antenna it is recommended to place the gateway such that the antenna region is along the edge of the board or extending outward from the edge of the board. The area under the chip antenna region should be voided of all signals and planes

See the figure images below showing recommended placement with the gateway chip antenna.

**Figure 2-7 PW2050 Gateway with Chip Antenna Board Edge Mounting**



**Note:** The chip antenna region of the the PW2050 gateway shown in red above is at the top edge of the PCB. The area in red should be voided to optimize antenna performance.

## Serial Interface

The PremierWave 2050 gateways has two external serial interfaces. The signal levels on the serial interface are 3.3V tolerant. The serial interfaces require an external transceiver in order to connect to external RS232, RS485, or RS422 networks. The signals of the Serial Ports may be connected as shown in the reference schematic below. The transceiver shown in the

reference schematic is of type Exar, part number SP336. This transceiver is a multiprotocol RS232, RS485, RS422 transceiver. Single protocol transceivers may be used as required. The PremierWave 2050 interface may also be directly connected to the UART interface of an external CPU.

**Table 2-5 PremierWave 2050 Serial Port Signals**

| Signal | Gateway Pin | Description                                          |
|--------|-------------|------------------------------------------------------|
| TXD1   | 83          | Serial transmit data output                          |
| RTS1   | 81          | Serial ready-to-send / serial transmit enable output |
| RXD1   | 82          | Serial receive data input                            |
| CTS1   | 80          | Serial clear-to-send input                           |
| TXD2   | 79          | Serial transmit data output 2                        |
| RTS2   | 24          | Serial ready-to-send / serial transmit enable output |
| RXD2   | 78          | Serial receive data input 2                          |
| CTS2   | 25          | Serial clear-to-send input                           |

Figure 2-8 Serial Port Example

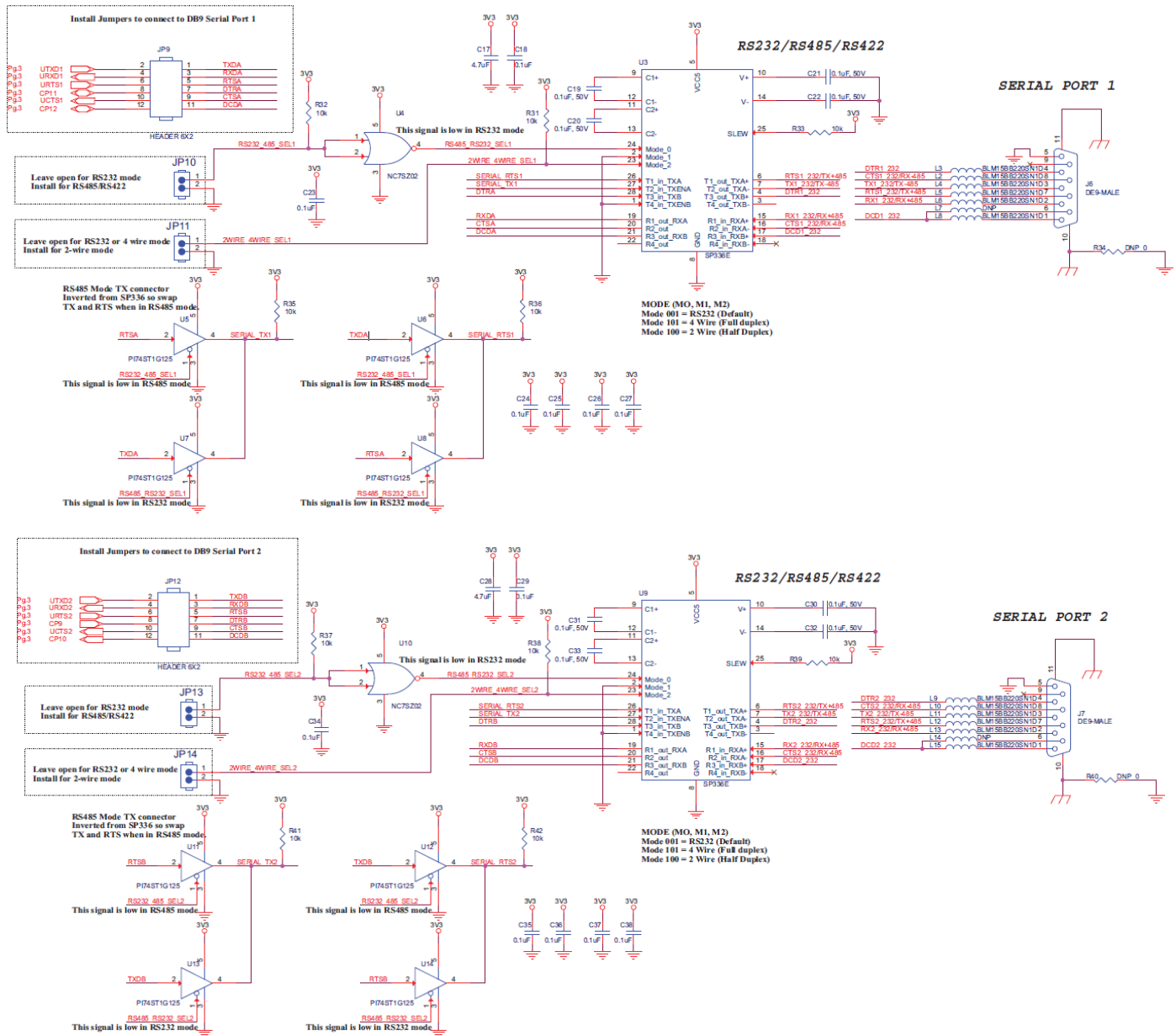


Table 2-6 Example RS232 Connections (Serial Transceiver Required)

| PremierWave 2050 Signal |                         | DTE Connector |      |        | DCE Connector |      |        |
|-------------------------|-------------------------|---------------|------|--------|---------------|------|--------|
| Signal (Logic)          | Description             | DB9           | DB25 | Signal | DB9           | DB25 | Signal |
| RxDx                    | Data In                 | 2             | 3    | RxDx   | 3             | 2    | TxDx   |
| TxDx                    | Data Out                | 3             | 2    | TxDx   | 2             | 3    | RxDx   |
| RTSx                    | H/W Flow Control Output | 7             | 4    | RTSx   | 8             | 5    | CTSx   |
| CTSx                    | H/W Flow Control Input  | 8             | 5    | CTSx   | 7             | 4    | RTSx   |
| CPx                     | Modem Control Input     | 1             | 8    | DCDx   | 4             | 20   | DTRx   |
| CPy                     | Modem Control Output    | 4             | 20   | DTRx   | 1             | 8    | DCDx   |

**Table 2-7 Example RS422/485 Connections (Serial Transceiver Required)**

| PremierWave 2050 Signal (logic) | Description  | RS485 Signal | DB25 4 Wire | DB25 2 Wire | DB9 4 wire | DB9 2 wire |
|---------------------------------|--------------|--------------|-------------|-------------|------------|------------|
| TXDx                            | Data Out     | TX+485       | 14          | 14          | 7          | 7          |
| TXDx                            | Data Out     | TX-485       | 15          | 15          | 3          | 3          |
| RXDx                            | Data In      | RX+485       | 21          | 14          | 2          | 7          |
| RXDx                            | Data In      | RX-485       | 22          | 15          | 8          | 3          |
| RTSx                            | TX Enable    |              |             |             |            |            |
| CPx                             | RS485 Select |              |             |             |            |            |
| CPy                             | RS485 2-wire |              |             |             |            |            |

**Note:** The IO pins for PremierWave 2050 gateway are set to floating input on power up until configured by unit firmware. An external 100K ohm pull-up may be required on the serial transmit signal to prevent downstream UART devices from detecting false characters on initial power up.

## Ethernet Interface

The unit provides a 10/100 Mbps Ethernet interface for connection to an external network through external magnetics and an external RJ45. The figure below shows the Ethernet connections to a 10/100 Ethernet RJ45 Jack with Magnetics, J5 in the figure. The RJ45 Magnetic Jack is Belfuse part number 08B0-1D1T-06-F.

The Ethernet differential pair signals, ERXM/ERXP and ETXM/ETXP should be routed as 100-ohm differential pairs on a layer next to the signal ground plane. The use of vias on these signals should be minimized. Center tap signals RXCT and TXCT should be routed with at least 20 mil trace thickness. The area underneath the RJ45 magnetic jack should be void of all signals and planes. The connector shield should be connected to chassis. It is recommended that 1206 resistor pads from chassis ground to signal ground be placed next to each of the shield tabs. The resistor pads allow for 0 ohm jumper, ferrite beads, or decoupling caps to be installed as needed for EMI/EMC improvement.

The Ethernet LED signals should be routed to discrete LEDs or to the LED pins on the RJ45 through 220 ohm or larger resistors. The LED signals are active low.

Also shown in the figure is an optional active choke that can be used to improve ESD, EFT, and EMI/EMC performance in harsh environments. The device is shown as U22 in the figure and is Akros part number AS1602. This device features route through pin assignments allowing for the Ethernet differential signal pairs to be routed without altering the trace impedance or adding vias. Due to this routing the device could be installed or depopulated as needed. Lantronix has performed all certification to FCC Class B without U22 populated.

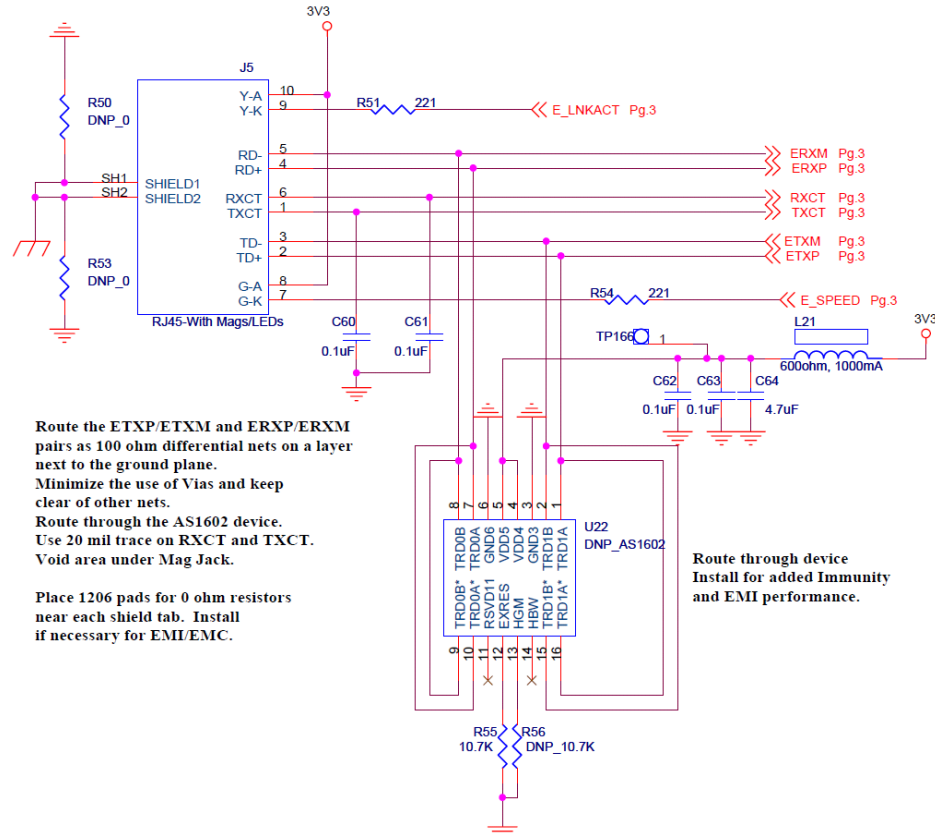
The Ethernet signals may be left disconnected if unused.

See the Lantronix app note, *How to Connect a Lantronix Embedded Module to a Wired Ethernet Port* for more details on Ethernet connection and routing, [http://www.lantronix.com/pdf/appnotes/Connect-LTRX-Embed-Module-to-Wired-Ethernet\\_AN.pdf](http://www.lantronix.com/pdf/appnotes/Connect-LTRX-Embed-Module-to-Wired-Ethernet_AN.pdf).

Table 2-8 Ethernet Port Signals

| Pin Name | Description                                                          | PremierWave 2050 Pins | Signal Requirement                               | RJ45 MagJack Belfuse, 08B0-1D1T-06-F Pin assignment |
|----------|----------------------------------------------------------------------|-----------------------|--------------------------------------------------|-----------------------------------------------------|
| ERXM     | Ethernet Receive Negative signal.                                    | 41                    | 100 ohm differential pair with ERXP              | 5                                                   |
| EXRP     | Ethernet Receive Positive signal.                                    | 40                    | 100 ohm differential pair with ERXM              | 4                                                   |
| ETXM     | Ethernet Transmit Negative signal.                                   | 35                    | 100 ohm differential pair with ETXP              | 3                                                   |
| ETXP     | Ethernet Transmit Positive signal.                                   | 34                    | 100 ohm differential pair with ETXM              | 2                                                   |
| RXCT     | Center tap for receive pair.                                         | 38                    | Route > 20 mil width                             | 6                                                   |
| TXCT     | Center tap for transmit pair                                         | 37                    | Route > 20 mil width                             | 1                                                   |
| Chassis  | Unit chassis                                                         | -                     | RJ45 connector shield                            | Shield tabs                                         |
| E_LNKACT | Link / activity LED. Active low. Solid for link, blink for activity. | 72                    | Route to LED cathode through 220 ohm or greater. | 9                                                   |
| E_SPEED  | Link Speed Active low for 100Mbps, Off (high) for 10Mbps.            | 56                    | Route to LED cathode through 220 ohm or greater. | 7                                                   |
| 3V3      | 3.3 V power                                                          | 3V3                   | 3.3V power, connect to LED anodes.               | 8, 10                                               |

Figure 2-9 Ethernet Connections to an External 10/100 RJ45 Magnetic Jack (J5)



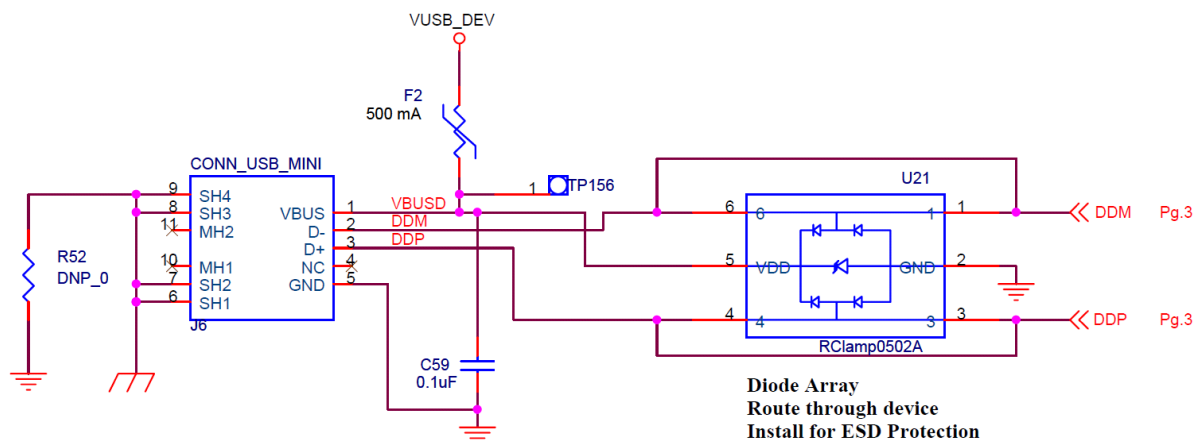
## USB Device Port

The PremierWave 2050 gateway has one USB 2.0 device port interface for connection to an upstream USB device. The port consists of a differential pair, signals DDP and DDM. These signals should be routed as a 90 ohm differential pair on a signal layer next to the signal ground plane. The use of vias should be minimized on these signals. The USB signals can be connected to a USB Mini Type B USB port or directly to an IC with a USB host port. If connecting to an external port that is user accessible it is recommended to add a TVS diode array to the signal nets for ESD protection. The ESD array shown in the figure is of type SEMTECH RClamp0502A. This device features through pin routing to minimize trace impedance changes and simplify routing. The footprint for the TVS array can be added to the PCB and the part can be depopulated if it is not needed. It is recommended that the power drawn off the USB Mini Type B connector be limited to less than 500 mA per USB requirements. If the USB device port is unused the DDP and DDM pins may be left disconnected.

**Table 2-9 USB Device Port Signals**

| Pin Name | Description                  | Gateway Pins | Signal Requirement                                | Mini Type B USB Device Connector Pin |
|----------|------------------------------|--------------|---------------------------------------------------|--------------------------------------|
| USB+/DDP | USB Device Port Positive pin | 18           | Route as 90 ohm differential pair with DDM signal | 3                                    |
| USB-/DDM | USB Device Port Negative pin | 19           | Route as 90 ohm differential pair with DDP signal | 2                                    |
| 5V       | 5V power from USB cable      |              | Current limit to 500 mA per port                  | 1                                    |
| Ground   | Signal Ground                | Ground       | Ground plane                                      | 5                                    |

**Figure 2-10 USB Device Interface Example (PremierWave 2050 Wi-Fi only)**



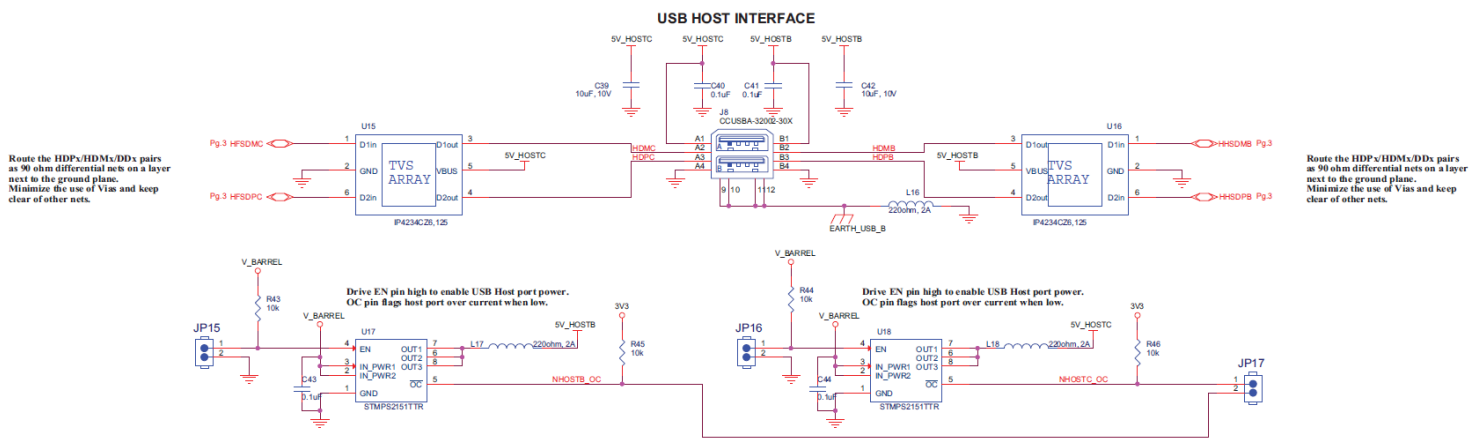
## USB Host Port

The PremierWave 2050 gateway has two USB 2.0 host port interfaces for connection to downstream USB devices. Each port consists of a differential pair. Port USB 2 is a high speed port and port USB 3 is a full speed port. These signals should be routed as 90 ohm differential pairs on a signal layer next to the signal ground plane. The use of vias should be minimized on these signals. The USB signals can be connected to a USB type A dual USB port as shown in the figure below or directly to an IC with a USB device port. If connecting to an external port that is user accessible it is recommended to add a TVS diode array to the signal nets for ESD protection. The ESD array shown in the figure is of type NXP, IP4234CZ6. If connecting to an off board device that needs power add a USB power switch to current limit the 5V power connection at the connector. USB requires that each port be limited to 500 mA maximum sustained current. If using the USB host ports the end system must take into account the amount of power consumed by the PremierWave 2050 gateway and each USB device connected to the host ports. The schematic below shows how to connect 5V to a USB host connector using an ST, STMP2151 power distribution switch. The USB host port 5V power is not provided by the PremierWave 2050 gateway. If the USB host ports are unused their pins may be left disconnected.

**Table 2-10 USB Host Port Signals**

| Pin Name          | Description                     | PremierWave 2050 Pins | Signal Requirement                | Type A USB Host connector pin |
|-------------------|---------------------------------|-----------------------|-----------------------------------|-------------------------------|
| USB2+/HHSDPB      | USB HS Host Port A Positive pin | 21                    | Route as 90 ohm differential pair | B3                            |
| USB2-/HHSDPM      | USB HS Host Port A Negative pin | 22                    | Route as 90 ohm differential pair | B2                            |
| USB3+/HFSDPC      | USB FS Host Port B Positive pin | 52                    | Route as 90 ohm differential pair | A3                            |
| USB3-/HFSDMC      | USB FS Host Port B Negative pin | 53                    | Route as 90 ohm differential pair | A2                            |
| 5V(User supplied) | 5V power for USB connector      |                       | Current limit to 500 mA per port  | A1, B1                        |
| Ground            | Signal Ground                   | Ground                | Ground plane                      | A4, B4                        |

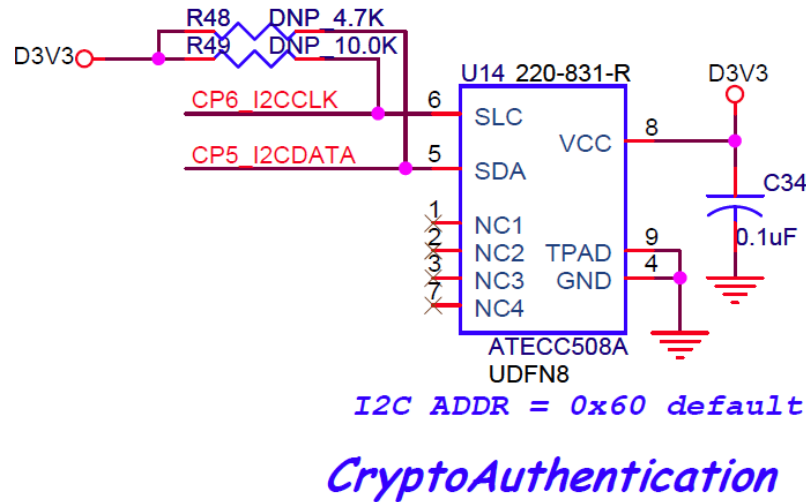
**Figure 2-11 USB Host Interface Connections**



## Integrating Secure Element in Your Designs

The PremierWave 2050 module can be connected to an external Microchip ATECC508A Crypto Authentication device for secure boot and secure OTA updates as well as for securely storing keys/credentials for edge applications. The device will connect to the module on the CP5 and CP6 pins as shown in the image below.

**Figure 2-12 External Security Chip Connections**



**Table 2-11 I2C Connections to External ATECC508A Device**

| Pin Name    | Description                 | PW2050 Pin | ATECC508A Pin |
|-------------|-----------------------------|------------|---------------|
| CP6_I2CCLK  | Configurable pin/ I2C clock | 17         | 6             |
| CP5_I2CDATA | Configurable pin/ I2C data  | 16         | 5             |

**Note:** Refer to the user guide for details on using the secure boot functions and for enabling access via provided APIs to keys/credentials stored within the Secure Element.

## LEDs

The PremierWave 2050 gateway contains several external signals that are intended to drive external status LEDs. The LEDs are listed below. The signals may be connected as shown in the reference schematic figure below.

**Table 2-12 PremierWave 2050 Wi-Fi Status LED Output Signals**

| Signal       | Pin | Description                                                       |
|--------------|-----|-------------------------------------------------------------------|
| WI-FI LED    | 73  | Wi-Fi Status LED, active low                                      |
| SYS LED      | 67  | System status LED, active high                                    |
| ETH SPEED    | 56  | Ethernet 100Mbps ON (Active low), 10Mbps OFF                      |
| ETH LINK/ACT | 72  | Ethernet link ON (Active low)<br>Ethernet activity Blink (toggle) |

## General Purpose I/O Pins

PremierWave 2050 gateway contains 13 pins which may be used as configurable inputs or outputs. Listed below are the configurable I/O pins. These pins are 3.3V tolerant.

**Table 2-13 Ethernet Interface PremierWave 2050 Serial Port Signals**

| Signal  | Pin | Description<br>PremierWave 2050      | Reset State |
|---------|-----|--------------------------------------|-------------|
| CP1     | 71  | Configurable I/O                     | Input       |
| CP2/INT | 68  | Configurable I/O-SPI interrupt input | Input       |
| CP3     | 12  | Configurable I/O- SPI MISO           | Input       |
| CP4     | 13  | Configurable I/O-SPI MOSI            | Input       |
| CP5     | 16  | Configurable I/O                     | Input       |
| CP6     | 17  | Configurable I/O                     | Input       |
| CP7     | 14  | Configurable I/O-SPI Clock           | Input       |
| CP8     | 15  | Configurable I/O-SPI Chip Select     | Input       |
| CP9     | 26  | Configurable I/O                     | Input       |
| CP10    | 60  | Configurable I/O                     | Input       |
| CP11    | 59  | Configurable I/O                     | Input       |
| CP12    | 58  | Configurable I/O                     | Input       |
| CP13    | 57  | Configurable I/O                     | Input       |

## Reset Pins

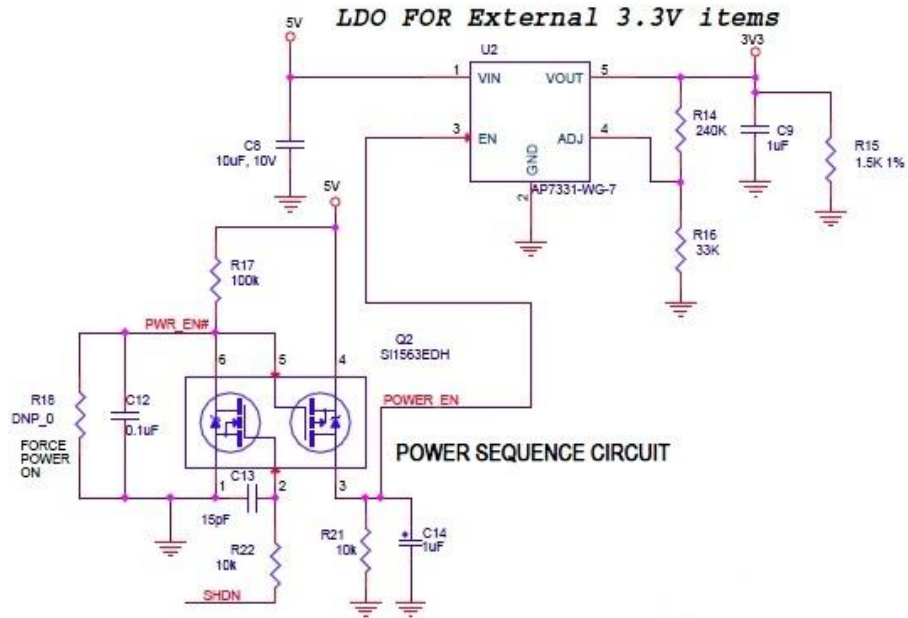
PremierWave 2050 gateways have two signals for use as reset signals. Signal EXT\_RESET# is a hardware controlled input signal that will reboot the PremierWave 2050 processor when asserted low. Signal DEFAULT# is polled by the PremierWave 2050 software. When DEFAULT# is asserted low for six seconds, the unit will reset the system to the default manufacturing settings and reboot the unit. PremierWave 2050 has an additional signal that can be used to wake up the unit processor when the unit is in a sleep or power down state. The SHDN signal is active when the gateway is in the shutdown state. Use the SHDN signal to gate off external logic when the gateway is in the shutdown state to minimize power

**Table 2-14 PremierWave 2050 Reset Signals**

| Signal     | Pin | Description                                                                                                                                | Reset State |
|------------|-----|--------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| EXT_RESET# | 77  | Unit hardware reset, active low. Drive low for 50ms to reboot unit. Signal should be driven high or left floating after reset.             | Input       |
| DEFAULT#   | 66  | Unit reset to default, active low. Drive low for 6 seconds or longer to reset unit to default settings.                                    | Input       |
| WAKE       | 65  | CPU wake up input. The PW2050 gateway wakes from low power state on a rising edge. Refer to user guide for WAKE pin configuration options. | Input       |

|      |    |                                                                                                                                                |  |
|------|----|------------------------------------------------------------------------------------------------------------------------------------------------|--|
| SHDN | 88 | Indicates when the gateway is in Standby state. Use to power off external devices. See evaluation board schematic for recommended connections. |  |
|------|----|------------------------------------------------------------------------------------------------------------------------------------------------|--|

Figure 2-13 Recommended Use of SHDN Signal to Shut Off External Power Rail



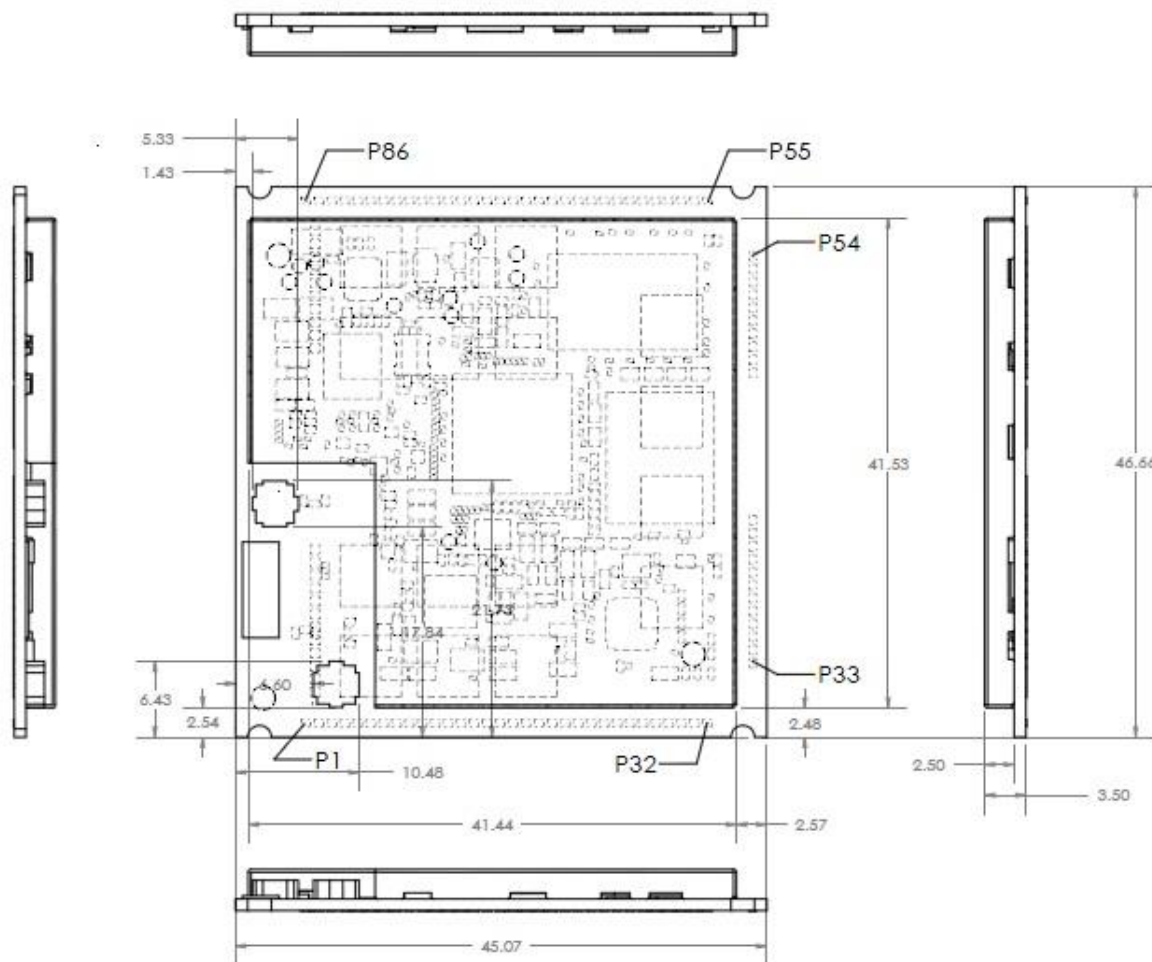
### 3: PCB Footprint and the PW2050 Dimensions

The gateway recommended footprint is shown below. The antenna region should ideally be placed on the edge of the board. The area under the antenna region should be void of all signals and planes. The antenna location inside of the end unit and installation should be chosen such that the antenna has as clear as possible line of site to the connecting WLAN devices. The antenna path should be as clear as possible from metal, ground and power planes from adjacent PCBs and other objects that can interfere with the signal path to the connecting WLAN devices.

#### Access CAD Files

1. Go to <http://www.lantronix.com/products/cad-visio.html>.
2. Click **Download CAD files here** to access the **Registration Form**.

Figure 3-1 PremierWave 2050 Gateway Dimensions





**Note:** The recommended stencil thickness is 4-5 mil. The stencil aperture should not exceed the size of the pad. Solder volume must be controlled. It is recommended that the aperture be set to 1:0.8 of the pad size. For example, the 0.8x0.6 mm pad would use a 0.64x0.48 mm stencil. Thicker stencils will require further reduction in stencil aperture. First article and routine inspection of the printing quality is necessary to ensure high yield. At a minimum, visually inspect the unit utilizing a magnifier with 10x magnification; otherwise inspection with a solder paste inspection (SPI) machine is preferred. Lantronix recommends a final standoff height after reflow of 75 to 100  $\mu\text{m}$ .

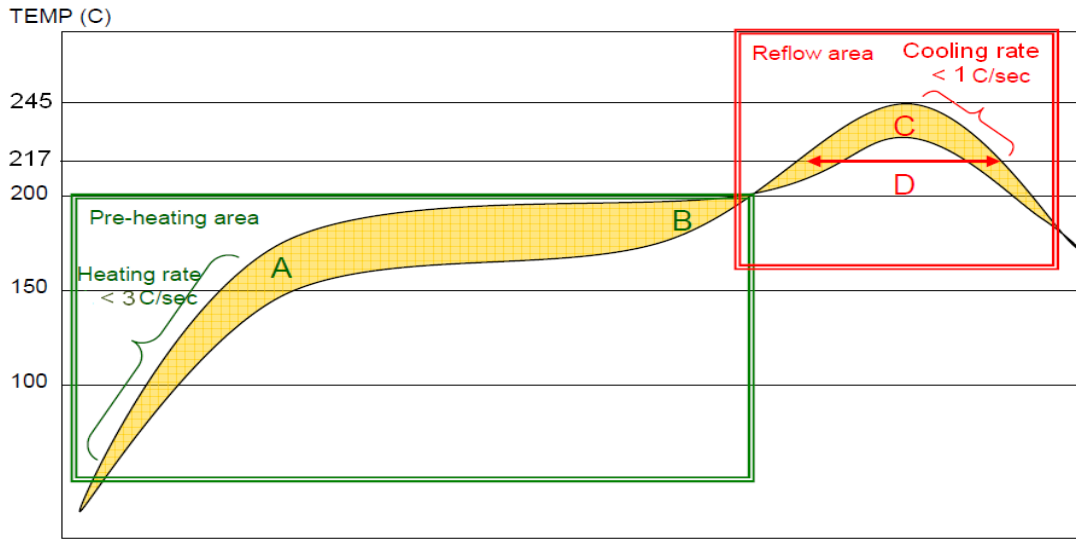
## Reflow Profile Guideline

The reflow profile is dependent on many factors including flux selection, solder composition, and the capability of the user's reflow equipment.

Lantronix does not recommend a specific reflow profile but provides the following general guidelines:

- ◆ The solder composition typically sets the peak temperatures of the profile.
- ◆ Lantronix recommends lead free solder pastes SAC305: Type 4. Water soluble or no-clean solder pastes are acceptable.
- ◆ Reflow equipment is needed at nine heater zones at minimum. Lantronix recommends a forced air type reflow oven with nitrogen.
- ◆ Lantronix recommends that the peak temperature at the solder joint be within 235°C ~ 245°C, and the maximum component temperature should not exceed 260°C.
- ◆ Lantronix recommends that the solder joint heating time above 217°C last between 40-90 seconds, and at a minimum of 40 seconds.
- ◆ Excessive ramp/cooling rates ( $>3^{\circ}\text{C/s}$ ) should be avoided.
- ◆ To develop the reflow profile, Lantronix recommends that the user place thermocouples at various locations on the assembly to confirm that all locations meet the profile requirements. The critical locations are the gateway solder joints.
- ◆ When developing the reflow profile, Lantronix recommends that a fully loaded assembly be used to assure that the total thermal mass is accounted for.

Figure 3-3 Recommended Reflow Profile



- (1) Solder paste alloy: SAC305(Sn96.5/Ag3.0/Cu0.5)(Lead free solder paste is recommended by Lantronix.)
- (2) A-B. Temp.(Pre-heat): 150~200 °C; soak time:60~120 seconds.
- (3) C. Peak temp: <245 °C
- (4) D. Time above 217 °C: 40~90 sec.
- (5) Suggested optimal cooling rate is <1 °C /sec. from peak to 217 °C.
- (6) Utilize a minimum of nine heater zones for Reflow equipment.
- (7) Nitrogen usage is recommended when the oxygen concentration is controlled at less than 1500 ppm.

**Note:** Need to inspect solder joint by X-ray post reflow for voiding and solder shorts.

## Sample Solder Process Using 5 Mil Stencil

### 1. Introduction

This application note provides a general guideline for assembling a PremierWave 2050 gateway on a reference PCB.

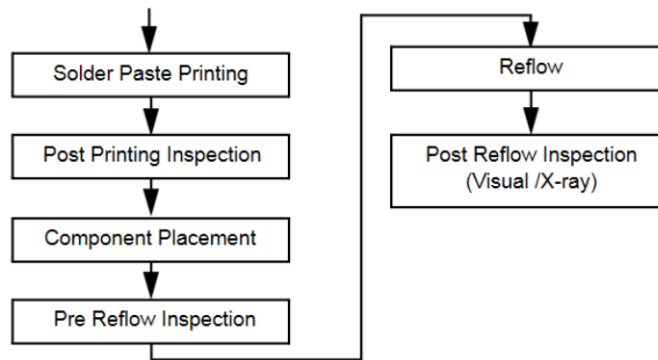
### 2. Scope

Contains generic information for PremierWave 2050 packages assembled internally. An actual experiment on a larger sample size is required to optimize the assembly process.

### 3. Assembly Process

Due to package layout and dimension, standard pick and place process is highly recommended. Manual soldering should be avoided.

Figure 3-4 SMT Process Flow



### 4. Solder Paste and Stencil Design

Senju SAC305 Type 4 No-Clean was used in this experiment.

Aperture for the PremierWave 2050 gateway was opened 25 mil x 23 mil for rectangle pads and 25 mil x 31 mil for square pads.

Thickness of stencil: 5 mil

### 5. Solder Paste Printing

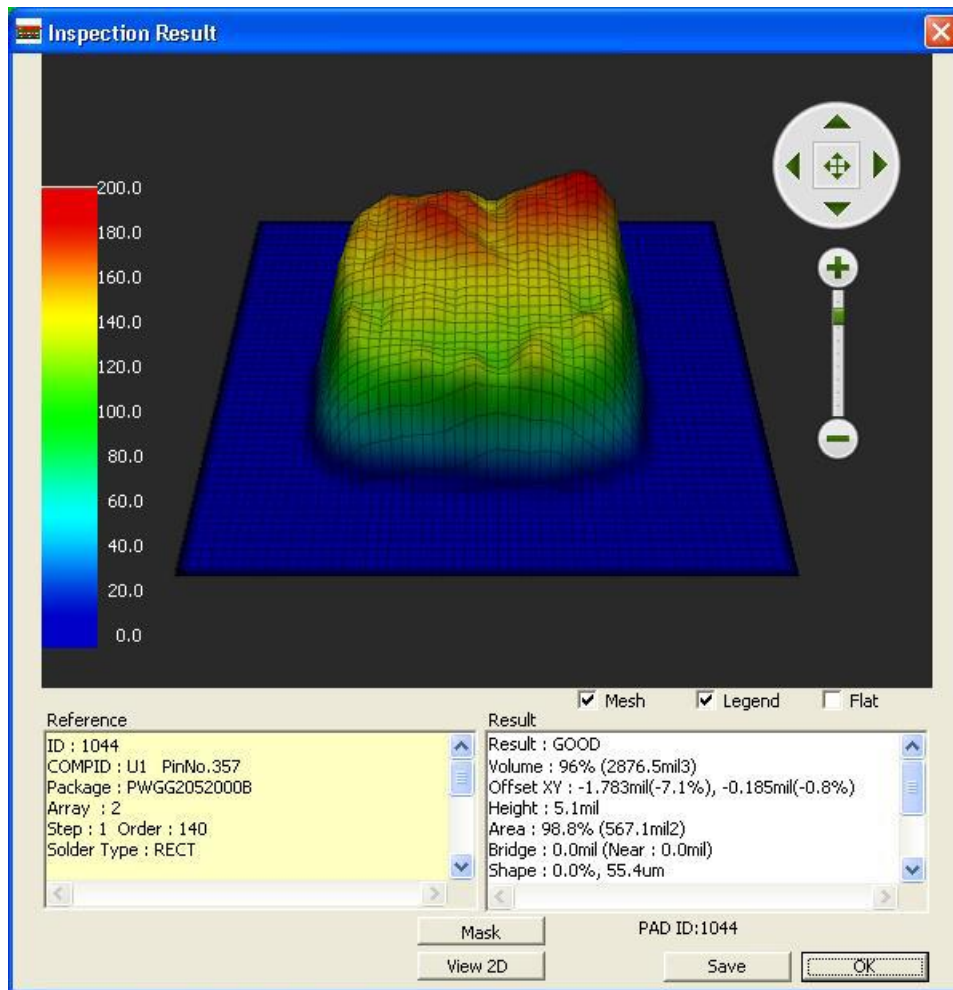
Solder paste printing was done with the following parameters:

- ♦ Printing speed forward/backward: 10 mm/s
- ♦ Printing Pressure forward/backward: 25 N
- ♦ Snap off: -0.50 mm
- ♦ Separation speed: 1.0 mm/s

The expected volume of solder paste for Rectangle pads per stencil design:  
 $25 \text{ mil} \times 23 \times 5 \text{ mil} = 2875 \text{ mil}^3$

Inspection result from SPI for Rectangle pad:  $2876.5 \text{ mil}^3$

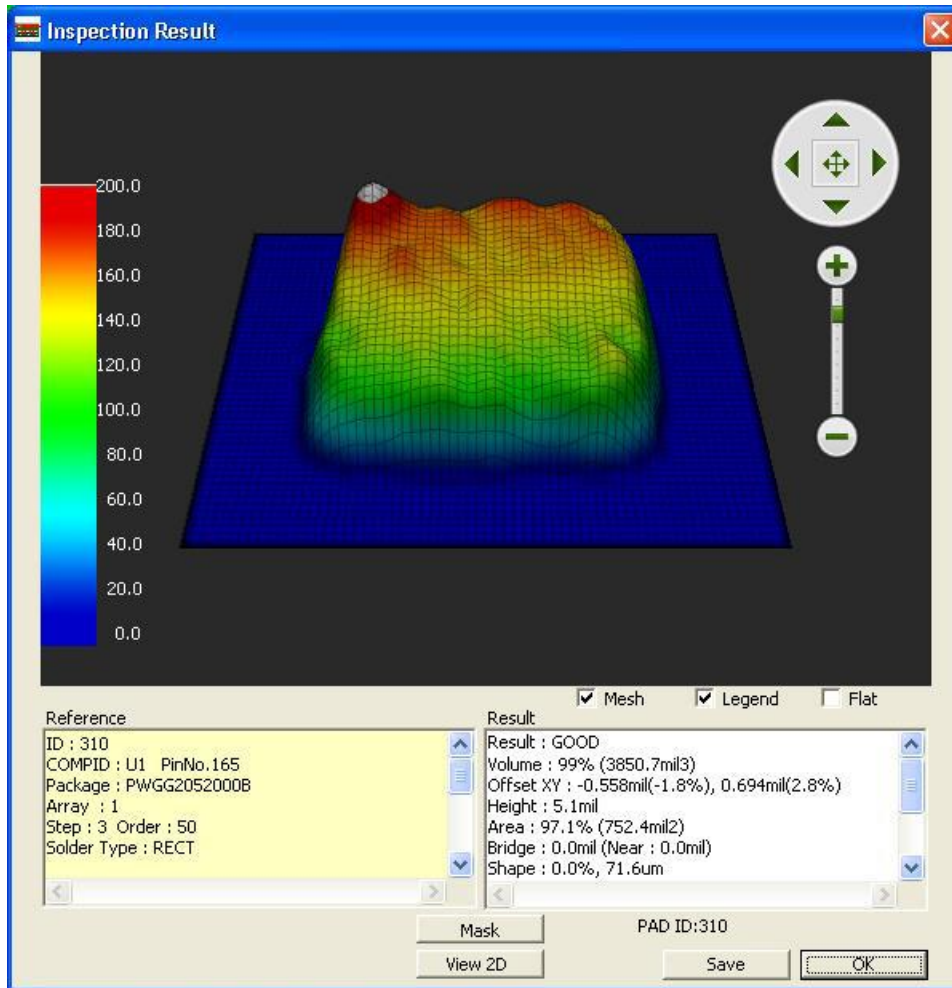
Figure 3-5 SPI Rectangle Pad 2876.5 mm Inspection Result



The expected volume of solder paste for Square pads per stencil design:  
 $25 \text{ mil} \times 31 \times 5 \text{ mil} = 3875 \text{ mil}^3$

Inspection result from SPI for Square pads: 3850.7 mil<sup>3</sup>

Figure 3-6 SPI Square Pad 3850.7 mm Inspection Result



## 6. Component placement

The component must be programmed correctly for pick and place machine to ensure the vision system is able to inspect all the pads before placement. Placement accuracy plays an important role to get success on installing the gateway on this assembly.

Placement speed: Should be at a slowest speed possible to avoid rotation when spindle is traveling.

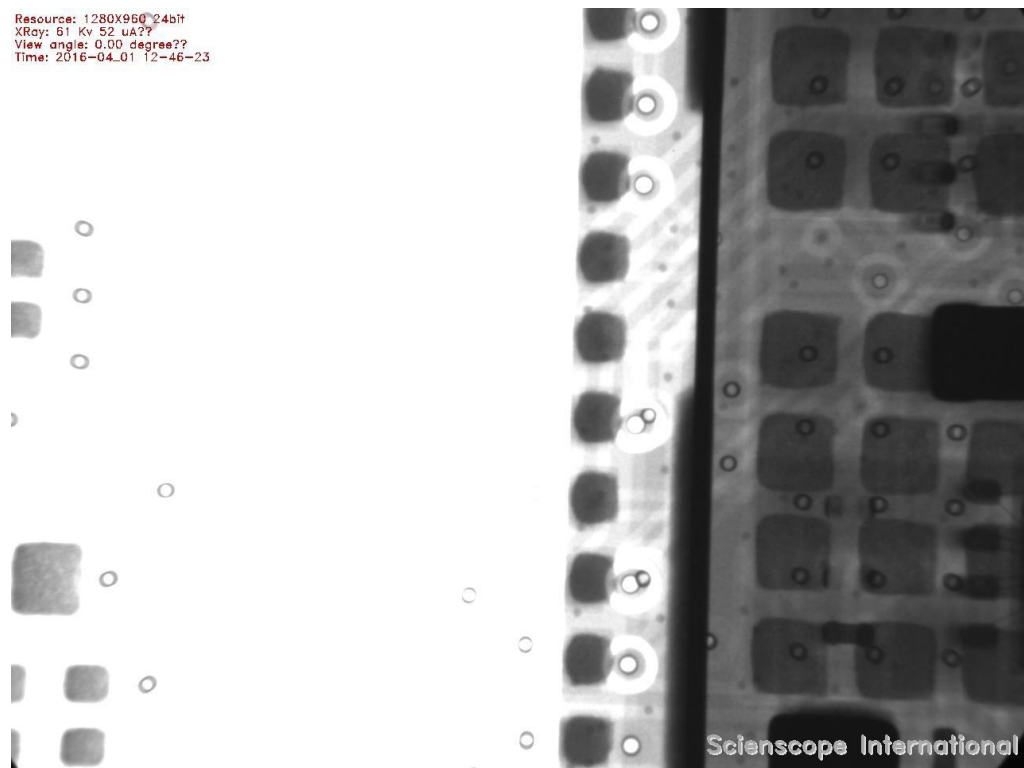
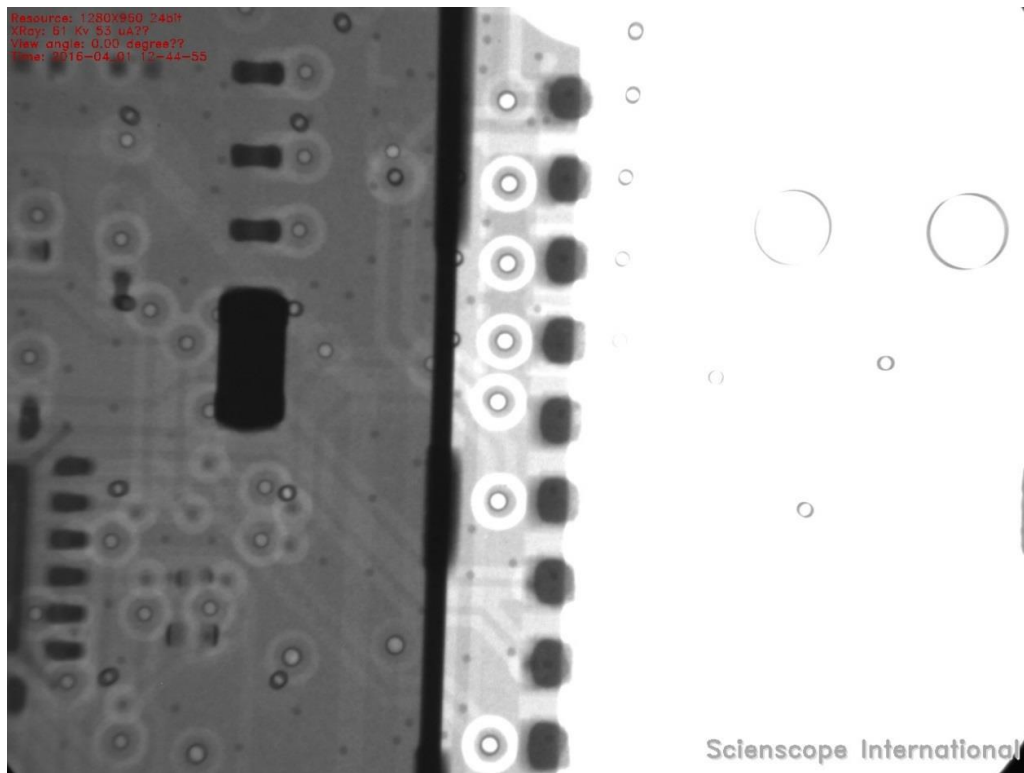
Placement force: 150 grams.

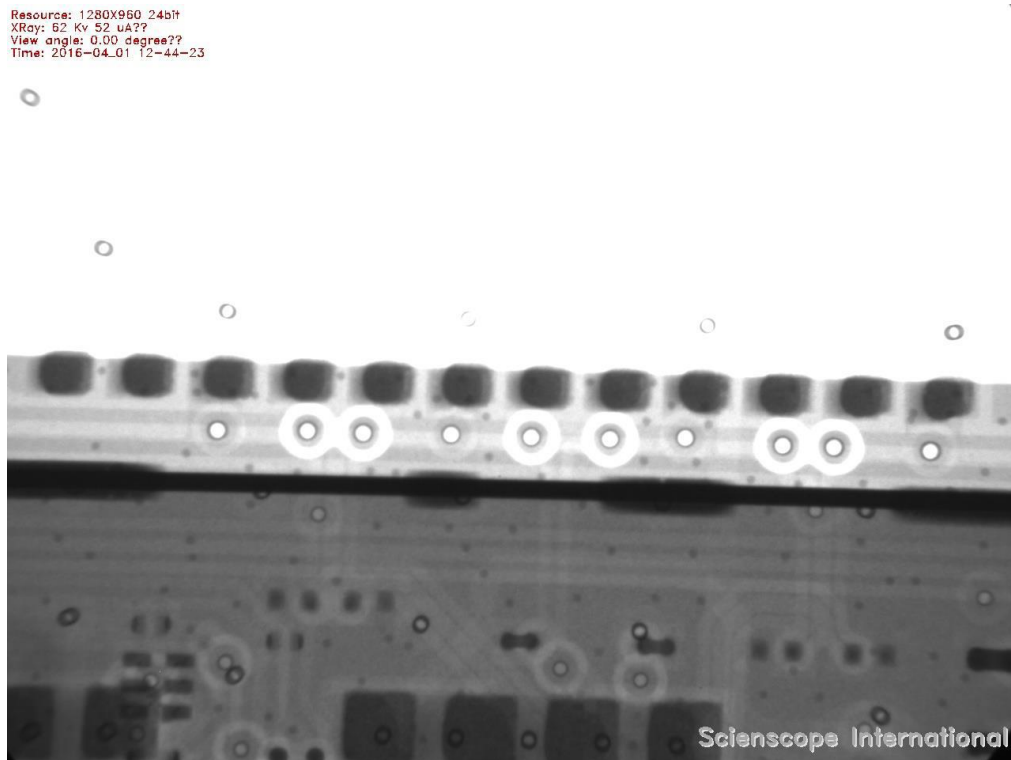
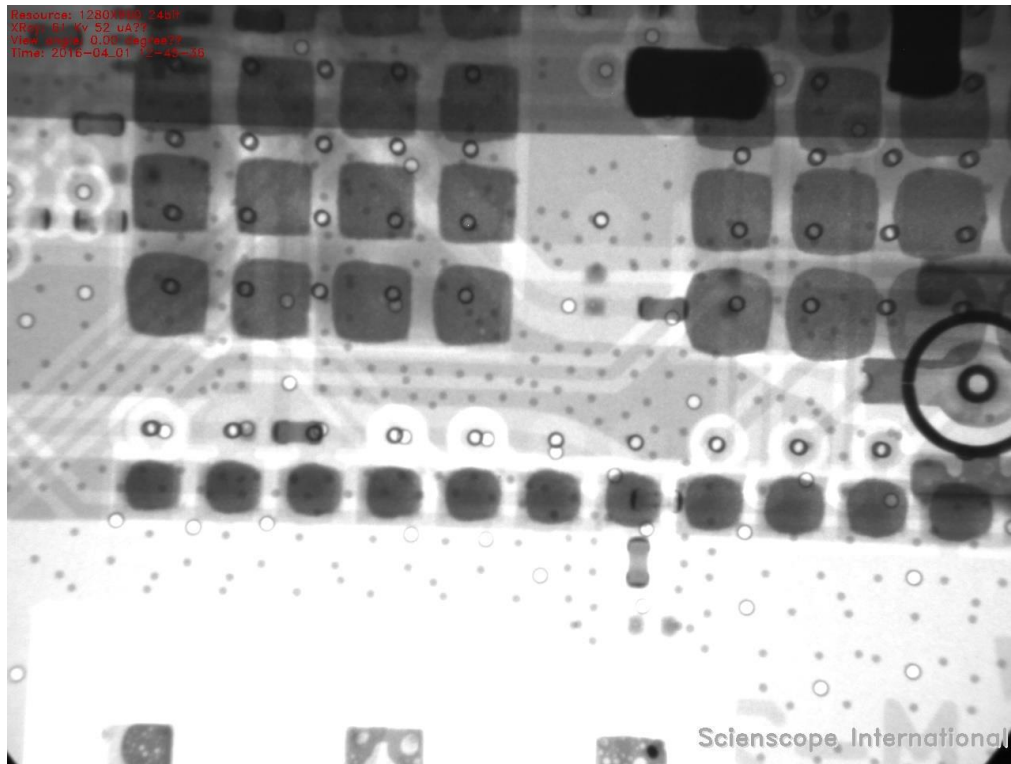
## 7. Pre-Reflow Inspection

Inspection after placement under X-Ray machine

The result shows that the placement is accurate and ready for reflow.

Figure 3-7 X-Ray Machine Pre-Reflow Inspection





## 8. Reflow

**Table 3-1 Oven Setting**

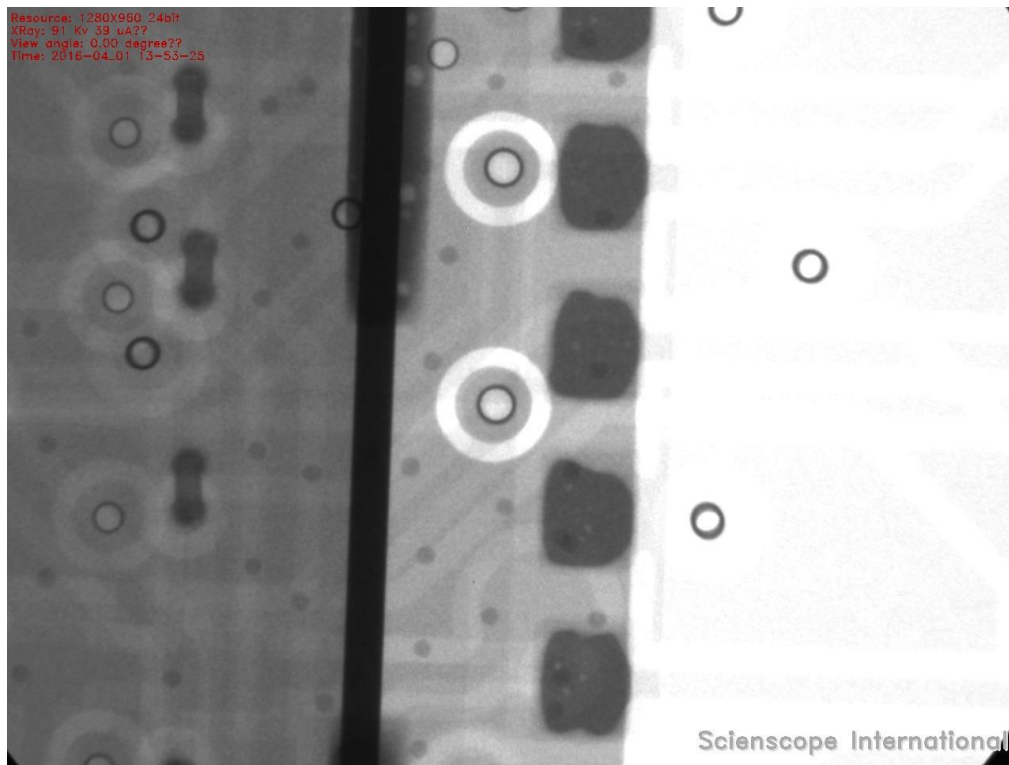
|               | Zone 1 | Zone2 | Zone 3 | Zone 4 | Zone 5 | Zone 6 | Zone 7 | Zone8 |
|---------------|--------|-------|--------|--------|--------|--------|--------|-------|
| <b>Top</b>    | 140    | 155   | 165    | 175    | 190    | 250    | 265    | 265   |
| <b>Bottom</b> | 140    | 155   | 165    | 175    | 190    | 250    | 265    | 265   |

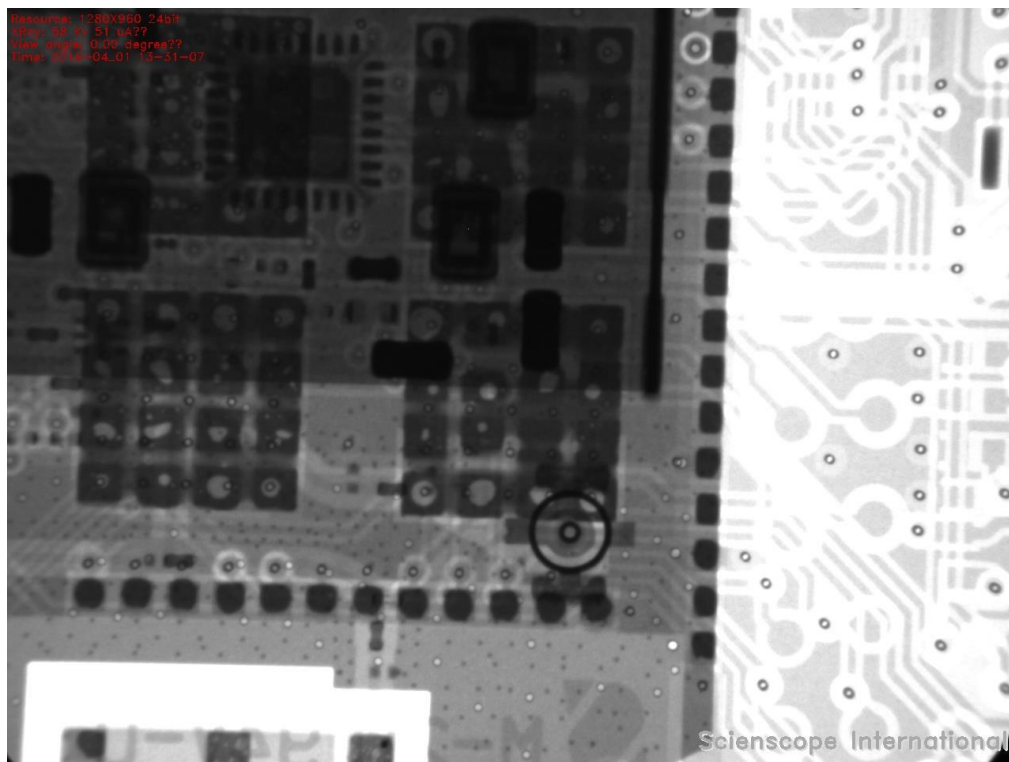
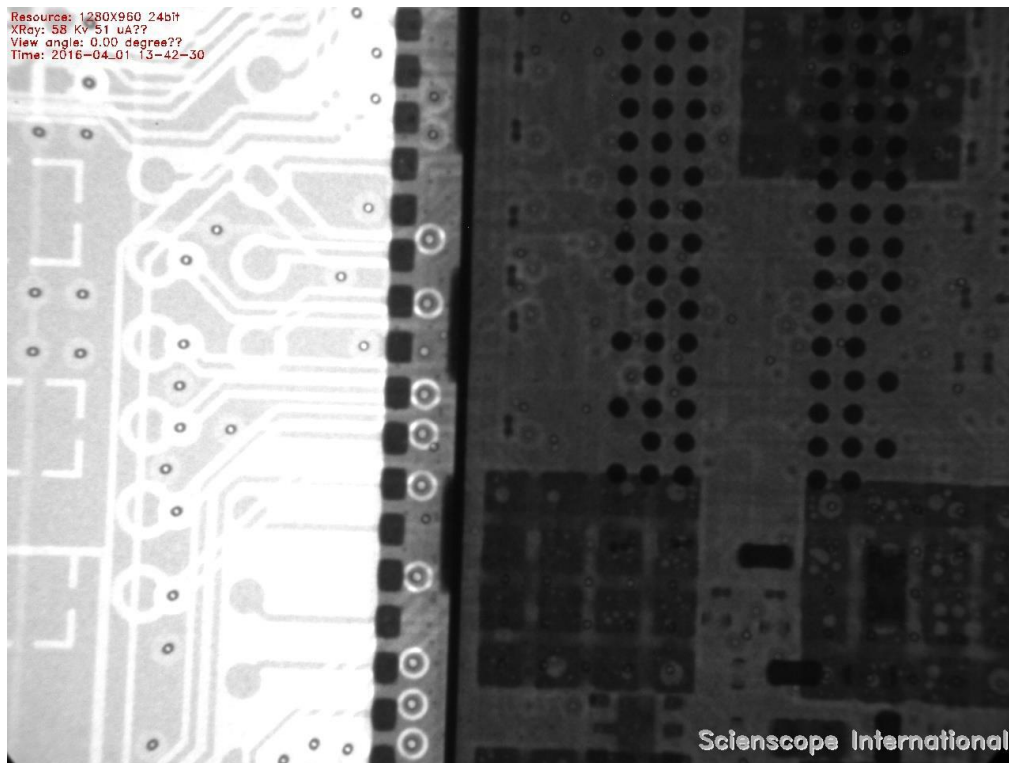
Belt Speed: 24 in/min

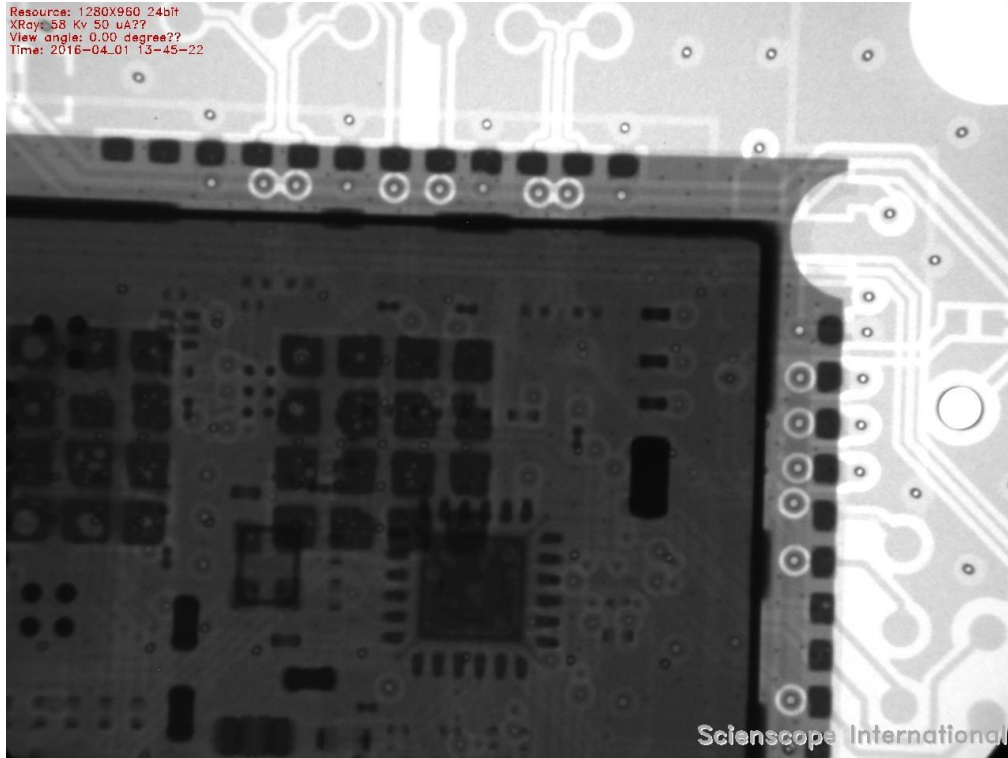
## 9. Post Reflow Inspection

X-Ray results show a very normal and standard solder fill and voiding is acceptable per IPC-A-610 class 2.

**Figure 3-8 X-Ray Machine Post Reflow Inspection**







### MSD (Moisture Sensitive Device) Control for the PW2050 Gateway

1. The PremierWave 2050 gateway is a moisture sensitive device; the MSL level is 3.
2. Gateways to be subjected to reflow solder or other high temperature processes must be mounted within 168 hours of opening the vacuum containment bag in factory conditions.
3. The gateway requires baking before mounting, if:
  - a. The Humidity Indicator Card reads  $>10\%$  when read at  $23 \pm 5^{\circ}\text{C}$
  - b. The MSL3 are not met
4. If baking is required, optional condition as below (refer to IPC/JEDEC J-STD-033):
  - a. Bake 9 hours @  $125^{\circ}\text{C}$  (Tray base)
  - b. Bake 33 hours @  $90^{\circ}\text{C}/\leq 5\%\text{RH}$  (Tray base)
  - c. Bake 13 days @  $40^{\circ}\text{C}/\leq 5\%\text{RH}$  (Tape/Reel base)

**Note:** After baking, the floor time of gateway should be recalculated.

## Product Information Label

The product information label contains important information about your specific unit, such as its part number, revision, manufacturing date code, product model, country of origin, datamatrix barcode and MAC address.

Figure 3-9 PremierWave 2050 Product Label



## Evaluation Board Schematic

Figure 3-10 Evaluation Board Schematic (1 of 7)

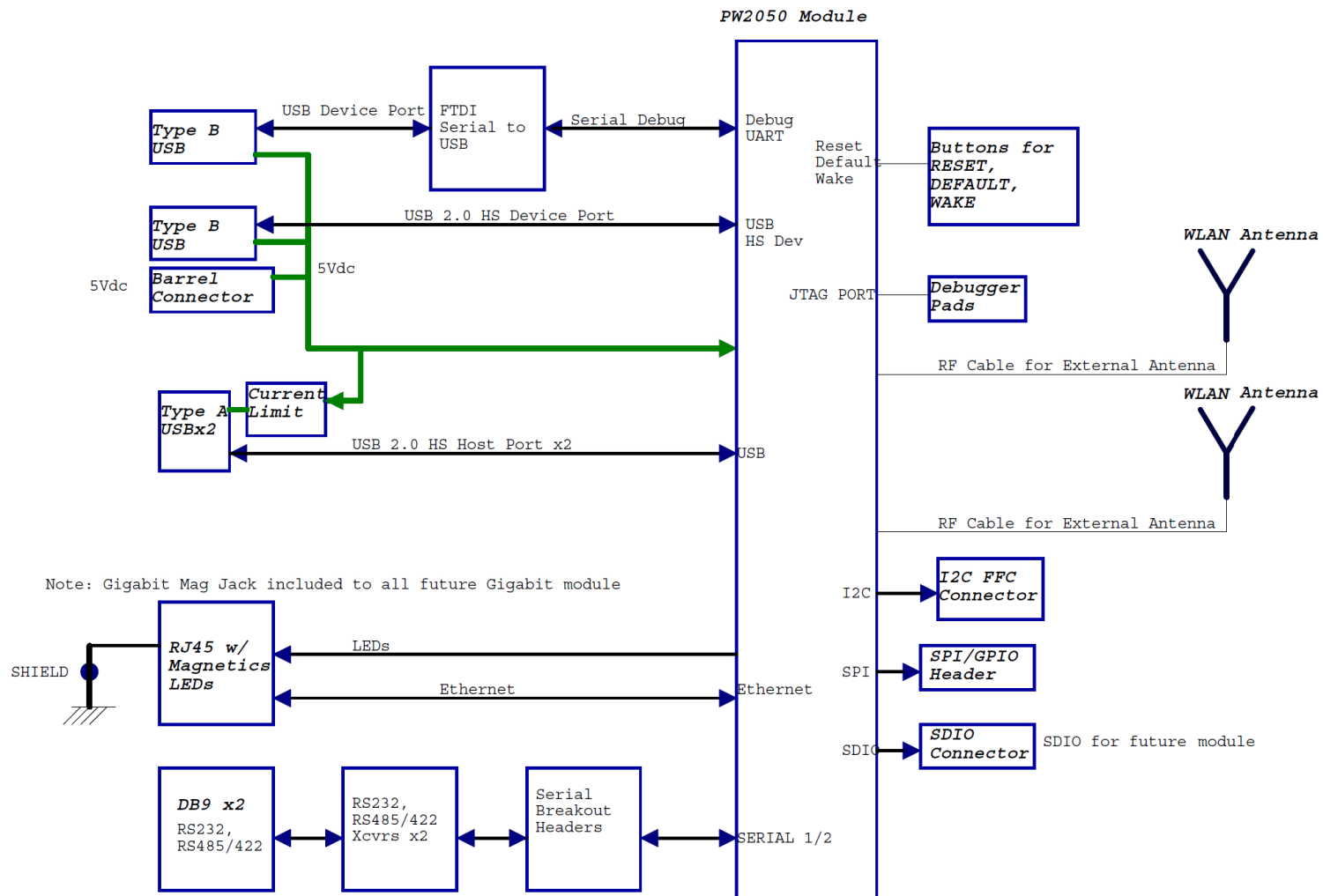


Figure 3-11 Evaluation Board Schematic (2 of 7)

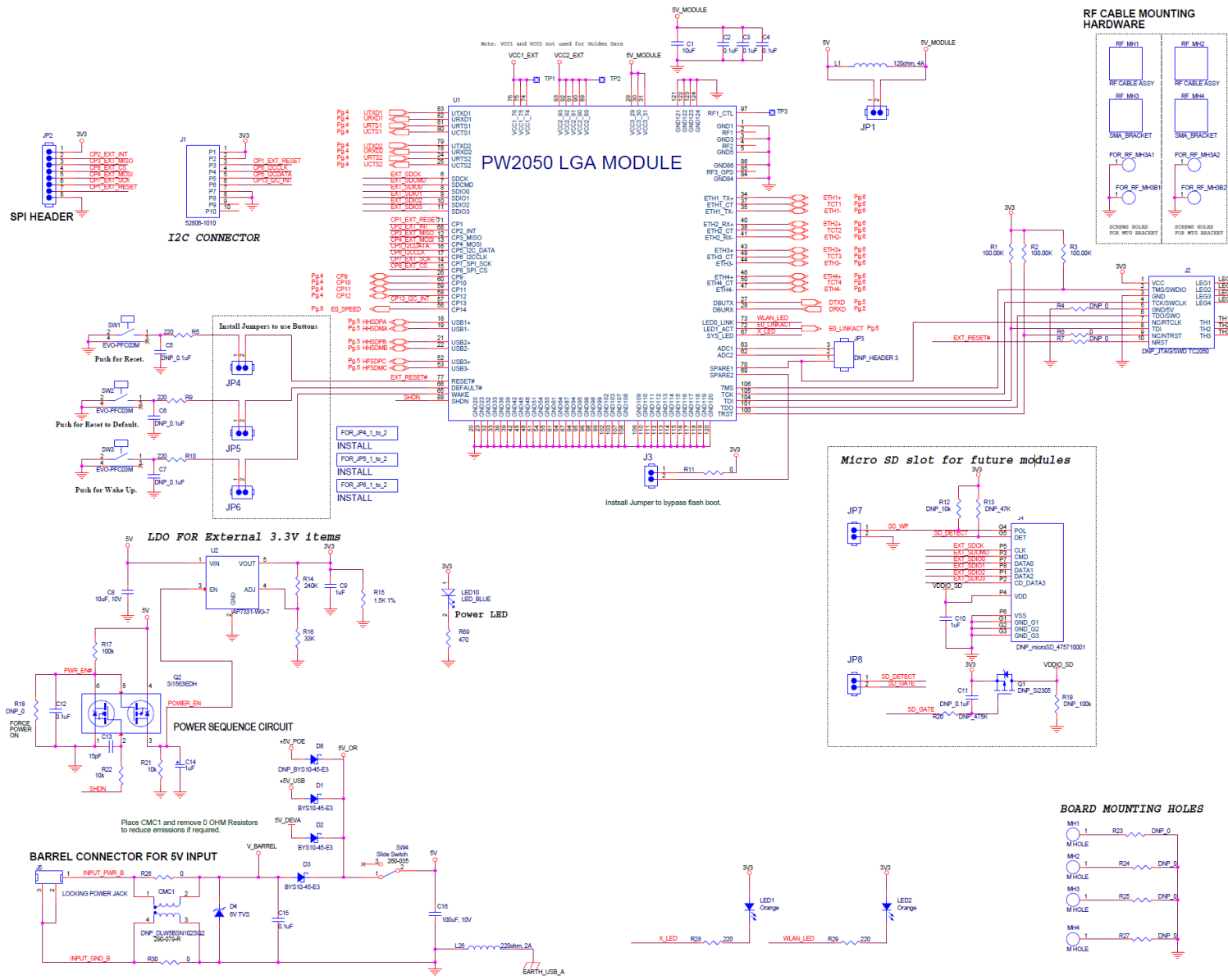


Figure 3-12 Evaluation Board Schematic (3 of 7)

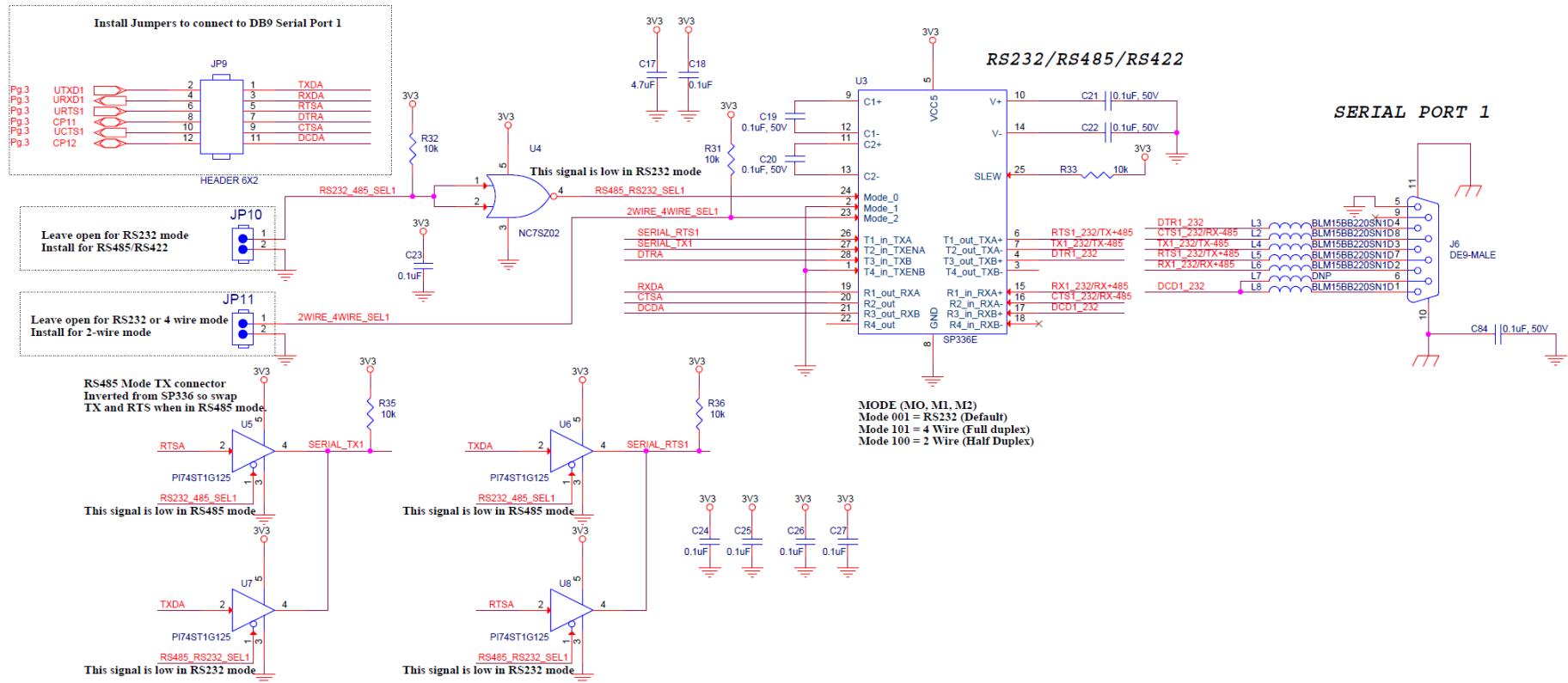


Figure 3-13 Evaluation Board Schematic (4 of 7)

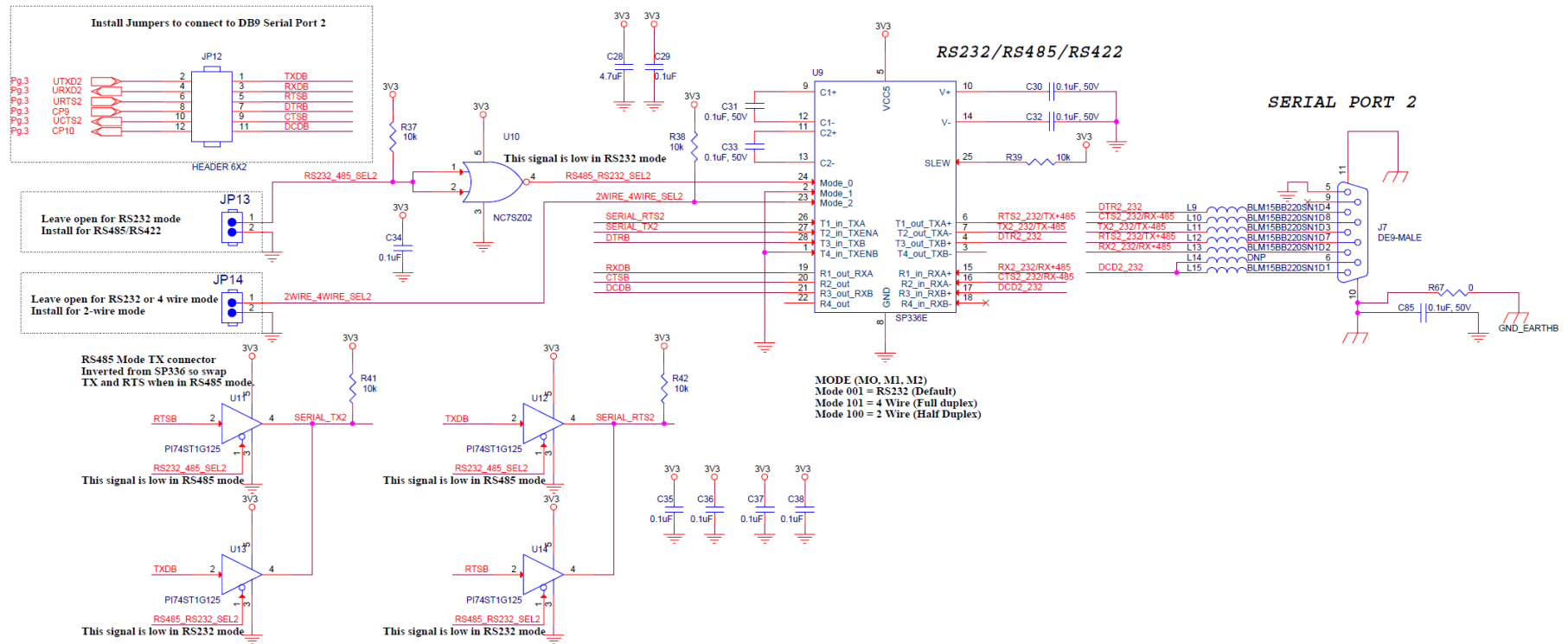


Figure 3-14 Evaluation Board Schematic (5 of 7)

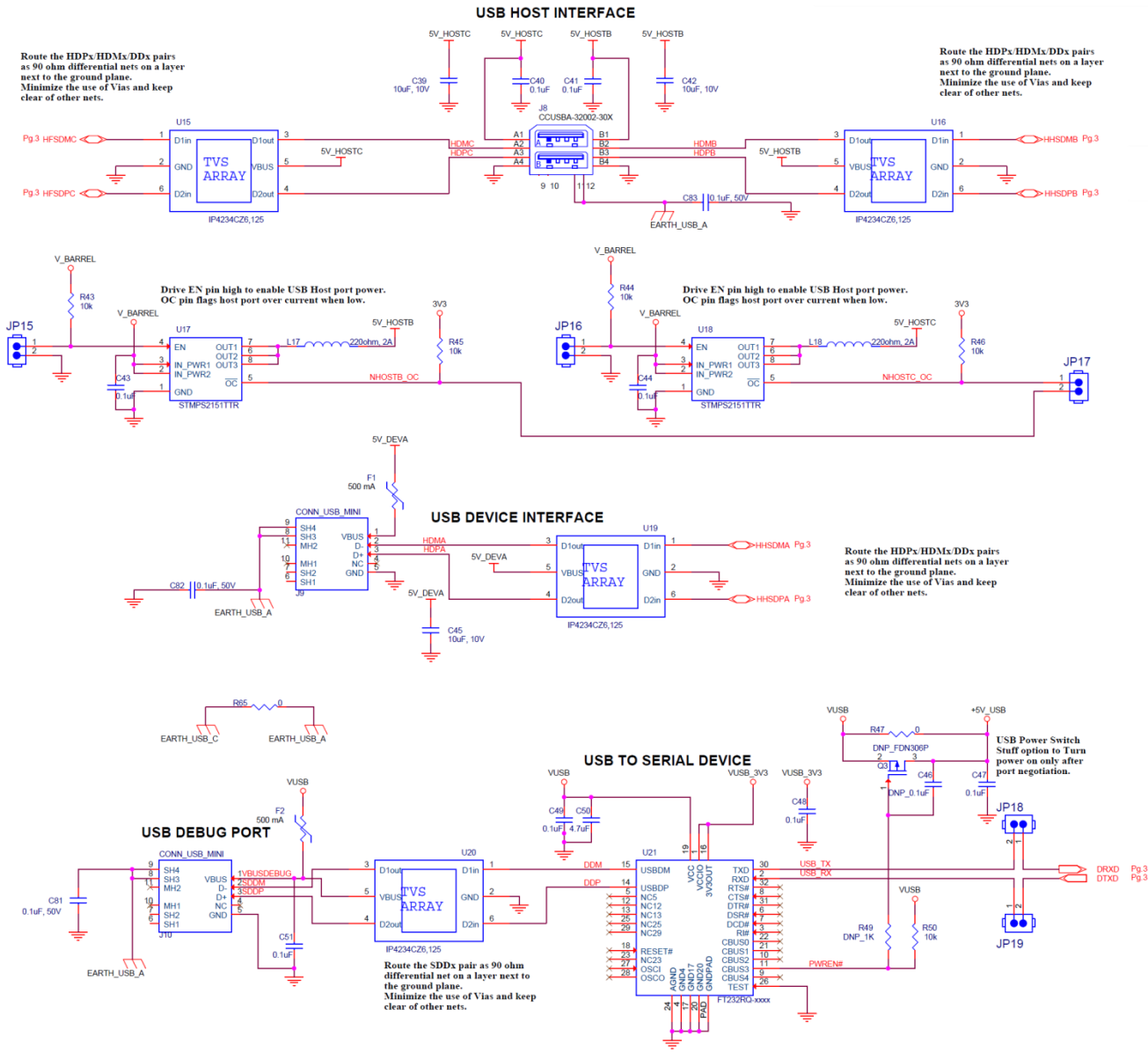
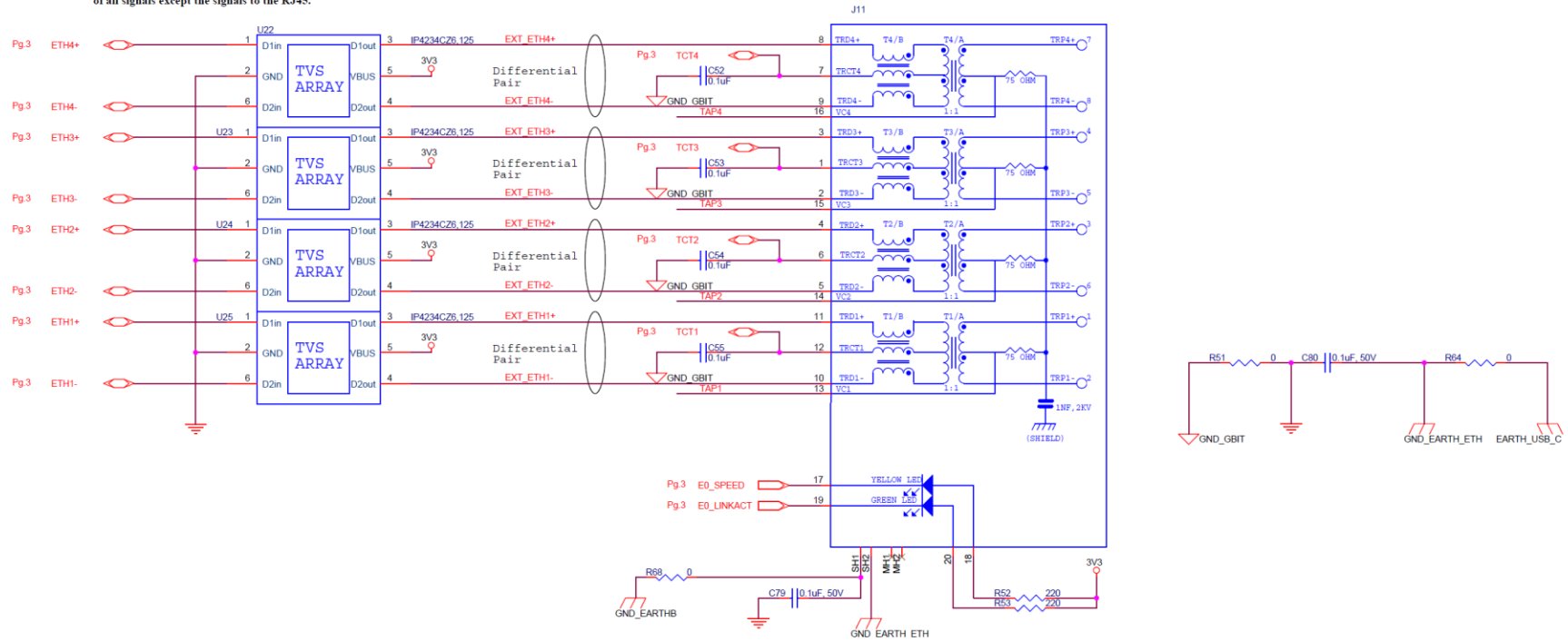


Figure 3-15 Evaluation Board Schematic (6 of 7)

Route the ETHx+/ETHx- pairs as 100 ohm differential nets on a layer next to the ground plane.  
Minimize the use of Vias and keep clear of other nets.  
Use 20 mil trace on TCTx.  
Void area under RJ Jack of all signals except the signals to the RJ45.

**ETHERNET POE MAG JACK**

Gigabit Mag Jack used for compatibility with future Gigabit modules



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