# EZRadioPRO® Development Kits User's Guide

## 1. Kits Overview

This user's guide describes the development kits of the EZRadioPRO wireless development kit family. Each kit contains two RF nodes based on the Wireless Motherboard to support evaluation and development of sub-GHz RF links with the different EZRadioPRO devices. Table 1 lists the RF pico boards of the kits that use the latest C2A revision of the EZRadioPRO ICs. Table 2 lists the RF pico boards of the obsolete kits that use the previous B1B revision of the EZRadioPRO ICs. Table 3 lists the content that is common to all kits.

**Table 1. RF Pico Boards of the EZRadioPRO Development Kits**

| Qty | Description | Part Number |
|---|---|---|
| | **Si4461 Development Kit 868 MHz** | **4461C-868-PDK** |
| 2 | Si4461 RF Transceiver Pico board 868 MHz, 14 dBm, direct tie | 4461CPCE14D868-EK |
| | **Si4438 Development Kit 490 MHz** | **4438C-490-PDK** |
| 2 | Si4438 RF Transceiver Pico board 490 MHz, 20 dBm, direct tie | 4438CPCE20D490-EK |
| | **Si4463 Development Kit 915 MHz** | **4463C-915-PDK** |
| 2 | Si4463 RF Transceiver Pico board 915 MHz, 20 dBm, switched | 4463CPCE20C915-EK |

**Table 2. RF Pico Boards of the obsolete EZRadioPRO Development Kits**

| Qty | Description | Part Number |
|---|---|---|
| | **Si4060/Si4362 Development Kit 868 MHz** | **4060-868-PDK** |
| 1 | Si4060 RF Transmitter Pico Board 868 MHz, 10 dBm | 4060-PCE10B868-EK |
| 1 | Si4362 RF Receiver Pico Board 868 MHz | 4362-PRXB868-EK |
| | **Si4063/Si4362 Development Kit 915 MHz** | **4063-915-PDK** |
| 1 | Si4063 RF Transmitter Pico board 915 MHz, 20 dBm | 4063-PCE20B915-EK |
| 1 | Si4362 RF Receiver Pico board 915 MHz | 4362-PRXB915-EK |
| | **Si4461 Development Kit 868 MHz** | **4461-868-PDK** |
| 2 | Si4461 RF Transceiver Pico board 868 MHz, 14 dBm, direct tie | 4461-PCE14D868-EK |
| | **Si4438 Development Kit 490 MHz** | **4438-490-PDK** |
| 2 | Si4438 RF Transceiver Pico board 490 MHz, 20 dBm, direct tie | 4438-PCE20D490 |
| | **Si4463 Development Kit 915 MHz** | **4463-915-PDK** |
| 2 | Si4463 RF Transceiver Pico Board 915 MHz, 20 dBm, switched | 4463-PCE20C915-EK |

**Table 3. Content Common to Every Kit**

| Qty | Description | Part Number |
|---|---|---|
| 2 | Wireless Motherboard | MSC-WMB93X |
| 2 | C8051F930 MCU Pico Board | UPPI-930-RF |
| 2 | USB cable (USBA-USB mini) | |
| 2 | Antenna with SMA connection | MSC-AT50-XXX |
| 1 | Kit user guide | |


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# 2. Software Setup

There are two software tools provided by Silicon Labs to aid in EZRadioPRO software development, the Wireless Development Suite (WDS) and the Silicon Labs Integrated Development Environment (IDE). The recommended starting point for EZRadioPRO development is the WDS software tool. This tool is able to identify the connected boards by reading their identification memories (EBID) and provides valuable help by greatly simplifying radio configuration, evaluation, and application development.

## 2.1. Hardware and Software Requirements for WDS

The following hardware and software is required to run the WDS:

- Windows XP or later
- Microsoft .NET framework 3.5 or later
- Silicon Labs CP210x VCP driver
- WDS v3.2.7.0 or later

The lack of the .NET framework and VCP driver are recognized during the WDS installation. The install wizard will install the missing components after prompting the user for consent.

## 2.2. Download WDS

WDS can be obtained from the Silicon Labs web site free of charge at

http://www.silabs.com/Support%20Documents/Software/WDS3-Setup.exe

## 2.3. Installation Steps

If WDS is already installed on your machine, skip this section.

**Note:** Before installing this software, local administration rights must be obtained from your network administrator.

1. Start WDS3-Setup.exe.
2. Click “Next” to start the installation process.
3. Accept the license agreement by clicking the check box, and then press the “Next” button.
4. Select the installation folder.
   It is recommended to use the default folder, C:\Program Files\Silabs\WDS3
5. When your settings are confirmed, click “Install” to continue.
6. Click “Finish” to close the WDS Installer.

## 3. Hardware Setup

After checking the kit contents against Tables 2 and 3, the kit can be put into operation by performing the steps listed below.

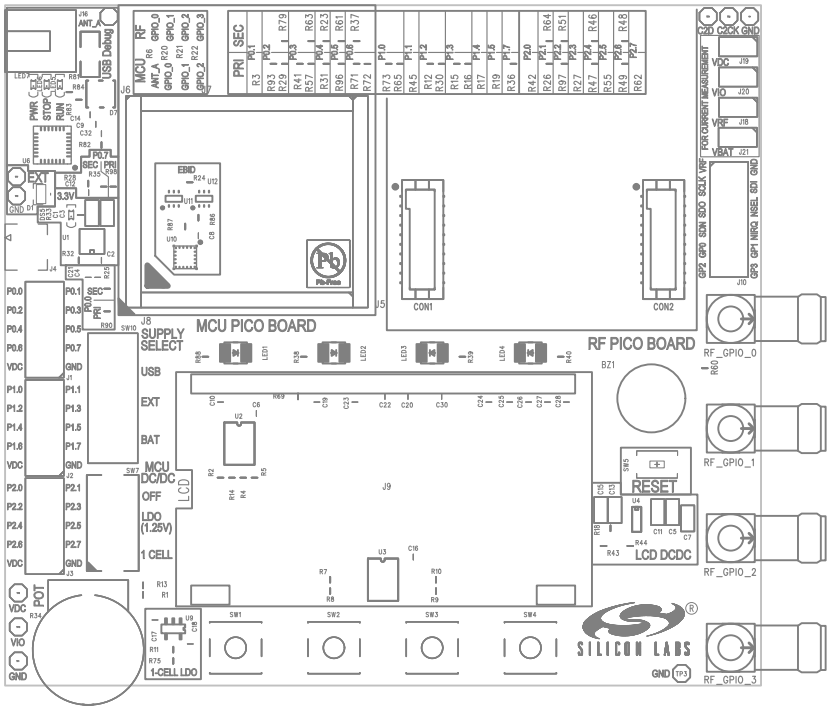


**Figure 1. Wireless Motherboard Top Markings**

1. Insert an RF Pico board into the connectors labeled as CON1 and CON2 on the Wireless Motherboard (WMB).
2. Insert a UPPI-930-RF MCU Pico Board into the connectors, J5, J6, J7, and J8, on the WMB. The dotted corner of the F930 MCU has to point to the triangle symbol on the WMB.
3. Connect the antenna to the SMA connector on the RF Pico Board.
4. Set the SUPPLY SELECT switch to the USB position.
5. Set the MCU DC/DC switch to the OFF position.
6. Ensure that all the CURRENT MEASUREMENT jumpers are in place.
7. Start the WDS on your PC.
8. Using one of the USB cables in the kit, connect the WMB to the PC.
9. If necessary wait for Windows to install the debug interface driver.
10. WDS must identify the connected board and open an Application Manager window that lists information about the identified board.
11. Boards are shipped without preloaded software. Sample codes can be configured and downloaded to the MCU from WDS. For details on how to use the WDS, see the WDS User's Guides listed in "4. Useful Documentation" on page 5".

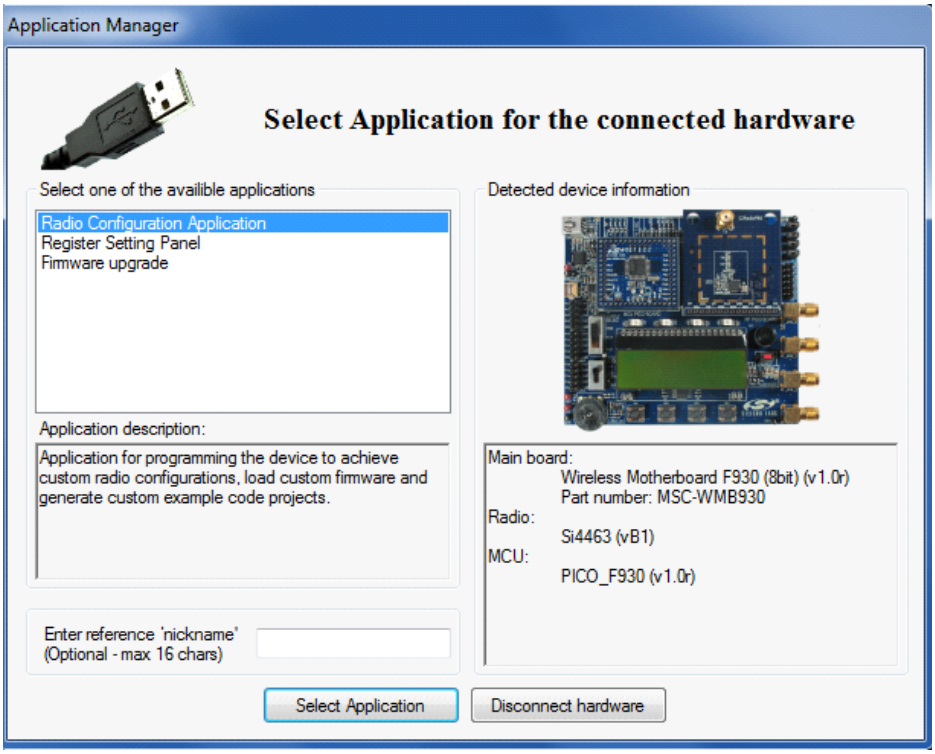


**Figure 2. WDS Application Manager Window**

Repeat steps 1 to 9 for the other node of the kit.

The two nodes are now ready for evaluation. Detailed descriptions of the example codes can be found in the programming guide listed in "4. Useful Documentation" on page 5.

The following is a quick-step guide to performing simple packet TX/RX.

1. Leave both nodes powered from the USB as described above.
2. Select “Radio Configuration Application”.
3. From the Radio Configuration Application window, select “Standard Packet TX” for one node and “Standard Packet RX” for the other node.
4. 4Leave the default parameter settings untouched; simply click “Download project”.
5. Now, the simple TX/RX sample project is running on the boards. When pressing one of the SW1 to SW4 buttons on the TX board, packets are sent, and the corresponding LED of LED1 to LED4 lights up during the transmission. On the RX side, LED1 is always on, while different combinations of LED2 to LED4 light up during successful packet reception according to the button pressed.

## 4. Useful Documentation

For general information on the EZRadioPRO chips, see the following data sheets:

- Si406x Data Sheet
- Si4362 Data Sheet
- Si446x Data Sheet

For hardware design guidance, see the following application notes:

- AN627: Si4060/Si4460/61 Low-Power PA Matching
- AN629: Si4460/61/63/64 RF ICs Layout Design Guide
- AN643: Si446x/Si4362 RX LNA Matching
- AN648: Si4063/Si4463/64 TX Matching

For detailed information on lab measurements and data sheet parameter verification, refer to the following application notes:

- AN655: Range Test Application for EZRadio® and EZRadioPRO®
- AN796: Wireless Development Suite General Description
- AN632: WDS User's Guide for EZRadioPRO® Devices

For detailed information on programming the radio, refer to the following documents:

- Si406x API Descriptions
- Si4362 API Descriptions
- Si446x API Descriptions
- AN633: Programming Guide for EZRadioPRO® Si4x6x Devices
- Download WDS3 installer
- Download Silicon Laboratories IDE installer

More useful documents can be accessed via the EZRadioPRO web pages at
http://www.silabs.com/products/wireless/EZRadioPRO/Pages/default.aspx

## 5. The Wireless Motherboard Hardware Platform

The wireless motherboard platform is a demo, evaluation, and development platform for EZRadioPRO radio ICs. It consists of a wireless motherboard and interchangeable MCU and RF pico boards.

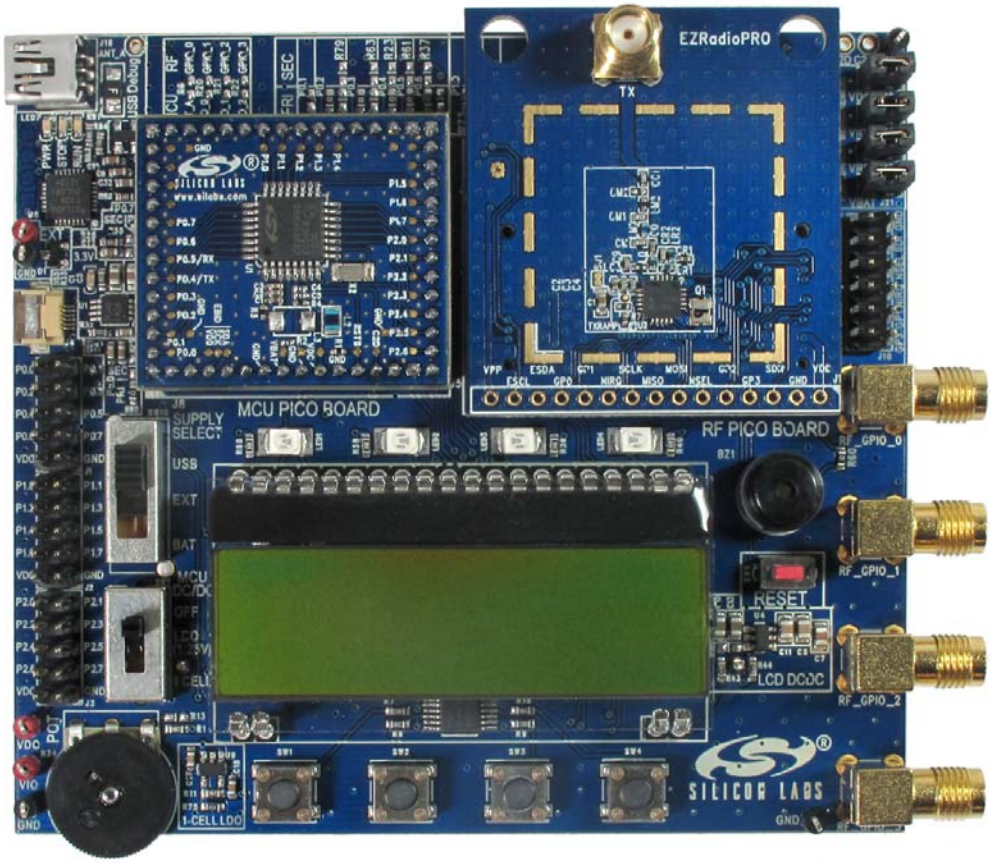


**Figure 3. 8-bit Wireless Motherboard Platform**

## 5.1. The Wireless Motherboard

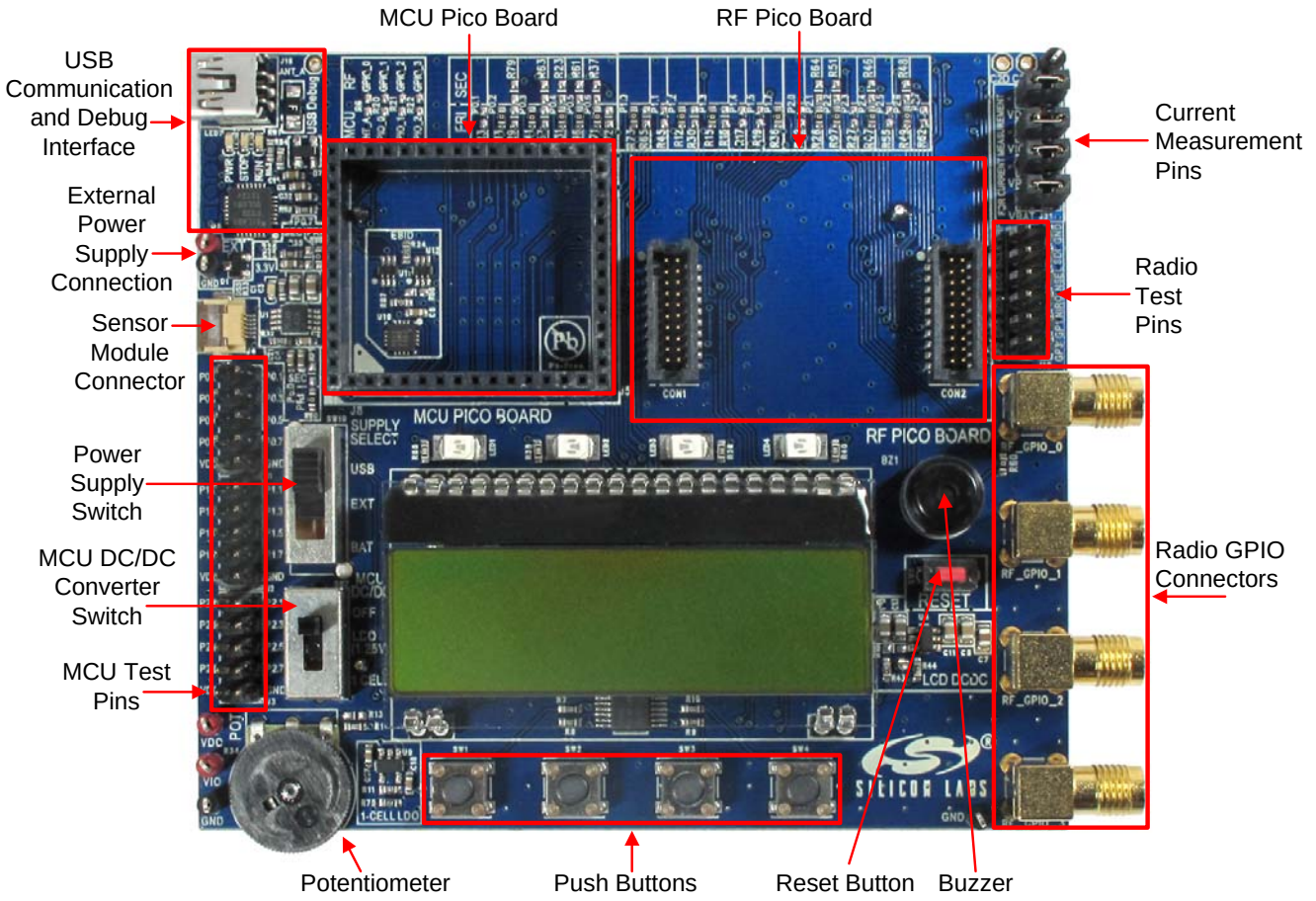


**Figure 4. Wireless Motherboard**

The wireless motherboard contains four pushbuttons, four LEDs, and a buzzer as simple user interfaces. A graphical LCD displays menu items for range testing purposes and a potentiometer demonstrates analog capabilities of the MCU. A switch supports the power options of the MCU's built-in dc/dc converter. Using the current measurement jumpers, current consumption can be measured separately either for the MCU, the radio, or the peripherals. The motherboard contains test pins for all I/O pins of the MCU and for all digital pins of the radio. In addition, there are SMA connectors for the GPIOs of the radio for test equipment connection. A USB communication interface as well as a built-in Silicon Labs USB-to-C2 debug adapter are integrated onto the board so that the wireless motherboard (WMB) can be directly connected via USB to the PC for downloading and debugging code on the MCU.

An interface connection towards sensor modules can also be found. The MCU is also connected to the RF pico board through a connector pair.

## 5.2. Power Scheme

The power source of the platform can be selected with the power supply selector switch “SUPPLY SELECT” on the WMB board. If this switch is in the ”USB” position, supply voltage is provided by the PC that is connected to the ”J16” mini USB connector. If this switch is in the ”BAT” position, the supply voltage is provided by two AA batteries in the battery holder on the bottom side of the board. If the ”SUPPLY SELECT” switch is in the ”EXT” position, supply voltage is provided by an external power source through the ”TP7” and “TP9” points.

Using the ”MCU dc/dc” switch, the internal dc/dc converter of the C88051F930 MCU on the MCU pico board can be activated if the connected pico board supports this function. If the switch is in ”OFF” position, the MCU's dc/dc converter is inactive and the supply voltage is only determined by the state of the “SUPPLY SELECT” switch.

Positioning the switch to either ”LDO (1.25 V)” or ”1 CELL” position will turn on the MCU's dc/dc converter by connecting 1.25–1.5 V supply voltage to the VBAT pin and removing external power from the VDC pin. The MCU will provide 1.9 V in default setting on its VDC pin to all the other connected loads. Since this current is limited, it may be necessary to disconnect or disable some loading part of the board. For further details, see the MCU data sheet and the board schematic. The board schematic can be found in the EZRadioPRO Development Kit User's Guide. A complete CAD design pack of the board is also available at www.silabs.com.

## 5.3. RF Pico Board

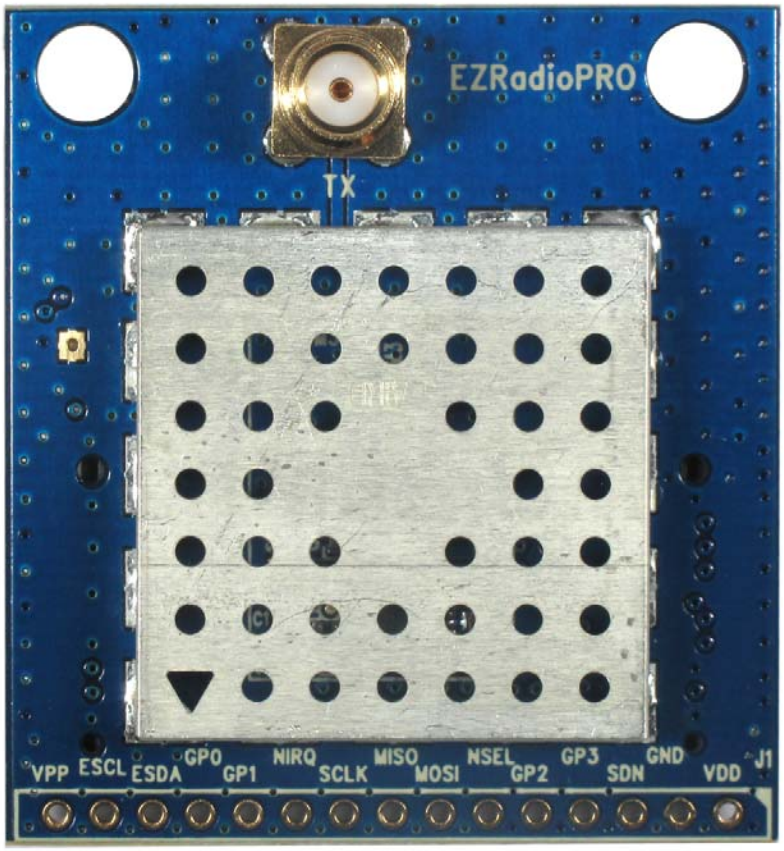


**Figure 5. RF Pico Board Front Side**

The RF pico board is a radio module that contains an EZRadioPRO radio IC, matching network and an SMA connector on the top side. These components apart from the antenna connector are covered by a metal shield for noise reduction. The digital signals of the radio (SCLK, SDI, SDO, NSEL, SCL, SDA, VDD and GND) can be accessed on test points at the edge of the board. The boards also have a factory loaded board identification memory (EBID) on the bottom side that contains data that describes the board properties. Via the unified RF pico connector pair on the bottom side of the board, any RF pico board can be connected to the WMB.

**Table 4. Connections between the WMB Board and the RF Pico Board**

| Si446x, Si4362, Si406x, Si4438 | | | WMB | | C8051F930 |
|---|---|---|---|---|---|
| **Pin Number** | **Pin Name** | **Pin Function** | **RF Pico board J1 connector** | **WMB Con2 connector** | **Pin Name** |
| EP,18 | GND | Ground | 2 | 1,2,19,20 | GND |
| 8 | VDD | Voltage Supply input | 1 | 17,18 | VDD |
| 11 | NIRQ | Interrupt output active low | 10 | 7 | P0.1 |
| 1 | SDN | Shutdown input active high | 3 | 8 | P2.3 |
| 15 | NSEL | SPI select input | 6 | 6 | P1.4 |
| 12 | SCLK | SPI clock input | 9 | 5 | P1.0 |
| 14 | SDI | SPI data input | 7 | 3 | P1.2 |
| 13 | SDO | SPI data output | 8 | 4 | P1.1 |
| 9 | GPIO_0 | General Purpose I/O | 12 | 11 | P2.6 (2nd) |
| 10 | GPIO_1 | General Purpose I/O | 11 | 12 | P1.3 |
| 19 | GPIO_2 | General Purpose I/O | 5 | 13 | P2.5 |
| 20 | GPIO_3 | General Purpose I/O | 4 | 14 | P2.4 |

The schematic of an RF Pico Board can be found in the next chapter. The complete CAD design pack of each RF pico board type is also available at www.silabs.com.

## 5.4. Setting up and Connecting the WMB to the PC

Steps for connecting the platform to the PC:

1. Connect an RF Pico Board to the WMB board through the CON1 and CON2 connectors.
2. Insert a UPPI-930-RF MCU pico board in the connectors J5, J6, J7, J8 on the WMB. The dotted corner of the C8051F930 MCU has to point to the triangle symbol on the WMB.
3. Connect an antenna to the SMA connector on the RF Pico Board.
4. Select the desired power source with the SUPPLY SELECT switch.
5. Ensure that all the CURRENT MEASUREMENT jumpers are in place.
6. Connect the WMB board to a USB port of the PC.
7. Wait for Windows to install the driver of the debug interface if necessary.

## 6. Wireless Motherboard Schematics

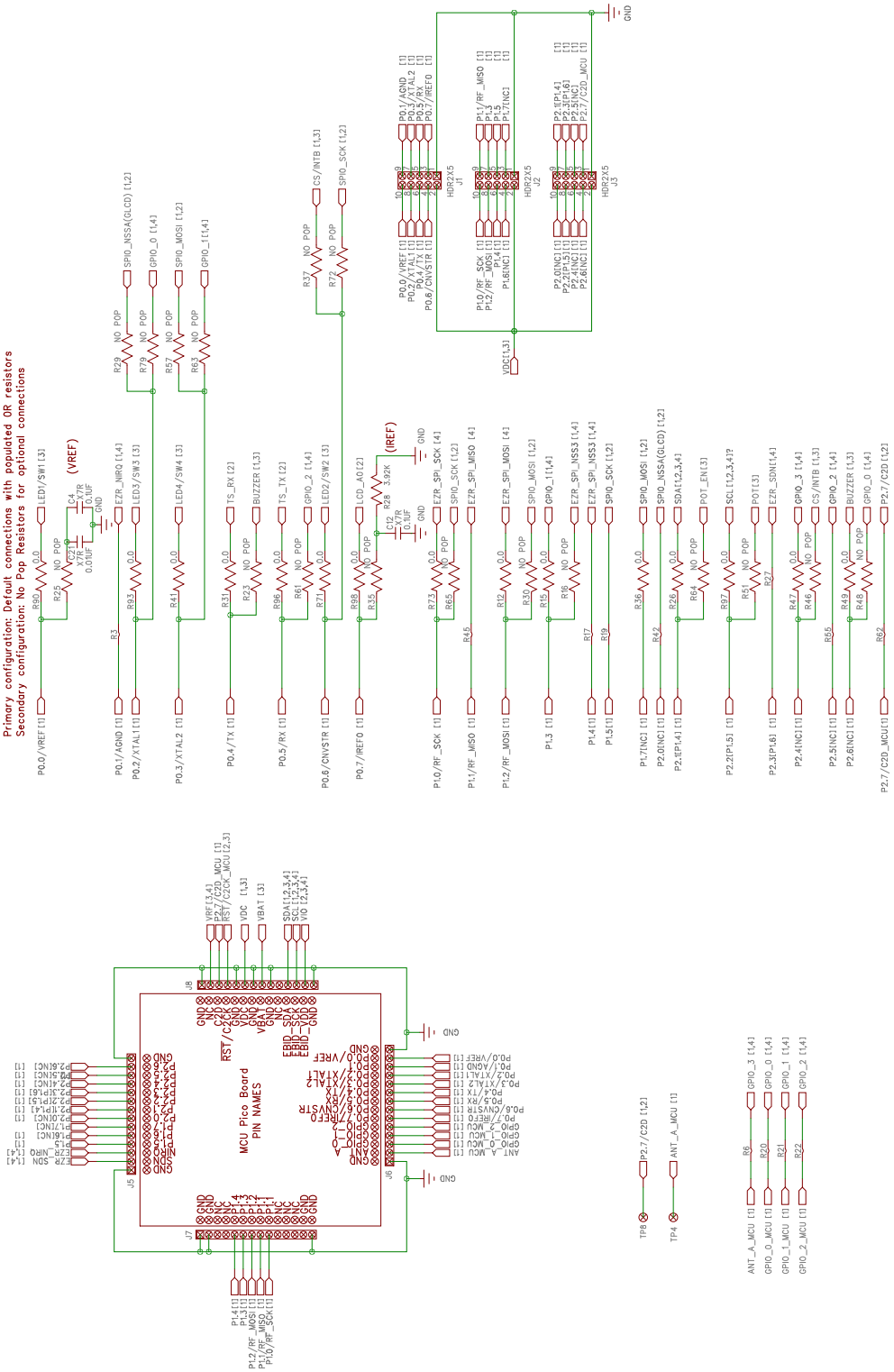


**Figure 6. Wireless Motherboard Schematic (1 of 4)**

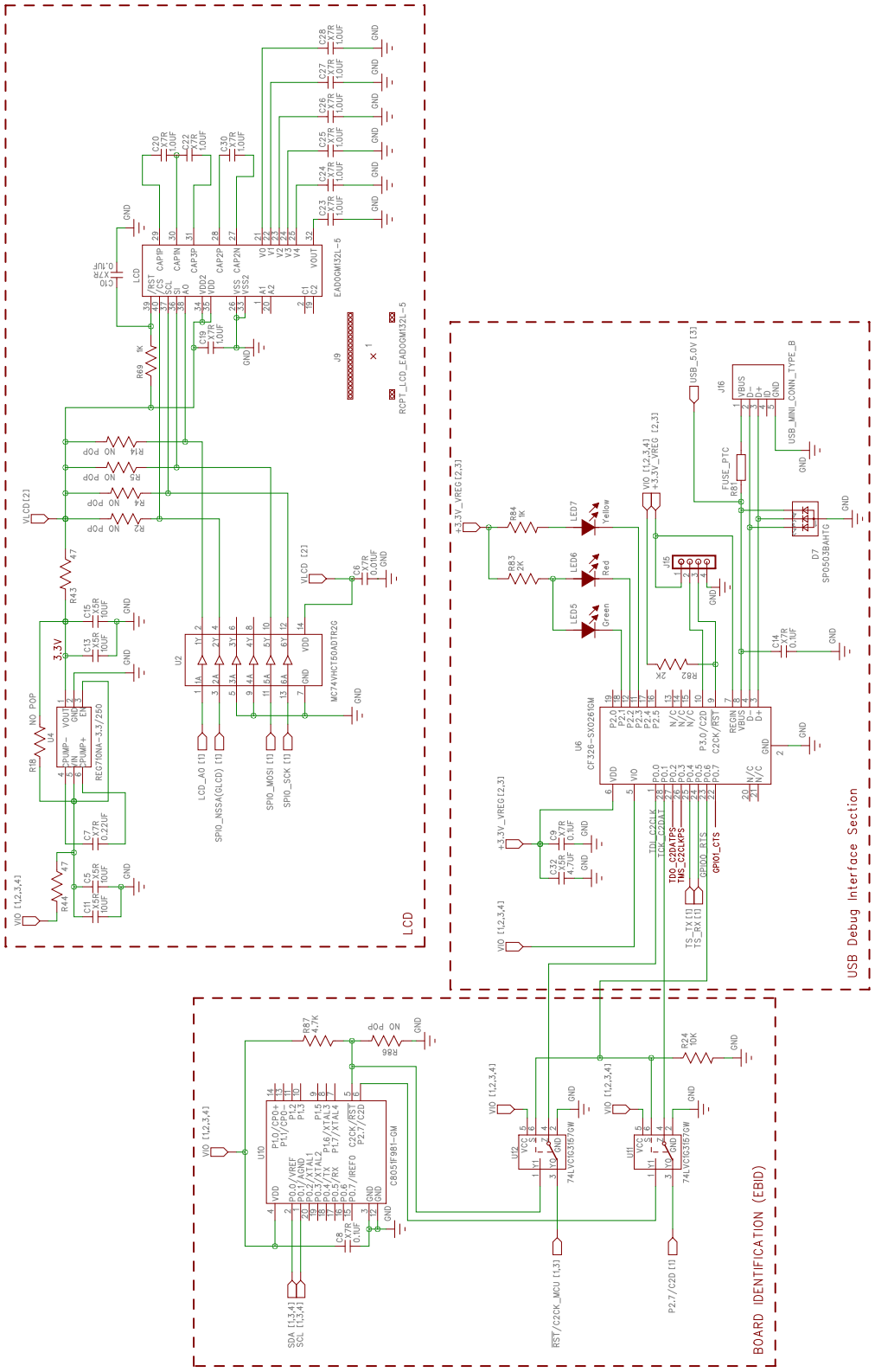


**Figure 7. Wireless Motherboard Schematic (2 of 4)**

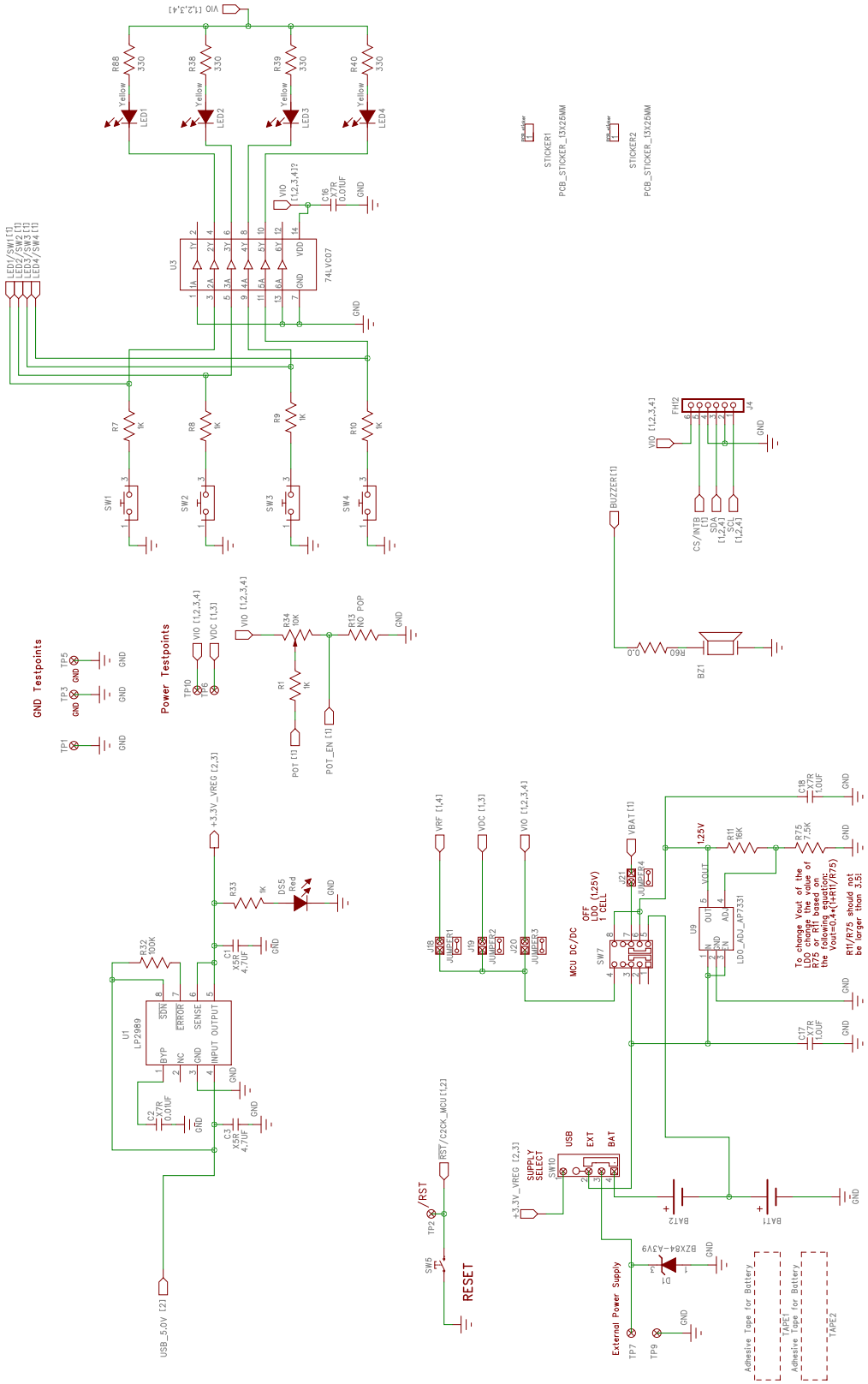


Figure 8. Wireless Motherboard Schematic (3 of 4)

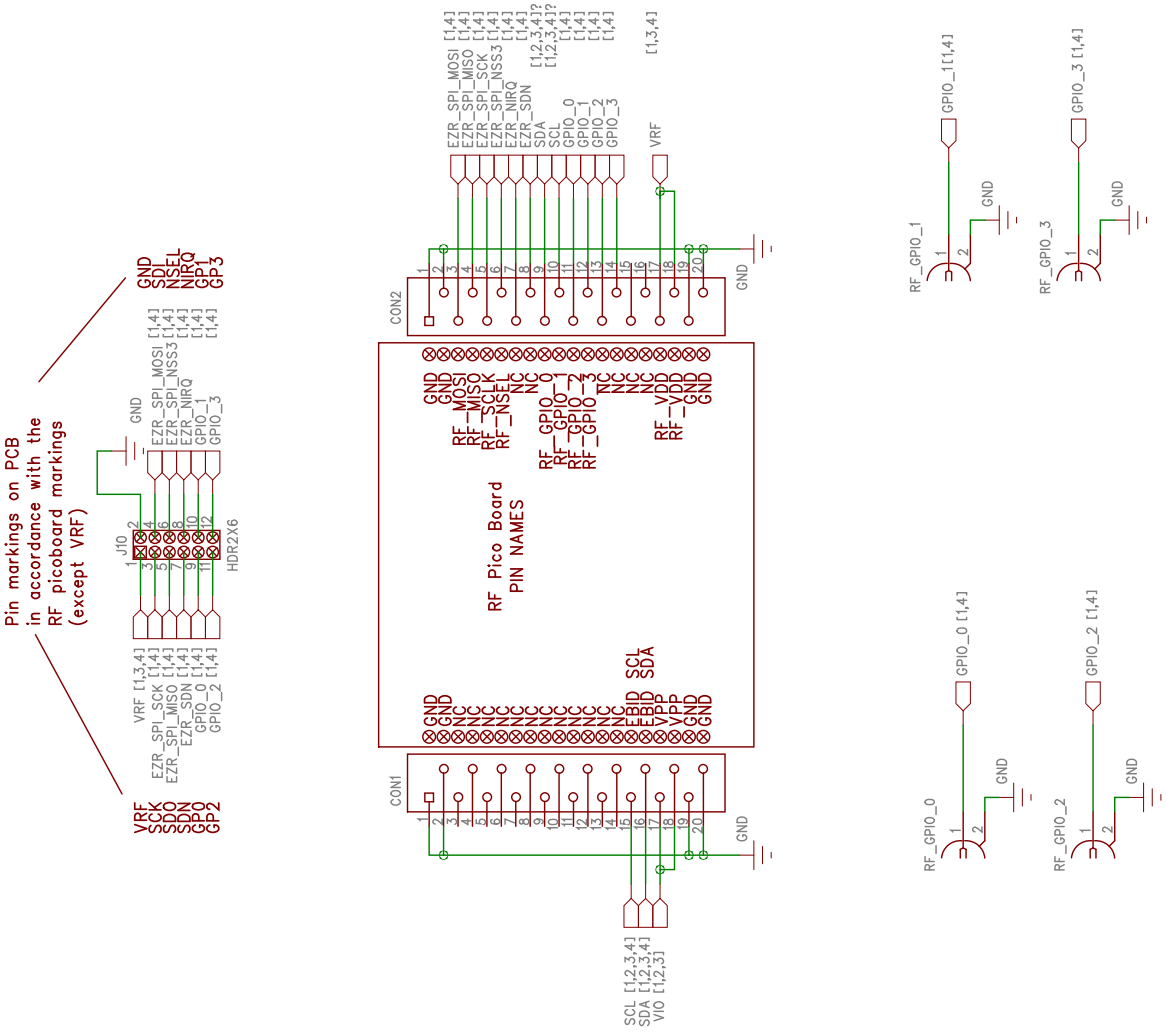


**Figure 9. Wireless Motherboard Schematic (4 of 4)**

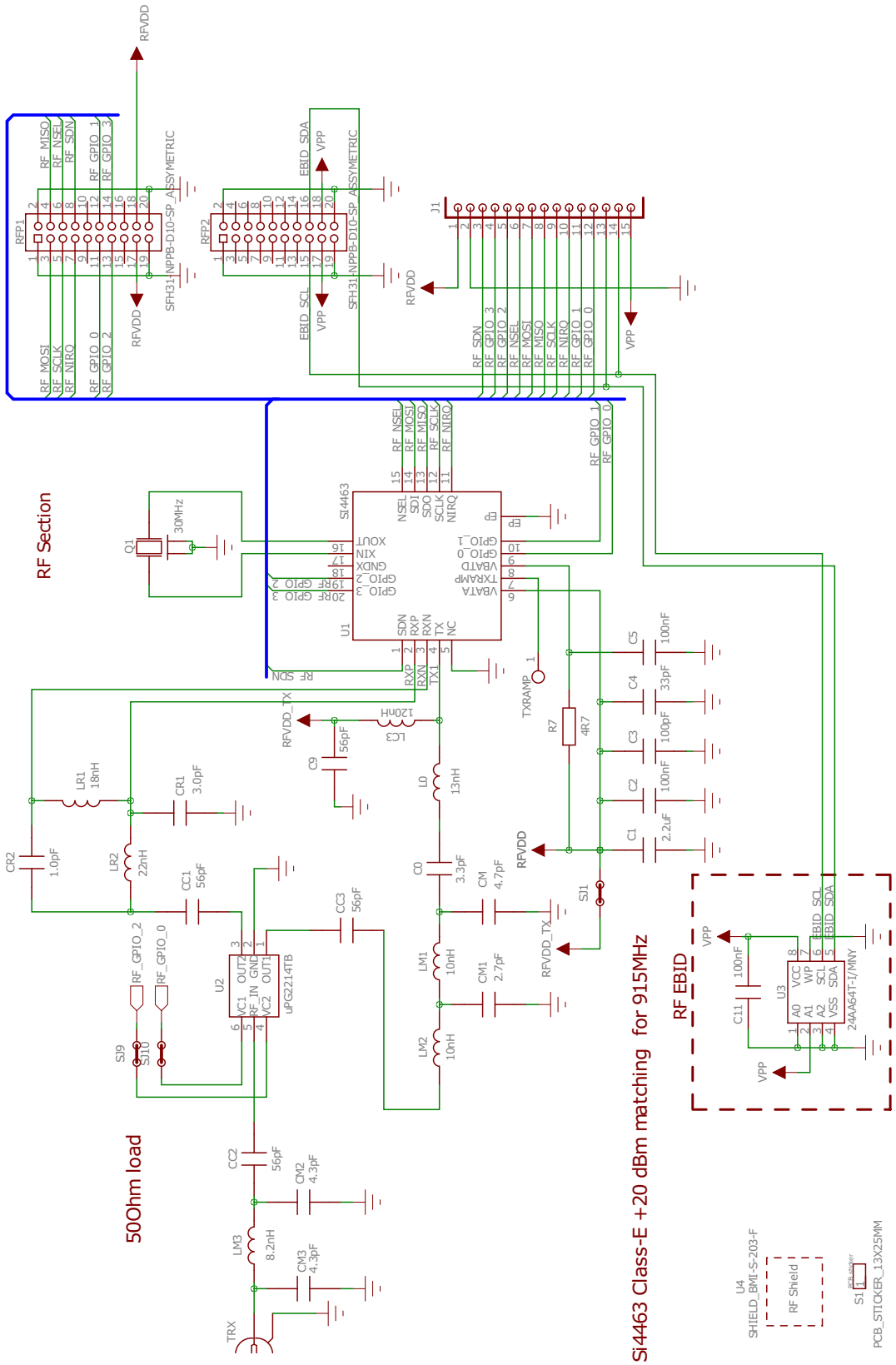


**Figure 10. RF Pico Board**

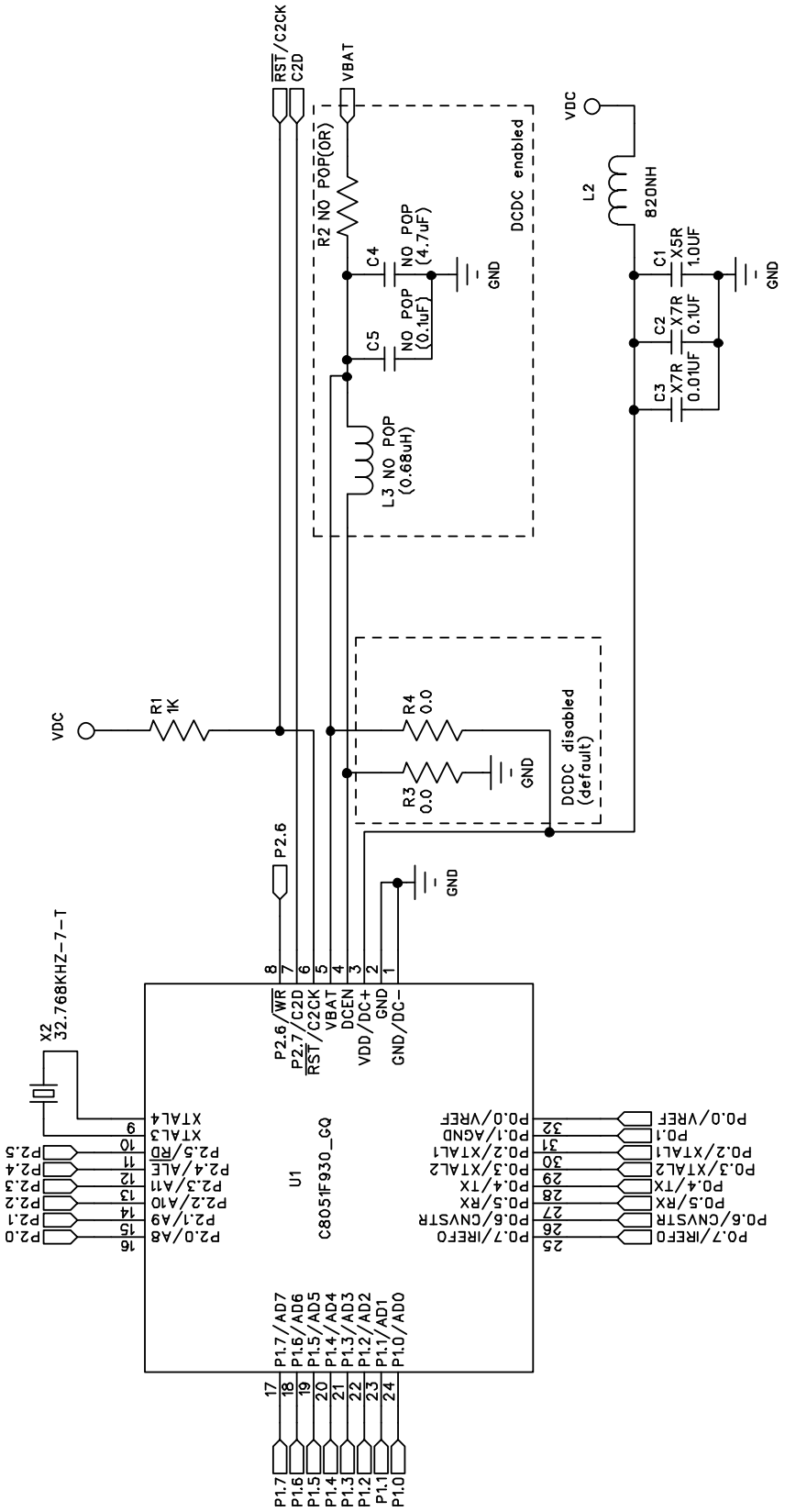


**Figure 11. UPPI-930-RF MCU Pico Board Schematic (1 of 2)**

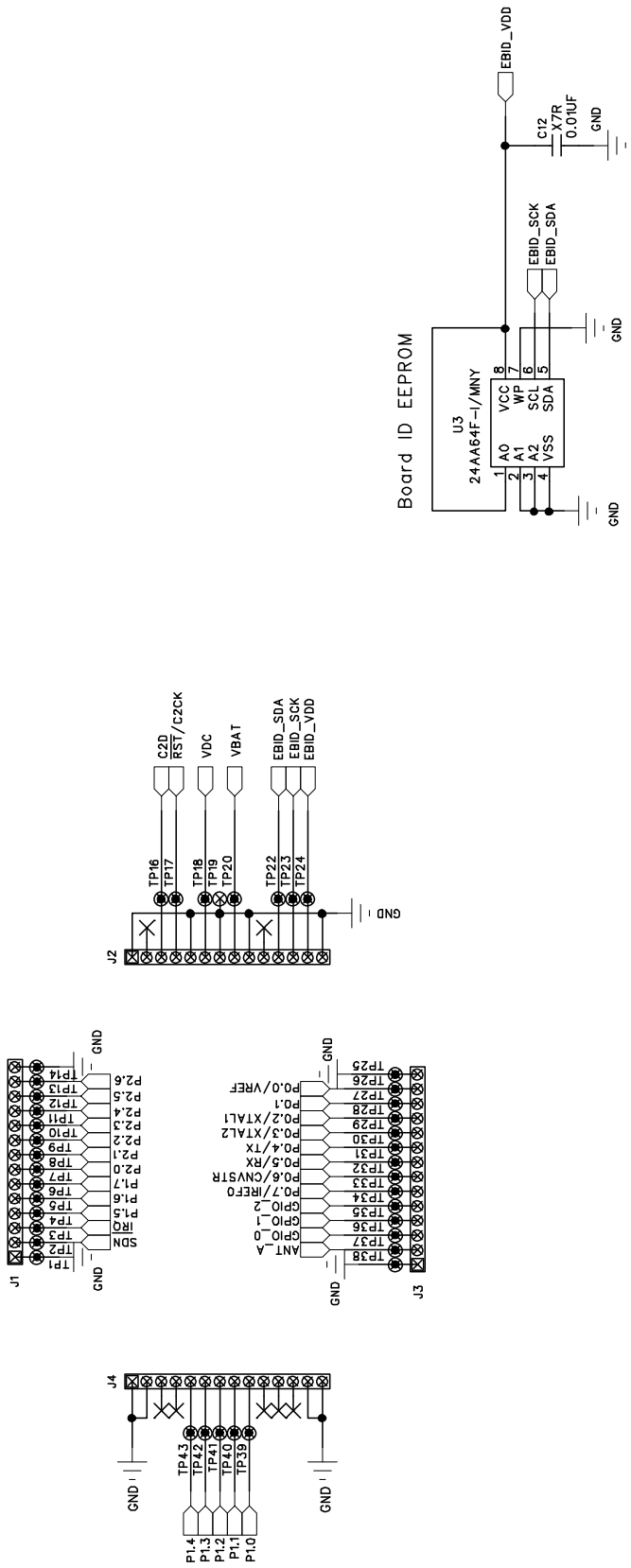


**Figure 12. UPPI-930-RF MCU Pico Board Schematic (2 of 2)**

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