



# EZRadio-DK User's Guide

## EZRADIO Si4455 TWO-WAY AND Si4012/Si4355 ONE-WAY LINK DEVELOPMENT KIT USER'S GUIDE

### 1. Kits Overview

This user's guide describes the development kits of the Silicon Labs' EZRadio<sup>®</sup> product family. Each kit contains two RF nodes based on the Wireless Motherboard (WMB) to support evaluation and development of sub-GHz RF links with the different EZRadio ICs. Table 1 lists the boards of the kits that use the latest C2A revision of the EZRadio ICs. Table 2 lists the boards of the obsolete kits that use the previous B1B revision of the EZRadio ICs. Table 3 lists the content that is common to all kits.

- The WMB has an LCD display and four LEDs to display information and four push-buttons to receive user commands. Additionally, the Silicon Labs Toolstick Base Adapter is integrated on the board to be easily connected to the PC for downloading and debugging user applications.
- The RF pico board provides connection to the radio device.
- The kits support use of the Wireless Development Suite (WDS) for setting radio parameters and managing sample codes.
- The kits support the use of the Silicon Laboratories Integrated Development Environment (IDE) for software debugging and the use of the Keil C compiler, assembler, and linker toolchain.

**Table 1. Development Boards of the EZRadio Development Kits**

| Qty | Description  | Part Number          |
|-----|--|----------------------|
|     | <b>Si4455 EZRadio Two-Way Link Development Kit 434 MHz</b> | <b>4455C-434-PDK</b> |
| 2   | Si4455 434 MHz RF Pico board with SMA connector            | 4455CPCE10D434M      |
| 2   | Wireless Motherboard                                       | MSC-WMB930           |
| 2   | C8051F930 MCU Pico Board                                   | UPPI-930-RF          |
|     | <b>Si4455 EZRadio Two-Way Link Development Kit 868 MHz</b> | <b>4455C-868-PDK</b> |
| 2   | Si4455 868 MHz RF Pico board with SMA connector            | 4455CPCE10D868M      |
| 2   | Wireless Motherboard                                       | MSC-WMB930           |
| 2   | C8051F930 MCU Pico Board                                   | UPPI-930-RF          |
|     | <b>Si4455 EZRadio Two-Way Link Development Kit 915 MHz</b> | <b>4455C-915-PDK</b> |
| 2   | Si4455 915 MHz RF Pico board with SMA connector            | 4455CPCE10D915M      |
| 2   | Wireless Motherboard                                       | MSC-WMB930           |
| 2   | C8051F930 MCU Pico Board                                   | UPPI-930-RF          |

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**Table 2. Development Boards of the Obsolete EZRadio Development Kits**

| Qty | Description   | Part Number         |
|-----|---|---------------------|
|     | <b>Si4455 EZRadio Two-Way Link Development Kit 434 MHz</b>        | <b>4455-434-PDK</b> |
| 2   | Si4455 434 MHz RF Pico board with SMA connector                   | 4455-PCE10D434M     |
| 2   | Wireless Motherboard  | MSC-WMB930          |
| 2   | C8051F930 MCU Pico Board  | UPPI-930-RF         |
|     | <b>Si4455 EZRadio Two-Way Link Development Kit 868 MHz</b>        | <b>4455-868-PDK</b> |
| 2   | Si4455 868 MHz RF Pico board with SMA connector                   | 4455-PCE10D868M     |
| 2   | Wireless Motherboard  | MSC-WMB930          |
| 2   | C8051F930 MCU Pico Board  | UPPI-930-RF         |
|     | <b>Si4455 EZRadio Two-Way Link Development Kit 915 MHz</b>        | <b>4455-915-PDK</b> |
| 2   | Si4455 915 MHz RF Pico board with SMA connector                   | 4455-PCE10D915M     |
| 2   | Wireless Motherboard  | MSC-WMB930          |
| 2   | C8051F930 MCU Pico Board  | UPPI-930-RF         |
|     | <b>Si4012/Si4355 EZRadio One-Way Link Development Kit 434 MHz</b> | <b>4012-434-PDK</b> |
| 1   | Si4355 434 MHz RF Pico board with SMA connector                   | 4355-PRXB434M       |
| 1   | Wireless Motherboard  | MSC-WMB930          |
| 1   | C8051F930 MCU Pico Board  | UPPI-930-RF         |
| 1   | Si4012 434 MHz RF Pico board with SMA connector                   | 4012-PSC10B434      |
| 1   | LCD Base Board  | MSC-LCDBB930-PER    |
|     | <b>Si4012/Si4355 EZRadio One-Way Link Development Kit 915 MHz</b> | <b>4012-915-PDK</b> |
| 1   | Si4355 915 MHz RF Pico board with SMA connector                   | 4355-PRXB915M       |
| 1   | Wireless Motherboard  | MSC-WMB930          |
| 1   | C8051F930 MCU Pico Board  | UPPI-930-RF         |
| 1   | Si4012 915 MHz RF Pico board with SMA connector                   | 4012-PSC10B915      |
| 1   | LCD Base Board  | MSC-LCDBB930-PER    |

**Table 3. Common Kit Content**

| Qty | Description                          | Part Number  |
|-----|--------------------------------------|--------------|
| 2   | USB cable (USBA-USB mini)            |              |
| 2   | Antenna with SMA connection          | MSC-AT50-XXX |
| 4   | AA Battery                           |              |
| 1   | EZRadio Development Kit User's Guide |              |

## 2. Software Setup

There are two software tools provided by Silicon Labs to aid in EZRadio software development: the Wireless Development Suite (WDS) and the Silicon Labs Integrated Development Environment (IDE). The recommended starting point for EZRadio 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

- 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 permission.

### 2.2. Download WDS

The WDS can be obtained from the Silicon Labs website free of charge. For more information, see links in "4. Useful Documents" on page 6.

### 2.3. Installation Steps

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

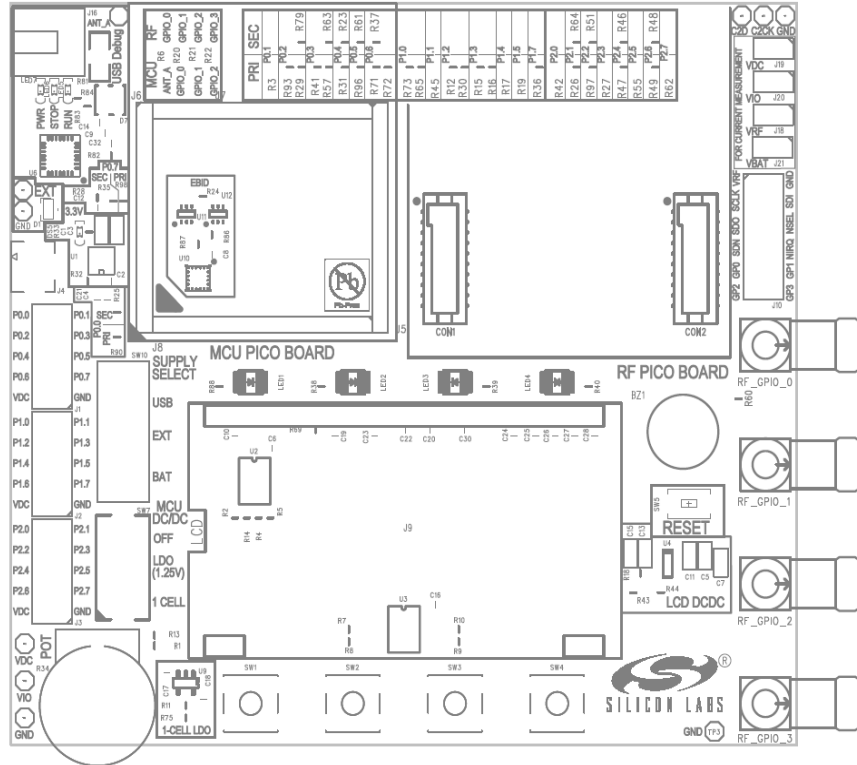
1. Start WDS3-Setup.exe
2. Click "Next" to start the installation process
3. Accept the license agreement by clicking the check box, and then press the "Next" button.
4. Select the installation folder.  
It is recommended to use the default folder, C:\Program Files\Silabs\WDS3
5. When your settings are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

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## 3. Hardware Setup

### 3.1. Si4355/4455 Nodes

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 WMB.
2. Insert an MCU Pico Board into the connectors, J5, J6, J7, and J8, on the WMB. Align the triangle symbol on the MCU Pico board or the dotted corner of the MCU with 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 USB position.
5. Set the MCU DC/DC switch to the OFF position.
6. Ensure that all the CURRENT MEASUREMENT jumpers (J18-J21) 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. Wait for Windows to install the driver of the debug interface if necessary.
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 WMCU from WDS. For details on how to use the WDS, see the WDS User's Guides listed in "4. Useful Documents" on page 6.

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 Documents" on page 6. 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. Leave 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.

## 3.2. Si4012 Node

1. Insert the Si4012 RF Pico board into the connectors labeled as RFP1 and RFP2 on the LCD Base Board.
2. Connect the antenna to the SMA connector on the RF Pico Board
3. Set the SUPPLY SELECT switch (SW1) to USB position
4. Start the WDS on your PC
5. Using one of the USB cables in the kit, connect the Base Board to the PC.
6. If necessary wait for Windows to install the debug interface driver.
7. WDS must identify the connected board and open an Application Manager window that lists information about the identified board.
8. Boards are shipped without preloaded software. Sample codes can be configured and downloaded to the MCU from WDS. For details of how to use the WDS see the WDS User's Guides listed in "Section 4. Useful documents".

The node is now ready for evaluation. Detailed description of the example codes can be found in the Si4012 programming guide listed in "Section 4. Useful documents".

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

1. Leave the node powered from USB as described above.
2. Select Radio Configuration Application
3. Set the Center Frequency to the value selected (or default) on the receiver node.
4. On the lower part of the Radio Configuration Application window select Packet TX sample project
5. Leave other default parameter settings untouched, just click "Load firmware".

Now the Packet TX sample project is running on the board. When pressing one of SW1, SW2 or SW3 buttons on the board, packets are sent and the corresponding LED of LED1, LED2 or LED3 lights up after the transmission.

On the RX side, the corresponding LED lights up during successful packet receptions.

A description of the LCD Base Board can be found in "[AN746: Si4012 Programming Guide.](#)" A complete CAD design pack plus PDF schematic is also available on the Si4012 product page of [www.silabs.com](http://www.silabs.com).

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## 4. Useful Documents

For general information on the EZRadio ICs, see the following data sheets:

- [Si4355 Data Sheet](#)
- [Si4455 Data Sheet](#)
- [Si4012 Data Sheet](#)

For detailed information on how to program the EZRadio ICs, refer to the following documents:

- [AN692: Si4355/4455 Programming Guide and Sample Codes](#)
- [AN746: Si4012 Programming Guide](#)
- [EZRadio API Documentation](#)

Available Tools:

- [Silicon Laboratories IDE installer](#)
- [WDS3 installer](#)

For hardware design guidance, see the following application notes:

- [AN685: Layout Design Guide for the Si4455/4355 RF ICS](#)
- [AN686: Antennas for the Si4455/4355 RF ICs](#)
- [AN693: Si4455 Low-Power PA Matching](#)

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

- [AN655: Range Test Application for the EZRadio and EZRadioPRO devices](#)
- [AN796: Wireless Development Suite General Description](#)
- [AN797: WDS User's Guide for EZRadio Devices](#)

A complete CAD design pack of all development boards and other useful documents can be accessed via the EZRadio web pages at [www.silabs.com](http://www.silabs.com).

## 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.

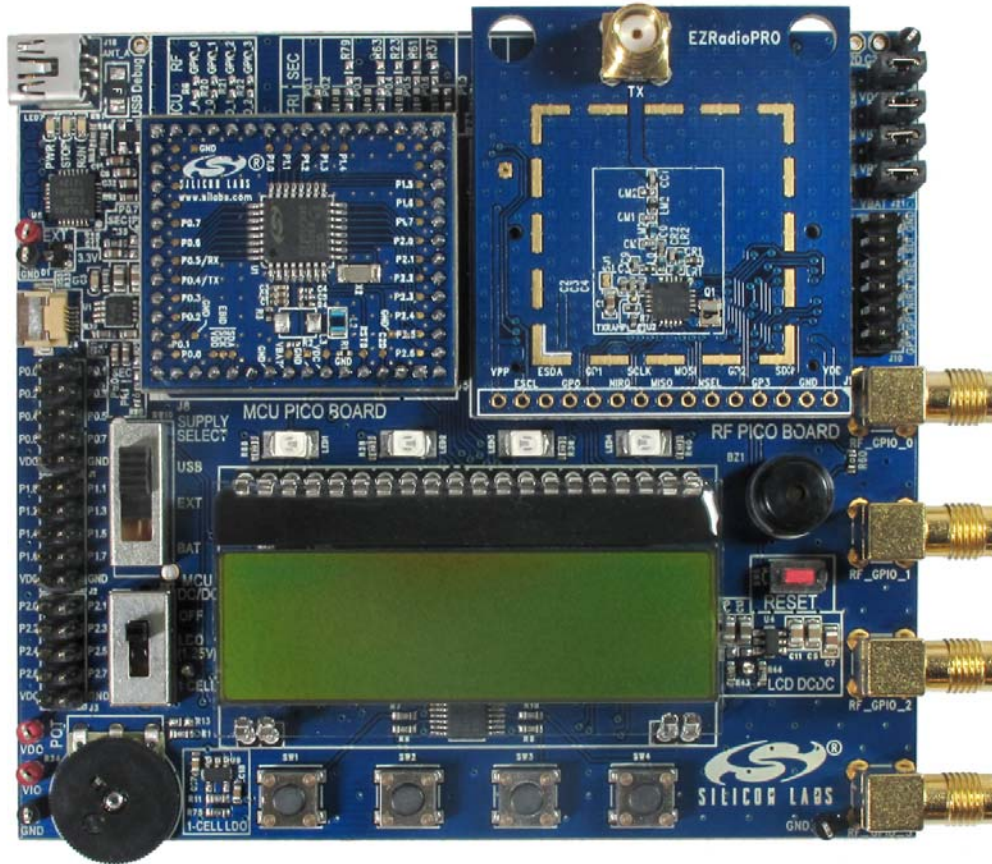
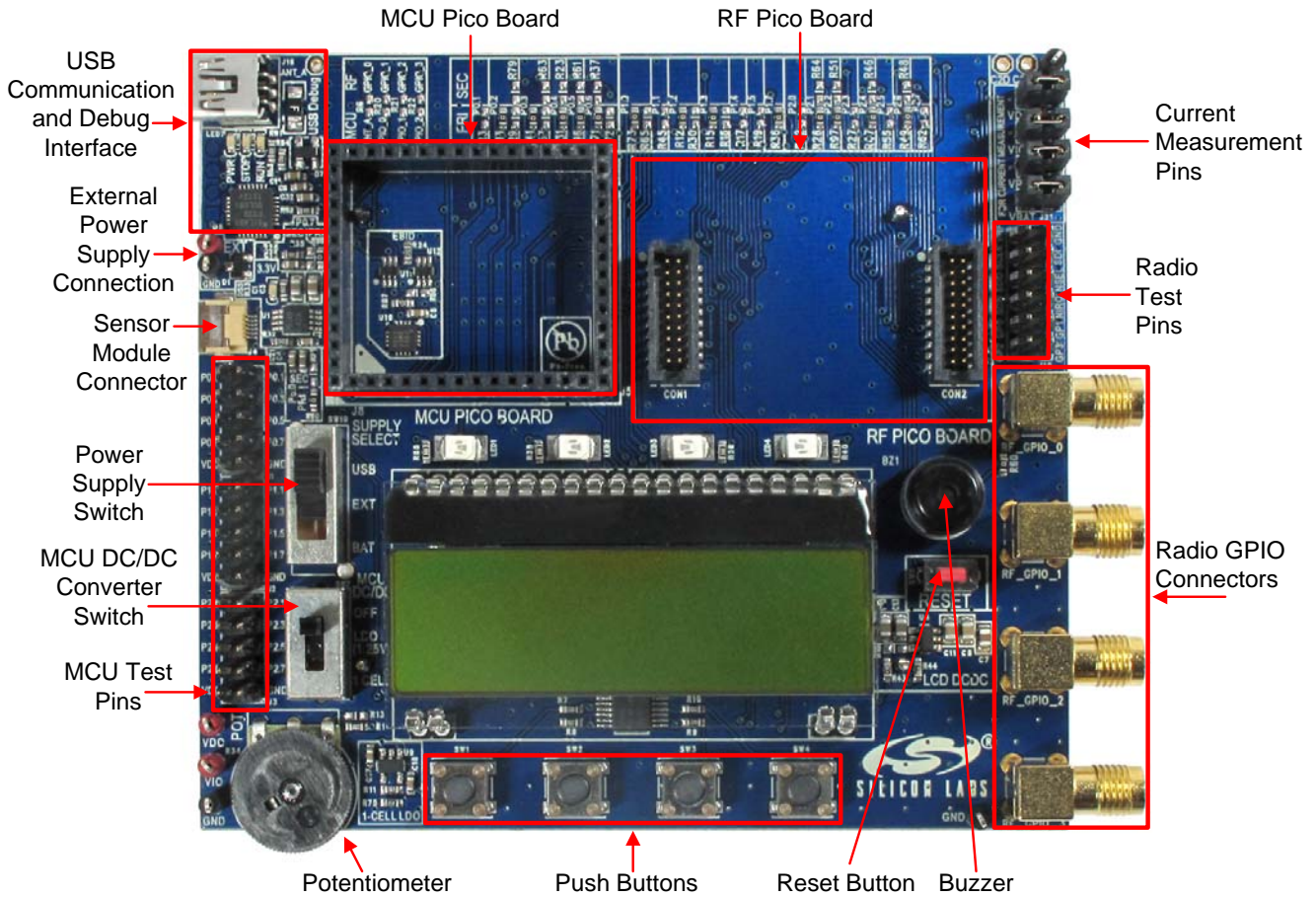


Figure 2. 8-Bit Wireless Motherboard Platform



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## 5.1. The Wireless Motherboard



**Figure 3. Wireless Motherboard**

The wireless motherboard contains four pushbuttons, four LEDs, and a buzzer, which function as simple user interfaces. A graphical LCD displays menu items for range testing purposes, and a potentiometer demonstrates the 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 connection of test equipment. 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. There is also an interface connection for sensor modules. The MCU is also connected to the RF pico board through a connector pair.



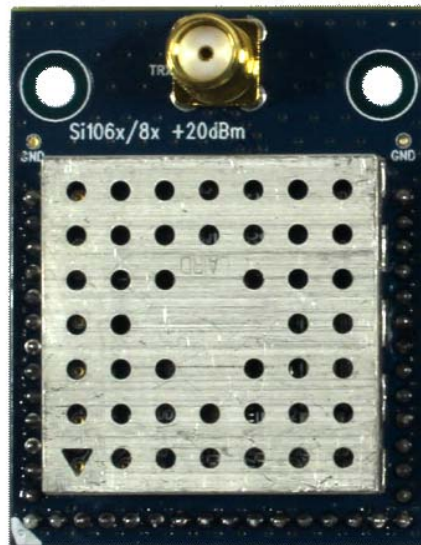
## 5.2. Power Scheme

The power source of the platform can be selected with the “SUPPLY SELECT” power supply selector switch 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 the “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 the 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](http://www.silabs.com).

## 5.3. RF Pico Board



**Figure 4. RF Pico Board Top Side**

The RF pico board is a radio module that contains an EZRadio 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 describing the board properties. Any RF Pico board can be connected to the WMB via the unified RF Pico connector-pair on the bottom side of the board. Table 4 lists the connections between the MCU and the radio or other peripherals.

Some GPIOs of the MCU has dual function. Primary functions are factory connected on the WMB. Secondary functions can be connected by desoldering a 0  $\Omega$  resistor that connects the primary function and soldering it into the proper position to connect the secondary function. Secondary connections are listed in parenthesis in Table 4.

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**Table 4. MCU, Radio, and Peripheral Connections**

| Si4x55 Pin | Si4012 Pin | Name                | RF Pico Board J1 | WMB CON2  | C51F930 Pin | 0 $\Omega$ Resistor |
|------------|------------|---------------------|------------------|-----------|-------------|---------------------|
| EP,1,6,9   | 2          | GND                 | 2                | 1,2,19,20 | GND         |                     |
| 7,8        | 5          | VDD                 | 1                | 17,18     | VDD         |                     |
| 12         |            | NIRQ                | 10               | 7         | P0.1        |                     |
| 2          |            | SDN                 | 3                | 8         | P2.3        |                     |
| 16         |            | NSEL                | 6                | 6         | P1.4        |                     |
| 13         |            | SCLK                | 9                | 5         | P1.0        |                     |
| 15         |            | SDI                 | 7                | 3         | P1.2        |                     |
| 14         |            | SDO                 | 8                | 4         | P1.1        |                     |
| 10         |            | GPIO_0              | 12               | 11        | (P2.6)      | (R48)               |
| 11         |            | GPIO_1              | 11               | 12        | P1.3        |                     |
| 19         |            | GPIO_2              | 5                | 13        | P2.5        |                     |
| 20         |            | GPIO_3              | 4                | 14        | P2.4        |                     |
|            | 10         | SDA                 | 3                | 9         | P2.1        | R26                 |
|            | 9          | SCL                 | 4                | 10        | P2.2        | R97                 |
|            | 7          | NIRQ                | 6                | 7         | P0.1        |                     |
|            | 8          | SDN                 | 5                | 8         | P2.3        |                     |
|            |            | SW1/LED1            |                  |           | P0.0        | R90                 |
|            |            | SW2/LED2            |                  |           | P0.6        |                     |
|            |            | SW3/LED3            |                  |           | P0.2        |                     |
|            |            | SW4/LED4            |                  |           | P0.3        |                     |
|            |            | BUZZER              |                  |           | P2.6        | R49                 |
|            |            | TS_RX               |                  |           | P0.4        |                     |
|            |            | TS_TX               |                  |           | P0.5        |                     |
|            |            | LCD_A0              |                  |           | P1.6        | R98                 |
|            |            | SPI0_SCK            |                  |           | P1.5        |                     |
|            |            | SPI0_MISO           |                  |           | P1.6        |                     |
|            |            | SPI0_MOSI           |                  |           | P1.7        |                     |
|            |            | SPI0_NSSA<br>(GLCD) |                  |           | P2.0        |                     |
|            |            | VREF                |                  |           | (P0.0)      | (R25)               |
|            |            | IREF                |                  |           | (P1.6)      | (R35)               |
|            |            | POT_EN              |                  |           | (P2.1)      | (R64)               |
|            |            | POT                 |                  |           | (P2.2)      | (R51)               |
|            |            | CS/INTb             |                  |           | P2.4        |                     |

## 6. Board Schematics

The complete design pack of all RF Pico boards and all WMBs can be found at [www.silabs.com](http://www.silabs.com).

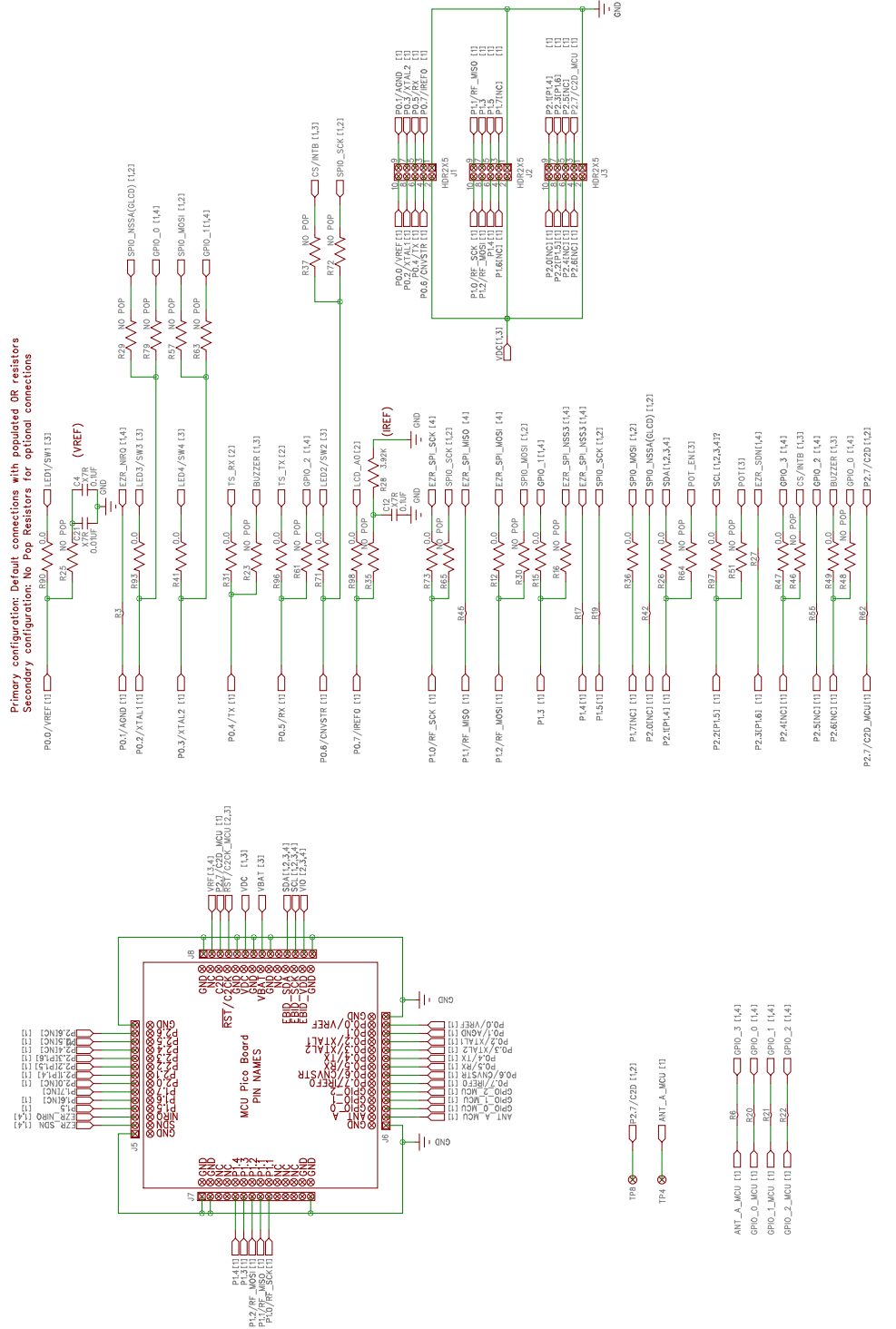


Figure 5. Wireless Motherboard Schematic (1 of 4)

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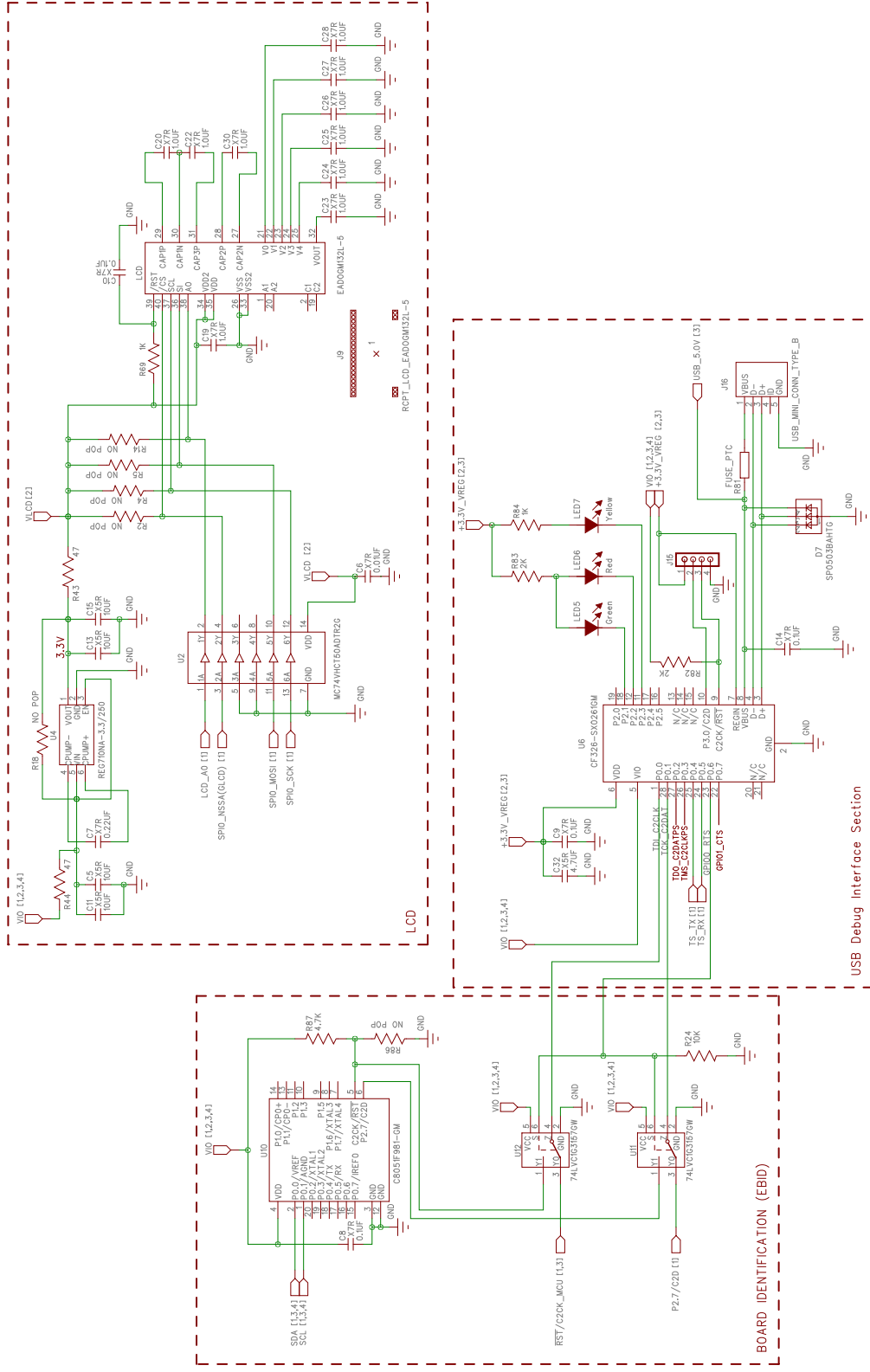


Figure 6. Wireless Motherboard Schematic (2 of 4)







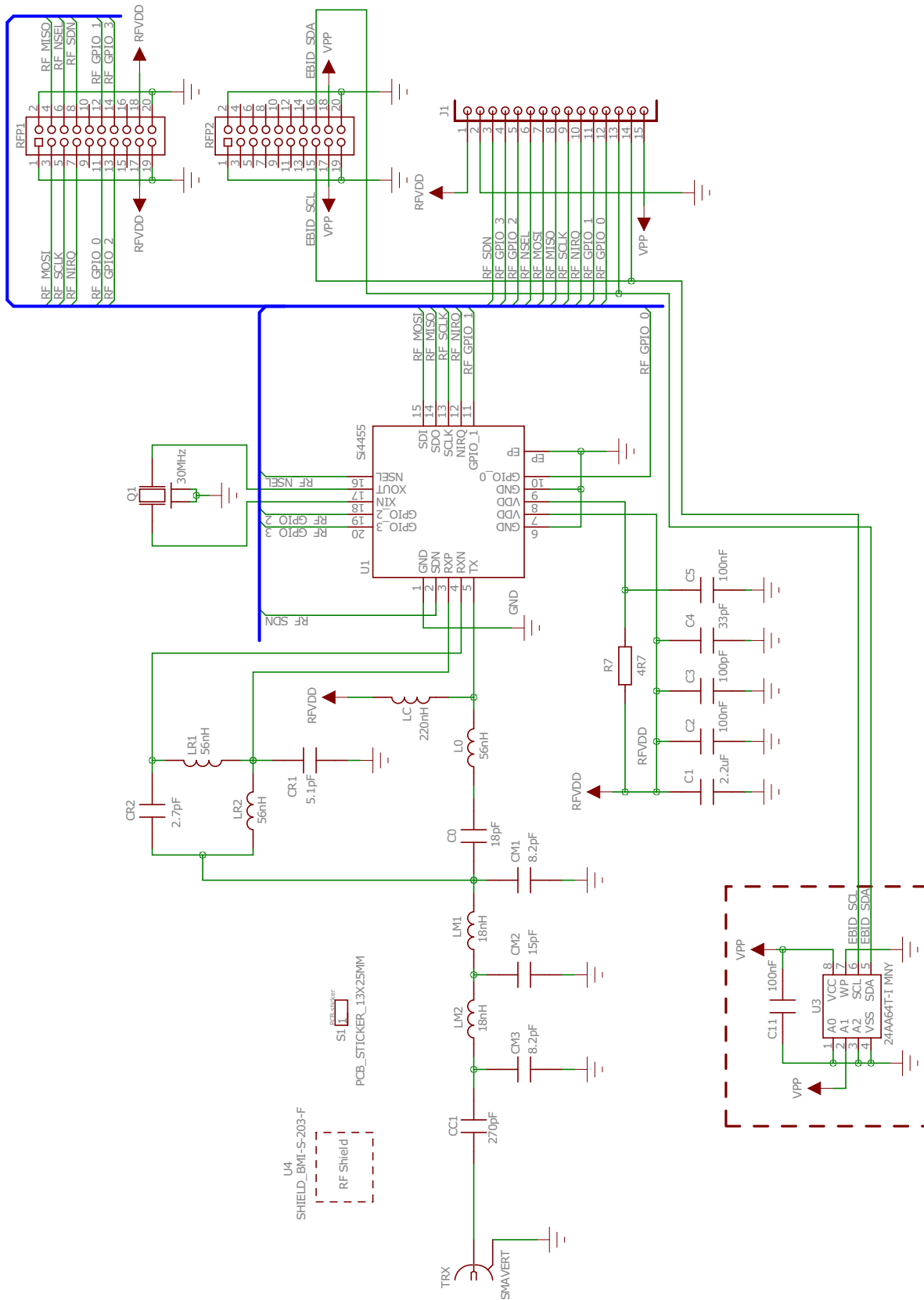


Figure 9. 4455-PCE10D434M RF Pico Board Schematic

## RF Section Matching network for 915MHz with wirewound inductors

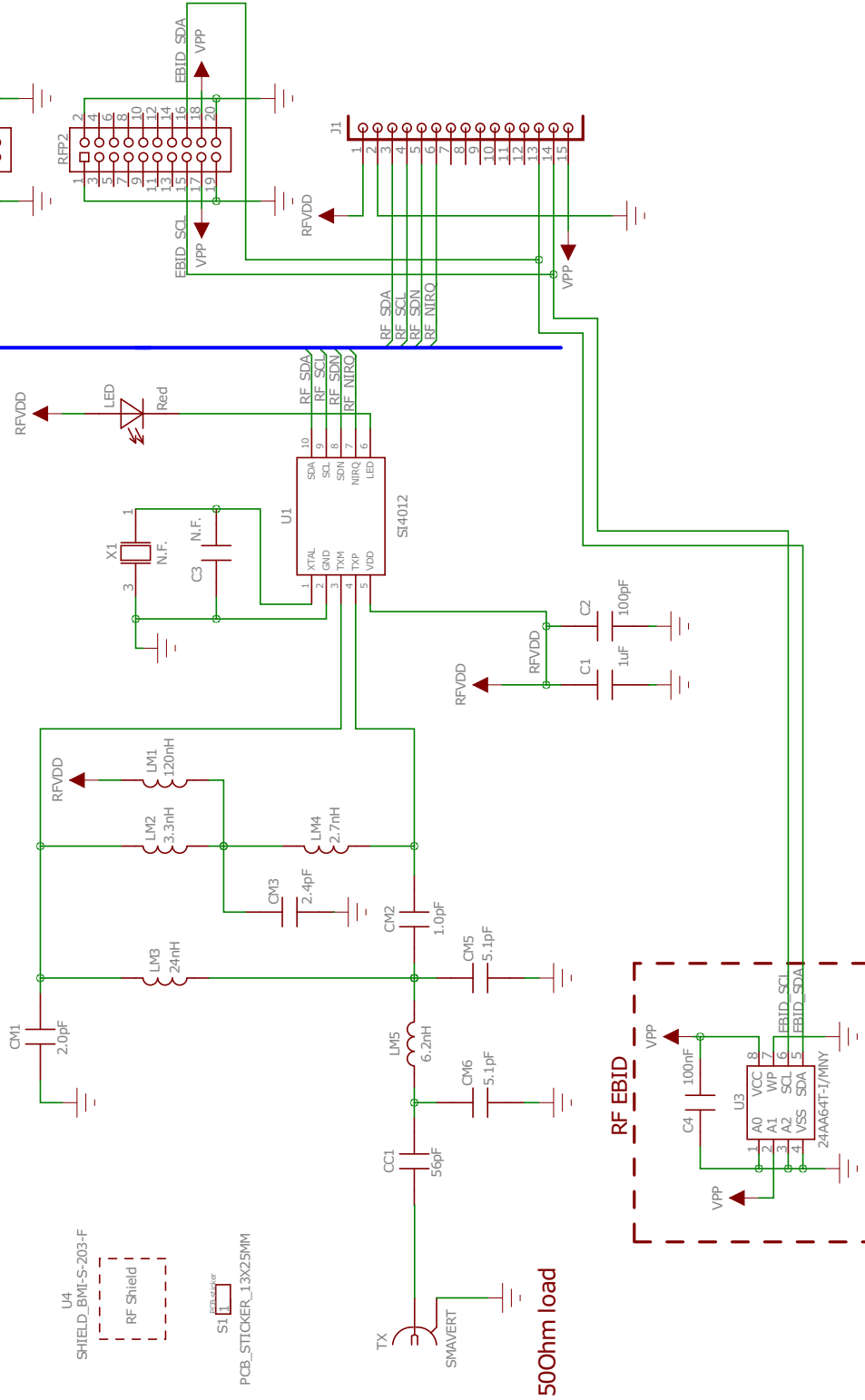
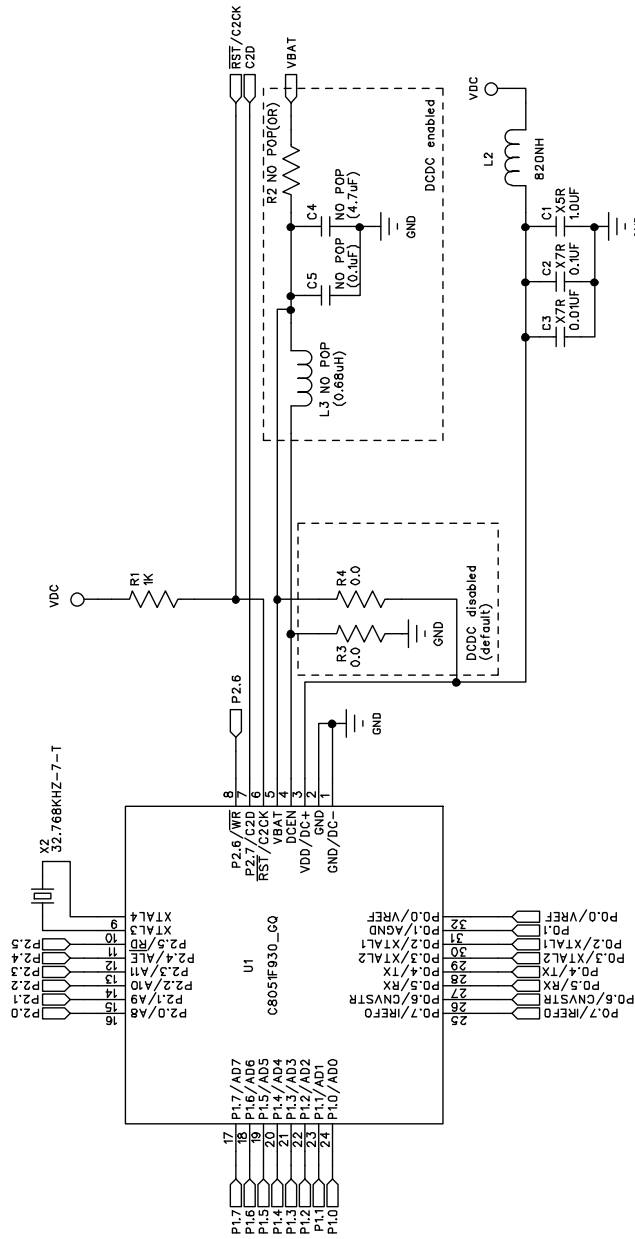


Figure 10. 4012-PSC10B915 RF Pico Board Schematic



| DCDC Configuration |                        |                           |
|--------------------|------------------------|---------------------------|
| DC supply: VBAT    | DCDC enabled           | DCDC disabled             |
| DC supply: VDC     | 0.9-1.8V in            | not connected             |
| R2-C4-C5-L3        | 1.8-3.3V out populated | 1.8-3.6V in not populated |
| R3-R4              | not populated          | populated                 |

Figure 11. UPPI-930-RF MCU Pico Board Schematic



## Simplify Studio

One-click access to MCU tools, documentation, software, source code libraries & more. Available for Windows, Mac and Linux!

[www.silabs.com/simplify](http://www.silabs.com/simplify)



**MCU Portfolio**  
[www.silabs.com/mcu](http://www.silabs.com/mcu)



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