QBLUE Development Kit

QN902x Evaluation Board User Guide

Version 0.4

Table of Contents

1. Introduction

QN902x is an ultra low power, high performance and highly integrated Bluetooth v4.0 Low Energy (BLE) solution for Bluetooth Smart applications. The Evaluation board provides users the environment for evaluating QN902x device performance and testing, which has a QN902x chip mounted on the PCB with the required decoupling capacitor, 16M crystal, RF matching components, SMA connector, GPIO connector, Supply Voltage connector and other parts.

1.1 About this manual

This manual contains the hardware description of QN902x BLE Evaluation Board in QBLUE Development Kit. It starts with a quick overview of the QN902x EVB, followed by the hardware details of the board. Also the schematics and PCB silkscreen of the QN902x EVB are included.
The two versions of QN902x BLE Evaluation Boards which are named QN9020EVB_V4.3 and QN9020EVB_V4.4 will be described in the following parts.

1.2 Acronyms and Abbreviations

BLE	Bluetooth Low Energy
SMA	Surface Mount Assembly
PCB	Printed Circuit Board
GPIO	General Purpose Input Output
EVB	Evaluation Board

2. QN9020 Evaluation Board Overview

The photos of QN9020EVB_V4.3 both sides are shown in Figure 1, as well as the detailed components PCB placement in Figure 2, and components list in Table 1.

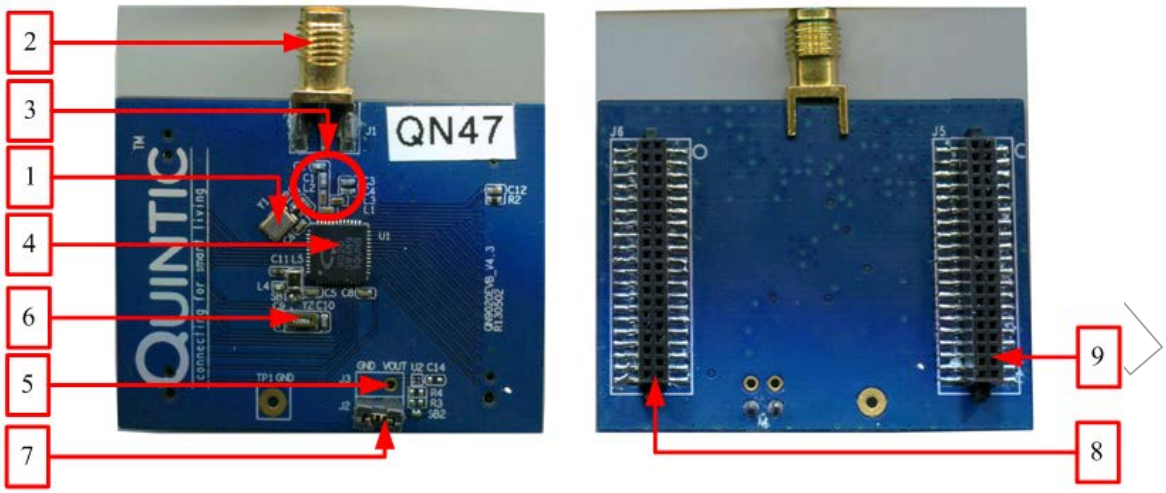

Figure 1 QN9020EVB_V4.3 Overview

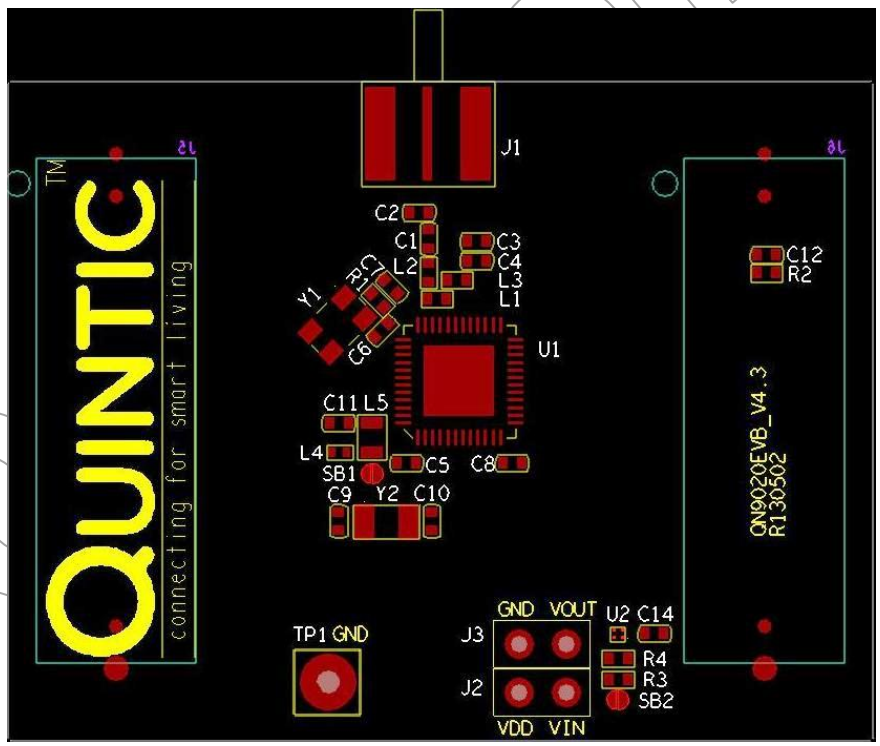

Figure 2 QN9020EVB_V4.3 PCB Placement

Table 1 QN902x EVB Component List

Number	Component	Description
1	Y1	16M crystal
2	J1	SMA connector. Connecting Antenna or cable for testing
3	RF matching circuit	RF matching circuit
4	U1	QN9020 device
5	J3	Header for connecting Voltmeter.
6	Y2	External 32.768KHz clock
7	J2	Power supply header for QN9020.
8	J6	Connector. Used for connecting mother board
9	J5	Connector. Used for connecting mother board

The photos of QN9020EVB_V4.4 both sides are shown in Figure 3, as well as the detailed components PCB placement in Figure 4, and components list in Table 2.

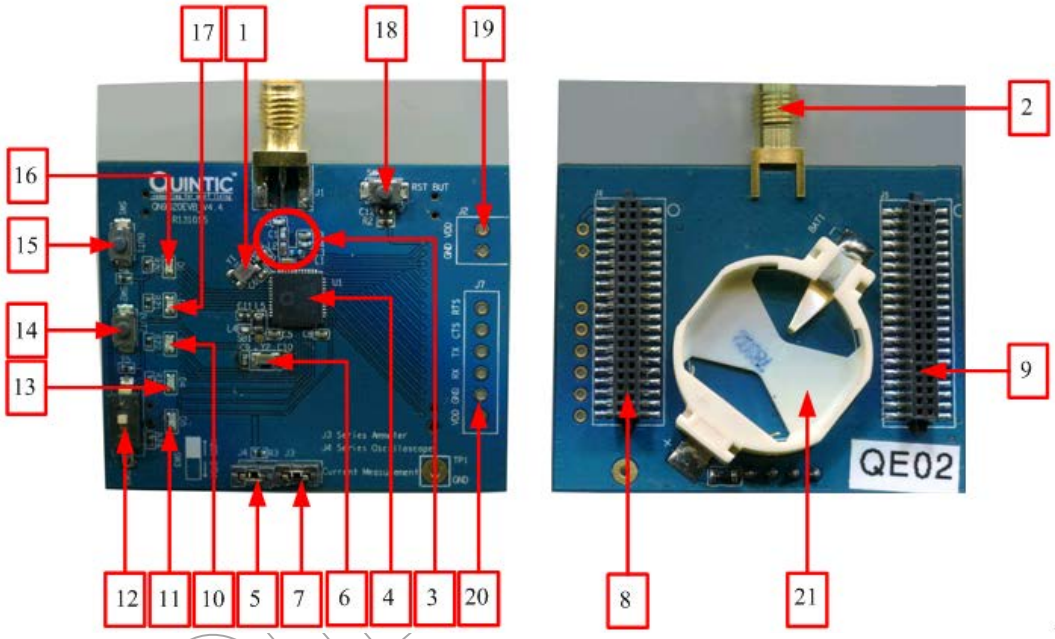

Figure 3 QN9020EVB_V4.4 Overview

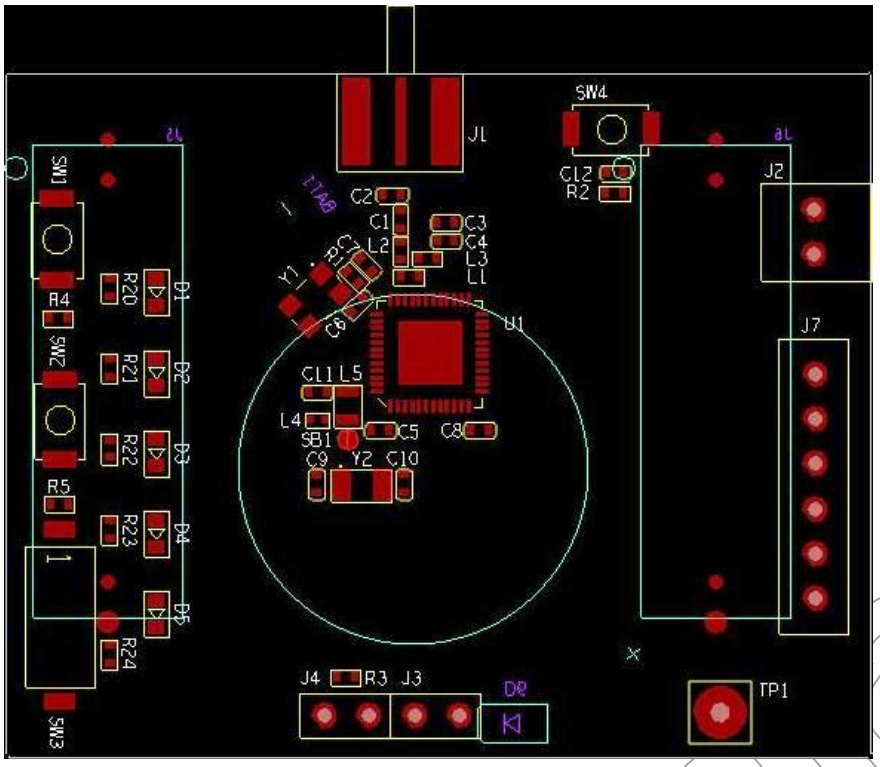

Figure 4 QN9020EVB_V4.4 PCB Placement

Table 2 QN9020EVB_V4.4 Component List

Number	Component	Description
1	Y1	16M crystal
2	J1	SMA connector. Connecting Antenna or cable for testing
3	RF matching circuit	RF matching circuit
4	U1	QN9020 device
5	J4	Header for connecting Oscilloscope to measure the QN9020 device current waveform
6	Y2	External 32.768KHz clock
7	J3	Header for connecting Ammeter to measure the QN9020 device current
8	J6	Connector. Used for connecting mother board
9	J5	Connector. Used for connecting mother board
10	D3	LED3
11	D5	LED5
12	SW3	QN9020 work mode selecting.(Normal Mode or Direct Test Mode)
13	D4	LED4
14	SW2	BUTTON2
15	SW1	BUTTON1
16	D1	LED1

17	D2	LED2
18	SW4	QN9020 hardware Reset Button
19	J2	External Power Supply connector
20	J7	UART interface
21	BAT1	CR2032 Battery holder

2.1 DC-DC down converter

The QN902x integrates highly efficient DC-DC down converter to generate all internal supply voltage. The optional integrated DC-DC down converter can be utilized to further reduce the current consumption.

The DC-DC converter circuit contains inductor L5, L4, decoupling capacitor C11 and optional solder bridge SB1. The solder bridge SB1 connects output voltage of DC-DC converter with external voltage supplied by DK motherboard. When QN902x device works in DC-DC mode, the solder bridge will be disconnected. Please refer to Figure 5 for the circuit of this part.

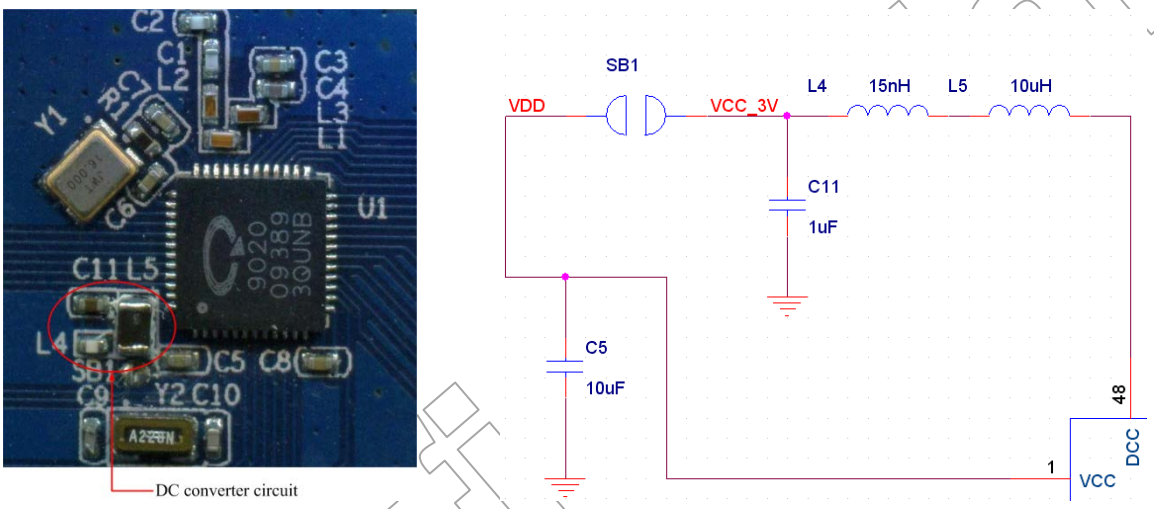

Figure 5 QN902x EVB DC-DC Down Converter

2.2 RF matching circuit

The QN902x radio transceiver requires a network to match 50 ohm impedance antenna. The matching network contains 3 inductors and 4 capacitors. The following Figure 6 shows the radio matching network and PCB layout. Since the QN902x works at 2.4GHz frequency, the parasitic effect from PCB board would be interfere with radio matching easily. So we must be careful to some layout details. For deducing parasitic capacitance, we move the inductor L1to device as close as possible. For deducing transmission influence, we keep the matching network as short as possible.

The given value of matching network on the schematic is only suitable for following placement on the PCB board. If the placement changed, the matching network value would be adjusted a little. J1 is a SMA connector used for connecting 50 ohm impedance cable or Antenna.

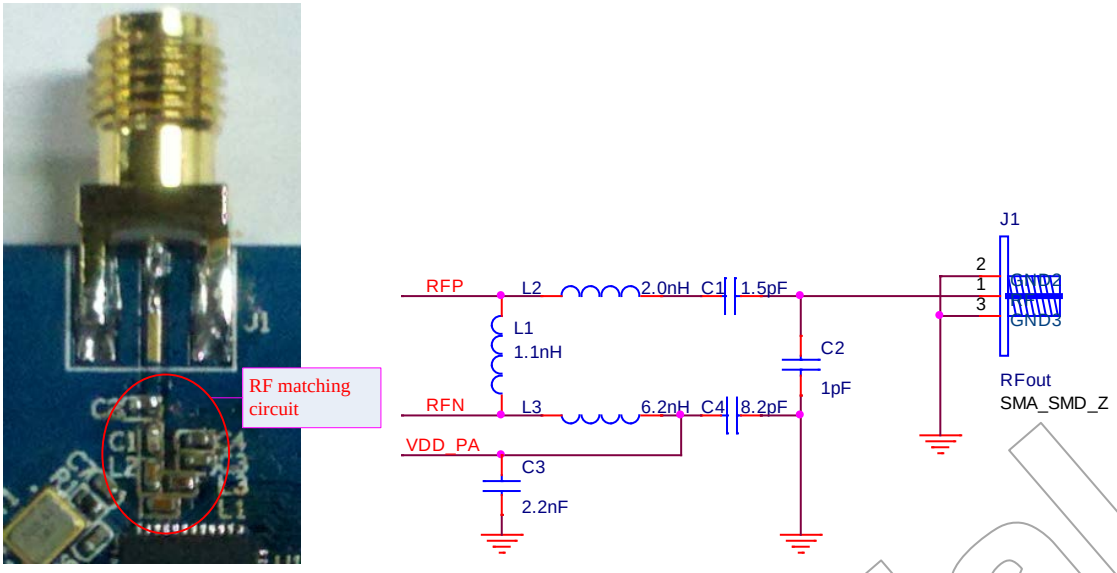

Figure 6 QN902x RF Matching Circuit

2.3 GPIO connector assignment

J5, J6 are connectors for connecting to DK motherboard. Each connector has 40 pins, and the net names are assigned as follows.

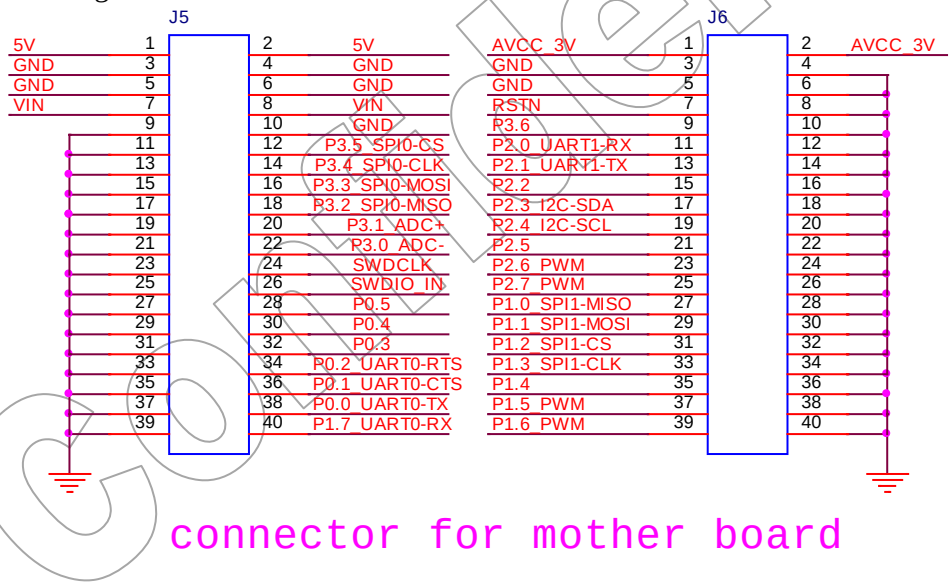

Table 3 J5 Connector Pin List

Pin Number	Net Name	Pin Number	Net Name
J5-1	5V. Mother Board offered, not used	J5-2	5V. Mother Board offered, not used

J5-3	GND	J5-4	GND
J5-5	GND	J5-6	GND
J5-7	3V. Power supply for QN9020	J5-8	3V. Power supply for QN9020
J5-9	GND	J5-10	GND
J5-11	GND	J5-12	QN9020 I/O port. P3_5
J5-13	GND	J5-14	QN9020 I/O port. P3_4
J5-15	GND	J5-16	QN9020 I/O port. P3_3
J5-17	GND	J5-18	QN9020 I/O port. P3_2
J5-19	GND	J5-20	QN9020 I/O port. P3_1
J5-21	GND	J5-22	QN9020 I/O port. P3_0
J5-23	GND	J5-24	SWDCLK
J5-25	GND	J5-26	SWDIO
J5-27	GND	J5-28	QN9020 I/O port. P0_5
J5-29	GND	J5-30	QN9020 I/O port. P0_4
J5-31	GND	J5-32	QN9020 I/O port. P0_3
J5-33	GND	J5-34	QN9020 I/O port. P0_2
J5-35	GND	J5-36	QN9020 I/O port. P0_1
J5-37	GND	J5-38	QN9020 I/O port. P0_0
J5-39	GND	J5-40	QN9020 I/O port. P1_7

Table 4 J5 Connector Pin List

Pin Number	Net Name	Pin Number	Net Name
J6-1	3V. Mother Board offered, not used	J6-2	3V. Mother Board offered, not used
J6-3	GND	J6-4	GND
J6-5	GND	J6-6	GND
J6-7	RESET PIN	J6-8	GND
J6-9	QN9020 I/O port. P3_6	J6-10	GND
J6-11	QN9020 I/O port. P2_0	J6-12	GND
J6-13	QN9020 I/O port. P2_1	J6-14	GND
J6-15	QN9020 I/O port. P2_2	J6-16	GND
J6-17	QN9020 I/O port. P2_3	J6-18	GND
J6-19	QN9020 I/O port. P2_4	J6-20	GND
J6-21	QN9020 I/O port. P2_5	J6-22	GND
J6-23	QN9020 I/O port. P2_6	J6-24	GND
J6-25	QN9020 I/O port. P2_7	J6-26	GND
J6-27	QN9020 I/O port. P1_0	J6-28	GND
J6-29	QN9020 I/O port. P1_1	J6-30	GND
J6-31	QN9020 I/O port. P1_2	J6-32	GND

J6-33	QN9020 I/O port. P1_3	J6-34	GND
J6-35	QN9020 I/O port. P1_4	J6-36	GND
J6-37	QN9020 I/O port. P1_5	J6-38	GND
J6-39	QN9020 I/O port. P1_6	J6-40	GND

In addition to the listed above, the version of QN9020EVB_V4.4 also has some unique parts. Two user buttons, hardware reset button, five indicator LEDs, work mode selected switch, CR2032 Battery holder, current waveform measured Jumper, UART interface and external Power Supply interface. With these parts the QN9020EVB_V4.4 can work standalone without Motherboard. These unique parts will be described in the next section.

2.4 Button

Button1 and Button2 are connected to the GPIO P1.4 and P1.5 of QN9020. When using buttons functions, the GPIO P1.4 and P1.5 must be configured as an input. Push button means giving a logical low input to QN9020.

2.5 Reset Button

The reset button has two functions. One is used to hardware resets the QN9020, and the other is used to establish connection between the hardware and ISP Studio when download code to QN9020 with UART interface.

2.6 UART interface

The UART interface can be connected to the USB to UART adapt board to download the code to QN9020 with ISP studio. It can also be connected to the Bluetooth Tester to do RF performance test. The UART interface definition is shown in figure7.

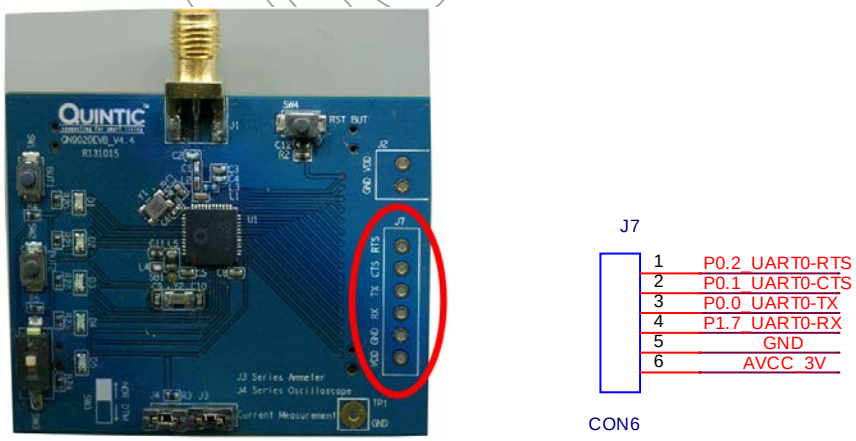

Figure 7 UART interface definition

2.7 LED

The QN9020EVB_V4.4 board has five inductor LEDs, which are named from LED1 to LED5. They are connected to QN9020's P0.5 to P0.1 as shown in figure8.

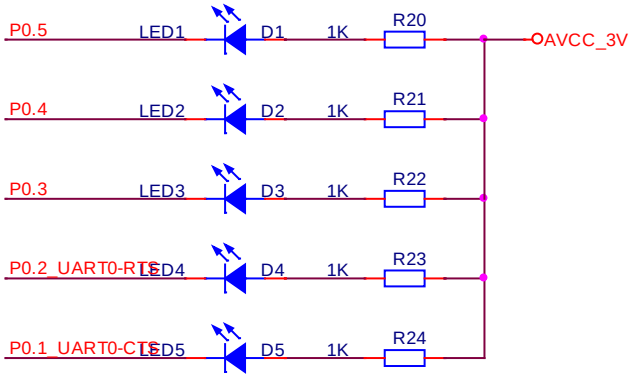

Figure 8 LED Connections

2.8 Work Mode selected

The switch SW3 is connected to the GPIO P3.1 of QN9020, that determines the QN9020 in normal mode or direct test mode. When the GPIO P3.1 is in logical low, it will trig the QN9020 enter into direct test mode. "DTM" or" NOR" is marked on the board as shown in figure9. DTM means direct test mode and NOR means normal mode.

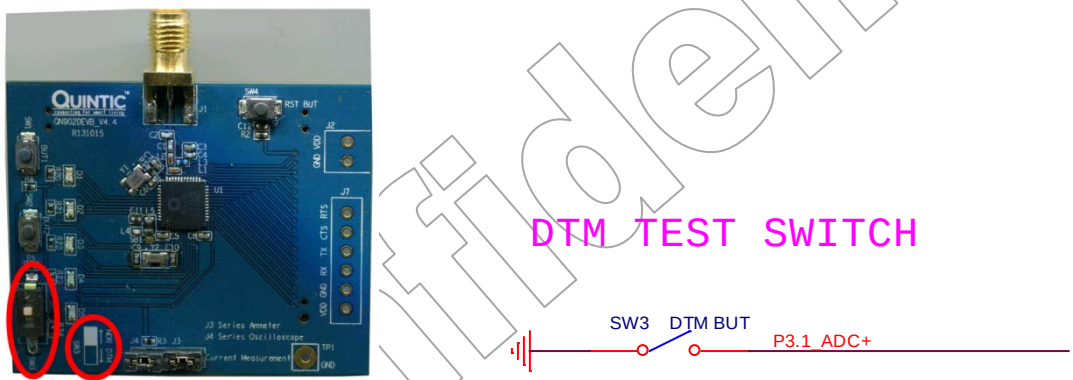

Figure 9 QN9020 Mode selecting

2.9 Power Supply

The CR2032 Battery holder is an interface that offers work voltage for QN9020. The connector J2 can be connected to the external power supply, which is another way to power the board of QN9020EVB_V4.4. The range of work voltage of QN9020 is from 2.4 volt to 3.6 volt.

3. Current Measurement

The Jumper J2 on the board of QN9020EVB_V4.3 can be connected to the digital Ammeter in series to measure the QN9020 current as shown in figure10. Some components could not be mounted, such as U2, R3, R4, but the solder bridge SB2 should be shorted.

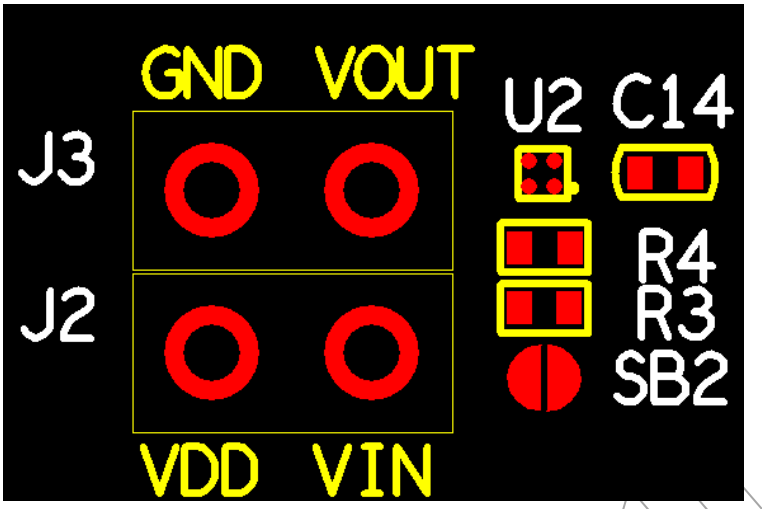

Figure 10 Connection for current measurement on QN9020EVB_V4.3

But on the board of QN9020EVB_V4.4, the Jumper J3 can be connected to the digital Ammeter in series to measure the QN9020 current. The Jumper J4 can be connected to the Oscilloscope in series to measure the current waveform with time variable. The principle of getting the waveform is from the formula I=V/R. Where R is 10 Ohm resistor mounted on the board, V is the voltage of both ends of the 10 Ohm resistor. The voltage waveform can be read from the Oscilloscope. So it's easy to get the current waveform. The connection as is shown in figure11

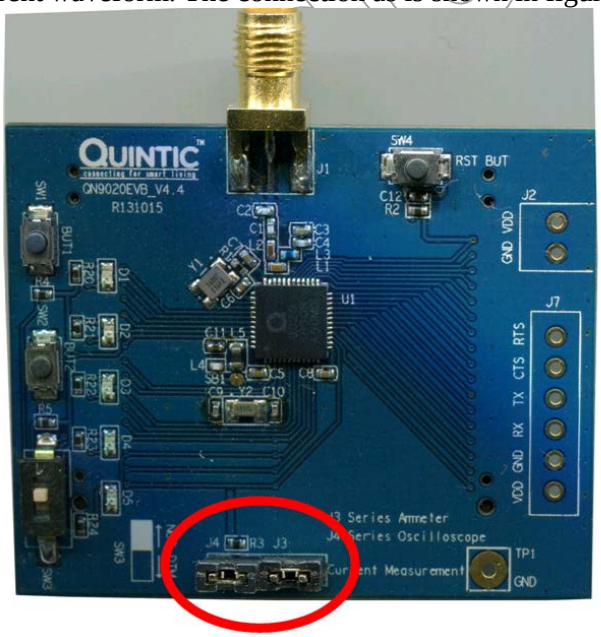

Figure 11 connection for current measurement on QN9020EVB_V4.4

4. Reference Schematics

Please refer to DK QN902x reference schematics as follows.

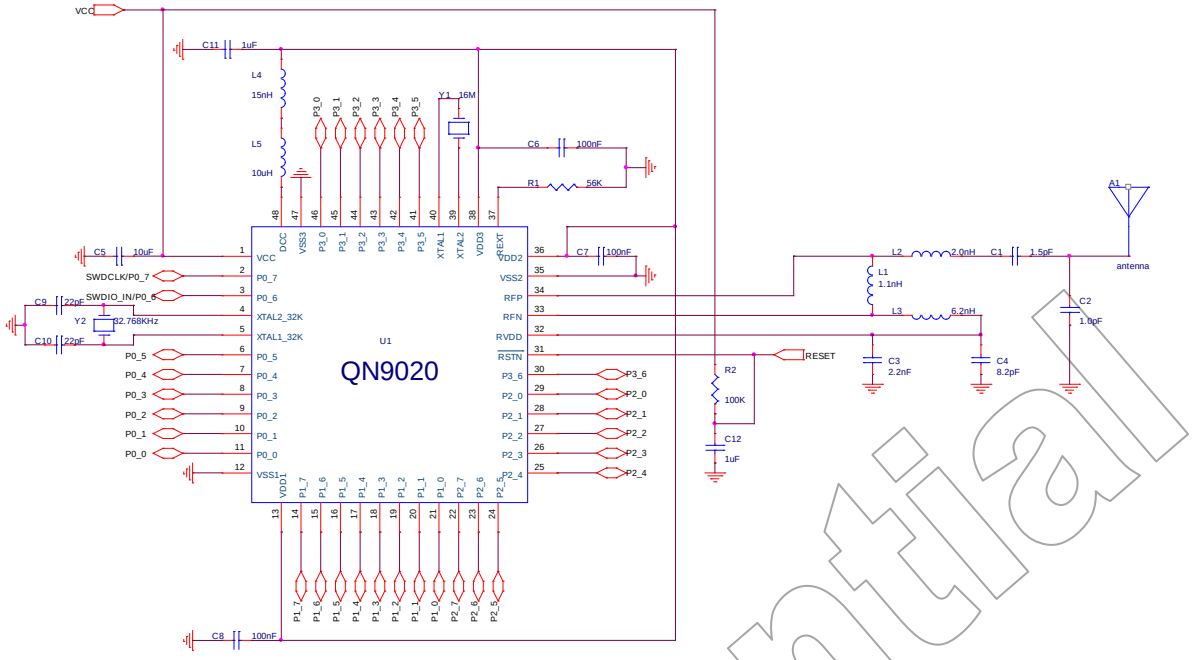

Figure 12 QN9020 Reference Schematic

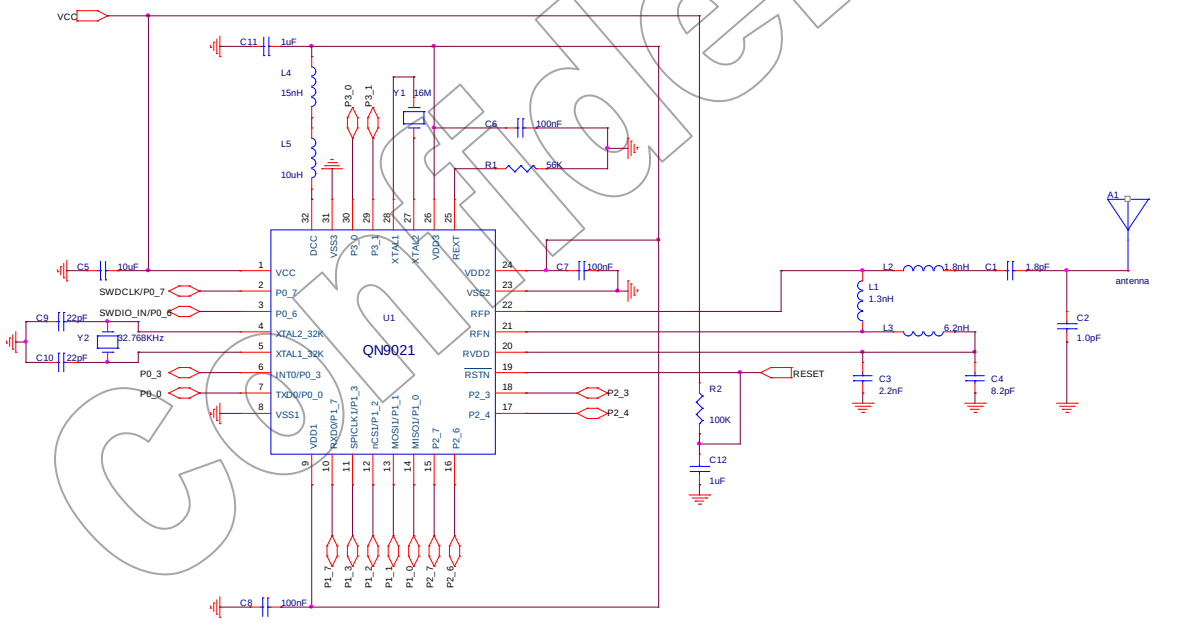

Figure 13 QN9021 Reference Schematic

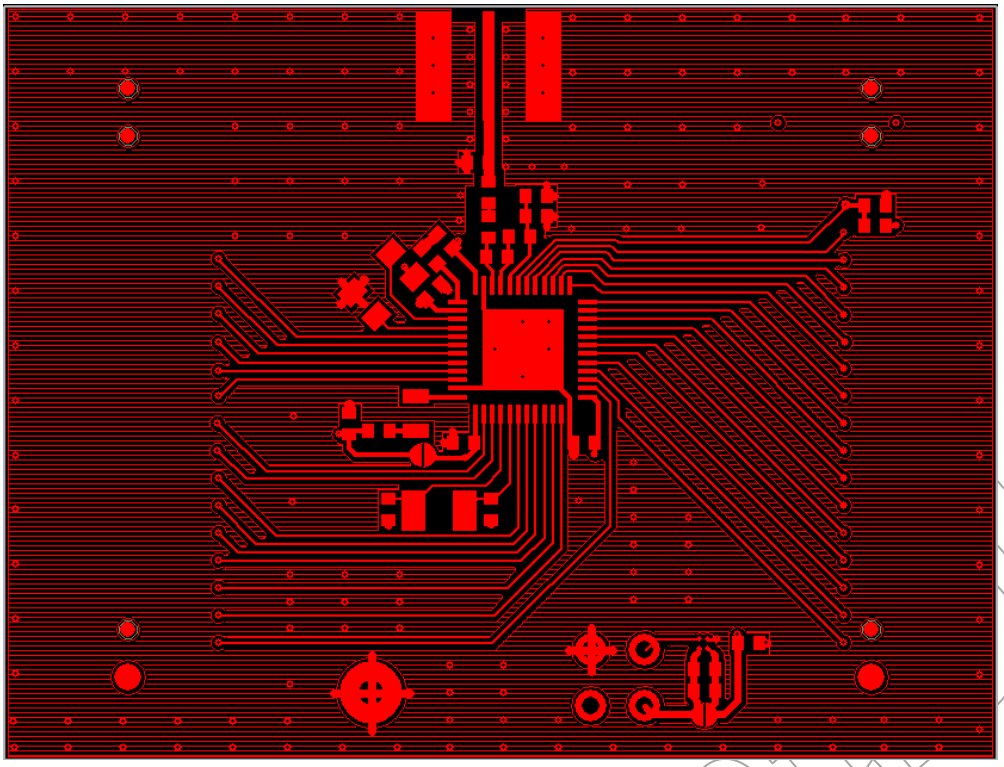

Figure 14 PCB Layout, TOP

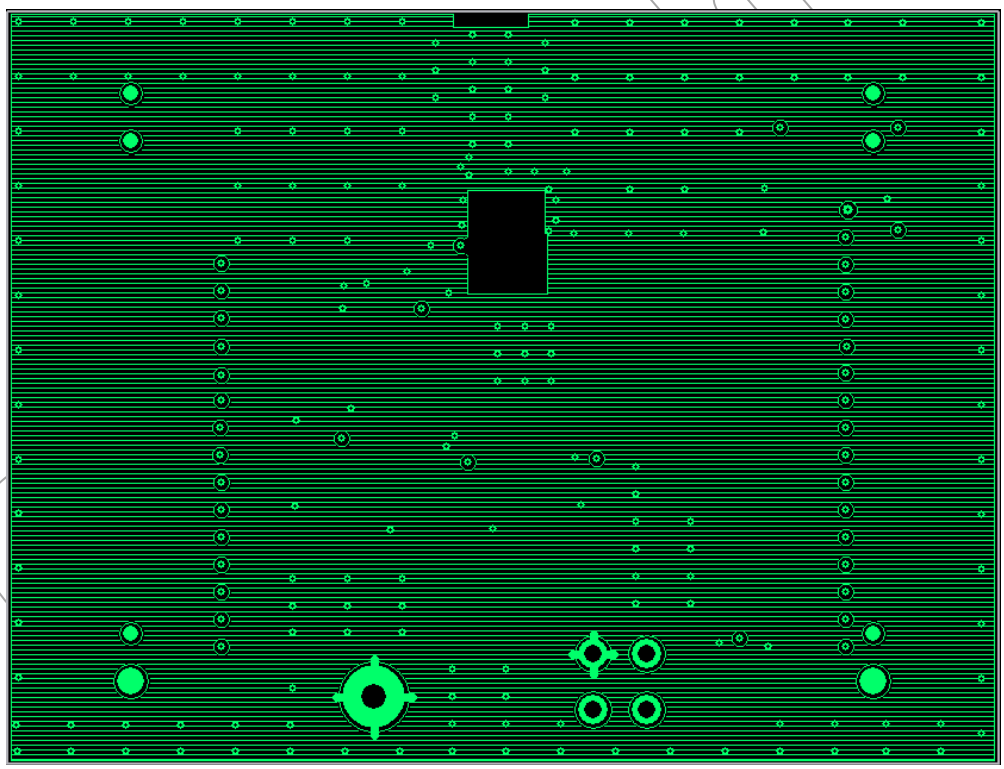

Figure 15 PCB Layout, GND

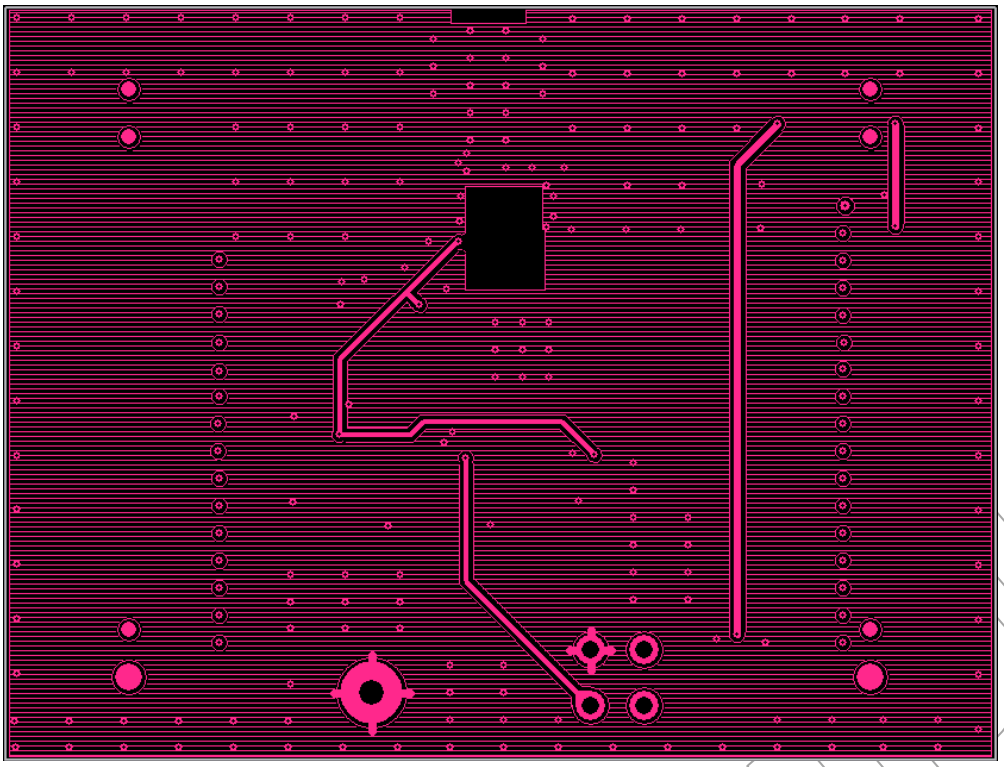

Figure 16 PCB Layout, Power

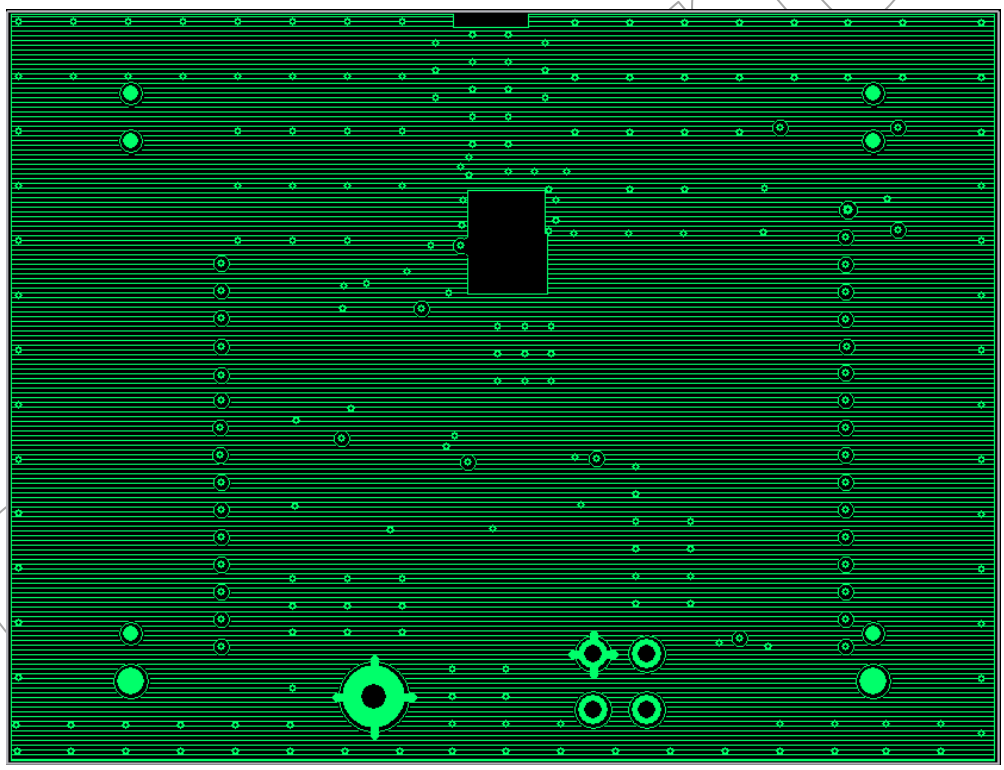

Figure 17 PCB Layout, BOTTOM

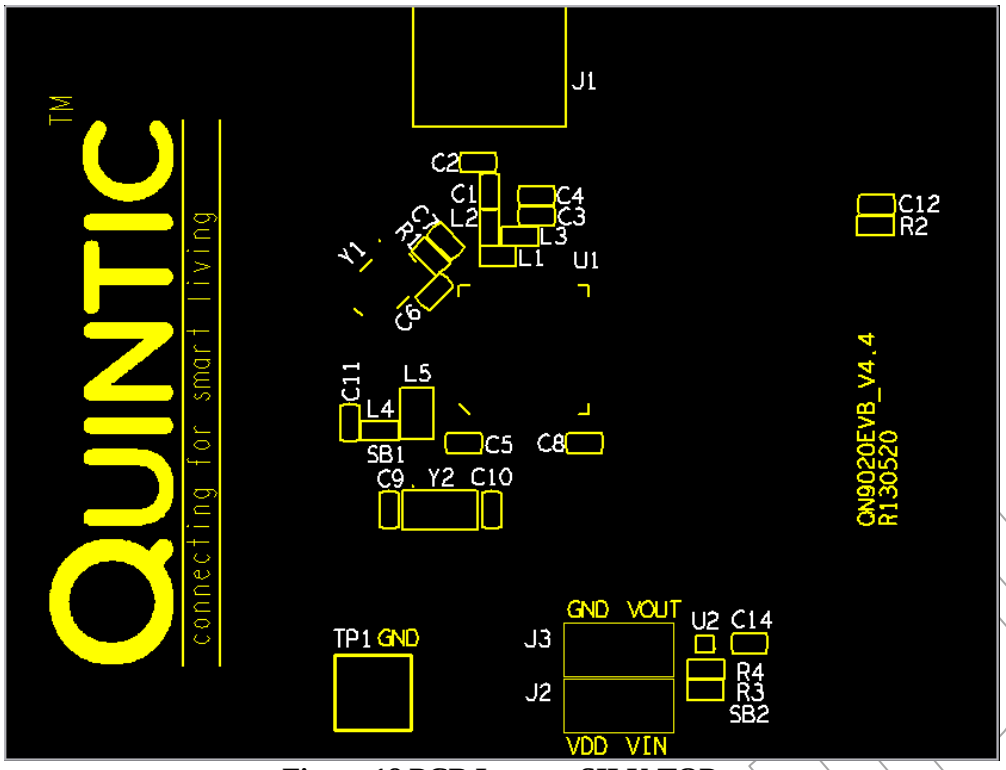

Figure 18 PCB Layout, SILK TOP

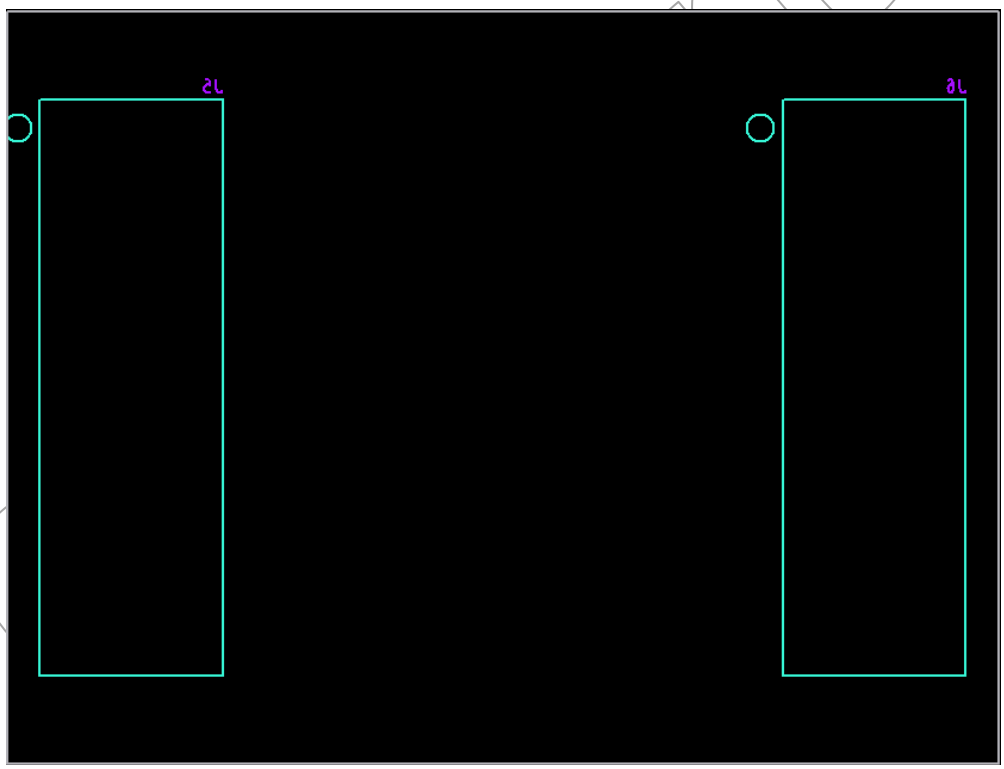

Figure 19 PCB Layout, SILK BOTTOM

Release History

REVISION	CHANGE DESCRIPTION	DATE
0.1	Initial release	2013-04-07
0.2	Change the net name VCC_3V3 to VCC_3V;	2013-05-22
0.3	Update the schematic	2013-08-27
0.4	Insert the Section from 2.4 to 2.9 to describe QN9020EVB_V4.4 board; Add the current measurement of QN9020EVB_V4.4 in Section 3; Change the capacitor C5 from 100nF to 10uF in the schematic;	2014-01-16

