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DK User Guide

Rev. <MM.mm> — 27 April 2016 **DK User Guide**

Document information

Info	Content
Keywords	QN908x DK, User Guide
Abstract	This document is an introduction of QN908x DK V1.2 board

Revision history

Rev	Date	Description
0.1	20160818	Initial release
0.2	20160908	Update Figures, schematics and PCB layout according to QN908x DK board V1.0, add QN9080 QFN Module board information.
0.3	20161110	Update pictures, schematics according to QN908x DK board V1.1, add current test using DC Power Analyzer. Add notes about using battery as power supply for QN9080 module.
0.4	20170117	Update pictures, schematics according to QN908x DK board V1.2, and change the jumper default settings.

Contact information

For more information, please visit: http://www.nxp.com

1. Introduction

QN908x DK board is designed for QN908x HVQFN and WLCSP package IC evaluation and development. It is very convenient to evaluate QN908x's functions and performance. There are also some useful peripherals, like GPIOs, PMod and Arduino interface. J-Link and J-Trace functions are all supported for debugging QN908x. ISP download function is also supported and very easy to use.

1.1 Purpose

This document introduces all functions of QN908x DK V1.2 board,and descripts all parts on QN908x DK V1.2 board in details.

1.2 Kit contents

The QN9080 DK includes the following:

- QN9080DK board
- QN9080 USB dongle
- USB cable

2. Hardware description

The QN9080 DK board provides easy access to peripherals such as

buttons, piezo buzzer and LED. The board also provides useful interfaces such as a USB port for UART communication and CMSIS-DAP debug, and standard Arduino & Pmod connector.

A USB dongle is a Bluetooth device powered by the QN9080. It acts as a master/slave when

communicating with the QN9080 devices..

2.1 Hardware overview

QN908x DK V1.2 board is shown in Figure 1. The detailed information is listed in Table 1.

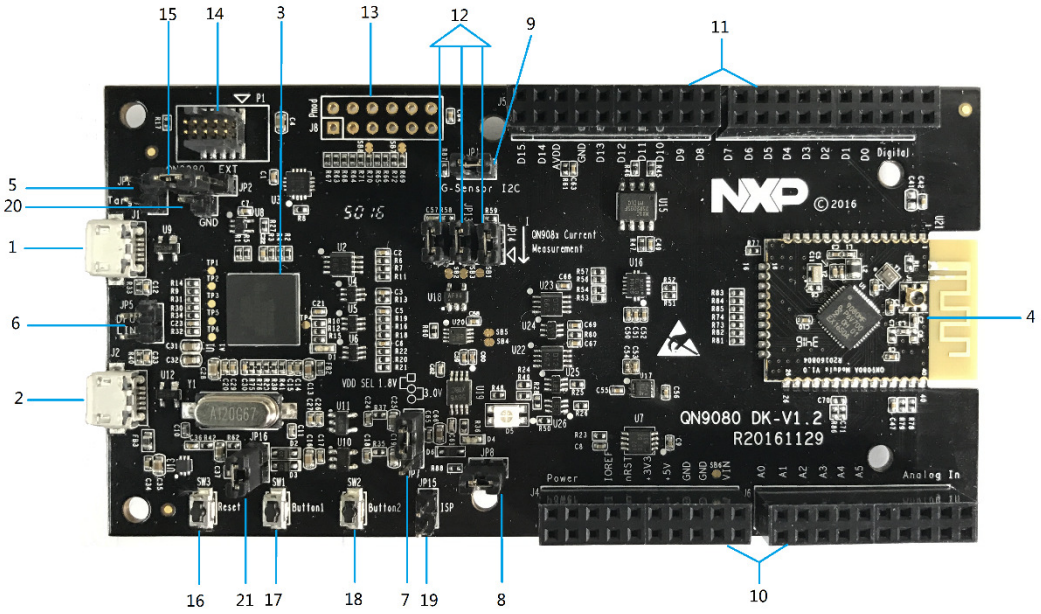


Figure 1 Board overview

Table 1 QN908x DK V1.2 board's mark information list.

Number	Name	Description
1	QN908x USB port	QN908x USB Port, it provides power supply to the whole board and USB signal path to QN908x Module
2	LPC4322 USB port	LPC4322 USB Port, it provides power supply to the whole board and the USB signal path is connected to LPC4322
3	LPC4322	LPC4322 works as JTAG/SWD Link bridge
4	QN908x Module	QN908x Module board has two types of board according to QN908x chip package: HVQFN and

		WLCSP
5	Jumper JP1	Jumper to select JTAG/SWD Link bridge target, Open: On board target (Default) Short: Off board target
6	Jumper JP5	Jumper to set LPC4322 DFU mode, Short: DFU mode enable Open: Normal mode (Default)
7	Jumper JP7	QN908x Module power supply voltage select Jumper: 1-2: 1.8V Power supply 2-3: 3.0V Power supply
8	Jumper JP8	Jumper to select QN908x ISP UART path mode, Short: UART path enable (Default) Open: UART path disable
9	Jumper JP11	Jumper to select QN908x external I2C path mode, Short: I2C path enable (Default) Open: I2C path disable
10	Header J5 and J7	QN908x GPIO for test and compatible to Arduino board interface
11	Header J4 and J6	QN908x GPIO for test and compatible to Arduino board interface
12	Jumper JP12, JP13, JP14	Jumper to select Power Consumption Test
13	Header J8	PMod interface connector, compatible to PMod
14	J-Link Connector	Used to offer JTAG/SWD interfaces for off-board target
15	Jumper JP2	Jumper to select QN908x Power supply source, on-board power or EXT power
16	Button3 SW3	Button3 used to reset QN908x chip
17	Button1 SW1	Button1 is a function button defined by user
18	Button2 SW2	Button2 is a function button defined by user
19	Jumper JP15	Jumper used to enable QN908x chip mode function
20	GND Pin	GND pin used as test ground pin
21	Jumper JP16	Jumper used to cut off USB leakage, when DK board powered by battery

2.2 Default jumper settings on DK board

s shown in Figure 2, power, JTAG/SWD, UART and I2C enable jumpers are connected in default. Table 2 and Table 3 show jumper's function and how to connect.

Figure 2 Board jumper default settings

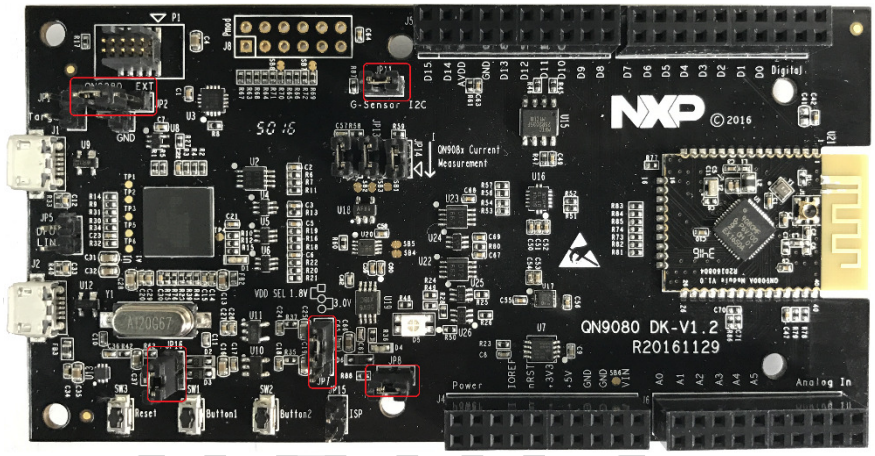


Table 2 QN9080A MINIDK board's default jumper settings

Jumper	Jumpers Setting	Function
JP2	Pin 1,2 shorted	QN908x on-board power
JP7	Pin 1,2 shorted	QN908x's power(1.8V)
	Pin 2,3 shorted	QN908x's power(3V)
JP8	Pin 1,2 open	UART path disable
JP11	Pin 1, 2 open	I2C path disable
JP16	Pin 1,2 shorted	When DK board powered by battery, leave it open

2.3 J-Link OB debugger

The J-Link MCUXpresso OB provides both SWD/JTAG and UART interface. Users can download or update firmware into a QN908x device by using the UART or JTAG/SWD interface. There is the J-Link connector for programming and debugging off-board target, shown in Figure 3.

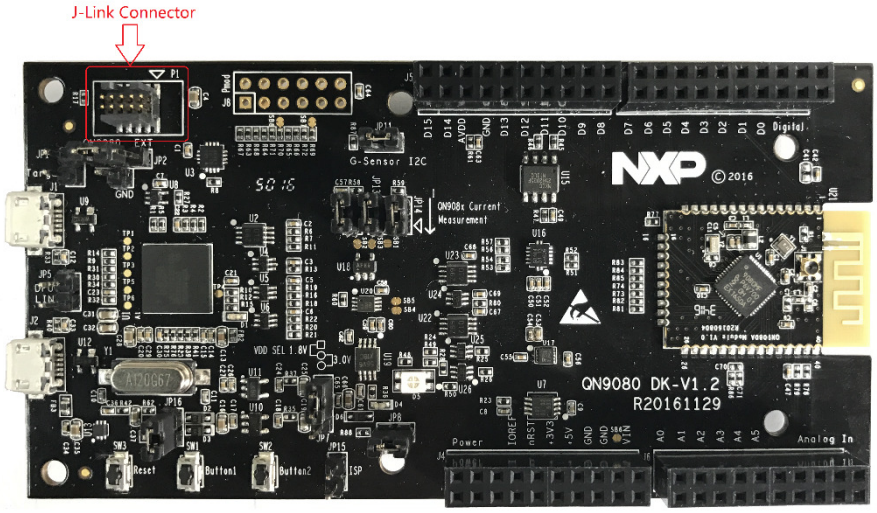


Figure 3 J-Link connector

2.4 QN9080 Module

QN908x IC integrates a BLE radio, controller, protocol stack and profile software on a single chip, which can provide a flexible and easy way to use BLE SoC solution. It also includes a high performance MCU (32-bit ARM Cortex-M4F), on-chip memory, and peripherals for users to develop a truly single chip wireless MCU solution.

Shown in Figure 4.

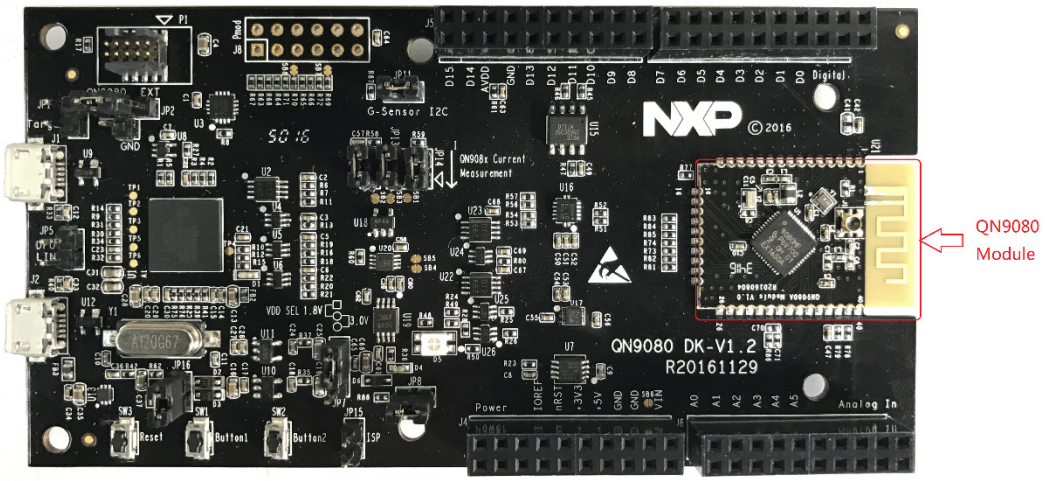


Figure 4 QN9080 Module Board

QN908x Module has MIFA antenna on front of board. So it can work without external antenna. There is a RF connector that is with switch on RF front-end. You can easily do RF test by connecting a RF cable to the RF connector.

2.5 GPIO and Arduino interface

On QN908x DK board, the connectors J4, J5, J6 and J7 provide all GPIO connection output. And it is also compatible to Arduino board interface. The interface schematic is shown in Figure 5.

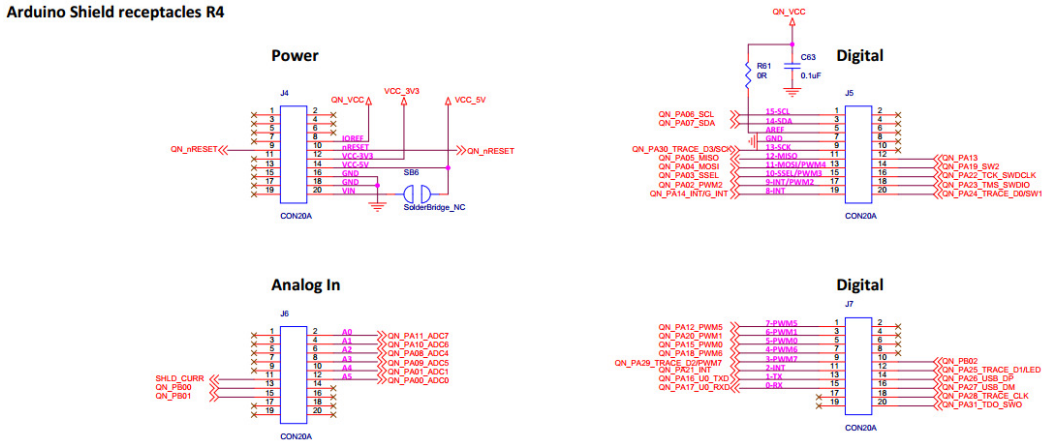


Figure 5 QN908x DK board GPIO and Arduino interface

2.6 QN908x reset button

The reset button is used to provide hardware reset to the QN908x device. Shown in Figure 6.

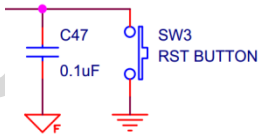
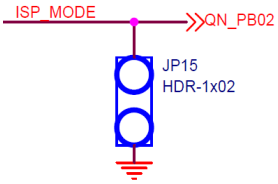


Figure 6 Reset button

2.7 ISP mode jumper

"JP15" is the ISP mode jumper which is used to set QN908x ISP mode. When the jumper is shorted, the chip mode "PB02" pin is connected to GND and this function is enabled. When the jumper is open, the ISP mode function is disabled. Shown in Figure 7.

Figure 7 Chip mode jumper



ISP Enable (JP15)	
EXE Mode	Open(Default)
ISP Mode	Short

2.8 JTAG interface

The board provides a SWD/JTAG interface for the usage of external debugger. Shown in Figure 8.

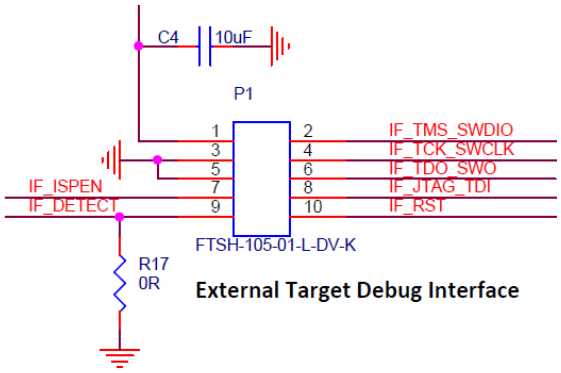


Figure 8 JTAG interface

2.9 Buttons

As shown in Figure 9 for detailed circuits, the DK board offers three buttons. When using the buttons “SW1” and “SW2”, the GPIO must be configured as inputs. Logic LOW input is applied to GPIO when a button is pressed.

Figure 9 Buttons

The button “SW3” is used to reset QN908x chip. Press down the button, QN908x will be reset.

2.10 LED

The board offers a three colors RGB LED. The connections are shown in Figure 10. The LED will light up when the corresponding GPIO outputs switch to logic High level. The control pins of GPIO are QN_PA13, QN_PA25 and QN_PA31. The GPIO QN_PA13 can work at PWM out mode. So that the brightness of LED can change with PWM pulse width.

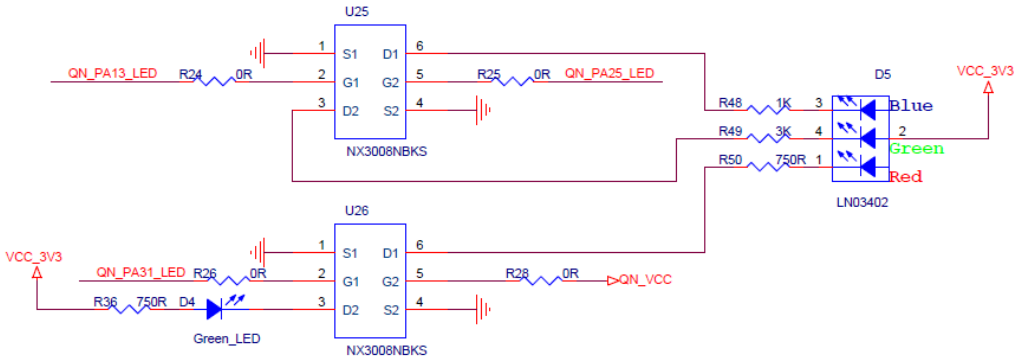


Figure 10 LED

3. DK Board Application Function

3.1 J-Link OB Interface

QN908x DK V1.2 board offers JTAG/SWD interface either to on-board QN908x or off-board target. It also provides USB to UART interface for QN908x.

3.1.1 J-Link to on-board QN908x

When programing or debugging the QN908x device using the SEGGER J-Link OB, JP1 and JP2 should be configured as shown in Table 3.

Table 3 ISP mode jumper setting

JP1	Open, J-Link target is on-board QN9080
JP2	Short Pin1,2, QN908x power enable.

When downloading firmware into QN908x with ISP mode, you should enable UART path and set Chip mode pin to ground. The jumper set shown in Table 4.

Table 4 ISP mode jumper setting

JP8	Short, UART path enable
JP15	Short, ISP mode enable

There is ISP download operation flow, shown in Figure 11.

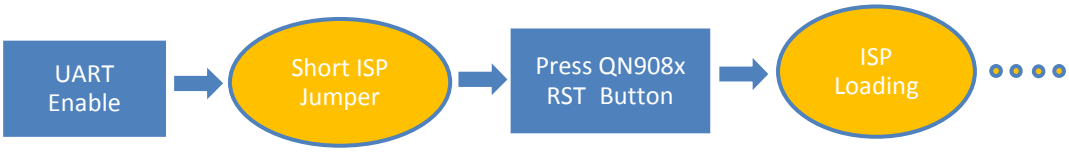


Figure 11 ISP download operation flow

After ISP download operation, move the jumper cap on JP15 away and leave JP15 open. Then the QN908x chip can go into normal mode normally.

3.1.2 J-Link to off-board target

When using QN908x DK board to program or debug off-board target by JTAG/SWD interface, JP1 and JP2 should be configured as shown in Table 5.

Table 5 ISP mode jumper setting

JP1	Short, J-Link target is off-board target
JP2	Short pin 2,3, 3V power disable on JTAG/SWD connector

3.2 Current Consumption Test

QN908x DK board has two ways to measure QN908x chip current consumption. One

way is that the current can be measured by on board precise resistor used for I-to-V conversion. The small voltage signal amplified by operation amplifier and given to ADC. Then it can be calculated by LPC4322 and shown in MCUXpresso IDE. Another way is that the current is measured by external Ammeter through Jumper JP14.

3.2.1 Current Test using LPC4322

The QN908x DK board has an on-board current measurement circuit consisting of a MAX9634T (U18) current monitor chip and a 12-bit ADC (ADC122S021, U19) with a 12-bit sample at 50k to 200ksps. The on-board MAX9634T current monitor measures the voltage across the QN908x VCC V-sense resistors; either 8.24Ω or 4.12 Ω if JP13 is installed. The MAX9634 multiplies the sense voltage by 25 times to provide a voltage range suitable for the ADC to measure.
A 2-input analog mux is used to choose which channel to be measured, the QN9080 or the devices from expansion board on the DK extension connectors. The current measurement circuit is controlled by the Link2 processor and is not user programmable. Power measurement utilities with this feature are available only after MCUXpresso IDE installation.
Due to input offset voltage variations in the MAX9634, the current measurement circuit is not recommended for measuring current below 150uA.

The QN908x current can be measured by the voltage across a sense resistor in series with the supply. The voltage across a series 4.12Ω resistor with the target QN908x VCC can be manually measured at JP12 on the PCB. Use Ohm's law to calculate the current (QN908x current = measured voltage / 4.12Ω). As an example, if the measured voltage is 10mV, then 10e-3 / 4.12Ω = 2.44mA. Note that the current consumed by the MAX9634 used in the on-board current measurement will be included in the voltage measured across this resistor. The detailed schematic shown in Figure 12.

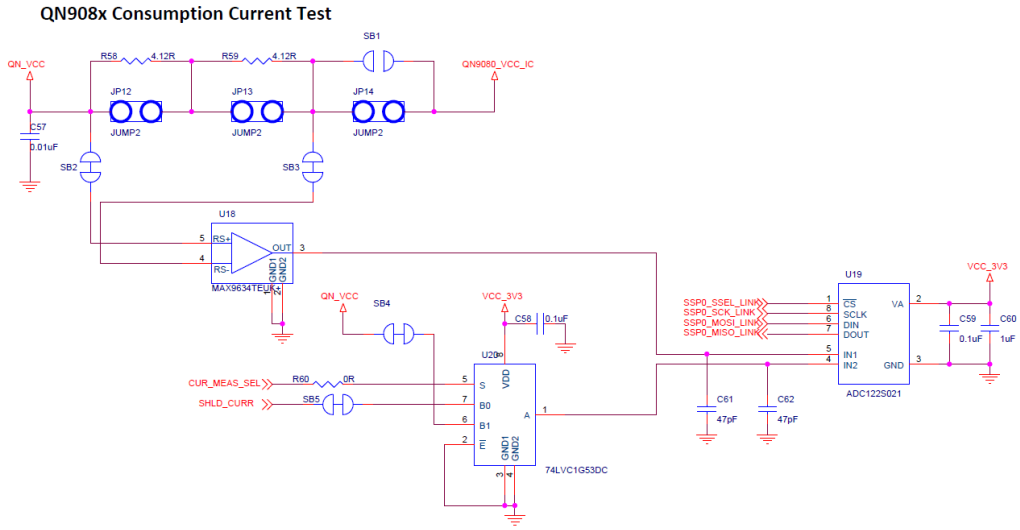


Figure 12 Current Test Using LPC Processor

When doing current test using Link2 processor, the Jumper JP12、JP13 and JP14 will be set like shown in Table 6 .

Table 6 Current Test Jumpers Setting

JP12	Open, when used for Link2 processor current test
JP13	Open, when used for Link2 processor current test

JP14	Short, when no digital ammeter series in

3.2.1 Current Test using digital ammeter

When doing current test using external digital ammeter, the Jumper JP12、JP13 and JP14 will be set like shown in Table 7. A jumper cap is used to short the pins. The schematic shown in Figure 13.

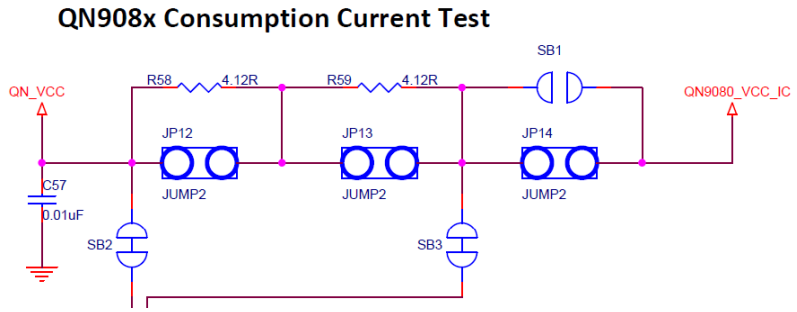


Figure 13 Current Test Using Ammeter

When doing current test using ammeter, the Jumper JP12、JP13 and JP14 will be set like shown in Table 7.

Table 7 Current Test Jumpers Setting

JP12	Short, when used for Ammeter current test
JP13	Short, when used for Ammeter current test
JP14	Need an ammeter series in

3.2.2 Current Test using DC Power Analyzer

When measuring current using DC Power Analyzer, there are two ways to do this: One way is using the DC Power Analyzer as an ammeter which share the same settings as ammeter test. The other way is using the DC Power Analyzer as the power supply to DUT.

In this case, the QN9080 Module is power by DC Power Analyzer. The QN_VCC power pin is on Jumper JP14, where a triangle symbol indicates the pin. Also, there is a GND pin nearby Jumper JP2, which can be used as power ground.

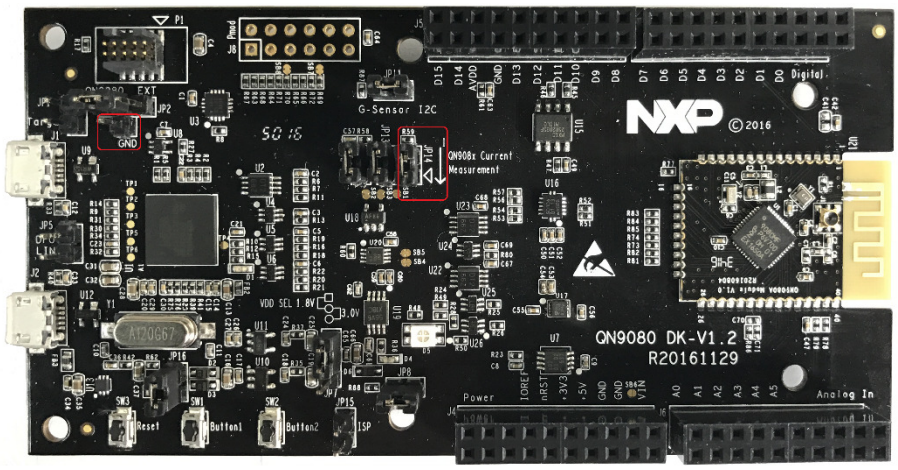


Figure 14 QN_VCC Power pin

3.3 RF Connective Test with CBT

QN908x Module RF signal can be tested by on-trace RF connector. This RF connector manufacturer is Murata. When performing the RF test with CBT instruments system, there may need an expansion board to match signal voltage level from UART to RS232 interface. The RS232 expansion board can get power supply from QN908x DK Board through connectors. The connection of two boards shown in Figure 15.

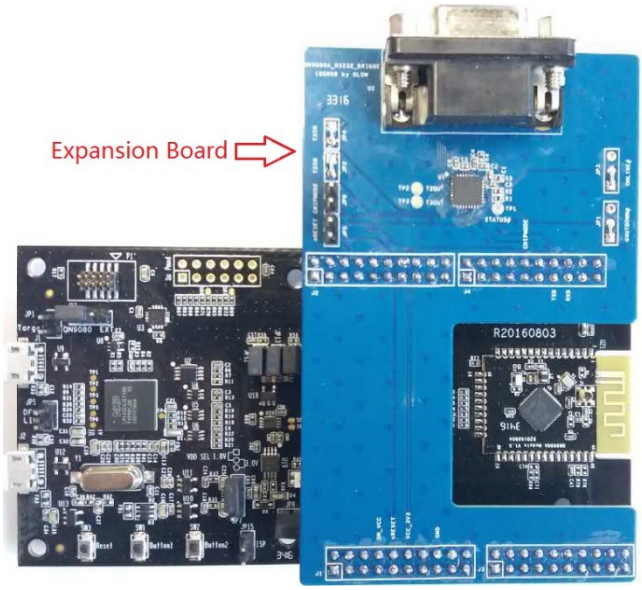


Figure 15 RF CBT test with Expansion Board

Before RF test, you should download “Controller Mode” software to QN908x Module or make the QN908x enter the DTM mode. Then Connect an RF cable from QN908x

Module to CBT and set the CBT RS232 Baud Rate@115200 bps. After that, you can start your RF test.

4. QN9080 USB Dongle

4.1 Dongle Hardware

USB Dongle works together with QTool and behaves as a master or slave when talking to QN9080 DK or other devices. Just as illustrated in diagram below, USB Dongle receives commands from QTool via virtual COM port, by which QN908x would be initialized as a Master or Slave device. All tests can be performed by QTool after initialization.

4.2 Dongle Connection

QN908x USB dongle is a USB interfaced device with a QN9080 packed in. With driver and SDK installed in computer (refer to QN9080 quick start guide), user can use QTool in SDK to control the QN9080 in dongle to work as a central device. The K board with USB power supply from computer works as a peripheral device. The connection of the dongle is illustrated as blow figure. For QTool usage, please refer to QTool User Manual

4.3 Dongle Authentication

HVIN: QN9080 BLE Dongle:

FCC ID: 2AIHS9080DG

R 018-170145

5. Appendix

5.1 Schematics

5.1.1 QN908x DK main board

QN908x DK V1.22 board schematic have five parts: Power, LPC processor, QN908x-BLE, QN908x-Function and Arduino Interface.

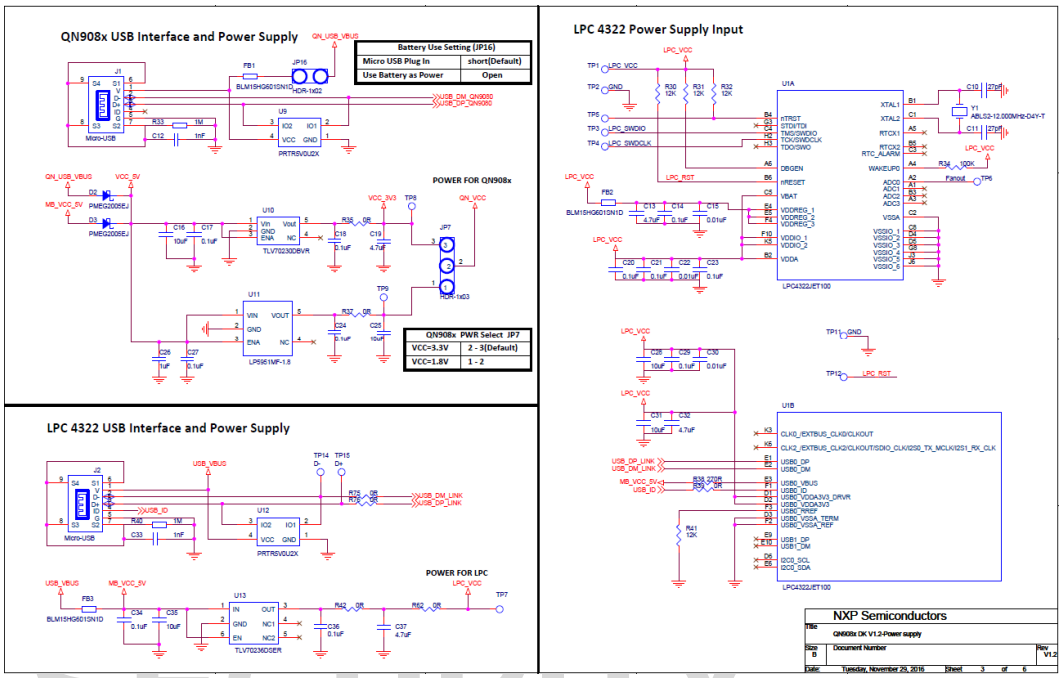


Figure 16 Power schematic for QN908x DK board

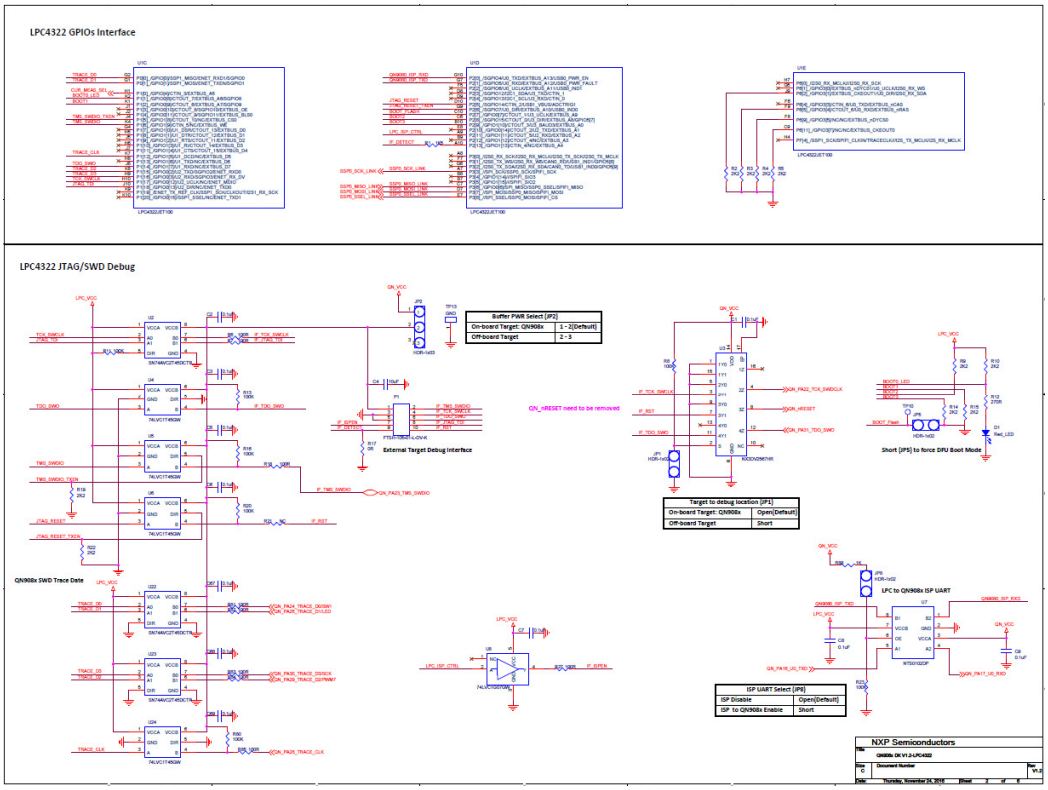


Figure 17 LPC processor schematic for QN908x DK board

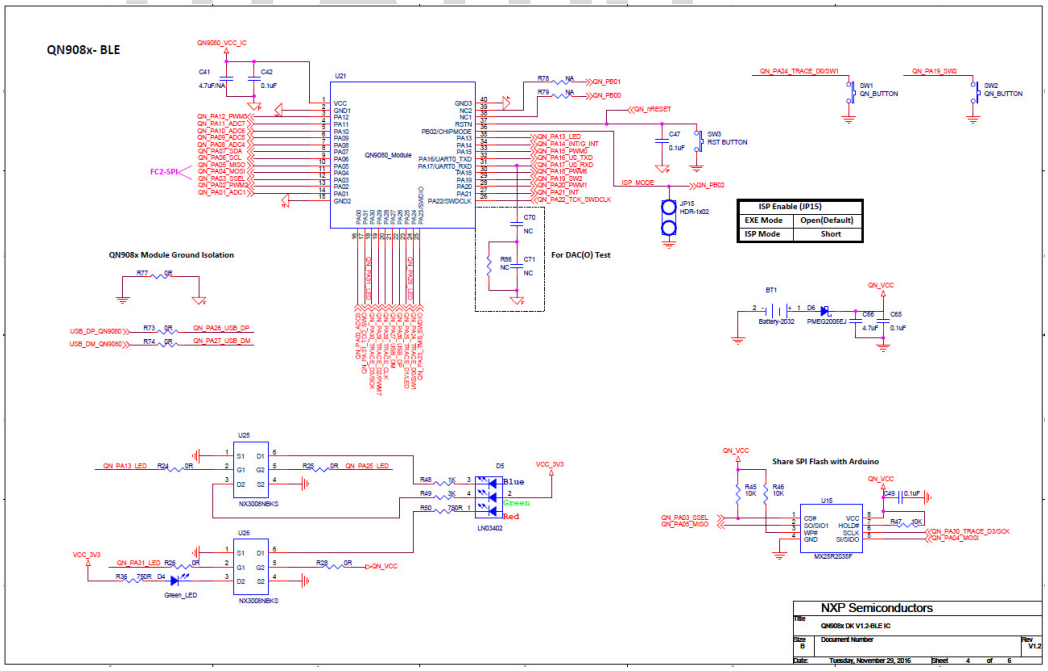


Figure 18 QN908x-BLE schematic for QN908x DK board

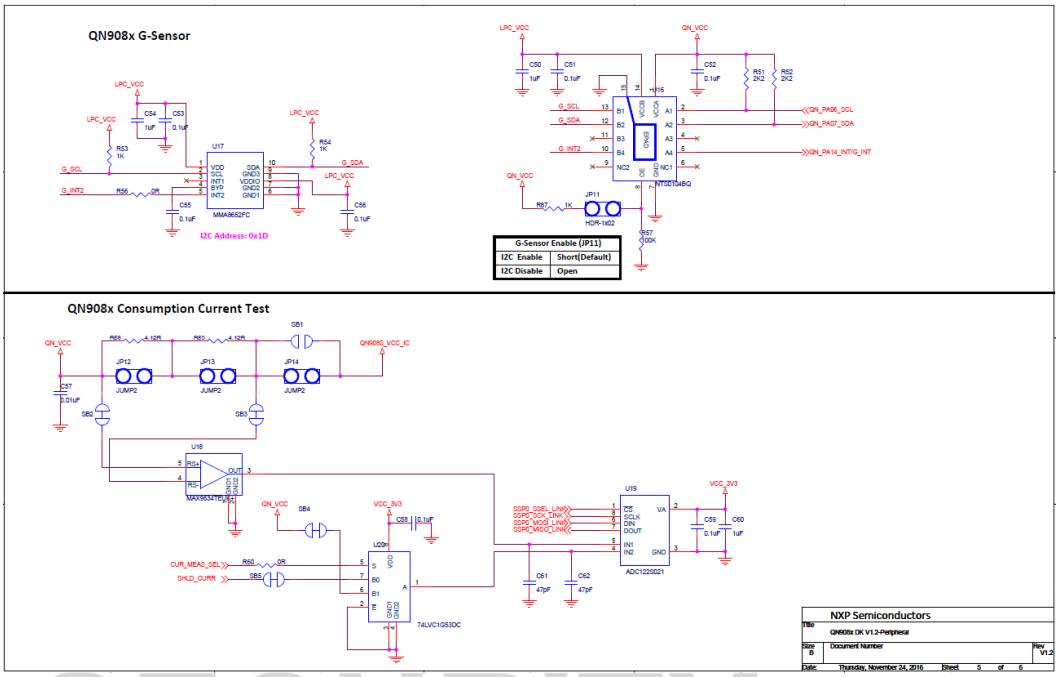


Figure 19 QN908x-Function schematic for QN908x DK board

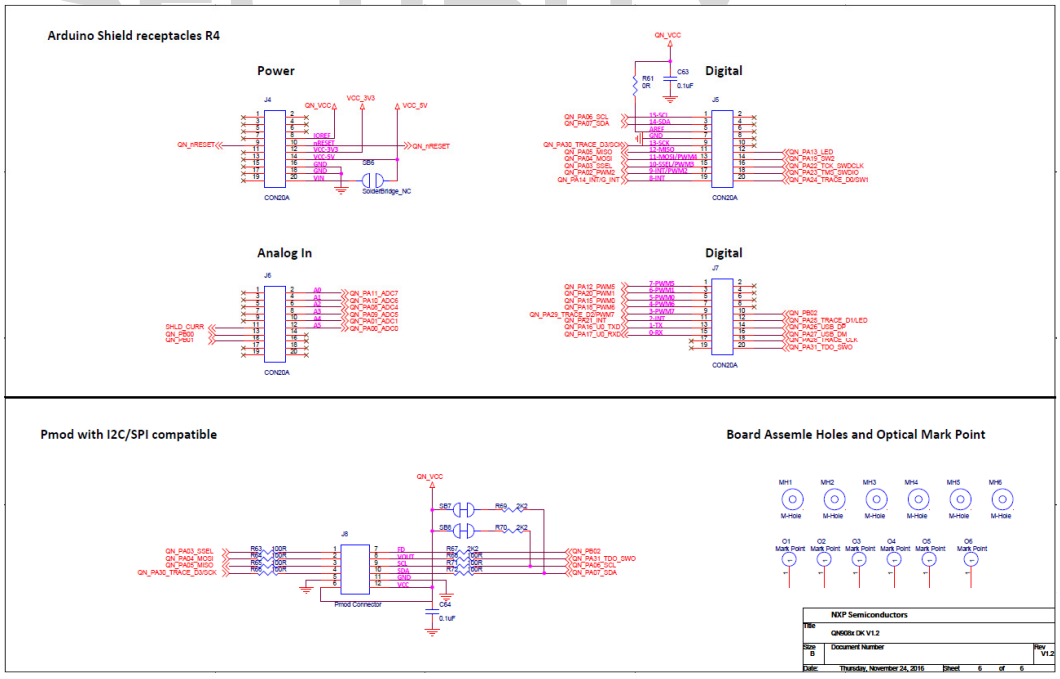


Figure 20 Arduino Interface schematic for QN908x DK board

5.1.2 QN9080 module board

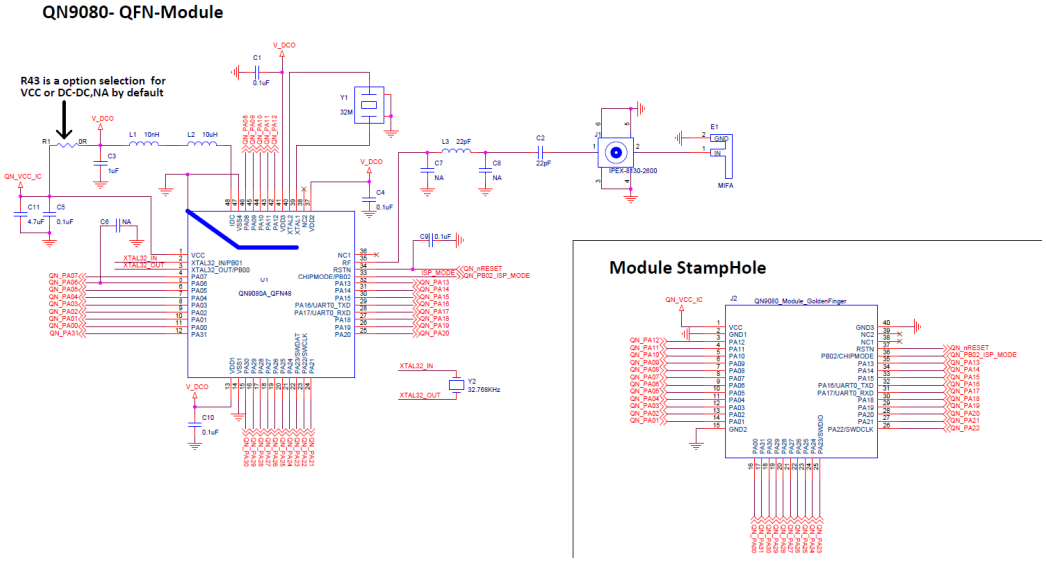


Figure 21 QN9080 QFN Module board

5.2 PCB layout

5.2.1 QN908x DK main board

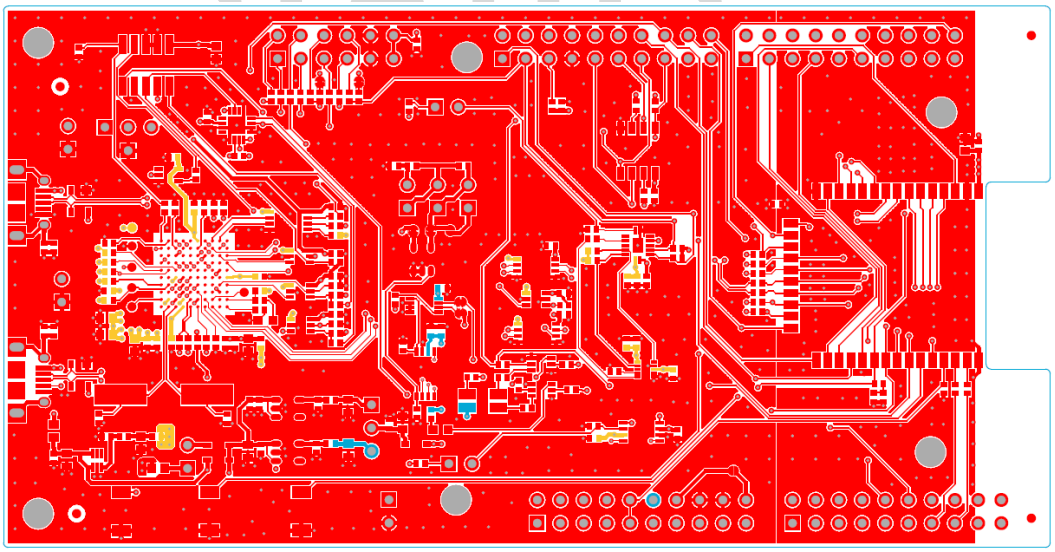


Figure 22 Top Etch

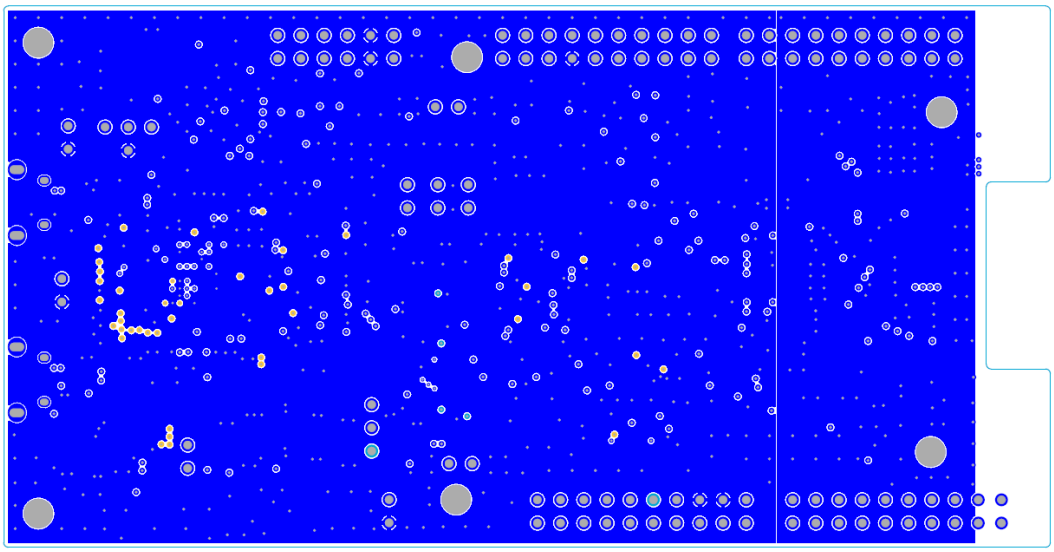


Figure 23 GND Plane

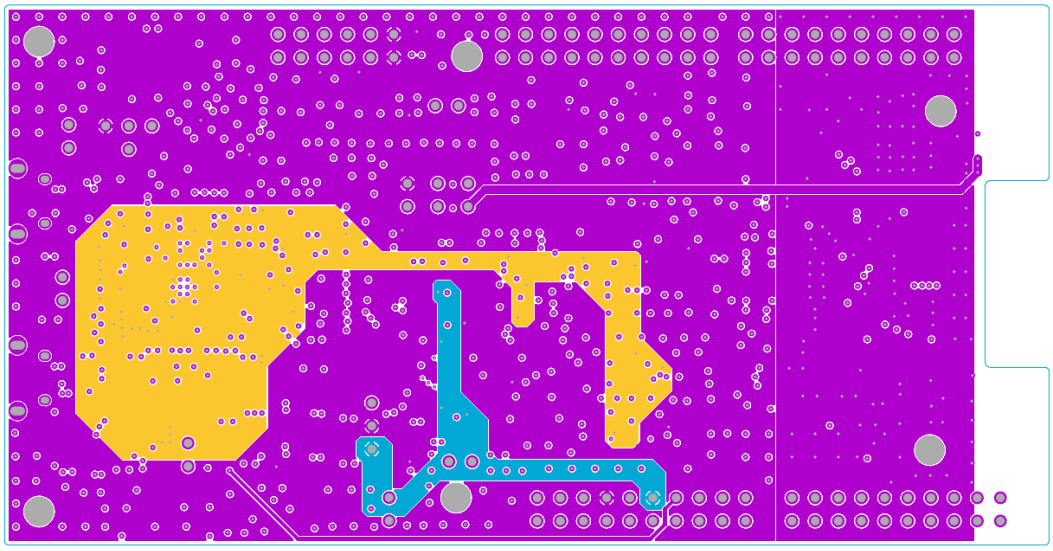


Figure 24 PWR Plane

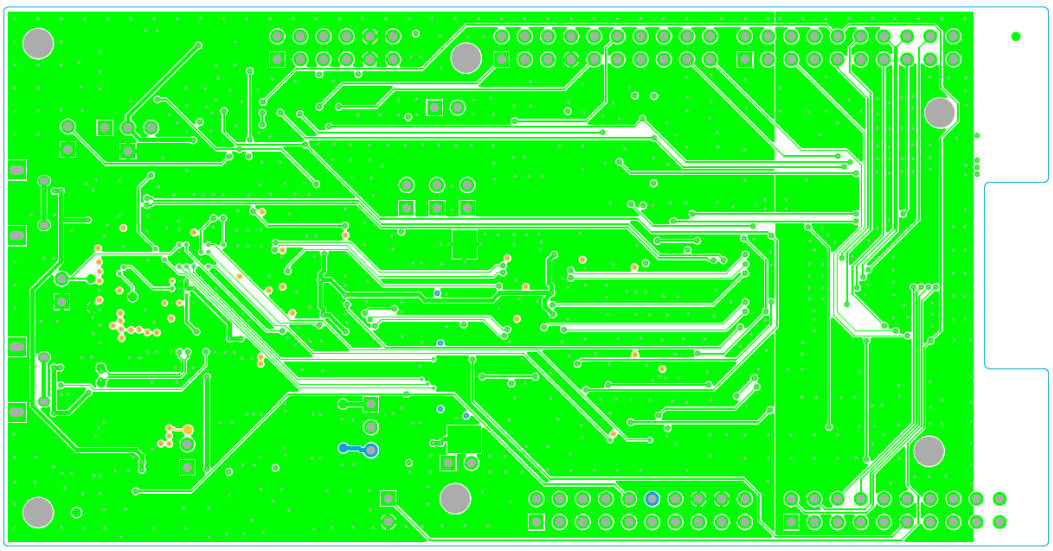


Figure 25 Bottom Etch

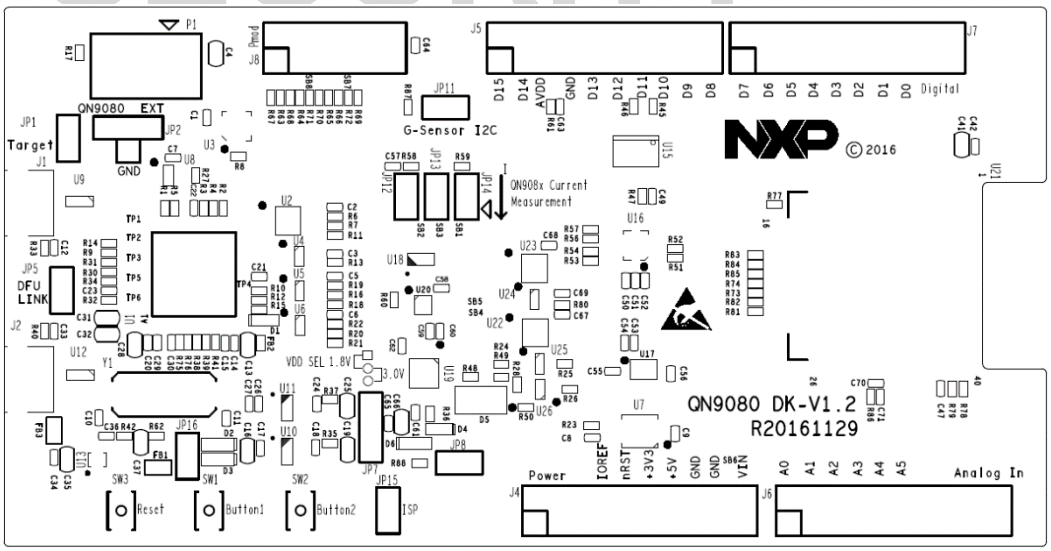


Figure 26 Top Silkscreen

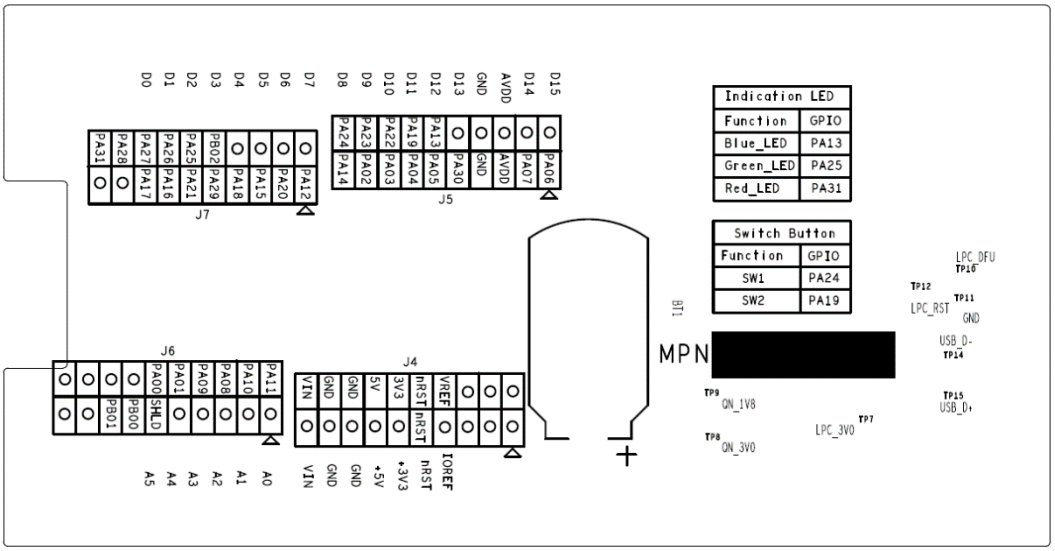


Figure 27 Bottom Silkscreen

5.2.2 QN9080 QFN board

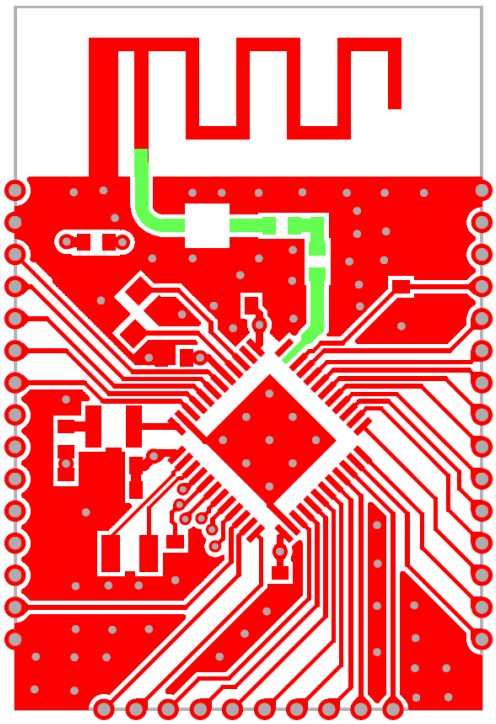


Figure 28 Top Etch

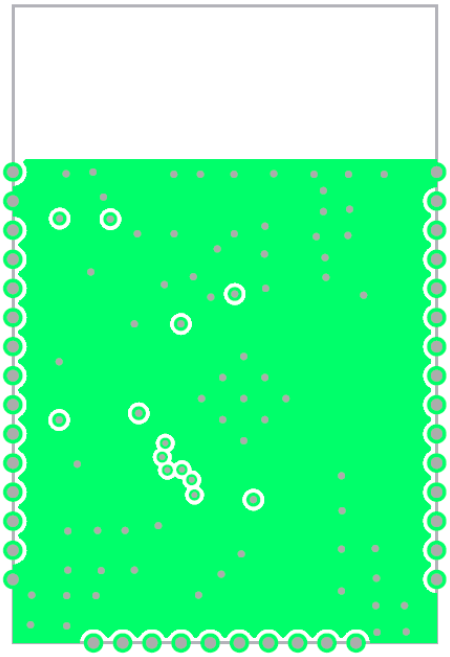


Figure 29 GND Plane

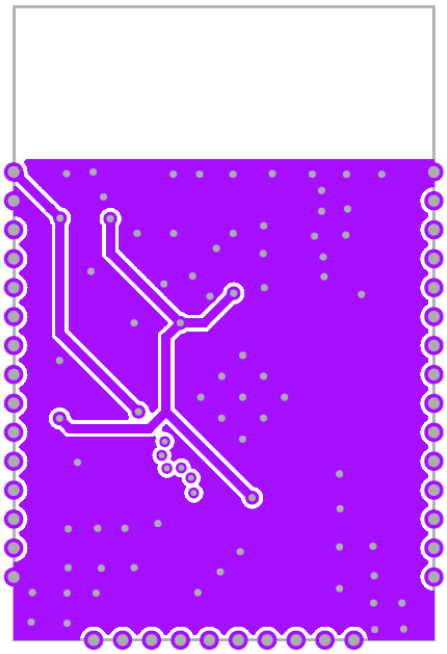


Figure 30 PWR Plane

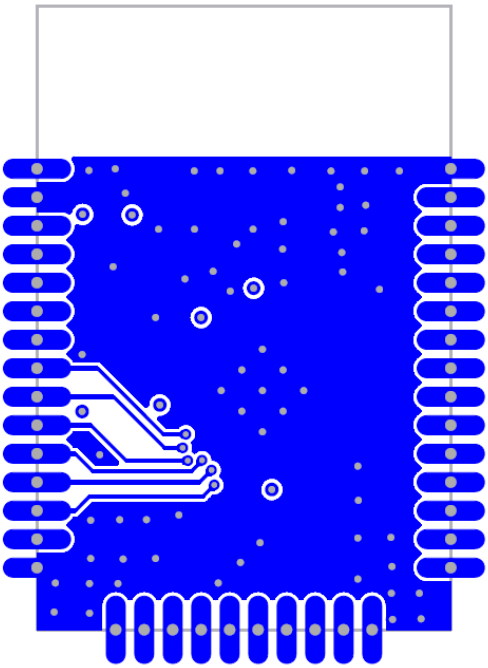


Figure 31 Bottom Etch

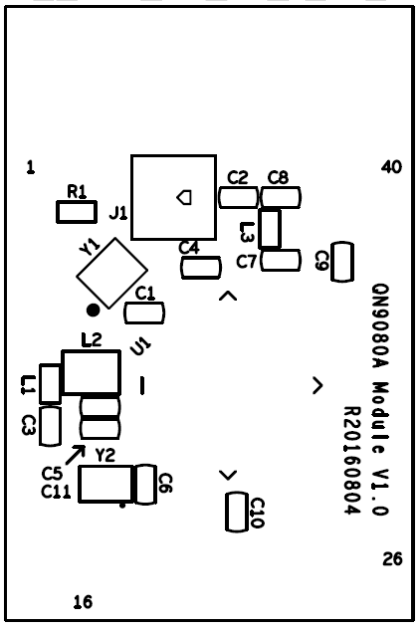


Figure 32 Top Silkscreen

5.3 Dimension for PCB board

5.3.1 QN908x DK board

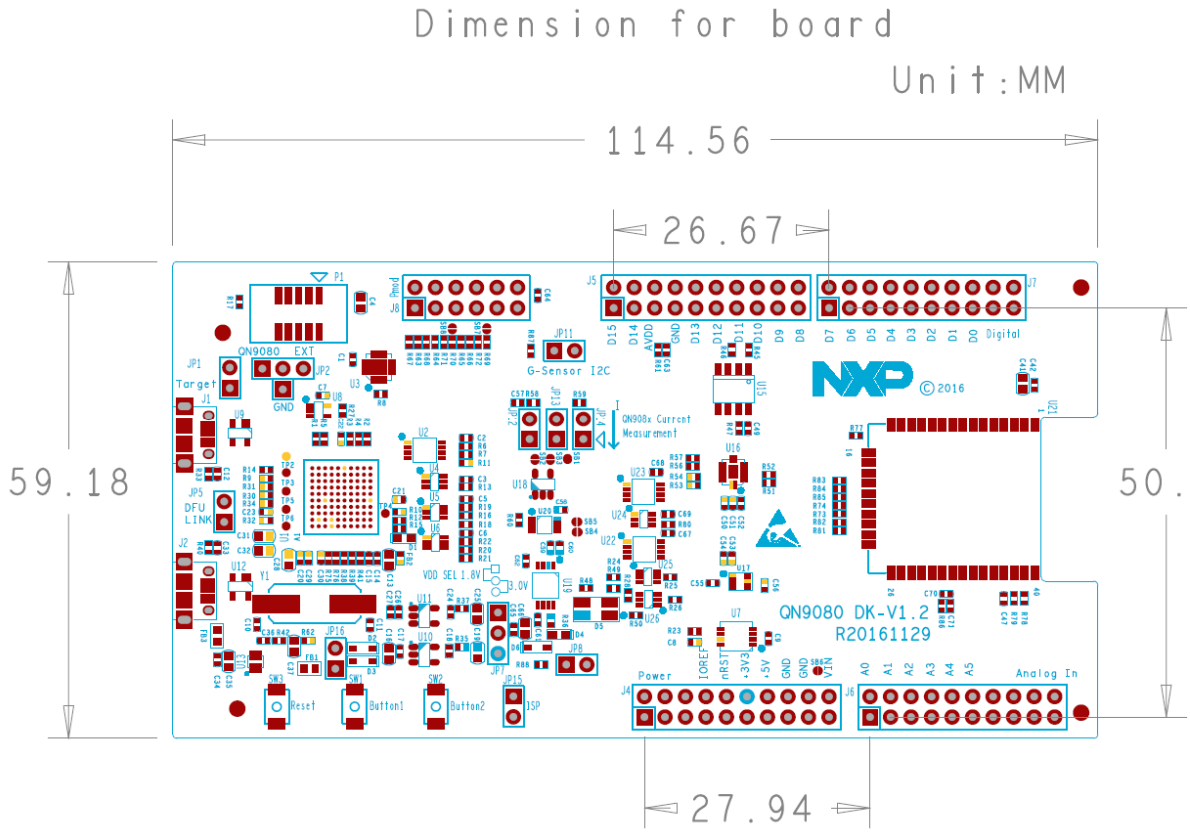


Figure 33 Dimension for QN908x DK board

5.3.2 QN9080 QFN Module

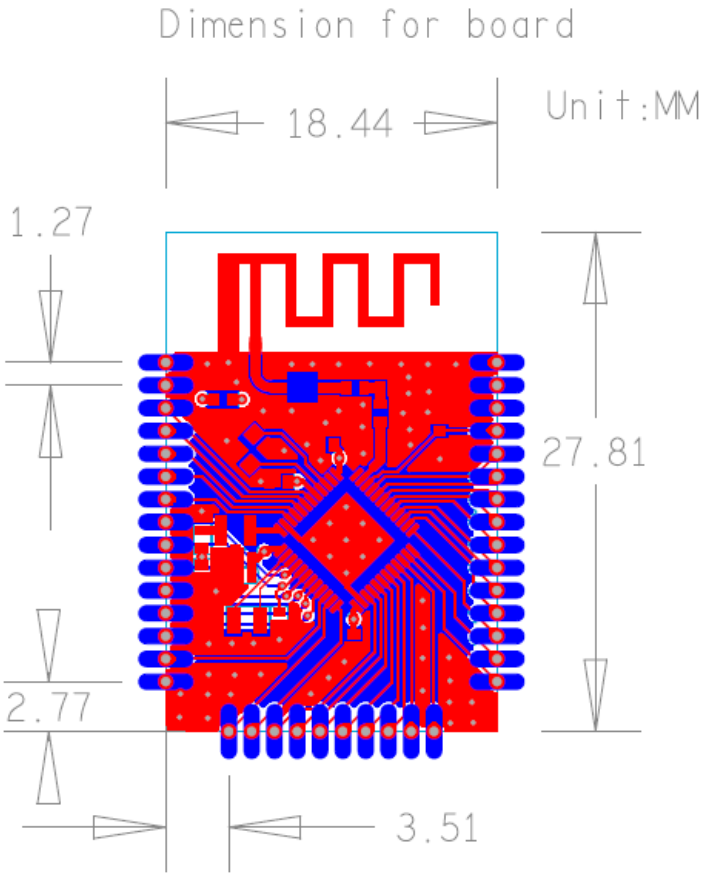


Figure 34 Dimension for QN9080 QFN Module board

5.4 Notes for using lithium battery as power supply

When use lithium battery as the power supply for QN9080 module, some tips need to be pay attention to.

- To avoid current leakage from QN9080 USB data line, it is a must to leave JP16 open.
- To avoid current leakage from Tri-color LED, it is recommended to remove the resistor R48, R49 and R50.

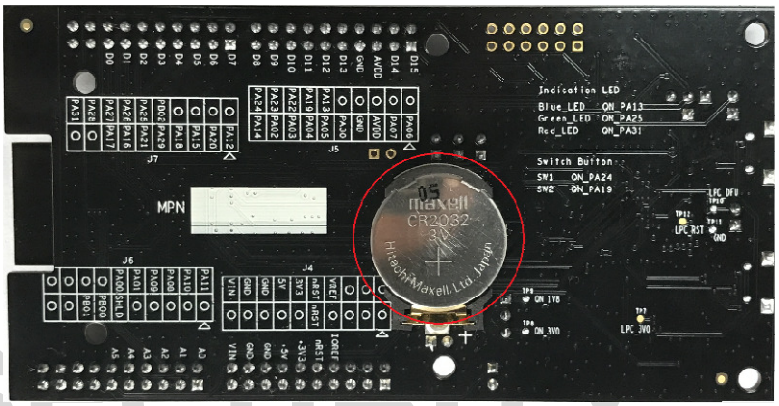


Figure 35 Lithium battery using for QN908x DK board

5.5 Statements

FCC Compliance Statement

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

-- Reorient or relocate the receiving antenna.

-- Increase the separation between the equipment and receiver.

-- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

-- Consult the dealer or an experienced radio/TV technician for help.

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.

IC Compliance Statement

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

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<License statement text>

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7. Contents

Date of release: 27 April 2016
Document identifier: <DOC_ID>

Figture list

Date of release: 27 April 2016
Document identifier: <DOC_ID>

Date of release: 27 April 2016

Document identifier: <DOC_ID>