QN908x

DK User's Guide

Rev. 1.2 — April 2018

Revision history

Rev	Date	Description
0.1	20160818	Initial release.
0.2	20160908	Updated the figures, schematics, and PCB layout according to the QN908x DK board V1.0 and added the QN9080 QFN module board information.
0.3	20161110	Updated pictures and schematics according to the QN908x DK board V1.1, added the current test using the DC power analyzer. Added notes about using a battery as the power supply for the QN9080 module.
0.4	20170117	Updated pictures and schematics according to the QN908x DK board V1.2 and changed the jumper default settings.
1.0	20170613	Public release.
1.1	20180201	Updated software tool information.
1.2	20180410	Updated the USB Dongle usage and firmware updating information.

Contact information

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

1. Introduction

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

1.1 Purpose

This document introduces all functions of the QN908x DK V1.2 board and describes all its parts in detail.

1.2 Kit contents

QN908x DK includes the following:

◆ QN908x DK board

◆ QN9080 USB dongle

◆ USB cable

QN908x-DK

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User's Guide

Rev. 1.2 — April 2018

3 of 27

2. Hardware description

The QN908x DK board provides easy access to peripherals, such as the buttons and LED. The board also provides useful interfaces, such as the USB port for UART communication and CMSIS-DAP debugger, and the standard Arduino & Pmod connector. The USB dongle is a Bluetooth device powered by QN9080. It acts as a master/slave when communicating with the QN908x devices.

2.1 Hardware overview

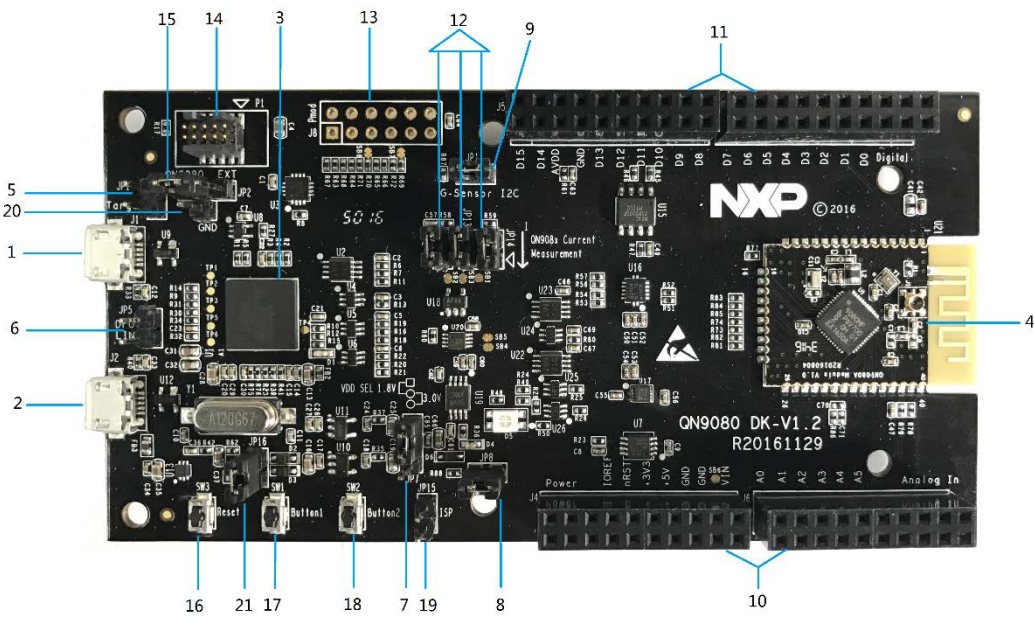The QN908x DK V1.2 board is shown in Fig 1. The detailed information is listed in Table 1.

Fig 1.   Board overview

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

Number	Name	Description
1	QN908x USB port	The QN908x USB port provides power supply to the whole board and the USB signal path to the QN908x module.
2	LPC4322 USB port	The LPC4322 USB port provides power supply to the whole board and the USB signal path is connected to LPC4322.
3	LPC4322	LPC4322 works as the JTAG/SWD link bridge.
4	QN908x module	The QN908x module board comes in two types, according to the QN908x chip package: HVQFN and WLCSP.
5	Jumper JP1	This jumper sets the JTAG/SWD link bridge target: • Open: on-board target (default) • Short: off-board target
6	Jumper JP5	This jumper sets the LPC4322 DFU mode: • Short: DFU mode enabled • Open: normal mode (default)
7	Jumper JP7	This jumper sets the QN908x module power supply voltage: • 1-2: 1.8 V power supply • 2-3: 3.0 V power supply (default)
8	Jumper JP8	This jumper sets the QN908x ISP UART path mode: • Short: UART path enabled (default) • Open: UART path disabled
9	Jumper JP11	This jumper sets the QN908x external I^2C path mode: • Short: I^2C path enabled (default) • Open: I^2C path disabled
10	Header J5 and J7	QN908x GPIO for testing and compatible with the Arduino board interface.
11	Header J4 and J6	QN908x GPIO for testing and compatible with the Arduino board interface.
12	Jumper JP12, JP13, JP14	These jumpers are used for the power consumption test.
13	Header J8	PMod interface connector, compatible with PMod.
14	Debugger connector	Used to offer the JTAG/SWD interfaces to the off-board target.
15	Jumper JP2	This jumper sets the QN908x power supply source: on-board power or EXT power.
16	Button3 SW3	Button3 resets the QN908x chip.
17	Button1 SW1	Button1 is a function button defined by the user.
18	Button2 SW2	Button2 is a function button defined by the user.
19	Jumper JP15	Jumper used to enable the QN908x chip mode function.
20	GND Pin	GND pin used as the test ground pin.
21	Jumper JP16	Jumper used to cut off the USB leakage, when the DK board is powered by a battery.

QN908x-DK

User's Guide   **Rev. 1.2 — April 2018**   **5 of 27**

2.2 Default jumper settings on the DK board

As shown in Fig 2, the power, JTAG/SWD, UART, and I²C enable jumpers are connected by default. Table 2 and Table 3 show the jumpers' functions and how to set them.
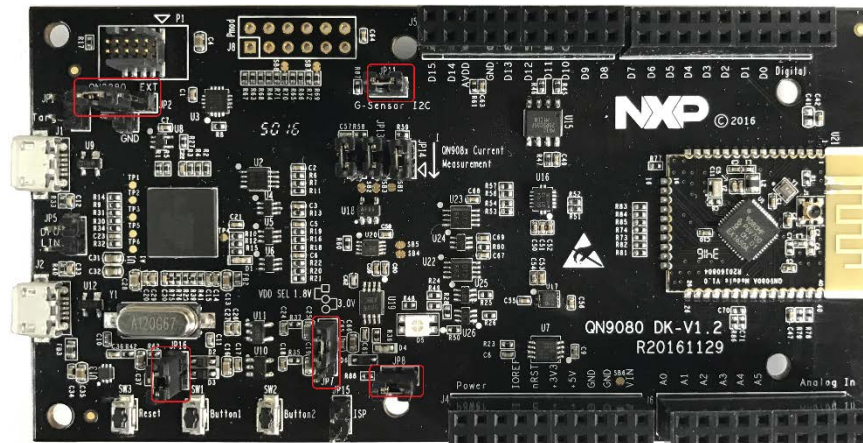

Fig 2. Board jumper default settings

Table 2. QN9080 DK board's default jumper settings

Jumper	Jumper setting	Function
JP2	Pin 1, 2 shorted	QN908x's on-board power
JP7	Pin 2, 3 shorted	QN908x's power (3 V)
JP8	Pin 1, 2 shorted	UART path enabled
JP11	Pin 1, 2 shorted	I²C path enabled
JP16	Pin 1, 2 shorted	When the DK board is powered by a battery, leave it open.

2.3 LPC4322 debugger

The LPC4322 debugger supports both the CMSIS-DAP (default) and the J-Link interface. It provides both the SWD/JTAG and UART interfaces. See section 4.4 in UM11097 on how to change the debug interface to J-Link and the other way round. You may download or update the firmware into the QN908x device using the UART or JTAG/SWD interfaces. There is a debugger connector to program and debug an off-board target (shown in Fig 3).

QN908x-DK

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User's Guide

Rev. 1.2 — April 2018

6 of 27

Fig 3.   Debugger connector

2.4 QN908x module

The QN908x IC integrates the BLE radio, controller, protocol stack, and profile software on a single chip, which provides a flexible and easy way to use the 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.
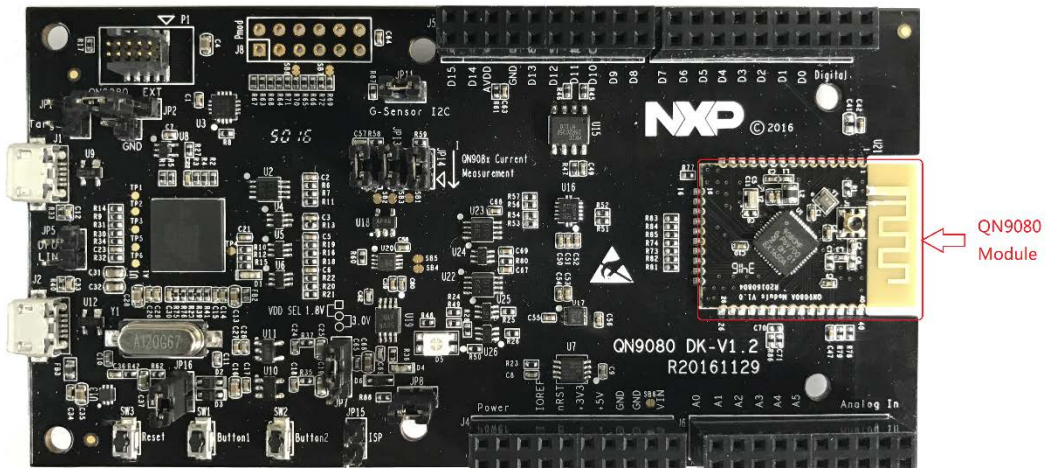
The QN9080 module is shown in Fig 4.

Fig 4.   QN9080 module board

The QN908x module has a MIFA antenna on the front side of the board. Therefore, it can work without an external antenna. There is a RF connector that has a switch on the RF front-end. You can easily perform the RF test by connecting an RF cable to the RF connector.

2.5 GPIO and Arduino interfaces

On the QN908x DK board, the J4, J5, J6, and J7 connectors all provide GPIO connection outputs. The board is also compatible with the Arduino board interface. The interface schematic is shown in Fig 5.
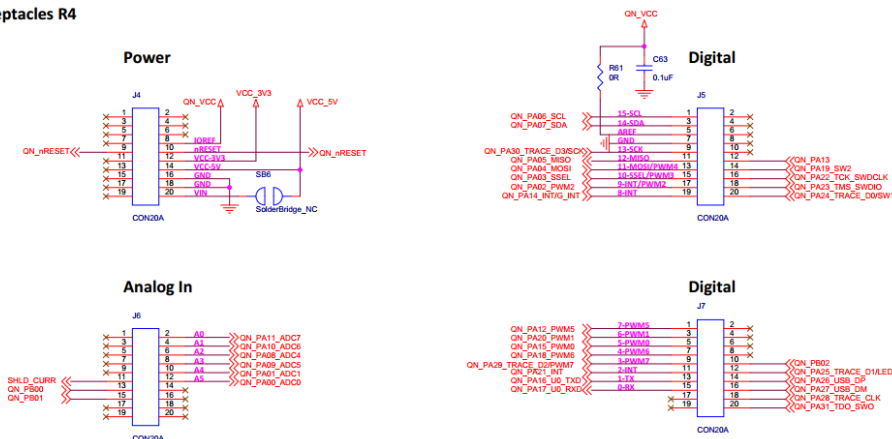

Fig 5. QN908x DK board GPIO and Arduino interface

2.6 QN908x reset button

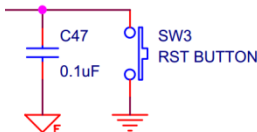The reset button is used to provide a hardware reset to the QN908x device, as shown in Fig 6).

Fig 6. Reset button

2.7 ISP mode jumper

JP15 is the ISP mode jumper used to set the QN908x ISP mode. When the jumper is shorted, the PB02 chip mode pin is connected to GND and this function is enabled. When the jumper is open, the ISP mode function is disabled, as shown in Fig 7.
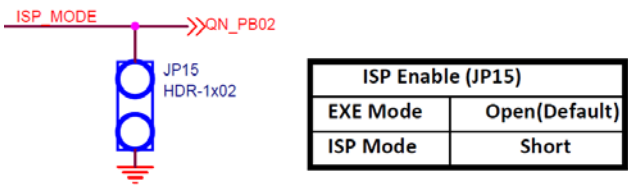

ISP Enable (JP15)	
EXE Mode	Open(Default)
ISP Mode	Short

Fig 7. Chip mode jumper

QN908x-DK

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User's Guide

Rev. 1.2 — April 2018

8 of 27

2.8 SWD/JTAG interface

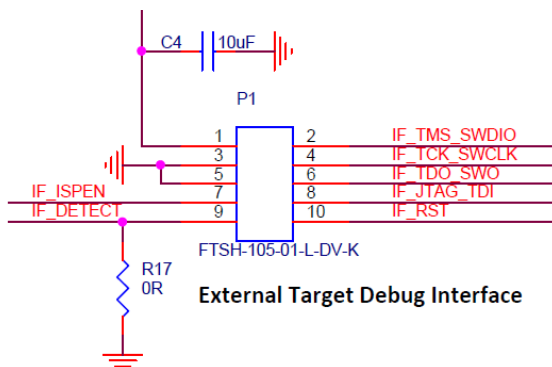The board provides a SWD/JTAG interface to be used by an external debugger, as shown in Fig 8.

Fig 8.   Debugger interface

2.9 Buttons

As shown in Fig 9, the DK board offers three buttons. When using the SW1 and SW2 buttons, the GPIO must be configured as the input. The logic LOW input is applied to the GPIO when a button is pressed.
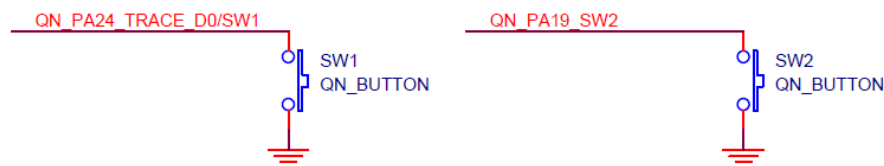

Fig 9.   Buttons

The SW3 button is used to reset the QN908x chip. Press the button to reset the QN908x.

2.10 LED

The board offers a 3-color RGB LED. The connections are shown in Fig 10. The LED lights up when the corresponding GPIO outputs switch to the logic high level. The GPIO control pins are QN_PA13, QN_PA25, and QN_PA31. The GPIO QN_PA13 can work in the PWM out mode. Therefore, the brightness of the LED can change with the PWM pulse width.
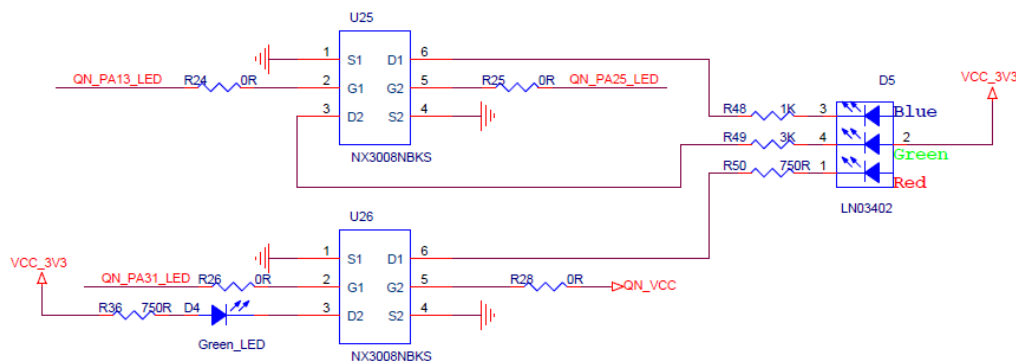

Fig 10.   LED

QN908x-DK

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User's Guide   **Rev. 1.2 — April 2018**   **9 of 27**

3. DK board application function

3.1 CMSIS-DAP interface

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

To change to the CMSIS-DAP interface, see Chapter 4.4 in UM11097.

3.1.1 CMSIS-DAP to on-board QN908x

When programing or debugging a QN908x device using the CMSIS-DAP interface, JP1 and JP2 must be configured according to Table 3.

Table 3.   ISP mode jumper setting

JP1	Open, CMSIS-DAP target is on-board QN9080
JP2	Short pin 1, 2, QN908x power enable

When downloading firmware into the QN908x with the ISP mode, enable the UART path and set the chip mode pin to ground. The jumper setting is shown in Table 4.

Table 4.   ISP mode jumper setting

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

The ISP download operation flow is shown in Fig 11.

Fig 11.   ISP download operation flow

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

3.1.2 CMSIS-DAP to off-board target

When using the QN908x DK board to program or debug off-board targets by the JTAG/SWD interface, JP1 and JP2 must be configured according to Table 5.

Table 5.   ISP mode jumper setting

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

3.2 Current consumption test

The QN908x DK board provides two ways to measure the QN908x chip current consumption. One way is to measure the current by the on-board precise resistor used for the I-to-V conversion. The small voltage signal is amplified by the operation amplifier and fed to the ADC. Then, it can be calculated by LPC4322 and shown in the MCUXpresso IDE. Another way is to measure the current by an external ammeter on jumper JP14.

3.2.1 Current test using LPC4322

The QN908x DK board has an on-board current measurement circuit consisting of the MAX9634T (U18) current monitor chip and the 12-bit ADC (ADC122S021, U19) with a 12-bit sampling from 50 ksps to 200 ksps. The on-board MAX9634T current monitor measures the voltage across the QN908x VCC V-sense resistors; either 8.24 Ω or 4.12 Ω if JP13 is installed. MAX9634 multiplies the sense voltage 25 times to provide a voltage range suitable for the ADC to measure.

A 2-input analog mux is used to select the channel to be measured; either the QN9080 or the devices from the expansion board on the DK extension connectors. The current measurement circuit is controlled by the Link2 processor and is not user-programmable. The power-measurement utilities with this feature are available only after installing the MCUXpresso IDE.

Due to the input offset voltage variations in MAX9634, the current measurement circuit is not recommended for measuring currents below 150 μA.

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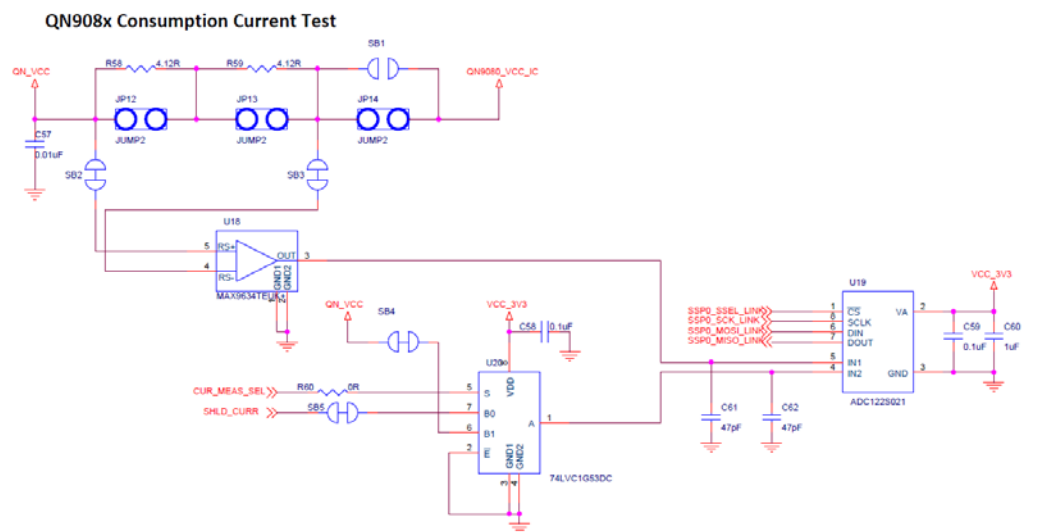

Fig 12.   Current test using the LPC processor

When performing the current test using the Link2 processor, jumpers JP12, JP13, and JP14 must be set according to Table 6 .

Table 6.   Current test jumper setting

JP12	Open when used for the Link2 processor current test
JP13	Open when used for the Link2 processor current test
JP14	Short when no digital ammeter series in

QN908x-DK

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User's Guide

Rev. 1.2 — April 2018

11 of 27

3.2.2 Current test using a digital ammeter

When performing the current test using an external digital ammeter, jumpers JP12, JP13, and JP14 must be set according to Table 7. Use a jumper cap to short the pins. The schematic is shown in Fig 13.
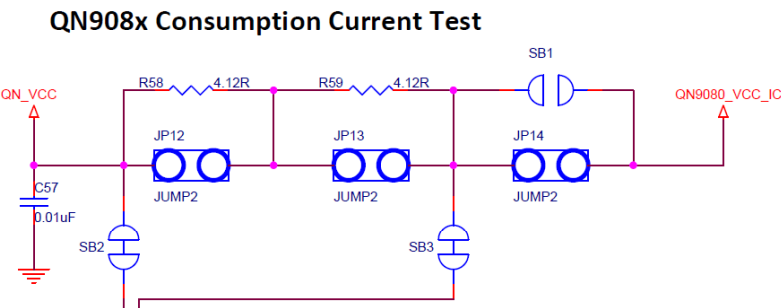

Fig 13.   Current test using an ammeter

When performing the current test using an ammeter, jumpers JP12, JP13, and JP14 must be set according to Table 7.

Table 7.   Current test jumper setting

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

3.2.3 Current test using a DC power analyzer

Measure the current using a DC power analyzer in these two ways: one way is to use the DC power analyzer as an ammeter that shares the same settings as the ammeter test, and the other way is to use the DC power analyzer as the power supply for the DUT.

In this case, the QN9080 module is powered by the DC power analyzer. The QN_VCC power pin is on jumper JP14, where a triangle symbol indicates the pin. The GND pin near jumper JP2 can be also used as the power ground.
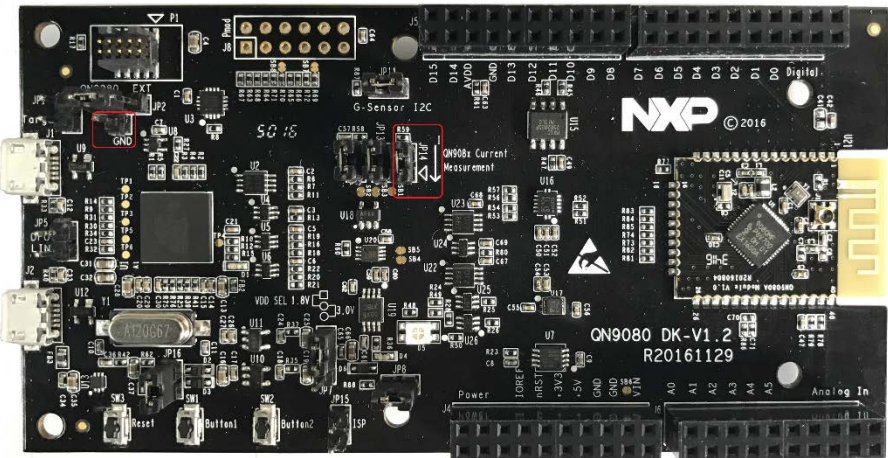
Fig 14.   QN_VCC power pin

3.3 RF connective test with CBT

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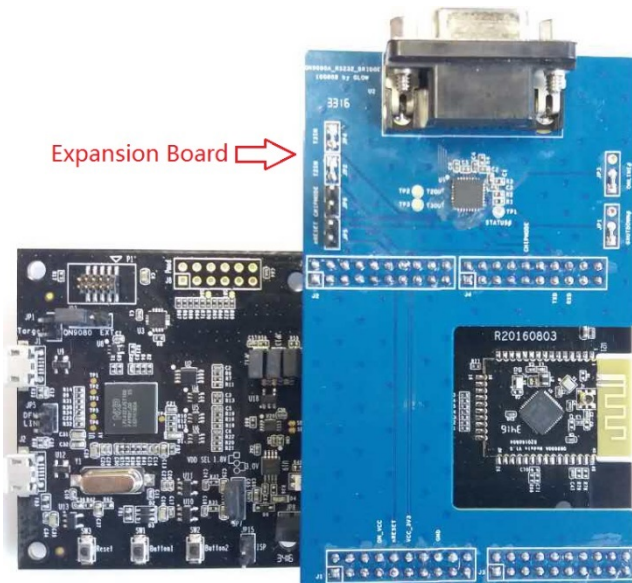

Fig 15. RF CBT test with the expansion board

Before the RF test, download the Controller Mode binary file to the QN908x module to put the QN908x into the DTM mode. Connect an RF cable from the QN908x module to the CBT and set the CBT RS232 baud rate to 115200 bit/s. After that, start the RF test.

4. QN9080 USB dongle

4.1 Dongle hardware

Fig 16. Dongle hardware

The QN9080 USB dongle works together with the Connectivity QTool and behaves either as a master or as a slave when talking to the QN908x DK or other devices. As shown in Fig 17, the USB dongle receives commands from Connectivity QTool via a virtual COM port, which initializes the QN9080 dongle either as a master or slave device. All tests can be performed by Connectivity QTool after the initialization.

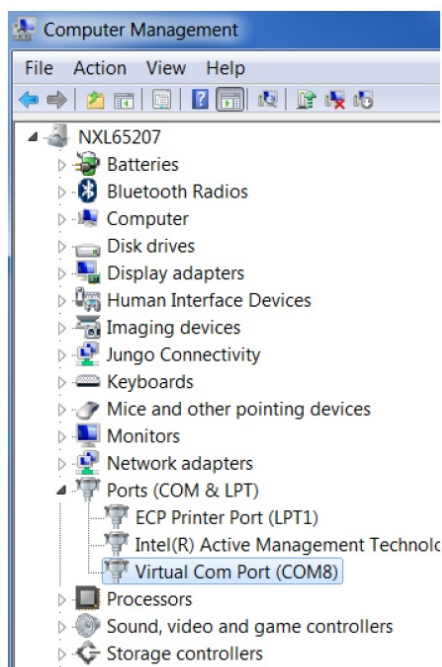To update the firmware of the QN9080 USB dongle, see Chapter 4.3 in UM11097.

QN908x-DK

User's Guide **Rev. 1.2 — April 2018** **13 of 27**

Fig 17. Connection as virtual COM port

4.2 Dongle connection

The QN9080 USB dongle is a USB-interfaced device with the QN9080 built in. With the driver and SDK installed on your computer (See Chapter 4.2 in document UM11097), use the Connectivity QTool in SDK to control the QN9080 in the dongle to work as a central/peripheral device. The DK board is supplied from the USB port and works as a peripheral/central device. The dongle connection is illustrated in the below figure. See the Connectivity QTool User Manual for information about the Connectivity QTool usage.

5. Appendix

5.1 Schematics

5.1.1 QN908x DK main board

The QN908x DK V1.2 board schematic has five parts: power, LPC processor, QN908x-BLE, QN908x-function, and Arduino interface.
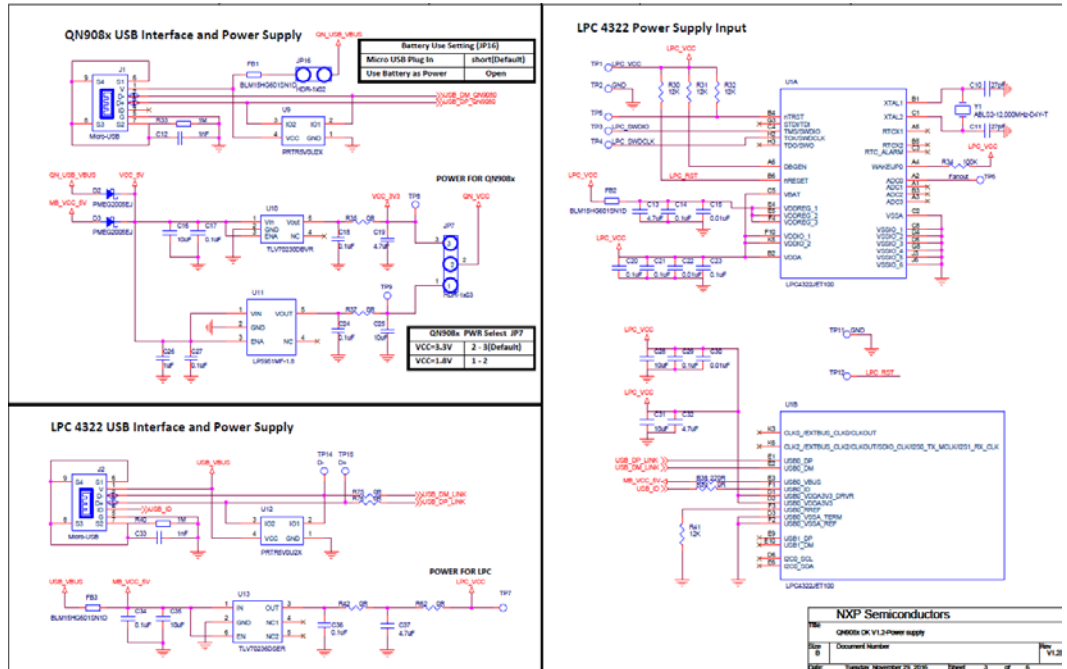
Fig 18. Power schematic of the QN908x DK board
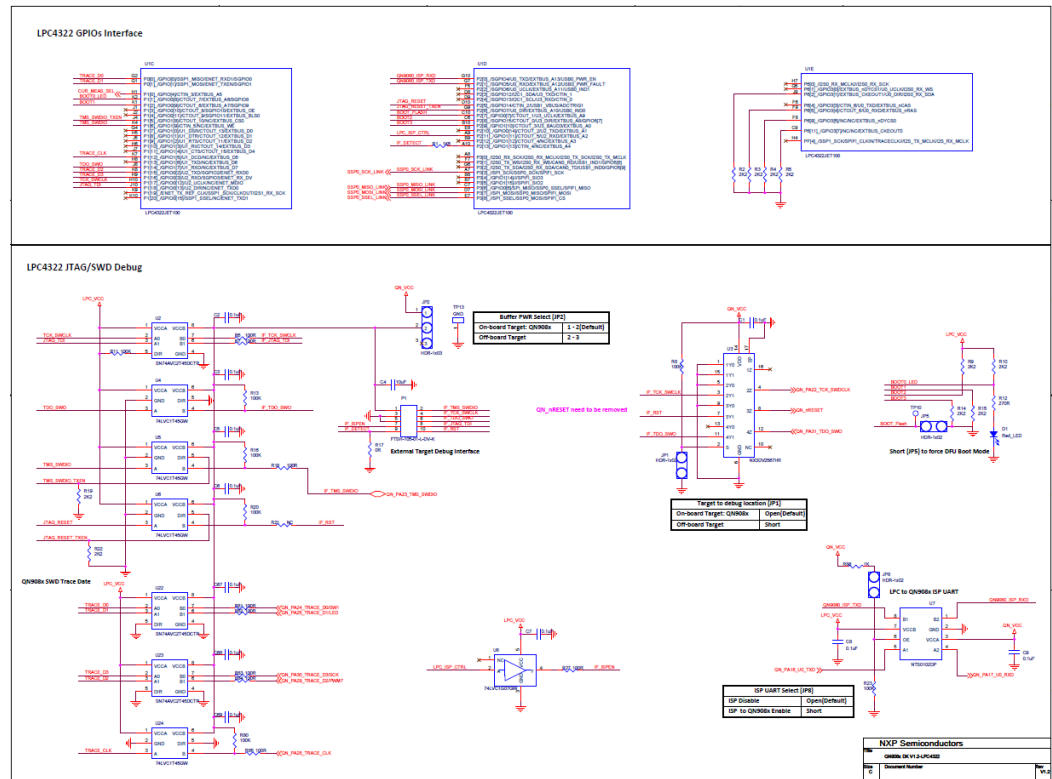
Fig 19. LPC processor schematic of the QN908x DK board

QN908x-DK

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User's Guide

Rev. 1.2 — April 2018

15 of 27
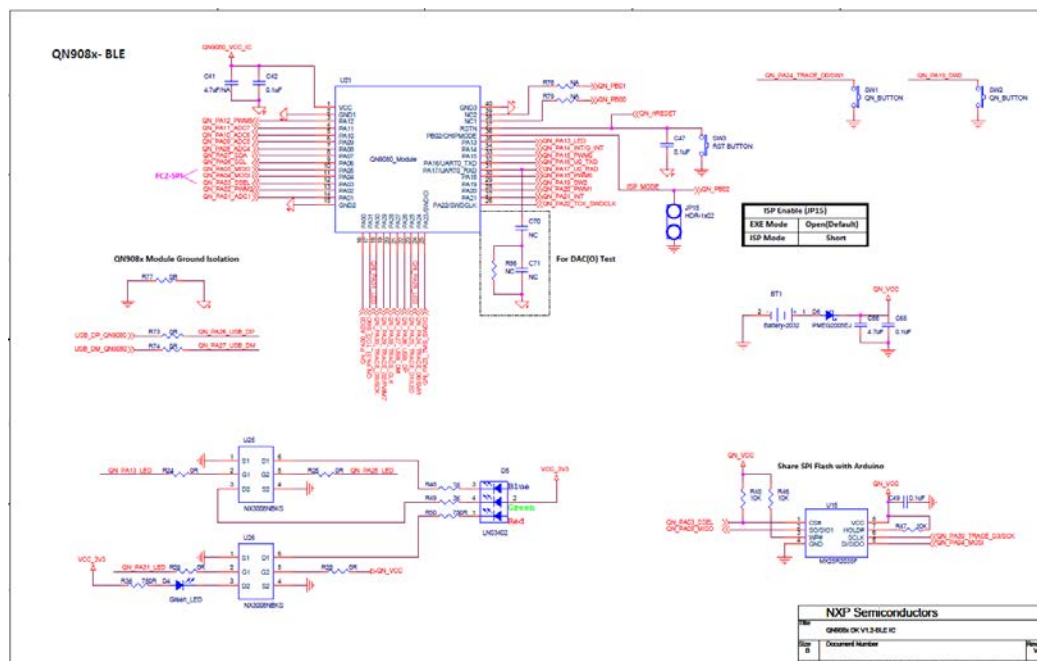
Fig 20. QN908x-BLE schematic of the QN908x DK board
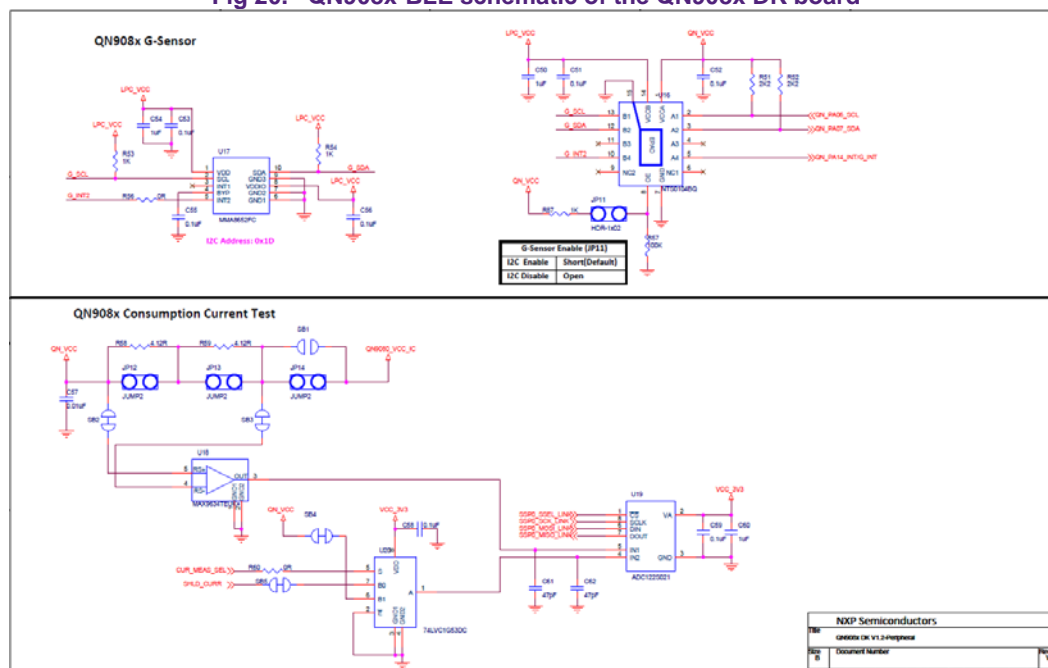
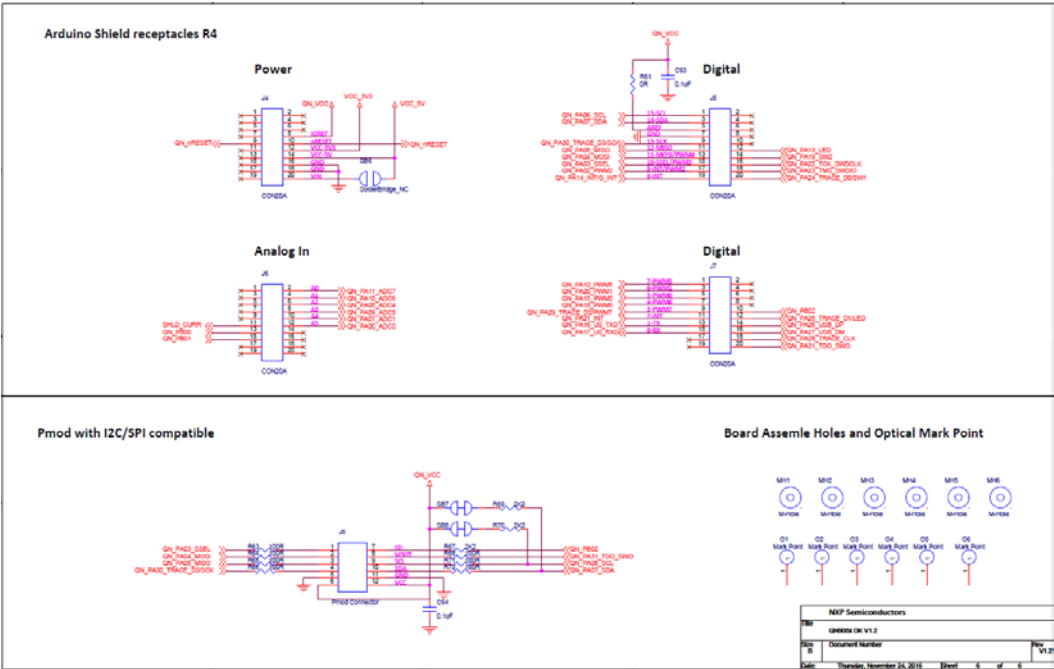**Fig 21. QN908x-function schematic of the QN908x DK board**

QN908x-DK

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User's Guide

Rev. 1.2 — April 2018

16 of 27

Fig 22.   Arduino interface schematic of the QN908x DK board

5.1.2   QN9080 module board

Fig 23.   QN9080 QFN module board

QN908x-DK

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User's Guide

Rev. 1.2 — April 2018

17 of 27
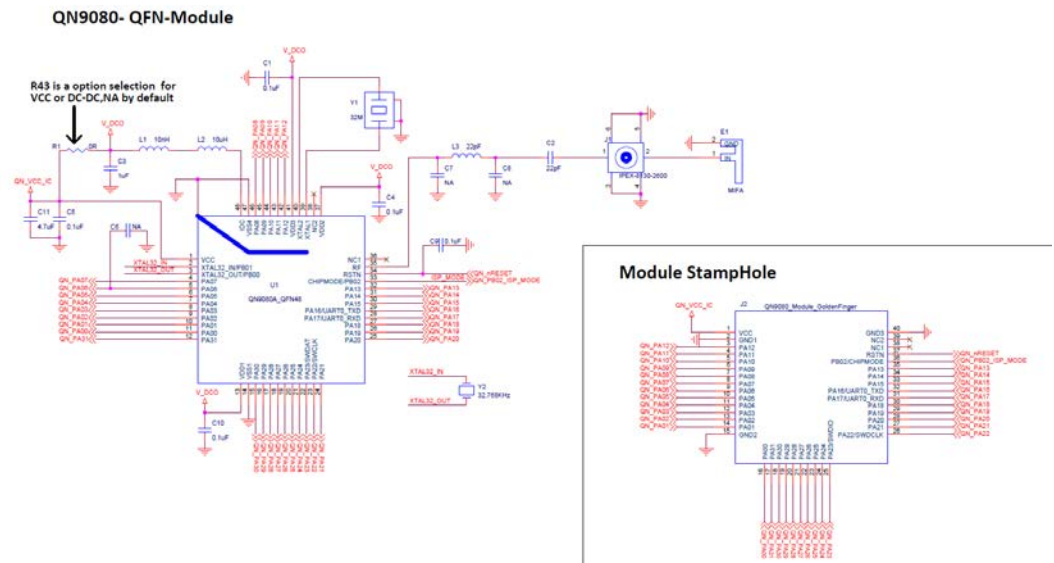
5.2 PCB layout

5.2.1 QN908x DK main board
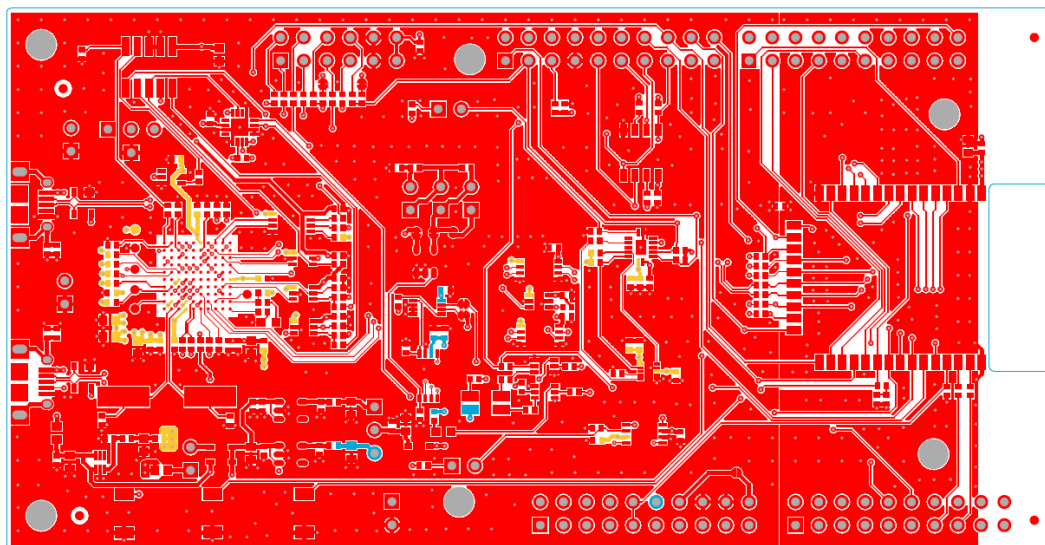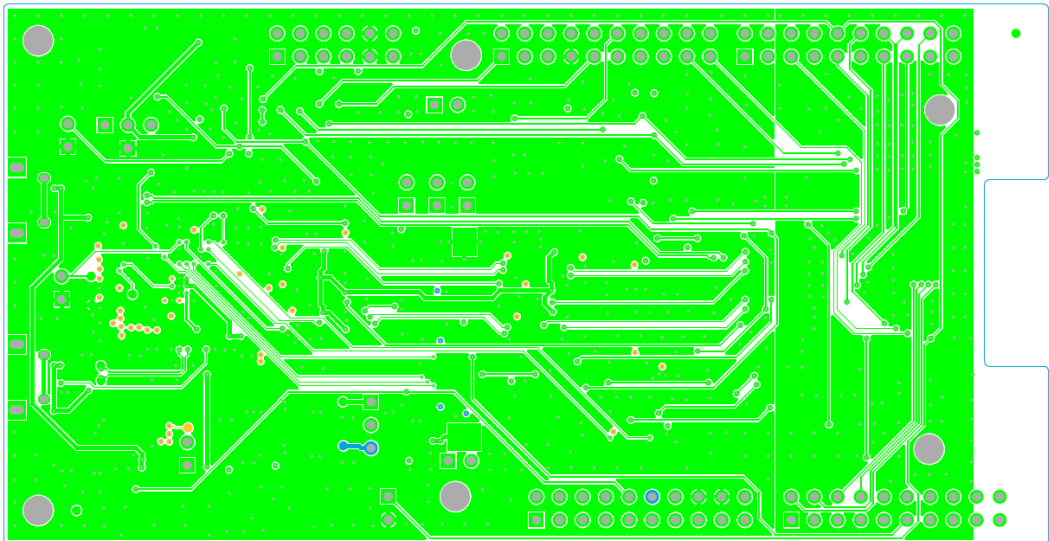

Fig 24. Top etch

Fig 25. GND plane

QN908x-DK

User's Guide **Rev. 1.2 — April 2018** **18 of 27**
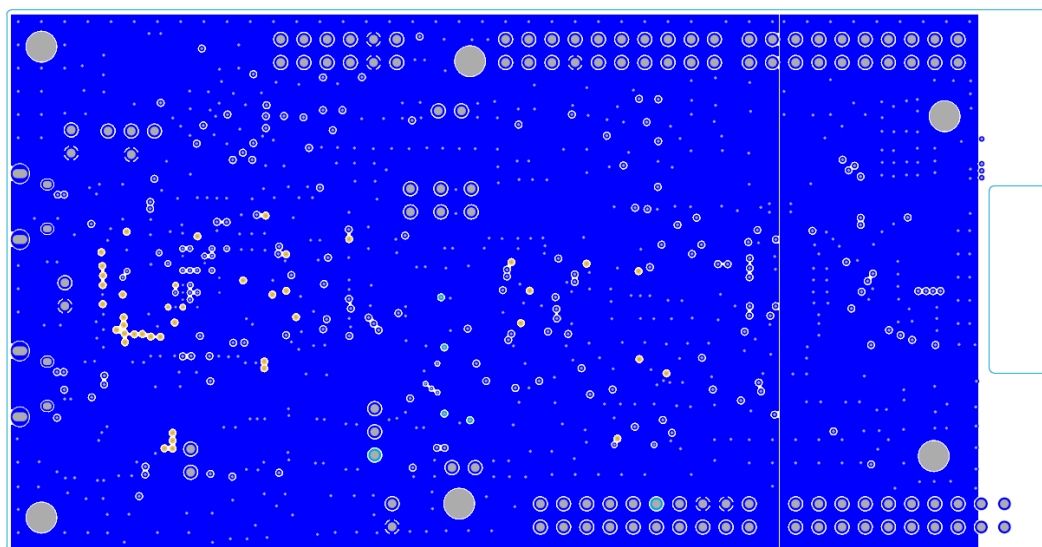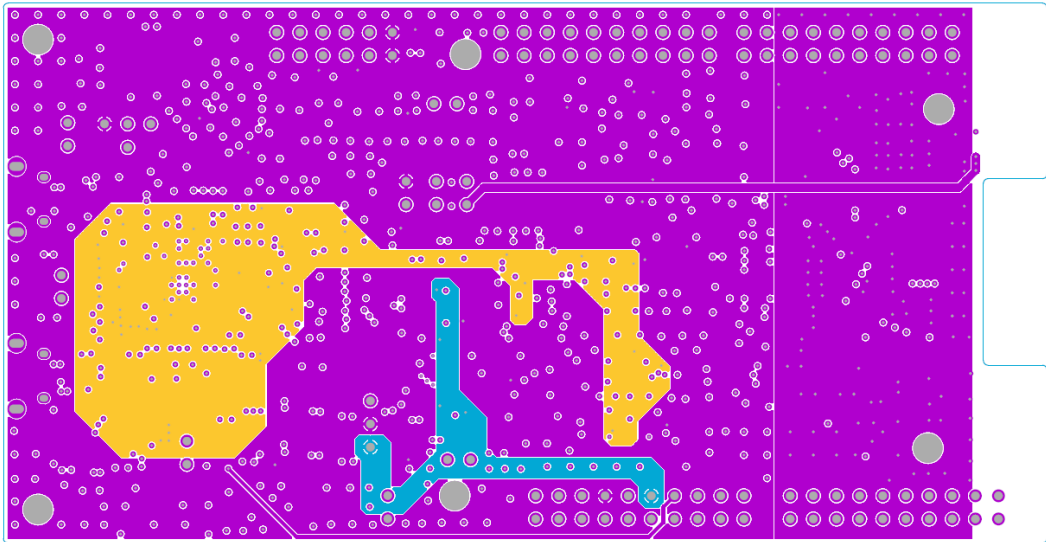
Fig 26.   PWR plane

Fig 27.   Top silkscreen

QN908x-DK

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User's Guide

Rev. 1.2 — April 2018

19 of 27
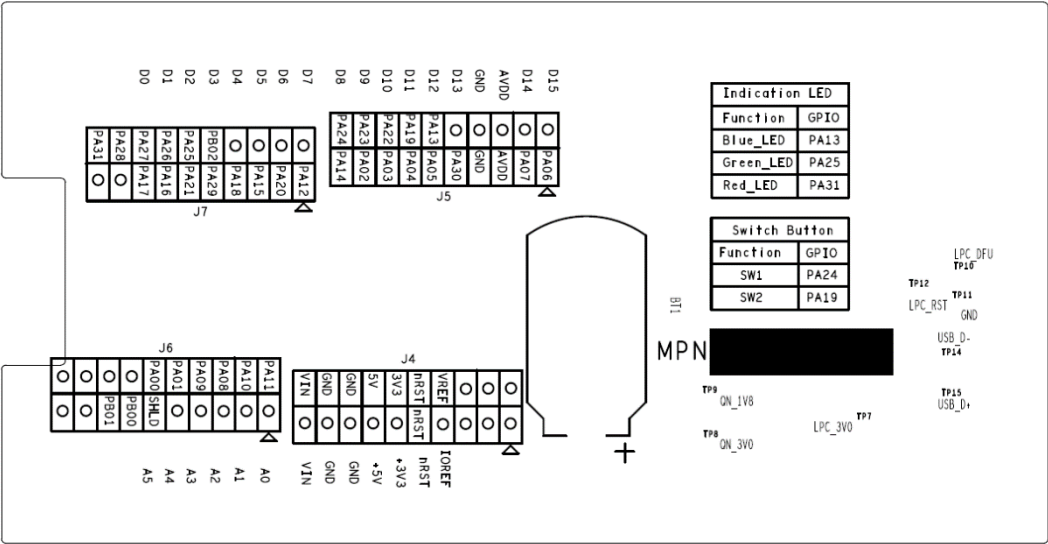
Fig 28.   Bottom silkscreen

5.2.2   QN9080 QFN board
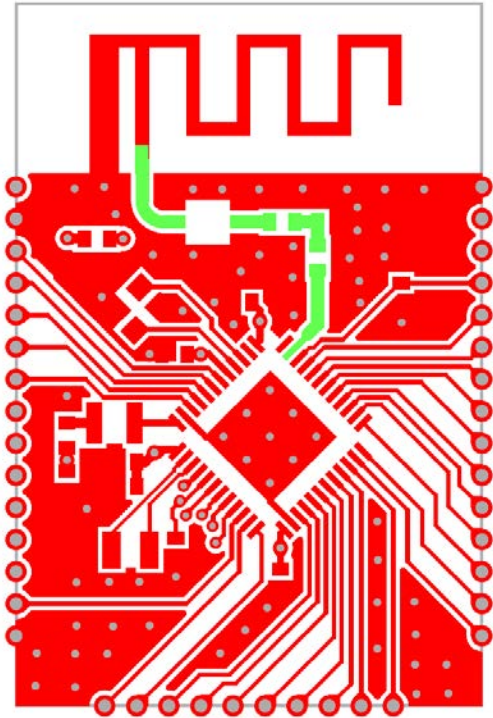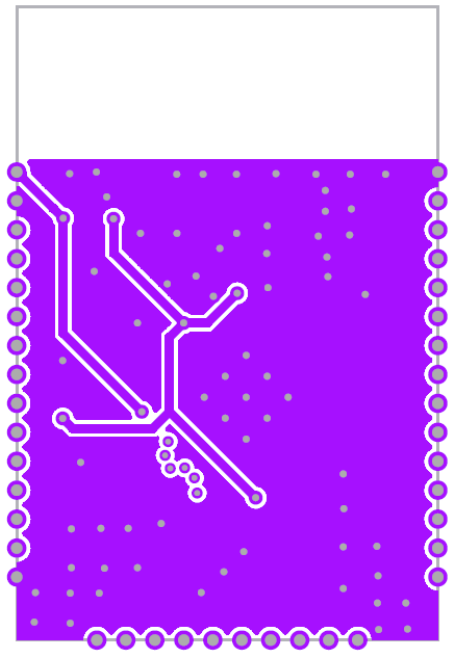

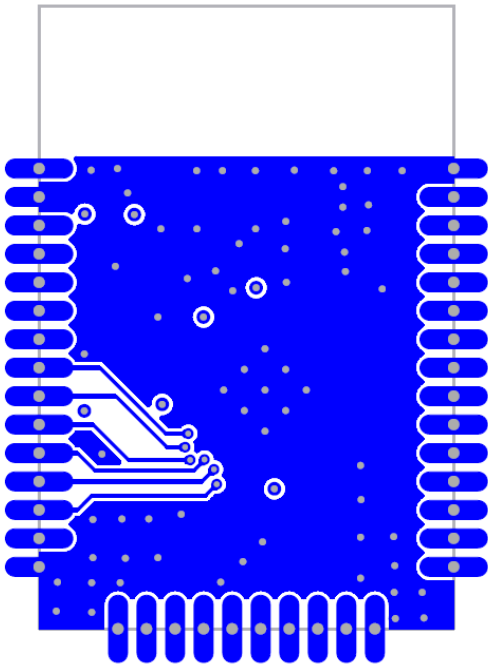**Fig 29.   Top etch**
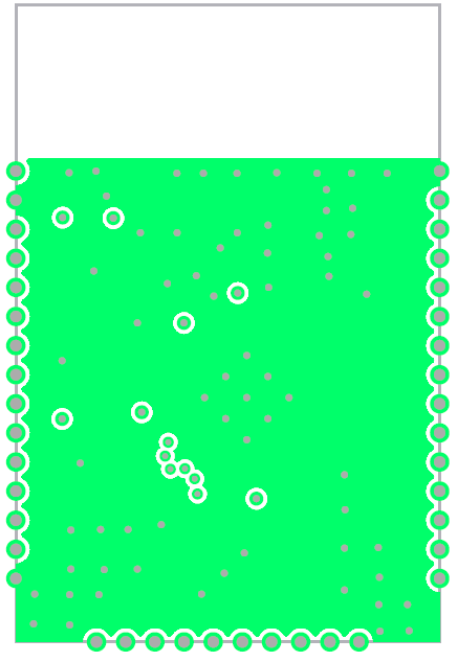
Fig 30. GND plane

Fig 31. PWR plane

QN908x-DK

User's Guide **Rev. 1.2 — April 2018** **21 of 27**

Fig 32.   Bottom etch

Fig 33.   Top silkscreen

QN908x-DK

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User's Guide

Rev. 1.2 — April 2018

22 of 27
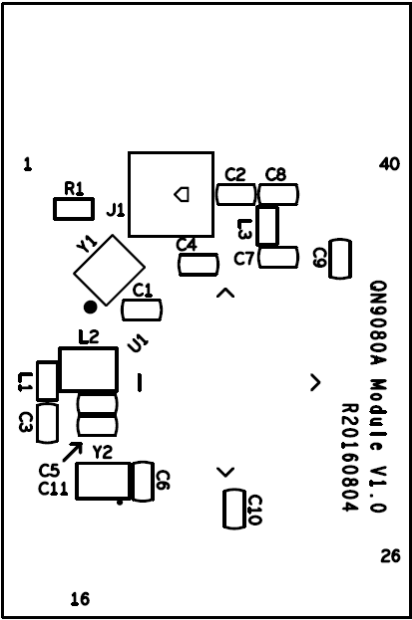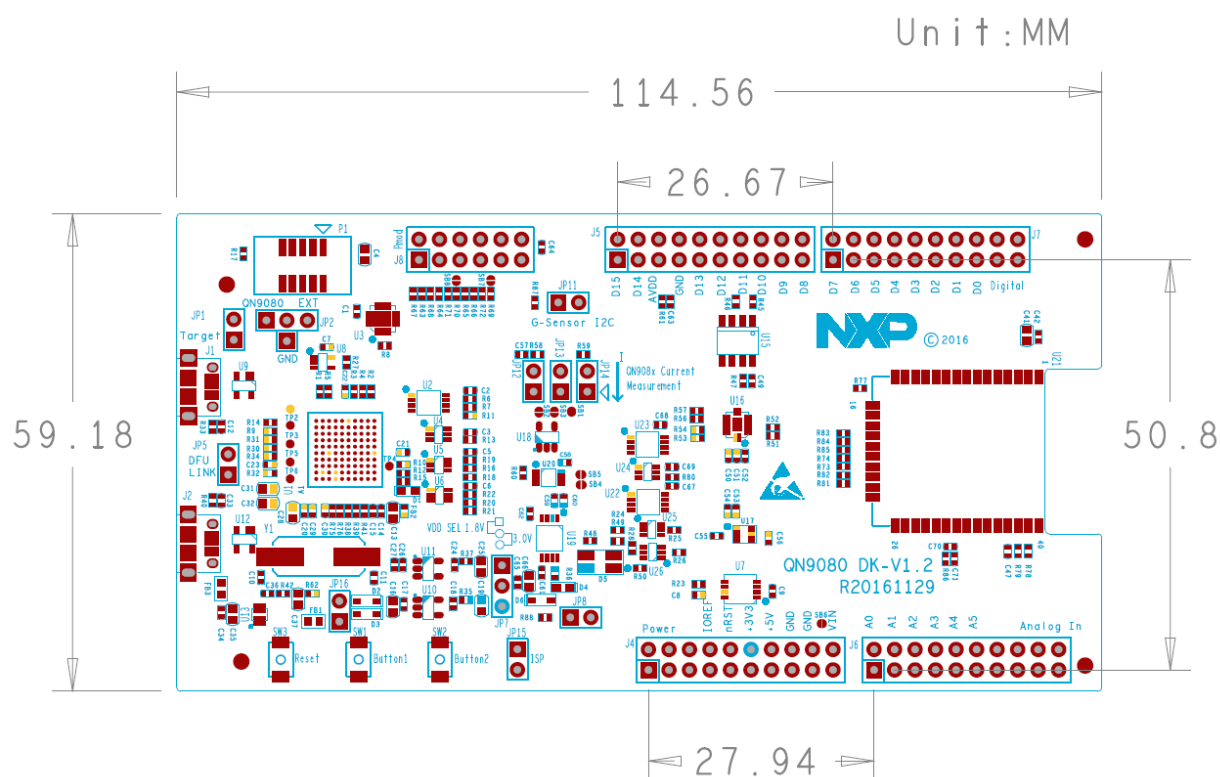
5.3 Dimensions of the PCB board

5.3.1 QN908x DK board

Fig 34. Dimensions of the QN908x DK board
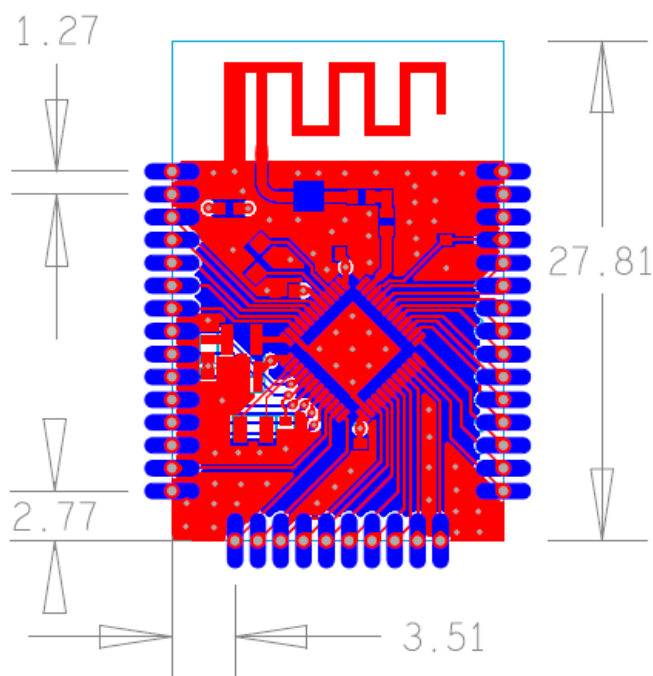
5.3.2 QN9080 QFN module

Fig 35. Dimensions of the QN9080 QFN module board

5.4 Notes for using a lithium battery

When using a lithium battery as the power supply for the QN9080 module, pay attention to the following:

◆ To avoid current leakage from the QN9080 USB data line, leave the JP16 open.

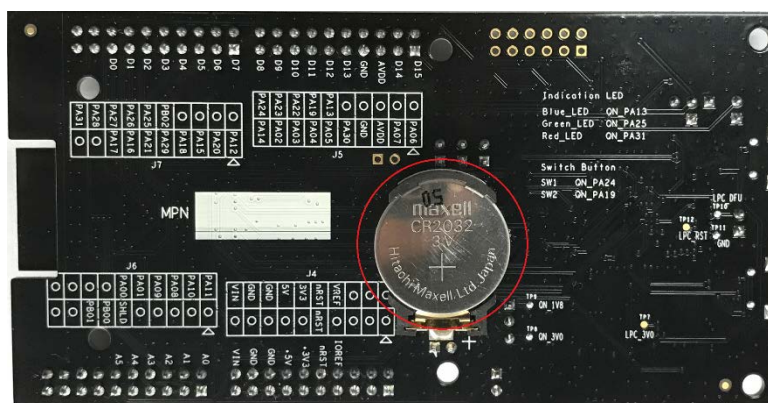◆ To avoid current leakage from the 3-color LED, remove resistors R48, R49, and R50.

Fig 36. Lithium battery on the QN908x DK board

5.5 Statements

5.5.1 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.

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.

6. Legal information

6.1 Definitions

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6.3 Licenses

Purchase of NXP <xxx> components
<License statement text>

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User's Guide

Rev. 1.2 — April 2018

26 of 27

7. Contents