UM10878

PN7120 NFC controller SBC kit user manual

Rev. 1.5 — 9 February 2021 User manual
318515 COMPANY PUBLIC

Document information

Information	Content
Keywords	OM5577, PN7120, demo kit, Raspberry Pi, BeagleBone
Abstract	This document is the user manual of the PN7120 NFC controller SBC kit.

1 Revision history

Revision history

Rev	Date	Description
1.5	20210209	Removed Windows IoT support
1.4	20170104	Added CE certification details
1.3	20160707	Added demo kit performance details
1.2	20160503	FCC statement updated
1.1	20151007	• FCC statement added • Note about useless of some components on the schematics added • Section Legal information updated
1.0	20150519	First release

2 Introduction

The present document describes the OM5577/PN7120S demonstration kit, a flexible and easy-to-use Single Board Computer (SBC) Kit for the PN7120 NFC controller.

It contains a PN7120 NFC controller board, a Raspberry Pi interface board, a BeagleBone interface board, as well as an NFC Forum Type 2 Tag in a form of a MIFARE Ultralight card. It enables the development of an NFC solution based on PN7120 in a Linux or Android environment.

In this document, the term „MIFARE Ultralight card“ refers to a MIFARE Ultralight IC-based contactless card.

PN7120 is a full NFC controller solution with integrated firmware and NCI interface designed for contactless communication at 13.56 MHz.

This document presents first an overview of the kit.

Then, it gives printed circuit boards details.

Finally, it provides information for reuse of the kit in different environments.

This kit is registered as FCC certified module (FCC ID: OWROM5577-PN7120S).

3 Overview

3.1 Kit description

OM5577/PN7120S kit is a high performance fully NFC-compliant expansion board for both Raspberry Pi (refer to [1] for more details) and BeagleBone (refer to [2] for more details). It meets compliance with reader mode, P2P mode and Card emulation mode standards. The board features an integrated high performance RF antenna to insure high interoperability level with NFC devices.

3.2 Kit content

The kit is composed of 3 printed circuit boards and a MIFARE Ultralight EV1 card.

Figure 1. PN7120NFC controller SBC kit content

3.2.1 PN7120 NFC controller board

The PN7120 NFC controller board is the main board of the demonstration kit. It embeds the PN7120 and all related circuitry.

It also includes an onboard RF antenna with related matching circuitry.

This main board has to be used in association with one of the 2 interface boards depending on the target user environment (Raspberry Pi or BeagleBone).

For this purpose, it integrates dedicated connectors allowing boards assembly.

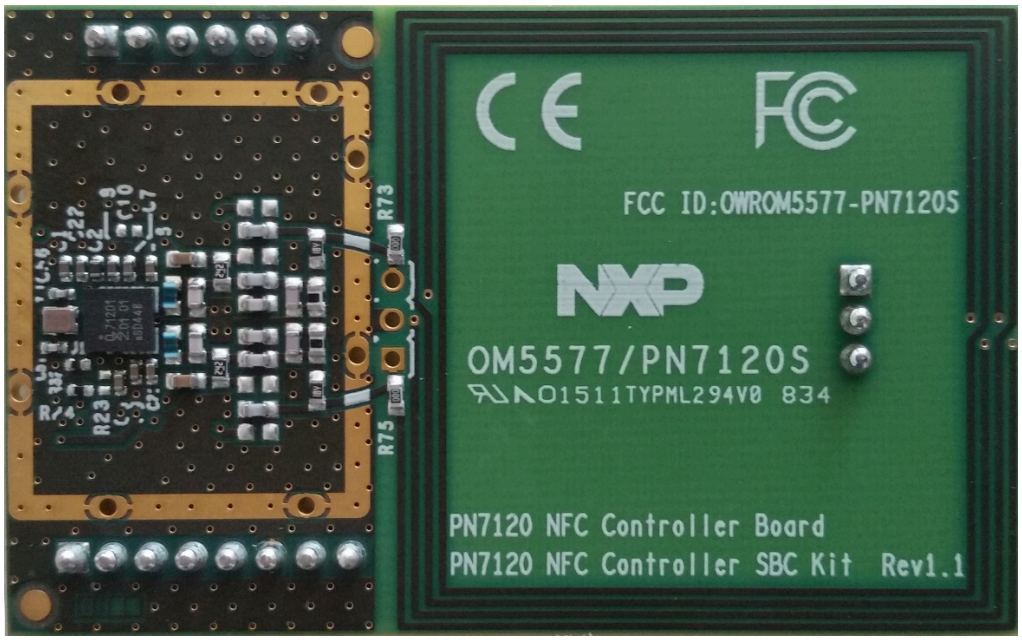


Figure 2. PN7120 NFC Controller Board

3.2.2 BeagleBone interface board

The BeagleBone interface board offers support for connection to BeagleBone board (refer to [2] for more details).

As such it integrates the connectors allowing the PN7120 NFC controller board to be plugged on it, as well as connectors to be assembled on top of the BeagleBone board.

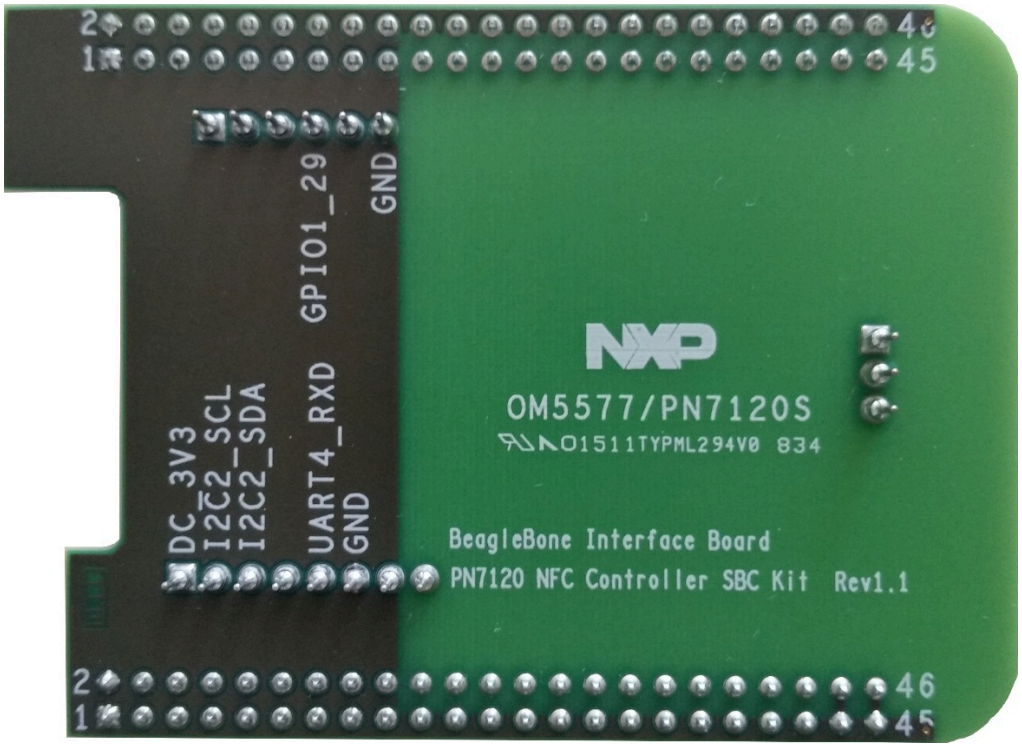


Figure 3. BeagleBone interface board

3.2.3 Raspberry Pi interface board

The Raspberry Pi interface board offers support for connection to Raspberry Pi board (refer to [1] for more details).

As such it integrates the connectors allowing the PN7120 NFC controller board to be plugged on it, as well as connector to be assembled on top of the Raspberry Pi board.

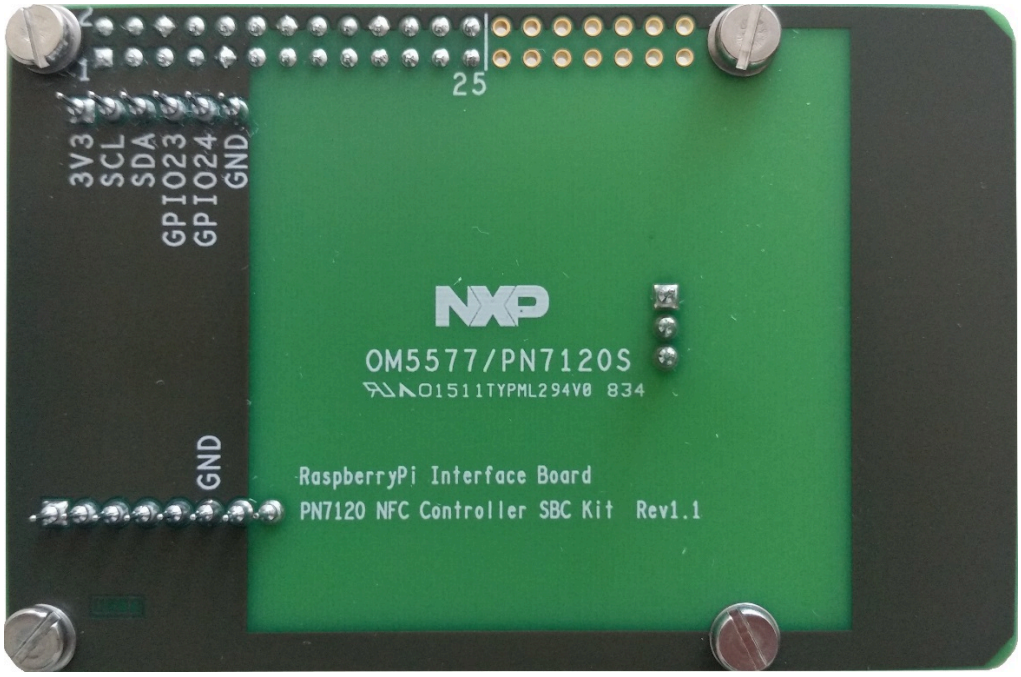


Figure 4. Raspberry Pi Interface Board

3.2.4 MIFARE Ultralight EV1 card

OM5577/PN7120S kit includes a MIFARE Ultralight EV1 card allowing to demonstrate NFC reader capabilities of PN7120 NFC controller.

MIFARE Ultralight EV1 is the next generation of paper ticketing smart card IC for limited-use applications. It offers solution developers and operators the maximum flexibility for their ticketing schemes and additional security options.

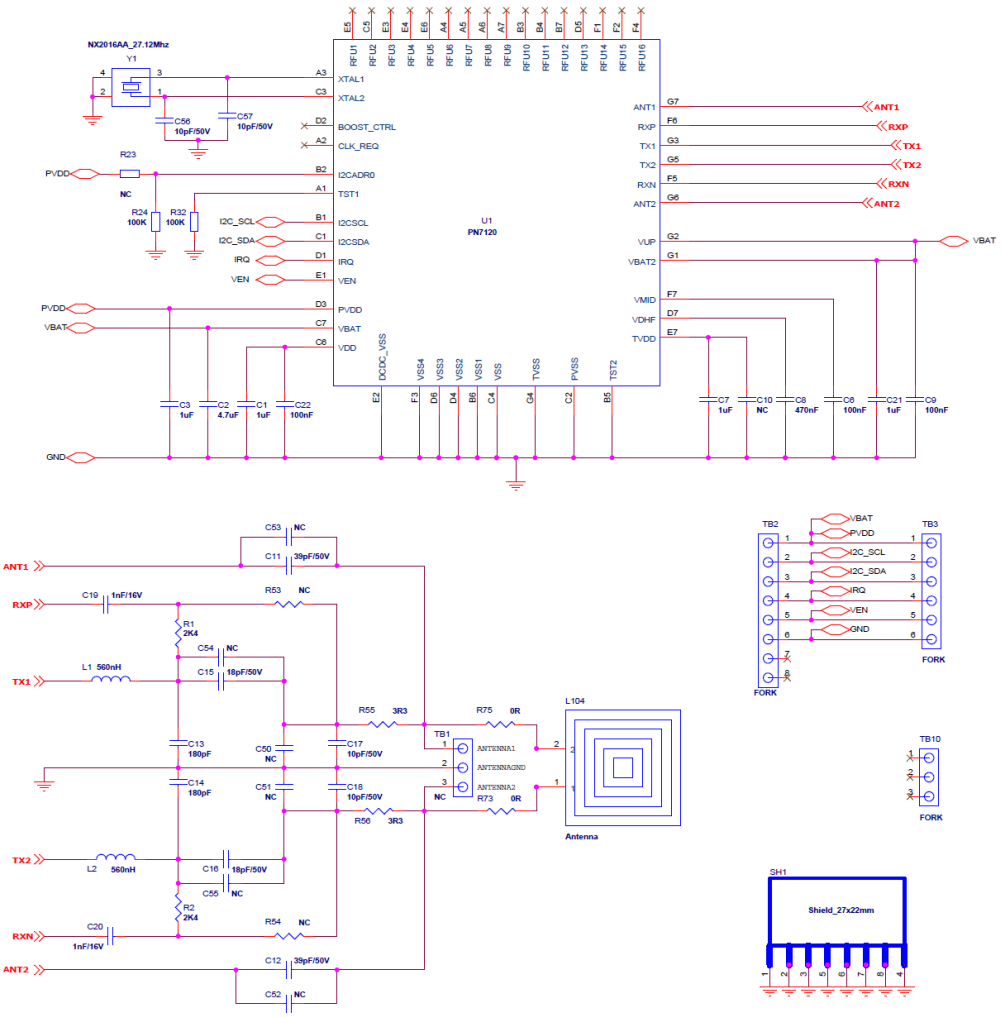
For the current purpose of PN7120 NFC Controller demonstration, the card has been set as NFC Forum Type 2 Tag, and pre-configured with NDEF URI type message "https://www.nxp.com/products/rfid-nfc/nfc-hf/nfc-readers/development-kits-for-pn7120-plugn-play-nfc-controller:OM5577".

Figure 5. MIFARE Ultralight EV1 card

4 Details

4.1 PN7120 NFC controller board

4.1.1 Schematics



Notes: *- C8 capacitor (on PN7120 pin D7) has been identified useless*
- R53/R54 resistors have been identified useless

Figure 6. PN7120 NFC controller board schematics

4.1.2 Layout

4.1.2.1 Components layers

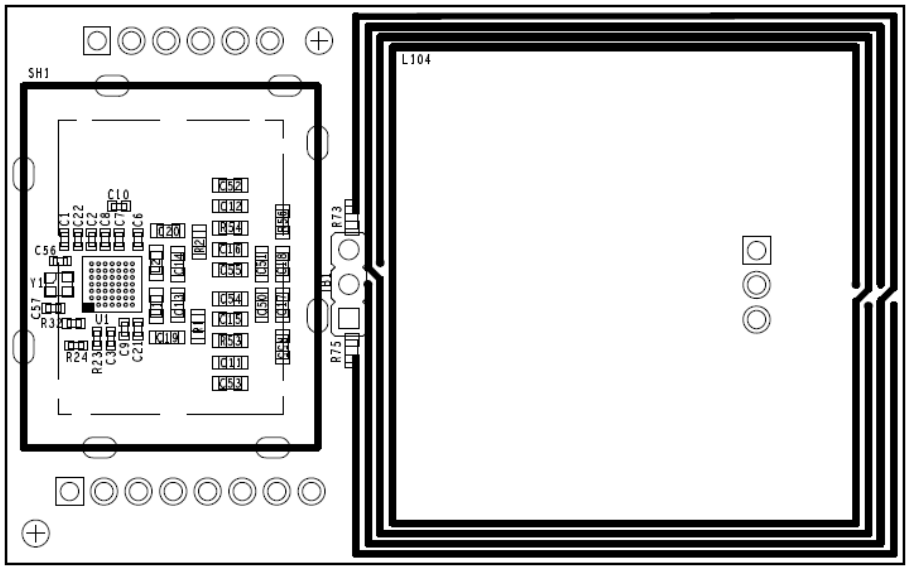


Figure 7. PN7120 NFC controller board top components layers

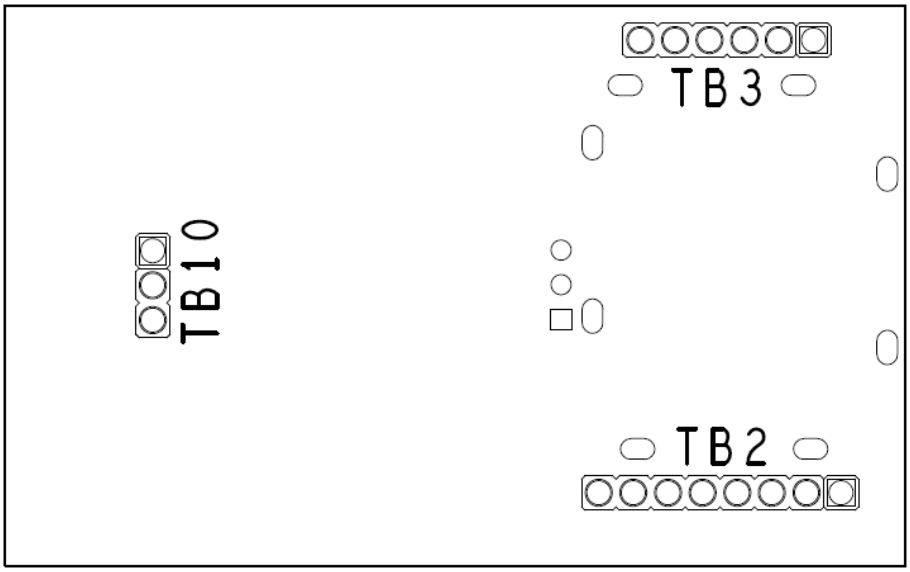


Figure 8. PN7120 NFC controller board bottom components layers

4.1.2.2 Layer 1

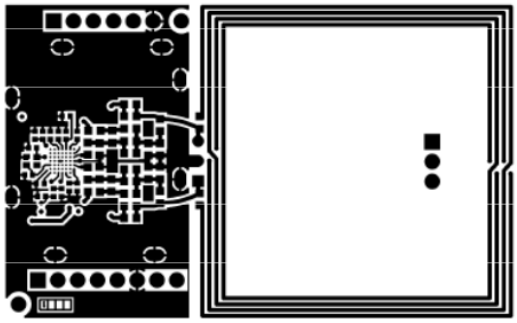


Figure 9. PN7120 NFC controller board layer 1

4.1.2.3 Layer 2

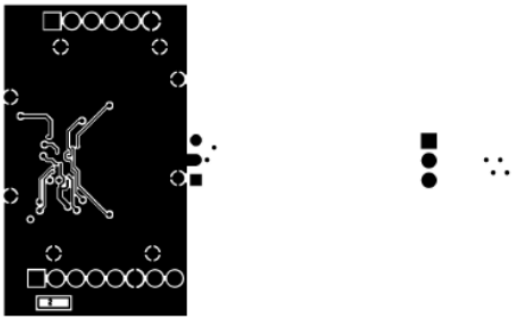


Figure 10. PN7120 NFC controller board layer 2

4.1.2.4 Top silkscreen layer

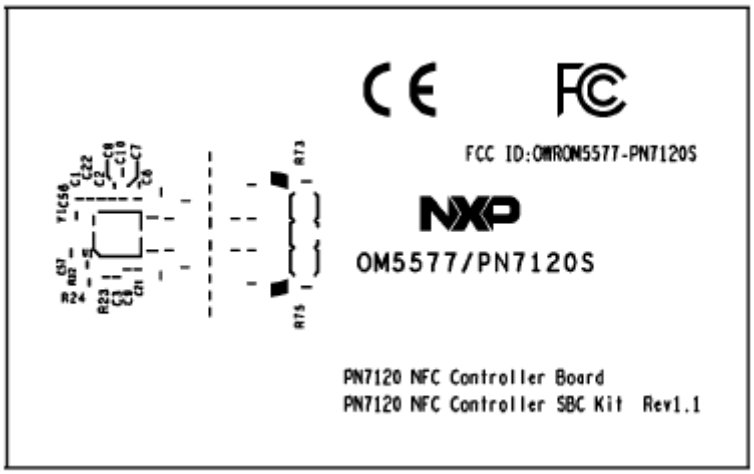


Figure 11. PN7120 NFC controller board top silkscreen layer

4.2 BeagleBone interface board

4.2.1 Schematics

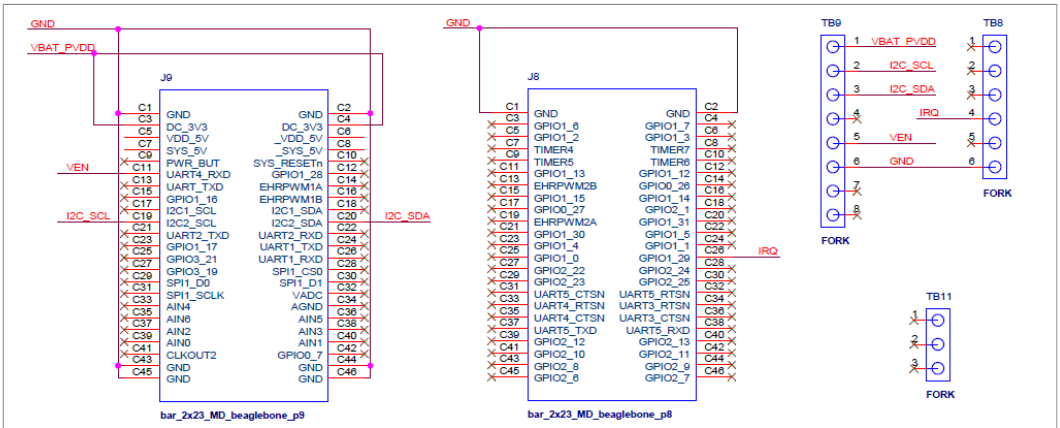


Figure 12. BeagleBone Interface Board schematics

4.2.2 Layout

4.2.2.1 Components layers

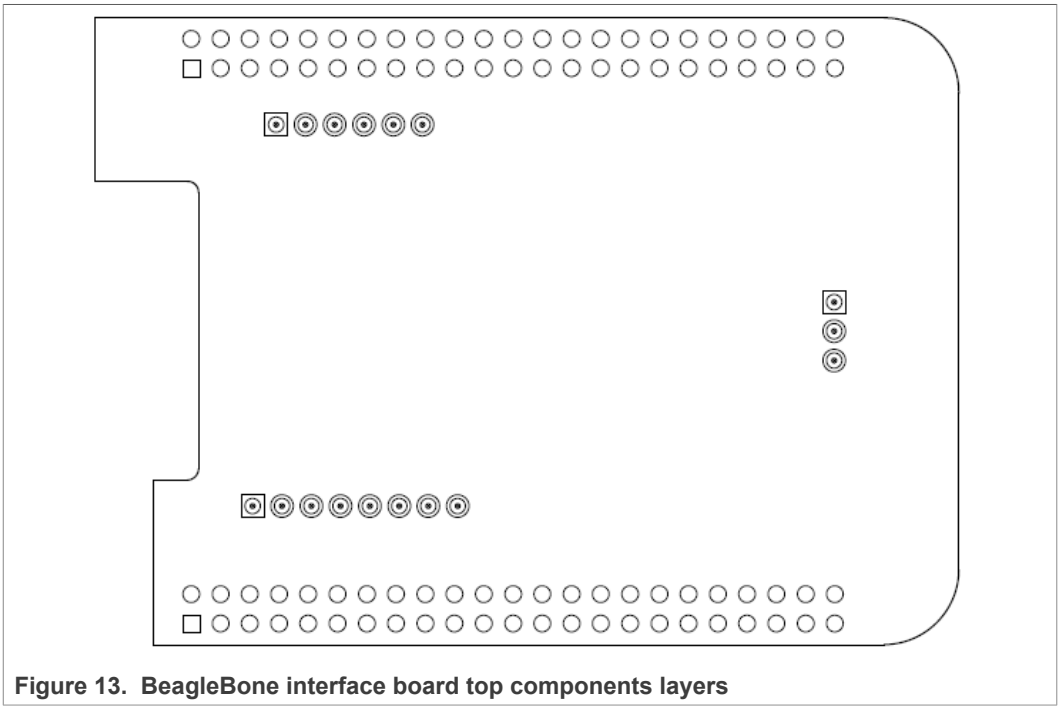


Figure 13. BeagleBone interface board top components layers

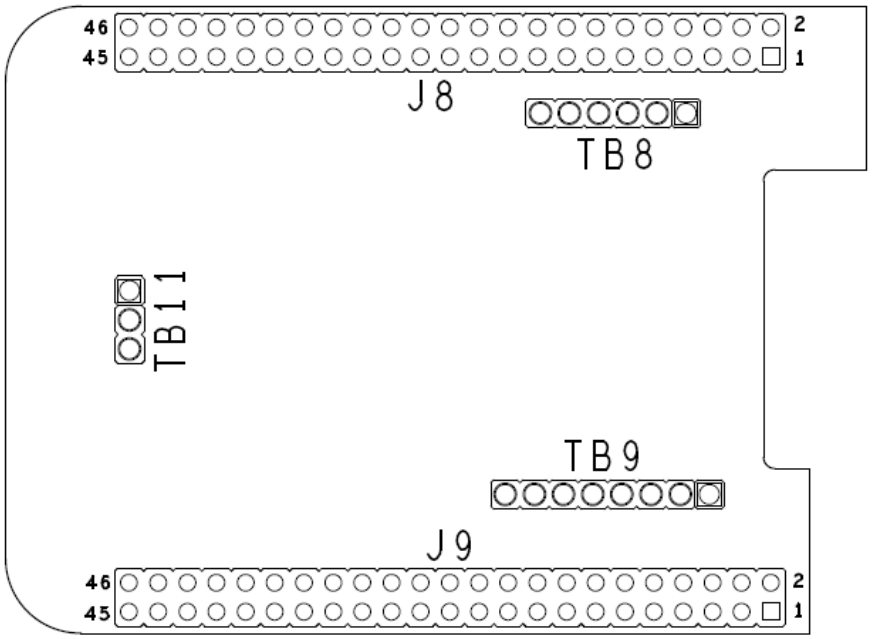


Figure 14. BeagleBone interface board bottom components layers

4.2.2.2 Layers 1 and 2

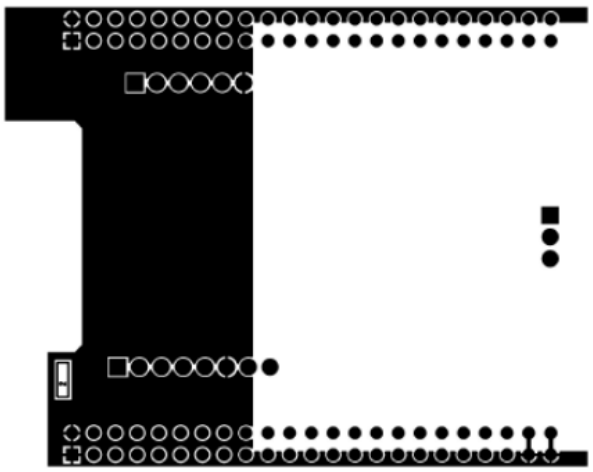


Figure 15. BeagleBone interface board layers 1 and 2

4.2.2.3 Layer 3

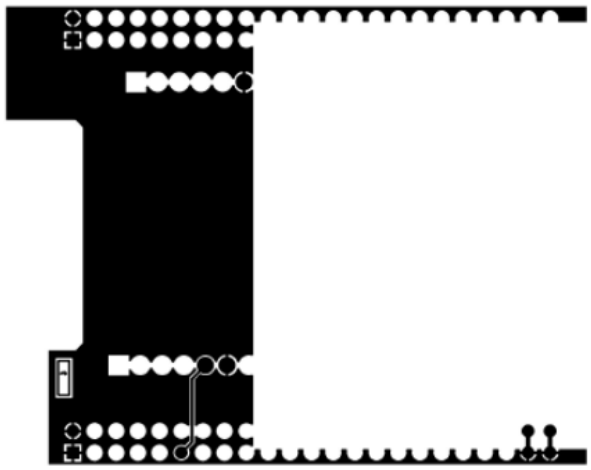


Figure 16. BeagleBone interface board layer 3

4.2.2.4 Layer 4

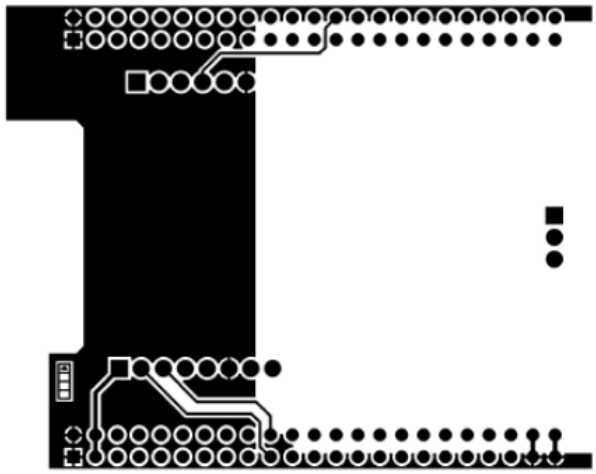


Figure 17. BeagleBone interface board layer 4

4.2.2.5 Top silkscreen layer

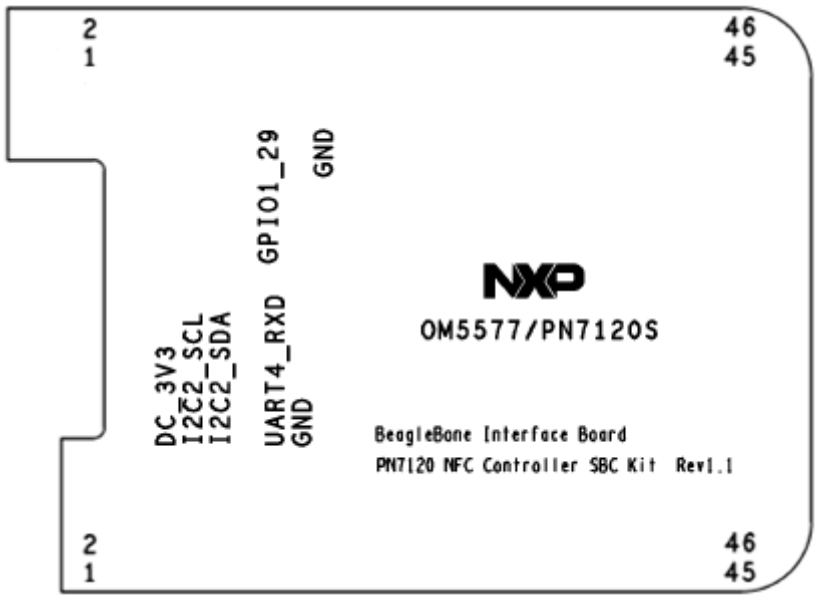


Figure 18. BeagleBone interface board top silkscreen layer

4.3 Raspberry Pi interface board

4.3.1 Schematics

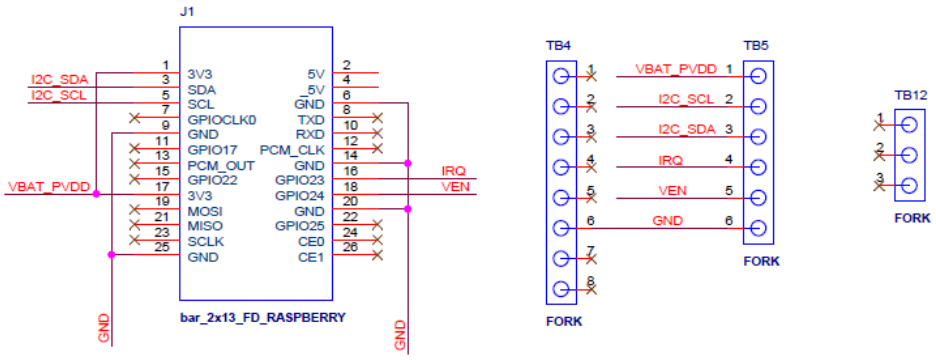


Figure 19. Raspberry Pi interface board schematics

4.3.2 Layout

4.3.2.1 Components layers

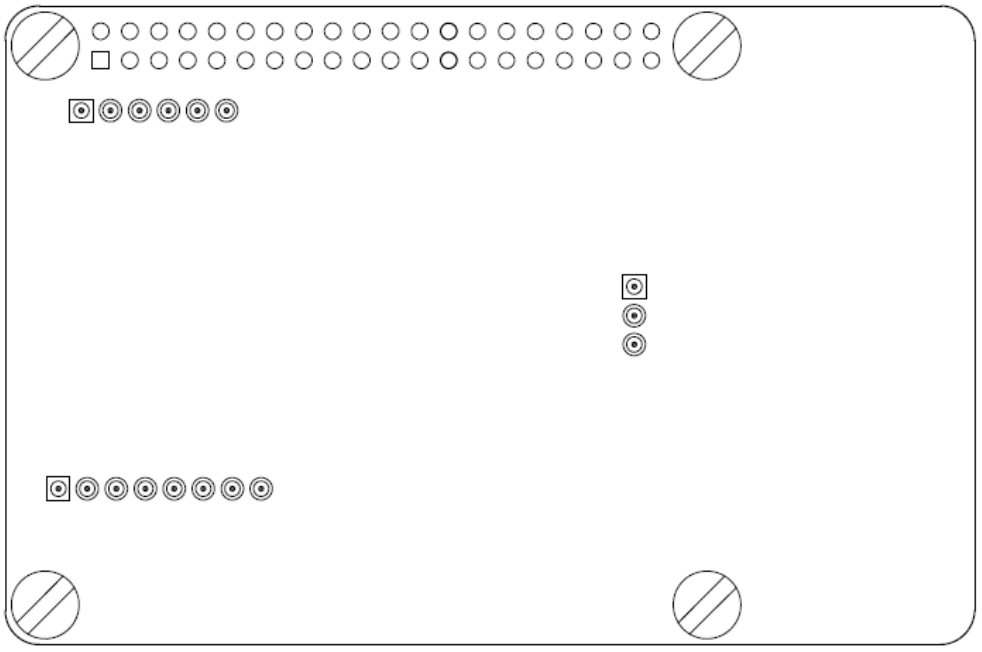


Figure 20. Raspberry Pi interface board top components layers

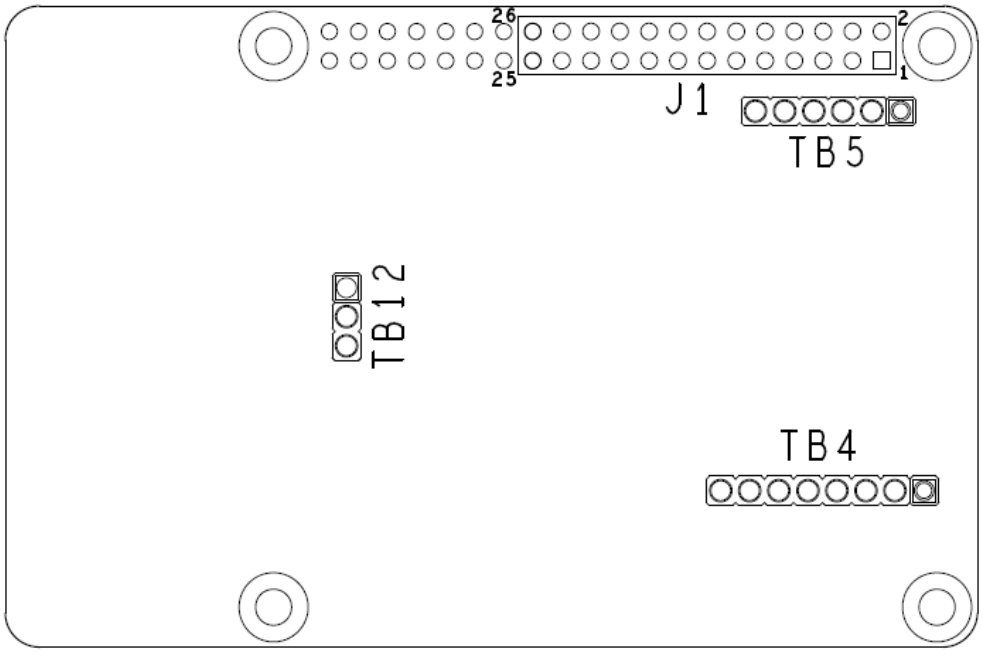


Figure 21. Raspberry Pi Interface board bottom components layers

4.3.2.2 Layers 1 and 2

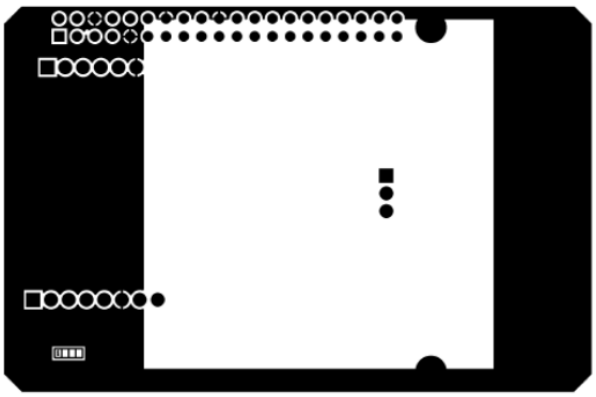


Figure 22. Raspberry Pi interface board layers 1 and 2

4.3.2.3 Layer 3

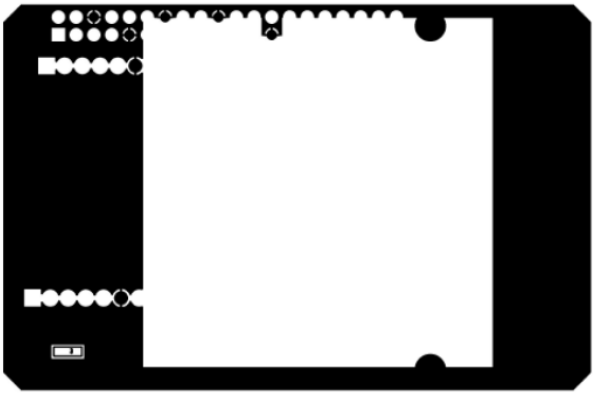


Figure 23. Raspberry Pi interface board layer 3

4.3.2.4 Layer 4

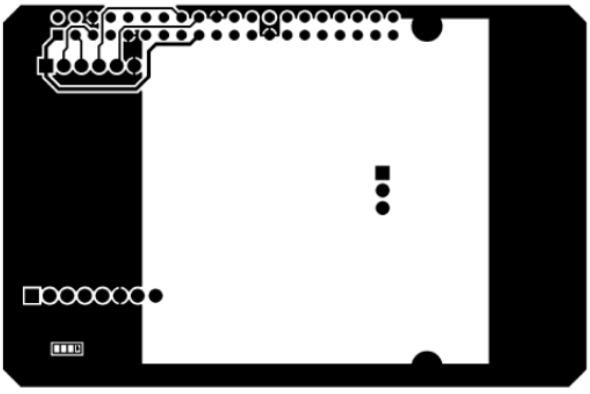


Figure 24. Raspberry Pi interface board layer 4

4.3.2.5 Top silkscreen layer

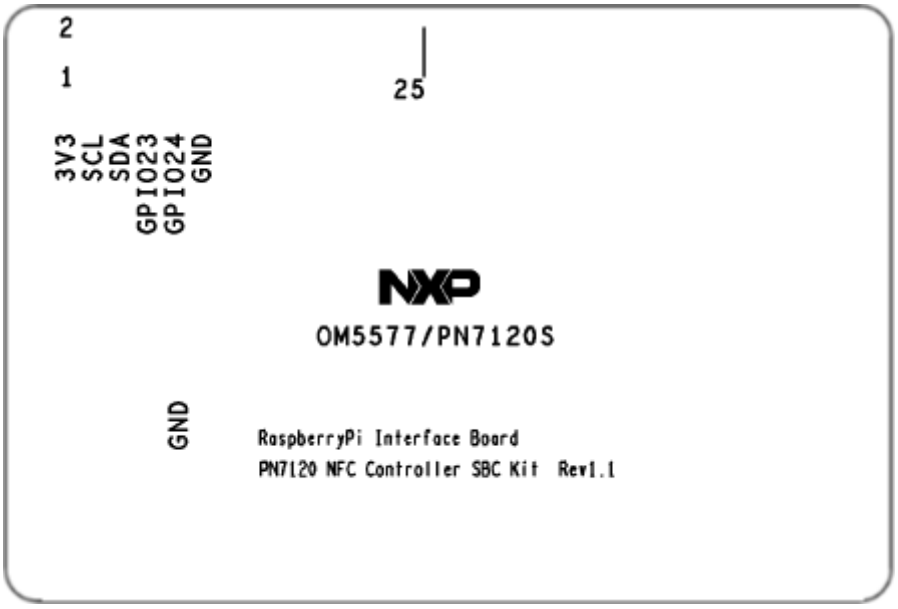


Figure 25. Raspberry Pi interface board top silkscreen layer

5 PN7120 NFC controller board performances

Following RF performance results are obtained running the demo kit:

Table 1. Power transfer (Poll mode)
Measured with EMVCo reference PICC

@ 0 cm	@ 1 cm	@ 2 cm	@ 3 cm
7.6 V	6.7 V	4.3 V	1.2 V

Table 2. Reader/Writer mode performance

Card type	Communication distance (mm)
ISO 15693 UPM RaceTrack	120
NFC Sample Card (NTAG216 – ID1)	80
NFC Sticker (NTAG216 – 40x40)	68
Topaz (35mm Round)	55
Type B (ID1)	45
FeliCa (ID1)	36

Table 3. Peer to Peer mode performances
Vs Samsung Galaxy S7 phone

Communication distance	
moving phone from far to close	moving phone from close to far
50	65

Table 4. Card mode performance
Vs NXP Pegoda Reader

Communication distance (mm)
180

6 Additional information

6.1 Using different antenna

The OM5577/PN7120S kit provides a flexible way of connecting an external RF antenna to be used in place of the onboard one.

On the PN7120 NFC controller board, the dedicated 3 pins connector referenced as TB1 allows connecting your own antenna.

In this case, the onboard antenna must be first disconnected, removing resistors R75 and R73.

Obviously matching circuitry must be adapted as described in related document “AN11564 - PN7120 antenna and tuning design guide” (can be downloaded from PN7120 product web page [3]).

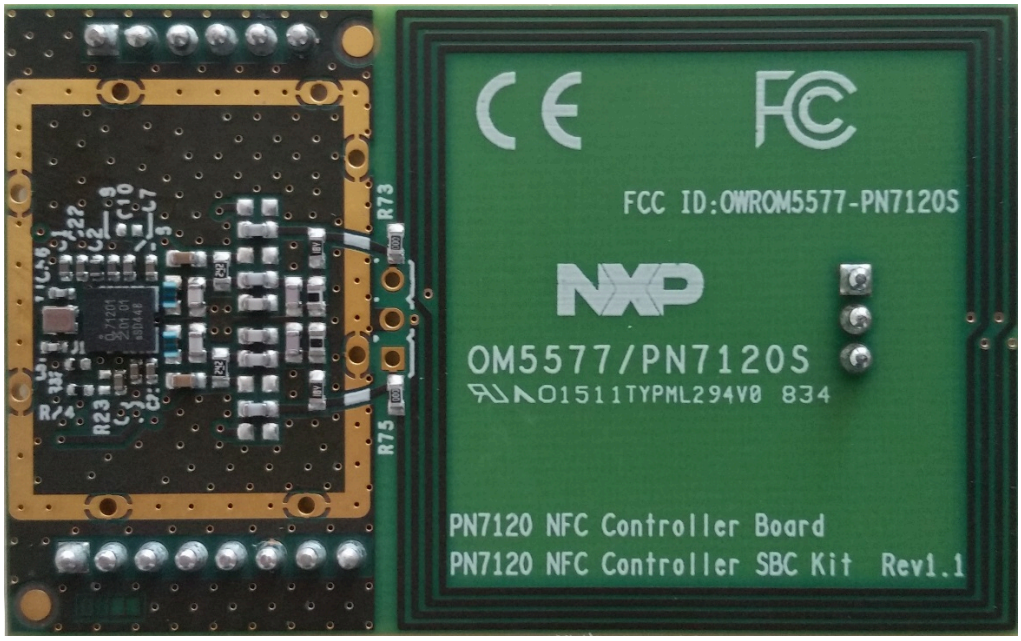


Figure 26. PN7120 NFC controller board RF antenna components

Table 5. PN7120 NFC controller board TB1 connector pinout

TB1	PN7120 signal
#1	ANTENNA 1
#2	GND
#3	ANTENNA 2

6.2 Using in another system

The OM5577/PN7120S demonstration kit can be reuse in another system than Raspberry Pi or BeagleBone.

Indeed, the PN7120 NFC controller board provides all required signal on TB2 and TB3 (signals are duplicated on both connectors) connectors to interface boards.

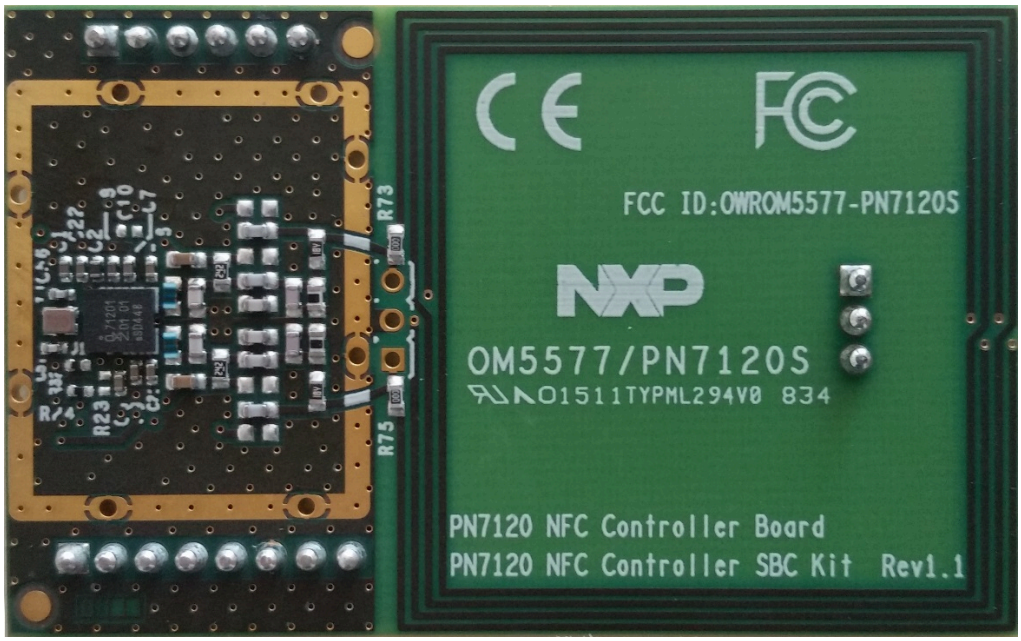


Figure 27. PN7120 NFC controller board interface connectors

Table 6. PN7120 NFC controller board TB2 connector pinout

TB2	PN7120 signal
#1	VBAT/VDD(PAD): 3.3 V supply voltage
#2	I2CSCL: I2C-bus serial clock input
#3	I2CSDA: I2C-bus serial data
#4	IRQ: interrupt request output
#5	VEN: reset pin
#6	GND: ground
#7	Not connected
#8	Not connected

Table 7. PN7120 NFC controller board TB3 connector pinout

TB3	PN7120 signal
#1	VBAT/VDD(PAD): 3.3 V supply voltage
#2	I2CSCL: I2C-bus serial clock input
#3	I2CSDA: I2C-bus serial data
#4	IRQ: interrupt request output
#5	VEN: reset pin
#6	GND: ground

7 Product certification

Only the default configuration of the product is considered in below certification statements. Other configurations, described in Section 6, are excluded.

7.1 European Conformity

The PN7120 NFC controller board (see Section 3.2.1) meets applicable tests and performance criteria for residential, commercial and light industrial environments in European standards:

- EN 301 489-3: Electromagnetic compatibility and Radio spectrum Matters; ElectroMagnetic Compatibility
- EN 50364: Limitation of human exposure to electromagnetic fields
- EN 300 330-2: Electromagnetic compatibility and Radio spectrum Matters; Short Range Devices
- EN 60950-1: Information Technology Equipment - Safety

Electrostatic discharge immunity evaluation not been conducted on the whole accessible parts, the device must be protected against those discharges.

Interface Boards (see Section 3.2.2 and Section 3.2.3) have not been used during the conformity evaluation then they are not in the scope of the current conformity statement.

The product must be provided with fire enclosure or must be supplied by a limiter power source according to Item 2.5 of EN 60950-1. Power must deliver safety extra low voltage.

Additionally, the current conformity is only applicable in the following conditions:

- Product VBAT power supply is 3.3 V
- Operational temperature is between -20 °C and 55 °C
- Cables used to enforce the product must be of maximum 3 meters length

7.2 Federal Communication Commission Interference Statement

7.2.1 FCC grant

The PN7120 NFC controller board have been tested to fulfil the approval requirements FCC 47 CFR part 15: 2014 (§15.225).

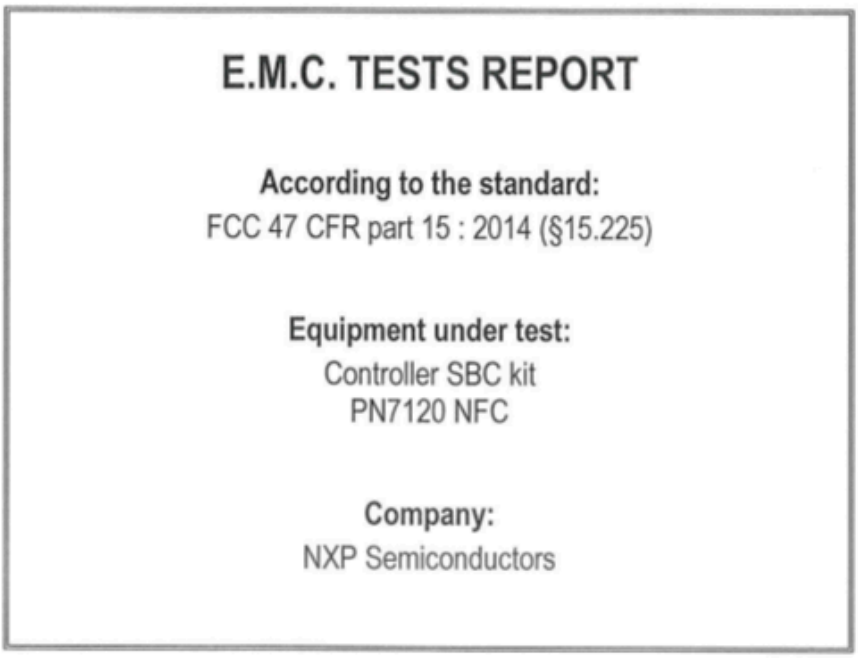


Figure 28. FCC accreditation

7.2.2 Installation instructions

PN7120 NFC controller board can then be reused as a module for integration into end devices following below instruction/restrictions:

- The module is limited to OEM installation ONLY
- The OEM/Integrators are responsible for ensuring that the end user has no manual instructions to remove or install module
- The module is limited to installation in mobile or fixed applications, according to Part 2.1091(b)
- Separate approval is required for all other operating configurations, including portable configurations with respect to Part 2.1093 and different antenna configurations
- Authorized antennas per Part 15.204 (including ant. spec.)
- Antenna installation requirements, where relevant
- The finished product user manual must include following statements:
  – Part 15.19 Warning Statement:

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.

- Part 15.21 Warning Statement:

The user manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note: The grantee is not responsible for any changes or modifications not expressly approved by the third party responsible for compliance. Such modifications could void the user's authority to operate the equipment.

- End users must be provided with transmitter/antenna installation requirements and operating conditions for satisfying RF exposure compliance:
  - A separate section should clearly state "FCC RF Exposure requirements"
  - Required operating conditions for end users
  - Antenna/or transmitter installation requirements, where relevant (for example: The antenna used with this module must be installed to provide a separation distance of at least 20 cm from all persons, and must not transmit simultaneously with any other antenna or transmitter.)
- « Contains Transmitter module FCC ID:OWROM5577-PN7120S » or «Contains FCC ID: OWROM5577-PN7120S »

8 References

[1] The Raspberry Pi is a credit card sized computer. The initial idea behind it was to develop a small and cheap computer to be used by kids all over the world to learn programming. In the end, it became very popular among developers all over the world.
The heart of the Raspberry Pi is a SoC (System on Chip). This contains an ARM11 running at 700 MHz and a graphics processor that is capable of Blu-ray quality playback, using H.264 at 40MBits/s. It has a fast 3D core accessed using the supplied OpenGL ES2.0 and Open VG libraries. In addition, the Model B has 512 MB RAM included in its SoC.
To get started quickly, the Raspberry Pi Foundation provides several preconfigured Linux distributions.
For more information about it, please visit https://www.raspberrypi.org/

[2] BeagleBone is a low-power open source hardware single-board credit-card-sized Linux computer that connects to the Internet and runs software such as Android and Ubuntu. With plenty of I/O and processing power for real-time analysis provided by a 720 MHz ARM® processor-based SoC (System on Chip), BeagleBone can be complemented with cape plug-in boards to augment functionality.
For more information about it, please visit http://beagleboard.org/bone.

[3] PN7120 product web page: https://www.nxp.com/products/rfid-nfc/nfc-hf/nfc-readers/nfc-controller-with-integrated-firmware-and-nci-interface-for-home-appliances:PN7120

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