UM10935

PN7150 NFC Controller SBC Kit User Manual

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User manual
COMPANY PUBLIC

Document information

Info	Content
Keywords	OM5578, PN7150, Demo kit, Raspberry Pi, BeagleBone, Arduino
Abstract	This document is the user manual of the PN7150 NFC Controller SBC kit.

Revision history

Rev	Date	Description
1.2	20160707	Added demo kit performance details
1.1	20160518	• Updated with kit pictures and FCC statement change • Security status changed into “COMPANY PUBLIC”
1.0	20151210	First official release version

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1. Introduction

The present document describes the OM5578/PN7150S demonstration kit, a flexible and easy-to-use Single Board Computer (SBC) Kit for the PN7150 NFC Controller.

It enables the development of an NFC solution based on PN7150 in a Linux, Android or Windows for IoT environment or even in system based on RTOS or without OS.

It exists in different configurations:

- OM5578/PN7150RPI to be used with Raspberry Pi platform (see [1])
- OM5578/PN7150BBB to be used with BeagleBone Interface Board (see [2])
- OM5578/PN7150ARD to be used with platforms offering Arduino compatible interface (see [3]), like LPCXpresso (see [5]) or Kinetis Freedom (see [4]).

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: OWROM5578-PN7150S)

2. Overview

2.1 Kits description

All 3 OM5578 kits contains a PN7150 NFC Controller Board, a dedicated interface board, as well as an NFC Sample Card in form of an NFC Forum Type 2 Tag.

Fig 1. OM5578/PN7150RPI kit overview

Fig 2. OM5578/PN7150BBB kit overview

Fig 3. OM5578/PN7150ARD kit overview

2.2 PN7150 NFC Controller Board

The OM5578 PN7150 NFC Controller Board is high performance fully NFC compliant expansion board, meeting 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.

It has to be used in association with one interface board according to the targeted user environment. For this purpose it integrates the NFC generic interface allowing assembly with OM29110 Interface boards (see [6]).

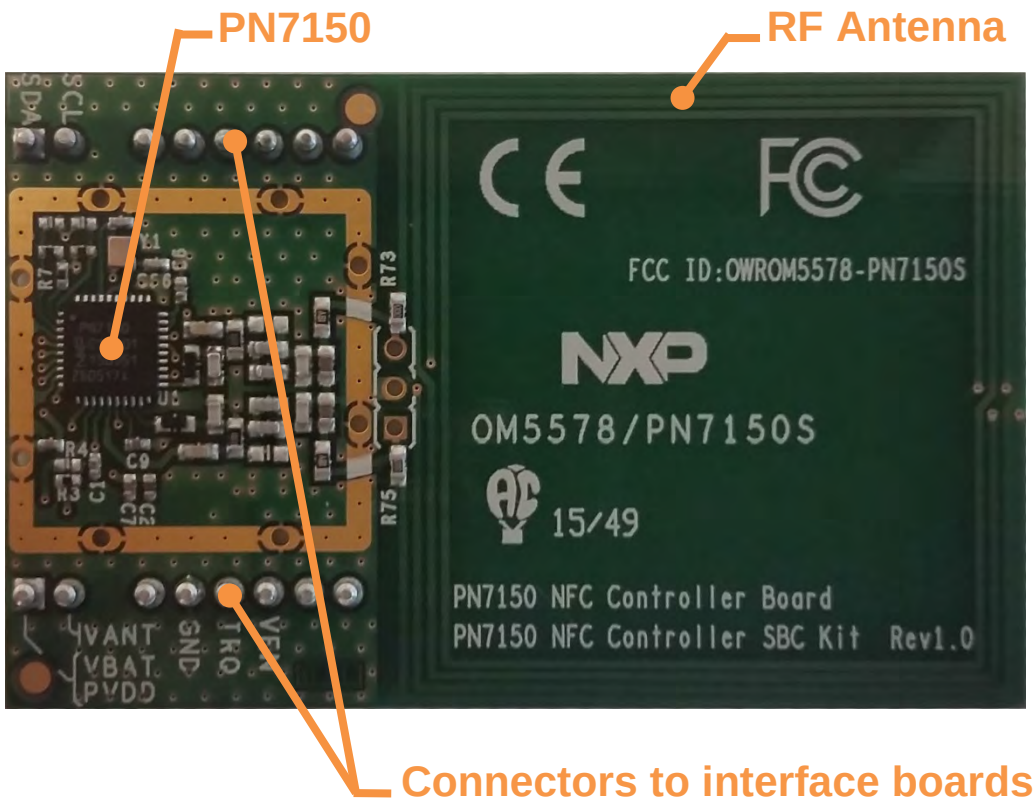

Fig 4. OM5578/PN7150S PN7150 NFC Controller Board

2.3 OM29110 Interface Boards

The OM29110 Interface Boards offer support for connection to Raspberry Pi, BeagleBone or Arduino Compatible Interface platforms (refer to [6] for more details).

Fig 5. OM29110RPI Raspberry Pi Interface Board

Fig 6. OM29110BBB BeagleBone Interface Board

Fig 7. OM29110ARD Arduino Interface Board

2.4 NFC Sample Card

OM5578/PN7150S kit includes a NFC Sample Card, based on NTAG216 tag IC, allowing to demonstrate NFC reader capabilities of PN7150 NFC Controller.

For the current purpose of PN7150 NFC Controller demonstration, the card has been pre-configured with NDEF URI type message “http://www.nxp.com/demoboard/OM5578”.

Fig 8. NFC Sample Card

3. PN7150 NFC Controller Board details

3.1 Schematics

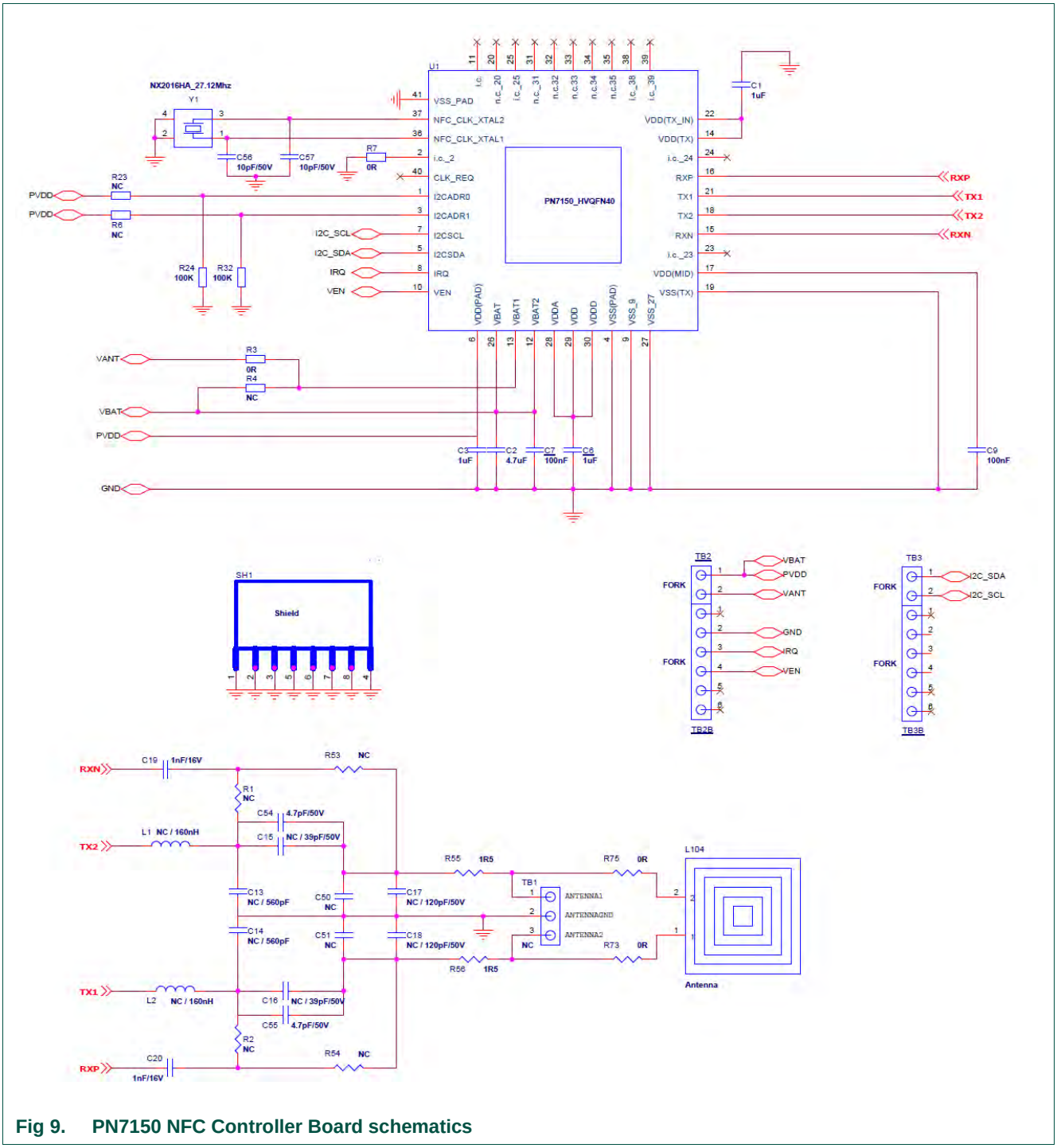

Fig 9. PN7150 NFC Controller Board schematics

3.2 Layout

3.2.1 Components layers

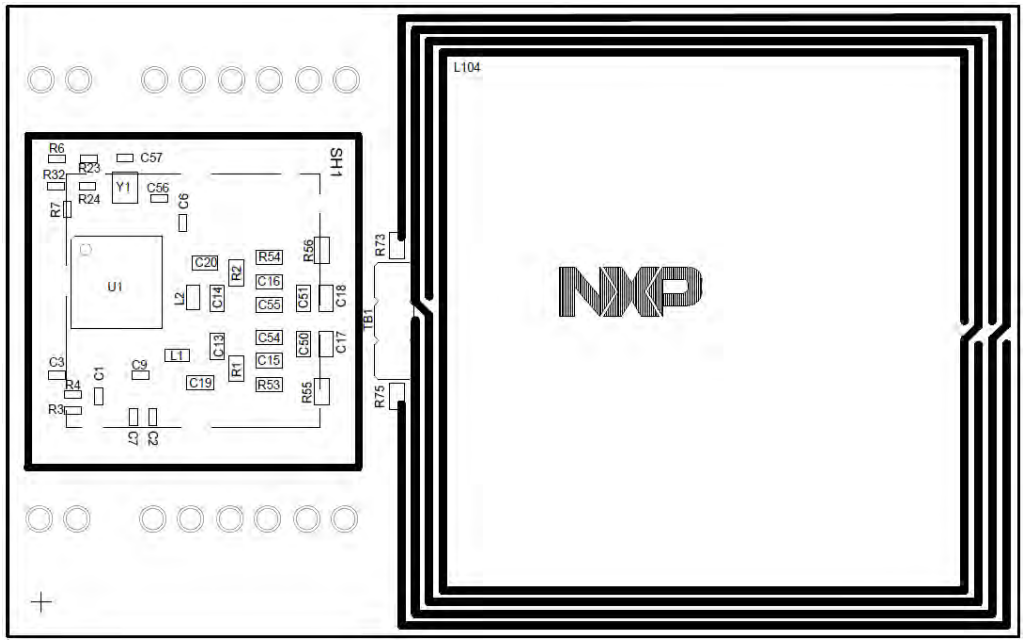

Fig 10. PN7150 NFC Controller Board Top components layers

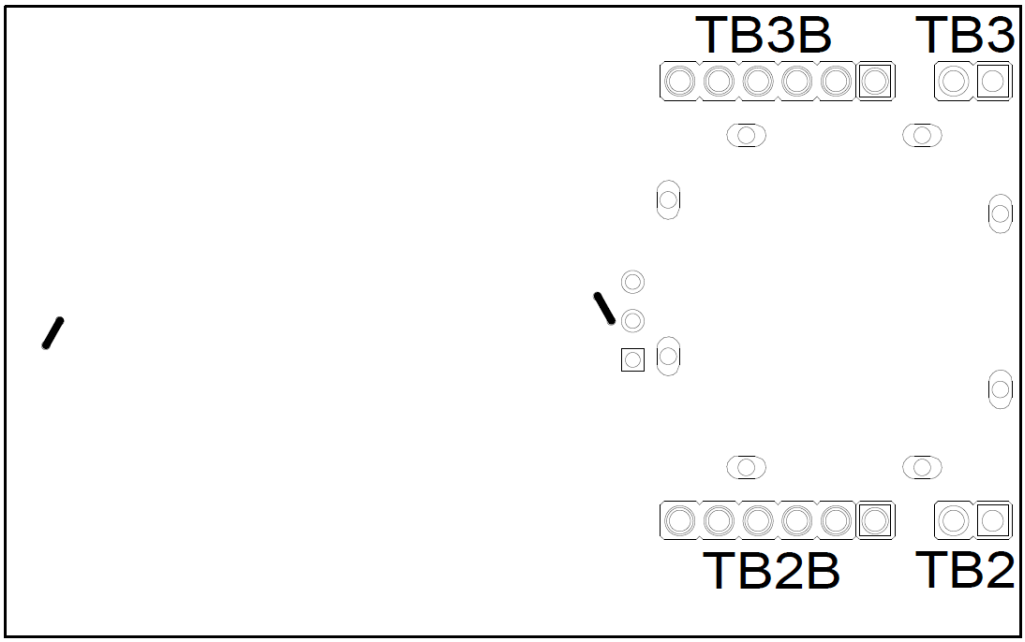

Fig 11. PN7150 NFC Controller Board Bottom components layers

3.2.2 Layer 1

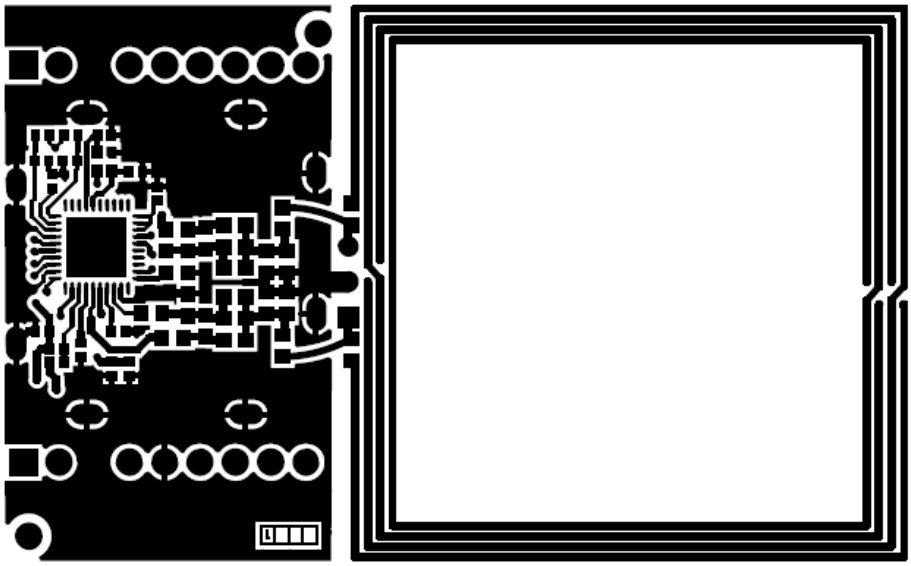

Fig 12. PN7150 NFC Controller Board Layer 1

3.2.3 Layer 2

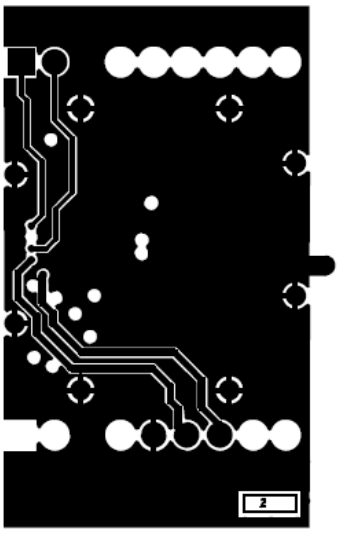

Fig 13. PN7150 NFC Controller Board Layer 2

3.2.4 Layer 3

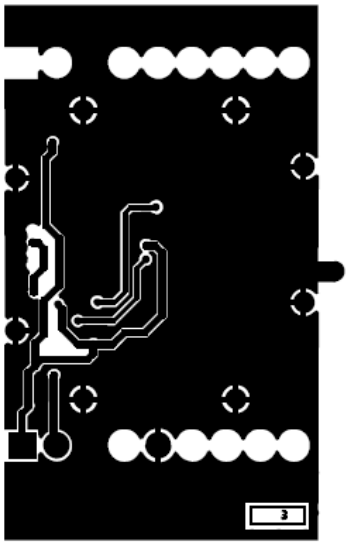

Fig 14. PN7150 NFC Controller Board Layer 3

3.2.5 Layer 4

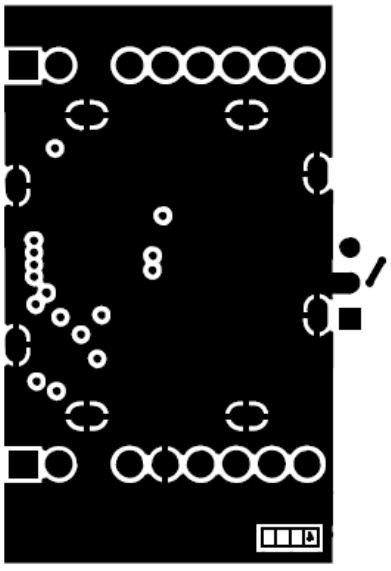

Fig 15. PN7150 NFC Controller Board Layer 4

3.2.6 Top Silkscreen layer

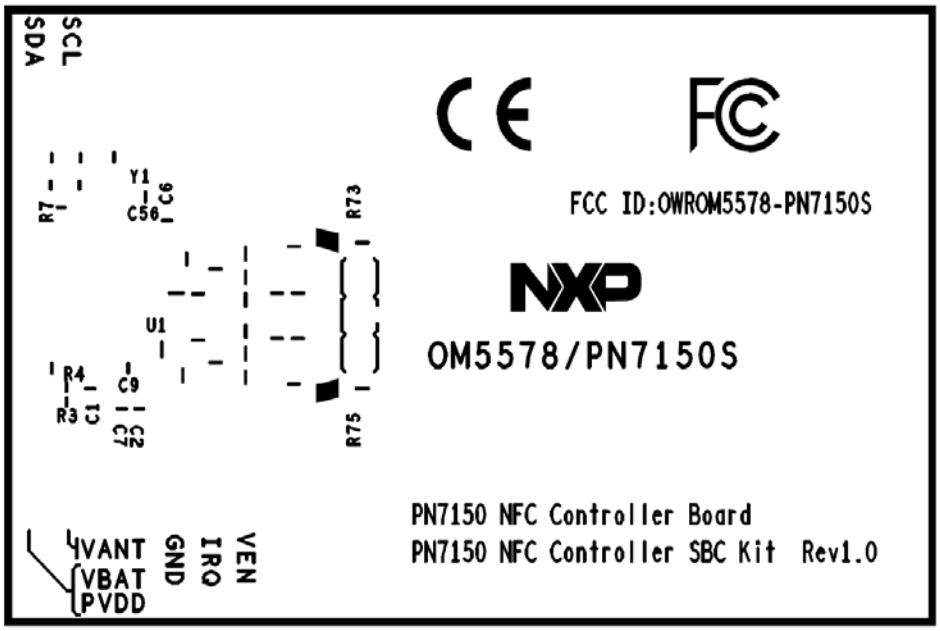

Fig 16. PN7150 NFC Controller Board Top silkscreen layer

4. PN7150 NFC Controller Board performances

4.1 Settings configuration

Following performance results are obtained applying dedicated configuration to PN7150 optimized for OM5578 characteristics. Those are:

Table 1. RF settings

Transition	Register	Value
RF_CLIF_CFG_INITIATOR	CLIF_AGC_INPUT_REG	90 01 F4 01
RF_CLIF_CFG_TARGET	CLIF_ANA_RX_REG	01 90 03 00
RF_CLIF_CFG_TARGET	CLIF_SIGPRO_ADCBCM_THRESHOLD_REG	B0 01 10 00
RF_CLIF_CFG_TARGET	CLIF_ANA_TX_AMPLITUDE_REG	02 00 FF FF
RF_CLIF_CFG_TARGET	CLIF_TEST_CONTROL_REG	06
RF_CLIF_CFG_TECHNO_I_TX15693	CLIF_ANA_TX_AMPLITUDE_REG	88 00 FF FF
RF_CLIF_CFG_TECHNO_I_RX15693	CLIF_ANA_RX_REG	23 00
RF_CLIF_CFG_TECHNO_I_RX15693	CLIF_SIGPRO_RM_CONFIG1_REG	50 34 0C 00
RF_CLIF_CFG_BR_106_I_TXA	CLIF_ANA_TX_AMPLITUDE_REG	F8 00 FF FF
RF_CLIF_CFG_BR_106_I_RXA_P	CLIF_SIGPRO_RM_CONFIG1_REG	24 37 0C 00
RF_CLIF_CFG_BR_106_I_RXA_P	CLIF_AGC_CONFIG0_REG	86 80 00 70
RF_CLIF_CFG_BR_106_I_RXA_P	CLIF_ANA_RX_REG	22 00
RF_CLIF_CFG_BR_848_I_RXA	CLIF_SIGPRO_RM_CONFIG1_REG	15 45 0D 00
RF_CLIF_CFG_BR_106_I_RXB	CLIF_ANA_RX_REG	22 00
RF_CLIF_CFG_BR_106_I_RXB	CLIF_SIGPRO_RM_CONFIG1_REG	05 59 0E 00
RF_CLIF_CFG_BR_106_I_TXB	CLIF_ANA_TX_AMPLITUDE_REG	88 00 FF FF
RF_CLIF_CFG_BR_212_I_RXF_P	CLIF_SIGPRO_RM_CONFIG1_REG	05 9F 0C 00
RF_CLIF_CFG_BR_212_I_TXF	CLIF_ANA_TX_AMPLITUDE_REG	88 00 FF FF
RF_CLIF_CFG_I_ACTIVE	CLIF_AGC_CONFIG0_REG	80 86 00 70

Table 2. Clock settings

Register	Value
CLIF_ANA_CLK_MAN_REG	57 33 14 17 00 AA 85 00 80 55 2A 04 00 63 00 00 00

4.2 RF performances

Table 3. Power Transfer (Poll mode)

Measured with EMVCo reference PICC

@ 0cm	@ 1cm	@ 2cm	@3 cm
7.6 V	6.7 V	4,3 V	1,2 V

Table 4. 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 5. 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 6. Card Mode performance

Vs NXP Pegoda Reader

Communication distance (mm)
180

5. Additional information

5.1 Using different Antenna

The OM5578/PN7150S kit provide a flexible way of connecting an external RF antenna to be used in place of the on-board one.

On the PN7150 NFC Controller Board, the dedicated 3 pins connector referenced as TB1 allows to connect your own antenna.

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

Obviously matching circuitry must be adapted as described in related document “AN11755 - PN7150 Antenna Design and Matching Guide”.

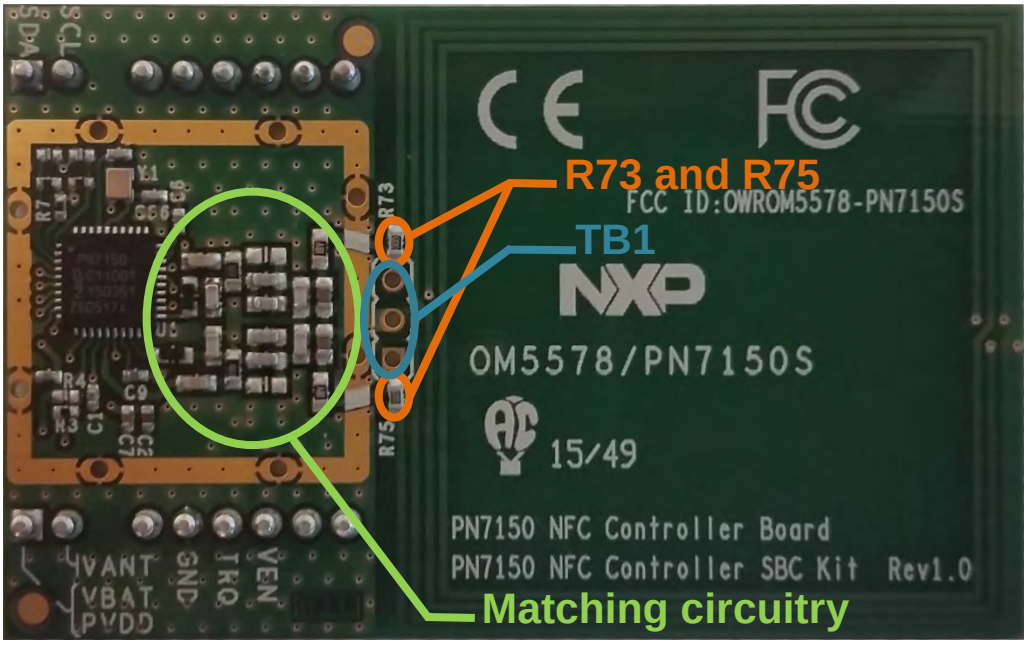

Fig 17. PN7150 NFC Controller Board RF Antenna components

Table 7. PN7150 NFC Controller Board TB1 connector pinout

TB1	PN7150 signal
#1	ANTENNA 1
#2	GND
#3	ANTENNA 2

5.2 Using different TVDD supply option

The OM5578/PN7150S kit comes with Configuration 2: external 5V used to generate TVDD (refer to “AN11756 – PN7150 Hardware Design Guide” for more details). The 5V being provided by the under layer SBC platform via the VANT pin of connector TB2.

However, it is still possible to switch to Configuration 1: VBAT used to generate the TVDD. This is done by removing R3 and placing a 0 ohm resistor in R4 place.

Then related registry setting must be applied accordingly (see “AN11756 – PN7150 Hardware Design Guide”).

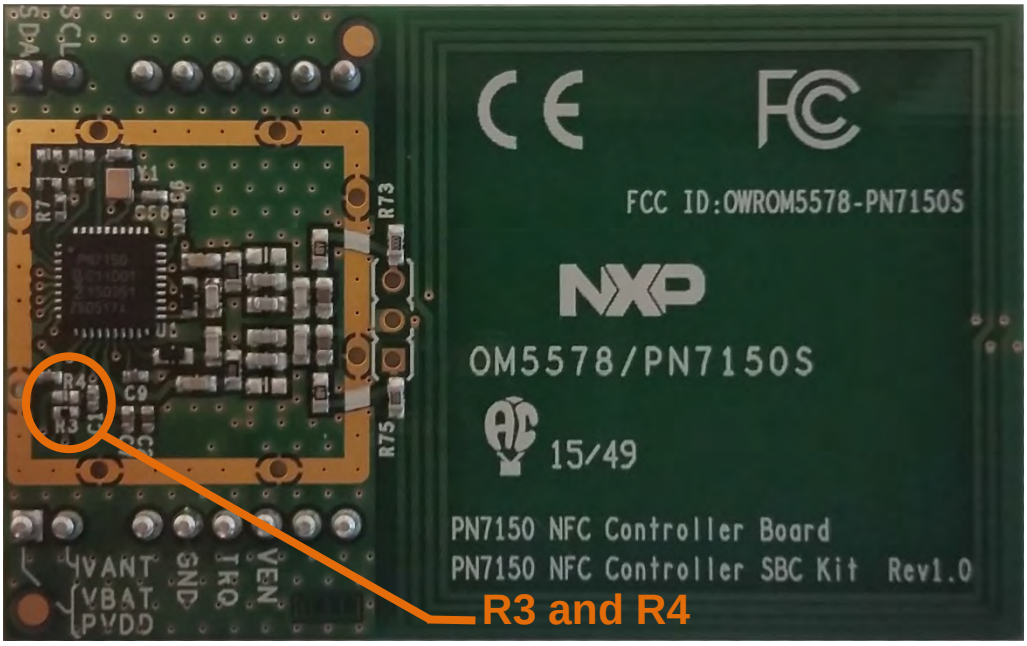

Fig 18. PN7150 NFC Controller TVDD supply option

5.3 Using different I2C address

The OM5578/PN7150S kit comes with default 0x28 (7 bits) I2C address.

However, it is still possible to change it (between 0x28 and 0x2B) by setting of R6, R23, R24 and R32 resistors.

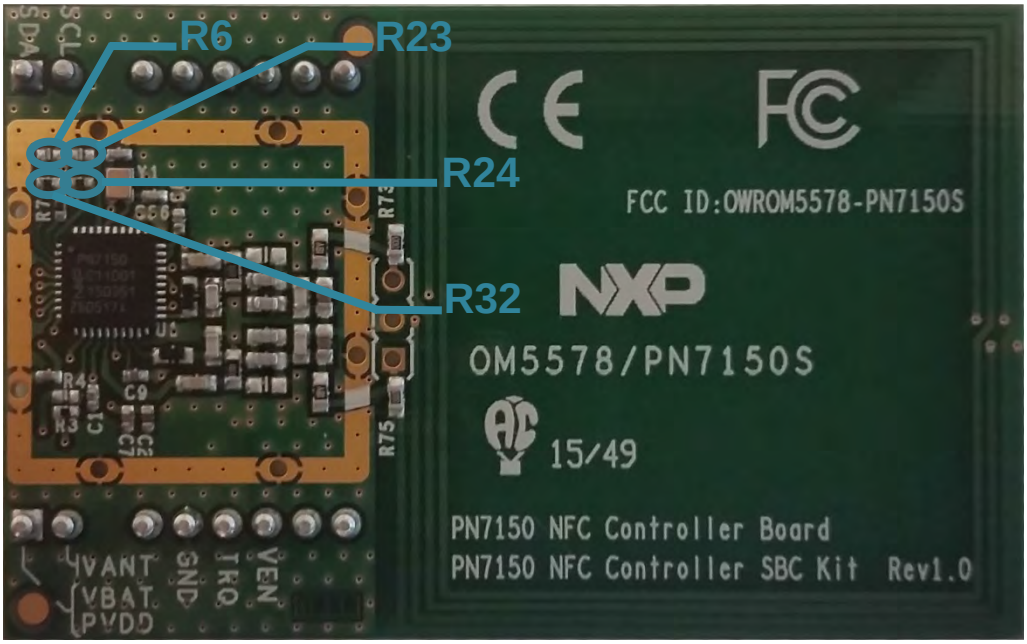

Fig 19. PN7150 NFC Controller I2C address configuration

Table 8. I2C address configuration

I2C address	R6	R23	R24	R32
0x28	Open	Open	Short	Short
0x29	Open	Short	Open	Short
0x2A	Short	Open	Short	Open
0x2B	Short	Short	Open	Open

5.4 Using in another system

The OM5578/PN7150S demonstration kit can be reuse in another system (different from Raspberry Pi or BeagleBone, and not offering Arduino Compatible interface).

Indeed, the PN7150 NFC Controller Board provides all required signal on TB2 and TB3 (signals are duplicated on both connectors) connectors to interface boards.

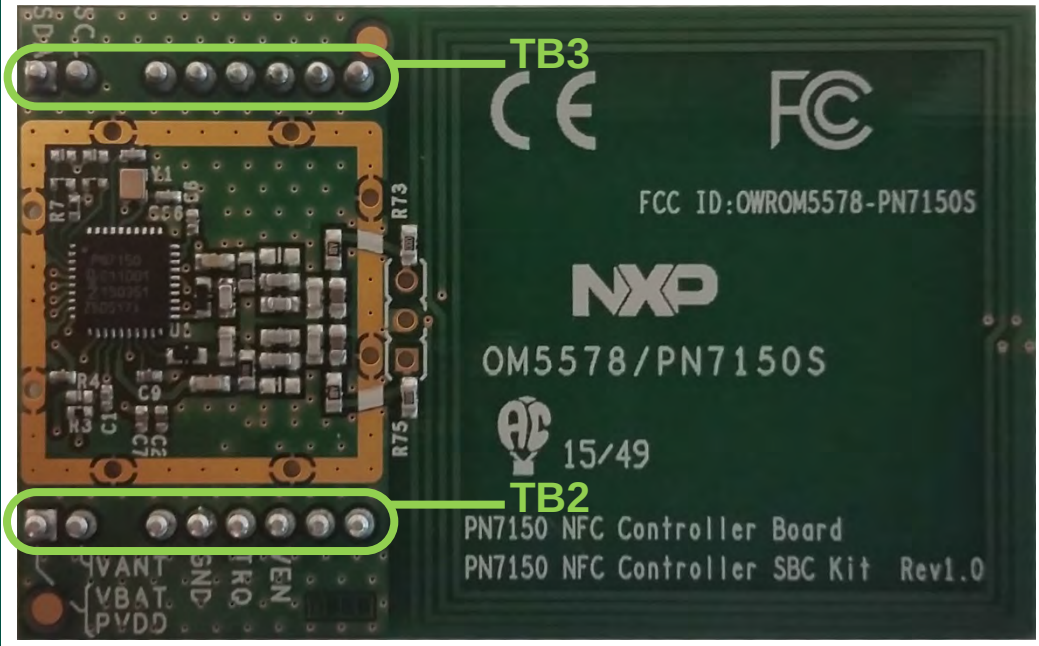

Fig 20. PN7150 NFC Controller Board interface connectors

Table 9. PN7150 NFC Controller Board TB2 connector pinout

TB2	PN7150 signal
#1	VBAT/VDD(PAD): 3.3V supply voltage
#2	VANT: 5V optional supply voltage
#3	Not connected
#4	GND: ground
#5	IRQ: interrupt request output
#6	VEN: reset pin
#7	Not connected
#8	Not connected

Table 10. PN7150 NFC Controller Board TB3 connector pinout

TB3	PN7150 signal
#1	I2CSDA: I2C-bus serial data
#2	I2CSCL: I2C-bus serial clock input
#3	Not connected
#4	Not connected
#5	Not connected
#6	Not connected
#7	Not connected
#8	Not connected

6. Federal Communication Commission Interference Statement

6.1 FCC Grant

The PN7150 NFC Controller Board have been tested to fulfil the approval requirements FCC 47 CFR part 15: 2014 (§15.225).

The related FCCID is: OWROM5578-PN7150S

6.2 Installation instructions

PN7150 NFC Controller board can 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's 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.)

o « Contains Transmitter module FCC ID :OWROM5575-PN7150S » or «Contains FCC ID : OWROM5578-PN7150S »

7. References

[1] The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It's capable of doing everything you'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games.

For more information about it please visit www.nxp.com/redirect/raspberrypi.org/

[2] The BeagleBone is a low-cost, community-supported development platform for developers and hobbyists. It is a credit-card-sized Linux computer that connects to the Internet and runs software such as Android 4.0 and Ubuntu. With plenty of I/O and processing power for real-time analysis provided by an ARM® processor.

For more information about it please visit www.nxp.com/redirect/beagleboard.org/bone

[3] The Arduino Uno is a microcontroller board with 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button.

For more information about it please visit www.nxp.com/redirect/arduino.cc/en/Main/ArduinoBoardUno.

[4] The Freedom-K64F is an ultra-low-cost development platform for Kinetis K64, K63, and K24 MCUs.

For more information about it please visit http://www.nxp.com/products/software-and-tools/hardware-development-tools/freedom-development-boards/freedom-development-platform-for-kinetis-k64-k63-and-k24-mcus:FRDM-K64F

[5] LPCXpresso is a low-cost development platform available from NXP, supporting NXP's ARM-based microcontrollers. The platform is comprised of a simplified Eclipse-based IDE and low-cost target boards which include an attached JTAG debugger. LPCXpresso is an end-to-end solution enabling embedded engineers to develop their applications from initial evaluation to final production.

For more information about it please visit http://www.nxp.com/products/software-and-tools/hardware-development-tools/lpcxpresso-boards:LPCXPRESSO-BOARDS

[6] The OM29110 Interface boards are used to connect NFC's demo boards (e.g. OM5578 related to PN7150 NFC Controller) to Single-Board-Computer (like Raspberry Pi, BeagleBone…).

More details in the related UM10956 - OM29110 NFC's SBC Interface Boards User Manual: http://www.nxp.com/documents/user_manual/UM10956.pdf

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