AN12550

PNEV5190B evaluation board quick start guide

Rev. 1.8 — 29 August 2022 Application note

Document information

Information	Content
Keywords	PN5190, PNEV5190B, PNEV5190M, PN5190 evaluation board, PN5190 customer board, PN5190 GUI, GUI, PN5190 support tool, NFC Cockpit
Abstract	This document describes the PNEV5190B V1.0 (PN5190 evaluation board), and how to use it. It describes the NFC Cockpit (PN5190 GUI Version 5.5.0 or later), which allows an easy basic access to the PN5190 registers and EEPROM in combination with basic reader functionality.

1 Revision history

Revision history

Rev	Date	Description
1.8.	20220829	• Section 7: corrected
1.7	20220819	• Link to NFC Cockpit added in Section 6. • Two notes added in Section 3.5.3. • Link to the PN5190 homepage with reference to Secure Firmware Downloader added in Section 6. • Description to use the built in OpenSDA added in Section 4.3.1. • Note with link to Section 5.3.2 added in Section 4.3.3. • Chapter Section 6 updated with correct web links. • Section 7: added
1.6	20211209	• Typos corrected in the introduction. • Introduction updated with "EMVCo 3.1". • Board supply options clarified in Section 3.1. • OpenSDA added in Section 3.1. • Power supply option corrected in Section 3.5.2. • Default configuration for the Section 3.3 corrected. • LED status information updated in Section 3.4. • Recommendation added in Section 3.5.3. • Information about OpenSDA added in Section 4.3.1. • Information about different K82 FW added in Section 5.2.5.
1.5	20210423	• The format of this application note has been redesigned to comply with the new identity guidelines of NXP Semiconductors. • Section 6: updated
1.4	20201218	Update of the software section
1.3	20200929	Update versions numbers for PN5190 CQS1
1.2	20200109	Figure 6 layout corrected
1.1	20191217	AN number corrected, typos removed
1.0	20191128	First version

2 Introduction

This document describes the PNEV5190B (PN5190 evaluation board), which provides an easy evaluation of the features and functions of the PN5190.

It provides the first steps to operate the board, using the NFC Cockpit (PN5190 GUI Version 6.7.0 or higher, see [6]).

The default antenna is a 45 mm x 45 mm antenna with some metal layer inside the antenna area. This antenna is not an optimum antenna as such, but intends to demonstrate the performance and register settings of the PN5190 under typical design constraints like LCD or some metal (e.g. PCB) inside the antenna area. The EMVCo default settings, as provided in the NFC Cockpit (Version 6.3.0. or higher) package, can be used to demonstrate an EMVC0 3.1 L1 analog compliance under the assumption that the antenna surface is a few mm above the antenna PCB (which simulates e.g. a plastic housing).

2.1 PN5190 registers and EEPROM concept

The PN5190 uses internal registers to adapt and optimize the functionality and performance for each of the supported protocols and data rates dependent on the connected antenna, matching network and receiver path. It offers an EEPROM, which contains the default settings for all the supported protocols. These settings are loaded into the registers with the LOAD_RF_CONFIGURATION (0Dh) command for each supported protocol and data rate.

The default EEPROM configuration settings are optimized for the 45 mm x 45 mm antenna of the board PNEV5190B and can be changed by the user in case a customized antenna and matching network is used. The command LOAD_RF_CONFIGURATION allows initializing multiple registers with an efficient single command and allows distinguishing between transmit and receive configuration. Update of the registers relevant for a selected protocol is done by copying the content of EEPROM addresses to registers. Not all protocols require the initialization of all or the same registers, the command LOAD_RF_ CONFIGURATION considers this by initializing the registers relevant for the currently selected protocol only.

The EEPROM content can be updated using the command UPDATE_RF_CONFIGURATION (0Eh). The command does not require any physical EEPROM address, but works directly with the register address information and the protocol for which this data is intended to be used. This allows a convenient initialization of all relevant values for operation.

Some of these settings can or even **must** be adapted toward a new antenna design (e.g. the dynamic power control). All those design-specific settings should be stored in the PN5190 EEPROM to allow a proper functionality.

Some EEPROM configuration data is independent from the used protocols and defines e.g. the startup behavior of the PN5190 or the functionality of low-power card detection (LPCD). This configuration data might also be adapted for optimum performance of the chip.

2.2 PNEV5190B concept

The basic **concept of the PNEV5190B** is to enable the user to perform a quick evaluation of the PN5190 and also connect their own antenna to the PNEV5190B board. In addition, dedicated boards which allow to solder custom antenna matching components are available. The NFC Cockpit can be used to optimize the RF performance of the PN5190 antenna tuning, to perform the DPC calibration and the related TX and RX optimization without touching any source code.

All the relevant registers can be modified and fine-tuned using the NFC Cockpit. After successful register optimization, the found settings can be stored in the PN5190 EEPROM.

The NFC Cockpit also allows a dump of the complete user EEPROM content into an XML file. This file then can be loaded again into the EEPROM. That allows to manage and exchange different user or antenna configurations. In addition, the optimized register settings using the NFC Cockpit can be used during user code development as well.

As soon as the register settings for the targeted protocols and data rates are defined, the NFC Reader Library including the HAL can be used to start the development of the user application. Examples illustrate the usage of the library for typical use cases.

The source code examples of the NFC Reader Library can be used to develop an own application directly on the Kinetis MCU K82 (see [4]) or can serve as a starting point for porting the NXP NFC Reader Library to any other microcontroller platform.

3 Hardware

The PNEV5190B V1.0, as shown in Figure 1, provides some test functions which might not be used for the typical hardware and software evaluation. The PNEV5190M (module) can be used as a simple standard reader module without modification. In addition, it can be used to define and optimize the analog settings for any connected antenna or it can be used to develop and modify any RFID and NFC application based on the NFC Reader Library.

3.1 Hardware introduction

The PN5190 is supplied with a supply voltage, which can be chosen between internal and external supply. For the internal supply either 5 V, 3.3 V or 1.8 V (for VDDIO) can be used. The external power supply shall be 5 V DC (polarity does not matter) since the board provides a rectifier and LDO to supply the circuit with 6 V (optional, if input supply voltage ≥7.5 V), 5 V, 3.3 V and 1.8 V.

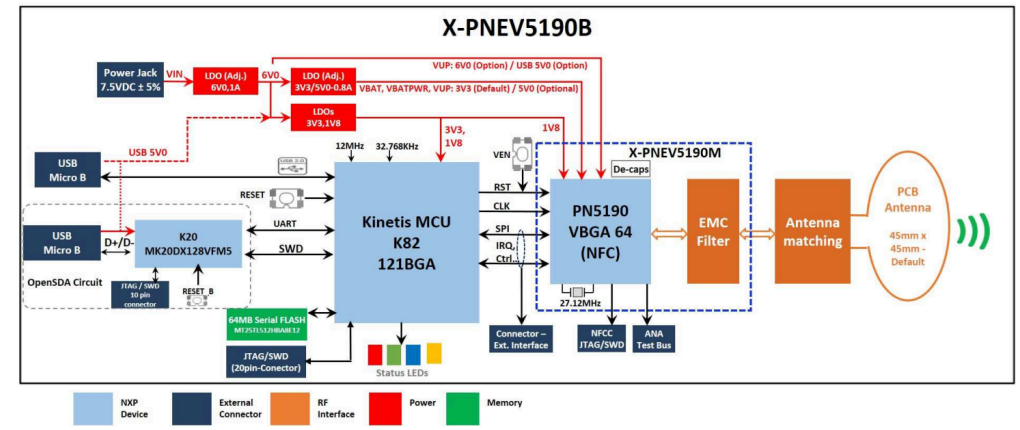
Warning: The PN5190 in default configuration requires 3.3 V with up to 1A. This requires an external power supply, i.e. the USB supply typically does not provide enough current. On the other hand, it does not make sense to drive the PNEV5190BP with a supply voltage higher than 5 V, when using the PN5190 in default configuration. Supplying the PNEV5190BP with >5 V only heats up the LDOs.

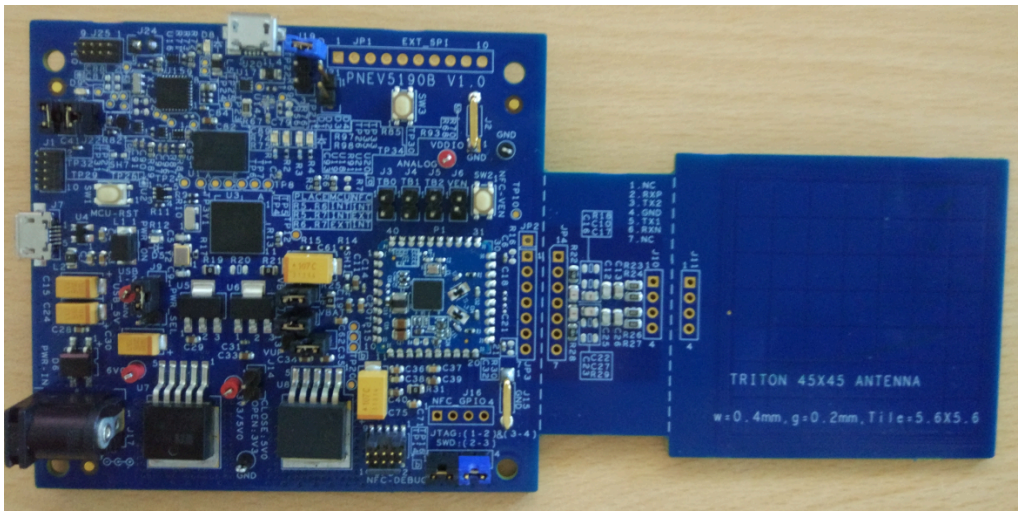
The PN5190 is connected to a Kinetis K82 121BGA µC via SPI. A specific firmware on the K82 allows using the PNEV5190B together with the NFC Cockpit.

The connection to the PC is done via USB micro connection.

Another connection option allows connecting a Linker / LPC-LINK2 board to the PNEV5190B with a debug cable. Alternatively the OpenSDA interface can be used. This allows the development of custom software or the execution of the NXP NFC Reader Library code including samples.

In case a different host microcontroller shall be used, the SPI interface is available for connection to an external host (the onboard K82 is not used in this case).





1. Version 1.0

Figure 1. PNEV5190B Customer evaluation board

The PNEV5190B customer evaluation board consists of 2 PCBs:

The PNEV5190B (base board) and the PNEV5190M (module board), as shown in Figure 2 and Figure 3. The PNEV5190M is soldered onto the PNEV5190B and contains the PN5190 itself and the major components, as required to operate the IC, e.g. the DC-DC inductor, the EMC filter and some block capacitors. The layout of the module board can be taken as reference.

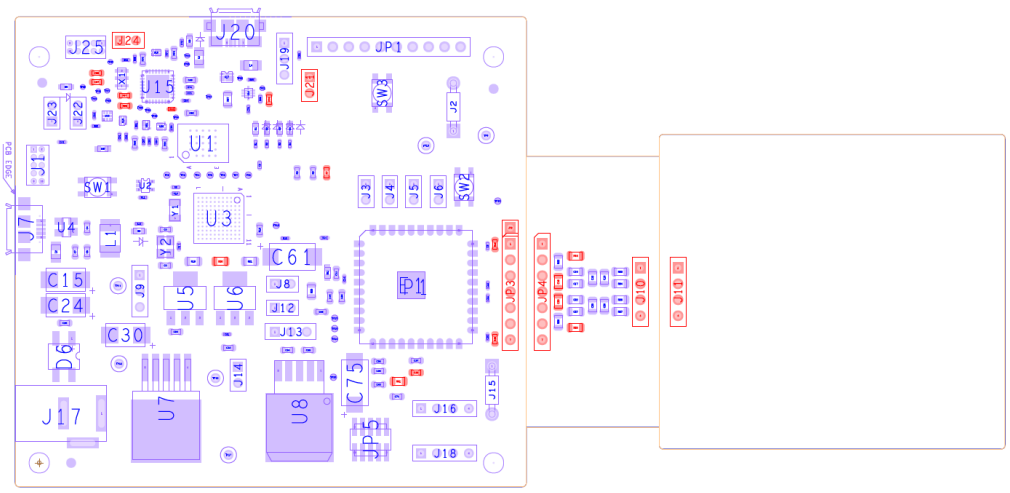


Figure 2. PNEV5190B base board top view (placement)

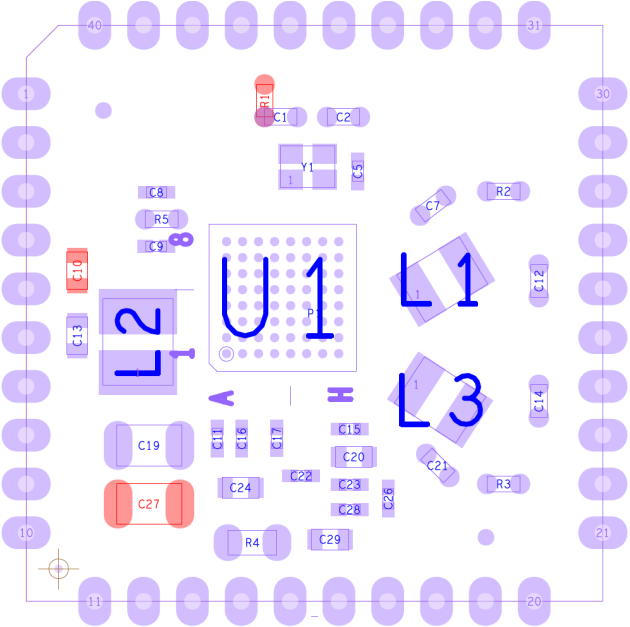


Figure 3. PNEV5190M Module board top view (placement)

3.2 Schematics

The complete schematics of the PNEV5190B base board are shown in the following figures. The more detailed reference data is available in [5].

3.2.1 K82

The PNEV5190B uses a Kinetis K82 121BGA microcontroller (Figure 4).

An LPC Link can be connected to the K82 via the JTAG/SWD interface (see Figure 5).

In addition, an OpenSDA interface is provided for debugging the K82 by using a Kinetis MK20DX128VFM5 (Figure 6).

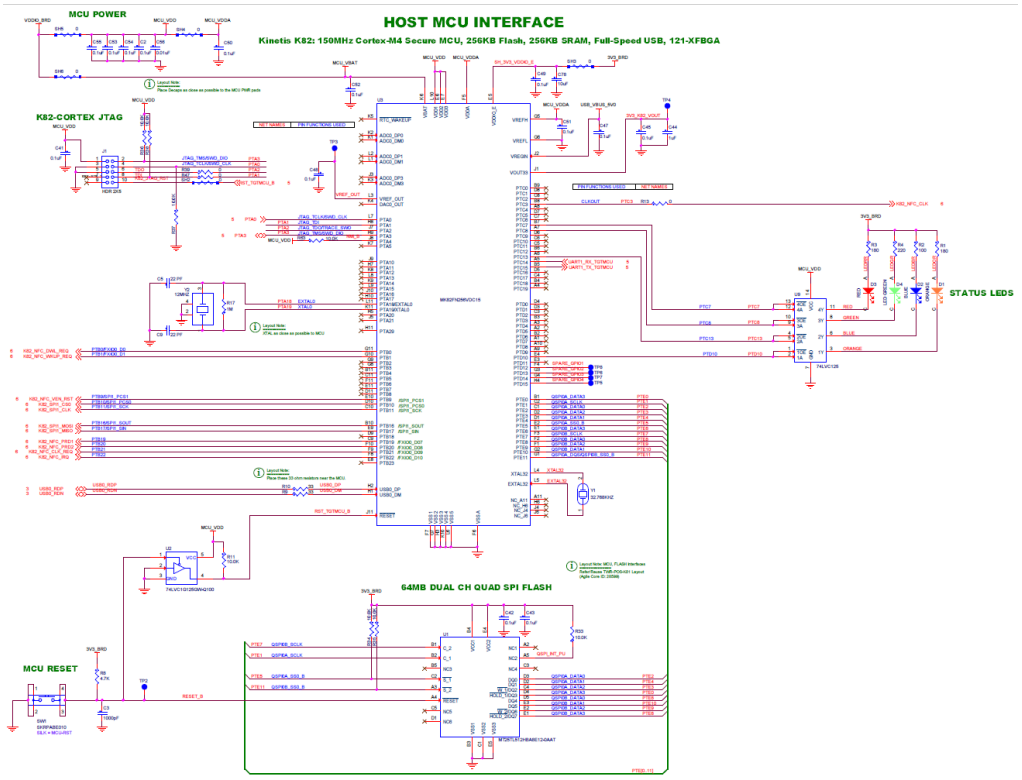


Figure 4. K82 main schematics

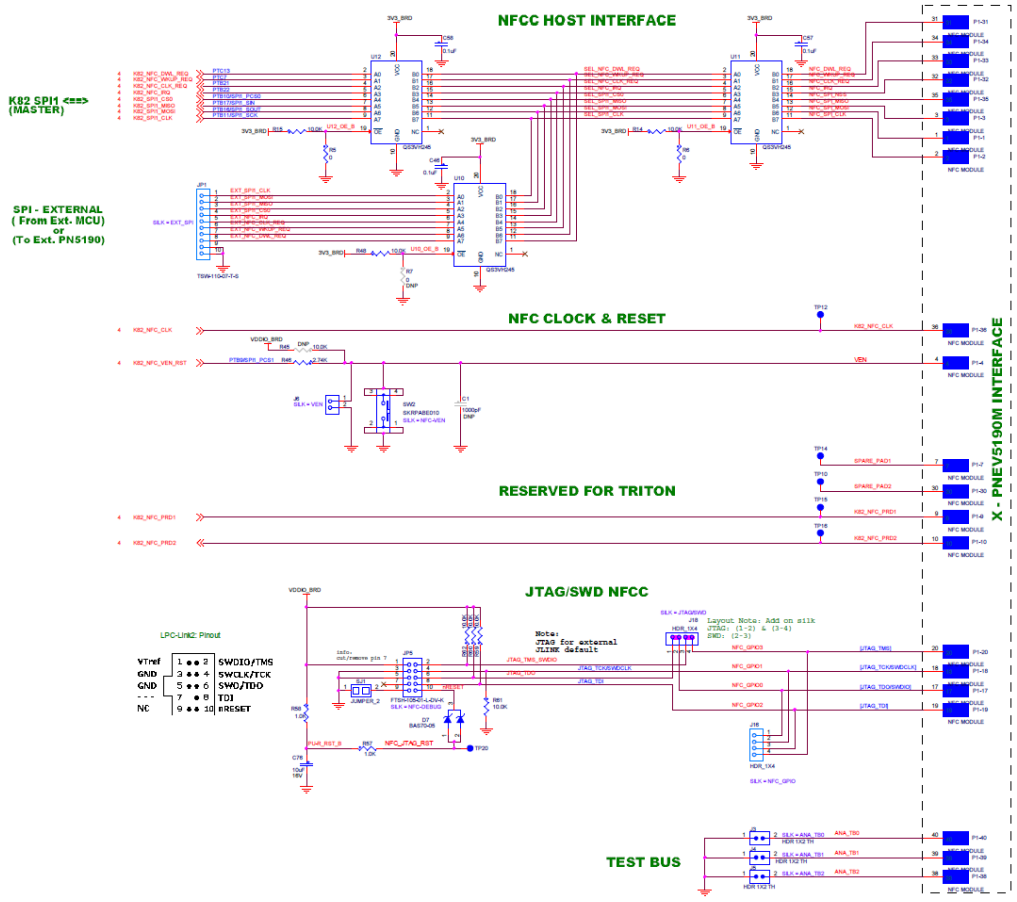


Figure 5. PNEV5190M interface

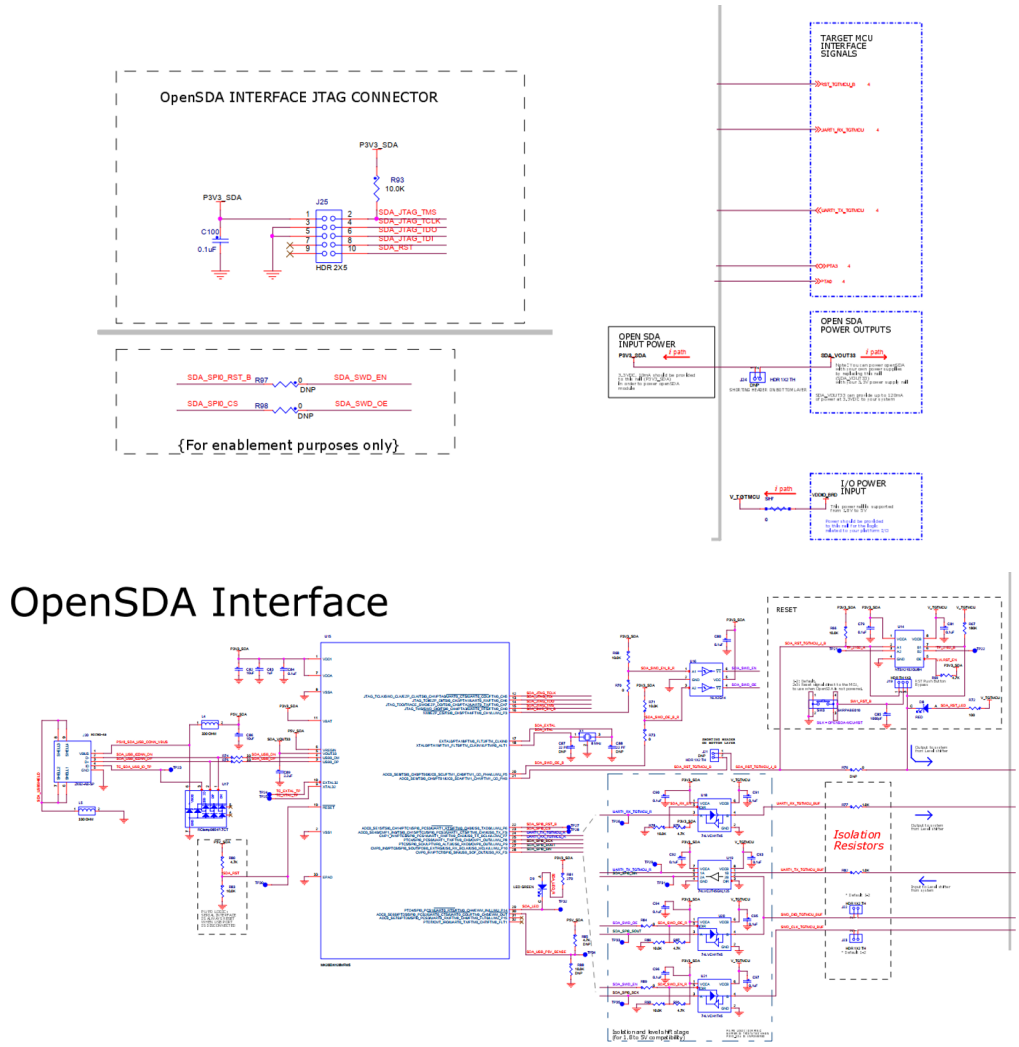


Figure 6. OpenSDA for K82 (MK20DX128VFM5)

3.2.2 Power supply

The default settings use the external power supply from the power jack connector. The external power supply shall always be used, if the DC-DC is enabled (default), since a standard USB connection typically does not provide enough current to drive the up to 2 W output power of the PN5190. The DC power input should provide a DC voltage around 5 V with a current of at least 800 mA. The polarity does not matter, since there is a rectifier foreseen. The inrush current of the DC-DC can be up to 1.6 A, when enabling the RF field.

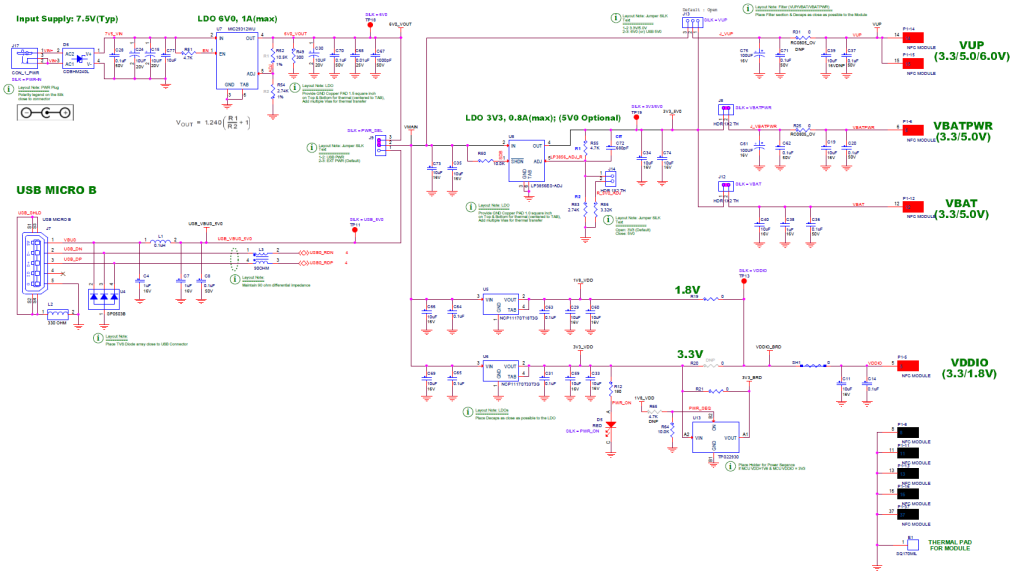


Figure 7. PNEV5190BP power supply section

As soon as the board is supplied with power, the red LED D5 must be on.

Note: *The default setup provides the usage with the NFC Cockpit. The related Secondary Firmware for the K82 starts automatically after powering up the PNEV5190BP, and initializes the PN5190. A proper initialization is indicated with the blue LED D2.*

The PNEV5190B has different supply pins for the PNEV5190M (module board) as shown in Table 1. For further details on the supply options of the PN5190 itself, refer to [1].

Table 1. PNEV5190M module supply pins

Attention: there are PN5190 (IC) pins with the same name!

Pin Name	Type	Description
VBAT	Supply input	3.3 V Main Input Supply Voltage
VBATPWR	Supply input	= VBAT = 3.3 V Main Input Supply Voltage
VDDIO	Supply input	1.8 V IO power supply
VUP	-	not used in default configuration (VUP is supplied by the PN5190 internal DC-DC)

The PN5190B base board provides four LDOs:

1. U8 for supplying the PNEV5190M with VBAT. The default configuration provides VBAT = 3.3 V. Optionally this voltage can be set to 4.8 V.
2. U5 for supplying the VDDIO and the µC supply (VDDIO_BRD = MCU_VDD = MCU_VDDA) with 3.3 V. This LDO is not used in default configuration.
3. U6 for supplying the VDDIO and the µC supply (VDDIO_BRD = MCU_VDD = MCU_VDDA) with 1.8 V. This LDO is used in default configuration.
4. U7 for supplying the overall board with 6 V. This LDO is used in default configuration.

The default configuration uses the following jumpers closed:

J9: 2-3 -> external power supply

J8: closed -> VBATPWR supplied with VBAT = 3.3 V

J12: closed -> VBAT supplied with 3.3 V

The default configuration uses the following jumpers open:

J3: open

J4: open

J5: open

J6: open

J13: open (this jumper can be used to bypass the DC-DC, but only if the EEPROM settings are done properly AND the required board modifications are made properly)

J14: open

J8 can be used to measure the current consumption of the TX driver circuit including the DC-DC.

J12 can be used to measure the supply current consumption, excluding the TX driver part.

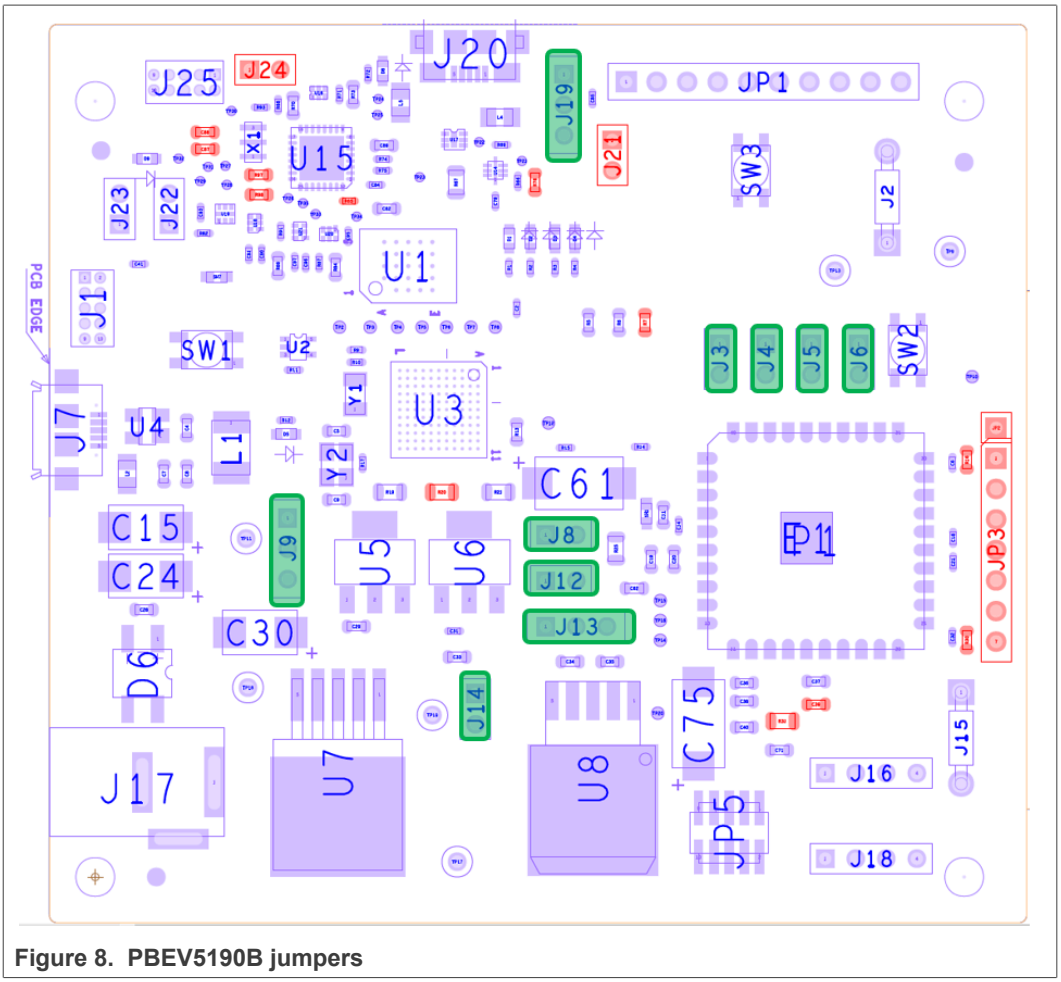


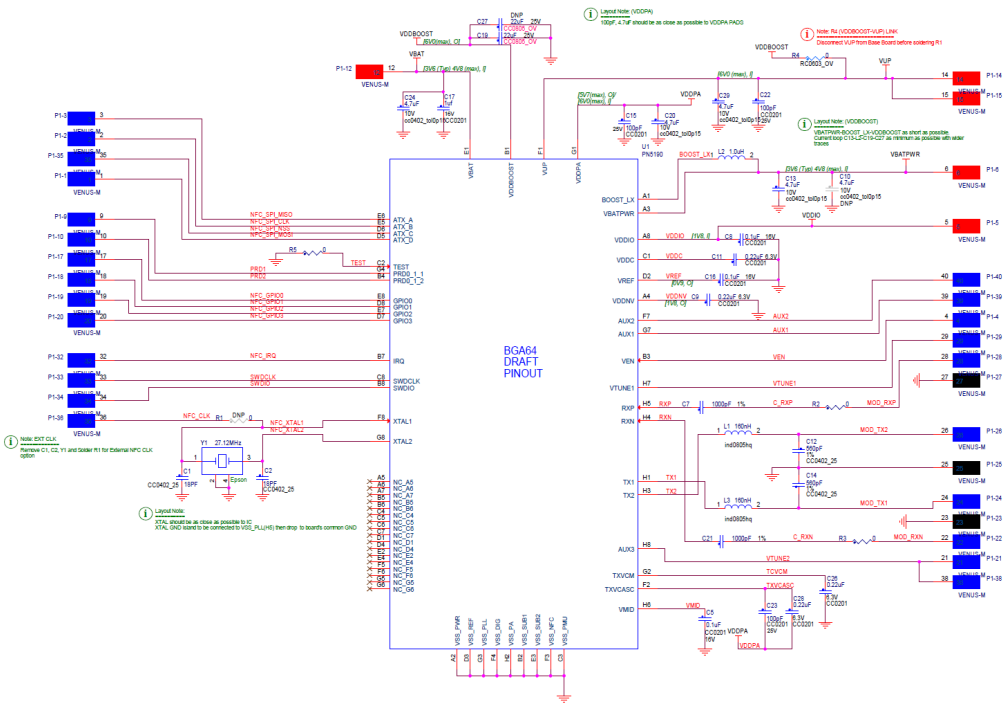
Figure 8. PBEV5190B jumpers

3.2.3 PNEV5190M module board

The PNEV5190M module board is shown in Figure 9. The module board contains the most relevant components, directly connected to the PN5190, i.e. the EMC filter inductors, the DC-DC inductor, the major block capacitors and the 27.12 MHz crystal.

The default clock is based on this 27.12 MHz crystal, but the board supports the option to test external clock input, if needed.

The relevant test signals can be derived from the test pins at the bottom of the board.



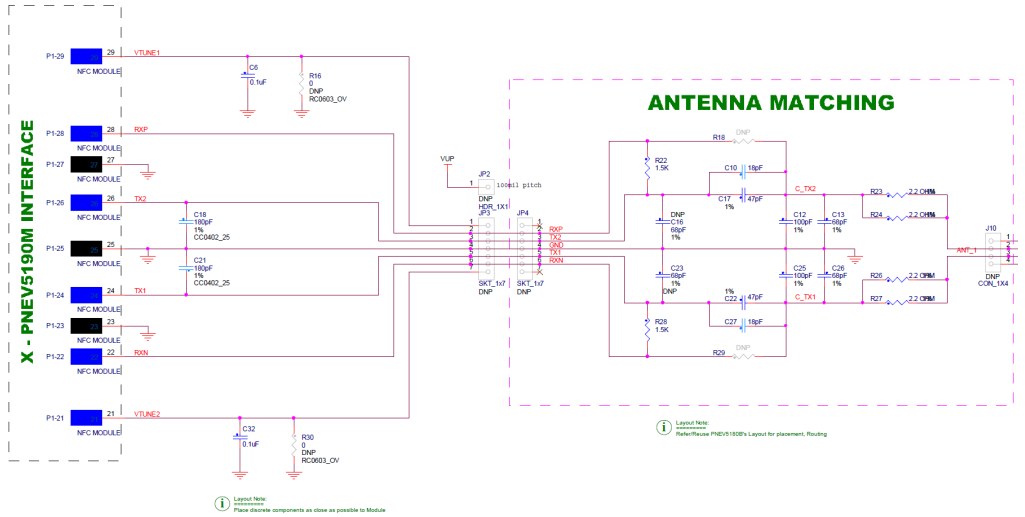
1. GND pads: 8,11,13,16,37
2. RFU pads: 7, 30, 31

Figure 9. PNEV5190M module board schematics

3.2.4 PNEV5190 antenna

The antenna connection uses the standard tuning circuit. The EMC filter is designed with a cut-off frequency of f_{EMC} = 14.25 MHz, and the antenna impedance is tuned to Z = 15…16Ω.

The details of antenna tuning are described in [2].



1. 45 mm x 45 mm antenna coil connected to J10

Figure 10. PNEV5190B antenna circuit

The PN5190 antenna tuning (see Figure 11) improves the transfer function compared to the standard “asymmetrical” tuning and therefore allows using a higher system Q factor, which results in a higher field strength. The disadvantage of the loading effect, which causes an increased current ITVDD, is compensated with the PN5190 Dynamic Power Control (DPC, for details refer to [3]). For more details on the PN5190 antenna tuning, refer to [2] PN5190 Antenna design guide.

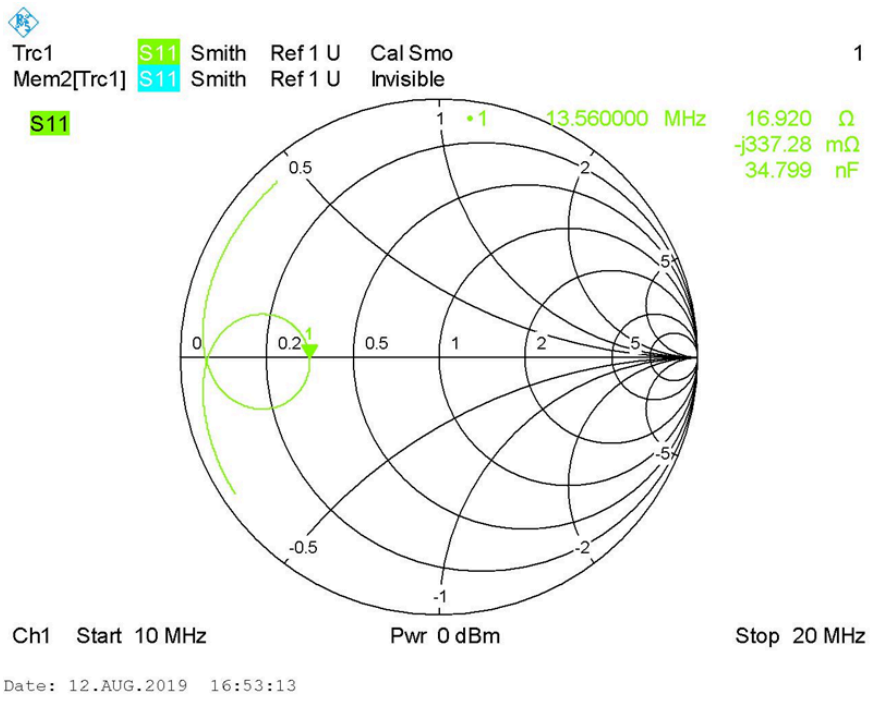


Figure 11. PNEV5190B evaluation board antenna tuning

3.3 K20 OpenSDA interface

The OpenSDA software for K20 is available in the default PNEV5190BP:

To use the OpenSDA debug for the K82, JP24 needs to be closed (default = closed with a short in the bottom layer). To open J24, the bottom layer needs to be cut open.

Connecting the OpenSDA via a USB Micro cable to the PC is indicated with a green LED D9 (above J22 and J23).

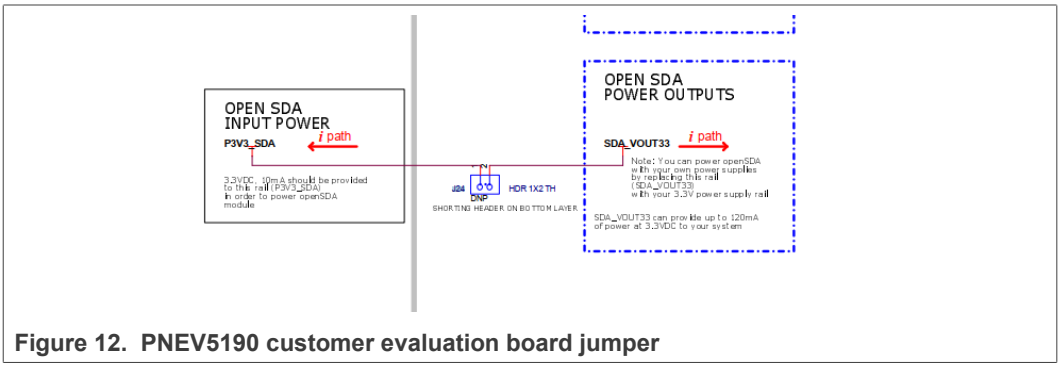


Figure 12. PNEV5190 customer evaluation board jumper

3.4 LED status indication

There is a power red LED, indicating the board is properly powered. It is driven by the 3V3 output of U6.

There are four LEDs (D1…D4) available, indicating some function of the PNEV5190B, when using the PNEV5190BP with the default K82 Secondary Firmware:

1. When RESET button is released, the LEDs flash to indicate that the secondary K82 FW and the PN5190 FW is working properly.
2. The blue LED indicates, that the PN5190 has been initialized, but no VCOM interface is opened.
3. The green LED turns on, when the VCOM interface is opened.
4. The orange LED indicates a communication via SPI.
5. The red LED blinking indicates that the PN5190 initialization failed. This might indicate a missing or corrupted PN5190 FW (e.g. if a previous secure FW update had been interrupted).

3.5 Jumper settings

The default jumper settings allow a direct use with the USB connector and an external power supply. This might show limited performance due to a current limitation on the USB host. So for real performance measurements, the external power supply should be used.

3.5.1 USB only

USB only (no external power supply) is not recommended at all. Most USB Hosts cannot supply sufficient power over all nor handle an inrush current of 1.6 A.

3.5.2 External power supply

The default configuration requires an external 5 V DC power supply, providing at least 800 mA (up to 1.6 A inrush).

3.5.3 First-time use

Make sure that the K82 is flashed with the correct firmware NNC_uC_VCOM_03.05.09 (Compiled on Sep 24 2020 13:37:14) or later.

Note: *It is strongly recommended to use the latest Secondary Firmware (NNC_uC_VCOM_x), which is delivered with the latest NFC Cockpit installation package. After starting the PNEV5190BP the first time with the NFC Cockpit, the <Load Secondary Firmware> in the Extra tab can be used to flash the latest version. The NFC Cockpit automatically directs the user to the correct folder, where the latest K82 secondary firmware can be found. Typically several options in the default folder are offered: all of them work properly with the NFC Cockpit.*

Note: *Be aware of the two different firmwares: one for the K82 (which is called "Secondary Firmware", to connect the PNEV5190BP to the NFC Cockpit), the other one for the PN5190 itself (which is called "Secure firmware").*

4 PN5190 secure firmware update

The PN5190 supports secure firmware update and it provides an easy way to upload the firmware via the NFC Cockpit tool or by an application hosted on the microcontroller, which implements secure firmware update functionality.

This document describes the process of how to flash the PN5190 FW to the PNEV5190B evaluation board. It also explains how to prepare the firmware update software for any microcontroller connected to the PN5190 IC.

The PNEV5190B customer evaluation board and MCUXpresso IDE toolchain are used as a reference to describe the functionality.

4.1 Requirements

This section describes the system and hardware requirements needed to upload the new version of the PN5190 FW.

4.1.1 System requirements

NFC Cockpit tool requirements:

- The chapters below are describing the installation process of it
- PC with USB port running on Microsoft Windows 10 operating system
- VCOM CDC drivers (drivers are available in the installation package)

Firmware download library requirements:

- Secure FW upload demo application is available in the provided release package
- The demo application is prepared for the MCUXpresso IDE toolchain.

4.1.2 Hardware requirements

- Enabled SPI host connection between microcontroller and PN5190 IC
- USB connection between PC and microcontroller

Note:

PNEV5190B evaluation board provides all features required to test “Secure FW update”.

4.2 Block diagram overview

At a very high level, the system is divided into three parts.

- PC host
- Microcontroller host
- PN5190

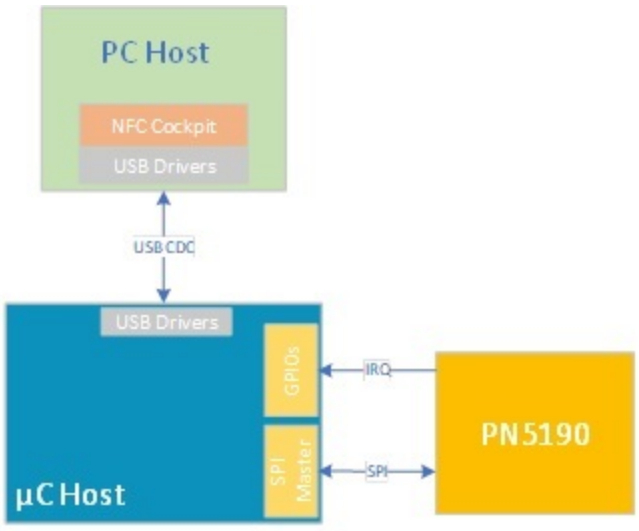


Figure 13. PNEV5190 firmware block diagram

4.2.1 PC host

The PC is hosting the NFC Cockpit tool, and it should provide a USB connection. The PC host is connected to the microcontroller host via a USB Serial VCOM interface.

PC host is optional; it is required in case of using the NFC Cockpit tool.

4.2.2 Microcontroller host

Microcontroller, in this setup, works as a medium between PC and PN5190. The purpose of it is to receive data from the PC over the USB interface and forward them to PN5190 via the SPI interface.

In case of setup, where secure FW update application is hosted on the microcontroller host, the app reads the firmware data from an external source and sends them to PN5190 IC via SPI interface.

4.2.3 PN5190

The PN5190 is a highly integrated high-performance full NFC Forum-compliant frontend IC for contactless communication at 13.56 MHz.

PN5190 supports secure FW updates, and guidelines are described in the next sections.

4.3 Reference application

NXP provides “DownloadLibEx1” application as a reference example (called "PN5190 Secure Firmware Downloader, see [7]), which demonstrates how to flash a new firmware by an application hosted on the target microcontroller. The example includes the implementation of all needed commands in the “Secure firmware download” mode.

The reference application package is prepared for the Kinetis K82 µC, and it works together with the PNEV5190B development board. The project is built with the MCUXpresso IDE.

A reference example uses secure download library, which provides the implementation of the secure download APIs. It is recommended to use it in the customer application.

4.3.1 Preconditions

It is required to set up the system comprising the PNEV5190B evaluation board and LPC-Link2 or Segger J-Link, as shown in the figure below.

To be able to use the prepared software package, all components listed in the table below are required:

Table 2. Development Environment

Device	Version	Description
PNEV5190B	1.0 or higher	PNEV5190 Customer evaluation board (hardware)
Optional: LPC-LINK2 or Segger J-Link	1.0	Optional standalone debug adapter (hardware): alternatively the built in OpenSDA can be used
MCUXpresso IDE	11.2.0 or higher	Development IDE (PC software)

The next figure shows how to connect the PNEV5190B Development board with Segger J-Link and PC. The development board in this setup is powered by USB (which is not recommended if the RF Front-End is used).

Note: *No extra debug hardware like Segger J-Link or LPC-Link2 is required, since the OpenSDA can be used instead. The OpenSDA simply uses the second Micro USB port (J20).*

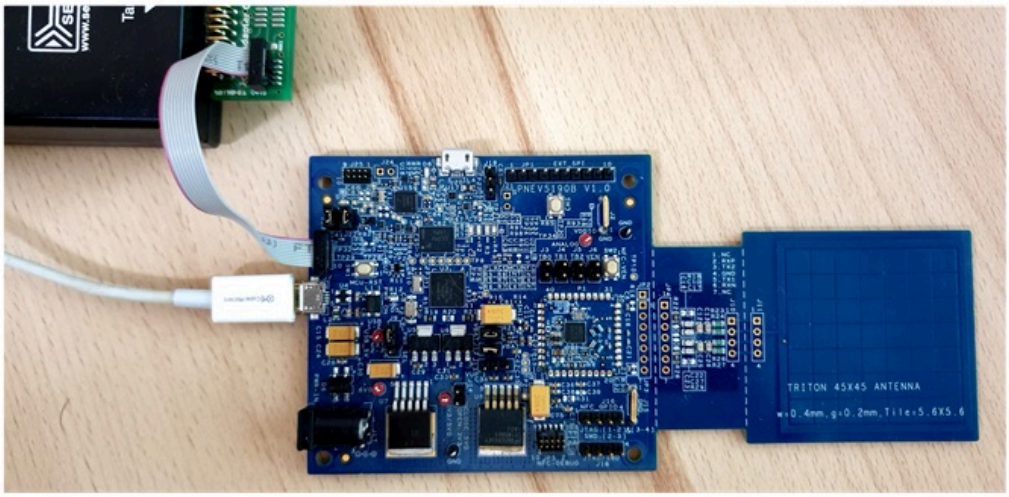


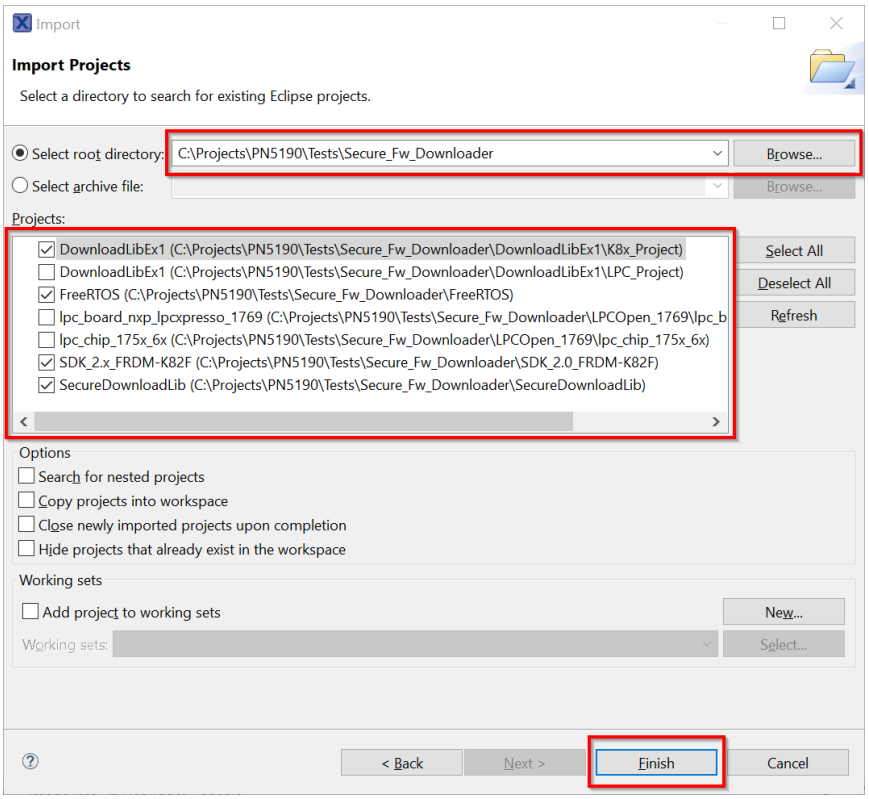
Figure 14. System setup

Before continuing, it is necessary to download the latest PN5190 SW release package and extract it to an empty folder.

4.3.2 Import reference project

To import secure firmware update project, follow steps below:

1. Open MCUXpresso IDE in a new workspace
2. Import project from the previously extracted folder

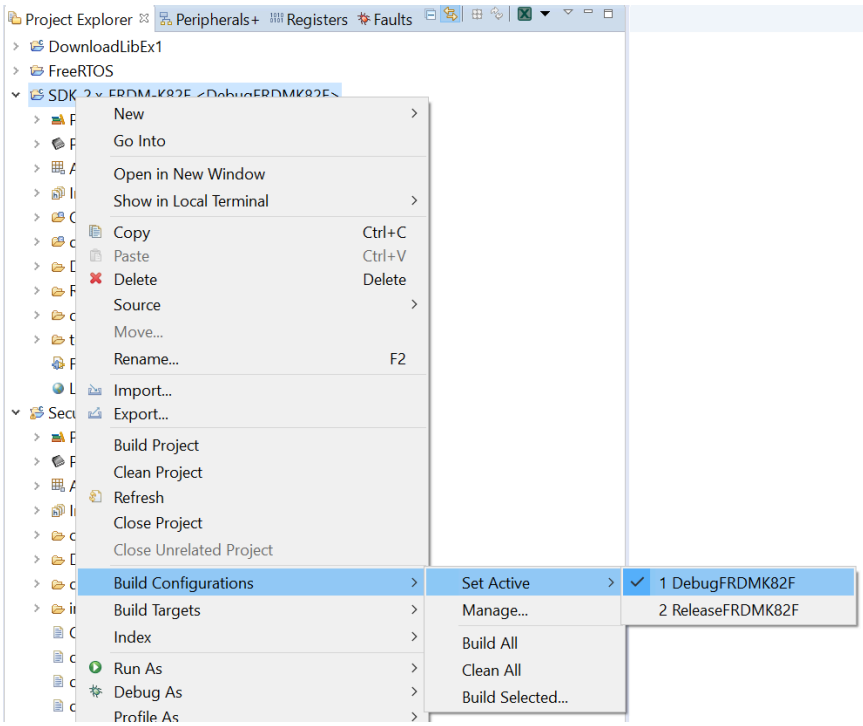


1. Click “Import projects …” in the Project Explorer window
2. Select “General/Existing Projects into Workspace” option and click “Next” button
3. Browse to the “Secure_Fw_Downloader” folder
4. Select projects as shown on the picture above and click the “Finish” button

Figure 15. Import Secure Firmware Project to the MCUXpresso IDE

4.3.3 Build, run and debug project

After a successful project import, check for the correct project configuration. All three projects shall be configured for “DebugFRDMK82F”.



1. Right-click on the project
2. Select “Build Configurations/SetActive/DebugFRDMK82F” option

Figure 16. Import secure firmware project to the MCUXpresso IDE

After that step, the project structure shall look like in the picture below.

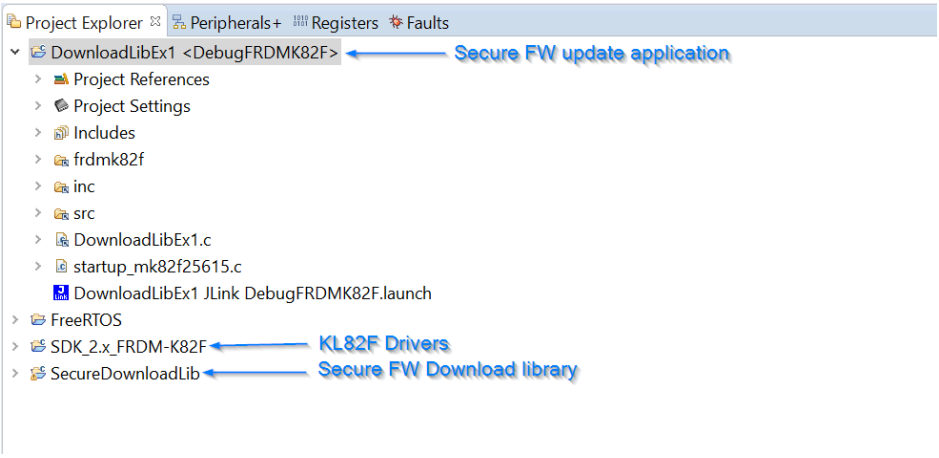


Figure 17. Project Explorer Window

Note: *Make sure the K82 FRDM SDK is installed as described in Section 5.3.2.*

As a next step, it is necessary to build all projects. That can be achieved by clicking the “Build all projects” in the “Quickstart Panel”.

The next step is to flash and debug the application. Highlight the “DownloadLibEx1” project in the “Project Explorer” window and click “Debug” in the “Quickstart Panel”, as shown in the next figure. The MCUXpresso IDE builds the application, flash the application binary, and starts with the debugging process.

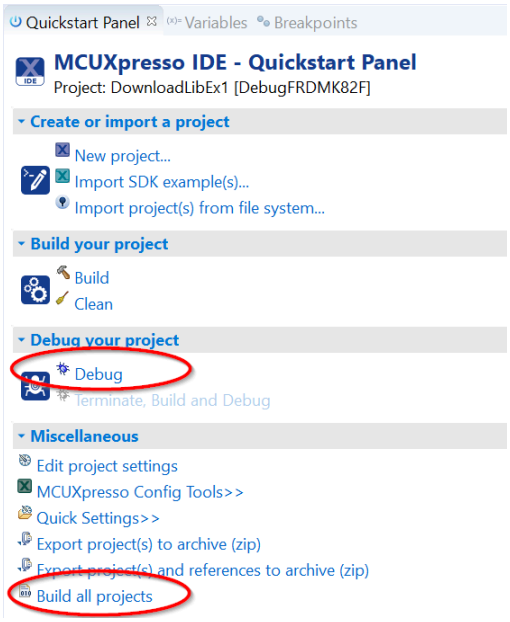


Figure 18. Flash and debug application

After that, the application starts, and it printout options for the supported tasks.

```
******** Secure Firmware Update ********

 Select the Option
        - Enter 1 for FW Version.
        - Enter 2 to Get DieID.

        - Enter 3 to perform SOFT RESET.
        - Enter 4 to CheckSessionState.

        - ********** PN5190 SPECIFIC ONLY **********
        - Enter 12 for Firmware Update 0.x

Select Option:
(For MCUXpresso, you may have to press many enter keys after your input)
```

Figure 19. Application debug printouts

4.3.4 Secure download library

“Secure download library” is part of the reference application and provides an implementation of the secure download mode. The secure download library is written in C programing language, and it can be ported to any customer application running on the µC.

Secure download library contains an implementation of the platform (SPI interface and HW configuration), and this part of the library should be adopted in case it is used on any other platform.

It is highly recommended to use the secure download library in the customer application.

The table below lists all APIs supported by the library:

Table 3. API provided by secure download library

Device	Description
phDlhalHw_Pn5190_Download_Init	Initialize the download library.
phDlhalHw_Pn5190_Download_CheckIntegrity	Returns the integrity information of the existing firmware.
phDlhalHw_Pn5190_Download_CheckSessionState	Check and return the current download session state.

5 Software

The PNEV5190B evaluation board is delivered with a graphical user interface application (GUI), the NXP NFC Cockpit. The NFC Cockpit can be used to explore the functionality of the PN5190 and perform RF and antenna design-related tests. It allows a direct register access as well as EEPROM read and writes access, and it allows testing and calibrating the DPC. The NFC Cockpit therefore, can be used to configure and test the PN5190.

5.1 K82 firmware and driver

The K82 firmware is installed by default on the PNEV5190BP and is ready to use. So, no Kinetis firmware installation is required, if the board is only used with the NFC Cockpit.

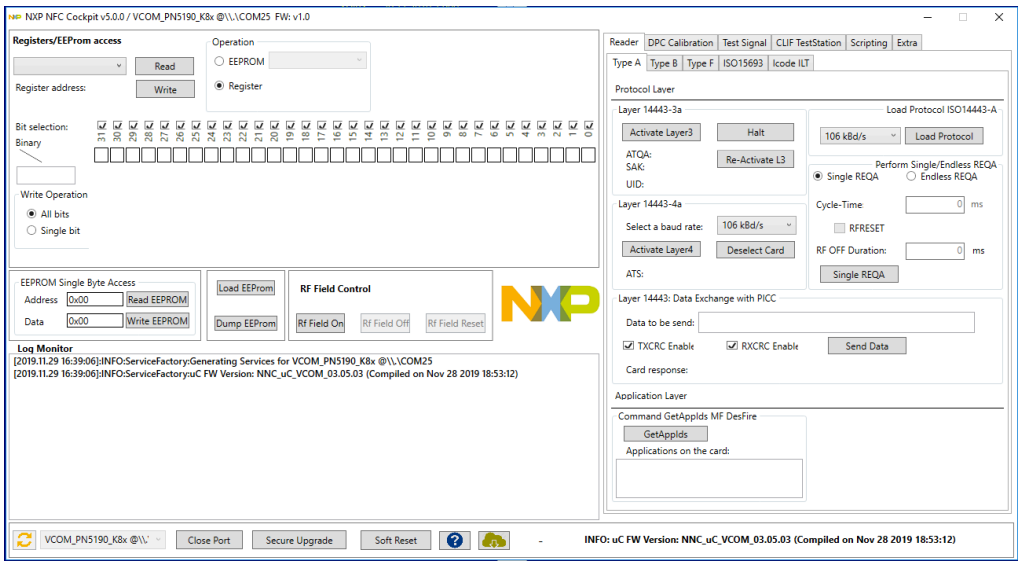
Note: *Still it is recommended updating to the latest version of the secondary firmware, using the latest version of the NFC Cockpit.*

However, the K82 might have been used for software development together with one of the samples (including the NXP NFC Reader Library). In this case, the K82 FW must be reinstalled afterwards, if the PNEV5190BP is supposed to be used together with the NFC Cockpit again. Reason for this is that any software development using the MCUXpresso will erase the default firmware. Therefore, the K82 FW installation is described in the following section.

In any case, the correct PC driver must be installed, before the NFC Cockpit can be used with the PNEV5190B evaluation board. The installation of the NFC Cockpit will automaticall install the required driver, too.

5.2 PN5190 NFC Cockpit

The PN5190 NFC Cockpit can be installed and started (see Figure 20).



1. Status when starting the NFC Cockpit with connected PNEV5190B board

Figure 20. NFC Cockpit with PNEV5190B initial view

After starting the NFC Cockpit, the communication link between the PC and the PNEV5190B (via the K82 interface) is enabled automatically.

Note:

The PN5190 NFC Cockpit is a development tool, and therefore allows many different kinds of operations, even "useless" ones at a first glance. The correct use of the NFC Cockpit is required to operate the PN5190 properly.

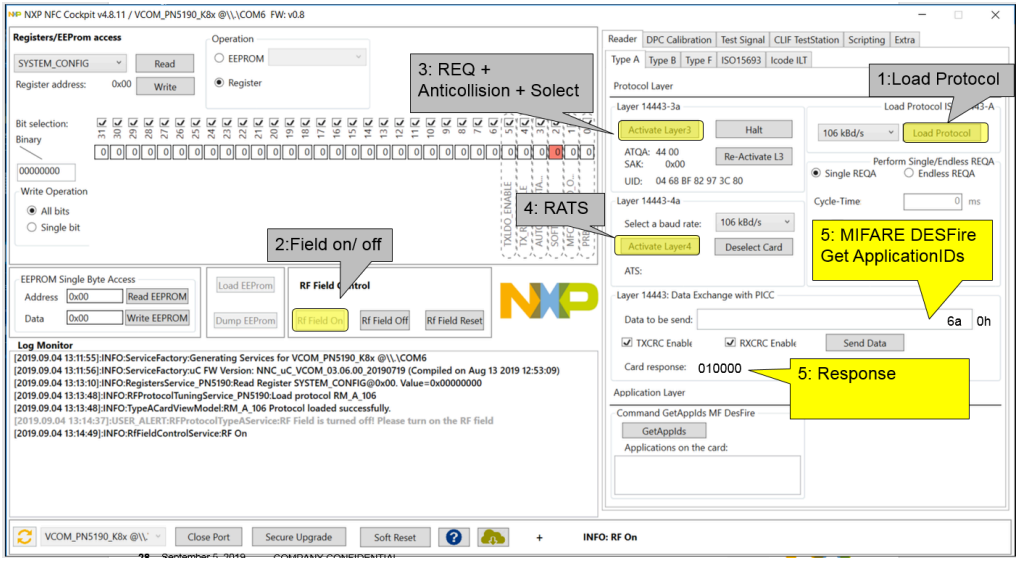
Example: Without enabling the field, no card can be operated, even though the PN5190 can be operated.

Figure 21 shows the activation of a MIFARE DESFire card, using the <Load Protocol> + <Field On> + <Activate Layer3>, followed by <Activate Layer4>. The PN5190 NFC Cockpit shows the card responses like ATQA, SAK, and ATS.

Afterwards the ISO/IEC 14443-4 protocol can be used to exchange data. Figure 21 shows the MIFARE DESFire command "Get Application ID" (0x6A), which returns the AIDs.

Note:

Make sure that either the CRC is enabled or added manually in the data field.



1. 0x6a = Get Application ID command of MIFARE DESFire EV1

Figure 21. PN5190 NFC Cockpit: Activation of a MIFARE DESFire EV1 card + Get Application ID

Similar functionality does exist for ISO/IEC 14443 A and B, for NFC type F and for ISO/IEC 15693 communication.

Be aware that a LOAD_RF_CONFIG command must be executed manually before the corresponding protocol settings are loaded from the EEPROM into the registers. This can be used to perform:

1. <Load Protocol> (e.g. type A 106)
2. <Field On>
3. <Single REQA> (using the EEPROM settings)

4. Select a TX register, e.g. RF_CONTROL_TX, enable TX_SET_BYPASS_SC_SHAPING
5. Change some register bits, and write back into RAM
6. <Single REQA> shows the register changes (probing the field and checking the envelope)

This allows an easy and quick optimization of TX and RX parameters before changing the EERPOM.

1. <Load Protocol> (e.g. type A 106)
2. <Single REQA> (using again the EEPROM settings)

5.2.1 PN5190 register access

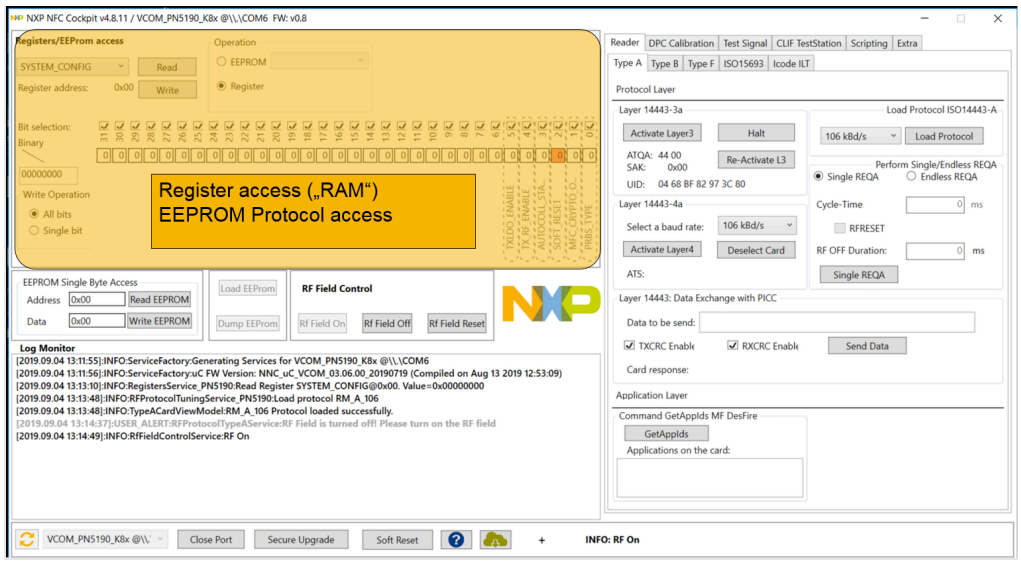
The PN5190 NFC Cockpit allows the reading and writing of all the PN5190 registers (see Figure 22).

Selecting a register reads and shows the hexadecimal content as well as the corresponding bit values. The input allows changing each bit separately as well as writing hexadecimal values. Writing back the value changes the PN5190 register.

A help function automatically shows a short description of the (part of the) registers itself, if the mouse is moved over the names.

Note:

Some register content cannot be changed manually ("read only") and some content might be overwritten by the PN5190 firmware.



1. Register area is a RAM area, i.e. might be overwritten or changed automatically.

Figure 22. PN5190 register access

All registers, which are used in the LOAD_RF_CONFIG command, can be read from the EEPROM. The user must select the register and the protocol.

All registers, which are used in the LOAD_RF_CONFIG command, can be written into the EEPROM. The user must select the register and the protocol.

This allows an easy EEPROM update of the relevant TX and RX registers after optimization in RAM.

5.2.2 PN5190 direct EEPROM access

The NFC Cockpit allows 4 options of EEPROM access (see Figure 23):

- Read EEPROM

Reads a single byte from EEPROM using byte address

- Write EEPROM

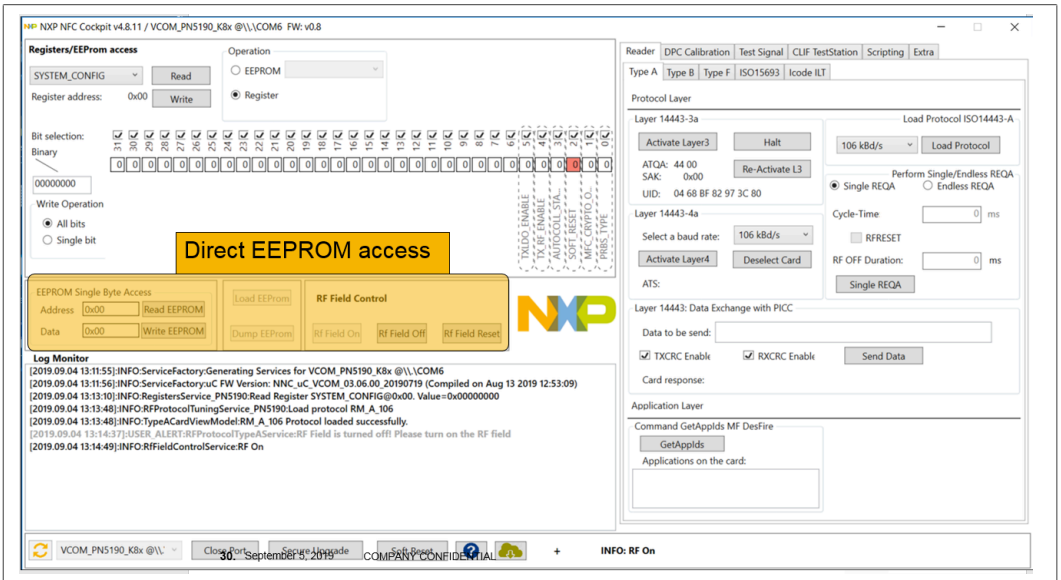
Writes a single byte into EEPROM using byte address

- Dump EEPROM

Stores the complete user area of the PN5190 EEPROM into an XML file. This can be used to generate a backup of all settings or to transfer optimized settings onto another board or into own software. It makes sense to save all default EEPROM settings into a file, before modifying the EEPROM.

- Load EEPROM

Loads an XML file and stores the content into the user area of the PN5190 EEPROM. The format is fixed and must fit.



1. EEPROM means User area of the EEPROM

Figure 23. PN5190 direct EEPROM access

5.2.3 PN5190 analog and digital test signals

The NFC cockpit allows using the PN5190 internal test bus, to route the digital and analog test signals to the given test pins. Details can be found in the CTS description.

The test pins can be found at TB0, TB1 and TB2.

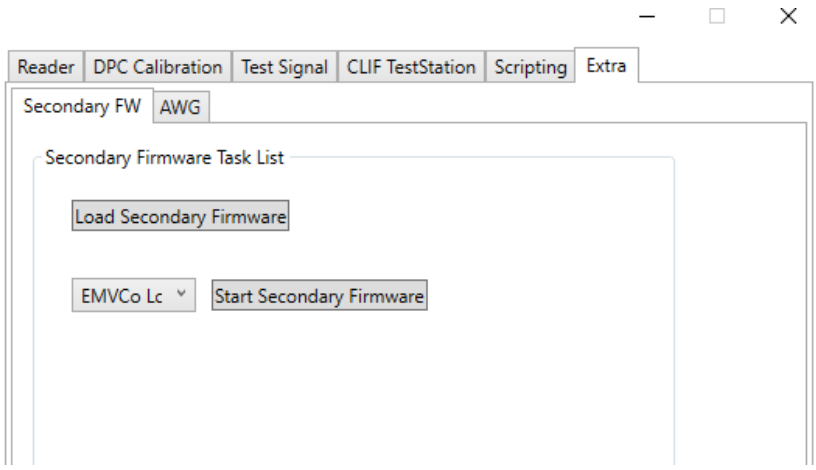
5.2.4 PN5190 dynamic power control

The NFC Cockpit supports an easy and straight forward calibration of the DPC. All details can be found in [2].

5.2.5 EMVCo loopback application

The NFC Cockpit offers the option to start applications on the K82 firmware. The default application, as provided with the standard K82 firmware, allows running an EMVCo Loopback function.

The EMVCo Loopback can be started by selecting the < EMVCo Loop Back (digital)> and then pressing the <Start Secondary Firmware> button (see Figure 24). The function runs on the PNEV5190B independently from the PC, but can be stopped by pressing the <Stop Secondary Firmware> button.



1. Start the EMVCo application with <Start Secondary Firmware>

Figure 24. NFC Cockpit with EMVCo loopback App

The NFC Cockpit installation folder provides several Secondary K82 Firmwares. All of them can be operated from and with the NFC Cockpit. Even the version with the EMVCo Loopback comes in two different flavors: One with a frame size of 256 bytes (FSDI = 8) and another one with a frame size of 1024 bytes (FSDI = 10). The latter one might not work in all EMVCo analog test environments.

5.3 NFC Reader Library support of the PN5190

NXP provides a library to support users in developing an NFC application. The library is available in the PN5190 SW release package.

NXP NFC Reader Library is written in C language, and it is shared as source code. Therefore it can be ported to almost any µC.

5.3.1 Import library and demo application to the MCUXpresso IDE

This chapter explains how to use the MCUXpresso IDE tool to build the NFC Reader Library demo applications.

As a first step, extract the zipped library package (“NxpNfcRdLib_06.03.00_20200512.zip”, or higher) to an empty folder and follow steps described below.

1. Open MCUXpresso IDE
   The “MCUXpresso IDE Launcher” dialog box appears and prompts to select a workspace to use. It is recommended to use an empty folder as a new workspace.

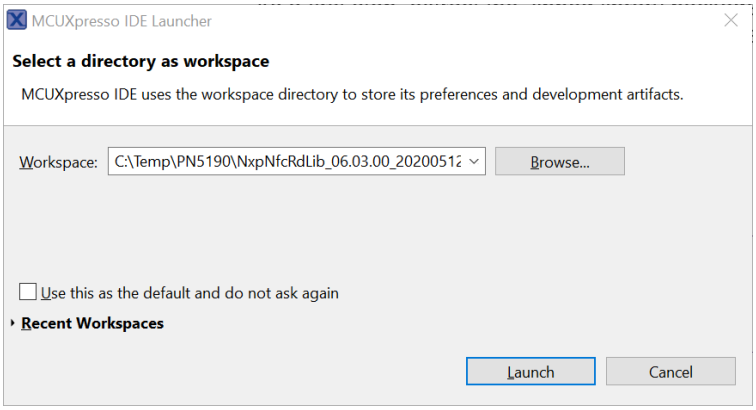


Figure 25. MCUXpresso IDE launcher

The IDE starts and displays the welcome page.

2. Import NFC Reader Library and demo applications
   Select “Import projects…” from the “Project Explorer” window.

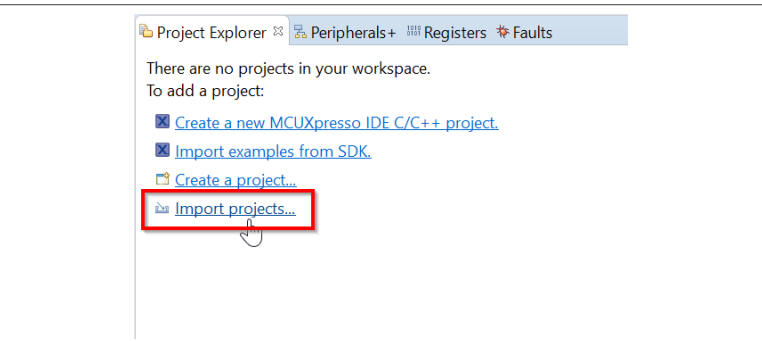


Figure 26. MCUXpresso IDE launcher

3. Import wizard appears
   Select “General/Existing Projects into Workspace” and click “Next” button.

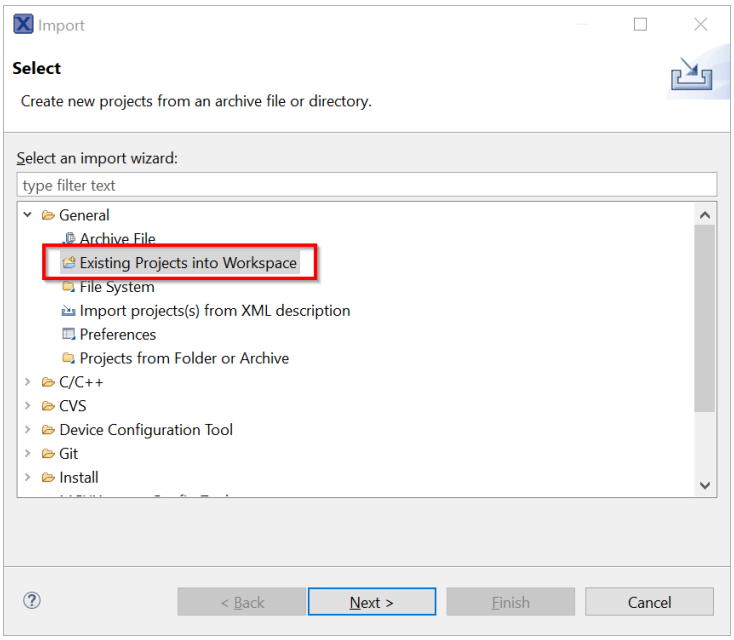
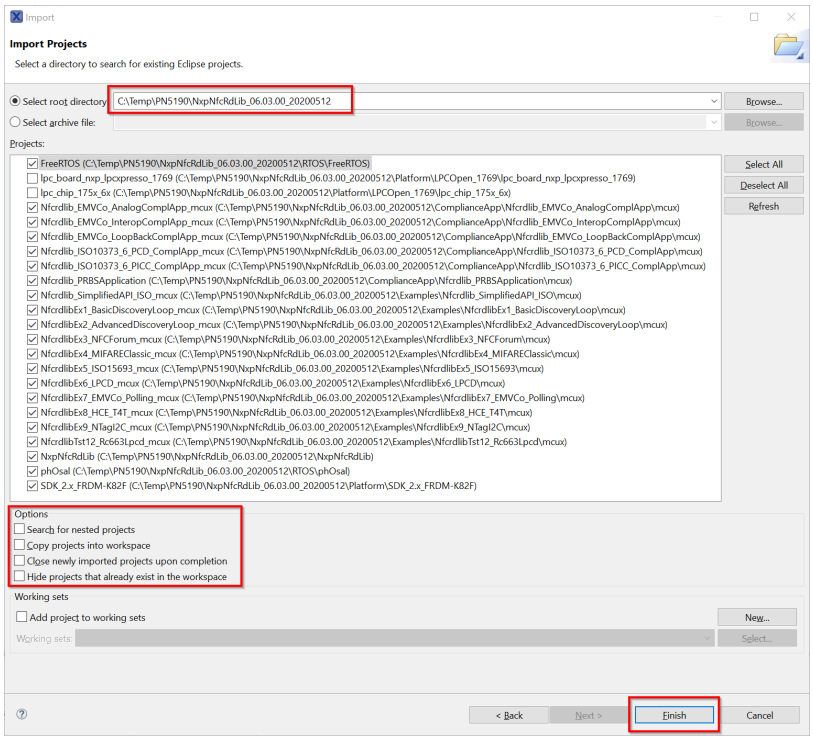


Figure 27. MCUXpresso IDE Launcher

4. Select the projects root folder
   Browse to the unzipped folder with the NFC Reader Library



a. Browse to the NFC Reader Library folder
b. Select project as depicted on the screenshot above
c. Leave all options unchecked
d. Click “Finish” button to import selected projects

Figure 28. Import selected projects to the Workspace

5. All imported projects shall be listed in the “Project Explorer” window

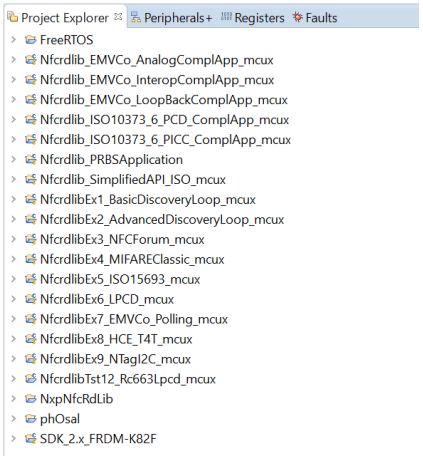


Figure 29. NFC Reader Library projects

5.3.2 Install FRDM-K82F SDK

It is mandatory to install K82F SDK to build, run or debug projects. The SDK is available and shall be downloaded from the NXP website.

1. Left-click at Installed SDKs view. Pop-up menu appears

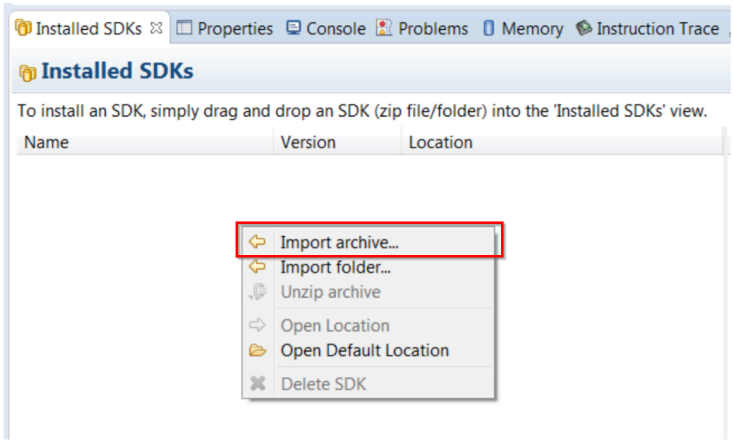


Figure 30. Adding SDK – step 1

2. Right-click “Import archive” and browse to the K82F SDK zip file. Import process starts automatically

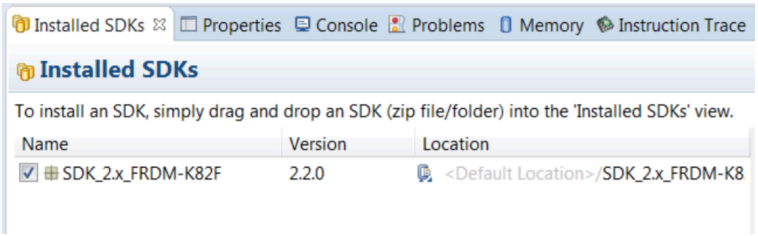


Figure 31. Adding SDK – step 2

5.3.3 Build, debug and run projects

Provided NFC Reader Library project and demo application projects are pre-configured to be used with the PNEV5190B v1.0 customer demo board.

As a next step, all projects shall be built. Select the “Build all projects” in the “Quickstart Panel” window.

Alternatively, select “Project > Build” to build only one project at the time.

6 References

[1] PN5190 NFC frontend, Product data sheet, https://www.nxp.com/docs/en/data-sheet/PN5190.pdf

[2] AN12549 PN5190 antenna design guide, https://www.nxp.com/docs/en/application-note/AN12549.pdf

[3] PN5190 dynamic power control is part of AN12549 PN5190 antenna design guide, https://www.nxp.com/docs/en/application-note/AN12549.pdf

[4] AN11802 NFC Reader Library for Linux installation guidelines https://www.nxp.com/docs/en/application-note/AN11802.pdf

[5] PNEV5190BP reference data package (schematics & laylout, module board spec) on the PNEV5190BP product homepage https://www.nxp.com/products/rfid-nfc/nfc-hf/nfc-readers/development-board-for-pn5190:PNEV5190BP

[6] NXP NFC Cockpit https://www.nxp.com/products/rfid-nfc/nfc-hf/nfc-readers/nfc-cockpit-configuration-tool-for-nfc-ics:NFC-COCKPIT

[7] PN5190 Secure Firmware Downloader from https://www.nxp.com/products/rfid-nfc/nfc-hf/nfc-readers/nfc-frontend-supporting-challenging-rf-environment-for-payment-physical-access-control:PN5190

7 Radio Equipment Directive (RED)

The following information is provided per Article 10.8 of the Radio Equipment Directive 2014/53/EU:

(a) Frequency bands in which the equipment operates.

(b) The maximum RF power transmitted.

Table 4. Characteristics

PN	RF Technology	(a) Freq Ranges (EU)	(b) Max Transmitted Power
PNEV5190BP	NFC	13.56 MHz ±7 kHz	-11 dBm

EUROPEAN DECLARATION OF CONFORMITY (Simplified DoC per Article 10.9 of the Radio Equipment Directive 2014/53/EU). This apparatus, namely PNEV5190BP demo board, conforms to the Radio Equipment Directive 2014/53/EU.

The full EU Declaration of Conformity for this apparatus can be found at this location: https://www.nxp.com/products/rfid-nfc/nfc-hf/nfc-readers/development-board-for-pn5190:PNEV5190BP.

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