AN11308

Quick Start Up Guide PNEV512B Board

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Application note
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Document information

Info	Content
Keywords	PN512, Blueboard, LPCXpresso, MCU, Code Red, eclipse, LPC1769, LPC1227, NFC Reader Library, PNEV512B
Abstract	This application note is related to the installation procedures of the PNEV512B Board. It describes the actions to be done to become acquainted with the demo reader

Revision history

Rev	Date	Description
1.8	20141201	Added a note about RAM limitation of LPC1227 in section 5.3
1.7	20140721	Small corrections
1.6	20140519	Removed the note about the version of the LPCXpresso IDE. Some small corrections. Changed the description and pictures of the projects Polling and, Classic Changed the P2P description due to a software update. Removed the description about the projects Ultralight and DESFire. All projects are now based on the NFC Reader Library version 3.010. Therefore all projects have been refactored. Added support for the development board LPCXpresso LPC1769 which is based on an ARM Cortex M3 microcontroller. The NFC Reader Library is now called NFC Reader Library
1.5	20140114	Added description for Card Emulation T4T and T2T.
1.4	20131011	Added info about what version of the LPCXpresso IDE to use.
1.3	20130613	Added description about the P2P Snep Client
1.2	20130221	Added description of the P2P project. Added information about the use of the projects in conjunction with the LPC1227 MCU. Added information about the documentation of the NFC Reader Library. Added information about the exemplary project of code size optimization of the NFC Reader Library.
1.1	20130108	Red circles of some figures corrected
1.0	20121217	First release

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1. Introduction

This application note gives a detailed overview of the hardware for working with the PN512 contactless reader IC, we use the LPCXpresso LPC 1769 and the Blueboard (**Chapter** 2), the installation procedures of the Development Environment (**Chapter** 4.1) and the handling of the reader projects using the NFC Reader Library (**Chapter 5**).

The projects used in this documentation are:

- Communication with MIFARE Classic → **Chapter** 5.1
- Polling for Tags in the RF - field → **Chapter** 5.2
- Using the PN512 in Card Emulation mode (**LPC1227 only**) → **Chapter** 6
- Exemplary Peer to Peer implementation → **Chapter** 5.3

Each project can also run on the LPCXpresso LPC1227 board (**Chapter** 7.3).

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2. Hardware overview of the Demo Reader

The demo reader is made up of 2 separate boards:

- A PNEV512B demo board provided by NXP (12NC: 9352 981 99699). This board has connectors which are designed to exactly fit the ones of the companion LPCXpresso LPC 1227 and LPCXpresso LPC 1769 development boards.
- A commercial LPCXpresso LPC 1769 development board (12NC: 935291912598, Type: OM13000+598) which can be provided by NXP or bought directly on the market. See Ref. [12].

Once the two boards are put together via the connectors, the demo reader is ready for use.

2.1 PNEV512B demo board

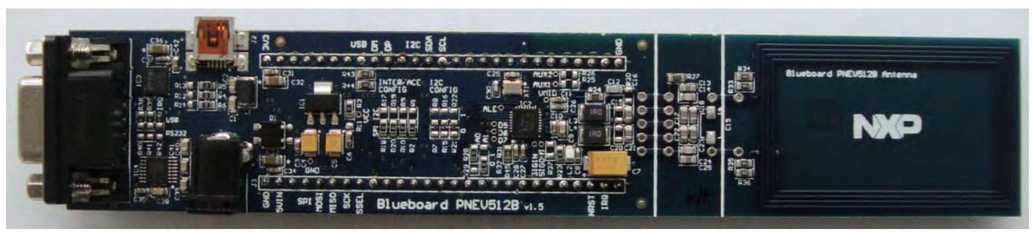

Fig 1. Picture of PNEV512B demo board

The PNEV512B demo board embeds the contactless communication transceiver IC PN512 with all its elements needed for transmission: EMC filter, matching network and the antenna. The PN512 supports different kind of contactless communication methods and protocols at 13.56 MHz:

- Reader/Writer mode supporting ISO/IEC 14443A/MIFARE and FeliCa scheme
- Reader/Writer mode supporting ISO/IEC 14443B
- Card Operation mode supporting ISO/IEC 14443A/MIFARE and FeliCa scheme
- NFCIP-1 mode
- Refer to the data sheet of this IC [2] for more details

Thanks to the relevant solder bridges, the host link of the PNEV512B demo board can be configured for:

- I²C
- SPI
- UART (optional, see Section 2.7)

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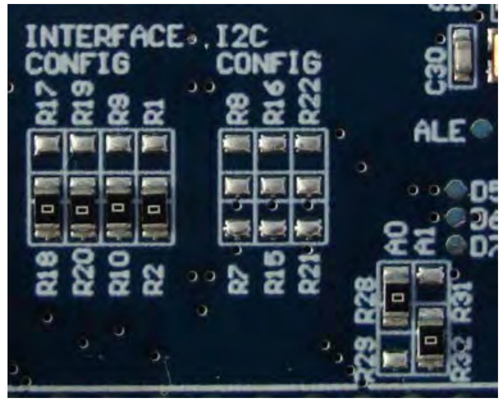

Fig 2. Picture of solder bridges in default configuration

The default interface configuration of the PNEV512B demo board is SPI. The detailed interface configuration is described in section 2.7.

Additional interface and power supply options are described in section 2.8.

2.2 CE certification of the Blueboard

The current version of the demo board (v.1.5) is CE (European Conformity) compliant.

2.3 LPCXpresso LPC1769 development board

To work with the provided projects, one will also need an LPCXpresso LPC development board. Such a board is **not included** in the Blueboard hardware package.

The LPC1769 development board integrates an NXP ARM Cortex-M3 microcontroller LPC1769 with 512 Kbytes of Flash memory and 64 Kbytes of RAM. It integrates a lot of hardware parts:

- Serial UART interface,
- SPI controller,
- I^2C controller,
- Serial Wire test/debug interface,
- For detailed information, see LPC1769 product site [3]

The LPCXpresso board contains a JTAG/ SWD debugger called the “LPC-Link” and a target MCU. LPC-Link is equipped with a 10-pin JTAG header and it seamlessly connects to the target via USB (the USB interface and other debug features are provided by NXP’s ARM9 based LPC3154 MCU).

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Fig 3. Picture of LPCXpresso LPC1769 development board

2.4 Alternative to the LPCXpresso LPC1769

With the provided code one can use the LPCXpresso **LPC1227** (**12NC:** 935294603598, **Type:** OM13008+598) instead of the LPCXpresso LPC1769 without the need of any adaptation in the code. Compared to the LPCXpresso LPC1769 it has a smaller flash memory of 128 KB instead of 512 KB and a Cortex M0 processor. For instructions on how to change the project settings to work with the LPC1227 see the description in section 7.2.

2.5 Preparation of the hardware

The first step after unpacking the Blueboard and the LPCXpresso is soldering the connectors onto the boards to get them together. In our example we use a multipoint connector as one can see on the pictures below.

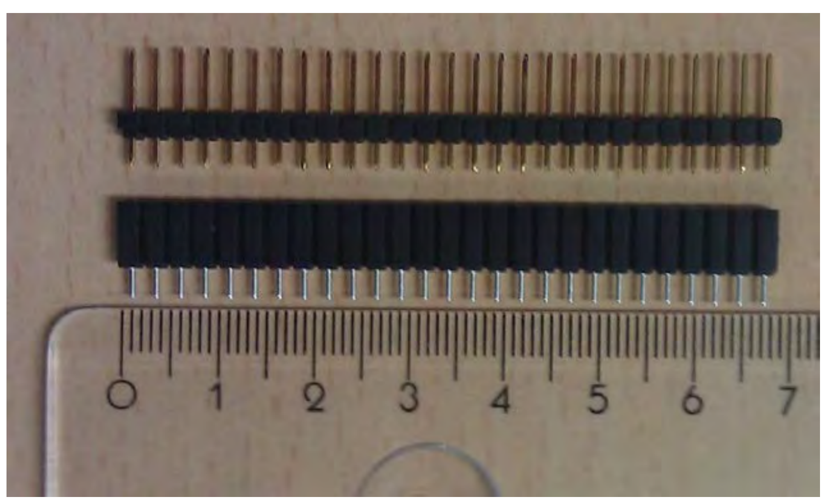

Fig 4. Multipoint Connectors we used

One may buy these connectors at any electronic store. Here are some examples [4].

After soldering the connectors, join the boards as shown on the following figure.

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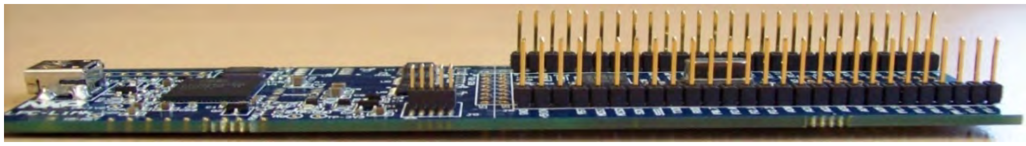

Fig 5. LPCXpresso with the Multipoint Connectors

Now the hardware is ready for use. Please connect the LPCXpresso board with the Blueboard.

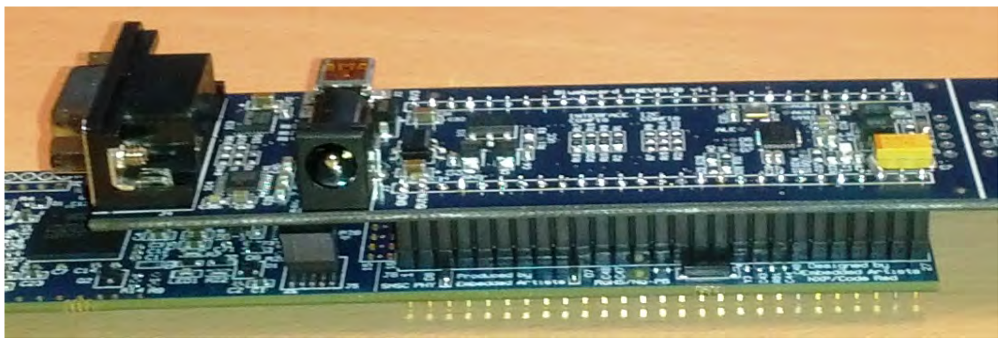

Fig 6. Connect the two boards

2.6 Interesting points of measurement

On the PNEV512B demo board one can find test pads for measurement purposes.

- VCC
- GND
- D5
- D6
- D7
- ALE
- AUX1
- AUX2
- SIGIN
- SIGOUT
- IRQ
- VMID

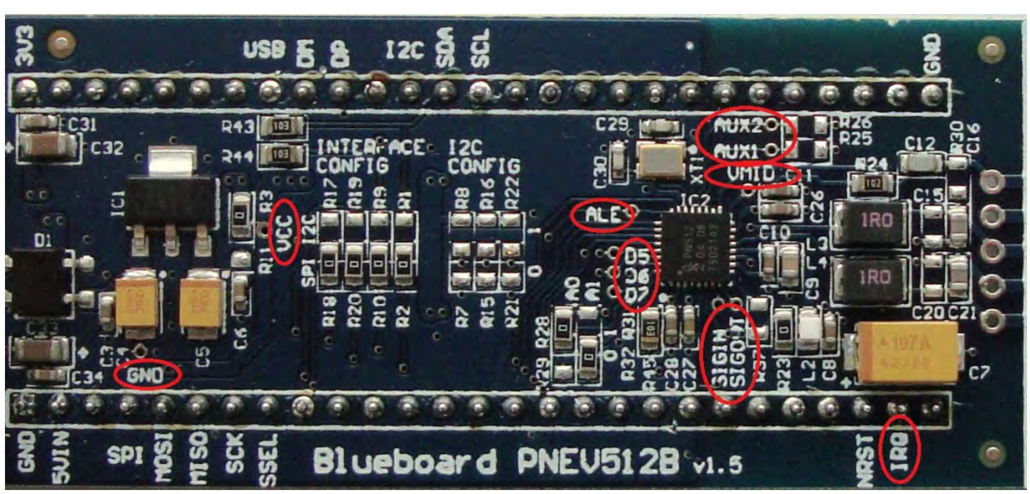

Fig 7. Interesting points of measurement

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2.7 Preparing the Blueboard for the use with SPI or I²C

The Blueboard is generally delivered in SPI configuration. To change the interface to I²C the four appropriate 0R0 resistors in the interface config section need to be resoldered to the I²C side of the solder jumpers. Also the two 0R0 resistors at A0 and A1 need to be changed.

Table 1. A0 and A1 interface configuration

Appropriate solder jumpers (0R0 resistors) for interface configuration

Signal	Interface type		
	SPI	I²C	UART(optional)
A0	R28	R29	R29
A1	R32	R31	R32

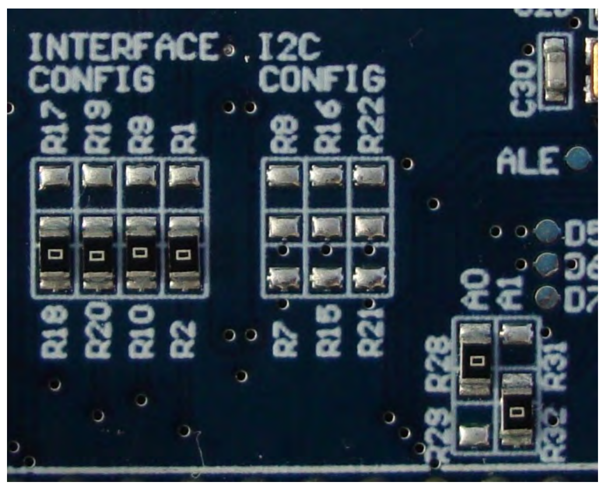

Fig 8. Blueboard in SPI configuration

To use the Blueboard in I²C configuration with the provided software projects, one has to carry out two minor adaptations in the code, which are described in section 7.5.

The I²C-address can be configured either by software or by hardware. To set the I²C-address by hardware the solder jumpers in the I²C config section (see picture above) have to be connected appropriately. R7, R15 and R24 are logically LOW and R8, R16 and R22 logically HIGH.

2.8 Optional interfaces and power supply

The PNEV512B demo board is normally controlled by the LPCXpresso Board. With the optional interfaces and power supply the demo board can be controlled directly by a PC without the LPCXpresso Board.

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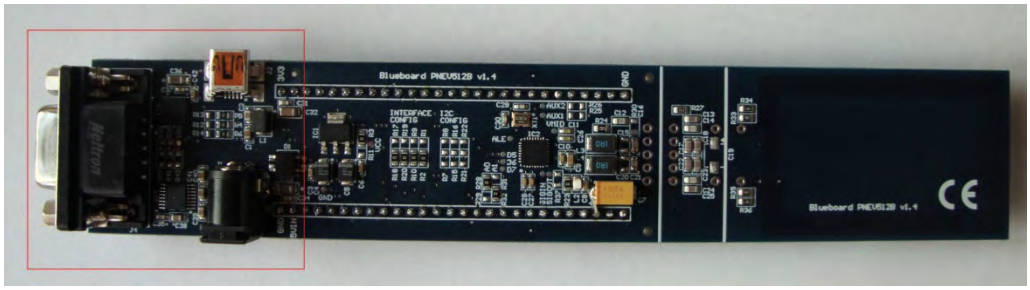

Fig 9. Additional interfaces

To use the additional interfaces the interface selection signals A0 and A1 have to be configured to UART mode (see section 2.7, Table 1).

2.8.1 Configuring the additional interfaces

With the appropriate solder jumpers two different serial interfaces can be selected.

Table 2. Solder Jumpers for selecting the additional interfaces

Interface type	Resistors
USB	R38, R39
RS232	R40, R41, R42

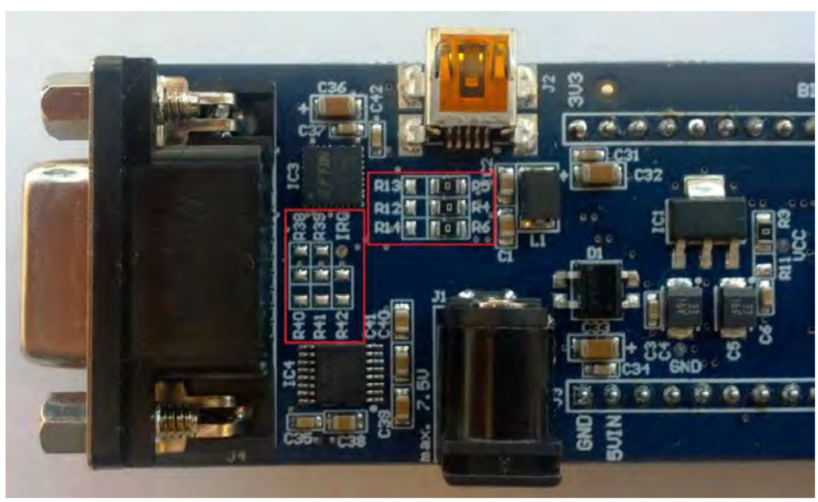

Fig 10. Solder jumpers for additional interface configuration

In delivery default configuration the USB-connector of the PNEV512B demo board is directly routed to the USB-pins of the LPCXpresso Board µC in order to use the USB connector as an additional USB connector of the LPCXpresso Board.

For using the USB interface in UART mode the following solder jumper configuration is needed:

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Table 3. Solder Jumpers for USB connector configuration

Connection type	Resistors
LPCXpresso-USB	R4, R5, R6
UART-USB	R12, R13, R14

2.8.2 Configuring the power supply

When using the PNEV512 demo board without the LPCXpresso Board an additional 5VDC power supply is needed. The onboard voltage regulator provides the 3.3VDC supply voltage VCC.

Table 4. VCC power supply configuration

Power supply	Resistors
LPCXpresso Board	R3
External 5VDC	R11

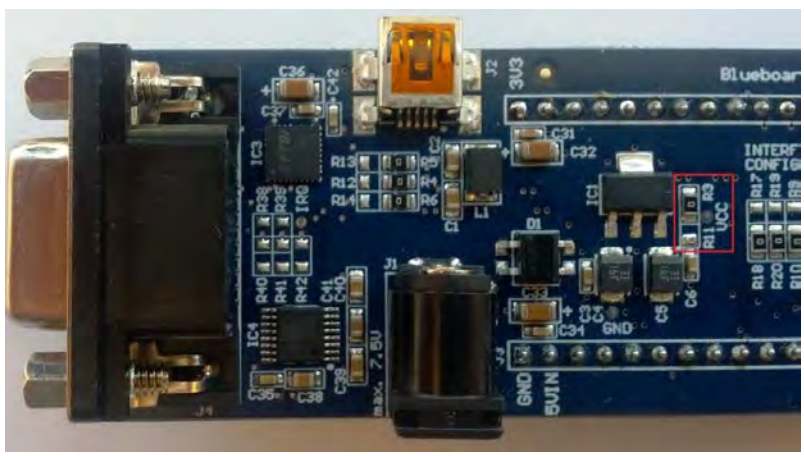

Fig 11. Solder jumper for VCC power supply configuration

2.9 Other supported system architectures

The projects described in this guide are also available on Linux. The projects are preconfigured for the use on the Raspberry Pi with the Raspbian image. The SPI interface is used for the communication between the application and the NFC controller. The software and the start guide can be downloaded at the product page of the EXPLORE-NFC [13].

Although this guide only describes the use of the EXPLORE-NFC extension board, it also supports the PNEV512B and the CLEV663B Blueboards. These Blueboards can be used with a special adaptor called BluePi. For information about how to configure the hardware and the software please refer to section 7.7.

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3. Installation of the LPCXpresso Board

The guidelines for installing the reader are as follows:

- Connect the LPCXpresso Board to a real USB2.0 port of the PC (for speed reasons) using the mini-USB connector. The PC detects and installs the Board automatically.
- Once the Board has been installed, open the Device Manager of the PC to check that the installation was successful. The item "USB Device with DFU Capabilities" is being displayed.

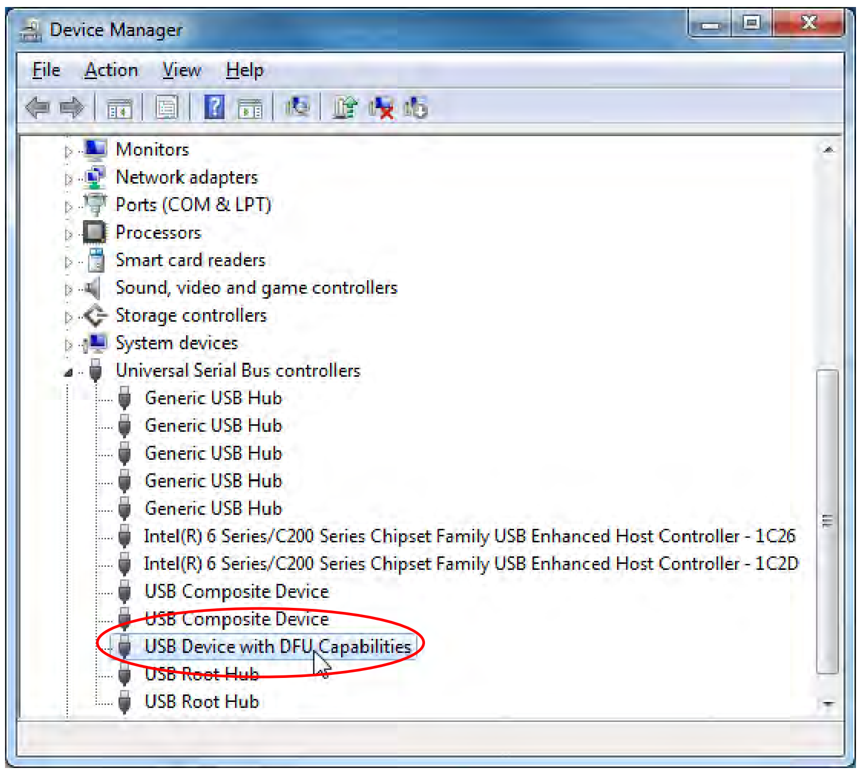

Fig 12. Enumeration of the LPCXpresso Board in Device Manager Window

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4. Managing the Demo Reader project with LPCXpresso IDE

The demo reader project is delivered in a zip package. It can be extracted, edited, compiled and linked with LPCXpresso IDE.

LPCXpresso is a new, low-cost development platform available at NXP. It supports NXP's ARM-based LPC microcontrollers. The platform comprises a simplified Eclipse-based IDE and low-cost target boards which include an attached JTAG debugger.

This tool can freely be downloaded from the LPCXpresso website [1]. Before one can download the software, it is necessary to create an account. Creating an account is absolutely free.

4.1 Installation of LPCXpresso IDE

The IDE is installed into a single directory of one's choice. Multiple versions can be installed simultaneously without any issues. The installation starts after double-clicking the installer file.

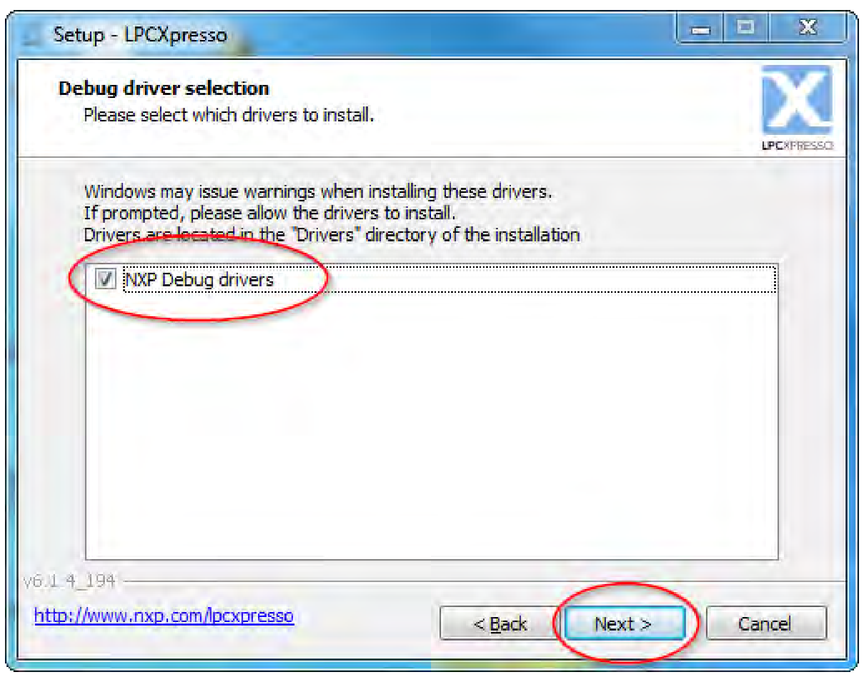

Fig 13. LPCXpresso installation NXP Debug drivers

Make sure, the checkbox for installing the NXP Debug drivers is activated.

During the installation, the user will be asked if he wants to install some required drivers. The installation of these drivers should be accepted.

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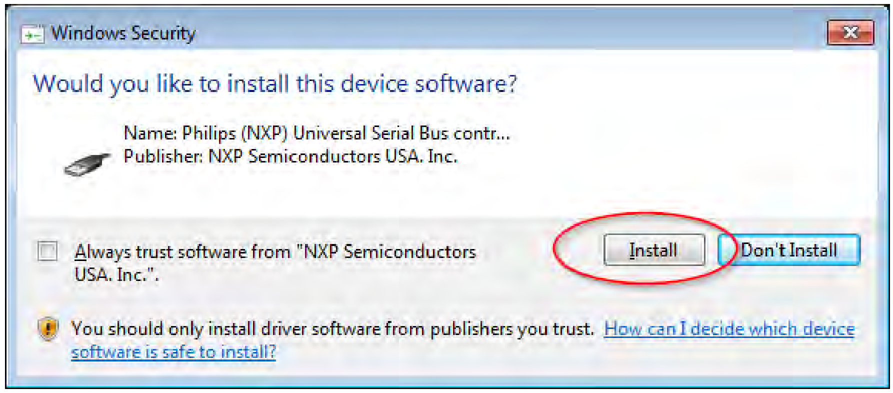

Fig 14. Windows Security dialog

After the setup wizard has finished one can launch the newly installed IDE.

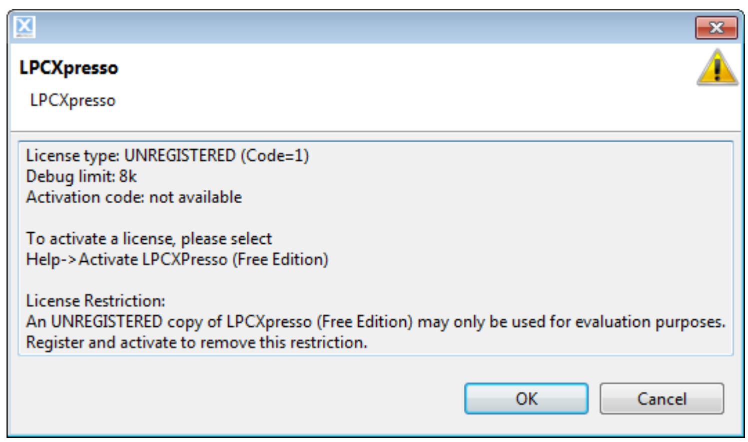

Fig 15. LPCXpresso IDE

Directly after the first start of the Eclipse IDE one will see an info dialogue that this is only an unregistered copy of LPCXpresso IDE. Just confirm the dialog and follow the instructions on the Welcome Screen to get a registered version without the debug limit of 8k. The registration is free and is needed to navigate to the website of Code Red. The Link is shown in the menu, Help → Product activation → Create Serial number and Activate...

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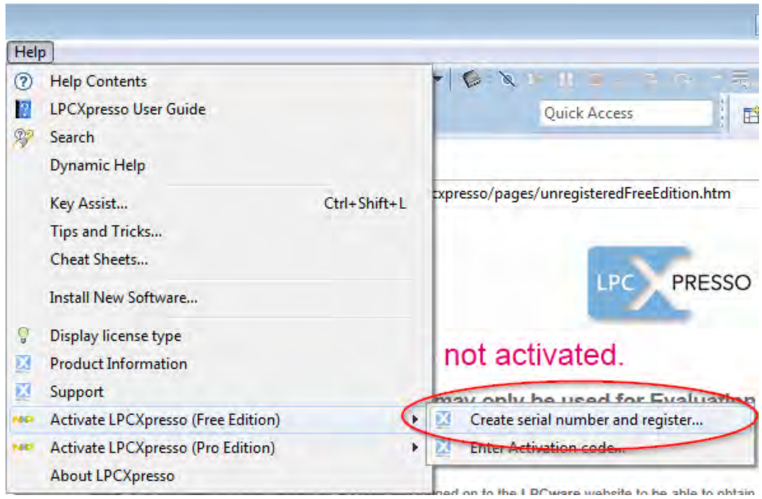

Fig 16. Product activation

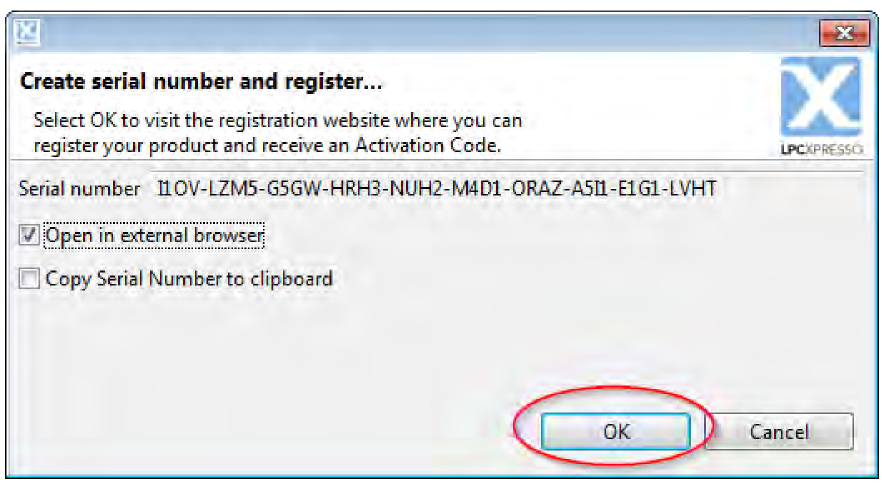

Fig 17. Product activation

If one doesn't already have an account at Code Red, please sign up to get an activation code. The code will be sent to the provided e-mail address.

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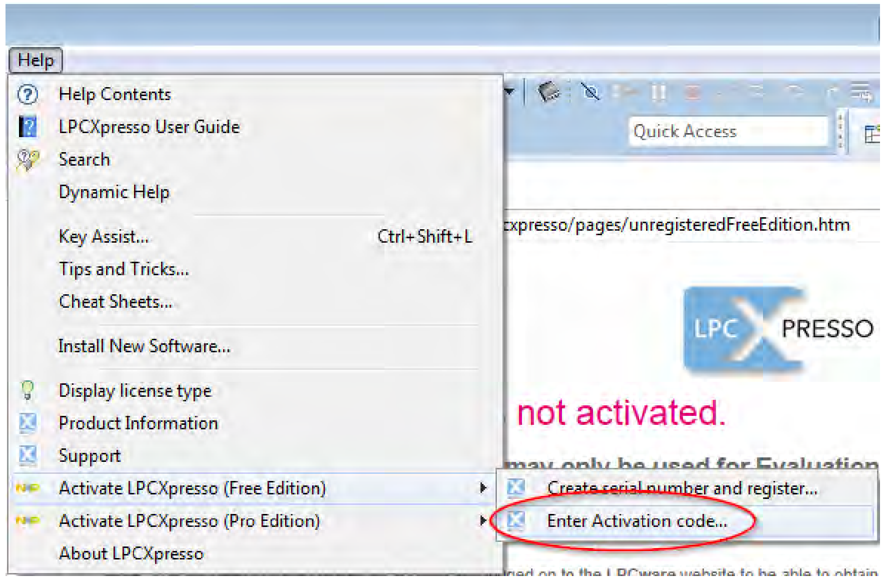

Fig 18. Product activation

Once the activation code arrives please open the activation window by pointing to Help → Product activation → Enter Activation code, and enter the code.

The success of the product activation will be confirmed by an info dialogue.

4.2 Extraction of the demo reader project

All demo reader projects are divided into three sub projects.

One project that contains the NFC Reader Library, one project that contains all hardware dependent parts and one project that contains the user application.

The projects “Classic” and “Polling” are distributed in one package that can be imported into the LPCXpresso IDE in one single action. The following example is based on this package.

The sequence of installing the reference reader projects is indicated:

- Start the LPCXpresso IDE.
- Select the option “Import project(s)” (see picture below).
- Browse the zip archive.
- LPCXpresso IDE unzips the software package.
- The software package is ready for use.

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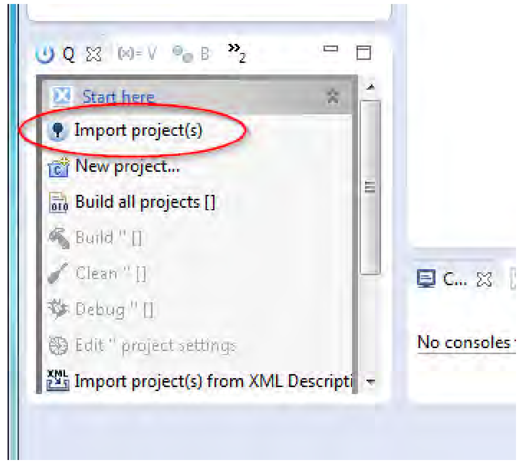

Fig 19. Importing a project into the LPCXpresso IDE

In the Quick Panel on the left hand side, choose “Import projects(s)”.

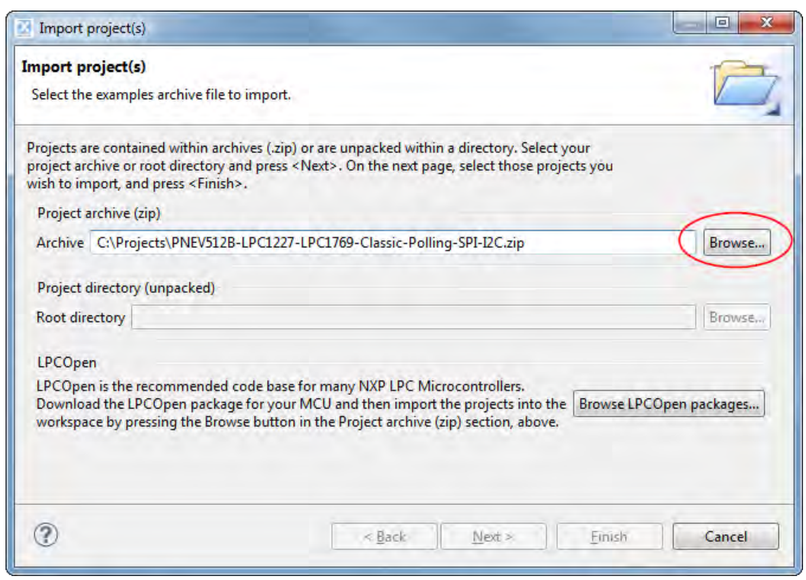

Fig 20. Importing a project into the LPCXpresso IDE

Browse the desired package and click “Next”.

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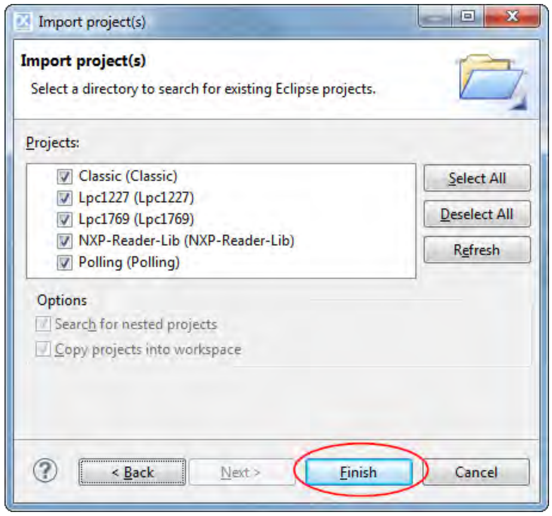

Fig 21. Importing a project into the LPCXpresso IDE

For a working demo project you need to import at least three sub projects. One application project (Classic or Polling), the NFC Reader Library and one MCU library (LPC1227 or LPC1769).

When the import process has finished one can start browsing the code.

Before one can run the project, the LPCXpresso board containing the PN512 Blueboard needs to be connected to the computer. Wait until the adequate drivers have been installed.

4.3 Run the project

Before running the project, please ensure that the LPCXpresso with the PNEV512B demo board is connected to the computer.

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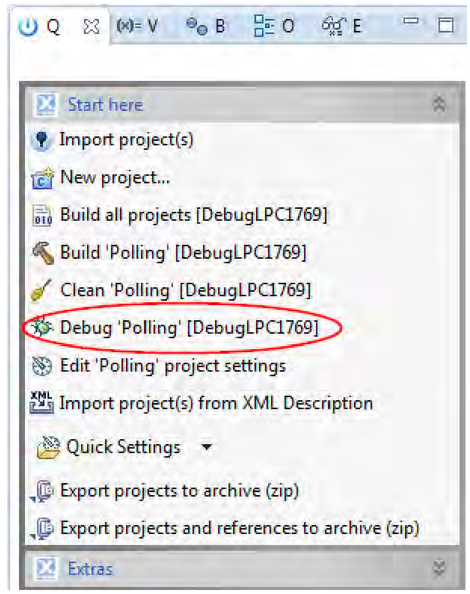

Fig 22. Run the project

Choose the desired project and click the Debug Button on the left hand side as shown in the example picture. **Make sure, the name of the build configuration as well as the selected MCU matches the name of the used microcontroller. See sections 7.2 and 7.3 for further information.**

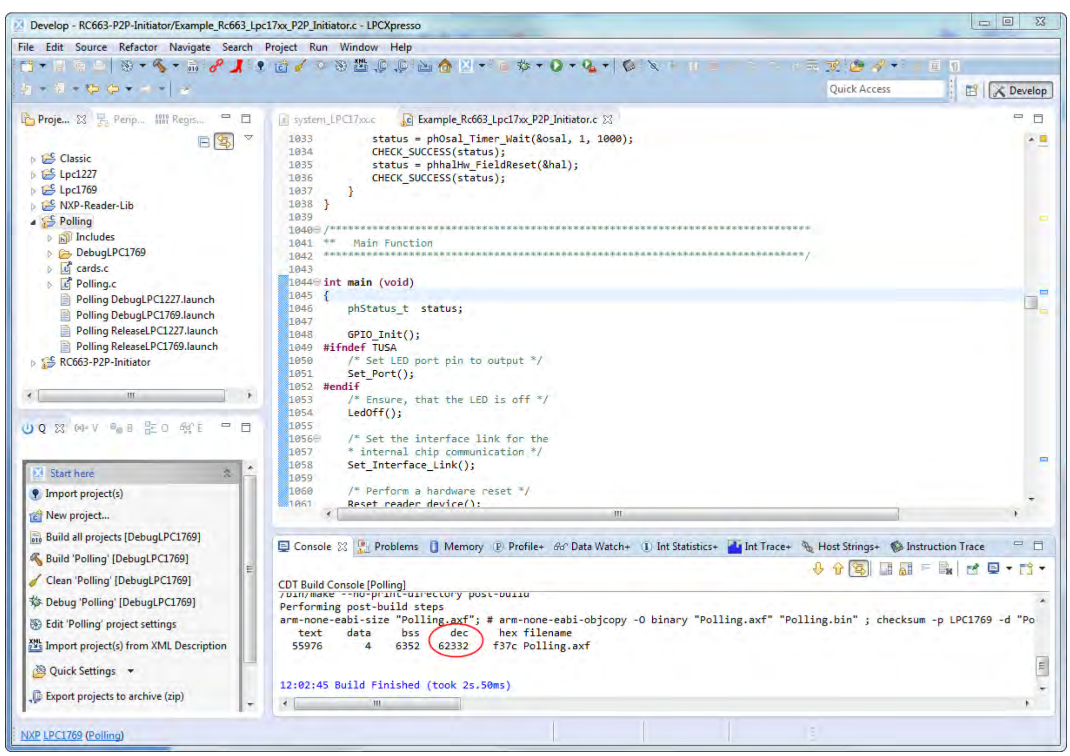

Fig 23. Run the project

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After the build process one can see the size of the image in the console window.

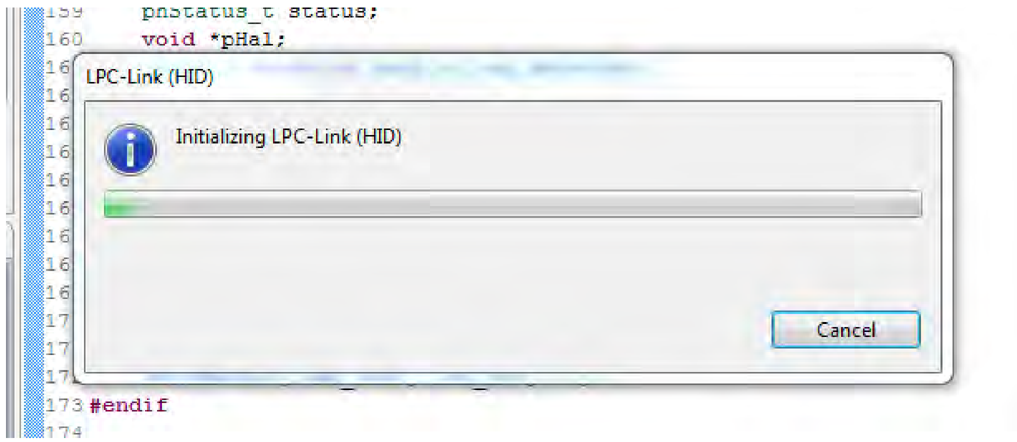

Fig 24. Run the project

The initialization of the LPC-Link can take a few seconds.

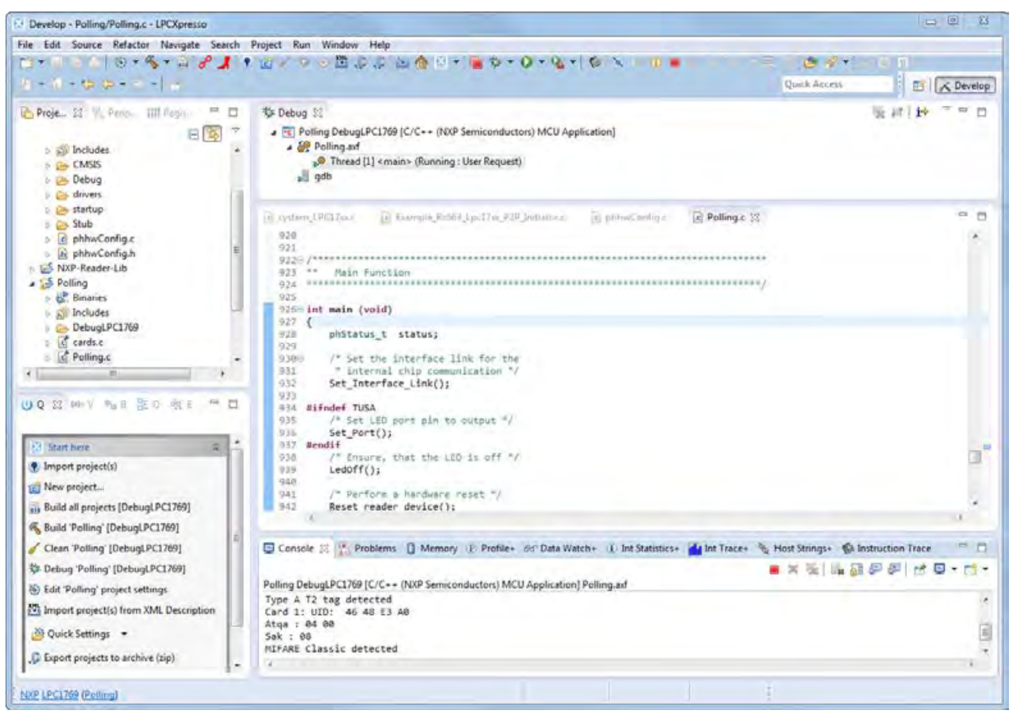

Fig 25. Run the project

After the software upload, the execution of the project starts immediately.

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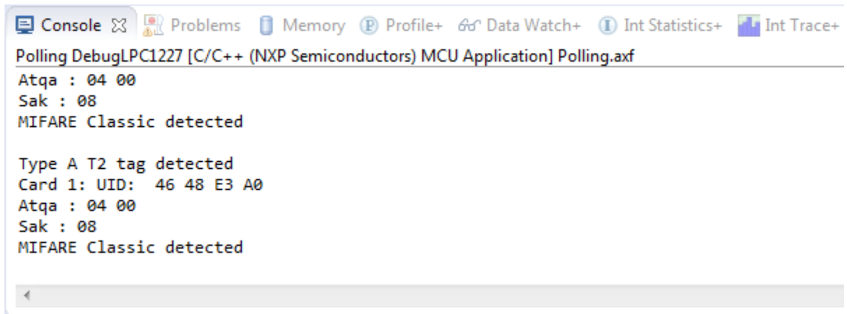

Fig 26. Run the project

In the console window at the bottom one will see the debug output of the execution.

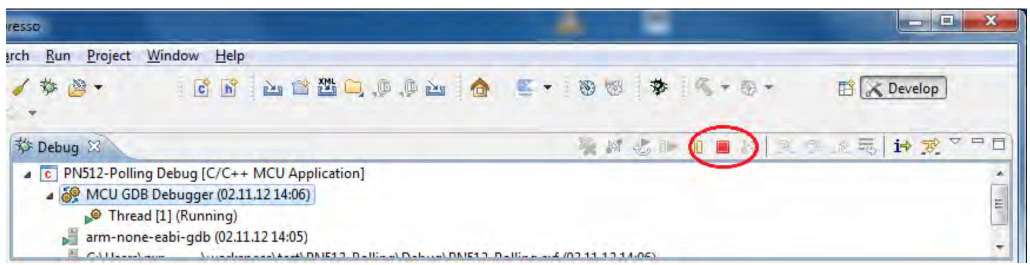

Fig 27. Stop the project

After the execution has reached the end of the main function please click the Terminate button to stop the execution. Otherwise one won't be able to rerun the project.

One can now do the following with the buttons near the top of the "Debug" view:

	Run the program.
	Step over C/C++ line.
	Step into a function.
	Stop the debugger.
	Pause execution of the running program.
	Instruction stepping mode (disassembly).

Fig 28. Debug Buttons

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5. Associated Projects

All example projects are available for download at the product page of the PNEV512B [8] in the documents section and are being distributed in one single file.

All projects are packaged into a single installer file. After downloading the zip file please extract it and run the installer. The installer just copies all you need to get started to your hard disk.

Every example project can either run on an LPCXpresso LPC1769 or on an LPCXpresso LPC1227. Information about how to switch between microcontrollers can be found in section 7.2 and 7.3.

5.1 Communication with MIFARE Classic

Based on examples this project shows how read-write access can be achieved on this type of card.

5.2 Polling

Based on examples this project shows how to initiate a basic communication with the following cards:

- MIFARE Ultralight
- MIFARE Classic
- MIFARE Plus
- MIFARE DESFire
- FeliCa compliant cards
- ISO/IEC 14443-B cards

This example project also looks for cards in range of the RF field in a continuous loop and returns the type of the detected card or tag to the console window.

5.2.1 General card detection

This project makes use of the built in discovery loop to detect the type of cards inside the RF field.

5.3 Peer to Peer examples

Based on three examples the user should get a basic understanding on how to use the P2P NFC technology.

Every P2P example can be configured to act as a server or as a client.

Note: None of the SNEP – Server examples can be executed on the LPCXpresso LPC1227 because of its limited RAM.

For a detailed introduction into the P2P functionality please consult the user manual **UM10721 - NXP NFC Reader Library User Manual**. It can be downloaded at the web site of the PNEV512B demo board [8].

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6. Additional projects

Besides examples based on the NFC Reader Library, additionally we provide functionalities that are not yet supported by this library. Components of the following packages cannot be exchanged with packages from the examples based on the NFC Reader Library.

6.1 Tag Type 2 and Type 4 Card Emulation

Note: This example only works with the LPCXpresso LPC1227 development board.

Note: Card Emulation mode is currently not supported by the NFC Reader Library v3.010. Therefore the card emulation project is based on a modified version of the NXP Reader Library v2.1.

This project is being distributed within a different installer file and needs to be downloaded separately from the demo board web site [8].

The PN512 supports 4 different operating modes:

- Reader/Writer mode supporting ISO/IEC 14443A/MIFARE and FeliCa compliant scheme
- Reader/Writer mode supporting ISO/IEC 14443B
- Card Operation mode supporting ISO/IEC 14443A/MIFARE and FeliCa compliant scheme
- NFCIP-1 mode

The card operation mode is passive mode, in which the PN512 does not generate an RF field but acts as a card that modulates the field for communication with the reader. The IC only supports parts of the ISO/IEC 14443-protocols, the ISO/IEC 14443-4 as well as the ISO/IEC 7816-4 commands need to be provided by the Microcontroller.

A specification to store data for any kind of service and application is specified in the NFC Forum and it is called NFC Data Exchange Format. Storing NDEF formatted data inside contactless card products as mapping models as well as the management of NFC forum device as a specific platform such as a NFC Forum Type 4 Tag are defined in [7]. The following project shows an exemplary implementation of a Tag 4 Type Card on the PN512. Therefore one NDEF File and one capability container (CC) file, with ISO file identifier (ISO FID) equal to E103h, are presented to the reader.

6.1.1 Configuration of the example project

In order to change some of the possible options before compiling the project, the file "src\nxprdlib\intfs\phCardEmu_Options.h" should be edited. This file contains toggles to enable/disable the T2T and T4T functionality, memory sizes, as well as the pin numbers in which the PN512 chip is connected to the LPC1227. Further options are also indicated on the file.

Before flashing the modified project it is mandatory to perform a **Mass erase** on the flash memory of the LPC1227. This can be achieved by clicking the **Program Flash** icon in the LPCXpresso IDE.

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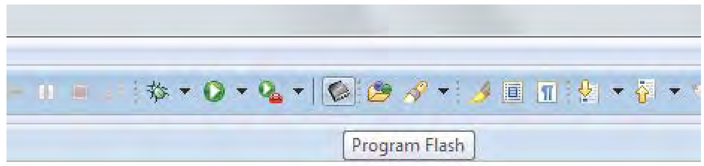

Fig 29. Program Flash icon in LPCXpresso IDE

In the Program Flash wizard the Mass erase feature can be found in the **Erase flash memory** tab. After activating the **Mass erase** algorithm click OK to perform the procedure.

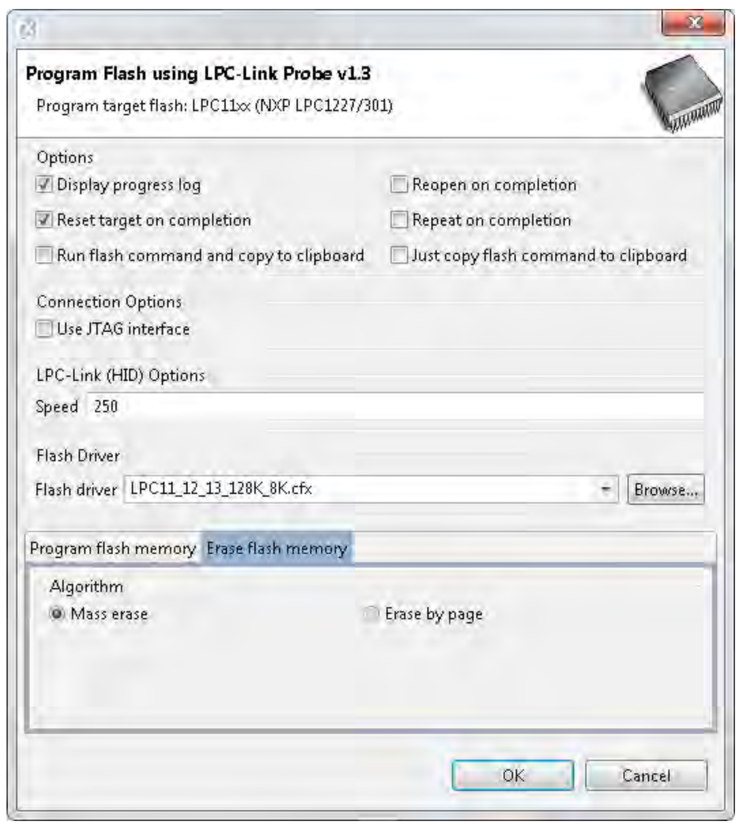

Fig 30. Program Flash wizard with Erase flash memory tab

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6.1.2 Changing the NDEF message

The predefined NDEF message can be changed in the following files:

- T4T: ../src/nxprdlib/comps/phce7816p4T_Apps/phce7816p4T_T4T_Const.c

```
main.c    phce7816p4T_T4T_Const.c
#include <phce7816p4T_T4T.h>

#define NORMAL 0
#define MAX_SMARTPOSTER 1
#define BIG_MIME_IMAGE 2
#define MAX_VCARD 3

// define this to one of the above for NDEF predefined content
#define T4T_NDEFFILE_PREDEF      NORMAL

// This is the data structure returned by the GetData on tag GetVersion
const byte TLV_VERSION[] = {
    P1_GETDATA_TAG_VERSION, P2_GETDATA_TAG_VERSION, (byte)0x16, // header: version informat
    (byte)'1', (byte)'3',                 // year in ASCII
    (byte)'0', (byte)'1',                 // month in ASCII
    (byte)'1', (byte)'5',                 // day in ASCII
    (byte)' ',
    (byte)'N', (byte)'X', (byte)'P',
```

Fig 31. Change NDEF content for T4T

- T2T: ../src/nxprdlib/comps/phceT2TCmdHdl/src/Sw/phceT2T_Const.c

```
main.c    phceT2T_Const.c
#include "phceT2T_Sw.h"

#define NORMAL 0
#define MAX_SMARTPOSTER 1
#define BIG_MIME_IMAGE 2
#define MAX_VCARD 3

// define this to one of the above for NDEF predefined content
#define T4T_NDEFFILE_PREDEF      NORMAL

const uint8_t T2T_LOCK_CC_DEF[16] = {
                                       0x00, 0x00, 0x00, 0x00, // internal bytes
                                       0x00, 0x00, 0x00, 0x00, // internal bytes
                                       0x00, 0x00, 0x00, 0x00, // internal bytes AND
                                                               // static lock bytes (
                                       // CC
                                       0xE1, 0x10, 0x00, 0x00  // 3rd byte - data mem
};
```

Fig 32. Change NDEF content for T2T

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6.1.3 Program flow

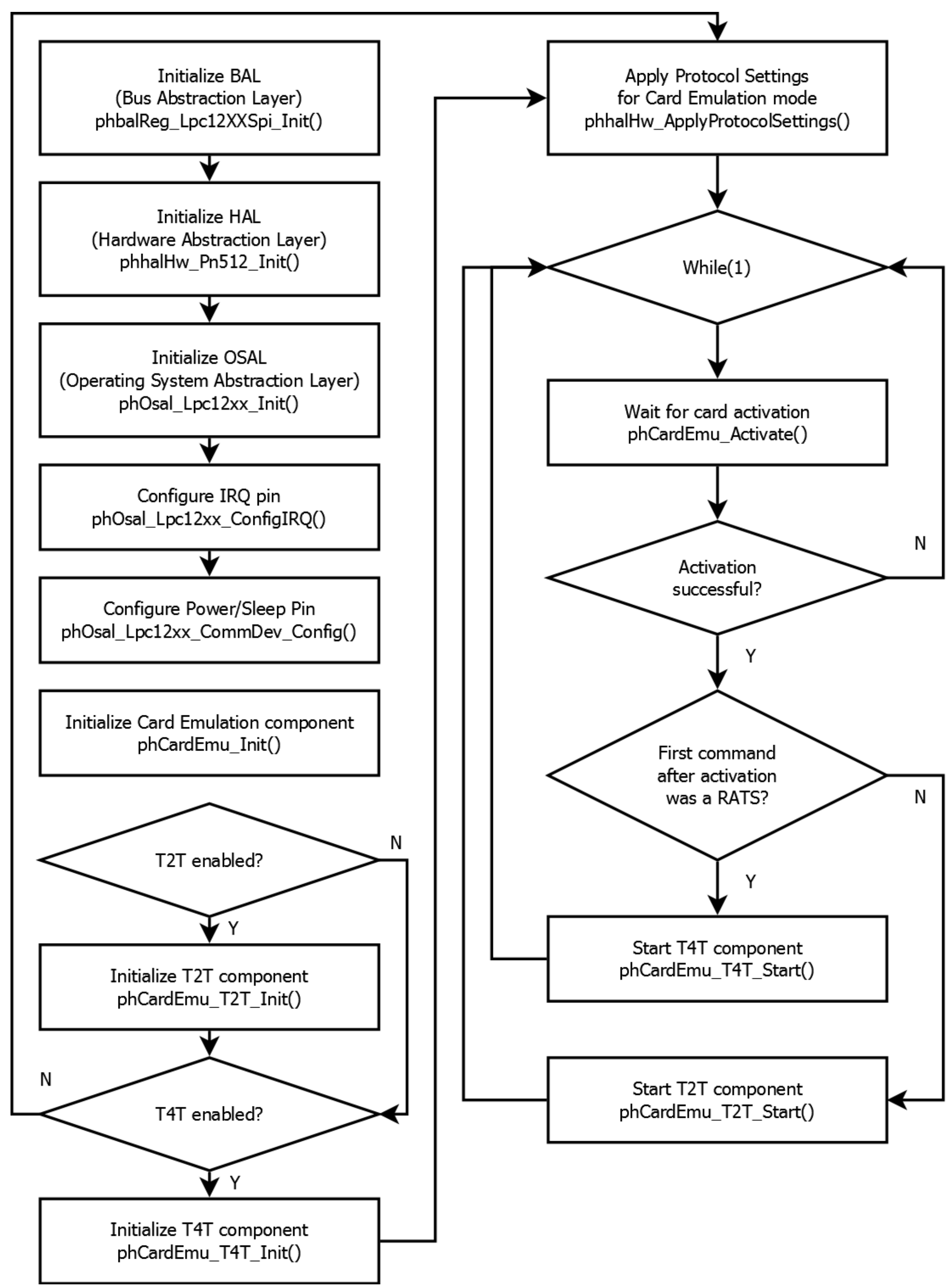

Fig 33. Program flow of the Card Emulation application

The first blocks describe the initialization of the necessary layers and components independent of the card emulation. Depending which tag type is used the appropriate component will then be initialized. If Tag Type 2 and Tag Type 4 are enabled, both are

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being initialized. After applying the protocol settings, the PN512 waits for a successful activation of the card side. According to the first command (RATS – yes or no) after the card activation the appropriate tag type component starts.

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7. Supplementary Notes

7.1 Software architecture

The software of the reference reader is based on the NFC Reader Library [5]. It intends to be simple, modular, easily readable and quickly portable by all the customers. This philosophy is reflected in its architecture which is divided into 4 layers:

- BAL (Bus Abstraction Layer),
- HAL (Hardware Abstraction Layer)
- PAL (Protocol Abstraction Layer)
- AL (Abstraction Layer)

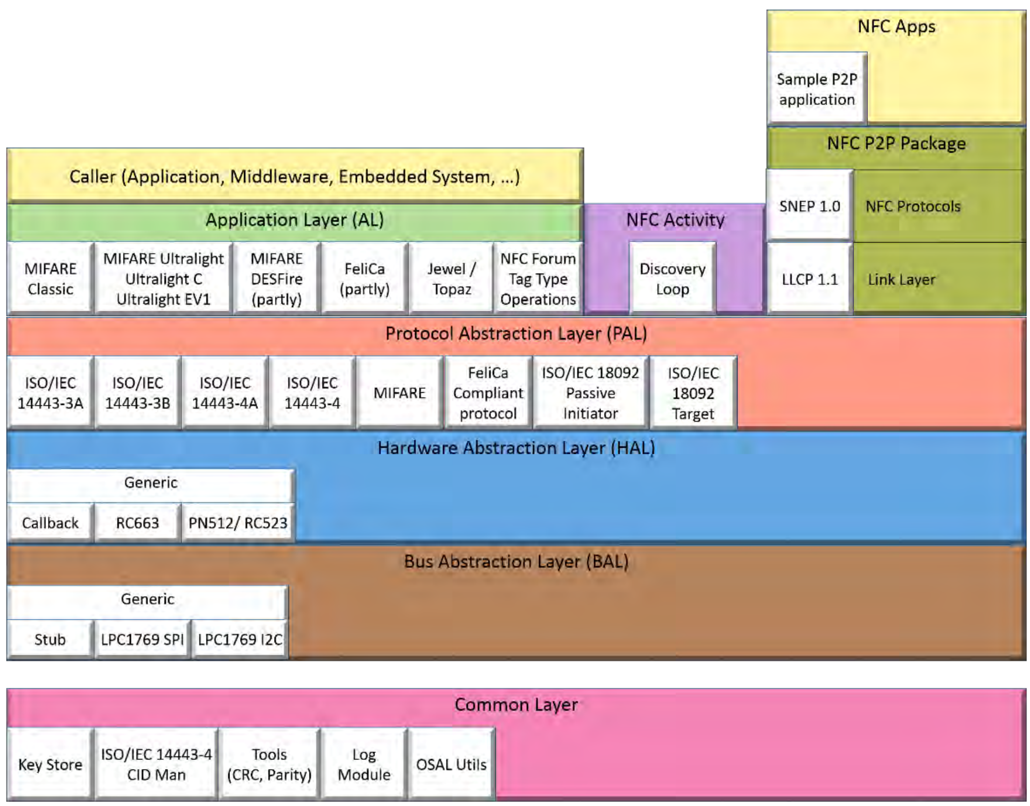

Fig 34. Architecture of the NFC Reader Library

For a detailed description of the NFC Reader Library please refer to the user manual **UM10721 - NXP NFC Reader Library User Manual**.

Documentation of the API can be found in the document **UM10802 - NXP NFC Reader Library API.** Both can be downloaded at the web site of the PNEV512B demo board [8].

7.1.1 Bus abstraction layer

This layer offers functions to abstract the hardware parts of the LPC1XXX microcontroller.

These functions use the specific libraries available for the LPC1XXX family microcontroller. Based on these stacks, the communication routines for the relevant

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physical media I2C/SPI can be easily designed. These drivers are specific for the LPC1XXX family and therefore cannot be ported to other microcontrollers.

7.1.2 Hardware abstraction layer

This layer offers functions to abstract the hardware parts of the transceiver PN512.

7.1.3 Protocol abstraction layer

Every PAL function is a low level function realizing a single functionality. It is encapsulated in a module which is independent from the others. The user can easily design his application by doing a drag-and-drop of the relevant module.

The following PAL modules are available in this software package:

- ISO/IEC 14443-3A,
- ISO/IEC 14443-3B,
- ISO/IEC 14443-4A/B,
- MIFARE,
- ISO/IEC15693,
- FeliCa,
- NFC Initiator
- NFC Target

7.1.4 Application layer

Lying on the previous software layers, the application layer is on top of the reader software package. It combines elements of the previous three parts into high level functionalities.

7.2 Build configuration

All the projects mentioned in section 5 are available in debug configuration. Additionally, the Polling project comprises the release configuration.

- Debug configuration

  This configuration is mainly used when the target board is attached to the PC with the JTAG debugger. It allows the display of debug messages in the console window, which is useful in the early stage of the project.

- Release configuration

  Once the project is debugged and mature, it might be interesting to use the release configuration, to use the hardware stand alone. No debug messages are displayed in the console window.

  Note, that only in Release Configuration one can flash the software onto the Blueboard and start it automatically, once power has been attached to the board.

Projects that can run on different MCUs have dedicated build configurations for each MCU. For example the polling project works on the MCUs LPC1227 and LPC1769 and can be configured for release or debug configuration. Therefore this project offers four different build configurations:

- DebugLPC1227
- ReleaseLPC1227
- DebugLPC1769

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- ReleaseLPC1769

The build configuration can be selected as follows:

- Click on the project in the project window of the LPCXpresso IDE,
- Right click of the mouse → Select Build Configuration,
- Set active DebugLPC1227 build (or ReleaseLPC1227 build) for LPC1227.

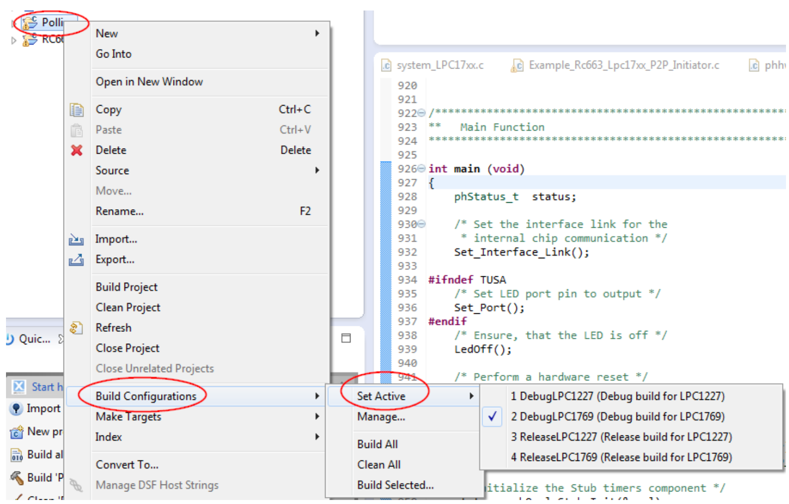

Fig 35. Select the build configuration

Note: When switching from one MCU to another, please take care to also switch to the correct MCU setting within the LPCXpresso IDE. See chapter 7.3.

7.3 Setting the MCU

There are many LPC microcontrollers supported by the LPCXpresso IDE build in compiler. Before compiling a project, the correct MCU need to be set.

- Right click the project → choose properties (at the bottom)
- C/C++ build → MCU settings → expand desired LPC1xxx MCU group → choose the correct microcontroller → click OK

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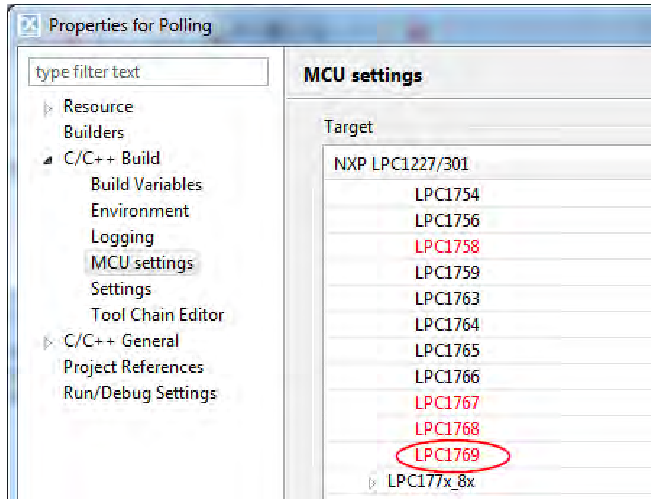

Fig 36. Selection of the LPC1769 MCU

7.4 Level of compiler optimization

When the code size at the current compiler level overloads the FLASH size of the target board (128K for the ARM-based microcontroller LPC1227), a higher compiler optimization level can be selected to reduce the code size of the project.

The following steps can be followed to select a level of compiler optimization:

- Click on the application project in the project window of the LPCXpresso IDE,
- Right click of the mouse → Select properties → Select C/C++ build,
- Select Settings → Optimization,
- Choose the desired level in the combo box.

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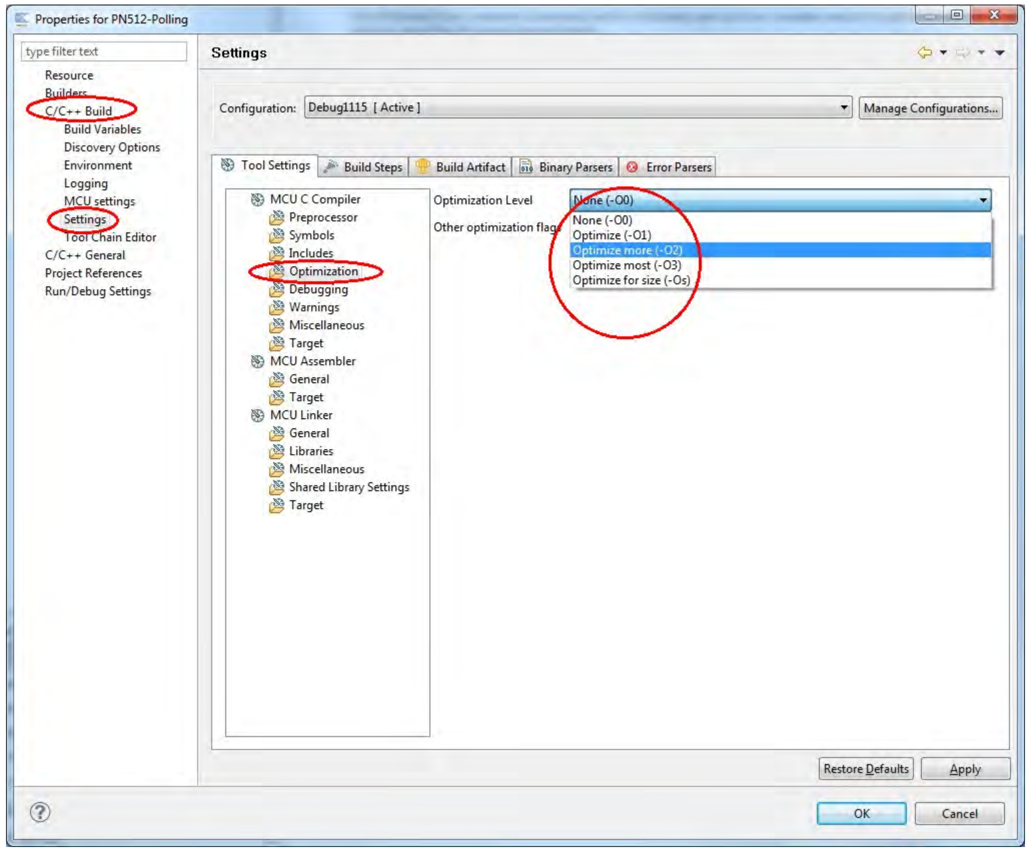

Fig 37. Select the level of optimization

7.4.1 Optimization issues

When optimization is enabled, it will reorder code. What this means is that the code from multiple C lines will be intermingled. In addition, assignments and initializations might be pulled out of loops so they are only executed once. Changes like these will make the code confusing to debug. Some symptoms one might see are breakpoints that only work the first time through, or seeing the debugger's current line indicator fail to advance or even move backwards when clicking step. It is best to always use –O0 for debugging.

7.5 Preparing the projects for the use of the Blueboard in I²C configuration

To use the projects in I²C configuration one has to do some small adaptations in the file phhwConfig.h located in the MCU project LPC1xxx.

1. Open the file phhwConfig.h and
   a. Uncomment the line #define I2C_USED.
   b. Comment the line #define SPI_USED.

7.6 Removing the initial breakpoint on debug startup

When the debugger starts, it automatically sets a breakpoint at the first statement in the `main()` function. One can remove this breakpoint as follows:

- Right click on the project and choose Launch Configurations → Edit current…

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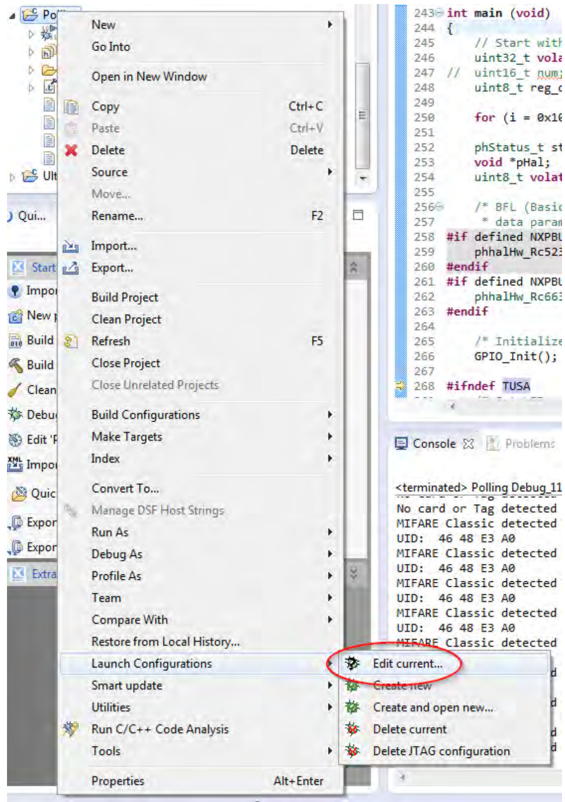
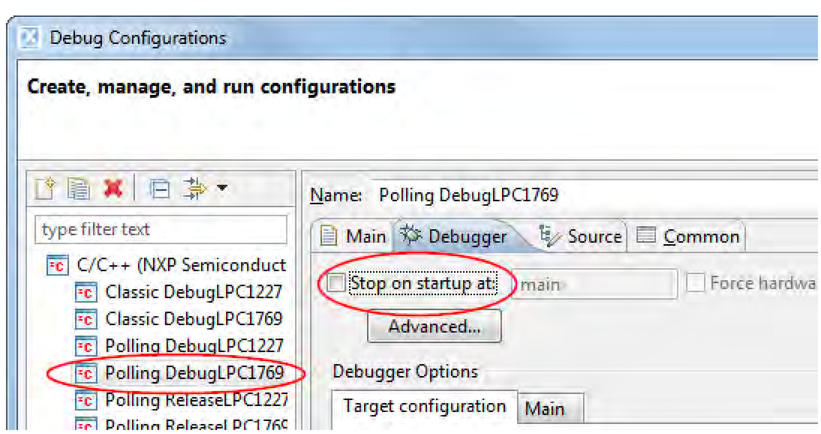


Fig 38. Open Current Launch Configuration

- Choose the Debug configuration

2. Choose the tab Debugger
3. Uncheck the box near “Stop on startup at:”
4. Click onto Apply and then Close.



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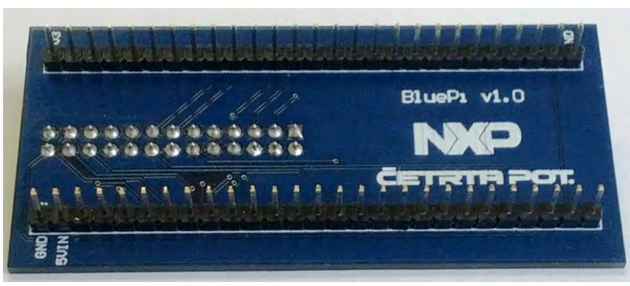
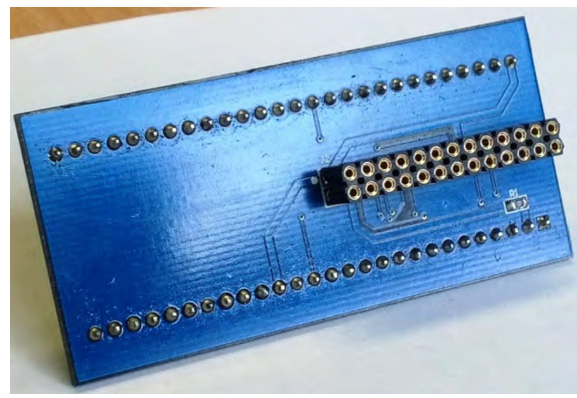
7.7 Using the Blueboard with the Raspberry Pi

Detailed instructions about how to run the NFC Reader Library on the Raspberry Pi can be found in the Start Guide linked at the product page of the EXPLORE-NFC [13]. This sub chapter only describes some information that is not included in the start guide of the EXPLORE-NFC.

7.7.1 Preparing the hardware



a. Connector for the Blueboard



b. Connector for the Raspberry Pi

Fig 39. BluePi adaptor

- Connect the PNEV512B Blueboard to the BluePi adaptor.
- Connect the adaptor to the Raspberry Pi

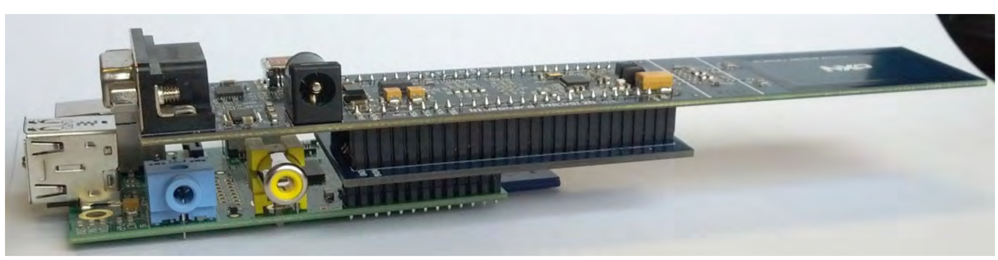


Fig 40. PNEV512B Blueboard connected to the Raspberry Pi

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8. References

[1] **LPCXpresso website**
http://www.lpcware.com/lpcxpresso/download

[2] **PN512 product information and data sheet**
http://www.nxp.com/products/interface_and_connectivity/nfc_contactless_reader_ics/series/PN512.html

[3] **LPC176x/5x User manual**
http://www.nxp.com/documents/user_manual/UM10360.pdf

[4] **Multipoint Connectors we used:**
Grid Dimension: 2.54mm, at least 27 pins
http://www.conrad.at/ce/de/product/741119/STIFTLEISTE
and
http://www.conrad.at/ce/de/product/736427/BUCHSENLEISTE-EINREIHIG

[5] **Direct link to the NFC Reader Library**
Not yet available

[6] **Using the PNEV512B in Card Emulation mode**
http://www.nxp.com/demoboard/PNEV512B.html

[7] **TYPE 4 TAG: NFC Forum, Type 4 Tag Operation Specification, Version 1.0, March 13, 2007**
http://www.nfc-forum.org/specs

[8] **PNEV512B demo board site**
http://www.nxp.com/demoboard/PNEV512B.html

[9] **NXP NFC Reader Library User Manual**
http://www.nxp.com/documents/user_manual/UM10721.pdf

[10] **Technical Specification** – Simple NDEF Exchange Protocol, NFCForum-TS-SNEP_1.0
http://www.nfc-forum.org/specs/spec_license

[11] **EMV** – The table of card types and their matching AIDs are available on
http://www.en.wikipedia.org/wiki/EMV

[12] **LPCXpresso LPC1769 development board**
http://www.nxp.com/demoboard/OM13000.html

[13] **EXPLORE-NFC product page**
http://www.nxp.com/demoboard/PNEV512R.html#documentation

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