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PN5180 SW Quick start guide

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User manual COMPANY PUBLIC

Document information

Info	Content
Keywords	PN5180, PN5180 SW design, PNEV5180B, NFC NXP Cockpit
Abstract	This user manual is related to the installation procedures of the PN5180 Evaluation board, which are related to the installation of the SW sample projects as well as the re-installation of the original LPC firmware to run the NFC Cockpit. It describes the steps to be done to become acquainted with the demo reader especially for SW development.



Revision history

Rev	Date	Description
1.4	20170117	Updated description how to flash FW for the NFC Cockpit tool.
1.3	20170105	Updated examples descriptions, reworked firmware update
1.2	20161124	Updated examples descriptions
1.1	20160803	Note in section 5 regarding the LPCXpresso version added HCE, NFC Forum and MIFARE DESFire added to the Associated projects Cockpit version changed from 2.2 to 2.3 Required LPCXpresso version changed from 7.9 to 8.1.4 RTOS options added
1.0	20151126	Initial version

Contact information

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

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1. Introduction

This document is the continuation of the "AN11744 - PN5180 Quick start guide" and describes the installation procedures of the SW development environment and handling SW example projects using the NFC Reader Library prepared for the PN5180 evaluation board.

It also describes how to re-install the original LPC firmware binary to use the NFC Cockpit again.

Projects used and explained in this documentation are:

Table 1	Ι.	Exam	ple	pro	iects

Example	Description
NfcrdlilbEx1_Basic DiscoveryLoop	Explains how to poll for different technologies (Tag, P2P, HCE), detect and report them. Default configuration parameters are used.
NfcrdlilbEx2_AdvancedDi scoveryLoop	Explains how to poll for different technologies (Tag, P2P, HCE), detect and report them. All configuration parameters are used and explained.
NfcrdlilbEx3_ NFCForum	Explains how to configure the NFC Reader Library for different P2P modes such as Active Mode, Target Mode, Initiator Mode and SNEP Client/Server.
NfcrdlilbEx4_MIFARE Classic	Explains the usage of standard MIFARE commands.
NfcrdlilbEx5_ ISO15693	Explains the usage of this technology and provides an overview about the most common commands.
NfcrdlilbEx7_ EMVCo_Polling	Explains polling for EMVCo payment cards.
NfcrdlilbEx8_ HCE_T4T	Explains how to emulate a NFC Forum Type 4 Tag supporting read and write operations.
NfcrdlilbEx9_ NTagI2C	Explains NTAG-I2C specific commands.
NfcrdlilbEx10_ MIFAREDESFire	Explains the usage of MIFARE DESFire cards. (This example is delivered with the NFC Reader Library version available via NXP DocStore)
NfcrdlibEx11_ISO10373_ PCD	Example is used to perform ISO 10373-6 PCD compliance validation.
Nfcrdlib_SimplifiedAPI EMVCo	EMVCo loopback application with simplified API, which can be used for EMVCo level 1 digital certification.
Nfcrdlib_SimplifiedAPI ISO	Explains how to use simplified API with different types of cards.

Example projects delivered with the NFC Reader Library

2. Managing the PN5180 SW projects with LPCXpresso IDE

The PN5180 SW projects are delivered in a zip package and can be extracted, edited, compiled and linked with LPCXpresso IDE.

The LPCXpresso IDE is a low-cost highly integrated software development environment for NXP's LPC microcontrollers and includes all the tools necessary to develop highquality software solutions in a timely and cost effective fashion. LPCXpresso IDE is based on Eclipse and has many enhancements to simplify development with NXP LPC microcontrollers. It also features the industry-standard GNU tool chain, with a choice of a proprietary optimized C library or the standard "Newlib" library. The LPCXpresso IDE can build an executable of any size with full code optimization.

Designed for simplicity and ease of use, the LPCXpresso IDE provides software engineers a quick and easy way to develop their applications.

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.

2.1 Development environment

To use PN5180 prepared software package all components listed in the Table 2 are required.

Table 2. Development	Environment	
Item	Version	Description
PN5180EV5180B	1.0 or higher	PN5180 Customer Evaluation board (hardware)
LPC-Link 2	1.0	Standalone debug adaptor (hardware)
LPCXpresso IDE	8.1.4 or higher	Development IDE (PC software)

2.2 Installation procedure of the LPCXpresso IDE

The LPCXpresso IDE is installed into a single directory, of your choice. Unlike many software packages, the LPCXpresso IDE does not install or use any keys in the Windows Registry, or use or modify any environment variables (including PATH), resulting in a very clean installation that does not interfere with anything else on your PC. Should you wish to use the command-line tools, a command file is provided to set up the path for the local command window.

Multiple versions can be installed simultaneously without any issues.

The installation starts after double-clicking the installer file.

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

During the installation, the user will be asked to install some required drivers. The installation of these drivers shall be accepted.

Would you like to install this device software? Name Philips (NXP) Universal Serial Bus contr Publisher NXP Semiconductors USA. Inc.
Always trust software from "NXP Semiconductors USA. Inc.". You should only install driver software from publishers you trust. <u>How can I decide which device</u>

After the setup wizard has finished, the newly installed IDE can be launched.

Fig 3. LPCXpresso	Register and activate to remove this restriction. OK Cancel	

Directly after the first start of the LPCXpresso IDE, an info dialog will appear with the message of an unregistered copy of the LPCXpresso IDE.

Confirm the dialog and follow the instructions on the Welcome Screen to get a registered version with the debug limit of 256k. The registration is free of a charge. The link to the

registration page is shown in the menu, Help \rightarrow Activate LPCXpresso \rightarrow Create Serial number and register.

Hel ? ? ??	Help Contents LPCXpresso User Guide Search Dynamic Help		V V V V V V V V V V V V V V V V V V V
	Key Assist Tips and Tricks Cheat Sheets	Ctrl+Shift+L	xpresso/pages/unregisteredFreeEdition.htm
	Install New Software		LPC PRESSO
	Display license type Product Information		not activated.
NP	Support Activate LPCXpresso (Free Edition)	(·	Create serial number and register
NP	Activate LPCXpresso (Pro Edition) About LPCXpresso	×	Enter Activation code

	×
Create serial number and register Select OK to visit the registration website where you can register your product and receive an Activation Code.	
Serial number IIOV-LZM5-G5GW-HRH3-NUH2-M4D1-ORAZ-A5II-E1G1-LV Copp Serial Number to clipboard	HT
ОК	Cancel
Fig 5. Product activation (2)	

In case that you do not have an account on the

http://www.nxp.com/redirect/lpcware.com, simply sign up to get an activation code. The code will be sent to the provided e-mail address.

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Help		
Help Contents		r 🕼 🔌 🕩 🗉 🖷 🖉 A. O. J. 🛼
IPCXpresso User Guide		Quick Access
💖 Search		
Dynamic Help		
Key Assist	Ctrl+Shift+L	cxpresso/pages/unregisteredFreeEdition.htm
Tips and Tricks		
Cheat Sheets		
Install New Software		LPC PRESSO
O Display license type		
Product Information		not activated.
🔀 Support	_	may only be used for Evaluation
NP Activate LPCXpresso (Free Edition)	۱.	Create cerial number and register
NP Activate LPCXpresso (Pro Edition)	•<	Enter Activation code
About LPCXpresso		red on to the LPC ware website to be able to obtain
Product activation (3)		

Once you receive the activation code open the activation window by pointing to Help \rightarrow Activate LPCXpresso \rightarrow Enter Activation code, and enter the code.

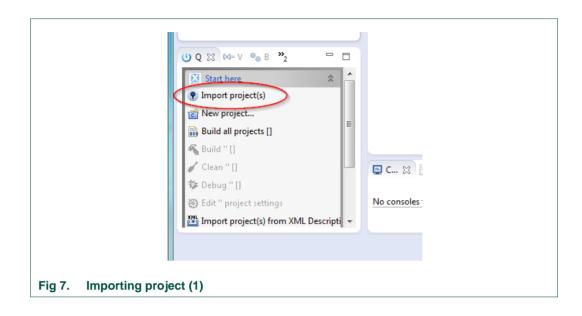
The success of the product activation will be confirmed by an info dialogue.

2.3 Importing provided SW example projects

The use of quick start panel provides rapid access to the most commonly used features of the LPCXpresso IDE. Quick start panel allows easy import projects, create new projects, build and debug projects.

The sequence of installing the software projects is indicated:

- Start the LPCXpresso IDE.
- Open new or dedicated workspace
- 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.



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

	Import project(s) Import project(s) Select the examples archive file to import.	
	Projects are contained within archives (.zip) or are unpacked within a directory. Select your project archive or root directory and press < Next>. On the next page, select those projects you wish to import, and press <finish>.</finish>	
	Project archives for LPCOpen and 'legacy' examples are provided. Project archive (zip) Archive Dr.CLEV6638 LPC1769 NFC-Reader-Library-v3.092, SPI-I2C.zip	
	Project directory Browse	
	LPCOpen LPCOpen is the recommended code base for Cortex-M based NXP LPC Microcontrollers.	
	LPCXpresso includes the LPCOpen packages which can be imported directly by pressing the button in the Project archive (zip) section, above, and navigating to the Examples/LPCOpen Alternatively, press the button below to Browse the LPCWare.com website for latest resourc Browse LPCOpen resources on LPCWare.com	
	(Sack Next > Einish Cancel	
Fig 8. Importing project		

Browse the desired package and click "Next".

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Import project(s)	
Import project(s) Select a directory to search for existing Eclipse projects.	
Projects Projects Projects Projects Select All Project (Pact769) Project (Pact769)	
(?) < Back Next > Finish Cancel	

For a working demo project you need to import at least four sub projects. One example project, the NFC Reader Library, FreeRTOS, one chip library and one board library.

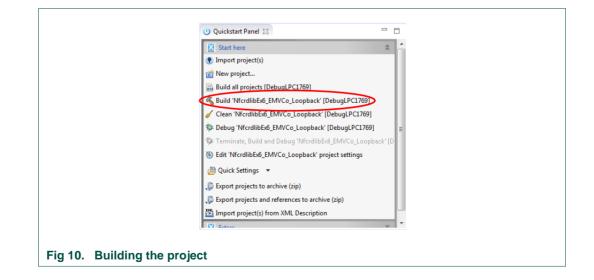
When the import process has finished one can start browsing the code.

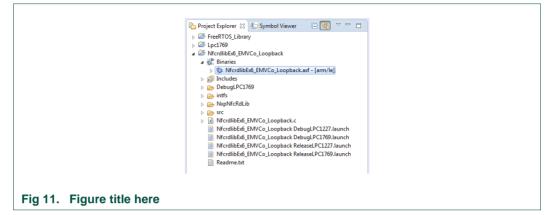
Before one can run the project, the LPCXpresso board containing the PN5180 Blueboard needs to be connected to the computer. Wait until the adequate drivers have been installed.

2.4 Building projects

Building projects in a workspace is a simple case of using the Quick start Panel - 'Build all projects'. Alternatively a single project can be selected in the "Project Explorer View" and built separately. Note that building a single project may also trigger a build of any associated library projects.

The project can be built as shown in the Fig 10.





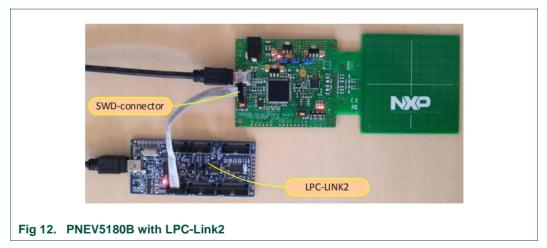
As a part of the build output, the binary for the "User Flash" file is created. This binary file can be later also used to update PN5180 User Flash via USB mass storage interface.

The project settings, compiler and link flags can be changed in the project properties dialog. To open the project properties dialog, select appropriate project in the "Project Explorer View" and click "Edit 'selected-project' project settings".

2.5 Running and debugging a project

This description shows how to run the "*NfcrdlibEx6_EMVCo_Loopback*" example application for the PN5180 evaluation development board. The same basic principles will apply for all other examples. In cases where example will need additional configuration this will be detailed described in the example description.

First of all you need to ensure that your PN5180 evaluation board is connected to the computer via LPC-LINK2, as shown in Fig 12.

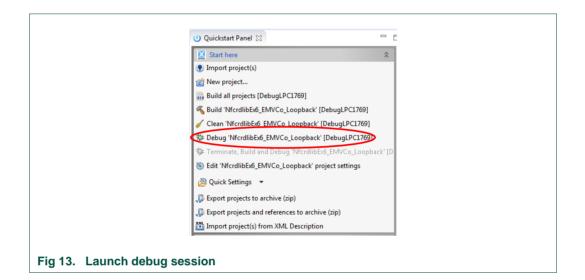


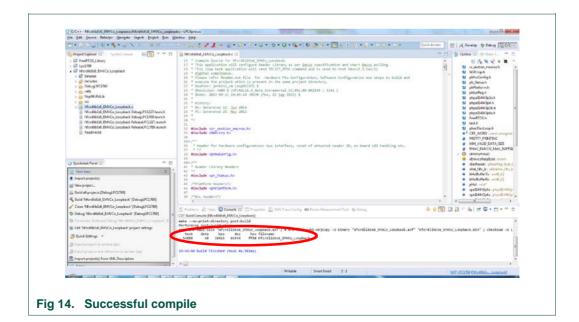
When debug is started, the program is automatically downloaded to the target and it's programmed to the LPC1769 flash memory; a default breakpoint is set on the first

instruction in main (), the application is started (by simulating a processor reset), and code is executed until the default breakpoint is hit.

To start debugging your application on the PN5180, simply highlight the project in the Project Explorer and then in the Quick start Panel click Debug, as shown in Fig 13. The LPCXpresso IDE will first build application, flash application binary and then will start with debugging.

Before running the project, please ensure that the correct microcontroller and the correct build configurations are chosen. Information about how to do this can be found in the Fig 26 and chapter 6.3.





	×	×	
	Connect to emulator: NXP Pn74xx 1 emulator found. Select the emulator to use		
	Emulator family Name	Serial number/ Manufacturer	
	Redlink Server LPC-LINK2 REDLINK	\\?\hid#vid_21 NXP	
		П	
	Emulator search options Search again		
	Remember my selection (for this Launch co	nfiguration)	
	?	OK Cancel	
Fig 15. Select the launc	h configuration		

Select "LPC-LINK2 REDLINK" as a debug emulator.

After successful software upload, the execution of the project starts immediately, but might halt at the initial breakpoint. To resume execution, please click the resume button.

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In the console window application debug outputs of the execution can be seen.



After the execution has reached the end of the main function please click the Terminate button to stop the execution. Otherwise rerun of the project will be possible.

		Run the program.
	¢	Step over C/C++ line.
	P	Step into a function.
		Stop the debugger.
	88	Pause execution of the running program.
	i⇒	Instruction stepping mode (disassembly).
Fig 18. Debug Butto	ns	

Buttons in the debug toolbar provide next functionalities:

3. Managing the PN5180 SW projects with Linux and KDS IDE

Detailed description and guideline, how to import and manage NFC NXP Reader Library projects in Linux and Kinetis Design Studio (KDS) environment, check:

- AN11802 NFC Reader Library for Linux Installation Guidelines
- AN11908 NFC Reader Library for KDS Installation Guidelines

4. Associated projects

All example projects are available for download at the PN5180 product page 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 extract it and run the installer. The installer make a copy of all documents and SW on the hard disk.

By default the projects are preconfigured to be run on the LPCXpresso LPC1769 development board. For instructions about how to run the projects on the LPCXpresso LPC11U68 development board, refer to chapter 6.2 and 6.3, please.

Running the projects with, or without FreeRTOS

All projects described in the following sub chapters can be configured to run with or without FreeRTOS operating system. To enable/disable FreeRTOS support, define settings in the file "../intfs/ph_NxpBuild_App.h" needs to be configured properly.

E.g. enable FreeRTOS

//#define NXPBUILD__PH_OSAL_NULLOS
#define NXPBUILD__PH_OSAL_FREERTOS

ICODE support

In order to detect ICODE SLI, SLIX and SLIX2 cards appropriate HAL digital delay should be enabled. Define settings in the file "../intfs/ph_NxpBuild_App.h" needs to be configured properly.

E.g. enabling HAL digital delay

```
#ifdef NXPBUILD__PHHAL_HW_PN5180
    #define PN5180_HAL_DIGITAL_DELAY /**< Enable to ...
#endif /* NXPBUILD PHHAL HW PN5180 */</pre>
```

4.1 Example 1 – Basic Discovery Loop

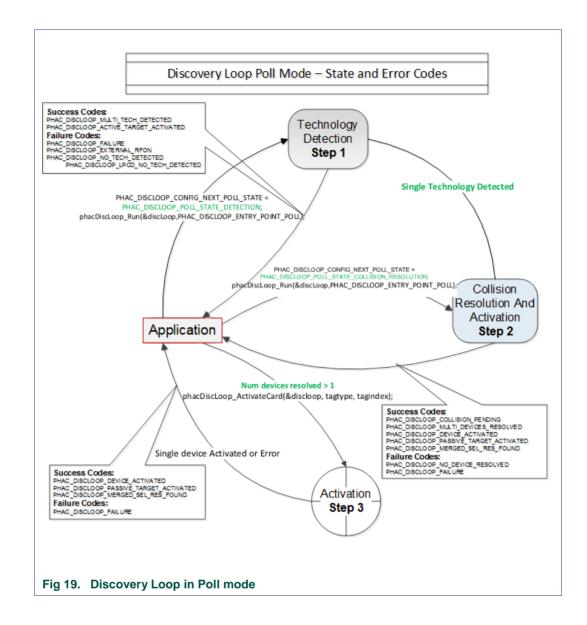
The Discovery Loop can be seen as the entry point when starting to communicate with an NFC tag or device. It scans the close environment for tags and devices of different technologies.

Example is implemented to work in POLL and LISTEN mode of the discovery loop. Information (like UID, SAK, and Product Type for MIFARE Cards) of the detected tags are printed out and it also prints information when it gets activated as a target by an external initiator/reader. Whenever multiple technologies are detected, example select first detected technology and resolve it.

In passive poll mode, Low Power Card Detection (LPCD) is enabled.

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The core function of this example is "BasicDiscoveryLoop Demo()", where initialization of the NFC Reader library and polling for NFC technologies is implemented. After each polling loop, application is checking polling result and printout information about the detected tags or devices.

This example is using default DiscoveryLoop configuration, which enables all supported technologies and it is limited to one device for each technology.

ISO14443P3A ISO15693- SLI FeliCa TYPEF_TARGET_PASSIVE ISO14443P4A ISO18000P3M3 TYPEA_TARGET_PASSIVE TYPEF_TARGET_ACTIVE ISO18092MPI ISO14443P3B TYPEA_TARGET_ACTIVE

Table 3. Supported technologies

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4.2 Example 2 – Advanced Discovery Loop

Additionally to Example 1 the Advanced Discovery Loop example explains the different configuration options of the Discovery Loop and configure DiscoveryLoop with default values based on the interested profile, NFC or EMVCo.

The configuration of the "DiscoveryLoop" is implemented in "LoadProfile()" function.

4.3 Example 3 – NFC Forum

Explains how to configure the NFC Reader Library for different P2P modes such as Active Mode, Target Mode, Initiator Mode and SNEP Client/Server.

In Snep Server mode the example waits for a connection from a Snep Client. When the connection between client and server is establish, client send a data and server read it. The application displays read data in the console window of the LPCXpresso IDE.

In Snep Client mode, the application tries to connect to a Snep Server. Once the connection is established, it transmits an NDEF message to the server.

4.4 Example 4 – MIFARE Classic

This example demonstrate how to configure "DiscoveryLoop" to poll for only one technology and how to resolve detected card, in this example MIFARE Classic is used.

Once MIFARE Classic card is activated, application printout information like UID, ATQA and SAK and perform the authentication with MIFARE default key. After successful authentication basic read/write operations are implemented.

This example is good start in case of working with only one card or to see how to manage MIFARE Classic cards.

4.5 Example 5 - ISO15693

Similar to the previous example, this one is also using only one technology, in that case ISO15693. "*DiscoveryLoop*" is configured to resolve only one device and in the example it is shown how to change Tx Guard Time for T5T cards, this is implemented in "phApp_Init()" function.

Once ICODE SLI is resolved and activated, application printout card information like type of the card and UID, and it will read and write from/to the memory block.

This example is good start in case of working with only one card or to see how to manage ISO15693 type of the cards.

For a much more extensive example, demonstrating the use of ISO/IEC 15693 and ISE/IEC 18000-3 Mode 3 tags (ICODE SLI and ICODE ILT). In order to assure ICODE SLI and ILT detection please check HAL digital delay define settings as described in chapter 4.

4.6 Example 7 – EMVCo Polling

The EMVCo Polling example it is demonstrated how to configure NFC Reader Library as specified by EMVCo specifications and starts polling for EMVCo cards.

Once an EMVCo compatible card is resolved and activated, it demonstrates the exchange of APDU commands. This example shall help the developers getting started more quickly when working with EMVCo cards.

4.7 Example 8 – HCE T4T

Example 8 implements a Type 4 Tag card emulation according to NFC Forum Type 4 Tag specification. The example supports all specified commands such as *Select*, *ReadBinary*, *UpdateBinary*.

With this example our reader is in card emulation mode (HCE) and it support reading and writing data. Default data is configured as an NDEF message as a url <u>www.nxp.com</u>.

The maximum NDEF length the reader can write is limited by NDEF file size used in example (default configured as 1024 bytes).

4.8 Example 9 – NTAG-I2C

The NTAG-I2C example demonstrates the use of special features which are supported by NTAG-I2C. By using POLL mode of the discovery loop, example detect the NTag I2C cards and displays detected tag information like UID, ATQA, SAK, Version info and perform "*Page Read*" and "*PageWrite*" commands.

For more details about the NTAG-I2C and its functionalities please consult the related product page [2]

4.9 Example 10 – MIFARE DESFire

The MIFARE DESFire example demonstrates how to use MIFARE DESFire EV1 cards.

Once MIFARE DESFire card is resolved and activated, it displays MIFARE DESFire applications created by this example previously and it displays 32bit signed integer which is incremented after each successful detection of tag.

In case no application is present on the tag, new application will be created with two new files to hold NXPNFCRDLIB version used to create this application and another file to hold 32bit signed integer.

Note: This example including the required modules of the NFC Reader Library is only available via NXP Docstore.

4.10 Example 11 – ISO10373 PCD

This example is used to perform ISO 10373-6 PCD compliance validation. This example has to be executed in the DUT which has an ISO 14443 based PCD implementation. The ISO 10373-6 test methods verifies the compliance to the ISO 14443 protocols. An external tool like Micropross MP300 implements the test methods for the ISO 10373-6 and is used as the counterpart for this testing.

4.11 Simplified API EMVCo

This application will configure Reader Library as per EMVCo specification and start EMVCo polling. This loop back application will send SELECT_PPSE command and is used to test EMVCo.3.1a(L1) digital compliance. Simplified approach, after library initialization, is using only three commands:

- phNfcLib_Activate()
- phNfcLib_Transmit()
- phNfcLib_Receive()

4.12 Simplified API ISO

This example is a reference application to demonstrate the usage of Simplified API with ISO profile. Application contains example of Type A Layer 4, Type B Layer 4, MIFARE DESFire, MIFARE Ultralight, MIFARE Classic, ISO5693 and ISO18000p3m3.

Example demonstrates how to use simplified API, which require, after successful library initialization, only three commands:

- phNfcLib_Activate()
- phNfcLib_Transmit()
- phNfcLib_Receive()

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5. Flashing Firmware on the LPC1769

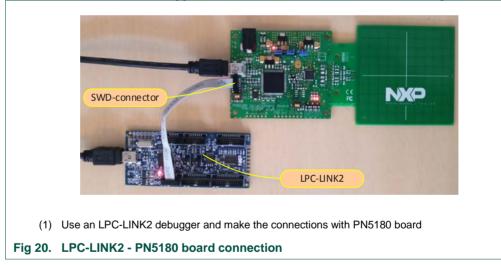
Flashing VCOM firmware is the procedure needed to prepare PN5180 evaluation board to be used with the Cockpit tool. The Cockpit tool is software design tool for prototyping NXP NFC card reader applications.

VCOM firmware which needs to be flashed on the LPC1769 is provided with the installer package of the NXP NFC Cockpit application and it can be found in "\NxpNfcCockpit_v3.7.0.0\firmware\Secondary_PN5180" folder.

This folder contains several binaries which can be used as VCOM firmware application:

- BootLoader_And_Nfcrdlib_SimplifiedAPI_EMVCo_Secondary.bin
- BootLoader_And_phRfOnOff_Secondary.bin
- BootLoader_And_phUcBal_Secondary.bin

Steps required to flash VCOM application: Connect the LPC-LINK2 debugger to the PN5180 board as shown in the Fig 20.



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Use the LPCXpresso Program Flash utility flash to flash bootloader binary to the MCU.

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ApiDocumentation	
FreeRTOS_Library	Program Flash using LPC-LINK2 CMSIS-DAP V5.173
Ipc_board_nxp_lpcxpresso_1769	
⊳ 🐸 lpc_chip_175x_6x	Program target flash: LPC17xx (NXP LPC1769)
» Mfcrdlib_SimplifiedAPI_EMVCo	Adda.
» Mfcrdlib_SimplifiedAPI_ISO	Options
» MfcrdlibEx1_BasicDiscoveryLoop	☑ Display progress log ☑ Reopen on completion
MicrollibEx10_MIFAREDESFire	Reset target on completion
Includes	
👂 🗁 DebugLPC1769	Run flash command and copy to clipboard 🔲 Just copy flash command to clipboard
FreeRTOS	Connection Options
b >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>	Use JTAG interface
▷ Comparison Network Netwo	
	Extended
 IfcrdlibEx10_MIFAREDESFire.c NfcrdlibEx10_MIFAREDESFire Debug 	JLPC17 Additional options
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Second	Connect script Browse
NfcrdlibEx3 NFCForum	
NfcrdlibEx4_MIFAREClassic	Flash Driver
» MfcrdlibEx5_ISO15693	Flash driver LPC175x_6x_512.cfx
» MfcrdlibEx7_EMVCo_Polling	
» StordlibEx8_HCE_T4T	Program flash memory Erase flash memory
<	
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X Start here	Erase Options
Import project(s)	Mass erase O Mass erase O
📸 New project	
🗟 Build all projects [DebugLPC1769]	OK Cancel
Suild 'NfcrdlibEx10_MIFAREDESFire' [Debu	aLPC1
Clean 'NfcrdlibEx10_MIFAREDESFire' [Debu 	*** MIFARE DESFire Example ***
We DENNE INKELIDER AN IMPADEDECT // IDEN	
	sting LPCXpresso project) and set the MCU type to LPC1769
(2) Create (or Open an exi	
(2) Create (or Open an exi(3) Chose "Program flash"	from menu bar
(3) Chose "Program flash"(4) Select bootloader binar	ry, e.g.
 (3) Chose "Program flash" (4) Select bootloader binar 'NxpNfcCockpit_v3.7.0 	ry, e.g. .0\firmware\Secondary_PN5180\BootLoader_And_Nfcrdlib_SimplifiedA
 (3) Chose "Program flash" (4) Select bootloader binar 'NxpNfcCockpit_v3.7.0 EMVCo_Secondary.bir 	ry, e.g. .0\firmware\Secondary_PN5180\BootLoader_And_Nfcrdlib_SimplifiedA ı'
 (3) Chose "Program flash" (4) Select bootloader binar 'NxpNfcCockpit_v3.7.0 	ry, e.g. .0\firmware\Secondary_PN5180\BootLoader_And_Nfcrdlib_SimplifiedA ı'
 (3) Chose "Program flash" (4) Select bootloader binar 'NxpNfcCockpit_v3.7.0 EMVCo_Secondary.bir (5) Set base address to 0x 	ry, e.g. .0\firmware\Secondary_PN5180\BootLoader_And_Nfcrdlib_SimplifiedA [^] :00
 (3) Chose "Program flash" (4) Select bootloader binar 'NxpNfcCockpit_v3.7.0 EMVCo_Secondary.bir (5) Set base address to 0x (6) Press "OK" button and 	ry, e.g. .0\firmware\Secondary_PN5180\BootLoader_And_Nfcrdlib_SimplifiedA n' k00 flash the bootloader
 (3) Chose "Program flash" (4) Select bootloader binar 'NxpNfcCockpit_v3.7.0 EMVCo_Secondary.bin (5) Set base address to 0x 	ry, e.g. .0\firmware\Secondary_PN5180\BootLoader_And_Nfcrdlib_SimplifiedA n' k00 flash the bootloader

Flash the binary on the PNEV5180B and ensure that the process succeeds.

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Program F	ash				
	n_redlink -flash-load-exec "C			NVD at DC1760, load b	
\firmware\	Secondary_PN5180\BootLoad	er_And_phUcBal_Secon	dary.bin" -g -2 -vendor:	=NXP -pLPC1/69 -load-b	ase=0x00 -
Ps: (72) at (0007000: 4096 bytes - 32768/4	4960			
Ps: (81) at (0008000: 4096 bytes - 36864/4	4960			
	0009000: 4096 bytes - 40960/4				
	0000A000: 4096 bytes - 45056/				
	Vrote page 0-10 with 44960 k				
	hished writing Flash successfu	lly.			
Nt: Flash W		ECLD (-)			
Nt: Reset ta	0xAFA0 bytes in 797ms (abou	DOKB/S)			1
Nu Neset ta	iger (core)				
					Þ
4					
٠					
4				ОК	
				ОК	
<		-		ОК	

Disconnect the USB cable, remove LPC-LINK2 connection and reset the board.

The board appears as a VCOM device:

Hardware and Sound > Devices and Printers	Search Devices and Printers	×
File Edit View Tools Help Add a device Add a printer		0
 Unspecified (2) Logitech USB Headset NxpNfcCockpit 		
PN5180 Board Correctly installed		

The PN5180 based evaluation board is ready now to be used with the NXP NFC Cockpit tool.

6. Supplementary Notes

6.1 General Software Architecture

The software of the reference reader is based on the NFC Reader Library Fig 24. 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)

						Demo apps							Demo apps on Simplified
	Basic DiscoveryLoop Application	Advanced DiscoveryLoop Application	NFC Forum demo Application	MIFARE Classic application	application	EMVCo polling demo application	Emu. T4T	NTAG I2C demo application					EMVCo Loop back app for Compliance
			AL (Appli	cation Layer) -	Commandsets			NFC	Activity	HCE Layer		P Package	Simplified API
	Classic UI	IFARE Part tralight, MIFAF EV1 DESF Cmd	RE FeliCa Cmd re set	Topaz	C Forum ISO/IE Tag 15893 serations		ICODE SLI		overy Iop	T4T-A	SNEP 1.0 Sw LLCP 1.1	Protocols Link Layer	
	Ser Se		Sw	Sw St		Sw	Sw	Sw	т. Т	Sw	Sw		
				PAL (Protocol Abstra	ction Layer) – A	Activation and	Exchange					
H	ISO/IEC 14443 3A / Jewel			0/IEC MIF# 4443 4	ARE ISO/IE0 14443 4mC	C Felica compliant protocol	ISO/IEC 18092 Initiator	ISO/IEC 18092 Targe	ISO/IE0				
	Sw	Sw S	y Sw	Sw	Stub Sw	Sw	Sw	Siv	Sar	Sw			
					HAL (Hardwa	re Abstraction	Layer) - Read	ers					
		Generic											
	PN5180	RC663 PI	17462AU										
U					PAL (Pue)	Abstraction Lav	or) Interface						
					DAL (DUS /	NUSTICUUT Lay	er) • Interface	•					
		Generic											
	LpcOpenSPI	KinetisSPI	RaspberryPi LinuxSPI										
					Comr	non (Layer inde	pendent)						
	Key Store	ISO14443-4	Tools	Log OSAL	Utils CryptoSy	m CryptoRng		phPlatform					
	,		RC, Parity)										
	Sw RC663			Linux Free RTOS	NULL Sw	Sw	PN7462AU LP	C1789 K82	Raspberry				

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

6.1.2 Hardware abstraction layer

This layer offers functions to abstract the hardware parts of the transceiver CLRC663.

6.1.3 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.

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The following PAL modules are available in this software package:

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

6.1.4 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.

6.2 Build configuration

All the projects mentioned in Chapter 0 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.

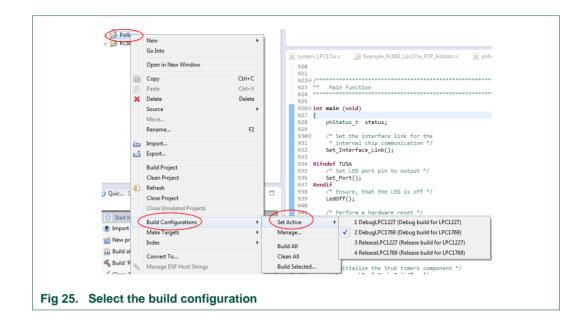
• Release configuration

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.

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 DebugLPC1769 build (or ReleaseLPC1769 build) for LPC1769.

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

type filter text	MCU settings
 Resource Builders 	Target
⊿ C/C++ Build	NXP LPC1227/301
Build Variables	LPC1754
Environment	LPC1756
Logging	LPC1758
MCU settings Settings	LPC1759
Tool Chain Editor	LPC1763
C/C++ General	LPC1764
Project References	LPC1765
Run/Debug Settings	LPC1766
·····yy···y-	LPC1767
	LPC1768
	LPC1769
	▷ LPC177x_8x

6.4 Level of compiler optimization

When the code size at the current compiler level overloads the FLASH size of the target board (512K for the ARM-based microcontroller LPC1769), 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.

e filter text	Settings	(⇒ <
Resource		*
Builders C/C++ Build Build Variables	Configuration: Debug1115 [Active]	▼ Manage Configurat
Discovery Options Environment	🛞 Tool Settings 🎤 Build Steps 🤶 Build Artifact 🖩 Binary Parsers 🧿 Error Parsers	
Logging MCU settings Settings Tool Chain Editor C/C++ General Project References Run/Debug Settings	MCU C Compiler Preprocessor Symbols Includes Optimization Debugging Warnings Markings Target Deputation	
	 MCU Assembler General MCU Linker General Libraries Miscellaneous Shared Library Settings Target 	
		Restore <u>D</u> efaults
)		OK Can

6.4.1 Optimization issues

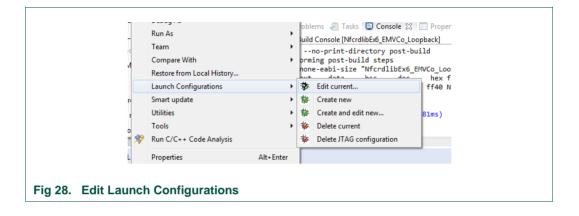
When optimization is enabled, it will reorder code. What this means is that the code from multiple C lines will be intermingled. In addition, assignments and initializations might be pulled out of loops so they are only executed once. Changes like these will make the code confusing to debug. Some symptoms 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.

6.5 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:

1. Right click on the project and choose Launch Configurations \rightarrow Edit current...



Create, manage, and run configurations		фс
[] B ¥ 8 ≱ •	Name: NfcrdlibEx6_EMVCo_Loopback DebugLPC	1769
type filter text	Main 🕸 Debugger 😼 Source 🔳 Comr	non
CCC-= 000 Semiconductory MCU Application CL227 CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL CONTROL Norollabol, BMCCo, Loopback Releasel PC1769 CCC-> Application CCC-> Application CCC-> Postmartem Debuggier CCC-> Remort Application CCC-> CONTROL CONTROL CCC-> CONTROL CONTROL CCC-> CONTROL CCCC-> CONTROL CCC-> C	Blop en startup at: main Advanced. Debugger Option Target configuration Main Debug context of NNP ICUT69 (contex-m) Debug Context of NNP ICUT69 (contex-m) Debug Context on SND + Edit/ITAG Configuration Option al Additional options Atack only al Context Script al Debug Level Disconnect behavior	
m Filter matched 11 of 11 items		Apply Revert
Filter matched 11 of 11 items		Debug Close

7. References

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

- [2] NTAG-I2C http://www.nxp.com/products/identification_and_security/nfc_and_reader_ics/conne cted_tag_solutions/series/NT3H1101_NT3H1201.html
- [3] AN11744 PN5180 evaluation board quick start guide, <u>www.nxp.com</u>
- [4] AN11742 PN5180 Dynamic Power Control, <u>www.nxp.com</u>

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PN5180 SW Quick start guide

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