Training Mobile Knowledge

PN7462 family – Product support package

NFC + MCU + CT + SW in one chip

MobileKnowledge
April 2016

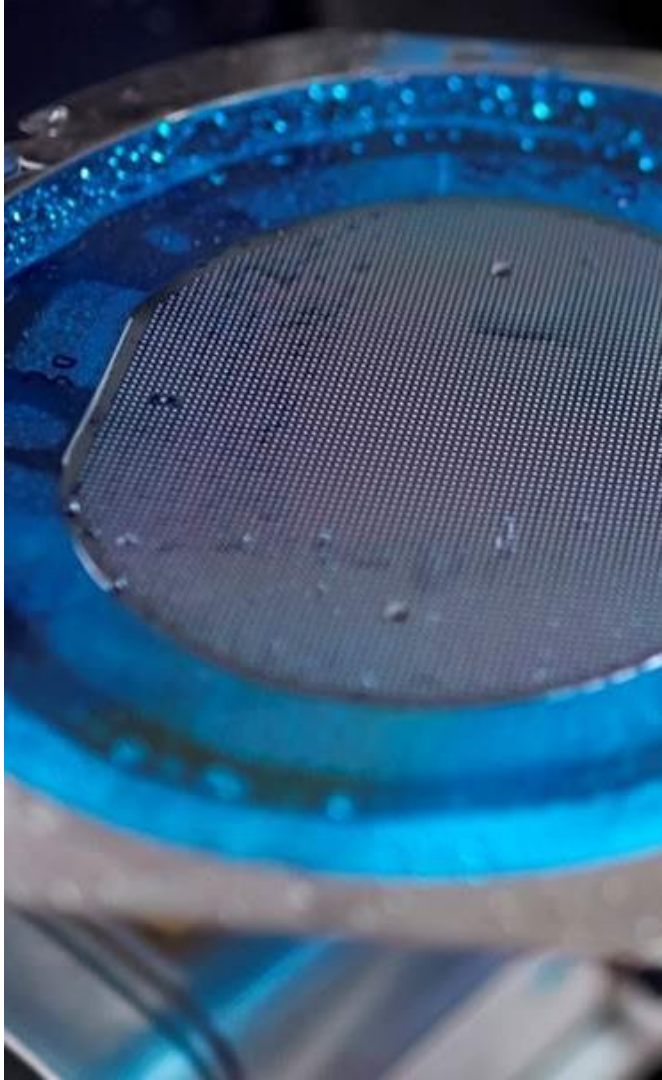
Agenda

Session 13th April: PN7462 family introduction

- Positioning within the NFC portfolio and overview
- Target markets and benefits
- PN7462 family derivatives
- Detailed product description and key features
- OM27460CDK development kit and product support package
- Ordering details

Session 20th April: **PN7462 product support package**

- Where to find PN7462 documentation
- OM27462CDK development kit
- PN7462AU hardware overview
- PN7462 SW architecture and SW development environment
- PN7462 NFC Cockpit
- Datasheet, application notes, user manuals and other tools



Last session - Quick review

PN7462 – Feature overview

Full NFC Interface

Contactless Reader
- ISO/IEC 14443
- ISO/IEC 15693
-ISO/IEC 18000-3M3
- NFC Forum type tags 1 to 5
- Felica

P2P
-Active and passive initiator and target according to ISO/IEC18092

Card Emulation
ISO/IEC 14443-A card emulation via host

Microcontroller

- 160/80 kB Flash
- 12 kB RAM
- 4 kB E²PROM
- Cortex M0 Core @ 20 MHz

Host and peripherals

SPI
I²C
USB
HSUART
Host / Slave Interfaces

I²C
SPI
Master Interfaces

UART
ISO 7816
Optionnal Contact Interface

12 to 21 **GPIOs**

Additional features

- **Integrated Voltage monitoring** for Battery operated devices
- **Low Power Card Detection**
- **SWD or integrated USB mass storage** (primary downloader) for code download

Package
HVQFN64

Standard compliance

EMVCo CT and CLESS

NFC Forum NFC Analog and Digital

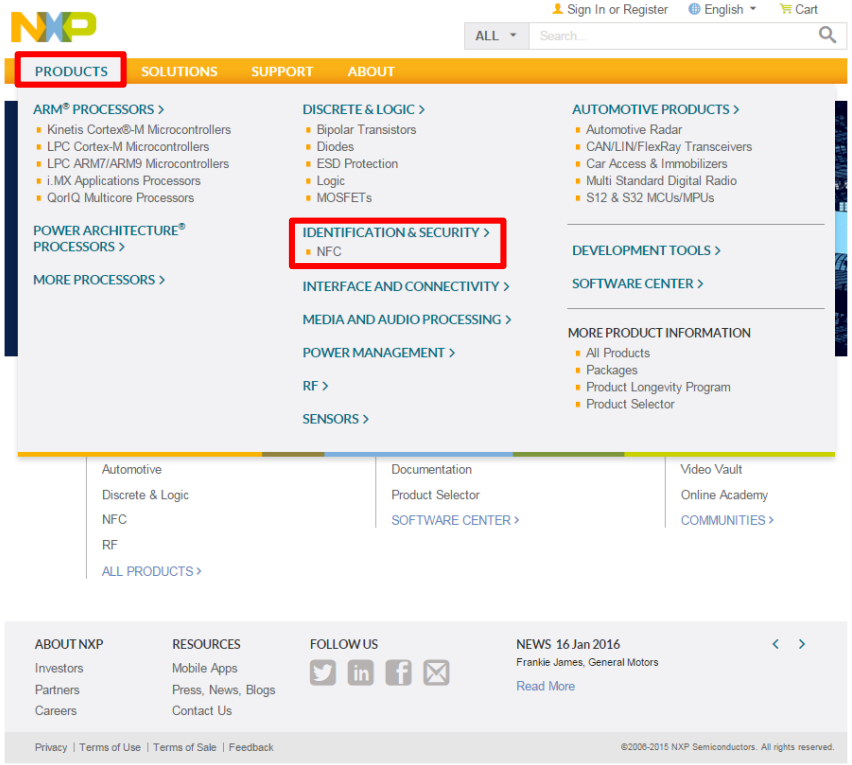
PN7462 family is the solution for your application

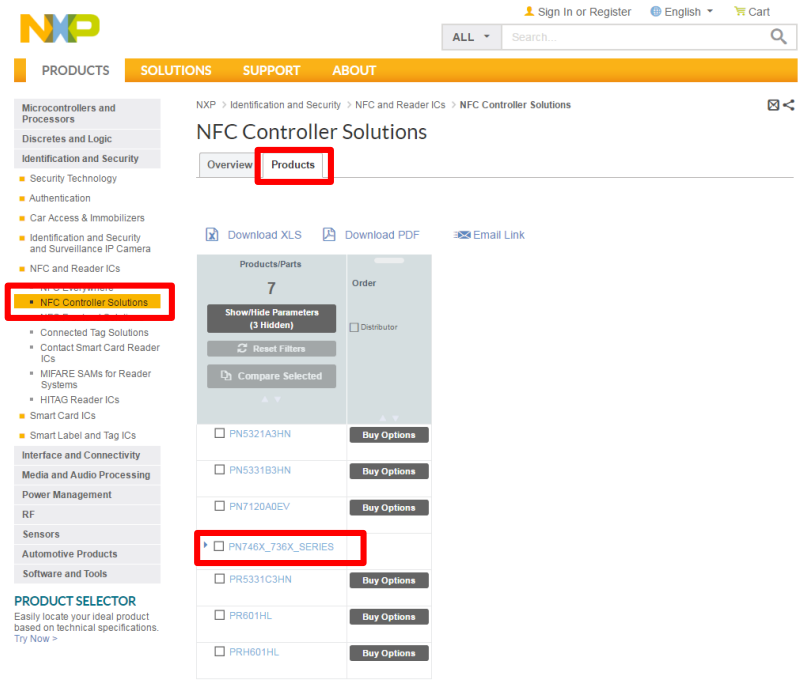
Typical applications	PN7462	PN7362	PN7360
Corporate access	✓	✓	✓
Hospitality (access)		✓	✓
Payment terminal	✓		
Home banking	✓		
USB reader		✓	✓
Gaming console accessories		✓	✓
NFC enabled board game		✓	✓

PN7462	PN7362	PN7360	**Features**
160 kB	160 kB	80 kB	Flash
✓			Contact reader

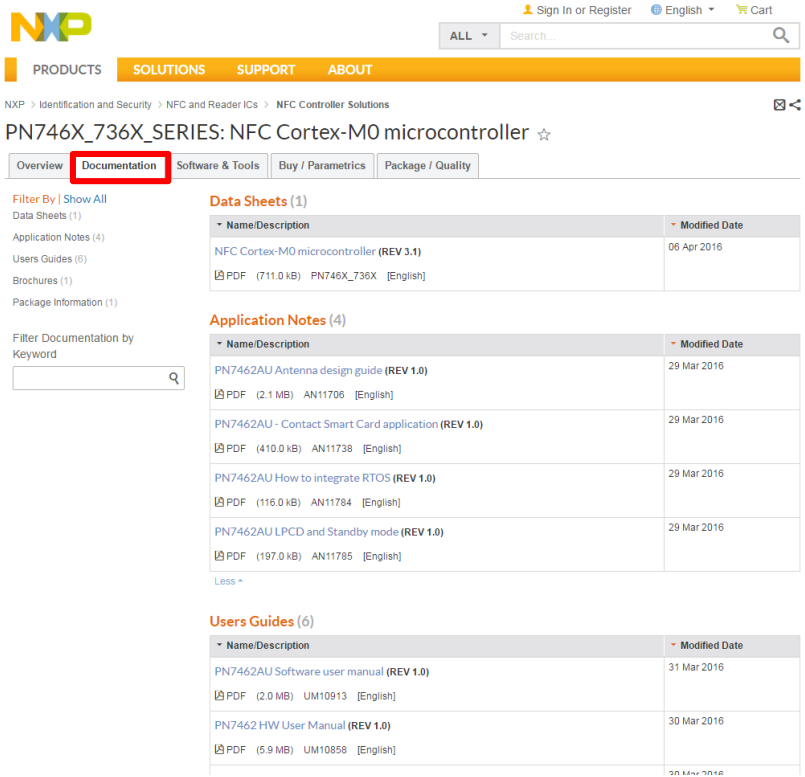
Where to find PN7462 documentation

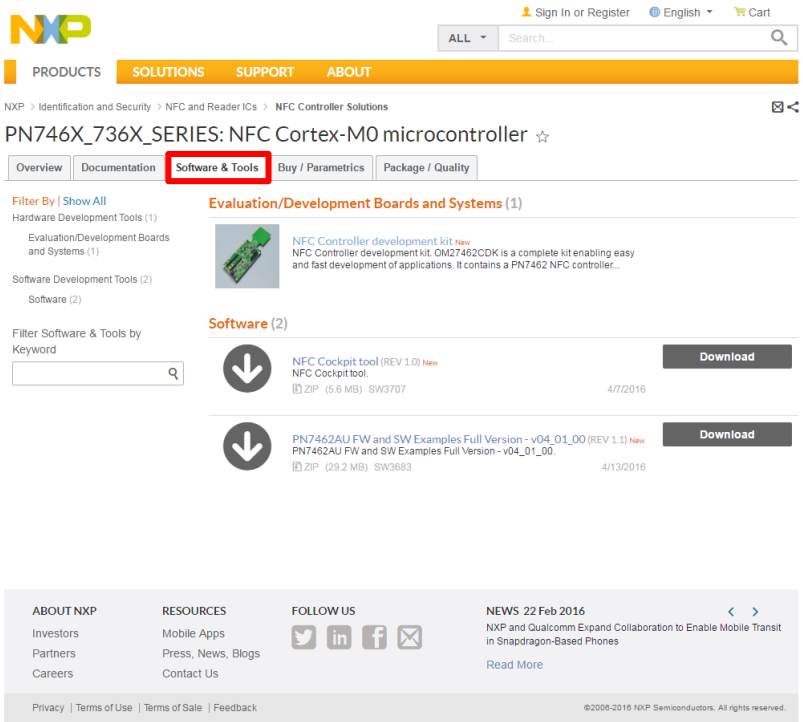
Where to find PN7462 documentation





Where to find PN7462 documentation





PN7462 product support package in a nutshell

NFC Controller development kit	› PN7462 NFC controller development kit OM27460CDK
PN7462AU FW and SW examples	› SW3683 – Installer package PN7462AU FW and SW Examples full version v4.0_01_00
PN7462AU NFC Cockpit	› SW3683 - Installer package PN7462 NFC Cockpit v1.3
Documentation	› AN11706 – PN7462AU Antenna design guide › AN11738 – PN7462AU Contact smartcard application › AN11784 – PN7462AU How to integrate RTOS › AN11785 – PN7462AU LPCD and standby mode › UM10833 – PN7462 Quick start guide – customer board › UM10913 – Software user manual › UM10957 – PN7462AU Door access user manual › UM10915 – PN7462AU PC CCID reader user manual › UM10951 – PN7462 Reference POS application

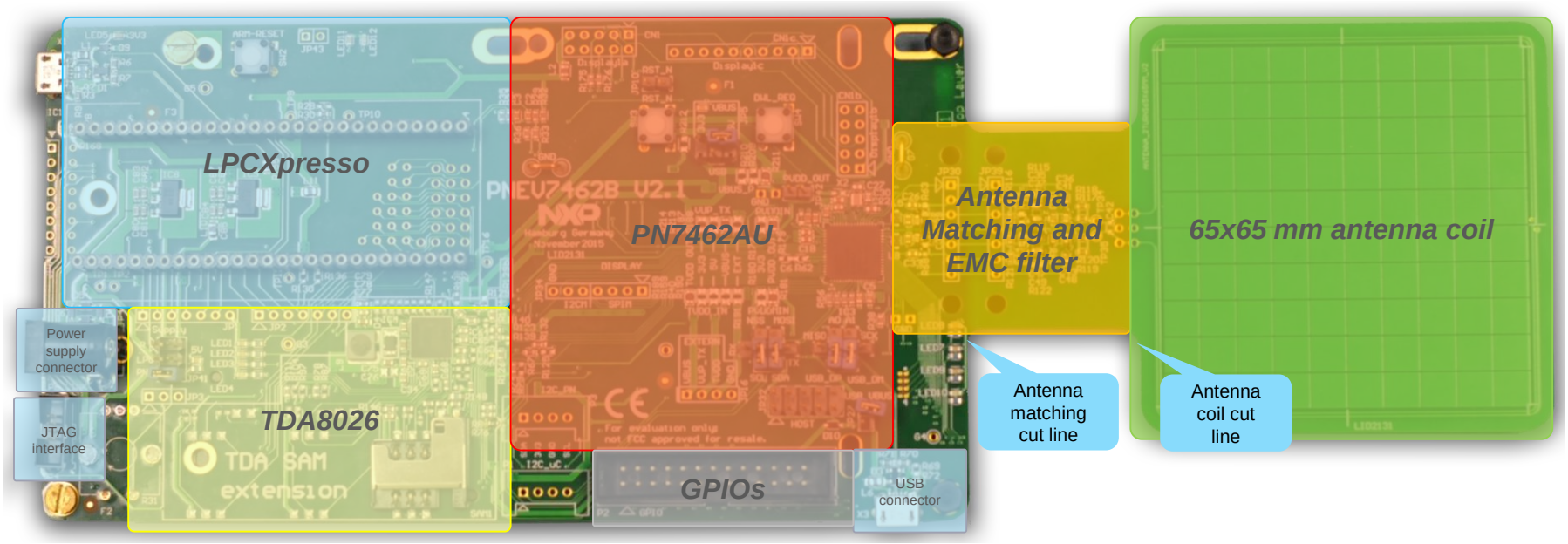
OM27462CDK development kit

- The OM27462CDK development kit features
  - Easy antenna design with NFC Cockpit SW and PCBs adaptors for antenna matching
  - Easy application development with full NFC Forum complaint and contact SW libraries
  - Smartcard reader and SAM slots extension
  - Two different antennas (65x65 and 30x50mm) with matching components
  - 3 PCBs for individual antenna matching
  - 10 PN7462 samples
- And it is completed with an extensive set of documentation, source code examples and video tutorials

Demokits at edemoboard portal and distis

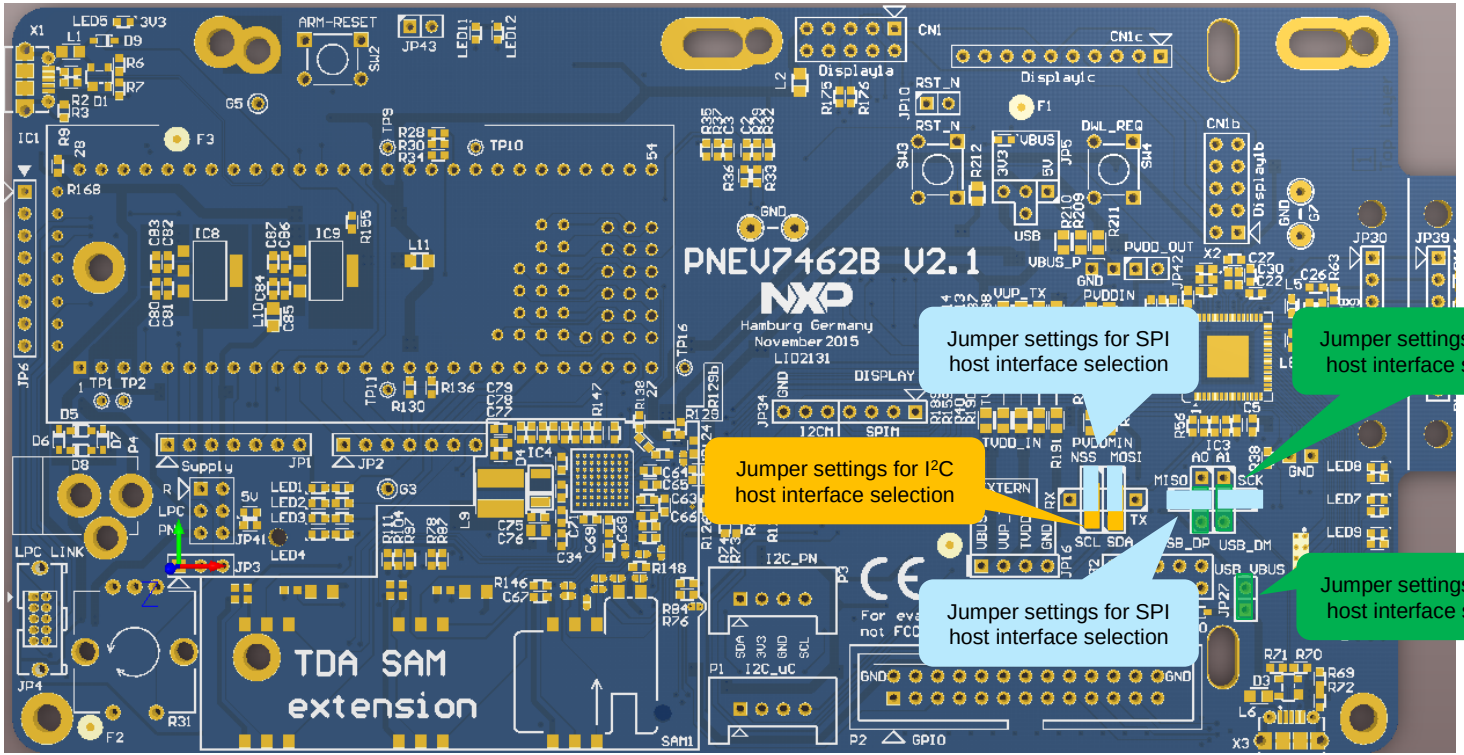
Reference	12NC	Product description
OM27462CDK		PN7462 NFC controller development kit

PN7462AU hardware introduction



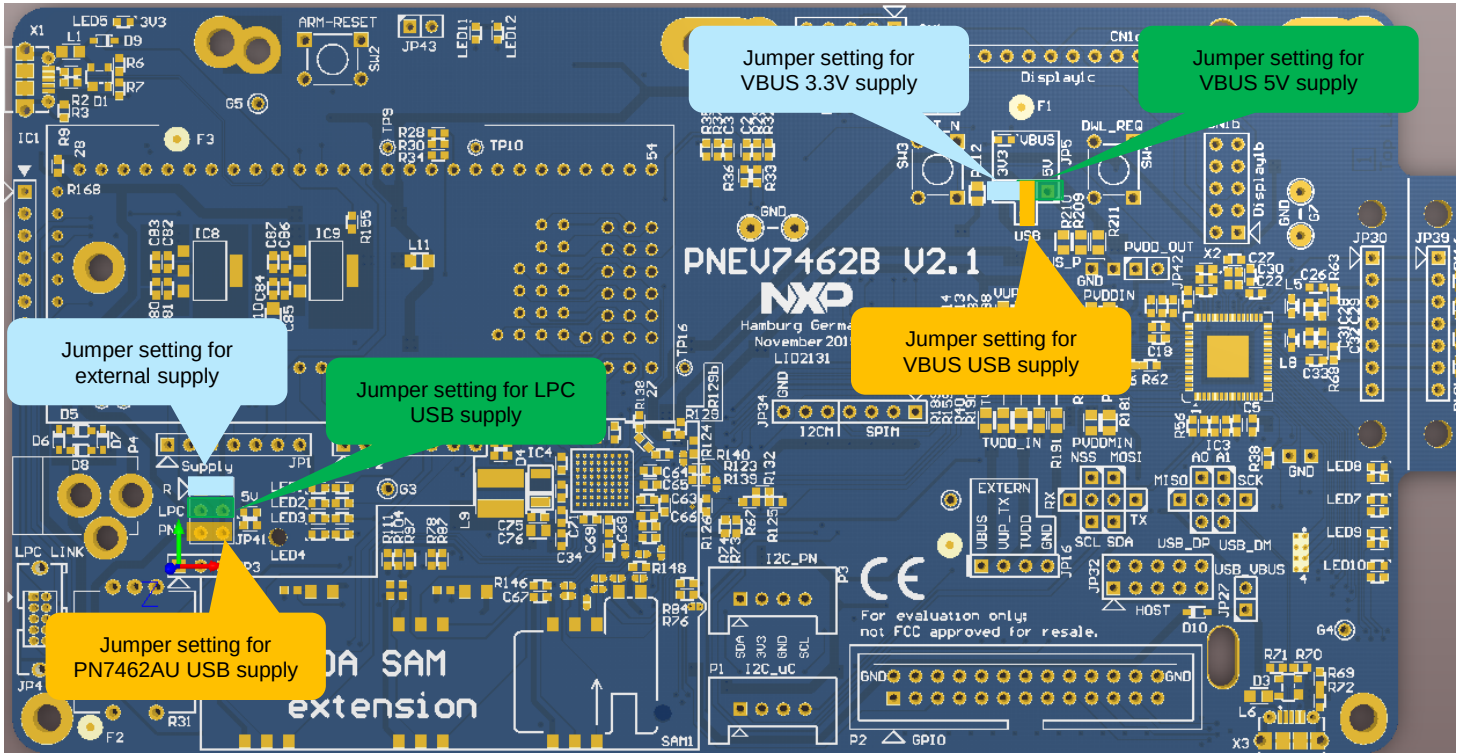
PN7462AU hardware introduction

Host interface selection



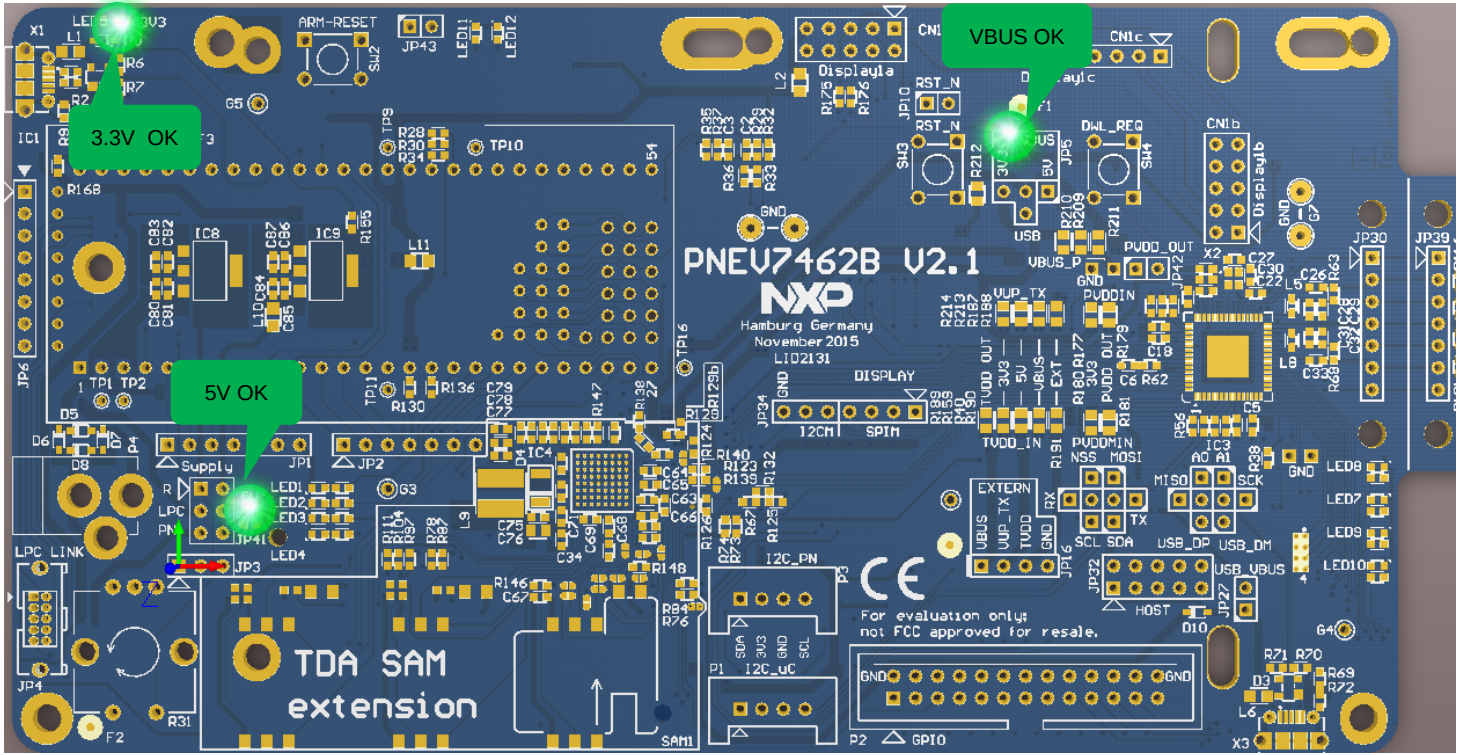
PN7462AU hardware introduction

Board and PN7462 supply settings



PN7462AU hardware introduction

Supply status LED indicators



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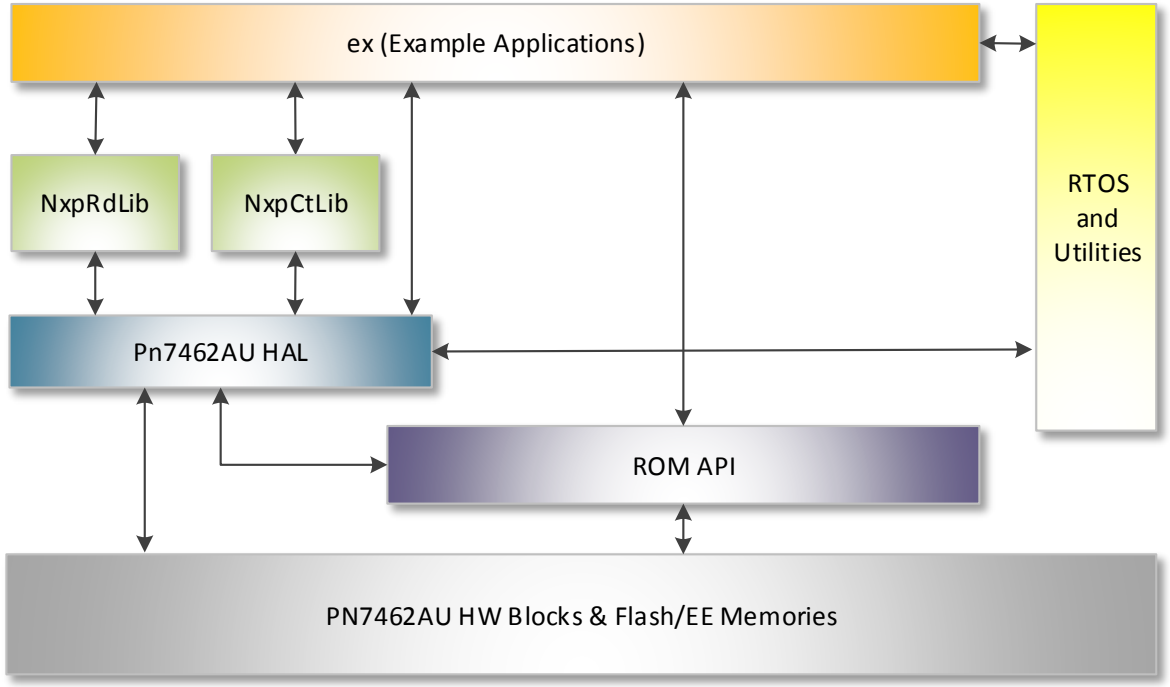
PN7462AU SW architecture stack

- The PN7462AU Firmware is modular software written in C language.
- It provides an API that enables customers to create their own contact and contactless software stack and applications for the PN7462AU.
- The SW stack consists of 4 main layers:
  - Application and example layer
  - Protocol abstraction layer
  - Hardware abstraction layer
  - RTOS and utilizes layer



PN7462AU SW architecture stack

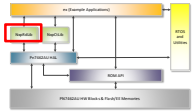
PN7462 HAL

- Hardware abstraction layer (HAL) is responsible for the CPU, communication, memory and utility peripherals.

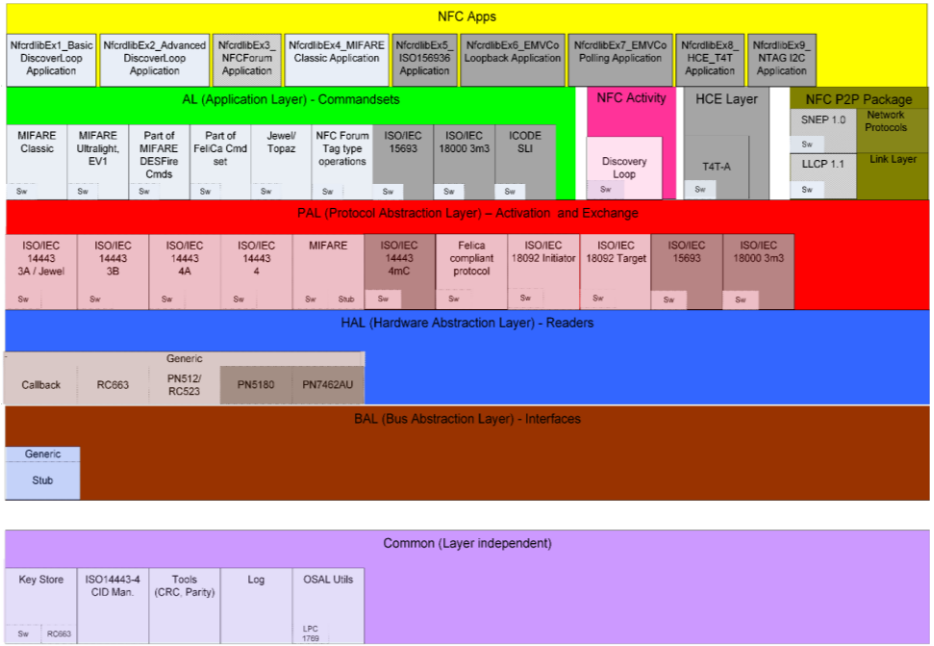
- The HW functions can further be divided into:
  - **Atomic functions:** functions which configure the HW, but don't result in any event from the HW, EEPROM, Flash, CRC, RNG, PMU/ PCR.
  - **Blocking functions**: functions which configure the HW and wait until one or more expected events occur from the HW. CLIF HAL, CT HAL, I2CM/ SPIM HAL
  - **Non-blocking functions:** functions which configure the HW and expect one or more events, but don´t wait until they occur. The events are notified to the caller of the function. Timer, Host interface.

PN7462AU SW architecture stack

PN7462 NXP NFC contactless protocol library



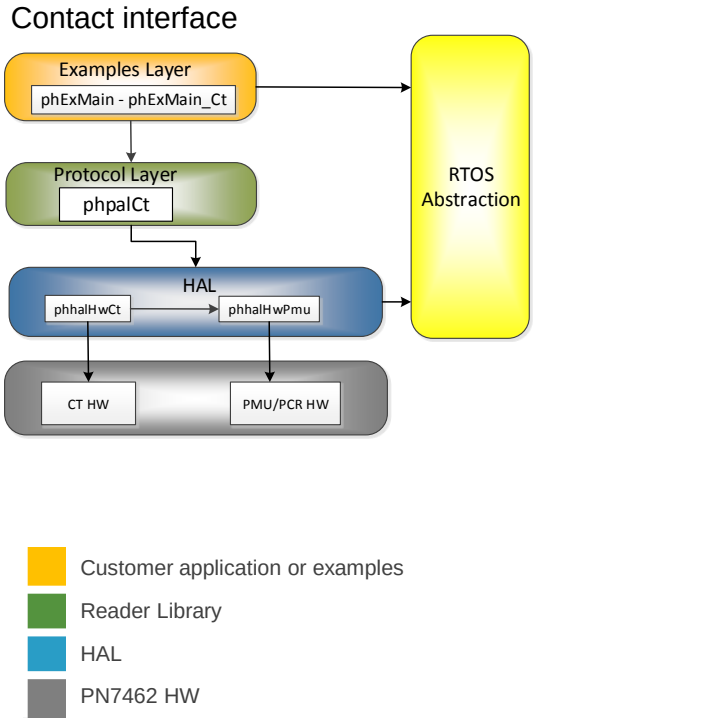
- The NFC Reader Library implements for PN7462AU application development:
  - Contactless protocol components
  - Application components.
  - ISO/IEC contactless standard protocol components
- Protocol abstraction Layer (PAL)
  - Implement HW independent communication protocols for contactless
- Application Layer (AL)
  - Customer applications shall be implemented in the application layer and can directly use HAL APIs or APIs from the PAL libraries.



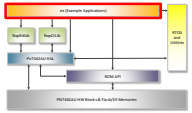
PN7462AU SW architecture stack

PN7462 NXP contact protocol library

- The CT Protocol library can be configured with two different profiles, namely ISO7816 or EMVCo profile.
- **Contact Protocol Abstraction Layer (PAL)**
  - Protocol selection
  - T=0, T=1 management
- **Contact Hardware Abstraction Layer (HAL)**
  - Interface configuration
  - Activation / deactivation
  - Low level transceiver
- **PN7462 Hardware Abstraction Layer (HAL)**
  - Activation / deactivation
  - Card protection
  - Card power supply



PN7462AU PSP SW examples



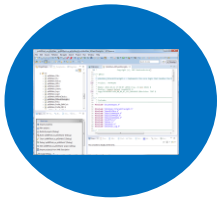
SW project	Description
phExMain	Example which implements the polling for contact and contactless cards. It is the root of many sub examples described below
phExEMVCo	Example which implements the polling for the EMVCo contact and contactless cards and implement reference EMV transaction.
phExRF	Example which implements the polling for contactless cards without NFC Reader Library support. Application use only HAL APIs and perform same CLIF functionality
phExCT	Example which implements simple polling for contact cards. Application use only HAL APIs
phExCTEMVCo	Example which implements the CT functionality with CT Pal library support
phExC7816	Example which implements the CT functionality with CT library support
phExHif	Example which is demonstrating the host interface loop back functionality for I2C, SPI, HSU and master interface functionality for I2CM, SPIM. Besides that it demonstrates secondary downloader functionality to EEPROM and FLASH memory over SPI Host interface.
phExHCE	Example which demonstrates how to use PN7462AU in Host Card Emulation mode
phExLLCP	Example which is demonstrating Peer-To-Peer (P2P) communication between PN7462AU and NFC Device.
phExPOS	POS use-case shows how to use PN7462AU in combination with second application hosted on the µController.
phExCCID	The PC USB reader application demonstrate how to use the PN7462AU Customer Demo board as a CCID reader and shows how connected PN7462AU via USB interface
phExDoorAccess	This document describes “Door Access application” and shows how PN7462AU Customer Demo board can be used in the door access management

PN7462AU SW development environment

What do you need?

PN7462AU SW package

- Folder containing the PN7462AU FW source code and SW examples provided to support PN7462AU. They are ready to import and compile within the LPCXpresso IDE development environment.

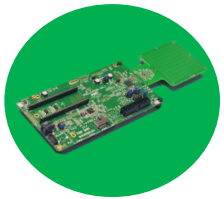


LPCXpresso IDE v8.0

- It is a low-cost development tool platform, available directly from NXP, that provides a quick way to develop advanced applications using NXP's highly efficient and low-power LPC microcontrollers. It includes everything to take end users from evaluation to final products

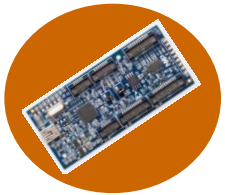
PN7462AU LPCXpresso plugin

- A separate PN7462AU plugin is required for development of PN7462AU firmware via LPCXpresso for operations such as build and download code and access internal peripheral registers of the PN7462AU.



PN7462AU board

- The PN7462AU board enables easy antenna design with the NFC Cockpit software and fast application development with the full NFC Forum compliant and contact software libraries



LPC Link2 board

- It is an extensible, stand-alone debug adapter, that can be connected to virtually any development board, and that supports a broad variety of development tools and IDEs via downloadable firmware images

PN7462AU SW development environment

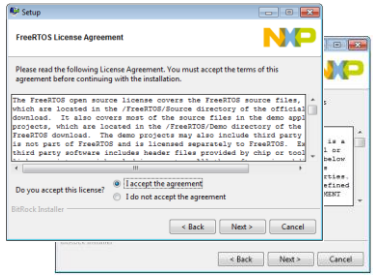
Getting started

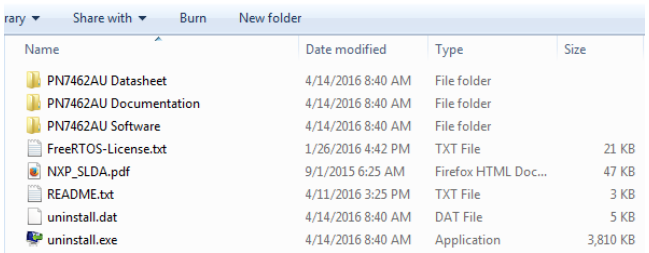
1. Download and install PN7462AU SW package
2. Download, install and activate LPCXpresso IDE
3. Install PN7462AU LPCXpresso plugin
4. Import SW examples into LPCXpresso IDE
5. Build and run or debug a SW example

Setting up PN7462AU SW development environment

Step 1: Download and install PN7462AU SW package

- Download PN7462AU FW and SW examples full version v04_01_00
  - http://cache.nxp.com/documents/software/SW3683.zip
- Unzip and install the SW3683 installer
  - *Accept NXP and FreeRTOS SW licenses*
- Check the installation directory
  - *Datasheet, documentation and SW is extracted*

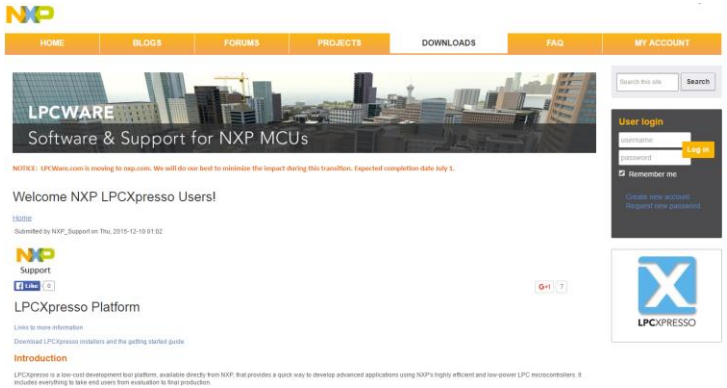




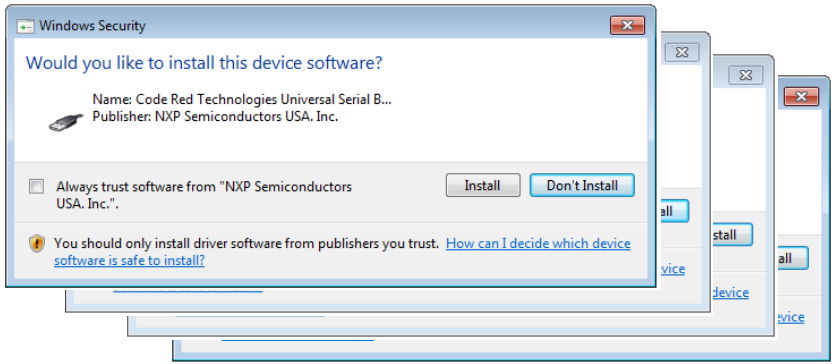
Setting up PN7462AU SW development environment

Step 2: Download and install LPCXpresso IDE

- Download LPCXpresso IDE
  - *Free download at LPCware website*



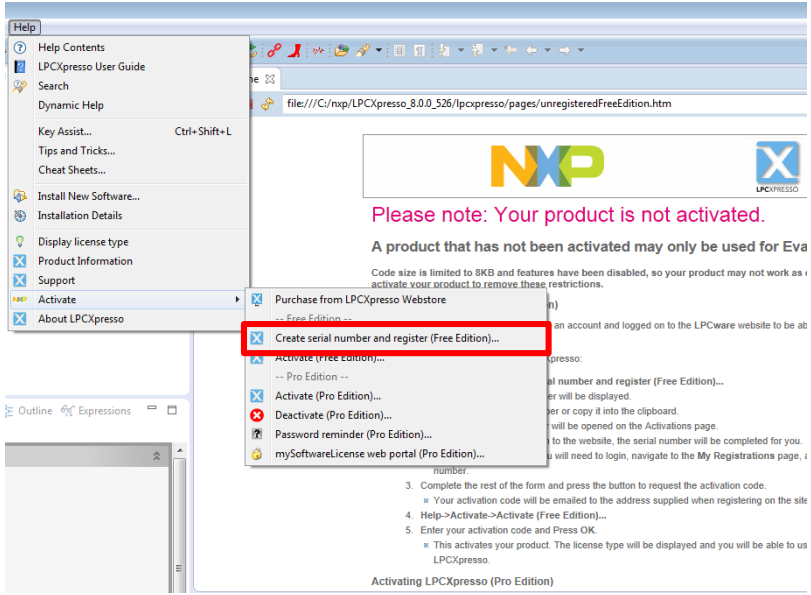
- Accept the installation of the required drivers
  - *NXP LPC-Link1 Debug, NXP LPC-Link2 Redlink and Red Probe debug drivers, etc*

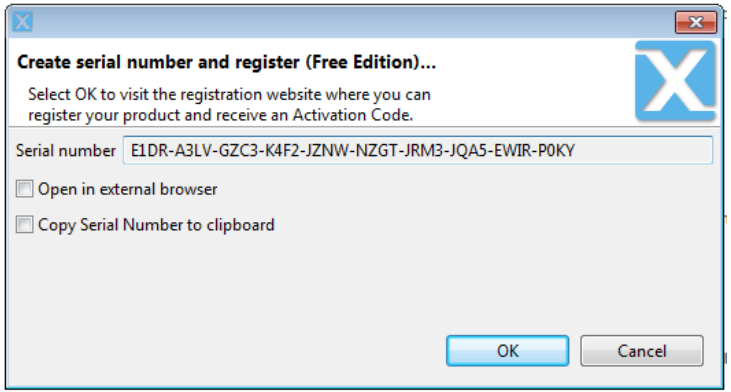


Setting up PN7462AU SW development environment

Step 2: Get serial number for your LPCXpresso copy

- LPCXpresso IDE product activation
  - *Help → Activate LPCXpresso → Create Serial Number*

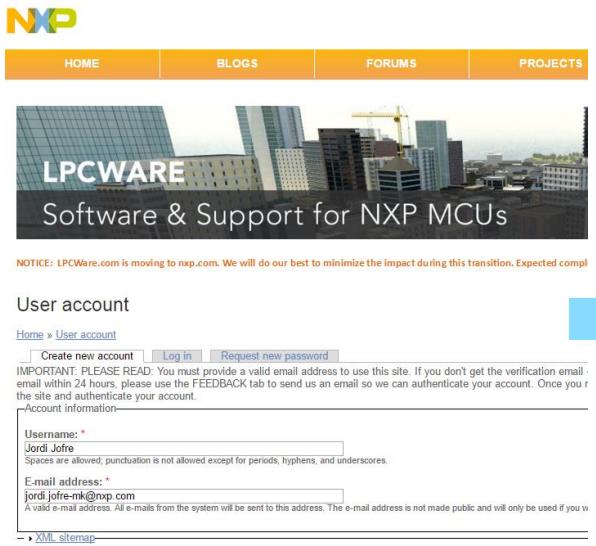


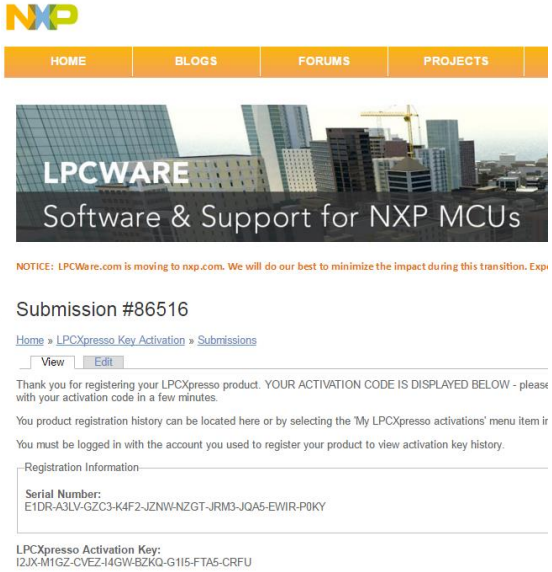


Setting up PN7462AU SW development environment

Step 2: Register and obtain your activation key

- LPCXpresso IDE product activation
  - *Register and obtain your activation key in LPCware website*

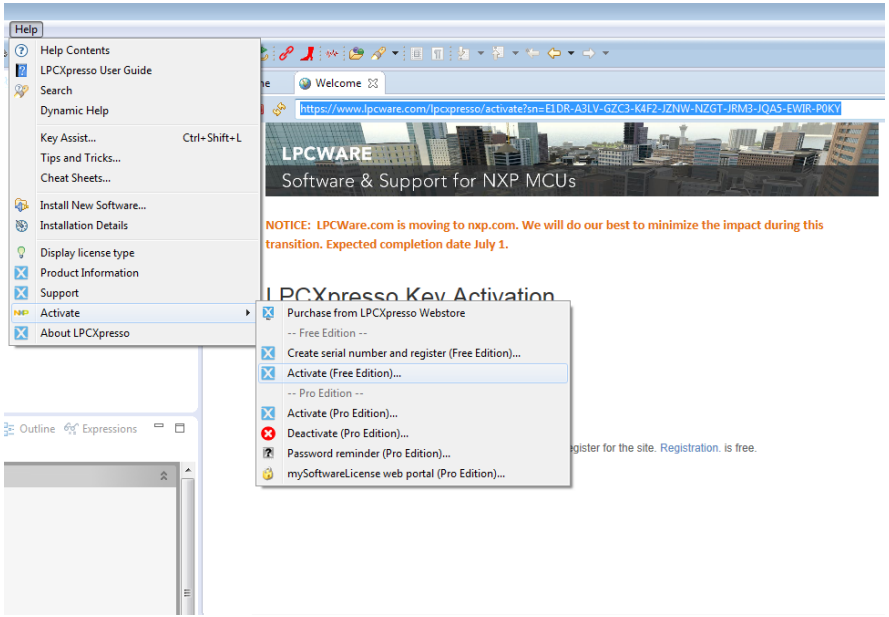


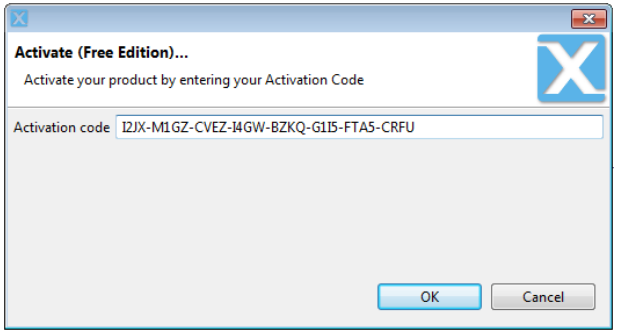


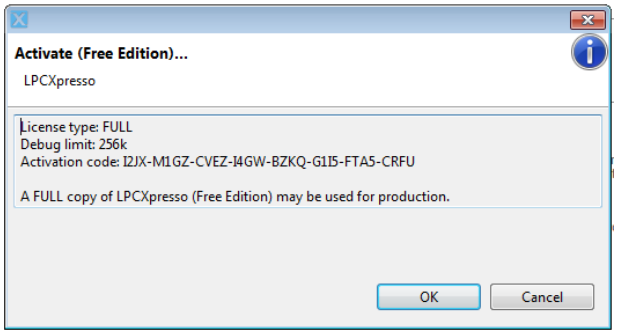
Setting up PN7462AU SW development environment

Step 2: Activate your LPCXpresso copy

- LPCXpresso IDE product activation
  - *Activate your LPCXpresso copy*



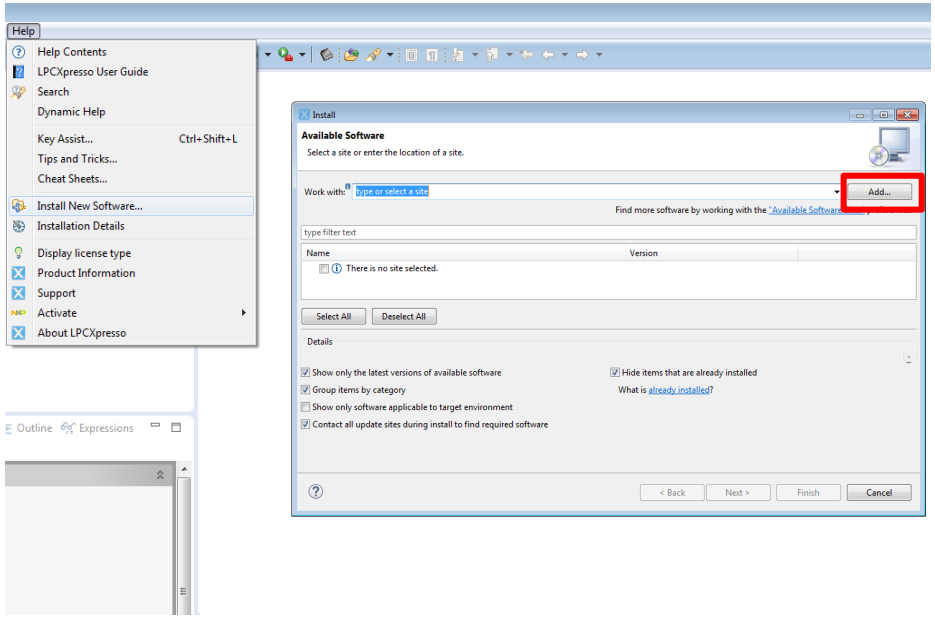


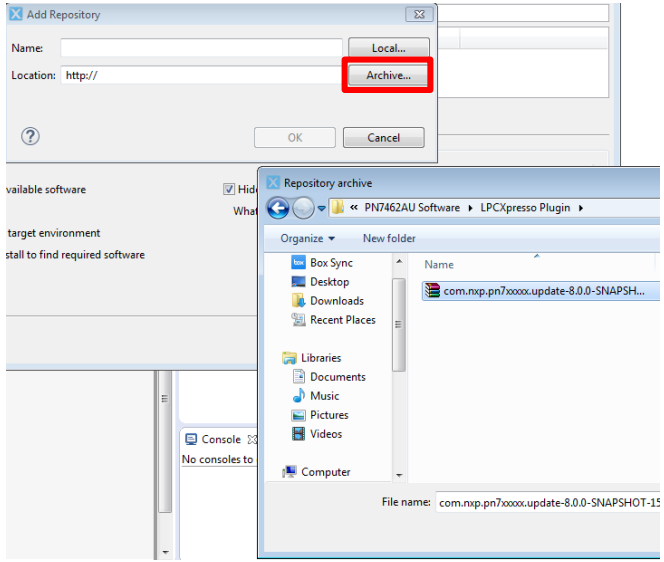


Setting up PN7462AU SW development environment

Step 3: Adding PN7462AU LPCXpresso plugin

- Find PN7462AU LPCXpresso plugin in your installation directory
  - *Your directory → PN7462AU Software → LPCXpresso plugin*

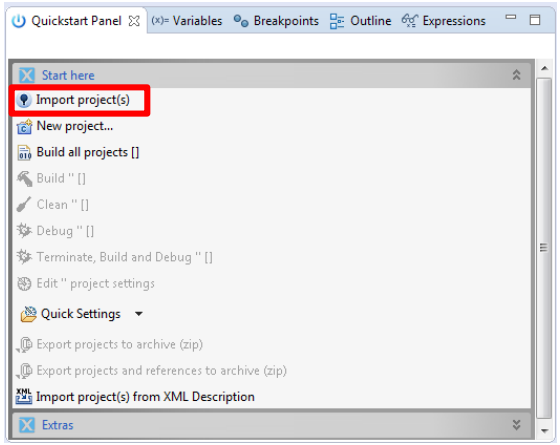


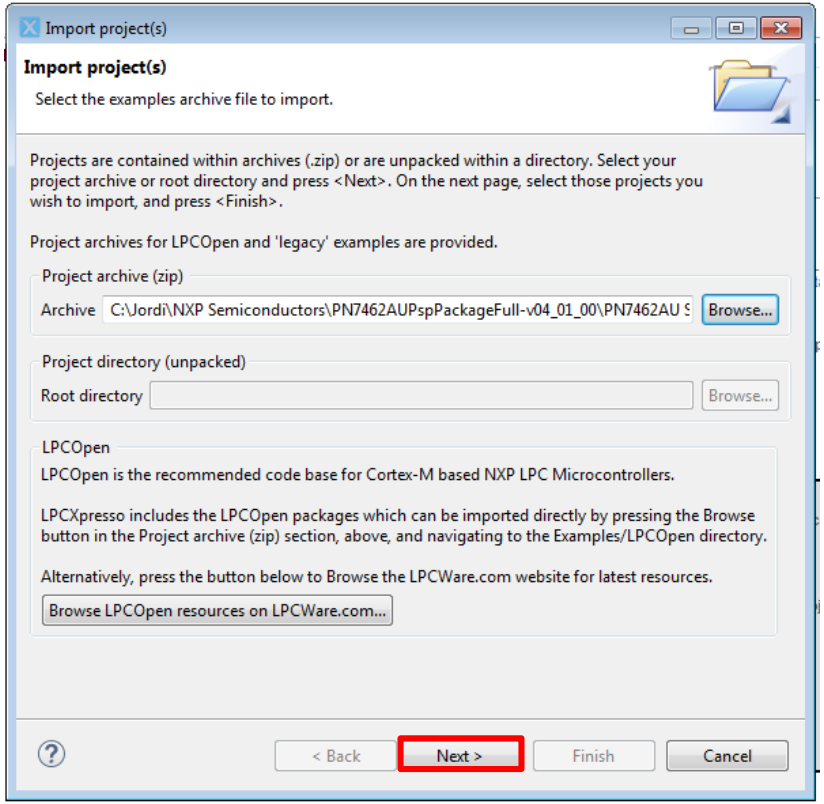


Setting up PN7462AU SW development environment

Step 4: Importing provided SW example projects

- Start the LPCXpresso IDE and select new workspace
- Select the option Import Projects
- Browse the zip archive in your installation directory

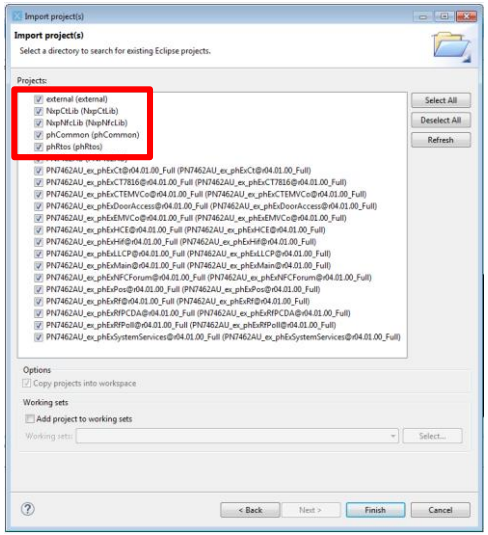


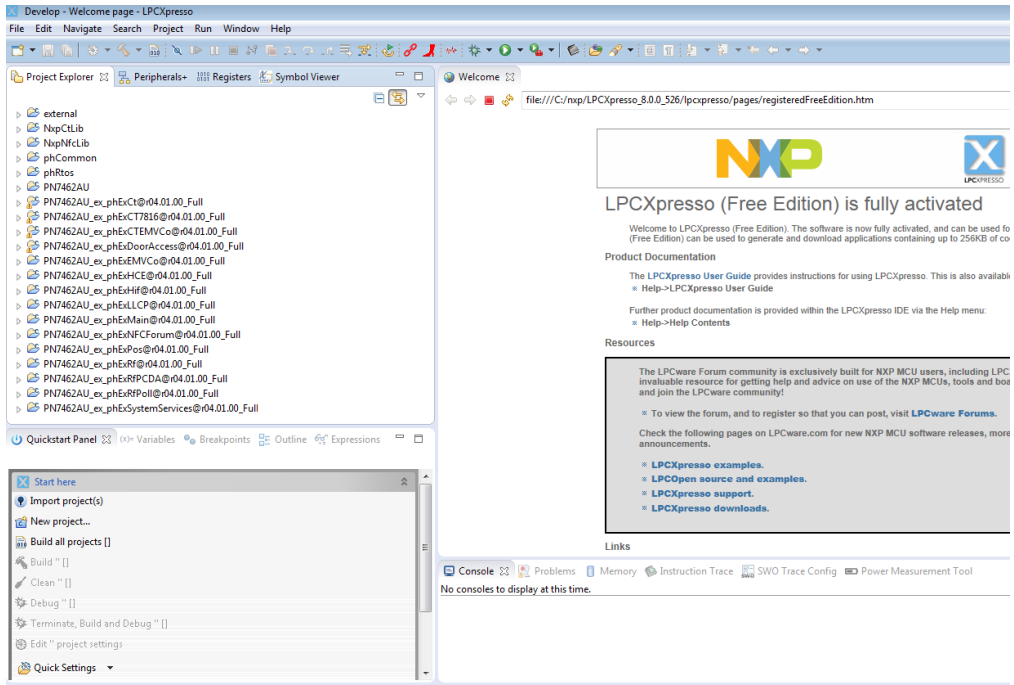


Setting up PN7462AU SW development environment

Step 4: Importing provided SW example projects

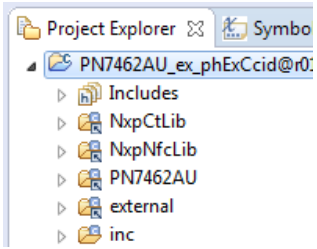
- LPCXpresso IDE unzips the SW package
- SW examples packages are ready for use



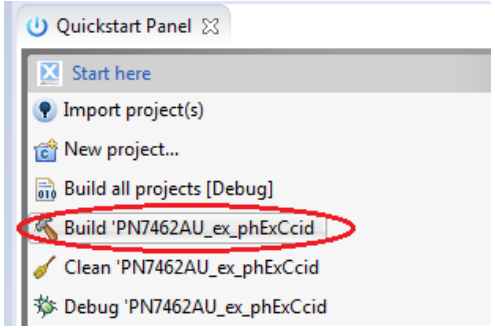


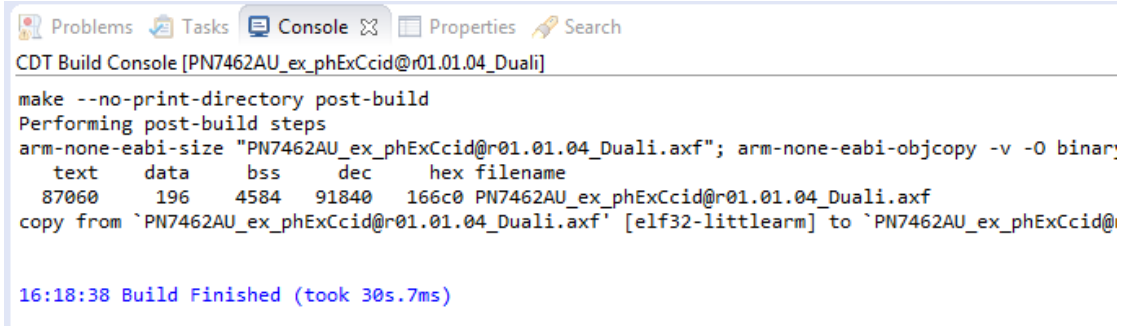
Setting up PN7462AU SW development environment

Step 5: Build a SW example using LPCXpresso IDE



- Connect the PN7462AU customer demo board
  - PC + LPC-Link2 + Customer demo board
- Select project from the Project Explorer view
- Press build from the Quickstart Panel

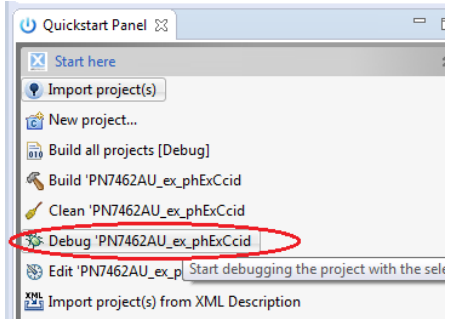


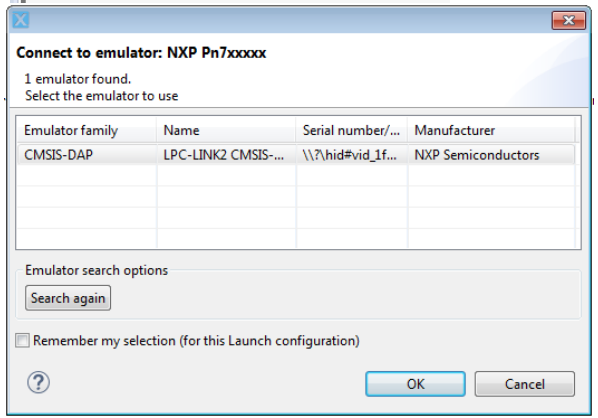


After the build process, you can see the size of the image in the console window

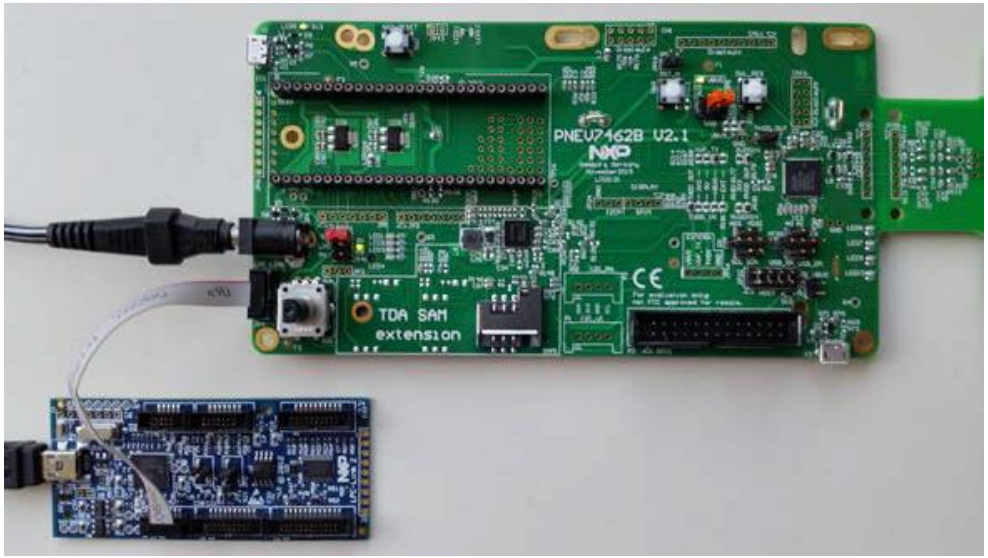
Setting up PN7462AU SW development environment

Step 5: Debugging a SW example using LPCXpresso IDE





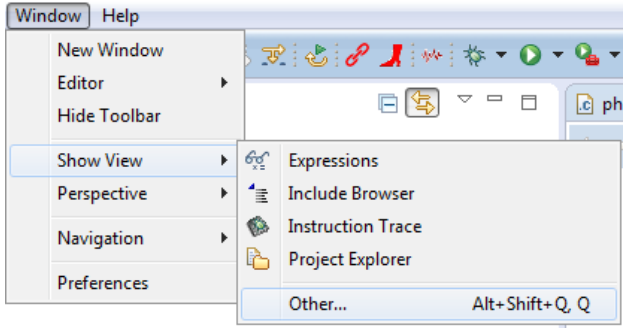
- Select “debug” option in the quick start panel
  - Select the right emulator

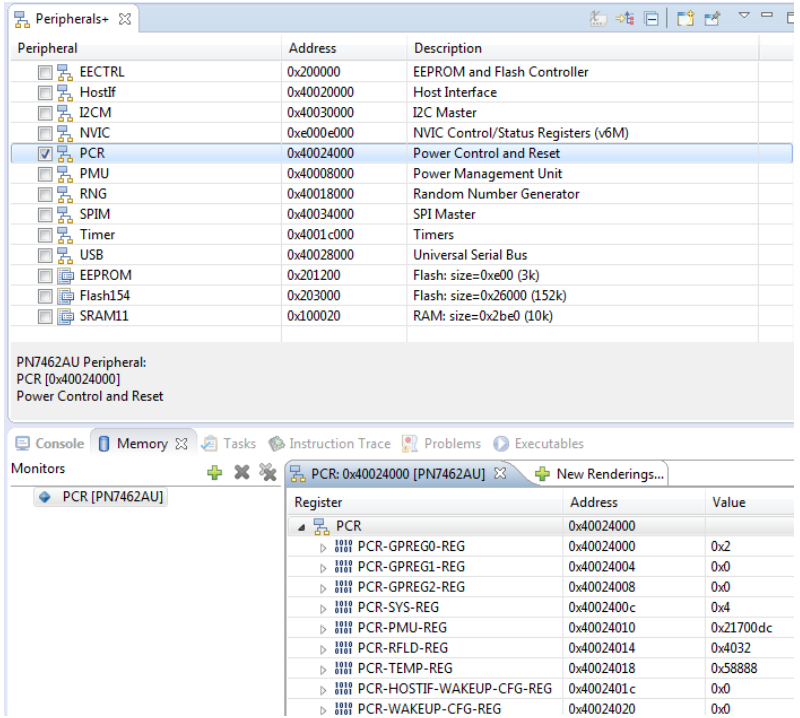


Setting up PN7462AU SW development environment

Step 5: Peripheral view

- Go to window → show view → other → select “peripherals”
- Go to debug mode
  - Direct access to PN7462AU registers
  - Direct access to PN7462 memory
- Select the relevant peripheral
- You will see the register, bit fields and description

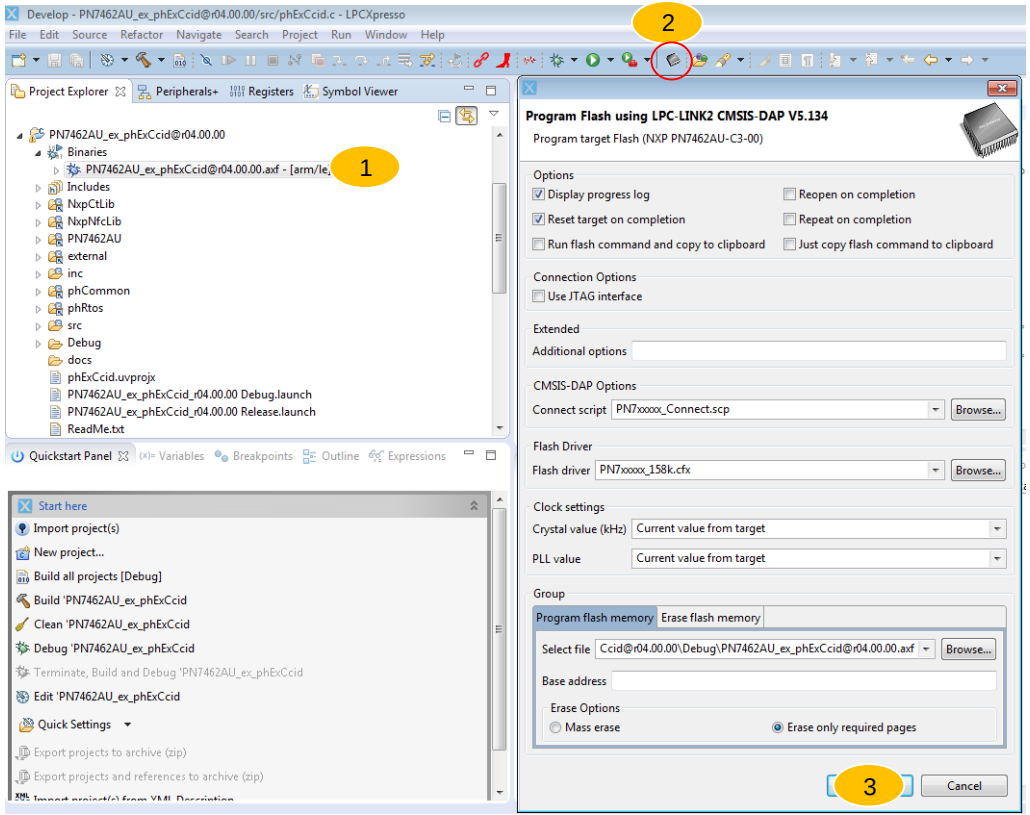




Setting up PN7462AU SW development environment

Step 5: Flashing a SW example using LPCXpresso IDE

- Select build output binary file
- Click on the “program flash option”
- Ensure that all the options are set properly and click OK

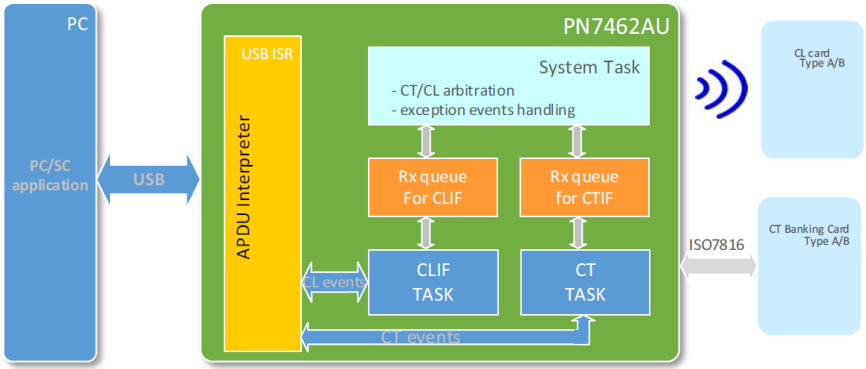


PN7462AU SW development

Example: *Running and using PN7462AU PC CCID SW example*

PN7462AU PC CCID SW example

- The CCID reader example describes how to connect PN7462AU by USB interface to a PC and provide the CCID protocol implementation on the top of the physical link.
- The CCID reader example can be tested with any PC/SC application running on the PC with Windows OS.
- PN7462AU CCID reader application has the following modules:
  - **USB ISR:** send and receive the CCID class commands
  - **System task:** Responsible for initiating CT/CL task messages, notifications and any exceptions
  - **Contactless task**: Wait for messages from system task to start CL task for polling.
  - **Contact task**: Wait for messages from system task to start CT task for card activation



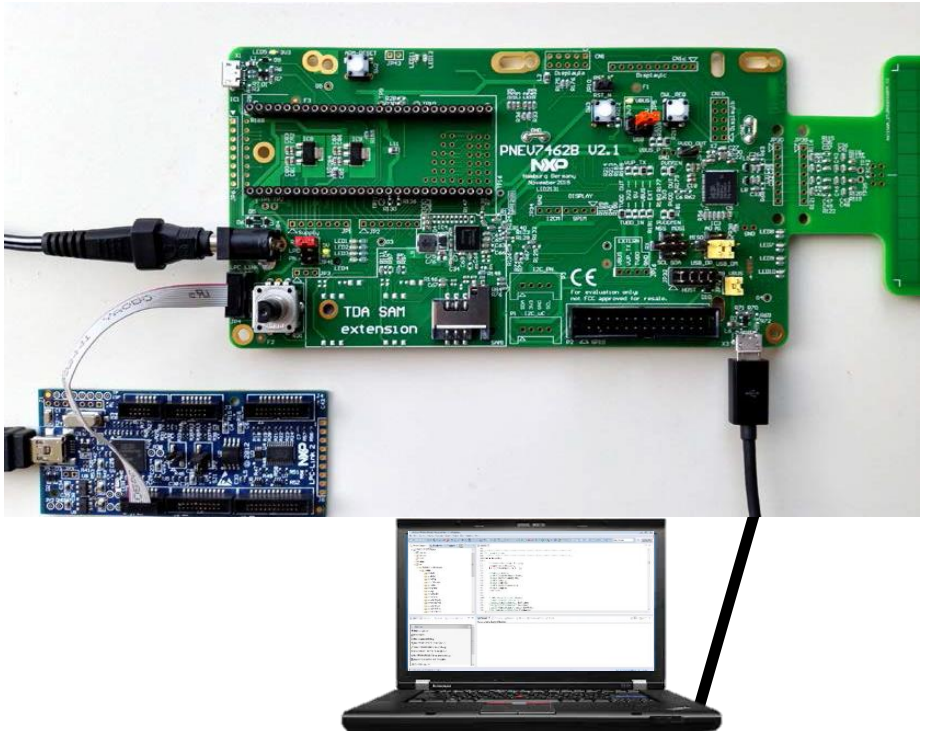
PN7462AU PC CCID SW example

HW components to run this demo

- To prepare the HW environment, components listed in the table below are required.

Item	Purpose
PN7462AU	Demoboard for running the project
LPC-Link2	Stand-alone debug adapter
USB cable	For PC connection
Power adapter	Board supply

Note: External Power Adapter is not mandatory, the board can be supplied by USB only



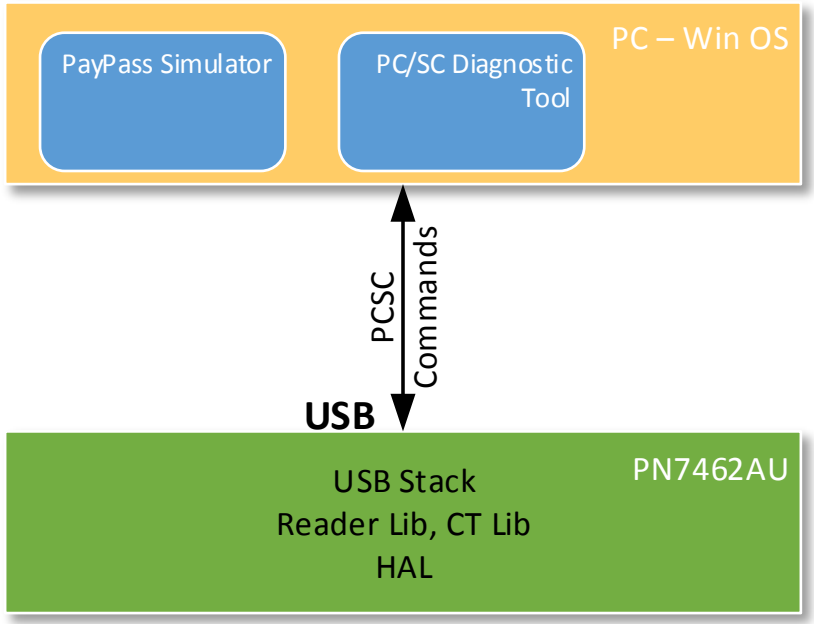
PN7462AU PC CCID SW example

Running and using the example

1. Download and import the PC CCID Reader application source code in LPCXpresso environment
2. Build and compile the SW project.
3. Debug SW project

4. Execute PC PayPass Simulator tool
    1. Perform a contactless payment transaction
    2. Perform a contact payment transaction

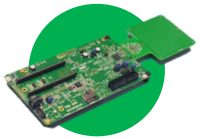
5. Execute SCRTester tool
    1. Perform an authentication with a MIFARE Classic card
    2. Read a MIFARE Classic data block



PN7462 product support package in a nutshell

NFC Controller development kit	› PN7462 NFC controller development kit OM27460CDK
PN7462AU FW and SW examples	› SW3683 – Installer package PN7462AU FW and SW Examples full version v4.0_01_00
PN7462AU NFC Cockpit	› SW3683 - Installer package PN7462 NFC Cockpit v1.3
Documentation	› AN11706 – PN7462AU Antenna design guide › AN11738 – PN7462AU Contact smartcard application › AN11784 – PN7462AU How to integrate RTOS › AN11785 – PN7462AU LPCD and standby mode › UM10833 – PN7462 Quick start guide – customer board › UM10913 – Software user manual › UM10957 – PN7462AU Door access user manual › UM10915 – PN7462AU PC CCID reader user manual › UM10951 – PN7462 Reference POS application

PN7462AU NFC Cockpit



PN7462AU board

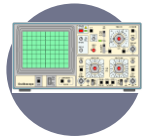
- The PN7462AU board enables easy antenna design with the NFC Cockpit software and fast application development with the full NFC Forum compliant and contact software libraries

PN7462AU NFC Cockpit FW

- The PN7462AU NFC Cockpit tool expects a specific firmware to already be part of the PN7462AU board. The firmware binary for this purpose is provided with the installer. The firmware is coupled with the EEPROM layout existing in the IC.

PN7462AU NFC Cockpit

- The PN7462AU NFC Cockpit is a PC based interface (GUI) which allows you to control the PN7462AU for development and customer support. It gathers in one window all the needed functions.

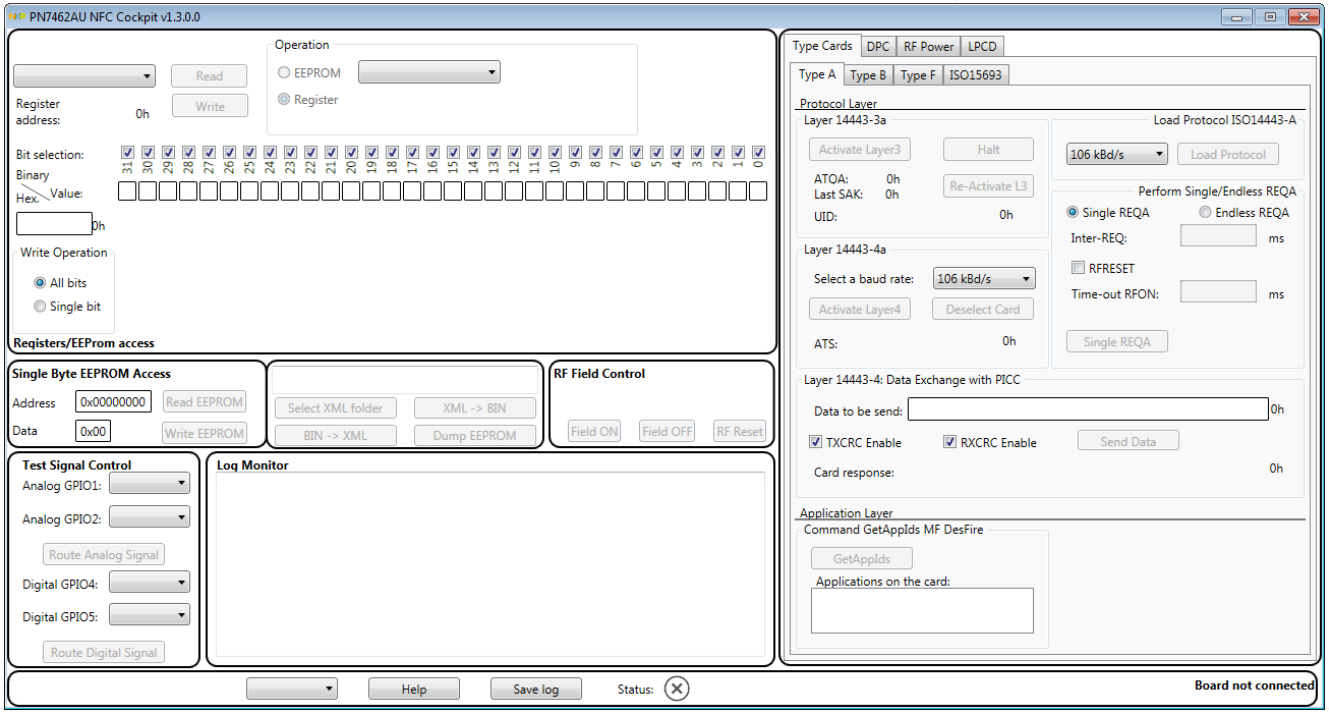


Lab equipment

- Other equipment you may need depending on the tests and measurements to be performed (e.g. oscilloscope, waveform generator, vector network analyzer, probes, multimeter, reference PICCs, wires, components, etc.)

PN7462AU NFC Cockpit, the complete design tool for engineers

- The NFC Cockpit is a PC based interface which allows you to easily control all PN7462 functions.
- The support tool is composed of these parts:
  - Registers and EEPROM access
  - Low Power Card Detect(LPCD)
  - Dynamic Power Control(DPC)
  - Test signals control
  - Generic commands
  - Log monitor
  - Type cards
  - Status bar



PN7462AU NFC Cockpit

Getting started

1. Download and install PN7462AU NFC Cockpit package and related drivers
2. PN7462AU NFC Cockpit HW preparation
3. Flashing PN7462AU NFC Cockpit FW into PN7462AU board
4. Start PN7462AU NFC Cockpit and provide directory for EEPROM and XML files
5. Perform your tests and generate a EEPROM binary with your device configuration

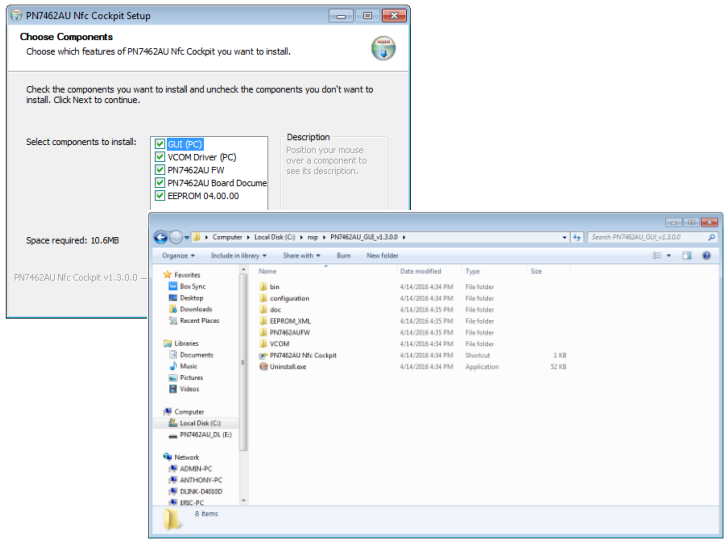
PN7462AU NFC Cockpit

Step 1: Download and install PN7462AU NFC Cockpit package and related drivers

- Download PN74612AU NFC Cockpit
  - http://cache.nxp.com/documents/software/SW3707.zip

- Unzip and install the SW3707 installer
  - *Accept NXP SW licenses*

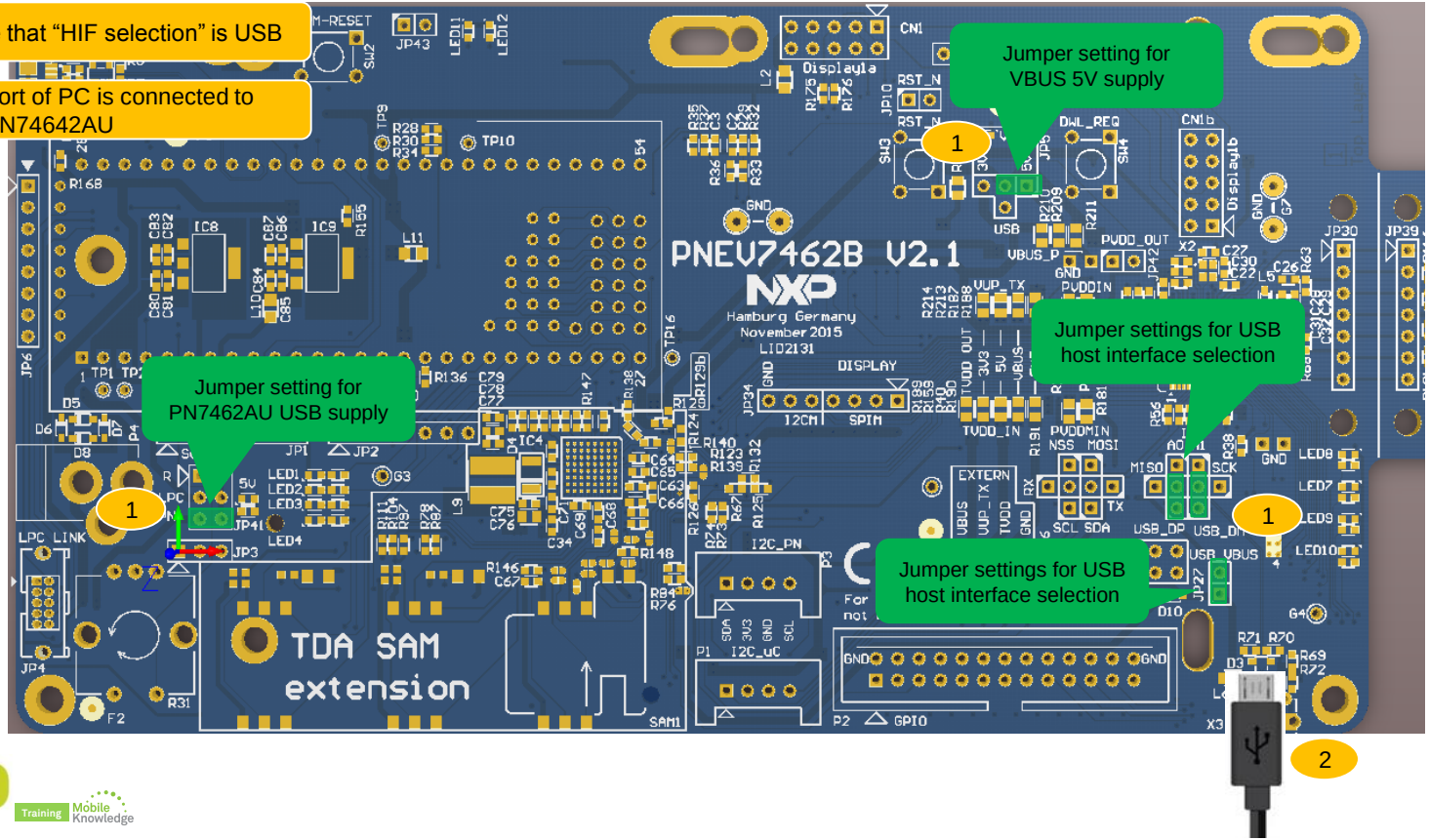
- Install all the components
  - *GUI, VCOM driver, PN7462AU FW, EEPROM XML, etc*



PN7462AU NFC Cockpit

Step 2: HW preparation

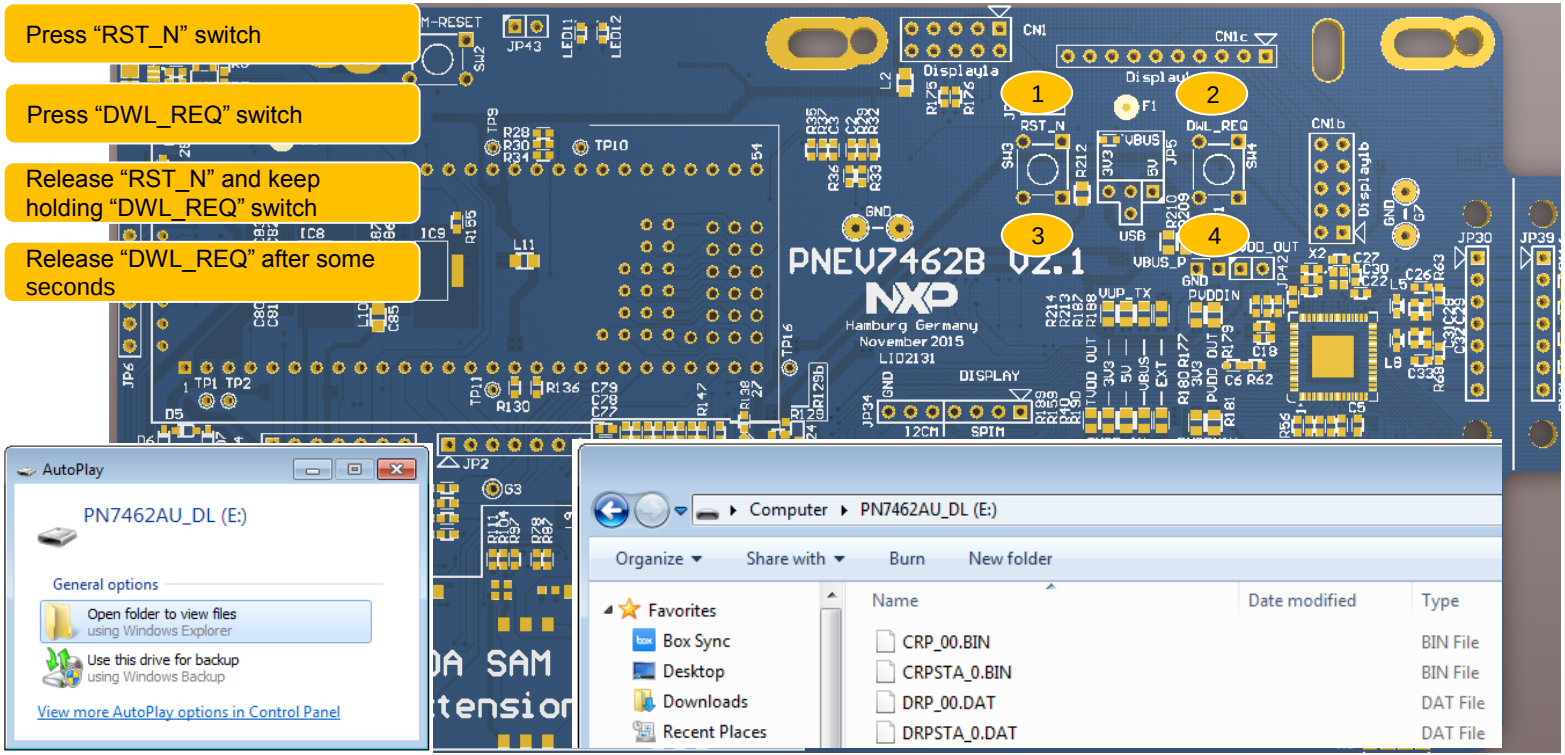
1. Ensure that “HIF selection” is USB
2. USB Port of PC is connected to USB-PN74642AU



PN7462AU NFC Cockpit

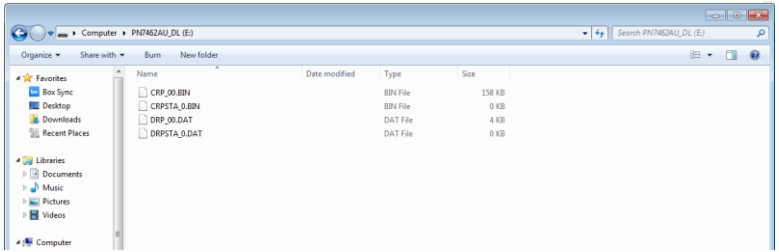
Step 3: Flash NFC Cockpit FW - Mounting USB as mass storage

1. Press “RST_N” switch
2. Press “DWL_REQ” switch
3. Release “RST_N” and keep holding “DWL_REQ” switch
4. Release “DWL_REQ” after some seconds

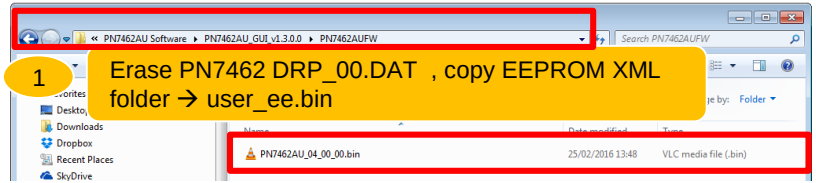


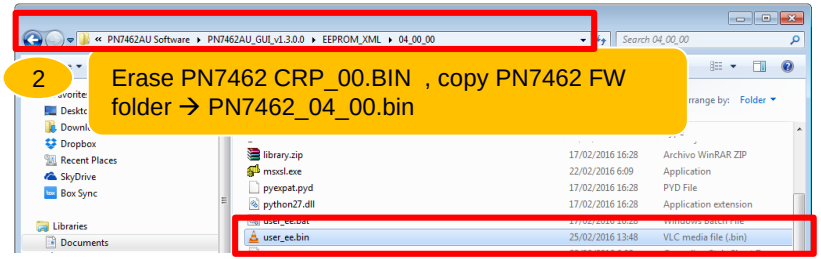
PN7462AU NFC Cockpit

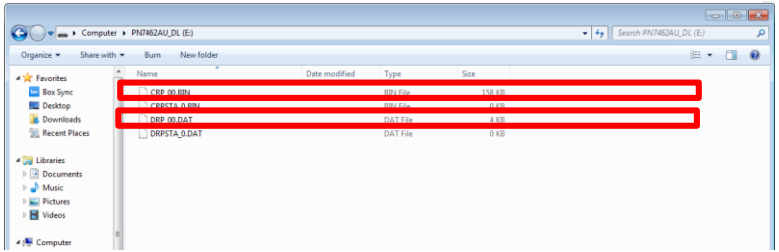
Step 3: Update binary for the EEPROM and FW



File	Description
CRP_<nn>.BIN	PN7462AU user flash code
CRPSTA_<s>.BIN	Status of previous write operation to user flash
DRP_<nn>.DAT	PN7462AU user EEPROM data
DRPSTA_<s>.DAT	Status of previous write operation to user EEPROM



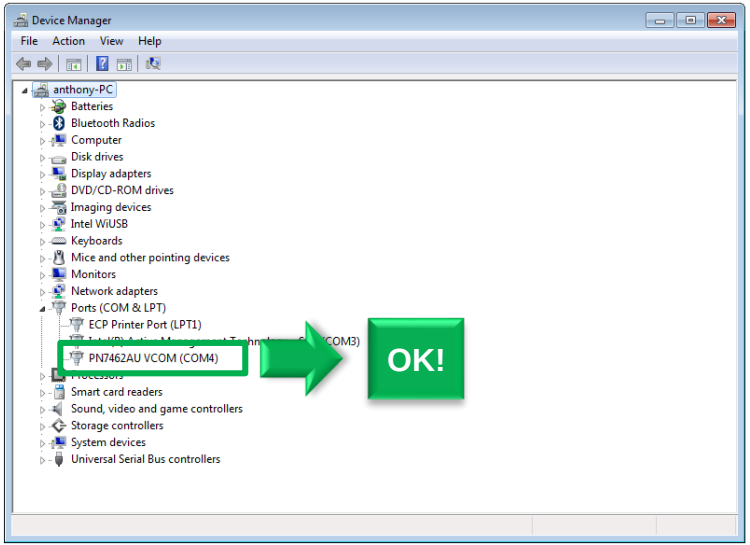




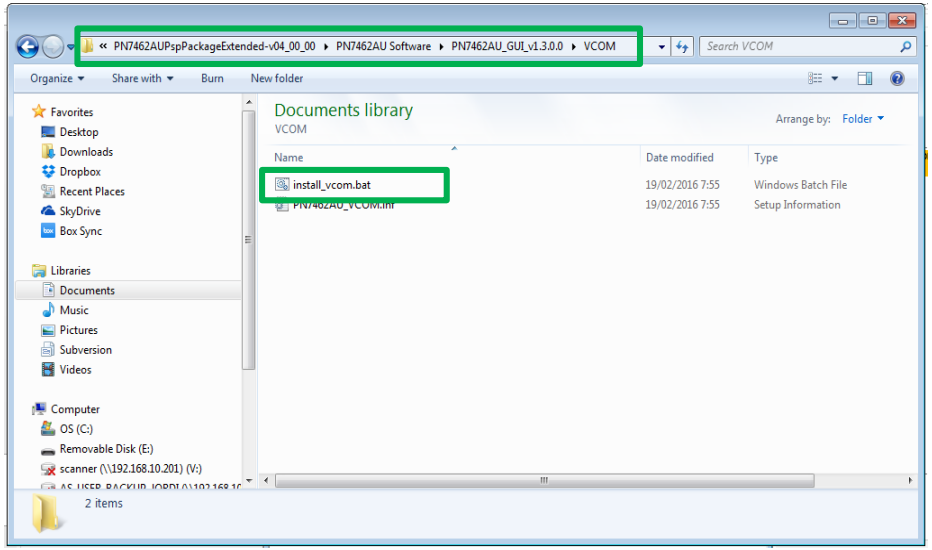
PN7462AU NFC Cockpit

Step 3: Check VCOM driver is installed

- Check VCOM driver is installed and recognized

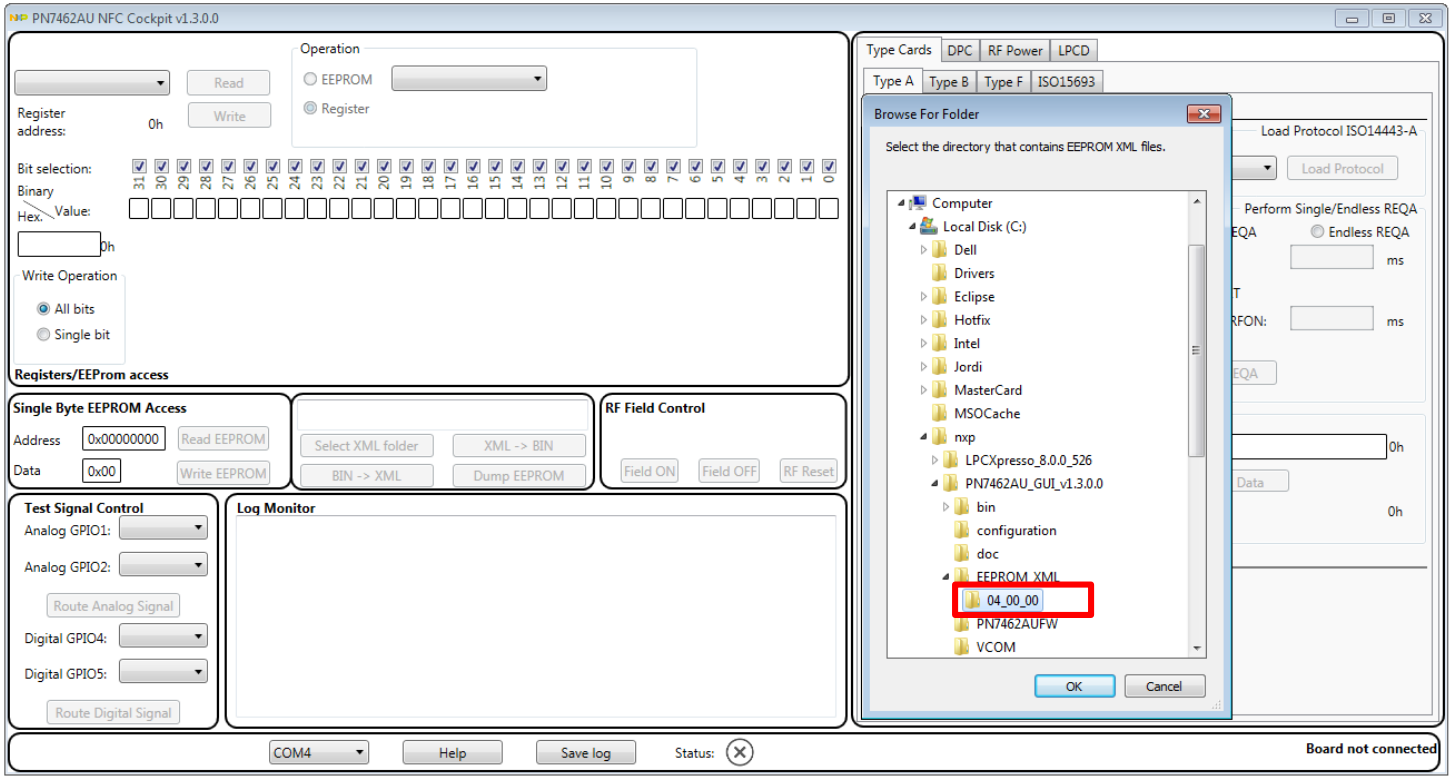


- If VCOM driver is not automatically installed, manually install it running with administrator rights *install_vcom.bat*



PN7462AU NFC Cockpit

Step 4: Open NFC Cockpit and init EEPROM XML folder

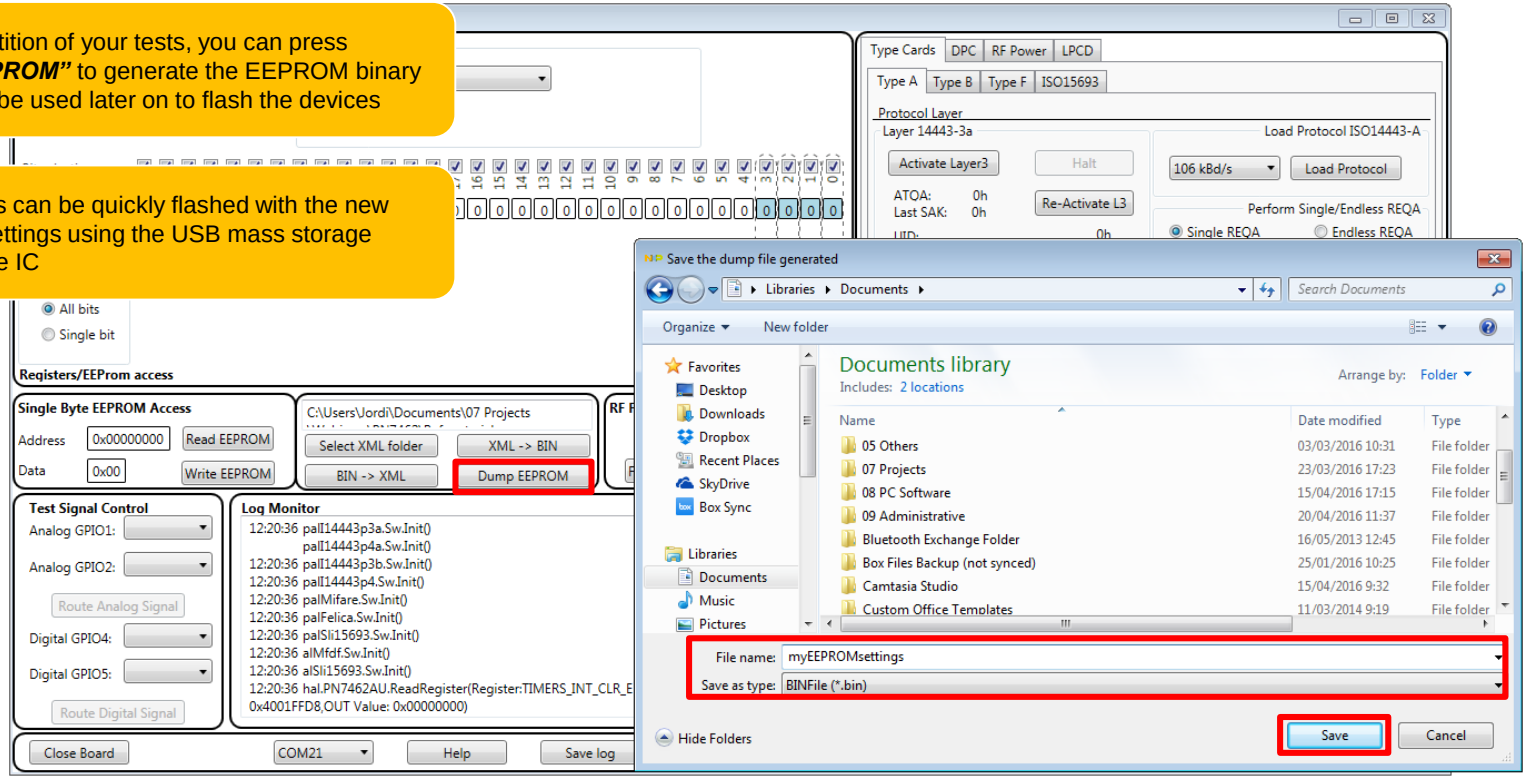


PN7462AU NFC Cockpit

Step 5: Dump EEPROM settings

After competition of your tests, you can press ***"Dump EEPROM"*** to generate the EEPROM binary file that can be used later on to flash the devices

Your devices can be quickly flashed with the new EEPROM settings using the USB mass storage feature of the IC



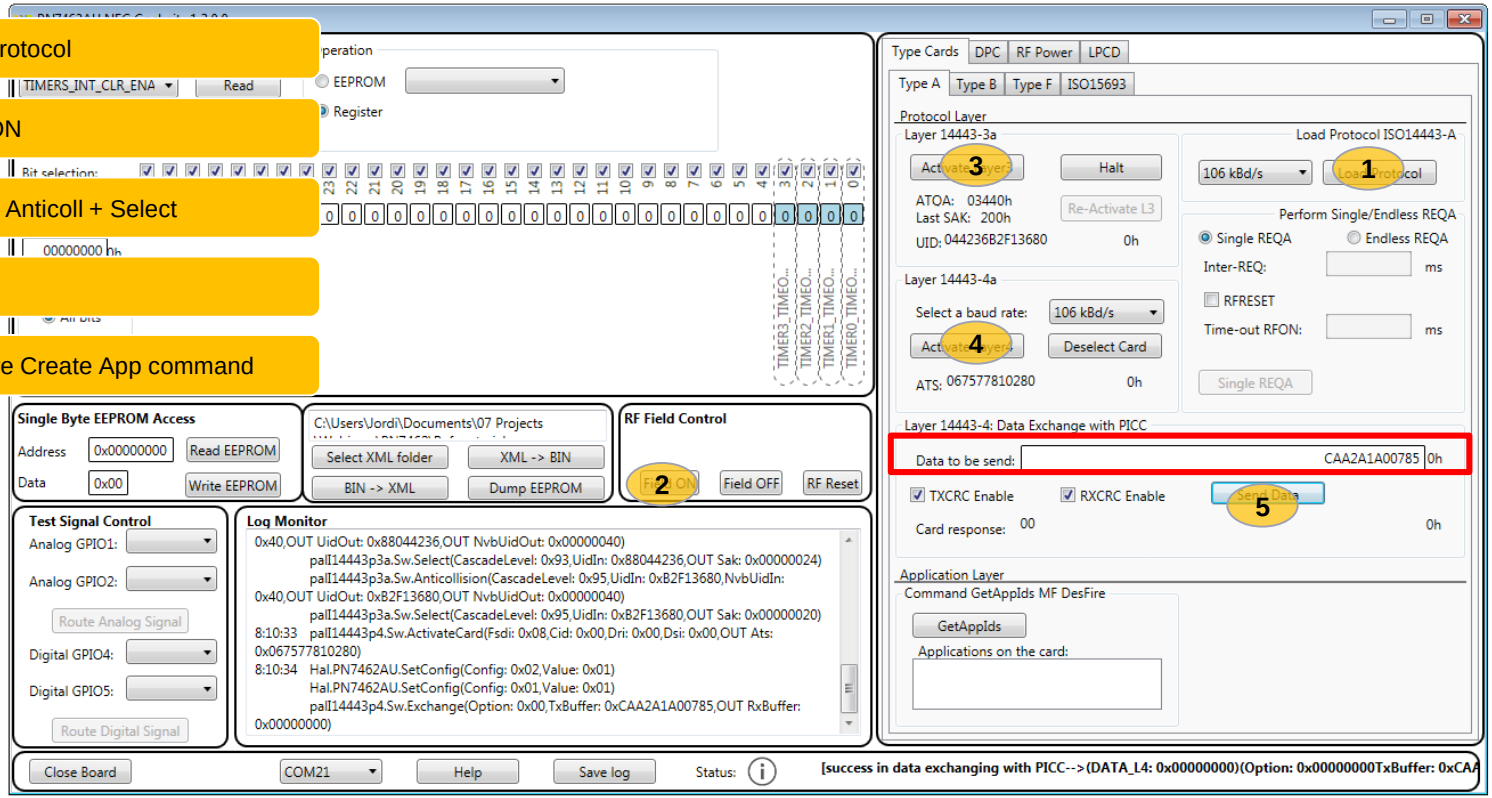
PN7462AU NFC Cockpit

Simple demonstration of use

PN7462 NFC Cockpit: *Reader mode*

"*Create application*" command to a MIFARE DESFire card

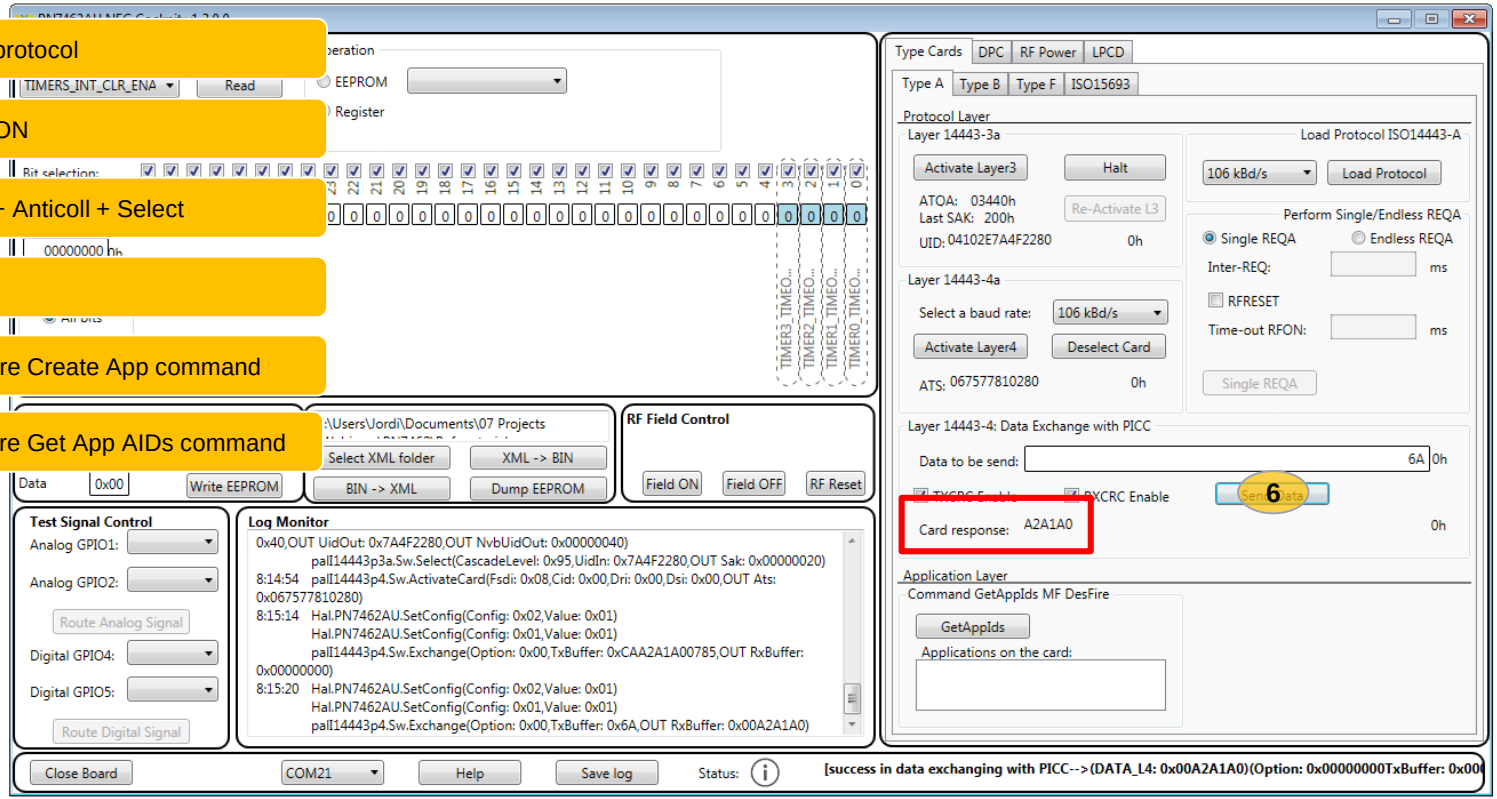
1. Load protocol
2. Field ON
3. REQ + Anticoll + Select
4. RATS
5. DESFire Create App command



PN7462 NFC Cockpit: *Reader mode*

"Get Application AIDs" command to a MIFARE DESFire card

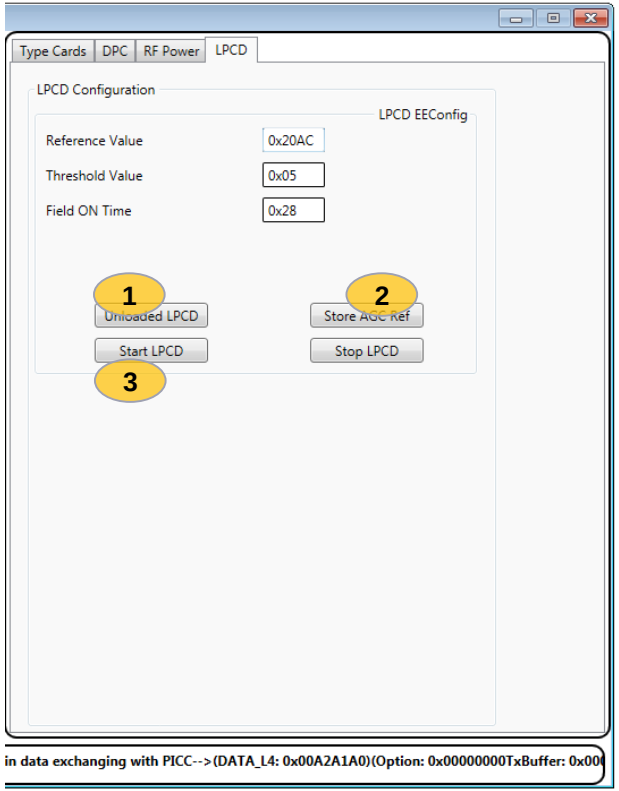
1. Load protocol
2. Field ON
3. REQ + Anticoll + Select
4. RATS
5. DESFire Create App command
6. DESFire Get App AIDs command



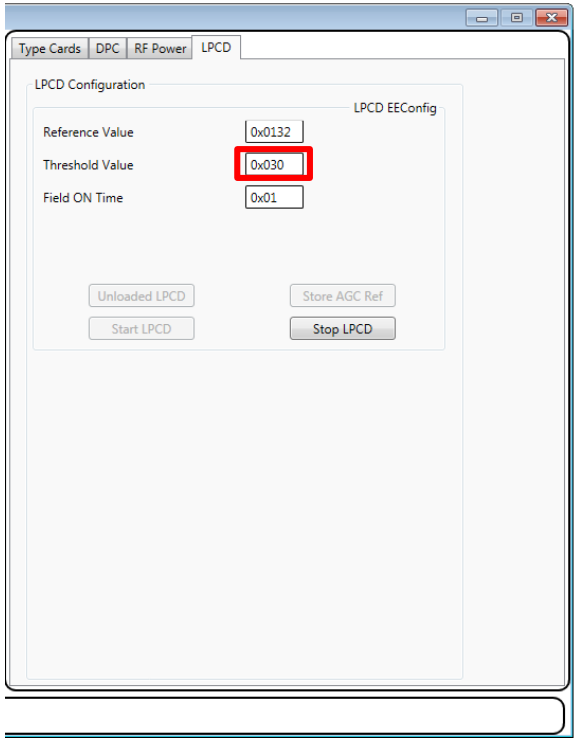
PN7462 NFC Cockpit:
Low-power card detection (LPCD)

- The low-power card detection (LPCD) is an energy saving configuration option for the PN5180.
- The LPCD works in two phases:
  - **Standby phase**: Controlled by a wake-up counter and which timing can be defined
  - **Detection phase**: The RF field is switched on for a defined interval and the current AGC value is compared against a reference value.
    - If the current AGC value exceeds the reference value + the defined threshold → card detected
    - Otherwise, chip moves to standby phase again.

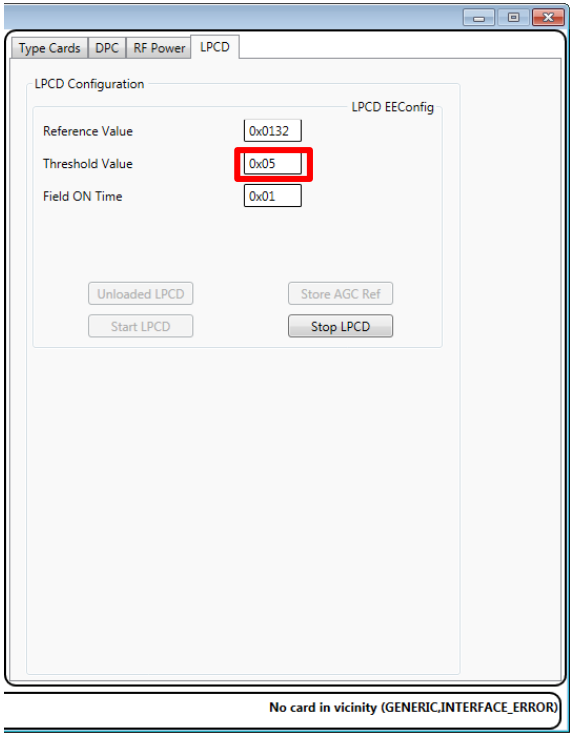
For more details about LPCD, refer to AN



PN7462 NFC Cockpit:
Low-power card detection (LPCD)



PN7462 NFC Cockpit:
Low-power card detection (LPCD)



PN7462 product support package in a nutshell

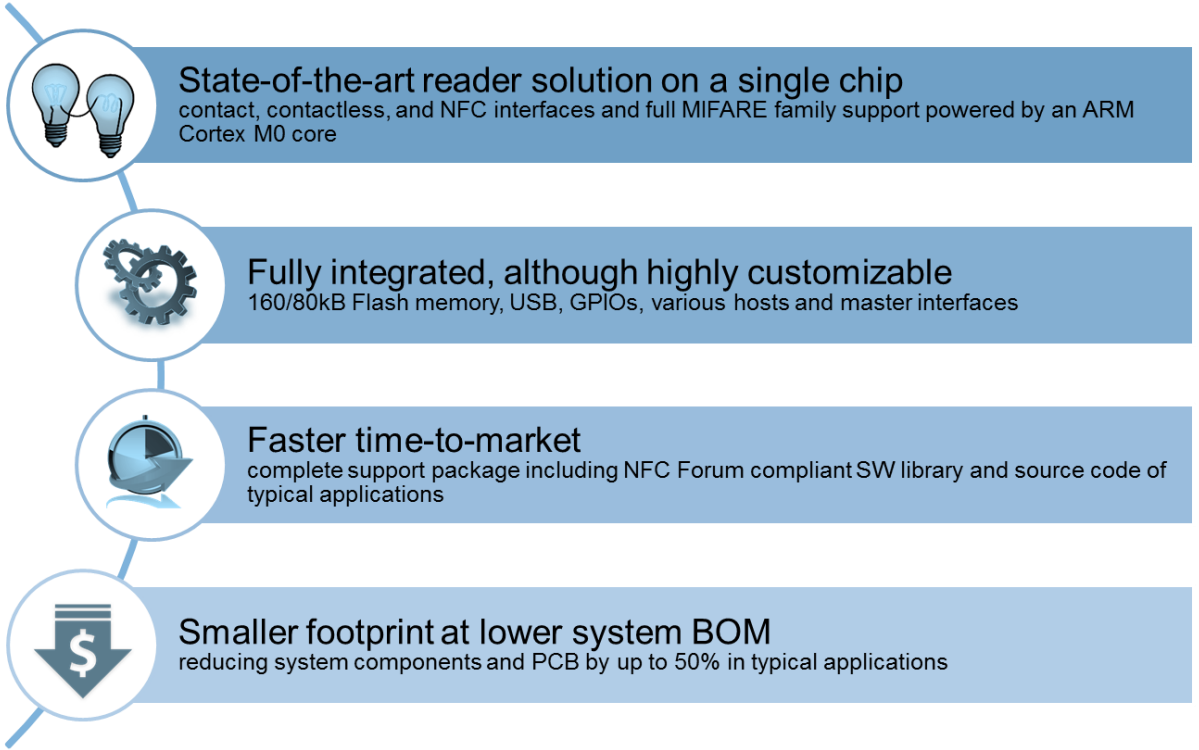
NFC Controller development kit	› PN7462 NFC controller development kit OM27460CDK
PN7462AU FW and SW examples	› SW3683 – Installer package PN7462AU FW and SW Examples full version v4.0_01_00
PN7462AU NFC Cockpit	› SW3683 - Installer package PN7462 NFC Cockpit v1.3
Documentation	› AN11706 – PN7462AU Antenna design guide › AN11738 – PN7462AU Contact smartcard application › AN11784 – PN7462AU How to integrate RTOS › AN11785 – PN7462AU LPCD and standby mode › UM10833 – PN7462 Quick start guide – customer board › UM10913 – Software user manual › UM10957 – PN7462AU Door access user manual › UM10915 – PN7462AU PC CCID reader user manual › UM10951 – PN7462 Reference POS application

PN7462 product documentation

Doc ID	Doc Name	Description
PN746x_736X	NFC Cortex-M0 microcontroller with ISO/IEC7816 interface	This document describes the functionality and electrical specification of the PN7462 NFC controller family
AN11706	PN7462AU Antenna design guide	This document describes the antenna design related to the PN7462AU
AN11738	PN7462AU Contact smart card application	This document describers how to use the contact smart card interface on the PN7462AU
AN11784	PN7462AU How to integrate RTOS	This document describes the steps required for integration of RTOS with PN7462AU firmware
AN11785	PN7462AU LPCD and standby mode	This document describes the principle of low power card detection offered by the PN7462AU
UM10833	PN7462 Quick Start Guide - customer board	This document describes the required basic circuitry to operate the PN7462AU and it also describes how to setup and use the PN7462AU customer demo board
UM10913	Software User Manual	This document describes the PN7462AU/PN7360AU FW architecture and how to use it
UM10957	PN7462AU door access user manual	This document server as a user manual for the Door Access Demo application use case demo on PN7462 board
UM10915	PN7462AU PC CCID reader user manual	This document briefs the setup environment required for PC CCID reader use case demo on PN7462 board
UM10951	PN7462 Reference POS application	This document briefs the setup environment required for the POS application use case demo on PN7462 board

Final remarks

PN7462 – First all-in-one full NFC solution



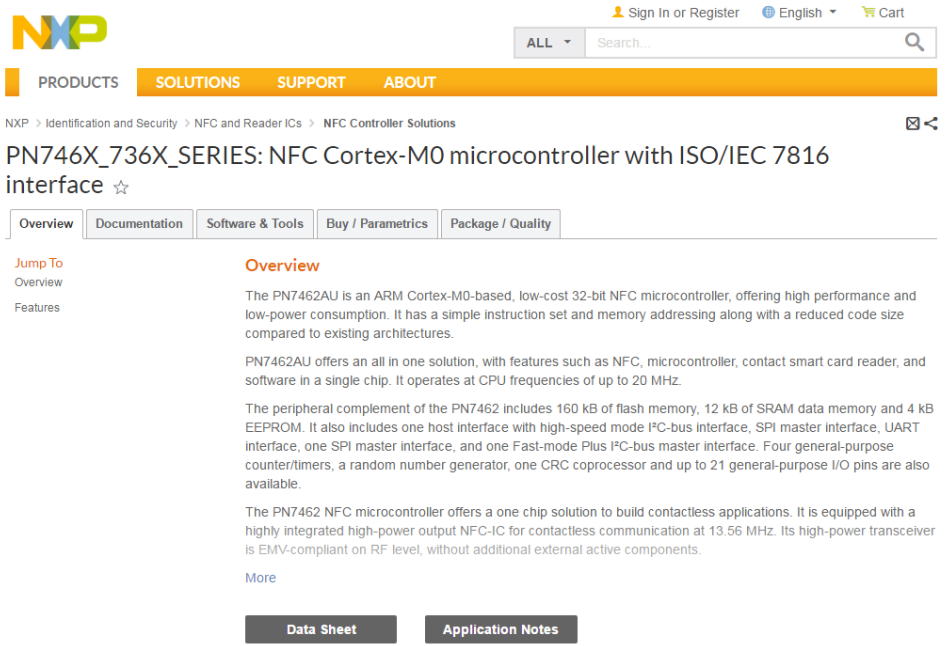
PN7462 family ordering information and samples

Product	Flash memory	Contact interface	Delivery	12NC
PN7462	160 kB	Yes	Single Tray	9353 076 92551
			Reel	9353 076 92518
PN7362	160 kB	No	Single Tray	9353 084 36551
			Reel	9353 084 36518
PN7362	80 kB	No	Single Tray	9353 077 96551
			Reel	9353 077 96518

Product samples can be ordered from eSample by clicking on “NXP Customer Support” → “Samples”

Do you need more?
Resources and useful links

- NFC Everywhere
  http://www.nxp.com/nfc
- PN7462 family product website
  http://www.nxp.com/products/identification-and-security/nfc-and-reader-ics/nfc-controller-solutions/nfc-cortex-m0-microcontroller-with-iso-iec-7816-interface:PN746X_736X_SERIES
- OM27462CDK NFC controller development kit website
  http://www.nxp.com/products/identification-and-security/nfc-and-reader-ics/nfc-controller-solutions/nfc-controller-development-kit:OM27462CDK
- NFC support community
  https://community.freescale.com/community/nfc?hdr=1&subcf=SUPPORT



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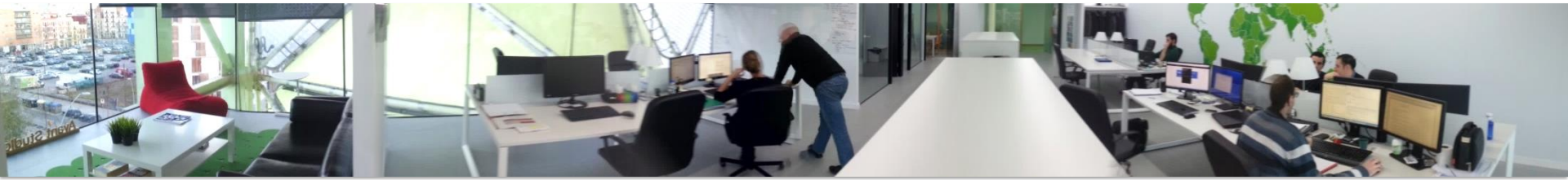
Software development in Android and iOS
Embedded software for MCUs
JCOP, Java Card operating Systems
Hardware design and development
Digital, analog, sensor acquisition, power management
Wireless communications WiFi, ZigBee, Bluetooth, BLE
Contactless antenna RF design, evaluation and testing

MIFARE applications
End-to-end systems, readers and card-related designs
EMVco applications
Readers, cards, design for test compliancy (including PCI)
Secure Element management
GlobalPlatform compliant backend solutions
Secure services provisioning OTA, TSM services



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PN7462 family – product support package

Jordi Jofre (Speaker) / Eric Leroux (Host)

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