# NXP AN11461 sensor Application note

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This application note is related to the installation procedures of the PTEV501B Board. It describes the board and the required actions to hand on quickly the Evaluation board.

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Quick Start Up Guide PTEV501B Board

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<b>Document information</b>	on
Info	Content
Keywords	PTEV501, PT501, LPCXpresso, MCU, Code Red, eclipse, LPC1227, reader library
Abstract	This application note is related to the installation procedures of the PTEV501B Board. It describes the board and the required actions to hand on quickly the Evaluation board.



#### **Revision history**

Rev	Date	Description
1.2	20140306	Updated clock configuration for use with external clock source
1.1	20131212	Added Mass erase description and schematics of PTEV501B analog part
1.0	20131118	First release

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# 1. Introduction

This application note gives a detailed overview of the hardware for operating with the PT501 NFC Card Emulation and NFC Peer-to-Peer Solution [1]. We use the LPCXpresso LPC 1227 [4] and the Blueboard (**Chapter 2**), the installation procedures of the Development Environment (**Chapter 5.1**) and the handling of the project using the NXP Reader Library (**Chapter 5.3**).

The projects used in this documentation are:

Card Emulation

# 2. Hardware overview of the PT501 Card Emulation solution

The PT501 Card Emulation solution is made up of 2 separate boards:

- A PTEV501B Evaluation board [3] provided by NXP (**12NC**: 9353 029 06699). This board has connectors which are designed to fit exactly to the ones of the companion LPCXpresso LPC 1227 development board.
- A commercial LPCXpresso LPC 1227 development board [4] (12NC: 935294603598, Type: OM13008) which can be provided by NXP or bought directly on the market. See [2].

Once the two boards are put together via the connectors, the PT501 Card Emulation solution is ready for use.

# 2.1 PTEV501B Evaluation board



The PTEV501B Evaluation board embeds the PT501 generic 13.56 MHz communication interface, with matching network and the antenna. The PT501 supports different kind of contactless communication methods and protocols at 13.56 MHz:

- Passive target device for NFC IP-1 mode communication (Peer to Peer)
- Card operation mode supporting ISO/IEC 14443-A and FeliCa compliant protocol

Thanks to the relevant solder bridges, the host link of PTEV501B Evaluation board can be configured for:

- I<sup>2</sup>C
- SPI

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The default interface configuration of the PTEV501B Evaluation board is SPI. The detailed interface configuration is described in section 2.6.

# 2.1.1 Comparison with the PNEV512B Evaluation board

The PTEV501B has basically the same board layout as the PNEV512B Evaluation board. Since the PT501 acts as passive device in card emulation and P2P mode, all parts for the transmitter output are not necessary. This is visible if one compares the two boards as in Figure 3.



 
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 The list of necessary components for the receiver part find here:

Table 1. Necessary compone	nts of the PTEV501B analo	g part
Component type	Part Nr.	Value
Capacitor	C12, C15, C20	1 nF
Capacitor	C13, C25	220 pF
Resistor	R16	1 kΩ
Resistor	R19	0 Ω
Resistor	R25, R26, R27, R29	4,4 Ω







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Figure 4 and 5 show the analog parts of the PTEV501B and PNEV512B boards. DNP (do not place) means that this components have routed footprints but are not placed on the PCB to show the differences to the PNEV512B.

Table 2	Unused com	nonents of th	he PNEV512B	analog part
	Unused com	iponenta or ti		analog part

Component type	Part Nr.
Inductor	L2, L3, L4
Resistor	R23
Capacitor	C7, C8, C14, C16, C17, C18, C21, C22, C23, C24

#### 2.2 CE certification of the Blueboard

The PTEV501B V1.0 is CE certified.

#### 2.3 LPCXpresso LPC1227 development board

The LPC1227 development board integrates a NXP ARM Cortex-M0 microcontroller LPC1227 with 128 Kbytes of Flash memory and 8 Kbytes of RAM. It integrates a lot of hardware parts:

- 1 Serial UART interface,
- 1 SPI controller,
- 1 I<sup>2</sup>C controller,
- Serial Wire test/debug interface,
- For detailed information, see LPC12xx User Manual [5]

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).



Fig 6. Picture of LPCXpresso LPC1227 development board

#### 2.4 Preparation of the hardware

The first step after unpacking the Blue Board 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.

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#### Fig 7. Multipoint Connectors we used

One may buy these connectors at any electronic store. Here are some examples [7]. After soldering the connectors connect the boards as shown on the following figure.



#### Fig 8. LPCXpresso with the Multipoint Connectors

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



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# 2.5 Interesting points of measurement

On the PTEV501B Evaluation board are test pads for measurement purposes.

- VCC GND D5 •
- AUX1 .
- D7
- ALE

SIGOUT

D6

•

AUX2

IRQ

- SIGIN
- VMID



# 2.6 Preparing the Blueboard for the use with SPI or I<sup>2</sup>C

The Blueboard is generally delivered in SPI configuration. To change the interface to I<sup>2</sup>C the four appropriate 0R0 resistors in the interface config section need to be resoldered on the I<sup>2</sup>C side of the solder jumpers. Also the two 0R0 resistors at A0 and A1 need to be changed.

#### Table 3. A0 and A1 interface configuration

Appropriate solder jumpers (0R0 resistors) for interface configuration

Signal	Interface type	
	SPI	I <sup>2</sup> C
A0	R20	R21
A1	R24	R23

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The I<sup>2</sup>C-address can be configured either by software or by hardware. To set the I<sup>2</sup>Caddress by hardware the solder jumpers in the I<sup>2</sup>C config section (see Figure 11) has to be connected appropriately. R3, R7 and R13 are logically LOW and R4, R8 and R15 logically HIGH.



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# 3. PT501 clock requirements

The PT501 is characterized to a frequency of **27.12 MHz**, but it is possible to operate it with a frequency between **1 MHz** and **33 MHz** on pin OSZIN. As clock source any stable CLK-signal in this frequency range can be used. To avoid that unwanted noise disturbs the clock, the PT501 has an internal frequency check.

The operating frequency of 13.56 MHz and the expected 13.56 MHz, derived from the 27.12MHz clock source are compared. If the frequencies differ too much, the received RF-clock is assumed to be a disturbance and the card cannot be used. This is the case e.g. if an external clock of 2 MHz is provided on the CLK input pin.

To use other frequencies than 13.56 MHz the RF-clock frequency check can be disabled by register settings. See *3.2 Software configuration*.

**Note:** The correct register settings to disable the frequency check are mandatory if a clock **below 23 MHz** is used, between 23 MHz and 33 MHz it can be enabled.

# 3.1 Hardware configuration

The PTEV501B is prepared to be used in conjunction with an on board crystal oscillator or a clock generated by the LPC1227 LPCXpresso Board. The following table describes the necessary soldering changes for the different configurations:

#### Table 4.PT501 clock configuration

R31 can be placed as $0\Omega$ resistor or solder bridge				
Clock source	R31	XT1	C29	C30
Crystal oscillator (default)	Not placed	27,12 MHz	15pF	15pF
External clock from LPC1227 LPCXpresso Board	0 Ω	Not placed	Not placed	Not placed



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Figure 15a shows a snippet of the PTEV501B schematics. If one would like to use a different CLK-source as described above, the external clock signal should be connected to pin OSCIN by connecting to one of the component pads shown in Figure 15b.



#### 3.2 Software configuration

This section describes the software configuration for the PTEV501B with an external clock source. This can either be the CLKOUT-function of the LPC1227 or any stable clock signal in the frequency range of 1 MHz to 33 MHz.

#### 3.2.1 LPC1227 LPCXpresso Board as clock source

Please make sure to change the hardware configuration as defined in section 3 before loading and running the modified software package into the LPC1227 to avoid breaking any hardware.

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To use the PTEV501B with the LPC1227 LPCXpresso Board as external clock source some modifications need to be done in the *system\_LPC12xx.c* file:

#### 3.2.1.1 Configure the Main Clock

For this example configuration a frequency of 24 MHz is used. To achieve this following settings of the SYSPLLCTRL register are required.

The SYSPLLCLKSEL\_Val (0x01 for System Oscillator) defines the clock source for the internal System PLL which must be activated by setting the SYSPLL\_SETUP to 1.

The SYSPLLCTRL\_Val specifies the output frequency of the System PLL. This can be configured by the Bits 0-6 of the SYSPLLCTRL register, in this case a frequency of 24 MHz.

Other system clock settings may also be used as long as the LPC1227 generated clock is in the range as defined in section 3. Please refer to the LPC122x User Manual [6] and Data Sheet [5] for detailed description of the supported configurations.

The MAINCLKSEL\_Val sets the clock source for the system Main clock (0x3 for the System PLL output).

-	_				
🖻 main.c	🖻 main.c 🛛 🚺 system_LPC12xx.c 🛛 🔪				
126 */					
127 <b>#defin</b>	CLOCK_SETUP	1			
128 <b>#defin</b>	MAINCLK_SETUP	1			
129 <b>#defin</b>	SYSOSC_SETUP	1			
130 <b>#defin</b>	SYSOSCCTRL_Val	0x00000000			
131 <b>#defin</b>	SYSPLLCLKSEL_Val	0x00000001			
132 <b>#defin</b>	SYSPLL_SETUP	1			
133 <b>#defin</b>	SYSPLLCTRL_Val	0x00000041			
134 <b>#defin</b>	MAINCLKSEL_Val	0x00000003			
Fig 16. Main Clock configuration					

#### 3.2.1.2 Enable the CLKOUT functionality

To use the CLKOUT pin of the LPC1227 the CLKOUTCLK\_SETUP has to be enabled. The CLKOUTCLKSEL\_Val specifies the clock source, here 0x3 for the Main clock at 24 MHz, so no further division by the CLKOUTCLKDIV\_Val is needed (0x01).



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#### 3.2.1.3 Configure the CLKOUT setup

With the enabled CLKOUTCLK\_SETUP in the previous section the #if statement for the CLKOUT configuration is true.

The CLKOUT function is routed to PIO0\_12 and needs to be configured (0x02). It is very important to update the clock source by toggling the CLKOUTUEN register.

101	
482 482	Hif (CLEQUITCLE SETUR)
483	LPC IOCON->PIO0 12  = 0x02; /* CLKOUT function */
484	LPC SYSCON->CLKOUTCLKSEL = CLKOUTCLKSEL Val;
485	LPC SYSCON->CLKOUTUEN = 0x01; /* update CLKOUT source
486	LPC_SYSCON->CLKOUTUEN = 0x00;
487	LPC_SYSCON->CLKOUTUEN = 0x01;
488	LPC_SYSCON->CLKOUTDIV = CLKOUTCLKDIV_Val;
489	#endif

For detailed information about the LPC1227 clock configuration and register settings please refer to the product datasheet and user manual.

#### 3.2.2 Other clock source

If any other clock source with a frequency between 1 MHz and 23 MHz is used for the PT501, following register settings are mandatory to turn off the frequency check:

- 1. Write 0xBF to register 0x3C
- 2. Read from register 0x3C

In the Card Emulation software package this register setting can be activated/deactivated by the *#define PT501\_EXT\_XTAL* statement in *main.c*.

```
156 #ifdef PT501 EXT XTAL
       /* switch off frequency check */
 157
 158
         uint8 t value = 0;
 159
 160
          status = phhalHw_WriteRegister((phhalHw_Rc523_DataParams_t *)&hal, 0x3C, 0xBF);
 161
         CHECK_STATUS(status);
 162
 163
          status = phhalHw_ReadRegister((phhalHw_Rc523_DataParams_t *)&hal, 0x3C, &value);
 164
          CHECK_STATUS(status);
 165 #endif
Fig 19. Register settings for the frequency check function in main.c
```

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# 4. Installation of the LPCXpresso Board

The guidelines to install 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 is installed, open the Device Manager of the PC to check that the installation is successful. The item "USB Device with DFU Capabilities" is displayed.

Please be sure to always connect both USB ports to the computer. If the USB port of the Blueboard is not connected to an USB port, it won't work because of the missing power.

<u>File Action View H</u> elp	
Monitors	-
🔋 📲 Network adapters	
Ports (COM & LPT)	
Processors	
👂 - 📋 Smart card readers	
Sound, video and game controllers	
Storage controllers	
🛿 📲 System devices	
🧉 🟺 Universal Serial Bus controllers	Ē
🟺 Generic USB Hub	
🟺 Generic USB Hub	-
Intel(R) 6 Series/C200 Series Chipset Family USB Enhanced Host Controller - 1C26	
Intel(R) 6 Series/C200 Series Chipset Family USB Enhanced Host Controller - 1C2D	
USB Composite Device	
USB Composite Device	
USB Device with DFU Capabilities	
USB Root Hub	-
USB Root Hub	1

Fig 20. Enumeration of the LPCXpresso Board in Device Manager Window

# 5. Managing the PT501 CE solution project with LPCXpresso IDE

The PT501 Card emulation solution project is delivered in a zip package. It can be extracted, edited, compiled and linked with LPCXpresso<sup>™</sup> IDE.

LPCXpresso<sup>™</sup> is a new, low-cost development platform available from NXP. It supports NXP's ARM-based LPC microcontrollers. The platform is comprised of a simplified Eclipse-based IDE and low-cost target boards which include an attached JTAG debugger.

Use at least the LPCXpresso version 4.2 or higher to benefit a bug-free IDE and the upto-date features.

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This tool can be freely downloaded from the LPCXpresso website [2]. Before one can download the software, it is necessary to create an account. Creating an account is absolutely free.

# 5.1 Installation of LPCXpresso IDE

The IDE is installed into a single directory, of one's choice. Multiple versions cans be installed simultaneously without any issues. The installation starts after double-clicking the installer file. Then click "next" on the setup wizard.

NP	Welcome to the LPCXpresso Setup Wizard
	This will install LPCXpresso 4.1.0 [Build 190] on your computer.
LPC PRESSO	It is recommended that you close all other applications before continuing.
	Click Next to continue, or Cancel to exit Setup.
Powered by	
http://www.nxp.com/pcxpresso	Next > Cancel

Then read the license agreement then click next.

Setup - LPCXpresso		
License Agreement Please read the following important inform	ation before continuing.	PRESSO
Please read the following License Agreeme agreement before continuing with the inst	ent. You must accept the terms of this allation.	
CODE RED TECHNO	DLOGIES, LIMITED	
End-User Licence Agreement for L Too	PCXpresso Software Development	
Novemb	er 2009	
THIS END USER LICENCE AGREE AGREEMENT BETWEEN YOU (EIT SINGLE LEGAL ENTITY) AND COL	EMENT ("LICENCE") IS A LEGAL THER A SINGLE INDIVIDUAL, OR DE RED TECHNOLOGIES LIMITED	Ŧ
I accept the agreement ○ I do not accept the agreement	Print	
http://www.nxp.com/pcxpresso	< Back	ncel

There are numbers of other screens on the setup wizard but generally the default options can be accepted. After installation, an information file will be displayed. Click "Next" to accomplish the installation.

Installing	-
Please wait while Setup installs LPCXpresso on your computer.	PRESS
Extracting files	
C:\\pcxpresso\Tools\libexec\gcc\arm-none-eabi\4.5.1\cc1.exe	
V4.1)0_190	
http://www.nxp.com/lpcxpresso	Cancel

After this installation step one will be asked if he wants to install some required drivers. The installation of these drivers should be accepted.

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

NP	Completing the LPCXpresso Setup Wizard
DE DECCO	Setup has finished installing LPCXpresso on your computer. The application may be launched by selecting the installed icons.
LPC PRESSO	Click Finish to exit Setup.
and the second s	V Launch LPCXpresso v4.1
	Getting Started
	Red State Guide
Powered by	
code_red	
http://www.nxp.com/pcxpresso	< Back Einish

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#### Fig 26. LPCXpresso IDE

Directly after the first start of the Eclipse IDE one will see an info dialog, 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 needs one to navigate to the website of Code Red. The Link is shown in the menu, Help  $\rightarrow$  Product activation  $\rightarrow$  Create Serial number and Activate...

i li	<ul> <li>Help Contents</li> <li>Search</li> <li>Dynamic Help</li> </ul>		9 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
	Key Assist Tips and Tricks	Ctrl+Shift+L	
	Product activation	۱.	© Display license type
	Support Install New Software	$\sim$	Create Serial number and Activate
	About LPCXpresso		🗿 Upgrade your product

 
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Create Serial number and Activate Select OK to visit the registration website where your register your product and receive an Activation Cr	ou can ode.
Serial	
Open in external browser	
Copy Serial Number to clipboard	
	OK Cancel

#### Fig 28. 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.

Window	Hel	p		
	0 27	Help Contents Search Dynamic Help Key Assist Ctrl+Shift+L Tips and Tricks	9	5 × 8 + 6 4 -
		Product activation	0	Display license type
		Support	E.	Create Serial number and Activate
		Install New Software	Щ.	Enter Activation code
		About LPCXpresso	-	Upgrade your product

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

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

# 5.2 Extraction of the PT501 CE solution project

Once the LPCXpresso<sup>™</sup> IDE is installed on a Computer, the sequence of installing the reference reader project is indicated:

- Start the LPCXpresso™ IDE.
- Select the option "Import project(s)" (see picture below).
- Browse the zip archive.

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- LPCXpresso<sup>™</sup> IDE unzips the software package.
- The software package is ready for use.

ile Edit Mavidare Search Fiolect Voli	window Heip		
<mark>1 •                                      </mark>	E B 🖬 🛱 🖾 C 🖉 A 🖬 🙆 🖉 🖲 8	10 \$ 5.0.	😭 🔀 Develop
🔓 Proje 😂 📲 Core 🚮 Perip 📃 🗖			-
E			
) Qu 23 (■ Re   09= Va   % Br ) □ □ Start here ☆ ▲			
Mew project  Import project(s)			
Build Import projects E			
🖌 Clean "[]			
🌣 Debug " []			
🖉 Quick Settings 💌			
🔄 Project and File wizards 🛛 😤	📮 Console 🛛 🔣 Problems 🔋 Memory 🚇 Red Trace Preview	= × 🖗 🔓 🚮	
🔄 Import and Export 🔹 🛠	<terminated> RC663 Debug [C/C++ MCU Application] C:\Users\mine\Docum</terminated>	ents\LPCXpresso_4.1.0_190\wo	orkspace\RC663\Debug\RC663.a
import archived projects (zip)			
🖆 Import exisiting projects 🛛 🔹 👘	4		-1
0.		<u>RC663</u>	NXP LPC1114/30

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

mport project(s) Select the examples archive file to import.	D
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></next>	-
Project archive (zip)	
Archive C:\PT501-CardEmu-LPC1227.zip	Browse
Project directory (unpacked)	
Root directory	Browne
Browse for more examples" to view the latest examples and download to your local drive. Then use press "Browse" (above) to import into your workspace. Browse for	r more examples)
	Cancal

Fig 31. Importing a project into the LPCXpresso IDE

Browse the desired project and click "Next".

a na an an tao an ta	
(mport project(s)	The second
Select a directory to search for existing Eclipse projects.	
<u>Projects:</u>	
PTEV501B_CardEmu_LPC1227 (/)	Select All
	Deselect All
	Refresh
Conv. mojects into workspace	
	Control 1
S Dark Mext * Dins	n Cancer

When the import process has finished one can start browsing the code. Most interesting might be the main.c which is located in ../src/main.c in the project.

Before one can run the project, the Evaluation board with the PT501 needs to be connected to the computer. Wait until the according drivers have been installed.

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# 5.3 Start the project

One can quickly start the reader project by editing the main function in the module **main.c**. This function first performs the hardware initializations of the LPC1227 and the PT501.

Detailed descriptions of the code in the form of comments are provided in the **main.c** file. This should provide a detailed overview of how to initialize certain components.

#### 5.3.1 Run the project

Before running the project, please ensure that the LPCXpresso with the PTEV501B Evaluation board is connected with the computer.

(H) Start here	1
Import project(s)	
📸 New project	
📷 Build all projects [Debug]	
🐔 Build 'PTEV5018_CardEmu_LPC1227' [Debug]	
Clean 'PTEV501B_CardEmu_LPC1227' [Debug]	
Debug 'PTEV501B_CardEmu_LPC1227' [Debug]	
Bdit 'PTEV501B_CardEmu_LPC1227' project setting	35
Import project(s) from XML Description	
🖉 Quick Settings 👻	
🕼 Export projects to archive (zip)	
🕼 Export projects and references to archive (zip)	
(3) Extras	

#### Fig 33. Run the project

Choose the desired project and click at the left side the Debug Button like shown at the example picture.





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

6	Initializing LPC-Link (H	HID)	
			Cancel

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

6 Q (* 2 - 4 -		A Percept
Proj 🛛 🚻 Core 🛃 Peri 📄	🗆 🏇 Debug 🕸 🙀	& ■ <b>  </b> ■    ■ @
PN512-Polling		1/00)
Src State State State State	R main.c X	e e e e e e e e e e e e e e e e e e e
<ul> <li>phSubBal</li> <li>main.c</li> <li>startup</li> <li>config</li> </ul>	E 153 unsigned int volatile i; 154 uint8 t reg data; 155 // uint8_t buf[64]; 156	,
Comis     Comis     driver     Detroit	<pre>157 for (i = 0x1000; i &gt; 0; i); 158 159 phStatus_t status; 160 void *pHal;</pre>	
Start here New project Pumport project(s) Build all projects [Debug] Build "PNS12-Polling" [Debug] Clean "DNS12-Polling" [Debug]	<pre>% 163 /* BFL (Basic Function Library) 164 * data parameter storage */ 165 phhalHw_Rc523_DataParams_t halReader; 166 167 /* Initialize GFIG (sets up clock) */ 168 GFIGInit(); 168 170 #ifndef TUSA</pre>	
Debug 'PN512-Polling' [Debug]		
( Quick Settings *	Console 23 Problems U Memory Red Trace Preview     PN512-Polling Debug IC/C++ MCU Application1 C:\Users\nxp \worksprex\test\PN512-Polling	■ = = = = = = = = = = = = = = = = = = =
Project and File wizards	No card or Tag detected No card or Tag detected No card or Tag detected	
K Build and Settings	No card of Tag detected	
E Debug and Run	No card or Tag detected	
Extras	MIFARE Classic detected	
0*		PN512-Polling NXP LPC1115/303

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

#### PTEV501B Quick Startup Guide

h <u>R</u> un <u>P</u> roject <u>W</u> indow <u>H</u> elp		
· ◆		The second secon
Debug 🕄	N	
PN512-Polling Debug [C/C++ MCU Application]		
MCU GDB Debugger (02.11.12 14:06)		
arm-none-eabi-gdb (02.11.12 14:05)		
Colleges (		

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 towards the top of the "Debug" view:

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

Fig 38. Debug Buttons

# 6. Card Emulation - Associated Project

# 6.1 Tag Type 2 and Type 4 Card Emulation

#### This example only works with the LPCXpresso LPC1227 development board.

The PT501 supports 2 different operating modes:

- Passive target device for NFC IP-1 mode communication (Peer to Peer)
- Card operation mode supporting ISO/IEC 14443-A and FeliCa compliant protocol

The card operation mode is passive mode, in which the PT501 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-A protocol, 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 [9]. The following project shows an exemplary implementation of a Tag 4 Type Card on the PN501. 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 PT501 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.



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.

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rooram Elash using LPC-Link Probe v1.3	
Program target flash:   PC11xx (NXP   PC1227/3)	01)
riogram cargee name in other (now in other) of	Nome
Options	
🗹 Display progress log	Reopen on completion
Reset target on completion	🔲 Repeat on completion
Run flash command and copy to clipboard	🔲 Just copy flash command to clipboard
Connection Options	
Use JTAG interface	
LPC-Link (HID) Options	
Speed 250	
Flash Driver	
Flash driver LPC11_12_13_128K_8K.cfx	+ Browse
rogram flash memory Erase flash memory	
Algorithm	
Mass erase	Erase by page
	UN Lancel

#### 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

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nain.c	🖻 phce7816p4T_T4T_Const.c 🕱
1	<pre>#include <phce7816p4t_t4t.h></phce7816p4t_t4t.h></pre>
2	
З	#define NORMAL 0
4	#define MAX_SMARTPOSTER 1
5	#define BIG_MIME_IMAGE 2
6	#define MAX_VCARD 3
7	
8	${\mathcal H}$ define this to one of the above for NDEF predefined content
9	#define T4T_NDEFFILE_PREDEF NORMAL
10	
11	// This is the data structure returned by the GetData on tag GetVersion
12	<pre>const byte TLV_VERSION[] = {</pre>
13	P1_GETDATA_TAG_VERSION, P2_GETDATA_TAG_VERSION, (byte)0x16, // header: version informat
14	(byte)'1', (byte)'3', // year in ASCII
15	(byte)'0', (byte)'1', // month in ASCII
16	(byte)'1', (byte)'5', // day in ASCII
17	(byte)'',
18	(byte)'N', (byte)'X', (byte)'P',
Fig 4	11. Change NDEF content for T4T

• T2T: ../src/nxprdlib/comps/phceT2TCmdHdl/src/Sw/phceT2T\_Const.c

🖻 main.c 🛛 🖻 phceT2T_Const.c 🛛		
1 <b>#include "phce</b> T2T_Sw.h"		
2		
3 #define NORMAL 0		
<pre>4 #define MAX_SMARTPOSTER 1</pre>		
5 #define BIG_MIME_IMAGE 2		
6 #define MAX_VCARD 3		
8 // define this to one of the above for	NDEF predetined content	
9 #define 141 NDEFFILE_PREDEF NORMAL		
$10$ 11 const wint8 t T2T LOCK (C DEE[16] = {		
	axaa, axaa, axaa, axaa	. // internal bytes
13	0x00. 0x00. 0x00. 0x00	. // internal bytes
14	0x00, 0x00, 0x00, 0x00	// internal bytes AND
15		<pre>// static lock bytes ()</pre>
16	// cc	
17	0xE1, 0x10, 0x00, 0x00	🕽 // 3rd byte - data mem
18 };		
19		
- 20		
Fig 42. Change NDEF content for T2T		

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# 6.1.3 Program flow



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 PT501 waits for a successful activation or the card side. According to the first command (RATS – yes or no) after the card activation the appropriate tag type component starts.

# 7. References

- [1] PT501 data sheet http://www.nxp.com/documents/data\_sheet/PT501.pdf
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- [3] PTEV501 Evaluation board http://www.nxp.com/demoboard/PTEV501.html
- [4] LPC1227 LPCXpresso Board www.nxp.com/redirect/embeddedartists.com/products/lpcxpresso/lpc1227\_xpr.php
- [5] LPC122x family data sheet http://www.nxp.com/documents/data\_sheet/LPC122X.pdf
- [6] LPC122X family User Manual http://www.nxp.com/documents/user\_manual/UM10441.pdf
- [7] Multipoint Connectors we used: Grid Dimension: 2.54mm, at least 27 pins www.nxp.com/redirect/conrad.at/ce/de/product/741119/STIFTLEISTE-1-X-36-POLIG-VERGOL-RM-254 and www.nxp.com/redirect/conrad.at/ce/de/product/736427/BUCHSENLEISTE-EINREIHIG-36-POLIG-RM254
- [8] Direct link to the NXP Reader Library http://www.nxp.com/documents/software/200310.zip
- [9] TYPE 4 TAG: NFC Forum, Type 4 Tag Operation Specification, Version 1.0, March 13, 2007
   www.nxp.com/redirect/nfc-forum.org/specs

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