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PN5180 Evaluation board quick start guide Rev. 1.2 — 7 April 2016

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Document information

Info	Content
Keywords	PN5180, PNEV5180B, PN5180 evaluation board, PN5180 customer board, PN5180 GUI, GUI, PN5180 Support Tool, NFC Cockpit
Abstract	This document describes the PNEV5180B 2.0 (PN5180 evaluation board), and how to use it. It describes the NFC Cockpit (PN5180 GUI Version 2.3), which allows an easy basic access to the PN5180 registers and EEPROM in combination with basic reader functionality.



Revision history

Rev	Date	Description
1.2	20160407	Update for NFC Cockpit 2.3, EMVCO App added
1.1	20151125	Section <u>5 References</u> updated
1.0	20151124	First release

Contact information

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1. Introduction

This document describes the PNEV5180B 2.2 (PN5180 evaluation board), which provides an easy evaluation of the features and functions of the PN5180.

It provides the first steps to operate the board, using the NFC Cockpit (PN5180 GUI Version 2.3).

The default antenna is a 65mm x 65mm antenna with some metal layer inside the antenna area. This antenna is not an optimum antenna as such, but intends to demonstrate the performance and register settings of the PN5180 under typical design constraints like LCD or some metal (e.g. PCB) inside the antenna area.

1.1 PN5180 registers & EEPROM concept

The PN5180 uses internal registers to adapt and optimize the functionality and performance for each of the supported protocols and data rates dependent on the connected antenna, matching network and receiver path. It offers an EEPROM, which contains the default settings for all the supported protocols. These settings are loaded into the registers with the LOAD RF_CONFIG command for each supported protocol and data rate

The default EEPROM configuration settings are optimized for the 65mmx65mm antenna of the board PNEV5180B, and can be updated by the user in case a customized antenna and matching network is used. The command LOAD_RF_CONFIG allows to initialize multiple registers with an efficient single command, and allows to distinguish between transmit and receive configuration. Update of the registers relevant for a selected protocol is done by copying the content of EEPROM addresses to registers. Not all protocols require the initialization of all or the same registers, the command LOAD_RF_CONFIG considers this by initializing the registers relevant for the currently selected protocol only.

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

Some of these settings can or even **must** be adapted towards a new antenna design (e.g. the DPC calibration). All those settings should be stored in the PN5180 EEPROM to allow a proper functionality.

Some EEPROM configuration data is independent from the used protocols and defines e.g. the startup behavior of the PN5180 or the functionality of LowPower Card detection and requires attention as well for optimum performance of the chip.

1.2 PNEV5180B concept

The basic **concept of the PNEV5180B** is to enable the user to perform a quick evaluation of the PN5180, and also connect his own antenna to the PNEV5180 board. In addition, dedicated boards which allow to solder custom matching components are available. The NFC Cockpit can be used to optimize the PN5180 antenna tuning, to perform the DPC calibration and the related TX and Rx optimization without touching any source code.

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All the relevant PN5180 registers can be modified and fine-tuned using the NFC Cockpit. After successful register optimization the found settings can be stored in the PN5180 EEPROM.

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

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

The source code examples of the NFC Reader Library can be used to develop an own application directly on the LPC1769 (see [5]), or can serve as a starting point for porting the NFC Library to any other microcontroller platform.

2. Hardware

The PNEV5180B V2.2, as shown in Fig 1, provides a lot of test functions which might not be used for the typical hardware and software evaluation. It can be used as a simple standard reader without modification, it can be used to define and optimize the analog settings for any connected antenna or it can be used to develop and modify any RFID and NFC application based on the NFC Reader Library.

2.1 Hardware introduction

The PN5180 is supplied with a supply voltage, which can be chosen between: internal and external supply. For the internal supply either 5V or 3.3V can be used. The external power supply can be an AC or DC supply (polarity does not matter) with at least 7.5V, since the board provide a rectifier and LDO to supply the circuit with 5V and 3.3V.

The PN5180 is connected to an NXP LPC1769 μ C via SPI. A specific firmware on the LPC1769 allows to use the PNEV5180B in together with the NFC Cockpit.

The connection to the PC is done via USB. Both USB Mini and USB Micro connectors are supported.

Another connection option allows to connect a LPC-LINK2 board the PN5180B by means of a debug cable. This allows the development of custom software or the execution of the NFC Reader Library code including samples.

In case a different host microcontroller shall be used, the SPI interface is available for connection to an external host (the on board LPC1769 is not used in this case).

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2.2 Schematics

The complete schematics of the PN5180 evaluation board are shown in the Fig 3, Fig 4, Fig 5, Fig 6, and Fig 7.

2.2.1 LPC1769

The PNEV5180B contains an NXP LPC1769 (see Fig 3).

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An LPC Linker can be connected to the LPC1769 via the JTAG interface (see Fig 4).

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2.2.2 Power supply

The default settings use the power supply from the USB connector. For the maximum performance and a better test capability the external power supply should be connected. The AC or DC power input can cover any power supply providing an AC or DC voltage between 7.5 and 12V.

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The PN5180 evaluation board provides two LDOs, one for 5V and one for 3.3V. 5V LDO is only be used, if the external power supply is connected and used (J101 default).

Three jumpers can be used to evaluate the different power supply options:

J101: either external or USB power supply (default)

J303: either VBAT = 5V or 3.3V (default)

J300: closed (default) or to measure the ITVDD

2.2.3 PN5180

The PN5180 is shown in Fig 6.

The default clock is based on a 27.12 MHz crystal, but the board supports external clock input, if needed.

During the antenna tuning and overall hardware design typically the ITVDD must be checked. This can be done with the JP300 ("TVDD"), either using an external power supply or just using an ampere meter instead of the jumper.

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

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The antenna connection uses the standard tuning circuit. The EMC filter is designed with a cut off frequency of f_{EMC} = 15.65 MHz, and the antenna impedance is tuned to Z = 20 Ω .



<u>Note</u>: The antenna impedance tuning and measurement must be done with R = 10Ω between ANT1 and ANT2.

The symmetrical tuning (see Fig 8) improves the transfer function compared to the standard "asymmetrical" tuning and thus allows to use a higher system Q factor, which results in a higher field strength. The disadvantage of the loading effect, which causes an increased current ITVDD, is compensated with the PN5180 Dynamic Power Control (DPC, for details refer to [4]).



2.3 Jumper settings

Three jumpers can be used to evaluate the different power supply options: J101: either external or USB power supply (default) J303: either VBAT = 5V or 3.3V (default) J300: closed (default) or to measure the ITVDD

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Fig 9 shows the default jumper settings for operation powered via USB. Fig 10 shows the jumper setting for the operation externally powered.



3. Software

The PNEV5180B 2.0 evaluation board is delivered with a graphical user interface application (GUI), the NFC Cockpit. The PN5180 NFC Cockpit can be used to explore the functionality of the PN5180 and perform RF and antenna design related tests. It allows a direct register access as well as EEPROM read and write access, and it allows to test and calibrate the DPC. The NFC Cockpit therefore can be used to configure & test the PN5180.

3.1 LPC Firmware and Driver

The LPC firmware is installed by default on the PNEV5180B and is ready to use. So no LPC firmware installation is required, if the board is only used with the NFC Cockpit.

However, the LPC1769 might be used for software development together with one of the samples (including the NFC Reader Library). In such case the LPC FW must be reinstalled afterwards, if the PNEV5180B is supposed to be used together with the NFC Cockpit again. Reason for this is that any software development using the LPCXpresso will erase the default firmware. Therefore the LPC FW installation is described in the following section.

In any case the correct PC driver must be installed, before the NFC Cockpit can be used with the PNEV5180B 2.0 evaluation board.

3.1.1 LPC Firmware installation

The LPC firmware provides a boot loader, which can be used to install or update the firmware. To activate the boot loader, close the SW200 (button not assembled), while powering up the PNEV5180B, as shown in Fig 11.



This registers the device as USB mass storage device on the PC as shown in figure 13. This mass storage device contains one file: the "lpc_main.bin". This file can be removed, and the new firmware binary file can be copied into the storage device. As soon as the upload is done, the folder closes and the USB storage device is automatically disconnected from the PC. The LPCXpresso board is automatically reset.

The PNEV5180B is ready now to be used now with the NFC Cockpit.

Note: The NFC Cockpit 2.3 offers a new functionality to flash and start an EMVco Loopback function. This functionality requires an update of the LPC firmware.

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3.1.2 LPC Driver installation

At first connection of the PNEV5180B (with firmware) to the PC, the device asks for a driver. The driver must be chosen from

\Name of the GUI package\PC_SW\LPCBOARD_DRIVER_WIN

After successful installation of the driver, the device must be registered as two LIBUSB_WIN32 devices (one for each SPI line), as shown in Fig 13.

If only one device is registered, either old drivers have been chosen or an older version of lpc_main.bin is used.

Note for possible future NFC Cockpit updates: Please make sure to use latest driver version, otherwise the application might not work correctly. In case of doubt re-install the driver of the corresponding NFC Cockpit package.

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Note: In some cases a wrong driver might be automatically installed without notice after connection of the PNEV5180B board (see Fig 14). In such case the driver needs to be manually updated.

File Action View Help	
NVPLABDT051	
Computer	
🕑 🥌 Disk drives	
🕑 📑 Display adapters	
I S DVD/CD-ROM drives	
+ 🕮 Human Interface Devices	
🗉 🔁 IDE ATA/ATAPI controllers	
🕂 🤝 Keyboards	
E libush-win32 devices	
USB2Serial	
Mice and other pointing devices	
🛞 🧕 Monitors	
Image Network adapters	
🕑 😪 NuDAQ Boards	
Other devices	
Gi USB2Serial_2	
Ports (COM & LPT)	
Processors	
Sound, video and game controllers	
System devices	
Geo Universal Senal Bus controllers	

3.2 PN5180 NFC Cockpit

The PN5180 NFC Cockpit can be installed and started (see Fig 15).

Operation	Type Cards LPCD DPC
SYSTEM_CONFIG Read EEPROM	Type A Type B Type F ISO15693
Register address: 000h Write 🔍 Register	Protocol Laver
	Layer 14443-3a Load Protocol ISO14443
	Activate Layer3 Halt 106 kBd/s Load Protocol
	ATOA: 0h Re-Activate L3 Barform Single/Endlars REC
	Last SAK: Oh Single REQA Endless REQ/
000000	Inter-REQ: ms
Write Operation	Layer 14443-4a
All bits Single bit	Select a baud rate: 100 kbd/s Time-out RFON: ms
· · · · · · · · · · · · · · · · · · ·	Activate Layer4 Desidect Card
Registers/EEProm access	ATS: Oh Single REQ4
EEPROM Single Byte Access	Layer 14443-4: Data Exchange with PICC
Address UX00 Read EEPROM	Data to be send: 0h
Data Ux00 Write EEPROM Access Load EEProm Field On Field Off RF Reset	TXCRC Enable RXCRC Enable Send Data
Test Signal Control	Card response: 0h
Digital Signal/ 15:51:28 Hal.pn518.Init(TxBufferSize:012C 0h RxBufferSize:012C 0h) 15:51:28 pal(1444303a.Sw/Init/0	
pal[14443p4a.Sw.Init()	Application Laver Command GetAppIds MF DesFire
Test Signal: 15:51:28 pall14443p50:5%.init() 15:51:28 pall14443p4:SwJnit()	instanciete
Output:	Applications on the card:
15:51:28 palSli15693.Sw.Init() 15:51:28 alM6f Su.Init()	
Parts Cined	
15:51:28 alSi15693.Sw.Init()	
15:51:28 als/ii.2693.5.w.int() 15:51:28 hal.pn518.Generic ReadRegister(Address:00 0h,OUT Value:00 0h)	
L3:51:22 alsii:2093.Swi.httj L3:51:28 hal.pn518.Generic ReadRegister(Address:00 0h,OUT Value:00 0h) Close Board Soft Reset Service Upgrade Help Save log Status: () Isuccess in reading the IPCD confi	guration>(pDataRead:AC20050501F0F0 0h)(bE2PromAddress:34 0h bDataLenoth:07

Fig 15. PN5180 Initial view

After starting the NFC Cockpit, the communication link between the PC and the PNEV5180B (via the LPC interface) is enabled automatically.

Note: The PN5180 NFC Cockpit is a development tool, and therefore allows many different kind of operations, even "useless" ones at a first glance. The correct use of the NFC Cockpit is required to operate the PN5180 properly.

Example: without enabling the Field no card can be operated, even though the PN5180 can be operated.

The Fig 16 shows the activation of a MIFARE DESFire card, using the <Load Protocol> + <Field On> + <Activate Layer3>, followed by <Activate Layer4>. The PN5180 NFC Cockpit shows the card responses like ATQA, SAK, and ATS.

Afterwards the ISO/IEC 14443-4 protocol can be used to exchange data. The Fig 16 shows the MIFARE DESFire command "Get Application ID" (0x6A), which returns the AIDs.

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

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	Operation		Type Cards LPCD DPC	
STEM_CONFIG • Read	C EEPROM	3: REQ + Anticollison + Select	Type A Type B Type F ISO15693	1: Load Protocol
gister address: 000h Write	e Kegister	Anticollison · Oelect	Protocol Layer Layer 14443-3a	Load OI ISO14443-
selection:	25 S		Activate Layer3 Halt	106 kBd/s • Load Protocol
X Value: 000000			Last SAK: 200h	Perform Single/Endless REQ
00000000		A. DATO	UID: 80582239 Oh	Inter-REC) ms
Vrite Operation		4. RAIS	Select a baud rate: 106 kBa	MIFARE DESFire
Single bit		CTIVE WTOCO MFC CF RBS_T FU FU FU FO MMC	Activate Layer4 Desei	et ApplicationIDs ms
egisters/EEProm access	2	Field on	ATS: 067577810280 0H	Simple REQA
EPROM Single Byte Access	Dump EEProm	RF Field 9	Layer 14443-4: Data Exchange with PIC	c
Data 0x00 Write EEPRO	M Load EEProm	Field Off RF Reset	Data to be send:	6a Oh
Test Signal Control	Log Monitor		TXCRC Enable	able Send Data
igital Signal/	15:54:42 Hal.pn518.Generic.ApplyProtocolSetti pall14443p3a.Sw.Generic.RepuestA(O	tings(CardType:01.0h)	Card response:	5: Response
mencil piglines	pall14443p3a.Sw.Generic Anticollision 0h.NvbUidIn:40 0h.OUT UidOut:80582239 0h.C	n(CascadeLevel:93 0h,UidIn:80582239 DUT NvbUidOut:40 0h)	Application Laver Command GetApplds MF DesFire	
est Signal:	pall14443p3a.Sw.Generic.Select(Casca 15:54:46 pall14443p4.Sw.Generic.ActivateCard	adeLevel:93 0h,UidIn:80582239 0h,OUT Sak:20 0h) i(Fsdi:08 0h,Cid:00 0h,Dri:00 0h,Dsi:00 0h,OUT	GetApplds	
Jutput:	Ats:067577810280 0h) 16:1:33 Hal.pn518.Generic.SetConfig(Config:0	02 0h,Value:01 0h)	Applications on the card:	
Route Signal	Hal.pn518.Generic.SetConfig(Config: pall14443p4.Sw.Generic.Exchange(Op	01 0h,Value:01 0h) ption:00 0h,TxBuffer:5A 0h,OUT RxBuffer:010000		
J	UN)			

(2) 0x6a = Get Application ID command of MIFARE DESFire EV1

Fig 16. PN5180 NFC Cockpit: Activation of a MIFARE DESFire EV1 card + Get Application ID

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

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

- (3) <Load Protocol> (e.g. type A 106)
- (4) <Field On>
- (5) <Single REQA> (using the EEPROM settings)
- (6) Select a TX register, e.g. RF_CONTROL_TX, enable TX_SET_BYPASS_SC_SHAPING
- (7) Change some register bits, and write back into RAM
- (8) <Single REQA> shows the register changes (probing the field and checking the envelop)

This allows an easy and quick optimization of Tx and Rx parameters before changing the EERPOM.

- (9) <Load Protocol> (e.g. type A 106)
- (10) <Single REQA> (using again the EEPROM settings)

3.2.1 PN5180 Register access

The PN5180 NFC Cockpit allows the reading and writing of all the PN5180 registers (see Fig 17).

Selecting a register reads and shows the hexadecimal content as well as the corresponding bit values. The input allows to change each bit separately as well as writing hexadecimal values. Writing back the value changes the PN5180 register.

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

<u>Note:</u> Some register content cannot be changed manually ("read only") and some content might be overwritten by the PN5180 firmware.

Operation	Type Cards LPCD DPC
TEM_CONFIG + Read EEPROM *	Type A Type B Type F ISO15693
ster address: 000h Write Register	Protocol Laver
	Layer 14443-3a Load Protocol ISO14443
	Activate Layer3 Halt 106 kBd/s Load Protocol
	ATQA: 03040h Br-Activate [3] Bedar Black Barlow
	Last SAK: 200h Perform Single Endless REC
	Inter-REQ:
ite Operation Register access ("RAM")	Layer 14443-4a
All bits EEDPOM Procotol accore	Select a baud rate: 106 kBd/s Time out PEON:
	Activate Layer4 Deselect Card
isters/EEProm access	ATS: 067577810280 0h Smale REQ4
ROM Single Byte Access	Laure 14442 A Data Evolution with DICC
Address 0x00 Read EEPROM Dump EEProm	Layer 14445-4: Data Exchange with PICC
Data 0x00 Write FEPROM Load EEProm Eveld On Eveld Off PE Paret	Data to be send: 6a 0f
EEPROM Access	TXCRC Enable RXCRC Enable Send Data
est Signal Control	Card response: 010000 0h
ital Signal/ pall24443p3a.Sw.Generic.RepuestA(OUT atqA:0304 0h)	
pall14443p3a.5w.Generic.Anticollision(CascadeLevel:93 0h,Uidln:80582239	Application Laver Command GetApplds ME DesFire
t Signal: pal124443p3a.Sw.Generic.Select(CascadeLevel/93 0h,UidIn:80582239 0h,OUT Sal:20 0h)	Cash alk
15:54:46 pall14443p4.Sw.Generic ActivateCard(Fsdi:08 0h,Cid:00 0h,Dri:00 0h,Dsi:00 0h,OUT	Applications on the card
Put: AG:00/37/61/200 Un/ 16:1:33 Hal.pn518.Generic.SetConfig(Config:02 0h, Value:01 0h)	Apprication of the card.
Hallph518.Generic.SetConfig(Config:01.0h, Value:01.0h)	
Oh)	
ose Board Soft Reset Secure Upgode Help Save log Status: (j) [success in data exchanging with PICC	C>(DATA_L4:010000 0h)(Option:00 0h TxBuffer:6A 0h TXCRC:01 0h RXCRC:01 0h)

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

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

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

3.2.2 PN5180 direct EEPROM access

The NFC Cockpit allows 4 options of EEPROM access (see Fig 18):

- Read EEPROM
 - Reads a single byte from EEPROM using byte address
- Write EEPROM

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Writes a single byte into EEPROM using byte address

Dump EEPROM

Stores the complete user area of the PN5180 EEPROM into a XML file. This can be used to generate a backup of all settings or to transfer optimized settings onto another board or into own software.

Load EEPROM

Load a XML file and stores the content into the user area of the PN5180 EEPROM. The format is fixed and must fit.



3.2.3 PN5180 analog and digital test signals

The NFC cockpit allows to use the PN5180 internal test bus, if enabled (refer to TESTBUS_ENABLE, see [1]) to route some digital and analog test signals to the given testpins (IRQ, AUX1, AUX2 and GPIO1), as shown in Fig 19.

The test pins can be found at J302 (pin row).

Note: Be aware that some test pins might be used already (e.g. IRQ)!

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	Operation	Type Cards LPCD DPC
YSTEM_CONFIG Read	EEPROM	Type A Type B Type F ISO15693
egister address: 000h Write	Register	Protocol Layer Layer 14443-3a Load Protocol ISO14443-4
t selection: mary Value: 00000000 Write Operation All bits Single bit. egisters/EEProm access	ACTOF MODE. ACTOF	Activate Layer3 Halt 106 kBd/s Lead Protocol ATOA: 03040h Ine-dedivate L3 Perform Single/Endless REQ UD, 80582239 0h Single REQA Endless REQA Layer 1443-4a Inter-REQ: ms Select a baud rate: 106 kBd/s Time-out RFON: ms Activate Layer4 Deselect Card Single REQA Endless REQA
	Load EEProm Field On Field Off RF Reset OM Access Load EEProm Field On Field Off RF Reset Source instruction returns Source instruction returns Source instruction returns Source instruction returns 15:5442 Halph518.Generic ApplyProtocolSettings(CardType:01.0h) Source instruction returns Source instruction returns 19:54443p3a.Sw. Generic AnticolIsion(CascadeLevel:93.0h.UidIn:80582239 Source instruction returns Source instruction returns	Card response: 010000 0h
Test Signal:	0h,Nv6Uidin400h,OUT UidOut805822390h,OUT Nv6Uid0vt400h) pall14443p3aSwCenericSeteCtocadeLevel390 NUId1R05822390h,OUT Sak200h) 15:5446 pall14443p4Sw.GenericActivateCard(Fsdio80h,Cids00h,Dri000h,Dri000h,Dsi000h,OUT Ats0675778102800h) 16:133 Haipn518.GenericSetConfig(Config:020h,Value010h) Haipn518.GenericSetConfig(Config:020h,Value010h) pall14443p4Sw.GenericExchange(Option000h,Tx8uffer:6A0h,OUT Rx8uffer:010000 0h)	Command GetAppids MF Destrie GetApplds Applications on the card:

Fig 19. PN5180 analog and digital test signals

The analog test signals can directly be selected, for the digital signals a test bus group must be selected first, as shown in Fig 20. Then the digital signal out of the group can be selected as shown in Fig 21, and finally the test pin must be selected as shown in Fig 22.

Afterwards the <Route Signal> activates the chosen test signals ate the chosen test pins.

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Operation	Type Cards LPCD DPC
X_OVERSHOOT_CON + Read EEPROM *	Type A Type B Type F ISO15693
egister address: 150h Write Register	Protocol Layer
	Layer 14443-3a Load Protocol ISO14443-
it selection:	Image: Second
	ATOA: 03040h Re-Activate 13 Perform Single/Endless RED
60000000	UID: 80582239 Oh Single REQA Endless REQA
5	5 Inter-REQ: ms
Write Operation	Select a band aster (106 b0d/c a)
Single bit	Time-out RFQN: ms
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Activate Layer4 Deselect Card
Registers/EEProm access	ATS: 067577810280 Oh Single REQA
EEPROM Single Byte Access Dump EEProm RF Field Control	Layer 14443-4: Data Exchange with PICC
Address 0x00 Read EEPROM	Data to be send: 5a Oh
Data 0x00 Write EEPROM Access Load EEProm Field On	Field Off RF Reset
Test Signal Control	Card response: 010000 0h
Digital Signal/ pall14443p3a.Sw.Generic Anticollision(CascadeLevel:93 (0h,Uidh:80582239
Analog signou: Analog output of value defined in register DAC, VALUE Recover D-channel signal: depending on SIGRO IN SEL ather samples Socials from AD	220 0h) Application Layer Command Get Applies ME DecEire
Analog - Receiver E-channel signal depending on SIGPRO IN SEL within samples signals from ADC	Werkelpte or Sigin
Filtered Editarine Lagran (recontine)	Applications on the card:
Clock signal group Transmitter encoder group	0000
Timer group	
Transceive group	
Receiver data transfer group Close Board S Receiver error group	[success in reading the logical register>(REGISTER_CONTENT:00 0h)(Address:15 0h)]

		Operation	-			Ту	pe Cards LPCD DP	c		
TX_OVERSHOOT_CC	DN • Read	@ EEPROM				T	Туре А Туре В Туре	e F ISO15693		
Register address:	150h Write	C Register				P	Protocol Layer			
						5. G. 1	Layer 14443-3a		Loa	d Protocol ISO14443-
it selection:	2000		8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	35			Activate Layer3	Halt	106 kBd/s 🔹	Load Protocol
inary							ATQA: 03040h	Ré-derivate (3	Pador	n Single/England REC
ex. value							Last SAK: 200h	Ob	Single REQA	Endless REQA
0000000	10		1		-16	ie.	010.		Inter-REQ:	ms
Write Operation	OH		10		HOCH	PER I	Layer 14443+4a		RFRESET	
 All bits 	VERS		RVEL		VER	VERS	Select a baud rate:	106 kBd/s *	Time-out RFON:	ms
107 Single bit	TR.O		RESE		DX C	0.00	Activate Layer4	Deselect Card		
Registers/EEProm	access				· · · · · · · · · · · · · · · · · · ·	and a second	ATS: 067577810280	Oh	Single REQA	
EEPROM Single Byt	te Access		[RF Field Control	C		Laver 14443-4: Data Fr	change with PICC		
Address 0	x00 Read EE	PROM	Dump EEProm	1.000.000.00			Dura bound	in the second		62 04
Data 0	x00 Write EE	PROM FEPROM Access	Load EEProm	Field On	Field Off RF F	Reset	Data to be send:	-	(11) (11) (11) (11) (11) (11) (11) (11)	
			A			$ \rightarrow $	TXCRC Enable	RXCRC Enable	Send Data	1
Test Signal Cont	trol	pall14443p3	a.Sw.Generic Anticollisio	on(CascadeLevel:93.0	h UidIn:80582239		Card response: 010	3000		Oh
Analog Signalin	Transmitter en	0h,NvbUidIn:40 0h,OL	UT UidOut:80582239 0h	OUT NvbUidOut:40		A A	Application Laver			
* 3 P . 1	(15:54:46 pall14443p4	Sw.Generic ActivateCar	d(Fsdi:08 0h,Cid:00 0	h Dri:00 0h Dsi:00 0h OUT	in)	Command GetApplds	MF DesFire		
Test signal:	13.56 MHz Clock	Ats:067577810280 0h)	Concernant and			GetApplds			
Output:	Output TX envelo	ope 🎽 Digi	ital test sig	nal of sele	ected bus gro	pup	Applications on the	card:		
	LIX-INQ	Oh) pł				1				
	Route Signal	16:14:42 Halpn518.Ge	eneric.ApplyProtocolSet eneric.ReadRegister(Adr	ttings(CardType:01 0)	1) e-00.0b)	-	L			
		10:14:47 nalion J10.0e	and the second se							

Fig 21. PN5180 digital test signal selection

AN11744

AN11744

Uperation	Type Cards LPCD DPC
K_OVERSHOOT_CON + Read EEPROM *	Type A Type B Type F ISO15693
egister address: 150h Write 🔍 Register	Protocol Laver
	Load Protocol ISO14443-
tselection:	Activate Layer3 Halt 106 kBd/s Load Protocol
	ATQA: 03040h Last SAK: 200h Re-dmoare L3 Perform Single/Endless REQ
00000000	UTD: 80582239 Oh Single REQA C Endless REQA
5 15 15	Inter-REQ: ms
Write Operation OP	Salad a burd atta 105 LOA/a
© Single bit	Time-out RFON: ms
	Activate Layer4 Leselect Card
egisters/EEProm access	AT5: 067577810280 Oh Single REQA
EPROM Single Byte Access	Layer 14443-4: Data Exchange with PICC
Address 0x00 Read EEPROM	Data to be send: 6a Oh
Data 0x00 Write EEPROM Access Load EEProm Field On Field Off RF Reset	TYCOC Enable PYCOC Enable Send Data
Test Signal Control	
Digital Signal/ Transmitter en pall14443p3a.Sw.Generic.Anticollision(CascadeLevel:93 0h.Uidln:80582239	Caro response: 50000
hnalog Signale 0h, NvbUidIn:40 0h, OUT UidOut:80582239 0h, OUT NvbUidOut:40 0h) pall14443p3a, Sw. Generic: Select(CascadeLevel:93 0h, UidIn:80582239 0h, OUT Sak:20 0h)	Application Laver
Test Signal: Dutout TX) . IS:54:46 pall14443p4.5w.Generic ActivateCard(Fsdi:08 0h,Cid:00 0h,Dri:00 0h,Dui00 0h,OUT	Command GetAppIds MF DesFire
16:1:33 Hal.pn518.Generic.SetConfig(Config:02 0h, Value:01 0h)	GetAppids
Dutput: Hal.pn518.Generic.SetConfig(Config:01 0h, Value:01 0h) pall14443p4.Sw.Generic.Exchange(Option:00 0h TxBuffer:6A 0h OUT RxBuffer:010000	Applications on the card:
AUX2 (details of the second se	

3.2.4 PN5180 Low power card detection

The NFC Cockpit allows the configuration and test of the Low Power Card Detection (LPCD) of the PN5180 as shown in Fig 23.

The LPCD parameter, which are stored in the EEPROM (details refer to [1]), can be changed and the LPCD can be started.

<u>Note:</u> Press <Field Off> before starting the LPCD, otherwise the PN5180 wakes up immediately once.

AN11744

Operation	Type Cards LPCD DPC
YSTEM_CONFIG Read EEPROM	LPCD Configuration
egister address: 000h Write @ Register	LPCD EEConfig
	Reference Value Di204E
selection:	Threshold Value 0x05
	DODOO Field ON Time 0x05
00000000	GPO Taggle Before Field ON Time 0xF0
Pad: provious wake with po pard (a g due	GPO Toggle After Field OFF Time 0xF0
to phono without NEO)	Use Auto Calibration * Enable GPIO Control
to phone without NFC)	Update Config
egisters/EEProm	A.A.A.L.L.
EPROM Single Byte Ref Field Control	StandBy Time 200 ms
Address 0x00 M	
	hue to eard
Data 0x00 EEPROM Access Load EEProm Black: wake of	Lue to card Perform LPCD Stop LPCD
Data 0x00 EEPROM Access Load EEProm Black: wake of Test Signal Control	Perform LPCD Stop LPCD
Data 0x00 EEPROM Access Load EEProm Black: wake of Cog Monitor Digital Signal/ 17:9:18 als15693 Swintit) 17:9:18 als15693 Swintit) 17:9:18 als15693 Swintit)	Perform LPCD Stop LPCD
Data 0x00 EEPROM Access Load EEProm Black: Wake of Cog Monitor Digital Signal Dig	Low Power Card Detection
Data Ox00 EEPROM Access Load EEProm Black: wake of Test Signal Control Cog Monitor 7/3/3/8 National Signal (National (National Signal (National Signal (National (National (Nationa (Nati	Low Power Card Detection
Data Ox00 EEPROM Access Load EEProm Black: wake of Test Signal Control Cog Monitor 17:19:18 algn518.66menc.ReadRegister(algn612) mOUT Value.00 0h) 17:19:20 Halpn518.66menc.ReadRegister(algn62) mOUT Value.00 0h) 17:19:20 Halpn518.66menc.ReadRegister(algn62) mOUT Value.00 0h) 17:19:20 Halpn518.66menc.ReadRegister(algn62) mOUT Value.00 0h) 17:19:20 Halpn518.66menc.ReadRegister(algn62) mOUT Value.00 0h) 17:19:20 Halpn518.66menc.ReadRegister(algn62) mOUT Value.00 0h) 17:19:20 Halpn518.66menc.ReadRegister(algn62) mOUT Value.00 0h) 17:19:20 Halpn518.66menc.ReadRegister(algn62) mOUT Value.00 0h) 17:19:20 Halpn518.66menc.ReadRegister(algn62) mOUT Value.00 0h) 17:19:20 Halpn518.66menc.ReadRegister(algn62) mOUT Value.00 0h) 17:19:20 Halpn518.66menc.ReadRegister(algn62) mOUT Value.00 0h) 17:19:20 Halpn518.66menc.ReadRegister(algn62) mOUT Value.00 0h) 17:19:20 Halpn518.66menc.ReadRegister(algn62) mOUT Value.00 0h) 17:19:20 Halpn518.66menc.ReadRegister(algn62) mOUT Value.00 0h) 17:19:20 Halpn518.66menc.ReadRegister(algn62) MOUT Value.00 0h) 17:19:20 Halpn518.66menc.ReadRegister(algn62) mOUT Value.00 0h) 17:19:20 Halpn518.60menc.Halpn518 MOUT Value.00 0h) <td>Low Power Card Detection</td>	Low Power Card Detection
Data 0x00 EEPROM Access Load EEProm Black: Wake O Cog Monitor 17:19:20 Halph518.Generic.ReadRegister(A Indice Signals Indic	Low Power Card Detection
Data Data <th< td=""><td>Low Power Card Detection</td></th<>	Low Power Card Detection

(1) LPCD had been started twice: first time wake up without card, second time wake up due to card.

Fig 23. PN5180 LPCD

3.2.5 PN5180 Dynamic Power Control

The NFC Cockpit supports the correlation test as well as an easy and straight forward calibration of the DPC itself. All details can be found in [4].

3.2.6 EMVCo Loopback application

The NFC Cockpit 2.3 offers the option to flash the EMVco Loopback application into the LPC and start this application from the NFC Cockpit.

The EMVco Loopback must be flashed **once** into the LPC firmware by pressing the <Laod EMVCO App> button (see Fig 24).

The EMVco Loopback can be started by pressing the <Start EMVco App> button, and then is executed on the LPC. The function can be stopped by pressing the <Stop EMVCO App> button, but afterwards the PNEV5180B must be reset to continue with the standard NFC Cockpit functionality.

This Emvco loopback functionality requires the update of the LPC firmware (lpc_main.bin) with the latest version (part of the installer package), as described in 3.1.1.

AN11744

TEM_CONFIG - Read EEPROM	Type Cards LPCD DPC EMVCo Loopback
ster address: 000h Write @ Register	
	Load EMVCO App Start EMVCo App
y Value DODODODODODODODODODODODODODODODODODODO	
000000 ph	
te Operation	
All bits VIII 0000 (11 10 10 10 10 10 10 10 10 10 10 10 10 1	
ROM Single Byte Access	1
dress 0x00 Read EEPROM Dump EEProm	
ta 0x00 Write EEPROM EEPROM Access	
t Signal Control Used Monitor 9:50:6 Used.linit()	
ital Signal/ 9:50:6 Hal.pn5180.Init(Tx8ufferSize:012C 0h,Rx8ufferSize:012C 0h) 9:50:6 pall14443p3a.Sw.Init()	
pall14443p4a.SwInit() 9:50:6 pall14443o3b.SwJnit()	
stonai: 950.6 pall14443p4.5w.Init() 950.6 pall14443p4.5w.Init()	
put: 9:50:6 palFelica.Sw.Init() 9:50:6 palFelica.Sw.Init()	
9:50:6 alMfdf.Sw.Init()	
demodeling instantion in design also also also also also also also also	
9:50/b al3/112093.5w1ntt) 9:50/6 hal.pn5180.Generic.ReadRegister(Address:00 0h,OUT Value:00 0h)	

Fig 24. NFC Cockpit with EMVCo Loopback App

4. First time use

Make sure the LPC1769 is flashed with the correct FW (default).

4.1 Jumper settings

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

4.1.1 USB only

The jumper settings as shown in Fig 9 provide the default settings, using only USB for power supply (no external supply required).

4.1.2 External power supply

For the use of an external power supply the jumper J101 must be changed as shown in Fig 10.

The external power supply must provide a voltage level of V_{ext} = 7.5 ... 12V with 500mA.

For some of the analog tests (i.e. measuring ITVDD) it might be useful to only power the TVDD supply externally. This can be done using the jumper JP300, as shown in Fig 25.

Either the jumper can be replaced with a DC ampere meter to measure the ITVDD, or an external 5Vdc power supply can be directly connected to the right pin of JP300.

<u>Note:</u> Several GND pins are provided on the board. They all are connected.

AN11744 PN5180 Evaluation board



5. References

- [1] PN5180 datasheet, <u>www.nxp.com</u>
- [2] AN11740 PN5180 Antenna design guide
- [3] AN11741 PN5180 DPC Antenna design
- [4] AN11742 PN5180 Dynamic Power Control
- [5] UM10954 PN5180 SW Quick start guide

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