



PN5180 – The best full NFC frontend on the market

Product support package

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January 2016

Agenda

Session 13th January: PN5180 Introduction

- ▶ Positioning within the NFC portfolio and overview
- ▶ Target markets and benefits
- ▶ Product description and key features, including the outstanding Dynamic Power Control
- ▶ PN5180 design tools, documentation and ordering details

Watch [recording](#)

Session 27th January: PN5180 product support package

- ▶ Where to find PN5180 documentation
- ▶ OM25180FDK demokit, PNEV5180B and SW driver installation
- ▶ PN5180 NFC Cockpit application
- ▶ PN5180 SW development environment, NFC Reader Library and available SW examples
- ▶ Datasheet, application notes, user manuals and other tools



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| Compare Selected | | <input type="checkbox"/> Parallel; | <input type="checkbox"/> 3.3 - 5.0 | | <input type="checkbox"/> ISO/IEC 14443A, ISO/IEC 14443B, ISO/IEC 15693 | <input type="checkbox"/> 5 |
| PN512 | Buy Options | UART, I2C, SPI | 1.8 - 3.6 | NFC Frontend solution | ISO/IEC 14443A, ISO/IEC 14443B, Felica, ISO/IEC | 2.5 - 3.6 |
| PN5180 | | | | | | |
| PN5180ADHN | | | | | | |

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PN5180: High-power NFC frontend solution ☆

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- NFC Reader Library V3.092.12.001547 for PNEV5180B including all software examples (REV 1.0)
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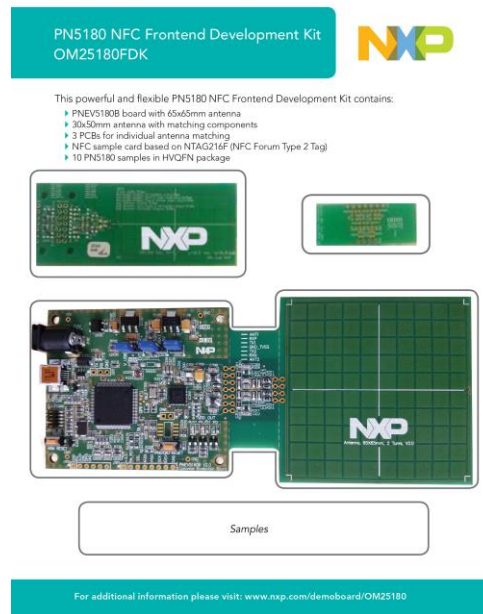
PN5180 product support package in a nutshell



| | |
|---------------------------|--|
| Demokit | › PN5180 NFC frontend development kit OM25180FDK |
| NFC Cockpit | › SW3524 - Installer package PN5180 NFC Cockpit v2.2 |
| NFC Reader Library | › SW3522 - NFC Reader Library for PNEV5180B including all SW examples |
| Documentation | <ul style="list-style-type: none">› 75017673 - PN5180 leaflet› PN5180 - Product datasheet› AN11742 - PN5180 Dynamic Power Control› AN11744 - PN5180 evaluation board quick start guide› AN11740 - PN5180 antenna design guide› AN11741 - How to design an antenna with DPC› UM10954 - PN5180 SW quick start guide› SW3545 - PN5180 antenna design tools |

PN5180 NFC frontend development kit OM25180FDK

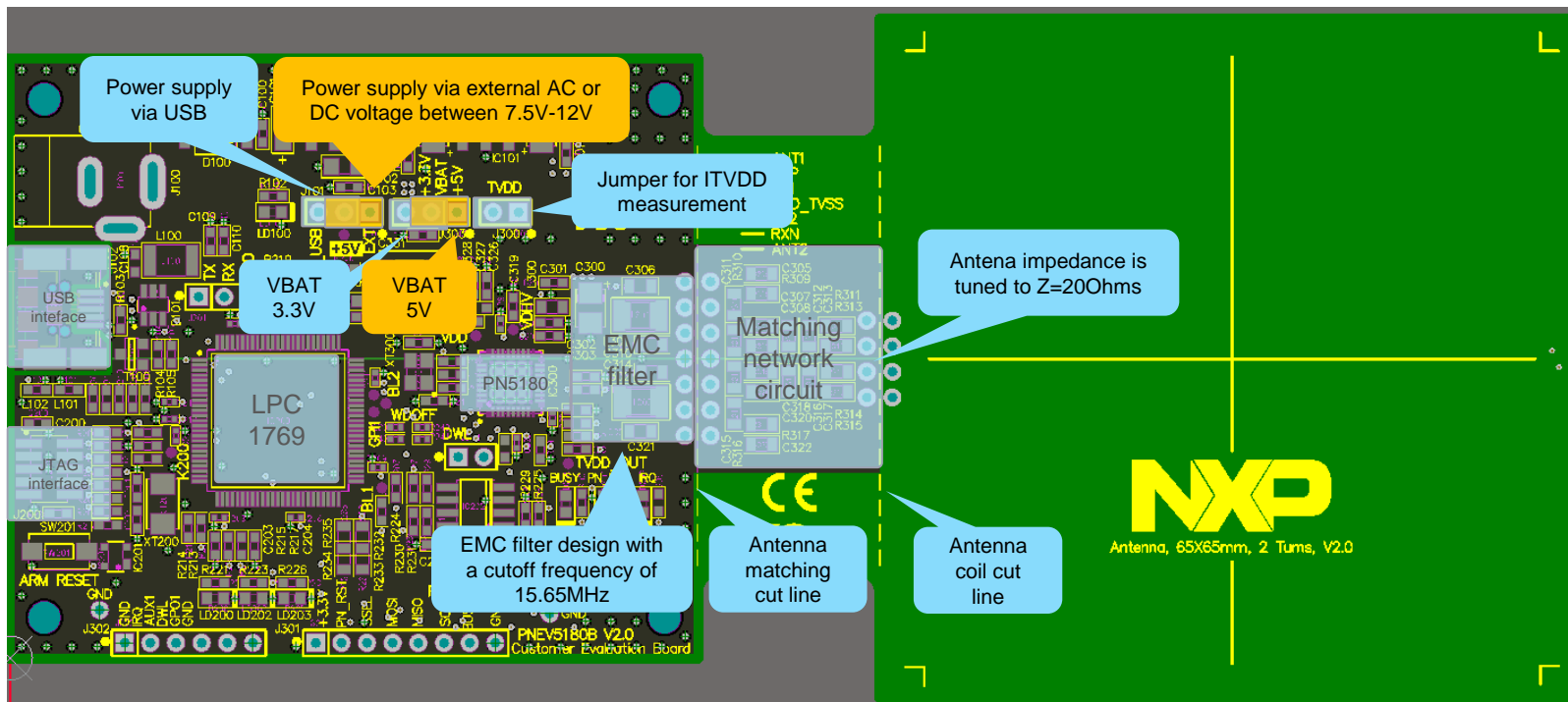
- ▶ PNEV5180B Evaluation board embeds the high-performance, full NFC Forum-compliant frontend PN5180.
- ▶ PNEV5180B can be used for SW development, hardware design, to explore PN5180 functionality and perform RF and antenna design related tests.
- ▶ PNEV5180B board with 65x65mm antenna and 30x50mm antenna with matching components.
- ▶ LPC1769 uC mounted fix on the board. SPI interface accessible for connection of other uC.
- ▶ CE/FCC certified PNEV5180B board.



Demokits at edemoboard portal and distis

| Reference | 12NC | Product description |
|------------|--------------|-------------------------------------|
| OM25180FDK | 935307319699 | PN5180 NFC frontend development kit |

PNEV5180B v2.0 hardware introduction



PNEV5180B Windows driver installation

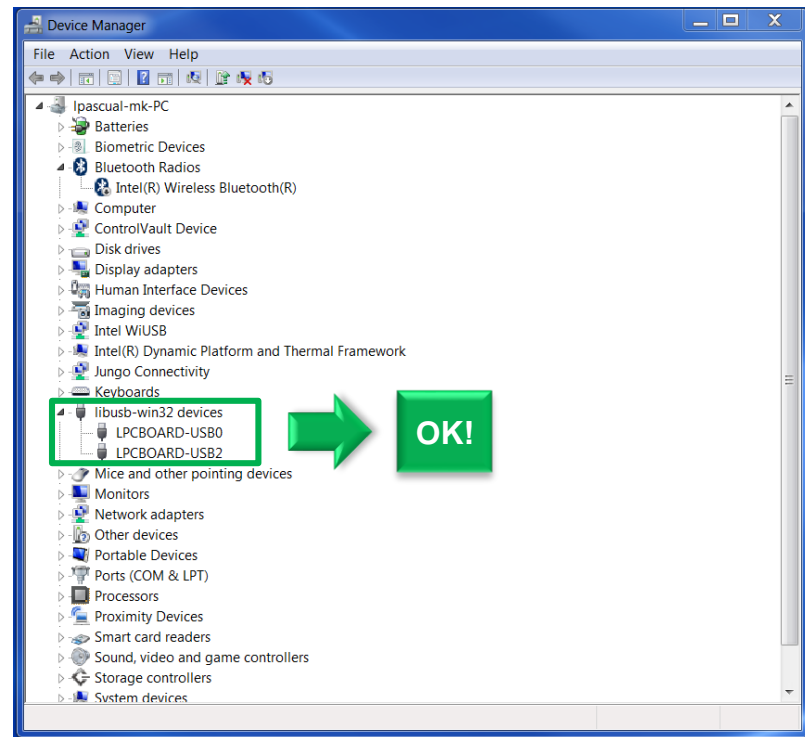
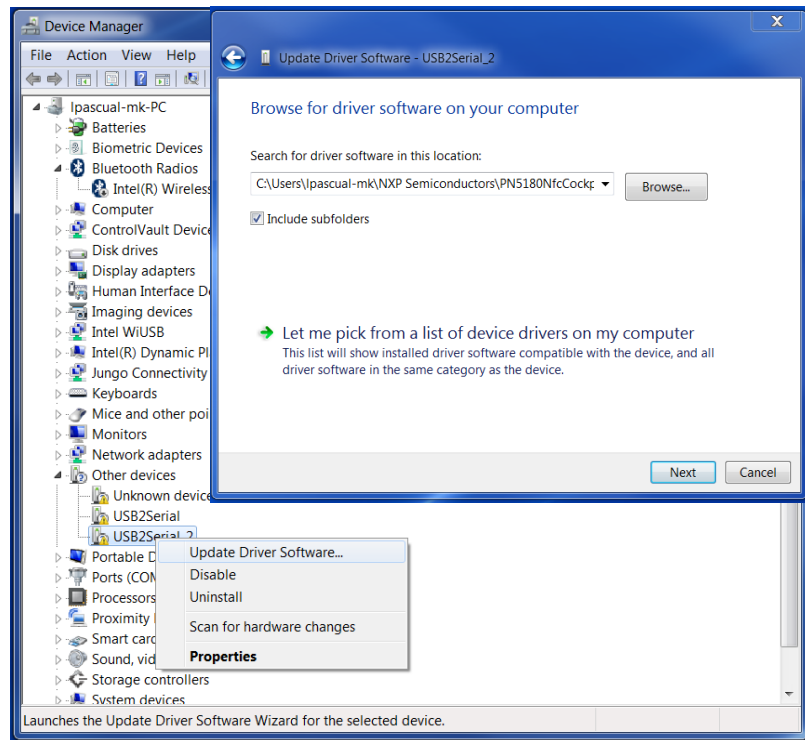
- ▶ At first connection of the PNEV5180B to the PC, the NXP LPC USB driver for Windows needs to be installed.
- ▶ The PNEV5180 is delivered with LPC FW installed (ready to use). Simply connect the PNEV5180B to a Windows PC via USB.

- 1** Download and run *SW3524 file*
Installer package PN5180 NFC Cockpit v2.2
- 2** Manually install the Windows USB driver.
Driver must be chosen from \LPCBOARD_DRIVER_WIN
- 3** Start the PN5180 NFC Cockpit.
PNEV5180B v1.0 or higher required



PNEV5180B Windows driver installation

Step 2: Manually install the LPC USB driver for Windows.



PN5180 product support package in a nutshell



| | |
|---------------------------|--|
| Demokit | › PN5180 NFC frontend development kit OM25180FDK |
| NFC Cockpit | › SW3524 - Installer package PN5180 NFC Cockpit v2.2 |
| NFC Reader Library | › SW3522 - NFC Reader Library for PNEV5180B including all SW examples |
| Documentation | <ul style="list-style-type: none">› 75017673 - PN5180 leaflet› PN5180 - Product datasheet› AN11742 - PN5180 Dynamic Power Control› AN11744 - PN5180 evaluation board quick start guide› AN11740 - PN5180 antenna design guide› AN11741 - How to design an antenna with DPC› UM10954 - PN5180 SW quick start guide› SW3545 - PN5180 antenna design tools |

PN5180 NFC Cockpit

GUI overview

PN5180 NFC Cockpit: *The complete design tool for engineers*

The screenshot displays the PN5180 NFC Cockpit v2.2 software interface, which is divided into several functional panels:

- Registers/EEPROM access:** This panel at the top left includes a dropdown for 'SYSTEM_CONFIG', buttons for 'Read' and 'Write', and a 'Register address' field set to '000h'. It also features a 'Bit selection' section with checkboxes for bits 31 through 0, and a 'Hex. Value' field showing '00000000h'. Below this is a 'Write Operation' section with radio buttons for 'All bits' and 'Single bit'. A large annotation 'Register access (including bit descriptions)' points to the bit selection area, and 'Read & Write register (temporary)' and 'Read & Write EEPROM configurations' point to the address and value fields respectively.
- EEPROM Single Byte Access:** Located below the first panel, it has 'Address' and 'Data' fields (both set to '0x00') and buttons for 'Read EEPROM', 'Write EEPROM', 'Dump EEPROM', and 'Load EEPROM'. An annotation 'Direct EEPROM Read & Write' points to the address and data fields.
- RF Field Control:** This panel includes buttons for 'Field ON', 'Field OFF', and 'RF Reset'. An annotation 'RF Field control' points to these buttons.
- Test Signal Control:** On the bottom left, it features dropdowns for 'Digital Signal/' and 'Analog Signals', a 'Test Signal:' dropdown, and an 'Output:' dropdown. A 'Route Signal' button is at the bottom. An annotation 'Test signals' points to the 'Test Signal:' dropdown.
- Log Monitor:** This panel displays a list of log entries with timestamps and command names. An annotation 'Log window: Command History' points to the log list.
- Protocol Layer:** The right side of the interface is dedicated to protocol configuration. It includes tabs for 'Type Cards' (LPCD, DPC) and 'Type A', 'Type B', 'Type F', 'ISO15693'. It shows 'Protocol Layer' settings for 'Layer 14443-3a' and 'Layer 14443-4a', including buttons for 'Activate Layer3', 'Halt', 'Re-Activate L3', 'Load Protocol', and 'Perform Single/Endless REQA'. It also includes fields for 'ATO: 0h', 'Last SAK: 0h', 'UID: 0h', 'Inter-REQ: ms', and 'AT: 0h'. An annotation 'Reader mode for Type A, Type B, Type F and ISO/IEC15693' points to the 'Type A' tab. Another annotation 'Low Power Card Detection (LPCD)' points to the 'LPCD' tab. A third annotation 'Dynamic Power Control (DPC)' points to the 'DPC' tab.

The bottom of the interface features a status bar with buttons for 'Close Board', 'Soft Reset', 'Help', and 'Save log', along with a 'Status:' indicator.

PN5180 NFC Cockpit

Used as a simple standard reader

PN5180 NFC Cockpit: *Reader mode*

“Create application” command to a MIFARE DESFire card

The screenshot displays the PN5180 NFC Cockpit v2.2 software interface, which is used for configuring and communicating with NFC cards. The interface is divided into several sections, and five specific steps are highlighted with yellow callouts:

- Load protocol**: Located in the top left, under the 'Operation' tab, the 'Load Protocol' button is highlighted.
- Field ON**: Located in the top left, under the 'RF Field Control' tab, the 'Field ON' button is highlighted.
- REQ + Anticoll + Select**: Located in the top left, under the 'Test Signal Control' tab, the 'REQ' button is highlighted.
- RATS**: Located in the top left, under the 'Test Signal Control' tab, the 'RATS' button is highlighted.
- DESFire Create App command**: Located in the bottom right, under the 'Application Layer' tab, the 'GetApplds' button is highlighted.

The interface also shows various configuration options, including card type (LPCD, DPC), protocol layer (Layer 14443-3a, Layer 14443-4a), baud rate (106 kBd/s), and data exchange settings. The 'Data to be send' field is highlighted in red, showing the command CAA2A1A00785 0h. The 'Log Monitor' section displays a list of commands and their responses, including the 'GetApplds' command.

PN5180 NFC Cockpit: Reader mode

“Get Application AIDs” command to a MIFARE DESFire card

The screenshot displays the PN5180 NFC Cockpit v2.2 software interface, which is used for configuring and communicating with an NFC reader. The interface is divided into several sections, and a sequence of six steps is highlighted with yellow callouts on the left side:

- Load protocol**: The 'Protocol Layer' is set to 'Layer 14443-3a'.
- Field ON**: The 'Field ON' button is clicked in the 'RF Field Control' section.
- REQ + Anticoll + Select**: The 'Single REQA' option is selected under 'Perform Single/Endless REQA'.
- RATS**: The 'RATS' button is clicked in the 'Test Signal Control' section.
- DESFire Create App command**: The 'Create App' button is clicked in the 'Application Layer' section.
- DESFire Get App AIDs command**: The 'GetAppAids' button is clicked in the 'Application Layer' section.

The 'Card response' field in the 'Application Layer' section shows the response 'A2A1A0', which is highlighted with a red box and a yellow callout labeled '6'. The 'Log Monitor' section shows the sequence of commands and responses sent to the card, including 'Select', 'ActivateCard', 'SetConfig', and 'Exchange'.

The interface also includes a 'Test Signal Control' section with buttons for 'Digital Signal', 'Analog Signals', 'Test Signal', and 'Output', and a 'Route Signal' button. The 'Log Monitor' section displays a list of log entries with timestamps and command details. The 'Application Layer' section shows the 'GetAppAids' command and the resulting 'Card response'.

PN5180 NFC Cockpit

Analog and digital test signals

PN5180 NFC Cockpit: Analog and digital test signals

PN5180 NFC Cockpit v2.2

Operation: EEPROM, Register

Register address: 000h

Bit selection: 31, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1, 0

Binary Value: 00000000h

Write Operation: All bits, Single bit

Registers/EEProm access

EEPROM Single Byte Access: Address 0x00, Data 0x00, Read EEPROM, Write EEPROM, Dump EEPROM, Load EEPROM

RF Field Control: Field ON, Field OFF, RF Reset

Test Signal Control: 1 Choose Analog test signal or Digital test bus group

Digital Signal/Analog Signals: Transmitter, Receiver, Clock signal group, Transmitter encoder group, Timer group, Cardmode protocol group, Transceiver group, Receiver data transfer group, Receiver error group

Type Cards: LPCD, DPC

Type A: Type B, Type F, ISO15693

Protocol Layer: Layer 14443-3a, Layer 14443-4a, Layer 14443-4b

Load Protocol ISO14443-A

Activate Layer3, Halt, Re-Activate L3, Perform Single/Endless REQA, Inter-REQ, RFRESET, Time-out RFON, Single REQA

ATO: 03440h, Last SAK: 200h, UID: 04786421801D80, ATS: 067577810280

Layer 14443-4: Data Exchange with PICC

Data to be send: 6A 0h

TXCRC Enable, RXCRC Enable, Send Data

Card response: A2A1A0 0h

Applications on the card: F DesFire

[success in data exchanging with PICC-->(DATA_L4:A2A1A0 0h)(Option:00 0h TxBuffer:6A 0h TXCRC:0h)

PN5180 NFC Cockpit: Analog and digital test signals

PN5180 NFC Cockpit v2.2

Operation: ☐ EEPROM ☒ Register

SYSTEM_CONFIG: Read Write

Register address: 000h

Bit selection: ☒ 31 ☒ 30 ☒ 29 ☒ 28 ☒ 27 ☒ 26 ☒ 25 ☒ 24 ☒ 23 ☒ 22 ☒ 21 ☒ 20 ☒ 19 ☒ 18 ☒ 17 ☒ 16 ☒ 15 ☒ 14 ☒ 13 ☒ 12 ☒ 11 ☒ 10 ☒ 9 ☒ 8 ☒ 7 ☒ 6 ☒ 5 ☒ 4 ☒ 3 ☒ 2 ☒ 1 ☒ 0

Binary Value: 00000000

Hex. Value: 00000000

Write Operation: ☒ All bits ☐ Single bit

Registers/EEProm access

EEPROM Single Byte Access: Address 0x00 Read EEPROM Data 0x00 Write EEPROM Dump EEPROM Load EEPROM

RF Field Control: Field ON Field OFF RF Reset

Test Signal Control: Digital Signal/Analog Signals: Transmitte Test Signal: 13.56 MHz Output: Output TX envelope Tx-IRQ Route Signal

Log Monitor: 9:23:32 pal14443p3a.Sw.Generic.Select(CascadeLevel:95 0h,Udin:21801D80 0h,OUT Sak:20 0h) 9:23:32 pal14443p4.Sw.Generic.ActivateCard(Fsdi:08 0h,Cid:00 0h,Dri:00 0h,Dsi:00 0h,OUT Ats:067577810280 0h) 9:23:38 Hal.pn5180.Generic.SetConfig(Config:02 0h,Value:01 0h) 9:23:38 Hal.pn5180.Generic.SetConfig(Config:01 0h,Value:01 0h) 9:23:38 Hal.pn5180.Generic.SetConfig(Config:01 0h,Value:01 0h) 9:23:38 Hal.pn5180.Generic.SetConfig(Config:01 0h,Value:01 0h) 9:23:38 Hal.pn5180.Generic.Exchange(Option:00 0h,TxBuffer:6A 0h,OUT RxBuffer:A2A1A0 0h)

Type Cards: LPCD DPC

Type A Type B Type F ISO15693

Protocol Layer

Layer 14443-3a: Activate Layer3 Halt 106 kBd/s Load Protocol

ATO: 03440h Last SAK: 200h UID: 04786421801D80 0h

Perform Single/Endless REQA: ☒ Single REQA ☐ Endless REQA Inter-REQ: ms RFRESET Time-out RFON: ms

Layer 14443-4a: Select a baud rate: 106 kBd/s Activate Layer4 Deselect Card

ATS: 067577810280 0h

Layer 14443-4: Data Exchange with PICC

Data to be send: 6A 0h

☒ TXCRC Enable ☒ RXCRC Enable Send Data

Card response: A2A1A0 0h

Application Layer

Command GetAppls MF DesFire

Send Data

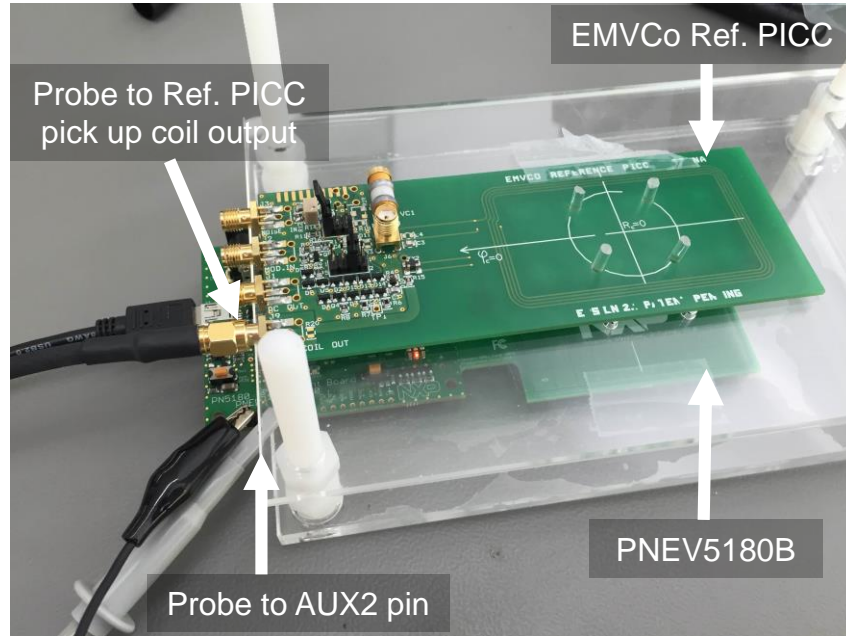
Send Data

Status: [i] [success in data exchanging with PICC-->(DATA_L4:A2A1A0 0h)(Option:00 0h TxBuffer:6A 0h TXCRC0)

PN5180 NFC Cockpit: Analog and digital test signals

PN5180 NFC Cockpit: Analog and digital test signals

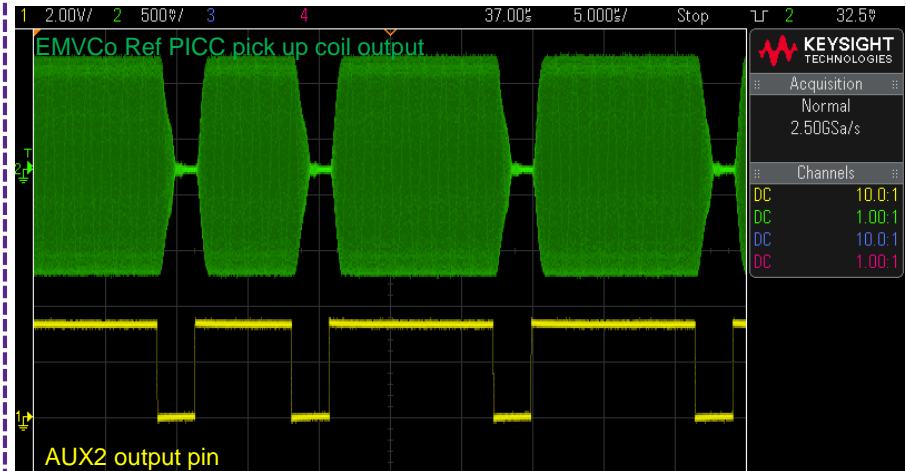
e.g. Output Tx envelope test signal



Digital signal: Transmitter encoder group

Test signal: Output Tx envelope

Output: AUX2



PN5180 NFC Cockpit

Low-power card detection (LPCD)

PN5180 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 internal 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 PN5180 datasheet

The screenshot displays the PN5180 NFC Cockpit software interface. The 'LPCD Configuration' window is open, showing various settings for low-power card detection. The 'Reference Value' is set to 0x20AC, 'Threshold Value' to 0x30, 'Field ON Time' to 0x01, 'GPO Toggle Before Field ON Time' to 0xF0, and 'GPO Toggle After Field OFF Time' to 0xF0. The 'StandBy Time' is set to 200 ms. The 'Update Config' button is highlighted with a yellow callout. The 'Perform LPCD' button is also highlighted. The 'Log Monitor' window shows a list of log entries, including 'CARD DETECTED ...'.

1 Define a threshold value (e.g. 0x03 ... 0x30)

2 Define a field on time (e.g: 0x01)

3 Define a standby time

4 Click Update Config

5 Click Perform LPCD

6 Log window shows when card is detected

Log Monitor

```
0h,bDataLength:05 0h)
10:26:22 hal.pn5180.ReadE2Prom(bE2PromAddress:34 0h,bDataLength:07 0h,OUT
ReadData:AC20010301F0F0 0h)
10:26:26 hal.pn5180.Cmd_Lpcd(LpcdMode:01 0h,detectionTimeUs:C8 0h)
10:26:30 hal.pn5180.Cmd_Lpcd(LpcdMode:01 0h,detectionTimeUs:C8 0h)
10:26:34 hal.pn5180.Cmd_Lpcd(LpcdMode:01 0h,detectionTimeUs:C8 0h)
10:26:41 hal.pn5180.Cmd_Lpcd(LpcdMode:01 0h,detectionTimeUs:C8 0h)
10:28:4 hal.pn5180.WriteE2Prom(bE2PromAddress:36 0h,pDataToWrite:F0F0013001
0h,bDataLength:05 0h)
10:28:4 hal.pn5180.ReadE2Prom(bE2PromAddress:34 0h,bDataLength:07 0h,OUT
ReadData:AC20013001F0F0 0h)
10:28:9 hal.pn5180.Cmd_Lpcd(LpcdMode:01 0h,detectionTimeUs:C8 0h)
```

CARD DETECTED ...

PN5180 NFC Cockpit: *Low-power card detection (LPCD)*

Type Cards LPCD DPC

LPCD Configuration

Reference Value

Threshold Value 1

Field ON Time

GPO Toggle Before Field ON Time

GPO Toggle After Field OFF Time

Use Auto Calibration ☐ Enable GPIO Control

LPCD Operation

StandBy Time ms

1

The load detunes the antenna, which increases the AGC measurement. If the AGC value exceeds the reference value plus the threshold value defined, the reader “sense” that a card is within the antenna field

CARD DETECTED ...



PN5180 NFC Cockpit: *Low-power card detection (LPCD)*

Type Cards | LPCD | DPC

LPCD Configuration

Reference Value

Threshold Value 1

Field ON Time

GPO Toggle Before Field ON Time

GPO Toggle After Field OFF Time

Use Auto Calibration ☐ Enable GPIO Control

LPCD EEConfig

StandBy Time ms

LPCD Operation

CARD DETECTED ...

1

As we decrease the threshold value, the reader becomes more sensitive to load detection → it needs a smaller antenna detuning effect to “sense” the card



PN5180 NFC Cockpit

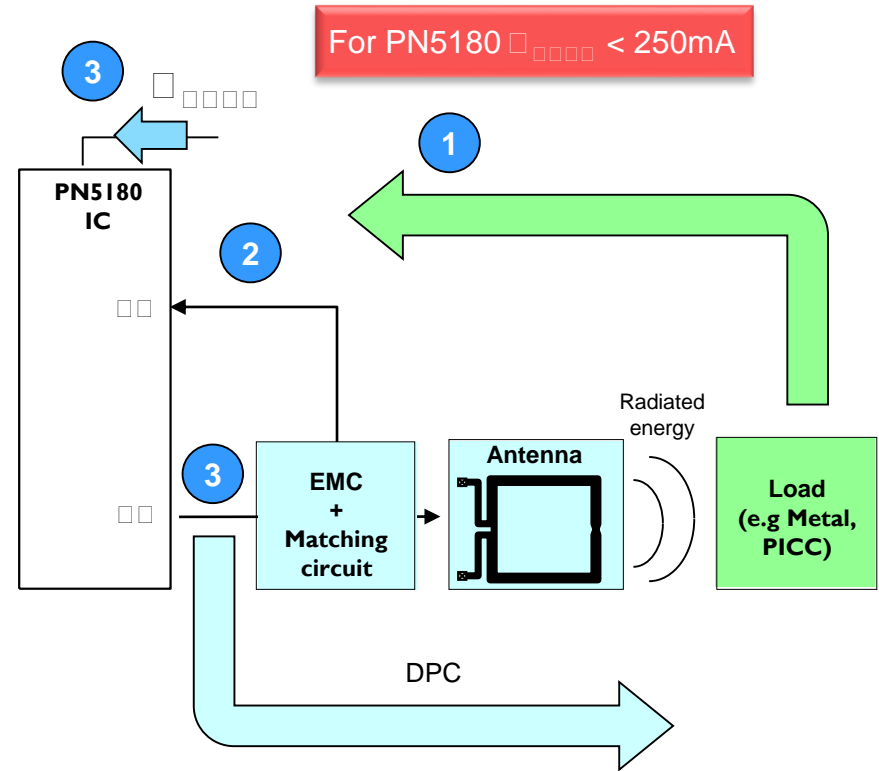
Dynamic Power Control (DPC)

How does DPC work?

“Symmetrical” antenna with DPC

- 1 A load change decreases the impedance, i.e. increases ITVDD and field strength
- 2 The DPC uses the changed Automated Gain Control (AGC) value to change TVDD settings
- 3 The changed TVDD settings reduce the ITVDD and power and field strength

DPC uses gears to control the Tx output power and consequently, controls current / field strength



What needs to be defined for DPC

0

Perform correction test

- ▶ Ensure linear relationship between AGC value and ITVDD current

1

Define number of gears (DPC_AGC_GEAR_LUT_SIZE)

- ▶ Up to 15 gears can be stored (i.e. Up to 15 output power steps can be defined)

2

Define Tx settings per gear (DPC_AGC_GEAR_LUT)

- ▶ It defines the output power settings per gear.

3

Define high threshold value per gear (DPC_THRSH_HIGH)

- ▶ It defines the maximum measured field strength per gear. The DPC switches to the next gear as soon as this threshold is achieved.

4

Define a shift value to set the low threshold (DPC_AGC_SHIFT_VALUE)

- ▶ For switching back from a lower to a higher output power, the field strength needs to become lower than the low threshold.



PN5180 NFC Cockpit: *Correlation test*

1 Define two loading conditions (e.g. Ref PICC and metal loading)

2 Measure and type ITVDD value in unloaded condition

3 Define ITVDD step (e.g 10mA)

4 Define maximum ITVDD (e.g 250mA)

5 Click start loading

6 Save the first measurement (ITVDD – unloaded condition)

PN5180 NFC Cockpit: *Correlation test*

Type Cards LPCD DPC

CORRELATION TEST DPC Calibration

ACG vs ITVDD

ITVDD unloaded 181 mA Number of Loading Cases 2

ITVDD Step Size 10 (0 to 20) AGC Value: 0x014F Hex

ITVDD Max 250 mA Current ITVDD: 191 mA

Stop Loading Save AGC Value

AGC Values In Hex and Dec for each Loading Case

Information

For ITVDD value = 191
AGC Value = 354

OK

Note: ITVDD and ITVDDMax value ranges from 0 to 250 Export AGC Value

- 1 Define two loading conditions (e.g. Ref PICC and metal loading)
- 2 Measure and type ITVDD value in unloaded condition
- 3 Define ITVDD step (e.g 10mA)
- 4 Define maximum ITVDD (e.g 250mA)
- 5 Click start loading
- 6 Save the first measurement (ITVDD – unloaded condition)
- 7 Save the second measurement when ITVDD = ITVDDunloaded + 10 mA

PN5180 NFC Cockpit: *Correlation test*

Type Cards | LPCD | DPC

CORRELATION TEST | DPC Calibration

ACG vs ITVDD

ITVDD unloaded: 181 mA Number of Loading Cases: 2

ITVDD Step Size: 10 (0 to 20) AGC Value: 0x01AA Hex

ITVDD Max: 250 mA Current ITVDD: 241 mA

Stop Loading Save AGC Value

AGC Values In Hex and Dec for each Loading Case

| ITVDD | Reference | Reference |
|-------|-----------|-----------|
| 181 | 337 | 0x0151 |
| 191 | 353 | 0x0161 |
| 201 | 369 | 0x0171 |
| 211 | 385 | 0x0181 |
| 221 | 401 | 0x0191 |
| 231 | 412 | 0x019C |
| 241 | 426 | 0x01AA |

Loading case Name

Please enter the Name Loading cases

Default 1

OK Cancel

Note: ITVDD and ITVDDMax value ranges from 0 to 250 Export AGC Value

- 1 Define two loading conditions (e.g. Ref PICC and metal loading)
- 2 Measure and type ITVDD value in unloaded condition
- 3 Define ITVDD step (e.g 10mA)
- 4 Define maximum ITVDD (e.g 250mA)
- 5 Click start loading
- 6 Save the first measurement (ITVDD – unloaded condition)
- 7 Save the second measurement when ITVDD = ITVDDunloaded + 10 mA
- 8 Repeat the process until ITVDD max is reached
- 9 Start with the second loading condition (e.g Metal loading)

PN5180 NFC Cockpit: *Correlation test*

TYPE CARDS LPCD DPC

CORRELATION TEST DPC Calibration

ACG vs ITVDD

ITVDD unloaded mA Number of Loading Cases

ITVDD Step Size (0 to 20) AGC Value: 0x01A7 Hex

ITVDD Max mA Current ITVDD: 241 mA

AGC Values In Hex and Dec for each Loading Case

| ITVDD | Reference | Reference | Metal AG | Metal AG |
|-------|-----------|-----------|----------|----------|
| 181 | 337 | 0x0151 | 335 | 0x014F |
| 191 | 353 | 0x0161 | 348 | 0x015C |
| 201 | 369 | 0x0171 | 360 | 0x0168 |
| 211 | 385 | 0x0181 | 380 | 0x017C |
| 221 | 401 | 0x0191 | 395 | |
| 231 | 412 | 0x019C | 411 | |
| 241 | 426 | 0x01AA | 423 | |

Loading Cases Completed

Note: ITVDD and ITVDDMax value ranges from 0 to 250

- 1 Define two loading conditions (e.g. Ref PICC and metal loading)
 - 2 Measure and type ITVDD value in unloaded condition
 - 3 Define ITVDD step (e.g 10mA)
 - 4 Define maximum ITVDD (e.g 250mA)
 - 5 Click start loading
 - 6 Save the first measurement (ITVDD – unloaded condition)
 - 7 Save the second measurement when ITVDD = ITVDDunloaded + 10 mA
 - 8 Repeat the process until ITVDD max is reached
 - 9 Start with the second loading condition (e.g Metal loading)
- Repeat steps 6 to 8 for second loading condition

PN5180 NFC Cockpit: *Verify ITVDD-AGC linear relationship*

Type Cards LPCD DPC

CORRELATION TEST DPC Calibration

ACG vs ITVDD

ITVDD unloaded mA Number of Loading Cases

ITVDD Step Size (0 to 20) AGC Value: 0x01A7 Hex

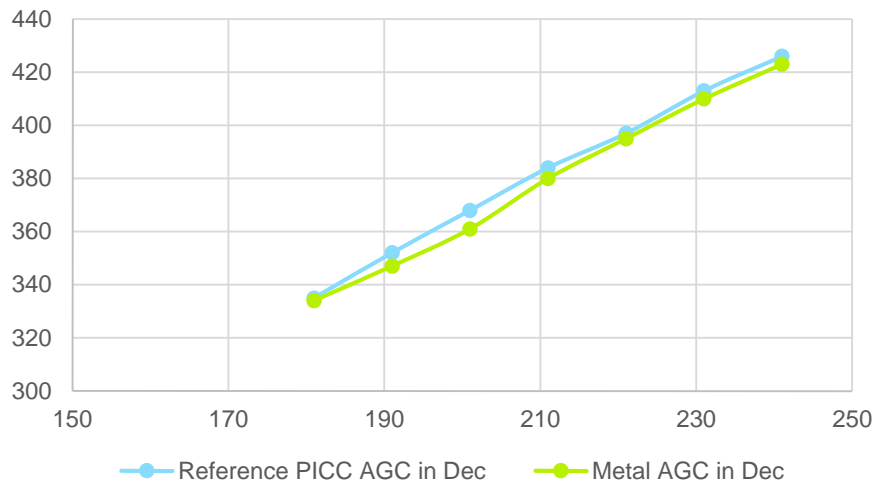
ITVDD Max mA Current ITVDD: 241 mA

AGC Values In Hex and Dec for each Loading Case

| ITVDD | Reference | Reference | Metal AG | Metal AG |
|-------|-----------|-----------|----------|----------|
| 181 | 337 | 0x0151 | 335 | 0x014F |
| 191 | 353 | 0x0161 | 348 | 0x015C |
| 201 | 369 | 0x0171 | 360 | 0x0168 |
| 211 | 385 | 0x0181 | 380 | 0x017C |
| 221 | 401 | 0x0191 | 395 | 0x018B |
| 231 | 412 | 0x019C | 411 | 0x019B |
| 241 | 426 | 0x01AA | 423 | 0x01A7 |

Note: ITVDD and ITVDDMax value ranges from 0 to 250

AGC versus ITVDD



Plot the results and verify it exists a linear relation between AGC and ITVDD

More info about how to perform a correlation test AN11742 Dynamic Power Control

What needs to be defined for DPC

0

Perform correction test

- ▶ Ensure linear relationship between AGC value and ITVDD current

1

Define number of gears (DPC_AGC_GEAR_LUT_SIZE)

- ▶ Up to 15 gears can be stored (i.e. Up to 15 output power steps can be defined)

2

Define Tx settings per gear (DPC_AGC_GEAR_LUT)

- ▶ It defines the output power settings per gear.

3

Define high threshold value per gear (DPC_THRSH_HIGH)

- ▶ It defines the maximum measured field strength per gear. The DPC switches to the next gear as soon as this threshold is achieved.

4

Define a shift value to set the low threshold (DPC_AGC_SHIFT_VALUE)

- ▶ For switching back from a lower to a higher output power, the field strength needs to become lower than the low threshold.



PN5180 NFC Cockpit: *DPC calibration*

Type Cards LPCD DPC

CORRELATION TEST DPC Calibration

Number of Gears 2

ITVDD Limit 3

AGC Value: Hex

☒ Clear Gear AGC Threshold values

☒ Clear Gear TX Settings

Clear Gear Values 1

| Gear | GEAR TX SET |
|------|-------------|
| 1 | F9 |
| 2 | F7 |
| 3 | F0 |
| 4 | F6 |

Start Calibration 5

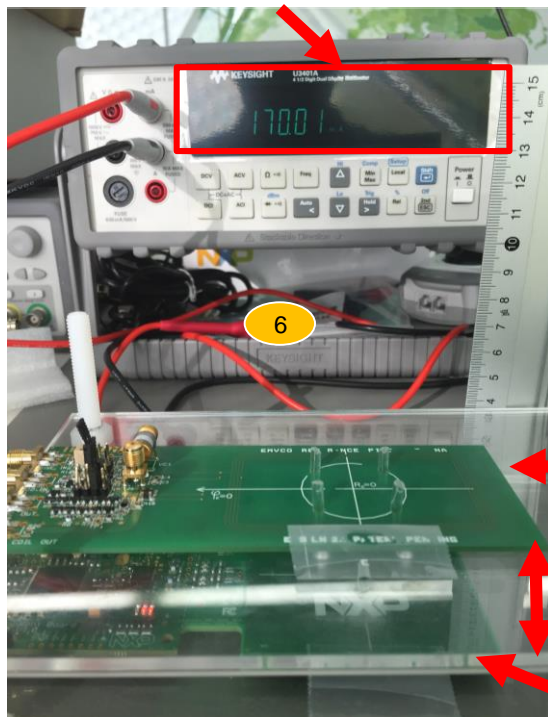
ITVDD Limit Gear

Update Gear AGC

- 1 Clean DPC part of the EEPROM
- 2 Choose number of gears
- 3 Choose ITVDD switch value, which then makes the DPC switch to the next gear
- 4 Enter the Tx setting per Gear. Each Gear TX SET corresponds to a voltage level at TVDD
- 5 Click start calibration

PN5180 NFC Cockpit: *DPC calibration setup*

Ampermeter connected to the ITVDD jumper



- 1 Clean DPC part of the EEPROM
- 2 Choose number of gears
- 3 Choose ITVDD switch value, which then makes the DPC switch to the next gear
- 4 Enter the Tx setting per Gear. Each Gear TX SET corresponds to a voltage level at TVDD
- 5 Click start calibration
- 6 Change load until the ITVDD reach the limit (e.g. 170mA)

EMVCo Ref PICC

Modify load distance until ITVDD limit is reached

PNEV5180B

PN5180 NFC Cockpit: *DPC calibration*

Type Cards | LPCD | DPC

CORRELATION TEST | DPC Calibration

Number of Gears: 4
ITVDD Limit: 170 mA
AGC Value: Hex

☒ Clear Gear AGC Threshold values
☒ Clear Gear TX Settings
Clear Gear Values

| Gear | GEAR TX SET |
|------|-------------|
| 1 | F9 |
| 2 | F7 |
| 3 | F0 |
| 4 | F6 |

Information

Gear with TxSettings = 0xF9
Gear AGCValue = 306
ITVDD Limit value = 170

OK

Start Calibration | ITVDD Limit Gear | Update Gear AGC

7

- 1 Clean DPC part of the EEPROM
- 2 Choose number of gears
- 3 Choose ITVDD switch value, which then makes the DPC switch to the next gear
- 4 Enter the Tx setting per Gear. Each Gear TX SET corresponds to a voltage level at TVDD
- 5 Click start calibration
- 6 Change load until the ITVDD reach the limit (e.g. 170mA)
- 7 Click ITVDD Limit Gear and take AGC threshold value

PN5180 NFC Cockpit: *DPC calibration*

Type Cards | LPCD | **DPC**

CORRELATION TEST | **DPC Calibration**

Number of Gears: 4
ITVDD Limit: 170 mA
AGC Value: 0x0110 Hex

☒ Clear Gear AGC Threshold values
☒ Clear Gear TX Settings
Clear Gear Values

| Gear | GEAR TX SET | Gear AGC-He | Gear AGC-De | |
|------|-------------|-------------|-------------|---|
| 1 | F9 | 0x0132 | 306 | 8 |
| 2 | F7 | 0x0130 | 304 | |
| 3 | F0 | 0x0131 | 305 | |
| 4 | F6 | 0x0110 | 272 | |

EEPROM updated with AGC values
OK

Start Calibration | ITVDD Limit Gear | Update Gear AGC

9

- 1 Clean DPC part of the EEPROM
- 2 Choose number of gears
- 3 Choose ITVDD switch value, which then makes the DPC switch to the next gear
- 4 Enter the Tx setting per Gear. Each Gear TX SET corresponds to a voltage level at TVDD
- 5 Click start calibration
- 6 Change load until the ITVDD reach the limit (e.g. 170mA)
- 7 Click ITVDD Limit Gear and take AGC threshold value
- 8 Repeat the process for all Gears until the table is completed
- 9 Click Update Gear AGC

PN5180 NFC Cockpit: *DPC calibration in action*

After successful DPC calibration, the PN5180 **automatically** switches the Gear (Tx power setting) when ITVDD hits the configured limit (e.g. 170mA)

More info about how to perform a DPC calibration in AN11742 Dynamic Power Control



PN5180 NFC Cockpit

DPC Tx shaping

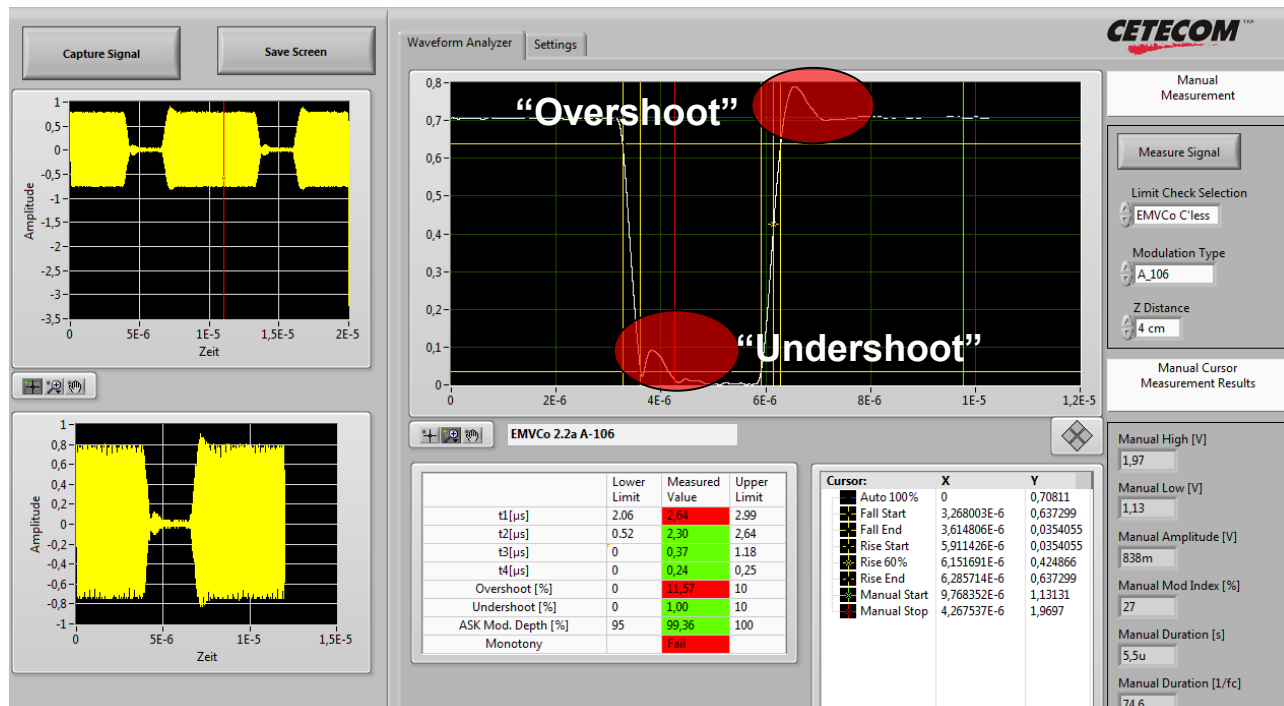
Why do we need DPC Tx shaping?

► OPTION 1: Change antenna tuning

- HW change: time consuming
- Reduce Q-factor: decreases operating distance

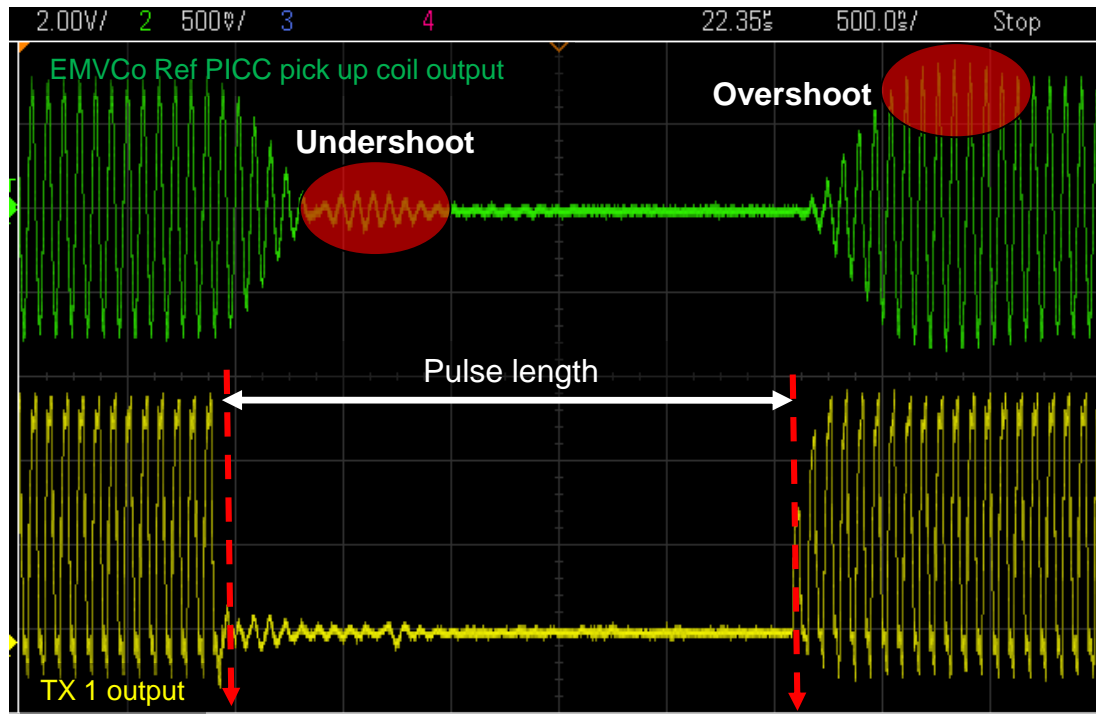
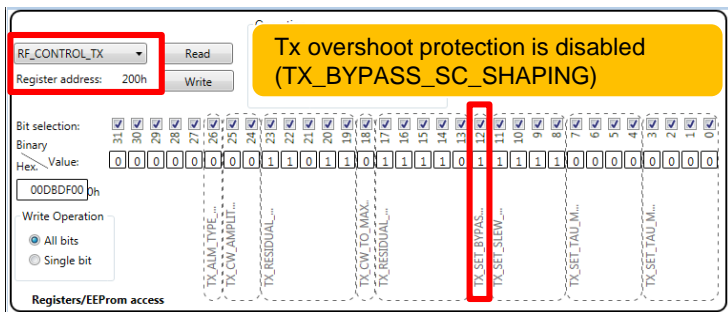
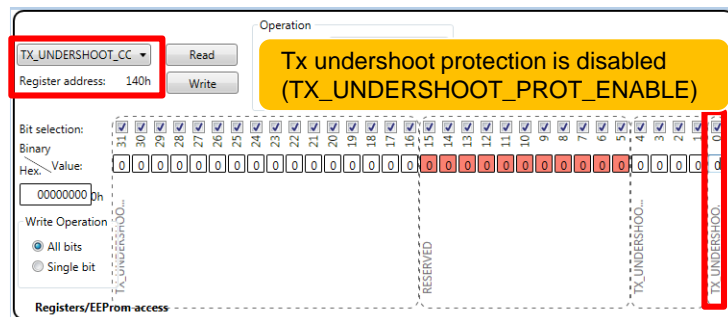
► OPTION 2: Use DPC Tx shaping

- EEPROM change: Low effort
- No change of antenna tuning: same operating distance



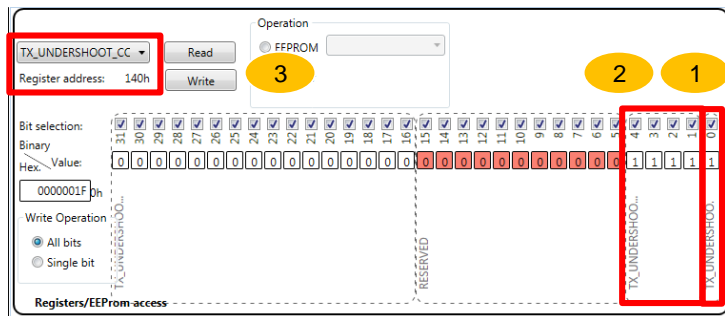
PN5180 NFC Cockpit: DPC Tx shaping for a standard Type A pulse

Without DPC Tx shaping applied

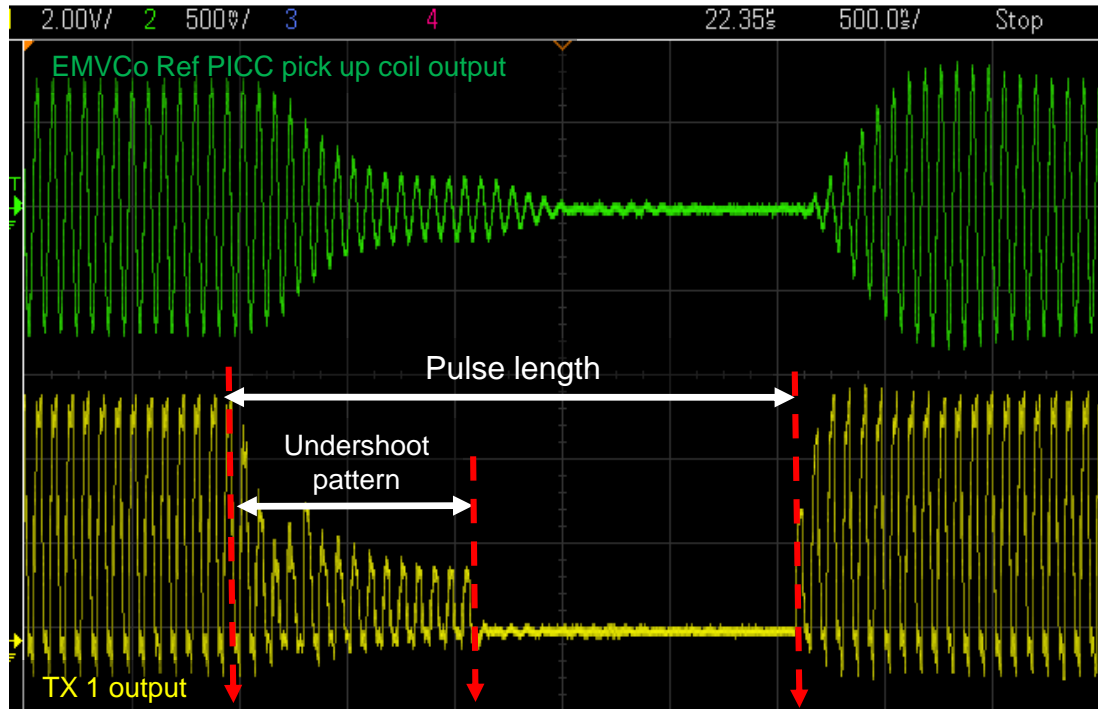


PN5180 NFC Cockpit: DPC Tx shaping for a standard Type A pulse

DPC undershoot shaping pattern applied



- 1 Enable Tx undershoot protection (TX_UNDERSHOOT_PROT_ENABLE)
- 2 Define Tx undershoot pattern length (0x00 ... 0x0F)
- 3 Write new register configuration



PN5180 NFC Cockpit: DPC Tx shaping for a standard Type A pulse

DPC Tx SC shaping pattern applied

RF_CONTROL_TX

Register address: 200h

Operation: EEPROM

Bit selection:

| Bit | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------|-----------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|
| Binary | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| Hex. Value | 000BCF0Fh | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Write Operation:

☒ All bits

☐ Single bit

Registers/EEProm access

TX_AIM_TYPE

TX_CW_AMPLITUDE

TX_RESIDUAL

TX_CW_TO_MAX

TX_RESIDUAL

TX_SET_BYPASS

TX_SET_SLEW

TX_SET_TAU_ML

TX_SET_TAU_ML

1

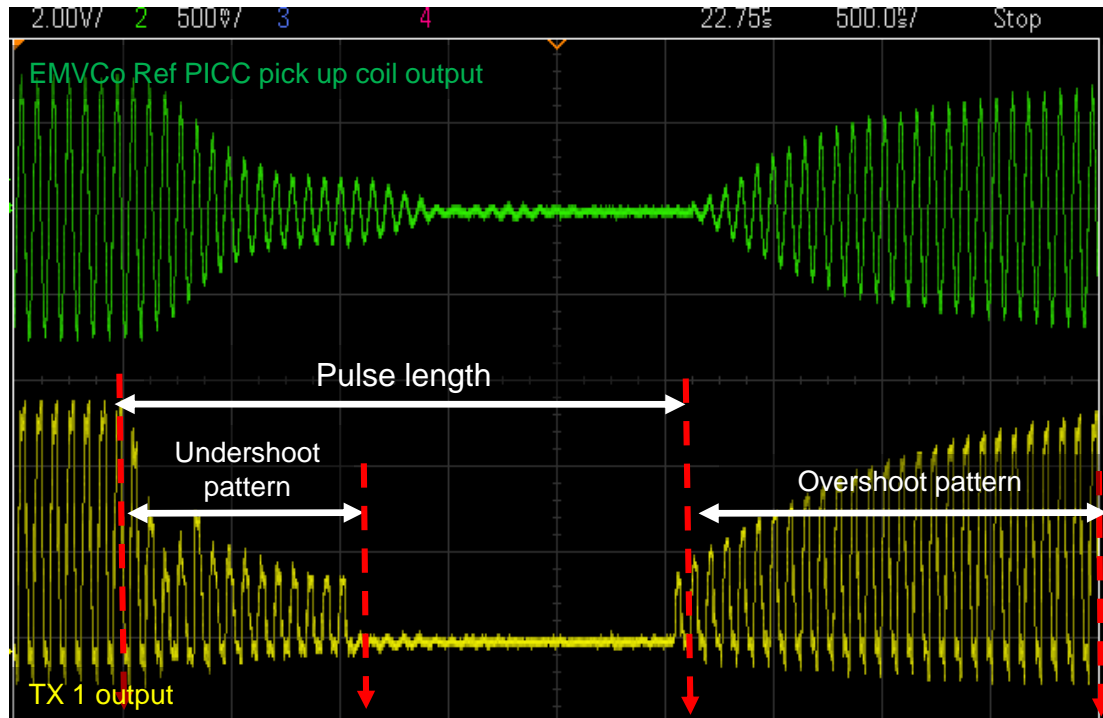
Enable Tx overshoot protection
(TX_BYPASS_SC_SHAPING)

2

Define a overshoot protection pattern by tuning
the rise time behavior (0x00 ... 0x0F)
(TAU_MOD_RISING)

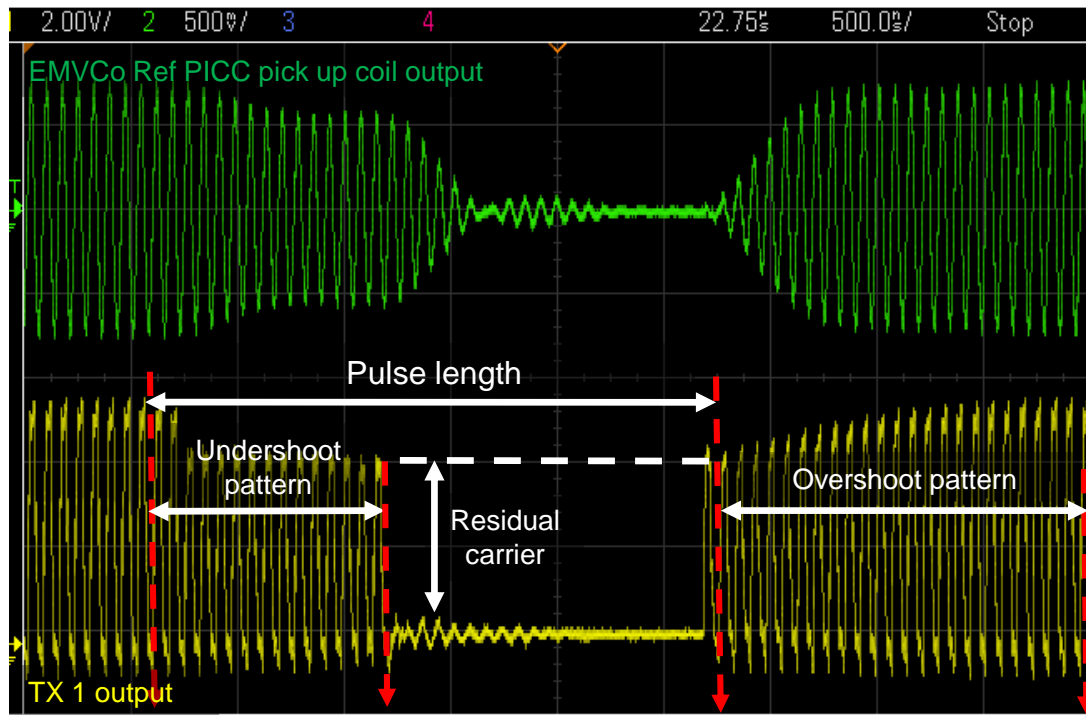
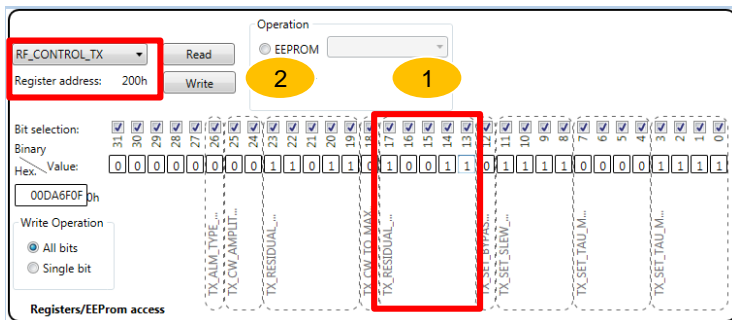
3

Write new register configuration



PN5180 NFC Cockpit: DPC Tx shaping for a standard Type A pulse

DPC Tx Residual carrier shaping pattern applied



1

Define the carrier level at the end of the undershoot pattern and at the end of the pulse (when the rise time of the pulse starts)

2

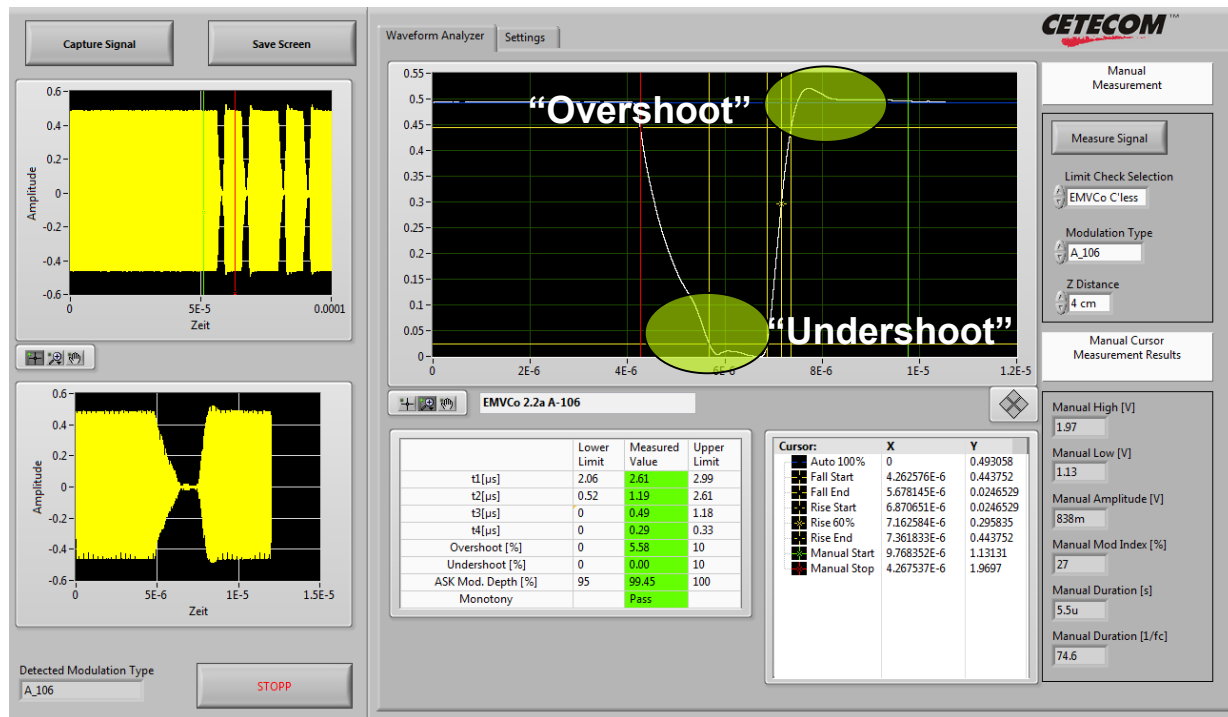
Write new register configuration

PN5180 NFC Cockpit: DPC Tx shaping for a standard Type A pulse

DPC Tx shaping result after fine tuning

After a proper Tx shaping register tune, we can manage to reduce overshoot and undershoot and therefore, pass EMVCo certification without any HW modification

More info about Tx shaping recommended settings in AN11742 Dynamic Power Control



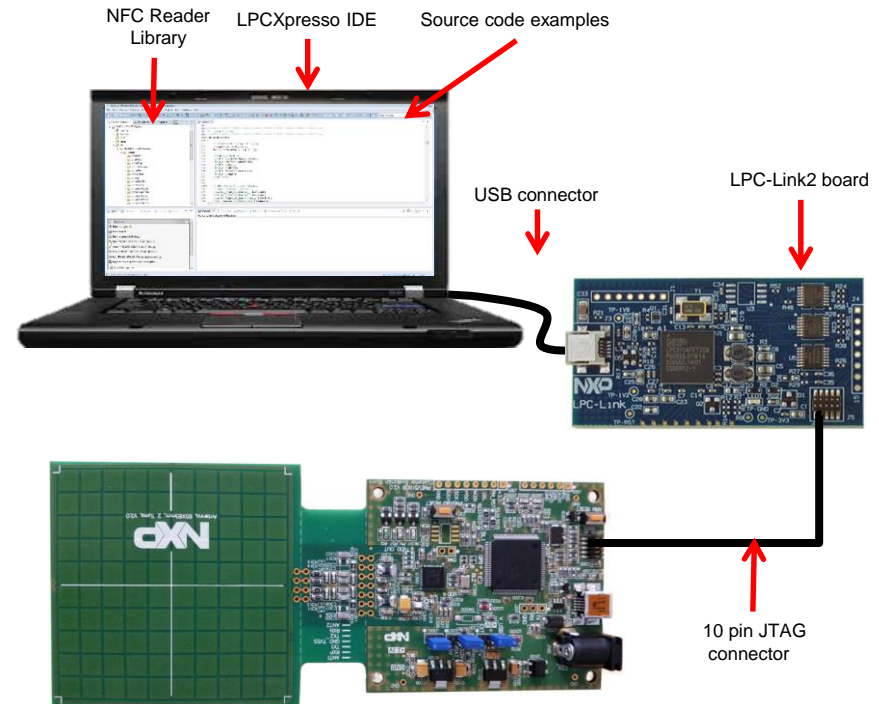
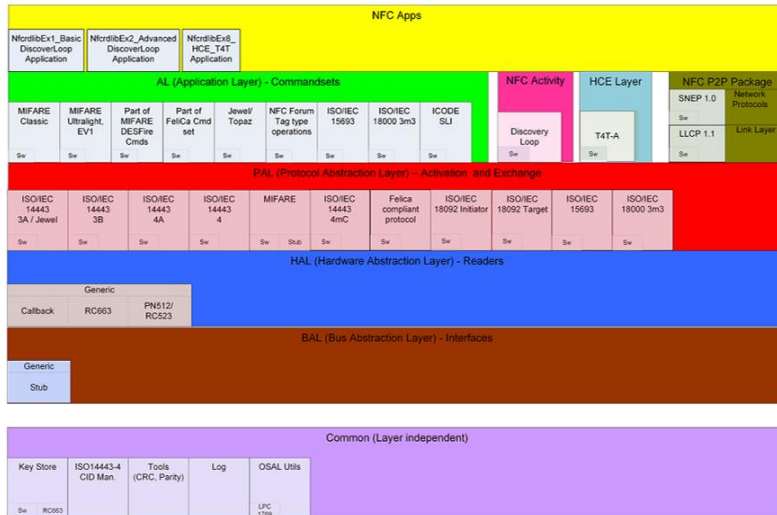
PN5180 product support package in a nutshell



| | |
|---------------------------|--|
| Demokit | › PN5180 NFC frontend development kit OM25180FDK |
| NFC Cockpit | › SW3524 - Installer package PN5180 NFC Cockpit v2.2 |
| NFC Reader Library | › SW3522 - NFC Reader Library for PNEV5180B including all SW examples |
| Documentation | <ul style="list-style-type: none">› 75017673 - PN5180 leaflet› PN5180 - Product datasheet› AN11742 - PN5180 Dynamic Power Control› AN11744 - PN5180 evaluation board quick start guide› AN11740 - PN5180 antenna design guide› AN11741 - How to design an antenna with DPC› UM10954 - PN5180 SW quick start guide› SW3545 - PN5180 antenna design tools |

Easy test and debugging based on NFC Reader Library examples

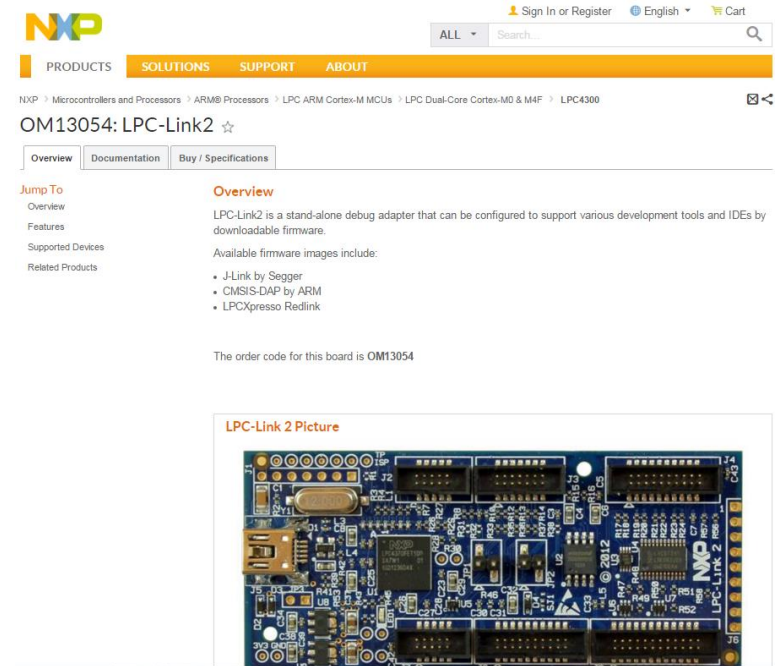
- ▶ The NFC Reader Library is encapsulated into layers and components written in ANSI C.
 - Each layer consists of different components having a generic interface and a specific implementation
- ▶ The library structure provides a modular way of programming and setting up the reader interface.



Getting started with SW development

1

Acquire a LPC-Link2 board
Available at eDemoboard and Distis



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OM13054: LPC-Link2 ☆

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- Overview
- Features
- Supported Devices
- Related Products

Overview


LPC-Link2 is a stand-alone debug adapter that can be configured to support various development tools and IDEs by downloadable firmware.

Available firmware images include:

- J-Link by Segger
- CMSIS-DAP by ARM
- LPCXpresso Redlink

The order code for this board is OM13054

LPC-Link 2 Picture



| Reference | 12NC | Product description |
|-----------|--------------|---------------------|
| OM13054 | 935300265598 | LPC-Link2 |

Getting started with SW development

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Acquire a LPC-Link2 board
Available at eDemoboard and Distis

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Download and install LPCXpresso IDE
Free download at LPCware [website](#)



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Submitted by lpcxpresso-support on Thu, 2015-11-26 00:33



Documentation

Before downloading, please read:

- LPCXpresso IDE v8 User Guide
 - Also available
 - LPCXpresso IDE v7 User Guide
 - LPCXpresso IDE v6 User Guide
- LPCXpresso IDE Release Notes
- LPCXpresso IDE End User License Agreement (EULA)

Product downloads

Click on the operating system that you wish to run LPCXpresso IDE on to download the LPCXpresso IDE installer...

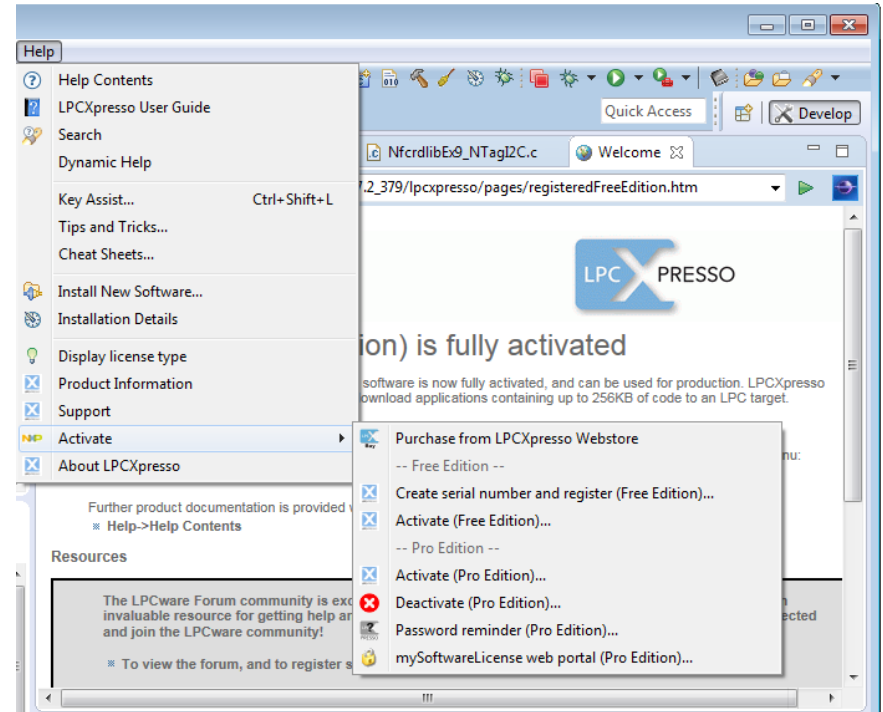
- [Windows download](#)
 - Windows Vista or later is required. 32-bit and 64-bit systems are supported
- [Linux download](#)
 - Supported distributions are listed in the User Guide. 32-bit and 64-bit systems are supported
- [Mac OS X download](#)
 - Mac OS X Mountain Lion (10.8.5) or later is required

Once downloaded and installed, you can [activate LPCXpresso IDE \(Free Edition\)](#) or purchase LPCXpresso IDE (Pro Edition) directly from the [NXP LPCXpresso IDE webstore](#) and then activate LK

[Older versions of LPCXpresso IDE](#)

Getting started with SW development

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Free download at LPCware [website](#)
- 3** LPCXpresso IDE product activation
Help → Activate LPCXpresso → Create Serial Number and register



Getting started with SW development

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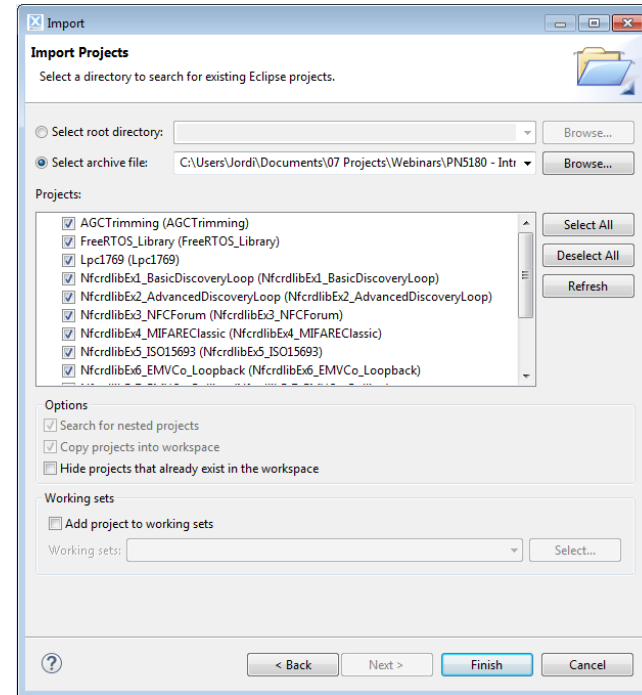
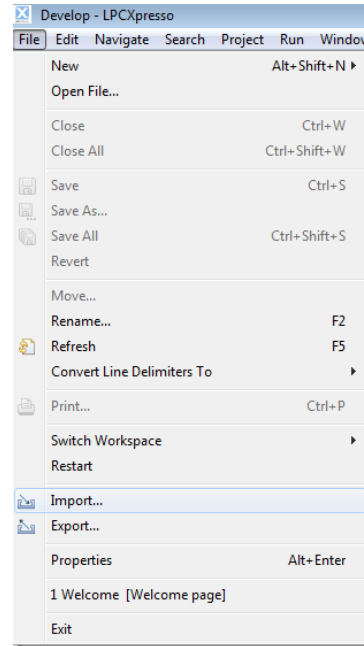
Download and install LPCXpresso IDE
Free download at LPCware [website](#)

3

LPCXpresso IDE product activation
*Help → Activate LPCXpresso → Create
Serial Number and register*

4

Importing provided SW example projects
Download and unzip SW3522 package



Getting started with SW development

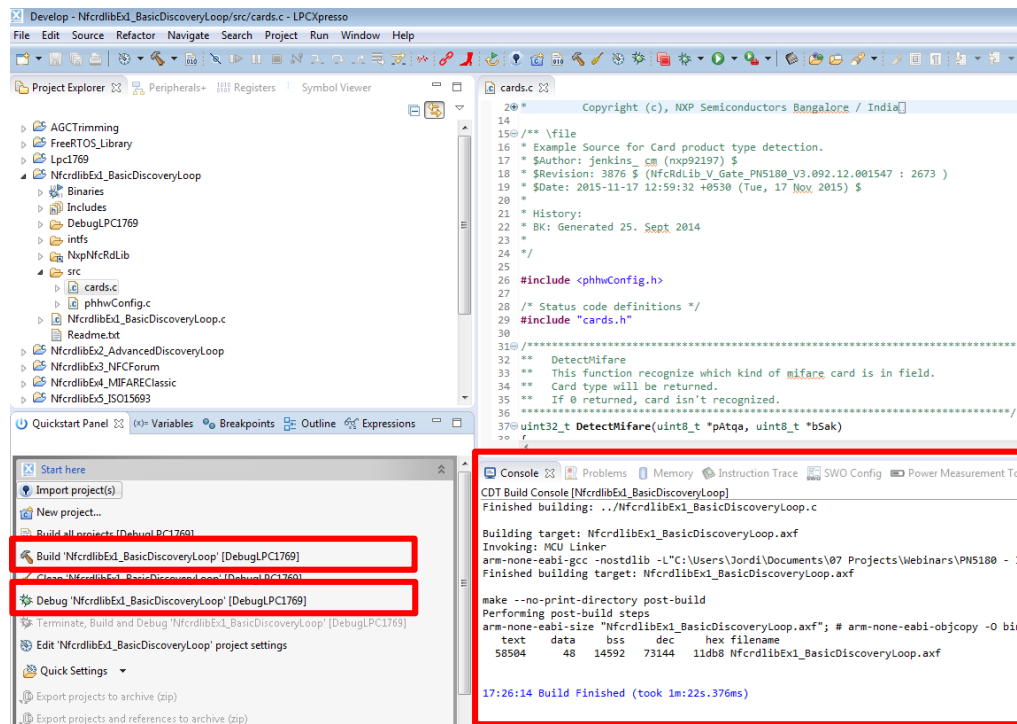
- 1** Acquire a LPC Link2 board
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Free download at LPCware [website](#)
- 3** LPCXpresso IDE product activation
Help → Activate LPCXpresso → Create Serial Number and register
- 4** Importing provided SW example projects
Download and unzip SW3522 package

| SW example | Description |
|-------------------------------------|--|
| NfcrdlibEx1 Basic Discovery Loop | Shows how to poll for different technologies (P2P,Tag,HCE), detect and report them |
| NfcrdlibEx2 Advanced Discovery Loop | Shows how to poll for different technologies (P2P,Tag,HCE), detect and report them |
| NfcrdlibEx3 NFCForum | Shows both the P2P and reader function to detect Type A, B, F and V. |
| NfcrdlibEx4 MIFAREClassic | Shows the usage of standard MIFARE commands |
| NfcrdlibEx5 ISO15693 | Shows the usage of ISO15693 technology and the most common commands |
| NfcrdlibEx6 EMVCo_Loopback | Application used for EMVCo L1 PCD certification |
| NfcrdlibEx7 EMVCo_Polling | Shows how to poll for EMVCo payment cards |
| NfcrdlibEx8 HCE_T4T | Demonstrate the card emulation of a Type 4 Tag |
| NfcrdlibEx9 NTAG_I2C | Shows the usage of NTAG I2C specific commands |
| NfcrdlibEx10 ISO18000_3M3 | Shows how to detect this type of cards and displays tag info like UID. |
| AGC Trimming | Shows how to perform measurements to determine right XI value for the antenna |

Getting started with SW development

- 1 Acquire a LPC Link2 board
Available at eDemoboard and Distis
- 2 Download and install LPCXpresso IDE
Free download at [LPCware website](#)
- 3 LPCXpresso IDE product activation
Help → Activate LPCXpresso → Create Serial Number and register
- 4 Importing provided SW example projects
Download and unzip SW3522 package
- 5 Compile, run and debug your application
Using LPCXpresso IDE

After new SW has been loaded into the PNEV5180, the default SW needs to be flashed in order to use again NFC cockpit. More info in AN11744 Evaluation board quick start guide



PN5180 product support package in a nutshell



| | |
|---------------------------|--|
| Demokit | › PN5180 NFC frontend development kit OM25180FDK |
| NFC Cockpit | › SW3524 - Installer package PN5180 NFC Cockpit v2.2 |
| NFC Reader Library | › SW3522 - NFC Reader Library for PNEV5180B including all SW examples |
| Documentation | <ul style="list-style-type: none">› 75017673 - PN5180 leaflet› PN5180 - Product datasheet› AN11742 - PN5180 Dynamic Power Control› AN11744 - PN5180 evaluation board quick start guide› AN11740 - PN5180 antenna design guide› AN11741 - How to design an antenna with DPC› UM10954 - PN5180 SW quick start guide› SW3545 - PN5180 antenna design tools |

Datasheet, application notes, user manuals and other tools

| Doc ID | Doc Name | Description |
|----------|---|---|
| 75017673 | PN5180 leaflet | High performance full NFC Forum compliant frontend |
| PN5180 | PN5180 product datasheet | This document describes the functionality and electrical specification of the PN5180 NFC frontend |
| AN11742 | PN5180 Dynamic Power Control | This document describes how to use the Dynamic Power Control feature |
| AN11744 | PN5180 evaluation board quick start guide | This document describes the PN5180 evaluation board and how to use it. It describes the NFC Cockpit v2.2 which allows an easy basic access to the PN5180 registers and EEPROM in combination with basic reader functionality |
| AN11740 | PN5180 antenna design guide | This document describes the “standard” antenna design and tuning related to the PN5180 |
| AN11741 | How to design an antenna with DPC | This document describes the “symmetrical” antenna design, which must be used together with the Dynamic Power Control (therefore, called DPC antenna tuning). |
| UM10954 | PN5180 SW quick start guide | This User Manual is related to the installation procedures of the PN5180 evaluation board, SW sample projects as well as the re-installation of the original LPC firmware to run the NFC Cockpit. It describes the steps to be done to become acquainted with the demo reader especially for the SW development |
| SW3545 | PN5180 antenna design tools | This file contains an Excel sheet for the calculation of the matching and tuning components for an NFC Reader antenna, including a macro for RFSIM99 |

Final remarks

PN5180 is supported by advanced tools that make it easier than ever to develop a design



NFC frontend development kit OM25180FDK
Available at eDemoboard and Distis



NFC Cockpit design tool
A professional GUI tool for engineers that ease design process, antenna tuning and waveform shaping



Dynamic Power Control
Delivering robust performance while controlling antenna current, RF power and the related waveforms to deliver optimized RF performance even under detuned conditions



NFC Forum, EMVCo and ISO/IEC compliant library
Modular, easily readable and quickly portable SW library complemented by ready-to-use SW examples and tested against standardized tests.



Do you need more?

Resources and useful links

- ▶ NFC Everywhere
<http://www.nxp.com/nfc>
- ▶ PN5180 product website
<http://www.nxp.com/products/identification-and-security/nfc-and-reader-ics/nfc-frontend-solutions/high-power-nfc-frontend-solution:PN5180>
- ▶ OM25180FDK demokit website
www.nxp.com/board/OM25180FDK.html
- ▶ NFC innovation lab video to get a quick intro into the new features that come along with the PN5180
<https://www.youtube.com/watch?v=Q0jFC27TLEQ>
- ▶ NXP Tech community
<http://nxpcommunity.force.com/community/CommunityOverview>

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OM25180FDK: PN5180 NFC frontend development kit OM25180FDK ☆

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Overview

Features

Overview

OM25180FDK is a flexible and easy to use frontend development kit for PN5180. It contains a PNEV5180B board with 65 mm x 65 mm antenna optimized for EMVCo applications, a 30 mm x 50 mm antenna with matching components optimized for NFC applications, three small antenna matching PCBs (appr. 30 mm x 50 mm sized) for implementation of a custom antenna matching circuit, an NFC sample card based on NTAG216F (NFC Forum Type 2 Tag) and 10 PN5180 samples in HVQFN package.

Application Notes

PN5180 block diagram

PN5180 NFC Frontend Development Kit
OM25180FDK

This powerful and flexible PN5180 NFC Frontend Development Kit contains:

- PNEV5180B board with matching antenna
- 30mm x 50mm antenna with matching components
- 3 PCBs for individual antenna matching and custom "Smart Tag"
- NFC sample card based on NTAG216F (NFC Forum Type 2 Tag)
- 10x PN5180 samples in HVQFN package

PN5180 – The best full NFC frontend on the market

Jordi Jofre (Speaker) / Eric Leroux (Host)

Thank you for your kind attention!

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