AN14225

How to use PN722x with contact cards
Rev. 1.0 — 28 May 2024 **Application note**

Document information

Information	Content
Keywords	PN7220, NCI, payment, NFC Forum, Android, NFC, Contact Cards, TDA
Abstract	This document describes how to use PN722xBPx with contact cards.

1 Introduction

This document describes how to use PNEV722xBPx with TDA8035 and contact cards. For more information, refer to [1], [2], and [3].

Note: *Before reading this document, consult [4].*

Contact cards examples for PNEV722xBPx are described in the document [5].

2 Hardware setup

To use PN722x with contact cards, the following HW is required:

• PNEV722xBP1 or PNEV722xBP2 board
• TDA8035 evaluation board
• Contact card like SAM AV3 or simmilar

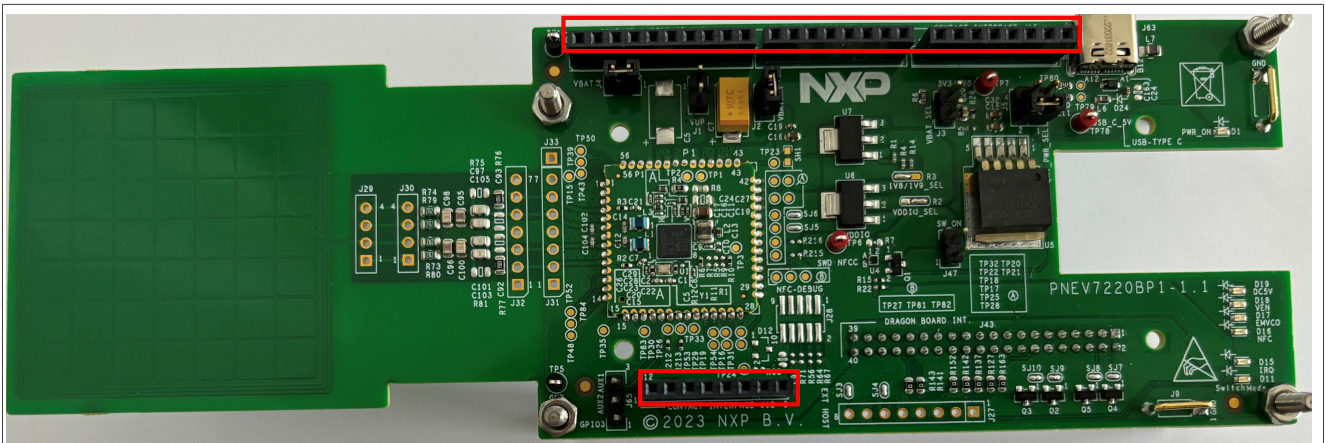PNEV722xBPx can be connected to the TDA8035 evaluation board via the connectors highlihgted in Figure 1.

Figure 1. PNEV722xBPx connectors for TDA8035

Figure 2 shows stack PNEV722xBPx and the TDA8035 evaluation board .
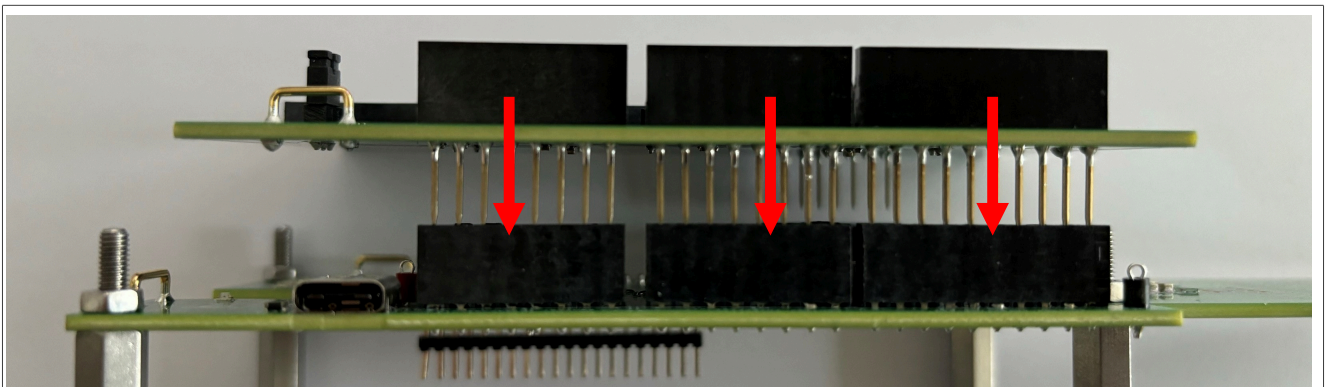

Figure 2. How to stack together PNEV722xBPx and TDA8035

In general PN722x supports up to 3 different TDA8035, but with one evaluation board, two contact cards can be connected. See Figure 3 for contact card placement.
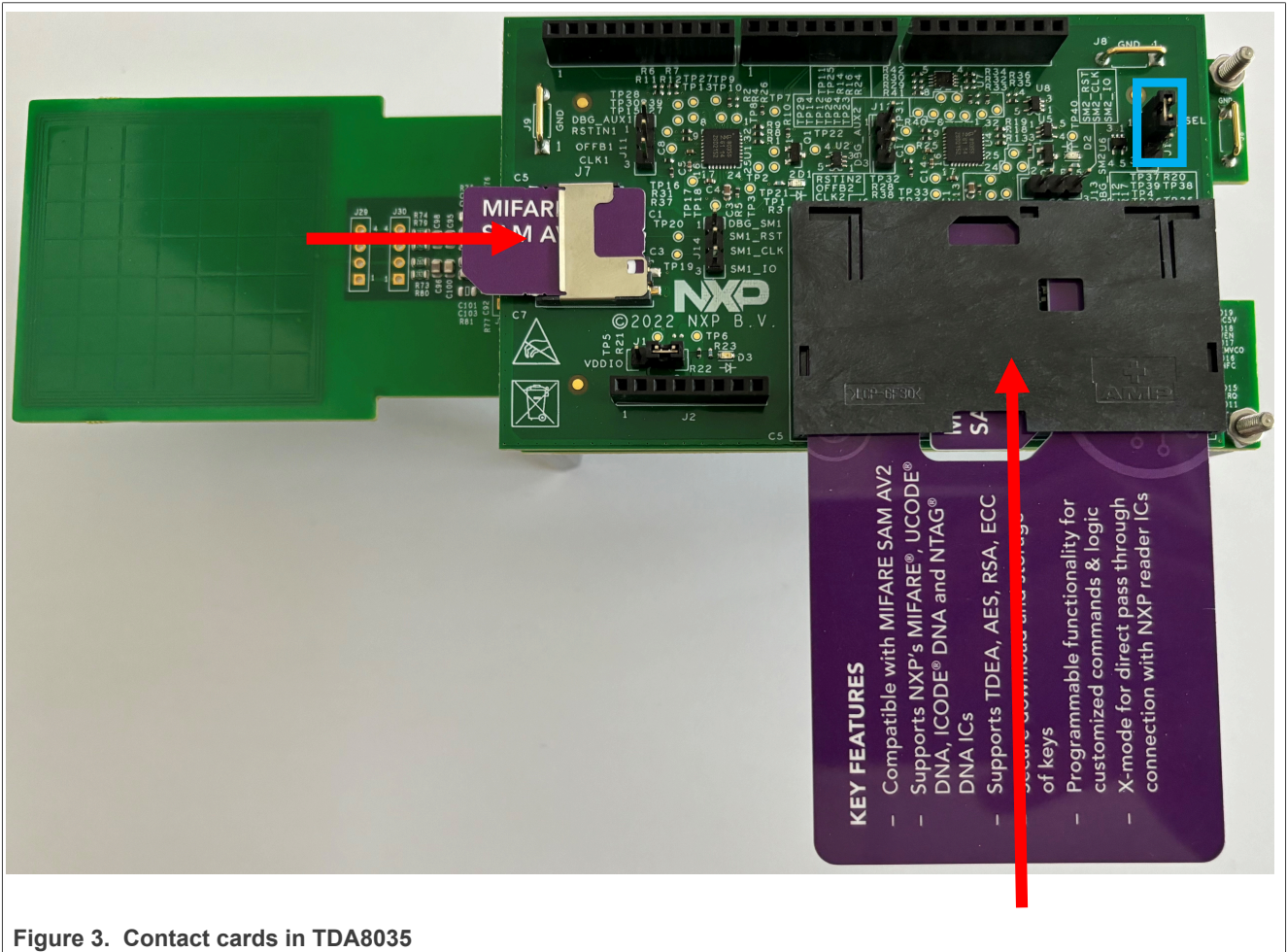

Figure 3. Contact cards in TDA8035

Jumper on J10 on TDA8035 need to connect 2-3 (see Figure 3 highlighted in blue).

3 Software setup

Refer to [4] for instructions on how to run Android and test applications for PN722x. Instruction for setting up an environment for dual-host payment CT examples, consult [5].

4   Use case explanation

PN722x supports two ISO slots and one payment slot. Use cases for:

1. ISO slots: SAM is connected before the DH boot process and during the boot. Contact cards cannot be removed from the two slots dynamically.
2. Payment slot: A contact card can be inserted or removed dynamically.

Note: *For more information, refer to [1].*

5 Software flow

As mentioned in Section 4 "Use case explanation", the payment contact card can be inserted/removed dynamically and ISO slot cards need to be present already before/during bootup and they cannot be inserted/removed in the lifetime of execution. PN722x supports three TDA slots, but the TDA8035 evaluation board supports only two.

Each slot receives its own NFCEE ID:

- 0x20 is payment slot by default. On Figure 3 this slot is the one with small SAM card.
- 0x21 is ISO slot by default. On Figure 3 this slot is the one with big SAM card.
- 0x22 is also ISO slot by default.

When the system is booting up, MW sends NFCEE_DISCOVER_CMD and FW will return the information about all three TDA evaluation boards (see Figure 4).

```
23:14:00.472 --> 220000    -=(NFCEE_DISCOVER_CMD)=-
23:14:00.511     4200020003    3 NFCEE found
23:14:00.511     6200062000101000000    <<NFCEE_DISCOVER_NTF>> 20 disabled:APDU
23:14:00.511     6200062100101000000    <<NFCEE_DISCOVER_NTF>> 21 disabled:APDU
23:14:00.512     6200062200101000000    <<NFCEE_DISCOVER_NTF>> 22 disabled:APDU
```

Figure 4. NFCEE_DISCOVER_CMD

Since the payment slot can be used dynamically, notifications are issued by FW to MW when a card is removed or inserted into the slot (see Figure 5).

```
23:23:46.391     6200062000201000000    <<NFCEE_DISCOVER_NTF>> 20 removed:APDU
23:23:48.642     6200062000101000000    <<NFCEE_DISCOVER_NTF>> 20 disabled:APDU
```

Figure 5. NFCEE_DISCOVER_NTF for payment slot

Note: *ISO slots are not dynamic, so if a card is removed or inserted, there will be no notification issues by FW, even more, such actions can break the FW/MW flow.*

The applications explained in [4] can be used.

When the connection with a TDA evaluation board is established, the following set of commands, responses, and notifications is presented:

```
00:10:41.259 --> 2201022101    -=(NFCEE_MODE_SET_CMD)=- enabled 21
00:10:41.260     42010100
00:10:41.304     62010100    <<NFCEE_MODE_SET_NTF>>
00:10:41.306     620023210001011C3BDF18FF81F1FE43003F07834D49464152452053414D204156333000    <<NFCEE_DISCOVER_NTF>> 21 enabled:APDU
                 ATR:3BDF18FF81F1FE43003F07834D49464152452053414D204156333000
00:10:41.308 --> 200406030101022100    -=(CORE_CONN_CREATE_CMD)=- NFCEE
                 21 APDU
00:10:41.308     40040400FF010B
```

Figure 6. Establish the connection with the TDA

For closing the connection with the TDA:

```
00:11:28.001 --> 2005010B    -=(CORE_CONN_CLOSE_CMD)=-
00:11:28.002     40050100
00:11:28.003 --> 2201022100    -=(NFCEE_MODE_SET_CMD)=- disabled 21
00:11:28.011     42010100
00:11:28.012     62010100    <<NFCEE_MODE_SET_NTF>>
```

Figure 7. Closing the connection with the TDA

When connection is established, APDU commands encapsulated into NCI data packets are used to communicate with the contact card. For more information check User manual.

6 How to switch slot from ISO to payment and back

During the product design phase, different slot configurations for the payment slot might be desired. NXP provides the capability to configure slots with "CT_EMVCO_PROFILE_CONFIG" configuration.

Note: *Since EEPROM has a limited number of read/write cycles, users must be careful on how many times this value is changed. Ideally, this change is only performed **once**.*

Table 1. CT_EMVCO_PROFILE_CONFIG

Name	Description	EEPROM Offset	Len	Default value
CT_EMVCO_ PROFILE_ CONFIG	Parameters to configure the Mode of CT interface profile: Byte 1 (MSB) value : Mode/Profile: 0x00 => ISO Mode 0x01 => Payment Mode 0x02-0xFF => RFU Byte 2 (LSB) value : NFCEE ID: 0x20 => Slot 1 0x21 => Slot 2 0x22 => Slot 3 Other values => RFU	0x6B1	2	0x01 0x20

The easiest way to change the configuration is via the NFC Cockpit tool (see [4] for more information). Figure 8 shows how to read out the configuration. Enter the EEPROM offset into the "Address" field and click "Read EEPROM", the data field is filled with the NFCEE ID that is currently used as the payment slot.
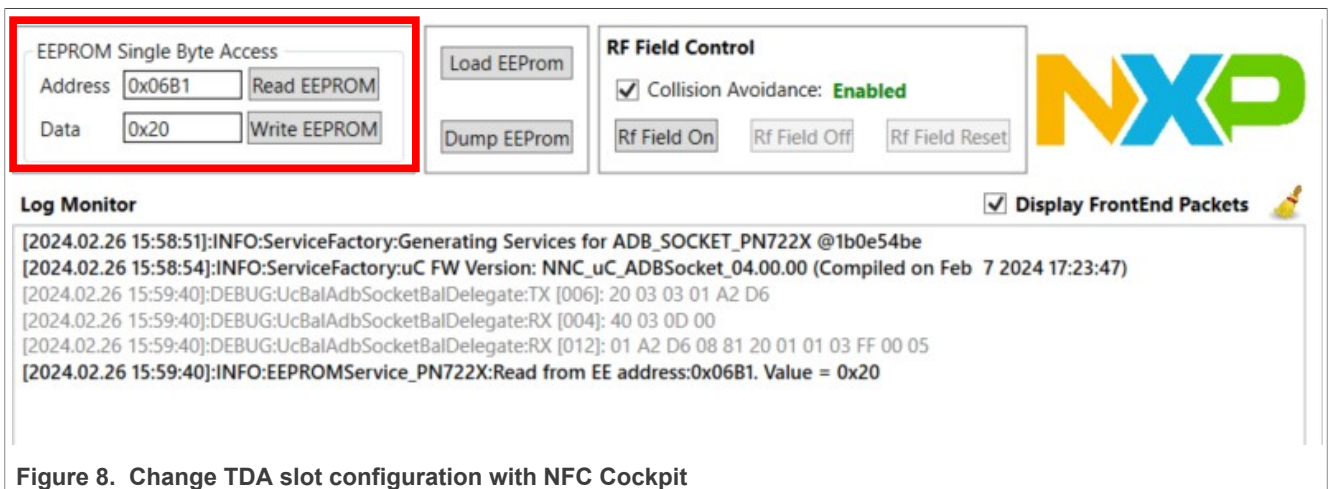

Figure 8. Change TDA slot configuration with NFC Cockpit

If users want to change the payment slot to NFCEE ID 0x21, enter 0x21 into the "Data" field and click "Write EEPROM" to change the configuration. Since this is an EEPROM setting, PN722x must be reset before the configuration is in use..

Figure 9. Write setting into EEPROM

The payment slot can also be changed to NFCEE ID 0x21 via the NCI command "CORE_SET_CONFIG_CMD" as follows:.

```
20 02 0C 01 A2 D6 08 81 21 01 01 03 FF 00 02
```

Command must be added into libnfc_nxp.conf file inside "NXP_CORE_CONF_EXTN" field.

```
##############################################################################
# NXP Proprietary core configuration extensions
# For more details refer to the NFC Controller User Manual
# Eg. NXP_CORE_CONF_EXTN={20, 02, 09, 01, A0, 5E, 01, 01} Dummy Data
NXP_CORE_CONF_EXTN={20, 02, 0C, 01, A2, D6, 08, 81, 21, 01, 01, 03, FF, 00, 02}
```

Figure 10. NXP_CORE_CONF_EXTN in libnfc-nxp.conf

7   Abbreviations and acronyms

Table 2. Abbreviations

Acronym	Description
APDU	application protocol data unit
AOSP	Android open source project
DH	device host
HAL	hardware abstraction layer
FW	firmware
I^{2}C	Inter-Integrated Circuit
LPCD	lower powered card detection
NCI	NFC controller interface
NFC	near-field communication
MW	middleware
PLL	phase-locked loop
P2P	peer to peer
RF	radio frequency
SDA	serial data
SMCU	secure microcontroller
SW	software

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8 References

[1] User manual – UM11810 - PN722X NFC Controller (link)

[2] Data sheet – PN7220 NFC controller with NCI interface supporting EMV and NFC Forum applications (link)

[3] Webpage – PN7220 – EMV L1 Compliant NFC Controller with NCI Interface Supporting EMV and NFC Forum Applications (link)

[4] User guide – UG10068 – PN7220 – Quick start guide (link)

[5] Application note – AN14224 - How to use PN7220 in Dual-Host mode (link)

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10 Revision history

Table 3. Revision history

Document ID	Release date	Description
AN14225 v.1.0	28 May 2024	• Initial version

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